VŠB – Technical University of Ostrava
Faculty of Electrical Engineering and Computer Science
Department of Computer Science

SPS - Semestral project

SPS - Semestrální projekt

2021

Martin Pustka, Vadim Karačencev

Abstrakt

Semestrální projekt do předmětu SPS v 1. semestru navazujícího magisterského studia. Projekt obsahuje

Klíčová slova: SPS, IPv4, IPv6, OSPFv3, BGP, Spanning Tree, STP, RPVST+, Agregace, VRF MGMT, Konvergence, FHRP, Standby, VRRP, PortChannel

Abstract

SPS

Keywords: SPS, IPv4, IPv6, OSPFv3, BGP, Spanning Tree, STP, RPVST+, Aggregation, VRF MGMT, Convergence, FHRP, Standby, VRRP, PortChannel

Contents

1 VLANs plan

Name	Number	Description
Klient 101	101	
Klient 102	102	
Klient 103	103	
Server 301	301	
Server 302	301	
Server 303	303	
g	9	data traffic
M	91	management VRF
MA	18	management VRF
unused	998	not used ports
native	999	native

2 L2 access & distribution

2.1 VLANs implementation

do sh vlan

```
ALSW1(config)#do sh vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active
18   MA                               active    Gi1/0
101  klient101                        active    Gi0/3
102  klient102                        active
103  klient103                        active
301  server301                        active    Gi0/0
302  server302                        active
303  server303                        active
998  unused                           active
999  native                           active
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
18   enet  100018     1500  -      -      -        -    -        0      0
101  enet  100101     1500  -      -      -        -    -        0      0
102  enet  100102     1500  -      -      -        -    -        0      0
103  enet  100103     1500  -      -      -        -    -        0      0
301  enet  100301     1500  -      -      -        -    -        0      0
302  enet  100302     1500  -      -      -        -    -        0      0
303  enet  100303     1500  -      -      -        -    -        0      0
998  enet  100998     1500  -      -      -        -    -        0      0
999  enet  100999     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

Remote SPAN VLANs
------------------------------------------------------------------------------


Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
```

Figure 1: ALSW1 VLANs

```
DLSW1(config)#do sh vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi0/3
18   MA                               active
101  klient101                        active
102  klient102                        active
103  klient103                        active
301  server301                        active
302  server302                        active
303  server303                        active
998  unused                           active
999  native                           active
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
18   enet  100018     1500  -      -      -        -    -        0      0
101  enet  100101     1500  -      -      -        -    -        0      0
102  enet  100102     1500  -      -      -        -    -        0      0
103  enet  100103     1500  -      -      -        -    -        0      0
301  enet  100301     1500  -      -      -        -    -        0      0
302  enet  100302     1500  -      -      -        -    -        0      0
303  enet  100303     1500  -      -      -        -    -        0      0
998  enet  100998     1500  -      -      -        -    -        0      0
999  enet  100999     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

Remote SPAN VLANs
------------------------------------------------------------------------------


Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
```

Figure 2: DLSW1 VLANs

```
DLSW2(config)#do sh vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi0/3
18   MA                               active
101  klient101                        active
102  klient102                        active
103  klient103                        active
301  server301                        active
302  server302                        active
303  server303                        active
998  unused                           active
999  native                           active
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
18   enet  100018     1500  -      -      -        -    -        0      0
101  enet  100101     1500  -      -      -        -    -        0      0
102  enet  100102     1500  -      -      -        -    -        0      0
103  enet  100103     1500  -      -      -        -    -        0      0
301  enet  100301     1500  -      -      -        -    -        0      0
302  enet  100302     1500  -      -      -        -    -        0      0
303  enet  100303     1500  -      -      -        -    -        0      0
998  enet  100998     1500  -      -      -        -    -        0      0
999  enet  100999     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

Remote SPAN VLANs
------------------------------------------------------------------------------


Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
```

Figure 3: DLSW2 VLANs

2.2 Trunks

do sh int trunk

```
ALSW1(config)#do sh int trunk

Port        Mode             Encapsulation  Status        Native vlan
Gi0/1       on               802.1q         trunking      999
Gi0/2       on               802.1q         trunking      999
Gi1/1       on               802.1q         trunking      999
Gi1/2       on               802.1q         trunking      999
Gi1/3       on               802.1q         trunking      999

Port        Vlans allowed on trunk
Gi0/1       18,101-103,301-303,999
Gi0/2       18,101-103,301-303,999
Gi1/1       998
Gi1/2       998
Gi1/3       998

Port        Vlans allowed and active in management domain
Gi0/1       18,101-103,301-303,999
Gi0/2       18,101-103,301-303,999
Gi1/1       998
Gi1/2       998
Gi1/3       998

Port        Vlans in spanning tree forwarding state and not pruned
Gi0/1       18,301-303,999
Gi0/2       18,101-103,999
Gi1/1       998
Gi1/2       998
Gi1/3       998
```

Figure 4: ALSW1 Trunks

```
DLSW1(config)#do sh int trunk

Port        Mode             Encapsulation  Status        Native vlan
Gi0/0       on               802.1q         trunking      999
Gi0/1       on               802.1q         trunking      999
Gi1/0       on               802.1q         trunking      999
Po1         on               802.1q         trunking      999

Port        Vlans allowed on trunk
Gi0/0       998
Gi0/1       18,101-103,301-303,999
Gi1/0       18,101-103,301-303,999
Po1         18,101-103,301-303,999

Port        Vlans allowed and active in management domain
Gi0/0       998
Gi0/1       18,101-103,301-303,999
Gi1/0       18,101-103,301-303,999
Po1         18,101-103,301-303,999

Port        Vlans in spanning tree forwarding state and not pruned
Gi0/0       998
Gi0/1       18,101-103,301-303,999
Gi1/0       18,101-103,301-303,999
Po1         18,101-103,301-303,999
```

Figure 5: DLSW1 Trunks

```
DLSW2(config)#do sh int trunk

Port        Mode             Encapsulation  Status        Native vlan
Gi0/0       on               802.1q         trunking      999
Gi0/1       on               802.1q         trunking      999
Gi1/0       on               802.1q         trunking      999
Po1         on               802.1q         trunking      999

Port        Vlans allowed on trunk
Gi0/0       998
Gi0/1       18,101-103,301-303,999
Gi1/0       18,101-103,301-303,999
Po1         18,101-103,301-303,999

Port        Vlans allowed and active in management domain
Gi0/0       998
Gi0/1       18,101-103,301-303,999
Gi1/0       18,101-103,301-303,999
Po1         18,101-103,301-303,999

Port        Vlans in spanning tree forwarding state and not pruned
Gi0/0       998
Gi0/1       18,101-103,301-303,999
Gi1/0       18,101-103,301-303,999
Po1         101-103,301-303
```

Figure 6: DLSW2 Trunks

2.3 LACP

do sh etherchannel summary

```
DLSW1(config)#do sh 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: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------
1      Po1(SU)         LACP      Gi0/2(P)    Gi0/3(s)
```

Figure 7: DLSW1 LACP

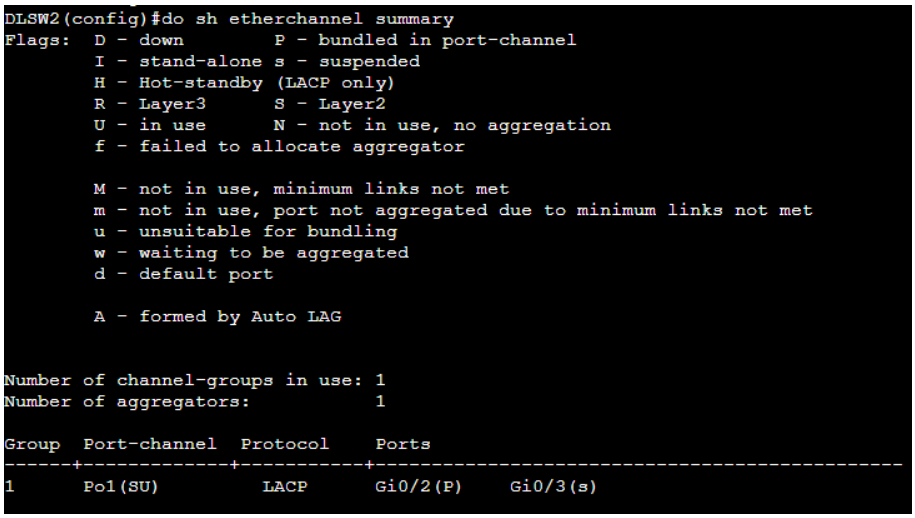


Figure 8: DLSW2 LACP

3 Spanning Tree

do sh spanning-tree

```
ALSW1(config)#do sh spanning-tree

VLAN0018
  Spanning tree enabled protocol rstp
  Root ID     Priority    32786
              Address     5254.0005.5cd0
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32786  (priority 32768 sys-id-ext 18)
              Address     5254.0005.5cd0
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi0/2               Desg FWD 4         128.3    P2p
Gi1/0               Desg FWD 4         128.5    P2p



VLAN0101
  Spanning tree enabled protocol rstp
  Root ID     Priority    28773
              Address     5254.0016.6c37
              Cost        9
              Port        3 (GigabitEthernet0/2)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32869  (priority 32768 sys-id-ext 101)
              Address     5254.0005.5cd0
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Altn BLK 20        128.2    P2p
Gi0/2               Root FWD 5         128.3    P2p
Gi0/3               Desg FWD 4         128.4    P2p Edge
```

Figure 9: ALSW1 STP 1/5

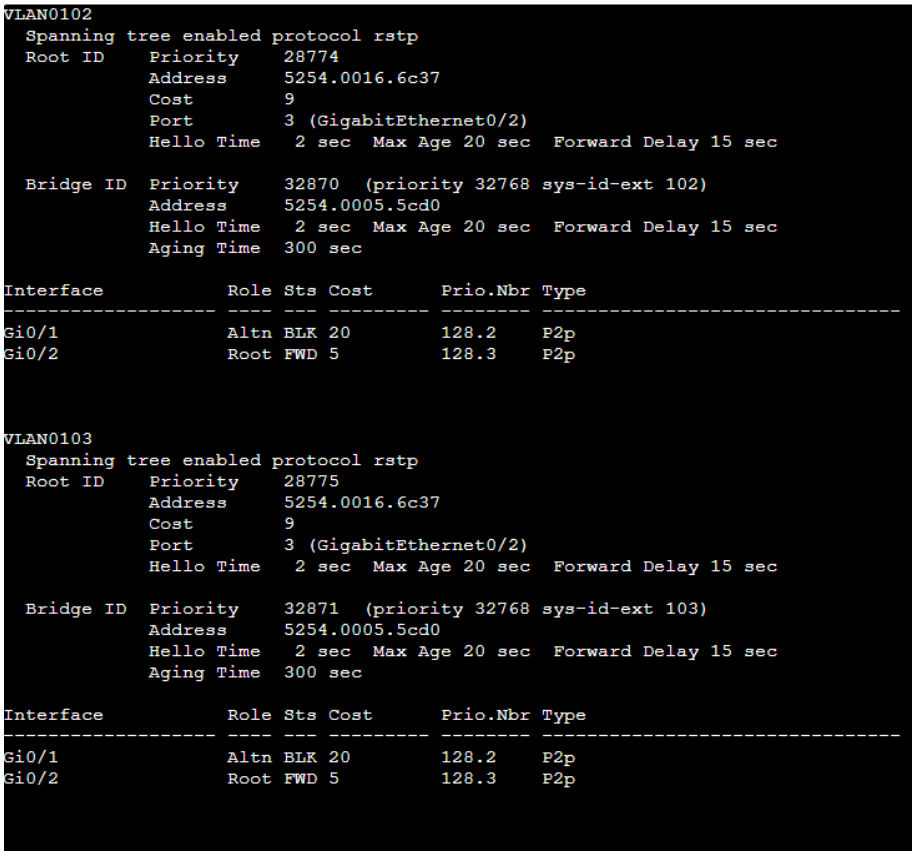


Figure 10: ALSW1 STP 2/5

```
VLAN0301
  Spanning tree enabled protocol rstp
  Root ID     Priority    24877
              Address     5254.0016.6c37
              Cost        5
              Port        2 (GigabitEthernet0/1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    33069  (priority 32768 sys-id-ext 301)
              Address     5254.0005.5cd0
              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
Gi0/1               Root FWD 5         128.2    P2p
Gi0/2               Altn BLK 20        128.3    P2p


VLAN0302
  Spanning tree enabled protocol rstp
  Root ID     Priority    24878
              Address     5254.0016.6c37
              Cost        5
              Port        2 (GigabitEthernet0/1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    33070  (priority 32768 sys-id-ext 302)
              Address     5254.0005.5cd0
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Root FWD 5         128.2    P2p
Gi0/2               Altn BLK 20        128.3    P2p
```

Figure 11: ALSW1 STP 3/5

```
VLAN0303
  Spanning tree enabled protocol rstp
  Root ID     Priority    24879
              Address     5254.0016.6c37
              Cost        5
              Port        2 (GigabitEthernet0/1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    33071  (priority 32768 sys-id-ext 303)
              Address     5254.0005.5cd0
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Root FWD 5         128.2    P2p
Gi0/2               Altn BLK 20        128.3    P2p


VLAN0998
  Spanning tree enabled protocol rstp
  Root ID     Priority    33766
              Address     5254.0005.5cd0
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    33766  (priority 32768 sys-id-ext 998)
              Address     5254.0005.5cd0
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi1/1               Desg FWD 4         128.6    P2p
Gi1/2               Desg FWD 4         128.7    P2p
Gi1/3               Desg FWD 4         128.8    P2p
```

Figure 12: ALSW1 STP 4/5

```
VLAN0999
  Spanning tree enabled protocol rstp
  Root ID     Priority    33767
              Address     5254.0005.5cd0
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    33767  (priority 32768 sys-id-ext 999)
              Address     5254.0005.5cd0
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi0/2               Desg FWD 4         128.3    P2p
```

Figure 13: ALSW1 STP 5/5

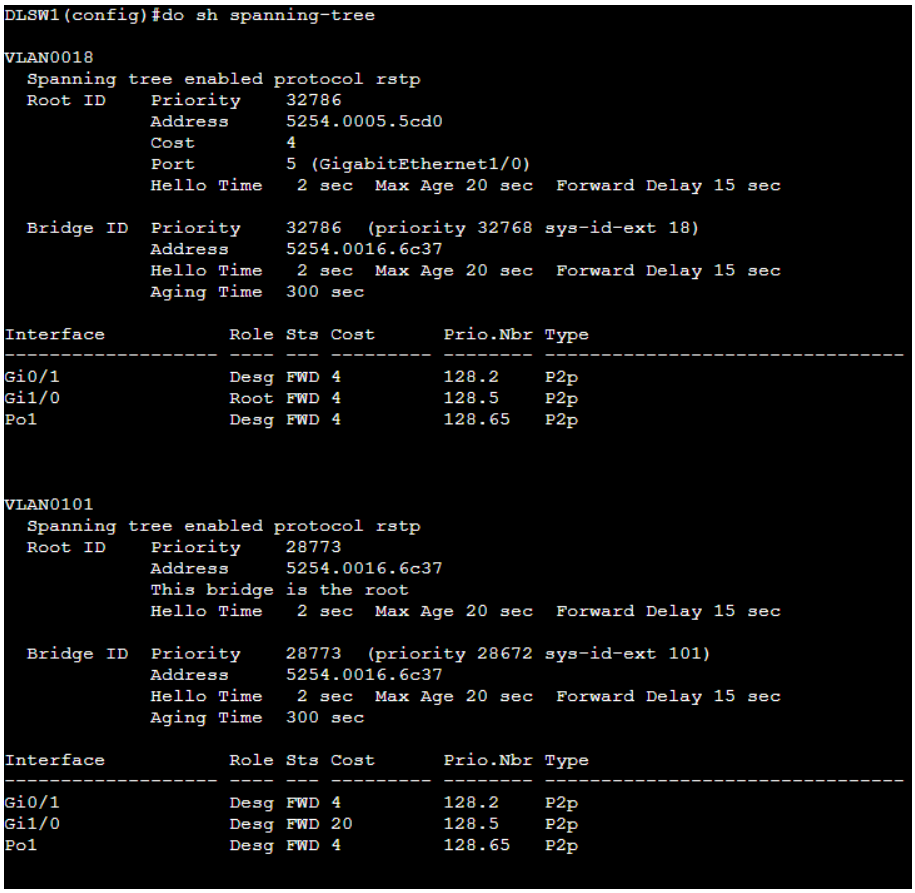


Figure 14: DLSW1 STP 1/5

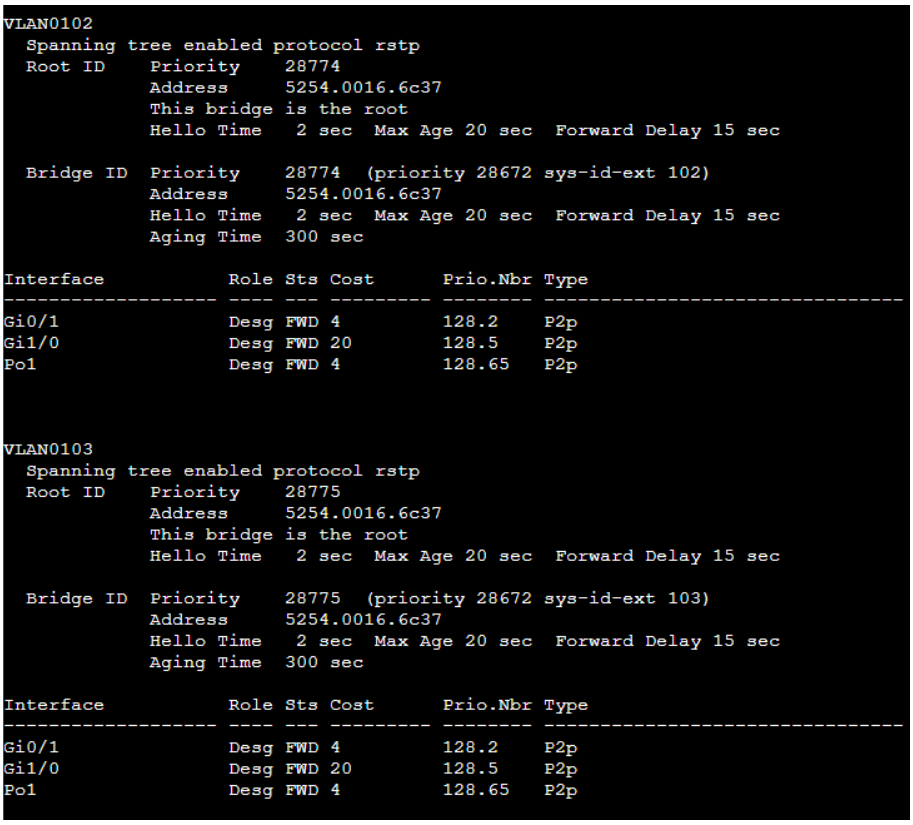


Figure 15: DLSW1 STP 2/5

```
VLAN0301
  Spanning tree enabled protocol rstp
  Root ID     Priority    24877
              Address     5254.0016.6c37
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    24877  (priority 24576 sys-id-ext 301)
              Address     5254.0016.6c37
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Desg FWD 5         128.5    P2p
Po1                 Desg FWD 4         128.65   P2p


VLAN0302
  Spanning tree enabled protocol rstp
  Root ID     Priority    24878
              Address     5254.0016.6c37
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    24878  (priority 24576 sys-id-ext 302)
              Address     5254.0016.6c37
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Desg FWD 5         128.5    P2p
Po1                 Desg FWD 4         128.65   P2p
```

Figure 16: DLSW1 STP 3/5

```
VLAN0303
  Spanning tree enabled protocol rstp
  Root ID     Priority    24879
              Address     5254.0016.6c37
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    24879  (priority 24576 sys-id-ext 303)
              Address     5254.0016.6c37
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Desg FWD 5         128.5    P2p
Po1                 Desg FWD 4         128.65   P2p


VLAN0998
  Spanning tree enabled protocol rstp
  Root ID     Priority    33766
              Address     5254.0016.6c37
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    33766  (priority 32768 sys-id-ext 998)
              Address     5254.0016.6c37
              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
```

Figure 17: DLSW1 STP 4/5

```
VLAN0999
  Spanning tree enabled protocol rstp
  Root ID     Priority    33767
              Address     5254.0005.5cd0
              Cost        4
              Port        5 (GigabitEthernet1/0)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    33767  (priority 32768 sys-id-ext 999)
              Address     5254.0016.6c37
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Root FWD 4         128.5    P2p
Po1                 Desg FWD 4         128.65   P2p
```

Figure 18: DLSW1 STP 5/5

```
DLSW2(config)#do sh spanning-tree

VLAN0018
  Spanning tree enabled protocol rstp
  Root ID     Priority    32786
              Address     5254.0005.5cd0
              Cost        4
              Port        5 (GigabitEthernet1/0)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32786  (priority 32768 sys-id-ext 18)
              Address     5254.001d.c647
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Root FWD 4         128.5    P2p
Po1                 Altn BLK 4         128.65   P2p


VLAN0101
  Spanning tree enabled protocol rstp
  Root ID     Priority    28773
              Address     5254.0016.6c37
              Cost        4
              Port        65 (Port-channel1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    28773  (priority 28672 sys-id-ext 101)
              Address     5254.001d.c647
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Desg FWD 5         128.5    P2p
Po1                 Root FWD 4         128.65   P2p
```

Figure 19: DLSW2 STP 1/5

```
VLAN0102
  Spanning tree enabled protocol rstp
  Root ID     Priority    28774
              Address     5254.0016.6c37
              Cost        4
              Port        65 (Port-channel1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    28774  (priority 28672 sys-id-ext 102)
              Address     5254.001d.c647
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Desg FWD 5         128.5    P2p
Po1                 Root FWD 4         128.65   P2p


VLAN0103
  Spanning tree enabled protocol rstp
  Root ID     Priority    28775
              Address     5254.0016.6c37
              Cost        4
              Port        65 (Port-channel1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    28775  (priority 28672 sys-id-ext 103)
              Address     5254.001d.c647
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Desg FWD 5         128.5    P2p
Po1                 Root FWD 4         128.65   P2p
```

Figure 20: DLSW2 STP 2/5

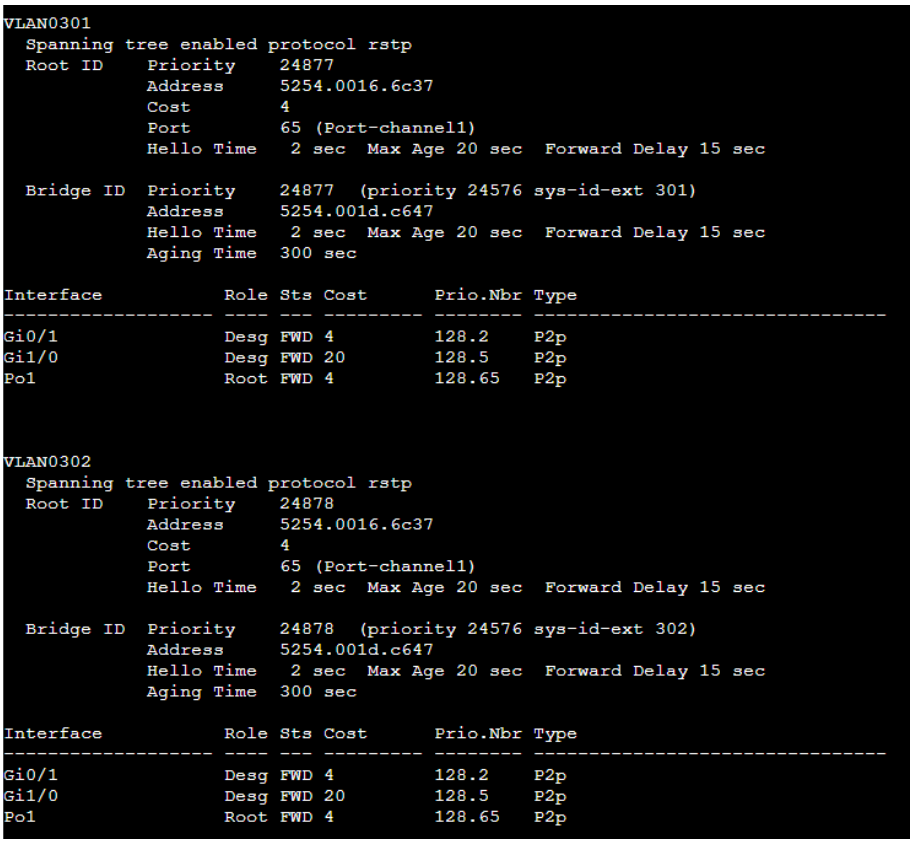


Figure 21: DLSW2 STP 3/5

```
VLAN0303
  Spanning tree enabled protocol rstp
  Root ID     Priority    24879
              Address     5254.0016.6c37
              Cost        4
              Port        65 (Port-channel1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    24879  (priority 24576 sys-id-ext 303)
              Address     5254.001d.c647
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Desg FWD 20        128.5    P2p
Po1                 Root FWD 4         128.65   P2p


VLAN0998
  Spanning tree enabled protocol rstp
  Root ID     Priority    33766
              Address     5254.001d.c647
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    33766  (priority 32768 sys-id-ext 998)
              Address     5254.001d.c647
              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
```

Figure 22: DLSW2 STP 4/5

```
VLAN0999
  Spanning tree enabled protocol rstp
  Root ID     Priority    33767
              Address     5254.0005.5cd0
              Cost        4
              Port        5 (GigabitEthernet1/0)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    33767  (priority 32768 sys-id-ext 999)
              Address     5254.001d.c647
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi0/1               Desg FWD 4         128.2    P2p
Gi1/0               Root FWD 4         128.5    P2p
Po1                 Altn BLK 4         128.65   P2p
```

Figure 23: DLSW2 STP 5/5

4 Addressing

4.1 IPv4

Klient/server

Name	Network address	Description
VLAN 101	44.9.0.0/25	Client VLAN 1
VLAN 102	44.9.0.128/26	Client VLAN 2
VLAN 103	44.9.0.192/28	Client VLAN 3
Client 1	44.9.1.0/25	First client subnet
...	...	...
Client 200	44.9.100.128/25	Last client subnet
...	...	...
Server 1	44.9.222.0/25	First server subnet
...	...	...
Server 50	44.9.246.128/25	Last server subnet
VLAN 301	44.9.247.0/25	Server VLAN 1
VLAN 302	44.9.247.128/26	Server VLAN 2
VLAN 303	44.9.247.192/28	Server VLAN 3

Global

Name	Network address	First address	Second address	Description
R1-WAN1	2001:9999:0:1::/127	2001:9999:0:1::1	2001:9999:0:1::	IC Link
R1-WAN2	2001:9999:0:1::2/127	2001:9999:0:1::3	2001:9999:0:1::2	IC Link
R2-WAN1	2001:9999:0:1::4/127	2001:9999:0:1::5	2001:9999:0:1::4	IC Link
R2-WAN2	2001:9999:0:1::6/127	2001:9999:0:1::7	2001:9999:0:1::6	IC Link
WAN1-WAN2	2001:9999:0:1::8/127	2001:9999:0:1::8	2001:9999:0:1::9	IC Link
WAN1-ISP1	2001:9999:0:1::A/127	2001:9999:0:1::B	2001:9999:0:1::A	IC Link
WAN2-ISP2	2001:9999:0:1::C/127	2001:9999:0:1::D	2001:9999:0:1::C	IC Link
ISP1-ISP2	2001:9999:0:1::E/127	2001:9999:0:1::E	2001:9999:0:1::F	IC Link
DLSW1	2001:9999:0:1::400/128	2001:9999:0:1::400	-	Loopback0
DLSW2	2001:9999:0:1::401/128	2001:9999:0:1::401	-	Loopback0
ALSW1	2001:9999:0:1::402/128	2001:9999:0:1::402	-	Loopback0
R1	2001:9999:0:1::403/128	2001:9999:0:1::403	-	Loopback0
R2	2001:9999:0:1::404/128	2001:9999:0:1::404	-	Loopback0
WAN1	2001:9999:0:1::405/128	2001:9999:0:1::405	-	Loopback0
WAN2	2001:9999:0:1::406/128	2001:9999:0:1::406	-	Loopback0
ISP1	2001:9999:0:1::407/128	2001:9999:0:1::407	-	Loopback0
ISP2	2001:9999:0:1::408/128	2001:9999:0:1::408	-	Loopback0

