CISCO VALIDATED DESIGN

Intelligent WAN Multiple Data Center Deployment Guide

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Deploying the Cisco Intelligent WAN

This guide is one in a series of IWAN advanced deployment guides that focus on how to deploy the advanced features of the Cisco Intelligent WAN (IWAN). These guides build on the configurations deployed in the Intelligent WAN Deployment Guide and are optional components of its base IWAN configurations.

The advanced guides are as follows:

- IWAN High Availability and Scalability Deployment Guide
- IWAN Multiple Data Center Deployment Guide (this guide)
- IWAN Multiple Transports Deployment Guide
- IWAN Multiple VRF Deployment Guide
- IWAN Public Key Infrastructure Deployment Guide
- IWAN NetFlow Monitoring Deployment Guide
- IWAN Remote Site 4G LTE Deployment Guide

For design details, see Intelligent WAN Design Summary.

For configuration details, see Intelligent WAN Configuration Files Guide.

For an automated way to deploy IWAN, use the APIC-EM IWAN Application. For more information, see the Cisco IWAN Application on APIC-EM User Guide.

If want to use TrustSec with your IWAN deployment, see "Configuring SGT Propagation" in the User-to-Data-Center Access Control Using TrustSec Deployment Guide.

DEPLOYMENT DETAILS

How to Read Commands

This guide uses the following conventions for commands that you enter at the command-line interface (CLI).

Commands to enter at a CLI prompt:

```
configure terminal
```

Commands that specify a value for a variable:

```
ntp server 10.10.48.17
```

Commands with variables that you must define:

```
class-map [highest class name]
```

Commands at a CLI or script prompt:

```
Router# enable
```

Long commands that line wrap are underlined. Enter them as one command:

```
police rate 10000 pps burst 10000
packets conform-action
```

Noteworthy parts of system output (or of device configuration files) are highlighted:

```
interface Vlan64
  ip address 10.5.204.5 255.255.255.0
```

Deploying Multiple Data Centers

Use this guide to deploy a second data center location as a transit site for geographic redundancy and scalability. This concept works with any of the IWAN design models.

This type of configuration offers the following benefits:

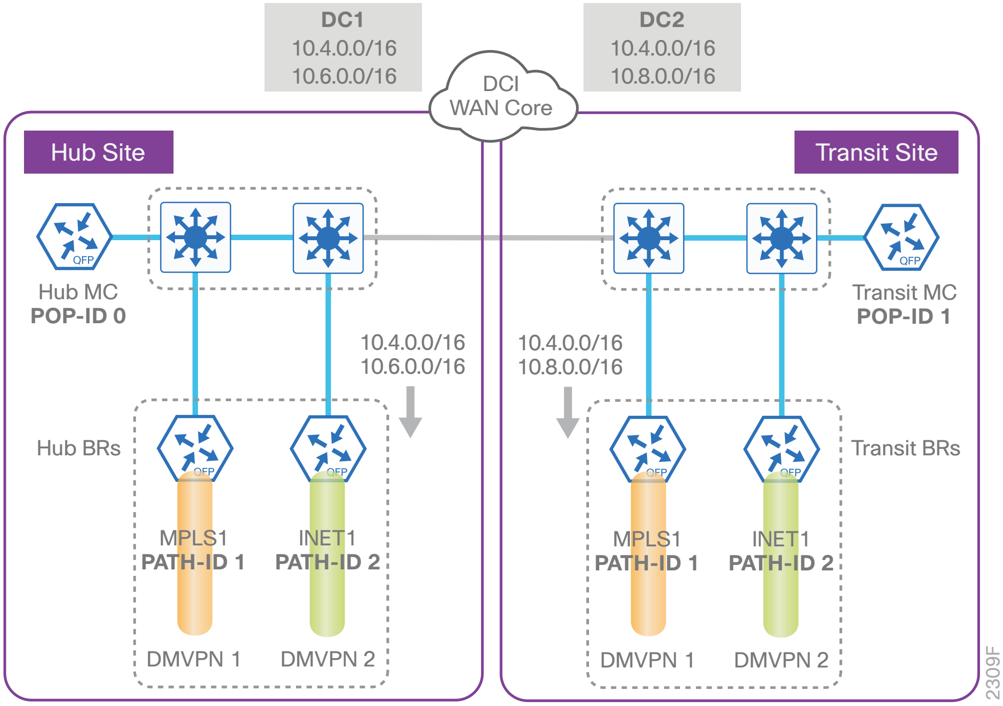
- Data centers are reachable across the WAN core for each transit site using a Data Center Interconnect.
- Remote sites can access any data center across either hub.
- Data centers can reach any remote site across any of the transit sites.
- Multiple hub BRs per DMVPN per site may be required for horizontal scaling, as noted in the previous process.

This design introduces the concept of a transit master controller and transit BRs.

- **Transit Master Controller**—The Transit MC is the MC at the transit-site. There is no policy configuration on this device. It receives policy from the Hub MC. This device acts as MC for that site for making path optimization decision. The configuration includes the IP address of the hub MC.
- **Transit Border Router**—This is a BR at the transit MC site. This is the device where WAN interfaces terminate. There can only be one WAN interface on the device. There can be one or more transit BRs. On the transit BRs, PfRv3 must be configured with:
  - The address of the transit MC.
  - The path name on external interfaces.
  - The path ID on external interfaces.

The following diagram shows the transit MC with two additional transit BRs and where they fit into the IWAN hybrid design model.

Figure 1 *IWAN hybrid design model—Second data center as a transit site*



With the IOS release used for this guide, data center affinity is enabled by default. It is applicable for both path preference and load balancing. There is no CLI change required and PfR will use the primary data center as its preference for all traffic.

If the MPLS1 path is primary and INET1 path is secondary in your design, the path preference will be as follows:

- Path #1 to 10.4.0.0/16 is MPLS1 path to DC#1
- Path #2 to 10.4.0.0/16 is INET1 path to DC#1
- Path #3 to 10.4.0.0/16 is MPLS1 path to DC#2
- Path #4 to 10.4.0.0/16 is INET1 path to DC#2

If you want the path preference to be the MPLS path as primary and INET path as fallback across data centers, there is a domain **transit-site-affinity** command to disable data center affinity.

```
domain iwan
 vrf default
  master hub
   advanced
    no transit-site-affinity
```

If **no transit-site-affinity** is enabled, the failover order for the example given above would be as follows:

- Path #1 to 10.4.0.0/16 is MPLS1 path to DC#1
- Path #2 to 10.4.0.0/16 is MPLS1 path to DC#2
- Path #3 to 10.4.0.0/16 is INET1 path to DC#1
- Path #4 to 10.4.0.0/16 is INET1 path to DC#2

PROCESS

Configuring Transit Border Routers

1. Copy the configuration from existing router to the new router
2. Configure the transit BR platform
3. Configure connectivity to the LAN
4. Configure the routing protocol for the LAN
5. Connect to the MPLS WAN or Internet
6. Configure the mGRE tunnel
7. Configure the routing protocol for the WAN
8. Configure network address translation on the firewall

For this process, you configure two transit site BRs with similar base configurations as the existing hub BRs. You have to make changes to the base configurations and the remote site routers to take advantage of the new transit site location.

