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Intelligent WAN

Configuration Files Guide

January 2015



Table of Contents

Preface.....	1
Introduction	2
Product List	4
IOS Certificate Authority	9
IWAN-IOS-CA	10
WAN-Aggregation Site–IWAN Hybrid Design Model.....	16
PFR-MC-ASR-1004-1	17
VPN-MPLS-ASR1002X-1: Primary WAN link.....	22
VPN-INET-4451X-2: Secondary WAN link.....	31
WAN Remote-Site Devices–IWAN Hybrid Design Model.....	41
Remote Site 11: Single-Router, Dual-Link (MPLS and INET).....	42
RS11-2921: Primary and secondary WAN links.....	42
Remote Site 12: Dual-Router, Dual-Link (MPLS and INET)	53
RS12-2911-1: Primary WAN link.....	53
RS12-2911-2: Secondary WAN link	63
Remote Site 51: Single-Router, Dual-Link (MPLS and INET w/ 4G LTE Fallback).....	73
RS51-2921: Primary, secondary and tertiary WAN links.....	73
WAN-Aggregation Devices–IWAN Dual Internet Design Model	88
PFR-MC-ASR-1004-2.....	89
VPN-INET-ASR1002X-3: Primary WAN link.....	94
VPN-INET-ASR1002X-4: Secondary WAN link.....	103
WAN Remote-Site Devices–IWAN Dual Internet Design Model	114
Remote Site 13: Single-Router, Dual-Link (INET1 and INET2).....	115
RS13-2911: Primary and secondary WAN links.....	115
Remote Site 14: Dual-Router, Dual-Link (INET1 and INET2).....	128
RS14-2921-1: Primary WAN link	128
RS14-2921-2: Secondary WAN link.....	138

Preface

Cisco Validated Designs (CVDs) present systems that are based on common use cases or engineering priorities. CVDs incorporate a broad set of technologies, features, and applications that address customer needs. Cisco engineers have comprehensively tested and documented each design in order to ensure faster, more reliable, and fully predictable deployment.

CVDs include two guide types that provide tested design details:

- **Technology design guides** provide deployment details, information about validated products and software, and best practices for specific types of technology.
- **Solution design guides** integrate existing CVDs but also include product features and functionality across Cisco products and sometimes include information about third-party integration.

Both CVD types provide a tested starting point for Cisco partners or customers to begin designing and deploying systems.

CVD Foundation Series

This CVD Foundation guide is a part of the *January 2015 Series*. As Cisco develops a CVD Foundation series, the guides themselves are tested together, in the same network lab. This approach assures that the guides in a series are fully compatible with one another. Each series describes a lab-validated, complete system.

The CVD Foundation series incorporates wired and wireless LAN, WAN, data center, security, and network management technologies. Using the CVD Foundation simplifies system integration, allowing you to select solutions that solve an organization's problems—without worrying about the technical complexity.

To ensure the compatibility of designs in the CVD Foundation, you should use guides that belong to the same release. For the most recent CVD Foundation guides, please visit [the CVD Foundation web site](#).

Comments and Questions

If you would like to comment on a guide or ask questions, please use the [feedback form](#).

Introduction

The Cisco Intelligent WAN (IWAN) solution provides design and implementation guidance for organizations looking to deploy wide area network (WAN) transport with a transport-independent design (TID), intelligent path control, application optimization, and secure encrypted communications between branch locations while reducing the operating cost of the WAN. IWAN takes full advantage of cost-effective transport services in order to increase bandwidth capacity without compromising performance, reliability, or security of collaboration or cloud-based applications.

This document provides the available configuration files for the products used in the [Intelligent WAN Technology Design Guide](#). It is a companion document to the design guide as a reference for engineers who are evaluating or deploying the CVD.

Both this guide and the [Intelligent WAN Technology Design Guide](#) provide the complete list of products used in the lab-testing of this design.

The first design model is the IWAN Hybrid, which uses MPLS paired with Internet VPN as WAN transports. In this design model, the MPLS WAN can provide more bandwidth for the critical classes of services needed for key applications and can provide SLA guarantees for these applications. The second design model is the IWAN Dual Internet, which uses a pair of Internet service providers to further reduce cost while maintaining a high level of resiliency for the WAN. A third design model, the IWAN Dual MPLS, is not covered in this guide.

Figure 1 - IWAN hybrid model-WAN aggregation site overview

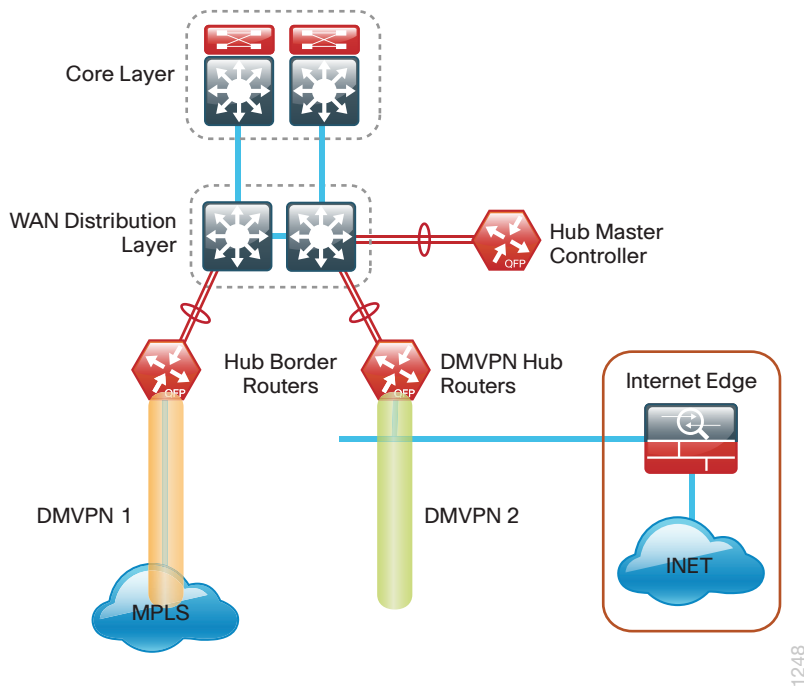


Figure 2 - IWAN dual Internet model–WAN aggregation site overview

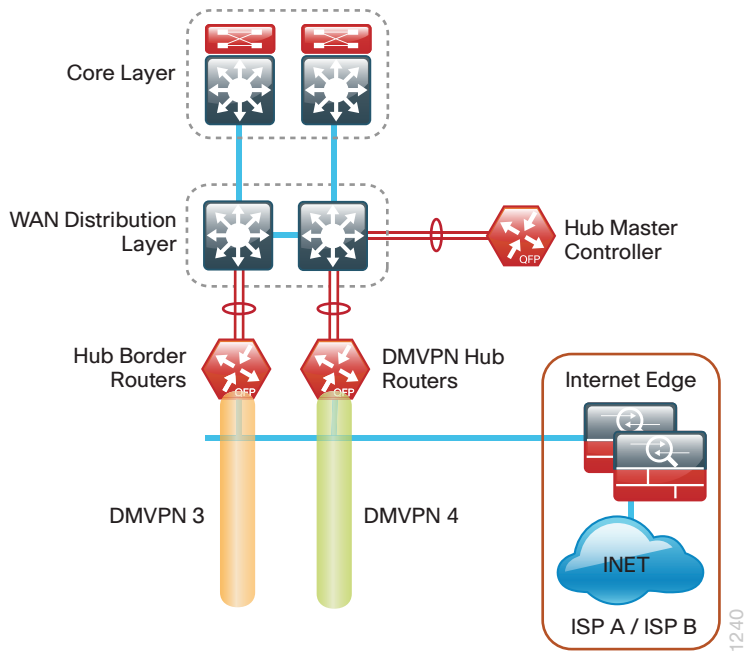
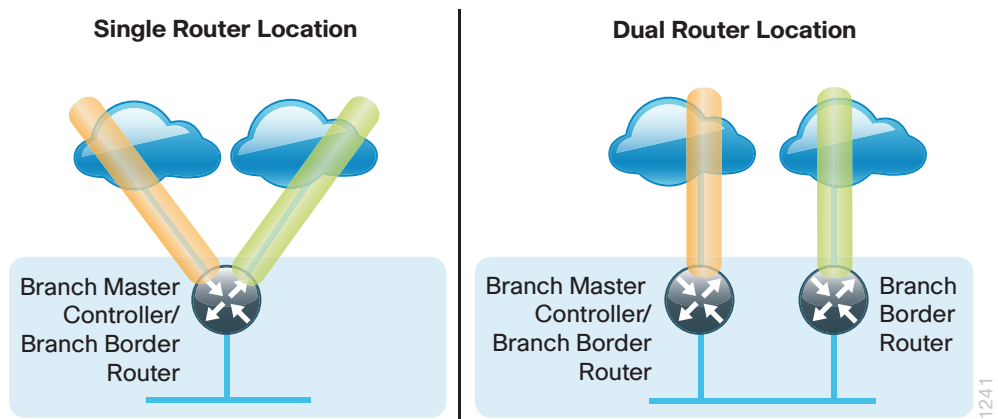


Figure 3 - IWAN–Remote-site overview



Product List

WAN Aggregation

Place In Network	Product Description	Part Number	SW Version	Feature Set
WAN-aggregation Router	Aggregation Services 1002X Router	ASR1002X-5G-VPNK9	IOS-XE 15.5(1)S	Advanced Enterprise
	Cisco ISR 4451-X Security Bundle w/SEC license PAK	ISR4451-X-SEC/K9	IOS-XE 15.5(1)S	securityk9

WAN Remote Site

Place In Network	Product Description	Part Number	SW Version	Feature Set
Modular WAN Remote-site Router	Cisco ISR 4451 w/ 4GE,3NIM,2SM,8G FLASH, 4G DRAM, IP Base, SEC, AX license with: DATA, AVC, ISR-WAAS with 2500 connection RTU	ISR4451-X-AX/K9	IOS-XE 15.5(1)S	securityk9, appxk9
	Cisco ISR 3945 w/ SPE150, 3GE, 4EHWIC, 4DSP, 4SM, 256MBCF, 1GBDRAM, IP Base, SEC, AX licenses with; DATA, AVC, and WAAS/vWAAS with 2500 connection RTU	C3945-AX/K9	15.4(3)M1	securityk9, datak9, uck9
	Cisco ISR 3925 w/ SPE100 (3GE, 4EHWIC, 4DSP, 2SM, 256MBCF, 1GBDRAM, IP Base, SEC, AXlicenses with; DATA, AVC, WAAS/vWAAS with 2500 connection RTU	C3925-AX/K9	15.4(3)M1	securityk9, datak9, uck9
	Unified Communications Paper PAK for Cisco 3900 Series	SL-39-UC-K9		
	Cisco ISR 2951 w/ 3 GE, 4 EHWIC, 3 DSP, 2 SM, 256MB CF, 1GB DRAM, IP Base, SEC, AX license with; DATA, AVC, and WAAS/vWAAS with 1300 connection RTU	C2951-AX/K9	15.4(3)M1	securityk9, datak9, uck9
	Cisco ISR 2921 w/ 3 GE, 4 EHWIC, 3 DSP, 1 SM, 256MB CF, 1GB DRAM, IP Base, SEC, AX license with; DATA, AVC, and WAAS/vWAAS with 1300 connection RTU	C2921-AX/K9	15.4(3)M1	securityk9, datak9, uck9
	Cisco ISR 2911 w/ 3 GE,4 EHWIC, 2 DSP, 1 SM, 256MB CF, 1GB DRAM, IP Base, SEC, AX license with; DATA, AVC and WAAS/vWAAS with 1300 connection RTU	C2911-AX/K9	15.4(3)M1	securityk9, datak9, uck9
	Unified Communications Paper PAK for Cisco 2900 Series	SL-29-UC-K9		
	Cisco ISR 1941 Router w/ 2 GE, 2 EHWIC slots, 256MB CF, 2.5GB DRAM, IP Base, DATA, SEC, AX license with; AVC and WAAS-Express	C1941-AX/K9	15.4(3)M1	securityk9, datak9

Internet Edge

Place In Network	Product Description	Part Number	SW Version	Feature Set
Firewall	Cisco ASA 5545-X IPS Edition - security appliance	ASA5545-IPS-K9	ASA 9.1(5), IPS 7.1(8p2) E4	
	Cisco ASA 5525-X IPS Edition - security appliance	ASA5525-IPS-K9	ASA 9.1(5), IPS 7.1(8p2) E4	
	Cisco ASA 5515-X IPS Edition - security appliance	ASA5515-IPS-K9	ASA 9.1(5), IPS 7.1(8p2) E4	
	Cisco ASA 5512-X IPS Edition - security appliance	ASA5512-IPS-K9	ASA 9.1(5), IPS 7.1(8p2) E4	
	Cisco ASA 5512-X Security Plus license	ASA5512-SEC-PL		
	Firewall Management	ASDM	7.1(6)	

Internet Edge LAN

Place In Network	Product Description	Part Number	SW Version	Feature Set
DMZ Switch	Cisco Catalyst 2960-X Series 24 10/100/1000 PoE and 2 SFP+ Uplink	WS-C2960X-24PS	15.0(2)EX5	LAN Base
	Cisco Catalyst 2960-X FlexStack-Plus Hot-Swappable Stacking Module	C2960X-STACK		

LAN Access Layer

Place In Network	Product Description	Part Number	SW Version	Feature Set
Modular Access Layer Switch	Cisco Catalyst 4500E Series 4507R+E 7-slot Chassis with 48Gbps per slot	WS-C4507R+E	3.3.1XO(15.1.1XO1)	IP Base
	Cisco Catalyst 4500E Supervisor Engine 8-E, Unified Access, 928Gbps	WS-X45-SUP8-E	3.3.1XO(15.1.1XO1)	IP Base
	Cisco Catalyst 4500E 12-port 10GbE SFP+ Fiber Module	WS-X4712-SFP+E		
	Cisco Catalyst 4500E 48-Port 802.3at PoE+ 10/100/1000 (RJ-45)	WS-X4748-RJ45V+E		
	Cisco Catalyst 4500E Series 4507R+E 7-slot Chassis with 48Gbps per slot	WS-C4507R+E	3.5.3E(15.2.1E3)	IP Base
	Cisco Catalyst 4500E Supervisor Engine 7L-E, 520Gbps	WS-X45-SUP7L-E	3.5.3E(15.2.1E3)	IP Base
	Cisco Catalyst 4500E 48 Ethernet 10/100/1000 (RJ45) PoE+,UPoE ports	WS-X4748-UPOE+E		
	Cisco Catalyst 4500E 48 Ethernet 10/100/1000 (RJ45) PoE+ ports	WS-X4648-RJ45V+E		

Place In Network	Product Description	Part Number	SW Version	Feature Set
Stackable Access Layer Switch	Cisco Catalyst 3850 Series Stackable 48 Ethernet 10/100/1000 PoE+ ports	WS-C3850-48F	3.3.3SE(15.0.1EZ3)	IP Base
	Cisco Catalyst 3850 Series Stackable 24 Ethernet 10/100/1000 PoE+ Ports	WS-C3850-24P	3.3.3SE(15.0.1EZ3)	IP Base
	Cisco Catalyst 3850 Series 2 x 10GE Network Module	C3850-NM-2-10G		
	Cisco Catalyst 3850 Series 4 x 1GE Network Module	C3850-NM-4-1G		
	Cisco Catalyst 3650 Series 24 Ethernet 10/100/1000 PoE+ and 2x10GE or 4x1GE Uplink	WS-C3650-24PD	3.3.3SE(15.0.1EZ3)	IP Base
	Cisco Catalyst 3650 Series 24 Ethernet 10/100/1000 PoE+ and 4x1GE Uplink	WS-C3650-24PS	3.3.3SE(15.0.1EZ3)	IP Base
	Cisco Catalyst 3650 Series Stack Module	C3650-STACK		
	Cisco Catalyst 3750-X Series Stackable 48 Ethernet 10/100/1000 PoE+ ports	WS-C3750X-48PF-S	15.2(1)E3	IP Base
	Cisco Catalyst 3750-X Series Stackable 24 Ethernet 10/100/1000 PoE+ ports	WS-C3750X-24P-S	15.2(1)E3	IP Base
	Cisco Catalyst 3750-X Series Two 10GbE SFP+ and Two GbE SFP ports network module	C3KX-NM-10G		
	Cisco Catalyst 3750-X Series Four GbE SFP ports network module	C3KX-NM-1G		
	Cisco Catalyst 2960-X Series 24 10/100/1000 Ethernet and 2 SFP+ Uplink	WS-C2960X-24PD	15.0(2)EX5	LAN Base
	Standalone Access Layer Switch	Cisco Catalyst 3650 Series 24 Ethernet 10/100/1000 PoE+ and 4x1GE Uplink	WS-C3650-24PS	3.3.3SE(15.01EZ3)

LAN Distribution Layer

Place In Network	Product Description	Part Number	SW Version	Feature Set
Modular Distribution Layer Virtual Switch Pair	Cisco Catalyst 6500 VSS Supervisor 2T with 2 ports 10GbE and PFC4	VS-S2T-10G	15.1(2)SY3	IP Services
	Cisco Catalyst 6800 Series 6807-XL 7-Slot Modular Chassis	C6807-XL	15.1(2)SY3	IP Services
	Cisco Catalyst 6500 4-port 40GbE/16-port 10GbE Fiber Module w/DFC4	WS-X6904-40G-2T		
	Cisco Catalyst 6500 4-port 10GbE SFP+ adapter for WX-X6904-40G module	CVR-CFP-4SFP10G		
	Cisco Catalyst 6500 CEF720 48 port 10/100/1000mb Ethernet	WS-X6748-GE-TX		
	Cisco Catalyst 6500 Distributed Forwarding Card 4	WS-F6K-DFC4-A		
	Cisco Catalyst 6500 Series 6506-E 6-Slot Chassis	WS-C6506-E	15.1(2)SY3	IP services
	Cisco Catalyst 6500 VSS Supervisor 2T with 2 ports 10GbE and PFC4	VS-S2T-10G	15.1(2)SY3	IP services
	Cisco Catalyst 6500 4-port 40GbE/16-port 10GbE Fiber Module w/DFC4	WS-X6904-40G-2T		
	Cisco Catalyst 6500 4-port 10GbE SFP+ adapter for WX-X6904-40G module	CVR-CFP-4SFP10G		
	Cisco Catalyst 6500 48-port GigE Mod (SFP)	WS-X6748-SFP		
	Cisco Catalyst 6500 Distributed Forwarding Card 4	WS-F6K-DFC4-A		
	Cisco Catalyst 6500 24-port GigE Mod (SFP)	WS-X6724-SFP		
	Cisco Catalyst 6500 Distributed Forwarding Card 4	WS-F6K-DFC4-A		
Extensible Fixed Distribution Layer Virtual Switch Pair	Cisco Catalyst 6800 Series 6880-X Extensible Fixed Aggregation Switch (Standard Tables)	C6880-X-LE	15.1(2)SY3	IP Services
	Cisco Catalyst 6800 Series 6880-X Multi Rate Port Card (Standard Tables)	C6880-X-LE-16P10G		
Modular Distribution Layer Virtual Switch Pair	Cisco Catalyst 4500E Series 4507R+E 7-slot Chassis with 48Gbps per slot	WS-C4507R+E	3.5.3E(15.2.1E3)	Enterprise Services
	Cisco Catalyst 4500E Supervisor Engine 7-E, 848Gbps	WS-X45-SUP7-E	3.5.3E(15.2.1E3)	Enterprise Services
	Cisco Catalyst 4500E 12-port 10GbE SFP+ Fiber Module	WS-X4712-SFP+E		
	Cisco Catalyst 4500E 48-Port 802.3at PoE+ 10/100/1000 (RJ-45)	WS-X4748-RJ45V+E		
Fixed Distribution Layer Virtual Switch Pair	Cisco Catalyst 4500-X Series 32 Port 10GbE IP Base Front-to-Back Cooling WS-C4500X-32SFP+ 3.5.3E(15.2.1E3) Enterprise Services			

Place In Network	Product Description	Part Number	SW Version	Feature Set
Fixed Distribution Layer Virtual Switch Pair	Cisco Catalyst 4500-X Series 32 Port 10GbE IP Base Front-to-Back Cooling WS-C4500X-32SFP+ 3.5.3E(15.2.1E3) Enterprise Services			
Stackable Distribution Layer Switch	Cisco Catalyst 3850 Series Stackable Switch with 12 SFP Ethernet	WS-C3850-12S	3.3.3SE(15.0.1EZ3)	IP Services
	Cisco Catalyst 3850 Series 4 x 1GE Network Module	C3850-NM-4-1G		
	Cisco Catalyst 3850 Series 2 x 10GE Network Module	C3850-NM-2-10G		
	Cisco Catalyst 3750-X Series Stackable 12 GbE SFP ports	WS-C3750X-12S-E	15.2(1)E3	IP Services
	Cisco Catalyst 3750-X Series Two 10GbE SFP+ and Two GbE SFP ports network module	C3KX-NM-10G		
	Cisco Catalyst 3750-X Series Four GbE SFP ports network module	C3KX-NM-1G		

IOS Certificate Authority

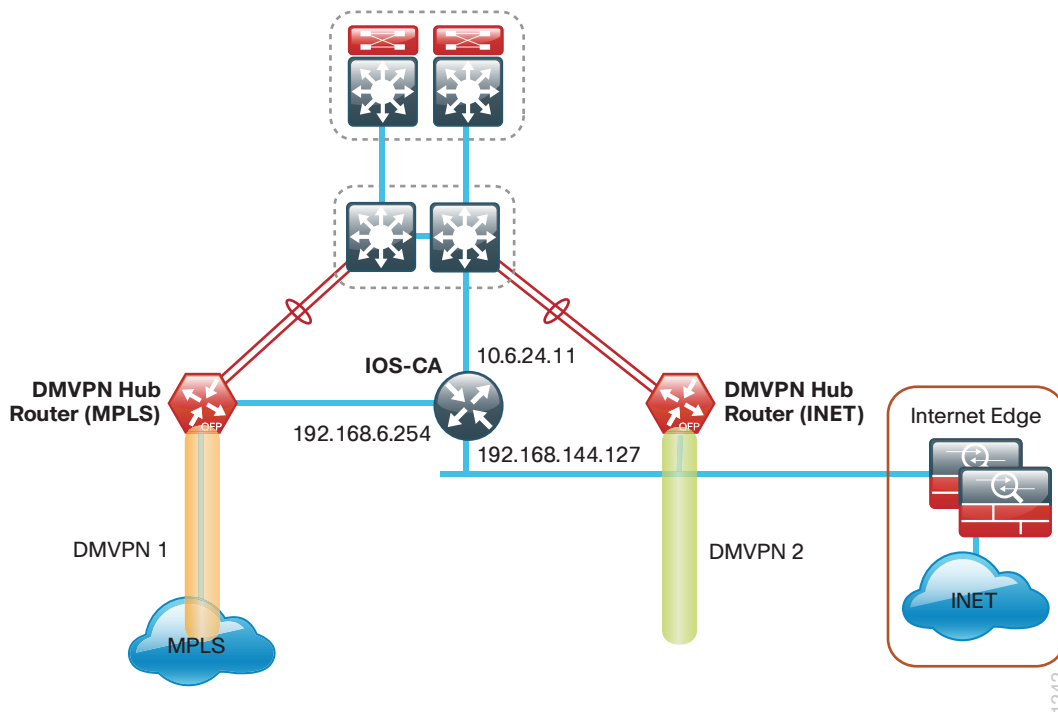
Use this optional configuration if you want to deploy an IOS Certificate Authority (IOS CA) on a router in your DMZ with access from the internal network and the MPLS provider network. Skip this configuration if you are using pre-shared keys or if you plan to use a different certificate authority. You can create a more complex CA environment, but the same basic reachability principles will apply for an IWAN enabled solution.

You configure an IOS CA with three interfaces:

- The first interface on the internal LAN allows access from the hub routers and is also used for managing the router.
- The second interface on the DMZ allows access from remote site routers with Internet connectivity.
- The third interface on the MPLS provider network allows access from remote site routers with MPLS connectivity.

Each interface is in its own VRF and there is no routing between the interfaces. Three static routes allow the IOS CA to reach each network individually.

Figure 4 - IOS Certificate Authority



The following table provides the IP addresses for the IOS Certificate Authority.

