

CCIE EI LAB Version 1.1 DOO

1 Existing Network Review and Tuning

1.1 Introduction

Welcome to the Deploy, Operate, Optimize (DOO) module for XANDER Pharmaceuticals.

The topology you will be working on this module will be similar, but not necessarily identical, to the network that you helped design in the previous module.

It may also include technologies and feature sets not touched upon previously.

1.2 Configure VLANs

Ensure that the VLANs and forwarding are configured on all switches and switchports according to the following table.

Site	VLAN	Switch	Port(s)	802.1q Tagged
HQ	2000	SW101	Po1, Po3	Yes
HQ	2000	SW102	Po2, Po3	Yes
HQ	2000	SW110	Po1, Po2	Yes
HQ	2000	SW110	Ge0/0	No
HQ	2001	SW101	Po1, Po3	Yes
HQ	2001	SW102	Po2, Po3	Yes
HQ	2001	SW110	Po1, Po2	Yes
HQ	2001	SW110	Ge0/1	No
Branch#3	2000	SW601	Ge2/0	Yes
Branch#3	2000	SW602	Ge2/0	Yes
Branch#3	2000	SW610	Ge2/0-1	Yes
Branch#3	2000	SW610	Ge0/0	No
Branch#3	2001	SW601	Ge2/0	Yes
Branch#3	2001	SW602	Ge2/0	Yes
Branch#3	2001	SW610	Ge2/0-1	Yes
Branch#3	2001	SW610	Ge0/1	No



WOLF-LAB 网络技术实验室
上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

Solution:

SW101 & SW102:

This part of the content will be configured in Q1.3

SW110:

```
SW110(config)#interface g0/0
SW110(config-if)#switchport mode access
SW110(config-if)#switchport access vlan 2000
SW110(config-if)#no shutdown
SW110(config-if)#exit
SW110(config)#interface g0/1
SW110(config-if)#switchport mode access
SW110(config-if)#switchport access vlan 2001
SW110(config-if)#no shutdown
SW110(config-if)#exit
SW110(config)#+
```

SW601 & SW602:

```
SW60x(config)#interface g2/0
SW60x(config-if)#switchport trunk encapsulation dot1q
SW60x(config-if)#switchport mode trunk
SW60x(config-if)#switchport trunk allowed vlan 1,2000,2001
SW60x(config-if)#no shutdown
SW60x(config-if)#exit
SW60x(config)#+
```

SW610:

```
SW610(config)#interface range g2/0-1
SW610(config-if-range)#switchport trunk encapsulation dot1q
SW610(config-if-range)#switchport mode trunk
SW610(config-if-range)#switchport trunk allowed vlan 1,2000,2001
SW610(config-if-range)#no shutdown
SW610(config-if-range)#exit
SW610(config)#interface g0/0
SW610(config-if)#switchport mode access
SW610(config-if)#switchport access vlan 2000
SW610(config-if)#no shutdown
SW610(config-if)#exit
SW610(config)#interface g0/1
SW610(config-if)#switchport mode access
SW610(config-if)#switchport access vlan 2001
SW610(config-if)#no shutdown
```



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Website: www.wolf-lab.com
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SW610(config-if)#exit

SW610(config)#

Verify:

SW601:

SW601#**show vlan brief**

VLAN Name	Status	Ports
1 default	active	Gi0/3, Gi1/0, Gi1/1, Gi1/2 Gi1/3, Gi2/1, Gi2/2, Gi2/3
1002 fddi-default	act/unsup	
1003 token-ring-default	act/unsup	
1004 fddinet-default	act/unsup	
1005 trnet-default	act/unsup	
2000 VLAN2000	active	
2001 VLAN2001	active	

SW601#

SW601#**show interface trunk**

Port	Mode	Encapsulation	Status	Native vlan
Gi2/0	on	802.1q	trunking	1

Port Vlans allowed on trunk
Gi2/0 1,2000-2001

Port Vlans allowed and active in management domain
Gi2/0 1,2000-2001

Port Vlans in spanning tree forwarding state and not pruned
Gi2/0 1,2000-2001

SW601#

SW602:

SW602#**show vlan brief**

VLAN Name	Status	Ports
1 default	active	Gi0/3, Gi1/0, Gi1/1, Gi1/2 Gi1/3, Gi2/1, Gi2/2, Gi2/3
1002 fddi-default	act/unsup	

1003 token-ring-default act/unsup

1004 fddinet-default act/unsup

1005 trnet-default act/unsup

2000 VLAN2000 active

2001 VLAN2001 active

SW602#

SW602#show interface trunk

Port	Mode	Encapsulation	Status	Native vlan
Gi2/0	on	802.1q	trunking	1

Port Vlans allowed on trunk

Gi2/0 1,2000-2001

Port Vlans allowed and active in management domain

Gi2/0 1,2000-2001

Port Vlans in spanning tree forwarding state and not pruned

Gi2/0 1,2000-2001

SW602#

SW610:

SW610#show vlan brief

VLAN Name	Status	Ports
1 default	active	Gi0/2, Gi0/3, Gi1/0, Gi1/1 Gi1/2, Gi1/3, Gi2/2, Gi2/3
1002 fddi-default	act/unsup	
1003 token-ring-default	act/unsup	
1004 fddinet-default	act/unsup	
1005 trnet-default	act/unsup	
2000 VLAN2000	active	Gi0/0
2001 VLAN2001	active	Gi0/1

SW610#

SW610#show interface trunk

Port	Mode	Encapsulation	Status	Native vlan
Gi2/0	on	802.1q	trunking	1
Gi2/1	on	802.1q	trunking	1

Port Vlans allowed on trunk

Gi2/0 1,2000-2001

Gi2/1 1,2000-2001

Port Vlans allowed and active in management domain
 Gi2/0 1,2000-2001
 Gi2/1 1,2000-2001

Port Vlans in spanning tree forwarding state and not pruned
 Gi2/0 1,2000-2001
 Gi2/1 1,2000-2001
 SW610#

1.3 Configure EtherChannel

Ensure that the EtherChannel links are configured on the switches at Headquarters according to the following table.

EtherChannel ID	Switch A	Switchports	Switch B	Switchports	Type
1	SW101	Ge1/2-3	SW110	Ge1/0-1	802.3ad
2	SW102	Ge1/2-3	SW110	Ge1/2-3	802.3ad
3	SW101	Ge2/0-1	SW102	Ge2/0-1	802.3ad

Ensure the STP features are configured on the switches at Headquarters according to the following requirements:

- The protocol must support a separate instance for each VLAN.
- The protocol must support only three states.
- All endpoint-facing ports must bypass the STP forwarding delay, without configuring individual switchports.
- SW101 must be the root bridge for VLANs 2000-2001, with SW102 as the secondary. Use the lowest possible priority values to achieve this.
- SW101 and SW102 must ignore superior BPDUs for the other switches at Headquarters. While superior BPDUs are received, traffic must not be forwarded on the receiving port.



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai

Website: www.wolf-lab.com

E-mail: support@wolf-lab.com

Solution:

SW101:

```
SW101(config)#spanning-tree mode rapid-pvst
SW101(config)#spanning-tree vlan 2000-2001 priority 0
SW101(config)#spanning-tree portfast edge default
SW101(config)#no interface po1
SW101(config)#no interface po3
SW101(config)#interface range g1/2-3
SW101(config-if-range)#switchport trunk encapsulation dot1q
SW101(config-if-range)#switchport mod trunk
SW101(config-if-range)#switchport trunk allowed vlan 1,2000,2001
SW101(config-if-range)#no shutdown
SW101(config-if-range)#channel-group 1 mode active
SW101(config-if-range)#exit
SW101(config)#interface range g2/0-1
SW101(config-if-range)#switchport trunk encapsulation dot1q
SW101(config-if-range)#switchport mod trunk
SW101(config-if-range)#switchport trunk allowed vlan 1,2000,2001
SW101(config-if-range)#no shutdown
SW101(config-if-range)#channel-group 3 mode active
SW101(config-if-range)#exit
SW101(config)#interface range po1, po3
SW101(config-if-range)#spanning-tree guard root
SW101(config-if-range)#interface range gi0/3, gi1/0-3,gi2/0-1
SW101(config-if-range)#spanning-tree guard root
SW101(config-if-range)#exit
SW101(config)#

```

SW102:

```
SW102(config)#spanning-tree mode rapid-pvst
SW102(config)#spanning-tree vlan 2000-2001 priority 4096
SW102(config)#spanning-tree portfast edge default
SW102(config)#no interface po2
SW102(config)#no interface po3
SW102(config)#interface range g1/2-3
SW102(config-if-range)#switchport trunk encapsulation dot1q
SW102(config-if-range)#switchport mod trunk
SW102(config-if-range)#switchport trunk allowed vlan 1,2000,2001
SW102(config-if-range)#no shutdown
SW102(config-if-range)#channel-group 2 mode active
SW102(config-if-range)#exit

```



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Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai

Website: www.wolf-lab.com

E-mail: support@wolf-lab.com

```
SW102(config)#interface range g2/0-1
SW102(config-if-range)#switchport trunk encapsulation dot1q
SW102(config-if-range)#switchport mod trunk
SW102(config-if-range)#switchport trunk allowed vlan 1,2000,2001
SW102(config-if-range)#no shutdown
SW102(config-if-range)#channel-group 3 mode active
SW102(config-if-range)#exit
SW102(config)#interface po2
SW102(config-if-range)#spanning-tree guard root
SW102(config-if-range)#exit
SW102(config)#interface range gi0/3, gi1/0-3
SW102(config-if-range)#spanning-tree guard root
SW102(config-if-range)#exit
SW102(config)#

```

SW110:

```
SW110(config)#spanning-tree mode rapid-pvst
SW110(config)#spanning-tree portfast edge default
SW110(config)#no interface port-channel 1
SW110(config)#no interface port-channel 2
SW110(config)#interface range g1/0-1
SW110(config-if-range)#switchport trunk encapsulation dot1q
SW110(config-if-range)#switchport mod trunk
SW110(config-if-range)#switchport trunk allowed vlan 1,2000,2001
SW110(config-if-range)#no shutdown
SW110(config-if-range)#channel-group 1 mode active
SW110(config-if-range)#exit
SW110(config)#interface range g1/2-3
SW110(config-if-range)#switchport trunk encapsulation dot1q
SW110(config-if-range)#switchport mod trunk
SW110(config-if-range)#switchport trunk allowed vlan 1,2000,2001
SW110(config-if-range)#no shutdown
SW110(config-if-range)#channel-group 2 mode active
SW110(config-if-range)#exit
SW110(config)#

```



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Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

Verify:

SW101:

SW101#**show etherchannel summary**

Flags: D - down P - bundled in port-channel
I - stand-alone S - suspended
H - Hot-standby (LACP only)
R - Layer3 S - Layer2
U - in use N - not in use, no aggregation
f - failed to allocate aggregator

M - not in use, minimum links not met
m - not in use, port not aggregated due to minimum links not met
u - unsuitable for bundling
w - waiting to be aggregated
d - default port

A - formed by Auto LAG

Number of channel-groups in use: 2
Number of aggregators: 2

Group	Port-channel	Protocol	Ports
1	Po1(SU)	LACP	Gi1/2(P) Gi1/3(P)
3	Po3(SU)	LACP	Gi2/0(P) Gi2/1(P)

SW101#

SW101#**show vlan brief**

VLAN Name	Status	Ports
1 default	active	Gi0/3, Gi1/0, Gi1/1, Gi2/2 Gi2/3
1002 fddi-default	act/unsup	
1003 token-ring-default	act/unsup	
1004 fddinet-default	act/unsup	
1005 trnet-default	act/unsup	
2000 VLAN2000	active	
2001 VLAN2001	active	

SW101#



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District,Shanghai

Website: www.wolf-lab.com

E-mail: support@wolf-lab.com

SW101#show interface trunk

Port	Mode	Encapsulation	Status	Native vlan
Po1	on	802.1q	trunking	1
Po3	on	802.1q	trunking	1

Port Vlans allowed on trunk

Po1	1,2000-2001
Po3	1,2000-2001

Port Vlans allowed and active in management domain

Po1	1,2000-2001
Po3	1,2000-2001

Port Vlans in spanning tree forwarding state and not pruned

Po1	1,2000-2001
Po3	1,2000-2001

SW101#

SW101#show spanning-tree vlan 2000

VLAN2000

Spanning tree enabled protocol rstp

Root ID	Priority	2000
	Address	5000.0011.0000
This bridge is the root		
Hello Time	2 sec	Max Age 20 sec Forward Delay 15 sec

Bridge ID	Priority	2000	(priority 0 sys-id-ext 2000)
	Address	5000.0011.0000	
Hello Time	2 sec	Max Age 20 sec	Forward Delay 15 sec
Aging Time	300 sec		

Interface	Role	Sts	Cost	Prio.Nbr	Type
Po1	Desg	FWD	3	128.65	P2p
Po3	Desg	FWD	3	128.66	P2p

SW101#

SW101#show spanning-tree vlan 2001

VLAN2001

Spanning tree enabled protocol rstp

技术改变命运!



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Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

Root ID	Priority	2001
Address	5000.0011.0000	
This bridge is the root		
Hello Time	2 sec	Max Age 20 sec Forward Delay 15 sec

Bridge ID	Priority	2001 (priority 0 sys-id-ext 2001)
Address	5000.0011.0000	
Hello Time	2 sec	Max Age 20 sec Forward Delay 15 sec
Aging Time	300 sec	

Interface	Role Sts	Cost	Prio.Nbr	Type
-----------	----------	------	----------	------

Po1	Desg FWD 3	128.65	P2p
Po3	Desg FWD 3	128.66	P2p

SW101#

SW101#show spanning-tree interface po1 active detail

Port 65 (Port-channel1) of VLAN0001 is designated forwarding

Port path cost 3, Port priority 128, Port Identifier 128.65.

Designated root has priority 32769, address 5000.0011.0000

Designated bridge has priority 32769, address 5000.0011.0000

Designated port id is 128.65, designated path cost 0

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

Link type is point-to-point by default

Root guard is enabled on the port

BPDU: sent 618, received 4

Port 65 (Port-channel1) of VLAN2000 is designated forwarding

Port path cost 3, Port priority 128, Port Identifier 128.65.

Designated root has priority 2000, address 5000.0011.0000

Designated bridge has priority 2000, address 5000.0011.0000

Designated port id is 128.65, designated path cost 0

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

Link type is point-to-point by default

Root guard is enabled on the port

BPDU: sent 618, received 4

Port 65 (Port-channel1) of VLAN2001 is designated forwarding

Port path cost 3, Port priority 128, Port Identifier 128.65.

Designated root has priority 2001, address 5000.0011.0000



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District,Shanghai

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E-mail: support@wolf-lab.com

Designated bridge has priority 2001, address 5000.0011.0000

Designated port id is 128.65, designated path cost 0

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

Link type is point-to-point by default

Root guard is enabled on the port

BPDU: sent 618, received 4

SW101#

SW101#**show spanning-tree interface po3 active detail**

Port 66 (Port-channel3) of VLAN0001 is designated forwarding

Port path cost 3, Port priority 128, Port Identifier 128.66.

Designated root has priority 32769, address 5000.0011.0000

Designated bridge has priority 32769, address 5000.0011.0000

Designated port id is 128.66, designated path cost 0

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

Link type is point-to-point by default

Root guard is enabled on the port

BPDU: sent 705, received 12

Port 66 (Port-channel3) of VLAN2000 is designated forwarding

Port path cost 3, Port priority 128, Port Identifier 128.66.

Designated root has priority 2000, address 5000.0011.0000

Designated bridge has priority 2000, address 5000.0011.0000

Designated port id is 128.66, designated path cost 0

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

Link type is point-to-point by default

Root guard is enabled on the port

BPDU: sent 705, received 12

Port 66 (Port-channel3) of VLAN2001 is designated forwarding

Port path cost 3, Port priority 128, Port Identifier 128.66.

Designated root has priority 2001, address 5000.0011.0000

Designated bridge has priority 2001, address 5000.0011.0000

Designated port id is 128.66, designated path cost 0

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

Link type is point-to-point by default

Root guard is enabled on the port

BPDU: sent 705, received 12

SW102:

 SW102#**show etherchannel summary**

Flags: D - down P - bundled in port-channel

I - stand-alone s - suspended

H - Hot-standby (LACP only)

R - Layer3 S - Layer2

U - in use N - not in use, no aggregation

f - failed to allocate aggregator

M - not in use, minimum links not met

m - not in use, port not aggregated due to minimum links not met

u - unsuitable for bundling

w - waiting to be aggregated

d - default port

A - formed by Auto LAG

Number of channel-groups in use: 2

Number of aggregators: 2

Group	Port-channel	Protocol	Ports
2	Po2(SU)	LACP	Gi1/2(P) Gi1/3(P)
3	Po3(SU)	LACP	Gi2/0(P) Gi2/1(P)

SW102#

 SW102#**show vlan brief**

VLAN Name	Status	Ports
1 default	active	Gi0/3, Gi1/0, Gi1/1, Gi2/2 Gi2/3
1002 fddi-default	act/unsup	
1003 token-ring-default	act/unsup	
1004 fddinet-default	act/unsup	
1005 trnet-default	act/unsup	
2000 VLAN2000	active	
2001 VLAN2001	active	

SW102#

 SW102#**show interface trunk**



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai
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Port	Mode	Encapsulation	Status	Native vlan
Po2	on	802.1q	trunking	1
Po3	on	802.1q	trunking	1

Port	Vlans allowed on trunk
Po2	1,2000-2001
Po3	1,2000-2001

Port	Vlans allowed and active in management domain
Po2	1,2000-2001
Po3	1,2000-2001

Port	Vlans in spanning tree forwarding state and not pruned
Po2	1,2000-2001
Po3	1,2000-2001

SW102#
SW102#**show spanning-tree vlan 2000**

VLAN2000

Spanning tree enabled protocol **rstp**

Root ID	Priority	2000
	Address	5000.0011.0000
	Cost	3
	Port	66 (Port-channel3)
	Hello Time	2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID	Priority	6096 (priority 4096 sys-id-ext 2000)
	Address	5000.0012.0000
	Hello Time	2 sec Max Age 20 sec Forward Delay 15 sec
	Aging Time	300 sec

Interface	Role	Sts	Cost	Prio.Nbr	Type
Po2	Desg	FWD	3	128.65	P2p
Po3	Root	FWD	3	128.66	P2p

SW102#
SW102#**show spanning-tree vlan 2001**

VLAN2001

Spanning tree enabled protocol **rstp**

Root ID	Priority	2001
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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai

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E-mail: support@wolf-lab.com

Address	5000.0011.0000
Cost	3
Port	66 (Port-channel3)
Hello Time	2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID	Priority	6097 (priority 4096 sys-id-ext 2001)
	Address	5000.0012.0000
	Hello Time	2 sec Max Age 20 sec Forward Delay 15 sec
	Aging Time	300 sec

Interface	Role	Sts	Cost	Prio.Nbr	Type
-----------	------	-----	------	----------	------

Po2	Desg	FWD	3	128.65	P2p
Po3	Root	FWD	3	128.66	P2p

SW102#

SW102#**show spanning-tree interface po2 active detail**

Port 65 (Port-channel2) of VLAN0001 is designated forwarding

Port path cost 3, Port priority 128, Port Identifier 128.65.

