IS-IS External IP Route Test & Use Cases

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Version 4 (pdf version)

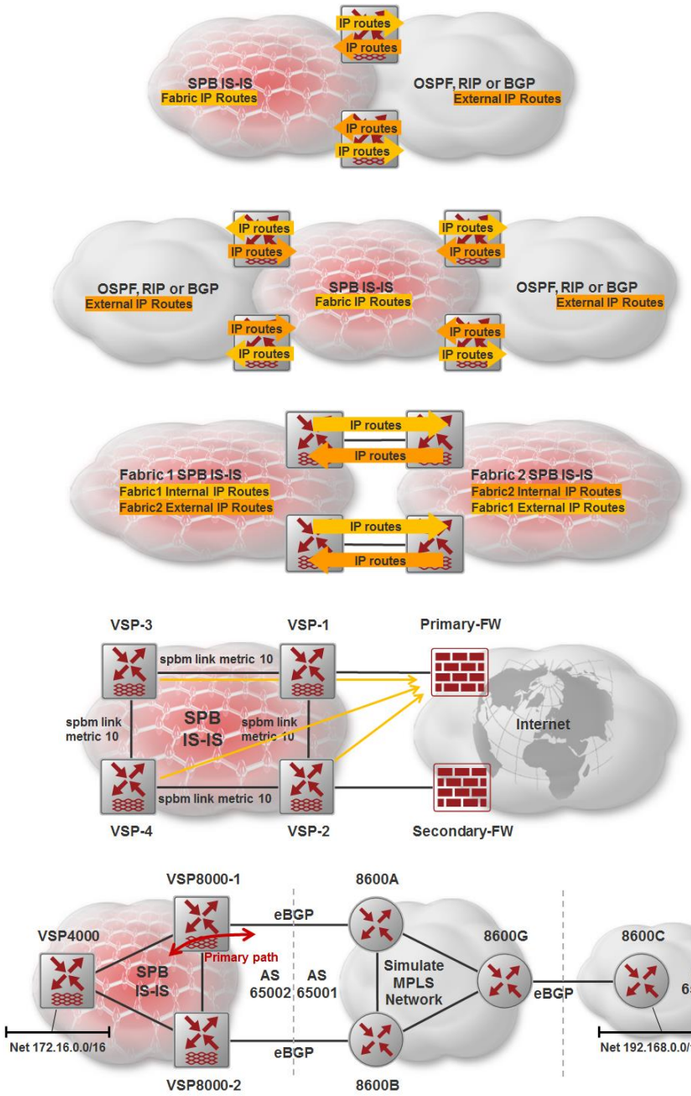
Compatibility Warning

- ISIS External Routes are new in VOSS 5.0
- The following nodes can co-exist in an SPB Fabric using ISIS External routes, but they will treat ISIS External routes just as if they were Internal Routes; they must however have these minimal software versions:
  - VOSS VPS with software versions 4.2.1.x
  - VSP9000 with software version 4.1.0.0 or later
  - ERS8600 or ERS8800 with software version 7.2.23.0 or later
  - ERS4900/5900 running IP Shortcuts with software version 7.2.0 or later
  - ERS4800 running IP Shortcuts since version 5.10.0
  - These older devices thus cannot be used as border routers in use case examples 1,2,3,5 but can operate as non-border routers just fine (as illustrated in example 3); in the use case 4 they can operate though only if the Primary Firewall BEB is the only BEB to announce the ISIS default route

Summary of Use Cases Explored

- ISIS Accept Policies and ISIS External Routes are leveraged in the following 5 use cases
- In the first 3 cases both border routers IP route between the two clouds in an active-active fashion
- In the last 2 cases the requirement is that all traffic be IP routed over a Primary path, and only fail over to the Secondary path in case of Primary path failure
- It is quite possible that there is more than one way to achieve the desired goal in each use case
- The objective of this deck is also to show the different approaches we have in our armory now (e.g. match or set external metric in either redistribution or accept policies); flexibility is key

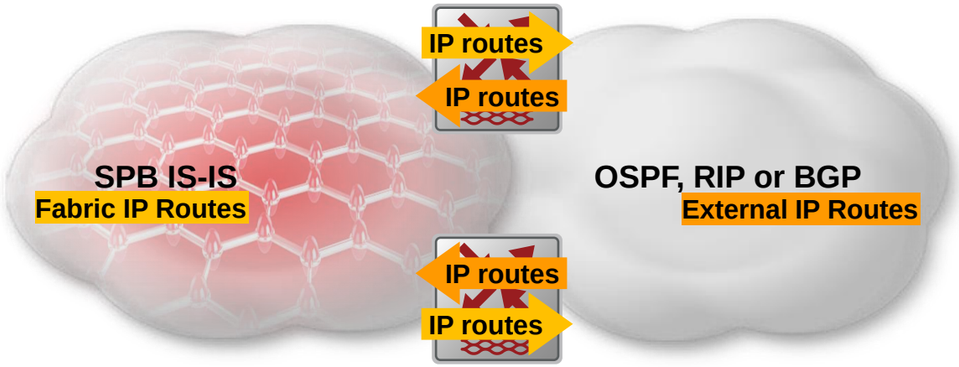
1. Routing between ISIS (SPB) and other IP routing protocols with redundant border routers
2. Routing between ISIS (SPB) and other IP routing protocols with many redundant boundaries
3. Routing between two separate SPB Fabrics
4. Routing towards a Primary Firewall
5. Routing between ISIS (SPB) and BGP(MPLS) using Primary & Backup paths



Routing between ISIS (SPB) and other IP routing protocols with redundant border routers

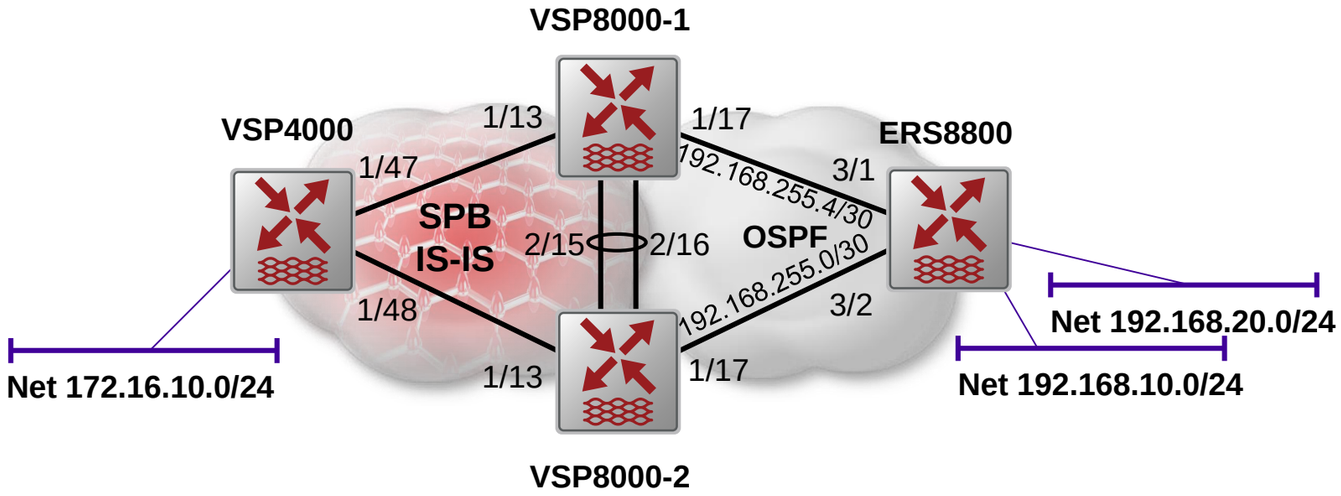
Leveraging IS-IS Accept policies + IS-IS External routes

Routing between ISIS (SPB) and other IP routing protocols



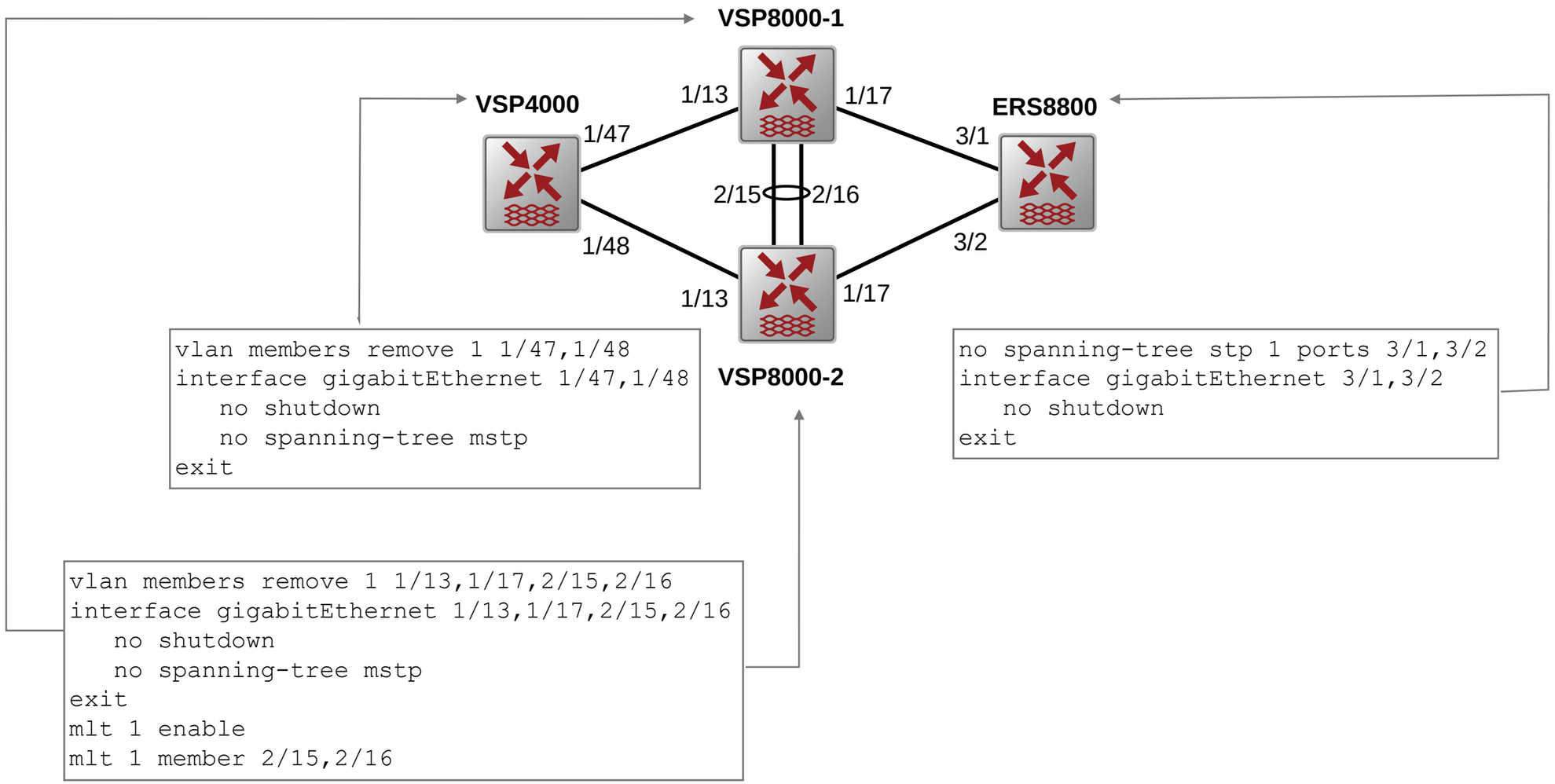
- GOAL = IP route between the two clouds
  - SPB (ISIS) Fabric IP routes are redistributed to OSPF, RIP or BGP in one direction
  - OSPF, RIP or BGP routes are redistributed into ISIS in the opposite direction
  - Two border routers are used for redundancy, and both can forward traffic at the same time
- CHALLENGE = not to get into routing loops where the IP routes redistributed by one router in one direction end up being re-redistributed to the same cloud where they came from by the other router
- These slides will use an OSPF Cloud; but the same config and principles will equally work for BGP & RIP

Setup, Equipment & Software used

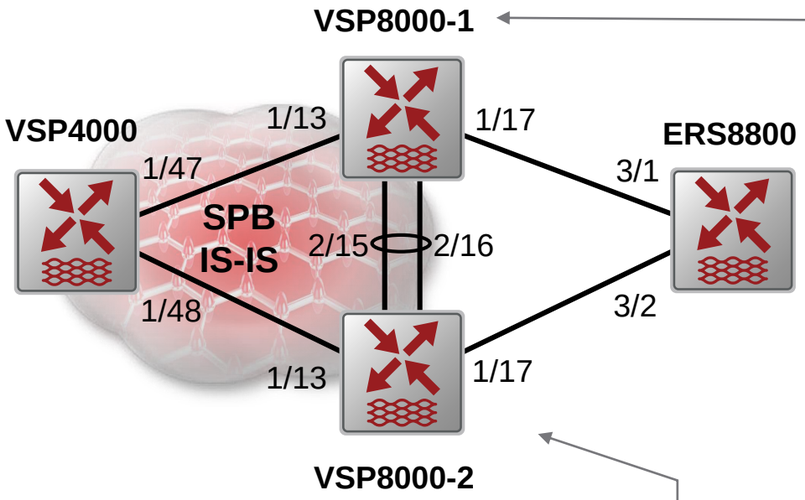


- VSP4000
  - VSP 4850GTS-PWR+ / 6.1.0.0_B021
- VSP8000-1
  - VSP 8404 / 6.1.0.0_B021
    - Slot1 8424GT
    - Slot2 8418XSQ
- VSP8000-2
  - VSP 8242XSQ / 6.1.0.0_B021
- ERS8800
  - 7.2.25.0GA

Port & MLT Config



SPB Global Config

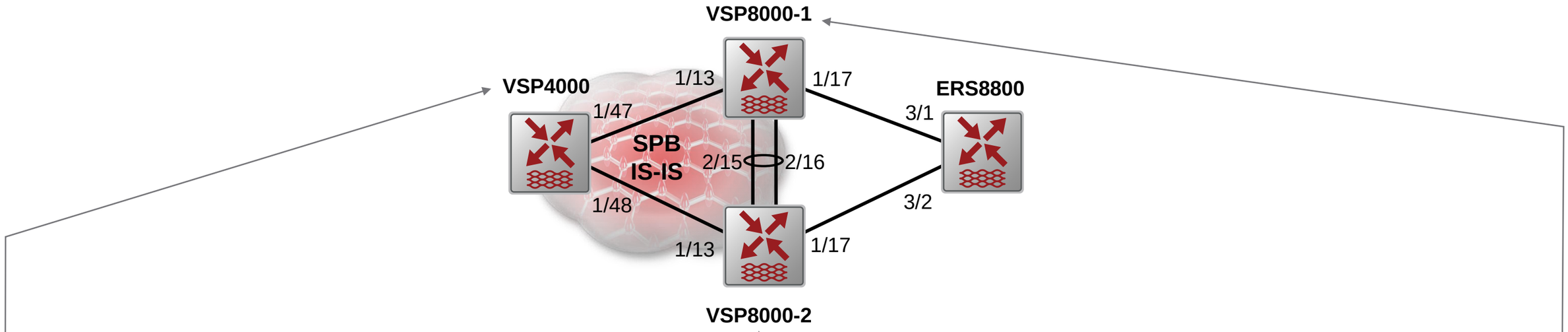



```
prompt VSP4000
interface loopback 1
   ip address 10.0.0.40/32
exit
spbm
router isis
   system-id 00bb.0000.4000
   manual-area 49.0000
   ip-source-address 10.0.0.40
   spbm 1
   spbm 1 nick-name 0.00.40
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 40
cfm spbm enable
```

```
prompt VSP8000-2
interface loopback 1
   ip address 10.0.0.82/32
exit
spbm
router isis
   system-id 00bb.0000.8200
   manual-area 49.0000
   ip-source-address 10.0.0.82
   spbm 1
   spbm 1 nick-name 0.00.82
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 82
cfm spbm enable
```

```
prompt VSP8000-1
interface loopback 1
   ip address 10.0.0.81/32
exit
spbm
router isis
   system-id 00bb.0000.8100
   manual-area 49.0000
   ip-source-address 10.0.0.81
   spbm 1
   spbm 1 nick-name 0.00.81
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 81
cfm spbm enable
```

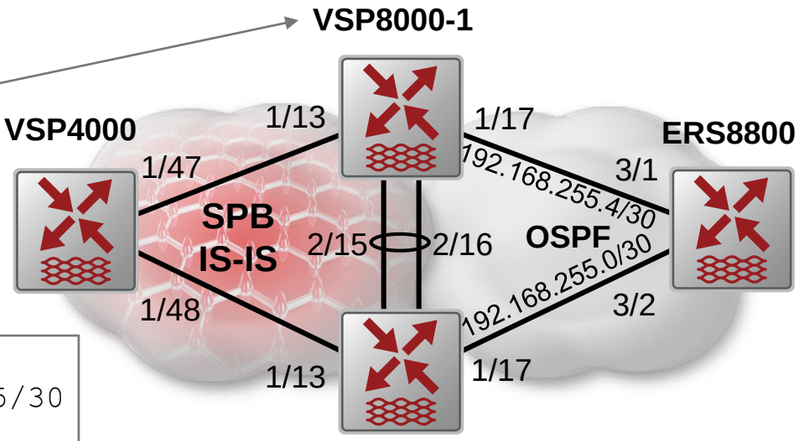
SPB Interface Config




```
interface GigabitEthernet 1/47,1/48
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

```
interface GigabitEthernet 1/13
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
interface mlt 1
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

OSPF Config

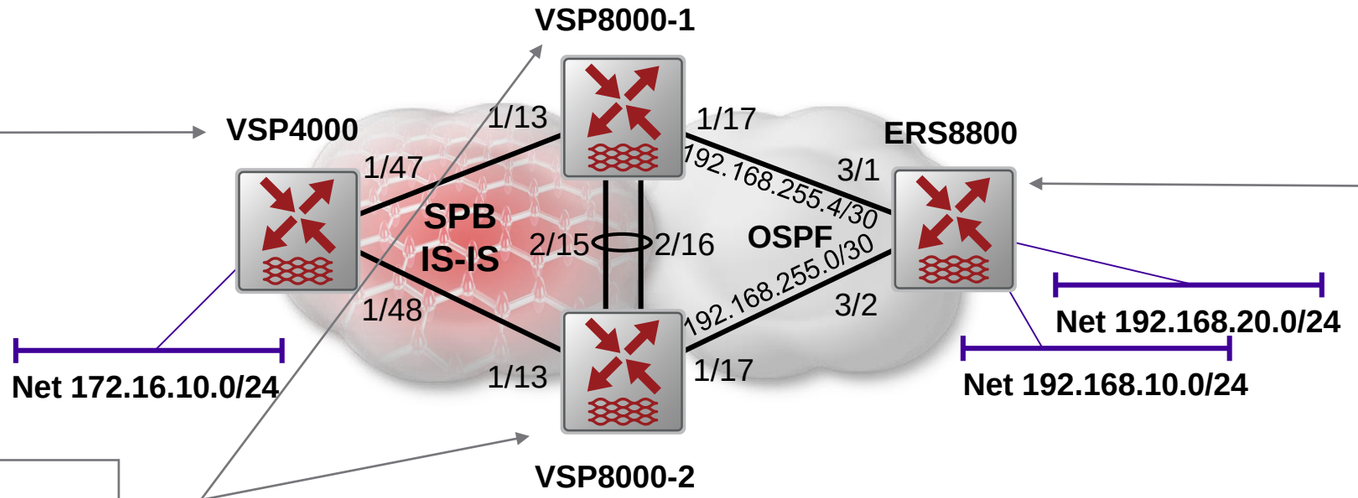



```
interface GigabitEthernet 1/17
   brouter vlan 3902 subnet 192.168.255.5/30
   ip ospf enable
exit
router ospf
   router-id 10.0.0.81
exit
router ospf enable
```

```
interface GigabitEthernet 1/17
   brouter vlan 3901 subnet 192.168.255.1/30
   ip ospf enable
exit
router ospf
   router-id 10.0.0.82
exit
router ospf enable
```

```
prompt ERS8800
interface GigabitEthernet 3/1,3/2
   brouter port 3/1 vlan 3902 subnet 192.168.255.6/30
   brouter port 3/2 vlan 3901 subnet 192.168.255.2/30
   ip ospf enable
exit
interface loopback 1
   ip address 10.0.0.88/32
   ip ospf
exit
router ospf
   router-id 10.0.0.88
exit
router ospf enable
```