Table 1 - IOS CA IP addresses

Network	IP Address	NAT IP Address
Internal	10.6.24.11	N/A
Internet DMZ	192.168.144.127	172.16.140.110 (ISP-A)
MPLS Provider	192.168.6.254	N/A

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
```

IWAN-IOS-CA

```
version 15.4  
service timestamps debug datetime msec localtime  
service timestamps log datetime msec localtime  
service password-encryption  
!  
hostname IWAN-IOS-CA  
!  
boot-start-marker  
boot-end-marker  
!  
!  
vrf definition IWAN-PUBLIC  
description IWAN PUBLIC (Internet DMZ)  
!  
address-family ipv4  
exit-address-family  
!
```

```

vrf definition IWAN-TRANSPORT-1
  description IWAN TRANSPORT 1 (MPLS)
  !
  address-family ipv4
  exit-address-family
  !
enable secret 5 $1$ItSJ$9qG2zCulF1zLEqYzK2ayf1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
  server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
!
!
cts logging verbose
!
crypto pki server IWAN-IOS-CA
  database level complete
  no database archive
  issuer-name CN=IWAN-IOS-CA.cisco.local L=SanJose St=CA C=US
  grant auto
  lifetime certificate 730
  cdp-url http://10.6.24.11/cgi-bin/pkiclient.exe?operation=GetCRL
  database url crl nvram:
!
crypto pki trustpoint IWAN-IOS-CA
  revocation-check crl
  rsakeypair IWAN-IOS-CA
!
crypto pki trustpoint TP-self-signed-4277773906

```



```

enrollment selfsigned
subject-name cn=IOS-Self-Signed-Certificate-4277773906
revocation-check none
rsakeypair TP-self-signed-4277773906
!
!
crypto pki certificate chain IWAN-IOS-CA
certificate ca 01
30820247 308201B0 A0030201 02020101 300D0609 2A864886 F70D0101 04050030
37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
32353231 31393432 5A170D31 37313232 34323131 3934325A 30373135 30330603
55040313 2C495741 4E2D494F 532D4341 2E636973 636F2E6C 6F63616C 204C3D53
616E4A6F 73652053 743D4341 20433D55 5330819F 300D0609 2A864886 F70D0101
01050003 818D0030 81890281 8100E1F3 60BA63B4 2C2971DA 10457139 3765E38C
05FBB109 8FB0929C 32A8FA30 D5320EDB 968F4FDF E29F439F 27537B49 6F0BD278
9EBB3FDF 46603234 B9CF4395 5D9F046B B9D4145A 0A1F3C7A 4A496ABB 808F0097
B8B8E49E 696F7C9F 201E9030 CED7B305 F8882A05 6725693B 3A8B0B27 D771E6C3
543A6D98 8B3BE1C7 9B42C549 95CB0203 010001A3 63306130 0F060355 1D130101
FF040530 030101FF 300E0603 551D0F01 01FF0404 03020186 301F0603 551D2304
18301680 148B57F8 AD759FB8 E9696295 0930B589 1C88919C 06301D06 03551D0E
04160414 8B57F8AD 759FB8E9 69629509 30B5891C 88919C06 300D0609 2A864886
F70D0101 04050003 81810043 03F15527 55D3FFA4 C7BE393E A4E6E242 C86ED8DF
4CDC83C5 6A283ECE FA0DC9E8 9F640F4B 34FE1847 D4CEF5E2 309AC0D2 563E979B
E9574558 B0E7C56C A3A1AA85 6C1DBC4E AE99C09F F4553D0B 7DF57390 33E67C0E
18017676 68977BBD 453E9012 5B5887F2 840A6B76 F5AC61CB 1E636166 56CB8F17
3E071F09 AECB291E 918A0B
quit
crypto pki certificate chain TP-self-signed-4277773906
certificate self-signed 01
3082022B 30820194 A0030201 02020101 300D0609 2A864886 F70D0101 05050030
31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
69666963 6174652D 34323737 37373339 3036301E 170D3134 31323236 31303435
34335A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D34 32373737
37333930 3630819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281
8100B01B F92B8579 A1C0A24A 2575B8BD 4A52A2EB B5771E60 97238108 A89F9A15
D7DAA2D5 6A0723D9 D8573D91 61C1CD84 20EE89B8 F018B069 11D228F0 2590968B
753CCCD3 667C39B7 B0FEFC91 6A12F9EF 336AA5AB 688A70E8 B9064FF8 235A04C0
D5EBE33B F7C7978D 469D22D9 B39F184C D913C58B CA564425 ADDF0DDA 8FBAA225
BF890203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF 301F0603
551D2304 18301680 14EF3EE6 8D94FA24 9517D696 71320BA2 793AB40D B3301D06
03551D0E 04160414 EF3EE68D 94FA2495 17D69671 320BA279 3AB40DB3 300D0609
2A864886 F70D0101 05050003 8181005A A3A3DB82 6F4104E7 46312773 408CE555
066EB080 B51680C2 1DCB578A 8583963A 85CD3FC1 F1A57442 02AF1E7E 750B4901
32527ADA 914779C3 CC0F5297 A3A865E8 AD976B5D 8526DE6A 66543C59 3EE6E7E7
03B9696D 8986FCC6 1B79846E 851E4A8F 0E4B78B7 5598679E 59DCA17F E8BE6473

```

```

A74C7280 C4EDE7F7 9C6F5890 355DB1
quit
voice-card 0
!
!
license udi pid CISCO2911/K9 sn FTX1446A181
hw-module ism 0
!
!
username admin secret 5 $1$jyBG$G1nTGa9MO/bDpTrxYQ29q/
!
redundancy
!
!
ip ssh source-interface GigabitEthernet0/0
ip ssh version 2
ip scp server enable
!
!
interface Embedded-Service-Engine0/0
no ip address
shutdown
!
interface GigabitEthernet0/0
description Internal
ip address 10.6.24.11 255.255.255.224
duplex auto
speed auto
!
interface ISM0/0
no ip address
shutdown
!
interface ISM0/1
no ip address
shutdown
!
interface GigabitEthernet0/1
description Internet DMZ
vrf forwarding IWAN-PUBLIC
ip address 192.168.144.127 255.255.255.0
duplex auto
speed auto
!
interface GigabitEthernet0/2
description MPLS Provider
vrf forwarding IWAN-TRANSPORT-1

```

```

ip address 192.168.6.254 255.255.255.252
duplex auto
speed auto
!
!
interface Vlan1
no ip address
shutdown
!
ip forward-protocol nd
!
ip http server
ip http authentication aaa
ip http secure-server
!
ip route 0.0.0.0 0.0.0.0 10.6.24.1
ip route vrf IWAN-PUBLIC 0.0.0.0 0.0.0.0 192.168.144.1
ip route vrf IWAN-TRANSPORT-1 0.0.0.0 0.0.0.0 192.168.6.253
ip tacacs source-interface GigabitEthernet0/0
!
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server ifindex persist
tacacs server TACACS-SERVER-1
address ipv4 10.4.48.15
key 7 01200307490E12242455
!
!
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
gatekeeper
shutdown
!
!
line con 0
logging synchronous
transport preferred none

```

```
line aux 0
line vty 0 4
  transport preferred none
  transport input ssh
line vty 5 15
  transport preferred none
  transport input ssh
!
scheduler allocate 20000 1000
ntp source GigabitEthernet0/0
ntp update-calendar
ntp server 10.4.48.17
!
end
```

WAN-Aggregation Site–IWAN Hybrid Design Model

Performance Routing Version 3 (PfRv3) consists of two major Cisco IOS components: an MC and a BR. The MC defines the policies and applies them to various traffic classes that traverse the BR systems. The MC can be configured to learn and control traffic classes on the network.

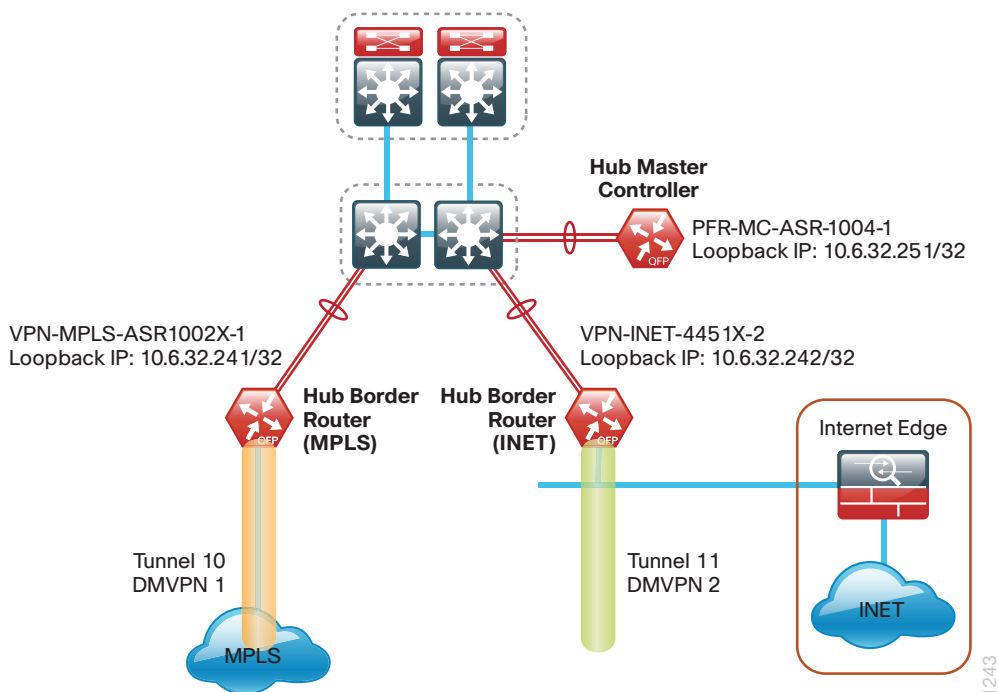
There are two different roles a device can play at the WAN aggregation site of a PfRv3 configuration:

- **Hub Master Controller**–The hub MC is the MC at the primary WAN aggregation site. This is the MC device where all PfRv3 policies are configured. It also acts as MC for that site and makes path-optimization decision. There is only one hub MC per IWAN domain.
- **Hub Border Router**–This is a BR at the hub MC site. This is the device where WAN interfaces terminate. There can be one or more WAN interfaces on the same device. There can be one or more hub BRs. On the Hub BRs, PfRv3 must be configured with:
 - The address of the local MC.
 - The path name on external interfaces.

The first design model is the IWAN Hybrid, which uses a primary MPLS transport paired with Internet VPN as a secondary transport. In this design model, the MPLS WAN provides SLA class of service guarantees for key applications. The second design model is the IWAN Dual Internet, which uses a pair of Internet service providers to further reduce cost while leveraging PfR in order to mitigate network performance problems on a single Internet provider.

This section includes configuration files corresponding to the IWAN hybrid design model WAN aggregation site, as referenced in the figure below.

Figure 5 - WAN-aggregation details–IWAN hybrid design model



The following table provides the loopback addresses for the WAN aggregation devices in the IWAN hybrid design model.

Table 2 - Hub router IP addresses

IWAN function	Host name	Loopback IP address	Port channel IP address
Hub MC	PFR-MC-ASR-1004-1	10.6.32.251/32	10.6.32.151/26
Hub BR (INET1)	VPN-MPLS-ASR1002X-1	10.6.32.241/32	10.6.32.2/30
Hub BR (INET2)	VPN-INET-4451X-2	10.6.32.242/32	10.6.32.6/30

PFR-MC-ASR-1004-1

```

version 15.4
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
no platform punt-keepalive disable-kernel-core
!
hostname PFR-MC-ASR1004-1
!
boot-start-marker
boot-end-marker
!
!
vrf definition Mgmt-intf
!
address-family ipv4
exit-address-family
!
address-family ipv6
exit-address-family
!
enable secret 5 $1$Za2f$1jS13JiQSXSuCWtQvKXqy0
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!

```



```

!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
subscriber templating
!
multilink bundle-name authenticated
!
domain iwan
vrf default
  master hub
    source-interface Loopback0
    site-prefixes prefix-list PRIMARY-SITE-PREFIXES
    password 7 08221D5D0A16544541
    load-balance
    advanced
    enterprise-prefix prefix-list ENTERPRISE-PREFIXES
    collector 10.4.48.178 port 2055
    class VOICE sequence 10
      match dscp ef policy voice
      path-preference MPLS fallback INET
    class INTERACTIVE-VIDEO sequence 20
      match dscp cs4 policy real-time-video
      match dscp af41 policy real-time-video
      match dscp af42 policy real-time-video
      path-preference MPLS fallback INET
    class CRITICAL-DATA sequence 30
      match dscp af21 policy low-latency-data
      path-preference MPLS fallback INET
!
key chain LAN-KEY
  key 1
    key-string 7 03070A180500701E1D
!
!
crypto pki trustpoint TP-self-signed-1075269315
  enrollment selfsigned
  subject-name cn=IOS-Self-Signed-Certificate-1075269315
  revocation-check none
  rsakeypair TP-self-signed-1075269315
!
!
crypto pki certificate chain TP-self-signed-1075269315
  certificate self-signed 01
    3082022B 30820194 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

```

```

31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
69666963 6174652D 31303735 32363933 3135301E 170D3134 30393130 31393233
32305A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D31 30373532
36393331 3530819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281
8100B7EB 0635B710 250227A2 6DAA15D6 967503F7 733422B1 9A547E55 F773B08D
F52CC1FF 70DE3CC7 C8AD2797 4DA65810 BFD28E2F AB9DCFA5 2C20E01E 2DD03B43
D9001897 DAE73F56 DD522238 E89F3724 68781509 B22A2A3E DA6B78BC 978E50A3
E243E2C2 564A4C29 2FF769A3 1197AF4F CA80C1A0 2FF54885 663993FD C897F5F0
E5590203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF 301F0603
551D2304 18301680 145E9E44 35B3B58E E731BCF7 0000F697 D853760C 4D301D06
03551D0E 04160414 5E9E4435 B3B58EE7 31BCF700 00F697D8 53760C4D 300D0609
2A864886 F70D0101 05050003 818100B5 3C753688 71ACE0A6 76C77E24 8C63F22B
0D51ABEB A1BEFE13 B814B368 17F4CB03 38772212 9C114D45 9CE047A8 2768D0D0
58B70788 94B7635D 463518BA C4B37A22 658A16D8 2A59651C 823A40B9 71EC1907
D87C209B 4FB0D1D3 38557538 B09F70F8 69B44B99 7896EBE3 498ABC83 84EB7814
5CEECA3E 4E3D856A 64F01A80 7E5603
quit
spanning-tree extend system-id
!
username admin secret 5 $1$x7zB$M2eGJlSRGLixfFRS8uiNP.
!
redundancy
mode none
!
!
cdp run
!
ip ftp source-interface Loopback0
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
!
interface Loopback0
ip address 10.6.32.251 255.255.255.255
!
interface Port-channel21
description IWAN-D3750X
ip address 10.6.32.151 255.255.255.192
no negotiation auto
!
interface GigabitEthernet0/0/0
description IW-WAN-D3750X Gig1/0/13
no ip address
media-type rj45
negotiation auto

```

```

cdp enable
channel-group 21
!
interface GigabitEthernet0/0/1
description IW-WAN-D3750X Gig2/0/13
no ip address
media-type rj45
negotiation auto
cdp enable
channel-group 21
!
interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
passive-interface
exit-af-interface
!
af-interface Port-channel21
authentication mode md5
authentication key-chain LAN-KEY
no passive-interface
exit-af-interface
!
topology base
exit-af-topology
network 10.6.0.0 0.1.255.255
eigrp router-id 10.6.32.251
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
ip http secure-server
ip tacacs source-interface Loopback0
!
!
ip prefix-list ENTERPRISE-PREFIXES seq 10 permit 10.4.0.0/14

```

```
!  
ip prefix-list PRIMARY-SITE-PREFIXES seq 10 permit 10.4.0.0/16  
ip prefix-list PRIMARY-SITE-PREFIXES seq 20 permit 10.6.0.0/16  
no service-routing capabilities-manager  
!  
snmp-server community cisco RO  
snmp-server community cisco123 RW  
snmp-server trap-source Loopback0  
!  
tacacs server TACACS-SERVER-1  
  address ipv4 10.4.48.15  
  key 7 15210E0F162F3F0F2D2A  
!  
!  
control-plane  
!  
!  
line con 0  
  transport preferred none  
  stopbits 1  
line aux 0  
  stopbits 1  
line vty 0 4  
  exec-timeout 0 0  
  transport preferred none  
  transport input ssh  
line vty 5 15  
  transport preferred none  
  transport input ssh  
!  
ntp source Loopback0  
ntp server 10.4.48.17  
!  
end
```

VPN-MPLS-ASR1002X-1: Primary WAN link

```
version 15.4
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
no platform punt-keepalive disable-kernel-core
!
hostname VPN-MPLS-ASR1002X-1
!
boot-start-marker
boot-end-marker
!
aqm-register-fnf
!
vrf definition IWAN-TRANSPORT-1
!
  address-family ipv4
  exit-address-family
!
vrf definition Mgmt-intf
!
  address-family ipv4
  exit-address-family
!
  address-family ipv6
  exit-address-family
!
enable secret 5 $1$S7wW$LwAu9mADPzeXE.yQjFmIc1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
  server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local
```

```

ip multicast-routing distributed
!
!
subscriber templating
!
!
flow record Record-FNF-IWAN
  description Flexible NetFlow for IWAN Monitoring
  match ipv4 tos
  match ipv4 protocol
  match ipv4 source address
  match ipv4 destination address
  match transport source-port
  match transport destination-port
  match interface input
  match flow direction
  collect routing source as
  collect routing destination as
  collect routing next-hop address ipv4
  collect ipv4 dscp
  collect ipv4 id
  collect ipv4 source prefix
  collect ipv4 source mask
  collect ipv4 destination mask
  collect transport tcp flags
  collect interface output
  collect flow sampler
  collect counter bytes
  collect counter packets
  collect timestamp sys-uptime first
  collect timestamp sys-uptime last
  collect application name
!
!
flow exporter Export-FNF-LiveAction
  description FNFv9 with LiveAction
  destination 10.4.48.178
  source Loopback0
  transport udp 2055
  option interface-table
  option application-table
  option application-attributes
!
!
flow monitor Monitor-FNF-IWAN
  description IWAN Traffic Analysis

```



```

exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
multilink bundle-name authenticated
!
domain iwan
vrf default
border
source-interface Loopback0
master 10.6.32.251
password 7 06055E324F41584B56
collector 10.4.48.178 port 2055
!
key chain LAN-KEY
key 1
key-string 7 011057175804575D72
key chain WAN-KEY
key 1
key-string 7 0007421507545A545C
!
!
license udi pid ASR1002-X sn JAE180107T0
license boot level adventerprise
spanning-tree extend system-id
!
username admin secret 5 $1$SnKm$ibEw/1V702JMAMj/C/qzs.
!
redundancy
mode none
!
!
!
crypto ikev2 keyring DMVPN-KEYRING-1
peer ANY
address 0.0.0.0 0.0.0.0
pre-shared-key c1sco123
!
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-1
match fvrf IWAN-TRANSPORT-1
match identity remote address 0.0.0.0
authentication remote pre-share
authentication local pre-share
keyring local DMVPN-KEYRING-1
!

```

```

!
cdp run
!
ip ftp source-interface Loopback0
ip tftp source-interface GigabitEthernet0
!
class-map match-any STREAMING-VIDEO
  match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
  match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
  match dscp af11 af21
class-map match-any NET-CTRL-MGMT
  match dscp cs2 cs6
class-map match-any VOICE
  match dscp ef
class-map match-any SCAVENGER
  match dscp cs1
class-map match-any CALL-SIGNALING
  match dscp cs3
!
policy-map WAN
  class INTERACTIVE-VIDEO
    bandwidth remaining percent 30
    random-detect dscp-based
    set dscp tunnel af41
  class STREAMING-VIDEO
    bandwidth remaining percent 10
    random-detect dscp-based
    set dscp tunnel af41
  class NET-CTRL-MGMT
    bandwidth remaining percent 5
    set dscp tunnel cs6
  class CALL-SIGNALING
    bandwidth remaining percent 4
    set dscp tunnel af41
  class CRITICAL-DATA
    bandwidth remaining percent 25
    random-detect dscp-based
    set dscp tunnel af21
  class SCAVENGER
    bandwidth remaining percent 1
    set dscp tunnel af11
  class VOICE
    priority level 1
    police cir percent 10
    set dscp tunnel ef

```

```

class class-default
  bandwidth remaining percent 25
  random-detect
  set dscp tunnel default
policy-map RS-GROUP-200MBPS-POLICY
  class class-default
    shape average 200000000
    bandwidth remaining ratio 200
    service-policy WAN
policy-map RS-GROUP-4G-POLICY
  class class-default
    shape average 8000000
    bandwidth remaining ratio 8
    service-policy WAN
policy-map RS-GROUP-20MBPS-POLICY
  class class-default
    shape average 20000000
    bandwidth remaining ratio 20
    service-policy WAN
policy-map WAN-INTERFACE-G0/0/3-SHAPE-ONLY
  class class-default
    shape average 1000000000
policy-map RS-GROUP-30MBPS-POLICY
  class class-default
    shape average 30000000
    bandwidth remaining ratio 30
    service-policy WAN
policy-map RS-GROUP-300MBPS-POLICY
  class class-default
    shape average 300000000
    bandwidth remaining ratio 300
    service-policy WAN
policy-map RS-GROUP-100MBPS-POLICY
  class class-default
    shape average 100000000
    bandwidth remaining ratio 100
    service-policy WAN
policy-map RS-GROUP-50MBPS-POLICY
  class class-default
    shape average 50000000
    bandwidth remaining ratio 50
    service-policy WAN
policy-map RS-GROUP-10MBPS-POLICY
  class class-default
    shape average 10000000
    bandwidth remaining ratio 10
    service-policy WAN

```

```

!
!
crypto ipsec security-association replay window-size 512
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-1
set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-1
!
!
interface Loopback0
ip address 10.6.32.241 255.255.255.255
ip pim sparse-mode
!
interface Port-channel1
description IWAN-D3750X
ip address 10.6.32.2 255.255.255.252
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim sparse-mode
no negotiation auto
!
interface Tunnel10
bandwidth 1000000
ip address 10.6.34.1 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim nbma-mode
ip pim sparse-mode
ip nhrp authentication cisco123
ip nhrp map multicast dynamic
ip nhrp map group RS-GROUP-50MBPS service-policy output RS-GROUP-50MBPS-POLICY
ip nhrp map group RS-GROUP-10MBPS service-policy output RS-GROUP-10MBPS-POLICY
ip nhrp map group RS-GROUP-300MBPS service-policy output RS-GROUP-300MBPS-POLICY
ip nhrp map group RS-GROUP-200MBPS service-policy output RS-GROUP-200MBPS-POLICY
ip nhrp map group RS-GROUP-100MBPS service-policy output RS-GROUP-100MBPS-POLICY
ip nhrp map group RS-GROUP-30MBPS service-policy output RS-GROUP-30MBPS-POLICY
ip nhrp map group RS-GROUP-20MBPS service-policy output RS-GROUP-20MBPS-POLICY
ip nhrp map group RS-GROUP-4G service-policy output RS-GROUP-4G-POLICY
ip nhrp network-id 101
ip nhrp holdtime 600
ip nhrp redirect
ip tcp adjust-mss 1360

```

```

delay 1000
tunnel source GigabitEthernet0/0/3
tunnel mode gre multipoint
tunnel key 101
tunnel vrf IWAN-TRANSPORT-1
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-1
domain iwan path MPLS
!
interface GigabitEthernet0/0/0
description IWAN-D3750X Gig1/0/1
no ip address
negotiation auto
cdp enable
channel-group 1
!
interface GigabitEthernet0/0/1
description IWAN-D3750X Gig2/0/1
no ip address
negotiation auto
cdp enable
channel-group 1
!
interface GigabitEthernet0/0/2
no ip address
negotiation auto
!
interface GigabitEthernet0/0/3
bandwidth 1000000
vrf forwarding IWAN-TRANSPORT-1
ip address 192.168.6.1 255.255.255.252
negotiation auto
service-policy output WAN-INTERFACE-G0/0/3-SHAPE-ONLY
!
interface GigabitEthernet0/0/4
no ip address
negotiation auto
!
interface GigabitEthernet0/0/5
description IWAN-IOS-CA
vrf forwarding IWAN-TRANSPORT-1
ip address 192.168.6.253 255.255.255.252
negotiation auto
cdp enable
!
interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address

```

```

shutdown
negotiation auto
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
  passive-interface
exit-af-interface
!
af-interface Port-channell
  authentication mode md5
  authentication key-chain LAN-KEY
  no passive-interface
exit-af-interface
!
af-interface Tunnel10
  authentication mode md5
  authentication key-chain WAN-KEY
  hello-interval 20
  hold-time 60
  no passive-interface
  no split-horizon
exit-af-interface
!
topology base
  distribute-list route-map SET-TAG-DMVPN-1 out Port-channell
  distribute-list route-map SET-TAG-ALL out Tunnel10
  distribute-list route-map BLOCK-DMVPN-2 in Port-channell
exit-af-topology
network 10.6.0.0 0.1.255.255
eigrp router-id 10.6.32.241
nsf
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
no ip http secure-server
ip pim autorp listener
ip pim register-source Loopback0
ip route vrf IWAN-TRANSPORT-1 0.0.0.0 0.0.0.0 192.168.6.2
ip tacacs source-interface Loopback0
!

```

```

ip access-list standard DMVPN-1-SPOKES
  permit 10.6.34.0 0.0.1.255
!
no service-routing capabilities-manager
!
route-map BLOCK-DMVPN-2 deny 10
  description Do not advertise routes sourced from DMVPN-2
  match tag 102
!
route-map BLOCK-DMVPN-2 permit 100
!
route-map SET-TAG-DMVPN-1 permit 10
  description Tag routes sourced from DMVPN-1
  match ip route-source DMVPN-1-SPOKES
  set tag 101
!
route-map SET-TAG-DMVPN-1 permit 100
  description Advertise all other routes with no tag
!
route-map SET-TAG-ALL permit 10
  set tag 101
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server trap-source Loopback0
snmp ifmib ifindex persist
!
tacacs server TACACS-SERVER-1
  address ipv4 10.4.48.15
  key 7 15210E0F162F3F0F2D2A
!
!
control-plane
!
!
line con 0
  exec-timeout 0 0
  transport preferred none
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  transport preferred none
line vty 5 15
  transport preferred none
!

```

```
ntp source Loopback0
ntp server 10.4.48.17
!
!
end
```

VPN-INET-4451X-2: Secondary WAN link

```
version 15.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
no platform punt-keepalive disable-kernel-core
!
hostname VPN-INET-4451X-2
!
boot-start-marker
boot-end-marker
!
!
vrf definition IWAN-TRANSPORT-2
!
address-family ipv4
exit-address-family
!
vrf definition Mgmt-intf
!
address-family ipv4
exit-address-family
!
address-family ipv6
exit-address-family
!
enable secret 5 $1$S7wW$LwAu9mADPzeXE.yQjFmIc1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
aaa session-id common
```



```

clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local

ip multicast-routing distributed
!
!
subscriber templating
!
multilink bundle-name authenticated
!
flow record Record-FNF-IWAN
  description Flexible NetFlow for IWAN Monitoring
  match ipv4 tos
  match ipv4 protocol
  match ipv4 source address
  match ipv4 destination address
  match transport source-port
  match transport destination-port
  match interface input
  match flow direction
  collect routing source as
  collect routing destination as
  collect routing next-hop address ipv4
  collect ipv4 dscp
  collect ipv4 id
  collect ipv4 source prefix
  collect ipv4 source mask
  collect ipv4 destination mask
  collect transport tcp flags
  collect interface output
  collect flow sampler
  collect counter bytes
  collect counter packets
  collect timestamp sys-uptime first
  collect timestamp sys-uptime last
  collect application name
!
!
flow exporter Export-FNF-LiveAction
  description FNFv9 with LiveAction
  destination 10.4.48.178
  source Loopback0
  transport udp 2055
  option application-attributes

```

