Citrix SD-WAN 11.5

Contents

Release Notes for Citrix SD-WAN 11.5 Release

August 24, 2022

This release notes document describes the enhancements and changes, fixed and known issues that exist for Citrix SD-WAN 11.5.

Notes

This release notes document does not include security related fixes. For a list of security related fixes and advisories, see the Citrix security bulletin.

What's New

The enhancements and changes that are available in SD-WAN 11.5 release.

Miscellaneous

Citrix SD-WAN 11.5 release specifications

- Citrix SD-WAN 11.5.0 is a Limited Availability release, recommended and supported only for specific customers/production deployments.
- SD-WAN 11.5.0 release does not support Advanced Edition (AE), Premium Edition (PE), WAN Optimization deployments.
- SD-WAN 11.5.0 supports only the platforms mentioned in SD-WAN platform models and software packages.
- SD-WAN 11.5.0 does not support Citrix SD-WAN Center or Citrix SD-WAN Orchestrator for on-premises.
- SD-WAN 11.5.0 firmware is not available on the Citrix Downloads page.
- SD-WAN 11.5.0 release is available only via Citrix SD-WAN Orchestrator service and only on selected geographical POPs.
- Ensure to get the required approvals and guidance from Citrix Product Management / Citrix Support before deploying 11.5.0 on any production network.

[NSSDW-38486]

Citrix SD-WAN Orchestrator service replaces SD-WAN Configuration Editor:

From Citrix SD-WAN 11.5 release, SD-WAN Configuration Editor and SD-WAN Center are superseded by Citrix SD-WAN Orchestrator service. Citrix SD-WAN Orchestrator service supports all configurations that are currently done through SD-WAN Configuration Editor. For more details on Citrix SD-WAN Orchestrator service, see Citrix SD-WAN Orchestrator service.

[NSSDW-33528]

IPv6 support:

From Citrix SD-WAN 11.5.0 release onwards, the following data plane features of Citrix SD-WAN appliances support IPv6 address:

- Application Routes
- Citrix Cloud and Gateway service optimization
- Domain name based application classification
- Dynamic PAC file customization
- Dynamic Routing
- Firewall Defaults
- Multicast
- Office 365 Optimization
- PPPoE
- Site Reports - Routing Protocols
- VRRP

After configuring the above-listed features, if you disable IPv4 or IPv6 protocol, then the features do not work as expected.

[SDW-23397, NSSDW-29150, NSSDW-29152, NSSDW-29154, NSSDW-29155, NSSDW-29156, NSSDW-29468, NSSDW-1940, NSSDW-1995]

Monitoring enhancements:

The following Monitoring dashboards are enhanced and are available on the new appliance UI:

- DNS transparent forwarder
- Firewall connections, Firewall filter, Firewall NAT
- IGMP, IGMP proxy, IGMP statistics
- IKE, IPsec
- Multicast group, Multicast group source, Multicast group destination
- PPPoE sessions

- VRRP

[NSSDW-33763]

Platform and systems

Reference material - application signature library

The DPI application signature library has been updated.

[NSSDW-38209]

Fixed Issues

The issues that are addressed in SD-WAN 11.5 release.

Miscellaneous

The management interface status of some SD-WAN appliances was displayed as Down on the **Ethernet Interface Settings** page of the UI. This issue occurred when some appliances that had in-band management supported, the option to use out of band was available. Therefore, the appliances used out of band management interface to access SD-WAN Orchestrator service.

[NSSDW-37028]

Known Issues

The issues that exist in SD-WAN 11.5 release.

In case of scaled deployment on configuration change on any site or WAN link, the routing engine restart causes BGP sessions to flap.

[SDWANHELP-2594]

An SD-WAN appliance crashed unexpectedly. This issue occurred when:

- IPv6 multicast traffic was flowing during a software upgrade.
- IPv6 Multicast traffic was sourced using an Intranet GRE Tunnel and was replicated to multiple branches over the virtual path using MLDv2 proxy configuration.

Workaround: Disable IPv6 Multicast traffic during the software upgrade and enable once the upgrade is successful.

[NSSDW-38495]

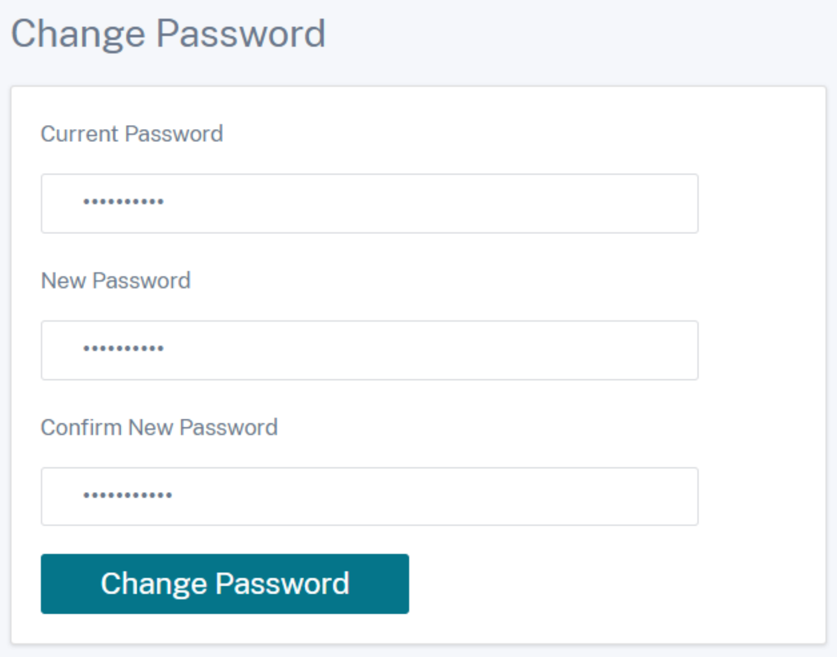
New user interface for SD-WAN appliances

August 24, 2022

A new User Interface (UI) is introduced for SD-WAN appliances. The new UI is built using the latest UI technologies. The new UI design improves the security, has an improved look and feel, it is more performant, secure, and responsive. But the new UI has retained the flow and page layout of each feature from the legacy UI.

From Citrix SD-WAN 11.4 release onwards, the New UI is enabled, by default, on all the Citrix SD-WAN appliances that are configured as clients.

> **Note**
>
> - Provisioning the Citrix SD-WAN appliances as an MCN redirects you to the legacy UI.
> - All local users with an Admin role and remote admin users can access the new user interface. Remote user accounts are authenticated through RADIUS or TACACS+ authentication servers. It is mandatory to change the default admin user account password while provisioning the SD-WAN appliance. The default password is the serial number of the SD-WAN appliance and is mandated to change on first time after logon to the device.



Change Password

Current Password: ••••••••••

New Password: ••••••••••

Confirm New Password: •••••••••••

The legacy UI is maintained for backward compatibility and is deprecated. The legacy UI can be accessed using the URL **https: // < ip-address >/cgi-bin/login.cgi**. The user name and password for the user **admin** remains the same across both (new/legacy) user interfaces, and first time login procedures can be done using either interface. Additional users will be supported in future versions of the new UI.

Citrix SD-WAN new user interface

The new UI can be accessed using Google Chrome (version 81), Mozilla Firefox, Microsoft Edge (version 81+), and Legacy Microsoft Edge (version 44+) browsers.

> **NOTE**
>
> Microsoft Internet Explorer, Apple Safari, and other browsers are not supported.

To access the new UI page, perform the following:

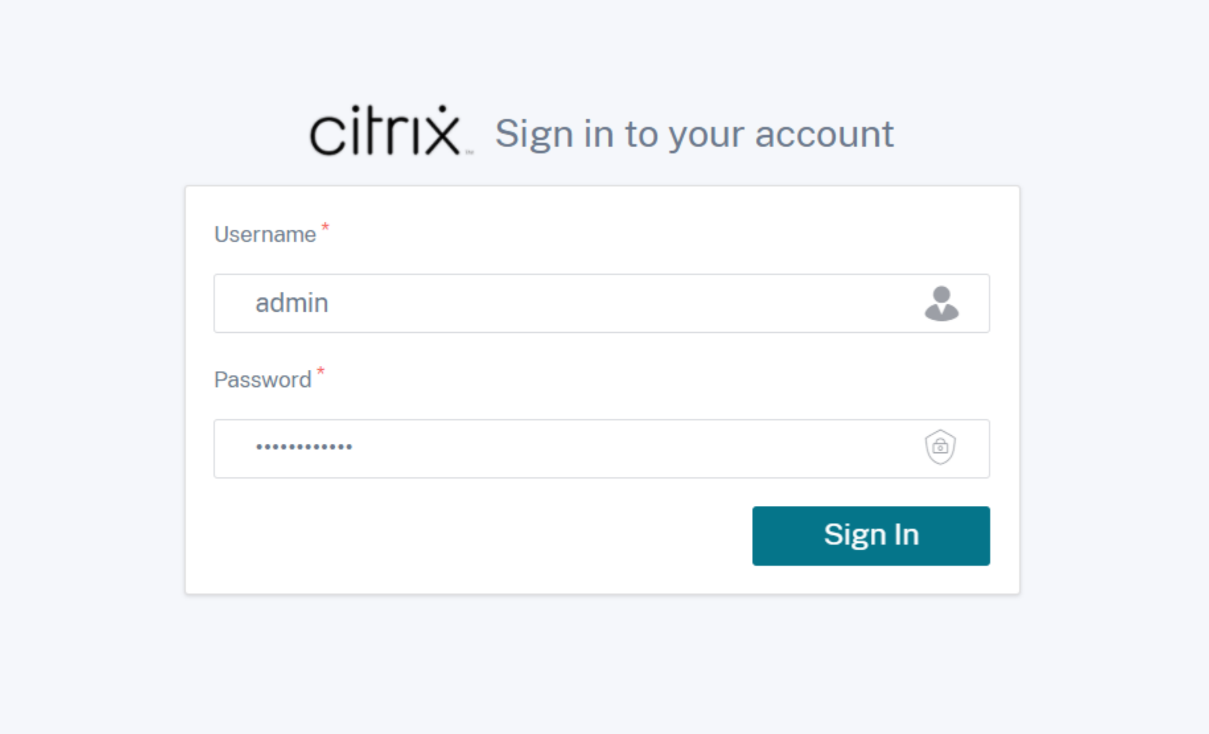
1. Open a new browser tab and navigate to **https: // < management-ip >** to access the new UI on the SD-WAN appliance. If you are accessing an IPv6 address, enter `https://<[IPv6 address]>`.

   Example: `https://[fd73:xxxx:yyyy:26::9]`

> **Note**
>
> In the scenario where the In-band management is enabled, the interface IP address can be provided in **< management-ip >** to access the new UI. The In-band management can be enabled on multiple trusted interfaces that are enabled to be used for IP services. You can access the UI using the management IP and in-band virtual IPs.

1. Provide the user name and password. Click **Sign In**.

The Citrix SD-WAN user interface page appears.



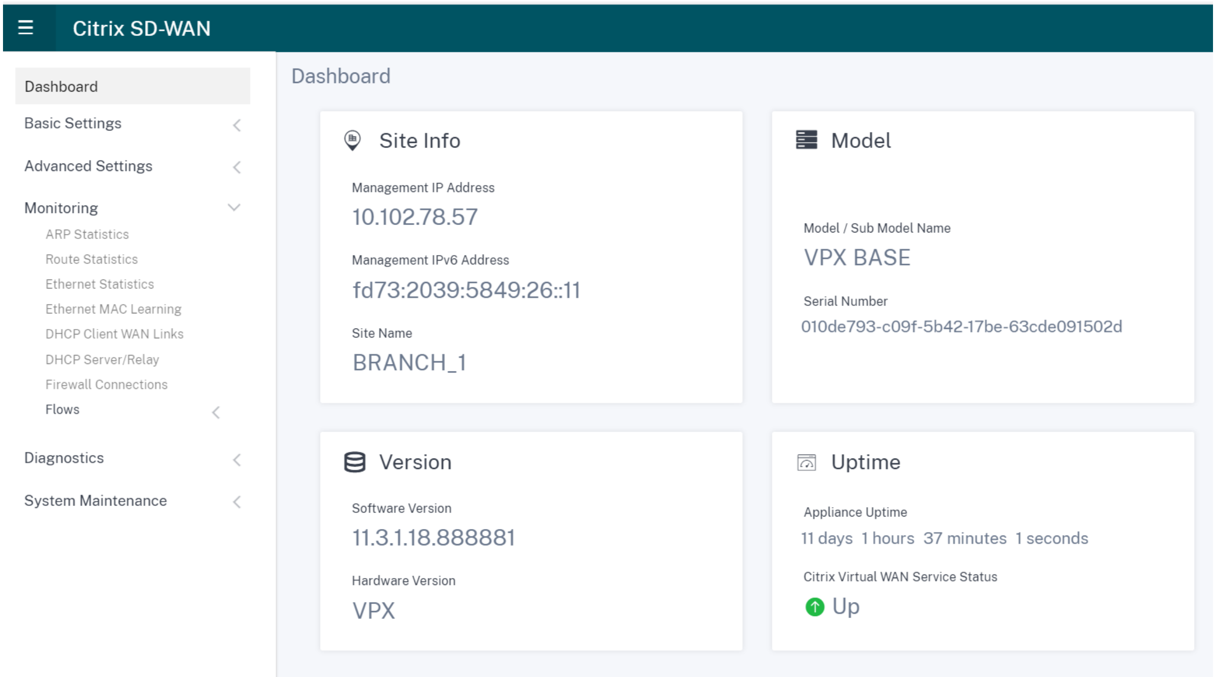
Username *

admin

Password *

••••••••••••

Once you have successfully logged in, you can see that the navigation panel is on the left side. Also, you can see a notifications banner on the dashboard if there are any warnings or errors.



Dashboard

Site Info

Management IP Address
10.102.78.57

Management IPv6 Address
fd73:2039:5849:26::11

Site Name
BRANCH_1

Model

Model / Sub Model Name
VPX BASE

Serial Number
010de793-c09f-5b42-17be-63cde091502d

Version

Software Version
11.3.1.18.888881

Hardware Version
VPX

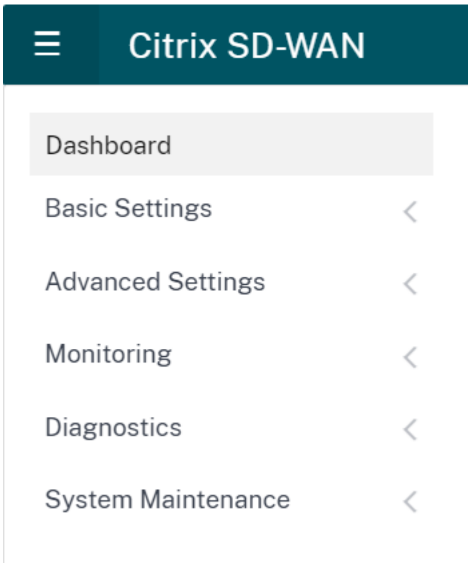
Uptime

Appliance Uptime
11 days 1 hours 37 minutes 1 seconds

Citrix Virtual WAN Service Status
● Up

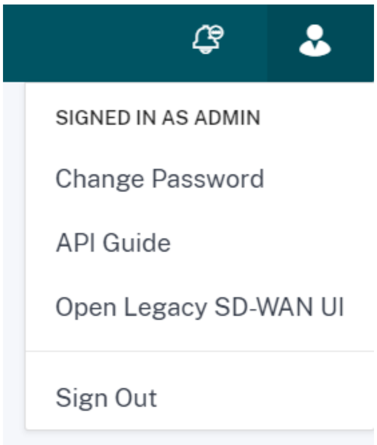
Navigation

The left navigation sidebar can be hidden or made visible on click of the hamburger icon. The hamburger icon on the top left corner provides links to the dashboard, **basic/advanced** settings, monitoring, and management related options.



Menu bar

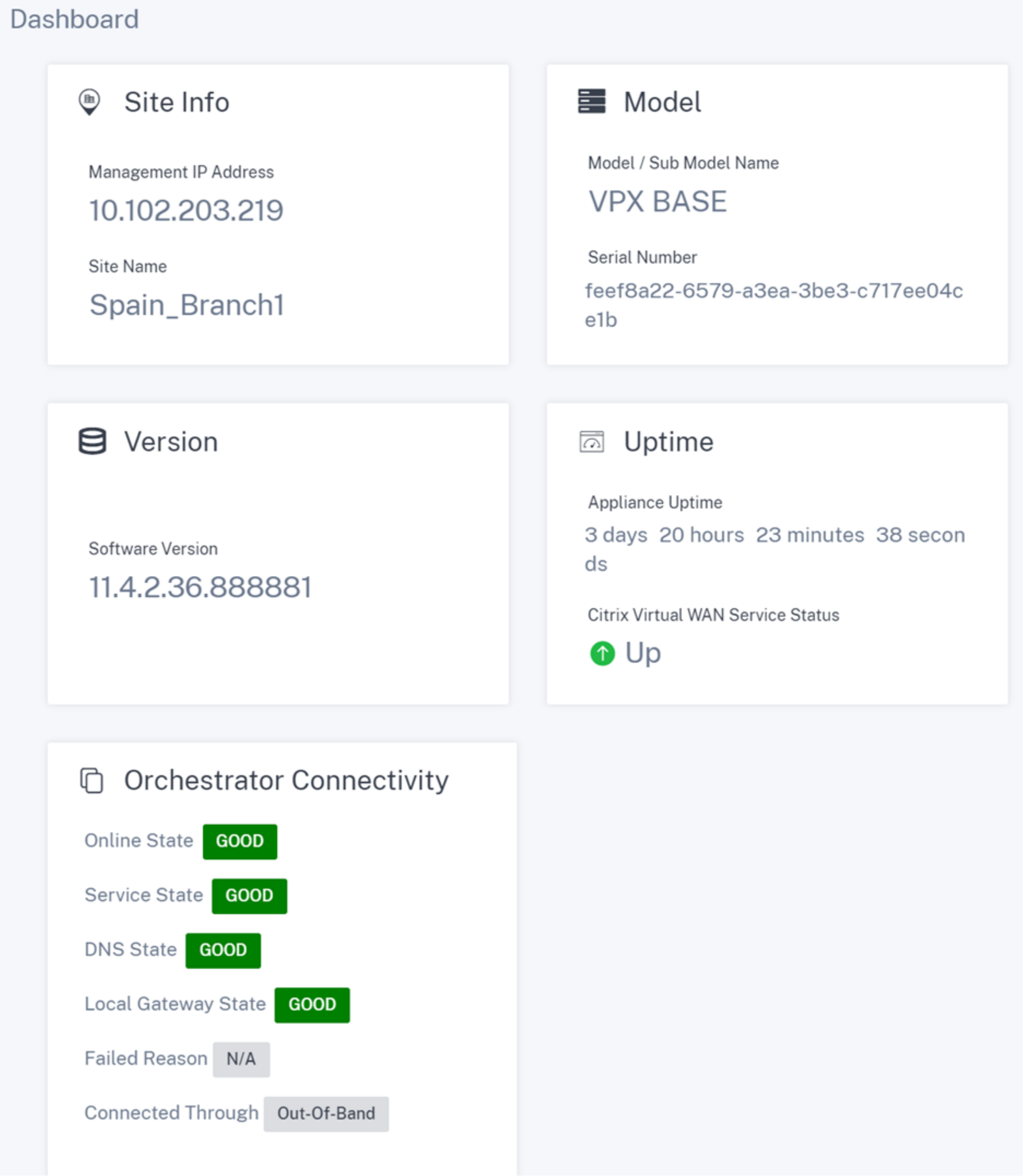
The user menu on the top right corner displays the logged-on user details. You can open the legacy user interface in a new browser tab by clicking the **Open Legacy SD-WAN UI** option. Click the bell icon for any notifications.



Dashboard

The **Dashboard** page displays the following basic information of the SD-WAN appliance as a tile view:

- **Site** –Displays the site information with **Management IP Address** and **Site Name**
- **Model** –Displays the **Model/Sub Model Name** and **Serial Number**
- **Version** –Displays **Software** and **Hardware** version
- **Uptime** - Displays **Appliance Uptime**, **Citrix Virtual WAN Service Status** and **Orchestrator Connectivity Status**.
- **High Availability** - Displays the local and peer appliance HA status and the last HA update received time.
- **Metered Links** –Displays the usage and billing details for links on which metering is enabled.
- **Orchestrator Connectivity** - Displays the appliance connectivity status with Citrix SD-WAN Orchestrator service. The following Status Information is displayed:
  - **Online State**- Indicates the connection status between the appliance and Citrix SD-WAN Orchestrator service. Periodic heartbeat signals are sent by the appliance to Citrix SD-WAN Orchestrator service to identify the connection state as Good or Bad.
  - **Service State**- Indicates the https reachability of the appliance to all the required SD-WAN Orchestrator services such as download, home, logging, stats. If the service state is bad, it means that the connection is established but all or some of the services are not reachable. The unreachable service name is displayed.
  - **DNS State**- Indicates the FQDNs DNS resolution status. If the DNS state is bad, it means that the DNS resolution of one of the FQDNs is failing. The unresolved FQDN's name is displayed.
  - **Local Gateway State**- Indicates the default gateway status. For an Out-Of-Band connection, the gateway state is determined by pinging the default gateway. For an In-Band connection, the gateway state is determined by pinging the in-band Ethernet interface IP address.
  - **Connected Through**- Indicates how the appliance reaches Citrix SD-WAN Orchestrator service. Either through Out-Of-Band, which is the default configuration or through In-Band, if In-band management is configured.
  - **Failed Reason**: Reason for failure while connecting to SD-WAN Orchestrator service.



Dashboard

Site Info

Management IP Address

10.102.203.219

Site Name

Spain_Branch1

Model

Model / Sub Model Name

VPX BASE

Serial Number

feef8a22-6579-a3ea-3be3-c717ee04ce1b

Version

Software Version

11.4.2.36.888881

Uptime

Appliance Uptime

3 days 20 hours 23 minutes 38 seconds

Citrix Virtual WAN Service Status

Up

Orchestrator Connectivity

Online State GOOD

Service State GOOD

DNS State GOOD

Local Gateway State GOOD

Failed Reason N/A

Connected Through Out-Of-Band

Basic settings

The SD-WAN appliance **Basic Settings** include the following entities configuration. The new UI provides a separate page for configuring each entity individually.

- Management and DNS

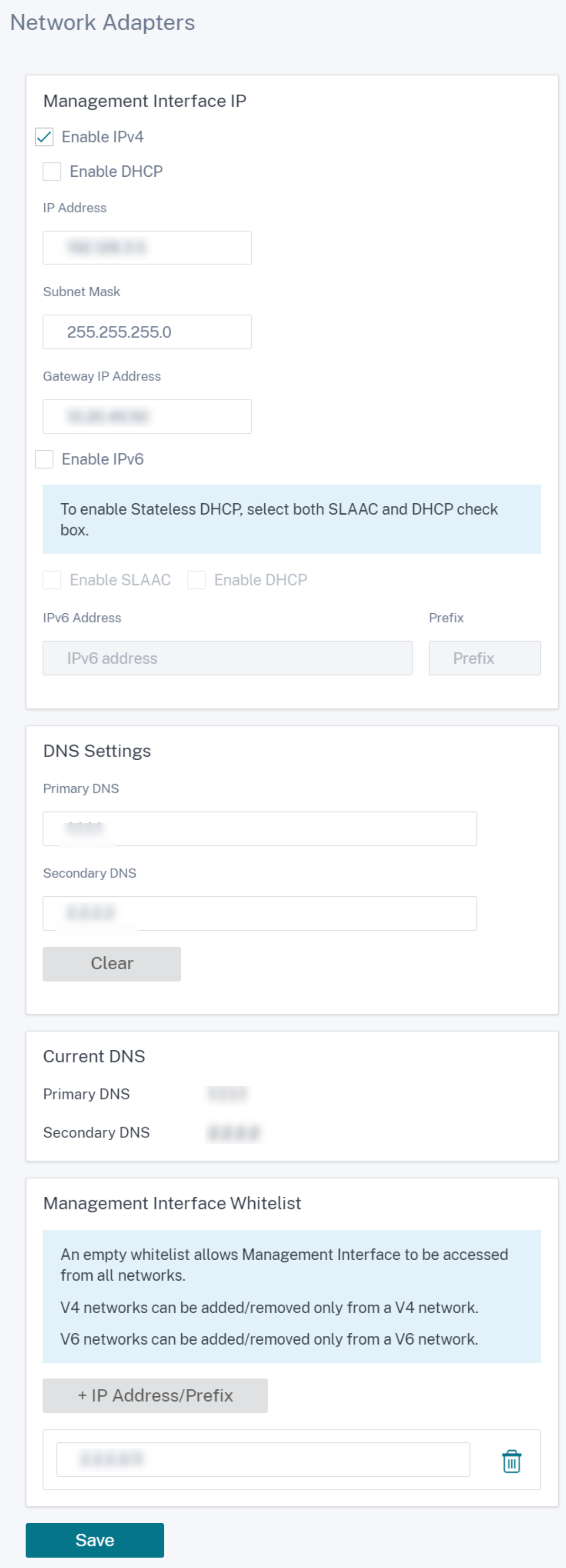
- Interface Settings
- LACP LAG Group
- Date and Time
- RADIUS Server
- TACACS+ Server

Management and DNS

From the **Management and DNS** page, you can configure the management interface IP address and DNS settings. For more information, see Configure Management IP Address.

The management interface allow list is an approved list of IP addresses or IP domains that have permission to access your management interface. An empty list allows Management Interface to be accessed from all networks. You can add IP addresses to ensure that the management IP address is accessible only by the trusted networks.

To add or remove an IPv4 address to the allowed list, you must access the SD-WAN appliance management interface using an IPv4 address only. Similarly, to add or remove an IPv6 address to the allowed list, you must access the SD-WAN appliance management interface using an IPv6 address only



Network Adapters

Management Interface IP

☑ Enable IPv4

□ Enable DHCP

IP Address: [redacted]

Subnet Mask: 255.255.255.0

Gateway IP Address: [redacted]

□ Enable IPv6

To enable Stateless DHCP, select both SLAAC and DHCP check box.

□ Enable SLAAC □ Enable DHCP

IPv6 Address: IPv6 address

Prefix: Prefix

DNS Settings

Primary DNS: [redacted]

Secondary DNS: [redacted]

Clear

Current DNS

Primary DNS [redacted]

Secondary DNS [redacted]

Management Interface Whitelist

An empty whitelist allows Management Interface to be accessed from all networks.

V4 networks can be added/removed only from a V4 network.

V6 networks can be added/removed only from a V6 network.

+ IP Address/Prefix

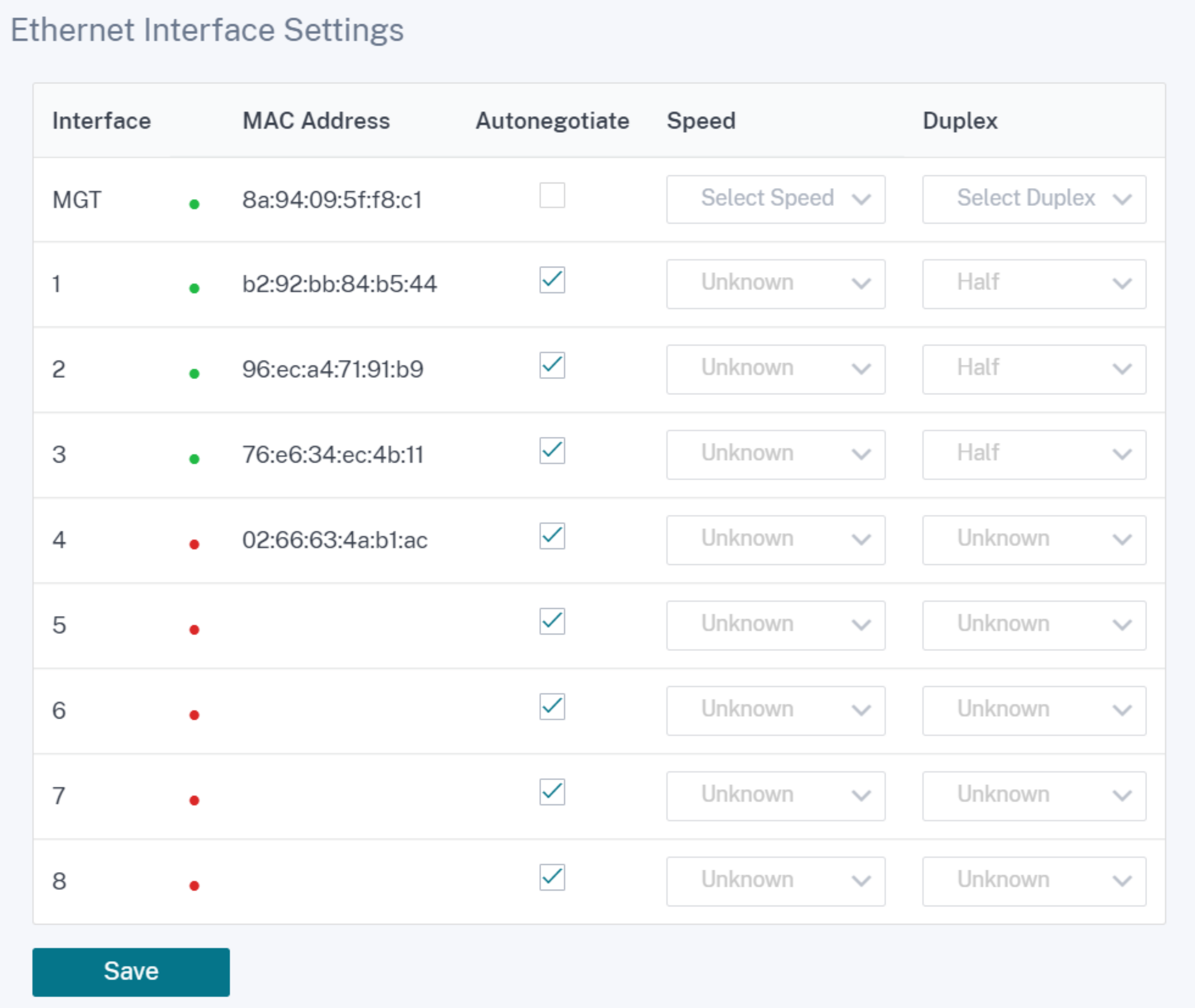
[redacted]

Save

Enter the **IP address, Subnet mask,** and **Gateway IP address** for the appliance that you want to configure. Under the **DNS Settings** section, provide the primary and secondary DNS server detail and click **Save**.

Interface settings

The **Interface Settings** page displays the Ethernet port configuration data. The ports that are down are indicated as a red dot against the MAC address.



Ethernet Interface Settings

Interface		MAC Address	Autonegotiate	Speed	Duplex
MGT	🟢	8a:94:09:5f:f8:c1	☐	Select Speed	Select Duplex
1	🟢	b2:92:bb:84:b5:44	☑	Unknown	Half
2	🟢	96:ec:a4:71:91:b9	☑	Unknown	Half
3	🟢	76:e6:34:ec:4b:11	☑	Unknown	Half
4	🔴	02:66:63:4a:b1:ac	☑	Unknown	Unknown
5	🔴		☑	Unknown	Unknown
6	🔴		☑	Unknown	Unknown
7	🔴		☑	Unknown	Unknown
8	🔴		☑	Unknown	Unknown

LACP LAG group

The Link Aggregation Groups (LAG) functionality allows you to group two or more ports on your SD-WAN appliance to work together as a single port. This ensures increased availability, link redundancy, and enhanced performance.

Earlier, only the Active-Backup mode was supported in LAG. From Citrix SD-WAN 11.3 release onwards, the 802.3AD Link Aggregation Control Protocol (LACP) protocol based negotiations are supported. The LACP is a standard protocol and provides more functionality for LAGs.

In Active-Backup mode, at any time only one port is active and the other ports are in backup mode. The active and backup supports rely on the Data Plane Development Kit (DPDK) package for LAG functionality.

With the LACP, you can send the traffic through all the ports simultaneously. As a benefit, you get more bandwidth along with the link redundancy mechanism. The LACP implementation supports the Active-Active mode. Now with the Active-Backup mode, you also can select full LACP Active-Active mode from the SD-WAN UI.

The LAG functionality is available only on the following DPDK supported platforms:

- Citrix SD-WAN 110 SE
- Citrix SD-WAN 210 SE
- Citrix SD-WAN 410 SE
- Citrix SD-WAN 1100 SE/PE
- Citrix SD-WAN 2100 SE/PE
- Citrix SD-WAN 4100, and 5100 SE
- Citrix SD-WAN 6100 SE

> **Note**
>
> The LAG functionality is not supported on VPX/VPXL platforms.

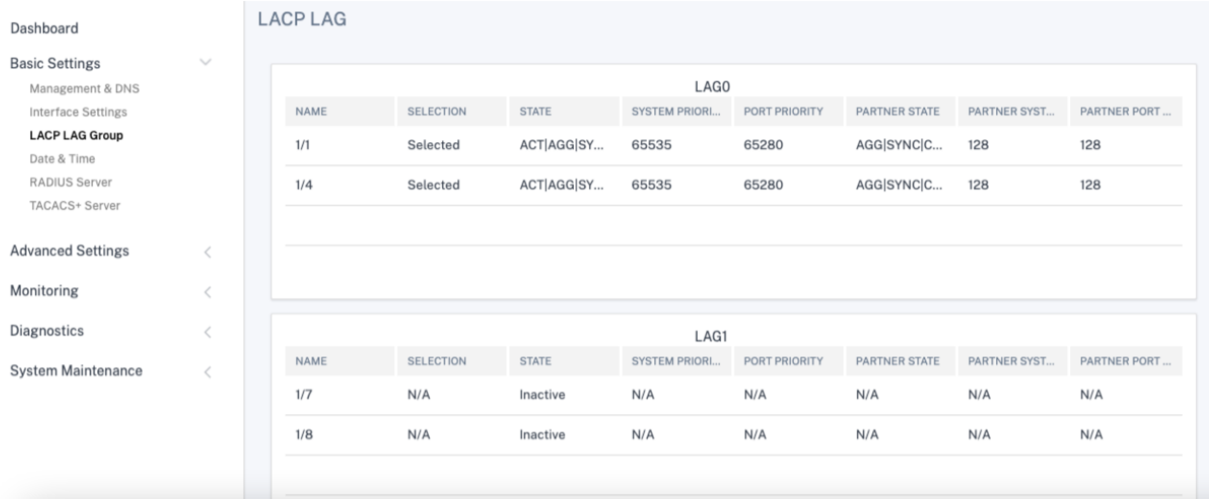
You can create a maximum of 4 LAGs with a maximum of 4 ports grouped in each LAG on the Citrix SD-WAN appliances.

For the Citrix SD-WAN 210 and 410 appliances, a maximum of 3 LAGs and for the Citrix SD-WAN 110 appliance, a maximum of 2 LAGs can be created.

You can create LAG using the Legacy UI or SD-WAN Orchestrator only. In the New UI, you can only view the details of the created LAG.

To view LAG details navigate to **Basic Settings** > **LACP LAG Group**.

You can view LACP LAG details such as the current state, system, and port priority details of active and partner ports.



LACP LAG

LAG0

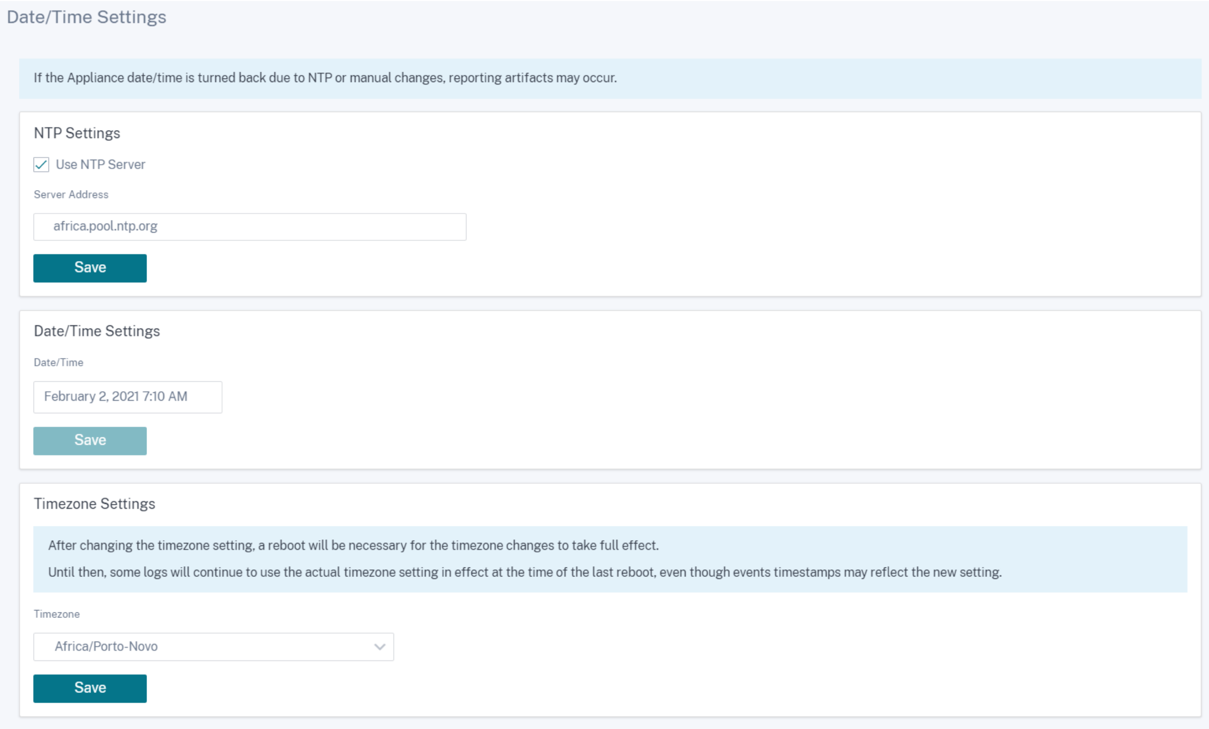
NAME	SELECTION	STATE	SYSTEM PRIORI...	PORT PRIORITY	PARTNER STATE	PARTNER SYST...	PARTNER PORT ...
1/1	Selected	ACT|AGG|SY...	65535	65280	AGG|SYNC|C...	128	128
1/4	Selected	ACT|AGG|SY...	65535	65280	AGG|SYNC|C...	128	128

LAG1

NAME	SELECTION	STATE	SYSTEM PRIORI...	PORT PRIORITY	PARTNER STATE	PARTNER SYST...	PARTNER PORT ...
1/7	N/A	Inactive	N/A	N/A	N/A	N/A	N/A
1/8	N/A	Inactive	N/A	N/A	N/A	N/A	N/A

Date and Time

From the **Date and Time** settings page, you must set the date and time on the appliance. For more information, see Set date and time.



Date/Time Settings

If the Appliance date/time is turned back due to NTP or manual changes, reporting artifacts may occur.

NTP Settings

☑ Use NTP Server

Server Address: africa.pool.ntp.org

Date/Time Settings

Date/Time: February 2, 2021 7:10 AM

Timezone Settings

After changing the timezone setting, a reboot will be necessary for the timezone changes to take full effect.
Until then, some logs will continue to use the actual timezone setting in effect at the time of the last reboot, even though events timestamps may reflect the new setting.

Timezone: Africa/Porto-Novo

RADIUS Server

You can configure an SD-WAN appliance to authenticate user access with one or more RADIUS servers.

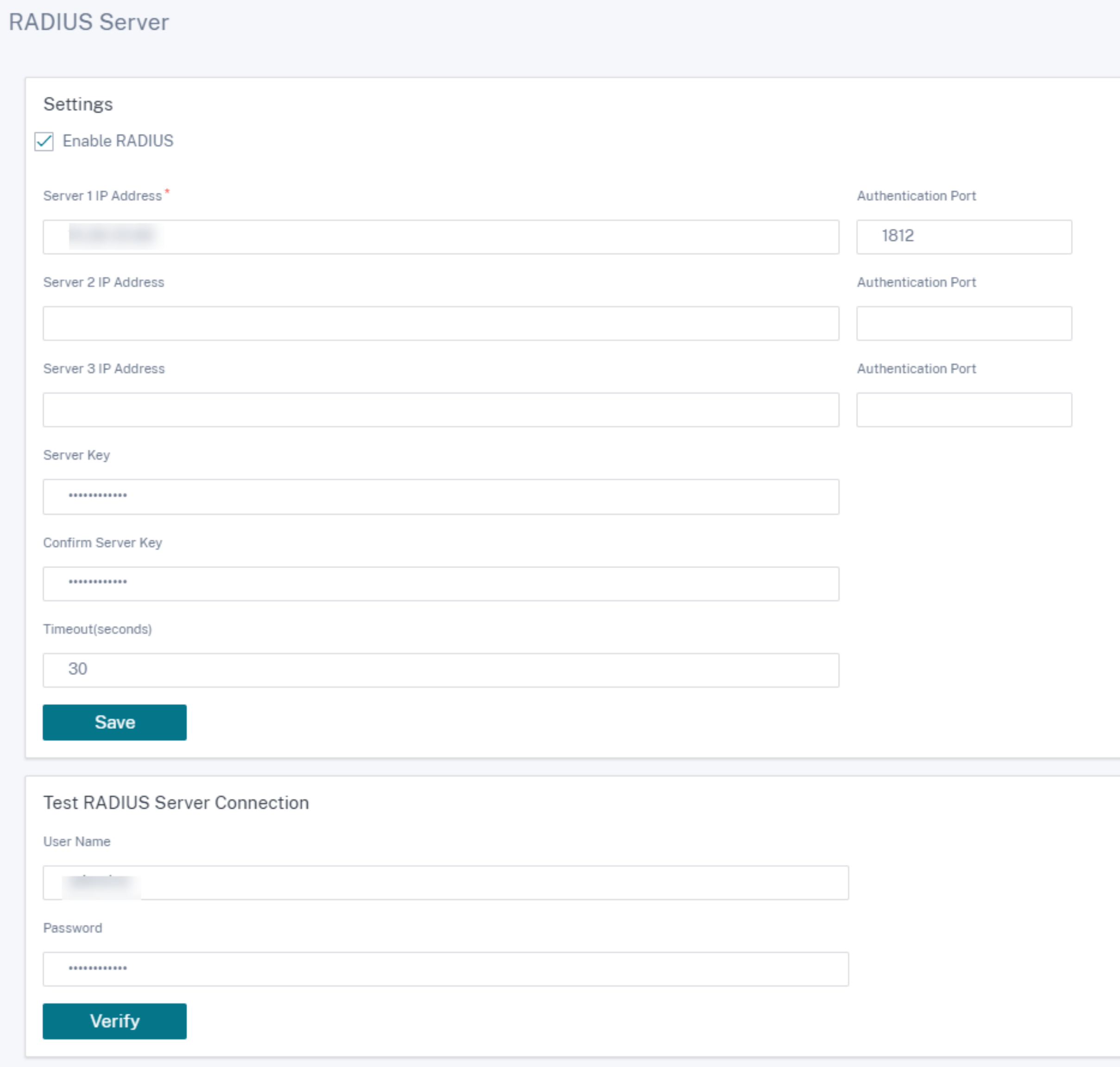
To configure the RADIUS server:

1. Select the **Enable RADIUS** check box.
2. Enter the **Server IP Address** and **Authentication Port**. A maximum of three server IP addresses can be configured.

   > **NOTE**
   >
   > To configure an IPv6 address, ensure that the RADIUS server is also configured with an IPv6 address.

3. Enter the **Server Key** and confirm.
4. Enter the **Timeout** value in seconds.
5. Click **Save**.

You can also test the RADIUS server connection. Enter the **User Name** and **Password**. Click **Verify**.



RADIUS Server

Settings

☑ Enable RADIUS

Server 1 IP Address * [redacted] Authentication Port 1812

Server 2 IP Address Authentication Port

Server 3 IP Address Authentication Port

Server Key ••••••••••••

Confirm Server Key ••••••••••••

Timeout(seconds) 30

Test RADIUS Server Connection

User Name [redacted]

Password ••••••••••••

TACACS+ Server

You can configure a TACACS+ server for authentication. Similar to RADIUS authentication, TACACS+ uses a secret key, an IP address, and the port number. The default port number is 49.

To configure the TACACS+ server:

1. Select the **Enable TACACS+** check box.
2. Enter the **Server IP Address** and **Authentication Port**. A maximum of three server IP addresses can be configured.

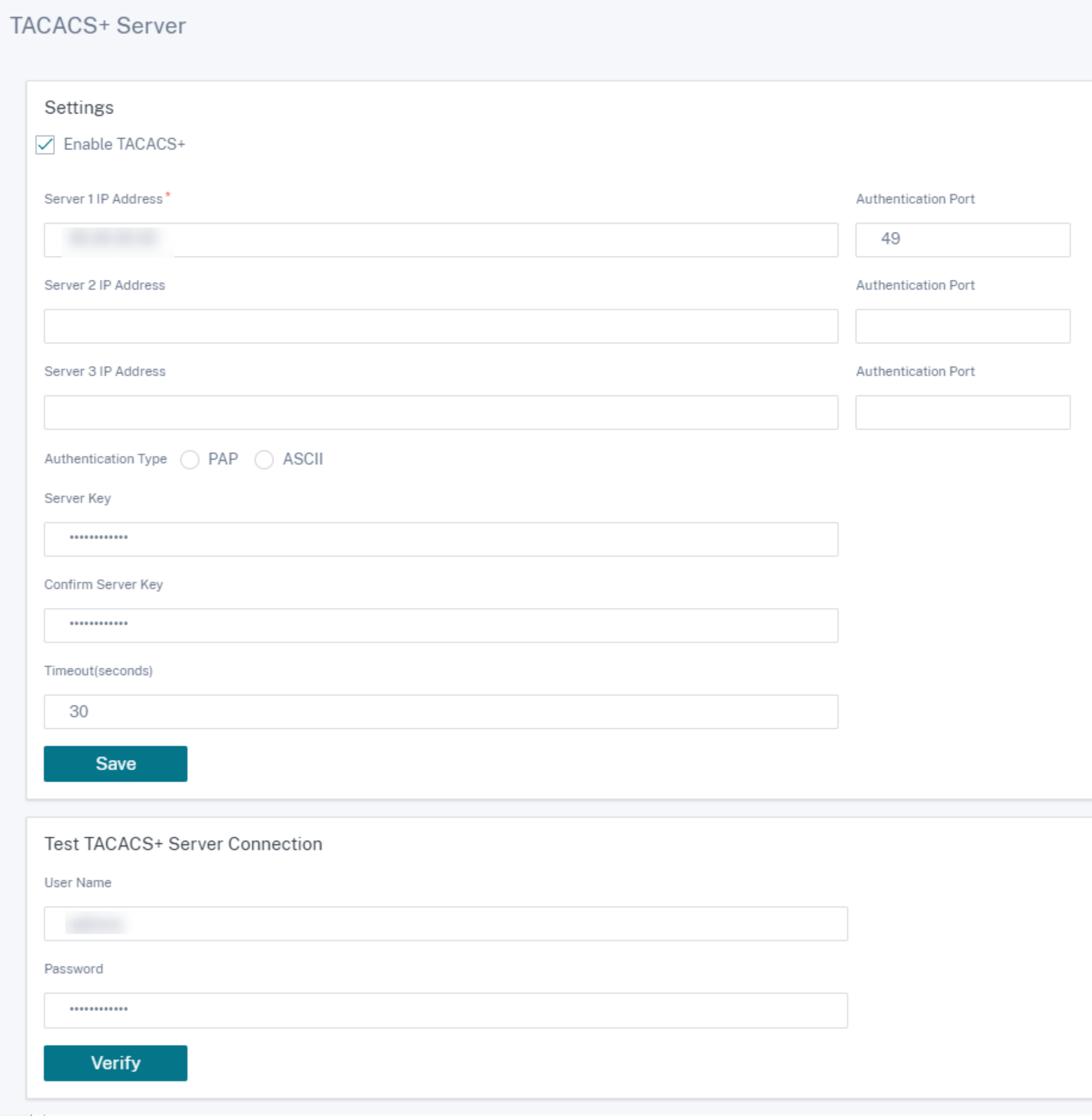
> **NOTE**
>
> To configure an IPv6 address, ensure that the TACACS+ server is also configured with an IPv6 address.

3. Select **PAP** or **ASCII** as the Authentication Type.

    - PAP: Uses Password Authentication Protocol (PAP) to strengthen user authentication by assigning a strong shared secret to the TACACS+ server.
    - ASCII: Uses ASCII character set to strengthen user authentication by assigning a strong shared secret to the TACACS+ server.

4. Enter the **Server Key** and confirm.
5. Enter the **Timeout** value in seconds.
6. Click **Save**.

You can also test the TACACS+ server connection. Enter the **User Name** and **Password**. Click **Verify**.



TACACS+ Server

Settings

☑ Enable TACACS+

Server 1 IP Address*: [redacted]
Authentication Port: 49

Server 2 IP Address:
Authentication Port:

Server 3 IP Address:
Authentication Port:

Authentication Type ○ PAP ○ ASCII

Server Key: ••••••••••••

Confirm Server Key: ••••••••••••

Timeout(seconds): 30

Test TACACS+ Server Connection

User Name: [redacted]

Password: ••••••••••••

Advanced settings

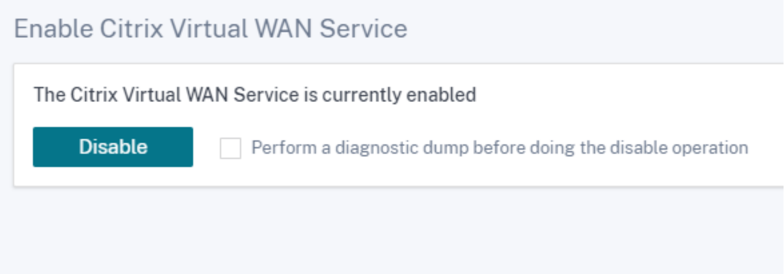
The SD-WAN appliance **Advanced Settings** include the following entities configuration.

- Citrix Virtual WAN Service
- High Availability
- Mobile Broadband
- Licensing
- Fallback Configuration
- HTTPS Certificate

- On-prem Orchestrator

Citrix Virtual WAN service

The **CItrix Virtual WAN Service** page allows you to enable/disable the Citrix Virtual WAN Service. For more information, see Configure Virtual WAN Service.



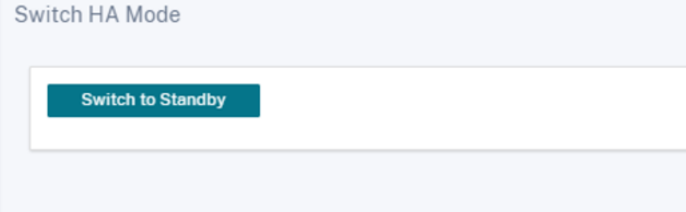
Enable Citrix Virtual WAN Service

The Citrix Virtual WAN Service is currently enabled

Disable
□ Perform a diagnostic dump before doing the disable operation

High Availability

From the **High Availability** page, you can toggle between active and standby state for an SD-WAN high availability (HA) setup. The high availability status is available in the dashboard (if high availability is configured). For more information, see High Availability Mode.



Mobile broadband

The Citrix SD-WAN appliances such as the Citrix SD-WAN 210 SE LTE and 110 LTE Wi-Fi appliances have a built-in internal LTE modem. You can also connect an external 3G/4G USB modem on the following Citrix SD-WAN appliances.

- Citrix SD-WAN 210 SE
- Citrix SD-WAN 210 SE LTE
- Citrix SD-WAN 110 SE
- Citrix SD-WAN 110 LTE Wi-Fi SE

CDC Ethernet, MBIM, and NCM are the three types of external USB modems supported.

For more information on configuring LTE using the legacy GUI, see the following topic:

- Configure LTE functionality on 210 SE LTE appliance

- Configure LTE functionality on 110-LTE-WiFi appliance
- Configure external USB LTE modem

For an internal LTE modem, insert the SIM card into the SIM card slot of the Citrix SD-WAN appliance. Fix the antennas to the Citrix SD-WAN appliance. For more information, see Installing the LTE antennas and power on the appliance.

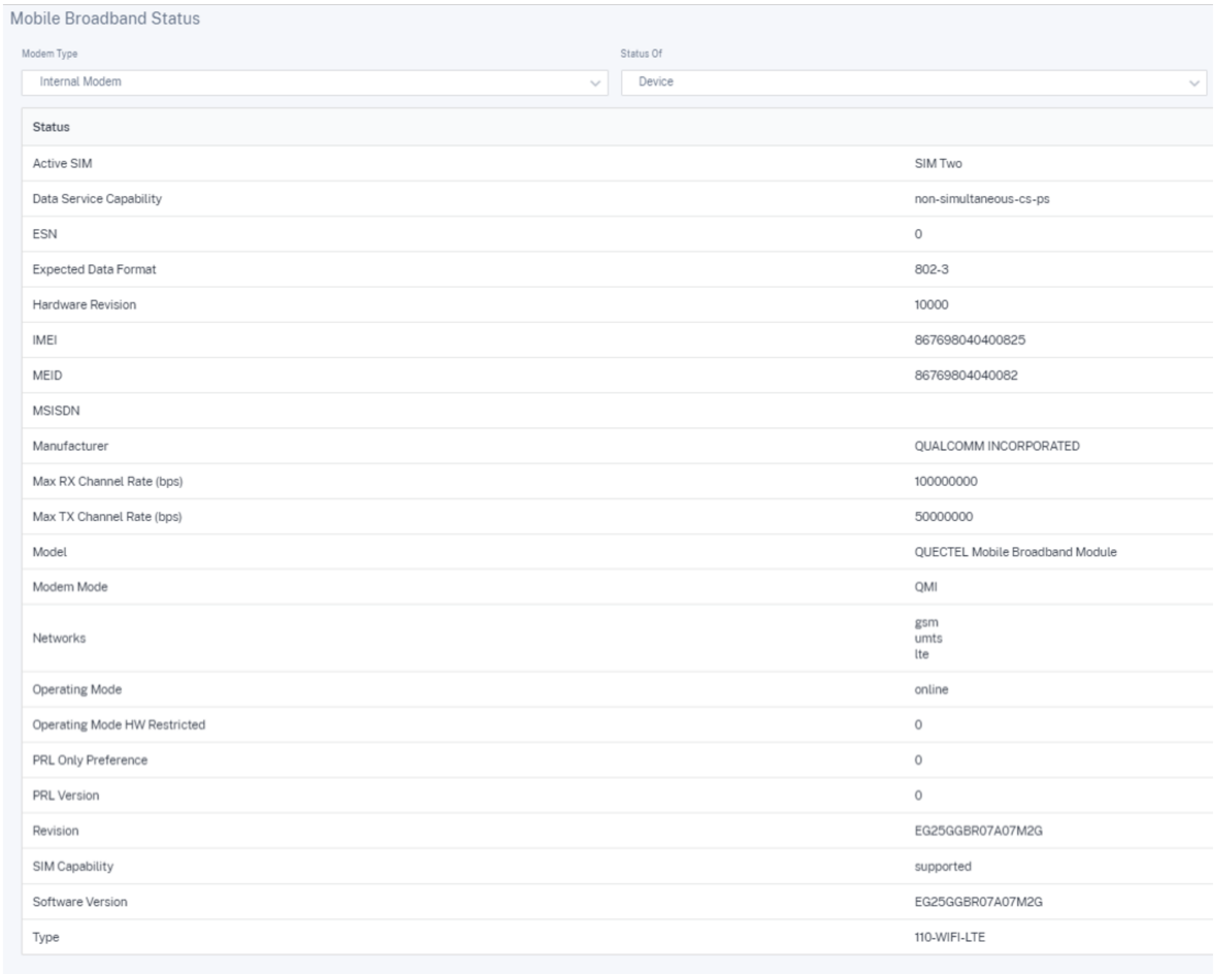
> **Note**
>
> Citrix SD-WAN 110-LTE-WiFi appliance has two standard (2FF) SIM slots. To use Micro (3FF) and Nano (4FF) size SIMs, use a SIM adapter. Snap the smaller SIM into the adapter. You can obtain the adapter from Citrix as a Field Replaceable Unit (FRU) or from the SIM provider. Hot-swapping of SIM for the internal LTE modem is supported only on the Citrix SD-WAN 110-LTE-WiFi appliance.

Perquisites for external LTE modem:

- Use the supported USB LTE dongles. The supported dongle hardware models are Verizon USB730L and AT&T USB800.
- Ensure that a SIM card is inserted into the USB LTE dongle. The CDC Ethernet LTE dongles are pre-configured with a static IP address, this interferes with the configuration and cause connection failure or intermittent connection, if the SIM card is not inserted.
- Before inserting a CDC Ethernet LTE dongle into the SD-WAN appliance, connect the external USB stick to a Windows/Linux machine and ensure that the internet is working properly with proper APN and Mobile Data Roaming configuration. Ensure that the **Connection mode** of the USB dongle is changed from the default value **Manual** to **Auto**.

> **Note**
>
> - The Citrix SD-WAN appliances support only one USB LTE dongle at a time. If more than one USB dongle is plugged in, unplug all the dongles and plug in only one dongle.
> - The Citrix SD-WAN appliances do not support user name and password for USB modems. Ensure that the user name and password feature are disabled on the modem during setup.
> - Unplugging or rebooting an external MBIM dongle impacts the internal LTE modem data session. This is an expected behavior.
> - When an external LTE modem is plugged-in, the SD-WAN appliance takes about 3 minutes to recognize it.

To view the mobile broadband status, select the modem type.



Mobile Broadband Status

Modem Type: Internal Modem

Status Of: Device

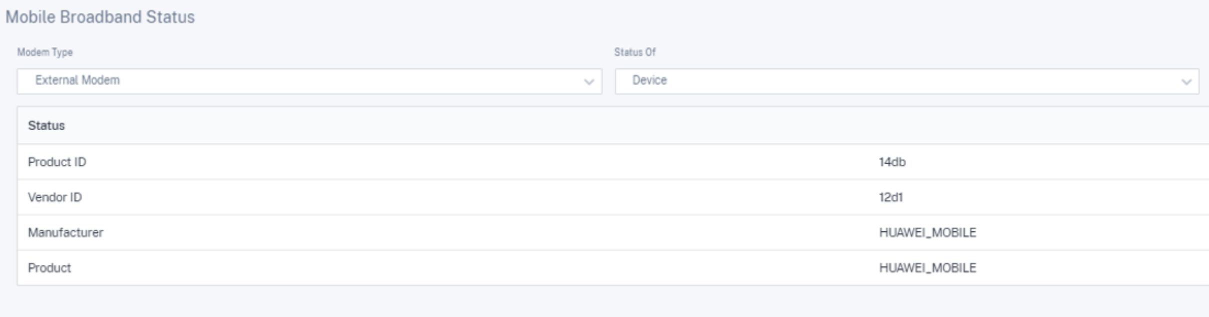
Status	
Active SIM	SIM Two
Data Service Capability	non-simultaneous-cs-ps
ESN	0
Expected Data Format	802-3
Hardware Revision	10000
IMEI	867698040400825
MEID	86769804040082
MSISDN	
Manufacturer	QUALCOMM INCORPORATED
Max RX Channel Rate (bps)	100000000
Max TX Channel Rate (bps)	50000000
Model	QUECTEL Mobile Broadband Module
Modem Mode	QMI
Networks	gsm umts lte
Operating Mode	online
Operating Mode HW Restricted	0
PRL Only Preference	0
PRL Version	0
Revision	EG25GGBR07A07M2G
SIM Capability	supported
Software Version	EG25GGBR07A07M2G
Type	110-WIFI-LTE

The following are some useful status information:

- **Modem Type**: Select the modem type as External or Internal. Internal modem shows the status under **Mobile Broadband > Status** page. All the other sections such as SIM preference, APN settings, Enable/Disable the modem, Reboot modem, and Refresh SIM are available under **Mobile Broadband > Operations** page.
- **Active SIM**: At any given time, only one SIM can be active. Displays the SIM that is currently active.
- **Operating Mode**: Displays the modem state.
- **SIM Capabilities**: Displays whether the SIM is supported or not.
- **Model**: Displays the mobile broadband module name.

If you select the **External** modem, it shows the status of the external modem. But if the external modem is not configured, it shows a warning message as **Selected Modem is not configured on this device**.

Device details for CDC Ethernet external modem.



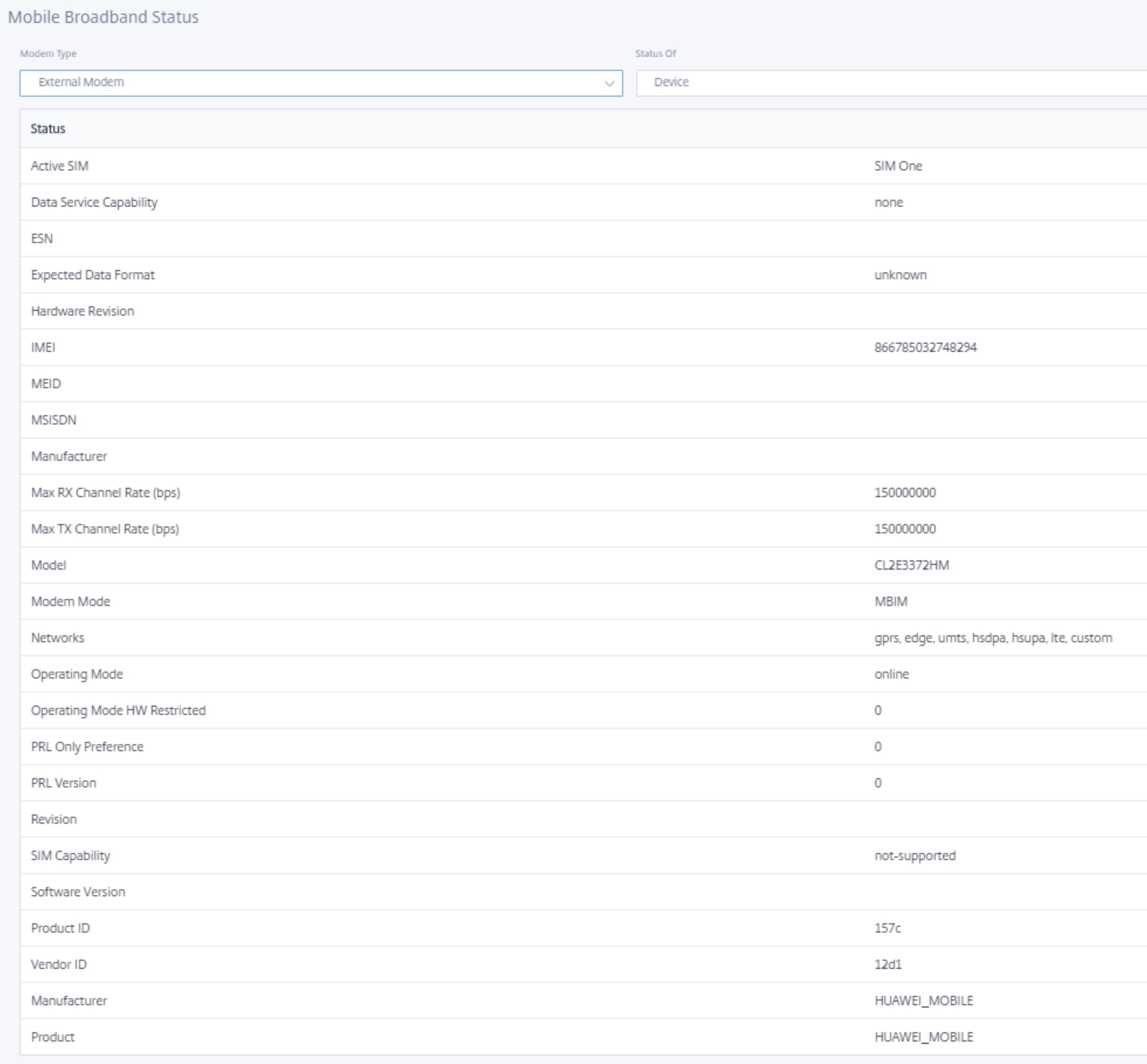
Mobile Broadband Status

Modem Type: External Modem

Status Of: Device

Status	
Product ID	14db
Vendor ID	12d1
Manufacturer	HUAWEI_MOBILE
Product	HUAWEI_MOBILE

Device details for MBIM and NCM external modems. The **Modem Mode** field displays the external dongle type.



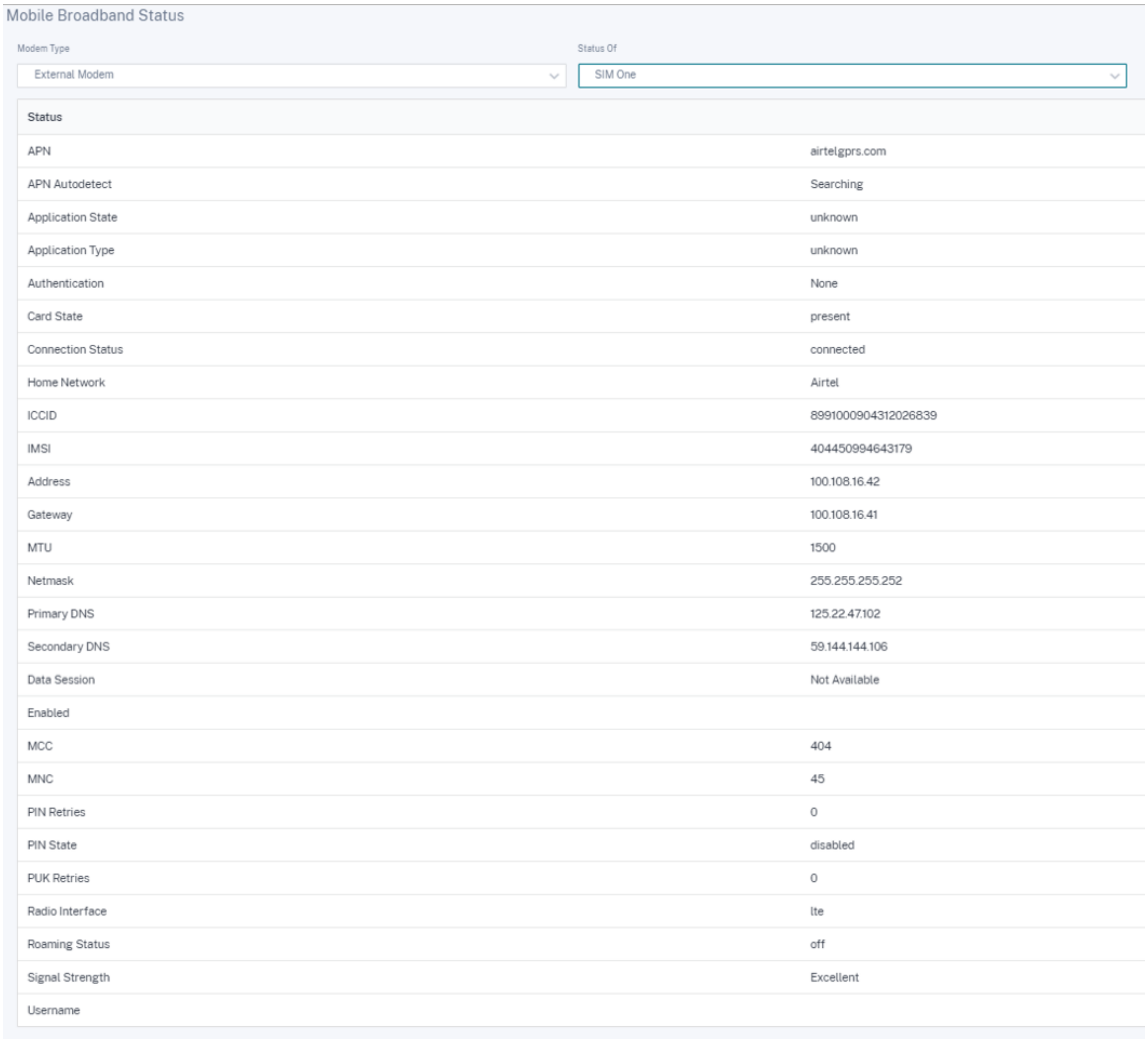
Mobile Broadband Status

Modem Type: External Modem

Status Of: Device

Status	
Active SIM	SIM One
Data Service Capability	none
ESN	
Expected Data Format	unknown
Hardware Revision	
IMEI	866785032748294
MEID	
MSISDN	
Manufacturer	
Max RX Channel Rate (bps)	150000000
Max TX Channel Rate (bps)	150000000
Model	CL2E3372HM
Modem Mode	MBIM
Networks	gprs, edge, umts, hsdpa, hsupa, lte, custom
Operating Mode	online
Operating Mode HW Restricted	0
PRL Only Preference	0
PRL Version	0
Revision	
SIM Capability	not-supported
Software Version	
Product ID	157c
Vendor ID	12d1
Manufacturer	HUAWEI_MOBILE
Product	HUAWEI_MOBILE

SIM details are displayed for MBIM and NCM external modems only.



Mobile Broadband Status

Modem Type: External Modem

Status Of: SIM One

Status	
APN	airtelgprs.com
APN Autodetect	Searching
Application State	unknown
Application Type	unknown
Authentication	None
Card State	present
Connection Status	connected
Home Network	Airtel
ICCID	8991000904312026839
IMSI	404450994643179
Address	100.108.16.42
Gateway	100.108.16.41
MTU	1500
Netmask	255.255.255.252
Primary DNS	125.22.47.102
Secondary DNS	59.144.144.106
Data Session	Not Available
Enabled	
MCC	404
MNC	45
PIN Retries	0
PIN State	disabled
PUK Retries	0
Radio Interface	lte
Roaming Status	off
Signal Strength	Excellent
Username	

Mobile broadband operations Operations that are supported on internal and external modems:

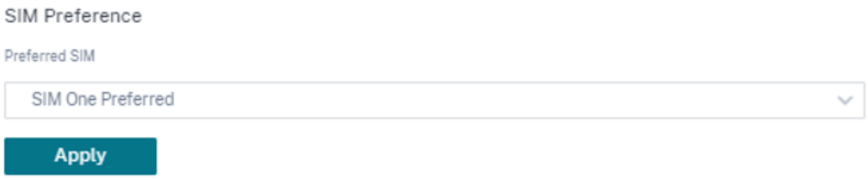
Operations	Internal modem	External modem - CDC Ethernet	External modem - MBIM and NCM
SIM preference	Yes - For appliances that support dual SIM	No	No
SIM PIN	Yes	No	No
APN settings	Yes	No	Yes
Network settings	Yes	No	No
Roaming	Yes	No	No
Manage firmware	Yes	No	No

Operations	Internal modem	External modem - CDC Ethernet	External modem - MBIM and NCM
Enable/Disable modem	Yes	No	Yes
Reboot modem	Yes	No	No
Refresh SIM	Yes	No	No

SIM preference You can insert dual SIMs on a Citrix SD-WAN 110-LTE-WiFi appliance. At any given time, only one SIM is active. Select the **SIM preference**:

- **SIM One preferred**: If two SIMs are inserted, on boot-up the LTE modem uses SIM One, if available. When the LTE modem is up and running it uses whichever SIM (SIM One or SIM Two) is useable at that moment and will continue to use it until the SIM is active.
- **SIM Two preferred**: If two SIMs are inserted, on boot-up the LTE modem uses SIM Two, if available. When the LTE modem is up and running it uses whichever SIM (SIM One or SIM Two) is useable at that moment and will continue to use it until the SIM is active.
- **SIM One**: Only SIM One is used, irrespective of the SIM state on both the SIM slots. SIM One is always active.
- **SIM Two**: Only SIM Two is used, irrespective of the SIM state on both the SIM slots. SIM Two is always active.

> **Note**
>
> The SIM Preference option is not available for the Citrix SD-WAN 210-SE LTE Wi-Fi appliance as it has only one SIM card slot.

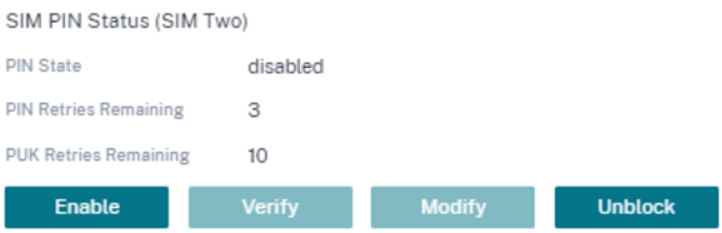

SIM Preference

Preferred SIM: SIM One Preferred

SIM PIN

If you have inserted a SIM card that is locked with a PIN, the SIM status is in **Enabled and Not Verified** state. You cannot use the SIM card until it is verified using the SIM PIN. You can obtain the SIM PIN from the carrier.

To perform SIM PIN operations, navigate to **Advanced Settings > Mobile Broadband > Operations > SIM PIN status**.



SIM PIN Status (SIM Two)

PIN State	disabled
PIN Retries Remaining	3
PUK Retries Remaining	10

You can perform the following operations:

- **Verify SIM PIN**: Click **Verify**. Enter the SIM PIN provided by the carrier and click **Verify**. The status changes to **Enabled and Verified**.
- **Enable SIM PIN**: You can enable SIM PIN for a SIM that has SIM PIN disabled. Click **Enable**. Enter the SIM PIN provided by the carrier and click **Enable**. If the SIM PIN state changes to **Enabled and Not Verified**, it means that the PIN is not verified and you cannot perform any LTE related operations until the PIN is verified. Click **Verify**. Enter the SIM PIN provided by the carrier and click **Verify**.
- **Disable SIM PIN**: You can choose to disable SIM PIN functionality for a SIM for which SIM PIN is enabled and verified. Click **Disable**. Enter the SIM PIN and click **Disable**.
- **Modify SIM PIN**: Once the PIN is in Enabled and Verified state you can choose to change the PIN. Click **Modify**. Enter the SIM PIN provided by the carrier. Enter the new SIM PIN and confirm it. Click **Modify**.
- **Unblock SIM** - If you forget the SIM PIN, you can reset the SIM PIN using the SIM PUK obtained from the carrier. To unblock a SIM, click **Unblock**. Enter the SIM PIN and SIM PUK obtained from the carrier and click **Unblock**.

  > **Note**
  >
  > The SIM card gets permanently blocked with 10 unsuccessful attempts of PUK, while unblocking the SIM. Contact the carrier service provider for a new SIM card.

APN settings

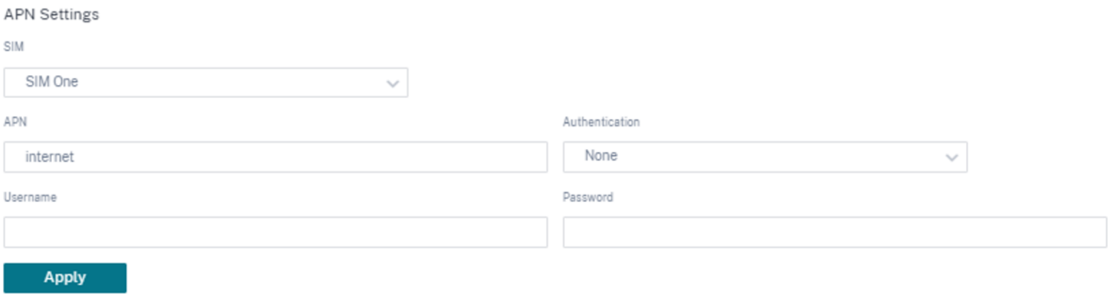
1. To configure the APN settings, navigate to **Advanced Settings > Mobile Broadband > Operations >** and go to the **APN settings** section.

   > **Note**
   >
   > Obtain the APN information from the carrier.

2. Select the SIM card, enter the **APN, Username, Password,** and **Authentication** provided by the carrier. You can choose from PAP, CHAP, PAPCHAP authentication protocols. If the carrier has not provided any authentication type, set it to **None**.

> **Note**
>
> All these fields are optional.

3. Click **Apply**.



APN Settings

SIM: SIM One

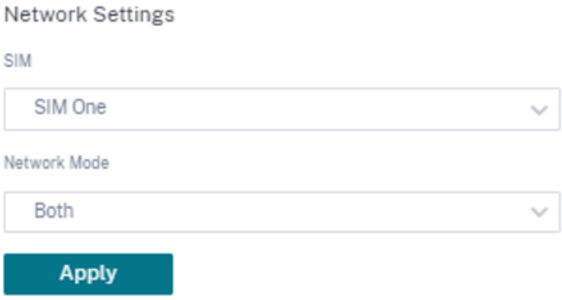
APN: internet

Authentication: None

Username:

Password:

Network settings You can select the mobile network on Citrix SD-WAN appliances that support the internal LTE modem. The supported networks are 3G, 4G, or both.

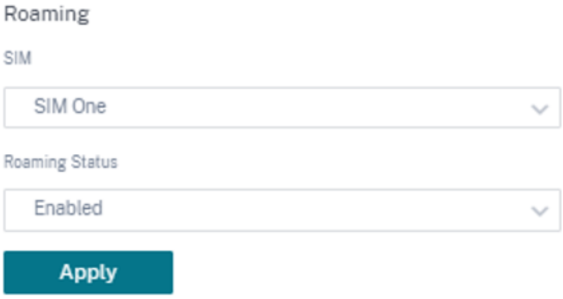


Network Settings

SIM: SIM One

Network Mode: Both

Roaming The roaming option is enabled by default on your LTE appliances, you can choose to disable it.



Roaming

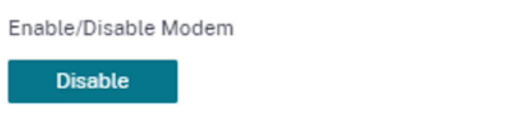
SIM: SIM One

Roaming Status: Enabled

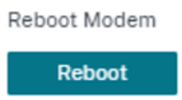
Manage Firmware

Every LTE enabled appliance has a set of firmware available. You can select from the existing list of firmware or upload a firmware and apply it. If you are unsure of which firmware to use, select the **AUTO-SIM** option. The AUTO-SIM option allows the LTE modem to choose the most matching firmware based on the inserted SIM card.

Enable/Disable modem Enable/disable modem depending on your intent to use the LTE functionality. By default, the LTE modem is enabled.

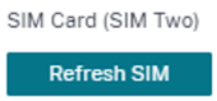


Reboot modem Reboots the modem. It can take up to 7 minutes for the reboot operation to complete.



Refresh SIM Use the **Refresh SIM** option when the SIM card is not detect properly by the LTE-WiFi modem.

> **Note**
>
> The Refresh SIM operation is applicable for the active SIM only.



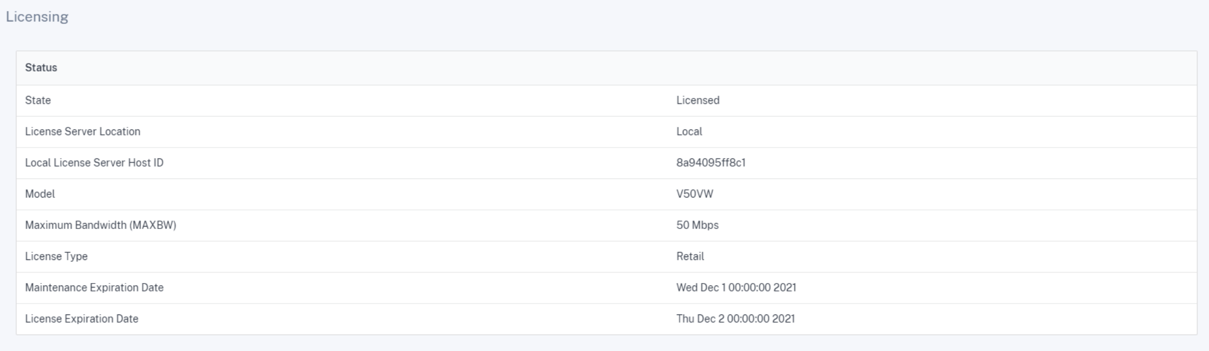
You can remotely view and manage all the LTE sites in your network using the Citrix SD-WAN Center. For more information see, Remote LTE site management.

For more information on LTE configuration, see Configure LTE functionality on 110-LTE-WiFi appliance and Configure LTE functionality on 210 SE LTE appliance.

For information on configuring external LTE modem, see Configure external USB LTE modem.

Licensing

The **Licensing** page displays the license details such as, server location, model, license type and so on.



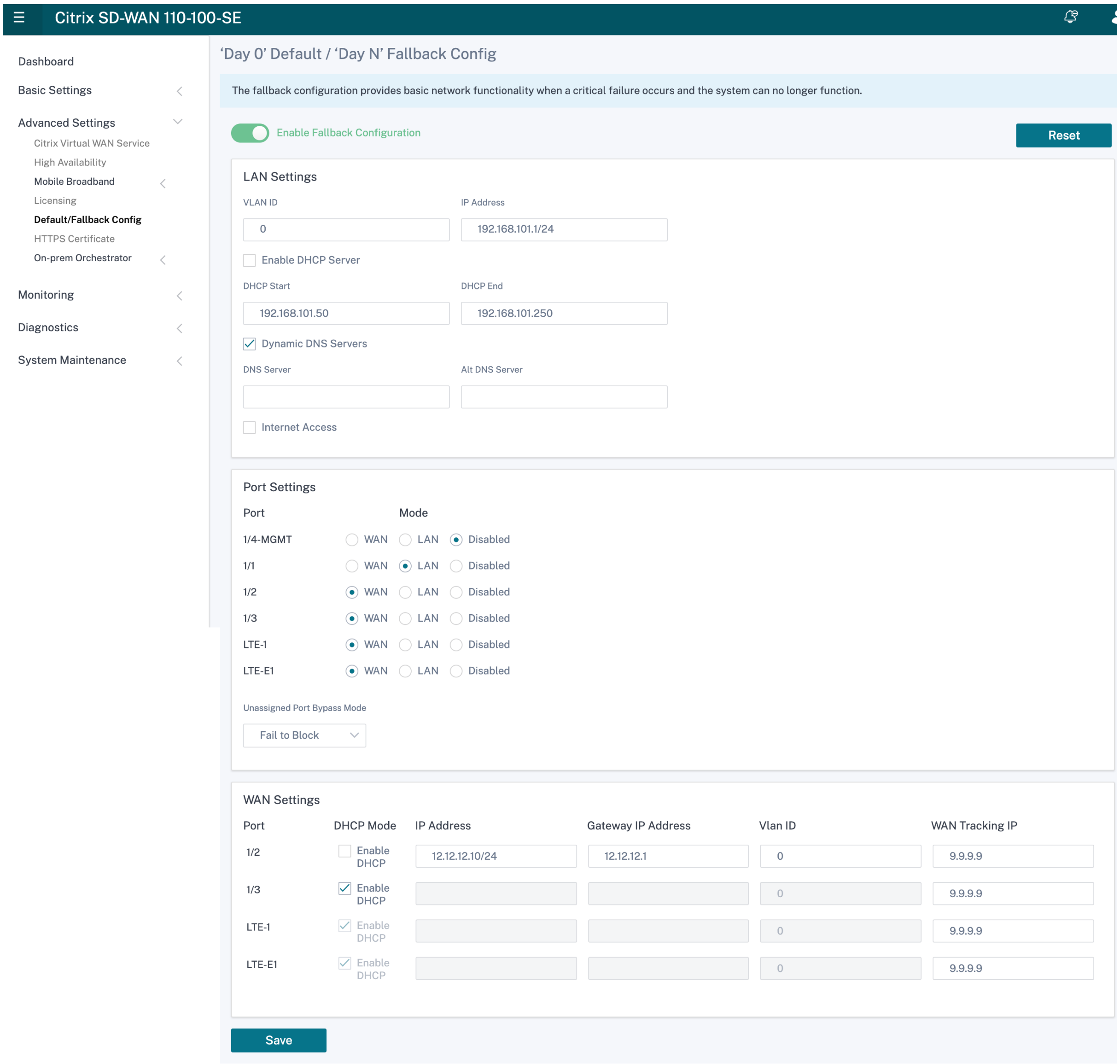
Licensing

Status	
State	Licensed
License Server Location	Local
Local License Server Host ID	8a94095ff8c1
Model	V50VW
Maximum Bandwidth (MAXBW)	50 Mbps
License Type	Retail
Maintenance Expiration Date	Wed Dec 1 00:00:00 2021
License Expiration Date	Thu Dec 2 00:00:00 2021

> **Note**
>
> When installing and applying a license from the SD-WAN Center, make sure that your specific appliance supports the SD-WAN appliance edition you want to enable, and that you have the correct software version available.

Default/Fallback configuration

The **Default/Fallback Configuration** page displays the stored fallback configuration data. If the fallback configuration is disabled, you can enable it by switching on the **Enable Fallback Configuration** switch.



'Day 0' Default / 'Day N' Fallback Config

The fallback configuration provides basic network functionality when a critical failure occurs and the system can no longer function.

Enable Fallback Configuration

LAN Settings

VLAN ID: 0	IP Address: 192.168.101.1/24
□ Enable DHCP Server	
DHCP Start: 192.168.101.50	DHCP End: 192.168.101.250
☑ Dynamic DNS Servers	
DNS Server:	Alt DNS Server:
□ Internet Access	

Port Settings

Port	Mode		
1/4-MGMT	○ WAN	○ LAN	● Disabled
1/1	○ WAN	● LAN	○ Disabled
1/2	● WAN	○ LAN	○ Disabled
1/3	● WAN	○ LAN	○ Disabled
LTE-1	● WAN	○ LAN	○ Disabled
LTE-E1	● WAN	○ LAN	○ Disabled

Unassigned Port Bypass Mode: Fail to Block

WAN Settings

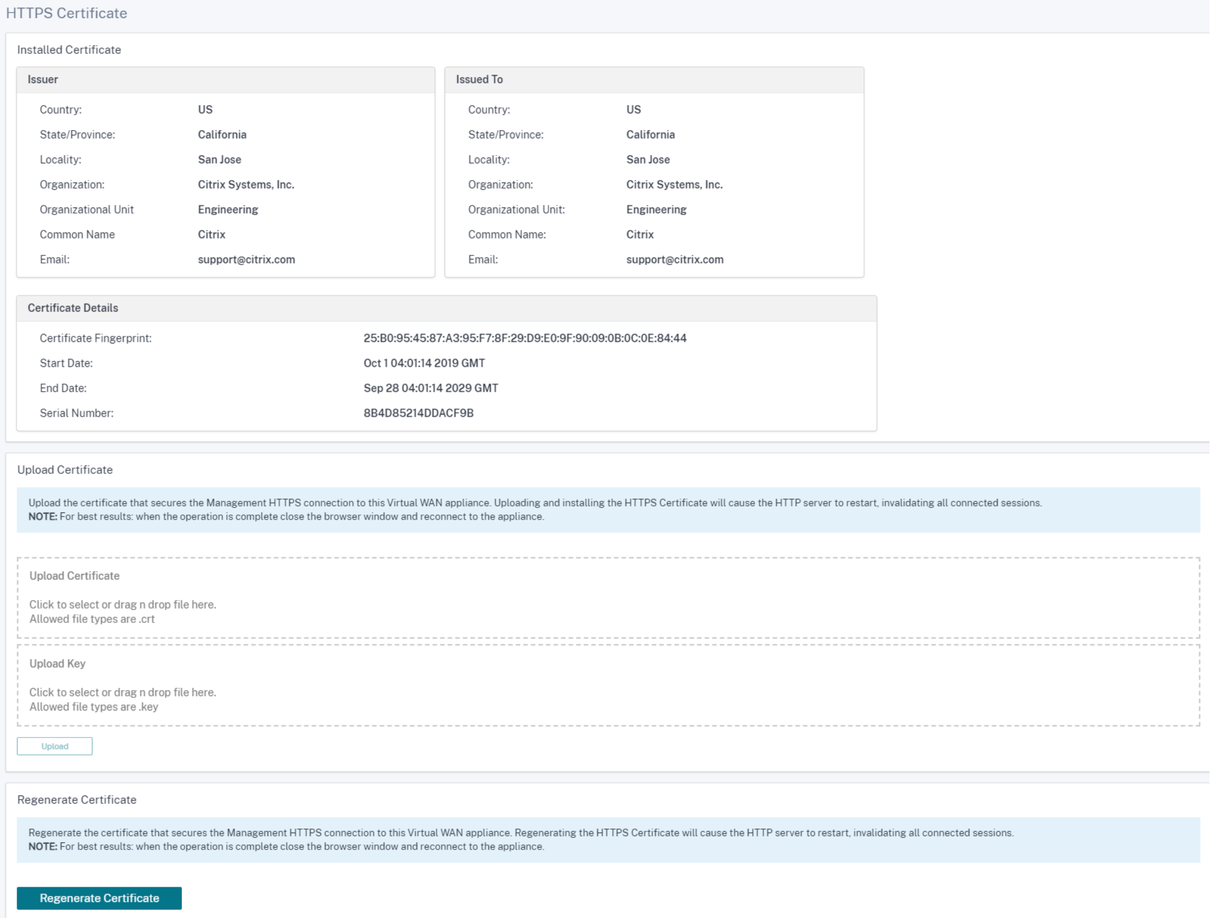
Port	DHCP Mode	IP Address	Gateway IP Address	Vlan ID	WAN Tracking IP
1/2	□ Enable DHCP	12.12.12.10/24	12.12.12.1	0	9.9.9.9
1/3	☑ Enable DHCP			0	9.9.9.9
LTE-1	☑ Enable DHCP			0	9.9.9.9
LTE-E1	☑ Enable DHCP			0	9.9.9.9

> **Note**
>
> LTE interfaces cannot be configured with static IP address.

For more information see, Default/Fallback configuration.

HTTPS certificate

HTTPS certificate is required for establishing a secured connection. The **HTTPS Certificate** page displays the details of the HTTPS certificate that is already installed. For more information, see HTTPS certificates.



HTTPS Certificate

Installed Certificate

Issuer	
Country:	US
State/Province:	California
Locality:	San Jose
Organization:	Citrix Systems, Inc.
Organizational Unit	Engineering
Common Name	Citrix
Email:	support@citrix.com

Issued To	
Country:	US
State/Province:	California
Locality:	San Jose
Organization:	Citrix Systems, Inc.
Organizational Unit:	Engineering
Common Name:	Citrix
Email:	support@citrix.com

Certificate Details	
Certificate Fingerprint:	25:B0:95:45:87:A3:95:F7:8F:29:D9:E0:9F:90:09:0B:0C:0E:84:44
Start Date:	Oct 1 04:01:14 2019 GMT
End Date:	Sep 28 04:01:14 2029 GMT
Serial Number:	8B4D85214DDACF9B

Upload Certificate

Upload the certificate that secures the Management HTTPS connection to this Virtual WAN appliance. Uploading and installing the HTTPS Certificate will cause the HTTP server to restart, invalidating all connected sessions.
NOTE: For best results: when the operation is complete close the browser window and reconnect to the appliance.

Upload Certificate

Click to select or drag n drop file here.
Allowed file types are .crt

Upload Key

Click to select or drag n drop file here.
Allowed file types are .key

Regenerate Certificate

Regenerate the certificate that secures the Management HTTPS connection to this Virtual WAN appliance. Regenerating the HTTPS Certificate will cause the HTTP server to restart, invalidating all connected sessions.
NOTE: For best results: when the operation is complete close the browser window and reconnect to the appliance.

On-prem Orchestrator

Citrix On-prem SD-WAN Orchestrator is the on-premises software version of the Citrix SD-WAN Orchestrator service. Citrix On-prem SD-WAN Orchestrator provides a single-pane of glass management platform for Citrix partners to manage multiple customers centrally, with suitable role based access controls.

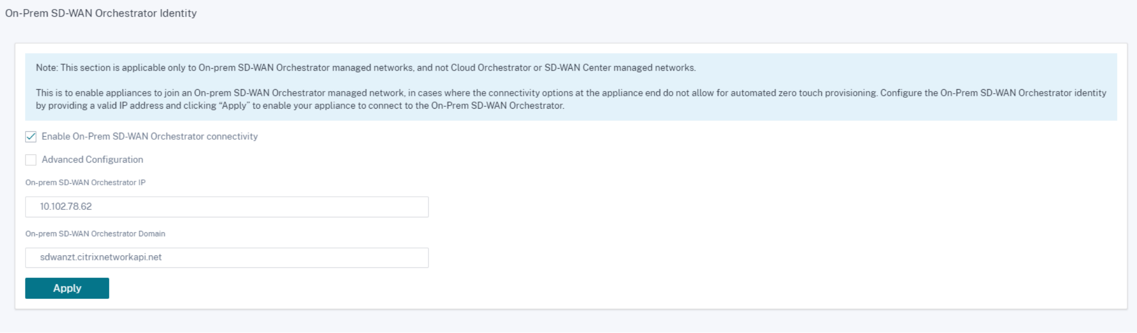
You can establish a connection between your Citrix SD-WAN appliance and the Citrix On-prem SD-WAN Orchestrator by enabling Orchestrator connectivity and specifying the On-prem SD-WAN Orchestrator identity.

> **Note**
>
> - The **On-prem SD-WAN Orchestrator configuration on SD-WAN appliance** feature is an enabler for Citrix On-prem SD-WAN Orchestrator. The Citrix On-prem SD-WAN Orchestrator configuration on SD-WAN appliance feature is currently not available. It is targeted for a future release.
> - Zero-touch deployment will not work if **On-prem SD-WAN Orchestrator configuration on**

> **SD-WAN appliance** feature is configured on the SD-WAN appliances.

To enable Orchestrator connectivity:

1. In the appliance GUI, navigate to **Advanced Settings > On-prem Orchestrator > Identity**.
2. Select **Enable On-prem SD-WAN Orchestrator Connectivity** check box.

   On-Prem SD-WAN Orchestrator Identity

   Note: This section is applicable only to On-prem SD-WAN Orchestrator managed networks, and not Cloud Orchestrator or SD-WAN Center managed networks.

   This is to enable appliances to join an On-prem SD-WAN Orchestrator managed network, in cases where the connectivity options at the appliance end do not allow for automated zero touch provisioning. Configure the On-Prem SD-WAN Orchestrator identity by providing a valid IP address and clicking "Apply" to enable your appliance to connect to the On-Prem SD-WAN Orchestrator.

   ☑ Enable On-Prem SD-WAN Orchestrator connectivity

   □ Advanced Configuration

   On-prem SD-WAN Orchestrator IP: 10.102.78.62

   On-prem SD-WAN Orchestrator Domain: sdwanzt.citrixnetworkapi.net

3. Enter either the On-prem SD-WAN Orchestrator IP address or Domain or both (IP address and domain) for configuration.

   If the customer configures only Domain, then they must ensure to add DNS record in their Local DNS server and must configure DNS Server IP Address on SD-WAN Appliances. To configure, navigate to **Configuration > Network Adapters > IP Address**.

   For example, if the On-prem SD-WAN Orchestrator Domain is configured as citrix.com. then you must create a DNS record in DNS Server for the below FQDN and On-prem SD-WAN Orchestrator IP Address:

   - download.citrix.com
   - sdwanzt.citrix.com
   - sdwan-home.citrix.com

   In case of advanced configuration:

   For Example: If the On-prem Orchestrator domain is configured as **citrix.com**, the Download Management Service Domain is configured as **download.citrix**.com, and the Statistics Management Service Domain is configured as **statistics.citrix.com**. Then you must create a DNS record in DNS Server for the below FQDN and corresponding IP Address:

   - download.citrix.com
   - sdwanzt.citrix.com
   - statistics.citrix.com

   On-prem Orchestrator might support running services like download, statistics on independent server instance, to enable better scalability for large networks. You can select the **Advanced Configuration** and configure the **Download Management Service and Statistic Management** service.

Select the **Advanced Configuration** check box and provide the following details:

- **Download Management Service IP/Domain**: Provide the IP address /domain that helps offload SD-WAN software and configuration download aspects, to an independent server instance, to enable better scalability for large networks.
- **Statistic Management Service IP/Domain**: Provide the IP address/domain that helps offload collection and management of SD-WAN statistics from devices, to an independent server instance, to enable better scalability for large networks.

4. Click **Apply**.

   To Regenerate, Download, and Upload the SD-WAN appliance or On-prem SD-WAN Orchestrator certificate, navigate to **Advanced Settings > On-prem Orchestrator > Certificate**.

   If the On-prem Orchestrator **Authentication Type** is disabled, then Appliance can connect to the On-prem Orchestrator either via **No Authentication** or **One-way Authentication** or **Two-way Authentication mode**.

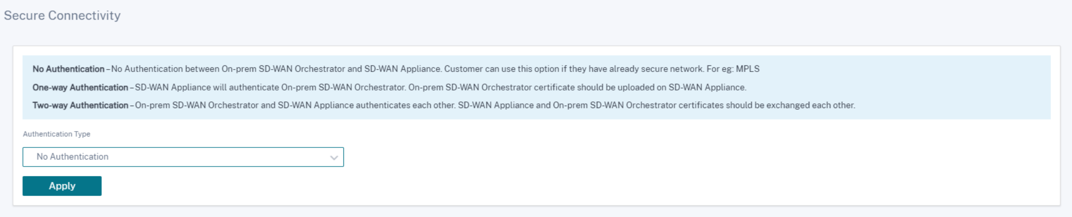
   If the On-prem Orchestrator **Authentication Type** is enabled, then Appliance can only able to connect to the On-prem Orchestrator via **Two-way Authentication**.

   While disabling **Authentication Type** in On-prem Orchestrator from enable state, existing appliances in One-way Authentication mode goes to disconnected state. Customers have to change the appliance Authentication Type to Two-way Authentication and upload the SD-WAN Appliance certificate to the On-prem Orchestrator to get it connected.

   > **Note**
   >
   > - Generated certificates are X509 self-signed certificates.
   > - Customer must regenerate the certificates if the certificate is expired or compromised.
   > - Validity of the certificate is 10 years.
   > - You can view the certificate details such as, fingerprint, start date, and end date
   > - Customer must ensure that the certificates are regenerated and exchanged between On-prem Orchestrator and SD-WAN appliance to avoid loss of appliance connectivity with On-prem orchestrator.

5. Select the **Authentication Type**. The following are the authentications types that are supported between the SD-WAN appliance and On-prem SD-WAN Orchestrator connectivity:

   - **No Authentication** –No authentication between the On-prem SD-WAN Orchestrator and SD-WAN appliance, and there is no need to use the SD-WAN Appliance or On-prem SD-WAN Orchestrator Certificate. But you can use this option if you have a secure network such as MPLS.



Secure Connectivity

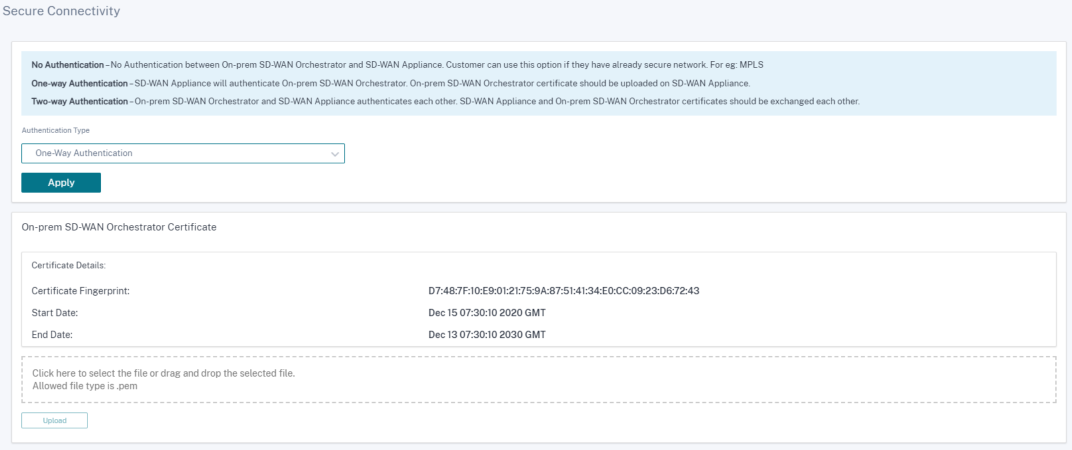
No Authentication – No Authentication between On-prem SD-WAN Orchestrator and SD-WAN Appliance. Customer can use this option if they have already secure network. For eg: MPLS

One-way Authentication – SD-WAN Appliance will authenticate On-prem SD-WAN Orchestrator. On-prem SD-WAN Orchestrator certificate should be uploaded on SD-WAN Appliance.

Two-way Authentication – On-prem SD-WAN Orchestrator and SD-WAN Appliance authenticates each other. SD-WAN Appliance and On-prem SD-WAN Orchestrator certificates should be exchanged each other.

Authentication Type: No Authentication

- **One-way Authentication** –On selecting the One-way Authentication type, you must upload the On-prem Orchestrator certificate. Download the On-prem Orchestrator from the On-prem Orchestrator and click Upload. SD-WAN appliance trusts the On-prem Orchestrator using the uploaded certificates.



Secure Connectivity

No Authentication – No Authentication between On-prem SD-WAN Orchestrator and SD-WAN Appliance. Customer can use this option if they have already secure network. For eg: MPLS

One-way Authentication – SD-WAN Appliance will authenticate On-prem SD-WAN Orchestrator. On-prem SD-WAN Orchestrator certificate should be uploaded on SD-WAN Appliance.

Two-way Authentication – On-prem SD-WAN Orchestrator and SD-WAN Appliance authenticates each other. SD-WAN Appliance and On-prem SD-WAN Orchestrator certificates should be exchanged each other.

Authentication Type: One-Way Authentication

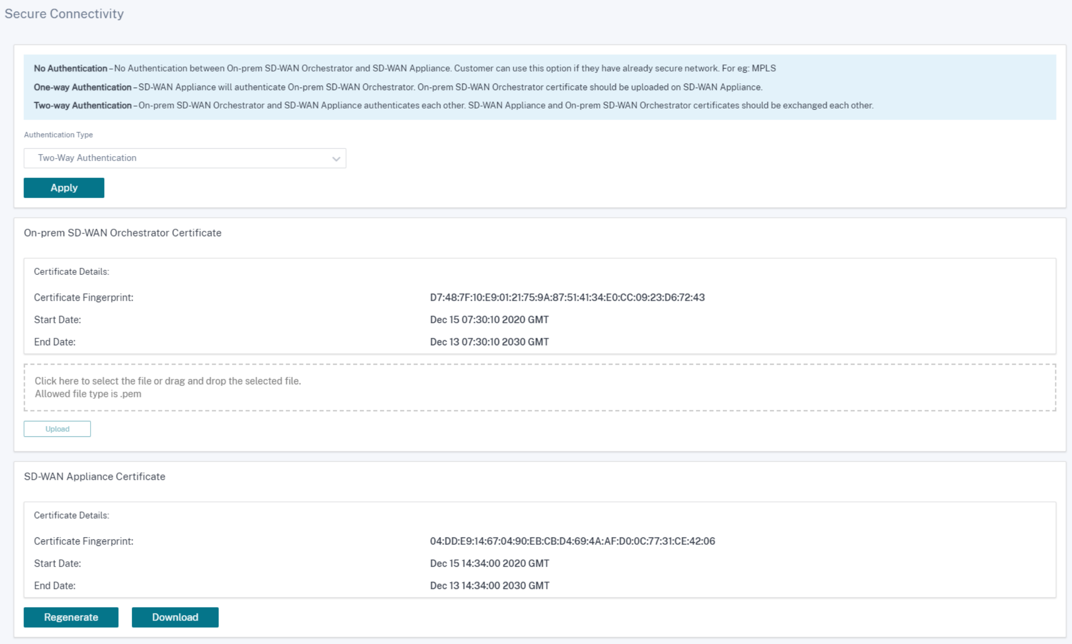
On-prem SD-WAN Orchestrator Certificate

Certificate Details:

Certificate Fingerprint:	D7:48:7F:10:E9:01:21:75:9A:87:51:41:34:E0:CC:09:23:D6:72:43
Start Date:	Dec 15 07:30:10 2020 GMT
End Date:	Dec 13 07:30:10 2030 GMT

Click here to select the file or drag and drop the selected file.
Allowed file type is .pem

- **Two-way Authentication** –On-prem Orchestrator and Appliance certificates have to be exchanged with each other. For **Two-way Authentication**, you must regenerate, download, and upload the SD-WAN appliance certificate on the on-prem Orchestrator. SD-WAN appliance and On-prem Orchestrator trusts each other using the exchanged certificates.



Secure Connectivity

No Authentication – No Authentication between On-prem SD-WAN Orchestrator and SD-WAN Appliance. Customer can use this option if they have already secure network. For eg: MPLS

One-way Authentication – SD-WAN Appliance will authenticate On-prem SD-WAN Orchestrator. On-prem SD-WAN Orchestrator certificate should be uploaded on SD-WAN Appliance.

Two-way Authentication – On-prem SD-WAN Orchestrator and SD-WAN Appliance authenticates each other. SD-WAN Appliance and On-prem SD-WAN Orchestrator certificates should be exchanged each other.

Authentication Type: Two-Way Authentication

On-prem SD-WAN Orchestrator Certificate

Certificate Details:

Certificate Fingerprint:	D7:48:7F:10:E9:01:21:75:9A:87:51:41:34:E0:CC:09:23:D6:72:43
Start Date:	Dec 15 07:30:10 2020 GMT
End Date:	Dec 13 07:30:10 2030 GMT

Click here to select the file or drag and drop the selected file.
Allowed file type is .pem

SD-WAN Appliance Certificate

Certificate Details:

Certificate Fingerprint:	04:DD:E9:14:67:04:90:EB:CB:D4:69:4A:AF:D0:0C:77:31:CE:42:06
Start Date:	Dec 15 14:34:00 2020 GMT
End Date:	Dec 13 14:34:00 2030 GMT

> **Note**
>
> It is recommended to use only One-way Authentication or Two-way Authentication. If there was No Authentication, you have to choose the secure DNS server.

To disable the on-prem SD-WAN Orchestrator connectivity, clear **Enable ON-prem SD-WAN Orchestrator Connectivity** and click **Apply**. To convert On-prem orchestrator managed network to either Cloud Orchestrator or MCN Managed network, you need to disable On-prem SD-WAN Orchestrator Connectivity and must perform the configuration reset. To reset configuration, navigate to **Configuration > System Maintenance > Configuration Reset**.

Upgrade and Downgrade

- After upgrading the SD-WAN appliance from 11.1.1/11.2.0/10.2.7 to 11.2.1 software version, you must exchange both appliance and On-prem Orchestrator certificates.
- After Downgrading the SD-WAN appliance from 11.2.1 to 11.1.1/11.2.0/10.2.7 software version, you must apply identity settings again on the Citrix SD-WAN appliance UI. If any issues related to On-prem SD-WAN Orchestrator configuration or SD-WAN appliance connectivity, disable the On-prem SD-WAN Orchestrator connectivity and then enable the On-prem SD-WAN Orchestrator connectivity again.

The On-prem SD-WAN Orchestrator Authentication Type must be disabled to manage the SD-WAN appliances running 10.2.7/11.1.1/11.2.0 software version.

Monitoring

Under Monitoring section, you can view the **Address Resolution Protocol (ARP), Route, Ethernet, Ethernet MAC** statistics along with **DHCP Client WAN Links, SLAAC WAN Links, DHCP Server/Relay, Firewall Connections, Flows**, and **DNS Statistics**.

- **ARP, Route, Ethernet, and Ethernet MAC Statistics**: You can see the statistics information for ARP, Route, Ethernet, and Ethernet MAC. Using the statistics information, you can verify any traffic or interface errors. For more information, see Viewing Statistical Information.
- **DHCP Client WAN links**: The DHCP Client WAN Links page provides the status of learned IPs. You can request to renew the IP, which refreshes the lease time. You can also choose to **Release Renew**, which issues a new IP address with a new lease. For more details, see Monitoring DHCP client WAN links.
- **SLAAC WAN Links**: The SLAAC WAN links page provides details about the IPv6 addresses that SLAAC assigns to the virtual interfaces. You can also select **Release Renew** to allow SLAAC to assign a new IP address or the same IP address with a new lease to the IPv6 client.
- **DHCP Server/Relay**: You can use the SD-WAN appliance as either DHCP Servers or DHCP Relay agents.

  - The DHCP server feature allows devices on the same network as the SD-WAN appliance's LAN/WAN interface to obtain their IP configuration from the SD-WAN appliance.
  - The DHCP relay feature allows your SD-WAN appliances to forward DHCP packets between DHCP client and server.

  For more information, see DHCP server and DHCP relay.
- **Firewall Connections**: The **Firewall Connections** page provides the Firewall connection statistics. You can see how the firewall policies are acting on the traffic for each Application. For more information, see Viewing Firewall Statistics.
- **Flows**: The **Flows** section provides basic instructions for viewing Virtual WAN flow information. For more details, see Viewing Flow Information.
- **DNS Proxy Statistics**: This page provides details about the configured DNS proxies. Click **Refresh** to get the current data. For more information, see Domain name system.

Diagnostics

The **Diagnostics** section provides the options to test and investigate connectivity issues. For more information, see Diagnostics.

> **Note**
>
> For the Citrix SD-WAN 110 appliance, only one diagnostic package can be present at a time. For the Citrix SD-WAN 210 appliance, a maximum of five diagnostic packages are allowed.

System maintenance

Use the **System Maintenance** section to perform maintenance activities. The **System Maintenance** page contains the following options:

- **Delete Files**: You can delete Log files, Backup files, and Archived Databases. Select the file that you want to delete from the drop-down menu and click the delete button.
- **Restart System**: You can restart the virtual WAN service or reboot the system.
- **Local Change Management**: The **Local Change Management** process allows you to upload a new appliance package to this individual appliance.
- **Configuration Reset**: You can reset the configuration. This option clears out the user data, logs, history, and local configuration data on this appliance.
- **Factory Reset**: Use **Factory Reset** option to reset the SD-WAN appliance to the shipped version.

> **Note**
>
> All of these features are already explained in details in the existing SD-WAN documentation.

Unsupported platforms

The new UI does not support the following SD-WAN appliances:

- Citrix SD-WAN 1000 SE / PE
- Citrix SD-WAN 2000 SE / PE
- Citrix SD-WAN 4000 SE

Citrix SD-WAN 11.5 release upgrade impact

August 24, 2022

- Citrix SD-WAN 11.5.0 is a Limited Availability release, recommended and supported only for specific customers/production deployments.
- SD-WAN 11.5.0 release does not support Advanced Edition(AE), Premium Edition(PE), WAN Optimization deployments.

- SD-WAN 11.5.0 supports only the platforms mentioned in SD-WAN platform models and software packages.
- SD-WAN 11.5.0 does not support Citrix SD-WAN Center or Citrix SD-WAN Orchestrator for on-premises.
- SD-WAN 11.5.0 firmware is not available on the Citrix Downloads page.
- SD-WAN 11.5.0 release is available only via Citrix SD-WAN Orchestrator service and only on selected geographical POPs.
- Ensure to get the required approvals and guidance from Citrix Product Management / Citrix Support before deploying 11.5.0 on any production network.

System requirements

August 24, 2022

Hardware requirements

Instructions for installing SD-WAN appliances are provided in Setting up the SD-WAN appliances.

Firmware requirements

All Citrix SD-WAN appliance models in a Virtual WAN environment are required to be running the same Citrix SD-WAN firmware release.

> **Note**
>
> Appliances running earlier software versions cannot establish a Virtual Path connection to the appliance running SD-WAN release 11.4. For additional information, please contact the Citrix support team.

Software requirements

From SD-WAN 11.5 release onwards, SD-WAN appliance licensing is managed through Citrix SD-WAN Orchestrator service. For details regarding license requirements, see Licensing.

Browser Requirements

Browsers must have cookies enabled, and JavaScript installed and enabled.

The SD-WAN Management Web Interface is supported on the following browsers:

- Mozilla Firefox 49+
- Google Chrome 51+
- Microsoft Edge 13+

Supported browsers must have cookies enabled, and JavaScript installed and enabled.

Hypervisor

Citrix SD-WAN SE/PE VPX can be configured on the following hypervisors:

- VMware ESXi server, version 5.5.0 or higher.
- Citrix Hypervisor 6.5 or higher.
- Microsoft Hyper-V 2012 R2 or higher.
- Linux KVM

Cloud Platform

Citrix SD-WAN SE/PE VPX can be configured on the following cloud platforms:

- Microsoft Azure
- Amazon Web Services
- Google Cloud Platform

SD-WAN platform models

August 24, 2022

The following are the supported SD-WAN standard edition hardware appliance models:

SD-WAN SE PLATFORM MODEL	ROLE
110-SE/110-LTE-WiFi/110-WiFi-SE	Small branch appliance
210-SE/210-SE LTE	Small branch appliance
1100-SE	Large branch appliance
2100-SE	Large branch appliance
4100-SE	Data Center - Master Control Node (MCN) appliance

SD-WAN SE PLATFORM MODEL	ROLE
5100-SE	Data Center - Master Control Node (MCN) appliance
6100-SE	Data Center - Master Control Node (MCN) appliance

SD-WAN VPX virtual appliances (SD-WAN VPX-SE)

The following are the supported SD-WAN VPX Virtual Appliance (VPX-SE) models:

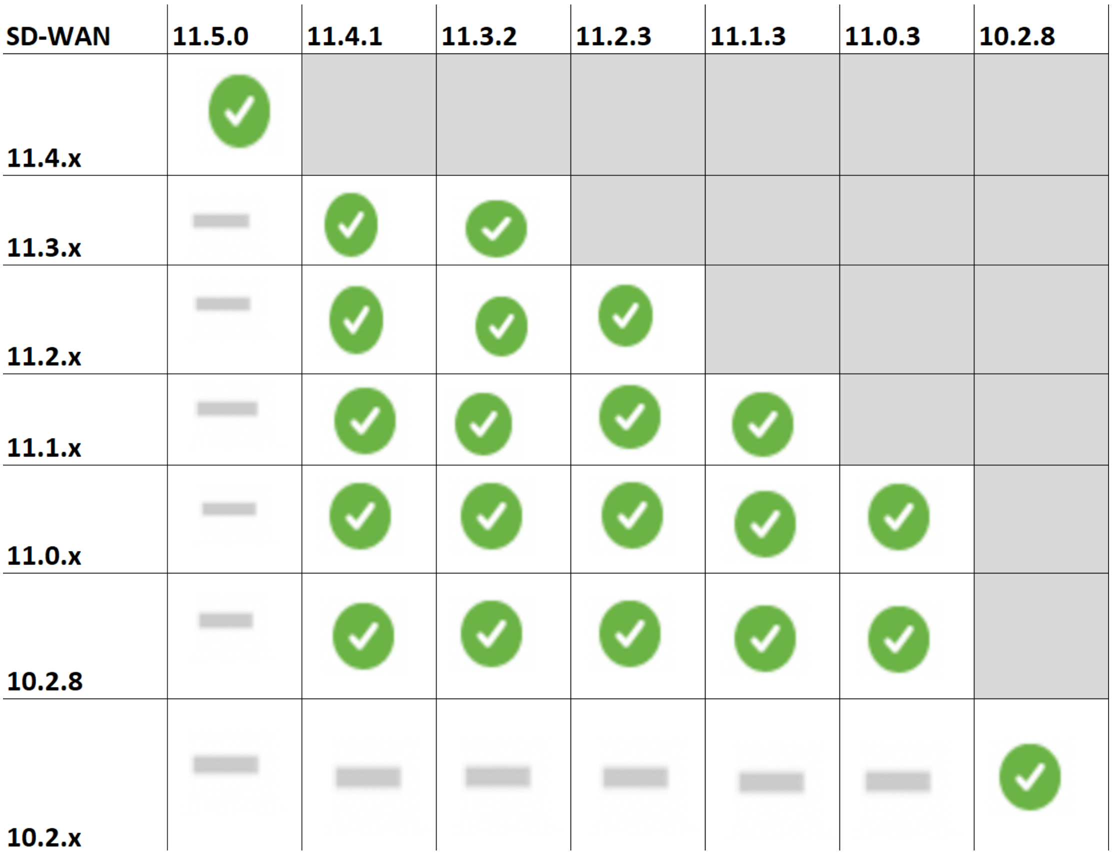
SD-WAN VPX-SE PLATFORM MODELS	ROLE
VPX 20-SE	MCN or client appliance, small branch
VPX 50-SE	MCN or client appliance, small branch
VPX 100-SE	MCN or client appliance, small branch
VPX 200-SE	MCN or client appliance, small branch
VPX 500-SE	MCN or client appliance, small branch
VPX 1000-SE	MCN or client appliance, small branch

For more information, see the Prerequisites of Citrix SD-WAN Virtual VPX Standard Edition.

Upgrade paths

August 24, 2022

The following table provides details of all the Citrix SD-WAN software version that you can upgrade to, from the previous versions.



SD-WAN	11.5.0	11.4.1	11.3.2	11.2.3	11.1.3	11.0.3	10.2.8
11.4.x	✓						
11.3.x	–	✓	✓				
11.2.x	–	✓	✓	✓			
11.1.x	–	✓	✓	✓	✓		
11.0.x	–	✓	✓	✓	✓	✓	
10.2.8	–	✓	✓	✓	✓	✓	
10.2.x	–	–	–	–	–	–	✓

The upgrade paths information is also available in the Citrix Upgrade Guide.

> **Note**
>
> - Customers upgrading from Citrix SD-WAN release 9.3.x are recommended to upgrade to 10.2.8 before upgrading to any major release.
> - While performing software upgrade, ensure that staging to all connected sites is completed before activating. If activation is done before staging completes by enabling Ignore Incomplete, the virtual path might not come up with MCN for the sites to which staging was still in progress. To recover the network, it is required perform local change management for those sites manually.
> - From Citrix SD-WAN release 11.0.0 onwards, the underlying OS/kernel for the SD-WAN software is upgraded to a newer version. It requires an automatic reboot to be performed during the upgrade process. As a result, the expected time for upgrading each appliance is increased by approximately 100 seconds. In addition, by including the new OS, the size of the upgrade package transferred to each branch appliance is increased by approximately 90 MB.

Configuration

September 19, 2022

After you have installed the SD-WAN software and licenses, you can configure SD-WAN appliance settings to start managing your network and deployment.

Initial Setup

These procedures must be completed for each appliance you want to add to your SD-WAN. Consequently, this process will require some coordination with your Site Administrators across your network, to ensure the appliances are prepared and ready to deploy at the proper time. However, once the Master Control Node (MCN) is configured and deployed, you can add client appliances (client nodes) to your SD-WAN at any time.

For each appliance you want to add to your Virtual WAN, you will need to do the following.

1. Set up the SD-WAN Appliance hardware and any SD-WAN VPX Virtual Appliances (SD-WAN VPX-VW) you will be deploying.
2. Set the Management IP Address for the appliance and verify the connection.
3. Set the date and time on the appliance.
4. Set the console session **Timeout** threshold to a high or the maximum value.

   > **Warning**
   >
   > If your console session times out or you log out of the Management Web Interface before saving your configuration, any unsaved configuration changes will be lost. You must then log back into the system, and repeat the configuration procedure from the beginning. For that reason, it is strongly recommended that you set the console session **Timeout** interval to a high value when creating or modifying a configuration package, or performing other complex tasks.

5. Upload and install the software license file on the appliance.

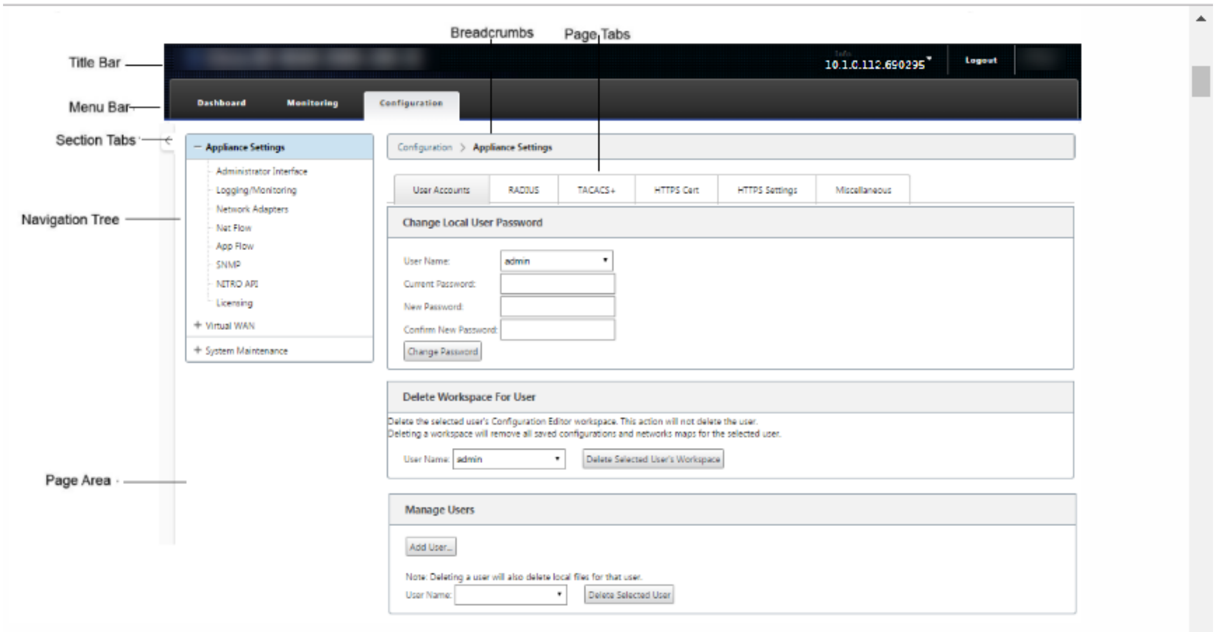
For instructions on installing a SD-WAN Virtual Appliance (SD-WAN VPX), see the following sections:

- About SD-WAN VPX.
- Installing and Deploying a SD-WAN VPX-SE on ESXi.

Overview of Web Interface (UI) Layout

This section provides basic navigation instructions, and a navigation roadmap of the SD-WAN web management interface page hierarchy.

Basic navigation The below figure outlines the basic navigation elements of the Web Management Interface, and the terminology used to identify them.



Change Local User Password

User Name: admin

Current Password:

New Password:

Confirm New Password:

Delete Workspace For User

Delete the selected user's Configuration Editor workspace. This action will not delete the user.
Deleting a workspace will remove all saved configurations and networks maps for the selected user.

User Name: admin

Manage Users

Note: Deleting a user will also delete local files for that user.

User Name:

The basic navigation elements are as follows:

- **Title bar** –This displays the appliance model number, Host IP Address for the appliance, the version of the software package currently running on the appliance, and the user name for the current login session. The title bar also contains the **Logout** button for terminating the session.
- **Main menu bar** –This is the bar displayed below the title bar on every Management Web Interface screen. This contains the section tabs for displaying the navigation tree and pages for a selected section.
- **Section tabs** –The section tabs are located in the main menu bar at the top of the page. These are the top-level categories for the Web Management Interface pages and forms. Each section has its own navigation tree for navigating the page hierarchy in that section. Click a **section** tab to display the navigation tree for that section.
- **Navigation tree** –The navigation tree is located in the left pane, below the main menu bar. This displays the navigation tree for a section. Click a section tab to display the navigation tree for that section. The navigation tree offers the following display and navigation options:
  - Click a section tab to display the navigation tree and page hierarchy for that section.

  - Click + (plus sign) next to a branch in the tree to reveal the available pages for that branch topic.
  - Click a page name to display that page in the page area.
  - Click –(minus sign) next to a branch item to close the branch.

- **Breadcrumbs** –This displays the navigation path to the current page. The breadcrumbs are at the top of the page area, just below the main menu bar. Active navigation links display in blue font. The name of the current page is displayed in black bold font.
- **Page area** –This is the page display and work area for the selected page. Select an item in the navigation tree to display the default page for that item.
- **Page tabs** –Some pages contain tabs for displaying more child pages for that topic or configuration form. These are located at the top of the page area, just below the breadcrumbs display. Sometimes (as for the **Change Management** wizard), tabs are located in the left pane of the page area, between the navigation tree and the work area of the page.
- **Page area resizing** – For some pages, you can grow or shrink the width of the page area (or sections of it) to reveal more fields in a table or form. Where this is the case, there is a gray, vertical resize bar on the right border of a page area pane, form, or table. Roll your cursor over the resize bar until the cursor changes to a bi-directional arrow. Then click and drag the bar to the right or left to grow or shrink the area width.

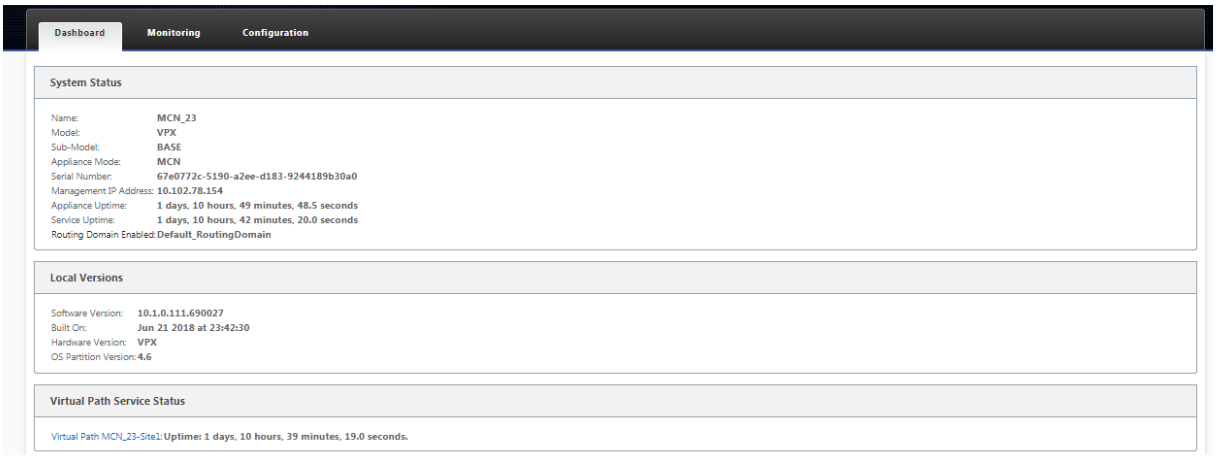
  If the resize bar is not available for a page, you can click and drag the right edge of your browser to display the full page.

Web management interface dashboard Click the **Dashboard** section tab to display basic information for the local appliance.

The **Dashboard** page displays the following basic information for the appliance:

- System status
- Virtual Path service status
- Local appliance software package version information

The following figure shows a sample Master Control Node (MCN) appliance **Dashboard** display.



System Status

Name: MCN_23
Model: VPX
Sub-Model: BASE
Appliance Mode: MCN
Serial Number: 67e0772c-5190-a2ee-d183-9244189b30a0
Management IP Address: 10.102.78.154
Appliance Uptime: 1 days, 10 hours, 49 minutes, 48.5 seconds
Service Uptime: 1 days, 10 hours, 42 minutes, 20.0 seconds
Routing Domain Enabled: Default_RoutingDomain

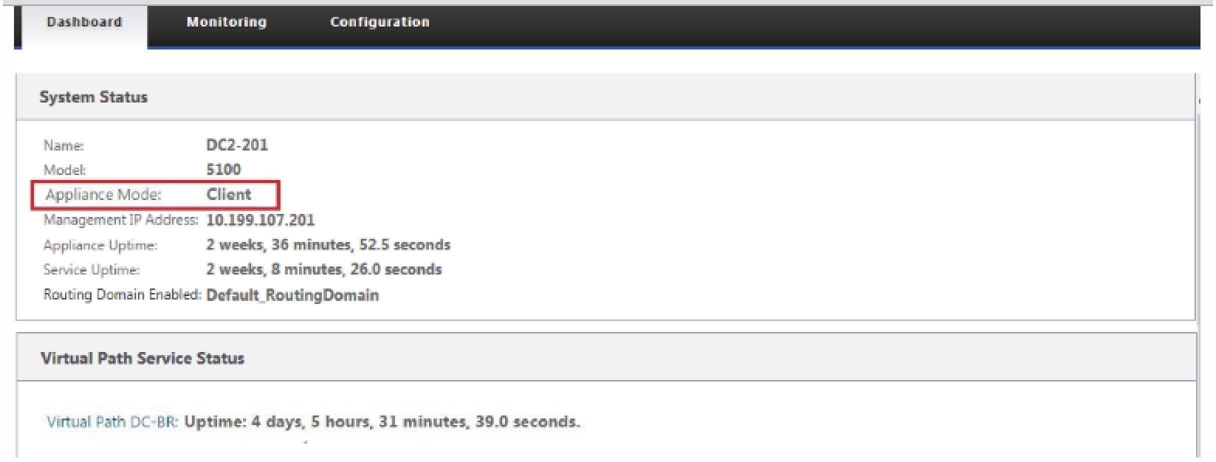
Local Versions

Software Version: 10.1.0.111.690027
Built On: Jun 21 2018 at 23:42:30
Hardware Version: VPX
OS Partition Version: 4.6

Virtual Path Service Status

Virtual Path MCN_23-Site1: Uptime: 1 days, 10 hours, 39 minutes, 19.0 seconds.

The following figure shows a sample client appliance Dashboard display.



System Status

Name: DC2-201
Model: 5100
Appliance Mode: Client
Management IP Address: 10.199.107.201
Appliance Uptime: 2 weeks, 36 minutes, 52.5 seconds
Service Uptime: 2 weeks, 8 minutes, 26.0 seconds
Routing Domain Enabled: Default_RoutingDomain

Virtual Path Service Status

Virtual Path DC-BR: Uptime: 4 days, 5 hours, 31 minutes, 39.0 seconds.

Setting up the Appliance Hardware

To set up Citrix SD-WAN appliance hardware (physical appliance), do the following:

1. Set up the chassis.

   Citrix SD-WAN Appliances can be installed in a standard rack. For desktop installation, place the chassis on a flat surface. Ensure that there is a minimum of 2 inches of clearance at the sides and back of the appliance, for proper ventilation.

2. Connect the Power.

   a) Ensure the power switch is set to Off.
   b) Plug the power cord into the appliance and an AC outlet.
   c) Press the power button on the front of the appliance.

3. Connect the power.

   a) Ensure the power switch is set to Off.

   b) Plug the power cord into the appliance and an AC outlet.
   c) Press the power button on the front of the appliance.

4. Connect the appliance Management Port to a personal computer.

   You need to connect the appliance to a PC in preparation for completing the next procedure, setting the Management IP Address for the appliance.

   > **Note**
   >
   > Before you connect the appliance, ensure the Ethernet port is enabled on the PC. Use an Ethernet cable to connect the SD-WAN Appliance Management Port to the default Ethernet port on a personal computer.

SD-WAN VPX-SE Management Port The SD-WAN VPX-SE Virtual Appliance is a Virtual Machine, so there is no physical Management Port. However, if you did not configure the Management IP Address for the SD-WAN VPX-SE when you created the VPX Virtual Machine, you need to do so now, as outlined in the section, Configuring the Management IP Address for the SD-WAN VPX-SE.

The SD-WAN VPX-SE Virtual Appliance is a Virtual Machine, so there is no physical Management Port. However, if you did not configure the Management IP Address for the SD-WAN VPX-SE when you created the VPX Virtual Machine, you need to do so now, as outlined in the section, Configuring the Management IP Address for the SD-WAN VPX-SE.

Configure Management IP Address

To enable remote access to an SD-WAN appliance, you must specify a unique Management IP Address for the appliance. To do so, you must first connect the appliance to a PC. You can then open a browser on the PC and connect directly to the Management Web Interface on the appliance, where you can set the Management IP Address for that appliance. The Management IP Address must be unique for each appliance.

Citrix SD-WAN appliances support both IPv4 and IPv6 protocols. You can configure IPv4, IPv6, or both (dual stack). When both IPv4 and IPv6 protocols are configured, the IPv4 protocol takes precedence over the IPv6 protocol.

> **NOTE**
>
> - To configure an IPv4 or IPv6 address in feature specific configurations, ensure that the same protocol is enabled and configured as the management interface protocol. For example, if you want to configure an IPv6 address for an SMTP server, ensure that an IPv6 address is configured as the management interface address.
> - Link-local addresses (IPv6 addresses starting with "fe80") are not allowed.

> - To configure an IPv6 address, you must have a router in the network that advertises IPv6 address.

The procedures are different for setting the Management IP Address for a hardware SD-WAN Appliance and a VPX Virtual Appliance (Citrix SD-WAN VPX-SE). For instructions for configuring the address for each type of appliance, see the following:

- **SD-WAN VPX Virtual Appliance** – See the sections, [Configuring the Management IP Address for the SD-WAN VPX-SE and Differences Between an SD-WAN VPX-SE and SD-WAN WANOP VPX Installation.

To configure the Management IP Address for a hardware SD-WAN Appliance, do the following:

> **Note**
>
> You must repeat the following process for each hardware appliance you want to add to your network.

1. If you are configuring a hardware SD-WAN appliance, physically connect the appliance to a PC.

   - If you have not already done so, connect one end of an Ethernet cable to the Management Port on the appliance, and the other end to the default Ethernet port on the PC.

   > **Note**
   >
   > Ensure that the Ethernet port is enabled on the PC you are using to connect to the appliance.

2. Record the current Ethernet port settings for the PC you are using to set the appliance Management IP Address.

   You must change the **Ethernet port** settings on the PC before you can set the appliance Management IP Address. Be sure to record the original settings so you can restore them after configuring the Management IP Address.

3. Change the IP Address for the PC.

   On the PC, open your network interface settings and change the IP Address for your PC to the following:

   - 192.168.100.50

4. Change the **Subnet Mask** setting on your PC to the following:

   - 255.255.0.0

5. On the PC, open a browser and enter the default IP Address for the appliance. Enter the following IP Address in the address line of the browser:

   - 192.168.100.1

> **Note**
>
> It is recommended that you use Google Chrome browser when connecting to an SD-WAN appliance.
>
> Ignore any browser certificate warnings for the Management Web Interface.

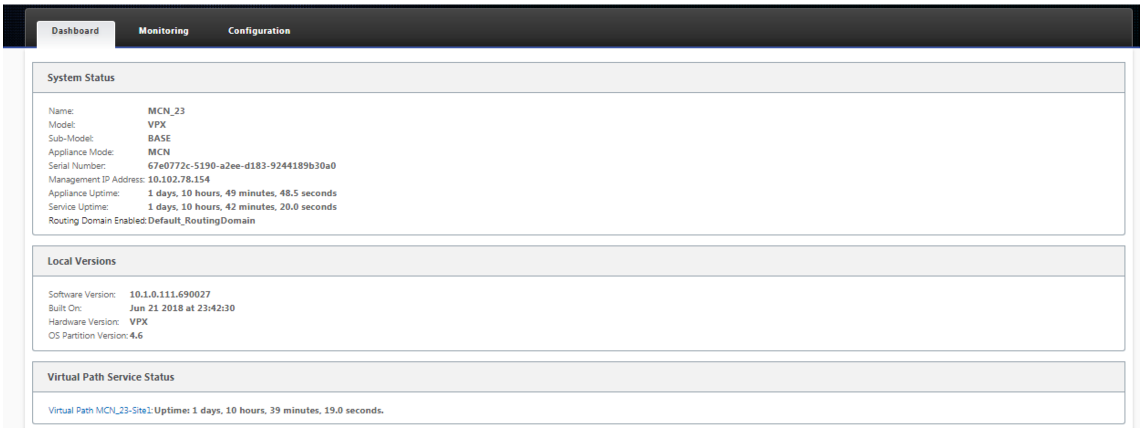
This opens the SD-WAN management web interface login screen on the connected appliance.

6. Enter the administrator user name and password, and click **Login**.

   - Default administrator user name: *admin*
   - Default administrator password: *password*

   > **Note**
   >
   > It is recommended that you change the default password. Be sure to record the password in a secure location, as password recovery might require a configuration reset.

   After you have logged into the management web interface, the **Dashboard** page displays, as shown below.

   System Status

   Name: MCN_23
   Model: VPX
   Sub-Model: BASE
   Appliance Mode: MCN
   Serial Number: 67e0772c-5190-a2ee-d183-9244189b30a0
   Management IP Address: 10.102.78.154
   Appliance Uptime: 1 days, 10 hours, 49 minutes, 48.5 seconds
   Service Uptime: 1 days, 10 hours, 42 minutes, 20.0 seconds
   Routing Domain Enabled: Default_RoutingDomain

   Local Versions

   Software Version: 10.1.0.111.690027
   Built On: Jun 21 2018 at 23:42:30
   Hardware Version: VPX
   OS Partition Version: 4.6

   Virtual Path Service Status

   Virtual Path MCN_23-Site1: Uptime: 1 days, 10 hours, 39 minutes, 19.0 seconds.

   The first time you log into the management web interface on an appliance, the **Dashboard** displays an Alert icon (goldenrod delta) and alert message indicating that the SD-WAN Service is disabled, and the license has not been installed. For now, you can ignore this alert. The alert will be resolved after you have installed the license, and completed the configuration and deployment process for the appliance.

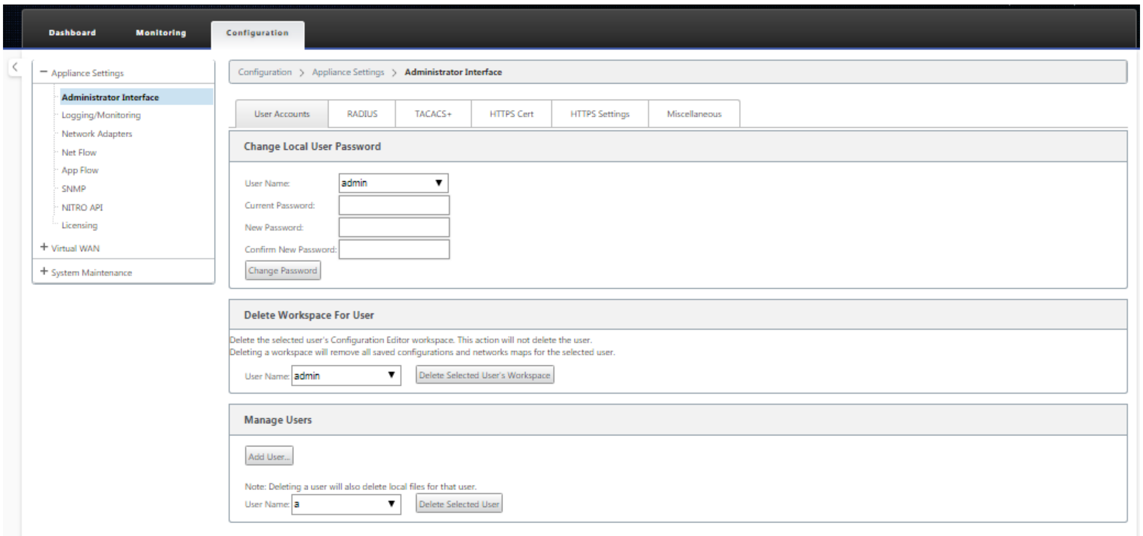
7. In the main menu bar, select the **Configuration** section tab.

   This displays the **Configuration** navigation tree in the left pane of the screen. The **Configuration** navigation tree contains the following three primary branches:

   - Appliance Settings
   - Virtual WAN

- System Maintenance

When you select the **Configuration** tab, the **Appliance Settings** branch automatically opens, with the **Administrator Interface** page preselected by default, as shown in the below figure.



User Name: admin
Current Password:
New Password:
Confirm New Password:

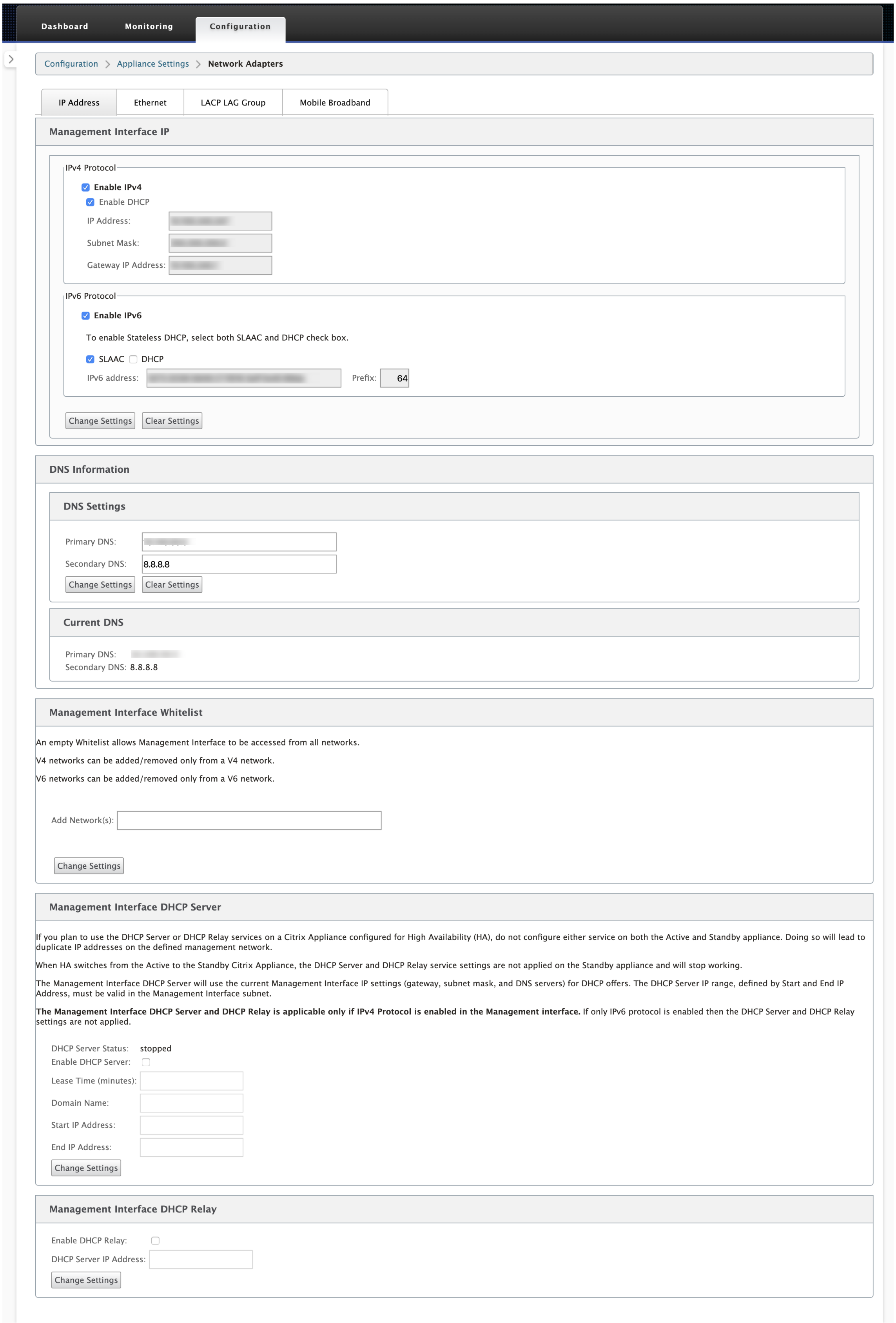
Delete the selected user's Configuration Editor workspace. This action will not delete the user.
Deleting a workspace will remove all saved configurations and networks maps for the selected user.

User Name: admin

Note: Deleting a user will also delete local files for that user.

User Name: a

8. In the **Appliance Settings** branch of the navigation tree, select **Network Adapters**. This displays the **Network Adapters** settings page with the **IP Address** tab preselected by default, as shown in the below figure.



Management Interface IP

IPv4 Protocol

☑ **Enable IPv4**

☑ Enable DHCP

IP Address: [redacted]

Subnet Mask: [redacted]

Gateway IP Address: [redacted]

IPv6 Protocol

☑ **Enable IPv6**

To enable Stateless DHCP, select both SLAAC and DHCP check box.

☑ SLAAC ☐ DHCP

IPv6 address: [redacted] Prefix: 64

DNS Information

DNS Settings

Primary DNS: [redacted]

Secondary DNS: 8.8.8.8

Current DNS

Primary DNS: [redacted]

Secondary DNS: 8.8.8.8

Management Interface Whitelist

An empty Whitelist allows Management Interface to be accessed from all networks.

V4 networks can be added/removed only from a V4 network.

V6 networks can be added/removed only from a V6 network.

Add Network(s):

Management Interface DHCP Server

If you plan to use the DHCP Server or DHCP Relay services on a Citrix Appliance configured for High Availability (HA), do not configure either service on both the Active and Standby appliance. Doing so will lead to duplicate IP addresses on the defined management network.

When HA switches from the Active to the Standby Citrix Appliance, the DHCP Server and DHCP Relay service settings are not applied on the Standby appliance and will stop working.

The Management Interface DHCP Server will use the current Management Interface IP settings (gateway, subnet mask, and DNS servers) for DHCP offers. The DHCP Server IP range, defined by Start and End IP Address, must be valid in the Management Interface subnet.

The Management Interface DHCP Server and DHCP Relay is applicable only if IPv4 Protocol is enabled in the Management interface. If only IPv6 protocol is enabled then the DHCP Server and DHCP Relay settings are not applied.

DHCP Server Status: stopped

Enable DHCP Server: ☐

Lease Time (minutes):

Domain Name:

Start IP Address:

End IP Address:

Management Interface DHCP Relay

Enable DHCP Relay: ☐

DHCP Server IP Address:

9. In the IP Address tab, enable one of the following:

    - **IPv4 Protocol**: To enable IPv4 address, select the **Enable IPv4** check box. Dynamic Host Control Protocol (DHCP) assigns an IP address and other network configuration parameters dynamically to each device on the network. Select **Enable DHCP** for assigning IP address dynamically. To configure the IP address manually, provide the following details:

        - IP Address
        - Subnet Mask
        - Gateway IP Address

    - **IPv6 Protocol**: To enable IPv6 address, select **Enable IPv6** check box. You can configure IPv6 address manually or enable DHCP or SLAAC to assign IP address automatically.

        To configure manually, provide the following details:

        - IP Address
        - Prefix

        To configure SLAAC, select the **SLAAC** check box. SLAAC automatically assigns an IPv6 address to each device on the network. SLAAC enables an IPv6 client to generate its own addresses using a combination of locally available information and information advertised by routers through Neighbor Discovery Protocol (NDP).

        To configure DHCP, select the **DHCP** check box. To enable stateless DHCP, select both **SLAAC** and **DHCP** check boxes.

    - **Both IPv4 and IPv6 Protocols**: Select both **Enable IPv6** and **Enable IPv4** check boxes to enable both IPv4 and IPv6 protocols. In such scenarios, the SD-WAN appliance has one IPv4 management IP address and one IPv6 management address.

> **NOTE**
>
> - The management IP address must be unique for each appliance.
> - The **Management Interface DHCP Server** and **DHCP Relay** sections on the IP Address tab are applicable only if IPv4 Protocol is enabled in the Management interface.
> - When the management interface acts as the DHCP client, the host name is used in DHCP client messages as option 12. From Citrix SD-WAN release 11.2.3 onwards and up to release 11.4.1, the host name was set as **sdwan**. From Citrix SD-WAN release 11.4.1 onwards, the host name is the same as the site name.
>   If the site name is changed or configured for the first time, then until the configuration update is completed and the virtual WAN service is up, the old site name or **sdwan** is used as the host name in DHCP client messages. After the configuration update is completed and the virtual WAN service is up, the subsequent DHCP client messages use the new site name.

10. Click **Change Settings**. A confirmation dialog box displays, prompting you to verify that you want to change these settings.

11. Click **OK**.

12. Change the network interface settings on your PC back to the original settings.

    > **Note**
    >
    > Changing the IP address for your PC automatically closes the connection to the appliance, and terminates your login session on the management web interface.

13. Disconnect the appliance from the PC and connect the appliance to your network router or switch. Disconnect the Ethernet cable from the PC, but do not disconnect it from your appliance. Connect the free end of the cable to your network router or switch.

    The SD-WAN appliance is now connected to and available on your network.

14. Test the connection. On a PC connected to your network, open a browser and enter the Management IP Address you configured for the appliance in the following format:

    For IPv4 address: `https://<IPv4 address>`

    Example: `https://10.10.2.3`

    For IPv6 address: `https://<[IPv6 address]>`

    Example: `https://[fd73:xxxx:yyyy:26::9]`

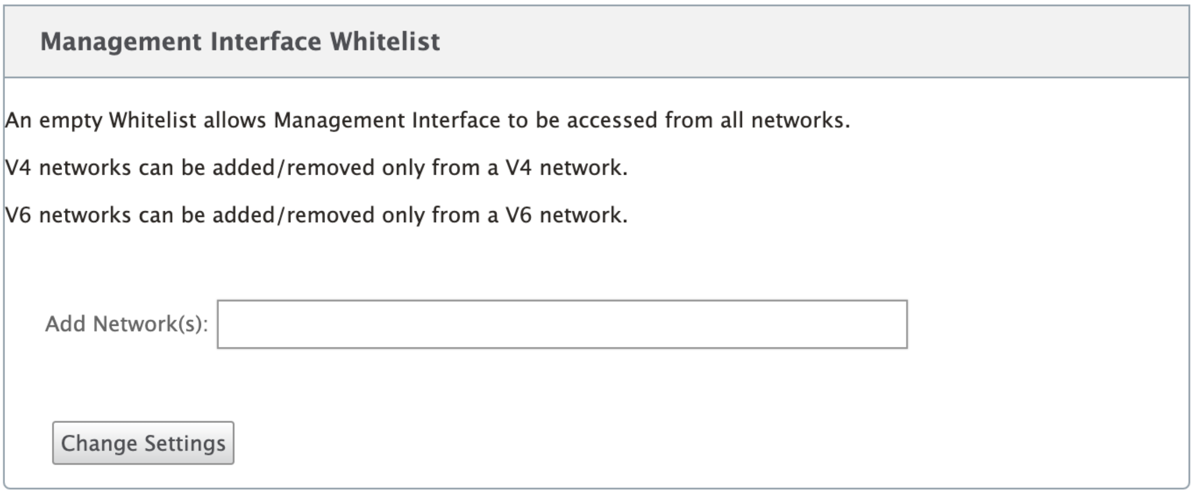
    If the connection is successful, this displays the **Login** screen for the SD-WAN management web interface on the appliance you configured.

    > **Tip**
    >
    > After verifying the connection, do not log out of the management web interface. You are using it to complete the remaining tasks outlined in the subsequent sections.

    You have now set the management IP address of your SD-WAN appliance, and can connect to the appliance from any location in your network.

Management interface allow list Allowed list is an approved list of IP addresses or IP domains that have permission to access your management interface. An empty list allows Management Interface to be accessed from all networks. You can add IP addresses to ensure that the management IP address is accessible only by the trusted networks.

To add or remove an IPv4 address to the allowed list, you must access the SD-WAN appliance management interface using an IPv4 address only. Similarly, to add or remove an IPv6 address to the allowed list, you must access the SD-WAN appliance management interface using an IPv6 address only.



Management Interface Whitelist

An empty Whitelist allows Management Interface to be accessed from all networks.

V4 networks can be added/removed only from a V4 network.

V6 networks can be added/removed only from a V6 network.

Add Network(s):

Set date and time

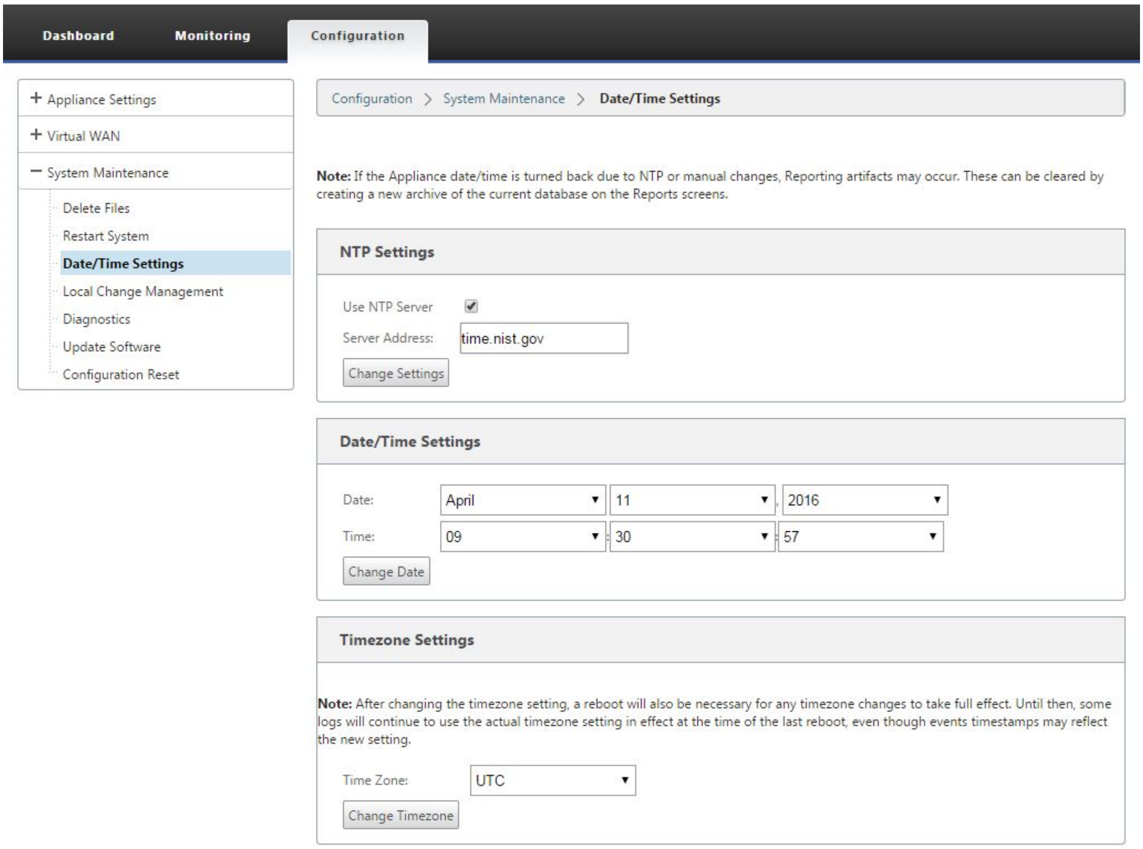
Before installing the SD-WAN software license on an appliance, you must set the date and time on the appliance.

> **Note**
>
> - You must repeat this process for each appliance you want to add to your network.
> - If the current time is changed either manually or through NTP server, and the newly set time is more than the session time-out timer, then the UI session gets logged out.

To set the date and time, do the following:

1. Log into the Management Web Interface on the appliance you are configuring.
2. In the main menu bar, select the **Configuration tab.**

   This displays the **Configuration** navigation tree in the left pane of the screen.
3. Open the **System Maintenance branch** in the navigation tree.
4. Under the **System Maintenance branch, select Date/Time Settings**. This displays the **Date/-Time Settings** page, as following.



Note: If the Appliance date/time is turned back due to NTP or manual changes, Reporting artifacts may occur. These can be cleared by creating a new archive of the current database on the Reports screens.

NTP Settings

Use NTP Server ☑

Server Address: time.nist.gov

Date/Time Settings

Date: April 11, 2016

Time: 09 : 30 : 57

Timezone Settings

Note: After changing the timezone setting, a reboot will also be necessary for any timezone changes to take full effect. Until then, some logs will continue to use the actual timezone setting in effect at the time of the last reboot, even though events timestamps may reflect the new setting.

Time Zone: UTC

5. Select the time zone from the **Time Zone** field drop-down menu at the bottom of the page.

   > **Note**
   >
   > If you have to change the time zone setting, you must do this before setting the date and time, or your settings do not persist as entered.

6. Click **Change Timezone**. This updates the time zone and recalculates the current date and time setting, accordingly. If you set the correct date and time before this step, then your settings are no longer correct. When the time zone update completes, a success Alert icon (green check mark) and status message displays in the top section of the page.

7. (Optional) Enable NTP Server service.

   a) Select **Use NTP Server**.
   b) Enter the server address in the **Server Address** field.
   c) Click **Change Settings**.
   A success Alert icon (green checkmark) and status message displays when the update completes.

8. Select the month, day, and year from the **Date** field drop-down menus.

9. Select the hour, minutes, and seconds from the **Time** field drop-down menus.

10. Click **Change Date**.

> **Note:**
>
> This updates the date and time setting, but does not display a success Alert icon or status message.

The next step is to set the console session **Timeout** threshold to the maximum value. This step is optional, but recommended. This prevents the session from terminating prematurely while you are working on the configuration, which can result in a loss of work. Instructions for setting the console session **Timeout** value are provided in the following section. If you do not want to reset the timeout threshold, you can proceed directly to the section, Uploading and Installing the SD-WAN Software License File.

> **Warning**
>
> If your console session times out or you log out of the Management Web Interface before saving your configuration, any unsaved configuration changes are lost. Log back into the system, and repeat the configuration procedure from the beginning.

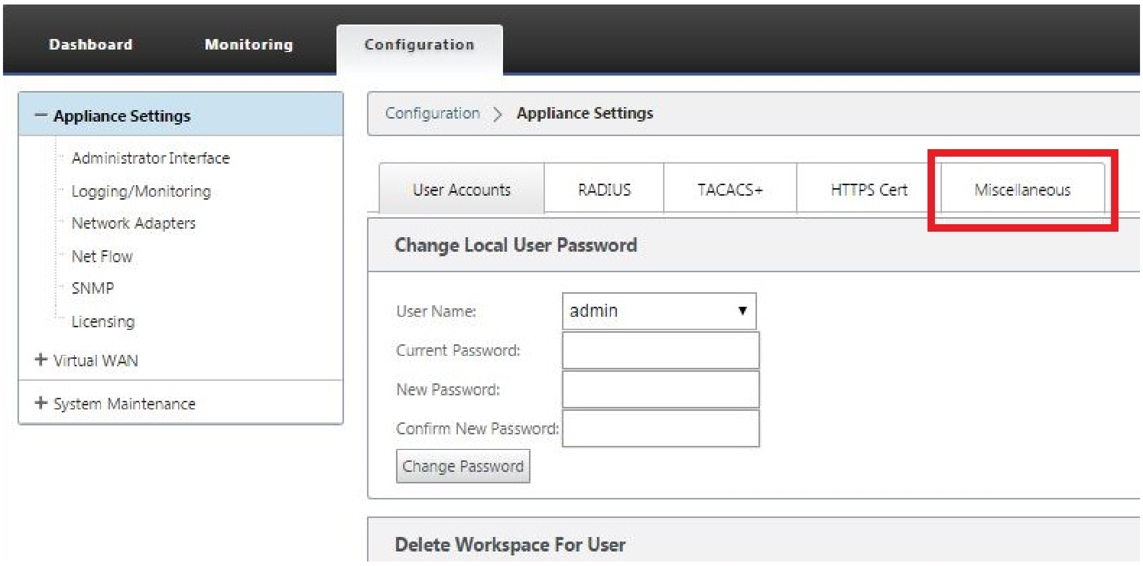
Session timeout

If your console session times out or you log out of the Management Web Interface before saving your configuration, any unsaved configuration changes are lost. You must then log back into the system, and repeat the configuration procedure from the beginning. For that reason, it is recommended that you set the console session **Timeout** interval to a high value when creating or modifying a configuration package, or performing other complex tasks. The default is 60 minutes. The maximum is 9,999 minutes. For security reasons, you should then reset it to a lower threshold after completing those tasks.

To reset the console session **Timeout** interval, do the following:

1. Select the **Configuration** tab, and then select the **Appliance Settings** branch in the navigation tree.

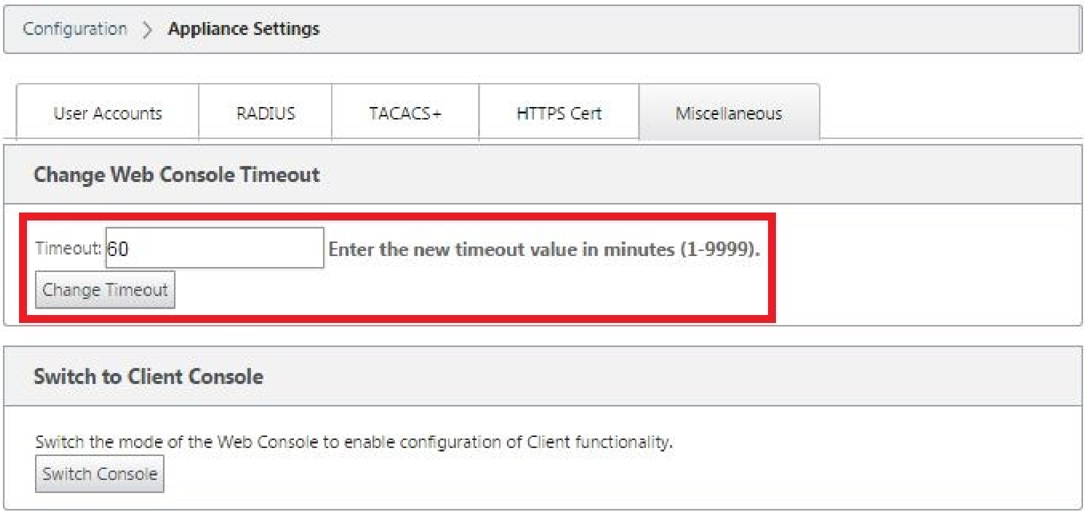
   This displays the **Appliance Settings** page, with the **User Accounts** tab preselected by default.



User Name: admin
Current Password:
New Password:
Confirm New Password:

2. Select the **Miscellaneous** tab (far right corner).

   This displays the **Miscellaneous** tab page.



Timeout: 60 Enter the new timeout value in minutes (1-9999).

Switch the mode of the Web Console to enable configuration of Client functionality.

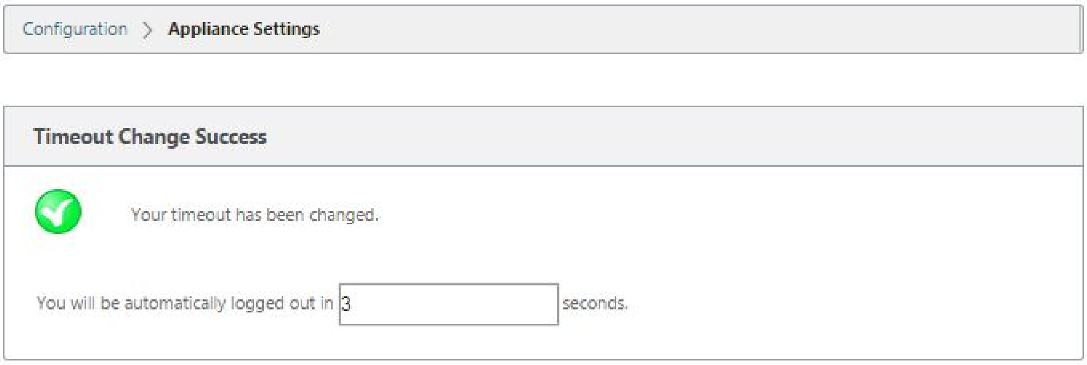
3. Enter the console **Timeout** value.

   In the **Timeout** field of the **Change Web Console Timeout** section, enter a higher value (in minutes) up to the maximum value of 9999. The default is 60, which is much too brief for an initial configuration session.

   > **Note**
   >
   > For security reasons, be sure to reset this value to a lower interval after completing the configuration and deployment.

4. Click **Change Timeout**.

This resets the session **Timeout** interval, and displays a success message when the operation completes.



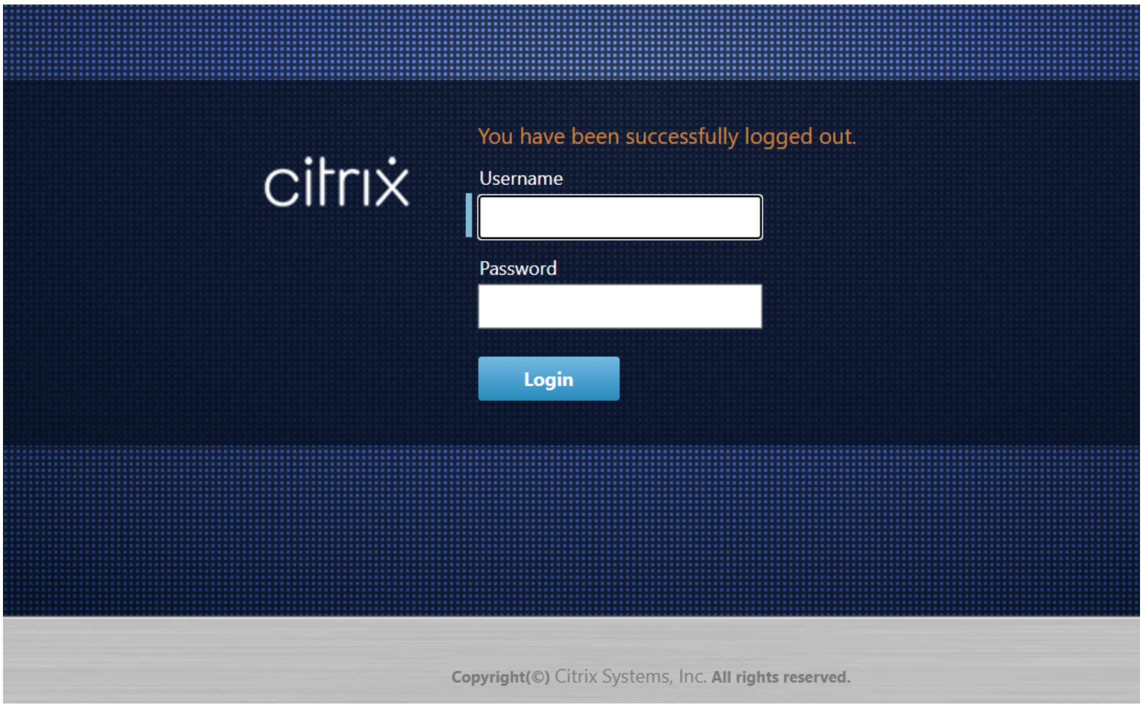
Configuration > Appliance Settings

Timeout Change Success

Your timeout has been changed.

You will be automatically logged out in 3 seconds.

After a brief interval (a few seconds), the session is terminated and you are automatically logged out of the Management Web Interface. The Login page appears.



You have been successfully logged out.

5. Enter the Administrator user name (*admin*) and password (*password*), and click **Login**.

   The next step is to upload and install the SD-WAN software license file on the appliance.

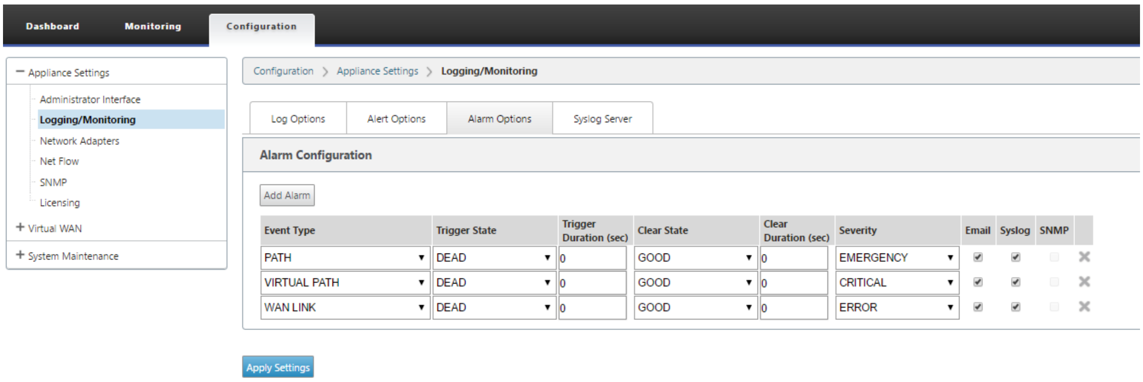
Configure Alarms

You can now configure your SD-WAN appliance to identify alarm conditions based on your network and priorities, generate alerts, and receive notifications via email, syslog, or SNMP trap.

An alarm is a configured alert consisting of an event type, a trigger state, a clear state, and a severity.

To configure alarm settings:

1. In the SD-WAN web management interface, navigate to **Configuration** > **Appliance Settings** > **Logging/Monitoring** and click **Alarm Options**.
2. Click **Add Alarm to** add a new alarm.



Alarm Configuration

Event Type	Trigger State	Trigger Duration (sec)	Clear State	Clear Duration (sec)	Severity	Email	Syslog	SNMP	
PATH	DEAD	0	GOOD	0	EMERGENCY	☑	☑	□	✕
VIRTUAL PATH	DEAD	0	GOOD	0	CRITICAL	☑	☑	□	✕
WAN LINK	DEAD	0	GOOD	0	ERROR	☑	☑	□	✕

3. Select or enter values for the following fields:

   - **Event Type**: The SD-WAN appliance can trigger alarms for particular subsystems or objects in the network, these are called event types. The available event types are SERVICE, VIRTUAL_PATH, WANLINK, PATH, DYNAMIC_VIRTUAL_PATH, WAN_LINK_CONGESTION, USAGE_CONGESTION, FAN, POWER_SUPPLY, PROXY_ARP, ETHERNET, DISCOVERED_MTU, GRE_TUNNEL, and IPSEC_TUNNEL.
   - **Trigger State:** The event state that triggers an alarm for an Event Type. The available Trigger State options depend on the chosen event type.
   - **Trigger Duration**: The duration in seconds, this determines how quickly the appliance triggers an alarm. Enter '0'to receive immediate alerts or enter a value between 15-7200 seconds. Alarms are not triggered, if more events occur on the same object within the Trigger Duration period. More alarms are triggered only if an event persists longer than the Trigger Duration period.
   - **Clear State**: The event state that clears an alarm for an Event Type after the alarm is triggered. The available Clear State options depend on the chosen Trigger State.
   - **Clear Duration:** The duration in seconds, this determines how long to wait before clearing an alarm. Enter '0'to immediately clear the alarm or enter a value between 15-7200 seconds. The alarm is not cleared, if another clear state event occurs on the same object within the specified time.
   - **Severity**: A user-defined field that determines how urgent an alarm is. The severity is displayed in the alerts sent when the alarm is triggered or cleared and in the triggered alarm summary.
   - **Email**: Alarm trigger and clear alerts for the Event Type is sent via email.
   - **Syslog**: Alarm trigger and clear alerts for the Event Type is sent via Syslog.

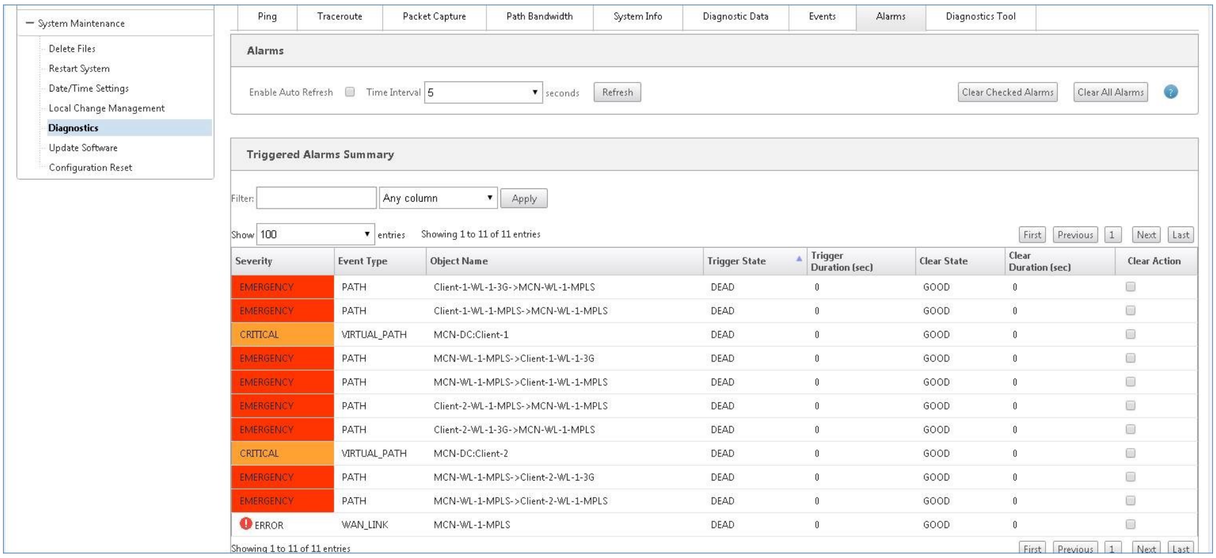
- **SNMP**: Alarm trigger and clear alerts for the Event Type is sent via SNMP trap.

4. Continue adding alarms as required.
5. Click **Apply Settings**.

Viewing triggered alarms **To view a summary of all the triggered alarms:**

In the SD-WAN web management interface, navigate to **Configuration** > **System Maintenance > Diagnostics** > **Alarms**.

A list of all the triggered alarms is displayed.



Showing 1 to 11 of 11 entries

Severity	Event Type	Object Name	Trigger State	Trigger Duration (sec)	Clear State	Clear Duration (sec)	Clear Action
EMERGENCY	PATH	Client-1-WL-1-3G->MCN-WL-1-MPLS	DEAD	0	GOOD	0	□
EMERGENCY	PATH	Client-1-WL-1-MPLS->MCN-WL-1-MPLS	DEAD	0	GOOD	0	□
CRITICAL	VIRTUAL_PATH	MCN-DC:Client-1	DEAD	0	GOOD	0	□
EMERGENCY	PATH	MCN-WL-1-MPLS->Client-1-WL-1-3G	DEAD	0	GOOD	0	□
EMERGENCY	PATH	MCN-WL-1-MPLS->Client-1-WL-1-MPLS	DEAD	0	GOOD	0	□
EMERGENCY	PATH	Client-2-WL-1-MPLS->MCN-WL-1-MPLS	DEAD	0	GOOD	0	□
EMERGENCY	PATH	Client-2-WL-1-3G->MCN-WL-1-MPLS	DEAD	0	GOOD	0	□
CRITICAL	VIRTUAL_PATH	MCN-DC:Client-2	DEAD	0	GOOD	0	□
EMERGENCY	PATH	MCN-WL-1-MPLS->Client-2-WL-1-3G	DEAD	0	GOOD	0	□
EMERGENCY	PATH	MCN-WL-1-MPLS->Client-2-WL-1-MPLS	DEAD	0	GOOD	0	□
ERROR	WAN_LINK	MCN-WL-1-MPLS	DEAD	0	GOOD	0	□

Showing 1 to 11 of 11 entries

Clearing triggered alarms **To manually clear triggered alarms:**

1. In the SD-WAN web management interface, navigate to **Configuration** > **System Maintenance > Diagnostics** > **Alarms**.
2. In the **Clear Action** column, select the alarms that you want to clear.
3. Click **Clear Checked Alarms**. Alternately, Click **Clear All Alarms** to clear all the alarms.

Setup Master Control Node

The **SD-WAN Master Control Node (MCN)** is the head end appliance in the Virtual WAN. Typically, this is a Virtual WAN appliance deployed at the data center. The MCN serves as the distribution point for the initial system configuration and any subsequent configuration changes. In addition, you conduct most upgrade procedures through the Management Web Interface on the MCN. There can be only one active MCN in a Virtual WAN.

By default, appliances have the pre-assigned role of client. To establish an appliance as the MCN, you must first add and configure the MCN site, and then stage and activate the configuration and appropriate software package on the designated MCN appliance.

From Citrix SD-WAN 11.5 release onwards, you can set up an MCN through Citrix SD-WAN Orchestrator service. For more information, see Deployment and Site configuration.

Connecting the client appliances to your network

For an initial deployment, or if you are adding client nodes to an existing SD-WAN, the next step is for the branch site administrators to connect the client appliances to the network at their respective branch sites. This is in preparation for uploading and activating the appropriate SD-WAN appliance packages to the clients. Connect each branch site administrator to initiate and coordinate these procedures.

To connect the site appliances to the SD-WAN, site administrators should do the following:

1. If you have not already done so, set up the client appliances.

   For each appliance you want to add to your SD-WAN, do the following:

   a) Set up the SD-WAN appliance hardware and any SD-WAN VPX virtual appliances (SD-WAN VPX-SE) you are deploying.
   b) Set the Management IP Address for the appliance and verify the connection.
   c) Set the date and time on the appliance. Set the console session timeout threshold to a high or the maximum value.
   d) Upload and install the software license file on the appliance.

2. Connect the appliance to the branch site LAN. Connect one end of an Ethernet cable to a port configured for LAN on the SD-WAN appliance. Then connect other end of the cable to the LAN switch.

3. Connect the appliance to the WAN. Connect one end of an Ethernet cable to a port configured for WAN on the SD-WAN appliance. Then connect the other end of the cable to the WAN router.

The next step is for the branch site administrators to install and activate the appropriate SD-WAN appliance package on their respective clients.

Accessing the shell command

From SD-WAN 11.4.1 release onwards, Admin account users can run the shell command from the SD-WAN CLI console directly, without being prompted for the login credentials of the CBVWSSH static account. This feature enhances the security of your SD-WAN appliances as it removes the hard coded password of the CBVWSSH account and replaces it using a more secure method. To run the shell command, login to the SD-WAN CLI console and type `shell`.

> **Note**
>
> - This functionality is supported only for Admin account users. It is not supported for Network administrators, Security administrators, or Viewer account users.
> - This functionality is meant for troubleshooting purposes only. Any system-specific changes that are made through the `shell` command are supervised by Citrix.

Upgrade When you upgrade your SD-WAN appliance to the 11.4.1 version, the password of the default admin account gets synchronized with the CBVWSSH account. This synchronization between the CBVWSSH account and the default admin account happens every time you edit/update the admin account.

Downgrade When you downgrade your SD-WAN appliance from 11.4.1 to an older version, you get an option to and reset the password of the default admin account. However, the new password does not get synchronized to the CBVWSSH account. Therefore, to be able to access the `shell` command even after a downgrade, it is mandatory to remember the current password before downgrading your appliance.

Deploy Citrix SD-WAN Standard Edition in OpenStack using CloudInit

You can now deploy Citrix SD-WAN Standard Edition (SE) in an OpenStack environment. For this, Citrix SD-WAN image must support config-drive functionality.

> **NOTE**
>
> Create Citrix image to support config-drive functionality.

Config-drive functionality supports the following parameter configuration to establish communication with Citrix Orchestrator via the management network:

- Mgmt. ipv4 address
- Mgmt. gateway
- Name-server1
- Name-server2
- Serial number - Used for authentication and it must be reused for the new instance. Serial number passed in clouding must overwrite the autogenerated trial number in the VPX instance.

> **Note**
>
> - To reuse the serial number, an init script is incorporated in SD-WAN that run on an OpenStack and change the serial number in /etc/default/family.
> - Orchestrator must have a unique serial number with SD-WAN appliances to work.

Cloudinit script supports contextualization for SD-WAN deployment in OpenStack with config-drive.

In the process of contextualization, the infrastructure makes the context available to the virtual machine and the virtual machine interprets the context. On contextualization, the virtual machine can start certain services, create users, or set networking and configuration parameters.

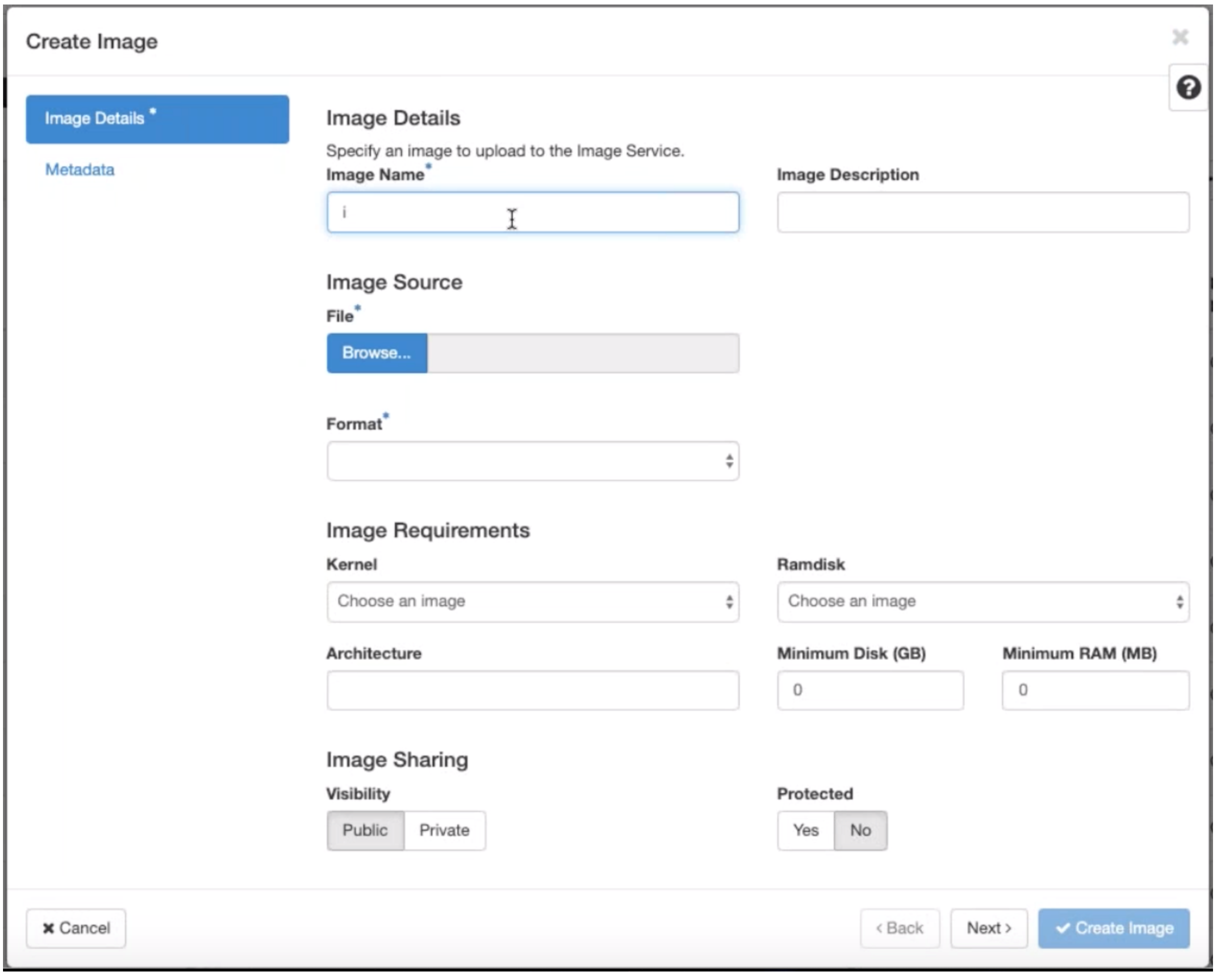
For an SD-WAN instance in OpenStack, the inputs needed for Management IP, DNS, and serial number from the users. The Cloudinit script parses these inputs and provision the instance with the given information.