Test networks config using CLIPs



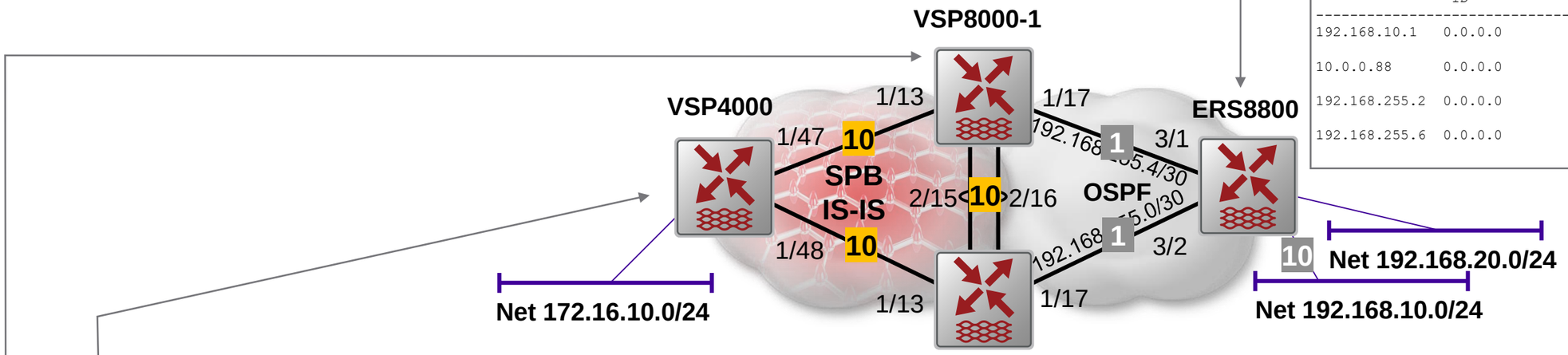

```
interface loopback 2
   ip address 172.16.10.1/24
exit
router isis
   redistribute direct
   redistribute direct enable
exit
isis apply redistribute direct
```

```
router isis
   redistribute direct
   redistribute direct enable
exit
isis apply redistribute direct
```

```
interface loopback 2
   ip address 192.168.10.1/24
   ip ospf
exit
interface loopback 3
   ip address 192.168.20.1/24
exit
router ospf
   as-boundary-router enable
   redistribute direct
   redistribute direct enable
exit
ip ospf apply redistribute direct
```

- Net 192.168.10.0/24 will be an OSPF intra-area route
- Net 192.168.20.0/24 will be an OSPF AS external route
- We also redistribute directs on the VSP8000 border routers since this will typically be the case anyway

ISIS & OSPF link metrics




```
ERS8800:5#% show ip ospf interface
=============================================================================================
                              OSPF Interface - GlobalRouter
=============================================================================================
INTERFACE       AREA           ADM IFST MET PRI DR/              TYPE AUTH      MTU
                ID                              BDR                   TYPE      IGNO
---------------------------------------------------------------------------------------------
192.168.10.1    0.0.0.0        en  DR   10  1   192.168.10.1     pass none      dis
                                                0.0.0.0
10.0.0.88       0.0.0.0        en  DR   10  1   10.0.0.88        pass none      dis
                                                0.0.0.0
192.168.255.2   0.0.0.0        en  DR   1   1   192.168.255.2    brdc none      dis
                                                192.168.255.1
192.168.255.6   0.0.0.0        en  DR   1   1   192.168.255.6    brdc none      dis
                                                192.168.255.5
```

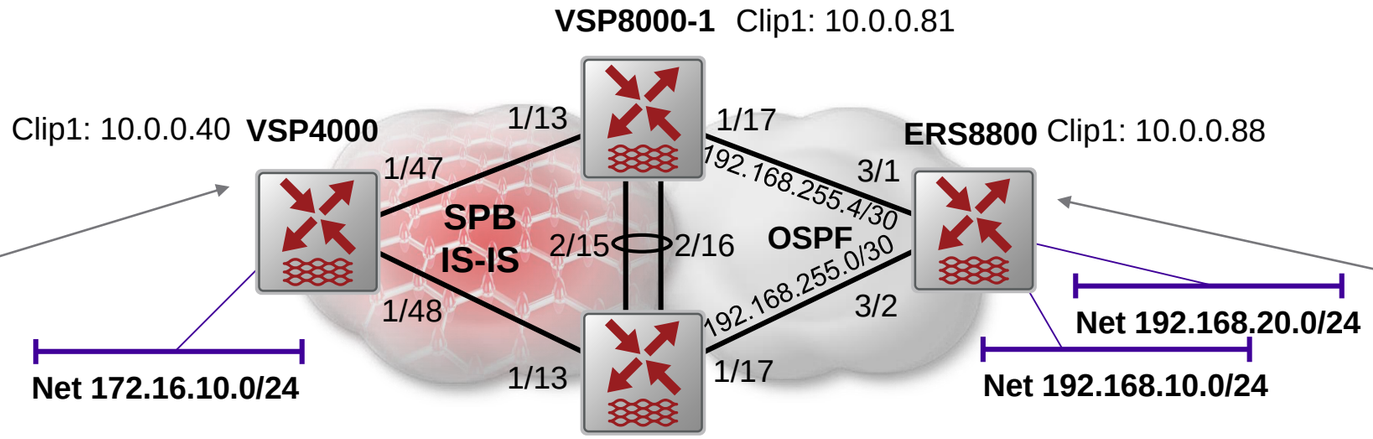
```
VSP4000:1#% show isis interface
=============================================================================================
                                ISIS Interfaces
=============================================================================================
IFIDX             TYPE    LEVEL     OP-STATE  ADM-STATE  ADJ    UP-ADJ  SPBM-L1-METRIC
---------------------------------------------------------------------------------------------
Port1/47          pt-pt   Level 1   UP        UP         1      1       10
Port1/48          pt-pt   Level 1   UP        UP         1      1       10
```

```
VSP8000-1:1#% show isis interface
=============================================================================================
                                ISIS Interfaces
=============================================================================================
IFIDX             TYPE    LEVEL     OP-STATE  ADM-STATE  ADJ    UP-ADJ  SPBM-L1-METRIC
---------------------------------------------------------------------------------------------
Port1/13          pt-pt   Level 1   UP        UP         1      1       10
Mlt1              pt-pt   Level 1   UP        UP         1      1       10

VSP8000-1:1#% show ip ospf interface
=============================================================================================
                            OSPF Interface - GlobalRouter
=============================================================================================
INTERFACE       AREA           ADM IFST MET PRI DR/              TYPE AUTH      MTU
                ID                              BDR                   TYPE      IGNO
---------------------------------------------------------------------------------------------
192.168.255.5   0.0.0.0        en  BDR  1   1   192.168.255.6    brdc none      dis
                                                192.168.255.5
```

```
VSP8000-2:1#% show isis interface
=============================================================================================
                                ISIS Interfaces
=============================================================================================
IFIDX             TYPE    LEVEL     OP-STATE  ADM-STATE  ADJ    UP-ADJ  SPBM-L1-METRIC
---------------------------------------------------------------------------------------------
Port1/13          pt-pt   Level 1   UP        UP         1      1       10
Mlt1              pt-pt   Level 1   UP        UP         1      1       10

VSP8000-2:1#% show ip ospf interface
=============================================================================================
                            OSPF Interface - GlobalRouter
=============================================================================================
INTERFACE       AREA           ADM IFST MET PRI DR/              TYPE AUTH      MTU
                ID                              BDR                   TYPE      IGNO
---------------------------------------------------------------------------------------------
192.168.255.1   0.0.0.0        en  BDR  1   1   192.168.255.2    brdc none      dis
                                                192.168.255.1
```

- ISIS NNI links use default SPBM L1-metric of 10
- OSPF interface metrics at default 1 (for Gig Ethernet) and 10 for CLIPs

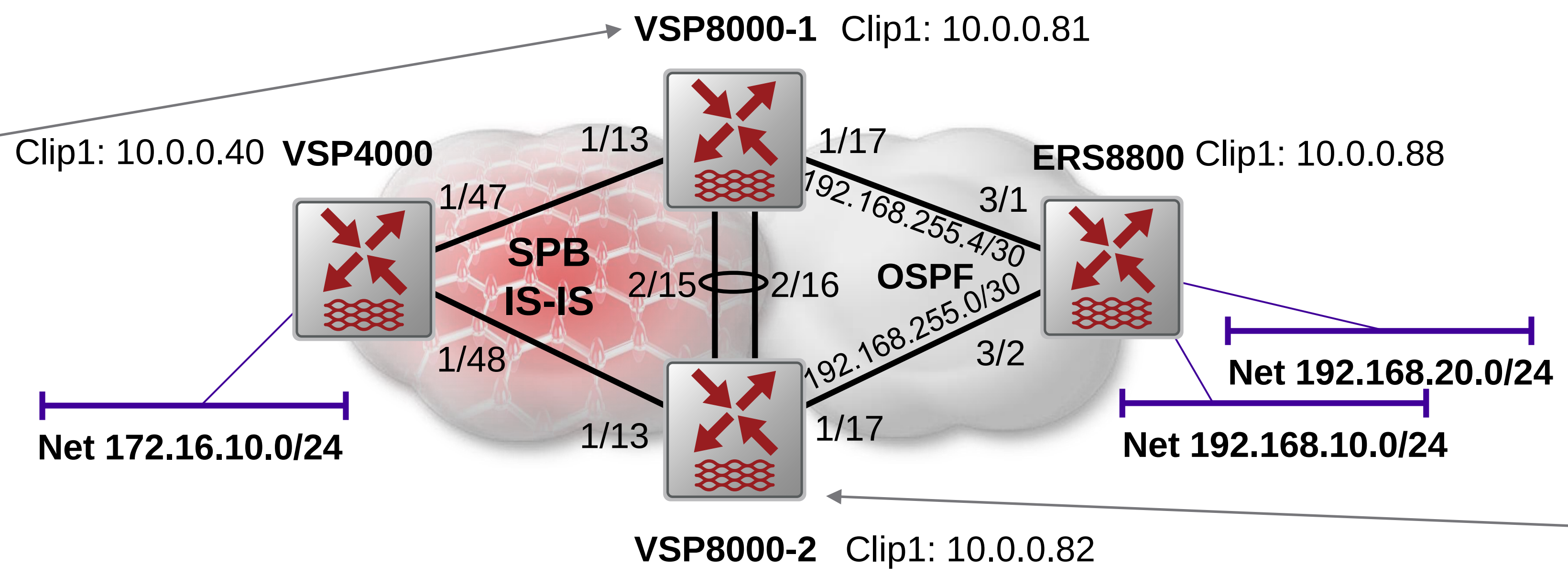
IP routes before ISIS ⇔ OSPF redistribution




```
VSP4000:1#% show ip route
=============================================================================================================
                                        IP Route - GlobalRouter
=============================================================================================================
                                                  NH                    INTER
DST             MASK            NEXT              VRF/ISID        COST  FACE     PROT AGE TYPE PRF
-------------------------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 10.0.0.40         -               1     0        LOC  0   DB   0
10.0.0.81       255.255.255.255 VSP8000-1         GlobalRouter    10    4051     ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP8000-2         GlobalRouter    10    4051     ISIS 0   IBS  7
172.16.10.0     255.255.255.0   172.16.10.1       -               1     0        LOC  0   DB   0
192.168.255.0   255.255.255.252 VSP8000-2         GlobalRouter    10    4051     ISIS 0   IBS  7
192.168.255.4   255.255.255.252 VSP8000-1         GlobalRouter    10    4051     ISIS 0   IBS  7
```

```
ERS8800:5#% show ip route
=============================================================================================================
                                        IP Route - GlobalRouter
=============================================================================================================
                                                  NH                    INTER
DST             MASK            NEXT              VRF             COST  FACE     PROT AGE TYPE PRF
-------------------------------------------------------------------------------------------------------------
10.0.0.88       255.255.255.255 10.0.0.88         -               1     0        LOC  0   DB   0
192.168.10.0    255.255.255.0   192.168.10.1      -               1     0        LOC  0   DB   0
192.168.20.0    255.255.255.0   192.168.20.1      -               1     0        LOC  0   DB   0
192.168.255.0   255.255.255.252 192.168.255.2     -               1     3/2      LOC  0   DB   0
192.168.255.4   255.255.255.252 192.168.255.6     -               1     3/1      LOC  0   DB   0
```

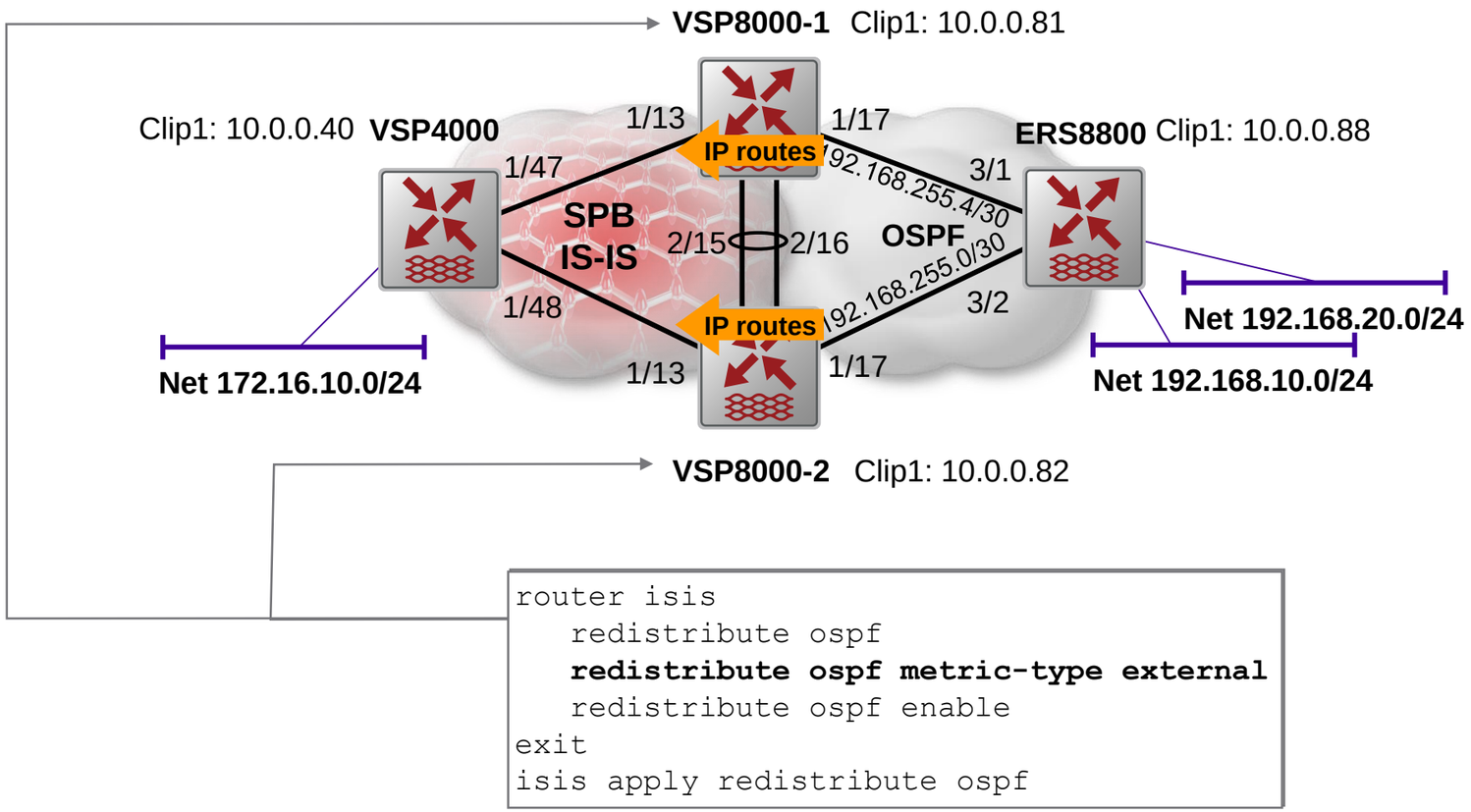
IP routes before ISIS ⇔ OSPF redistribution




```
VSP8000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                        INTER
DST              MASK             NEXT             VRF/ISID         COST     FACE      PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 VSP4000           GlobalRouter     10       4051      ISIS 0   IBS  7
10.0.0.81        255.255.255.255 10.0.0.81         -                1        0         LOC  0   DB   0
10.0.0.82        255.255.255.255 VSP8000-2         GlobalRouter     10       4051      ISIS 0   IBS  7
10.0.0.88        255.255.255.255 192.168.255.6     GlobalRouter     11       1/17      OSPF 0   IB   20
172.16.10.0      255.255.255.0   VSP4000           GlobalRouter     10       4051      ISIS 0   IBS  7
192.168.10.0     255.255.255.0   192.168.255.6     GlobalRouter     11       1/17      OSPF 0   IB   20
192.168.20.0     255.255.255.0   192.168.255.6     GlobalRouter     1        1/17      OSPF 0   IB   125
192.168.255.0    255.255.255.252 VSP8000-2         GlobalRouter     10       4051      ISIS 0   IBS  7
192.168.255.4    255.255.255.252 192.168.255.5     -                1        1/17      LOC  0   DB   0
```

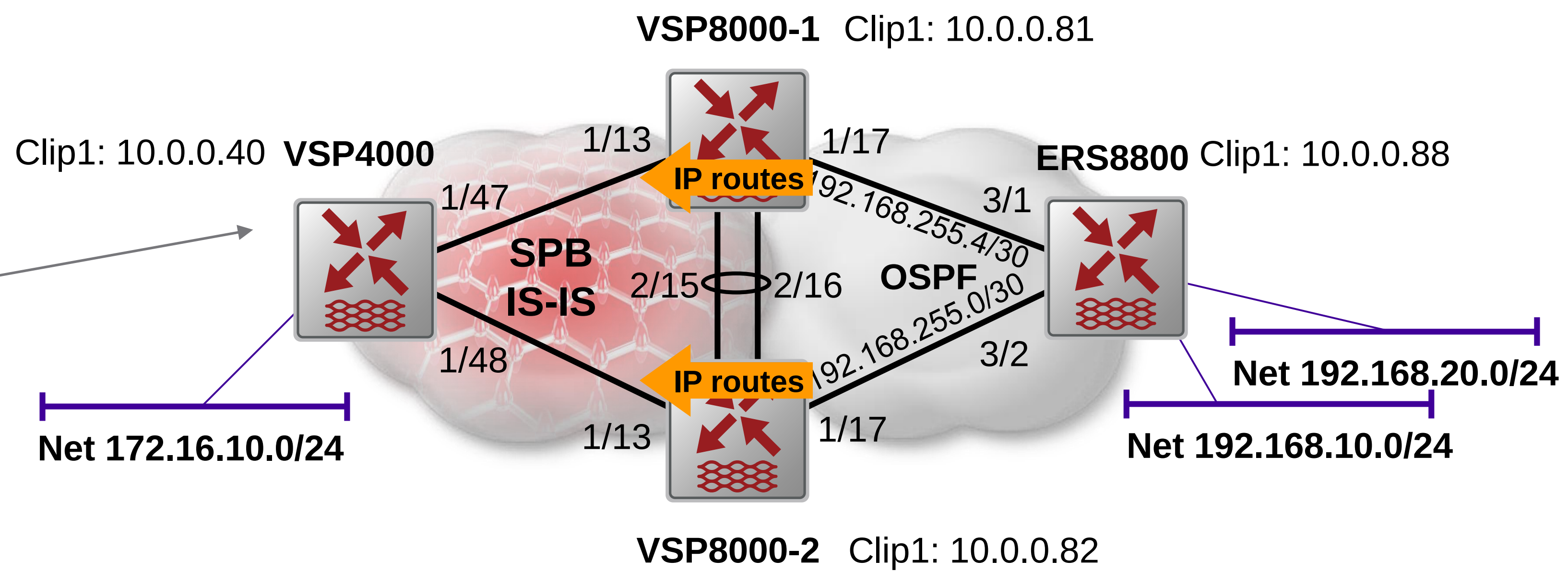
```
VSP8000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                        INTER
DST              MASK             NEXT             VRF/ISID         COST     FACE      PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 VSP4000           GlobalRouter     10       4051      ISIS 0   IBS  7
10.0.0.81        255.255.255.255 VSP8000-1         GlobalRouter     10       4051      ISIS 0   IBS  7
10.0.0.82        255.255.255.255 10.0.0.82         -                1        0         LOC  0   DB   0
10.0.0.88        255.255.255.255 192.168.255.2     GlobalRouter     11       1/17      OSPF 0   IB   20
172.16.10.0      255.255.255.0   VSP4000           GlobalRouter     10       4051      ISIS 0   IBS  7
192.168.10.0     255.255.255.0   192.168.255.2     GlobalRouter     11       1/17      OSPF 0   IB   20
192.168.20.0     255.255.255.0   192.168.255.2     GlobalRouter     1        1/17      OSPF 0   IB   125
192.168.255.0    255.255.255.252 192.168.255.1     -                1        1/17      LOC  0   DB   0
192.168.255.4    255.255.255.252 VSP8000-1         GlobalRouter     10       4051      ISIS 0   IBS  7
```

IS-IS ← OSPF Redistribution - Config



- We redistribute all OSPF routes into ISIS and make them of metric-type “External”

