CVP – Enterprise Cisco SD-WAN Retail Profile (Hybrid WAN, Segmentation, Zone-Based Firewall, Quality of Service, and Centralized Policies)

Contents

Profile introduction

The Cisco Software Defined WAN (SD-WAN) is a cloud-hosted and cloud-delivered overlay WAN architecture that facilitates digital and cloud transformation for enterprises. It significantly drops WAN costs, reduces the time to deploy services, build application resiliency and provides a robust security architecture for hybrid networks.

Cisco SD-WAN solves many critical enterprise problems, including:

- Establishing transport-independent WAN for lower cost and higher diversity
- Meeting Service-Level Agreements (SLAs) for business-critical and real-time applications
- Providing end-to-end segmentation for protecting critical enterprise compute resources
- Extending seamlessly into the private/public cloud
- Providing direct Internet access from the branches with Zone-Based Firewall
- Providing secured control and data plane connectivity

Cisco SD-WAN provides data plane and control plane separation by having controllers in the cloud (public or private).

This document covers the enterprise solution profile built with the features described below.

Security

The Cisco SD-WAN solution offers secure control and management communications between the routers and the control components. Data plane communication between the WAN Edge routers is encrypted and secured based on IPSec encapsulation.

Hybrid transport

There are two data centers in this profile with each data center having two SD-WAN routers. All of the data-center SD-WAN routers are connected to Internet and Multiprotocol Label Switching (MPLS) transports.

The branches have a range of connectivity models. Some are hybrid and connected to the Internet and MPLS; some are connected to only one transport, either to the Internet or to MPLS.

The same profile was configured and tested with dual Internet transports.

Segmentation and Zone-Based Firewall (ZBFW)

There can be multiple segments in the branches, and, with Cisco SD-WAN, a user is able to keep the segments separate within the branch and on the overlay. In this profile, two VPN segments have been defined. One segment is used for Guest Wi-Fi (VPN 40) and requires Direct Internet Access (DIA) only. A guest segment is not allowed to talk to any other segment within the branch or on the overlay. The store segment (VPN 10) has three VLANs, for VoIP, for Point-Of-Sale (POS) systems, and for employees.

Zone-Based Firewall is deployed for the traffic from Guest Wi-Fi VPN to DIA.

Policy- based hub-and-spoke topology

Centralized policies are deployed to establish a hub-and-spoke topology between the data centers and the branches.

One set of branches prefers the default route from Data Center 1 (DC1), and another set of branches prefers the default from Data Center 2 (DC2).

Quality of Service

Quality of Service (QoS) is configured on all devices. The WAN bandwidth is appropriately distributed between different types of applications. Voice is given dedicated bandwidth on WAN interfaces and placed in a Low Latency Queue. Other traffic classes share the remaining bandwidth among them based on weight assignment.

SLA based application-aware routing policies

Centralized application-aware routing policies are configured for hybrid sites. Voice SLAs are defined and MPLS is defined as the preferred path for Voice traffic. Internet is defined as the preferred path for Best-Effort traffic.

Dynamic Host Configuration Protocol (DHCP) servers for the branches

The WAN edge routers in the branches are configured as DHCP) servers for some of the segments for allocating IP addresses to the clients.

High Availability

In the data center, Border Gateway Protocol (BGP) is deployed for dynamic routing.

One set of branches utilizes Virtual Router Redundancy Protocol (VRRP) on the SD-WAN edge routers connected to the Layer2 (L2) switch within the branch. Another set of branches run Open Shortest Path First (OSPF) Protocol between the SD-WAN edge router and the Layer 3 (L3) switch within the branch.

Table 1. Profile feature summary

Deployment area	Features
Security	TLS/DTLS certificate-based control plane, IPsec-based data plane, Segmentation, Zone-Based Firewall
Services	QoS, DIA, NAT, ACL, DHCP Server
Routing	BGP, OSPF, VRRP
Centralized Policies	SLA-based path selection, policy-based hub-and-spoke topology
Centralized Management	Configuration, Monitoring and Policy management through vManage

Network profile

Based on research, customer feedback, and configuration samples, the SD-WAN profile is designed with a generic deployment topology that you can easily modify to fit any specific deployment scenario. This profile caters to enterprise network deployments with a large number of remote/branch offices and few data centers.