While launching instances in an OpenStack cloud environment, Citrix SD-WAN appliance need to support two technologies that are User Data and CloudInit to support automated configuration of instances at boot time.

Perform the following steps to provisioning SD-WAN SE in an OpenStack environment:

Pre-requisites

Go to **Images** and click **Create Image**.



Specify an image to upload to the Image Service.

Minimum Disk (GB): 0

Minimum RAM (MB): 0

Visibility: Public Private

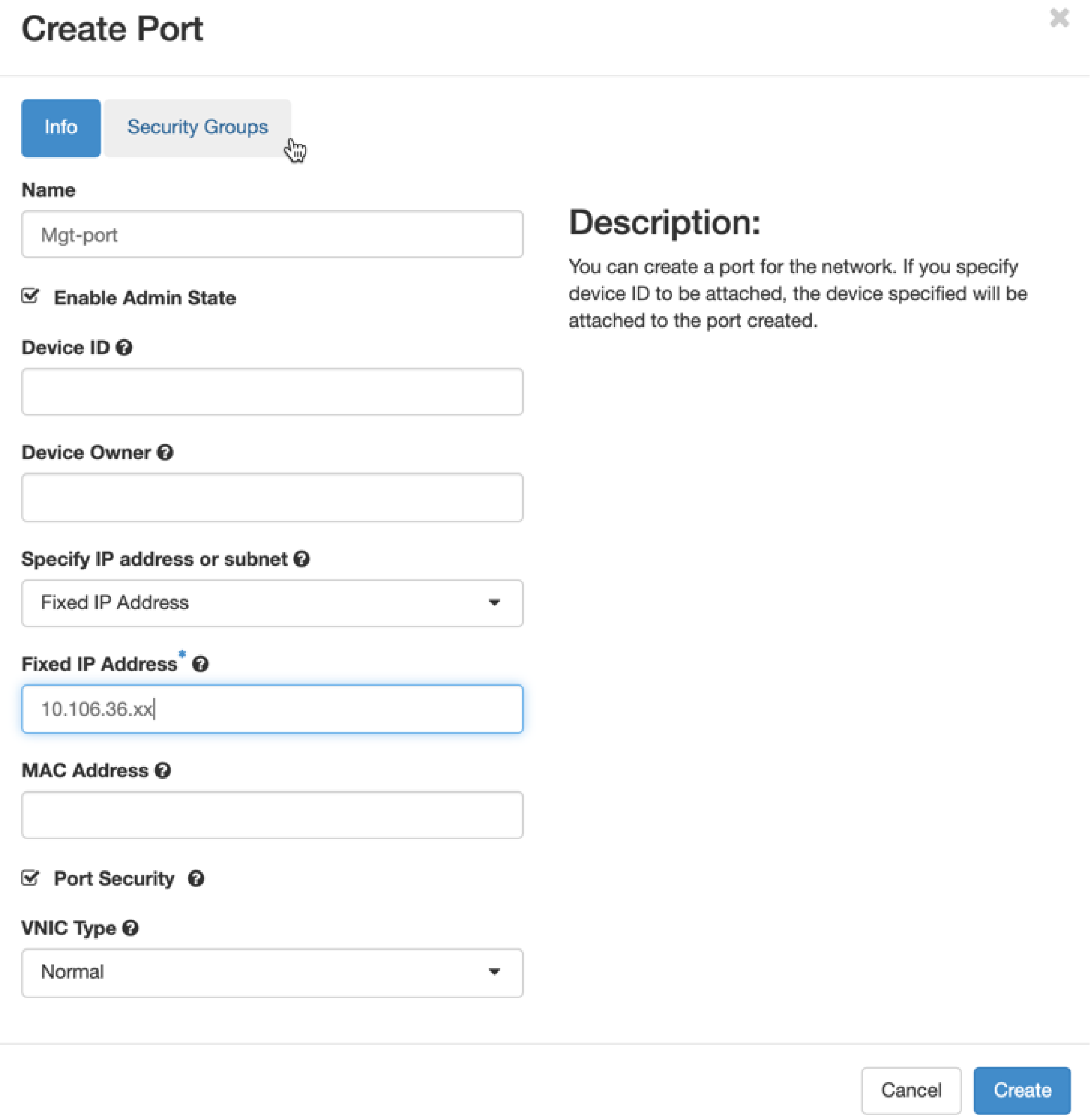
Protected: Yes No

- **Image Name** - Provide the image name.
- **Image Description** –Add an image description.
- **File** - Browse for the kvm.qcow2 image file from your local drive and select it.
- **Format** –Select the QCOW2 –QEMU Emulator disk format from the drop-down list.

Click **Create Image**.

Both Network and network port must create initially and predefined. To create network port:

1. Select **Networks** under **Network** and go to **Port** tab.
2. Click **Create Port** and provide the necessary detail and click Create.



Create Port

Name: Mgt-port

☑ Enable Admin State

Device ID:

Device Owner:

Specify IP address or subnet: Fixed IP Address

Fixed IP Address*: 10.106.36.xx

MAC Address:

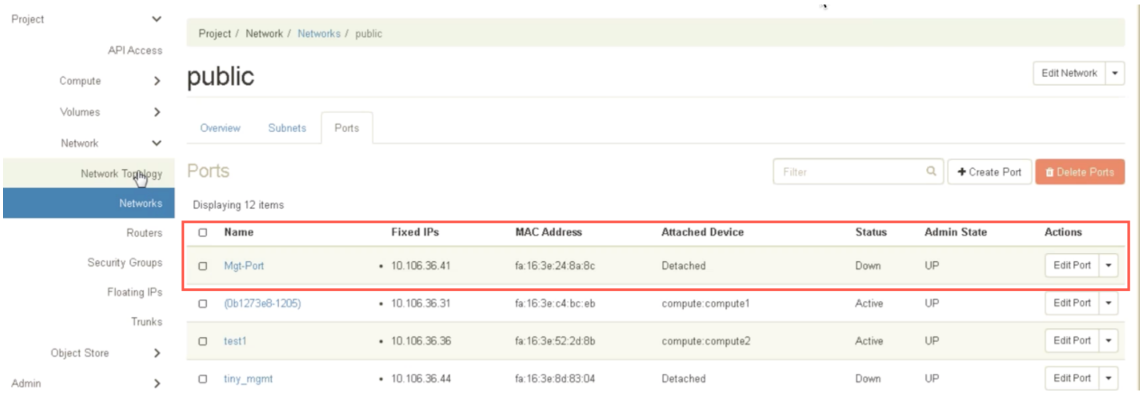
☑ Port Security

VNIC Type: Normal

Description:

You can create a port for the network. If you specify device ID to be attached, the device specified will be attached to the port created.

If you select **Fixed IP Address**, then you must provide the subnet IP address for the new port.



Project / Network / Networks / public

public

Ports

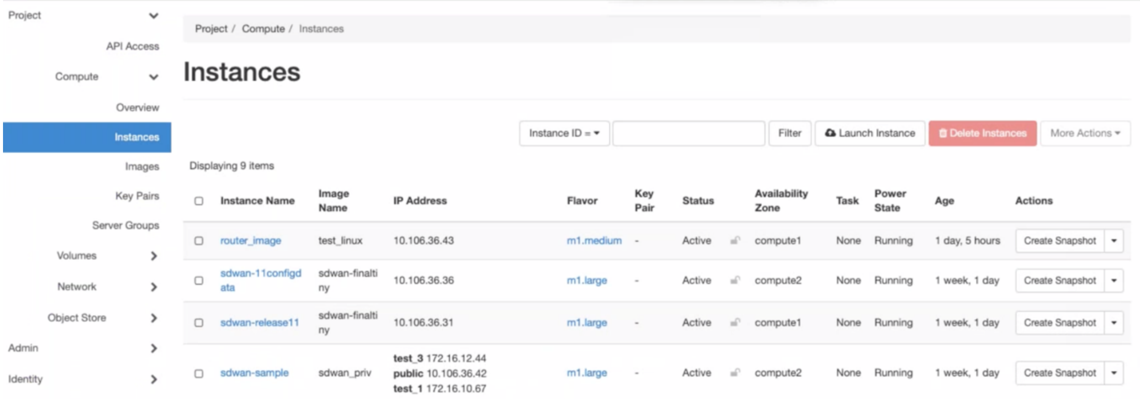
Displaying 12 items

□	Name	Fixed IPs	MAC Address	Attached Device	Status	Admin State	Actions
□	Mgt-Port	• 10.106.36.41	fa:16:3e:24:8a:8c	Detached	Down	UP	Edit Port
□	(0b1273e8-1205)	• 10.106.36.31	fa:16:3e:c4:bc:eb	compute:compute1	Active	UP	Edit Port
□	test1	• 10.106.36.36	fa:16:3e:52:2d:8b	compute:compute2	Active	UP	Edit Port
□	tiny_mgmt	• 10.106.36.44	fa:16:3e:8d:83:04	Detached	Down	UP	Edit Port

The port is created and as it is not attached to any device, the current status shows Detached.

Create OpenStack instance to enable config-drive and pass the user_data.

3. Log in to OpenStack and configure Instances.

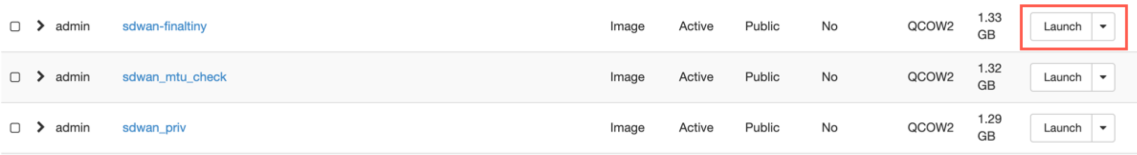


□	Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
□	router_image	test_linux	10.106.36.43	m1.medium	-	Active	compute1	None	Running	1 day, 5 hours	Create Snapshot
□	sdwan-11configdata	sdwan-finaltiny	10.106.36.36	m1.large	-	Active	compute2	None	Running	1 week, 1 day	Create Snapshot
□	sdwan-release11	sdwan-finaltiny	10.106.36.31	m1.large	-	Active	compute1	None	Running	1 week, 1 day	Create Snapshot
□	sdwan-sample	sdwan_priv	**test_3** 172.16.12.44 **public** 10.106.36.42 **test_1** 172.16.10.67	m1.large	-	Active	compute2	None	Running	1 week, 1 day	Create Snapshot

4. Download the **kvm.qcow2.gz** file and untar it.

5. Go to **Instances** and click **Launch Instance**.

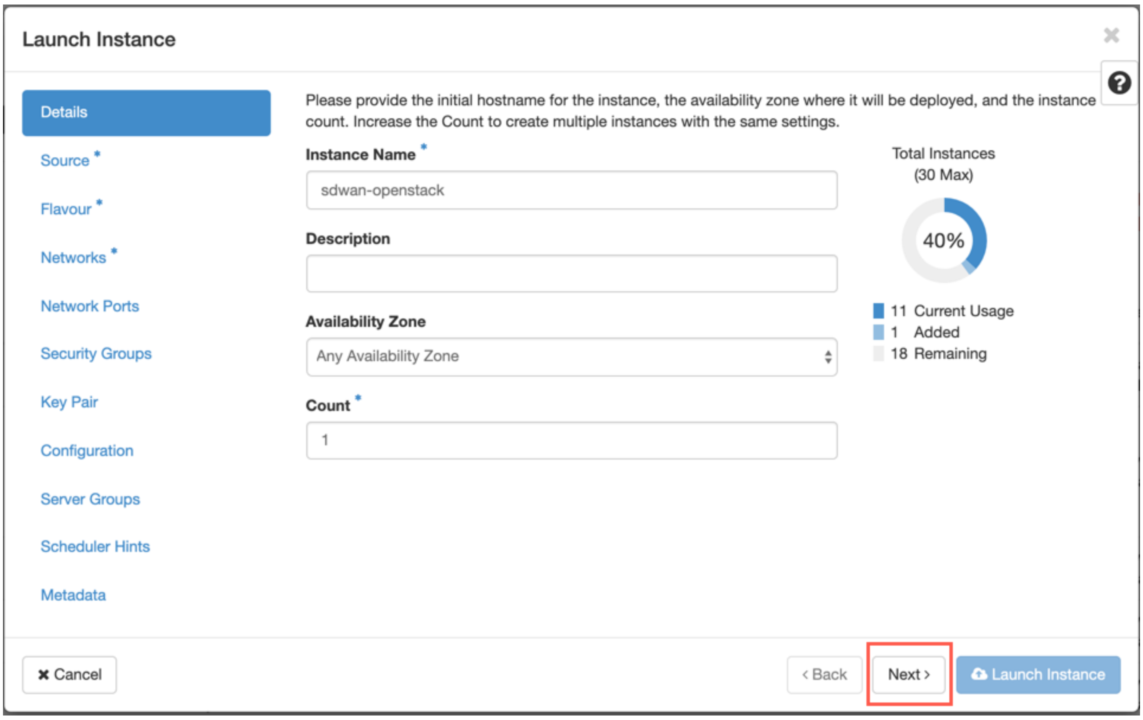
> **NOTE**
>
> You can go back to **Instances** and click **Launch Instance** or from the Images screen click **Launch** once the image is created.



□	>	admin	sdwan-finaltiny	Image	Active	Public	No	QCOW2	1.33 GB	Launch
□	>	admin	sdwan_mtu_check	Image	Active	Public	No	QCOW2	1.32 GB	Launch
□	>	admin	sdwan_priv	Image	Active	Public	No	QCOW2	1.29 GB	Launch

6. Under **Details** tab, provide the following information:

   - **Instance Name** –Provide the host name for the instance.
   - **Description** –Add description for the instance.
   - **Availability Zone** –Select the availability zone from the drop-down list where you want to deploy the instance.
   - **Count** –Enter the instance count. You can increase the count to create multiple instances with the same settings. Click **Next**.



Launch Instance

Please provide the initial hostname for the instance, the availability zone where it will be deployed, and the instance count. Increase the Count to create multiple instances with the same settings.

Instance Name *: sdwan-openstack

Description:

Availability Zone: Any Availability Zone

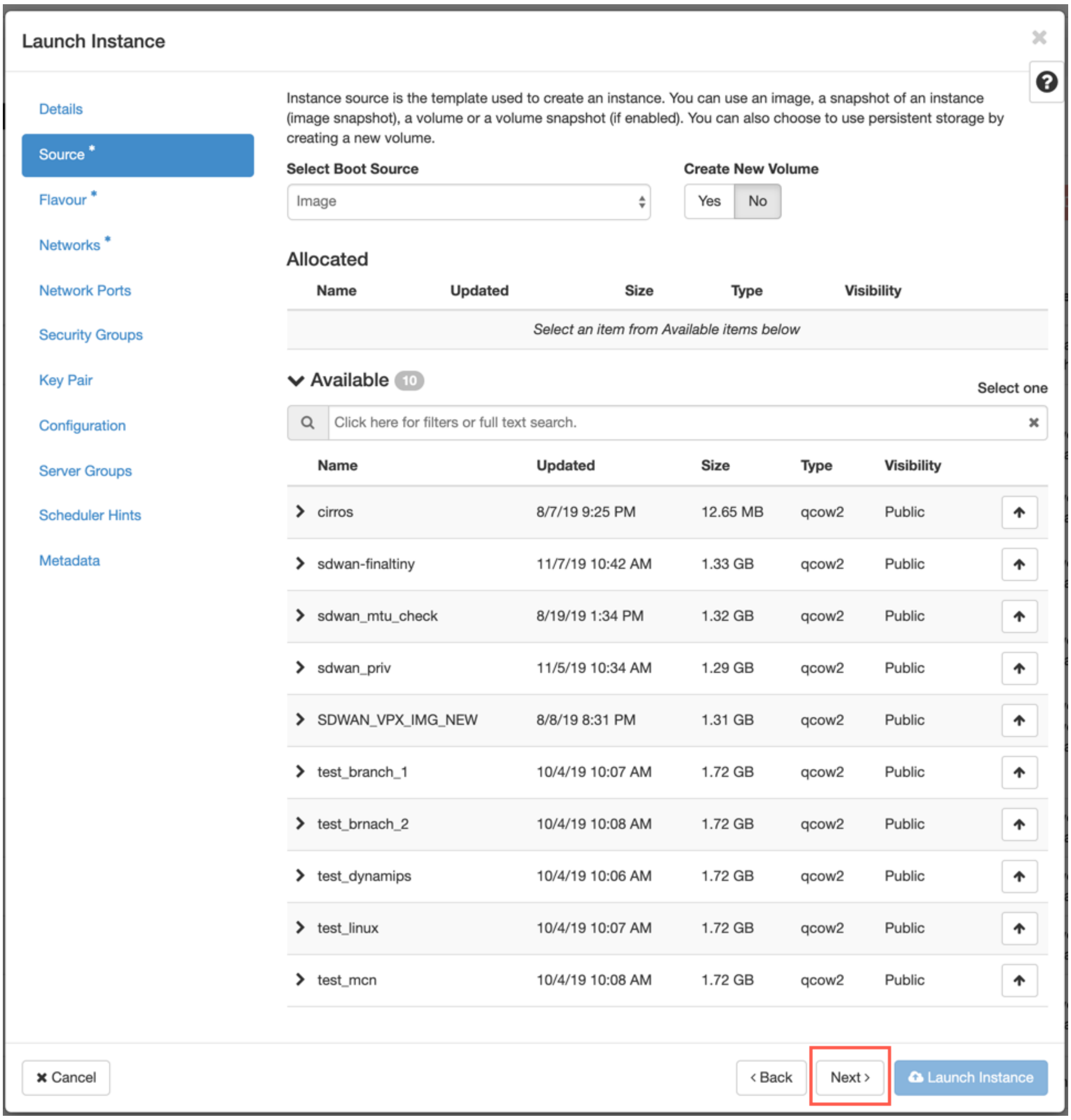
Count *: 1

Total Instances (30 Max)

40%

11 Current Usage
1 Added
18 Remaining

7. In **Source** tab, select **No** under **Create New Volume** and click**Next**. Instance source is the template used to create an instance.



Instance source is the template used to create an instance. You can use an image, a snapshot of an instance (image snapshot), a volume or a volume snapshot (if enabled). You can also choose to use persistent storage by creating a new volume.

Select Boot Source: Image

Create New Volume: Yes [✓ No]

Allocated

Name	Updated	Size	Type	Visibility
Select an item from Available items below				

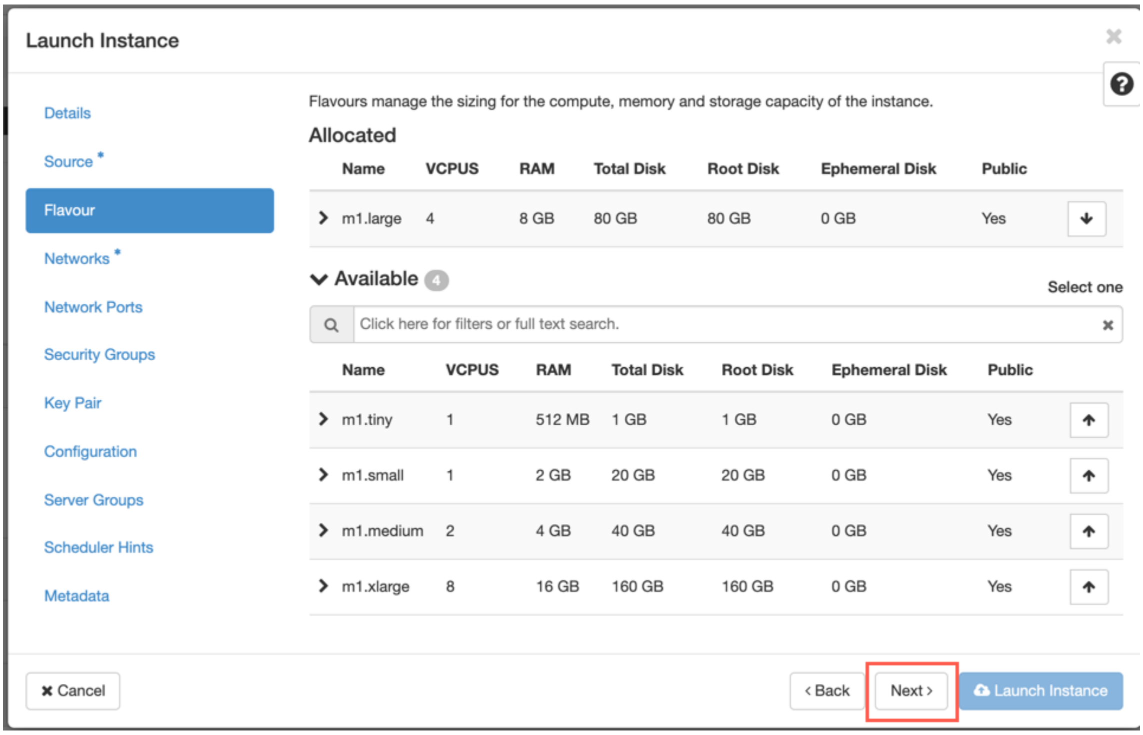
Available 10

Name	Updated	Size	Type	Visibility
cirros	8/7/19 9:25 PM	12.65 MB	qcow2	Public
sdwan-finaltiny	11/7/19 10:42 AM	1.33 GB	qcow2	Public
sdwan_mtu_check	8/19/19 1:34 PM	1.32 GB	qcow2	Public
sdwan_priv	11/5/19 10:34 AM	1.29 GB	qcow2	Public
SDWAN_VPX_IMG_NEW	8/8/19 8:31 PM	1.31 GB	qcow2	Public
test_branch_1	10/4/19 10:07 AM	1.72 GB	qcow2	Public
test_brnach_2	10/4/19 10:08 AM	1.72 GB	qcow2	Public
test_dynamips	10/4/19 10:06 AM	1.72 GB	qcow2	Public
test_linux	10/4/19 10:07 AM	1.72 GB	qcow2	Public
test_mcn	10/4/19 10:08 AM	1.72 GB	qcow2	Public

8. Select **Flavour** for the instance and click Next. The flavour you select for an instance manages the amount of compute, storage, and memory capacity of the instance.

> **NOTE**
>
> The flavour you select must have enough resources allocated to support the type of instance you are trying to create. Flavours that do not provide enough resources for your instance are identified on the available table with a yellow warning icon.

Administrators are responsible for creating and managing flavours. Click the arrow (at the right side) to allocate.



Flavours manage the sizing for the compute, memory and storage capacity of the instance.

Allocated

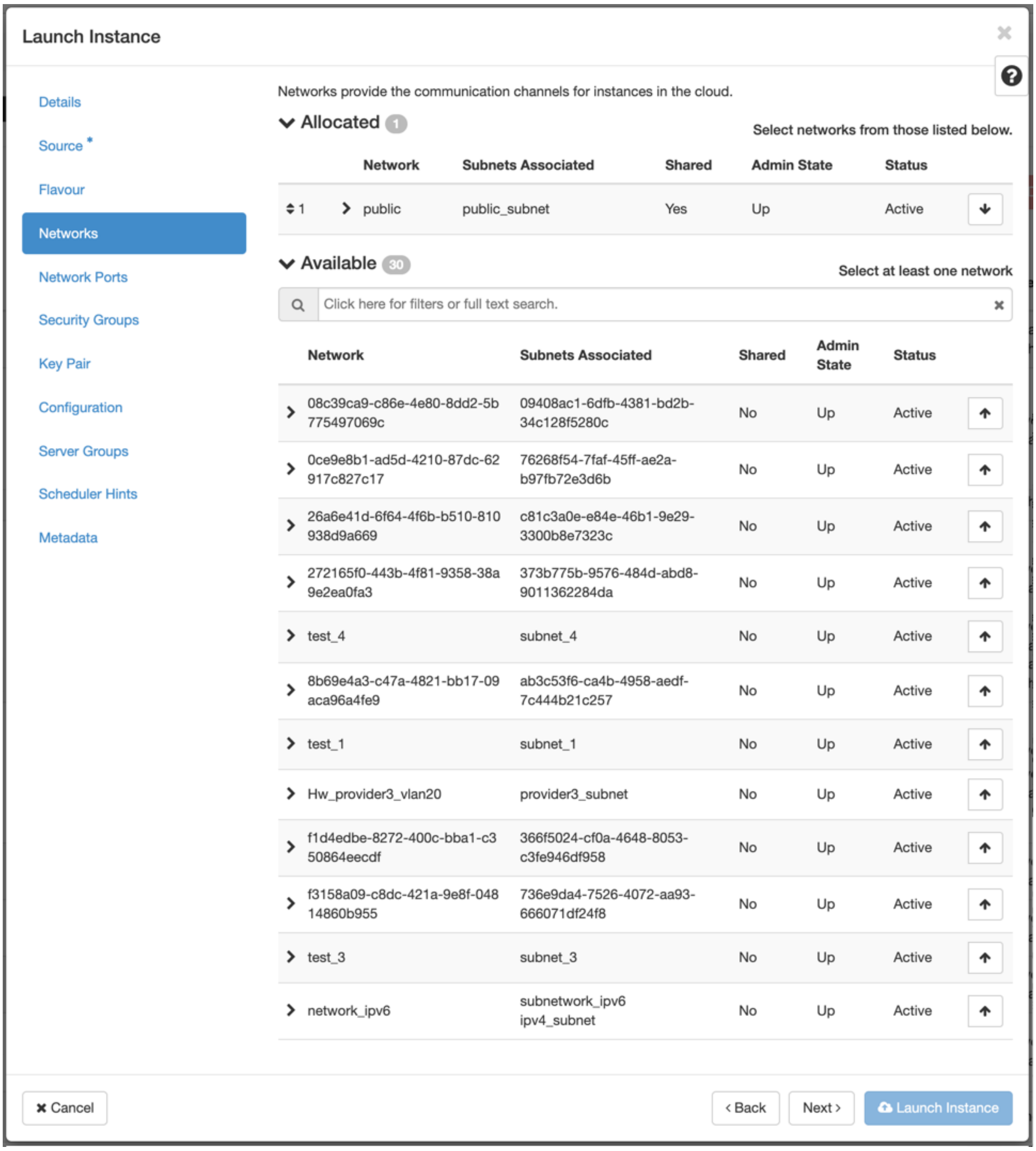
Name	VCPUS	RAM	Total Disk	Root Disk	Ephemeral Disk	Public
m1.large	4	8 GB	80 GB	80 GB	0 GB	Yes

Available

Name	VCPUS	RAM	Total Disk	Root Disk	Ephemeral Disk	Public
m1.tiny	1	512 MB	1 GB	1 GB	0 GB	Yes
m1.small	1	2 GB	20 GB	20 GB	0 GB	Yes
m1.medium	2	4 GB	40 GB	40 GB	0 GB	Yes
m1.xlarge	8	16 GB	160 GB	160 GB	0 GB	Yes

9. Select the network and click **Next**. Networks provide the communication channels for instances.

> **NOTE**
>
> An Administrator is created the Provider networks and these networks are map to an existing physical network in the data center. Similarly Project networks are created by Users and these networks are fully isolated and are project-specific.



Networks provide the communication channels for instances in the cloud.

Allocated 1

Select networks from those listed below.

	Network	Subnets Associated	Shared	Admin State	Status	
⇕1	› public	public_subnet	Yes	Up	Active	↓

Available 30

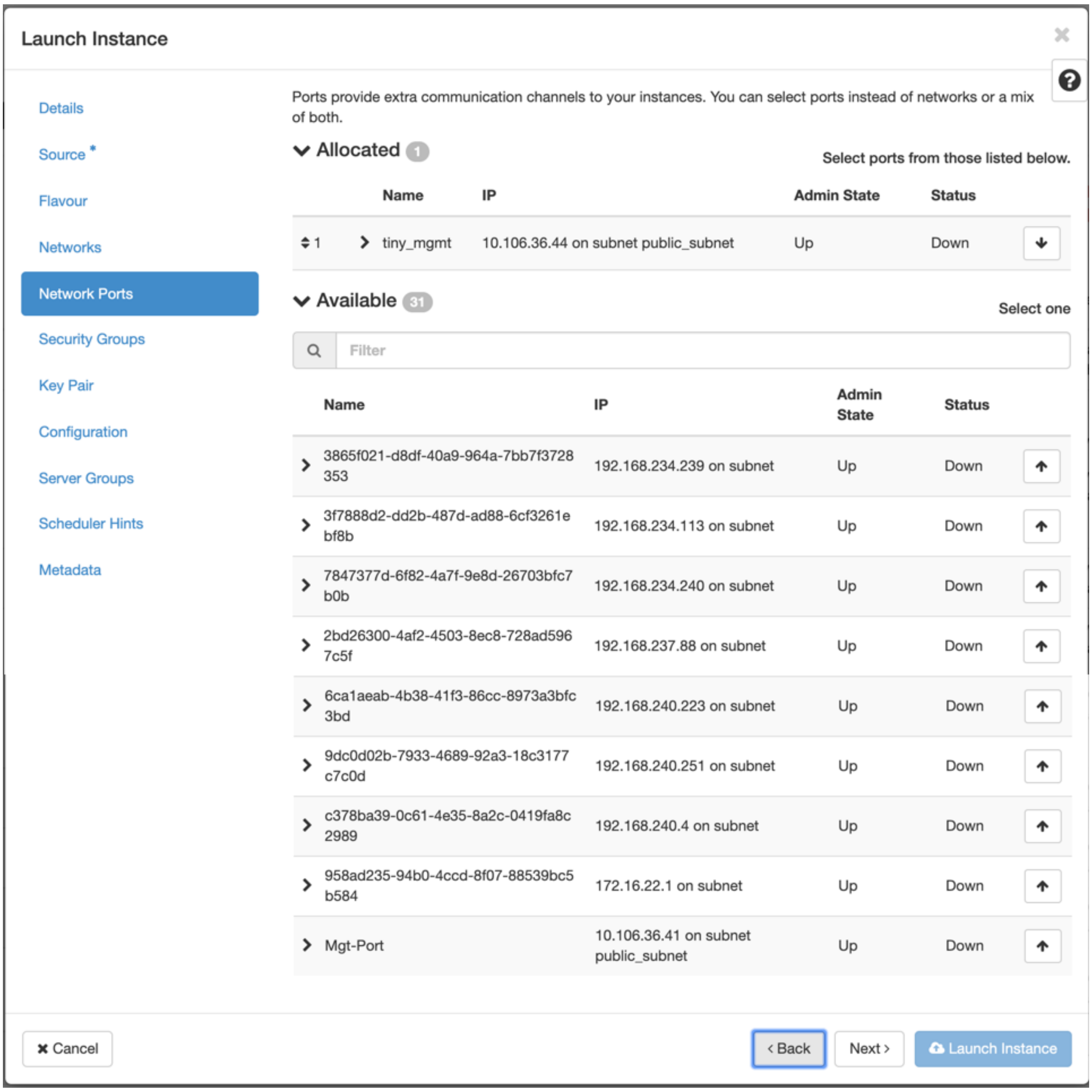
Select at least one network

Click here for filters or full text search.

Network	Subnets Associated	Shared	Admin State	Status	
› 08c39ca9-c86e-4e80-8dd2-5b775497069c	09408ac1-6dfb-4381-bd2b-34c128f5280c	No	Up	Active	↑
› 0ce9e8b1-ad5d-4210-87dc-62917c827c17	76268f54-7faf-45ff-ae2a-b97fb72e3d6b	No	Up	Active	↑
› 26a6e41d-6f64-4f6b-b510-810938d9a669	c81c3a0e-e84e-46b1-9e29-3300b8e7323c	No	Up	Active	↑
› 272165f0-443b-4f81-9358-38a9e2ea0fa3	373b775b-9576-484d-abd8-9011362284da	No	Up	Active	↑
› test_4	subnet_4	No	Up	Active	↑
› 8b69e4a3-c47a-4821-bb17-09aca96a4fe9	ab3c53f6-ca4b-4958-aedf-7c444b21c257	No	Up	Active	↑
› test_1	subnet_1	No	Up	Active	↑
› Hw_provider3_vlan20	provider3_subnet	No	Up	Active	↑
› f1d4edbe-8272-400c-bba1-c350864eecdf	366f5024-cf0a-4648-8053-c3fe946df958	No	Up	Active	↑
› f3158a09-c8dc-421a-9e8f-04814860b955	736e9da4-7526-4072-aa93-666071df24f8	No	Up	Active	↑
› test_3	subnet_3	No	Up	Active	↑
› network_ipv6	subnetwork_ipv6 ipv4_subnet	No	Up	Active	↑

10. Select a network port for the instance and click **Next**. Network ports provide additional communication channels to the instances.

> **NOTE**
>
> You can select ports instead of networks or a mix of both.



Ports provide extra communication channels to your instances. You can select ports instead of networks or a mix of both.

Allocated 1

Select ports from those listed below.

	Name	IP	Admin State	Status
1	tiny_mgmt	10.106.36.44 on subnet public_subnet	Up	Down

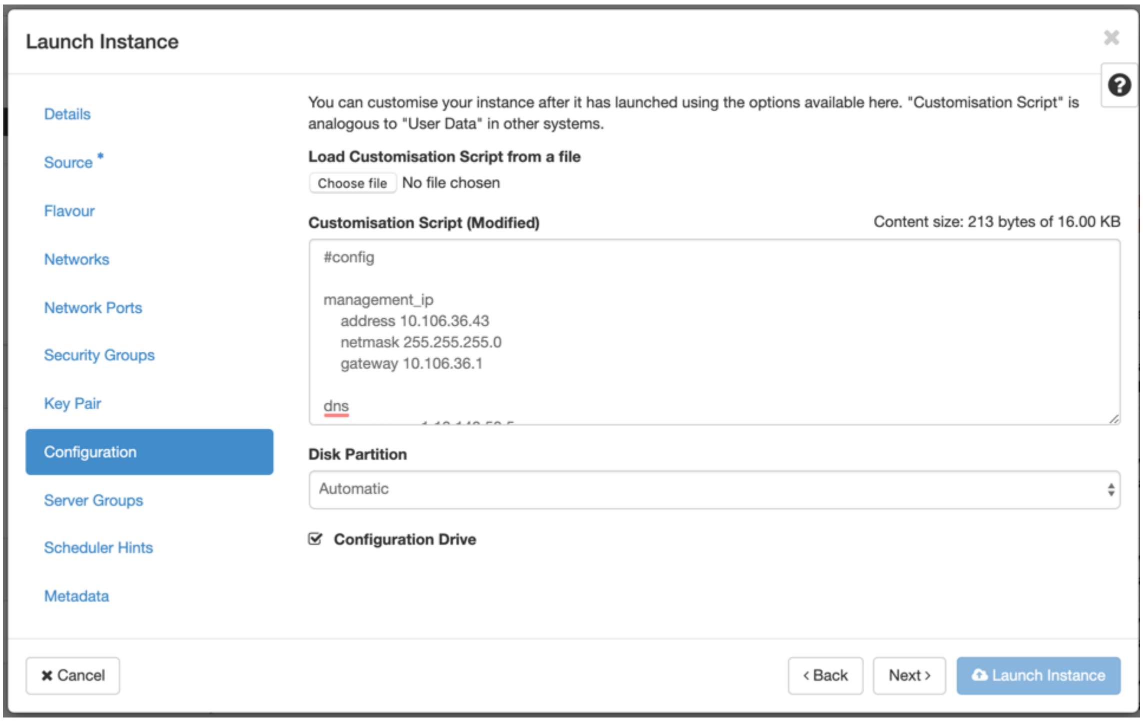
Available 31

Select one

Name	IP	Admin State	Status
3865f021-d8df-40a9-964a-7bb7f3728353	192.168.234.239 on subnet	Up	Down
3f7888d2-dd2b-487d-ad88-6cf3261ebf8b	192.168.234.113 on subnet	Up	Down
7847377d-6f82-4a7f-9e8d-26703bfc7b0b	192.168.234.240 on subnet	Up	Down
2bd26300-4af2-4503-8ec8-728ad5967c5f	192.168.237.88 on subnet	Up	Down
6ca1aeab-4b38-41f3-86cc-8973a3bfc3bd	192.168.240.223 on subnet	Up	Down
9dc0d02b-7933-4689-92a3-18c3177c7c0d	192.168.240.251 on subnet	Up	Down
c378ba39-0c61-4e35-8a2c-0419fa8c2989	192.168.240.4 on subnet	Up	Down
958ad235-94b0-4ccd-8f07-88539bc5b584	172.16.22.1 on subnet	Up	Down
Mgt-Port	10.106.36.41 on subnet public_subnet	Up	Down

11. Go to **Configuration** and click **Choose file**. Select the user_data file. You can view the **Management IP**, **DNS**, and **Serial Number** information in the user_data file.

12. Enable the **Configuration Drive** check box. By enabling the configuration drive you can put the user metadata inside the image.



You can customise your instance after it has launched using the options available here. "Customisation Script" is analogous to "User Data" in other systems.

Load Customisation Script from a file

No file chosen

Customisation Script (Modified)

Content size: 213 bytes of 16.00 KB

```
#config

management_ip
   address 10.106.36.43
   netmask 255.255.255.0
   gateway 10.106.36.1

dns
```

Disk Partition

Automatic

☑ Configuration Drive

13. Click **Launch Instance**.

Configure LTE functionality on 210 SE LTE appliance

August 24, 2022

You can connect a Citrix SD-WAN 210-SE LTE appliance to your network using an LTE connection. This topic provides details on configuring mobile broadband settings, configuring the data center and branch appliances for LTE and so on. For more information on the Citrix SD-WAN 210-SE LTE hardware platform, see Citrix SD-WAN 210 Standard Edition Appliances.

> **Note**
>
> The LTE connectivity depends on the SIM carrier or service provider network. For information on how to configure and manage LTE sites in your network, see LTE firmware upgrade.

Getting started with Citrix SD-WAN 210-SE LTE

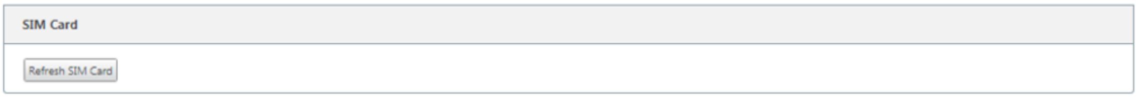
1. Insert the SIM card into the SIM card slot of the Citrix SD-WAN 210-SE LTE.

   > **Note:**
   >
   > Only a standard or 2FF SIM card (15x25 mm) is supported.

2. Fix the antennas to the Citrix SD-WAN 210-SE LTE appliance. For more information, see Installing the LTE antennas.

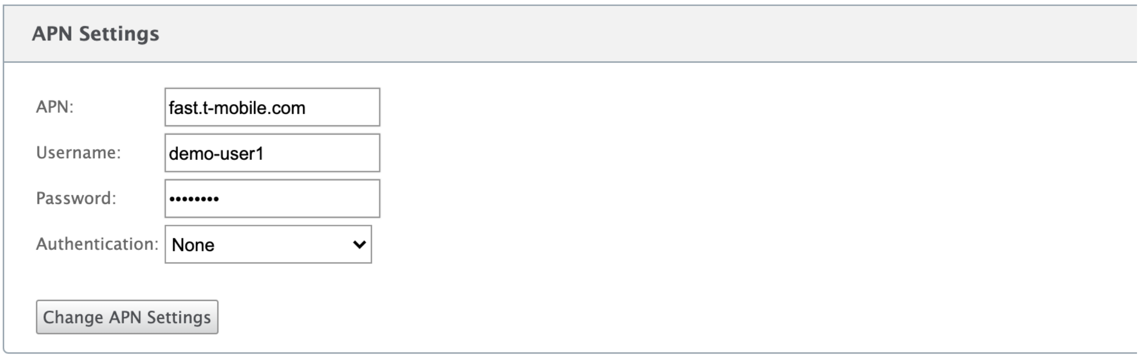
3. Power on the appliance.

> **Note**
>
> If you have inserted the SIM into an appliance that is already powered ON and booted up, navigate to **Configuration > Appliance Settings > Network Adapters > Mobile Broadband > SIM Card** and click **Refresh SIM Card**.



4. Configure the APN settings. In the SD-WAN GUI navigate to **Configuration > Appliance Settings > Network Adapters > Mobile Broadband > APN settings**.

> **Note:**
> Obtain the APN information from the carrier.



APN: fast.t-mobile.com

Username: demo-user1

Password: ••••••••

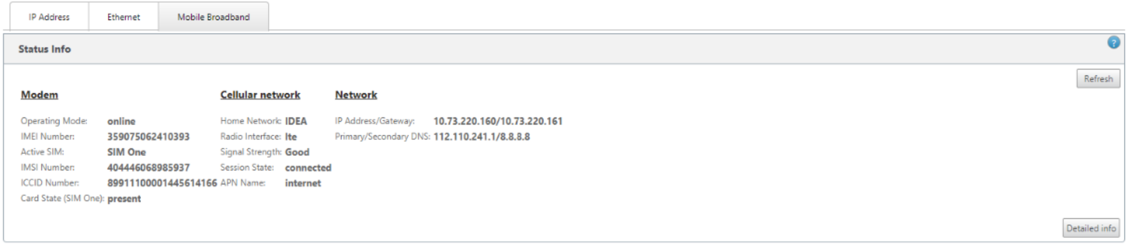
Authentication: None

5. Enter the **APN**, **Username**, **Password** and **Authentication** provided by the carrier. You can choose from PAP, CHAP, PAPCHAP authentication protocols. If the carrier has not provided any authentication type, set it to **None**.

6. Click **Change APN Settings**.

7. In the SD-WAN appliance GUI, navigate to **Configuration > Appliance Settings > Network Adapters > Mobile Broadband**.

   You can view the Mobile broadband settings status information.



Modem

Operating Mode: online
IMEI Number: 359075062410393
Active SIM: SIM One
IMSI Number: 404446068985937
ICCID Number: 89911100001445614166
Card State (SIM One): present

Cellular network

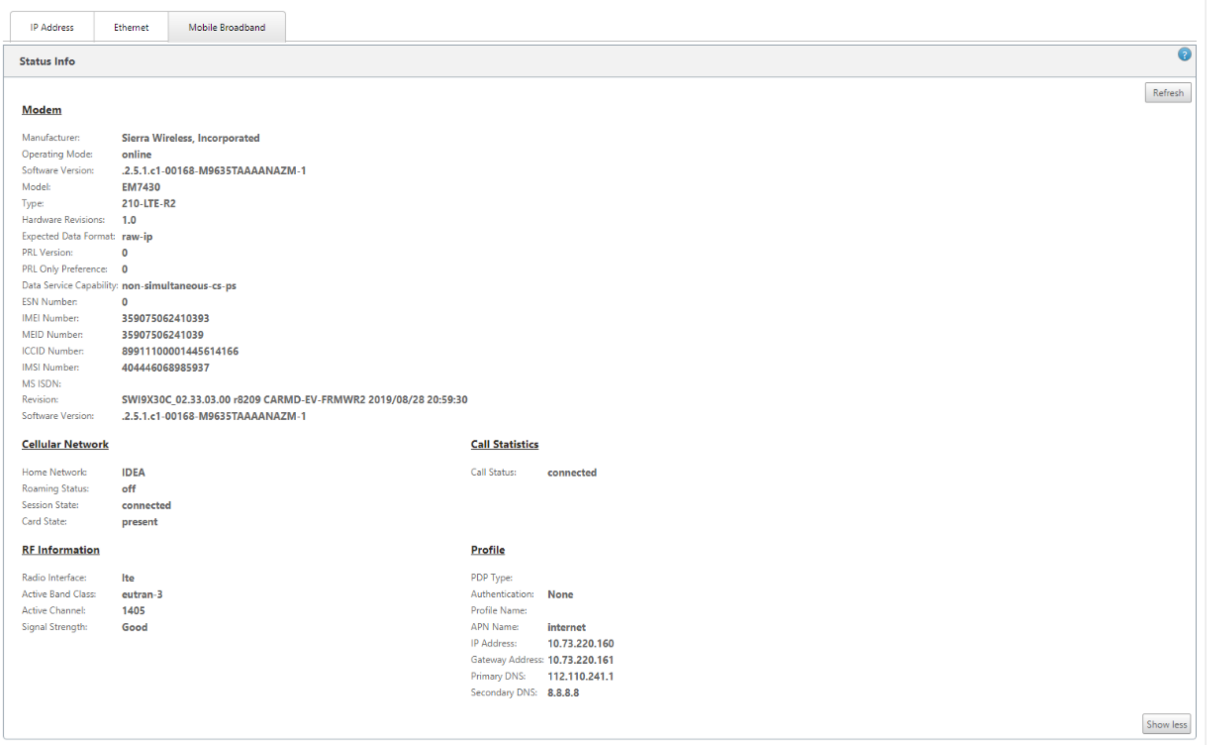
Home Network: IDEA
Radio Interface: lte
Signal Strength: Good
Session State: connected
APN Name: internet

Network

IP Address/Gateway: 10.73.220.160/10.73.220.161
Primary/Secondary DNS: 112.110.241.1/8.8.8.8

The following are some useful status information:

- **Operating Mode**: Displays the modem state.
- **Active SIM**: At any given time, only one SIM can be active. Displayed the SIM that is currently active.
- **Card State**: Present indicates that SIM is properly inserted.
- **Signal strength**: Quality of signal strength - excellent, good, fair, poor, or no signal.
- **Home network**: Carrier of the inserted SIM.
- **APN name**: The access point name used by the LTE modem.
- **Session state**: Connected indicates that the device has joined the network. If the session state is disconnected, check with the carrier whether the account has been activated of if the data plan is enabled.



Status Info

Modem

Manufacturer: Sierra Wireless, Incorporated
Operating Mode: online
Software Version: .2.5.1.c1-00168-M9635TAAAANAZM-1
Model: EM7430
Type: 210-LTE-R2
Hardware Revisions: 1.0
Expected Data Format: raw-ip
PRL Version: 0
PRL Only Preference: 0
Data Service Capability: non-simultaneous-cs-ps
ESN Number: 0
IMEI Number: 359075062410393
MEID Number: 35907506241039
ICCID Number: 89911100001445614166
IMSI Number: 404446068985937
MS ISDN:
Revision: SWI9X30C_02.33.03.00 r8209 CARMD-EV-FRMWR2 2019/08/28 20:59:30
Software Version: .2.5.1.c1-00168-M9635TAAAANAZM-1

Cellular Network

Home Network: IDEA
Roaming Status: off
Session State: connected
Card State: present

Call Statistics

Call Status: connected

RF Information

Radio Interface: lte
Active Band Class: eutran-3
Active Channel: 1405
Signal Strength: Good

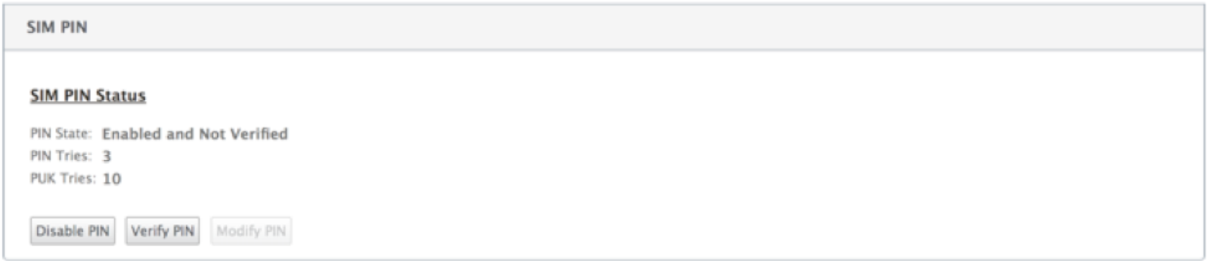
Profile

PDP Type:
Authentication: None
Profile Name:
APN Name: internet
IP Address: 10.73.220.160
Gateway Address: 10.73.220.161
Primary DNS: 112.110.241.1
Secondary DNS: 8.8.8.8

SIM PIN

If you have inserted a SIM card that is locked with a PIN, the SIM status is Enabled and Not Verified** state. You cannot use the SIM card until it is verified using the SIM PIN. You can obtain the SIM PIN from the carrier.

To perform SIM PIN operations, navigate to **Configuration > Appliance Settings > Network Adapters > Mobile Broadband > SIM PIN**.

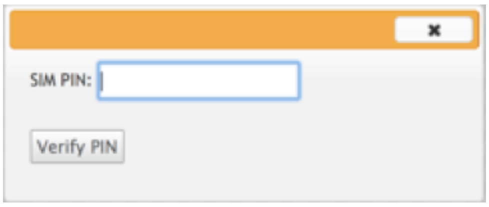


SIM PIN

SIM PIN Status

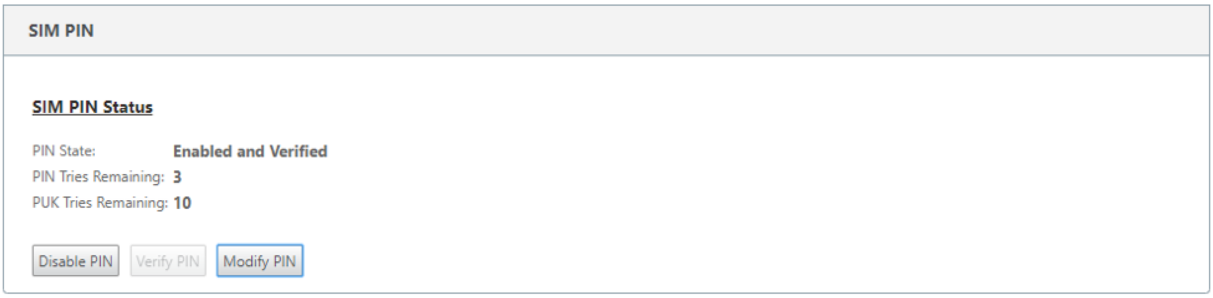
PIN State: Enabled and Not Verified
PIN Tries: 3
PUK Tries: 10

Click **Verify PIN**. Enter the SIM PIN provided by the carrier and click **Verify PIN**.



SIM PIN:

The status changes to **Enabled and Verified**.



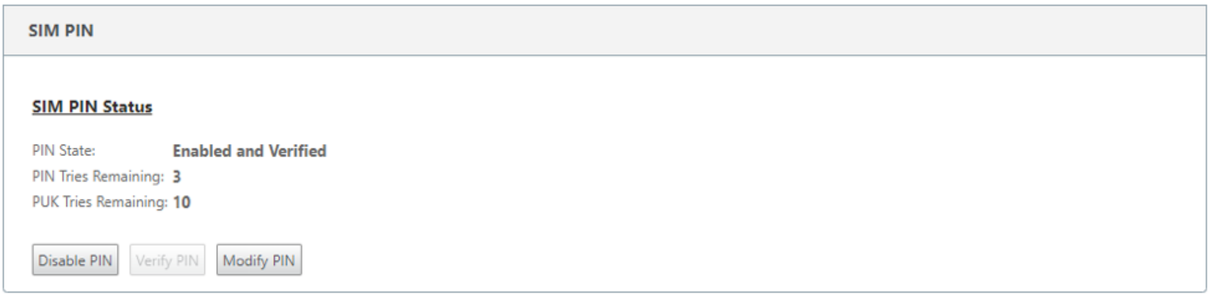
SIM PIN

SIM PIN Status

PIN State: Enabled and Verified
PIN Tries Remaining: 3
PUK Tries Remaining: 10

Disable SIM PIN

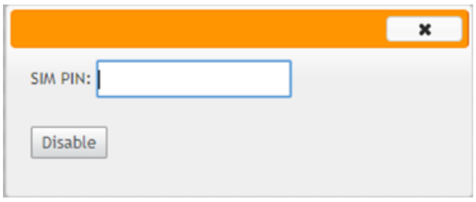
You can choose to disable SIM PIN functionality for a SIM for which SIM PIN is enabled and verified.



SIM PIN

SIM PIN Status

PIN State: Enabled and Verified
PIN Tries Remaining: 3
PUK Tries Remaining: 10

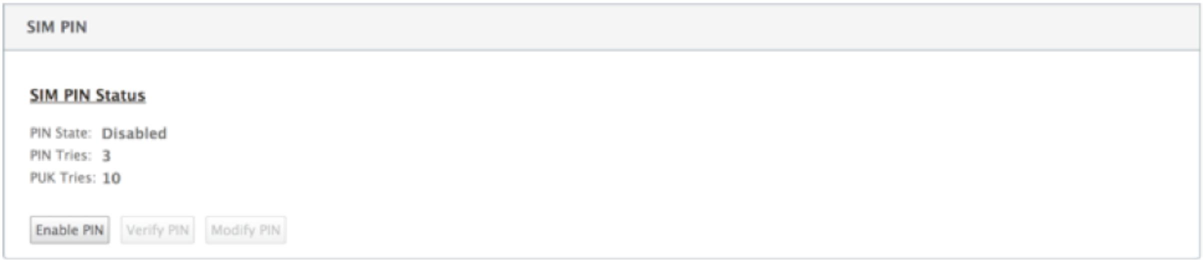


SIM PIN:

Click **Disable PIN**. Enter the **SIM PIN** and click **Disable**.

Enable SIM PIN

SIM PIN can be enabled for the SIM for which it is disabled.

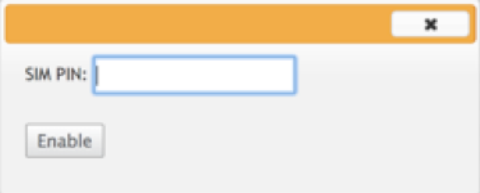


SIM PIN

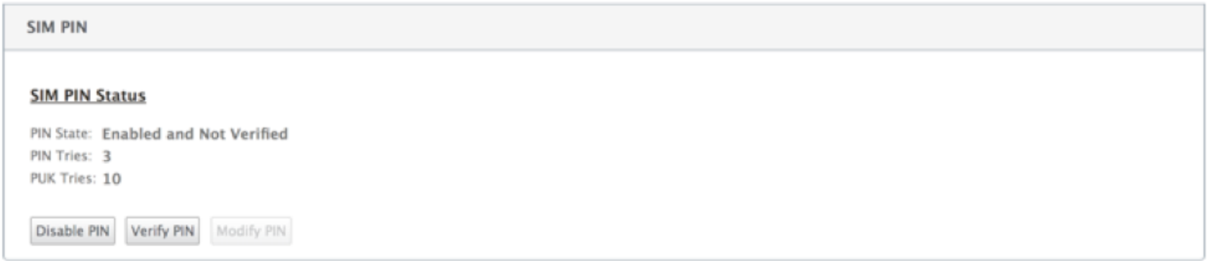
SIM PIN Status

PIN State: Disabled
PIN Tries: 3
PUK Tries: 10

Click **Enable PIN**. Enter the SIM PIN provided by the carrier and click **Enable**.



If the SIM PIN state changes to **Enabled and Not Verified**, it means that the PIN is not verified and you cannot perform any LTE related operations until the PIN is verified.

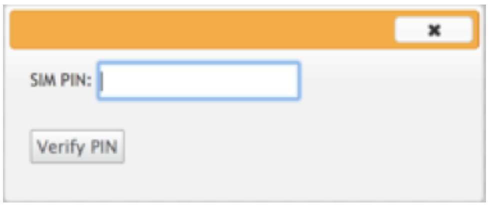


SIM PIN

SIM PIN Status

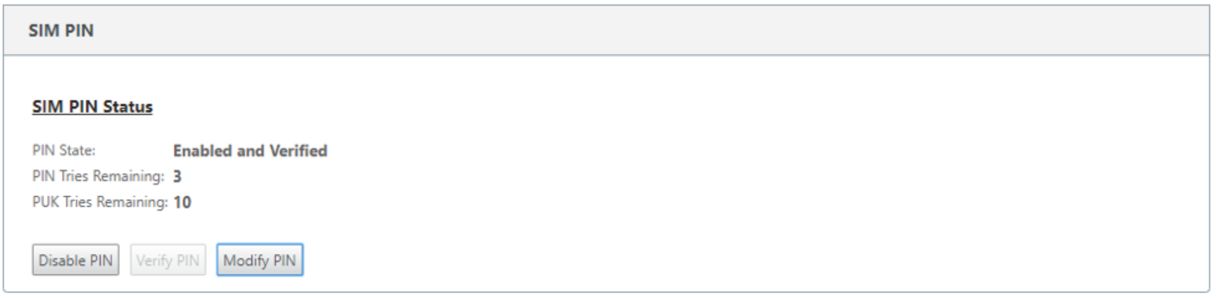
PIN State: Enabled and Not Verified
PIN Tries: 3
PUK Tries: 10

Click **Verify PIN**. Enter the SIM PIN provided by the carrier and click **Verify PIN**.



Modify SIM PIN

Once the PIN is in **Enabled and Verified** state you can choose to change the PIN.

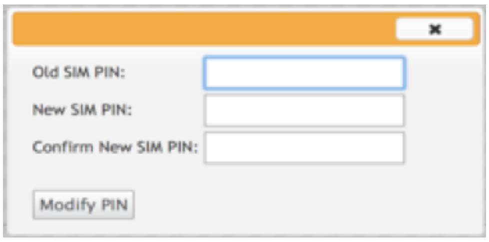


SIM PIN

SIM PIN Status

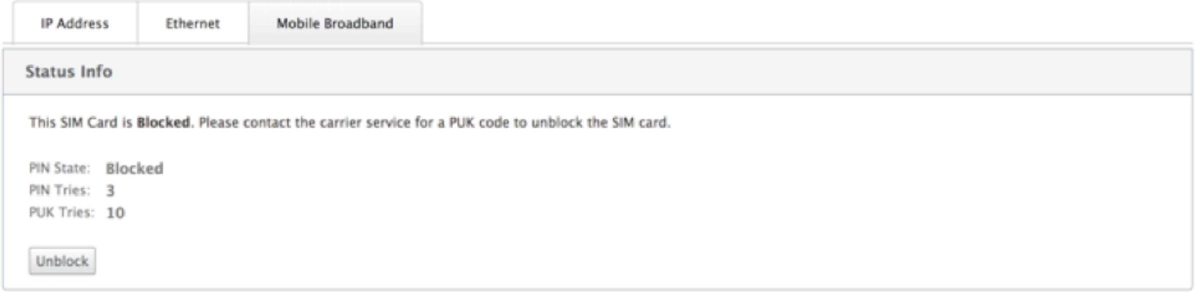
PIN State: Enabled and Verified
PIN Tries Remaining: 3
PUK Tries Remaining: 10

Click **Modify PIN**. Enter the SIM PIN provided by the carrier. Enter the new SIM PIN and confirm it. Click **Modify PIN**.



Unblock SIM

If you forget the SIM PIN, you can reset the SIM PIN using the SIM PUK obtained from the carrier.

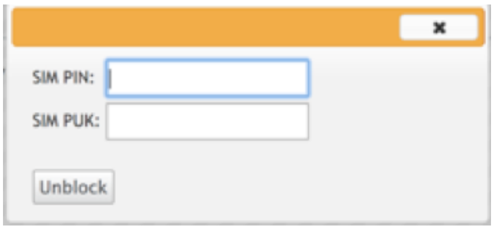


Status Info

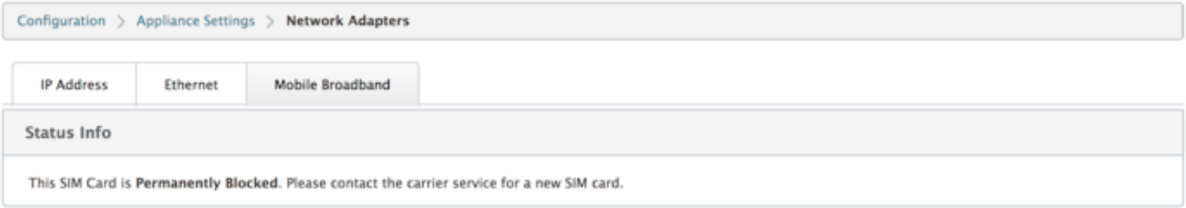
This SIM Card is **Blocked**. Please contact the carrier service for a PUK code to unblock the SIM card.

PIN State: Blocked
PIN Tries: 3
PUK Tries: 10

To unblock a SIM, click **Unblock**. Enter the **SIM PIN and SIM PUK** obtained from the carrier and click **Unblock**.



> **Note:**
> The SIM card gets permanently blocked with 10 unsuccessful attempts of PUK, while unblocking the SIM. Contact the carrier service provider for a new SIM card.

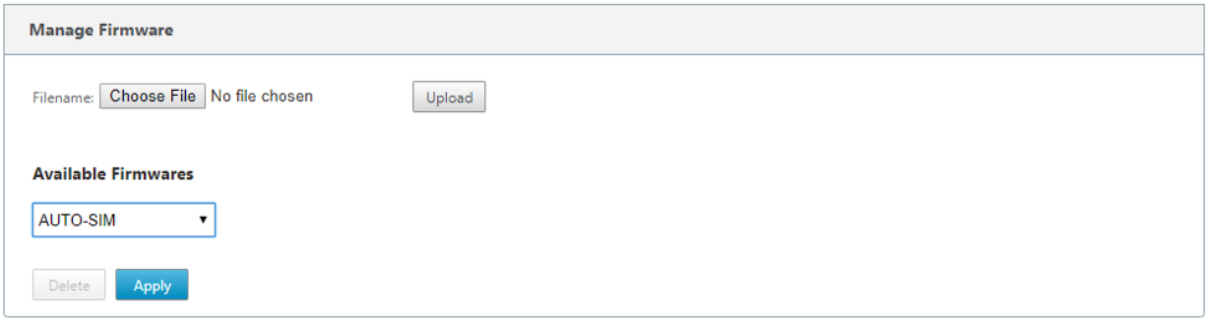


This SIM Card is **Permanently Blocked**. Please contact the carrier service for a new SIM card.

Manage Firmware

Every appliance that has LTE enabled will have a set of available firmware. You can select from the existing list of firmware or upload a firmware and apply it.

If you are unsure of which firmware to use, select the AUTO-SIM option to allow the LTE modem to choose the most matching firmware based on the inserted SIM card.

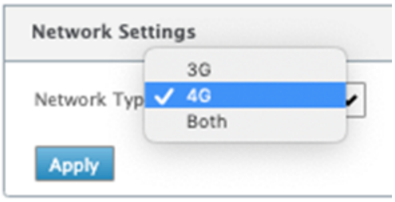


Filename: No file chosen

AUTO-SIM

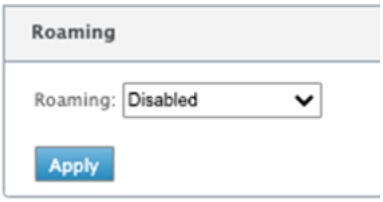
Network Settings

You can select the mobile network on Citrix SD-WAN appliances that support internal LTE modems. The supported networks are 3G, 4G, or both.



Roaming

The roaming option is enabled by default on your LTE appliances, you can choose to disable it.



Enable/Disable modem

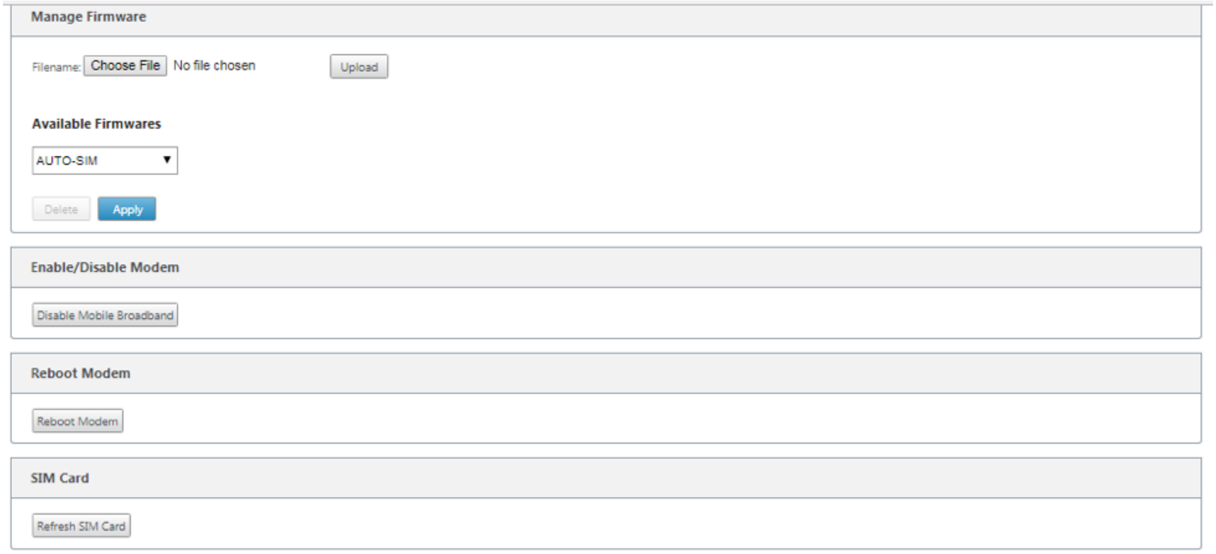
Enable/disable the modem depending on your intent to use the LTE functionality. By default, the LTE modem is enabled.

Reboot modem

Reboots the modem. It can take up to 3-5 minutes for the reboot operation to complete.

Refresh SIM

Use this option when you hot swap the SIM card to detect the new SIM card by the 210-SE LTE modem.

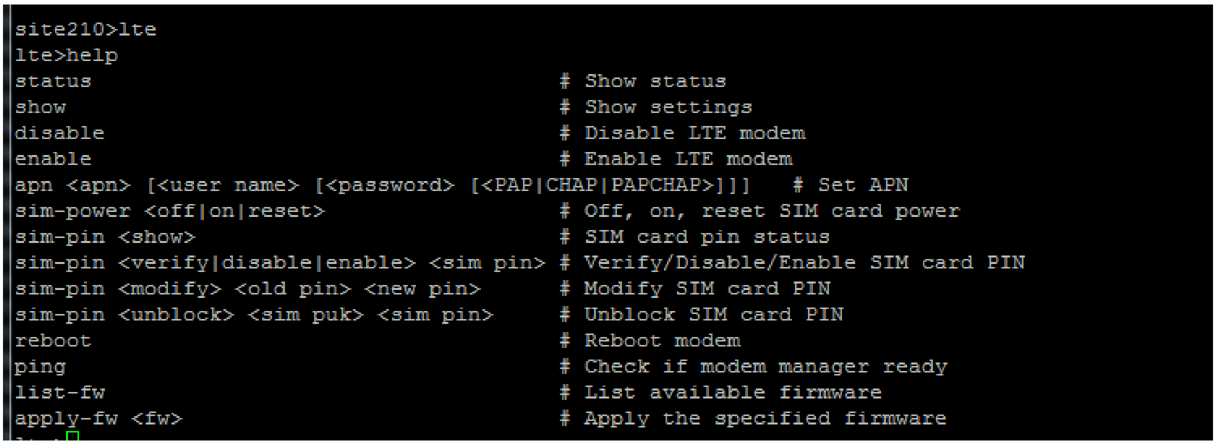


Configure the LTE functionality using CLI

To configure the 210-SE LTE modem using the CLI.

1. Log into the Citrix SD-WAN appliance console.
2. At the prompt, type the user name and password to gain CLI interface access.

3. At the prompt, type the command **lte**. Type **>help**. This displays the list of LTE commands available for configuration.



```
site210>lte
lte>help
status                                    # Show status
show                                      # Show settings
disable                                   # Disable LTE modem
enable                                    # Enable LTE modem
apn <apn> [<user name> [<password> [<PAP|CHAP|PAPCHAP>]]]   # Set APN
sim-power <off|on|reset>                  # Off, on, reset SIM card power
sim-pin <show>                            # SIM card pin status
sim-pin <verify|disable|enable> <sim pin> # Verify/Disable/Enable SIM card PIN
sim-pin <modify> <old pin> <new pin>      # Modify SIM card PIN
sim-pin <unblock> <sim puk> <sim pin>     # Unblock SIM card PIN
reboot                                    # Reboot modem
ping                                      # Check if modem manager ready
list-fw                                   # List available firmware
apply-fw <fw>                             # Apply the specified firmware
```

The following table lists the **LTE** command descriptions.

Command	Description
Help {lte>help}	Lists the available LTE commands and parameters
Status {lte>status}	Displays LTE connectivity status
Show {lte>show}	Displays LTE settings
Disable {lte>disable}	Disables LTE modem
Enable {lte>enable}	Enables LTE modem
Apn {lte>apn}	Configures APN settings information
Sim-power off, on, reset>{lte>sim-power off,on,reset}	Powers off SIM card, Power on SIM card, Refresh SIM card
SIM PIN {lte>sim-pin}	Powers off SIM card, Power on SIM card, Refresh SIM card
Reboot {lte>reboot}	Restarts LTE modem
Ping {lte>ping}	Pings LTE modem
List-fw {lte>list-fw}	Lists firmware available on the R1 or R2 LTE modems
Apply-fw {lte>apply-fw}	Applies firmware specific to a carrier

Zero-touch deployment over LTE

Pre-requisites for enabling zero-touch deployment service over LTE

1. Install the antenna and the SIM card for the 210-SE LTE appliance.
2. Ensure that the SIM card has an activated data plan.
3. Ensure that the management port is not connected.

    - If the management port is connected, disconnect the management port and then restart the appliance.
    - If a static IP address on the Management Interface is configured, you need to configure the Management Interface with DHCP, apply the configuration, and then disconnect the Management port, and restart the appliance.

4. Ensure that the 210-SE appliance configuration has the internet service defined for the LTE interface.

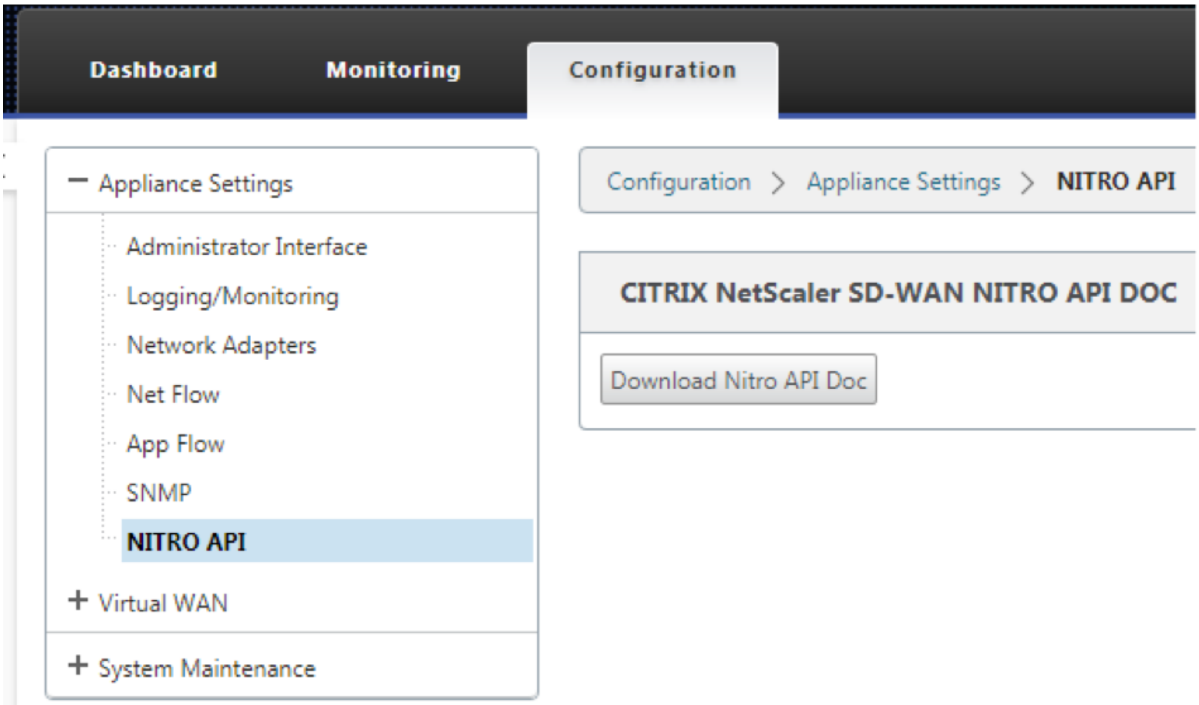
When the appliance is powered on, the zero-touch deployment service uses the LTE port to obtain the latest SD-WAN software and SD-WAN configuration only when the management port has not been connected.

Zero-touch deployment Service over management interface for 210-SE LTE appliance

Connect the Management Port and use the standard zero-touch deployment procedure that is supported on all other non-LTE platforms.

LTE REST API

For information about the LTE REST API, navigate to the SD-WAN GUI and go to **Configuration > Appliance Settings >NITRO API**. Click **Download Nitro API** Doc. The REST API for SIM PIN functionality is introduced in Citrix SD-WAN 11.0.



AT commands

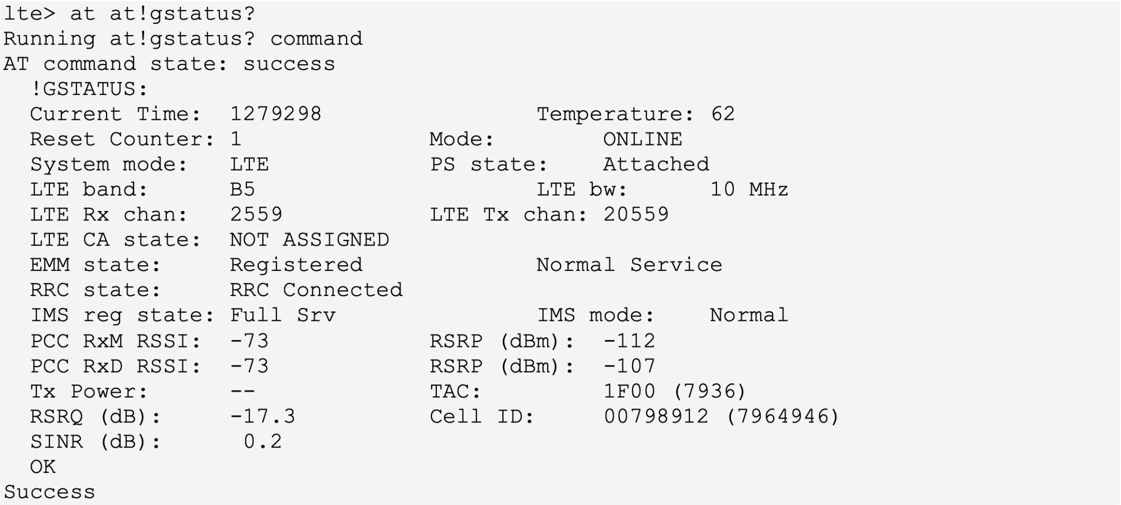
AT commands help in monitoring and troubleshooting LTE modem configuration and status. AT is the abbreviation for **ATtension**. As every command line starts with **at**, they are called AT commands. Citrix SD-WAN platform models that support LTE support running AT commands. AT commands are modem specific and therefore the list of AT commands varies across the platforms.

To run AT commands, perform the following steps:

1. Log into the Citrix SD-WAN appliance console.
2. At the prompt, type the user name and password to gain CLI interface access.
3. At the prompt, type **lte**.
4. Enter **at** and then enter the AT command.

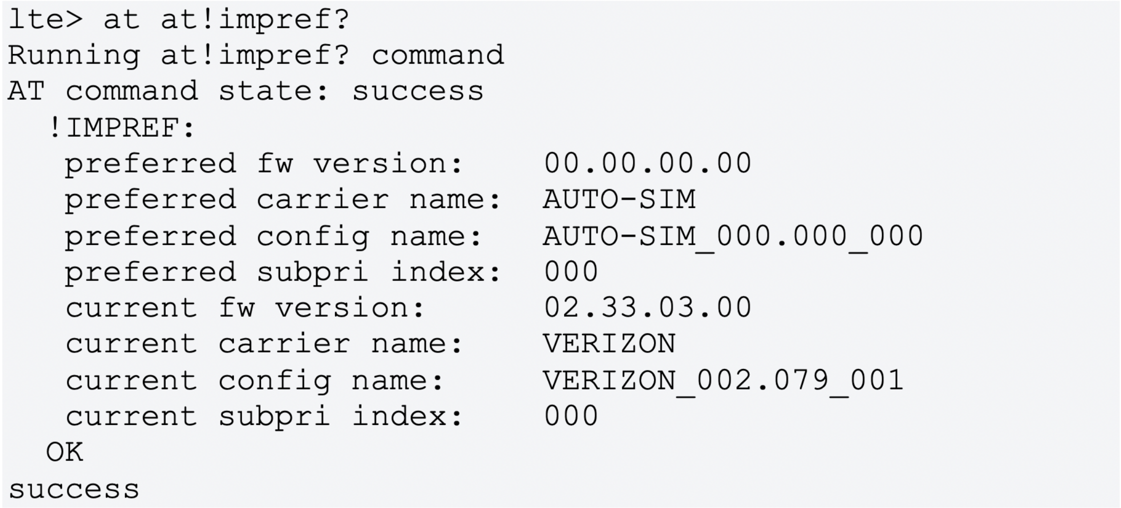
The following is an example:

- **at at+cpin** –Provides SIM status information.
- **at at!gstatus** - Provides LTE modem status information.



```
lte> at at!gstatus?
Running at!gstatus? command
AT command state: success
  !GSTATUS:
  Current Time:  1279298                Temperature: 62
  Reset Counter: 1              Mode:        ONLINE
  System mode:   LTE            PS state:    Attached
  LTE band:      B5                     LTE bw:      10 MHz
  LTE Rx chan:   2559           LTE Tx chan: 20559
  LTE CA state:  NOT ASSIGNED
  EMM state:     Registered             Normal Service
  RRC state:     RRC Connected
  IMS reg state: Full Srv               IMS mode:    Normal
  PCC RxM RSSI:  -73            RSRP (dBm):  -112
  PCC RxD RSSI:  -73            RSRP (dBm):  -107
  Tx Power:      --             TAC:         1F00 (7936)
  RSRQ (dB):     -17.3          Cell ID:     00798912 (7964946)
  SINR (dB):      0.2
  OK
Success
```

- **at at!impref?** - Provides modem firmware and network carrier information.



```
lte> at at!impref?
Running at!impref? command
AT command state: success
  !IMPREF:
   preferred fw version:    00.00.00.00
   preferred carrier name:  AUTO-SIM
   preferred config name:   AUTO-SIM_000.000_000
   preferred subpri index:  000
   current fw version:      02.33.03.00
   current carrier name:    VERIZON
   current config name:     VERIZON_002.079_001
   current subpri index:    000
  OK
success
```

Configure LTE functionality on 110-LTE-WiFi appliance

August 24, 2022

You can connect a Citrix SD-WAN 110-LTE-WiFi appliance to your network using an LTE connection. This topic provides details on configuring mobile broadband settings, configuring the data center and branch appliances for LTE and so on. For more information on the Citrix 110-LTE-WiFi hardware platform, see Citrix SD-WAN 110 Standard Edition Appliances.

> **Note**

> - The LTE connectivity depends on the SIM carrier or service provider network.
> - For information on how to configure and manage all the LTE sites in your network, see LTE firmware template.

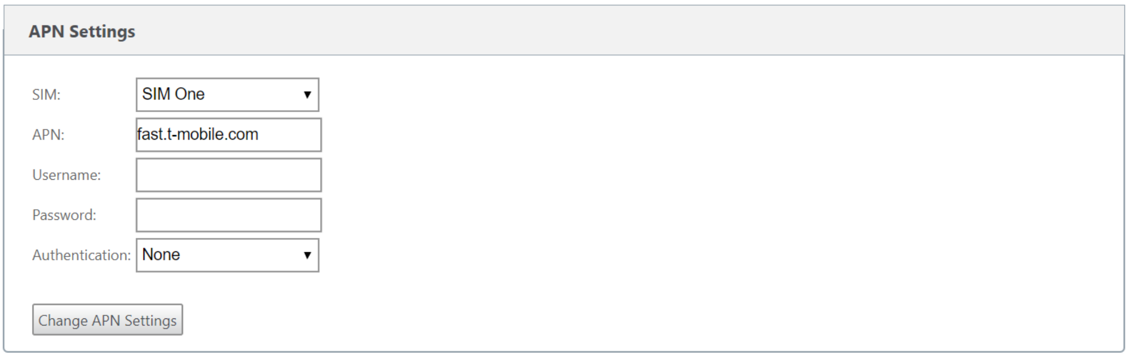
Getting started with Citrix SD-WAN 110-LTE-WiFi

1. Power ON the appliance and insert the SIM card into the SIM card slot of the Citrix SD-WAN 110-LTE-WiFi appliance.

   > **Note**
   >
   > Citrix SD-WAN 110-LTE-WiFi appliance has two standard (2FF) SIM slots. To use Micro (3FF) and Nano (4FF) size SIMs, use a SIM adapter. Snap the smaller SIM into the adapter. You can obtain the adapter from Citrix as a Field Replaceable Unit (FRU) or from the SIM provider.

2. Fix the antennas to the Citrix SD-WAN 110-LTE-WiFi appliance. For more information, see Installing the LTE antennas.
3. Power on the appliance.
4. Configure the APN settings. In the SD-WAN GUI navigate to **Configuration > Appliance Settings > Network Adapters > Mobile Broadband > APN settings**.

   > **Note**
   >
   > Obtain the APN information from the carrier.



APN Settings

SIM: SIM One

APN: fast.t-mobile.com

Username:

Password:

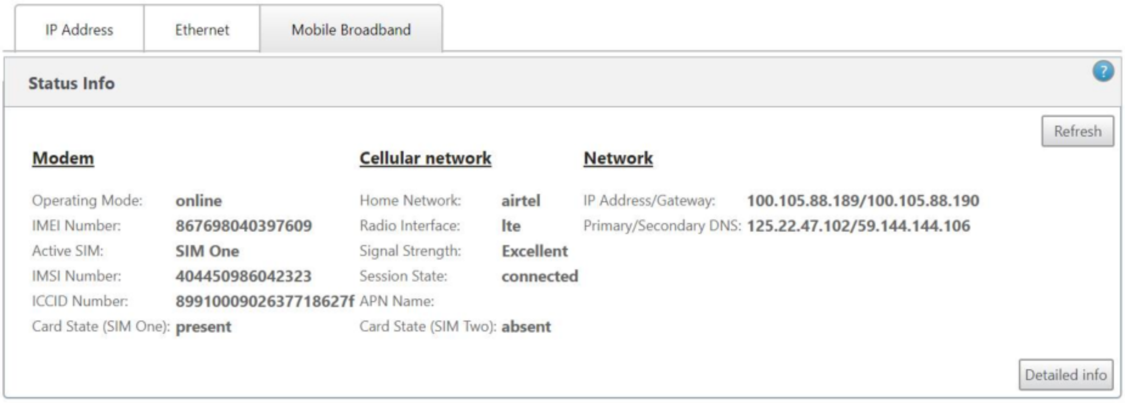
Authentication: None

5. Select the SIM card, enter the **APN**, **Username**, **Password**, and **Authentication** provided by the carrier. You can choose from PAP, CHAP, PAPCHAP authentication protocols. If the carrier has not provided any authentication type, set it to **None**.

   > **Note**
   >
   > All these fields are optional.

6. Click **Change APN Settings**.
7. In the SD-WAN appliance GUI, navigate to **Configuration** > **Appliance Settings** > **Network Adapters** > **Mobile Broadband**.

   You can view the Mobile broadband settings status information.



Status Info

Modem

Operating Mode: online
IMEI Number: 867698040397609
Active SIM: SIM One
IMSI Number: 404450986042323
ICCID Number: 8991000902637718627f
Card State (SIM One): present

Cellular network

Home Network: airtel
Radio Interface: lte
Signal Strength: Excellent
Session State: connected
APN Name:
Card State (SIM Two): absent

Network

IP Address/Gateway: 100.105.88.189/100.105.88.190
Primary/Secondary DNS: 125.22.47.102/59.144.144.106

The following are some useful status information:

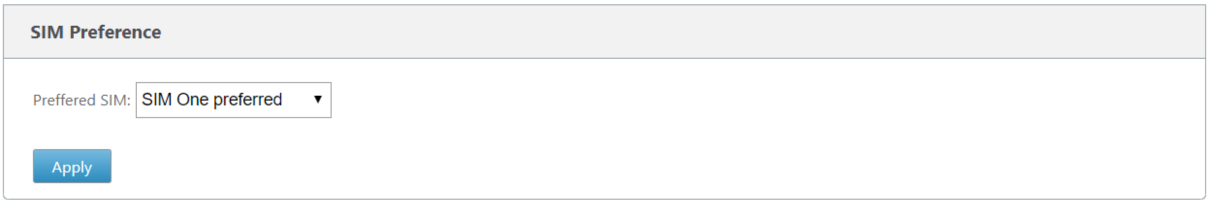
- **Operating Mode**: Displays the modem state.
- **Active SIM**: At any given time, only one SIM can be active. Displayed the SIM that is currently active.
- **Card State**: Present indicates that SIM is properly inserted.
- **Signal strength**: Quality of signal strength - excellent, good, fair, poor, or no signal.
- **Home network**: Carrier of the inserted SIM.
- **APN name**: The access point name used by the LTE modem.
- **Session state**: Connected indicates that the device has joined the network. If the session state is disconnected, check with the carrier if the account is activated and the data plan is enabled.

SIM Preference

You can insert two SIMs on a Citrix SD-WAN 110-LTE-WiFi appliance. At any given time, only one SIM is active. Select the **SIM preference**:

- **SIM One preferred**: If two SIMs are inserted, on boot-up the LTE modem uses SIM One, if available. When the LTE modem is up and running it uses whichever SIM (SIM One or SIM Two) is useable at that moment. It continues to use it until the SIM is active.
- **SIM Two preferred**: If two SIMs are inserted, on boot-up the LTE modem uses SIM Two, if available. When the LTE modem is up and running it uses whichever SIM (SIM One or SIM Two) is useable at that moment. It continues to use it until the SIM is active.
- **SIM One**: Only SIM One is used, irrespective of the SIM state on both the SIM slots. SIM One is always active.

- **SIM Two**: Only SIM Two is used, irrespective of the SIM state on both the SIM slots. SIM Two is always active.


SIM Preference

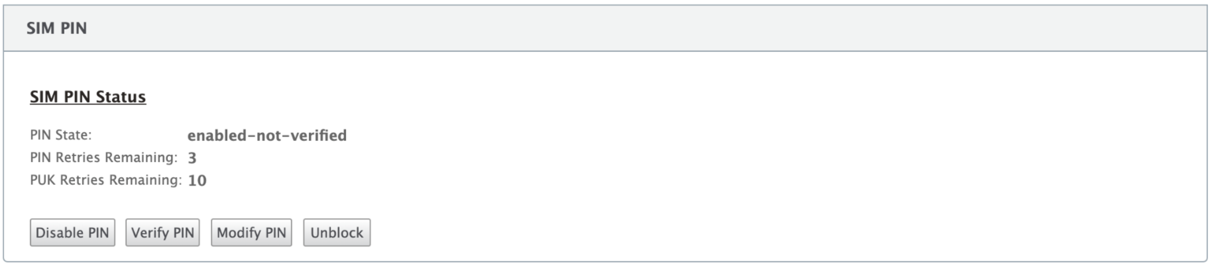
Preffered SIM: SIM One preferred ▼

SIM PIN

If you have inserted a SIM card that is locked with a PIN, the SIM status is **enabled-not-verified** state. You cannot use the SIM card until it is verified using the SIM PIN. You can obtain the SIM PIN from the carrier.

> **Note**
>
> The SIM PIN operations are applicable for the active SIM only.

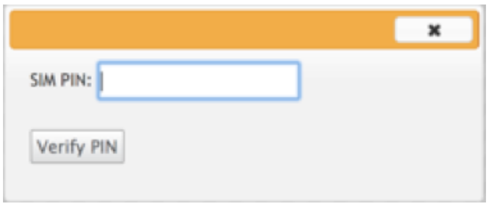
To perform SIM PIN operations, navigate to **Configuration > Appliance Settings > Network Adapters > Mobile Broadband > SIM PIN**.


SIM PIN

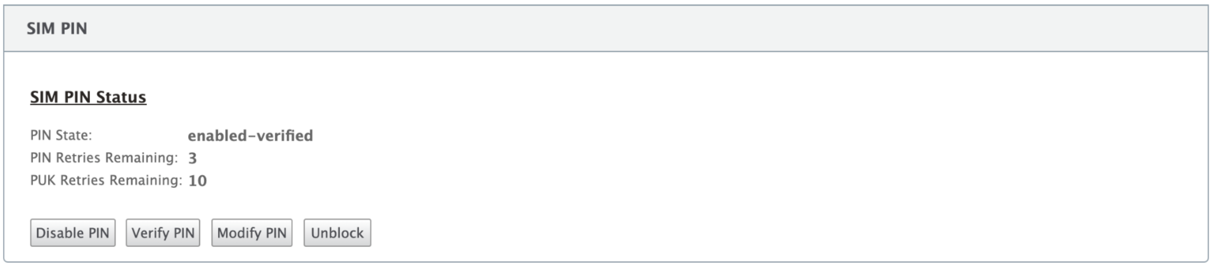
SIM PIN Status

PIN State: enabled-not-verified
PIN Retries Remaining: 3
PUK Retries Remaining: 10

Click **Verify PIN**. Enter the SIM PIN provided by the carrier and click **Verify PIN**.


SIM PIN:

The status changes to **enabled-verified**.

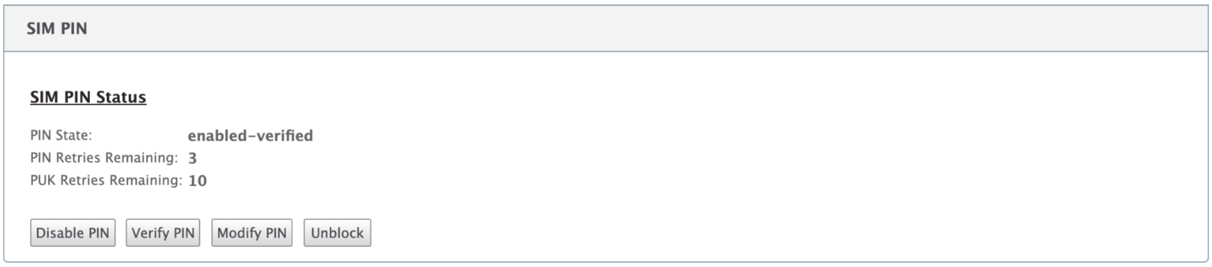

SIM PIN

SIM PIN Status

PIN State: enabled-verified
PIN Retries Remaining: 3
PUK Retries Remaining: 10

Disable SIM PIN

You can choose to disable SIM PIN functionality for a SIM for which SIM PIN is enabled and verified.

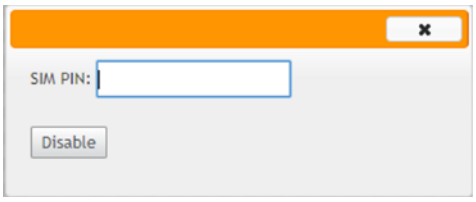


SIM PIN

SIM PIN Status

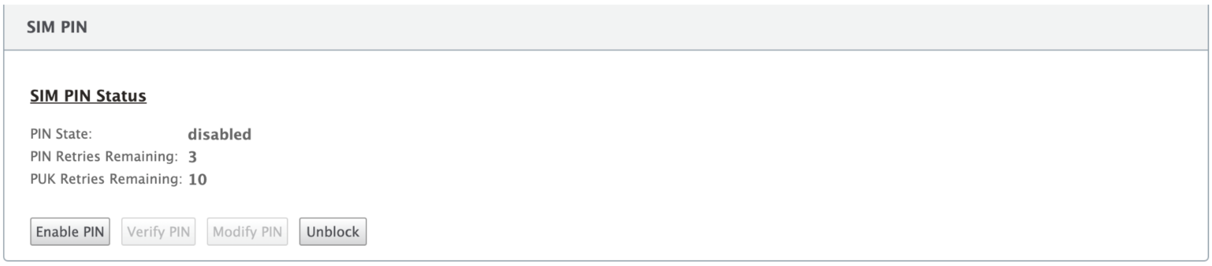
PIN State: enabled-verified
PIN Retries Remaining: 3
PUK Retries Remaining: 10

Click **Disable PIN**. Enter the **SIM PIN** and click **Disable**.



Enable SIM PIN

SIM PIN can be enabled for the SIM for which it is disabled.

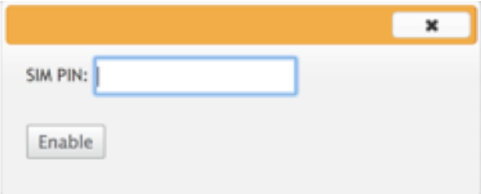


SIM PIN

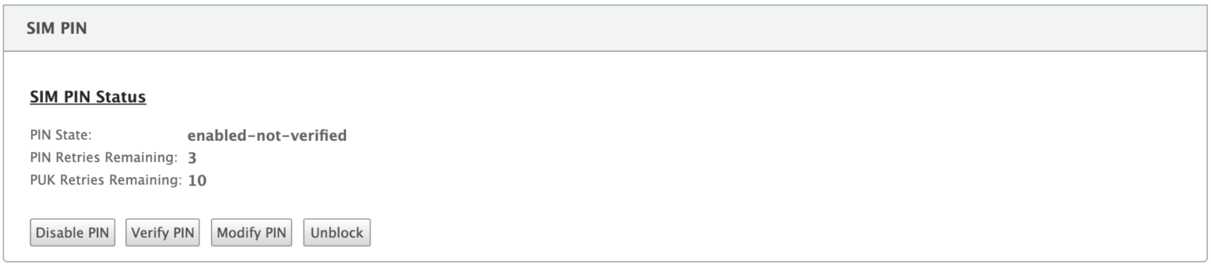
SIM PIN Status

PIN State: disabled
PIN Retries Remaining: 3
PUK Retries Remaining: 10

Click **Enable PIN**. Enter the SIM PIN provided by the carrier and click **Enable**.



If the SIM PIN state changes to **enabled-not-verified**, it means that the PIN is not verified and you cannot perform any LTE related operations until the PIN is verified.

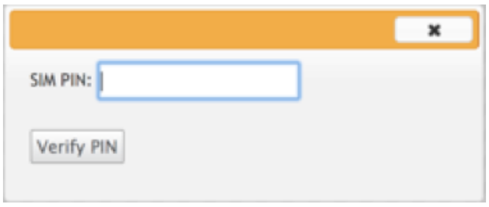


SIM PIN

SIM PIN Status

PIN State: enabled-not-verified
PIN Retries Remaining: 3
PUK Retries Remaining: 10

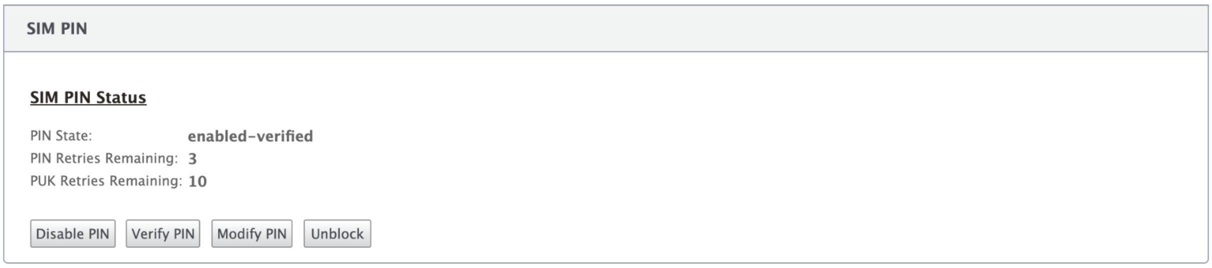
Click **Verify PIN**. Enter the SIM PIN provided by the carrier and click **Verify PIN**.



SIM PIN:

Modify SIM PIN

Once the PIN is in **enabled-verified** state you can choose to change the PIN.

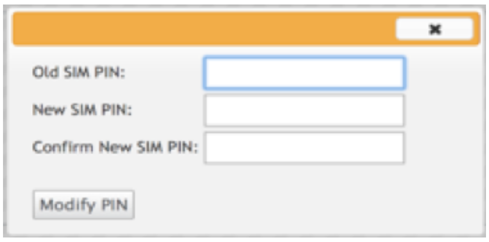


SIM PIN

SIM PIN Status

PIN State: enabled-verified
PIN Retries Remaining: 3
PUK Retries Remaining: 10

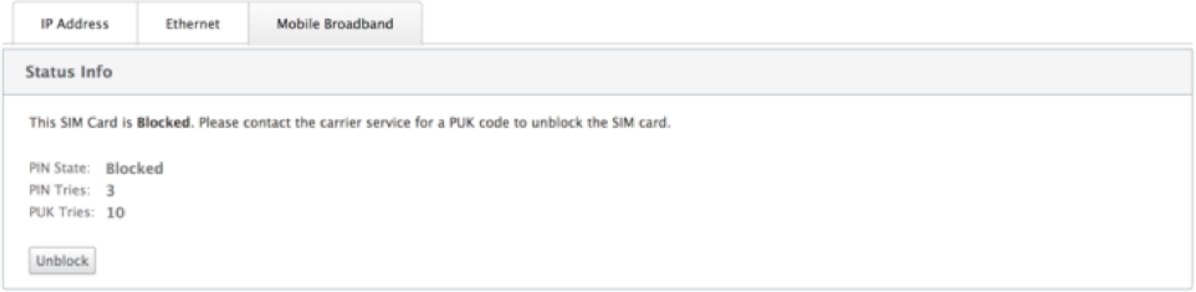
Click **Modify PIN**. Enter the SIM PIN provided by the carrier. Enter the new SIM PIN and confirm it. Click **Modify PIN**.



Old SIM PIN:
New SIM PIN:
Confirm New SIM PIN:

Unblock SIM

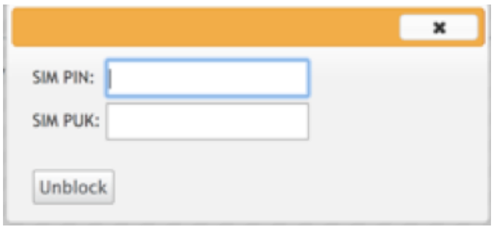
If you forget the SIM PIN, you can reset the SIM PIN using the SIM PUK obtained from the carrier.



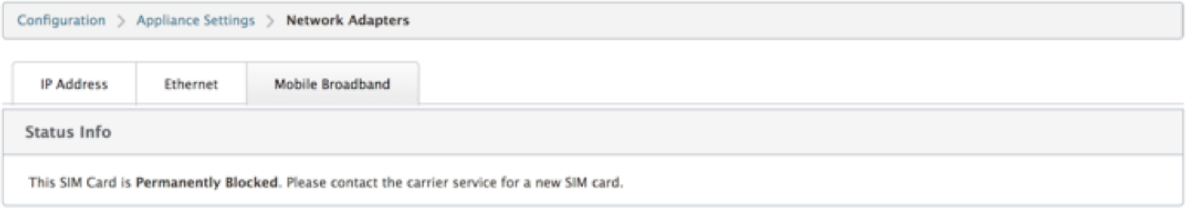
This SIM Card is **Blocked**. Please contact the carrier service for a PUK code to unblock the SIM card.

PIN State: Blocked
PIN Tries: 3
PUK Tries: 10

To unblock a SIM, click **Unblock**. Enter the **SIM PIN** of your choice. Enter the **SIM PUK** obtained from the carrier and click **Unblock**.



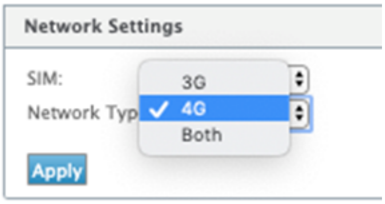
> **Note:**
>
> The SIM card gets permanently blocked with 10 unsuccessful attempts of PUK, while unblocking the SIM. You need to contact the carrier service provider for a new SIM card.



This SIM Card is **Permanently Blocked**. Please contact the carrier service for a new SIM card.

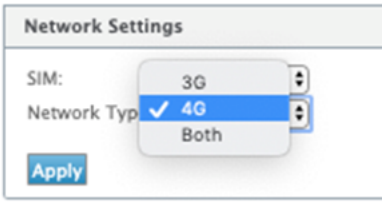
Network Settings

You can select the mobile network on the Citrix SD-WAN appliances that support internal LTE modems. The supported networks are 3G, 4G, or both.



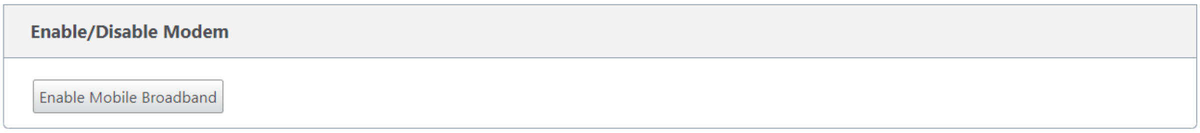
Roaming

The roaming option is enabled by default on your LTE appliances, you can choose to disable it.



Enable/Disable modem

Enable/disable modem depending on your intent to use the LTE functionality. By default, the LTE modem is enabled.



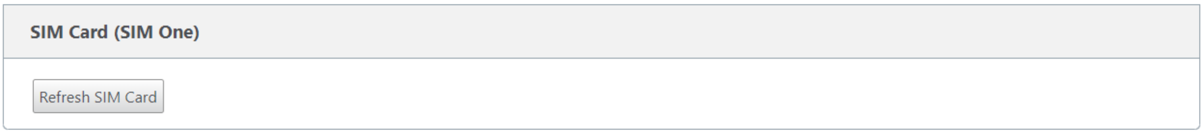
Reboot modem

Reboots the modem. It can take up to 7 minutes for the reboot operation to complete.

Refresh SIM

Use this option when the SIM card is not detect properly by the 110-LTE-WiFi modem.

> **Note**
>
> The Refresh SIM operation is applicable for the active SIM only.

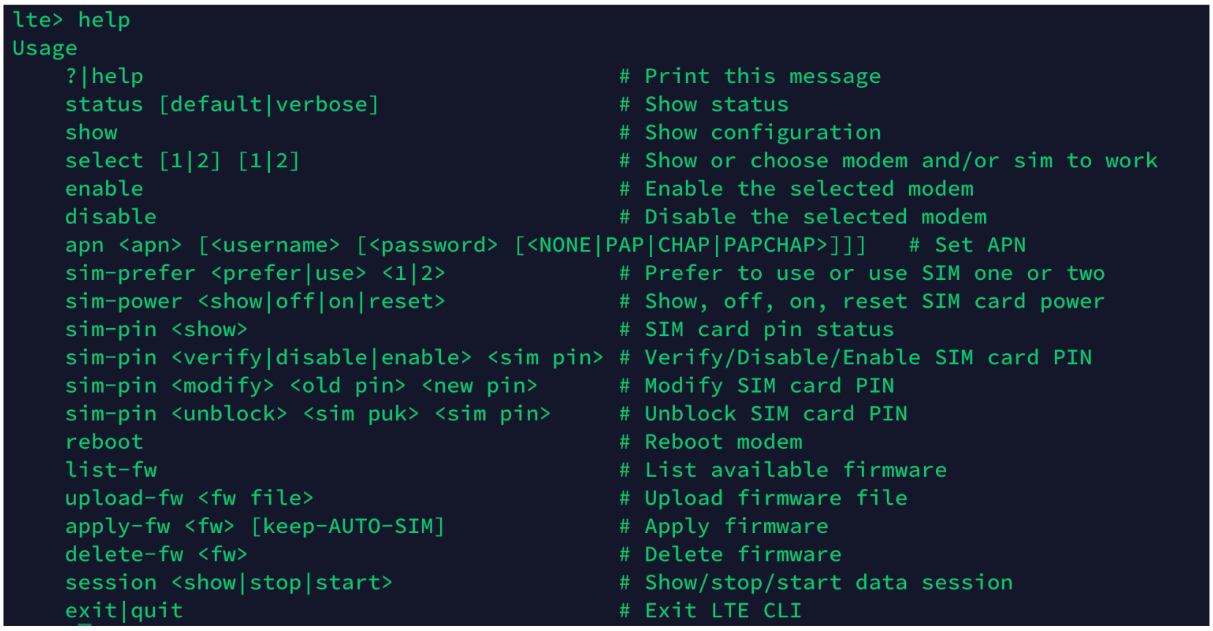


Configure the LTE functionality using CLI

To configure the 110-LTE-WiFi modem using CLI.

1. Log into the Citrix SD-WAN appliance console.
2. At the prompt, type the user name and password to gain CLI interface access.

3. At the prompt, type the command **lte**. Type **>help**. This displays the list of LTE commands available for configuration.



```
lte> help
Usage
    ?|help                                    # Print this message
    status [default|verbose]                  # Show status
    show                                      # Show configuration
    select [1|2] [1|2]                        # Show or choose modem and/or sim to work
    enable                                    # Enable the selected modem
    disable                                   # Disable the selected modem
    apn <apn> [<username> [<password> [<NONE|PAP|CHAP|PAPCHAP>]]]   # Set APN
    sim-prefer <prefer|use> <1|2>             # Prefer to use or use SIM one or two
    sim-power <show|off|on|reset>             # Show, off, on, reset SIM card power
    sim-pin <show>                            # SIM card pin status
    sim-pin <verify|disable|enable> <sim pin> # Verify/Disable/Enable SIM card PIN
    sim-pin <modify> <old pin> <new pin>      # Modify SIM card PIN
    sim-pin <unblock> <sim puk> <sim pin>     # Unblock SIM card PIN
    reboot                                    # Reboot modem
    list-fw                                   # List available firmware
    upload-fw <fw file>                       # Upload firmware file
    apply-fw <fw> [keep-AUTO-SIM]             # Apply firmware
    delete-fw <fw>                            # Delete firmware
    session <show|stop|start>                 # Show/stop/start data session
    exit|quit                                 # Exit LTE CLI
```

The following table lists the **LTE** command descriptions.

Command	Description
Help {lte>help}	Lists the available LTE commands and parameters
Status {lte>status}	Displays LTE connectivity status
Show {lte>show}	Displays LTE settings
Disable {lte>disable}	Disables LTE modem
Enable {lte>enable}	Enables LTE modem
Apn {lte>apn}	Configures APN settings information
Sim-power off, on, reset>{lte>sim-power off,on,reset}	Powers off sim card, Power on sim card, Refresh sim card
Select [1l2] [1l2] {lte>select [1l2] [1l2]}	Select the SIM for LTE modem.
SIM-prefer {lte>sim-prefer}	Select the SIM preferred or to be used.
SIM PIN {lte>sim-pin}	SIM PIN related operations
Reboot {lte>reboot}	Restarts LTE modem

> **Note**
>
> The firmware related operations are not supported on the 110-LTE-WiFi appliance.

Zero-touch deployment over LTE

The SD-WAN 110 SE appliance supports both day-0 provisioning and day-n management of SD-WAN appliances via the management and data ports

Pre-requisites for enabling zero-touch deployment service over LTE:

1. Install the antenna, power ON the appliance, and insert the SIM card.
2. Ensure that the SIM card has an activated data plan.
3. Ensure that the management/data port is not connected.
    - If the management/data port is connected, disconnect the management/data port.
    - If a static IP address on the management/data Interface is configured, you must configure the management/data interface with DHCP, apply the configuration, and then disconnect the management/data port.
4. Ensure the 110-LTE-WiFi appliance configuration has the internet service defined for the LTE interface.

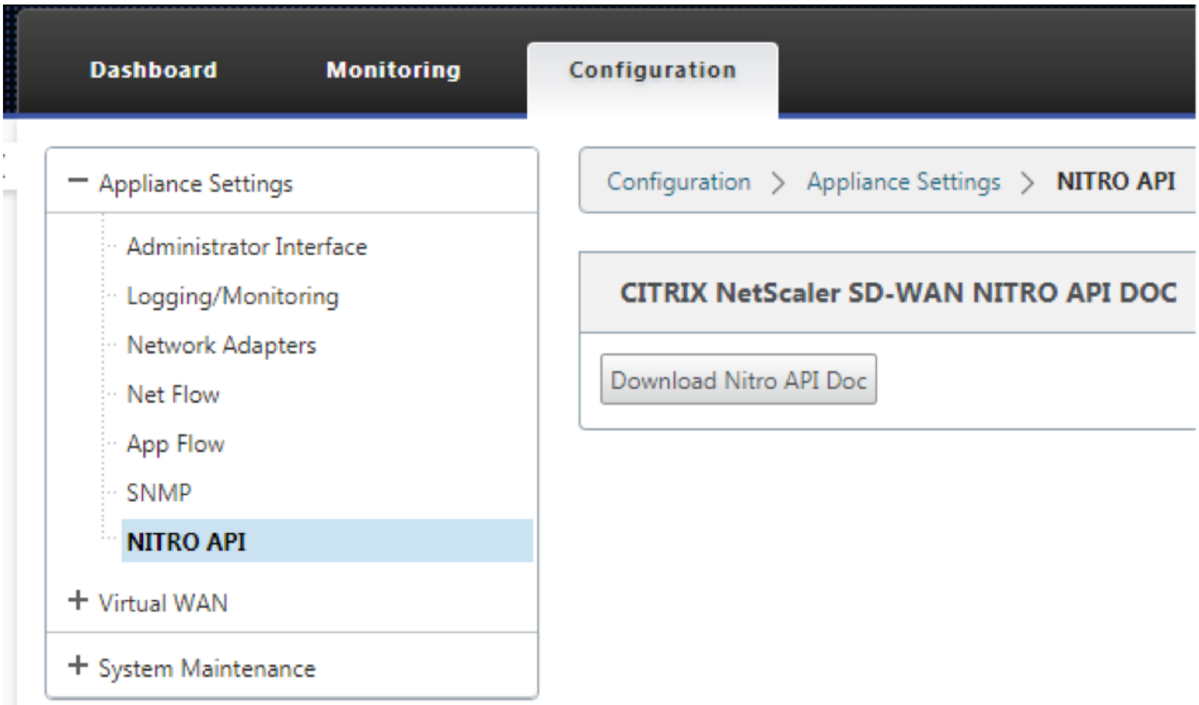
When the appliance is powered on, the zero-touch deployment service uses the LTE port to obtain the latest SD-WAN software and SD-WAN configuration.

Zero-touch deployment Service over management/data interface for 110-SE LTE appliance

Connect the management/data port to the Internet and use the standard zero-touch deployment procedure that is supported on all other non-LTE platforms.

LTE REST API

For information about the LTE REST API, navigate to the SD-WAN GUI and go to **Configuration > Appliance Settings >NITRO API**. Click **Download Nitro API** Doc. The REST API for SIM PIN functionality is introduced in Citrix SD-WAN 11.0.



AT commands

AT commands help in monitoring and troubleshooting LTE modem configuration and status. AT is the abbreviation for **ATtension**. As every command line starts with **at**, they are called AT commands. Citrix SD-WAN platform models that support LTE support running AT commands. AT commands are modem specific and therefore the list of AT commands varies across the platforms.

To run AT commands, perform the following steps:

1. Log into the Citrix SD-WAN appliance console.
2. At the prompt, type the user name and password to gain CLI interface access.
3. At the prompt, type **lte**.
4. Enter **at** and then enter the AT command.

The following is an example:

- **at at+cpin** –Provides SIM status information.

Configure external USB LTE modem

August 24, 2022

You can connect an external 3G/4G USB modem on certain Citrix SD-WAN appliances. The appliances use the 3G/4G network along with other connections to form a virtual network that aggregates bandwidth and provides resiliency. If there is a connectivity failure on the other interfaces, traffic is automatically redirected through the USB LTE modem. The following appliances support an external USB modem:

- Citrix SD-WAN 210 SE
- Citrix SD-WAN 210 SE LTE
- Citrix SD-WAN 110 SE
- Citrix SD-WAN 110 Wi-Fi SE
- Citrix SD-WAN 110 LTE Wi-Fi SE
- Citrix SD-WAN 1100 SE
- Citrix SD-WAN 2100 SE

The Citrix SD-WAN 210 SE LTE and Citrix SD-WAN 110 LTE Wi-Fi SE appliances have a built-in LTE modem. Active dual LTE is supported on these appliances.

CDC Ethernet, MBIM, and NCM are the three types of external USB modems supported. You can configure the **APN** settings and Enable/Disable modem on MBIM and NCM USB modems. Mobile broadband operations are not supported on CDC Ethernet USB modems.

> **Note**
>
> The external LTE dongles with modem type as MBIM do not work on Citrix SD-WAN 2100 platform.

Connecting the USB modem

Enable and test the USB modem according to the guidelines provided by your wireless carrier.

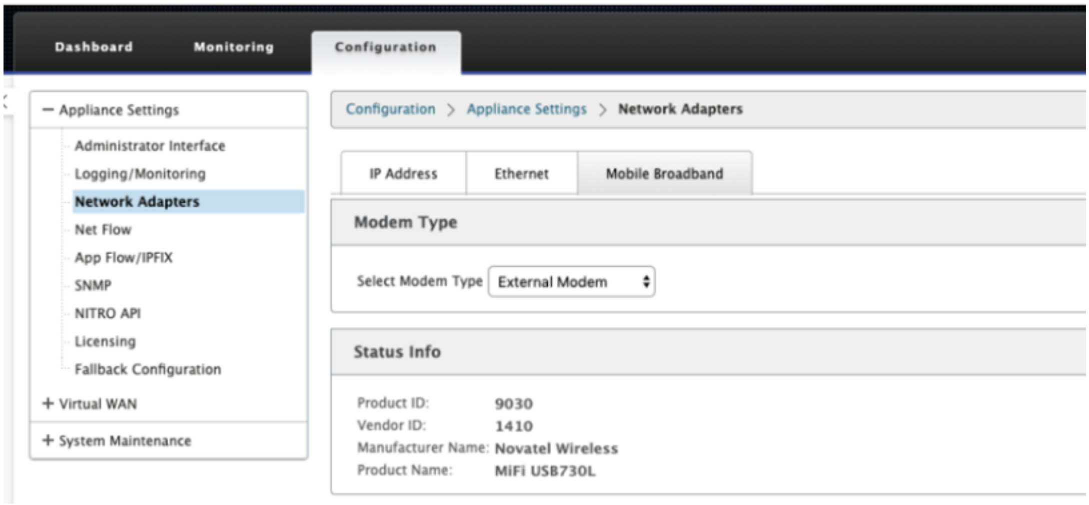
Perquisites for external LTE modem:

- Use the supported USB LTE dongles. The supported dongle hardware models are Verizon USB730L and AT&T USB800.
- Ensure that a SIM card is inserted into the USB LTE dongle. The CDC Ethernet LTE dongles are preconfigured with a static IP address, this interferes with the configuration and cause connection failure or intermittent connection, if the SIM card is not inserted.
- Before inserting a CDC Ethernet LTE dongle into the SD-WAN appliance, connect the external USB stick to a Windows/Linux machine and ensure that the internet is working properly with proper APN and Mobile Data Roaming configuration. Ensure that the **Connection mode** of the USB dongle is changed from the default value **Manual** to **Auto**.

> **Note**
>
> - The Citrix SD-WAN appliances support only one USB LTE dongle at a time. If more than one

> USB dongle is plugged in, unplug all the dongles and plug in only one dongle.
> - The Citrix SD-WAN appliances do not support user name and password for USB modems. Ensure that the user name and password feature are disabled on the modem during setup.
> - Unplugging or rebooting an external MBIM dongle impacts the internal LTE modem data session. This is an expected behavior.
> - When an external LTE modem is plugged-in, the SD-WAN appliance takes about 3 minutes to recognize it.

To view the external modem details, in the appliance UI navigate to **Configuration** > **Appliance Settings** > **Network Adapters** > **Mobile Broadband**. Select **External Modem** as the modem type.



Select Modem Type: External Modem

Product ID: 9030
Vendor ID: 1410
Manufacturer Name: Novatel Wireless
Product Name: MiFi USB730L

> **Note**
>
> The LTE USB dongle model number is not displayed in **Status Info** section.

Mobile broadband operations

Operations that are supported on CDC Ethernet and MBIM / NCM external modems:

Operations	External modem - CDC Ethernet	External modem - MBIM and NCM
SIM preference	No	No
SIM PIN	No	No
APN settings	No	Yes
Network settings	No	No
Roaming	No	No

Operations	External modem - CDC Ethernet	External modem - MBIM and NCM
Manage firmware	No	No
Enable/Disable modem	No	Yes
Reboot modem	No	No
Refresh SIM	No	No

Configure the external USB modem

You can configure an LTE sites using an external USB modem through Citrix SD-WAN Orchestrator service. For more infomation, see LTE firmware upgrade.

Zero-touch deployment over LTE

Pre-requisites for enabling zero-touch deployment service over USB LTE modem:

- Insert the USB modem in the Citrix SD-WAN appliance. For more information, see Connecting the USB modem.
- Ensure that the SIM card on the USB modem has an activated data plan.
- Ensure that the management/data port is not connected. If the management/data port is connected, disconnect it.
- Ensure that the appliance configuration has the internet service defined for the LTE interface.

When the appliance is powered ON, the zero-touch deployment service uses the LTE-E1 port to obtain the latest SD-WAN software and configuration.

For information about zero-touch deployment through the SD-WAN Orchestrator service see, Zero Touch Deployment.

Supported USB modems

The following modems are compatible with Citrix SD-WAN appliances.

> **Note**
>
> Citrix does not control the wireless carrier firmware updates. Therefore compatibility of new modem firmware to Citrix SD-WAN software is not guaranteed. The customer controls the modem firmware update. Citrix recommends testing a firmware update on a single site before pushing it across the entire network.

Region	Wireless Carrier/ Manufacturer	USB Modem	Modem Type Supported	Interfaces
USA	Verizon	Global Modem USB730L	cdc_ether	4G only
USA	AT&T	AT&T Global Modem USB800	cdc_ether	4G only

AT commands

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To run AT commands, perform the following steps:

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2. At the prompt, type the user name and password to gain CLI interface access.
3. At the prompt, type **lte**.
4. Enter **at** and then enter the AT command.

The following is an example:

at at+cpin –Provides SIM status information.

Deployments

August 24, 2022

Following are some of the use case scenarios implemented by using Citrix SD-WAN appliances:

- Deploying SD-WAN in Gateway Mode
- Inline Mode
- Deploying SD-WAN in PBR mode (Virtual Inline Mode)
- Dynamic Paths for Branch to Branch Communication
- WAN to WAN forwarding
- Building an SD-WAN Network
- Routing for LAN Segmentation

- Zero Touch Deployment
- Single Region Deployment
- Multi Region Deployment
- High Availability

Checklist and how to deploy

August 24, 2022

It is strongly recommended that before beginning the installation, you first read through the Citrix Virtual WAN Deployment Planning Guide. This article discusses the essential Virtual WAN concepts and features, and provides guidelines for planning your deployment.

Prepare for deployment

The following list outlines the steps and procedures involved in deploying the SD-WAN Standard Editions.

To view some of the deployment use cases, see Deployments.

1. Gather your Citrix SD-WAN deployment information.
2. Set up the Citrix SD-WAN appliances.
    - For each hardware appliance you want to add to your SD-WAN deployment, you must complete the following tasks:
        - Set up the appliance hardware.
        - Set the Management IP Address for the appliance and verify the connection.
        - Set the date and time on the appliance.
        - (Optional) Set the console session **Timeout** interval to a high or the maximum value.
3. Upload and install the software license file on the appliance.

Installation and configuration checklist

Gather the following information for each SD-WAN site you want to deploy:

- The licensing information for your product

- Required Network IP Addresses for each appliance to be deployed:
  - Management IP Address
  - Virtual IP Addresses
  - Site Name
  - Appliance Name (one per site)
  - SD-WAN Appliance Model (for each appliance to be deployed)
  - Deployment Mode (MCN or Client)
  - Topology
  - Gateway MPLS
  - GRE Tunnel information
  - Routes
  - VLANs
  - Bandwidth at each site for each circuit

Best practices

August 24, 2022

This article outlines deployment best practices for the Citrix SD-WAN solution. It provides general guidance, advantages, use cases for the following Citrix SD-WAN deployment mode.

Edge/Gateway Mode

Recommendations

The following are the recommendations for the **Gateway** mode deployment:

1. The Gateway mode is best used for SD-WAN branches where router consolidation happens and customers are ready to allow SD-WAN to be the edge device terminating connections.
2. A great network architecture can be rendered with a scrupulous design when a project is built from scratch.

> **Note**
>
> The Gateway mode can be used on the data center side for the existing projects with some infrastructure disruption.

Advantages/Use cases

The following are the advantages/use cases for the Gateway mode deployment:

1. Best use case for Router/Firewall/Network element consolidation at the customer branch.
2. Simple and easy LAN host management via DHCP.
    - Allows SD-WAN to become the next-hop and offer DHCP based IP addressing to all LAN hosts for data ports.
3. All connections terminate at the SD-WAN edge/gateway and management becomes easy.
4. SD-WAN is the focal point of edge routing and is steered of all traffic. The decisions are made on the edge to breakout or backhaul or overlay including the bandwidth/capacity accounting.
5. All LAN subnets hosts as the LAN hosts are allowed to have SD-WAN LAN VIP as the next-hop. If SD-WAN LAN connects to a core switch, you can run dynamic routing to get visibility to all LAN subnets.
6. Great flexibility for High Availability (HA) - Strict recommendation for the gateway mode so that the site operates with an Active/Standby mode. Also, it helps to prevent traffic blackhole if the SD-WAN device goes down.
    - Switches available at the branch - Parallel high availability can work in gateway mode.
    - Switches not available at the branch - SD-WAN can also operate on SD-WAN edge high availability mode (fail-to-wire high availability mode) where the two SD-WAN boxes are daisy-chained to make use of fail-to-wire ports to act as a converged high availability pair.
7. Allow the Internet to be defined as **UNTRUSTED** interfaces which automatically create a dynamic NAT for breakout and source NAT the connection so the response comes back to SD-WAN.
8. Security considerations to **UNTRUSTED** interfaces are implied naturally, in that only ICMP/ARP/UDP control packets on 4980 are allowed.

Cautions

The following are the information that you need to be careful about in the Gateway mode:

- **Careful design and Network Architecture** - Gateway mode might need careful design and networking considerations as the entire branch/edge networking is in SD-WAN. What to block, what to route, how to network LAN, how to terminate WANs, and so on.
- **Failure of Device** - Edge mode cannot have the fail-to-wire capability. The entire branch goes down when the device is down.
- **Security Posture** - As the routing is managed at the edge, the security postures such as firewall, breakout/backhaul considerations are crucial and that must be conceived with the customer.
- **High Availability** –Fail-to-wire high availability must have some port availability considerations and depending on deployments might become tricky to design.
  - SD-WAN 110 is NOT an option as it does not have fail-to-wire ports.

For instance, if you need 2 WAN Links to operate, you need 5 ports including a dedicated port for the high availability interface including the LAN interface.

Inline Mode –Fail-to-wire/Fail-to-block

Recommendations

The following are the recommendations for the **Inline** mode deployment:

1. The inline mode is best for the branches where the existing infrastructure is not to be changed and SD-WAN sits transparently inline to the LAN segment.
2. Data center's can also employ inline fail-to-wire or inline parallel high availability as it is immensely important to ensure that the data center workloads are not blackholed due to device down/crash.

Advantages and use-cases

The following are the advantages/use cases for the Inline mode deployment:

1. Keeping the MPLS router therefore fail-to-wire is a lovely feature. Fail-to-wire capable devices enable seamless failover to underlay infrastructure if the box went down.
   - If your devices support fail-to-wire (SD-WAN 210 and above), this allows placing a single SD-WAN inline to hardware bypass the LAN traffic to the customer edge router when the SD-WAN crashes/goes down.
   - If the MPLS Links are present that yield a natural extension to the customer's LAN/Intranet, the fail-to-wire bridge-pair port is the best choice (fail-to-wire capable pairs) such that,

when the device crashes or goes down the LAN traffic is hardware bypassed to the customer edge router (still maintained the next hop).

2. Networking is simple.
3. SD-WAN sees all traffic through the inline mode, so it is the best-case scenario for the proper bandwidth/capacity accounting.
4. Few integration requirements as you need only an IP of the L2 segment. LAN segments are well known as you have an arm to the LAN interface. If you connect to a core switch, you can also run dynamic routing to get visibility to all LAN subnets.
5. Customer's expectations are that SD-WAN must blend into the existing infrastructure as a new network node (nothing else changes).
6. **Proxy ARP** –In inline mode, it is a blessing for SD-WAN to proxy ARP requests to LAN next-hop if the gateway went down or the SD-WAN interface towards next-hop went down.

    - Generally, in inline mode with bridge-pair (fail-to-block or fail-to-wire) with multiple WAN connections (MPLS/Internet), it is recommended to enable Proxy ARP for the bridge pair interface that connects the LAN hosts to their next-hop gateway.
    - For any reason when the next-hop is down or the SD-WAN interface to the next-hop is down rendering the gateway unreachable, SD-WAN acts as a proxy for ARP requests allowing the LAN hosts to still seamlessly send packets and use the remaining WAN connections that keep the virtual path up.

7. **High availability** - If fail-to-wire is not an option, devices can be placed in parallel high availability (common LAN and WAN interfaces for the Active/Standby) devices to achieve redundancy.

    - If your appliances don't support fail-to-wire, like the SD-WAN 110, you have to go with inline parallel high availability that enables to have a standby device kick in if the primary went down.

Cautions

The following are the information that you need to be careful about in the **Inline** mode:

- Plumbing network with two arms to the SD-WAN (LAN and WAN side), needs some downtime as the network must be plumbed in two arms.
- Must ensure if fail-to-wire is used, it is behind a customer edge router/firewall in a **TRUSTED** zone so that security is not compromised.
- MPLS QoS changes a little in this as the previous QoS policies might have depended on the source IP addresses or DSCP based which will now be masked because of an overlay.

- Care must be taken to repurpose the MPLS router with a well-designed SD-WAN specific reserved bandwidth with a specific DSCP tag, such that SD-WAN's QoS takes care of prioritizing traffic and sends out high priority applications immediately followed by other classes (but be able to account for the overall bandwidth reserved for SD-WAN on the MPLS router). MPLS queues are an alternative or MPLS with a single DSCP set on the auto path group that can take care of this.
- If the Internet interfaces are **TRUSTED** as the links terminate on the customer edge router, to use Internet service, you must write an exclusive dynamic NAT rule to enable internet breakout from the appliance.
- If the Internet links are the only WAN connections and still terminate on the customer edge router, it is still fine to bypass the connections if the customer edge router takes precautions to steer the packets via their existing underlay infrastructure.
  - Proper care must be taken to account for the flow of bypassing LAN traffic over bridge-pair with an Internet connection and when the appliance is down. Since this is a sensitive enterprise Intranet traffic, in the eve of failure, the customer must know how to handle it.

Virtual Inline/One-arm mode

Recommendations

The following are the recommendations for the **Virtual Inline** mode deployment:

1. The virtual inline mode is best for data center networking as the SD-WAN network plumbing can be worked on parallel while the data center is serving its existing workloads with existing infrastructure.
2. SD-WAN is in a one-arm interface that is managed with an SLA tracking on VIPs. If the tracking goes down, the traffic resumes routing via existing underlay infrastructure.
3. Branches can also be deployed in virtual inline mode, however are more predominant with Inline/Gateway deployments.

Advantages and Use-cases

The following are the advantages/use cases for the **Virtual Inline** mode deployment:

1. Simplest and recommended way to network SD-WAN in the data center.
   - The virtual inline mode allows parallel network plumbing of SD-WAN with the head-end core router.

    - The virtual inline mode allows us to easily define PBRs to divert LAN traffic must go through SD-WAN and get overlay benefits.

2. Seamless failover to underlying infrastructure if SD-WAN is to fail, and seamless forwarding to SD-WAN for overlay benefits under normal conditions.
3. Simple **Networking** and **Integration** requirements. The single one-arm interface from headend router to SD-WAN in virtual inline.
4. Easy to deploy dynamic routing in **Import only mode** (export nothing) to get visibility of LAN subnets so they can be sent to remote SD-WAN peer appliances.
5. Easy to define PBR on the routers (1 per WAN VIP) to indicate how to choose the physical.

Cautions

The following are the information that you need to be careful about in the **Virtual Inline** mode:

- Proper care must be taken to distinctly MAP the SD-WAN logical VIP of a WAN link defined to the right physical interface (else this might cause undesirable issues in WAN metric assessment and choice of wan paths).
- Proper design considerations are to be made to know if all traffic is diverted via SD-WAN or only specific traffic.
- This means SD-WAN must be dedicated some share of bandwidth exclusively for itself that must be set on the interfaces such that SD-WAN's capacity is not used by other non-SD-WAN traffic causing undesirable outcomes.
    - Bandwidth accounting issues and congestion issues might occur if SD-WAN WAN links capacity is defined incorrectly.
- Dynamic routing can cause some issues if improperly designed where if the SD-WAN routes data center and branch VIPs are exported to the headend and if routing is influenced towards SD-WAN, overlay packets start looping and cause undesirable outcomes.
- Dynamic routing must be properly administered considering all potential factors of what to learn/what to advertise.
- One-arm physical interface might become a bottleneck sometimes. Needs some design considerations in those lines as it caters to both upload/download and also acts as LAN to LAN and LAN to WAN/WAN to LAN traffic from SD-WAN.
- Excessive LAN to LAN traffic might be a point to note during design.
- If the dynamic routing is not used, there must be proper care if administering all LAN subnets, which if not, might cause undesirable routing issues.

- There are potential routing loop issues if you define some default route (0.0.0.0/0) on the SD-WAN in the virtual inline to point back to the headend router. In such situations, if the virtual path went down, any traffic coming from the data center LAN (like monitoring traffic) is looped back to the headend and back to SD-WAN causing undesirable routing issues (If the virtual path is down, the remote branch subnets become reachable **NO** causing the default route to be HIT, that causes the loop issues).

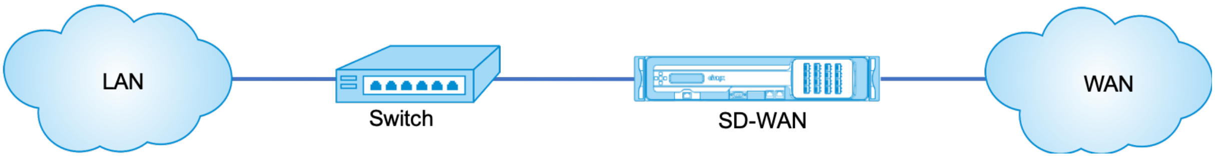
Gateway mode

August 24, 2022

Gateway mode places the SD-WAN appliance physically in the path (two-arm deployment) and requires changes in the existing network infrastructure to make the SD-WAN appliance the default gateway for the entire LAN network for that site. Gateway mode used for new networks and router replacement. Gateway mode allows SD-WAN appliances:

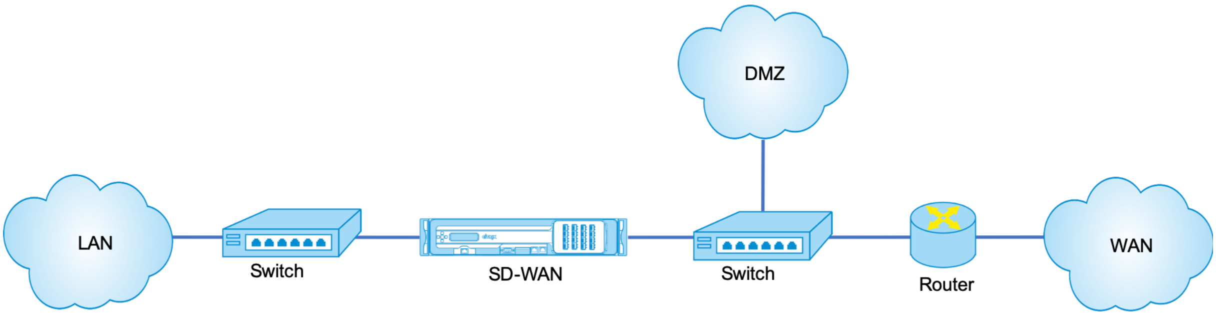
- To view all traffic to and from the WAN
- To perform local routing

Gateway deployment mode is supported on Citrix SD-WAN Orchestrator service. For more information, see Interfaces.



> **Note**
>
> An SD-WAN deployed in Gateway mode acts as a Layer 3 device and cannot perform fail-to-wire. All interfaces involved will be configured for **Fail-to-block**. In the event of appliance failure, the default gateway for the site will also fail, causing an outage until the appliance and default gateway are restored.

In the **Inline** mode, the SD-WAN appliance appears to be an Ethernet bridge. Most of the SD-WAN appliance models include a fail-to-wire (Ethernet bypass) feature for inline mode. If power fails, a relay closes and the input and output ports become electrically connected, allowing the Ethernet signal to pass through from one port to another. In the fail-to-wire mode, the SD-WAN appliance looks like a cross-over cable connecting the two ports. Inline mode used to integrate into already well-defined networks.

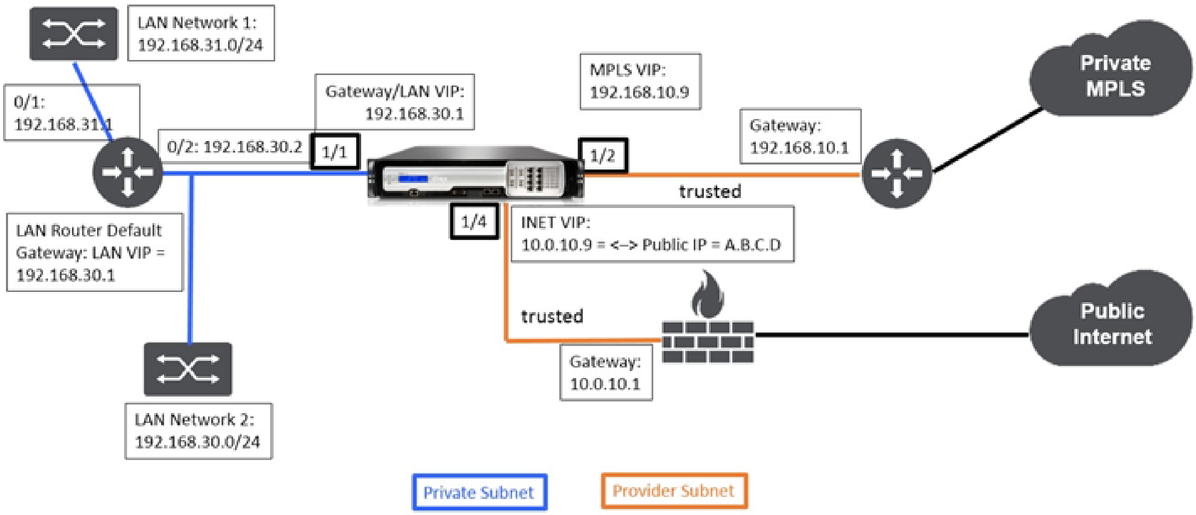


This article provides step-by-step procedure to configure an SD-WAN appliance in Gateway mode in a sample network setup. Inline deployment is also described for the branch side to complete the configuration. A network can continue to function if an Inline device is removed, but loses all access if the Gateway device is removed.

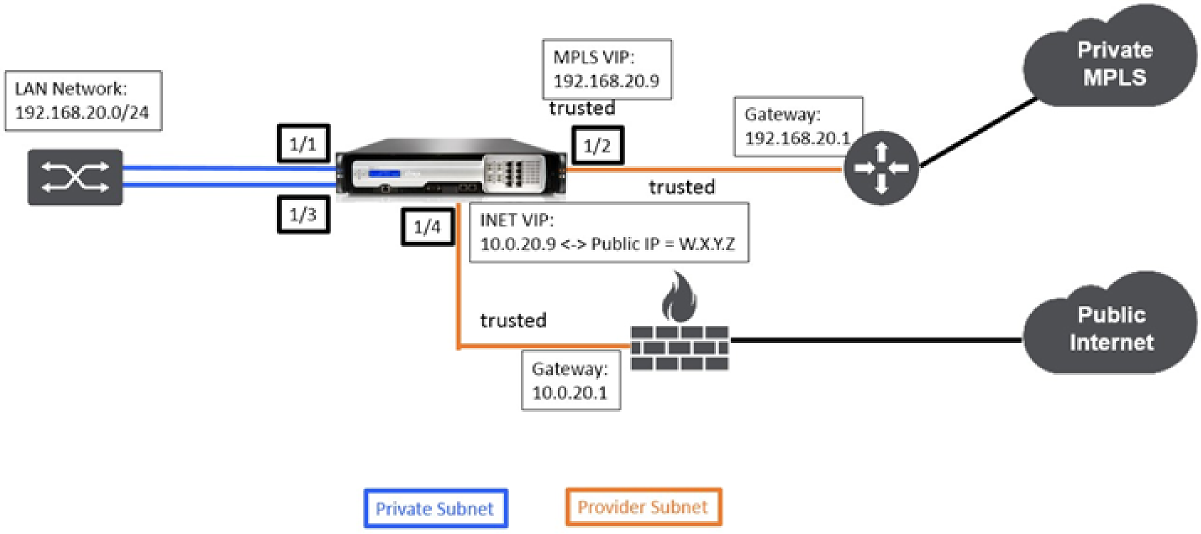
Topology

The following illustrations describe the topologies supported in an SD-WAN network.

Data Center in gateway deployment


LAN Network 1: 192.168.31.0/24
0/1: 192.168.31.1
Gateway/LAN VIP: 192.168.30.1
MPLS VIP: 192.168.10.9
Private MPLS
Gateway: 192.168.10.1
0/2: 192.168.30.2
1/1
1/2
trusted
LAN Router Default Gateway: LAN VIP = 192.168.30.1
1/4
INET VIP: 10.0.10.9 = <-> Public IP = A.B.C.D
trusted
Public Internet
Gateway: 10.0.10.1
LAN Network 2: 192.168.30.0/24
Private Subnet
Provider Subnet

Branch in inline deployment



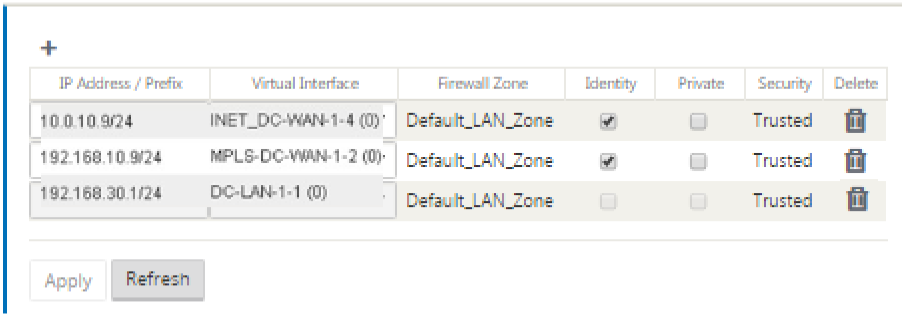
Data center site gateway mode configuration

Following are the high-level configuration steps to configure data center site Gateway deployment:

1. Create a DC site.
2. Populate Interface Groups based on connected Ethernet interfaces.
3. Create Virtual IP address for each virtual interface.
4. Populate WAN links based on physical rate and not burst speeds using Internet and MPLS Links.
5. Populate Routes if there are more subnets in the LAN infrastructure.

To create Virtual IP (VIP) address for each virtual interface

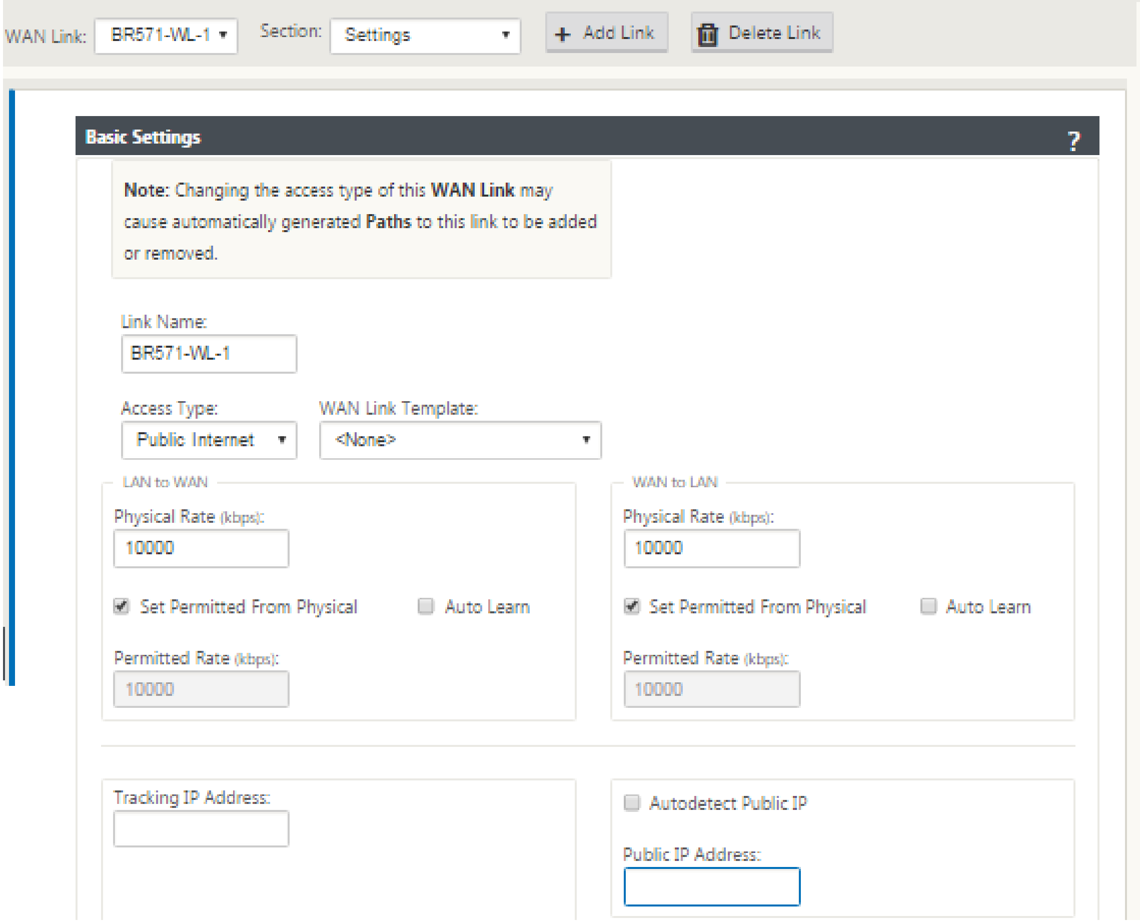
1. Create a VIP on the appropriate subnet for each WAN Link. VIPs are used for communication between two SD-WAN appliances in the Virtual WAN environment.
2. Create a Virtual IP Address to be used as the Gateway address for the LAN network.



IP Address / Prefix	Virtual Interface	Firewall Zone	Identity	Private	Security	Delete
10.0.10.9/24	INET_DC-WAN-1-4 (0)	Default_LAN_Zone	☑	□	Trusted	🗑
192.168.10.9/24	MPLS-DC-WAN-1-2 (0)	Default_LAN_Zone	☑	□	Trusted	🗑
192.168.30.1/24	DC-LAN-1-1 (0)	Default_LAN_Zone	□	□	Trusted	🗑

To populate WAN links based on physical rate and not on burst speeds using Internet link:

1. Navigate to **WAN Links**, click the **+ Add Link** button to add a WAN Link for the Internet link.
2. Populate Internet link details, including the supplied Public IP address as shown below. AutoDetect **Public IP** cannot be selected for SD-WAN appliance configured as MCN.
3. Navigate to **Access Interfaces**, from the section drop-down menu, and click the **+ Add** button to add interface details specific for the Internet link.
4. Populate Access Interface for IP and gateway addresses as shown below.



Note: Changing the access type of this **WAN Link** may cause automatically generated **Paths** to this link to be added or removed.

Link Name: BR571-WL-1

Access Type: Public Internet

WAN Link Template: <None>

LAN to WAN

Physical Rate (kbps): 10000

☑ Set Permitted From Physical □ Auto Learn

Permitted Rate (kbps): 10000

WAN to LAN

Physical Rate (kbps): 10000

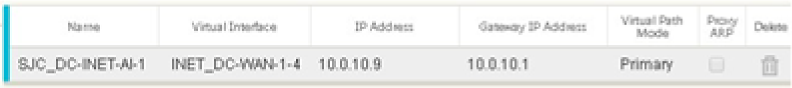
☑ Set Permitted From Physical □ Auto Learn

Permitted Rate (kbps): 10000

Tracking IP Address:

□ Autodetect Public IP

Public IP Address:

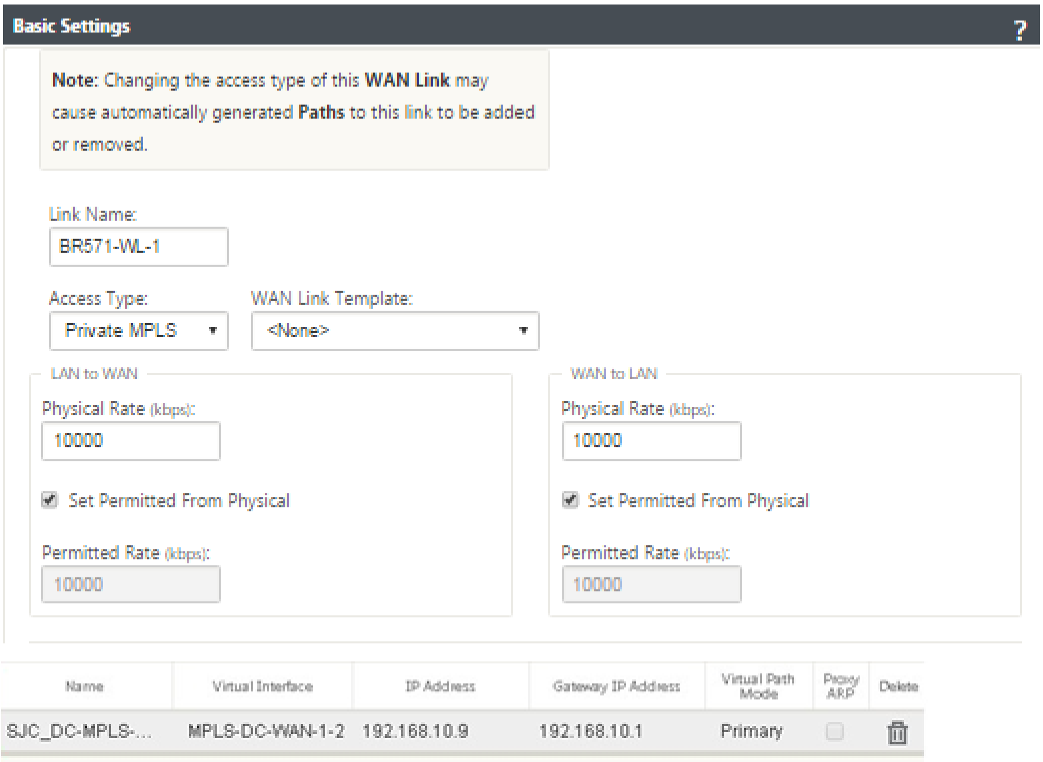


Name	Virtual Interface	IP Address	Gateway IP Address	Virtual Path Mode	Proxy ARP	Delete
SJC_DC-INET-AI-1	INET_DC-WAN-1-4	10.0.10.9	10.0.10.1	Primary	□	

To create MPLS Link

1. Navigate to **WAN Links**, click the **+** button to add a WAN Link for the MPLS link.
2. Populate MPLS link details as shown below.

3. Navigate to **Access Interfaces**, click the **+** button to add interface detail specific for the MPLS link.
4. Populate Access Interface for IP and gateway addresses as shown below.



Basic Settings

Note: Changing the access type of this **WAN Link** may cause automatically generated **Paths** to this link to be added or removed.

Link Name: BR571-WL-1

Access Type: Private MPLS

WAN Link Template: <None>

LAN to WAN

Physical Rate (kbps): 10000

☑ Set Permitted From Physical

Permitted Rate (kbps): 10000

WAN to LAN

Physical Rate (kbps): 10000

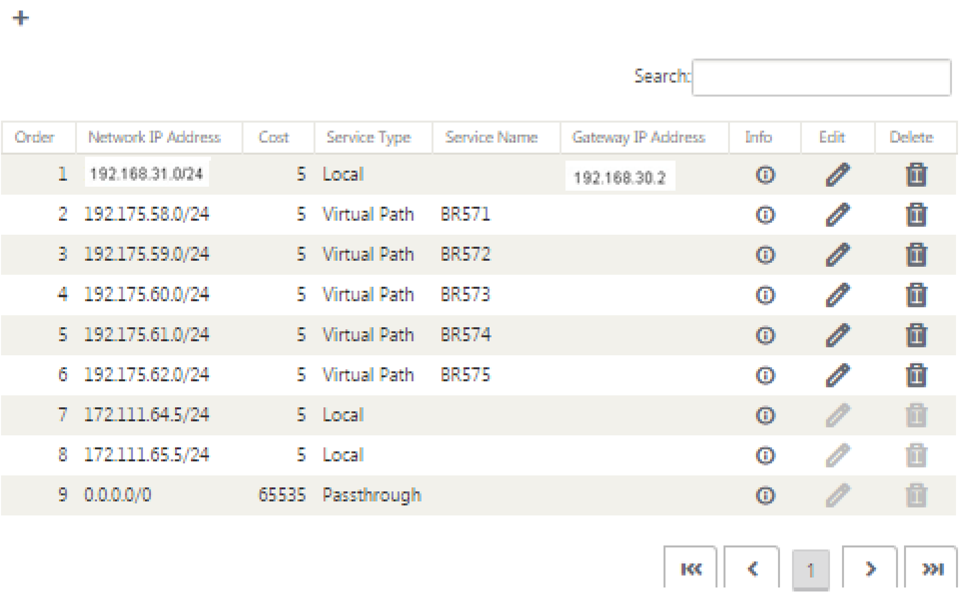
☑ Set Permitted From Physical

Permitted Rate (kbps): 10000

Name	Virtual Interface	IP Address	Gateway IP Address	Virtual Path Mode	Proxy ARP	Delete
SJC_DC-MPLS-...	MPLS-DC-WAN-1-2	192.168.10.9	192.168.10.1	Primary	□	🗑

To populate Routes

Routes are auto-created based on the above configuration. The DC LAN sample topology shown above has an extra LAN subnet which is **192.168.31.0/24**. A route needs to be created for this subnet. Gateway IP address must be in the same subnet as the DC LAN VIP as shown below.



Order	Network IP Address	Cost	Service Type	Service Name	Gateway IP Address	Info	Edit	Delete
1	192.168.31.0/24	5	Local		192.168.30.2			
2	192.175.58.0/24	5	Virtual Path	BR571				
3	192.175.59.0/24	5	Virtual Path	BR572				
4	192.175.60.0/24	5	Virtual Path	BR573				
5	192.175.61.0/24	5	Virtual Path	BR574				
6	192.175.62.0/24	5	Virtual Path	BR575				
7	172.111.64.5/24	5	Local					
8	172.111.65.5/24	5	Local					
9	0.0.0.0/0	65535	Passthrough					

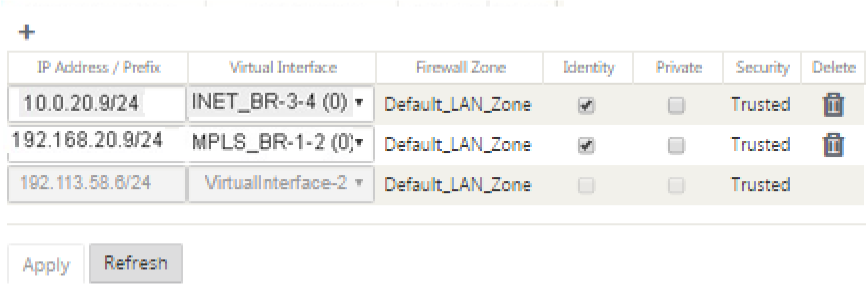
Branch site inline deployment configuration

Following are the high-level configuration steps to configure Branch site for Inline deployment:

1. Create a Branch site.
2. Populate Interface Groups based on connected Ethernet interfaces.
3. Create Virtual IP address for each virtual interface.
4. Populate WAN links based on physical rate and not burst speeds using Internet and MPLS Links.
5. Populate Routes if there are more subnets in the LAN infrastructure.

To create Virtual IP (VIP) address for each virtual interface

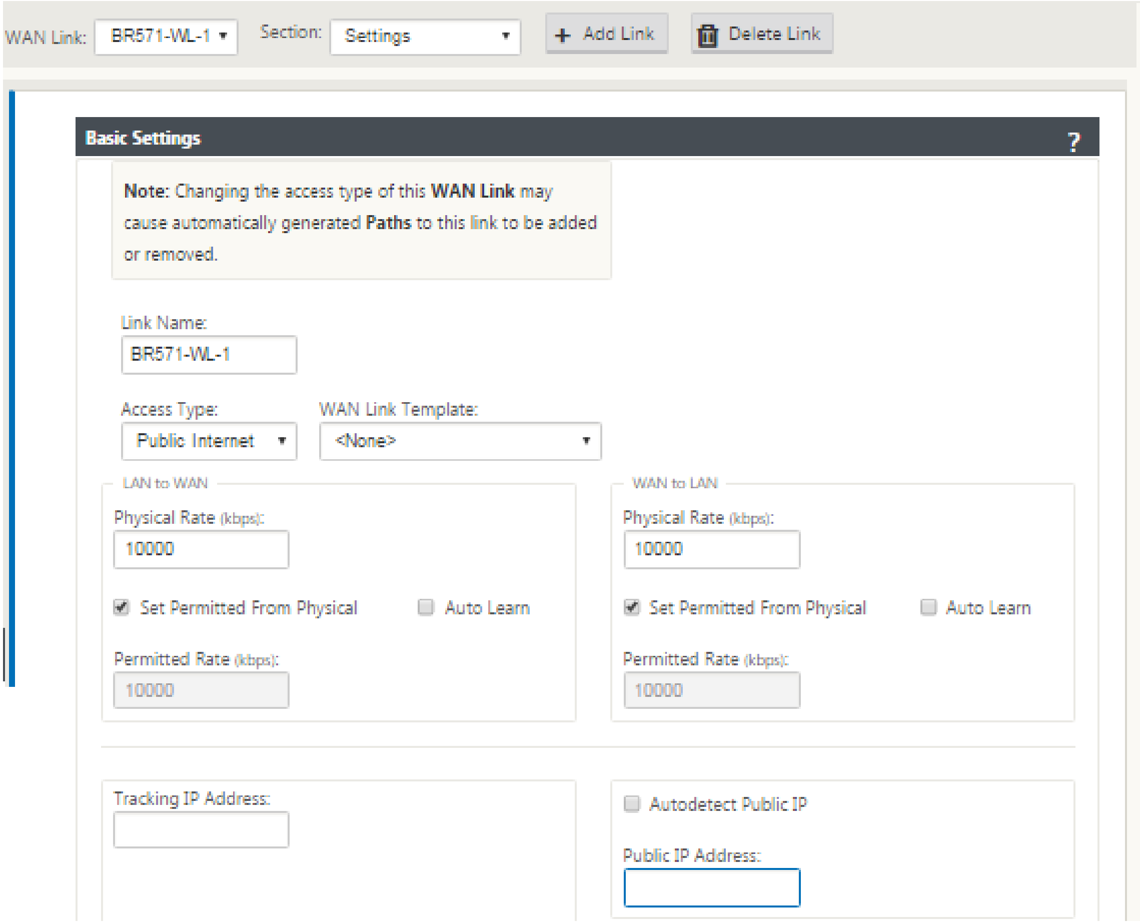
1. Create a Virtual IP address on the appropriate subnet for each WAN Link. VIPs are used for communication between two SD-WAN appliances in the Virtual WAN environment.



IP Address / Prefix	Virtual Interface	Firewall Zone	Identity	Private	Security	Delete
10.0.20.9/24	INET_BR-3-4 (0)	Default_LAN_Zone	☑	☐	Trusted	
192.168.20.9/24	MPLS_BR-1-2 (0)	Default_LAN_Zone	☑	☐	Trusted	
192.113.58.6/24	VirtualInterface-2	Default_LAN_Zone	☐	☐	Trusted	

To populate WAN links based on physical rate and not on burst speeds using Internet link:

1. Navigate to **WAN Links**, click the **+** button to add a WAN Link for the Internet link.
2. Populate Internet link details, including the Auto Detect Public IP address as shown below.
3. Navigate to **Access Interfaces**, click the **+** button to add interface details specific for the Internet link.
4. Populate Access Interface for IP address and gateway as shown below.



Note: Changing the access type of this **WAN Link** may cause automatically generated **Paths** to this link to be added or removed.

Link Name: BR571-WL-1

Access Type: Public Internet

WAN Link Template: <None>

LAN to WAN

Physical Rate (kbps): 10000

☑ Set Permitted From Physical ☐ Auto Learn

Permitted Rate (kbps): 10000

WAN to LAN

Physical Rate (kbps): 10000

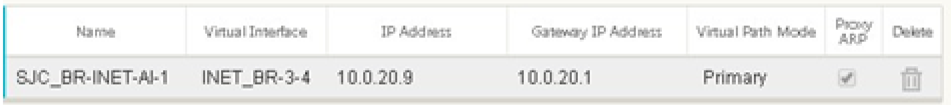
☑ Set Permitted From Physical ☐ Auto Learn

Permitted Rate (kbps): 10000

Tracking IP Address:

☐ Autodetect Public IP

Public IP Address:

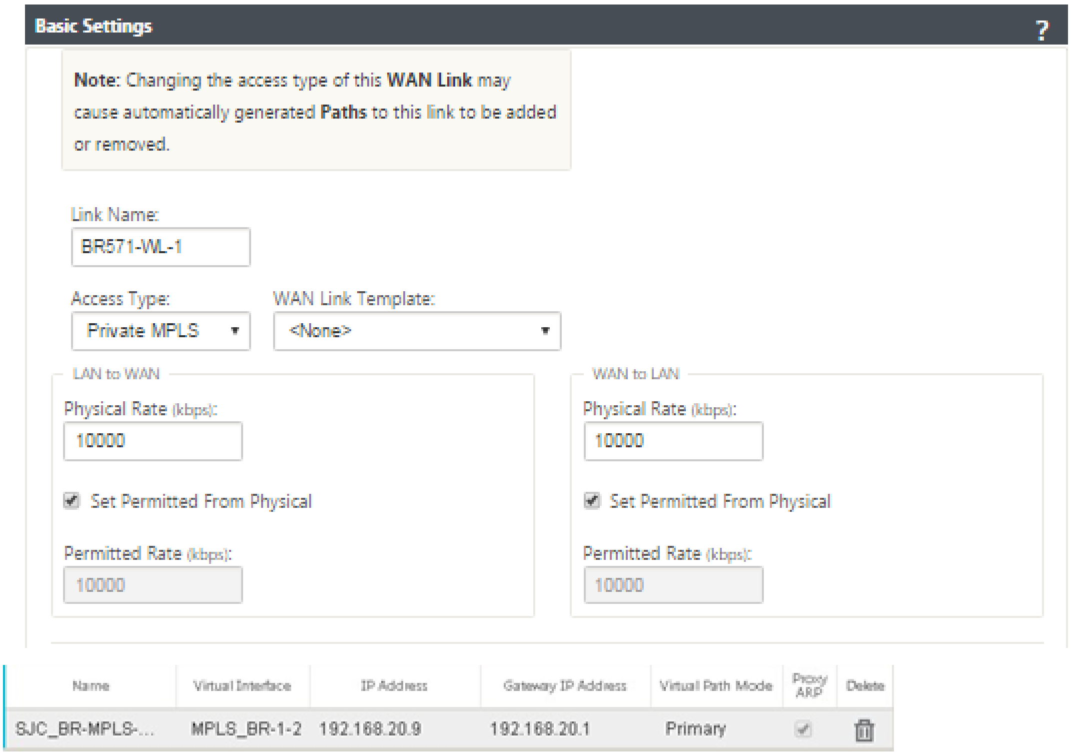


Name	Virtual Interface	IP Address	Gateway IP Address	Virtual Path Mode	Proxy ARP	Delete
SJC_BR-INET-AI-1	INET_BR-3-4	10.0.20.9	10.0.20.1	Primary	☑	🗑

To create MPLS link

1. Navigate to WAN Links, click the **+** button to add a WAN Link for the MPLS link.
2. Populate MPLS link details as shown below.
3. Navigate to Access Interfaces, click the **+** button to add interface details specific for the MPLS link.

4. Populate Access Interface for IP address and gateway as shown below.



Basic Settings ?

Note: Changing the access type of this **WAN Link** may cause automatically generated **Paths** to this link to be added or removed.

Link Name: BR571-WL-1

Access Type: Private MPLS

WAN Link Template: <None>

LAN to WAN

Physical Rate (kbps): 10000

☑ Set Permitted From Physical

Permitted Rate (kbps): 10000

WAN to LAN

Physical Rate (kbps): 10000

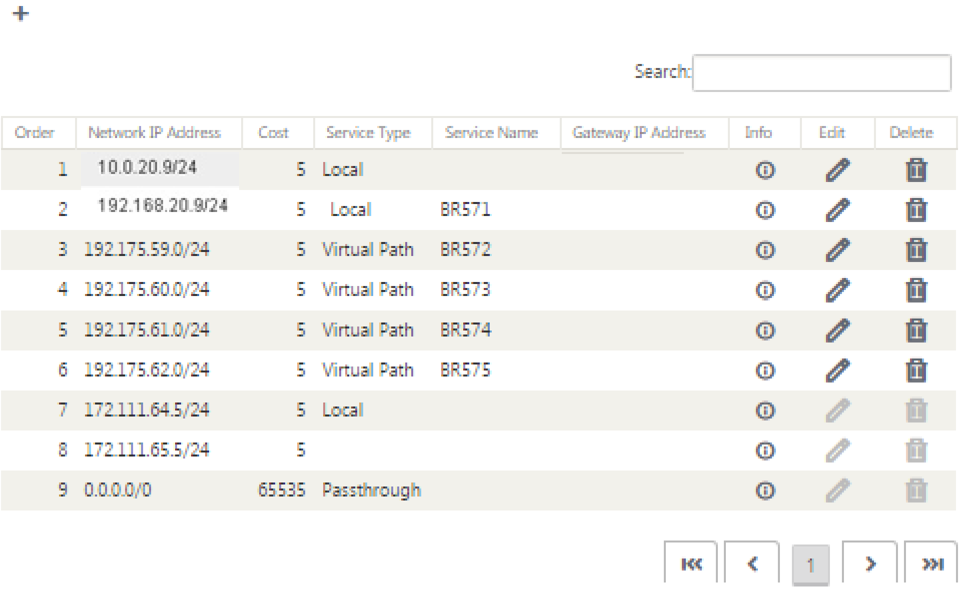
☑ Set Permitted From Physical

Permitted Rate (kbps): 10000

Name	Virtual Interface	IP Address	Gateway IP Address	Virtual Path Mode	Proxy ARP	Delete
SJC_BR-MPLS-...	MPLS_BR-1-2	192.168.20.9	192.168.20.1	Primary	✓	🗑

To populate routes

Routes are auto-created based on above configuration. In case there are more subnets specific to this remote branch office, then specific routes need to be added identifying which gateway to direct traffic to reach those back-end subnets.



+

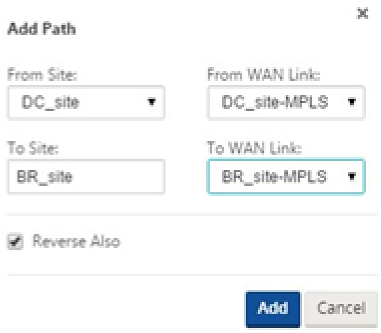
Search:

Order	Network IP Address	Cost	Service Type	Service Name	Gateway IP Address	Info	Edit	Delete
1	10.0.20.9/24	5	Local			ⓘ	✎	🗑
2	192.168.20.9/24	5	Local	BR571		ⓘ	✎	🗑
3	192.175.59.0/24	5	Virtual Path	BR572		ⓘ	✎	🗑
4	192.175.60.0/24	5	Virtual Path	BR573		ⓘ	✎	🗑
5	192.175.61.0/24	5	Virtual Path	BR574		ⓘ	✎	🗑
6	192.175.62.0/24	5	Virtual Path	BR575		ⓘ	✎	🗑
7	172.111.64.5/24	5	Local			ⓘ	✎	🗑
8	172.111.65.5/24	5				ⓘ	✎	🗑
9	0.0.0.0/0	65535	Passthrough			ⓘ	✎	🗑

Resolve audit errors

After completing configuration for DC and Branch sites, you will be alerted to resolve audit error on both DC and BR sites.

By default, the system generates paths for WAN Links defined as access type Public Internet. You would be required to use the auto-path group function or enable paths manually for WAN Links with an access type of Private Internet. Paths for MPLS links can be enabled by clicking Add operator (in the green rectangle).


Add Path

From Site: DC_site

From WAN Link: DC_site-MPLS

To Site: BR_site

To WAN Link: BR_site-MPLS

☑ Reverse Also

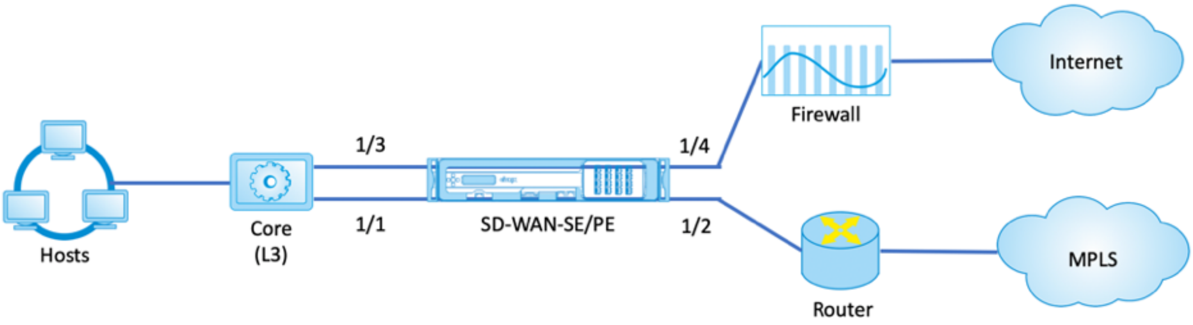
After completing all the above steps, proceed to Preparing the SD-WAN Appliance Packages.–>

Inline mode

August 24, 2022

This article provides the detail on configuring a branch with **Inline Deployment** mode. In this mode, the SD-WAN appliance appears to be an Ethernet bridge. Most of the SD-WAN appliance models include a **fail-to-wire** (Ethernet bypass) feature for inline mode. If power fails, a relay closes and the input and output ports become electrically connected, allowing the Ethernet signal to pass through from one port to another. In the fail-to-wire mode, the SD-WAN appliance looks like a cross-over cable connecting the two ports.

In the following diagram interfaces 1/1 and 1/2 are hardware bypass pairs and will fail-to-wire connecting the Core to the edge MPLS Router. Interfaces 1/3 and 1/4 are also hardware bypass pairs and will fail-to-wire connecting the Core to the edge Firewall. For more information on SD-WAN Orchestrator service-based Inline mode deployment, see Interfaces.



Virtual inline mode

August 24, 2022

In virtual inline mode, the router uses routing protocol such as PBR, OSPF, or BGP to redirect incoming and outgoing WAN traffic to the appliance, and the appliance forwards the processed packets back to the router.

The following article describes the step-by-step procedure to configure two SD-WAN (SD-WAN SE) appliances:

- Data Center appliance in virtual inline mode
- Branch appliance in Inline mode
- Routing protocol must be configured either at the core switch or further upstream at the router. The router must monitor the health of the SD-WAN appliance so that the appliance can be bypassed if it fails.
- Virtual inline mode places the SD-WAN appliance physically out of path (one-arm deployment) that is, only a single Ethernet interface to be used (Example: Interface 1/5) with bypass mode set to fail-to-block (FTB).
  Citrix SD-WAN appliance must be configured to pass traffic to the proper gateway. Traffic intended for the Virtual Path is directed towards the SD-WAN appliance and then encapsulated and directed to the appropriate WAN link.

Gather information

Gather the following information required for configuring virtual inline mode:

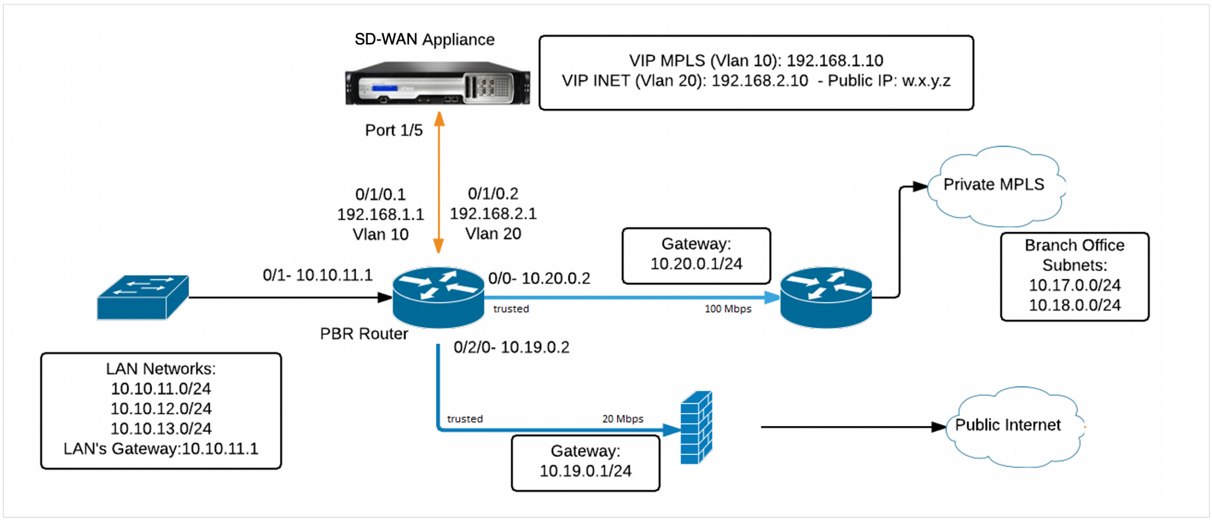
- Accurate network diagram of your local and remote sites including:
  - Local and Remote WAN links and their bandwidths in both directions, their subnets, Virtual IP Addresses and Gateways from each link, Routes, and VLANs.

- Deployment Table

For information on SD-WAN Orchestrator service-based Virtual Inline mode deployment, see Interfaces.

The following is a sample network diagram and deployment table:

Data center topology –Virtual inline mode



Resolving audit errors

After completing the configuration for Data Center and Branch sites, you will be alerted to resolve the audit errors on both DC and BR sites. Resolve the audit errors (if any).

Build an SD-WAN network

August 24, 2022

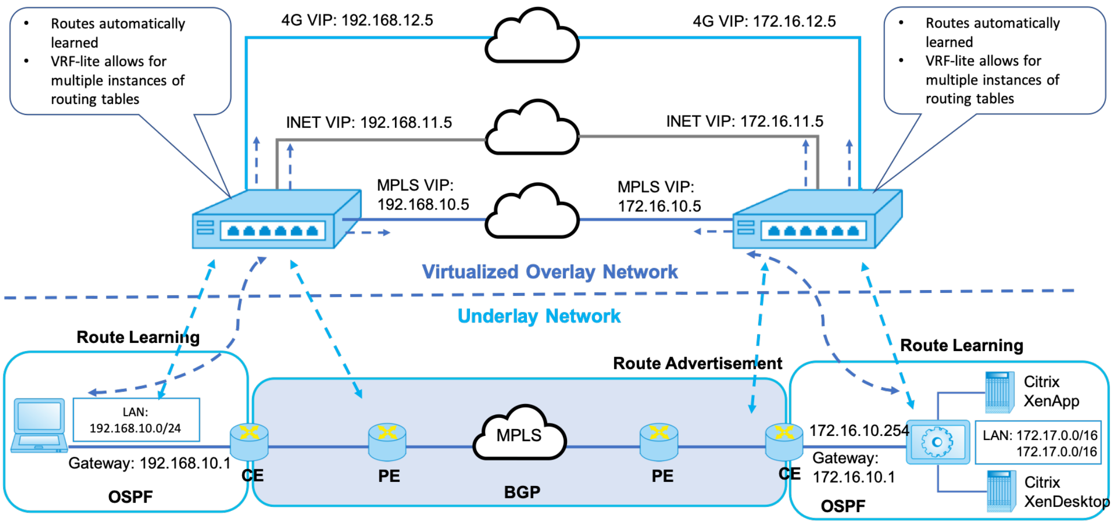
To build an SD-WAN overlay network without the need to build SD-WAN overlay route tables:

1. Create a WAN Path tunnel across each WAN link between two SD-WAN appliances.
2. Configure Virtual IP to represent the endpoint for each WAN link. You can establish encrypted WAN paths through the current L3 Network.
3. Aggregate 2, 3, and 4 WAN paths (physical links) into a single Virtual Path allowing packets to traverse the WAN utilizing the SD-WAN overlay network instead of the existing underlay which is least intelligent and cost inefficient.

SD-WAN routing components and network topology

- Local –subnet resides at this site (advertised to SD-WAN environment)
- Virtual Path –sent through Virtualized Path to the selected site appliance
- Intranet –sites with no SD-WAN appliance
- Internet –internet bound traffic
- Pass-through –untouched traffic, in one bridge interface out the other
- Default route (0.0.0.0/0) defined - Used for pass-through traffic not captured by the SD-WAN overlay route table, or utilized at the MCN to instruct clients sites to forward all traffic back to MCN node for back-haul of internet traffic.

SD-WAN overlay dynamic network routing



High availability

August 24, 2022

This topic covers the High Availability (high availability) deployments and configurations supported by SD-WAN appliances (Standard Edition).

Citrix SD-WAN appliances can be deployed in high availability configuration as a pair of appliances in Active/Standby roles. There are three modes of high availability deployment:

- Parallel Inline high availability

- Fail-to-Wire high availability
- One-Arm high availability

These high availability deployment modes are similar to the Virtual Router Redundancy Protocol (VRRP) and use a proprietary SD-WAN protocol. Both Client Nodes (Clients) and Master Control Nodes (MCNs) within an SD-WAN network can be deployed in a high availability configuration. The primary and secondary appliance must be the same platform models.

In high availability configuration, one SD-WAN appliance at the site is designated as the Active appliance. The Standby appliance monitors the Active appliance. Configuration is mirrored across both appliances. If the Standby appliance loses connectivity with the Active appliance for a defined period, the Standby appliance assumes the identity of the Active appliance and takes over the traffic load. Depending on the deployment mode, this fast failover has minimal impact on the application traffic passing through the network.

High availability deployment modes

One-Arm mode:

In One-Arm mode, the high availability appliance pair is outside of the data path. Application traffic is redirected to the appliance pair with Policy Based Routing (PBR). One-Arm mode is implemented when a single insertion point in the network is not feasible or to counter the challenges of fail-to-wire. The Standby appliance can be added to the same VLAN or subnet as the Active appliance and the router.

In One-Arm mode, it is recommended that the SD-WAN appliances do not reside in the data network subnets. The virtual path traffic does not have to traverse the PBR and avoids route loops. The SD-WAN appliance and router have to be directly connected, either through an Ethernet port or be in the same VLAN.

- **IP SLA monitoring for fall back**:

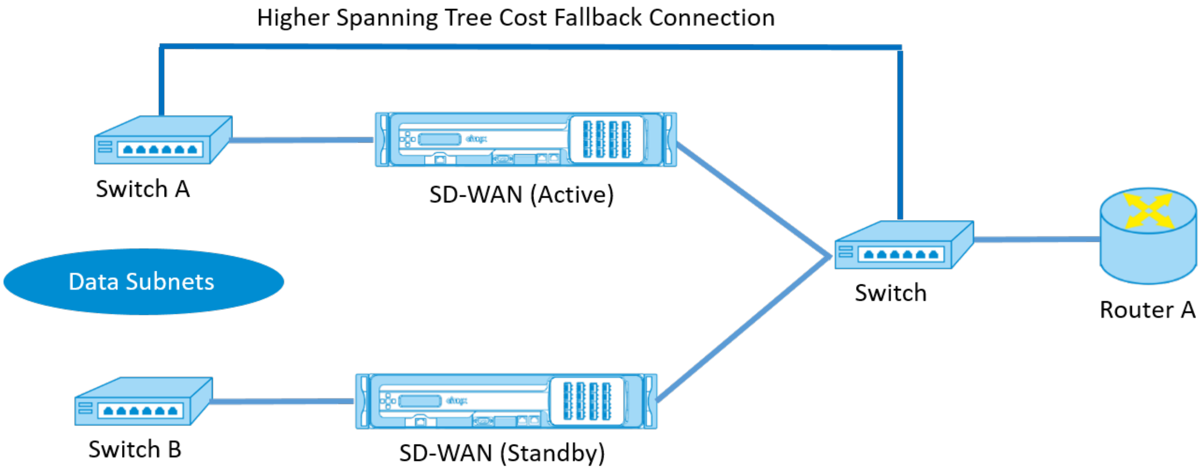
  The active traffic flows even if the virtual path is down, as long as one of the SD-WAN appliances is active. The SD-WAN appliance redirects traffic back to the router as Intranet traffic. However, if both active/standby SD-WAN appliances become inactive, the router tries to redirect traffic to the appliances. IP SLA monitoring can be configured at the router to disable PBR, if the next appliance is not reachable. It allows the router to fall back to perform a route lookup and forward packets appropriately.

Parallel Inline high availability mode:

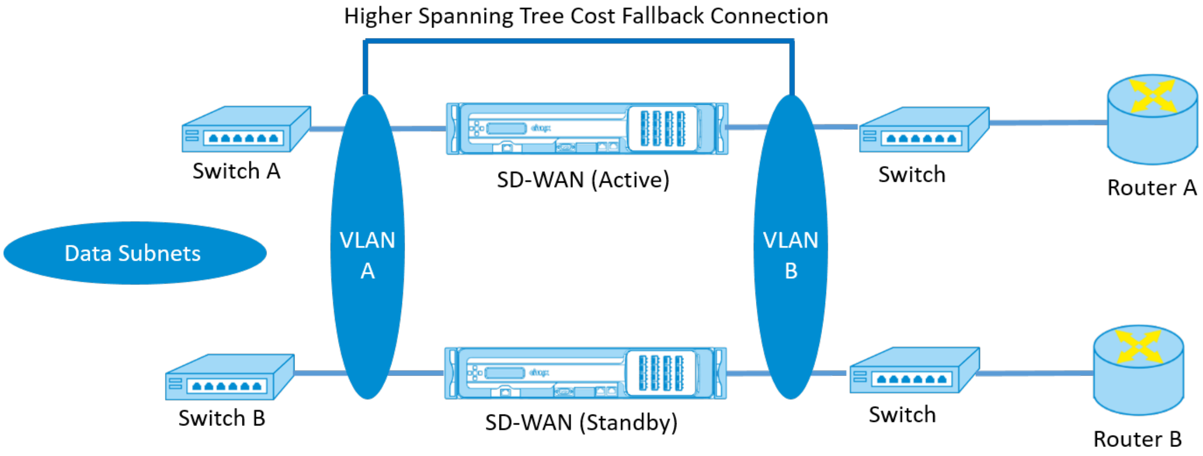
In Parallel Inline high availability mode, the SD-WAN appliances are deployed alongside each other, inline with the data path. Only one path through the Active appliance is used. It is important to note that bypass interface groups are configured to be fail-to-block to avoid bridging loops during a failover.

The high availability state can be monitored through the inline interface groups, or through a direct connection between the appliances. External Tracking can be used to monitor the reachability of the upstream or downstream network infrastructure. For example; switch port failure to direct high availability state change, if needed.

If both active and standby SD-WAN appliances are disabled or fail, a tertiary path can be used directly between the switch and router. This path must have a higher spanning tree cost than the SD-WAN paths so that it is not used under normal conditions. Failover in parallel inline high availability mode depends on the configured failover time, the default failover time is 1000 ms. However, a failover has a traffic impact of 3-5 seconds. Fall back to the tertiary path impacts traffic for the duration of spanning tree re-convergence. If there are out of path connections to other WAN Links, both appliances must be connected to them.



In more complex scenarios, where multiple routers might be using VRRP, non-routable VLANs are recommended to ensure that the LAN side switch and routers are reachable at layer 2.



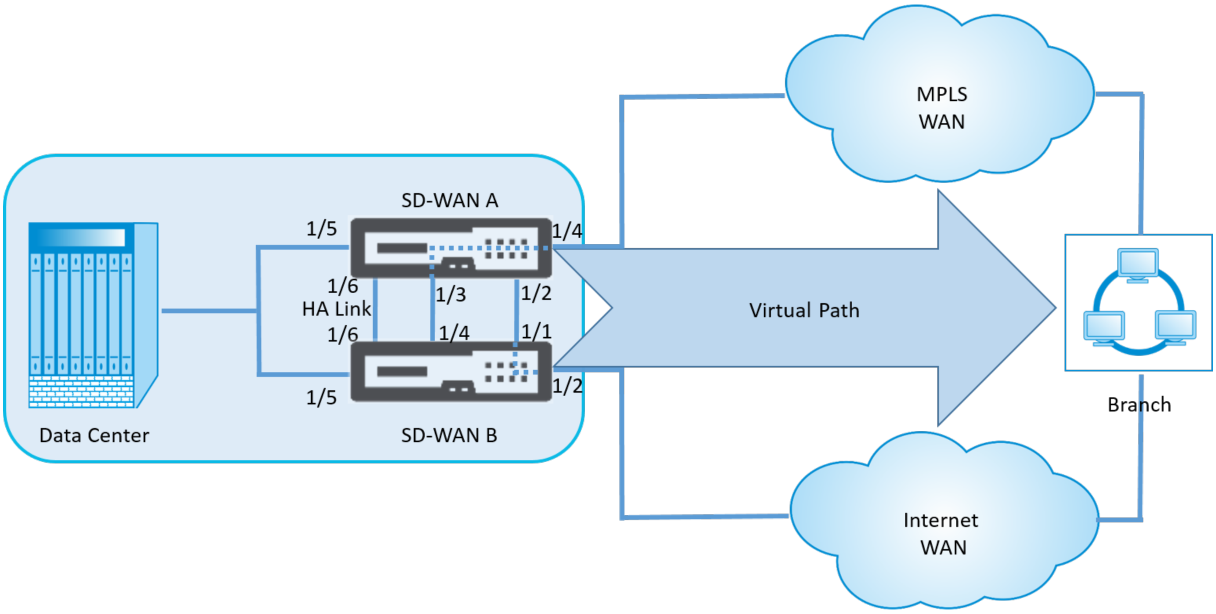
Fail-to-Wire mode:

In fail-to-wire mode, the SD-WAN appliances are inline in the same data path. The bypass interface groups must be in the fail-to-wire mode with the Standby appliance in a passthrough or bypass state. A direct connection between the two appliances on a separate port must be configured and used for the high availability interface group.