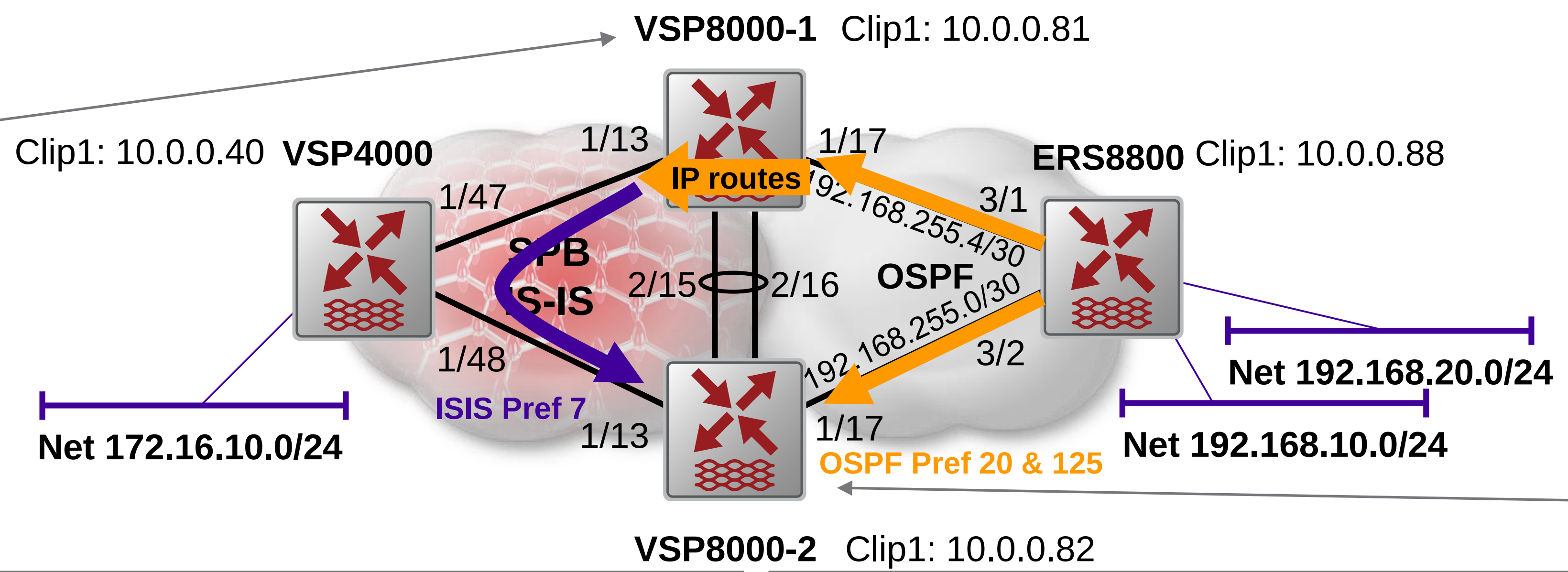
IS-IS ← OSPF Redistribution - Checking



- So far so good

```
VSP4000:1#% show ip route
================================================================================================
                                      IP Route - GlobalRouter
================================================================================================
                                                  NH                      INTER
DST             MASK            NEXT              VRF/ISID         COST   FACE      PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 10.0.0.40         -                1      0         LOC  0   DB   0
10.0.0.81       255.255.255.255 VSP8000-1         GlobalRouter     10     4051      ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP8000-2         GlobalRouter     10     4051      ISIS 0   IBS  7
10.0.0.88       255.255.255.255 VSP8000-1         GlobalRouter     11     4051      ISIS 0   IBS  7
172.16.10.0     255.255.255.0   172.16.10.1       -                1      0         LOC  0   DB   0
192.168.10.0    255.255.255.0   VSP8000-1         GlobalRouter     11     4051      ISIS 0   IBS  7
192.168.20.0    255.255.255.0   VSP8000-1         GlobalRouter     1      4051      ISIS 0   IBS  7
192.168.255.0   255.255.255.252 VSP8000-2         GlobalRouter     10     4051      ISIS 0   IBS  7
192.168.255.4   255.255.255.252 VSP8000-1         GlobalRouter     10     4051      ISIS 0   IBS  7
```

IS-IS ← OSPF Redistribution - Checking



VSP8000-1:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	10.0.0.81	-	1	0	LOC	0	DB	0
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	**255.255.255.255**	**192.168.255.6**	**GlobalRouter**	**11**	**1/17**	**OSPF**	**0**	**IB**	**20**
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	**255.255.255.0**	**192.168.255.6**	**GlobalRouter**	**11**	**1/17**	**OSPF**	**0**	**IB**	**20**
192.168.20.0	**255.255.255.0**	**192.168.255.6**	**GlobalRouter**	**1**	**1/17**	**OSPF**	**0**	**IB**	**125**
192.168.255.0	255.255.255.252	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.255.4	255.255.255.252	192.168.255.5	-	1	1/17	LOC	0	DB	0

- Ok, so what's happening here is that VSP8000-1 was slightly quicker than VSP8000-2 in redistributing OSPF routes into ISIS
- So VSP8000-2 now sees the same IP routes from both OSPF & ISIS
- ISIS has a higher protocol preference (7 is lower than OSPF's 20 or 125)

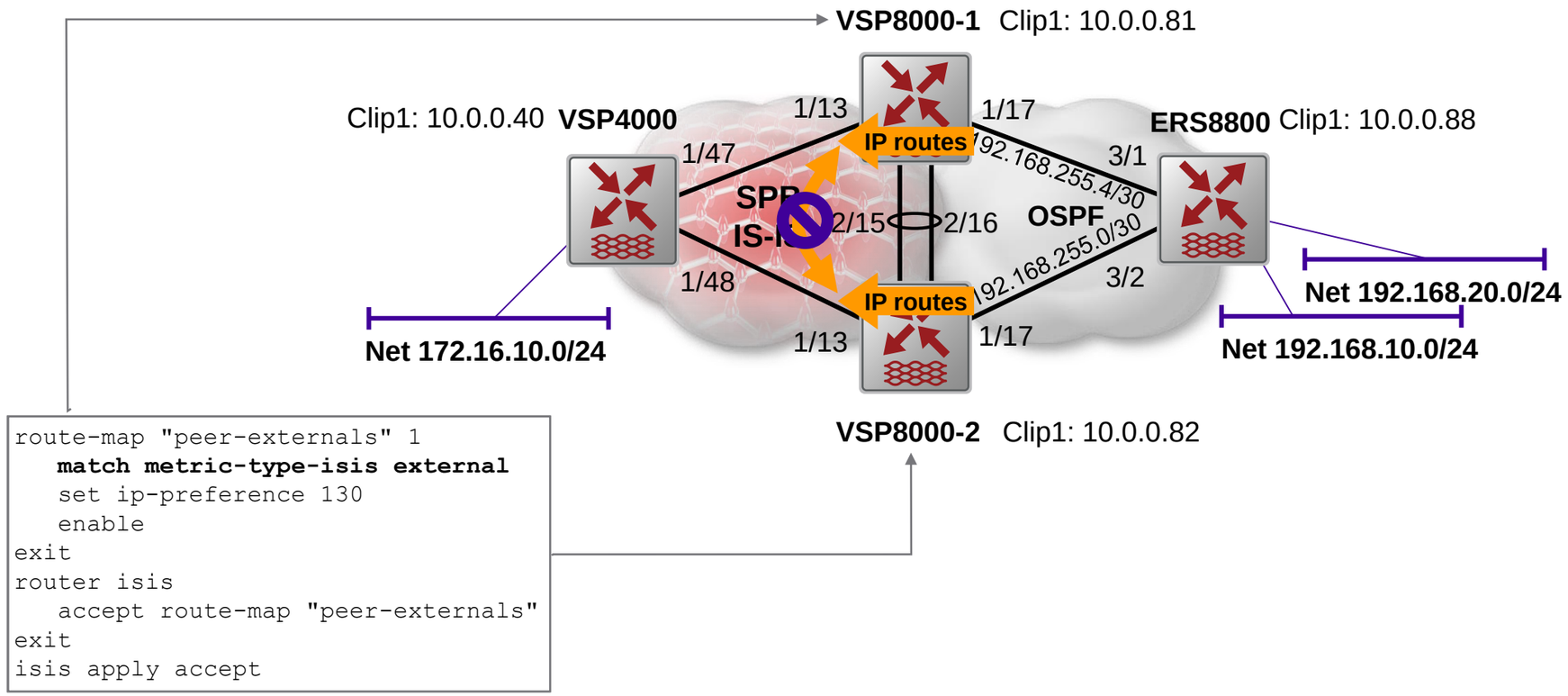
VSP8000-2:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	10.0.0.82	-	1	0	LOC	0	DB	0
10.0.0.88	**255.255.255.255**	**VSP8000-1**	**GlobalRouter**	**11**	**4051**	**ISIS**	**0**	**IBS**	**7**
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	**255.255.255.0**	**VSP8000-1**	**GlobalRouter**	**11**	**4051**	**ISIS**	**0**	**IBS**	**7**
192.168.20.0	**255.255.255.0**	**VSP8000-1**	**GlobalRouter**	**1**	**4051**	**ISIS**	**0**	**IBS**	**7**
192.168.255.0	255.255.255.252	192.168.255.1	-	1	1/17	LOC	0	DB	0
192.168.255.4	255.255.255.252	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7

- So VSP8000-2 replaces in its routing table the OSPF routes with the ISIS ones
- Now VSP8000-2 is no longer redistributing the OSPF routes into ISIS, since it has none in its routing table
- This state of affairs remains stable in the current state, but it clearly is not optimal

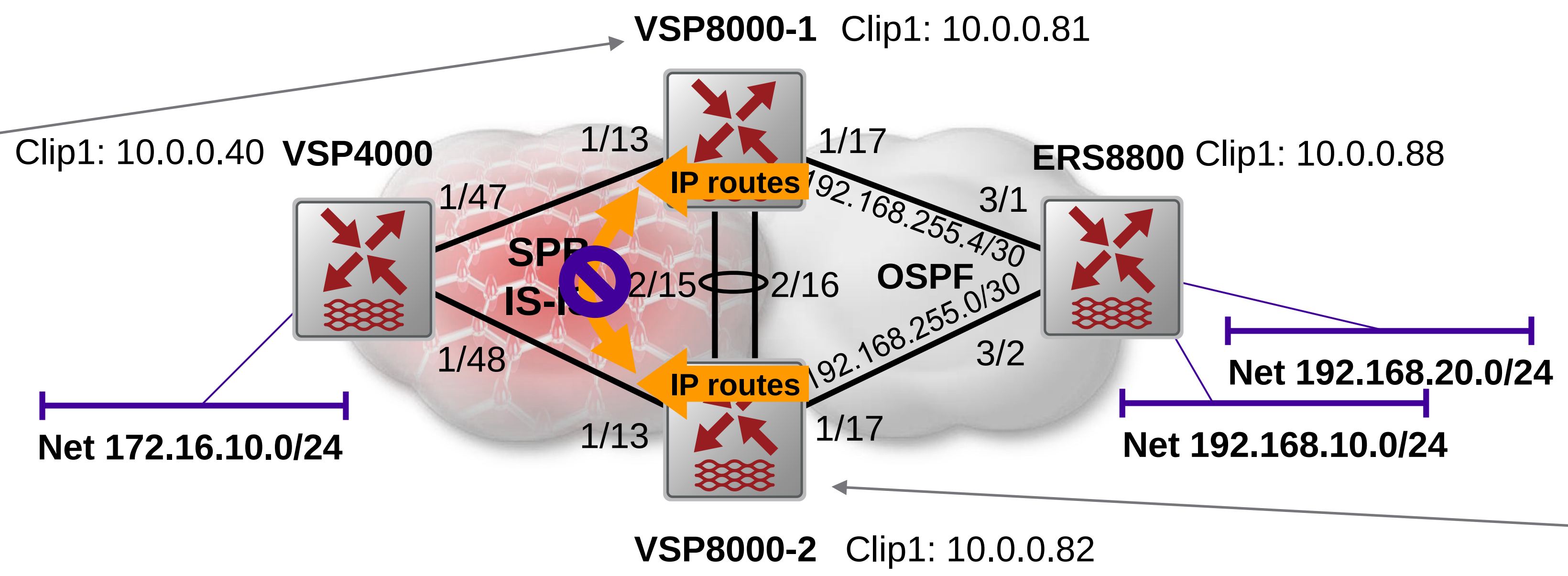
IS-IS ← OSPF Redistribution - Fixing




```
route-map "peer-externals" 1
   match metric-type-isis external
   set ip-preference 130
   enable
exit
router isis
   accept route-map "peer-externals"
exit
isis apply accept
```

- This ISIS Accept policy ensures that the 2 VSP8000 border routers will only accept ISIS “External” routes with a modified preference of 130 (instead of SPB’s default preference 7)
- OSPF routes have preference levels ranging between 20, 25,120 or 125 (depending on OSPF route type)
- Hence we are ensuring that the border routers will never install ISIS External routes (from each other) as long as they have the original OSPF routes

IS-IS 🡨 OSPF Redistribution – Checking again



VSP8000-1:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	10.0.0.81	-	1	0	LOC	0	DB	0
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	255.255.255.255	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.20.0	255.255.255.0	192.168.255.6	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.255.0	255.255.255.252	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.255.4	255.255.255.252	192.168.255.5	-	1	1/17	LOC	0	DB	0

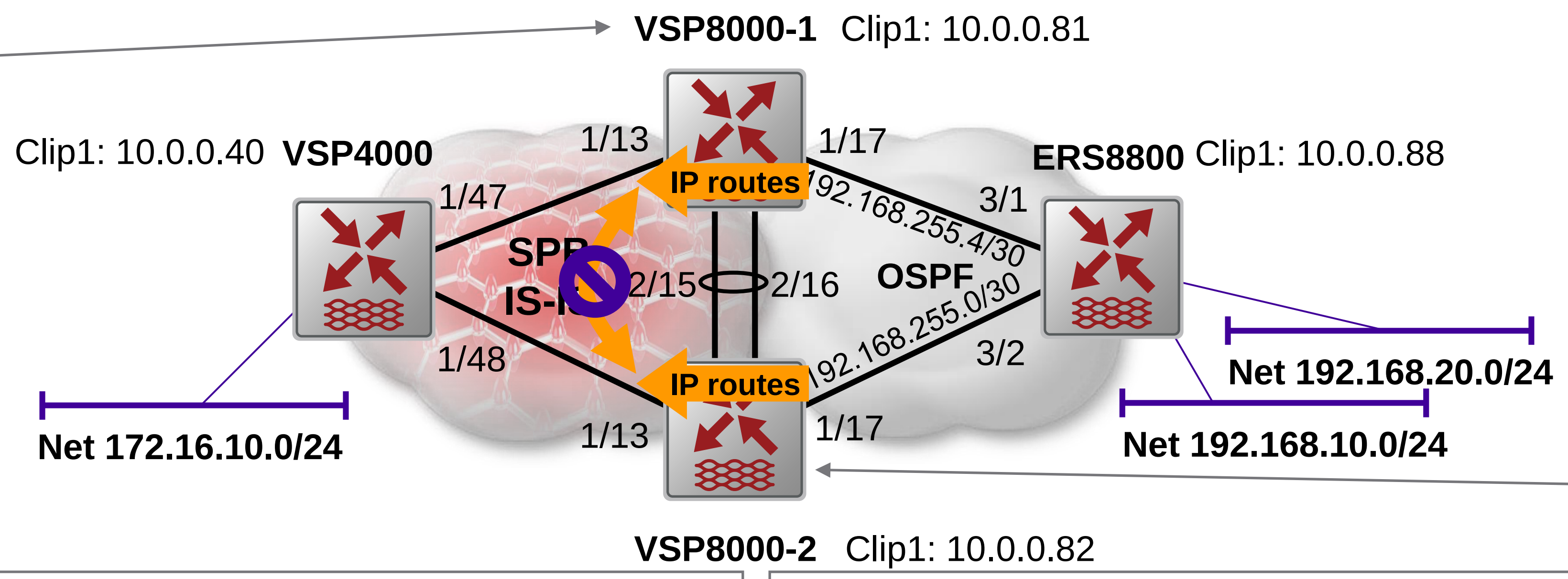
VSP8000-2:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	10.0.0.82	-	1	0	LOC	0	DB	0
10.0.0.88	255.255.255.255	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.20.0	255.255.255.0	192.168.255.2	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.255.0	255.255.255.252	192.168.255.1	-	1	1/17	LOC	0	DB	0
192.168.255.4	255.255.255.252	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7

- Looking good now for both VSP8000 border routers

IS-IS ← OSPF Redistribution – Checking accepted ISIS External routes

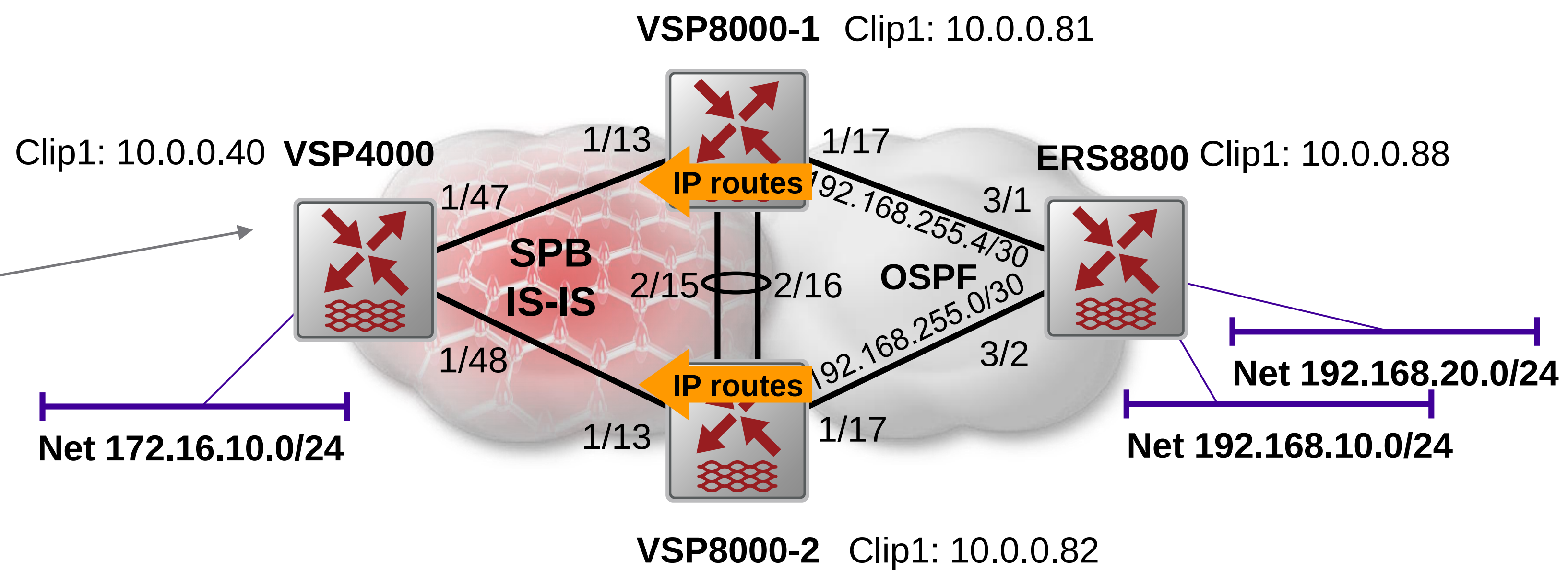



```
VSP8000-1:1#% show ip route alternative
================================================================================
                          IP Route - GlobalRouter
================================================================================
                                          NH                     INTER
DST            MASK            NEXT              VRF/ISID      COST  FACE     PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.40      255.255.255.255 VSP4000           GlobalRouter  10    4051     ISIS 0   IBS  7
10.0.0.81      255.255.255.255 10.0.0.81         -             1     0        LOC  0   DB   0
10.0.0.82      255.255.255.255 VSP8000-2         GlobalRouter  10    4051     ISIS 0   IBS  7
10.0.0.88      255.255.255.255 192.168.255.6     GlobalRouter  11    1/17     OSPF 0   IB   20
10.0.0.88      255.255.255.255 VSP8000-2         GlobalRouter  11    4051     ISIS 0   IAS  130
172.16.10.0    255.255.255.0   VSP4000           GlobalRouter  10    4051     ISIS 0   IBS  7
192.168.10.0   255.255.255.0   192.168.255.6     GlobalRouter  11    1/17     OSPF 0   IB   20
192.168.10.0   255.255.255.0   VSP8000-2         GlobalRouter  11    4051     ISIS 0   IAS  130
192.168.20.0   255.255.255.0   192.168.255.6     GlobalRouter  1     1/17     OSPF 0   IB   125
192.168.20.0   255.255.255.0   VSP8000-2         GlobalRouter  1     4051     ISIS 0   IAS  130
192.168.255.0  255.255.255.252 VSP8000-2         GlobalRouter  10    4051     ISIS 0   IBS  7
192.168.255.0  255.255.255.252 192.168.255.6     GlobalRouter  2     1/17     OSPF 0   IA   20
192.168.255.4  255.255.255.252 192.168.255.5     -             1     1/17     LOC  0   DB   0
```

```
VSP8000-2:1#% show ip route alternative
================================================================================
                          IP Route - GlobalRouter
================================================================================
                                          NH                     INTER
DST            MASK            NEXT              VRF/ISID      COST  FACE     PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.40      255.255.255.255 VSP4000           GlobalRouter  10    4051     ISIS 0   IBS  7
10.0.0.81      255.255.255.255 VSP8000-1         GlobalRouter  10    4051     ISIS 0   IBS  7
10.0.0.82      255.255.255.255 10.0.0.82         -             1     0        LOC  0   DB   0
10.0.0.88      255.255.255.255 192.168.255.2     GlobalRouter  11    1/17     OSPF 0   IB   20
10.0.0.88      255.255.255.255 VSP8000-1         GlobalRouter  11    4051     ISIS 0   IAS  130
172.16.10.0    255.255.255.0   VSP4000           GlobalRouter  10    4051     ISIS 0   IBS  7
192.168.10.0   255.255.255.0   192.168.255.2     GlobalRouter  11    1/17     OSPF 0   IB   20
192.168.10.0   255.255.255.0   VSP8000-1         GlobalRouter  11    4051     ISIS 0   IAS  130
192.168.20.0   255.255.255.0   192.168.255.2     GlobalRouter  1     1/17     OSPF 0   IB   125
192.168.20.0   255.255.255.0   VSP8000-1         GlobalRouter  1     4051     ISIS 0   IAS  130
192.168.255.0  255.255.255.252 192.168.255.1     -             1     1/17     LOC  0   DB   0
192.168.255.4  255.255.255.252 VSP8000-1         GlobalRouter  10    4051     ISIS 0   IBS  7
192.168.255.4  255.255.255.252 192.168.255.2     GlobalRouter  2     1/17     OSPF 0   IA   20
```