```

option interface-table
option application-table
!
!
flow monitor Monitor-FNF-IWAN
description IWAN Traffic Analysis
exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
!
domain iwan
vrf default
border
source-interface Loopback0
master 10.6.32.251
password 7 070C705F4D06485744
collector 10.4.48.178 port 2055
!
!
key chain LAN-KEY
key 1
key-string 7 0508571C22431F5B4A
key chain WAN-KEY
key 1
key-string 7 0508571C22431F5B4A
!
!
crypto pki trustpoint TP-self-signed-2077203431
enrollment selfsigned
subject-name cn=IOS-Self-Signed-Certificate-2077203431
revocation-check none
rsa-keypair TP-self-signed-2077203431
!
!
crypto pki certificate chain TP-self-signed-2077203431
certificate self-signed 01
3082022B 30820194 A0030201 02020101 300D0609 2A864886 F70D0101 05050030
31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
69666963 6174652D 32303737 32303334 3331301E 170D3134 31303233 30303338
30395A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 30373732
30333433 3130819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281
8100C3DF E4F96E61 4C9A0BAE 552C676E 9EC1CBB7 CE76E71A D958A313 1BFBB071
8782F4B0 EBF466C3 85D014E6 49702A7B 3717D1B6 7D898C5A CF4DF176 D9170508
DCDA0DEB 544C9B3E 48F08203 DD154BEB 1B73A0B3 AA4C021F 30B583EE 159AF91E

```

```

88F2E13A 79FE34AD 003EA144 C71C93D3 A04FDC7D D7F652B2 8C6CC03B D99EB3A0
50EF0203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF 301F0603
551D2304 18301680 14D8F661 D9D60F95 66467373 703E21E1 A4B75DCC F0301D06
03551D0E 04160414 D8F661D9 D60F9566 46737370 3E21E1A4 B75DCCF0 300D0609
2A864886 F70D0101 05050003 8181000C 6EC57985 B4CE1D7F 811FDC68 0432B7F2
E08A4C9C A4AB1A0A 4C90424B CBDC927A 8A17F2D1 47B8EA6C 0D21C117 277DCB82
04671823 1FA264B9 06ED13BC C8F1CF99 CDE7309B 61A19BD1 1861197E 359F21F0
43487CB6 55204FE6 C2FA9938 6626B865 DFE7A521 4E6AE68E AFB42341 1BD90838
B5AD83EE 3B9C7F52 60D420E9 C18510
quit
!
!
voice-card 0/4
no watchdog
!
license udi pid ISR4451-X/K9 sn FOC1831B5RU
spanning-tree extend system-id
!
username admin secret 5 $1$SnKm$ibEw/1V702JMAMj/C/qzs.
!
redundancy
mode none
!
!
crypto ikev2 keyring DMVPN-KEYRING-2
peer ANY
address 0.0.0.0 0.0.0.0
pre-shared-key cisco123
!
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-2
match fvrf IWAN-TRANSPORT-2
match identity remote address 0.0.0.0
authentication remote pre-share
authentication local pre-share
keyring local DMVPN-KEYRING-2
!
!
ip ftp source-interface Loopback0
ip tftp source-interface GigabitEthernet0
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
class-map match-any STREAMING-VIDEO
match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO

```

```

    match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
    match dscp af11 af21
class-map match-any NET-CTRL-MGMT
    match dscp cs2 cs6
class-map match-any VOICE
    match dscp ef
class-map match-any SCAVENGER
    match dscp cs1
class-map match-any CALL-SIGNALING
    match dscp cs3
!
policy-map WAN
class INTERACTIVE-VIDEO
    bandwidth remaining percent 30
    random-detect dscp-based
    set dscp tunnel af41
class STREAMING-VIDEO
    bandwidth remaining percent 10
    random-detect dscp-based
    set dscp tunnel af41
class NET-CTRL-MGMT
    bandwidth remaining percent 5
    set dscp tunnel cs6
class CALL-SIGNALING
    bandwidth remaining percent 4
    set dscp tunnel af41
class CRITICAL-DATA
    bandwidth remaining percent 25
    random-detect dscp-based
    set dscp tunnel af21
class SCAVENGER
    bandwidth remaining percent 1
    set dscp tunnel af11
class VOICE
    priority level 1
    police cir percent 10
    set dscp tunnel ef
class class-default
    bandwidth remaining percent 25
    random-detect
    set dscp tunnel default
policy-map RS-GROUP-200MBPS-POLICY
class class-default
    shape average 200000000
    bandwidth remaining ratio 200
    service-policy WAN

```

```

policy-map RS-GROUP-4G-POLICY
  class class-default
    shape average 8000000
    bandwidth remaining ratio 8
    service-policy WAN
policy-map RS-GROUP-20MBPS-POLICY
  class class-default
    shape average 20000000
    bandwidth remaining ratio 20
    service-policy WAN
policy-map WAN-INTERFACE-G0/0/3-SHAPE-ONLY
  class class-default
    shape average 500000000
policy-map RS-GROUP-30MBPS-POLICY
  class class-default
    shape average 30000000
    bandwidth remaining ratio 30
    service-policy WAN
policy-map RS-GROUP-300MBPS-POLICY
  class class-default
    shape average 300000000
    bandwidth remaining ratio 300
    service-policy WAN
policy-map RS-GROUP-100MBPS-POLICY
  class class-default
    shape average 100000000
    bandwidth remaining ratio 100
    service-policy WAN
policy-map RS-GROUP-50MBPS-POLICY
  class class-default
    shape average 50000000
    bandwidth remaining ratio 50
    service-policy WAN
policy-map RS-GROUP-10MBPS-POLICY
  class class-default
    shape average 10000000
    bandwidth remaining ratio 10
    service-policy WAN
!
!
crypto ipsec security-association replay window-size 1024
! Warning: window size of 512 actually used
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
  mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-2

```

```

set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-2
!
!
interface Loopback0
 ip address 10.6.32.242 255.255.255.255
 ip pim sparse-mode
!
interface Port-channel2
 description IWAN-D3750X
 ip address 10.6.32.6 255.255.255.252
 ip flow monitor Monitor-FNF-IWAN input
 ip flow monitor Monitor-FNF-IWAN output
 ip pim sparse-mode
 no negotiation auto
 hold-queue 150 in
!
interface Tunnell11
 bandwidth 500000
 ip address 10.6.36.1 255.255.254.0
 no ip redirects
 ip mtu 1400
 ip flow monitor Monitor-FNF-IWAN input
 ip flow monitor Monitor-FNF-IWAN output
 ip pim nbma-mode
 ip pim sparse-mode
 ip nhrp authentication cisco123
 ip nhrp map multicast dynamic
 ip nhrp network-id 102
 ip nhrp holdtime 600
 ip nhrp redirect
 ip tcp adjust-mss 1360
 delay 2000
 nhrp map group RS-GROUP-300MBPS service-policy output RS-GROUP-300MBPS-POLICY
 nhrp map group RS-GROUP-200MBPS service-policy output RS-GROUP-200MBPS-POLICY
 nhrp map group RS-GROUP-100MBPS service-policy output RS-GROUP-100MBPS-POLICY
 nhrp map group RS-GROUP-50MBPS service-policy output RS-GROUP-50MBPS-POLICY
 nhrp map group RS-GROUP-30MBPS service-policy output RS-GROUP-30MBPS-POLICY
 nhrp map group RS-GROUP-20MBPS service-policy output RS-GROUP-20MBPS-POLICY
 nhrp map group RS-GROUP-10MBPS service-policy output RS-GROUP-10MBPS-POLICY
 nhrp map group RS-GROUP-4G service-policy output RS-GROUP-4G-POLICY
 tunnel source GigabitEthernet0/0/3
 tunnel mode gre multipoint
 tunnel key 102
 tunnel vrf IWAN-TRANSPORT-2
 tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-2
 domain iwan path INET

```

```

!
interface GigabitEthernet0/0/0
  description IWAN-D3750X Gig1/0/1
  no ip address
  negotiation auto
  channel-group 2
!
interface GigabitEthernet0/0/1
  description IWAN-D3750X Gig2/0/1
  no ip address
  negotiation auto
  channel-group 2
!
interface GigabitEthernet0/0/2
  no ip address
  shutdown
  negotiation auto
!
interface GigabitEthernet0/0/3
  description VPN-DMZ
  bandwidth 500000
  vrf forwarding IWAN-TRANSPORT-2
  ip address 192.168.146.10 255.255.255.0
  negotiation auto
  service-policy output WAN-INTERFACE-G0/0/3-SHAPE-ONLY
!
interface Service-Engine0/4/0
!
interface GigabitEthernet0
  vrf forwarding Mgmt-intf
  no ip address
  shutdown
  negotiation auto
!
!
router eigrp IWAN-EIGRP
!
  address-family ipv4 unicast autonomous-system 400
  !
  af-interface default
    passive-interface
  exit-af-interface
  !
  af-interface Port-channel2
    authentication mode md5
    authentication key-chain LAN-KEY
    no passive-interface

```

```

exit-af-interface
!
af-interface Tunnell1
  authentication mode md5
  authentication key-chain WAN-KEY
  hello-interval 20
  hold-time 60
  no passive-interface
  no split-horizon
exit-af-interface
!
topology base
  distribute-list route-map SET-TAG-DMVPN-2 out Port-channel2
  distribute-list route-map SET-TAG-ALL out Tunnell1
  distribute-list route-map BLOCK-DMVPN-1 in Port-channel2
exit-af-topology
network 10.6.0.0 0.1.255.255
eigrp router-id 10.6.32.242
exit-address-family
!
ip forward-protocol nd
no ip http server
ip http authentication aaa
ip http secure-server
ip pim autorp listener
ip pim register-source Loopback0
ip route vrf IWAN-TRANSPORT-2 0.0.0.0 0.0.0.0 192.168.146.1
ip tacacs source-interface Loopback0
!
!
ip access-list standard DMVPN-2-SPOKES
  permit 10.6.36.0 0.0.1.255
!
no service-routing capabilities-manager
!
route-map BLOCK-DMVPN-1 deny 10
  description Do not advertise routes sourced from DMVPN-1
  match tag 101
!
route-map BLOCK-DMVPN-1 permit 100
!
route-map SET-TAG-DMVPN-2 permit 10
  description Tag routes sourced from DMVPN-2
  match ip route-source DMVPN-2-SPOKES
  set tag 102
!
route-map SET-TAG-DMVPN-2 permit 100

```



```

description Advertise all other routes with no tag
!
route-map SET-TAG-ALL permit 10
  set tag 102
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server trap-source Loopback0
snmp ifmib ifindex persist
!
tacacs server TACACS-SERVER-1
  address ipv4 10.4.48.15
  key 7 15210E0F162F3F0F2D2A
!
!
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
line con 0
  exec-timeout 0 0
  transport preferred none
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  transport preferred none
  transport input ssh
line vty 5 15
  exec-timeout 0 0
  transport preferred none
  transport input ssh
!
ntp source Loopback0
ntp server 10.4.48.17
!
end

```

WAN Remote-Site Devices—IWAN Hybrid Design Model

Performance Routing Version 3 (PfRv3) consists of two major Cisco IOS components: an MC and a BR. The MC defines the policies and applies them to various traffic classes that traverse the BR systems. The MC can be configured to learn and control traffic classes on the network.

There are two different roles a device can play at the remote site of a PfRv3 configuration:

- **Branch Master Controller**—The Branch MC is the MC at the branch-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.
- **Branch Border Router**—This is a BR at the branch-site. The configuration on this device enables BR functionality and includes the IP address of the site local MC. The WAN interface that terminates on the device is detected automatically.

The first design model is the IWAN Hybrid, which uses a primary MPLS transport paired with Internet VPN as a secondary transport. In this design model, the MPLS WAN provides SLA class of service guarantees for key applications. The second design model is the IWAN Dual Internet, which uses a pair of Internet service providers to further reduce cost while leveraging PfR in order to mitigate network performance problems on a single Internet provider.

This section includes configuration files corresponding to the IWAN hybrid design model remote site, as referenced in the figure below.

Figure 6 - WAN remote-site details—IWAN hybrid design model

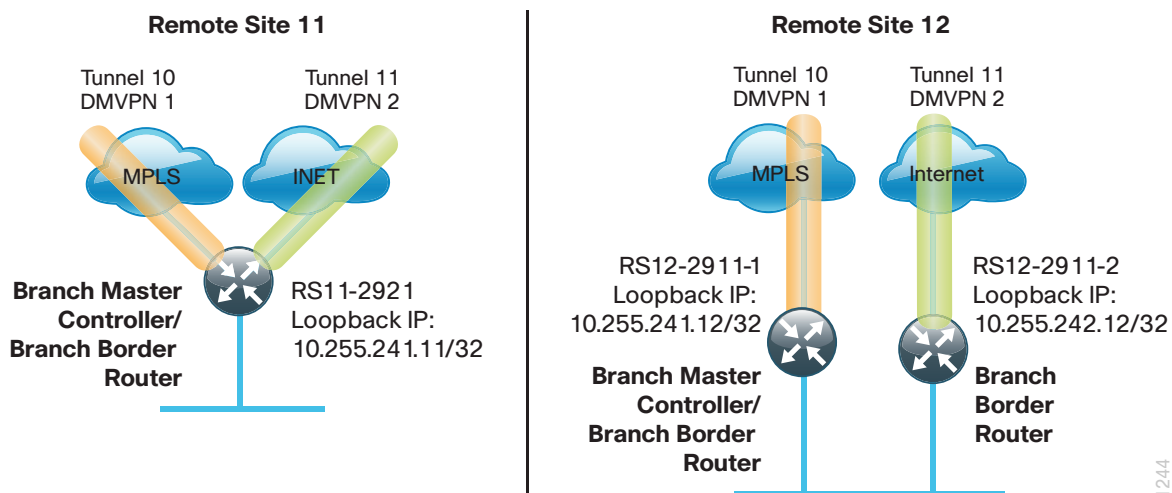


Table 3 - Remote site router loopback IP addresses

IWAN function	Host name	Loopback IP address
Branch MC/BR (MPLS/INET)	RS11-2921	10.255.241.11/32
Branch MC/BR (MPLS)	RS12-2911-1	10.255.241.12/32
Branch BR (INET)	RS12-2911-2	10.255.242.12/32
Branch MC/BR (MPLS/INET)	RS51-2921	10.255.241.51/32

Remote Site 11: Single-Router, Dual-Link (MPLS and INET)

The following table lists the policed-rate link speeds for the remote-site quality-of-service (QoS) traffic-shaping policies and Performance Routing (PFR) policies.

Table 4 - Remote-site policed-rate link speeds and delay

Location	MPLS link speed/ delay	INET link speed/ delay
Remote Site 11	30 Mbps/ 10000 us	20 Mbps/ 20000 us

RS11-2921: Primary and secondary WAN links

```

version 15.4
no service pad
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
!
hostname RS11-2921
!
boot-start-marker
boot-end-marker
!
!
vrf definition IWAN-TRANSPORT-1
!
address-family ipv4
exit-address-family
!
vrf definition IWAN-TRANSPORT-2
!
address-family ipv4
exit-address-family

```

```

!
! card type command needed for slot/vwic-slot 0/0
enable secret 5 $1$9Fn0$CyD6nXnYByt3qIjhGmJN90
!
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
  server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authentication login MODULE none
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local
ip multicast-routing
ip cef
no ipv6 cef
!
!
flow exporter Export-FNF-LiveAction
  description FNFv9 with LiveAction
  destination 10.4.48.178
  source Loopback0
  output-features
  transport udp 2055
  option interface-table
  option application-table
  option application-attributes
!
!
flow record Record-FNF-IWAN
  description Flexible NetFlow for IWAN Monitoring
  match ipv4 tos
  match ipv4 protocol
  match ipv4 source address
  match ipv4 destination address
  match transport source-port
  match transport destination-port
  match interface input

```

```

match flow direction
collect routing source as
collect routing destination as
collect routing next-hop address ipv4
collect ipv4 dscp
collect ipv4 id
collect ipv4 source prefix
collect ipv4 source mask
collect ipv4 destination mask
collect transport tcp flags
collect interface output
collect flow sampler
collect counter bytes
collect counter packets
collect timestamp sys-uptime first
collect timestamp sys-uptime last
collect application name
!
!
flow monitor Monitor-FNF-IWAN
description IWAN Traffic Analysis
exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
multilink bundle-name authenticated
!
!
domain iwan
vrf default
border
source-interface Loopback0
master local
password 7 0508571C22431F5B4A
collector 10.4.48.178 port 2055
master branch
source-interface Loopback0
password 7 141443180F0B7B7977
hub 10.6.32.251
collector 10.4.48.178 port 2055
!
!
key chain WAN-KEY
key 1
key-string 7 110A4816141D5A5E57
cts logging verbose

```

```

!
crypto pki trustpoint TP-self-signed-1964877055
  enrollment selfsigned
  subject-name cn=IOS-Self-Signed-Certificate-1964877055
  revocation-check none
  rsakeypair TP-self-signed-1964877055
!
!
crypto pki certificate chain TP-self-signed-1964877055
  certificate self-signed 01
    3082022B 30820194 A0030201 02020101 300D0609 2A864886 F70D0101 05050030
    31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
    69666963 6174652D 31393634 38373730 3535301E 170D3134 30393130 32323033
    31345A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
    4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D31 39363438
    37373035 3530819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281
    8100ABD3 6AC5DC47 904A3F28 3C661DA6 9449D13B 12E8B94F 9C7850F9 CBE5AE7A
    3735E8CC E5498771 31EFD5B8 23A3B9E0 72CD5055 10E1D202 482D15CE D93C9A97
    AB454B75 B317A5FB F6DF9263 A90535D8 ADF5765B 46C350AA 0846984E B7F2F95C
    9B73E8CB 23DD0C9F 5A06453D 4F633BBA 06327A93 477297E6 1F85447C E298E747
    A9230203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF 301F0603
    551D2304 18301680 14E1ECA0 76034EDC 42D59A21 3DE2DEF5 AEA6281E 7B301D06
    03551D0E 04160414 E1ECA076 034EDC42 D59A213D E2DEF5AE A6281E7B 300D0609
    2A864886 F70D0101 05050003 81810081 8B9A34C7 C2DE52FE 32510DCE 60BE946D
    95B11C09 9C7EA130 8D6EA358 B2211D10 5CB8A277 5D9E0FF7 2D93F624 FF43B03F
    C71FEE76 9F3E4092 D6790360 94A65D8C CA69EE68 F655F429 BE25384B 786E1F0A
    2984CE9E 335C6D84 49E29CB9 DFBADB19 8F6944CE BABC2642 3C54F2C3 429BFC4A
    B3988203 EE555961 42CB3211 51C109
  quit
!
voice-card 0
!
!
license udi pid CISCO2921/K9 sn FTX1419ALZK
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package datak9
hw-module pvdm 0/0
!
hw-module sm 1
!
!
username admin secret 5 $1$WDoB$V/fffGytGtAHRiSkHwtPh.
!
redundancy
!
!
crypto ikev2 keyring DMVPN-KEYRING-1

```

```

peer ANY
  address 0.0.0.0 0.0.0.0
  pre-shared-key c1sco123
!
!
crypto ikev2 keyring DMVPN-KEYRING-2
  peer ANY
    address 0.0.0.0 0.0.0.0
    pre-shared-key c1sco123
  !
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-1
  match fvrf IWAN-TRANSPORT-1
  match identity remote address 0.0.0.0
  authentication remote pre-share
  authentication local pre-share
  keyring local DMVPN-KEYRING-1
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-2
  match fvrf IWAN-TRANSPORT-2
  match identity remote address 0.0.0.0
  authentication remote pre-share
  authentication local pre-share
  keyring local DMVPN-KEYRING-2
!
crypto ikev2 dpd 40 5 on-demand
!
!
ip ftp source-interface Loopback0
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
class-map match-any STREAMING-VIDEO
  match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
  match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
  match dscp af11 af21
class-map match-any NET-CTRL-MGMT
  match dscp cs2 cs6
class-map match-any VOICE
  match dscp ef
class-map match-any SCAVENGER
  match dscp cs1
class-map match-any CALL-SIGNALING
  match dscp cs3

```

```

!
policy-map WAN
  class INTERACTIVE-VIDEO
    bandwidth remaining percent 30
    random-detect dscp-based
    set dscp af41
  class STREAMING-VIDEO
    bandwidth remaining percent 10
    random-detect dscp-based
    set dscp af41
  class NET-CTRL-MGMT
    bandwidth remaining percent 5
    set dscp cs6
  class CALL-SIGNALING
    bandwidth remaining percent 4
    set dscp af41
  class CRITICAL-DATA
    bandwidth remaining percent 25
    random-detect dscp-based
    set dscp af21
  class SCAVENGER
    bandwidth remaining percent 1
    set dscp af11
  class VOICE
    priority level 1
    police cir percent 10
    set dscp ef
  class class-default
    bandwidth remaining percent 25
    random-detect
    set dscp default
policy-map WAN-INTERFACE-G0/0
  class class-default
    shape average 30000000
    service-policy WAN
policy-map WAN-INTERFACE-G0/1
  class class-default
    shape average 20000000
    service-policy WAN
!
!
crypto ipsec security-association replay window-size 1024
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
  mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-1

```



```

set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-1
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-2
set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-2
!
!
interface Loopback0
ip address 10.255.241.11 255.255.255.255
ip pim sparse-mode
!
interface Tunnel10
bandwidth 30000
ip address 10.6.34.11 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim dr-priority 0
ip pim sparse-mode
ip nhrp authentication cisco123
ip nhrp group RS-GROUP-30MBPS
ip nhrp network-id 101
ip nhrp holdtime 600
ip nhrp nhs 10.6.34.1 nbma 192.168.6.1 multicast
ip nhrp registration no-unique
ip nhrp shortcut
ip tcp adjust-mss 1360
delay 1000
if-state nhrp
tunnel source GigabitEthernet0/0
tunnel mode gre multipoint
tunnel key 101
tunnel vrf IWAN-TRANSPORT-1
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-1
!
interface Tunnel11
bandwidth 20000
ip address 10.6.36.11 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim dr-priority 0
ip pim sparse-mode
ip nhrp authentication cisco123

```

```

ip nhrp group RS-GROUP-20MBPS
ip nhrp network-id 102
ip nhrp holdtime 600
ip nhrp nhs 10.6.36.1 nbma 172.16.140.1 multicast
ip nhrp registration no-unique
ip nhrp shortcut
ip tcp adjust-mss 1360
delay 2000
if-state nhrp
tunnel source GigabitEthernet0/1
tunnel mode gre multipoint
tunnel key 102
tunnel vrf IWAN-TRANSPORT-2
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-2
!
interface Embedded-Service-Engine0/0
no ip address
shutdown
!
interface GigabitEthernet0/0
bandwidth 30000
vrf forwarding IWAN-TRANSPORT-1
ip address 192.168.6.5 255.255.255.252
no ip redirects
no ip unreachable
no ip proxy-arp
duplex auto
speed auto
no lldp transmit
no lldp receive
no mop enabled
service-policy output WAN-INTERFACE-G0/0
!
interface GigabitEthernet0/1
bandwidth 20000
vrf forwarding IWAN-TRANSPORT-2
ip address dhcp
ip access-group ACL-INET-PUBLIC in
no ip redirects
no ip unreachable
no ip proxy-arp
duplex auto
speed auto
no lldp transmit
no lldp receive
no cdp enable
no mop enabled

```

```

service-policy output WAN-INTERFACE-G0/1
!
interface GigabitEthernet0/2
description RS11-A2960X Gig1/0/48
no ip address
duplex auto
speed auto
!
interface GigabitEthernet0/2.64
encapsulation dot1Q 64
ip address 10.7.2.1 255.255.255.0
ip helper-address 10.4.48.10
ip pim sparse-mode
!
interface GigabitEthernet0/2.65
encapsulation dot1Q 65
ip address 10.7.4.1 255.255.255.0
ip helper-address 10.4.48.10
ip pim sparse-mode
!
interface GigabitEthernet0/2.69
encapsulation dot1Q 69
ip address 10.7.3.1 255.255.255.0
ip helper-address 10.4.48.10
ip pim sparse-mode
!
interface GigabitEthernet0/2.70
encapsulation dot1Q 70
ip address 10.7.5.1 255.255.255.0
ip helper-address 10.4.48.10
ip pim sparse-mode
!
interface SM1/0
no ip address
!
interface SM1/1
no ip address
!
interface Vlan1
no ip address
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default

```

```

    passive-interface
exit-af-interface
!
af-interface Tunnel10
    summary-address 10.7.0.0 255.255.248.0
    authentication mode md5
    authentication key-chain WAN-KEY
    hello-interval 20
    hold-time 60
    no passive-interface
exit-af-interface
!
af-interface Tunnel11
    summary-address 10.7.0.0 255.255.248.0
    authentication mode md5
    authentication key-chain WAN-KEY
    hello-interval 20
    hold-time 60
    no passive-interface
exit-af-interface
!
topology base
exit-af-topology
network 10.6.34.0 0.0.1.255
network 10.6.36.0 0.0.1.255
network 10.7.0.0 0.0.255.255
network 10.255.0.0 0.0.255.255
eigrp router-id 10.255.241.11
eigrp stub connected summary redistributed
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
ip http secure-server
!
ip pim autorp listener
ip pim register-source Loopback0
ip route vrf IWAN-TRANSPORT-1 0.0.0.0 0.0.0.0 192.168.6.6
ip tacacs source-interface Loopback0
!
ip access-list extended ACL-INET-PUBLIC
    permit udp any any eq non500-isakmp
    permit udp any any eq isakmp
    permit esp any any
    permit udp any any eq bootpc

```