Topology diagram

Figure 1. Topology overview

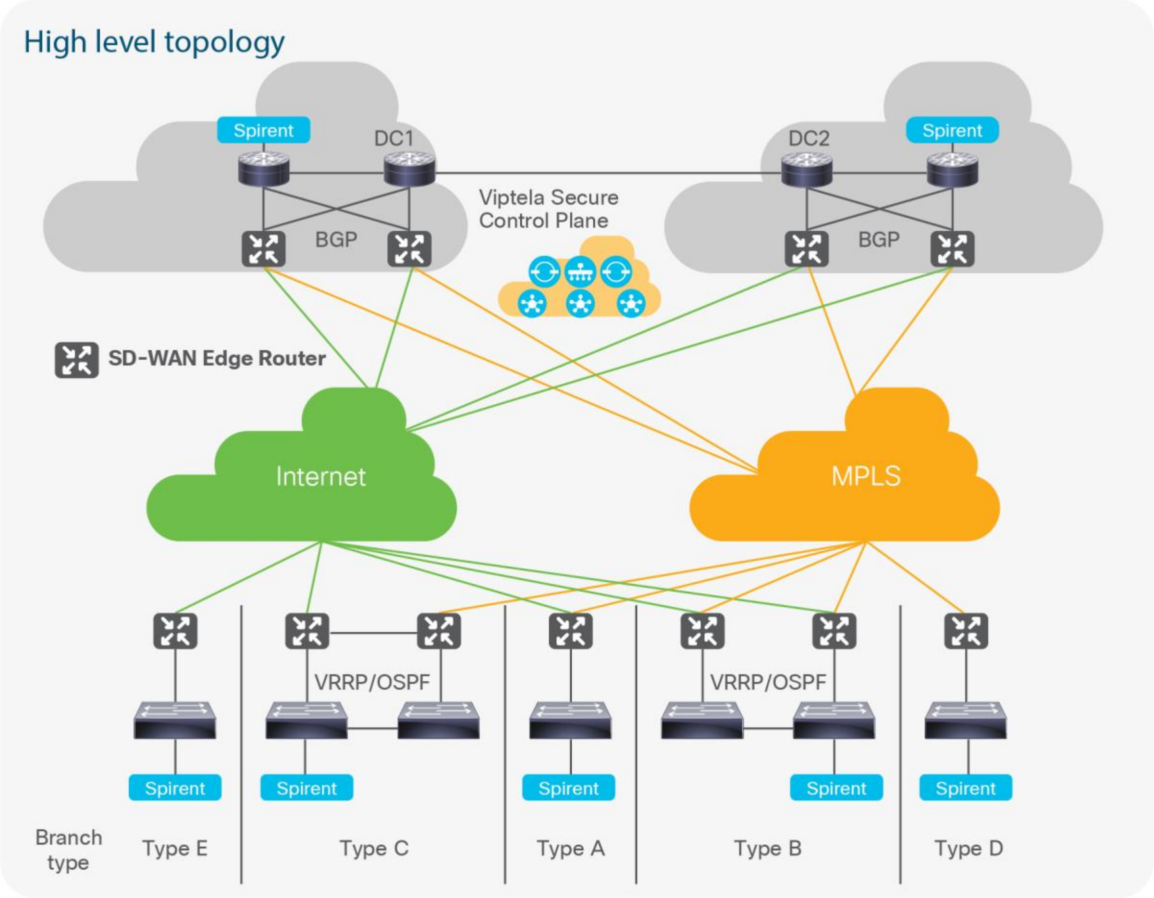
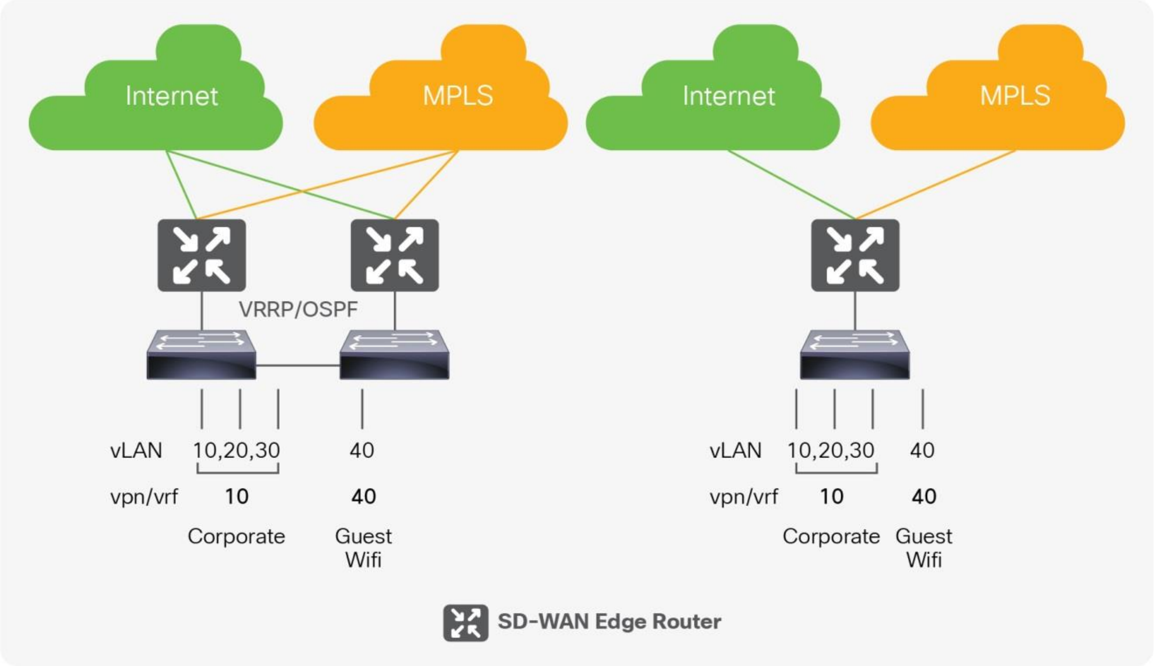