- Here we see that the border VSP8000s learn from each other the already redistributed OSPF routes as ISIS External routes, but our Accept policy ensures they get a preference of 130 (in orange) which ensures that these will not displace the preferred OSPF route (in green) and remain thus as alternative routes; we will come back to alternative routes as they present problems…

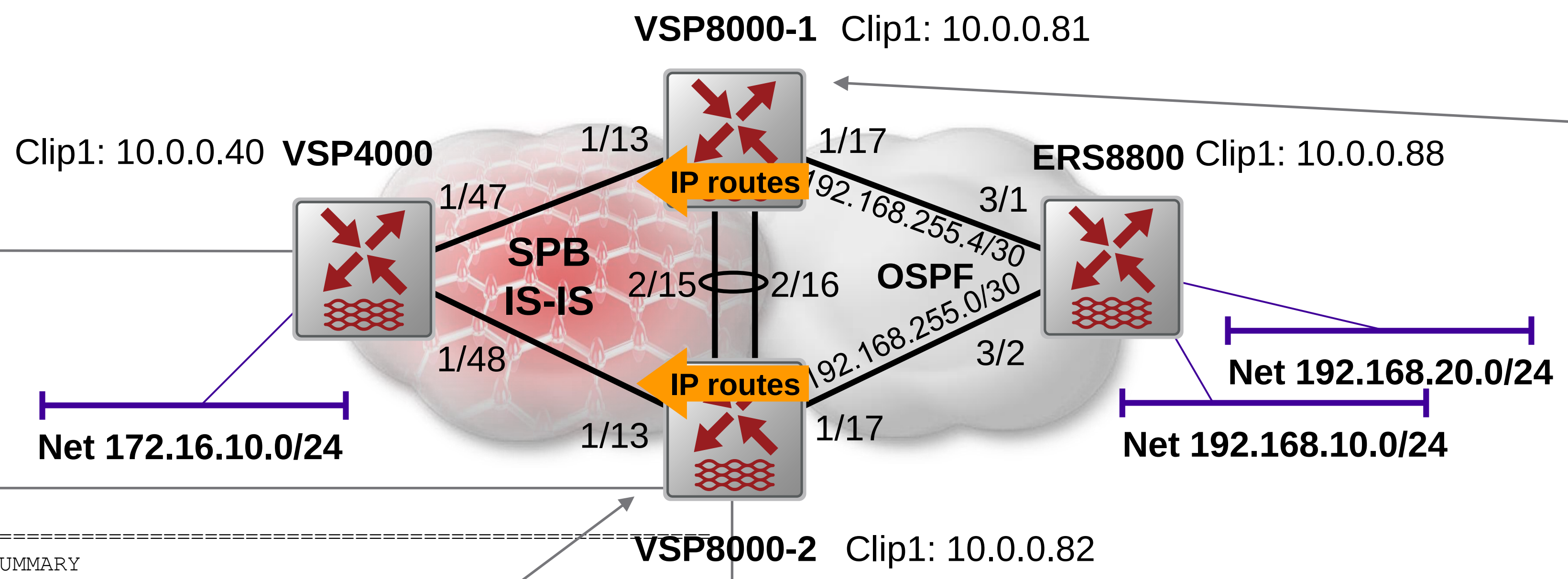
IS-IS 🡐 OSPF Redistribution – Checking




```
VSP4000:1#% show ip route
================================================================================================
                                   IP Route - GlobalRouter
================================================================================================
                                                    NH                  INTER
DST             MASK            NEXT                VRF/ISID      COST  FACE     PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 10.0.0.40           -             1     0        LOC  0   DB   0
10.0.0.81       255.255.255.255 VSP8000-1           GlobalRouter  10    4051     ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP8000-2           GlobalRouter  10    4051     ISIS 0   IBS  7
10.0.0.88       255.255.255.255 VSP8000-1           GlobalRouter  11    4051     ISIS 0   IBS  7
172.16.10.0     255.255.255.0   172.16.10.1         -             1     0        LOC  0   DB   0
192.168.10.0    255.255.255.0   VSP8000-1           GlobalRouter  11    4051     ISIS 0   IBS  7
192.168.20.0    255.255.255.0   VSP8000-1           GlobalRouter  1     4051     ISIS 0   IBS  7
192.168.255.0   255.255.255.252 VSP8000-2           GlobalRouter  10    4051     ISIS 0   IBS  7
192.168.255.4   255.255.255.252 VSP8000-1           GlobalRouter  10    4051     ISIS 0   IBS  7
```

- No change here, still looking good
- We will enable IP ECMP later

IS-IS 🡐 OSPF Redistribution – Checking



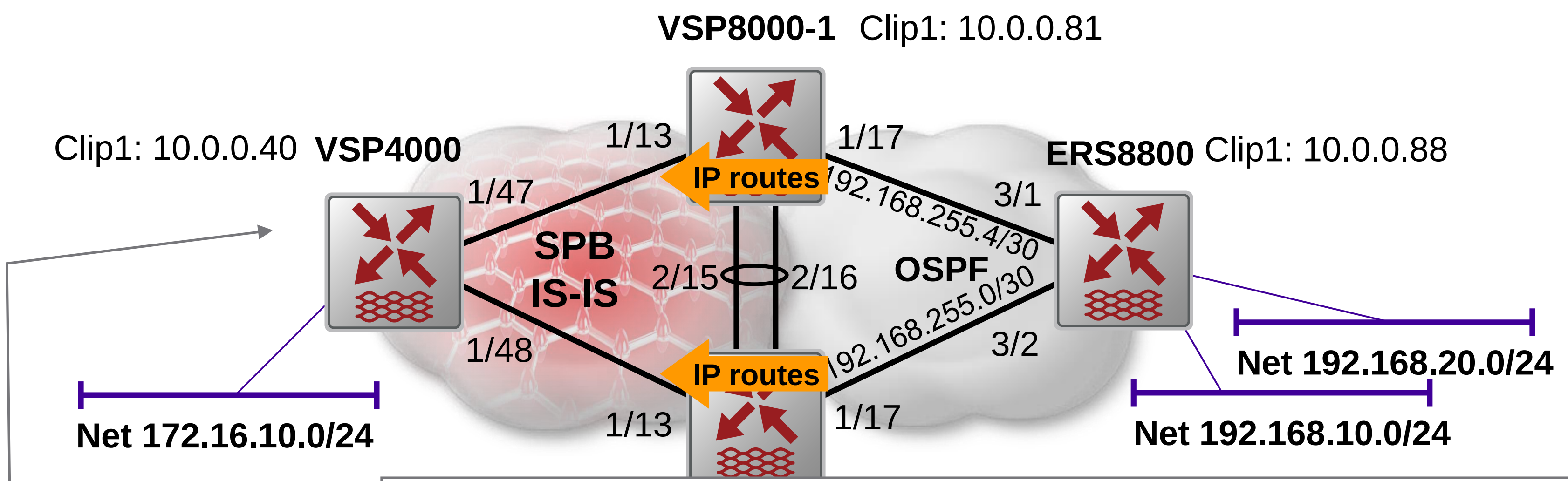

```
VSP4000:1#% show isis lsdb ip-unicast
================================================================================================
                        ISIS IP-UNICAST-ROUTE SUMMARY
================================================================================================
                          PREFIX           METRIC    TLV   LSP   HOST
I-SID     ADDRESS         LENGTH  METRIC   TYPE      TYPE  FRAG  NAME
------------------------------------------------------------------------------
-         10.0.0.40       32      1        Internal  135   0x2   VSP4000
-         172.16.10.0     24      1        Internal  135   0x2   VSP4000
-         10.0.0.81       32      1        Internal  135   0x2   VSP8000-1
-         192.168.255.4   30      1        Internal  135   0x2   VSP8000-1
-         10.0.0.88       32      11       External  135   0x2   VSP8000-1
-         192.168.10.0    24      11       External  135   0x2   VSP8000-1
-         192.168.20.0    24      1        External  135   0x2   VSP8000-1
-         10.0.0.82       32      1        Internal  135   0x2   VSP8000-2
-         192.168.255.0   30      1        Internal  135   0x2   VSP8000-2
-         10.0.0.88       32      11       External  135   0x2   VSP8000-2
-         192.168.10.0    24      11       External  135   0x2   VSP8000-2
-         192.168.20.0    24      1        External  135   0x2   VSP8000-2
```

```
VSP8000-1:1#% show ip route
==========================================================================================================
                                   IP Route - GlobalRouter
==========================================================================================================
                                                  NH                   INTER
DST             MASK             NEXT             VRF/ISID      COST   FACE   PROT AGE TYPE PRF
----------------------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255  VSP4000          GlobalRouter  10     4051   ISIS 0   IBS  7
10.0.0.81       255.255.255.255  10.0.0.81        -             1      0      LOC  0   DB   0
10.0.0.82       255.255.255.255  VSP8000-2        GlobalRouter  10     4051   ISIS 0   IBS  7
10.0.0.88       255.255.255.255  192.168.255.6    GlobalRouter  11     1/17   OSPF 0   IB   20
172.16.10.0     255.255.255.0    VSP4000          GlobalRouter  10     4051   ISIS 0   IBS  7
192.168.10.0    255.255.255.0    192.168.255.6    GlobalRouter  11     1/17   OSPF 0   IB   20
192.168.20.0    255.255.255.0    192.168.255.6    GlobalRouter  1      1/17   OSPF 0   IB   125
192.168.255.0   255.255.255.252  VSP8000-2        GlobalRouter  10     4051   ISIS 0   IBS  7
192.168.255.4   255.255.255.252  192.168.255.5    -             1      1/17   LOC  0   DB   0
```

```
VSP8000-2:1#%
=============
=============
DST
-------------
10.0.0.40
10.0.0.81
10.0.0.82       255.255.255.255  10.0.0.82        -             1      0      LOC  0   DB   0
10.0.0.88       255.255.255.255  192.168.255.2    GlobalRouter  11     1/17   OSPF 0   IB   20
172.16.10.0     255.255.255.0    VSP4000          GlobalRouter  10     4051   ISIS 0   IBS  7
192.168.10.0    255.255.255.0    192.168.255.2    GlobalRouter  11     1/17   OSPF 0   IB   20
192.168.20.0    255.255.255.0    192.168.255.2    GlobalRouter  1      1/17   OSPF 0   IB   125
192.168.255.0   255.255.255.252  192.168.255.1    -             1      1/17   LOC  0   DB   0
192.168.255.4   255.255.255.252  VSP8000-1        GlobalRouter  10     4051   ISIS 0   IBS  7
```

- OSPF routes are marked as External routes in the ISIS LSDB
- Note how the original route cost is used as the ISIS route metric
  - This metric is only used as a tie breaker for Internal routes, but becomes the primary route selection metric for External routes (though not relevant to this particular use case)

IS-IS 🡐 OSPF Redistribution – Checking



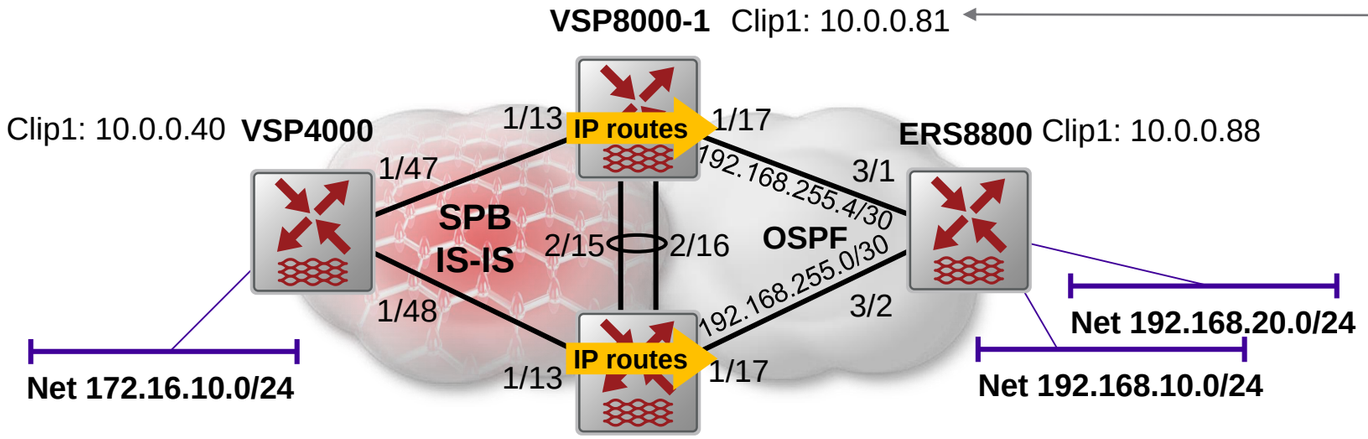
- This table shows all the ISIS IP routes installed in the VSP4000 IP routing table
- For each route the SPB shortest path outgoing interface is shown as well as metrics:
  - SPBM Cost = Internal Metric
  - Prefix Cost = External Metric
  - Prefix Type = Internal / External
  - Route Preference

```
VSP4000:1#% show isis spbm ip-unicast-fib all
```

SPBM IP-UNICAST FIB ENTRY INFO

VRF	VRF ISID	DEST ISID	Destination	NH BEB	VLAN	OUTGOING INTERFACE	SPBM COST	PREFIX COST	PREFIX TYPE	IP ROUTE PREFERENCE
GRT	-	-	10.0.0.81/32	VSP8000-1	4051	1/47	10	1	Internal	7
GRT	-	-	10.0.0.81/32	VSP8000-1	4052	1/47	10	1	Internal	7
GRT	-	-	10.0.0.82/32	VSP8000-2	4051	1/48	10	1	Internal	7
GRT	-	-	10.0.0.82/32	VSP8000-2	4052	1/48	10	1	Internal	7
GRT	-	-	10.0.0.88/32	VSP8000-1	4051	1/47	10	11	External	7
GRT	-	-	10.0.0.88/32	VSP8000-1	4052	1/47	10	11	External	7
GRT	-	-	10.0.0.88/32	VSP8000-2	4051	1/48	10	11	External	7
GRT	-	-	10.0.0.88/32	VSP8000-2	4052	1/48	10	11	External	7
GRT	-	-	192.168.10.0/24	VSP8000-1	4051	1/47	10	11	External	7
GRT	-	-	192.168.10.0/24	VSP8000-1	4052	1/47	10	11	External	7
GRT	-	-	192.168.10.0/24	VSP8000-2	4051	1/48	10	11	External	7
GRT	-	-	192.168.10.0/24	VSP8000-2	4052	1/48	10	11	External	7
GRT	-	-	192.168.20.0/24	VSP8000-1	4051	1/47	10	1	External	7
GRT	-	-	192.168.20.0/24	VSP8000-1	4052	1/47	10	1	External	7
GRT	-	-	192.168.20.0/24	VSP8000-2	4051	1/48	10	1	External	7
GRT	-	-	192.168.20.0/24	VSP8000-2	4052	1/48	10	1	External	7
GRT	-	-	192.168.255.0/30	VSP8000-2	4051	1/48	10	1	Internal	7
GRT	-	-	192.168.255.0/30	VSP8000-2	4052	1/48	10	1	Internal	7
GRT	-	-	192.168.255.4/30	VSP8000-1	4051	1/47	10	1	Internal	7
GRT	-	-	192.168.255.4/30	VSP8000-1	4052	1/47	10	1	Internal	7

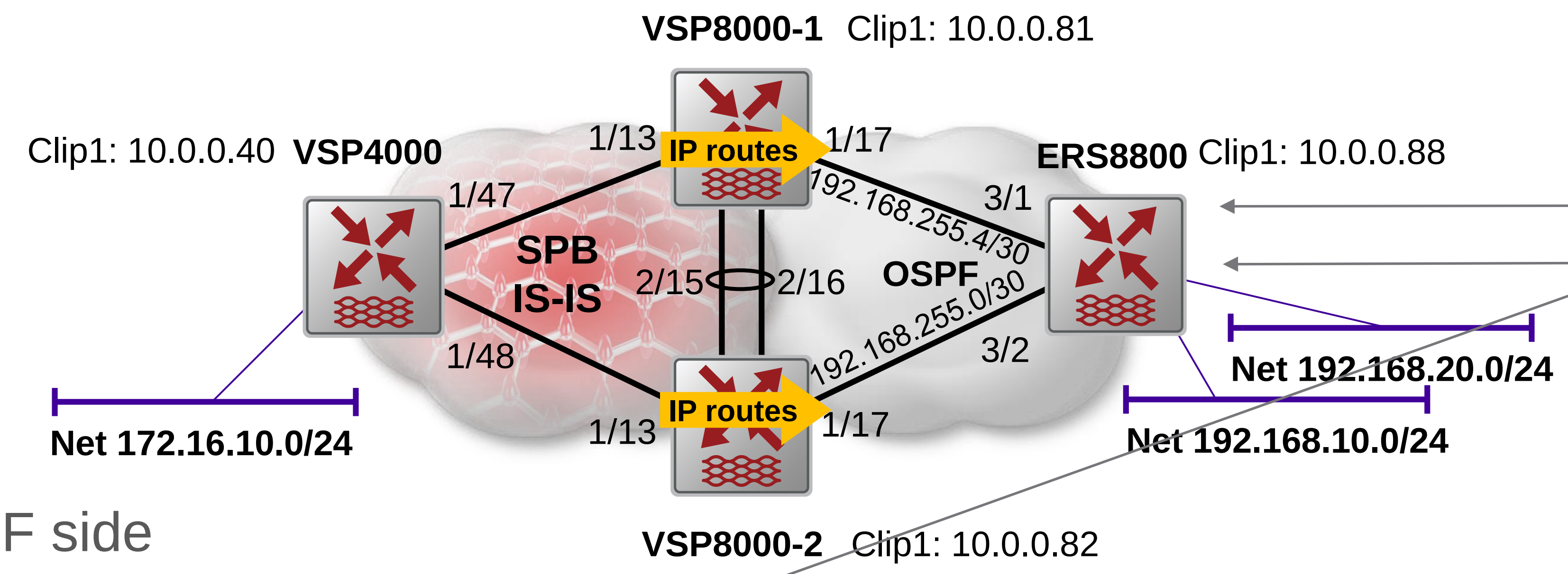
IS-IS ➔ OSPF Redistribution - Config




```
route-map isis-internal 1
   match metric-type-isis internal
   enable
exit
router ospf
   as-boundary-router enable
   redistribute isis
   redistribute isis route-map isis-internal
   redistribute isis enable
exit
ip ospf apply redistribute isis
```

- In the reverse direction, we now redistribute only IS-IS Internal routes into OSPF
  - OSPF routes were redistributed into ISIS as External routes, so by redistributing only ISIS Internal routes into OSPF we can be sure that no IP route which originated from OSPF will ever be reflected back into OSPF
- NOTE: VSP8000-1 & VSP8000-2 need to be OSPF ASBRs
- NOTE: In older versions of VOSS software the command to assign a route-map to an OSPF redistribution was “redistribute <proto> route-policy” and not “redistribute <proto> route-map”

IS-IS ➔ OSPF Redistribution - Checking



- Looking good on OSPF side
- Note how all the ISIS redistributed routes are seen as OSPF LSA5 external routes

ERS8800:5#% show ip ospf ase

OSPF AsExternal Lsas - GlobalRouter

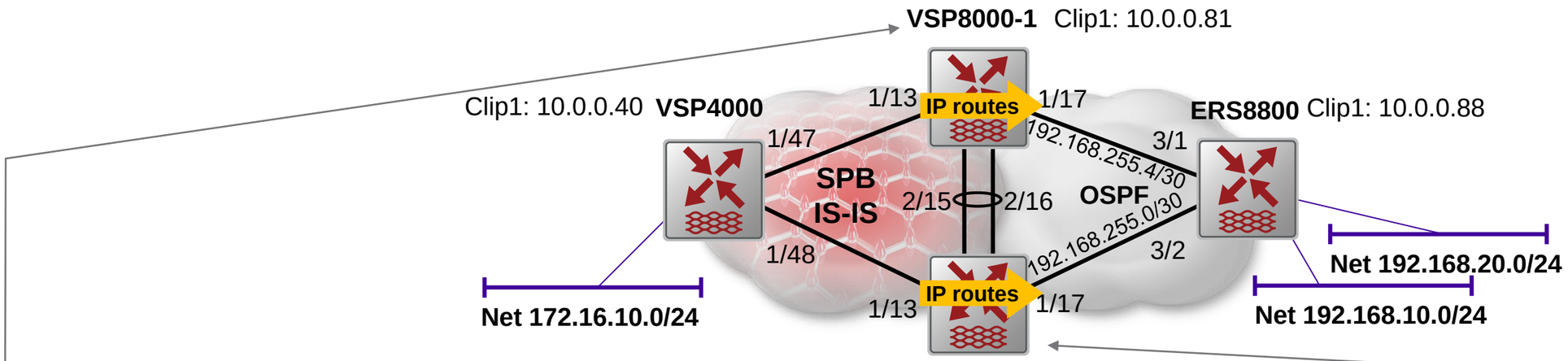
LSTYPE	LINKSTATEID	ADV_ROUTER	ETYPE	METRIC	ASE_FWD_ADDR	AGE	SEQ_	
AsExternal	10.0.0.40	10.0.0.81	2	10	0.0.0.0	359	0x80	
AsExternal	10.0.0.40	10.0.0.82	2	10	0.0.0.0	349	0x80	
AsExternal	10.0.0.81	10.0.0.82	2	10	0.0.0.0	349	0x80	
AsExternal	10.0.0.82	10.0.0.81	2	10	0.0.0.0	359	0x80	
AsExternal	172.16.10.0	10.0.0.81	2	10	0.0.0.0	359	0x80	
AsExternal	172.16.10.0	10.0.0.82	2	10	0.0.0.0	349	0x80	
AsExternal	192.168.20.0	10.0.0.88	2	1	0.0.0.0	333	0x80	
AsExternal	192.168.255.0	10.0.0.81	2	10	0.0.0.0	359	0x80	
AsExternal	192.168.255.4	10.0.0.82	2	10	0.0.0.0	349	0x80000001	0x13ee