Designated root has priority 32769, address 5000.0011.0000

Designated bridge has priority 32769, address 5000.0012.0000

Designated port id is 128.65, designated path cost 3

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

Link type is point-to-point by default

Root guard is enabled on the port

BPDU: sent 711, received 4

Port 65 (Port-channel2) of VLAN2000 is designated forwarding

Port path cost 3, Port priority 128, Port Identifier 128.65.

Designated root has priority 2000, address 5000.0011.0000

Designated bridge has priority 6096, address 5000.0012.0000

Designated port id is 128.65, designated path cost 3

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

Link type is point-to-point by default

Root guard is enabled on the port

BPDU: sent 711, received 4

Port 65 (Port-channel2) of VLAN2001 is designated forwarding

Port path cost 3, Port priority 128, Port Identifier 128.65.

Designated root has priority 2001, address 5000.0011.0000



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai

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E-mail: support@wolf-lab.com

Designated bridge has priority 6097, address 5000.0012.0000

Designated port id is 128.65, designated path cost 3

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

Link type is point-to-point by default

Root guard is enabled on the port

BPDU: sent 711, received 4

SW102#

SW110:

SW110#**show etherchannel summary**

Flags: D - down P - bundled in port-channel

I - stand-alone S - suspended

H - Hot-standby (LACP only)

R - Layer3 S - Layer2

U - in use N - not in use, no aggregation

f - failed to allocate aggregator

M - not in use, minimum links not met

m - not in use, port not aggregated due to minimum links not met

u - unsuitable for bundling

w - waiting to be aggregated

d - default port

A - formed by Auto LAG

Number of channel-groups in use: 2

Number of aggregators: 2

Group	Port-channel	Protocol	Ports
1	Po1(SU)	LACP	Gi1/0(P)
2	Po2(SU)	LACP	Gi1/2(P) Gi1/3(P)

1	Po1(SU)	LACP	Gi1/0(P)
2	Po2(SU)	LACP	Gi1/2(P) Gi1/3(P)

SW110#

SW110#**show vlan brief**

VLAN Name	Status	Ports
<hr/>		
1 default	active	Gi0/2, Gi0/3
1002 fddi-default	act/unsup	
1003 token-ring-default	act/unsup	



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1004 fddinet-default	act/unsup
1005 trnet-default	act/unsup
2000 VLAN2000	active Gi0/0
2001 VLAN2001	active Gi0/1

SW110#

SW110#**show interface trunk**

Port	Mode	Encapsulation	Status	Native vlan
Po1	on	802.1q	trunking	1
Po2	on	802.1q	trunking	1

Port Vlans allowed on trunk

Po1	1,2000-2001
Po2	1,2000-2001

Port Vlans allowed and active in management domain

Po1	1,2000-2001
Po2	1,2000-2001

Port Vlans in spanning tree forwarding state and not pruned

Po1	1,2000-2001
Po2	none

SW110#

SW110#**show spanning-tree summary**

Switch is in rapid-pvst mode

Root bridge for: none

Extended system ID	is enabled
Portfast Default	is edge
Portfast Edge BPDU Guard Default	is disabled
Portfast Edge BPDU Filter Default	is disabled
Loopguard Default	is disabled
PVST Simulation Default	is enabled but inactive in rapid-pvst mode
Bridge Assurance	is enabled
EtherChannel misconfig guard	is enabled
Configured Pathcost method used is short	
UplinkFast	is disabled
BackboneFast	is disabled

Name Blocking Listening Learning Forwarding STP Active

VLAN0001	1	0	0	3	4
VLAN2000	1	0	0	2	3
VLAN2001	1	0	0	2	3



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3 vlans 3 0 0 7 10

SW110#

SW110#**show spanning-tree vlan 2000**

VLAN2000

Spanning tree enabled protocol rstp

Root ID	Priority	2000
Address	5000.0011.0000	
Cost	3	
Port	65 (Port-channel1)	
Hello Time	2 sec	Max Age 20 sec Forward Delay 15 sec

Bridge ID	Priority	34768 (priority 32768 sys-id-ext 2000)
Address	5000.0013.0000	
Hello Time	2 sec	Max Age 20 sec Forward Delay 15 sec
Aging Time	300 sec	

Interface	Role	Sts	Cost	Prio.Nbr	Type
Gi0/0	Desg	FWD	4	128.1	P2p Edge
Po1	Root	FWD	3	128.65	P2p
Po2	Altn	BLK	3	128.66	P2p

SW110#

SW110#**show spanning-tree vlan 2001**

VLAN2001

Spanning tree enabled protocol rstp

Root ID	Priority	2001
Address	5000.0011.0000	
Cost	3	
Port	65 (Port-channel1)	
Hello Time	2 sec	Max Age 20 sec Forward Delay 15 sec

Bridge ID	Priority	34769 (priority 32768 sys-id-ext 2001)
Address	5000.0013.0000	
Hello Time	2 sec	Max Age 20 sec Forward Delay 15 sec
Aging Time	300 sec	

Interface	Role	Sts	Cost	Prio.Nbr	Type
-----------	------	-----	------	----------	------



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Gi0/1	Desg	FWD 4	128.2	P2p Edge
Po1	Root	FWD 3	128.65	P2p
Po2	Altn	BLK 3	128.66	P2p

SW110#

1.4 Configure Network Services

Ensure that network services are configured at Headquarters according to the following table.

VLAN	Subnet	Default Gateway	DHCP Server
2000	10.1.100.0/24	10.1.100.1	10.2.255.211
2001	10.1.101.0/24	10.1.101.1	10.2.255.211

Ensure that first-hop gateways for these VLANs are configured according to the following requirements:

- Use a protocol that sends Hello messages by using a multicast address of 224.0.0.102 and supports up to 4,096 groups.
- Group numbers for each VLAN must match the respective VLAN ID.
- SW101 must be active and have a priority of 10 above the default.
- SW102 must be standby and have the default priority.
- Both first-hop gateway switches must transition to active if their priority becomes superior.
- Both first-hop gateway switches must generate ARPs for the VLAN by using the MAC address of their respective interfaces.
- DHCP requests received by both first-hop gateway switches must have the circuit identifier added automatically to the message.

Solution:

SW101:

```
SW101(config)#ip dhcp relay information trust-all
SW101(config-if)#ip dhcp relay information option
SW101(config-if)#interface vlan 2000
SW101(config-if)#standby version 2
SW101(config-if)#standby use-bia
SW101(config-if)#standby 2000 ip 10.1.100.1
SW101(config-if)#standby 2000 priority 110
SW101(config-if)#standby 2000 preempt
```



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```
SW101(config-if)#ip helper-address 10.2.255.211
SW101(config-if)#no shutdown
SW101(config-if)#exit
SW101(config)#interface vlan 2001
SW101(config-if)#standby version 2
SW101(config-if)#standby use-bia
SW101(config-if)#standby 2001 ip 10.1.101.1
SW101(config-if)#standby 2001 priority 110
SW101(config-if)#standby 2001 preempt
SW101(config-if)#ip helper-address 10.2.255.211
SW101(config-if)#no shutdown
SW101(config-if)#exit
SW101(config)#

```

SW102:

```
SW102(config)#ip dhcp relay information trust-all
SW102(config)#ip dhcp relay information option
SW102(config)#interface Vlan2000
SW102(config-if)#standby version 2
SW102(config-if)#standby use-bia
SW102(config-if)#standby 2000 ip 10.1.100.1
SW102(config-if)#standby 2000 preempt
SW102(config-if)#ip helper-address 10.2.255.211
SW102(config-if)#no shutdown
SW102(config-if)#exit
SW102(config)#interface Vlan2001
SW102(config-if)#standby use-bia
SW102(config-if)#standby version 2
SW102(config-if)#standby 2001 ip 10.1.101.1
SW102(config-if)#standby 2001 preempt
SW102(config-if)#ip helper-address 10.2.255.211
SW102(config-if)#no shutdown
SW102(config-if)#exit
SW102(config)#

```



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Verify:

SW101:

SW101#**show standby brief**

P indicates configured to preempt.

Interface	Grp	Pri	P State	Active	Standby	Virtual IP
VI2000		2000	110 P	Active	local	10.1.100.3
VI2001		2001	110 P	Active	local	10.1.101.3

SW101#

SW101#**show standby vlan 2000**

Vlan2000 - Group 2000 (version 2)

State is Active

2 state changes, last state change 00:05:27

Virtual IP address is 10.1.100.1

Active virtual MAC address is 5000.0011.87d0 (MAC In Use)

Local virtual MAC address is 5000.0011.87d0 (bia)

Hello time 3 sec, hold time 10 sec

Next hello sent in 2.160 secs

Preemption enabled

Active router is local

Standby router is 10.1.100.3, priority 100 (expires in 9.648 sec)

Priority 110 (configured 110)

Group name is "hsrp-VI2000-2000" (default)

SW101#

SW101#**show standby vlan 2001**

Vlan2001 - Group 2001 (version 2)

State is Active

2 state changes, last state change 00:05:28

Virtual IP address is 10.1.101.1

Active virtual MAC address is 5000.0011.87d1 (MAC In Use)

Local virtual MAC address is 5000.0011.87d1 (bia)

Hello time 3 sec, hold time 10 sec

Next hello sent in 2.256 secs

Preemption enabled

Active router is local

Standby router is 10.1.101.3, priority 100 (expires in 9.600 sec)

Priority 110 (configured 110)

Group name is "hsrp-VI2001-2001" (default)

SW101#

SW101#**show ip helper-address**

Interface	Helper-Address	VPN VRG Name
-----------	----------------	--------------

VRG State



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Vlan2000	10.2.255.211	0	None	Unknown
Vlan2001	10.2.255.211	0	None	Unknown

SW101#

SW102:

SW102#**show standby brief**

P indicates configured to preempt.

Interface	Grp	Pri	P State	Active	Standby	Virtual IP	
VI2000	2000	100	P	Standby	10.1.100.2	local	10.1.100.1
VI2001	2001	100	P	Standby	10.1.101.2	local	10.1.101.1

SW102#

SW102#**show standby vlan 2000**

Vlan2000 - Group 2000 (version 2)

State is Standby

1 state change, last state change 00:05:27

Virtual IP address is 10.1.100.1

Active virtual MAC address is 5000.0011.87d0 (MAC Not In Use)

Local virtual MAC address is 5000.0012.87d0 (bia)

Hello time 3 sec, hold time 10 sec

Next hello sent in 0.016 secs

Preemption enabled

Active router is 10.1.100.2, priority 110 (expires in 11.008 sec)

Standby router is local

Priority 100 (default 100)

Group name is "hsrp-VI2000-2000" (default)

SW102#

SW102#**show standby vlan 2001**

Vlan2001 - Group 2001 (version 2)

State is Standby

1 state change, last state change 00:05:32

Virtual IP address is 10.1.101.1

Active virtual MAC address is 5000.0011.87d1 (MAC Not In Use)

Local virtual MAC address is 5000.0012.87d1 (bia)

Hello time 3 sec, hold time 10 sec

Next hello sent in 1.280 secs

Preemption enabled

Active router is 10.1.101.2, priority 110 (expires in 8.896 sec)

Standby router is local

Priority 100 (default 100)

Group name is "hsrp-VI2001-2001" (default)

SW102#

SW102#**show ip helper-address**



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Interface	Helper-Address	VPN	VRG Name	VRG State
Vlan2000	10.2.255.211	0	None	Unknown
Vlan2001	10.2.255.211	0	None	Unknown
SW102#				

1.5 Intra-Site Routing (DC-HQ)

Ensure that OSPF is configured for IPv4 Intra-site routing between all Layer 3 non-SD-WAN routers at Headquarters and data center sites according to the following requirements:

- All the OSPF neighbors in the data centers and at Headquarters must be fully established.
- OSPF must be enabled on all interfaces, except for the following.
 - ◆ R23 - GE4
 - ◆ R24 - GE4
 - ◆ R21 - GE1
 - ◆ R22 - GE1
 - ◆ R11 - GE0/0
 - ◆ R12 - GE0/0

Solution:

SW101 & SW102:

```
SW10x(config)#interface range Vlan2000-2001  
SW10x(config-if-range)#ip ospf 1 area 0  
SW10x(config-if-range)#exit  
SW10x(config)#+
```

R11 & R12:

```
R1x(config)#interface range g0/1-3,lo0  
R1x(config-if-range)#ip ospf 1 area 0  
R1x(config-if-range)#exit  
R1x(config)#+
```

SW201 & SW202:

```
SW20x(config)#router ospf 1  
SW20x(config-router)#no passive-interface g1/2  
SW20x(config-router)#exit  
SW20x(config)#interface Vlan3999  
SW20x(config-if)#no shutdown
```



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```
SW20x(config-if)#exit  
SW20x(config)#interface Vlan4000  
SW20x(config-if)#no shutdown  
SW20x(config-if)#exit  
SW20x(config)#+
```

R21 & R22:

```
R2x(config)#interface range g2-4,lo0  
R2x(config-if-range)#ip ospf 1 area 0  
R2x(config-if-range)#exit  
R2x(config)#+
```

R23:

```
R23(config)#router ospf 1  
R23(config-router)#router-id 10.2.255.23  
R23(config-router)#exit  
R23(config)#interface range g2-3,lo0  
R23(config-if-range)#ip ospf 1 area 0  
R23(config-if-range)#exit  
R23(config)#+
```

R24:

```
R24(config)#router ospf 1  
R24(config-router)#router-id 10.2.255.24  
R24(config-router)#exit  
R24(config)#interface range g2-3,lo0  
R24(config-if-range)#ip ospf 1 area 0  
R24(config-if-range)#exit  
R24(config)#+
```

cEdge21:

User Access Verification

Username: **admin**

Password: **CCIE!nfr4**

```
cEdge21#  
cEdge21#config-transaction  
cEdge21(config)# sdwan  
cEdge21(config-sdwan)# interface GigabitEthernet2 //Intf name cannot be abbreviated! (case sensitive)  
cEdge21(config-interface-GigabitEthernet2)# tunnel-interface  
cEdge21(config-tunnel-interface)# allow-service ospf  
cEdge21(config-tunnel-interface)# exit
```



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```
cEdge21(config-interface-GigabitEthernet2)# exit
cEdge21(config-sdwan)# interface GigabitEthernet3 //Intf name cannot be abbreviated! (case sensitive)
cEdge21(config-interface-GigabitEthernet3)# tunnel-interface
cEdge21(config-tunnel-interface)# allow-service ospf
cEdge21(config-tunnel-interface)# exit
cEdge21(config-interface-GigabitEthernet3)# commit
Commit complete.
cEdge21(config-interface-GigabitEthernet3)# end
cEdge21#
```

cEdge22:

User Access Verification

Username: admin

Password: CCIE!nfr4