```

!
no service-routing capabilities-manager
!
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server ifindex persist
snmp-server trap-source Loopback0
tacacs server TACACS-SERVER-1
  address ipv4 10.4.48.15
  key 7 0235015819031B0A4957
!
!
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
gatekeeper
  shutdown
!
!
line con 0
  logging synchronous
  transport preferred none
line aux 0
line vty 0 4
  exec-timeout 0 0
  transport preferred none
  transport input ssh
line vty 5 15
  transport preferred none
  transport input ssh
!
scheduler allocate 20000 1000
ntp source Loopback0
ntp update-calendar
ntp server 10.4.48.17
!
end

```

Remote Site 12: Dual-Router, Dual-Link (MPLS and INET)

The following table lists the policed-rate link speeds for the remote-site QoS traffic-shaping policies and PfR policies.

Table 5 - Remote-site policed-rate link speeds and delay

Location	MPLS link speed/ delay	INET link speed/ delay
Remote Site 12	20 Mbps/ 10000 us	10 Mbps/ 20000 us

RS12-2911-1: Primary WAN link

```
version 15.4
no service pad
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
!
hostname RS12-2911-1
!
boot-start-marker
boot-end-marker
!
!
vrf definition IWAN-TRANSPORT-1
!
  address-family ipv4
  exit-address-family
!
enable secret 5 $1$S7wW$LwAu9mADPzeXE.yQjFmIc1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
  server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authentication login MODULE none
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
```

```

!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local
ip multicast-routing
ip cef
no ipv6 cef
!
!
flow exporter Export-FNF-LiveAction
  description FNFv9 with LiveAction
  destination 10.4.48.178
  source Loopback0
  output-features
  transport udp 2055
  option interface-table
  option application-table
  option application-attributes
!
!
flow record Record-FNF-IWAN
  description Flexible NetFlow for IWAN Monitoring
  match ipv4 tos
  match ipv4 protocol
  match ipv4 source address
  match ipv4 destination address
  match transport source-port
  match transport destination-port
  match interface input
  match flow direction
  collect routing source as
  collect routing destination as
  collect routing next-hop address ipv4
  collect ipv4 dscp
  collect ipv4 id
  collect ipv4 source prefix
  collect ipv4 source mask
  collect ipv4 destination mask
  collect transport tcp flags
  collect interface output
  collect flow sampler
  collect counter bytes
  collect counter packets
  collect timestamp sys-uptime first

```

```

collect timestamp sys-uptime last
collect application name
!
!
flow monitor Monitor-FNF-IWAN
description IWAN Traffic Analysis
exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
multilink bundle-name authenticated
!
!
domain iwan
vrf default
border
    source-interface Loopback0
    master local
    password 7 0508571C22431F5B4A
    collector 10.4.48.178 port 2055
master branch
    source-interface Loopback0
    password 7 141443180F0B7B7977
    hub 10.6.32.251
    collector 10.4.48.178 port 2055
!
!
key chain WAN-KEY
key 1
    key-string 7 110A4816141D5A5E57
cts logging verbose
!
crypto pki trustpoint TP-self-signed-4080407948
    enrollment selfsigned
    subject-name cn=IOS-Self-Signed-Certificate-4080407948
    revocation-check none
    rsakeypair TP-self-signed-4080407948
!
!
crypto pki certificate chain TP-self-signed-4080407948
certificate self-signed 01
    3082022B 30820194 A0030201 02020101 300D0609 2A864886 F70D0101 05050030
    31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
    69666963 6174652D 34303830 34303739 3438301E 170D3134 30393131 31373434
    32395A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
    4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D34 30383034

```



```

30373934 3830819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281
8100B9C0 2F51508F 539B78B3 48F7DF27 8BF7FC6D E75EE595 58D7DCB6 082FCEF1
EE51D23B 5BA31537 8C99DB87 5771ED30 9BA3AC27 84B362EE 9E5CBE00 65FD93F9
B3EDF47A D4084F74 367164DB 1E5E90BE FAE7EB69 7D46CB68 97DF256E 61431783
225C0395 94B49DF5 8A0DCDC2 14685367 D72F872B 4857F786 63BBFC57 1D3713D6
0DE30203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF 301F0603
551D2304 18301680 14054EB4 FA30EA25 8035E19A 6AAD3B4E 7008E073 C8301D06
03551D0E 04160414 054EB4FA 30EA2580 35E19A6A AD3B4E70 08E073C8 300D0609
2A864886 F70D0101 05050003 8181008D EB9DDEF0 7C109214 E102097C 88C6095D
53C60443 D376808C 6434FBB2 5BA44651 EBFFD15D 02728854 08901A2B FC877E4C
84DBE179 34740A05 84D17544 D08C2EAA 01F74BC5 60280C63 1153D003 83C76092
2B66B54E A1C9928C E9DA752B 6448A5D0 D4FCA407 51910E94 2AE482AE 64CEC8AB
4E1DECE6 D21C9497 E75E7057 8FC630
quit
voice-card 0
!
!
license udi pid CISCO2911/K9 sn FTX1527AMSU
license accept end user agreement
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package uck9
license boot module c2900 technology-package datak9
hw-module pvdm 0/0
!
hw-module sm 1
!
!
username admin secret 5 $1$SnKm$ibEw/1V702JMAMj/C/qzs.
!
redundancy
!
crypto ikev2 proposal AES/CBC/256
  encryption aes-cbc-256
  integrity sha512
  group 14
!
!
crypto ikev2 keyring DMVPN-KEYRING-1
  peer ANY
    address 0.0.0.0 0.0.0.0
    pre-shared-key cisco123
!
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-1
  match fvrf IWAN-TRANSPORT-1
  match identity remote address 0.0.0.0
  authentication remote pre-share

```

```

authentication local pre-share
keyring local DMVPN-KEYRING-1
!
crypto ikev2 dpd 40 5 on-demand
!
!
track 50 interface Tunnel10 line-protocol
delay up 20
!
ip ftp source-interface Loopback0
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
class-map match-any STREAMING-VIDEO
match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
match dscp af11 af21
class-map match-any NET-CTRL-MGMT
match dscp cs2 cs6
class-map match-any VOICE
match dscp ef
class-map match-any SCAVENGER
match dscp cs1
class-map match-any CALL-SIGNALING
match dscp cs3
!
policy-map WAN
class INTERACTIVE-VIDEO
bandwidth remaining percent 30
random-detect dscp-based
set dscp af41
class STREAMING-VIDEO
bandwidth remaining percent 10
random-detect dscp-based
set dscp af41
class NET-CTRL-MGMT
bandwidth remaining percent 5
set dscp cs6
class CALL-SIGNALING
bandwidth remaining percent 4
set dscp af41
class CRITICAL-DATA
bandwidth remaining percent 25
random-detect dscp-based

```

```

    set dscp af21
class SCAVENGER
    bandwidth remaining percent 1
    set dscp af11
class VOICE
    priority level 1
    police cir percent 10
    set dscp ef
class class-default
    bandwidth remaining percent 25
    random-detect
    set dscp default
policy-map WAN-INTERFACE-G0/0
    class class-default
        shape average 20000000
        service-policy WAN
!
!
crypto ipsec security-association replay window-size 1024
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
    mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-1
    set transform-set AES256/SHA/TRANSPORT
    set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-1
!
!
interface Loopback0
    ip address 10.255.241.12 255.255.255.255
    ip pim sparse-mode
!
interface Tunnel10
    bandwidth 20000
    ip address 10.6.34.12 255.255.254.0
    no ip redirects
    ip mtu 1400
    ip flow monitor Monitor-FNF-IWAN input
    ip flow monitor Monitor-FNF-IWAN output
    ip pim dr-priority 0
    ip pim sparse-mode
    ip nhrp authentication cisco123
    ip nhrp group RS-GROUP-20MBPS
    ip nhrp network-id 101
    ip nhrp holdtime 600
    ip nhrp nhs 10.6.34.1 nbma 192.168.6.1 multicast
    ip nhrp registration no-unique

```

```

ip nhrp shortcut
ip tcp adjust-mss 1360
delay 1000
if-state nhrp
tunnel source GigabitEthernet0/0
tunnel mode gre multipoint
tunnel key 101
tunnel vrf IWAN-TRANSPORT-1
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-1
!
interface Port-channel1
description Link to RS12-A2960X
no ip address
!
interface Port-channel1.64
description Data
encapsulation dot1Q 64
ip address 10.7.18.2 255.255.255.0
ip helper-address 10.4.48.10
ip pim dr-priority 110
ip pim sparse-mode
standby 1 ip 10.7.18.1
standby 1 priority 110
standby 1 preempt
standby 1 authentication md5 key-string 7 110A4816141D5A5E57
standby 1 track 50 decrement 10
!
interface Port-channel1.69
description Voice
encapsulation dot1Q 69
ip address 10.7.19.2 255.255.255.0
ip helper-address 10.4.48.10
ip pim dr-priority 110
ip pim sparse-mode
standby 1 ip 10.7.19.1
standby 1 priority 110
standby 1 preempt
standby 1 authentication md5 key-string 7 04585A150C2E1D1C5A
standby 1 track 50 decrement 10
!
interface Port-channel1.99
description Transit Net
encapsulation dot1Q 99
ip address 10.7.16.9 255.255.255.252
ip pim sparse-mode
!
interface Embedded-Service-Engine0/0

```

```

no ip address
shutdown
!
interface GigabitEthernet0/0
bandwidth 20000
vrf forwarding IWAN-TRANSPORT-1
ip address 192.168.6.9 255.255.255.252
no ip redirects
no ip unreachable
no ip proxy-arp
duplex auto
speed auto
no lldp transmit
no lldp receive
no mop enabled
service-policy output WAN-INTERFACE-G0/0
!
interface GigabitEthernet0/1
description RS12-A2960X (gig1/0/47)
no ip address
duplex auto
speed auto
channel-group 1
!
interface GigabitEthernet0/2
description RS12-A2960X (gig2/0/47)
no ip address
duplex auto
speed auto
channel-group 1
!
interface ucsel/0
no ip address
!
interface ucsel/1
no ip address
!
interface Vlan1
no ip address
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
passive-interface

```

```

exit-af-interface
!
af-interface Tunnel10
  summary-address 10.7.16.0 255.255.248.0
  authentication mode md5
  authentication key-chain WAN-KEY
  hello-interval 20
  hold-time 60
  no passive-interface
exit-af-interface
!
af-interface Port-channell1.99
  authentication mode md5
  authentication key-chain WAN-KEY
  no passive-interface
exit-af-interface
!
topology base
  distribute-list route-map ROUTE-LIST out Tunnel10
exit-af-topology
network 10.6.34.0 0.0.1.255
network 10.7.0.0 0.0.255.255
network 10.255.0.0 0.0.255.255
eigrp router-id 10.255.241.12
eigrp stub connected summary redistributed leak-map STUB-LEAK-ALL
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
ip http secure-server
!
ip pim autorp listener
ip pim register-source Loopback0
ip route 10.7.18.10 255.255.255.255 ucse1/0
ip route 10.7.18.11 255.255.255.255 ucse1/0
ip route vrf IWAN-TRANSPORT-1 0.0.0.0 0.0.0.0 192.168.6.10
ip tacacs source-interface Loopback0
!
no service-routing capabilities-manager
!
route-map STUB-LEAK-ALL permit 100
!
route-map ROUTE-LIST deny 10
  description Block readvertisement of learned WAN routes
  match tag 101 102

```

```

!
route-map ROUTE-LIST permit 100
  description Advertise all other routes
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server ifindex persist
snmp-server trap-source Loopback0
tacacs server TACACS-SERVER-1
  address ipv4 10.4.48.15
  key 7 15210E0F162F3F0F2D2A
!
!
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
gatekeeper
  shutdown
!
!
line con 0
  logging synchronous
  transport preferred none
  stopbits 1
line aux 0
line vty 0 4
  exec-timeout 0 0
  transport preferred none
  transport input ssh
line vty 5 15
  transport preferred none
  transport input ssh
!
scheduler allocate 20000 1000
ntp source Loopback0
ntp update-calendar
ntp server 10.4.48.17
!
end

```

RS12-2911-2: Secondary WAN link

```
version 15.4
no service pad
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
!
hostname RS12-2911-2
!
boot-start-marker
boot-end-marker
!
!
vrf definition IWAN-TRANSPORT-2
!
  address-family ipv4
  exit-address-family
!
! card type command needed for slot/vwic-slot 0/0
enable secret 5 $1$S7wW$LwAu9mADPzeXE.yQjFmIc1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
  server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authentication login MODULE none
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local
ip multicast-routing
ip cef
no ipv6 cef
!
!
```



```

flow exporter Export-FNF-LiveAction
description FNFv9 with LiveAction
destination 10.4.48.178
source Loopback0
output-features
transport udp 2055
option interface-table
option application-table
option application-attributes
!
!
flow record Record-FNF-IWAN
description Flexible NetFlow for IWAN Monitoring
match ipv4 tos
match ipv4 protocol
match ipv4 source address
match ipv4 destination address
match transport source-port
match transport destination-port
match interface input
match flow direction
collect routing source as
collect routing destination as
collect routing next-hop address ipv4
collect ipv4 dscp
collect ipv4 id
collect ipv4 source prefix
collect ipv4 source mask
collect ipv4 destination mask
collect transport tcp flags
collect interface output
collect flow sampler
collect counter bytes
collect counter packets
collect timestamp sys-uptime first
collect timestamp sys-uptime last
collect application name
!
!
flow monitor Monitor-FNF-IWAN
description IWAN Traffic Analysis
exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
multilink bundle-name authenticated

```

```

!
!
domain iwan
  vrf default
    border
      source-interface Loopback0
      master 10.255.241.12
      password 7 08221D5D0A16544541
      collector 10.4.48.178 port 2055
    !
  !
  key chain WAN-KEY
    key 1
      key-string 7 110A4816141D5A5E57
  cts logging verbose
  !
  crypto pki trustpoint TP-self-signed-1260640194
    enrollment selfsigned
    subject-name cn=IOS-Self-Signed-Certificate-1260640194
    revocation-check none
    rsakeypair TP-self-signed-1260640194
  !
  !
  crypto pki certificate chain TP-self-signed-1260640194
    certificate self-signed 01
      3082024F 308201B8 A0030201 02020101 300D0609 2A864886 F70D0101 04050030
      31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
      69666963 6174652D 31323630 36343031 3934301E 170D3134 30393131 31373138
      35345A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
      4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D31 32363036
      34303139 3430819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281
      8100C901 B60515CB A0C3F88C A699CB15 F811C11E 24898B1E 46A43416 B16A56F0
      173E023C 404EB7C2 65B2F847 127BB0AF F4EC4DBC 0050532E 2E316C7C 47A41366
      B1166827 E6B96052 AB20008A 593441DB CCD5D333 2B5819A0 8F743249 2D07BEC0
      70F3714C E302A8C8 644B32F0 AFBADFDC 2E05FF4D 30192927 DAF05979 11CECF3E
      A9BF0203 010001A3 77307530 0F060355 1D130101 FF040530 030101FF 30220603
      551D1104 1B301982 17525331 322D3239 31312D32 2E636973 636F2E6C 6F63616C
      301F0603 551D2304 18301680 149F61C1 A06E4625 B2AF1A5A AA7E892B D5A4930B
      91301D06 03551D0E 04160414 9F61C1A0 6E4625B2 AF1A5AAA 7E892BD5 A4930B91
      300D0609 2A864886 F70D0101 04050003 81810001 885A05C0 B51B9F1A 61B1E5E0
      B1E91A28 71F30E47 CE6F7EBD 9A3AD813 72BD6E58 478B5DC7 38FDBF20 8A7F0821
      33B9796A 07787972 6368E37A 1EB9FB1B C52CC27B 1F1AA722 92CE21B8 88C17EF2
      4F383DBE 4064F72D 5827591F C0CC56A1 4E488DCF 35F1158F E36E3BB7 3251AD6A
      BE041363 C34936C8 20D8BDB3 DF86E7F4 288970
    quit
  voice-card 0
  !

```

```

!
license udi pid CISCO2911/K9 sn FTX1420AJLL
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package uck9
license boot module c2900 technology-package datak9
hw-module pvdm 0/0
!
hw-module pvdm 0/1
!
hw-module sm 1
!
!
username admin secret 5 $1$SnKm$ibEw/1V702JMAMj/C/qzs.
!
redundancy
!
crypto ikev2 proposal AES/CBC/256
  encryption aes-cbc-256
  integrity sha512
  group 14
!
!
crypto ikev2 keyring DMVPN-KEYRING-2
  peer ANY
    address 0.0.0.0 0.0.0.0
    pre-shared-key cisco123
!
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-2
  match fvrf IWAN-TRANSPORT-2
  match identity remote address 0.0.0.0
  authentication remote pre-share
  authentication local pre-share
  keyring local DMVPN-KEYRING-2
!
crypto ikev2 dpd 40 5 on-demand
!
!
ip ftp source-interface Loopback0
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
class-map match-any STREAMING-VIDEO
  match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
  match dscp cs4 af41 af42

```

```

class-map match-any CRITICAL-DATA
  match dscp af11 af21
class-map match-any NET-CTRL-MGMT
  match dscp cs2 cs6
class-map match-any VOICE
  match dscp ef
class-map match-any SCAVENGER
  match dscp cs1
class-map match-any CALL-SIGNALING
  match dscp cs3
!
policy-map WAN
  class INTERACTIVE-VIDEO
    bandwidth remaining percent 30
    random-detect dscp-based
    set dscp af41
  class STREAMING-VIDEO
    bandwidth remaining percent 10
    random-detect dscp-based
    set dscp af41
  class NET-CTRL-MGMT
    bandwidth remaining percent 5
    set dscp cs6
  class CALL-SIGNALING
    bandwidth remaining percent 4
    set dscp af41
  class CRITICAL-DATA
    bandwidth remaining percent 25
    random-detect dscp-based
    set dscp af21
  class SCAVENGER
    bandwidth remaining percent 1
    set dscp af11
  class VOICE
    priority level 1
    police cir percent 10
    set dscp ef
  class class-default
    bandwidth remaining percent 25
    random-detect
    set dscp default
policy-map WAN-INTERFACE-G0/0
  class class-default
    shape average 10000000
    service-policy WAN
!
!

```

```

crypto ipsec security-association replay window-size 1024
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-2
set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-2
!
!
interface Loopback0
ip address 10.255.242.12 255.255.255.255
ip pim sparse-mode
!
interface Tunnel11
bandwidth 10000
ip address 10.6.36.12 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim dr-priority 0
ip pim sparse-mode
ip nhrp authentication cisco123
ip nhrp group RS-GROUP-10MBPS
ip nhrp network-id 102
ip nhrp holdtime 600
ip nhrp nhs 10.6.36.1 nbma 172.16.140.1 multicast
ip nhrp registration no-unique
ip nhrp shortcut
ip tcp adjust-mss 1360
delay 2000
if-state nhrp
tunnel source GigabitEthernet0/0
tunnel mode gre multipoint
tunnel key 102
tunnel vrf IWAN-TRANSPORT-2
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-2
!
interface Port-channel2
description Link to RS12-A2960X
no ip address
!
interface Port-channel2.64
description Data
encapsulation dot1Q 64
ip address 10.7.18.3 255.255.255.0

```

```

ip helper-address 10.4.48.10
ip pim dr-priority 105
ip pim sparse-mode
standby 1 ip 10.7.18.1
standby 1 priority 105
standby 1 preempt
standby 1 authentication md5 key-string 7 06055E324F41584B56
!
interface Port-channel2.69
description Voice
encapsulation dot1Q 69
ip address 10.7.19.3 255.255.255.0
ip helper-address 10.4.48.10
ip pim dr-priority 105
ip pim sparse-mode
standby 1 ip 10.7.19.1
standby 1 priority 105
standby 1 preempt
standby 1 authentication md5 key-string 7 121A540411045D5679
!
interface Port-channel2.99
description Transit Net
encapsulation dot1Q 99
ip address 10.7.16.10 255.255.255.252
ip pim sparse-mode
!
interface Embedded-Service-Engine0/0
no ip address
shutdown
!
interface GigabitEthernet0/0
bandwidth 10000
vrf forwarding IWAN-TRANSPORT-2
ip address dhcp
ip access-group ACL-INET-PUBLIC in
no ip redirects
no ip unreachable
no ip proxy-arp
duplex auto
speed auto
no lldp transmit
no lldp receive
no cdp enable
no mop enabled
service-policy output WAN-INTERFACE-G0/0
!
interface GigabitEthernet0/1

```

```

description RS12-A2960X (gig1/0/48)
no ip address
duplex auto
speed auto
channel-group 2
!
interface GigabitEthernet0/2
description RS12-A2960X (gig2/0/48)
no ip address
duplex auto
speed auto
channel-group 2
!
interface ucsel/0
no ip address
!
interface ucsel/1
no ip address
!
interface Vlan1
no ip address
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
passive-interface
exit-af-interface
!
af-interface Tunnel11
summary-address 10.7.16.0 255.255.248.0
authentication mode md5
authentication key-chain WAN-KEY
hello-interval 20
hold-time 60
no passive-interface
exit-af-interface
!
af-interface Port-channel2.99
authentication mode md5
authentication key-chain WAN-KEY
no passive-interface
exit-af-interface
!
topology base

```

```

    distribute-list route-map ROUTE-LIST out Tunnel11
  exit-af-topology
  network 10.6.36.0 0.0.1.255
  network 10.7.0.0 0.0.255.255
  network 10.255.0.0 0.0.255.255
  eigrp router-id 10.255.242.12
  eigrp stub connected summary redistributed leak-map STUB-LEAK-ALL
  exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
ip http secure-server
!
ip pim autorp listener
ip pim register-source Loopback0
ip route 10.7.18.12 255.255.255.255 ucsel/0
ip route 10.7.18.13 255.255.255.255 ucsel/0
ip tacacs source-interface Loopback0
!
ip access-list extended ACL-INET-PUBLIC
  permit udp any any eq non500-isakmp
  permit udp any any eq isakmp
  permit esp any any
  permit udp any any eq bootpc
!
no service-routing capabilities-manager
!
route-map STUB-LEAK-ALL permit 100
!
route-map ROUTE-LIST deny 10
  description Block readvertisement of learned WAN routes
  match tag 101 102
!
route-map ROUTE-LIST permit 100
  description Advertise all other routes
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server ifindex persist
snmp-server trap-source Loopback0
tacacs server TACACS-SERVER-1
  address ipv4 10.4.48.15
  key 7 15210E0F162F3F0F2D2A
!
!

```

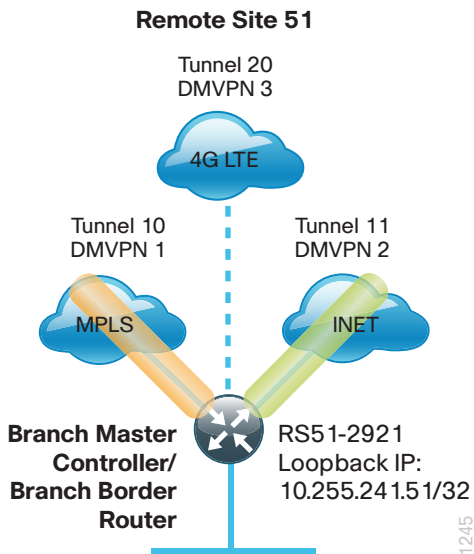


```
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
gatekeeper
  shutdown
!
!
line con 0
  logging synchronous
  transport preferred none
  stopbits 1
line aux 0
line vty 0 4
  exec-timeout 0 0
  transport preferred none
  transport input ssh
line vty 5 15
  transport preferred none
  transport input ssh
!
scheduler allocate 20000 1000
ntp source Loopback0
ntp update-calendar
ntp server 10.4.48.17
!
end
```

Remote Site 51: Single-Router, Dual-Link (MPLS and INET w/ 4G LTE Fallback)

This section includes configuration files corresponding to the IWAN hybrid design model with 4G LTE fallback, as referenced in the figure below.

Figure 7 - WAN remote-site details—IWAN hybrid design model w/ 4G LTE



The following table lists the policed-rate link speeds for the remote-site QoS traffic-shaping policies and PfR policies.

Table 6 - Remote-site policed-rate link speeds and delay

Location	MPLS link speed/ delay	INET link speed/ delay	4G link speed/ delay
Remote Site 51	30 Mbps/ 10000 us	10 Mbps/ 20000 us	8 Mbps/ N/A

RS51-2921: Primary, secondary and tertiary WAN links

```

version 15.4
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
!
hostname RS51-2921
!
boot-start-marker
boot-end-marker
!
aqm-register-fnf
!
vrf definition IWAN-TRANSPORT-1

```

```

!
address-family ipv4
exit-address-family
!
vrf definition IWAN-TRANSPORT-2
!
address-family ipv4
exit-address-family
!
vrf definition IWAN-TRANSPORT-3
!
address-family ipv4
exit-address-family
!
card type t1 0 0
enable secret 5 $1$Gu5w$KepQBQqwzWMQigAJvHrS0/
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authentication login MODULE none
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
network-clock-participate wic 0
!
!
ip domain name cisco.local
ip multicast-routing
ip cef
ip wccp source-interface Loopback0
no ipv6 cef
!
!
flow exporter Export-FNF-LiveAction
description FNFv9 with LiveAction
destination 10.4.48.178
source Loopback0
output-features

```

```

transport udp 2055
option interface-table
option application-table
option application-attributes
!
!
flow record Record-FNF-IWAN
description Flexible NetFlow for IWAN Monitoring
match ipv4 tos
match ipv4 protocol
match ipv4 source address
match ipv4 destination address
match transport source-port
match transport destination-port
match interface input
match flow direction
collect routing source as
collect routing destination as
collect routing next-hop address ipv4
collect ipv4 dscp
collect ipv4 id
collect ipv4 source prefix
collect ipv4 source mask
collect ipv4 destination mask
collect transport tcp flags
collect interface output
collect flow sampler
collect counter bytes
collect counter packets
collect timestamp sys-uptime first
collect timestamp sys-uptime last
collect application name
!
!
flow monitor Monitor-FNF-IWAN
description IWAN Traffic Analysis
exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
multilink bundle-name authenticated
!
!
domain iwan
vrf default
border

```