The transit site BR routers have unique IP addresses and port-channel assignments, but the rest of the configuration items are the same.

Table 1 Path and IP addresses for hub BRs

Host name	Path	Path ID	Loopback IP address	Port-channel IP address	MPLS/Internet DMZ IP address
HY-MPLS1-ASR1002X-1	MPLS1	1	10.6.32.241/32	10.6.32.2/30	192.168.6.1/24
HY-INET1-ASR1002X-2	INET1	2	10.6.32.242/32	10.6.32.6/30	192.168.146.10/24

Table 2 Path and IP addresses for transit BRs

Host name	Path	Path ID	Loopback IP address	Port-channel IP address	MPLS/Internet DMZ IP address
HY-MPLS1-ASR1002X-T1	MPLS1	1	10.8.32.241/32	10.8.32.2/30	192.168.6.41/24
HY-INET1-ASR1002X-T2	INET1	2	10.8.32.242/32	10.8.32.6/30	192.168.146.11/24

Follow the process "Configuring DMVPN Hub Router," using the base PfR information from the first two hub BRs. Make the required changes from the procedures below to add a transit site to your IWAN domain.

Procedure 1 Copy the configuration from existing router to the new router

Optional

If the hardware for the corresponding transit BR is identical to the hub BR, you can use this optional procedure to copy the configuration file from one router to the other as a starting point, and then follow the procedures below. Skip this procedure if you do not want to copy the configuration from an existing router.

Step 1: Copy the running configuration from an existing router to your FTP server.

```
HY-MPLS1-ASR1002X-1# copy running-config ftp://cisco:cisco@10.4.48.27
Address or name of remote host [10.4.48.27]?
Destination filename [hy-mpls1-asr1002x-1-confg]?
Writing hy-mpls1-asr1002x-1-confg !
15884 bytes copied in 0.800 secs (12707 bytes/sec)
```

Step 2: From the console of the new transit BR, copy and paste the configuration into the router before making the changes below.

You can also make the changes below in a text editor before pasting the configuration into the router.

Procedure 2 Configure the transit BR platform

In this procedure, you configure system settings that are unique to the transit BR.

Step 1: Configure the device host name to make it easy to identify the device.

```
hostname HY-MPLS1-ASR1002X-T1
```

Step 2: Configure an in-band management interface.

The loopback interface is a logical interface that is always reachable as long as the device is powered on and any IP interface is reachable to the network.

The loopback address is commonly a host address with a 32-bit address mask.

```
interface Loopback 0
  ip address 10.8.32.241 255.255.255.255
```

Procedure 3 Configure connectivity to the LAN

Any links to adjacent distribution layers should be Layer 3 links or Layer 3 EtherChannels. Choose a unique port-channel interface from the LAN switch perspective.

Step 1: Configure a Layer 3 interface.

```
interface Port-channel1
  description IWAN-D3750X-T
  ip address 10.8.32.2 255.255.255.252
  ip pim sparse-mode
  no shutdown
```

Step 2: Configure EtherChannel member interfaces. Configure the physical interfaces to tie to the logical port-channel by using the **channel-group** command. The number for the port-channel and channel-group must match. Not all router platforms can support LACP to negotiate with the switch, so EtherChannel is configured statically.

```
interface GigabitEthernet0/0/0
 description IWAN-D3750X-T Gig1/0/1

interface GigabitEthernet0/0/1
 description IWAN-D3750X-T Gig2/0/1

interface range GigabitEthernet0/0/0, GigabitEthernet0/0/1
  no ip address
  cdp enable
  channel-group 1
  no shutdown
```

Procedure 4 Configure the routing protocol for the LAN

If you are planning to use EIGRP, choose option 1. If you are planning to use BGP on the WAN and OSPF on the LAN, choose option 2.

Option 1: EIGRP on the LAN

The following table shows the EIGRP LAN delay in use.

Table 3 EIGRP LAN delay for IWAN transit routers

LAN Interface	EIGRP LAN Delay (10 usec)
All LAN	50000

Step 1: Configure IP unicast routing using EIGRP named mode.

In this design, the tunnel, port-channel and loopback must be EIGRP interfaces. The loopback may remain a passive interface. The network range must include all interface IP addresses, either in a single network statement or in multiple network statements.

This design uses a best practice of assigning the router ID to a loopback address.

```
router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
  network 10.6.0.0 0.1.255.255
  network 10.8.0.0 0.1.255.255
  eigrp router-id 10.8.32.241
 exit-address-family
```

Step 2: Configure the EIGRP interface.

Allow EIGRP to form neighbor relationships across the interface in order to establish peering adjacencies and exchange route tables. In this step, you configure EIGRP authentication by using the authentication key specified in the previous procedure.

```
router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
  af-interface Port-channel1
   no passive-interface
   authentication mode md5
   authentication key-chain LAN-KEY
  exit-af-interface
 exit-address-family
```

Step 3: Configure the throughput delay on the LAN interface.

At the hub location where there are multiple border routers, the interface throughput delay setting should be set to influence the EIGRP routing protocol path preference.

Tech Tip

If you are using Port-channel interfaces with two Gigabit Ethernet members as recommended in this guide, you will have to double the LAN path delay to 500000 microseconds (usec), instead of the standard IWAN setting of 250000.

Set the internal LAN path to 500000 microseconds (usec). The delay command is entered in 10 usec units.

```
interface Port-channel1
  delay 50000
```

Option 2: OSPF on the LAN

Step 1: Configure OSPF Area 0 by using the loopback interface IP address as the router-id.

```
router ospf 100
 router-id 10.8.32.241
```

Step 2: Remove passive interface for the LAN interface.

```
router ospf 100
 no passive-interface Port-channel1
```

Procedure 5 Connect to the MPLS WAN or Internet

Each IWAN DMVPN hub requires a connection to the WAN transport, which for the hybrid model is either MPLS or Internet.

If you are using MPLS in this design, the DMVPN hub is connected to the service provider's MPLS PE router. The IP addressing used between IWAN CE and MPLS PE routers must be negotiated with your MPLS carrier.

If you are using the Internet in this design, the DMVPN hub is connected through a Cisco ASA 5500 using a DMZ interface specifically created and configured for a VPN termination router.

The IP address that you use for the Internet-facing interface of the DMVPN hub router must be an Internet-routable address. There are two possible methods for accomplishing this task:

- Assign a routable IP address directly to the router.
- Assign a non-routable RFC-1918 address directly to the router and use a static NAT on the Cisco ASA 5500 to translate the router IP address to a routable IP address.

This design assumes that the Cisco ASA 5500 is configured for static NAT for the DMVPN hub router.