```
cEdge22#
cEdge22#config-transaction
cEdge22(config)# sdwan
cEdge22(config-sdwan)# interface GigabitEthernet2 //Intf name cannot be abbreviated! (case sensitive)
cEdge22(config-interface-GigabitEthernet2)# tunnel-interface
cEdge22(config-tunnel-interface)# allow-service ospf
cEdge22(config-tunnel-interface)# exit
cEdge22(config-interface-GigabitEthernet2)# exit
cEdge22(config-sdwan)# interface GigabitEthernet3 //Intf name cannot be abbreviated! (case sensitive)
cEdge22(config-interface-GigabitEthernet3)# tunnel-interface
cEdge22(config-tunnel-interface)# allow-service ospf
cEdge22(config-tunnel-interface)# exit
cEdge22(config-interface-GigabitEthernet3)# commit
Commit complete.
cEdge22(config-interface-GigabitEthernet3)# end
cEdge22#
```



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Verify:

SW101:

SW101#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.255.102	1	FULL/DR	00:00:31	10.1.101.3	Vlan2001
10.1.255.102	1	FULL/DR	00:00:34	10.1.100.3	Vlan2000
10.2.255.201	1	FULL/BDR	00:00:35	10.2.241.1	GigabitEthernet0/2
10.1.255.12	1	FULL/BDR	00:00:39	10.1.12.1	GigabitEthernet0/1
10.1.255.11	1	FULL/BDR	00:00:39	10.1.10.1	GigabitEthernet0/0

SW101#

SW102:

SW102#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.255.101	1	FULL/BDR	00:00:31	10.1.100.2	Vlan2000
10.1.255.101	1	FULL/BDR	00:00:33	10.1.101.2	Vlan2001
10.2.255.202	1	FULL/BDR	00:00:38	10.2.242.1	GigabitEthernet0/2
10.1.255.11	1	FULL/BDR	00:00:32	10.1.13.1	GigabitEthernet0/1
10.1.255.12	1	FULL/BDR	00:00:33	10.1.11.1	GigabitEthernet0/0

SW102#

R11:

R11#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.255.101	1	FULL/DR	00:00:38	10.1.10.2	GigabitEthernet0/3
10.1.255.102	1	FULL/DR	00:00:39	10.1.13.2	GigabitEthernet0/2
10.1.255.12	1	FULL/DR	00:00:37	10.1.99.2	GigabitEthernet0/1

R11#

R12:

R12#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.255.102	1	FULL/DR	00:00:34	10.1.11.2	GigabitEthernet0/3
10.1.255.101	1	FULL/DR	00:00:32	10.1.12.2	GigabitEthernet0/2
10.1.255.11	1	FULL/BDR	00:00:33	10.1.99.1	GigabitEthernet0/1

R12#



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E-mail: support@wolf-lab.com

SW201:

SW201#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.255.101	1	FULL/DR	00:00:39	10.2.241.2	GigabitEthernet1/2
10.2.202.1	1	FULL/BDR	00:00:38	10.2.201.1	Vlan4000
10.2.202.2	1	FULL/DROTHER	00:00:37	10.2.201.2	Vlan4000
1.99.2.1	1	FULL/BDR	00:00:34	10.2.201.9	Vlan3999
1.99.2.2	1	FULL/DR	00:00:38	10.2.201.10	Vlan3999
10.2.255.211	1	FULL/DR	00:00:36	10.2.20.2	GigabitEthernet1/1
10.2.255.212	1	FULL/DR	00:00:38	10.2.23.2	GigabitEthernet1/0
10.2.255.202	1	FULL/DR	00:00:38	10.2.109.2	GigabitEthernet0/3
10.2.255.22	1	FULL/BDR	00:00:38	10.2.12.1	GigabitEthernet0/1
10.2.255.21	1	FULL/BDR	00:00:38	10.2.10.1	GigabitEthernet0/0

SW201#

SW202:

SW202#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.255.102	1	FULL/DR	00:00:37	10.2.242.2	GigabitEthernet1/2
10.2.202.1	1	FULL/DROTHER	00:00:37	10.2.202.1	Vlan4000
10.2.202.2	1	FULL/BDR	00:00:34	10.2.202.2	Vlan4000
1.99.2.1	1	FULL/BDR	00:00:36	10.2.202.9	Vlan3999
1.99.2.2	1	FULL/DR	00:00:32	10.2.202.10	Vlan3999
10.2.255.212	1	FULL/DR	00:00:33	10.2.21.2	GigabitEthernet1/1
10.2.255.211	1	FULL/DR	00:00:31	10.2.22.2	GigabitEthernet1/0
10.2.255.201	1	FULL/BDR	00:00:39	10.2.109.1	GigabitEthernet0/3
10.2.255.21	1	FULL/BDR	00:00:34	10.2.13.1	GigabitEthernet0/1
10.2.255.22	1	FULL/BDR	00:00:33	10.2.11.1	GigabitEthernet0/0

SW202#

SW211:

SW211#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.2.255.24	1	FULL/BDR	00:00:31	10.2.114.1	GigabitEthernet1/0
10.2.255.23	1	FULL/BDR	00:00:39	10.2.115.1	GigabitEthernet0/3
10.2.255.212	1	FULL/DR	00:00:36	10.2.119.2	GigabitEthernet0/2
10.2.255.202	1	FULL/BDR	00:00:36	10.2.22.1	GigabitEthernet0/1
10.2.255.201	1	FULL/BDR	00:00:33	10.2.20.1	GigabitEthernet0/0

SW211#



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E-mail: support@wolf-lab.com

SW212:

SW212#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.2.255.24	1	FULL/BDR	00:00:38	10.2.214.1	GigabitEthernet1/0
10.2.255.23	1	FULL/BDR	00:00:38	10.2.215.1	GigabitEthernet0/3
10.2.255.211	1	FULL/BDR	00:00:37	10.2.119.1	GigabitEthernet0/2
10.2.255.201	1	FULL/BDR	00:00:31	10.2.23.1	GigabitEthernet0/1
10.2.255.202	1	FULL/BDR	00:00:38	10.2.21.1	GigabitEthernet0/0

SW212#

R21:

R21#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.2.255.201	1	FULL/DR	00:00:35	10.2.10.2	GigabitEthernet4
10.2.255.202	1	FULL/DR	00:00:38	10.2.13.2	GigabitEthernet3
10.2.255.22	1	FULL/BDR	00:00:36	10.2.99.2	GigabitEthernet2

R21#

R22:

R22#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.2.255.21	1	FULL/DR	00:00:38	10.2.99.1	GigabitEthernet2
10.2.255.201	1	FULL/DR	00:00:38	10.2.12.2	GigabitEthernet3
10.2.255.202	1	FULL/DR	00:00:32	10.2.11.2	GigabitEthernet4

R22#

R23:

R23#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.2.255.212	1	FULL/DR	00:00:32	10.2.215.2	GigabitEthernet3
10.2.255.211	1	FULL/DR	00:00:38	10.2.115.2	GigabitEthernet2

R23#



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E-mail: support@wolf-lab.com

R24:

R24#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.2.255.211	1	FULL/DR	00:00:34	10.2.114.2	GigabitEthernet2
10.2.255.212	1	FULL/DR	00:00:37	10.2.214.2	GigabitEthernet3

R24#

cEdge21:

cEdge21#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.2.202.2	1	FULL/BDR	00:00:31	10.2.202.2	GigabitEthernet3
10.2.255.202	1	FULL/DR	00:00:30	10.2.202.3	GigabitEthernet3
10.2.202.2	1	FULL/DROTHER	00:00:36	10.2.201.2	GigabitEthernet2
10.2.255.201	1	FULL/DR	00:00:32	10.2.201.3	GigabitEthernet2
1.99.2.2	1	FULL/DR	00:00:32	10.2.202.10	GigabitEthernet3.3999
10.2.255.202	1	FULL/DROTHER	00:00:37	10.2.202.11	GigabitEthernet3.3999
1.99.2.2	1	FULL/DR	00:00:37	10.2.201.10	GigabitEthernet2.3999
10.2.255.201	1	FULL/DROTHER	00:00:33	10.2.201.11	GigabitEthernet2.3999

cEdge21#

cEdge22:

cEdge22#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.2.202.1	1	FULL/DROTHER	00:00:33	10.2.202.1	GigabitEthernet3
10.2.255.202	1	FULL/DR	00:00:39	10.2.202.3	GigabitEthernet3
10.2.202.1	1	FULL/BDR	00:00:38	10.2.201.1	GigabitEthernet2
10.2.255.201	1	FULL/DR	00:00:39	10.2.201.3	GigabitEthernet2
1.99.2.1	1	FULL/BDR	00:00:32	10.2.202.9	GigabitEthernet3.3999
10.2.255.202	1	FULL/DROTHER	00:00:36	10.2.202.11	GigabitEthernet3.3999
1.99.2.1	1	FULL/BDR	00:00:34	10.2.201.9	GigabitEthernet2.3999
10.2.255.201	1	FULL/DROTHER	00:00:31	10.2.201.11	GigabitEthernet2.3999

cEdge22#



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E-mail: support@wolf-lab.com

1.6 Intra-Site Routing (BR3)

Ensure the Branch #3 is configured with IGP to enable route propagation from the LAN into Xanriers WAN. The solution must meet the following requirements:

- Branch #3 must use an EIGRP named mode by using a process named ccie and the autonomous system number 65006.
- Branch #3 must use EIGRP MD5 authentication for all LAN-facing peering.
- A key chain CCIE_MD5 must be used to complete this task.
 - ◆ String CCIE!nfr4
- All LAN subnets must advertise to EIGRP
- Do not use redistribution to achieve this task.
- Use a single command to advertise all subnets.

Solution:

R61:

```
R61(config)#key chain CCIE_MD5
R61(config-keychain)#key 1
R61(config-keychain-key)#key-string CCIE!nfr4
R61(config-keychain-key)#exit
R61(config-keychain)#exit
R61(config)#router eigrp ccie
R61(config-router)#address-family ipv4 unicast autonomous-system 65006
R61(config-router-af)#network 10.0.0.0
R61(config-router-af)#af-interface g0/1
R61(config-router-af-interface)#authentication mode md5
R61(config-router-af-interface)#authentication key-chain CCIE_MD5
R61(config-router-af-interface)#no passive-interface
R61(config-router-af-interface)#exit
R61(config-router-af)#af-interface g0/2
R61(config-router-af-interface)#authentication mode md5
R61(config-router-af-interface)#authentication key-chain CCIE_MD5
R61(config-router-af-interface)#no passive-interface
R61(config-router-af-interface)#exit
R61(config-router-af)#af-interface g0/3
R61(config-router-af-interface)#authentication mode md5
R61(config-router-af-interface)#authentication key-chain CCIE_MD5
R61(config-router-af-interface)#no passive-interface
```



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E-mail: support@wolf-lab.com

R61(config-router-af-interface)#**exit**

R61(config-router-af)#**exit**

R61(config-router)#**exit**

R61(config)#

R62:

R62(config)#**key chain CCIE_MD5**

R62(config-keychain)#**key 1**

R62(config-keychain-key)#**key-string CCIE!nfr4**

R62(config-keychain-key)#**exit**

R62(config-keychain)#**exit**

R62(config)#

SW601 & SW602:

SW60x(config)#**key chain CCIE_MD5**

SW60x(config-keychain)#**key 1**

SW60x(config-keychain-key)#**key-string CCIE!nfr4**

SW60x(config-keychain-key)#**exit**

SW60x(config-keychain)#**exit**

SW60x(config)#**router eigrp ccie**

SW60x(config-router)#**address-family ipv4 unicast autonomous-system 65006**

SW60x(config-router-af)#**network 10.0.0.0**

SW60x(config-router-af)#**af-interface default**

SW60x(config-router-af-interface)#**passive-interface**

SW60x(config-router-af-interface)#**exit**

SW60x(config-router-af)#**af-interface g0/0**

SW60x(config-router-af-interface)#**authentication mode md5**

SW60x(config-router-af-interface)#**authentication key-chain CCIE_MD5**

SW60x(config-router-af-interface)#**no passive-interface**

SW60x(config-router-af-interface)#**exit**

SW60x(config-router-af)#**af-interface g0/1**

SW60x(config-router-af-interface)#**authentication mode md5**

SW60x(config-router-af-interface)#**authentication key-chain CCIE_MD5**

SW60x(config-router-af-interface)#**no passive-interface**

SW60x(config-router-af-interface)#**exit**

SW60x(config-router-af)#**af-interface g0/2**

SW60x(config-router-af-interface)#**authentication mode md5**

SW60x(config-router-af-interface)#**authentication key-chain CCIE_MD5**

SW60x(config-router-af-interface)#**no passive-interface**

SW60x(config-router-af-interface)#**exit**

SW60x(config-router)#**exit**

SW60x(config)#



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E-mail: support@wolf-lab.com

Verify:

R61:

R61#show ip eigrp neighbors

EIGRP-IPv4 VR(ccie) Address-Family Neighbors for AS(65006)

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q	Seq Cnt Num
2	10.6.10.2	Gi0/3	12 00:00:02	11	100	0	24
1	10.6.12.2	Gi0/2	12 00:00:02	10	100	0	25
0	10.6.99.2	Gi0/1	13 00:00:06	15	100	0	28

R61#

R61#show key chain

Key-chain CCIE_MD5:

key 1 -- text "CCIE!nfr4"

accept lifetime (always valid) - (always valid) [valid now]

send lifetime (always valid) - (always valid) [valid now]

R61#

R61#show ip eigrp interface detail

EIGRP-IPv4 VR(ccie) Address-Family Interfaces for AS(65006)

Xmit Queue		PeerQ	Mean	Pacing Time	Multicast	Pending	
Interface	Peers	Un/Reliable	Un/Reliable	SRTT	Un/Reliable	Flow Timer	Routes
Gi0/1	1	0/0	0/0	660	0/0	3288	0

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 6/0

Hello's sent/expedited: 29/1

Un/reliable mcasts: 0/6 Un/reliable ucasts: 7/2

Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0

Retransmissions sent: 1 Out-of-sequence rcvd: 0

Topology-ids on interface - 0

Authentication mode is md5, key-chain is "CCIE_MD5"

Topologies advertised on this interface: base

Topologies not advertised on this interface:

Gi0/2	1	0/0	0/0	20	0/0	96	0
-------	---	-----	-----	----	-----	----	---

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 5/0

Hello's sent/expedited: 30/1



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Un/reliable mcasts: 0/5 Un/reliable ucasts: 2/2
Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0
Retransmissions sent: 1 Out-of-sequence rcvd: 0
Topology-ids on interface - 0
Authentication mode is md5, key-chain is "CCIE_MD5"
Topologies advertised on this interface: base
Topologies not advertised on this interface:

Gi0/3 1 0/0 0/0 11 0/0 50 0

Hello-interval is 5, Hold-time is 15
Split-horizon is enabled
Next xmit serial <none>
Packetized sent/expedited: 5/0
Hello's sent/expedited: 29/1
Un/reliable mcasts: 0/5 Un/reliable ucasts: 3/2
Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0
Retransmissions sent: 1 Out-of-sequence rcvd: 0
Topology-ids on interface - 0
Authentication mode is md5, key-chain is "CCIE_MD5"
Topologies advertised on this interface: base
Topologies not advertised on this interface:

R61#

R61#**show ip route eigrp**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 15 subnets, 3 masks
D 10.6.11.0/30 [90/15360] via 10.6.99.2, 00:01:21, GigabitEthernet0/1
[90/15360] via 10.6.12.2, 00:01:21, GigabitEthernet0/2
D 10.6.13.0/30 [90/15360] via 10.6.99.2, 00:01:21, GigabitEthernet0/1
[90/15360] via 10.6.10.2, 00:01:21, GigabitEthernet0/3
D 10.6.109.0/30 [90/15360] via 10.6.12.2, 00:01:21, GigabitEthernet0/2
[90/15360] via 10.6.10.2, 00:01:21, GigabitEthernet0/3



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Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District,Shanghai

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E-mail: support@wolf-lab.com