Management

Name	Network address	First address	Second address	Description
R1-WAN1	44.9.253.248/31	44.9.253.248	44.9.253.249	IC Link
R1-WAN2	44.9.253.250/31	44.9.253.250	44.9.253.251	IC Link
R2-WAN1	44.9.253.252/31	44.9.253.252	44.9.253.253	IC Link
R2-WAN2	44.9.253.254/31	44.9.253.254	44.9.253.255	IC Link
VRRP	44.9.252.0/24	44.9.252.1	-	R1 & R2 virtual
R1	44.9.252.0/24	44.9.252.2	-	Adress on interface
R2	44.9.252.0/24	44.9.252.3	-	Adress on interface
DLSW1	44.9.252.0/24	44.9.252.4	-	VLAN 18
DLSW2	44.9.252.0/24	44.9.252.5	-	VLAN 18
ALSW1	44.9.252.0/24	44.9.252.6	-	VLAN 18
TEST PC	44.9.252.0/24	44.9.252.20	-	VLAN 18
R1	44.9.253.244/32	44.9.253.244	-	Loopback1
R2	44.9.253.245/32	44.9.253.245	-	Loopback1
WAN1	44.9.253.246/32	44.9.253.246	-	Loopback1
WAN2	44.9.253.247/32	44.9.253.247	-	Loopback1

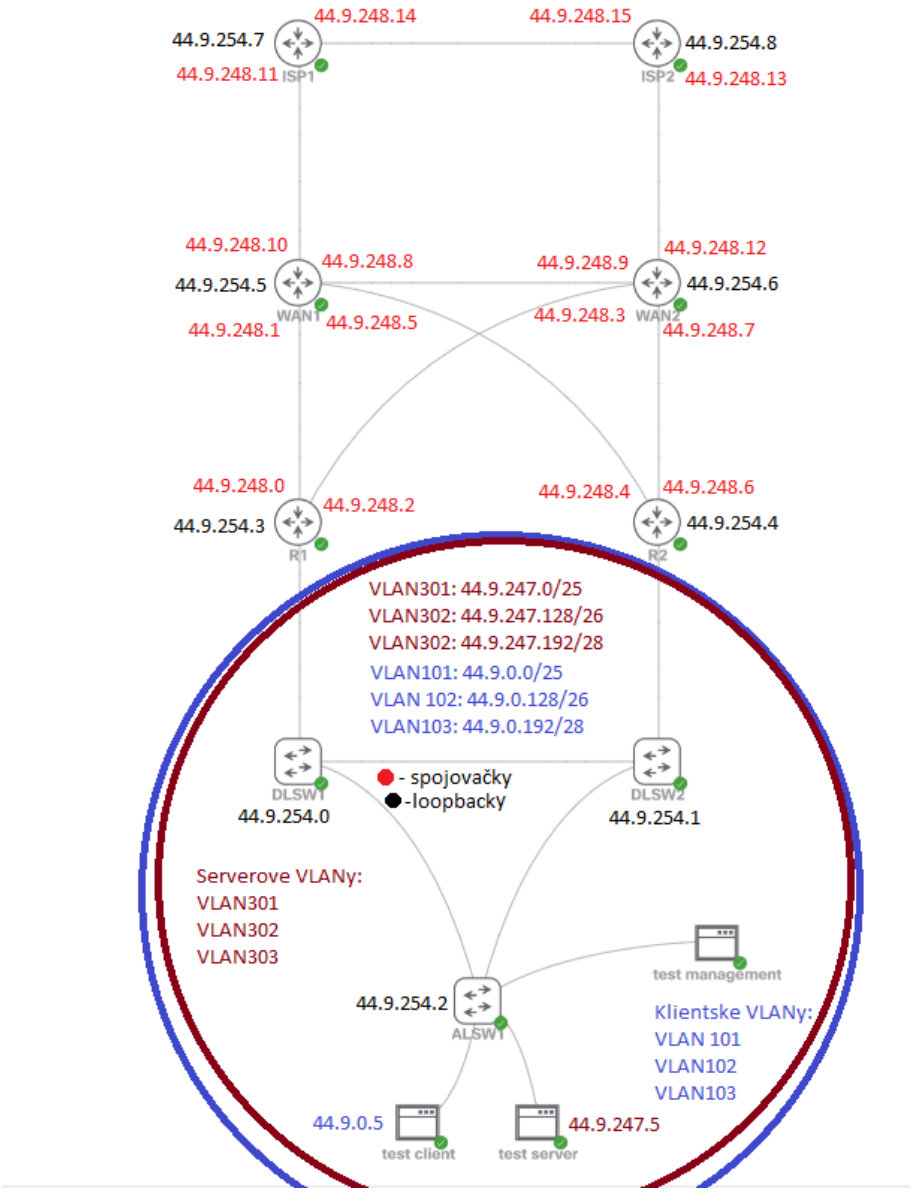


Figure 24: IPv4 addressing

4.2 IPv6

Klient/server

Name	Network address	Description
VLAN 101	2001:9999:1::/64	Client VLAN 1
VLAN 102	2001:9999:1:1::/64	Client VLAN 2
VLAN 103	2001:9999:1:2::/64	Client VLAN 3
Client 1	2001:9999:1:3:/64	First client subnet
...	...	...
Client 200	2001:9999:1:ca::/64	Last client subnet
VLAN 301	2001:9999:2::/64	Server VLAN 1
VLAN 302	2001:9999:2:1::/64	Server VLAN 2
VLAN 303	2001:9999:2:2::/64	Server VLAN 3
Server 1	2001:9999:2:3::/64	First server subnet
...	...	...
Server 50	2001:9999:2:34::/64	Last server subnet

Global

Name	Network address	First address	Second address	Description
R1-WAN1	2001:9999:0:1::/127	2001:9999:0:1::1	2001:9999:0:1::	IC Link
R1-WAN2	2001:9999:0:1::2/127	2001:9999:0:1::3	2001:9999:0:1::2	IC Link
R2-WAN1	2001:9999:0:1::4/127	2001:9999:0:1::5	2001:9999:0:1::4	IC Link
R2-WAN2	2001:9999:0:1::6/127	2001:9999:0:1::7	2001:9999:0:1::6	IC Link
WAN1-WAN2	2001:9999:0:1::8/127	2001:9999:0:1::8	2001:9999:0:1::9	IC Link
WAN1-ISP1	2001:9999:0:1::A/127	2001:9999:0:1::B	2001:9999:0:1::A	IC Link
WAN2-ISP2	2001:9999:0:1::C/127	2001:9999:0:1::D	2001:9999:0:1::C	IC Link
ISP1-ISP2	2001:9999:0:1::E/127	2001:9999:0:1::E	2001:9999:0:1::F	IC Link
DLSW1	2001:9999:0:1::400/128	2001:9999:0:1::400	-	Loopback0
DLSW2	2001:9999:0:1::401/128	2001:9999:0:1::401	-	Loopback0
ALSW1	2001:9999:0:1::402/128	2001:9999:0:1::402	-	Loopback0
R1	2001:9999:0:1::403/128	2001:9999:0:1::403	-	Loopback0
R2	2001:9999:0:1::404/128	2001:9999:0:1::404	-	Loopback0
WAN1	2001:9999:0:1::405/128	2001:9999:0:1::405	-	Loopback0
WAN2	2001:9999:0:1::406/128	2001:9999:0:1::406	-	Loopback0
ISP1	2001:9999:0:1::407/128	2001:9999:0:1::407	-	Loopback0
ISP2	2001:9999:0:1::408/128	2001:9999:0:1::408	-	Loopback0

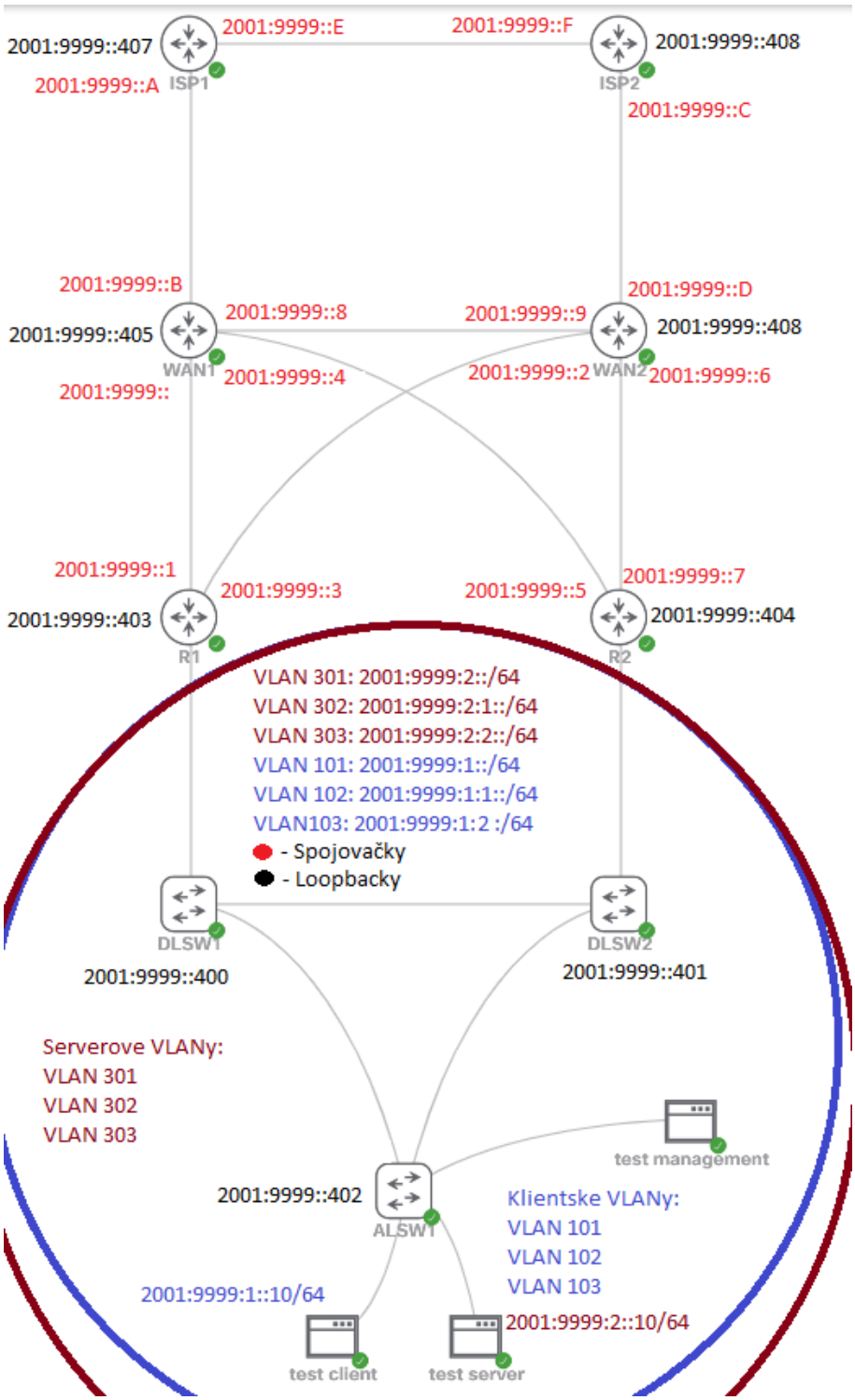


Figure 25: IPv6 addressing

4.3 Convergence

Routing from client to 2.0.0.1/2001:9999:2000::1 prefers route through R2-WAN1-ISP1-ISP2 standby took 0s STP - took 6s

```
localhost:~$ ping 2.0.0.1
PING 2.0.0.1 (2.0.0.1): 56 data bytes
64 bytes from 2.0.0.1: seq=0 ttl=42 time=13.931 ms
64 bytes from 2.0.0.1: seq=1 ttl=42 time=11.964 ms
64 bytes from 2.0.0.1: seq=2 ttl=42 time=16.135 ms
64 bytes from 2.0.0.1: seq=3 ttl=42 time=10.684 ms
64 bytes from 2.0.0.1: seq=9 ttl=42 time=1026.999 ms
64 bytes from 2.0.0.1: seq=10 ttl=42 time=27.915 ms
64 bytes from 2.0.0.1: seq=11 ttl=42 time=11.829 ms
64 bytes from 2.0.0.1: seq=12 ttl=42 time=9.769 ms
64 bytes from 2.0.0.1: seq=13 ttl=42 time=11.090 ms
```

Figure 26: IPv4 STP convergence

```
localhost:~$ ping 2001:9999:2000::1
PING 2001:9999:2000::1 (2001:9999:2000::1): 56 data bytes
64 bytes from 2001:9999:2000::1: seq=0 ttl=61 time=13.318 ms
64 bytes from 2001:9999:2000::1: seq=1 ttl=61 time=13.008 ms
64 bytes from 2001:9999:2000::1: seq=2 ttl=61 time=15.762 ms
64 bytes from 2001:9999:2000::1: seq=3 ttl=61 time=11.775 ms
64 bytes from 2001:9999:2000::1: seq=10 ttl=61 time=37.407 ms
64 bytes from 2001:9999:2000::1: seq=11 ttl=61 time=14.863 ms
64 bytes from 2001:9999:2000::1: seq=12 ttl=61 time=11.216 ms
64 bytes from 2001:9999:2000::1: seq=13 ttl=61 time=12.995 ms
```

Figure 27: IPv6 STP Convergence

OSPFv3 - took 5s

```
64 bytes from 2.0.0.1: seq=5 ttl=42 time=12.438 ms
64 bytes from 2.0.0.1: seq=6 ttl=42 time=10.133 ms
64 bytes from 2.0.0.1: seq=7 ttl=42 time=17.241 ms
64 bytes from 2.0.0.1: seq=8 ttl=42 time=14.576 ms
64 bytes from 2.0.0.1: seq=9 ttl=42 time=12.428 ms
64 bytes from 2.0.0.1: seq=10 ttl=42 time=12.211 ms
64 bytes from 2.0.0.1: seq=16 ttl=42 time=12.899 ms
64 bytes from 2.0.0.1: seq=17 ttl=42 time=20.203 ms
64 bytes from 2.0.0.1: seq=18 ttl=42 time=12.350 ms
64 bytes from 2.0.0.1: seq=19 ttl=42 time=21.667 ms
64 bytes from 2.0.0.1: seq=20 ttl=42 time=12.085 ms
```

Figure 28: IPv4 OSPFv3 convergence

```
64 bytes from 2001:9999:2000::1: seq=3 ttl=61 time=9.863 ms
64 bytes from 2001:9999:2000::1: seq=4 ttl=61 time=9.815 ms
64 bytes from 2001:9999:2000::1: seq=5 ttl=61 time=13.206 ms
64 bytes from 2001:9999:2000::1: seq=6 ttl=61 time=8.706 ms
64 bytes from 2001:9999:2000::1: seq=7 ttl=61 time=11.633 ms
64 bytes from 2001:9999:2000::1: seq=8 ttl=61 time=20.986 ms
64 bytes from 2001:9999:2000::1: seq=9 ttl=61 time=9.508 ms
64 bytes from 2001:9999:2000::1: seq=15 ttl=61 time=9.437 ms
64 bytes from 2001:9999:2000::1: seq=16 ttl=61 time=8.076 ms
64 bytes from 2001:9999:2000::1: seq=17 ttl=61 time=12.409 ms
64 bytes from 2001:9999:2000::1: seq=18 ttl=61 time=15.159 ms
64 bytes from 2001:9999:2000::1: seq=19 ttl=61 time=8.730 ms
```

Figure 29: IPv6 OSPFv3 convergence

BGP - took 180s

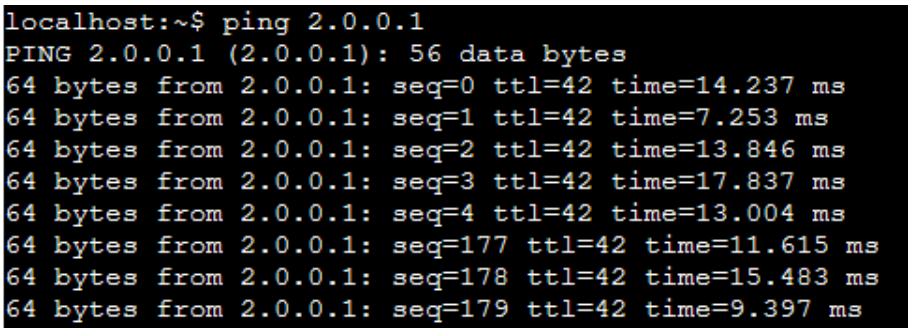


Figure 30: IPv4 BGP convergence

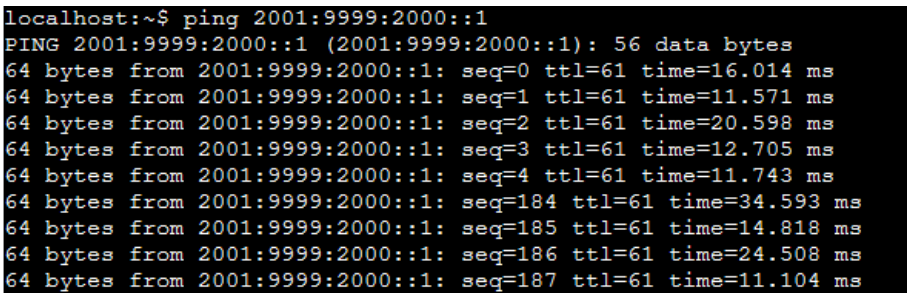


Figure 31: IPv6 BGP convergence

5 FHRP

5.1 Implementation

do sh standby br

```
R1(config-subif)#do sh standby br
                  P indicates configured to preempt.
                  |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi0/1.101   11   120 P Standby FE80::5054:FF:FE17:C2F3
                                               local           FE80::5:73FF:FEA0:B
Gi0/1.101   101  120 P Standby 44.9.0.3        local           44.9.0.1
Gi0/1.102   12   120 P Standby FE80::5054:FF:FE17:C2F3
                                               local           FE80::5:73FF:FEA0:C
Gi0/1.102   102  120 P Standby 44.9.0.131      local           44.9.0.129
Gi0/1.103   13   120 P Standby FE80::5054:FF:FE17:C2F3
                                               local           FE80::5:73FF:FEA0:D
Gi0/1.103   103  120 P Standby 44.9.0.195      local           44.9.0.193
Gi0/1.301   1    150 P Active  local           44.9.247.3      44.9.247.1
Gi0/1.301   21   150 P Active  local           FE80::5054:FF:FE17:C2F3
                                                               FE80::5:73FF:FEA0:15
Gi0/1.302   2    150 P Active  local           44.9.247.131    44.9.247.129
Gi0/1.302   22   150 P Active  local           FE80::5054:FF:FE17:C2F3
                                                               FE80::5:73FF:FEA0:16
Gi0/1.303   3    150 P Active  local           44.9.247.195    44.9.247.193
Gi0/1.303   23   150 P Active  local           FE80::5054:FF:FE17:C2F3
                                                               FE80::5:73FF:FEA0:17
```

Figure 32: R1 FHRP implementace

```
R2(config-subif)#do sh standby br
                  P indicates configured to preempt.
                  |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi0/1.101   11   120 P Active  local           FE80::5054:FF:FE06:69A1
                                                               FE80::5:73FF:FEA0:B
Gi0/1.101   101  150 P Active  local           44.9.0.2        44.9.0.1
Gi0/1.102   12   150 P Active  local           FE80::5054:FF:FE06:69A1
                                                               FE80::5:73FF:FEA0:C
Gi0/1.102   102  150 P Active  local           44.9.0.130      44.9.0.129
Gi0/1.103   13   150 P Active  local           FE80::5054:FF:FE06:69A1
                                                               FE80::5:73FF:FEA0:D
Gi0/1.103   103  150 P Active  local           44.9.0.194      44.9.0.193
Gi0/1.301   1    120 P Standby 44.9.247.2      local           44.9.247.1
Gi0/1.301   21   120 P Standby FE80::5054:FF:FE06:69A1
                                               local           FE80::5:73FF:FEA0:15
Gi0/1.302   2    120 P Standby 44.9.247.130    local           44.9.247.129
Gi0/1.302   22   120 P Standby FE80::5054:FF:FE06:69A1
                                               local           FE80::5:73FF:FEA0:16
Gi0/1.303   3    120 P Standby 44.9.247.194    local           44.9.247.193
Gi0/1.303   23   120 P Standby FE80::5054:FF:FE06:69A1
                                               local           FE80::5:73FF:FEA0:17
```

Figure 33: R2 FHRP implementace

5.2 Tracking

do sh standby

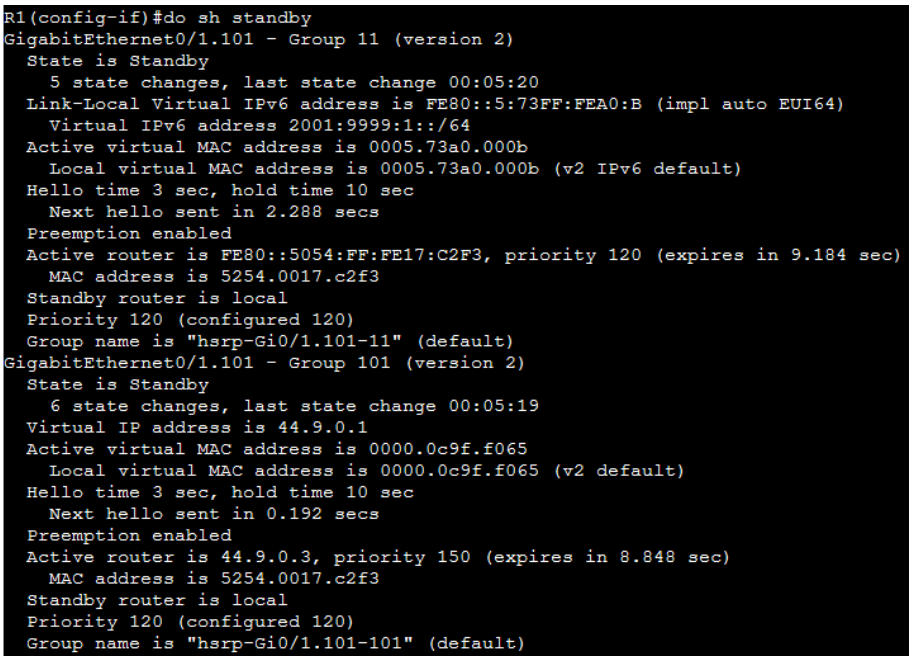


Figure 34: R1 FHRP detail 1/6

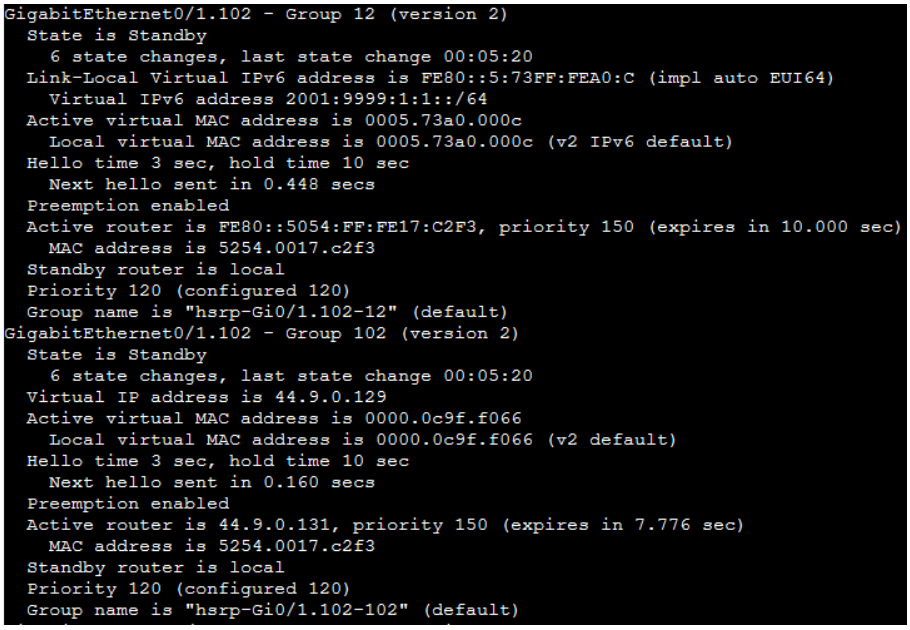


Figure 35: R1 FHRP detail 2/6

```
GigabitEthernet0/1.103 - Group 13 (version 2)
  State is Standby
    3 state changes, last state change 00:05:18
  Link-Local Virtual IPv6 address is FE80::5:73FF:FEA0:D (impl auto EUI64)
    Virtual IPv6 address 2001:9999:1:2::/64
  Active virtual MAC address is 0005.73a0.000d
    Local virtual MAC address is 0005.73a0.000d (v2 IPv6 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.392 secs
  Preemption enabled
  Active router is FE80::5054:FF:FE17:C2F3, priority 150 (expires in 8.448 sec)
    MAC address is 5254.0017.c2f3
  Standby router is local
  Priority 120 (configured 120)
  Group name is "hsrp-Gi0/1.103-13" (default)
GigabitEthernet0/1.103 - Group 103 (version 2)
  State is Standby
    3 state changes, last state change 00:05:21
  Virtual IP address is 44.9.0.193
  Active virtual MAC address is 0000.0c9f.f067
    Local virtual MAC address is 0000.0c9f.f067 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.864 secs
  Preemption enabled
  Active router is 44.9.0.195, priority 150 (expires in 9.760 sec)
    MAC address is 5254.0017.c2f3
  Standby router is local
  Priority 120 (configured 120)
  Group name is "hsrp-Gi0/1.103-103" (default)
```

Figure 36: R1 FHRP detail 3/6

```
GigabitEthernet0/1.301 - Group 1 (version 2)
  State is Active
    4 state changes, last state change 00:05:41
  Virtual IP address is 44.9.247.1
  Active virtual MAC address is 0000.0c9f.f001
    Local virtual MAC address is 0000.0c9f.f001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.864 secs
  Preemption enabled
  Active router is local
  Standby router is 44.9.247.3, priority 120 (expires in 10.848 sec)
  Priority 150 (configured 150)
    Track object 301 state Up decrement 30
  Group name is "hsrp-Gi0/1.301-1" (default)
GigabitEthernet0/1.301 - Group 21 (version 2)
  State is Active
    4 state changes, last state change 00:05:41
  Link-Local Virtual IPv6 address is FE80::5:73FF:FEA0:15 (impl auto EUI64)
    Virtual IPv6 address 2001:9999:2::/64
  Active virtual MAC address is 0005.73a0.0015
    Local virtual MAC address is 0005.73a0.0015 (v2 IPv6 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.672 secs
  Preemption enabled
  Active router is local
  Standby router is FE80::5054:FF:FE17:C2F3, priority 120 (expires in 10.880 sec)
  Priority 150 (configured 150)
    Track object 31 state Up decrement 30
  Group name is "hsrp-Gi0/1.301-21" (default)
```

Figure 37: R1 FHRP detail 4/6

```
GigabitEthernet0/1.302 - Group 2 (version 2)
  State is Active
    4 state changes, last state change 00:05:42
  Virtual IP address is 44.9.247.129
  Active virtual MAC address is 0000.0c9f.f002
    Local virtual MAC address is 0000.0c9f.f002 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.040 secs
  Preemption enabled
  Active router is local
  Standby router is 44.9.247.131, priority 120 (expires in 11.360 sec)
  Priority 150 (configured 150)
    Track object 302 state Up decrement 30
  Group name is "hsrp-Gi0/1.302-2" (default)
GigabitEthernet0/1.302 - Group 22 (version 2)
  State is Active
    4 state changes, last state change 00:05:41
  Link-Local Virtual IPv6 address is FE80::5:73FF:FEA0:16 (impl auto EUI64)
    Virtual IPv6 address 2001:9999:2:1::/64
  Active virtual MAC address is 0005.73a0.0016
    Local virtual MAC address is 0005.73a0.0016 (v2 IPv6 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.128 secs
  Preemption enabled
  Active router is local
  Standby router is FE80::5054:FF:FE17:C2F3, priority 120 (expires in 8.000 sec)
  Priority 150 (configured 150)
    Track object 32 state Up decrement 30
  Group name is "hsrp-Gi0/1.302-22" (default)
```