> **Note**
>
> - High availability switchover in fail-to-wire mode takes approximately 10–12 seconds because of the delay in ports to recover from Fail-to-Wire mode.
> - If the high availability connection between the appliances fails, both appliances go into Active state and cause a service interruption. To mitigate the service interruption, assign multiple high availability connections so that there is no single point of failure.
> - It is imperative that in high availability Fail-to-Wire Mode, a separate port is used in the hardware appliance pairs for the high availability control exchange mechanism to help with state convergence.

Because of a physical state change when the SD-WAN appliances switch over from Active to Standby, failover can cause partial loss of connectivity depending on how long the auto-negotiation takes on the Ethernet ports.

The following illustration shows an example of the Fail-to-Wire deployment.



The One-Arm high availability configuration or Parallel Inline high availability configuration is recommended for data centers or Sites that forward a high volume of traffic to minimize disruption during failover.

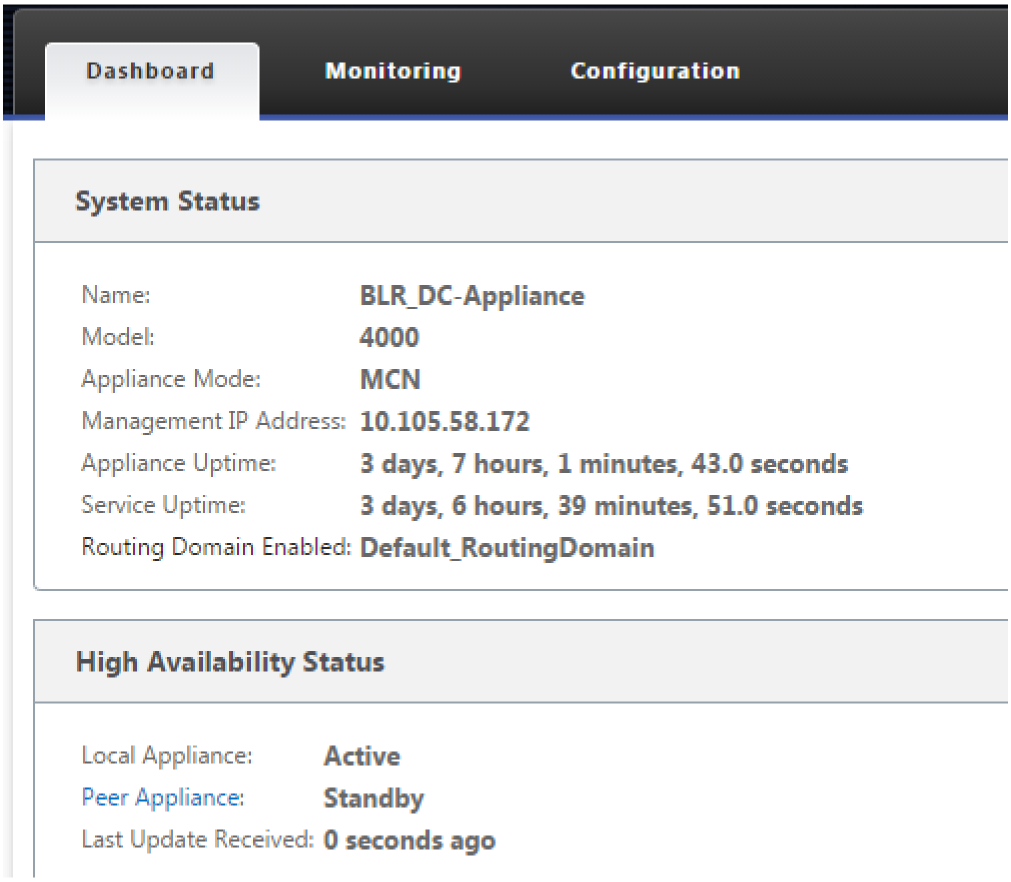
If minimal loss of service is acceptable during a failover, then Fail-to-Wire high availability mode is a better solution. The Fail-to-Wire high availability mode protects against appliance failure and parallel inline high availability protects against all failures. In all scenarios, high availability is valuable to preserve the continuity of the SD-WAN network during a system failure.

For more information on SD-WAN Orchestrator service-based HA deployment, see Device details.

Monitoring

To monitor high availability configuration:

Log in to the SD-WAN web management interface for the Active and Standby appliance's for which high availability is implemented. View high availability status under the **Dashboard** tab.

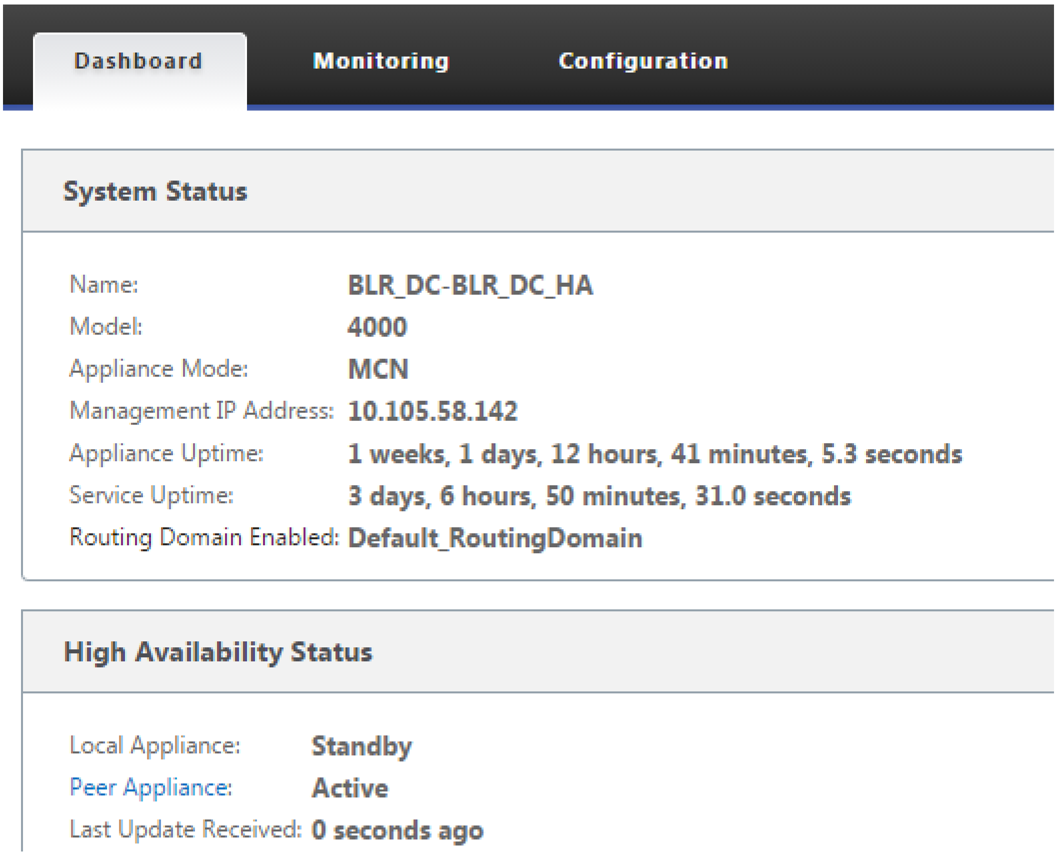


System Status

Name: BLR_DC-Appliance
Model: 4000
Appliance Mode: MCN
Management IP Address: 10.105.58.172
Appliance Uptime: 3 days, 7 hours, 1 minutes, 43.0 seconds
Service Uptime: 3 days, 6 hours, 39 minutes, 51.0 seconds
Routing Domain Enabled: Default_RoutingDomain

High Availability Status

Local Appliance: Active
Peer Appliance: Standby
Last Update Received: 0 seconds ago



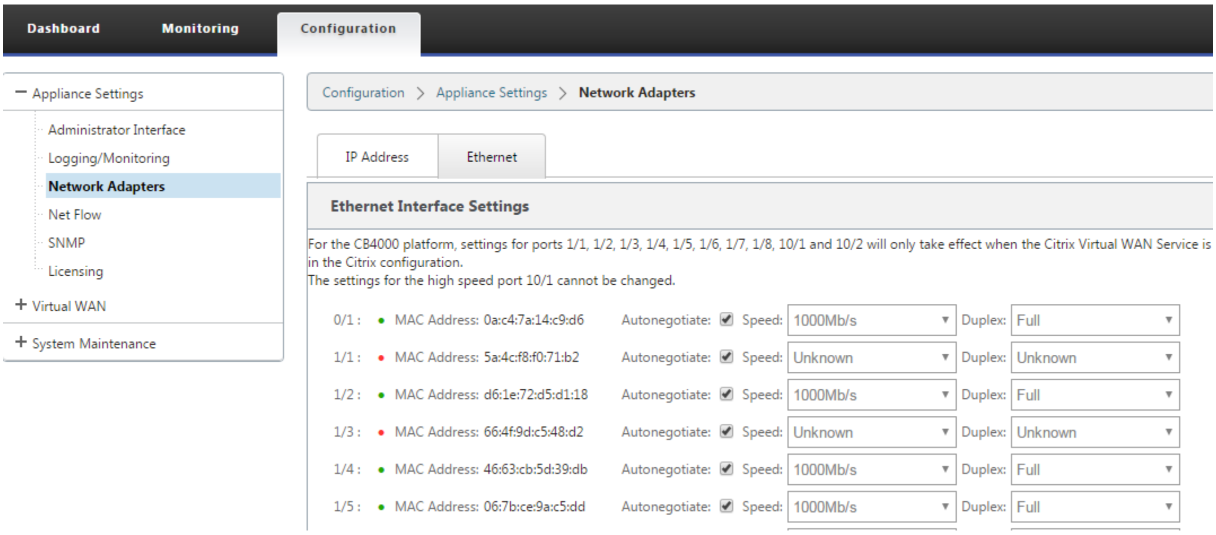
System Status

Name:	**BLR_DC-BLR_DC_HA**
Model:	**4000**
Appliance Mode:	**MCN**
Management IP Address:	**10.105.58.142**
Appliance Uptime:	**1 weeks, 1 days, 12 hours, 41 minutes, 5.3 seconds**
Service Uptime:	**3 days, 6 hours, 50 minutes, 31.0 seconds**
Routing Domain Enabled:	**Default_RoutingDomain**

High Availability Status

Local Appliance:	**Standby**
Peer Appliance:	**Active**
Last Update Received:	**0 seconds ago**

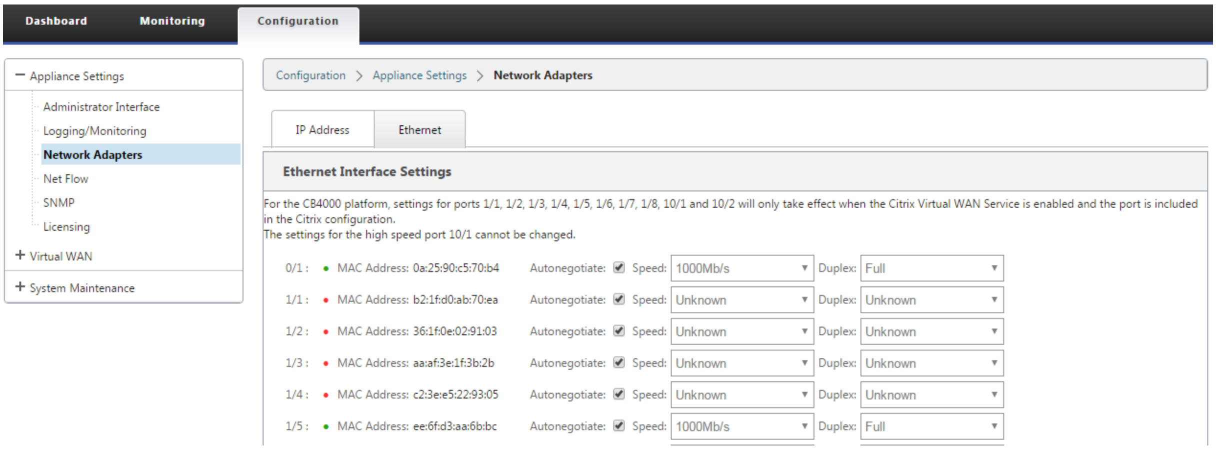
For Network Adapter details of Active and Standby high availability appliances, navigate to **Configuration** > **Appliance Settings** > **Network Adapters** > **Ethernet** tab.



Ethernet Interface Settings

For the CB4000 platform, settings for ports 1/1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 10/1 and 10/2 will only take effect when the Citrix Virtual WAN Service is in the Citrix configuration.
The settings for the high speed port 10/1 cannot be changed.

0/1 :	● MAC Address: 0a:c4:7a:14:c9:d6	Autonegotiate: ☑	Speed: 1000Mb/s	Duplex: Full
1/1 :	● MAC Address: 5a:4c:f8:f0:71:b2	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
1/2 :	● MAC Address: d6:1e:72:d5:d1:18	Autonegotiate: ☑	Speed: 1000Mb/s	Duplex: Full
1/3 :	● MAC Address: 66:4f:9d:c5:48:d2	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
1/4 :	● MAC Address: 46:63:cb:5d:39:db	Autonegotiate: ☑	Speed: 1000Mb/s	Duplex: Full
1/5 :	● MAC Address: 06:7b:ce:9a:c5:dd	Autonegotiate: ☑	Speed: 1000Mb/s	Duplex: Full



Ethernet Interface Settings

For the CB4000 platform, settings for ports 1/1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 10/1 and 10/2 will only take effect when the Citrix Virtual WAN Service is enabled and the port is included in the Citrix configuration.
The settings for the high speed port 10/1 cannot be changed.

```
0/1 :  ● MAC Address: 0a:25:90:c5:70:b4   Autonegotiate: ☑  Speed: 1000Mb/s  Duplex: Full
1/1 :  ● MAC Address: b2:1f:d0:ab:70:ea   Autonegotiate: ☑  Speed: Unknown   Duplex: Unknown
1/2 :  ● MAC Address: 36:1f:0e:02:91:03   Autonegotiate: ☑  Speed: Unknown   Duplex: Unknown
1/3 :  ● MAC Address: aa:af:3e:1f:3b:2b   Autonegotiate: ☑  Speed: Unknown   Duplex: Unknown
1/4 :  ● MAC Address: c2:3e:e5:22:93:05   Autonegotiate: ☑  Speed: Unknown   Duplex: Unknown
1/5 :  ● MAC Address: ee:6f:d3:aa:6b:bc   Autonegotiate: ☑  Speed: 1000Mb/s  Duplex: Full
```

Troubleshooting

Perform the following troubleshooting steps while configuring the SD-WAN appliance in High Availability (HA) mode:

1. The primary reason for split-brain issue is due to communication problem between the HA appliances.

    - Check if any issue with the connectivity (such as, the ports on both the SD-WAN appliance are up or down) between the SD-WAN appliances.
    - Must disable SD-WAN service on one of the SD-WAN appliances to ensure only one SD-WAN appliance be active.

2. You can verify the HA related logs that is logged into **SDWAN_common.log** file.

    > **NOTE**
    > All the HA related logs is logged with the key word **racp**.

3. You can verify the port related events in **SDWAN_common.log** file (such as, the HA enabled ports goes down or up).

4. For every HA state change, one SD-WAN event is logged. So if the logs are rolled over, you can verify the event logs to get the event details.

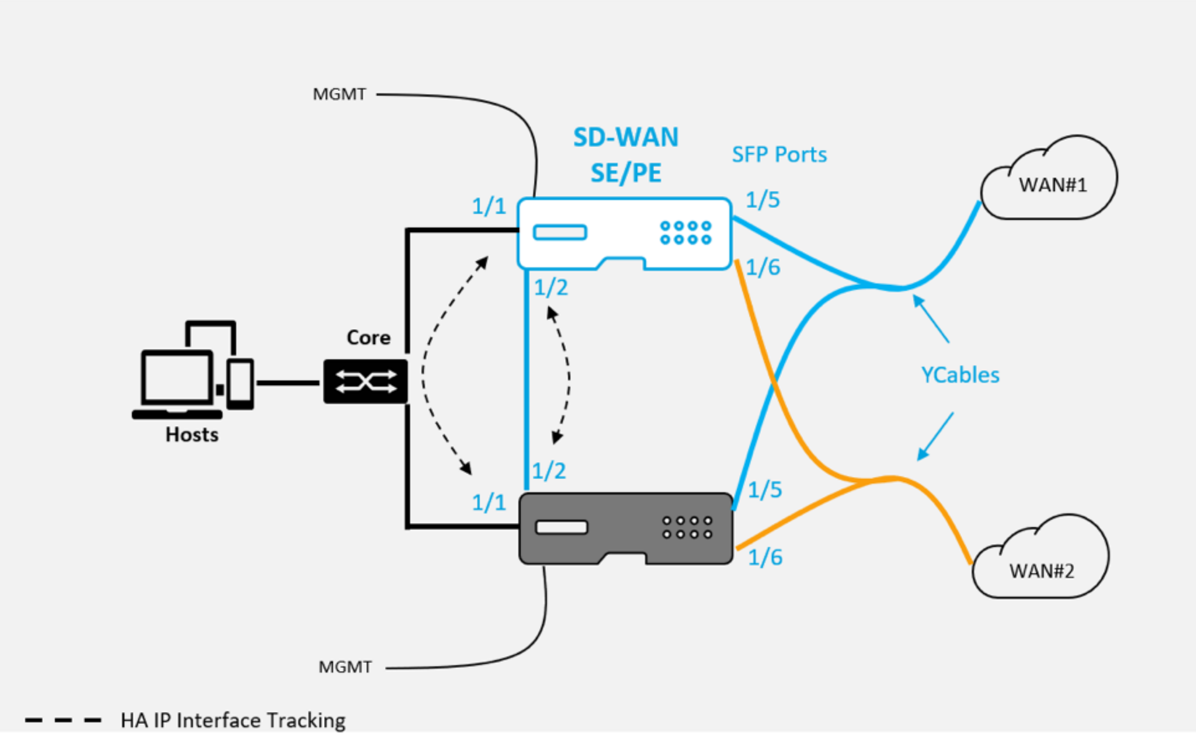
Enable Edge Mode High Availability Using Fiber Optic Y-Cable

August 24, 2022

> Note: In release 10.2 version 2, this functionality is applicable to the 1100 SE appliance only.

The following procedure describes the steps to enable High Availability (HA) on 1100 SE appliances deployed in Edge Mode where the handoffs from the WAN link service providers are fiber optic.
The available Small Form-factor Pluggable (SFP) ports on 1100 appliances can be used with fiber optic Y-Cables to enable high availability feature for Edge Mode deployment.
On the 1100 SE appliance the splitter cable split end connects to fiber ports of two 1100 appliances that are configured in HA pair.
The fiber optic Y-Cable has three ends. One end connects to the fiber handoff of the provider and the other two ends connect to SFP ports configured for that WAN link on two 1100 SE appliances deployed in HA pair. The splitter cable is used to divide one incoming signal into multiple signals.

For information on SD-WAN Orchestrator service-based Edge Mode HA deployment, see Device details.



Limitations:

- HA Fail-to-Wire Mode configuration using Y-cable is not supported.
- The SFPs connected to the Y-cable, cannot be used as HA IP interface tracking.
- Software release 10.2.2 or greater, and 11.0 or greater is required to support this deployment.

Zero touch

August 24, 2022

> **Note**
>
> The Zero Touch Deployment service is supported only on select Citrix SD-WAN appliances:
>
> - SD-WAN 110 Standard Edition
> - SD-WAN 210 Standard Edition
> - SD-WAN 1100 Standard Edition
> - SD-WAN 2100 Standard Edition
> - SD-WAN AWS VPX instance

Zero-touch deployment Cloud Service is a Citrix operated and managed cloud-based service which allows discovery of new appliances in the Citrix SD-WAN network, primarily focused on streamlining the deployment process for Citrix SD-WAN at branch or cloud service office locations. The zero-touch deployment Cloud Service is publicly accessible from any point in a network via public Internet access. The zero-touch deployment Cloud Service is accessed over the Secure Socket Layer (SSL) Protocol.

The zero-touch deployment Cloud Services securely communicate with back-end Citrix services hosting stored identification of Citrix customers who have purchased Zero Touch capable devices (for example 2100-SE). The back-end services are in place to authenticate any Zero Touch Deployment request, properly validating the association between the Customer Account and the Serial Numbers of Citrix SD-WAN appliances.

For more information, see the Citrix SD-WAN Orchestrator service Zero touch deployment topic.

ZTD High-Level Architecture and Workflow:

Data Center Site:

Citrix SD-WAN Administrator –A user with Administration rights of the SD-WAN environment with the following primary responsibilities:

- Citrix Cloud Login to initiate the Zero Touch Deployment Service for new site node deployment.

Network Administrator –A user responsible for Enterprise network management (DHCP, DNS, internet, firewall, and so on).

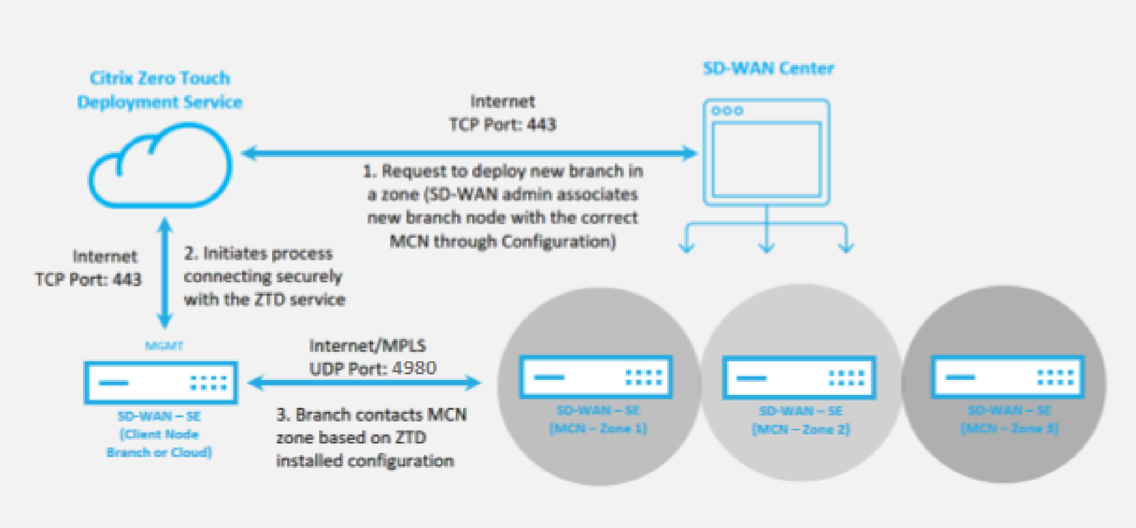
Remote Site:

Onsite Installer –A local contact or hired installer for on-site activity with the following primary responsibilities:

- Physically unpack the Citrix SD-WAN appliance.

- Reimage non-ZTD ready appliances.
    - Required for: SD-WAN 1000-SE, 2000-SE, 1000-EE, 2000-EE
    - Not required for: SD-WAN 410-SE, 2100-SE
- Power cable the appliance.
- Cable the appliance for internet connectivity on the Management interface (for example MGMT, or 0/1).
- Cable the appliance for WAN link connectivity on the Data interfaces (for example apA.WAN, apB.WAN, apC.WAN, 0/2, 0/3, 0/5, and so on).

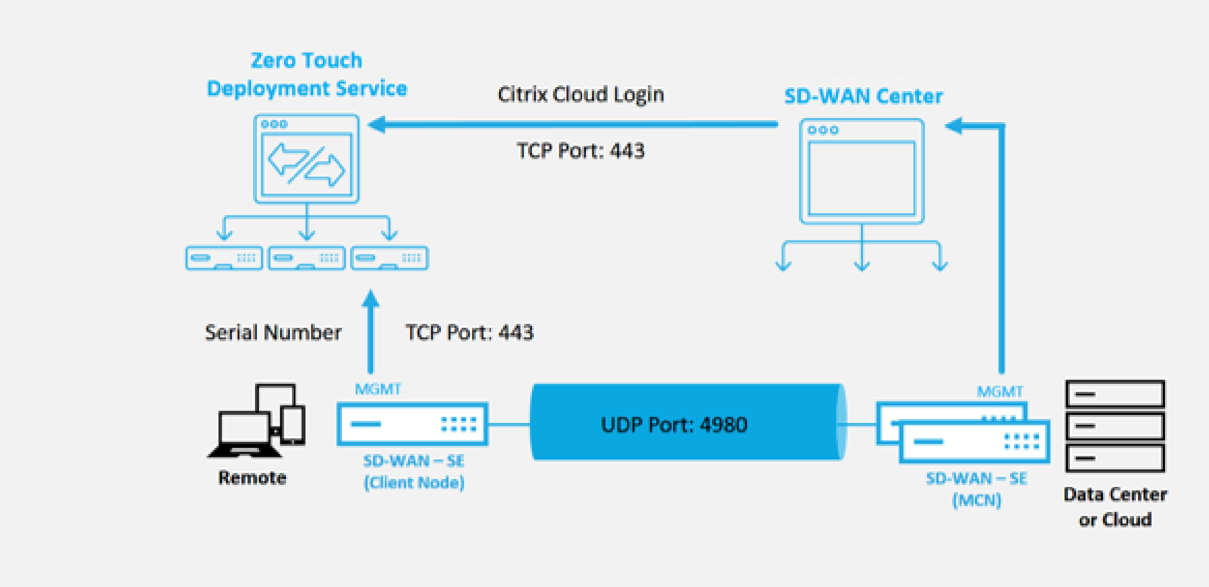
    > **Note**
    >
    > The interface layout is different for each model, so reference the documentation for identification of data and management ports.

    
    Citrix Zero Touch Deployment Service
SD-WAN Center
Internet
TCP Port: 443
1. Request to deploy new branch in a zone (SD-WAN admin associates new branch node with the correct MCN through Configuration)
Internet
TCP Port: 443
2. Initiates process connecting securely with the ZTD service
MGMT
Internet/MPLS
UDP Port: 4980
SD-WAN – SE (Client Node Branch or Cloud)
3. Branch contacts MCN zone based on ZTD installed configuration
SD-WAN – SE (MCN – Zone 1)
SD-WAN – SE (MCN – Zone 2)
SD-WAN – SE (MCN – Zone 3)

The following prerequisites are required before starting any Zero Touch Deployment service:

- Actively running SD-WAN promoted to Master Control Node (MCN).
- Citrix Cloud Login credentials created on https://onboarding.cloud.com (reference the instruction below on account creation).
- Management network connectivity (SD-WAN Appliance) to the Internet on port 443, either directly or through a proxy server.
- (Optional) At least one actively running SD-WAN appliance operating at a branch office in Client Mode with valid Virtual Path connectivity to MCN to help validate successful path establishment across the existing underlay network.

The last prerequisite is not a requirement, but allows the SD-WAN Administrator to validate that the underlay network allows Virtual Paths to be established when the Zero Touch Deployment is complete with any newly added site. Primarily, this validates that the appropriate Firewall and Route policies are in place to either NAT traffic accordingly or confirm the ability for UDP port 4980 can successfully penetrate the network to reach the MCN.



Zero Touch Deployment Service Overview:

To use the Zero Touch Deployment Service (or zero-touch deployment Cloud Service), an Administrator must begin by deploying the first SD-WAN device in the environment.

After a working SD-WAN environment is up and running registration into the Zero Touch Deployment Service is accomplished through creating a Citrix Cloud account login. Logging into the Zero Touch Service authenticates the Customer ID associated with the particular SD-WAN environment.

When the SD-WAN Administrator initiates a site for deployment using the zero-touch deployment process, you have the option to pre-authenticate the appliance to be used for zero-touch deployment by pre-populating the serial number, and initiating email communication to the on-site installer to begin on-site activity.

The Onsite Installer receives email communication that the site is ready for Zero Touch Deployment and can begin the installation procedure of powering on and cabling the appliance for DHCP IP address assignment and internet access on the MGMT port. Also, cabling in any LAN and WAN ports. Everything else is initiated by the zero-touch deployment Service and progress is monitored by using the activation URL. In the event the remote node to be installed is a cloud instance, opening up the activation URL begins the workflow to automatically install the instance in the designated cloud environment, no action is needed by a local installer.

The Zero Touch Deployment Cloud Service automates the following actions:

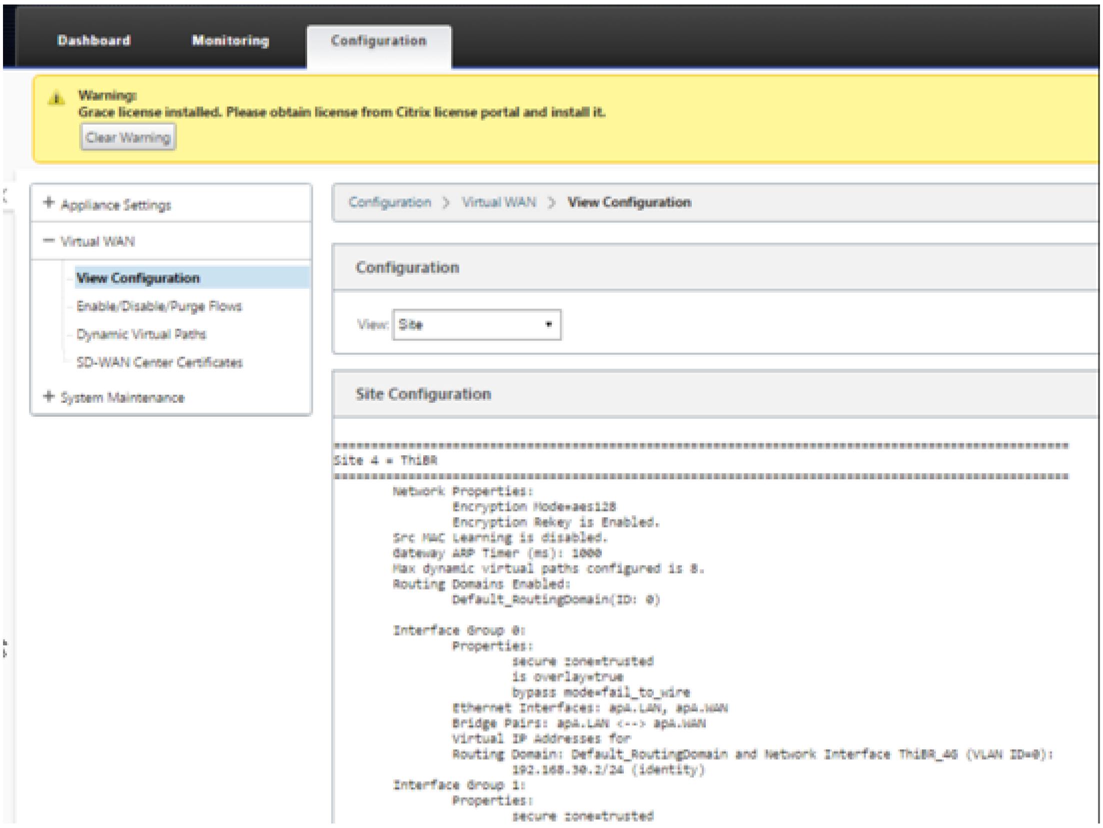
Download and Update the zero-touch deployment Agent if new features are available on the branch appliance.

- Authenticate the branch appliance by validating the serial number.
- Push the configuration file specific for the targeted appliance to the branch appliance.
- Install the configuration file on the branch appliance.
- Push any missing SD-WAN software components or required updates to the branch appliance.
- Push a temporary 10 Mbps license file for confirmation of Virtual Path establishment to the branch appliance.
- Enable the SD-WAN Service on the branch appliance.

More steps are required of the SD-WAN Administrator to install a permanent license file on the appliance.

> **Note**
>
> While performing a branch configuration that already has the same version of appliance software used in MCN, the zero-touch-deployment process will not download the appliance software file again. This change is applicable for fresh factory shipped appliances, appliances reset to factory defaults, and configuration reset administratively. If there is the configuration reset, select the **Reboot after revert** check box to initiate the zero-touch deployment process.

The appliance configuration can be validated using the **Configuration** > **Virtual WAN** > **View Configuration** page.



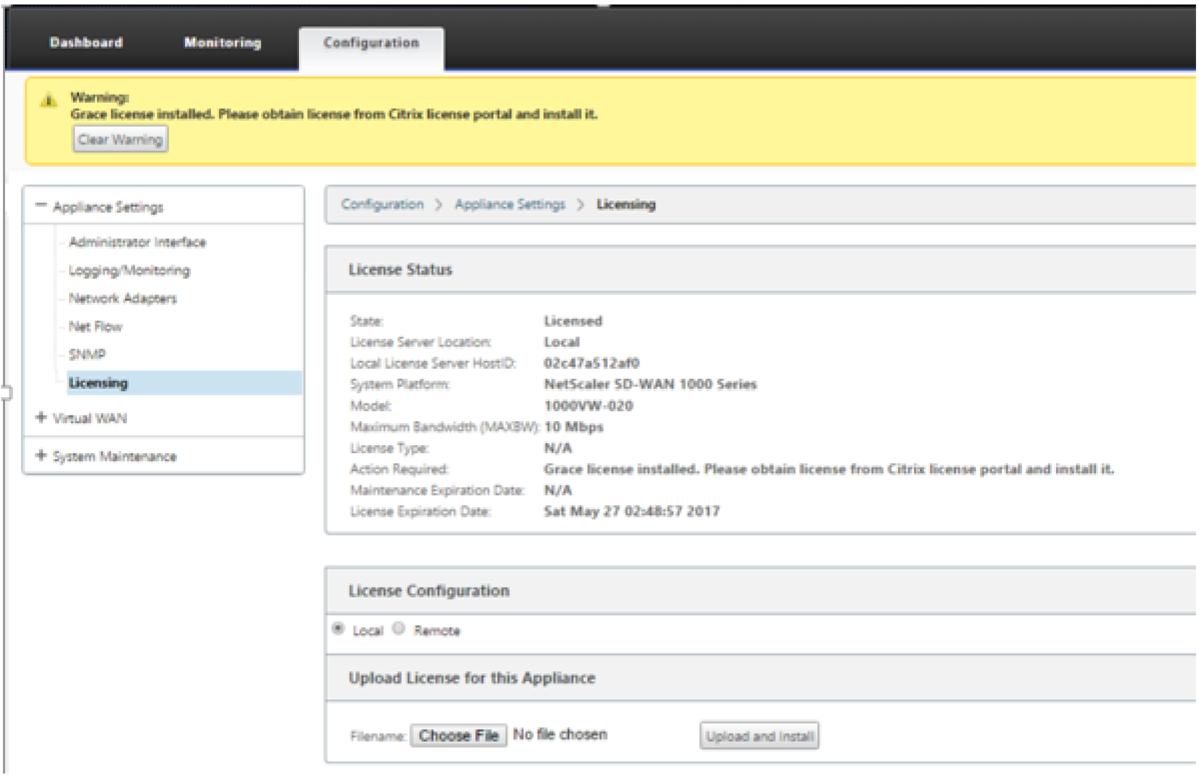
Warning:
Grace license installed. Please obtain license from Citrix license portal and install it.

View: Site

```
====================================================================================================
Site 4 = ThiBR
====================================================================================================
        Network Properties:
                Encryption Mode=aes128
                Encryption Rekey is Enabled.
        Src MAC Learning is disabled.
        Gateway ARP Timer (ms): 1000
        Max dynamic virtual paths configured is 8.
        Routing Domains Enabled:
                Default_RoutingDomain(ID: 0)

        Interface Group 0:
                Properties:
                        secure zone=trusted
                        is overlay=true
                        bypass mode=fail_to_wire
                Ethernet Interfaces: apA.LAN, apA.WAN
                Bridge Pairs: apA.LAN <--> apA.WAN
                Virtual IP Addresses for
                Routing Domain: Default_RoutingDomain and Network Interface ThiBR_AG (VLAN ID=0):
                        192.168.30.2/24 (identity)
        Interface Group 1:
                Properties:
                        secure zone=trusted
```

The appliance license file can be updated to a permanent license using the **Configuration** > **Appliance Settings** > **Licensing** page.



Warning:
Grace license installed. Please obtain license from Citrix license portal and install it.

License Status

State:	Licensed
License Server Location:	Local
Local License Server HostID:	02c47a512af0
System Platform:	NetScaler SD-WAN 1000 Series
Model:	1000VW-020
Maximum Bandwidth (MAXBW):	10 Mbps
License Type:	N/A
Action Required:	Grace license installed. Please obtain license from Citrix license portal and install it.
Maintenance Expiration Date:	N/A
License Expiration Date:	Sat May 27 02:48:57 2017

License Configuration

● Local ○ Remote

Upload License for this Appliance

Filename: No file chosen

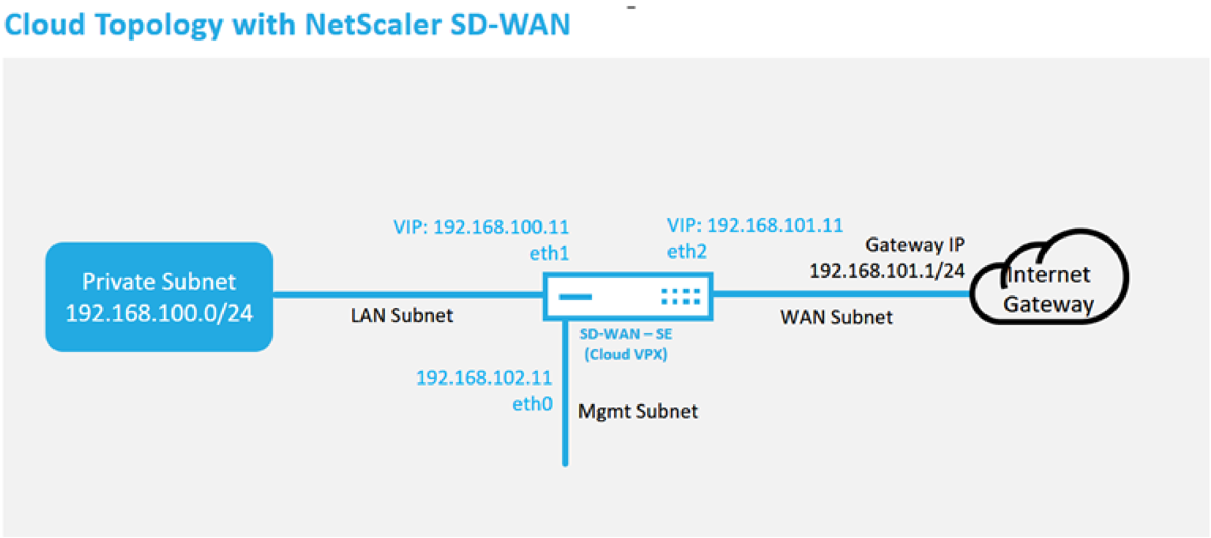
After uploading and installing the permanent license file, the Grace License warning banner disappears and during the license install process no loss in connectivity to the remote site will occur (zero pings are dropped).

AWS

August 24, 2022

With SD-WAN release 11.5, zero touch deployment in an AWS environment is supported through SD-WAN Orchestrator service.

> **Note**
>
> - Cloud deployed SD-WAN instances must be deployed in Edge/Gateway mode.
> - The template for the cloud instance is limited to three interfaces; Management, LAN, and WAN (in that order).
> - The available cloud templates for SD-WAN VPX are currently hard-set to obtain the #.#.#.11 IP address of the available subnets in the VPC .



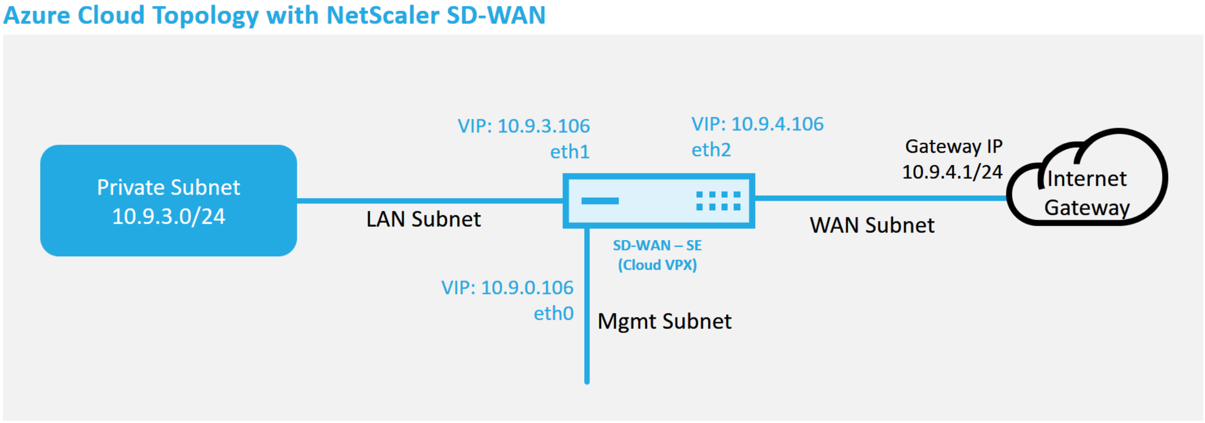
This is an example deployment of a SD-WAN cloud deployed site, the Citrix SD-WAN device is deployed as the edge device servicing a single Internet WAN link in this cloud network. Remote sites will be able to leverage multiple distinct Internet WAN links connecting into this same Internet Gateway for the cloud, providing resiliency and aggregated bandwidth connectivity from any SD-WAN deploy site to the cloud infrastructure. This provides cost effective and highly reliable connectivity to the cloud.

Azure

August 24, 2022

With SD-WAN release 11.5, zero touch deployment in an Azure environment is supported through SD-WAN Orchestrator service.

> **Note**
>
> - Cloud deployed SD-WAN instances must be deployed in Edge/Gateway mode.
> - The template for the cloud instance is limited to three interfaces; Management, LAN, and WAN (in that order).
> - The available Azure cloud templates for SD-WAN VPX are currently hard-set to obtain the 10.9.4.106 IP for the WAN, 10.9.3.106 IP for the LAN, and 10.9.0.16 IP for the Management address. The SD-WAN configuration for the Azure node targeted for Zero Touch must match this layout.
> - The Azure site name in the configuration must be all lowercase with no special characters (e.g. ztdazure).



This is an example deployment of an SD-WAN cloud deployed site, the Citrix SD-WAN device is deployed as the edge device servicing a single Internet WAN link in this cloud network. Remote sites will be able to leverage multiple distinct Internet WAN links connecting into this same Internet Gateway for the cloud, providing resiliency and aggregated bandwidth connectivity from any SD-WAN deploy site to the cloud infrastructure. This provides cost effective and highly reliable connectivity to the cloud.

Single-region deployment

August 24, 2022

Regions allow you to define a network hierarchy with distributed management. A Region must define a Regional Control Node (RCN) which will take over functions performed by the Network Control Node (MCN) for its Region. The MCN is the controller for the Default Region. Static and Dynamic Virtual Paths are not permitted between Regions. RCNs manage traffic between Regions. A single-region deployment in an SD-WAN network can support network sites less than 550.

For more information about Single region deployment through Citrix SD-WAN Orchestrator service, see Regions.

Multi-region deployment

August 24, 2022

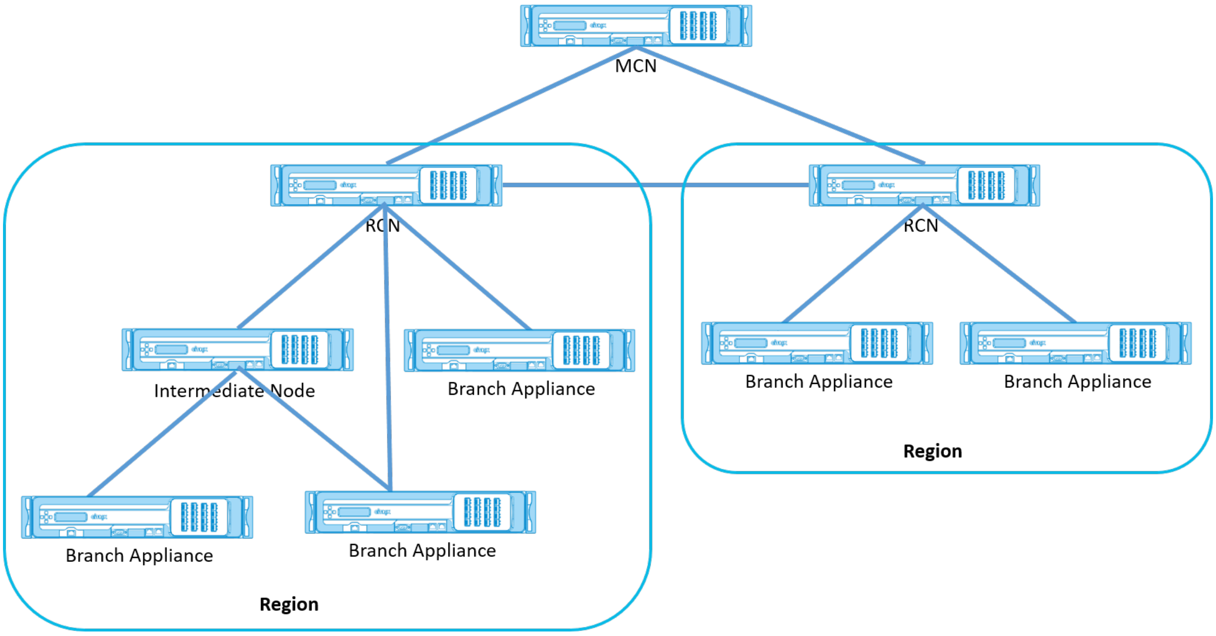
An SD-WAN appliance configured as Master Control Node (MCN) supports multi-region deployment. The MCN manages multiple Regional Control Nodes (RCNs). Each RCN, in turn, manages multiple client sites. The MCN can also be used to manage some of the client sites directly.

With MCN as the control node of the network and RCNs as the control nodes of the regions, SD-WAN can manage up to 6000 sites.

Multi-region deployment enables you to fragment a network into regions and set up a tiered network; such as branch (client) > RCN > MCN.

An MCN with a single region can be configured with a maximum of 1000 sites. You can keep the existing sites in the default region and add new regions with RCNs and their sites for multi-region deployment.

For more information about Multi-region deployment through Citrix SD-WAN Orchestrator service, see Regions.



The following table provides the list of platforms supported for configuring primary and secondary MCN/RCN.

> **NOTE**
>
> Use the Citrix SD-WAN 210 SE appliance as an MCN only in the SD-WAN Orchestrator managed networks.

Platform Edition	Primary/Secondary MCN	Primary/Secondary RCN
110-SE	No	No
210-SE	Yes	Yes
1100-SE	Yes	Yes
VPX-SE, VPXL-SE	Yes	Yes

Platform Edition	Primary/Secondary MCN	Primary/Secondary RCN
2100-SE, 4100-SE, 5100-SE, 6100-SE	Yes	Yes

Configuration guide for Citrix Virtual Apps and Desktops workloads

August 24, 2022

Citrix SD-WAN is a next-generation WAN Edge solution that accelerates digital transformation with flexible, automated, secure connectivity, and performance for SaaS, cloud, and virtual applications to ensure an always-on workspace experience.

Citrix SD-WAN is the recommended and best way for organizations using the Citrix Virtual Apps and Desktops Service to connect to Citrix Virtual Apps and Desktops workloads in the Cloud. For more information, see Citrix blog.

This document focuses on configuring Citrix SD-WAN for connectivity to/from Citrix Virtual Apps and Desktops workloads on Azure.

Benefits

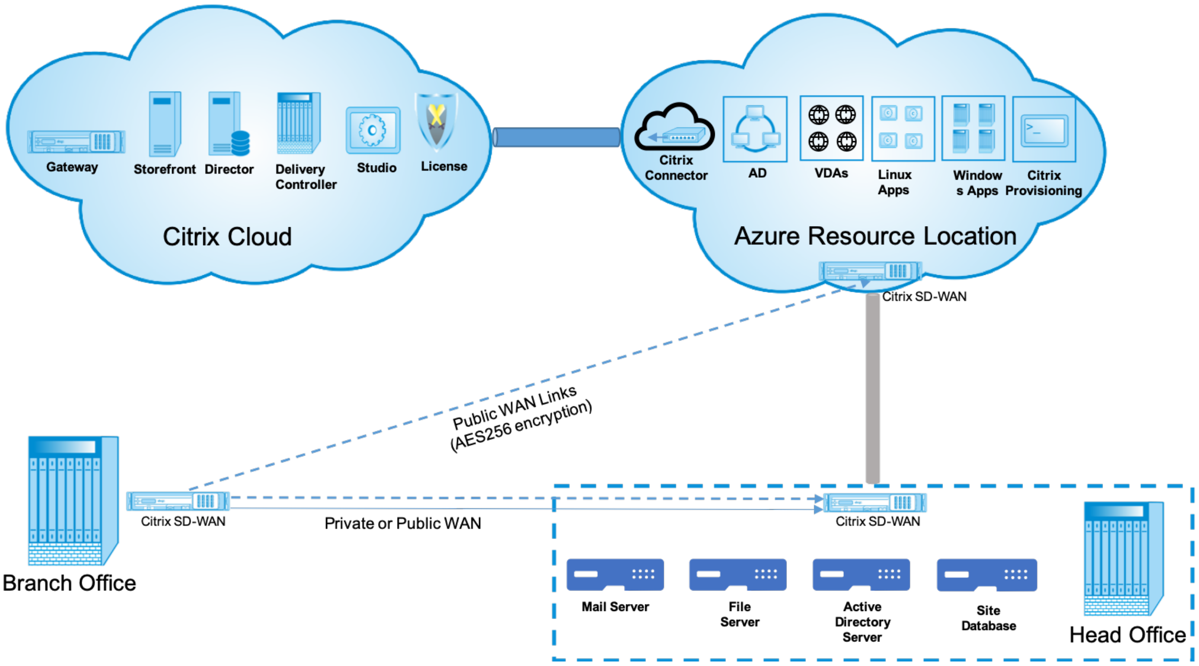
- Easy to set up SD-WAN in Citrix Virtual Apps and Desktops through a guided workflow
- Always-on, high performance connectivity through advanced SD-WAN technologies
- Benefits across all connections (VDA-to-DC, user-to-VDA, VDA-to-cloud, user-to-cloud)
- Reduces latency compared to backhauling traffic to the data center
- Traffic management to ensure Quality of Service (QoS)
  - QoS across HDX/ICA traffic streams (single-port multi-stream HDX AutoQoS)
  - QoS between HDX and other traffic
  - HDX QoS Fairness between users
  - End-to-end QoS
- Link bonding delivers more bandwidth for faster performance
- High Availability with seamless link failover and SD-WAN redundancy on Azure
- Optimized VoIP experience (packet racing for reduced jitter and minimal packet loss, QoS, local break-out for reduced latency)
- Major cost savings and must be faster and easier to deploy compared to Azure ExpressRoute

Pre-requisites

Adhere the following pre-requisites to evaluate and deploy the Citrix Virtual Apps and Desktops workloads capabilities:

- You must have either have an existing SD-WAN network or build a new one.
- You must have a subscription to Citrix Virtual Apps and Desktops Service.
- To make a use of SD-WAN features such as, multi-stream HDX AutoQoS and deep visibility, the Network Location Service (NLS) must be configured for all the SD-WAN sites in your network.
- You must have a DNS server and AD deployed where the client endpoints are present (often co-located in your data center environment) or you can utilize Azure Active Directory (AAD).
- The DNS server must be capable of resolving both internal (private) and external (public) IPs.
- Ensure that the FQDN (sdwan-location.citrixnetworkapi.net) is added to the allowed list in the firewall. This is the FQDN for Network Location Service which is critical in sending traffic over the SD-WAN virtual path. Also, a better way if you are comfortable with whitelisting wild card FQDN's would be to add *.citrixnetworkapi.net to the allowed list as this is the subdomain for other Citrix Cloud services such as zero touch provisioning.
- Enroll at sdwan.cloud.com to use the SD-WAN orchestrator for managing your SD-WAN network. SD-WAN Orchestrator is a Citrix Cloud based multitenant management platform for Citrix SD-WAN.

Deployment architecture

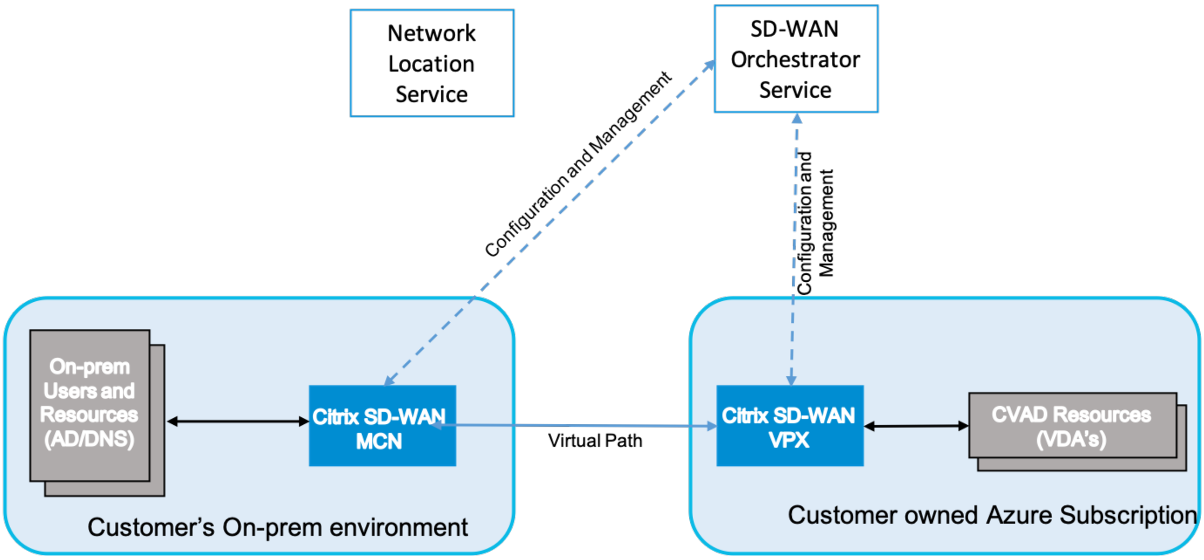


The following entities are required for deployment:

- An on-premises location hosting the SD-WAN appliance which can either be deployed in branch mode or as an MCN (Master control Node). The branch mode or MCN contains the client machines, active directory, and DNS. However, you can also choose to use Azure's DNS and AD. In most scenarios, the on-premises location serves as a data center and houses the MCN.
- **Citrix Virtual Apps and Desktops cloud service** –Citrix Virtual Apps and Desktops provides virtualization solutions that give IT control of virtual machines, applications, and security while providing anywhere access for any device. End users can use applications and desktops independently of the device's operating system and interface.

  Using the Citrix Virtual Apps and Desktops Service, you can deliver secure virtual apps and desktops to any device, and leave most of the product installation, setup, configuration, upgrades, and monitoring to Citrix. You maintain complete control over applications, policies, and users while delivering the best user experience on any device.
- **Citrix connector/cloud connector** - You connect your resources to the service through Citrix Cloud Connector, which serves as a channel for communication between Citrix Cloud and your resource locations. Cloud Connector enables cloud management without requiring any complex networking or infrastructure configuration such as VPNs or IPsec tunnels. Resource locations contain the machines and other resources that deliver applications and desktops to your subscribers.
- **SD-WAN Orchestrator** –Citrix SD-WAN Orchestrator is a cloud-hosted, multitenant management service available to **Do It Yourself** enterprises and Citrix Partners. Citrix partners can use SD-WAN Orchestrator to manage multiple customers with a single pane of glass, and suitable role-based access controls.
- **Virtual and physical SD-WAN appliances** –This runs as multiple instances within the cloud (VMs) and on-premises in the data center and in the branches (physical appliances or VMs) to provide connectivity among these locations and to/from the public Internet. SD-WAN instance in Citrix Virtual Apps and Desktops is created as a single or a set of virtual appliances (in case of HA deployment) by provisioning these instances via Azure Marketplace. SD-WAN appliances in other locations (DC and branches) are created by the customer. All of these SD-WAN appliances are managed (in terms of configuration and software upgrades) by SD-WAN Administrators through SD-WAN Orchestrator.

Deployment and configuration


Network Location Service
SD-WAN Orchestrator Service
Configuration and Management
Configuration and Management
On-prem Users and Resources (AD/DNS)
Citrix SD-WAN MCN
Virtual Path
Citrix SD-WAN VPX
CVAD Resources (VDA's)
Customer's On-prem environment
Customer owned Azure Subscription

In a common deployment, a customer would have the Citrix SD-WAN appliance (H/W or VPX) deployed as an MCN in their DC/large office. The customer DC would usually host on-prem users and resources such as AD and DNS servers. In some scenarios the customer can make use of Azure Active Directory services (AADS) and DNS, both of which are supported by Citrix SD-WAN and CMD integration.

Within the customer managed Azure subscription, the customer needs to deploy the Citrix SD-WAN virtual appliance and VDAs. The SD-WAN appliances are managed via SD-WAN Orchestrator. Once the SD-WAN appliance gets configured, it connects to the existing Citrix SD-WAN network and further tasks such as configuration, visibility, and management are handled via SD-WAN Orchestrator.

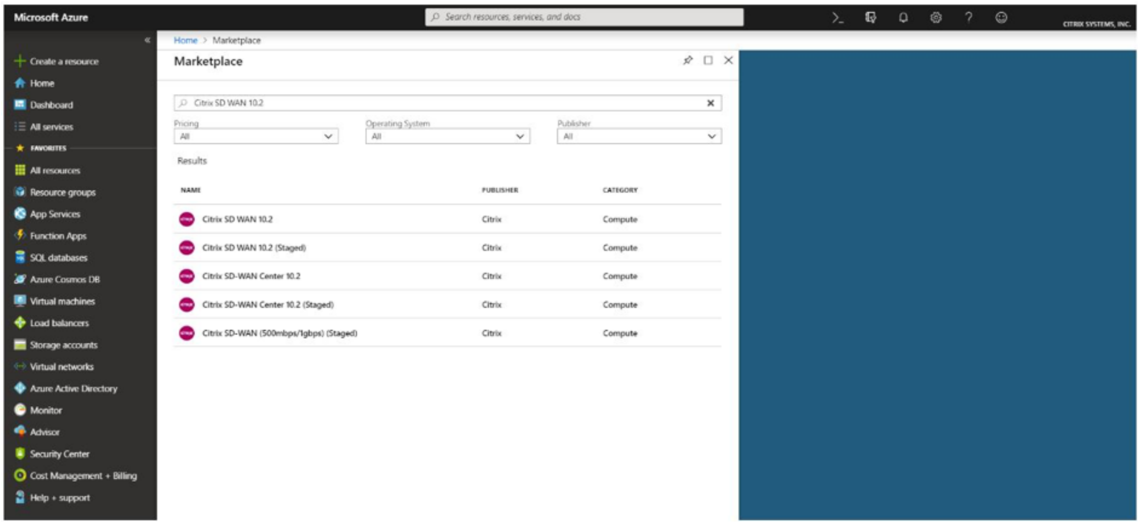
The third component in this integration is the **Network Location Service (NLS)** that allows internal users to bypass the gateway and connect to the VDA's directly, reducing latency for internal network traffic. You can configure NLS manually or through Citrix SD-WAN Orchestrator. For more information, see NLS.

Configuration

Citrix SD-WAN VM is deployed within a specified region (as needed by the customer) and can be connected to multiple branch office locations through MPLS, Internet, or 4G/LTE. Within a Virtual Network (VNET) infrastructure, SD-WAN Standard Edition (SE) VM is deployed in gateway mode. The VNET has routes towards the Azure gateway. The SD-WAN instance has a route towards the Azure gateway for internet connectivity. This route needs to be created manually.

1. In a web browser, go to Azure portal. Log into Microsoft Azure account and search for Citrix SD-WAN Standard Edition.

2. In the search results, choose the Citrix SD-WAN Standard Edition solution. Click **Create** after going through the description and making sure the solution chosen is correct.



Citrix SD WAN 10.2

Pricing: All

Operating System: All

Publisher: All

Results

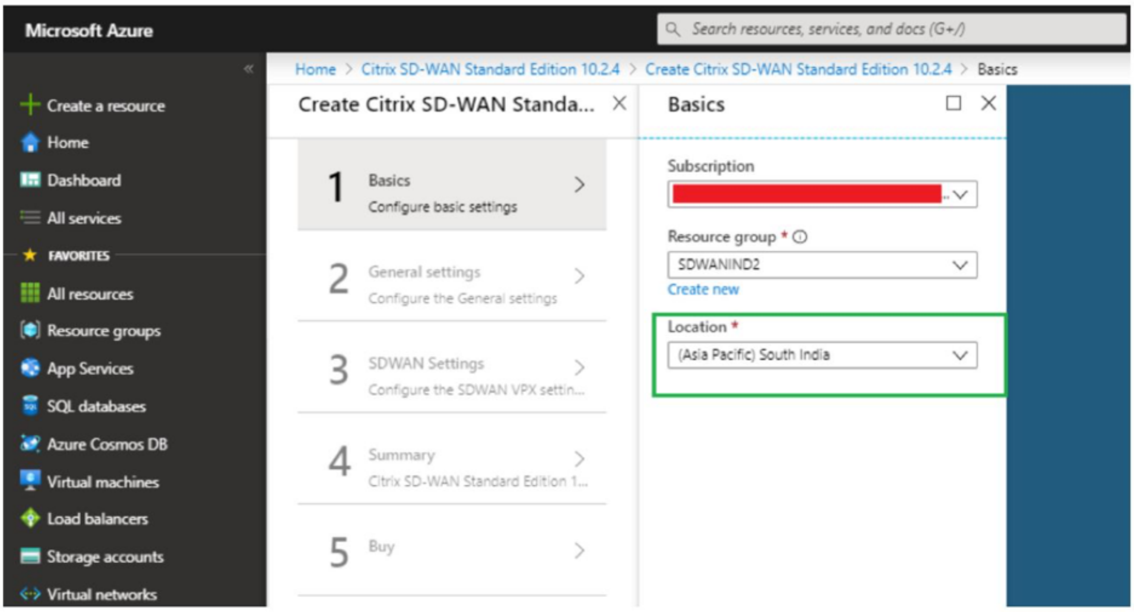
NAME	PUBLISHER	CATEGORY
Citrix SD WAN 10.2	Citrix	Compute
Citrix SD WAN 10.2 (Staged)	Citrix	Compute
Citrix SD-WAN Center 10.2	Citrix	Compute
Citrix SD-WAN Center 10.2 (Staged)	Citrix	Compute
Citrix SD-WAN (500mbps/1gbps) (Staged)	Citrix	Compute

On click of **Create**, a wizard prompting with necessary details to create the virtual machine.

3. In the **Basic settings** page, choose the resource group in which you want to deploy the SD-WAN SE solution.

   A resource group is a container that holds related resources for an Azure solution. The resource group can include all the resources for the solution, or only those resources that you want to manage as a group. You can decide how you want to allocate resources to resource groups based on your deployment.

   For Citrix SD-WAN, it's recommended that the resource group you choose must be empty. Similarly, pick the Azure region where you want to deploy the SD-WAN instance. The region must be the same as the region in which your Citrix Virtual Apps and Desktops resources are deployed.



Home > Citrix SD-WAN Standard Edition 10.2.4 > Create Citrix SD-WAN Standard Edition 10.2.4 > Basics

Create Citrix SD-WAN Standa...

1 Basics
Configure basic settings

2 General settings
Configure the General settings

3 SDWAN Settings
Configure the SDWAN VPX settin...

4 Summary
Citrix SD-WAN Standard Edition 1...

5 Buy

Basics

Subscription: [redacted]

Resource group *: SDWANIND2

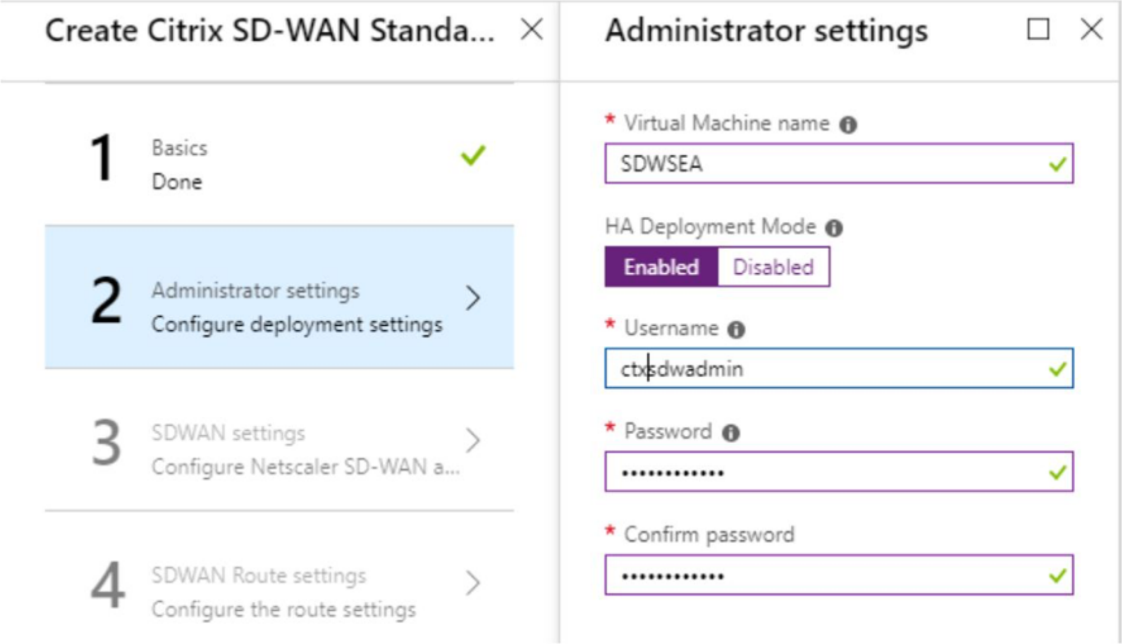
Create new

Location *: (Asia Pacific) South India

4. Under **Administrator settings** page, provide a name for the Virtual Machine. Choose a user name and strong password. The password must consist of an upper-case letter, special character and must be more than nine characters. Click **OK**.

   This password is required to log in to the management interface of the instance as a guest user. To get admin access to the instance, use admin as the user name and the password created while provisioning the instance. If you use the user name created while provisioning the instance, you get read-only access. Also, choose the deployment type here.

   If you want to deploy a single instance then make sure that you choose disabled from the HA Deployment mode option, else pick enabled. For production networks, Citrix always recommends deploying instances in HA mode as it guards your network against failures of the instance.



Create Citrix SD-WAN Standa...

1 Basics
Done ✓

2 Administrator settings
Configure deployment settings

3 SDWAN settings
Configure Netscaler SD-WAN a...

4 SDWAN Route settings
Configure the route settings

Administrator settings

* Virtual Machine name: SDWSEA ✓

HA Deployment Mode: [✓ Enabled] Disabled

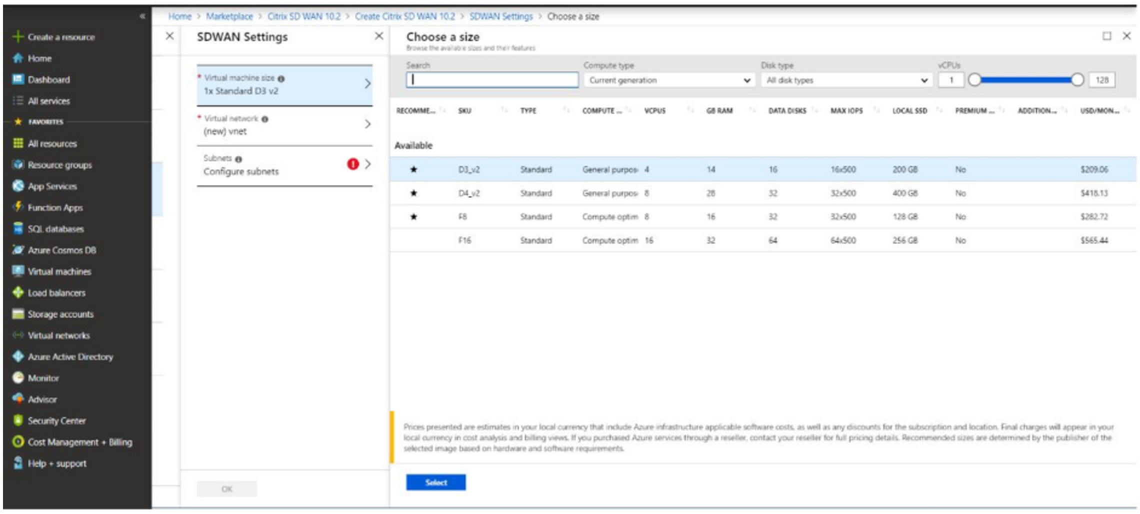
* Username: ctxsdwadmin ✓

* Password: •••••••••••• ✓

* Confirm password: •••••••••••• ✓

5. Under the **SD-WAN settings** page, choose the instance in which you want to run the image. Choose the following instance type as per your requirement:

   - Instance type D3_V2 for maximum uni-directional throughput of 200 Mbps with direct connectivity to a maximum of 16 branches.
   - Instance type D4_V2 for maximum uni-directional throughput of 500 Mbps with direct connectivity to a maximum of 16 branches.
   - Instance type F8 standard for maximum uni-directional throughput of 1 Gbps with direct connectivity to a maximum of 64 branches.
   - Instance type F16 standard for maximum uni-directional throughput of 1 Gbps with direct connectivity to a maximum of 128 branches.



SDWAN Settings

* Virtual machine size: 1x Standard D3 v2

* Virtual network: (new) vnet

Subnets: Configure subnets

Choose a size
Browse the available sizes and their features

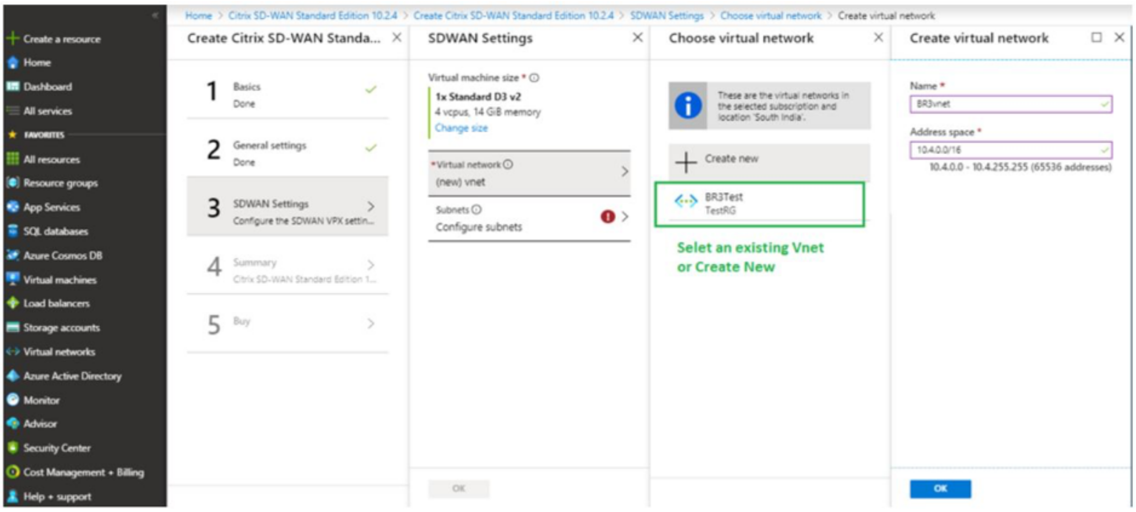
Search: | Compute type: Current generation | Disk type: All disk types | vCPUs: 1 – 128

Available

RECOMME...	SKU	TYPE	COMPUTE ...	VCPUS	GB RAM	DATA DISKS	MAX IOPS	LOCAL SSD	PREMIUM ...	ADDITION...	USD/MON...
★	D3_v2	Standard	General purpos	4	14	16	16x500	200 GB	No		$209.06
★	D4_v2	Standard	General purpos	8	28	32	32x500	400 GB	No		$418.13
★	F8	Standard	Compute optim	8	16	32	32x500	128 GB	No		$282.72
	F16	Standard	Compute optim	16	32	64	64x500	256 GB	No		$565.44

Prices presented are estimates in your local currency that include Azure infrastructure applicable software costs, as well as any discounts for the subscription and location. Final charges will appear in your local currency in cost analysis and billing views. If you purchased Azure services through a reseller, contact your reseller for full pricing details. Recommended sizes are determined by the publisher of the selected image based on hardware and software requirements.

6. Create a new Virtual Network (VNet) or use an existing VNet. This is the most critical step for the deployment as this step chooses the subnets to be assigned to the interfaces of the SD-WAN VPX VM.



Virtual machine size *
1x Standard D3 v2
4 vcpus, 14 GiB memory

*Virtual network
(new) vnet

Subnets
Configure subnets

These are the virtual networks in the selected subscription and location 'South India'.

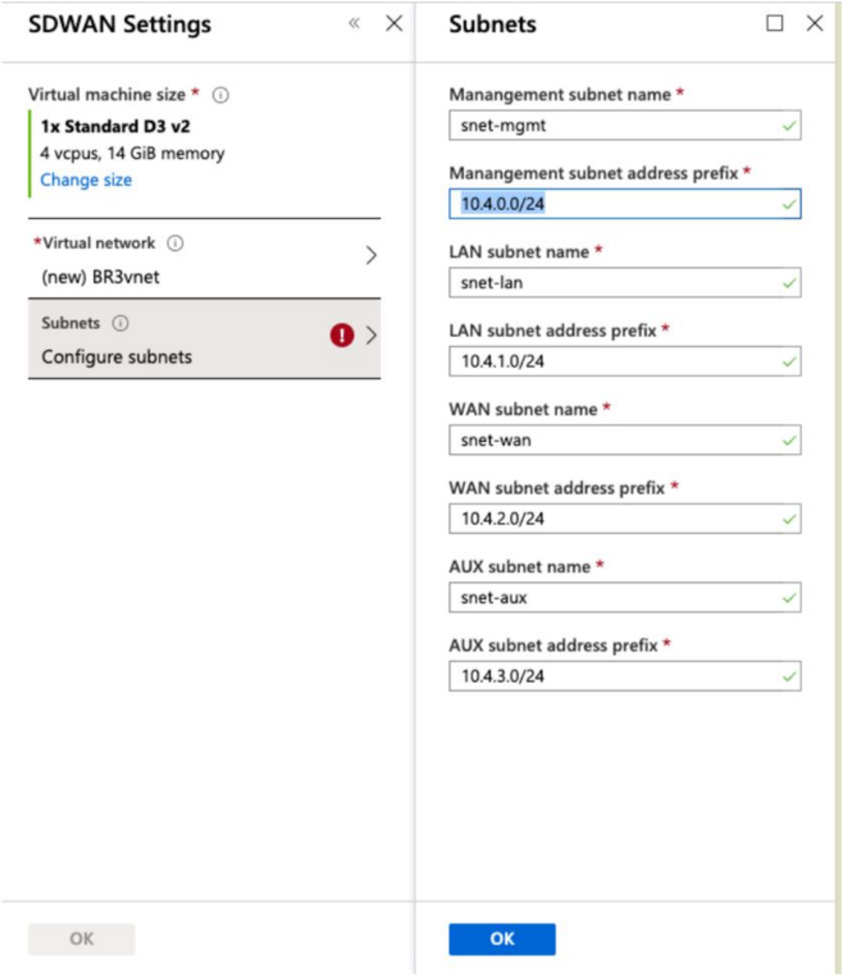
BR3Test
TestRG

Selet an existing Vnet or Create New

Name *
BR3vnet

Address space *
10.4.0.0/16
10.4.0.0 - 10.4.255.255 (65536 addresses)

The aux subnet is only needed when you are deploying the instances in HA mode. Ensure that the SD-WAN instance is being deployed in the same VNet as your Citrix Virtual Apps and Desktops resources and is on the same subnet as the LAN interface of the SD-WAN VPX appliance.



SDWAN Settings

Virtual machine size *

1x Standard D3 v2

4 vcpus, 14 GiB memory

Change size

*Virtual network

(new) BR3vnet

Subnets

Configure subnets

Subnets

Manangement subnet name *: snet-mgmt

Manangement subnet address prefix *: 10.4.0.0/24

LAN subnet name *: snet-lan

LAN subnet address prefix *: 10.4.1.0/24

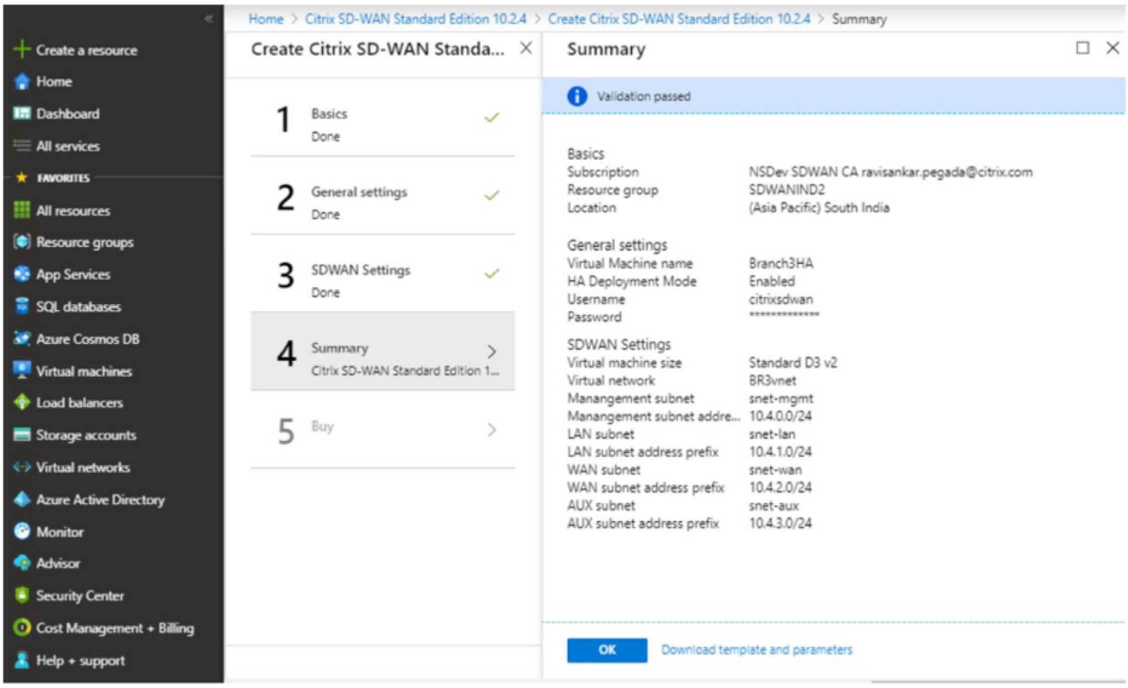
WAN subnet name *: snet-wan

WAN subnet address prefix *: 10.4.2.0/24

AUX subnet name *: snet-aux

AUX subnet address prefix *: 10.4.3.0/24

7. Verify the configuration in the **Summary** page and click **OK**.



Validation passed

Basics

Subscription	NSDev SDWAN CA ravisankar.pegada@citrix.com
Resource group	SDWANIND2
Location	(Asia Pacific) South India

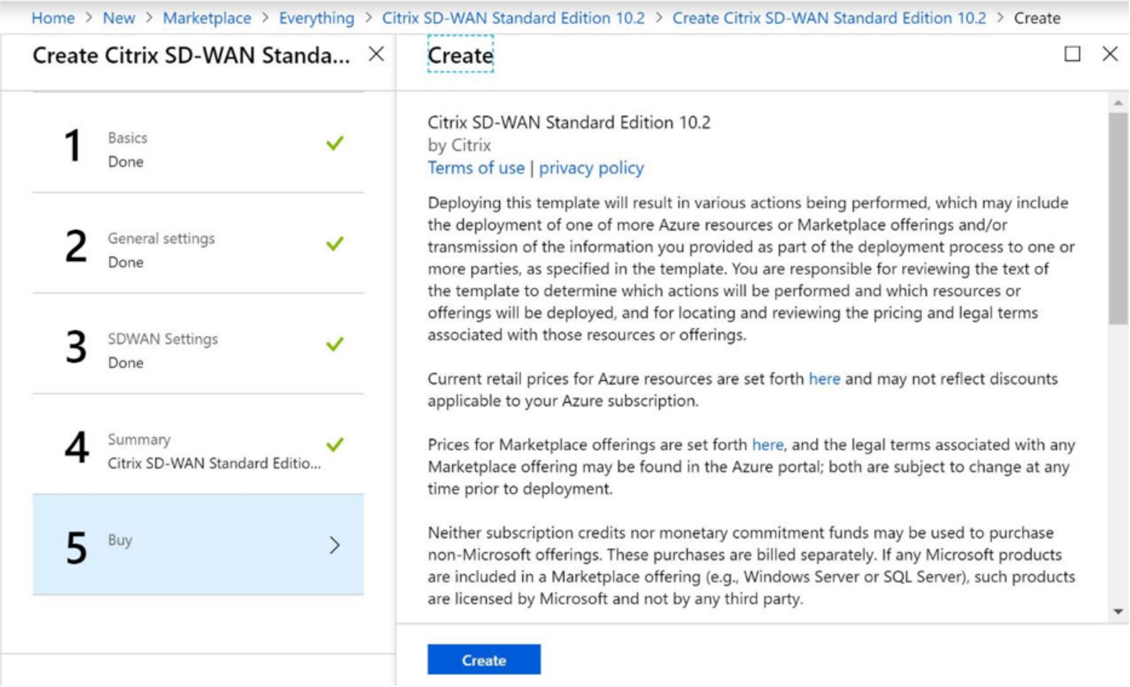
General settings

Virtual Machine name	Branch3HA
HA Deployment Mode	Enabled
Username	citrixsdwan
Password	*************

SDWAN Settings

Virtual machine size	Standard D3 v2
Virtual network	BR3vnet
Manangement subnet	snet-mgmt
Manangement subnet addre...	10.4.0.0/24
LAN subnet	snet-lan
LAN subnet address prefix	10.4.1.0/24
WAN subnet	snet-wan
WAN subnet address prefix	10.4.2.0/24
AUX subnet	snet-aux
AUX subnet address prefix	10.4.3.0/24

8. On the **Buy** page, click **Create** to start the provisioning process for the instances. It can take around 10 minutes for the instance to get provisioned. You get a notification in the Azure management portal suggesting the success/failure of instance creation.



Home > New > Marketplace > Everything > Citrix SD-WAN Standard Edition 10.2 > Create Citrix SD-WAN Standard Edition 10.2 > Create
Create Citrix SD-WAN Standa...
1 Basics Done
2 General settings Done
3 SDWAN Settings Done
4 Summary Citrix SD-WAN Standard Editio...
5 Buy
Create
Create

Citrix SD-WAN Standard Edition 10.2
by Citrix
Terms of use | privacy policy

Deploying this template will result in various actions being performed, which may include the deployment of one of more Azure resources or Marketplace offerings and/or transmission of the information you provided as part of the deployment process to one or more parties, as specified in the template. You are responsible for reviewing the text of the template to determine which actions will be performed and which resources or offerings will be deployed, and for locating and reviewing the pricing and legal terms associated with those resources or offerings.

Current retail prices for Azure resources are set forth here and may not reflect discounts applicable to your Azure subscription.

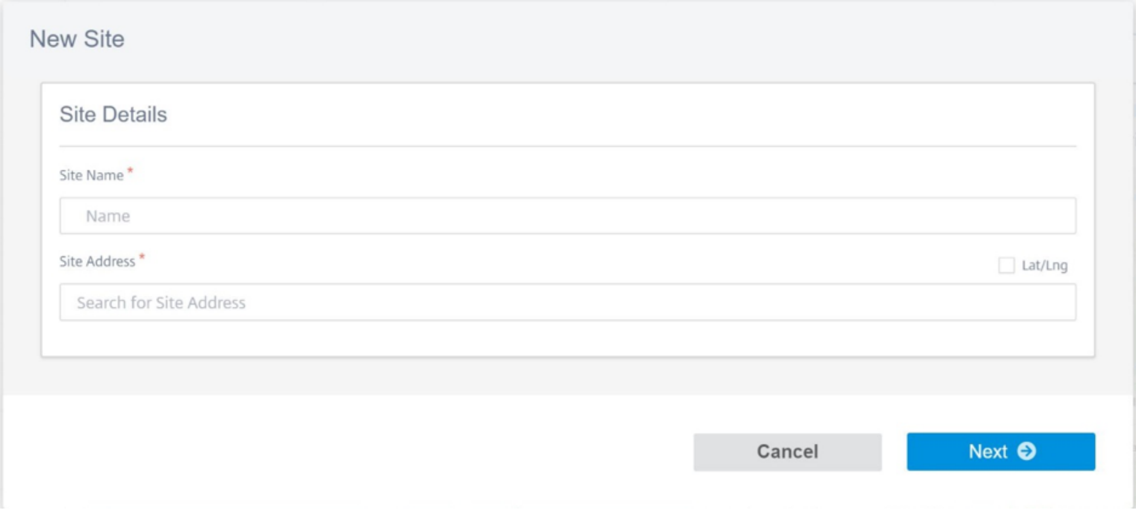
Prices for Marketplace offerings are set forth here, and the legal terms associated with any Marketplace offering may be found in the Azure portal; both are subject to change at any time prior to deployment.

Neither subscription credits nor monetary commitment funds may be used to purchase non-Microsoft offerings. These purchases are billed separately. If any Microsoft products are included in a Marketplace offering (e.g., Windows Server or SQL Server), such products are licensed by Microsoft and not by any third party.

Once the instance is created successfully, fetch the public IP assigned to the management interface of the SD-WAN instance. It can be found under the networking section of the resource group within which the instance has been provisioned. Once retrieved you might use it to log in to the instance.

> **Note**
>
> For admin access, the user name is **admin** and the password is the one that you have set during instance creation.

9. Once the site has been provisioned, log into the SD-WAN Orchestrator to configure it. As mentioned in the pre-requisites, you must have the entitlement to SD-WAN Orchestrator to configure the site. If you do not have it yet, refer Citrix SD-WAN Orchestrator Onboarding.
10. If you have an SD-WAN network already, then proceed to creating the configuration for the site that you provisioned in Azure. Otherwise you must create an MCN. For more information, see Network configuration.
11. Once you have access to SD-WAN Orchestrator and already have set up an MCN, login to SD-WAN orchestrator and click the **+New site** to start configuring the SD-WAN VPX appliance (that you have provisioned in Azure).



New Site

Site Details

Site Name *

Name

Site Address *

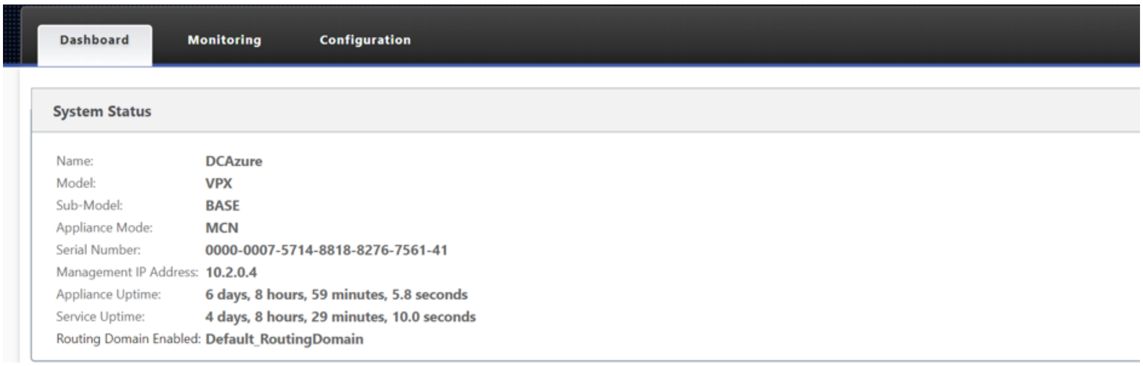
□ Lat/Lng

Search for Site Address

12. Provide a unique site name and enter the address based on the region in which you are provisioning the image. To set up the instance in Azure, refer Basic settings.

> **Note**
>
> To fetch the serial number of the instance in Azure, log in to the instance via the public management IP. You can see the serial number on the dashboard screen. If you are configuring instances in HA then both the serial numbers must be captured. Also, while configuring the instance, ensure that the interfaces are chosen as **Trusted**.

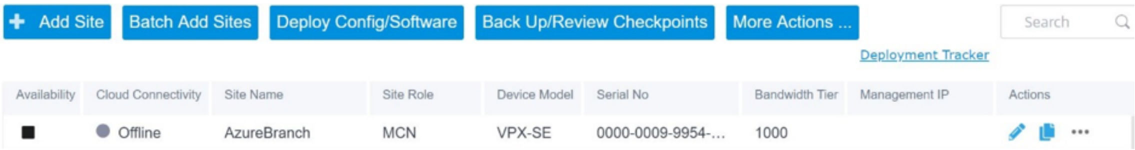
13. For fetching the IP addresses associated with LAN and WAN interfaces on Azure. Navigate to the **Azure portal > Resource groups > Resource group** where the SD-WAN is **provisioned >SD-WAN VM > Networking**.



System Status

Name:	DCAzure
Model:	VPX
Sub-Model:	BASE
Appliance Mode:	MCN
Serial Number:	0000-0007-5714-8818-8276-7561-41
Management IP Address:	10.2.0.4
Appliance Uptime:	6 days, 8 hours, 59 minutes, 5.8 seconds
Service Uptime:	4 days, 8 hours, 29 minutes, 10.0 seconds
Routing Domain Enabled:	Default_RoutingDomain

14. Once you are done with the configuration of the instance. Click **Deploy Config/Software** by navigating to **Configuration > Network config Home**.



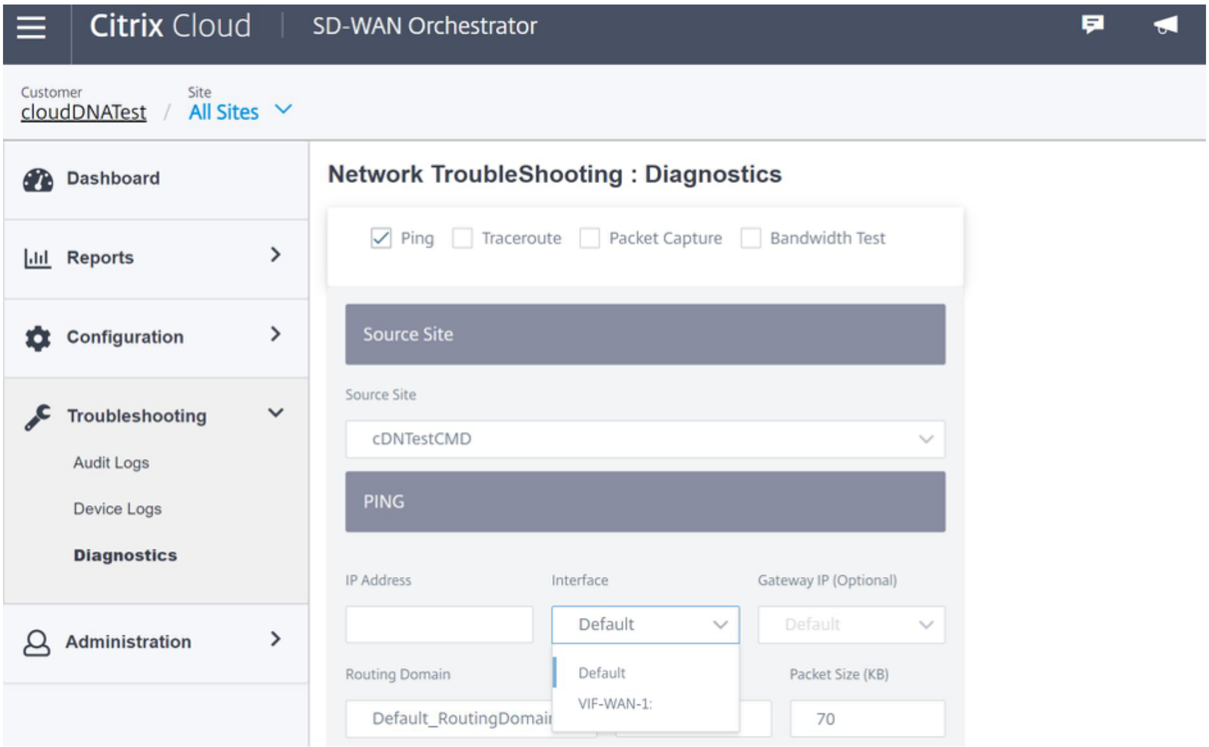
Availability	Cloud Connectivity	Site Name	Site Role	Device Model	Serial No	Bandwidth Tier	Management IP	Actions
■	● Offline	AzureBranch	MCN	VPX-SE	0000-0009-9954-...	1000		✎ ⧉ •••

15. If there are no issues and the configuration is accurate, you must have the virtual paths up between the instance in Azure and your MCN once the configuration deployment is run.

Citrix Virtual Apps and Desktops configuration

As highlighted in the Deployment and configuration section, the AD/DNS is present in the on-premises location acting as the DC and in a deployment featuring SD-WAN it presents behind the SD-WAN that is on the LAN network. It is the IP of your AD/DNS that you need to configure here. In case you are making use of Azure Active Directory service/DNS, configure **168.63.129.16** as the DNS IP.

If you are making use of an on-premises AD/DNS.Check if you are able to ping the IP of your DNS from your SD-WAN appliance. You can do this by navigating to **Troubleshooting > Diagnostics**. Check the **Ping** check box and initiate a ping from the LAN interface/Default interface of the SD-WAN appliance to the IP of your AD/DNS.



Network TroubleShooting : Diagnostics

☑ Ping □ Traceroute □ Packet Capture □ Bandwidth Test

Source Site

Source Site: cDNTestCMD

PING

IP Address:

Interface: Default (Default, VIF-WAN-1:)

Gateway IP (Optional): Default

Routing Domain: Default_RoutingDomai

Packet Size (KB): 70

If the ping succeeds, then it signifies that your AD/DNS can be reached successfully, if not then it means there is routing issue in your network which is preventing reachability to your AD/DNS. If possible, try to host your AD and SD-WAN appliance on the same LAN segment.

In case there is still an issue, get in touch with your network admin. Without completing this step successfully, the catalog creation step will not succeed and you get an error message as **Global DNS IP not configured**.

> **Note**
>
> Ensure that the DNS is capable of resolving both internal and external IPs.

Network location service

With the **Network Location** service in Citrix Cloud, you can optimize internal traffic to the apps and desktops you make available to subscribers'workspaces to make HDX sessions faster. Users on both internal and external networks have to connect to VDAs through an external gateway. While this is expected for external users, internal users experience slower connections to virtual resources. The **Network Location** service allows internal users to bypass the gateway and connect to the VDAs directly, reducing latency for internal network traffic.

Configuration

To set up the **Network Location** service, use one of the following methods:

- **Citrix SD-WAN Orchestrator**: For detailed information on configuring NLS using Citrix SD-WAN Orchestrator, see Network location service.
- **Network Location service PowerShell module that Citrix provides**: For detailed information on configuring NLS using PowerShell module, see PowerShell module and configuration.

The network locations share the public IP ranges of the networks where your internal users are connecting from. When subscribers launch Virtual Apps and Desktops sessions from their workspace, Citrix Cloud detects whether subscribers are internal or external to the company network based on the public IP address of the network from which they are connecting.

If a subscriber connects from the internal network, Citrix Cloud routes the connection directly to the VDA, bypassing Citrix Gateway. If a subscriber connects externally, Citrix Cloud routes the subscriber through Citrix Gateway as expected and then redirects the subscriber to the VDA in the internal network.

> **NOTE**
>
> The public IP that needs to be configured in network location service needs to be the public IP assigned to the WAN links.

Domain name system

August 24, 2022

Domain Name System (DNS) translates human readable domain names to machine-readable IP addresses, and vice versa. Citrix SD-WAN provides the following DNS features:

- DNS Proxy
- DNS Transparent Forwarding

You can configure a DNS proxy or DNS transparent forwarding through Citrix SD-WAN Orchestrator service using the following types of DNS service:

- **Static DNS service**: Allows you to configure the static IPv4 DNS server IP addresses. You can create Internal, ISP, google, or any other open source DNS service. Static DNS service can be configured at global and site level.
- **Dynamic DNS service**: Allows you to configure the dynamic IPv4 DNS server IP addresses. Dynamic DNS service can be configured at site level only. Only one dynamic DNS service is permitted per site.

- **StaticV6 DNS service**: Allows you to configure the static IPv6 DNS server IP addresses. You can create Internal, ISP, google, or any other open source DNS service. StaticV6 DNS service can be configured at global and site level.
- **DynamicV6 DNS service**: Allows you to configure the dynamic IPv6 DNS server IP addresses. DynamicV6 DNS service can be configured at site level only. Only one dynamic DNS service is permitted per site.

DNS proxy

You can configure a proxy with multiple forwarders that helps steering DNS requests based on application domain names. DNS forwarding works for the requests that are received through UDP connections. For information on how to configure DNS proxy through SD-WAN Orchestrator service, see DNS proxy.

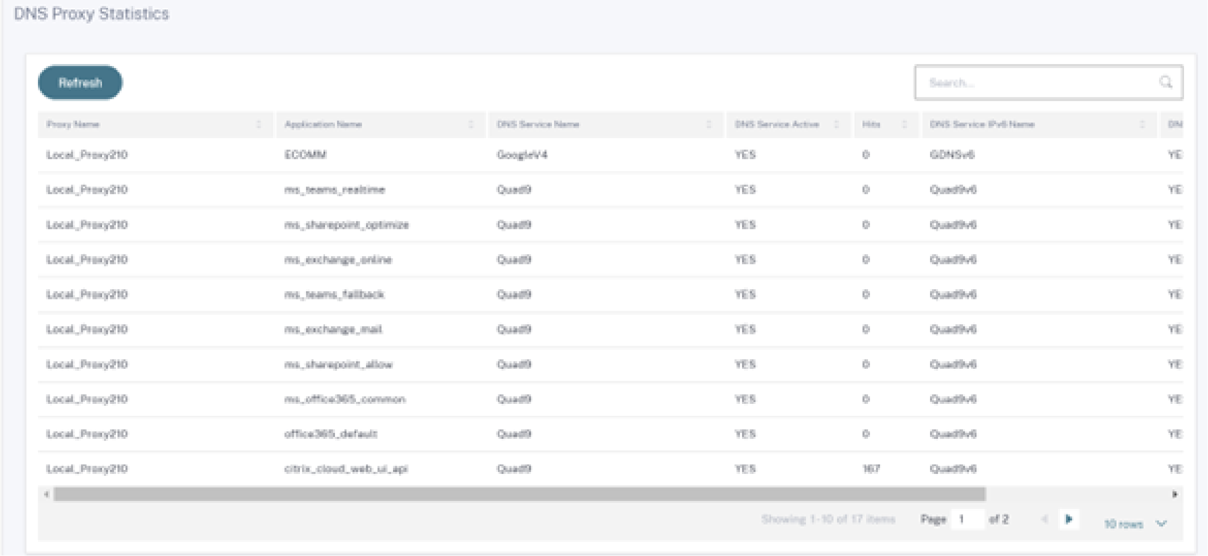
DNS transparent forwarder

Citrix SD-WAN can be configured as a transparent DNS forwarder. In this mode, SD-WAN can intercept DNS requests that are not destined to its IP address and forward them to the specified DNS service. Only the DNS requests coming from local service on trusted interfaces are intercepted. If the DNS requests match any applications in the DNS forwarder list, then it is forwarded to the configured DNS service. DNS forwarding is supported only for requests coming over UDP connections. For information on how to configure DNS tranparent forwarder through SD-WAN Orchestrator service, see DNS tranparent forwarders.

Monitoring

To view Proxy statistics and Transparent forwarder statistics, navigate to **Monitoring > DNS**.
You can view the application name, DNS service name, DNS service status, and the number of hits to the DNS service.

Proxy Statistics

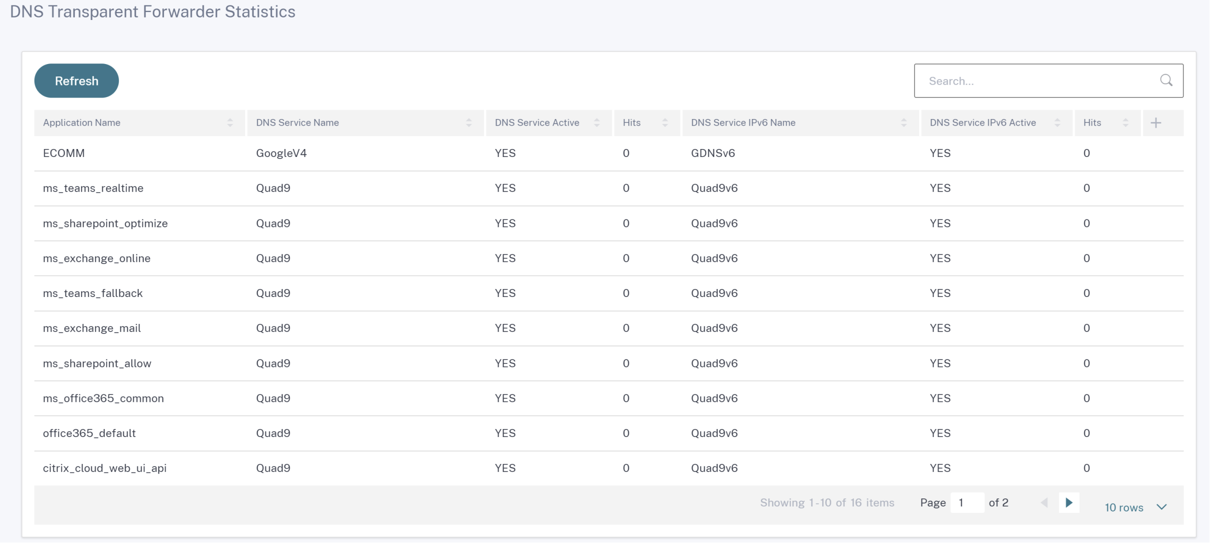


DNS Proxy Statistics

Proxy Name	Application Name	DNS Service Name	DNS Service Active	Hits	DNS Service IPv6 Name	DN
Local_Proxy210	ECOMM	GoogleV4	YES	0	GDNSv6	YE
Local_Proxy210	ms_teams_realtime	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_sharepoint_optimize	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_exchange_online	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_teams_fallback	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_exchange_mail	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_sharepoint_allow	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_office365_common	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	office365_default	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	citrix_cloud_web_ui_api	Quad9	YES	167	Quad9v6	YE

Showing 1-10 of 17 items Page 1 of 2 10 rows

Transparent Forwarder Statistics



DNS Transparent Forwarder Statistics

Application Name	DNS Service Name	DNS Service Active	Hits	DNS Service IPv6 Name	DNS Service IPv6 Active	Hits
ECOMM	GoogleV4	YES	0	GDNSv6	YES	0
ms_teams_realtime	Quad9	YES	0	Quad9v6	YES	0
ms_sharepoint_optimize	Quad9	YES	0	Quad9v6	YES	0
ms_exchange_online	Quad9	YES	0	Quad9v6	YES	0
ms_teams_fallback	Quad9	YES	0	Quad9v6	YES	0
ms_exchange_mail	Quad9	YES	0	Quad9v6	YES	0
ms_sharepoint_allow	Quad9	YES	0	Quad9v6	YES	0
ms_office365_common	Quad9	YES	0	Quad9v6	YES	0
office365_default	Quad9	YES	0	Quad9v6	YES	0
citrix_cloud_web_ui_api	Quad9	YES	0	Quad9v6	YES	0

Showing 1-10 of 16 items Page 1 of 2 10 rows

DHCP

September 19, 2022

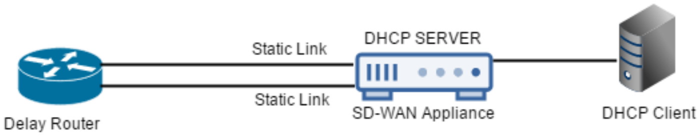
Citrix SD-WAN introduces the ability to use Standard Edition appliances as either DHCP Servers or DHCP Relay agents. The DHCP server feature allows devices on the same network as the SD-WAN appliance's LAN/WAN interface to obtain their IP configuration from the SD-WAN appliance. The DHCP relay feature allows your SD-WAN appliances to forward DHCP packets between DHCP client and server.

The following are the benefits of using the DHCP server and DHCP relay features:

- Reduce the amount of equipment at client site.
- Replace router at client site (Easy deployment of edge router services).
- Simplify the client site network.
- Configuration of Router without CLI commands.
- Reduce manual configuration on simple client sites.

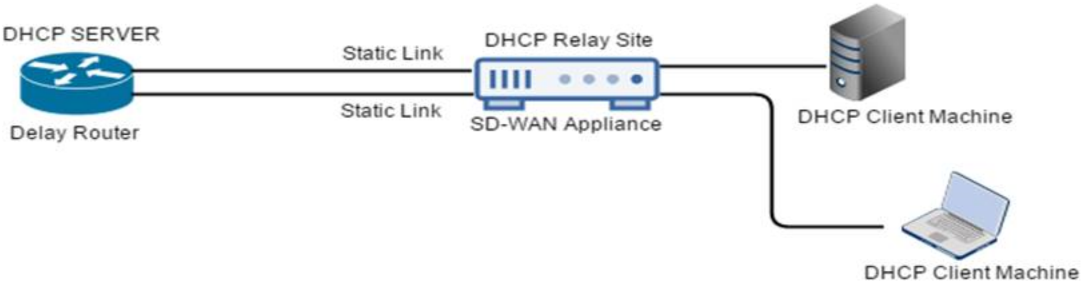
DHCP server

Citrix SD-WAN appliances can be configured as DHCP server. It can assigns and manages IP addresses from specified address pools within the network to DHCP clients. The DHCP server can be configured to assign more parameters such as the IP address of the Domain Name System (DNS) server and the default router. DHCP server accepts address assignment requests and renewals. The DHCP server also accepts broadcasts from locally attached LAN segments or from DHCP requests forwarded by other DHCP relay agents within the network.



DHCP relay

A DHCP relay agent is a host or router that forwards DHCP packets between clients and servers. Network administrators can use the DHCP Relay service of the SD-WAN appliances to relay requests and replies between local DHCP Clients and a remote DHCP Server. It allows local hosts to acquire dynamic IP addresses from the remote DHCP Server. Relay agent receives DHCP messages and generates a new DHCP message to send out on another interface.



WAN link IP address learning through DHCP client

Citrix SD-WAN appliances support WAN Link IP address learning through DHCP Clients. This functionality reduces the amount of manual configuration required to deploy SD-WAN appliances and reduces ISP costs by eliminating the need to purchase static IP addresses. SD-WAN appliances can obtain dynamic IP addresses for WAN Links on untrusted interfaces. This eliminates the need for an intermediary WAN router to perform this function.

> **Note**
>
> - DHCP Client can only be configured for untrusted non-bridged interfaces configured as Client Nodes.
> - DHCP client and data port can be enabled on MCN/RCN only if Public IP address is configured.
> - One-Arm or Policy Based Routing (PBR) deployment is not supported on the site with DHCP Client configuration.
> - DHCP events are logged from the client's perspective only and no DHCP server logs are generated.

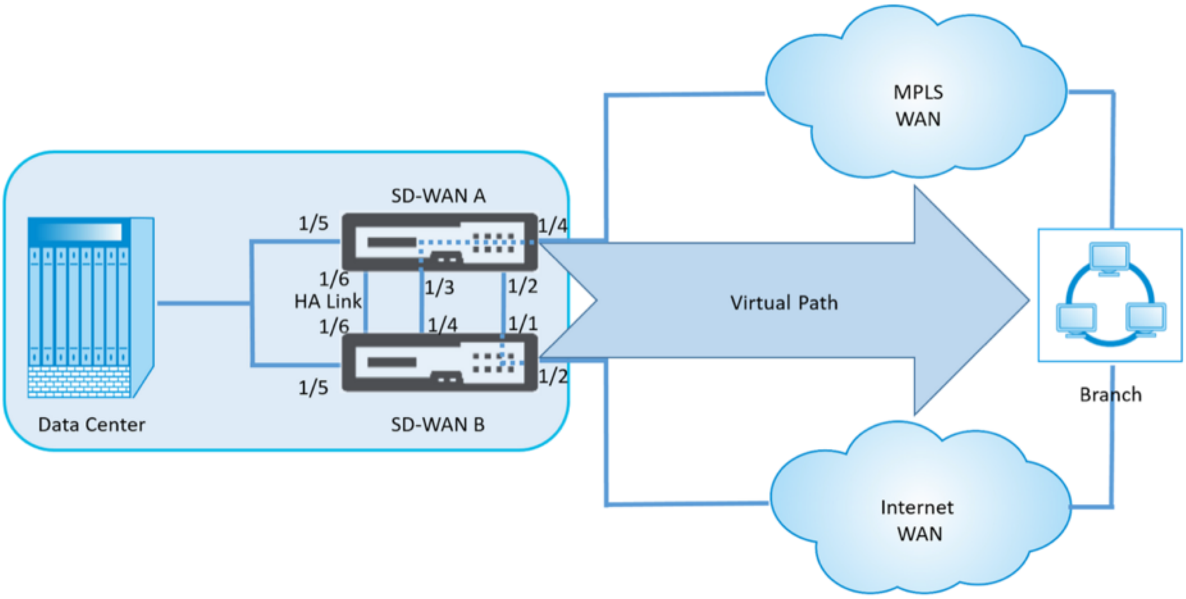
From Citrix SD-WAN 11.5 release onwards, you can configure DHCP for an untrusted virtual interface on fail-to-block mode through Citrix SD-WAN Orchestrator service. For more information, see WAN link IP address learning through DHCP client.

DHCP support on Fail-to-Wire port

Earlier, the DHCP client was only supported on Fail-to-block port. With 11.2.0 release, the DHCP client capability is extended on fail-to-wire port for the branch site with serial High Availability (HA) deployments. This enhancement:

- Allows the DHCP client configuration on untrusted interface group that has fail-to-wire bridge pair and serial HA deployments.
- Allows DHCP interfaces to be selected as part of **Private Intranet WAN links**.

DHCP client is now supported on the private intranet link.



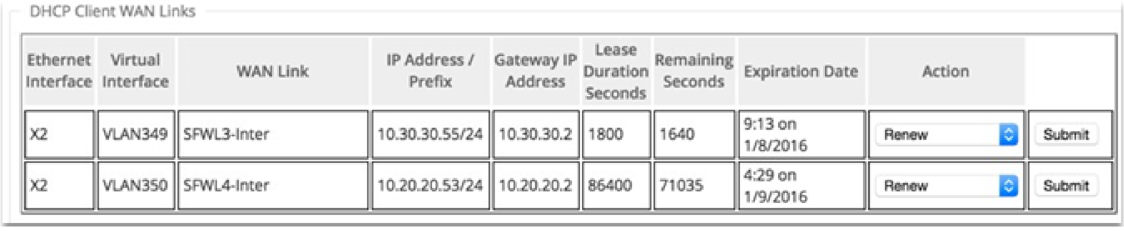
> **Note**:
>
> A LAN interface must not be connected into the fail-to-wire pair as packets might be bridged between the interfaces.

Monitoring DHCP client WAN links

The runtime Virtual IP address, Subnet Mask, and Gateway settings are logged and archived in a log file called *SDWANVW_ip_learned.log.* Events are generated when Dynamic Virtual IPs are learned, released, or expired, and when there is a communication issue with the learned Gateway or DHCP server. Or when duplicate IP addresses are detected in the archived log file. If duplicate IPs are detected at a site, Dynamic Virtual IP addresses are released and renewed until all Virtual Interfaces at the site obtain unique Virtual IP addresses.

To monitor DHCP client WAN links:

1. In the SD-WAN appliance, **Enable/Disable/Purge Flows** page, the DHCP Client WAN Links table provides the status of learned IPs.
2. You can request to renew the IP, which refreshes the lease time. You can also choose to **Release Renew**, which issues a new IP address or the same IP address with a new lease.



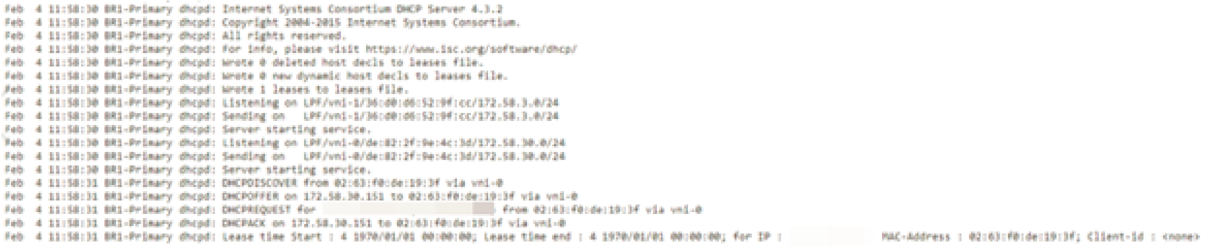
DHCP Client WAN Links

Ethernet Interface	Virtual Interface	WAN Link	IP Address / Prefix	Gateway IP Address	Lease Duration Seconds	Remaining Seconds	Expiration Date	Action	
X2	VLAN349	SFWL3-Inter	10.30.30.55/24	10.30.30.2	1800	1640	9:13 on 1/8/2016	Renew	Submit
X2	VLAN350	SFWL4-Inter	10.20.20.53/24	10.20.20.2	86400	71035	4:29 on 1/9/2016	Renew	Submit

DHCP logs

Citrix SD-WAN enables you to generate DHCP server logs for IP addresses. Whenever IP addresses are allocated to endpoints, the logs are generated. The logs contain details such as the timestamp of the IP address allocation and lease duration, MAC address, the client ID and so on. The client ID **none** indicates that it is not present in the DHCP request.

To generate and view DHCP logs, navigate to **Configuration** > **Logging/Monitoring**. Select the **SD-WAN_dhcp.log** option from the drop-down list and click **View Log**.



```
Feb  4 11:58:30 BR1-Primary dhcpd: Internet Systems Consortium DHCP Server 4.3.2
Feb  4 11:58:30 BR1-Primary dhcpd: Copyright 2004-2015 Internet Systems Consortium.
Feb  4 11:58:30 BR1-Primary dhcpd: All rights reserved.
Feb  4 11:58:30 BR1-Primary dhcpd: For info, please visit https://www.isc.org/software/dhcp/
Feb  4 11:58:30 BR1-Primary dhcpd: Wrote 0 deleted host decls to leases file.
Feb  4 11:58:30 BR1-Primary dhcpd: Wrote 0 new dynamic host decls to leases file.
Feb  4 11:58:30 BR1-Primary dhcpd: Wrote 1 leases to leases file.
Feb  4 11:58:30 BR1-Primary dhcpd: Listening on LPF/vni-1/36:d0:d6:52:9f:cc/172.58.3.0/24
Feb  4 11:58:30 BR1-Primary dhcpd: Sending on   LPF/vni-1/36:d0:d6:52:9f:cc/172.58.3.0/24
Feb  4 11:58:30 BR1-Primary dhcpd: Server starting service.
Feb  4 11:58:30 BR1-Primary dhcpd: Listening on LPF/vni-0/de:82:2f:9e:4c:3d/172.58.30.0/24
Feb  4 11:58:30 BR1-Primary dhcpd: Sending on   LPF/vni-0/de:82:2f:9e:4c:3d/172.58.30.0/24
Feb  4 11:58:30 BR1-Primary dhcpd: Server starting service.
Feb  4 11:58:31 BR1-Primary dhcpd: DHCPDISCOVER from 02:63:f0:de:19:3f via vni-0
Feb  4 11:58:31 BR1-Primary dhcpd: DHCPOFFER on 172.58.30.151 to 02:63:f0:de:19:3f via vni-0
Feb  4 11:58:31 BR1-Primary dhcpd: DHCPREQUEST for [redacted] from 02:63:f0:de:19:3f via vni-0
Feb  4 11:58:31 BR1-Primary dhcpd: DHCPACK on 172.58.30.151 to 02:63:f0:de:19:3f via vni-0
Feb  4 11:58:31 BR1-Primary dhcpd: Lease time Start : 4 1970/01/01 00:00:00; Lease time end : 4 1970/01/01 00:00:00; for IP : [redacted] MAC-Address : 02:63:f0:de:19:3f; Client-Id : <none>
```

> **Note**
>
> These logs are generated only when Citrix SD-WAN acts as a DHCP server.

Dynamic PAC file customization

August 24, 2022

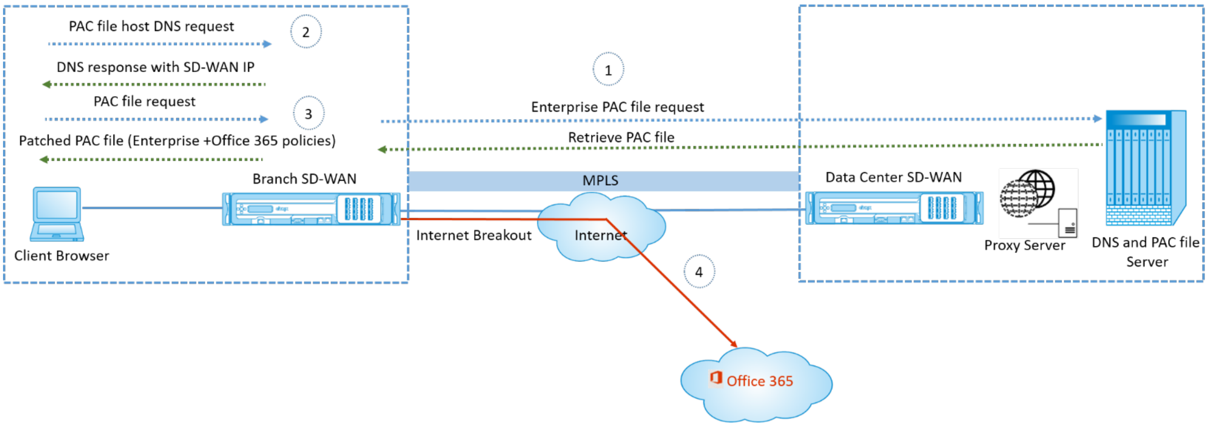
With the increase in enterprise adoption of mission-critical SaaS applications and distributed workforce, it becomes highly critical to reduce latency and congestion. Latency and congestion are inherent in traditional methods of backhauling traffic through the Data Center. Citrix SD-WAN allows direct internet break out of SaaS applications such as Office 365. For more information, see Office 365 Optimization.

If there are explicit web proxies configured on the enterprise deployment all traffic are steered to the web proxy making it difficult for classification and direct internet breakout. The solution is to exclude SaaS application traffic from getting proxied by customizing the enterprise PAC (Proxy Auto-Config) file.

Citrix SD-WAN 11.0 allows proxy bypass and local Internet breakout for Office 365 application traffic by dynamically generating and serving custom PAC file. PAC file is a JavaScript function that defines whether web browser requests go directly to the destination or to a web proxy server.

How PAC file customization works

Ideally, the enterprise network host PAC file on the internal web server, these proxy settings are distributed via group policy. The Client browser requests for PAC files from the enterprise web server. The Citrix SD-WAN appliance serves the customized PAC files for sites where Office 365 breakout is enabled.



1. Citrix SD-WAN periodically requests and retrieves the latest copy of the enterprise PAC file from the enterprise web server. The Citrix SD-WAN appliance patches office 365 URLs to the enterprise PAC file. The enterprise PAC file is expected to have a placeholder (SD-WAN specific tag) where the Office 365 URLs are seamlessly patched.
2. The Client browser raises a DNS request for enterprise PAC file host. Citrix SD-WAN intercepts the request for the proxy configuration file FQDN and responds with the Citrix SD-WAN VIP.
3. The Client browser requests for the PAC file. Citrix SD-WAN appliance serves the patched PAC file locally. The PAC file includes enterprise proxy configuration and Office 365 URL exclusion policies.
4. On receiving a request for Office 365 application, the Citrix SD-WAN appliance performs a direct internet breakout.

Prerequisites

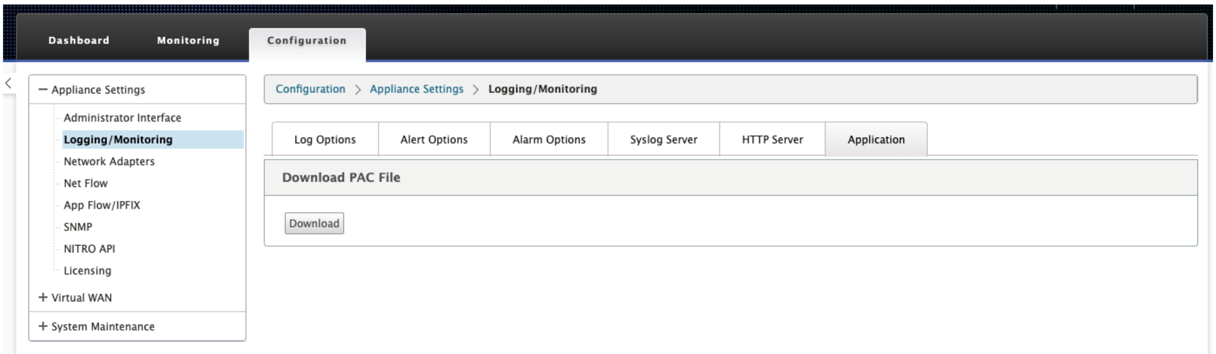
1. The enterprises should have a PAC file hosted.
2. The PAC file should have a placeholder *SDWAN_TAG* or one occurrence of *findproxyforurl* function for patching Office 365 URLs.
3. The PAC file URL should be domain based and not IP based.
4. The PAC file is served only over the trusted identity VIPs.
5. Citrix SD-WAN appliance should be able to download enterprise PAC file over its management interface.

Configure PAC file customization

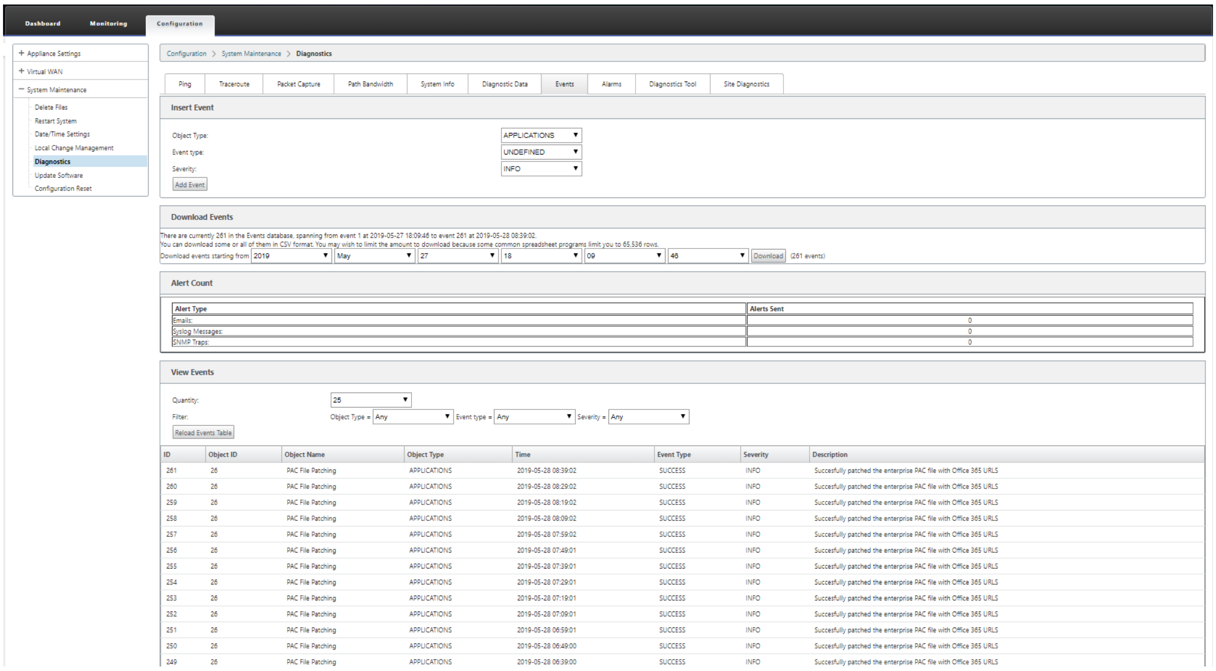
You can enable PAC file customization using Citrix SD-WAN Orchestrator service. For more information, see Proxy auto config.

Troubleshooting

You can download the customized PAC file from the Citrix SD-WAN appliance for troubleshooting. Navigate to **Configuration** > **Appliance Settings** > **Logging/Monitoring** > **Application and click Download**.



You can also view the PAC file patching status in the **Events** section, navigate to **Configuration** > **System Maintenance** > **Diagnostics**, click **Events** tab.



Insert Event

Object Type: APPLICATIONS

Event type: UNDEFINED

Severity: INFO

Download Events

There are currently 261 in the Events database, spanning from event 1 at 2019-05-27 18:09:46 to event 261 at 2019-05-28 08:39:02.
You can download some or all of them in CSV format. You may wish to limit the amount to download because some common spreadsheet programs limit you to 65,536 rows.
Download events starting from 2019 May 27 18 09 46 (261 events)

Alert Count

Alert Type	Alerts Sent
Emails:	0
Syslog Messages:	0
SNMP Traps:	0

View Events

Quantity: 25

Filter: Object Type = Any Event type = Any Severity = Any

ID	Object ID	Object Name	Object Type	Time	Event Type	Severity	Description
261	26	PAC File Patching	APPLICATIONS	2019-05-28 08:39:02	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
260	26	PAC File Patching	APPLICATIONS	2019-05-28 08:29:02	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
259	26	PAC File Patching	APPLICATIONS	2019-05-28 08:19:02	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
258	26	PAC File Patching	APPLICATIONS	2019-05-28 08:09:02	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
257	26	PAC File Patching	APPLICATIONS	2019-05-28 07:59:02	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
256	26	PAC File Patching	APPLICATIONS	2019-05-28 07:49:01	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
255	26	PAC File Patching	APPLICATIONS	2019-05-28 07:39:01	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
254	26	PAC File Patching	APPLICATIONS	2019-05-28 07:29:01	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
253	26	PAC File Patching	APPLICATIONS	2019-05-28 07:19:01	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
252	26	PAC File Patching	APPLICATIONS	2019-05-28 07:09:01	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
251	26	PAC File Patching	APPLICATIONS	2019-05-28 06:59:01	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
250	26	PAC File Patching	APPLICATIONS	2019-05-28 06:49:00	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS
249	26	PAC File Patching	APPLICATIONS	2019-05-28 06:39:00	SUCCESS	INFO	Succesfully patched the enterprise PAC file with Office 365 URLS

Limitations

- HTTPS PAC file server requests are not supported.
- Multiple PAC files in a network are not supported, including PAC files for routing domains or security zones.
- Generating PAC file on Citrix SD-WAN from scratch is not supported.
- WPAD through DHCP is not supported.

GRE tunnel

August 24, 2022

The GRE Tunnel feature allows you to configure Citrix SD-WAN Appliances to terminate GRE tunnels on the LAN or Intranet.To configure a GRE Tunnel using SD-WAN Orchestrator service, see GRE service.

In-band and backup management

August 24, 2022

In-band management

Citrix SD-WAN allows you to manage the SD-WAN appliance in two ways, out-of-band management and in-band management. Out-of-band management allows you to create a management IP using a port reserved for management, which carries management traffic only. In-band management allows you to use the SD-WAN data ports for management. It carries both data and management traffic, without having to configure an addition management path.

In-band management allows virtual IP addresses to connect to management services such as web UI and SSH. You can enable In-band management on multiple trusted interfaces that are enabled to be used for IP services. You can access the web UI and SSH using the management IP and in-band virtual IPs.

From Citrix SD-WAN 11.4.2 release onwards, it is mandatory to configure In-band management to establish connectivity to Citrix SD-WAN Orchestrator service through an In-band management port. Otherwise, the appliance loses connectivity to Citrix SD-WAN Orchestrator service when the management port is not connected and the In-band IP address is also not configured.

> **Note**
>
> - Citrix SD-WAN Orchestrator service does not allow configuring **Service Type** as **Any** for destination NAT policies.
> - Avoid disabling the service when the only management connectivity is in-band HA. You can get yourself locked out of the appliance if you disable the service.

From Citrix SD-WAN 11.5 onwards, you can enable in-band management on a virtual IP only through Citrix SD-WAN Orchestrator service. For more information, see Inband management.

From Citrix SD-WAN 11.3.1 release onwards, In-band management supports High Availability appliance pairs. The communication between the primary and secondary appliances happen through the virtual interfaces using NAT.

The following ports allow communication with management services on the HA appliances:

- HTTPS
  - 443 - Connects to the HA active
  - 444 - Redirects to the HA primary
  - 445 - Redirects to the HA secondary
- SSH
  - 22 - Connects to the HA active
  - 23 - Redirects to the HA primary
  - 24 - Redirects to the HA secondary
- SNMP
  - 161 - Connects to the HA active
  - 162 - Redirects to the HA primary
  - 163 - Redirects to the HA secondary

Use destination NAT policies to create IP addresses that allow connectivity to In-band HA without the need to enter a port.

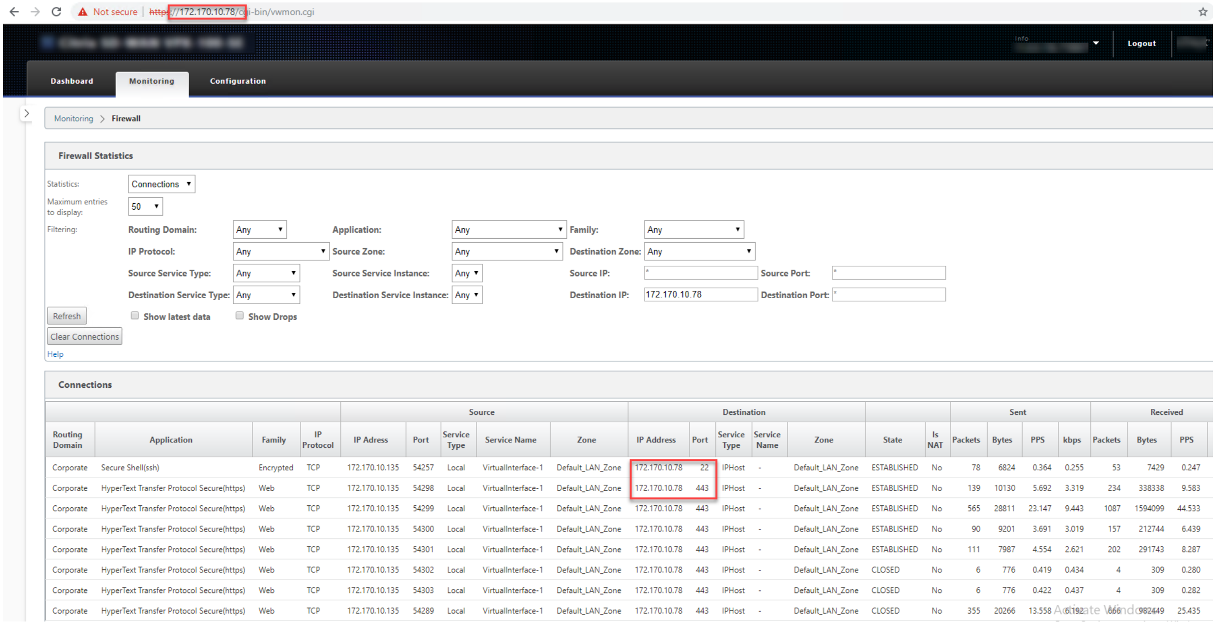
For example, the following in-band IP addresses are used to access the appliances:

- Active appliance - 1.0.1.2
- Primary appliance - 1.0.1.10
- Secondary appliance - 1.0.1.11

Monitoring in-band management

In the preceding example, we have enabled in-band management on 172.170.10.78 virtual IP. You can use this IP to access the web UI and SSH.

In the web UI navigate to **Monitoring** > **Firewall**. You can see SSH and web UI accessed using the virtual IP on port 22 and 443 respectively in the **Destination IP address** column.



Firewall Statistics

Statistics: Connections
Maximum entries to display: 50
Filtering:
Routing Domain: Any
Application: Any
Family: Any
IP Protocol: Any
Source Zone: Any
Destination Zone: Any
Source Service Type: Any
Source Service Instance: Any
Source IP: *
Source Port: *
Destination Service Type: Any
Destination Service Instance: Any
Destination IP: 172.170.10.78
Destination Port: *

Refresh
□ Show latest data
□ Show Drops
Clear Connections
Help

Connections

				Source					Destination							Sent				Received		
Routing Domain	Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State	Is NAT	Packets	Bytes	PPS	kbps	Packets	Bytes	PPS
Corporate	Secure Shell(ssh)	Encrypted	TCP	172.170.10.135	54257	Local	VirtualInterface-1	Default_LAN_Zone	172.170.10.78	22	IPHost	-	Default_LAN_Zone	ESTABLISHED	No	78	6824	0.364	0.255	53	7429	0.247
Corporate	HyperText Transfer Protocol Secure(https)	Web	TCP	172.170.10.135	54298	Local	VirtualInterface-1	Default_LAN_Zone	172.170.10.78	443	IPHost	-	Default_LAN_Zone	ESTABLISHED	No	139	10130	5.692	3.319	234	338338	9.583
Corporate	HyperText Transfer Protocol Secure(https)	Web	TCP	172.170.10.135	54299	Local	VirtualInterface-1	Default_LAN_Zone	172.170.10.78	443	IPHost	-	Default_LAN_Zone	ESTABLISHED	No	565	28811	23.147	9.443	1087	1594099	44.533
Corporate	HyperText Transfer Protocol Secure(https)	Web	TCP	172.170.10.135	54300	Local	VirtualInterface-1	Default_LAN_Zone	172.170.10.78	443	IPHost	-	Default_LAN_Zone	ESTABLISHED	No	90	9201	3.691	3.019	157	212744	6.439
Corporate	HyperText Transfer Protocol Secure(https)	Web	TCP	172.170.10.135	54301	Local	VirtualInterface-1	Default_LAN_Zone	172.170.10.78	443	IPHost	-	Default_LAN_Zone	ESTABLISHED	No	111	7987	4.554	2.621	202	291743	8.287
Corporate	HyperText Transfer Protocol Secure(https)	Web	TCP	172.170.10.135	54302	Local	VirtualInterface-1	Default_LAN_Zone	172.170.10.78	443	IPHost	-	Default_LAN_Zone	CLOSED	No	6	776	0.419	0.434	4	309	0.280
Corporate	HyperText Transfer Protocol Secure(https)	Web	TCP	172.170.10.135	54303	Local	VirtualInterface-1	Default_LAN_Zone	172.170.10.78	443	IPHost	-	Default_LAN_Zone	CLOSED	No	6	776	0.422	0.437	4	309	0.282
Corporate	HyperText Transfer Protocol Secure(https)	Web	TCP	172.170.10.135	54289	Local	VirtualInterface-1	Default_LAN_Zone	172.170.10.78	443	IPHost	-	Default_LAN_Zone	CLOSED	No	355	20266	13.558	6.192	666	982449	25.435

In-band provisioning

The need to deploy SD-WAN appliances in simpler environments like home or small branches has increased significantly. Configuring separate management access for simpler deployments is an added overhead. Zero-touch deployment along with in-band management feature enables provisioning and configuration management via designated data ports. Zero-touch deployment is now supported on the designated data ports and there is no need to use a separate management port for zero-touch deployment. Citrix SD-WAN also allows to fail over management traffic seamlessly to the management port when the data port goes down and vice versa.

An appliance in factory shipped state, that supports in-band provisioning, can be provisioned by simply connecting the data or management port to the internet. The appliances that support in-band provisioning have specific ports for LAN and WAN. The appliance in factory reset state has a default configuration that allows to establish a connection with the zero-touch deployment service. The LAN port acts as the DHCP server and assigns a dynamic IP to the WAN port that acts as a DHCP client. The WAN links monitor the Quad 9 DNS service to determine WAN connectivity.

> **Note**
>
> In-band provisioning is applicable to SD-WAN 110 SE and SD-WAN VPX platforms only.

Once the IP address is obtained and a connection is established with the zero-touch deployment service the configuration packages are downloaded and installed on the appliance.

Note: For day-0 provisioning of SD-WAN appliances through the data ports, the appliance software version must be SD-WAN 11.1.0 or higher.

The default configuration of an appliance in factory reset state includes the following configurations:

- DHCP Server on LAN port
- DHCP client on WAN port
- QUAD9 configuration for DNS
- Default LAN IP is 192.168.0.1
- Grace License of 35 days.

Once the appliance is provisioned, the default configuration is disabled and is overridden by the configuration received from the zero-touch deployment service. If an appliance license or grace license expiries, the default configuration is activated, to ensure that the appliance remains connected to the zero-touch deployment service and receives licenses managed via zero-touch deployment.

Default/Fallback configuration

Fallback configuration ensures that the appliance remains connected to the zero-touch deployment service if there is link failure, configuration mismatch, or software mismatch. Fallback configuration is enabled by default on the appliances that have a default configuration profile. You can also edit the fallback configuration as per your existing LAN network settings.

Note: After the initial appliance provisioning, ensure that the fallback configuration is enabled for zero-touch deployment service connectivity.

The following table provides the details of pre-designated WAN and LAN ports for fallback configuration on different platforms:

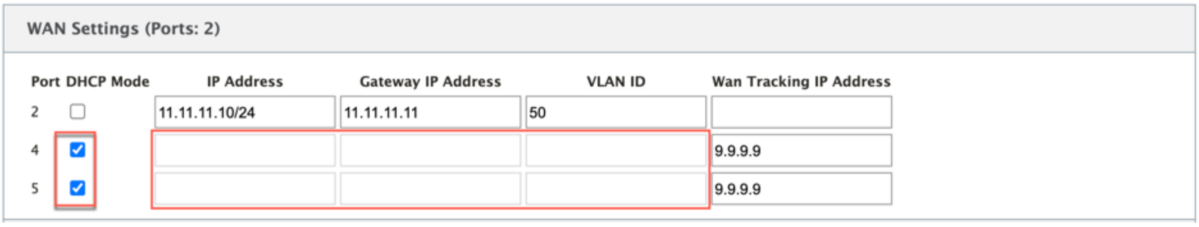
Platform	WAN Ports	LAN Ports
110	1/2	1/1
110-LTE	1/2, LTE-1	1/1
210	1/4, 1/5	1/3
210-LTE	1/4, 1/5, LTE-1	1/3
VPX	2	1
1100	1/4, 1/5, 1/6	1/3 (FTB)

From Citrix SD-WAN 11.3.1 release, the WAN port settings are configurable. WAN ports can be configured as independent WAN Links using DHCP client and monitor the Quad9 DNS service to determine

WAN connectivity. You can configure WAN IPs/static IPs for the WAN ports in the absence of DHCP to use In-band management for initial provisioning.

> **Note**
>
> You can only configure the Ethernet ports with the static IPs. The static IPs are not configurable with LTE-1 and LTE-E1 ports. Though you can add the LTE-1 and LTE-E1 port as WAN, the configuration fields remain non-editable.

When you add a WAN port, it gets added under the **WAN Settings (Port: 2)** section with the **DHCP Mode** check box selected by default. If the **DHCP Mode** check box is selected, the **IP Address, Gateway IP Address,** and the **VLAN ID** text fields are grayed out. Clear the **DHCP Mode** check box, if you want to configure the static IP.



WAN Settings (Ports: 2)

Port	DHCP Mode	IP Address	Gateway IP Address	VLAN ID	Wan Tracking IP Address
2	☐	11.11.11.10/24	11.11.11.11	50	
4	☑				9.9.9.9
5	☑				9.9.9.9

By default the **WAN Tracking IP Address** field is auto filled with the 9.9.9.9. You can change the address as needed.

> **Note**
>
> If you are selecting the **Dynamic DNS Servers** check box, ensure to add/configure at least one WAN port with the **DHCP Mode** selected.

Configurable Management or Data port

In-band management allows the data ports to carry both data and management traffic, eliminating the need for a dedicated management port. This leaves the management port unused on the low end appliances, which already have low port density. Citrix SD-WAN allows you to configure the management port to operate as either a data port or a management port.

> **Note**
>
> You can convert the management port to data port only on the following platforms:
>
> - Citrix SD-WAN 110 SE/LTE
> - Citrix SD-WAN 210 SE/LTE

You can configure a management port only when in-band management is enabled on other trusted interfaces on the appliance.

Backup management network

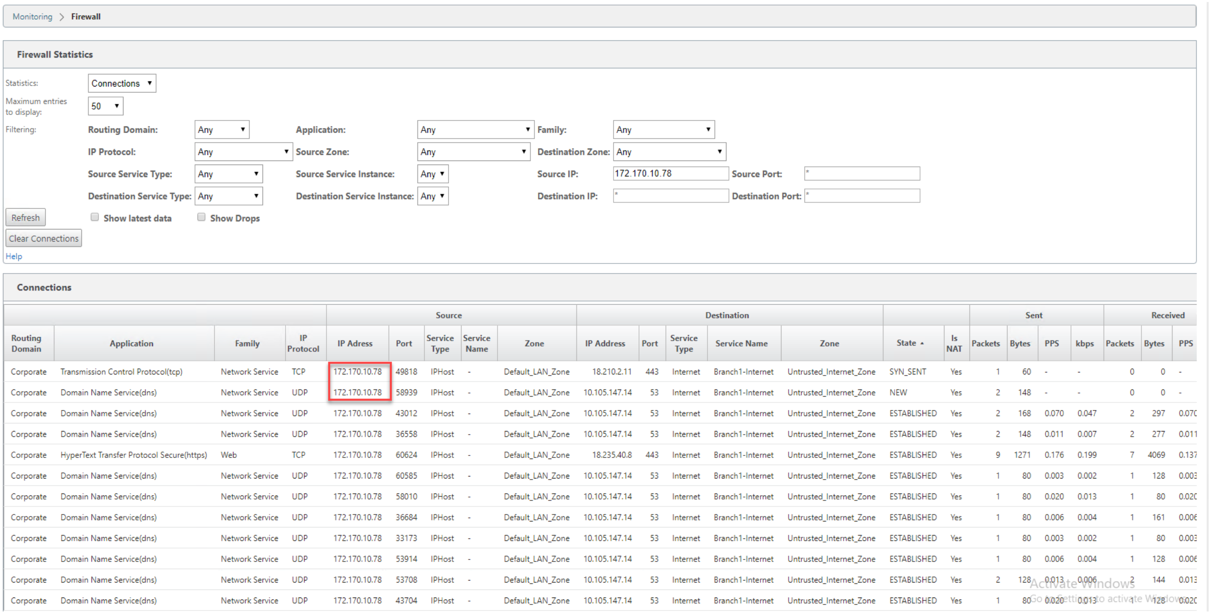
You can configure a virtual IP address as a back-up management network. It is used as the management IP address if the management port is not configured with a default gateway.

> **Note**
>
> If a site has an Internet service configured with a single routing domain, a trusted interface with identity enabled is selected as the backup management network by default.

Monitoring backup management

In the preceding example, we have selected 172.170.10.78 virtual IP as the backup management network. If the management IP address is not configured with a default gateway, you can use this IP to access the web UI and SSH.

In the web UI navigate to **Monitoring** > **Firewall**. You can see this virtual IP address as the source IP address for SSH and web UI access.



Firewall Statistics

Statistics: Connections

Maximum entries to display: 50

Filtering:

Routing Domain: Any
Application: Any
Family: Any
IP Protocol: Any
Source Zone: Any
Destination Zone: Any
Source Service Type: Any
Source Service Instance: Any
Source IP: 172.170.10.78
Source Port: *
Destination Service Type: Any
Destination Service Instance: Any
Destination IP: *
Destination Port: *

Connections

				Source					Destination							Sent				Received		
Routing Domain	Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State ▲	Is NAT	Packets	Bytes	PPS	kbps	Packets	Bytes	PPS
Corporate	Transmission Control Protocol(tcp)	Network Service	TCP	172.170.10.78	49818	IPHost	-	Default_LAN_Zone	18.210.2.11	443	Internet	Branch1-Internet	Untrusted_Internet_Zone	SYN_SENT	Yes	1	60	-	-	0	0	-
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	58939	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	NEW	Yes	2	148	-	-	0	0	-
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	43012	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	2	168	0.070	0.047	2	297	0.070
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	36558	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	2	148	0.011	0.007	2	277	0.011
Corporate	HyperText Transfer Protocol Secure(https)	Web	TCP	172.170.10.78	60624	IPHost	-	Default_LAN_Zone	18.235.40.8	443	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	9	1271	0.176	0.199	7	4069	0.137
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	60585	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	1	80	0.003	0.002	1	128	0.003
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	58010	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	1	80	0.020	0.013	1	80	0.020
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	36684	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	1	80	0.006	0.004	1	161	0.006
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	33173	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	1	80	0.003	0.002	1	80	0.003
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	53914	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	1	80	0.006	0.004	1	128	0.006
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	53708	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	2	128	0.013	0.006	2	144	0.013
Corporate	Domain Name Service(dns)	Network Service	UDP	172.170.10.78	43704	IPHost	-	Default_LAN_Zone	10.105.147.14	53	Internet	Branch1-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	1	80	0.020	0.013	1	128	0.020

Internet access

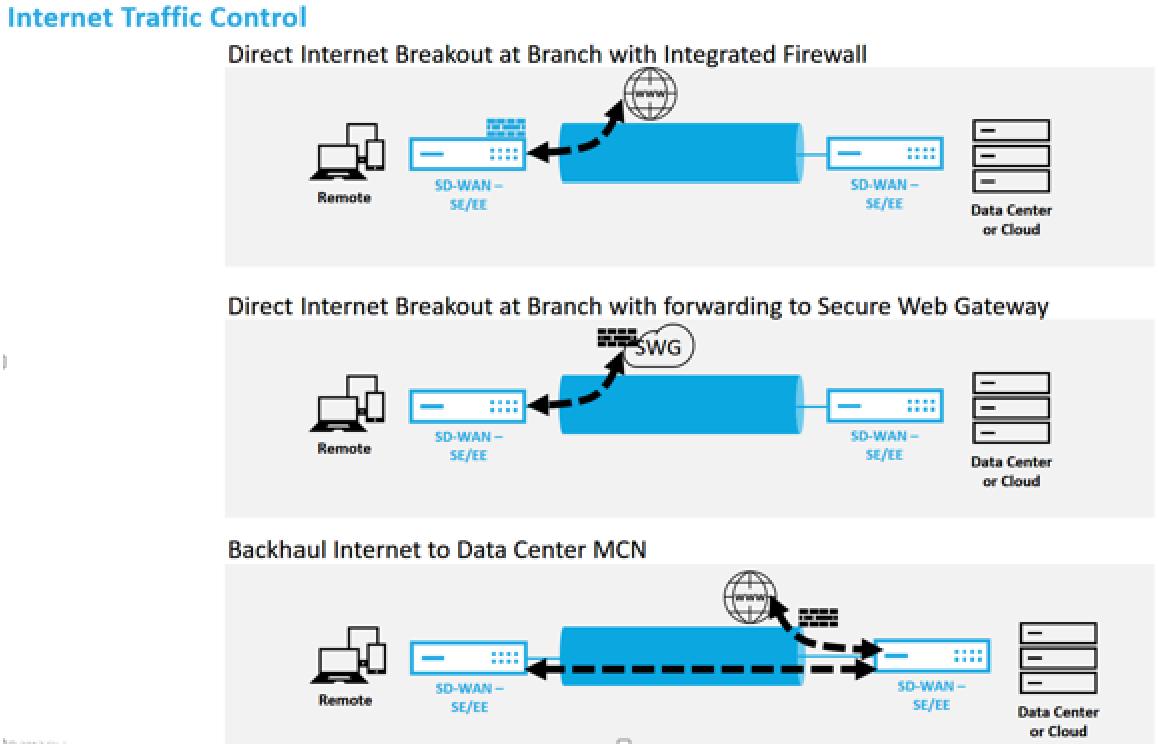
September 19, 2022

The Internet Service is used for traffic between an end-user site and sites on the public internet. Internet service traffic is not encapsulated by SD-WAN and does not have the same capabilities as traffic that is delivered across the Virtual Path Service. However, it is important to classify and take account for this traffic on the SD-WAN. Traffic that is identified as Internet Service enables the added ability of SD-WAN being able to actively manage WAN link bandwidth by rate-limiting Internet traffic relative to traffic delivered across the Virtual Path and Intranet traffic per the configuration established by the administrator. In addition to bandwidth provisioning capabilities, SD-WAN has the added capability to load balance traffic delivered across the Internet Service using multiple Internet WAN links, or optionally, utilizing the Internet WAN links in a primary or secondary configuration.

Internet traffic control using the Internet Service on SD-WAN appliances can be configured in the following deployment modes:

- Direct Internet Breakout at Branch with Integrated Firewall
- Direct Internet Breakout at Branch forwarding to Secure Web Gateway
- Backhaul Internet to Data Center MCN

For information on how to configure an Internet service through Citrix SD-WAN Orchestrator service, see Internet Service.



Internet Traffic Control

Direct Internet Breakout at Branch with Integrated Firewall

Direct Internet Breakout at Branch with forwarding to Secure Web Gateway

Backhaul Internet to Data Center MCN

Direct Internet Breakout at Branch with Integrated Firewall

The Internet Service can be utilized in the various deployment modes supported by Citrix SD-WAN.

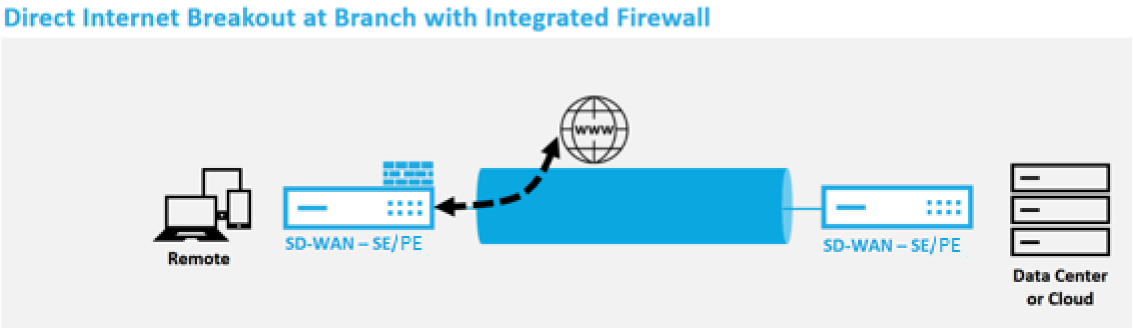
- Inline Deployment Mode (SD-WAN Overlay)

Citrix SD-WAN can be deployed as an overlay solution in any network. As an overlay solution, SD-WAN generally is deployed behind existing edge routers and/or firewalls. If SD-WAN is deployed behind a network firewall, the interface can be configured as trusted and Internet traffic can be delivered to the firewall as an internet gateway.

- Edge or Gateway Mode

Citrix SD-WAN can be deployed as the edge device, replacing existing edge router and/or firewall devices. Onboard firewall feature allows SD-WAN to protect the network from direct internet connectivity. In this mode, the interface connected to the public internet link is configured as untrusted, forcing encryption to be enabled, and firewall and Dynamic NAT features are enabled to secure the network.

For information on how to configure an Internet service through Citrix SD-WAN Orchestrator service, see Internet Service.



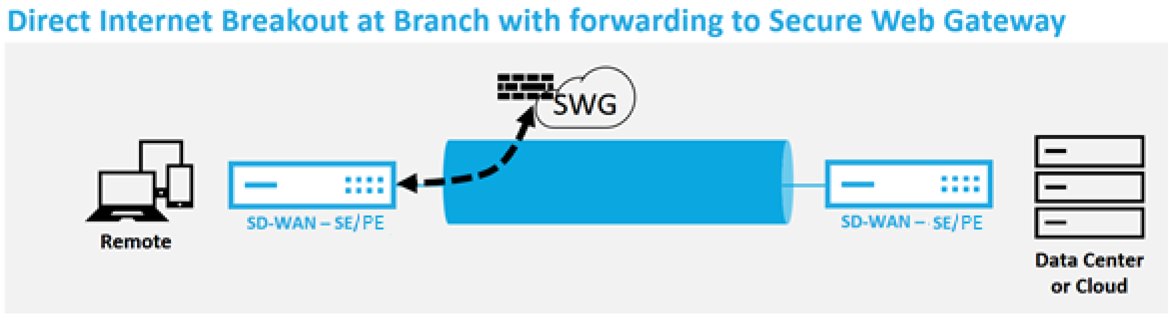
Direct Internet Access with Secure Web Gateway

To secure traffic and enforce policies, enterprises often use MPLS links to backhaul branch traffic to the corporate data center. The data center applies security policies, filters traffic through security appliances to detect malware, and routes the traffic through an ISP. Such backhauling over private MPLS links is expensive. It also results in significant latency, which creates a poor user experience at the branch site. There is also a risk that users bypass your security controls.

An alternative to backhauling is to add security appliances at the branch. However, the cost and complexity increases as you install multiple appliances to maintain consistent policies across the sites. Most significantly, if you have many branch offices, cost management becomes impractical.

One alternative is to enforce security without adding cost, complexity, or latency would be to route all branch Internet traffic using Citrix SD-WAN to the Secure Web Gateway Service. A third-party Secure Web Gateway Service enables granular and central security policy creation to be using by all connected networks. The policies are applied consistently whether the user is at the data center or a branch site. Because Secure Web Gateway solutions are cloud based, you don't have to add more costly security appliances to the network.

For information on how to configure an Internet service through Citrix SD-WAN Orchestrator service, see Internet Service.


Direct Internet Breakout at Branch with forwarding to Secure Web Gateway
SWG
Remote
SD-WAN – SE/PE
SD-WAN – SE/PE
Data Center
or Cloud

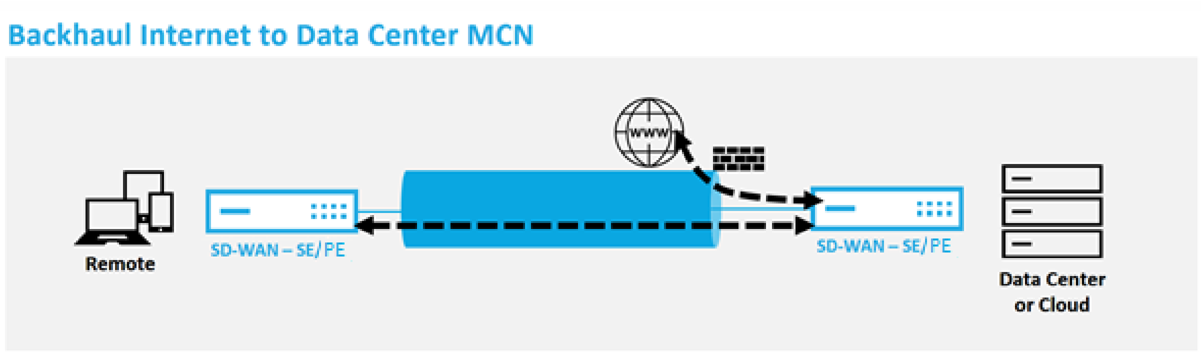
Citrix SD-WAN supports the following third party Secure Web Gateway solutions:

- Zscaler
- Forcepoint
- Palo Alto
- Citrix Secure Internet Access

Backhaul Internet

The Citrix SD-WAN solution can backhaul Internet traffic to the MCN site or other branch sites. Backhaul indicates that the traffic destined for the Internet is sent back through another predefined site that can access the Internet. It is useful for networks that do not allow Internet access directly because of security concerns or the underlay networks topology. An example would be a remote site that lacks an external firewall where the on-board SD-WAN firewall does not meet the security requirements for that site. For some environments, backhauling all remote site internet traffic through the hardened DMZ at the Data Center might be the best approach to providing Internet access to users at remote offices. This approach does however have its limitations to be aware of following and the underlay WAN links size appropriately.

- Backhaul of internet traffic adds latency to internet connectivity and is variable depending on the distance of the branch site for the data center.
- Backhaul of internet traffic consumes bandwidth on the Virtual Path and is accounted for in sizing of WAN links.
- Backhaul of internet traffic might over-subscribe the Internet WAN link at the Data Center.

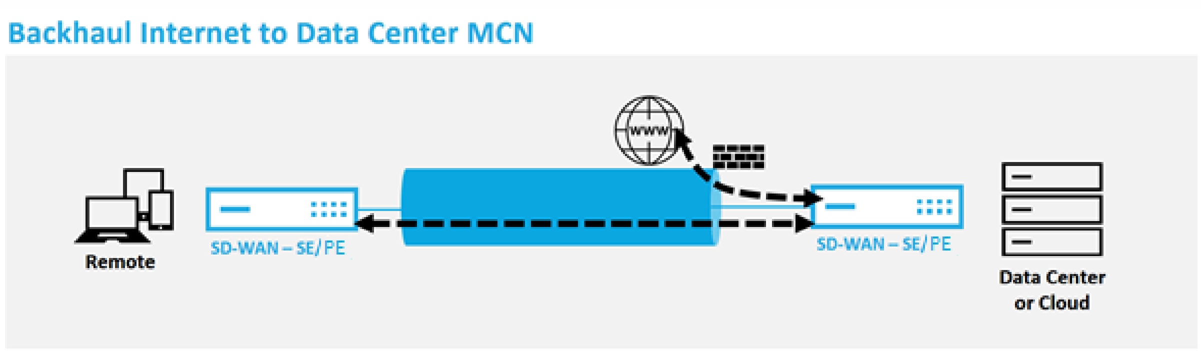


All Citrix SD-WAN devices can terminate up to eight distinct Internet WAN links into a single device. Licensed throughput capabilities for the aggregated WAN links are listed per respective appliance on the Citrix SD-WAN data sheet.

Hairpin Mode

With hairpin deployment, you can implement use of a Remote Hub site for internet access through backhaul or hairpin when local internet services are unavailable or are experiencing slower traffic. You can apply high bandwidth routing between client sites by allowing backhauling from specific sites.

The purpose of a hairpin deployment from a non-WAN to a WAN forwarding site is to provide more efficient deployment process and more streamlined technical implementation. You can use a remote hub site for internet access when needs arise, and can route flows through the virtual path to the SD-WAN network.



For example, consider an administrator with multiple SD-WAN Sites, A and B. Site A has poor internet service. Site B has usable internet service, with which you want to backhaul traffic from site A to site B only. You can try to accomplish this without the complexity of strategically weighted route costs and propagation to sites that should not receive the traffic.

Also, the route table is not shared across all sites in a Hairpin deployment. For example, if traffic is hairpin'ned between Site A and Site B through Site C, then only Site C would be aware of site A's and B's routes. Site A and Site B do not share each other's route table unlike in WAN-to-WAN forwarding.

When traffic is Hairpin’ned between Site A and Site B through Site C, the static routes are required to be added in Site A and Site B indicating that the next hop for both the sites is the intermediate Site C.

WAN-to-WAN Forwarding and Hairpin deployment have certain differences, namely:

1. Dynamic Virtual Paths are not configured. Always, the intermediate site sees all the traffic between the two sites.
2. Does not participate in WAN-to-WAN Forwarding groups.

   WAN-to-WAN Forwarding and Hairpin deployment are mutually exclusive. Only one of them can be configured at any given point in time.

   Citrix SD-WAN SE and VPX (virtual) appliances support hairpin deployment. You can now configure a 0.0.0.0/0 route to hairpin traffic between two locations without affecting any additional locations. If hairpinning used for intranet traffic, specific Intranet routes are added to the client site to forward intranet traffic through the virtual path to the hairpin site. Enabling WAN-to-WAN forwarding to accomplish hairpin functionality is no longer required.

Hosted firewalls

September 19, 2022

Citrix SD-WAN Orchestrator service supports the following hosted firewalls:

- Palo Alto Networks
- Check Point

Palo Alto Networks firewall integration on SD-WAN 1100 platform

Citrix SD-WAN supports hosting Palo Alto Networks Next-Generation Virtual Machine (VM)-Series Firewall on the SD-WAN 1100 platform. The following are the supported virtual machine models:

- VM 50
- VM 100

The Palo Alto Network virtual machine series firewall runs as a virtual machine on SD-WAN 1100 platform. The firewall virtual machine is integrated in **Virtual Wire** mode with two data virtual interfaces connected to it. Required traffic can be redirected to the firewall virtual machine by configuring policies on SD-WAN.

For information on how to provision the firewall virtual machine through SD-WAN Orchestrator service, see Hosted firewalls.

Benefits

The following are the primary goals or benefits of Palo Alto Networks integration on the SD-WAN 1100 platform:

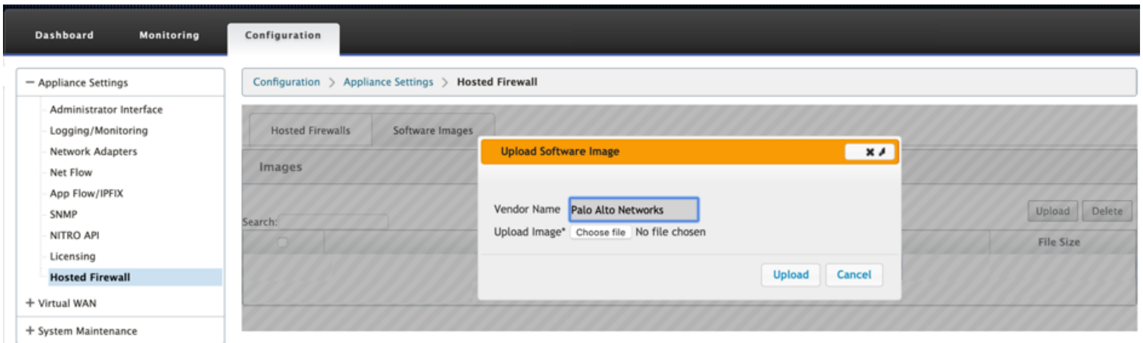
- Branch device consolidation: A single appliance that does both SD-WAN and advanced security.
- Branch office security with on-prem NGFW (Next Generation Firewall) to protect LAN-to-LAN, LAN-to-Internet, and Internet-to-LAN traffic.

Firewall virtual machine provisioning through SD-WAN appliance GUI

On SD-WAN platform, provision and boot up the hosted virtual machine. Perform the following steps for provisioning:

1. From Citrix SD-WAN GUI, navigate to **Configuration >** expand **Appliance Settings >** select **Hosted Firewall**.
2. Upload the software image:

   - Select the **Software Images** tab. Select the Vendor name as **Palo Alto Networks**.
   - Choose the software image file.
   - Click **Upload**.

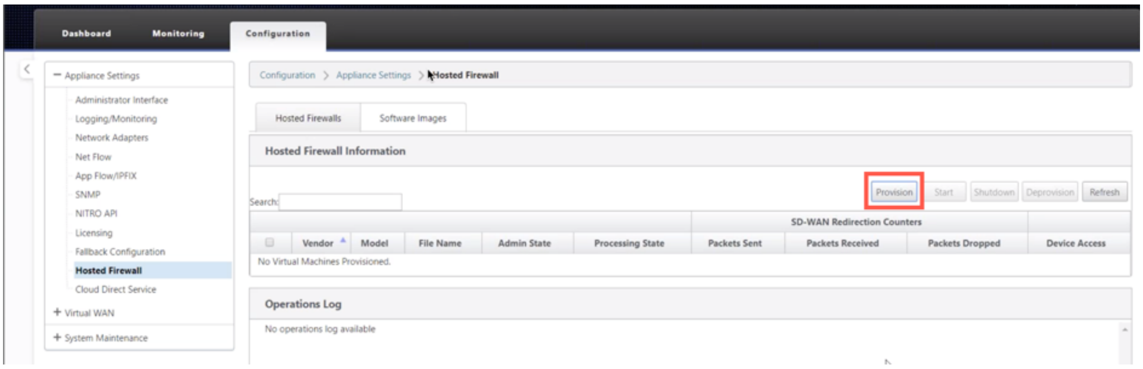
   

   Vendor Name: Palo Alto Networks
   Upload Image*: Choose file No file chosen

   > **Note**
   >
   > Maximum of two software image can be uploaded. Uploading of the Palo Alto Networks virtual machine image might take longer time depending on the bandwidth availability.

   You can see a status bar to track the upload process. The file detail reflects, once the image is uploaded successfully. The image that is used for provisioning cannot be deleted. Do not perform any action or go back to any other page until the image file shows 100% uploaded.

3. For provisioning, select **Hosted Firewalls** tab and click **Provision** button.



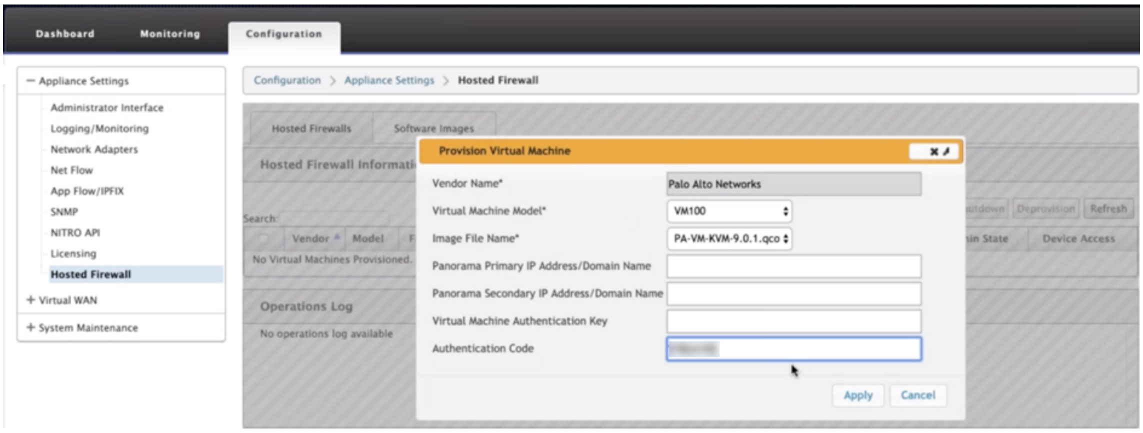
No Virtual Machines Provisioned.

No operations log available

4. Provide the following details for provisioning.

    - **Vendor Name**: Select the Vendor as **Palo Alto Networks**.
    - **Virtual Machine Model**: Select the virtual machine model number from the list.
    - **Image File Name**: Select the Image file.
    - **Panorama Primary IP Address/Domain Name**: Provide the Panorama primary IP address or fully qualified domain name (Optional).
    - **Panorama Secondary IP Address/Domain Name**: Provide the Panorama secondary IP address or fully qualified domain name (Optional).
    - **Virtual Machine Authentication Key**: Provide the virtual machine authentication key (Optional).

      Virtual Machine Authentication Key is needed for automatic registration of the Palo Alto Networks virtual machine to the Panorama.
    - **Authentication Code**: Enter the authentication code (virtual machine license code) (Optional).
    - Click **Apply**.



Provision Virtual Machine

Vendor Name*: Palo Alto Networks

Virtual Machine Model*: VM100

Image File Name*: PA-VM-KVM-9.0.1.qcow

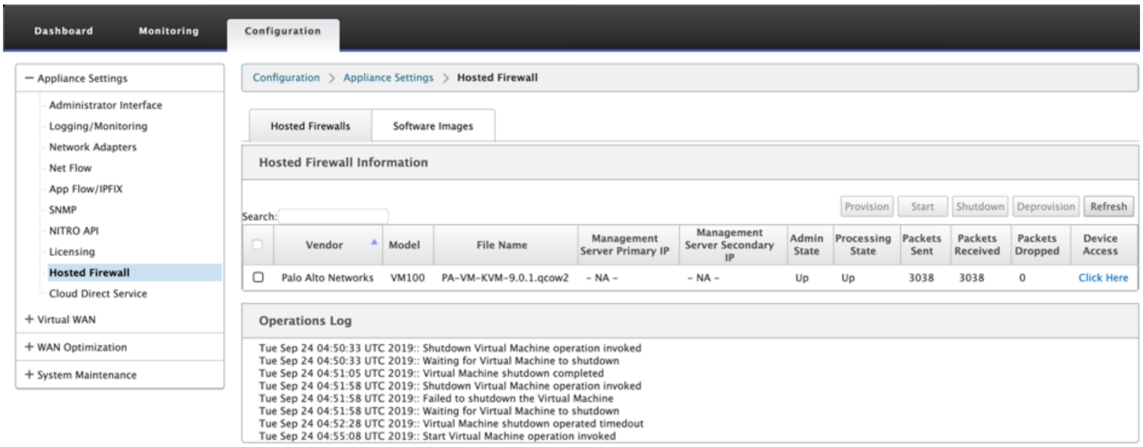
Panorama Primary IP Address/Domain Name:

Panorama Secondary IP Address/Domain Name:

Virtual Machine Authentication Key:

Authentication Code:

5. Click **Refresh** to get the latest status. After the Palo Alto Networks virtual machine is completely bootup, it will reflect on the SD-WAN UI with the operations Log detail.



□	Vendor	Model	File Name	Management Server Primary IP	Management Server Secondary IP	Admin State	Processing State	Packets Sent	Packets Received	Packets Dropped	Device Access
□	Palo Alto Networks	VM100	PA-VM-KVM-9.0.1.qcow2	- NA -	- NA -	Up	Up	3038	3038	0	Click Here

Operations Log

```
Tue Sep 24 04:50:33 UTC 2019:: Shutdown Virtual Machine operation invoked
Tue Sep 24 04:50:33 UTC 2019:: Waiting for Virtual Machine to shutdown
Tue Sep 24 04:51:05 UTC 2019:: Virtual Machine shutdown completed
Tue Sep 24 04:51:58 UTC 2019:: Shutdown Virtual Machine operation invoked
Tue Sep 24 04:51:58 UTC 2019:: Failed to shutdown the Virtual Machine
Tue Sep 24 04:51:58 UTC 2019:: Waiting for Virtual Machine to shutdown
Tue Sep 24 04:52:28 UTC 2019:: Virtual Machine shutdown operated timedout
Tue Sep 24 04:55:08 UTC 2019:: Start Virtual Machine operation invoked
```

- **Admin State**: Indicates if the virtual machine is up or down.
- **Processing State**: Datapath processing state of the virtual machine.
- **Packet Sent**: Packets sent from SD-WAN to the security virtual machine.
- **Packet Received**: Packets received by SD-WAN from the security virtual machine.
- **Packet Dropped**: Packets dropped by SD-WAN (for example, when the security virtual machine is down).
- **Device Access**: Click the link to get the GUI access to the security virtual machine.

You can **Start, Shutdown,** and **Deprovision** the virtual machine as needed. Use **Click Here** option to access the Palo Alto Networks virtual machine GUI or use your management IP along with 4100 port (management IP: 4100).

> **Note**
>
> Always use incognito mode to access the Palo Alto Networks GUI.

Check Point firewall integration the on SD-WAN 1100 platform

Citrix SD-WAN supports hosting **Check Point Quantum Edge** on the SD-WAN 1100 platform.

The **Check Point Quantum Edge** runs as a virtual machine on the SD-WAN 1100 SE platform. The firewall virtual machine is integrated in Bridge mode with two data virtual interfaces connected to it. Required traffic can be redirected to the firewall virtual machine by configuring policies on SD-WAN.

For information on how to provision the firewall virtual machine through SD-WAN Orchestrator service, see Hosted firewalls.

> **Note**
>
> From Citrix SD-WAN 11.3.1 onwards, the Check Point VM version 80.20 and above are supported for provisioning VM on new sites.

Benefits

The following are the primary goals or benefits of Check Point integration on the SD-WAN 1100 platform:

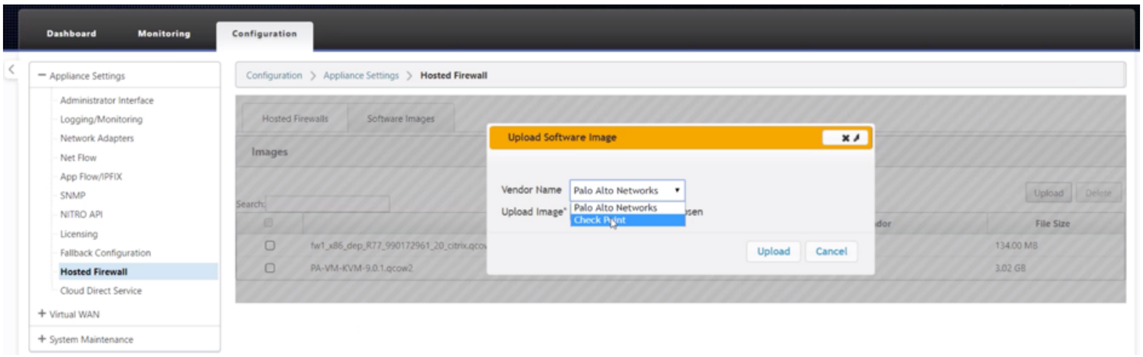
- Branch device consolidation: A single appliance that does both SD-WAN and advanced security
- Branch office security with on-prem NGFW (Next Generation Firewall) to protect LAN-to-LAN, LAN-to-Internet, and Internet-to-LAN traffic

Firewall virtual machine provisioning through SD-WAN appliance GUI

On SD-WAN platform, provision and boot up the hosted virtual machine. Perform the following steps for provisioning:

1. From the Citrix SD-WAN GUI, navigate to **Configuration > Appliance Settings >** select **Hosted Firewall**.
2. Upload the software image:

   - Select the **Software Images** tab. Select the **Vendor Name** as Check Point.
   - Choose the software image file.
   - Click **Upload**.

   Vendor Name: Palo Alto Networks

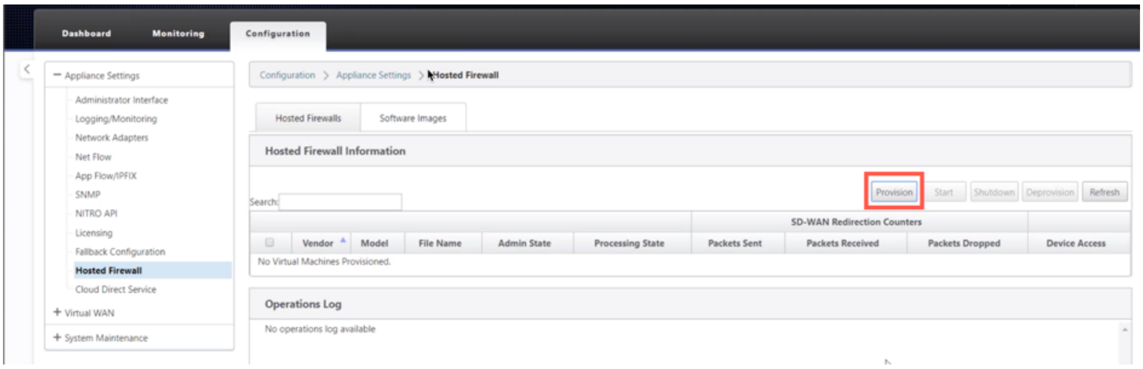
   Upload Image*

		File Size
□	fw1_x86_dep_R77_990172961_20_citrix.qcov	134.00 MB
□	PA-VM-KVM-9.0.1.qcow2	3.02 GB

   > **Note**
   >
   > Maximum of two images can be uploaded. Uploading of the Check Point virtual machine image might take longer time depending on the bandwidth availability.

   You can see a status bar to track the upload process. The file detail reflects, once the image is uploaded successfully. The image that is used for provisioning cannot be deleted. Do not perform any action or go back to any other page until the image file shows 100% uploaded.

3. For provisioning, select **Hosted Firewall** tab > click **Provision** button.

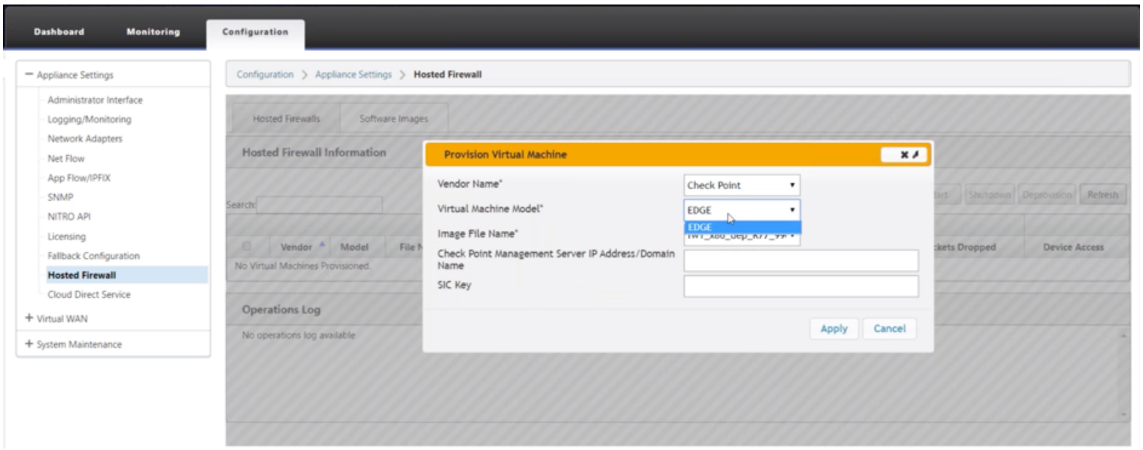


No Virtual Machines Provisioned.

No operations log available

4. Provide the following details for provisioning.

   - **Vendor Name**: Select the **Vendor Name** as Check Point.
   - **Virtual Machine Model**: The virtual machine model is auto filled as **Edge**.
   - **Image File Name**: The image file name is auto-populated.
   - **Check Point Management Server IP Address/Domain**: Provide the check point management server IP address/domain.
   - **SIC Key**: Provide the SIC key (Optional). SIC creates trusted connections between **Check Point** components. Click **Apply**.



Vendor Name*: Check Point

Virtual Machine Model*: EDGE

Image File Name*:

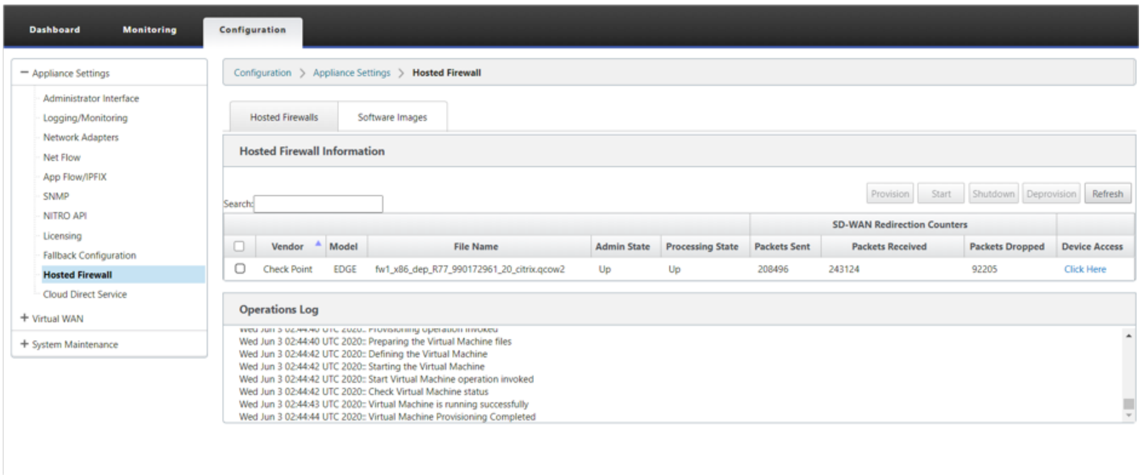
Check Point Management Server IP Address/Domain Name:

SIC Key:

No Virtual Machines Provisioned.

No operations log available

5. Click **Refresh** to get the latest status. After the Check Point virtual machine is completely bootup, it will reflect on the SD-WAN UI with the operations Log detail.



Hosted Firewall Information

						SD-WAN Redirection Counters			
□	Vendor	Model	File Name	Admin State	Processing State	Packets Sent	Packets Received	Packets Dropped	Device Access
□	Check Point	EDGE	fw1_x86_dep_R77_990172961_20_citrix.qcow2	Up	Up	208496	243124	92205	Click Here

Operations Log

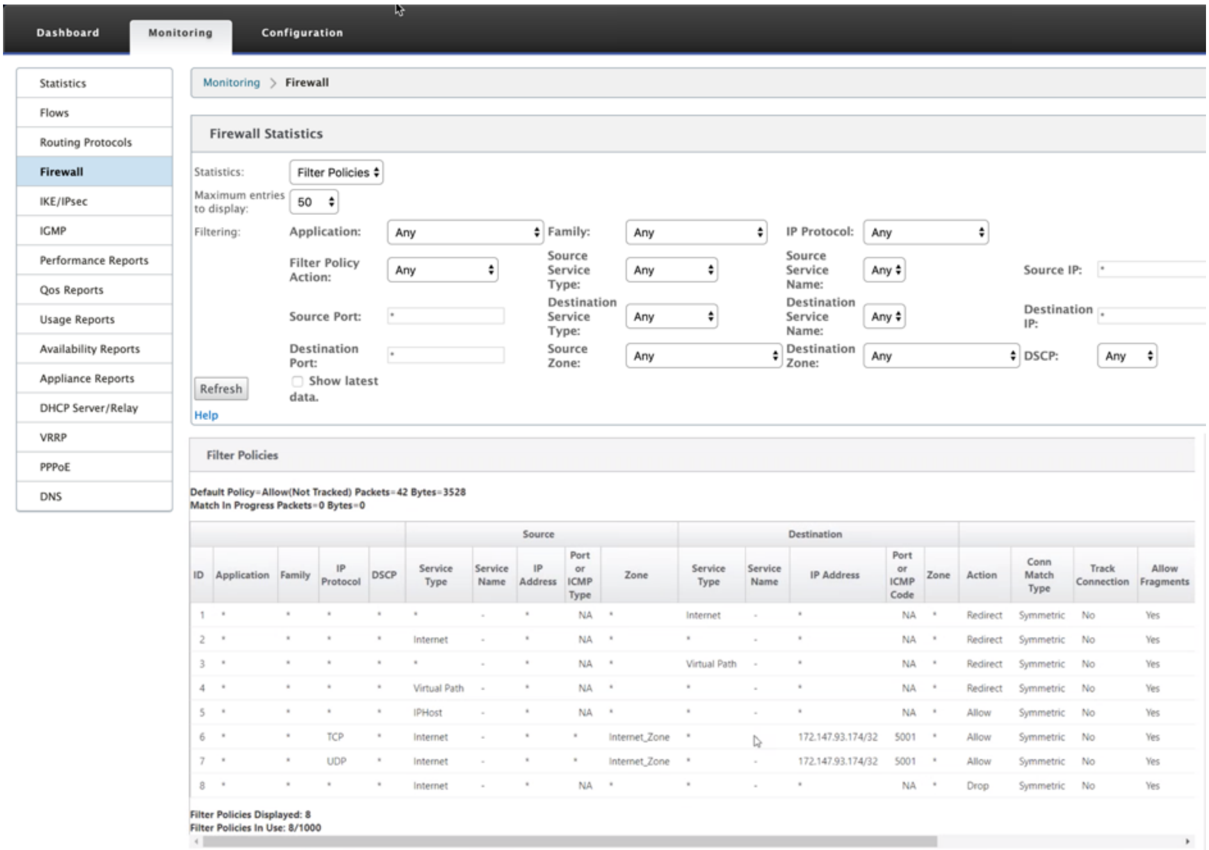
```
Wed Jun 3 02:44:40 UTC 2020:: Provisioning operation invoked
Wed Jun 3 02:44:40 UTC 2020:: Preparing the Virtual Machine files
Wed Jun 3 02:44:42 UTC 2020:: Defining the Virtual Machine
Wed Jun 3 02:44:42 UTC 2020:: Starting the Virtual Machine
Wed Jun 3 02:44:42 UTC 2020:: Start Virtual Machine operation invoked
Wed Jun 3 02:44:42 UTC 2020:: Check Virtual Machine status
Wed Jun 3 02:44:43 UTC 2020:: Virtual Machine is running successfully
Wed Jun 3 02:44:44 UTC 2020:: Virtual Machine Provisioning Completed
```

- **Admin State**: Indicates if the virtual machine is up or down.
- **Processing State**: Datapath processing state of the virtual machine.
- **Packet Sent**: Packets sent from SD-WAN to the security virtual machine.
- **Packet Received**: Packets received by SD-WAN from the security virtual machine.
- **Packet Dropped**: Packets dropped by SD-WAN (for example, when the security virtual machine is down).
- **Device Access**: Click the link to get the GUI access to the security virtual machine.