```

source-interface Loopback0
master local
password 7 04585A150C2E1D1C5A
collector 10.4.48.178 port 2055
master branch
source-interface Loopback0
password 7 094F1F1A1A0A464058
hub 10.6.32.251
collector 10.4.48.178 port 2055
!
!
isdn switch-type primary-ni
!
chat-script LTE "" "AT!CALL" TIMEOUT 60 "OK"
chat-script lte "" "AT!CALL" TIMEOUT 60 "OK"
!
key chain WAN-KEY
key 1
key-string 7 110A4816141D5A5E57
cts logging verbose
!
crypto pki trustpoint TP-self-signed-687984884
enrollment selfsigned
subject-name cn=IOS-Self-Signed-Certificate-687984884
revocation-check none
rsaкеypair TP-self-signed-687984884
!
!
crypto pki certificate chain TP-self-signed-687984884
certificate self-signed 01
30820229 30820192 A0030201 02020101 300D0609 2A864886 F70D0101 05050030
30312E30 2C060355 04031325 494F532D 53656C66 2D536967 6E65642D 43657274
69666963 6174652D 36383739 38343838 34301E17 0D313430 35323831 36313333
375A170D 32303031 30313030 30303030 5A303031 2E302C06 03550403 1325494F
532D5365 6C662D53 69676E65 642D4365 72746966 69636174 652D3638 37393834
38383430 819F300D 06092A86 4886F70D 01010105 0003818D 00308189 02818100
ACE7E5DB 5CB57FA8 52687F84 35006BE7 E33E9778 EAFCA488 250E1650 5968EB2D
38637C7A F7ED84AC F9A0C58C FD5B5BA3 7B57E16E A27FEC64 190412BA F921040B
CA6F9BE4 F9FD064E 87D136C8 698E12B9 408D5A60 5E90DD32 0139A747 0DD11922
F4B1C67C A35AE385 642F9AFE 9F25C765 82DE4A88 824866A9 B36D37E9 7FA6B0D7
02030100 01A35330 51300F06 03551D13 0101FF04 05300301 01FF301F 0603551D
23041830 168014B0 442941F8 19EA98DA B0EE69BF F5EF16C8 75036330 1D060355
1D0E0416 0414B044 2941F819 EA98DAB0 EE69BFF5 EF16C875 0363300D 06092A86
4886F70D 01010505 00038181 00A0E0C4 AAA79D0F 7A576751 16A2DA4F C2CB56EF
BCB7E03E 60BEB07 529DBE84 2854D39B A960A3EF 64F5EA06 31503B0B 6B347F80
0419E06E B4E72197 02D701CD 12EEB28A 54F97DF8 AD665D6F 0F4A3836 CC3BE0D4
A8E82A49 A442377C AC879304 830873E9 01E76026 FCABD6D3 3BA0F5BC C915E868

```

```

    ADC1CC57 39C55804 0E057D94 5F
quit
voice-card 0
    dspfarm
    dsp services dspfarm
!
!
voice service voip
    allow-connections sip to sip
    fax protocol t38 version 0 ls-redundancy 0 hs-redundancy 0 fallback none
    sip
        bind control source-interface loopback
        bind media source-interface loopback
        registrar server expires max 600 min 60
!
voice class codec 1
    codec preference 1 g711ulaw
    codec preference 2 g711alaw
    codec preference 3 g729r8
    codec preference 4 ilbc
!
!
license udi pid CISCO2921/K9 sn FTX1451AJLZ
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package datak9
hw-module pvdm 0/0
!
hw-module sm 1
!
!
username admin password 7 130646010803557878
!
redundancy
!
!
crypto ikev2 keyring DMVPN-KEYRING-1
    peer ANY
        address 0.0.0.0 0.0.0.0
        pre-shared-key cisco123
!
!
crypto ikev2 keyring DMVPN-KEYRING-2
    peer ANY
        address 0.0.0.0 0.0.0.0
        pre-shared-key cisco123
!
!

```

```

crypto ikev2 keyring DMVPN-KEYRING-3
  peer ANY
    address 0.0.0.0 0.0.0.0
    pre-shared-key cisco123
  !
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-1
  match fvrf IWAN-TRANSPORT-1
  match identity remote address 0.0.0.0
  authentication remote pre-share
  authentication local pre-share
  keyring local DMVPN-KEYRING-1
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-2
  match fvrf IWAN-TRANSPORT-2
  match identity remote address 0.0.0.0
  authentication remote pre-share
  authentication local pre-share
  keyring local DMVPN-KEYRING-2
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-3
  match fvrf IWAN-TRANSPORT-3
  match identity remote address 0.0.0.0
  authentication remote pre-share
  authentication local pre-share
  keyring local DMVPN-KEYRING-3
!
crypto ikev2 dpd 40 5 on-demand
!
!
controller T1 0/0/0
  cablelength short 110
  pri-group timeslots 1-24
  description PSTN PRI
!
controller Cellular 0/1
  lte modem link-recovery rssi onset-threshold -110
  lte modem link-recovery monitor-timer 20
  lte modem link-recovery wait-timer 10
  lte modem link-recovery debounce-count 6
!
track 10 interface Tunnel10 line-protocol
!
track 11 interface Tunnel11 line-protocol
!
track 20 list boolean or
  object 10

```

```

object 11
delay up 20
!
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
class-map match-any STREAMING-VIDEO
  match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
  match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
  match dscp af11 af21
class-map match-any NET-CTRL-MGMT
  match dscp cs2 cs6
class-map match-any VOICE
  match dscp ef
class-map match-any SCAVENGER
  match dscp cs1
class-map match-any CALL-SIGNALING
  match dscp cs3
!
policy-map WAN
  class INTERACTIVE-VIDEO
    bandwidth remaining percent 30
    random-detect dscp-based
    set dscp af41
  class STREAMING-VIDEO
    bandwidth remaining percent 10
    random-detect dscp-based
    set dscp af41
  class NET-CTRL-MGMT
    bandwidth remaining percent 5
    set dscp cs6
  class CALL-SIGNALING
    bandwidth remaining percent 4
    set dscp af41
  class CRITICAL-DATA
    bandwidth remaining percent 25
    random-detect dscp-based
    set dscp af21
  class SCAVENGER
    bandwidth remaining percent 1
    set dscp af11
  class VOICE
    priority level 1
    police cir percent 10

```



```

    set dscp ef
class class-default
    bandwidth remaining percent 25
    random-detect
    set dscp default
policy-map WAN-INTERFACE-Cellular
class class-default
    shape average 8000000
    service-policy WAN
policy-map WAN-INTERFACE-G0/0
class class-default
    shape average 30000000
    service-policy WAN
policy-map WAN-INTERFACE-G0/1
class class-default
    shape average 10000000
    service-policy WAN
!
!
crypto ipsec security-association replay window-size 1024
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-1
set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-1
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-2
set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-2
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-3
set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-3
!
!
interface Loopback0
ip address 10.255.241.51 255.255.255.255
ip pim sparse-mode
!
interface Tunnel10
bandwidth 30000
ip address 10.6.34.51 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input

```

```

ip flow monitor Monitor-FNF-IWAN output
ip pim dr-priority 0
ip pim sparse-mode
ip nhrp authentication cisco123
ip nhrp group RS-GROUP-30MBPS
ip nhrp network-id 101
ip nhrp holdtime 600
ip nhrp nhs 10.6.34.1 nbma 192.168.6.1 multicast
ip nhrp nhs cluster 0 max-connections 1
ip nhrp registration no-unique
ip nhrp shortcut
ip tcp adjust-mss 1360
delay 1000
if-state nhrp
tunnel source GigabitEthernet0/0
tunnel mode gre multipoint
tunnel key 101
tunnel vrf IWAN-TRANSPORT-1
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-1
!
interface Tunnel11
bandwidth 10000
ip address 10.6.36.51 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim dr-priority 0
ip pim sparse-mode
ip nhrp authentication cisco123
ip nhrp group RS-GROUP-10MBPS
ip nhrp network-id 102
ip nhrp holdtime 600
ip nhrp nhs 10.6.36.1 nbma 172.16.140.1 multicast
ip nhrp nhs cluster 0 max-connections 1
ip nhrp registration no-unique
ip nhrp shortcut
ip tcp adjust-mss 1360
delay 2000
if-state nhrp
tunnel source GigabitEthernet0/1
tunnel mode gre multipoint
tunnel key 102
tunnel vrf IWAN-TRANSPORT-2
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-2
!
interface Tunnel20

```

```

bandwidth 8000
ip address 10.6.38.51 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim dr-priority 0
ip pim sparse-mode
ip nhrp authentication cisco123
ip nhrp group RS-GROUP-4G-POLICY
ip nhrp network-id 201
ip nhrp holdtime 600
ip nhrp nhs 10.6.38.1 nbma 173.36.197.94 multicast
ip nhrp registration no-unique
ip nhrp shortcut
ip tcp adjust-mss 1360
if-state nhrp
tunnel source Cellular0/1/0
tunnel mode gre multipoint
tunnel key 201
tunnel vrf IWAN-TRANSPORT-3
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-3
!
interface Embedded-Service-Engine0/0
no ip address
shutdown
!
interface GigabitEthernet0/0
bandwidth 30000
vrf forwarding IWAN-TRANSPORT-1
ip address 192.168.6.37 255.255.255.252
duplex auto
speed auto
service-policy output WAN-INTERFACE-G0/0
!
interface GigabitEthernet0/1
bandwidth 10000
vrf forwarding IWAN-TRANSPORT-2
ip address dhcp
ip access-group ACL-INET-PUBLIC in
duplex auto
speed auto
service-policy output WAN-INTERFACE-G0/1
!
interface GigabitEthernet0/2
description RS51-A3650 (Gig 1/0/24)
no ip address

```

```

duplex auto
speed auto
!
interface GigabitEthernet0/2.64
description Data
encapsulation dot1Q 64
ip address 10.7.250.1 255.255.255.0
ip helper-address 10.4.48.10
ip pim sparse-mode
!
interface GigabitEthernet0/2.69
encapsulation dot1Q 69
ip address 10.7.251.1 255.255.255.0
ip helper-address 10.4.48.10
ip pim sparse-mode
!
interface Serial0/0/0:23
no ip address
encapsulation hdlc
isdn switch-type primary-ni
isdn incoming-voice voice
no cdp enable
!
interface SM1/0
no ip address
!
interface SM1/1
no ip address
!
interface Cellular0/1/0
bandwidth 8000
vrf forwarding IWAN-TRANSPORT-3
ip address negotiated
ip access-group ACL-INET-PUBLIC-4G in
no ip unreachable
encapsulation slip
shutdown
dialer in-band
dialer idle-timeout 0
dialer string LTE
dialer watch-group 1
no peer default ip address
async mode interactive
service-policy output WAN-INTERFACE-Cellular
!
interface Vlan1
no ip address

```

```

!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
  passive-interface
exit-af-interface
!
af-interface Tunnel10
  summary-address 10.7.248.0 255.255.248.0
  authentication mode md5
  authentication key-chain WAN-KEY
  hello-interval 20
  hold-time 60
  no passive-interface
exit-af-interface
!
af-interface Tunnel11
  summary-address 10.7.248.0 255.255.248.0
  authentication mode md5
  authentication key-chain WAN-KEY
  hello-interval 20
  hold-time 60
  no passive-interface
exit-af-interface
!
af-interface Tunnel20
  summary-address 10.7.248.0 255.255.248.0
  authentication mode md5
  authentication key-chain WAN-KEY
  hello-interval 20
  hold-time 60
  no passive-interface
exit-af-interface
!
topology base
exit-af-topology
network 10.6.34.0 0.0.1.255
network 10.6.36.0 0.0.1.255
network 10.6.38.0 0.0.1.255
network 10.7.0.0 0.0.255.255
network 10.255.0.0 0.0.255.255
eigrp router-id 10.255.241.51
eigrp stub connected summary redistributed
exit-address-family

```

```

!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
ip http secure-server
!
ip pim autorp listener
ip pim register-source Loopback0
ip route vrf IWAN-TRANSPORT-1 0.0.0.0 0.0.0.0 192.168.6.38
ip route vrf IWAN-TRANSPORT-3 0.0.0.0 0.0.0.0 Cellular0/1/0
ip tacacs source-interface Loopback0
!
ip access-list extended ACL-INET-PUBLIC
 permit udp any any eq non500-isakmp
 permit udp any any eq isakmp
 permit esp any any
 permit udp any any eq bootpc
 permit icmp any any echo
 permit icmp any any echo-reply
 permit icmp any any ttl-exceeded
 permit icmp any any port-unreachable
ip access-list extended ACL-INET-PUBLIC-4G
 permit udp any any eq non500-isakmp
 permit udp any any eq isakmp
 permit esp any any
 permit icmp any any echo
 permit icmp any any echo-reply
 permit icmp any any ttl-exceeded
 permit icmp any any port-unreachable
!
ip sla auto discovery
no service-routing capabilities-manager
dialer watch-list 1 ip 127.0.0.255 255.255.255.255
dialer watch-list 1 delay route-check initial 60
dialer watch-list 1 delay connect 1
!
snmp-server community cisco RO 55
snmp-server community cisco123 RW 55
snmp-server ifindex persist
snmp-server trap-source Loopback0
tacacs server TACACS-SERVER-1
 address ipv4 10.4.48.15
 key 7 122A0014000E182F2F32
!
!
control-plane

```

```

!
!
voice-port 0/0/0:23
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
gatekeeper
  shutdown
!
!
line con 0
  logging synchronous
  transport preferred none
line aux 0
line vty 0 4
  exec-timeout 0 0
  transport preferred none
  transport input ssh
line vty 5 15
  exec-timeout 0 0
  transport preferred none
  transport input ssh
!
scheduler allocate 20000 1000
ntp source Loopback0
ntp update-calendar
ntp server 10.4.48.17
event manager applet ACTIVATE-LTE
  event track 20 state down
  action 1 cli command "enable"
  action 2 cli command "configure terminal"
  action 3 cli command "interface cellular0/1/0"
  action 4 cli command "no shutdown"
  action 5 cli command "end"
  action 99 syslog msg "Both tunnels down - Activating 4G interface"
event manager applet DEACTIVATE-LTE
  event track 20 state up
  action 1 cli command "enable"
  action 2 cli command "configure terminal"
  action 3 cli command "interface cellular0/1/0"

```

```
action 4 cli command "shutdown"  
action 5 cli command "end"  
action 99 syslog msg "Connectivity Restored - Deactivating 4G interface"  
!  
end
```


WAN-Aggregation Devices–IWAN Dual Internet Design Model

Performance Routing Version 3 (PfRv3) consists of two major Cisco IOS components: an MC and a BR. The MC defines the policies and applies them to various traffic classes that traverse the BR systems. The MC can be configured to learn and control traffic classes on the network.

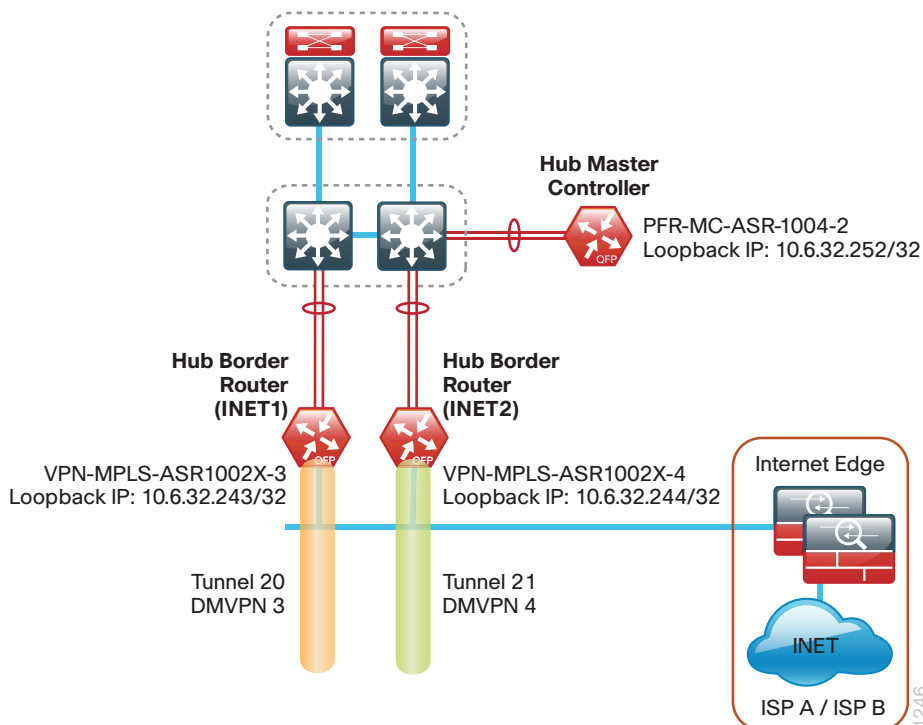
There are two different roles a device can play at the WAN aggregation site of a PfRv3 configuration:

- **Hub Master Controller**–The hub MC is the MC at the primary WAN aggregation site. This is the MC device where all PfRv3 policies are configured. It also acts as MC for that site and makes path-optimization decision. There is only one hub MC per IWAN domain.
- **Hub Border Router**–This is a BR at the hub MC site. This is the device where WAN interfaces terminate. There can be one or more WAN interfaces on the same device. There can be one or more hub BRs. On the Hub BRs, PfRv3 must be configured with:
 - The address of the local MC.
 - The path name on external interfaces.

The first design model is the IWAN Hybrid, which uses a primary MPLS transport paired with Internet VPN as a secondary transport. In this design model, the MPLS WAN provides SLA class of service guarantees for key applications. The second design model is the IWAN Dual Internet, which uses a pair of Internet service providers to further reduce cost while leveraging PfR in order to mitigate network performance problems on a single Internet provider.

This section includes configuration files corresponding to the IWAN dual Internet design model WAN aggregation site, as referenced in the figure below.

Figure 8 - WAN-aggregation site details–Dual Internet design model



The following table provides the loopback addresses for the WAN aggregation devices in the IWAN dual Internet design model.

Table 7 - Hub router IP addresses

IWAN function	Host name	Loopback IP address	Port channel IP address
Hub MC	PFR-MC-ASR-1004-2	10.6.32.252/32	10.6.32.152/26
Hub BR (INET1)	VPN-INET-ASR1002X-3	10.6.32.243/32	10.6.32.18/30
Hub BR (INET2)	VPN-INET-ASR1002X-4	10.6.32.244/32	10.6.32.22/30

PFR-MC-ASR-1004-2

```

version 15.5
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
no platform punt-keepalive disable-kernel-core
no platform punt-keepalive settings
!
hostname Pfr-MC-ASR1004-2
!
boot-start-marker
boot-end-marker
!
!
vrf definition Mgmt-intf
!
  address-family ipv4
  exit-address-family
!
  address-family ipv6
  exit-address-family
!
enable secret 5 $1$mKNt$VPr4J4yoEfm6cpOb/E0Sn.
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
  server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!

```

```

!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
subscriber templating
!
multilink bundle-name authenticated
!
domain iwan2
vrf default
  master hub
    source-interface Loopback0
    site-prefixes prefix-list PRIMARY-SITE-PREFIXES
    password 7 094F1F1A1A0A464058
    load-balance
    advanced
    enterprise-prefix prefix-list ENTERPRISE-PREFIXES
    collector 10.4.48.178 port 2055
    class VOICE sequence 10
      match dscp ef policy voice
      path-preference INET1 fallback INET2
    class INTERACTIVE-VIDEO sequence 20
      match dscp cs4 policy real-time-video
      match dscp af41 policy real-time-video
      match dscp af42 policy real-time-video
      path-preference INET1 fallback INET2
    class CRITICAL-DATA sequence 30
      match dscp af21 policy low-latency-data
      path-preference INET1 fallback INET2
!
key chain LAN-KEY
  key 1
    key-string 7 104D580A061843595F
!
!
crypto pki trustpoint TP-self-signed-2545953486
  enrollment selfsigned
  subject-name cn=IOS-Self-Signed-Certificate-2545953486
  revocation-check none
  rsa-keypair TP-self-signed-2545953486
!
!
crypto pki certificate chain TP-self-signed-2545953486
  certificate self-signed 01
    3082022B 30820194 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

```

```

31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
69666963 6174652D 32353435 39353334 3836301E 170D3134 30393130 32333436
34325A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 35343539
35333438 3630819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281
8100C544 D06AC840 96B87760 03EB0F74 9616C6FC 2597CF6B CEEAE075 721E0F21
42AB1A54 99637886 950897C7 CBBF8773 8E710E0B D98E29CA 4AF3A001 974EFF50
A22979EA 37D50584 2C500ED9 73D33544 F1CDA5AD 96A37E2F 77E8F3C2 7ADC94E4
1E8E578A 0B79016B 60780527 9ADE639E 451E16DC 92A29D95 6CB4AC5F 54780825
ED790203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF 301F0603
551D2304 18301680 141BD911 DC902997 48E81CD3 AF7728BC 209FB148 7F301D06
03551D0E 04160414 1BD911DC 90299748 E81CD3AF 7728BC20 9FB1487F 300D0609
2A864886 F70D0101 05050003 8181005A 5A6F1DF2 69A9B79B 870BF96B D68F85EF
C435A421 3D566FD5 AD461B6B 6BE6F5FD FB6E5082 1AAA8BD8 ACB336B5 2E37861B
55EB98CC AC124A55 67099A09 D15DB859 B8148517 F0BF8A50 0A89C06B 9145BD41
B4CE2630 00A5A19B FEC265C7 3A14B42A 3A2DF993 73C93B06 A256D22B 00224321
5A432445 4576247E 57F3C8D4 E599F9
quit
spanning-tree extend system-id
!
username admin secret 5 $1$GO9Y$mz7wOY3FEYhj0zVqi.lrE/
!
redundancy
!
!
cdp run
!
ip ftp source-interface Loopback0
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
!
interface Loopback0
 ip address 10.6.32.252 255.255.255.255
!
interface Port-channel22
 description IWAN-D3750X
 ip address 10.6.32.152 255.255.255.192
 no negotiation auto
!
interface GigabitEthernet0/0/0
 description IW-WAN-D3750X Gig1/0/14
 no ip address
 media-type rj45
 negotiation auto
 cdp enable

```

```

channel-group 22
!
interface GigabitEthernet0/0/1
description IW-WAN-D3750X Gig2/0/14
no ip address
media-type rj45
negotiation auto
cdp enable
channel-group 22
!
interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
passive-interface
exit-af-interface
!
af-interface Port-channel22
authentication mode md5
authentication key-chain LAN-KEY
no passive-interface
exit-af-interface
!
topology base
exit-af-topology
network 10.6.0.0 0.1.255.255
eigrp router-id 10.6.32.252
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
ip http secure-server
ip tacacs source-interface Loopback0
!
!
ip prefix-list ENTERPRISE-PREFIXES seq 10 permit 10.4.0.0/14
!

```

```
ip prefix-list PRIMARY-SITE-PREFIXES seq 10 permit 10.4.0.0/16
ip prefix-list PRIMARY-SITE-PREFIXES seq 20 permit 10.6.0.0/16
no service-routing capabilities-manager
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server trap-source Loopback0
!
tacacs server TACACS-SERVER-1
  address ipv4 10.4.48.15
  key 7 15210E0F162F3F0F2D2A
!
!
control-plane
!
!
line con 0
  transport preferred none
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  transport preferred none
  transport input ssh
line vty 5 15
  transport preferred none
  transport input ssh
!
ntp source Loopback0
ntp server 10.4.48.17
!
end
```

VPN-INET-ASR1002X-3: Primary WAN link

```
version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
no platform punt-keepalive disable-kernel-core
!
hostname VPN-INET-ASR1002X-3
!
boot-start-marker
boot-end-marker
!
aqm-register-fnf
!
vrf definition IWAN-TRANSPORT-3
!
  address-family ipv4
  exit-address-family
!
vrf definition Mgmt-intf
!
  address-family ipv4
  exit-address-family
!
  address-family ipv6
  exit-address-family
!
enable secret 5 $1$S7wW$LwAu9mADPzeXE.yQjFmIc1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
  server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local
```

```

ip multicast-routing distributed
!
!
subscriber templating
!
!
flow record Record-FNF-IWAN
  description Flexible NetFlow for IWAN Monitoring
  match ipv4 tos
  match ipv4 protocol
  match ipv4 source address
  match ipv4 destination address
  match transport source-port
  match transport destination-port
  match interface input
  match flow direction
  collect routing source as
  collect routing destination as
  collect routing next-hop address ipv4
  collect ipv4 dscp
  collect ipv4 id
  collect ipv4 source prefix
  collect ipv4 source mask
  collect ipv4 destination mask
  collect transport tcp flags
  collect interface output
  collect flow sampler
  collect counter bytes
  collect counter packets
  collect timestamp sys-uptime first
  collect timestamp sys-uptime last
  collect application name
!
!
flow exporter Export-FNF-LiveAction
  description FNFv9 with LiveAction
  destination 10.4.48.178
  source Loopback0
  transport udp 2055
  option interface-table
  option application-table
  option application-attributes
!
!
flow monitor Monitor-FNF-IWAN
  description IWAN Traffic Analysis

```



```

exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
multilink bundle-name authenticated
!
domain iwan2
vrf default
border
source-interface Loopback0
master 10.6.32.252
password 7 104D580A061843595F
collector 10.4.48.178 port 2055
!
key chain LAN-KEY
key 1
key-string 7 0508571C22431F5B4A
key chain WAN-KEY
key 1
key-string 7 08221D5D0A16544541
!
!
license udi pid ASR1002-X sn JAE183501DR
spanning-tree extend system-id
!
username admin secret 5 $1$SnKm$ibEw/1V702JMAMj/C/qzs.
!
redundancy
mode none
!
!
crypto ikev2 keyring DMVPN-KEYRING-3
peer ANY
address 0.0.0.0 0.0.0.0
pre-shared-key cisco123
!
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-3
match fvrf IWAN-TRANSPORT-3
match identity remote address 0.0.0.0
authentication remote pre-share
authentication local pre-share
keyring local DMVPN-KEYRING-3
!
!
cdp run

```