Figure 38: R1 FHRP detail 5/6

```
GigabitEthernet0/1.303 - Group 3 (version 2)
  State is Active
    4 state changes, last state change 00:05:42
  Virtual IP address is 44.9.247.193
  Active virtual MAC address is 0000.0c9f.f003
    Local virtual MAC address is 0000.0c9f.f003 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.136 secs
  Preemption enabled
  Active router is local
  Standby router is 44.9.247.195, priority 120 (expires in 9.680 sec)
  Priority 150 (configured 150)
    Track object 303 state Up decrement 30
  Group name is "hsrp-Gi0/1.303-3" (default)
GigabitEthernet0/1.303 - Group 23 (version 2)
  State is Active
    4 state changes, last state change 00:05:41
  Link-Local Virtual IPv6 address is FE80::5:73FF:FEA0:17 (impl auto EUI64)
    Virtual IPv6 address 2001:9999:2:2::/64
  Active virtual MAC address is 0005.73a0.0017
    Local virtual MAC address is 0005.73a0.0017 (v2 IPv6 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.464 secs
  Preemption enabled
  Active router is local
  Standby router is FE80::5054:FF:FE17:C2F3, priority 120 (expires in 10.288 sec)
  Priority 150 (configured 150)
    Track object 33 state Up decrement 30
  Group name is "hsrp-Gi0/1.303-23" (default)
```

Figure 39: R1 FHRP detail 6/6

```
R2(config-if)#do sh standby
GigabitEthernet0/1.101 - Group 11 (version 2)
  State is Active
    2 state changes, last state change 01:54:45
  Link-Local Virtual IPv6 address is FE80::5:73FF:FEA0:B (impl auto EUI64)
    Virtual IPv6 address 2001:9999:1::/64
  Active virtual MAC address is 0005.73a0.000b
    Local virtual MAC address is 0005.73a0.000b (v2 IPv6 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.112 secs
  Preemption enabled
  Active router is local
  Standby router is FE80::5054:FF:FE06:69A1, priority 120 (expires in 8.688 sec)
  Priority 120 (configured 120)
    Track object 11 state Up decrement 30
  Group name is "hsrp-Gi0/1.101-11" (default)
GigabitEthernet0/1.101 - Group 101 (version 2)
  State is Active
    1 state change, last state change 01:55:07
  Virtual IP address is 44.9.0.1
  Active virtual MAC address is 0000.0c9f.f065
    Local virtual MAC address is 0000.0c9f.f065 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.288 secs
  Preemption enabled
  Active router is local
  Standby router is 44.9.0.2, priority 120 (expires in 8.816 sec)
  Priority 150 (configured 150)
    Track object 101 state Up decrement 30
  Group name is "hsrp-Gi0/1.101-101" (default)
```

Figure 40: R2 FHRP detail 1/6

```
GigabitEthernet0/1.102 - Group 12 (version 2)
  State is Active
    1 state change, last state change 01:55:07
  Link-Local Virtual IPv6 address is FE80::5:73FF:FEA0:C (impl auto EUI64)
    Virtual IPv6 address 2001:9999:1:1::/64
  Active virtual MAC address is 0005.73a0.000c
    Local virtual MAC address is 0005.73a0.000c (v2 IPv6 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.576 secs
  Preemption enabled
  Active router is local
  Standby router is FE80::5054:FF:FE06:69A1, priority 120 (expires in 9.600 sec)
  Priority 150 (configured 150)
    Track object 12 state Up decrement 30
  Group name is "hsrp-Gi0/1.102-12" (default)
GigabitEthernet0/1.102 - Group 102 (version 2)
  State is Active
    1 state change, last state change 01:55:06
  Virtual IP address is 44.9.0.129
  Active virtual MAC address is 0000.0c9f.f066
    Local virtual MAC address is 0000.0c9f.f066 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.192 secs
  Preemption enabled
  Active router is local
  Standby router is 44.9.0.130, priority 120 (expires in 8.176 sec)
  Priority 150 (configured 150)
    Track object 102 state Up decrement 30
  Group name is "hsrp-Gi0/1.102-102" (default)
```

Figure 41: R2 FHRP detail 2/6

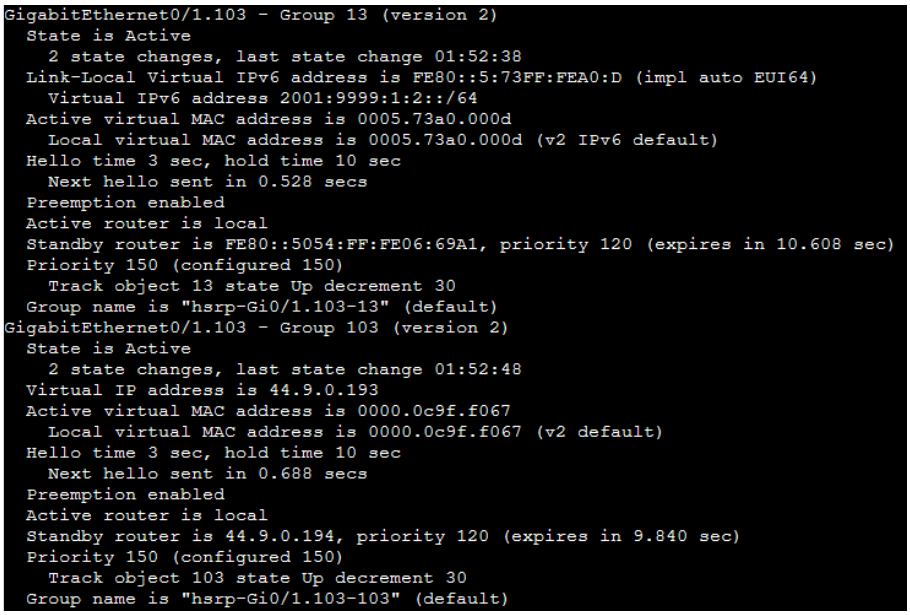


Figure 42: R2 FHRP detail 3/6

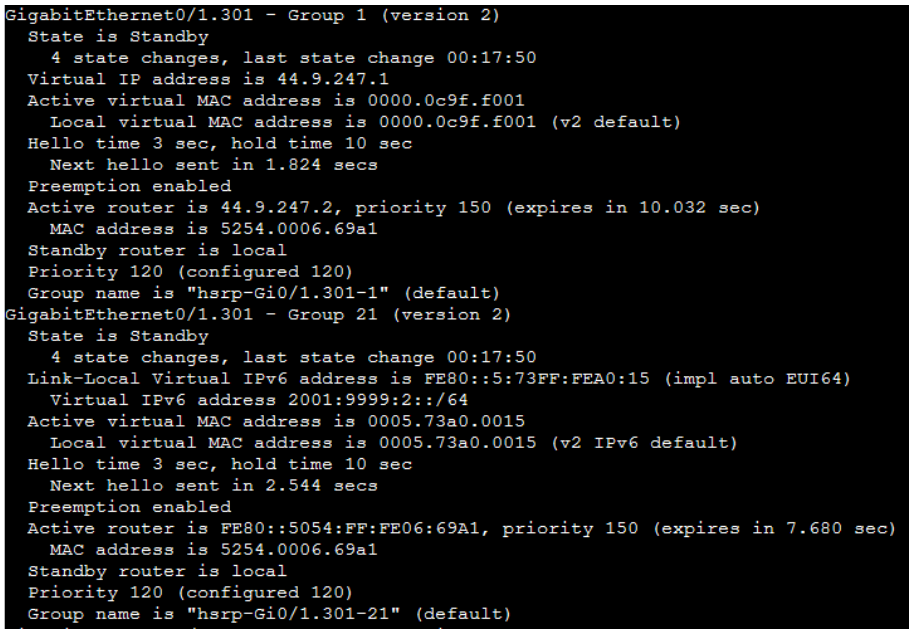


Figure 43: R2 FHRP detail 4/6

```
GigabitEthernet0/1.302 - Group 2 (version 2)
  State is Standby
    4 state changes, last state change 00:17:50
  Virtual IP address is 44.9.247.129
  Active virtual MAC address is 0000.0c9f.f002
    Local virtual MAC address is 0000.0c9f.f002 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.136 secs
  Preemption enabled
  Active router is 44.9.247.130, priority 150 (expires in 10.944 sec)
    MAC address is 5254.0006.69a1
  Standby router is local
  Priority 120 (configured 120)
  Group name is "hsrp-Gi0/1.302-2" (default)
GigabitEthernet0/1.302 - Group 22 (version 2)
  State is Standby
    4 state changes, last state change 00:17:50
  Link-Local Virtual IPv6 address is FE80::5:73FF:FEA0:16 (impl auto EUI64)
    Virtual IPv6 address 2001:9999:2:1::/64
  Active virtual MAC address is 0005.73a0.0016
    Local virtual MAC address is 0005.73a0.0016 (v2 IPv6 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.272 secs
  Preemption enabled
  Active router is FE80::5054:FF:FE06:69A1, priority 150 (expires in 8.288 sec)
    MAC address is 5254.0006.69a1
  Standby router is local
  Priority 120 (configured 120)
  Group name is "hsrp-Gi0/1.302-22" (default)
```

Figure 44: R2 FHRP detail 5/6

```
GigabitEthernet0/1.303 - Group 3 (version 2)
  State is Standby
    4 state changes, last state change 00:17:50
  Virtual IP address is 44.9.247.193
  Active virtual MAC address is 0000.0c9f.f003
    Local virtual MAC address is 0000.0c9f.f003 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.304 secs
  Preemption enabled
  Active router is 44.9.247.194, priority 150 (expires in 8.192 sec)
    MAC address is 5254.0006.69a1
  Standby router is local
  Priority 120 (configured 120)
  Group name is "hsrp-Gi0/1.303-3" (default)
GigabitEthernet0/1.303 - Group 23 (version 2)
  State is Standby
    4 state changes, last state change 00:17:48
  Link-Local Virtual IPv6 address is FE80::5:73FF:FEA0:17 (impl auto EUI64)
    Virtual IPv6 address 2001:9999:2:2::/64
  Active virtual MAC address is 0005.73a0.0017
    Local virtual MAC address is 0005.73a0.0017 (v2 IPv6 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.552 secs
  Preemption enabled
  Active router is FE80::5054:FF:FE06:69A1, priority 150 (expires in 8.000 sec)
    MAC address is 5254.0006.69a1
  Standby router is local
  Priority 120 (configured 120)
  Group name is "hsrp-Gi0/1.303-23" (default)
```

Figure 45: R2 FHRP detail 6/6

do sh track

```
R1(config-if)#do sh track
Track 31
  IPv6 route 2001:9999:2::/64 reachability
  Reachability is Up (connected)
    1 change, last change 01:50:00
  First-hop interface is GigabitEthernet0/1.301
  Tracked by:
    HSRP GigabitEthernet0/1.301 21
Track 32
  IPv6 route 2001:9999:2:1::/64 reachability
  Reachability is Up (connected)
    1 change, last change 01:50:00
  First-hop interface is GigabitEthernet0/1.302
  Tracked by:
    HSRP GigabitEthernet0/1.302 22
Track 33
  IPv6 route 2001:9999:2:2::/64 reachability
  Reachability is Up (connected)
    1 change, last change 01:50:00
  First-hop interface is GigabitEthernet0/1.303
  Tracked by:
    HSRP GigabitEthernet0/1.303 23
Track 301
  IP route 44.9.247.0 255.255.255.128 reachability
  Reachability is Up (connected)
    2 changes, last change 02:19:48
  First-hop interface is GigabitEthernet0/1.301
  Tracked by:
    HSRP GigabitEthernet0/1.301 1
Track 302
  IP route 44.9.247.128 255.255.255.192 reachability
  Reachability is Up (connected)
    2 changes, last change 02:19:48
  First-hop interface is GigabitEthernet0/1.302
  Tracked by:
    HSRP GigabitEthernet0/1.302 2
Track 303
  IP route 44.9.247.192 255.255.255.240 reachability
  Reachability is Up (connected)
    2 changes, last change 02:19:48
  First-hop interface is GigabitEthernet0/1.303
  Tracked by:
    HSRP GigabitEthernet0/1.303 3
```

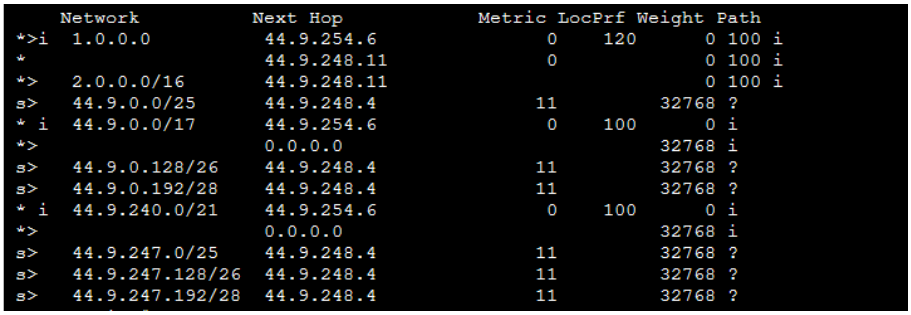
Figure 46: R1 Tracking

```
R2(config-if)#do sh track
Track 11
  IPv6 route 2001:9999:1::/64 reachability
  Reachability is Up (connected)
    1 change, last change 01:59:35
  First-hop interface is GigabitEthernet0/1.101
  Tracked by:
    HSRP GigabitEthernet0/1.101 11
Track 12
  IPv6 route 2001:9999:1:1::/64 reachability
  Reachability is Up (connected)
    1 change, last change 01:59:35
  First-hop interface is GigabitEthernet0/1.102
  Tracked by:
    HSRP GigabitEthernet0/1.102 12
Track 13
  IPv6 route 2001:9999:1:2::/64 reachability
  Reachability is Up (connected)
    1 change, last change 01:59:35
  First-hop interface is GigabitEthernet0/1.103
  Tracked by:
    HSRP GigabitEthernet0/1.103 13
Track 101
  IP route 44.9.0.0 255.255.255.128 reachability
  Reachability is Up (connected)
    2 changes, last change 02:28:14
  First-hop interface is GigabitEthernet0/1.101
  Tracked by:
    HSRP GigabitEthernet0/1.101 101
Track 102
  IP route 44.9.0.128 255.255.255.192 reachability
  Reachability is Up (connected)
    2 changes, last change 02:28:14
  First-hop interface is GigabitEthernet0/1.102
  Tracked by:
    HSRP GigabitEthernet0/1.102 102
Track 103
  IP route 44.9.0.192 255.255.255.240 reachability
  Reachability is Up (connected)
    2 changes, last change 02:28:14
  First-hop interface is GigabitEthernet0/1.103
  Tracked by:
    HSRP GigabitEthernet0/1.103 103
```

Figure 47: R2 Tracking

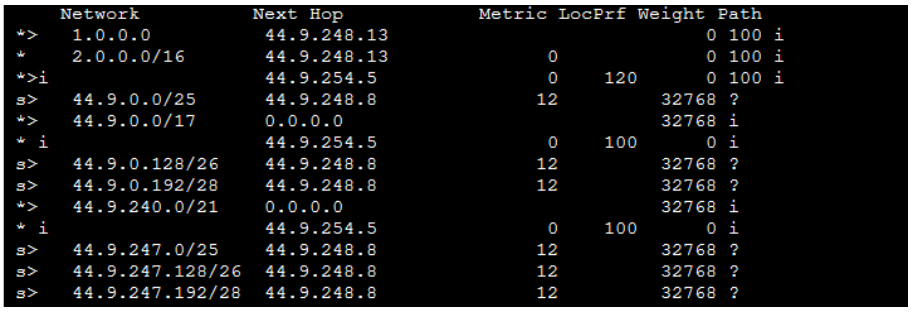
6 BGP & Aggregation

do sh ip bgp



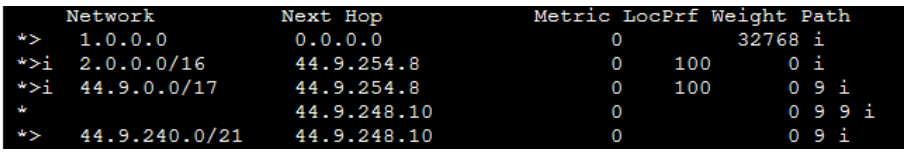
	Network	Next Hop	Metric	LocPrf	Weight	Path
*>i	1.0.0.0	44.9.254.6	0	120	0	100 i
*		44.9.248.11	0		0	100 i
*>	2.0.0.0/16	44.9.248.11			0	100 i
s>	44.9.0.0/25	44.9.248.4	11		32768	?
* i	44.9.0.0/17	44.9.254.6	0	100	0	i
*>		0.0.0.0			32768	i
s>	44.9.0.128/26	44.9.248.4	11		32768	?
s>	44.9.0.192/28	44.9.248.4	11		32768	?
* i	44.9.240.0/21	44.9.254.6	0	100	0	i
*>		0.0.0.0			32768	i
s>	44.9.247.0/25	44.9.248.4	11		32768	?
s>	44.9.247.128/26	44.9.248.4	11		32768	?
s>	44.9.247.192/28	44.9.248.4	11		32768	?

Figure 48: WAN1 IPv4 BGP



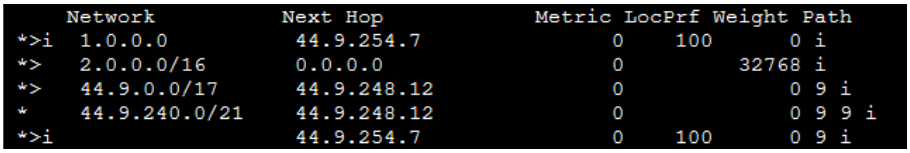
	Network	Next Hop	Metric	LocPrf	Weight	Path
*>	1.0.0.0	44.9.248.13			0	100 i
*	2.0.0.0/16	44.9.248.13	0		0	100 i
*>i		44.9.254.5	0	120	0	100 i
s>	44.9.0.0/25	44.9.248.8	12		32768	?
*>	44.9.0.0/17	0.0.0.0			32768	i
* i		44.9.254.5	0	100	0	i
s>	44.9.0.128/26	44.9.248.8	12		32768	?
s>	44.9.0.192/28	44.9.248.8	12		32768	?
*>	44.9.240.0/21	0.0.0.0			32768	i
* i		44.9.254.5	0	100	0	i
s>	44.9.247.0/25	44.9.248.8	12		32768	?
s>	44.9.247.128/26	44.9.248.8	12		32768	?
s>	44.9.247.192/28	44.9.248.8	12		32768	?

Figure 49: WAN2 IPv4 BGP



	Network	Next Hop	Metric	LocPrf	Weight	Path
*>	1.0.0.0	0.0.0.0	0		32768	i
*>i	2.0.0.0/16	44.9.254.8	0	100	0	i
*>i	44.9.0.0/17	44.9.254.8	0	100	0	9 i
*		44.9.248.10	0		0	9 9 i
*>	44.9.240.0/21	44.9.248.10	0		0	9 i

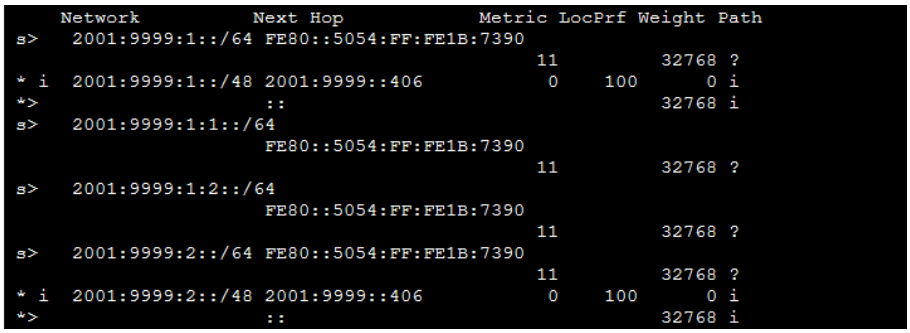
Figure 50: ISP1 IPv4 BGP



	Network	Next Hop	Metric	LocPrf	Weight	Path
*>i	1.0.0.0	44.9.254.7	0	100	0	i
*>	2.0.0.0/16	0.0.0.0	0		32768	i
*>	44.9.0.0/17	44.9.248.12	0		0	9 i
*	44.9.240.0/21	44.9.248.12	0		0	9 9 i
*>i		44.9.254.7	0	100	0	9 i

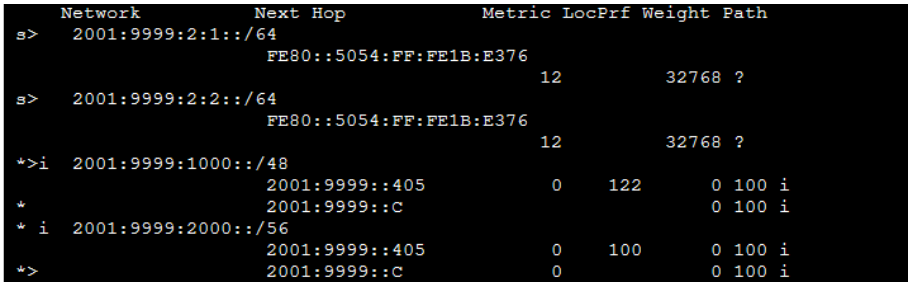
Figure 51: ISP2 IPv4 BGP

do sh bgp ipv6 unicast



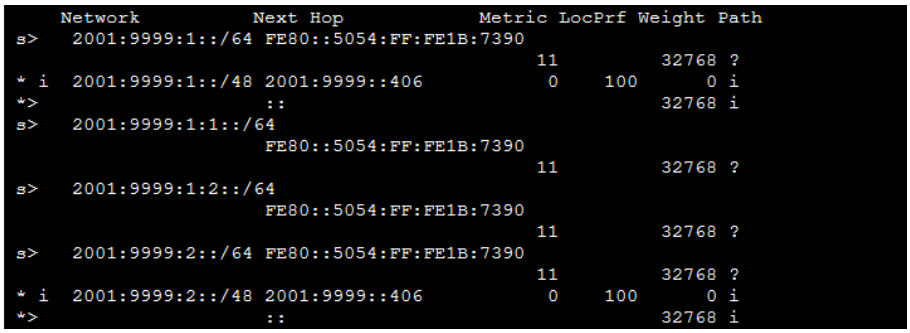
```
    Network          Next Hop            Metric LocPrf Weight Path
s>   2001:9999:1::/64 FE80::5054:FF:FE1B:7390
                                           11         32768 ?
* i  2001:9999:1::/48 2001:9999::406          0    100      0 i
*>                    ::                                  32768 i
s>   2001:9999:1:1::/64
                      FE80::5054:FF:FE1B:7390
                                           11         32768 ?
s>   2001:9999:1:2::/64
                      FE80::5054:FF:FE1B:7390
                                           11         32768 ?
s>   2001:9999:2::/64 FE80::5054:FF:FE1B:7390
                                           11         32768 ?
* i  2001:9999:2::/48 2001:9999::406          0    100      0 i
*>                    ::                                  32768 i
```

Figure 52: WAN1 IPv6 BGP 1/2



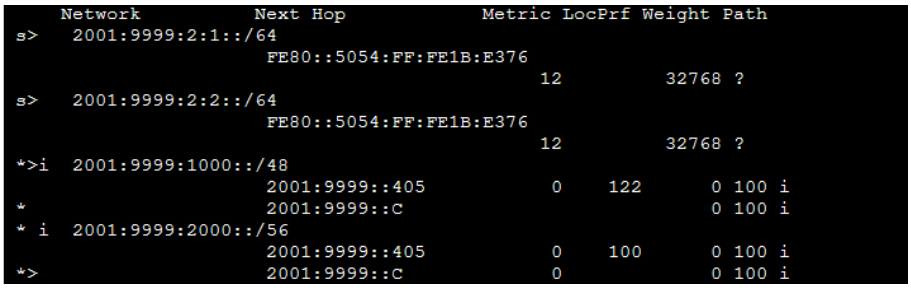
```
    Network          Next Hop            Metric LocPrf Weight Path
s>   2001:9999:2:1::/64
                      FE80::5054:FF:FE1B:E376
                                           12         32768 ?
s>   2001:9999:2:2::/64
                      FE80::5054:FF:FE1B:E376
                                           12         32768 ?
*>i  2001:9999:1000::/48
                      2001:9999::405          0    122      0 100 i
*                     2001:9999::C                         0 100 i
* i  2001:9999:2000::/56
                      2001:9999::405          0    100      0 100 i
*>                    2001:9999::C            0             0 100 i
```

Figure 53: WAN2 IPv6 BGP 2/2



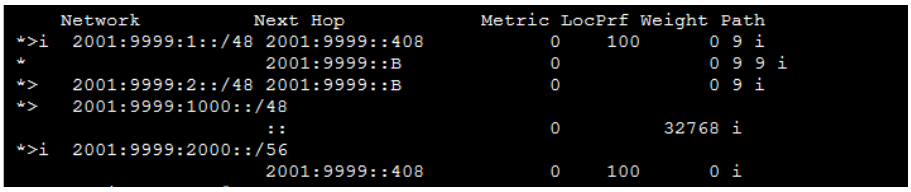
```
    Network          Next Hop            Metric LocPrf Weight Path
s>   2001:9999:1::/64 FE80::5054:FF:FE1B:7390
                                           11         32768 ?
* i  2001:9999:1::/48 2001:9999::406          0    100      0 i
*>                    ::                                  32768 i
s>   2001:9999:1:1::/64
                      FE80::5054:FF:FE1B:7390
                                           11         32768 ?
s>   2001:9999:1:2::/64
                      FE80::5054:FF:FE1B:7390
                                           11         32768 ?
s>   2001:9999:2::/64 FE80::5054:FF:FE1B:7390
                                           11         32768 ?
* i  2001:9999:2::/48 2001:9999::406          0    100      0 i
*>                    ::                                  32768 i
```

Figure 54: WAN1 IPv6 BGP 1/2



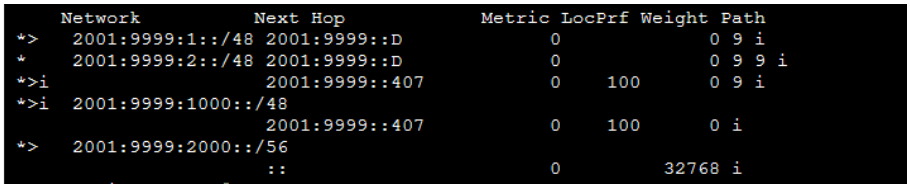
```
    Network          Next Hop            Metric LocPrf Weight Path
s>   2001:9999:2:1::/64
                      FE80::5054:FF:FE1B:E376
                                           12         32768 ?
s>   2001:9999:2:2::/64
                      FE80::5054:FF:FE1B:E376
                                           12         32768 ?
*>i  2001:9999:1000::/48
                      2001:9999::405          0    122      0 100 i
*                     2001:9999::C                         0 100 i
* i  2001:9999:2000::/56
                      2001:9999::405          0    100      0 100 i
*>                    2001:9999::C            0             0 100 i
```

Figure 55: WAN2 IPv6 BGP 2/2



```
    Network          Next Hop            Metric LocPrf Weight Path
*>i  2001:9999:1::/48 2001:9999::408           0    100      0 9 i
*                     2001:9999::B             0             0 9 9 i
*>   2001:9999:2::/48 2001:9999::B             0             0 9 i
*>   2001:9999:1000::/48
                      ::                       0         32768 i
*>i  2001:9999:2000::/56
                      2001:9999::408           0    100      0 i
```

Figure 56: ISP1 IPv6 BGP



```
    Network          Next Hop            Metric LocPrf Weight Path
*>   2001:9999:1::/48 2001:9999::D             0             0 9 i
*    2001:9999:2::/48 2001:9999::D             0             0 9 9 i
*>i                   2001:9999::407           0    100      0 9 i
*>i  2001:9999:1000::/48
                      2001:9999::407           0    100      0 i
*>   2001:9999:2000::/56
                      ::                       0         32768 i
```