You can **Start, Shutdown,** and **Deprovision** the virtual machine as needed. Use **Click Here** option to access the Check Point virtual machine GUI or use your management IP along with 4100 port (management IP: 4100).

> **Note**
>
> Always use incognito mode to access the Check Point GUI.

While all the network configuration is up and running mode, you can monitor the connection under **Monitoring > Firewall > Filter Policies**.



Firewall Statistics

Statistics: Filter Policies
Maximum entries to display: 50
Filtering:
Application: Any
Family: Any
IP Protocol: Any
Filter Policy Action: Any
Source Service Type: Any
Source Service Name: Any
Source IP: *
Source Port: *
Destination Service Type: Any
Destination Service Name: Any
Destination IP: *
Destination Port: *
Source Zone: Any
Destination Zone: Any
DSCP: Any
□ Show latest data.

Filter Policies

Default Policy=Allow(Not Tracked) Packets=42 Bytes=3528
Match In Progress Packets=0 Bytes=0

					Source					Destination								
ID	Application	Family	IP Protocol	DSCP	Service Type	Service Name	IP Address	Port or ICMP Type	Zone	Service Type	Service Name	IP Address	Port or ICMP Code	Zone	Action	Conn Match Type	Track Connection	Allow Fragments
1	*	*	*	*	*	-	*	NA	*	Internet	-	*	NA	*	Redirect	Symmetric	No	Yes
2	*	*	*	*	Internet	-	*	NA	*	*	-	*	NA	*	Redirect	Symmetric	No	Yes
3	*	*	*	*	*	-	*	NA	*	Virtual Path	-	*	NA	*	Redirect	Symmetric	No	Yes
4	*	*	*	*	Virtual Path	-	*	NA	*	*	-	*	NA	*	Redirect	Symmetric	No	Yes
5	*	*	*	*	IPHost	-	*	NA	*	*	-	*	NA	*	Allow	Symmetric	No	Yes
6	*	*	TCP	*	Internet	-	*	*	Internet_Zone	*		172.147.93.174/32	5001	*	Allow	Symmetric	No	Yes
7	*	*	UDP	*	Internet	-	*	*	Internet_Zone	*	-	172.147.93.174/32	5001	*	Allow	Symmetric	No	Yes
8	*	*	*	*	Internet	-	*	NA	*	*	-	*	NA	*	Drop	Symmetric	No	Yes

Filter Policies Displayed: 8
Filter Policies In Use: 8/1000

Link Aggregation Groups

August 24, 2022

The Link Aggregation Groups (LAG) functionality allows you to group two or more ports on your SD-WAN appliance to work together as a single port. This ensures increased availability, link redundancy, and enhanced performance.

Earlier, only the Active-Backup mode was supported in LAG. From Citrix SD-WAN 11.3 release onwards, the 802.3AD Link Aggregation Control Protocol (LACP) protocol based negotiations are supported. The LACP is a standard protocol and provides more functionality for LAGs.

In Active-Backup mode, at any time only one port is active and the other ports are in backup mode. The active and backup supports rely on the Data Plane Development Kit (DPDK) package for LAG functionality.

With the LACP, you can send the traffic through all the ports simultaneously. As a benefit, you get more bandwidth along with the link redundancy mechanism. The LACP implementation supports the **Active-Active** mode. Now with the Active-Backup mode, you also have an option to select full LACP Active-Active mode from the SD-WAN UI.

The LAG functionality is available only on the following DPDK supported platforms:

- Citrix SD-WAN 110 SE
- Citrix SD-WAN 210 SE
- Citrix SD-WAN 1100 SE
- Citrix SD-WAN 2100 SE
- Citrix SD-WAN 4100 SE
- Citrix SD-WAN 5100 SE
- Citrix SD-WAN 6100 SE

> **Note**
>
> The LAG functionality is not supported on VPX/VPXL platforms.

Limitations

- You can create a maximum of four LAGs with a maximum of four ports grouped in each LAG on the Citrix SD-WAN appliances.
- The port priority and system priority options are not supported with the LACP implementation.

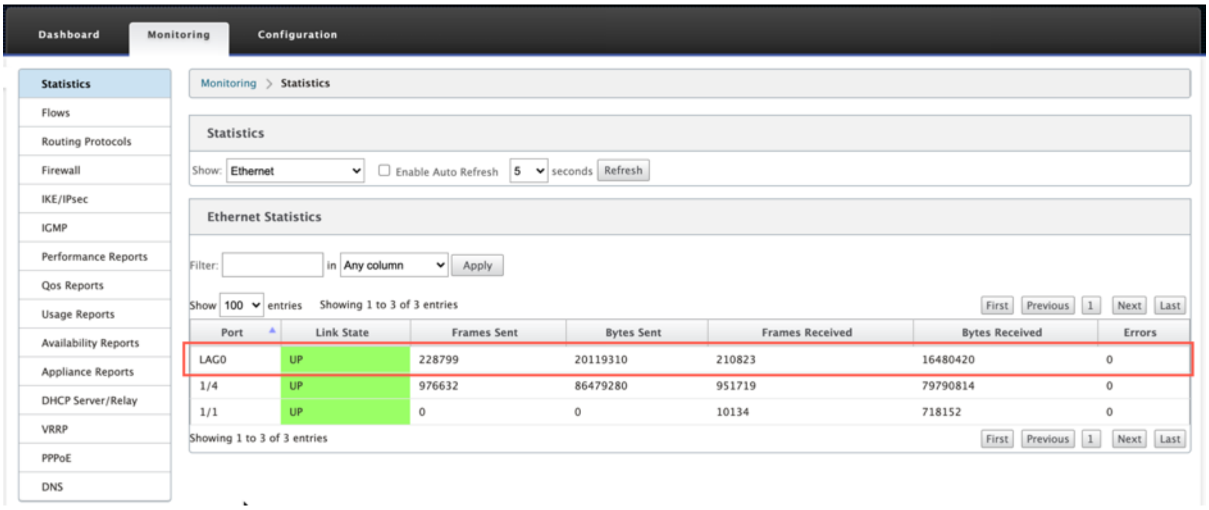
With 11.3 release onwards, in SD-WAN with the LACP implementation, the ports are always in active mode. That means SD-WAN can always start the negotiation.

> **Note**
>
> - For Citrix SD-WAN 210 SE appliances, you can create only one LAG with a maximum of three ports grouped in it.
> - The Link State Propagation (LSP) feature is not supported if LAGs are used as Ethernet interfaces in Interface Groups.

From Citrix SD-WAN 11.5 onwards, you can configure Link aggregation groups through SD-WAN Orchestrator service. For more information, see Link aggregation groups.

Monitoring and Troubleshooting

To view the statistics or the link state, navigate to **Monitoring > Statistics**. Select **Ethernet** from the **Show** drop-down list.



Statistics

Show: Ethernet ☐ Enable Auto Refresh 5 seconds

Ethernet Statistics

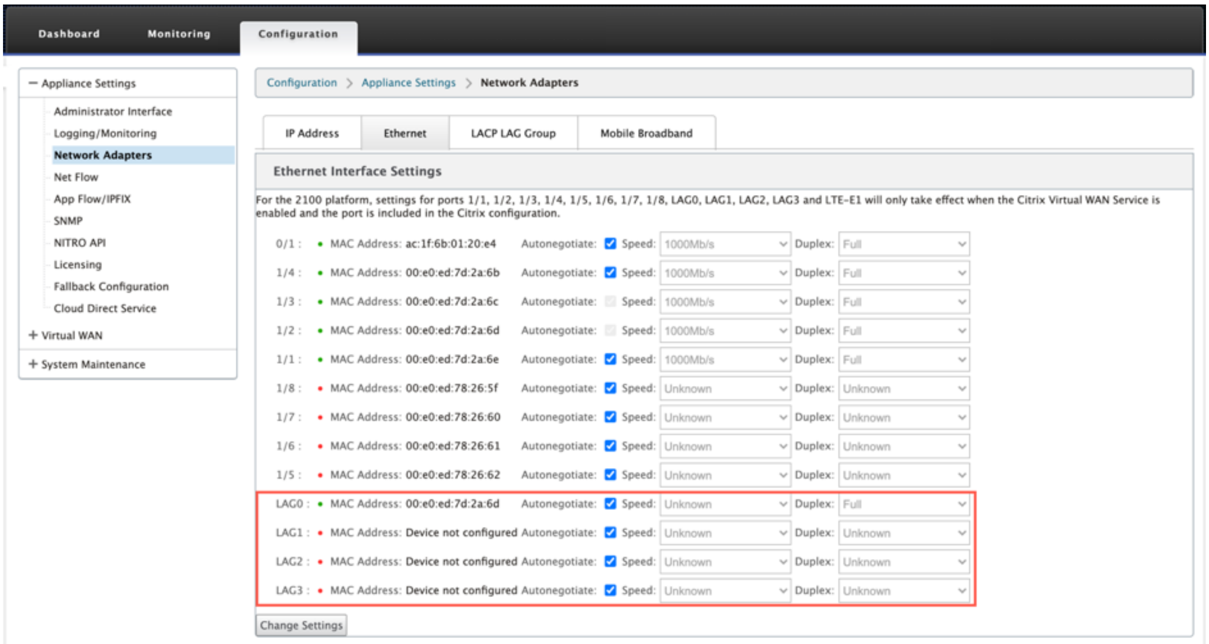
Filter: in Any column

Show 100 entries Showing 1 to 3 of 3 entries

Port	Link State	Frames Sent	Bytes Sent	Frames Received	Bytes Received	Errors
LAG0	UP	228799	20119310	210823	16480420	0
1/4	UP	976632	86479280	951719	79790814	0
1/1	UP	0	0	10134	718152	0

Showing 1 to 3 of 3 entries

To view the active and standby LAG ports, navigate to **Configuration** > **Appliance Settings** > **Network Adapters** > **Ethernet**.

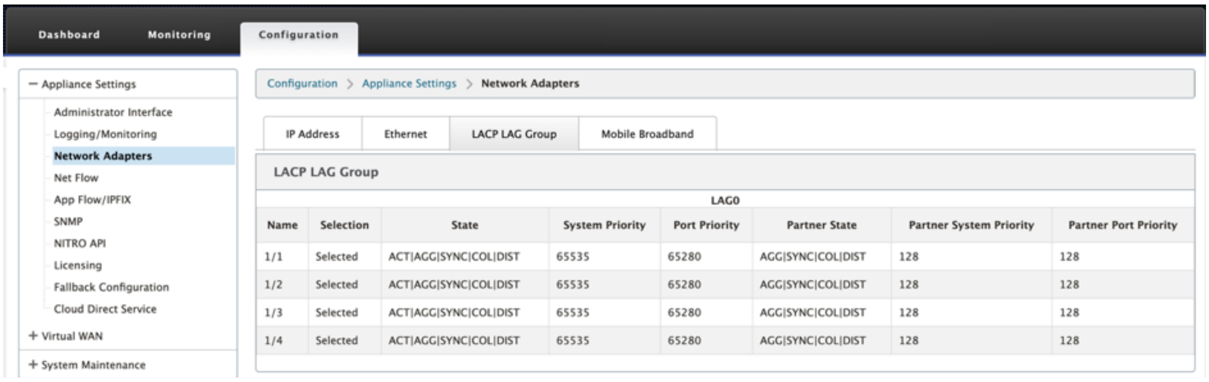


Ethernet Interface Settings

For the 2100 platform, settings for ports 1/1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, LAG0, LAG1, LAG2, LAG3 and LTE-E1 will only take effect when the Citrix Virtual WAN Service is enabled and the port is included in the Citrix configuration.

```
0/1 :  ● MAC Address: ac:1f:6b:01:20:e4        Autonegotiate: ☑ Speed: 1000Mb/s  Duplex: Full
1/4 :  ● MAC Address: 00:e0:ed:7d:2a:6b        Autonegotiate: ☑ Speed: 1000Mb/s  Duplex: Full
1/3 :  ● MAC Address: 00:e0:ed:7d:2a:6c        Autonegotiate: ☐ Speed: 1000Mb/s  Duplex: Full
1/2 :  ● MAC Address: 00:e0:ed:7d:2a:6d        Autonegotiate: ☐ Speed: 1000Mb/s  Duplex: Full
1/1 :  ● MAC Address: 00:e0:ed:7d:2a:6e        Autonegotiate: ☑ Speed: 1000Mb/s  Duplex: Full
1/8 :  ● MAC Address: 00:e0:ed:78:26:5f        Autonegotiate: ☑ Speed: Unknown   Duplex: Unknown
1/7 :  ● MAC Address: 00:e0:ed:78:26:60        Autonegotiate: ☑ Speed: Unknown   Duplex: Unknown
1/6 :  ● MAC Address: 00:e0:ed:78:26:61        Autonegotiate: ☑ Speed: Unknown   Duplex: Unknown
1/5 :  ● MAC Address: 00:e0:ed:78:26:62        Autonegotiate: ☑ Speed: Unknown   Duplex: Unknown
LAG0 : ● MAC Address: 00:e0:ed:7d:2a:6d        Autonegotiate: ☑ Speed: Unknown   Duplex: Full
LAG1 : ● MAC Address: Device not configured Autonegotiate: ☑ Speed: Unknown   Duplex: Unknown
LAG2 : ● MAC Address: Device not configured Autonegotiate: ☑ Speed: Unknown   Duplex: Unknown
LAG3 : ● MAC Address: Device not configured Autonegotiate: ☑ Speed: Unknown   Duplex: Unknown
```

Select the **LACP LAG Group** tab to view the various details related to the LACP LAG group.



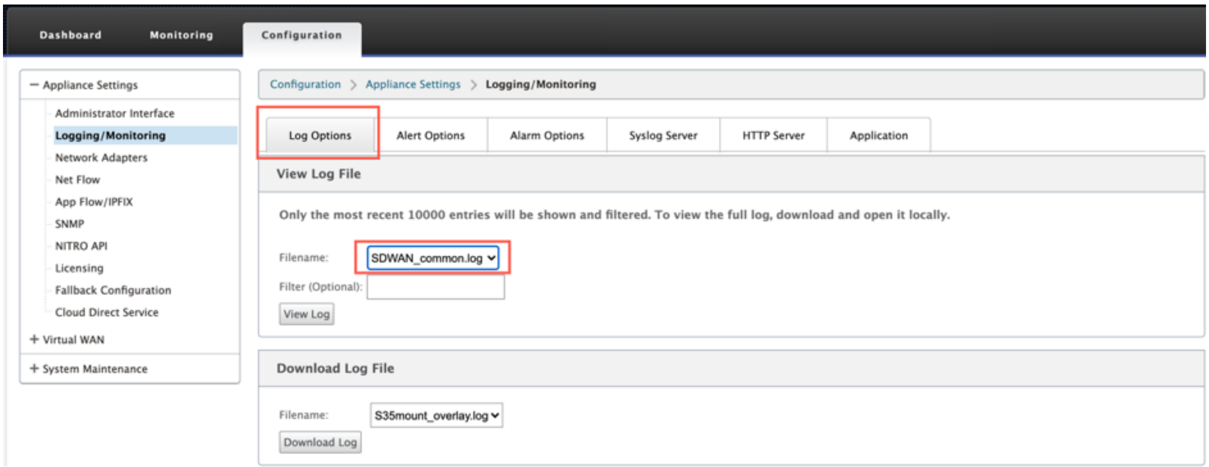
LACP LAG Group

LAG0

Name	Selection	State	System Priority	Port Priority	Partner State	Partner System Priority	Partner Port Priority
1/1	Selected	ACT|AGG|SYNC|COL|DIST	65535	65280	AGG|SYNC|COL|DIST	128	128
1/2	Selected	ACT|AGG|SYNC|COL|DIST	65535	65280	AGG|SYNC|COL|DIST	128	128
1/3	Selected	ACT|AGG|SYNC|COL|DIST	65535	65280	AGG|SYNC|COL|DIST	128	128
1/4	Selected	ACT|AGG|SYNC|COL|DIST	65535	65280	AGG|SYNC|COL|DIST	128	128

> **Note**
>
> You cannot change settings for individual member ports, any configuration changes made to the LAG, is automatically pushed to the member ports.

You can download the log files for further troubleshooting. Navigate to **Configuration > Logging/-Monitoring** and select **SDWAN_common.log** from the **Log Options** tab.



Only the most recent 10000 entries will be shown and filtered. To view the full log, download and open it locally.

Filename: SDWAN_common.log

Filter (Optional):

Filename: S35mount_overlay.log

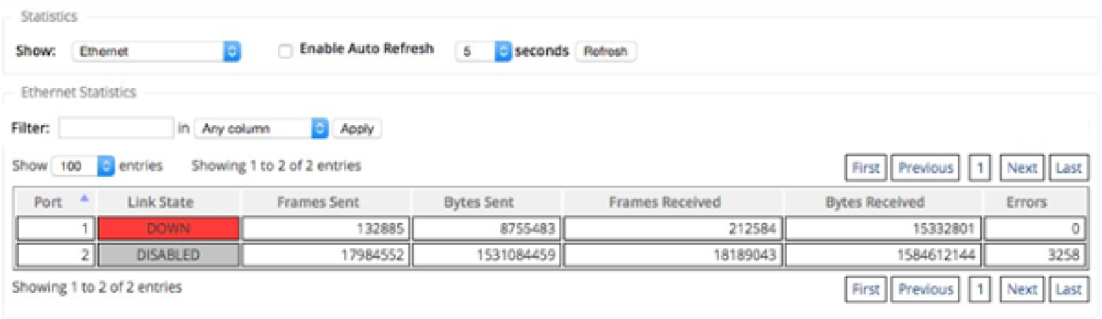
Link state propagation

August 24, 2022

The Link state propagation (LSP) feature allows network administrators to keep the link state of a bypass pair synchronized allowing attached devices on the other side of the link to view when links are inactive. When one port of a bypass pair becomes inactive, the coupled link is de-activated administratively. If your network architecture includes a parallel failover network, this forces traffic to transition to that network. Once the disrupted link is restored, its corresponding link automatically becomes active.

Monitoring link statistics

1. In the **Monitor > Statistics** page, choose **Ethernet from** the **Show** drop-down menu to view the status of the bypass port pair with Link State Propagation enabled. Observe that the LAN side link is down and later the WAN side link of the bypass pair is administratively DISABLED.



Statistics

Show: Ethernet

□ Enable Auto Refresh 5 seconds

Ethernet Statistics

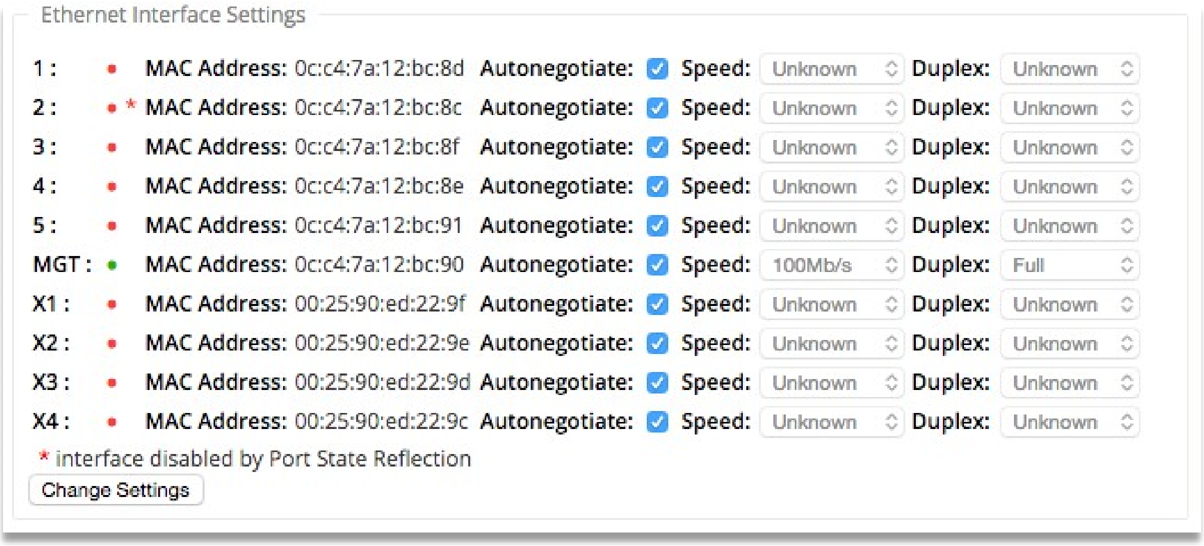
Filter: in Any column

Show 100 entries Showing 1 to 2 of 2 entries

Port	Link State	Frames Sent	Bytes Sent	Frames Received	Bytes Received	Errors
1	DOWN	132885	8755483	212584	15332801	0
2	DISABLED	17984552	1531084459	18189043	1584612144	3258

Showing 1 to 2 of 2 entries

2. Navigate to **Configuration > Appliance Settings** > **Network Adapters > Ethernet** tab. The ports that are administratively down are indicated by a red asterisk (*) in the **Ethernet Interface Settings** list.



Ethernet Interface Settings

1 :	●	MAC Address: 0c:c4:7a:12:bc:8d	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
2 :	● *	MAC Address: 0c:c4:7a:12:bc:8c	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
3 :	●	MAC Address: 0c:c4:7a:12:bc:8f	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
4 :	●	MAC Address: 0c:c4:7a:12:bc:8e	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
5 :	●	MAC Address: 0c:c4:7a:12:bc:91	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
MGT :	●	MAC Address: 0c:c4:7a:12:bc:90	Autonegotiate: ☑	Speed: 100Mb/s	Duplex: Full
X1 :	●	MAC Address: 00:25:90:ed:22:9f	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
X2 :	●	MAC Address: 00:25:90:ed:22:9e	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
X3 :	●	MAC Address: 00:25:90:ed:22:9d	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown
X4 :	●	MAC Address: 00:25:90:ed:22:9c	Autonegotiate: ☑	Speed: Unknown	Duplex: Unknown

* interface disabled by Port State Reflection

Metering and Standby WAN Links

August 24, 2022

Citrix SD-WAN supports enabling metered links, which can be configured such that user traffic is only transmitted on a specific Internet WAN Link when all other available WAN Links are disabled.

Metered links conserve bandwidth on links that are billed based on usage. With the metered links you can configure the links as the Last Resort link, which disallows the usage of the link until all other non-metered links are down or degraded. Set Last Resort is typically enabled when there are three WAN Links to a site (that is, MPLS, Broadband Internet, 4G/LTE) and one of the WAN links is 4G/LTE and might be too costly for a business to allow usage unless it is necessary. Metering is not enabled by default and can be enabled on a WAN link of any access type (Public Internet / Private MPLS / Private Intranet). If metering is enabled, you can optionally configure the following:

- Data Cap
- Billing Cycle (weekly/monthly)
- Start Date
- Standby Mode
- Priority
- Active heartbeat interval - Interval at which a heartbeat message is sent by an appliance to its peer on the other end of the virtual path when there has been no traffic (user/control) on the path for at least a heartbeat interval

With a local metered link, the dashboard of an appliance shows a **WAN Link Metering** table at the bottom with metering information.

Bandwidth usage on a local metered link is tracked against the configured data cap. When the usage exceeds 50%, 75% or 90% of the configured data cap, the appliance generates an event to alert the user and a warning banner is displayed across the top of the dashboard of the appliance. A metered path can be formed with 1 or 2 metered links. If a path is formed between two metered links, the active heartbeat interval used on the metered path is the larger of the two configured active heartbeat intervals on the links.

A metered path is a non-standby path and is always eligible for user traffic. When there is at least one non-metered path that is in GOOD state, a metered path carries the reduced amount of control traffic and is avoided when the forwarding plane searches for a path for a duplicate packet.

Standby mode

The standby mode of a WAN link is disabled by default. To enable standby mode, you must specify in which one of the following two modes the standby link operates

- **On-demand**: The standby link that becomes active when one of the conditions is met.

  When the available bandwidth in the virtual path is less than the configured on-demand bandwidth limit AND there is sufficient usage. Sufficient usage is defined as more than 95% (ON_DEMAND_USAGE_THRESHOLD_PCT) of the current available bandwidth, or the difference between current available bandwidth and current usage is less than 250 kbps (ON_DEMAND_THRESHOLD_GAP_KBPS) both parameters can be changed using t2_variables when all the non-standby paths are dead or disabled.

- **Last-resort** - a standby link that becomes active only when all non-standby links and on-demand standby links are dead or disabled.

- Standby priority indicates the order in which a standby link becomes active, if there are multiple standby links:

  - a priority 1 standby link becomes active first whereas a priority 3 standby link becomes active last
  - Multiple standby links can be assigned the same priority

When configuring a standby link, you can specify standby priority and two heartbeat intervals:

- **Active heartbeat interval** - the heartbeat interval used when the standby path is active (default 50ms/1s/2s/3s/4s/5s/6s/7s/8s/9s/10s)
- **Standby heartbeat interval** - the heartbeat interval used when the standby path is inactive (default 1s/2s/3s/4s/5s/6s/7s/8s/9s/10s/disabled)

A standby path is formed with 1 or 2 standby links.

- **On-Demand** - An on-demand standby path is formed between:
  - a non-standby link and an on-demand standby link
  - 2 on-demand standby links
- **Last-Resort** - A last-resort standby path is formed between:
  - a non-standby link and a last-resort standby link
  - an on-demand standby link and a last-resort standby link
  - 2 last-resort standby links

The heartbeat intervals used on a standby path are determined as follows:

- If standby heartbeat is disabled on at least 1 of the 2 links, heartbeat is disabled on the standby path while inactive.
- If standby heartbeat is not disabled on either link, then the larger of the two values are used when the standby path is standby.
- If active heartbeat interval is configured on both links, then the larger of the two values are used when the standby path is active.

Heartbeat (keep alive) messages:

- On a non-standby path, heartbeat messages are sent only when there has been no traffic (control or user) for at least a heartbeat interval. The heartbeat interval varies depending on the path state. For **non-standby, non-metered** paths:
  - 50 ms when the path state is GOOD
  - 25 ms when the path state is BAD

On a standby path, the heartbeat interval used depends on the activity state and the path state:

- While inactive, if the heartbeat is not disabled, heartbeat messages are sent regularly at the configured standby heartbeat interval since no other traffic is allowed on it.

- the configured active heartbeat interval is used when the path state is GOOD.
- 1/2 the configured active heartbeat interval is used when the path state is BAD.
- While active, like non-standby paths, heartbeat messages are sent only when there has been no traffic (control or user) for at least the configured active heartbeat interval.
- the configured standby heartbeat interval is used when the path state is GOOD.
- 1/2 the configured standby heartbeat interval is used when the path state is BAD.

While inactive, standby paths are not eligible for user traffic. The only control protocol messages sent on inactive standby paths are heartbeat messages, which are for connectivity failure detection and quality metrics gathering. When standby paths are active, they are eligible for user traffic with added time cost. This is done so that the non-standby paths, if available, are favored during forwarding path selection.

The path state of a standby path with disabled heartbeat, while inactive, is assumed to be GOOD and it is displayed as GOOD in the Path Statistics table under **Monitoring**. When it becomes active, unlike a non-standby path that starts in DEAD state until it hears from its Virtual Path peer, it starts in GOOD state. If connectivity with the Virtual Path peer is not detected, the path goes BAD and then DEAD. If connectivity with the Virtual Path peer is re-established, the path goes BAD and then GOOD again.

If such standby path goes DEAD and then becomes inactive, the path state does not immediately change to (assumed) GOOD. Instead, it is kept in DEAD state for time so that it cannot be used immediately. This is to prevent activity from oscillating between a lower priority path group with assumed good DEAD paths and a higher priority path group with actually GOOD paths. This on-hold period (NO_HB_PATH_ON_HOLD_PERIOD_MS) is set to 5 min and can be changed via t2_variables.

If path MTU discovery is enabled on a Virtual Path, the standby path's MTU is not used to calculate the Virtual Path's MTU while the path is standby. When the standby path becomes active, the Virtual Path' s MTU is recalculated considering the standby path's MTU. (The Virtual Path's MTU is the smallest path MTU among all active paths within the Virtual Path).

Events and log messages are generated when a standby path transitions between standby and active.

From SD-WAN 11.5 onwards, you can configure metered and standby WAN links using Citrix SD-WAN Orchestrator service. For more information, see Metering and Standby WAN Links.

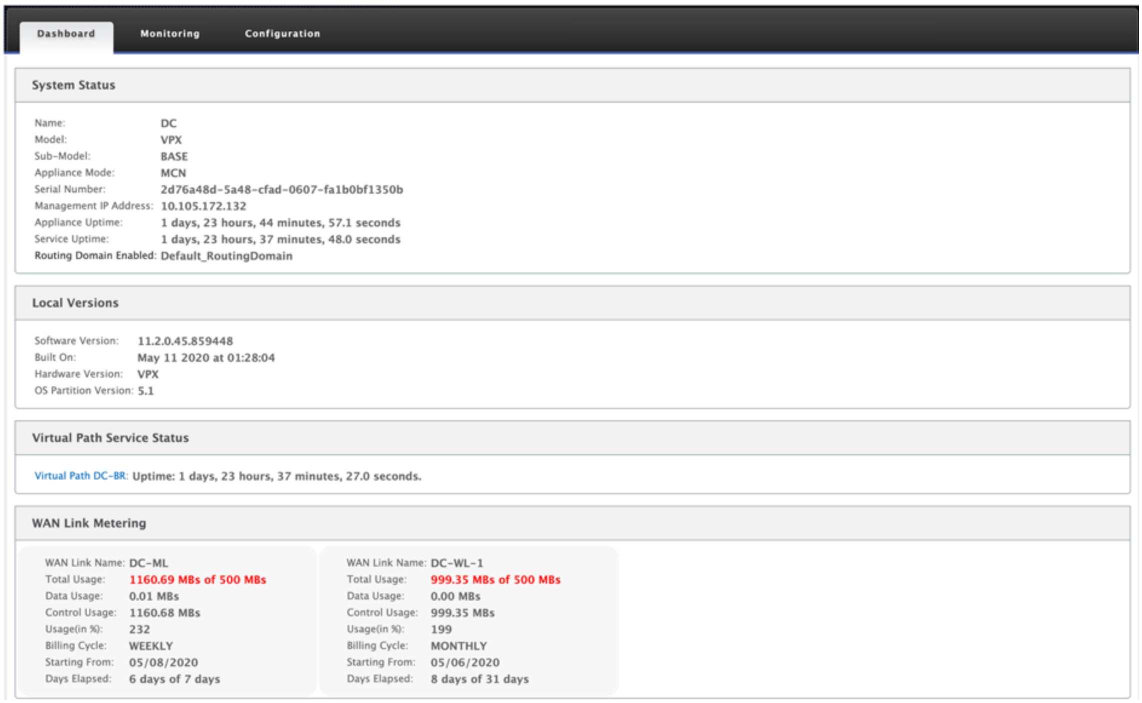
Configuration pre-requisites:

- A meter link might be of any access type.
- All links at a site can be configured with metering enabled.
- A standby link might be of Public Internet or Private Intranet access type. A WAN link of Private MPLS access type cannot be configured as a standby link.

- At least one non-standby link must be configured per site. A maximum of 3 standby links per site is supported.
- Internet/Intranet services might not be configured on on-demand standby links. On-demand standby links support Virtual Path service only.
- Internet service might be configured on a last-resort standby link, but only load balance mode is supported.
- Intranet service might be configured on a last-resort standby link, but only secondary mode is supported and primary reclaim must be enabled.

Monitor metered and standby WAN links

- The Dashboard page provides the following **WAN Link Metering** information with the usage values:
  - **WAN Link Name**: Displays the WAN link name.
  - **Total Usage**: Displays the total traffic usage (Data usage + Control usage).
  - **Data Usage**: Displays the usage by user traffic.
  - **Control Usage**: Displays the usage by control traffic.
  - **Usage (in %)**: Displays the used data cap value in percentage (Total Usage/Data Cap) x 100.
  - **Billing Cycle**: Billing frequency (weekly/monthly)
  - **Starting From**: Start date of the billing cycle
  - **Days Elapsed**: The time elapsed (in days, hours, minutes, and seconds)



System Status

Name:	DC
Model:	VPX
Sub-Model:	BASE
Appliance Mode:	MCN
Serial Number:	2d76a48d-5a48-cfad-0607-fa1b0bf1350b
Management IP Address:	10.105.172.132
Appliance Uptime:	1 days, 23 hours, 44 minutes, 57.1 seconds
Service Uptime:	1 days, 23 hours, 37 minutes, 48.0 seconds
Routing Domain Enabled:	Default_RoutingDomain

Local Versions

Software Version:	11.2.0.45.859448
Built On:	May 11 2020 at 01:28:04
Hardware Version:	VPX
OS Partition Version:	5.1

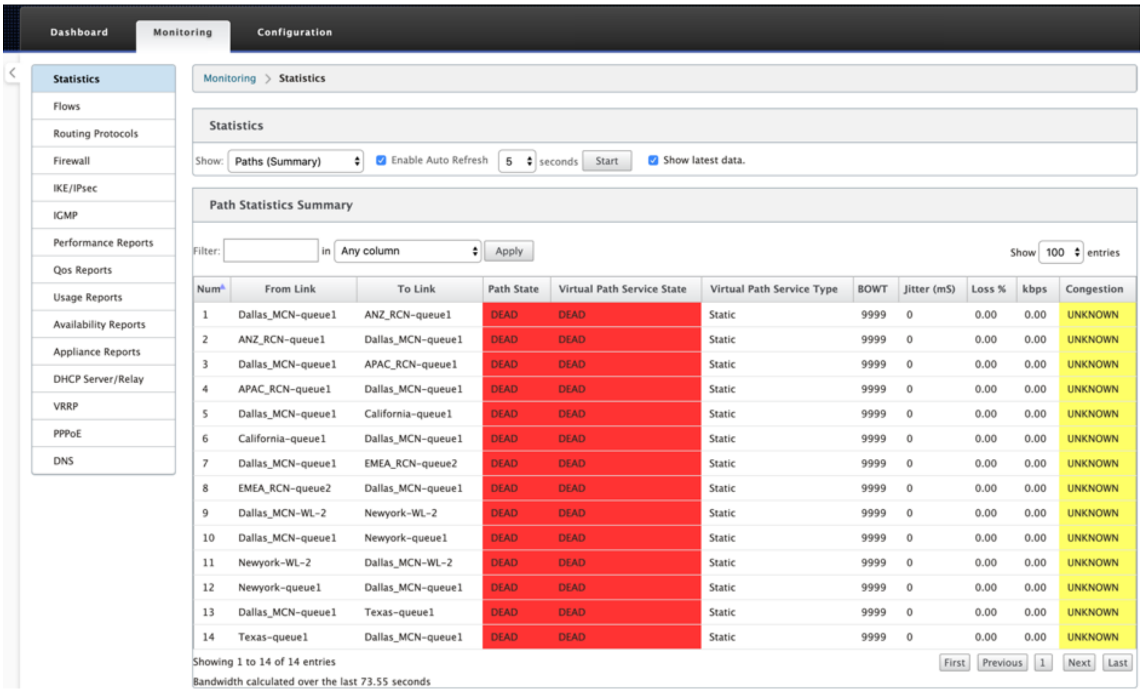
Virtual Path Service Status

Virtual Path DC-BR: Uptime: 1 days, 23 hours, 37 minutes, 27.0 seconds.

WAN Link Metering

WAN Link Name:	DC-ML	WAN Link Name:	DC-WL-1
Total Usage:	1160.69 MBs of 500 MBs	Total Usage:	999.35 MBs of 500 MBs
Data Usage:	0.01 MBs	Data Usage:	0.00 MBs
Control Usage:	1160.68 MBs	Control Usage:	999.35 MBs
Usage(in %):	232	Usage(in %):	199
Billing Cycle:	WEEKLY	Billing Cycle:	MONTHLY
Starting From:	05/08/2020	Starting From:	05/06/2020
Days Elapsed:	6 days of 7 days	Days Elapsed:	8 days of 31 days

- When path statistics (**Monitoring > Statistics > Paths**) are displayed, metered links and standby links are marked as shown in the screenshot.



Statistics

Show: Paths (Summary) ☑ Enable Auto Refresh 5 seconds ☑ Show latest data.

Path Statistics Summary

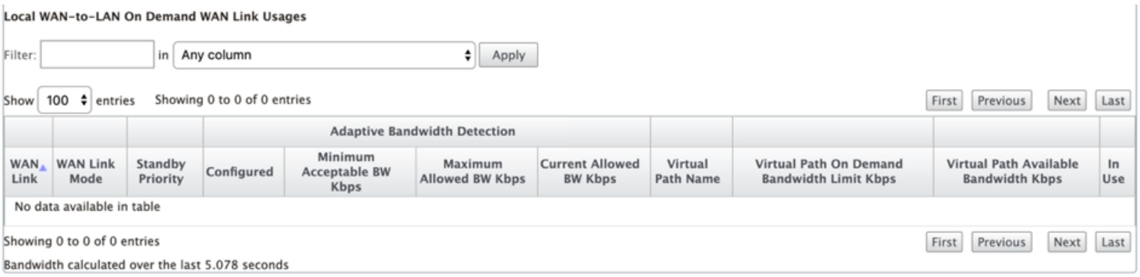
Filter: in Any column Show 100 entries

Num	From Link	To Link	Path State	Virtual Path Service State	Virtual Path Service Type	BOWT	Jitter (mS)	Loss %	kbps	Congestion
1	Dallas_MCN-queue1	ANZ_RCN-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
2	ANZ_RCN-queue1	Dallas_MCN-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
3	Dallas_MCN-queue1	APAC_RCN-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
4	APAC_RCN-queue1	Dallas_MCN-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
5	Dallas_MCN-queue1	California-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
6	California-queue1	Dallas_MCN-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
7	Dallas_MCN-queue1	EMEA_RCN-queue2	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
8	EMEA_RCN-queue2	Dallas_MCN-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
9	Dallas_MCN-WL-2	Newyork-WL-2	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
10	Dallas_MCN-queue1	Newyork-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
11	Newyork-WL-2	Dallas_MCN-WL-2	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
12	Newyork-queue1	Dallas_MCN-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
13	Dallas_MCN-queue1	Texas-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN
14	Texas-queue1	Dallas_MCN-queue1	DEAD	DEAD	Static	9999	0	0.00	0.00	UNKNOWN

Showing 1 to 14 of 14 entries

Bandwidth calculated over the last 73.55 seconds

- If the appliance has a Virtual Path that has a local or remote on-demand standby link, when WAN link usage statistics are viewed, an extra table showing on-demand bandwidth is displayed at the bottom of the page (**Monitoring > Statistics > WAN Link Usage**).



Local WAN-to-LAN On Demand WAN Link Usages

Filter: in Any column

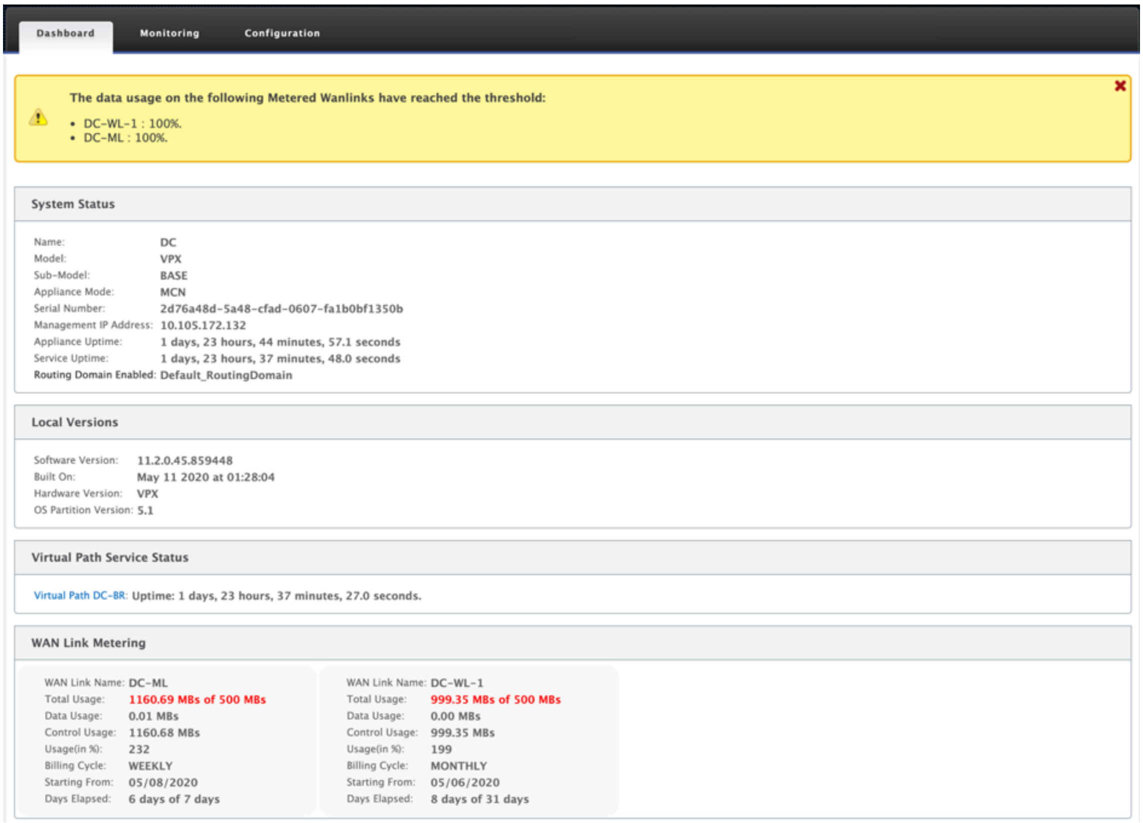
Show 100 entries Showing 0 to 0 of 0 entries

			Adaptive Bandwidth Detection							
WAN Link	WAN Link Mode	Standby Priority	Configured	Minimum Acceptable BW Kbps	Maximum Allowed BW Kbps	Current Allowed BW Kbps	Virtual Path Name	Virtual Path On Demand Bandwidth Limit Kbps	Virtual Path Available Bandwidth Kbps	In Use
No data available in table										

Showing 0 to 0 of 0 entries

Bandwidth calculated over the last 5.078 seconds

- When the usage on a metered link exceeds 50% of the configured data cap, a warning banner is displayed across the top of the dashboard. In addition, if the usage exceeds 75% of the configured data cap, the numerical metering information toward the bottom of the dashboard is highlighted.



The data usage on the following Metered Wanlinks have reached the threshold:

- DC-WL-1 : 100%.
- DC-ML : 100%.

System Status

Name:	DC
Model:	VPX
Sub-Model:	BASE
Appliance Mode:	MCN
Serial Number:	2d76a48d-5a48-cfad-0607-fa1b0bf1350b
Management IP Address:	10.105.172.132
Appliance Uptime:	1 days, 23 hours, 44 minutes, 57.1 seconds
Service Uptime:	1 days, 23 hours, 37 minutes, 48.0 seconds
Routing Domain Enabled:	Default_RoutingDomain

Local Versions

Software Version:	11.2.0.45.859448
Built On:	May 11 2020 at 01:28:04
Hardware Version:	VPX
OS Partition Version:	5.1

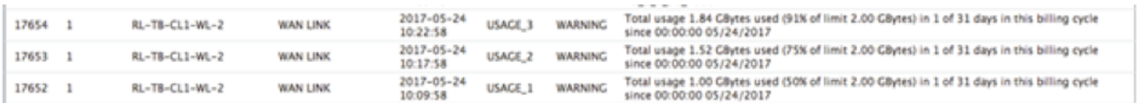
Virtual Path Service Status

Virtual Path DC-BR: Uptime: 1 days, 23 hours, 37 minutes, 27.0 seconds.

WAN Link Metering

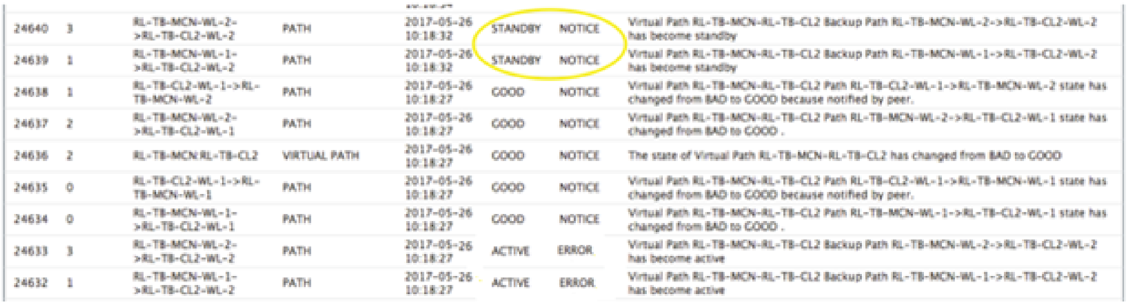
WAN Link Name:	DC-ML	WAN Link Name:	DC-WL-1
Total Usage:	1160.69 MBs of 500 MBs	Total Usage:	999.35 MBs of 500 MBs
Data Usage:	0.01 MBs	Data Usage:	0.00 MBs
Control Usage:	1160.68 MBs	Control Usage:	999.35 MBs
Usage(in %):	232	Usage(in %):	199
Billing Cycle:	WEEKLY	Billing Cycle:	MONTHLY
Starting From:	05/08/2020	Starting From:	05/06/2020
Days Elapsed:	6 days of 7 days	Days Elapsed:	8 days of 31 days

A WAN link usage event is also generated at the appliance when the usage exceeds 50%, 75%, and 90% of the configured data cap.



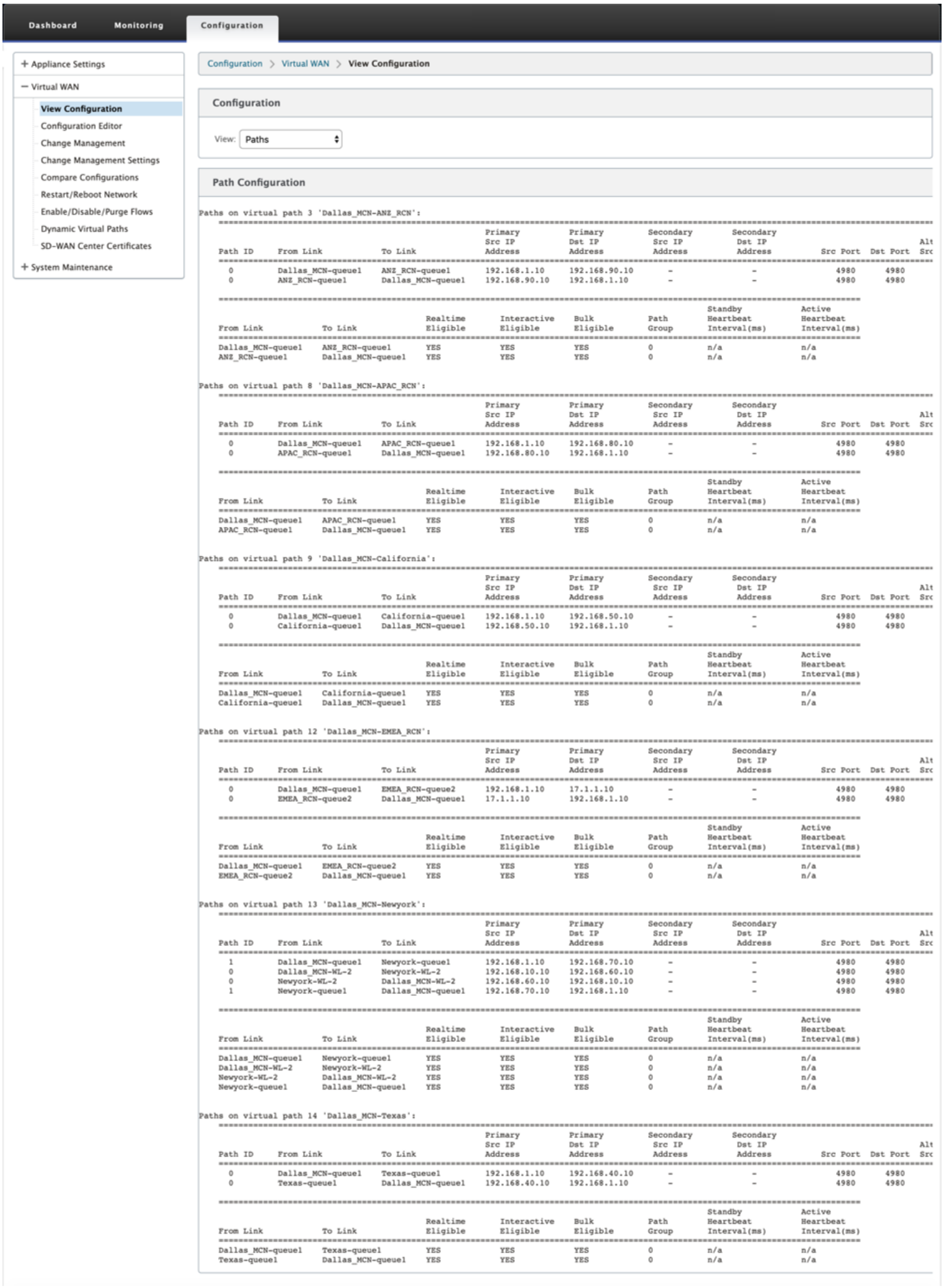
17654	1	RL-TB-CL1-WL-2	WAN LINK	2017-05-24 10:22:58	USAGE_3	WARNING	Total usage 1.84 GBytes used (91% of limit 2.00 GBytes) in 1 of 31 days in this billing cycle since 00:00:00 05/24/2017
17653	1	RL-TB-CL1-WL-2	WAN LINK	2017-05-24 10:17:58	USAGE_2	WARNING	Total usage 1.52 GBytes used (75% of limit 2.00 GBytes) in 1 of 31 days in this billing cycle since 00:00:00 05/24/2017
17652	1	RL-TB-CL1-WL-2	WAN LINK	2017-05-24 10:09:58	USAGE_1	WARNING	Total usage 1.00 GBytes used (50% of limit 2.00 GBytes) in 1 of 31 days in this billing cycle since 00:00:00 05/24/2017

1. When a standby path transitions between standby and active state, an event is generated by the appliance.



24640	3	RL-TB-MCN-WL-2->RL-TB-CL2-WL-2	PATH	2017-05-26 10:18:32	STANDBY	NOTICE	Virtual Path RL-TB-MCN-RL-TB-CL2 Backup Path RL-TB-MCN-WL-2->RL-TB-CL2-WL-2 has become standby
24639	1	RL-TB-MCN-WL-1->RL-TB-CL2-WL-2	PATH	2017-05-26 10:18:32	STANDBY	NOTICE	Virtual Path RL-TB-MCN-RL-TB-CL2 Backup Path RL-TB-MCN-WL-1->RL-TB-CL2-WL-2 has become standby
24638	1	RL-TB-CL2-WL-1->RL-TB-MCN-WL-2	PATH	2017-05-26 10:18:27	GOOD	NOTICE	Virtual Path RL-TB-MCN-RL-TB-CL2 Path RL-TB-CL2-WL-1->RL-TB-MCN-WL-2 state has changed from BAD to GOOD because notified by peer.
24637	2	RL-TB-MCN-WL-2->RL-TB-CL2-WL-1	PATH	2017-05-26 10:18:27	GOOD	NOTICE	Virtual Path RL-TB-MCN-RL-TB-CL2 Path RL-TB-MCN-WL-2->RL-TB-CL2-WL-1 state has changed from BAD to GOOD .
24636	2	RL-TB-MCN-RL-TB-CL2	VIRTUAL PATH	2017-05-26 10:18:27	GOOD	NOTICE	The state of Virtual Path RL-TB-MCN-RL-TB-CL2 has changed from BAD to GOOD
24635	0	RL-TB-CL2-WL-1->RL-TB-MCN-WL-1	PATH	2017-05-26 10:18:27	GOOD	NOTICE	Virtual Path RL-TB-MCN-RL-TB-CL2 Path RL-TB-CL2-WL-1->RL-TB-MCN-WL-1 state has changed from BAD to GOOD because notified by peer.
24634	0	RL-TB-MCN-WL-1->RL-TB-CL2-WL-1	PATH	2017-05-26 10:18:27	GOOD	NOTICE	Virtual Path RL-TB-MCN-RL-TB-CL2 Path RL-TB-MCN-WL-1->RL-TB-CL2-WL-1 state has changed from BAD to GOOD .
24633	3	RL-TB-MCN-WL-2->RL-TB-CL2-WL-2	PATH	2017-05-26 10:18:27	ACTIVE	ERROR	Virtual Path RL-TB-MCN-RL-TB-CL2 Backup Path RL-TB-MCN-WL-2->RL-TB-CL2-WL-2 has become active
24632	1	RL-TB-MCN-WL-1->RL-TB-CL2-WL-2	PATH	2017-05-26 10:18:27	ACTIVE	ERROR	Virtual Path RL-TB-MCN-RL-TB-CL2 Backup Path RL-TB-MCN-WL-1->RL-TB-CL2-WL-2 has become active

2. The configured active and standby heartbeat intervals for each path can be viewed at **Configuration** > **Virtual WAN** > **View Configuration** > **Paths**.



Configuration

View: Paths

Path Configuration

```
Paths on virtual path 3 'Dallas_MCN-ANZ_RCN':
    =====================================================================================================================================
                                                      Primary        Primary        Secondary      Secondary
                                                      Src IP         Dst IP          Src IP         Dst IP                           Alt
    Path ID     From Link          To Link            Address        Address        Address        Address        Src Port  Dst Port  Src
    =====================================================================================================================================
     0          Dallas_MCN-queue1  ANZ_RCN-queue1     192.168.1.10   192.168.90.10   -              -                 4980      4980
     0          ANZ_RCN-queue1     Dallas_MCN-queue1  192.168.90.10  192.168.1.10    -              -                 4980      4980

    ==============================================================================================================
                                                                                      Standby         Active
                                            Realtime     Interactive  Bulk        Path    Heartbeat       Heartbeat
    From Link         To Link           Eligible     Eligible     Eligible    Group   Interval(ms)    Interval(ms)
    ==============================================================================================================
    Dallas_MCN-queue1 ANZ_RCN-queue1    YES          YES          YES         0       n/a             n/a
    ANZ_RCN-queue1    Dallas_MCN-queue1 YES          YES          YES         0       n/a             n/a

Paths on virtual path 8 'Dallas_MCN-APAC_RCN':
    =====================================================================================================================================
                                                      Primary        Primary        Secondary      Secondary
                                                      Src IP         Dst IP          Src IP         Dst IP                           Alt
    Path ID     From Link          To Link            Address        Address        Address        Address        Src Port  Dst Port  Src
    =====================================================================================================================================
     0          Dallas_MCN-queue1  APAC_RCN-queue1    192.168.1.10   192.168.80.10   -              -                 4980      4980
     0          APAC_RCN-queue1    Dallas_MCN-queue1  192.168.80.10  192.168.1.10    -              -                 4980      4980

    ==============================================================================================================
                                                                                      Standby         Active
                                            Realtime     Interactive  Bulk        Path    Heartbeat       Heartbeat
    From Link         To Link           Eligible     Eligible     Eligible    Group   Interval(ms)    Interval(ms)
    ==============================================================================================================
    Dallas_MCN-queue1 APAC_RCN-queue1   YES          YES          YES         0       n/a             n/a
    APAC_RCN-queue1   Dallas_MCN-queue1 YES          YES          YES         0       n/a             n/a

Paths on virtual path 9 'Dallas_MCN-California':
    =====================================================================================================================================
                                                      Primary        Primary        Secondary      Secondary
                                                      Src IP         Dst IP          Src IP         Dst IP                           Alt
    Path ID     From Link          To Link            Address        Address        Address        Address        Src Port  Dst Port  Src
    =====================================================================================================================================
     0          Dallas_MCN-queue1  California-queue1  192.168.1.10   192.168.50.10   -              -                 4980      4980
     0          California-queue1  Dallas_MCN-queue1  192.168.50.10  192.168.1.10    -              -                 4980      4980

    ==============================================================================================================
                                                                                      Standby         Active
                                            Realtime     Interactive  Bulk        Path    Heartbeat       Heartbeat
    From Link         To Link           Eligible     Eligible     Eligible    Group   Interval(ms)    Interval(ms)
    ==============================================================================================================
    Dallas_MCN-queue1 California-queue1 YES          YES          YES         0       n/a             n/a
    California-queue1 Dallas_MCN-queue1 YES          YES          YES         0       n/a             n/a

Paths on virtual path 12 'Dallas_MCN-EMEA_RCN':
    =====================================================================================================================================
                                                      Primary        Primary        Secondary      Secondary
                                                      Src IP         Dst IP          Src IP         Dst IP                           Alt
    Path ID     From Link          To Link            Address        Address        Address        Address        Src Port  Dst Port  Src
    =====================================================================================================================================
     0          Dallas_MCN-queue1  EMEA_RCN-queue2    192.168.1.10   17.1.1.10       -              -                 4980      4980
     0          EMEA_RCN-queue2    Dallas_MCN-queue1  17.1.1.10      192.168.1.10    -              -                 4980      4980

    ==============================================================================================================
                                                                                      Standby         Active
                                            Realtime     Interactive  Bulk        Path    Heartbeat       Heartbeat
    From Link         To Link           Eligible     Eligible     Eligible    Group   Interval(ms)    Interval(ms)
    ==============================================================================================================
    Dallas_MCN-queue1 EMEA_RCN-queue2   YES          YES          YES         0       n/a             n/a
    EMEA_RCN-queue2   Dallas_MCN-queue1 YES          YES          YES         0       n/a             n/a

Paths on virtual path 13 'Dallas_MCN-Newyork':
    =====================================================================================================================================
                                                      Primary        Primary        Secondary      Secondary
                                                      Src IP         Dst IP          Src IP         Dst IP                           Alt
    Path ID     From Link          To Link            Address        Address        Address        Address        Src Port  Dst Port  Src
    =====================================================================================================================================
     1          Dallas_MCN-queue1  Newyork-queue1     192.168.1.10   192.168.70.10   -              -                 4980      4980
     0          Dallas_MCN-WL-2    Newyork-WL-2       192.168.10.10  192.168.60.10   -              -                 4980      4980
     0          Newyork-WL-2       Dallas_MCN-WL-2    192.168.60.10  192.168.10.10   -              -                 4980      4980
     1          Newyork-queue1     Dallas_MCN-queue1  192.168.70.10  192.168.1.10    -              -                 4980      4980

    ==============================================================================================================
                                                                                      Standby         Active
                                            Realtime     Interactive  Bulk        Path    Heartbeat       Heartbeat
    From Link         To Link           Eligible     Eligible     Eligible    Group   Interval(ms)    Interval(ms)
    ==============================================================================================================
    Dallas_MCN-queue1 Newyork-queue1    YES          YES          YES         0       n/a             n/a
    Dallas_MCN-WL-2   Newyork-WL-2      YES          YES          YES         0       n/a             n/a
    Newyork-WL-2      Dallas_MCN-WL-2   YES          YES          YES         0       n/a             n/a
    Newyork-queue1    Dallas_MCN-queue1 YES          YES          YES         0       n/a             n/a

Paths on virtual path 14 'Dallas_MCN-Texas':
    =====================================================================================================================================
                                                      Primary        Primary        Secondary      Secondary
                                                      Src IP         Dst IP          Src IP         Dst IP                           Alt
    Path ID     From Link          To Link            Address        Address        Address        Address        Src Port  Dst Port  Src
    =====================================================================================================================================
     0          Dallas_MCN-queue1  Texas-queue1       192.168.1.10   192.168.40.10   -              -                 4980      4980
     0          Texas-queue1       Dallas_MCN-queue1  192.168.40.10  192.168.1.10    -              -                 4980      4980

    ==============================================================================================================
                                                                                      Standby         Active
                                            Realtime     Interactive  Bulk        Path    Heartbeat       Heartbeat
    From Link         To Link           Eligible     Eligible     Eligible    Group   Interval(ms)    Interval(ms)
    ==============================================================================================================
    Dallas_MCN-queue1 Texas-queue1      YES          YES          YES         0       n/a             n/a
    Texas-queue1      Dallas_MCN-queue1 YES          YES          YES         0       n/a             n/a
```

Office 365 optimization

August 24, 2022

The **Office 365 Optimization** features adhere to the Microsoft Office 365 Network Connectivity Principles, to optimize Office 365. Office 365 is provided as a service through several service endpoints (front doors) located globally. To achieve optimal user experience for Office 365 traffic, Microsoft recommends redirecting Office365 traffic directly to the Internet from branch environments. Avoid practices such as backhauling to a central proxy. Office 365 traffic such as Outlook, Word are sensitive to latency and backhauling traffic introduces more latency resulting in poor user experience. Citrix SD-WAN allows you to configure policies to break out Office 365 traffic to the Internet.

The Office 365 traffic is directed to the nearest Office 365 service endpoint, which exists at the edges of Microsoft Office 365 infrastructure worldwide. Once traffic reaches a front door, it goes over Microsoft’s network and reaches the actual destination. It minimizes latency as the round trip time from the customer network to the Office 365 endpoint reduces.

Office 365 endpoints

Office 365 endpoints are a set of network addresses and subnets. Office 365 endpoints are classified into **Optimize**, **Allow**, and **Default** categories. Citrix SD-WAN 11.4.0 provides a more granular classification of the **Optimize** and **Allow** categories, enabling selective bookending to improve the performance of network-sensitive Office 365 traffic. Directing network-sensitive traffic to SD-WAN in the cloud (Cloud Direct or an SD-WAN VPX on Azure), or from an at-home SD-WAN device to an SD-WAN at a nearby location with more reliable Internet connectivity, enables QoS and superior connection resilience compared to simply steering the traffic to the nearest Office 365 front door, at the cost of an increase in latency. A bookended SD-WAN solution with QoS reduces VoIP dropouts and disconnects, reduces jitter and improves media-quality mean opinion scores for Microsoft Teams:

- **Optimize** - These endpoints provide connectivity to every Office 365 service and feature, and are sensitive to availability, performance, and latency. It represents over 75% of Office 365 bandwidth, connections, and volume of data. All the Optimize endpoints are hosted in Microsoft data centers. Service requests to these endpoints must breakout from the branch to the Internet and must not go through the data center.

The **Optimize** category is classified into the following subcategories:

```
- Teams Realtime
- Exchange Online
- SharePoint Optimize
```

For information about upgrade considerations, see Important considerations for upgrade.

- **Allow** - These endpoints provide connectivity to specific Office 365 services and features only, and are not so sensitive to network performance and latency. The representation of Office 365 bandwidth and connection count is also lower. These endpoints are hosted in Microsoft data centers. Service requests to these endpoints might breakout from the branch to the Internet or might go through the data center.

The **Allow** category is classified into the following subcategories:

```
- Teams TCP Fallback
- Exchange Mail
- SharePoint Allow
- Office365 Common
```

For information about upgrade considerations, see Important considerations for upgrade.

> **Note**
>
> The **Teams Realtime** subcategory uses the UDP real-time transport protocol to manage Microsoft Teams traffic, whereas the **Teams TCP Fallback** subcategory uses the TCP transport layer protocol. As media traffic is highly latency sensitive, you might prefer this traffic to take the most direct path possible and to use UDP instead of TCP as the transport layer protocol (most preferred transport for interactive real-time media in terms of quality). While UDP is a preferred protocol for Teams media traffic, it requires certain ports to be allowed in the firewall. If the ports are not allowed, Teams traffic uses TCP as a fallback, and enabling optimization for Teams TCP Fallback ensures better delivery of the Teams application in this scenario. For more information, see Microsoft Teams call flows.

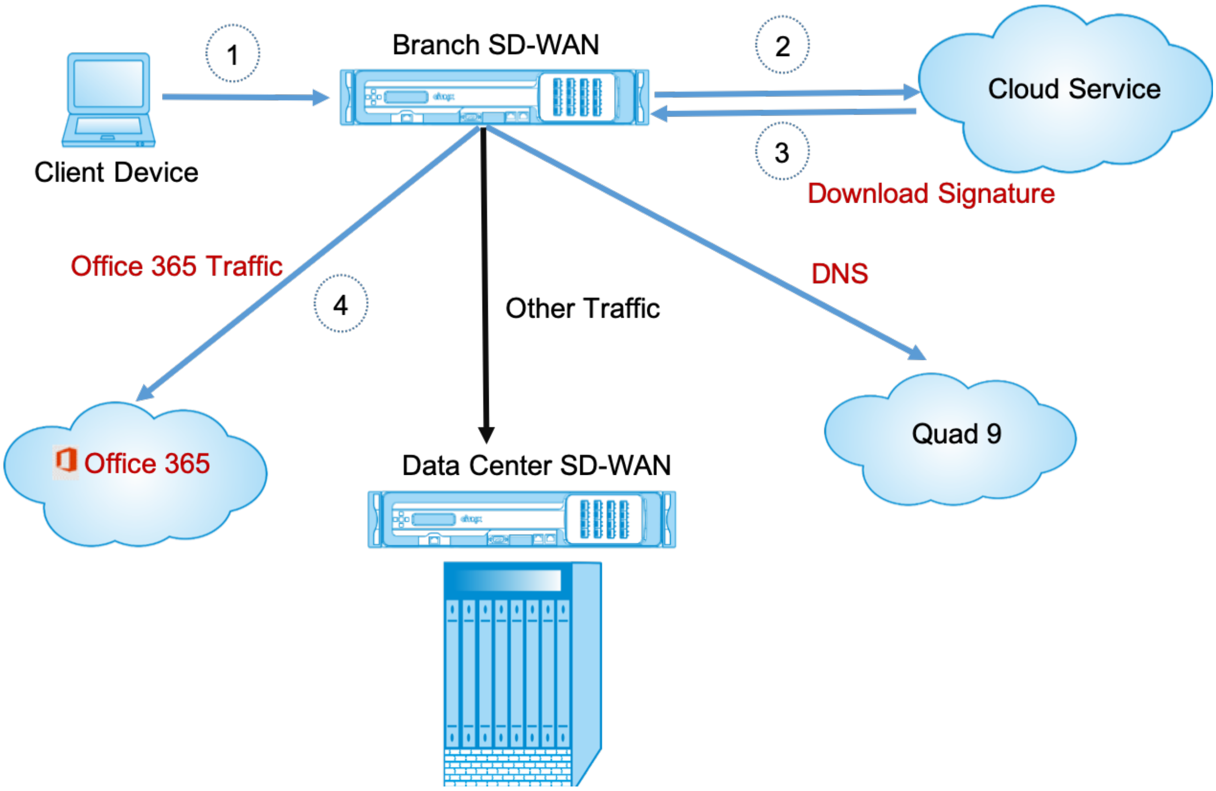
- **Default** - These endpoints provide Office 365 services that do not require any optimization, and can be treated as normal Internet traffic. Some of these endpoints might not be hosted in Microsoft data centers. The traffic in this category is not susceptible to variations in latency. Therefore, direct breaking out of this type of traffic does not cause any performance improvement when compared to Internet breakout. In addition, the traffic in this category may not always be Office 365 traffic. Hence, it is recommended to disable this option when enabling Office 365 breakout in your network.

How Office 365 optimization works

The Microsoft endpoint signatures are updated at most once a day. Agent on the appliance polls the Citrix service (sdwan-app-routing.citrixnetworkapi.net), every day to obtain the latest set of end-point signatures. The SD-WAN appliance polls the Citrix service (sdwan-app-routing.citrixnetworkapi.net), once every day, when the appliance is turned on. If there are new signatures available, the appliance downloads it and stores it in the database. The signatures are essentially a list of URLs and IPs used to detect Office 365 traffic based on which traffic steering policies can be configured.

> **Note**
>
> Except for the Office 365 Default category, first packet detection and classification of Office 365 traffic is performed by default, irrespective of whether the Office 365 breakout feature is enabled or not.

When a request for the Office 365 application arrives, the application classifier, does a first packet classifier database lookup, identifies, and marks Office 365 traffic. Once the Office 365 traffic is classified, the auto created application route and firewall policies take effect and breaks out the traffic directly to the Internet. The Office 365 DNS requests are forwarded to specific DNS services like Quad9. For more information, see Domain name system.



The signatures are downloaded from Cloud Service (sdwan-app-routing.citrixnetworkapi.net).

From Citrix SD-WAN 11.5 onwards, you can configure Office 365 breakout using Citrix SD-WAN Orchestrator service. For more information, see Office 365 optimization.

Transparent forwarder for Office 365

The branch breaks out for Office 365 begins with a DNS request. The DNS request going through Office 365 domains have to be steered locally. If Office 365 Internet break out is enabled, the internal DNS routes are determined and the transparent forwarders list is auto populated. Office 365 DNS requests are forwarded to open source DNS service Quad 9 by default. Quad 9 DNS service is secure, scalable, and has multi pop presence. You can change the DNS service if necessary. Transparent forwarders for Office 365 applications are created at every branch that has Internet service and office 365 breakout enabled.

If you are using another DNS proxy or if SD-WAN is configured as the DNS proxy, the forwarder list is auto populated with forwarders for Office 365 applications.

Important considerations for upgrade

Optimize and Allow categories

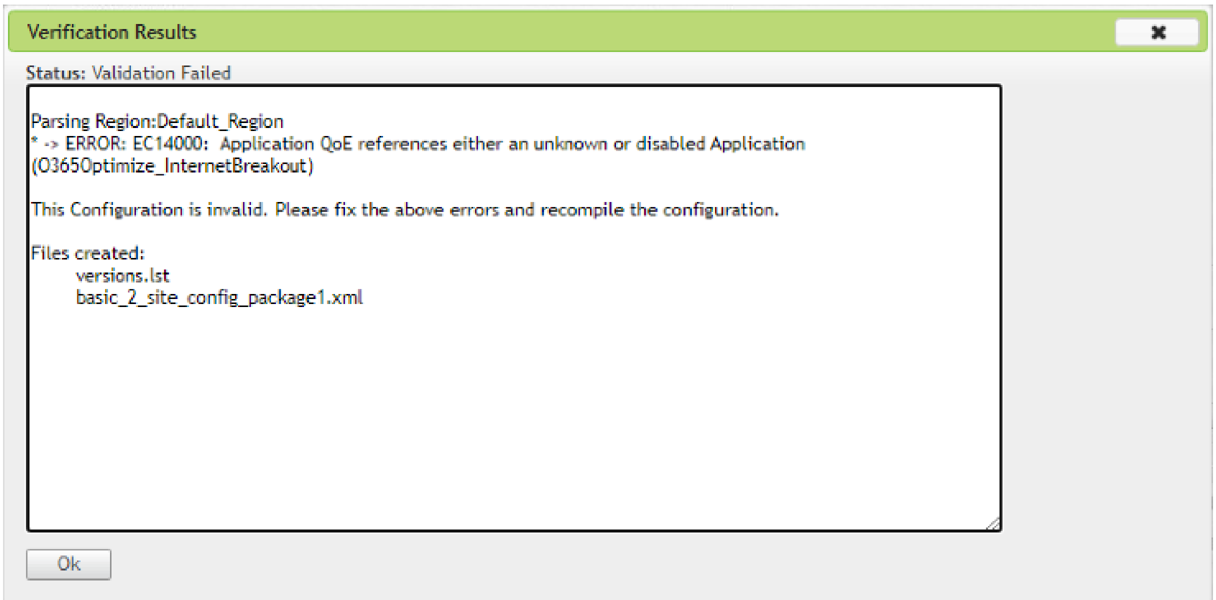
If you have enabled the Internet breakout policy for the **Optimize** and **Allow** Office 365 categories, Citrix SD-WAN automatically enables the Internet breakout policy for the corresponding subcategories upon upgrade to Citrix SD-WAN 11.4.0.

When you downgrade to a software version older than Citrix SD-WAN 11.4.0, you must manually enable Internet breakout for the **Optimize** or **Allow** Office 365 category irrespective of whether you enabled the corresponding subcategories in the Citrix SD-WAN 11.4.0 version or not.

Office 365 application objects

If you have created rules/routes using the **O365Optimize_InternetBreakout** and **O365Allow_InternetBreakout** auto-generated application objects, ensure to delete the rules/routes before upgrading to Citrix SD-WAN 11.4.0. After the upgrade, you can create rules/ routes using the corresponding new application objects.

If you proceed with Citrix SD-WAN 11.4.0 upgrade without deleting the rules/routes, you see an error and thus, the upgrade becomes unsuccessful. In the below example, a user has configured an Application QoE profile and is seeing an error while trying to upgrade to Citrix SD-WAN 11.4.0 without deleting the rules/routes:



```
Parsing Region:Default_Region
* -> ERROR: EC14000:  Application QoE references either an unknown or disabled Application
(O365Optimize_InternetBreakout)

This Configuration is invalid. Please fix the above errors and recompile the configuration.

Files created:
      versions.lst
      basic_2_site_config_package1.xml
```

> **Note**
>
> This upgrade is not required for auto-created rules/routes. It applies only to rules/ routes that you have created.

DNS

If you have created DNS Proxy rules or DNS transparent forwarder rules using the **Office 365 Optimize** and **Office 365 Allow** applications, ensure to delete the rules before upgrading to Citrix SD-WAN 11.4.0. After the upgrade, you can create the rules again using the corresponding new applications.

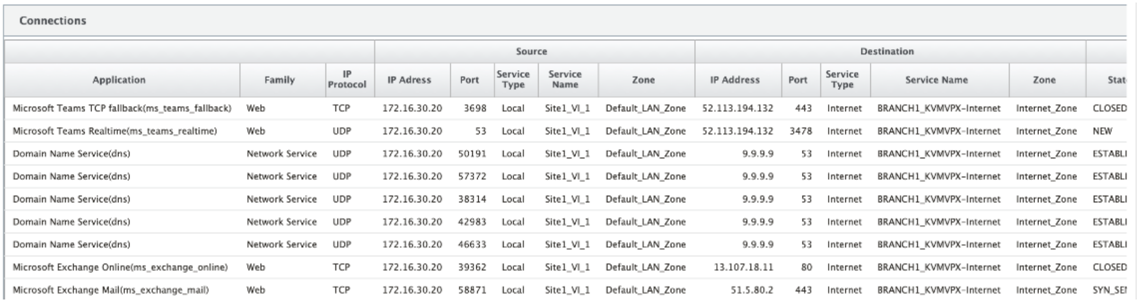
If you proceed with Citrix SD-WAN 11.4.0 upgrade without deleting the old DNS proxy or transparent forwarder rules, you do not see any error and upgrade becomes successful too. However, the DNS proxy rules and transparent forwarding rules do not take effect in Citrix SD-WAN 11.4.0.

> **Note**
>
> This activity does not apply to the auto-created DNS rules. It applies only to DNS rules that you have created.

Monitoring

You can monitor the office 365 application statistics in the following SD-WAN statistic reports:

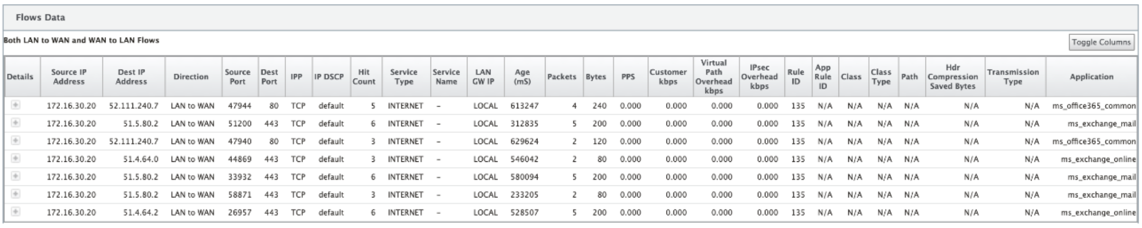
- Firewall Statistics



Connections

			Source					Destination					
Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	Stat
Microsoft Teams TCP fallback(ms_teams_fallback)	Web	TCP	172.16.30.20	3698	Local	Site1_VI_1	Default_LAN_Zone	52.113.194.132	443	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	CLOSED
Microsoft Teams Realtime(ms_teams_realtime)	Web	UDP	172.16.30.20	53	Local	Site1_VI_1	Default_LAN_Zone	52.113.194.132	3478	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	NEW
Domain Name Service(dns)	Network Service	UDP	172.16.30.20	50191	Local	Site1_VI_1	Default_LAN_Zone	9.9.9.9	53	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	ESTABLI
Domain Name Service(dns)	Network Service	UDP	172.16.30.20	57372	Local	Site1_VI_1	Default_LAN_Zone	9.9.9.9	53	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	ESTABLI
Domain Name Service(dns)	Network Service	UDP	172.16.30.20	38314	Local	Site1_VI_1	Default_LAN_Zone	9.9.9.9	53	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	ESTABLI
Domain Name Service(dns)	Network Service	UDP	172.16.30.20	42983	Local	Site1_VI_1	Default_LAN_Zone	9.9.9.9	53	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	ESTABLI
Domain Name Service(dns)	Network Service	UDP	172.16.30.20	46633	Local	Site1_VI_1	Default_LAN_Zone	9.9.9.9	53	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	ESTABLI
Microsoft Exchange Online(ms_exchange_online)	Web	TCP	172.16.30.20	39362	Local	Site1_VI_1	Default_LAN_Zone	13.107.18.11	80	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	CLOSED
Microsoft Exchange Mail(ms_exchange_mail)	Web	TCP	172.16.30.20	58871	Local	Site1_VI_1	Default_LAN_Zone	51.5.80.2	443	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	SYN_SEI

- Flows

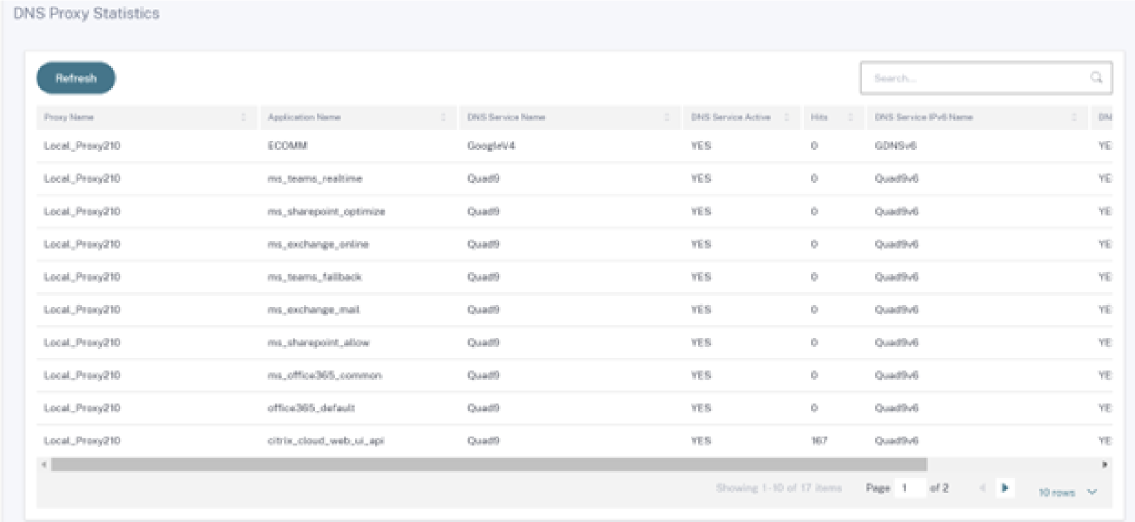


Flows Data

Both LAN to WAN and WAN to LAN Flows

Details	Source IP Address	Dest IP Address	Direction	Source Port	Dest Port	IPP	IP DSCP	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
+	172.16.30.20	52.111.240.7	LAN to WAN	47944	80	TCP	default	5	INTERNET	-	LOCAL	613247	4	240	0.000	0.000	0.000	0.000	135	N/A	N/A	N/A	N/A	N/A	N/A	ms_office365_common
+	172.16.30.20	51.5.80.2	LAN to WAN	51200	443	TCP	default	6	INTERNET	-	LOCAL	312835	5	200	0.000	0.000	0.000	0.000	135	N/A	N/A	N/A	N/A	N/A	N/A	ms_exchange_mail
+	172.16.30.20	52.111.240.7	LAN to WAN	47940	80	TCP	default	3	INTERNET	-	LOCAL	629624	2	120	0.000	0.000	0.000	0.000	135	N/A	N/A	N/A	N/A	N/A	N/A	ms_office365_common
+	172.16.30.20	51.4.64.0	LAN to WAN	44869	443	TCP	default	3	INTERNET	-	LOCAL	546042	2	80	0.000	0.000	0.000	0.000	135	N/A	N/A	N/A	N/A	N/A	N/A	ms_exchange_online
+	172.16.30.20	51.5.80.2	LAN to WAN	33932	443	TCP	default	6	INTERNET	-	LOCAL	580094	5	200	0.000	0.000	0.000	0.000	135	N/A	N/A	N/A	N/A	N/A	N/A	ms_exchange_mail
+	172.16.30.20	51.5.80.2	LAN to WAN	58871	443	TCP	default	3	INTERNET	-	LOCAL	233205	2	80	0.000	0.000	0.000	0.000	135	N/A	N/A	N/A	N/A	N/A	N/A	ms_exchange_mail
+	172.16.30.20	51.4.64.2	LAN to WAN	26957	443	TCP	default	6	INTERNET	-	LOCAL	528507	5	200	0.000	0.000	0.000	0.000	135	N/A	N/A	N/A	N/A	N/A	N/A	ms_exchange_online

- DNS Statistics

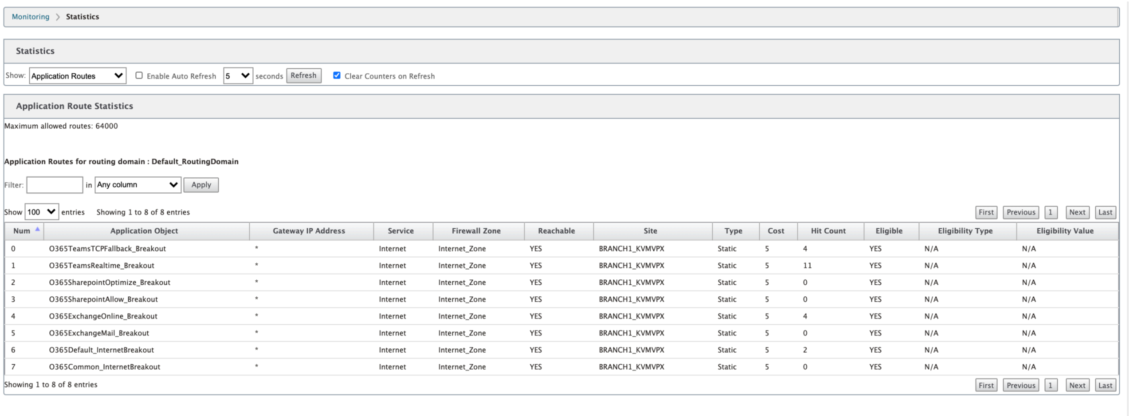


DNS Proxy Statistics

Proxy Name	Application Name	DNS Service Name	DNS Service Active	Hits	DNS Service IPv6 Name	DN
Local_Proxy210	ECOMM	GoogleV4	YES	0	GDNSv6	YE
Local_Proxy210	ms_teams_realtime	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_sharepoint_optimize	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_exchange_online	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_teams_fallback	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_exchange_mail	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_sharepoint_allow	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	ms_office365_common	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	office365_default	Quad9	YES	0	Quad9v6	YE
Local_Proxy210	citrix_cloud_web_ui_api	Quad9	YES	167	Quad9v6	YE

Showing 1-10 of 17 items Page 1 of 2

- Application Route Statistics



Statistics

Show: Application Routes ☐ Enable Auto Refresh 5 seconds Refresh ☑ Clear Counters on Refresh

Application Route Statistics

Maximum allowed routes: 64000

Application Routes for routing domain : Default_RoutingDomain

Filter: in Any column Apply

Show 100 entries Showing 1 to 8 of 8 entries

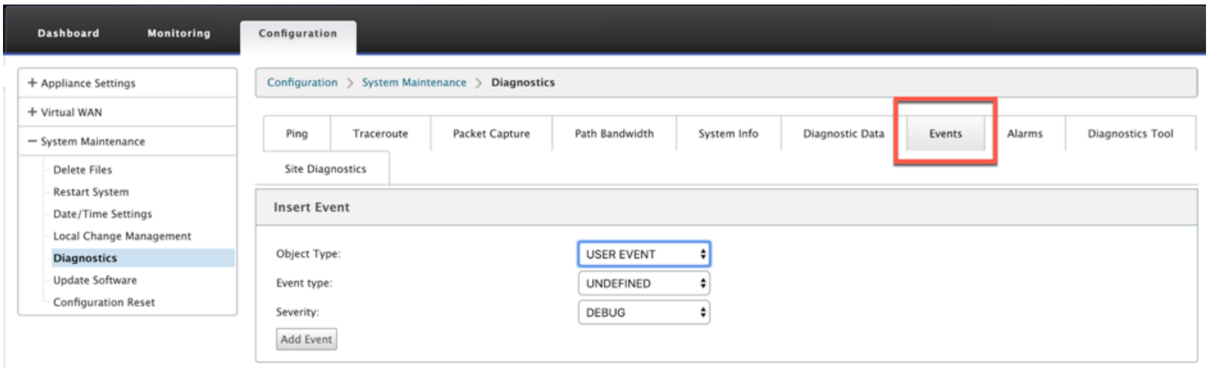
Num	Application Object	Gateway IP Address	Service	Firewall Zone	Reachable	Site	Type	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	O365TeamsTCPFallback_Breakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	5	4	YES	N/A	N/A
1	O365TeamsRealtime_Breakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	5	11	YES	N/A	N/A
2	O365SharepointOptimize_Breakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	5	0	YES	N/A	N/A
3	O365SharepointAllow_Breakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	5	0	YES	N/A	N/A
4	O365ExchangeOnline_Breakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	5	4	YES	N/A	N/A
5	O365ExchangeMail_Breakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	5	0	YES	N/A	N/A
6	O365Default_InternetBreakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	5	2	YES	N/A	N/A
7	O365Common_InternetBreakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	5	0	YES	N/A	N/A

Showing 1 to 8 of 8 entries

Troubleshooting

You can view the service error in the **Events** section of the SD-WAN appliance.

To check the errors, navigate to **Configuration > System Maintenance > Diagnostics**, click **Events** tab.



Insert Event

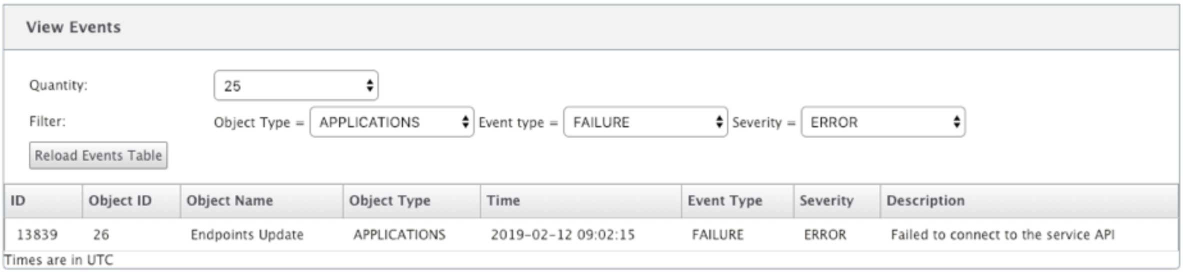
Object Type: USER EVENT

Event type: UNDEFINED

Severity: DEBUG

Add Event

If there is an issue in connecting to the Citrix service (sdwan-app-routing.citrixnetworkapi.net), then the error message reflects under the **View Events** table.



View Events

Quantity: 25

Filter: Object Type = APPLICATIONS Event type = FAILURE Severity = ERROR

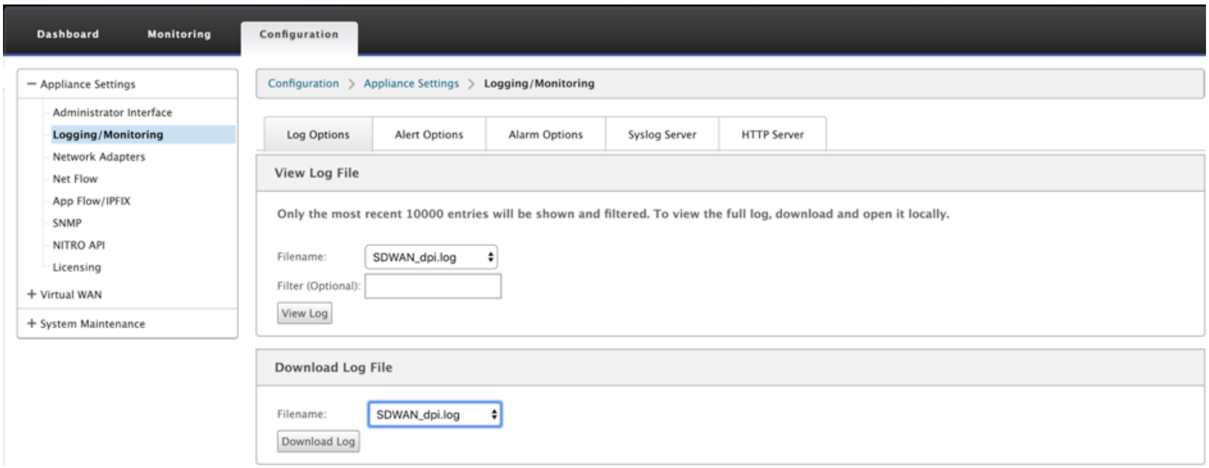
Reload Events Table

ID	Object ID	Object Name	Object Type	Time	Event Type	Severity	Description
13839	26	Endpoints Update	APPLICATIONS	2019-02-12 09:02:15	FAILURE	ERROR	Failed to connect to the service API

Times are in UTC

The connectivity errors are also logged to **SDWAN_dpi.log**. To view the log, navigate to **Configuration > Appliance Settings > Logging/ Monitoring > Log Options**. Select the **SDWAN_dpi.log** from the drop-down list and click View **Log**.

You can also download the log file. To download the log file, select the required log file from the drop-down list under the **Download Log file** section and click **Download Log**.



View Log File

Only the most recent 10000 entries will be shown and filtered. To view the full log, download and open it locally.

Filename: SDWAN_dpi.log

Filter (Optional):

View Log

Download Log File

Filename: SDWAN_dpi.log

Download Log

Limitations

- If the Office 365 breakout policy is configured, deep packet inspection is not performed on connections destined to the configured category of IP addresses.
- The auto created firewall policy and application routes are uneditable.
- The auto created firewall policy has the lowest priority and is uneditable.
- The route cost for the auto created application route is five. You can override it with a lower cost route.

Office 365 beacon service

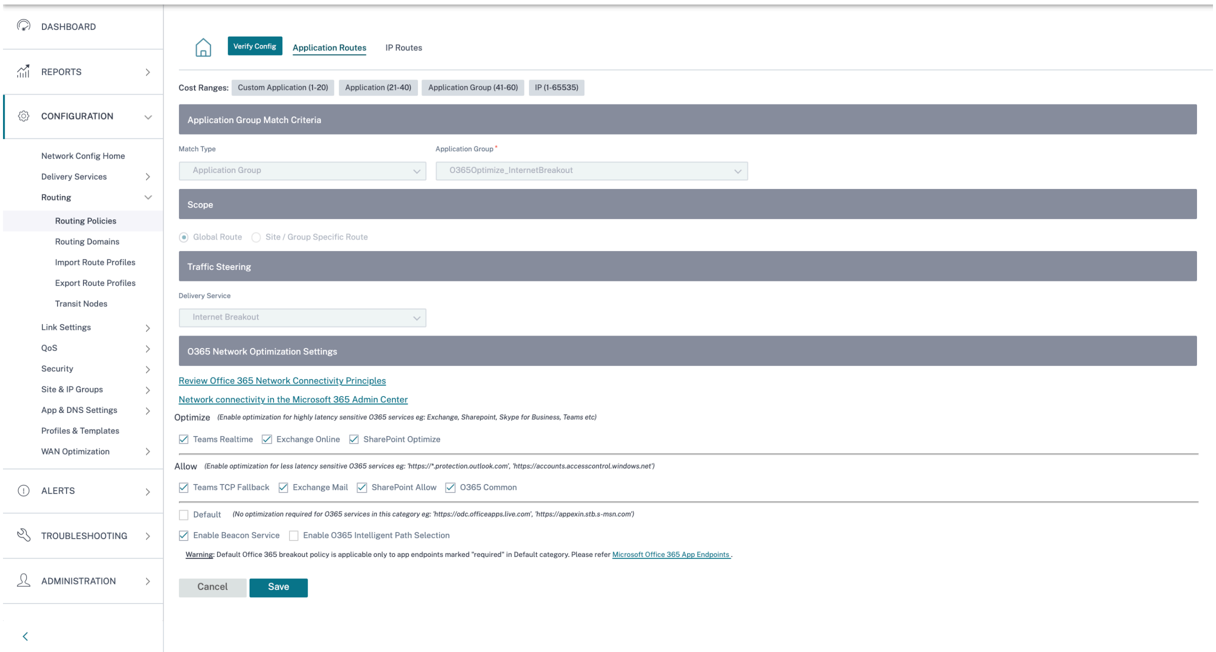
Microsoft provides the Office 365 beacon service to measure the Office 365 reachability through the WAN links. The beacon service is basically a URL - sdwan.measure.office.com/apc/trans.png, which is probed at regular intervals. Probing is done on each appliance for every internet enabled WAN link. With each probe, an HTTP request is sent to the beacon service and an HTTP response is expected. The HTTP response confirms the availability and reachability of the Office 365 service.

Citrix SD-WAN allows you to not only perform beacon probing, but also determines the latency to reach Office 365 endpoints through each WAN link. The latency is the round trip time taken to send a request and get a response from the Office 365 beacon service over a WAN link. This enables network administrators to view the beacon service latency report and manually choose the best internet link for direct Office 365 breakout. Beacon probing is enabled only through Citrix SD-WAN Orchestrator. By default, beacon probing is enabled on all Internet enabled WAN links when Office 365 break-out is enabled through Citrix SD-WAN Orchestrator.

> **Note**
>
> Office 365 beacon probing is not enabled on metered links.

You can choose to disable Office 365 beacon probing and view latency reports on the SD-WAN Orchestrator. For more information, see Office 365 optimization.

To disable Office 365 beacon service, in SD-WAN Orchestrator, at network level navigate to **Configuration** > **Routing** > **Routing Policies** > **O365 Network Optimization Settings** and clear **Enable Beacon Service**.



Cost Ranges: Custom Application (1-20) Application (21-40) Application Group (41-60) IP (1-65535)

Application Group Match Criteria

Match Type: Application Group

Application Group *: O365Optimize_InternetBreakout

Scope

● Global Route ○ Site / Group Specific Route

Traffic Steering

Delivery Service: Internet Breakout

O365 Network Optimization Settings

Review Office 365 Network Connectivity Principles

Network connectivity in the Microsoft 365 Admin Center

Optimize *(Enable optimization for highly latency sensitive O365 services eg: Exchange, Sharepoint, Skype for Business, Teams etc)*

☑ Teams Realtime ☑ Exchange Online ☑ SharePoint Optimize

Allow *(Enable optimization for less latency sensitive O365 services eg: 'https://*.protection.outlook.com', 'https://accounts.accesscontrol.windows.net')*

☑ Teams TCP Fallback ☑ Exchange Mail ☑ SharePoint Allow ☑ O365 Common

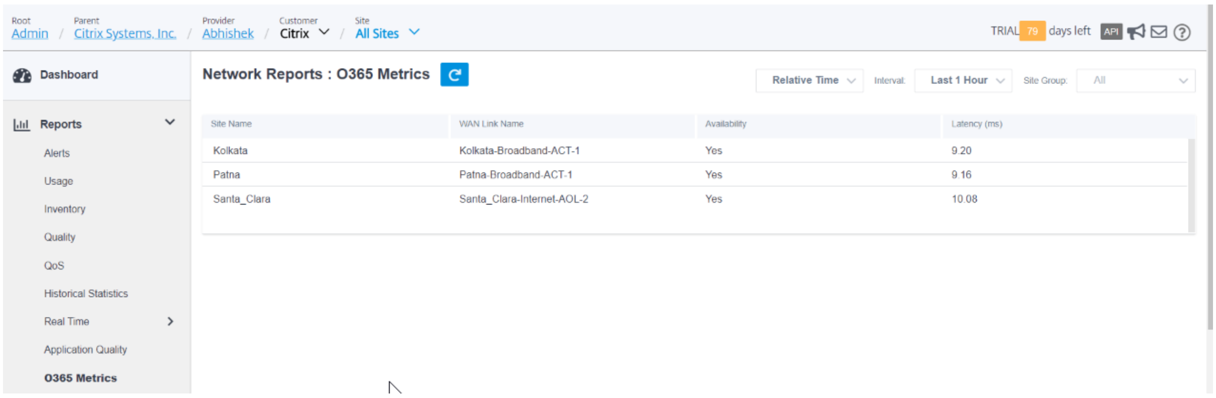
□ Default *(No optimization required for O365 services in this category eg: 'https://odc.officeapps.live.com', 'https://appexin.stb.s-msn.com')*

☑ Enable Beacon Service □ Enable O365 Intelligent Path Selection

Warning: Default Office 365 breakout policy is applicable only to app endpoints marked "required" in Default category. Please refer Microsoft Office 365 App Endpoints .

Cancel Save

To view the beacon probing availability and latency reports, in Citrix SD-WAN Orchestrator, at network level navigate to **Reports** > **O365 Metrics**.

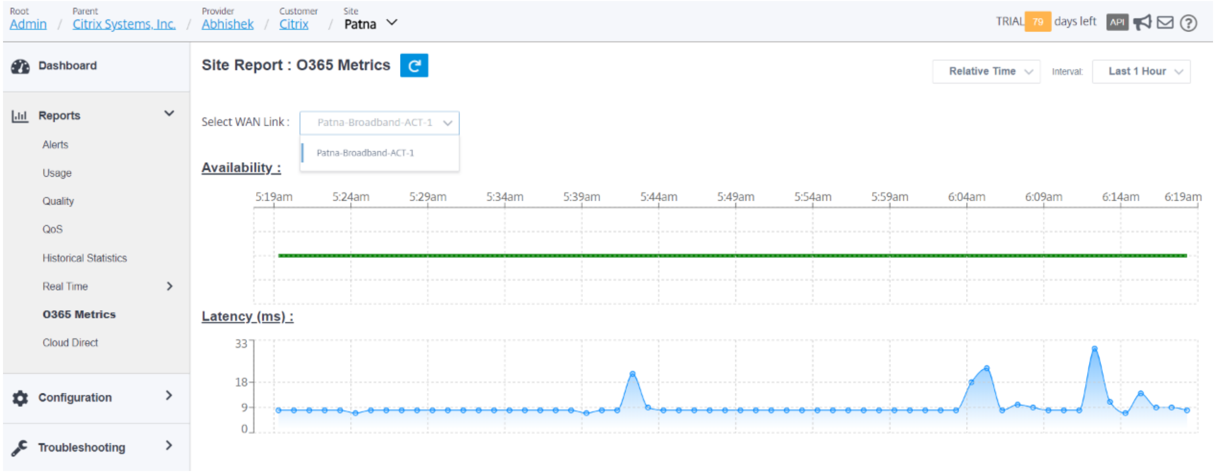


Network Reports : O365 Metrics

Relative Time Interval: Last 1 Hour Site Group: All

Site Name	WAN Link Name	Availability	Latency (ms)
Kolkata	Kolkata-Broadband-ACT-1	Yes	9.20
Patna	Patna-Broadband-ACT-1	Yes	9.16
Santa_Clara	Santa_Clara-Internet-AOL-2	Yes	10.08

To view a detailed site level report of beacon service, in SD-WAN Orchestrator, at site level navigate to **Reports** > **O365 Metrics**.


Site Report : O365 Metrics

Select WAN Link : Patna-Broadband-ACT-1

Relative Time

Interval: Last 1 Hour

Citrix Cloud and Gateway service optimization

August 24, 2022

With the **Citrix Cloud and Gateway Service optimization** feature enhancement, you can detect and route traffic destined for Citrix Cloud and Gateway Service. You can create policies to either break the traffic out to internet directly or, to send it via a backhaul route over virtual path. In the absence of this feature, when the default route is virtual path, gateway service will hairpin back to the customer’ s Data Center and then would go out to Internet adding unnecessary latency. In addition to that, you now get visibility into Citrix Gateway service and Citrix Cloud traffic and can create QoS policies to prioritize it over virtual path.

The Citrix Cloud and Gateway Service breakout feature is enabled by default in Citrix SD-WAN software version 11.2.1 and above.

For Citrix SD-WAN software version below 11.3.0, the first packet detection and classification of Citrix Cloud and Gateway Service traffic is performed only if the Citrix Cloud and Gateway Service breakout feature is not disabled.

For Citrix SD-WAN software version 11.3.0 and above, the first packet detection and classification of Citrix Cloud and Gateway Service traffic is performed irrespective of whether the Citrix Cloud and Gateway Service breakout feature is enabled or not.

> **Note**
>
> - You can configure the Citrix Cloud and Gateway Service optimization only through Citrix SD-WAN Orchestrator. For more information, see Gateway service optimization.
> - **Citrix SD-WAN Orchestrator traffic optimization** is introduced from Citrix SD-WAN soft-

> ware version 11.2.3 or higher. The goal is to provide a more granular classification, and thus, separately identify Citrix SD-WAN Orchestrator traffic and other dependent services' traffic from Citrix Cloud, and provide an Internet breakout option. As a result, customers can now choose to optimize only the Citrix SD-WAN Orchestrator traffic.

Citrix Cloud and Gateway Service categories

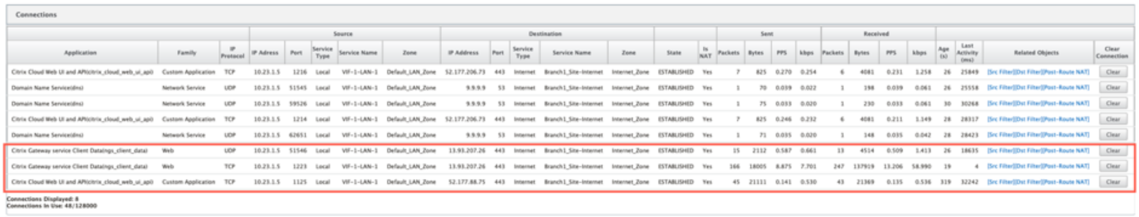
Following are the traffic categories used for classification and optimization purposes:

- **Citrix Cloud**: Enable to detect and route traffic destined for Citrix Cloud Web UI and APIs.
    - Citrix SD-WAN Orchestrator and dependant critical services:
        - **Citrix SD-WAN Orchestrator**: Enables direct internet breakout of heartbeat and other traffic required to establish and maintain connectivity between Citrix SD-WAN appliance, and Citrix SD-WAN Orchestrator.
        - **Citrix Cloud Download Service**: Enables direct internet breakout for download of appliance software, configuration, scripts, and so on onto the Citrix SD-WAN appliance.
- **Citrix Gateway Service**: Enable to detect and route traffic (control and data) destined for Citrix Gateway Service.
    - **Gateway Service Client Data**: Enables direct internet breakout of ICA data tunnels between clients and Citrix Gateway Service. It requires high bandwidth and low latency.
    - **Gateway Service Server Data**: Enables direct internet breakout of ICA data tunnels between Virtual Delivery Agents (VDAs) and Citrix Gateway Service. It requires high bandwidth and low latency and only relevant in VDA resource locations (VDA to Citrix Gateway Service connections).
    - **Gateway Service Control Traffic**: Enables direct internet breakout of the control traffic. No specific QoS considerations.
    - **Gateway Service Web Proxy Traffic**: Enables direct internet breakout of the Web proxy traffic. It requires high bandwidth but latency requirements might vary.

Monitoring

You can monitor the Gateway service statistics in the following SD-WAN statistic reports:

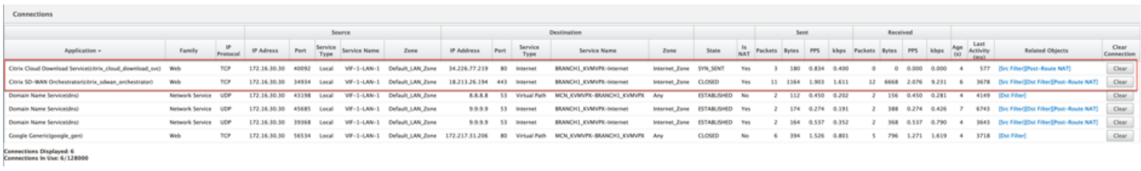
- Firewall Statistics



Connections

			Source					Destination							Sent				Received							
Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State	Is NAT	Packets	Bytes	PPS	kbps	Packets	Bytes	PPS	kbps	Age (s)	Last Activity (ms)	Related Objects	Clear Connection
Citrix Cloud Web UI and API(citrix_cloud_web_ui_api)	Custom Application	TCP	10.23.1.5	1216	Local	VIF-1-LAN-1	Default_LAN_Zone	52.177.206.73	443	Internet	Branch1_Site-Internet	Internet_Zone	ESTABLISHED	Yes	7	825	0.270	0.254	6	4081	0.231	1.258	26	25849	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Domain Name Service(dns)	Network Service	UDP	10.23.1.5	51545	Local	VIF-1-LAN-1	Default_LAN_Zone	9.9.9.9	53	Internet	Branch1_Site-Internet	Internet_Zone	ESTABLISHED	Yes	1	70	0.039	0.022	1	198	0.039	0.061	26	25558	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Domain Name Service(dns)	Network Service	UDP	10.23.1.5	59526	Local	VIF-1-LAN-1	Default_LAN_Zone	9.9.9.9	53	Internet	Branch1_Site-Internet	Internet_Zone	ESTABLISHED	Yes	1	75	0.033	0.020	1	230	0.033	0.061	30	30268	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Citrix Cloud Web UI and API(citrix_cloud_web_ui_api)	Custom Application	TCP	10.23.1.5	1214	Local	VIF-1-LAN-1	Default_LAN_Zone	52.177.206.73	443	Internet	Branch1_Site-Internet	Internet_Zone	ESTABLISHED	Yes	7	825	0.246	0.232	6	4081	0.211	1.149	28	28317	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Domain Name Service(dns)	Network Service	UDP	10.23.1.5	62651	Local	VIF-1-LAN-1	Default_LAN_Zone	9.9.9.9	53	Internet	Branch1_Site-Internet	Internet_Zone	ESTABLISHED	Yes	1	71	0.035	0.020	1	148	0.035	0.042	28	28423	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Citrix Gateway service Client Data(ngs_client_data)	Web	UDP	10.23.1.5	51546	Local	VIF-1-LAN-1	Default_LAN_Zone	13.93.207.26	443	Internet	Branch1_Site-Internet	Internet_Zone	ESTABLISHED	Yes	15	2112	0.587	0.661	13	4514	0.509	1.413	26	18635	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Citrix Gateway service Client Data(ngs_client_data)	Web	TCP	10.23.1.5	1223	Local	VIF-1-LAN-1	Default_LAN_Zone	13.93.207.26	443	Internet	Branch1_Site-Internet	Internet_Zone	ESTABLISHED	Yes	166	18005	8.875	7.701	247	137919	13.206	58.990	19	4	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Citrix Cloud Web UI and API(citrix_cloud_web_ui_api)	Custom Application	TCP	10.23.1.5	1125	Local	VIF-1-LAN-1	Default_LAN_Zone	52.177.88.75	443	Internet	Branch1_Site-Internet	Internet_Zone	ESTABLISHED	Yes	45	21111	0.141	0.530	43	21369	0.135	0.536	319	32242	[Src Filter][Dst Filter][Post-Route NAT]	Clear

Connections Displayed: 8
Connections In Use: 48/128000

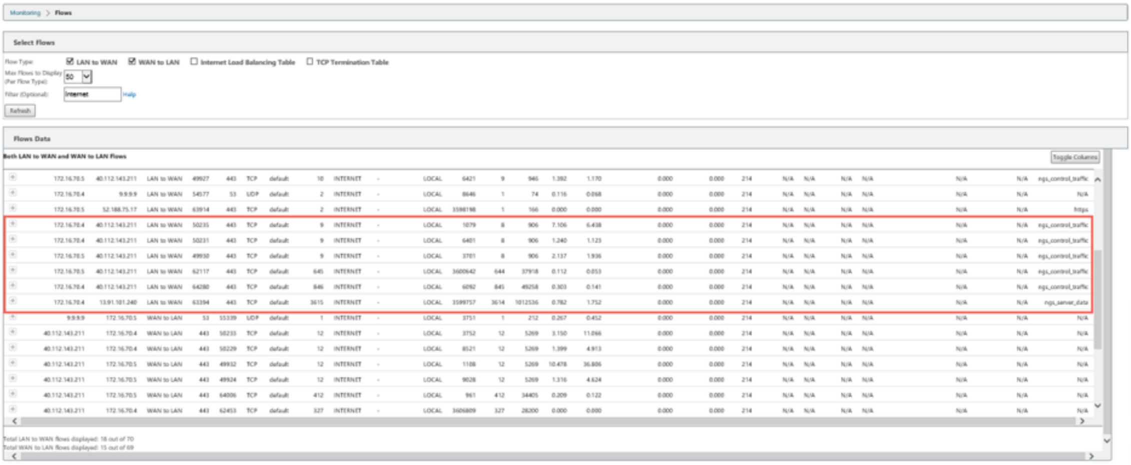


Connections

			Source					Destination							Sent				Received							
Application ▾	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State	Is NAT	Packets	Bytes	PPS	kbps	Packets	Bytes	PPS	kbps	Age (s)	Last Activity (ms)	Related Objects	Clear Connection
Citrix Cloud Download Service(citrix_cloud_download_svc)	Web	TCP	172.16.30.30	40092	Local	VIF-1-LAN-1	Default_LAN_Zone	34.226.77.219	80	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	SYN_SENT	Yes	3	180	0.834	0.400	0	0	0.000	0.000	4	577	[Src Filter][Post-Route NAT]	Clear
Citrix SD-WAN Orchestrator(citrix_sdwan_orchestrator)	Web	TCP	172.16.30.30	34934	Local	VIF-1-LAN-1	Default_LAN_Zone	18.213.26.194	443	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	CLOSED	Yes	11	1164	1.903	1.611	12	6668	2.076	9.231	6	3678	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	43198	Local	VIF-1-LAN-1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Any	ESTABLISHED	No	2	112	0.450	0.202	2	156	0.450	0.281	4	4149	[Dst Filter]	Clear
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	45685	Local	VIF-1-LAN-1	Default_LAN_Zone	9.9.9.9	53	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	ESTABLISHED	Yes	2	174	0.274	0.191	2	388	0.274	0.426	7	6743	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	39368	Local	VIF-1-LAN-1	Default_LAN_Zone	9.9.9.9	53	Internet	BRANCH1_KVMVPX-Internet	Internet_Zone	ESTABLISHED	Yes	2	164	0.537	0.352	2	368	0.537	0.790	4	3643	[Src Filter][Dst Filter][Post-Route NAT]	Clear
Google Generic(google_gen)	Web	TCP	172.16.30.30	56534	Local	VIF-1-LAN-1	Default_LAN_Zone	172.217.31.206	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Any	CLOSED	No	6	394	1.526	0.801	5	796	1.271	1.619	4	3718	[Dst Filter]	Clear

Connections Displayed: 6
Connections In Use: 6/128000

- Flows



Monitoring > Flows

Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN ☐ Internet Load Balancing Table ☐ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

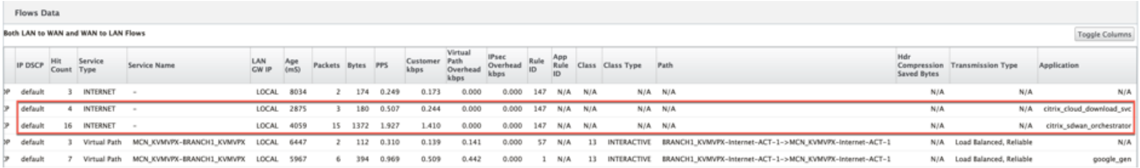
Filter (Optional): Internet

Flows Data

Both LAN to WAN and WAN to LAN Flows

+	172.16.70.5	40.112.143.211	LAN to WAN	49927	443	TCP	default	10	INTERNET	-	LOCAL	6421	9	946	1.392	1.170	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	ngs_control_traffic
+	172.16.70.4	9.9.9.9	LAN to WAN	54577	53	UDP	default	2	INTERNET	-	LOCAL	8646	1	74	0.116	0.068	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	N/A
+	172.16.70.5	52.188.75.17	LAN to WAN	63914	443	TCP	default	2	INTERNET	-	LOCAL	3598198	1	166	0.000	0.000	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	https
+	172.16.70.4	40.112.143.211	LAN to WAN	50235	443	TCP	default	9	INTERNET	-	LOCAL	1079	8	906	7.106	6.438	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	ngs_control_traffic
+	172.16.70.4	40.112.143.211	LAN to WAN	50231	443	TCP	default	9	INTERNET	-	LOCAL	6401	8	906	1.240	1.123	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	ngs_control_traffic
+	172.16.70.5	40.112.143.211	LAN to WAN	49930	443	TCP	default	9	INTERNET	-	LOCAL	3701	8	906	2.137	1.936	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	ngs_control_traffic
+	172.16.70.5	40.112.143.211	LAN to WAN	62117	443	TCP	default	645	INTERNET	-	LOCAL	3600642	644	37918	0.112	0.053	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	ngs_control_traffic
+	172.16.70.4	40.112.143.211	LAN to WAN	64280	443	TCP	default	846	INTERNET	-	LOCAL	6092	845	49258	0.303	0.141	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	ngs_control_traffic
+	172.16.70.4	13.91.101.240	LAN to WAN	63394	443	TCP	default	3615	INTERNET	-	LOCAL	3599757	3614	1012536	0.782	1.752	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	ngs_server_data
+	9.9.9.9	172.16.70.5	WAN to LAN	53	55339	UDP	default	1	INTERNET	-	LOCAL	3751	1	212	0.267	0.452	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	N/A
+	40.112.143.211	172.16.70.4	WAN to LAN	443	50233	TCP	default	12	INTERNET	-	LOCAL	3752	12	5269	3.150	11.066	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	N/A
+	40.112.143.211	172.16.70.4	WAN to LAN	443	50229	TCP	default	12	INTERNET	-	LOCAL	8521	12	5269	1.399	4.913	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	N/A
+	40.112.143.211	172.16.70.5	WAN to LAN	443	49932	TCP	default	12	INTERNET	-	LOCAL	1108	12	5269	10.478	36.806	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	N/A
+	40.112.143.211	172.16.70.5	WAN to LAN	443	49924	TCP	default	12	INTERNET	-	LOCAL	9028	12	5269	1.316	4.624	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	N/A
+	40.112.143.211	172.16.70.5	WAN to LAN	443	64006	TCP	default	412	INTERNET	-	LOCAL	961	412	34405	0.209	0.122	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	N/A
+	40.112.143.211	172.16.70.4	WAN to LAN	443	62453	TCP	default	327	INTERNET	-	LOCAL	3606809	327	28200	0.000	0.000	0.000	0.000	214	N/A	N/A	N/A	N/A	N/A	N/A

Total LAN to WAN flows displayed: 18 out of 70
Total WAN to LAN flows displayed: 15 out of 69

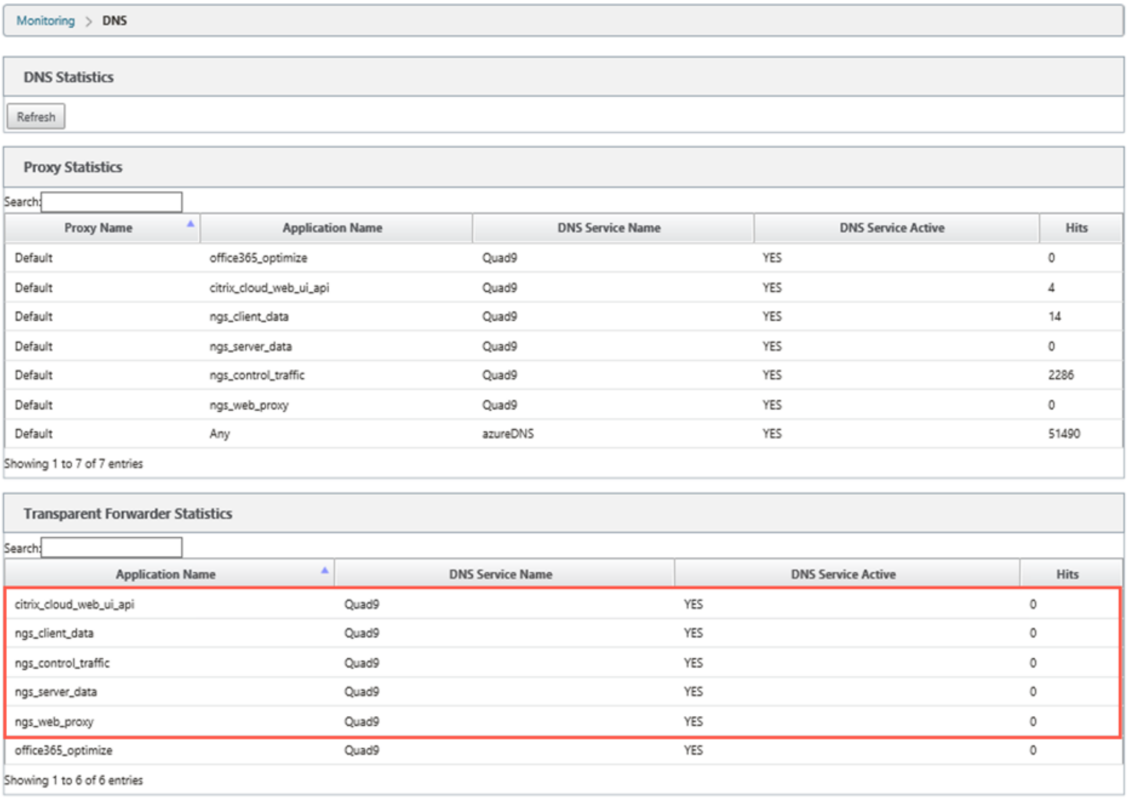


Flows Data

Both LAN to WAN and WAN to LAN Flows

	IP DSCP	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
DP	default	3	INTERNET	-	LOCAL	8034	2	174	0.249	0.173	0.000	0.000	147	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P	default	4	INTERNET	-	LOCAL	2875	3	180	0.507	0.244	0.000	0.000	147	N/A	N/A	N/A	N/A	N/A	N/A	citrix_cloud_download_svc
P	default	16	INTERNET	-	LOCAL	4059	15	1372	1.927	1.410	0.000	0.000	147	N/A	N/A	N/A	N/A	N/A	N/A	citrix_sdwan_orchestrator
DP	default	3	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	6447	2	112	0.310	0.139	0.141	0.000	57	N/A	13	INTERACTIVE	BRANCH1_KVMVPX-Internet-ACT-1->MCN_KVMVPX-Internet-ACT-1	N/A	Load Balanced, Reliable	N/A
P	default	7	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	5967	6	394	0.969	0.509	0.442	0.000	1	N/A	13	INTERACTIVE	BRANCH1_KVMVPX-Internet-ACT-1->MCN_KVMVPX-Internet-ACT-1	N/A	Load Balanced, Reliable	google_gen

- DNS Statistics



DNS Statistics

Proxy Statistics

Search:

Proxy Name	Application Name	DNS Service Name	DNS Service Active	Hits
Default	office365_optimize	Quad9	YES	0
Default	citrix_cloud_web_ui_api	Quad9	YES	4
Default	ngs_client_data	Quad9	YES	14
Default	ngs_server_data	Quad9	YES	0
Default	ngs_control_traffic	Quad9	YES	2286
Default	ngs_web_proxy	Quad9	YES	0
Default	Any	azureDNS	YES	51490

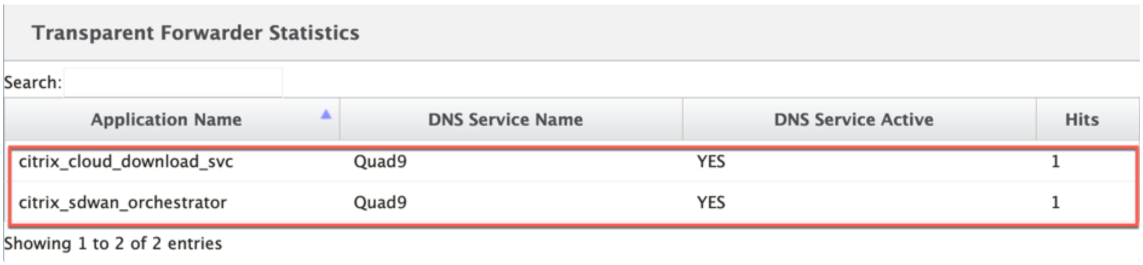
Showing 1 to 7 of 7 entries

Transparent Forwarder Statistics

Search:

Application Name	DNS Service Name	DNS Service Active	Hits
citrix_cloud_web_ui_api	Quad9	YES	0
ngs_client_data	Quad9	YES	0
ngs_control_traffic	Quad9	YES	0
ngs_server_data	Quad9	YES	0
ngs_web_proxy	Quad9	YES	0
office365_optimize	Quad9	YES	0

Showing 1 to 6 of 6 entries



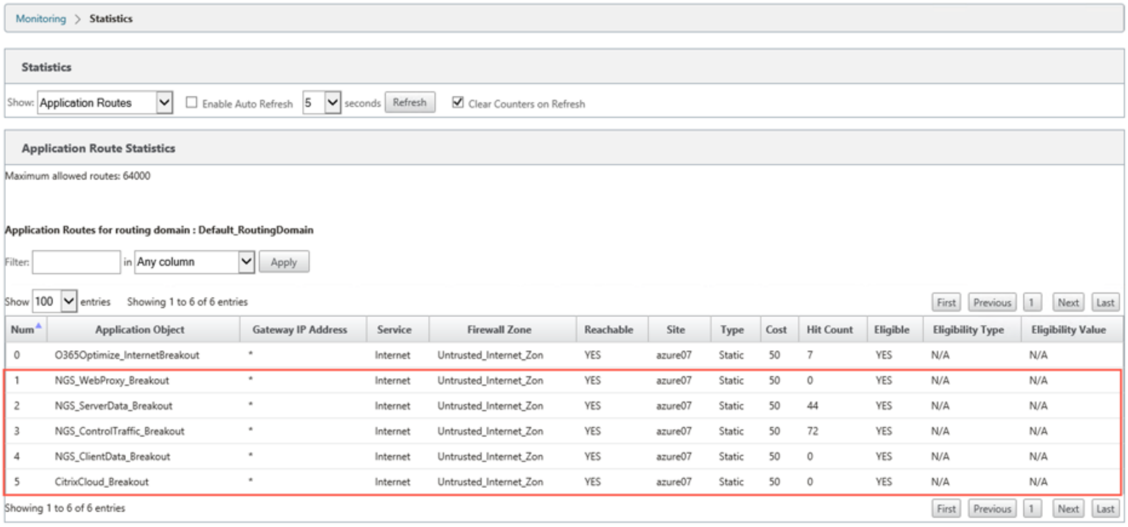
Transparent Forwarder Statistics

Search:

Application Name	DNS Service Name	DNS Service Active	Hits
citrix_cloud_download_svc	Quad9	YES	1
citrix_sdwan_orchestrator	Quad9	YES	1

Showing 1 to 2 of 2 entries

- Application Route Statistics



Statistics

Show: Application Routes ☐ Enable Auto Refresh 5 seconds ☑ Clear Counters on Refresh

Application Route Statistics

Maximum allowed routes: 64000

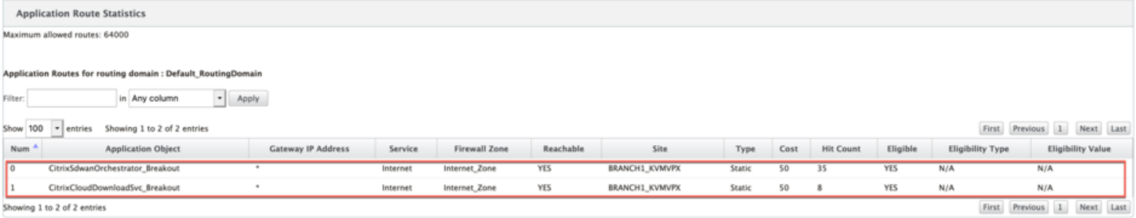
Application Routes for routing domain : Default_RoutingDomain

Filter: in Any column

Show 100 entries Showing 1 to 6 of 6 entries

Num	Application Object	Gateway IP Address	Service	Firewall Zone	Reachable	Site	Type	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	O365Optimize_InternetBreakout	*	Internet	Untrusted_Internet_Zon	YES	azure07	Static	50	7	YES	N/A	N/A
1	NGS_WebProxy_Breakout	*	Internet	Untrusted_Internet_Zon	YES	azure07	Static	50	0	YES	N/A	N/A
2	NGS_ServerData_Breakout	*	Internet	Untrusted_Internet_Zon	YES	azure07	Static	50	44	YES	N/A	N/A
3	NGS_ControlTraffic_Breakout	*	Internet	Untrusted_Internet_Zon	YES	azure07	Static	50	72	YES	N/A	N/A
4	NGS_ClientData_Breakout	*	Internet	Untrusted_Internet_Zon	YES	azure07	Static	50	0	YES	N/A	N/A
5	CitrixCloud_Breakout	*	Internet	Untrusted_Internet_Zon	YES	azure07	Static	50	0	YES	N/A	N/A

Showing 1 to 6 of 6 entries



Application Route Statistics

Maximum allowed routes: 64000

Application Routes for routing domain : Default_RoutingDomain

Filter: in Any column Apply

Show 100 entries Showing 1 to 2 of 2 entries

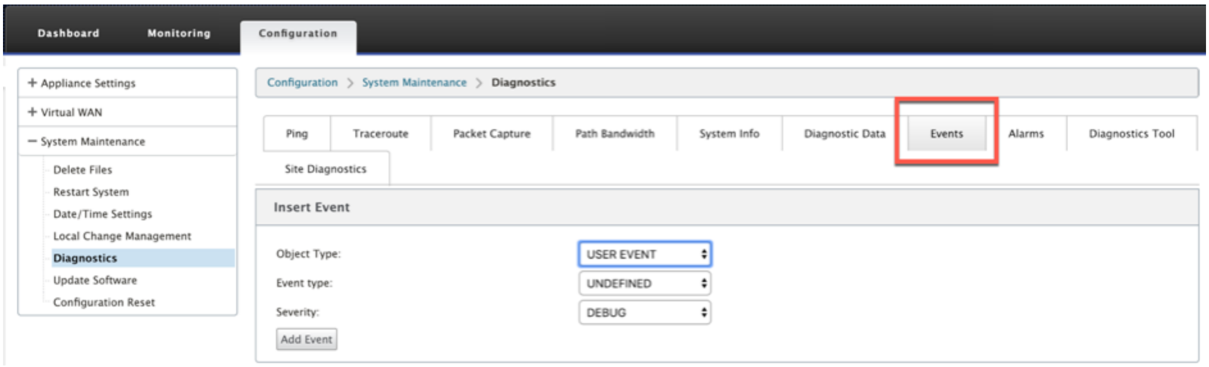
Num	Application Object	Gateway IP Address	Service	Firewall Zone	Reachable	Site	Type	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	CitrixSdwanOrchestrator_Breakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	50	35	YES	N/A	N/A
1	CitrixCloudDownloadSvc_Breakout	*	Internet	Internet_Zone	YES	BRANCH1_KVMVPX	Static	50	8	YES	N/A	N/A

Showing 1 to 2 of 2 entries

Troubleshooting

You can view the service error in the **Events** section of the SD-WAN appliance.

To check the errors, navigate to **Configuration > System Maintenance > Diagnostics**, click **Events** tab.

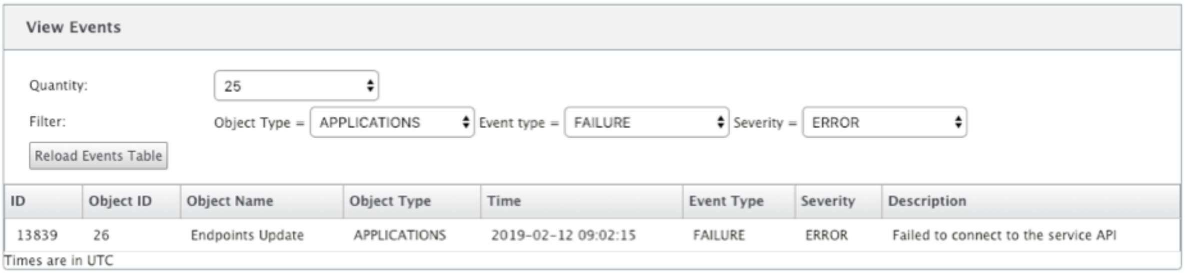


Object Type: USER EVENT

Event type: UNDEFINED

Severity: DEBUG

If there is an issue in connecting to the Citrix service (sdwan-app-routing.citrixnetworkapi.net), then the error message reflects under the **View Events** table.



View Events

Quantity: 25

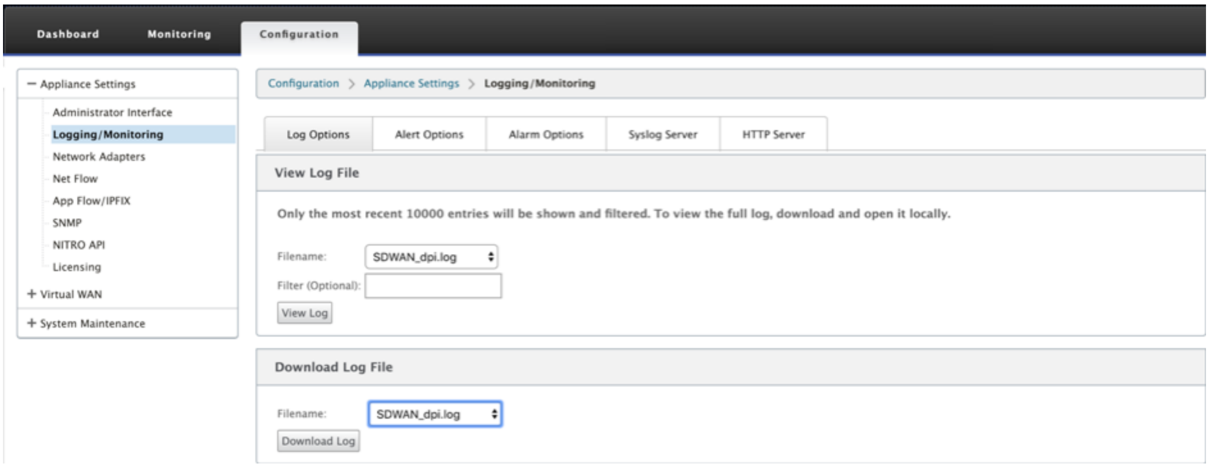
Filter: Object Type = APPLICATIONS Event type = FAILURE Severity = ERROR

ID	Object ID	Object Name	Object Type	Time	Event Type	Severity	Description
13839	26	Endpoints Update	APPLICATIONS	2019-02-12 09:02:15	FAILURE	ERROR	Failed to connect to the service API

Times are in UTC

The connectivity errors are also logged to **SDWAN_dpi.log**. To view the log, navigate to **Configuration > Appliance Settings > Logging/ Monitoring > Log Options**. Select the SDWAN_dpi.log from the drop-down list and click **View Log**.

You can also download the log file. To download the log file, select the required log file from the drop-down list under the **Download Log file** section and click **Download Log**.



Only the most recent 10000 entries will be shown and filtered. To view the full log, download and open it locally.

Filename: SDWAN_dpi.log

Filter (Optional):

Filename: SDWAN_dpi.log

PPPoE Sessions

August 24, 2022

Point-to-Point Protocol over Ethernet (PPPoE) connects multiple computer users on an Ethernet LAN to a remote site through common customer premises appliances, for example; Citrix SD-WAN. PPPoE allows users to share a common Digital Subscriber Line (DSL), cable modem, or wireless connection to the Internet. PPPoE combines the Point-to-Point Protocol (PPP), commonly used in dialup connections, with the Ethernet protocol, which supports multiple users in a LAN. The PPP protocol information is encapsulated within an Ethernet frame.

Citrix SD-WAN appliances use PPPoE to provide support Internet service provider (ISP) to have ongoing and continuous DSL and cable modem connections unlike dialup connections. PPPoE provides each user-remote site session to learn each other's network addresses through an initial exchange called "discovery". After a session is established between an individual user and the remote site, for example, an ISP provider, the session can be monitored. Corporations use shared Internet access over DSL lines using Ethernet and PPPoE.

Citrix SD-WAN acts as a PPPoE client. It authenticates with the PPPoE server and obtains dynamic IP address, or uses static IP address to establish PPPoE connections.

The following are required to establish successful PPPoE sessions:

- Configure virtual network interface (VNI).
- Unique credentials for creating PPPoE session.
- Configure WAN link. Each VNI can have only one WAN link configured.
- Configure Virtual IP address. Each session obtains a unique IP address, dynamic, or static based on the provided configuration.

- Deploy appliance in bridge mode to use PPPoE with static IP address and configure the interface as "trusted."
- Static IP is preferred to have a configuration to force the server proposed IP; if different from the configured static IP, otherwise an error can occur.
- Deploy appliance as an Edge device to use PPPoE with dynamic IP and configure the interface as "untrusted."
- Authentication protocols supported are, PAP, CHAP, EAP-MD5, EAP-SRP.
- Maximum number of multiple sessions depends on the number of VNIs configured.
- Create multiple VNIs to support Multiple PPPoE sessions per interface group.

  > **Note**:
  >
  > Multiple VNIs are allowed to create with same 802.1Q >VLAN tag.

Limitations for PPPoE configuration:

- 802.1q VLAN tagging is not supported.
- EAP-TLS authentication is not supported.
- Address/Control compression.
- Deflate Compression.
- Protocol field compression negotiation.
- Compression Control Protocol.
- BSD Compress Compression.
- IPX protocols.
- PPP Multi Link.
- Van Jacobson style TCP/IP header compression.
- Connection-ID compression option in Van Jacobson style TCP/IP header compression.
- PPPoE is not supported on LTE interfaces

From Citrix SD-WAN 11.3.1 release, an extra 8 bytes PPPoE header is considered for adjusting TCP Maximum Segment Size (MSS). The extra 8 bytes PPPoE header adjusts the MSS in the synchronize packets based on the MTU.

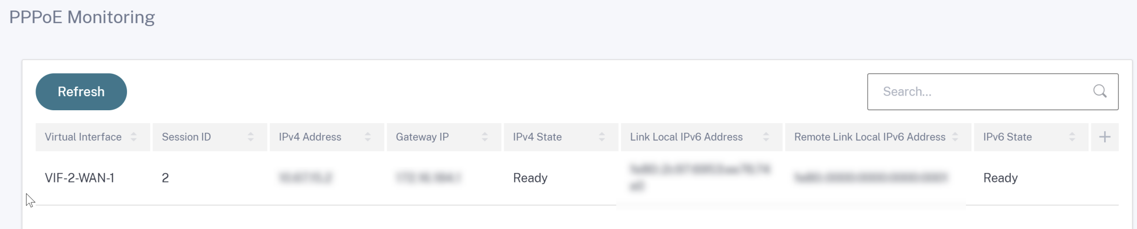
For information on how to configure PPPoE through Citrix SD-WAN Orchestrator service, see Interfaces.

Monitor PPPoE sessions

You can monitor PPPoE sessions by navigating to the **Monitoring > PPPoE** page in the SD-WAN GUI.

The PPPoE page provides status information of the configured VNIs with the PPPoE static or dynamic client mode. It allows you to manually start and stop the sessions for troubleshooting purposes from Citrix SD-WAN Orchestrator service.

- If the VNI is up and ready, the **IP and Gateway IP** columns shows the current values in the session. It indicates that these are recently received values.
- If the VNI is stopped or is in failed state, the values are last received values.



Virtual Interface	Session ID	IPv4 Address	Gateway IP	IPv4 State	Link Local IPv6 Address	Remote Link Local IPv6 Address	IPv6 State
VIF-2-WAN-1	2	[redacted]	[redacted]	Ready	[redacted]	[redacted]	Ready

The **State** column displays the status of the PPPoE session using three color codes; green, red, yellow, and values. The following table describes the states and descriptions. You can hover over the states to obtain descriptions.

PPPoE session type	Color	Description
Configured	Yellow	A VNI is configured with PPPoE. This is an initial state.
Dialing	Yellow	After a VNI is configured, the PPPoE session state moves to dialing state by starting the PPPoE discovery. Packet information is captured.
Session	Yellow	VNI is moved from Discovery state to Session state. waiting to receive IP, if dynamic or waiting for acknowledgment from server for the advertised IP, if static.
Ready	green	IP packets are received and VNI and associated WAN link is ready for use.

PPPoE session type	Color	Description
Failed	red	PPP/PPPoE session is terminated. The reason for the failure can be due to Invalid Configuration or fatal error. The session attempts to reconnect after 30 seconds.
Stopped	yellow	PPP/PPPoE session is manually stopped.
Terminating	yellow	An intermediate state terminating due to a reason. This state automatically starts after certain duration (5 seconds for normal error or 30 secs for a fatal error).
Disabled	yellow	The SD-WAN service is disabled.

Troubleshooting PPPoE session failures

On the Monitoring page, when there is a problem in establishing a PPPoE session:

- Hovering mouse over the Failed status shows the reason for the recent failure.
- To establish a fresh session or for troubleshooting an active PPPoE session, use the monitoring->PPPoE page and restart the session.
- If a PPPoE session is stopped manually, it cannot be started until either it is manually started and a configuration change is activated, or service is restarted.

A PPPoE session might fail due to the following reasons:

- When SD-WAN fails to authenticate itself to the peer due to incorrect username/password in the configuration.
- PPP negotiation fails - negotiation does not reach the point where at least one network protocol is running.
- System memory or system resource issue.
- Invalid/bad configuration (wrong AC name or service name).
- Failed to open serial port due to operating system error.
- No response received for the echo packets (link is bad or server is not responding).

- There were several continuous unsuccessful dialing sessions with in a minute.

After 10 consecutive failures, the reason for the failure is observed.

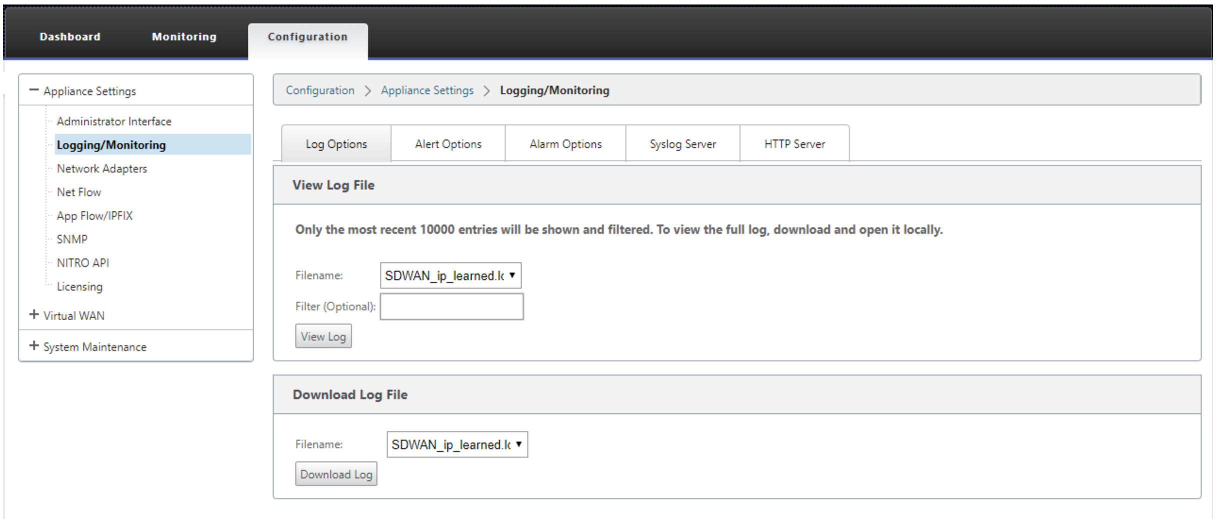
- If the failure is normal, it restarts immediately.
- If the failure is an error then restart reverts for 10 seconds.
- If the failure is fatal the restart reverts for 30 seconds before restarting.

LCP Echo request packets are generated from SD-WAN for every 60 seconds and failure to receive 5 echo responses is considered as link failure and it re-establishes the session.

PPPoE log file

The *SDWAN_ip_learned.log* file contains logs related to PPPoE.

To view or download the *SDWAN_ip_learned.log* file from the SD-WAN GUI, navigate to **Appliance Settings** > **Logging/Monitoring** > **Log Options**. View or download the *SDWAN_ip_learned.log* file.



View Log File

Only the most recent 10000 entries will be shown and filtered. To view the full log, download and open it locally.

Filename: SDWAN_ip_learned.lo

Filter (Optional):

Download Log File

Filename: SDWAN_ip_learned.lo

Quality of service

October 21, 2022

The network between office locations and the data center or cloud must transport a multitude of applications and data, including high quality video or real-time voice. Bandwidth sensitive applications stretch the network's capabilities and resources. Citrix SD-WAN provides guaranteed, secure, measurable, and predictable network services. This is achieved by managing the delay, jitter, bandwidth, and packet loss on the network.

The Citrix SD-WAN solution includes a sophisticated application Quality-of-Service (QoS) engine that accesses the application traffic and prioritizes critical applications. It also understands the requirements for WAN network quality, and picks a network path based on the quality characteristics in real time.

The topics in the following sections discuss QoS classes, IP rules, application QoS rules, and other components that are required to define application QoS.

From SD-WAN 11.5 release onwards, QoS features are configurable through Citrix SD-WAN Orchestrator service. For more information, see Quality of Service.

Classes

The Citrix SD-WAN configuration provides a default set of application and IP/Port based QoS policies that are applied to all traffic going over Virtual Paths. These settings can be customized to fit the deployment needs.

Classes are useful to prioritize the traffic. Application and IP/Port based QoS policies classify traffic and put it into appropriate classes specified in the configuration.

Citrix SD-WAN Orchestrator service supports 13 classes. For more information, see Classes.

The following are the different types of classes:

- **Real-time**: Used for low latency, low bandwidth, time-sensitive traffic. Real-time applications are time sensitive but don't really need high bandwidth (for example voice over IP). Real-time applications are sensitive to latency and jitter, but can tolerate some loss.
- **Interactive**: Used for interactive traffic with low to medium latency requirements and low to medium bandwidth requirements. The interaction is typically between a client and a server. The communication might not need high bandwidth but is sensitive to loss and latency.
- **Bulk**: Used for high bandwidth traffic and applications that can tolerate high latency. Applications that handle file transfer and need high bandwidth are categorized as bulk class. These applications involve little human interference and are mostly handled by the systems themselves.

Bandwidth sharing among classes

Bandwidth is shared among classes as follows:

- **Real-time**: Traffic hitting real-time classes are guaranteed to have low latency and bandwidth is capped to the class share when there is competing traffic.
- **Interactive**: Traffic hitting the interactive classes get remaining bandwidth after serving real-time traffic and the available bandwidth is fair shared among the interactive classes.

- **Bulk**: Bulk is best effort. Bandwidth left over after serving real-time and interactive traffic is given to bulk classes on a fair share basis. Bulk traffic can starve if real-time and interactive traffic utilizes all the available bandwidth.

> **Note**
>
> Any class can use all available bandwidth when there is no contention.

The following example explains the bandwidth distribution based on the class configuration:

Consider there is an aggregated bandwidth of 10 Mbps over Virtual Path. If the class configuration is

- Real-time: 30%
- Interactive High: 40%
- Interactive Medium: 20%
- Interactive Low: 10%
- Bulk: 100%

The bandwidth distribution outcome is:

- Real-time traffic gets 30% of 10Mbs (3 Mbps) based on the need. If it needs less than 10%, then the rest of the bandwidth is made available to the other classes.
- Interactive classes share the remaining bandwidth on fair share basis (4 Mbps: 2 Mbps: 1 Mbps).
- Anything leftover when real-time, interactive traffic is not fully using their shares is given to the Bulk class.

Rules by IP address and port number

Rules by IP address and port number feature helps you to create rules for your network and take certain Quality of Service (QoS) decisions based on the rules. You can create custom rules for your network. For example, you can create a rule as –If source IP address is 172.186.30.74 and destination IP address is 172.186.10.89, set **Transmit mode** as Persistent Path and **LAN to WAN Class** as 10(real-time_class)”.

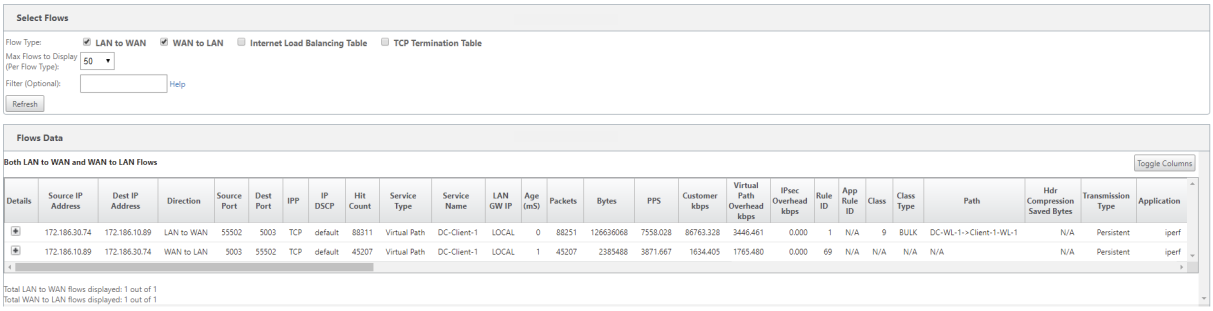
You can create rules locally at a site level or at the global level. If more than one site requires the same rule, you can create a template for rules globally under **Global > Virtual Path Default Sets > Rules**. The template can then be attached to the sites where the rules need to be applied. Even if a site is associated with the globally created rule template, you can create site specific rules. In such cases, site specific rules take precedence and override the globally created rule template.

From Citrix SD-WAN 11.5 release onwards, you can create IP rules using Citrix SD-WAN Orchestrator service. For more information, see IP rules.

Verify rules

Navigate to **Monitoring > Flows**. Select **Flow Type** field located in the **Select Flows** section at the top of the **Flows** page. Next to the **Flow Type** field there is a row of check boxes for selecting the flow information you want to view. Verify if the flow information is according to the configured rules.

Example:
The rule "If source IP address is 172.186.30.74 and destination IP address is 172.186.10.89, set **Transmit mode** as Persistent Path"shows the following **Flows Data**.



Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

Filter (Optional):

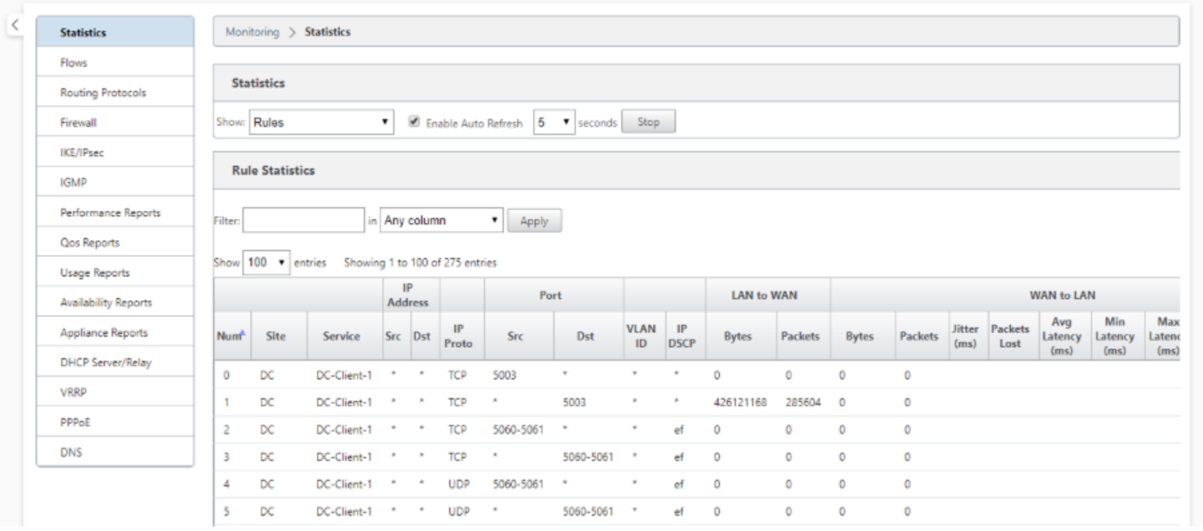
Flows Data

Both LAN to WAN and WAN to LAN Flows

Details	Source IP Address	Dest IP Address	Direction	Source Port	Dest Port	IPP	IP DSCP	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
⊞	172.186.30.74	172.186.10.89	LAN to WAN	55502	5003	TCP	default	88311	Virtual Path	DC-Client-1	LOCAL	0	88251	126636068	7558.028	86763.328	3446.461	0.000	1	N/A	9	BULK	DC-WL-1->Client-1-WL-1	N/A	Persistent	iperf
⊞	172.186.10.89	172.186.30.74	WAN to LAN	5003	55502	TCP	default	45207	Virtual Path	DC-Client-1	LOCAL	1	45207	2385488	3871.667	1634.405	1765.480	0.000	69	N/A	N/A	N/A	N/A	N/A	Persistent	iperf

Total LAN to WAN flows displayed: 1 out of 1
Total WAN to LAN flows displayed: 1 out of 1

Navigate to **Monitoring > Statistics** and verify the configured rules.



Statistics

Show: Rules ☑ Enable Auto Refresh 5 seconds

Rule Statistics

Filter: in Any column

Show 100 entries Showing 1 to 100 of 275 entries

			IP Address			Port				LAN to WAN		WAN to LAN						
Num	Site	Service	Src	Dst	IP Proto	Src	Dst	VLAN ID	IP DSCP	Bytes	Packets	Bytes	Packets	Jitter (ms)	Packets Lost	Avg Latency (ms)	Min Latency (ms)	Max Latenc (ms)
0	DC	DC-Client-1	*	*	TCP	5003	*	*	*	0	0	0	0					
1	DC	DC-Client-1	*	*	TCP	*	5003	*	*	426121168	285604	0	0					
2	DC	DC-Client-1	*	*	TCP	5060-5061	*	*	ef	0	0	0	0					
3	DC	DC-Client-1	*	*	TCP	*	5060-5061	*	ef	0	0	0	0					
4	DC	DC-Client-1	*	*	UDP	5060-5061	*	*	ef	0	0	0	0					
5	DC	DC-Client-1	*	*	UDP	*	5060-5061	*	ef	0	0	0	0					

Rules by application name

The Application classification feature allows the Citrix SD-WAN appliance to parse incoming traffic and classify them as belonging to a particular application or application family. This classification allows us to enhance the QoS of individual application or application families by creating and applying application rules.

You can filter traffic flows based on application, application family, or application object match-types and apply application rules to them. he application rules are similar to Internet Protocol (IP) rules.

For information on IP rules see, Rules by IP Address and Port Number.

For every application rule, you can specify the mode of transmission. The following are the available transmit modes:

- **Load Balance Path**: Application traffic for the flow is balanced across multiple paths. Traffic is sent through the best path until that path is used. The remaining packets are sent through the next best path.
- **Persistent Path**: Application traffic remains on the same path until the path is no longer available.
- **Duplicate Path**: Application traffic is duplicated across multiple paths, increasing reliability.

The application rules are associated to classes. For information on classes, see Customizing Classes.

By default, the following five pre-defined application rules are available for Citrix ICA applications:

Rule	Class	Transmit Mode	Retransmit Lost Packets	Enable Packet Aggregation	Enable Packet Resequencing	Resequence Hold Time (ms)	Discard Late Resequencing Packets	Drop Limit (ms)	Drop Depth (bytes)	Enable RED	Disable Limit (ms)	Disable Depth (bytes)
HDX_Priority_0	0 (HDX_priority_tag_0)	Load Balance Path	True	False	True	250	True	350	30000	True	0	128000
HDX_Priority_1	1 (HDX_priority_tag_1)	Load Balance Path	True	False	True	250	True	350	30000	True	0	128000
HDX_Priority_2	2 (HDX_priority_tag_2)	Load Balance Path	True	False	True	250	True	350	30000	True	0	128000
HDX_Priority_3	3 (HDX_priority_tag_3)	Load Balance Path	True	False	True	250	True	350	30000	True	0	128000

Rule	Class	Transmit Mode	Retransmit Lost Packets	Enable Packet Aggregation	Enable Packet Resequencing	Resequence Hold Time (ms)	Discard Late Resequencing Packets	Drop Limit (ms)	Drop Depth (bytes)	Enable RED	Disable Limit (ms)	Disable Depth (bytes)
HDX	11 (interactive_high_class)	Load Balance Path	True	False	True	250	True	350	30000	True	0	128000

How application rules are applied?

In the SD-WAN network, when the incoming packets reach the SD-WAN appliance, the initial few packets do not undergo DPI classification. At this point, the IP rule attributes such as Class, TCP termination are applied to the packets. After DPI classification, the application rule attributes such as Class, transmit mode override the IP rule attributes.

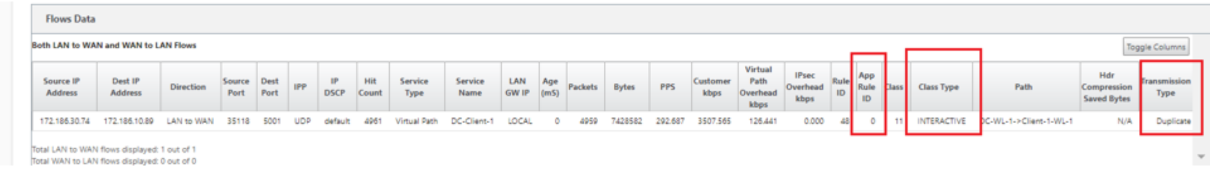
The IP rules have more number of attributes as compared to the application rules. The application rule overrides only a few IP rule attributes, the rest of the IP rule attributes remain processed on the packets.

For example, consider you have specified an application rule for a webmail application such as Google Mail that uses the SMTP protocol. The IP rule set for SMTP protocol is applied initially before DPI classification. After parsing the packets and classifying it as belonging to Google Mail application, the application rule specified for the Google Mail application is applied.

To create application rules using Citrix SD-WAN Orchestrator, see Application rules.

To confirm if application rules are applied to traffic flow, navigate to **Monitoring** > **Flows**.

Make a note of the app rule id and check if the class type and transmission mode are as per your rule configuration.



Flows Data

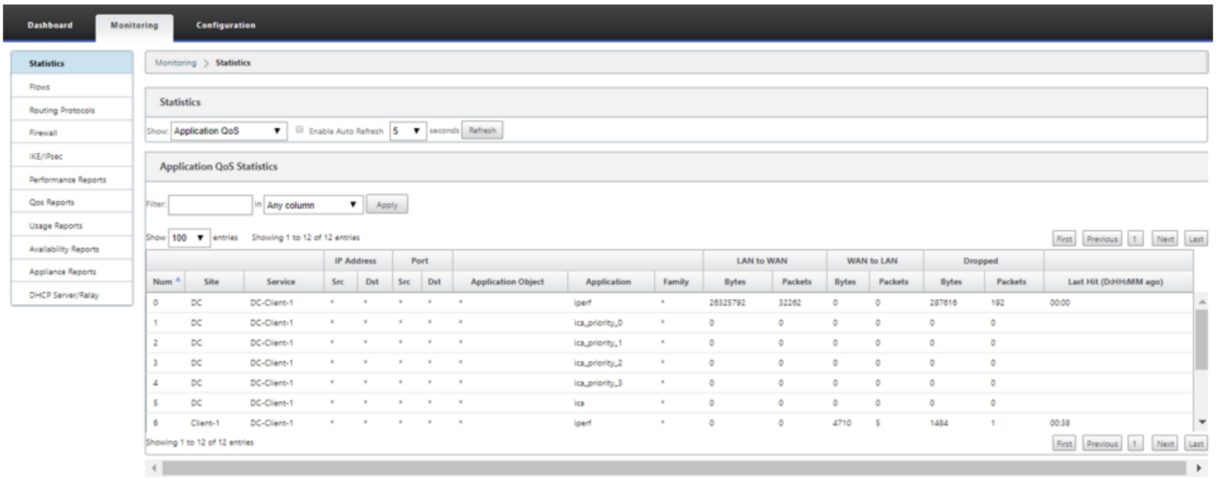
Both LAN to WAN and WAN to LAN Flows

Source IP Address	Dest IP Address	Direction	Source Port	Dest Port	IPP	IP DSCP	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	lass	Class Type	Path	Hdr Compression Saved Bytes	ransmission Type
172.186.30.74	172.186.10.89	LAN to WAN	35118	5001	UDP	default	4961	Virtual Path	DC-Client-1	LOCAL	0	4959	7428582	292.687	3507.565	126.441	0.000	48	0	11	INTERACTIVE	C-WL-1->Client-1-WL-1	N/A	Duplicate

Total LAN to WAN flows displayed: 1 out of 1
Total WAN to LAN flows displayed: 0 out of 0

You can monitor the application QoS such as no of packets / bytes uploaded, downloaded, or dropped at each site by navigating to **Monitoring** > **Statistics** > **Application QoS**.

The **Num** parameter indicates the app rule id. Check for the app rule id obtained from the flow.



Statistics

Show: Application QoS ▼ □ Enable Auto Refresh 5 ▼ seconds Refresh

Application QoS Statistics

Filter: in Any column ▼ Apply

Show 100 ▼ entries Showing 1 to 12 of 12 entries

			IP Address		Port					LAN to WAN		WAN to LAN		Dropped		
Num	Site	Service	Src	Dst	Src	Dst	Application Object	Application	Family	Bytes	Packets	Bytes	Packets	Bytes	Packets	Last Hit (D:HH:MM ago)
0	DC	DC-Client-1	*	*	*	*	*	iperf	*	26325792	32262	0	0	287616	192	00:00
1	DC	DC-Client-1	*	*	*	*	*	ica_priority_0	*	0	0	0	0	0	0	
2	DC	DC-Client-1	*	*	*	*	*	ica_priority_1	*	0	0	0	0	0	0	
3	DC	DC-Client-1	*	*	*	*	*	ica_priority_2	*	0	0	0	0	0	0	
4	DC	DC-Client-1	*	*	*	*	*	ica_priority_3	*	0	0	0	0	0	0	
5	DC	DC-Client-1	*	*	*	*	*	ica	*	0	0	0	0	0	0	
6	Client-1	DC-Client-1	*	*	*	*	*	iperf	*	0	0	4710	5	1484	1	00:38

Showing 1 to 12 of 12 entries

Creating custom applications

You can use application objects to define custom applications based on the following match types:

- IP protocol
- Application name
- Application family

The DPI classifier analyzes the incoming packets and classifies it as applications based on the specified match criteria. You can use these classified custom applications in QoS, firewall, and application routing.

> **Tip**
>
> You can specify one or more match types.

Application classification

The Citrix SD-WAN appliances perform deep packet inspection (DPI) to identify and classify applications using the following techniques:

- DPI library classification
- Citrix-proprietary Independent Computing Architecture (ICA) classification
- Application vendor APIs (for example Microsoft REST APIs for Office 365)
- Domain name based application classification

DPI library classification

The Deep Packet Inspection (DPI) library recognizes thousands of commercial applications. It enables real-time discovery and classification of applications. Using the DPI technology, the SD-WAN appliance analyses the incoming packets and classifies the traffic as belonging to a particular application or application family. Application classification for each connection takes a few packets.

To enable DPI library classification on Citrix SD-WAN Orchestrator service, see DPI library classification.

ICA classification

Citrix SD-WAN appliances can also identify and classify Citrix HDX traffic for virtual apps and desktops. Citrix SD-WAN recognizes the following variations of the ICA protocol:

- ICA
- ICA-CGP
- Single Stream ICA (SSI)
- Multi-Stream ICA (MSI)
- ICA over TCP
- ICA over UDP/EDT
- ICA over non-standard ports (including Multi-Port ICA)
- HDX Adaptive Transport
- ICA over WebSocket (used by HTML5 Receiver)

> **Note**
>
> Classification of ICA traffic delivered over SSL/TLS or DTLS is not supported in SD-WAN Standard Edition.
>
> Classification of network traffic is done during initial connections or flow establishment. Therefore, pre-existing connections are not classified as ICA. Classification of connections is also lost when the connection table is cleared manually.
>
> Framehawk traffic and Audio-over-UDP/RTP are not classified as HDX applications. They are reported as either "UDP"or "Unknown Protocol."
>
> Since release 10 version 1, the SD-WAN appliance can differentiate each ICA data stream in multistream ICA even in a single-port configuration. Each ICA stream is classified as a separate application with its own default QoS class for prioritization.
>
> - For Multi-Stream ICA functionality to work properly, you must have SD-WAN Standard Edition 10.1 or above.

> - For HDX user based reports to be shown on SDWAN-Center, you must have SD-WAN Standard Edition 11.0 or above.
>
> Minimum software requirements for HDX information virtual channel:
>
> - A Current Release of Citrix Virtual Apps and Desktops (formerly XenApp and XenDesktop), since the prerequisite functionality was introduced in XenApp and XenDesktop 7.17 and is not included in the 7.15 Long-Term Service Release.
> - A version of the Citrix Workspace app (or its predecessor, Citrix Receiver) that supports multi-stream ICA and the HDX Insights information virtual channel, CTXNSAP. Look for **HDX Insight with NSAP VC** and Multiport/Multi-stream ICA in the Citrix Workspace app Feature Matrix. See the currently supported release versions at HDX Insights.
> - From 11.2 release onwards, packet duplication is now enabled by default for HDX real-time traffic when multi-stream ICA is in use.

Once classified, the ICA application can be used in application rules and to view application statistics similar to other classified applications.

There are five default application rules for ICA applications one each for the following priority tags:

- Independent Computing Architecture (Citrix)(ICA)
- ICA Real-time (ica_priority_0)
- ICA Interactive (ica_priority_1)
- ICA Bulk-Transfer (ica_prority_2)
- ICA Background(ica_priority_3)

For more information, see Rules by Application Name

If you are running a combination of software that does not support Multi-Stream ICA over a single port, then to perform QoS you must configure multiple ports, one for each ICA stream.
To classify HDX on non-standard ports as configured in XA/XD server policy, you must add those ports in ICA port configurations. Also, to match traffic on those ports to valid IP rules, you must update the ICA IP rules.

In the ICA IP and port list you can specify non-standard ports used in XA/XD policy to process for HDX classification. IP address is used to further restrict the ports to a specific destination. Use '*'for port destined to any IP address. IP address with combination of SSL port is also used to indicate that the traffic is likely ICA even though the traffic is not finally classified as ICA. This indication is used to send L4 AppFlow records to support multi-hop reports in Citrix Application Delivery Management.

To enable ICA based classification on Citrix SD-WAN Orchestrator service, see ICA classification.

Application vendor API based classification

Citrix SD-WAN supports the following application vendor API based classification:

- Office 365. For more information, see Office 365 optimization.
- Citrix Cloud and Citrix Gateway service. For more information, see Gateway Service Optimization.

Domain name based application classification

The DPI classification engine is enhanced to classify applications based on the domain name and patterns. After the DNS forwarder intercepts and parses the DNS requests, the DPI engine uses the IP classifier to perform first packet classification. Further DPI library and ICA classification are done and the domain name based application ID is appended.

The Domain name based application feature allows you to group several domain names and treat it as a single application. Making it easier to apply firewall, application steering, QoS, and other rules. A maximum of 64 domain name based applications can be configured.

To define domain name based applications on Citrix SD-WAN Orchestrator service, see Domain name based application classification.

> **Note**
>
> - From 11.4.2 release onwards, the Domain name-based applications support configurable ports and protocol in Citrix SD-WAN Orchestrator service. For more information, see Domains and applications.
> - From Citrix SD-WAN 11.5.0 release onwards, AAAA records are supported on Citrix SD-WAN Orchestrator service.

Limitations

- If there are no DNS request/response corresponding to a domain name based application, the DPI engine does not classify the domain name based application and hence does not apply the application rules corresponding to the domain name based application.
- If an Application Object is created such that the port range includes port 80 and/or port 443, with a specific IP address match type that corresponds to a domain name based application, the DPI engine does not classify the domain name based application.
- If explicit web proxies are configured, you have to add all the domain name patterns to the PAC file, to ensure that the DNS response does not always return the same IP address.

- The domain name based application classifications are reset on configuration upgrade. Reclassification happens based on pre 11.0.2 release classification techniques such as DPI library classification, ICA classification and Vendor application APIs based classification.
- The application signatures learned (destination IP addresses) by domain name based application classification are reset on configuration update.
- Only the standard DNS queries and their responses are processed.
- DNS response records split over multiple packets are not processed. Only DNS responses in a single packet are processed.
- DNS over TCP is not supported.
- Only top-level domains are supported as domain name patterns.

Classifying encrypted traffic

Citrix SD-WAN appliance detects and reports encrypted traffic, as part of application reporting, in the following two methods:

- For HTTPS traffic, the DPI engine inspects the SSL certificate to read the common name, which carries the name of the service (for example - Facebook, Twitter). Depending on the application architecture only one certificate might be used for several service types (for example - email, news, and so on). If different services use different certificates, the DPI engine would be able to differentiate between services.
- For applications that use their own encryption protocol, the DPI engine looks for binary patterns in the flows for instance in case of Skype the DPI engine looks for a binary pattern inside the certificate and determines the application.

Application Objects

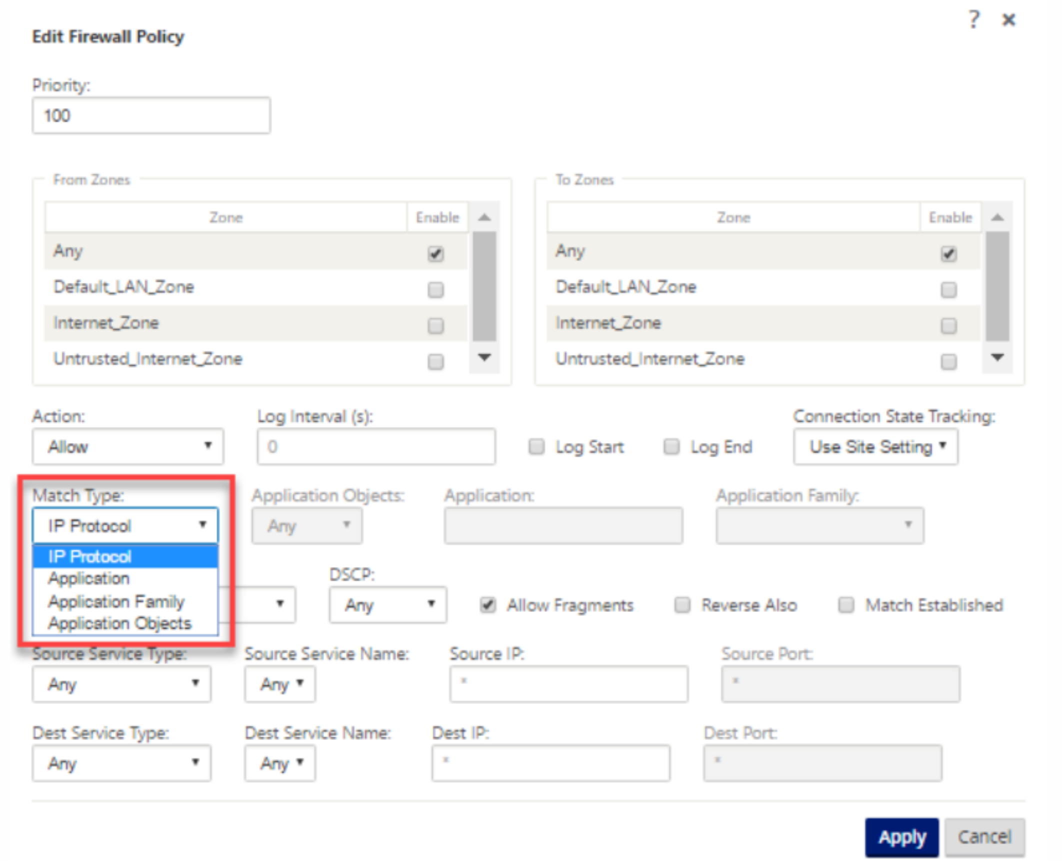
Application objects enable you to group different types of match criteria into a single object that can be used in firewall policies and application steering. IP Protocol, Application, and Application Family are the available match types.

The following features use the application object as a match type:

- Application Routes
- Firewall policy
- Application QoS Rules
- Application QoE

Using Application Classification with a Firewall

The classification of traffic as applications, application families or domain names enables you to use the application, application families, and application objects as match types to filter traffic and apply firewall policy and rules. It applies for all Pre, Post, and local policies. For more information about firewall, see Stateful Firewall and NAT Support.



Edit Firewall Policy

Priority: 100

From Zones

Zone	Enable
Any	☑
Default_LAN_Zone	☐
Internet_Zone	☐
Untrusted_Internet_Zone	☐

To Zones

Zone	Enable
Any	☑
Default_LAN_Zone	☐
Internet_Zone	☐
Untrusted_Internet_Zone	☐

Action: Allow

Log Interval (s): 0

☐ Log Start ☐ Log End

Connection State Tracking: Use Site Setting

Match Type: IP Protocol

Application Objects: Any

Application:

Application Family:

DSCP: Any

☑ Allow Fragments ☐ Reverse Also ☐ Match Established

Source Service Type: Any

Source Service Name: Any

Source IP: *

Source Port: *

Dest Service Type: Any

Dest Service Name: Any

Dest IP: *

Dest Port: *

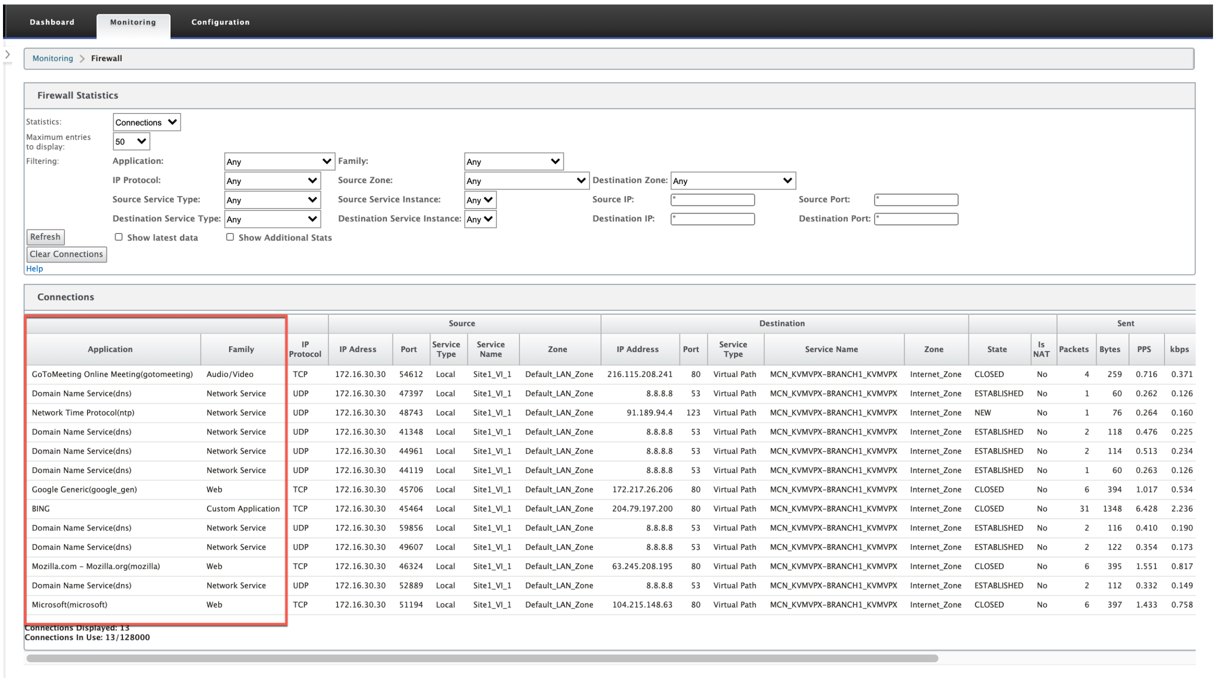
–>

Viewing Application Classification

After enabling application classification, you can view the application name and application family details in the following reports:

- Firewall connection Statistics
- Flows information
- Application statistics

Firewall connection statistics Navigate to **Monitoring > Firewall**. Under **Connections** section, the **Application** and **Family** columns list the applications and its associated family.



Firewall Statistics

Statistics: Connections
Maximum entries to display: 50
Filtering:
Application: Any
Family: Any
IP Protocol: Any
Source Zone: Any
Destination Zone: Any
Source Service Type: Any
Source Service Instance: Any
Source IP: *
Source Port: *
Destination Service Type: Any
Destination Service Instance: Any
Destination IP: *
Destination Port: *

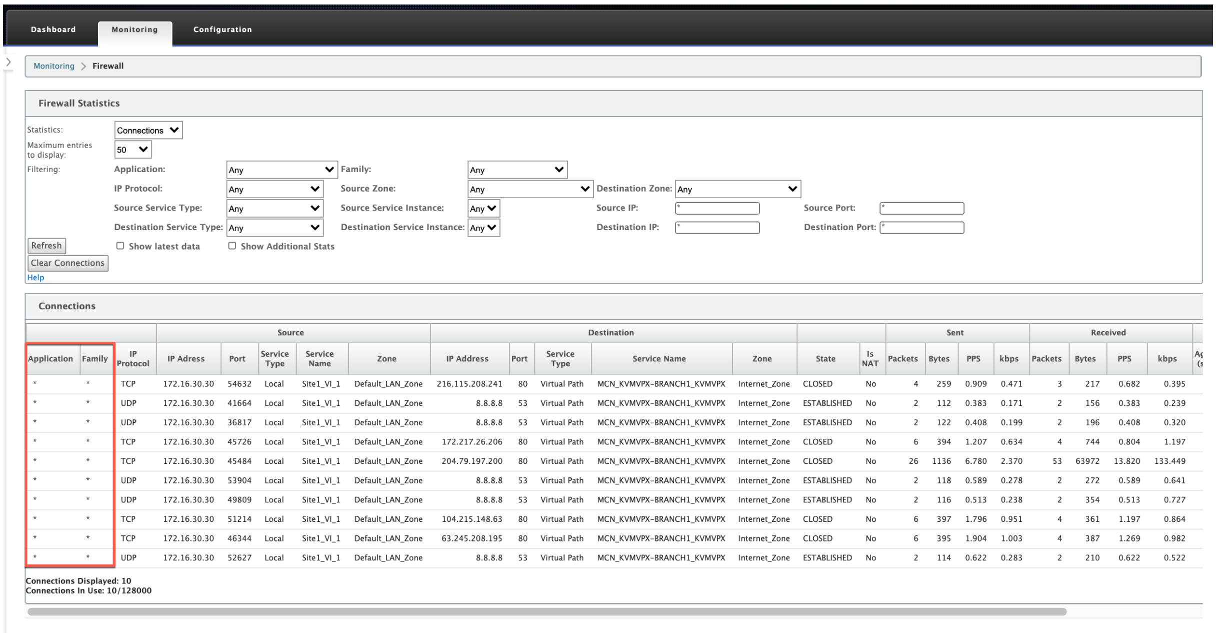
□ Show latest data
□ Show Additional Stats

Connections

			Source					Destination							Sent			
Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State	Is NAT	Packets	Bytes	PPS	kbps
GoToMeeting Online Meeting(gotomeeting)	Audio/Video	TCP	172.16.30.30	54612	Local	Site1_VI_1	Default_LAN_Zone	216.115.208.241	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	4	259	0.716	0.371
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	47397	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	1	60	0.262	0.126
Network Time Protocol(ntp)	Network Service	UDP	172.16.30.30	48743	Local	Site1_VI_1	Default_LAN_Zone	91.189.94.4	123	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	NEW	No	1	76	0.264	0.160
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	41348	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	118	0.476	0.225
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	44961	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	114	0.513	0.234
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	44119	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	1	60	0.263	0.126
Google Generic(google_gen)	Web	TCP	172.16.30.30	45706	Local	Site1_VI_1	Default_LAN_Zone	172.217.26.206	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	6	394	1.017	0.534
BING	Custom Application	TCP	172.16.30.30	45464	Local	Site1_VI_1	Default_LAN_Zone	204.79.197.200	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	31	1348	6.428	2.236
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	59856	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	116	0.410	0.190
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	49607	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	122	0.354	0.173
Mozilla.com – Mozilla.org(mozilla)	Web	TCP	172.16.30.30	46324	Local	Site1_VI_1	Default_LAN_Zone	63.245.208.195	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	6	395	1.551	0.817
Domain Name Service(dns)	Network Service	UDP	172.16.30.30	52889	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	112	0.332	0.149
Microsoft(microsoft)	Web	TCP	172.16.30.30	51194	Local	Site1_VI_1	Default_LAN_Zone	104.215.148.63	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	6	397	1.433	0.758

Connections Displayed: 13
Connections In Use: 13/128000

If you do not enable application classification, the **Application** and **Family** columns do not show any data.



Firewall Statistics

Statistics: Connections
Maximum entries to display: 50
Filtering:
Application: Any
Family: Any
IP Protocol: Any
Source Zone: Any
Destination Zone: Any
Source Service Type: Any
Source Service Instance: Any
Source IP: *
Source Port: *
Destination Service Type: Any
Destination Service Instance: Any
Destination IP: *
Destination Port: *

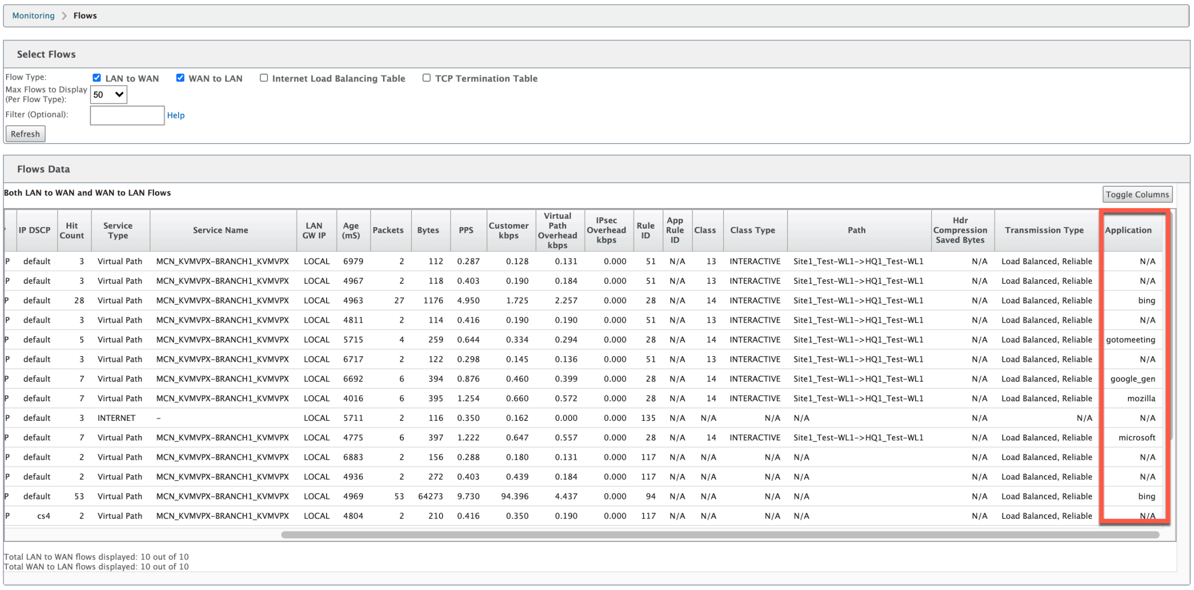
□ Show latest data
□ Show Additional Stats

Connections

			Source					Destination							Sent				Received				
Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State	Is NAT	Packets	Bytes	PPS	kbps	Packets	Bytes	PPS	kbps	Ag (s
*	*	TCP	172.16.30.30	54632	Local	Site1_VI_1	Default_LAN_Zone	216.115.208.241	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	4	259	0.909	0.471	3	217	0.682	0.395	
*	*	UDP	172.16.30.30	41664	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	112	0.383	0.171	2	156	0.383	0.239	
*	*	UDP	172.16.30.30	36817	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	122	0.408	0.199	2	196	0.408	0.320	
*	*	TCP	172.16.30.30	45726	Local	Site1_VI_1	Default_LAN_Zone	172.217.26.206	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	6	394	1.207	0.634	4	744	0.804	1.197	
*	*	TCP	172.16.30.30	45484	Local	Site1_VI_1	Default_LAN_Zone	204.79.197.200	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	26	1136	6.780	2.370	53	63972	13.820	133.449	
*	*	UDP	172.16.30.30	53904	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	118	0.589	0.278	2	272	0.589	0.641	
*	*	UDP	172.16.30.30	49809	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	116	0.513	0.238	2	354	0.513	0.727	
*	*	TCP	172.16.30.30	51214	Local	Site1_VI_1	Default_LAN_Zone	104.215.148.63	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	6	397	1.796	0.951	4	361	1.197	0.864	
*	*	TCP	172.16.30.30	46344	Local	Site1_VI_1	Default_LAN_Zone	63.245.208.195	80	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	CLOSED	No	6	395	1.904	1.003	4	387	1.269	0.982	
*	*	UDP	172.16.30.30	52627	Local	Site1_VI_1	Default_LAN_Zone	8.8.8.8	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	Internet_Zone	ESTABLISHED	No	2	114	0.622	0.283	2	210	0.622	0.522	

Connections Displayed: 10
Connections In Use: 10/128000

Flows Information Navigate to **Monitoring > Flows**. Under **Flows Data** section, the **Application** column lists the application details.



Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN ☐ Internet Load Balancing Table ☐ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

Filter (Optional): Help

Flows Data

Both LAN to WAN and WAN to LAN Flows

	IP DSCP	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
P	default	3	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	6979	2	112	0.287	0.128	0.131	0.000	51	N/A	13	INTERACTIVE	Site1_Test-WL1->HQ1_Test-WL1	N/A	Load Balanced, Reliable	N/A
P	default	3	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	4967	2	118	0.403	0.190	0.184	0.000	51	N/A	13	INTERACTIVE	Site1_Test-WL1->HQ1_Test-WL1	N/A	Load Balanced, Reliable	N/A
P	default	28	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	4963	27	1176	4.950	1.725	2.257	0.000	28	N/A	14	INTERACTIVE	Site1_Test-WL1->HQ1_Test-WL1	N/A	Load Balanced, Reliable	bing
P	default	3	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	4811	2	114	0.416	0.190	0.190	0.000	51	N/A	13	INTERACTIVE	Site1_Test-WL1->HQ1_Test-WL1	N/A	Load Balanced, Reliable	N/A
P	default	5	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	5715	4	259	0.644	0.334	0.294	0.000	28	N/A	14	INTERACTIVE	Site1_Test-WL1->HQ1_Test-WL1	N/A	Load Balanced, Reliable	gotomeeting
P	default	3	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	6717	2	122	0.298	0.145	0.136	0.000	51	N/A	13	INTERACTIVE	Site1_Test-WL1->HQ1_Test-WL1	N/A	Load Balanced, Reliable	N/A
P	default	7	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	6692	6	394	0.876	0.460	0.399	0.000	28	N/A	14	INTERACTIVE	Site1_Test-WL1->HQ1_Test-WL1	N/A	Load Balanced, Reliable	google_gen
P	default	7	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	4016	6	395	1.254	0.660	0.572	0.000	28	N/A	14	INTERACTIVE	Site1_Test-WL1->HQ1_Test-WL1	N/A	Load Balanced, Reliable	mozilla
P	default	3	INTERNET	–	LOCAL	5711	2	116	0.350	0.162	0.000	0.000	135	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P	default	7	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	4775	6	397	1.222	0.647	0.557	0.000	28	N/A	14	INTERACTIVE	Site1_Test-WL1->HQ1_Test-WL1	N/A	Load Balanced, Reliable	microsoft
P	default	2	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	6883	2	156	0.288	0.180	0.131	0.000	117	N/A	N/A	N/A	N/A	N/A	Load Balanced, Reliable	N/A
P	default	2	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	4936	2	272	0.403	0.439	0.184	0.000	117	N/A	N/A	N/A	N/A	N/A	Load Balanced, Reliable	N/A
P	default	53	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	4969	53	64273	9.730	94.396	4.437	0.000	94	N/A	N/A	N/A	N/A	N/A	Load Balanced, Reliable	bing
P	cs4	2	Virtual Path	MCN_KVMVPX-BRANCH1_KVMVPX	LOCAL	4804	2	210	0.416	0.350	0.190	0.000	117	N/A	N/A	N/A	N/A	N/A	Load Balanced, Reliable	N/A

Total LAN to WAN flows displayed: 10 out of 10
Total WAN to LAN flows displayed: 10 out of 10

Application statistics Navigate to **Monitoring > Statistics**. Under **Application Statistics** section, the **Application** column lists the application details.

Troubleshooting

After enabling application classification, you can view the reports under the **Monitoring** section and ensure that they show application details. For more information, see Viewing Application Classification.

If there is any unexpected behavior, collect the STS diagnostics bundle while the issue is being observed, and share it with the Citrix Support team.

The STS bundle can be created and downloaded using **Configuration > System Maintenance > Diagnostics > Diagnostic Information**.

QoS fairness (RED)

The QoS fairness feature improves the fairness of multiple virtual path flows by using QoS classes and Random Early Detection (RED). A virtual path can be assigned to one of the 16 different classes. A class can be one of three basic types:

- Realtime classes serve traffic flows that demand prompt service up to a certain bandwidth limit. Low latency is preferred over aggregate throughput.
- Interactive classes have lower priority than realtime but have absolute priority over bulk traffic.
- Bulk classes get what is left over from realtime and interactive classes, because latency is less important for bulk traffic.

Users specify different bandwidth requirements for different classes, which enable the virtual path scheduler to arbitrate competing bandwidth requests from multiple classes of the same type. The scheduler uses the Hierarchical Fair Service Curve (HFSC) algorithm to achieve fairness among the classes.

HFSC services classes in first-in, first-out (FIFO) order. Before scheduling packets, Citrix SD-WAN examines the amount of traffic pending for the packets class. When excessive traffic is pending, the packets are dropped instead of being put into the queue (tail dropping).

Why does TCP cause queuing?

TCP cannot control how quickly the network can transmit data. To control bandwidth, TCP implements the concept of a bandwidth window, which is the amount of unacknowledged traffic that it allows in the network. It initially starts with a small window and doubles the size of that window whenever acknowledgments are received. This is called the slow start or exponential growth phase.

TCP identifies network congestion by detecting dropped packets. If the TCP stack sends a burst of packets that introduce a 250 ms delay, TCP does not detect congestion if none of the packets are discarded, so it continues to increase the size of the window. It might continue to do so until the wait time reaches 600–800 ms.

When TCP is not in the slow start mode, it reduces the bandwidth by half when packet loss is detected, and increases the allowed bandwidth by one packet for each acknowledgment received. TCP therefore alternates between putting upward pressure on the bandwidth and backing off. Unfortunately, if the wait time reaches 800 ms by the time packet loss is detected, the bandwidth reduction causes a transmission delay.

Impact on QoS fairness

When TCP transmission delay occurs, providing any kind of fairness guarantee within a virtual-path class is difficult. The virtual path scheduler must apply tail-drop behavior to avoid holding enormous amounts of traffic. The nature of TCP connections is such that a small number of traffic flows to fill the virtual path, making it difficult for a new TCP connection to achieve a fair share of the bandwidth. Sharing bandwidth fairly requires making sure that bandwidth is available for new packets to be transmitted.

Random Early Detection

Random Early Detection (RED) prevents traffic queues from filling up and causing tail-drop actions. It prevents needless queuing by the virtual path scheduler, without affecting the throughput that a TCP connection can achieve.

For information on how to use and enable RED, see How to use RED.

MPLS queues

This feature simplifies creating SD-WAN configurations when adding a Multiprotocol Layer Switching (MPLS) WAN Link. Previously, each MPLS queue required one WAN Link to be created. Each WAN Link required a unique Virtual IP Address (VIP) to create the WAN Link and a unique Differentiated Services Code Point (DSCP) tag corresponding to the provider's queuing scheme. After defining a WAN Link for each MPLS queue, the Intranet Service to map to a specific queue is defined.

Currently, a new MPLS specific WAN Link definition (that is, Access Type) is available. When a new Private MPLS Access Type is selected, you can define the MPLS queues associated with the WAN Link. This allows a single VIP with multiple DSCP tags that correspond to the provider's queuing implementation for the MPLS WAN Link. This maps the Intranet Service to multiple MPLS Queues on a single MPLS WAN Link. For information on how to configure MPLS using Citrix SD-WAN Orchestrator service, see MPLS queues.

> **Note**
>
> If you have existing MPLS configurations and would like to implement the Private MPLS Access Type, contact Citrix Support for assistance.

Assign autopath group to virtual path-WAN Link

The Autopath Group defined is the same for the MCN and Client appliance. This allows the system to build the Paths automatically. At the MCN site, you can also expand the WAN Link associated with the virtual path.

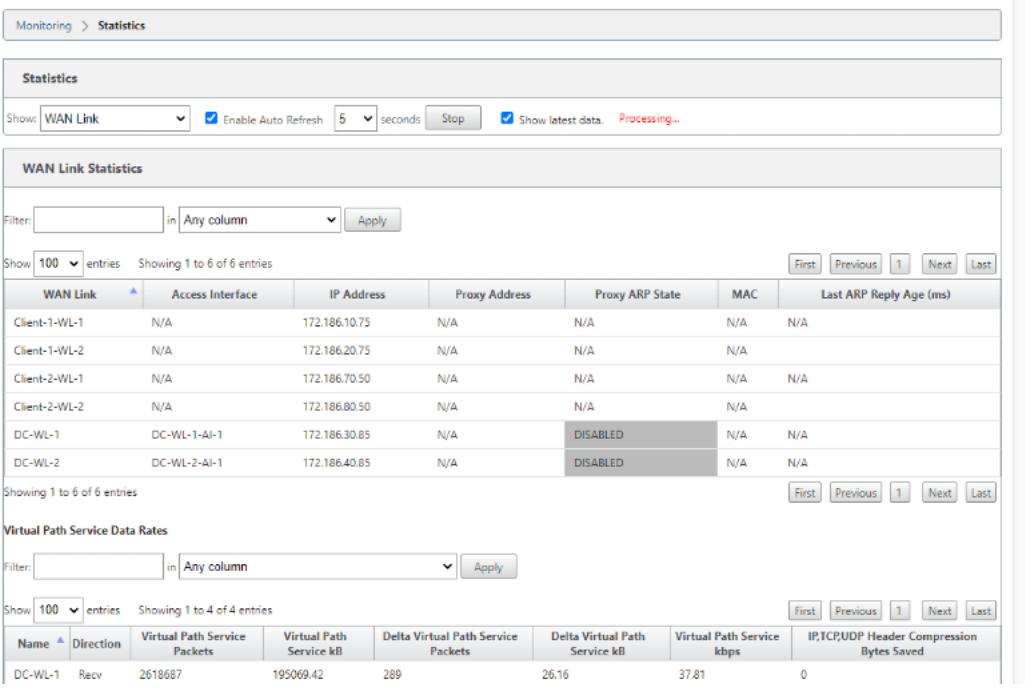
View permitted rate and congestion for WAN links

The SD-WAN web interface now allows you to view the permitted rate for WAN Links and WAN Link Usages and whether a WAN Link, Path, or Virtual Path is in congested state. In the previous releases, this information was only available in SD-WAN log files and through the CLI. These options are now available in the web interface to help with troubleshooting.

View permitted rate Permitted Rate is the amount of bandwidth that a particular WAN Link, Virtual Path Service, Intranet Service, or Internet Service is permitted to use at a given point in time. The permitted rate for a WAN Link is static, and is defined explicitly in the SD-WAN configuration. The permitted rate for a Virtual Path Service, Intranet Service, or Internet Service will fluctuate over time, in response to congestion, user demand, and Fair Shares, but will always be greater than or equal to the Minimum Reserved Bandwidth for the Service.

Monitor WAN link

Go to **Monitor** > **Statistics**, and select **WAN Link** from the **Show** drop-down list.



Show: WAN Link ☑ Enable Auto Refresh 5 seconds Stop ☑ Show latest data. Processing...

WAN Link Statistics

Filter: in Any column

Show 100 entries Showing 1 to 6 of 6 entries

WAN Link	Access Interface	IP Address	Proxy Address	Proxy ARP State	MAC	Last ARP Reply Age (ms)
Client-1-WL-1	N/A	172.186.10.75	N/A	N/A	N/A	N/A
Client-1-WL-2	N/A	172.186.20.75	N/A	N/A	N/A	
Client-2-WL-1	N/A	172.186.70.50	N/A	N/A	N/A	N/A
Client-2-WL-2	N/A	172.186.80.50	N/A	N/A	N/A	
DC-WL-1	DC-WL-1-AI-1	172.186.30.85	N/A	DISABLED	N/A	N/A
DC-WL-2	DC-WL-2-AI-1	172.186.40.85	N/A	DISABLED	N/A	N/A

Showing 1 to 6 of 6 entries

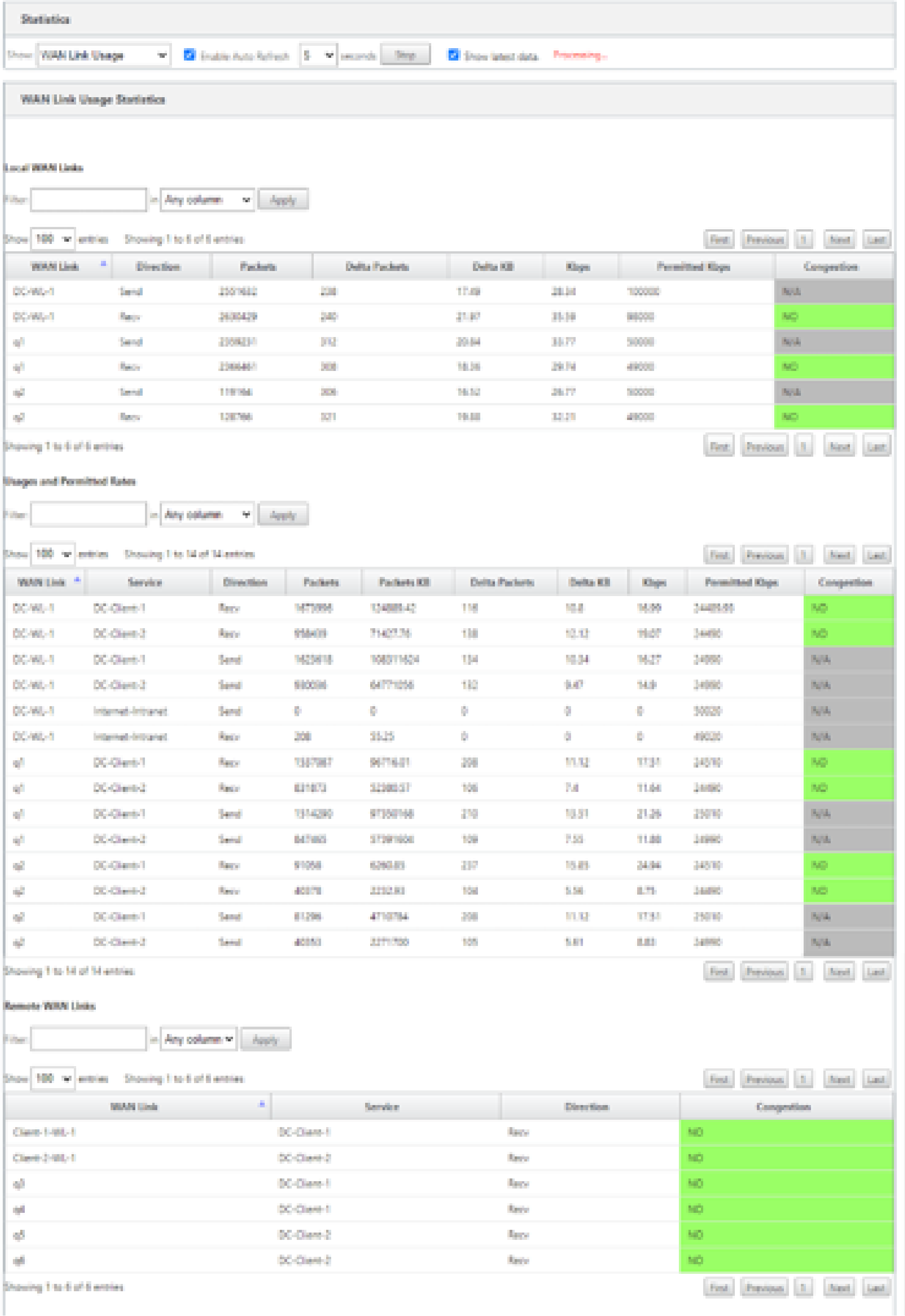
Virtual Path Service Data Rates

Filter: in Any column

Show 100 entries Showing 1 to 4 of 4 entries

Name	Direction	Virtual Path Service Packets	Virtual Path Service kB	Delta Virtual Path Service Packets	Delta Virtual Path Service kB	Virtual Path Service kbps	IP,TCP,UDP Header Compression Bytes Saved
DC-WL-1	Recv	2618687	195069.42	289	26.16	37.81	0

Go to **Monitor > Statistics**, and select **WAN Link Usage** from the **Show** drop-down list.



Statistics

Show: WAN Link Usage ☑ Enable Auto Refresh 5 seconds Stop ☑ Show latest data Processing...

WAN Link Usage Statistics

Local WAN Links

Filter: in Any column Apply

Show 100 entries Showing 1 to 6 of 6 entries

WAN Link	Direction	Packets	Delta Packets	Delta KB	Kbps	Permitted Kbps	Congestion
DC-WL-1	Send	2331632	238	17.49	28.34	100000	N/A
DC-WL-1	Recv	2630429	240	21.97	35.38	98000	NO
ql	Send	2359231	372	20.64	33.77	50000	N/A
ql	Recv	2366461	308	18.36	29.74	49000	NO
q2	Send	119164	306	16.52	26.77	50000	N/A
q2	Recv	128766	321	19.88	32.21	49000	NO

Showing 1 to 6 of 6 entries

Usages and Permitted Rates

Filter: in Any column Apply

Show 100 entries Showing 1 to 14 of 14 entries

WAN Link	Service	Direction	Packets	Packets KB	Delta Packets	Delta KB	Kbps	Permitted Kbps	Congestion
DC-WL-1	DC-Client-1	Recv	1473998	124885.42	118	10.8	16.99	24485.93	NO
DC-WL-1	DC-Client-2	Recv	958439	71427.76	138	12.12	19.07	24490	NO
DC-WL-1	DC-Client-1	Send	1423618	108311624	134	10.34	16.27	24990	N/A
DC-WL-1	DC-Client-2	Send	930036	64771056	132	9.47	14.9	24990	N/A
DC-WL-1	Internet-Intranet	Send	0	0	0	0	0	50020	N/A
DC-WL-1	Internet-Intranet	Recv	208	33.25	0	0	0	49020	N/A
ql	DC-Client-1	Recv	1337087	96716.01	208	11.12	17.31	24510	NO
ql	DC-Client-2	Recv	831873	52380.57	106	7.4	11.64	24490	NO
ql	DC-Client-1	Send	1314290	97350168	210	13.51	21.29	25010	N/A
ql	DC-Client-2	Send	847465	57391656	109	7.53	11.88	24990	N/A
q2	DC-Client-1	Recv	91058	6260.83	237	15.83	24.94	24510	NO
q2	DC-Client-2	Recv	40378	2232.83	104	5.56	8.75	24490	NO
q2	DC-Client-1	Send	81296	4710784	208	11.12	17.51	25010	N/A
q2	DC-Client-2	Send	40353	2271700	105	5.61	8.83	24990	N/A

Showing 1 to 14 of 14 entries

Remote WAN Links

Filter: in Any column Apply

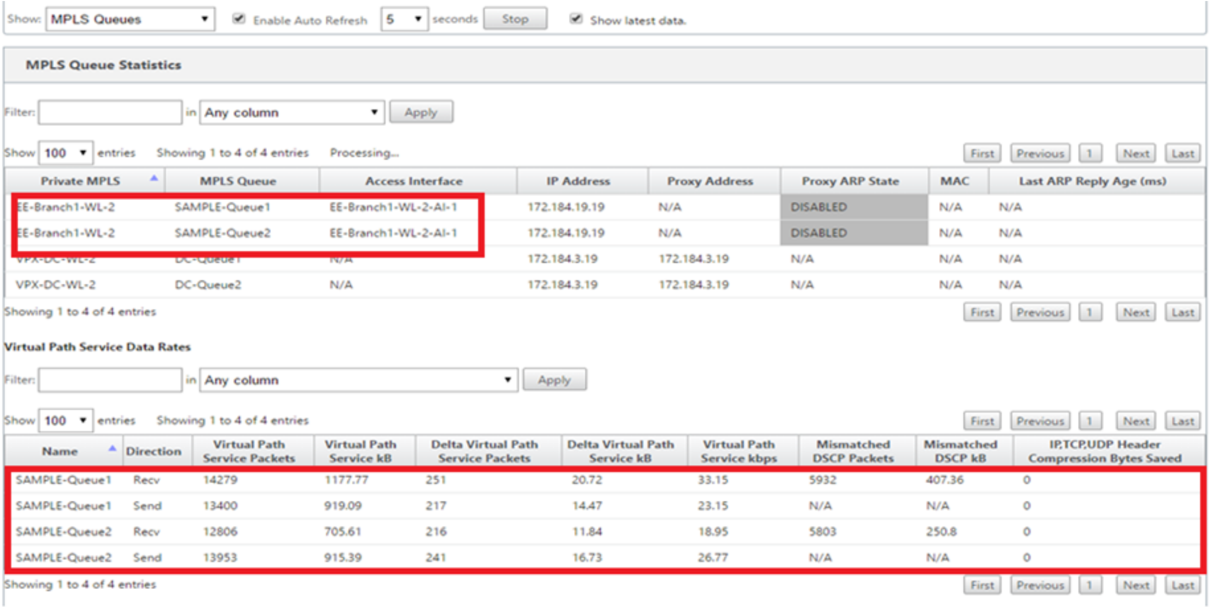
Show 100 entries Showing 1 to 6 of 6 entries

WAN Link	Service	Direction	Congestion
Client-1-WL-1	DC-Client-1	Recv	NO
Client-2-WL-1	DC-Client-2	Recv	NO
q3	DC-Client-1	Recv	NO
q4	DC-Client-1	Recv	NO
q5	DC-Client-2	Recv	NO
q6	DC-Client-2	Recv	NO

Showing 1 to 6 of 6 entries

Monitor MPLS queues

Go to **Monitor** > **Statistics**, and select **MPLS Queues** from the **Show** drop-down list.



Show: MPLS Queues ☑ Enable Auto Refresh 5 seconds Stop ☑ Show latest data.

MPLS Queue Statistics

Filter: in Any column Apply

Show 100 entries Showing 1 to 4 of 4 entries Processing...

Private MPLS	MPLS Queue	Access Interface	IP Address	Proxy Address	Proxy ARP State	MAC	Last ARP Reply Age (ms)
EE-Branch1-WL-2	SAMPLE-Queue1	EE-Branch1-WL-2-AI-1	172.184.19.19	N/A	DISABLED	N/A	N/A
EE-Branch1-WL-2	SAMPLE-Queue2	EE-Branch1-WL-2-AI-1	172.184.19.19	N/A	DISABLED	N/A	N/A
VPX-DC-WL-2	DC-Queue1	N/A	172.184.3.19	172.184.3.19	N/A	N/A	N/A
VPX-DC-WL-2	DC-Queue2	N/A	172.184.3.19	172.184.3.19	N/A	N/A	N/A

Showing 1 to 4 of 4 entries

Virtual Path Service Data Rates

Filter: in Any column Apply

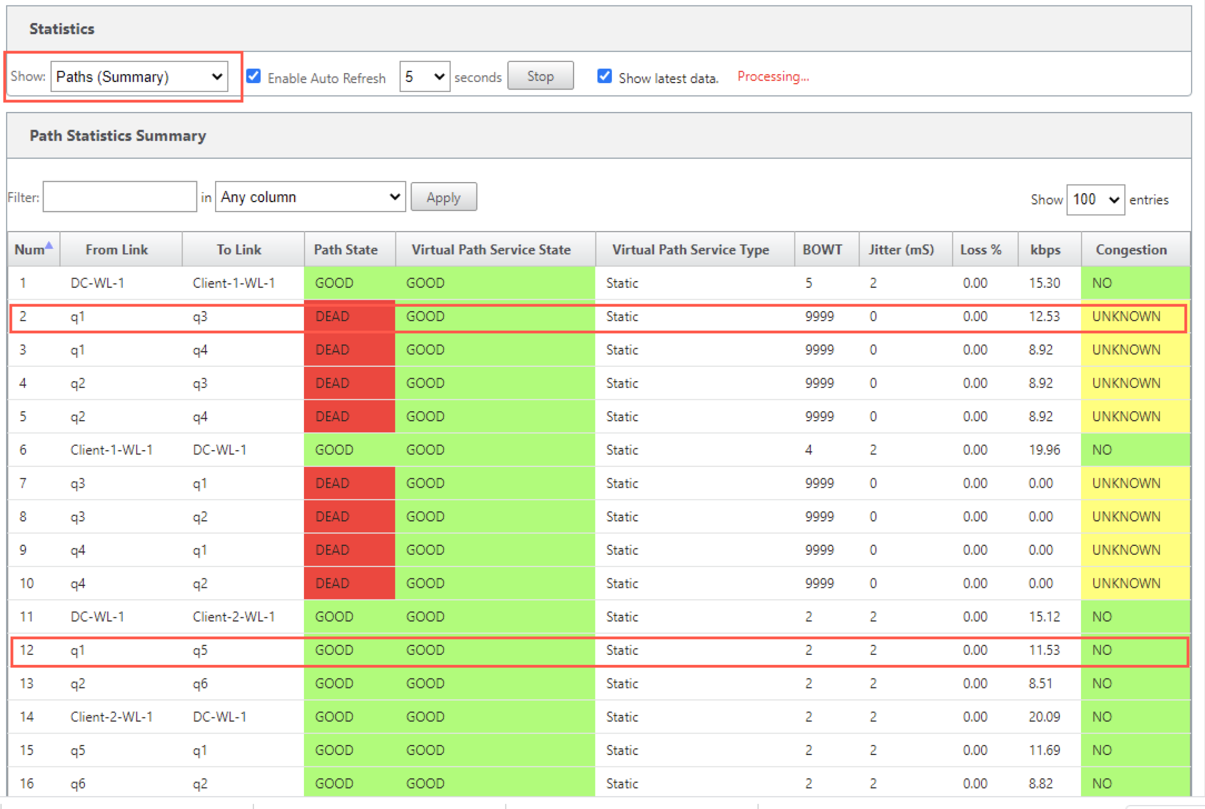
Show 100 entries Showing 1 to 4 of 4 entries

Name	Direction	Virtual Path Service Packets	Virtual Path Service kB	Delta Virtual Path Service Packets	Delta Virtual Path Service kB	Virtual Path Service kbps	Mismatched DSCP Packets	Mismatched DSCP kB	IP,TCP,UDP Header Compression Bytes Saved
SAMPLE-Queue1	Recv	14279	1177.77	251	20.72	33.15	5932	407.36	0
SAMPLE-Queue1	Send	13400	919.09	217	14.47	23.15	N/A	N/A	0
SAMPLE-Queue2	Recv	12806	705.61	216	11.84	18.95	5803	250.8	0
SAMPLE-Queue2	Send	13953	915.39	241	16.73	26.77	N/A	N/A	0

Showing 1 to 4 of 4 entries

Troubleshooting MPLS queues

To check the status of MPLS queues, navigate to **Monitor > Statistics** and select **Paths (summary)** from the **Show** drop-down list. In the following example, the path from MPLS queue "q1"to "q3"is in DEAD state and shown in red. The path from MPLS queue "q1"to "q5"is in GOOD state and shown in green.



Statistics

Show: Paths (Summary) ☑ Enable Auto Refresh 5 seconds Stop ☑ Show latest data. Processing...

Path Statistics Summary

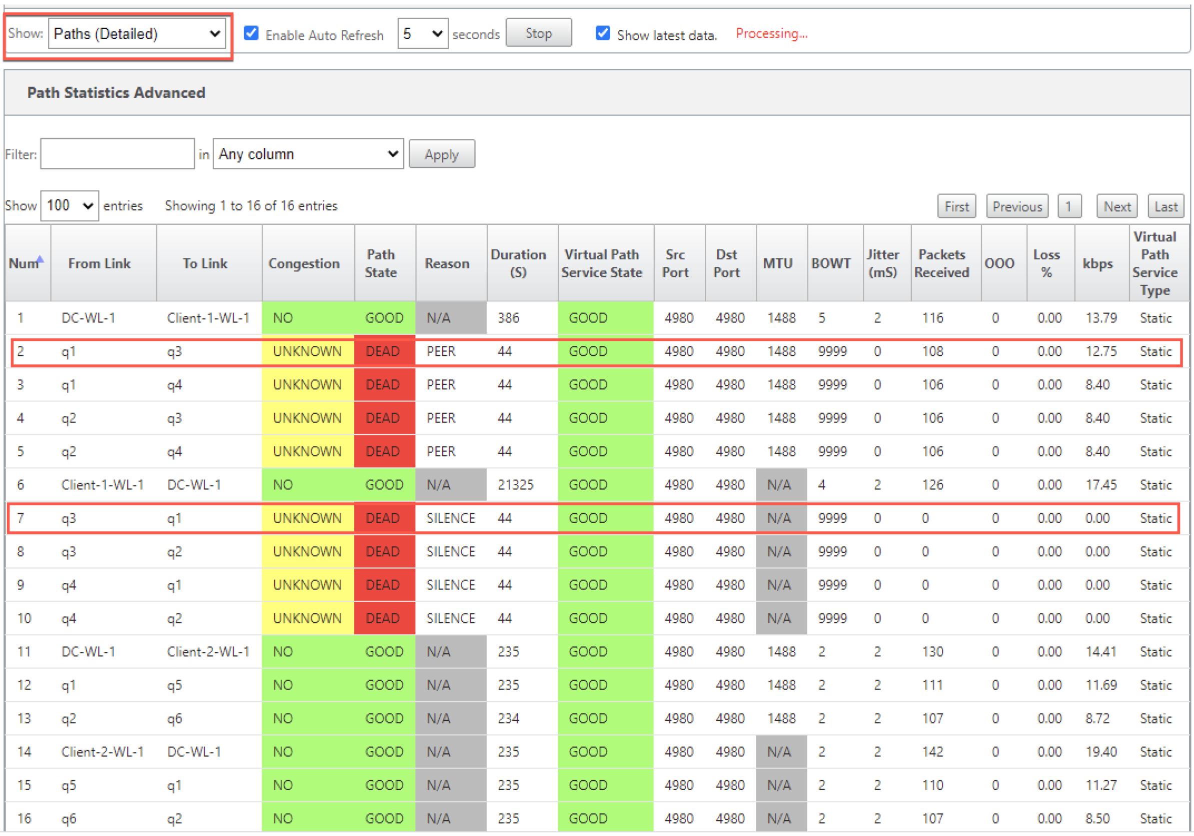
Filter: in Any column Apply Show 100 entries

Num	From Link	To Link	Path State	Virtual Path Service State	Virtual Path Service Type	BOWT	Jitter (mS)	Loss %	kbps	Congestion
1	DC-WL-1	Client-1-WL-1	GOOD	GOOD	Static	5	2	0.00	15.30	NO
2	q1	q3	DEAD	GOOD	Static	9999	0	0.00	12.53	UNKNOWN
3	q1	q4	DEAD	GOOD	Static	9999	0	0.00	8.92	UNKNOWN
4	q2	q3	DEAD	GOOD	Static	9999	0	0.00	8.92	UNKNOWN
5	q2	q4	DEAD	GOOD	Static	9999	0	0.00	8.92	UNKNOWN
6	Client-1-WL-1	DC-WL-1	GOOD	GOOD	Static	4	2	0.00	19.96	NO
7	q3	q1	DEAD	GOOD	Static	9999	0	0.00	0.00	UNKNOWN
8	q3	q2	DEAD	GOOD	Static	9999	0	0.00	0.00	UNKNOWN
9	q4	q1	DEAD	GOOD	Static	9999	0	0.00	0.00	UNKNOWN
10	q4	q2	DEAD	GOOD	Static	9999	0	0.00	0.00	UNKNOWN
11	DC-WL-1	Client-2-WL-1	GOOD	GOOD	Static	2	2	0.00	15.12	NO
12	q1	q5	GOOD	GOOD	Static	2	2	0.00	11.53	NO
13	q2	q6	GOOD	GOOD	Static	2	2	0.00	8.51	NO
14	Client-2-WL-1	DC-WL-1	GOOD	GOOD	Static	2	2	0.00	20.09	NO
15	q5	q1	GOOD	GOOD	Static	2	2	0.00	11.69	NO
16	q6	q2	GOOD	GOOD	Static	2	2	0.00	8.82	NO

For detailed information on paths, select **Paths (Detailed)** from the **Show** drop-down list. The information on paths such as reason for the state, duration, source port, destination port, MTU are available

In the following example, the path from MPLS queue “q1”to “q3”is in DEAD state and the reason is PEER. The path from MPLS queue “q3”to “q1”is dead and the reason is SILENCE. The following table provides the list if available reasons and its descriptions.

Reason	Description
GATEWAY	The path is DEAD as the appliance cannot reach or detect the gateway
SILENCE	The path is BAD or DEAD because the appliance has not received packets from the peer site
LOSS	The path is BAD due to packet loss
PEER	The peer site is reporting the path is BAD



Show: Paths (Detailed) ☑ Enable Auto Refresh 5 seconds Stop ☑ Show latest data. Processing...

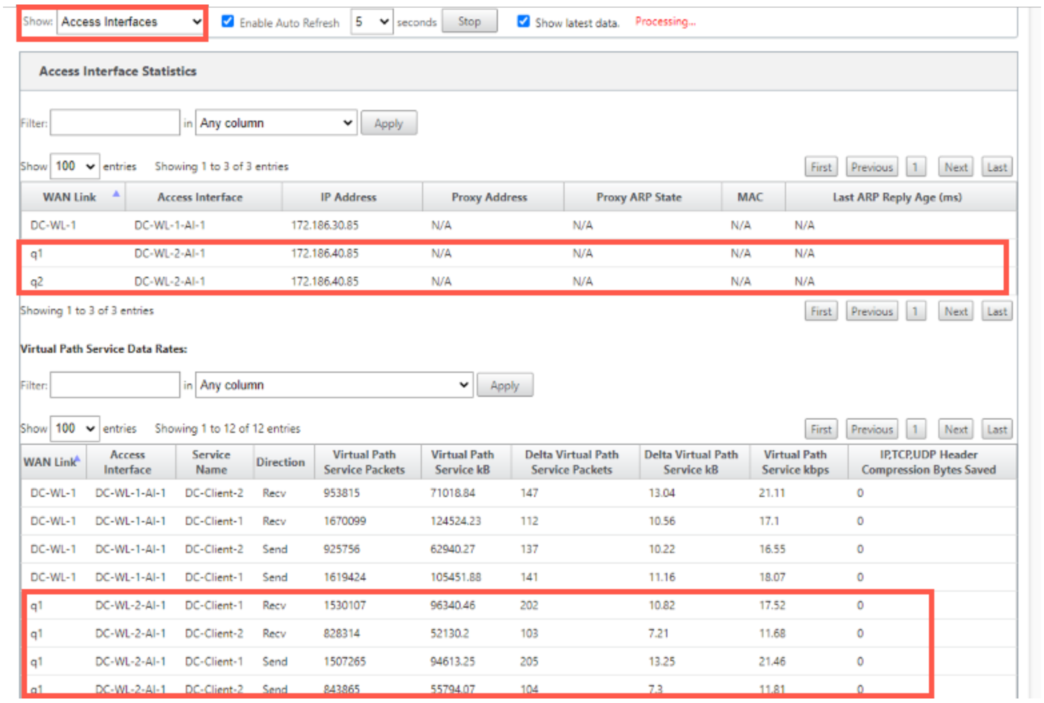
Path Statistics Advanced

Filter: in Any column Apply

Show 100 entries Showing 1 to 16 of 16 entries

Num	From Link	To Link	Congestion	Path State	Reason	Duration (S)	Virtual Path Service State	Src Port	Dst Port	MTU	BOWT	Jitter (mS)	Packets Received	OOO	Loss %	kbps	Virtual Path Service Type
1	DC-WL-1	Client-1-WL-1	NO	GOOD	N/A	386	GOOD	4980	4980	1488	5	2	116	0	0.00	13.79	Static
2	q1	q3	UNKNOWN	DEAD	PEER	44	GOOD	4980	4980	1488	9999	0	108	0	0.00	12.75	Static
3	q1	q4	UNKNOWN	DEAD	PEER	44	GOOD	4980	4980	1488	9999	0	106	0	0.00	8.40	Static
4	q2	q3	UNKNOWN	DEAD	PEER	44	GOOD	4980	4980	1488	9999	0	106	0	0.00	8.40	Static
5	q2	q4	UNKNOWN	DEAD	PEER	44	GOOD	4980	4980	1488	9999	0	106	0	0.00	8.40	Static
6	Client-1-WL-1	DC-WL-1	NO	GOOD	N/A	21325	GOOD	4980	4980	N/A	4	2	126	0	0.00	17.45	Static
7	q3	q1	UNKNOWN	DEAD	SILENCE	44	GOOD	4980	4980	N/A	9999	0	0	0	0.00	0.00	Static
8	q3	q2	UNKNOWN	DEAD	SILENCE	44	GOOD	4980	4980	N/A	9999	0	0	0	0.00	0.00	Static
9	q4	q1	UNKNOWN	DEAD	SILENCE	44	GOOD	4980	4980	N/A	9999	0	0	0	0.00	0.00	Static
10	q4	q2	UNKNOWN	DEAD	SILENCE	44	GOOD	4980	4980	N/A	9999	0	0	0	0.00	0.00	Static
11	DC-WL-1	Client-2-WL-1	NO	GOOD	N/A	235	GOOD	4980	4980	1488	2	2	130	0	0.00	14.41	Static
12	q1	q5	NO	GOOD	N/A	235	GOOD	4980	4980	1488	2	2	111	0	0.00	11.69	Static
13	q2	q6	NO	GOOD	N/A	234	GOOD	4980	4980	1488	2	2	107	0	0.00	8.72	Static
14	Client-2-WL-1	DC-WL-1	NO	GOOD	N/A	235	GOOD	4980	4980	N/A	2	2	142	0	0.00	19.40	Static
15	q5	q1	NO	GOOD	N/A	235	GOOD	4980	4980	N/A	2	2	110	0	0.00	11.27	Static
16	q6	q2	NO	GOOD	N/A	235	GOOD	4980	4980	N/A	2	2	107	0	0.00	8.50	Static

To check the access interface and IP address associated with the MPLS queues, select **Access Interfaces** from the **Show** drop-down list.



Show: Access Interfaces ☑ Enable Auto Refresh 5 seconds Stop ☑ Show latest data. Processing...

Access Interface Statistics

Filter: in Any column Apply

Show 100 entries Showing 1 to 3 of 3 entries

WAN Link	Access Interface	IP Address	Proxy Address	Proxy ARP State	MAC	Last ARP Reply Age (ms)
DC-WL-1	DC-WL-1-AI-1	172.186.30.85	N/A	N/A	N/A	N/A
q1	DC-WL-2-AI-1	172.186.40.85	N/A	N/A	N/A	N/A
q2	DC-WL-2-AI-1	172.186.40.85	N/A	N/A	N/A	N/A

Showing 1 to 3 of 3 entries

Virtual Path Service Data Rates:

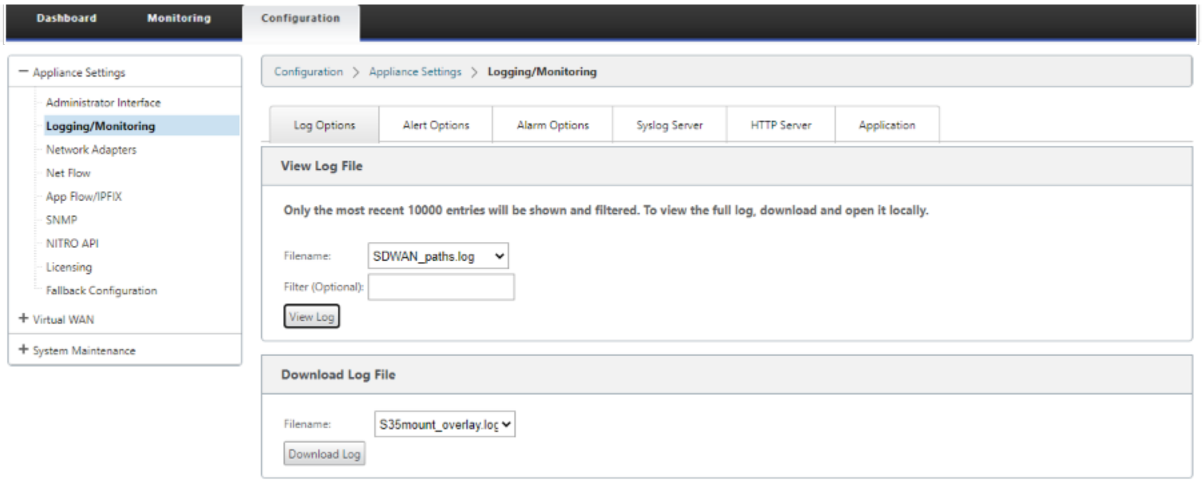
Filter: in Any column Apply

Show 100 entries Showing 1 to 12 of 12 entries

WAN Link	Access Interface	Service Name	Direction	Virtual Path Service Packets	Virtual Path Service kB	Delta Virtual Path Service Packets	Delta Virtual Path Service kB	Virtual Path Service kbps	IP,TCP,UDP Header Compression Bytes Saved
DC-WL-1	DC-WL-1-AI-1	DC-Client-2	Recv	953815	71018.84	147	13.04	21.11	0
DC-WL-1	DC-WL-1-AI-1	DC-Client-1	Recv	1670099	124524.23	112	10.56	17.1	0
DC-WL-1	DC-WL-1-AI-1	DC-Client-2	Send	925756	62940.27	137	10.22	16.55	0
DC-WL-1	DC-WL-1-AI-1	DC-Client-1	Send	1619424	105451.88	141	11.16	18.07	0
q1	DC-WL-2-AI-1	DC-Client-1	Recv	1530107	96340.46	202	10.82	17.52	0
q1	DC-WL-2-AI-1	DC-Client-2	Recv	828314	52130.2	103	7.21	11.68	0
q1	DC-WL-2-AI-1	DC-Client-1	Send	1507265	94613.25	205	13.25	21.46	0
q1	DC-WL-2-AI-1	DC-Client-2	Send	843865	55794.07	104	7.3	11.81	0

You can download the log files for further troubleshooting. Navigate to **Configuration > Logging/-**

Monitoring and select **SDWAN_paths.log** or **SDWAN_common.log** from the **Log Options** tab.



Only the most recent 10000 entries will be shown and filtered. To view the full log, download and open it locally.

Filename: SDWAN_paths.log

Filter (Optional):

Filename: S35mount_overlay.log

Reporting

September 22, 2022

Application QoE

Application QoE is a measure of Quality of Experience of applications in the SD-WAN network. It measures the quality of applications that flow through the virtual paths between two SD-WAN appliances. The **Application QoE** score is a value between 0 and 10. The score range that it falls in determines the quality of an application.

Quality	Range
Good	8–10
Fair	4–8
Poor	0–4

Application QoE score can be used to measure quality of applications and identify problematic trends.

You can define the quality thresholds for real-time and interactive appliances using QoE profiles, and map these profiles to applications or applications objects.

> **Note**
>
> To monitor Application QoE, it is essential to enable Deep Packet Inspection. For more information, see Application classification.

Real-time application QoE

The Application QoE calculation for real-time applications uses a Citrix innovative technique, which is derived from MOS score.

The default threshold values are:

- Latency threshold: 160 ms
- Jitter Threshold: 30 ms
- Packet loss threshold: 2%

A flow of a real-time application that meets the thresholds for latency, loss, and jitter is considered to be of good quality.

QoE for Real-time applications is determined from the percentage of flows that meet the threshold divided by the total number of flow samples.

QoE for Real-time = (No of flow samples that meet the threshold / Total no of flow samples) * 100

It is represented as QoE score ranging from 0 to 10.

You can create QoE profiles with custom threshold values and apply to applications or application objects.

> **Note**
>
> The QoE value can be zero if the network conditions are outside of the configured thresholds for real-time traffic.

Interactive application QoE

The Application QoE for interactive applications uses a Citrix innovative technique based on packet loss and burst rate thresholds.

Interactive applications are sensitive to packet loss and throughput. Therefore, we measure the packet loss percentage, and the burst rate of ingress and egress traffic in a flow.

The configurable thresholds are:

- Packet loss percentage.
- Percentage of expected egress burst rate in comparison to the ingress burst rate.

The default threshold values are:

- Packet loss threshold: 1%
- Burst rate: 60%

A flow is of good quality if the following conditions are met:

- The percentage loss for a flow is less that the configured threshold.
- The egress burst rate is at least the configured percentage of ingress burst rate.

Configuring application QoE

Map application or application objects to default or custom QoE profiles.
You can create custom QoE profiles for real-time and interactive traffic and map up to 10 applications or application objects with QoE profiles.

To create custom QoE profiles through Citrix SD-WAN Orchestrator service, see Application QoE profiles.

HDX QoE

Network parameters such as latency, jitter, and packet drop affect the user experience of HDX users. Quality of Experience (QoE) is introduced to help the users understand and check their ICA quality of experience. QoE is a calculated index, which indicates the ICA traffic performance. The users can tune the rules and policy to improve the QoE.

The QoE is a numeric value between 0–100, the higher the value the better the user experience. QoE is enabled by default for all ICA / HDX applications.

The parameters used to calculate QoE, are measured between the two SD-WAN appliances located at the client and server side and not measured between the client or the server appliances themselves. Latency, jitter, and packet drop are measured at the flow level and it can be different from the statistics at the link level. The end host (client or server) application might never know that there is a packet loss on the WAN. If the retransmit succeeds, the flow level packet loss rate is lower than the link level loss. However, as a result, it might increase latency and jitter a bit.

Default configuration for HDX traffic enables SD-WAN to retransmit packets, thus improves the QoE index value that was lost due to packet loss in the network.

In the HDX dashboard on Citrix SD-WAN Orchestrator, you can view a graphical representation of the overall quality of HDX applications. The HDX applications are classified into the following three quality categories:

Quality	QoE Range
Good	80–100
Fair	50–80
Poor	0–50

A list of the bottom five sites with the least QoE is also displayed in the HDX dashboard.

A graphical representation of the QoE for different time intervals allows you to monitor the performance of HDX applications at each site.

For more information on how to configure HDX QoE using Citrix SD-WAN Orchestrator service, see HDX dashboard and reports.

> **Note**
>
> - *Do not expect the WAN link latency, jitter, and packet drop would always match application latency, jitter, and packet drop. WAN Link loss correlates to the actual WAN packet loss, while application loss is after retransmit, which is lower than WAN link loss.*
> - *WAN Link latency displayed in the GUI is BOWT (Best One Way Time). It is the best metrics of the link as a means to gauge the health of the link. The application QoE tracks and calculates the total and average latency of all the packets for that application. This often does not match the link BOWT.*
> - *When an MSI session starts, during ICA handshake, the session might be temporarily counted as 4 SSI instead of 1 MSI. After the handshake is complete, it will converge to 1 MSI. If the conversion happens before the SQL table is updated, it might show up in ICA_Summary for that minute.*
> - *On session reconnect, since initial protocol information is not exchanged, SD-WAN is not able to identify MSI, hence each connection is counted as SSI information.*
> - *For UDP connections, after the connection is closed, it can take up to 5 minutes for the connection to show as closed and updated in ICA_Summary. For TCP connections, after the connection is closed, it can take up to 2 minutes to show as closed in ICA_Summary.*
> - *QoE of TCP sessions and UDP sessions might not be the same on the same path due to the inherent different between TCP and UDP.*
> - *If one user launches two virtual desktops, the number of users is countered as two.*

Multiple Net Flow Collectors

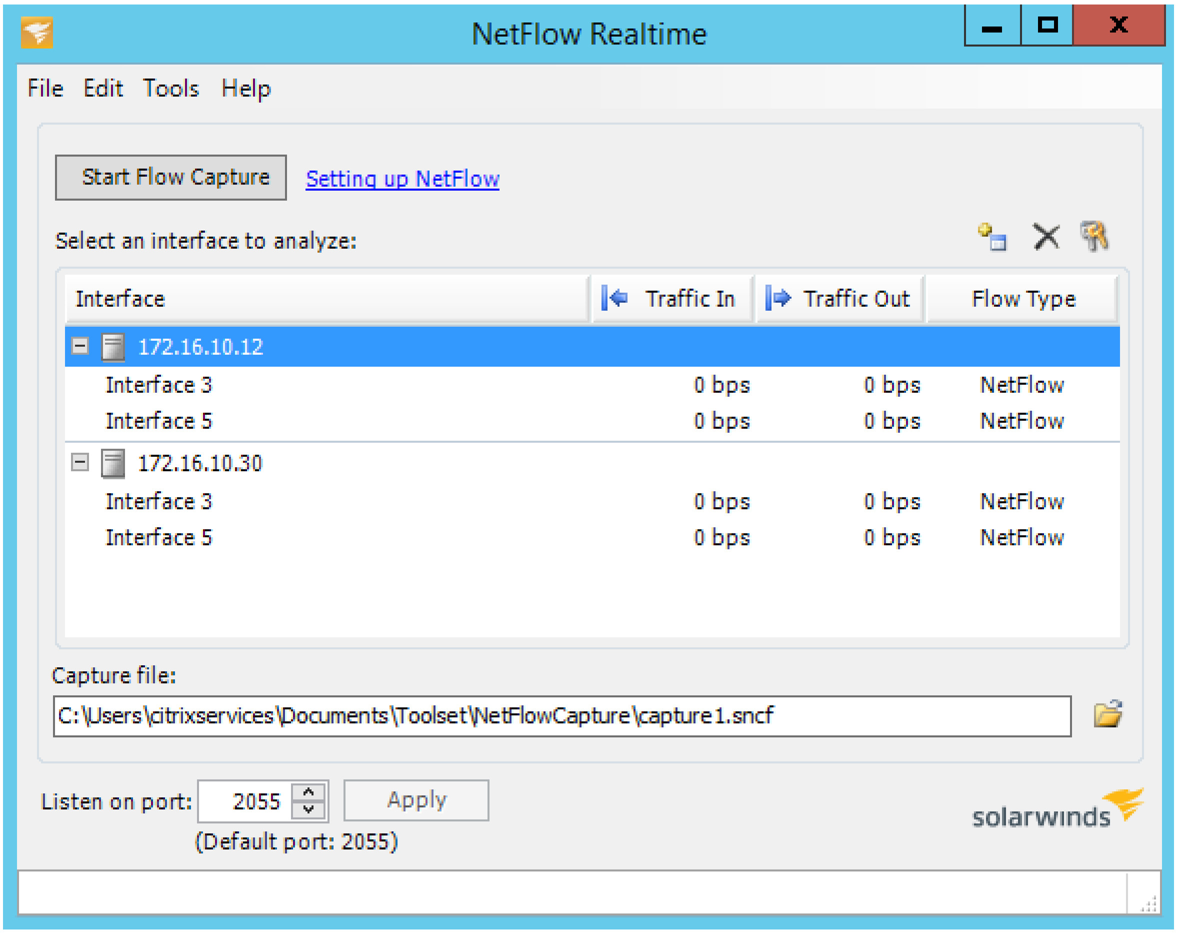
Net Flow Collectors collect IP network traffic as it enters or exits an SD-WAN interface. By analyzing the data provided by Net Flow, you can determine the source and destination of traffic, class of service, and the causes for traffic congestion. Citrix SD-WAN devices can be configured to send basic Net

Flow version 5 statistical data to the configured Net Flow collector. Citrix SD-WAN provides Net Flow support for traffic flows that are obscured by the transport reliable protocol. Devices on the WAN edge of the solution lose capability to collect Net Flow records since only the SD-WAN encapsulated UDP packets are displayed. Net Flow is supported on the Citrix SD-WAN Standard Edition appliances.

For information on how to configure Net Flow Hosts using Citrix SD-WAN Orchestrator service, see Netflow host settings.

NetFlow Export

Net Flow data is exported from the SD-WAN device management port. On your Net Flow collector tool, the SD-WAN devices are listed as the configured management IP address, if SNMP is not configured. The interfaces are listed as one for incoming and a second for outgoing (Virtual Path traffic). For more information, see SNMP.



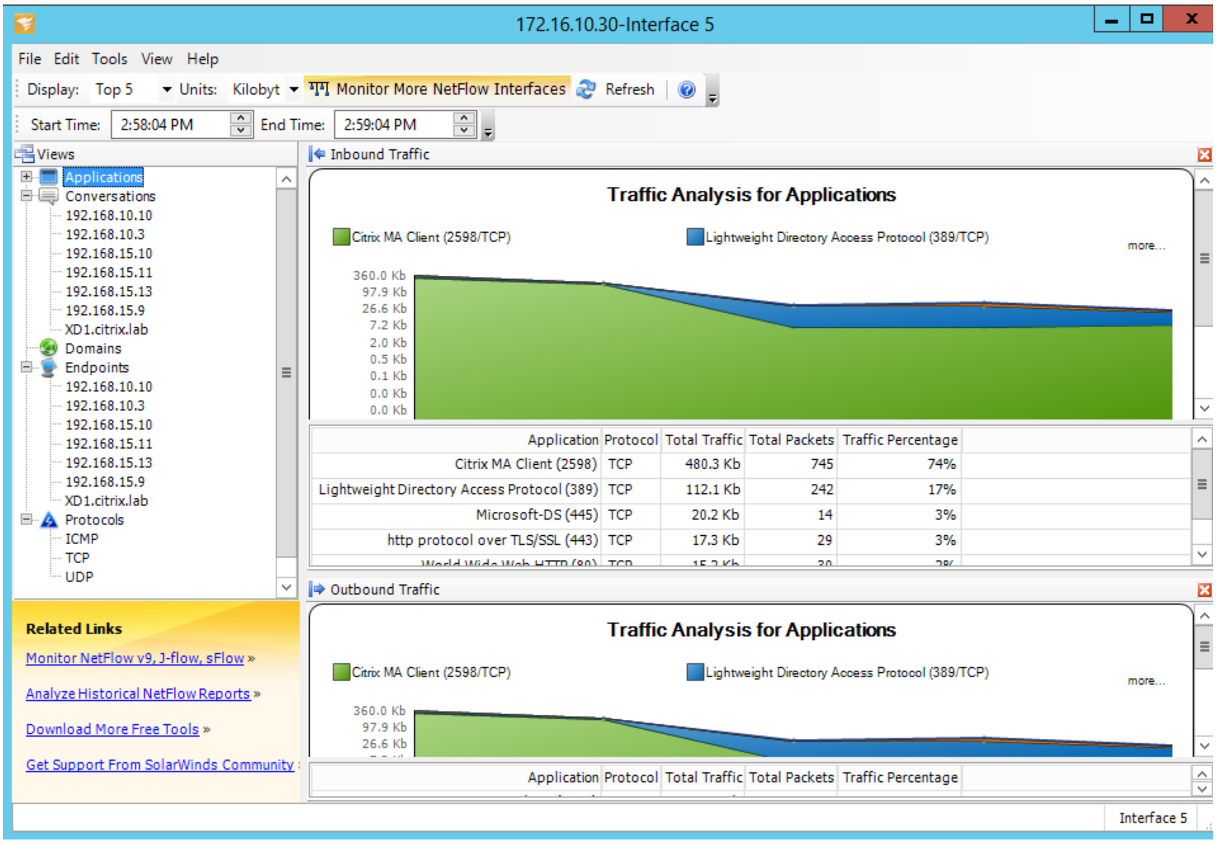
Select an interface to analyze:

Interface	Traffic In	Traffic Out	Flow Type
172.16.10.12			
Interface 3	0 bps	0 bps	NetFlow
Interface 5	0 bps	0 bps	NetFlow
172.16.10.30			
Interface 3	0 bps	0 bps	NetFlow
Interface 5	0 bps	0 bps	NetFlow

Capture file: C:\Users\citrixservices\Documents\Toolset\NetFlowCapture\capture1.sncf

Listen on port: 2055

(Default port: 2055)



Application	Protocol	Total Traffic	Total Packets	Traffic Percentage
Citrix MA Client (2598)	TCP	480.3 Kb	745	74%
Lightweight Directory Access Protocol (389)	TCP	112.1 Kb	242	17%
Microsoft-DS (445)	TCP	20.2 Kb	14	3%
http protocol over TLS/SSL (443)	TCP	17.3 Kb	29	3%
World Wide Web HTTP (80)	TCP	15.2 Kb	30	2%

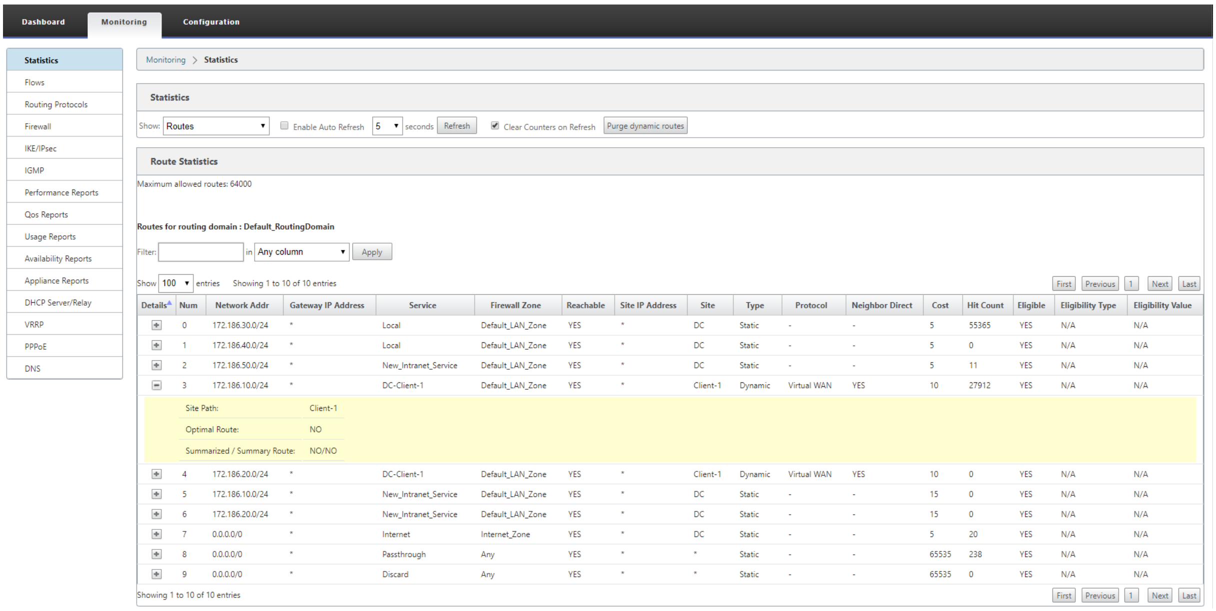
Application	Protocol	Total Traffic	Total Packets	Traffic Percentage

NetFlow Limitations

- With Netflow enabled on SD-WAN Standard Edition appliances, Virtual Path data is streamed to the designated Netflow collectors. One limitation with this is that one cannot differentiate which physical WAN link is being used by SD-WAN, as the solution reports aggregated Virtual Path information (A Virtual Path may comprise of multiple distinct WAN Paths), there is no way to filter the Netflow records for the distinct WAN paths.
- TCP control Bits report as N/A which indicates SD-WAN does not follow the internet standard for Netflow exports based on RFC 7011 which has element ID 6 for tcpControlBits (IANA). Without TCP Flags, calculating round trip time (RTT), latency, jitter, and other performance metrics in the flow data is not possible. From the security side, without TCP flags, the Net Flow collector cannot determine if there are FIN, ACK/RST, or SYN scans occurring.

Route statistics

To view route statistics of your SD-WAN appliances, in the SD-WAN GUI navigate to **Monitoring** > **Statistics** > **Routes**.



Statistics

Show: Routes ☐ Enable Auto Refresh 5 seconds ☑ Clear Counters on Refresh

Route Statistics

Maximum allowed routes: 64000

Routes for routing domain : Default_RoutingDomain

Filter: in Any column

Show 100 entries Showing 1 to 10 of 10 entries

Details	Num	Network Addr	Gateway IP Address	Service	Firewall Zone	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
+	0	172.186.30.0/24	*	Local	Default_LAN_Zone	YES	*	DC	Static	-	-	5	55365	YES	N/A	N/A
+	1	172.186.40.0/24	*	Local	Default_LAN_Zone	YES	*	DC	Static	-	-	5	0	YES	N/A	N/A
+	2	172.186.50.0/24	*	New_Intranet_Service	Default_LAN_Zone	YES	*	DC	Static	-	-	5	11	YES	N/A	N/A
−	3	172.186.10.0/24	*	DC-Client-1	Default_LAN_Zone	YES	*	Client-1	Dynamic	Virtual WAN	YES	10	27912	YES	N/A	N/A
	Site Path:	Client-1														
	Optimal Route:	NO														
	Summarized / Summary Route:	NO/NO														
+	4	172.186.20.0/24	*	DC-Client-1	Default_LAN_Zone	YES	*	Client-1	Dynamic	Virtual WAN	YES	10	0	YES	N/A	N/A
+	5	172.186.10.0/24	*	New_Intranet_Service	Default_LAN_Zone	YES	*	DC	Static	-	-	15	0	YES	N/A	N/A
+	6	172.186.20.0/24	*	New_Intranet_Service	Default_LAN_Zone	YES	*	DC	Static	-	-	15	0	YES	N/A	N/A
+	7	0.0.0.0/0	*	Internet	Internet_Zone	YES	*	DC	Static	-	-	5	20	YES	N/A	N/A
+	8	0.0.0.0/0	*	Passthrough	Any	YES	*	*	Static	-	-	65535	238	YES	N/A	N/A
+	9	0.0.0.0/0	*	Discard	Any	YES	*	*	Static	-	-	65535	0	YES	N/A	N/A

Showing 1 to 10 of 10 entries

You can view the following parameters:

- **Network Address**: The Network address and subnet mask of the route.
- **Details**: Click + to display the following information.
    - **Site Path**: Site Path is a source of truth metric for the received prefix. It is used in situations where WAN to WAN forwarding is enabled on multiple devices and in mesh deployment. Multiple such prefixes are received and the administrators are able to judge the prefix attributes by viewing the site path.

      For example, consider a simple topology of Branch1, Branch2, and MCN along with a Geo MCN. Branch1 has a prefix 172.16.1.0/24 and has to get to Branch2. Geo MCN and MCN have WAN to WAN forwarding enabled.

      The prefix 172.16.1.0/24 can get to Branch2 via Branch1-MCN-Branch2, Branch1-Geo-Branch2, and Branch1-MCN-Geo-Branch2. For each of these distinct prefixes the routing table is updated with their site path metric. The site path metric indicates the origin of the route prefix and the cost involved to get to Branch2.
    - **Optimal Route**: Optimal route indicates whether the route is the optimal route to reach that subnet compared to all other routes. This optimal route is exported to other sites.
    - **Summarized/ Summary Route**: A summary route is a route configured explicitly by an administrator to summarize multiple prefixes that fall in the supernet. Summarized routes are the prefixes that fall under the summary route.

      For example, assume that we have a summary route 172.16.0.0/16. This is a summary route only and not a summarized route. A summary route has Summary 'YES'and Summarized 'NO'. If there are few other subnets like 172.16.1.0/24, 172.16.2.0/24 and

172.16.3.0/24, these three routes fall under the summary route or the supernet and hence are called summarized routes. A summarized route has Summarized 'YES'and Summary 'NO'.

- **Gateway IP Address**: The IP address of the gateway/route used to reach this route.
- **Service**: The type of Citrix SD-WAN service.
- **Firewall Zone**: The firewall zone used by the route.
- **Reachable**: Is the route reachable or not.
- **Site IP Address**: The IP address of the site.
- **Site**: The name of the site.
- **Type**: Type of a route depends upon the source of the route learning. The routes on the LAN side and routes entered manually during configuration are Static routes. Routes learned from the SD-WAN or dynamic routing peers are Dynamic routes.
- **Protocol**: The protocol of the prefixes.
  - **Local**: Local virtual IPs of the appliance.
  - **Virtual WAN**: Prefixes learned from peer SD-WAN appliances.
  - **OSPF**: Prefixes learned from OSPF dynamic routing peer.
  - **BGP**: Prefixes learned from BGP dynamic routing peer.
- **Neighbor Direct**: Indicates whether the subnet is connected to the branch from which the route came to the appliance.
- **Cost**: The cost used to determine the best path to a destination network.
- **Hit Count**: The number of times a route was hit to forward a packet to that subnet.
- **Eligible**: Indicates that the route is eligible and is used for forwarding or routing the packets to the prefix hit during traffic processing.
- **Eligibility Type**: The following two eligibility types are available.
  - **Gateway eligibility**: Determines if the gateway is reachable or not.
  - **Path eligibility**: Determines if the path is DEAD or NOT DEAD.
- **Eligibility Value**: The value selected for the gateway or the path in the configuration while the route is created in the system. For instance a route can be called eligible based on a path MCN-WL-1->BR1-WL-2. So the eligibility value for this route in the routes section is the value MCN-WL-1->BR1-WL-2.

Routing

September 22, 2022

> **Note**
>
> From SD-WAN 11.5 release onwards, all the routing configurations are supported only through Citrix SD-WAN Orchestrator service. For information regarding Citrix SD-WAN Orchestrator service routing configurations, see Routing.

Dynamic Routing

Citrix SD-WAN introduces support for well known Routing protocols under the **Dynamic Routing** feature. This feature facilitates the discovery of LAN subnets, advertise virtual path routes to work more seamlessly within networks using the BGP and OSPF protocols, allowing SD-WAN to be seamlessly deployed in an existing environment without the need for static route configurations and graceful router failover.

Route Filtering

For networks with Route Learning enabled, Citrix SD-WAN provides more control over which SD-WAN routes are advertised to routing neighbors rather and which routes are received from routing neighbors, rather than advertising and accepting all or no routes.

- Export Filters are used to include or exclude routes for advertisement using OSPF and BGP protocols based on specific match criteria.
- Import Filters are used to accept or not accept routes which are received using OSPF and BGP neighbors based on specific match criteria.

Route filtering is implemented on LAN routes and Virtual Path routes in an SD-WAN network (Data Center/Branch) and is advertised to a non-SD-WAN network through using BGP and OSPF.

Route Summarization

Route summarization reduces the number of routes that a router must maintain. A summary route is a single route that is used to represent multiple routes. It saves bandwidth by sending a single route advertisement, reducing the number of links between routers. It saves memory because only one route address is maintained. The CPU resources are used more efficiently by avoiding recursive lookups.

VRRP

Virtual Router Redundancy Protocol (VRRP) is a widely used protocol that provides device redundancy to eliminate the single point of failure inherent in the static default-routed environment. VRRP allows you to configure two or more routers to form a group. This group appears as a single default gateway with one virtual IP address and one virtual MAC address.

Citrix SD-WAN (release version 10.0 and later) supports VRRP version 2 and version 3 to inter-operate with any third party routers. The SD-WAN appliance acts as a master router and direct the traffic to use the Virtual Path Service between sites. You can configure the SD-WAN appliance as the VRRP master by configuring the Virtual Interface IP as the VRRP IP and by manually setting the priority to a higher value than the peer routers. You can configure the advertisement interval and the preempt option.

Using CLI to Access Routing Functionality

You can view additional information related to dynamic routing and the protocol status. Type the following command and syntax to access the routing daemon and view the list of commands.

‘

dynamic_routing?

‘

SD-WAN Overlay Routing

August 24, 2022

Citrix SD-WAN provides resilient and robust connectivity between remote sites, data centers, and cloud networks. The SD-WAN solution can accomplish this by establishing tunnels between SD-WAN appliances in the network enabling connectivity between sites by applying route tables that overlay the existing underlay network. SD-WAN route tables can fully replace or coexist with the existing routing infrastructure.

Citrix SD-WAN appliances measure the paths available unidirectionally in terms of availability, loss, latency, jitter and congestion characteristics, and select the best path on a per-packet basis. This means that the path chosen from Site A to Site B, need not necessarily be the path chosen from Site B to Site A. The best path at a given time is selected independently in each direction. Citrix SD-WAN offers packet-based path selection for rapid adaptation to any network changes. SD-WAN appliances can detect path outages after just two or three missing packets, allowing seamless subsecond failover of application traffic to the next-best WAN path. SD-WAN appliances recalculate every WAN link status in about 50 ms. The following article provides detailed routing configuration within the Citrix SD-WAN network.

Citrix SD-WAN Route Table

The SD-WAN allows static route entries for specific sites, and route entries learned from the underlay network through supported routing protocols; such as OSPF, eBGP, and iBGP. Routes are not only defined by their next hop but by their service type. This determines how the route is forwarded. The following are the main service types in use:

- **Local Service:** Denotes any route or subnet local to the SD-WAN appliance. This includes the Virtual Interface subnets (automatically creates local routes), and any local route defined in the route table (with a local next hop). The route is advertised to other SD-WAN appliances that have a Virtual Path to this local site where this route is configured when trusted as a partner.

> **Note**
>
> Be cautious when adding default routes, and summary routes as local routes as these can result in virtual path routes at other sites. Always check the route tables to make sure the correct routing is in effect.

- **Virtual Path** –Denotes any local route learned from a remote SD-WAN site that is reachable down the virtual paths. These routes are normally automatic, however a virtual path route can be added manually at a site. Any traffic for this route is forwarded to the defined Virtual Path for this destination route (subnet).
- **Intranet** –Denotes routes that are reachable through a private WAN link (MPLS, P2P, VPN, and so on). For example, a remote branch that is on the MPLS network but does not have an SD-WAN appliance. It is assumed that these routes must be forwarded to a certain WAN router. Intranet Service is not enabled by default. Any traffic matching this route (subnet) is classified as intranet for this appliance for delivery to a site that does not have an SD-WAN solution.

> **Note**
>
> Notice that when adding an Intranet route there is no next hop, but rather a forward to an Intranet Service. The Service is associated with a given WAN link.

- **Internet** –This is similar to Intranet but is used to define traffic flowing to public Internet WAN links rather than private WAN links. One unique difference is that the Internet service can be associated with multiple WAN links and set to load balance (per flow) or be active/backup. A default Internet route gets created when internet service is enabled (it is off by default). Any traffic matching this route (subnet) is classified as Internet for this appliance for delivery to public internet resources.

> **Note**

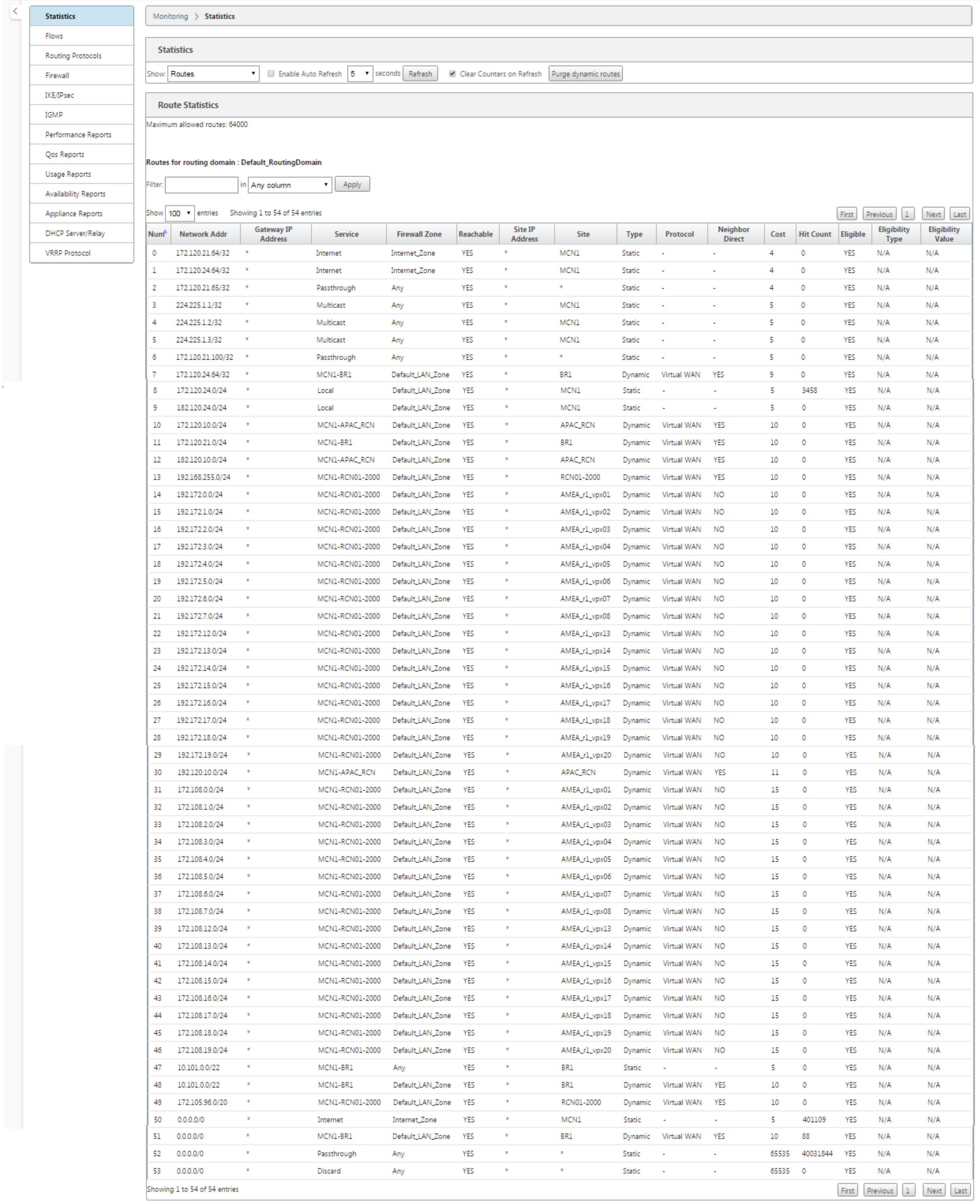
> Internet Service routes can be advertised to the other SD-WAN appliances or prevented from being exported depending on whether you are backhauling Internet access over the Virtual Paths.

- **Passthrough** –This service acts as a last resort or override service when an appliance is in-line mode. If a destination IP address fails to match with any other route, then the SD-WAN appliance simply forwards it onto the WAN link next hop. A default route: 0.0.0.0/0 cost of 16 pass-through route is created automatically. Passthrough does not work when the SD-WAN appliance is deployed out of path or in Edge/Gateway mode. Any traffic matching this route (subnet) is classified as passthrough for this appliance. It is recommended that passthrough traffic is limited as much as possible.

> **Note**
>
> Passthrough can be useful when conducting a POC to avoid having to configure numerous routings, however be careful in production because SD-WAN does not account for WAN link utilization for traffic sent to passthrough. It is also helpful when troubleshooting issues and you want to take a certain IP flow out of delivery over the Virtual Path.

- **Discard** - This is not a service but a last resort route that drops the packets if it matches. Normally this does not occur expect when the SD-WAN appliance is deployed out of the path. You must have an Intranet service or local route as a catch all route, otherwise the traffic is discarded as there is no passthrough service (even though a passthrough default route will be present).

The route table for the local client node can be monitored on the **Monitoring** > **Statistics** page with Routes selected for the **Show** drop-down list.



Statistics

Show: Routes ☐ Enable Auto Refresh 5 seconds ☑ Clear Counters on Refresh

Route Statistics

Maximum allowed routes: 64000

Routes for routing domain : Default_RoutingDomain

Filter: in Any column

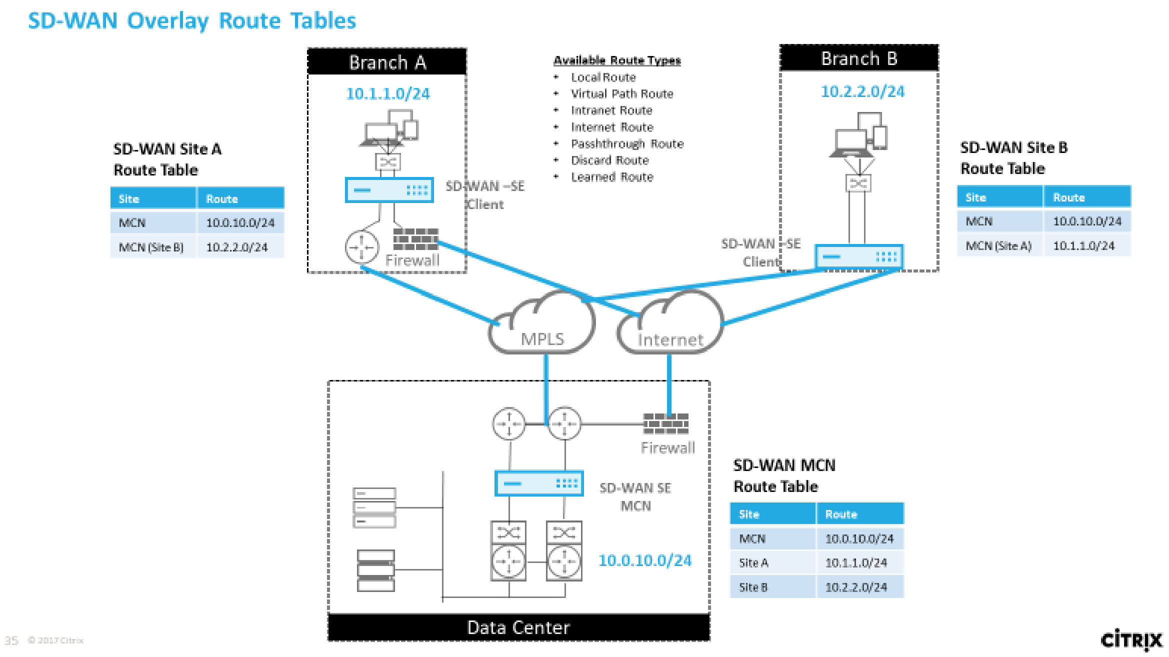
Show 100 entries Showing 1 to 54 of 54 entries

Num	Network Addr	Gateway IP Address	Service	Firewall Zone	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	172.120.21.64/32	*	Internet	Internet_Zone	YES	*	MCN1	Static	-	-	4	0	YES	N/A	N/A
1	172.120.24.64/32	*	Internet	Internet_Zone	YES	*	MCN1	Static	-	-	4	0	YES	N/A	N/A
2	172.120.21.65/32	*	Passthrough	Any	YES	*	*	Static	-	-	4	0	YES	N/A	N/A
3	224.225.1.1/32	*	Multicast	Any	YES	*	MCN1	Static	-	-	5	0	YES	N/A	N/A
4	224.225.1.2/32	*	Multicast	Any	YES	*	MCN1	Static	-	-	5	0	YES	N/A	N/A
5	224.225.1.3/32	*	Multicast	Any	YES	*	MCN1	Static	-	-	5	0	YES	N/A	N/A
6	172.120.21.100/32	*	Passthrough	Any	YES	*	*	Static	-	-	5	0	YES	N/A	N/A
7	172.120.24.64/32	*	MCN1-BR1	Default_LAN_Zone	YES	*	BR1	Dynamic	Virtual WAN	YES	9	0	YES	N/A	N/A
8	172.120.24.0/24	*	Local	Default_LAN_Zone	YES	*	MCN1	Static	-	-	5	3458	YES	N/A	N/A
9	182.120.24.0/24	*	Local	Default_LAN_Zone	YES	*	MCN1	Static	-	-	5	0	YES	N/A	N/A
10	172.120.10.0/24	*	MCN1-APAC_RCN	Default_LAN_Zone	YES	*	APAC_RCN	Dynamic	Virtual WAN	YES	10	0	YES	N/A	N/A
11	172.120.21.0/24	*	MCN1-BR1	Default_LAN_Zone	YES	*	BR1	Dynamic	Virtual WAN	YES	10	0	YES	N/A	N/A
12	182.120.10.0/24	*	MCN1-APAC_RCN	Default_LAN_Zone	YES	*	APAC_RCN	Dynamic	Virtual WAN	YES	10	0	YES	N/A	N/A
13	192.168.255.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	RCN01-2000	Dynamic	Virtual WAN	YES	10	0	YES	N/A	N/A
14	192.172.0.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx01	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
15	192.172.1.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx02	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
16	192.172.2.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx03	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
17	192.172.3.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx04	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
18	192.172.4.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx05	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
19	192.172.5.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx06	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
20	192.172.6.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx07	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
21	192.172.7.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx08	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
22	192.172.12.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx13	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
23	192.172.13.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx14	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
24	192.172.14.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx15	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
25	192.172.15.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx16	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
26	192.172.16.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx17	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
27	192.172.17.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx18	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
28	192.172.18.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx19	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
29	192.172.19.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx20	Dynamic	Virtual WAN	NO	10	0	YES	N/A	N/A
30	192.120.10.0/24	*	MCN1-APAC_RCN	Default_LAN_Zone	YES	*	APAC_RCN	Dynamic	Virtual WAN	YES	11	0	YES	N/A	N/A
31	172.108.0.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx01	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
32	172.108.1.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx02	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
33	172.108.2.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx03	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
34	172.108.3.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx04	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
35	172.108.4.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx05	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
36	172.108.5.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx06	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
37	172.108.6.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx07	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
38	172.108.7.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx08	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
39	172.108.12.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx13	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
40	172.108.13.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx14	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
41	172.108.14.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx15	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
42	172.108.15.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx16	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
43	172.108.16.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx17	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
44	172.108.17.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx18	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
45	172.108.18.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx19	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
46	172.108.19.0/24	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	AMEA_r1_vpx20	Dynamic	Virtual WAN	NO	15	0	YES	N/A	N/A
47	10.101.0.0/22	*	MCN1-BR1	Any	YES	*	BR1	Static	-	-	5	0	YES	N/A	N/A
48	10.101.0.0/22	*	MCN1-BR1	Default_LAN_Zone	YES	*	BR1	Dynamic	Virtual WAN	YES	10	0	YES	N/A	N/A
49	172.105.96.0/20	*	MCN1-RCN01-2000	Default_LAN_Zone	YES	*	RCN01-2000	Dynamic	Virtual WAN	YES	10	0	YES	N/A	N/A
50	0.0.0.0/0	*	Internet	Internet_Zone	YES	*	MCN1	Static	-	-	5	401109	YES	N/A	N/A
51	0.0.0.0/0	*	MCN1-BR1	Default_LAN_Zone	YES	*	BR1	Dynamic	Virtual WAN	YES	10	88	YES	N/A	N/A
52	0.0.0.0/0	*	Passthrough	Any	YES	*	*	Static	-	-	65535	40031844	YES	N/A	N/A
53	0.0.0.0/0	*	Discard	Any	YES	*	*	Static	-	-	65535	0	YES	N/A	N/A

Showing 1 to 54 of 54 entries

Each route for remote branch office subnets is advertised as a Service through the Virtual Path connecting through the MCN, with the **Site** column populated with the client node where the destination resides as a local subnet.

In the following example, with **WAN-to-WAN Forwarding** (Routes Export) enabled, Branch A has a route table entry for the Branch B subnet (10.2.2.0/24) through the MCN as a next hop.



SD-WAN Overlay Route Tables

SD-WAN Site A Route Table

Site	Route
MCN	10.0.10.0/24
MCN (Site B)	10.2.2.0/24

SD-WAN Site B Route Table

Site	Route
MCN	10.0.10.0/24
MCN (Site A)	10.1.1.0/24

SD-WAN MCN Route Table

Site	Route
MCN	10.0.10.0/24
Site A	10.1.1.0/24
Site B	10.2.2.0/24

Available Route Types

- Local Route
- Virtual Path Route
- Intranet Route
- Internet Route
- Passthrough Route
- Discard Route
- Learned Route

How Citrix SD-WAN Traffic Matches on Defined Routes

The match process for defined routes on Citrix SD-WAN is based on the longest prefix match for the destination subnet (similar to a router operation). The more specific the route, the higher the change on it being matched. Sorting is done in the following order:

1. Longest prefix matches
2. Cost
3. Service

Therefore a /32 route always precedes a /31 route. For two /32 routes, a cost 4 route always precedes a cost 5 route. For two /32 cost 5 routes, routes are chosen based on ordered IP host. Service order is as follows: Local, Virtual Path, Intranet, Internet, Passthrough, Discard.

As an example, consider the following two routes as follows:

- 192.168.1.0/24 Cost 5
- 192.168.1.64/26 Cost 10

A packet destined for the 192.168.1.65 host would use the latter route even though the cost is higher. Based on this, it is common for configuration to be in place for only the routes intended to be delivered over the Virtual Path overlay with other traffic falling into catch all routes such as a default route to the passthrough service.

Routes can be configured in a site node route table that have the same prefix. The tie break then goes to the route cost, the service type (Virtual Path, Intranet, Internet, and so on), and the next hop IP.

Citrix SD-WAN Routing Packet Flow

- LAN to WAN (Virtual Path) Traffic Route Matching:
  1. Incoming traffic is received by the LAN interface and is processed.
  2. The received frame is compared to the route table for the longest prefix match.
  3. If a match is found, the frame is processed by the rule engine and a flow is created in the flow database.
- WAN to LAN (Virtual Path) Traffic Route Matching:
  1. Virtual Path traffic is received by SD-WAN from the tunnel and is processed.
  2. The appliance compares the source IP address to see if the source is local.
     - If yes –then WAN eligible and match IP destination to routing table/Virtual Path.
     - If no –then WAN to WAN forwarding enabled check.
  3. (WAN to WAN Forwarding disabled) Forward to LAN based on local routes.
  4. (WAN to WAN Forwarding enabled) Forward to Virtual Path based on route table.
- Non-Virtual Path Traffic:
  1. Incoming traffic is received on the LAN interface and is processed.
  2. The received frame is compared to the route table for the longest prefix match.
  3. If a match is found, the frame is processed by the rule engine and a flow is created in the flow database.

Citrix SD-WAN Routing Protocol Support

Citrix SD-WAN release 9.1 introduced OSPF and BGP routing protocols into the configuration. Introducing routing protocols to SD-WAN enabled easier integration of SD-WAN in more complex underlay networks where routing protocols are actively in use. With the same routing protocols enabled on SD-WAN Orchestrator service, configuration of subnets denoted to make use of the SD-WAN overlay was made easier. In addition, the routing protocols enable communication between SD-WAN and non-SD-WAN sites with direct communication to existing customer edge routers using the common routing protocol. Citrix SD-WAN participating in routing protocols operating in the underlay network can be done regardless of the deployment mode of SD-WAN (Inline mode, Virtual Inline mode, or Edge/Gateway mode). Also, SD-WAN can be deployed in "learn only"mode where SD-WAN can receive routes but not advertise routes back to the underlay. This is useful when introducing the SD-WAN solution into a network where the routing infrastructure is complex or uncertain.

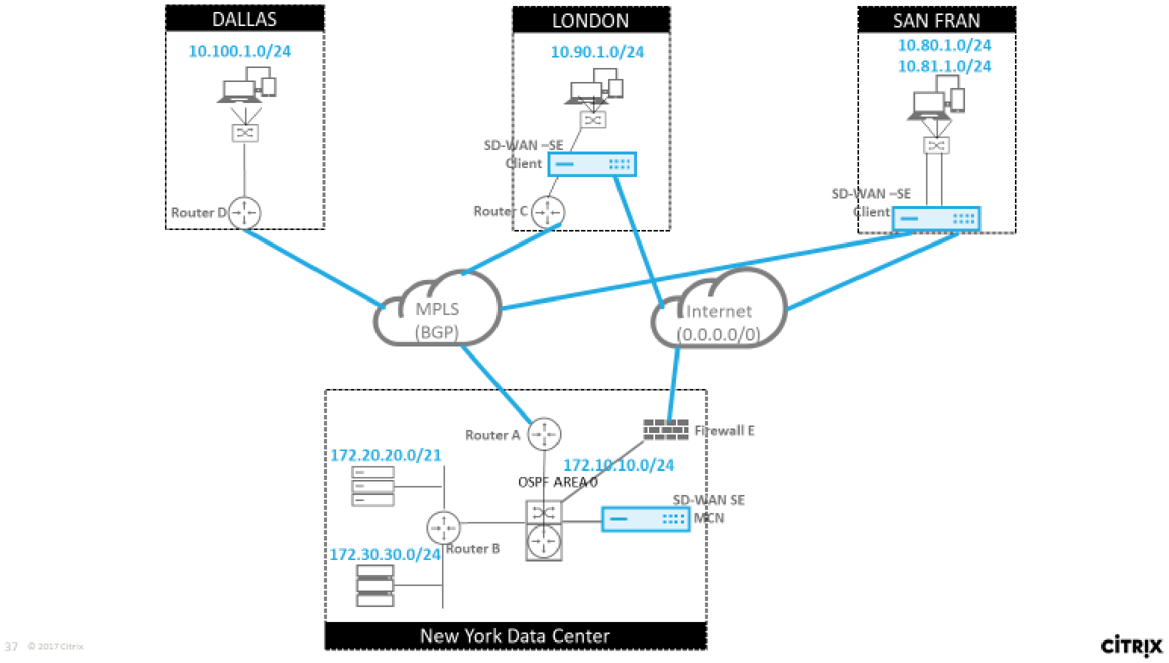
> **Important**
>
> It is easy to leak the unwanted route, if you are not careful.

The SD-WAN Virtual Path route table works as an External Gateway Protocol (EGP), similar to BGP (think site-to-site). For example, when SD-WAN advertises routes from the SD-WAN appliance to OSPF they are typically considered external to site and protocol.

> **Note**
>
> Be aware of environments that have IGPs across the entire infrastructure (across the WAN) as it does complicate how SD-WAN advertised routes are used. EIGRP is extensively used in the market and SD-WAN does not interoperate with that protocol.

One challenge in introducing Routing Protocols to an SD-WAN deployment is that the route table is not available until the SD-WAN service is enabled and operation in the network, therefore it is not recommended to enable advertise routes from the SD-WAN appliance initially. Use the import and export filters for a gradual introduction of routing protocols on SD-WAN.

Let us take a closer look by reviewing the following example:



In this example, we examine a routing protocol use case. The preceding network has four locations; New York, Dallas, London, and San Francisco. We deploy SD-WAN appliances at three of these locations, and utilize SD-WAN to create a hybrid WAN network where MPLS and Internet WAN Links will be used to provide a Virtualized WAN. Since Dallas will not have an SD-WAN device, we must consider how to best integrate with existing route protocols to that site to ensure full connectivity between underlay and SD-WAN overlay networks.

In the example network, eBGP is used between all four locations across the MPLS network. Each location has its own Autonomous System Number (ASN).

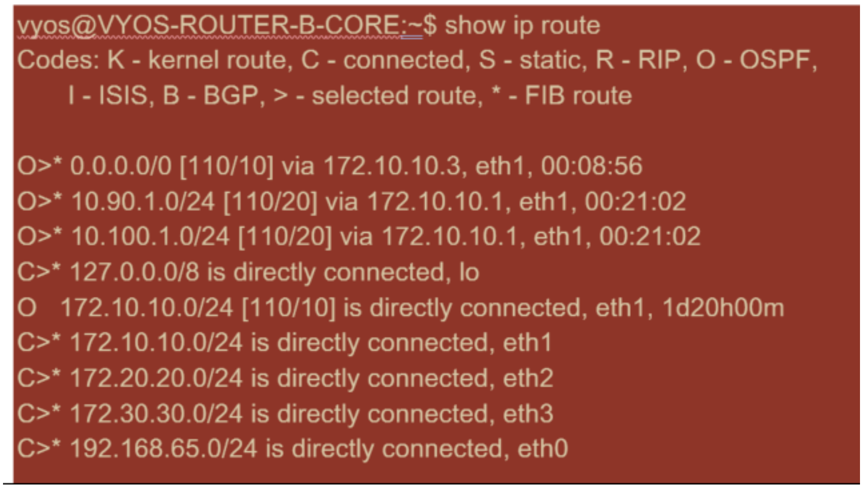
In the New York Data Center, OSPF is running to advertise the core Data Center subnets to the remote sites and also announce a default route from the New York Firewall (E). In this example, all internet traffic is backhauled to the data center, even though the London and San Francisco Branches have a path to the internet.

The San Francisco site also must be noted not to have a router. SD-WAN is deployed in Edge/Gateway mode with that appliance being the default gateway for the San Francisco subnet and also participating in eBGP to the MPLS.

- With the New York Data Center, take note that the SD-WAN is deployed in Virtual Inline mode. The intent is to participate in the existing OSPF routing protocol to get traffic forwarded to the appliance as the preferred gateway.
- The London site is deployed in traditional inline mode. The upstream WAN Router (C) will still be the default gateway for the London subnet.
- The San Francisco site is a newly introduced site to this network and the SD-WAN is planned to be deployed in Edge/Gateway mode and act as the default gateway for the new San Francisco subnet.

Review some of the existing underlay route tables before implementing SD-WAN.

New York Core Router B:



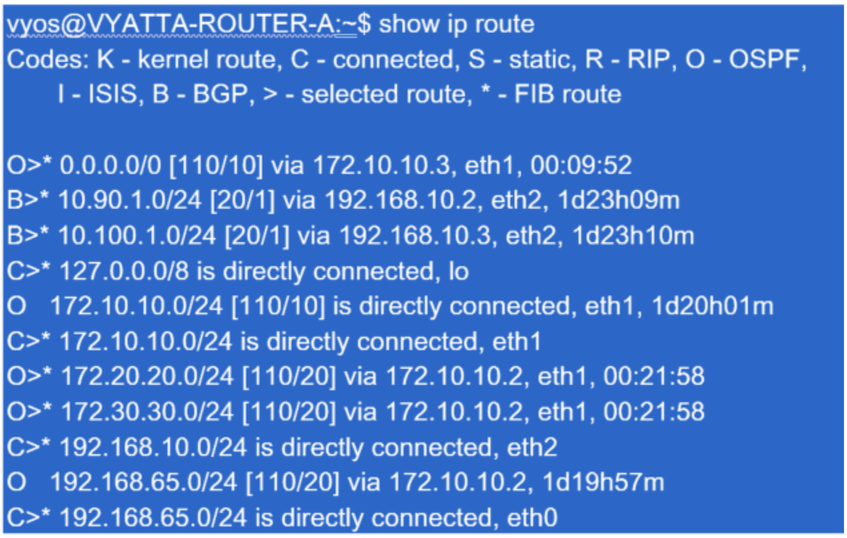
```
vyos@VYOS-ROUTER-B-CORE:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route

O>* 0.0.0.0/0 [110/10] via 172.10.10.3, eth1, 00:08:56
O>* 10.90.1.0/24 [110/20] via 172.10.10.1, eth1, 00:21:02
O>* 10.100.1.0/24 [110/20] via 172.10.10.1, eth1, 00:21:02
C>* 127.0.0.0/8 is directly connected, lo
O   172.10.10.0/24 [110/10] is directly connected, eth1, 1d20h00m
C>* 172.10.10.0/24 is directly connected, eth1
C>* 172.20.20.0/24 is directly connected, eth2
C>* 172.30.30.0/24 is directly connected, eth3
C>* 192.168.65.0/24 is directly connected, eth0
```

The local New York subnets (172.x.x.x) are available on router B as directly connected, and from the route table we identify that the default route is 172.10.10.3 (Firewall E). Also, we can see that Dallas

(10.90.1.0/24) and London (10.100.1.0/24) subnets are available via 172.10.10.1 (MPLS Router A). The route costs indicate that they were learned from eBGP.

> **Note**
>
> In the example provided, San Francisco is not listed as a route, because we have not yet deployed the site with SD-WAN in Edge/Gateway mode for that network.



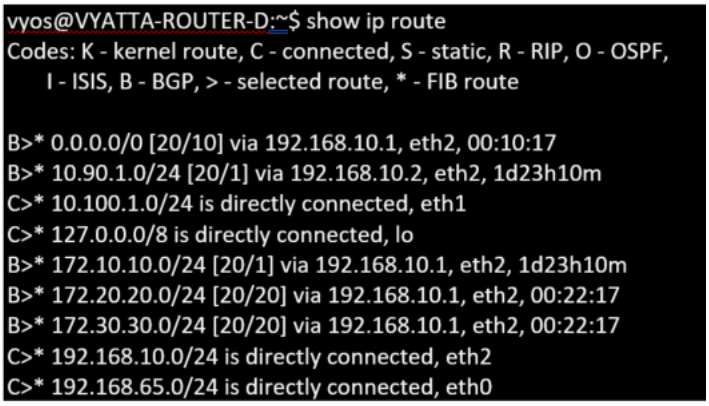
```
vyos@VYATTA-ROUTER-A:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route

O>* 0.0.0.0/0 [110/10] via 172.10.10.3, eth1, 00:09:52
B>* 10.90.1.0/24 [20/1] via 192.168.10.2, eth2, 1d23h09m
B>* 10.100.1.0/24 [20/1] via 192.168.10.3, eth2, 1d23h10m
C>* 127.0.0.0/8 is directly connected, lo
O   172.10.10.0/24 [110/10] is directly connected, eth1, 1d20h01m
C>* 172.10.10.0/24 is directly connected, eth1
O>* 172.20.20.0/24 [110/20] via 172.10.10.2, eth1, 00:21:58
O>* 172.30.30.0/24 [110/20] via 172.10.10.2, eth1, 00:21:58
C>* 192.168.10.0/24 is directly connected, eth2
O   192.168.65.0/24 [110/20] via 172.10.10.2, 1d19h57m
C>* 192.168.65.0/24 is directly connected, eth0
```

For the New York WAN Router (A), OSPF learned routes and routes learned across the MPLS through eBGP are listed routes. Note the route costs. BGP is lower administrative domain and cost by default 20/1 compared to OSPF 110/10.

Dallas Router D:

For the Dallas WAN Router (D) all routes are learned across the MPLS.



```
vyos@VYATTA-ROUTER-D:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
     I - ISIS, B - BGP, > - selected route, * - FIB route

B>* 0.0.0.0/0 [20/10] via 192.168.10.1, eth2, 00:10:17
B>* 10.90.1.0/24 [20/1] via 192.168.10.2, eth2, 1d23h10m
C>* 10.100.1.0/24 is directly connected, eth1
C>* 127.0.0.0/8 is directly connected, lo
B>* 172.10.10.0/24 [20/1] via 192.168.10.1, eth2, 1d23h10m
B>* 172.20.20.0/24 [20/20] via 192.168.10.1, eth2, 00:22:17
B>* 172.30.30.0/24 [20/20] via 192.168.10.1, eth2, 00:22:17
C>* 192.168.10.0/24 is directly connected, eth2
C>* 192.168.65.0/24 is directly connected, eth0
```

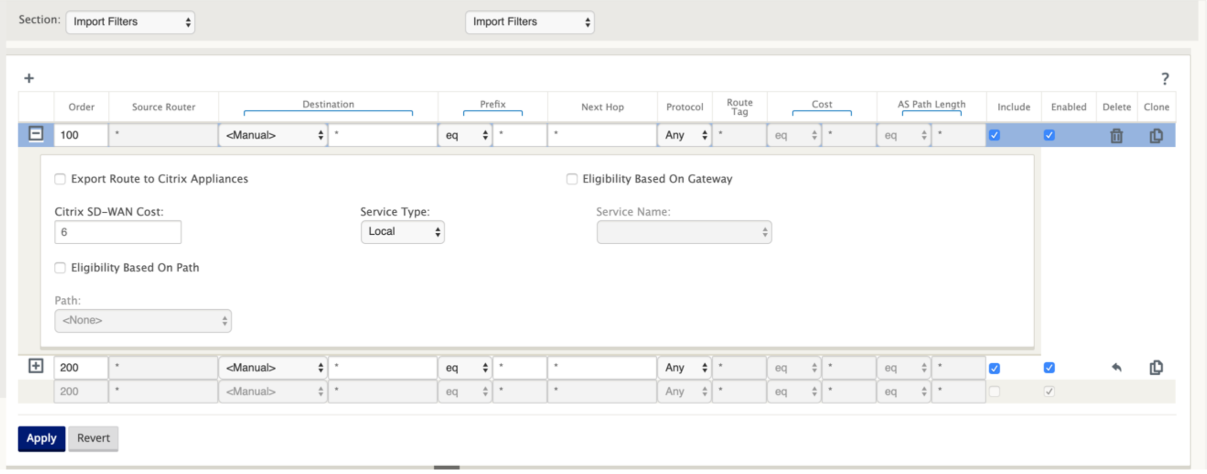
> **Note**
>
> In this example, you can ignore the 192.168.65.0/24 subnet. This is a management network and not pertinent to the example. All the Routers are connected to the management subnet but is

> not advertised in any routing protocol.

The eBGP peers with each other location. Each ASN is different.

It is important to understand how the routes are passed between the Virtual Path routing table and the dynamic route protocols in use. It is easy to create routing loops or advertise routes in an adverse way. The filter mechanism gives us the ability to control what gets into and out of the routing table. We consider each location in turn.

- The San Francisco location has two local subnets **10.80.1.0/24** and **10.81.1.0/24**. We want to advertise them through eBGP so that sites like Dallas can still reach the San Francisco site over the underlay network and also sites like London and New York can still reach San Francisco over the Virtual Path overlay network. We also want to learn from eBGP reachability to all sites in case the SD-WAN Virtual Path overlay goes down and the environment must fall back to using just the MPLS. We also do not want to readvertise anything SD-WAN learns from eBGP to the SD-WAN routers. To accomplish this, the filters must be configured as follows:
- Import all routes from eBGP. Do not readvertise/export routes to SD-WAN appliances.



Section: Import Filters | Import Filters

	Order	Source Router	Destination		Prefix		Next Hop	Protocol	Route Tag	Cost		AS Path Length		Include	Enabled	Delete	Clone
⊟	100	*	<Manual>	*	eq	*	*	Any	*	eq	*	eq	*	☑	☑		
⊞	200	*	<Manual>	*	eq	*	*	Any	*	eq	*	eq	*	☑	☑		
	200	*	<Manual>	*	eq	*	*	Any	*	eq	*	eq	*	☐	☑		

☐ Export Route to Citrix Appliances

☐ Eligibility Based On Gateway

Citrix SD-WAN Cost: 6

Service Type: Local

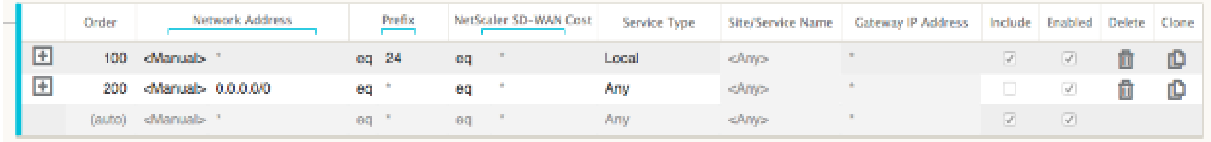
Service Name:

☐ Eligibility Based On Path

Path: <None>

- Export local routes to eBGP

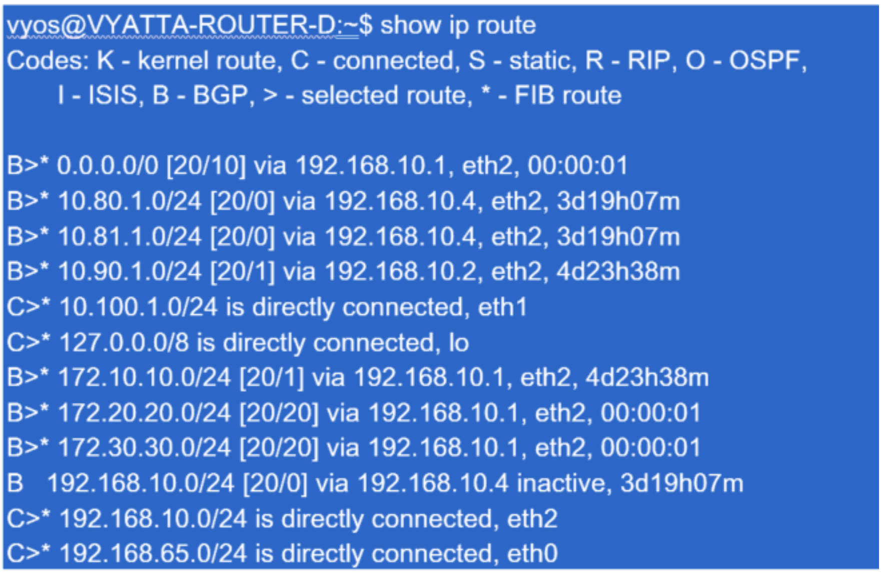
The default rule for export is to export everything. Rule 200 is used to override the fault rule not to readvertise the routes. Any route matching any prefix SD-WAN has learned across the Virtual Paths.



	Order	Network Address		Prefix		NetScaler SD-WAN Cost		Service Type	Site/Service Name	Gateway IP Address	Include	Enabled	Delete	Clone
⊞	100	<Manual>	*	eq	24	eq	*	Local	<Any>	*	☑	☑		
⊞	200	<Manual>	0.0.0.0/0	eq	*	eq	*	Any	<Any>	*	☐	☑		
	(auto)	<Manual>	*	eq	*	eq	*	Any	<Any>	*	☑	☑		

After the Citrix SD-WAN appliances have been deployed, we can take a refreshed look at the route tables for the BGP router at the Dallas site. We see 10.80.1.0/24 and 10.81.1.0/24 subnets are being seen correctly through eBGP from the San Francisco SD-WAN.

Dallas Router D:

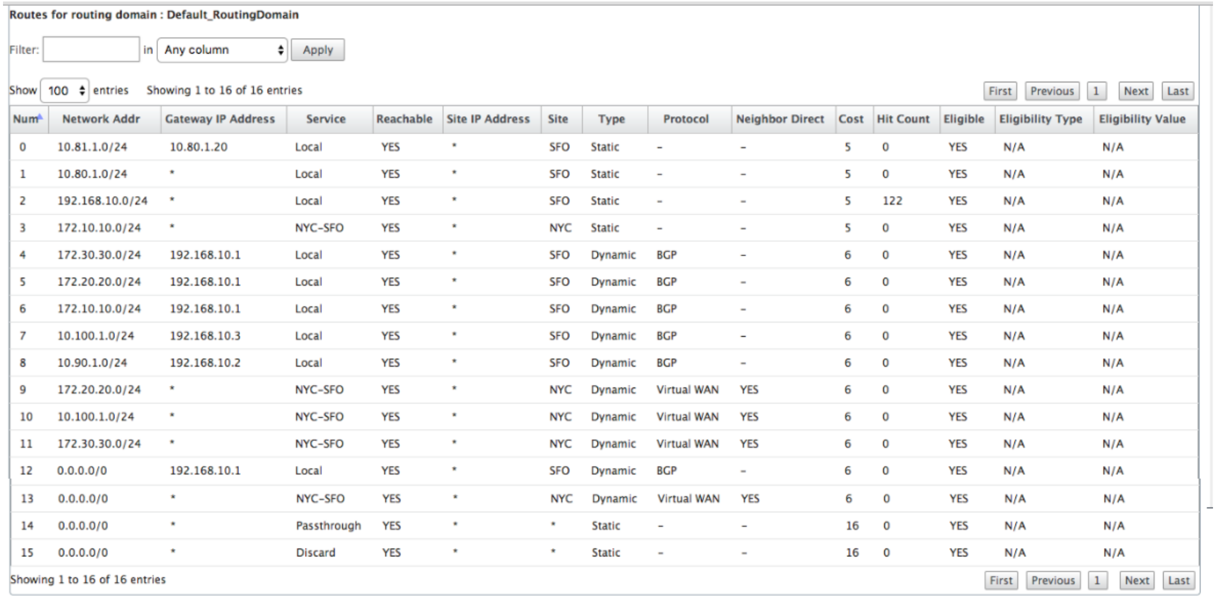


```
vyos@VYATTA-ROUTER-D:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
     I - ISIS, B - BGP, > - selected route, * - FIB route

B>* 0.0.0.0/0 [20/10] via 192.168.10.1, eth2, 00:00:01
B>* 10.80.1.0/24 [20/0] via 192.168.10.4, eth2, 3d19h07m
B>* 10.81.1.0/24 [20/0] via 192.168.10.4, eth2, 3d19h07m
B>* 10.90.1.0/24 [20/1] via 192.168.10.2, eth2, 4d23h38m
C>* 10.100.1.0/24 is directly connected, eth1
C>* 127.0.0.0/8 is directly connected, lo
B>* 172.10.10.0/24 [20/1] via 192.168.10.1, eth2, 4d23h38m
B>* 172.20.20.0/24 [20/20] via 192.168.10.1, eth2, 00:00:01
B>* 172.30.30.0/24 [20/20] via 192.168.10.1, eth2, 00:00:01
B   192.168.10.0/24 [20/0] via 192.168.10.4 inactive, 3d19h07m
C>* 192.168.10.0/24 is directly connected, eth2
C>* 192.168.65.0/24 is directly connected, eth0
```

Further, the Citrix SD-WAN route table can be viewed on the **Monitoring** > **Statistics** > **Show Routes** page.

San Francisco Citrix SD-WAN:



Routes for routing domain : Default_RoutingDomain

Filter: in Any column

Show 100 entries Showing 1 to 16 of 16 entries

Num	Network Addr	Gateway IP Address	Service	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	10.81.1.0/24	10.80.1.20	Local	YES	*	SFO	Static	-	-	5	0	YES	N/A	N/A
1	10.80.1.0/24	*	Local	YES	*	SFO	Static	-	-	5	0	YES	N/A	N/A
2	192.168.10.0/24	*	Local	YES	*	SFO	Static	-	-	5	122	YES	N/A	N/A
3	172.10.10.0/24	*	NYC-SFO	YES	*	NYC	Static	-	-	5	0	YES	N/A	N/A
4	172.30.30.0/24	192.168.10.1	Local	YES	*	SFO	Dynamic	BGP	-	6	0	YES	N/A	N/A
5	172.20.20.0/24	192.168.10.1	Local	YES	*	SFO	Dynamic	BGP	-	6	0	YES	N/A	N/A
6	172.10.10.0/24	192.168.10.1	Local	YES	*	SFO	Dynamic	BGP	-	6	0	YES	N/A	N/A
7	10.100.1.0/24	192.168.10.3	Local	YES	*	SFO	Dynamic	BGP	-	6	0	YES	N/A	N/A
8	10.90.1.0/24	192.168.10.2	Local	YES	*	SFO	Dynamic	BGP	-	6	0	YES	N/A	N/A
9	172.20.20.0/24	*	NYC-SFO	YES	*	NYC	Dynamic	Virtual WAN	YES	6	0	YES	N/A	N/A
10	10.100.1.0/24	*	NYC-SFO	YES	*	NYC	Dynamic	Virtual WAN	YES	6	0	YES	N/A	N/A
11	172.30.30.0/24	*	NYC-SFO	YES	*	NYC	Dynamic	Virtual WAN	YES	6	0	YES	N/A	N/A
12	0.0.0.0/0	192.168.10.1	Local	YES	*	SFO	Dynamic	BGP	-	6	0	YES	N/A	N/A
13	0.0.0.0/0	*	NYC-SFO	YES	*	NYC	Dynamic	Virtual WAN	YES	6	0	YES	N/A	N/A
14	0.0.0.0/0	*	Passthrough	YES	*	*	Static	-	-	16	0	YES	N/A	N/A
15	0.0.0.0/0	*	Discard	YES	*	*	Static	-	-	16	0	YES	N/A	N/A

Showing 1 to 16 of 16 entries

Citrix SD-WAN shows all the routes learned, including routes available through the Virtual Path overlay.

Let us consider 172.10.10.0/24, which is located in the New York Data Center. This route is being learned in two ways:

- As a Virtual Path route (Number 3), service = NYC-SFO with a cost of 5 and type static. This is a local subnet advertised by SD-WAN appliance in New York. It is static in that it is either directly connected to the appliance or it is a manual static route entered in the configuration. It is reachable because the Virtual Path between the sites is in a working/up state.

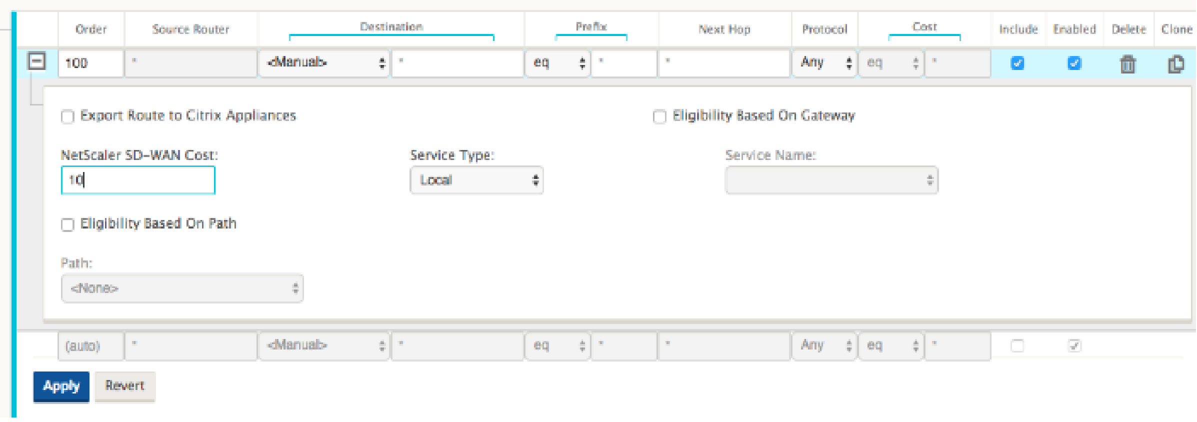
- As an advertised route through BGP (Number 6), with a cost of 6. This is now considered a fallback route.

Since the prefix is equal and the cost is different, SD-WAN uses the Virtual Path route unless it becomes unavailable in which case the fallback route is learned through BGP.

Now, let us consider the route 172.20.20.0/24.

- This is learned as a Virtual Path route (Number 9) but has a type of dynamic and a cost of 6. This means that the remote SD-WAN appliance learned this route through a routing protocol, in this case OSPF. By default the route cost is higher.
- SD-WAN also learns this route through BGP with the same cost, so in this case this route might be preferred over the Virtual Path route.

To ensure correct routing, we must increase the BGP route cost to make sure if we have a Virtual Path route and it is the preferred route. This can be done by adjusting the import filter route weight to be higher than the default of 6.



Order	Source Router	Destination		Prefix		Next Hop	Protocol	Cost		Include	Enabled	Delete	Clone
100	*	<Manual>	*	eq	*	*	Any	eq	*	☑	☑		
(auto)	*	<Manual>	*	eq	*	*	Any	eq	*	☐	☑		

☐ Export Route to Citrix Appliances

☐ Eligibility Based On Gateway

NetScaler SD-WAN Cost: 10

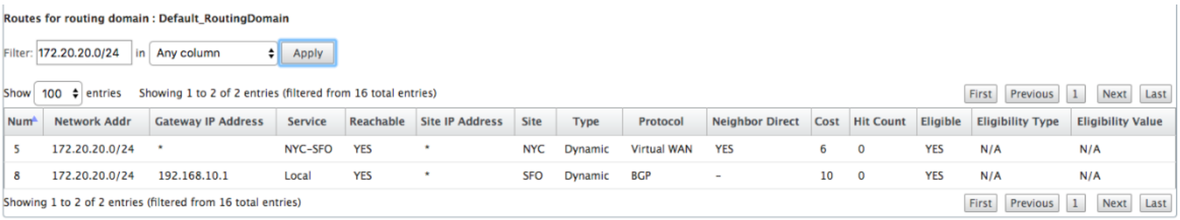
Service Type: Local

Service Name:

☐ Eligibility Based On Path

Path: <None>

After making the adjustment, we can refresh the SD-WAN route table on the San Francisco appliance to see the adjusted route costs. Use the filter option to focus the displayed list.



Routes for routing domain : Default_RoutingDomain

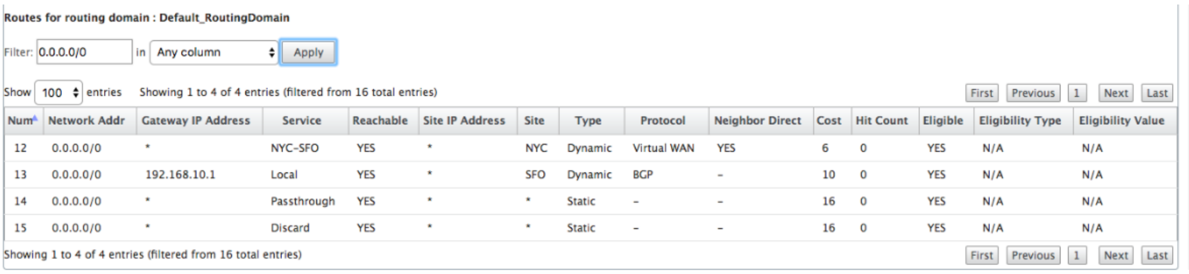
Filter: 172.20.20.0/24 in Any column

Show 100 entries Showing 1 to 2 of 2 entries (filtered from 16 total entries)

Num	Network Addr	Gateway IP Address	Service	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
5	172.20.20.0/24	*	NYC-SFO	YES	*	NYC	Dynamic	Virtual WAN	YES	6	0	YES	N/A	N/A
8	172.20.20.0/24	192.168.10.1	Local	YES	*	SFO	Dynamic	BGP	-	10	0	YES	N/A	N/A

Showing 1 to 2 of 2 entries (filtered from 16 total entries)

Finally, let us look at the learned default route on the San Francisco SD-WAN. We want to backhaul all internet traffic to New York. We can see that we send it using the Virtual Path, if it is up, or through the MPLS network as a fallback.



Routes for routing domain : Default_RoutingDomain

Filter: 0.0.0.0/0 in Any column Apply

Show 100 entries Showing 1 to 4 of 4 entries (filtered from 16 total entries) First Previous 1 Next Last

Num	Network Addr	Gateway IP Address	Service	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
12	0.0.0.0/0	*	NYC-SFO	YES	*	NYC	Dynamic	Virtual WAN	YES	6	0	YES	N/A	N/A
13	0.0.0.0/0	192.168.10.1	Local	YES	*	SFO	Dynamic	BGP	-	10	0	YES	N/A	N/A
14	0.0.0.0/0	*	Passthrough	YES	*	*	Static	-	-	16	0	YES	N/A	N/A
15	0.0.0.0/0	*	Discard	YES	*	*	Static	-	-	16	0	YES	N/A	N/A

Showing 1 to 4 of 4 entries (filtered from 16 total entries) First Previous 1 Next Last

We also see a passthrough and discard route with cost 16. These are automatic routes that cannot be removed. If the device is inline, the passthrough route is used as a last resort so if a packet cannot be matched to a more specific route, SD-WAN will pass it along to the next hop of the interface group. If the SD-WAN is out of path or in edge/gateway mode, there is no passthrough service, in which case SD-WAN drops the packet using the default discard route. The Hit Count indicates the number of packets that are hitting each route, which can be valuable when troubleshooting.

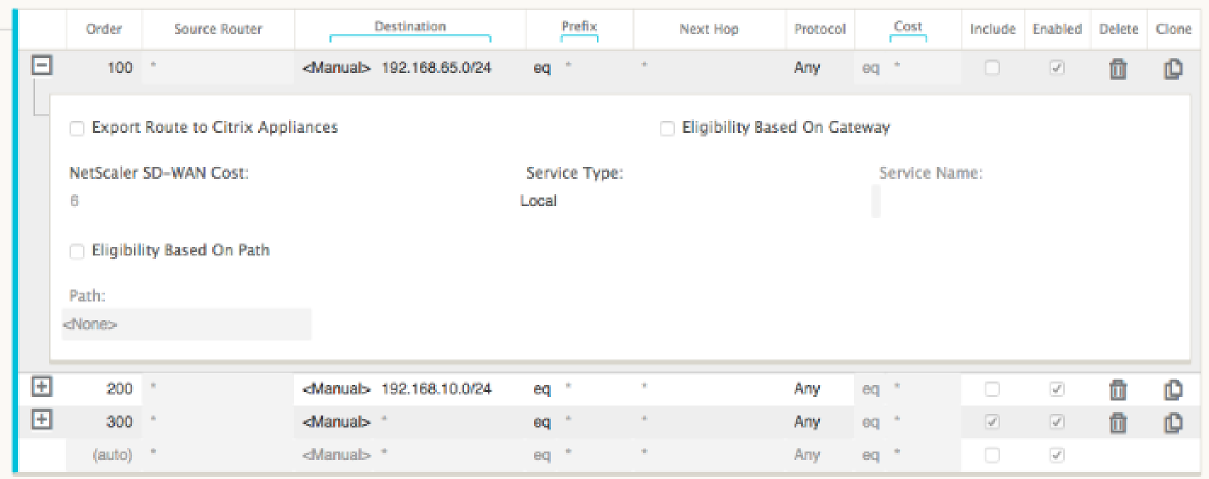
Now focusing on the New York site, we want to get traffic destined for remote sites (London and San Francisco) to be directed to the SD-WAN appliance when the Virtual Path is active.

There are multiple subnets available in the New York site:

- 172.10.10.0/24 (directly connected)
- 172.20.20.0/24 (advertised via OSPF from the core router B)
- 172.30.30.0/24 (advertised via OSPF from the core router B)

We also are required to provide traffic flow to Dallas (10.100.1.0/24) through MPLS.

Lastly, we want all internet bound traffic route to the Firewall E through 172.10.10.3 as a next hop. SD-WAN learns this default route through OSPF and to advertise across the Virtual Path. The filters for the New York site are:



	Order	Source Router	Destination	Prefix	Next Hop	Protocol	Cost	Include	Enabled	Delete	Clone
⊟	100	*	<Manual> 192.168.65.0/24	eq *	*	Any	eq *	☐	☑	🗑	⧉

☐ Export Route to Citrix Appliances

☐ Eligibility Based On Gateway

NetScaler SD-WAN Cost: 6

Service Type: Local

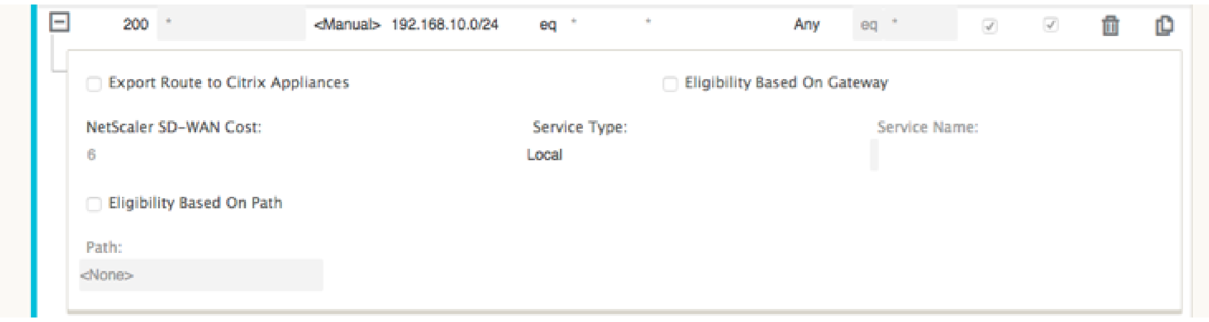
Service Name:

☐ Eligibility Based On Path

Path: <None>

	Order	Source Router	Destination	Prefix	Next Hop	Protocol	Cost	Include	Enabled	Delete	Clone
⊞	200	*	<Manual> 192.168.10.0/24	eq *	*	Any	eq *	☐	☑	🗑	⧉
⊞	300	*	<Manual> *	eq *	*	Any	eq *	☑	☑	🗑	⧉
	(auto)	*	<Manual> *	eq *	*	Any	eq *	☐	☑		

The New York SD-WAN site imports all routes for the management network. This can be ignored. We can focus on filter 200.



200	*	<Manual> 192.168.10.0/24	eq	*	*	Any	eq	*	✓	✓

☐ Export Route to Citrix Appliances

☐ Eligibility Based On Gateway

NetScaler SD-WAN Cost: 6

Service Type: Local

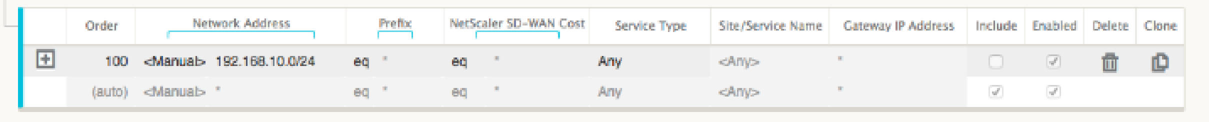
Service Name:

☐ Eligibility Based On Path

Path: <None>

Filter 200 is used to import 192.168.10.0/24 (our MPLS core) for reachability but not to export it to the virtual path. Select the **Include** check box and ensure that the **Export Route to Citrix Appliances** check box is cleared. All other routes are then included.

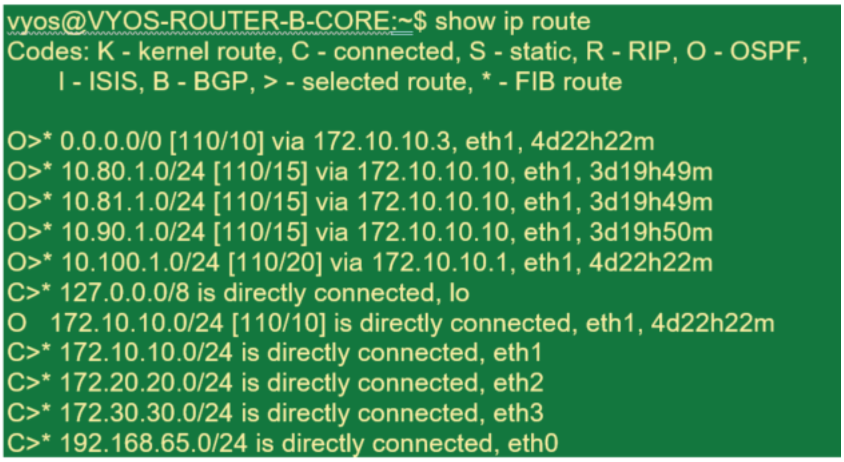
For the export filters, we can exclude the route for 192.168.10.0/24. This is because, as a directly connected subnet in the San Francisco site, we cannot filter this route out at the source, so it is suppressed at this end.



Order	Network Address	Prefix	NetScaler SD-WAN Cost	Service Type	Site/Service Name	Gateway IP Address	Include	Enabled	Delete	Clone
100	<Manual> 192.168.10.0/24	eq *	eq *	Any	<Any>	*	☐	✓		
(auto)	<Manual> *	eq *	eq *	Any	<Any>	*	✓	✓		

Now let us review the refreshed route table starting at the core route in the New York site.

New York Router B:

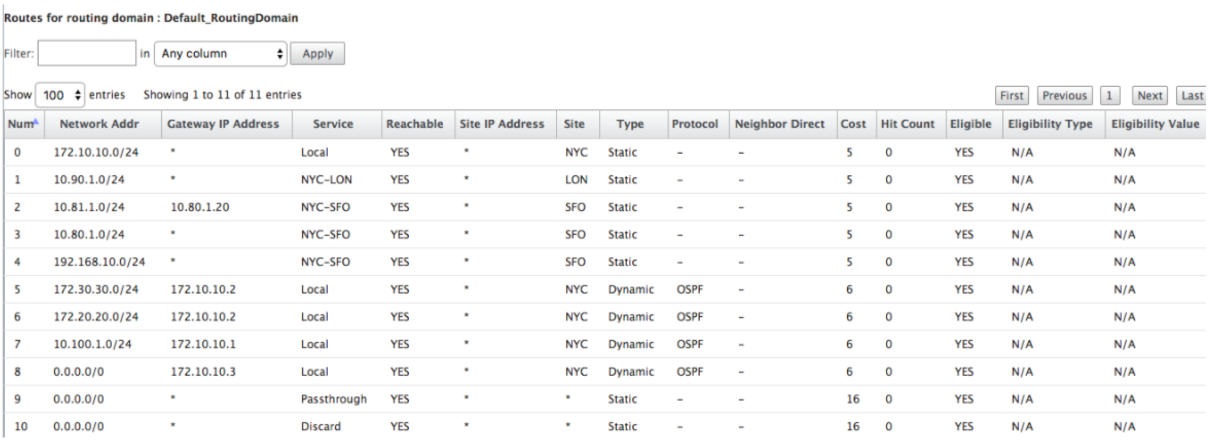


```
vyos@VYOS-ROUTER-B-CORE:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route

O>* 0.0.0.0/0 [110/10] via 172.10.10.3, eth1, 4d22h22m
O>* 10.80.1.0/24 [110/15] via 172.10.10.10, eth1, 3d19h49m
O>* 10.81.1.0/24 [110/15] via 172.10.10.10, eth1, 3d19h49m
O>* 10.90.1.0/24 [110/15] via 172.10.10.10, eth1, 3d19h50m
O>* 10.100.1.0/24 [110/20] via 172.10.10.1, eth1, 4d22h22m
C>* 127.0.0.0/8 is directly connected, lo
O   172.10.10.0/24 [110/10] is directly connected, eth1, 4d22h22m
C>* 172.10.10.0/24 is directly connected, eth1
C>* 172.20.20.0/24 is directly connected, eth2
C>* 172.30.30.0/24 is directly connected, eth3
C>* 192.168.65.0/24 is directly connected, eth0
```

We can see the subnets for San Francisco (10.80.1.0 & 10.81.1.0) and London (10.90.1.0) now being advertised via the New York SD-WAN Appliance (172.10.10.10). The route 10.100.1.0/24 is still being advertised through the underlay MPLS Router A. Let us review the New York site SD-WAN route table.

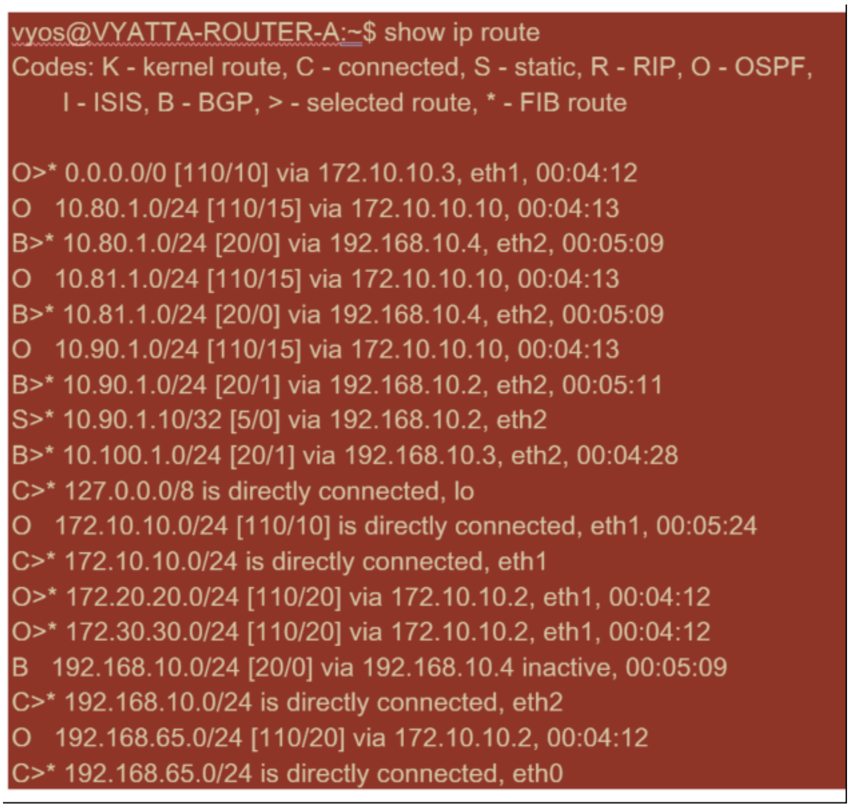
New York site SD-WAN Route Table:



Routes for routing domain : Default_RoutingDomain

Num	Network Addr	Gateway IP Address	Service	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	172.10.10.0/24	*	Local	YES	*	NYC	Static	-	-	5	0	YES	N/A	N/A
1	10.90.1.0/24	*	NYC-LON	YES	*	LON	Static	-	-	5	0	YES	N/A	N/A
2	10.81.1.0/24	10.80.1.20	NYC-SFO	YES	*	SFO	Static	-	-	5	0	YES	N/A	N/A
3	10.80.1.0/24	*	NYC-SFO	YES	*	SFO	Static	-	-	5	0	YES	N/A	N/A
4	192.168.10.0/24	*	NYC-SFO	YES	*	SFO	Static	-	-	5	0	YES	N/A	N/A
5	172.30.30.0/24	172.10.10.2	Local	YES	*	NYC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
6	172.20.20.0/24	172.10.10.2	Local	YES	*	NYC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
7	10.100.1.0/24	172.10.10.1	Local	YES	*	NYC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
8	0.0.0.0/0	172.10.10.3	Local	YES	*	NYC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
9	0.0.0.0/0	*	Passthrough	YES	*	*	Static	-	-	16	0	YES	N/A	N/A
10	0.0.0.0/0	*	Discard	YES	*	*	Static	-	-	16	0	YES	N/A	N/A

We can see the correct routes for both the local subnets learned via OSPF, a route to the Dallas site learned from the MPLS Router A and the remote subnets for the San Francisco and London sites. Let us look at the MPLS Router A. This router is participating in OSPF and BGP.

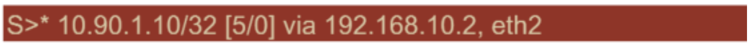


```
vyos@VYATTA-ROUTER-A:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route

O>* 0.0.0.0/0 [110/10] via 172.10.10.3, eth1, 00:04:12
O   10.80.1.0/24 [110/15] via 172.10.10.10, 00:04:13
B>* 10.80.1.0/24 [20/0] via 192.168.10.4, eth2, 00:05:09
O   10.81.1.0/24 [110/15] via 172.10.10.10, 00:04:13
B>* 10.81.1.0/24 [20/0] via 192.168.10.4, eth2, 00:05:09
O   10.90.1.0/24 [110/15] via 172.10.10.10, 00:04:13
B>* 10.90.1.0/24 [20/1] via 192.168.10.2, eth2, 00:05:11
S>* 10.90.1.10/32 [5/0] via 192.168.10.2, eth2
B>* 10.100.1.0/24 [20/1] via 192.168.10.3, eth2, 00:04:28
C>* 127.0.0.0/8 is directly connected, lo
O   172.10.10.0/24 [110/10] is directly connected, eth1, 00:05:24
C>* 172.10.10.0/24 is directly connected, eth1
O>* 172.20.20.0/24 [110/20] via 172.10.10.2, eth1, 00:04:12
O>* 172.30.30.0/24 [110/20] via 172.10.10.2, eth1, 00:04:12
B   192.168.10.0/24 [20/0] via 192.168.10.4 inactive, 00:05:09
C>* 192.168.10.0/24 is directly connected, eth2
O   192.168.65.0/24 [110/20] via 172.10.10.2, 00:04:12
C>* 192.168.65.0/24 is directly connected, eth0
```

From the route table, this Router A is learning the remote subnets through BGP and OSPF with the Administrative distance and cost of the BGP route (20/5) being lower than OSPF (110/10) and hence preferred. In this example, network where there is only one core route, this might not cause concern. However, traffic arriving here would be delivered via the MPLS network rather than being sent to the SD-WAN Appliance (172.10.10.10). If we want to maintain complete routing symmetry, we would need a route map to adjust the AD/Metric cost so that there is route preference from the route coming from 172.10.10.10 rather than the route learned via eBGP.

Alternatively, a "backdoor"route can be configured to force the router to prefer the OSPF route over the BGP route. Notice the static route for the SD-WAN Virtual IP address to the London site SD-WAN appliance.



```
S>* 10.90.1.10/32 [5/0] via 192.168.10.2, eth2
```

This is necessary to ensure that the Virtual Path is rerouted back to the New York site SD-WAN appliance if the MPLS path goes down. Since there is a route for the 10.90.1.0/24 being advertised via 172.10.10.10 (New York SD-WAN). It is also recommended to create an override service rule to drop any UDP 4,980 packets at the SD-WAN appliance to prevent the Virtual Path from coming back to itself.

Dynamic Virtual Paths

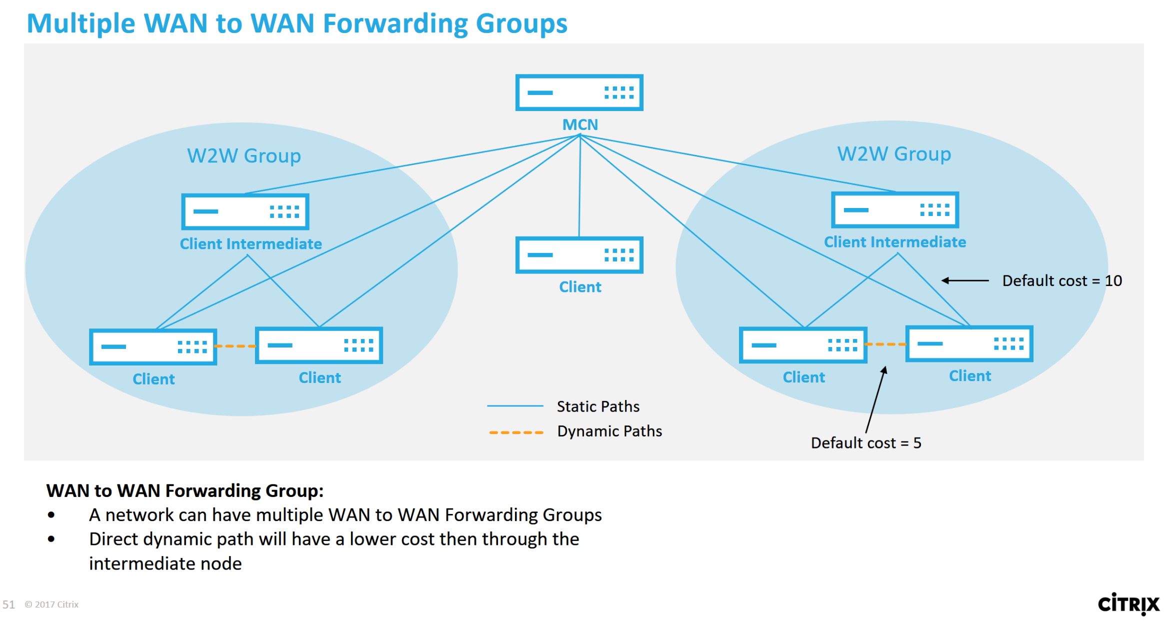
Dynamic Virtual Paths can be allowed between two client nodes to build on-demand virtual paths for direct communication between the two sites. The advantage of a dynamic virtual path is that traffic can flow directly from one client node to the second without having to traverse the MCN or two virtual paths, which can add latency to the traffic flow. Dynamic virtual paths are built and removed dynamically based on user-defined traffic thresholds. These thresholds are defined as either packets per second (pps) or bandwidth (kbps). This functionality enables a dynamic full mesh SD-WAN overlay topology.

Once the thresholds for dynamic virtual paths are met, the client nodes dynamically create their virtualized path to one another using all available WAN paths between the sites and make full use of it in the following manner:

- Send Bulk data if any exists and verify no loss, then
- Send Interactive data and verify no loss, then
- Send Real Time data after the Bulk and Interactive data are considered stable (no loss or acceptable levels)
- If there is no Bulk or interactive data send Real Time Data after the Dynamic Virtual Path has been stable for a period
- If the user data falls below the configured thresholds for a user defined period, the dynamic virtual path is torn down

Dynamic Virtual Paths have the concept of an Intermediate site. The intermediate site can be an MCN site or any other site in the network that has Static Virtual Path configured and connected to two or more other client nodes. Another design consideration requirement is to have WAN-to-WAN Forwarding enabled, allowing all routes from all sites to be advertised to the client nodes where the dynamic virtual path is desired.

Multiple WAN-to-WAN Forwarding Groups are allowed in SD-WAN, enabling full control to path establishment between certain client nodes and not others.



Multiple WAN to WAN Forwarding Groups

WAN to WAN Forwarding Group:

- A network can have multiple WAN to WAN Forwarding Groups
- Direct dynamic path will have a lower cost then through the intermediate node

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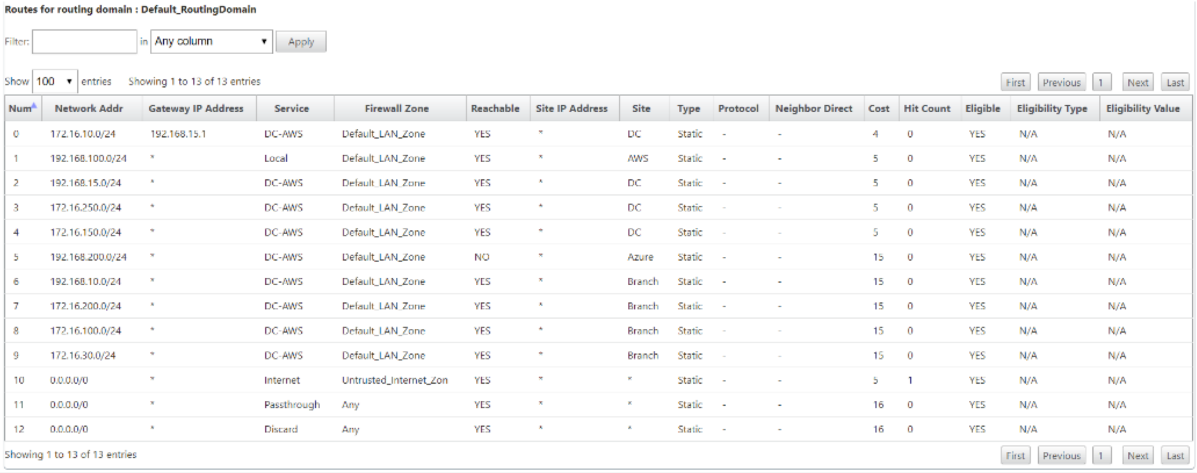
Each SD-WAN device has its own unique route table with the following details defined for each route:

- Num –order of route of this appliance based on match process (lowest Num processed first)
- Network address –subnet or host address
- Gateway if necessary
- Service –what service is applied for this route
- Firewall Zone –the firewall zone classification of the route
- Reachable –Identifies if the Virtual Path state is active for this site
- Site –The name of the site where the route is expected to exist
- Type –Identification of route type (Static or Dynamic)
- Neighbor Direct
- Cost - cost of the specific route
- Hit Count –how many times the route has been used per packet. This would be used to verify that a route is being hit correctly.
- Eligible
- Eligibility Type

- Eligibility Value

The following is an example SD-WAN site route table:



Routes for routing domain : Default_RoutingDomain

Filter: in Any column Apply

Show 100 entries Showing 1 to 13 of 13 entries

Num	Network Addr	Gateway IP Address	Service	Firewall Zone	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	172.16.10.0/24	192.168.15.1	DC-AWS	Default_LAN_Zone	YES	*	DC	Static	-	-	4	0	YES	N/A	N/A
1	192.168.100.0/24	*	Local	Default_LAN_Zone	YES	*	AWS	Static	-	-	5	0	YES	N/A	N/A
2	192.168.15.0/24	*	DC-AWS	Default_LAN_Zone	YES	*	DC	Static	-	-	5	0	YES	N/A	N/A
3	172.16.250.0/24	*	DC-AWS	Default_LAN_Zone	YES	*	DC	Static	-	-	5	0	YES	N/A	N/A
4	172.16.150.0/24	*	DC-AWS	Default_LAN_Zone	YES	*	DC	Static	-	-	5	0	YES	N/A	N/A
5	192.168.200.0/24	*	DC-AWS	Default_LAN_Zone	NO	*	Azure	Static	-	-	15	0	YES	N/A	N/A
6	192.168.10.0/24	*	DC-AWS	Default_LAN_Zone	YES	*	Branch	Static	-	-	15	0	YES	N/A	N/A
7	172.16.200.0/24	*	DC-AWS	Default_LAN_Zone	YES	*	Branch	Static	-	-	15	0	YES	N/A	N/A
8	172.16.100.0/24	*	DC-AWS	Default_LAN_Zone	YES	*	Branch	Static	-	-	15	0	YES	N/A	N/A
9	172.16.30.0/24	*	DC-AWS	Default_LAN_Zone	YES	*	Branch	Static	-	-	15	0	YES	N/A	N/A
10	0.0.0.0/0	*	Internet	Untrusted_Internet_Zon	YES	*	*	Static	-	-	5	1	YES	N/A	N/A
11	0.0.0.0/0	*	Passthrough	Any	YES	*	*	Static	-	-	16	0	YES	N/A	N/A
12	0.0.0.0/0	*	Discard	Any	YES	*	*	Static	-	-	16	0	YES	N/A	N/A

Showing 1 to 13 of 13 entries

Notice from the preceding SD-WAN route table that there are more elements not normally available in traditional routers. Most notable is the "Reachable"column, which renders the route either active or inactive (yes/no) depending on the WAN path state. Routes listed here are suppressed based on various states of the service (the Virtual Path being down as an example). Other events that can force a route to be ineligible are path down state, next hop unreachable, or WAN link down.

From the preceding table, we can see 14 defined routes. A description of the routes or groups of routes is described as follows:

- Route 0 –On the MCN this is a Host subnet route that resides at the DC site. 172.16.10.0/24 resides in the DC LAN and 192.168.15.1 is the gateway on the LAN that is the next hop that will get to that subnet.
- Route 1 –This is a local route to this SD-WAN device that displaying the route table.
- Route 2–4 –These are the subnets that are part of the virtual interfaces configured for the DC site SD-WAN. These subnets are derived from the trusted virtual interfaces defined.
- Route 5 –This is a shared route to another client node that is shared by the MCN with a Reachability status of No due to the down Virtual Path between that site and the MCN.
- Route 6–9 –These routes exist at another client site. For this route, a Virtual Path route is created for matching WAN ingress traffic destined for the remote site on the Virtual Path.
- Route 10 –With the Internet Service defined, the system adds a catch all route for direct internet breakout for this local site.
- Route 11 –Passthrough is the default route the system always adds to allow packets to flow through in case there is no match on any existing routes. The Passthrough is not groomed, typically local broadcasts and ARP traffic are mapped to this service.

- Route 12 –Discard is the default route the system always adds to drop anything undefined.

The Default Route Cost Values:

- WAN to WAN Forwarding –10
- Default Direct Route Cost –5
- Auto Generated Routes –5
- Virtual Path –5
- Local –5
- Intranet –5
- Internet –5
- Passthrough –5
- Optional –route is 0.0.0.0/0 defined as a service level

After defining these routes, it is important to understand how the traffic flows using the defined routes. These traffic flows are broken into the following flows:

- LAN to WAN (Virtual Path) –Traffic going into the SD-WAN overlay tunnel
- WAN to LAN (Virtual Path) –Traffic existing the SD-WAN overlay tunnel
- Non-Virtual Path Traffic –Traffic routed to the underlay network

Intranet and Internet Routes

For the Intranet and Internet service types, the user must have defined an SD-WAN WAN Link to support those types of services. It is a pre-requisite for any defined routes for either of these services. If the WAN link is not defined to support the Intranet Service, it is considered as a local route. The Intranet, Internet, and Passthrough routes are only relevant to the site/appliance they are configured for.

When defining Intranet, Internet or Passthrough routes the following are design considerations:

- Must have service defined on the WAN link (Intranet/Internet –required)
- Intranet/Internet must have gateway defined for the WAN link
- Relevant to local SD-WAN device
- Intranet routes can be learned via the Virtual Path but are done so at a higher cost
- With Internet Service, there is automatically a default route created (0.0.0.0/0) catch all route with a max cost

- Do no assume that Passthrough works, it must be tested/verified, also test with Virtual Path down/disabled to verify desired behavior
- Route tables are static unless the route learning feature is enabled

  The maximum supported limit for multiple routing parameters is as follows:

- Maximum Routing Domains: 255
- Maximum Access Interfaces per WAN Link: 64
- Maximum BGP neighbors per site: 255
- Maximum OSPF area per site: 255
- Maximum Virtual Interfaces per OSPF area: 255
- Maximum Route Learning import filters per site: 512
- Maximum Route Learning export filters per site: 512
- Maximum BGP routing policies: 255
- Maximum BGP community string objects: 255

Routing Domain

August 24, 2022

Citrix SD-WAN allows segmenting networks for more security and manageability by using the Routing Domain. For example, you can separate guest network traffic from employee traffic, create distinct routing domains to segment large corporate networks, and segment traffic to support multiple customer networks. Each routing domain has its own routing table and enables the support for overlapping IP subnets.

Citrix SD-WAN appliances implement OSPF and BGP routing protocols for the routing domains to control and segment network traffic.

A Virtual Path can communicate using all routing domains regardless of the definition of the access point. This is possible because SD-WAN encapsulation includes the routing domain information for the packet. Therefore, both end networks know where the packet belongs to. It is not necessary to create a WAN Link or an Access Interface for each routing domain.

Following are the list of points to consider when configuring the Routing Domain functionality:

- By default, routing domains are enabled on an MCN.
- Routing domains are enabled on the Branch sites.
- Each enabled routing domain must have a virtual interface and virtual IP associated with it.

- Routing selection is part of all the following configurations:
  - Interface group
  - Virtual IP
  - GRE
  - WAN Link -> Access Interface
  - IPsec tunnels
  - Routes
  - Rules
- Routing domains are exposed in the web interface configuration only when multiple domains are created.
- For a Public Internet link, only one primary and secondary access interfaces can be created.
- For a Private Intranet/MPLS link, one primary and secondary access interface can be created per routing domain.

Configure Routing Domain

August 24, 2022

Citrix SD-WAN appliances enable configuring routing protocols providing single point of administration to manage a corporate network, or a branch office network, or a data center network. You can configure up to 254 routing domains.

With 11.0.2 release, **Routing domains without routable Virtual IPs (VIPs)** is allowed with the following capabilities:

- Allow a device to have a Routing Domain for untrusted or no Interfaces.
- Allow branches to communicate among one another over a Routing Domain that has no physical presence at an intermediate site.

Use CLI to Access Routing

August 24, 2022

In Citrix SD-WAN release version 10.0, you can view additional information related to dynamic routing and the protocol status. Type the following command and syntax to access routing daemon and view the list of commands.

```
dynamic_routing?
<!--NeedCopy-->
```

Dynamic Routing

August 24, 2022

The following two dynamic routing protocols are supported by Citrix SD-WAN:

- Open Shortest Path First (OSPF)
- Border Gateway Protocol (BGP)

Prior to Citrix SD-WAN 11.3.1 release, the dynamic routing capabilities were available only for a single router ID. You can configure a unique router ID either globally for the entire protocol (one for OSPF and BGP) or provide no router ID. If a router ID is not provided, the lowest IP of the Virtual Network Instances (VNIs) participating in dynamic routing is auto-selected as the default router ID.

From Citrix SD-WAN 11.3.1 release onwards, you can not only configure a router ID for the entire protocol but also configure a router ID for each routing domain. With this enhancement, you can enable stable dynamic routing across multiple instances with different router ID's converging in a stable manner.

If you configure a router ID for a specific routing domain, the specific router ID overrides the protocol level routing domain.

OSPF

OSPF is a routing protocol developed for Internet Protocol (IP) networks by the Interior Gateway Protocol (IGP) group of the Internet Engineering Task Force (IETF). It includes the early version of OSI's Intermediate System to Intermediate System (IS-IS) routing protocol.

OSPF protocol is open, which means that its specification is in the public domain (RFC 1247). OSPF is based on the Shortest Path First (SPF) algorithm called Dijkstra. It is a link-state routing protocol that calls for sending Link-State Advertisements (LSAs) to all other routers within the same hierarchical area. Information on attached interfaces, metrics used, and other variables are included in OSPF LSAs. OSPF routers accumulate link-state information, which is used by the SPF algorithm to calculate the shortest path to each node.

> **Note**
>
> - Citrix SD-WAN appliances do not participate as Designated Router (DR) and BDR (Backup

> Designated Router) on each multi-access network since the default DR priority is set to "0."
>
> - Citrix SD-WAN appliance does not support summarization as an Area Border Router (ABR).

BGP

BGP is an inter-autonomous system routing protocol. An autonomous network or group of networks is managed under a common administration and with common routing policies. BGP is used to exchange routing information for the Internet and is the protocol used between ISPs. Customer networks deploy Interior gateway protocols such as RIP or OSPF for the exchange of routing information within their networks. Customers connect to ISPs, and ISPs use BGP to exchange customer and ISP routes. When BGP is used between Autonomous Systems (AS), the protocol is called External BGP (EBGP). If a service provider is using BGP to exchange routes within an AS, then the protocol is called Interior BGP (IBGP).

BGP is a robust and scalable routing protocol deployed on the Internet. To achieve scalability, BGP uses many route parameters called attributes to define routing policies and maintain a stable routing environment. BGP neighbors exchange full routing information when the TCP connection between neighbors is first established. When changes to the routing table are detected, the BGP routers send to their neighbors only those routes that have changed. BGP routers do not send periodic routing updates, and advertise only the optimal path to a destination network. You can configure Citrix SD-WAN appliances to learn routes and advertise routes using BGP.

Exterior BGP (eBGP)

Citrix SD-WAN appliances connect to a switch on the LAN side and a Router on the WAN side. As SD-WAN technology starts becoming more integral to Enterprise network deployments, SD-WAN appliances replace the Routers. SD-WAN implements eBGP dynamic routing protocol to function as a dedicated routing device.

SD-WAN appliance establishes a neighborship with peer routers using eBGP towards WAN side and is able to learn, advertise routes from and to peers. You can select importing and exporting eBGP learned routes on peer devices. Also, SD-WAN static, virtual path learned routes can be configured to advertise to eBGP peers.

For more information, see the following use cases:

- SD-WAN site Communicating with non-SD-WAN site over eBGP
- Communication Between SD-WAN sites Using Virtual Path and eBGP
- Implementing OSPF in one-arm topology
- OSPF Type5 to Type1 deployment in MPLS Network
- SD-WAN and non-SD-WAN (third-party) appliance OSPF deployment
- Implementing OSPF using SD-WAN network with high-availability setup

AS path length

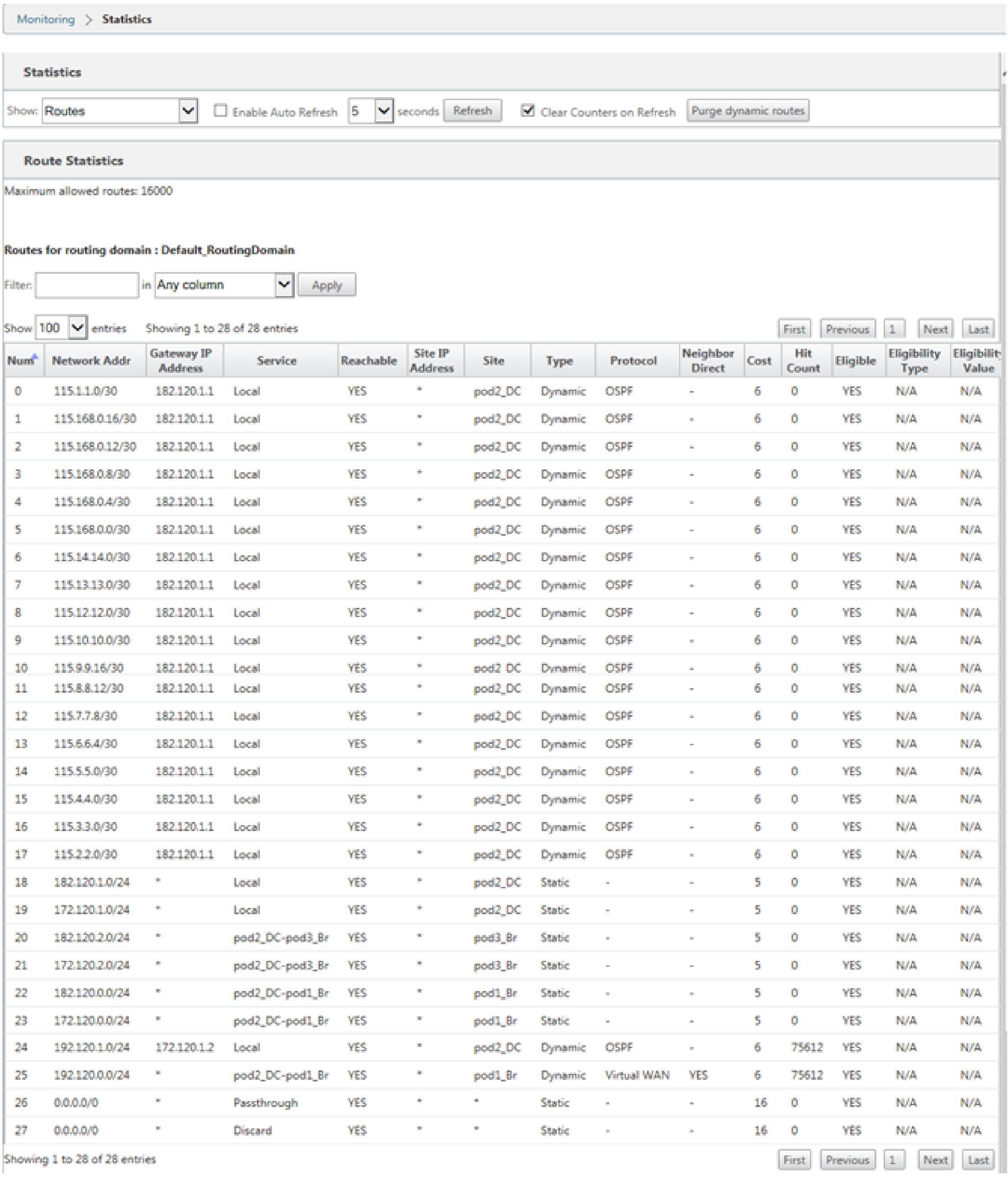
BGP protocol uses the **AS path length** attribute to determine the best route. The AS path length indicates the number of autonomous systems traversed in a route. Citrix SD-WAN uses the **BGP AS path length** attribute to filter and import routes.

Non-SD-WAN appliances can choose to route traffic to Primary DC or Secondary DC SD-WAN appliances by importing routes based on their AS path length. You can also dynamically steer traffic from a router to Secondary DC by simply increasing the AS path length of the Primary DC appliance on the router, making it unpreferable. Eliminating the need to change the route cost and perform a configuration update.

Monitor route statistics

Navigate to **Monitor** > **Statistics**. Select **Routes** from the **Show** drop-down menu.

All functions for applicable Routes are supported in Citrix SD-WAN network regardless of whether a Route is Dynamic or Static.



Maximum allowed routes: 16000

Routes for routing domain : Default_RoutingDomain

Showing 1 to 28 of 28 entries

Num	Network Addr	Gateway IP Address	Service	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibilit
0	115.1.1.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
1	115.168.0.16/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
2	115.168.0.12/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
3	115.168.0.8/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
4	115.168.0.4/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
5	115.168.0.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
6	115.14.14.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
7	115.13.13.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
8	115.12.12.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
9	115.10.10.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
10	115.9.9.16/30	182.120.1.1	Local	YES	*	pod2 DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
11	115.8.8.12/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
12	115.7.7.8/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
13	115.6.6.4/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
14	115.5.5.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
15	115.4.4.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
16	115.3.3.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
17	115.2.2.0/30	182.120.1.1	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	0	YES	N/A	N/A
18	182.120.1.0/24	*	Local	YES	*	pod2_DC	Static	-	-	5	0	YES	N/A	N/A
19	172.120.1.0/24	*	Local	YES	*	pod2_DC	Static	-	-	5	0	YES	N/A	N/A
20	182.120.2.0/24	*	pod2_DC-pod3_Br	YES	*	pod3_Br	Static	-	-	5	0	YES	N/A	N/A
21	172.120.2.0/24	*	pod2_DC-pod3_Br	YES	*	pod3_Br	Static	-	-	5	0	YES	N/A	N/A
22	182.120.0.0/24	*	pod2_DC-pod1_Br	YES	*	pod1_Br	Static	-	-	5	0	YES	N/A	N/A
23	172.120.0.0/24	*	pod2_DC-pod1_Br	YES	*	pod1_Br	Static	-	-	5	0	YES	N/A	N/A
24	192.120.1.0/24	172.120.1.2	Local	YES	*	pod2_DC	Dynamic	OSPF	-	6	75612	YES	N/A	N/A
25	192.120.0.0/24	*	pod2_DC-pod1_Br	YES	*	pod1_Br	Dynamic	Virtual WAN	YES	6	75612	YES	N/A	N/A
26	0.0.0.0/0	*	Passthrough	YES	*	*	Static	-	-	16	0	YES	N/A	N/A
27	0.0.0.0/0	*	Discard	YES	*	*	Static	-	-	16	0	YES	N/A	N/A

Showing 1 to 28 of 28 entries

OSPF

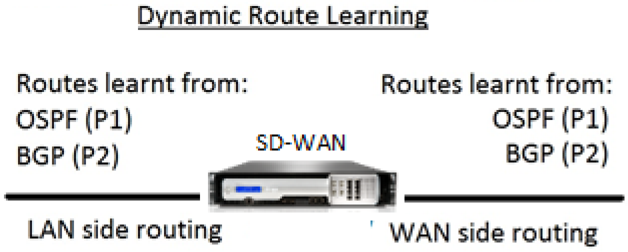
August 24, 2022

LAN Side: Dynamic Route Learning

OSPF running on the LAN port of Citrix SD-WAN appliance deployed in Gateway Mode:

Citrix SD-WAN appliances perform route discovery of Layer 3 routing advertisements within a local customer network (both branch and data center) for each of the desired routing protocols (OSPF and BGP). The routes that are learned are dynamically captured and displayed.

This eliminates the need for SD-WAN administrators to statically define the LAN-side networking environment for each appliance that is part of the SD-WAN network.



WAN Side: Dynamic Route Sharing

Citrix SD-WAN appliance having an AREA defined as a STUB area by limiting the learning of Type 5 AS-external LSA.

Citrix SD-WAN appliances can advertise the locally learned dynamic routes with the MCN. The MCN can then relay these routes to other SD-WAN appliances in the network. This exchange of information dynamically allows for maintaining connectivity between sites across the changing network.

OSPF Deployment Modes

In previous releases, OSPF instance learned routes from SD-WAN were treated as external routes with Type 5 LSA only. These routes were advertised to its neighbor routers in Type 5 External LSA. This resulted in SD-WAN routes to be less preferred routes according to the OSPF path selection algorithm.

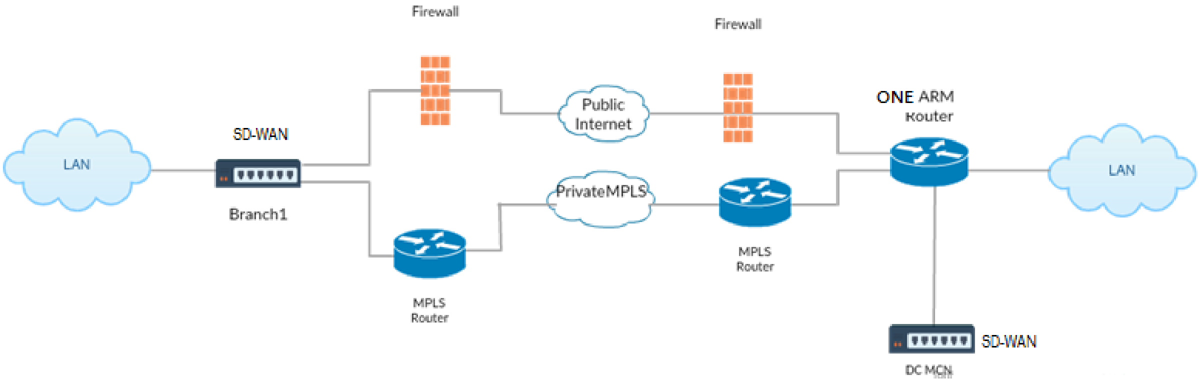
With the latest release, SD-WAN can now advertise routes as intra-area routes (LSA Type 1) to get preference as per its route cost using the OSPF path selection algorithm. The route cost can be configured and advertised to the neighbor router. This allows for deploying the SD-WAN appliance in a one-arm mode described below.

Implementing OSPF in One-Arm Topology

In one-arm configuration, the router needs complicated PBR or WCCP configuration in OSPF deployments. By changing the default export route type from Type 5 to Type 1 we can simplify this deployment. If SD-WAN routes are advertised as intra-area routes with less cost, and the SD-WAN appliance becomes active, the neighbor router selects SD-WAN routes and automatically begins forwarding traffic through the SD-WAN network. Additional PBR or WCCP configuration is not required any longer.

Prerequisites:

- SD-WAN Appliances at the DC and Branch sites must be running the latest release version.
- End-to-End IP connectivity must be configured and working fine.
- OSPF is enabled on all the sites.

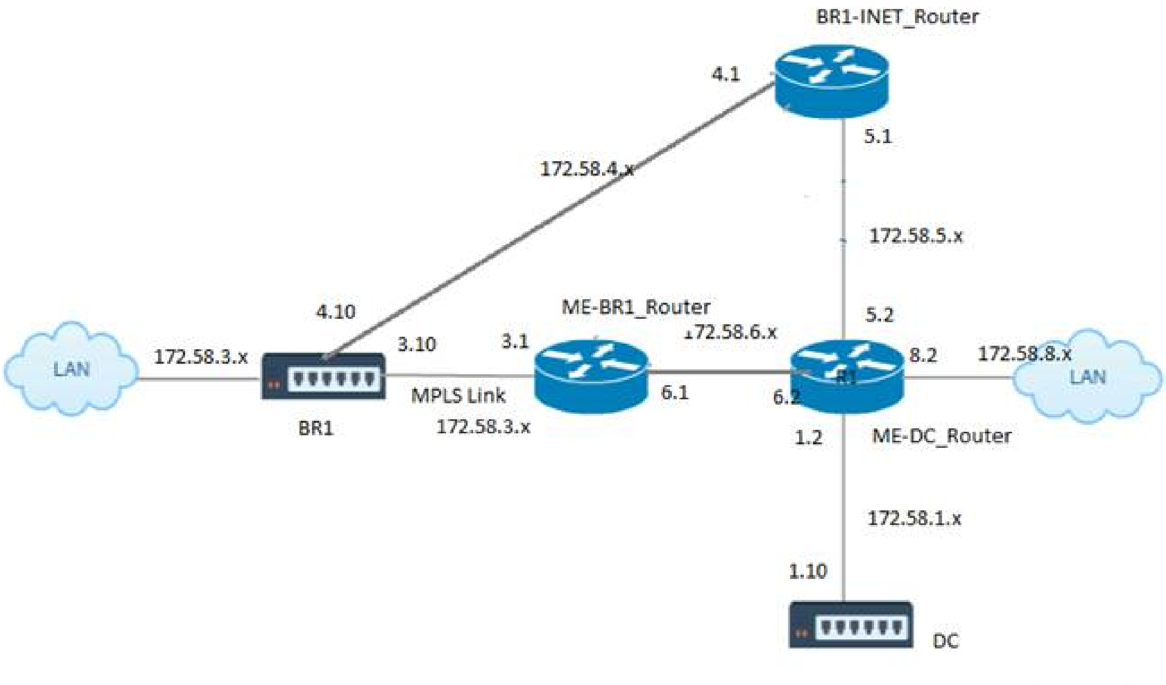


As shown in the illustration above, DC MCN is deployed in one-arm topology. When the DC site is up, the one-arm router forwards all traffic from the local LAN to other sites, such as the Branch's local LAN whose destination IP address is within the same subnet to the SD-WAN first, then the SD-WAN appliance wraps all packets and sends it to the router with all the packets destination IP address in the Branch Virtual IP address. The router then forwards those packets to WAN.

When the DC site is down, the router forwards all traffic from local LAN to other sites (branch site's local LAN, destination IP is within subnet) to WAN directly, and not to the SD-WAN appliance.

OSPF Type5 to Type1 Deployment in MPLS Network

The following deployment mode is provided to avoid loop formation in an MPLS network configured using SD-WAN appliances. The illustration below describes the standard MPLS network implementation.



In the above illustration:

- OSPF is configured between *ME-BR1_Router* and *ME-DC_Router* in area 0.
- OSPF is configured between *ME-DC_Router* and *DC* in area 0.

Recommended Configuration:

- DC VW and ME-DC_Router on area0
- ME-BR1_Router and ME-DC_Router on area0
- BR1 VW and ME-BR1_Router on area0

On the ME-DC_Router:

1. Add, static route for 172.58.3.10/32(Virtual IP of BR1 for MPLS Link) through 172.58.6.1
2. Add, static route for 172.58.4.10/32(Virtual IP of BR1 for INET) through 172.58.5.1

Adding static routes prevents loop formation between the ME-DC_Router and DC SD-WAN appliance. If you do not add static routes, the MCN forwards traffic to the ME-DC Router, and back from the router to the MCN and this creates a loop continuously.

The static routes which are not PBR routes but the destination Host IP based routes traverse towards the right link to be chosen from the DC side based on the path chosen and the encapsulation performed thereafter. Therefore, with these static routes configured, the encapsulated packets with any destination Virtual IP of the BR1 SD-WAN appliance would use these links as per the best path selected by the DC MCN.

Add ACL to avoid loop formation when IPHOST routes are installed (if no static Virtual IPs configured):

- If the IPHOST routes advertised by the BR1 SD-WAN appliance are installed by the MCN router *ME-DC_Router* and not added as static routes as mentioned above, there is a possibility of loop formation if the OSPF participating interface (172.58.6.x) between ME-BR1_Router and ME-DC_Router goes down. This is because with this interface down, the IPHOST routes are flushed from ME-DC_Router's routing table.
- If this happens, MCN forwards the encapsulated packet destined to one the BR1 VIPs to the ME-DC Router and back from the router to the MCN and loop continuously.

On the ME-BR1_Router:

Advertise 172.58.3.x network to ME-DC_Router with a higher cost than the cost advertised for the same network by DC, if the same AREA-ID is used between **ME-BR1_Router <-> ME-DC_Router** and **ME-DC_Router <-> DC (SD-WAN)**.

- Based on the cost metric computation of OSPF 10^8/BW and the cost for route prefixes are based on the interface type. SD-WAN appliances advertise the virtual path and virtual WAN specific static routes to the external or peer routers with the default SD-WAN cost of 5.
- If the ME-BR1_Router is also advertising 172.58.3.0/24 as an internal OSPF type 1 route alongside DC (SD-WAN) which also advertises the same prefix as an internal OSPF Type 1 route, then according to cost computation, by default the ME-BR1_Router's route will be configured, as the cost is lesser than SD-WAN's default cost of 5. To avoid this and make the SD-WAN appliance chosen as the preferred route initially, the interface cost of (172.58.3.1) must be manipulated to make it higher on the ME-BR1_Router so that the DC SD-WAN route is configured in the routing table of the ME-DC_Router.

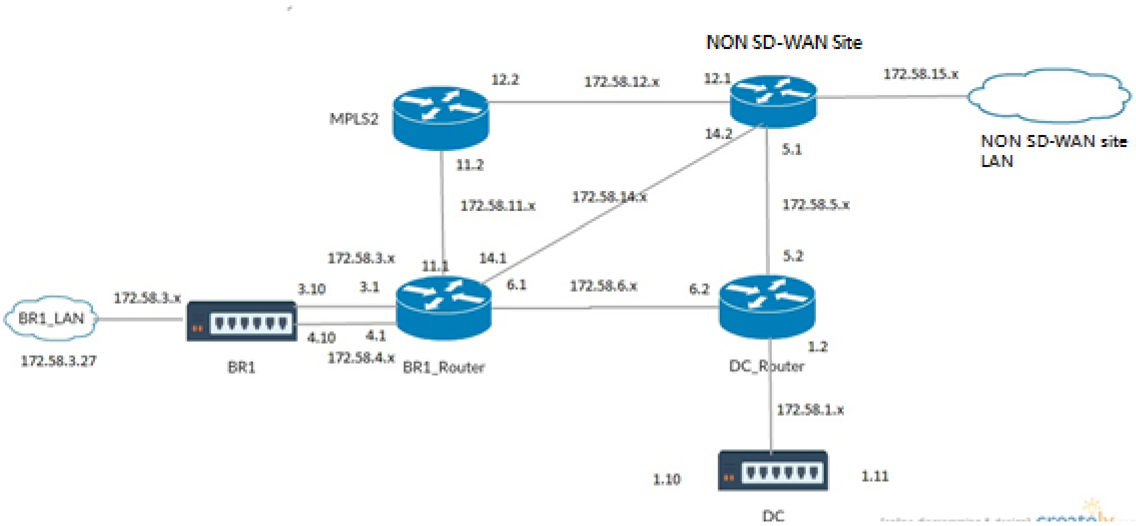
This also ensures that when the DC SD-WAN appliance fails, the alternate route to use ME-BR1_Router as the next preferred gateway ensures uninterrupted traffic flow.

Use ME-DC_Router as a source for advertising 172.58.8.0/24 network to both DC SD-WAN and the ME-BR1_Router:

With this route, the DC SD-WAN can send packets to the upstream router being aware of the LAN subnet after decapsulation. If DC SD-WAN goes down, the legacy routing infrastructure would help ME-BR1_Router use the ME-DC_Router as the next hop to reach the 172.58.8.x network.

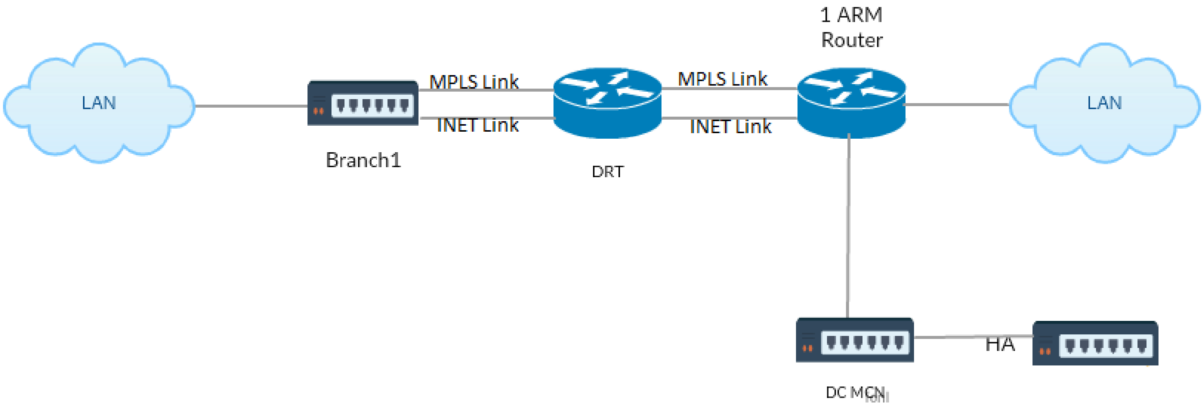
SD-WAN and Third-Party (non-SD-WAN) Appliance Deployment

As shown in the illustration below, the third-party appliance site can get to Site B's LAN by sending traffic to Site B directly. If it cannot send traffic directly, the fallback route goes to Site A, then using the virtual path between DC to Branch sites to get to the Branch. If that fails, it uses MPLS2 to get to the Branch site.



Traffic flow can be observed in the SD-WAN GUI under **Monitoring** > **Flows**.

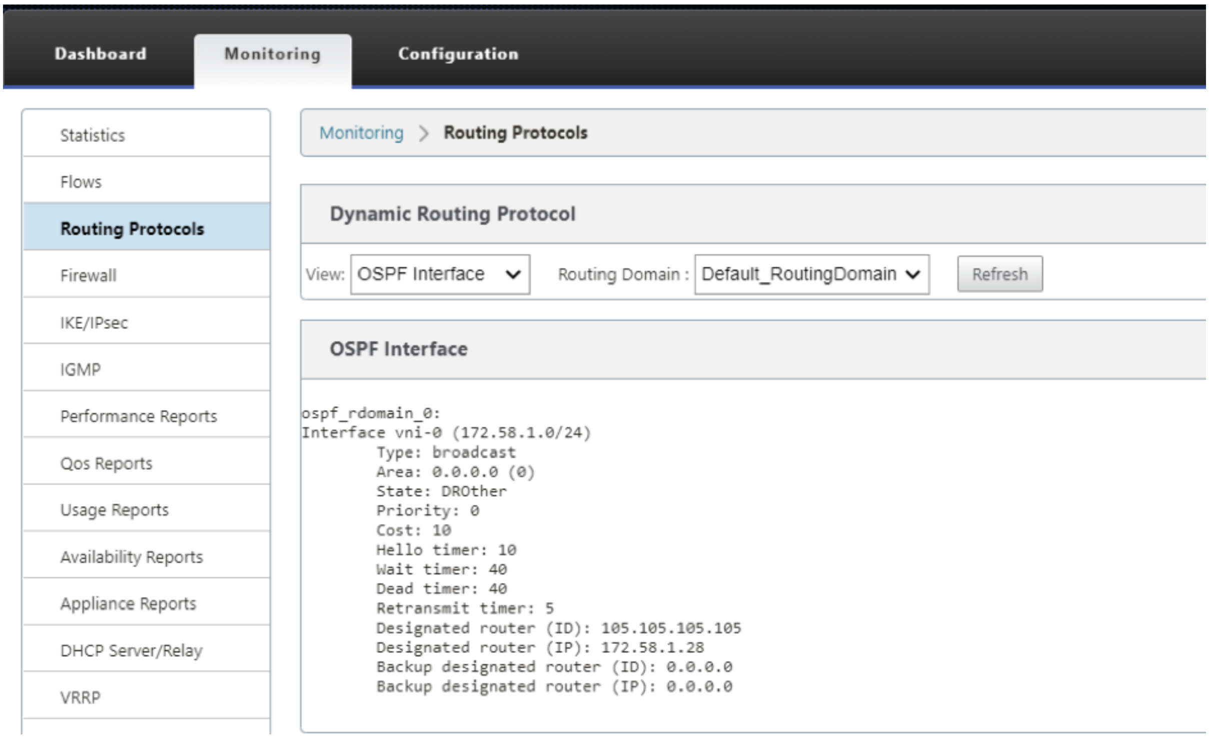
Implementing OSPF with SD-WAN Network in High Availability Setup



OSPF Type5 to Type1 with high-availability sites during failover to standby appliance and deployed in high-availablity setup:

Troubleshooting

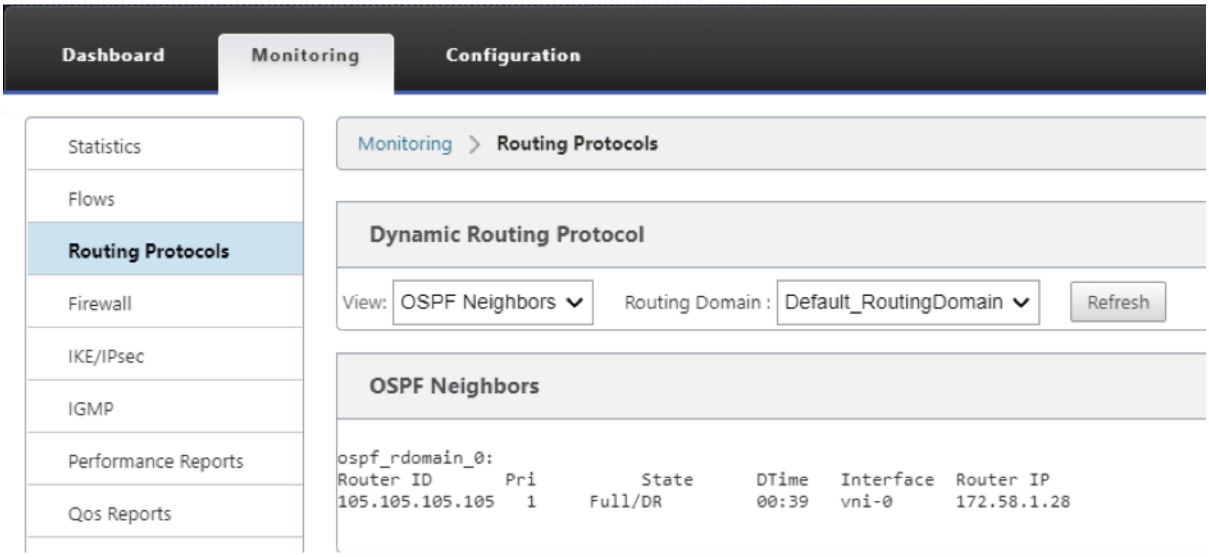
You can view the OSPF parameters under **Monitoring >Routing Protocols**.



View: OSPF Interface

Routing Domain : Default_RoutingDomain

```
ospf_rdomain_0:
Interface vni-0 (172.58.1.0/24)
        Type: broadcast
        Area: 0.0.0.0 (0)
        State: DROther
        Priority: 0
        Cost: 10
        Hello timer: 10
        Wait timer: 40
        Dead timer: 40
        Retransmit timer: 5
        Designated router (ID): 105.105.105.105
        Designated router (IP): 172.58.1.28
        Backup designated router (ID): 0.0.0.0
        Backup designated router (IP): 0.0.0.0
```

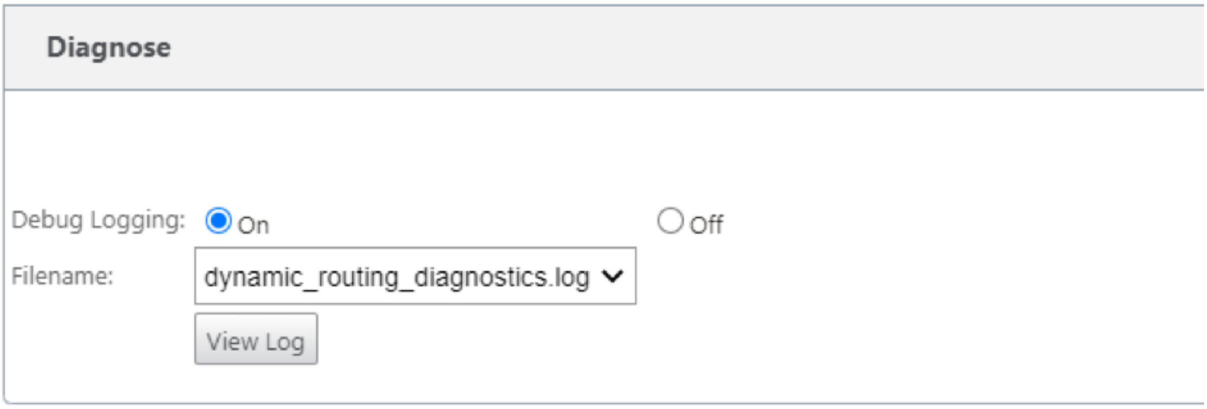


View: OSPF Neighbors

Routing Domain : Default_RoutingDomain

```
ospf_rdomain_0:
Router ID        Pri          State       DTime   Interface  Router IP
105.105.105.105   1     Full/DR           00:39   vni-0      172.58.1.28
```

You can also observe the Dynamic routing logs to see if there is any issue with OSPF Convergence.