```

!
ip ftp source-interface Loopback0
ip tftp source-interface GigabitEthernet0
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
class-map match-any STREAMING-VIDEO
  match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
  match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
  match dscp af11 af21
class-map match-any NET-CTRL-MGMT
  match dscp cs2 cs6
class-map match-any VOICE
  match dscp ef
class-map match-any SCAVENGER
  match dscp cs1
class-map match-any CALL-SIGNALING
  match dscp cs3
!
policy-map WAN
  class INTERACTIVE-VIDEO
    bandwidth remaining percent 30
    random-detect dscp-based
    set dscp tunnel af41
  class STREAMING-VIDEO
    bandwidth remaining percent 10
    random-detect dscp-based
    set dscp tunnel af41
  class NET-CTRL-MGMT
    bandwidth remaining percent 5
    set dscp tunnel cs6
  class CALL-SIGNALING
    bandwidth remaining percent 4
    set dscp tunnel af41
  class CRITICAL-DATA
    bandwidth remaining percent 25
    random-detect dscp-based
    set dscp tunnel af21
  class SCAVENGER
    bandwidth remaining percent 1
    set dscp tunnel af11
  class VOICE
    priority level 1
    police cir percent 10

```

```

    set dscp tunnel ef
class class-default
    bandwidth remaining percent 25
    random-detect
    set dscp tunnel default
policy-map RS-GROUP-200MBPS-POLICY
class class-default
    shape average 200000000
    bandwidth remaining ratio 200
    service-policy WAN
policy-map RS-GROUP-4G-POLICY
class class-default
    shape average 8000000
    bandwidth remaining ratio 8
    service-policy WAN
policy-map RS-GROUP-20MBPS-POLICY
class class-default
    shape average 20000000
    bandwidth remaining ratio 20
    service-policy WAN
policy-map WAN-INTERFACE-G0/0/3-SHAPE-ONLY
class class-default
    shape average 1000000000
policy-map RS-GROUP-30MBPS-POLICY
class class-default
    shape average 30000000
    bandwidth remaining ratio 30
    service-policy WAN
policy-map RS-GROUP-300MBPS-POLICY
class class-default
    shape average 300000000
    bandwidth remaining ratio 300
    service-policy WAN
policy-map RS-GROUP-100MBPS-POLICY
class class-default
    shape average 100000000
    bandwidth remaining ratio 100
    service-policy WAN
policy-map RS-GROUP-50MBPS-POLICY
class class-default
    shape average 50000000
    bandwidth remaining ratio 50
    service-policy WAN
policy-map RS-GROUP-10MBPS-POLICY
class class-default
    shape average 10000000
    bandwidth remaining ratio 10

```

```

    service-policy WAN
!
!
crypto ipsec security-association replay window-size 512
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-3
set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-3
!
!
interface Loopback0
ip address 10.6.32.243 255.255.255.255
ip pim sparse-mode
!
interface Port-channel3
description IWAN-D3750X
ip address 10.6.32.18 255.255.255.252
ip pim sparse-mode
no negotiation auto
!
!
interface Tunnel20
bandwidth 1000000
ip address 10.6.38.1 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim nbma-mode
ip pim sparse-mode
ip nhrp authentication cisco123
ip nhrp map multicast dynamic
ip nhrp map group RS-GROUP-300MBPS service-policy output RS-GROUP-300MBPS-POLICY
ip nhrp map group RS-GROUP-200MBPS service-policy output RS-GROUP-200MBPS-POLICY
ip nhrp map group RS-GROUP-100MBPS service-policy output RS-GROUP-100MBPS-POLICY
ip nhrp map group RS-GROUP-50MBPS service-policy output RS-GROUP-50MBPS-POLICY
ip nhrp map group RS-GROUP-30MBPS service-policy output RS-GROUP-30MBPS-POLICY
ip nhrp map group RS-GROUP-20MBPS service-policy output RS-GROUP-20MBPS-POLICY
ip nhrp map group RS-GROUP-10MBPS service-policy output RS-GROUP-10MBPS-POLICY
ip nhrp map group RS-GROUP-4G service-policy output RS-GROUP-4G-POLICY
ip nhrp network-id 201
ip nhrp holdtime 600
ip nhrp redirect
ip tcp adjust-mss 1360

```

```

delay 1000
tunnel source GigabitEthernet0/0/3
tunnel mode gre multipoint
tunnel key 201
tunnel vrf IWAN-TRANSPORT-3
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-3
domain iwan2 path INET1
!
interface GigabitEthernet0/0/0
description IWAN-D3750X Gig1/0/1
no ip address
negotiation auto
cdp enable
channel-group 3
!
interface GigabitEthernet0/0/1
description IWAN-D3750X Gig2/0/1
no ip address
negotiation auto
cdp enable
channel-group 3
!
interface GigabitEthernet0/0/2
no ip address
negotiation auto
cdp enable
!
interface GigabitEthernet0/0/3
description VPN-DMZ
bandwidth 1000000
vrf forwarding IWAN-TRANSPORT-3
ip address 192.168.146.20 255.255.255.0
negotiation auto
cdp enable
service-policy output WAN-INTERFACE-G0/0/3-SHAPE-ONLY
!
interface GigabitEthernet0/0/4
no ip address
shutdown
negotiation auto
!
interface GigabitEthernet0/0/5
no ip address
shutdown
negotiation auto
!
interface GigabitEthernet0

```

```

vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
  passive-interface
exit-af-interface
!
af-interface Port-channel3
  authentication mode md5
  authentication key-chain LAN-KEY
  no passive-interface
exit-af-interface
!
af-interface Tunnel20
  authentication mode md5
  authentication key-chain WAN-KEY
  hello-interval 20
  hold-time 60
  no passive-interface
  no split-horizon
exit-af-interface
!
topology base
  distribute-list route-map SET-TAG-DMVPN-3 out Port-channel3
  distribute-list route-map SET-TAG-ALL out Tunnel20
  distribute-list route-map BLOCK-DMVPN-4 in Port-channel3
exit-af-topology
network 10.6.0.0 0.1.255.255
eigrp router-id 10.6.32.243
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
no ip http secure-server
ip pim autorp listener
ip pim register-source Loopback0
ip route vrf IWAN-TRANSPORT-3 0.0.0.0 0.0.0.0 192.168.146.1
ip tacacs source-interface Loopback0

```

```

!
!
no service-routing capabilities-manager
!
route-map BLOCK-DMVPN-4 deny 10
  description Do not advertise routes sourced from DMVPN-4
  match tag 202
!
route-map BLOCK-DMVPN-4 permit 100
!
route-map SET-TAG-DMVPN-3 permit 10
  description Tag routes sourced from DMVPN-3
  match ip route-source DMVPN-3-SPOKES
  set tag 201
!
route-map SET-TAG-DMVPN-3 permit 100
  description Advertise all other routes with no tag
!
route-map SET-TAG-ALL permit 10
  set tag 201
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server trap-source Loopback0
snmp ifmib ifindex persist
!
tacacs server TACACS-SERVER-1
  address ipv4 10.4.48.15
  key 7 15210E0F162F3F0F2D2A
!
!
control-plane
!
!
line con 0
  transport preferred none
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  transport preferred none
  transport input ssh
line vty 5 15
  transport preferred none
  transport input ssh
!

```

```
ntp source Loopback0
ntp server 10.4.48.17
!
!
end
```

VPN-INET-ASR1002X-4: Secondary WAN link

```
version 15.5
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
no platform punt-keepalive disable-kernel-core
!
hostname VPN-INET-ASR1002X-4
!
boot-start-marker
boot-end-marker
!
aqm-register-fnf
!
vrf definition IWAN-TRANSPORT-4
!
address-family ipv4
exit-address-family
!
vrf definition Mgmt-intf
!
address-family ipv4
exit-address-family
!
address-family ipv6
exit-address-family
!
enable secret 5 $1$S7wW$LwAu9mADPzeXE.yQjFmIc1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
```



```

aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local

ip multicast-routing distributed
!
!
subscriber templating
!
!
flow record Record-FNF-IWAN
  description Flexible NetFlow for IWAN Monitoring
  match ipv4 tos
  match ipv4 protocol
  match ipv4 source address
  match ipv4 destination address
  match transport source-port
  match transport destination-port
  match interface input
  match flow direction
  collect routing source as
  collect routing destination as
  collect routing next-hop address ipv4
  collect ipv4 dscp
  collect ipv4 id
  collect ipv4 source prefix
  collect ipv4 source mask
  collect ipv4 destination mask
  collect transport tcp flags
  collect interface output
  collect flow sampler
  collect counter bytes
  collect counter packets
  collect timestamp sys-uptime first
  collect timestamp sys-uptime last
  collect application name
!
!
flow exporter Export-FNF-LiveAction
  description FNFv9 with LiveAction
  destination 10.4.48.178
  source Loopback0
  transport udp 2055
  option interface-table

```

```

option application-table
option application-attributes
!
!
flow monitor Monitor-FNF-IWAN
description IWAN Traffic Analysis
exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
multilink bundle-name authenticated
!
domain iwan2
vrf default
border
source-interface Loopback0
master 10.6.32.252
password 7 04585A150C2E1D1C5A
collector 10.4.48.178 port 2055
!
key chain LAN-KEY
key 1
key-string 7 011057175804575D72
key chain WAN-KEY
key 1
key-string 7 130646010803557878
!
!
crypto pki trustpoint IWAN-CA
enrollment url http://10.6.24.11:80
serial-number none
fqdn VPN-INET-ASR1002X-4.cisco.local
ip-address 10.6.32.244
fingerprint 75BEF6259A9876CF6F341FE586D4A5D8
revocation-check none
rsaкеypair IWAN-CA-KEYS 2048 2048
!
!
crypto pki certificate chain IWAN-CA
certificate 07
30820317 30820280 A0030201 02020107 300D0609 2A864886 F70D0101 05050030
37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
32353232 30363134 5A170D31 36313232 34323230 3631345A 304A3148 30180609
2A864886 F70D0109 08130B31 302E362E 33322E32 3434302C 06092A86 4886F70D
01090216 1F56504E 2D494E45 542D4153 52313030 32582D34 2E636973 636F2E6C

```

```
6F63616C 30820122 300D0609 2A864886 F70D0101 01050003 82010F00 3082010A
02820101 00A2E7AB 45665C50 A5539848 A10F9CFF C5D11304 94516183 5918B054
DB4C5011 D83DA209 2A8300F2 EBE762C9 7168467E 1995E5D4 DC39D1AE F5B32FD2
413FA080 9F9C5140 DBDAEAD2 1990E08A 8A07A722 FCAB6979 3F2A3B07 F3A35070
5E7E2A5E 2F42F90F CE7B446F 9E22249B 29FD8326 38D5259A 269F4C54 5EE747EB
A5ED1277 E46B19EC 54466563 71DD786B C667ABE6 A873031C AB537D58 2B3C8F7A
F410AF49 BF325EF2 457B5BAF 81DE65DD 2BD02B0C CA4D5BCB A354796E 5D742ECE
E17F824C 1DEB92E8 236CA8B9 77CAD66D 632FE053 F25F7BBE CB986AB3 433A0110
46E9DD97 DEE17691 5D9344D5 8446C7D0 DF063128 AAD0BBF9 1EC8F7E7 F54EC63E
4C22833F 3F020301 0001A381 9B308198 30490603 551D1F04 42304030 3EA03CA0
3A863868 7474703A 2F2F3130 2E362E32 342E3131 2F636769 2D62696E 2F706B69
636C6965 6E742E65 78653F6F 70657261 74696F6E 3D476574 43524C30 0B060355
1D0F0404 03020520 301F0603 551D2304 18301680 148B57F8 AD759FB8 E9696295
0930B589 1C88919C 06301D06 03551D0E 04160414 0DCC6849 6E37261C 05A0EEFD
FFCE51B9 F49FC430 300D0609 2A864886 F70D0101 05050003 81810081 2F00D1FC
96DE4F6D 0B289DE1 C4197F9B 7F389CA4 F6B8A31F F748638F A42B0362 EBDEDB78
F12FC67E 8A664DE6 D1353BDE 1C0643D2 C7D00679 F73B87D7 D383708C E15B94BB
BC333F2B EF0A37B5 5819BC1A 98E02FEE 30B6234C 6AAE29FD D6D0FD2E DC6A5061
CBB0B0C1 1FFF3E45 B9395BD9 737B405C A54F36F0 4ED6F24D C06658
```

quit

certificate 06

```
30820317 30820280 A0030201 02020106 300D0609 2A864886 F70D0101 05050030
37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
32353232 30353537 5A170D31 36313232 34323230 3535375A 304A3148 30180609
2A864886 F70D0109 08130B31 302E362E 33322E32 3434302C 06092A86 4886F70D
01090216 1F56504E 2D494E45 542D4153 52313030 32582D34 2E636973 636F2E6C
6F63616C 30820122 300D0609 2A864886 F70D0101 01050003 82010F00 3082010A
02820101 00B4C9DC 0E76E30F 12898051 A216E34B 8154F70F 9114D7E7 9A507D08
9D2E2C98 0CBF61E0 4CA2B937 A3976883 6AC41D15 1BD0FE9F 1DE4E6D1 BC15D5AB
576F8F00 F8B4D2FC D190CBF6 5AD76E04 29FC9213 E2AE7DD9 583AEC5A 695BB91E
BEFC8C00 B66DC9EE 8640FADC 65B07A72 ADBEE330 161596D5 F31E3328 6C282838
FE763242 A7E76F53 4BBABC5C 58AD076E AB9B0BFB 1B6F77A8 14561FBB 67C1CBD0
220EA130 E273E445 1E515FBE A7871D7A F7BFD520 05C5A0A1 A0315E33 F749D1E3
4A8A9757 C0372252 7C4CB490 CEA873BD 446675CB 10695A75 22245FE8 C984BDD8
010E69AA 196BEB4E 402EEC56 30CC74A4 64CA81B2 576341DA 3CE8217E D6E06CD9
CE018C0C 71020301 0001A381 9B308198 30490603 551D1F04 42304030 3EA03CA0
3A863868 7474703A 2F2F3130 2E362E32 342E3131 2F636769 2D62696E 2F706B69
636C6965 6E742E65 78653F6F 70657261 74696F6E 3D476574 43524C30 0B060355
1D0F0404 03020780 301F0603 551D2304 18301680 148B57F8 AD759FB8 E9696295
0930B589 1C88919C 06301D06 03551D0E 04160414 C114D64E F50995EA 3C8CF265
C57C8891 DE2CD0B5 300D0609 2A864886 F70D0101 05050003 818100D0 E7E8FBFA
DEF56064 15B5CE8B F64EE3BE 861EE405 00E0A681 13B5EBDF C3338B45 6ADFF58E
A0813C37 42FF28F6 985B386E AE58B2F5 7E60A81E 087FBB03 80B1EC38 CEB0837B
C95F5052 59C600B8 3CFF4893 82CB233C 897CB0D1 C4BE7B6A 51BA15B2 1792551A
8C0CBDDD B24D71A8 C1F393AF C8C90906 47E3AE2E BF361567 92E5E6
```

quit

```

certificate ca 01
 30820247 308201B0 A0030201 02020101 300D0609 2A864886 F70D0101 04050030
 37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
 63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
 32353231 31393432 5A170D31 37313232 34323131 3934325A 30373135 30330603
 55040313 2C495741 4E2D494F 532D4341 2E636973 636F2E6C 6F63616C 204C3D53
 616E4A6F 73652053 743D4341 20433D55 5330819F 300D0609 2A864886 F70D0101
 01050003 818D0030 81890281 8100E1F3 60BA63B4 2C2971DA 10457139 3765E38C
 05FBB109 8FB0929C 32A8FA30 D5320EDB 968F4FDF E29F439F 27537B49 6F0BD278
 9EBB3FDF 46603234 B9CF4395 5D9F046B B9D4145A 0A1F3C7A 4A496ABB 808F0097
 B8B8E49E 696F7C9F 201E9030 CED7B305 F8882A05 6725693B 3A8B0B27 D771E6C3
 543A6D98 8B3BE1C7 9B42C549 95CB0203 010001A3 63306130 0F060355 1D130101
 FF040530 030101FF 300E0603 551D0F01 01FF0404 03020186 301F0603 551D2304
 18301680 148B57F8 AD759FB8 E9696295 0930B589 1C88919C 06301D06 03551D0E
 04160414 8B57F8AD 759FB8E9 69629509 30B5891C 88919C06 300D0609 2A864886
 F70D0101 04050003 81810043 03F15527 55D3FFA4 C7BE393E A4E6E242 C86ED8DF
 4CDC83C5 6A283ECE FA0DC9E8 9F640F4B 34FE1847 D4CEF5E2 309AC0D2 563E979B
 E9574558 B0E7C56C A3A1AA85 6C1DBC4E AE99C09F F4553D0B 7DF57390 33E67C0E
 18017676 68977BBD 453E9012 5B5887F2 840A6B76 F5AC61CB 1E636166 56CB8F17
 3E071F09 AECB291E 918A0B
quit
license udi pid ASR1002-X sn JAE18340330
license accept end user agreement
spanning-tree extend system-id
!
username admin secret 5 $1$SnKm$ibEw/1V702JMAMj/C/qzs.
!
redundancy
mode none
!
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-4
match fvrf IWAN-TRANSPORT-4
match identity remote address 0.0.0.0
authentication remote rsa-sig
authentication local rsa-sig
pki trustpoint IWAN-CA
!
!
cdp run
!
ip ftp source-interface Loopback0
ip tftp source-interface GigabitEthernet0
ip ssh source-interface Loopback0
ip ssh version 2
!
class-map match-any STREAMING-VIDEO

```

```

    match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
    match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
    match dscp af11 af21
class-map match-any NET-CTRL-MGMT
    match dscp cs2 cs6
class-map match-any VOICE
    match dscp ef
class-map match-any SCAVENGER
    match dscp cs1
class-map match-any CALL-SIGNALING
    match dscp cs3
!
policy-map WAN
    class INTERACTIVE-VIDEO
        bandwidth remaining percent 30
        random-detect dscp-based
        set dscp tunnel af41
    class STREAMING-VIDEO
        bandwidth remaining percent 10
        random-detect dscp-based
        set dscp tunnel af41
    class NET-CTRL-MGMT
        bandwidth remaining percent 5
        set dscp tunnel cs6
    class CALL-SIGNALING
        bandwidth remaining percent 4
        set dscp tunnel af41
    class CRITICAL-DATA
        bandwidth remaining percent 25
        random-detect dscp-based
        set dscp tunnel af21
    class SCAVENGER
        bandwidth remaining percent 1
        set dscp tunnel af11
    class VOICE
        priority level 1
        police cir percent 10
        set dscp tunnel ef
    class class-default
        bandwidth remaining percent 25
        random-detect
        set dscp tunnel default
policy-map RS-GROUP-200MBPS-POLICY
    class class-default
        shape average 200000000

```

```

    bandwidth remaining ratio 200
    service-policy WAN
policy-map RS-GROUP-4G-POLICY
    class class-default
    shape average 8000000
    bandwidth remaining ratio 8
    service-policy WAN
policy-map RS-GROUP-20MBPS-POLICY
    class class-default
    shape average 20000000
    bandwidth remaining ratio 20
    service-policy WAN
policy-map WAN-INTERFACE-G0/0/3-SHAPE-ONLY
    class class-default
    shape average 500000000
policy-map RS-GROUP-30MBPS-POLICY
    class class-default
    shape average 30000000
    bandwidth remaining ratio 30
    service-policy WAN
policy-map RS-GROUP-300MBPS-POLICY
    class class-default
    shape average 300000000
    bandwidth remaining ratio 300
    service-policy WAN
policy-map RS-GROUP-100MBPS-POLICY
    class class-default
    shape average 100000000
    bandwidth remaining ratio 100
    service-policy WAN
policy-map RS-GROUP-50MBPS-POLICY
    class class-default
    shape average 50000000
    bandwidth remaining ratio 50
    service-policy WAN
policy-map RS-GROUP-10MBPS-POLICY
    class class-default
    shape average 10000000
    bandwidth remaining ratio 10
    service-policy WAN
!
!
crypto ipsec security-association replay window-size 512
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
    mode transport
!

```

```

crypto ipsec profile DMVPN-PROFILE-TRANSPORT-4
  set transform-set AES256/SHA/TRANSPORT
  set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-4
!
!
interface Loopback0
  ip address 10.6.32.244 255.255.255.255
  ip pim sparse-mode
!
interface Port-channel4
  description IWAN-D3750X
  ip address 10.6.32.22 255.255.255.252
  ip pim sparse-mode
  no negotiation auto
!
interface Tunnel21
  bandwidth 500000
  ip address 10.6.40.1 255.255.254.0
  no ip redirects
  ip mtu 1400
  ip flow monitor Monitor-FNF-IWAN input
  ip flow monitor Monitor-FNF-IWAN output
  ip pim nbma-mode
  ip pim sparse-mode
  ip nhrp authentication cisco123
  ip nhrp map multicast dynamic
  ip nhrp map group RS-GROUP-300MBPS service-policy output RS-GROUP-300MBPS-POLICY
  ip nhrp map group RS-GROUP-200MBPS service-policy output RS-GROUP-200MBPS-POLICY
  ip nhrp map group RS-GROUP-100MBPS service-policy output RS-GROUP-100MBPS-POLICY
  ip nhrp map group RS-GROUP-50MBPS service-policy output RS-GROUP-50MBPS-POLICY
  ip nhrp map group RS-GROUP-30MBPS service-policy output RS-GROUP-30MBPS-POLICY
  ip nhrp map group RS-GROUP-20MBPS service-policy output RS-GROUP-20MBPS-POLICY
  ip nhrp map group RS-GROUP-10MBPS service-policy output RS-GROUP-10MBPS-POLICY
  ip nhrp map group RS-GROUP-4G service-policy output RS-GROUP-4G-POLICY
  ip nhrp network-id 202
  ip nhrp holdtime 600
  ip nhrp redirect
  ip tcp adjust-mss 1360
  delay 2000
  tunnel source GigabitEthernet0/0/3
  tunnel mode gre multipoint
  tunnel key 202
  tunnel vrf IWAN-TRANSPORT-4
  tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-4
  domain iwan2 path INET2
!
interface GigabitEthernet0/0/0

```

```

description IW-WAN-D3750X (gig1/0/4)
no ip address
negotiation auto
cdp enable
channel-group 4
!
interface GigabitEthernet0/0/1
description IW-WAN-D3750X (gig2/0/4)
no ip address
negotiation auto
cdp enable
channel-group 4
!
interface GigabitEthernet0/0/2
no ip address
negotiation auto
cdp enable
!
interface GigabitEthernet0/0/3
description VPN-DMZ
bandwidth 500000
vrf forwarding IWAN-TRANSPORT-4
ip address 192.168.146.21 255.255.255.0
negotiation auto
cdp enable
service-policy output WAN-INTERFACE-G0/0/3-SHAPE-ONLY
!
interface GigabitEthernet0/0/4
no ip address
shutdown
negotiation auto
!
interface GigabitEthernet0/0/5
no ip address
shutdown
negotiation auto
!
interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400

```



```

!
af-interface default
  passive-interface
exit-af-interface
!
af-interface Port-channel4
  authentication mode md5
  authentication key-chain LAN-KEY
  no passive-interface
exit-af-interface
!
af-interface Tunnel21
  authentication mode md5
  authentication key-chain WAN-KEY
  hello-interval 20
  hold-time 60
  no passive-interface
  no split-horizon
exit-af-interface
!
topology base
  distribute-list route-map SET-TAG-DMVPN-4 out Port-channel4
  distribute-list route-map SET-TAG-ALL out Tunnel21
  distribute-list route-map BLOCK-DMVPN-3 in Port-channel4
exit-af-topology
network 10.6.0.0 0.1.255.255
eigrp router-id 10.6.32.244
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
no ip http secure-server
ip http client source-interface GigabitEthernet0/0/3
ip pim autorp listener
ip pim register-source Loopback0
ip route vrf IWAN-TRANSPORT-4 0.0.0.0 0.0.0.0 192.168.146.1
ip tacacs source-interface Loopback0
!
!
no service-routing capabilities-manager
!
route-map BLOCK-DMVPN-3 deny 10
  description Do not advertise routes sourced from DMVPN-3
  match tag 201
!

```