Option 1: MPLS WAN physical WAN interface

The DMVPN design is using FVRF, so you must place the WAN interface into the VRF configured in the previous procedure.

Step 1: Enable the interface, select the VRF, and assign the IP address.

```
interface GigabitEthernet0/0/3
 vrf forwarding IWAN-TRANSPORT-1
 ip address 192.168.6.41 255.255.255.252
 no shutdown
```

Step 2: Configure the VRF-specific default routing.

The VRF created for FVRF must have its own default route to the MPLS. This default route points to the MPLS PE router's IP address and is used by DMVPN for tunnel establishment.

```
ip route vrf IWAN-TRANSPORT-1 0.0.0.0 0.0.0.0 192.168.6.42
```

Option 2: Internet WAN physical WAN interface

Step 1: The DMVPN design is using FVRF, so you must place the WAN interface into the VRF configured in Procedure 3, "Configure the WAN-facing VRF."

Step 2: Enable the interface, select the VRF, and assign the IP address.

```
interface GigabitEthernet0/0/3
 vrf forwarding IWAN-TRANSPORT-2
 ip address 192.168.146.11 255.255.255.0
 no shutdown
```

Step 3: Configure the VRF-specific default routing.

The VRF created for FVRF must have its own default route to the Internet. This default route points to the Cisco ASA 5500's DMZ interface IP address.

```
ip route vrf IWAN-TRANSPORT-2 0.0.0.0 0.0.0.0 192.168.146.1
```

Procedure 6 Configure the mGRE tunnel

The parameters in the table below are used in this procedure. Choose the row that represents the transit site BR that you are configuring. This procedure applies to the transit site BR in the IWAN hybrid design model.

Table 4 DMVPN tunnel parameters for transit BRs

Hostname	Tunnel type	Tunnel number	Tunnel IP address
HY-MPLS1-ASR1002X-T1	MPLS1	10	10.6.34.2/23
HY-INET1-ASR1002X-T2	INET1	11	10.6.36.2/23

Step 1: Configure the basic interface settings.

The tunnel number is arbitrary, but it is best to begin tunnel numbering at 10 or above, because other features deployed in this design may also require tunnels and they may select lower numbers by default.

```
interface Tunnel10
 ip address 10.6.34.2 255.255.254.0
```

Procedure 7 Configure the routing protocol for the WAN

If you are planning to use EIGRP, choose option 1. If you are planning to use BGP on the WAN and OSPF on the LAN, choose option 2.

Option 1: EIGRP on the WAN

Step 1: Configure EIGRP network summarization.

The IP assignments for the entire network were designed so they can be summarized within a few aggregate routes. As configured below, the **summary-address** command suppresses the more specific routes. If any network within the summary is present in the route table, the summary is advertised to the remote sites, which offers a measure of resiliency. If the various networks cannot be summarized, then EIGRP continues to advertise the specific routes.

```
router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
  af-interface Tunnel10
   summary-address 10.6.0.0 255.255.0.0
   summary-address 10.7.0.0 255.255.0.0
   summary-address 10.8.0.0 255.255.0.0
   summary-address 10.255.240.0 255.255.248.0
  exit-af-interface
```

Step 2: Configure EIGRP summary metrics.

Step 3: If there are many component routes to be summarized and the component routes are frequently updated, the metrics are also updated frequently, which may cause a spike in the CPU usage. The **summary-metric** command explicitly sets the metric for the summary regardless of the component route metric, which reduces the computational load on a router.

The first value is the bandwidth metric in Kbits per second. The second value is the delay metric in 10 usecs. The third value is the reliability metric where 255 is 100% reliable. The fourth value is the effective bandwidth metric (loading) where 255 is 100% loaded. The fifth value is the MTU of the path.

Tech Tip

EIGRP uses the path's minimum bandwidth as part of the metric calculation. The path's minimum bandwidth is defined in a route advertisement in the minimum bandwidth path attribute. Setting the summary metric bandwidth (first value) to 10 Mbps essentially removes the ability to differentiate between a 10 Mbps tunnel (MPLS1) and a 100 Mbps circuit (INET1) because both paths have a minimum bandwidth of 10 Mbps. Setting the summary metric bandwidth to 10 Gbps as recommended in this guide allows the calculations on the branch router to differentiate tunnel bandwidth regardless of the size of each path.

Use the identical values for each summary address defined in the previous step.

```
router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
  topology base
   summary-metric 10.6.0.0/16 10000000 10000 255 1 1500
   summary-metric 10.7.0.0/16 10000000 10000 255 1 1500
   summary-metric 10.8.0.0/16 10000000 10000 255 1 1500
   summary-metric 10.255.240.0/21 10000000 10000 255 1 1500
  exit-af-topology
```

Step 4: Configure the throughput delay on the tunnel interface.

The tunnel interface throughput delay setting should be set to influence the EIGRP routing protocol path preference. Set the primary WAN path to 10000 usec and the secondary WAN path to 20000 usec to prefer one over the other. The delay command is entered in 10 usec units.

```
interface Tunnel10
  delay 1000
```

Step 5: Tag the routes for data center (POP) affinity.

In this design, there are different IP subnets for each DMVPN network, and the EIGRP tags are clearly defined to help with readability and troubleshooting. When a design uses more than one POP site, tags are required in order to identify the different DMVPN hub router locations, which allows a remote site to prefer one POP over the other.

Outbound distribute-lists are used to set tags on the DMVPN hub routers towards the WAN. The remote-site routers use **eigrp stub-site** in order to protect against becoming transit sites.

The following tables show specific route tags in use.

Table 5 Route tag information for hub BRs at POP1

DMVPN hub	DMVPN tunnel key	Tag tunnel
HY-MPLS1-ASR1002X-1	101 (MPLS1)	101 (All routes)
HY-INET1-ASR1002X-2	102 (INET1)	102 (All routes)

Table 6 Route tag information for transit BRs at POP2

DMVPN hub	DMVPN tunnel key	Tag tunnel
HY-MPLS1-ASR1002X-T1	106 (MPLS1)	106 (All routes)
HY-INET1-ASR1002X-T2	107 (INET1)	107 (All routes)

The following examples show the hub and transit border routers in the IWAN hybrid design model.

Example: POP1 MPLS hub border router—HY-MPLS1-ASR1002X-1

```
route-map SET-TAG-ALL permit 10
 description Tag all routes advertised through the tunnel
 set tag 101

router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
   topology base
   distribute-list route-map SET-TAG-ALL out Tunnel10
```

Example: POP1 INET hub border router—HY-INET1-ASR1002X-2

```
route-map SET-TAG-ALL permit 10
 description Tag all routes advertised through the tunnel
 set tag 102

router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
   topology base
   distribute-list route-map SET-TAG-ALL out Tunnel11
```

Example: POP2 MPLS transit border router—HY-MPLS1-ASR1002X-T1

```
route-map SET-TAG-ALL permit 10
 description Tag all routes advertised through the tunnel
 set tag 106

router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
   topology base
   distribute-list route-map SET-TAG-ALL out Tunnel10
```

Example: POP2 INET transit border router—HY-INET1-ASR1002X-T2

```
route-map SET-TAG-ALL permit 10
 description Tag all routes advertised through the tunnel
 set tag 107

router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
   topology base
   distribute-list route-map SET-TAG-ALL out Tunnel11
```

Option 2: BGP on the WAN

The following table shows the tunnel DMVPN IP subnets, local preferences, community strings, and metrics in use.