Diagnose

Debug Logging: ● On ○ Off

Filename: dynamic_routing_diagnostics.log

BGP

August 24, 2022

The SD-WAN BGP routing functionality enables you to:

- Configure the autonomous system (AS) number of a neighbor or other peer router (iBGP or eBGP).
- Create BGP policies to be applied selectively to a set of networks on a per-neighbor basis, in either direction (import or export). An SD-WAN appliance supports eight policies per site, with up to eight network objects (or eight networks) associated with a policy.
- For each policy, users can configure multiple community strings, AS-PATH-PREPEND, MED attribute. Users can configure up to 10 attributes for each policy.

> **Note**
>
> Only local preference and the IGP metric for path selection and manipulation is allowed.

Configuring Neighbors

To configure eBGP, an extra column to the existing BGP neighbors section is added to configure the neighbor AS number. The existing configurations are pre-populated to this field with the local AS number when you import the previous configuration using the SD-WAN 9.2 configuration editor.

The neighbor configuration also has an optional advanced section (expandable row) where you can add Policies for each neighbor.

Configuring Advanced Neighbors

With this option, you can add network objects and add a configured BGP policy for that network object. This is similar to creating a route map and ACL to match certain routes and configuring BGP attributes for that neighbor. You can specify the direction to indicate if this policy is applied for incoming or outgoing routes.

The default policy is to <accept> all routes. Accept and reject policies are defaults and cannot be modified.

You have the ability to match routes based on Network address (destination address), AS Path, Community string and assign a policy and select direction for the policy to be applied.

1. Go to **Monitoring** > **Routing Protocols** > **Dynamic Routing Protocols** to monitor the configured BGP policies and neighbors for the DC or Branch site appliance.

You can enable debug logging and to view log files for routing from the **Monitor** > **Routing Protocol** page. The logs for the routing daemon are split into separate log files. The standard routing information is stored in *dynamic_routing.log* while dynamic routing issues are captured in *dynamic_routing_diagnostics.log* which can be viewed from monitoring of routing protocols.

BGP Soft Reconfiguration

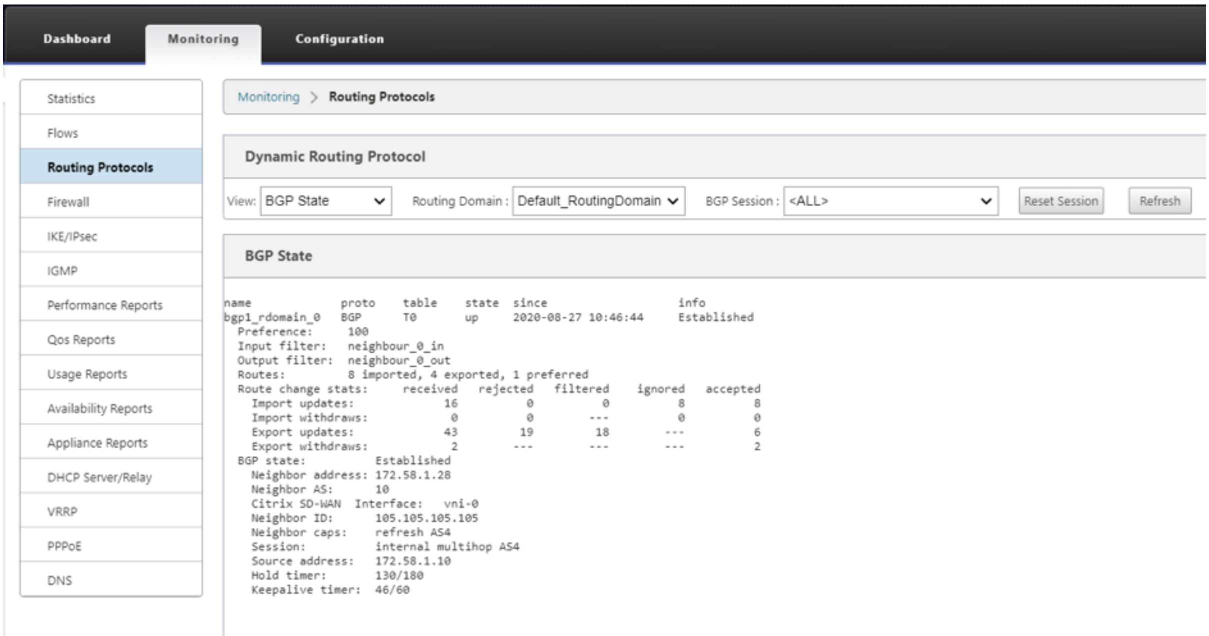
Routing policies for BGP peer include configurations such as route-map, distribute-list, prefix-list, and filter-list that might impact inbound or outbound routing table updates. When there is a change in the routing policy, the BGP session must be cleared, or reset, for the new policy to take effect.

Clearing a BGP session using a hard reset invalidates the cache and results in negative impact on the operation of the networks as the information in the cache becomes unavailable.

The BGP Soft Reset Enhancement feature provides automatic support for dynamic soft reset of inbound BGP routing table updates that are not dependent upon stored routing table update information.

Troubleshooting

To view the BGP parameters, navigate to **Monitoring > Routing Protocols** > select **BGP State** from the **View** field.



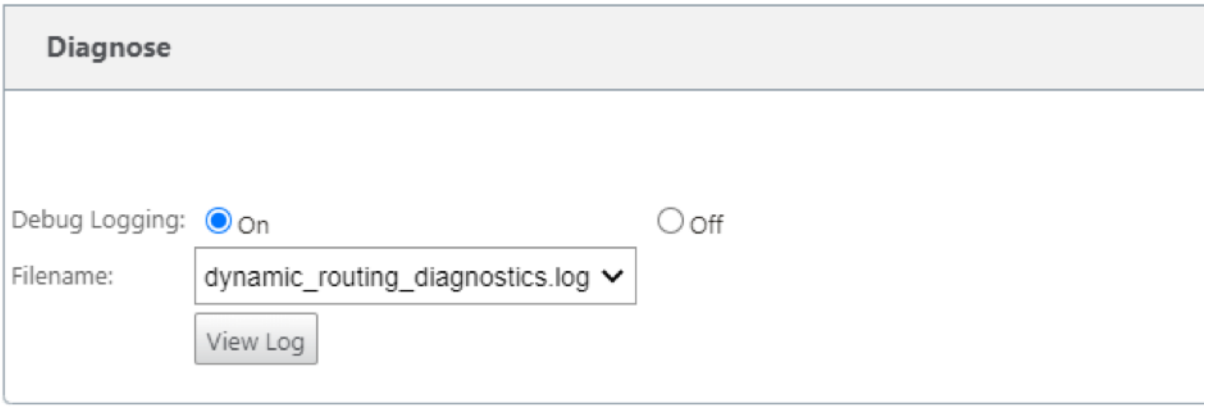
View: BGP State

Routing Domain : Default_RoutingDomain

BGP Session : <ALL>

```
name            proto    table    state  since                  info
bgp1_rdomain_0  BGP      T0       up     2020-08-27 10:46:44    Established
  Preference:     100
  Input filter:   neighbour_0_in
  Output filter:  neighbour_0_out
  Routes:         8 imported, 4 exported, 1 preferred
  Route change stats:     received   rejected   filtered    ignored   accepted
    Import updates:             16          0          0          8          8
    Import withdraws:            0          0        ---          0          0
    Export updates:             43         19         18        ---          6
    Export withdraws:            2        ---        ---        ---          2
  BGP state:          Established
    Neighbor address: 172.58.1.28
    Neighbor AS:      10
    Citrix SD-WAN  Interface:   vni-0
    Neighbor ID:      105.105.105.105
    Neighbor caps:    refresh AS4
    Session:          internal multihop AS4
    Source address:   172.58.1.10
    Hold timer:       130/180
    Keepalive timer:  46/60
```

You can observe theDynamic routing logs to see if there is any issue with BGP Convergence.



Debug Logging: ● On ○ Off

Filename: dynamic_routing_diagnostics.log

iBGP

August 24, 2022

Citrix SD-WAN appliance with iBGP on the LAN side and eBGP on the WAN side:

Citrix SD-WAN appliances advertise all the eBGP routes learnt into the IGP domain with NEXT HOP SELF when deployed with iBGP on the LAN side and eBGP on the WAN side.

Multiple iBGP LAN Routers in a Linear Network Topology with Direct Peering and meshed with Citrix SD-WAN.

Limitations:

- AS-Path prepend, Med, and Community attributes are not supported.
- Route filtering between OSPF and BGP during redistribution is not supported. Either all (or) none of the routes learned from OSPF are advertised to BGP peers and vice-versa.
- Route aggregation is not supported.
- Only a Max of 16 BGP peers (including iBGP and eBGP) can be configured.

eBGP

August 24, 2022

SD-WAN site communicating with non SD-WAN site over eBGP:

When a site without SD-WAN appliance is communicating with another site with SD-WAN appliance (Site-A) over a single WAN path (only internet is available), and if the site with SD-WAN appliance (Site-A) loses internet connectivity, then the site without SD-WAN can communicate with Site-A through another SD-WAN appliance site (Site-B). Site-B funnels traffic from the site without SD-WAN appliance to the Site-A.

Communication between SD-WAN sites using Virtual Path and eBGP:

Provides underlay route learning to communicate with remote site local subnets when the virtual path is down between two sites while the Virtual WAN appliance is still up and running.

Application Route

August 24, 2022

In a typical enterprise network, the branch offices access applications on the on-premises data center, the cloud data center, or the SaaS applications. The application routing feature, allows you to steer the applications through your network easily and cost-efficiently. For example, when a user on the branch site is trying to access a SaaS application the traffic can be routed such that the branch offices can access the SaaS applications on the internet directly, without having to go through the data center first.

Citrix SD-WAN allows you to define the application routes for the following services:

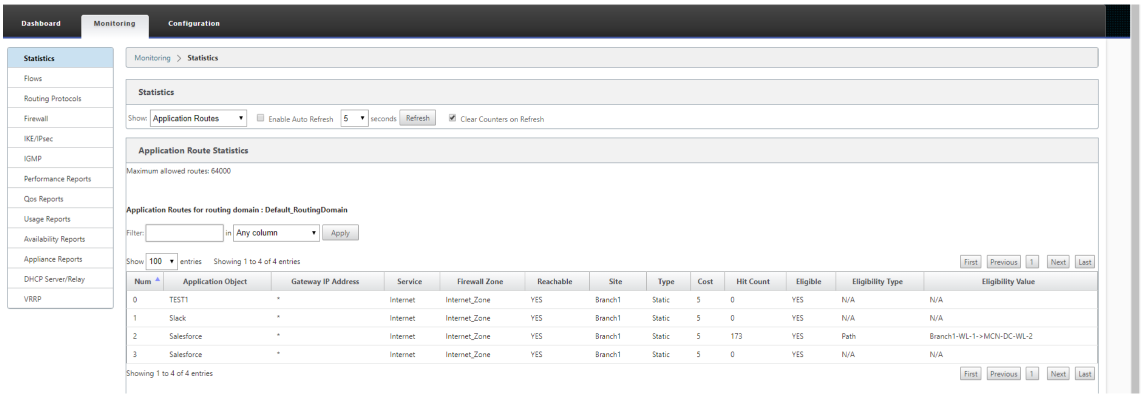
- **Virtual Path**: This service manages traffic across the Virtual Paths. A Virtual Path is a logical link between two WAN links. It comprises a collection of WAN Paths combined to provide high service-level communication between two SD-WAN nodes. The SD-WAN appliance measures the network on a per-path basis and adapts to changing application demand and WAN conditions. A Virtual Path can be static (always exists) or dynamic (exists only when traffic between two SD-WAN Appliances reaches a configured threshold).

- **Internet:** This service manages traffic between an Enterprise site and sites on the public Internet. Internet traffic is not encapsulated. When congestion occurs, the SD-WAN actively manages bandwidth by rate-limiting Internet traffic relative to the Virtual Path, and Intranet traffic.
- **Intranet**: This service manages Enterprise Intranet traffic that has not been defined for transmission across a Virtual Path. Intranet traffic is not encapsulated. The SD-WAN manages bandwidth by rate-limiting this traffic relative to other service types during times of congestion. Under certain conditions, and if Intranet Fallback is configured on the Virtual Path, traffic that ordinarily travels through Virtual Path can instead be treated as Intranet traffic.
- **Local**: This service manages traffic local to the site that matches no other service. SD-WAN ignores traffic sourced and destined to a local route.
- **GRE Tunnel**: This service manages IP traffic destined for a GRE tunnel, and matches the LAN GRE tunnel configured at the site. The GRE Tunnel feature enables you to configure SD-WAN appliances to terminate GRE tunnels on the LAN. For a route with service type GRE Tunnel, the gateway must reside in one of the tunnel subnets of the local GRE tunnel.
- **LAN IPsec Tunnel**: This service manages IP traffic destined for a LAN IPsec tunnel, and matches the LAN IPsec tunnel configured at the site. The LAN IPsec Tunnel feature enables you to configure SD-WAN Appliances to terminate IPsec tunnels on the LAN or WAN side.

To perform service steering for applications, it is important to identify an application on the first packet itself. Initially, the packets flow through the IP route once the traffic is classified and the application is known, the corresponding application route is used. First packet classification is achieved by learning the IP subnets and ports associated with application objects. These are obtained using historical classification results of the DPI classifier, and user configured IP port match types.

To view statistics data for the application routes:

1. In the SD-WAN GUI, navigate to **Monitoring** > **Statistics**.
2. From the **Show** drop-down list, select **Application Routes**.



Statistics

Show: Application Routes ▾ □ Enable Auto Refresh 5 ▾ seconds ☑ Clear Counters on Refresh

Application Route Statistics

Maximum allowed routes: 64000

Application Routes for routing domain : Default_RoutingDomain

Filter: in Any column ▾

Show 100 ▾ entries Showing 1 to 4 of 4 entries

Num	Application Object	Gateway IP Address	Service	Firewall Zone	Reachable	Site	Type	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	TEST1	*	Internet	Internet_Zone	YES	Branch1	Static	5	0	YES	N/A	N/A
1	Slack	*	Internet	Internet_Zone	YES	Branch1	Static	5	0	YES	N/A	N/A
2	Salesforce	*	Internet	Internet_Zone	YES	Branch1	Static	5	173	YES	Path	Branch1-WL-1->MCN-DC-WL-2
3	Salesforce	*	Internet	Internet_Zone	YES	Branch1	Static	5	0	YES	N/A	N/A

Showing 1 to 4 of 4 entries

You can view the following statistics:

- **Application Object**: Name of the application object.
- **Gateway IP Address**: The gateway IP address used by application objects with GRE Tunnel service type.
- **Service**: The service type mapped to the application object.
- **Firewall Zone**: The firewall zone that this route falls in.
- **Reachable**: The status of the application route.
- **Site**: Name of the site.
- **Type**: Indicates if the route is static or dynamic.
- **Cost**: The priority of the route.
- **Hit Count**: The number of times the application route is used to steer the traffic.
- **Eligible**: Is the application route eligible to send the traffic.
- **Eligibility Type**: The type of route eligibility condition applied to this route. The eligibility type can be Path, Gateway, or Tunnel.
- **Eligibility Value**: The value specified for the route eligibility condition.

> **Note**
>
> In the current release, applications that belong to application family, match type defined in application object, cannot be steered.

Troubleshooting

After creating the application route, you can confirm that the application is correctly routed to the intended service using the **Monitoring** section.

To view if the application is correctly routed to the intended service, navigate to the following pages:

- **Monitoring > Statistics > Application Routes**
- **Monitoring > Flows**
- **Monitoring > Firewall**

If there is any unexpected routing behavior, collect the STS diagnostics bundle while the issue is being observed, and share it with the Citrix Support team.

The STS bundle can be created and downloaded using **Configuration > System Maintenance > Diagnostics > Diagnostic Information**.

Route filtering

August 24, 2022

For networks with Route Learning enabled, Citrix SD-WAN provides more control over which SD-WAN routes are advertised to routing neighbors rather and which routes are received from routing neighbors, rather than advertising and accepting all or no routes.

- Export Filters are used to include or exclude routes for advertisement using OSPF and BGP protocols based on specific match criteria. Export filter rules are the rules that have to be meet when advertising SD-WAN routes over dynamic routing protocols. All the routes are advertised to peers by default.
- Import Filters are used to accept or not accept routes which are received using OSPF and BGP neighbors based on specific match criteria. Import filter rules are the rules that have to be meet before importing dynamic routes into the SD-WAN route database. No routes are imported by default.

Route filtering is implemented on LAN routes and Virtual Path routes in an SD-WAN network (Data Center/Branch) and is advertised to a non-SD-WAN network through using BGP and OSPF.

You can configure up to 512 Export Filters and 512 Import Filters. This is the overall limit, not per routing domain limit.

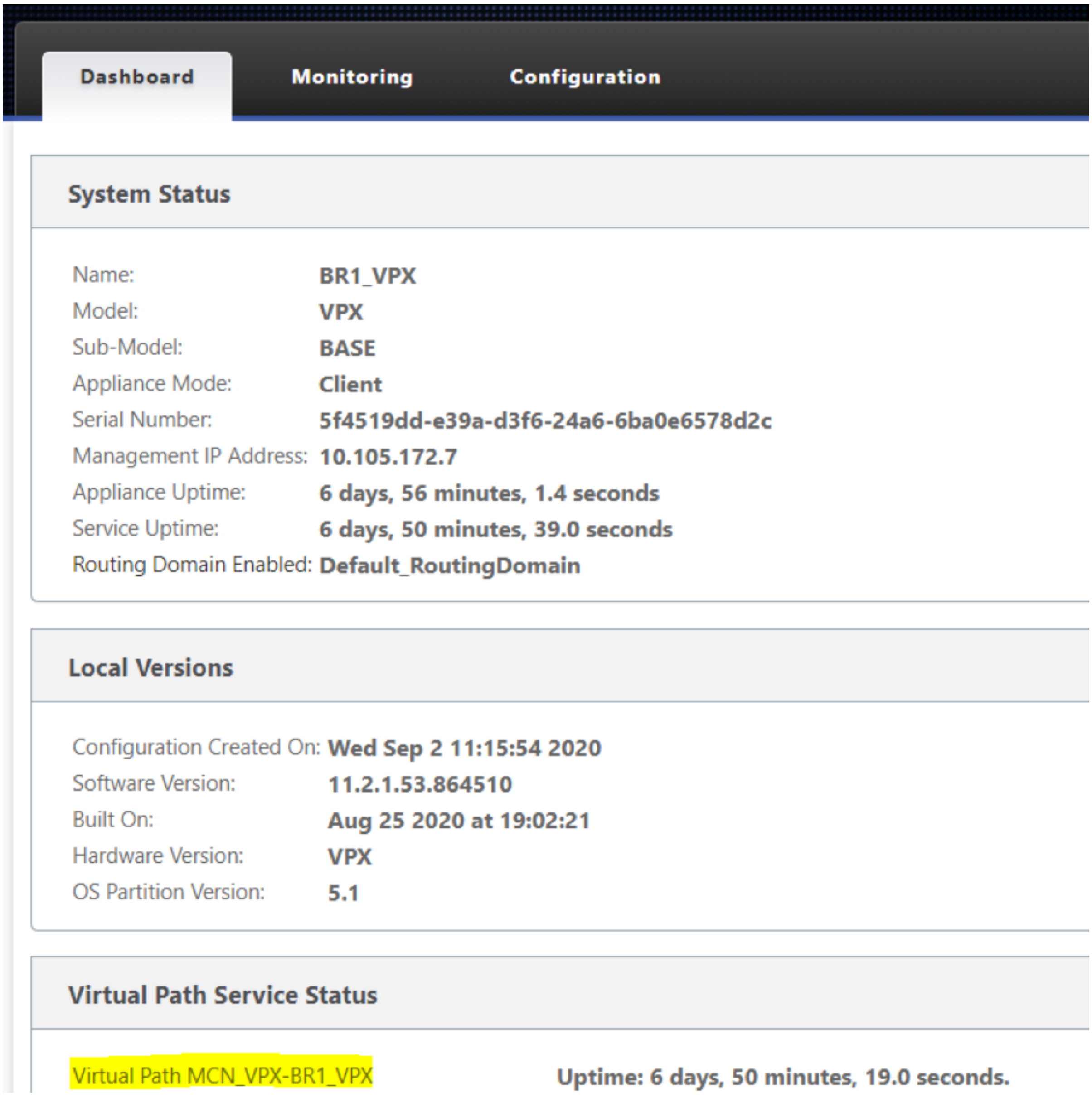
Route Summarization

August 24, 2022

With the increase in the size of the enterprise networks, the routers need to maintain the large number of routes in their routing table. The routers require increased CPU, memory and bandwidth resources to look up the large routing tables, and maintain individual routes. You can configure a summary route with Local and Discard service types. This summary route is advertised to the next-hop devices.

Troubleshooting

The summarized routes configured on the MCN are sent to the Branch over the virtual path. In case you do not see the virtual path details in the route table of the Branch, check the Branch dashboard. The dashboard displays the status of the virtual path between the MCN and Branch.



System Status

Name: BR1_VPX
Model: VPX
Sub-Model: BASE
Appliance Mode: Client
Serial Number: 5f4519dd-e39a-d3f6-24a6-6ba0e6578d2c
Management IP Address: 10.105.172.7
Appliance Uptime: 6 days, 56 minutes, 1.4 seconds
Service Uptime: 6 days, 50 minutes, 39.0 seconds
Routing Domain Enabled: Default_RoutingDomain

Local Versions

Configuration Created On: Wed Sep 2 11:15:54 2020
Software Version: 11.2.1.53.864510
Built On: Aug 25 2020 at 19:02:21
Hardware Version: VPX
OS Partition Version: 5.1

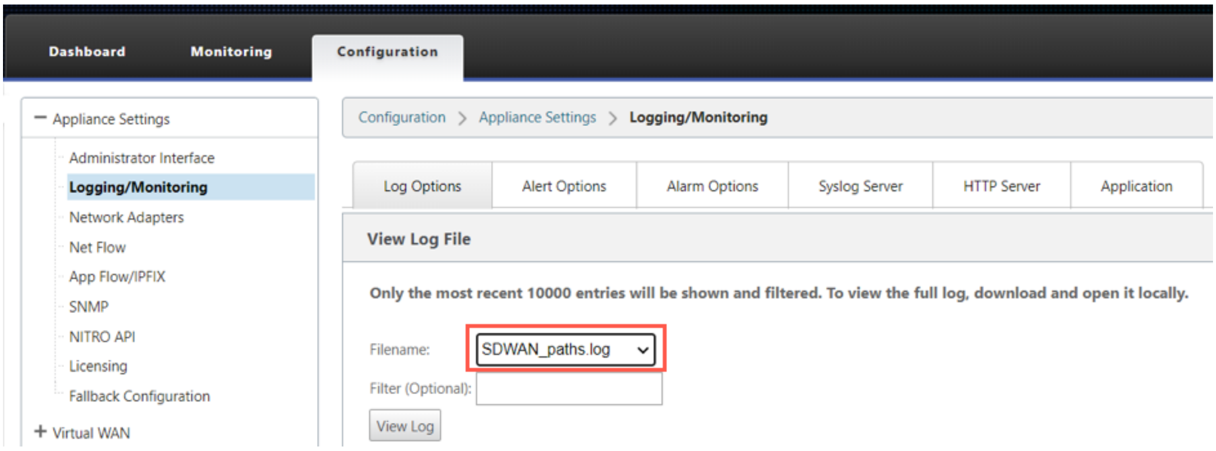
Virtual Path Service Status

Virtual Path MCN_VPX-BR1_VPX Uptime: 6 days, 50 minutes, 19.0 seconds.

If the virtual path is down, check the reason for it under **Configuration > Logging/Monitoring**.

Select one of the following files from the **filename** drop-down list to verify:

- SDWAN_paths.log
- SDWAN_common.log



Only the most recent 10000 entries will be shown and filtered. To view the full log, download and open it locally.

Filename: SDWAN_paths.log

Filter (Optional):

Protocol preference

August 24, 2022

Protocol preference is a Citrix SD-WAN specific feature, which is similar to router administrative distance. The protocol with the highest preference order is the most preferred. The route using the protocol with the highest protocol preference value. The protocol precedence information is local to the Citrix SD-WAN appliance and is not advertised to peer network elements.

Multicast routing

August 24, 2022

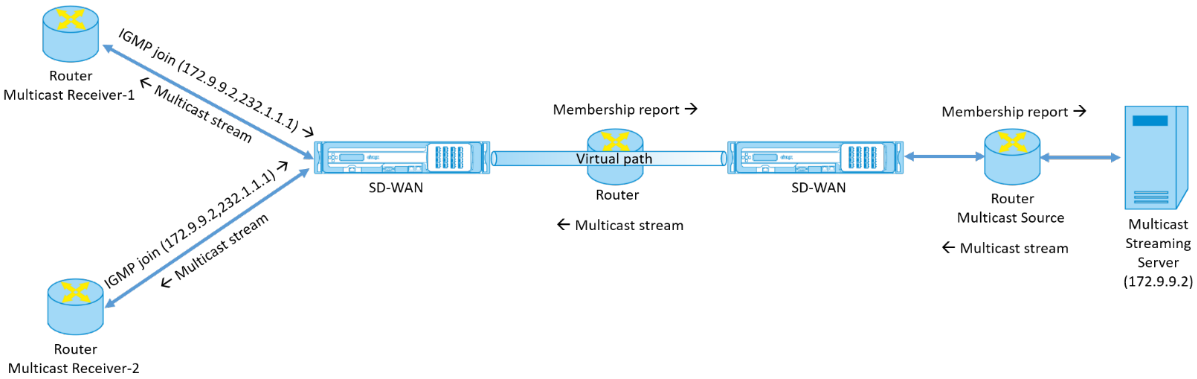
Multicast routing enables efficient distribution of one-to-many traffic. A multicast source, sends multicast traffic in a single stream to a multicast group. The multicast group contains receivers such as hosts and adjacent routers that use the IGMP protocol for multicast communication. Voice over IP, Video on demand, IP television, and Video conferencing are some of the common technologies that use multicast routing. When you enable multicast routing on the Citrix SD-WAN appliance, the appliance acts as a multicast router.

Source specific multicast

Multicast protocols typically allow multicast receivers to receive multicast traffic from any source. With source specific multicast (SSM), you can specify the source from which the receivers receive the multicast traffic. It ensures that the receivers are not open listeners to every source that is sending multicast streams but rather listen to a particular multicast source. SSM reduces the cost of resources used in consuming traffic from every possible source and also provides a layer of security by ensuring that the receivers receive traffic from a known sender.

The following topology shows two multicast receivers at a branch site and a multicast server (172.9.9.2) at the Data Center. The multicast server streams traffic over a particular group (232.1.1.1), the receivers join the group. Any traffic streamed on the multicast group is relayed to all the receivers that joined the group.

> **Note**
>
> For SSM to work, the multicast group IP must fall within the range 232.0.0.0/8.



1. The multicast receivers send an IP IGMP join request indicating that the receivers want to join the multicast group and want to receive the multicast stream from the source. The IGMP join includes 2 attributes the multicast source and group (S, G). IGMP Version 3 is used for SSM on the multicast source and the receiver to relay some INCLUDE specific source addresses. SSM allows the receivers to explicitly receive streams from specific Multicast servers, whose source address is explicitly provided by the receivers as part of the JOIN request. In this example, an IGMP v3 join request is triggered with an explicit include source list, which contains the source 172.9.9.2, to be the address that sends the multicast stream over the group 232.1.1.1.
2. The Citrix SD-WAN at the branch listens to all the IGMP requests from these receivers and converts it into a membership report and sends it over the Virtual Path to the SD-WAN appliance at the data center.
3. The Citrix SD-WAN appliance at the data center receives the membership report over the Virtual Path and forwards it to the Multicast Source, establishing a control channel.
4. The Multicast source transmits the multicast stream over the Virtual path to the multicast receivers.

The control channel traffic and the multicast stream flow through the established virtual path between the branch and the data center. The Citrix SD-WAN overlay path insures and insulates multicast traffic from WAN degradation or link brownouts.

Configure multicast

To configure multicast, perform the following on the SD-WAN appliance at both the source and destination.

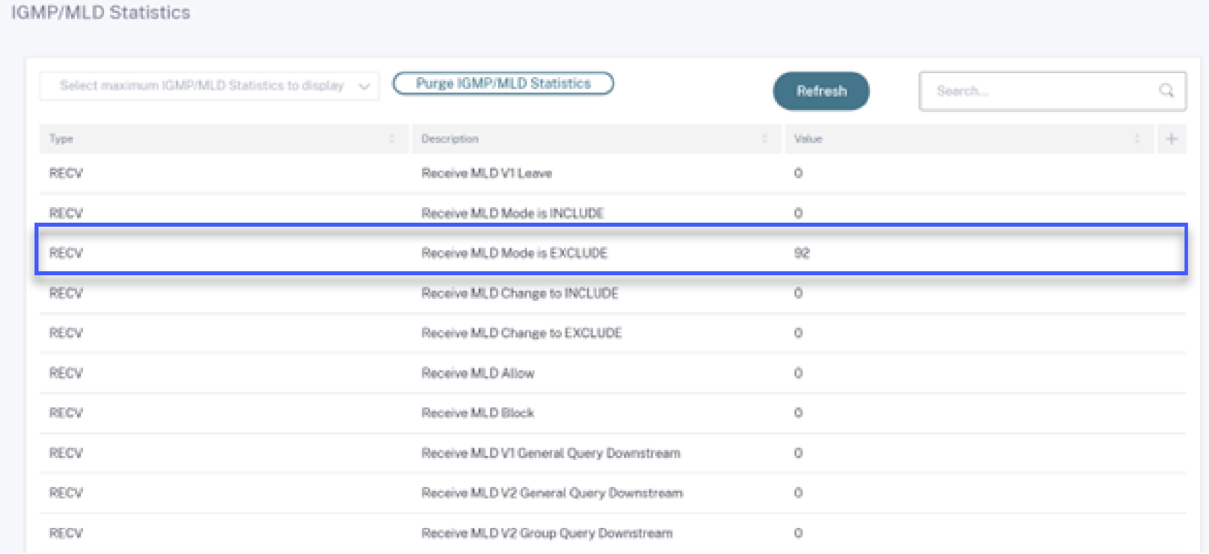
1. Create a multicast group - Provide a name and IP address for the multicast group. The multicast group IP must fall within the range 232.0.0.0/8 for source specific multicast.
2. Enable IGMP proxy –You can configure the Citrix SD-WAN appliance as an IGMP proxy to carry the IGMP control channel information for multicast routing. IGMP V3 is required for single source multicast.
3. Define the upstream and downstream services - An upstream interface enables the IGMP PROXY to connect to the SD-WAN appliance closer to the actual multicast source that streams the traffic. A downstream interface enables the IGMP Proxy to connect to the hosts that are farther away from the actual multicast source that streams the traffic.
   The upstream and downstream services are different for the appliance at the source and the appliance at the destination.

Monitoring

IGMP statistics

When the multicast receivers initiate a join group request, you can see the receiver details under **Monitoring** > **IGMP** on the appliance. You can see this information on the appliances at both the source and the destination.

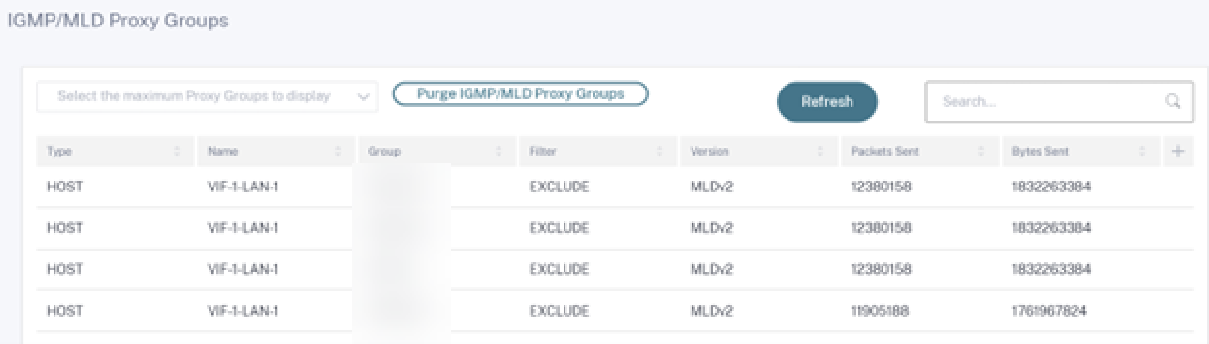
The following image shows an MLD join initiated and the message type RECV is used to receive multicast group addresses. You can also see the IGMP/MLD message statistics below.



IGMP/MLD Statistics
Select maximum IGMP/MLD Statistics to display
Purge IGMP/MLD Statistics
Refresh
Search...

Type	Description	Value
RECV	Receive MLD V1 Leave	0
RECV	Receive MLD Mode is INCLUDE	0
RECV	Receive MLD Mode is EXCLUDE	92
RECV	Receive MLD Change to INCLUDE	0
RECV	Receive MLD Change to EXCLUDE	0
RECV	Receive MLD Allow	0
RECV	Receive MLD Block	0
RECV	Receive MLD V1 General Query Downstream	0
RECV	Receive MLD V2 General Query Downstream	0
RECV	Receive MLD V2 Group Query Downstream	0

The following image shows information about IGMP/MLD proxy groups. You can also see the IGMP/MLD proxy group statistics and the version used.


IGMP/MLD Proxy Groups
Select the maximum Proxy Groups to display
Purge IGMP/MLD Proxy Groups
Refresh
Search...

Type	Name	Group	Filter	Version	Packets Sent	Bytes Sent
HOST	VIF-1-LAN-1	[redacted]	EXCLUDE	MLDv2	12380158	1832263384
HOST	VIF-1-LAN-1	[redacted]	EXCLUDE	MLDv2	12380158	1832263384
HOST	VIF-1-LAN-1	[redacted]	EXCLUDE	MLDv2	12380158	1832263384
HOST	VIF-1-LAN-1	[redacted]	EXCLUDE	MLDv2	11905188	1761967824

Configure Virtual Path Route Cost

August 24, 2022

Citrix SD-WAN supports the following routing enhancements related to data center administration.

For example, consider the SD-WAN network with two data centers; one in North America and one in Europe. You want all sites in North America to route traffic through the data center in North America and all sites in Europe to use the Europe data center. Previously, in SD-WAN 9.3 and earlier release versions, this functionality of data center administration was not supported. This is implemented with the introduction of Virtual Path Route cost.

- Virtual Path Route cost: You can configure the Virtual Path route cost for individual virtual paths that are added to the route cost when a route is learned from a remote site.

This feature invalidates or deletes the WAN to WAN forwarding Cost.

- OSPF Route Cost: You can now import OSPF route cost (type1 metric) by enabling **Copy OSPF Route Cost** in the import filters. OSPF Route cost is considered in route selection instead of SD-WAN cost. Cost up to 65534 instead of 15 is supported, but it is advisable to accommodate for an appropriate virtual path route cost that is added if the route is learned from a remote site.
- BGP - VP cost to MED: You can now copy the Virtual Path route cost for SD-WAN routes into BGP MED values when exporting (redistributing) SD-WAN routes to BGP peers. This can be set for individual neighbors by creating a BGP policy and applying it in the "OUT"direction for each neighbor.
- Any site can have multiple virtual paths to other sites. Sometimes, if there is a Branch to which there is connectivity to services through more virtual paths, there can be two virtual paths from the Branch site. One virtual path through DC1 and the other through DC2. DC1 can be an MCN and DC2 can be a Geo-MCN, and can be configured as another site with Static Virtual Path.

- Add a default cost for each VP as 1. Virtual Path Route cost helps associate a cost to each virtual path of a site. This helps to manipulate route exchanges/updates over a specific virtual path instead of default site cost. With this, we can manipulate which data center to be preferred for sending out the traffic.
- Allow cost to be configured within a small range of values (for example; 1–10) for each VP.
- Virtual path cost must be added to any route shared with neighbor sites to indicate routing preference, including routes learned via Dynamic Routing.
- No Static Virtual Path must have a lower cost than a Dynamic Virtual Path.

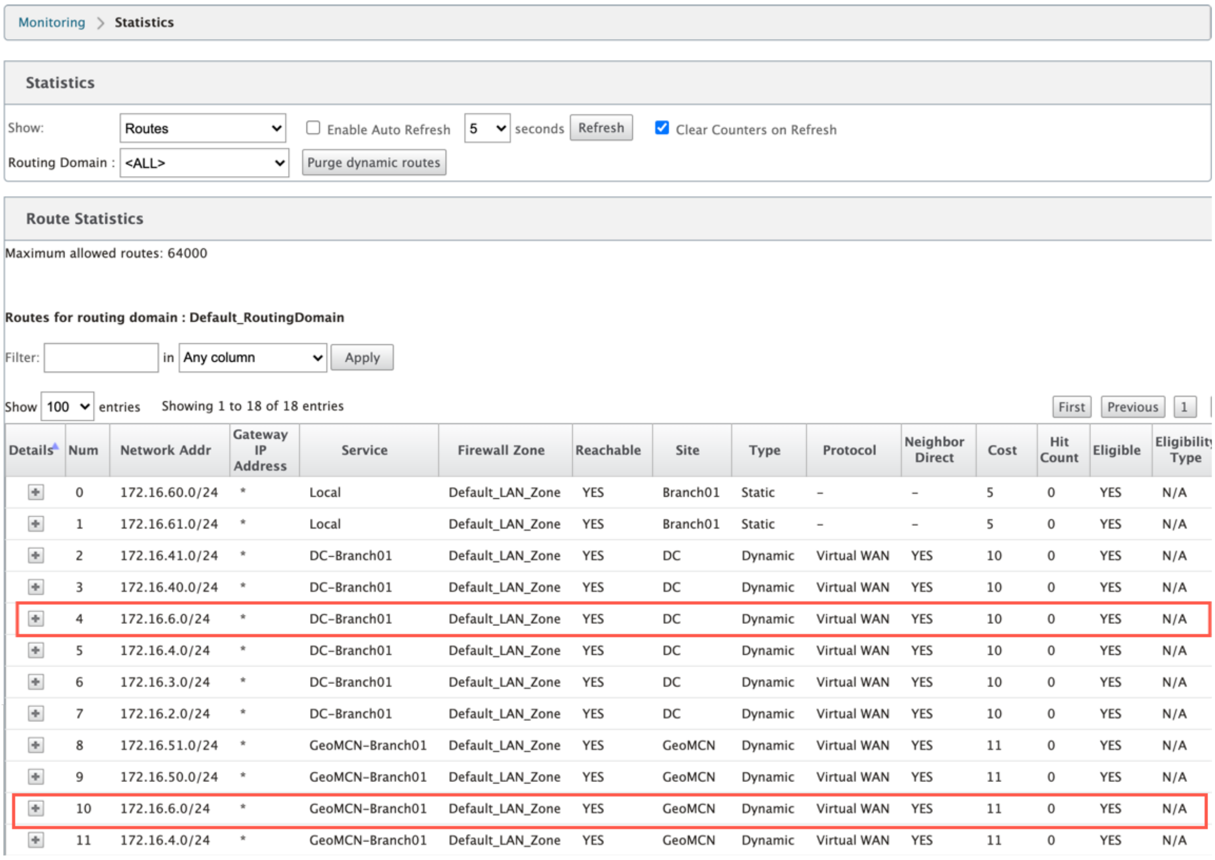
> **Note**
>
> VP Route cost deprecates the WAN to WAN forwarding cost that existed in release versions earlier than release version 10.0. The routing decisions based on WAN to WAN forwarding costs have to be reinfluenced by using VP route cost as the WAN to WAN forwarding cost has no significance when you migrate to release version 10.0.

Monitoring and Troubleshooting

The routing table displays how the same subnets advertised by two sites connected to a branch site over the virtual path are installed with precedence of cost with Virtual Path route cost addition.

To verify the route cost and which routes are used in the routing table, navigate to **Monitoring > Statistics >** under **Show** field, select **Routes**. Route costs and hit counts can be verified in the same page.

The following figure shows the route table with two different costs for the same route which is 172.16.6.0/24 with cost 10 and 11 for services **DC-Branch01** and **GEOMCN-Branch01** respectively.



Statistics

Show: Routes

☐ Enable Auto Refresh 5 seconds Refresh

☑ Clear Counters on Refresh

Routing Domain : <ALL>

Route Statistics

Maximum allowed routes: 64000

Routes for routing domain : Default_RoutingDomain

Filter: in Any column

Show 100 entries Showing 1 to 18 of 18 entries

Details	Num	Network Addr	Gateway IP Address	Service	Firewall Zone	Reachable	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type
⊞	0	172.16.60.0/24	*	Local	Default_LAN_Zone	YES	Branch01	Static	–	–	5	0	YES	N/A
⊞	1	172.16.61.0/24	*	Local	Default_LAN_Zone	YES	Branch01	Static	–	–	5	0	YES	N/A
⊞	2	172.16.41.0/24	*	DC-Branch01	Default_LAN_Zone	YES	DC	Dynamic	Virtual WAN	YES	10	0	YES	N/A
⊞	3	172.16.40.0/24	*	DC-Branch01	Default_LAN_Zone	YES	DC	Dynamic	Virtual WAN	YES	10	0	YES	N/A
⊞	4	172.16.6.0/24	*	DC-Branch01	Default_LAN_Zone	YES	DC	Dynamic	Virtual WAN	YES	10	0	YES	N/A
⊞	5	172.16.4.0/24	*	DC-Branch01	Default_LAN_Zone	YES	DC	Dynamic	Virtual WAN	YES	10	0	YES	N/A
⊞	6	172.16.3.0/24	*	DC-Branch01	Default_LAN_Zone	YES	DC	Dynamic	Virtual WAN	YES	10	0	YES	N/A
⊞	7	172.16.2.0/24	*	DC-Branch01	Default_LAN_Zone	YES	DC	Dynamic	Virtual WAN	YES	10	0	YES	N/A
⊞	8	172.16.51.0/24	*	GeoMCN-Branch01	Default_LAN_Zone	YES	GeoMCN	Dynamic	Virtual WAN	YES	11	0	YES	N/A
⊞	9	172.16.50.0/24	*	GeoMCN-Branch01	Default_LAN_Zone	YES	GeoMCN	Dynamic	Virtual WAN	YES	11	0	YES	N/A
⊞	10	172.16.6.0/24	*	GeoMCN-Branch01	Default_LAN_Zone	YES	GeoMCN	Dynamic	Virtual WAN	YES	11	0	YES	N/A
⊞	11	172.16.4.0/24	*	GeoMCN-Branch01	Default_LAN_Zone	YES	GeoMCN	Dynamic	Virtual WAN	YES	11	0	YES	N/A

Configure Virtual Router Redundancy Protocol

August 24, 2022

Virtual Router Redundancy Protocol (VRRP) is a widely used protocol that provides device redundancy to eliminate the single point of failure inherent in the static default-routed environment. VRRP allows you to configure two or more routers to form a group. This group appears as a single default gateway with one virtual IP address and one virtual MAC address.

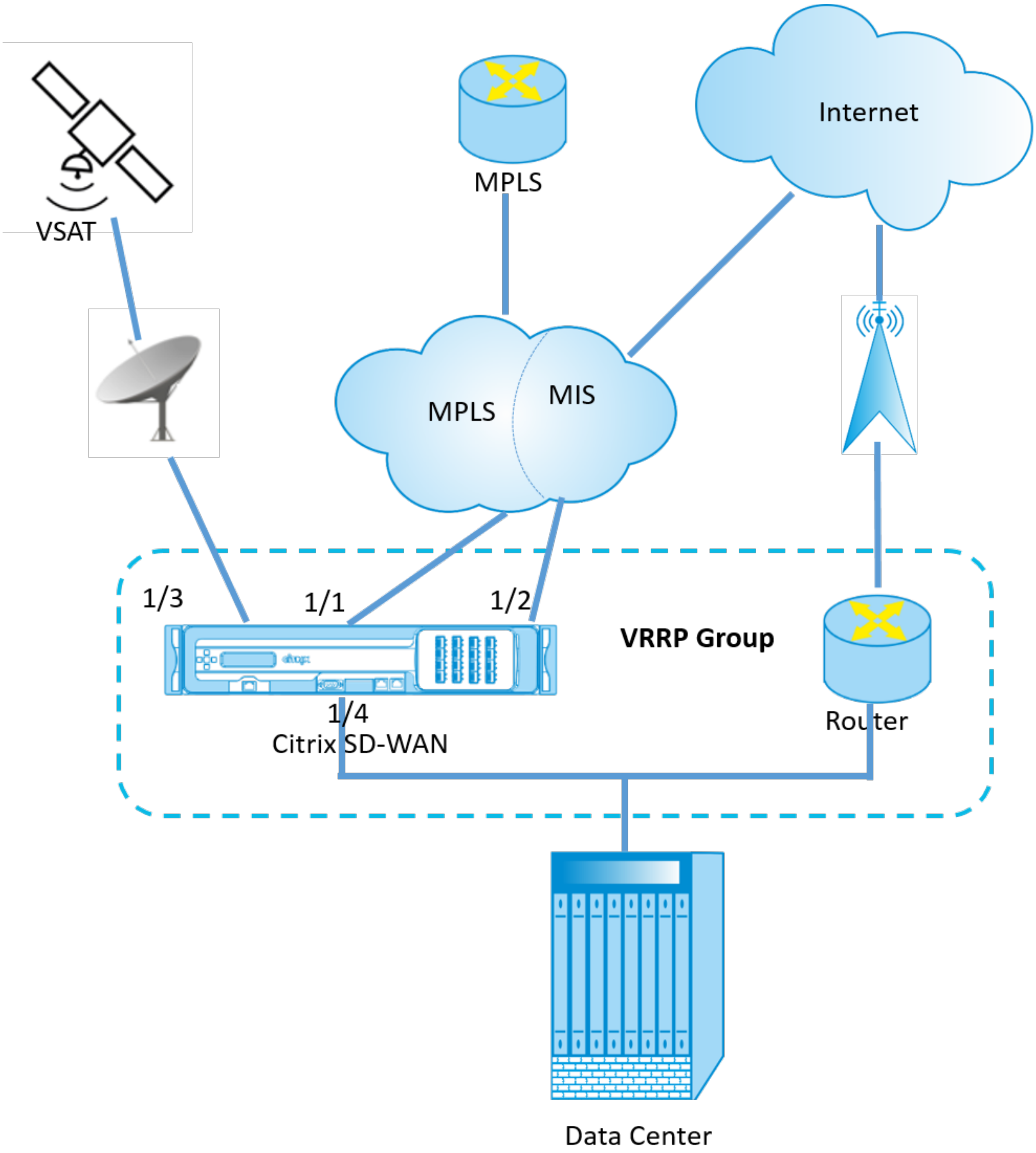
A back-up router automatically takes over if the primary / master router fails. In a VRRP set-up, the master router sends a VRRP packet known as an advertisement to the back-up routers. If the master router stops sending the advertisement, the back-up router sets the interval timer. If no advertisement is received within this hold period, the back-up router initiates the failover routine.

VRRP specifies an election process in which, the router with the highest priority becomes the master. If the priority is the same among the routers, the router with the highest IP address becomes the master. The other routers are in backup state. The election process is initiated again if the master fails, a new router joins the group, or an existing router leaves the group.

VRRP ensures a high availability default path without configuring dynamic routing or router discovery protocols on every end-host.

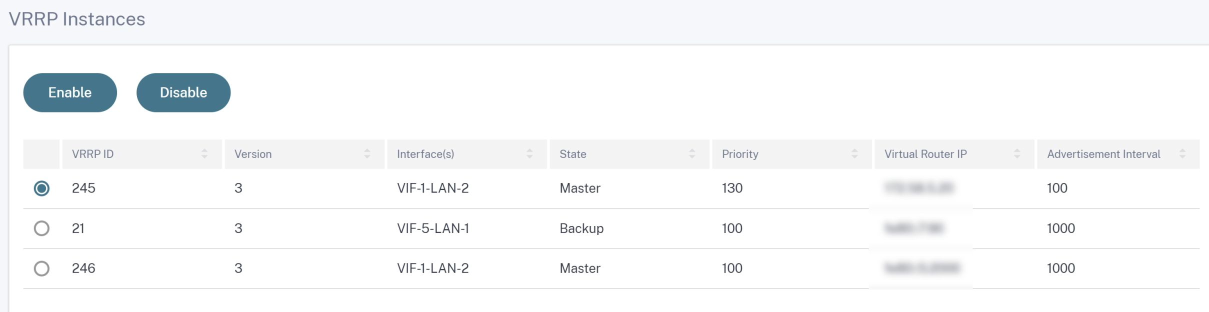
Citrix SD-WAN release version 10.1 supports VRRP version 2 and version 3 to inter-operate with any third party routers. The SD-WAN appliance acts as a master router and direct the traffic to use the Virtual Path Service between sites. You can configure the SD-WAN appliance as the VRRP master by configuring the Virtual Interface IP as the VRRP IP and by manually setting the priority to a higher value than the peer routers. You can configure the advertisement interval and the preempt option.

The below network diagram shows a Citrix SD-WAN appliance and a router configured as a VRRP group. The SD-WAN appliance is configured to be the master. If the SD-WAN appliance fails, the back-up router takes-over within milliseconds, ensuring that there is no downtime.



VRRP Statistics

You can view the VRRP statistics under **Monitoring** > **VRRP**.



VRRP Instances

	VRRP ID	Version	Interface(s)	State	Priority	Virtual Router IP	Advertisement Interval
●	245	3	VIF-1-LAN-2	Master	130	[redacted]	100
○	21	3	VIF-5-LAN-1	Backup	100	[redacted]	1000
○	246	3	VIF-1-LAN-2	Master	100	[redacted]	1000

You can view the following statistics data:

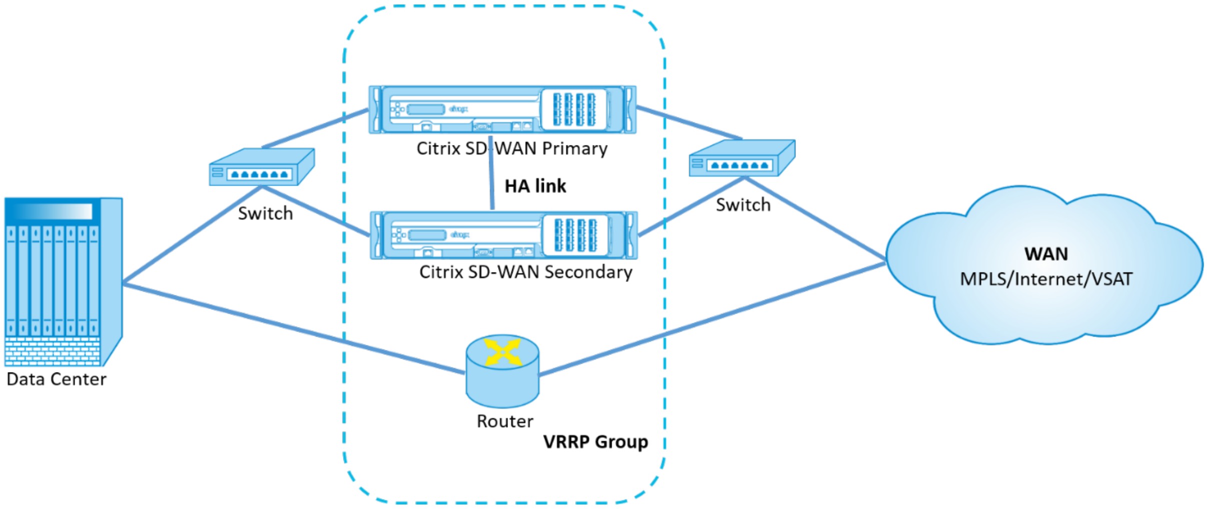
- **VRRP ID:** The VRRP group ID
- **Version:** The VRRP protocol version.
- **Interface:** The virtual interface used for VRRP.
- **State:** The VRRP state of the SD-WAN appliance. It indicates whether the appliance is a master or a backup.
- **Priority:** The priority of the SD-WAN appliance for a VRRP Group
- **Virtual Router IP:** The virtual router IP address for the VRRP group.
- **Advertisement Interval:** The frequency of VRRP advertisements.
- **Enable:** Select this to enable the VRRP instance on the SD-WAN appliance.
- **Disable:** Select this to disable the VRRP instance on the SD-WAN appliance.

Limitations

- VRRP is supported in Gateway Mode deployment only.
- You can configure up to four VRRP IDs (VRID).
- Up to 16 virtual network interfaces can participate in VRID.

High Availability and VRRP

You can significantly reduce network downtime and traffic disruption by leveraging both the high availability and VRRP features on your SD-WAN network. Deploy a pair of Citrix SD-WAN appliance in active/standby roles along with a standby router to form the VRRP group. This group appears as a single default gateway with one virtual IP address and one virtual MAC address.



The following are 2 cases with the above deployment:

1st case: High availability failover timer on SD-WAN equals the VRRP failover timer.

The expected behavior is high availability switchover to happen before the VRRP switchover, that is the traffic continues to flow through the new Active SD-WAN appliance. In this case SD-WAN continues with the VRRP Master role.

2nd case: High availability failover timer on SD-WAN greater than the VRRP failover timer.

The expected behavior is the VRRP switchover to the router happens, that is the router becomes VRRP Master and traffic might momentarily flow through the router, bypassing the SD-WAN appliance.

But once the high availability switchover happens, SD-WAN again becomes VRRP Master, that is the traffic now flows through the new active SD-WAN appliance.

For more information on high availability deployment modes, see High Availability.

Routing Support for LAN Segmentation

August 24, 2022

The SD-WAN Standard Edition appliances implement LAN segmentation across distinct sites where either appliance is deployed. The appliances recognize and maintain a record of the LAN side VLANs available, and configure rules around what other LAN segments (VLANs) can connect to at a remote location with another SD-WAN Standard Edition appliance.

The above capability is implemented by using a Virtual Routing and Forwarding (VRF) table that is maintained in the SD-WAN Standard Edition appliance, which keeps track of the remote IP address ranges accessible to a local LAN segment. This VLAN-to-VLAN traffic would still traverse the WAN through the same pre-established Virtual Path between the two appliances (no new paths need to be created).

An example use case for this functionality is that a WAN administrator may be able to segment local branch networking environment through a VLAN, and provide some of those segments (VLANs) access to DC-side LAN segments that have access to the internet, while others may not obtain such access.

Inter-routing domain service

August 24, 2022

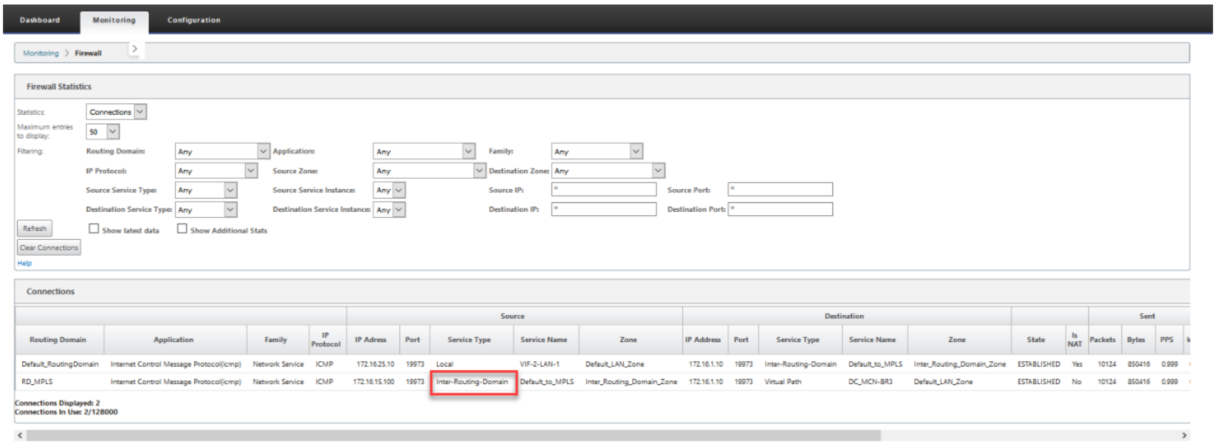
Citrix SD-WAN allows you to segment the network using Routing Domains, ensuring high security and easy management. With the use of the Routing Domain the traffic is isolated from each other in the overlay network. Each routing domain maintains its own routing table. However, sometimes we need to route the traffic between the Routing domains. For example if shared services such as printer, scanner, and mail server are provisioned as a separate Routing Domain. Inter-routing domain is required to enable users from different routing domains to access the shared services.

Citrix SD-WAN provides Static Inter-Routing Domain Service, enabling route leaking between Routing Domains within a site or between different sites. This eliminates the need for an edge router to handle route leaking. The Inter-routing domain service can further be used to set up routes, firewall policies, and NAT rules.

A new Firewall Zone, **Inter_Routing_Domain_Zone** is created by default and serves as the firewall zone for the Inter-Routing Domain Services for routing and filtering.

Monitoring

You can view monitoring statistics for connections that use inter-routing-domain services under **Monitoring** > **Firewall Statistics** > **Connections**.



Firewall Statistics

Statistics: Connections

Maximum entries to display: 50

Filtering:

Routing Domain: Any; Application: Any; Family: Any

IP Protocol: Any; Source Zone: Any; Destination Zone: Any

Source Service Type: Any; Source Service Instance: Any; Source IP: *; Source Port: *

Destination Service Type: Any; Destination Service Instance: Any; Destination IP: *; Destination Port: *

□ Show latest data □ Show Additional Stats

Connections

				Source					Destination							Sent		
Routing Domain	Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State	Is NAT	Packets	Bytes	PPS
Default_RoutingDomain	Internet Control Message Protocol(icmp)	Network Service	ICMP	172.16.25.10	19973	Local	VIF-2-LAN-1	Default_LAN_Zone	172.16.1.10	19973	Inter-Routing-Domain	Default_to_MPLS	Inter_Routing_Domain_Zone	ESTABLISHED	Yes	10124	850416	0.999
RD_MPLS	Internet Control Message Protocol(icmp)	Network Service	ICMP	172.16.15.100	19973	Inter-Routing-Domain	Default_to_MPLS	Inter_Routing_Domain_Zone	172.16.1.10	19973	Virtual Path	DC_MCN-BR3	Default_LAN_Zone	ESTABLISHED	No	10124	850416	0.999

Connections Displayed: 2
Connections In Use: 2/128000

ECMP load balancing

August 24, 2022

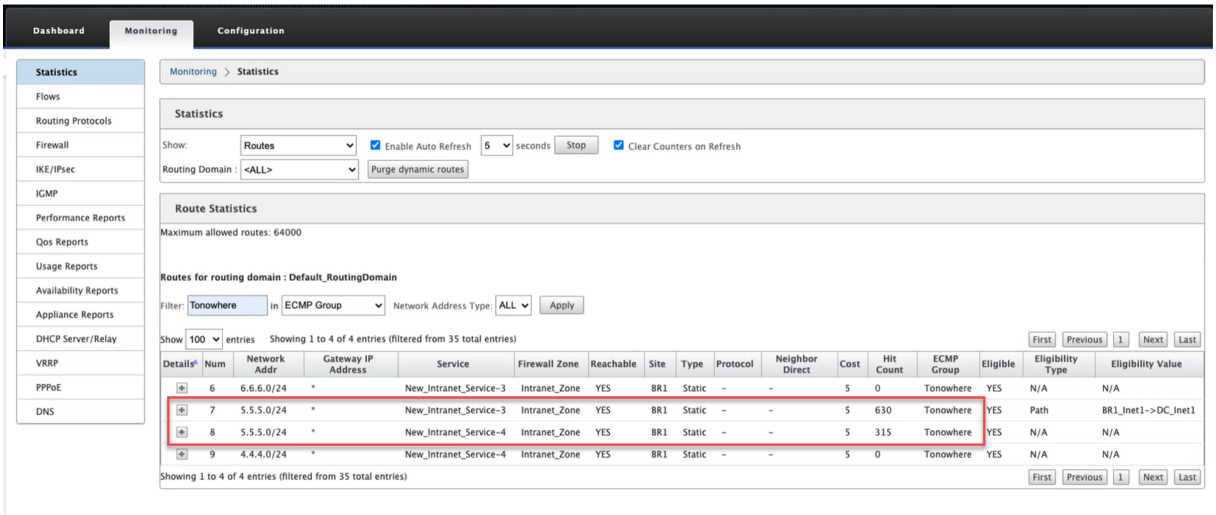
Equal Cost Multi-Path (ECMP) groups allow you to group multiple paths with the same cost, destination, and service. The connections or session data is load balanced across all the paths in the ECMP group depending on the type of ECMP group. For example, consider a network with two WAN links between a branch and a data center having the same route cost. Traditionally, one of the WAN links would be active and the other remains dormant acting as a fallback link. With ECMP Groups, you can group these WAN links together and allow traffic to be load balanced through both the WAN links. ECMP load balancing ensures:

- Distribution of traffic over multiple equal-cost paths.
- Optimal usage of available bandwidth.
- Dynamic transfer of traffic to other ECMP member path, if a link fails. ECMP supports static routes on IPsec / GRE tunnels.

ECMP load balancing is supported on Virtual Paths and Intranet services. ECMP groups are defined at the global level. You can define a maximum of 254 ECMP groups in your network. The maximum number of ECMP eligible routes in an ECMP group depend on your appliance and license type. The following two types of ECMP groups are supported on Citrix SD-WAN:

- Source/destination IP address: Networks where multiple clients try to connect to the same destination, the connections are load balanced across equal cost WAN links.
- Session: Networks where a single client is connected to a destination and multiple sessions are spawned. The session data is load balanced across equal cost WAN links.

To monitor ECMP load balancing, in the SD-WAN UI, navigate to **Monitoring** > **Statistics** > **Routes** and filter the search results using the ECMP group name.



Statistics

Show: Routes ☑ Enable Auto Refresh 5 seconds ☑ Clear Counters on Refresh

Routing Domain : <ALL>

Route Statistics

Maximum allowed routes: 64000

Routes for routing domain : Default_RoutingDomain

Filter: Tonowhere in ECMP Group Network Address Type: ALL

Show 100 entries Showing 1 to 4 of 4 entries (filtered from 35 total entries)

Details	Num	Network Addr	Gateway IP Address	Service	Firewall Zone	Reachable	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	ECMP Group	Eligible	Eligibility Type	Eligibility Value
+	6	6.6.6.0/24	*	New_Intranet_Service-3	Intranet_Zone	YES	BR1	Static	-	-	5	0	Tonowhere	YES	N/A	N/A
+	7	5.5.5.0/24	*	New_Intranet_Service-3	Intranet_Zone	YES	BR1	Static	-	-	5	630	Tonowhere	YES	Path	BR1_Inet1->DC_Inet1
+	8	5.5.5.0/24	*	New_Intranet_Service-4	Intranet_Zone	YES	BR1	Static	-	-	5	315	Tonowhere	YES	N/A	N/A
+	9	4.4.4.0/24	*	New_Intranet_Service-4	Intranet_Zone	YES	BR1	Static	-	-	5	0	Tonowhere	YES	N/A	N/A

Showing 1 to 4 of 4 entries (filtered from 35 total entries)

In the sample data, we see that all the routes within a service having a common ECMP group are part of that ECMP group. For example, 6.6.6.0/24 and 5.5.5.0/24 are in the ECMP Group **Tonowhere**. However, the traffic load is balanced between the services **New_Intranet_Service-3** and **New_Intranet_Service-4** that share a destination IP 5.5.5.0/24 and are associated to the same ECMP group.

> **Note**
>
> For the SIA and Zscaler service, you can load balance across two IPsec tunnel paths with ECMP (Active/Active).

Security

August 24, 2022

The topics in this section provide general security guidance for Citrix SD-WAN deployments.

Citrix SD-WAN deployment guidelines

To maintain security through the deployment lifecycle, Citrix recommends the following security consideration:

- Physical Security
- Appliance Security
- Network Security
- Administration and Management

The topics described in the following links provide more information about how to configure security for SD-WAN networks using:

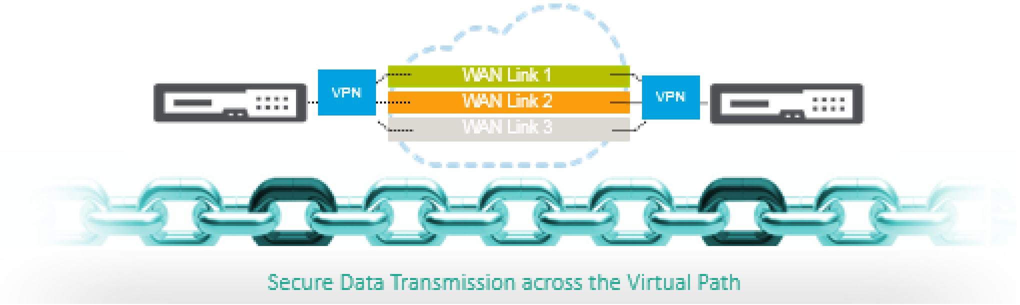
- IPsec tunnels
- Firewall

IPSec Tunnel Termination

August 24, 2022

Citrix SD-WAN supports IPsec virtual paths, enabling third-party devices to terminate IPsec VPN Tunnels on the LAN or WAN side of a Citrix SD-WAN appliance. You can secure site-to-site IPsec Tunnels terminating on an SD-WAN appliance by using a 140-2 Level 1 FIPS certified IPsec cryptographicbinary.

Citrix SD-WAN also supports resilient IPsec tunneling using a differentiated virtual path tunneling mechanism.



> **Important Note**:
>
> - From SD-WAN 11.5 release onwards, all the IPsec tunnel configurations and IKE settings are supported only through Citrix SD-WAN Orchestrator service. For information regarding Citrix SD-WAN Orchestrator service IPsec/IKE configurations, see IPsec service.
> - Citrix SD-WAN supports connectivity to Oracle Cloud Infrastructure (OCI) through IPsec.

Citrix SD-WAN integration with AWS Transit Gateway

August 24, 2022

Amazon Web Service (AWS) Transit Gateway service enables customers to connect their Amazon Virtual Private Clouds (VPCs) and their on-premises networks to a single gateway. As the number of workloads running on AWS grows, you can scale your networks across multiple accounts and Amazon VPCs to keep up with the growth.

You can now connect pairs of Amazon VPCs using peering. However, managing point-to-point connectivity across many Amazon VPCs, without the ability to centrally manage the connectivity policies, can be operationally costly and cumbersome. For on-premises connectivity, you need to attach your AWS VPN to each individual Amazon VPC. This solution can be time consuming to build and hard to manage when the number of VPCs grows into the hundreds.

With **AWS Transit Gateway**, you only have to create and manage a single connection from the central gateway into each Amazon VPC, on-premises data center, or remote office across your network. The Transit Gateway acts as a hub that controls how traffic is routed among all the connected networks which act like spokes. This hub and spoke model significantly simplifies management and reduces operational costs because each network only has to connect to the Transit Gateway and not to every other network. Any new VPC is connected to the Transit Gateway and automatically available to every other network that is connected to the Transit Gateway. This ease of connectivity makes it easy to scale your network as you grow.

As enterprises migrate an increasing number of applications, services, and infrastructure to the cloud, they are rapidly deploying SD-WAN to realize the benefits of broadband connectivity and to directly connect branch site users to cloud resources. There are many challenges with the complexities of building and managing global private networks using internet transport services to connect geographically distributed locations and users with proximity-based cloud resources. The **AWS Transit Gateway Network Manager** changes this paradigm. Now, Citrix SD-WAN customers who use AWS can use Citrix SD-WAN with AWS transit gateway by integrating Citrix SD-WAN branch appliance AWS Transit Gateway to deliver the highest quality of experience for users with the ability to reach out to all VPCs connected to the Transit Gateway.

The following are the steps to integrate Citrix SD-WAN with AWS Transit Gateway:

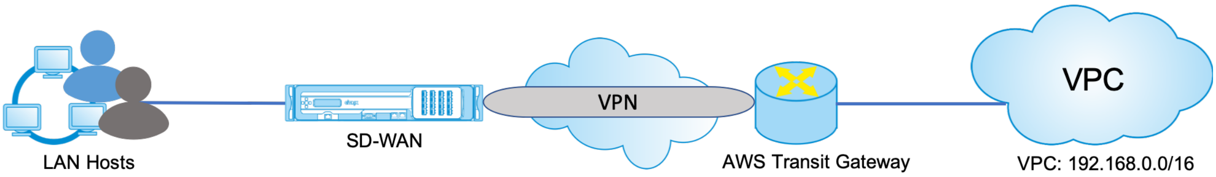
1. Create the AWS Transit Gateway.
2. Attach a VPN to the Transit Gateway (either existing VPN or a new one).
3. Attach VPN to the configured Transit Gateway where the VPN is with SD-WAN site located On-prem or in any cloud (AWS, Azure, or GCP).
4. Establish the Border Gateway Protocol (BGP) peering over the IPsec Tunnel with the AWS Transit Gateway from Citrix SD-WAN to learn the networks (VPCs) attached to Transit Gateway.

Use case

The use case is to reach out to resources deployed within AWS (in any VPC) from the branch environment. Using AWS Transit Gateway allows the traffic to reach to all VPCs connected to the Transit Gateway without dealing with BGP routes. To achieve this, perform the following methods:

- Establish the IPsec to AWS Transit Gateway from the branch Citrix SD-WAN appliance. In this deployment method you will not get full SD-WAN benefits as the traffic will go over IPsec.
- Deploy a Citrix SD-WAN appliance within AWS and connect it to your On-prem Citrix SD-WAN appliance via virtual path.

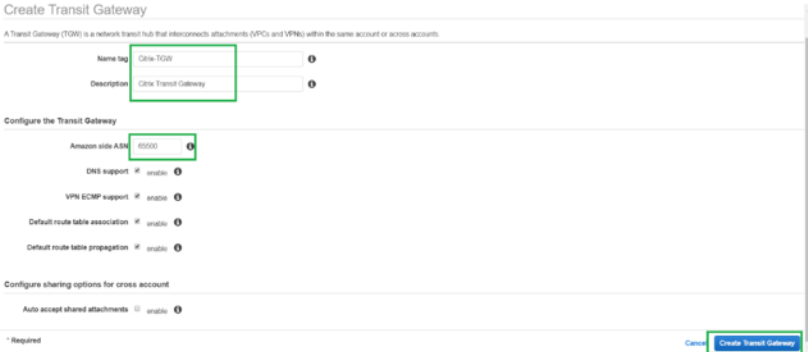
Regardless of which method is chosen, the traffic reaches to the VPCs connected to the Transit Gateway without manually manage the routing within AWS infra.



AWS Transit Gateway configuration

To create the **AWS Transit Gateway**, navigate to VPC dashboard and go to **Transit Gateway** section.

1. Provide the Transit Gateway Name, Description, and Amazon ASN number as highlighted in the following screenshot and click **Create Transit Gateway**.



Create Transit Gateway

A Transit Gateway (TGW) is a network transit hub that interconnects attachments (VPCs and VPNs) within the same account or across accounts.

Name tag: Citrix-TGW

Description: Citrix Transit Gateway

Configure the Transit Gateway

Amazon side ASN: 65500

DNS support ☑ enable

VPN ECMP support ☑ enable

Default route table association ☑ enable

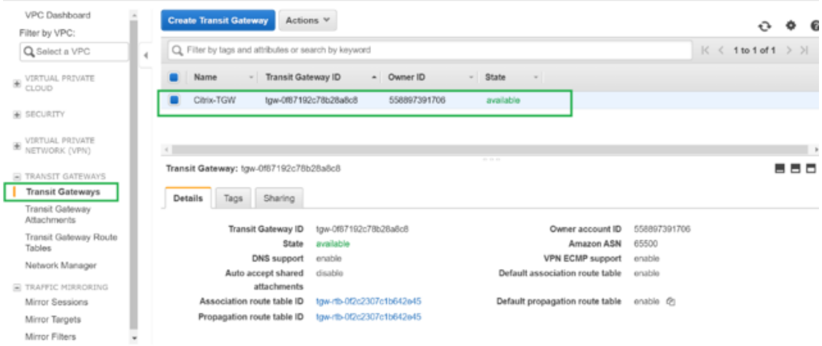
Default route table propagation ☑ enable

Configure sharing options for cross account

Auto accept shared attachments □ enable

* Required

Once the Transit Gateway creation is completed, you can see the status as **Available**.



Name	Transit Gateway ID	Owner ID	State
Citrix-TGW	tgw-0f87192c78b28a8c8	558897391706	available

Transit Gateway: tgw-0f87192c78b28a8c8

Transit Gateway ID: tgw-0f87192c78b28a8c8

State: available

DNS support: enable

Auto accept shared attachments: disable

Association route table ID: tgw-rtb-0f2c2307c1b642e45

Propagation route table ID: tgw-rtb-0f2c2307c1b642e45

Owner account ID: 558897391706

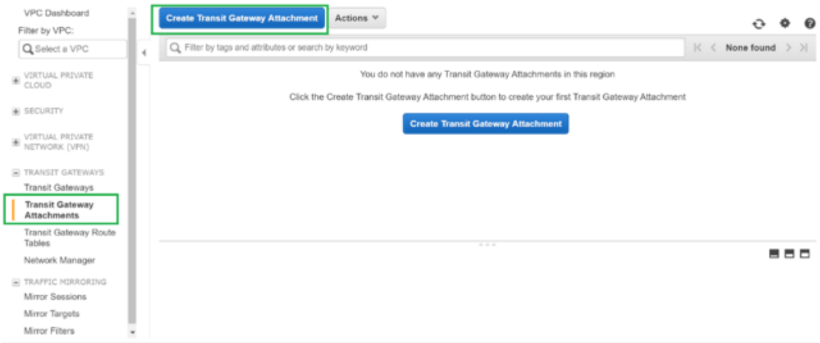
Amazon ASN: 65500

VPN ECMP support: enable

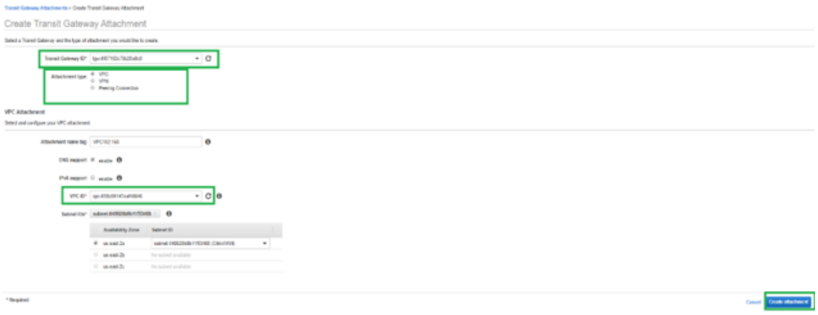
Default association route table: enable

Default propagation route table: enable

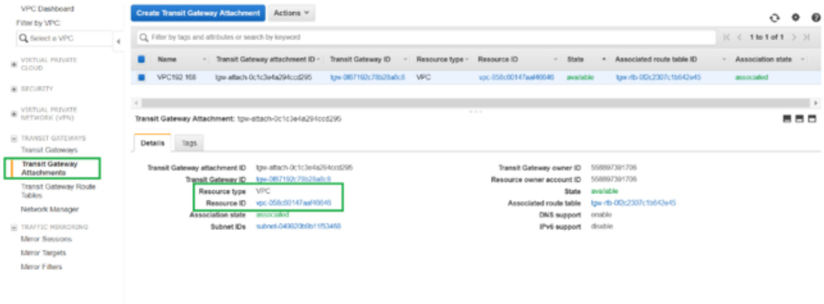
2. To create the **Transit Gateway Attachments**, navigate to **Transit Gateways > Transit Gateway Attachments** and click **Create Transit Gateway Attachment**.


VPC Dashboard
Filter by VPC:
Select a VPC
VIRTUAL PRIVATE CLOUD
SECURITY
VIRTUAL PRIVATE NETWORK (VPN)
TRANSIT GATEWAYS
Transit Gateways
Transit Gateway Attachments
Transit Gateway Route Tables
Network Manager
TRAFFIC MIRRORING
Mirror Sessions
Mirror Targets
Mirror Filters
Create Transit Gateway Attachment
Actions
Filter by tags and attributes or search by keyword
None found
You do not have any Transit Gateway Attachments in this region
Click the Create Transit Gateway Attachment button to create your first Transit Gateway Attachment
Create Transit Gateway Attachment

3. Select the Transit Gateway created from the drop-down list and select attachment type as **VPC**. Provide the attachment name tag and select the VPC ID that you want to attach to the Transit Gateway created. One of the subnets from the selected VPC will be auto selected. Click **Create Attachment** to attach VPC to the Transit Gateway.



4. After attaching the VPC to the transit gateway, you can see that the **Resource type VPC** got associated to the Transit Gateway.



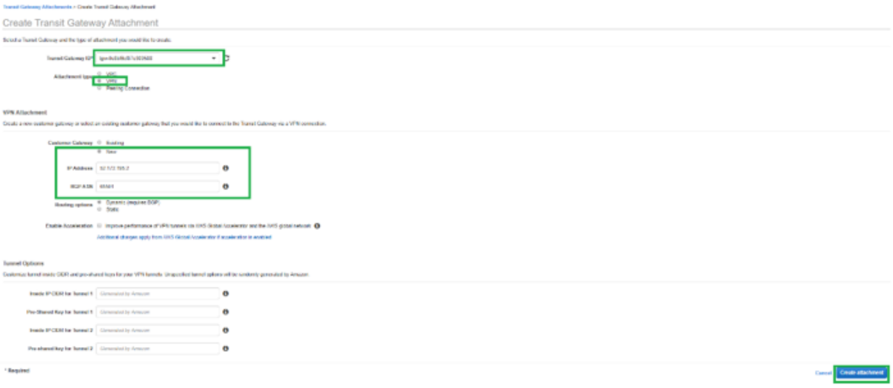
Name	Transit Gateway attachment ID	Transit Gateway ID	Resource type	Resource ID	State	Associated route table ID	Association state
VPC192.168	tgw-attach-0c1c3e4a294ccd295	tgw-0f87192c78b28a8c0	VPC	vpc-058c60147aaf46646	available	tgw-rtb-00c2307c1b642e45	associated

Transit Gateway Attachment: tgw-attach-0c1c3e4a294ccd295

Transit Gateway attachment ID	tgw-attach-0c1c3e4a294ccd295	Transit Gateway owner ID	558897391706
Transit Gateway ID	tgw-0f87192c78b28a8c0	Resource owner account ID	558897391706
Resource type	VPC	State	available
Resource ID	vpc-058c60147aaf46646	Associated route table	tgw-rtb-00c2307c1b642e45
Association state	associated	DNS support	enable
Subnet IDs	subnet-04902b0b11f53468	IPv6 support	disable

5. To attach SD-WAN to the Transit Gateway using VPN, select the **Transit Gateway ID** from the drop-down list and select **Attachment type** as **VPN**. Ensure that you select the correct Transit Gateway ID.

   Attach a new VPN Customer Gateway by providing the SD-WAN WAN link Public IP address and its BGP ASN Number. Click **Create Attachment** to attach VPN with Transit Gateway.



Transit Gateway Attachments > Create Transit Gateway Attachment

Create Transit Gateway Attachment

Select a Transit Gateway and the type of attachment you would like to create.

Transit Gateway ID* [illegible]

Attachment type* ○ VPC ● VPN ○ Peering Connection

VPN Attachment

Create a new customer gateway or select an existing customer gateway that you would like to connect to the Transit Gateway via a VPN connection.

Customer Gateway ○ Existing ● New

IP Address 52.172.195.2

BGP ASN 65501

Routing options ● Dynamic (requires BGP) ○ Static

Enable Acceleration □ Improve performance of VPN tunnels via AWS Global Accelerator and the AWS global network

Additional charges apply from AWS Global Accelerator if acceleration is enabled

Tunnel Options

Customize tunnel inside CIDR and pre-shared keys for your VPN tunnels. Unspecified tunnel options will be randomly generated by Amazon.

Inside IP CIDR for Tunnel 1 Generated by Amazon

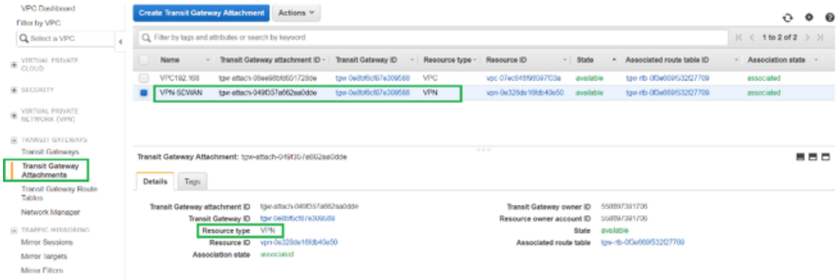
Pre-Shared Key for Tunnel 1 Generated by Amazon

Inside IP CIDR for Tunnel 2 Generated by Amazon

Pre-shared key for Tunnel 2 Generated by Amazon

* Required

6. Once the VPN Attached to the Transit Gateway, you can view the details as shown in the following screenshot:



Name	Transit Gateway attachment ID	Transit Gateway ID	Resource type	Resource ID	State	Associated route table ID	Association state
VPC192.168	tgw-attach-08ee98bfd6517280e	tgw-0e8bf6cf87e309568	VPC	vpc-07ec6481f98597f03e	available	tgw-rtb-0f3e669f532f27709	associated
VPN-SDWAN	tgw-attach-049f357a662aa0dde	tgw-0e8bf6cf87e309568	VPN	vpn-0e328de16fdb40e50	available	tgw-rtb-0f3e669f532f27709	associated

Transit Gateway Attachment: tgw-attach-049f357a662aa0dde

Transit Gateway attachment ID tgw-attach-049f357a662aa0dde

Transit Gateway ID tgw-0e8bf6cf87e309568

Resource type VPN

Resource ID vpn-0e328de16fdb40e50

Association state associated

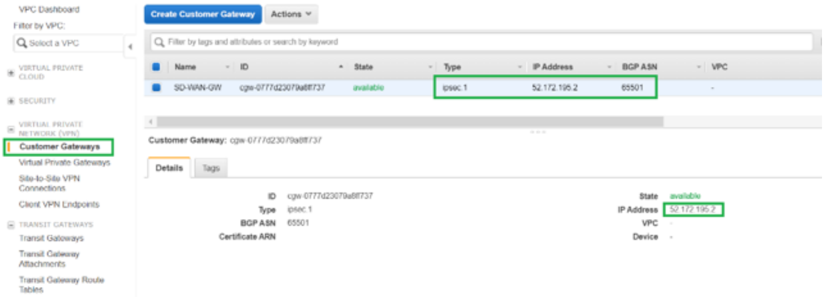
Transit Gateway owner ID 558897391706

Resource owner account ID 558897391706

State available

Associated route table tgw-rtb-0f3e669f532f27709

7. Under **Customer Gateways**, SD-WAN Customer Gateway and Site-to-Site VPN Connection is created as part of VPN Attachment to Transit Gateway. You can see that the SD-WAN Customer Gateway is created along with the IP address of this Customer Gateway that represents the WAN link Public IP address of SD-WAN.



Name	ID	State	Type	IP Address	BGP ASN	VPC
SD-WAN-GW	cgw-0777d23079a8f737	available	ipsec.1	52.172.195.2	65501	-

Customer Gateway: cgw-0777d23079a8f737

ID cgw-0777d23079a8f737

Type ipsec.1

BGP ASN 65501

Certificate ARN

State available

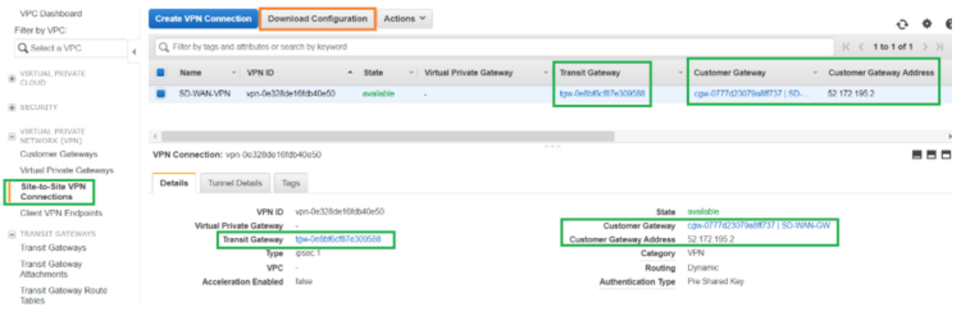
IP Address 52.172.195.2

VPC -

Device -

8. Navigate to **Site-to-Site VPN Connections** to download **SD-WAN Customer Gateway VPN Configuration**. This configuration file has two IPsec Tunnel details along with the BGP peer information. Two tunnels are created from SD-WAN to Transit Gateway for redundancy.

   You can see that SD-WAN WAN link Public IP address was configured as the Customer Gateway Address.



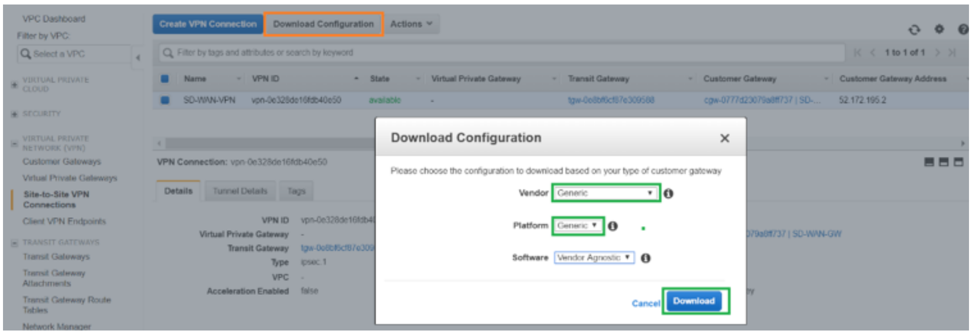
Name	VPN ID	State	Virtual Private Gateway	Transit Gateway	Customer Gateway	Customer Gateway Address
SD-WAN-VPN	vpn-0e328de16fdb40e50	available	-	tgw-0e8bf6cf87e309588	cgw-0777d23079a8ff737 | SD-...	52.172.195.2

VPN Connection: vpn-0e328de16fdb40e50

VPN ID vpn-0e328de16fdb40e50
Virtual Private Gateway -
Transit Gateway tgw-0e8bf6cf87e309588
Type ipsec.1
VPC -
Acceleration Enabled false

State available
Customer Gateway cgw-0777d23079a8ff737 | SD-WAN-GW
Customer Gateway Address 52.172.195.2
Category VPN
Routing Dynamic
Authentication Type Pre Shared Key

9. Click **Download Configuration** and download the VPN configuration file. Select the **Vendor**, **Platform** as **Generic**, and **Software** as **Vendor Agnostic**.



Please choose the configuration to download based on your type of customer gateway

Vendor Generic
Platform Generic
Software Vendor Agnostic

The downloaded configuration file contains the following information:

- IKE config
- IPsec configuration for AWS Transit Gateway
- Tunnel interface configuration
- BGP configuration

This information is available for two IPsec tunnels for High Availability (HA). Ensure that you configure both the tunnel end points while configuring this in SD-WAN. See the following screenshot for reference:

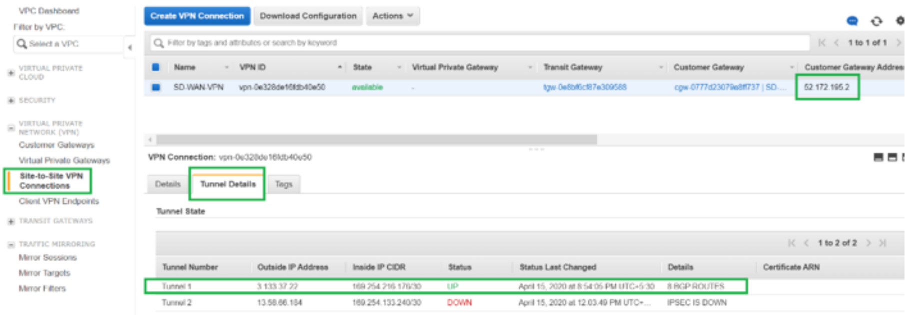
Configure Intranet service on SD-WAN

To configure an Intranet service through Citrix SD-WAN Orchestrator service, go to Delivery services.

Monitoring and Troubleshooting on AWS

1. To verify the IPsec Tunnel establishment status on AWS, Navigate to **VIRTUAL PRIVATE NETWORK(VPN) > Site-to-Site VPN Connections**. In the following screenshot, you can observe that the Customer Gateway Address represents SD-WAN Link Public IP address using which you have established tunnel.

The Tunnel status is shown as **UP**. Also it can be observed that AWS has learned **8 BGP ROUTES** from SD-WAN. This means SD-WAN is able to establish Tunnel with AWS Transit Gateway and also able to exchange routes over BGP.



Name	VPN ID	State	Virtual Private Gateway	Transit Gateway	Customer Gateway	Customer Gateway Addres
SD-WAN-VPN	vpn-0e328de16fdb40e50	available	-	tgw-0e8bf6cf87e309588	cgw-0777d23079e8ff737 | SD-...	52.172.195.2

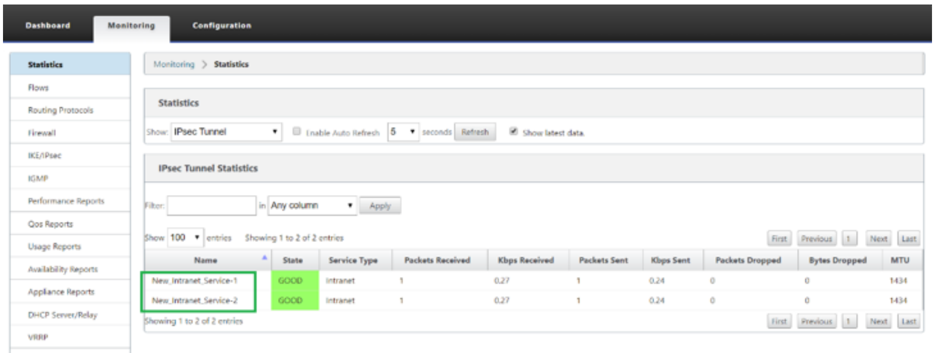
VPN Connection: vpn-0e328de16fdb40e50

Tunnel State

Tunnel Number	Outside IP Address	Inside IP CIDR	Status	Status Last Changed	Details	Certificate ARN
Tunnel 1	3.133.37.22	169.254.216.176/30	UP	April 15, 2020 at 8:54:05 PM UTC+5:30	8 BGP ROUTES	
Tunnel 2	13.58.66.184	169.254.133.240/30	DOWN	April 15, 2020 at 12:03:49 PM UTC+...	IPSEC IS DOWN	

2. Configure IPsec and BGP details related to the second tunnel based on the downloaded configuration file on SD-WAN.

   Status related to both the tunnels can be Monitored on SD-WAN as follows:



Statistics

Show: IPsec Tunnel ☐ Enable Auto Refresh 5 seconds ☑ Show latest data.

IPsec Tunnel Statistics

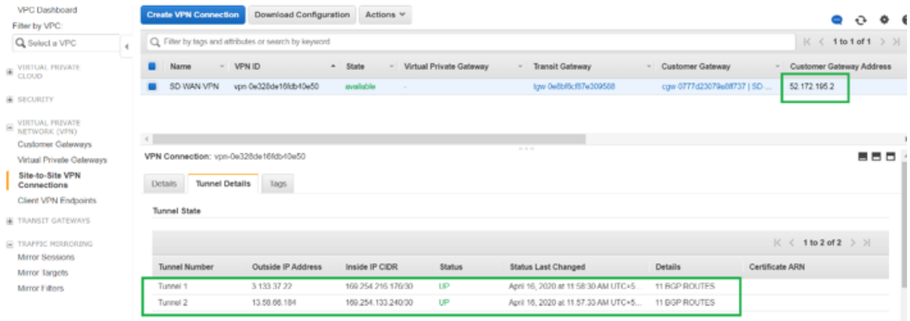
Filter: in Any column

Show 100 entries Showing 1 to 2 of 2 entries

Name	State	Service Type	Packets Received	Kbps Received	Packets Sent	Kbps Sent	Packets Dropped	Bytes Dropped	MTU
New_Intranet_Service-1	GOOD	Intranet	1	0.27	1	0.24	0	0	1434
New_Intranet_Service-2	GOOD	Intranet	1	0.27	1	0.24	0	0	1434

Showing 1 to 2 of 2 entries

3. Status related to both the tunnels can be Monitored on AWS as follows:



Name	VPN ID	State	Virtual Private Gateway	Transit Gateway	Customer Gateway	Customer Gateway Address
SD-WAN-VPN	vpn-0e328de16fdb40e50	available	-	tgw-0e8bf6cf87e309588	cgw-0777d23079e8ff737 | SD-...	52.172.195.2

VPN Connection: vpn-0e328de16fdb40e50

Tunnel State

Tunnel Number	Outside IP Address	Inside IP CIDR	Status	Status Last Changed	Details	Certificate ARN
Tunnel 1	3.133.37.22	169.254.216.176/30	UP	April 16, 2020 at 11:58:30 AM UTC+5...	11 BGP ROUTES	
Tunnel 2	13.58.66.184	169.254.133.240/30	UP	April 16, 2020 at 11:57:33 AM UTC+5...	11 BGP ROUTES	

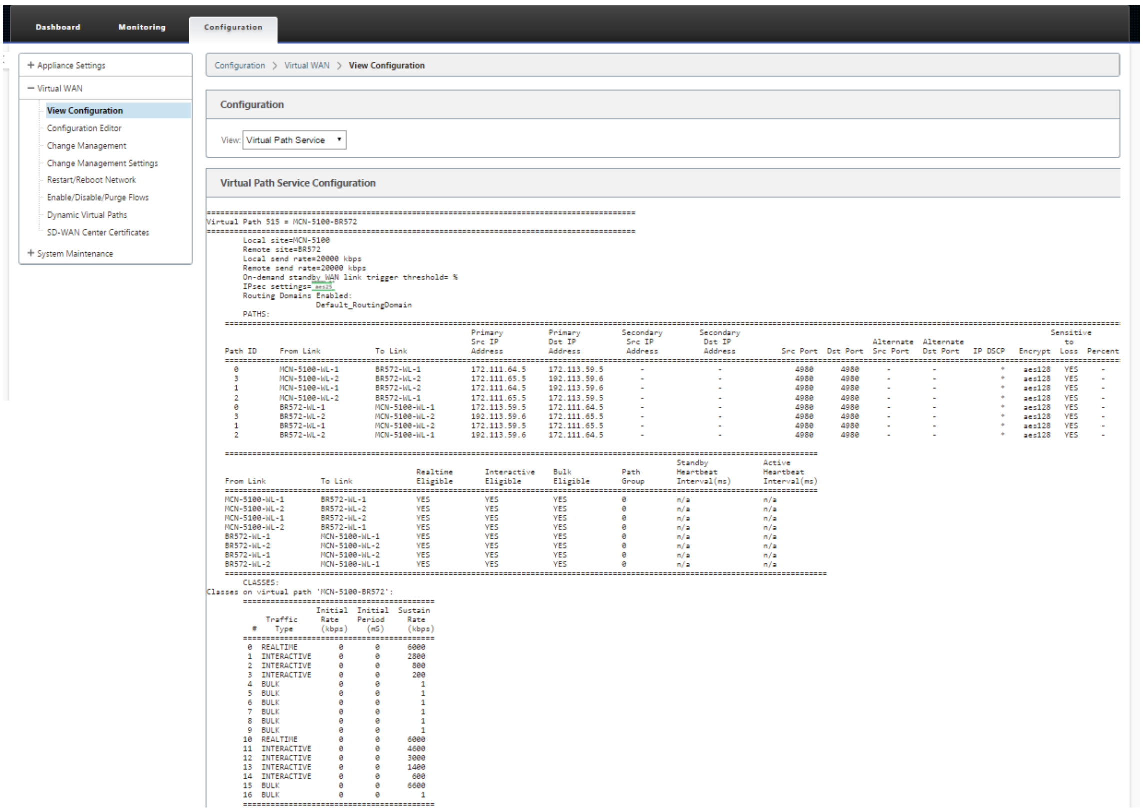
How to view ipsec tunnel configuration

August 24, 2022

To view ipsec tunnel configuration:

1. Navigate to **Configuration > Virtual WAN** > **View Configuration**.

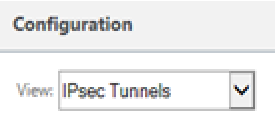
2. Select **Virtual Path Service** from the drop-down menu. The IPsec settings are displayed only if IPsec is enabled.



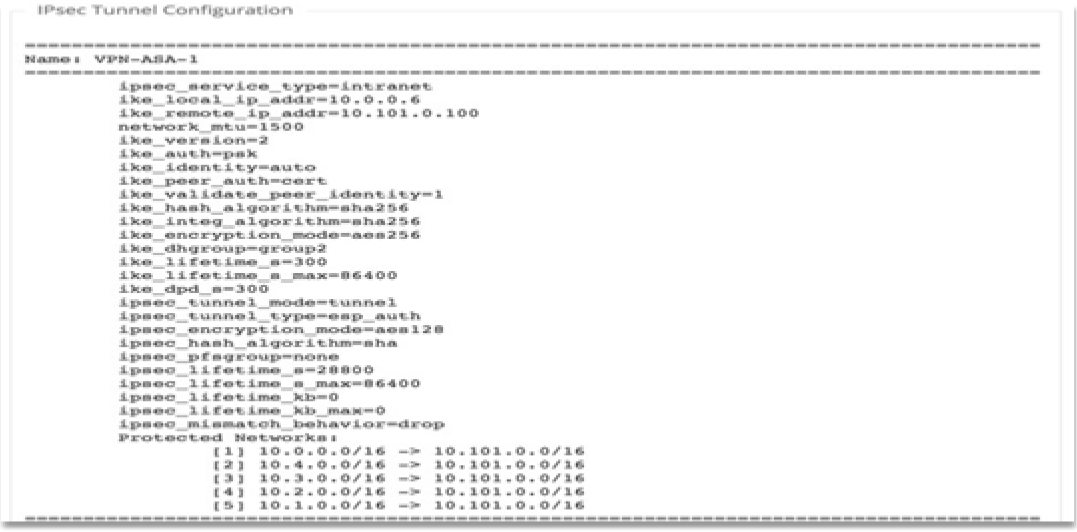
View: Virtual Path Service

```
==========================================================================================
Virtual Path 515 = MCN-5100-BR572
==========================================================================================
        Local site=MCN-5100
        Remote site=BR572
        Local send rate=20000 kbps
        Remote send rate=20000 kbps
        On-demand standby WAN link trigger threshold= %
        IPsec settings= aes25
        Routing Domains Enabled:
                        Default_RoutingDomain
        PATHS:
    ==============================================================================================================================================================================
                                                     Primary         Primary          Secondary        Secondary                                                              Sensitive
                                                     Src IP          Dst IP            Src IP           Dst IP                           Alternate  Alternate                      to
    Path ID     From Link           To Link          Address         Address           Address          Address            Src Port  Dst Port  Src Port   Dst Port   IP DSCP   Encrypt  Loss   Percent
    ==============================================================================================================================================================================
      0         MCN-5100-WL-1       BR572-WL-1       172.111.64.5    172.113.59.5         -                -                  4980      4980      -          -          *      aes128   YES      -
      3         MCN-5100-WL-2       BR572-WL-2       172.111.65.5    192.113.59.6         -                -                  4980      4980      -          -          *      aes128   YES      -
      1         MCN-5100-WL-1       BR572-WL-2       172.111.64.5    192.113.59.6         -                -                  4980      4980      -          -          *      aes128   YES      -
      2         MCN-5100-WL-2       BR572-WL-1       172.111.65.5    172.113.59.5         -                -                  4980      4980      -          -          *      aes128   YES      -
      0         BR572-WL-1          MCN-5100-WL-1    172.113.59.5    172.111.64.5         -                -                  4980      4980      -          -          *      aes128   YES      -
      3         BR572-WL-2          MCN-5100-WL-2    192.113.59.6    172.111.65.5         -                -                  4980      4980      -          -          *      aes128   YES      -
      1         BR572-WL-1          MCN-5100-WL-2    172.113.59.5    172.111.65.5         -                -                  4980      4980      -          -          *      aes128   YES      -
      2         BR572-WL-2          MCN-5100-WL-1    192.113.59.6    172.111.64.5         -                -                  4980      4980      -          -          *      aes128   YES      -

    ==============================================================================================================
                                                                                          Standby          Active
                                       Realtime     Interactive   Bulk        Path        Heartbeat        Heartbeat
    From Link          To Link         Eligible     Eligible      Eligible    Group       Interval(ms)     Interval(ms)
    ==============================================================================================================
    MCN-5100-WL-1      BR572-WL-1      YES          YES           YES         0           n/a              n/a
    MCN-5100-WL-2      BR572-WL-2      YES          YES           YES         0           n/a              n/a
    MCN-5100-WL-1      BR572-WL-2      YES          YES           YES         0           n/a              n/a
    MCN-5100-WL-2      BR572-WL-1      YES          YES           YES         0           n/a              n/a
    BR572-WL-1         MCN-5100-WL-1   YES          YES           YES         0           n/a              n/a
    BR572-WL-2         MCN-5100-WL-2   YES          YES           YES         0           n/a              n/a
    BR572-WL-1         MCN-5100-WL-2   YES          YES           YES         0           n/a              n/a
    BR572-WL-2         MCN-5100-WL-1   YES          YES           YES         0           n/a              n/a
    ===============================================================================================================
        CLASSES:
Classes on virtual path 'MCN-5100-BR572':
        ==========================================
                        Initial  Initial  Sustain
             Traffic     Rate    Period    Rate
          #   Type      (kbps)    (mS)    (kbps)
        ==========================================
         0  REALTIME        0       0      6000
         1  INTERACTIVE     0       0      2800
         2  INTERACTIVE     0       0       800
         3  INTERACTIVE     0       0       200
         4  BULK            0       0         1
         5  BULK            0       0         1
         6  BULK            0       0         1
         7  BULK            0       0         1
         8  BULK            0       0         1
         9  BULK            0       0         1
        10  REALTIME        0       0      6000
        11  INTERACTIVE     0       0      4600
        12  INTERACTIVE     0       0      3000
        13  INTERACTIVE     0       0      1400
        14  INTERACTIVE     0       0       600
        15  BULK            0       0      6600
        16  BULK            0       0         1
        ==========================================
```

3. Select **IPsec Tunnels** from the drop-down menu to view the IPsec Tunnel configuration.



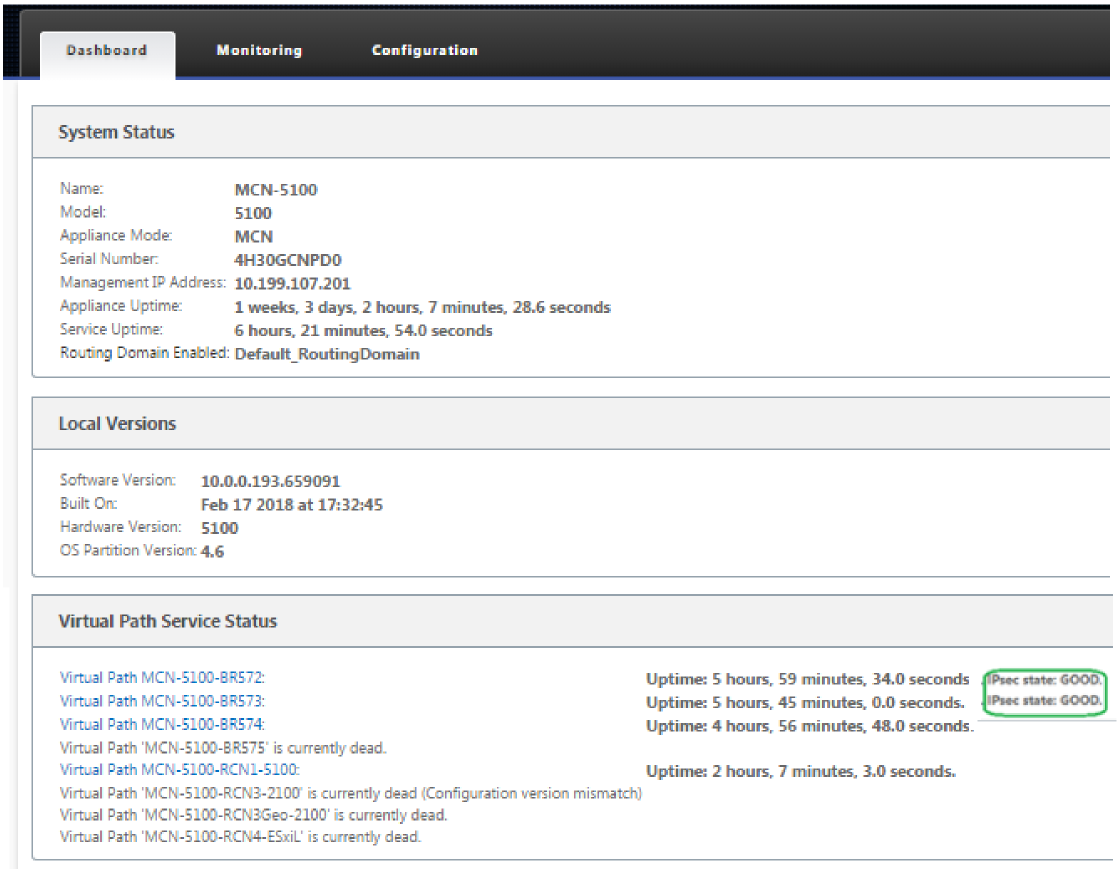
View: IPsec Tunnels



IPsec Tunnel Configuration

```
=========================================================================================
Name: VPN-ASA-1
=========================================================================================
        ipsec_service_type=intranet
        ike_local_ip_addr=10.0.0.6
        ike_remote_ip_addr=10.101.0.100
        network_mtu=1500
        ike_version=2
        ike_auth=psk
        ike_identity=auto
        ike_peer_auth=cert
        ike_validate_peer_identity=1
        ike_hash_algorithm=sha256
        ike_integ_algorithm=sha256
        ike_encryption_mode=aes256
        ike_dhgroup=group2
        ike_lifetime_s=300
        ike_lifetime_s_max=86400
        ike_dpd_s=300
        ipsec_tunnel_mode=tunnel
        ipsec_tunnel_type=esp_auth
        ipsec_encryption_mode=aes128
        ipsec_hash_algorithm=sha
        ipsec_pfsgroup=none
        ipsec_lifetime_s=28800
        ipsec_lifetime_s_max=86400
        ipsec_lifetime_kb=0
        ipsec_lifetime_kb_max=0
        ipsec_mismatch_behavior=drop
        Protected Networks:
                [1] 10.0.0.0/16 -> 10.101.0.0/16
                [2] 10.4.0.0/16 -> 10.101.0.0/16
                [3] 10.3.0.0/16 -> 10.101.0.0/16
                [4] 10.2.0.0/16 -> 10.101.0.0/16
                [5] 10.1.0.0/16 -> 10.101.0.0/16
=========================================================================================
```

4. Each virtual path will show its own IPsec tunnel status as shown below.



System Status

Name: MCN-5100
Model: 5100
Appliance Mode: MCN
Serial Number: 4H30GCNPD0
Management IP Address: 10.199.107.201
Appliance Uptime: 1 weeks, 3 days, 2 hours, 7 minutes, 28.6 seconds
Service Uptime: 6 hours, 21 minutes, 54.0 seconds
Routing Domain Enabled: Default_RoutingDomain

Local Versions

Software Version: 10.0.0.193.659091
Built On: Feb 17 2018 at 17:32:45
Hardware Version: 5100
OS Partition Version: 4.6

Virtual Path Service Status

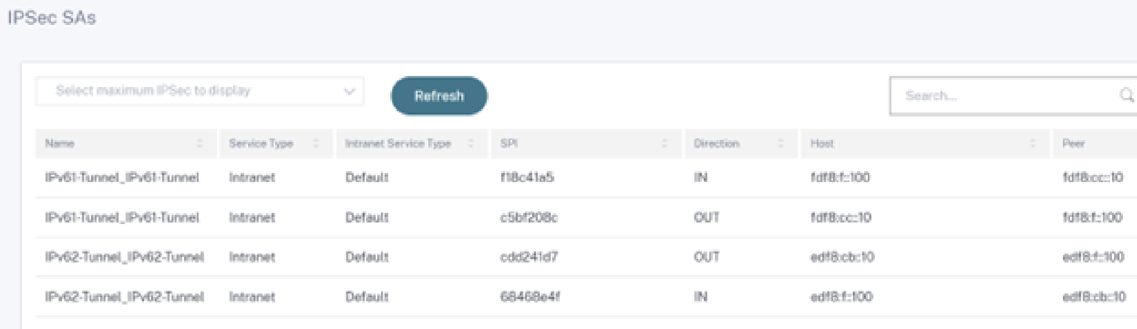
Virtual Path MCN-5100-BR572: Uptime: 5 hours, 59 minutes, 34.0 seconds. IPsec state: GOOD.
Virtual Path MCN-5100-BR573: Uptime: 5 hours, 45 minutes, 0.0 seconds. IPsec state: GOOD.
Virtual Path MCN-5100-BR574: Uptime: 4 hours, 56 minutes, 48.0 seconds.
Virtual Path 'MCN-5100-BR575' is currently dead.
Virtual Path MCN-5100-RCN1-5100: Uptime: 2 hours, 7 minutes, 3.0 seconds.
Virtual Path 'MCN-5100-RCN3-2100' is currently dead (Configuration version mismatch)
Virtual Path 'MCN-5100-RCN3Geo-2100' is currently dead.
Virtual Path 'MCN-5100-RCN4-ESxiL' is currently dead.

IPSec monitoring and logging

August 24, 2022

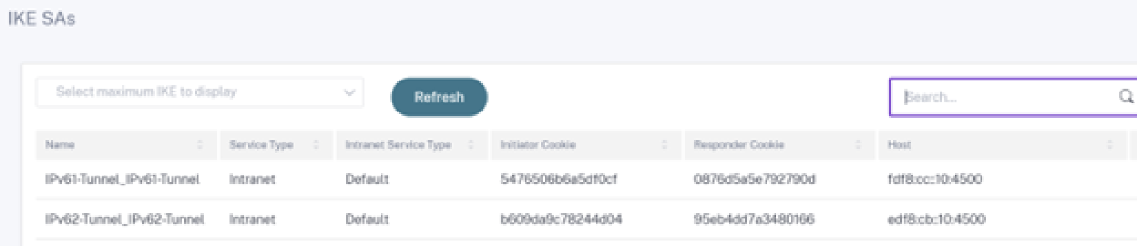
To monitor IPsec/IKE SA statistics:

1. Navigate to **Monitor > IPsec**. Choose **IPsec SAs**:



Name	Service Type	Intranet Service Type	SPI	Direction	Host	Peer
IPv61-Tunnel_IPv61-Tunnel	Intranet	Default	f18c41a5	IN	fdf8:f::100	fdf8:cc::10
IPv61-Tunnel_IPv61-Tunnel	Intranet	Default	c5bf208c	OUT	fdf8:cc::10	fdf8:f::100
IPv62-Tunnel_IPv62-Tunnel	Intranet	Default	cdd241d7	OUT	edf8:cb::10	edf8:f::100
IPv62-Tunnel_IPv62-Tunnel	Intranet	Default	68468e4f	IN	edf8:f::100	edf8:cb::10

2. Navigate to **Monitor** > **IKE SAs**. Observe the configured IPsec tunnels, the IKE and IPsec service associations between two or mode VPN endpoints configured within the SD-WAN network.

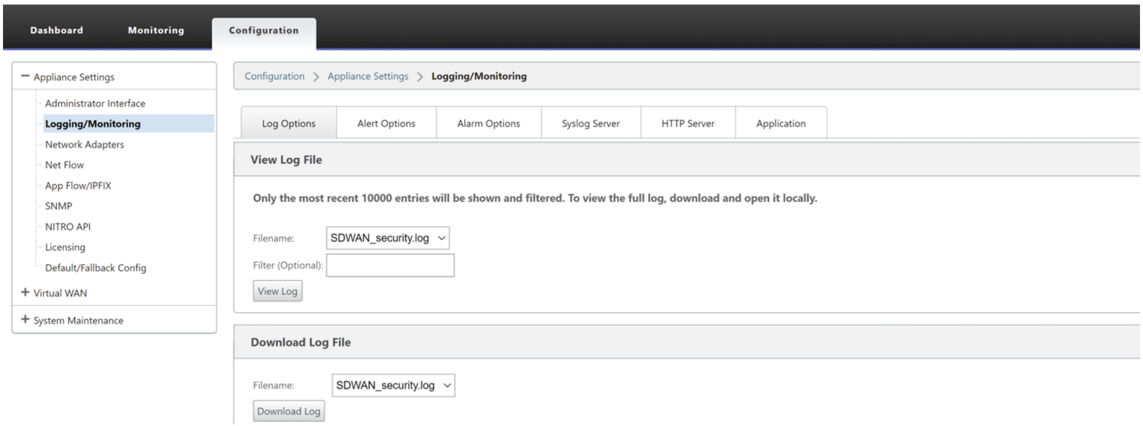


Name	Service Type	Intranet Service Type	Initiator Cookie	Responder Cookie	Host
IPv61-Tunnel_IPv61-Tunnel	Intranet	Default	5476506b6a5df0cf	0876d5a5e792790d	fdf8:cc::10:4500
IPv62-Tunnel_IPv62-Tunnel	Intranet	Default	b609da9c78244d04	95eb4dd7a3480166	edf8:cb::10:4500

How to monitor IPsec logs

1. Navigate to **Configuration** > **Appliance Settings** > **Logging/Monitoring**. Select **Filename** from the drop-down menu and click **View Log**. You can view the following log details for the IPsec tunnel:

   - Creation and Deletion of IPsec tunnel
   - IPsec tunnel status change



View Log File

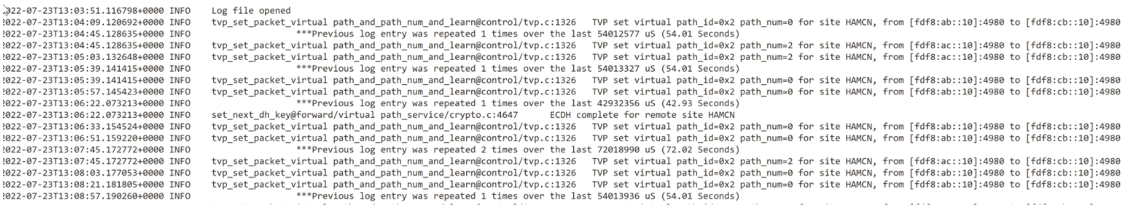
Only the most recent 10000 entries will be shown and filtered. To view the full log, download and open it locally.

Filename: SDWAN_security.log

Filter (Optional):

Download Log File

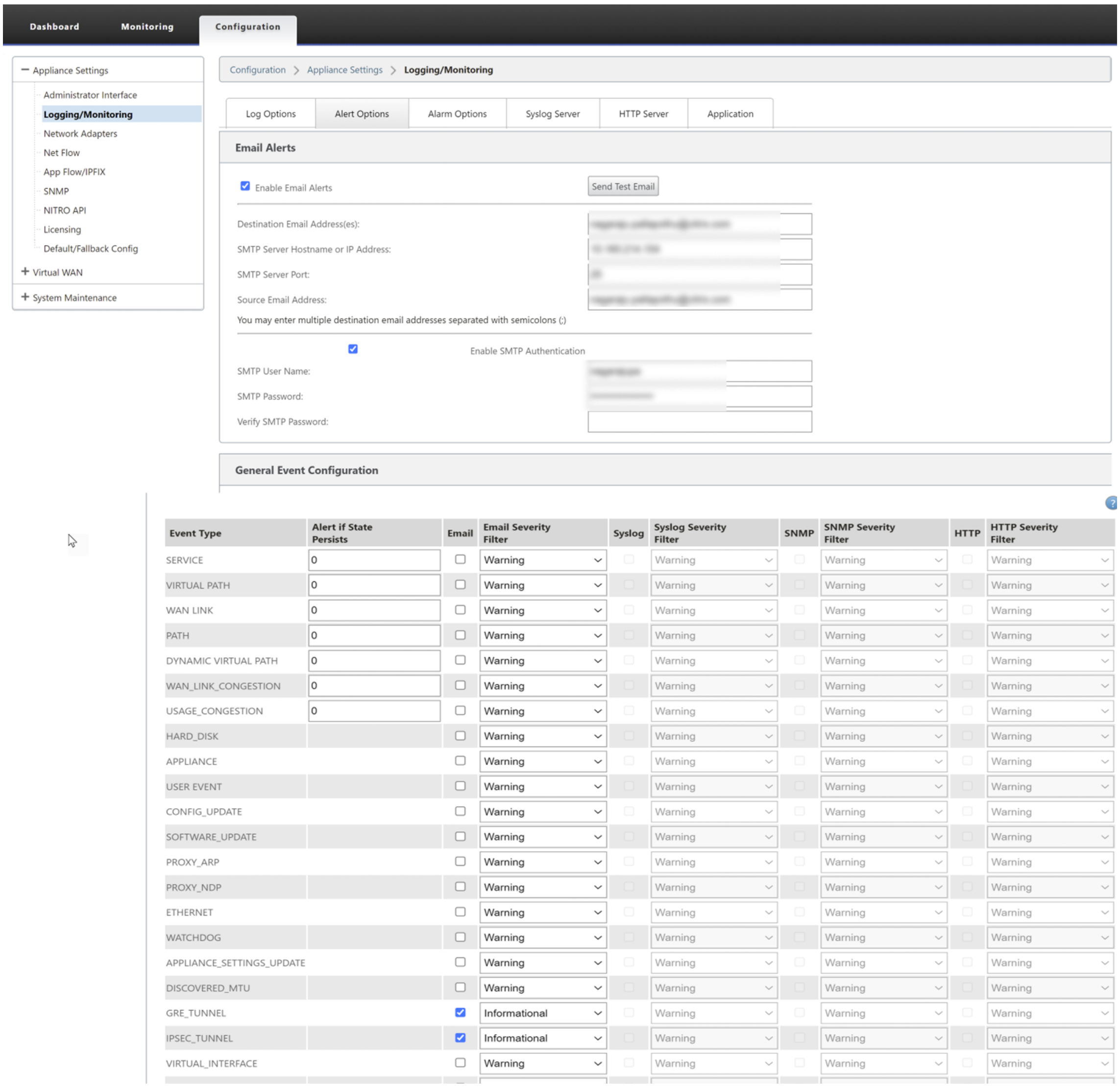
Filename: SDWAN_security.log



```
2022-07-23T13:03:51.116798+0000 INFO    Log file opened
2022-07-23T13:04:09.120692+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=0 for site HAMCN, from [fdf8:ab::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:04:45.128635+0000 INFO                    ***Previous log entry was repeated 1 times over the last 54012577 uS (54.01 Seconds)
2022-07-23T13:04:45.128635+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=2 for site HAMCN, from [fdf8:ac::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:05:03.132648+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=2 for site HAMCN, from [fdf8:ac::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:05:39.141415+0000 INFO                    ***Previous log entry was repeated 1 times over the last 54013327 uS (54.01 Seconds)
2022-07-23T13:05:39.141415+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=0 for site HAMCN, from [fdf8:ab::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:05:57.145423+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=0 for site HAMCN, from [fdf8:ab::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:06:22.073213+0000 INFO                    ***Previous log entry was repeated 1 times over the last 42932356 uS (42.93 Seconds)
2022-07-23T13:06:22.073213+0000 INFO    set_next_dh_key@forward/virtual path_service/crypto.c:4647      ECDH complete for remote site HAMCN
2022-07-23T13:06:33.154524+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=0 for site HAMCN, from [fdf8:ab::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:06:51.159220+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=0 for site HAMCN, from [fdf8:ab::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:07:45.172772+0000 INFO                    ***Previous log entry was repeated 2 times over the last 72018990 uS (72.02 Seconds)
2022-07-23T13:07:45.172772+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=2 for site HAMCN, from [fdf8:ac::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:08:03.177053+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=0 for site HAMCN, from [fdf8:ab::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:08:21.181805+0000 INFO    tvp_set_packet_virtual path_and_path_num_and_learn@control/tvp.c:1326   TVP set virtual path_id=0x2 path_num=0 for site HAMCN, from [fdf8:ab::10]:4980 to [fdf8:cb::10]:4980
2022-07-23T13:08:57.190260+0000 INFO                    ***Previous log entry was repeated 1 times over the last 54013936 uS (54.01 Seconds)
```

How to view IPsec tunnel alerts

1. Navigate to **Configuration** > **Appliance Settings > Logging/Monitoring** > **Alert Options**.
2. Create Email and Syslog alerts for IPsec tunnel state reporting.
    - Supports IPSEC_TUNNEL as one of the Event types which allows you to configure Email and Syslog Severity Filters.



Email Alerts

☑ Enable Email Alerts

Destination Email Address(es): [redacted]

SMTP Server Hostname or IP Address: [redacted]

SMTP Server Port: [redacted]

Source Email Address: [redacted]

You may enter multiple destination email addresses separated with semicolons (;)

☑ Enable SMTP Authentication

SMTP User Name: [redacted]

SMTP Password: [redacted]

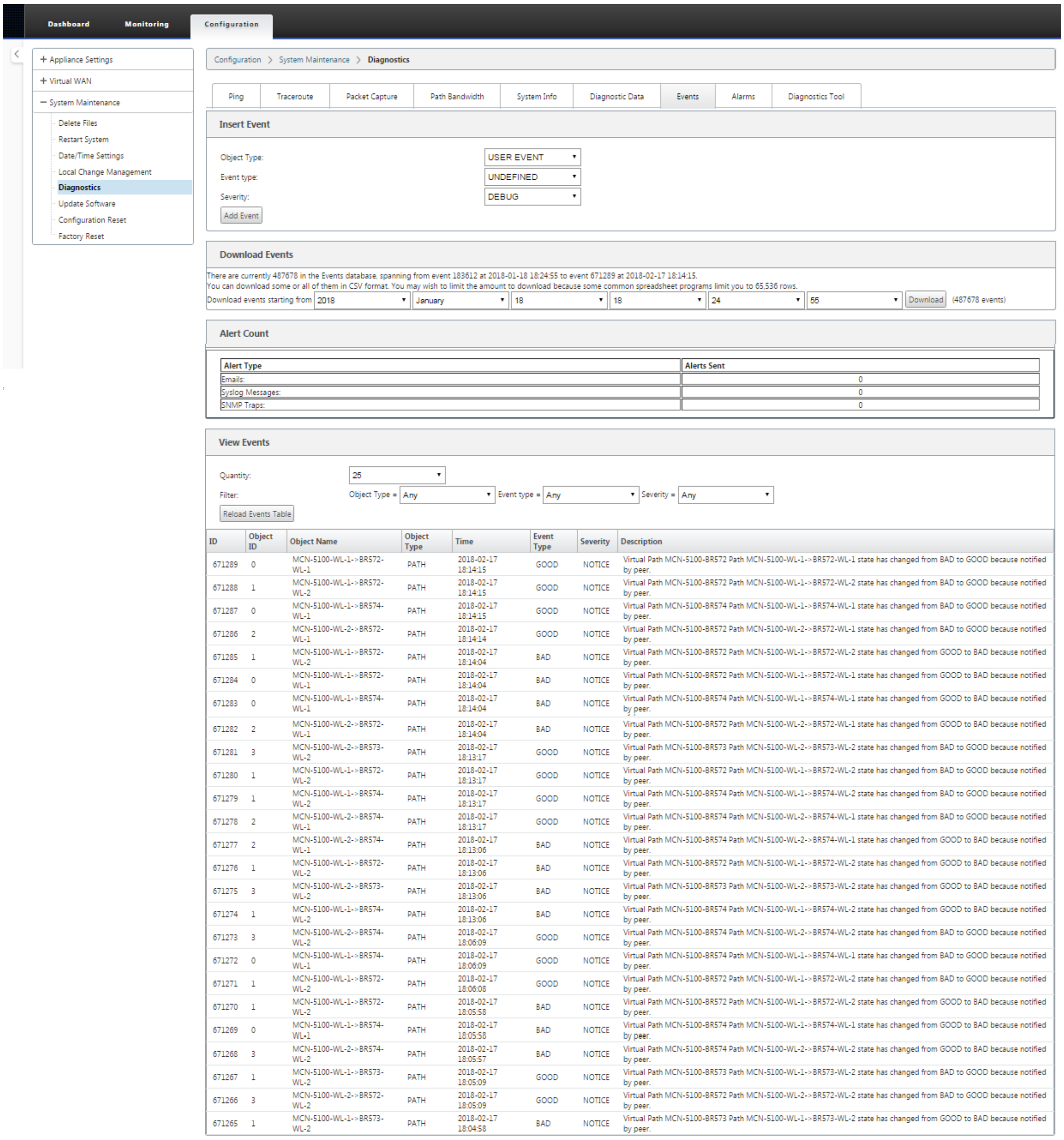
Verify SMTP Password:

General Event Configuration

Event Type	Alert if State Persists	Email	Email Severity Filter	Syslog	Syslog Severity Filter	SNMP	SNMP Severity Filter	HTTP	HTTP Severity Filter
SERVICE	0	☐	Warning	☐	Warning	☐	Warning	☐	Warning
VIRTUAL PATH	0	☐	Warning	☐	Warning	☐	Warning	☐	Warning
WAN LINK	0	☐	Warning	☐	Warning	☐	Warning	☐	Warning
PATH	0	☐	Warning	☐	Warning	☐	Warning	☐	Warning
DYNAMIC VIRTUAL PATH	0	☐	Warning	☐	Warning	☐	Warning	☐	Warning
WAN_LINK_CONGESTION	0	☐	Warning	☐	Warning	☐	Warning	☐	Warning
USAGE_CONGESTION	0	☐	Warning	☐	Warning	☐	Warning	☐	Warning
HARD_DISK		☐	Warning	☐	Warning	☐	Warning	☐	Warning
APPLIANCE		☐	Warning	☐	Warning	☐	Warning	☐	Warning
USER EVENT		☐	Warning	☐	Warning	☐	Warning	☐	Warning
CONFIG_UPDATE		☐	Warning	☐	Warning	☐	Warning	☐	Warning
SOFTWARE_UPDATE		☐	Warning	☐	Warning	☐	Warning	☐	Warning
PROXY_ARP		☐	Warning	☐	Warning	☐	Warning	☐	Warning
PROXY_NDP		☐	Warning	☐	Warning	☐	Warning	☐	Warning
ETHERNET		☐	Warning	☐	Warning	☐	Warning	☐	Warning
WATCHDOG		☐	Warning	☐	Warning	☐	Warning	☐	Warning
APPLIANCE_SETTINGS_UPDATE		☐	Warning	☐	Warning	☐	Warning	☐	Warning
DISCOVERED_MTU		☐	Warning	☐	Warning	☐	Warning	☐	Warning
GRE_TUNNEL		☑	Informational	☐	Warning	☐	Warning	☐	Warning
IPSEC_TUNNEL		☑	Informational	☐	Warning	☐	Warning	☐	Warning
VIRTUAL_INTERFACE		☐	Warning	☐	Warning	☐	Warning	☐	Warning

How to monitor IPsec tunnel events

1. Navigate to **Configuration > System Maintenance** > **Diagnostics** > **Events**.
2. Add events based on the **IPSEC_TUNNEL** object type. Create filters for all IPsec related events.



Insert Event

Object Type: USER EVENT

Event type: UNDEFINED

Severity: DEBUG

Download Events

There are currently 487678 in the Events database, spanning from event 183612 at 2018-01-18 18:24:55 to event 671289 at 2018-02-17 18:14:15.
You can download some or all of them in CSV format. You may wish to limit the amount to download because some common spreadsheet programs limit you to 65,536 rows.

Download events starting from 2018 January 18 18 24 55 (487678 events)

Alert Count

Alert Type	Alerts Sent
Emails:	0
Syslog Messages:	0
SNMP Traps:	0

View Events

Quantity: 25

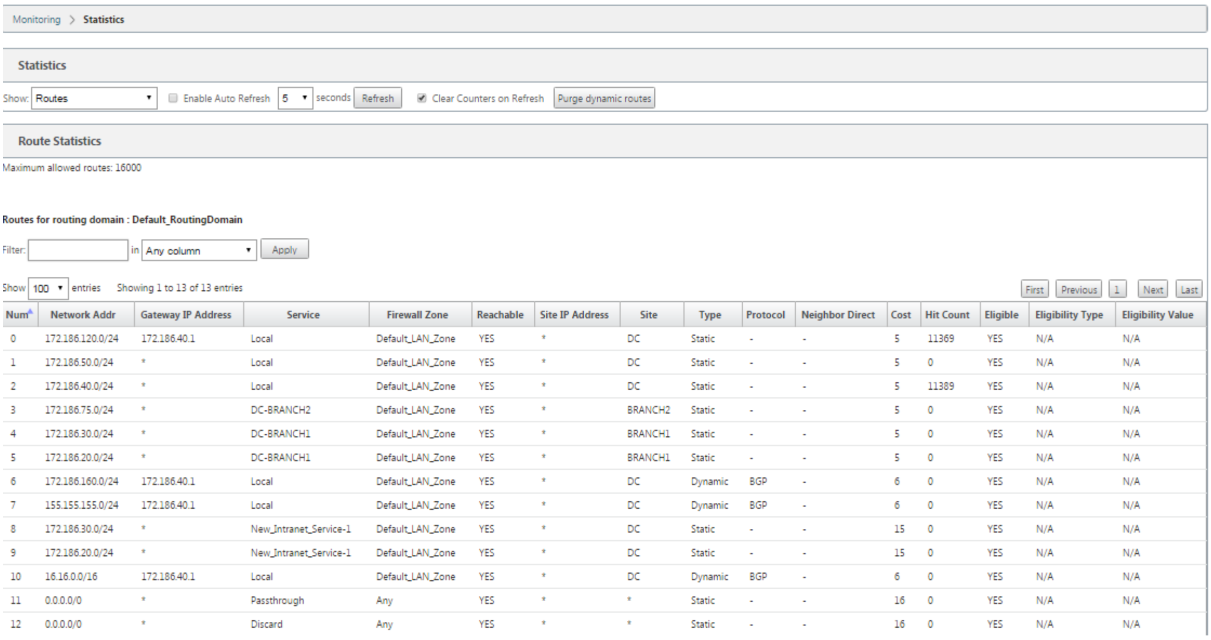
Filter: Object Type = Any Event type = Any Severity = Any

ID	Object ID	Object Name	Object Type	Time	Event Type	Severity	Description
671289	0	MCN-5100-WL-1->BR572-WL-1	PATH	2018-02-17 18:14:15	GOOD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-1->BR572-WL-1 state has changed from BAD to GOOD because notified by peer.
671288	1	MCN-5100-WL-1->BR572-WL-2	PATH	2018-02-17 18:14:15	GOOD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-1->BR572-WL-2 state has changed from BAD to GOOD because notified by peer.
671287	0	MCN-5100-WL-1->BR574-WL-1	PATH	2018-02-17 18:14:15	GOOD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-1->BR574-WL-1 state has changed from BAD to GOOD because notified by peer.
671286	2	MCN-5100-WL-2->BR572-WL-1	PATH	2018-02-17 18:14:14	GOOD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-2->BR572-WL-1 state has changed from BAD to GOOD because notified by peer.
671285	1	MCN-5100-WL-1->BR572-WL-2	PATH	2018-02-17 18:14:04	BAD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-1->BR572-WL-2 state has changed from GOOD to BAD because notified by peer.
671284	0	MCN-5100-WL-1->BR572-WL-1	PATH	2018-02-17 18:14:04	BAD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-1->BR572-WL-1 state has changed from GOOD to BAD because notified by peer.
671283	0	MCN-5100-WL-1->BR574-WL-1	PATH	2018-02-17 18:14:04	BAD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-1->BR574-WL-1 state has changed from GOOD to BAD because notified by peer.
671282	2	MCN-5100-WL-2->BR572-WL-1	PATH	2018-02-17 18:14:04	BAD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-2->BR572-WL-1 state has changed from GOOD to BAD because notified by peer.
671281	3	MCN-5100-WL-2->BR573-WL-2	PATH	2018-02-17 18:13:17	GOOD	NOTICE	Virtual Path MCN-5100-BR573 Path MCN-5100-WL-2->BR573-WL-2 state has changed from BAD to GOOD because notified by peer.
671280	1	MCN-5100-WL-1->BR572-WL-2	PATH	2018-02-17 18:13:17	GOOD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-1->BR572-WL-2 state has changed from BAD to GOOD because notified by peer.
671279	1	MCN-5100-WL-1->BR574-WL-2	PATH	2018-02-17 18:13:17	GOOD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-1->BR574-WL-2 state has changed from BAD to GOOD because notified by peer.
671278	2	MCN-5100-WL-2->BR574-WL-1	PATH	2018-02-17 18:13:17	GOOD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-2->BR574-WL-1 state has changed from BAD to GOOD because notified by peer.
671277	2	MCN-5100-WL-2->BR574-WL-1	PATH	2018-02-17 18:13:06	BAD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-2->BR574-WL-1 state has changed from GOOD to BAD because notified by peer.
671276	1	MCN-5100-WL-1->BR572-WL-2	PATH	2018-02-17 18:13:06	BAD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-1->BR572-WL-2 state has changed from GOOD to BAD because notified by peer.
671275	3	MCN-5100-WL-2->BR573-WL-2	PATH	2018-02-17 18:13:06	BAD	NOTICE	Virtual Path MCN-5100-BR573 Path MCN-5100-WL-2->BR573-WL-2 state has changed from GOOD to BAD because notified by peer.
671274	1	MCN-5100-WL-1->BR574-WL-2	PATH	2018-02-17 18:13:06	BAD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-1->BR574-WL-2 state has changed from GOOD to BAD because notified by peer.
671273	3	MCN-5100-WL-2->BR574-WL-2	PATH	2018-02-17 18:06:09	GOOD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-2->BR574-WL-2 state has changed from BAD to GOOD because notified by peer.
671272	0	MCN-5100-WL-1->BR574-WL-1	PATH	2018-02-17 18:06:09	GOOD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-1->BR574-WL-1 state has changed from BAD to GOOD because notified by peer.
671271	1	MCN-5100-WL-1->BR572-WL-2	PATH	2018-02-17 18:06:08	GOOD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-1->BR572-WL-2 state has changed from BAD to GOOD because notified by peer.
671270	1	MCN-5100-WL-1->BR572-WL-2	PATH	2018-02-17 18:05:58	BAD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-1->BR572-WL-2 state has changed from GOOD to BAD because notified by peer.
671269	0	MCN-5100-WL-1->BR574-WL-1	PATH	2018-02-17 18:05:58	BAD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-1->BR574-WL-1 state has changed from GOOD to BAD because notified by peer.
671268	3	MCN-5100-WL-2->BR574-WL-2	PATH	2018-02-17 18:05:57	BAD	NOTICE	Virtual Path MCN-5100-BR574 Path MCN-5100-WL-2->BR574-WL-2 state has changed from GOOD to BAD because notified by peer.
671267	1	MCN-5100-WL-1->BR573-WL-2	PATH	2018-02-17 18:05:09	GOOD	NOTICE	Virtual Path MCN-5100-BR573 Path MCN-5100-WL-1->BR573-WL-2 state has changed from BAD to GOOD because notified by peer.
671266	3	MCN-5100-WL-2->BR572-WL-2	PATH	2018-02-17 18:05:09	GOOD	NOTICE	Virtual Path MCN-5100-BR572 Path MCN-5100-WL-2->BR572-WL-2 state has changed from BAD to GOOD because notified by peer.
671265	1	MCN-5100-WL-1->BR573-WL-2	PATH	2018-02-17 18:04:58	BAD	NOTICE	Virtual Path MCN-5100-BR573 Path MCN-5100-WL-1->BR573-WL-2 state has changed from GOOD to BAD because notified by peer.

Eligibility for ipsec non-virtual path routes

August 24, 2022

In previous releases, ipsec tunnel routes would remain in the route table, even if the tunnel became unavailable.



Maximum allowed routes: 16000

Routes for routing domain : Default_RoutingDomain

Showing 1 to 13 of 13 entries

Num	Network Addr	Gateway IP Address	Service	Firewall Zone	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	172.186.120.0/24	172.186.40.1	Local	Default_LAN_Zone	YES	*	DC	Static	-	-	5	11369	YES	N/A	N/A
1	172.186.50.0/24	*	Local	Default_LAN_Zone	YES	*	DC	Static	-	-	5	0	YES	N/A	N/A
2	172.186.40.0/24	*	Local	Default_LAN_Zone	YES	*	DC	Static	-	-	5	11389	YES	N/A	N/A
3	172.186.75.0/24	*	DC-BRANCH2	Default_LAN_Zone	YES	*	BRANCH2	Static	-	-	5	0	YES	N/A	N/A
4	172.186.30.0/24	*	DC-BRANCH1	Default_LAN_Zone	YES	*	BRANCH1	Static	-	-	5	0	YES	N/A	N/A
5	172.186.20.0/24	*	DC-BRANCH1	Default_LAN_Zone	YES	*	BRANCH1	Static	-	-	5	0	YES	N/A	N/A
6	172.186.160.0/24	172.186.40.1	Local	Default_LAN_Zone	YES	*	DC	Dynamic	BGP	-	6	0	YES	N/A	N/A
7	155.155.155.0/24	172.186.40.1	Local	Default_LAN_Zone	YES	*	DC	Dynamic	BGP	-	6	0	YES	N/A	N/A
8	172.186.30.0/24	*	New_Intranet_Service-1	Default_LAN_Zone	YES	*	DC	Static	-	-	15	0	YES	N/A	N/A
9	172.186.20.0/24	*	New_Intranet_Service-1	Default_LAN_Zone	YES	*	DC	Static	-	-	15	0	YES	N/A	N/A
10	16.16.0.0/16	172.186.40.1	Local	Default_LAN_Zone	YES	*	DC	Dynamic	BGP	-	6	0	YES	N/A	N/A
11	0.0.0.0/0	*	Passthrough	Any	YES	*	*	Static	-	-	16	0	YES	N/A	N/A
12	0.0.0.0/0	*	Discard	Any	YES	*	*	Static	-	-	16	0	YES	N/A	N/A

FIPS Compliance

August 24, 2022

In Citrix SD-WAN, FIPS mode enforces users to configure FIPS compliant settings for their IPsec Tunnels and IPsec settings for Virtual Paths.

- Displays the FIPS compliant IKE Mode.
- Displays a FIPS Compliant IKE DH Group from which users can select the required parameters for configuring the appliance in FIPS compliant mode (2,5,14 –21).
- Displays the FIPS compliant IPsec Tunnel Type in IPsec settings for Virtual Paths
- IKE Hash and (IKEv2) Integrity mode, IPsec auth mode.
- Performs audit errors for FIPS based Lifetime Settings

To enable FIPS compliance by using the Citrix SD-WAN Orchestrator service, see FIPS mode.

Citrix SD-WAN secure web gateway

August 24, 2022

To secure traffic and enforce policies, enterprises often use MPLS links to backhaul branch traffic to the corporate data center. The data center applies security policies, filters traffic through security appliances to detect malware, and routes the traffic through an ISP. Such backhauling over private MPLS links is expensive. It also results in significant latency, which creates a poor user experience at the branch site. There is also a risk that users bypass your security controls.

An alternative to backhauling is to add security appliances at the branch. However, the cost and complexity increases as you install multiple appliances to maintain consistent policies across the sites.And if you have many branch offices, cost management becomes impractical.

Zscaler:

The ideal solution to enforce security without adding cost, complexity, or latency is to route all branch Internet traffic from the Citrix SD-WAN appliance to the Zscaler Cloud Security Platform. You can then use a central Zscaler console to create granular security policies for your users. The policies are applied consistently whether the user is at the data center or a branch site. Because the Zscaler security solution is cloud based, you don't have to add more security appliances to the network.

FIPS Compliance:

The National Institute for Standards and Technology (NIST) develops Federal Information Processing Standards (FIPS) in areas for which no voluntary standards exist. FIPS addresses the following issues:

- Compatibility between different systems.
- Data and software portability.
- Cost-effective computer security and privacy of sensitive information.

FIPS specifies the security requirements for a cryptographic module used in security systems. To apply these security standards to the processing done by a Citrix SD-WAN appliance, configure FIPS mode.

Forcepoint:

By using Citrix SD-WAN, you can use the Firewall redirect (transparent proxy by Destination NAT) feature to redirect internet (HTTP and HTTPS) traffic from an SD-WAN appliance at the enterprise edge to the Forcepoint cloud-hosted security module. You can redirect HTTP traffic from port 80 to port 8081 and HTTPS traffic from port 443 to port 8443 of the nearest Forcepoint cloud proxy server.

Zscaler Integration by using GRE tunnels and IPsec tunnels

August 24, 2022

The Zscaler Cloud Security Platform acts as a series of security check posts in more than 100 data centers around the world. By simply redirecting your internet traffic to Zscaler, you can immediately secure your stores, branches, and remote locations. Zscaler connects users and the internet, inspecting every byte of traffic, even if it is encrypted or compressed.

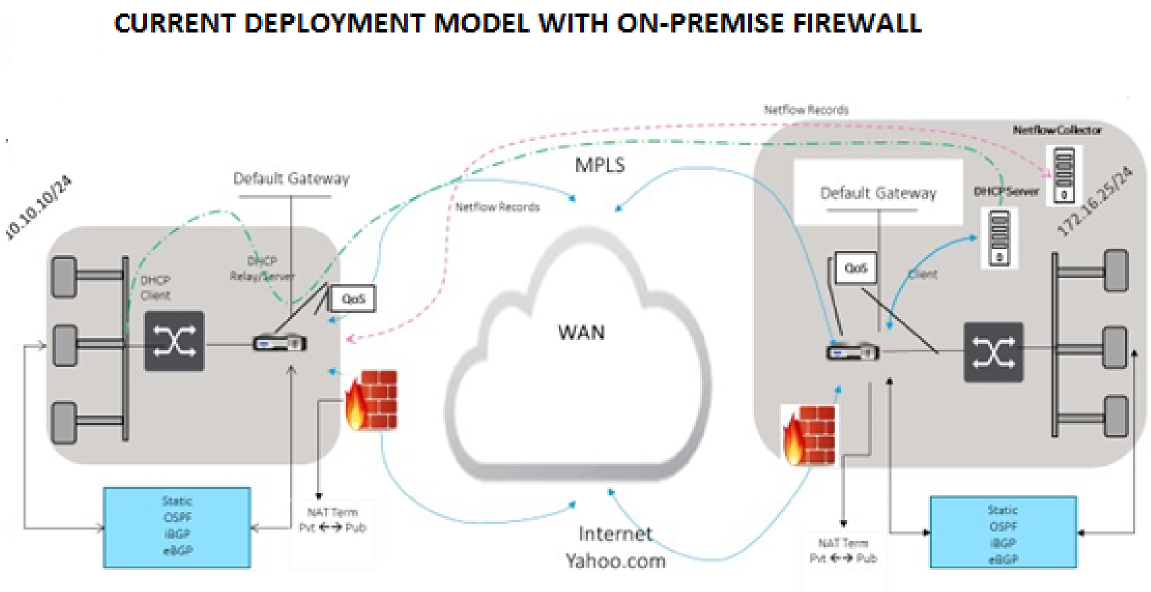
Citrix SD-WAN appliances can connect to a Zscaler cloud network through GRE tunnels at the customer's site. A Zscaler deployment using SD-WAN appliances supports the following functionality:

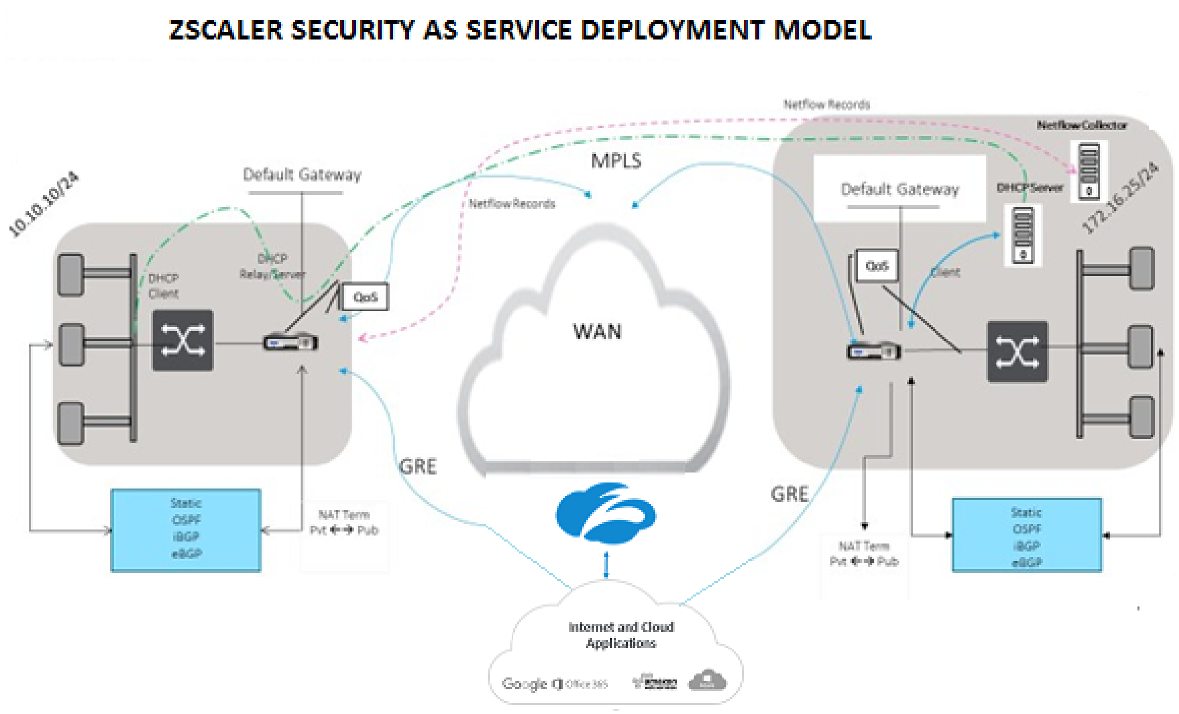
- Forwarding all GRE traffic to Zscaler, thereby enabling direct Internet breakout.
- Direct internet access (DIA) using Zscaler on a per customer site basis.
  - On some sites, you might want to provide DIA with on-premises security equipment and not use Zscaler.
  - On some sites, you might choose to backhaul the traffic another customer site for internet access.
- Virtual routing and forwarding deployments.
- One WAN link as part of internet services.

Zscaler is a cloud service. You must set it up as a service and define the underlying WAN links:

- Configure an internet service at the data center and branch through GRE.
- Configure a trusted Public internet link at the data center and the branch sites.

Topology





To use GRE tunnel or IPsec Tunnel traffic forwarding:

1. Log into the Zscaler help portal at: https://help.zscaler.com/submit-ticket.
2. Raise a ticket and provide the static public IP address, which is used as the GRE tunnel or IPsec tunnel source IP address.

Zscaler uses the source IP address to identify the customer IP address. The source IP needs to be a static public IP. Zscaler responds with two ZEN IP addresses (Primary and Secondary) to transmit traffic to. GRE keep alive messages can be used to determine the health of the tunnels.

Zscaler uses the source IP address value to identify the customer IP address. This value must be a static public IP address. Zscaler responds with two ZEN IP addresses [DR1] to which to redirect traffic. GRE keep-alive messages can be used to determine the health of the tunnels.

Sample IP addresses

Primary

Internal Router IP address: 172.17.6.241/30
Internal ZEN IP address: 172.17.6.242/30

Secondary

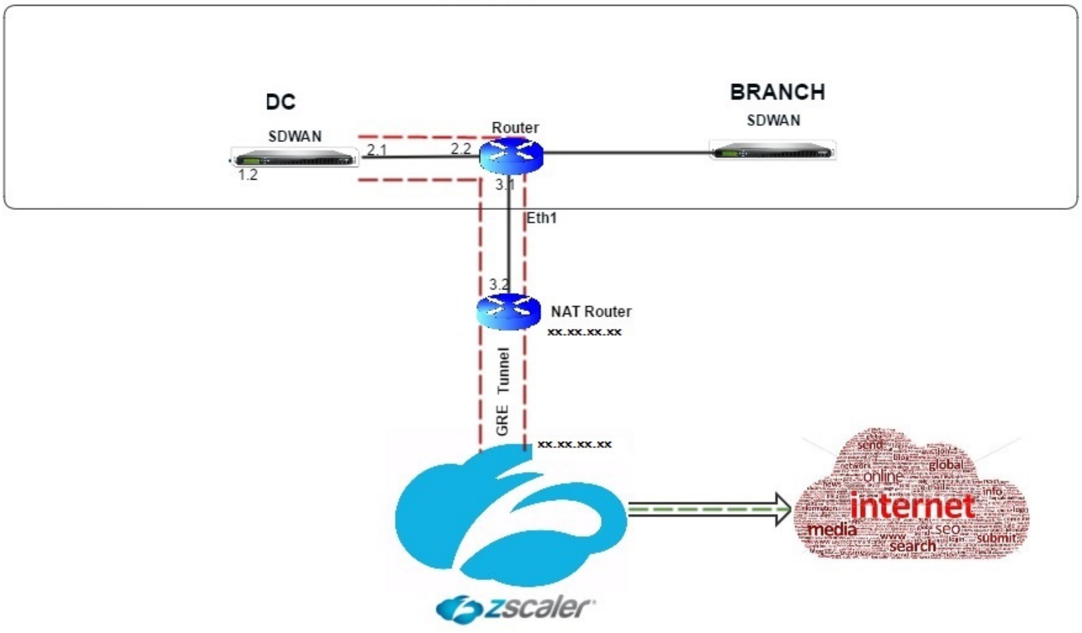
Internal Router IP address: 172.17.6.245/30
Internal ZEN IP address: 172.17.6.246/30

Configuring an Internet Service

To configure an internet service through Citrix SD-WAN Orchestrator service, see Delivery services. For more information about enabling Internet service for a site, see Direct Internet Breakout.

Configure GRE Tunnel

1. Source IP address is the Tunnel Source IP address. If the Tunnel Source IP address is NATted, the Public Source IP address is the public Tunnel Source IP address, even if it is NATted on a different intermediate device.
2. Destination IP address is the ZEN IP address that Zscaler provides.
3. The Source IP address and the Destination IP address are the router GRE headers when the original payload is encapsulated.
4. Tunnel IP address and Prefix are the IP addressing on the GRE tunnel itself. This is useful for routing traffic over the GRE tunnel. The traffic needs this IP address as the gateway address.



To configure GRE Tunnel through Cirix SD-WAN Orchestrator service, see GRE tunnel.

Configure routes for GRE tunnels

Configure routes to forward internet prefix services to the Zscaler GRE Tunnels.

- The ZEN IP address (Tunnel destination IP, shown as 104.129.194.38 in the above figure) must be set to service-type Internet. This is required so that traffic destined to Zscaler is accounted from the Internet service.
- All traffic destined to Zscaler must match the default route 0/0 and be transmitted over the GRE tunnel. Ensure that the 0/0 route used for [DR1 the GRE tunnel has a lower Cost than Passthrough or any other Service type.
- Similarly, the backup GRE tunnel to Zscaler must have a higher cost than that of the Primary GRE tunnel.
- Ensure that nonrecursive routes exist for the ZEN IP address.

  > **Note**
  >
  > If you do not have specific routes for the Zscaler IP address, configure the route prefix 0.0.0.0/0 to match the ZEN IP address and route it through a GRE tunnel encapsulation loop. This configuration uses the tunnels in an active-backup mode. With the values shown in the above figure, traffic automatically switches over to the tunnel with gateway IP address 172.17.6.242. If desired, configure a backhaul virtual path route. Otherwise, set the keep-alive interval of the backup tunnel to zero. This enables secure internet access to a site even if both the tunnels to Zscaler fail.
  >
  > GRE keep-alive messages are supported. A new field called **Public Source IP** that provides the NAT address of the GRE Source address is added to the Citrix SD-WAN GUI interface (in the case when SD-WAN appliance Tunnel Source is NATted by an intermediate device). The Citrix SD-WAN GUI includes a field called Public Source IP, which provides the NAT address of the GRE Source address when the Citrix SD-WAN appliance's Tunnel Source is NATted by an intermediate device.

Limitations

- Multiple VRF deployments are not supported.
- Primary backup GRE tunnels are supported for a high-availability design mode only.

To monitor GRE and IPsec tunnel statistics:

In the SD-WAN web interface, navigate to **Monitoring** > **Statistics** > [**GRE Tunnel**	**IPsec Tunnel**].

For more information, see; monitoring IPsec tunnels and GRE tunnels topics.

Firewall Traffic Redirection Support by Using Forcepoint in Citrix SD-WAN

August 24, 2022

Forcepoint supports the following features, although SD-WAN supports only the firewall redirect feature:

- IPSec with PKI
- IPsec with PSK
- Proxy chaining using PAC file configuration
- Proxy chaining with standard headers
- Proxy chaining with proprietary headers removing the need to configure the client¹s IP range - partnership/development
- Firewall redirect (transparent proxy by Destination NAT)

The Destination NAT policy enables enterprises to route internet traffic through cloud-hosted security service using ForcePoint.

Review the following use case to understand how to configure Destination NAT in SD-WAN appliances and redirect internet traffic through a secure cloud-based firewall service.

Pre-requisites:

1. Log in to the Forcepoint portal site. Create a policy by providing the Enterprise Public IP address through which internet traffic needs to be redirected to Forcepoint. Obtain the Primary and Secondary IP addresses to which the internet traffic should be redirected.

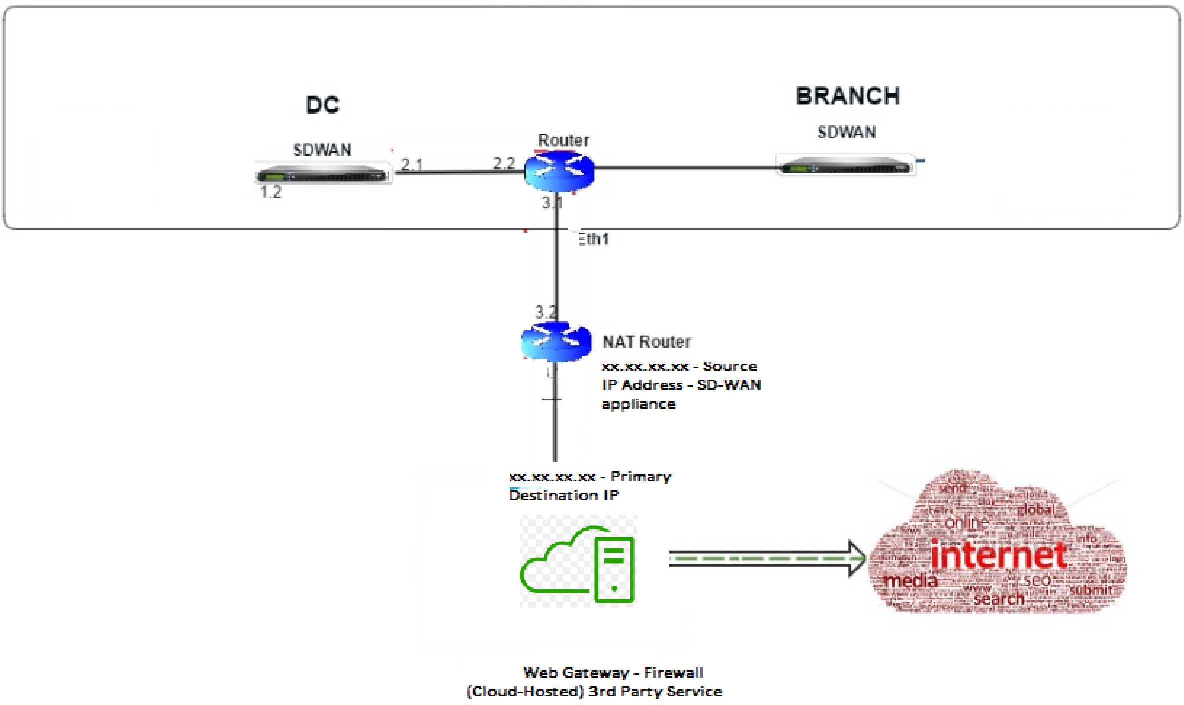
2. In the SD-WAN GUI, on an SD-WAN appliance at the DC site, configure Internet service associated with WAN links.

3. Destination NAT is performed using Destination IP address of the internet traffic. This destination address is changed to the Forcepoint public IP address.

4. Configure Destination NAT policy by providing the source IP address and the primary IP address. The source IP is the internet IP address of the SD-WAN appliance inside ports 80 (http) and 443 (https) which is redirected/translated to the primary destination IP address of the cloud-based firewall gateway with outside ports 8081 (http) and 8443 (https) respectively.

5. After configuring DNAT policy, ensure that the Routes configured on the DC have the Internet service type selected for the SD-WAN network IP address.

You can configure NAT using Citrix SD-WAN Orchestrator service. For more information, see Network address translation.

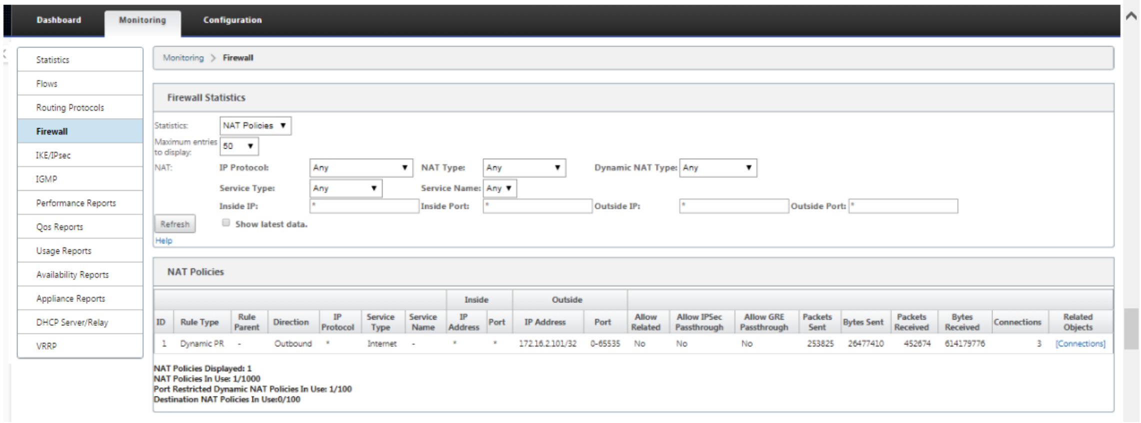


Monitoring a Destination NAT Policy (Firewall)

You can also use the Citrix SD-WAN GUI to monitor the current DNAT policy configuration.

To monitor the current Destination NAT policy configuration:

1. In the Citrix SD-WAN GUI, navigate to **Monitoring** > **Firewall** > **NAT Policies**.
2. Select the tab that includes the statistics you want to monitor.



Firewall Statistics

Statistics: NAT Policies

Maximum entries to display: 50

NAT: IP Protocol: Any NAT Type: Any Dynamic NAT Type: Any

Service Type: Any Service Name: Any

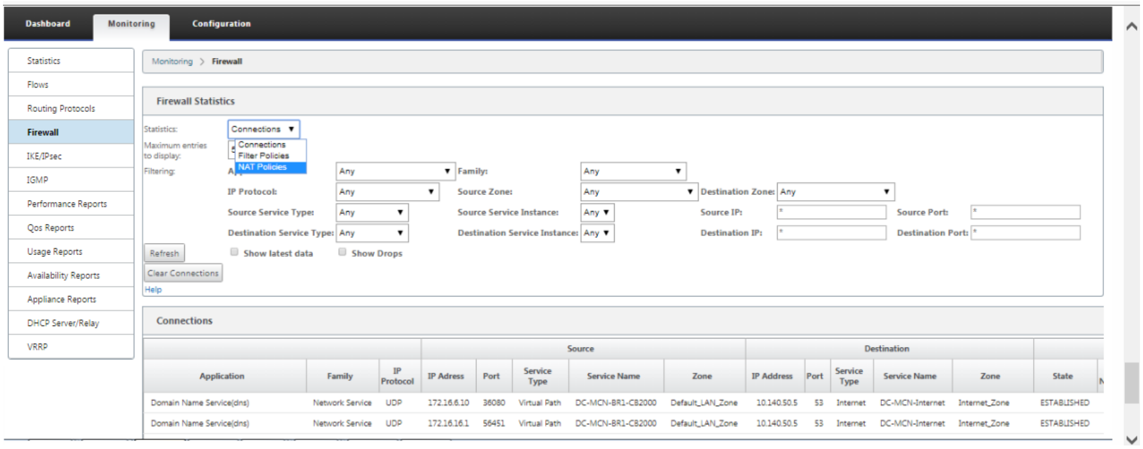
Inside IP: * Inside Port: * Outside IP: * Outside Port: *

□ Show latest data.

NAT Policies

							Inside		Outside										
ID	Rule Type	Rule Parent	Direction	IP Protocol	Service Type	Service Name	IP Address	Port	IP Address	Port	Allow Related	Allow IPSec Passthrough	Allow GRE Passthrough	Packets Sent	Bytes Sent	Packets Received	Bytes Received	Connections	Related Objects
1	Dynamic PR	-	Outbound	*	Internet	-	*	*	172.16.2.101/32	0-65535	No	No	No	253825	26477410	452674	614179776	3	[Connections]

NAT Policies Displayed: 1
NAT Policies In Use: 1/1000
Port Restricted Dynamic NAT Policies In Use: 1/100
Destination NAT Policies In Use:0/100



Firewall Statistics

Statistics: Connections

Maximum entries to display:

Filtering: Ap Any Family: Any

IP Protocol: Any Source Zone: Any Destination Zone: Any

Source Service Type: Any Source Service Instance: Any Source IP: * Source Port: *

Destination Service Type: Any Destination Service Instance: Any Destination IP: * Destination Port: *

□ Show latest data □ Show Drops

Connections

			Source					Destination					
Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State
Domain Name Service(dns)	Network Service	UDP	172.16.6.10	36080	Virtual Path	DC-MCN-BR1-CB2000	Default_LAN_Zone	10.140.50.5	53	Internet	DC-MCN-Internet	Internet_Zone	ESTABLISHED
Domain Name Service(dns)	Network Service	UDP	172.16.16.1	56451	Virtual Path	DC-MCN-BR1-CB2000	Default_LAN_Zone	10.140.50.5	53	Internet	DC-MCN-Internet	Internet_Zone	ESTABLISHED

Palo Alto integration using IPsec tunnels

August 24, 2022

Palo Alto networks deliver cloud-based security infrastructure for protecting remote networks. It provides security by allowing organizations to set up regional, cloud-based firewalls that protect the SD-WAN fabric.

Prisma Access service for remote networks allows you to onboard remote network locations and deliver security for users. It removes the complexity in configuring and managing devices at every remote location. The service provides an efficient way to easily add new remote network locations and minimize the operational challenges with ensuring that users at these locations are always connected and secure, and it allows you to manage policy centrally from Panorama for consistent and streamlined security for your remote network locations.

To connect your remote network locations to the Prisma Access service, you can use the Palo Alto Networks next-generation firewall or a third-party, IPSec-compliant device including SD-WAN, which can establish an IPsec tunnel to the service.

- Plan the Prisma Access Service for Remote Networks
- Configure the Prisma Access Service for Remote Networks
- Onboard Remote Networks with Configuration Import

The Citrix SD-WAN solution already provided the ability to break out Internet traffic from the branch. This is critical to delivering a more reliable, low-latency user experience, while avoiding the introduction of an expensive security stack at each branch. Citrix SD-WAN and Palo Alto Networks now offer distributed enterprises a more reliable and secure way to connect users in branches to applications in the cloud.

Citrix SD-WAN appliances can connect to the Palo Alto cloud service (Prisma Access Service) network through IPsec tunnels from SD-WAN appliances locations with minimal configuration.

Stateful Firewall and NAT Support

August 24, 2022

This feature provides a firewall built into the SD-WAN application. The firewall allows policies between services and zones, and supports Static NAT, Dynamic NAT (PAT), and Dynamic NAT with Port Forwarding. More firewall capabilities include:

- Provide security for user traffic within SD-WAN network (Enterprise and Service Providers)
- (Potential) Reduction of External Equipment (Enterprise and Service Providers)
- Using the same IP address space for Multiple customers: NAT Capability (Service Providers)
- Apply multiple firewalls from a global perspective (Service Providers)
- Filtering traffic flows between Zones
- Filtering traffic between services within a Zone
- Filtering traffic between services that reside in different Zones
- Filtering traffic between services at a site
- Defining Filter Policies to Allow, Deny, or Reject flows
- Tracking flow state for selected flows
- Applying Global Policy Templates
- Support for Port Address Translation for traffic to the Internet on an untrusted port, as well as port forwarding inbound and outbound
- Provide Static Network Address Translation (Static NAT)
- Provide Dynamic Network Address Translation (Dynamic NAT)
- Port Address Translation (PAT)
- Port-Forwarding

> **Note**
>
> It is not recommended to use firewall in Fail-to-Wire inline mode due to security reasons.

Global firewall settings

August 24, 2022

Once you have created the firewall policy templates you can use this policy to configure firewall settings for Citrix SD-WAN Network. Using the Global firewall settings, you can configure the global firewall parameters, these settings are applied to all the sites on the virtual WAN network.

Advanced firewall settings

August 24, 2022

You can configure the advanced firewall settings for every site individually. This will override the global settings.

To configure advanced firewall settings at the site level, see Firewall settings.

Zones

August 24, 2022

You can configure zones in the network and define policies to control how traffic enters and leaves zones. By default, the following zones are created:

- Internet_Zone
  - Applies to traffic to or from an Internet service using a Trusted interface.
- Untrusted_Internet_Zone
  - Applies to traffic to or from an Internet service using an Untrusted interface.
- Default_LAN_Zone
  - Applies to traffic to or from an object with a configurable zone, where the zone has not been set.

You can create your own zones and assign them to the following types of objects:

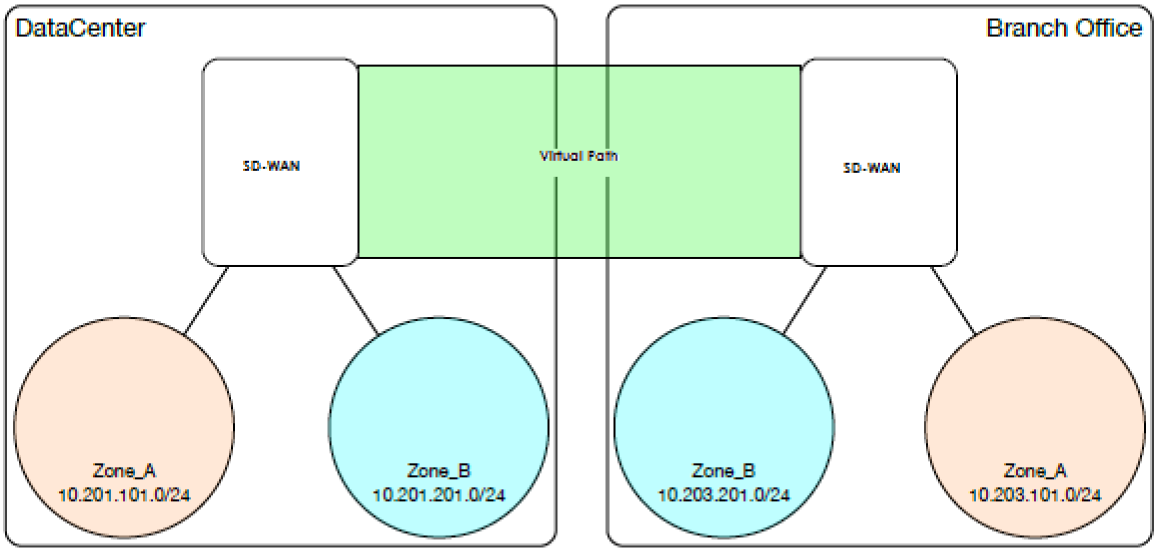
- Virtual Network Interfaces (VNI)
- Intranet Services
- GRE Tunnels
- LAN IPsec Tunnels

The destination zone of a packet is determined based on the destination route match. When a SD-WAN appliance looks up the destination subnet in the route table, the packet will match a route, which has a zone assigned to it.

- Source zone
  - Non-Virtual Path: Determined through the Virtual Network Interface packet was received on.
  - Virtual Path: Determined through source zone field in packet flow header.
  - Virtual network interface - the packet was received on at source site.
- Destination zone
  - Determined through destination route lookup of packet.

Routes shared with remote sites in the SD-WAN maintain information about the destination zone, including routes learned through dynamic routing protocol (BGP, OSPF). Using this mechanism, zones gain global significance in SD-WAN network and allow end-to-end filtering within the network. The use of zones provides a network administrator an efficient way to segment network traffic based on customer, business unit, or department.

The capability of SD-WAN firewall allows the user to filter traffic between services within a single zone, or to create policies that can be applied between services in different zones, as shown in figure below. In the example below, we have Zone_A and Zone_B, each of which has a LAN Virtual network interface.



Policies

August 24, 2022

Policies provide the ability to allow, deny, reject, or count and continue specific traffic flows. You can configure Firewall policies through Citrix SD-WAN Orchestrator service. For more information, see Firewall policies.

Network Address Translation (NAT)

August 24, 2022

Network Address Translation (NAT) performs IP address conservation to preserve the limited number of registered IPv4 addresses. It enables private IP networks that use unregistered IP addresses to connect to the Internet. The NAT feature on Citrix SD-WAN connects your private SD-WAN network with the public internet. It translates the private addresses in the internal network into a legal public address. NAT also ensures extra security by advertising only one address for the entire network to the internet, hiding the entire internal network. Citrix SD-WAN supports the following NAT types:

- Static one-to-one NAT
- Dynamic NAT (PAT- Port Address Translation)
- Dynamic NAT with Port Forwarding rules

> **Note**
>
> The NAT capability can only be configured through Citrix SD-WAN Orchestrator service at the site level. There is no global configuration (templates) for NAT. All NAT policies are defined from a Source-NAT (“SNAT)”translation. Corresponding Destination-NAT (“DNAT”) rules are created automatically for the user. For more information, see Network address translation.

Static NAT

August 24, 2022

Static NAT is a one-to-one mapping of a private IP address or subnet inside the SD-WAN network to a public IP address or subnet outside the SD-WAN network. Configure Static NAT by manually entering the inside IP address and the outside IP address to which it has to translate. You can configure Static NAT for the Local, Virtual Paths, Internet, Intranet, and Inter-routing domain services.

Inbound and Outbound NAT

The direction for a connection can either be inside to outside or outside to inside. When a NAT rule is created, it is applied to both the directions depending on the direction match type.

- Inbound: The source address is translated for packets received on the service. The destination address is translated for packets transmitted on the service. For example, Internet service to LAN service –For packets received (Internet to LAN), the source IP address is translated. For packets transmitted (LAN to Internet), the destination IP address is translated.
- Outbound: The destination address is translated for packets received on the service. The source address is translated for packets transmitted on the service. For example, LAN service to Internet service –for packets transmitted (LAN to Internet) the source IP address is translated. For packets received (Internet to LAN) the destination IP address is translated.

Zone Derivation

The source and destination firewall zones for the inbound or outbound traffic should not be the same. If both the source and destination firewall zones are the same, NAT is not performed on the traffic.

For outbound NAT, the outside zone is automatically derived from the service. Every service on SD-WAN is associated to a zone by default. For example, Internet service on a trusted internet link is associated with the trusted internet zone. Similarly, for an inbound NAT, the inside zone is derived from the service.

For a Virtual path service NAT zone derivation does not happen automatically, you have to manually enter the inside and outside zone. NAT is performed on traffic belonging to these zones only. Zones cannot be derived for virtual paths because there might be multiple zones within the Virtual path subnets.

Static NAT Policies for IPv6 Internet service

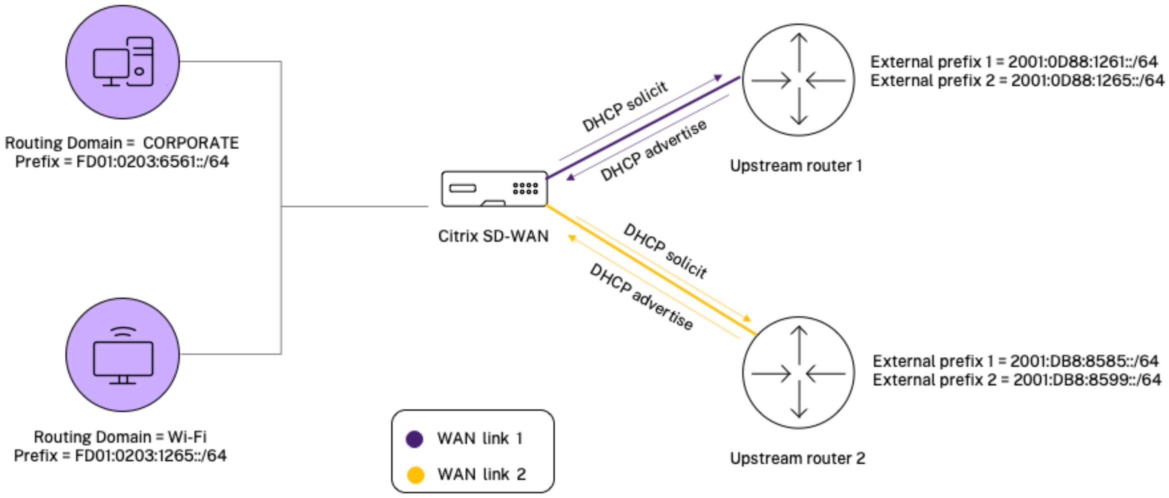
Citrix SD-WAN supports static NAT policies for IPv6 Internet service from release 11.4.0 onwards. A static NAT policy for IPv6 Internet service specifies the mapping of an inside network prefix to an outside network prefix. The number of static NAT policies required depends on the number of inside networks and the number of outside networks (WAN links). If there are **M** number of inside networks and **N** number of WAN links, then the number of static NAT policies required is **M x N**.

From Citrix SD-WAN release 11.4.0 onwards, while creating a static NAT policy, you can either enter the outside IP address manually or enable **Autolearn via PD**. When **Autolearn via PD** is enabled, the Citrix SD-WAN appliance receives delegated prefixes from the upstream delegating router through DHCPv6 Prefix Delegation. Before Citrix SD-WAN release 11.4.0, the outside IP address was derived from the service automatically and there was no option to enter the outside IP address manually. If you are upgrading an appliance to 11.4.0 or a later release and have static NAT policies configured for IPv6 Internet service, then you must manually update the policies.

Configuration example

In the following topology, the Citrix SD-WAN appliance is configured with 2 inside networks and 2 WAN links:

- Inside network 1 resides in the CORPORATE routing domain with network prefix FD01:0203:6561::/64
- Inside network 2 resides in the Wi-Fi routing domain with network prefix FD01:0203:1265::/64
- Through WAN Link 1, the SD-WAN appliance receives from the upstream delegating router through DHCPv6 Prefix Delegation, 2 delegated prefixes 2001:0D88:1261::/64 and 2001:0D88:1265::/64. These 2 delegated prefixes are used as the outside network prefixes when the traffic from the inside networks transits WAN link 1.
- Through WAN Link 2, the SD-WAN appliance receives from the upstream delegating router through DHCPv6 Prefix Delegation, 2 delegated prefixes 2001:DB8:8585::/64 and 2001:DB8:8599::/64. These 2 delegated prefixes are used as the outside network prefixes when the traffic from the inside networks transits WAN link 2.

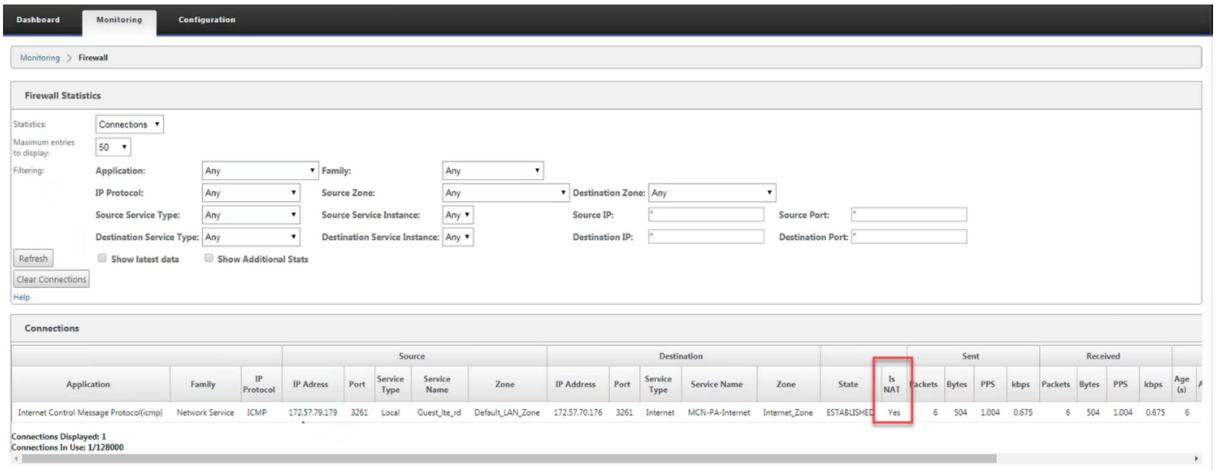

Routing Domain = CORPORATE
Prefix = FD01:0203:6561::/64
Routing Domain = Wi-Fi
Prefix = FD01:0203:1265::/64
Citrix SD-WAN
DHCP solicit
DHCP advertise
DHCP solicit
DHCP advertise
External prefix 1 = 2001:0D88:1261::/64
External prefix 2 = 2001:0D88:1265::/64
Upstream router 1
External prefix 1 = 2001:DB8:8585::/64
External prefix 2 = 2001:DB8:8599::/64
Upstream router 2
● WAN link 1
● WAN link 2

In this scenario, there are M=2 inside networks and N=2 WAN links. Therefore, the number of static NAT policies required for proper deployment of IPv6 Internet service is 2 x 2 = 4. These 4 static NAT policies specify the address translation for:

- Inside network 1 through WAN link 1
- Inside network 1 through WAN link 2
- Inside network 2 through WAN link 1
- Inside network 2 through WAN link 2

Monitoring

To monitor NAT, navigate to **Monitoring** > **Firewall Statistics** > **Connections**. For a connection you can see if NAT is done or not.



Statistics: Connections

Maximum entries to display: 50

Filtering:

Application: Any | Family: Any

IP Protocol: Any | Source Zone: Any | Destination Zone: Any

Source Service Type: Any | Source Service Instance: Any | Source IP: * | Source Port: *

Destination Service Type: Any | Destination Service Instance: Any | Destination IP: * | Destination Port: *

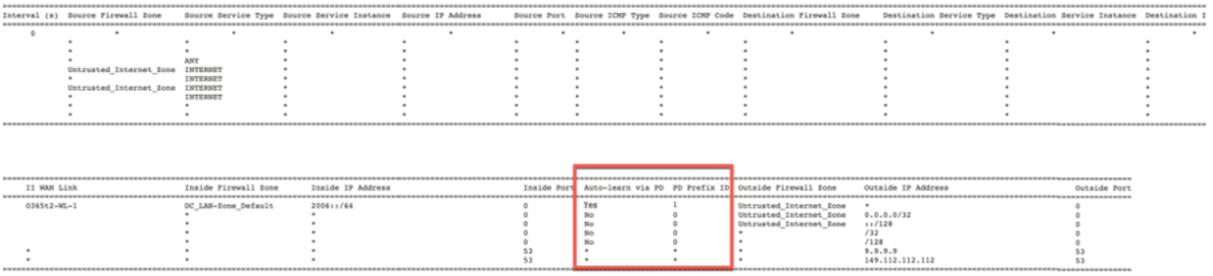
☐ Show latest data ☐ Show Additional Stats

Connections

			Source					Destination							Sent				Received				
Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State	Is NAT	Packets	Bytes	PPS	kbps	Packets	Bytes	PPS	kbps	Age (s)
Internet Control Message Protocol(icmp)	Network Service	ICMP	172.57.79.179	3261	Local	Guest_lte_rd	Default_LAN_Zone	172.57.70.176	3261	Internet	MCN-PA-Internet	Internet_Zone	ESTABLISHED	Yes	6	504	1.004	0.675	6	504	1.004	0.675	6

Connections Displayed: 1
Connections In Use: 1/128000

To check if Auto-learn via PD is configured for any NAT rule, navigate to **Configuration > Virtual WAN > View Configuration** and choose **Firewall** from the **View** drop-down list. **Auto-learn via PD** and **PD prefix ID** columns display the details.