Figure 57: ISP2 IPv6 BGP

prefixy

7 Management

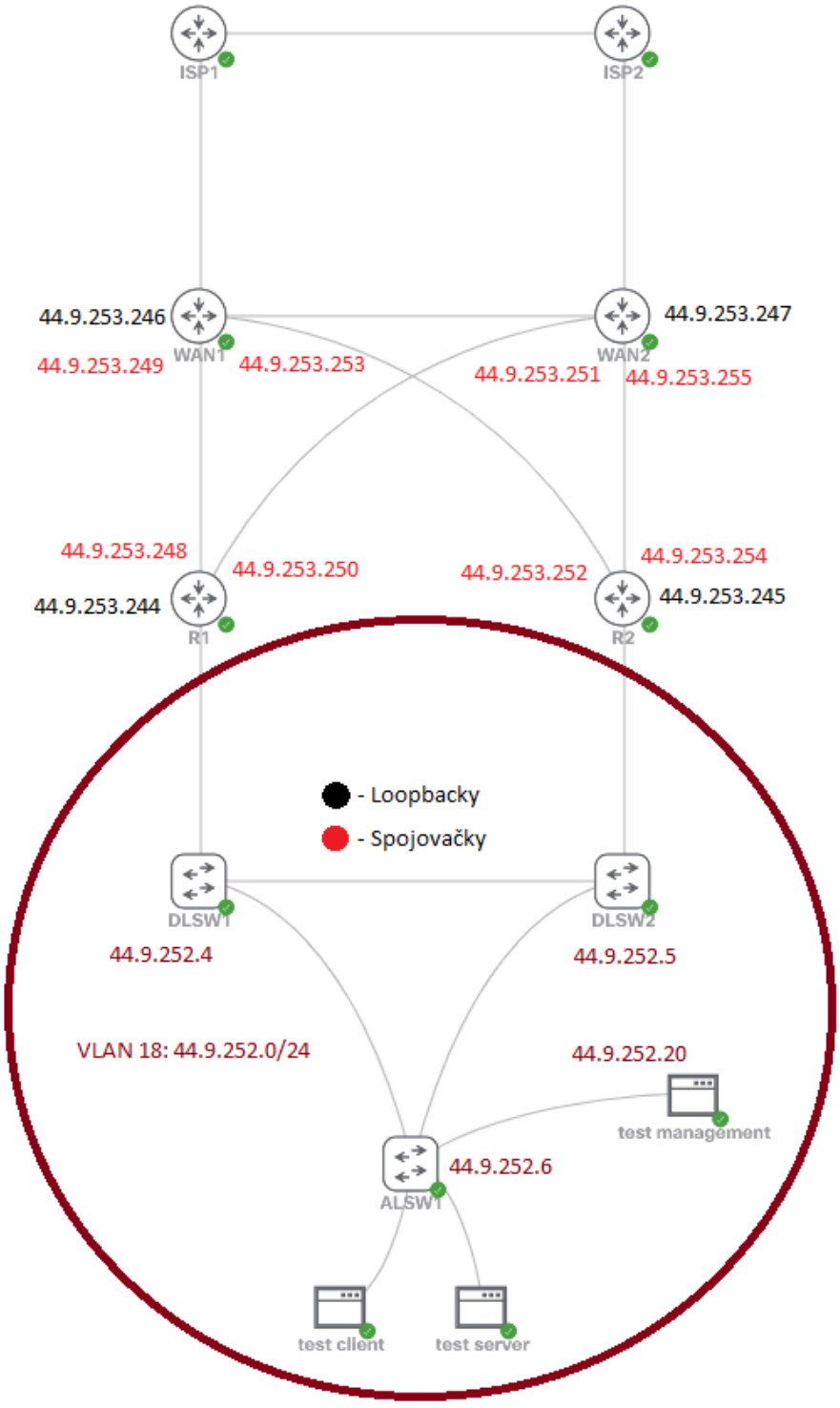


Figure 58: IPv4 management addressing

do sh eigrp address-family ipv4 vrf MGMT int

```
R1(config-if)#do sh eigrp address-family ipv4 vrf MGMT int
EIGRP-IPv4 Interfaces for AS(1) VRF(MGMT)
                        Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface               Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Gi0/1.18                  1        0/0          0/0        10       0/0           50          0
Gi0/2.91                  1        0/0          0/0         3       0/0           50          0
Gi0/3.91                  1        0/0          0/0      1590       0/0         7948          0
Lo1                       0        0/0          0/0         0       0/0            0          0
```

Figure 59: R1 VRF EIGRP

```
R2(config)#do sh eigrp address-family ipv4 vrf MGMT int
EIGRP-IPv4 Interfaces for AS(1) VRF(MGMT)
                        Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface               Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Gi0/1.18                  1        0/0          0/0        10       0/0           50          0
Gi0/2.91                  1        0/0          0/0       173       0/0          864          0
Gi0/3.91                  1        0/0          0/0         5       0/0           50          0
Lo1                       0        0/0          0/0         0       0/0            0          0
```

Figure 60: R2 VRF EIGRP

```
WAN1(config-if)#do sh eigrp address-family ipv4 vrf MGMT int
EIGRP-IPv4 Interfaces for AS(1) VRF(MGMT)
                        Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface               Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Gi0/3.91                  1        0/0          0/0         9       0/0           50          0
Gi0/4.91                  1        0/0          0/0         3       0/0           50          0
Lo1                       0        0/0          0/0         0       0/0            0          0
```

Figure 61: WAN1 VRF EIGRP

```
WAN2(config-router)#do sh eigrp address-family ipv4 vrf MGMT int
EIGRP-IPv4 Interfaces for AS(1) VRF(MGMT)
                        Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface               Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Gi0/3.91                  1        0/0          0/0         3       0/0           50          0
Gi0/4.91                  1        0/0          0/0         3       0/0           50          0
Lo1                       0        0/0          0/0         0       0/0            0          0
```

Figure 62: WAN2 VRF EIGRP

7.1 IPv4 VRRP

```
R1(config-if)#do sh vrrp
GigabitEthernet0/1.18 - Group 18
  State is Backup
  Virtual IP address is 44.9.252.1
  Virtual MAC address is 0000.5e00.0112
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 120
  Master Router is 44.9.252.3, priority is 120
  Master Advertisement interval is 1.000 sec
  Master Down interval is 3.531 sec (expires in 3.173 sec)
```

Figure 63: R1 IPv4 VRRP

```
R2(config)#do sh vrrp
GigabitEthernet0/1.18 - Group 18
  State is Master
  Virtual IP address is 44.9.252.1
  Virtual MAC address is 0000.5e00.0112
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 120
  Master Router is 44.9.252.3 (local), priority is 120
  Master Advertisement interval is 1.000 sec
  Master Down interval is 3.531 sec
```

Figure 64: R2 IPv4 VRRP

7.2 IPv4

do sh ip int br

```
ISP2(config)#do sh ip int br
Interface                  IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0         unassigned      YES unset  administratively down down
GigabitEthernet0/1         44.9.248.15     YES manual up                    up
GigabitEthernet0/2         44.9.248.13     YES manual up                    up
GigabitEthernet0/3         unassigned      YES unset  administratively down down
Loopback0                  44.9.254.8      YES manual up                    up
Loopback100                2.0.0.1         YES manual up                    up
```

Figure 65: ISP1 IPv4 interface brief

```
ISP1(config)#do sh ip int br
Interface                  IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0         unassigned      YES unset  administratively down down
GigabitEthernet0/1         44.9.248.14     YES manual up                    up
GigabitEthernet0/2         44.9.248.11     YES manual up                    up
GigabitEthernet0/3         unassigned      YES unset  administratively down down
Loopback0                  44.9.254.7      YES manual up                    up
Loopback100                1.0.0.1         YES manual up                    up
```

Figure 66: ISP2 IPv4 interface brief

```
WAN1(config-if)#do sh ip int br
Interface                  IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0         unassigned      YES unset  administratively down down
GigabitEthernet0/1         44.9.248.8      YES manual up                    up
GigabitEthernet0/2         44.9.248.10     YES manual up                    up
GigabitEthernet0/3         unassigned      YES unset  up                    up
GigabitEthernet0/3.9       44.9.248.1      YES manual up                    up
GigabitEthernet0/3.91      44.9.253.249    YES manual up                    up
GigabitEthernet0/4         unassigned      YES unset  up                    up
GigabitEthernet0/4.9       44.9.248.5      YES manual up                    up
GigabitEthernet0/4.91      44.9.253.253    YES manual up                    up
Loopback0                  44.9.254.5      YES manual up                    up
Loopback1                  44.9.253.246    YES manual up                    up
```

Figure 67: WAN1 IPv4 interface brief

```
WAN2(config-router)#do sh ip int br
Interface                  IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0         unassigned      YES unset  administratively down down
GigabitEthernet0/1         44.9.248.9      YES manual up                    up
GigabitEthernet0/2         44.9.248.12     YES manual up                    up
GigabitEthernet0/3         unassigned      YES unset  up                    up
GigabitEthernet0/3.9       44.9.248.7      YES manual up                    up
GigabitEthernet0/3.91      44.9.253.255    YES manual up                    up
GigabitEthernet0/4         unassigned      YES unset  up                    up
GigabitEthernet0/4.9       44.9.248.3      YES manual up                    up
GigabitEthernet0/4.91      44.9.253.251    YES manual up                    up
Loopback0                  44.9.254.6      YES manual up                    up
Loopback1                  44.9.253.247    YES manual up                    up
```

Figure 68: WAN2 IPv4 interface brief

```
R1(config)#do sh ip int br
Interface                  IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0         unassigned      YES unset  up                    up
GigabitEthernet0/0.9       unassigned      YES manual deleted               down
GigabitEthernet0/1         unassigned      YES unset  up                    up
GigabitEthernet0/1.18      44.9.252.2      YES manual up                    up
GigabitEthernet0/1.101     44.9.0.2        YES manual up                    up
GigabitEthernet0/1.102     44.9.0.130      YES manual up                    up
GigabitEthernet0/1.103     44.9.0.194      YES manual up                    up
GigabitEthernet0/1.301     44.9.247.2      YES manual up                    up
GigabitEthernet0/1.302     44.9.247.130    YES manual up                    up
GigabitEthernet0/1.303     44.9.247.194    YES manual up                    up
GigabitEthernet0/2         unassigned      YES unset  up                    up
GigabitEthernet0/2.9       44.9.248.2      YES manual up                    up
GigabitEthernet0/2.91      44.9.253.250    YES manual up                    up
GigabitEthernet0/3         unassigned      YES unset  up                    up
GigabitEthernet0/3.9       44.9.248.0      YES manual up                    up
GigabitEthernet0/3.91      44.9.253.248    YES manual up                    up
Loopback0                  44.9.254.3      YES manual up                    up
Loopback1                  44.9.253.244    YES manual up                    up
```

Figure 69: R1 IPv4 interface brief

```
R2(config)#do sh ip int br
Interface                  IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0         unassigned      YES unset  up                    up
GigabitEthernet0/0.9       unassigned      YES manual deleted               down
GigabitEthernet0/1         unassigned      YES unset  up                    up
GigabitEthernet0/1.18      44.9.252.3      YES manual up                    up
GigabitEthernet0/1.101     44.9.0.3        YES manual up                    up
GigabitEthernet0/1.102     44.9.0.131      YES manual up                    up
GigabitEthernet0/1.103     44.9.0.195      YES manual up                    up
GigabitEthernet0/1.301     44.9.247.3      YES manual up                    up
GigabitEthernet0/1.302     44.9.247.131    YES manual up                    up
GigabitEthernet0/1.303     44.9.247.195    YES manual up                    up
GigabitEthernet0/2         unassigned      YES unset  up                    up
GigabitEthernet0/2.9       44.9.248.4      YES manual up                    up
GigabitEthernet0/2.91      44.9.253.252    YES manual up                    up
GigabitEthernet0/3         unassigned      YES unset  up                    up
GigabitEthernet0/3.9       44.9.248.6      YES manual up                    up
GigabitEthernet0/3.91      44.9.253.254    YES manual up                    up
Loopback0                  44.9.254.4      YES manual up                    up
Loopback1                  44.9.253.245    YES manual up                    up
```

Figure 70: R2 IPv4 interface brief

```
DLSW1(config)#do sh ip int br
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  up                    up
GigabitEthernet0/1     unassigned      YES unset  up                    up
GigabitEthernet0/2     unassigned      YES unset  up                    up
GigabitEthernet0/3     unassigned      YES unset  up                    down
GigabitEthernet1/0     unassigned      YES unset  up                    up
Loopback0              44.9.254.0      YES manual up                    up
Port-channel1          unassigned      YES unset  up                    up
Vlan18                 44.9.252.4      YES manual up                    up
```

Figure 71: DLSW1 IPv4 interface brief

```
DLSW2(config)#do sh ip int br
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  up                    up
GigabitEthernet0/1     unassigned      YES unset  up                    up
GigabitEthernet0/2     unassigned      YES unset  up                    up
GigabitEthernet0/3     unassigned      YES unset  up                    down
GigabitEthernet1/0     unassigned      YES unset  up                    up
Loopback0              44.9.254.1      YES manual up                    up
Port-channel1          unassigned      YES unset  up                    up
Vlan18                 44.9.252.5      YES manual up                    up
```

Figure 72: DLSW2 IPv4 interface brief

```
ALSW1(config-if)#do sh ip int br
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  up                    up
GigabitEthernet0/1     unassigned      YES unset  up                    up
GigabitEthernet0/2     unassigned      YES unset  up                    up
GigabitEthernet0/3     unassigned      YES unset  up                    up
GigabitEthernet1/0     unassigned      YES unset  up                    up
GigabitEthernet1/1     unassigned      YES unset  up                    up
GigabitEthernet1/2     unassigned      YES unset  up                    up
GigabitEthernet1/3     unassigned      YES unset  up                    up
Loopback0              44.9.254.2      YES manual up                    up
Vlan18                 44.9.252.6      YES manual up                    up
Vlan101                44.9.0.126      YES manual up                    up
Vlan102                44.9.0.190      YES manual up                    up
Vlan103                44.9.0.206      YES manual up                    up
Vlan301                44.9.247.126    YES manual up                    up
Vlan302                44.9.247.190    YES manual up                    up
Vlan303                44.9.247.206    YES manual up                    up
```

Figure 73: ALSW1 IPv4 interface brief

do sh ip route

```
      1.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        1.0.0.0/8 is directly connected, Loopback100
L        1.0.0.1/32 is directly connected, Loopback100
      2.0.0.0/16 is subnetted, 1 subnets
B        2.0.0.0 [200/0] via 44.9.254.8, 02:15:52
      44.0.0.0/8 is variably subnetted, 12 subnets, 5 masks
B        44.9.0.0/25 [20/1] via 44.9.248.10, 01:32:08
B        44.9.0.128/26 [20/1] via 44.9.248.10, 01:32:08
B        44.9.0.192/28 [20/1] via 44.9.248.10, 01:32:08
B        44.9.247.0/25 [20/1] via 44.9.248.10, 01:32:08
B        44.9.247.128/26 [20/1] via 44.9.248.10, 01:32:08
B        44.9.247.192/28 [20/1] via 44.9.248.10, 01:32:08
C        44.9.248.10/31 is directly connected, GigabitEthernet0/2
L        44.9.248.11/32 is directly connected, GigabitEthernet0/2
C        44.9.248.14/31 is directly connected, GigabitEthernet0/1
L        44.9.248.14/32 is directly connected, GigabitEthernet0/1
C        44.9.254.7/32 is directly connected, Loopback0
S        44.9.254.8/32 [1/0] via 44.9.248.15
```

Figure 74: ISP1 IPv4 routes

```
B     1.0.0.0/8 [200/0] via 44.9.254.7, 02:16:01
      2.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        2.0.0.0/16 is directly connected, Loopback100
L        2.0.0.1/32 is directly connected, Loopback100
      44.0.0.0/8 is variably subnetted, 9 subnets, 5 masks
B        44.9.247.0/25 [20/1] via 44.9.248.12, 02:03:24
B        44.9.247.128/26 [20/1] via 44.9.248.12, 02:03:24
B        44.9.247.192/28 [20/1] via 44.9.248.12, 02:03:24
C        44.9.248.12/31 is directly connected, GigabitEthernet0/2
L        44.9.248.13/32 is directly connected, GigabitEthernet0/2
C        44.9.248.14/31 is directly connected, GigabitEthernet0/1
L        44.9.248.15/32 is directly connected, GigabitEthernet0/1
S        44.9.254.7/32 [1/0] via 44.9.248.14
C        44.9.254.8/32 is directly connected, Loopback0
```

Figure 75: ISP2 IPv4 routes

```
B     1.0.0.0/8 [20/0] via 44.9.248.11, 02:04:29
      2.0.0.0/16 is subnetted, 1 subnets
B        2.0.0.0 [20/0] via 44.9.248.11, 02:04:29
      44.0.0.0/8 is variably subnetted, 20 subnets, 5 masks
O E2     44.9.0.0/25 [110/1] via 44.9.248.4, 00:33:14, GigabitEthernet0/4.9
                     [110/1] via 44.9.248.0, 01:33:24, GigabitEthernet0/3.9
O E2     44.9.0.128/26 [110/1] via 44.9.248.4, 00:33:14, GigabitEthernet0/4.9
                       [110/1] via 44.9.248.0, 01:33:24, GigabitEthernet0/3.9
O E2     44.9.0.192/28 [110/1] via 44.9.248.4, 00:33:14, GigabitEthernet0/4.9
                       [110/1] via 44.9.248.0, 01:33:24, GigabitEthernet0/3.9
O E2     44.9.247.0/25 [110/1] via 44.9.248.4, 00:33:14, GigabitEthernet0/4.9
                       [110/1] via 44.9.248.0, 01:33:24, GigabitEthernet0/3.9
O E2     44.9.247.128/26
           [110/1] via 44.9.248.4, 00:33:14, GigabitEthernet0/4.9
           [110/1] via 44.9.248.0, 01:33:24, GigabitEthernet0/3.9
O E2     44.9.247.192/28
           [110/1] via 44.9.248.4, 00:33:14, GigabitEthernet0/4.9
           [110/1] via 44.9.248.0, 01:33:24, GigabitEthernet0/3.9
C        44.9.248.0/31 is directly connected, GigabitEthernet0/3.9
L        44.9.248.1/32 is directly connected, GigabitEthernet0/3.9
O        44.9.248.2/31 [110/51] via 44.9.248.9, 01:33:24, GigabitEthernet0/1
C        44.9.248.4/31 is directly connected, GigabitEthernet0/4.9
L        44.9.248.5/32 is directly connected, GigabitEthernet0/4.9
O        44.9.248.6/31 [110/51] via 44.9.248.9, 01:33:24, GigabitEthernet0/1
C        44.9.248.8/31 is directly connected, GigabitEthernet0/1
L        44.9.248.8/32 is directly connected, GigabitEthernet0/1
C        44.9.248.10/31 is directly connected, GigabitEthernet0/2
L        44.9.248.10/32 is directly connected, GigabitEthernet0/2
O        44.9.254.3/32 [110/10] via 44.9.248.0, 01:33:24, GigabitEthernet0/3.9
O        44.9.254.4/32 [110/10] via 44.9.248.4, 00:33:14, GigabitEthernet0/4.9
C        44.9.254.5/32 is directly connected, Loopback0
O        44.9.254.6/32 [110/1] via 44.9.248.9, 01:33:24, GigabitEthernet0/1
```

Figure 76: WAN1 IPv4 routes

```
B      1.0.0.0/8 [20/0] via 44.9.248.13, 02:06:41
       2.0.0.0/16 is subnetted, 1 subnets
B         2.0.0.0 [20/0] via 44.9.248.13, 02:06:41
       44.0.0.0/8 is variably subnetted, 20 subnets, 5 masks
O E2      44.9.0.0/25 [110/1] via 44.9.248.8, 00:35:29, GigabitEthernet0/1
O E2      44.9.0.128/26 [110/1] via 44.9.248.8, 00:35:29, GigabitEthernet0/1
O E2      44.9.0.192/28 [110/1] via 44.9.248.8, 00:35:29, GigabitEthernet0/1
O E2      44.9.247.0/25 [110/1] via 44.9.248.8, 00:35:29, GigabitEthernet0/1
O E2      44.9.247.128/26 [110/1] via 44.9.248.8, 00:35:29, GigabitEthernet0/1
O E2      44.9.247.192/28 [110/1] via 44.9.248.8, 00:35:29, GigabitEthernet0/1
O         44.9.248.0/31 [110/11] via 44.9.248.8, 01:35:25, GigabitEthernet0/1
C         44.9.248.2/31 is directly connected, GigabitEthernet0/4.9
L         44.9.248.3/32 is directly connected, GigabitEthernet0/4.9
O         44.9.248.4/31 [110/11] via 44.9.248.8, 00:35:19, GigabitEthernet0/1
C         44.9.248.6/31 is directly connected, GigabitEthernet0/3.9
L         44.9.248.7/32 is directly connected, GigabitEthernet0/3.9
C         44.9.248.8/31 is directly connected, GigabitEthernet0/1
L         44.9.248.9/32 is directly connected, GigabitEthernet0/1
C         44.9.248.12/31 is directly connected, GigabitEthernet0/2
L         44.9.248.12/32 is directly connected, GigabitEthernet0/2
O         44.9.254.3/32 [110/11] via 44.9.248.8, 01:35:25, GigabitEthernet0/1
O         44.9.254.4/32 [110/11] via 44.9.248.8, 00:35:29, GigabitEthernet0/1
O         44.9.254.5/32 [110/1] via 44.9.248.8, 01:35:25, GigabitEthernet0/1
C         44.9.254.6/32 is directly connected, Loopback0
```

Figure 77: WAN2 IPv4 routes

```
O*E2   0.0.0.0/0 [110/1] via 44.9.248.1, 01:10:48, GigabitEthernet0/3.9
       44.0.0.0/8 is variably subnetted, 23 subnets, 5 masks
C         44.9.0.0/25 is directly connected, GigabitEthernet0/1.101
L         44.9.0.2/32 is directly connected, GigabitEthernet0/1.101
C         44.9.0.128/26 is directly connected, GigabitEthernet0/1.102
L         44.9.0.130/32 is directly connected, GigabitEthernet0/1.102
C         44.9.0.192/28 is directly connected, GigabitEthernet0/1.103
L         44.9.0.194/32 is directly connected, GigabitEthernet0/1.103
C         44.9.247.0/25 is directly connected, GigabitEthernet0/1.301
L         44.9.247.2/32 is directly connected, GigabitEthernet0/1.301
C         44.9.247.128/26 is directly connected, GigabitEthernet0/1.302
L         44.9.247.130/32 is directly connected, GigabitEthernet0/1.302
C         44.9.247.192/28 is directly connected, GigabitEthernet0/1.303
L         44.9.247.194/32 is directly connected, GigabitEthernet0/1.303
C         44.9.248.0/31 is directly connected, GigabitEthernet0/3.9
L         44.9.248.0/32 is directly connected, GigabitEthernet0/3.9
C         44.9.248.2/31 is directly connected, GigabitEthernet0/2.9
L         44.9.248.2/32 is directly connected, GigabitEthernet0/2.9
O         44.9.248.4/31 [110/20] via 44.9.248.1, 00:10:31, GigabitEthernet0/3.9
O         44.9.248.6/31 [110/61] via 44.9.248.1, 01:10:48, GigabitEthernet0/3.9
O         44.9.248.8/31 [110/11] via 44.9.248.1, 01:10:48, GigabitEthernet0/3.9
C         44.9.254.3/32 is directly connected, Loopback0
O         44.9.254.4/32 [110/20] via 44.9.248.1, 00:10:41, GigabitEthernet0/3.9
O         44.9.254.5/32 [110/10] via 44.9.248.1, 01:10:48, GigabitEthernet0/3.9
O         44.9.254.6/32 [110/11] via 44.9.248.1, 01:10:48, GigabitEthernet0/3.9
```

Figure 78: R1 IPv4 routes

```
O*E2  0.0.0.0/0 [110/1] via 44.9.248.5, 00:11:11, GigabitEthernet0/2.9
      44.0.0.0/8 is variably subnetted, 23 subnets, 5 masks
C        44.9.0.0/25 is directly connected, GigabitEthernet0/1.101
L        44.9.0.3/32 is directly connected, GigabitEthernet0/1.101
C        44.9.0.128/26 is directly connected, GigabitEthernet0/1.102
L        44.9.0.131/32 is directly connected, GigabitEthernet0/1.102
C        44.9.0.192/28 is directly connected, GigabitEthernet0/1.103
L        44.9.0.195/32 is directly connected, GigabitEthernet0/1.103
C        44.9.247.0/25 is directly connected, GigabitEthernet0/1.301
L        44.9.247.3/32 is directly connected, GigabitEthernet0/1.301
C        44.9.247.128/26 is directly connected, GigabitEthernet0/1.302
L        44.9.247.131/32 is directly connected, GigabitEthernet0/1.302
C        44.9.247.192/28 is directly connected, GigabitEthernet0/1.303
L        44.9.247.195/32 is directly connected, GigabitEthernet0/1.303
O        44.9.248.0/31 [110/20] via 44.9.248.5, 00:11:11, GigabitEthernet0/2.9
O        44.9.248.2/31 [110/61] via 44.9.248.5, 00:11:11, GigabitEthernet0/2.9
C        44.9.248.4/31 is directly connected, GigabitEthernet0/2.9
L        44.9.248.4/32 is directly connected, GigabitEthernet0/2.9
C        44.9.248.6/31 is directly connected, GigabitEthernet0/3.9
L        44.9.248.6/32 is directly connected, GigabitEthernet0/3.9
O        44.9.248.8/31 [110/11] via 44.9.248.5, 00:11:11, GigabitEthernet0/2.9
O        44.9.254.3/32 [110/20] via 44.9.248.5, 00:11:11, GigabitEthernet0/2.9
C        44.9.254.4/32 is directly connected, Loopback0
O        44.9.254.5/32 [110/10] via 44.9.248.5, 00:11:11, GigabitEthernet0/2.9
O        44.9.254.6/32 [110/11] via 44.9.248.5, 00:11:11, GigabitEthernet0/2.9
```

Figure 79: R2 IPv4 routes

do sh ospfv3 ipv4 int br

```
R1(config-if)#do sh ospfv3 ipv4 int br
Interface    PID   Area            AF         Cost  State Nbrs F/C
Lo0          1     0               ipv4       1     LOOP  0/0
Gi0/3.9      1     0               ipv4       10    DR    1/1
Gi0/2.9      1     0               ipv4       50    BDR   1/1
Gi0/1.303    1     1               ipv4       1     DR    0/0
Gi0/1.302    1     1               ipv4       1     DR    0/0
Gi0/1.301    1     1               ipv4       1     DR    0/0
Gi0/1.103    1     1               ipv4       1     DR    0/0
Gi0/1.102    1     1               ipv4       1     DR    0/0
Gi0/1.101    1     1               ipv4       1     DR    0/0
```

Figure 80: R1 OSPFv3 Brief

```
R2(config)#do sh ospfv3 ipv4 int br
Interface    PID   Area            AF         Cost  State Nbrs F/C
Lo0          1     0               ipv4       1     LOOP  0/0
Gi0/3.9      1     0               ipv4       50    BDR   1/1
Gi0/2.9      1     0               ipv4       10    BDR   1/1
Gi0/1.303    1     1               ipv4       1     DR    0/0
Gi0/1.302    1     1               ipv4       1     DR    0/0
Gi0/1.301    1     1               ipv4       1     DR    0/0
Gi0/1.103    1     1               ipv4       1     DR    0/0
Gi0/1.102    1     1               ipv4       1     DR    0/0
Gi0/1.101    1     1               ipv4       1     DR    0/0
```

Figure 81: R2 OSPFv3 Brief

```
WAN1(config-if)#do sh ospfv3 ipv4 int br
Interface    PID   Area            AF         Cost  State Nbrs F/C
Lo0          1     0               ipv4       1     LOOP  0/0
Gi0/4.9      1     0               ipv4       10    DR    1/1
Gi0/3.9      1     0               ipv4       10    BDR   1/1
Gi0/1        1     0               ipv4       1     BDR   1/1
```