```
D 10.6.255.62/32 [90/10880] via 10.6.99.2, 00:01:21, GigabitEthernet0/1
D 10.6.255.161/32
    [90/10880] via 10.6.10.2, 00:01:21, GigabitEthernet0/3
D 10.6.255.162/32
    [90/10880] via 10.6.12.2, 00:01:21, GigabitEthernet0/2
```

R61#

R62:

R62#**show ip eigrp neighbor**

EIGRP-IPv4 VR(ccie) Address-Family Neighbors for AS(65006)

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q	Seq Cnt Num
0	10.6.99.1	Gi0/1	12	00:02:53	11	100	0 30
2	10.6.11.2	Gi0/3	14	00:09:24	11	100	0 23
1	10.6.13.2	Gi0/2	14	00:09:27	14	100	0 23

R62#

R62#**show key chain**

Key-chain CCIE_MD5:

key 1 -- text "CCIE!nfr4"

accept lifetime (always valid) - (always valid) [valid now]

send lifetime (always valid) - (always valid) [valid now]

R62#

R62#**show ip eigrp interface detail**

EIGRP-IPv4 VR(ccie) Address-Family Interfaces for AS(65006)

Interface	Peers	Xmit Queue Un/Reliable	PeerQ Un/Reliable	Mean SRTT	Pacing Time Un/Reliable	Multicast Flow Timer	Pending Routes
Gi0/1	1	0/0	0/0	11	0/0	50	0

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 9/0

Hello's sent/expedited: 1502/3

Un/reliable mcasts: 0/8 Un/reliable ucasts: 10/3

Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0

Retransmissions sent: 1 Out-of-sequence rcvd: 0

Topology-ids on interface - 0

Authentication mode is md5, key-chain is "CCIE_MD5"

Topologies advertised on this interface: base

Topologies not advertised on this interface:

Gi0/2	1	0/0	0/0	14	0/0	60	0
-------	---	-----	-----	----	-----	----	---

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled



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Next xmit serial <none>
Packetized sent/expedited: 8/0
Hello's sent/expedited: 1501/2
Un/reliable mcasts: 0/8 Un/reliable ucasts: 8/3
Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0
Retransmissions sent: 1 Out-of-sequence rcvd: 0
Topology-ids on interface - 0
Authentication mode is md5, key-chain is "CCIE_MDS"
Topologies advertised on this interface: base
Topologies not advertised on this interface:

Gi0/3 1 0/0 0/0 11 0/0 50 0

Hello-interval is 5, Hold-time is 15
Split-horizon is enabled
Next xmit serial <none>
Packetized sent/expedited: 7/0
Hello's sent/expedited: 1497/2
Un/reliable mcasts: 0/8 Un/reliable ucasts: 7/3
Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 1
Retransmissions sent: 1 Out-of-sequence rcvd: 0
Topology-ids on interface - 0
Authentication mode is md5, key-chain is "CCIE_MDS"
Topologies advertised on this interface: base
Topologies not advertised on this interface:

R62#

R62#show ip route eigrp

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 15 subnets, 3 masks
D 10.6.10.0/30 [90/15360] via 10.6.99.1, 00:01:31, GigabitEthernet0/1
[90/15360] via 10.6.13.2, 00:01:31, GigabitEthernet0/2
D 10.6.12.0/30 [90/15360] via 10.6.99.1, 00:01:31, GigabitEthernet0/1



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E-mail: support@wolf-lab.com

[90/15360] via 10.6.11.2, 00:01:31, GigabitEthernet0/3
D 10.6.109.0/30 [90/15360] via 10.6.13.2, 00:01:31, GigabitEthernet0/2
[90/15360] via 10.6.11.2, 00:01:31, GigabitEthernet0/3
D 10.6.255.61/32 [90/10880] via 10.6.99.1, 00:01:31, GigabitEthernet0/1
D 10.6.255.161/32
[90/10880] via 10.6.13.2, 00:01:31, GigabitEthernet0/2
D 10.6.255.162/32
[90/10880] via 10.6.11.2, 00:01:31, GigabitEthernet0/3
D 10.200.0.0/24
[90/76805120] via 10.6.99.1, 00:01:31, GigabitEthernet0/1
R62#

SW601:

SW601#**show ip eigrp neighbor**

EIGRP-IPv4 VR(ccie) Address-Family Neighbors for AS(65006)

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q	Seq Cnt Num
0	10.6.13.1	Gi0/1	11 00:00:03	9	100	0	39
1	10.6.10.1	Gi0/2	13 00:10:33	11	100	0	33
2	10.6.109.2	Gi0/0	11 00:17:04	11	100	0	27

SW601#

SW601#**show key chain**

Key-chain CCIE_MD5:

key 1 -- text "CCIE!nfr4"

accept lifetime (always valid) - (always valid) [valid now]

send lifetime (always valid) - (always valid) [valid now]

SW601#

SW601#**show ip eigrp interface detail**

EIGRP-IPv4 VR(ccie) Address-Family Interfaces for AS(65006)

Interface	Xmit Queue Peers	PeerQ Un/Reliable	Mean Un/Reliable	Pacing Time SRTT Un/Reliable	Multicast Flow Timer	Pending Routes
Gi0/0	1	0/0	0/0	14 0/0	68	0

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 5/0

Hello's sent/expedited: 192/2

Un/reliable mcasts: 0/6 Un/reliable ucasts: 8/3

Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0

Retransmissions sent: 1 Out-of-sequence rcvd: 0

Topology-ids on interface - 0

Authentication mode is md5, key-chain is "CCIE_MD5"

Topologies advertised on this interface: base



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Topologies not advertised on this interface:

Gi0/1 1 0/0 0/0 427 0/0 2124 0

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 6/1

Hello's sent/expedited: 192/2

Un/reliable mcasts: 0/7 Un/reliable ucasts: 10/3

Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0

Retransmissions sent: 1 Out-of-sequence rcvd: 0

Topology-ids on interface - 0

Authentication mode is md5, key-chain is "CCIE_MD5"

Topologies advertised on this interface: base

Topologies not advertised on this interface:

Gi0/2 1 0/0 0/0 12 0/0 50 0

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 5/0

Hello's sent/expedited: 194/3

Un/reliable mcasts: 0/5 Un/reliable ucasts: 10/4

Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0

Retransmissions sent: 2 Out-of-sequence rcvd: 0

Topology-ids on interface - 0

Authentication mode is md5, key-chain is "CCIE_MD5"

Topologies advertised on this interface: base

Topologies not advertised on this interface:

SW601#

SW601#**show ip route eigrp**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set



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10.0.0.0/8 is variably subnetted, 14 subnets, 3 masks

D 10.6.11.0/30 [90/15360] via 10.6.109.2, 00:02:03, GigabitEthernet0/0
[90/15360] via 10.6.13.1, 00:02:03, GigabitEthernet0/1

D 10.6.12.0/30 [90/15360] via 10.6.109.2, 00:02:03, GigabitEthernet0/0
[90/15360] via 10.6.10.1, 00:02:03, GigabitEthernet0/2

D 10.6.99.0/30 [90/15360] via 10.6.13.1, 00:02:03, GigabitEthernet0/1
[90/15360] via 10.6.10.1, 00:02:03, GigabitEthernet0/2

D 10.6.255.61/32 [90/10880] via 10.6.10.1, 00:02:03, GigabitEthernet0/2

D 10.6.255.62/32 [90/10880] via 10.6.13.1, 00:02:03, GigabitEthernet0/1

D 10.6.255.162/32
[90/10880] via 10.6.109.2, 00:02:03, GigabitEthernet0/0

D 10.200.0.0/24
[90/76805120] via 10.6.10.1, 00:02:03, GigabitEthernet0/2

SW601#

SW602:

SW602#show ip eigrp neighbor

EIGRP-IPv4 VR(ccie) Address-Family Neighbors for AS(65006)

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q	Seq Cnt	Num
2	10.6.11.1	Gi0/2	13 00:00:02	18	108	0	68	
0	10.6.109.1	Gi0/0	12 00:00:09	13	100	0	50	
1	10.6.12.1	Gi0/1	13 00:15:54	6	100	0	40	

SW602#

SW602#show key chain

Key-chain CCIE MD5:

key 1 -- text 'CCIE!nfr4"

accept lifetime (always valid) - (always valid) [valid now]

send lifetime (always valid) - (always valid) [valid now]

SW602#

SW602#show ip eigrp interface detail

EIGRP-IPv4 VR(ccie) Address-Family Interfaces for AS(65006)

Interface	Xmit Queue Peers	PeerQ Un/Reliable	Mean Un/Reliable	Pacing Time Un/Reliable	Multicast Flow Timer	Pending Routes
Gi0/0	1	0/0	0/0	343	0/0	2128

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 7/0

Hello's sent/expedited: 269/2

Un/reliable mcasts: 0/7 Un/reliable ucasts: 12/4

Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District ,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

10.0.0.0/8 is variably subnetted, 14 subnets, 3 masks
D 10.6.11.0/30 [90/15360] via 10.6.109.2, 00:02:03, GigabitEthernet0/0
[90/15360] via 10.6.13.1, 00:02:03, GigabitEthernet0/1
D 10.6.12.0/30 [90/15360] via 10.6.109.2, 00:02:03, GigabitEthernet0/0
[90/15360] via 10.6.10.1, 00:02:03, GigabitEthernet0/2
D 10.6.99.0/30 [90/15360] via 10.6.13.1, 00:02:03, GigabitEthernet0/1
[90/15360] via 10.6.10.1, 00:02:03, GigabitEthernet0/2
D 10.6.255.61/32 [90/10880] via 10.6.10.1, 00:02:03, GigabitEthernet0/2
D 10.6.255.62/32 [90/10880] via 10.6.13.1, 00:02:03, GigabitEthernet0/1
D 10.6.255.162/32
[90/10880] via 10.6.109.2, 00:02:03, GigabitEthernet0/0
D 10.200.0.0/24
[90/76805120] via 10.6.10.1, 00:02:03, GigabitEthernet0/2
SW601#

SW602:

SW602#show ip eigrp neighbor

EIGRP-IPv4 VR(ccie) Address-Family Neighbors for AS(65006)

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q	Seq Cnt	Num
2	10.6.11.1	Gi0/2	13 00:00:02	18	108	0	68	
0	10.6.109.1	Gi0/0	12 00:00:09	13	100	0	50	
1	10.6.12.1	Gi0/1	13 00:15:54	6	100	0	40	

SW602#

SW602#show key chain

Key-chain CCIE_MD5:

key 1 -- text 'CCIE!nfr4'

accept lifetime (always valid) - (always valid) [valid now]

send lifetime (always valid) - (always valid) [valid now]

SW602#

SW602#show ip eigrp interface detail

EIGRP-IPv4 VR(ccie) Address-Family Interfaces for AS(65006)

Interface	Xmit Peers	Queue Un/Reliable	PeerQ Un/Reliable	Mean SRTT	Pacing Un/Reliable	Time Multicast Flow Timer	Pending Routes
Gi0/0	1	0/0	0/0	343	0/0	2128	0

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 7/0

Hello's sent/expedited: 269/2

Un/reliable mcasts: 0/7 Un/reliable ucasts: 12/4

Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0



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E-mail: support@wolf-lab.com

Retransmissions sent: 1 Out-of-sequence rcvd: 0

Topology-ids on interface - 0

Authentication mode is md5, key-chain is "CCIE_MD5"

Topologies advertised on this interface: base

Topologies not advertised on this interface:

Gi0/1

1

0/0

0/0

8

0/0

50

0

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 5/0

Hello's sent/expedited: 271/3

Un/reliable mcasts: 0/5 Un/reliable ucasts: 9/3

Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0

Retransmissions sent: 1 Out-of-sequence rcvd: 0

Topology-ids on interface - 0

Authentication mode is md5, key-chain is "CCIE_MD5"

Topologies advertised on this interface: base

Topologies not advertised on this interface:

Gi0/2

1

0/0

0/0

336

0/0

2076

0

Hello-interval is 5, Hold-time is 15

Split-horizon is enabled

Next xmit serial <none>

Packetized sent/expedited: 6/0

Hello's sent/expedited: 270/2

Un/reliable mcasts: 0/7 Un/reliable ucasts: 14/4

Mcast exceptions: 0 CR packets: 0 ACKs suppressed: 0

Retransmissions sent: 1 Out-of-sequence rcvd: 0

Topology-ids on interface - 0

Authentication mode is md5, key-chain is "CCIE_MD5"

Topologies advertised on this interface: base

Topologies not advertised on this interface:

SW602#

SW602#**show ip route eigrp**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP



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- a - application route
+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

- 10.0.0.0/8 is variably subnetted, 14 subnets, 3 masks
- D 10.6.10.0/30 [90/15360] via 10.6.109.1, 00:03:03, GigabitEthernet0/0
[90/15360] via 10.6.12.1, 00:03:03, GigabitEthernet0/1
- D 10.6.13.0/30 [90/15360] via 10.6.109.1, 00:03:03, GigabitEthernet0/0
[90/15360] via 10.6.11.1, 00:03:03, GigabitEthernet0/2
- D 10.6.99.0/30 [90/15360] via 10.6.12.1, 00:03:03, GigabitEthernet0/1
[90/15360] via 10.6.11.1, 00:03:03, GigabitEthernet0/2
- D 10.6.255.61/32 [90/10880] via 10.6.12.1, 00:03:03, GigabitEthernet0/1
- D 10.6.255.62/32 [90/10880] via 10.6.11.1, 00:03:03, GigabitEthernet0/2
- D 10.6.255.161/32
[90/10880] via 10.6.109.1, 00:03:03, GigabitEthernet0/0
- D 10.200.0.0/24
[90/76805120] via 10.6.12.1, 00:03:03, GigabitEthernet0/1

SW602#

Global CCIE training and certification leader

1.7 MPLS Underlay

Configure the Global SP #1 to meet the following requirements:

- Verify that OSPF is configured on router R1, R2, R3, R4, R5 and R6. And that neighbourships are formed on all the internal-facing links of Global SP #1.
- Ensure that label switching is configured for the Global SP #1 core.
- All the routers must use loopback0 as the LDP router ID.
- There must be no type-2 LSAs in any of the router's LSDBs at Global SP #1.
- The LSAs in Global SP #1 must not contain information about any Transit links.

Solution:

R1 & R2:

```
Rx(config)#router ospf 1
Rx(config-router)#prefix-suppression
Rx(config-router)#mpls ldp autoconfig area 0
Rx(config-router)#exit
Rx(config)#mpls ldp router-id lo0 force
```



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```
Rx(config)#interface lo0
Rx(config-if-range)#ip ospf 1 area 0
Rx(config-if-range)#exit
Rx(config)#interface range g0/0-2
Rx(config-if-range)#ip ospf network point-to-point
Rx(config-if-range)#ip ospf 1 area 0
Rx(config-if-range)#mpls ip
Rx(config-if-range)#no shutdown
Rx(config-if-range)#exit
Rx(config)#

```

R3 & R5 & R6:

```
Rx(config)#router ospf 1
Rx(config-router)#prefix-suppression
Rx(config-router)#mpls ldp autoconfig area 0
Rx(config-router)#exit
Rx(config)#mpls ldp router-id lo0 force
Rx(config)#interface lo0
Rx(config-if)#ip ospf 1 area 0
Rx(config-if)#exit
Rx(config)#interface g8
Rx(config-if)#ip ospf network point-to-point
Rx(config-if)#ip ospf 1 area 0
Rx(config-if)#mpls ip
Rx(config-if)#no shutdown
Rx(config-if)#exit
Rx(config)#

```

R4:

```
R4(config)#router ospf 1
R4(config-router)#prefix-suppression
R4(config-router)#mpls ldp autoconfig area 0
R4(config-router)#exit
R4(config)#mpls ldp router-id lo0 force
R4(config)#interface lo0
R4(config-if)#ip address 100.255.254.4 255.255.255.255
R4(config-if)#ip ospf 1 area 0
R4(config-if)#exit
R4(config)#interface g8
R4(config-if)#ip ospf network point-to-point
R4(config-if)#ip ospf 1 area 0
R4(config-if)#mpls ip

```



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R4(config-if)#no shutdown

R4(config-if)#exit

R4(config)#



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E-mail: support@wolf-lab.com

Verify:

R1:

R1#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
100.255.254.5	0	FULL/ -	00:00:37	100.0.15.2	GigabitEthernet0/2
100.255.254.3	0	FULL/ -	00:00:32	100.0.13.2	GigabitEthernet0/1
100.255.254.2	0	FULL/ -	00:00:37	100.0.12.2	GigabitEthernet0/0

R1#

R1#**show ip ospf interface brief**

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs F/C
Lo0	1	0	100.255.254.1/32	1	LOOP	0/0
Gi0/2	1	0	100.0.15.1/30	1	P2P	1/1
Gi0/1	1	0	100.0.13.1/30	1	P2P	1/1
Gi0/0	1	0	100.0.12.1/30	1	P2P	1/1

R1#

R1#**show mpls ldp neighbor | i Pe**

Peer LDP Ident: 100.255.254.2:0; Local LDP Ident 100.255.254.1:0

Peer LDP Ident: 100.255.254.3:0; Local LDP Ident 100.255.254.1:0

Peer LDP Ident: 100.255.254.5:0; Local LDP Ident 100.255.254.1:0

R1#

R1#**show ip route ospf**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

100.0.0.0/8 is variably subnetted, 12 subnets, 2 masks

- O 100.255.254.2/32 [110/2] via 100.0.12.2, 00:04:03, GigabitEthernet0/0
- O 100.255.254.3/32 [110/2] via 100.0.13.2, 00:03:38, GigabitEthernet0/1
- O 100.255.254.4/32 [110/3] via 100.0.12.2, 00:03:38, GigabitEthernet0/0
- O 100.255.254.5/32 [110/2] via 100.0.15.2, 00:03:38, GigabitEthernet0/2
- O 100.255.254.6/32 [110/3] via 100.0.12.2, 00:03:28, GigabitEthernet0/0

R1#

R2:

R2#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
100.255.254.6	0	FULL/ -	00:00:38	100.0.26.2	GigabitEthernet0/2
100.255.254.4	0	FULL/ -	00:00:35	100.0.24.2	GigabitEthernet0/1
100.255.254.1	0	FULL/ -	00:00:39	100.0.12.1	GigabitEthernet0/0

R2#

R2#show ip ospf interface brief

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs F/C
Lo0	1	0	100.255.254.2/32	1	LOOP	0/0
Gi0/2	1	0	100.0.26.1/30	1	P2P	1/1
Gi0/1	1	0	100.0.24.1/30	1	P2P	1/1
Gi0/0	1	0	100.0.12.2/30	1	P2P	1/1

R2#

R2#show mpls ldp neighbor | i Pe

Peer LDP Ident: 100.255.254.1:0; Local LDP Ident 100.255.254.2:0

Peer LDP Ident: 100.255.254.4:0; Local LDP Ident 100.255.254.2:0

Peer LDP Ident: 100.255.254.6:0; Local LDP Ident 100.255.254.2:0

R2#

R2#show ip route ospf

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

100.0.0.0/8 is variably subnetted, 12 subnets, 2 masks

- 100.255.254.1/32 [110/2] via 100.0.12.1, 00:04:37, GigabitEthernet0/0
- 100.255.254.3/32 [110/3] via 100.0.12.1, 00:04:00, GigabitEthernet0/0
- 100.255.254.4/32 [110/2] via 100.0.24.2, 00:04:10, GigabitEthernet0/1
- 100.255.254.5/32 [110/3] via 100.0.12.1, 00:04:00, GigabitEthernet0/0
- 100.255.254.6/32 [110/2] via 100.0.26.2, 00:04:10, GigabitEthernet0/2

R2#



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District,Shanghai

Website: www.wolf-lab.com

E-mail: support@wolf-lab.com

R3:

R3#**show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
100.255.254.1	0	FULL/ -	00:00:37	100.0.13.1	GigabitEthernet8

R3#

R3#**show ip ospf interface brief**

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs F/C
Lo0	1	0	100.255.254.3/32	1	LOOP	0/0
Gi8	1	0	100.0.13.2/30	1	P2P	1/1

R3#R3#**show mpls ldp neighbor | i Pe**

Peer LDP Ident: 100.255.254.1:0; Local LDP Ident 100.255.254.3:0

R3#

R3#**show ip route ospf**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
H - NHRP, G - NHRP registered, g - NHRP registration summary
o - ODR, P - periodic downloaded static route, I - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR
& - replicated local route overrides by connected

Gateway of last resort is not set

100.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

- O 100.255.254.1/32 [110/2] via 100.0.13.1, 00:04:37, GigabitEthernet8
- O 100.255.254.2/32 [110/3] via 100.0.13.1, 00:04:37, GigabitEthernet8
- O 100.255.254.4/32 [110/4] via 100.0.13.1, 00:04:34, GigabitEthernet8
- O 100.255.254.5/32 [110/3] via 100.0.13.1, 00:04:33, GigabitEthernet8
- O 100.255.254.6/32 [110/4] via 100.0.13.1, 00:04:31, GigabitEthernet8

R3#



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E-mail: support@wolf-lab.com

R4:

R4#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
100.255.254.2	0	FULL/ -	00:00:31	100.0.24.1	GigabitEthernet8

R4#

R4#show ip ospf interface brief

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs F/C
Lo0	1	0	100.255.254.4/32	1	LOOP	0/0
Gi8	1	0	100.0.24.2/30	1	P2P	1/1

R4#

R4#show mpls ldp neighbor | i Pe

Peer LDP Ident: 100.255.254.2:0; Local LDP Ident 100.255.254.4:0

R4#

R4#show ip route ospf

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP

n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA

i - IS-IS, su - IS-IS summary, L1 - IS-IS level -1, L2 - IS-IS level -2

ia - IS-IS inter area, * - candidate default, U - per-user static route

H - NHRP, G - NHRP registered, g - NHRP registration summary

o - ODR, P - periodic downloaded static route, I - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

& - replicated local route overrides by connected

Gateway of last resort is not set

100.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

- O 100.255.254.1/32 [110/3] via 100.0.24.1, 00:05:33, GigabitEthernet8
- O 100.255.254.2/32 [110/2] via 100.0.24.1, 00:05:33, GigabitEthernet8
- O 100.255.254.3/32 [110/4] via 100.0.24.1, 00:05:21, GigabitEthernet8
- O 100.255.254.5/32 [110/4] via 100.0.24.1, 00:05:20, GigabitEthernet8
- O 100.255.254.6/32 [110/3] via 100.0.24.1, 00:05:26, GigabitEthernet8

R4#



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Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd, Xuhui District, Shanghai
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E-mail: support@wolf-lab.com

R5:

R5#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
100.255.254.1	0	FULL/	00:00:34	100.0.15.1	GigabitEthernet8

R5#

R5#show ip ospf interface brief

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs F/C
Lo0	1	0	100.255.254.5/32	1	LOOP	0/0
Gi8	1	0	100.0.15.2/30	1	P2P	1/1

R5#R5#show mpls ldp neighbor | i Pe

Peer LDP Ident: 100.255.254.1:0; Local LDP Ident 100.255.254.5:0

R5#

R5#show ip route ospf

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
H - NHRP, G - NHRP registered, g - NHRP registration summary
o - ODR, P - periodic downloaded static route, I - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from Pfr
& - replicated local route overrides by connected

Gateway of last resort is not set

100.0.0.0/8 is variably subnetted, 10 subnets, 2 masks

- O 100.255.254.1/32 [110/2] via 100.0.15.1, 00:05:20, GigabitEthernet8
- O 100.255.254.2/32 [110/3] via 100.0.15.1, 00:05:20, GigabitEthernet8
- O 100.255.254.3/32 [110/3] via 100.0.15.1, 00:05:20, GigabitEthernet8
- O 100.255.254.4/32 [110/4] via 100.0.15.1, 00:05:20, GigabitEthernet8
- O 100.255.254.6/32 [110/4] via 100.0.15.1, 00:05:18, GigabitEthernet8