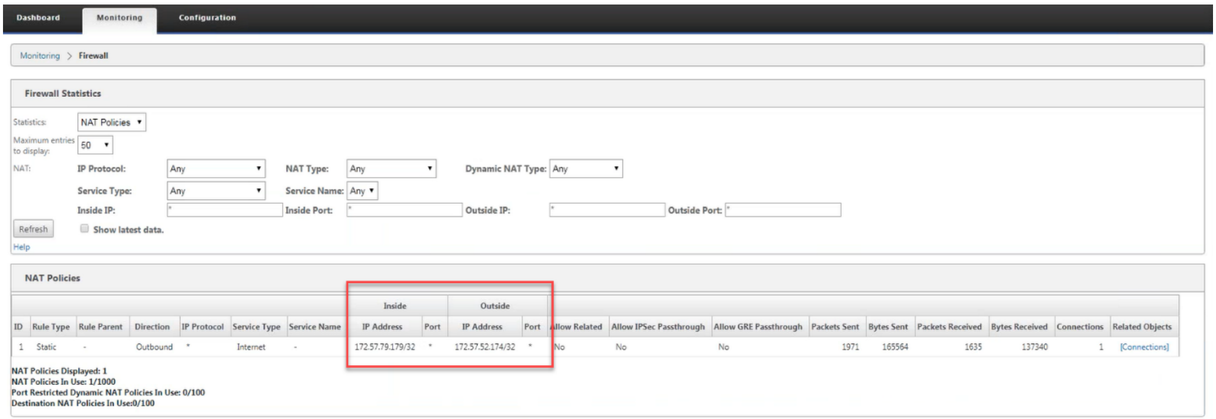


```
Interval (s)  Source Firewall Zone     Source Service Type  Source Service Instance  Source IP Address  Source Port  Source ICMP Type  Source ICMP Code  Destination Firewall Zone  Destination Service Type  Destination Service Instance  Destination I
    0            *                        *                    *                        *                  *            *                 *                 *                          *                         *                             *
                 *                        *                    *                        *                  *            *                 *                 *                          *                         *                             *
                 *                        *                    *                        *                  *            *                 *                 *                          *                         *                             *
                 *                        ANY                  *                        *                  *            *                 *                 *                          *                         *                             *
                 Untrusted_Internet_Zone  INTERNET             *                        *                  *            *                 *                 *                          *                         *                             *
                 *                        INTERNET             *                        *                  *            *                 *                 *                          *                         *                             *
                 Untrusted_Internet_Zone  INTERNET             *                        *                  *            *                 *                 *                          *                         *                             *
                 *                        INTERNET             *                        *                  *            *                 *                 *                          *                         *                             *
                 *                        *                    *                        *                  *            *                 *                 *                          *                         *                             *
                 *                        *                    *                        *                  *            *                 *                 *                          *                         *                             *
```

```
  II WAN Link        Inside Firewall Zone   Inside IP Address     Inside Port  Auto-learn via PD  PD Prefix ID  Outside Firewall Zone    Outside IP Address   Outside Port
  0365t2-WL-1        DC_LAN-Zone_Default    2006::/64             0            Yes                1             Untrusted_Internet_Zone  *                    0
                     *                      *                     0            No                 0             Untrusted_Internet_Zone  0.0.0.0/32           0
                     *                      *                     0            No                 0             Untrusted_Internet_Zone  ::/128               0
                     *                      *                     0            No                 0             *                        /32                  0
                     *                      *                     0            No                 0             *                        /128                 0
  *                  *                      *                     53           *                  *             *                        9.9.9.9              53
  *                  *                      *                     53           *                  *             *                        149.112.112.112      53
```

To further see the inside IP address to outside IP address mapping, click **Post-Route NAT** under **Related Objects** or navigate to **Monitoring** > **Firewall Statistics** > **NAT policies**.

The following screenshot shows the mapping of inside address to outside address in an IPv4 static NAT policy.



Firewall Statistics

Statistics: NAT Policies

Maximum entries to display: 50

NAT: IP Protocol: Any NAT Type: Any Dynamic NAT Type: Any

Service Type: Any Service Name: Any

Inside IP: * Inside Port: * Outside IP: * Outside Port: *

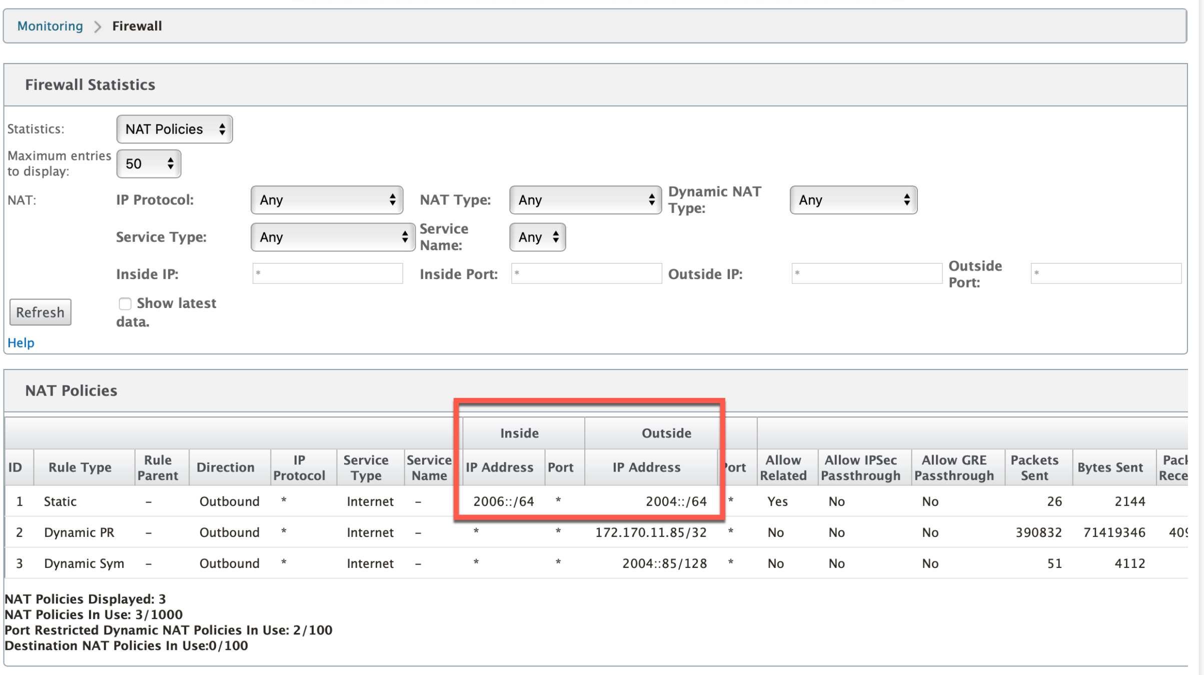
□ Show latest data.

NAT Policies

							Inside		Outside											
ID	Rule Type	Rule Parent	Direction	IP Protocol	Service Type	Service Name	IP Address	Port	IP Address	Port	Allow Related	Allow IPSec Passthrough	Allow GRE Passthrough	Packets Sent	Bytes Sent	Packets Received	Bytes Received	Connections	Related Objects
1	Static	-	Outbound	*	Internet	-	172.57.79.179/32	*	172.57.52.174/32	*	No	No	No	1971	165564	1635	137340	1	[Connections]

NAT Policies Displayed: 1
NAT Policies In Use: 1/1000
Port Restricted Dynamic NAT Policies In Use: 0/100
Destination NAT Policies In Use:0/100

The following screenshot shows the mapping of inside address to outside address in an IPv6 static NAT policy.



Firewall Statistics

Statistics: NAT Policies

Maximum entries to display: 50

NAT: IP Protocol: Any NAT Type: Any Dynamic NAT Type: Any

Service Type: Any Service Name: Any

Inside IP: * Inside Port: * Outside IP: * Outside Port: *

□ Show latest data.

NAT Policies

							Inside		Outside							
ID	Rule Type	Rule Parent	Direction	IP Protocol	Service Type	Service Name	IP Address	Port	IP Address	Port	Allow Related	Allow IPSec Passthrough	Allow GRE Passthrough	Packets Sent	Bytes Sent	Pack Rece
1	Static	–	Outbound	*	Internet	–	2006::/64	*	2004::/64	*	Yes	No	No	26	2144	
2	Dynamic PR	–	Outbound	*	Internet	–	*	*	172.170.11.85/32	*	No	No	No	390832	71419346	40
3	Dynamic Sym	–	Outbound	*	Internet	–	*	*	2004::85/128	*	No	No	No	51	4112	

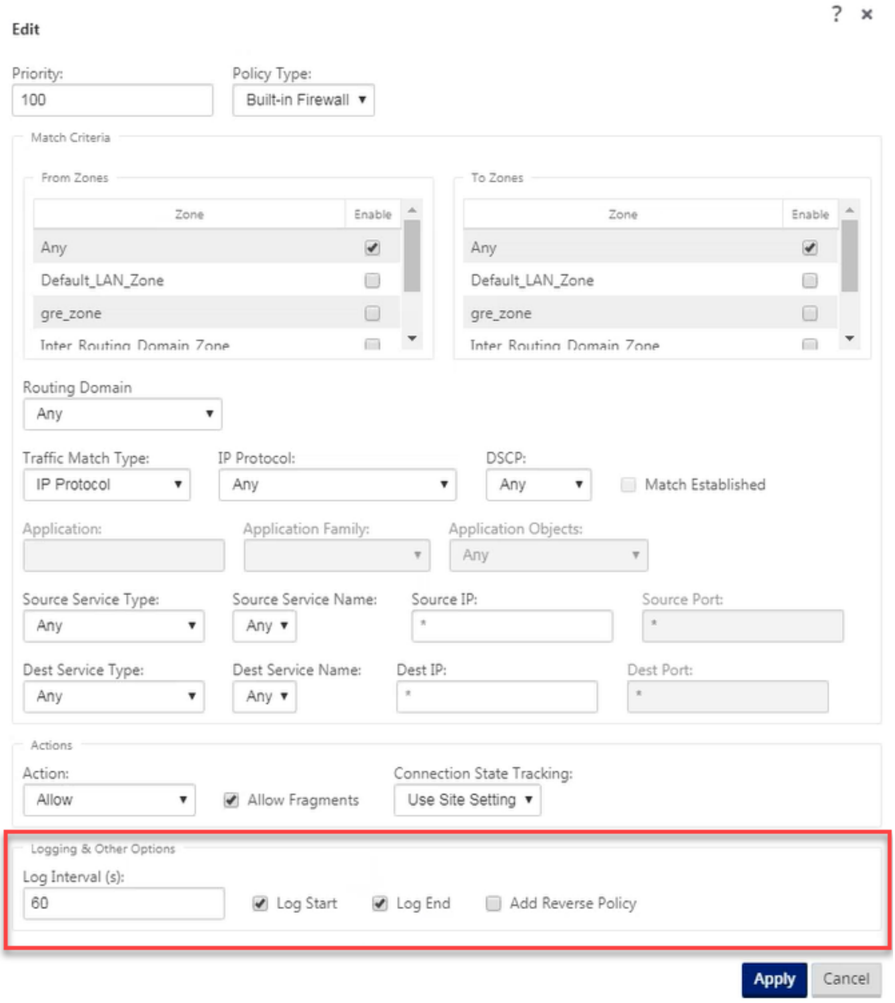
NAT Policies Displayed: 3
NAT Policies In Use: 3/1000
Port Restricted Dynamic NAT Policies In Use: 2/100
Destination NAT Policies In Use:0/100

Logs

You can view logs related to NAT in firewall logs. To view logs for NAT, create a firewall policy that matches your NAT policy and ensure that logging is enabled on the firewall filter. NAT logs display the following information:

- Date and time
- Routing domain
- IP protocol
- Source port

- Source IP address
- Translated IP address
- Translated port
- Destination IP address
- Destination port



Priority: 100
Policy Type: Built-in Firewall

From Zones:

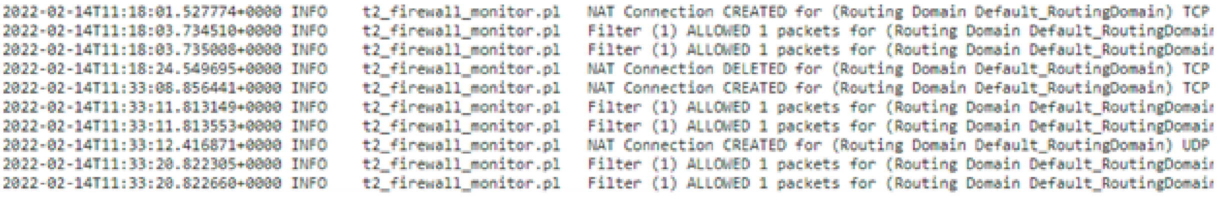
Zone	Enable
Any	☑
Default_LAN_Zone	☐
gre_zone	☐
Inter_Routing_Domain_Zone	☐

To Zones:

Zone	Enable
Any	☑
Default_LAN_Zone	☐
gre_zone	☐
Inter_Routing_Domain_Zone	☐

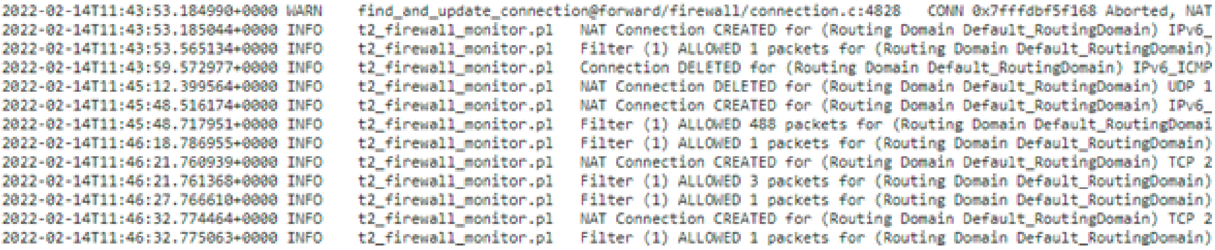
Routing Domain: Any
Traffic Match Type: IP Protocol
IP Protocol: Any
DSCP: Any
☐ Match Established
Application:
Application Family:
Application Objects: Any
Source Service Type: Any
Source Service Name: Any
Source IP: *
Source Port: *
Dest Service Type: Any
Dest Service Name: Any
Dest IP: *
Dest Port: *
Action: Allow
☑ Allow Fragments
Connection State Tracking: Use Site Setting
Log Interval (s): 60
☑ Log Start
☑ Log End
☐ Add Reverse Policy

To generate NAT logs, navigate to **Logging/Monitoring** > **Log Options**, select **SDWAN_firewall.log**, and click **View Log**.

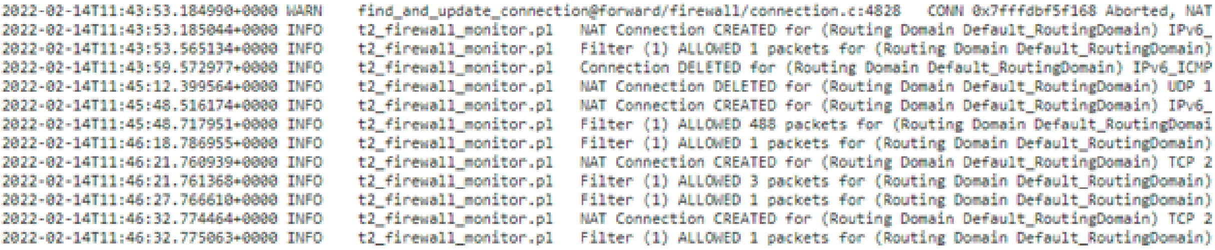


```
2022-02-14T11:18:01.527774+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP
2022-02-14T11:18:03.734510+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:18:03.735008+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:18:24.549695+0000 INFO    t2_firewall_monitor.pl   NAT Connection DELETED for (Routing Domain Default_RoutingDomain) TCP
2022-02-14T11:33:08.856441+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP
2022-02-14T11:33:11.813149+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:33:11.813553+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:33:12.416871+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) UDP
2022-02-14T11:33:20.822305+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:33:20.822660+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
```

The NAT connection details are displayed in the log file.



```
2022-02-14T11:43:53.184990+0000 WARN    find_and_update_connection@forward/firewall/connection.c:4828   CONN 0x7fffdbf5f168 Aborted, NAT
2022-02-14T11:43:53.185044+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) IPv6_
2022-02-14T11:43:53.565134+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:43:59.572977+0000 INFO    t2_firewall_monitor.pl   Connection DELETED for (Routing Domain Default_RoutingDomain) IPv6_ICMP
2022-02-14T11:45:12.399564+0000 INFO    t2_firewall_monitor.pl   NAT Connection DELETED for (Routing Domain Default_RoutingDomain) UDP 1
2022-02-14T11:45:48.516174+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) IPv6_
2022-02-14T11:45:48.717951+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 488 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:46:18.786955+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:46:21.760939+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP 2
2022-02-14T11:46:21.761368+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 3 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:46:27.766610+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:46:32.774464+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP 2
2022-02-14T11:46:32.775063+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
```



```
2022-02-14T11:43:53.184990+0000 WARN    find_and_update_connection@forward/firewall/connection.c:4828   CONN 0x7fffdbf5f168 Aborted, NAT
2022-02-14T11:43:53.185044+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) IPv6_
2022-02-14T11:43:53.565134+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:43:59.572977+0000 INFO    t2_firewall_monitor.pl   Connection DELETED for (Routing Domain Default_RoutingDomain) IPv6_ICMP
2022-02-14T11:45:12.399564+0000 INFO    t2_firewall_monitor.pl   NAT Connection DELETED for (Routing Domain Default_RoutingDomain) UDP 1
2022-02-14T11:45:48.516174+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) IPv6_
2022-02-14T11:45:48.717951+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 488 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:46:18.786955+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:46:21.760939+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP 2
2022-02-14T11:46:21.761368+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 3 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:46:27.766610+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:46:32.774464+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP 2
2022-02-14T11:46:32.775063+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
```

Dynamic NAT

August 24, 2022

Dynamic NAT is a many-to-one mapping of a private IP address or subnets inside the SD-WAN network to a public IP address or subnet outside the SD-WAN network. The traffic from different zones and subnets over trusted (inside) IP addresses in the LAN segment is sent over a single public (outside) IP address.

Dynamic NAT types

Dynamic NAT does Port Address Translation (PAT) along with IP address translation. Port numbers are used to distinguish which traffic belongs to which IP address. A single public IP address is used for all internal private IP addresses, but a different port number is assigned to each private IP address. PAT is a cost effective way to allow multiple hosts to connect to the Internet using a single Public IP address.

- **Port Restricted**: Port Restricted NAT uses the same outside port for all translations related to an Inside IP Address and Port pair. This mode is typically used to allow Internet P2P applications.
- **Symmetric**: Symmetric NAT uses the same outside port for all translations related to an Inside IP Address, Inside Port, Outside IP Address, and Outside Port tuple. This mode is typically used to enhance security or expand the maximum number of NAT sessions.

Inbound and Outbound NAT

The direction for a connection can either be inside to outside or outside to inside. When a NAT rule is created, it is applied to both the directions depending on the direction match type.

- **Outbound**: The destination address is translated for packets received on the service. The source address is translated for packets transmitted on the service. Outbound dynamic NAT is supported on Local, Internet, Intranet, and Inter-routing domain services. For WAN services such as Internet and Intranet services, the configured WAN link IP address is dynamically chosen as the outside IP address. For Local and Inter-routing domain services, provide an outside IP address. The Outside zone is derived from the selected service. A typical use case of outbound dynamic NAT is to simultaneously allow multiple users in your LAN to securely access the internet using a single Public IP address.
- **Inbound**: The source address is translated for packets received on the service. The destination address is translated for packets transmitted on the service. Inbound dynamic NAT is not supported on WAN services such as Internet and Intranet. There is an explicit audit error to indicate the same. Inbound dynamic NAT is supported on Local and Inter-routing domain services only. Provide an outside zone and outside IP address to be translated to. A typical use case for inbound dynamic NAT is to allow external users access email or web servers hosted in your private network.

Port Forwarding

Dynamic NAT with port forwarding allows you to port forward specific traffic to a defined IP address. This is typically used for inside hosts like web servers. Once the dynamic NAT is configured you can define the port forwarding policies. Configure dynamic NAT for IP address translation and define the port forwarding policy to map an outside port to an inside port. Dynamic NAT port forwarding is typically used to allow remote hosts to connect to a host or server on your private network. For a more detailed use case see, Citrix SD-WAN Dynamic NAT explained.

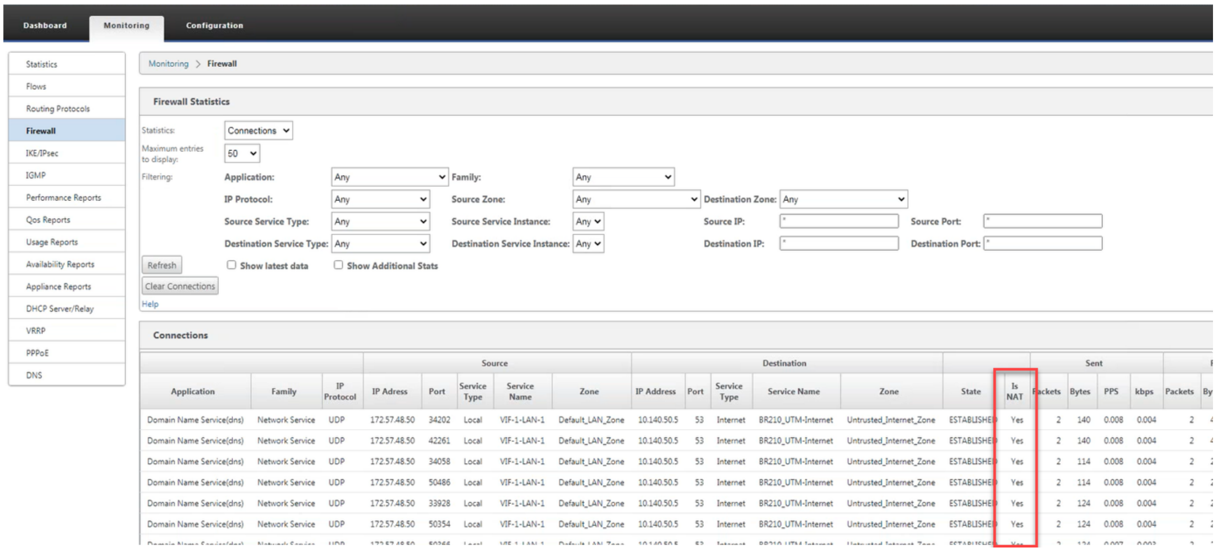
Auto-created Dynamic NAT policies

Dynamic NAT policies for the Internet service are auto created in the following cases:

- Configuring internet service on an untrusted interface (WAN link).
- Enabling internet access for all routing domains on a single WAN link using Citrix SD-WAN Orchestrator service. For more details, see Configure firewall segmentation.
- Configuring DNS forwarders or DNS proxy on SD-WAN Orchestrator service. For more details, see Domain name system.

Monitoring

To monitor dynamic NAT, navigate to **Monitoring** > **Firewall Statistics** > **Connections**. For a connection you can see if NAT is done or not.



Firewall Statistics

Statistics: Connections

Maximum entries to display: 50

Filtering: Application: Any; Family: Any; IP Protocol: Any; Source Zone: Any; Destination Zone: Any; Source Service Type: Any; Source Service Instance: Any; Source IP: *; Source Port: *; Destination Service Type: Any; Destination Service Instance: Any; Destination IP: *; Destination Port: *

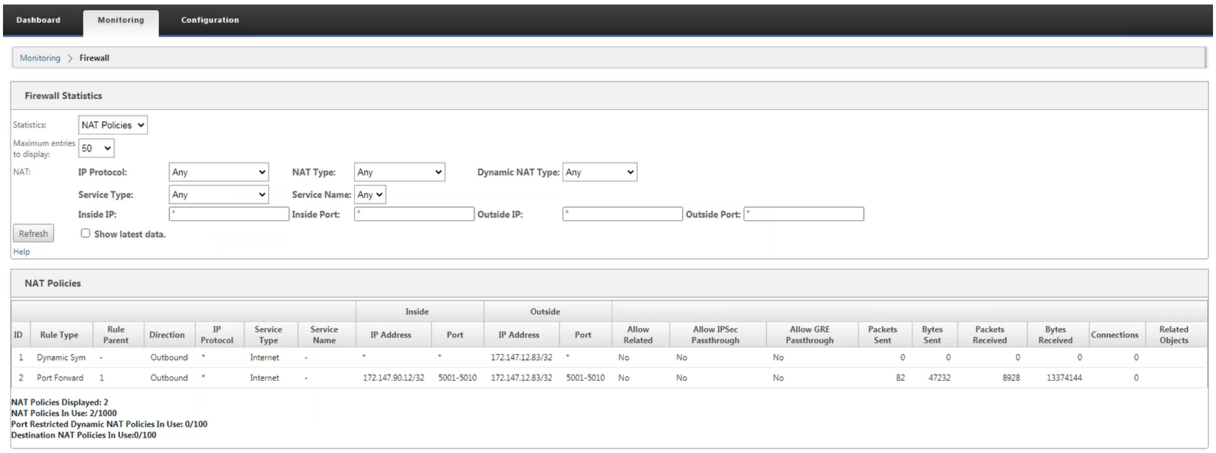
□ Show latest data □ Show Additional Stats

Connections

			Source					Destination							Sent				
Application	Family	IP Protocol	IP Adress	Port	Service Type	Service Name	Zone	IP Address	Port	Service Type	Service Name	Zone	State	Is NAT	Packets	Bytes	PPS	kbps	Packets
Domain Name Service(dns)	Network Service	UDP	172.57.48.50	34202	Local	VIF-1-LAN-1	Default_LAN_Zone	10.140.50.5	53	Internet	BR210_UTM-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	2	140	0.008	0.004	2
Domain Name Service(dns)	Network Service	UDP	172.57.48.50	42261	Local	VIF-1-LAN-1	Default_LAN_Zone	10.140.50.5	53	Internet	BR210_UTM-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	2	140	0.008	0.004	2
Domain Name Service(dns)	Network Service	UDP	172.57.48.50	34058	Local	VIF-1-LAN-1	Default_LAN_Zone	10.140.50.5	53	Internet	BR210_UTM-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	2	114	0.008	0.004	2
Domain Name Service(dns)	Network Service	UDP	172.57.48.50	50486	Local	VIF-1-LAN-1	Default_LAN_Zone	10.140.50.5	53	Internet	BR210_UTM-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	2	114	0.008	0.004	2
Domain Name Service(dns)	Network Service	UDP	172.57.48.50	33928	Local	VIF-1-LAN-1	Default_LAN_Zone	10.140.50.5	53	Internet	BR210_UTM-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	2	124	0.008	0.004	2
Domain Name Service(dns)	Network Service	UDP	172.57.48.50	50354	Local	VIF-1-LAN-1	Default_LAN_Zone	10.140.50.5	53	Internet	BR210_UTM-Internet	Untrusted_Internet_Zone	ESTABLISHED	Yes	2	124	0.008	0.004	2

To further see the inside IP address to outside IP address mapping, click **Pre-Route NAT** or **Post-route NAT** under **Related Objects** or navigate to **Monitoring** > **Firewall Statistics** > **NAT policies**.

The following screenshot shows the statistics for the Dynamic NAT rule of type symmetric and its corresponding port forwarding rule.



Firewall Statistics

Statistics: NAT Policies

Maximum entries to display: 50

NAT: IP Protocol: Any; NAT Type: Any; Dynamic NAT Type: Any; Service Type: Any; Service Name: Any; Inside IP: *; Inside Port: *; Outside IP: *; Outside Port: *

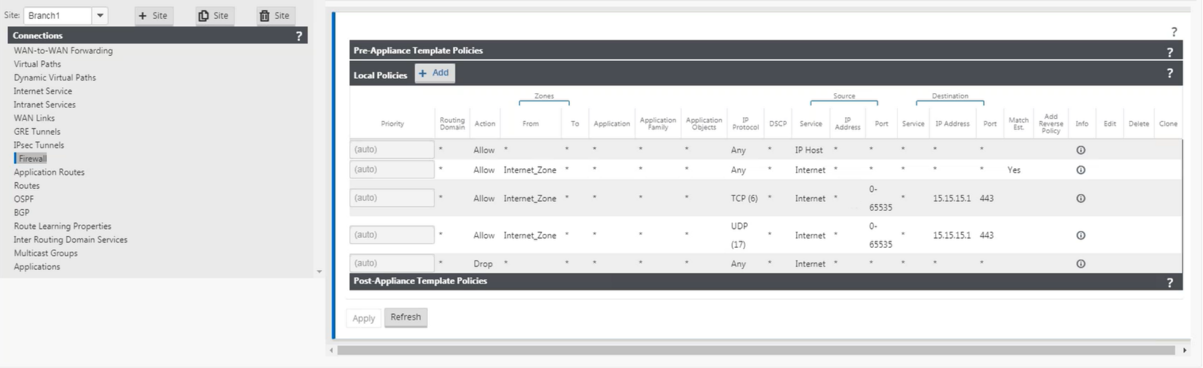
□ Show latest data.

NAT Policies

							Inside		Outside										
ID	Rule Type	Rule Parent	Direction	IP Protocol	Service Type	Service Name	IP Address	Port	IP Address	Port	Allow Related	Allow IPSec Passthrough	Allow GRE Passthrough	Packets Sent	Bytes Sent	Packets Received	Bytes Received	Connections	Related Objects
1	Dynamic Sym	-	Outbound	*	Internet	-	*	*	172.147.12.83/32	*	No	No	No	0	0	0	0	0	
2	Port Forward	1	Outbound	*	Internet	-	172.147.90.12/32	5001-5010	172.147.12.83/32	5001-5010	No	No	No	82	47232	8928	13374144	0	

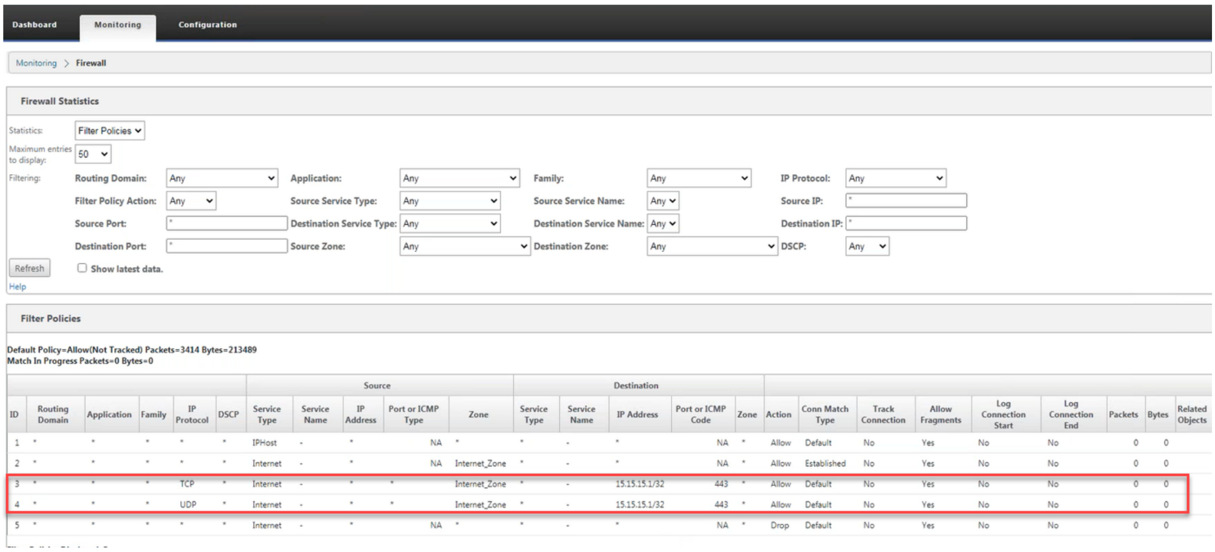
NAT Policies Displayed: 2
NAT Policies In Use: 2/1000
Port Restricted Dynamic NAT Policies In Use: 0/100
Destination NAT Policies In Use:0/100

When a port forwarding rule is created a corresponding firewall rule is also created.



			Zones							Source			Destination								
Priority	Routing Domain	Action	From	To	Application	Application Family	Application Objects	IP Protocol	DSCP	Service	IP Address	Port	Service	IP Address	Port	Match Est.	Add Reverse Policy	Info	Edit	Delete	Clone
(auto)	*	Allow	*	*	*	*	*	Any	*	IP Host	*	*	*	*	*			ⓘ			
(auto)	*	Allow	Internet_Zone	*	*	*	*	Any	*	Internet	*	*	*	*	*	Yes		ⓘ			
(auto)	*	Allow	Internet_Zone	*	*	*	*	TCP (6)	*	Internet	*	0-65535	*	15.15.15.1	443			ⓘ			
(auto)	*	Allow	Internet_Zone	*	*	*	*	UDP (17)	*	Internet	*	0-65535	*	15.15.15.1	443			ⓘ			
(auto)	*	Drop	*	*	*	*	*	Any	*	Internet	*	*	*	*	*			ⓘ			

You can see the filter policy statistics by navigating to **Monitoring** > **Firewall Statistics** > **Filter Policies**.



Firewall Statistics

Statistics: Filter Policies
Maximum entries to display: 50

Filtering:
Routing Domain: Any
Application: Any
Family: Any
IP Protocol: Any
Filter Policy Action: Any
Source Service Type: Any
Source Service Name: Any
Source IP: *
Source Port: *
Destination Service Type: Any
Destination Service Name: Any
Destination IP: *
Destination Port: *
Source Zone: Any
Destination Zone: Any
DSCP: Any

☐ Show latest data.

Filter Policies

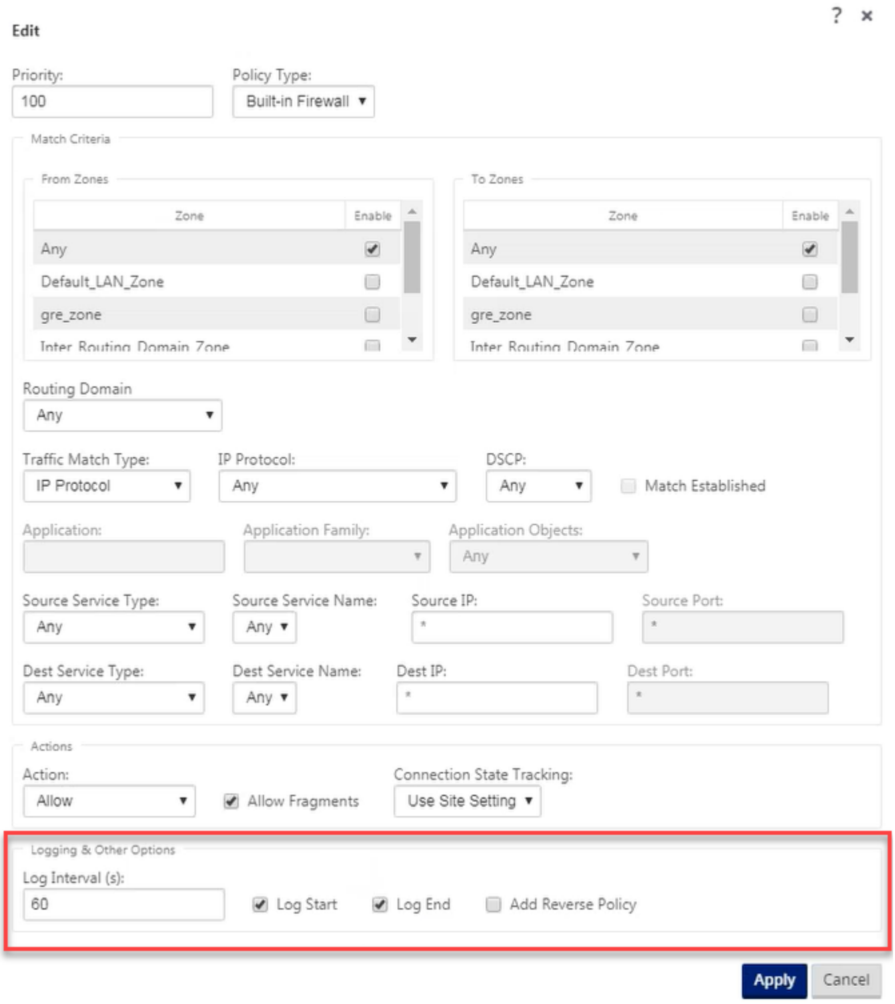
Default Policy=Allow(Not Tracked) Packets=3414 Bytes=213489
Match In Progress Packets=0 Bytes=0

						Source					Destination														
ID	Routing Domain	Application	Family	IP Protocol	DSCP	Service Type	Service Name	IP Address	Port or ICMP Type	Zone	Service Type	Service Name	IP Address	Port or ICMP Code	Zone	Action	Conn Match Type	Track Connection	Allow Fragments	Log Connection Start	Log Connection End	Packets	Bytes	Related Objects
1	*	*	*	*	*	IPHost	-	*	NA	*	*	-	*	NA	*	Allow	Default	No	Yes	No	No	0	0	
2	*	*	*	*	*	Internet	-	*	NA	Internet_Zone	*	-	*	NA	*	Allow	Established	No	Yes	No	No	0	0	
3	*	*	*	TCP	*	Internet	-	*	*	Internet_Zone	*	-	15.15.15.1/32	443	*	Allow	Default	No	Yes	No	No	0	0	
4	*	*	*	UDP	*	Internet	-	*	*	Internet_Zone	*	-	15.15.15.1/32	443	*	Allow	Default	No	Yes	No	No	0	0	
5	*	*	*	*	*	Internet	-	*	NA	*	*	-	*	NA	*	Drop	Default	No	Yes	No	No	0	0	

Logs

You can view logs related to NAT in firewall logs. To view logs for NAT, create a firewall policy that matches your NAT policy and ensure that logging is enabled on the firewall filter. NAT logs contain the following information:

- Date and time
- Routing domain
- IP protocol
- Source port
- Source IP address
- Translated IP address
- Translated port
- Destination IP address
- Destination port



Edit

Priority: 100

Policy Type: Built-in Firewall

Match Criteria

From Zones

Zone	Enable
Any	☑
Default_LAN_Zone	☐
gre_zone	☐
Inter Routing Domain Zone	☐

To Zones

Zone	Enable
Any	☑
Default_LAN_Zone	☐
gre_zone	☐
Inter Routing Domain Zone	☐

Routing Domain: Any

Traffic Match Type: IP Protocol

IP Protocol: Any

DSCP: Any

☐ Match Established

Application:

Application Family:

Application Objects: Any

Source Service Type: Any

Source Service Name: Any

Source IP: *

Source Port: *

Dest Service Type: Any

Dest Service Name: Any

Dest IP: *

Dest Port: *

Actions

Action: Allow

☑ Allow Fragments

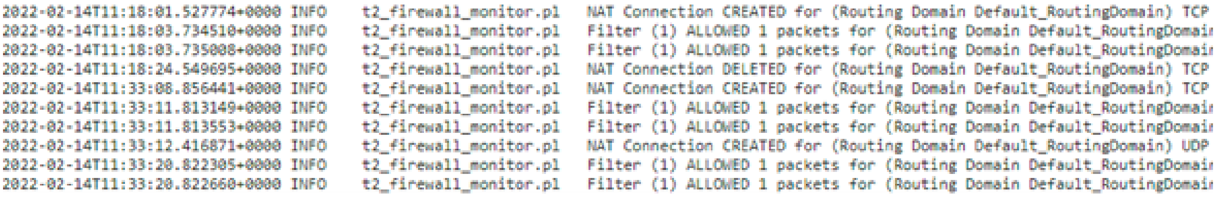
Connection State Tracking: Use Site Setting

Logging & Other Options

Log Interval (s): 60

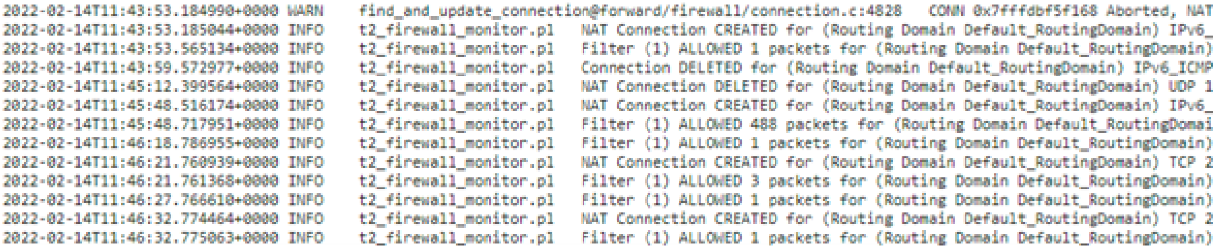
☑ Log Start ☑ Log End ☐ Add Reverse Policy

To generate NAT logs, navigate to **Logging/Monitoring** > **Log Options**, select **SDWAN_firewall.log**, and click **View Log**.



```
2022-02-14T11:18:01.527774+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP
2022-02-14T11:18:03.734510+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:18:03.735008+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:18:24.549695+0000 INFO    t2_firewall_monitor.pl   NAT Connection DELETED for (Routing Domain Default_RoutingDomain) TCP
2022-02-14T11:33:08.856441+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP
2022-02-14T11:33:11.813149+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:33:11.813553+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:33:12.416871+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) UDP
2022-02-14T11:33:20.822305+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:33:20.822660+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomai
```

The NAT connection details are displayed in the log file.



```
2022-02-14T11:43:53.184990+0000 WARN    find_and_update_connection@forward/firewall/connection.c:4828   CONN 0x7fffdbf5f168 Aborted, NAT
2022-02-14T11:43:53.185044+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) IPv6_
2022-02-14T11:43:53.565134+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:43:59.572977+0000 INFO    t2_firewall_monitor.pl   Connection DELETED for (Routing Domain Default_RoutingDomain) IPv6_ICMP
2022-02-14T11:45:12.399564+0000 INFO    t2_firewall_monitor.pl   NAT Connection DELETED for (Routing Domain Default_RoutingDomain) UDP 1
2022-02-14T11:45:48.516174+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) IPv6_
2022-02-14T11:45:48.717951+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 488 packets for (Routing Domain Default_RoutingDomai
2022-02-14T11:46:18.786955+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:46:21.760939+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP 2
2022-02-14T11:46:21.761368+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 3 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:46:27.766610+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
2022-02-14T11:46:32.774464+0000 INFO    t2_firewall_monitor.pl   NAT Connection CREATED for (Routing Domain Default_RoutingDomain) TCP 2
2022-02-14T11:46:32.775063+0000 INFO    t2_firewall_monitor.pl   Filter (1) ALLOWED 1 packets for (Routing Domain Default_RoutingDomain)
```

Configure Virtual WAN Service

August 24, 2022

The Citrix SD-WAN configuration describes and defines the topology of your Citrix SD-WAN network. For information on how to configure virtual WAN service using Citrix SD-WAN Orchestrator service, see Flows.

Security and encryption

Enabling encryption for SD-WAN (for the Virtual Paths) is optional. When encryption is enabled, SD-WAN uses the Advanced Encryption Standard (AES) to secure traffic across the Virtual Path. Both AES 128 bit and 256 bit ciphers (key sizes) are supported by the SD-WAN Appliances, and are configurable options.

Authentication between sites functions with the Virtual WAN Configuration. The network configuration has a secret key for each site. For each Virtual Path, the network configuration generates a key by combining the secret keys from the sites at each end of the Virtual Path. The initial key exchange that occurs after a Virtual Path is first set up, is dependent upon the ability to encrypt and decrypt packets with that combined key.

Configure firewall segmentation

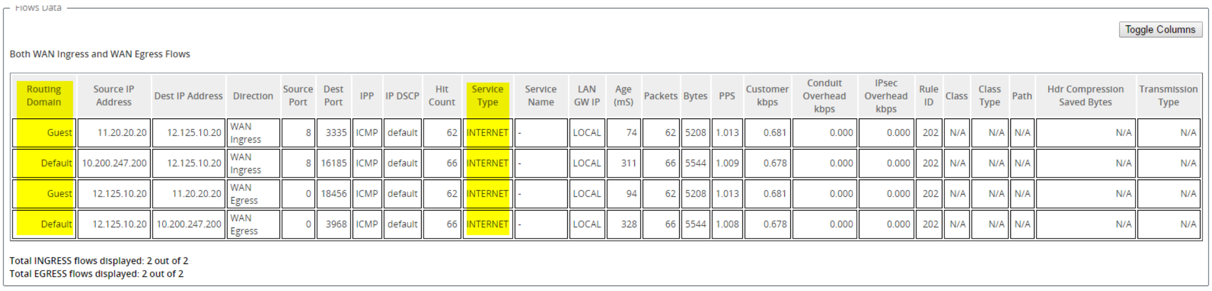
August 24, 2022

Virtual Route Forwarding (VRF) firewall segmentation provides multiple routing domains accesses to the internet through a common interface, with each domain's traffic isolated from that of the others. For example, employees and guests can access the internet through the same interface, without any access to each other's traffic. From SD-WAN 11.5 release onwards, you can configure firewall segmentation using Citrix SD-WAN Orchestrator service. For more informaation, see Firewall segmentation.

- Local guest-user Internet access
- Employee-user Internet access for defined applications
- Employee-users may continue hairpin all other traffic to the MCN
- Allow the user to add specific routes for specific routing domains.
- When enabled, this feature applies to all routing domains.

You can also create multiple access interfaces to accommodate separate public facing IP addresses. Either option provides the required security necessary for each user group.

You can confirm that each routing domain is using the internet service by checking the Routing Domain column in the Flows table of the web management interface under **Monitor** > **Flows**.

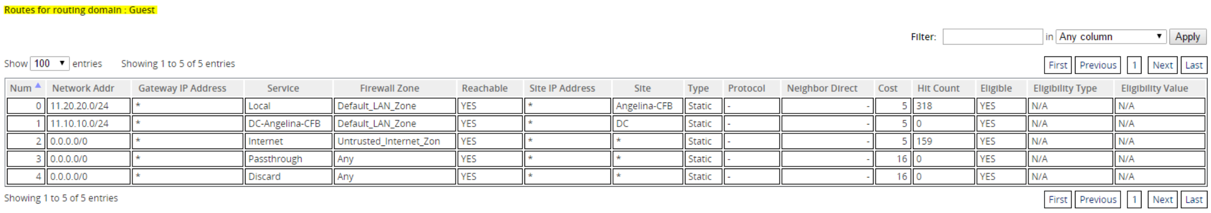


Both WAN Ingress and WAN Egress Flows

Routing Domain	Source IP Address	Dest IP Address	Direction	Source Port	Dest Port	IPP	IP DSCP	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Conduit Overhead kbps	IPsec Overhead kbps	Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type
Guest	11.20.20.20	12.125.10.20	WAN Ingress	8	3335	ICMP	default	62	INTERNET	-	LOCAL	74	62	5208	1.013	0.681	0.000	0.000	202	N/A	N/A	N/A	N/A	N/A
Default	10.200.247.200	12.125.10.20	WAN Ingress	8	16185	ICMP	default	66	INTERNET	-	LOCAL	311	66	5544	1.009	0.678	0.000	0.000	202	N/A	N/A	N/A	N/A	N/A
Guest	12.125.10.20	11.20.20.20	WAN Egress	0	18456	ICMP	default	62	INTERNET	-	LOCAL	94	62	5208	1.013	0.681	0.000	0.000	202	N/A	N/A	N/A	N/A	N/A
Default	12.125.10.20	10.200.247.200	WAN Egress	0	3968	ICMP	default	66	INTERNET	-	LOCAL	328	66	5544	1.008	0.678	0.000	0.000	202	N/A	N/A	N/A	N/A	N/A

Total INGRESS flows displayed: 2 out of 2
Total EGRESS flows displayed: 2 out of 2

You can also check the routing table for each routing domain under **Monitor** > **Statistics** > **Routes**.



Routes for routing domain : Guest

Showing 1 to 5 of 5 entries

Num	Network Addr	Gateway IP Address	Service	Firewall Zone	Reachable	Site IP Address	Site	Type	Protocol	Neighbor Direct	Cost	Hit Count	Eligible	Eligibility Type	Eligibility Value
0	11.20.20.0/24	*	Local	Default_LAN_Zone	YES	*	Angelina-CFB	Static	-	-	5	318	YES	N/A	N/A
1	11.10.10.0/24	*	DC-Angelina-CFB	Default_LAN_Zone	YES	*	DC	Static	-	-	5	0	YES	N/A	N/A
2	0.0.0.0/0	*	Internet	Untrusted_Internet_Zon	YES	*	*	Static	-	-	5	159	YES	N/A	N/A
3	0.0.0.0/0	*	Passthrough	Any	YES	*	*	Static	-	-	16	0	YES	N/A	N/A
4	0.0.0.0/0	*	Discard	Any	YES	*	*	Static	-	-	16	0	YES	N/A	N/A

Showing 1 to 5 of 5 entries

Use Cases

In previous Citrix SD-WAN releases, virtual routing and forwarding had the following issues, which have been resolved.

- Customers have multiple routing domains at a branch site without the requirement to include all domains at the data center (MCN). They need the ability to isolate different customers'traffic in a secure manner
- Customers must be able to have a single accessible firewalled Public IP address for multiple routing domains to access the internet at a site (extend beyond VRF lite).
- Customers need an Internet route for each routing domain supporting different services.
- Multiple routing domains at a branch site.
- Internet Access for different routing domains.

Multiple routing domains at a branch site

With the Virtual Forwarding and Routing Firewall segmentation enhancements, you can:

- Provide an infrastructure, at the branch site, that supports secure connectivity for at least two user groups, such as employees and guests. The infrastructure can support up to 16 routing domains.

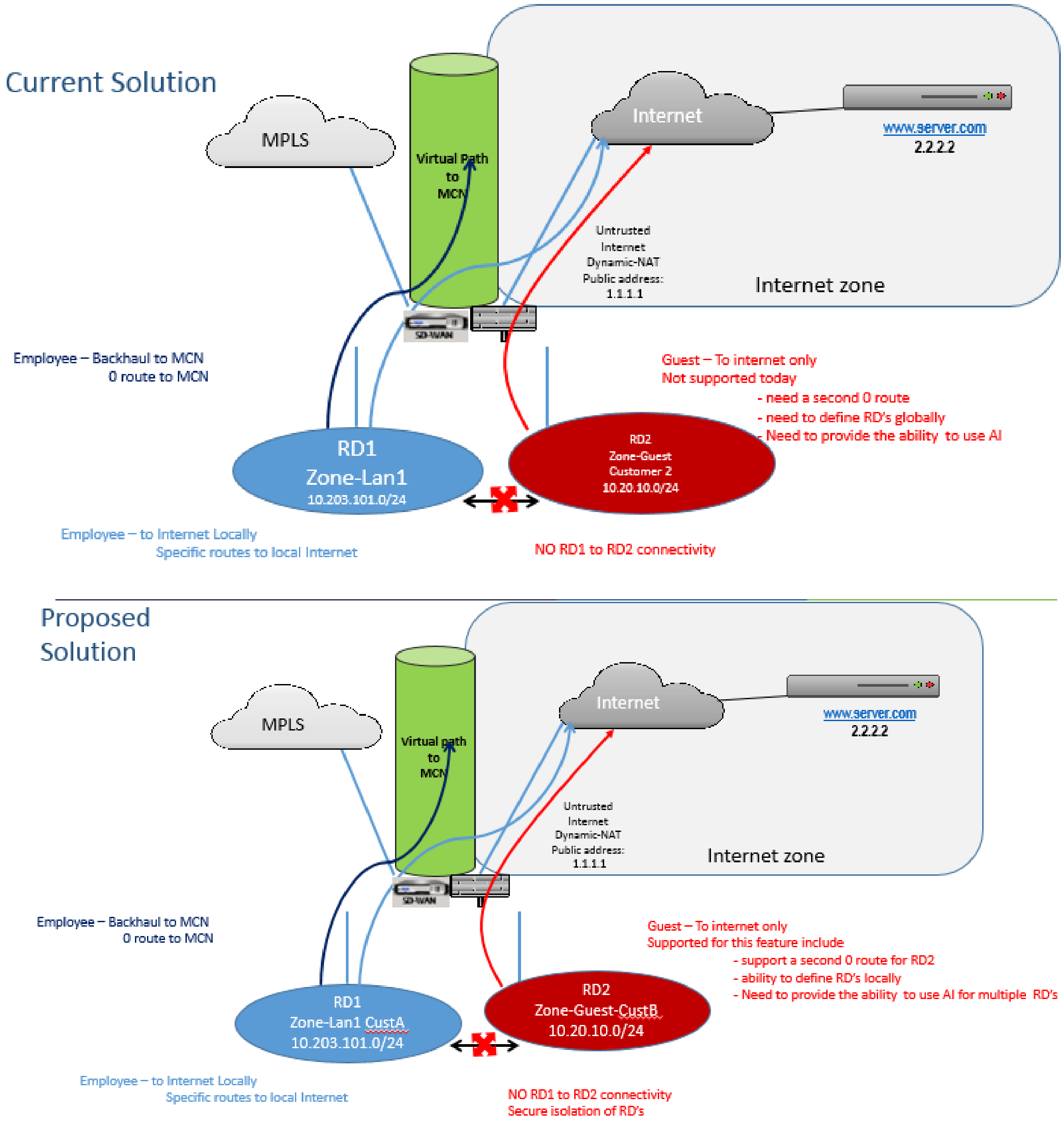
- Isolate each routing domain's traffic from the traffic of any other routing domain.

- Provide internet access for each routing domain,
  - A common Access Interface is required and acceptable
  - An Access Interface for each group with separate Public facing IP addresses
- Traffic for the employee can be routed directly out to the local internet (specific applications)
- Traffic for the employee can be routed or backhauled to the MCN for extensive filtering (0 route)
- Traffic for the routing domain can be routed directly out to the local internet (0 route)
- Supports specific routes per routing domain, if necessary
- Routing domains are VLAN based
- Removes the requirement for the RD to have to reside at the MCN
- Routing Domain can now be configured at a branch site only
- Allows you to assign multiple RD to an access interface (once enabled)
- Each RD is assigned a 0.0.0.0 route
- Allows specific routes to be added for an RD
- Allows traffic from different RD to exit to the internet using the same access interface
- Allows you to configure a different access interface for each RD
- Must be unique subnets (RD are assigned to a VLAN)
- Each RD can use the same FW default Zone
- The traffic is isolated through the Routing Domain
- Outbound flows have the RD as a component of the flow header. Allows SD-WAN to map return flows to correct Routing domain.

Prerequisites to configure multiple routing domains:

- Internet access is configured and assigned to a WAN Link.
- Firewall configured for NAT and correct policies applied.
- Second routing domain added globally.
- Each routing domain added to a site.
- Ensure that the Internet service has been defined correctly.

Deployment scenarios


Current Solution
MPLS
Virtual Path to MCN
Internet
www.server.com
2.2.2.2
Untrusted Internet Dynamic-NAT Public address: 1.1.1.1
Internet zone
SD-WAN
Employee – Backhaul to MCN
0 route to MCN
Guest – To internet only
Not supported today
- need a second 0 route
- need to define RD's globally
- Need to provide the ability to use AI
RD1
Zone-Lan1
10.203.101.0/24
RD2
Zone-Guest
Customer 2
10.20.10.0/24
Employee – to Internet Locally
Specific routes to local Internet
NO RD1 to RD2 connectivity
Proposed Solution
MPLS
Virtual path to MCN
Internet
www.server.com
2.2.2.2
Untrusted Internet Dynamic-NAT Public address: 1.1.1.1
Internet zone
SD-WAN
Employee – Backhaul to MCN
0 route to MCN
Guest – To internet only
Supported for this feature include
- support a second 0 route for RD2
- ability to define RD's locally
- Need to provide the ability to use AI for multiple RD's
RD1
Zone-Lan1 CustA
10.203.101.0/24
RD2
Zone-Guest-CustB
10.20.10.0/24
Employee – to Internet Locally
Specific routes to local Internet
NO RD1 to RD2 connectivity
Secure isolation of RD's

Limitations

- The internet service must be added to the WAN link before you can enable Internet access for all Routing Domains. (Until you do, the check box for enabling this option is grayed out).

  After enabling internet access for all routing domains, auto add a dynamic-NAT rule.
- Up to 16 Routing Domains per site.

- Access Interface (AI): Single AI per subnet.
- Multiple AIs require a separate VLAN for each AI.
- If you have two routing domains at a site and have a single WAN Link, both domains use the same public IP address.
- If Internet access for all routing domains is enabled, all sites can route to Internet. (If one routing domain does not require internet access, you can use the firewall to block its traffic.)
- No support for the same subnet in multiple routing domains.
- There is no audit functionality
- The WAN links are shared for Internet access.
- No QOS per routing domain; first come first serve.

Certificate authentication

August 24, 2022

Citrix SD-WAN ensures secure paths are established between appliances in the SD-WAN network by using security techniques such as network encryption and virtual path IPsec tunnels. In addition to the existing security measures, certificate based authentication is introduced in Citrix SD-WAN 11.0.2.

Certificate authentication allows organizations to use certificates issued by their private Certificate Authority (CA) to authenticate appliances. The appliances are authenticated before establishing the virtual paths. For example, if a branch appliance tries to connect to the data center and the certificate from the branch does not match with the certificate that the data center expects, the virtual path is not established.

The certificate issued by the CA binds a public key to the name of the appliance. The public key works with the corresponding private key possessed by the appliance identified by the certificate.

You can enable Certificate authentication of your SD-WAN appliance using Citrix SD-WAN Orchestrator service. For more information about Certificate authentication, see Certificate authentication.

AppFlow and IPFIX

August 24, 2022

AppFlow and IPFIX are flow export standards used to identify and collect application and transaction data in the network infrastructure. This data gives better visibility into application traffic utilization and performance.

The collected data, called flow records are transmitted to one or more IPv4 or IPv6 collectors. The collectors aggregate the flow records and generate real-time or historical reports.

AppFlow

AppFlow exports flow level data for HDX / ICA connections only. You can enable either the TCP only for HDX dataset template or the HDX dataset template. The TCP only for HDX dataset provides multi-hop data. The HDX dataset provides HDX insight data.

AppFlow Collectors like Splunk and Citrix ADM have dashboards to interpret and present these templates.

IPFIX

IPFIX is a collector export protocol used for exporting flow level data for all connections. For any connection, you can view information such as packet count, byte count, type of service, flow direction, routing domain, application name and so on. IPFIX flows are transmitted through the management interface. Most collectors can receive IPFIX flow records, but may need to build a custom dashboard to interpret IPFIX template.

The IPFIX template defines the order in which the data stream is to be interpreted. The collector receives a template record, followed by the data records. Citrix SD-WAN uses templates 611 and 613 to export IPv4 IPFIX flow data, 615 and 616 to export IPv6 IPFIX flow data along with Options template 612.

Application Flow Info (IPFIX) exports data sets as per templates 611 for IPv4 flows, 615 for IPv6 flows and 612 options Template with Application info.

Basic Properties (IPFIX) exports data sets as per templates 613 for IPv4 flows and 616 for IPv6 flows.

The following tables provide the detailed list of flow data associated with each IPFIX template.

Application Flow Info (IPFIX) - V10 templates

Template ID - 611

Info Element (IE)	IE name & ID	Type and len	Description
Observation point ID	observationPointId, 138	Unsigned32, 4	
Export process ID	exportingProcessId, 144	Unsigned32, 4	
Flow ID	flowId, 148	Unsigned64, 8	
Ipv4 SRC IP	sourceIPv4Address, 8	Ipv4address, 4	
Ipv4 DST IP	destinationIpv4Addres, 12	Ipv4address, 4	
Ipversion	ipVersion, 60	Unsigned8, 1	Set to 4.
IP protocol number	protocoldentifier,4	Unsigned8, 1	
Padding	N/A	Unsigned16, 2	
SRC Port	sourceTransportPort, 7	Unsigned16, 2	
DST Port	destinationTransportPort,11	Unsigned16, 2	
Pkt Count	packetDeltaCount, 2	Unsigned64, 8	
Byte Count	octetDeltaCount, 1	Unsigned64, 8	
Time for first pkt in microseconds	flowStartMicroseconds, 154	dateTimeMicroseconds, 8	
Time for lastpkt in microseconds	flowEndMicroseconds, 155	dateTimeMicroseconds, 8	
IP ToS	ipClassOfService, 5	Unsigned8, 1	
Flow Flags	tcpControlBits, 6	Unsigned8, 2	Currently set to 0.
Flow Direction	flowDirection, 61	Unsigned8, 1	0x00: ingress flow0x01: egress flowWAN-WAN and LAN-LAN flows are a possibility in SDWAN
Input Interface	ingressInterface, 10	Unsigned32, 4	Citrix SD-WAN load balances data flows through multiple member paths, hence a single data flow can have multiple input/output interface combinations.

Info Element (IE)	IE name & ID	Type and len	Description
Output Interface	egressInterface, 14	Unsigned32, 4	Citrix SD-WAN load balances data flows through multiple member paths, hence a single data flow can have multiple input/output interface combinations.
Input Vlan ID	vlanId, 58	Unsigned16, 2	
Output Vlan ID	postVlanId, 59	Unsigned16, 2	
VRF ID	ingressVRFID, 234	Unsigned32, 4	
Flow Key Indicator	flowKeyIndicator, 173	Unsigned64, 8	Set to 0x1E037F.
Application ID	applicationId, 95	octetArray, variable	The Application ID is same as the ID of the applications classified by the DPI engine. The application IDs remain constant. The application IDs for Custom domain name based applications change with every configuration update.

Template ID –615 (IPv6 flows)

Info Element (IE)	IE name & ID	Type and len	Comment
Observation point ID	observationPointId, 138	Unsigned32, 4	
Export process ID	exportingProcessId, 144	Unsigned32, 4	
Flow ID	flowId, 148	Unsigned64, 8	
Ipv6 SRC IP	sourceIPv6Address, 27	Ipv6address, 16	

Info Element (IE)	IE name & ID	Type and len	Comment
Ipv6 DST IP	destinationIpv6Address, 28	Ipv6address, 16	
Ipversion	ipVersion, 60	Unsigned8, 1	Set to 6
IP protocol number	protocoldentifier, 4	Unsigned8, 1	
Padding	N/A	Unsigned16, 2	
SRC Port	sourceTransportPort, 7	Unsigned16, 2	
DST Port	destinationTransportPort, 11	Unsigned16, 2	
Pkt Count	packetDeltaCount, 2	Unsigned64, 8	
Byte Count	octetDeltaCount, 1	Unsigned64, 8	
Time for first pkt in microseconds	flowStartMicroseconds, 154	dateTimeMicroseconds, 8	
Time for lastpkt in microseconds	flowEndMicroseconds, 155	dateTimeMicroseconds, 8	
IP ToS	ipClassOfService, 5	Unsigned8, 1	
Flow Flags	tcpControlBits, 6	Unsigned8, 2	Currently set to 0.
Flow Direction	flowDirection, 61	Unsigned8, 1	0x00: ingress flow0x01: egress flowWAN-WAN and LAN-LAN flows are a possibility in SDWAN

Info Element (IE)	IE name & ID	Type and len	Comment
Input Interface	ingressInterface, 10	Unsigned32, 4	Citrix SD-WAN load balances data flows through multiple member paths, hence a single data flow can have multiple input/output interface combinations.
Output Interface	egressInterface, 14	Unsigned32, 4	Citrix SD-WAN load balances data flows through multiple member paths, hence a single data flow can have multiple input/output interface combinations.
Input Vlan ID	vlanId, 58	Unsigned16, 2	
Output Vlan ID	postVlanId, 59	Unsigned16, 2	
VRF ID	ingressVRFID, 234	Unsigned32, 4	
Flow Key Indicator	flowKeyIndicator, 173	Unsigned64, 8	Set to 0x1E037F.

Info Element (IE)	IE name & ID	Type and len	Comment
Application ID	applicationId, 95	octetArray, variable	The Application ID is same as the ID of the applications classified by the DPI engine. The application IDs remain constant. The application IDs for Custom domain name based applications change with every configuration update.

Template 612 (Options Template)

Info Element (IE)	**IE name & ID**	**Type**	**Comment**
Application ID	applicationId, 95	octetArray	The Application ID is same as the ID of the applications classified by the DPI engine. The application IDs remain constant. The application IDs for Custom domain name based applications change with every configuration update.
Application Name	applicationName, 96	string	Specifies the name of the Citrix SDWAN specific proprietary application.

Info Element (IE)	IE name & ID	Type	Comment
Application Description	applicationDescription, 94	string	Specifies the description of the application.

Basic Properties (IPFIX) –V9 compliant template - Template 613 (IPv4 flows)

Info Element (IE)	IE name & ID	Type and len	Comment
Ipv4 SRC IP	sourceIPv4Address, 8	Ipv4address, 4	
Ipv4 DST IP	destinationIpv4Addres, 12	Ipv4address, 4	
Ipversion	ipVersion, 60	Unsigned8, 1	
IP protocol number	protocoldentifier, 4	Unsigned8, 1	
IP ToS	ipClassOfService, 5	Unsigned8, 1	
Flow Direction	flowDirection, 61	Unsigned8, 1	0x00: ingress flow0x01: egress flowWAN-WAN and LAN-LAN flows are a possibility in SDWAN
SRC Port	sourceTransportPort, 7	Unsigned16, 2	
DST Port	destinationTransportPort, 11	Unsigned16, 2	
Pkt Count	packetDeltaCount, 2	Unsigned64, 8	
Byte Count	octetDeltaCount, 1	Unsigned64, 8	
Input Interface	ingressInterface, 10	Unsigned32, 4	Citrix SD-WAN load balances data flows through multiple member paths, hence a single data flow can have multiple input/output interface combinations.

Info Element (IE)	**IE name & ID**	**Type and len**	**Comment**
Output Interface	egressInterface, 14	Unsigned32, 4	Citrix SD-WAN load balances data flows through multiple member paths, hence a single data flow can have multiple input/output interface combinations.
Input Vlan ID	vlanId, 58	Unsigned16, 2	
Output Vlan ID	postVlanId, 59	Unsigned16, 2	

Template ID –616 (IPv6 flows)

Info Element (IE)	IE name & ID	Type and len	Comment
Ipv6 SRC IP	sourceIPv6Address, 27	Ipv6address, 16	
Ipv6 DST IP	destinationIpv6Address, 28	Ipv6address, 16	
Ipversion	ipVersion, 60	Unsigned8, 1	Set to 6
IP protocol number	protocoldentifier,4	Unsigned8, 1	
IP ToS	ipClassOfService, 5	Unsigned8, 1	
Flow Direction	flowDirection, 61	Unsigned8, 1	0x00: ingress flow0x01: egress flowWAN-WAN and LAN-LAN flows are a possibility in SDWAN
SRC Port	sourceTransportPort, 7	Unsigned16, 2	
DST Port	destinationTransportPort, 11	Unsigned16, 2	
Pkt Count	packetDeltaCount, 2	Unsigned64, 8	

Info Element (IE)	IE name & ID	Type and len	Comment
Byte Count	octetDeltaCount, 1	Unsigned64, 8	
Input Interface	ingressInterface, 10	Unsigned32, 4	Citrix SD-WAN load balances data flows through multiple member paths, hence a single data flow can have multiple input/output interface combinations.
Output Interface	egressInterface, 14	Unsigned32, 4	Citrix SD-WAN load balances data flows through multiple member paths, hence a single data flow can have multiple input/output interface combinations.
Input Vlan ID	vlanId, 58	Unsigned16, 2	
Output Vlan ID	postVlanId, 59	Unsigned16, 2	

Limitations

- AppFlow does not support IPv6 collector and flow records.
- The export interval for Net Flow is increased from 15 seconds to 60 seconds.
- AppFlow/IPFIX flows are transmitted over UDP, on connection loss not all data is retransmitted. If the export interval is set to X minutes, the appliance stores X minutes of data only. Which is retransmitted after X minutes of connection loss.
- In Citrix SD-WAN, release 10 version 2 the **AppFlow** settings are made local to every appliance, while in the previous releases it was a global setting. If the SD-WAN software release is downgraded to any of the previous releases and if AppFlow is configured on any one of the appliances,

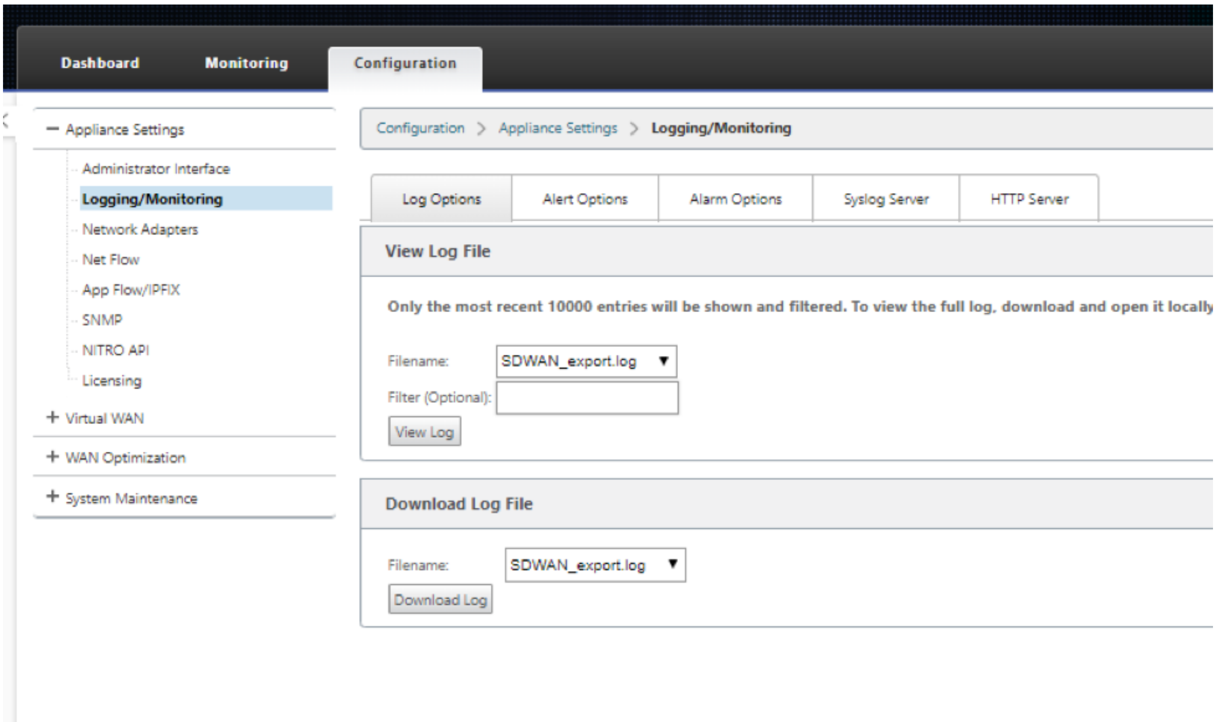
it will be applied globally to all alliances.

Configuring AppFlow/IPFIX

You can configure AppFlow / IPFIX only through Citrix SD-WAN Orchestrator service. For more information, see AppFlow and IPFIX.

Log files

For troubleshooting issues related to AppFlow / IPFIX export protocols, you can view and download the SDWAN_export.log files. Navigate to **Configuration > Logging / Monitoring** and select the **SD-WAN_export.log** files.



View Log File

Only the most recent 10000 entries will be shown and filtered. To view the full log, download and open it locally

Filename: SDWAN_export.log

Filter (Optional):

Download Log File

Filename: SDWAN_export.log

SNMP

August 24, 2022

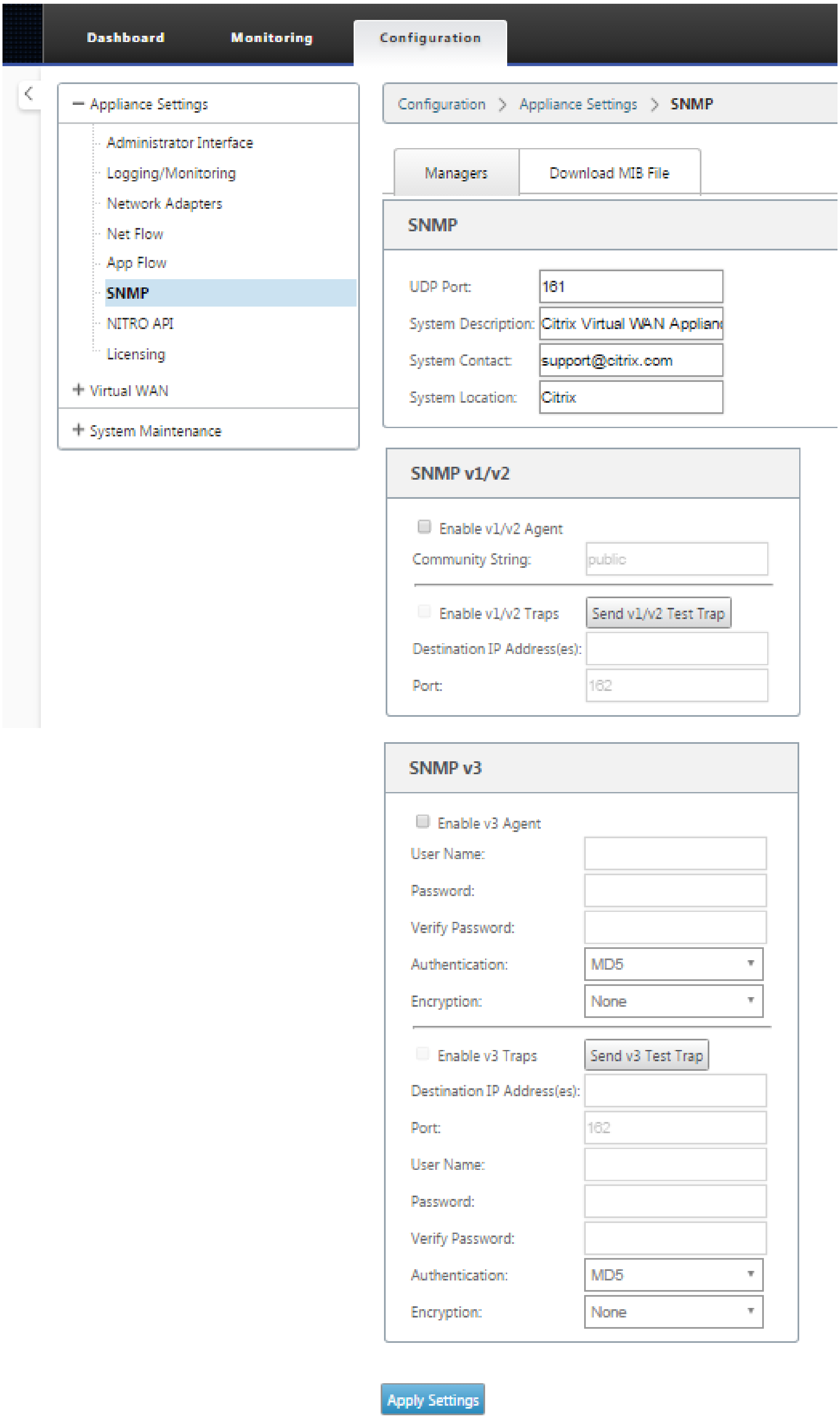
Citrix SD-WAN supports SNMPV1/V2 capability and only a single user account for each SNMPv3 capability. This restriction provides the following advantages:

- Ensuring SNMPv3 compliance for network devices

- Verification of SNMPv3 capability
- Easy configuration of SNMPv3

To configure SNMPv3 Polling and Traps, navigate to the SNMPv3 section of the **Configuration** -> **Appliance Settings** -> **SNMP** page, and fill in the fields as required.

> **NOTE**
>
> To configure an IPv6 address, ensure that the SNMP server is also configured with an IPv6 address.



SNMP

UDP Port: 161

System Description: Citrix Virtual WAN Applianc

System Contact: support@citrix.com

System Location: Citrix

SNMP v1/v2

□ Enable v1/v2 Agent

Community String: public

□ Enable v1/v2 Traps [Send v1/v2 Test Trap]

Destination IP Address(es):

Port: 162

SNMP v3

□ Enable v3 Agent

User Name:

Password:

Verify Password:

Authentication: MD5

Encryption: None

□ Enable v3 Traps [Send v3 Test Trap]

Destination IP Address(es):

Port: 162

User Name:

Password:

Verify Password:

Authentication: MD5

Encryption: None

[Apply Settings]

Standard MIB Support

The following standard MIBs are supported by the SD-WAN Appliances.

MIB	RFC (Definition Link)
DISMAN-EVENT-MIB	https://www.ietf.org/rfc/rfc2981.txt
IF-MIB	https://www.ietf.org/rfc/rfc2863.txt
IP-FORWARD-MIB	https://www.ietf.org/rfc/rfc4292.txt
IP-MIB (Partial)	https://www.ietf.org/rfc/rfc4293.txt
Q-BRIDGE-MIB (Partial)	http://www.ieee802.org/1/files/public/MIBs/IEEE8021-Q-BRIDGE-MIB-201112120000Z.mib
RFC1213-MIB	https://www.ietf.org/rfc/rfc1213.txt
SNMPv2-MIB	https://www.ietf.org/rfc/rfc3418.txt
TCP-MIB	https://www.ietf.org/rfc/rfc4022.txt
P-BRIDGE-MIB.txt	http://www.icir.org/fenner/mibs/extracted/P-BRIDGE-MIB-rfc2674.txt
RMON2-MIB.txt	https://www.ietf.org/rfc/rfc3273.txt
TOKEN-RING-RMON-MIB.txt	http://www.icir.org/fenner/mibs/extracted/TOKEN-RING-RMON-MIB-rmonmib-01.txt

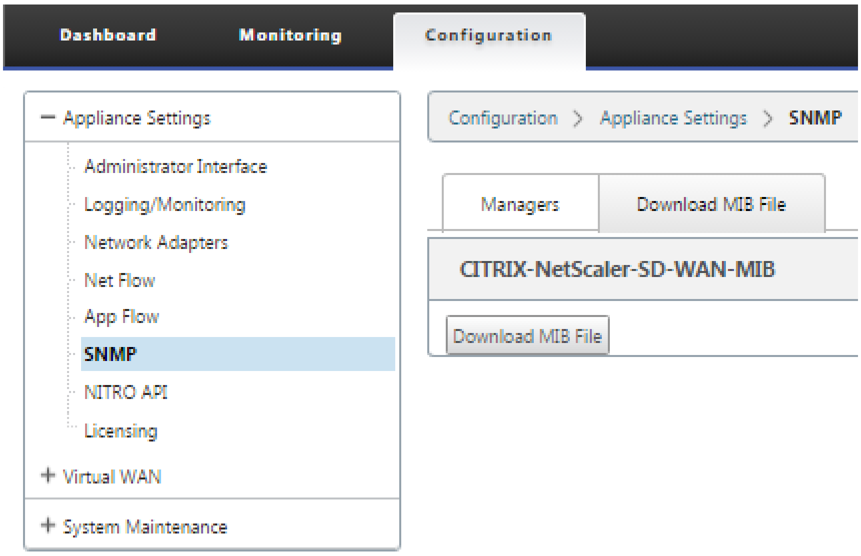
You must download the following SNMP files before you can start monitoring a Citrix SD-WAN appliance:

- CITRIX-COMMON-MIB.txt
- APPACCELERATION-SMI.txt
- APPACCELERATION-PRODUCTS-MIB.txt
- APPACCELERATION-TC.txt
- APPACCELERATION-STATUS-MIB.txt
- APPCACHE-MIB.txt
- SDX-MIB-smiv2.mib

The MIB files are used by SNMPv3 managers and SNMPv3 trap listeners. The files include the SD-WAN appliance enterprise MIBs, which provide SD-WAN-specific events. To download MIB files, in the SD-WAN web management interface:

1. Navigate to **Configuration** > **Appliance Settings** > **SNMP** > **Download MIB File** page.
2. Select the required **MIB** file.
3. Click **View**.

   The MIB file opens in MIB browser.



> **Note**
>
> - Support for these MIBs is provided by default by the **net-snmp snmpd** daemon process on Linux systems. The MIBs provide the basis for supporting Network Management applications.
> - The Ethernet port packet and byte counters are in the **IF-MIB** inside the **ifTable**. System information is in the system object.
> - Ethernet ports are included in the **ifTable**, so walking that must be sufficient to ensure that the SNMP subsystem is running.
> - Support for the **Q-BRIDGE-MIB** and the **IP-MIB** provides support for the network mapping application.

Administrative interface

August 24, 2022

You can manage and maintain your Citrix SD-WAN appliances using the following administrative options using Citrix SD-WAN Orchestrator service. For more information, see Appliance settings.

- User accounts
- RADIUS server
- TACACS+ server
- HTTPS Cert
- HTTPS Settings
- Miscellaneous

User accounts

You can add new user accounts and manage the existing user accounts under **Configuration > Appliance Settings > Administrator Interface page > User Accounts** tab.

You can choose to authenticate the newly added user accounts either locally by the SD-WAN appliance or remotely. User accounts that are authenticated remotely, are authenticated through RADIUS or TACACS+ authentication servers.

User roles

The following user roles are supported:

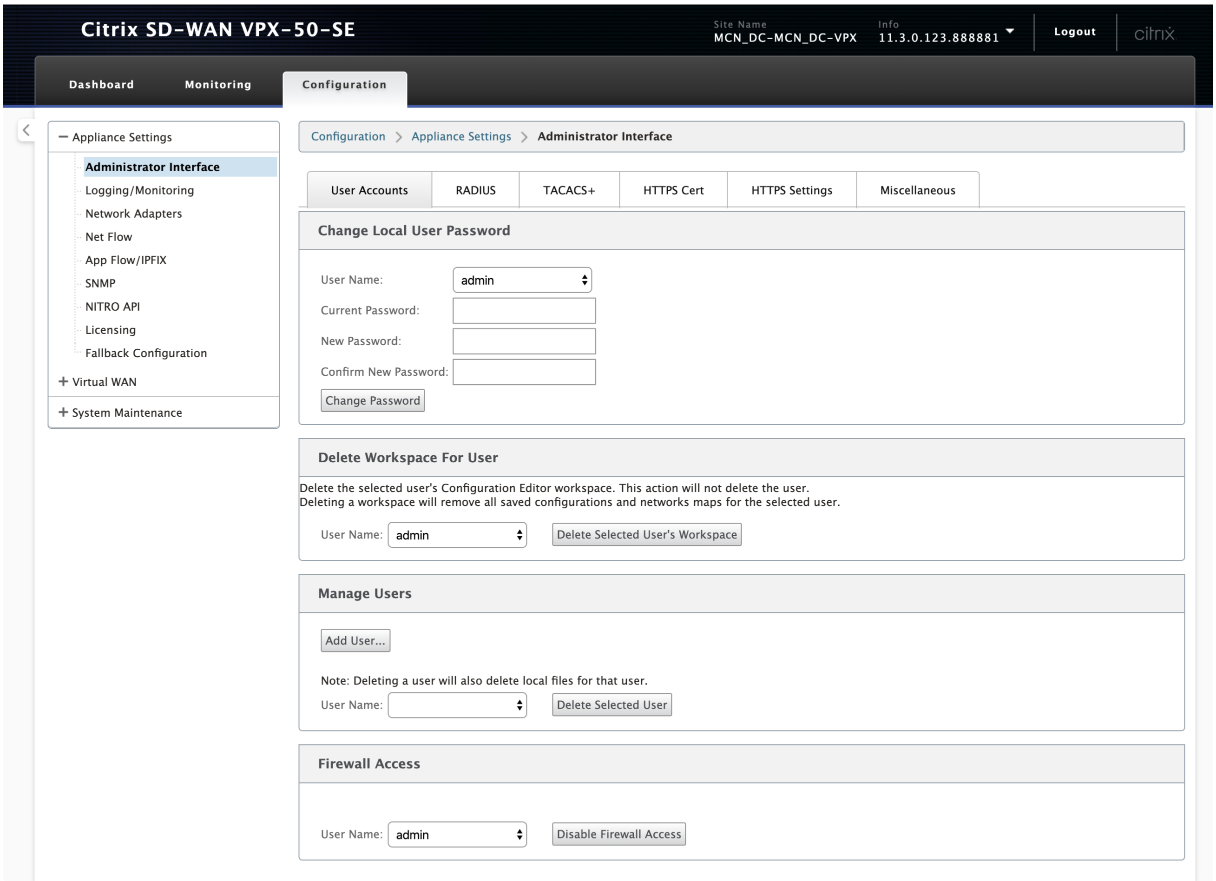
- **Viewer**: Viewer account is a read-only account with access to **Dashboard**, **Reporting**, and **Monitoring** pages.
- **Admin**: Admin account has the administrative privileges and read-write access to all the sections.

  A super administrator (admin) has the following privileges:

  - Can export the configuration to the change management inbox to perform a configuration and software update to the network.
  - Can also toggle the read-write access of the Network and Security Admins.
  - Maintains both network and security related settings.
- **Security Admin**: A security administrator has the read-write access only for the firewall and security related settings, while having read-only access to the remaining sections. Security administrator also has the capability to enable or disable write access to the firewall for other users except the super administrator (admin).
- **Network Admin**: A network administrator has read-write permissions to all the sections and can fully provision a branch except for the firewall and security related settings. The hosted firewall node is not available for the network administrator. In this case, the network administrator must import a new configuration.

Both network administrator and security administrator can make changes to the configuration and also deploy them on the network.

> **NOTE**
>
> The network administrator and security administrator cannot add or delete user accounts. They can only edit their own account passwords.



Change Local User Password

User Name: admin

Current Password:

New Password:

Confirm New Password:

Delete Workspace For User

Delete the selected user's Configuration Editor workspace. This action will not delete the user.
Deleting a workspace will remove all saved configurations and networks maps for the selected user.

User Name: admin

Manage Users

Note: Deleting a user will also delete local files for that user.

User Name:

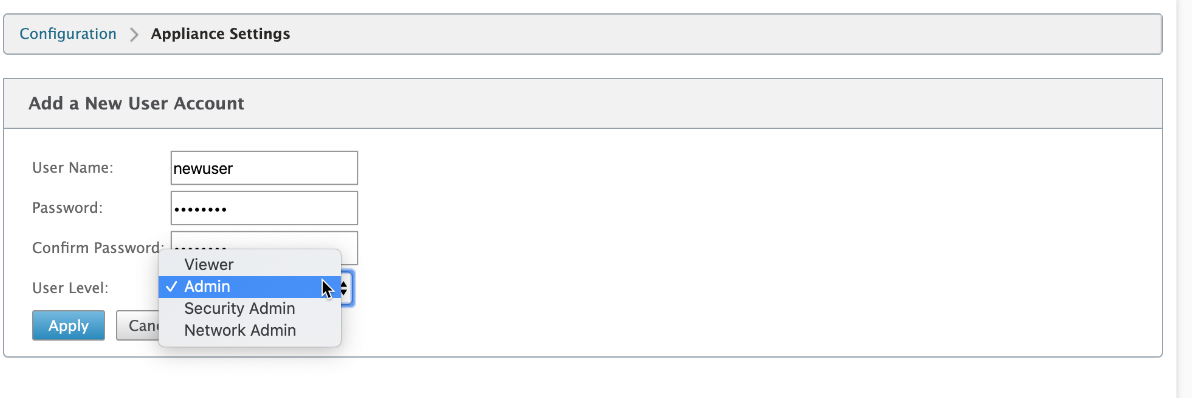
Firewall Access

User Name: admin

Add a user

To add a user, click **Add User** in the **Manage Users** section. Provide the **User Name** and **Password**. Select the user role from the **User Level** drop-down list and click **Apply**.

You can also delete a user account, if needed. Deleting a user also deletes the local files belonging to that user. To delete, under **Manage Users** section, select the user from the **User Name** drop-down list and click **Delete Selected User**.



User Name: newuser

Password: ••••••••

User Level: Admin

Change password of a user

The administrator role can change the password of a user account that is authenticated locally by the SD-WAN appliance.

To change the password, under **Change Local User Password** section, select the user from the **User Name** drop-down list. Enter the current password and the new password. Click **Change Password**.

RADIUS server

You can configure an SD-WAN appliance to authenticate user access with one or a maximum of three RADIUS servers. The default port is 1812.

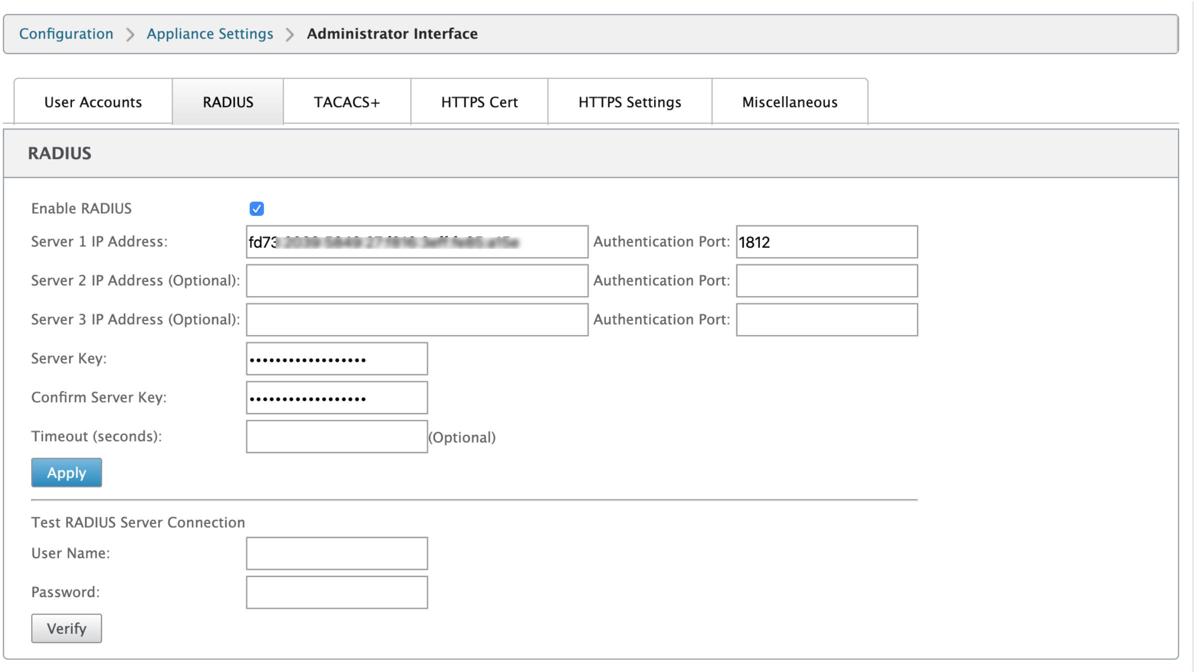
To configure the RADIUS server:

1. Navigate to **Configuration > Appliance Settings > Administrator Interface > RADIUS**.
2. Select the **Enable RADIUS** check box.
3. Enter the **Server IP Address** and **Authentication Port**. A maximum of three server IP addresses can be configured.

   > **NOTE**
   >
   > To configure an IPv6 address, ensure that the RADIUS server is also configured with an IPv6 address.

4. Enter the **Server Key** and confirm.
5. Enter the **Timeout** value in seconds.
6. Click **Save**.

You can also test the RADIUS server connection. Enter the **User Name** and **Password**. Click **Verify**.



Configuration > Appliance Settings > Administrator Interface

User Accounts | RADIUS | TACACS+ | HTTPS Cert | HTTPS Settings | Miscellaneous

RADIUS

Enable RADIUS ☑

Server 1 IP Address: fd73[redacted] Authentication Port: 1812

Server 2 IP Address (Optional): Authentication Port:

Server 3 IP Address (Optional): Authentication Port:

Server Key: ••••••••••••••••••

Confirm Server Key: ••••••••••••••••••

Timeout (seconds): (Optional)

Apply

Test RADIUS Server Connection

User Name:

Password:

Verify

TACACS+ server

You can configure a TACACS+ server for authentication. Similar to RADIUS authentication, TACACS+ uses a secret key, an IP address, and the port number. The default port number is 49.

To configure the TACACS+ server:

1. Navigate to **Configuration > Appliance Settings > Administrator Interface > TACACS+**.
2. Select the **Enable TACACS+** check box.
3. Enter the **Server IP Address** and **Authentication Port**. A maximum of three server IP addresses can be configured.

   > **NOTE**
   >
   > To configure an IPv6 address, ensure that the TACACS+ server is also configured with an IPv6 address.

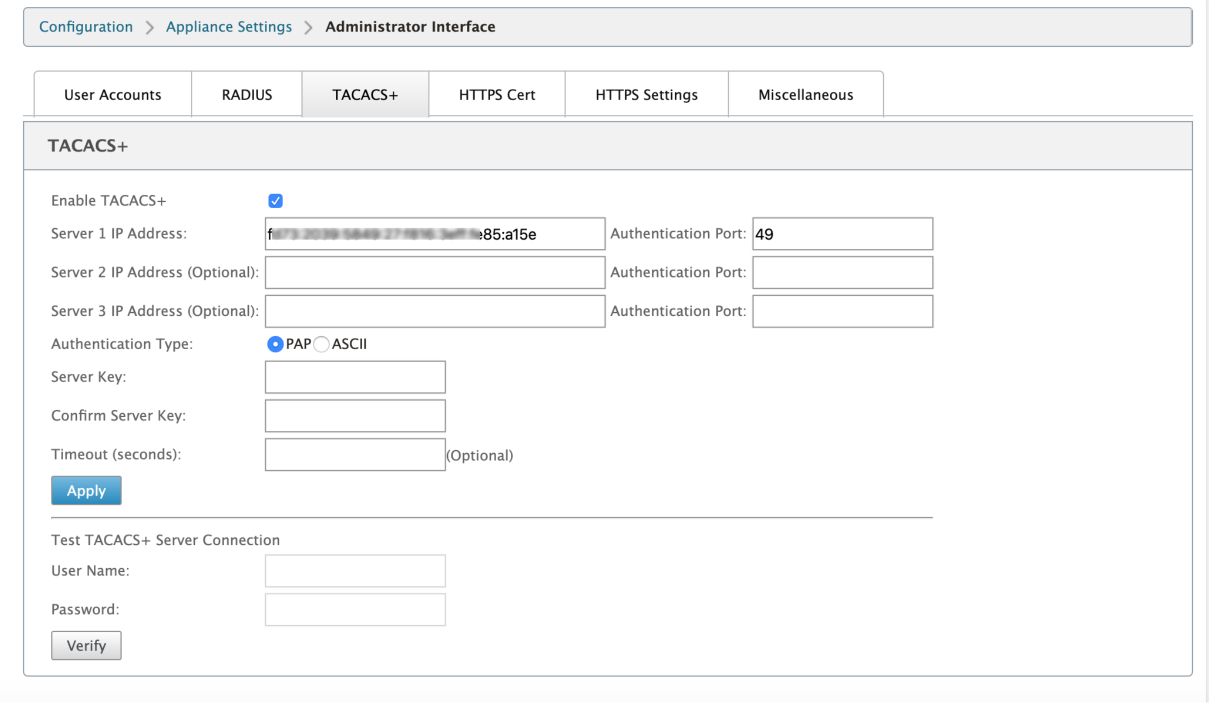
4. Select **PAP** or **ASCII** as the Authentication Type.

   - PAP: Uses Password Authentication Protocol (PAP) to strengthen user authentication by assigning a strong shared secret to the TACACS+ server.
   - ASCII: Uses the ASCII character set to strengthen user authentication by assigning a strong shared secret to the TACACS+ server.

5. Enter the **Server Key** and confirm.

6. Enter the **Timeout** value in seconds.
7. Click **Save**.

You can also test the TACACS+ server connection. Enter the **User Name** and **Password**. Click **Verify**.



TACACS+

Enable TACACS+ ☑

Server 1 IP Address: f[redacted]85:a15e Authentication Port: 49

Server 2 IP Address (Optional): Authentication Port:

Server 3 IP Address (Optional): Authentication Port:

Authentication Type: ● PAP ○ ASCII

Server Key:

Confirm Server Key:

Timeout (seconds): (Optional)

Test TACACS+ Server Connection

User Name:

Password:

NDP router advertisement and prefix delegation group

August 24, 2022

NDP router advertisement

In an IPv6 network, SD-WAN appliance periodically multicasts Router Advertisement (RA) messages to announce its availability and convey information to the neighboring appliances in the SD-WAN network. The router advertisements include the IPv6 prefix information. Neighbor Discovery protocol (NDP) running on SD-WAN appliances uses these router advertisements to determine the neighboring devices on the same link. It also determines each other's link-layer addresses, find neighbors, and maintain reachability information about the paths to active neighbors.

You can configure the NDP router advertisement using Citrix SD-WAN Orchestrator service. For more information, see NDP router advertisement.

Prefix delegation group

> **NOTE**
>
> Prefix delegation is not supported in Citrix SD-WAN 11.3 release.

Citrix SD-WAN appliances can be configured as a DHCPv6 client to request a prefix from the ISP using the configured WAN port. Once Citrix SD-WAN appliance receives the prefix, it uses the prefix to create a pool of IP addresses to cater the LAN clients. Citrix SD-WAN appliance then behaves as a DHCP server and advertise the prefix on the LAN ports to the LAN side clients.

You can configure prefix delegation through Citrix SD-WAN Orchestrator service. For more information, see Prefix delegation groups.

How-to-articles

August 24, 2022

The "How-to-articles"describe the procedure to configure supported features by Citrix SD-WAN. These articles contain information about some of the following important features:

Click a feature name below to view the list of how-to articles for that feature.

- Virtual Routing and Forwarding
- Enabling RED for QoS Fairness
- Configuration
- Dynamic Routing
- DHCP Server and DHCP Relay
- Route Filters
- IPsec Termination and Monitoring
- Secure Web Gateway
- QoS
- FIPS Compliant Operation - IPsec Tunnel
- Dynamic NAT Configuration
- Adaptive Bandwidth Detection
- Active Bandwidth Testing
- BGP Enhancements

- Service Class Association with SSL Profiles
- Zero touch Deployment

Configure access interface

August 24, 2022

To configure access interface through Citrix SD-WAN Orchestrator service, see WAN links.

Configure Virtual IP addresses

August 24, 2022

To configure Virtual IP Addresses through Citrix SD-WAN Orchestrator service, see WAN links.

Configure GRE Tunnels

August 24, 2022

To configure GRE Tunnels using Citrix SD-WAN Orchestrator service, see GRE service.

Setup dynamic paths for branch to branch communication

August 24, 2022

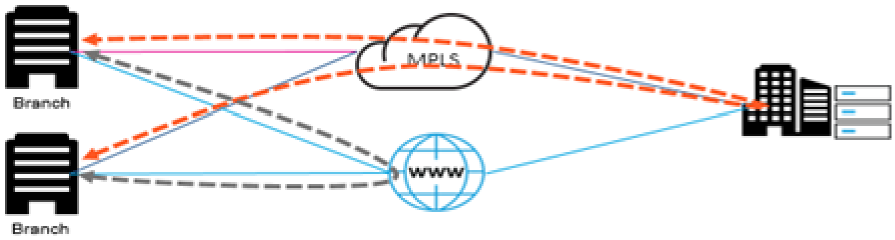
With demand for VoIP and video conferencing, the traffic is increasingly moving between offices. It is inefficient to set up full mesh connections through datacenters which can be time consuming.

With Citrix SD-WAN, you do not need to configure paths between every office. You can enable the Dynamic Path feature and the SD-WAN solution automatically creates paths between offices on demand. The session initially uses an existing fixed path. And as bandwidth and time threshold is met, a path is created dynamically if that new path has better performance characteristics than the fixed path. Session traffic is transmitted through the new path. This results in efficient usage of resources. Paths exist only when they are needed and reduce the amount of traffic getting transmitted to and from the datacenter.

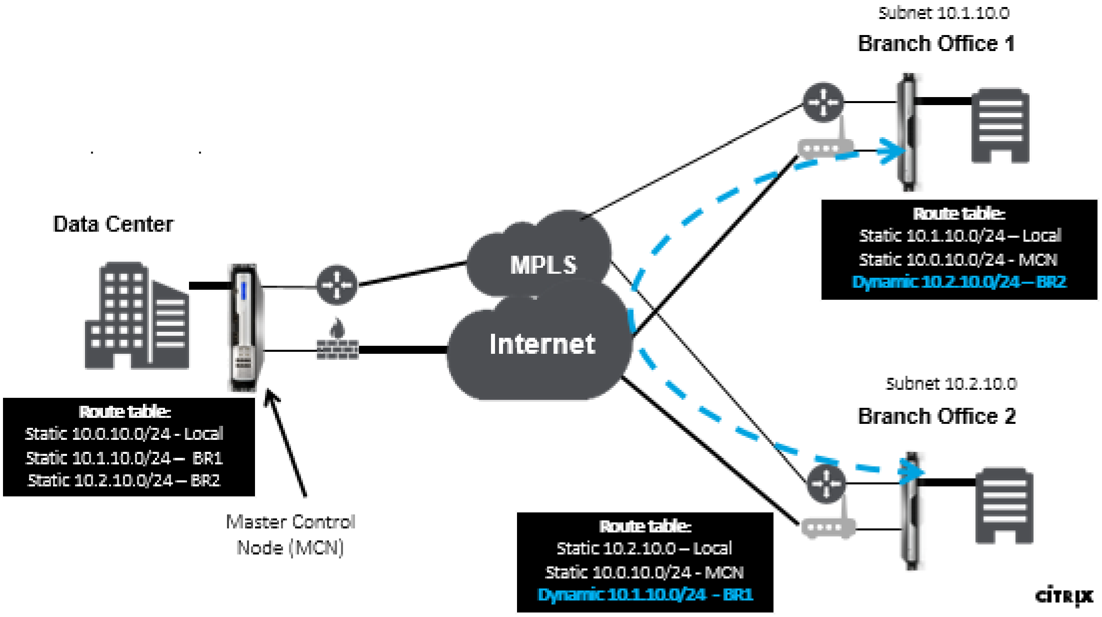
Additional benefits of SD-WAN network include:

- Bandwidth and PPS thresholds to allow branch to branch connections
- Reduce bandwidth requirements in and out of data center while minimizing latency
- Paths created on demand depend on set thresholds
- Dynamically release network resources when not required
- Reduce load on the Master Control Node and latency

Branch to branch communication using dynamic virtual paths:



SD-WAN network with dynamic path:


Subnet 10.1.10.0
Branch Office 1
Route table:
Static 10.1.10.0/24 – Local
Static 10.0.10.0/24 - MCN
Dynamic 10.2.10.0/24 – BR2
Data Center
MPLS
Internet
Route table:
Static 10.0.10.0/24 - Local
Static 10.1.10.0/24 – BR1
Static 10.2.10.0/24 – BR2
Master Control Node (MCN)
Subnet 10.2.10.0
Branch Office 2
Route table:
Static 10.2.10.0 – Local
Static 10.0.10.0/24 - MCN
Dynamic 10.1.10.0/24 - BR1
citrix

- Dynamic virtual paths are used for large scale deployments, such as Enterprises
- Smaller deployments use Static virtual paths and any-to-any virtual paths
- Always use Static virtual paths between two Data Centers (DC to DC)
- Not all WAN paths need to be configured for using Dynamic virtual path
- Each SD-WAN appliance has limited number of Dynamic virtual paths (8 dynamic lowest limit, 8 static lowest limit = total 16) that can be configured.

How to enable dynamic virtual path in the SD-WAN GUI

To enable dynamic virtual paths using Citrix SD-WAN Orchestrator service, see Virtual paths.

WAN-to-WAN forwarding

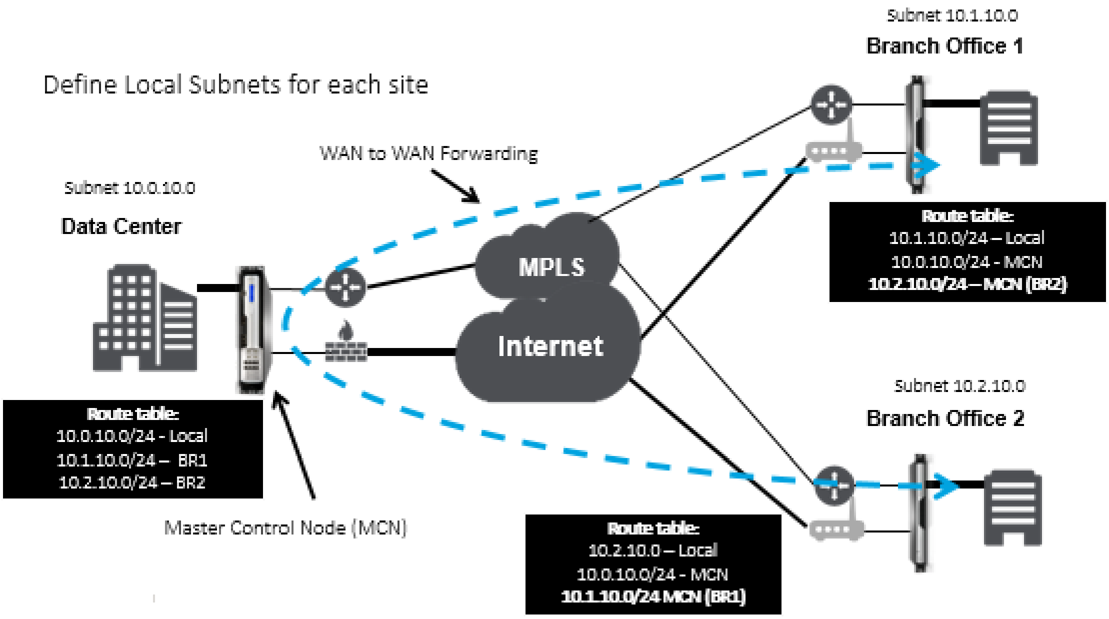
August 24, 2022

Enabling WAN-to-WAN forwarding on the MCN, allows the MCN to advertise remote site routes.

- Clients are aware of MCN local routes and other client site routes
- From client perspective, all routes are considered as MCN routes

When WAN-to-WAN forwarding is not enabled on the MCN, Branch to Branch communication issues are encountered in the customer network.

Appliances running in client mode are unaware of other branches subnets until WAN-to-WAN forwarding is enabled on the MCN. Enabling this option makes the branch SD-WAN nodes aware of other branch subnets. The traffic destined to other branches is forwarded to MCN. MCN routes it to the correct destination.



Monitoring and Troubleshooting

August 24, 2022

You can use the Citrix SD-WAN appliance web management interface to monitor and troubleshoot supported features. Below are the links to Monitoring and Troubleshooting topics applicable for Citrix SD-WAN appliances.

Monitoring Virtual WAN

Viewing Statistical Information

Viewing Flow Information

Viewing Reports

Viewing Firewall Statistics

Diagnostic Tool

Improved Path Mapping and Bandwidth

Troubleshooting Management IP

Active bandwidth testing

Adaptive bandwidth detection

Monitoring Virtual WAN

August 24, 2022

Viewing Basic Information for an Appliance

Use a browser to connect to the Management Web Interface of the appliance you want to monitor, and click the **Dashboard** tab to display basic information for that appliance.

The **Dashboard** page displays the following basic information for the local appliance:

System Status:

- **Name** –This is the name you assigned to the appliance when you added it to the system.
- **Model** –This is the Virtual WAN appliance model number.
- **Appliance Mode** –This indicates whether this appliance has been configured as the primary or secondary MCN, or as a client appliance.

- **Management IP Address** – This is the Management IP Address for the appliance.
- **Appliance Uptime** – This specifies the duration for which the appliance has been running since the last reboot.
- **Service Uptime** –This specifies the duration for which the Virtual WAN Service has been running since the last restart.

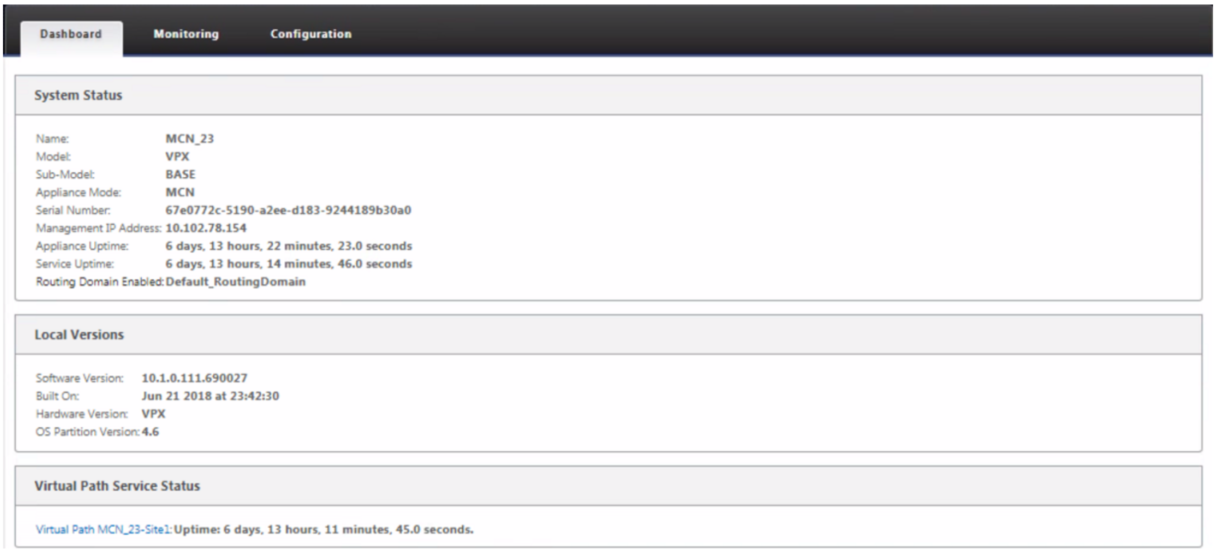
Virtual Path Service Status:

Virtual Path [site name] –This displays the status of all the Virtual Paths associated with this appliance. If the Virtual WAN Service is enabled, this section is included on the page. If the Virtual WAN Service is disabled, an Alert icon (goldenrod delta) and Alert message to that effect displays in place of this section.

Local Version Information:

- **Software version** – This is the version of the CloudBridge Virtual Path software package currently activated on the appliance.
- **Build on** –This is the build date for the product version currently running on the local appliance.
- **Hardware version** –This is the hardware model number and version of the appliance.
- **OS Partition Version** – This is the version of the OS partition currently active on the appliance.

The below figure shows a sample Dashboard page.



System Status

Name: MCN_23
Model: VPX
Sub-Model: BASE
Appliance Mode: MCN
Serial Number: 67e0772c-5190-a2ee-d183-9244189b30a0
Management IP Address: 10.102.78.154
Appliance Uptime: 6 days, 13 hours, 22 minutes, 23.0 seconds
Service Uptime: 6 days, 13 hours, 14 minutes, 46.0 seconds
Routing Domain Enabled: Default_RoutingDomain

Local Versions

Software Version: 10.1.0.111.690027
Built On: Jun 21 2018 at 23:42:30
Hardware Version: VPX
OS Partition Version: 4.6

Virtual Path Service Status

Virtual Path MCN_23-Site1: Uptime: 6 days, 13 hours, 11 minutes, 45.0 seconds.

Viewing Statistical Information

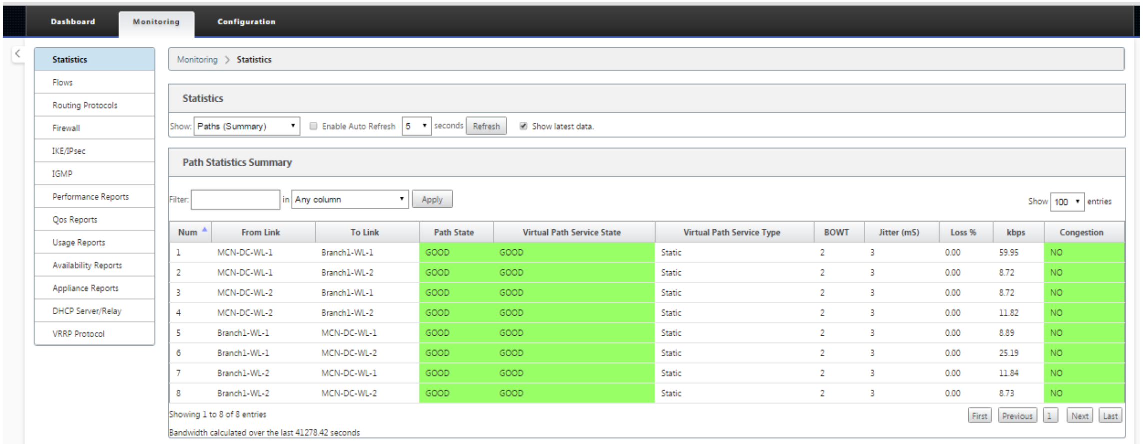
August 24, 2022

This section provides basic instructions for viewing Virtual WAN statistics information.

1. Log into the Management Web Interface for the MCN.
2. Select the **Monitoring** tab.

   This opens the **Monitoring** navigation tree in the left pane. By default, this also displays the **Statistics** page with **Paths** preselected in the **Show** field. This contains a detailed table of path statistics.

   > **Note**
   >
   > If you navigate to another **Monitoring** page (for example, **Flows**), you can return to this page by selecting **Statistics** in the **Monitoring** navigation tree (left pane).



Statistics

Show: Paths (Summary) □ Enable Auto Refresh 5 seconds ☑ Show latest data.

Path Statistics Summary

Filter: in Any column Show 100 entries

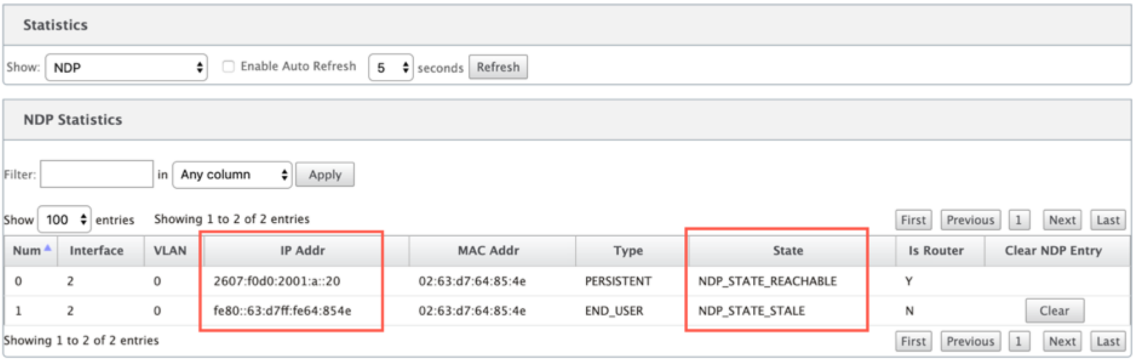
Num	From Link	To Link	Path State	Virtual Path Service State	Virtual Path Service Type	BOWT	Jitter (mS)	Loss %	kbps	Congestion
1	MCN-DC-WL-1	Branch1-WL-1	GOOD	GOOD	Static	2	3	0.00	59.95	NO
2	MCN-DC-WL-1	Branch1-WL-2	GOOD	GOOD	Static	2	3	0.00	8.72	NO
3	MCN-DC-WL-2	Branch1-WL-1	GOOD	GOOD	Static	2	3	0.00	8.72	NO
4	MCN-DC-WL-2	Branch1-WL-2	GOOD	GOOD	Static	2	3	0.00	11.82	NO
5	Branch1-WL-1	MCN-DC-WL-1	GOOD	GOOD	Static	2	3	0.00	8.89	NO
6	Branch1-WL-1	MCN-DC-WL-2	GOOD	GOOD	Static	2	3	0.00	25.19	NO
7	Branch1-WL-2	MCN-DC-WL-1	GOOD	GOOD	Static	2	3	0.00	11.84	NO
8	Branch1-WL-2	MCN-DC-WL-2	GOOD	GOOD	Static	2	3	0.00	8.73	NO

Showing 1 to 8 of 8 entries

Bandwidth calculated over the last 41278.42 seconds

With 11.1.0 release, Neighbor Discovery Protocol (NDP) option is added for debugging neighbor discovery issues.

1. Select the NDP option from the Show drop-down menu and you can view the state of NDP along with the IPv6 addresses.



Statistics

Show: NDP □ Enable Auto Refresh 5 seconds

NDP Statistics

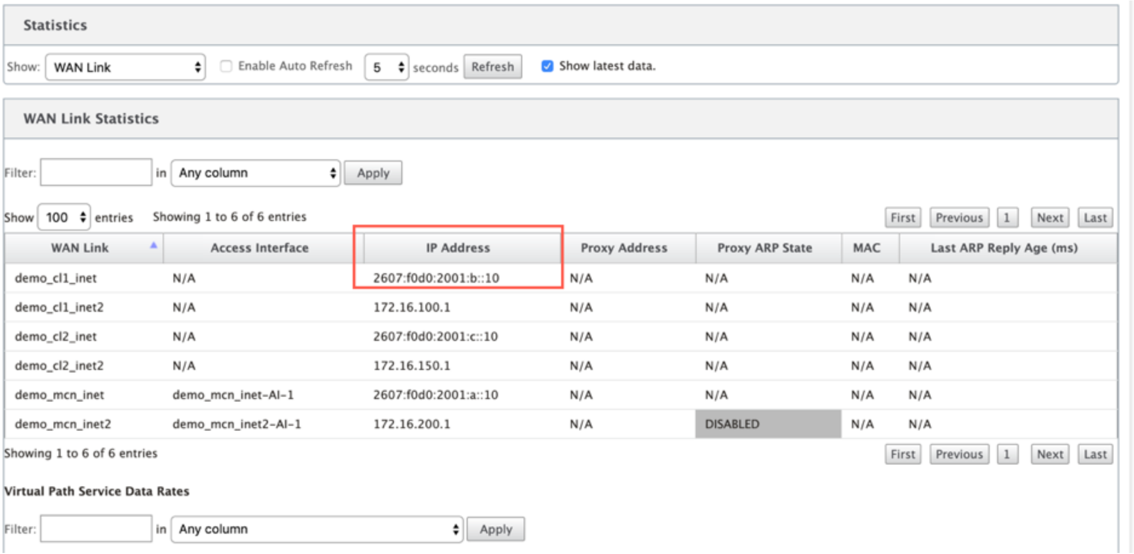
Filter: in Any column

Show 100 entries Showing 1 to 2 of 2 entries

Num	Interface	VLAN	IP Addr	MAC Addr	Type	State	Is Router	Clear NDP Entry
0	2	0	2607:f0d0:2001:a::20	02:63:d7:64:85:4e	PERSISTENT	NDP_STATE_REACHABLE	Y	
1	2	0	fe80::63:d7ff:fe64:854e	02:63:d7:64:85:4e	END_USER	NDP_STATE_STALE	N	Clear

Showing 1 to 2 of 2 entries

2. Select WAN Link from the drop-down menu. You can view the IPv6 address as well if you configured under IP Address tab.



Statistics

Show: WAN Link □ Enable Auto Refresh 5 seconds Refresh ☑ Show latest data.

WAN Link Statistics

Filter: in Any column Apply

Show 100 entries Showing 1 to 6 of 6 entries

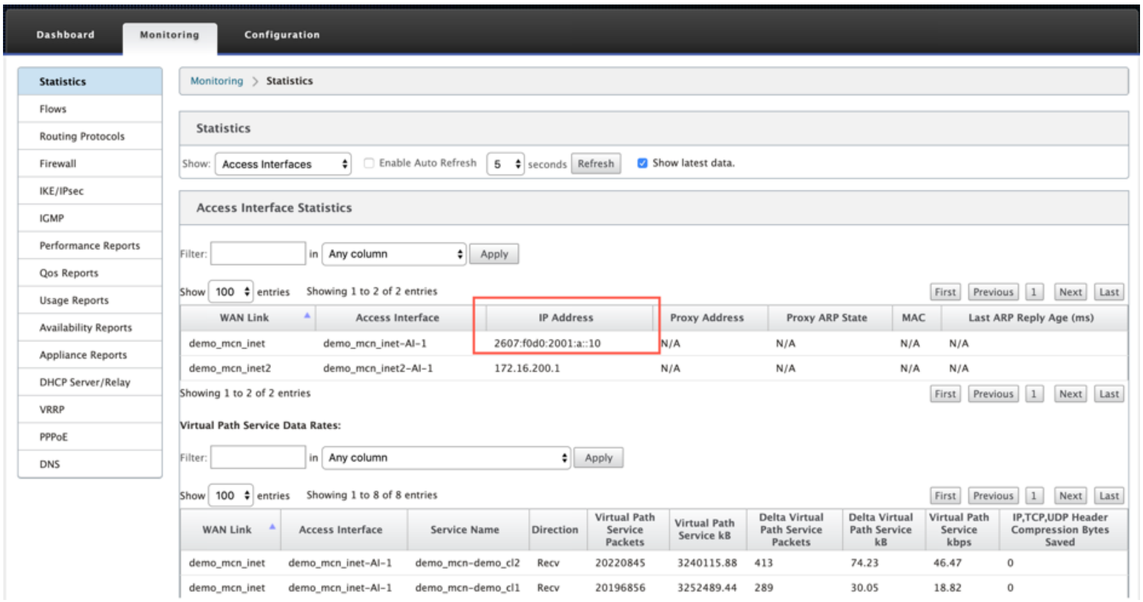
WAN Link	Access Interface	IP Address	Proxy Address	Proxy ARP State	MAC	Last ARP Reply Age (ms)
demo_cl1_inet	N/A	2607:f0d0:2001:b::10	N/A	N/A	N/A	N/A
demo_cl1_inet2	N/A	172.16.100.1	N/A	N/A	N/A	N/A
demo_cl2_inet	N/A	2607:f0d0:2001:c::10	N/A	N/A	N/A	N/A
demo_cl2_inet2	N/A	172.16.150.1	N/A	N/A	N/A	N/A
demo_mcn_inet	demo_mcn_inet-AI-1	2607:f0d0:2001:a::10	N/A	N/A	N/A	N/A
demo_mcn_inet2	demo_mcn_inet2-AI-1	172.16.200.1	N/A	DISABLED	N/A	N/A

Showing 1 to 6 of 6 entries

Virtual Path Service Data Rates

Filter: in Any column Apply

3. You can also view the Access Interface statistics.



Statistics

Show: Access Interfaces □ Enable Auto Refresh 5 seconds Refresh ☑ Show latest data.

Access Interface Statistics

Filter: in Any column Apply

Show 100 entries Showing 1 to 2 of 2 entries

WAN Link	Access Interface	IP Address	Proxy Address	Proxy ARP State	MAC	Last ARP Reply Age (ms)
demo_mcn_inet	demo_mcn_inet-AI-1	2607:f0d0:2001:a::10	N/A	N/A	N/A	N/A
demo_mcn_inet2	demo_mcn_inet2-AI-1	172.16.200.1	N/A	N/A	N/A	N/A

Showing 1 to 2 of 2 entries

Virtual Path Service Data Rates:

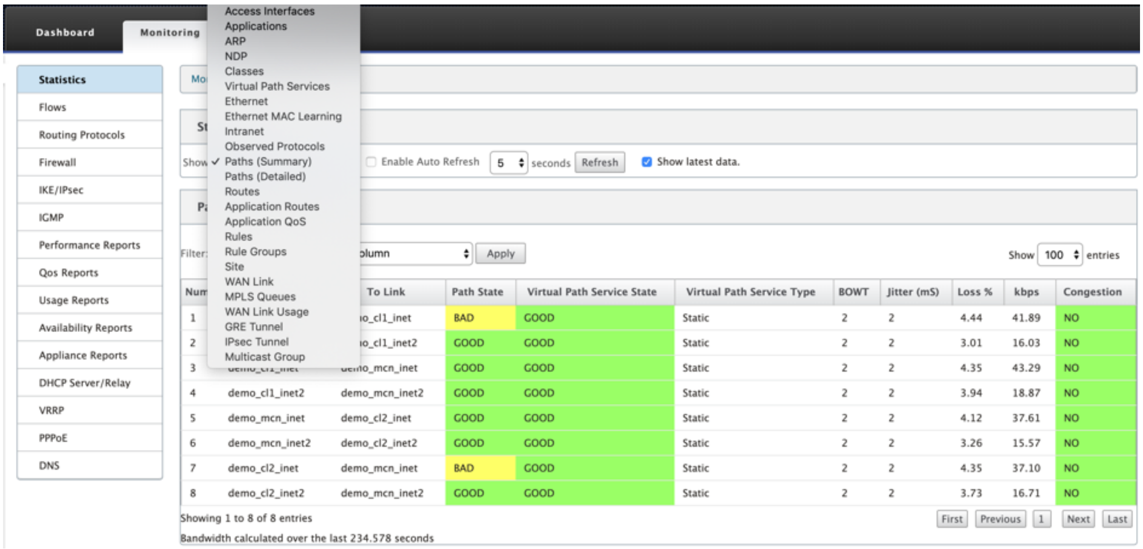
Filter: in Any column Apply

Show 100 entries Showing 1 to 8 of 8 entries

WAN Link	Access Interface	Service Name	Direction	Virtual Path Service Packets	Virtual Path Service kB	Delta Virtual Path Service Packets	Delta Virtual Path Service kB	Virtual Path Service kbps	IP,TCP,UDP Header Compression Bytes Saved
demo_mcn_inet	demo_mcn_inet-AI-1	demo_mcn-demo_cl2	Recv	20220845	3240115.88	413	74.23	46.47	0
demo_mcn_inet	demo_mcn_inet-AI-1	demo_mcn-demo_cl1	Recv	20196856	3252489.44	289	30.05	18.82	0

4. Open the **Show** drop-down menu.

   In addition to the **Paths, NDP, Access Interface,** and **WAN Links statistics**, the **Show** menu also offers several more options for filtering and viewing statistical information.



Show ✓ Paths (Summary)

□ Enable Auto Refresh 5 seconds

☑ Show latest data.

Show 100 entries

Num		To Link	Path State	Virtual Path Service State	Virtual Path Service Type	BOWT	Jitter (mS)	Loss %	kbps	Congestion
1		o_cl1_inet	BAD	GOOD	Static	2	2	4.44	41.89	NO
2		o_cl1_inet2	GOOD	GOOD	Static	2	2	3.01	16.03	NO
3	demo_cl1_inet	demo_mcn_inet	GOOD	GOOD	Static	2	2	4.35	43.29	NO
4	demo_cl1_inet2	demo_mcn_inet2	GOOD	GOOD	Static	2	2	3.94	18.87	NO
5	demo_mcn_inet	demo_cl2_inet	GOOD	GOOD	Static	2	2	4.12	37.61	NO
6	demo_mcn_inet2	demo_cl2_inet2	GOOD	GOOD	Static	2	2	3.26	15.57	NO
7	demo_cl2_inet	demo_mcn_inet	BAD	GOOD	Static	2	2	4.35	37.10	NO
8	demo_cl2_inet2	demo_mcn_inet2	GOOD	GOOD	Static	2	2	3.73	16.71	NO

Showing 1 to 8 of 8 entries

Bandwidth calculated over the last 234.578 seconds

Select a filter from the **Show** menu to view a table of statistical information for that topic.

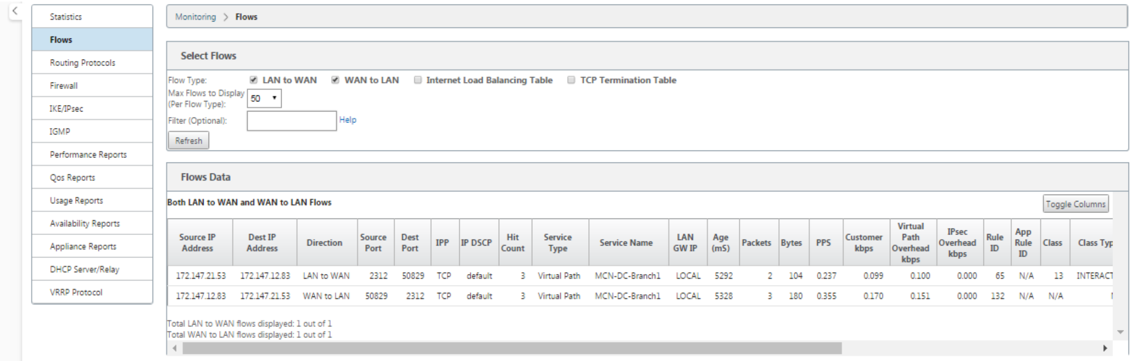
Viewing Flow Information

August 24, 2022

This section provides basic instructions for viewing Virtual WAN flow information.

To view flow information, do the following:

1. Log into the Management Web Interface for the MCN, and select the **Monitoring** tab. It opens the **Monitoring** navigation tree in the left pane.
2. Select the **Flows** branch in the navigation tree. It displays the **Flows** page with **LAN** to **WAN** preselected in the **Flow Type** field.



Flow Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

Filter (Optional):

Both LAN to WAN and WAN to LAN Flows

Source IP Address	Dest IP Address	Direction	Source Port	Dest Port	IPP	IP DSCP	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Typ
172.147.21.53	172.147.12.83	LAN to WAN	2312	50829	TCP	default	3	Virtual Path	MCN-DC-Branch1	LOCAL	5292	2	104	0.237	0.099	0.100	0.000	65	N/A	13	INTERACT
172.147.12.83	172.147.21.53	WAN to LAN	50829	2312	TCP	default	3	Virtual Path	MCN-DC-Branch1	LOCAL	5328	3	180	0.355	0.170	0.151	0.000	132	N/A	N/A	I

Total LAN to WAN flows displayed: 1 out of 1
Total WAN to LAN flows displayed: 1 out of 1

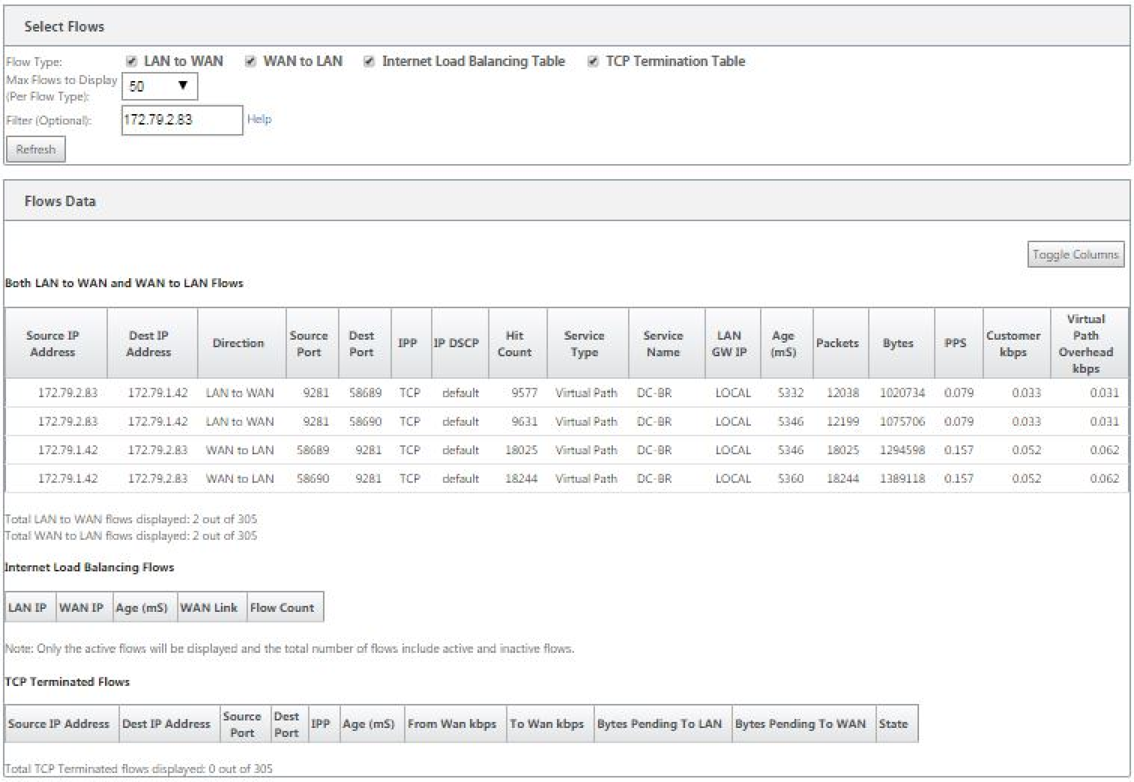
3. Select the **Flow Type**. The **Flow Type** field is located in the **Select Flows** section at the top of the **Flows** page. Next to the **Flow Type** field is a row of check box options for selecting the flow

information you want to view. You can check one or more boxes to filter the information to be displayed.

4. Select the **Max Flows to Display** from the drop-down menu next to that field.
5. It determines the number of entries to display in the **Flows** table. The options are: **50**, **100**, **1000**.
6. (Optional) Enter search text in the **Filter** field. It filters the table results so that only entries containing the search text display in the table.

> **Tip**
>
> To see detailed instructions for using filters to refine **Flow** table results, click **Help** to the right of the **Filter** field. To close the help display, click **Refresh** in the bottom left corner of the **Select Flows** section.

7. Click **Refresh** to display the filter results. The figure shows a sample **Flows** page filtered display with all flow types selected.



Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN ☑ Internet Load Balancing Table ☑ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

Filter (Optional): 172.79.2.83

Flows Data

Both LAN to WAN and WAN to LAN Flows

Source IP Address	Dest IP Address	Direction	Source Port	Dest Port	IPP	IP DSCP	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps
172.79.2.83	172.79.1.42	LAN to WAN	9281	58689	TCP	default	9577	Virtual Path	DC-BR	LOCAL	5332	12038	1020734	0.079	0.033	0.031
172.79.2.83	172.79.1.42	LAN to WAN	9281	58690	TCP	default	9631	Virtual Path	DC-BR	LOCAL	5346	12199	1075706	0.079	0.033	0.031
172.79.1.42	172.79.2.83	WAN to LAN	58689	9281	TCP	default	18025	Virtual Path	DC-BR	LOCAL	5346	18025	1294598	0.157	0.052	0.062
172.79.1.42	172.79.2.83	WAN to LAN	58690	9281	TCP	default	18244	Virtual Path	DC-BR	LOCAL	5360	18244	1389118	0.157	0.052	0.062

Total LAN to WAN flows displayed: 2 out of 305
Total WAN to LAN flows displayed: 2 out of 305

Internet Load Balancing Flows

LAN IP	WAN IP	Age (mS)	WAN Link	Flow Count

Note: Only the active flows will be displayed and the total number of flows include active and inactive flows.

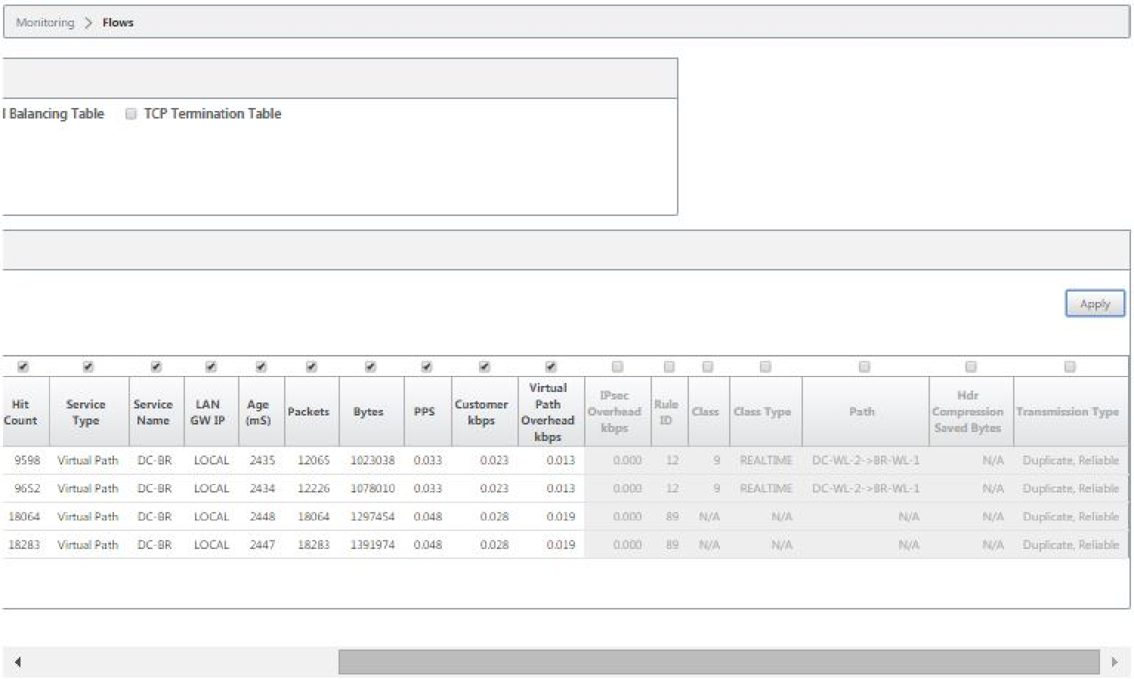
TCP Terminated Flows

Source IP Address	Dest IP Address	Source Port	Dest Port	IPP	Age (mS)	From Wan kbps	To Wan kbps	Bytes Pending To LAN	Bytes Pending To WAN	State

Total TCP Terminated flows displayed: 0 out of 305

8. (Optional) Select the columns to include in the table. Do the following:
9. Click **Toggle Columns** at the top right corner of the **Flows Data** table. It reveals any deselected columns, and opens a check box above each column for selecting or deselecting that column. Deselected columns display grayed out, as shown in the figure.

> **Note**
>
> By default, all the columns are selected, which can cause the table to be truncated in the display, obscuring the **Toggle Columns** button. If so, a horizontal scroll bar displays beneath the table. Slide the scroll bar to the right to view the truncated section of the table and reveal the **Toggle Columns** button. If the scroll bar is not available, try resizing the width of your browser window until the scroll bar is revealed.



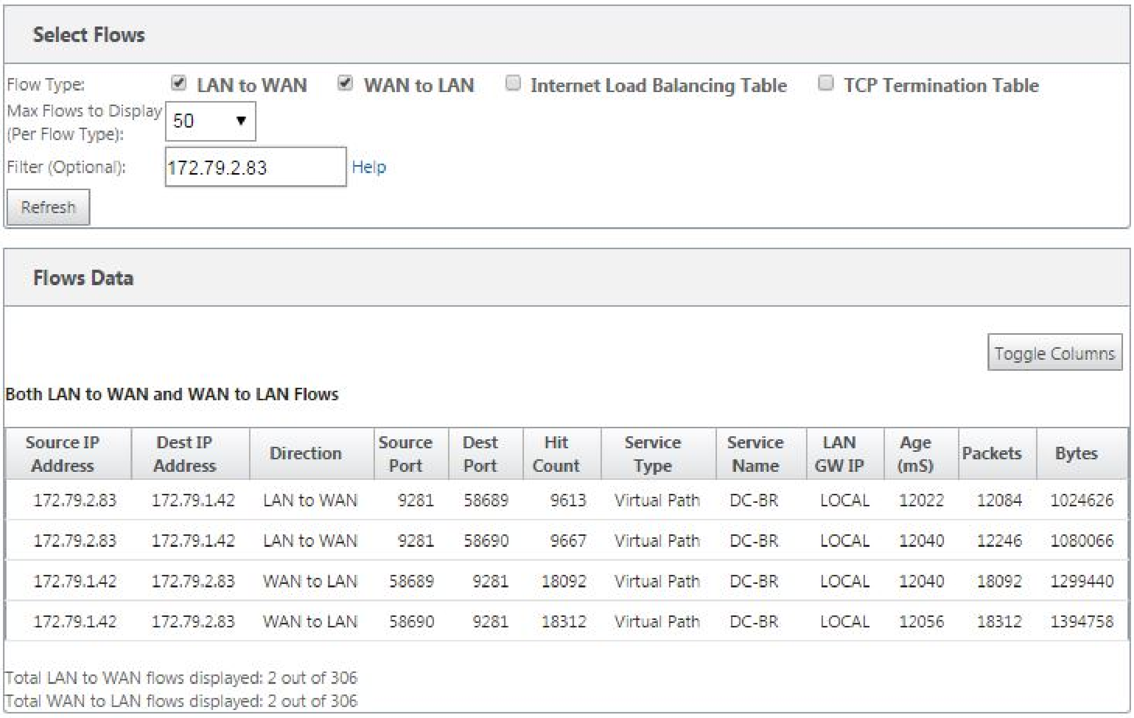
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	□	□	□	□	□	□	□
Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type
9598	Virtual Path	DC-BR	LOCAL	2435	12065	1023038	0.033	0.023	0.013	0.000	12	9	REALTIME	DC-WL-2->BR-WL-1	N/A	Duplicate, Reliable
9652	Virtual Path	DC-BR	LOCAL	2434	12226	1078010	0.033	0.023	0.013	0.000	12	9	REALTIME	DC-WL-2->BR-WL-1	N/A	Duplicate, Reliable
18064	Virtual Path	DC-BR	LOCAL	2448	18064	1297454	0.048	0.028	0.019	0.000	89	N/A	N/A	N/A	N/A	Duplicate, Reliable
18283	Virtual Path	DC-BR	LOCAL	2447	18283	1391974	0.048	0.028	0.019	0.000	89	N/A	N/A	N/A	N/A	Duplicate, Reliable

10. Click a check box to select or deselect a column.

    - **Source IP Address** - The source IP address for packets on this flow.
    - **Dest IP Address** - The destination IP address for packets on this flow.
    - **Direction** - The direction for packets on this flow - LAN to WAN or WAN to LAN.
    - **Source Port** - The source port for packets on this flow.
    - **Dest Port** - The destination port for packets on this flow.
    - **IPP** - The IP protocol number for packets on this flow.
    - **IP DSCP** - The IP DSCP tag setting for packets on this flow.
    - **Hit Count** - The number of times this flow has been searched for and found.
    - **Service Type** - Indicates whether this flow type is Virtual path, Internet, or Intranet traffic.
    - **Service Name** - The name of the virtual path that the virtual path traffic is using.
    - **LAN GW IP** - IP address for the LAN gateway, if one is specified.
    - **Age (mS)** - The time (in milliseconds) since a packet was classified in this flow.
    - **Packets** - Number of packets sent over the life of the flow.
    - **Bytes** - Number of bytes sent over the life of the flow.

- **PPS** - Packets per second over the period since the last refresh.
- **Customer kbps**/ **Virtual Path Overhead kbps** / **IPsec Overhead kbps** - Kilobits per second over the period since the last refresh.
- **Rule ID** - The ID of the rule that the traffic on this flow matched.
- **App Rule ID** - The ID of app the rule that the traffic on this flow matched.
- **Class** - The ID of the virtual path class that the traffic is using.
- **Class Type** - The type of the virtual path class (Realtime, Interactive, Bulk) the traffic is using.
- **Path** - The path that the traffic is using.
- **Hdr Compression Saved Bytes** - The number of saved bytes due to header compression.
- **Transmission Type** - The transmission type the traffic is using.
- **Application** - The name of the application in use.

11. Click **Apply** (above the top right corner of the table). It dismisses the selection options, and refreshes the table to include only the selected columns.



Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

Filter (Optional): 172.79.2.83

Flows Data

Both LAN to WAN and WAN to LAN Flows

Source IP Address	Dest IP Address	Direction	Source Port	Dest Port	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes
172.79.2.83	172.79.1.42	LAN to WAN	9281	58689	9613	Virtual Path	DC-BR	LOCAL	12022	12084	1024626
172.79.2.83	172.79.1.42	LAN to WAN	9281	58690	9667	Virtual Path	DC-BR	LOCAL	12040	12246	1080066
172.79.1.42	172.79.2.83	WAN to LAN	58689	9281	18092	Virtual Path	DC-BR	LOCAL	12040	18092	1299440
172.79.1.42	172.79.2.83	WAN to LAN	58690	9281	18312	Virtual Path	DC-BR	LOCAL	12056	18312	1394758

Total LAN to WAN flows displayed: 2 out of 306
Total WAN to LAN flows displayed: 2 out of 306

DPI Applications in SD-WAN Center

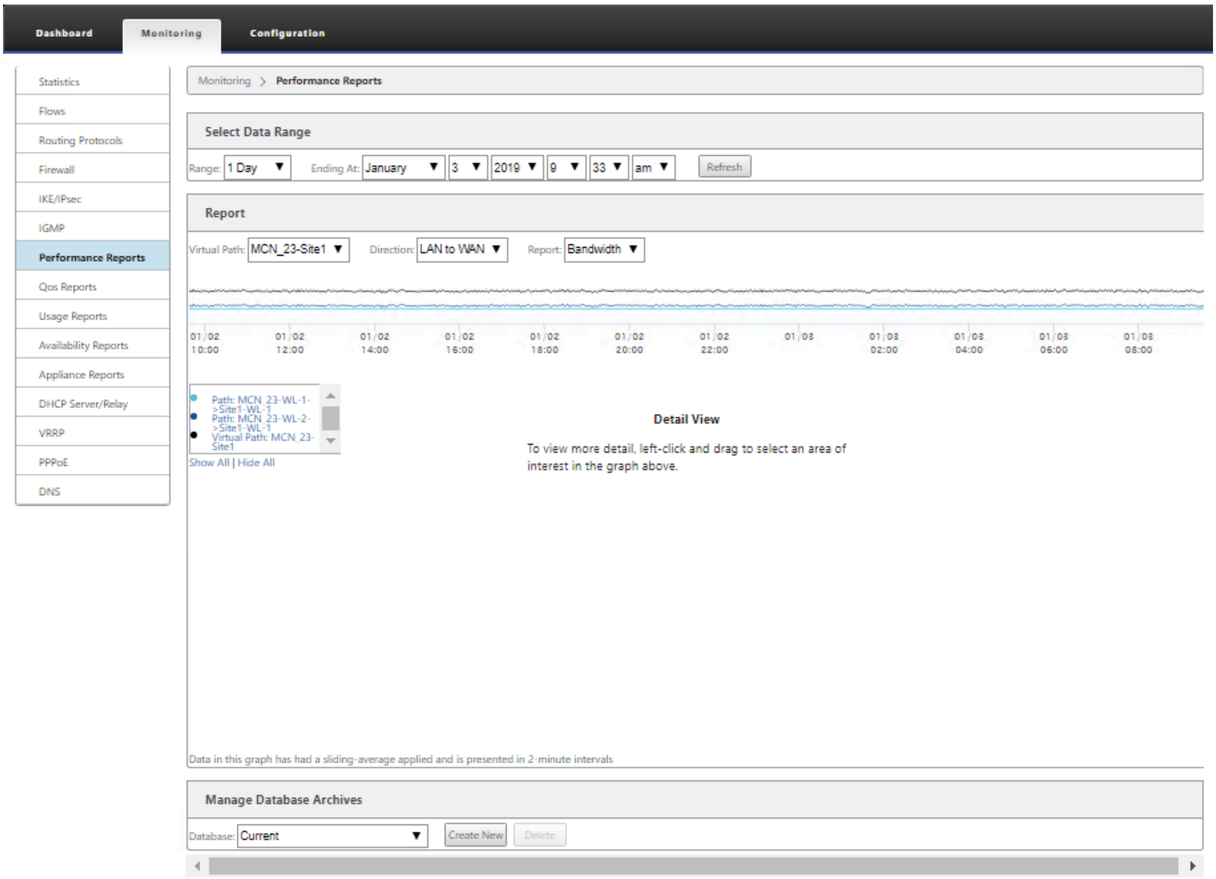
In earlier releases, around 4,000 applications and configured with 800 services (550 Virtual Paths, 256 Intranet Services) can be identified. Storing this data would impact overall system performance (CPU cycles and disk space needed to store the data). It also has an impact, if reporting on data per Usage or Path is supported.

While the data path provides information on every application gathered in a minute, the per minute stats reporting determines the top 100 applications and report on the aggregate of all other applications as "other."If there is high diversity of trackable applications in their network, it might affect clarity of data, particularly if we want to track/graph the usage of an application over time and the application falls out of the top 100 limit.

Viewing Reports

August 24, 2022

This section provides basic instructions for generating and viewing Virtual WAN reports about the local appliance using the Management Web Interface. An appliance can maintain up to 30 archives and purge the oldest archives which are more than 30 entries.



Range: 1 Day Ending At: January 3 2019 9 33 am

Virtual Path: MCN_23-Site1 Direction: LAN to WAN Report: Bandwidth

Detail View

To view more detail, left-click and drag to select an area of interest in the graph above.

Data in this graph has had a sliding-average applied and is presented in 2-minute intervals

Database: Current

> **Note**
>
> Reports generated on the Management Web Interface apply to the local appliance, only. To generate and view reports for the Virtual WAN, use the Virtual WAN Center Web Interface.

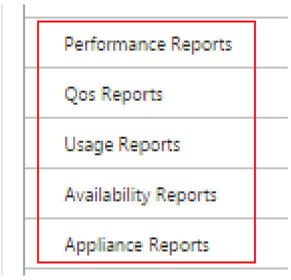
To generate and view Virtual WAN reports, do the following:

1. Log on to the Management Web Interface for the MCN, and select the **Monitoring** tab.

   This opens the **Monitoring** navigation tree in the left pane.

2. Select a report type from the navigation tree.

   The report types are listed as branches in the navigation tree, just below the **Flows** branch.

   Performance Reports
   Qos Reports
   Usage Reports
   Availability Reports
   Appliance Reports

   The available report types are as follows:

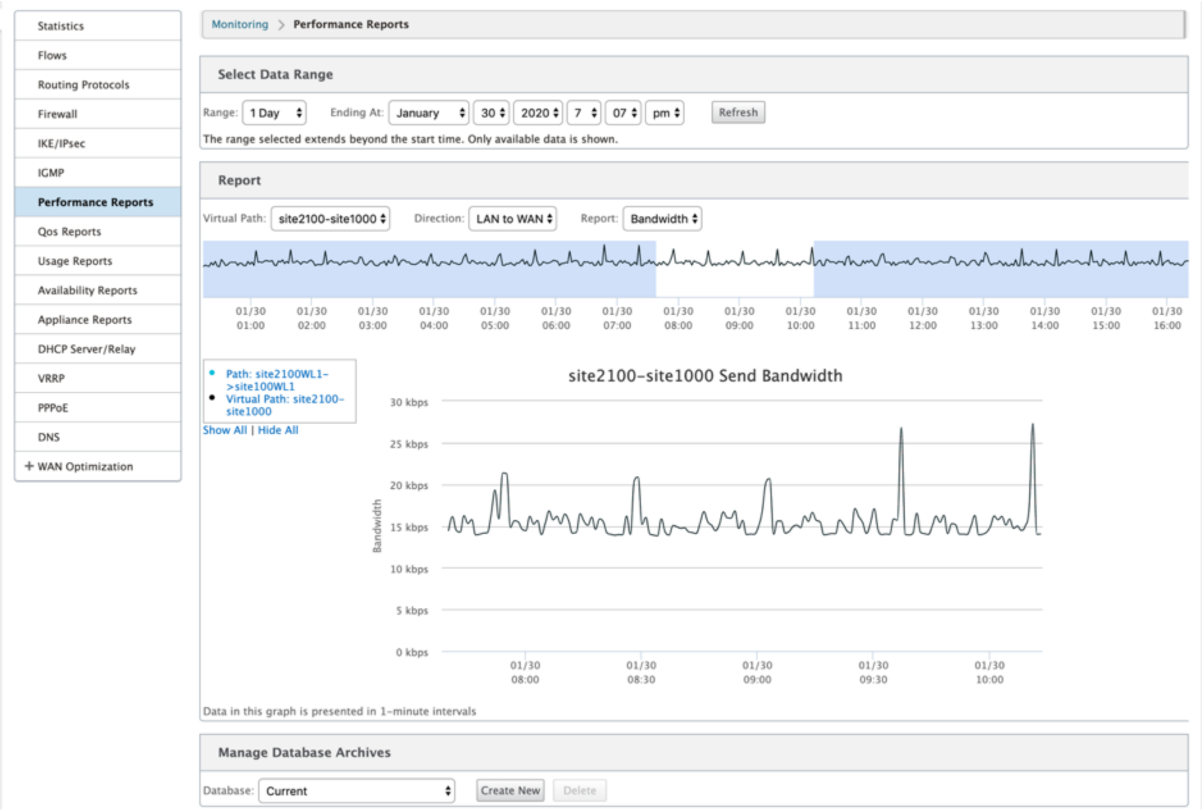
   - **Performance Reports**
   - **QoS Reports**
   - **Usage Reports**
   - **Availability Reports**
   - **Appliance Reports**

3. Select the report options.

In addition to the various types of reports, for each report type there are numerous options and filters for refining report results.

Performance reports

Citrix SD-WAN can show performance statistics at the site, virtual path, or Direction (LAN to WAN and WAN to LAN) level. With Citrix SD-WAN, you can collect metrics that show the efficiency of each link in milliseconds. To view more detail, left-click and select a specific area of path or time frame in the graph line.



Select Data Range

Range: 1 Day Ending At: January 30 2020 7 07 pm

The range selected extends beyond the start time. Only available data is shown.

Report

Virtual Path: site2100-site1000 Direction: LAN to WAN Report: Bandwidth

Data in this graph is presented in 1-minute intervals

Manage Database Archives

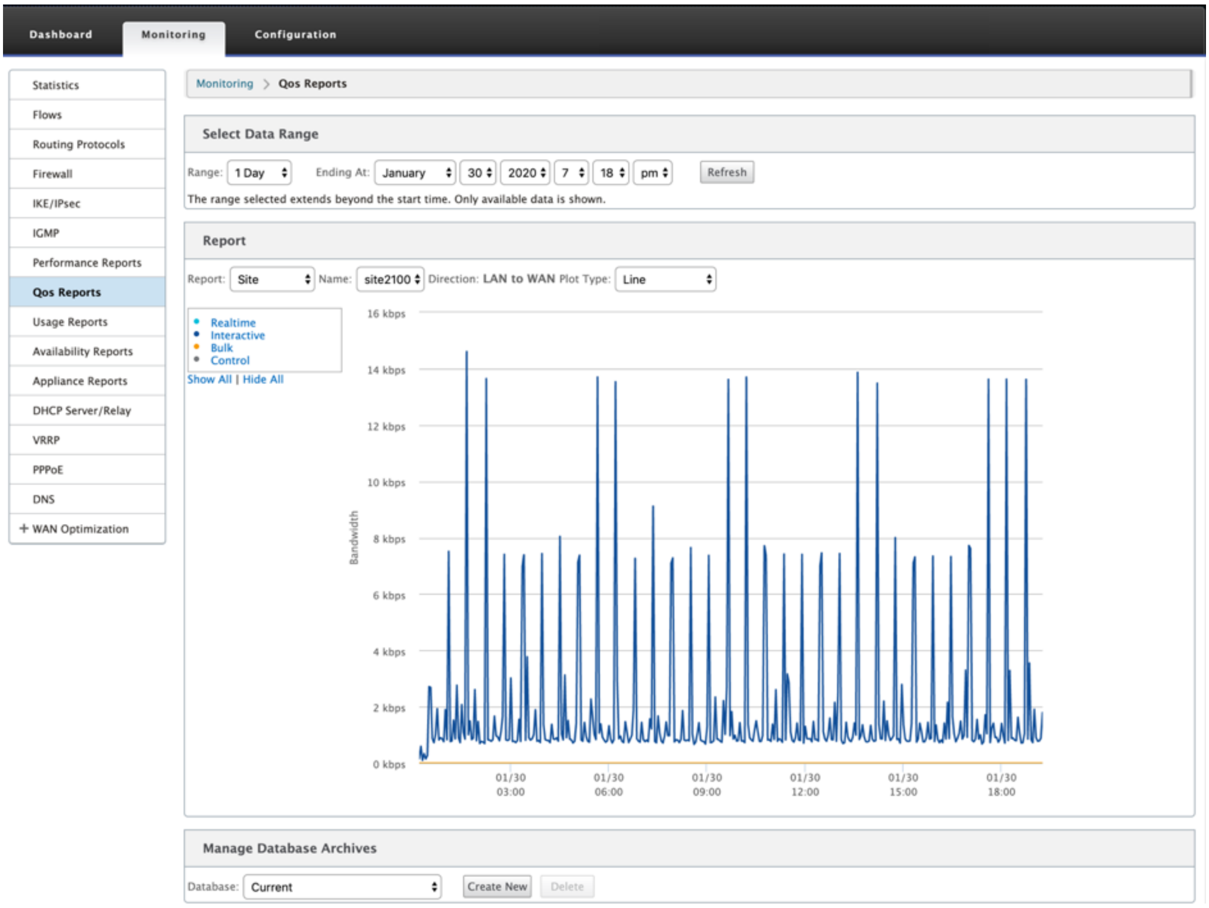
Database: Current

You can select the data range as needed with the following fields to view the performance report:

- **Virtual Path:** Select the Virtual Path from the drop-down list.
- **Direction:** Select the Direction as required (LAN to WAN or WAN to LAN).
- **Report:** Select the following network parameters to view the report:
  - Bandwidth
  - Latency
  - Jitter
  - Loss
  - Quality

QoS reports

You can monitor the application QoS report such as the number of packets or bytes uploaded, downloaded, or dropped at each Site, WAN Link, Virtual Path, and Path level.



Select Data Range

Range: 1 Day Ending At: January 30 2020 7 18 pm

The range selected extends beyond the start time. Only available data is shown.

Report

Report: Site Name: site2100 Direction: LAN to WAN Plot Type: Line

Manage Database Archives

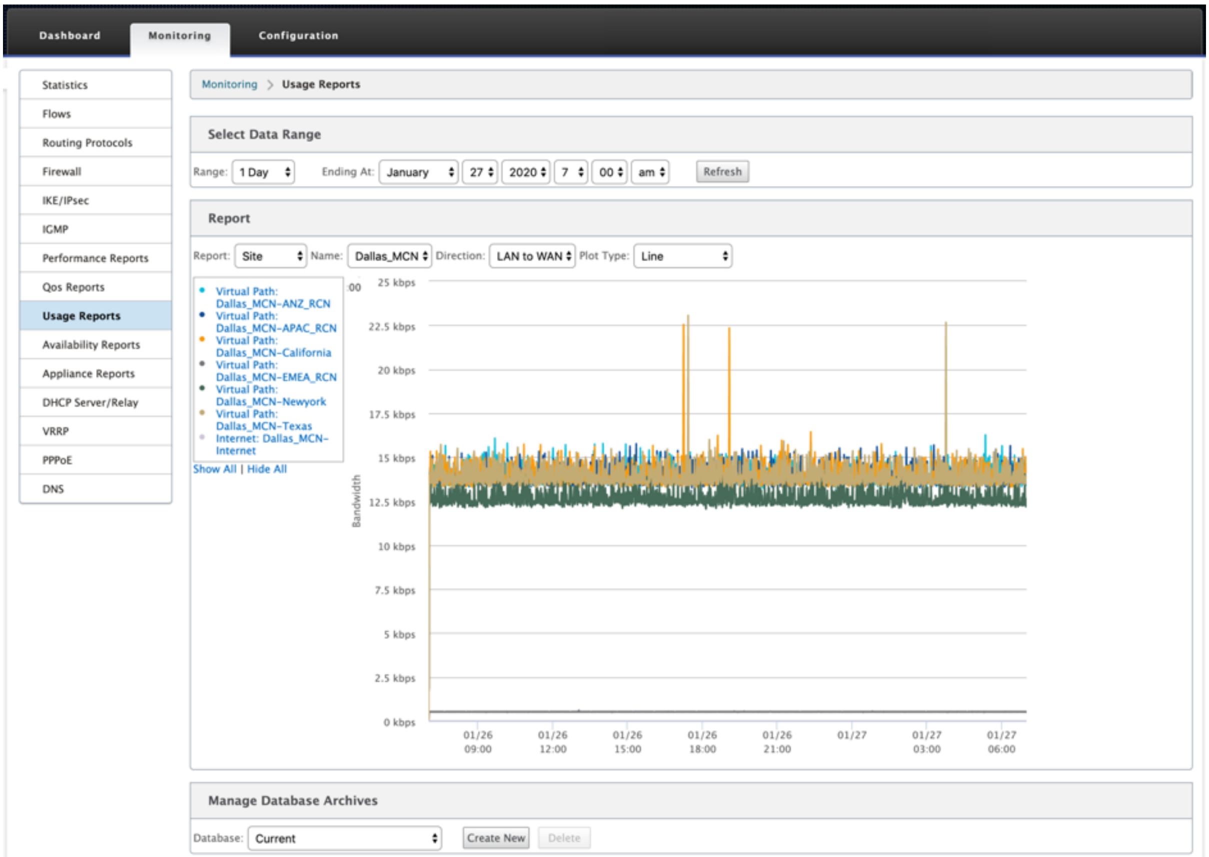
Database: Current

You can view the following metrics:

- **Real-time:** Bandwidth consumed by applications that belong to the real-time class type in the Citrix SD-WAN configuration. The performance of such applications depends on a great extent upon network latency. A delayed packet is worse than a lost packet (for example, VoIP, Skype for Business).
- **Interactive:** Bandwidth consumed by applications that belong to the interactive class type in the Citrix SD-WAN configuration. The performance of such applications depends on a great extent upon network latency, and packet loss (for example, XenDesktop, XenApp).
- **Bulk:** Bandwidth consumed by applications that belong to the bulk class type in the Citrix SD-WAN configuration. These applications involve little human intervention and are mostly handled by the systems themselves (for example, FTP, backup operations).
- **Control:** Bandwidth used to transfer control packets that contain routing, scheduling, and link statistics information.

Usage reports

The Usage reports deliver the Virtual paths usage information.



Monitoring > Usage Reports

Select Data Range

Range: 1 Day Ending At: January 27 2020 7 00 am

Report

Report: Site Name: Dallas_MCN Direction: LAN to WAN Plot Type: Line

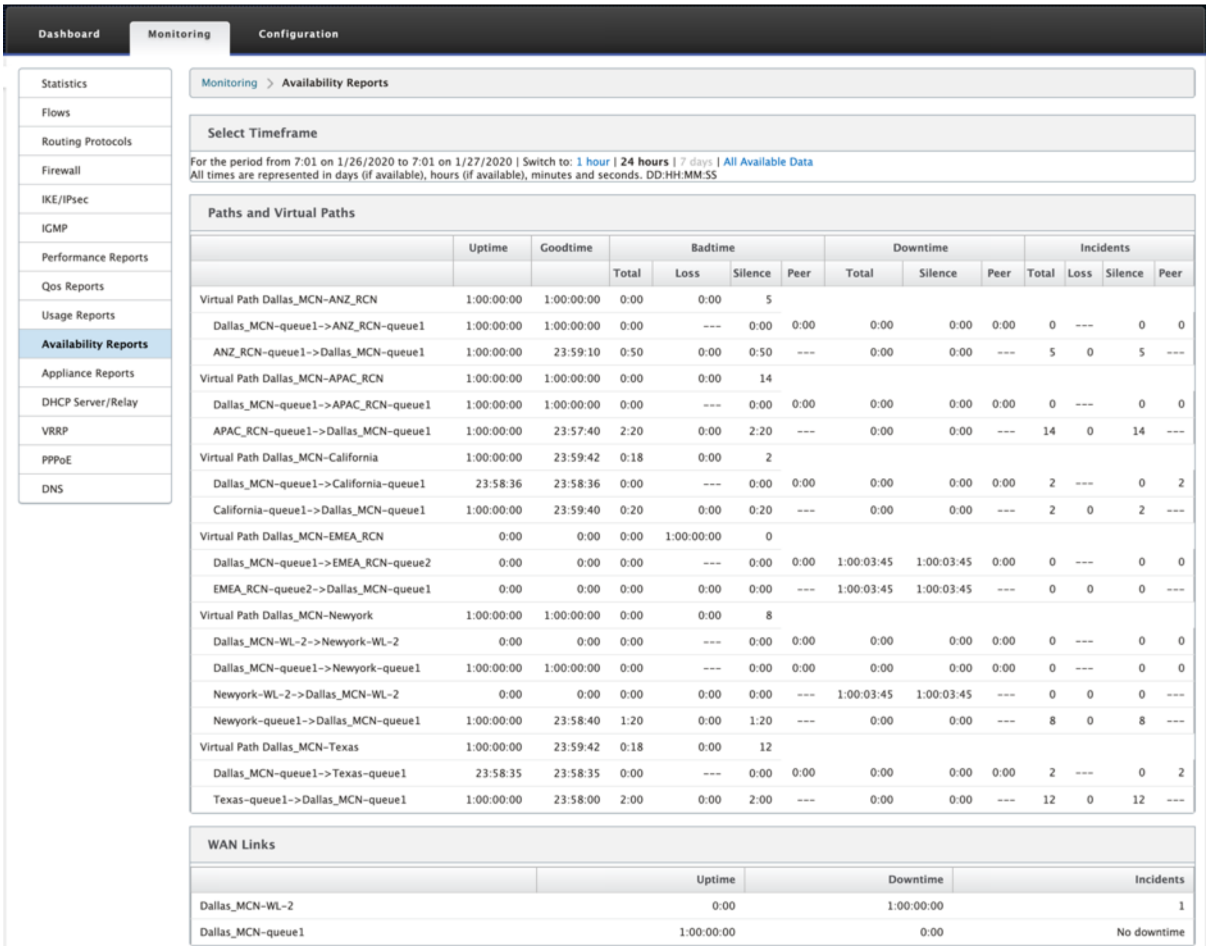
Manage Database Archives

Database: Current

- **Report:** Select **Site** or **WAN Link** from the drop-down list to view the report.
- **Name:** Select the name of the site or WAN link from the drop-down list.
- **Direction:** Select the direction as required (LAN to WAN or WAN to LAN).
- **Plot Type:** Select the Plot type from the drop-down list (Line or Area).

Availability reports

In this report, you can view the availability data of WAN Links, Paths, and Virtual Paths. You can also switch to or choose a specific time frame, such as 1 hour, 24 hours, and 7 days to see the available data. The Paths and Virtual Paths data are represented in a **DD:HH:MM:SS** format.



Select Timeframe

For the period from 7:01 on 1/26/2020 to 7:01 on 1/27/2020 | Switch to: 1 hour | 24 hours | 7 days | All Available Data
All times are represented in days (if available), hours (if available), minutes and seconds. DD:HH:MM:SS

Paths and Virtual Paths

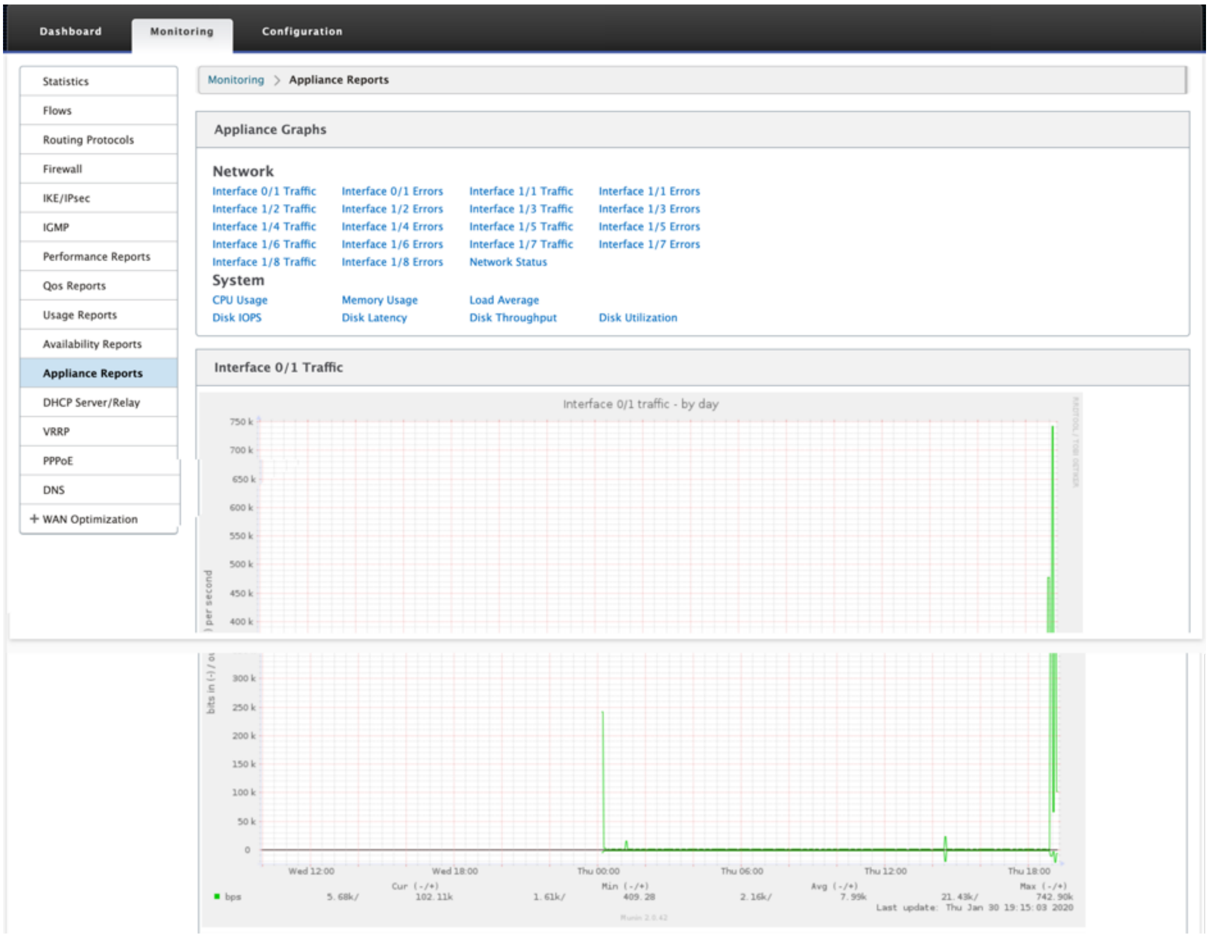
	Uptime	Goodtime	Badtime				Downtime			Incidents			
			Total	Loss	Silence	Peer	Total	Silence	Peer	Total	Loss	Silence	Peer
Virtual Path Dallas_MCN-ANZ_RCN	1:00:00:00	1:00:00:00	0:00	0:00	5								
Dallas_MCN-queue1->ANZ_RCN-queue1	1:00:00:00	1:00:00:00	0:00	---	0:00	0:00	0:00	0:00	0:00	0	---	0	0
ANZ_RCN-queue1->Dallas_MCN-queue1	1:00:00:00	23:59:10	0:50	0:00	0:50	---	0:00	0:00	---	5	0	5	---
Virtual Path Dallas_MCN-APAC_RCN	1:00:00:00	1:00:00:00	0:00	0:00	14								
Dallas_MCN-queue1->APAC_RCN-queue1	1:00:00:00	1:00:00:00	0:00	---	0:00	0:00	0:00	0:00	0:00	0	---	0	0
APAC_RCN-queue1->Dallas_MCN-queue1	1:00:00:00	23:57:40	2:20	0:00	2:20	---	0:00	0:00	---	14	0	14	---
Virtual Path Dallas_MCN-California	1:00:00:00	23:59:42	0:18	0:00	2								
Dallas_MCN-queue1->California-queue1	23:58:36	23:58:36	0:00	---	0:00	0:00	0:00	0:00	0:00	2	---	0	2
California-queue1->Dallas_MCN-queue1	1:00:00:00	23:59:40	0:20	0:00	0:20	---	0:00	0:00	---	2	0	2	---
Virtual Path Dallas_MCN-EMEA_RCN	0:00	0:00	0:00	1:00:00:00	0								
Dallas_MCN-queue1->EMEA_RCN-queue2	0:00	0:00	0:00	---	0:00	0:00	1:00:03:45	1:00:03:45	0:00	0	---	0	0
EMEA_RCN-queue2->Dallas_MCN-queue1	0:00	0:00	0:00	0:00	0:00	---	1:00:03:45	1:00:03:45	---	0	0	0	---
Virtual Path Dallas_MCN-Newyork	1:00:00:00	1:00:00:00	0:00	0:00	8								
Dallas_MCN-WL-2->Newyork-WL-2	0:00	0:00	0:00	---	0:00	0:00	0:00	0:00	0:00	0	---	0	0
Dallas_MCN-queue1->Newyork-queue1	1:00:00:00	1:00:00:00	0:00	---	0:00	0:00	0:00	0:00	0:00	0	---	0	0
Newyork-WL-2->Dallas_MCN-WL-2	0:00	0:00	0:00	0:00	0:00	---	1:00:03:45	1:00:03:45	---	0	0	0	---
Newyork-queue1->Dallas_MCN-queue1	1:00:00:00	23:58:40	1:20	0:00	1:20	---	0:00	0:00	---	8	0	8	---
Virtual Path Dallas_MCN-Texas	1:00:00:00	23:59:42	0:18	0:00	12								
Dallas_MCN-queue1->Texas-queue1	23:58:35	23:58:35	0:00	---	0:00	0:00	0:00	0:00	0:00	2	---	0	2
Texas-queue1->Dallas_MCN-queue1	1:00:00:00	23:58:00	2:00	0:00	2:00	---	0:00	0:00	---	12	0	12	---

WAN Links

	Uptime	Downtime	Incidents
Dallas_MCN-WL-2	0:00	1:00:00:00	1
Dallas_MCN-queue1	1:00:00:00	0:00	No downtime

Appliance reports

Appliance report delivers Network traffic and System usage reports. Click each link to view or monitor the appliance graph by day, weekly, monthly, and yearly.



Viewing Firewall Statistics

August 24, 2022

Once you have configured firewall and NAT policies, you can view the statistics of the connections, firewall policies and NAT policies as reports. You can filter the reports using the various filtering parameters.

For information on configuring firewall and NAT policies, see Stateful Firewall and NAT Support.

To view Firewall Statistics:

1. Navigate to **Monitoring** > **Firewall.**
2. Select, **Connections**, **Filter Policies, or NAT Policies** as required.
3. Set the filtering criteria as required.
4. Click **Refresh**.

Connections

You can check the statistics for Applications for the Firewall Policy. This enables you to see all connections that match to the selected Application, where they are coming from, where they are going to, and how much traffic they are generating. You can see how the firewall policies are acting on the traffic for each Application.

You can filter the connections statistics using the following parameters:

- Application - The application used as filter criteria for the connection.
- Family - The application family the used as filter criteria for the connection.
- IP Protocol - The IP protocol used by the connection.
- Source Zone - The zone from which the connection originated.
- Destination Zone - The zone from which responding traffic originates.
- Source Service Type - The service from which the connection originated.
- Source Service Instance - The instance of the service from which the connection originated.
- Source IP - The IP address from which the connection originated, input in dotted decimal notation with an optional subnet mask.
- Source Port - The port or range of ports from which the connection originated. A single port or a range of ports using the "-"character is accepted.
- Destination Service Type - The service from which responding traffic originates.
- Destination Service Instance - The instance of the service from which responding traffic originates.
- Destination IP - The IP address of the responding device, input in dotted decimal notation with an optional subnet mask.
- Destination Port - The port or range of ports used by the responding device. A single port or a range of ports using the "-"character is accepted.

Filter Policies

Policies enable you to specify actions for traffic flows. Group of firewall filters are created using Firewall Policy Templates and can be applied to all sites in the network or only to specific sites.

You can view statistics report for all the filter policies and filter it using the following parameters.

- Application object - The Application object used as a filter criteria in the firewall policy.
- Application - The application used as a filter criteria in the firewall policy

- Family - The application family used as filter criteria in the firewall policy.
- IP Protocol - The IP protocol that the filter policy matches.
- DSCP: The DSCP tag that the filter policy matches.
- Filter Policy Action - The action taken by the policy when a packet matches the filter.
- Source Service Type - The service from which the connection originated.
- Source Service Name - The instance of the service from which the connection originated.
- Source IP - The IP address from which the connection originated, input in dotted decimal notation with an optional subnet mask.
- Source Port - The port or range of ports from which the connection originated. A single port or a range of ports using the "-"character is accepted.
- Destination Service Type - The service to which responding traffic is destined.
- Destination Service Name - When applicable, the service to which responding traffic is destined.
- Destination IP - The IP address of the responding device, input in dotted decimal notation with an optional subnet mask.
- Destination Port - The port or range of ports used by the responding device. A single port or a range of ports using the "-"character is accepted.
- Source Zone - The origination zone matched by the filter policy.
- Destination Zone - The responding zone matched by the filter policy.

NAT Policies

You can view the statistics of all the Network Address Translation (NAT) policies and filter the report using the following parameters.

- IP Protocol - The IP protocol that the NAT policy matches.
- NAT Type - The type of NAT in use by the NAT policy.
- Dynamic NAT Type - The type of Dynamic NAT in use by the NAT policy.
- Service Type - The service type used by the NAT policy.
- Service Name - The instance of the service used by the NAT policy.
- Inside IP - The inside IP address, input in dotted decimal notation with an optional subnet mask.
- Inside Port- The inside port range used by the NAT policy. A single port or a range of ports using the "-"character is accepted.

- Outside IP - The outside IP address, input in dotted decimal notation with an optional subnet mask.
- Outside Port - The outside port range used by the NAT policy. A single port or a range of ports using the "-"character is accepted.

Diagnostics

August 24, 2022

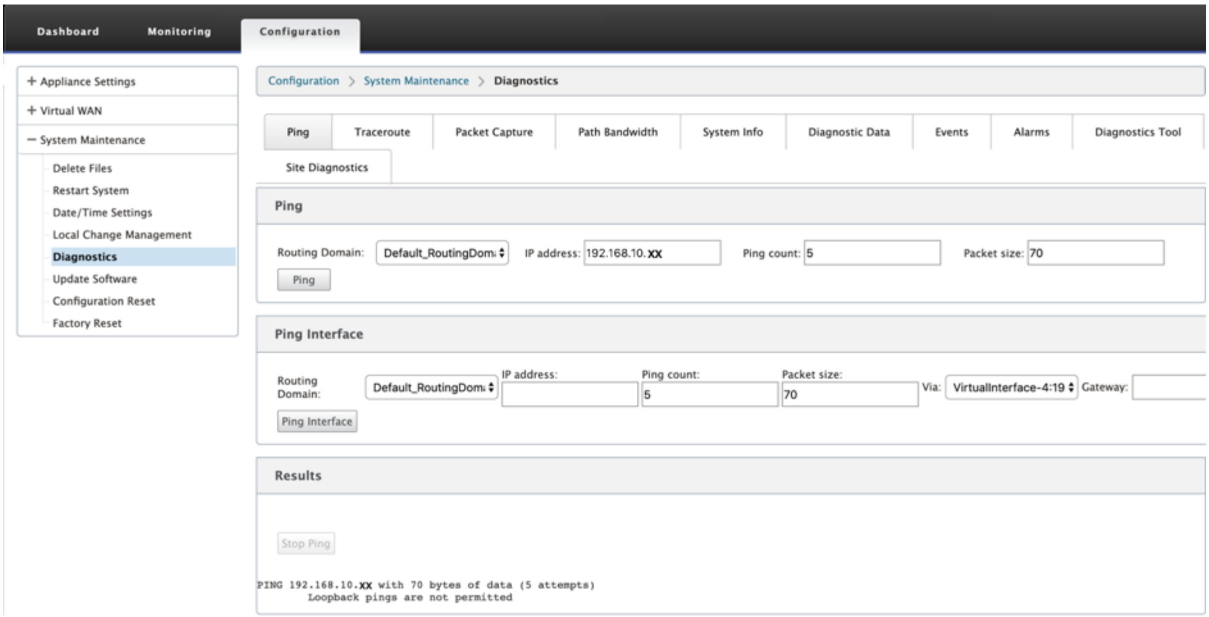
Citrix SD-WAN Diagnostics utilities provide the following options to test and investigate connectivity issues:

- Ping
- Traceroute
- Packet Capture
- Path Bandwidth
- System Info
- Diagnostics Data
- Events
- Alarms
- Diagnostics Tool
- Site Diagnostics

The diagnostic options in the **Citrix SD-WAN Dashboard** control data collection.

Ping

To use the **Ping** option, navigate to **Configuration > Diagnostics** and select **Ping**. You can use Ping to check host reachability and network connectivity.



Ping

Routing Domain: Default_RoutingDom IP address: 192.168.10.xx Ping count: 5 Packet size: 70

Ping Interface

Routing Domain: Default_RoutingDom IP address: Ping count: 5 Packet size: 70 Via: VirtualInterface-4:19 Gateway:

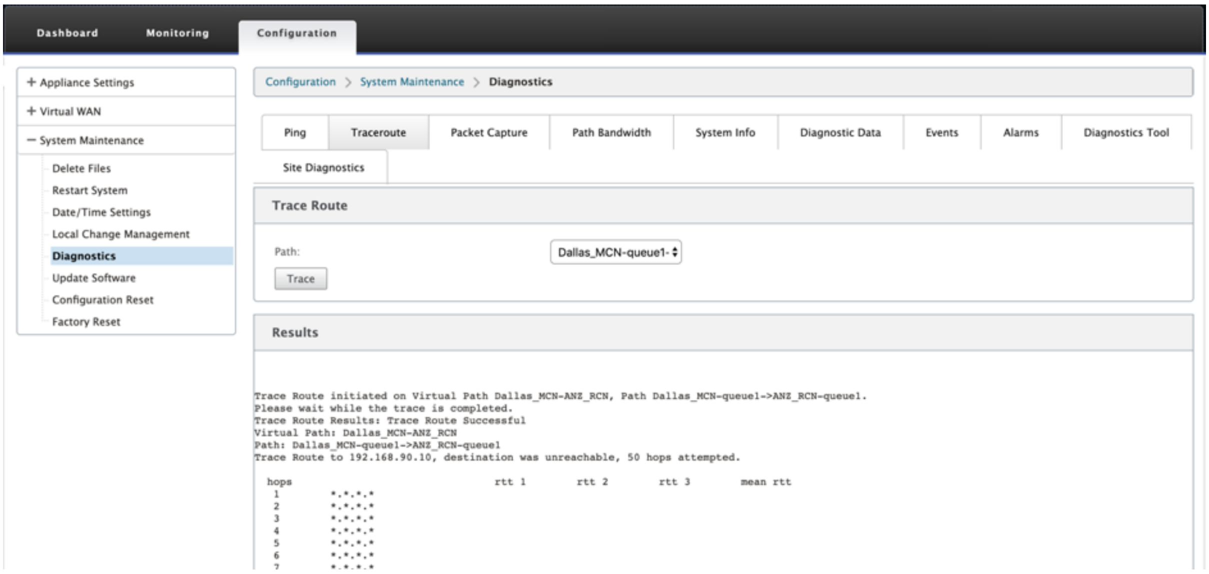
```
PING 192.168.10.xx with 70 bytes of data (5 attempts)
       Loopback pings are not permitted
```

Select the routing domain. Provide a valid IP address, number of ping counts (number of times to send the ping request), and packet size (number of data bytes). Click **Stop Ping** to stop an ongoing ping search.

You can ping through a specific interface. Select the routing domain and specify the IP address with ping count, packet size, and select the virtual interface from the drop-down list.

Traceroute

To use **Traceroute** option, navigate to **Configuration > expand System Maintenance > Diagnostics** and select **Traceroute**.