Figure 82: WAN1 OSPFv3 Brief

```
WAN2(config-router)#do sh ospfv3 ipv4 int br
Interface    PID   Area            AF         Cost  State Nbrs F/C
Lo0          1     0               ipv4       1     LOOP  0/0
Gi0/4.9      1     0               ipv4       50    DR    1/1
Gi0/3.9      1     0               ipv4       50    DR    1/1
Gi0/1        1     0               ipv4       1     DR    1/1
```

Figure 83: WAN2 OSPFv3 Brief

7.3 IPv6

do sh ipv6 int br

```
ISP1(config)#do sh ipv6 int br
GigabitEthernet0/0      [administratively down/down]
    unassigned
GigabitEthernet0/1      [up/up]
    FE80::5054:FF:FE15:C3EB
    2001:9999::E
GigabitEthernet0/2      [up/up]
    FE80::5054:FF:FE14:A49F
    2001:9999::A
GigabitEthernet0/3      [administratively down/down]
    unassigned
Loopback0               [up/up]
    FE80::5054:FF:FE09:3F75
    2001:9999::407
Loopback100             [up/up]
    FE80::5054:FF:FE09:3F75
    2001:9999:1000::1
```

Figure 84: ISP1 IPv6 interface brief

```
ISP2(config)#do sh ipv6 int br
GigabitEthernet0/0      [administratively down/down]
    unassigned
GigabitEthernet0/1      [up/up]
    FE80::5054:FF:FE03:212C
    2001:9999::F
GigabitEthernet0/2      [up/up]
    FE80::5054:FF:FE06:8F9B
    2001:9999::C
GigabitEthernet0/3      [administratively down/down]
    unassigned
Loopback0               [up/up]
    FE80::5054:FF:FE10:E291
    2001:9999::408
Loopback100             [up/up]
    FE80::5054:FF:FE10:E291
    2001:9999:2000::1
```

Figure 85: ISP2 IPv6 interface brief

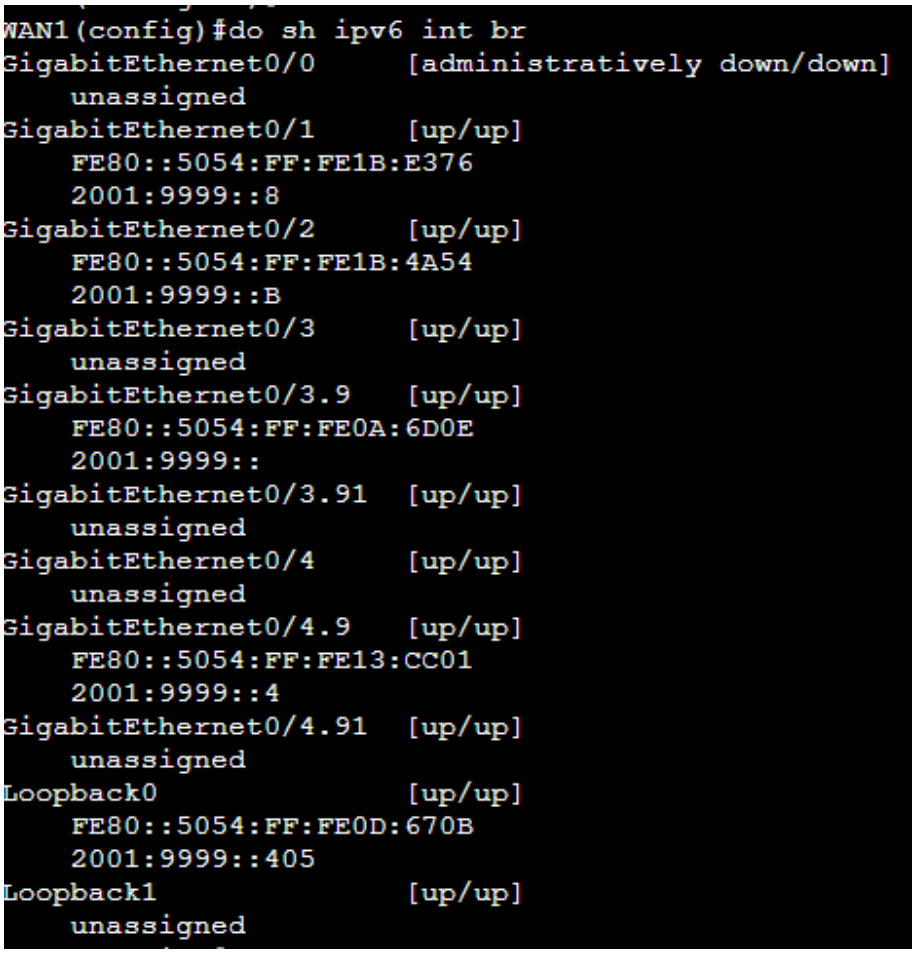


Figure 86: WAN1 IPv6 interface brief

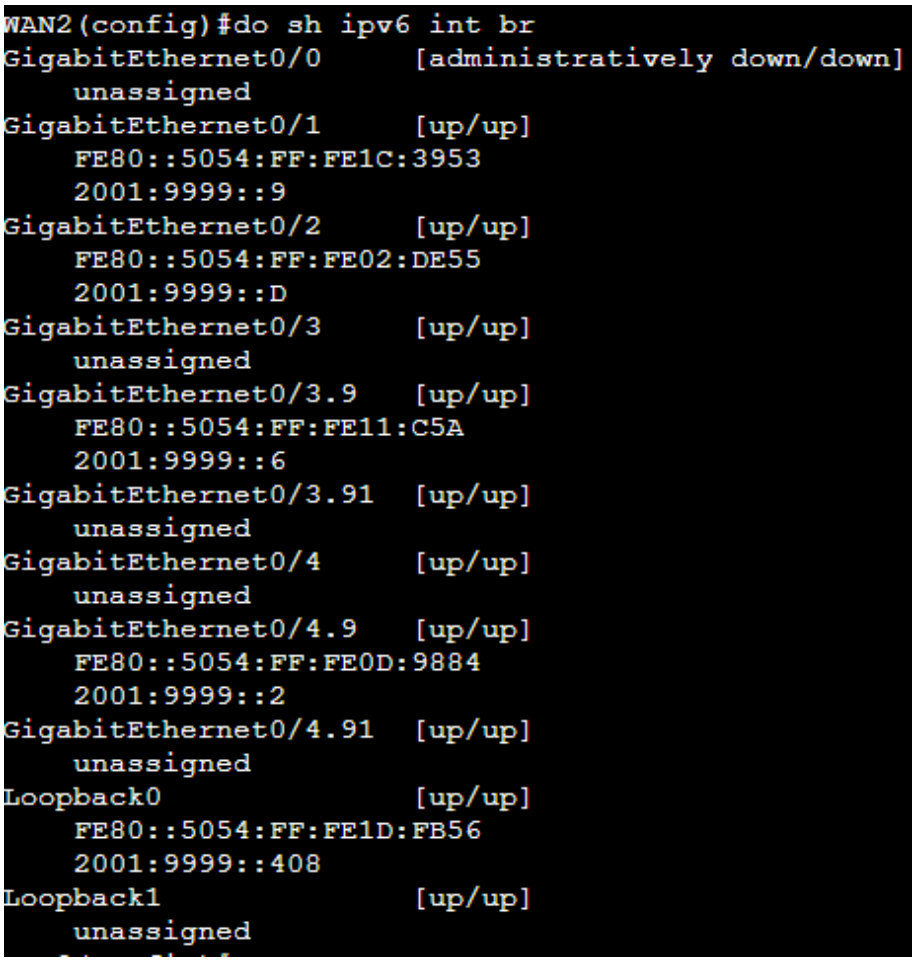


Figure 87: WAN2 IPv6 interface brief

```
R1(config)#do sh ipv6 int br
GigabitEthernet0/0      [up/up]
    unassigned
GigabitEthernet0/0.9    [deleted/down]
    unassigned
GigabitEthernet0/1      [up/up]
    unassigned
GigabitEthernet0/1.18   [up/up]
    unassigned
GigabitEthernet0/1.101  [up/up]
    FE80::5054:FF:FE06:69A1
    2001:9999:1::
    2001:9999:1::1
GigabitEthernet0/1.102  [up/up]
    FE80::5054:FF:FE06:69A1
    2001:9999:1:1::
    2001:9999:1:1::1
GigabitEthernet0/1.103  [up/up]
    FE80::5054:FF:FE06:69A1
    2001:9999:1:2::
    2001:9999:1:2::1
GigabitEthernet0/1.301  [up/up]
    FE80::5054:FF:FE06:69A1
    2001:9999:2::
    2001:9999:2::1
GigabitEthernet0/1.302  [up/up]
    FE80::5054:FF:FE06:69A1
    2001:9999:2:1::
    2001:9999:2:1::1
GigabitEthernet0/1.303  [up/up]
    FE80::5054:FF:FE06:69A1
    2001:9999:2:2::
    2001:9999:2:2::1
GigabitEthernet0/2      [up/up]
    unassigned
GigabitEthernet0/2.9    [up/up]
    FE80::5054:FF:FE02:5CF
    2001:9999::3
GigabitEthernet0/2.91   [up/up]
    unassigned
GigabitEthernet0/3      [up/up]
    unassigned
GigabitEthernet0/3.9    [up/up]
```

Figure 88: R1 IPv6 interface brief 1/2

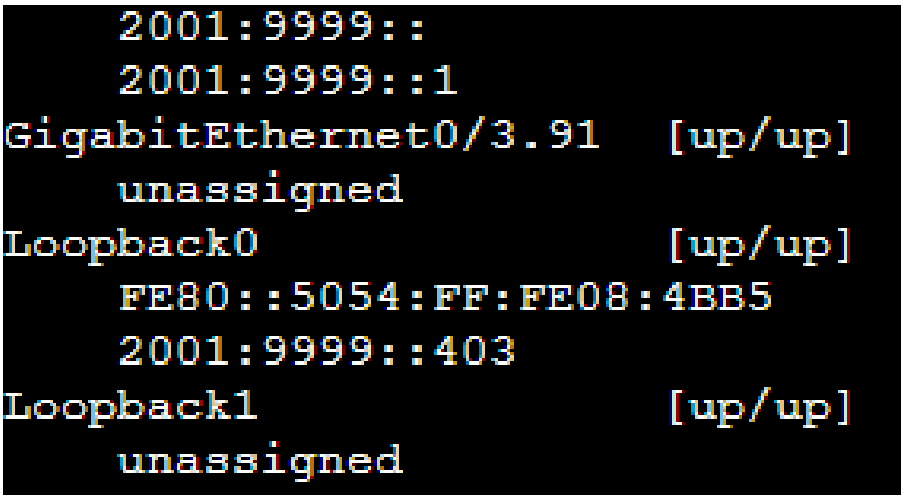


Figure 89: R1 IPv6 interface brief 2/2

```
R2(config)#do sh ipv6 int br
GigabitEthernet0/0      [up/up]
    unassigned
GigabitEthernet0/0.9    [deleted/down]
    unassigned
GigabitEthernet0/1      [up/up]
    unassigned
GigabitEthernet0/1.18   [up/up]
    unassigned
GigabitEthernet0/1.101  [up/up]
    FE80::5054:FF:FE17:C2F3
    2001:9999:1::
    2001:9999:1::2
GigabitEthernet0/1.102  [up/up]
    FE80::5054:FF:FE17:C2F3
    2001:9999:1:1::
    2001:9999:1:1::2
GigabitEthernet0/1.103  [up/up]
    FE80::5054:FF:FE17:C2F3
    2001:9999:1:2::
    2001:9999:1:2::2
GigabitEthernet0/1.301  [up/up]
    FE80::5054:FF:FE17:C2F3
    2001:9999:2::
    2001:9999:2::2
GigabitEthernet0/1.302  [up/up]
    FE80::5054:FF:FE17:C2F3
    2001:9999:2:1::
    2001:9999:2:1::2
GigabitEthernet0/1.303  [up/up]
    FE80::5054:FF:FE17:C2F3
    2001:9999:2:2::
    2001:9999:2:2::2
GigabitEthernet0/2      [up/up]
    unassigned
GigabitEthernet0/2.9    [up/up]
    FE80::5054:FF:FE1B:7390
    2001:9999::5
GigabitEthernet0/2.91   [up/up]
    unassigned
GigabitEthernet0/3      [up/up]
    unassigned
GigabitEthernet0/3.9    [up/up]
```

Figure 90: R2 IPv6 interface brief 1/2

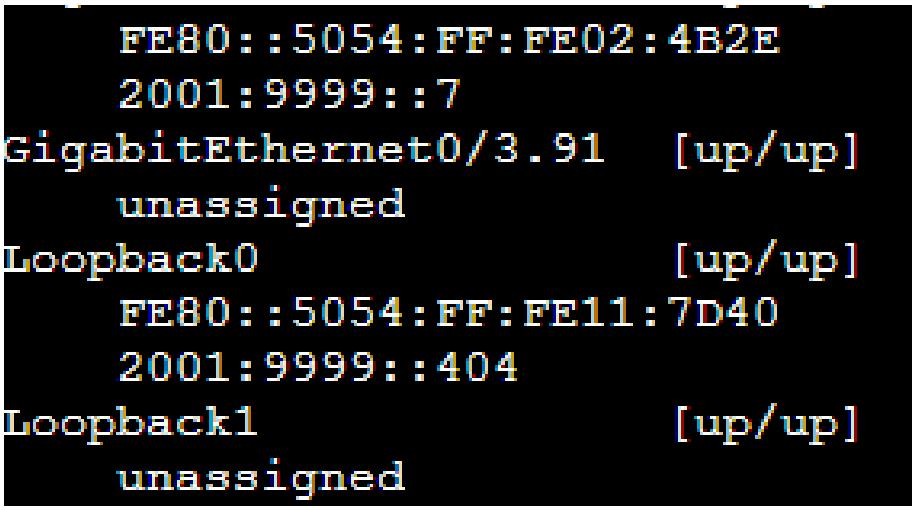


Figure 91: R2 IPv6 interface brief 1/2

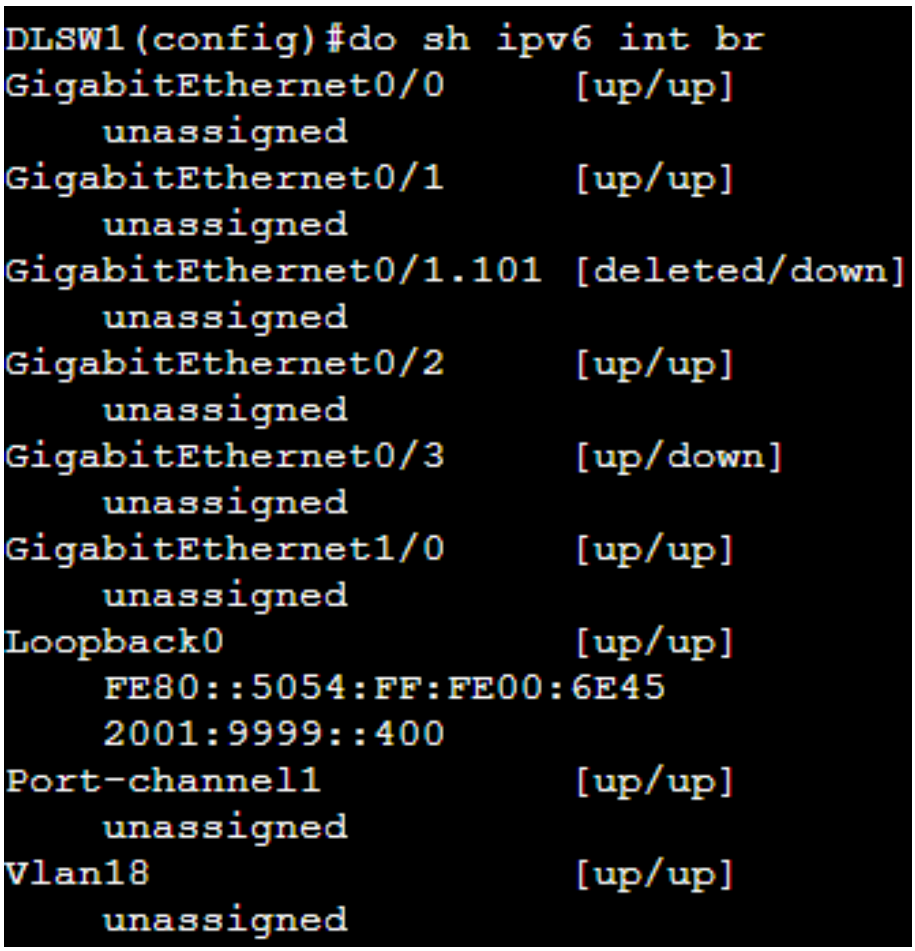


Figure 92: DLSW1 IPv6 interface brief

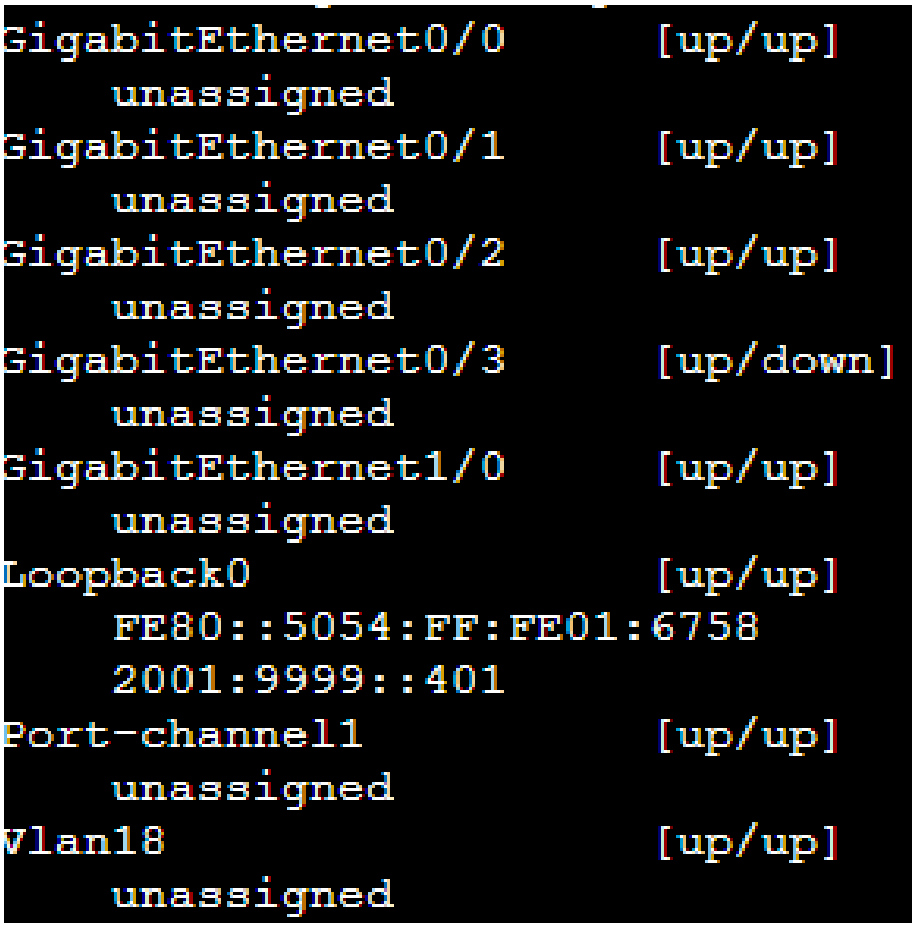


Figure 93: DLSW2 IPv6 interface brief

```
ALSW1(config)#do sh ipv6 int br
GigabitEthernet0/0       [up/up]
    unassigned
GigabitEthernet0/1       [up/up]
    unassigned
GigabitEthernet0/2       [up/up]
    unassigned
GigabitEthernet0/3       [up/up]
    unassigned
GigabitEthernet1/0       [up/up]
    unassigned
GigabitEthernet1/1       [up/up]
    unassigned
GigabitEthernet1/2       [up/up]
    unassigned
GigabitEthernet1/3       [up/up]
    unassigned
Loopback0                [up/up]
    FE80::5054:FF:FE0A:F92C
    2001:9999::402
Vlan18                   [up/up]
    unassigned
Vlan101                  [up/up]
    FE80::5054:FF:FE0A:8065
    2001:9999:1::3
Vlan102                  [up/up]
    unassigned
Vlan103                  [up/up]
    unassigned
Vlan301                  [up/up]
    unassigned
Vlan302                  [up/up]
    unassigned
Vlan303                  [up/up]
    unassigned
```

Figure 94: ALSW1 IPv6 interface brief

do sh ipv6 route

```
C   2001:9999::A/127 [0/0]
     via GigabitEthernet0/2, directly connected
L   2001:9999::A/128 [0/0]
     via GigabitEthernet0/2, receive
C   2001:9999::E/127 [0/0]
     via GigabitEthernet0/1, directly connected
L   2001:9999::E/128 [0/0]
     via GigabitEthernet0/1, receive
LC  2001:9999::407/128 [0/0]
     via Loopback0, receive
S   2001:9999::408/128 [1/0]
     via 2001:9999::F
C   2001:9999:1000::/48 [0/0]
     via Loopback100, directly connected
L   2001:9999:1000::1/128 [0/0]
     via Loopback100, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

Figure 95: ISP1 IPv6 routes

```
C   2001:9999::C/127 [0/0]
     via GigabitEthernet0/2, directly connected
L   2001:9999::C/128 [0/0]
     via GigabitEthernet0/2, receive
C   2001:9999::E/127 [0/0]
     via GigabitEthernet0/1, directly connected
L   2001:9999::F/128 [0/0]
     via GigabitEthernet0/1, receive
S   2001:9999::407/128 [1/0]
     via 2001:9999::E
LC  2001:9999::408/128 [0/0]
     via Loopback0, receive
B   2001:9999:1000::/48 [200/0]
     via 2001:9999::407
C   2001:9999:2000::/56 [0/0]
     via Loopback100, directly connected
L   2001:9999:2000::1/128 [0/0]
     via Loopback100, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

Figure 96: ISP2 IPv6 routes

```
C   2001:9999::/127 [0/0]
     via GigabitEthernet0/3.9, directly connected
O   2001:9999::2/127 [110/51]
     via FE80::5054:FF:FE1C:3953, GigabitEthernet0/1
C   2001:9999::4/127 [0/0]
     via GigabitEthernet0/4.9, directly connected
L   2001:9999::4/128 [0/0]
     via GigabitEthernet0/4.9, receive
O   2001:9999::6/127 [110/51]
     via FE80::5054:FF:FE1C:3953, GigabitEthernet0/1
C   2001:9999::8/127 [0/0]
     via GigabitEthernet0/1, directly connected
L   2001:9999::8/128 [0/0]
     via GigabitEthernet0/1, receive
C   2001:9999::A/127 [0/0]
     via GigabitEthernet0/2, directly connected
L   2001:9999::B/128 [0/0]
     via GigabitEthernet0/2, receive
O   2001:9999::403/128 [110/10]
     via FE80::5054:FF:FE1F:1E47, GigabitEthernet0/3.9
O   2001:9999::404/128 [110/10]
     via FE80::5054:FF:FE1B:7390, GigabitEthernet0/4.9
LC  2001:9999::405/128 [0/0]
     via Loopback0, receive
O   2001:9999::408/128 [110/1]
     via FE80::5054:FF:FE1C:3953, GigabitEthernet0/1
B   2001:9999:1000::/48 [20/0]
     via FE80::5054:FF:FE14:A49F, GigabitEthernet0/2
L   FF00::/8 [0/0]
     via Null0, receive
```

Figure 97: WAN1 IPv6 routes

```
O   2001:9999::/127 [110/11]
     via FE80::5054:FF:FE1B:E376, GigabitEthernet0/1
C   2001:9999::2/127 [0/0]
     via GigabitEthernet0/4.9, directly connected
L   2001:9999::2/128 [0/0]
     via GigabitEthernet0/4.9, receive
O   2001:9999::4/127 [110/11]
     via FE80::5054:FF:FE1B:E376, GigabitEthernet0/1
C   2001:9999::6/127 [0/0]
     via GigabitEthernet0/3.9, directly connected
L   2001:9999::6/128 [0/0]
     via GigabitEthernet0/3.9, receive
C   2001:9999::8/127 [0/0]
     via GigabitEthernet0/1, directly connected
L   2001:9999::9/128 [0/0]
     via GigabitEthernet0/1, receive
C   2001:9999::C/127 [0/0]
     via GigabitEthernet0/2, directly connected
L   2001:9999::D/128 [0/0]
     via GigabitEthernet0/2, receive
O   2001:9999::403/128 [110/11]
     via FE80::5054:FF:FE1B:E376, GigabitEthernet0/1
O   2001:9999::404/128 [110/11]
     via FE80::5054:FF:FE1B:E376, GigabitEthernet0/1
O   2001:9999::405/128 [110/1]
     via FE80::5054:FF:FE1B:E376, GigabitEthernet0/1
LC  2001:9999::408/128 [0/0]
     via Loopback0, receive
B   2001:9999:1000::/48 [20/0]
     via FE80::5054:FF:FE06:8F9B, GigabitEthernet0/2
L   FF00::/8 [0/0]
     via Null0, receive
```

Figure 98: WAN2 IPv6 routes

```
OE2 ::/0 [110/1], tag 2
     via FE80::5054:FF:FE0A:6D0E, GigabitEthernet0/3.9
C   2001:9999::/127 [0/0]
     via GigabitEthernet0/3.9, directly connected
L   2001:9999::/128 [0/0]
     via GigabitEthernet0/3.9, receive
L   2001:9999::1/128 [0/0]
     via GigabitEthernet0/3.9, receive
C   2001:9999::2/127 [0/0]
     via GigabitEthernet0/2.9, directly connected
L   2001:9999::3/128 [0/0]
     via GigabitEthernet0/2.9, receive
O   2001:9999::4/127 [110/20]
     via FE80::5054:FF:FE0A:6D0E, GigabitEthernet0/3.9
O   2001:9999::6/127 [110/61]
     via FE80::5054:FF:FE0A:6D0E, GigabitEthernet0/3.9
O   2001:9999::8/127 [110/11]
     via FE80::5054:FF:FE0A:6D0E, GigabitEthernet0/3.9
LC  2001:9999::403/128 [0/0]
     via Loopback0, receive
O   2001:9999::404/128 [110/20]
     via FE80::5054:FF:FE0A:6D0E, GigabitEthernet0/3.9
O   2001:9999::405/128 [110/10]
     via FE80::5054:FF:FE0A:6D0E, GigabitEthernet0/3.9
O   2001:9999::408/128 [110/11]
     via FE80::5054:FF:FE0A:6D0E, GigabitEthernet0/3.9
C   2001:9999:1::/64 [0/0]
     via GigabitEthernet0/1.101, directly connected
```

Figure 99: R1 IPv6 routes 1/2

```
L   2001:9999:1::1/128 [0/0]
     via GigabitEthernet0/1.101, receive
C   2001:9999:1:1::/64 [0/0]
     via GigabitEthernet0/1.102, directly connected
L   2001:9999:1:1::1/128 [0/0]
     via GigabitEthernet0/1.102, receive
C   2001:9999:1:2::/64 [0/0]
     via GigabitEthernet0/1.103, directly connected
L   2001:9999:1:2::1/128 [0/0]
     via GigabitEthernet0/1.103, receive
C   2001:9999:2::/64 [0/0]
     via GigabitEthernet0/1.301, directly connected
L   2001:9999:2::/128 [0/0]
     via GigabitEthernet0/1.301, receive
L   2001:9999:2::1/128 [0/0]
     via GigabitEthernet0/1.301, receive
C   2001:9999:2:1::/64 [0/0]
     via GigabitEthernet0/1.302, directly connected
L   2001:9999:2:1::/128 [0/0]
     via GigabitEthernet0/1.302, receive
L   2001:9999:2:1::1/128 [0/0]
     via GigabitEthernet0/1.302, receive
C   2001:9999:2:2::/64 [0/0]
     via GigabitEthernet0/1.303, directly connected
L   2001:9999:2:2::/128 [0/0]
     via GigabitEthernet0/1.303, receive
L   2001:9999:2:2::1/128 [0/0]
     via GigabitEthernet0/1.303, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

Figure 100: R1 IPv6 routes 2/2