Table 7 Tunnel IPs, local preferences, community strings, and metrics for hub BRs

DMVPN hub router	DMVPN Tunnels	BGP local preference	BGP community string	OSPF metric preferred POP	OSPF metric secondary POP
HY-MPLS1-ASR1002X-1	10.6.34.0/23	800 (MPLS1)	65100:100	1000	2000
HY-INET1-ASR1002X-2	10.6.36.0/23	780 (INET1)	65100:200	1200	2200

Table 8 Tunnel IPs, local preferences, community strings, and metrics for transit BRs

DMVPN hub router	DMVPN Tunnels	BGP local preference	BGP community string	OSPF metric preferred POP	OSPF metric secondary POP
HY-MPLS1-ASR1002X-T1	10.6.34.0/23	600 (MPLS1)	65100:101	1000	2000
HY-INET1-ASR1002X-T2	10.6.36.0/23	580 (INET1)	65100:202	1200	2200

Step 1: Configure BGP values for the tunnel interface. Use a private AS number for the BGP process. Assign this router's loopback address as the BGP router-id. Log the neighbor changes. Create a listen range that includes the subnet range of the tunnel interface. For internal BPG, use the same AS number for the remote sites. Create the route reflector and use the tunnel as the update source interface. Adjust the BGP hello and hold timers to 20 seconds and 60 seconds, respectively.

```
router bgp 65100
 bgp router-id 10.8.32.241
 bgp log-neighbor-changes
 bgp listen range 10.6.34.0/23 peer-group MPLS1-SPOKES
 neighbor MPLS1-SPOKES peer-group
 neighbor MPLS1-SPOKES remote-as 65100
 neighbor MPLS1-SPOKES description MPLS1 Spoke Route Reflector
 neighbor MPLS1-SPOKES update-source Tunnel10
 neighbor MPLS1-SPOKES timers 20 60
```

Step 2: Create the static null routes for the enterprise summary prefix and the site-specific prefixes.

```
ip route 10.4.0.0 255.252.0.0 Null0 254
ip route 10.8.0.0 255.255.0.0 Null0 254
ip route 10.4.0.0 255.255.0.0 Null0 254
```

Step 3: Configure the BGP address family. Define the network statements for the default network, the enterprise summary prefix, the site-specific prefixes, and the local MC loopback IP address the router will advertise to the remote sites. Configure BGP dynamic neighbors for the remote sites. Set the BGP distance and redistribute the internal networks.

```
router bgp 65100
 address-family ipv4
  bgp redistribute-internal
  network 0.0.0.0
  network 10.4.0.0 mask 255.252.0.0
  network 10.4.0.0 mask 255.255.0.0
  network 10.8.0.0 mask 255.255.0.0
  network 10.8.32.251 mask 255.255.255.255
  neighbor MPLS1-SPOKES activate
  neighbor MPLS1-SPOKES send-community
  neighbor MPLS1-SPOKES route-reflector-client
  neighbor MPLS1-SPOKES next-hop-self all
  neighbor MPLS1-SPOKES weight 50000
  neighbor MPLS1-SPOKES soft-reconfiguration inbound
  distance bgp 201 19 200
 exit-address-family
```

Step 4: Create the prefix lists for BGP.

Define the prefix-lists for the default network, the enterprise summary prefix, the site-specific prefixes, the local MC loopback IP address, and the subnet ranges for the DMVPN tunnels.

```
ip prefix-list DEFAULT-ROUTE seq 10 permit 0.0.0.0/0
ip prefix-list ENTERPRISE-PREFIX seq 10 permit 10.4.0.0/14
ip prefix-list LOCALDC-PREFIX seq 10 permit 10.4.0.0/16
ip prefix-list LOCALDC-PREFIX seq 20 permit 10.8.0.0/16
ip prefix-list LOCALMCLOOPBACK seq 10 permit 10.8.32.251/32
ip prefix-list TUNNEL-DMVPN seq 10 permit 10.6.34.0/23
```

Step 5: Create and apply the prefix route maps for BGP.

Define the route map to block prefixes inbound on the tunnel interface. Define the route map to allow prefixes to go out on the tunnel interface. Set the local preference and the community string for this DMVPN hub router. Apply the route maps to the BGP address family. Configure BGP to display communities in the format AA:NN.

Example: MPLS transit border router—HY-MPLS1-ASR1002X-T1

```
ip bgp-community new-format

route-map MPLS1-IN deny 10
 description All Blocked Prefixes to come IN on BGP
 match ip address prefix-list DEFAULT-ROUTE ENTERPRISE-PREFIX LOCALDC-PREFIX LOCALMCLOOPBACK TUNNEL-DMVPN

route-map MPLS1-IN permit 1000
 description Allow Everything Else

route-map MPLS1-OUT permit 10
 description All Allowed Prefixes to Go OUT on BGP to Spokes
 match ip address prefix-list DEFAULT-ROUTE ENTERPRISE-PREFIX LOCALDC-PREFIX LOCALMCLOOPBACK
 set local-preference 600
 set community 65100:101

router bgp 65100
 address-family ipv4
  neighbor MPLS1-SPOKES route-map MPLS1-IN in
  neighbor MPLS1-SPOKES route-map MPLS1-OUT out
exit-address-family
```

Example: INET transit border router—HY-INET1-ASR1002X-T2

```
ip bgp-community new-format

route-map INET1-IN deny 10
 description All Blocked Prefixes to come IN on BGP
 match ip address prefix-list DEFAULT-ROUTE ENTERPRISE-PREFIX LOCALDC-PREFIX LO-
CALMCLOOPBACK TUNNEL-DMVPN

route-map INET1-IN permit 1000
 description Allow Everything Else

route-map INET1-OUT permit 10
 description All Allowed Prefixes to Go OUT on BGP to Spokes
 match ip address prefix-list DEFAULT-ROUTE ENTERPRISE-PREFIX LOCALDC-PREFIX LO-
CALMCLOOPBACK
 set local-preference 580
 set community 65100:201

router bgp 65100
 address-family ipv4
  neighbor INET1-SPOKES route-map INET1-IN in
  neighbor INET1-SPOKES route-map INET1-OUT out
exit-address-family
```

Step 6: Create and apply the BGP to OSPF redistribution route map for hub BRs.

When there are two or more POP sites, there might be certain remote sites that want to prefer one POP over the other. This preference choice is done using a community string value, which is sent by the remote site router to indicate which POP they prefer.