Figure 2. Branch topology (Branch Type A and Type B)



Hardware and feature specifications

This section describes the 3-D feature matrix, where the hardware platforms are listed along with their Place In Network (PIN) and the relevant vertical deployment.

Key vertical features

Table 2 defines the Hardware, PIN, and SD-WAN features deployed.

Table 2. 3-D feature summary with hardware and PIN

PIN	Platforms	Critical features
SD-WAN routers in the data centers	Viptela vEdge 2000 Viptela vEdge 5000 Cisco® ASR 1001-HX ASR 1002-HX	Dynamic routing (BGP) Quality of Service (QoS) Hybrid WAN ACL
SD-WAN routers in the branches	vEdge100 vEdge1000 ISR 4331	Segmentation Zone-Based Firewall VRRP/OSPF DHCP Server Quality of Service (QoS) Hybrid WAN NAT/DIA TLOC-Extension ACL
Controller deployment	EXi6.0 vBond vSmart vManage	Centralized ● Management ● Control ● Provisioning ● Monitoring ● Policy

PIN	Platforms	Critical features
Internet transport	ISR/ASR Routers	IP routing for Internet transport
MPLS transport	ISR/ASR Routers	IP routing for MPLS transport
L2/L3 access switches	CAT3K	Provides L2/L3 connectivity in branches

Hardware profile

Table 3 defines the set of relevant servers, test equipment, and endpoints that are used to complete the end-to-end deployment.

This list of hardware, along with the relevant software versions and the role of these devices, complements the actual physical topology shown in Figure 1.

Table 3. Hardware profile of servers and endpoints

Virtual machine and hardware	Software version	Description
Spirent	Spirent Test Center	Generates L4/L7 traffic

Use case scenarios

Test methodology

To validate a new release, the network topology is upgraded with the new software image with an existing configuration composed of the use cases and the relevant traffic profile. New use cases acquired from the field or from customer deployments are added to the existing configuration.

With respect to the longevity of this profile, the setup, CPU, and memory use/leaks are monitored during the validation phase. Furthermore, to test the robustness of the software release and platform being tested, negative events are triggered during the use-case execution process.

Use cases

Table 4 describes the use cases executed as part of this profile test. The use cases are divided into buckets of technology areas to view complete coverage of the deployment scenarios.

The technology buckets comprise System Upgrade, Security, Network Service, Monitoring & Troubleshooting, simplified management, system health monitoring along with system, and network resiliency.

Table 4. List of use case scenarios

No	Focus area	Use cases
Centralized management using vManage		
1	System health monitoring	● Monitor site health ● Monitor device health ● Monitor Bidirectional Forwarding Detection (BFD) session state from the devices ● Monitor control session state ● Monitor BFD / transport performance statistics ● View alarms and events
2	Configuration templates	● Utilize the configuration template from vManage to update the device configuration ● Configure/update ACLs and route policies ● Define/update ZBFW policies
3	Centralized policy management	● Utilize vManage GUI interface to provision and update centralized policies
4	Software upgrade	● Upgrade the controllers and SD-WAN routers through vManage
5	Admin-tech	● Collect admin-tech from the controllers and SD-WAN edges