```
OE2 ::/0 [110/1], tag 2
     via FE80::5054:FF:FE13:CC01, GigabitEthernet0/2.9
O   2001:9999::/127 [110/20]
     via FE80::5054:FF:FE13:CC01, GigabitEthernet0/2.9
O   2001:9999::2/127 [110/61]
     via FE80::5054:FF:FE13:CC01, GigabitEthernet0/2.9
C   2001:9999::4/127 [0/0]
     via GigabitEthernet0/2.9, directly connected
L   2001:9999::5/128 [0/0]
     via GigabitEthernet0/2.9, receive
C   2001:9999::6/127 [0/0]
     via GigabitEthernet0/3.9, directly connected
L   2001:9999::7/128 [0/0]
     via GigabitEthernet0/3.9, receive
O   2001:9999::8/127 [110/11]
     via FE80::5054:FF:FE13:CC01, GigabitEthernet0/2.9
O   2001:9999::403/128 [110/20]
     via FE80::5054:FF:FE13:CC01, GigabitEthernet0/2.9
LC  2001:9999::404/128 [0/0]
     via Loopback0, receive
O   2001:9999::405/128 [110/10]
     via FE80::5054:FF:FE13:CC01, GigabitEthernet0/2.9
O   2001:9999::408/128 [110/11]
     via FE80::5054:FF:FE13:CC01, GigabitEthernet0/2.9
```

Figure 101: R2 IPv6 routes 1/2

```
C   2001:9999:1::/64 [0/0]
     via GigabitEthernet0/1.101, directly connected
L   2001:9999:1::/128 [0/0]
     via GigabitEthernet0/1.101, receive
L   2001:9999:1::2/128 [0/0]
     via GigabitEthernet0/1.101, receive
C   2001:9999:1:1::/64 [0/0]
     via GigabitEthernet0/1.102, directly connected
L   2001:9999:1:1::/128 [0/0]
     via GigabitEthernet0/1.102, receive
L   2001:9999:1:1::2/128 [0/0]
     via GigabitEthernet0/1.102, receive
C   2001:9999:1:2::/64 [0/0]
     via GigabitEthernet0/1.103, directly connected
L   2001:9999:1:2::/128 [0/0]
     via GigabitEthernet0/1.103, receive
L   2001:9999:1:2::2/128 [0/0]
     via GigabitEthernet0/1.103, receive
C   2001:9999:2::/64 [0/0]
     via GigabitEthernet0/1.301, directly connected
L   2001:9999:2::2/128 [0/0]
     via GigabitEthernet0/1.301, receive
C   2001:9999:2:1::/64 [0/0]
     via GigabitEthernet0/1.302, directly connected
L   2001:9999:2:1::2/128 [0/0]
     via GigabitEthernet0/1.302, receive
C   2001:9999:2:2::/64 [0/0]
     via GigabitEthernet0/1.303, directly connected
L   2001:9999:2:2::2/128 [0/0]
     via GigabitEthernet0/1.303, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

Figure 102: R2 IPv6 routes 2/2

do sh ospfv3 ipv6 int br

```
R1(config-if)#do sh ospfv3 ipv6 int br
Interface    PID   Area            AF         Cost  State Nbrs F/C
Lo0          2     0               ipv6       1     LOOP  0/0
Gi0/3.9      2     0               ipv6       10    DR    1/1
Gi0/2.9      2     0               ipv6       50    BDR   1/1
Gi0/1.303    2     2               ipv6       1     DR    0/0
Gi0/1.302    2     2               ipv6       1     DR    0/0
Gi0/1.301    2     2               ipv6       1     DR    0/0
Gi0/1.103    2     2               ipv6       1     DR    0/0
Gi0/1.102    2     2               ipv6       1     DR    0/0
Gi0/1.101    2     2               ipv6       1     DR    0/0
```

Figure 103: R1 OSPFv3 Brief

```
R2(config)#do sh ospfv3 ipv6 int br
Interface    PID   Area            AF         Cost  State Nbrs F/C
Lo0          2     0               ipv6       1     LOOP  0/0
Gi0/3.9      2     0               ipv6       50    BDR   1/1
Gi0/2.9      2     0               ipv6       10    BDR   1/1
Gi0/1.303    2     2               ipv6       1     DR    0/0
Gi0/1.302    2     2               ipv6       1     DR    0/0
Gi0/1.301    2     2               ipv6       1     DR    0/0
Gi0/1.103    2     2               ipv6       1     DR    0/0
Gi0/1.102    2     2               ipv6       1     DR    0/0
Gi0/1.101    2     2               ipv6       1     DR    0/0
```

Figure 104: R2 OSPFv3 Brief

```
WAN1(config-if)#do sh ospfv3 ipv6 int br
Interface    PID   Area            AF         Cost  State Nbrs F/C
Lo0          2     0               ipv6       1     LOOP  0/0
Gi0/4.9      2     0               ipv6       10    DR    1/1
Gi0/3.9      2     0               ipv6       10    BDR   1/1
Gi0/1        2     0               ipv6       1     BDR   1/1
```

Figure 105: WAN1 OSPFv3 Brief

```
WAN2(config-router)#do sh ospfv3 ipv6 int br
Interface    PID   Area            AF         Cost  State Nbrs F/C
Lo0          2     0               ipv6       1     LOOP  0/0
Gi0/4.9      2     0               ipv6       50    DR    1/1
Gi0/3.9      2     0               ipv6       50    DR    1/1
Gi0/1        2     0               ipv6       1     DR    1/1
```

Figure 106: WAN2 OSPFv3 Brief

8 IPv4 Connectivity

8.1 Ping

ping from client to each VLAN's interface on ALSW1

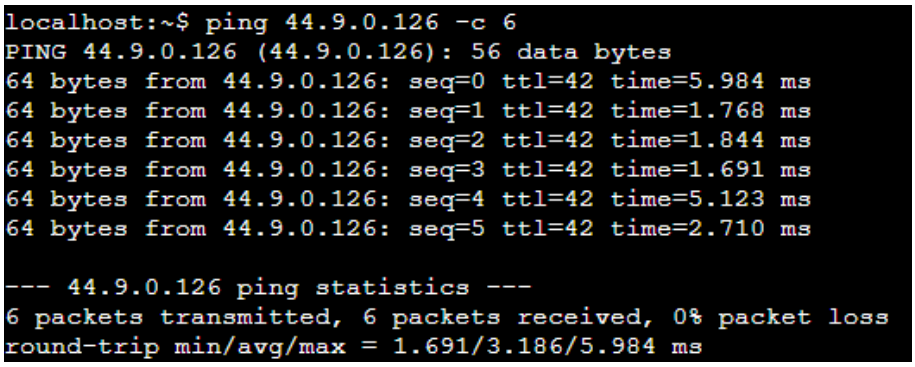


Figure 107: Client IPv4 ping to VLAN 101

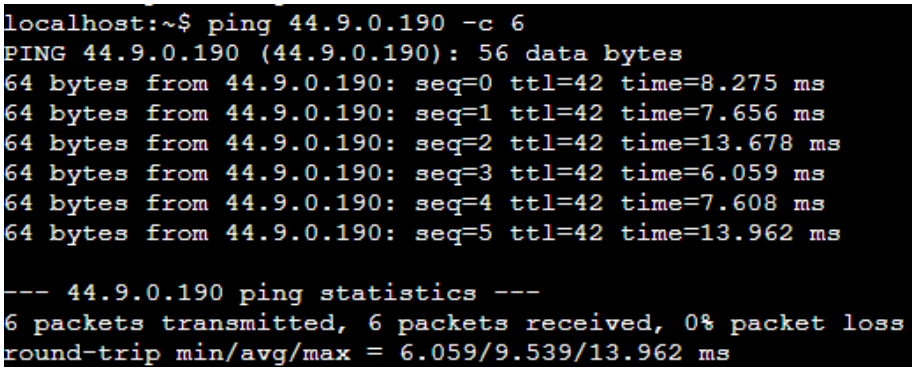


Figure 108: Client IPv4 ping to VLAN 102

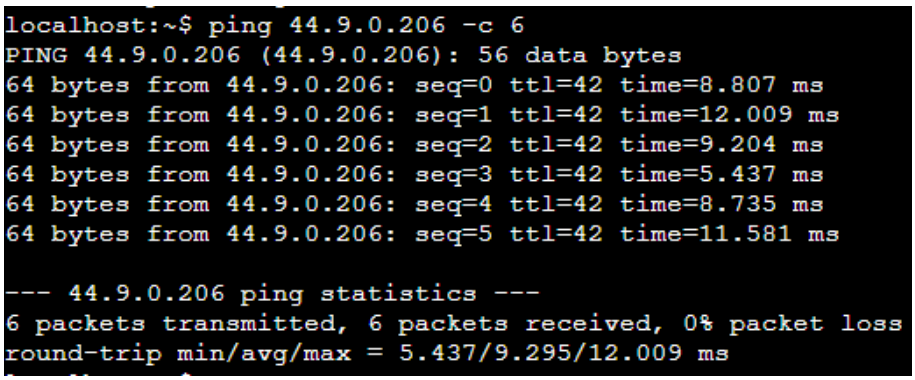


Figure 109: Client IPv4 ping to VLAN 103

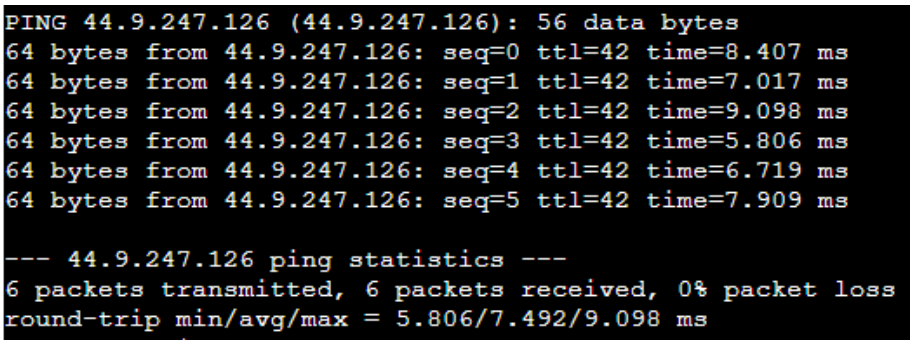


Figure 110: Client IPv4 ping to VLAN 301

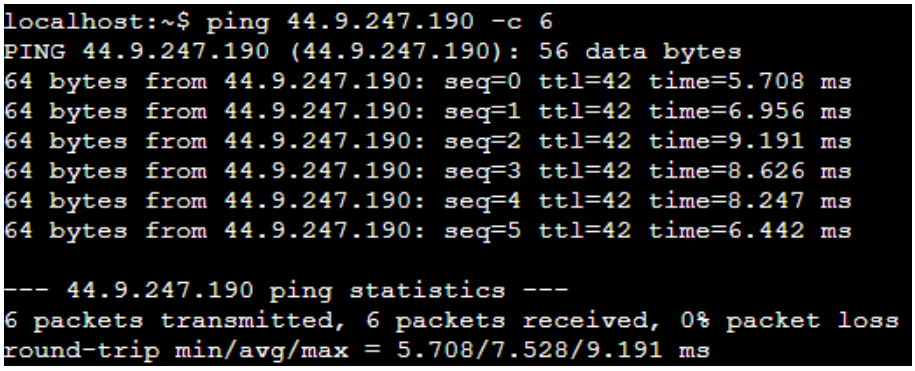


Figure 111: Client IPv4 ping to VLAN 302

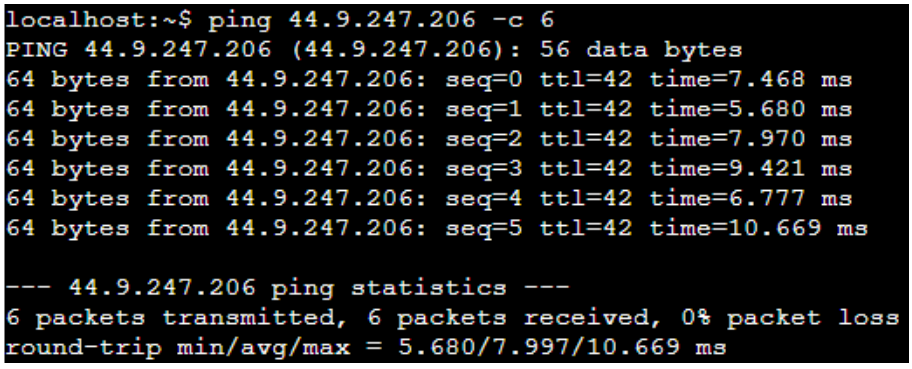


Figure 112: Client IPv4 ping to VLAN 303

ping from server to each VLAN's interface on ALSW1

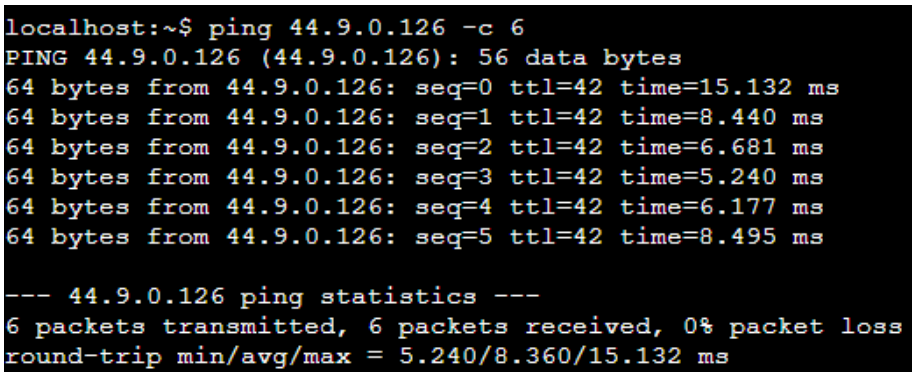


Figure 113: Server IPv4 ping to VLAN 101

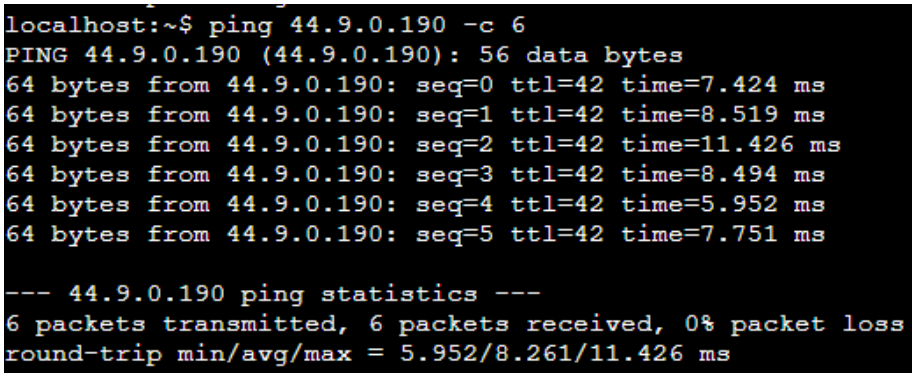


Figure 114: Server IPv4 ping to VLAN 102

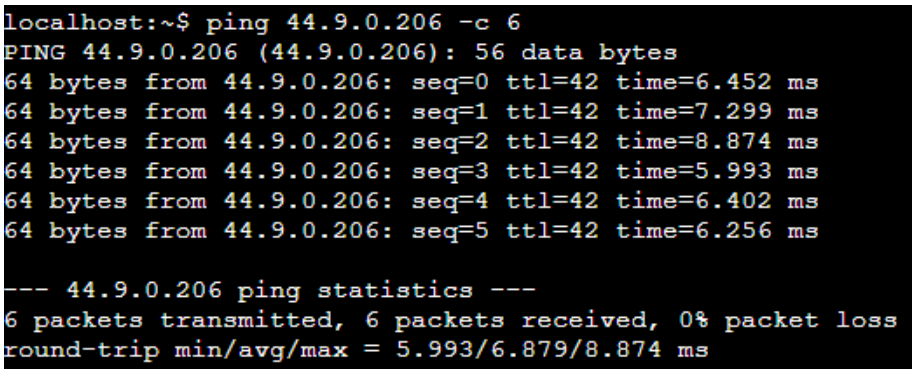


Figure 115: Server IPv4 ping to VLAN 103

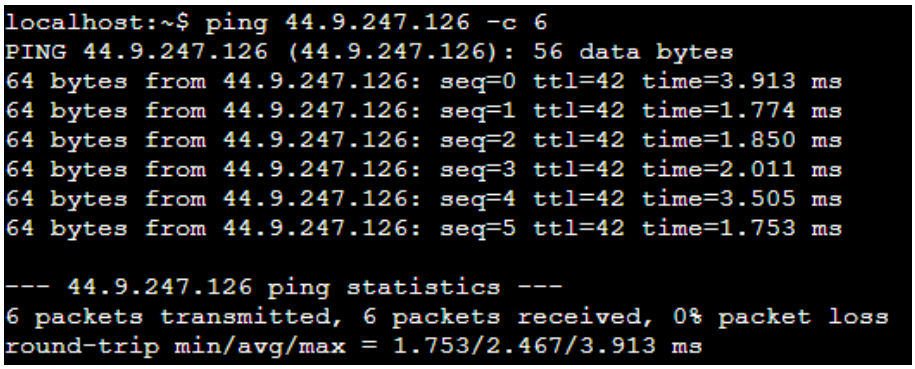


Figure 116: Server IPv4 ping to VLAN 301

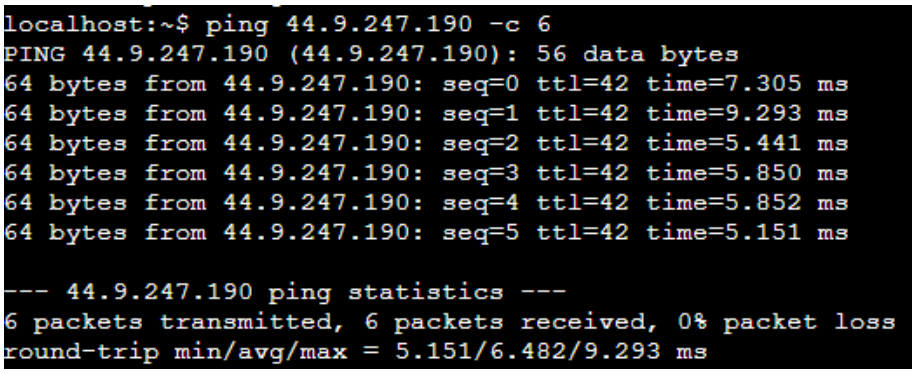


Figure 117: Server IPv4 ping to VLAN 302

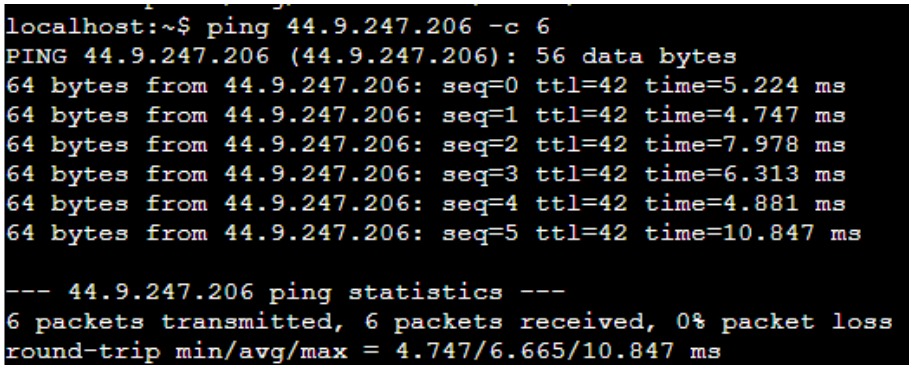


Figure 118: Server IPv4 ping to VLAN 303

8.2 Telnet

connection to VRF Telnet

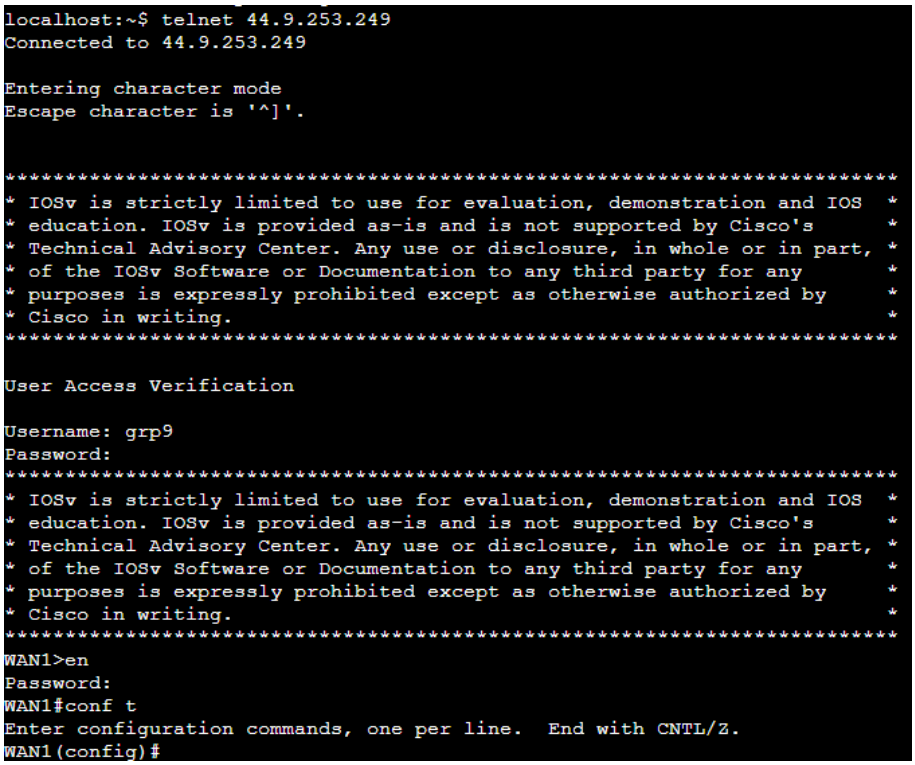


Figure 119: WAN1 IPv4 Telnet

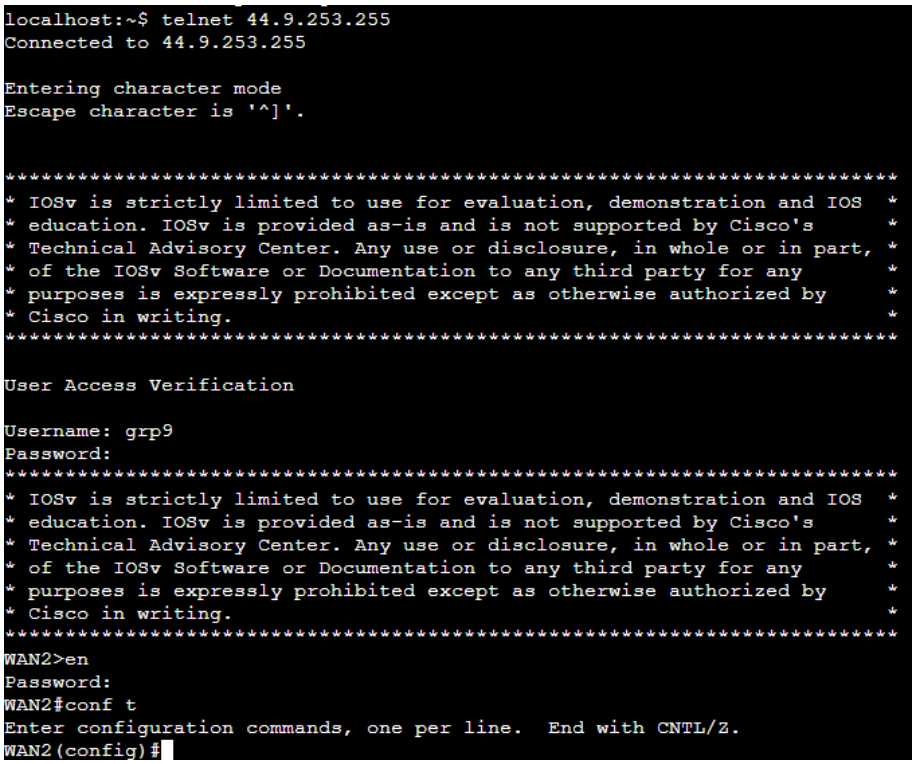


Figure 120: WAN2 IPv4 Telnet

```
localhost:~$ telnet 44.9.252.2
Connected to 44.9.252.2

Entering character mode
Escape character is '^]'.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User Access Verification

Username: grp9
Password:
******************************************************************************
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******************************************************************************
R1>en
Password:
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
```

Figure 121: R1 IPv4 Telnet

```
localhost:~$ telnet 44.9.252.3
Connected to 44.9.252.3

Entering character mode
Escape character is '^]'.


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User Access Verification

Username: grp9
Password:
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R2>en
Password:
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#
```

Figure 122: R2 IPv4 Telnet

```
localhost:~$ telnet 44.9.252.4
Connected to 44.9.252.4

Entering character mode
Escape character is '^]'.


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User Access Verification

Username: grp9
Password:
********************************************************************************
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********************************************************************************
DLSW1>en
Password:
DLSW1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
DLSW1(config)#
```

Figure 123: DLSW1 IPv4 Telnet

```
localhost:~$ telnet 44.9.252.5
Connected to 44.9.252.5

Entering character mode
Escape character is '^]'.


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********************************************************************************
User Access Verification

Username: grp9
Password:
********************************************************************************
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********************************************************************************
DLSW2>en
Password:
DLSW2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
DLSW2(config)#
```

Figure 124: DLSW2 IPv4 Telnet

```
localhost:~$ telnet 44.9.252.6
Connected to 44.9.252.6

Entering character mode
Escape character is '^]'.


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******************************************************************************

User Access Verification

Username: grp9
Password:
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******************************************************************************
ALSW1>en
Password:
ALSW1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
ALSW1(config)#
```

Figure 125: ALSW1 IPv4 Telnet

8.3 SSH

connection to VRF SSH

```
localhost:~$ ssh -l grp9 -oKexAlgorithms=+diffie-hellman-group14-sha1 44.9.253.2
49
The authenticity of host '44.9.253.249 (44.9.253.249)' can't be established.
RSA key fingerprint is SHA256:9R0FmgVL6jKYDrjE5TQNcgqUbHGKlBwJZppZsbKZK7c.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '44.9.253.249' (RSA) to the list of known hosts.

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Password: ******************************************************************

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******************************************************************************
WAN1>en
Password:
WAN1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
WAN1(config)#
```

Figure 126: WAN1 IPv4 SSH

```
localhost:~$ ssh -l grp9 -oKexAlgorithms=+diffie-hellman-group14-sha1 44.9.253.2
55
The authenticity of host '44.9.253.255 (44.9.253.255)' can't be established.
RSA key fingerprint is SHA256:SUBujsd7ru9/Pz5xzJHKuMr5m9oHH9TOVbc0aHmyWEU.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '44.9.253.255' (RSA) to the list of known hosts.

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Password: **************************************************************

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**************************************************************************
WAN2>en
Password:
WAN2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
WAN2(config)#
```

Figure 127: WAN2 IPv4 SSH

```
localhost:~$ ssh -l grp9 -oKexAlgorithms=+diffie-hellman-group14-sha1 44.9.252.2
The authenticity of host '44.9.252.2 (44.9.252.2)' can't be established.
RSA key fingerprint is SHA256:1x7zXfDNf88oKjwinsGUjTfp5RRgA0c8xWW5ojsW3n4.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '44.9.252.2' (RSA) to the list of known hosts.

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* Cisco in writing.                                                      *
Password: **************************************************************

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**************************************************************************
R1>en
Password:
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
```