R5#



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District ,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

R6:

R6#show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
100.255.254.2	0	FULL/	00:00:36	100.0.26.1	GigabitEthernet8

R6#

R6#show ip ospf interface brief

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs F/C
Lo0	1	0	100.255.254.6/32	1	LOOP	0/0
Gi8	1	0	100.0.26.2/30	1	P2P	1/1

R6#

R6#show mpls ldp neighbor | i Pe

Peer LDP Ident: 100.255.254.2:0; Local LDP Ident 100.255.254.6:0

R6#

R6#show ip route ospf

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
H - NHRP, G - NHRP registered, g - NHRP registration summary
o - ODR, P - periodic downloaded static route, I - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR
& - replicated local route overrides by connected

Gateway of last resort is not set

100.0.0.0/8 is variably subnetted, 10 subnets, 2 masks

- 100.255.254.1/32 [110/3] via 100.0.26.1, 00:05:48, GigabitEthernet8
- 100.255.254.2/32 [110/2] via 100.0.26.1, 00:05:48, GigabitEthernet8
- 100.255.254.3/32 [110/4] via 100.0.26.1, 00:05:42, GigabitEthernet8
- 100.255.254.4/32 [110/3] via 100.0.26.1, 00:05:48, GigabitEthernet8
- 100.255.254.5/32 [110/4] via 100.0.26.1, 00:05:41, GigabitEthernet8

R6#

1.8 MPLS Overlay

Configure Global SP #1 with MPLS and BGP to meet the following requirements:

- Ensure that routers R3, R4, R5 and R6 are provider edge (PE) routers.
 - ◆ The PE routers must exchange VRFv4 routes with each other without using a route reflector.
 - ◆ The PE routers must import and export all Xander's originated routes to the FABD2 VRF routing table.
 - ◆ R3 must have five active BGP peers
- Ensure that routers R1 and R2 are provider (P) routers.
 - ◆ These routers must not run BGP and must be used to switch packets based on labels.
- Ensure all BGP sessions at Global SP #1 are secured using the password CCIE!nfr4

Solution:

R3:

```
R3(config)#vrf definition fabd2
R3(config-vrf)#rd 10000:3
R3(config-vrf)#route-target both 10000:1
R3(config-vrf)#route-target import 10000:4
R3(config-vrf)#address-family ipv4
R3(config-vrf-af)#exit
R3(config-vrf)#exit
R3(config)#interface g1
R3(config-if)#vrf forwarding fabd2
R3(config-if)#ip address 100.3.11.1 255.255.255.252
R3(config-if)#no shutdown
R3(config-if)#exit
R3(config)#interface g2
R3(config-if)#vrf forwarding fabd2
R3(config-if)#ip address 100.3.21.1 255.255.255.252
R3(config-if)#no shutdown
R3(config-if)#exit
R3(config)#router bgp 10000
R3(config-router)#bgp router-id 100.255.254.3
R3(config-router)#no bgp default ipv4-unicast
R3(config-router)#neighbor 100.255.254.4 remote-as 10000
R3(config-router)#neighbor 100.255.254.4 update-source Loopback0
R3(config-router)#neighbor 100.255.254.4 password CCIE!nfr4
```



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```
R3(config-router)#neighbor 100.255.254.5 remote-as 10000
R3(config-router)#neighbor 100.255.254.5 update-source Loopback0
R3(config-router)#neighbor 100.255.254.5 password CC!E!nfr4
R3(config-router)#neighbor 100.255.254.6 remote-as 10000
R3(config-router)#neighbor 100.255.254.6 update-source Loopback0
R3(config-router)#neighbor 100.255.254.6 password CC!E!nfr4
R3(config-router)#address-family vpng4
R3(config-router-af)#neighbor 100.255.254.4 activate
R3(config-router-af)#neighbor 100.255.254.5 activate
R3(config-router-af)#neighbor 100.255.254.6 activate
R3(config-router-af)#exit
R3(config-router)#address-family ipv4 vrf fabd2
R3(config-router-af)#redistribute connected
R3(config-router-af)#neighbor 100.3.11.2 remote-as 65001
R3(config-router-af)#neighbor 100.3.21.2 remote-as 65002
R3(config-router-af)#end
R3#clear ip bgp *          <== Very very important !!!
R3#
```

R4:

```
R4(config)#vrf definition fabd2
R4(config-vrf)#route-target import 10000:1
R4(config-vrf)#exit
R4(config)#router bgp 10000
R4(config-router)#neighbor 100.255.254.3 password CC!E!nfr4
R4(config-router)#neighbor 100.255.254.5 password CC!E!nfr4
R4(config-router)#neighbor 100.255.254.6 password CC!E!nfr4
R4(config-router)#end
R4#clear ip bgp *          <== Very very important !!!
```

R5:

```
R5(config)#vrf definition fabd2
R5(config-vrf)#route-target import 10000:4
R5(config-vrf)#exit
R5(config)#router bgp 10000
R5(config-router)#neighbor 100.255.254.3 password CC!E!nfr4
R5(config-router)#neighbor 100.255.254.4 password CC!E!nfr4
R5(config-router)#neighbor 100.255.254.6 password CC!E!nfr4
R5(config-router)#end
R5#clear ip bgp *          <== Very very important !!!
```

R6:

```
R6(config)#vrf definition fabd2
```



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```
R6(config-vrf)#route-target import 10000:4  
R6(config-vrf)#exit  
R6(config)#router bgp 10000  
R6(config-router)#neighbor 100.255.254.3 password CCIE!nfr4  
R6(config-router)#neighbor 100.255.254.4 password CCIE!nfr4  
R6(config-router)#neighbor 100.255.254.5 password CCIE!nfr4  
R6(config-router)#end  
R6#clear ip bgp *           <== Very very important !!!
```

Verify:

R1:

```
R1#show ip bgp all summary  
% BGP not active
```

R1#

R2:

```
R2#show ip bgp all summary  
% BGP not active
```

R2#

WOLF-LAB
CCIE Training Center



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R3:

R3#**show ip bgp vpng4 all summary**

BGP router identifier 100.255.254.3, local AS number 10000
BGP table version is 1, main routing table version 1
4 network entries using 1024 bytes of memory
4 path entries using 544 bytes of memory
7/0 BGP path/bestpath attribute entries using 2184 bytes of memory
2 BGP AS-PATH entries using 48 bytes of memory
1 BGP extended community entries using 24 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 3824 total bytes of memory
BGP activity 10/6 prefixes, 10/6 paths, scan interval 60 secs
6 networks peaked at 22:23:58 Mar 30 2024 BJS (00:01:17.779 ago)

Neighbor	V	AS	MsgRcvd	MsgSent	To/Ver	InQ	OutQ	Up/Down	State/PfxRcd
100.3.11.2	4	65001	4	2	1	0	0	00:00:45	0
100.3.21.2	4	65002	6	2	1	0	0	00:00:46	2
100.255.254.4	4	10000	2	2	1	0	0	00:00:44	0
100.255.254.5	4	10000	2	2	1	0	0	00:00:41	0
100.255.254.6	4	10000	2	2	1	0	0	00:00:45	0

R3#

R3#**show ip bgp vpng4 all**

BGP table version is 17, local router ID is 100.255.254.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
x best-external, a additional-path, c RIB-compressed,
t secondary path, L long-lived-stale,

Origin codes: i - IGP, e - EGP, ? - incomplete

RPKI validation codes: V valid, I invalid, N Not found

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 10000:3 (default for vrf fabd2)					
*> 10.2.255.21/32	100.3.21.2	0		0	65002 i
*> 10.2.255.22/32	100.3.21.2			0	65002 i
*>i 10.6.255.61/32	100.255.254.5	0	100	0	65006 i
*>i 10.6.255.62/32	100.255.254.6	0	100	0	65006 i
*>i 10.7.255.70/32	100.255.254.6	0	100	0	65007 i
*> 100.3.11.0/30	0.0.0.0	0		32768 ?	
*> 100.3.21.0/30	0.0.0.0	0		32768 ?	
*>i 100.5.61.0/30	100.255.254.5	0	100	0	?
*>i 100.6.62.0/30	100.255.254.6	0	100	0	?



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```
*>i 100.6.70.0/30 100.255.254.6      0 100 0 ?  
Route Distinguisher: 10000:5  
*>i 10.6.255.61/32 100.255.254.5      0 100 0 65006 i  
*>i 100.5.61.0/30 100.255.254.5      0 100 0 ?  
Route Distinguisher: 10000:6  
*>i 10.6.255.62/32 100.255.254.6      0 100 0 65006 i  
*>i 10.7.255.70/32 100.255.254.6      0 100 0 65007 i  
*>i 100.6.62.0/30 100.255.254.6      0 100 0 ?  
*>i 100.6.70.0/30 100.255.254.6      0 100 0 ?
```

R3#

R3#**show ip route vrf fabd2**

Routing Table: fabd2

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, in - OMP

n - NAT, Ni - NAT inside, No - NAT outside, Na - NAT DIA

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default, U - per-user static route

H - NHRP, G - NHRP registered, gi - NHRP registration summary

o - ODR, P - periodic downloaded static route, L - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

& - replicated local route overrides by connected

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 5 subnets

B	10.2.255.21 [20/0] via 100.3.21.2, 00:00:50
B	10.2.255.22 [20/0] via 100.3.21.2, 00:00:50
B	10.6.255.61 [200/0] via 100.255.254.5, 00:00:50
B	10.6.255.62 [200/0] via 100.255.254.6, 00:00:49
B	10.7.255.70 [200/0] via 100.255.254.6, 00:00:49

100.0.0.0/8 is variably subnetted, 7 subnets, 2 masks

C	100.3.11.0/30 is directly connected, GigabitEthernet1
L	100.3.11.1/32 is directly connected, GigabitEthernet1
C	100.3.21.0/30 is directly connected, GigabitEthernet2
L	100.3.21.1/32 is directly connected, GigabitEthernet2
B	100.5.61.0/30 [200/0] via 100.255.254.5, 00:00:50
B	100.6.62.0/30 [200/0] via 100.255.254.6, 00:00:49
B	100.6.70.0/30 [200/0] via 100.255.254.6, 00:00:49

R3#



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R4:

R4#**show ip bgp vpng4 all summary**

BGP router identifier 100.255.254.4, local AS number 10000
BGP table version is 21, main routing table version 21
20 network entries using 5120 bytes of memory
20 path entries using 2720 bytes of memory
4/4 BGP path/bestpath attribute entries using 1248 bytes of memory
3 BGP AS-PATH entries using 72 bytes of memory
1 BGP extended community entries using 24 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 9184 total bytes of memory
BGP activity 32/12 prefixes, 32/12 paths, scan interval 60 secs
20 networks peaked at 22:25:41 Mar 30 2024 BJS (00:04:12.497 ago)

Neighbor	V	AS	MsgRcvd	MsgSent	ToVer	InQ	OutQ	Up/Down	State/PfxRcd
100.255.254.3	4	10000	11	8	21	0	0	0 00:05:22	4
100.255.254.5	4	10000	10	8	21	0	0	0 00:05:22	2
100.255.254.6	4	10000	11	8	21	0	0	0 00:05:20	4

R4#

R4#**show ip bgp vpng4 all**

BGP table version is 21, local router ID is 100.255.254.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
x best-external, a additional-path, c RIB-compressed,
t secondary path, L long-lived-stale.

Origin codes: i - IGP, e - EGP, ? - incomplete

RPKI validation codes: V valid, I invalid, N Not found

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 10000:3					
*>i 10.2.255.21/32	100.255.254.3	0	100	0	65002 i
*>i 10.2.255.22/32	100.255.254.3	0	100	0	65002 i
*>i 100.3.11.0/30	100.255.254.3	0	100	0	? ?
*>i 100.3.21.0/30	100.255.254.3	0	100	0	? ?
Route Distinguisher: 10000:4 (default for vrf fabd2)					
*>i 10.2.255.21/32	100.255.254.3	0	100	0	65002 i
*>i 10.2.255.22/32	100.255.254.3	0	100	0	65002 i
*>i 10.6.255.61/32	100.255.254.5	0	100	0	65006 i
*>i 10.6.255.62/32	100.255.254.6	0	100	0	65006 i
*>i 10.7.255.70/32	100.255.254.6	0	100	0	65007 i
*>i 100.3.11.0/30	100.255.254.3	0	100	0	? ?



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```
*>i 100.3.21.0/30    100.255.254.3      0   100   0 ?  
*>i 100.5.61.0/30    100.255.254.5      0   100   0 ?  
*>i 100.6.62.0/30    100.255.254.6      0   100   0 ?  
*>i 100.6.70.0/30    100.255.254.6      0   100   0 ?  
Route Distinguisher: 10000.5  
*>i 10.6.255.61/32    100.255.254.5      0   100   0 65006 i  
*>i 100.5.61.0/30    100.255.254.5      0   100   0 ?  
Route Distinguisher: 10000.6  
*>i 10.6.255.62/32    100.255.254.6      0   100   0 65006 i  
*>i 10.7.255.70/32    100.255.254.6      0   100   0 65007 i  
*>i 100.6.62.0/30    100.255.254.6      0   100   0 ?  
*>i 100.6.70.0/30    100.255.254.6      0   100   0 ?
```

R4#

R4#**show ip route vrf fabd2**

Routing Table: fabd2

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP

n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default, U - per-user static route

H - NHRP, G - NHRP registered, g - NHRP registration summary

o - ODR, P - periodic downloaded static route, I - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

& - replicated local route overrides by connected

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 5 subnets

```
B    10.2.255.21 [200/0] via 100.255.254.3, 00:04:28  
B    10.2.255.22 [200/0] via 100.255.254.3, 00:04:28  
B    10.6.255.61 [200/0] via 100.255.254.5, 00:04:41  
B    10.6.255.62 [200/0] via 100.255.254.6, 00:04:27  
B    10.7.255.70 [200/0] via 100.255.254.6, 00:04:27
```

100.0.0.0/30 is subnetted, 5 subnets

```
B    100.3.11.0 [200/0] via 100.255.254.3, 00:04:28  
B    100.3.21.0 [200/0] via 100.255.254.3, 00:04:28  
B    100.5.61.0 [200/0] via 100.255.254.5, 00:04:41  
B    100.6.62.0 [200/0] via 100.255.254.6, 00:04:27  
B    100.6.70.0 [200/0] via 100.255.254.6, 00:04:27
```



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R4#

R5:

R5#**show ip bgp vpng4 all summary**

BGP router identifier 100.255.254.5, local AS number 10000

BGP table version is 19, main routing table version 19

18 network entries using 4608 bytes of memory

18 path entries using 2448 bytes of memory

7/6 BGP path/bestpath attribute entries using 2184 bytes of memory

3 BGP AS-PATH entries using 72 bytes of memory

1 BGP extended community entries using 24 bytes of memory

0 BGP route-map cache entries using 0 bytes of memory

0 BGP filter-list cache entries using 0 bytes of memory

BGP using 9336 total bytes of memory

BGP activity 28/10 prefixes, 28/10 paths, scan interval 60 secs

18 networks peaked at 22:25:41 Mar 30 2024 BJS (00:05:28.521 ago)

Neighbor	V	AS	MsgRcvd	MsgSent	TblVer	InQ	OutQ	Up/Down	State/PfxRcd
100.5.61.2	4	65006	12	15	19	0	0	00:06:33	1
100.255.254.3	4	10000	12	11	19	0	0	00:06:35	4
100.255.254.4	4	10000	9	11	19	0	0	00:06:38	0
100.255.254.6	4	10000	12	12	19	0	0	00:06:32	4

R5#

R5#**show ip bgp vpng4 all**

BGP table version is 19, local router ID is 100.255.254.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,

x best-external, a additional-path, c RIB-compressed,

t secondary path, L long-lived-stale,

Origin codes: i - IGP, e - EGP, ? - incomplete

RPKI validation codes: V valid, ! invalid, N Not found

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 10000:3					
*>i 10.2.255.21/32	100.255.254.3	0	100	0	65002 i
*>i 10.2.255.22/32	100.255.254.3	0	100	0	65002 i
*>i 100.3.11.0/30	100.255.254.3	0	100	0	?
*>i 100.3.21.0/30	100.255.254.3	0	100	0	?
Route Distinguisher: 10000:5 (default for vrf fabd2)					
*>i 10.2.255.21/32	100.255.254.3	0	100	0	65002 i
*>i 10.2.255.22/32	100.255.254.3	0	100	0	65002 i
*> 10.6.255.61/32	100.5.61.2	0		0	65006 i
*>i 10.6.255.62/32	100.255.254.6	0	100	0	65006 i



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E-mail: support@wolf-lab.com

```
*>i 10.7.255.70/32 100.255.254.6      0 100 0 65007 i
*>i 100.3.11.0/30 100.255.254.3      0 100 0 ?
*>i 100.3.21.0/30 100.255.254.3      0 100 0 ?
*> 100.5.61.0/30 0.0.0.0              0          32768 ?
*>i 100.6.62.0/30 100.255.254.6      0 100 0 ?
*>i 100.6.70.0/30 100.255.254.6      0 100 0 ?
Route Distinguisher: 10000:6
*>i 10.6.255.62/32 100.255.254.6      0 100 0 65006 i
*>i 10.7.255.70/32 100.255.254.6      0 100 0 65007 i
*>i 100.6.62.0/30 100.255.254.6      0 100 0 ?
*>i 100.6.70.0/30 100.255.254.6      0 100 0 ?
R5#
R5#show ip route vrf fabd2
```

Routing Table: fabd2

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
H - NHRP, G - NHRP registered, g - NHRP registration summary
o - ODR, P - periodic downloaded static route, I - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR
& - replicated local route overrides by connected

Gateway of last resort is not set

```
10.0.0.0/32 is subnetted, 5 subnets
B    10.2.255.21 [200/0] via 100.255.254.3, 00:05:39
B    10.2.255.22 [200/0] via 100.255.254.3, 00:05:39
B    10.6.255.61 [20/0] via 100.5.61.2, 00:05:52
B    10.6.255.62 [200/0] via 100.255.254.6, 00:05:38
B    10.7.255.70 [200/0] via 100.255.254.6, 00:05:38
100.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
B    100.3.11.0/30 [200/0] via 100.255.254.3, 00:05:39
B    100.3.21.0/30 [200/0] via 100.255.254.3, 00:05:39
C    100.5.61.0/30 is directly connected, GigabitEthernet1
L    100.5.61.1/32 is directly connected, GigabitEthernet1
B    100.6.62.0/30 [200/0] via 100.255.254.6, 00:05:38
B    100.6.70.0/30 [200/0] via 100.255.254.6, 00:05:38
```