```

route-map BLOCK-DMVPN-3 permit 100
!
route-map SET-TAG-DMVPN-4 permit 10
  description Tag routes sourced from DMVPN-4
  match ip route-source DMVPN-4-SPOKES
  set tag 202
!
route-map SET-TAG-DMVPN-4 permit 100
  description Advertise all other routes with no tag
!
route-map SET-TAG-ALL permit 10
  set tag 202
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server trap-source Loopback0
snmp ifmib ifindex persist
!
tacacs server TACACS-SERVER-1
  address ipv4 10.4.48.15
  key 7 15210E0F162F3F0F2D2A
!
!
control-plane
!
!
line con 0
  transport preferred none
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  transport preferred none
  transport input ssh
line vty 5 15
  transport preferred none
  transport input ssh
!
ntp source Loopback0
ntp server 10.4.48.17
!
!
end

```

WAN Remote-Site Devices—IWAN Dual Internet Design Model

Performance Routing Version 3 (PfRv3) consists of two major Cisco IOS components: an MC and a BR. The MC defines the policies and applies them to various traffic classes that traverse the BR systems. The MC can be configured to learn and control traffic classes on the network.

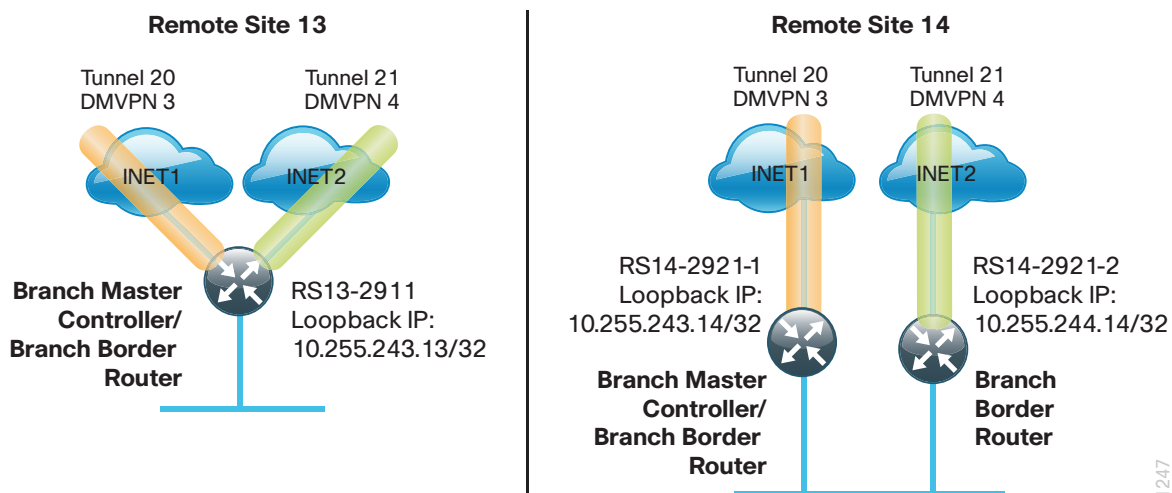
There are two different roles a device can play at the remote site of a PfRv3 configuration:

- **Branch Master Controller**—The Branch MC is the MC at the branch-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.
- **Branch Border Router**—This is a BR at the branch-site. The configuration on this device enables BR functionality and includes the IP address of the site local MC. The WAN interface that terminates on the device is detected automatically.

The first design model is the IWAN Hybrid, which uses a primary MPLS transport paired with Internet VPN as a secondary transport. In this design model, the MPLS WAN provides SLA class of service guarantees for key applications. The second design model is the IWAN Dual Internet, which uses a pair of Internet service providers to further reduce cost while leveraging PfR in order to mitigate network performance problems on a single Internet provider.

This section includes configuration files corresponding to the IWAN dual Internet design model remote site, as referenced in the figure below.

Figure 9 - WAN remote-site designs—IWAN dual Internet design model



1247

The following table provides the loopback addresses for the WAN remote site devices in the IWAN dual Internet design model.

Table 8 - Remote site router loopback IP addresses

IWAN function	Host name	Loopback IP address
Branch MC/BR (INET1/INET2)	RS13-2911	10.255.243.12/32
Branch MC/BR (INET1)	RS14-2921-1	10.255.243.14/32
Branch BR (INET2)	RS14-2921-2	10.255.244.14/32

Remote Site 13: Single-Router, Dual-Link (INET1 and INET2)

The following table lists the policed-rate link speeds for the remote-site QoS traffic-shaping policies and PFR policies.

Table 9 - Remote-site policed-rate link speeds and delay

Location	INET1 link speed/ delay	INET2 link speed/ delay
Remote Site 13	10 Mbps/ 10000 us	10 Mbps/ 20000 us

RS13-2911: Primary and secondary WAN links

```

version 15.4
no service pad
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
!
hostname RS13-2911
!
boot-start-marker
boot-end-marker
!
!
vrf definition IWAN-TRANSPORT-3
!
address-family ipv4
exit-address-family
!
vrf definition IWAN-TRANSPORT-4
!
address-family ipv4

```

```

    exit-address-family
!
logging buffered warnings
enable secret 5 $1$S7wW$LwAu9mADPzeXE.yQjFmIc1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
    server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authentication login MODULE none
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local
ip multicast-routing
ip cef
no ipv6 cef
!
!
flow exporter Export-FNF-LiveAction
    description FNFv9 with LiveAction
    destination 10.4.48.178
    source Loopback0
    output-features
    transport udp 2055
    option interface-table
    option application-table
    option application-attributes
!
!
flow record Record-FNF-IWAN
    description Flexible NetFlow for IWAN Monitoring
    match ipv4 tos
    match ipv4 protocol
    match ipv4 source address
    match ipv4 destination address
    match transport source-port
    match transport destination-port

```

```

match interface input
match flow direction
collect routing source as
collect routing destination as
collect routing next-hop address ipv4
collect ipv4 dscp
collect ipv4 id
collect ipv4 source prefix
collect ipv4 source mask
collect ipv4 destination mask
collect transport tcp flags
collect interface output
collect flow sampler
collect counter bytes
collect counter packets
collect timestamp sys-uptime first
collect timestamp sys-uptime last
collect application name
!
!
flow monitor Monitor-FNF-IWAN
description IWAN Traffic Analysis
exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
!
domain iwan2
vrf default
border
source-interface Loopback0
master local
password 7 0508571C22431F5B4A
collector 10.4.48.178 port 2055
master branch
source-interface Loopback0
password 7 06055E324F41584B56
hub 10.6.32.252
collector 10.4.48.178 port 2055
!
!
key chain WAN-KEY
key 1
key-string 7 110A4816141D5A5E57
cts logging verbose
!

```

```

crypto pki trustpoint TP-self-signed-1010928902
  enrollment selfsigned
  subject-name cn=IOS-Self-Signed-Certificate-1010928902
  revocation-check none
  rsakeypair TP-self-signed-1010928902
!
crypto pki trustpoint IWAN-CA
  enrollment url http://10.6.24.11:80
  serial-number none
  fqdn RS13-2911.cisco.local
  ip-address 10.255.243.13
  fingerprint 75BEF6259A9876CF6F341FE586D4A5D8
  revocation-check none
  rsakeypair IWAN-CA-KEYS 2048 2048
!
!
crypto pki certificate chain TP-self-signed-1010928902
  certificate self-signed 01
    3082024D 308201B6 A0030201 02020101 300D0609 2A864886 F70D0101 04050030
    31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
    69666963 6174652D 31303130 39323839 3032301E 170D3134 30393131 30303238
    30315A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
    4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D31 30313039
    32383930 3230819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281
    8100D191 2B49FB4D 6E69DA33 0A23F0F4 FE6A6D9D 5F7F739E E9D6BE38 CC371EA2
    B3B778A0 B2AD56B5 61A503FF EA258E39 67B97EAD A38D3848 01671355 D99F3FC8
    B753F4C6 520DC379 85337D39 93AB2744 9CA46E58 D7A7DAA5 24217AD0 FB3A27D4
    AE44B2E1 502D6ACC 4F763D61 10768C9F 7DDD89E0 E8689ABA B110C154 5253E10E
    C66F0203 010001A3 75307330 0F060355 1D130101 FF040530 030101FF 30200603
    551D1104 19301782 15525331 332D3239 31312E63 6973636F 2E6C6F63 616C301F
    0603551D 23041830 1680146C 89F39209 38C261D1 E687B3D4 878162B1 C6505330
    1D060355 1D0E0416 04146C89 F3920938 C261D1E6 87B3D487 8162B1C6 5053300D
    06092A86 4886F70D 01010405 00038181 007FAE0D 26EF5C6C 7C00983F 1B95EF76
    402579EF A8258767 10DF1AEC A732EDF8 0BD887A5 E107AEBF C35085FB 7A82FC37
    E98AEB2D AF65298D 25861BF6 C2572F3C A8A7C308 837DAC9A D343866C 5B8CD071
    1EB6909E FE263F87 2E0BD9DA 555976E6 43DC5406 B2A13827 32BC8A96 CB06A445
    C902CE00 989292CE E565EFE3 D94E36A0 CF
  quit
crypto pki certificate chain IWAN-CA
  certificate 15
    3082030F 30820278 A0030201 02020115 300D0609 2A864886 F70D0101 05050030
    37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
    63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
    32363131 32333036 5A170D31 36313232 35313132 3330365A 30423140 301A0609
    2A864886 F70D0109 08130D31 302E3235 352E3234 332E3133 30220609 2A864886
    F70D0109 02161552 5331332D 32393131 2E636973 636F2E6C 6F63616C 30820122
    300D0609 2A864886 F70D0101 01050003 82010F00 3082010A 02820101 00BC1683

```

914E2144 735E6375 6CD64AB2 B6711A4F C9865C13 851EF012 A286C17F 2A5514C9
0BB00482 AE3D9D5B 2C083894 7C2A4AB1 1A578A3C 5B6F3035 8DF7B640 00B88D34
2138E00B 26C65D94 D196BE6D AB4B4AB2 86F65502 23656A15 6616825D 642951D0
6838D85F 068157ED 7C861DC3 C9579BB9 E8CB07FF D0C03622 6F23DF51 E0537477
D4F8ACCC BF4AD21B 02FEAA85 4A05D54A 54153652 A828FAC0 0954FFF3 94E6221E
7E67BC43 F93337E9 393A6FD7 59A34A70 87C84E23 BAB173AD EC74E822 BDF3589
9684F319 33D58A48 10485441 94E1EFD6 5748F6D6 07E4DCBD 3FA52FB3 BEFC95DA
F435D616 16E37BBC 25014B49 369D7DCA 1FB2EE10 64A49D25 3634AA63 B9020301
0001A381 9B308198 30490603 551D1F04 42304030 3EA03CA0 3A863868 7474703A
2F2F3130 2E362E32 342E3131 2F636769 2D62696E 2F706B69 636C6965 6E742E65
78653F6F 70657261 74696F6E 3D476574 43524C30 0B060355 1D0F0404 03020520
301F0603 551D2304 18301680 148B57F8 AD759FB8 E9696295 0930B589 1C88919C
06301D06 03551D0E 04160414 D799CE1F 3B6C2EFB B410D893 C1C7A95C E62982AA
300D0609 2A864886 F70D0101 05050003 81810099 66E4E6AD A1FA3A49 615215FF
55CE8513 45C32297 FA3EBE23 893B0005 DF813A2F E20F3795 47F84C45 05C18E20
4747FABB 6DCF54DC 30939B44 1F37E771 A5CD6CB0 870E5F69 86F66C1E F835C558
D67A7871 B424D2F1 0C67B7A3 5B16388E D83A7E88 0D9257F4 6788B221 548EBA0B
F3C6D389 2FBFEBA0 B55651B6 CA08EB41 540EB9

quit

certificate 14

3082030F 30820278 A0030201 02020114 300D0609 2A864886 F70D0101 05050030
37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
32363131 32323438 5A170D31 36313232 35313132 3234385A 30423140 301A0609
2A864886 F70D0109 08130D31 302E3235 352E3234 332E3133 30220609 2A864886
F70D0109 02161552 5331332D 32393131 2E636973 636F2E6C 6F63616C 30820122
300D0609 2A864886 F70D0101 01050003 82010F00 3082010A 02820101 00A6860D
06493C54 7A5BCEF6 08632CF0 C4158779 C80113CC 8B804525 8D8D59E3 1E1540B7
BBBDF304 4C03AEAC 091FBE11 8CCDDF34 63D5396B 72E712F5 73B3BE1C 6917DEE2
FA676552 7C84AB06 0272630C 40D37C12 4D81C11C CB6C6BB0 7D7FC5F7 F26C1343
D0026667 A1AB3EF3 CCD2A5F4 749683BF FB8B6514 8A59EF2A AAD1FB4A 12DAAF4D
48535A8B E4847878 5C0D9CEE C876D7D8 B834248C EF6B9623 54738FAA 60977740
2D8F51DC 9CAA4E96 AEA71FFE 803DFC08 6551BC60 579393F5 BC4339A4 0C728007
05F37E71 4B1D0C3C E4D12F21 5612F57A C2EFB460 2829A4B3 7961A4EE F81F8FB8
0044F9DC 3A0EF932 E9EAA059 7A71A7EF 5C53BE78 4895B992 4278F301 F7020301
0001A381 9B308198 30490603 551D1F04 42304030 3EA03CA0 3A863868 7474703A
2F2F3130 2E362E32 342E3131 2F636769 2D62696E 2F706B69 636C6965 6E742E65
78653F6F 70657261 74696F6E 3D476574 43524C30 0B060355 1D0F0404 03020780
301F0603 551D2304 18301680 148B57F8 AD759FB8 E9696295 0930B589 1C88919C
06301D06 03551D0E 04160414 1B1C60E6 F27D0481 6FC5BDAE BA50803F D7E55EC9
300D0609 2A864886 F70D0101 05050003 8181006C D343B0A1 8A76043E 444890CB
D7C91968 748A5825 E29B3C7E 2DDB76F9 0006DD84 D352A0A2 5CB26F1A B66AC6CF
6A27D5B9 CA5C2A96 193E5D04 94052B8E 368C18E3 B4BABED8 7D53617D 6053EF20
A8737F1B 62EF1A18 0A197FAC 66D3A0B1 E648B9EB DE95A0C5 F81F5FF2 2EF3DAEE
461D71BA 0A9A9AB7 A3E7CD56 8F62F251 9E3B71

quit

certificate ca 01


```

30820247 308201B0 A0030201 02020101 300D0609 2A864886 F70D0101 04050030
37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
32353231 31393432 5A170D31 37313232 34323131 3934325A 30373135 30330603
55040313 2C495741 4E2D494F 532D4341 2E636973 636F2E6C 6F63616C 204C3D53
616E4A6F 73652053 743D4341 20433D55 5330819F 300D0609 2A864886 F70D0101
01050003 818D0030 81890281 8100E1F3 60BA63B4 2C2971DA 10457139 3765E38C
05FBB109 8FB0929C 32A8FA30 D5320EDB 968F4FDF E29F439F 27537B49 6F0BD278
9EBB3FDF 46603234 B9CF4395 5D9F046B B9D4145A 0A1F3C7A 4A496ABB 808F0097
B8B8E49E 696F7C9F 201E9030 CED7B305 F8882A05 6725693B 3A8B0B27 D771E6C3
543A6D98 8B3BE1C7 9B42C549 95CB0203 010001A3 63306130 0F060355 1D130101
FF040530 030101FF 300E0603 551D0F01 01FF0404 03020186 301F0603 551D2304
18301680 148B57F8 AD759FB8 E9696295 0930B589 1C88919C 06301D06 03551D0E
04160414 8B57F8AD 759FB8E9 69629509 30B5891C 88919C06 300D0609 2A864886
F70D0101 04050003 81810043 03F15527 55D3FFA4 C7BE393E A4E6E242 C86ED8DF
4CDC83C5 6A283ECE FA0DC9E8 9F640F4B 34FE1847 D4CEF5E2 309AC0D2 563E979B
E9574558 B0E7C56C A3A1AA85 6C1DBC4E AE99C09F F4553D0B 7DF57390 33E67C0E
18017676 68977BBD 453E9012 5B5887F2 840A6B76 F5AC61CB 1E636166 56CB8F17
3E071F09 AECB291E 918A0B
quit
voice-card 0
!
!
license udi pid CISCO2911/K9 sn FTX1451AHPB
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package uck9
license boot module c2900 technology-package datak9
hw-module pvdm 0/0
!
hw-module sm 1
!
!
username admin secret 5 $1$SnKm$ibEw/1V702JMAMj/C/qzs.
!
redundancy
!
!
crypto ikev2 keyring DMVPN-KEYRING-3
peer ANY
address 0.0.0.0 0.0.0.0
pre-shared-key cisco123
!
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-3
match fvrf IWAN-TRANSPORT-3
match identity remote address 0.0.0.0
authentication remote pre-share

```

```

authentication local pre-share
keyring local DMVPN-KEYRING-3
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-4
match fvrf IWAN-TRANSPORT-4
match identity remote address 0.0.0.0
authentication remote rsa-sig
authentication local rsa-sig
pki trustpoint IWAN-CA
!
crypto ikev2 dpd 40 5 on-demand
!
!
ip ftp source-interface Loopback0
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
class-map match-any STREAMING-VIDEO
match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
match dscp af11 af21
class-map match-any NET-CTRL-MGMT
match dscp cs2 cs6
class-map match-any VOICE
match dscp ef
class-map match-any SCAVENGER
match dscp cs1
class-map match-any CALL-SIGNALING
match dscp cs3
!
policy-map WAN
class INTERACTIVE-VIDEO
bandwidth remaining percent 30
random-detect dscp-based
set dscp af41
class STREAMING-VIDEO
bandwidth remaining percent 10
random-detect dscp-based
set dscp af41
class NET-CTRL-MGMT
bandwidth remaining percent 5
set dscp cs6
class CALL-SIGNALING
bandwidth remaining percent 4

```

```

    set dscp af41
class CRITICAL-DATA
    bandwidth remaining percent 25
    random-detect dscp-based
    set dscp af21
class SCAVENGER
    bandwidth remaining percent 1
    set dscp af11
class VOICE
    priority level 1
    police cir percent 10
    set dscp ef
class class-default
    bandwidth remaining percent 25
    random-detect
    set dscp default
policy-map WAN-INTERFACE-G0/0
    class class-default
        shape average 10000000
        service-policy WAN
policy-map WAN-INTERFACE-G0/1
    class class-default
        shape average 10000000
        service-policy WAN
!
!
crypto ipsec security-association replay window-size 1024
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
    mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-3
    set transform-set AES256/SHA/TRANSPORT
    set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-3
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-4
    set transform-set AES256/SHA/TRANSPORT
    set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-4
!
!
interface Loopback0
    ip address 10.255.243.13 255.255.255.255
    ip pim sparse-mode
!
interface Tunnel20
    bandwidth 10000
    ip address 10.6.38.13 255.255.254.0

```

```

no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim dr-priority 0
ip pim sparse-mode

ip nhrp authentication cisco123
ip nhrp group RS-GROUP-10MBPS
ip nhrp network-id 201
ip nhrp holdtime 600
ip nhrp nhs 10.6.38.1 nbma 172.16.140.11 multicast
ip nhrp registration no-unique
ip nhrp shortcut
ip tcp adjust-mss 1360
delay 1000
if-state nhrp
tunnel source GigabitEthernet0/0
tunnel mode gre multipoint
tunnel key 201
tunnel vrf IWAN-TRANSPORT-3
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-3
!
interface Tunnel21
bandwidth 10000
ip address 10.6.40.13 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim dr-priority 0
ip pim sparse-mode
ip nhrp authentication cisco123
ip nhrp group RS-GROUP-10MBPS
ip nhrp network-id 202
ip nhrp holdtime 600
ip nhrp nhs 10.6.40.1 nbma 172.17.140.11 multicast
ip nhrp registration no-unique
ip nhrp shortcut
ip tcp adjust-mss 1360
delay 2000
if-state nhrp
tunnel source GigabitEthernet0/1
tunnel mode gre multipoint
tunnel key 202
tunnel vrf IWAN-TRANSPORT-4
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-4

```

```

!
interface Embedded-Service-Engine0/0
  no ip address
  shutdown
!
interface GigabitEthernet0/0
  bandwidth 10000
  vrf forwarding IWAN-TRANSPORT-3
  ip address dhcp
  ip access-group ACL-INET-PUBLIC in
  no ip redirects
  no ip unreachable
  no ip proxy-arp
  duplex auto
  speed auto
  no lldp transmit
  no lldp receive
  no cdp enable
  no mop enabled
  service-policy output WAN-INTERFACE-G0/0
!
interface GigabitEthernet0/1
  description ISP
  bandwidth 10000
  vrf forwarding IWAN-TRANSPORT-4
  ip address dhcp

  duplex auto
  speed auto
  no cdp enable
  service-policy output WAN-INTERFACE-G0/1
!
interface GigabitEthernet0/2
  description RS13-A2960X Gig1/0/48
  no ip address
  duplex auto
  speed auto
!
interface GigabitEthernet0/2.64
  description Wired Data
  encapsulation dot1Q 64
  ip address 10.7.34.1 255.255.255.0
  ip helper-address 10.4.48.10
  ip pim sparse-mode
!
interface GigabitEthernet0/2.65
  description Wireless Data

```

```

encapsulation dot1Q 65
ip address 10.7.36.1 255.255.255.0
ip helper-address 10.4.48.10
ip pim sparse-mode
!
interface GigabitEthernet0/2.69
description VOICE
encapsulation dot1Q 69
ip address 10.7.35.1 255.255.255.0
ip helper-address 10.4.48.10
ip pim sparse-mode
!
interface GigabitEthernet0/2.70
description Wireless Voice
encapsulation dot1Q 70
ip address 10.7.37.1 255.255.255.0
ip helper-address 10.4.48.10
ip pim sparse-mode
!
interface SM1/0
no ip address
!
interface SM1/1
no ip address
!
interface Vlan1
no ip address
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
passive-interface
exit-af-interface
!
af-interface Tunnel20
summary-address 10.7.32.0 255.255.248.0
authentication mode md5
authentication key-chain WAN-KEY
hello-interval 20
hold-time 60
no passive-interface
exit-af-interface
!
af-interface Tunnel21

```

```

summary-address 10.7.32.0 255.255.248.0
authentication mode md5
authentication key-chain WAN-KEY
hello-interval 20
hold-time 60
no passive-interface
exit-af-interface
!
topology base
exit-af-topology
network 10.6.38.0 0.0.1.255
network 10.6.40.0 0.0.1.255
network 10.7.0.0 0.0.255.255
network 10.255.0.0 0.0.255.255
eigrp router-id 10.255.243.13
eigrp stub connected summary redistributed
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
ip http secure-server
!
ip pim autorp listener
ip pim register-source Loopback0
ip tacacs source-interface Loopback0
!
ip access-list extended ACL-INET-PUBLIC
 permit udp any any eq non500-isakmp
 permit udp any any eq isakmp
 permit esp any any
 permit udp any any eq bootpc
!
no service-routing capabilities-manager
!
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server ifindex persist
snmp-server trap-source Loopback0
tacacs server TACACS-SERVER-1
 address ipv4 10.4.48.15
 key 7 15210E0F162F3F0F2D2A
!
!
control-plane

```

```
!  
!  
mgcp behavior rsip-range tgcp-only  
mgcp behavior comedia-role none  
mgcp behavior comedia-check-media-src disable  
mgcp behavior comedia-sdp-force disable  
!  
mgcp profile default  
!  
!  
gatekeeper  
  shutdown  
!  
!  
!  
line con 0  
  logging synchronous  
  transport preferred none  
  stopbits 1  
line aux 0  
line vty 0 4  
  exec-timeout 0 0  
  transport preferred none  
  transport input ssh  
line vty 5 15  
  transport preferred none  
  transport input ssh  
!  
scheduler allocate 20000 1000  
ntp source Loopback0  
ntp update-calendar  
ntp server 10.4.48.17  
!  
end
```


Remote Site 14: Dual-Router, Dual-Link (INET1 and INET2)

The following table lists the policed-rate link speeds for the remote-site QoS traffic-shaping policies and PFR policies.

Table 10 - Remote-site policed-rate link speeds and delay

Location	INET1 link speed/ delay	INET2 link speed/ delay
Remote Site 14	10 Mbps/ 10000 us	10 Mbps/ 20000 us

RS14-2921-1: Primary WAN link

```
version 15.4
no service pad
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
!
hostname RS14-2921-1
!
boot-start-marker
boot-end-marker
!
!
vrf definition IWAN-TRANSPORT-3
!
  address-family ipv4
  exit-address-family
!
enable secret 5 $1$S7wW$LwAu9mADPzeXE.yQjFmIc1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
  server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
```

```

aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local
ip multicast-routing
ip cef
no ipv6 cef
!
!
flow exporter Export-FNF-LiveAction
  description FNFv9 with LiveAction
  destination 10.4.48.178
  source Loopback0
  output-features
  transport udp 2055
  option interface-table
  option application-table
  option application-attributes
!
!
flow record Record-FNF-IWAN
  description Flexible NetFlow for IWAN Monitoring
  match ipv4 tos
  match ipv4 protocol
  match ipv4 source address
  match ipv4 destination address
  match transport source-port
  match transport destination-port
  match interface input
  match flow direction
  collect routing source as
  collect routing destination as
  collect routing next-hop address ipv4
  collect ipv4 dscp
  collect ipv4 id
  collect ipv4 source prefix
  collect ipv4 source mask
  collect ipv4 destination mask
  collect transport tcp flags
  collect interface output
  collect flow sampler
  collect counter bytes
  collect counter packets
  collect timestamp sys-uptime first
  collect timestamp sys-uptime last

```

```

collect application name
!
!
flow monitor Monitor-FNF-IWAN
description IWAN Traffic Analysis
exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
multilink bundle-name authenticated
!
!
domain iwan2
vrf default
border
    source-interface Loopback0
    master local
    password 7 0007421507545A545C
    collector 10.4.48.178 port 2055
master branch
    source-interface Loopback0
    password 7 141443180F0B7B7977
    hub 10.6.32.252
    collector 10.4.48.178 port 2055
!
!
key chain WAN-KEY
key 1
    key-string 7 110A4816141D5A5E57
cts logging verbose
!
crypto pki trustpoint TP-self-signed-1846992888
    enrollment selfsigned
    subject-name cn=IOS-Self-Signed-Certificate-1846992888
    revocation-check none
    rsakeypair TP-self-signed-1846992888
!
!
crypto pki certificate chain TP-self-signed-1846992888
certificate self-signed 01
    3082022B 30820194 A0030201 02020101 300D0609 2A864886 F70D0101 05050030
    31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
    69666963 6174652D 31383436 39393238 3838301E 170D3134 30393131 31383536
    35375A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
    4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D31 38343639
    39323838 3830819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281

```