ERS8800:5#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	192.168.255.5	GlobalRout~	10	3/1	OSPF	0	IB	125
10.0.0.81	255.255.255.255	192.168.255.1	GlobalRout~	10	3/2	OSPF	0	IB	125
10.0.0.82	255.255.255.255	192.168.255.5	GlobalRout~	10	3/1	OSPF	0	IB	125
10.0.0.88	255.255.255.255	10.0.0.88	-	1	0	LOC	0	DB	0
172.16.10.0	255.255.255.0	192.168.255.5	GlobalRout~	10	3/1	OSPF	0	IB	125
192.168.10.0	255.255.255.0	192.168.10.1	-	1	0	LOC	0	DB	0
192.168.20.0	255.255.255.0	192.168.20.1	-	1	0	LOC	0	DB	0
192.168.255.0	255.255.255.252	192.168.255.2	-	1	3/2	LOC	0	DB	0
192.168.255.4	255.255.255.252	192.168.255.6	-	1	3/1	LOC	0	DB	0

IS-IS ➔ OSPF Redistribution - Checking

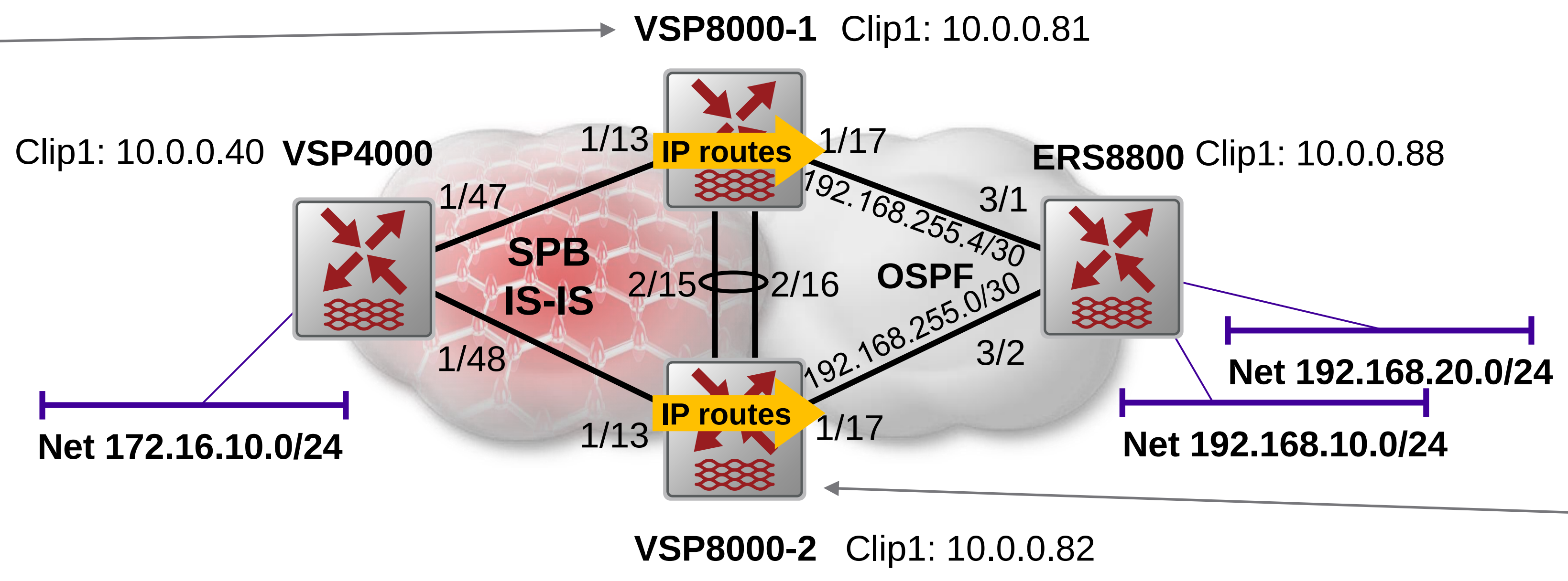



```
VSP8000-1:1#% show ip route
=============================================================================================================
                                        IP Route - GlobalRouter
=============================================================================================================
                                                  NH                          INTER
DST             MASK            NEXT            VRF/ISID        COST        FACE      PROT AGE TYPE  PRF
-------------------------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 VSP4000         GlobalRouter    10          4051      ISIS 0   IBS   7
10.0.0.81       255.255.255.255 10.0.0.81       -               1           0         LOC  0   DB    0
10.0.0.82       255.255.255.255 VSP8000-2       GlobalRouter    10          4051      ISIS 0   IBS   7
10.0.0.88       255.255.255.255 192.168.255.6   GlobalRouter    11          1/17      OSPF 0   IB    20
172.16.10.0     255.255.255.0   VSP4000         GlobalRouter    10          4051      ISIS 0   IBS   7
192.168.10.0    255.255.255.0   192.168.255.6   GlobalRouter    11          1/17      OSPF 0   IB    20
192.168.20.0    255.255.255.0   192.168.255.6   GlobalRouter    1           1/17      OSPF 0   IB    125
192.168.255.0   255.255.255.252 VSP8000-2       GlobalRouter    10          4051      ISIS 0   IBS   7
192.168.255.4   255.255.255.252 192.168.255.5   -               1           1/17      LOC  0   DB    0
```

```
VSP8000-2:1#% show ip route
=============================================================================================================
                                        IP Route - GlobalRouter
=============================================================================================================
                                                  NH                          INTER
DST             MASK            NEXT            VRF/ISID        COST        FACE      PROT AGE TYPE  PRF
-------------------------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 VSP4000         GlobalRouter    10          4051      ISIS 0   IBS   7
10.0.0.81       255.255.255.255 VSP8000-1       GlobalRouter    10          4051      ISIS 0   IBS   7
10.0.0.82       255.255.255.255 10.0.0.82       -               1           0         LOC  0   DB    0
10.0.0.88       255.255.255.255 192.168.255.2   GlobalRouter    11          1/17      OSPF 0   IB    20
172.16.10.0     255.255.255.0   VSP4000         GlobalRouter    10          4051      ISIS 0   IBS   7
192.168.10.0    255.255.255.0   192.168.255.2   GlobalRouter    11          1/17      OSPF 0   IB    20
192.168.20.0    255.255.255.0   192.168.255.2   GlobalRouter    1           1/17      OSPF 0   IB    125
192.168.255.0   255.255.255.252 192.168.255.1   -               1           1/17      LOC  0   DB    0
192.168.255.4   255.255.255.252 VSP8000-1       GlobalRouter    10          4051      ISIS 0   IBS   7
```

- It would seem all is looking good on the border routers… but not quite….

IS-IS ➔ OSPF Redistribution - Checking




```
VSP8000-1:1#% show ip route alternative
```

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.40	255.255.255.255	192.168.255.6	GlobalRouter	10	1/17	OSPF	0	IA	125
10.0.0.81	255.255.255.255	10.0.0.81	-	1	0	LOC	0	DB	0
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	255.255.255.255	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
10.0.0.88	255.255.255.255	VSP8000-2	GlobalRouter	11	4051	ISIS	0	IAS	130
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
172.16.10.0	255.255.255.0	192.168.255.6	GlobalRouter	10	1/17	OSPF	0	IA	125
192.168.10.0	255.255.255.0	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.10.0	255.255.255.0	VSP8000-2	GlobalRouter	11	4051	ISIS	0	IAS	130
192.168.20.0	255.255.255.0	192.168.255.6	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.20.0	255.255.255.0	VSP8000-2	GlobalRouter	1	4051	ISIS	0	IAS	130
192.168.255.0	255.255.255.252	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.255.0	255.255.255.252	192.168.255.6	GlobalRouter	2	1/17	OSPF	0	IA	20
192.168.255.4	255.255.255.252	192.168.255.5	-	1	1/17	LOC	0	DB	0

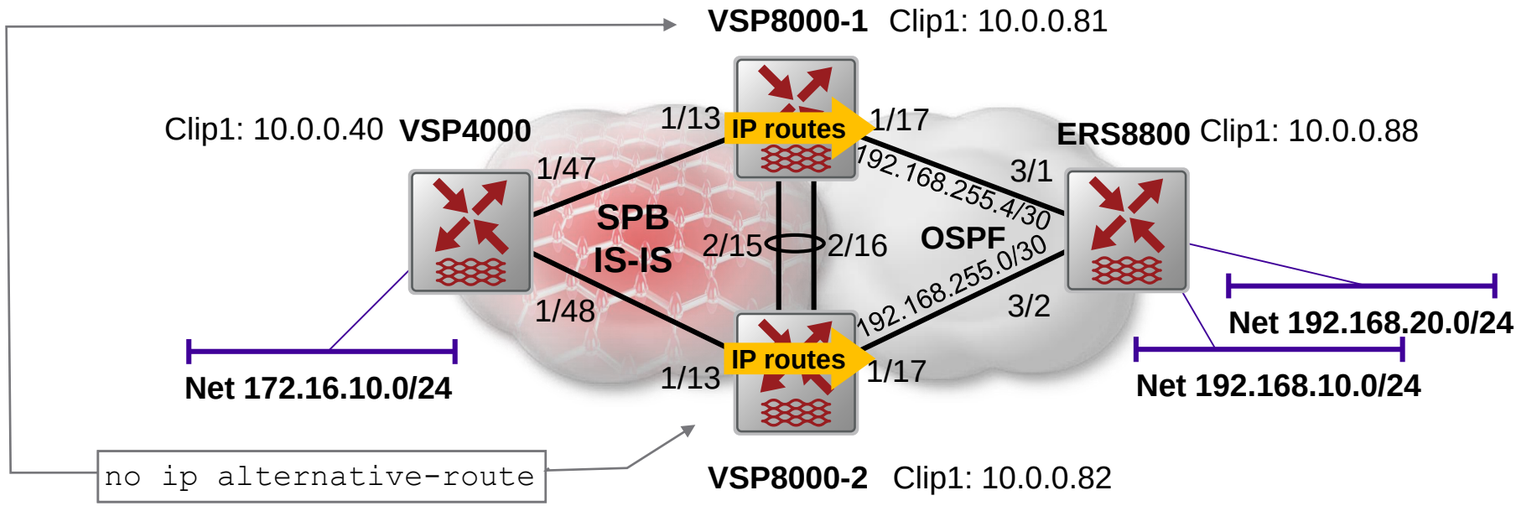
```
VSP8000-2:1#% show ip route alternative
```

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.40	255.255.255.255	192.168.255.2	GlobalRouter	10	1/17	OSPF	0	IA	125
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	10.0.0.82	-	1	0	LOC	0	DB	0
10.0.0.88	255.255.255.255	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
10.0.0.88	255.255.255.255	VSP8000-1	GlobalRouter	11	4051	ISIS	0	IAS	130
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
172.16.10.0	255.255.255.0	192.168.255.2	GlobalRouter	10	1/17	OSPF	0	IA	125
192.168.10.0	255.255.255.0	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.10.0	255.255.255.0	VSP8000-1	GlobalRouter	11	4051	ISIS	0	IAS	130
192.168.20.0	255.255.255.0	192.168.255.2	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.20.0	255.255.255.0	VSP8000-1	GlobalRouter	1	4051	ISIS	0	IAS	130
192.168.255.0	255.255.255.252	192.168.255.1	-	1	1/17	LOC	0	DB	0
192.168.255.4	255.255.255.252	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.255.4	255.255.255.252	192.168.255.2	GlobalRouter	2	1/17	OSPF	0	IA	20

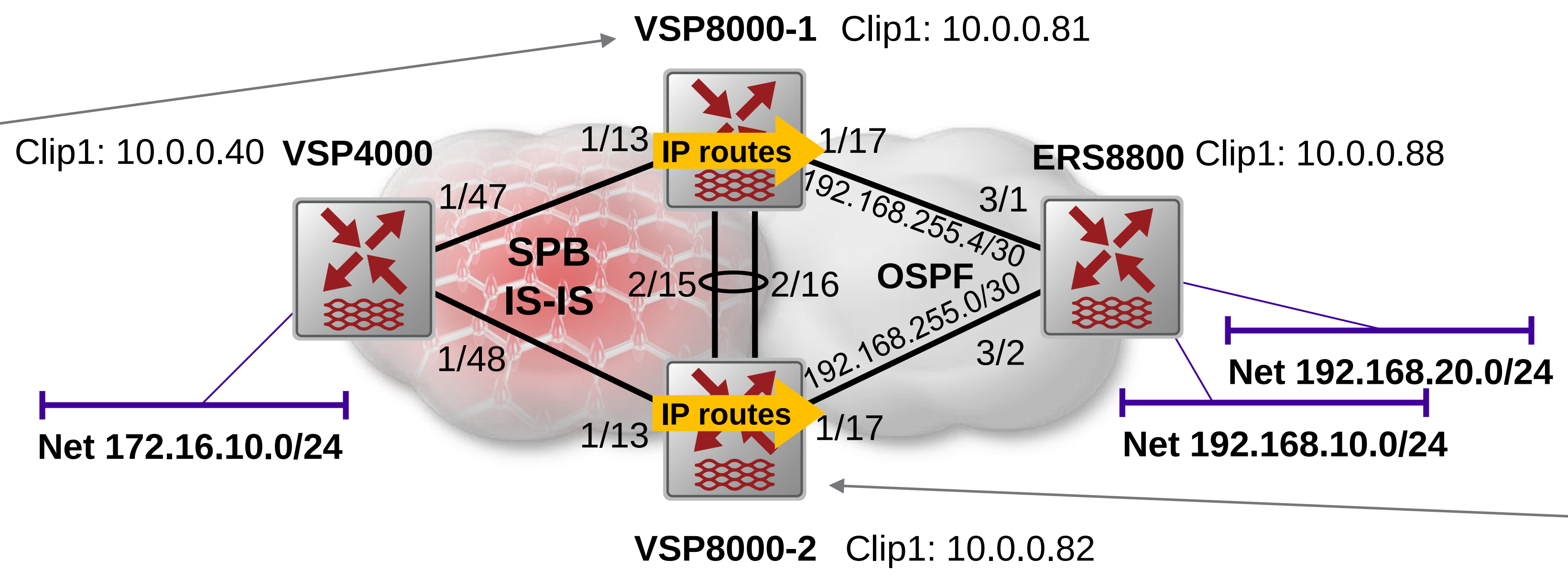
- The alternative routes in red are not good to have, because they will simply result in rapid route flapping (more on next slide)

IS-IS ➔ OSPF Redistribution - Fixing



- ISIS routes are preferred over OSPF ones, so the “alternative” OSPF routes that the VSP8000s learn from each other for ISIS networks that have been re-distributed into OSPF will not get installed
- However, if those ISIS routes were to become unavailable (e.g. reboot of VSP4000) then both VSP8000s would immediately remove the ISIS routes and replace them with these alternative OSPF routes, which would cause a temporary route flapping, with both VSP8000s temporarily announcing those routes back into ISIS (which is where they originated from!)
  - Same applies in reverse, for OSPF routes advertised into ISIS, for which we have upped the preference to 130
- The best approach is to simply disable alternative IP routes on the border routers, which is what we are doing here. This approach will also work with a RIP or BGP cloud

IS-IS ➔ OSPF Redistribution – Checking again



VSP8000-1:1#% show ip route **alternative**

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	10.0.0.81	-	1	0	LOC	0	DB	0
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	255.255.255.255	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.20.0	255.255.255.0	192.168.255.6	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.255.0	255.255.255.252	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.255.4	255.255.255.252	192.168.255.5	-	1	1/17	LOC	0	DB	0

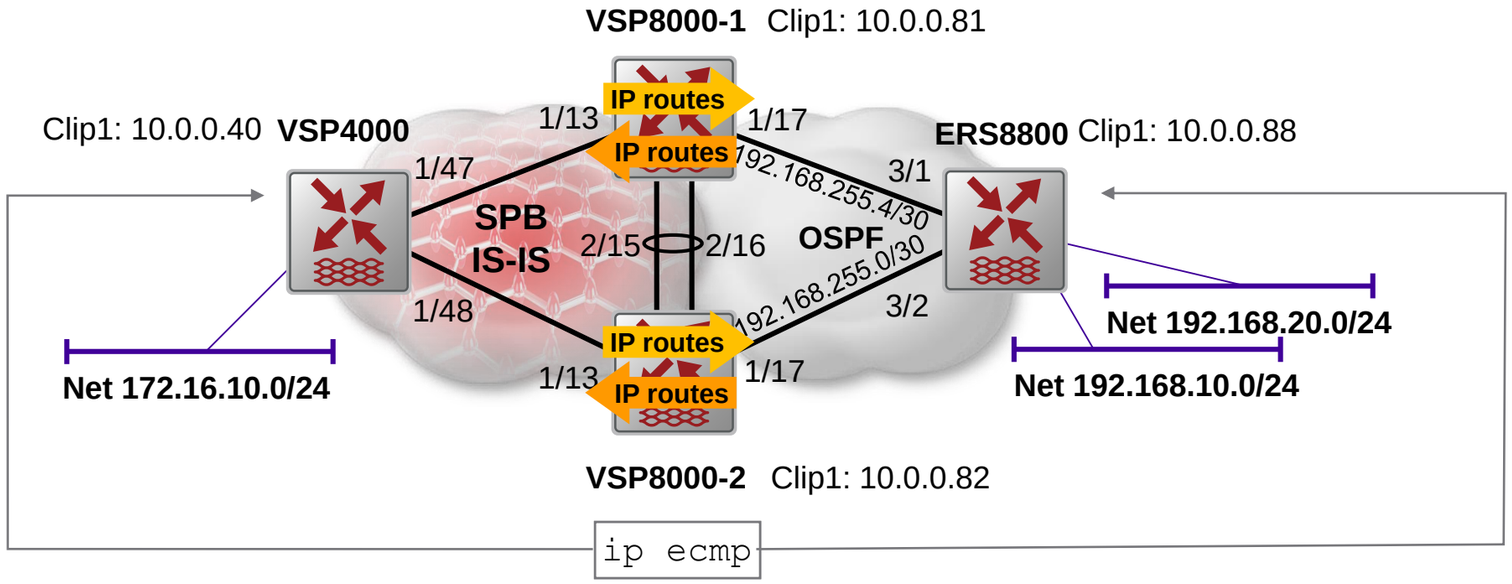
VSP8000-2:1#% show ip route **alternative**

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	10.0.0.82	-	1	0	LOC	0	DB	0
10.0.0.88	255.255.255.255	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.20.0	255.255.255.0	192.168.255.2	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.255.0	255.255.255.252	192.168.255.1	-	1	1/17	LOC	0	DB	0
192.168.255.4	255.255.255.252	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7

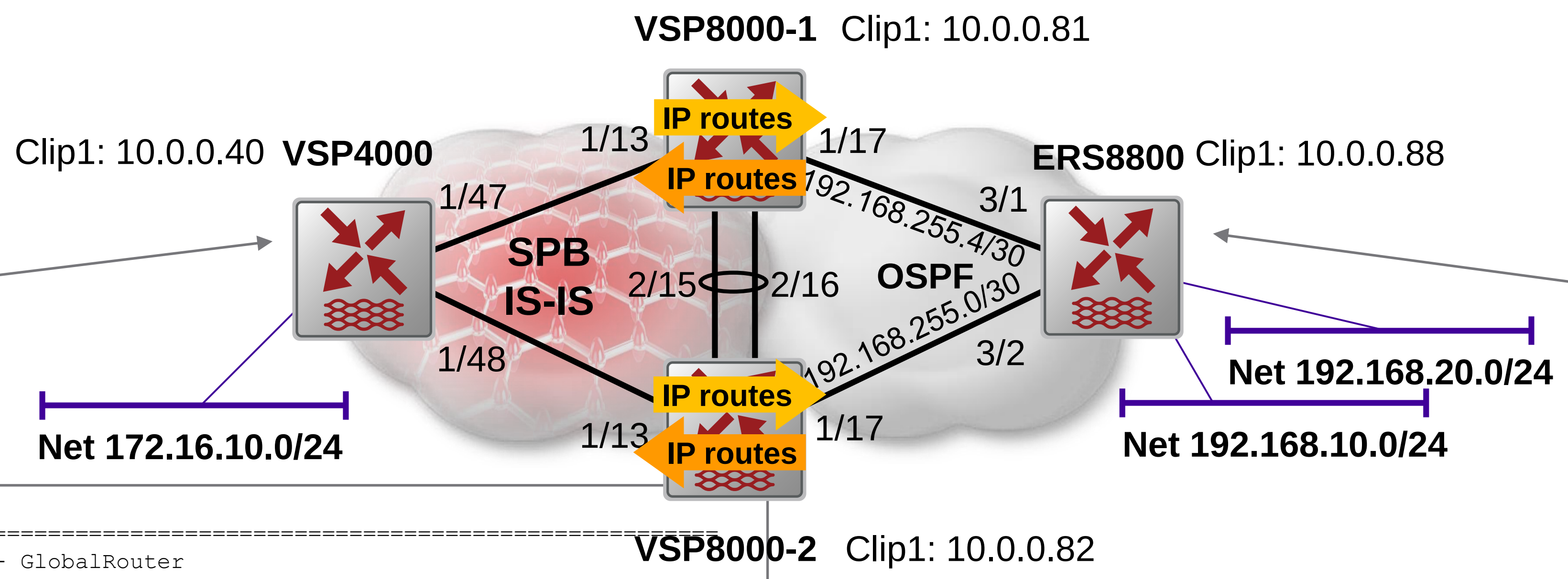
- Looking much better now (we got rid of all alternative routes)