No	Focus area	Use cases
6	Troubleshooting	● SSH into devices from vManage portal ● Issue real-time commands from device dashboard
Security		
7	Zone-Based Firewall	● Define and apply ZBFW to traffic that is allowed to use DIA from Guest Wi-Fi VPN/VRF
8	Segmentation	● Configure VLAN segments in the branch ● Guest Wi-Fi VPN segmented from corporate VPN ● VPN membership policy for the centralized vSmart policies
Network services		
9	Quality of Service (QoS)	● Provide classification of traffic for QoS using Access Control List (ACL) and map it to forwarding classes ● BW allocation forwarding class mapping to queues ● Voice traffic is mapped to Low Latency Queuing (LLQ) ● Shaping on the WAN interfaces
10	Centralized control policies	● Hub-and-spoke topology between data centers and remote branches ● Different branch groups prefer one data center over another for a default route
11	Centralized SLA-based routing policy	● Define SLA threshold for voice ● Prefer MPLS for voice ● Prefer Internet for best-effort data
12	VPN membership policy	● Utilize VPN membership policy to restrict Guest Wi-Fi routing from overlay
Routing		
13	BGP	● In the data center, run BGP between the SD-WAN edge routers and the data-center aggregation routers ● Redistribute routes between BGP and Overlay Management Protocol (OMP)
14	OSPF	● Run OSPF in the branches access switch/router ● Redistribute OSPF into OMP
15	VRRP	● Run VRRP on the vLANs in the branches
Application visibility		
16	cFLOWD/netflow	● Enable cFLOWD/netflow export to collector
17	DPI/NBAR	● Enable application visibility
System resiliency		
18	System resiliency	Verify system-level resiliency during the following events: ● Power failure ● WAN/LAN interface flaps ● Network impairments as per SLA requirements
Negative testing		
19		Verify that the system holds well and recovers to working condition after the following negative events are triggered: ● Configuration changes: add/remove configuration snippets, replace configuration ● Clear counters, clear routes ● Routing protocol interface flap

Appendix A: System configuration

The system configuration is the same across all controllers and WAN Edge routers, including Cisco XE SDWAN (cEdge) and Viptela SDWAN (vEdge).

```
system
 host-name               vEdge3
 system-ip               11.2.1.3
 site-id                 1200
 admin-tech-on-failure
 no route-consistency-check
 sp-organization-name    "Cisco Sy1 - 19968"
 organization-name       "Cisco Sy1 - 19968"
 vbond vbondesc.com
```

Appendix B: Hybrid transports VPN 0 configuration

vEdge with Hybrid Transport

```
vpn 0
 name "Transport VPN"
 dns 8.8.4.4 secondary
 dns 8.8.8.8 primary
 host vbondesc.com ip 21.1.1.11 21.1.2.11
 interface ge0/0
  ip address 20.1.3.101/24
  nat
  !
  tunnel-interface
   encapsulation ipsec
   color gold
   no allow-service bgp
   allow-service dhcp
   allow-service dns
   allow-service icmp
   no allow-service sshd
   no allow-service netconf
   no allow-service ntp
   no allow-service ospf
   no allow-service stun
   allow-service https
  !
  no shutdown
  shaping-rate 10000
  qos-map      WANQoS
 !
 interface ge0/1
  ip address 20.2.3.101/24
  tunnel-interface
   encapsulation ipsec
   color mpls restrict
   no allow-service bgp
   allow-service dhcp
   allow-service dns
   allow-service icmp
   no allow-service sshd
   no allow-service netconf
   no allow-service ntp
   no allow-service ospf
   no allow-service stun
   allow-service https
  !
  no shutdown
  shaping-rate 10000
  qos-map      WANQoS
 !
 interface ge0/7
  mtu      1504
  no shutdown
 !
 !
 ip route 0.0.0.0/0 20.1.3.1
 ip route 0.0.0.0/0 20.2.3.1
!
```

cEdge with Hybrid Transport

```
ip host vbondesc.com 21.1.1.11 21.1.2.11
ip name-server 8.8.4.4 8.8.8.8
ip route 0.0.0.0 0.0.0.0 20.1.15.1 1
ip route 0.0.0.0 0.0.0.0 20.2.15.1 1

interface GigabitEthernet0/0/0
 no shutdown
 arp timeout 1200
 mtu 1500
 negotiation auto
 service-policy output shape_GigabitEthernet0/0/0
 ip mtu 1500
 ip nat outside
 ip address 20.1.15.101 255.255.255.0
exit

interface GigabitEthernet0/0/1
 no shutdown
 arp timeout 1200
 mtu 1500
 negotiation auto
 service-policy output shape_GigabitEthernet0/0/1
 ip mtu 1500
 ip address 20.2.15.101 255.255.255.0
exit

interface Tunnel0
 no shutdown
 ip unnumbered GigabitEthernet0/0/0
 no ip redirects
 ipv6 unnumbered GigabitEthernet0/0/0
 no ipv6 redirects
 tunnel source GigabitEthernet0/0/0
 tunnel mode sdwan
```

```
exit
interface Tunnel1
 no shutdown
 ip unnumbered GigabitEthernet0/0/1
 no ip redirects
 ipv6 unnumbered GigabitEthernet0/0/1
 no ipv6 redirects
 tunnel source GigabitEthernet0/0/1
 tunnel mode sdwan
exit
!
sdwan
 interface GigabitEthernet0/0/0
  tunnel-interface
   color gold restrict
   no last-resort-circuit
   vmanage-connection-preference 5
   no allow-service all
   no allow-service bgp
   allow-service dhcp
   allow-service dns
   allow-service icmp
   no allow-service sshd
   no allow-service netconf
   no allow-service ntp
   no allow-service ospf
   no allow-service stun
   allow-service https
   encapsulation ipsec weight 1
  exit
 exit

 interface GigabitEthernet0/0/1
  tunnel-interface
   color mpls restrict
   no last-resort-circuit
   vmanage-connection-preference 5
   no allow-service all
   no allow-service bgp
   allow-service dhcp
   allow-service dns
   allow-service icmp
   no allow-service sshd
   no allow-service netconf
   no allow-service ntp
   no allow-service ospf
   no allow-service stun
   allow-service https
   encapsulation ipsec weight 1
  exit
 exit
```