Figure 128: R1 IPv4 SSH

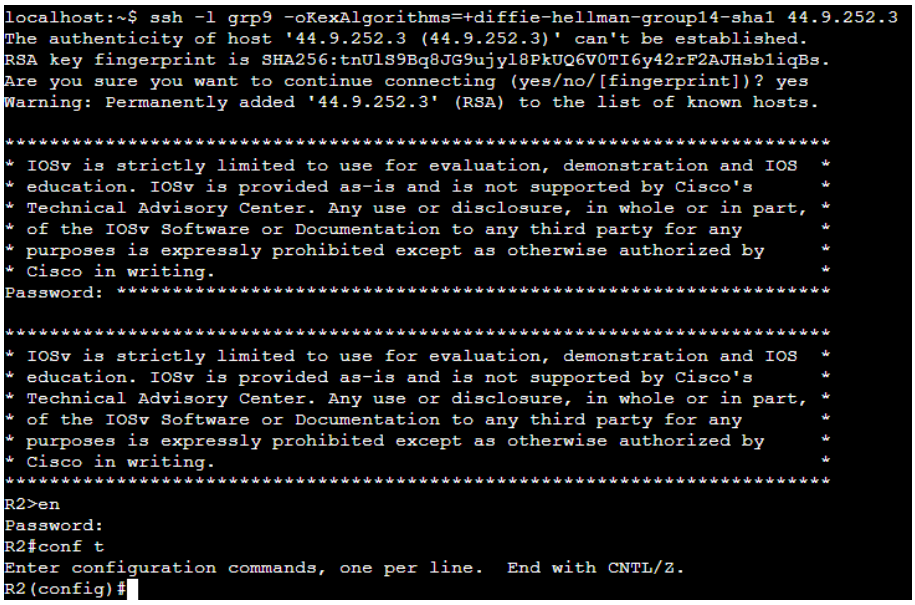

Figure 129: R2 IPv4 SSH

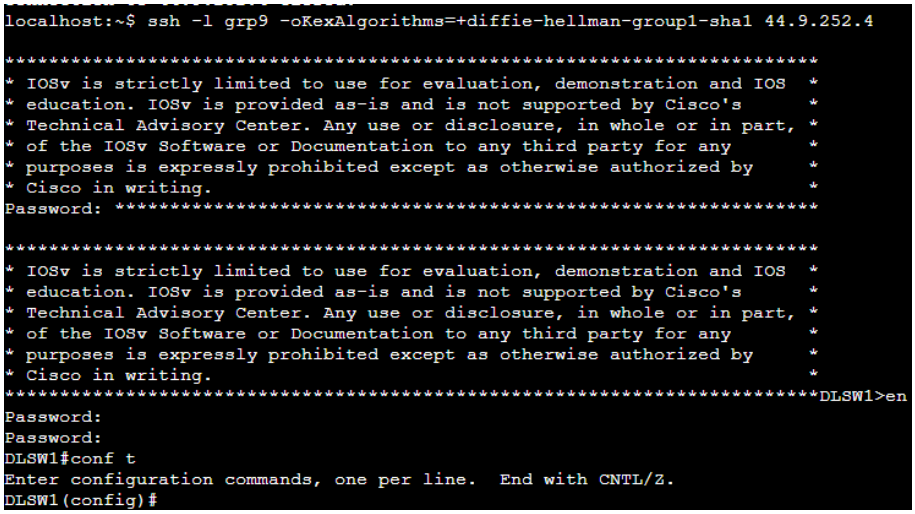

Figure 130: DLSW1 IPv4 SSH

Figure 131: DLSW2 IPv4 SSH

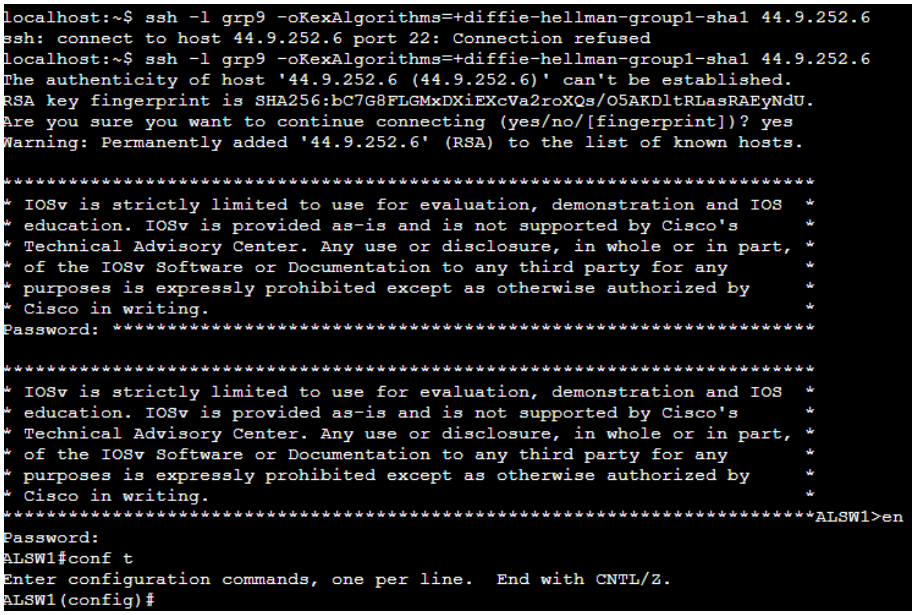

Figure 132: ALSW1 IPv4 SSH

8.4 Traceroute

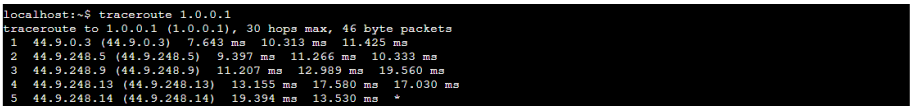

Figure 133: Client route to internet 1.0.0.1

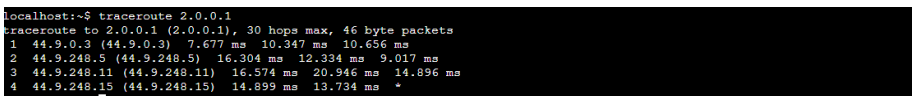

Figure 134: Client route to internet 2.0.0.1

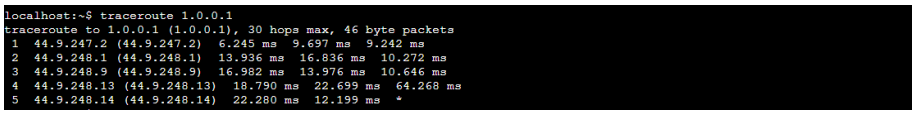

Figure 135: Server route to internet 1.0.0.1

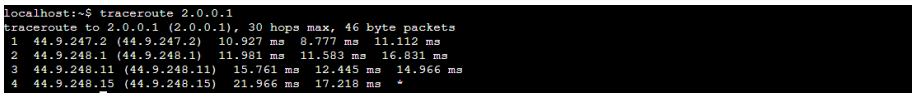

Figure 136: Server route to internet 2.0.0.1

9 IPv6 Connectivity

9.1 Ping

ping from client to each VLAN's interface on ALSW1

```
localhost:~$ ping 2001:9999:1:0::3 -c 4
PING 2001:9999:1:0::3 (2001:9999:1::3): 56 data bytes
64 bytes from 2001:9999:1::3: seq=0 ttl=64 time=4.959 ms
64 bytes from 2001:9999:1::3: seq=1 ttl=64 time=4.969 ms
64 bytes from 2001:9999:1::3: seq=2 ttl=64 time=2.175 ms
64 bytes from 2001:9999:1::3: seq=3 ttl=64 time=3.652 ms

--- 2001:9999:1:0::3 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

Figure 137: Client IPv4 ping to VLAN 101

```
localhost:~$ ping 2001:9999:1:1::3 -c 4
PING 2001:9999:1:1::3 (2001:9999:1:1::3): 56 data bytes
64 bytes from 2001:9999:1:1::3: seq=0 ttl=64 time=24.359 ms
64 bytes from 2001:9999:1:1::3: seq=1 ttl=64 time=8.252 ms
64 bytes from 2001:9999:1:1::3: seq=2 ttl=64 time=6.330 ms
64 bytes from 2001:9999:1:1::3: seq=3 ttl=64 time=6.072 ms

--- 2001:9999:1:1::3 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

Figure 138: Client IPv4 ping to VLAN 102

```
localhost:~$ ping 2001:9999:1:2::3 -c 4
PING 2001:9999:1:2::3 (2001:9999:1:2::3): 56 data bytes
64 bytes from 2001:9999:1:2::3: seq=0 ttl=64 time=16.636 ms
64 bytes from 2001:9999:1:2::3: seq=1 ttl=64 time=6.627 ms
64 bytes from 2001:9999:1:2::3: seq=2 ttl=64 time=11.517 ms
64 bytes from 2001:9999:1:2::3: seq=3 ttl=64 time=8.132 ms

--- 2001:9999:1:2::3 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

Figure 139: Client IPv4 ping to VLAN 103

```
localhost:~$ ping 2001:9999:2:0::3 -c 4
PING 2001:9999:2:0::3 (2001:9999:2::3): 56 data bytes
64 bytes from 2001:9999:2::3: seq=0 ttl=64 time=12.127 ms
64 bytes from 2001:9999:2::3: seq=1 ttl=64 time=16.016 ms
64 bytes from 2001:9999:2::3: seq=2 ttl=64 time=9.521 ms
64 bytes from 2001:9999:2::3: seq=3 ttl=64 time=7.308 ms

--- 2001:9999:2:0::3 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

Figure 140: Client IPv4 ping to VLAN 301

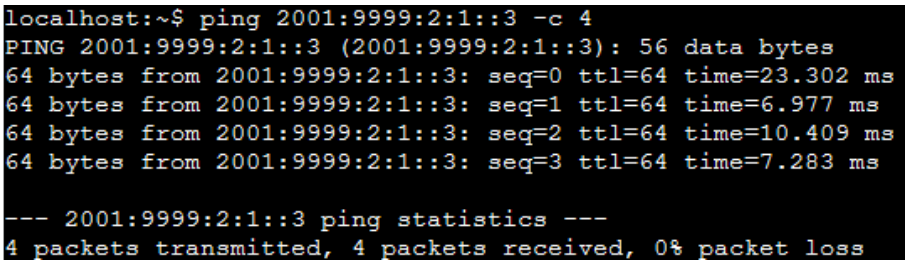

Figure 141: Client IPv4 ping to VLAN 302

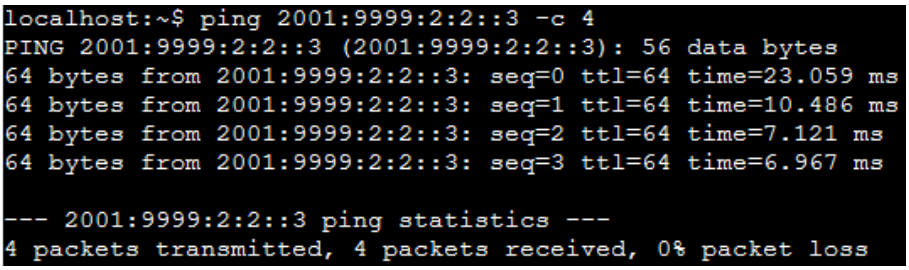

Figure 142: Client IPv4 ping to VLAN 303

ping from server to each VLAN's interface on ALSW1

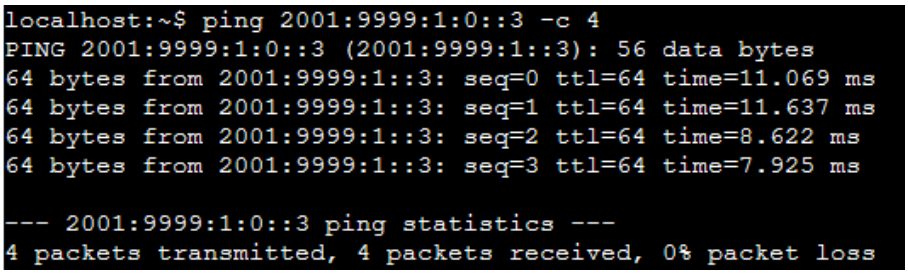

Figure 143: Server IPv4 ping to VLAN 101

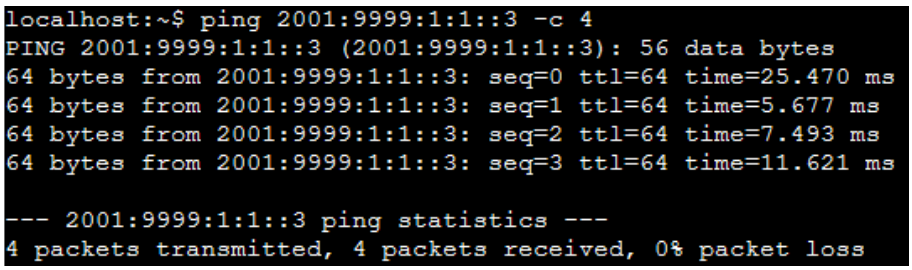

Figure 144: Server IPv4 ping to VLAN 102

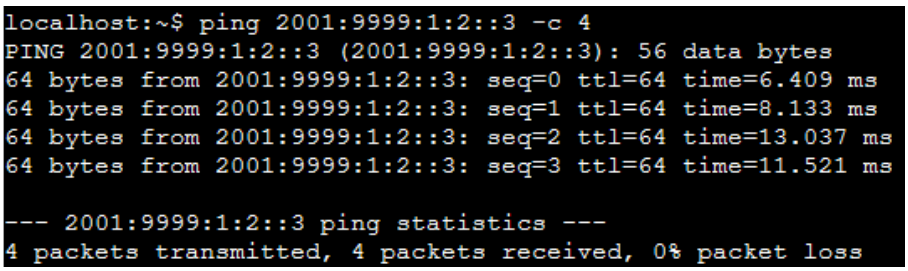

Figure 145: Server IPv4 ping to VLAN 103

```
localhost:~$ ping 2001:9999:2:0::3 -c 4
PING 2001:9999:2:0::3 (2001:9999:2::3): 56 data bytes
64 bytes from 2001:9999:2::3: seq=0 ttl=64 time=2.254 ms
64 bytes from 2001:9999:2::3: seq=1 ttl=64 time=4.361 ms
64 bytes from 2001:9999:2::3: seq=2 ttl=64 time=3.196 ms
64 bytes from 2001:9999:2::3: seq=3 ttl=64 time=3.199 ms

--- 2001:9999:2:0::3 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

Figure 146: Server IPv4 ping to VLAN 301

```
localhost:~$ ping 2001:9999:2:1::3 -c 4
PING 2001:9999:2:1::3 (2001:9999:2:1::3): 56 data bytes
64 bytes from 2001:9999:2:1::3: seq=0 ttl=64 time=18.125 ms
64 bytes from 2001:9999:2:1::3: seq=1 ttl=64 time=7.053 ms
64 bytes from 2001:9999:2:1::3: seq=2 ttl=64 time=6.937 ms
64 bytes from 2001:9999:2:1::3: seq=3 ttl=64 time=6.444 ms

--- 2001:9999:2:1::3 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

Figure 147: Server IPv4 ping to VLAN 302

```
localhost:~$ ping 2001:9999:2:2::3 -c 4
PING 2001:9999:2:2::3 (2001:9999:2:2::3): 56 data bytes
64 bytes from 2001:9999:2:2::3: seq=0 ttl=64 time=16.811 ms
64 bytes from 2001:9999:2:2::3: seq=1 ttl=64 time=10.266 ms
64 bytes from 2001:9999:2:2::3: seq=2 ttl=64 time=7.513 ms
64 bytes from 2001:9999:2:2::3: seq=3 ttl=64 time=15.038 ms

--- 2001:9999:2:2::3 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

Figure 148: Server IPv4 ping to VLAN 303

9.2 Traceroute

```
traceroute to 2001:9999:1000::1 (2001:9999:1000::1), 30 hops max, 72 byte packets
 1  2001:9999:1::2 (2001:9999:1::2)  5.653 ms  5.830 ms  14.064 ms
 2  2001:9999::4 (2001:9999::4)  10.023 ms  10.538 ms  10.546 ms
 3  2001:9999::a (2001:9999::a)  13.050 ms  20.381 ms  11.738 ms
```

Figure 149: Client route to internet 2001:9999:1000::1

```
traceroute to 2001:9999:2000::1 (2001:9999:2000::1), 30 hops max, 72 byte packets
 1  2001:9999:1::2 (2001:9999:1::2)  10.344 ms  7.617 ms  6.762 ms
 2  2001:9999::4 (2001:9999::4)  9.515 ms  6.817 ms  8.391 ms
 3  2001:9999::a (2001:9999::a)  8.309 ms  16.658 ms  12.941 ms
 4  2001:9999::f (2001:9999::f)  11.030 ms  11.437 ms  13.332 ms
```

Figure 150: Client route to internet 2001:9999:2000::1

```
traceroute to 2001:9999:1000::1 (2001:9999:1000::1), 30 hops max, 72 byte packets
 1  2001:9999:2::1 (2001:9999:2::1)  14.638 ms  6.395 ms  8.058 ms
 2  2001:9999:: (2001:9999::)  11.040 ms  25.764 ms  6.466 ms
 3  2001:9999::a (2001:9999::a)  13.818 ms  16.713 ms  11.937 ms
```

Figure 151: Server route to internet 2001:9999:1000::1

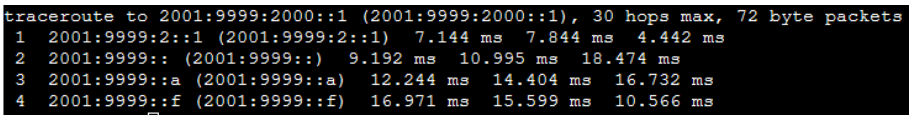

Figure 152: Server route to internet 2001:9999:2000::1

10 Run Configs

```
Building configuration...

Current configuration : 5324 bytes
!
! Last configuration change at 13:05:59 UTC Wed Feb 3 2021
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
service compress-config
!
hostname ALSW1
!
boot-start-marker
boot-end-marker
!
!
vrf definition MGMT
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
no logging console
enable password cisco
!
username grp9 password 0 cisco
no aaa new-model
!
!
!
!
!
!
!
!
no ip domain-lookup
ip domain-name sps.local
ip cef
no ipv6 cef
!
!
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface Loopback0
 description loopback
 ip address 44.9.254.2 255.255.255.255
 ipv6 address 2001:9999::402/128
!
```

```
interface GigabitEthernet0/0
 description ALSW1-Servery
 switchport access vlan 301
 switchport mode access
 negotiation auto
 spanning-tree portfast edge
 spanning-tree bpduguard enable
!
interface GigabitEthernet0/1
 description ALSW1-DLSW1
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
 spanning-tree vlan 101-103 cost 20
 spanning-tree vlan 301-303 cost 5
!
interface GigabitEthernet0/2
 description ALSW1-DLSW2
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
 spanning-tree vlan 101-103 cost 5
 spanning-tree vlan 301-303 cost 20
!
interface GigabitEthernet0/3
 description ALSW1-Klienty
 switchport access vlan 101
 switchport mode access
 negotiation auto
 spanning-tree portfast edge
 spanning-tree bpduguard enable
!
interface GigabitEthernet1/0
 description ALSW1-VRF-Test
 switchport access vlan 18
 switchport mode access
 negotiation auto
!
interface GigabitEthernet1/1
 switchport trunk allowed vlan 998
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
!
interface GigabitEthernet1/2
 switchport trunk allowed vlan 998
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
!
interface GigabitEthernet1/3
 switchport trunk allowed vlan 998
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
!
interface Vlan18
 description VRF-MGMT
 vrf forwarding MGMT
 ip address 44.9.252.6 255.255.255.0
!
interface Vlan101
```

```
 ip address 44.9.0.126 255.255.255.128
 ipv6 address 2001:9999:1::3/64
!
interface Vlan102
 ip address 44.9.0.190 255.255.255.192
 ipv6 address 2001:9999:1:1::3/64
!
interface Vlan103
 ip address 44.9.0.206 255.255.255.240
 ipv6 address 2001:9999:1:2::3/64
!
interface Vlan301
 ip address 44.9.247.126 255.255.255.128
 ipv6 address 2001:9999:2::3/64
!
interface Vlan302
 ip address 44.9.247.190 255.255.255.192
 ipv6 address 2001:9999:2:1::3/64
!
interface Vlan303
 ip address 44.9.247.206 255.255.255.240
 ipv6 address 2001:9999:2:2::3/64
!
ip forward-protocol nd
!
ip http server
ip http secure-server
!
ip ssh server algorithm encryption aes128-ctr aes192-ctr aes256-ctr
ip ssh client algorithm encryption aes128-ctr aes192-ctr aes256-ctr
!
!
access-list 1 permit any
!
!
!
!
control-plane
!
banner exec ^C
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banner login ^C
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**************************************************************************^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
line aux 0
```

```
line vty 0 4
 access-class 1 in vrf-also
 password cisco
 login local
 transport input telnet ssh
!
!
end
```

Listing 1: ALSW1 run config

```
Building configuration...

Current configuration : 4564 bytes
!
! Last configuration change at 13:12:09 UTC Wed Feb 3 2021
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
service compress-config
!
hostname DLSW1
!
boot-start-marker
boot-end-marker
!
!
vrf definition MGMT
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
no logging console
enable password cisco
!
username grp9 password 0 cisco
no aaa new-model
!
!
!
!
!
!
!
!
no ip domain-lookup
ip domain-name sps.local
ip cef
no ipv6 cef
!
!
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 101-103 priority 28672
spanning-tree vlan 301-303 priority 24576
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface Loopback0
 description loopback
 ip address 44.9.254.0 255.255.255.255
 ipv6 address 2001:9999::400/128
!
interface Port-channel1
```

```
 description DLSW1-DLSW2
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
!
interface GigabitEthernet0/0
 switchport trunk allowed vlan 998
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
!
interface GigabitEthernet0/1
 description DLSW1-R1
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
!
interface GigabitEthernet0/2
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
 channel-group 1 mode active
!
interface GigabitEthernet0/3
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
 channel-group 1 mode active
!
interface GigabitEthernet1/0
 description DLSW1-ALSW1
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
 spanning-tree vlan 101-103 cost 20
 spanning-tree vlan 301-303 cost 5
!
interface Vlan18
 description VRF-MGMT
 vrf forwarding MGMT
 ip address 44.9.252.4 255.255.255.0
!
ip forward-protocol nd
!
ip http server
ip http secure-server
!
ip ssh server algorithm encryption aes128-ctr aes192-ctr aes256-ctr
ip ssh client algorithm encryption aes128-ctr aes192-ctr aes256-ctr
!
!
access-list 1 permit any
!
!
!
!
control-plane
!
banner exec ^C
**************************************************************************
```

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banner login ^C
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**********************************************************************^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
line aux 0
line vty 0 4
 access-class 1 in vrf-also
 password cisco
 login local
 transport input telnet ssh
!
!
end
```

Listing 2: DLSW1 run config

```
Building configuration...

Current configuration : 4564 bytes
!
! Last configuration change at 13:12:15 UTC Wed Feb 3 2021
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
service compress-config
!
hostname DLSW2
!
boot-start-marker
boot-end-marker
!
!
vrf definition MGMT
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
no logging console
enable password cisco
!
username grp9 password 0 cisco
no aaa new-model
!
!
!
!
!
!
!
!
no ip domain-lookup
ip domain-name sps.local
ip cef
no ipv6 cef
!
!
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 101-103 priority 28672
spanning-tree vlan 301-303 priority 24576
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface Loopback0
 description loopback
 ip address 44.9.254.1 255.255.255.255
 ipv6 address 2001:9999::401/128
!
interface Port-channel1
```

```
 description DLSW2-DLSW1
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
!
interface GigabitEthernet0/0
 switchport trunk allowed vlan 998
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
!
interface GigabitEthernet0/1
 description DLSW2-R2
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
!
interface GigabitEthernet0/2
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
 channel-group 1 mode active
!
interface GigabitEthernet0/3
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
 channel-group 1 mode active
!
interface GigabitEthernet1/0
 description DLSW2-ALSW1
 switchport trunk allowed vlan 18,101-103,301-303,999
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 999
 switchport mode trunk
 negotiation auto
 spanning-tree vlan 101-103 cost 5
 spanning-tree vlan 301-303 cost 20
!
interface Vlan18
 description VRF-MGMT
 vrf forwarding MGMT
 ip address 44.9.252.5 255.255.255.0
!
ip forward-protocol nd
!
ip http server
ip http secure-server
!
ip ssh server algorithm encryption aes128-ctr aes192-ctr aes256-ctr
ip ssh client algorithm encryption aes128-ctr aes192-ctr aes256-ctr
!
!
access-list 1 permit any
!
!
!
!
control-plane
!
banner exec ^C
**************************************************************************
```

```
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banner login ^C
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**********************************************************************^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
line aux 0
line vty 0 4
 access-class 1 in vrf-also
 password cisco
 login local
 transport input telnet ssh
!
!
end
```

Listing 3: DLSW2 run config

```
Building configuration...

Current configuration : 7945 bytes
!
! Last configuration change at 13:37:26 UTC Wed Feb 3 2021
!
version 15.9
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
!
vrf definition MGMT
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
no logging console
enable password cisco
!
no aaa new-model
!
!
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
!
!
!
!
!
!
!
!
!
!
!
no ip domain lookup
ip domain name sps.local
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
username grp9 password 0 cisco
!
redundancy
!
!
track 31 ipv6 route 2001:9999:2::/64 reachability
!
track 32 ipv6 route 2001:9999:2:1::/64 reachability
!
track 33 ipv6 route 2001:9999:2:2::/64 reachability
!
track 301 ip route 44.9.247.0 255.255.255.128 reachability
```

```
!
track 302 ip route 44.9.247.128 255.255.255.192 reachability
!
track 303 ip route 44.9.247.192 255.255.255.240 reachability
!
!
!
!
!
!
!
!
!
!
!
!
!
interface Loopback0
 description loopback
 ip address 44.9.254.3 255.255.255.255
 ipv6 address 2001:9999::403/128
 ospfv3 2 ipv6 area 0
 ospfv3 1 ipv4 area 0
!
interface Loopback1
 description VRF-Loopback
 vrf forwarding MGMT
 ip address 44.9.253.244 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1
 description R1-DLSW1
 no ip address
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1.18
 description VLAN-MA-18
 encapsulation dot1Q 18
 vrf forwarding MGMT
 ip address 44.9.252.2 255.255.255.0
 vrrp 18 ip 44.9.252.1
 vrrp 18 priority 120
!
interface GigabitEthernet0/1.101
 description VLAN-Klient-101
 encapsulation dot1Q 101
 ip address 44.9.0.2 255.255.255.128
 standby version 2
 standby 11 ipv6 2001:9999:1::/64
 standby 11 priority 120
 standby 11 preempt
 standby 101 ip 44.9.0.1
 standby 101 priority 120
 standby 101 preempt
 ipv6 address 2001:9999:1::1/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.102
 description VLAN-Klient-102
 encapsulation dot1Q 102
```

```
 ip address 44.9.0.130 255.255.255.192
 standby version 2
 standby 12 ipv6 2001:9999:1:1::/64
 standby 12 priority 120
 standby 12 preempt
 standby 102 ip 44.9.0.129
 standby 102 priority 120
 standby 102 preempt
 ipv6 address 2001:9999:1:1::1/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.103
 description VLAN-Klient-103
 encapsulation dot1Q 103
 ip address 44.9.0.194 255.255.255.240
 standby version 2
 standby 13 ipv6 2001:9999:1:2::/64
 standby 13 priority 120
 standby 13 preempt
 standby 103 ip 44.9.0.193
 standby 103 priority 120
 standby 103 preempt
 ipv6 address 2001:9999:1:2::1/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.301
 description VLAN-Server-301
 encapsulation dot1Q 301
 ip address 44.9.247.2 255.255.255.128
 standby version 2
 standby 1 ip 44.9.247.1
 standby 1 priority 150
 standby 1 preempt
 standby 1 track 301 decrement 30
 standby 21 ipv6 2001:9999:2::/64
 standby 21 priority 150
 standby 21 preempt
 standby 21 track 31 decrement 30
 ipv6 address 2001:9999:2::1/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.302
 description VLAN-Server-302
 encapsulation dot1Q 302
 ip address 44.9.247.130 255.255.255.192
 standby version 2
 standby 2 ip 44.9.247.129
 standby 2 priority 150
 standby 2 preempt
 standby 2 track 302 decrement 30
 standby 22 ipv6 2001:9999:2:1::/64
 standby 22 priority 150
 standby 22 preempt
 standby 22 track 32 decrement 30
 ipv6 address 2001:9999:2:1::1/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.303
 description VLAN-Server-303
 encapsulation dot1Q 303
 ip address 44.9.247.194 255.255.255.240
 standby version 2
 standby 3 ip 44.9.247.193
 standby 3 priority 150
```

```
 standby 3 preempt
 standby 3 track 303 decrement 30
 standby 23 ipv6 2001:9999:2:2::/64
 standby 23 priority 150
 standby 23 preempt
 standby 23 track 33 decrement 30
 ipv6 address 2001:9999:2:2::1/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/2
 no ip address
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/2.9
 description R1-WAN2
 encapsulation dot1Q 9
 ip address 44.9.248.2 255.255.255.254
 ipv6 address 2001:9999::3/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 50
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 50
!
interface GigabitEthernet0/2.91
 description VLAN-M-91
 encapsulation dot1Q 91
 vrf forwarding MGMT
 ip address 44.9.253.250 255.255.255.254
!
interface GigabitEthernet0/3
 no ip address
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/3.9
 description R1-WAN1
 encapsulation dot1Q 9
 ip address 44.9.248.0 255.255.255.254
 ipv6 address 2001:9999::1/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 10
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 10
!
interface GigabitEthernet0/3.91
 description VLAN-M-91
 encapsulation dot1Q 91
 vrf forwarding MGMT
 ip address 44.9.253.248 255.255.255.254
!
!
router eigrp 1
 !
 address-family ipv4 vrf MGMT
  network 44.9.252.0 0.0.0.255
  network 44.9.253.244 0.0.0.0
  network 44.9.253.248 0.0.0.1
  network 44.9.253.250 0.0.0.1
  autonomous-system 1
 exit-address-family
!
router ospfv3 1
 router-id 44.9.254.3
 !
 address-family ipv4 unicast
```

```
  passive-interface default
  no passive-interface GigabitEthernet0/2.9
  no passive-interface GigabitEthernet0/3.9
 exit-address-family
!
router ospfv3 2
 router-id 44.9.254.3
 !
 address-family ipv6 unicast
  passive-interface default
  no passive-interface GigabitEthernet0/2.9
  no passive-interface GigabitEthernet0/3.9
 exit-address-family
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
ipv6 ioam timestamp
!
!
access-list 1 permit any
!
control-plane
!
banner exec ^C
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**************************************************************************^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
line aux 0
line vty 0 4
 access-class 1 in vrf-also
 password cisco
 login local
 transport input telnet ssh
!
no scheduler allocate
!
end
```