Path: Dallas_MCN-queue1-

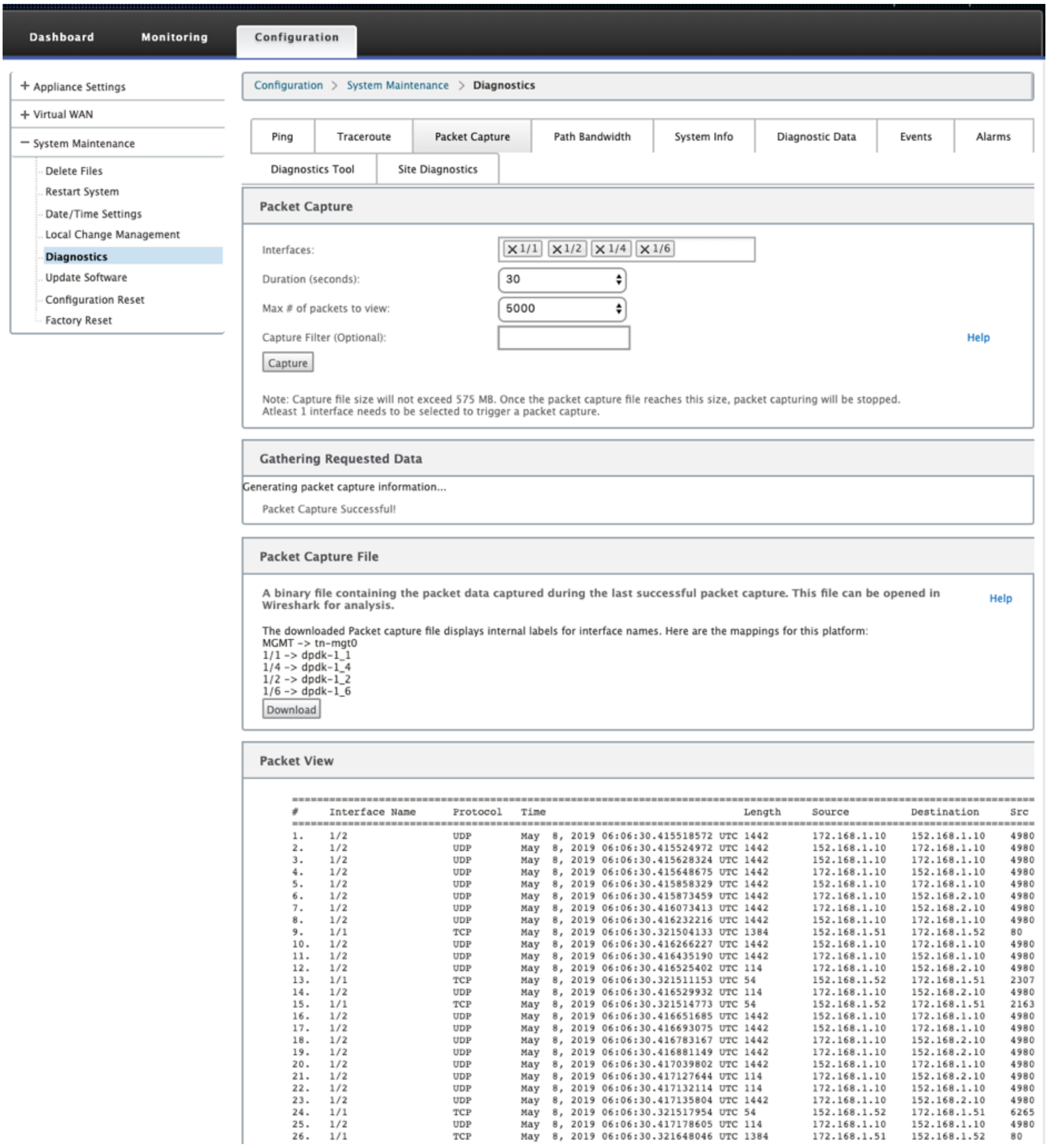
```
Trace Route initiated on Virtual Path Dallas_MCN-ANZ_RCN, Path Dallas_MCN-queue1->ANZ_RCN-queue1.
Please wait while the trace is completed.
Trace Route Results: Trace Route Successful
Virtual Path: Dallas_MCN-ANZ_RCN
Path: Dallas_MCN-queue1->ANZ_RCN-queue1
Trace Route to 192.168.90.10, destination was unreachable, 50 hops attempted.

  hops                              rtt 1        rtt 2        rtt 3        mean rtt
   1          *.*.*.*
   2          *.*.*.*
   3          *.*.*.*
   4          *.*.*.*
   5          *.*.*.*
   6          *.*.*.*
   7          *.*.*.*
```

Traceroute helps to discover and show the path or route to a remote server. Use the **Traceroute** option as a debugging tool to detect the points of failure in a network.

Select a path from the drop-down list and click **Trace**. You can view the details under **Results** section.

Packet capture

You can use the **Packet Capture** option to intercept the real-time data packet that is traversing over the selected active interface present in the selected site. Packet capture helps you to analyze and troubleshoot the network issues.



Packet Capture

Interfaces: ☒1/1 ☒1/2 ☒1/4 ☒1/6

Duration (seconds): 30

Max # of packets to view: 5000

Capture Filter (Optional):

Note: Capture file size will not exceed 575 MB. Once the packet capture file reaches this size, packet capturing will be stopped.
Atleast 1 interface needs to be selected to trigger a packet capture.

Gathering Requested Data

Generating packet capture information...

Packet Capture Successful!

Packet Capture File

A binary file containing the packet data captured during the last successful packet capture. This file can be opened in Wireshark for analysis.

The downloaded Packet capture file displays internal labels for interface names. Here are the mappings for this platform:
MGMT -> tn-mgt0
1/1 -> dpdk-1_1
1/4 -> dpdk-1_4
1/2 -> dpdk-1_2
1/6 -> dpdk-1_6

Packet View

```
===================================================================================================================
#    Interface Name   Protocol  Time                                Length     Source          Destination     Src
===================================================================================================================
1.   1/2              UDP       May  8, 2019 06:06:30.415518572 UTC 1442       172.168.1.10    152.168.1.10    4980
2.   1/2              UDP       May  8, 2019 06:06:30.415524972 UTC 1442       152.168.1.10    172.168.1.10    4980
3.   1/2              UDP       May  8, 2019 06:06:30.415628324 UTC 1442       152.168.1.10    172.168.1.10    4980
4.   1/2              UDP       May  8, 2019 06:06:30.415648675 UTC 1442       172.168.1.10    152.168.1.10    4980
5.   1/2              UDP       May  8, 2019 06:06:30.415858329 UTC 1442       152.168.1.10    172.168.1.10    4980
6.   1/2              UDP       May  8, 2019 06:06:30.415873459 UTC 1442       172.168.1.10    152.168.2.10    4980
7.   1/2              UDP       May  8, 2019 06:06:30.416073413 UTC 1442       172.168.1.10    152.168.2.10    4980
8.   1/2              UDP       May  8, 2019 06:06:30.416232216 UTC 1442       152.168.1.10    172.168.1.10    4980
9.   1/1              TCP       May  8, 2019 06:06:30.321504133 UTC 1384       152.168.1.51    172.168.1.52    80
10.  1/2              UDP       May  8, 2019 06:06:30.416266227 UTC 1442       152.168.1.10    172.168.1.10    4980
11.  1/2              UDP       May  8, 2019 06:06:30.416435190 UTC 1442       172.168.1.10    152.168.1.10    4980
12.  1/2              UDP       May  8, 2019 06:06:30.416525402 UTC 114        172.168.1.10    152.168.2.10    4980
13.  1/1              TCP       May  8, 2019 06:06:30.321511153 UTC 54         152.168.1.52    172.168.1.51    2307
14.  1/2              UDP       May  8, 2019 06:06:30.416529932 UTC 114        172.168.1.10    152.168.2.10    4980
15.  1/1              TCP       May  8, 2019 06:06:30.321514773 UTC 54         152.168.1.52    172.168.1.51    2163
16.  1/2              UDP       May  8, 2019 06:06:30.416651685 UTC 1442       152.168.1.10    172.168.1.10    4980
17.  1/2              UDP       May  8, 2019 06:06:30.416693075 UTC 1442       152.168.1.10    172.168.1.10    4980
18.  1/2              UDP       May  8, 2019 06:06:30.416783167 UTC 1442       172.168.1.10    152.168.2.10    4980
19.  1/2              UDP       May  8, 2019 06:06:30.416881149 UTC 1442       172.168.1.10    152.168.2.10    4980
20.  1/2              UDP       May  8, 2019 06:06:30.417039802 UTC 1442       152.168.1.10    172.168.1.10    4980
21.  1/2              UDP       May  8, 2019 06:06:30.417127644 UTC 114        172.168.1.10    152.168.2.10    4980
22.  1/2              UDP       May  8, 2019 06:06:30.417132114 UTC 114        172.168.1.10    152.168.1.10    4980
23.  1/2              UDP       May  8, 2019 06:06:30.417135804 UTC 1442       172.168.1.10    152.168.2.10    4980
24.  1/1              TCP       May  8, 2019 06:06:30.321517954 UTC 54         152.168.1.52    172.168.1.51    6265
25.  1/2              UDP       May  8, 2019 06:06:30.417178605 UTC 114        172.168.1.10    152.168.1.10    4980
26.  1/1              TCP       May  8, 2019 06:06:30.321648046 UTC 1384       172.168.1.51    152.168.1.52    80
```

Provide the following inputs for packet capture operation:

- **Interfaces** - Active interfaces are available for packet capture for the SD-WAN appliance. Select an interface or add interfaces from the drop-down list. At least one interface needs to be selected to trigger a packet capture.

  > **Note:**
  >
  > The ability to run packet capture across all the interfaces at once helps to speed up the troubleshooting task.

- **Duration(seconds**) –Duration (in seconds) for how long the data have to be captured.
- **Max # of packets to view** - Maximum limit of packets to view in the packet capture result.
- **Capture Filter (Optional)** - The optional Capture Filter field accepts a filter string that is used to determine which packets are captured. Packets are compared to the filter string and if the comparison result is true, then the packet is captured. If the filter is empty, then all packets are captured. For more information, see Capture Filters.

Following are some examples of this capture filter:

- **Ether proto\ARP** - Captures only ARP packets
- **Ether proto\IP** - Captures only IPv4 packets
- **VLAN 100** - Captures only packets with a VLAN of 100
- **Host 10.40.10.20** - Captures only IPv4 packets to or from the host with the address 10.40.10.20
- **Net 10.40.10.0 Mask 255.255.255.0** - Captures only IPv4 packets in the 10.40.10.0/24 subnet
- **IP proto \ TCP** - Captures only IPv4/TCP packets
- **Port 80** - Captures only IP packets to or from port 80
- **Port range 20–30** - Captures only IP packets to or from ports 20 through 30

> **Note**
>
> The maximum capture file size limit is up to 575 MB. Once the packet capture file reaches this size, packet capturing is stopped.

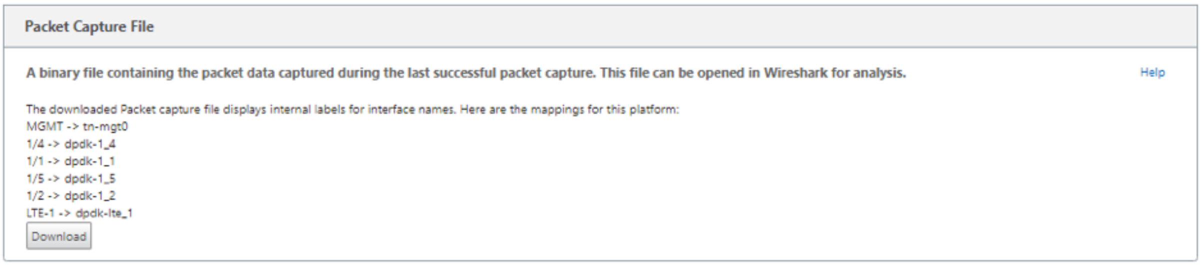
Click **Capture** to view the packet capture result. You can also download a binary file containing the packet data captured during the last successful packet capture.

Gathering requested data

You can see the status of generating packet capture information (whether packet capture is successful or no packet capture) in this table.

Packet capture file

Packets are captured as a binary data during the last successful packet capture. You can download the binary file to analyze the packet information offline. The interfaces name is different in the downloaded file as compared to the GUI interface. To view the internal interface mapping, click the Help option.

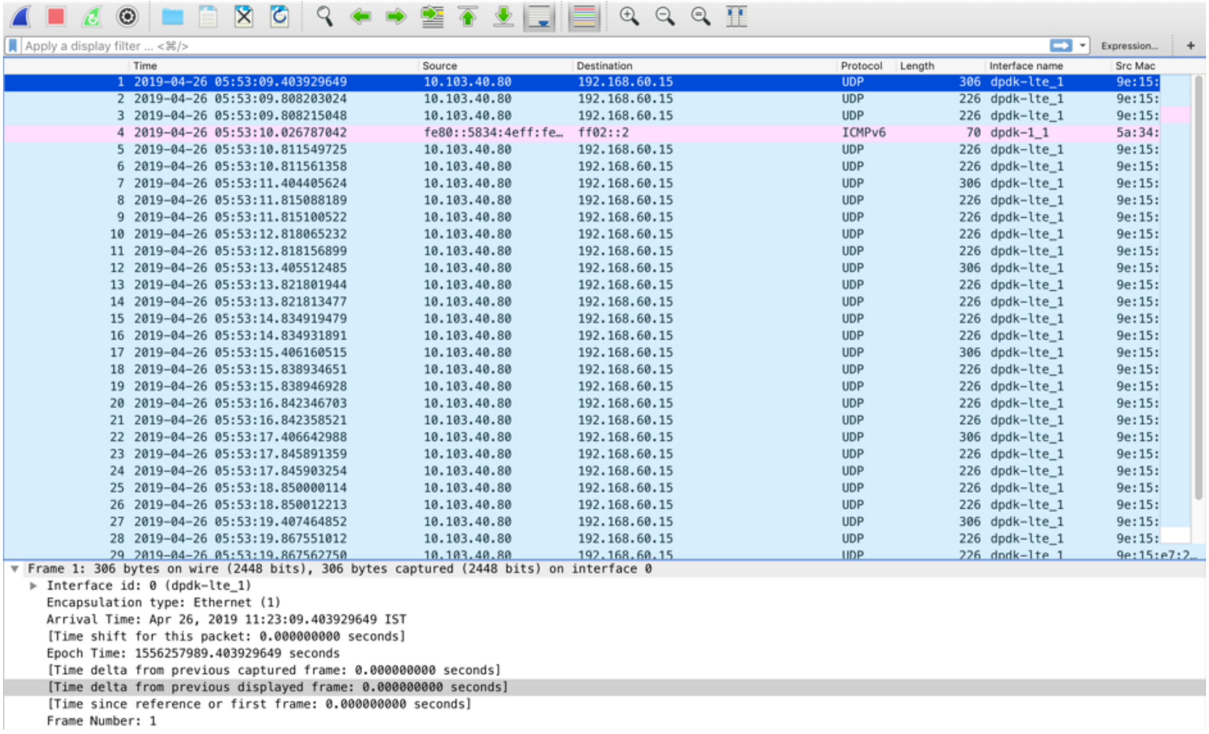


Packet Capture File

A binary file containing the packet data captured during the last successful packet capture. This file can be opened in Wireshark for analysis.

The downloaded Packet capture file displays internal labels for interface names. Here are the mappings for this platform:
MGMT -> tn-mgt0
1/4 -> dpdk-1_4
1/1 -> dpdk-1_1
1/5 -> dpdk-1_5
1/2 -> dpdk-1_2
LTE-1 -> dpdk-lte_1

You need **Wireshark** software 2.4.13 version or higher to open and read the binary file.



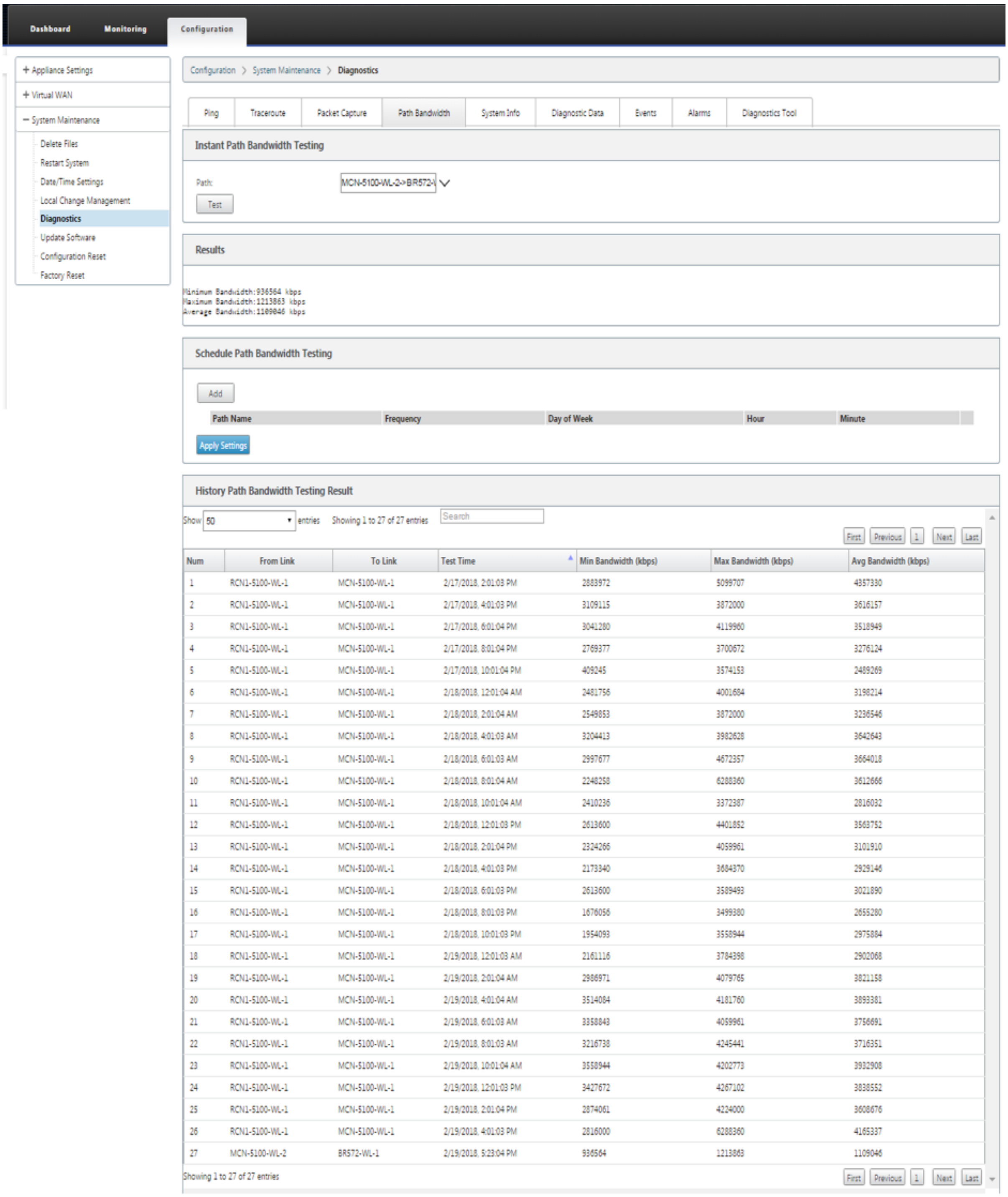
```
     Time                           Source              Destination       Protocol Length Interface name  Src Mac
   1 2019-04-26 05:53:09.403929649  10.103.40.80        192.168.60.15     UDP         306 dpdk-lte_1      9e:15:
   2 2019-04-26 05:53:09.808203024  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
   3 2019-04-26 05:53:09.808215048  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
   4 2019-04-26 05:53:10.026787042  fe80::5834:4eff:fe… ff02::2           ICMPv6       70 dpdk-1_1        5a:34:
   5 2019-04-26 05:53:10.811549725  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
   6 2019-04-26 05:53:10.811561358  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
   7 2019-04-26 05:53:11.404405624  10.103.40.80        192.168.60.15     UDP         306 dpdk-lte_1      9e:15:
   8 2019-04-26 05:53:11.815088189  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
   9 2019-04-26 05:53:11.815100522  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  10 2019-04-26 05:53:12.818065232  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  11 2019-04-26 05:53:12.818156899  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  12 2019-04-26 05:53:13.405512485  10.103.40.80        192.168.60.15     UDP         306 dpdk-lte_1      9e:15:
  13 2019-04-26 05:53:13.821801944  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  14 2019-04-26 05:53:13.821813477  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  15 2019-04-26 05:53:14.834919479  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  16 2019-04-26 05:53:14.834931891  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  17 2019-04-26 05:53:15.406160515  10.103.40.80        192.168.60.15     UDP         306 dpdk-lte_1      9e:15:
  18 2019-04-26 05:53:15.838934651  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  19 2019-04-26 05:53:15.838946928  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  20 2019-04-26 05:53:16.842346703  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  21 2019-04-26 05:53:16.842358521  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  22 2019-04-26 05:53:17.406642988  10.103.40.80        192.168.60.15     UDP         306 dpdk-lte_1      9e:15:
  23 2019-04-26 05:53:17.845891359  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  24 2019-04-26 05:53:17.845903254  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  25 2019-04-26 05:53:18.850000114  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  26 2019-04-26 05:53:18.850012213  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  27 2019-04-26 05:53:19.407464852  10.103.40.80        192.168.60.15     UDP         306 dpdk-lte_1      9e:15:
  28 2019-04-26 05:53:19.867551012  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:
  29 2019-04-26 05:53:19.867562750  10.103.40.80        192.168.60.15     UDP         226 dpdk-lte_1      9e:15:e7:2…
▼ Frame 1: 306 bytes on wire (2448 bits), 306 bytes captured (2448 bits) on interface 0
  ▶ Interface id: 0 (dpdk-lte_1)
    Encapsulation type: Ethernet (1)
    Arrival Time: Apr 26, 2019 11:23:09.403929649 IST
    [Time shift for this packet: 0.000000000 seconds]
    Epoch Time: 1556257989.403929649 seconds
    [Time delta from previous captured frame: 0.000000000 seconds]
    [Time delta from previous displayed frame: 0.000000000 seconds]
    [Time since reference or first frame: 0.000000000 seconds]
    Frame Number: 1
```

Packet view

If the packet capture file size is more, it takes more time to complete the rendering process for the packet view. In this case, it is recommended to download the file and use **Wireshark** for analysis instead of relying on the **Packet View** result.

Path bandwidth

To use the **Path Bandwidth** feature, navigate to **Configuration > expand System Maintenance > Diagnostics** and select **Path Bandwidth**.



Path: MCN-5100-WL-2->BR572-

```
Minimum Bandwidth:936564 kbps
Maximum Bandwidth:1213863 kbps
Average Bandwidth:1109046 kbps
```

Path Name	Frequency	Day of Week	Hour	Minute

Show 50 entries Showing 1 to 27 of 27 entries

Num	From Link	To Link	Test Time	Min Bandwidth (kbps)	Max Bandwidth (kbps)	Avg Bandwidth (kbps)
1	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 2:01:03 PM	2883972	5099707	4357330
2	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 4:01:03 PM	3109115	3872000	3616157
3	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 6:01:04 PM	3041280	4119960	3518949
4	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 8:01:04 PM	2769377	3700672	3276124
5	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 10:01:04 PM	409245	3574153	2489269
6	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 12:01:04 AM	2481756	4001684	3198214
7	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 2:01:04 AM	2549853	3872000	3236546
8	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 4:01:03 AM	3204413	3982628	3642643
9	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 6:01:03 AM	2997677	4672357	3664018
10	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 8:01:04 AM	2248258	6288360	3612666
11	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 10:01:04 AM	2410236	3372387	2816032
12	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 12:01:03 PM	2613600	4401852	3563752
13	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 2:01:04 PM	2324266	4059961	3101910
14	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 4:01:03 PM	2173340	3684370	2929146
15	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 6:01:03 PM	2613600	3589493	3021890
16	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 8:01:03 PM	1676056	3499380	2655280
17	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 10:01:03 PM	1954093	3558944	2975884
18	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 12:01:03 AM	2161116	3784398	2902068
19	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 2:01:04 AM	2986971	4079765	3821158
20	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 4:01:04 AM	3514084	4181760	3893381
21	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 6:01:03 AM	3358843	4059961	3756691
22	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 8:01:03 AM	3216738	4245441	3716351
23	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 10:01:04 AM	3558944	4202773	3932908
24	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 12:01:03 PM	3427672	4267102	3838552
25	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 2:01:04 PM	2874061	4224000	3608676
26	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 4:01:03 PM	2816000	6288360	4165337
27	MCN-5100-WL-2	BR572-WL-1	2/19/2018, 5:23:04 PM	936564	1213863	1109046

Showing 1 to 27 of 27 entries

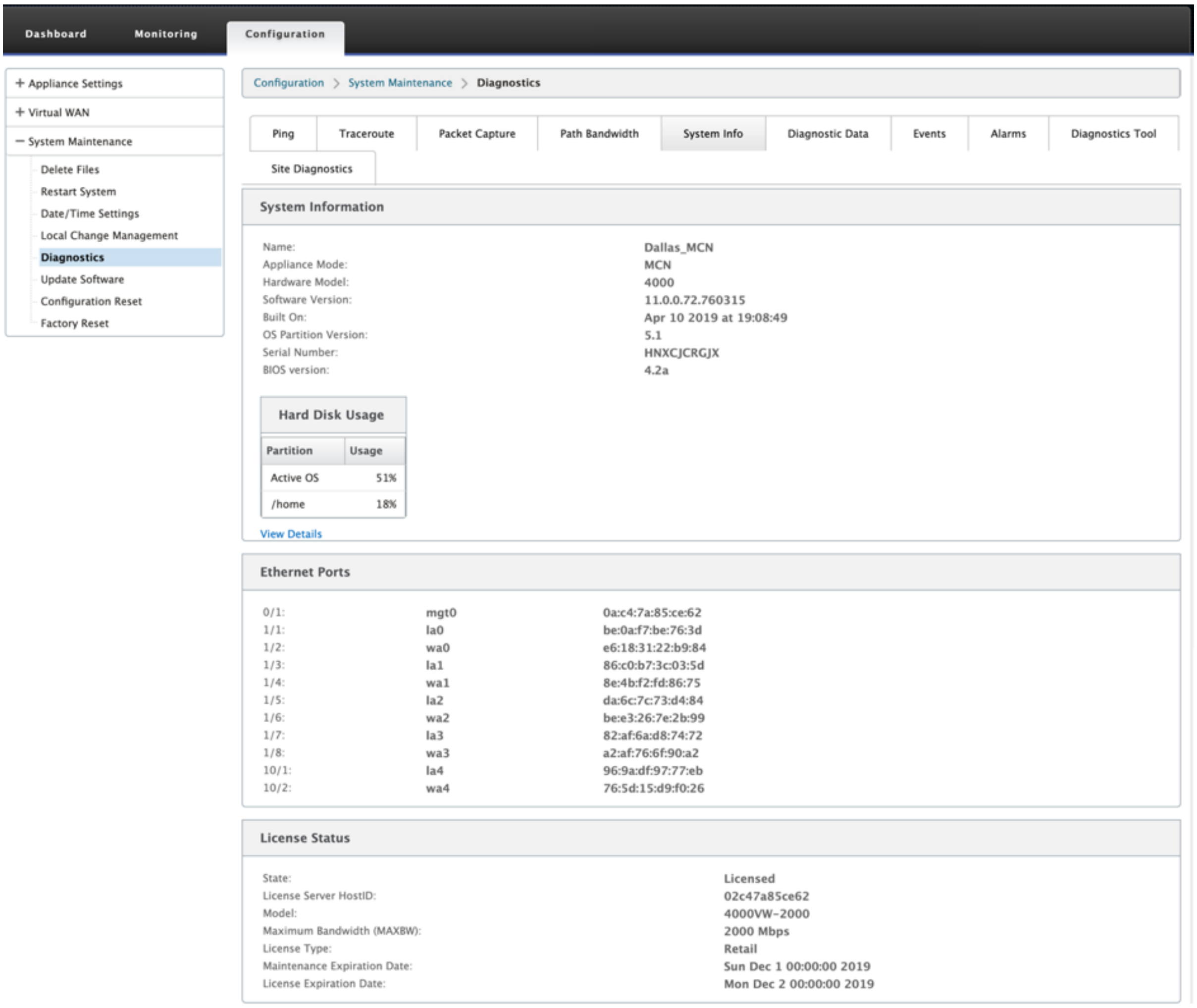
Active bandwidth testing enables you the ability to issue an instant path bandwidth test through public internet WAN link, or to schedule public internet WAN link bandwidth testing to be completed at specific times on a recurring basis.

The **Path Bandwidth** feature is useful for demonstrating how much bandwidth is available between two locations during new and existing installations. The values from the Path Bandwidth indicate maximum possible bandwidth. For an accurate allowed bandwidth, navigate to **Configuration** > **System Maintenance** > **Diagnostics** > **Site Diagnostics** > **Bandwidth Test**. For more information, see Active Bandwidth Testing.

System info

The **System Info** page provides the system information, ethernet ports detail, and license status.

To view the System Info, navigate to **Configuration > expand System Maintenance > Diagnostics** and select **System Info**.



System Information

Name:	Dallas_MCN
Appliance Mode:	MCN
Hardware Model:	4000
Software Version:	11.0.0.72.760315
Built On:	Apr 10 2019 at 19:08:49
OS Partition Version:	5.1
Serial Number:	HNXCJCRGJX
BIOS version:	4.2a

Hard Disk Usage

Partition	Usage
Active OS	51%
/home	18%

Ethernet Ports

0/1:	mgt0	0a:c4:7a:85:ce:62
1/1:	la0	be:0a:f7:be:76:3d
1/2:	wa0	e6:18:31:22:b9:84
1/3:	la1	86:c0:b7:3c:03:5d
1/4:	wa1	8e:4b:f2:fd:86:75
1/5:	la2	da:6c:7c:73:d4:84
1/6:	wa2	be:e3:26:7e:2b:99
1/7:	la3	82:af:6a:d8:74:72
1/8:	wa3	a2:af:76:6f:90:a2
10/1:	la4	96:9a:df:97:77:eb
10/2:	wa4	76:5d:15:d9:f0:26

License Status

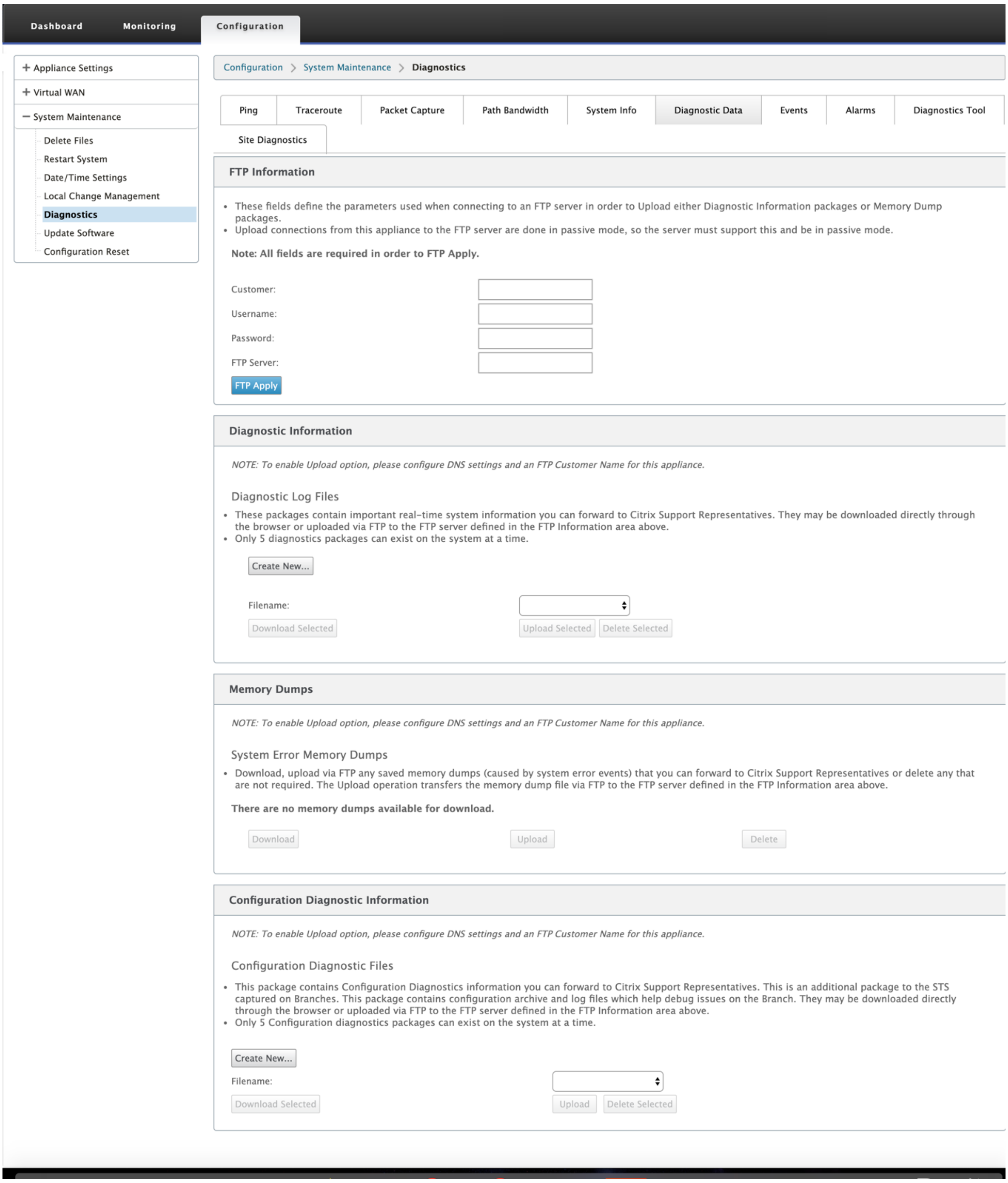
State:	Licensed
License Server HostID:	02c47a85ce62
Model:	4000VW-2000
Maximum Bandwidth (MAXBW):	2000 Mbps
License Type:	Retail
Maintenance Expiration Date:	Sun Dec 1 00:00:00 2019
License Expiration Date:	Mon Dec 2 00:00:00 2019

The **System Info** lists all the parameters that are not set to their defaults. This information is read-only. It is used by Support when some kind of misconfiguration is suspected. When you report a problem, you might be asked to check one or more values on this page.

Diagnostic data

Diagnostic Data allows you to generate a diagnostic data package for analysis by the Citrix Support team. You can download the **Diagnostics Log Files** package and share it with the Citrix Support team.

To view the **Diagnostic Data**, navigate to **Configuration > expand System Maintenance > Diagnostics** and select **Diagnostic Data**.



FTP Information

- These fields define the parameters used when connecting to an FTP server in order to Upload either Diagnostic Information packages or Memory Dump packages.
- Upload connections from this appliance to the FTP server are done in passive mode, so the server must support this and be in passive mode.

Note: All fields are required in order to FTP Apply.

Customer:

Username:

Password:

FTP Server:

FTP Apply

Diagnostic Information

NOTE: To enable Upload option, please configure DNS settings and an FTP Customer Name for this appliance.

Diagnostic Log Files

- These packages contain important real-time system information you can forward to Citrix Support Representatives. They may be downloaded directly through the browser or uploaded via FTP to the FTP server defined in the FTP Information area above.
- Only 5 diagnostics packages can exist on the system at a time.

Create New...

Filename:

Download Selected Upload Selected Delete Selected

Memory Dumps

NOTE: To enable Upload option, please configure DNS settings and an FTP Customer Name for this appliance.

System Error Memory Dumps

- Download, upload via FTP any saved memory dumps (caused by system error events) that you can forward to Citrix Support Representatives or delete any that are not required. The Upload operation transfers the memory dump file via FTP to the FTP server defined in the FTP Information area above.

There are no memory dumps available for download.

Download Upload Delete

Configuration Diagnostic Information

NOTE: To enable Upload option, please configure DNS settings and an FTP Customer Name for this appliance.

Configuration Diagnostic Files

- This package contains Configuration Diagnostics information you can forward to Citrix Support Representatives. This is an additional package to the STS captured on Branches. This package contains configuration archive and log files which help debug issues on the Branch. They may be downloaded directly through the browser or uploaded via FTP to the FTP server defined in the FTP Information area above.
- Only 5 Configuration diagnostics packages can exist on the system at a time.

Create New...

Filename:

Download Selected Upload Delete Selected

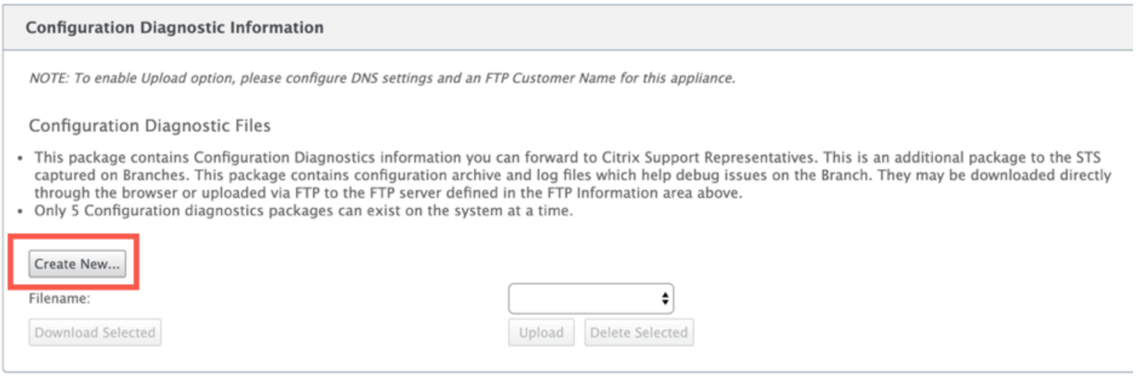
The **Diagnostics Data** includes:

- **FTP Information** –Provide the FTP parameters detail and click **FTP Apply**. The FTP information required to connect an FTP server to upload diagnostic information package.
- **Diagnostics Information** –The diagnostics log file package contains real-time system information that can be downloaded through the browser or uploaded via FTP to the FTP server.

> **Note:**
>
> Only five diagnostics packages can exist on the system at a time.

- **Configuration Diagnostic Information** - In the Citrix SD-WAN 11.0 release, the Network configuration file will not be available in the Diagnostic information collected for branch. For any support case, provide the diagnostic information of branch and Configuration diagnostic information from the control node the branch is connected to.

  To collect configuration diagnostic information from the Control Node GUI, navigate to **Configuration > System Maintenance > Diagnostics > Diagnostic Data** > under **Configuration Diagnostic Information**, click **Create New**.

  Configuration Diagnostic Information

  NOTE: To enable Upload option, please configure DNS settings and an FTP Customer Name for this appliance.

  Configuration Diagnostic Files

  - This package contains Configuration Diagnostics information you can forward to Citrix Support Representatives. This is an additional package to the STS captured on Branches. This package contains configuration archive and log files which help debug issues on the Branch. They may be downloaded directly through the browser or uploaded via FTP to the FTP server defined in the FTP Information area above.
  - Only 5 Configuration diagnostics packages can exist on the system at a time.

  On completion of the **Configuration Diagnostic Information** creation, click **Download Selected** file and provide this file to Citrix Support OR use the FTP apply operation available in the same page to FTP this file.

- **Memory Dumps** –You can download or upload the system error memory dumps file and share with the Citrix Support team. You can also delete the files if not required.

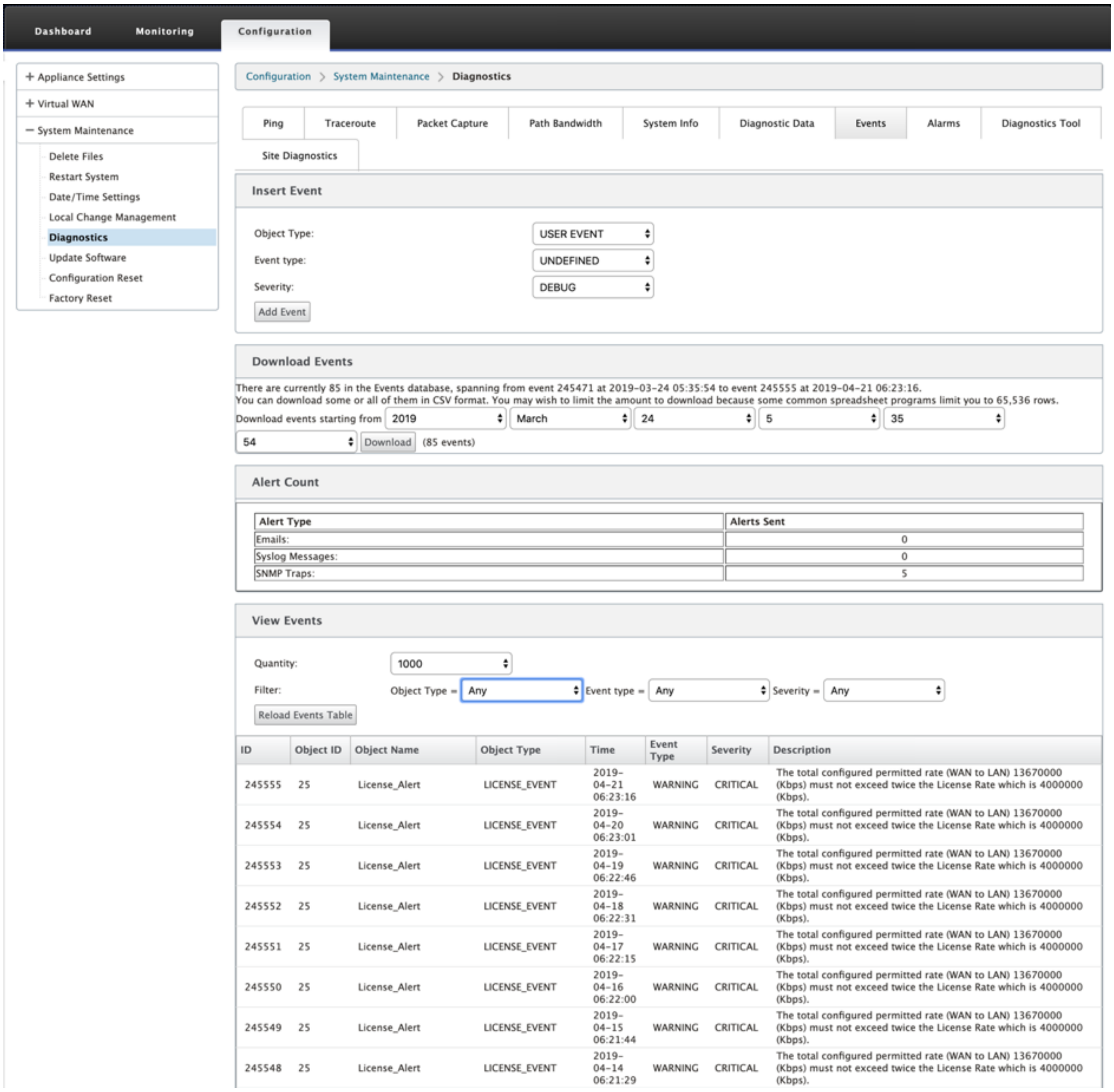
  > **NOTE:**
  >
  > By default the **Upload** option is in disabled mode. To enable it, configure **DNS** settings and an **FTP Customer Name** for this appliance.

Events

Use the **Events** feature to add, monitor, and manage the events generated. It helps to identify events in real-time, that helps you address issues immediately and keep the Citrix SD-WAN appliance running effectively. You can download events in CSV format.

To add an event, select object type, event type, and severity from the drop-down list and click **Add Event**.

To view **Events**, navigate to **Configuration >** expand **System Maintenance > Diagnostics** and select **Events**.



Insert Event

Object Type: USER EVENT

Event type: UNDEFINED

Severity: DEBUG

Add Event

Download Events

There are currently 85 in the Events database, spanning from event 245471 at 2019-03-24 05:35:54 to event 245555 at 2019-04-21 06:23:16.
You can download some or all of them in CSV format. You may wish to limit the amount to download because some common spreadsheet programs limit you to 65,536 rows.

Download events starting from 2019 March 24 5 35 54 Download (85 events)

Alert Count

Alert Type	Alerts Sent
Emails:	0
Syslog Messages:	0
SNMP Traps:	5

View Events

Quantity: 1000

Filter: Object Type = Any Event type = Any Severity = Any

Reload Events Table

ID	Object ID	Object Name	Object Type	Time	Event Type	Severity	Description
245555	25	License_Alert	LICENSE_EVENT	2019-04-21 06:23:16	WARNING	CRITICAL	The total configured permitted rate (WAN to LAN) 13670000 (Kbps) must not exceed twice the License Rate which is 4000000 (Kbps).
245554	25	License_Alert	LICENSE_EVENT	2019-04-20 06:23:01	WARNING	CRITICAL	The total configured permitted rate (WAN to LAN) 13670000 (Kbps) must not exceed twice the License Rate which is 4000000 (Kbps).
245553	25	License_Alert	LICENSE_EVENT	2019-04-19 06:22:46	WARNING	CRITICAL	The total configured permitted rate (WAN to LAN) 13670000 (Kbps) must not exceed twice the License Rate which is 4000000 (Kbps).
245552	25	License_Alert	LICENSE_EVENT	2019-04-18 06:22:31	WARNING	CRITICAL	The total configured permitted rate (WAN to LAN) 13670000 (Kbps) must not exceed twice the License Rate which is 4000000 (Kbps).
245551	25	License_Alert	LICENSE_EVENT	2019-04-17 06:22:15	WARNING	CRITICAL	The total configured permitted rate (WAN to LAN) 13670000 (Kbps) must not exceed twice the License Rate which is 4000000 (Kbps).
245550	25	License_Alert	LICENSE_EVENT	2019-04-16 06:22:00	WARNING	CRITICAL	The total configured permitted rate (WAN to LAN) 13670000 (Kbps) must not exceed twice the License Rate which is 4000000 (Kbps).
245549	25	License_Alert	LICENSE_EVENT	2019-04-15 06:21:44	WARNING	CRITICAL	The total configured permitted rate (WAN to LAN) 13670000 (Kbps) must not exceed twice the License Rate which is 4000000 (Kbps).
245548	25	License_Alert	LICENSE_EVENT	2019-04-14 06:21:29	WARNING	CRITICAL	The total configured permitted rate (WAN to LAN) 13670000 (Kbps) must not exceed twice the License Rate which is 4000000 (Kbps).

You can configure Citrix SD-WAN to send event notifications for different event types as **Emails, SNMP Traps,** or **Syslog Messages**.

Once the email, SNMP, and syslog notification settings are configured, you can select the severity for different event types and select the mode (email, SNMP, syslog) to send event notifications.

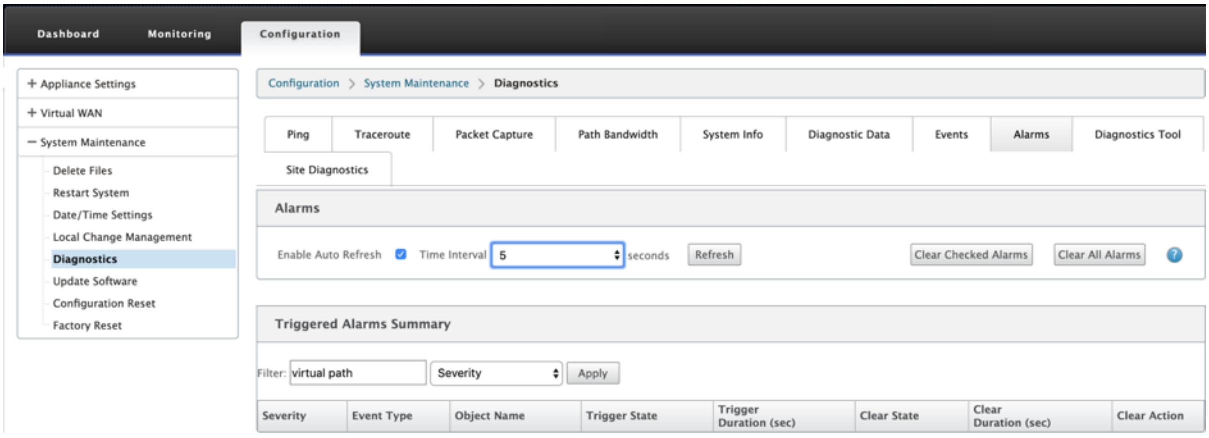
Notifications are generated for events equal to or above the specified severity level for the event type.

You can view the events detail under **View Events** table. The event details include the following information.

- **ID** –Event ID.
- **Object ID** - The ID of the object generating the event.
- **Object Name** - The name of the object generating the event.
- **Object Type** –The type of the object generating the event.
- **Time** –The time the event was generated.
- **Event Type** –The state of the object at the time of the event.
- **Severity** –The severity level of the event.
- **Description** –A text description of the event.

Alarms

You can view and clear the triggered alarm. To view **Alarms**, navigate to **Configuration > expand System Maintenance > Diagnostics** and select **Alarms**.



Enable Auto Refresh ☑ Time Interval 5 seconds

Filter: virtual path Severity

Severity	Event Type	Object Name	Trigger State	Trigger Duration (sec)	Clear State	Clear Duration (sec)	Clear Action

Select the alarms that you want to clear and click **Clear Checked Alarms** or click **Clear All Alarms** to clear all the alarms.

You can view the following summary of all the triggered alarms:

- **Severity** –The severity is displayed in the alerts sent when the alarm is triggered or cleared and in the triggered alarm summary.
- **Event Type** –The SD-WAN appliance can trigger alarms for particular subsystems or objects in the network. These alarms are called event types.
- **Object Name** –The name of the object generating the event.
- **Trigger State** –The event state that triggers an alarm for an Event Type.
- **Trigger Duration (sec)** –The duration in seconds determines how quickly the appliance triggers an alarm.
- **Clear State** –The event state that clears an alarm for an Event Type after the alarm is triggered.
- **Clear Duration (sec)** –The duration in seconds determines how long to wait before clearing an alarm.
- **Clear Action** –The action that is taken while clearing alarms.

Diagnostics tool

The **Diagnostic tool** is used to generate test traffic which allows you to troubleshoot network issues that might results in:

- Frequent change in path state from Good to Bad.
- Poor application performance.
- Higher packet loss

Most often, these problems arise due to rate limiting configured on firewall and router, incorrect bandwidth settings, low link speed, priority queue set by network provider and so on. The diagnostic tool allows you to identify the root cause of such issues and troubleshoot it.

The diagnostic tool removes the dependency on third-party tools such as iPerf which has to be manually installed on the Data Center and Branch hosts. It provides more control over the type of diagnostic traffic sent, the direction in which the diagnostic traffic flows, and the path on which the diagnostic traffic flows.

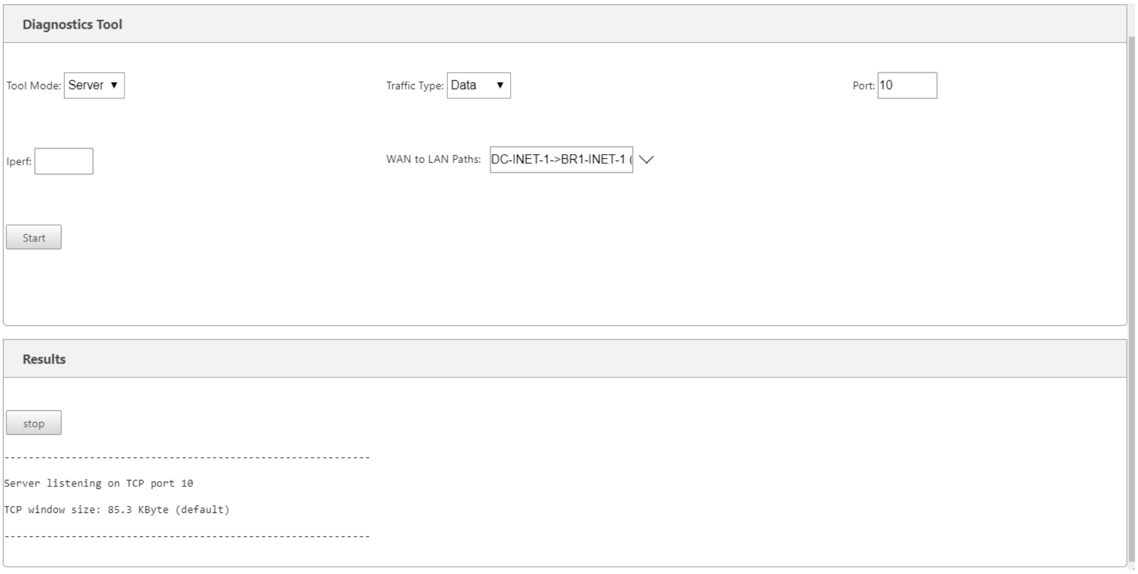
The diagnostic tool allows to generate the following two types of traffic:

- **Control**: Generates traffic with no QOS/scheduling applied to the packets. As a result, the packets are sent over the path selected in the UI, even if the path is not the best at the time. This traffic is used to test specific paths and helps to identify ISP-related issues. You can also use this to determine the bandwidth of the selected path.
- **Data**: Simulates the traffic generated from the host with SD-WAN traffic processing. Since QoS/scheduling is applied to the packets, the packets are sent over the best path available then. Traffic is sent over multiple paths if load balancing is enabled. This traffic is used to troubleshoot QoS/scheduler related issues.

> **Note**
>
> To run a diagnostic test on a path, you have to start the test on the appliances at both ends of the path. Start the diagnostic test as a server on one appliance and as a client on the other appliance.

To use diagnostics tool:

1. On both the appliances, click **Configuration** > **System Maintenance** > **Diagnostics** > **Diagnostics Tool**.



Tool Mode: Server

Traffic Type: Data

Port: 10

Iperf:

WAN to LAN Paths: DC-INET-1->BR1-INET-1 (

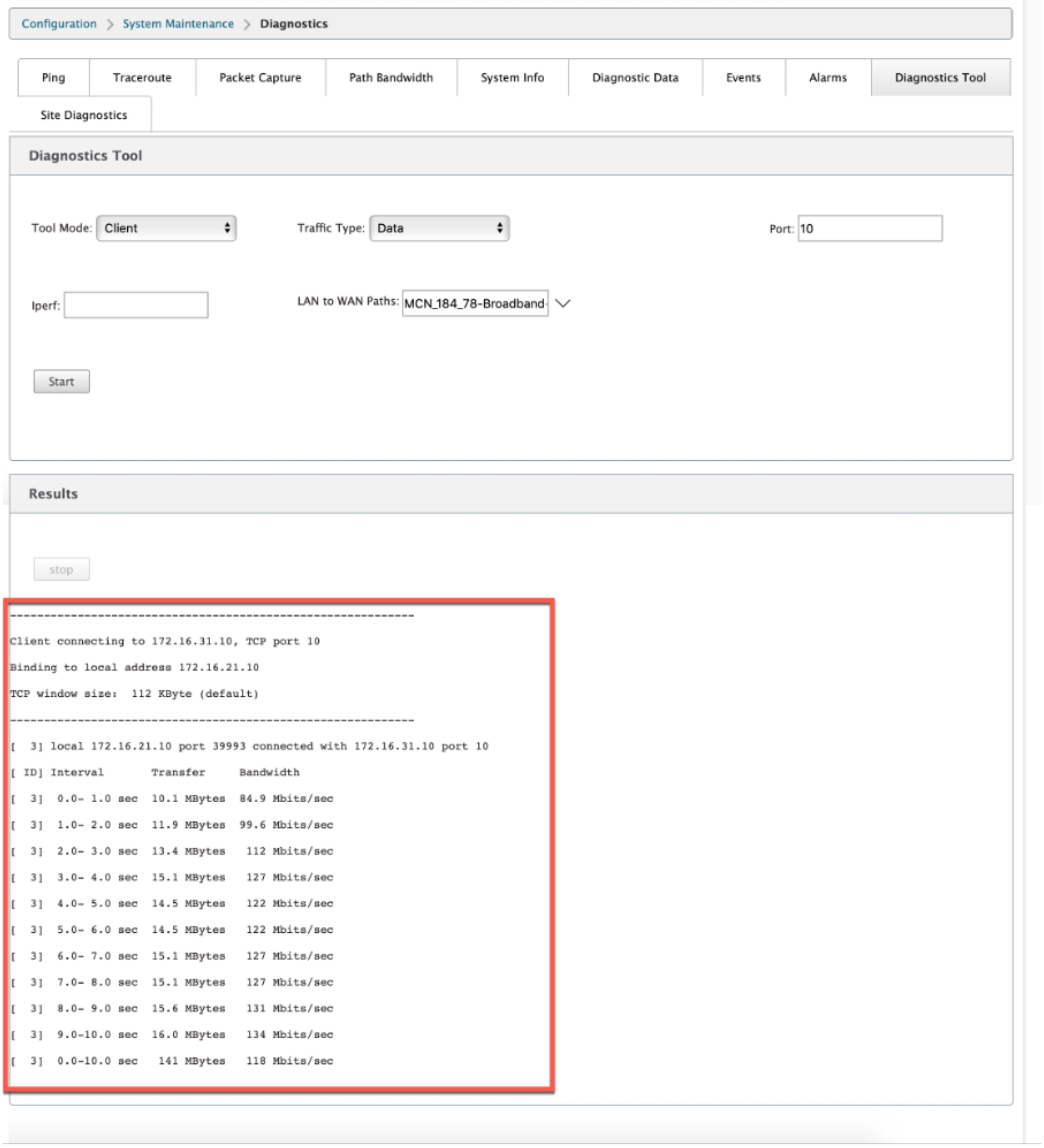
```
------------------------------------------------------------
Server listening on TCP port 10
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
```

2. In the **Tool Mode** field, select **Server** on one appliance and select **Client** on the appliance residing on the remote end of the selected path.
3. In the **Traffic Type** field, select the type of diagnostic traffic, either **Control** or **Data**. Select the same traffic type on both the appliances.
4. In the **Port** field, specify the **TCP / UDP** port number on which the diagnostic traffic is sent. Specify the same port number on both the appliances.
5. In the **Iperf** field, specify IPERF command-line options, if any.

   > **Note**
   >
   > You need not specify the following IPERF command-line options:
   >
   > - -c: Client mode option is added by the diagnostic tool.
   > - -s: Server mode option is added by the diagnostic tool.
   > - -B: Binding IPERF to specific IP/interface is done by the diagnostic tool depending on the path selected.
   > - -p: Port number is provided in the diagnostics tool.
   > - -i: Output interval in seconds.
   > - -t: Total duration of the test in seconds.

6. Select the WAN to LAN paths on which you want to send the diagnostic traffic. Select the same path on both the appliances.
7. Click **Start** on both the appliances.

The result displays the mode (client or server) of the selected appliance and the TCP or UDP port on which the test is run. It periodically displays the data transferred and bandwidth utilized for the interval specified until the total duration of the test is reached.



Tool Mode: Client

Traffic Type: Data

Port: 10

Iperf:

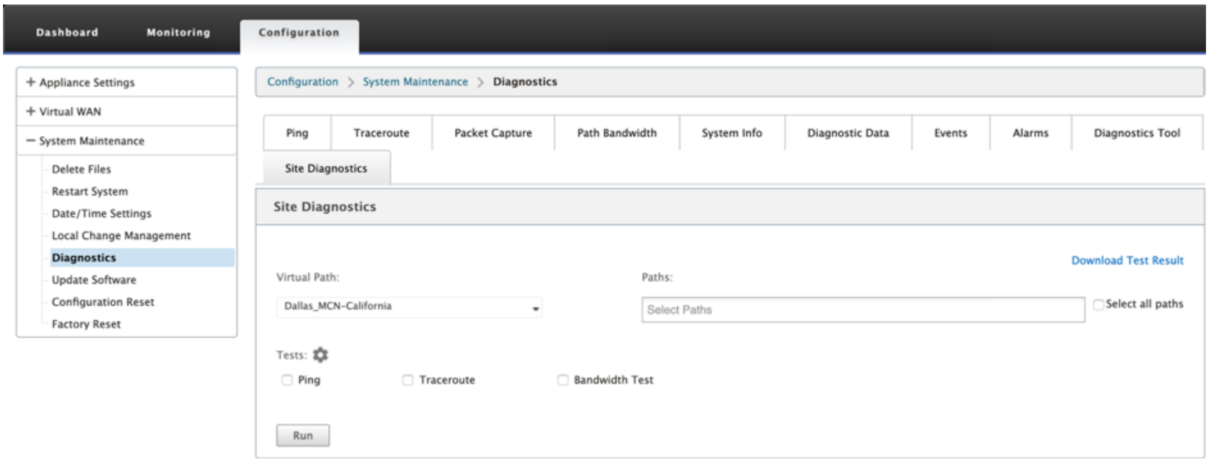
LAN to WAN Paths: MCN_184_78-Broadband

```
------------------------------------------------------------
Client connecting to 172.16.31.10, TCP port 10
Binding to local address 172.16.21.10
TCP window size:  112 KByte (default)
------------------------------------------------------------
[  3] local 172.16.21.10 port 39993 connected with 172.16.31.10 port 10
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.0 sec  10.1 MBytes  84.9 Mbits/sec
[  3]  1.0- 2.0 sec  11.9 MBytes  99.6 Mbits/sec
[  3]  2.0- 3.0 sec  13.4 MBytes   112 Mbits/sec
[  3]  3.0- 4.0 sec  15.1 MBytes   127 Mbits/sec
[  3]  4.0- 5.0 sec  14.5 MBytes   122 Mbits/sec
[  3]  5.0- 6.0 sec  14.5 MBytes   122 Mbits/sec
[  3]  6.0- 7.0 sec  15.1 MBytes   127 Mbits/sec
[  3]  7.0- 8.0 sec  15.1 MBytes   127 Mbits/sec
[  3]  8.0- 9.0 sec  15.6 MBytes   131 Mbits/sec
[  3]  9.0-10.0 sec  16.0 MBytes   134 Mbits/sec
[  3]  0.0-10.0 sec   141 MBytes   118 Mbits/sec
```

Site diagnostics

You can test the bandwidth usage, ping, and perform traceroute for the WAN links configured at different sites in the Citrix SD-WAN network. It provides information which helps in troubleshooting issues in the existing configuration.

To use **Site Diagnostics**, navigate to **Configuration >** expand **System Maintenance > Diagnostics** and select **Diagnostics Tool**.



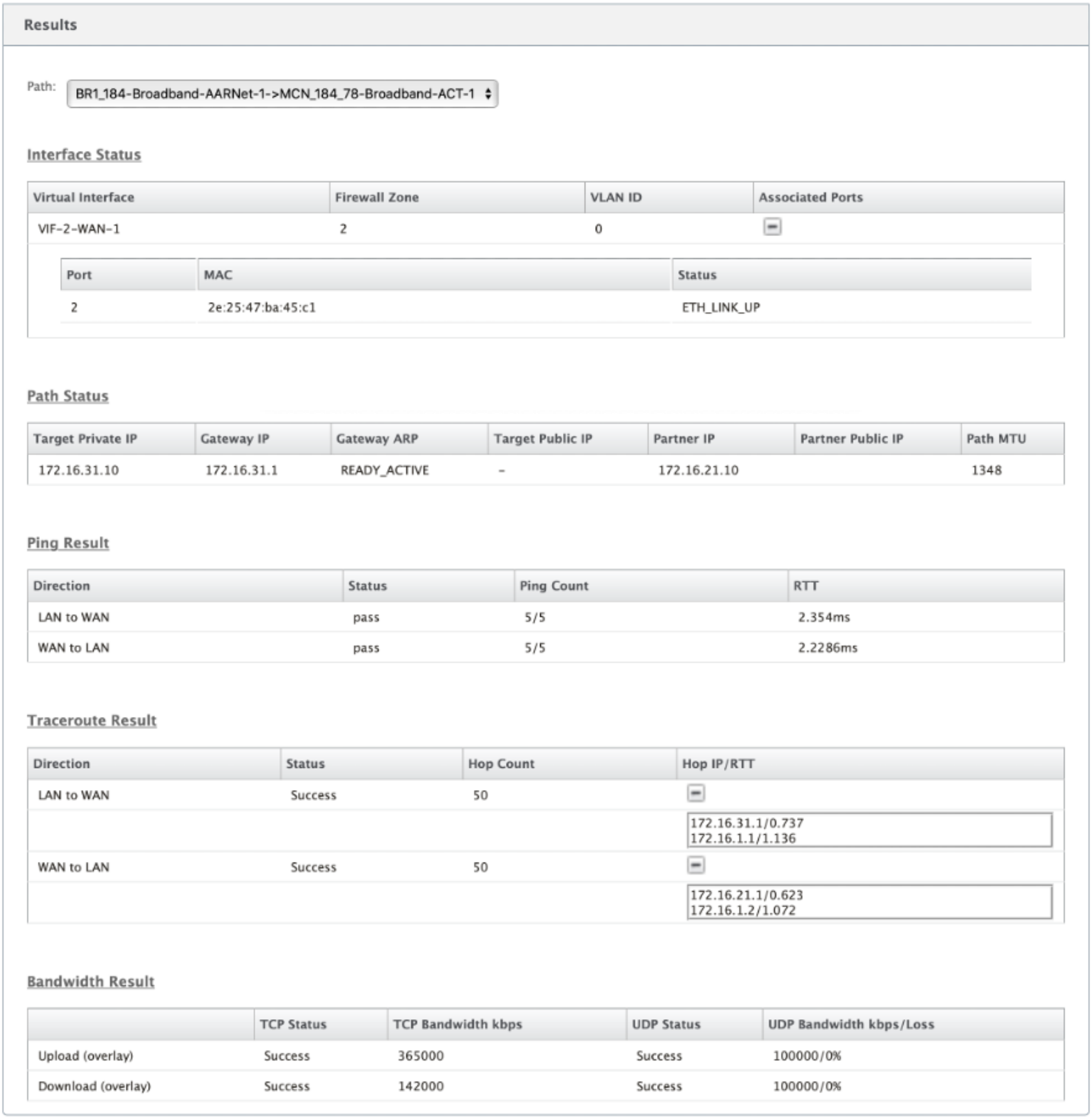
Virtual Path: Dallas_MCN-California

Paths: Select Paths □ Select all paths

Tests:
□ Ping □ Traceroute □ Bandwidth Test

The results section displays the following:

- **Interface Status**: Provides the name of the interface, number of firewall zones associated with the interface, VLAN ID, and its associated ports.
- **Path Status**: Provides the details of target private IP, Gateway IP, Target Public IP, Partner IP, Partner Public IP addresses. It also displays the status of Gateway ARP and path MTU.
- **Ping Result**: Provides the direction, status, count (including the number of attempts and failures), and RTT of the ping.
- **Traceroute Result**: Provides the direction, status, number of hops, and IP address or RTT of the hops.
- **Bandwidth Result**: Provides the status of TCP and UDP along with the bandwidth used (in kbps) for the overlay and underlay network. Compared to UDP, the bandwidth used by TCP is more, because UDP is bandwidth based and therefore uses only the configured bandwidth. TCP is a ramp up protocol; based on underlying network configuration, usage might report higher bandwidth compared to configured bandwidth.



Results

Path: BR1_184-Broadband-AARNet-1->MCN_184_78-Broadband-ACT-1

Interface Status

Virtual Interface	Firewall Zone	VLAN ID	Associated Ports
VIF-2-WAN-1	2	0	⊟

Port	MAC	Status
2	2e:25:47:ba:45:c1	ETH_LINK_UP

Path Status

Target Private IP	Gateway IP	Gateway ARP	Target Public IP	Partner IP	Partner Public IP	Path MTU
172.16.31.10	172.16.31.1	READY_ACTIVE	-	172.16.21.10		1348

Ping Result

Direction	Status	Ping Count	RTT
LAN to WAN	pass	5/5	2.354ms
WAN to LAN	pass	5/5	2.2286ms

Traceroute Result

Direction	Status	Hop Count	Hop IP/RTT
LAN to WAN	Success	50	⊟
			172.16.31.1/0.737 172.16.1.1/1.136
WAN to LAN	Success	50	⊟
			172.16.21.1/0.623 172.16.1.2/1.072

Bandwidth Result

	TCP Status	TCP Bandwidth kbps	UDP Status	UDP Bandwidth kbps/Loss
Upload (overlay)	Success	365000	Success	100000/0%
Download (overlay)	Success	142000	Success	100000/0%

Improved Path Mapping and Bandwidth Usage

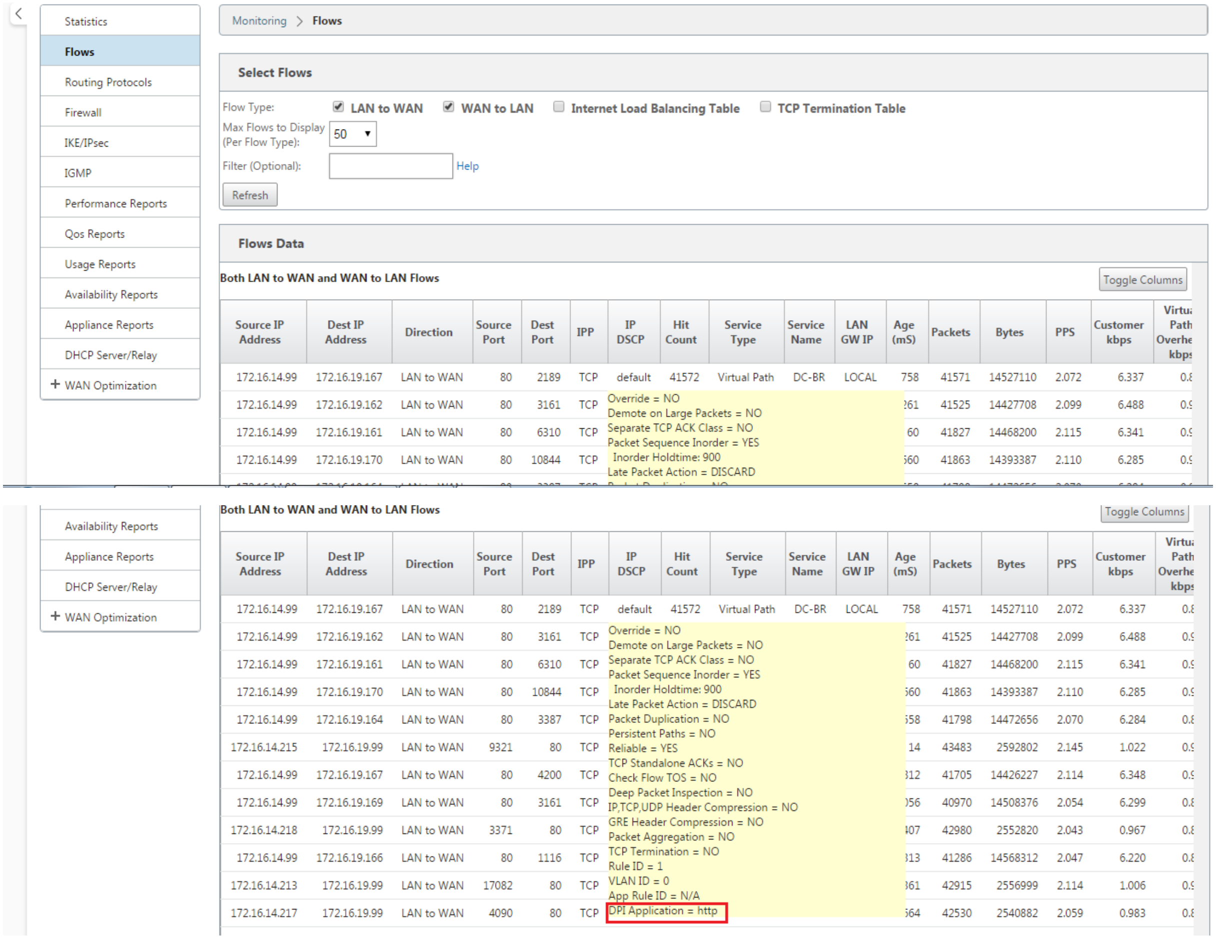
August 24, 2022

Path mapping and bandwidth usage enhancements are implemented in the Monitoring tab to show traffic flows. For instance, when only one virtual path is serving a network connection, and if that virtual path becomes inactive, a new best path is chosen and the initial path becomes the last best path. This scenario is implemented when demand for bandwidth is less and when only one path is chosen

When more than one virtual path is serving a connection, you notice one current best path and next best path, if available. If only one path exists to process traffic, assuming there are more than two paths processing traffic and the path table is updated with two paths, then the Monitoring tab in SD-WAN GUI for flows will display current best path as first path and the next comma separate path as the last best path. This scenario is implemented when there is a need for more paths with demand for bandwidth.

Monitoring DPI application information in SD-WAN GUI

The DPI application object name on the monitoring flow is stored and displayed in the SD-WAN GUI **Monitoring** -> **Flows** page. A tooltip is displayed to identify the DPI application.



Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

Filter (Optional): Help

Flows Data

Both LAN to WAN and WAN to LAN Flows

Source IP Address	Dest IP Address	Direction	Source Port	Dest Port	IPP	IP DSCP	Hit Count	Service Type	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtu Path Overhe kbps
172.16.14.99	172.16.19.167	LAN to WAN	80	2189	TCP	default	41572	Virtual Path	DC-BR	LOCAL	758	41571	14527110	2.072	6.337	0.8
172.16.14.99	172.16.19.162	LAN to WAN	80	3161	TCP						261	41525	14427708	2.099	6.488	0.9
172.16.14.99	172.16.19.161	LAN to WAN	80	6310	TCP						60	41827	14468200	2.115	6.341	0.9
172.16.14.99	172.16.19.170	LAN to WAN	80	10844	TCP						560	41863	14393387	2.110	6.285	0.9
172.16.14.99	172.16.19.164	LAN to WAN	80	3387	TCP						558	41798	14472656	2.070	6.284	0.8
172.16.14.215	172.16.19.99	LAN to WAN	9321	80	TCP						14	43483	2592802	2.145	1.022	0.9
172.16.14.99	172.16.19.167	LAN to WAN	80	4200	TCP						312	41705	14426227	2.114	6.348	0.9
172.16.14.99	172.16.19.169	LAN to WAN	80	3161	TCP						056	40970	14508376	2.054	6.299	0.8
172.16.14.218	172.16.19.99	LAN to WAN	3371	80	TCP						407	42980	2552820	2.043	0.967	0.8
172.16.14.99	172.16.19.166	LAN to WAN	80	1116	TCP						313	41286	14568312	2.047	6.220	0.8
172.16.14.213	172.16.19.99	LAN to WAN	17082	80	TCP						361	42915	2556999	2.114	1.006	0.9
172.16.14.217	172.16.19.99	LAN to WAN	4090	80	TCP						564	42530	2540882	2.059	0.983	0.8

Override = NO
Demote on Large Packets = NO
Separate TCP ACK Class = NO
Packet Sequence Inorder = YES
Inorder Holdtime: 900
Late Packet Action = DISCARD
Packet Duplication = NO
Persistent Paths = NO
Reliable = YES
TCP Standalone ACKs = NO
Check Flow TOS = NO
Deep Packet Inspection = NO
IP,TCP,UDP Header Compression = NO
GRE Header Compression = NO
Packet Aggregation = NO
TCP Termination = NO
Rule ID = 1
VLAN ID = 0
App Rule ID = N/A
DPI Application = http

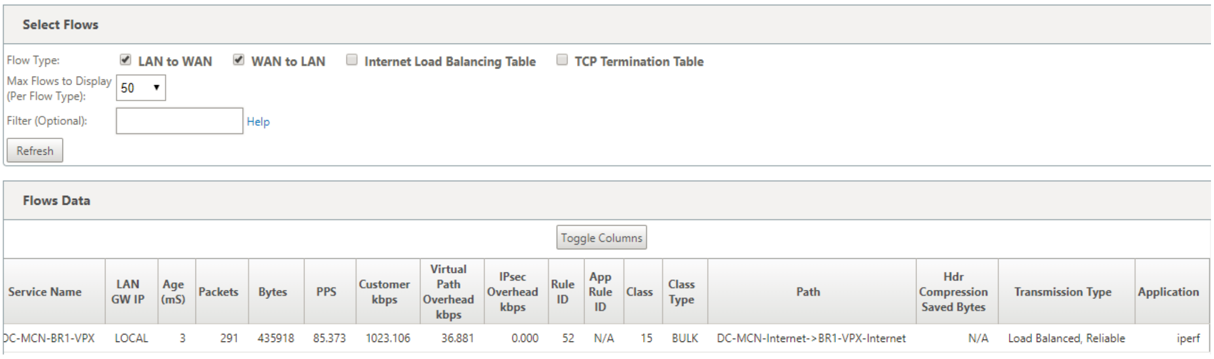
Monitoring Path information for traffic flow in SD-WAN GUI

It is possible that based on the incoming traffic rate demanding bandwidth, one or more paths are required to process the traffic.

For determining how path mapping is performed, review the following scenarios:

Load Balanced Transmission mode:

The following figure illustrates the scenario when traffic is initiated and all paths are good, one best path is chosen as bandwidth demand is enough to be served by one path. You notice that only one path **DC-MCN-Internet** -> **BR1-VPX-Internet** is chosen and the type of transmission type is displayed as **Load Balanced.**



Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

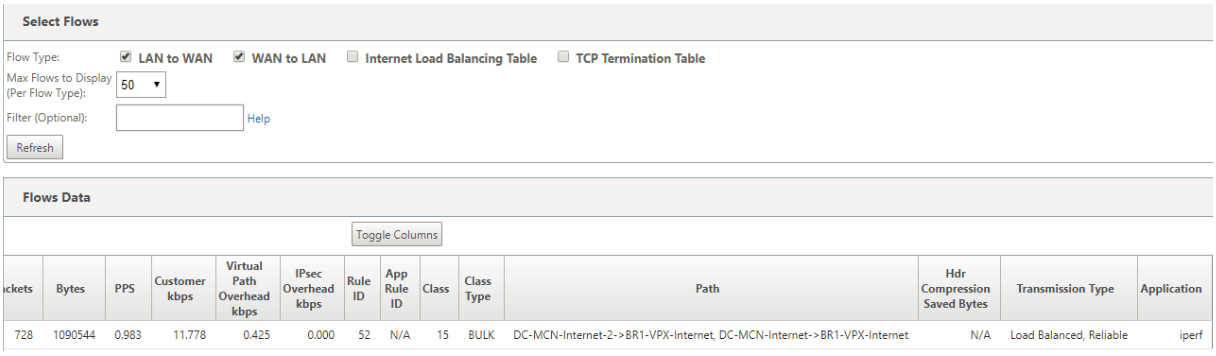
Filter (Optional):

Flows Data

Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
DC-MCN-BR1-VPX	LOCAL	3	291	435918	85.373	1023.106	36.881	0.000	52	N/A	15	BULK	DC-MCN-Internet->BR1-VPX-Internet	N/A	Load Balanced, Reliable	iperf

The following figure illustrates when traffic is flowing, and the WAN attributes of the path are degraded, you notice that a new path is chosen for processing traffic without disruption. In this case, the path mapping feature allows you to indicate that the current best path processing the traffic is **DC-MCN-Internet2 -> BR1-VPX-Internet** and the last best path that processed the traffic is **DC-MCN-Internet -> BR1-VPX-Internet**.

The last best path in this example is an indicator of which path served the connection earlier.



Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

Filter (Optional):

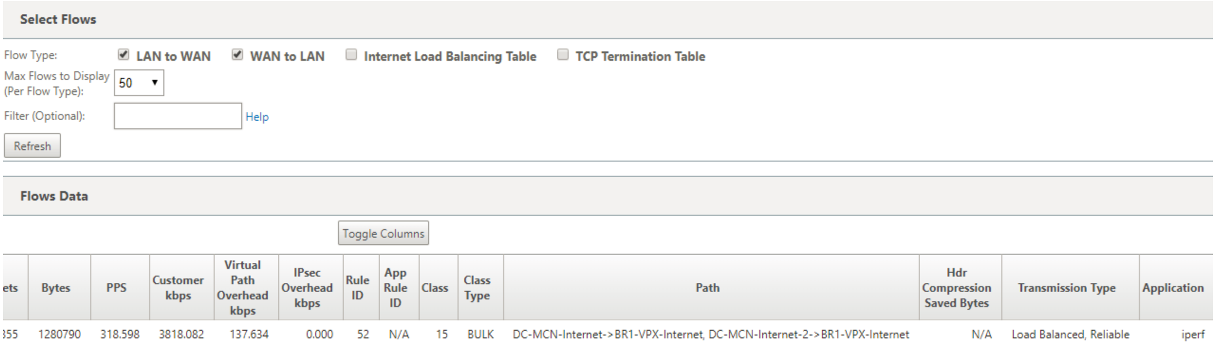
Flows Data

ckets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
728	1090544	0.983	11.778	0.425	0.000	52	N/A	15	BULK	DC-MCN-Internet-2->BR1-VPX-Internet, DC-MCN-Internet->BR1-VPX-Internet	N/A	Load Balanced, Reliable	iperf

The following figure illustrates that when traffic is ongoing and more than one path is chosen for traffic processing due to demand in bandwidth, as shown below, more than one path is chosen when the traffic is being sent. Unlike in the case above, here there may be more than two paths also serving the traffic but in the GUI only the two best paths that is currently serving the traffic is displayed.

Observe **DC-MCN-Internet->BR1-VPX-Internet**, **DC-MCN-Internet2->BR1-VPX-Internet** being the two paths shown in the **Flows Data** table.

> **Note**
>
> As indicated, only max two paths in the flows table are displayed.



Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

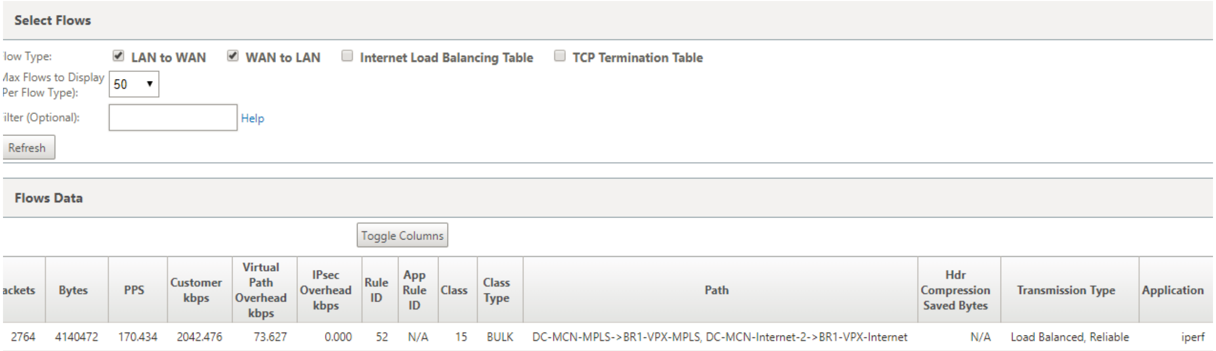
Filter (Optional): Help

Flows Data

ets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
355	1280790	318.598	3818.082	137.634	0.000	52	N/A	15	BULK	DC-MCN-Internet->BR1-VPX-Internet, DC-MCN-Internet-2->BR1-VPX-Internet	N/A	Load Balanced, Reliable	iperf

The following figure illustrates that when traffic is still flowing, if the current best path which is **DC-MCN-Internet->BR1-VPX-Internet** is unavailable/inactive/degraded in WAN attributes, the current best path chosen will appear first in the path section of **Flows Data** table followed by the last best path which is serving the traffic.

Since the **DC-MCN-Internet->BR1-VPX-Internet** was not best anymore, a new current best path was chosen by the system as **DC-MCN-MPLS->BR1-VPX-MPLS**, and the last best path that is actively serving connection along with current best path is **DC-MCN-Internet2->BR1-VPX-Internet** as both are needed for the current traffic demand of bandwidth.



Select Flows

low Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

lax Flows to Display Per Flow Type): 50

ilter (Optional): Help

Flows Data

ackets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
2764	4140472	170.434	2042.476	73.627	0.000	52	N/A	15	BULK	DC-MCN-MPLS->BR1-VPX-MPLS, DC-MCN-Internet-2->BR1-VPX-Internet	N/A	Load Balanced, Reliable	iperf

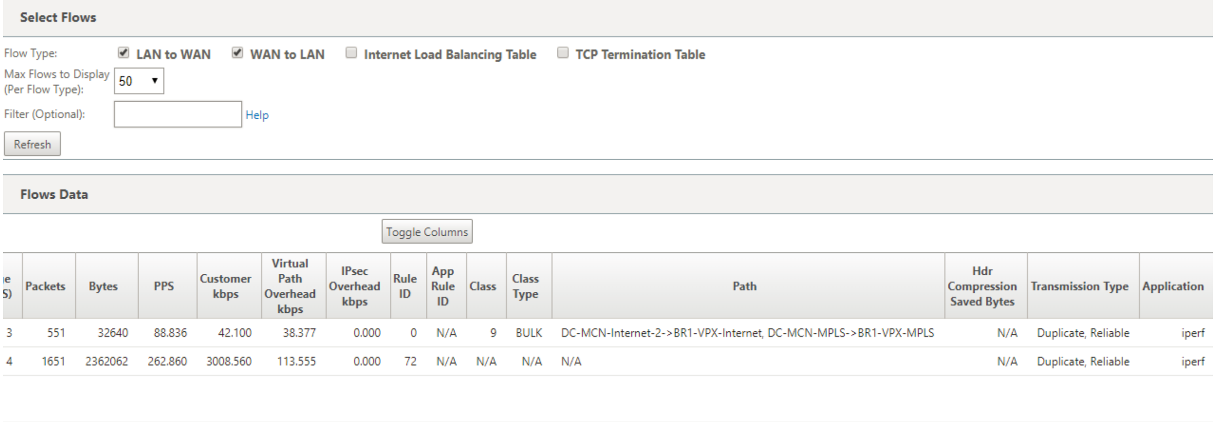
Duplicate Transmit Mode

General packet duplication mode ensures that two paths are initially taken for processing packets of the same connection to ensure reliable delivery by duplicating packets across two separate paths.

For Path Mapping, you notice that two paths being taken in the path section of the flow table as long as two paths exist to process flows by duplicating.

The following figure illustrates that wen traffic is flowing, it can be noticed that two paths are shown to be processing the traffic. Unlike any other mode, even if traffic demands less bandwidth that can be provided by just one path, this mode will always duplicate traffic across two paths for reliable application delivery.

You notice in the figure below, two paths in the path section of the **Flows Data** table; **DC-MCN-Internet2->BR-VPX-Internet**, **DC-MCN-MPLS->BR1-VPX-MPLS**.


Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

Filter (Optional): Help

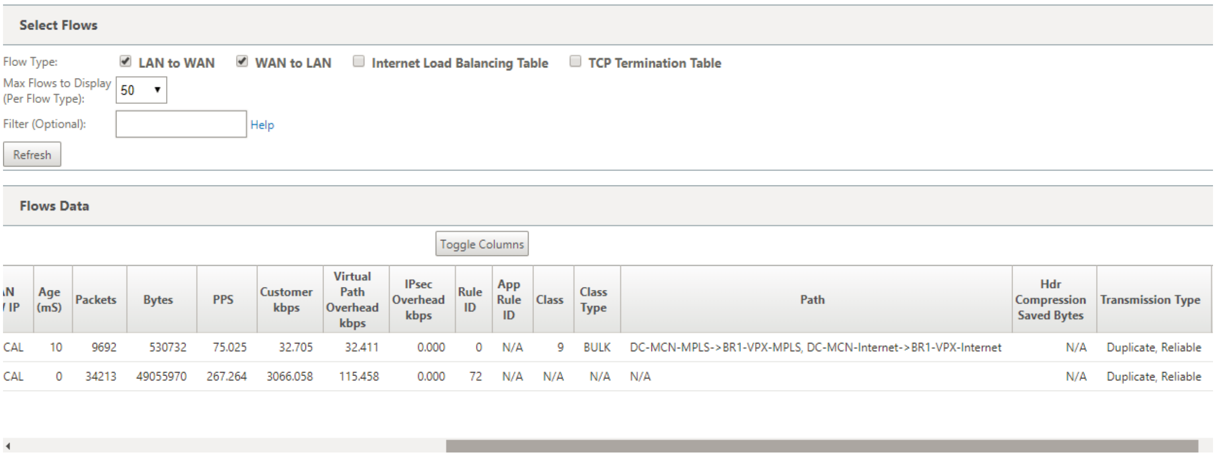
Refresh

Flows Data

Toggle Columns

e S)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
3	551	32640	88.836	42.100	38.377	0.000	0	N/A	9	BULK	DC-MCN-Internet-2->BR1-VPX-Internet, DC-MCN-MPLS->BR1-VPX-MPLS	N/A	Duplicate, Reliable	iperf
4	1651	2362062	262.860	3008.560	113.555	0.000	72	N/A	N/A	N/A	N/A	N/A	Duplicate, Reliable	iperf

The following figure illustrates that when traffic is flowing, if one of the current best paths becomes inactive, another path is chosen and there still be two paths as part of the path section in the **Flows Data** table.


Select Flows

Flow Type: ☑ LAN to WAN ☑ WAN to LAN □ Internet Load Balancing Table □ TCP Termination Table

Max Flows to Display (Per Flow Type): 50

Filter (Optional): Help

Refresh

Flows Data

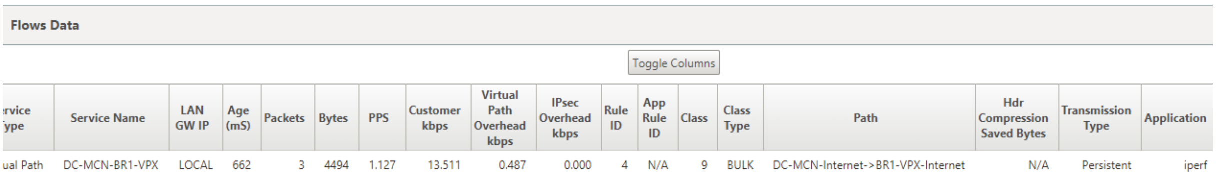
Toggle Columns

N / IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type
CAL	10	9692	530732	75.025	32.705	32.411	0.000	0	N/A	9	BULK	DC-MCN-MPLS->BR1-VPX-MPLS, DC-MCN-Internet->BR1-VPX-Internet	N/A	Duplicate, Reliable
CAL	0	34213	49055970	267.264	3066.058	115.458	0.000	72	N/A	N/A	N/A	N/A	N/A	Duplicate, Reliable

Persistent Path Transmit Mode

Persistent path transmit mode helps to retain packets of a flow based on path latency impedance.

The following figure illustrates only one path which is the best path currently handling the flows and its packets. There is no demand of bandwidth and one path serves it all. Currently there is only one best path which is **DC-MCN-Internet->BR1-VPX-Internet.**

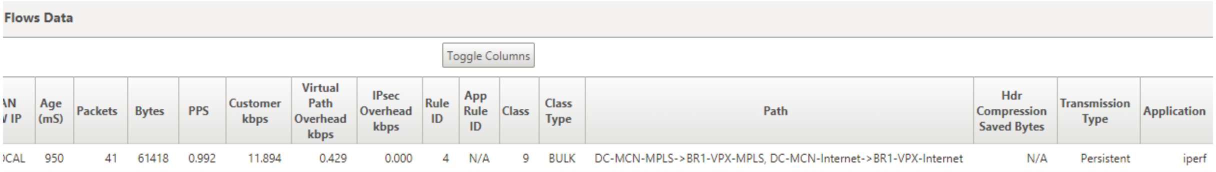


Flows Data

rvice ype	Service Name	LAN GW IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
ual Path	DC-MCN-BR1-VPX	LOCAL	662	3	4494	1.127	13.511	0.487	0.000	4	N/A	9	BULK	DC-MCN-Internet->BR1-VPX-Internet	N/A	Persistent	iperf

The following figure illustrates that if the path **DC-MCN-Internet->BR1-VPX-Internet** becomes latency prone or is disabled, you notice that new path takes effect and the current path **DC-MCN-Internet->BR1-VPX-Internet** becomes the last best path.

So the new path section shows **DC-MCN-MPLS->BR1-VPX-MPLS, DC-MCN-Internet->BR1-VPX-Internet**.

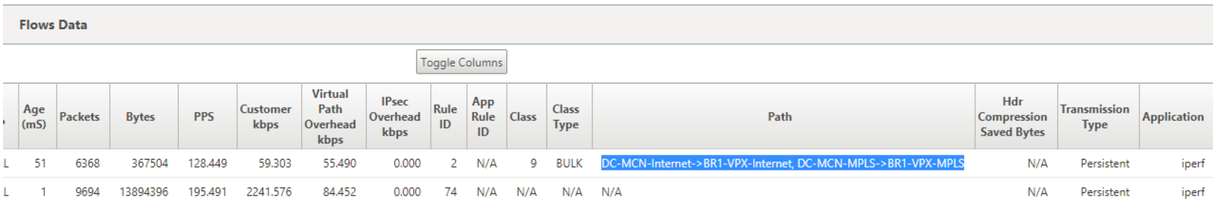


Flows Data

AN / IP	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
CAL	950	41	61418	0.992	11.894	0.429	0.000	4	N/A	9	BULK	DC-MCN-MPLS->BR1-VPX-MPLS, DC-MCN-Internet->BR1-VPX-Internet	N/A	Persistent	iperf

In persistent mode, there can be more than one path chosen to process traffic. In that case, the GUI displays both the paths with best and next best in the path section of the flow table from the beginning of the traffic flow.

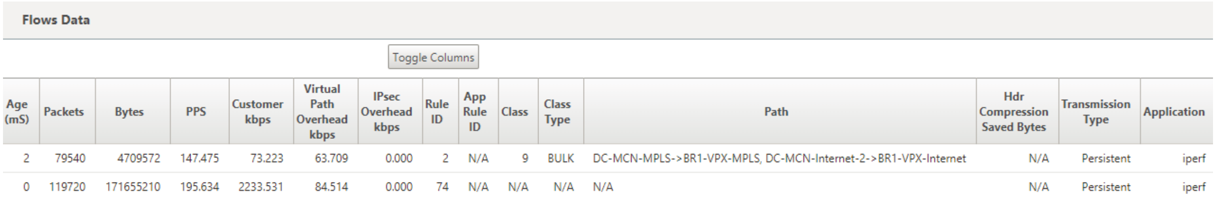
The following figure illustrates that the flow initially only needs more than two paths and they stay persistent as long as there is no path latency impedance crossing (50 ms). The two paths taken are shown as; **DC-MCN-Internet->BR1-VPX-Internet, DC-MCN-MPLS->BR1-VPX-MPLS.**



Flows Data

	Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
L	51	6368	367504	128.449	59.303	55.490	0.000	2	N/A	9	BULK	DC-MCN-Internet->BR1-VPX-Internet, DC-MCN-MPLS->BR1-VPX-MPLS	N/A	Persistent	iperf
L	1	9694	13894396	195.491	2241.576	84.452	0.000	74	N/A	N/A	N/A	N/A	N/A	Persistent	iperf

Assume that one of the best paths **DC-MCN-Internet** goes into high latency or is disabled. This makes a new path appear and the new path may be the best path or could be the second best path based on the decision of path selection at that instant of time.



Flows Data

Age (mS)	Packets	Bytes	PPS	Customer kbps	Virtual Path Overhead kbps	IPsec Overhead kbps	Rule ID	App Rule ID	Class	Class Type	Path	Hdr Compression Saved Bytes	Transmission Type	Application
2	79540	4709572	147.475	73.223	63.709	0.000	2	N/A	9	BULK	DC-MCN-MPLS->BR1-VPX-MPLS, DC-MCN-Internet-2->BR1-VPX-Internet	N/A	Persistent	iperf
0	119720	171655210	195.634	2233.531	84.514	0.000	74	N/A	N/A	N/A	N/A	N/A	Persistent	iperf

Troubleshooting Management IP

August 24, 2022

The following are the possible scenarios that you might encounter when configuring DHCP IP address. It also includes best practices and recommendations for configuring DHCP Management IP address when deploying SD-WAN appliances.

These recommendations are applicable to all platform models of SD-WAN Standard Edition - Physical and Virtual appliances.

> **Note**
>
> All hardware models of SD-WAN appliances are shipped with a factory default management IP address. Ensure that you configure the required DHCP IP address for the appliance during the setup process.
>
> All Virtual models of SD-WAN appliances (VPX models) and appliances which can be deployed in AWS environment do not have a factory default IP address assigned.

Appliances power on without DHCP servers reachable:

- Causes:
  - Ethernet management cable is disconnected
  - DHCP service is down for the connected network
- Expected behavior
  - Appliances with DHCP service enabled will retry DHCP request every 300 seconds (default value). The actual interval is approximately 7 minutes
  - Therefore, appliances with DHCP service enabled will acquire DHCP addresses within 7 minutes after DHCP servers become available. The delay ranges from 0 to 7 minutes

Assigned DHCP address expires:

- Expected behavior:
  - Appliances with DHCP service enabled will try to renew the lease before the address expires
  - Appliances start with new DHCP discovery, if the renew fails

Appliances with DHCP service enabled move from one DHCP enabled subnet to another subnet:

- Causes: Appliances move from an assigned DHCP subnet to a different DHCP subnet

- Expected behavior:
  - A permanent lease DHCP IP address assignment might require the appliances to be rebooted to acquire an IP address from the new DHCP server.
  - Upon DHCP lease expiration, appliances might reinitiate DHCP discovery protocol, if current DHCP server is not reachable.
  - Appliances acquire new IP addresses with a delay of 8 minutes. The gateway IP address is not modified in the GUI and CLI. It is updated after the reboot process is completed.

Recommendation:

- Always assign permanent lease for DHCP addresses assigned to Citrix SD-WAN appliances (physical/virtual). This allows appliances to have predictable management IP address.

Session-based HTTP Notifications

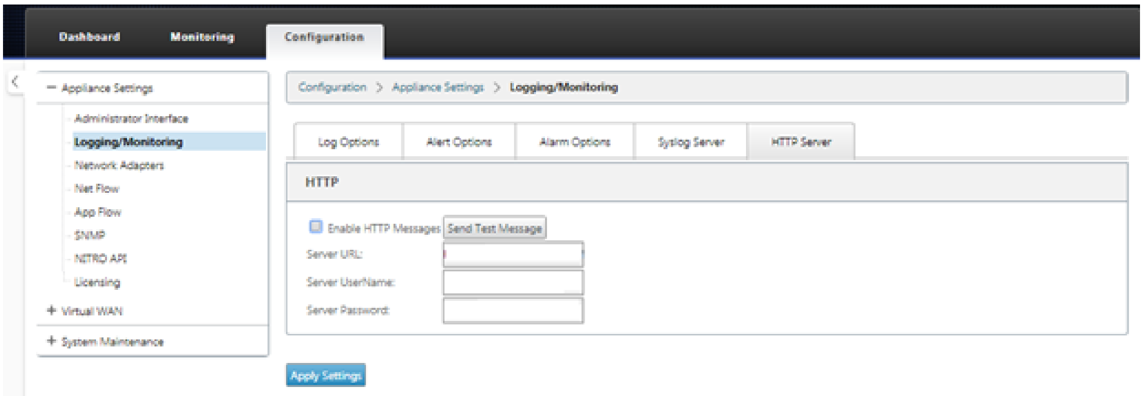
August 24, 2022

You can now configure event and alarm reporting for generic HTTP POST API service requests in the Citrix SD-WAN appliance GUI. The HTTP alarm and event notification configuration are similar to the email and SNMP events for events and alarms supported in SD-WAN.

The session based HTTP Post notification is sent to an external service; such as Service Now. The event notifications for HTTP server can be configured in the Citrix SD-WAN appliance GUI and Citrix SD-WAN Center.

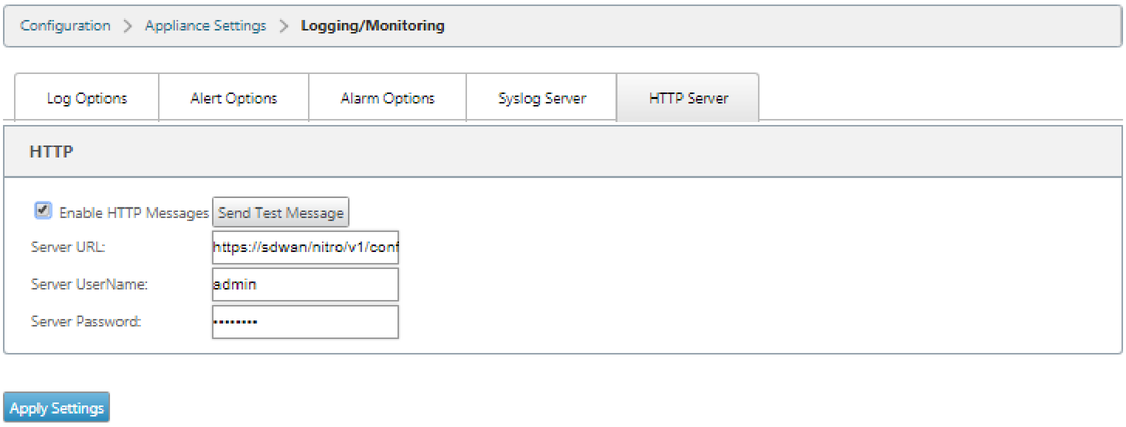
To configure HTTP POST notifications in the Citrix SD-WAN appliance GUI:

1. Navigate to **Configuration** > **Logging/Monitoring** > **HTTP Server**.



2. Click **Enable HTTP Messages**.

3. Enter **Server URL** of the HTTP server for which you want to receive notifications from. Enter the **Server UserName** and **Server Password**.



☑ Enable HTTP Messages

Server URL: https://sdwan/nitro/v1/conf

Server UserName: admin

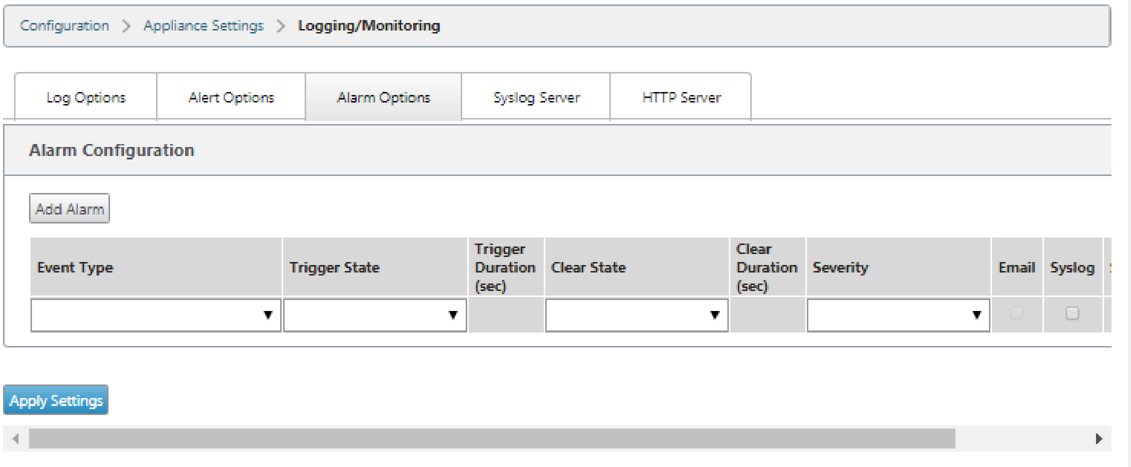
Server Password: ••••••••

4. Click **Apply Settings**. The page refreshes after the HTTP server notifications settings are applied.

> **Note**
>
> Use the **Send Test Message** option to verify that the HTTP server connection is successful.

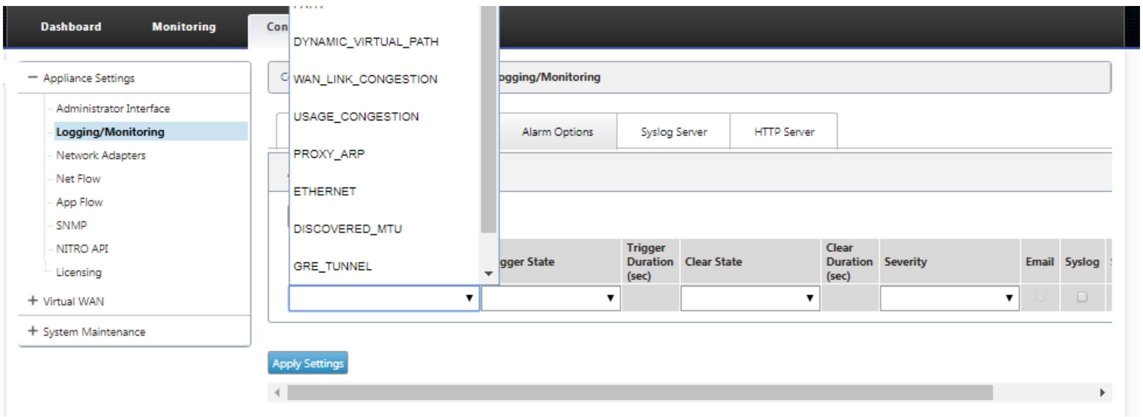
To add Alarm notification for HTTP server session:

1. In the **Logging/Monitoring** page, go to the **Alarm Options** tab page.
2. Click **Add Alarm**.



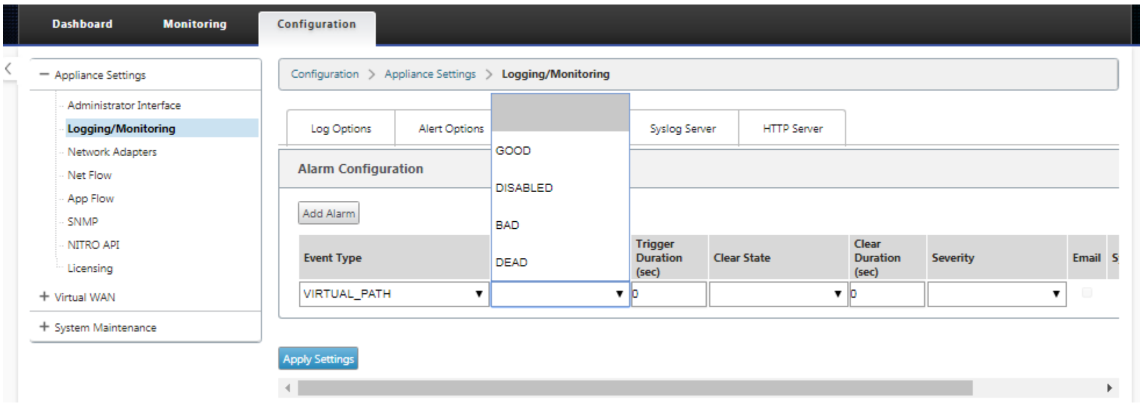
Event Type	Trigger State	Trigger Duration (sec)	Clear State	Clear Duration (sec)	Severity	Email	Syslog
▾	▾		▾		▾	□	□

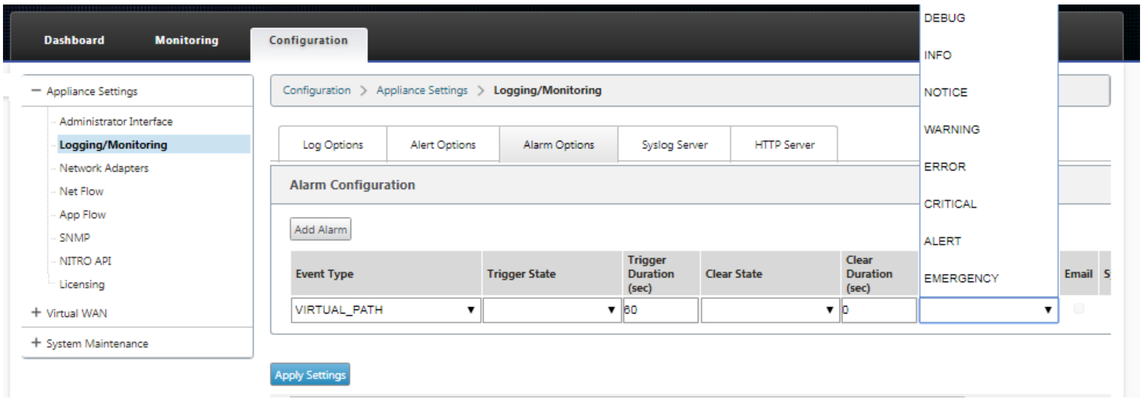
3. Select an **Event Type** from the drop-down list.



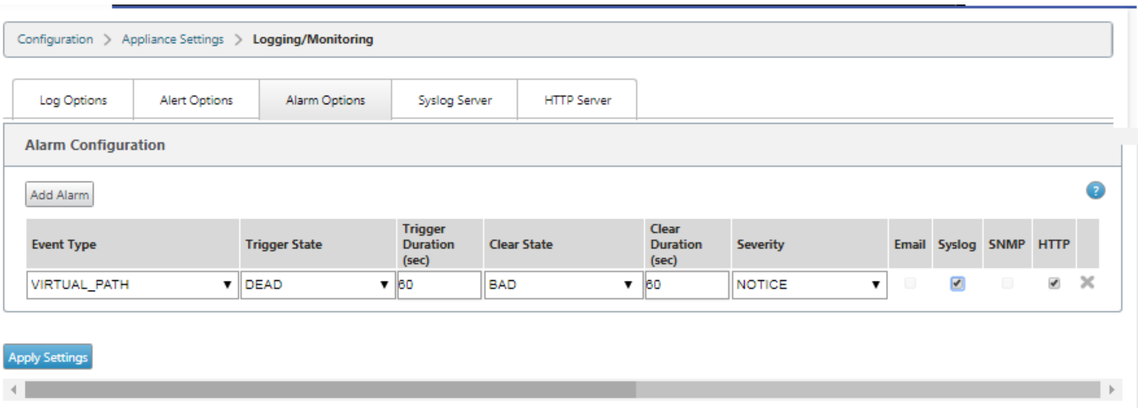
4. Select following alarm notification states for the chosen **Event Type**. The trigger state and clear state change according to the selected Event Type.

   - Trigger State –GOOD, DISABLED, BAD, DEAD
   - Trigger Duration –time in seconds
   - Clear State - GOOD, DISABLED, BAD, DEAD
   - Clear Duration –time in seconds
   - Severity –DEBUG, INFO, NOTICE, WARNING, ERROR, CRITICAL, EVENT, EMERGENCY





5. Select the **Syslog** and **HTTP** checkboxes to receive notifications specific to the Syslog and HTTP server events. Click **Apply Settings**.



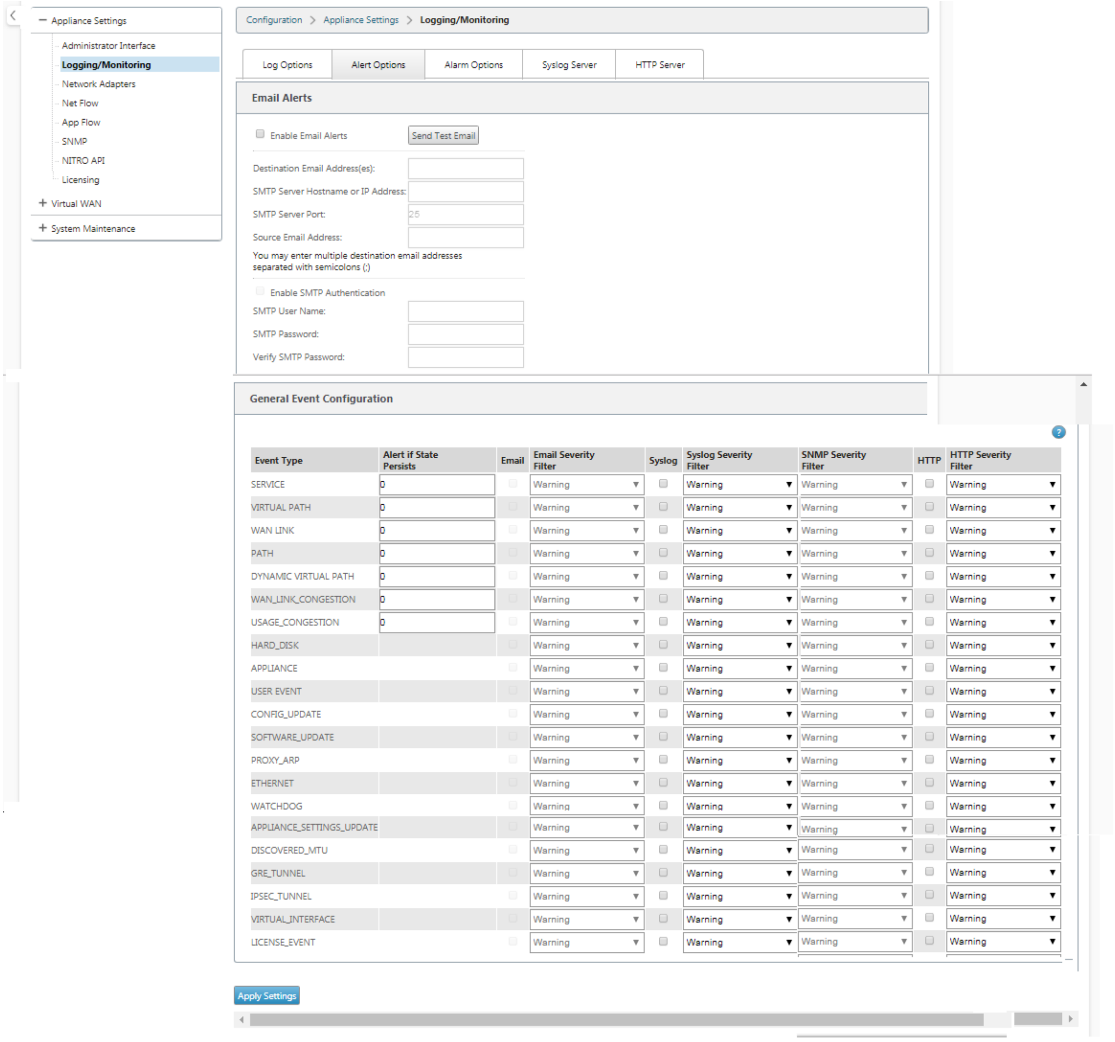
Alarm Configuration

Event Type	Trigger State	Trigger Duration (sec)	Clear State	Clear Duration (sec)	Severity	Email	Syslog	SNMP	HTTP
VIRTUAL_PATH	DEAD	60	BAD	60	NOTICE	□	☑	□	☑

To configure event options:

Go to the **Alert Options** tab page. Under **General Event Configuration** page; select the HTTP server notification filter for an **Event Type** and click **Apply Settings**.

- HTTP
- HTTP Severity Filter



Email Alerts

□ Enable Email Alerts Send Test Email

Destination Email Address(es):

SMTP Server Hostname or IP Address:

SMTP Server Port: 25

Source Email Address:

You may enter multiple destination email addresses separated with semicolons (;)

□ Enable SMTP Authentication

SMTP User Name:

SMTP Password:

Verify SMTP Password:

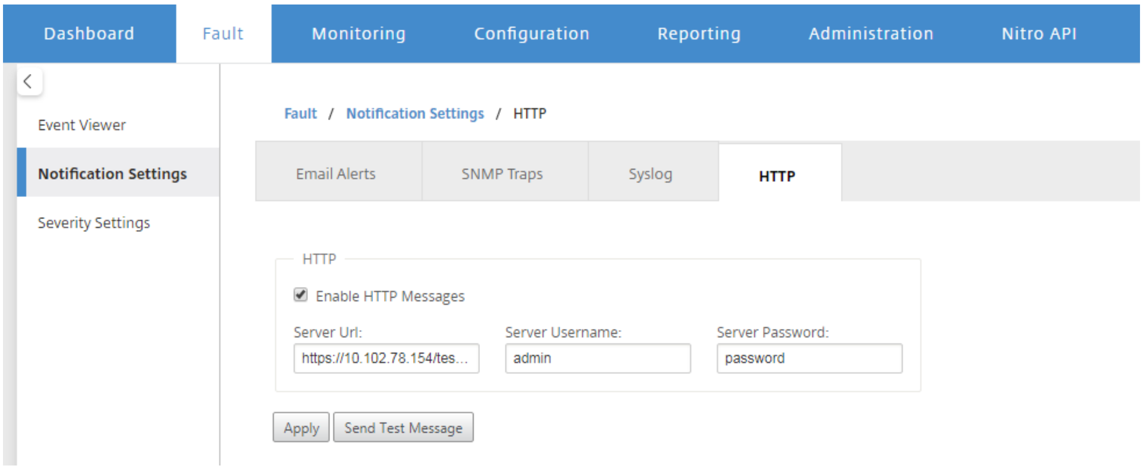
General Event Configuration

Event Type	Alert if State Persists	Email	Email Severity Filter	Syslog	Syslog Severity Filter	SNMP Severity Filter	HTTP	HTTP Severity Filter
SERVICE	0	□	Warning	□	Warning	Warning	□	Warning
VIRTUAL PATH	0	□	Warning	□	Warning	Warning	□	Warning
WAN LINK	0	□	Warning	□	Warning	Warning	□	Warning
PATH	0	□	Warning	□	Warning	Warning	□	Warning
DYNAMIC VIRTUAL PATH	0	□	Warning	□	Warning	Warning	□	Warning
WAN_LINK_CONGESTION	0	□	Warning	□	Warning	Warning	□	Warning
USAGE_CONGESTION	0	□	Warning	□	Warning	Warning	□	Warning
HARD_DISK		□	Warning	□	Warning	Warning	□	Warning
APPLIANCE		□	Warning	□	Warning	Warning	□	Warning
USER EVENT		□	Warning	□	Warning	Warning	□	Warning
CONFIG_UPDATE		□	Warning	□	Warning	Warning	□	Warning
SOFTWARE_UPDATE		□	Warning	□	Warning	Warning	□	Warning
PROXY_ARP		□	Warning	□	Warning	Warning	□	Warning
ETHERNET		□	Warning	□	Warning	Warning	□	Warning
WATCHDOG		□	Warning	□	Warning	Warning	□	Warning
APPLIANCE_SETTINGS_UPDATE		□	Warning	□	Warning	Warning	□	Warning
DISCOVERED_MTU		□	Warning	□	Warning	Warning	□	Warning
GRE_TUNNEL		□	Warning	□	Warning	Warning	□	Warning
IPSEC_TUNNEL		□	Warning	□	Warning	Warning	□	Warning
VIRTUAL_INTERFACE		□	Warning	□	Warning	Warning	□	Warning
LICENSE_EVENT		□	Warning	□	Warning	Warning	□	Warning

Configure HTTP Notifications in Citrix SD-WAN Center

To configure HTTP notifications:

1. Navigate to **Fault** > **Notification Settings** > **HTTP**.



HTTP

☑ Enable HTTP Messages

Server Url: https://10.102.78.154/tes...

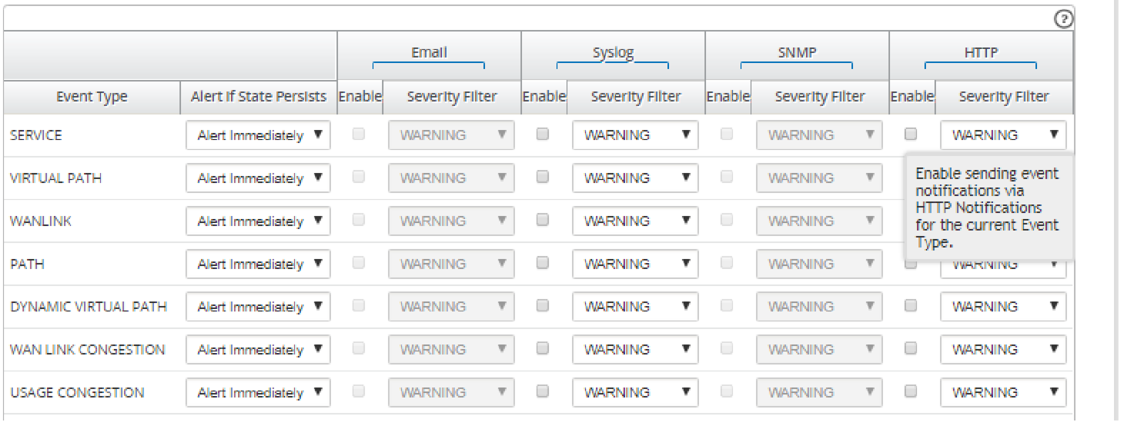
Server Username: admin

Server Password: password

2. Enter the **Server URL**, **Server UserName**, and **Server Password** for the HTTP server.
3. Click **Apply**

To configure severity settings:

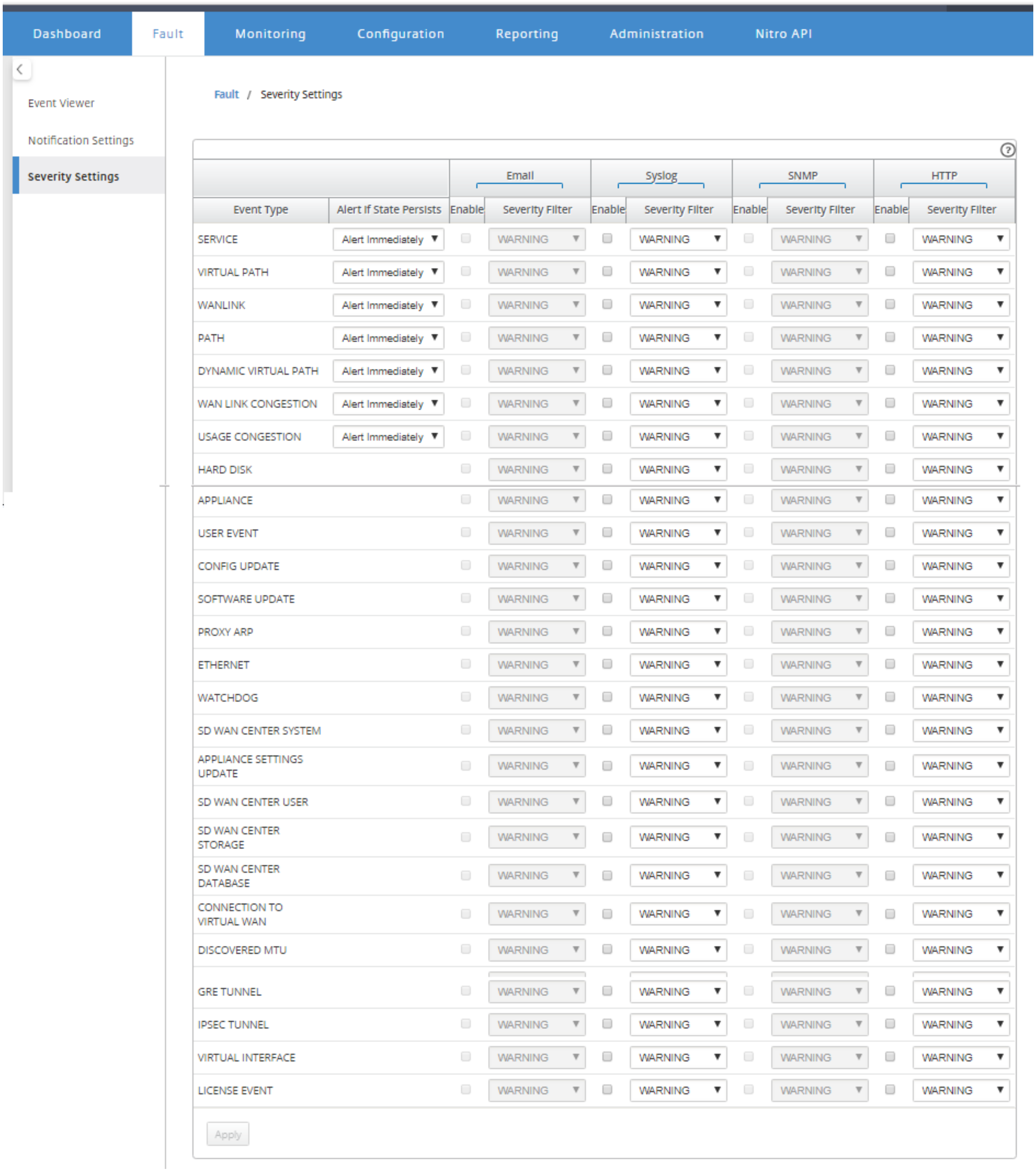
1. Go to the **Severity Settings** page. Click **Enable** to start monitoring HTTP notifications for a chosen Event Type.



		Email		Syslog		SNMP		HTTP	
Event Type	Alert If State Persists	Enable	Severity Filter	Enable	Severity Filter	Enable	Severity Filter	Enable	Severity Filter
SERVICE	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
VIRTUAL PATH	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼		
WANLINK	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼		
PATH	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
DYNAMIC VIRTUAL PATH	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
WAN LINK CONGESTION	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
USAGE CONGESTION	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼

Enable sending event notifications via HTTP Notifications for the current Event Type.

2. You can choose to monitor Email, Syslog, SNMP, and HTTP event notifications for the following Event Types. Click **Apply**.



Fault / Severity Settings

		Email		Syslog		SNMP		HTTP	
Event Type	Alert If State Persists	Enable	Severity Filter	Enable	Severity Filter	Enable	Severity Filter	Enable	Severity Filter
SERVICE	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
VIRTUAL PATH	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
WANLINK	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
PATH	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
DYNAMIC VIRTUAL PATH	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
WAN LINK CONGESTION	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
USAGE CONGESTION	Alert Immediately ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
HARD DISK		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
APPLIANCE		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
USER EVENT		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
CONFIG UPDATE		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
SOFTWARE UPDATE		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
PROXY ARP		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
ETHERNET		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
WATCHDOG		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
SD WAN CENTER SYSTEM		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
APPLIANCE SETTINGS UPDATE		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
SD WAN CENTER USER		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
SD WAN CENTER STORAGE		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
SD WAN CENTER DATABASE		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
CONNECTION TO VIRTUAL WAN		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
DISCOVERED MTU		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
GRE TUNNEL		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
IPSEC TUNNEL		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
VIRTUAL INTERFACE		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼
LICENSE EVENT		□	WARNING ▼	□	WARNING ▼	□	WARNING ▼	□	WARNING ▼

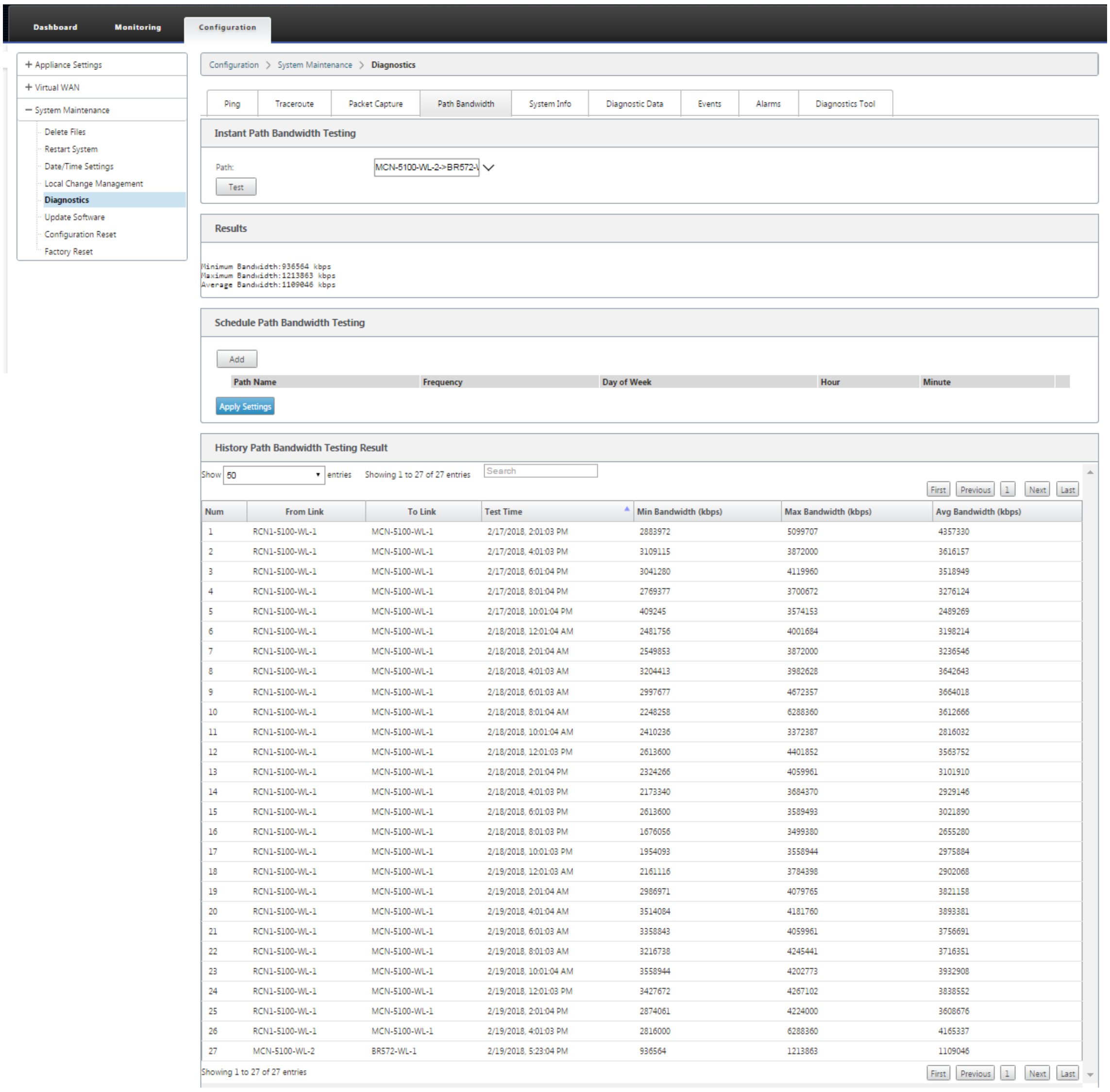
Active bandwidth testing

August 24, 2022

Active bandwidth testing enables you the ability to issue an instant path bandwidth test through public internet WAN link, or to schedule public internet WAN link bandwidth testing to be completed at specific times on a recurring basis. This feature is useful for demonstrating how much bandwidth is available between two locations during new and existing installations, also for testing paths to determine the outcome of setting and confirmation changes, such as adjusting DSCP tag settings or bandwidth Permitted Rates.

To use the active bandwidth testing feature:

1. Navigate to **System Maintenance** > **Diagnostics** > **Path Bandwidth**.
2. Select the desired **Path** and click **Test**.



Instant Path Bandwidth Testing

Path: MCN-5100-WL-2->BR572-\

Results

```
Minimum Bandwidth:936564 kbps
Maximum Bandwidth:1213863 kbps
Average Bandwidth:1109046 kbps
```

Schedule Path Bandwidth Testing

Path Name	Frequency	Day of Week	Hour	Minute

History Path Bandwidth Testing Result

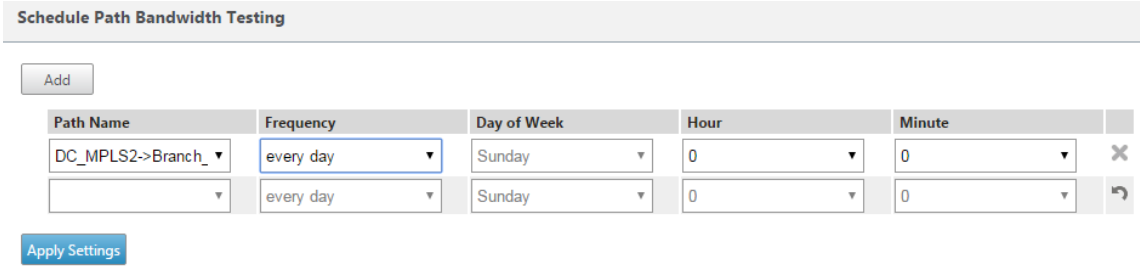
Show 50 entries Showing 1 to 27 of 27 entries Search

Num	From Link	To Link	Test Time	Min Bandwidth (kbps)	Max Bandwidth (kbps)	Avg Bandwidth (kbps)
1	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 2:01:03 PM	2883972	5099707	4357330
2	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 4:01:03 PM	3109115	3872000	3616157
3	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 6:01:04 PM	3041280	4119960	3518949
4	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 8:01:04 PM	2769377	3700672	3276124
5	RCN1-5100-WL-1	MCN-5100-WL-1	2/17/2018, 10:01:04 PM	409245	3574153	2489269
6	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 12:01:04 AM	2481756	4001684	3198214
7	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 2:01:04 AM	2549853	3872000	3236546
8	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 4:01:03 AM	3204413	3982628	3642643
9	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 6:01:03 AM	2997677	4672357	3664018
10	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 8:01:04 AM	2248258	6288360	3612666
11	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 10:01:04 AM	2410236	3372387	2816032
12	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 12:01:03 PM	2613600	4401852	3563752
13	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 2:01:04 PM	2324266	4059961	3101910
14	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 4:01:03 PM	2173340	3684370	2929146
15	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 6:01:03 PM	2613600	3589493	3021890
16	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 8:01:03 PM	1676056	3499380	2655280
17	RCN1-5100-WL-1	MCN-5100-WL-1	2/18/2018, 10:01:03 PM	1954093	3558944	2975884
18	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 12:01:03 AM	2161116	3784398	2902068
19	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 2:01:04 AM	2986971	4079765	3821158
20	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 4:01:04 AM	3514084	4181760	3893381
21	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 6:01:03 AM	3358843	4059961	3756691
22	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 8:01:03 AM	3216738	4245441	3716351
23	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 10:01:04 AM	3558944	4202773	3932908
24	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 12:01:03 PM	3427672	4267102	3838552
25	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 2:01:04 PM	2874061	4224000	3608676
26	RCN1-5100-WL-1	MCN-5100-WL-1	2/19/2018, 4:01:03 PM	2816000	6288360	4165337
27	MCN-5100-WL-2	BR572-WL-1	2/19/2018, 5:23:04 PM	936564	1213863	1109046

Showing 1 to 27 of 27 entries

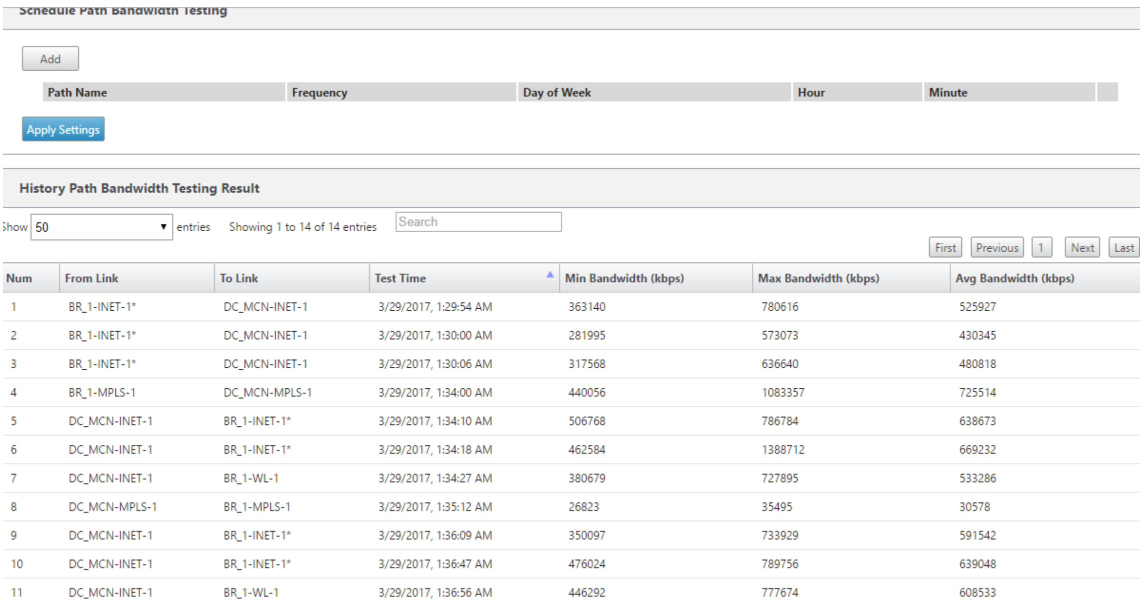
The output displays average bandwidth used as value to set as the permitted rate for the WAN Link minimum and maximum bandwidth results of the test. Along with the ability to test the bandwidth, you can now change the configuration file to use the learned bandwidth. This is accomplished through the Auto Learn option is under **Site** > [Site Name] > **WAN Links**> [WAN Link Name] > **Settings** and if enabled, the system uses the learned bandwidth.

You can also schedule recurring tests of path bandwidth in weekly, daily, or hourly intervals.



Path Name	Frequency	Day of Week	Hour	Minute
DC_MPLS2->Branch_	every day	Sunday	0	0
	every day	Sunday	0	0

> **Note**
>
> A history of the path bandwidth testing results is displayed at the bottom of this page and results are archived every seven days.



Showing 1 to 14 of 14 entries

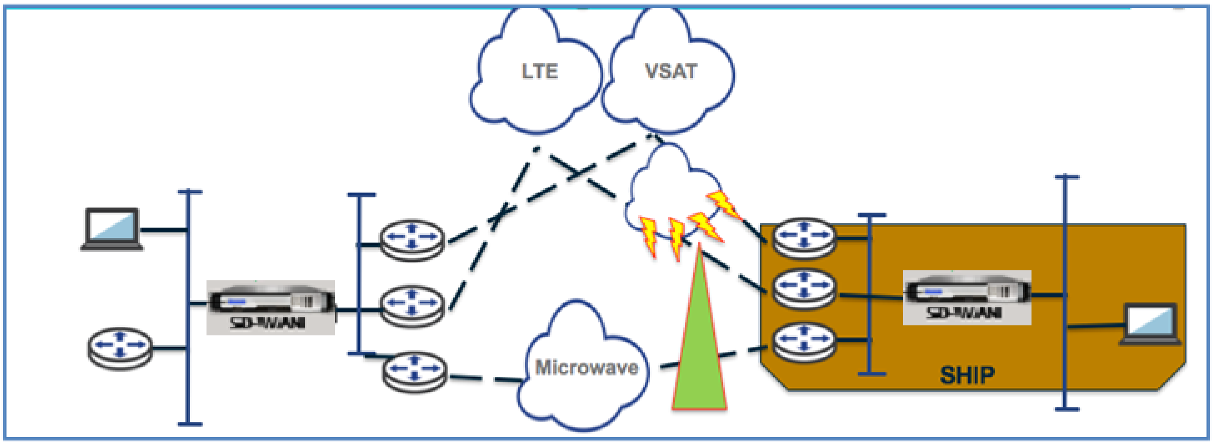
Num	From Link	To Link	Test Time	Min Bandwidth (kbps)	Max Bandwidth (kbps)	Avg Bandwidth (kbps)
1	BR_1-INET-1*	DC_MCN-INET-1	3/29/2017, 1:29:54 AM	363140	780616	525927
2	BR_1-INET-1*	DC_MCN-INET-1	3/29/2017, 1:30:00 AM	281995	573073	430345
3	BR_1-INET-1*	DC_MCN-INET-1	3/29/2017, 1:30:06 AM	317568	636640	480818
4	BR_1-MPLS-1	DC_MCN-MPLS-1	3/29/2017, 1:34:00 AM	440056	1083357	725514
5	DC_MCN-INET-1	BR_1-INET-1*	3/29/2017, 1:34:10 AM	506768	786784	638673
6	DC_MCN-INET-1	BR_1-INET-1*	3/29/2017, 1:34:18 AM	462584	1388712	669232
7	DC_MCN-INET-1	BR_1-WL-1	3/29/2017, 1:34:27 AM	380679	727895	533286
8	DC_MCN-MPLS-1	BR_1-MPLS-1	3/29/2017, 1:35:12 AM	26823	35495	30578
9	DC_MCN-INET-1	BR_1-INET-1*	3/29/2017, 1:36:09 AM	350097	733929	591542
10	DC_MCN-INET-1	BR_1-INET-1*	3/29/2017, 1:36:47 AM	476024	789756	639048
11	DC_MCN-INET-1	BR_1-WL-1	3/29/2017, 1:36:56 AM	446292	777674	608533

Adaptive bandwidth detection

August 24, 2022

This feature is applicable to networks with VSAT, LOS, Microwave, 3G/4G/LTE WAN Links, for which the available bandwidth varies based on weather and atmosphere conditions, location, and line of site obstructions. It allows the SD-WAN appliances to adjust the bandwidth rate on the WAN Link dynamically based on a defined bandwidth range (minimum and maximum WAN link rate) to use the maximum amount of available bandwidth without marking the paths BAD.

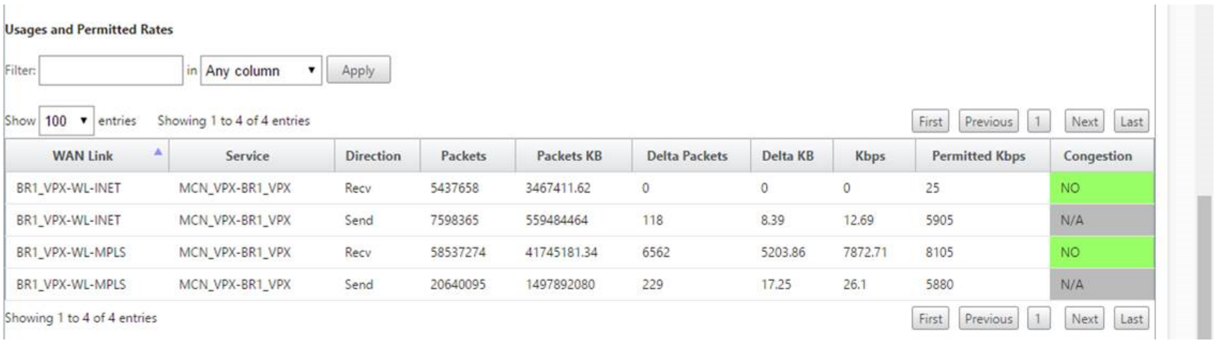
- Greater bandwidth reliability (Over VSAT, Microwave, 3G/4G, and LTE)
- Greater predictability of adaptive bandwidth over user configured settings



To enable adaptive bandwidth detection:

This feature needs Bad loss sensitivity option to be enabled (default/custom) as a prerequisite. From SD-WAN 11.5 release onwards, you can enable it on Citrix SD-WAN Orchestrator service. For more information, see Adaptive bandwidth detection.

View the **Usage and Permitted Rates** table by navigating to **Monitor** > **Statistics** > **WAN Link Usage** > **Usage** and **Permitted Rates**.



Usages and Permitted Rates

Showing 1 to 4 of 4 entries

WAN Link	Service	Direction	Packets	Packets KB	Delta Packets	Delta KB	Kbps	Permitted Kbps	Congestion
BR1_VPX-WL-INET	MCN_VPX-BR1_VPX	Recv	5437658	3467411.62	0	0	0	25	NO
BR1_VPX-WL-INET	MCN_VPX-BR1_VPX	Send	7598365	559484464	118	8.39	12.69	5905	N/A
BR1_VPX-WL-MPLS	MCN_VPX-BR1_VPX	Recv	58537274	41745181.34	6562	5203.86	7872.71	8105	NO
BR1_VPX-WL-MPLS	MCN_VPX-BR1_VPX	Send	20640095	1497892080	229	17.25	26.1	5880	N/A

Showing 1 to 4 of 4 entries

Best practices

August 24, 2022

The following topics provide the best practices to be followed when the Citrix SD-WAN solution is being designed, planned, and executed in your network.

Security

Routing

QoS

WAN links

Security

August 24, 2022

This article outlines security best practices for the Citrix SD-WAN solution. It provides general security guidance for Citrix SD-WAN deployments.

Citrix SD-WAN deployment guidelines

To maintain security through the deployment lifecycle, Citrix recommends the following security consideration:

- Physical Security
- Appliance Security
- Network Security
- Administration and Management

Physical security

Deploy Citrix SD-WAN Appliances in a Secure Server Room - The appliance or server on which Citrix SD-WAN is installed, should be placed in a secure server room or restricted data center facility, which protects the appliance from unauthorized access. At the minimum, access should be controlled by an electronic card reader. Access to the appliance is monitored by CCTV that continuously records all activity for auditing purposes. If a break-in, the electronic surveillance system should send an alarm to the security personnel for immediate response.

Protect Front Panel and Console Ports from Unauthorized Access - Secure the appliance in a large cage or rack with physical-key access control.

Protect Power Supply - Make sure that the appliance is protected with an uninterruptible power supply.

Appliance security

For appliance security, secure the operating system of any server hosting a Citrix SD-WAN virtual appliance (VPX), perform remote software updates, and the following secure lifecycle management practices:

- Secure the Operating System of the Server Hosting a Citrix SD-WAN VPX Appliance - A Citrix SD-WAN VPX appliance runs as a virtual appliance on a standard server. Access to the standard server should be protected with role based access control and strong password management. Also, Citrix recommends periodic updates to the server with the latest security patches for the operating system, and update-to-date antivirus software on the server.

- Perform Remote Software Updates - Install all security updates to resolve any known issues. Refer to the Security Bulletins webpage to sign up and receive up-to-date security alerts.
- Follow Secure Lifecycle Management Practices - To manage an appliance when redeploying, or initiating RMA, and decommissioning sensitive data, complete the data-reminisce countermeasures by removing the persistent data from the appliance.
- Deploy the management interface of the appliance behind the DMZ to ensure that there is no direct Internet Access to the Management interface. For added protection, ensure that the management network is isolated from the Internet, and only authorized users with approved management applications are running in the network.

Network Security

For network security, do not use the default SSL certificate. Use Transport Layer Security (TLS) when accessing the administrator interface, protect the appliance's non-routable management IP address, configure a high availability setup, and implement Administration and Management safeguards as appropriate for the deployment.

- Do not use the Default SSL Certificate - An SSL certificate from a reputable Certificate Authority simplifies the user experience for Internet-facing Web applications. Unlike the situation with a self-signed certificate or a certificate from the reputable Certificate Authority, web browsers do not require users to install the certificate from the reputable Certificate Authority to initiate secure communication to the Web server.
- Use Transport Layer Security when Accessing Administrator Interface - Make sure that the management IP address is not accessible from the Internet or is at least protected by a secured firewall. Make sure that the LOM IP address is not accessible from the Internet or is at least protected by a secured firewall.
- Secure Administration and Management Accounts –Create an alternative admin account, set strong passwords for admin and viewer accounts. When configure remote account access, consider configuring externally authenticated administrative management of accounts using RADIUS and TACAS. Change the default password for the admin user accounts, configure NTP, use the default session timeout value, use SNMPv3 with SHA Authentication and AES encryption.

Citrix SD-WAN overlay network protects data traversing the SD-WAN overlay network.

Secure administrator interface

For secure web management access, replace default system certificates by uploading and installing certificates from a reputable Certificate Authority. Go to, **Configuration> Appliance Settings> Administrator Interface** in the SD-WAN appliance GUI.

User accounts:

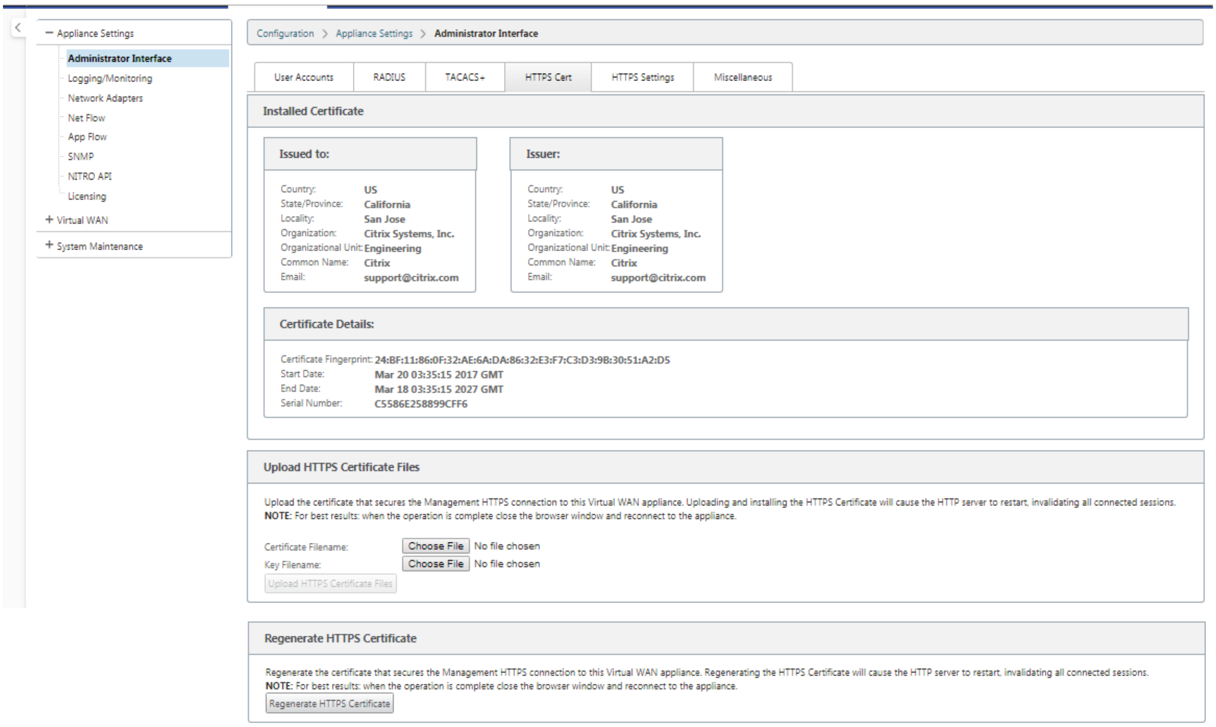
- Change local user password
- Manage users

HTTPS Certs:

- Certificate
- Key

Miscellaneous:

- Web Console Timeout



Installed Certificate

Issued to:

Country: US
State/Province: California
Locality: San Jose
Organization: Citrix Systems, Inc.
Organizational Unit: Engineering
Common Name: Citrix
Email: support@citrix.com

Issuer:

Country: US
State/Province: California
Locality: San Jose
Organization: Citrix Systems, Inc.
Organizational Unit: Engineering
Common Name: Citrix
Email: support@citrix.com

Certificate Details:

Certificate Fingerprint: 24:BF:11:86:0F:32:AE:6A:DA:86:32:E3:F7:C3:D3:9B:30:51:A2:D5
Start Date: Mar 20 03:35:15 2017 GMT
End Date: Mar 18 03:35:15 2027 GMT
Serial Number: C5586E258899CFF6

Upload HTTPS Certificate Files

Upload the certificate that secures the Management HTTPS connection to this Virtual WAN appliance. Uploading and installing the HTTPS Certificate will cause the HTTP server to restart, invalidating all connected sessions.
NOTE: For best results: when the operation is complete close the browser window and reconnect to the appliance.

Certificate Filename: No file chosen
Key Filename: No file chosen

Regenerate HTTPS Certificate

Regenerate the certificate that secures the Management HTTPS connection to this Virtual WAN appliance. Regenerating the HTTPS Certificate will cause the HTTP server to restart, invalidating all connected sessions.
NOTE: For best results: when the operation is complete close the browser window and reconnect to the appliance.

Consider using the Citrix Web App Firewall

Citrix ADC licensed appliance provides a built-in Citrix Web App Firewall that uses a positive security model and automatically learns the proper application behavior for protection against threats such as command injection, SQL injection, and Cross Site Scripting.

When you use the Citrix Web App Firewall, users can add extra security to the web application without code changes and with little change in configuration. For more information, see Introduction to Citrix Web Application Firewall.

Global virtual path encryption settings

- AES-128 data encryption is enabled by default. It is recommended to use AES-128 or more protection of AES-256 encryption level for path encryption. Ensure that "enable Encryption Key Rotation"is set to ensure key regeneration for every Virtual Path with encryption enabled using an Elliptic Curve Diffie-Hellman key exchange at intervals of 10-15 minutes.

If the network requires message authentication in addition to confidentiality (that is, tamper protection), Citrix recommends using IPsec data encryption. If only confidentiality is required, Citrix recommends using the enhanced headers.

- Extended Packet Encryption Header enables a randomly seeded counter to be prepended to the beginning of every encrypted message. When encrypted, this counter serves as a random initialization vector, deterministic only with the encryption key. This randomizes the output of the encryption, providing a strong message indistinguishably. Keep in mind that when enabled this option increases packet overhead by 16 bytes
- Extended Packet Authentication Trailer appends an authentication code to the end of every encrypted message. This trailer allows for the verification that packets are not modified in transit. Keep in mind this option increases packet overhead.

Firewall Security

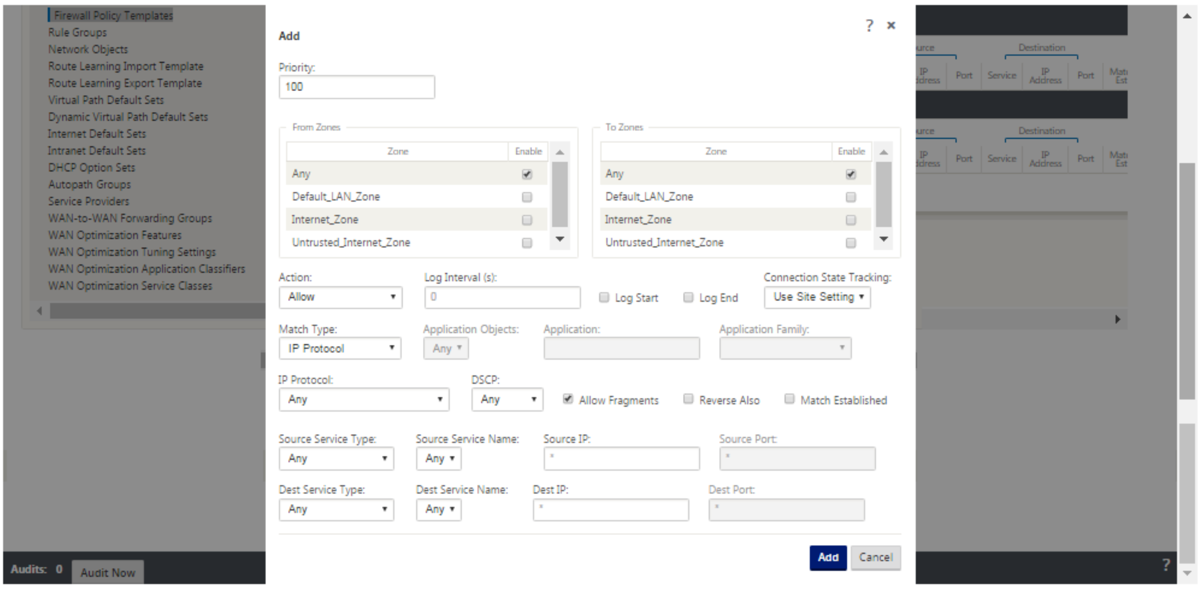
The recommended Firewall configuration is with a default Firewall action as deny all at first, then add exceptions. Prior to adding any rules, document and review the purpose of the firewall rule. Use Stateful inspection and Application level inspection where possible. Simplify rules and eliminate redundant rules. Define and adhere to a change management process that tracks and allows for review of changes to **Firewall** settings. Set the Firewall for all appliances to track connections through the appliance using the global settings. Tracking connections verifies that packets are properly formed and are appropriate for the connection state. Create Zones appropriate to the logical hierarchy of the network or functional areas of the organization. Keep in mind that zones are globally significant and can allow geographically disparate networks to be treated as the same security zone. Create the most specific policies possible to reduce the risk of security holes, avoid the use of Any in Allow rules. Configure and maintain a Global Policy Template to create a base level of security for all appliances in the network. Define Policy Templates based on the functional roles of appliances in the network and apply them where appropriate. Define Policies at individual sites only when necessary.

Global Firewall Templates - Firewall templates allow for the configuration of global parameters that impact the operation of the firewall on individual appliances operating in the SD-WAN overlay environment.

Default Firewall Actions –Allow enables packets not matching any filter policy are permitted. Deny enables packets not matching any filter policy are dropped.

Default Connection State Tracking –Enables bidirectional connection state tracking for TCP, UDP, and ICMP flows that do not match a filter policy or NAT rule. Asymmetric flows are blocked when this is enabled even when there are no Firewall policies defined. The settings may be defined at the site level which will override the global setting. If there is a possibility of asymmetric flows at a site, the recommendation is to enable this at a site or policy level and not globally.

Zones - Firewall zones define the logical security grouping of networks connected to the Citrix SD-WAN. Zones can be applied to Virtual Interfaces, Intranet Services, GRE Tunnels, and LAN IPsec Tunnels.


Firewall Policy Templates
Rule Groups
Network Objects
Route Learning Import Template
Route Learning Export Template
Virtual Path Default Sets
Dynamic Virtual Path Default Sets
Internet Default Sets
Intranet Default Sets
DHCP Option Sets
Autopath Groups
Service Providers
WAN-to-WAN Forwarding Groups
WAN Optimization Features
WAN Optimization Tuning Settings
WAN Optimization Application Classifiers
WAN Optimization Service Classes
Audits: 0
Audit Now
? ×

Add

Priority: 100

From Zones

Zone	Enable
Any	☑
Default_LAN_Zone	☐
Internet_Zone	☐
Untrusted_Internet_Zone	☐

To Zones

Zone	Enable
Any	☑
Default_LAN_Zone	☐
Internet_Zone	☐
Untrusted_Internet_Zone	☐

Action: Allow
Log Interval (s): 0
☐ Log Start ☐ Log End
Connection State Tracking: Use Site Setting

Match Type: IP Protocol
Application Objects: Any
Application:
Application Family:

IP Protocol: Any
DSCP: Any
☑ Allow Fragments ☐ Reverse Also ☐ Match Established

Source Service Type: Any
Source Service Name: Any
Source IP: *
Source Port: *

Dest Service Type: Any
Dest Service Name: Any
Dest IP: *
Dest Port: *

Add Cancel

WAN link security zone

Untrusted security zone should be configured on WAN links directly connected to a public (unsecure) network. Untrusted will set the WAN link to its most secure state, allowing only encrypted, authenticated, and authorized traffic to be accepted on the interface group. ARP and ICMP to the Virtual IP Address are the only other traffic type allowed. This setting will also ensure that only encrypted traffic is sent out of the interfaces associated with the Interface group.

Routing domains

Routing Domains are network systems that include a set of routers that are used to segment network traffic. Newly created sires are automatically associated with the default Routing Domain.

IPsec Tunnels

IPsec Tunnels secure both user data and header information. Citrix SD-WAN appliances can negotiate fixed IPsec tunnels on the LAN or WAN side with non-SD-WAN peers. For IPsec Tunnels over LAN, a Routing Domain must be selected. If the IPsec Tunnel uses an Intranet Service, the Routing Domain is pre-determined by the chosen Intranet Service.

IPsec tunnel is established across the Virtual Path before data can flow across the SD-WAN overlay network.

- Encapsulation Type options include ESP - data is encapsulated and encrypted, ESP+Auth –data is encapsulated, encrypted, and validated with an HMAC, AH –data is validated with an HMAC.
- Encryption Mode is the encryption algorithm used when ESP is enabled.
- Hash Algorithm is used to generate an HMAC.
- Lifetime is a preferred duration, in seconds, for an IPsec security association to exist. 0 can be used for unlimited.

IKE settings

Internet Key Exchange (IKE) is an IPsec protocol used to create a security association (SA). Citrix SD-WAN appliances support both IKEv1 and IKEv2 protocols.

- Mode can be either Main Mode or Aggressive Mode.
- Identity can be automatic to identify peer, or an IP address can be used to manually specify peer's IP address.
- Authentication enables Pre-Shared Key authentication or certificate as the method of authentication.
- Validate Peer Identity enables validation of the IKE's Peer Identity if the peer's ID type is supported, otherwise do not enable this feature.
- Diffie-Hellman Groups are available for IKE key generation with group 1 at 768-bit, group 2 at 1024-bit, and group 5 at 1536-bit group.
- Hash Algorithm includes MD5, SHA1, and SHA-256 has algorithms are available for IKE messages.
- Encryption Modes include AES-128, AES-192, and AES-256 encryption modes are available for IKE messages.
- IKEv2 settings include Peer Authentication and Integrity Algorithm.

Configuring firewall

Following common issues can be identified by verifying the upstream Router and Firewall configuration:

- MPLS Queues/QoS settings: Verify that UDP encapsulated traffic between SD-WAN Virtual IP addresses does not suffer due to **QoS** settings on the intermediate appliances in the network.
- All traffic on the WAN links configured on the SD-WAN network should be processed by the Citrix SD-WAN appliance using the right service type (Virtual Path, Internet, Intranet, and Local).
- If traffic has to bypass the Citrix SD-WAN appliance and use the same underlying link, proper bandwidth reservations for SD-WAN traffic should be made on the router. Also, the link capacity should be configured accordingly in the SD-WAN configuration.
- Verify that the intermediate Router/Firewall does not have any UDP flood and/or PPS limits enforced. This throttles the traffic when it is sent through the Virtual Path (UDP encapsulated).

Routing

August 24, 2022

This article outlines routing best practices for the Citrix SD-WAN solution.

Internet/Intranet routing service

When the Internet service is not configured to Internet bound traffic and instead, either a **Local** route or a **Passthrough** route is configured to reach the gateway router. The router uses the WAN links configured on the SD-WAN appliance, leading to link over-subscription issue.

If an Internet route is configured as **Local** at the MCN, it is learned by all the branch SD-WAN sites and configured as **Virtual Path Route** by default. This implies that Internet bound traffic at the branch appliance is routed through the Virtual Path to MCN.

Routing precedence

The order of routing precedence:

- Prefix Match: longest prefixes match.
- Service: Local, Virtual Path service, Internet, Intranet, Passthrough
- Route Cost

Routing asymmetry

Ensure that there is no routing asymmetry in the network (NetScaler SD-WAN appliance is transmitting traffic in only one direction). This creates issues with Firewall connection tracking, and deep packet inspection.

QoS

August 24, 2022

Consider the following when configuring QoS:

- Understand your network traffic patterns and requirement. You might have to observe the **QoS class statistics**, and change queue depths, and/or change the default QoS class share percentage to avoid tail-drops as shown in QoS statistics.
- Sometimes, the entire subnet is added to a rule for ease of configuration instead of creating Rules for particular application IP addresses. Adding entire subnet to a rule incorrectly maps all the traffic in the subnet to one Rule. Therefore the QoS classes associated with that Rule might lead to tail drop and poor application performance or user experience.

WAN Links

August 24, 2022

Citrix SD-WAN platforms support upto 8 public internet connections and 32 Private MPLS connections. This article outlines WAN link configuration best practices for the Citrix SD-WAN solution.

Points to remember while configuring WAN links:

- Configure the **Permitted and Physical** rate as the actual WAN link bandwidth. In cases where the entire WAN link capacity is not supposed to be used by the SD-WAN appliance, change the **Permitted** rate accordingly.

- When you are unsure of the bandwidth and if the links are non-reliable, you can enable the **Auto Learn** feature. The **Auto Learn** feature learns the underlying link capacity only, and uses the same value in the future.

- If the underlying link is not stable and does not guarantee fixed bandwidth (for example; 4G links), use the **Adaptive Bandwidth Detection** feature.

- It is not recommended to enable **Auto Learn** and **Adaptive Bandwidth Detection** on the same WAN link.
- Manually configure the MCN/RCN with the Ingress/Egress physical rate for all the WAN links since it is the central point of bandwidth distribution among multiple branches.
- For increased reliability of important datacenter workloads/services, when auto-learn is not used, use reliable links with SLA's that does not have random variation of capacity.
- If the underlying link is not stable, change the following Path settings:
  - Loss Settings
  - Disable Instability Sensitive
  - Silence time
- Use **Diagnostic tool** to check the link health/capacity.
- If SD-WAN is deployed in **one-arm** mode, ensure that you do not overrun the physical capacity of the underlying link.

Verifying ISP link Health

For new deployments, earlier than SD-WAN deployment and when adding new ISP link to the existing SD-WAN deployment:

- Verify the link type. For example; MPLS, ADSL, 4G.
- Network characteristics. For example - bandwidth, loss, latency, and jitter.

This information helps in configuring the SD-WAN network as per your requirements.

Network topology

It is commonly observed that specific network traffic bypasses the Citrix SD-WAN appliances, and uses the same underlying link configured in the SD-WAN network. Because SD-WAN does not have complete visibility over link utilization, there are chances that SD-WAN oversubscribes the link leading to performance and PATH issues.

Provisioning

Points to consider while provisioning SD-WAN:

- By default, all branches and WAN services (Virtual Path/Internet/Intranet) receive equal share of the bandwidth.

- Provisioning sites needs to be changed, when there is high disparity in terms of bandwidth requirement or availability between the connecting sites.
- When dynamic virtual paths are enabled between maximum available sites, the WAN link capacity is shared between the static virtual path to DC and the dynamic virtual paths.

FAQs

August 24, 2022

High availability

What is the difference between High Availability and Secondary (Geo) appliance?

- High Availability ensures fault tolerance. Secondary (Geo) appliance enables disaster recovery.
- High Availability can be configured for the MCN, RCN, and branch appliances. Secondary (Geo) appliance can be configured for MCN and RCNs only.
- High Availability appliances are configured within the same site or geographical location. A branch appliance in a different geographical location is configured as Secondary (Geo) MCN/RCN appliance.
- High Availability primary and secondary appliance should be the same platform models. The Secondary (Geo) appliance might or might not be the same platform model as the primary MCN/RCN.
- High Availability has higher priority over secondary (Geo). If an appliance (MCN/RCN) is configured with High Availability and Secondary (Geo) appliance, when the appliance fails the secondary high availability appliance becomes active. If both the high availability appliances fail or if the Data Center site crashes, the secondary (Geo) appliance becomes active.
- In High Availability, the primary/secondary switchover happens instantaneously or within 10-12 seconds depending upon the high availability deployment. The primary MCN/RCN to secondary (Geo) MCN/RCN switch over, happens after 15 seconds of the primary being inactive.
- High Availability configuration allows you to configure primary reclaim. You cannot configure primary reclaim for Secondary (Geo) appliance, the primary reclaim happens automatically after the primary appliance is back and the hold timer expires.

Single step upgrade

> **Note**
>
> The WANOP, SVM, and XenServer Supplemental/HFs are seen as OS Components.

Should I use *.tar.gz,* or single step upgrade *.zip* package to upgrade to 9.3.x from my current version (8.1.x, 9.1.x, 9.2.x)?

Use the *.tar.gz* files of the concerned platforms to upgrade the SD-WAN software to 9.3.x. After the SD-WAN software is upgraded to 9.3.x version, perform change management using the *.zip* package to transfer/stage OS component software packages. After activation, the MCN transfers/stages OS components for all the relevant branches.

After upgrading to 9.3.0 using single step upgrade package (.zip file) do, I need to perform.*upg* upgrade on each appliance?

No, OS software update/upgrade will be taken care by the single step upgrade *.zip* package and it is installed as per the scheduling details provided by you in the Change Management Settings of the respective sites.

Why should I use *.tar.gz* followed by *.zip* package to upgrade from earlier than 9.3 to 9.3.x, and why not directly use *.zip* package of 9.3.x?

Single Step upgrade package is supported from 9.3.0.161 onwards and on earlier release versions (prior to release 9.3) this package is not recognized. When the single step upgrade *.zip* package is uploaded into the Change Management inbox, the system throws an error stating that the package is not recognized. Hence, first upgrade the SD-WAN software to 9.3 or above version and then perform Change Management using the *.zip* package.

How will the OS Components be installed through single step upgrade, if.*upg* upgrade is not performed?

The MCN will transfer/stage OS components software packages based on the appliance model, after the Change Management is completed using single step upgrade *.zip* package. After activation, the MCN starts transferring/staging the OS components software packages for the branches that need them for the scheduled update/upgrade.

How do I install OS components, without scheduling for later installations?

Set the **Maintenance Window** value to ‘**0**’for instant installation of the OS components.

> **Note**
>
> The installation starts only when the appliance has received all the package that is needed for the site, even when **Maintenance Window** value is set to ‘**0**’.

What is the use of scheduling installation? Can I use schedule instructions to upgrade VW alone?

Scheduled installation was introduced in SD-WAN release 9.3, and is applicable for OS components only and not for VW software upgrade. With single step upgrade, you need not log into each appliance to perform OS components upgrade and the scheduling option allows you to schedule the OS components installation at a different time other than VW software version upgrade.

Why does the scheduling information in Change Management Settings page appears past schedule date by default and what does it mean?

The **Change Management Settings** page displays the default scheduling information that is, *"'start" : "2016-05-21 21:20:00,""window": 1, "repeat": 1, "unit": "days"'*. If the date is a past date it means that, the scheduled installation is based on the time and other parameters like maintenance window, repeat window, and unit and not the date.

What is default schedule installation date/time set to, is it generic or local appliance dependent?

By default the scheduling details is set as *'2016-05-21 at 21:20:00 (Maintenance window of 1 hour and repeated every 1 day)'*. This detail is local appliance site dependent.

How can I install OS Components immediately without waiting for the maintenance / scheduled window?

Set the **Maintenance Window** value to '**0**'in **Change Management Setting** page, this overrides the scheduled installation time.

Which package I should use for upgrade when current software version is 9.3.x or above?

Use single step upgrade *.zip* package to upgrade to any higher versions when the current software version 9.3.x or above.

When does the OS Components files get transferred/staged to the branches?

The OS components files are transferred/staged to relevant branches after the activation is completed when Change Management is done using single step upgrade *.zip* package to upgrade the system.

Which appliances receive OS Components files, Is it platform dependent or all branches receive it?

Appliances that are hypervisor based, such as **SD-WAN –400, 800, 1000, 2000 SE** and Bare metal **SD-WAN - 2100** running on EE license will receive OS components to upgrade.

How does scheduling work?

By default the scheduling details is set as *2016-05-21 at 21:20:00 (Maintenance window of 1 hour and repeated every 1 day*) and it implies that the system will check if new software is available for installation every day as repeat value is set to **1 days** and will have maintenance window of **1 hours** and the installation will get triggered/attempted (if new software is available) at **21:20:00** (local appliance time) effective from **2016-05-21**

How do I get to know if the OS Components have been upgraded?

In the **Status** column, you can see a green tick mark. On hovering over it, you can see the **Upgrade is Successful** message.

How can I schedule installation of OS components for RCN and its Branches?

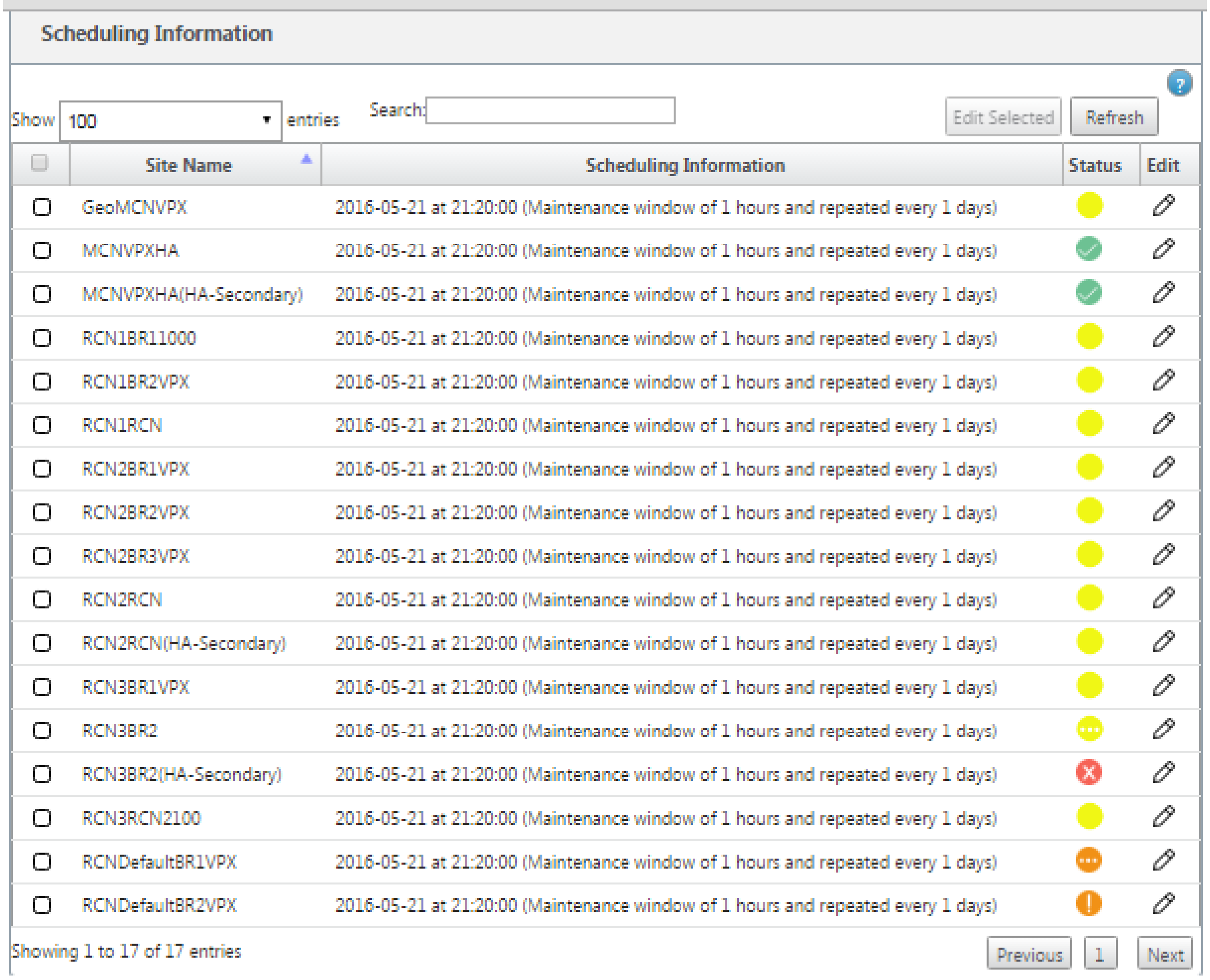
Scheduling for RCN is performed from the MCN **Change Management Settings** page. For RCN branches, you need to log into respective RCN and set the schedule details.

From where can I get the status of scheduled installation?

Status of scheduled installation for RCN can be obtained from the MCN **Change Management Settings** page. For RCN branches, you need to log in to respective RCN to get the status.

How do I get status of scheduled installation?

Use the refresh button provided on the **Change Management Settings** page to get status from MCN, and RCN for Branches in Default Region and RCN respectively.



Scheduling Information

Show 100 entries Search:

□	Site Name	Scheduling Information	Status	Edit
□	GeoMCNVPX	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	MCNVPXHA	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	✓	✎
□	MCNVPXHA(HA-Secondary)	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	✓	✎
□	RCN1BR11000	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCN1BR2VPX	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCN1RCN	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCN2BR1VPX	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCN2BR2VPX	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCN2BR3VPX	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCN2RCN	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCN2RCN(HA-Secondary)	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCN3BR1VPX	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCN3BR2	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	⋯	✎
□	RCN3BR2(HA-Secondary)	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	✗	✎
□	RCN3RCN2100	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	●	✎
□	RCNDefaultBR1VPX	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	⋯	✎
□	RCNDefaultBR2VPX	2016-05-21 at 21:20:00 (Maintenance window of 1 hours and repeated every 1 days)	!	✎

Showing 1 to 17 of 17 entries

Can I use *tar.gz* file to upgrade to next release, when single step upgrade was used for previous software upgrade?

You can use *tar.gz* file to upgrade, but it is not recommended because you can perform software upgrade by using the.*upg* file. Upload to upgrade operating system (OS) component software by logging into each applicable appliance. From release 9.3 version 1, the **Update Operating System Software** page is depreciated. As a result, you can perform change management by using the *.zip* package to upgrade OS components.

How can we validate the current running versions of OS Components?

Now you cannot validate the current running versions of OS components from the UI. You can log in from each console or get STS to view this information.

What difference it would make if I have bare metal appliances in my network? Does scheduling impact bare metal / Virtual appliances?

Bare Metal appliances like **SD-WAN –410,2100,4100,5100 SD-WAN** run only SD-WAN software. Bare metal appliances do not need OS components packages. These platforms are treated on par with SD-WAN VPX-SE appliances in terms of software need. The MCN will not transfer OS components packages to these appliances. Setting scheduling information will not take effect for these appliances, because they do not have any OS components that need upgrade.

How does SSU work in high availability environment / deployment?

In high availability deployment at MCN, we have a limitation, where the active MCN switch's/toggles the role of primary MCN during Change Management and Standby/Secondary MCN takes over. In this case, you can perform Change Management once again with the *.zip* package on the active MCN for the packages or you can switch back to primary MCN by toggling the role of active MCN so that original primary MCN can take up the role for the OS components packages to be staged to other branches.

How does single step upgrade work in high availability environment / deployment?

While performing single step upgrade in high availability deployment, the role of the primary MCN and the Standby MCN is toggled. This is a limitation. If this happens, perform Change Management again with the *.zip* package on the active MCN. Alternatively, you can switch back to the primary MCN by toggling the role of the active MCN so that the original primary MCN can stage OS components packages to the branches.

Is single step upgrade support for zero-touch deployment to restart strap the appliances?

Yes, it can be used.

Can I use single step upgrade to upgrade my standalone WANOP appliance?

No.

Can I use single step upgrade to upgrade standalone WANOP appliance deployed in two box mode?

No. Only SD-WAN appliance which is part of two box mode would be upgraded and not the WANOP standalone appliance.

Which package should I use to upgrade to multi-tier network?

Use the single step upgrade package *ns-sdw-sw-<release-version>.zip* file when the current software version is 9.3.x or above. MCN takes care of staging package to RCN and RCNs stage software package to its respective branches.

After uploading the *ns-sdw-sw-<release-version>.zip* file, I am seeing only one platform model under current software?

From release 10.0, support for scale architecture is introduced to speed up processing of single step upgrade. You can see only the MCN platform model under current software. Other appliance packages are listed/displayed/processed when you choose the **Verify** or **Stage Appliance** button.

For VPX/VPXL/bare metal appliances, which packages are staged for RCN?

Package is staged to RCNs because RCNs Branches can be of any platform model. Hence they need all packages.

How does my branch site behind the RCN obtain OS component packages if RCN is a VPX appliance, and branch is an appliance that needs these packages?

RCN stages the relevant package to the branch that needs the OS component packages after activation of SD-WAN VW software package.

Can I choose Ignore Incomplete during staging and proceed to next stage of change Management? What impact does it have for sites that have not completed staging when this button is selected?

Yes, you can click **Ignore Incomplete.** This enables **Next** button and the Progress bar is displayed. This option is provided for scenarios where the site is not reachable and change management is still waiting for staging to complete for those site, so users can proceed to next stage by ignoring the stage state and proceed to activation. After the site comes up, MCN stages the package after completion of activation.

Partial software upgrade

What is partial site upgrade and how can I use it?

Partial site software upgrade is a new feature introduced in release 10.0. You can stage newer version of release 10.x from the MCN and activate staged software version from **Local Change Management** page on selected sites/branches. Before activating staged software on site/branch, ensure that check box is enabled from MCN.

- This feature is disabled by default. The existing correction mechanism keeps the network in sync. The user has to choose to allow partial site upgrades by enabling a check box on the **Configuration** > **Change Management Settings** page.
- Partial Software Upgrade can be done only on a Branch or RCNs and not at the MCN.

Below is the usecase/scenario when partial site software upgrade can be used:

Validate if a software patch with relevant changes is compatible and working for a specific site (where partial site upgrade is done). Validate that the upgraded software is working as expected. This helps validate the new software and fix at a specific site before upgrading entire network with the new software.

Can I use this feature to upgrade from:

- 10.0 to 10.x
- 10.0.x to 10.0.y
- 11.0 to 11.y
- 11.0.x to 11.0.y
- All of the above

Partial Site Software Upgrade is applicable only when appliance is running software release 10.x and newer, and can be used within the same major version of software. It can be used between releases 10.0 to 10.0.x/10.x. Only as part of partial site software upgrade, configuration cannot be changed.

Can I test new feature to test as part of partial software upgrade by enabling them from the config?

No, partial software upgrade requires that now Active and Staged config to be identical. Only software version can change.

Can I disable Partial Software Upgrade for RCN?

No, Partial Software Upgrade can be enabled or disabled from MCN only. At RCN the feature is in read-only mode.

Can I use Partial Software Upgrade when I have active as 9.3.x and 10.0.x as staged?

No, the appliance should be running on release 10.0 as active software.

What happens when Partial Software Upgrade option is disabled from MCN, while some branches are already upgraded through this feature?

MCN sends notification to all appliances in the network that Partial Software Upgrade feature is disabled, and then all appliances in the network are auto-corrected by MCN to match to its active and staged version. However, note that MCN is expecting for Activate Staged option to be clicked from Activation page of **Change Management**. You can choose to activate the network by clicking **Activate Staged** button or click **Change Preparation** to cancel state by accepting the confirmation.

Change Management Roll Back

What is rolled back feature in Change management process?

From release 9.3, the Change management rollback feature enables roll back to the Working Configuration when unexpected events such as, t2-app crash or Virtual path state becomes inactive after a configuration update. The network and the appliances are monitored for 10 mins after the Configuration update and during that interval if the following conditions are met (provided user has enabled the feature), the Staged configuration will be activated. The Active software is rolled back to Staged.

What is the criteria for the configuration roll back to restart?

The rollback occurs, if the following scenarios are encountered:

1. MCN - After config/software change, if t2_app service gets disabled due to crash within 30 min interval.
2. MCN - After config/software change, if Virtual Path service is down for 30 minutes or longer after activation. The Rollback feature is initiated at the sites.
3. Site - After config/software change, if the Site loses its communication with MCN, then the rollback feature is initiated.
4. Site - After config/software change t2_app service gets disabled due to crash within 30 min interval.

What happens after rollback?

After configuration rollback, the faulty config/software is presented as Staged software.

How are users notified that roll back occurred?

A yellow banner at the top in the GUI saying Config is rolled back due to respective errors is displayed. Also, you can see it is change management status table. It shows **Configuration Error** or **Software error** corresponding to the site for which roll back occurred.

Does config and software both get rolled back?

Yes, if software upgrade is also performed along with configuration, and roll back scenario is encountered then Software also gets rolled back.

What happens if there is an issue in MCN and it crashes or loses connectivity with all the sites?

The entire network is rolled back except MCN. Notification is displayed, and all the sites show roll back status in the change management section. You can resolve the issue on MCN manually.

Can we disable this feature?

Yes, we can disable this feature just before activation. However, by default this feature is enabled.

How does roll back interact with Partial Software Upgrade when I have multi-tier network?

- If partial software upgrade is disabled, and if a site in a region (or the RCN) rolls back, the region with the problem is rolled back and once completed the rollback propagates up to the MCN. As a result, the MCN and the rest of the network to rolled back. Both the RCN in the region that rolled back, and the MCN display the rollback banner that the MCN cannot auto-dismiss the rollback banner at the RCN.
- If partial software upgrade is enabled, and if a site in a region (or the RCN) rolls back, only that region is rolled back. The rollback event does not propagate back to the MCN. As a result, the MCN leaves the region. The MCN does not show rollback banner and does not roll back itself or the network.

In both these scenarios, the RCN displays the rollback banner until it is dismissed. Because, it cannot be auto-dismissed by MCN.

Reference material

August 24, 2022

Application Signature Library

A list of applications that the Citrix SD-WAN appliances can identify using Deep Packet Inspection.