Enabling ECMP - Config



- Cherry on the cake, lets turn on IP ECMP

Enabling ECMP - Checking

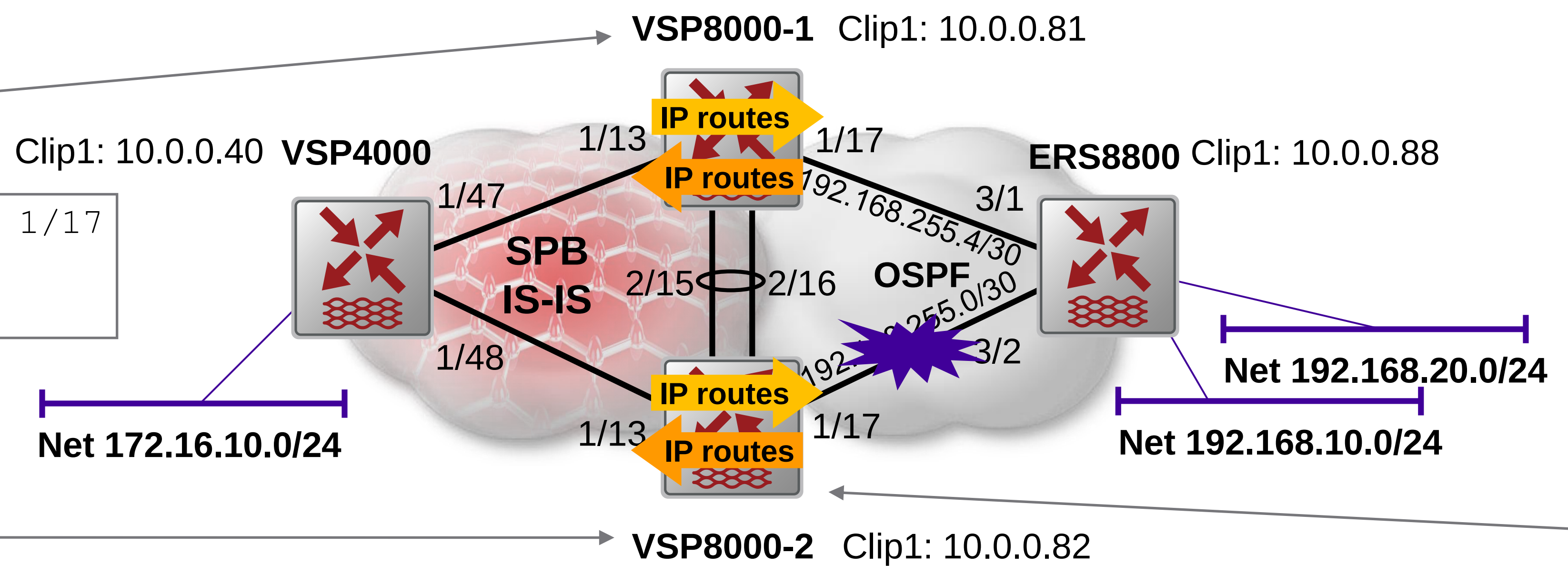



```
VSP4000:1#% show ip route
================================================================================================
                                  IP Route - GlobalRouter
================================================================================================
                                                     NH                      INTER
DST              MASK             NEXT               VRF/ISID         COST   FACE      PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  10.0.0.40          -                1      0         LOC  0   DB   0
10.0.0.81        255.255.255.255  VSP8000-1          GlobalRouter     10     4051      ISIS 0   IBSE 7
10.0.0.81        255.255.255.255  VSP8000-1          GlobalRouter     10     4052      ISIS 0   IBSE 7
10.0.0.82        255.255.255.255  VSP8000-2          GlobalRouter     10     4051      ISIS 0   IBSE 7
10.0.0.82        255.255.255.255  VSP8000-2          GlobalRouter     10     4052      ISIS 0   IBSE 7
10.0.0.88        255.255.255.255  VSP8000-1          GlobalRouter     11     4051      ISIS 0   IBSE 7
10.0.0.88        255.255.255.255  VSP8000-2          GlobalRouter     11     4051      ISIS 0   IBSE 7
10.0.0.88        255.255.255.255  VSP8000-1          GlobalRouter     11     4052      ISIS 0   IBSE 7
10.0.0.88        255.255.255.255  VSP8000-2          GlobalRouter     11     4052      ISIS 0   IBSE 7
172.16.10.0      255.255.255.0    172.16.10.1        -                1      0         LOC  0   DB   0
192.168.10.0     255.255.255.0    VSP8000-1          GlobalRouter     11     4051      ISIS 0   IBSE 7
192.168.10.0     255.255.255.0    VSP8000-2          GlobalRouter     11     4051      ISIS 0   IBSE 7
192.168.10.0     255.255.255.0    VSP8000-1          GlobalRouter     11     4052      ISIS 0   IBSE 7
192.168.10.0     255.255.255.0    VSP8000-2          GlobalRouter     11     4052      ISIS 0   IBSE 7
192.168.20.0     255.255.255.0    VSP8000-1          GlobalRouter     1      4051      ISIS 0   IBSE 7
192.168.20.0     255.255.255.0    VSP8000-2          GlobalRouter     1      4051      ISIS 0   IBSE 7
192.168.20.0     255.255.255.0    VSP8000-1          GlobalRouter     1      4052      ISIS 0   IBSE 7
192.168.20.0     255.255.255.0    VSP8000-2          GlobalRouter     1      4052      ISIS 0   IBSE 7
192.168.255.0    255.255.255.252  VSP8000-2          GlobalRouter     10     4051      ISIS 0   IBSE 7
192.168.255.0    255.255.255.252  VSP8000-2          GlobalRouter     10     4052      ISIS 0   IBSE 7
192.168.255.4    255.255.255.252  VSP8000-1          GlobalRouter     10     4051      ISIS 0   IBSE 7
192.168.255.4    255.255.255.252  VSP8000-1          GlobalRouter     10     4052      ISIS 0   IBSE 7
```

```
ERS8800:5#% show ip route
================================================================================================
                                  IP Route - GlobalRouter
================================================================================================
                                                     NH                    INTER
DST              MASK             NEXT               VRF          COST     FACE  PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  192.168.255.5      GlobalRout~  10       3/1   OSPF 0   IBE  125
10.0.0.40        255.255.255.255  192.168.255.1      GlobalRout~  10       3/2   OSPF 0   IBE  125
10.0.0.81        255.255.255.255  192.168.255.1      GlobalRout~  10       3/2   OSPF 0   IB   125
10.0.0.82        255.255.255.255  192.168.255.5      GlobalRout~  10       3/1   OSPF 0   IB   125
10.0.0.88        255.255.255.255  10.0.0.88          -            1        0     LOC  0   DB   0
172.16.10.0      255.255.255.0    192.168.255.5      GlobalRout~  10       3/1   OSPF 0   IBE  125
172.16.10.0      255.255.255.0    192.168.255.1      GlobalRout~  10       3/2   OSPF 0   IBE  125
192.168.10.0     255.255.255.0    192.168.10.1       -            1        0     LOC  0   DB   0
192.168.20.0     255.255.255.0    192.168.20.1       -            1        0     LOC  0   DB   0
192.168.255.0    255.255.255.252  192.168.255.2      -            1        3/2   LOC  0   DB   0
192.168.255.4    255.255.255.252  192.168.255.6      -            1        3/1   LOC  0   DB   0
```

- We get 4-way ECMP on VSP4000 and 2-way ECMP on the ERS8800

Testing failure on border router OSPF link




```
interface gigabitEthernet 1/17
   shutdown
exit
```

VSP8000-1:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	10.0.0.81	-	1	0	LOC	0	DB	0
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	**255.255.255.255**	**192.168.255.6**	**GlobalRouter**	**11**	**1/17**	**OSPF**	**0**	**IB**	**20**
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	**255.255.255.0**	**192.168.255.6**	**GlobalRouter**	**11**	**1/17**	**OSPF**	**0**	**IB**	**20**
192.168.20.0	**255.255.255.0**	**192.168.255.6**	**GlobalRouter**	**1**	**1/17**	**OSPF**	**0**	**IB**	**125**
192.168.255.4	255.255.255.252	192.168.255.5	-	1	1/17	LOC	0	DB	0

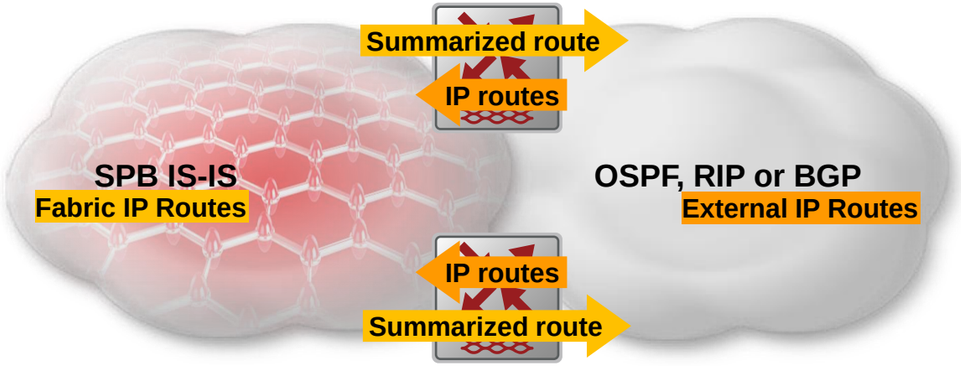
VSP8000-2:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	10.0.0.82	-	1	0	LOC	0	DB	0
10.0.0.88	**255.255.255.255**	**VSP8000-1**	**GlobalRouter**	**11**	**4051**	**ISIS**	**0**	**IBS**	**130**
172.16.10.0	255.255.255.0	VSP4000	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	**255.255.255.0**	**VSP8000-1**	**GlobalRouter**	**11**	**4051**	**ISIS**	**0**	**IBS**	**130**
192.168.20.0	**255.255.255.0**	**VSP8000-1**	**GlobalRouter**	**1**	**4051**	**ISIS**	**0**	**IBS**	**130**
192.168.255.4	255.255.255.252	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7

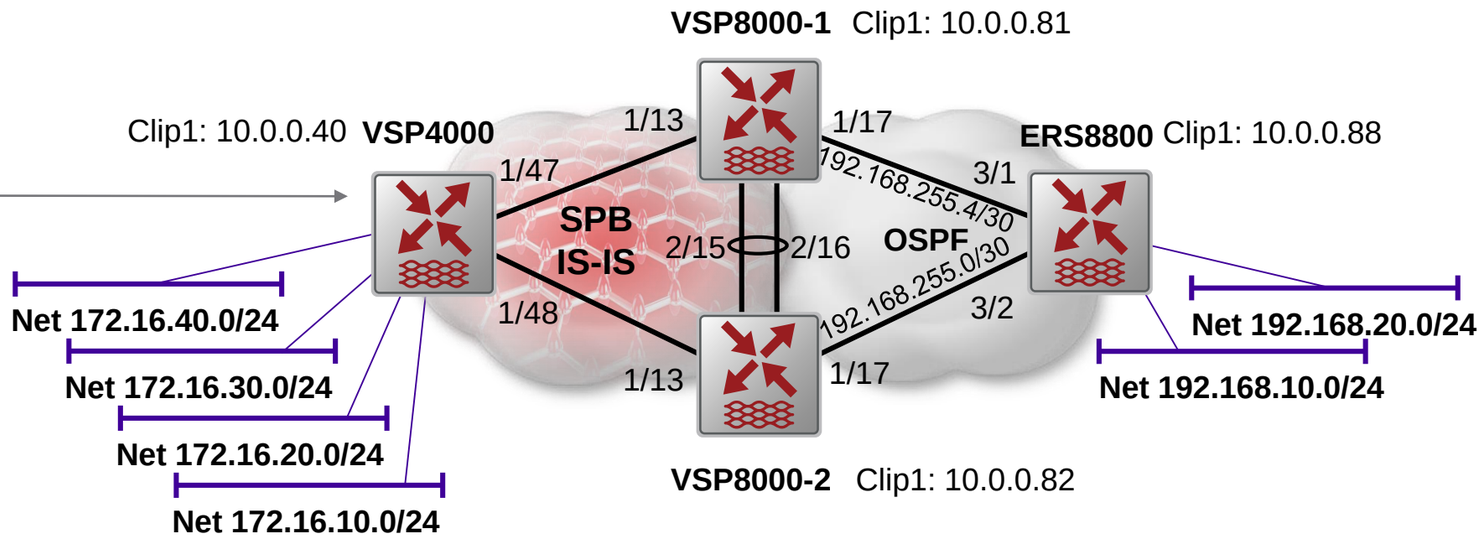
- Note that now VSP8000-2 has installed the ISIS External routes from VSP8000-1

Additional (optional!) Challenge
Aggregating ISIS routes and injecting a summarized route into OSPF



- Let us assume that we have many ISIS IP routes but that we do not want to advertise all of them into OSPF
- Instead we want to aggregate ISIS IP routes and inject into OSPF/RIP/BGP a single (or a few) summarized prefixes

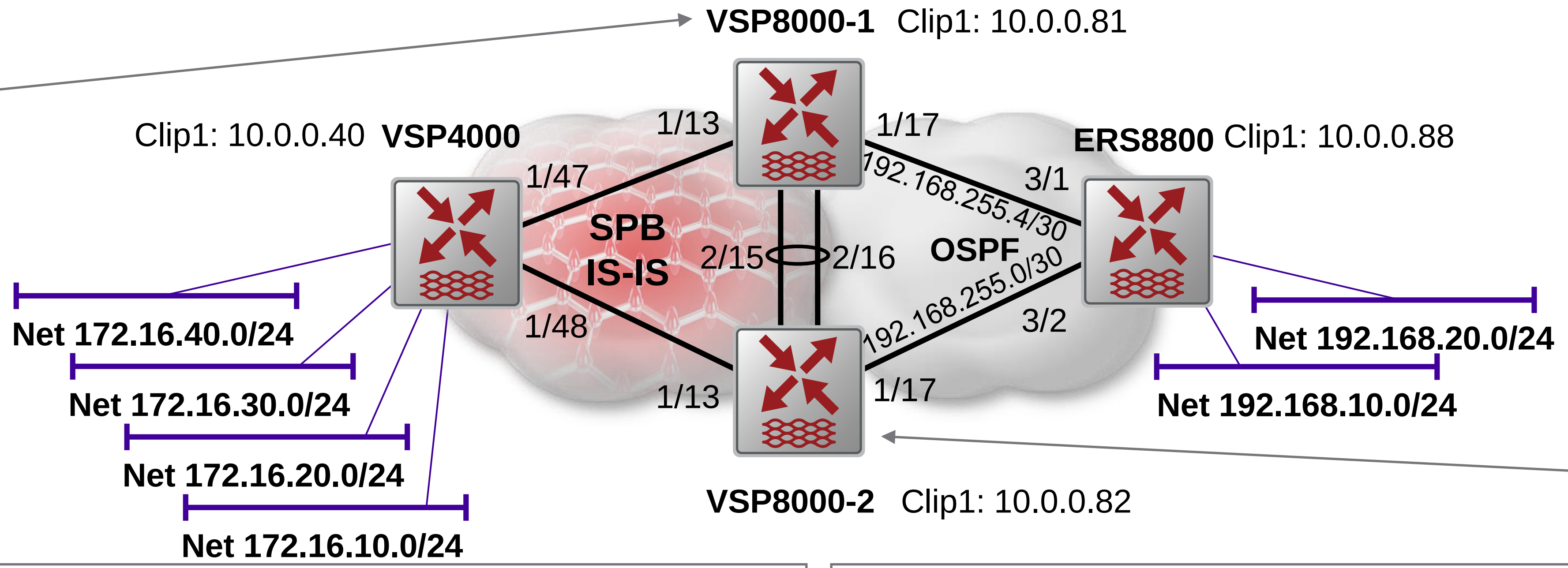
Aggregating ISIS routes and injecting a summarized route into OSPF - Prep




```
interface loopback 3
   ip address 172.16.20.1/24
exit
interface loopback 4
   ip address 172.16.30.1/24
exit
interface loopback 5
   ip address 172.16.40.1/24
exit
```

- Here we create some extra IP networks on VSP4000 in the 172.16.0.0/16 range

Aggregating ISIS routes and injecting a summarized route into OSPF - Prep

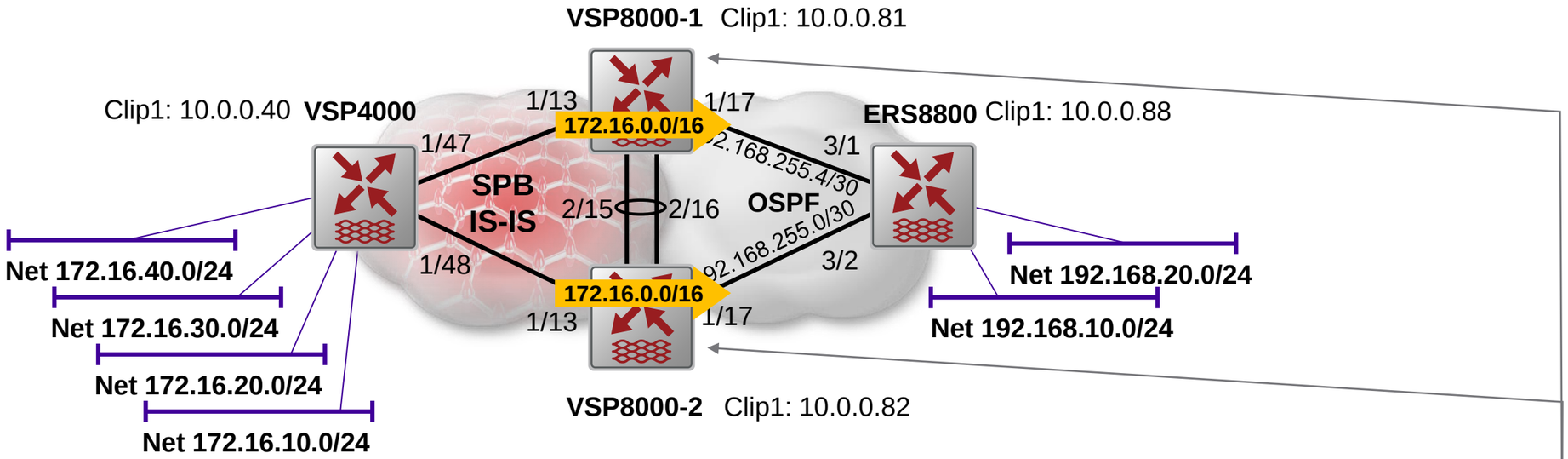



```
VSP8000-1:1#% show ip route
====================================================================================================
                                    IP Route - GlobalRouter
====================================================================================================
                                                    NH                      INTER
DST             MASK            NEXT                VRF/ISID        COST    FACE      PROT AGE TYPE PRF
----------------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
10.0.0.81       255.255.255.255 10.0.0.81           -               1       0         LOC  0   DB   0
10.0.0.82       255.255.255.255 VSP8000-2           GlobalRouter    10      4051      ISIS 0   IBS  7
10.0.0.88       255.255.255.255 192.168.255.6       GlobalRouter    11      1/17      OSPF 0   IB   20
172.16.10.0     255.255.255.0   VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
172.16.20.0     255.255.255.0   VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
172.16.30.0     255.255.255.0   VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
172.16.40.0     255.255.255.0   VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
192.168.10.0    255.255.255.0   192.168.255.6       GlobalRouter    11      1/17      OSPF 0   IB   20
192.168.20.0    255.255.255.0   192.168.255.6       GlobalRouter    1       1/17      OSPF 0   IB   125
192.168.255.0   255.255.255.252 VSP8000-2           GlobalRouter    10      4051      ISIS 0   IBS  7
192.168.255.4   255.255.255.252 192.168.255.5       -               1       1/17      LOC  0   DB   0
```

```
VSP8000-2:1#% show ip route
====================================================================================================
                                    IP Route - GlobalRouter
====================================================================================================
                                                    NH                      INTER
DST             MASK            NEXT                VRF/ISID        COST    FACE      PROT AGE TYPE PRF
----------------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
10.0.0.81       255.255.255.255 VSP8000-1           GlobalRouter    10      4051      ISIS 0   IBS  7
10.0.0.82       255.255.255.255 10.0.0.82           -               1       0         LOC  0   DB   0
10.0.0.88       255.255.255.255 192.168.255.2       GlobalRouter    11      1/17      OSPF 0   IB   20
172.16.10.0     255.255.255.0   VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
172.16.20.0     255.255.255.0   VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
172.16.30.0     255.255.255.0   VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
172.16.40.0     255.255.255.0   VSP4000             GlobalRouter    10      4051      ISIS 0   IBS  7
192.168.10.0    255.255.255.0   192.168.255.2       GlobalRouter    11      1/17      OSPF 0   IB   20
192.168.20.0    255.255.255.0   192.168.255.2       GlobalRouter    1       1/17      OSPF 0   IB   125
192.168.255.0   255.255.255.252 192.168.255.1       -               1       1/17      LOC  0   DB   0
192.168.255.4   255.255.255.252 VSP8000-1           GlobalRouter    10      4051      ISIS 0   IBS  7
```