Appendix C: Data center LAN-side configuration

vEdge Configuration

```
vpn 10
 router
  bgp 65220
   address-family ipv4-unicast
    maximum-paths paths 2
    redistribute omp
   !
   neighbor 10.201.1.2
    no shutdown
    remote-as 65221
   !
   neighbor 10.201.2.2
    no shutdown
    remote-as 65221
   !
  !
 !
 interface 10ge2/2
  ip address 10.201.1.1/24
  no shutdown
  access-list LAN-Classification in
 !
 interface 10ge2/3
  ip address 10.201.2.1/24
  no shutdown
  access-list LAN-Classification in
 !
!
```

cEdge Configuration

```
vrf definition 10
 rd 1:10
 address-family ipv4
  exit-address-family
 !
 address-family ipv6
  exit-address-family
 !
!
interface GigabitEthernet1/0/0
 no shutdown
 vrf forwarding 10
 ip address 10.201.3.1 255.255.255.0
!
interface GigabitEthernet1/0/1
 no shutdown
 vrf forwarding 10
 ip address 10.201.4.1 255.255.255.0
!

router bgp 65220
 timers bgp 60 180
 bgp log-neighbor-changes
 distance bgp 20 200 20
 address-family ipv4 unicast vrf 10
  maximum-paths 2
  neighbor 10.201.3.2 remote-as 65221
  neighbor 10.201.3.2 activate
  neighbor 10.201.3.2 ebgp-multihop 1
  neighbor 10.201.4.2 remote-as 65221
  neighbor 10.201.4.2 activate
  neighbor 10.201.4.2 ebgp-multihop 1
  redistribute omp
  exit-address-family
 !
!
```

Appendix D: DHCP and VRRP branch configuration

vEdge Configuration

```
vpn 10
 interface ge0/7.10
  ip address 10.10.1.1/24
  no shutdown
  access-list LAN-Classification in
  vrrp 10
   track-omp
   ipv4 10.10.1.3
  !
  dhcp-server
   address-pool 10.10.1.0/25
   exclude      10.10.1.1-10.10.1.100
   offer-time   600
   lease-time   86400
   admin-state  up
   options
    default-gateway 10.10.1.3
    dns-servers     8.8.8.8 8.8.4.4
   !
  !
 !
```

cEdge Configuration

```
ip dhcp excluded-address vrf 10 10.40.1.0 10.40.1.100
ip dhcp pool vrf-10-GigabitEthernet1/0/0.10
 vrf 10
 default-router 10.40.1.3
 dns-server 8.8.4.4 8.8.8.8
 network 10.40.1.0 255.255.255.0
 lease 1 0 0
exit



interface GigabitEthernet1/0/0.10
 no shutdown
 encapsulation dot1Q 10
 vrf forwarding 10
 ip mtu 1500
 ip address 10.40.1.1 255.255.255.0
 vrrp 10 address-family ipv4
  vrrpv2
  priority 40
  address 10.40.1.3
  track omp shutdown
 exit
exit
```