This example uses a community string in the form of AS:NN with AS being the BGP autonomous system number and NN being the value that selects the preferred POP.

Example:

65100:10 to prefer POP 1 (hub site)

65100:20 to prefer POP 2 (transit site)

The hub and transit BRs use the community string value they receive from the remote site to determine the OSPF metric for each location.

Define the community list to classify the remote sites as preferring POP1 or POP 2. Define the route map to block null routes from being distributed into OSPF. Set the metric to the appropriate value for the POP chosen by the remote site community string value. Apply the route map to the OSPF process when redistributing BGP.

The hub location matches the POP2 community string to set the higher metric values.

Example: POP1 MPLS1 border router—HY-MPLS1-ASR1002X-1

```
ip community-list standard POP2-SPOKES permit 65100:20

route-map REDIST-BGP-TO-OSPF permit 10
 description Secondary POP2 with higher Metric
 match community POP2-SPOKES
 set metric 2000
 set metric-type type-1

route-map REDIST-BGP-TO-OSPF deny 20
 description Block Null routes to be distributed from BGP to OSPF
 match ip address prefix-list DEFAULT-ROUTE ENTERPRISE-PREFIX LOCALDC-PREFIX

route-map REDIST-BGP-TO-OSPF permit 1000
 description Prefer POP1 with lower Metric
 set metric 1000
 set metric-type type-1

router ospf 100
 redistribute bgp 65100 subnets route-map REDIST-BGP-TO-OSPF
```

Example: POP1 INET1 border router—HY-INET1-ASR1002X-2

```
ip community-list standard POP2-SPOKES permit 65100:20

route-map REDIST-BGP-TO-OSPF permit 10
 description Secondary POP2 with higher Metric
 match community POP2-SPOKES
 set metric 2200
 set metric-type type-1

route-map REDIST-BGP-TO-OSPF deny 20
 description Block Null routes to be distributed from BGP to OSPF
 match ip address prefix-list DEFAULT-ROUTE ENTERPRISE-PREFIX LOCALDC-PREFIX

route-map REDIST-BGP-TO-OSPF permit 1000
```

```
 description Prefer POP1 with lower Metric
 set metric 1200
 set metric-type type-1

router ospf 100
 redistribute bgp 65100 subnets route-map REDIST-BGP-TO-OSPF
```

Step 7: Create and apply the updated BGP to OSPF redistribution route map for transit BRs.

The POP preference route map changes from the previous step have to be applied to the corresponding transit BRs at your POP2 location.

The transit location matches the POP1 community string to set the higher metric values.

Example: POP2 MPLS1 border router—HY-MPLS1-ASR1002X-T1

```
ip community-list standard POP1-SPOKES permit 65100:10

route-map REDIST-BGP-TO-OSPF permit 10
 description Secondary POP1 with higher Metric
 match community POP1-SPOKES
 set metric 2000
 set metric-type type-1

route-map REDIST-BGP-TO-OSPF deny 20
 description Block Null routes to be distributed from BGP to OSPF
 match ip address prefix-list DEFAULT-ROUTE ENTERPRISE-PREFIX LOCALDC-PREFIX

route-map REDIST-BGP-TO-OSPF permit 1000
 description Prefer POP2 with lower Metric
 set metric 1000
 set metric-type type-1

router ospf 100
 redistribute bgp 65100 subnets route-map REDIST-BGP-TO-OSPF
```

Example: POP2 INET1 border router—HY-INET1-ASR1002X-T2

```
ip community-list standard POP1-SPOKES permit 65100:10

route-map REDIST-BGP-TO-OSPF permit 10
 description Secondary POP1 with higher Metric
 match community POP1-SPOKES
 set metric 2200
 set metric-type type-1

route-map REDIST-BGP-TO-OSPF deny 20
 description Block Null routes to be distributed from BGP to OSPF
 match ip address prefix-list DEFAULT-ROUTE ENTERPRISE-PREFIX LOCALDC-PREFIX

route-map REDIST-BGP-TO-OSPF permit 1000
 description Prefer POP2 with lower Metric
 set metric 1200
 set metric-type type-1

router ospf 100
 redistribute bgp 65100 subnets route-map REDIST-BGP-TO-OSPF
```

Procedure 8 Configure network address translation on the firewall

You have to add the transit site Internet BR to your firewall configuration for network address translation.

The DMZ network uses private network (RFC 1918) addressing that is not Internet-routable, so the firewall must translate the DMZ address of the DMVPN hub router to an outside public address.

The example DMZ address to public IP address mapping is shown in the following table.

Table 9 DMVPN NAT address mapping

Hostname	DMVPN hub router DMZ address	DMVPN hub router public address (externally routable after NAT)
HY-INET1-ASR1002X-T2	192.168.146.13	172.16.140.2 (ISP-A)

First, to simplify the configuration of the security policy, you create the External DMZ network objects that are used in the firewall policies.

Table 10 External DMZ firewall network objects

Network object name	Object type	IP address	Description
outside-dmvpn-T2-ISPa	Host	172.16.140.2	DMVPN hub router T2 on ISP A (outside)

Step 1: Navigate to **Configuration > Firewall > Objects > Network Objects/Groups**.

Step 2: Click **Add > Network Object**.

The Add Network Object dialog box appears.

Step 3: In the **Name** box, enter the name. (Example: outside-dmvpn-T2-ISPa)

Step 4: In the **Type** list, choose **Host** or **Network**. (Example: Host)

Step 5: In the **IP Address** box, enter the address. (Example: 172.16.140.2)

Step 6: In the **Description** box, enter a useful description, and then click **OK**. (Example: DMVPN hub router T2 on ISP A)

Step 7: Repeat Step 2 through Step 6 for each object listed in the above table. If an object already exists, then skip to the next object listed in the table.

Step 8: After adding all of the objects listed, on the Network Objects/Groups pane, click **Apply**.

Next, you add a network object for the private DMZ address of the DMVPN hub router.

Table 11 Private DMZ firewall network objects

Network object name	Object type	IP address	Description
dmz-dmvpn-T2	Host	192.168.146.13	DMVPN hub router T2 on vpn-dmz

Step 9: Navigate to **Configuration > Firewall > Objects > Network Objects/Groups**.

Step 10: Click **Add > Network Object**.

The Add Network Object dialog box appears.

Step 11: In the **Name** box, enter the name. (Example: dmz-dmvpn-T2)

Step 12: In the **Type** list, choose **Host** or **Network**. (Example: Host)

Step 13: In the **IP Address** box, enter the address. (Example: 192.168.146.13)

Step 14: In the **Description** box, enter a useful description, and then click **OK**. (Example: DMVPN hub router T2 on vpn-dmz)

Step 15: Click the two down arrows. The NAT pane expands.

Step 16: Select **Add Automatic Address Translation Rules**.