```

8100CBC2 8FE21756 9F98E110 0EC183B5 6B9BE042 6DA3239E 3F25B9E3 FFE74615
B0C2D632 212516BB C2EA3701 73E4070B 998F3F78 ED9E1AAC 3162EDE2 A5FBE81D
5A09845F 54DDBE28 796C0AB8 32FA7765 9DE27299 E230BECD 9FA9167B 5CE9C913
C1F3F5A8 832D41EF 6A7865DE DFF55F83 859E5574 2CED133B F1D9B9CF 344160CE
D2ED0203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF 301F0603
551D2304 18301680 14B70674 0F96499B CB3E8B33 679242AB 188E35E1 32301D06
03551D0E 04160414 B706740F 96499BCB 3E8B3367 9242AB18 8E35E132 300D0609
2A864886 F70D0101 05050003 81810003 58A59C85 A4B3E63C 7FC74220 29323026
540AE197 FDCE07E8 79485A75 164EACA1 B15968DE FFA739A2 375BAC9A 038CEBD1
B0901ACD 1F16D83D 54906A1D CBFEF1C9 D858B05D 2C5B52DD DD9C59A6 DC8376E6
75D72E7F B08F621E C687C3DB 8847AFE4 90071719 DD99893D 6FE021F4 4358E677
1E667ADC 426D6FFA 162185B2 CF615F
quit
voice-card 0
!
!
license udi pid CISCO2921/K9 sn FTX1626ALL4
hw-module sm 1
!
!
username admin secret 5 $1$SnKm$ibEw/1V702JMAMj/C/qzs.
!
redundancy
!
!
crypto ikev2 keyring DMVPN-KEYRING-3
peer ANY
address 0.0.0.0 0.0.0.0
pre-shared-key cisco123
!
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-3
match fvrf IWAN-TRANSPORT-3
match identity remote address 0.0.0.0
authentication remote pre-share
authentication local pre-share
keyring local DMVPN-KEYRING-3
!
crypto ikev2 dpd 40 5 on-demand
!
!
track 50 interface Tunnel20 line-protocol
delay up 20
!
ip ftp source-interface Loopback0
ip ssh source-interface Loopback0
ip ssh version 2

```

```

ip scp server enable
!
class-map match-any STREAMING-VIDEO
  match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
  match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
  match dscp af11 af21
class-map match-any NET-CTRL-MGMT
  match dscp cs2 cs6
class-map match-any VOICE
  match dscp ef
class-map match-any SCAVENGER
  match dscp cs1
class-map match-any CALL-SIGNALING
  match dscp cs3
!
policy-map WAN
  class INTERACTIVE-VIDEO
    bandwidth remaining percent 30
    random-detect dscp-based
    set dscp af41
  class STREAMING-VIDEO
    bandwidth remaining percent 10
    random-detect dscp-based
    set dscp af41
  class NET-CTRL-MGMT
    bandwidth remaining percent 5
    set dscp cs6
  class CALL-SIGNALING
    bandwidth remaining percent 4
    set dscp af41
  class CRITICAL-DATA
    bandwidth remaining percent 25
    random-detect dscp-based
    set dscp af21
  class SCAVENGER
    bandwidth remaining percent 1
    set dscp af11
  class VOICE
    priority level 1
    police cir percent 10
    set dscp ef
  class class-default
    bandwidth remaining percent 25
    random-detect
    set dscp default

```

```

policy-map WAN-INTERFACE-G0/0
  class class-default
    shape average 30000000
    service-policy WAN
  !
  !
crypto ipsec security-association replay window-size 1024
!
crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
  mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-3
  set transform-set AES256/SHA/TRANSPORT
  set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-3
!
!
interface Loopback0
  ip address 10.255.243.14 255.255.255.255
  ip pim sparse-mode
!
interface Tunnel20
  bandwidth 30000
  ip address 10.6.38.14 255.255.254.0
  no ip redirects
  ip mtu 1400
  ip flow monitor Monitor-FNF-IWAN input
  ip flow monitor Monitor-FNF-IWAN output
  ip pim dr-priority 0
  ip pim sparse-mode
  ip nhrp authentication cisco123
  ip nhrp group RS-GROUP-30MBPS
  ip nhrp network-id 101
  ip nhrp holdtime 600
  ip nhrp nhs 10.6.38.1 nbma 172.16.140.11 multicast
  ip nhrp registration no-unique
  ip nhrp shortcut
  ip tcp adjust-mss 1360
  delay 1000
  if-state nhrp
  tunnel source GigabitEthernet0/0
  tunnel mode gre multipoint
  tunnel key 201
  tunnel vrf IWAN-TRANSPORT-3
  tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-3
!
interface Port-channel1
  description Link to RS14-A2960X

```

```

no ip address
!
interface Port-channel1.64
description Data
encapsulation dot1Q 64
ip address 10.7.50.2 255.255.255.0
ip helper-address 10.4.48.10
ip pim dr-priority 110
ip pim sparse-mode
standby 1 ip 10.7.50.1
standby 1 priority 110
standby 1 preempt
standby 1 authentication md5 key-string 7 0007421507545A545C
standby 1 track 50 decrement 10
!
interface Port-channel1.69
description Voice
encapsulation dot1Q 69
ip address 10.7.51.2 255.255.255.0
ip helper-address 10.4.48.10
ip pim dr-priority 110
ip pim sparse-mode
standby 1 ip 10.7.51.1
standby 1 priority 110
standby 1 preempt
standby 1 authentication md5 key-string 7 0007421507545A545C
standby 1 track 50 decrement 10
!
interface Port-channel1.99
description Transit Net
encapsulation dot1Q 99
ip address 10.7.48.9 255.255.255.252
ip pim sparse-mode
!
interface Embedded-Service-Engine0/0
no ip address
shutdown
!
interface GigabitEthernet0/0
bandwidth 30000
vrf forwarding IWAN-TRANSPORT-3
ip address dhcp
ip access-group ACL-INET-PUBLIC in
no ip redirects
no ip unreachable
no ip proxy-arp
duplex auto

```

```

speed auto
no lldp transmit
no lldp receive
no mop enabled
service-policy output WAN-INTERFACE-G0/0
!
interface GigabitEthernet0/1
description RS14-A2960X (gig1/0/47)
no ip address
duplex auto
speed auto
channel-group 1
!
interface GigabitEthernet0/2
description RS14-A2960X (gig2/0/47)
no ip address
duplex auto
speed auto
channel-group 1
!
interface ucse1/0
no ip address
!
interface ucse1/1
no ip address
!
interface Vlan1
no ip address
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
passive-interface
exit-af-interface
!
af-interface Tunnel20
summary-address 10.7.48.0 255.255.248.0
authentication mode md5
authentication key-chain WAN-KEY
hello-interval 20
hold-time 60
no passive-interface
exit-af-interface
!

```



```

af-interface Port-channel1.99
  authentication mode md5
  authentication key-chain WAN-KEY
  no passive-interface
exit-af-interface
!
topology base
  distribute-list route-map ROUTE-LIST out Tunnel20
  redistribute static
exit-af-topology
network 10.6.38.0 0.0.1.255
network 10.7.0.0 0.0.255.255
network 10.255.0.0 0.0.255.255
eigrp router-id 10.255.243.14
eigrp stub connected summary redistributed leak-map STUB-LEAK-ALL
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
ip http secure-server
!
ip pim autorp listener
ip pim register-source Loopback0
ip route 10.7.50.10 255.255.255.255 ucse1/0
ip route 10.7.50.11 255.255.255.255 ucse1/0
ip tacacs source-interface Loopback0
!
ip access-list standard R2-LOOPBACK
  permit 10.255.244.14
!
ip access-list extended ACL-INET-PUBLIC
  permit udp any any eq non500-isakmp
  permit udp any any eq isakmp
  permit esp any any
  permit udp any any eq bootpc
!
no service-routing capabilities-manager
!
route-map STUB-LEAK-ALL permit 100
!
route-map ROUTE-LIST deny 10
  description Block readvertisement of learned WAN routes
  match tag 201 202
!
route-map ROUTE-LIST permit 100

```

```

description Advertise all other routes
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server ifindex persist
snmp-server trap-source Loopback0
tacacs server TACACS-SERVER-1
address ipv4 10.4.48.15
key 7 15210E0F162F3F0F2D2A
!
!
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
gatekeeper
shutdown
!
!
line con 0
transport preferred none
stopbits 1
line aux 0
line vty 0 4
exec-timeout 0 0
transport preferred none
transport input ssh
line vty 5 15
transport preferred none
transport input ssh
!
scheduler allocate 20000 1000
ntp source Loopback0
ntp update-calendar
ntp server 10.4.48.17
!
end

```

RS14-2921-2: Secondary WAN link

```
version 15.4
no service pad
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
!
hostname RS14-2921-2
!
boot-start-marker
boot-end-marker
!
!
vrf definition IWAN-TRANSPORT-4
!
  address-family ipv4
  exit-address-family
!
! card type command needed for slot/vwic-slot 0/0
enable secret 5 $1$S7wW$LwAu9mADPzeXE.yQjFmIc1
!
aaa new-model
!
!
aaa group server tacacs+ TACACS-SERVERS
  server name TACACS-SERVER-1
!
aaa authentication login default group TACACS-SERVERS local
aaa authorization console
aaa authorization exec default group TACACS-SERVERS local
!
!
aaa session-id common
clock timezone PST -8 0
clock summer-time PDT recurring
!
!
ip domain name cisco.local
ip multicast-routing
ip cef
no ipv6 cef
!
!
flow exporter Export-FNF-LiveAction
```

```

description FNFv9 with LiveAction
destination 10.4.48.178
source Loopback0
output-features
transport udp 2055
option interface-table
option application-table
option application-attributes
!
!
flow record Record-FNF-IWAN
description Flexible NetFlow for IWAN Monitoring
match ipv4 tos
match ipv4 protocol
match ipv4 source address
match ipv4 destination address
match transport source-port
match transport destination-port
match interface input
match flow direction
collect routing source as
collect routing destination as
collect routing next-hop address ipv4
collect ipv4 dscp
collect ipv4 id
collect ipv4 source prefix
collect ipv4 source mask
collect ipv4 destination mask
collect transport tcp flags
collect interface output
collect flow sampler
collect counter bytes
collect counter packets
collect timestamp sys-uptime first
collect timestamp sys-uptime last
collect application name
!
!
flow monitor Monitor-FNF-IWAN
description IWAN Traffic Analysis
exporter Export-FNF-LiveAction
cache timeout inactive 10
cache timeout active 60
record Record-FNF-IWAN
!
multilink bundle-name authenticated
!

```

```

!
domain iwan2
  vrf default
    border
      source-interface Loopback0
      master 10.255.243.14
      password 7 011057175804575D72
      collector 10.4.48.178 port 2055
!
!
key chain WAN-KEY
  key 1
    key-string 7 110A4816141D5A5E57
cts logging verbose
!
crypto pki trustpoint IWAN-CA
  enrollment url http://172.16.140.110:80
  serial-number none
  fqdn RS14-2921-2.cisco.local
  ip-address 10.255.244.14
  fingerprint 75BEF6259A9876CF6F341FE586D4A5D8
  vrf IWAN-TRANSPORT-4
  revocation-check none
  rsakeypair IWAN-CA-KEYS 2048 2048
!
!
crypto pki certificate chain IWAN-CA
  certificate 03
    30820311 3082027A A0030201 02020103 300D0609 2A864886 F70D0101 05050030
    37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
    63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
    32353231 33343138 5A170D31 36313232 34323133 3431385A 30443142 301A0609
    2A864886 F70D0109 08130D31 302E3235 352E3234 342E3134 30240609 2A864886
    F70D0109 02161752 5331342D 32393231 2D322E63 6973636F 2E6C6F63 616C3082
    0122300D 06092A86 4886F70D 01010105 00038201 0F003082 010A0282 010100E2
    0A88710F AA02A9CA 8D86A3A5 594A17B3 F25019D3 49235D73 A6DD8CED 59A94BB3
    FA05E4D4 89A7852A A4CFA208 28984230 3E08EF83 5A8E761D 0BBCD446 9359C22C
    5ACEA363 B3A52F48 CC244EC8 F1E1258B 52D74A2F 37E881C8 2627B8DC 06AC05AB
    282A16A3 48A8F9A0 F72885BD 0B64244A 55F3ABF7 93532D67 05670594 868B7466
    13865D6B 7AAB2D69 52DCAB20 B35D5783 B68555BA 9634E567 OCCA5483 B4ECDB36
    429D82D9 B88F73B0 81237DFC 321F7506 77A03218 B9AE06F9 8D64B100 95FDEA7D
    36B2BC70 6F45D7EA 487ADC62 309F4B39 EB8F79FA C9ADB6E3 5BC5E0A4 42FAB8C6
    8AE30EEA 95F636D5 E75A6E26 63DA3A72 DCA69A62 A9E15940 C1A5AE6E D50D4302
    03010001 A3819B30 81983049 0603551D 1F044230 40303EA0 3CA03A86 38687474
    703A2F2F 31302E36 2E32342E 31312F63 67692D62 696E2F70 6B69636C 69656E74
    2E657865 3F6F7065 72617469 6F6E3D47 65744352 4C300B06 03551D0F 04040302
    0520301F 0603551D 23041830 1680148B 57F8AD75 9FB8E969 62950930 B5891C88

```

```
919C0630 1D060355 1D0E0416 04148FCF 4650FFD2 5C75F054 9B885677 3FF10454
657F300D 06092A86 4886F70D 01010505 00038181 00128990 AB03C361 D3A8626D
C3A7E41F B1E87D75 E3BF4A3A 7861D04D 15BA30F2 ADCEAA9A FB4893A6 DD575529
BEFCAA12 43833D8B 873B5BF8 14232148 29EF2345 98435CA7 C7D2ED8C B719A22A
CFB0AEA9 C7E92CE7 32CC7D1F 863E334E BEBC5119 099DF7C8 EA6EC1BD 119F3CA1
89F844B0 FAA1C77C FE89652F D13D0008 911E5BA5 71
```

quit

certificate 02

```
30820311 3082027A A0030201 02020102 300D0609 2A864886 F70D0101 05050030
37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
32353231 33343031 5A170D31 36313232 34323133 3430315A 30443142 301A0609
2A864886 F70D0109 08130D31 302E3235 352E3234 342E3134 30240609 2A864886
F70D0109 02161752 5331342D 32393231 2D322E63 6973636F 2E6C6F63 616C3082
0122300D 06092A86 4886F70D 01010105 00038201 0F003082 010A0282 010100B5
42056EF5 568FA64B 3D8FEF57 3A12A3A0 CD305B45 56B2C630 B76E90A7 0AFCCF82
BF0A3753 265DF19E ECB53AE1 3BB6817F 346451A7 A9EF1A08 DCA1F1B7 3E3299B3
DF75346A 73F39A0F E8F38AB8 F09442B0 C35F6718 42A7EE37 25A15AEC A7B9DDDC
D8AFE4CF F14B48EB 7CBF90A3 C2AF9B21 8C696B7B 433D6118 8670FC84 4AF47FE7
1B606361 015B580B 6AAEFA27 DE326513 447285C7 5610EF44 29CA4FF0 87125299
A8B0D02F EF5BB468 6726B0E4 607CBD0A 4F0861B2 43FD6C6B 62D85117 7F198686
0B5C5788 C1A6EA2F BB240532 AF66E05A 39256332 53207AE5 A584BDCC ECEA8099
2F5421D8 C42E742C A7D3CDB0 FA6E3F62 AF198C2D 6A8A5187 816F71DF 170E7F02
03010001 A3819B30 81983049 0603551D 1F044230 40303EA0 3CA03A86 38687474
703A2F2F 31302E36 2E32342E 31312F63 67692D62 696E2F70 6B69636C 69656E74
2E657865 3F6F7065 72617469 6F6E3D47 65744352 4C300B06 03551D0F 04040302
0780301F 0603551D 23041830 1680148B 57F8AD75 9FB8E969 62950930 B5891C88
919C0630 1D060355 1D0E0416 04144E9B CD87BD28 C24669D7 583F9F16 0272A763
A64A300D 06092A86 4886F70D 01010505 00038181 00993C35 5F604D97 5953CA8B
09B4C069 041BD227 16A83261 97F1AFEB D41C29AF 4FE61D5A 6C021DC9 D96BCF1C
55F4B02E 8E28D6A5 F9CFEC1A 299A5E95 653FB48E 6F2F1E16 7479ACDE 1ACB09CC
685C0533 A861CC0C 6F3E43F3 5027F462 C7A2508C 1CAECAC3 14D16CA7 E567B19C
6844EE2B 6D3CF590 5FD5B23C 2142621D F3D897DE F6
```

quit

certificate ca 01

```
30820247 308201B0 A0030201 02020101 300D0609 2A864886 F70D0101 04050030
37313530 33060355 0403132C 4957414E 2D494F53 2D43412E 63697363 6F2E6C6F
63616C20 4C3D5361 6E4A6F73 65205374 3D434120 433D5553 301E170D 31343132
32353231 31393432 5A170D31 37313232 34323131 3934325A 30373135 30330603
55040313 2C495741 4E2D494F 532D4341 2E636973 636F2E6C 6F63616C 204C3D53
616E4A6F 73652053 743D4341 20433D55 5330819F 300D0609 2A864886 F70D0101
01050003 818D0030 81890281 8100E1F3 60BA63B4 2C2971DA 10457139 3765E38C
05FBB109 8FB0929C 32A8FA30 D5320EDB 968F4FDF E29F439F 27537B49 6F0BD278
9EBB3FDF 46603234 B9CF4395 5D9F046B B9D4145A 0A1F3C7A 4A496ABB 808F0097
B8B8E49E 696F7C9F 201E9030 CED7B305 F8882A05 6725693B 3A8B0B27 D771E6C3
543A6D98 8B3BE1C7 9B42C549 95CB0203 010001A3 63306130 0F060355 1D130101
FF040530 030101FF 300E0603 551D0F01 01FF0404 03020186 301F0603 551D2304
```

```

18301680 148B57F8 AD759FB8 E9696295 0930B589 1C88919C 06301D06 03551D0E
04160414 8B57F8AD 759FB8E9 69629509 30B5891C 88919C06 300D0609 2A864886
F70D0101 04050003 81810043 03F15527 55D3FFA4 C7BE393E A4E6E242 C86ED8DF
4CDC83C5 6A283ECE FA0DC9E8 9F640F4B 34FE1847 D4CEF5E2 309AC0D2 563E979B
E9574558 B0E7C56C A3A1AA85 6C1DBC4E AE99C09F F4553D0B 7DF57390 33E67C0E
18017676 68977BBD 453E9012 5B5887F2 840A6B76 F5AC61CB 1E636166 56CB8F17
3E071F09 AECB291E 918A0B
quit
voice-card 0
!
!
license udi pid CISCO2921/K9 sn FTX1621AKEG
hw-module pvdm 0/0
!
hw-module pvdm 0/1
!
hw-module pvdm 0/2
!
hw-module sm 1
!
!
username admin secret 5 $1$SnKm$ibEw/1V702JMAMj/C/qzs.
!
redundancy
!
!
crypto ikev2 profile FVRF-IKEv2-IWAN-TRANSPORT-4
  match fvrf IWAN-TRANSPORT-4
  match identity remote address 0.0.0.0
  authentication remote rsa-sig
  authentication local rsa-sig
  pki trustpoint IWAN-CA
!
crypto ikev2 dpd 40 5 on-demand
!
!
ip ftp source-interface Loopback0
ip ssh source-interface Loopback0
ip ssh version 2
ip scp server enable
!
class-map match-any STREAMING-VIDEO
  match dscp af31 af32 cs5
class-map match-any INTERACTIVE-VIDEO
  match dscp cs4 af41 af42
class-map match-any CRITICAL-DATA
  match dscp af11 af21

```

```

class-map match-any NET-CTRL-MGMT
  match dscp cs2 cs6
class-map match-any VOICE
  match dscp ef
class-map match-any SCAVENGER
  match dscp cs1
class-map match-any CALL-SIGNALING
  match dscp cs3
!
policy-map WAN
  class INTERACTIVE-VIDEO
    bandwidth remaining percent 30
    random-detect dscp-based
    set dscp af41
  class STREAMING-VIDEO
    bandwidth remaining percent 10
    random-detect dscp-based
    set dscp af41
  class NET-CTRL-MGMT
    bandwidth remaining percent 5
    set dscp cs6
  class CALL-SIGNALING
    bandwidth remaining percent 4
    set dscp af41
  class CRITICAL-DATA
    bandwidth remaining percent 25
    random-detect dscp-based
    set dscp af21
  class SCAVENGER
    bandwidth remaining percent 1
    set dscp af11
  class VOICE
    priority level 1
    police cir percent 10
    set dscp ef
  class class-default
    bandwidth remaining percent 25
    random-detect
    set dscp default
policy-map WAN-INTERFACE-G0/0
  class class-default
    shape average 10000000
    service-policy WAN
!
!
crypto ipsec security-association replay window-size 1024
!

```



```

crypto ipsec transform-set AES256/SHA/TRANSPORT esp-aes 256 esp-sha-hmac
mode transport
!
crypto ipsec profile DMVPN-PROFILE-TRANSPORT-4
set transform-set AES256/SHA/TRANSPORT
set ikev2-profile FVRF-IKEv2-IWAN-TRANSPORT-4
!
!
interface Loopback0
ip address 10.255.244.14 255.255.255.255
ip pim sparse-mode
!
interface Tunnel21
bandwidth 10000
ip address 10.6.40.14 255.255.254.0
no ip redirects
ip mtu 1400
ip flow monitor Monitor-FNF-IWAN input
ip flow monitor Monitor-FNF-IWAN output
ip pim dr-priority 0
ip pim sparse-mode
ip nhrp authentication cisco123
ip nhrp group RS-GROUP-10MBPS
ip nhrp network-id 202
ip nhrp holdtime 600
ip nhrp nhs 10.6.40.1 nbma 172.17.140.11 multicast
ip nhrp registration no-unique
ip nhrp shortcut
ip tcp adjust-mss 1360
delay 2000
if-state nhrp
tunnel source GigabitEthernet0/0
tunnel mode gre multipoint
tunnel key 202
tunnel vrf IWAN-TRANSPORT-4
tunnel protection ipsec profile DMVPN-PROFILE-TRANSPORT-4
!
interface Port-channel2
description Link to RS14-A2960X
no ip address
!
interface Port-channel2.64
description Data
encapsulation dot1Q 64
ip address 10.7.50.3 255.255.255.0
ip helper-address 10.4.48.10
ip pim dr-priority 105

```

```

ip pim sparse-mode
standby 1 ip 10.7.50.1
standby 1 priority 105
standby 1 preempt
standby 1 authentication md5 key-string 7 03070A180500701E1D
!
interface Port-channel2.69
description Voice
encapsulation dot1Q 69
ip address 10.7.51.3 255.255.255.0
ip helper-address 10.4.48.10
ip pim dr-priority 105
ip pim sparse-mode
standby 1 ip 10.7.51.1
standby 1 priority 105
standby 1 preempt
standby 1 authentication md5 key-string 7 0508571C22431F5B4A
!
interface Port-channel2.99
description Transit Net
encapsulation dot1Q 99
ip address 10.7.48.10 255.255.255.252
ip pim sparse-mode
!
interface Embedded-Service-Engine0/0
no ip address
shutdown
!
interface GigabitEthernet0/0
bandwidth 10000
vrf forwarding IWAN-TRANSPORT-4
ip address dhcp
ip access-group ACL-INET-PUBLIC in
no ip redirects
no ip unreachable
no ip proxy-arp
duplex auto
speed auto
no lldp transmit
no lldp receive
no cdp enable
no mop enabled
service-policy output WAN-INTERFACE-G0/0
!
interface GigabitEthernet0/1
description RS14-A2960X (gig1/0/48)
no ip address

```

```

duplex auto
speed auto
channel-group 2
!
interface GigabitEthernet0/2
description RS14-A2960X (gig2/0/48)
no ip address
duplex auto
speed auto
channel-group 2
!
interface ucse1/0
no ip address
!
interface ucse1/1
no ip address
!
interface Vlan1
no ip address
!
!
router eigrp IWAN-EIGRP
!
address-family ipv4 unicast autonomous-system 400
!
af-interface default
passive-interface
exit-af-interface
!
af-interface Tunnel21
summary-address 10.7.48.0 255.255.248.0
authentication mode md5
authentication key-chain WAN-KEY
hello-interval 20
hold-time 60
no passive-interface
exit-af-interface
!
af-interface Port-channel2.99
authentication mode md5
authentication key-chain WAN-KEY
no passive-interface
exit-af-interface
!
topology base
distribute-list route-map ROUTE-LIST out Tunnel21
redistribute static

```

```

exit-af-topology
network 10.6.40.0 0.0.1.255
network 10.7.0.0 0.0.255.255
network 10.255.0.0 0.0.255.255
eigrp router-id 10.255.244.14
eigrp stub connected summary redistributed leak-map STUB-LEAK-ALL
exit-address-family
!
ip forward-protocol nd
!
no ip http server
ip http authentication aaa
ip http secure-server
!
ip pim autorp listener
ip pim register-source Loopback0
ip route 10.7.50.12 255.255.255.255 ucse1/0
ip route 10.7.50.13 255.255.255.255 ucse1/0
ip tacacs source-interface Loopback0
!
ip access-list extended ACL-INET-PUBLIC
 permit udp any any eq non500-isakmp
 permit udp any any eq isakmp
 permit esp any any
 permit udp any any eq bootpc
 permit tcp host 172.16.140.110 eq www any
!
no service-routing capabilities-manager
!
route-map STUB-LEAK-ALL permit 100
!
route-map ROUTE-LIST deny 10
 description Block readvertisement of learned WAN routes
 match tag 201 202
!
route-map ROUTE-LIST permit 100
 description Advertise all other routes
!
snmp-server community cisco RO
snmp-server community cisco123 RW
snmp-server ifindex persist
snmp-server trap-source Loopback0
tacacs server TACACS-SERVER-1
 address ipv4 10.4.48.15
 key 7 15210E0F162F3F0F2D2A
!
!

```

```
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
gatekeeper
  shutdown
!
!
line con 0
  transport preferred none
  stopbits 1
line aux 0
line vty 0 4
  exec-timeout 0 0
  transport preferred none
  transport input ssh
line vty 5 15
  transport preferred none
  transport input ssh
!
scheduler allocate 20000 1000
ntp source Loopback0
ntp update-calendar
ntp server 10.4.48.17
!
end
```

Feedback

Please use the [feedback form](#) to send comments and suggestions about this guide.



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