Listing 4: R1 run config

```
Building configuration...

Current configuration : 7945 bytes
!
! Last configuration change at 13:37:30 UTC Wed Feb 3 2021
!
version 15.9
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
!
vrf definition MGMT
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
no logging console
enable password cisco
!
no aaa new-model
!
!
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
!
!
!
!
!
!
!
!
!
!
!
no ip domain lookup
ip domain name sps.local
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
username grp9 password 0 cisco
!
redundancy
!
!
track 11 ipv6 route 2001:9999:1::/64 reachability
!
track 12 ipv6 route 2001:9999:1:1::/64 reachability
!
track 13 ipv6 route 2001:9999:1:2::/64 reachability
!
track 101 ip route 44.9.0.0 255.255.255.128 reachability
```

```
!
track 102 ip route 44.9.0.128 255.255.255.192 reachability
!
track 103 ip route 44.9.0.192 255.255.255.240 reachability
!
!
!
!
!
!
!
!
!
!
!
!
!
interface Loopback0
 description loopback
 ip address 44.9.254.4 255.255.255.255
 ipv6 address 2001:9999::404/128
 ospfv3 2 ipv6 area 0
 ospfv3 1 ipv4 area 0
!
interface Loopback1
 description VRF-Loopback
 vrf forwarding MGMT
 ip address 44.9.253.245 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1
 description R2-DLSW2
 no ip address
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1.18
 description VLAN-MA-18
 encapsulation dot1Q 18
 vrf forwarding MGMT
 ip address 44.9.252.3 255.255.255.0
 vrrp 18 ip 44.9.252.1
 vrrp 18 priority 120
!
interface GigabitEthernet0/1.101
 description VLAN-Klient-101
 encapsulation dot1Q 101
 ip address 44.9.0.3 255.255.255.128
 standby version 2
 standby 11 ipv6 2001:9999:1::/64
 standby 11 priority 150
 standby 11 preempt
 standby 11 track 11 decrement 30
 standby 101 ip 44.9.0.1
 standby 101 priority 150
 standby 101 preempt
 standby 101 track 101 decrement 30
 ipv6 address 2001:9999:1::2/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.102
```

```
 description VLAN-Klient-102
 encapsulation dot1Q 102
 ip address 44.9.0.131 255.255.255.192
 standby version 2
 standby 12 ipv6 2001:9999:1:1::/64
 standby 12 priority 150
 standby 12 preempt
 standby 12 track 12 decrement 30
 standby 102 ip 44.9.0.129
 standby 102 priority 150
 standby 102 preempt
 standby 102 track 102 decrement 30
 ipv6 address 2001:9999:1:1::2/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.103
 description VLAN-Klient-103
 encapsulation dot1Q 103
 ip address 44.9.0.195 255.255.255.240
 standby version 2
 standby 13 ipv6 2001:9999:1:2::/64
 standby 13 priority 150
 standby 13 preempt
 standby 13 track 13 decrement 30
 standby 103 ip 44.9.0.193
 standby 103 priority 150
 standby 103 preempt
 standby 103 track 103 decrement 30
 ipv6 address 2001:9999:1:2::2/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.301
 description VLAN-Server-301
 encapsulation dot1Q 301
 ip address 44.9.247.3 255.255.255.128
 standby version 2
 standby 1 ip 44.9.247.1
 standby 1 priority 120
 standby 1 preempt
 standby 21 ipv6 2001:9999:2::/64
 standby 21 priority 120
 standby 21 preempt
 ipv6 address 2001:9999:2::2/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.302
 description VLAN-Server-302
 encapsulation dot1Q 302
 ip address 44.9.247.131 255.255.255.192
 standby version 2
 standby 2 ip 44.9.247.129
 standby 2 priority 120
 standby 2 preempt
 standby 22 ipv6 2001:9999:2:1::/64
 standby 22 priority 120
 standby 22 preempt
 ipv6 address 2001:9999:2:1::2/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/1.303
 description VLAN-Server-303
 encapsulation dot1Q 303
 ip address 44.9.247.195 255.255.255.240
 standby version 2
```

```
 standby 3 ip 44.9.247.193
 standby 3 priority 120
 standby 3 preempt
 standby 23 ipv6 2001:9999:2:2::/64
 standby 23 priority 120
 standby 23 preempt
 ipv6 address 2001:9999:2:2::2/64
 ospfv3 2 ipv6 area 2
 ospfv3 1 ipv4 area 1
!
interface GigabitEthernet0/2
 no ip address
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/2.9
 description R2-WAN1
 encapsulation dot1Q 9
 ip address 44.9.248.4 255.255.255.254
 ipv6 address 2001:9999::5/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 10
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 10
!
interface GigabitEthernet0/2.91
 description VLAN-M-91
 encapsulation dot1Q 91
 vrf forwarding MGMT
 ip address 44.9.253.252 255.255.255.254
!
interface GigabitEthernet0/3
 no ip address
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/3.9
 description R2-WAN2
 encapsulation dot1Q 9
 ip address 44.9.248.6 255.255.255.254
 ipv6 address 2001:9999::7/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 50
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 50
!
interface GigabitEthernet0/3.91
 description VLAN-M-91
 encapsulation dot1Q 91
 vrf forwarding MGMT
 ip address 44.9.253.254 255.255.255.254
!
!
router eigrp 1
 !
 address-family ipv4 vrf MGMT
  network 44.9.252.0 0.0.0.255
  network 44.9.253.245 0.0.0.0
  network 44.9.253.252 0.0.0.1
  network 44.9.253.254 0.0.0.1
  autonomous-system 1
 exit-address-family
!
router ospfv3 1
 router-id 44.9.254.4
 !
 address-family ipv4 unicast
```

```
  passive-interface default
  no passive-interface GigabitEthernet0/2.9
  no passive-interface GigabitEthernet0/3.9
 exit-address-family
!
router ospfv3 2
 router-id 44.9.254.4
 !
 address-family ipv6 unicast
  passive-interface default
  no passive-interface GigabitEthernet0/2.9
  no passive-interface GigabitEthernet0/3.9
 exit-address-family
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
ipv6 ioam timestamp
!
!
access-list 1 permit any
!
control-plane
!
banner exec ^C
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**************************************************************************^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
line aux 0
line vty 0 4
 access-class 1 in vrf-also
 password cisco
 login local
 transport input telnet ssh
!
no scheduler allocate
!
end
```

Listing 5: R2 run config

```
Building configuration...

Current configuration : 8230 bytes
!
! Last configuration change at 13:37:41 UTC Wed Feb 3 2021
!
version 15.9
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname WAN1
!
boot-start-marker
boot-end-marker
!
!
vrf definition MGMT
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
no logging console
enable password cisco
!
no aaa new-model
!
!
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
!
!
!
!
!
!
!
!
!
!
!
no ip domain lookup
ip domain name sps.local
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
username grp9 password 0 cisco
!
redundancy
!
!
!
!
!
!
!
!
!
```

```
!
!
!
!
!
interface Loopback0
 description loopback
 ip address 44.9.254.5 255.255.255.255
 ipv6 address 2001:9999::405/128
 ospfv3 2 ipv6 area 0
 ospfv3 1 ipv4 area 0
!
interface Loopback1
 description VRF-Loopback
 vrf forwarding MGMT
 ip address 44.9.253.246 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1
 description WAN1-WAN2
 ip address 44.9.248.8 255.255.255.254
 duplex auto
 speed auto
 media-type rj45
 ipv6 address 2001:9999::8/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 10
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 10
!
interface GigabitEthernet0/2
 description WAN1-ISP1
 ip address 44.9.248.10 255.255.255.254
 duplex auto
 speed auto
 media-type rj45
 ipv6 address 2001:9999::B/127
!
interface GigabitEthernet0/3
 no ip address
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/3.9
 description WAN1-R1
 encapsulation dot1Q 9
 ip address 44.9.248.1 255.255.255.254
 ipv6 address 2001:9999::/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 10
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 10
!
interface GigabitEthernet0/3.91
 description VLAN-M-91
 encapsulation dot1Q 91
 vrf forwarding MGMT
 ip address 44.9.253.249 255.255.255.254
!
interface GigabitEthernet0/4
 no ip address
 duplex auto
```

```
 speed auto
 media-type rj45
!
interface GigabitEthernet0/4.9
 description WAN1-R2
 encapsulation dot1Q 9
 ip address 44.9.248.5 255.255.255.254
 ipv6 address 2001:9999::4/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 10
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 10
!
interface GigabitEthernet0/4.91
 description VLAN-M-91
 encapsulation dot1Q 91
 vrf forwarding MGMT
 ip address 44.9.253.253 255.255.255.254
!
!
router eigrp 1
 !
 address-family ipv4 vrf MGMT
  network 44.9.253.246 0.0.0.0
  network 44.9.253.248 0.0.0.1
  network 44.9.253.252 0.0.0.1
  autonomous-system 1
 exit-address-family
!
router ospfv3 1
 router-id 44.9.254.5
 !
 address-family ipv4 unicast
  passive-interface default
  no passive-interface GigabitEthernet0/1
  no passive-interface GigabitEthernet0/3.9
  no passive-interface GigabitEthernet0/4.9
  default-information originate always route-map RM_DEFAULT
 exit-address-family
!
router ospfv3 2
 router-id 44.9.254.5
 !
 address-family ipv6 unicast
  passive-interface default
  no passive-interface GigabitEthernet0/1
  no passive-interface GigabitEthernet0/3.9
  no passive-interface GigabitEthernet0/4.9
  default-information originate always
 exit-address-family
!
router bgp 9
 bgp log-neighbor-changes
 neighbor 2001:9999::A remote-as 100
 neighbor 2001:9999::406 remote-as 9
 neighbor 2001:9999::406 update-source Loopback0
 neighbor 44.9.248.11 remote-as 100
 neighbor 44.9.254.6 remote-as 9
 neighbor 44.9.254.6 update-source Loopback0
 !
 address-family ipv4
  aggregate-address 44.9.240.0 255.255.248.0 summary-only
  aggregate-address 44.9.224.0 255.255.240.0 summary-only
  aggregate-address 44.9.192.0 255.255.224.0 summary-only
  aggregate-address 44.9.128.0 255.255.192.0 summary-only
  aggregate-address 44.9.0.0 255.255.128.0 summary-only
  redistribute ospfv3 1 route-map RM_REDISTRIBUTE_IPV4
  no neighbor 2001:9999::A activate
  no neighbor 2001:9999::406 activate
```

```
  neighbor 44.9.248.11 activate
  neighbor 44.9.248.11 route-map RM_INTERNETOUT4 out
  neighbor 44.9.254.6 activate
  neighbor 44.9.254.6 next-hop-self
  neighbor 44.9.254.6 route-map RM_NEIGHBOROUT4 out
 exit-address-family
 !
 address-family ipv6
  redistribute ospf 2 route-map RM_REDISTRIBUTE_IPV6
  aggregate-address 2001:9999:2::/48 summary-only
  aggregate-address 2001:9999:1::/48 summary-only
  neighbor 2001:9999::A activate
  neighbor 2001:9999::A route-map RM_INTERNETOUT6 out
  neighbor 2001:9999::406 activate
  neighbor 2001:9999::406 next-hop-self
  neighbor 2001:9999::406 route-map RM_NEIGHBOROUT6 out
 exit-address-family
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
ip access-list standard REDISTRIBUTE_IPV4
 deny   44.9.248.0 0.0.7.255
 permit 44.9.0.0 0.0.255.255
!
!
ip prefix-list PL_DEFAULT seq 10 permit 44.9.248.10/31
!
ip prefix-list PL_KLIENT4 seq 10 permit 44.9.0.0/17
!
ip prefix-list PL_SERVER4 seq 10 permit 44.9.240.0/21
ipv6 ioam timestamp
!
!
ipv6 prefix-list PL_KLIENT6 seq 10 permit 2001:9999:1::/48
!
ipv6 prefix-list PL_NEIGHBOROUT6 seq 10 permit 2001:9999:1000::/48
!
ipv6 prefix-list PL_SERVER6 seq 10 permit 2001:9999:2::/48
route-map RM_DEFAULT permit 10
 match ip address prefix-list PL_DEFAULT
!
route-map RM_INTERNETOUT4 permit 10
 match ip address prefix-list PL_KLIENT4
 set as-path prepend 9
!
route-map RM_INTERNETOUT4 permit 20
 match ip address prefix-list PL_SERVER4
!
route-map RM_INTERNETOUT6 permit 10
 match ipv6 address prefix-list PL_KLIENT6
 set as-path prepend 9
!
route-map RM_INTERNETOUT6 permit 20
 match ipv6 address prefix-list PL_SERVER6
!
route-map RM_NEIGHBOROUT4 permit 10
 match ip address 2
 set local-preference 120
!
route-map RM_NEIGHBOROUT4 permit 20
!
route-map RM_NEIGHBOROUT6 permit 10
 match ipv6 address prefix-list PL_NEIGHBOROUT6
 set local-preference 120
!
route-map RM_NEIGHBOROUT6 permit 20
```

```
!
route-map RM_REDISTRIBUTE_IPV4 permit 10
 match ip address REDISTRIBUTE_IPV4
!
route-map RM_REDISTRIBUTE_IPV6 permit 10
 match ipv6 address REDISTRIBUTE_IPV6
!
!
access-list 2 permit 2.0.0.0 0.0.255.255
!
ipv6 access-list REDISTRIBUTE_IPV6
 permit ipv6 2001:9999:1::/48 any
 permit ipv6 2001:9999:2::/48 any
!
control-plane
!
banner exec ^C
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**************************************************************************^C
banner login ^C
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**************************************************************************^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
line aux 0
line vty 0 4
 access-class 1 in vrf-also
 password cisco
 login local
 transport input telnet ssh
!
no scheduler allocate
!
end
```

Listing 6: WAN1 run config

```
Building configuration...

Current configuration : 8229 bytes
!
! Last configuration change at 13:37:44 UTC Wed Feb 3 2021
!
version 15.9
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname WAN2
!
boot-start-marker
boot-end-marker
!
!
vrf definition MGMT
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
no logging console
enable password cisco
!
no aaa new-model
!
!
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
!
!
!
!
!
!
!
!
!
!
!
no ip domain lookup
ip domain name sps.local
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
username grp9 password 0 cisco
!
redundancy
!
!
!
!
!
!
!
!
!
```

```
!
!
!
!
!
interface Loopback0
 description loopback
 ip address 44.9.254.6 255.255.255.255
 ipv6 address 2001:9999::408/128
 ospfv3 2 ipv6 area 0
 ospfv3 1 ipv4 area 0
!
interface Loopback1
 description VRF-Loopback
 vrf forwarding MGMT
 ip address 44.9.253.247 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1
 description WAN1-WAN2
 ip address 44.9.248.9 255.255.255.254
 duplex auto
 speed auto
 media-type rj45
 ipv6 address 2001:9999::9/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 10
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 10
!
interface GigabitEthernet0/2
 description WAN2-ISP2
 ip address 44.9.248.12 255.255.255.254
 duplex auto
 speed auto
 media-type rj45
 ipv6 address 2001:9999::D/127
!
interface GigabitEthernet0/3
 no ip address
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/3.9
 description WAN2-R2
 encapsulation dot1Q 9
 ip address 44.9.248.7 255.255.255.254
 ipv6 address 2001:9999::6/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 50
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 50
!
interface GigabitEthernet0/3.91
 description VLAN-M-91
 encapsulation dot1Q 91
 vrf forwarding MGMT
 ip address 44.9.253.255 255.255.255.254
!
interface GigabitEthernet0/4
 no ip address
 duplex auto
```

```
 speed auto
 media-type rj45
!
interface GigabitEthernet0/4.9
 description WAN2-R1
 encapsulation dot1Q 9
 ip address 44.9.248.3 255.255.255.254
 ipv6 address 2001:9999::2/127
 ospfv3 2 ipv6 area 0
 ospfv3 2 ipv6 cost 50
 ospfv3 1 ipv4 area 0
 ospfv3 1 ipv4 cost 50
!
interface GigabitEthernet0/4.91
 description VLAN-M-91
 encapsulation dot1Q 91
 vrf forwarding MGMT
 ip address 44.9.253.251 255.255.255.254
!
!
router eigrp 1
 !
 address-family ipv4 vrf MGMT
  network 44.9.253.247 0.0.0.0
  network 44.9.253.250 0.0.0.1
  network 44.9.253.254 0.0.0.1
  autonomous-system 1
 exit-address-family
!
router ospfv3 1
 router-id 44.9.254.6
 !
 address-family ipv4 unicast
  passive-interface default
  no passive-interface GigabitEthernet0/1
  no passive-interface GigabitEthernet0/3.9
  no passive-interface GigabitEthernet0/4.9
  default-information originate always route-map RM_DEFAULT
 exit-address-family
!
router ospfv3 2
 router-id 44.9.254.6
 !
 address-family ipv6 unicast
  passive-interface default
  no passive-interface GigabitEthernet0/1
  no passive-interface GigabitEthernet0/3.9
  no passive-interface GigabitEthernet0/4.9
  default-information originate always
 exit-address-family
!
router bgp 9
 bgp log-neighbor-changes
 neighbor 2001:9999::C remote-as 100
 neighbor 2001:9999::405 remote-as 9
 neighbor 2001:9999::405 update-source Loopback0
 neighbor 44.9.248.13 remote-as 100
 neighbor 44.9.254.5 remote-as 9
 neighbor 44.9.254.5 update-source Loopback0
 !
 address-family ipv4
  aggregate-address 44.9.240.0 255.255.248.0 summary-only
  aggregate-address 44.9.224.0 255.255.240.0 summary-only
  aggregate-address 44.9.192.0 255.255.224.0 summary-only
  aggregate-address 44.9.128.0 255.255.192.0 summary-only
  aggregate-address 44.9.0.0 255.255.128.0 summary-only
  redistribute ospfv3 1 route-map RM_REDISTRIBUTE_IPV4
  no neighbor 2001:9999::C activate
  no neighbor 2001:9999::405 activate
```

```
  neighbor 44.9.248.13 activate
  neighbor 44.9.248.13 route-map RM_INTERNETOUT4 out
  neighbor 44.9.254.5 activate
  neighbor 44.9.254.5 next-hop-self
  neighbor 44.9.254.5 route-map RM_NEIGHBOROUT4 out
 exit-address-family
 !
 address-family ipv6
  redistribute ospf 2 route-map RM_REDISTRIBUTE_IPV6
  aggregate-address 2001:9999:2::/48 summary-only
  aggregate-address 2001:9999:1::/48 summary-only
  neighbor 2001:9999::C activate
  neighbor 2001:9999::C route-map RM_INTERNETOUT6 out
  neighbor 2001:9999::405 activate
  neighbor 2001:9999::405 next-hop-self
  neighbor 2001:9999::405 route-map RM_NEIGHBOROUT6 out
 exit-address-family
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
ip access-list standard REDISTRIBUTE_IPV4
 deny   44.9.248.0 0.0.7.255
 permit 44.9.0.0 0.0.255.255
!
!
ip prefix-list PL_DEFAULT seq 10 permit 44.9.248.12/31
!
ip prefix-list PL_KLIENT4 seq 10 permit 44.9.0.0/17
!
ip prefix-list PL_SERVER4 seq 10 permit 44.9.240.0/21
ipv6 ioam timestamp
!
!
ipv6 prefix-list PL_KLIENT6 seq 10 permit 2001:9999:1::/48
!
ipv6 prefix-list PL_NEIGHBOROUT6 seq 10 permit 2001:9999:2000::/48
!
ipv6 prefix-list PL_SERVER6 seq 10 permit 2001:9999:2::/48
route-map RM_DEFAULT permit 10
 match ip address prefix-list PL_DEFAULT
!
route-map RM_INTERNETOUT4 permit 10
 match ip address prefix-list PL_SERVER4
 set as-path prepend 9
!
route-map RM_INTERNETOUT4 permit 20
 match ip address prefix-list PL_KLIENT4
!
route-map RM_INTERNETOUT6 permit 10
 match ipv6 address prefix-list PL_SERVER6
 set as-path prepend 9
!
route-map RM_INTERNETOUT6 permit 20
 match ipv6 address prefix-list PL_KLIENT6
!
route-map RM_NEIGHBOROUT4 permit 10
 match ip address 1
 set local-preference 120
!
route-map RM_NEIGHBOROUT4 permit 20
!
route-map RM_NEIGHBOROUT6 permit 10
 match ipv6 address prefix-list PL_NEIGHBOROUT6
 set local-preference 120
!
route-map RM_NEIGHBOROUT6 permit 20
```

```
!
route-map RM_REDISTRIBUTE_IPV4 permit 10
 match ip address REDISTRIBUTE_IPV4
!
route-map RM_REDISTRIBUTE_IPV6 permit 10
 match ipv6 address REDISTRIBUTE_IPV6
!
!
access-list 1 permit 1.0.0.0 0.0.0.255
!
ipv6 access-list REDISTRIBUTE_IPV6
 permit ipv6 2001:9999:1::/48 any
 permit ipv6 2001:9999:2::/48 any
!
control-plane
!
banner exec ^C
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banner incoming ^C
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banner login ^C
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**************************************************************************^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
line aux 0
line vty 0 4
 access-class 1 in vrf-also
 password cisco
 login local
 transport input telnet ssh
!
no scheduler allocate
!
end
```

Listing 7: WAN2 run config

```
Building configuration...

Current configuration : 4186 bytes
!
! Last configuration change at 13:37:53 UTC Wed Feb 3 2021
!
version 15.9
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname ISP1
!
boot-start-marker
boot-end-marker
!
!
no logging console
!
no aaa new-model
!
!
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
!
!
!
!
!
!
!
!
!
!
!
no ip domain lookup
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
!
redundancy
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface Loopback0
 description loopback
 ip address 44.9.254.7 255.255.255.255
 ipv6 address 2001:9999::407/128
!
interface Loopback100
```

```
 description ToJsouTyInternety
 ip address 1.0.0.1 255.0.0.0
 ipv6 address 2001:9999:1000::1/48
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1
 description ISP1-ISP2
 ip address 44.9.248.14 255.255.255.254
 duplex auto
 speed auto
 media-type rj45
 ipv6 address 2001:9999::E/127
!
interface GigabitEthernet0/2
 description ISP1-WAN1
 ip address 44.9.248.11 255.255.255.254
 duplex auto
 speed auto
 media-type rj45
 ipv6 address 2001:9999::A/127
!
interface GigabitEthernet0/3
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
router bgp 100
 bgp log-neighbor-changes
 neighbor 2001:9999::B remote-as 9
 neighbor 2001:9999::408 remote-as 100
 neighbor 2001:9999::408 update-source Loopback0
 neighbor 44.9.248.10 remote-as 9
 neighbor 44.9.254.8 remote-as 100
 neighbor 44.9.254.8 update-source Loopback0
 !
 address-family ipv4
  network 1.0.0.0
  no neighbor 2001:9999::B activate
  no neighbor 2001:9999::408 activate
  neighbor 44.9.248.10 activate
  neighbor 44.9.254.8 activate
  neighbor 44.9.254.8 next-hop-self
 exit-address-family
 !
 address-family ipv6
  network 2001:9999:1000::/48
  neighbor 2001:9999::B activate
  neighbor 2001:9999::408 activate
  neighbor 2001:9999::408 next-hop-self
 exit-address-family
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
ip route 44.9.254.8 255.255.255.255 44.9.248.15
!
ipv6 route 2001:9999::408/128 2001:9999::F
ipv6 ioam timestamp
!
```

```
!
!
control-plane
!
banner exec ^C
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banner login ^C
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**************************************************************************^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
line aux 0
line vty 0 4
 login
 transport input none
!
no scheduler allocate
!
end
```

Listing 8: ISP1 run config

```
Building configuration...

Current configuration : 4205 bytes
!
! Last configuration change at 13:37:58 UTC Wed Feb 3 2021
!
version 15.9
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname ISP2
!
boot-start-marker
boot-end-marker
!
!
no logging console
!
no aaa new-model
!
!
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
!
!
!
!
!
!
!
!
!
!
!
no ip domain lookup
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
!
redundancy
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface Loopback0
 description loopback
 ip address 44.9.254.8 255.255.255.255
 ipv6 address 2001:9999::408/128
!
interface Loopback100
```

```
 description ToJsouTyInternety
 ip address 2.0.0.1 255.255.0.0
 ipv6 address 2001:9999:2000::1/56
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1
 description ISP2-ISP1
 ip address 44.9.248.15 255.255.255.254
 duplex auto
 speed auto
 media-type rj45
 ipv6 address 2001:9999::F/127
!
interface GigabitEthernet0/2
 description ISP2-WAN2
 ip address 44.9.248.13 255.255.255.254
 duplex auto
 speed auto
 media-type rj45
 ipv6 address 2001:9999::C/127
!
interface GigabitEthernet0/3
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
router bgp 100
 bgp log-neighbor-changes
 neighbor 2001:9999::D remote-as 9
 neighbor 2001:9999::407 remote-as 100
 neighbor 2001:9999::407 update-source Loopback0
 neighbor 44.9.248.12 remote-as 9
 neighbor 44.9.254.7 remote-as 100
 neighbor 44.9.254.7 update-source Loopback0
 !
 address-family ipv4
  network 2.0.0.0 mask 255.255.0.0
  no neighbor 2001:9999::D activate
  no neighbor 2001:9999::407 activate
  neighbor 44.9.248.12 activate
  neighbor 44.9.254.7 activate
  neighbor 44.9.254.7 next-hop-self
 exit-address-family
 !
 address-family ipv6
  network 2001:9999:2000::/56
  neighbor 2001:9999::D activate
  neighbor 2001:9999::407 activate
  neighbor 2001:9999::407 next-hop-self
 exit-address-family
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
ip route 44.9.254.7 255.255.255.255 44.9.248.14
!
ipv6 route 2001:9999::407/128 2001:9999::E
ipv6 ioam timestamp
!
```

```
!
!
control-plane
!
banner exec ^C
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**************************************************************************^C
banner login ^C
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**************************************************************************^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
line aux 0
line vty 0 4
 login
 transport input none
!
no scheduler allocate
!
end
```

Listing 9: ISP2 run config