- Here we create some extra IP networks on VSP4000 in the 172.16.0.0/16 range

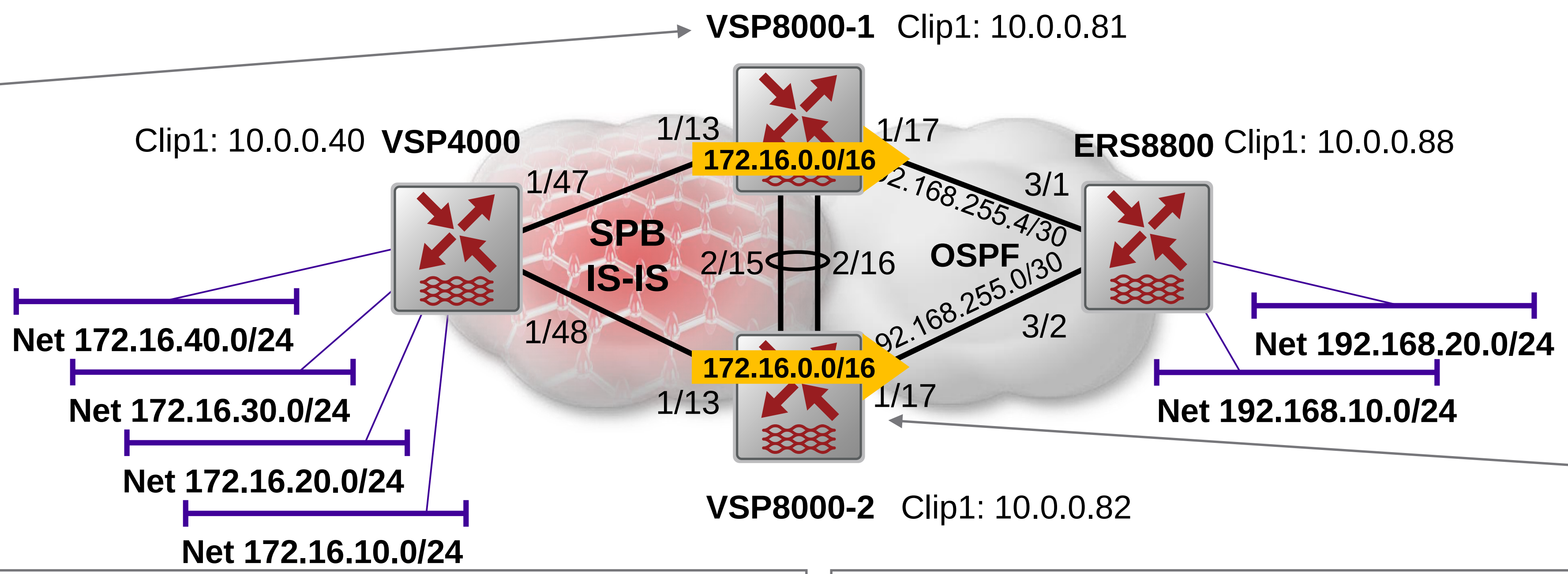
Aggregating ISIS routes and injecting a summarized route into OSPF - Config



- We replace our original “isis-internal” route-map with a new route-map for the existing ISIS ➔ OSPF redistribution
  - Route-map sequence 1: any ISIS Internal route falling within 172.16.0.0/16 will be aggregated and only the prefix 172.16.0.0/16 will be advertised instead
  - Route-map sequence 2: any other ISIS Internal route will be advertised as before
- We are also taking the pre-caution of configuring a corresponding static black-hole route for 172.16.0.0/16 on the VSP8000s with a preference of 8
  - This is a good idea whenever aggregating IP routes. There are 254 possible Class C routes within 172.16.0.0/16, but we only have 4 active. If the VSP8000s had a default route in their routing table and the OSPF cloud started forwarding traffic for network 172.16.100.100, this traffic would go into a routing loop until expiry of IP TTL. The static black hole route will prevent this from happening.
  - We set a preference of 8 so that should the prefix 172.16.0.0/16 be ISIS advertised by some other BEB in the ISIS cloud, this will have a higher preference of 7 and will automatically replace the static black-hole route

```
ip prefix-list net172 172.16.0.0/16 ge 16 le 32
route-map "isis-internal-aggregate" 1
   match metric-type-isis internal
   match network "net172"
   set injectlist "net172"
   enable
exit
route-map "isis-internal-aggregate" 2
   match metric-type-isis internal
enable
exit
router ospf
   redistribute isis route-map "isis-internal-aggregate"
exit
ip ospf apply redistribute isis
ip route 172.16.0.0 255.255.0.0 255.255.255.255 weight 65535 preference 8
```

Aggregating ISIS routes and injecting a summarized route into OSPF - Checking

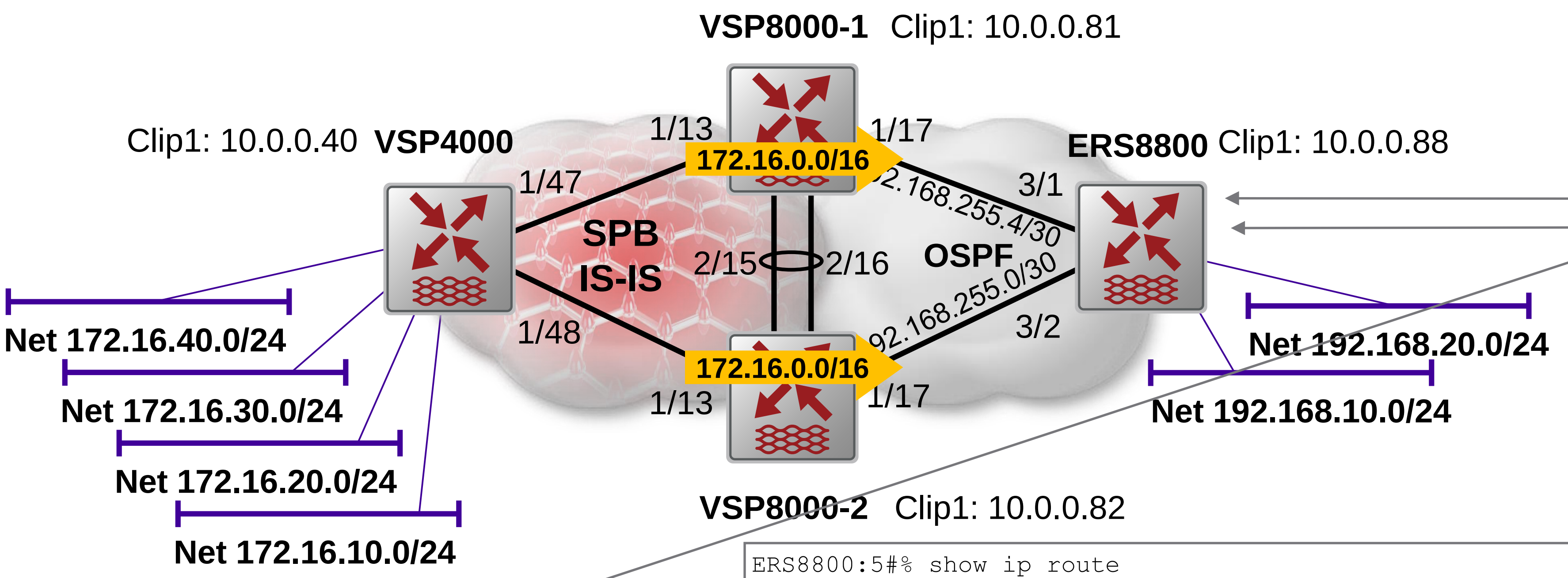



```
VSP8000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                      INTER
DST              MASK            NEXT             VRF/ISID          COST   FACE     PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
10.0.0.81        255.255.255.255 10.0.0.81        -                 1      0        LOC  0   DB   0
10.0.0.82        255.255.255.255 VSP8000-2        GlobalRouter      10     4051     ISIS 0   IBS  7
10.0.0.88        255.255.255.255 192.168.255.6    GlobalRouter      11     1/17     OSPF 0   IB   20
172.16.0.0       255.255.0.0     255.255.255.255  -                 65535  0        STAT 0   IB   8
172.16.10.0      255.255.255.0   VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
172.16.20.0      255.255.255.0   VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
172.16.30.0      255.255.255.0   VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
172.16.40.0      255.255.255.0   VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
192.168.10.0     255.255.255.0   192.168.255.6    GlobalRouter      11     1/17     OSPF 0   IB   20
192.168.20.0     255.255.255.0   192.168.255.6    GlobalRouter      1      1/17     OSPF 0   IB   125
192.168.255.0    255.255.255.252 VSP8000-2        GlobalRouter      10     4051     ISIS 0   IBS  7
192.168.255.4    255.255.255.252 192.168.255.5    -                 1      1/17     LOC  0   DB   0
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                      INTER
DST              MASK            NEXT             VRF/ISID          COST   FACE     PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
10.0.0.81        255.255.255.255 VSP8000-1        GlobalRouter      10     4051     ISIS 0   IBS  7
10.0.0.82        255.255.255.255 10.0.0.82        -                 1      0        LOC  0   DB   0
10.0.0.88        255.255.255.255 192.168.255.2    GlobalRouter      11     1/17     OSPF 0   IB   20
172.16.0.0       255.255.0.0     255.255.255.255  -                 65535  0        STAT 0   IB   8
172.16.10.0      255.255.255.0   VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
172.16.20.0      255.255.255.0   VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
172.16.30.0      255.255.255.0   VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
172.16.40.0      255.255.255.0   VSP4000          GlobalRouter      10     4051     ISIS 0   IBS  7
192.168.10.0     255.255.255.0   192.168.255.2    GlobalRouter      11     1/17     OSPF 0   IB   20
192.168.20.0     255.255.255.0   192.168.255.2    GlobalRouter      1      1/17     OSPF 0   IB   125
192.168.255.0    255.255.255.252 192.168.255.1    -                 1      1/17     LOC  0   DB   0
192.168.255.4    255.255.255.252 VSP8000-1        GlobalRouter      10     4051     ISIS 0   IBS  7
```

- Only change visible here is the appearance of the black-hole static route

Aggregating ISIS routes and injecting a summarized route into OSPF - Checking



- We see that the only the aggregated 172.16.0.0/16 was redistributed as an OSPF LSA5 external route by each border router

ERS8800:5#% show ip ospf ase

OSPF AsExternal Lsas - GlobalRouter

LSTYPE	LINKSTATEID	ADV_ROUTER	ETYPE	METRIC	ASE_FWD_ADDR	AGE	SEQ_NB	
AsExternal	10.0.0.40	10.0.0.81	2	10	0.0.0.0	1070	0x8000	
AsExternal	10.0.0.40	10.0.0.82	2	10	0.0.0.0	1070	0x8000	
AsExternal	10.0.0.81	10.0.0.82	2	10	0.0.0.0	1070	0x8000	
AsExternal	10.0.0.82	10.0.0.81	2	10	0.0.0.0	1070	0x8000	
AsExternal	**172.16.0.0**	**10.0.0.81**	**2**	**10**	**0.0.0.0**	**1070**	**0x8000**	
AsExternal	**172.16.0.0**	**10.0.0.82**	**2**	**10**	**0.0.0.0**	**1069**	**0x8000**	
AsExternal	192.168.20.0	10.0.0.88	2	1	0.0.0.0	1184	0x80000004	0x37f6
AsExternal	192.168.255.0	10.0.0.81	2	10	0.0.0.0	1070	0x80000001	0x41c5
AsExternal	192.168.255.4	10.0.0.82	2	10	0.0.0.0	1070	0x80000001	0x13ee

ERS8800:5#% show ip route

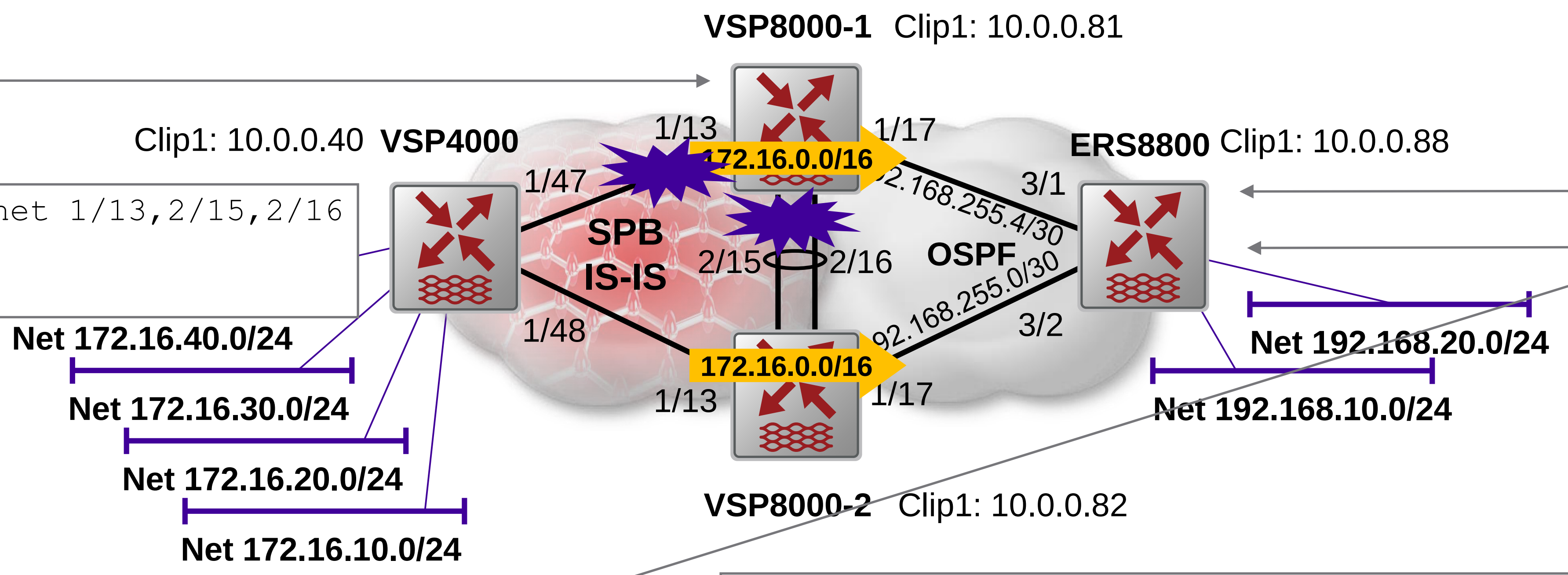
IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	192.168.255.5	GlobalRout~	10	3/1	OSPF	0	IBE	125
10.0.0.40	255.255.255.255	192.168.255.1	GlobalRout~	10	3/2	OSPF	0	IBE	125
10.0.0.81	255.255.255.255	192.168.255.1	GlobalRout~	10	3/2	OSPF	0	IB	125
10.0.0.82	255.255.255.255	192.168.255.5	GlobalRout~	10	3/1	OSPF	0	IB	125
10.0.0.88	255.255.255.255	10.0.0.88	-	1	0	LOC	0	DB	0
172.16.0.0	**255.255.0.0**	**192.168.255.5**	**GlobalRout~**	**10**	**3/1**	**OSPF**	**0**	**IBE**	**125**
172.16.0.0	**255.255.0.0**	**192.168.255.1**	**GlobalRout~**	**10**	**3/2**	**OSPF**	**0**	**IBE**	**125**
192.168.10.0	255.255.255.0	192.168.10.1	-	1	0	LOC	0	DB	0
192.168.20.0	255.255.255.0	192.168.20.1	-	1	0	LOC	0	DB	0
192.168.255.0	255.255.255.252	192.168.255.2	-	1	3/2	LOC	0	DB	0
192.168.255.4	255.255.255.252	192.168.255.6	-	1	3/1	LOC	0	DB	0

- And we see the aggregated route on the OSPF side

Aggregating ISIS routes and injecting a summarized route into OSPF – Testing

```
interface gigabitEthernet 1/13,2/15,2/16
   shutdown
exit
```

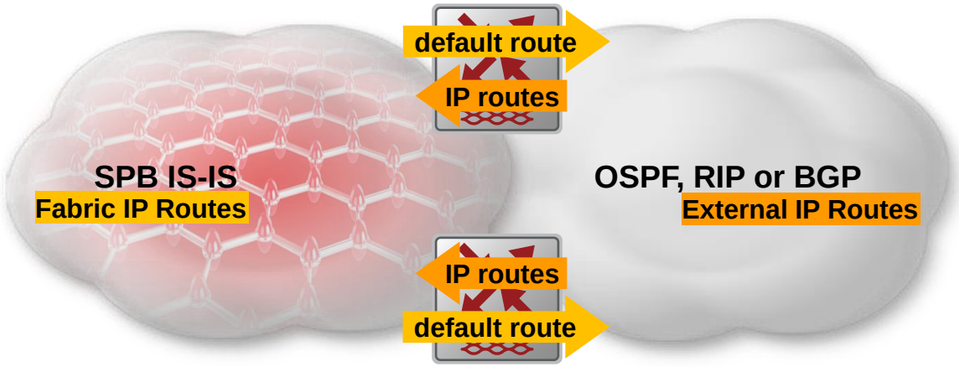


- As expected VSP8000-1 stops announcing the aggregated route as it no longer has any ISIS Internal routes matching the 172.16.0.0/24 range

```
ERS8800:5#% show ip route
================================================================================
                          IP Route - GlobalRouter
================================================================================
                                                NH                 INTER
DST            MASK            NEXT             VRF          COST  FACE  PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.40      255.255.255.255 192.168.255.1    GlobalRout~  10     3/2  OSPF 0   IB   125
10.0.0.88      255.255.255.255 10.0.0.88         -           1     0     LOC  0   DB   0
172.16.0.0     255.255.0.0     192.168.255.1    GlobalRout~  10     3/2  OSPF 0   IB   125
192.168.10.0   255.255.255.0   192.168.10.1      -           1     0     LOC  0   DB   0
192.168.20.0   255.255.255.0   192.168.20.1      -           1     0     LOC  0   DB   0
192.168.255.0  255.255.255.252 192.168.255.2     -           1      3/2  LOC  0   DB   0
192.168.255.4  255.255.255.252 192.168.255.6     -           1      3/1  LOC  0   DB   0
```

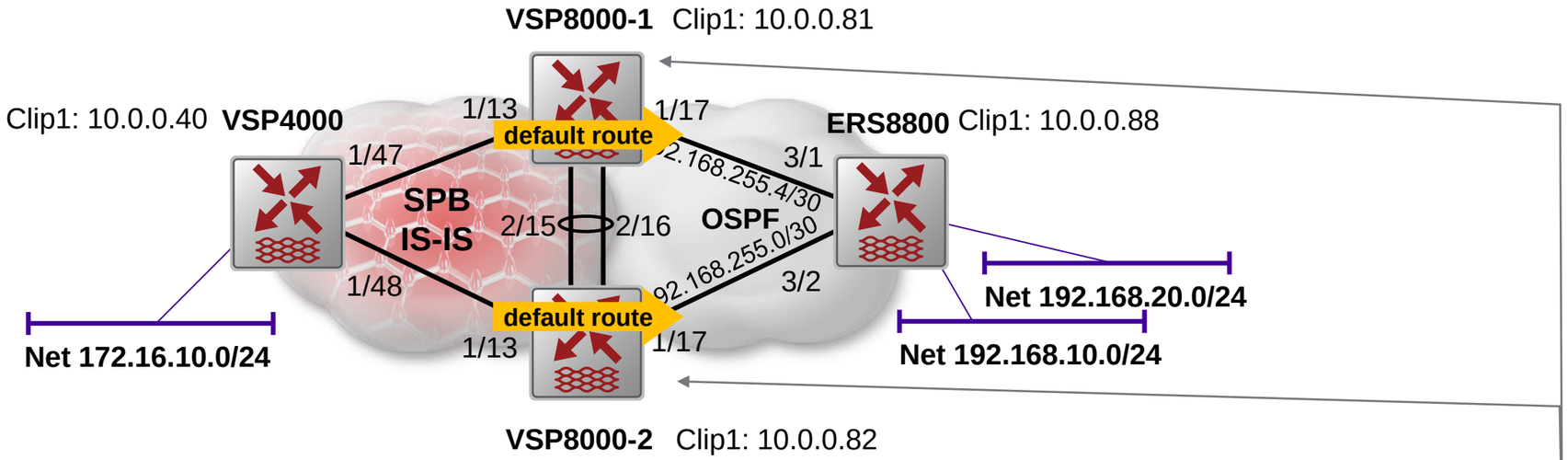
```
ERS8800:5#% show ip ospf ase
================================================================================
                    OSPF AsExternal Lsas - GlobalRouter
================================================================================
LSTYPE     LINKSTATEID    ADV_ROUTER     ETYPE  METRIC  ASE_FWD_ADDR   AGE   SEQ_
--------------------------------------------------------------------------------
AsExternal 10.0.0.40      10.0.0.82      2      10      0.0.0.0        1521  0x80000001 0xea4f
AsExternal 172.16.0.0     10.0.0.82      2      10      0.0.0.0        1520  0x80000002 0x7737
AsExternal 192.168.20.0   10.0.0.88      2      1       0.0.0.0        1635  0x80000004 0x37f6
```