Appendix E: Quality-of-Service (QoS) configuration

vEdge Configuration

```
vpn 0
interface ge0/0
  shaping-rate 10000
  qos-map      WANQoS
 !
interface ge0/1
  shaping-rate 10000
  qos-map      WANQoS
 !
```

```
vpn 10
 interface ge0/7.10

  access-list LAN-Classification in


policy

 class-map
  class Queue0 queue 0
  class Voice_EF queue 0
  class Queue1 queue 1
  class Queue2 queue 2
  class NetProtocol_CS3 queue 3
  class Queue3 queue 3
  class NetMgmt_CS2 queue 4
  class Queue4 queue 4
  class CriticalData_AF21 queue 5
  class Queue5 queue 5
  class Queue6 queue 6
  class Scavanger_AF11 queue 6
  class BestEffort_CS1 queue 7
  class Queue7 queue 7
 !
 access-list LAN-Classification
  sequence 1
   match
    destination-port 1719-1721
   !
   action accept
    class Voice_EF
    set
     dscp 46
    !
   !
  !
  sequence 11
   match
    destination-port 2326-2485
   !
   action accept
    class Voice_EF
    set
     dscp 46
    !
   !
  !
  sequence 21
   match
    protocol 8 88 89
   !
   action accept
    class NetProtocol_CS3
    set
     dscp 24
    !
   !
  !
  sequence 31
   match
    destination-port 22
   !
   action accept
    class NetProtocol_CS3
    set
     dscp 24
    !
   !
  !
  sequence 41
   match
    destination-ip 10.200.200.0/24
   !
   action accept
    class NetMgmt_CS2
    set
     dscp 16
    !
   !
  !
  sequence 51
   match
    destination-ip   10.200.201.0/24
    destination-port 161 162 514
   !
   action accept
    class CriticalData_AF21
    set
     dscp 20
    !
   !
  !
  sequence 61
   match
    destination-port 20 21
   !
   action accept
    class BestEffort_CS1
    set
     dscp 8
    !
   !
  !
  sequence 71
   match
    destination-ip 10.200.202.0/24
   !
   action accept
    class Scavanger_AF11
    set
     dscp 10
    !
   !
```

```
  !
  sequence 81
   action accept
    class BestEffort_CS1
    set
     dscp 10
    !
   !
  !
  default-action accept
 !
qos-scheduler WANQoS_0
  class             Queue0
  bandwidth-percent 11
  buffer-percent    11
  scheduling        llq
 !
 qos-scheduler WANQoS_1
  class             Queue1
  bandwidth-percent 10
  buffer-percent    10
  drops             red-drop
 !
 qos-scheduler WANQoS_2
  class             Queue2
  bandwidth-percent 10
  buffer-percent    10
  drops             red-drop
 !
 qos-scheduler WANQoS_3
  class             Queue3
  bandwidth-percent 5
  buffer-percent    5
  drops             red-drop
 !
 qos-scheduler WANQoS_4
  class             Queue4
  bandwidth-percent 2
  buffer-percent    2
  drops             red-drop
 !
 qos-scheduler WANQoS_5
  class             Queue5
  bandwidth-percent 48
  buffer-percent    48
  drops             red-drop
 !
 qos-scheduler WANQoS_6
  class             Queue6
  bandwidth-percent 5
  buffer-percent    5
  drops             red-drop
 !
 qos-scheduler WANQoS_7
  class             Queue7
  bandwidth-percent 9
  buffer-percent    9
  drops             red-drop
 !
 qos-map WANQoS
  qos-scheduler WANQoS_0
  qos-scheduler WANQoS_1
  qos-scheduler WANQoS_2
  qos-scheduler WANQoS_3
  qos-scheduler WANQoS_4
  qos-scheduler WANQoS_5
  qos-scheduler WANQoS_6
  qos-scheduler WANQoS_7
 !
!
```