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

R5#

R6:

R6#**show ip bgp vpng4 all summary**

BGP router identifier 100.255.254.6, local AS number 10000
BGP table version is 17, main routing table version 17
16 network entries using 4096 bytes of memory
16 path entries using 2176 bytes of memory
8/6 BGP path/bestpath attribute entries using 2496 bytes of memory
3 BGP AS-PATH entries using 72 bytes of memory
1 BGP extended community entries using 24 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 8864 total bytes of memory
BGP activity 24/8 prefixes, 24/8 paths, scan interval 60 secs
16 networks peaked at 22:25:41 Mar 30 2024 BJS (00:07:17.110 ago)

Neighbor	V	AS	MsgRcvd	MsgSent	TblVer	InQ	OutQ	Up/Down	State/PfxRcd
100.6.62.2	4	65006	14	17	17	0	0	00:08:21	1
100.6.70.2	4	65007	14	17	17	0	0	00:08:23	1
100.255.254.3	4	10000	14	14	17	0	0	00:08:27	4
100.255.254.4	4	10000	11	14	17	0	0	00:08:25	0
100.255.254.5	4	10000	13	14	17	0	0	00:08:21	2

R6#

R6#**show ip bgp vpng4 all**

BGP table version is 17, local router ID is 100.255.254.6

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,

x best-external, a additional-path, c RIB-compressed,

t secondary path, L long-lived-stale,

Origin codes: i - IGP, e - EGP, ? - incomplete

RPKI validation codes: V valid, I invalid, N Not found

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 10000:3					
*>i 10.2.255.21/32	100.255.254.3	0	100	0	65002 i
*>i 10.2.255.22/32	100.255.254.3	0	100	0	65002 i
*>i 100.3.11.0/30	100.255.254.3	0	100	0	?
*>i 100.3.21.0/30	100.255.254.3	0	100	0	?
Route Distinguisher: 10000:5					
*>i 10.6.255.61/32	100.255.254.5	0	100	0	65006 i
*>i 100.5.61.0/30	100.255.254.5	0	100	0	?
Route Distinguisher: 10000:6 (default for vrf fabd2)					



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District ,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

*>i	10.2.255.21/32	100.255.254.3	0	100	0 65002 i
*>i	10.2.255.22/32	100.255.254.3	0	100	0 65002 i
*>i	10.6.255.61/32	100.255.254.5	0	100	0 65006 i
*>	10.6.255.62/32	100.6.62.2	0		0 65006 i
*>	10.7.255.70/32	100.6.70.2	0		0 65007 i
*>i	100.3.11.0/30	100.255.254.3	0	100	0 ?
*>i	100.3.21.0/30	100.255.254.3	0	100	0 ?
*>i	100.5.61.0/30	100.255.254.5	0	100	0 ?
*>	100.6.62.0/30	0.0.0.0	0		32768 ?
*>	100.6.70.0/30	0.0.0.0	0		32768 ?

R6#

R6#**show ip route vrf fabd2**

Routing Table: fabd2

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP

n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default, U - per-user static route

H - NHRP, G - NHRP registered, g - NHRP registration summary

o - ODR, P - periodic downloaded static route, I - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

& - replicated local route overrides by connected

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 5 subnets

- B 10.2.255.21 [200/0] via 100.255.254.3, 00:07:31
- B 10.2.255.22 [200/0] via 100.255.254.3, 00:07:31
- B 10.6.255.61 [200/0] via 100.255.254.5, 00:07:31
- B 10.6.255.62 [20/0] via 100.6.62.2, 00:07:31
- B 10.7.255.70 [20/0] via 100.6.70.2, 00:07:31

100.0.0.0/8 is variably subnetted, 7 subnets, 2 masks

- B 100.3.11.0/30 [200/0] via 100.255.254.3, 00:07:31
- B 100.3.21.0/30 [200/0] via 100.255.254.3, 00:07:31
- B 100.5.61.0/30 [200/0] via 100.255.254.5, 00:07:31
- C 100.6.62.0/30 is directly connected, GigabitEthernet1
- L 100.6.62.1/32 is directly connected, GigabitEthernet1
- C 100.6.70.0/30 is directly connected, GigabitEthernet2.100
- L 100.6.70.1/32 is directly connected, GigabitEthernet2.100



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

R6#

1.9 Redistribution (IGP)

Configure the Headquarters CE to propagate service provider-learnt routes to the rest of HQ. The solution must meet the following requirements:

- Do not use BGP to achieve this goal.
- HQ internal link bandwidth must be taken into account when determining the best path to reach external networks learned from SP #1
- Ensure that the service provider routes are not advertised in a classful state

Solution:

R11:

```
R11(config)#router ospf 1
R11(config-router)#redistribute bgp 65001 subnets metric-type 1
R11(config-router)#exit
R11(config)#
```

Verify:

SW101:

```
SW101#show ip route | i O E
O E1      10.6.255.61/32 [110/2] via 10.1.10.1, 00:00:19, GigabitEthernet0/0
O E1      10.6.255.62/32 [110/2] via 10.1.10.1, 00:00:19, GigabitEthernet0/0
O E1      10.7.255.70/32 [110/2] via 10.1.10.1, 00:00:19, GigabitEthernet0/0
O F1      100.3.21.0 [110/2] via 10.1.10.1, 00:00:19, GigabitEthernet0/0
O E1      100.5.61.0 [110/2] via 10.1.10.1, 00:00:19, GigabitEthernet0/0
O E1      100.6.62.0 [110/2] via 10.1.10.1, 00:00:19, GigabitEthernet0/0
O E1      100.6.70.0 [110/2] via 10.1.10.1, 00:00:19, GigabitEthernet0/0
SW101#
```

SW201:

```
SW201#show ip route | i O E
O E1      10.6.255.61/32 [110/3] via 10.2.241.2, 00:00:46, GigabitEthernet1/2
O E1      10.6.255.62/32 [110/3] via 10.2.241.2, 00:00:46, GigabitEthernet1/2
O E1      10.7.255.70/32 [110/3] via 10.2.241.2, 00:00:46, GigabitEthernet1/2
```



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
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E-mail: support@wolf-lab.com

```
○ E1 100.3.21.0 [110/3] via 10.2.241.2, 00:00:46, GigabitEthernet1/2
○ E1 100.5.61.0 [110/3] via 10.2.241.2, 00:00:46, GigabitEthernet1/2
○ E1 100.6.62.0 [110/3] via 10.2.241.2, 00:00:46, GigabitEthernet1/2
○ E1 100.6.70.0 [110/3] via 10.2.241.2, 00:00:46, GigabitEthernet1/2
```

SW201#

R23:

R23#**show ip route | i O E**

```
○ E1 10.6.255.61/32 [110/5] via 10.2.215.2, 00:01:12, GigabitEthernet3
○ E1 10.6.255.62/32 [110/5] via 10.2.215.2, 00:01:12, GigabitEthernet3
○ E1 10.7.255.70/32 [110/5] via 10.2.215.2, 00:01:12, GigabitEthernet3
○ E1 100.3.21.0 [110/5] via 10.2.215.2, 00:01:12, GigabitEthernet3
○ E1 100.5.61.0 [110/5] via 10.2.215.2, 00:01:12, GigabitEthernet3
○ E1 100.6.62.0 [110/5] via 10.2.215.2, 00:01:12, GigabitEthernet3
○ E1 100.6.70.0 [110/5] via 10.2.215.2, 00:01:12, GigabitEthernet3
```

R23#

1.10 BGP fast fallover

Xander is looking for the following requirements to be implemented in their network:

- Configure the link between routers R5 and R61 and the link between routers R6 and R62 for enhanced failure detection.
- The link must be polled every 333 ms and considered in a failed state after three missed polls.
- Upon failure, the BGP peer must be brought down until the link is recovered.
- Protect the BGP sessions between R5-R61 and R6-R62 from CPU utilization-based attacks using forget IP packets.
- Routes R5-R61 and R6-R62 must only establish eBGP sessions with routers 1 hop away.
- The TCP sessions on top of which BGP peerings between R5-R61 operate must carry an MD5 flag.

Solution:

R5:

```
R5(config)#interface g1
R5(config-if)#bfd interval 333 min_rx 333 multiplier 3
R5(config-if)#exit
R5(config)#router bgp 10000
R5(config-router)#address-family ipv4 vrf fabd2
R5(config-router-af)#neighbor 100.5.61.2 ttl-security hops 1
```



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District ,Shanghai

Website: www.wolf-lab.com

E-mail: support@wolf-lab.com

```
R5(config-router-af)#neighbor 100.5.61.2 fall-over bfd  
R5(config-router-af)#neighbor 100.5.61.2 password CCIEInfr4  
R5(config-router-af)#end  
R5#clear ip bgp *          <== Very very important !!!
```

R61:

```
R61(config)#interface g0/0  
R61(config-if)#bfd interval 333 min_rx 333 multiplier 3  
R61(config-if)#exit  
R61(config)#router bgp 65006  
R61(config-router)#neighbor 100.5.61.1 ttl-security hops 1  
R61(config-router)#neighbor 100.5.61.1 fall-over bfd  
R61(config-router)#neighbor 100.5.61.1 password CCIEInfr4  
R61(config-router)#end  
R61#clear ip bgp *          <== Very very important !!!
```

R6:

```
R6(config)#interface g1  
R6(config-if)#bfd interval 333 min_rx 333 multiplier 3  
R6(config-if)#exit  
R6(config)#router bgp 10000  
R6(config-router)#address-family ipv4 vrf fabd2  
R6(config-router-af)#neighbor 100.6.62.2 ttl-security hops 1  
R6(config-router-af)#neighbor 100.6.62.2 fall-over bfd  
R6(config-router-af)#end  
R6#clear ip bgp *          <== Very very important !!!
```

R62:

```
R62(config)#interface g0/0  
R62(config-if)#bfd interval 333 min_rx 333 multiplier 3  
R62(config-if)#exit  
R62(config)#router bgp 65006  
R62(config-router)#neighbor 100.6.62.1 ttl-security hops 1  
R62(config-router)#neighbor 100.6.62.1 fall-over bfd  
R62(config-router)#end  
R62#clear ip bgp *          <== Very very important !!!
```



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District ,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

Verify:

R5:

R5#show bfd neighbor detail

IPv4 Sessions

NeighAddr	LD/RD	RH/RS	State	Int
100.5.61.2	4097/1	Up	Up	G1

Session state is UP and using echo function with 333 ms interval.

Session Host: Software

OurAddr: 100.5.61.1

Handle: 1

Local Diag: 0, Demand mode: 0, Poll bit: 0

MinTxInt: 1000000, MinRxInt: 1000000, Multiplier: 3

Received MinRxInt: 1000000, Received Multiplier: 3

Holddown (hits): 0(0), Hello (hits): 1000(37)

Rx Count: 37, Rx Interval (ms) min/max/avg: 3/1021/870 last: 511 ms ago

Tx Count: 39, Tx Interval (ms) min/max/avg: 3/996/831 last: 276 ms ago

Echo Rx Count: 110, Echo Rx Interval (ms) min/max/avg: 251/332/289 last: 39 ms ago

Echo Tx Count: 110, Echo Tx Interval (ms) min/max/avg: 251/332/289 last: 40 ms ago

Elapsed time watermarks: 0 0 (last: 0)

Registered protocols: BGP CEF

Uptime: 00:00:31

Last packet: Version: 1

- Diagnostic: 0

State bit: Up

- Demand bit: 0

Poll bit: 0

- Final bit: 0

C bit: 0

- Length: 24

Multiplier: 3

- Your Discr.: 4097

My Discr.: 1

- Min rx interval: 1000000

Min tx interval: 1000000

Min Echo interval: 333000

R5#

R5#show ip bgp vpng4 vrf fabd2 neighbor 100.5.61.2

BGP neighbor is 100.5.61.2, vrf fabd2, remote AS 65006, external link

Fall over configured for session

BFD is configured. BFD peer is Up. Using BFD to detect fast failover (single-hop).

BGP version 4, remote router ID 10.6.255.61

BGP state = Established, up for 00:02:53

Last read 00:00:14, last write 00:00:02, hold time is 180, keepalive interval is 60 seconds

Last update received: 00:02:02

Neighbor sessions:

1 active, is not multisession capable (disabled)



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Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District,Shanghai

Website: www.wolf-lab.com

E-mail: support@wolf-lab.com

Neighbor capabilities:

- Route refresh: advertised and received(new)
- Four-octets ASN Capability: advertised and received
- Address family IPv4 Unicast: advertised and received
- Enhanced Refresh Capability: advertised and received
- Multisession Capability:
- Stateful switchover support enabled: NO for session 1

Message statistics:

- InQ depth is 0
- OutQ depth is 0

	Sent	Rcvd
Opens:	1	1
Notifications:	0	0
Updates:	6	2
Keepalives:	4	4
Route Refresh:	0	0
Total:	11	7

Do log neighbor state changes (via global configuration)

Default minimum time between advertisement runs is 0 seconds

For address family: VPNv4 Unicast

Translates address family IPv4 Unicast for VRF fabcd2

Session: 100.5.61.2

BGP table version 19, neighbor version 19/0

Output queue size : 0

Index 5: Advertise bit 0

5 update-group member

Slow-peer detection is disabled

Slow-peer split-update-group dynamic is disabled

	Sent	Rcvd
Prefix activity:		
Prefixes Current:	9	1 (Consumes 136 bytes)
Prefixes Total:	9	1
Implicit Withdraw:	0	0
Explicit Withdraw:	0	0
Used as bestpath:	n/a	1
Used as multipath:	n/a	0
Used as secondary:	n/a	0

	Outbound	Inbound
Local Policy Denied Prefixes:	-----	-----
Bestpath from this peer:	1	n/a



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Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd,Xuhui District,Shanghai

Website: www.wolf-lab.com

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Total: 1 0

Number of NLRI in the update sent: max 4, min 0

Current session network count peaked at 1 entries at 22:46:43 Mar 30 2024 BJS (00:02:02.067 ago)

Highest network count observed at 1 entries at 22:03:55 Mar 30 2024 BJS (00:44:50.067 ago)

Last detected as dynamic slow peer: never

Dynamic slow peer recovered: never

Refresh Epoch: 1

Last Sent Refresh Start-of-rib: never

Last Sent Refresh End-of-rib: never

Last Received Refresh Start-of-rib: never

Last Received Refresh End-of-rib: never

	Sent	Recv
--	------	------

Refresh activity:

Refresh Start-of-RIB	0	0
Refresh End-of-RIB	0	0

Address tracking is enabled, the RIB does have a route to 100.5.61.2

Route to peer address reachability Up: 1; Down: 0

Last notification 00:44:51

Connections established 3; dropped 2

Last reset 00:03:00, due to BGP protocol initialization

External BGP neighbor may be up to 1 hop away.

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

Interface associated: GigabitEthernet1 (peering address in same link)

Transport(tcp) path-mtu-discovery is enabled

Graceful-Restart is disabled

SSO is disabled

Connection state is ESTAB, I/O status: 1, unread input bytes: 0

Connection is ECN Disabled, Minimum incoming TTL 254, Outgoing TTL 255

Local host: 100.5.61.1, Local port: 179

Foreign host: 100.5.61.2, Foreign port: 29371

Connection tableid (VRF): 1

Maximum output segment queue size: 50

Enqueued packets for retransmit: 0, input: 0 mis-ordered: 0 (0 bytes)

Event Timers (current time is 0x2AA8AA):

Timer	Starts	Wakeups	Next
Retrans	7	0	0x0
TimeWait	0	0	0x0
AckHold	6	5	0x0
SendWnd	0	0	0x0
KeepAlive	0	0	0x0



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
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GiveUp	0	0	0x0
PmtuAger	0	0	0x0
DeadWait	0	0	0x0
Linger	0	0	0x0
ProcessQ	0	0	0x0

iss: 1976839390 snduna: 1976839826 sndnxt: 1976839826
irs: 3547599626 rcvnxt: 3547599838

sndwnd: 15949 scale: 0 maxrcvwnd: 16384
rcvwnd: 16173 scale: 0 delrcvwnd: 211

SRTT: 607 ms, RTTO: 2949 ms, RTV: 2342 ms, KRTT: 0 ms
minRTT: 3 ms, maxRTT: 1000 ms, ACK hold: 200 ms
uptime: 173873 ms, Sent idletime: 2251 ms, Receive idletime: 2045 ms
Status Flags: passive open, gen tcbs
Option Flags: VRF id set, nagle, path mtu capable, md5, Retrans timeout
IP Precedence value : 6
Window update Optimisation : Disabled
ACK Optimisation : Disabled

Datagrams (max data segment is 1460 bytes):

Peer MSS: 1460
Rcvd: 13 (out of order: 0), with data: 6, total data bytes: 211
Sent: 15 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with data: 8, total data bytes: 435

Packets received in fast path: 0, fast processed: 0, slow path: 0
fast lock acquisition failures: 0, slow path: 0
TCP Semaphore 0x7FB4D4031610 FREE
R5#

R61:

R61#show bfd neighbor detail

IPv4 Sessions

NeighAddr	LD/RD	RH/RS	State	Int
100.5.61.1	1/4097	Up	Up	Gi0/0

Session state is UP and using echo function with 333 ms interval.

Session Host: Software

OurAddr: 100.5.61.2

Handle: 1

Local Diag: 0, Demand mode: 0, Poll bit: 0

MinTxInt: 1000000, MinRxInt: 1000000, Multiplier: 3



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District,Shanghai

Website: www.wolf-lab.com

E-mail: support@wolf-lab.com

Received MinRxInt: 1000000, Received Multiplier: 3

Holdown (hits): 0(0), Hello (hits): 1000(485)

Rx Count: 494, Rx Interval (ms) min/max/avg: 1/4309/865 last: 167 ms ago

Tx Count: 490, Tx Interval (ms) min/max/avg: 1/1002/871 last: 804 ms ago

Elapsed time watermarks: 0 0 (last: 0)

Registered protocols: CEF BGP

Uptime: 00:06:42

Last packet: Version: 1

- Diagnostic: 0

State bit: Up

- Demand bit: 0

Poll bit: 0

- Final bit: 0

C bit: 0

- Length: 24

Multiplier: 3

- Your Discr.: 1

My Discr.: 4097

- Min rx interval: 1000000

Min tx interval: 1000000

Min Echo interval: 333000

R61#

R61#show ip bgp neighbor 100.5.61.1

BGP neighbor is 100.5.61.1, remote AS 10000, external link

Fall over configured for session

BFD is configured. BFD peer is Up. Using BFD to detect fast failover (single-hop).