Step 17: In the **Translated Address** list, choose the network object created previously. (Example: outside-dm-vpn-T2-ISPa)

Step 18: Select **Use one-to-one address translation**, and then click **OK**.

Step 19: Repeat Step 10 through Step 18 for each object listed in the table above. If an object already exists, then skip to the next object listed in the table.

Step 20: After adding all of the objects listed, on the Network Objects/Groups pane, click **Apply**.

PROCESS

Configuring Transit Master Controller

1. Copy the configuration from existing router to the new router
2. Configure the transit MC platform
3. Configure connectivity to the LAN
4. Configure the routing protocol on the LAN

For this process, you configure a transit MC with a similar base configuration as the existing hub MC. You have to make changes to the base configuration and the remote site routers in order to take advantage of the new transit site location.

The additional MC router has a unique pop-id, IP addresses and port-channel assignments, and a much simpler PfR MC configuration, but the rest of the configuration is the same. The hub MC has a default pop-id of 0 and transit MCs pop-id start at 1.

Table 12 Hub and transit site MC IP addresses

Host name	Pop ID	Loopback IP address	Port-channel IP address
HY-MC-CSR1000v-1	0	10.6.32.251/32	10.6.32.151/25
HY-MC-ASR1002X-T1	1	10.8.32.251/32	10.8.32.151/25

Follow the process “Configuring Hub Master Controller” using the base PfR information from the hub MC. Make the required changes from the procedures below in order to add a transit site to your IWAN domain.

Procedure 1 Copy the configuration from existing router to the new router

Optional

If the hardware for the transit MC is identical to the hub MC, you can use this optional procedure to copy the configuration file from one router to the other as a starting point, and then follow the procedures below. Skip this procedure if you do not want to copy the configuration from an existing router.

Step 1: Copy the running configuration from an existing router to your FTP server.

```
HY-MC-CSR1000v-1# copy running-config ftp://cisco:cisco@10.4.48.27
Address or name of remote host [10.4.48.27]?
Destination filename [hy-mc-csr100v-1-confg]?
Writing hy-mc-csr100v-1-confg !
7856 bytes copied in 0.800 secs (9820 bytes/sec)
```

Step 2: From the console of the new transit MC, copy and paste the configuration into the router before making the changes below.

You can also make the changes below in a text editor before pasting the configuration into the router.

Procedure 2 Configure the transit MC platform

In this procedure, you configure system settings that are unique to the transit MC.

Step 1: Configure the device host name to make it easy to identify the device.

```
hostname HY-MC-ASR1002X-T1
```

Step 2: Configure an in-band management interface.

The loopback interface is a logical interface that is always reachable as long as the device is powered on and any IP interface is reachable to the network.

The loopback address is commonly a host address with a 32-bit address mask.

```
interface Loopback 0
  ip address 10.8.32.151 255.255.255.255
```

Step 3: Configure IP unicast routing using EIGRP named mode.

EIGRP is configured facing the LAN distribution or core layer. In this design, the port-channel interface and the loopback must be EIGRP interfaces. The loopback may remain a passive interface. The network range must include both interface IP addresses, either in a single network statement or in multiple network statements.

This design uses a best practice of assigning the router ID to a loopback address.

```
router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
  af-interface default
   passive-interface
  exit-af-interface
 network 10.8.0.0 0.1.255.255
 eigrp router-id 10.8.32.151
 exit-address-family
```

Procedure 3 Configure connectivity to the LAN

Any links to adjacent distribution layers should be Layer 3 links or Layer 3 EtherChannels.

Step 1: Configure a Layer 3 interface.

```
interface Port-channel21
  description IW-WAN-D3750X-T
  ip address 10.8.32.151 255.255.255.192
  no shutdown
```

Step 2: Configure EtherChannel member interfaces.

Configure the physical interfaces to tie to the logical port-channel by using the **channel-group** command. The number for the port-channel and channel-group must match. Not all router platforms can support LACP to negotiate with the switch, so EtherChannel is configured statically.

```
interface GigabitEthernet0/0/0
 description IW-WAN-D3750X-T Gig1/0/3

interface GigabitEthernet0/0/1
 description IW-WAN-D3750X-T Gig2/0/3

interface range GigabitEthernet0/0/0, GigabitEthernet0/0/1
  no ip address
  cdp enable
  channel-group 21
  no shutdown
```

Procedure 4 Configure the routing protocol on the LAN

If you are planning to use EIGRP, choose option 1. If you are planning to use BGP on the WAN and OSPF on the LAN, choose option 2.

Option 1: EIGRP on the LAN

Step 1: Configure IP unicast routing using EIGRP named mode.

The network range must include both interface IP addresses, either in a single network statement or in multiple network statements.

This design uses a best practice of assigning the router ID to a loopback address.

```
router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
  network 10.8.0.0 0.1.255.255
  eigrp router-id 10.8.32.151
 exit-address-family
```

Step 2: Configure the EIGRP interface.

Allow EIGRP to form neighbor relationships across the interface to establish peering adjacencies and exchange route tables. In this step, you configure EIGRP authentication by using the authentication key specified in the previous procedure.

```
router eigrp IWAN-EIGRP
 address-family ipv4 unicast autonomous-system 400
  af-interface Port-channel21
   no passive-interface
   authentication mode md5
   authentication key-chain LAN-KEY
  exit-af-interface
 exit-address-family
```

Option 2: OSPF on the LAN

Step 1: Configure OSPF Area 0 by using the network summary addresses and the loopback interface IP address as the router-id.

```
router ospf 100
 router-id 10.8.32.251
 network 10.8.32.128 0.0.0.63 area 0
 network 10.8.32.251 0.0.0.0 area 0
```

Step 2: Turn on passive-interface as the default and remove it for the LAN interface.

```
router ospf 100
 passive-interface default
 no passive-interface Port-channel21
```

PROCESS

Configuring PfR for Transit Location

1. Verify IP connectivity to remote site loopback interfaces
2. Configure prefixes for the data center
3. Configure PfR domain in the transit MC
4. Configure PfR domain in the transit BR
5. Verify PfR domain is operational on the transit MC

After the transit BRs and MC are configured, you will configure PfR for the transit site location.

Procedure 1 Verify IP connectivity to remote site loopback interfaces

It is mandatory to use loopback interfaces for the peering traffic between the BR and MC routers. For this design, you put the loopback addresses into a specific subnet range, so they are easily identified in the routing table. The loopback address ranges for the remote sites are as follows:

Table 13 Remote-site loopback IP address ranges

IWAN design model	Tunnel type	Loopback 0 address range
Hybrid—Primary Router	MPLS1	10.255.241.0/24
Hybrid—Secondary Router	INET1	10.255.242.0/24

Step 1: Verify that the loopback 0 interfaces on each of your remote sites are reachable from the transit MC by using the **show ip route** command.