cEdge Configuration

```
sdwan
 interface GigabitEthernet1/0/0.10
  access-list LAN-Classification in
 exit

class-map match-any BestEffort_CS1
 match qos-group 7
!
class-map match-any CriticalData_AF21
 match qos-group 5
!
class-map match-any NetMgmt_CS2
 match qos-group 4
!
class-map match-any NetProtocol_CS3
 match qos-group 3
!
class-map match-any Queue0
 match qos-group 0
!
class-map match-any Queue1
 match qos-group 1
!
class-map match-any Queue2
 match qos-group 2
!
class-map match-any Queue3
 match qos-group 3
!
class-map match-any Queue4
 match qos-group 4
!
class-map match-any Queue5
 match qos-group 5
!
```

```
class-map match-any Queue6
 match qos-group 6
!
class-map match-any Queue7
 match qos-group 7
!
class-map match-any Scavanger_AF11
 match qos-group 6
!
class-map match-any Voice_EF
 match qos-group 0
!
policy-map WANQoS
 class Queue0
  priority percent 11
 !
 class Queue1
  random-detect
  bandwidth percent 10
 !
 class class-default
  random-detect
  bandwidth percent 10
 !
 class Queue3
  random-detect
  bandwidth percent 5
 !
 class Queue4
  random-detect
  bandwidth percent 2
 !
 class Queue5
  random-detect
  bandwidth percent 48
 !
 class Queue6
  random-detect
  bandwidth percent 5
 !
 class Queue7
  random-detect
  bandwidth percent 9
 !
!
policy-map shape_GigabitEthernet0/0/0
 class class-default
  service-policy WANQoS
  shape average 10000000
 !
!
policy-map shape_GigabitEthernet0/0/1
 class class-default
  shape average 100000000
 !
!
interface GigabitEthernet0/0/0
 no shutdown
 arp timeout 1200
 ip address 20.1.16.101 255.255.255.0
 ip mtu 1500
 ip nat outside
 mtu 1500
 negotiation auto
 service-policy output shape_GigabitEthernet0/0/0
exit
interface GigabitEthernet0/0/1
 no shutdown
 arp timeout 1200
 ip address 20.2.16.101 255.255.255.0
 ip mtu 1500
 mtu 1500
 negotiation auto
 service-policy output shape_GigabitEthernet0/0/1
exit
```

```
policy
 class-map
  class BestEffort_CS1 queue 7
  class CriticalData_AF21 queue 5
  class NetMgmt_CS2 queue 4
  class NetProtocol_CS3 queue 3
  class Queue0 queue 0
  class Queue1 queue 1
  class Queue2 queue 2
  class Queue3 queue 3
  class Queue4 queue 4
  class Queue5 queue 5
  class Queue6 queue 6
  class Queue7 queue 7
  class Scavanger_AF11 queue 6
  class Voice_EF queue 0
 !
 access-list LAN-Classification
  sequence 1
   match
    destination-port 1719-1721
   !
   action accept
    class Voice_EF
    set
     dscp 46
    !
   !
  !
  sequence 11
   match
    destination-port 2326-2485
   !
   action accept
    class Voice_EF
    set
     dscp 46
    !
   !
  !
  sequence 21
   match
    protocol 8 88 89
   !
   action accept
    class NetProtocol_CS3
    set
     dscp 24
    !
   !
  !
  sequence 31
   match
    destination-port 22
   !
   action accept
    class NetProtocol_CS3
    set
     dscp 24
    !
   !
  !
  sequence 41
   match
    destination-ip 10.200.200.0/24
   !
   action accept
    class NetMgmt_CS2
    set
     dscp 16
    !
   !
  !
  sequence 51
   match
    destination-ip   10.200.201.0/24
    destination-port 161 162 514
   !
   action accept
    class CriticalData_AF21
    set
     dscp 20
    !
   !
  !
  sequence 61
   match
    destination-port 20 21
   !
   action accept
    class BestEffort_CS1
    set
     dscp 8
    !
   !
  !
  sequence 71
   match
    destination-ip 10.200.202.0/24
   !
   action accept
    class Scavanger_AF11
    set
     dscp 10
    !
   !
  !
  sequence 81
   action accept
    class BestEffort_CS1
    set
     dscp 10
    !
   !
```

```
    !
    default-action accept
   !
```

Appendix F: Guest Wi-Fi with DIA and ZBFW

vEdge Configuration

```
vpn 40
 name "Guest Wifi"
 interface ge0/7.40
  ip address 10.10.4.1/24
  no shutdown
  access-list WIFI-Classification in
  policer LimitWIFI out
  vrrp 40
   track-omp
   ipv4 10.10.4.3
  !
  dhcp-server
   address-pool 10.10.4.0/25
   exclude      10.10.4.1-10.10.4.100
   offer-time   600
   lease-time   86400
   admin-state  up
   options
    default-gateway 10.10.4.3
    dns-servers     8.8.8.8 8.8.4.4
   !
  !
 !
 ip route 0.0.0.0/0 vpn 0
!
policy
 policer LimitWIFI
  rate   2000000
  burst  30000
  exceed drop
 !
 zone GuestWifi
  vpn 40
 !
 zone InternetZone
  vpn 0
 !
 zone-pair ZP_GuestWifi_Internet_-630006705
  source-zone      GuestWifi
  destination-zone InternetZone
  zone-policy      GuestWifiZBFW
 !
zone-based-policy GuestWifiZBFW
  sequence 1
   match
    protocol 6
    destination-port 443 80 8080 8443
   !
   action inspect
   !
  !
  sequence 11
   match
    protocol 6 17
    destination-port 53
   !
   action inspect
   !
  !
  default-action drop
 !
 zone-to-nozone-internet allow
!
```