BGP version 4, remote router ID 100.255.254.5

BGP state = Established, up for 00:07:10

Last read 00:00:47, last write 00:00:04, hold time is 180, keepalive interval is 60 seconds

Neighbor sessions:

1 active, is not multisession capable (disabled)

Neighbor capabilities:

Route refresh: advertised and received(new)

Four-octets ASN Capability: advertised and received

Address family IPv4 Unicast: advertised and received

Enhanced Refresh Capability: advertised and received

Multisession Capability:

Stateful switchover support enabled: NO for session 1

Message statistics:

InQ depth is 0

OutQ depth is 0

	Sent	Rcvd
Opens:	1	1
Notifications:	0	0
Updates:	2	6
Keepalives:	9	8
Route Refresh:	0	0
Total:	12	15



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E-mail: support@wolf-lab.com

Do log neighbor state changes (via global configuration)

Default minimum time between advertisement runs is 30 seconds

For address family: IPv4 Unicast

Session: 100.5.61.1

BGP table version 10, neighbor version 10/0

Output queue size : 0

Index 4, Advertise bit 0

4 update-group member

Slow-peer detection is disabled

Slow-peer split-update-group dynamic is disabled

	Sent	Rcvd
--	------	------

Prefix activity:

Prefixes Current:	1	8 (Consumes 672 bytes)
-------------------	---	------------------------

Prefixes Total:	1	8
-----------------	---	---

Implicit Withdraw:	0	0
--------------------	---	---

Explicit Withdraw:	0	0
--------------------	---	---

Used as bestpath:	n/a	8
-------------------	-----	---

Used as multipath:	n/a	0
--------------------	-----	---

Used as secondary:	n/a	0
--------------------	-----	---

Local Policy Denied Prefixes:

	Outbound	Inbound
--	----------	---------

AS_PATH loop:	n/a	1
---------------	-----	---

Bestpath from this peer:	8	n/a
--------------------------	---	-----

Total:	8	1
--------	---	---

Number of NLRI in the update sent: max 1, min 0

Last detected as dynamic slow peer: never

Dynamic slow peer recovered: never

Refresh Epoch: 1

Last Sent Refresh Start-of-rib: never

Last Sent Refresh End-of-rib: never

Last Received Refresh Start-of-rib: never

Last Received Refresh End-of-rib: never

	Sent	Rcvd
--	------	------

Refresh activity:

----	----
------	------

Refresh Start-of-RIB	0	0
----------------------	---	---

Refresh End-of-RIB	0	0
--------------------	---	---

Address tracking is enabled, the RIB does have a route to 100.5.61.1

Route to peer address reachability Up: 1; Down: 0

Last notification 03:09:12

Connections established 4; dropped 3



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Last reset 00:07:17, due to BGP Notification received of session 1, Administrative Reset

External BGP neighbor may be up to 1 hop away.

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

Interface associated: GigabitEthernet0/0 (peering address in same link)

Transport(tcp) path-mtu-discovery is enabled

Graceful-Restart is disabled

SSO is disabled

Connection state is ESTAB, I/O status: 1, unread input bytes: 0

Connection is ECN Disabled, Minimum incoming TTL 254, Outgoing TTL 255

Local host: 100.5.61.2, Local port: 29371

Foreign host: 100.5.61.1, Foreign port: 179

Connection tableid (VRF): 0

Maximum output segment queue size: 50

Enqueued packets for retransmit: 0, input: 0 mis-ordered: 0 (0 bytes)

Event Timers (current time is 0xADBDF7):

Timer	Starts	Wakeups	Next
Retrans	12	0	0x0
TimeWait	0	0	0x0
AckHold	11	7	0x0
SendWnd	0	0	0x0
KeepAlive	0	0	0x0
GiveUp	0	0	0x0
PmtuAger	1	0	0xB05283
DeadWait	0	0	0x0
Linger	0	0	0x0
ProcessQ	0	0	0x0

iss: 3547599626 snduna: 3547599933 sndnxt: 3547599933

irs: 1976839390 rcvnxt: 1976839902

sndwnd: 16078 scale: 0 maxrcvwnd: 16384

rcvwnd: 15873 scale: 0 delrcvwnd: 511

SRTT: 798 ms, RTTO: 2221 ms, RTV: 1423 ms, KRTT: 0 ms

minRTT: 2 ms, maxRTT: 1000 ms, ACK hold: 200 ms

uptime: 430903 ms, Sent idletime: 4108 ms, Receive idletime: 3909 ms

Status Flags: active open

Option Flags: nagle, path mtu capable, md5

IP Precedence value : 6

Datagrams (max data segment is 1460 bytes):



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Rcvd: 24 (out of order: 0), with data: 12, total data bytes: 511

Sent: 22 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with data: 11, total data bytes: 305

Packets received in fast path: 0, fast processed: 0, slow path: 0

fast lock acquisition failures: 0, slow path: 0

TCP Semaphore 0x13204C74 FREE

R61#

R6:

R6#**show bfd neighbor detail**

IPv4 Sessions

NeighAddr

100.6.62.2

LD/RD	RH/RS	State	Int
4097/1	Up	Up	Gi1

Session state is UP and using echo function with 333 ms interval

Session Host: Software

OurAddr: 100.6.62.1

Handle: 1

Local Diag: 0, Demand mode: 0, Poll bit: 0

MinTxInt: 1000000, MinRxInt: 1000000, Multiplier: 3

Received MinRxInt: 1000000, Received Multiplier: 3

Holddown (hits): 0(0), Hello (hits): 1000(1050)

Rx Count: 1042, Rx Interval (ms) min/max/avg: 2/1263/884 last: 604 ms ago

Tx Count: 1052, Tx Interval (ms) min/max/avg: 1/1006/876 last: 25 ms ago

Echo Rx Count: 3151, Echo Rx Interval (ms) min/max/avg: 227/725/293 last: 102 ms ago

Echo Tx Count: 3151, Echo Tx Interval (ms) min/max/avg: 251/632/293 last: 103 ms ago

Elapsed time watermarks: 0 0 (last: 0)

Registered protocols: BGP CEF

Uptime: 00:15:22

Last packet: Version: 1

- Diagnostic: 0

State bit: Up

- Demand bit: 0

Poll bit: 0

- Final bit: 0

C bit: 0

Multiplier: 3

- Length: 24

My Discr.: 1

- Your Discr.: 4097

Min tx interval: 1000000

- Min rx interval: 1000000

Min Echo interval: 333000

R6#

R6#**show ip bgp vpng4 vrf fabd2 neighbor 100.6.62.2**

BGP neighbor is 100.6.62.2, vrf fabd2, remote AS 65006, external link

Fall over configured for session

BFD is configured. BFD peer is Up. Using BFD to detect fast failover (single-hop).

BGP version 4, remote router ID 10.6.255.62



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Website: www.wolf-lab.com

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BGP state = Established, up for 00:14:56

Last read 00:00:20, last write 00:00:55, hold time is 180, keepalive interval is 60 seconds

Last update received: 00:14:03

Neighbor sessions:

1 active, is not multisession capable (disabled)

Neighbor capabilities:

Route refresh: advertised and received(new)

Four-octets ASN Capability: advertised and received

Address family IPv4 Unicast: advertised and received

Enhanced Refresh Capability: advertised and received

Multisession Capability:

Stateful switchover support enabled: NO for session 1

Message statistics:

InQ depth is 0

OutQ depth is 0

	Sent	Rcvd
Opens:	1	1
Notifications:	0	0
Updates:	8	2
Keepalives:	15	17
Route Refresh:	0	0
Total:	24	20

Do log neighbor state changes (via global configuration)

Default minimum time between advertisement runs is 0 seconds

For address family: VPNV4 Unicast

Translates address family IPv4 Unicast for VRF fabd2

Session: 100.6.62.2

BGP table version 17, neighbor version 17/0

Output queue size : 0

Index 5, Advertise bit 0

5 update-group member

Slow-peer detection is disabled

Slow-peer split-update-group dynamic is disabled

	Sent	Rcvd
Prefix activity:	----	----
Prefixes Current:	10	1 (Consumes 136 bytes)
Prefixes Total:	10	1
Implicit Withdraw:	0	0
Explicit Withdraw:	0	0
Used as bestpath:	n/a	1
Used as multipath:	n/a	0



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Used as secondary: n/a 0

	Outbound	Inbound
--	----------	---------

Local Policy Denied Prefixes: ----- -----

Total: 0 0

Number of NLRI in the update sent: max 3, min 0

Current session network count peaked at 1 entries at 22:46:46 Mar 30 2024 BJS (00:14:04.755 ago)

Highest network count observed at 1 entries at 22:03:59 Mar 30 2024 BJS (00:56:51.755 ago)

Last detected as dynamic slow peer: never

Dynamic slow peer recovered: never

Refresh Epoch: 1

Last Sent Refresh Start-of-rib: never

Last Sent Refresh End-of-rib: never

Last Received Refresh Start-of-rib: never

Last Received Refresh End-of-rib: never

	Sent	Rcvd
Refresh activity:	-----	-----
Refresh Start-of-RIB	0	0
Refresh End-of-RIB	0	0

Address tracking is enabled, the RIB does have a route to 100.6.62.2

Route to peer address reachability Up: 1; Down: 0

Last notification 00:56:56

Connections established 3; dropped 2

Last reset 00:15:03, due to BGP protocol initialization

External BGP neighbor may be up to 1 hop away.

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

Interface associated: GigabitEthernet1 (peering address in same link)

Transport(tcp) path-mtu-discovery is enabled

Graceful-Restart is disabled

SSO is disabled

Connection state is ESTAB, I/O status: 1, unread input bytes: 0

Connection is ECN Disabled, Minimum incoming TTL 254, Outgoing TTL 255

Local host: 100.6.62.1, Local port: 179

Foreign host: 100.6.62.2, Foreign port: 13273

Connection tableid (VRF): 1

Maximum output segment queue size: 50

Enqueued packets for retransmit: 0, input: 0 mis-ordered: 0 (0 bytes)

Event Timers (current time is 0x35B4D1):

Timer	Starts	Wakeups	Next
Retrans	20	0	0x0



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TimeWait	0	0	0x0
AckHold	18	16	0x0
SendWnd	0	0	0x0
KeepAlive	0	0	0x0
GiveUp	0	0	0x0
PmtuAger	0	0	0x0
DeadWait	0	0	0x0
Linger	0	0	0x0
ProcessQ	0	0	0x0

iss: 3952062530 snduna: 3952063270 sndnxt: 3952063270
irs: 3040565741 rcvnxt: 3040566200

sndwnd: 15645 scale: 0 maxrcvwnd: 16384
rcvwnd: 15926 scale: 0 delrcvwnd: 458

SRTT: 931 ms, RTTO: 1468 ms, RTV: 537 ms, KRTT: 0 ms

minRTT: 6 ms, maxRTT: 1000 ms, ACK hold: 200 ms

uptime: 896454 ms, Sent idletime: 20157 ms, Receive idletime: 20357 ms

Status Flags: passive open, gen tcbs

Option Flags: VRF id set, nagle, path mtu capable

IP Precedence value : 6

Window update Optimisation : Disabled

ACK Optimisation : Disabled

Datagrams (max data segment is 1460 bytes):

Peer MSS: 1460

Rcvd: 39 (out of order: 0), with data: 19, total data bytes: 458

Sent: 39 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with data: 20, total data bytes: 739

Packets received in fast path: 0, fast processed: 0, slow path: 0

fast lock acquisition failures: 0, slow path: 0

TCP Semaphore 0x7FCCA4614558 FREE

R6#

R62:

R62#show bfd neighbor detail

IPv4 Sessions

NeighAddr	LD/RD	RH/RS	State	Int
100.6.62.1	1/4097	Up	Up	Gi0/0

Session state is UP and using echo function with 333 ms interval.

Session Host: Software



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Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai

Website: www.wolf-lab.com

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OurAddr: 100.6.62.2

Handle: 1

Local Diag: 0, Demand mode: 0, Poll bit: 0

MinTxInt: 1000000, MinRxInt: 1000000, Multiplier: 3

Received MinRxInt: 1000000, Received Multiplier: 3

Holddown (hits): 0(0), Hello (hits): 1000(1259)

Rx Count: 1271, Rx Interval (ms) min/max/avg: 1/999/868 last: 787 ms ago

Tx Count: 1261, Tx Interval (ms) min/max/avg: 1/1004/875 last: 735 ms ago

Elapsed time watermarks: 0 0 (last: 0)

Registered protocols: BGP CEF

Uptime: 00:18:24

Last packet: Version: 1

State bit: Up

Poll bit: 0

C bit: 0

Multiplier: 3

My Discr.: 4097

Min tx interval: 1000000

Min Echo interval: 333000

- Diagnostic: 0

- Demand bit: 0

- Final bit: 0

- Length: 24

- Your Discr.: 1

- Min rx interval: 1000000

R62#

R62#show ip bgp neighbor 100.6.62.1

BGP neighbor is 100.6.62.1, remote AS 10000, external link

Fall over configured for session

BFD is configured. BFD peer is Up. Using BFD to detect fast failover (single-hop).

BGP version 4, remote router ID 100.255.254.6

BGP state = Established, up for 00:18:36

Last read 00:00:20, last write 00:00:39, hold time is 180, keepalive interval is 60 seconds

Neighbor sessions:

1 active, is not multisession capable (disabled)

Neighbor capabilities:

Route refresh: advertised and received(new)

Four-octets ASN Capability: advertised and received

Address family IPv4 Unicast: advertised and received

Enhanced Refresh Capability: advertised and received

Multisession Capability:

Stateful switchover support enabled: NO for session 1

Message statistics:

InQ depth is 0

OutQ depth is 0

	Sent	Rcvd
Opens:	1	1
Notifications:	0	0



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Updates:	2	8
Keepalives:	21	20
Route Refresh:	0	0
Total:	24	29

Do log neighbor state changes (via global configuration)

Default minimum time between advertisement runs is 30 seconds

For address family: IPv4 Unicast

Session: 100.6.62.1

BGP table version 10, neighbor version 10/0

Output queue size : 0

Index 4, Advertise bit 0

4 update-group member

Slow-peer detection is disabled

Slow-peer split-update-group dynamic is disabled

	Sent	Rcvd
Prefix activity:	----	----
Prefixes Current:	1	8 (Consumes 672 bytes)
Prefixes Total:	1	8
Implicit Withdraw:	0	0
Explicit Withdraw:	0	0
Used as bestpath:	n/a	8
Used as multipath:	n/a	0
Used as secondary:	n/a	0

	Outbound	Inbound
Local Policy Denied Prefixes:	-----	-----
AS_PATH loop:	n/a	2
Bestpath from this peer:	8	n/a
Total:	8	2

Number of NLRI in the update sent: max 1, min 0

Last detected as dynamic slow peer: never

Dynamic slow peer recovered: never

Refresh Epoch: 1

Last Sent Refresh Start-of-rib: never

Last Sent Refresh End-of-rib: never

Last Received Refresh Start-of-rib: never

Last Received Refresh End-of-rib: never

	Sent	Rcvd
Refresh activity:	----	----
Refresh Start-of-RIB	0	0
Refresh End-of-RIB	0	0



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E-mail: support@wolf-lab.com

Address tracking is enabled, the RIB does have a route to 100.6.62.1

Route to peer address reachability Up: 1; Down: 0

Last notification 03:21:20

Connections established 4; dropped 3

Last reset 00:18:43, due to BGP Notification received of session 1, Administrative Reset

External BGP neighbor may be up to 1 hop away.

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

Interface associated: GigabitEthernet0/0 (peering address in same link)

Transport(tcp) path-mtu-discovery is enabled

Graceful-Restart is disabled

SSO is disabled

Connection state is ESTAB, I/O status: 1, unread input bytes: 0

Connection is ECN Disabled, Minimum incoming TTL 254, Outgoing TTL 255

Local host: 100.6.62.2, Local port: 13273

Foreign host: 100.6.62.1, Foreign port: 179

Connection tableid (VRF): 0

Maximum output segment queue size: 50

Enqueued packets for retransmit: 0, input: 0 mis ordered: 0 (0 bytes)

Event Timers (current time is 0xB8C3FA):

Timer	Starts	Wakeups	Next
Retrans	23	0	0x0
TimeWait	0	0	0x0
AckHold	25	22	0x0
SendWnd	0	0	0x0
KeepAlive	0	0	0x0
GiveUp	0	0	0x0
PmtuAger	329	328	0xB8C6E4
DeadWait	0	0	0x0
Linger	0	0	0x0
ProcessQ	0	0	0x0

iss: 3040565741 snduna: 3040566276 sndnxt: 3040566276

irs: 3952062530 rcvnx: 3952063365

sndwnd: 15850 scale: 0 maxrcvwnd: 16384
rcvwnd: 15550 scale: 0 delrcvwnd: 834

SRTT: 954 ms, RTTO: 1319 ms, RTV: 365 ms, KRTT: 0 ms

minRTT: 3 ms, maxRTT: 1000 ms, ACK hold: 200 ms

uptime: 1116619 ms, Sent idletime: 20090 ms, Receive idletime: 20291 ms

Status Flags: active open



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Option Flags: nagle, path mtu capable

IP Precedence value : 6

Datagrams (max data segment is 1460 bytes):

Rcvd: 48 (out of order: 0), with data: 25, total data bytes: 834

Sent: 48 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with data: 23, total data bytes: 534

Packets received in fast path: 0, fast processed: 0, slow path: 0

fast lock acquisition failures: 0, slow path: 0

TCP Semaphore 0x115115EC FREE

R62#

1.11 DMVPN (Branch 3/4)

Ensure that Dynamic Multipoint VPN (DMVPN) is configured by using router R24 as a hub and routers R61 and R70 as spokes to meet the following requirements:

- Branches must connect to the internet Service Provider (ISP) and receive a default route via BGP by using a dedicated VRF.
- All traffic crossing the internet must be encrypted by using a preshared key of CCIE!nfr4 with 3DES encryption and MD5 hashing.
- EIGRP must be used to propagate the below routes across tunnels. If needed, use a standard ACL at R5 to stop other means of propagation.
 - ◆ 10.2.114.0/30
 - ◆ 10.2.214.0/30
 - ◆ 10.2.255.24/32
- Tunnel maximum transmission units (MTUs) must match on all sites.