This example shows a loopback address range of 10.255.241.0/24 for nine remote site primary routers and an address range of 10.255.242.0/24 for four remote site secondary routers.

```
HY-MC-ASR1002X-T1# show ip route | include 10.255.241
D        10.255.241.11/32 [90/25610880] via 10.8.32.129, 1w2d, Port-channel21
D        10.255.241.12/32 [90/25610880] via 10.8.32.129, 1w2d, Port-channel21
D        10.255.241.31/32 [90/25610880] via 10.8.32.129, 1w2d, Port-channel21
D        10.255.241.32/32 [90/25610880] via 10.8.32.129, 1w2d, Port-channel21
D        10.255.241.41/32 [90/25610880] via 10.8.32.129, 1w2d, Port-channel21
D        10.255.241.42/32 [90/25610880] via 10.8.32.129, 1w2d, Port-channel21
D        10.255.241.51/32 [90/25610880] via 10.8.32.129, 1w3d, Port-channel21

MC-HY-ASR1002X-T1#show ip route | include 10.255.242
D        10.255.242.12/32 [90/25613440] via 10.8.32.129, 1w1d, Port-channel21
D        10.255.242.32/32 [90/25613440] via 10.8.32.129, 1w2d, Port-channel21
D        10.255.242.42/32 [90/25613440] via 10.8.32.129, 1w2d, Port-channel21
```

Procedure 2 Configure prefixes for the data center

Before the configuration of PfRv3 on the transit MC, you must create prefix lists for the data center. The enterprise-prefix list is only configured on the hub MC and you will not configure one on the transit MC.

The site-prefix range for the transit site includes the prefixes at this specific site, which is normally a WAN aggregation or data center site. Site-prefixes are typically statically defined at WAN aggregation and DC sites and discovered automatically at remote sites.

Tech Tip

The ip prefix-list options ge and le are not supported by PfR.

Step 1: Create the transit site prefix list.

```
ip prefix-list [prefix-list-name] seq [value] permit [prefix list]
```

Example

This example shows a data center network with two class B private address blocks of 10.4.0.0 and 10.8.0.0.

```
ip prefix-list DC2-PREFIXES seq 10 permit 10.4.0.0/16
ip prefix-list DC2-PREFIXES seq 20 permit 10.8.0.0/16
```

Procedure 3 Configure PfR domain in the transit MC

Domain policies are configured on the hub MC. These policies are distributed to branch MCs and the transit MC by using the peering infrastructure. All sites that are in the same domain will share the same set of PfR policies. The transit MC must peer to the hub MC to get the policy information.

Step 1: Create the transit MC domain.

```
domain [name]
 vrf [name]
  master transit [number]
   source-interface [interface]
   site-prefixes prefix-list [prefixes from previous procedure]
   password [password of hub MC]
   hub [IP address of hub MC]
```

Example

```
domain iwan
 vrf default
  master transit 1
   source-interface Loopback0
   site-prefixes prefix-list DC2-PREFIXES
   password c1sco123
   hub 10.6.32.251
```

Step 2: Verify the hub MC policy configuration is available by using the **show domain [name] master policy** command.

The output from this command should look the same as the output on the hub MC.

Procedure 4 Configure PfR domain in the transit BR

The transit BRs are also the DMVPN hub WAN aggregation routers for the transit site network. The PfRv3 configurations for standalone BRs are much simpler because they dynamically learn their policy information from the transit MC. The transit BR routers are also used to advertise the path names and path-ids specified in the hub MC configuration.

There is an optional feature called *zero-SLA* that reduces the probing to only the default class by muting the other DSCP probes. This feature is useful on Internet connections where nothing is guaranteed. Zero-SLA reduces bandwidth usage on metered interfaces such as 4G LTE or other Internet connections with a monthly data cap limit.

Tech Tip

If you want to add the zero-SLA feature to an existing hub BR, you must shut down the DMVPN tunnel interface before configuring. After the feature is added to the hub BR, bring the tunnel interface back up.

Table 14 Transit BR path and IP addresses

Host name	Path	Path ID	Loopback IP address	Zero SLA
HY-MPLS1-ASR1002X-T1	MPLS1	1	10.8.32.241/32	No
HY-INET1-ASR1002X-T2	INET1	2	10.8.32.242/32	Yes (optional)

Step 1: Create the transit BR domain.

```
domain [name]
 vrf [name]
  border (create the BR)
   source-interface [interface]
   master [IP address of transit MC]
   password [password of hub MC]
```

Example

```
domain iwan
 vrf default
  border
   source-interface Loopback0
   master 10.8.32.251
   password c1sco123
```

Step 2: Add the path names and path-ids to the tunnel interfaces of the transit BR.

```
interface Tunnel [value]
 domain [name] path [name] path-id [number] zero-sla
```

Example

This example is the primary transit BR using Tunnel 10 with MPLS as the provider.

```
interface Tunnel10
 domain iwan path MPLS1 path-id 1
```

Step 3: (Optional) This example is the secondary hub BR using Tunnel 11 with INET as the provider and the zero-sla feature. If this is an existing configuration, you shut down the interface, add the zero SLA feature. and then bring the interface back up.

```
interface Tunnel11
 shutdown
 domain iwan path INET1 path-id 2 zero-sla
 no shutdown
```

Step 4: Verify the border is operational by using the **show domain [name] border status** command.

Step 5: Repeat this procedure for each transit BR by using the appropriate path name and path-id.

Procedure 5 Verify PfR domain is operational on the transit MC

The PfR path names and path-ids are automatically discovered at the remote site routers from the configuration entered into the tunnel interfaces at the hub and transit sites. The hub MC uses the path names and path-ids to determine where traffic should be sent according to its policies.

Step 1: Verify the domain is operational from the transit MC using the **show domain [name] master status** command.

PROCESS

Configuring Remote-Site Routers for Transit Site BRs

1. Configure NHRP at remote site
2. Configure POP selection at remote site

There are additional commands you need to configure at a remote site to begin using the transit site BRs.

Procedure 1 Configure NHRP at remote site

An additional NHRP command has to be added to the tunnel interfaces of remote site BRs for them to begin using the transit BRs.

Table 15 NHRP parameters

Hostname	Tunnel type	Tunnel number	Tunnel IP address	MPLS/public IP address
HY-MPLS1-ASR1002X-T1	MPLS1	10	10.6.34.2	192.168.6.41
HY-INET1-ASR1002X-T2	INET1	11	10.6.36.2	172.16.140.2 (ISP A)

Step 1: Configure NHRP.

The DMVPN hub router is the NHRP server for all of the spokes. Remote routers use NHRP in order to determine the tunnel destinations for peers attached to the mGRE tunnel.

The spoke router requires an additional configuration statement in order to define the NHRP server. This statement includes the NBMA definition for the DMVPN hub router tunnel endpoint. Spoke routers require the NHRP multicast keyword in this statement.

The value used for the NHS is the mGRE tunnel address for the DMVPN hub router. The NBMA entry must be set to either the MPLS DMVPN hub router's actual public address or the outside NAT value of the DMVPN hub, as configured on the Cisco ASA 5500. This design uses the values shown in the table above.