cEdge Configuration

```
interface GigabitEthernet0/0/0
 no shutdown
 arp timeout 1200
 ip address 20.1.16.101 255.255.255.0
 ip mtu 1500
 ip nat outside
 mtu 1500
 negotiation auto
 service-policy output shape_GigabitEthernet0/0/0
exit

sdwan
   interface GigabitEthernet1/0/0.10
    access-list LAN-Classification in
   exit
  vrf definition 40
   rd 1:40
   address-family ipv4
    exit-address-family
   !
   address-family ipv6
    exit-address-family
   !
  !
  ip dhcp excluded-address vrf 40 10.40.1.0 10.40.1.100
  ip dhcp pool vrf-40-GigabitEthernet1/0/0.40
   vrf 40
   lease 1 0 0
   default-router 10.40.1.3
   dns-server 8.8.4.4 8.8.8.8
   network 10.40.1.0 255.255.255.0
  exit
  ip dhcp use hardware-address client-id

  ip access-list extended GuestWifiZBFW-seq-1-acl_
```

```
   11 permit object-group GuestWifiZBFW-seq-1-service-og_ any any
  !
  ip access-list extended GuestWifiZBFW-seq-11-acl_
   11 permit object-group GuestWifiZBFW-seq-11-service-og_ any any
  !

  ip nat inside source list nat-dia-vpn-hop-access-list interface
GigabitEthernet0/0/0 overload
  ip nat translation tcp-timeout 60
  ip nat translation udp-timeout 1
  ip nat route vrf 40 0.0.0.0 0.0.0.0 global

  !
  policy-map type inspect GuestWifiZBFW
   class GuestWifiZBFW-seq-1-cm_
     inspect
   !
   class GuestWifiZBFW-seq-11-cm_
     inspect
   !
   class class-default
     drop
   !
  !
  interface GigabitEthernet1/0/0.40
   no shutdown
   encapsulation dot1Q 10
   vrf forwarding 40
   ip address 10.40.1.1 255.255.255.0
   vrrp 10 address-family ipv4
    vrrpv2
    address 10.40.1.3
    priority 40
    track omp shutdown
   exit
  exit
  !
  object-group service GuestWifiZBFW-seq-1-service-og_
```

```
   tcp-udp 53
  !
  object-group service GuestWifiZBFW-seq-11-service-og_
   tcp 80
   tcp 443
   tcp 8080
   tcp 8443
  !
  parameter-map type inspect-global
   alert on
   log dropped-packets
   multi-tenancy
   vpn zone security
  !
  zone security GuestWifi
   vpn 40
  !
  zone security InternetZone
   vpn 0
  !
  zone-pair security ZP_GuestWifi_Internet_-630006705 source GuestWifi
destination InternetZone
   service-policy type inspect GuestWifiZBFW
  !
  policy
   policer LimitWIFI
    rate   2000000
    burst  30000
    exceed drop
   !
   access-list WIFI-Classification
    sequence 1
     action accept
      policer LimitWIFI
      class   Scavanger_AF11
      set
       dscp 10
      !
     !
    !
    default-action accept
   !
  !
 !
!
```

Appendix G: Centralized policies

Control policy applied toward branches in Group1

```
policy
 control-policy Group1BranchControl-Out
    sequence 1
     match route
      site-list DC1
      prefix-list DefaultPrefix
     !
     action accept
      set
       preference 100
      !
     !
    !
    sequence 11
     match route
      site-list DC1
     !
     action accept
     !
    !
    sequence 21
     match route
      site-list DC2
      prefix-list DefaultPrefix
     !
     action accept
      set
       preference 50
      !
     !
    !
    sequence 31
     match route
      site-list DC2
     !
     action accept
     !
    !
    sequence 41
     match tloc
      site-list DC1
     !
     action accept
     !
    !
    sequence 51
     match tloc
      site-list DC2
     !
     action accept
     !
    !
  default-action reject
 !
 vpn-membership vpnMembership_303141673
    sequence 10
     match
      vpn-list storeVPN
     !
     action accept
     !
    !
  default-action reject
 !
```

```
 lists
  prefix-list DefaultPrefix
   ip-prefix 0.0.0.0/0
  !
  site-list BranchGroup1
   site-id 1000-1999
  !
  site-list BranchGroup2
   site-id 2000-2999
  !
  site-list DC1
   site-id 100
  !
  site-list DC2
   site-id 200
  !
  vpn-list storeVPN
   vpn 10
  !
 !
!
apply-policy
 site-list BranchGroup1
  control-policy Group1BranchControl-Out out
  vpn-membership vpnMembership_303141673
 !
!
```

Application-aware routing policy for the branch

```
policy
sla-class BestEffort
 latency 250
 loss 10
 jitter 30
!
sla-class CriticalData
 latency 200
```

```
   loss 3
   jitter 20
  !
  sla-class Voice
   latency 150
   loss 1
   jitter 5
  !
 app-route-policy _storeVPN_CVP-APP-Route1
  vpn-list storeVPN
    sequence 1
     match
      dscp 46
     !
     action
      sla-class Voice  preferred-color mpls
     !
    !
    sequence 11
     match
      dscp 20
     !
     action
      sla-class CriticalData  preferred-color mpls
     !
    !
    sequence 21
     match
      dscp 0-10
     !
     action
      sla-class BestEffort  preferred-color gold
     !
    !
 !
lists
  prefix-list DefaultPrefix
   ip-prefix 0.0.0.0/0
  !
  site-list BranchGroup1
   site-id 1000-1999
  !
  site-list BranchGroup2
   site-id 2000-2999
  !
  site-list DC1
   site-id 100
  !
  site-list DC2
   site-id 200
  !
  vpn-list storeVPN
   vpn 10
  !
 !
!
apply-policy
 site-list BranchGroup1
  control-policy Group1BranchControl-Out out
!
!
```

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at **https://www.cisco.com/go/offices**.

Printed in USA