Solution:

R24:

```
R24(config)#crypto isakmp policy 10
R24(config-isakmp)#hash md5
R24(config-isakmp)#exit
R24(config)#no crypto isakmp key cisco address 0.0.0.0
R24(config)#crypto isakmp key CCIE!nfr4 address 0.0.0.0
R24(config)#interface tu0
R24(config-if)#tunnel source g1
R24(config-if)#tunnel protection ipsec profile prof
```



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E-mail: support@wolf-lab.com

```
R24(config-if)#ip nhrp map multicast dynamic
R24(config-if)#exit
R24(config)#router eigrp ccie
R24(config-router)#address-family ipv4 unicast autonomous-system 65006
R24(config-router-af)#af-interface tu0
R24(config-router-af-interface)#no passive-interface
R24(config-router-af-interface)#exit
R24(config-router-af)#exit
R24(config-router)#exit
R24(config)#
```

R61:

```
R61(config)#interface g0/4
R61(config-if)#vrf forwarding WAN
R61(config-if)#ip address 200.99.61.2 255.255.255.252
R61(config-if)#no shutdown
R61(config-if)#exit
R61(config)#no crypto isakmp key cisco address 0.0.0.0
R61(config)#crypto keyring KR vrf WAN
R61(config-keyring)#pre-shared-key address 0.0.0.0 key CCIE!nfr4
R61(config-keyring)#exit
R61(config)#interface tu0
R61(config-if)#tunnel source g0/4
R61(config-if)#tunnel vrf WAN
R61(config-if)#no ip nhrp map 10.2.255.24 10.200.0.1
R61(config-if)#ip nhrp map 10.200.0.1 200.99.24.2
R61(config-if)#no ip nhrp map multicast 10.2.255.24
R61(config-if)#ip nhrp map multicast 200.99.24.2
R61(config-if)#ip mtu 1440
R61(config-if)#no shutdown
R61(config-if)#exit
R61(config)#router eigrp ccie
R61(config-router)#address-family ipv4 unicast autonomous-system 65006
R61(config-router-af)#af-interface tu0
R61(config-router-af-interface)#no passive-interface
R61(config-router-af-interface)#exit
R61(config-router-af)#exit
R61(config-router)#exit
R61(config)#
```

R70:

```
R70(config)#interface g0/1
R70(config-subif)#vrf forwarding WAN
```



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```
R70(config-subif)#ip address 200.99.70.2 255.255.255.252
R70(config-if)#no shutdown
R70(config-subif)#exit
R70(config)#router bgp 65007
R70(config-router)#address-family ipv4 vrf WAN
R70(config-router-af)#neighbor 200.99.70.1 remote-as 19999
R70(config-router-af)#exit
R70(config-router)#exit
R70(config)#crypto keyring KR vrf WAN
R70(conf-keyring)#no pre-shared-key address 0.0.0.0 0.0.0.0 key cisco
R70(conf-keyring)#pre-shared-key address 0.0.0.0 0.0.0.0 key CCIEInfr4
R70(conf-keyring)#exit
R70(config)#interface tu0
R70(config-if)#tunnel source g0/1
R70(config-if)#tunnel vrf WAN
R70(config-if)#no ip nhrp map multicast 10.2.255.24
R70(config-if)#ip nhrp map multicast 200.99.24.2
R70(config-if)#no ip nhrp map 10.200.0.1 10.2.255.24
R70(config-if)#ip nhrp map 10.200.0.1 200.99.24.2
R70(config-if)#no shutdown
R70(config-if)#exit
R70(config)#router eigrp ccie
R70(config-router)#address-family ipv4 unicast autonomous-system 65006
R70(config-router-af)#af-interface tu0
R70(config-router-af-interface)#no passive-interface
R70(config-router-af-interface)#exit
R70(config-router-af)#exit
R70(config)#
```

R5:

```
R5(config)#access-list 1 deny 10.2.114.0 0.0.0.3
R5(config)#access-list 1 deny 10.2.214.0 0.0.0.3
R5(config)#access-list 1 deny 10.2.255.24
R5(config)#access-list 1 permit any
R5(config)#router bgp 10000
R5(config-router)#address-family ipv4 vrf fabd2
R5(config-router-af)#neighbor 100.5.61.2 distribute-list 1 out
R5(config-router-af)#neighbor 100.5.61.2 distribute-list 1 in
R5(config-router-af)#end
R5#clear ip bgp * soft           <== Very very important !!!
```



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai

Website: www.wolf-lab.com

E-mail: support@wolf-lab.com

Verify:

R24#**show dmvpn**

Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete

N - NATed, L - Local, X - No Socket

T1 - Route Installed, T2 - Nexthop-override, B - BGP

C - CTS Capable, I2 - Temporary

Ent --> Number of NHRP entries with same NBMA peer

NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting

UpDn Time --> Up or Down Time for a Tunnel

Interface: Tunnel0, IPv4 NHRP Details

Type:Hub, NHRP Peers:2,

#	Ent	Peer	NBMA Addr	Peer Tunnel Add	State	UpDn	Tm	Attrb
	1	200.99.61.2		10.200.0.61	UP	00:06:02		D
	1	200.99.70.2		10.200.0.70	UP	00:04:00		D

R24#

R24#**show ip eigrp neighbor**

EIGRP-IPv4 VR(ccie) Address-Family Neighbors for AS(65006)

H	Address	Interface	Hold Uptime	SRTT	RTO	Q	Seq
			(sec)	(ms)		Cnt	Num
1	10.200.0.70	Tu0		14 00:00:07	28	1398	0 6
0	10.200.0.61	Tu0		14 00:00:07	22	1398	0 60

R24#



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

R24#show crypto isakmp sa detail

Codes: C - IKE configuration mode, D - Dead Peer Detection

K - Keepalives, N - NAT-traversal

T - cTCP encapsulation, X - IKE Extended Authentication

psk - Preshared key, rsig - RSA signature

renc - RSA encryption

IPv4 Crypto ISAKMP SA

C-id	Local	Remote	I-VRF	Status	Encr	Hash	Auth	DH	Lifetime	Cap.
1003	200.99.24.2	200.99.61.2		ACTIVE	3des	md5	psk	2	23:51:00	
	Engine-id:Conn-id = SW:3									
1004	200.99.24.2	200.99.70.2		ACTIVE	3des	md5	psk	2	23:53:02	
	Engine-id:Conn-id = SW:4									

IPv6 Crypto ISAKMP SA

R24#

R24#show crypto ipsec sa

interface: Tunnel0

Crypto map tag: Tunnel0-head-0, local addr 200.99.24.2

protected vrf (none)

local ident (addr/mask/prot/port): (200.99.24.2/255.255.255.255/47/0)

remote ident (addr/mask/prot/port): (200.99.70.2/255.255.255.255/47/0)

current_peer 200.99.70.2 port 500

PERMIT, flags={origin_is_adl,}

#pkts encaps: 112, #pkts encrypt: 112, #pkts digest: 112

#pkts decaps: 110, #pkts decrypt: 110, #pkts verify: 110

#pkts compressed: 0, #pkts decompressed: 0

#pkts not compressed: 0, #pkts compr. failed: 0

#pkts not decompressed: 0, #pkts decompress failed: 0

#send errors 0, #recv errors 0

local crypto endpt.: 200.99.24.2, remote crypto endpt.: 200.99.70.2

plaintext mtu 1446, path mtu 1500, ip mtu 1500, ip mtu idb GigabitEthernet1

current outbound spi: 0x957799C4(2507643332)

PFS (Y/N): N, DH group: none

inbound esp sas:



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室

Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai

Website: www.wolf-lab.com

E-mail: support@wolf-lab.com

spi: 0x4858131F(1213731615)

transform: esp-3des esp-md5-hmac ,

in use settings ={Tunnel, }

conn id: 2007, flow_id: CSR:7, sibling_flags FFFFFFFF80000048, crypto map: Tunnel0-head-0, initiator : False

sa timing: remaining key lifetime (k/sec): (4607987/470)

IV size: 8 bytes

replay detection support: Y

Status: ACTIVE(ACTIVE)

inbound ah sas:

inbound pcp sas:

outbound esp sas:

spi: 0x957799C4(2507643332)

transform: esp-3des esp-md5-hmac ,

in use settings ={Tunnel, }

conn id: 2008, flow_id: CSR:8, sibling_flags FFFFFFFF80000048, crypto map: Tunnel0-head-0, initiator : False

sa timing: remaining key lifetime (k/sec): (4607989/470)

IV size: 8 bytes

replay detection support: Y

Status: ACTIVE(ACTIVE)

outbound ah sas:

outbound pcp sas:

protected vrf: (none)

local ident (addr/mask/prot/port): (200.99.24.2/255.255.255.255/47/0)

remote ident (addr/mask/prot/port): (200.99.61.2/255.255.255.255/47/0)

current_peer 200.99.61.2 port 500

PERMIT, flags={origin_is_acl,}

#pkts encaps: 136, #pkts encrypt: 136, #pkts digest: 136

#pkts decaps: 131, #pkts decrypt: 131, #pkts verify: 131

#pkts compressed: 0, #pkts decompressed: 0

#pkts not compressed: 0, #pkts compr. failed: 0

#pkts not decompressed: 0, #pkts decompress failed: 0

#send errors 0, #recv errors 0

local crypto endpt.: 200.99.24.2, remote crypto endpt.: 200.99.61.2

plaintext mtu 1446, path mtu 1500, ip mtu 1500, ip mtu idb GigabitEthernet1

current outbound spi: 0x7109DE91(1896472209)

PFS (Y/N): N, DH group: none



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

inbound esp sas:

```
spi: 0x8C69704D(2355720269)
transform: esp-3des esp-md5-hmac .
in use settings ={Tunnel, }
conn id: 2005, flow_id: CSR5, sibling_flags FFFFFFFF80000048, crypto map: Tunnel0-head-0, initiator : False
sa timing: remaining key lifetime (k/sec): (4607984/348)
IV size: 8 bytes
replay detection support: Y
Status: ACTIVE(ACTIVE)
```

inbound ah sas:

inbound pcp sas:

outbound esp sas:

```
spi: 0x7109DE91(1896472209)
transform: esp-3des esp-md5-hmac .
in use settings ={Tunnel, }
conn id: 2006, flow_id: CSR6, sibling_flags FFFFFFFF80000048, crypto map: Tunnel0-head-0, initiator : False
sa timing: remaining key lifetime (k/sec): (4607987/348)
IV size: 8 bytes
replay detection support: Y
Status: ACTIVE(ACTIVE)
```

outbound ah sas:

outbound pcp sas:

R24#

R61:

R61#**show dmvpn**

Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete

N - NATed, L - Local, X - No Socket

T1 - Route Installed, T2 - Nexthop-override

C - CTS Capable, I2 - Temporary

Ent --> Number of NHRP entries with same NBMA peer

NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting

UpDn Time --> Up or Down Time for a Tunnel

=====

Interface: Tunnel0, IPv4 NHRP Details

Type:Spoke, NHRP Peers:1,



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
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E-mail: support@wolf-lab.com

Ent Peer NBMA Addr Peer Tunnel Add State UpDn Tm Attrb

1 200.99.24.2 10.200.0.1 UP 00:15:48 S

R61#

R61#show ip eigrp neighbor

EIGRP-IPv4 VR(ccie) Address-Family Neighbors for AS(65006)

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q	Seq Cnt Num
3	10.200.0.1	Tu0	12 00:10:13	51	1440	0	17
2	10.6.10.2	Gi0/3	13 01:56:13	12	100	0	69
1	10.6.12.2	Gi0/2	13 01:56:13	17	102	0	74
0	10.6.99.2	Gi0/1	14 01:56:17	12	100	0	90

R61#

R61#show ip eigrp neighbor

EIGRP-IPv4 VR(ccie) Address-Family Neighbors for AS(65006)

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q	Seq Cnt Num
0	10.6.99.2	Gi0/1	14 00:00:05	14	100	0	40
3	10.200.0.1	Tu0	13 00:00:32	15	1440	0	8
2	10.6.12.2	Gi0/2	14 00:31:29	12	100	0	22
1	10.6.10.2	Gi0/3	10 00:31:34	10	100	0	25

R61#

R61#show crypto isakmp sa detail

Codes: C - IKE configuration mode, D - Dead Peer Detection

K - Keepalives, N - NAT-traversal

T - cTCP encapsulation, X - IKE Extended Authentication

psk - Preshared key, rsig - RSA signature

renc - RSA encryption

IPv4 Crypto ISAKMP SA

C-id	Local	Remote	I-VRF	Status	Encr	Hash	Auth	DH	Lifetime	Cap.
1002	200.99.61.2	200.99.24.2		ACTIVE	3des	md5	psk	2	23:43:53	

IPv6 Crypto ISAKMP SA

R61#

R61#show crypto ipsec sa

interface: Tunnel0



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E-mail: support@wolf-lab.com

Crypto map tag: Tunnel0-head-0, local addr 200.99.61.2

protected vrf: (none)
local ident (addr/mask/prot/port): (200.99.61.2/255.255.255.255/47/0)
remote ident (addr/mask/prot/port): (200.99.24.2/255.255.255.255/47/0)
current_peer 200.99.24.2 port 500
 PERMIT, flags={origin_is_acl,}
#pkts encaps: 315, #pkts encrypt: 315, #pkts digest: 315
#pkts decaps: 322, #pkts decrypt: 322, #pkts verify: 322
#pkts compressed: 0, #pkts decompressed: 0
#pkts not compressed: 0, #pkts compr. failed: 0
#pkts not decompressed: 0, #pkts decompress failed: 0
#send errors 0, #recv errors 0

local crypto endpt.: 200.99.61.2, remote crypto endpt.: 200.99.24.2
plaintext mtu 1446, path mtu 1500, ip mtu 1500, ip mtu idb GigabitEthernet0/4
current outbound spi: 0x6FE245A7(1877099943)
PFS (Y/N): N, DH group: none

inbound esp sas:
spi: 0x4D30365F(1295005279)
transform: esp-3des esp-md5-hmac ,
in use settings ={Tunnel, }
conn id: 5, flow_id: SW5, sibling_flags 80000040, crypto map: Tunnel0-head-0
sa timing: remaining key lifetime (k/sec): (4346626/733)
IV size: 8 bytes
replay detection support: Y
Status: ACTIVE(ACTIVE)

inbound ah sas:

inbound pcp sas:

outbound esp sas:
spi: 0x6FE245A7(1877099943)
transform: esp-3des esp-md5-hmac ,
in use settings ={Tunnel, }
conn id: 6, flow_id: SW6, sibling_flags 80000040, crypto map: Tunnel0-head-0
sa timing: remaining key lifetime (k/sec): (4346626/733)
IV size: 8 bytes
replay detection support: Y
Status: ACTIVE(ACTIVE)



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai
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E-mail: support@wolf-lab.com

outbound ah sas:

outbound pcp sas:

R61#

R70:

R70#**show dmvpn**

Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete

N - NATed, L - Local, X - No Socket

T1 - Route Installed, T2 - Nexthop-override

C - CTS Capable, I2 - Temporary

Ent --> Number of NHRP entries with same NBMA peer

NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting

UpDn Time --> Up or Down Time for a Tunnel

=====

Interface: Tunnel0, IPv4 NHRP Details

Type:Spoke, NHRP Peers:1

Ent Peer NBMA Addr Peer Tunnel Add State UpDn Tm Attrb

1 200.99.24.2 10.200.0.1 UP 00:19:20 S

R70#

R70#**show ip eigrp neighbor**

EIGRP-IPv4 VR(ccie) Address-Family Neighbors for AS(65006)

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q Cnt	Seq Num
0	10.200.0.1	Tu0	14 00:15:40	15	1440	0	17

R70#

R70#**show crypto isakmp sa detail**

Codes: C - IKE configuration mode, D - Dead Peer Detection

K - Keepalives, N - NAT-traversal

T - cTCP encapsulation, X - IKE Extended Authentication

psk - Preshared key, rsig - RSA signature

renc - RSA encryption

IPv4 Crypto ISAKMP SA

C-id Local Remote I-VRF Status Encr Hash Auth DH Lifetime Cap.

1001 200.99.70.2 200.99.24.2 ACTIVE 3des md5 psk 2 23:40:25
Engine-id:Conn-id = SW:1



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai
Website: www.wolf-lab.com
E-mail: support@wolf-lab.com

IPv6 Crypto ISAKMP SA

R70#

R70#**show crypto ipsec sa**

interface: Tunnel0

Crypto map tag: Tunnel0-head-0, local addr 200.99.70.2

protected vrf: (none)

local ident (addr/mask/prot/port): (200.99.70.2/255.255.255.255/47/0)

remote ident (addr/mask/prot/port): (200.99.24.2/255.255.255.255/47/0)

current_peer 200.99.24.2 port 500

PERMIT, flags={origin_is_acl,}

#pkts encaps: 277, #pkts encrypt: 277, #pkts digest: 277

#pkts decaps: 281, #pkts decrypt: 281, #pkts verify: 281

#pkts compressed: 0, #pkts decompressed: 0

#pkts not compressed: 0, #pkts compr, failed: 0

#pkts not decompressed: 0, #pkts decompress failed: 0

#send errors 0, #recv errors 0

local crypto endpt: 200.99.70.2, remote crypto endpt: 200.99.24.2

plaintext mtu 1446, path mtu 1500, ip mtu 1500, ip idb GigabitEthernet0/1

current outbound spi: 0xC458A155(3294142805)

PFS (Y/N): N, DH group: none

inbound esp sas:

spi: 0x26920A6C(647105132)

transform: esp-3des esp-md5-hmac ,

in use settings ={Tunnel, }

conn id: 3, flow_id: SW:3, sibling_flags 80000040, crypto map: Tunnel0-head-0

sa timing: remaining key lifetime (k/sec): (4373261/525)

IV size: 8 bytes

replay detection support: Y

Status: ACTIVE(ACTIVE)

inbound ah sas:

inbound pcp sas:

outbound esp sas:

spi: 0xC458A155(3294142805)

transform: esp-3des esp-md5-hmac ,

in use settings ={Tunnel, }



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上海市徐汇区漕宝路 82 号光大会展中心 E 座 1902-1904 室
Rm 1902 ,Block E, Guangda Exhibition , No.82, Caobao Rd.,Xuhui District ,Shanghai
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conn id: 4, flow_id: SW:4, sibling_flags 80000040, crypto map: Tunnel0-head-0
sa timing: remaining key lifetime (k/sec): (4373261/525)
IV size: 8 bytes
replay detection support: Y
Status: ACTIVE(ACTIVE)

outbound ah sas:

outbound pcp sas:

R70#

3.4 The End



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