Example: Single-router remote site for hybrid—RS11-2921

```
interface Tunnel10
 ip nhrp nhs 10.6.34.2 nbma 192.168.6.41 multicast

interface Tunnel11
 ip nhrp nhs 10.6.36.2 nbma 172.16.140.2 multicast
```

Step 2: Confirm the hub and transit BRs are reachable with **show ip eigrp neighbors**.

```
RS11-2921#show ip eigrp neighbors
EIGRP-IPv4 VR(IWAN-EIGRP) Address-Family Neighbors for AS(400)
H   Address      Interface     Hold Uptime   SRTT  RTO  Q   Seq
                               (sec)         (ms)       Cnt  Num
3   10.6.36.1    Tu11           55  1w3d       1   100  0   7806
2   10.6.34.1    Tu10           55  5w5d       1   100  0   17528
0   10.6.34.2    Tu10           57  5w5d       1   100  0   8851
1   10.6.36.2    Tu11           56  5w5d       1   100  0   16134
```

Step 3: Repeat this procedure for each remote site that will use the transit BRs.

Procedure 2 Configure POP selection at remote site

If you are planning to use EIGRP, choose option 1. If you are planning to use BGP on the WAN and OSPF on the LAN, choose option 2.

Option 1: EIGRP on the WAN

The following tables show specific EIGRP route tags in use from the previous procedure.

Table 16 Route tag information for hub location

Tunnel interface	DMVPN tunnel key	Tag tunnel	Metric
Tunnel 10 (DMVPN 1)	101 (MPLS1)	101 (All routes)	+10000
Tunnel 11 (DMVPN 2)	102 (INET1)	102 (All routes)	+20000

Table 17 Route tag information for transit location

Tunnel interface	DMVPN tunnel key	Tag tunnel	Metric
Tunnel 10 (DMVPN 1)	106 (MPLS1)	106 (All routes)	+10000
Tunnel 11 (DMVPN 2)	107 (INET1)	107 (All routes)	+20000

Set the EIGRP metric value higher for the routes tagged from the non-preferred site.

Step 1: Define the route maps to identify the tags from border routers in POP1 and POP 2.

Example: Single-router remote site that prefers POP1

```
route-map POP-SELECT permit 10
 description Prefer POP1 for MPLS1
 match tag 106
 set metric +10000

route-map POP-SELECT permit 50
 description Prefer POP1 for INET1
 match tag 107
 set metric +20000

route-map POP-SELECT permit 100
 description Allow the rest
```

Example: Single-router remote site that prefers POP2

```
route-map POP-SELECT permit 10
 description Prefer POP2 for MPLS1
 match tag 101
 set metric +10000

route-map POP-SELECT permit 50
 description Prefer POP2 for INET1
 match tag 102
 set metric +20000

route-map POP-SELECT permit 100
 description Allow the rest
```

Step 2: Apply the POP select route map on the inbound tunnel interfaces.

```
router eigrp IWAN-EIGRP

 address-family ipv4 unicast autonomous-system 400

  topology base
   distribute-list route-map POP-SELECT in Tunnel10
   distribute-list route-map POP-SELECT in Tunnel11
  exit-af-topology
```

Step 3: Repeat this process for each remote site that will use the transit BRs.

Option 2: BGP on the WAN

Table 18 Local preferences, community strings, and metrics for hub BRs at POP1

Transport	BGP local preference	BGP community string	OSPF metric preferred POP	OSPF metric secondary POP
MPLS1	800	65100:100	1000	2000
INET1	780	65100:200	1200	2200

Table 19 Local preferences, community strings, and metrics for transit BRs at POP2

Transport	BGP local preference	BGP community string	OSPF metric preferred POP	OSPF metric secondary POP
MPLS1	600 (MPLS1)	65100:101	1000	2000
INET1	580 (INET1)	65100:202	1200	2200

Step 1: Configure BGP to display communities in the format AA:NN.

```
ip bgp-community new-format
```

Step 2: Define the community lists to identify the border routers from POP1 and POP 2.

```
ip community-list standard POP1-MPLS1 permit 65100:100
ip community-list standard POP1-INET1 permit 65100:200

ip community-list standard POP2-MPLS1 permit 65100:101
ip community-list standard POP2-INET1 permit 65100:201
```

Step 3: Create the inbound route maps and update the outbound route map.

Update the outbound route map with a community string to signal the POP preference to the border routers.

Example:

65100:10 to prefer POP 1 (hub site)

65100:20 to prefer POP 2 (transit site)

Use a community string in the form of AS:NN with AS being the BGP autonomous system number and NN being the value that selects the preferred POP.

On the inbound route maps, set the local preference higher for preferred POP border routers.

Example: Single-router remote site that prefers POP1

```
route-map SPOKE-OUT permit 10
 description Prefer POP1 with community 65100:10
 set community 65100:10

route-map POP-SELECT permit 100
 description Prefer POP1 with higher LP
 match community POP1-MPLS1
 set local-preference 800

route-map POP-SELECT permit 120
```

```
 description Prefer POP1 with higher LP
 match community POP1-INET1
 set local-preference 780

route-map POP-SELECT permit 200
 match community POP2-MPLS1
 set local-preference 600

route-map POP-SELECT permit 220
 match community POP2-INET1
 set local-preference 580

route-map POP-SELECT permit 1000
 description If no match do not set LP
```

Example: Single-router remote site that prefers POP2

```
route-map SPOKE-OUT permit 10
 description Prefer POP2 with community 65100:20
 set community 65100:20

route-map POP-SELECT permit 100
 match community POP1-MPLS1
 set local-preference 600

route-map POP-SELECT permit 120
 match community POP1-INET1
 set local-preference 580

route-map POP-SELECT permit 200
 description Prefer POP2 with higher LP
 match community POP2-MPLS1
 set local-preference 800

route-map POP-SELECT permit 220
 description Prefer POP2 with higher LP
 match community POP2-INET1
```

```
 set local-preference 780

route-map POP-SELECT permit 1000
 description If no match do not set LP
```

Step 4: Apply the POP select route map on the inbound WAN transports.

```
router bgp 65100
 address-family ipv4
  neighbor MPLS1-HUB route-map POP-SELECT in
  neighbor INET1-HUB route-map POP-SELECT in
```

Step 5: Repeat this process for each remote site that will use the transit BRs.

Appendix A: Product List

To view the full list of IWAN-supported routers for this version of the CVD, see Supported Cisco Platforms and Software Releases.

Appendix B: Changes

This appendix summarizes the changes Cisco made to this guide since its last edition.

- Routing updates:
    - Simplified the EIGRP tagging and removed the filtering that was no longer needed
    - Added the EIGRP data center affinity use case to hub and remote sites
- Guide updates:
    - This new guide is one in a series of IWAN advanced deployment guides.

Please use the feedback form to send comments and suggestions about this guide.

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