Additional (optional!) Challenge
Only injecting a default route into OSPF



- Let us assume that SPB is the core network and that we only want to inject a default route into the other OSPF/BGP/RIP cloud
  - Rather than redistributing all ISIS IP routes available

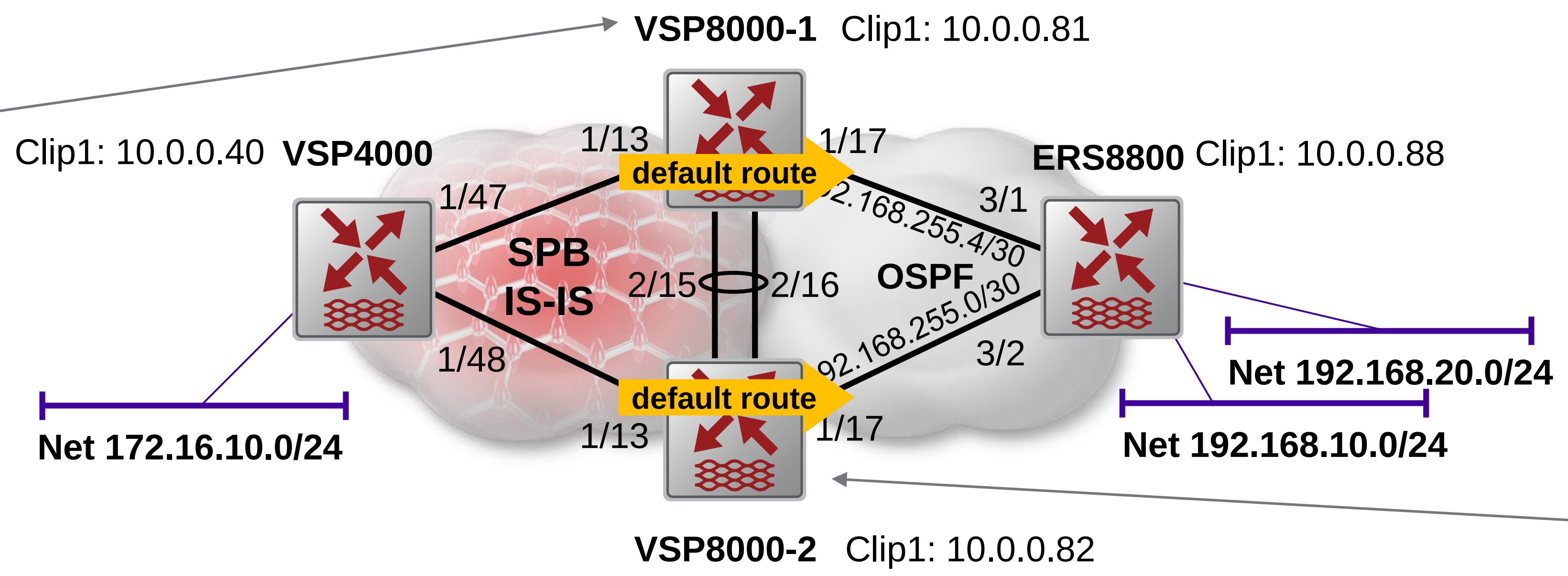
Only injecting a default route into OSPF - Config



- We replace our original “isis-internal” route-map with a new route-map for the existing ISIS ➔ OSPF redistribution
- The route-map policy will match any (ISIS) route but replace it with (inject) a default route
  - Should one of the VSP8000 remain isolated from the SPB Fabric, then it will have no ISIS routes to redistribute and will cease to announce a default route into OSPF
- We are also taking the pre-caution of configuring a corresponding default static black-hole route on the VSP8000s with a preference of 8
  - If a valid ISIS default route exists, this will have a higher preference of 7 and will replace the static black-hole default route
  - If a valid ISIS default route does not exist, then any traffic received from OSPF (after following the default route to SPB) which cannot be handled via more specific routes, will be dropped on the VSP8000s

```
ip prefix-list "default" 0.0.0.0/0
route-map "inject-default" 1
   set injectlist "default"
   enable
exit
router ospf
   redistribute isis route-policy "inject-default"
exit
ip ospf apply redistribute isis
ip route 0.0.0.0 0.0.0.0 255.255.255.255 weight 65535 preference 8
```

Only injecting a default route into OSPF - Checking

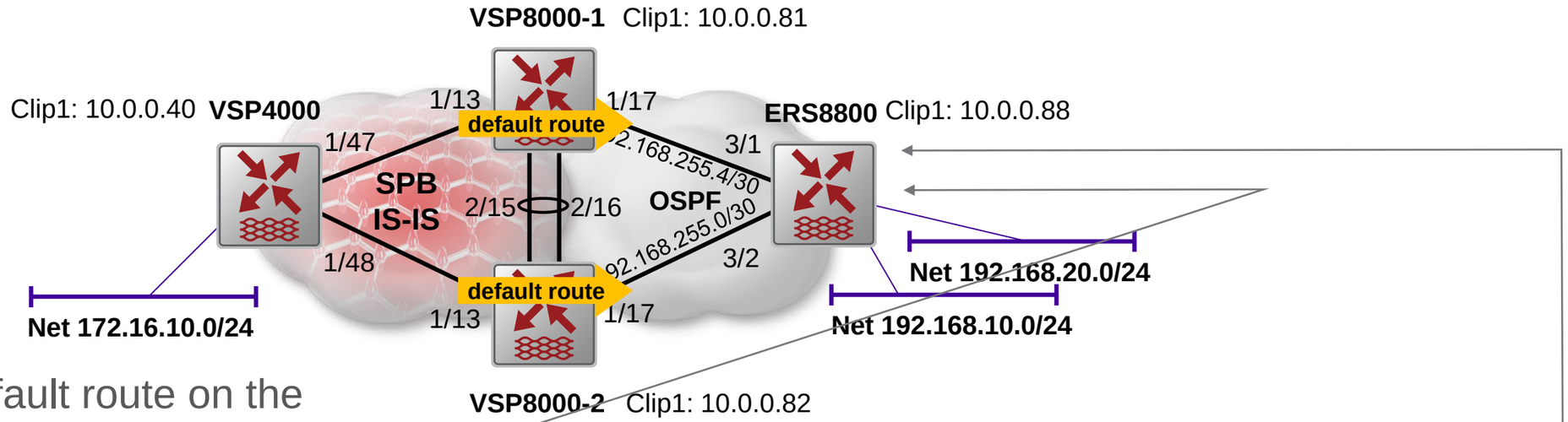



```
VSP8000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                NH                      INTER
DST             MASK            NEXT            VRF/ISID        COST    FACE    PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         255.255.255.255 -               65535   0       STAT 0   IB   8
10.0.0.40       255.255.255.255 VSP4000         GlobalRouter    10      4051    ISIS 0   IBS  7
10.0.0.81       255.255.255.255 10.0.0.81       -               1       0       LOC  0   DB   0
10.0.0.82       255.255.255.255 VSP8000-2       GlobalRouter    10      4051    ISIS 0   IBS  7
10.0.0.88       255.255.255.255 192.168.255.6   GlobalRouter    11      1/17    OSPF 0   IB   20
172.16.10.0     255.255.255.0   VSP4000         GlobalRouter    10      4051    ISIS 0   IBS  7
192.168.10.0    255.255.255.0   192.168.255.6   GlobalRouter    11      1/17    OSPF 0   IB   20
192.168.20.0    255.255.255.0   192.168.255.6   GlobalRouter    1       1/17    OSPF 0   IB   125
192.168.255.0   255.255.255.252 VSP8000-2       GlobalRouter    10      4051    ISIS 0   IBS  7
192.168.255.4   255.255.255.252 192.168.255.5   -               1       1/17    LOC  0   DB   0
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                NH                      INTER
DST             MASK            NEXT            VRF/ISID        COST    FACE    PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         255.255.255.255 -               65535   0       STAT 0   IB   8
10.0.0.40       255.255.255.255 VSP4000         GlobalRouter    10      4051    ISIS 0   IBS  7
10.0.0.81       255.255.255.255 VSP8000-1       GlobalRouter    10      4051    ISIS 0   IBS  7
10.0.0.82       255.255.255.255 10.0.0.82       -               1       0       LOC  0   DB   0
10.0.0.88       255.255.255.255 192.168.255.2   GlobalRouter    11      1/17    OSPF 0   IB   20
172.16.10.0     255.255.255.0   VSP4000         GlobalRouter    10      4051    ISIS 0   IBS  7
192.168.10.0    255.255.255.0   192.168.255.2   GlobalRouter    11      1/17    OSPF 0   IB   20
192.168.20.0    255.255.255.0   192.168.255.2   GlobalRouter    1       1/17    OSPF 0   IB   125
192.168.255.0   255.255.255.252 192.168.255.1   -               1       1/17    LOC  0   DB   0
192.168.255.4   255.255.255.252 VSP8000-1       GlobalRouter    10      4051    ISIS 0   IBS  7
```

- Only change visible here is the appearance of the default black-hole route

Only injecting a default route into OSPF - Checking

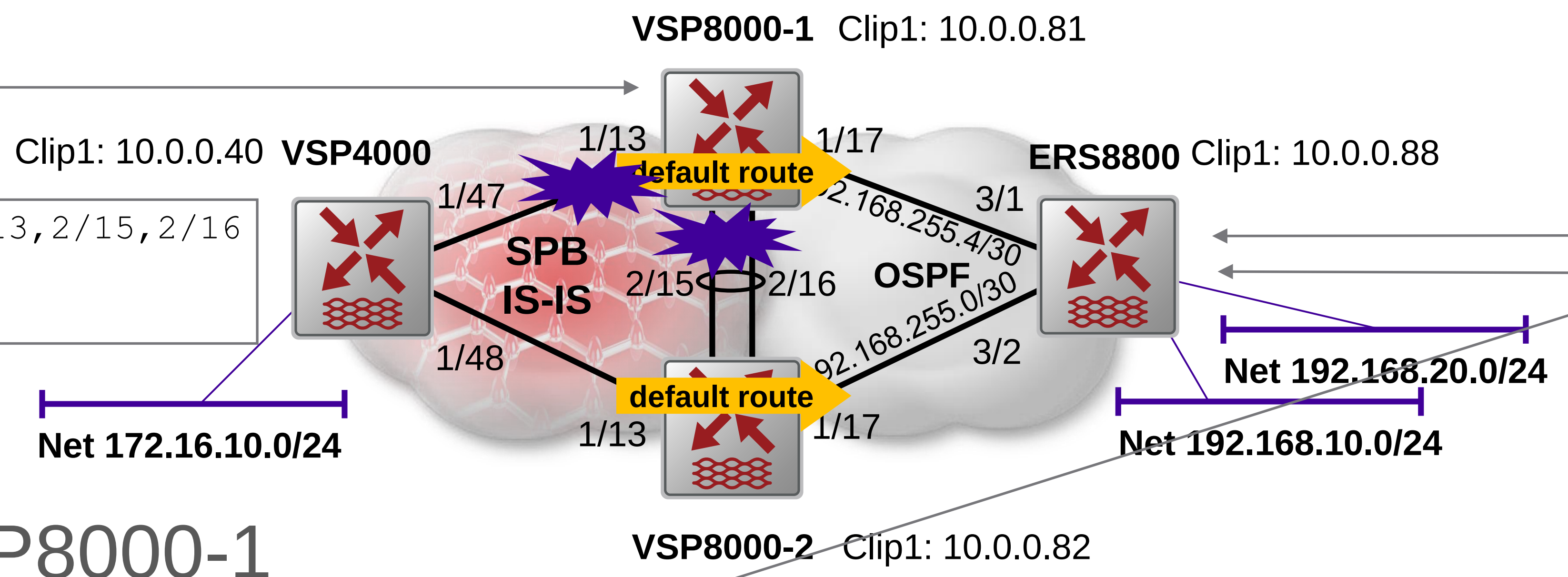


- Now we only see a default route on the OSPF side
- And only a default route was redistributed as an OSPF LSA5 external route by each border router

```
ERS8800:5#% show ip ospf ase
================================================================================
                    OSPF AsExternal Lsas - GlobalRouter
================================================================================
LSTYPE     LINKSTATEID     ADV_ROUTER      ETYPE  METRIC  ASE_FWD_ADDR     AGE  SEQ_
--------------------------------------------------------------------------------
AsExternal 0.0.0.0         10.0.0.81       2      10      0.0.0.0          321  0x80000001 0x568
AsExternal 0.0.0.0         10.0.0.82       2      10      0.0.0.0          309  0x80000001 0xfe6d
AsExternal 192.168.20.0    10.0.0.88       2      1       0.0.0.0          1274 0x80000009 0x2dfb
```

```
ERS8800:5#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                          NH                INTER
DST             MASK            NEXT                    VRF          COST FACE  PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         192.168.255.5           GlobalRout~ 10    3/1   OSPF 0   IBE  125
0.0.0.0         0.0.0.0         192.168.255.1           GlobalRout~ 10    3/2   OSPF 0   IBE  125
10.0.0.88       255.255.255.255 10.0.0.88                -          1     0     LOC  0   DB   0
192.168.10.0    255.255.255.0   192.168.10.1             -          1     0     LOC  0   DB   0
192.168.20.0    255.255.255.0   192.168.20.1             -          1     0     LOC  0   DB   0
192.168.255.0   255.255.255.252 192.168.255.2            -          1     3/2   LOC  0   DB   0
192.168.255.4   255.255.255.252 192.168.255.6            -          1     3/1   LOC  0   DB   0
```

Only injecting a default route into OSPF – Testing



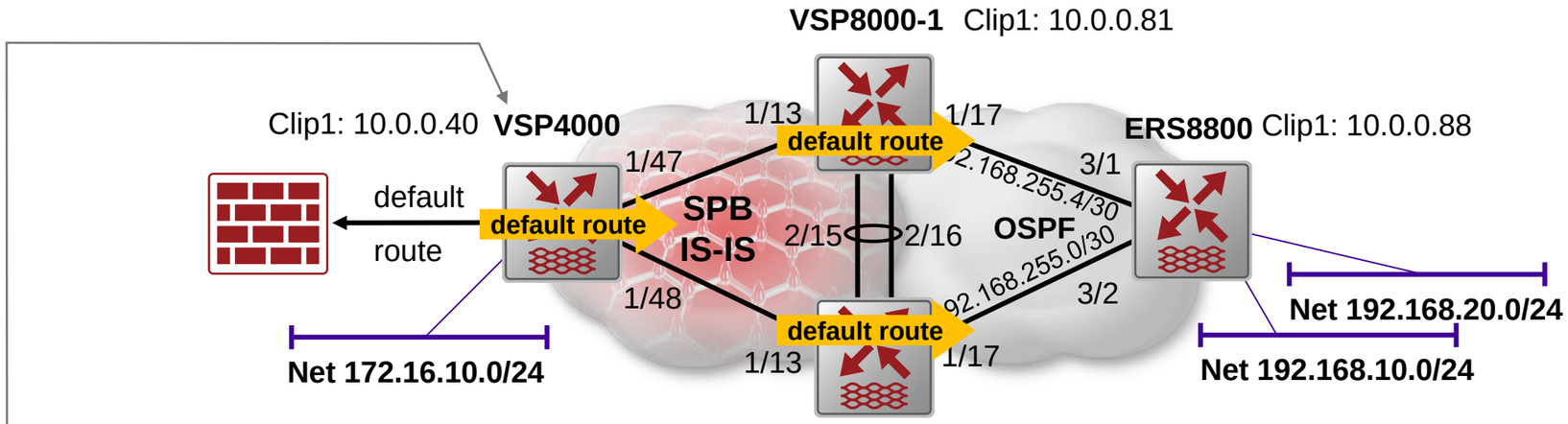

```
interface gigabitEthernet 1/13,2/15,2/16
   shutdown
exit
```

- As expected VSP8000-1 stops announcing the default route into OSPF once it looses all its ISIS routes

```
ERS8800:5#% show ip route
================================================================================
                           IP Route - GlobalRouter
================================================================================
                                                   NH                 INTER
DST             MASK            NEXT               VRF          COST  FACE  PROT AGE TYPE PRF
--------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         192.168.255.1      GlobalRout~  10     3/2  OSPF 0   IB   125
10.0.0.88       255.255.255.255 10.0.0.88           -           1     0     LOC  0   DB   0
192.168.10.0    255.255.255.0   192.168.10.1        -           1     0     LOC  0   DB   0
192.168.20.0    255.255.255.0   192.168.20.1        -           1     0     LOC  0   DB   0
192.168.255.0   255.255.255.252 192.168.255.2       -           1      3/2  LOC  0   DB   0
192.168.255.4   255.255.255.252 192.168.255.6       -           1      3/1  LOC  0   DB   0
```

```
ERS8800:5#% show ip ospf ase
================================================================================
                      OSPF AsExternal Lsas - GlobalRouter
================================================================================
LSTYPE     LINKSTATEID    ADV_ROUTER     ETYPE  METRIC  ASE_FWD_ADDR   AGE   SEQ_
--------------------------------------------------------------------------------
AsExternal 0.0.0.0        10.0.0.82      2      10      0.0.0.0        463   0x80000001 0xfe6d
AsExternal 192.168.20.0   10.0.0.88      2      1       0.0.0.0        1428  0x80000009 0x2dfb
```

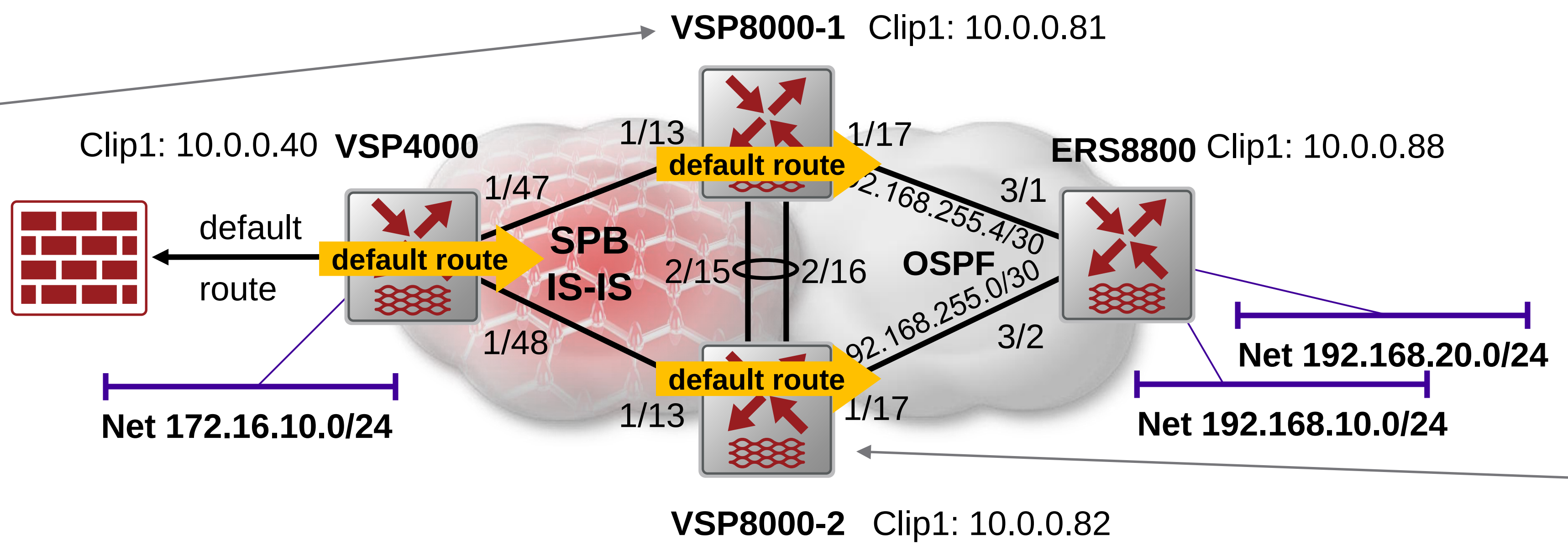
Only injecting a default route into OSPF – Testing




```
ip prefix-list "default" 0.0.0.0/0
route-map default-only 1
   match network default
   enable
exit
router isis
   redistribute static
   redistribute static route-map default-only
   redistribute static enable
exit
isis apply redistribute static
ip route 0.0.0.0 0.0.0.0 255.255.255.255 weight 10
```

- In this test we are going to create a default route in the SPB Fabric such that the border VSP8000s will see a default ISIS route
  - To simulate this we are simply creating a default static black-hole route on VSP4000 and redistributing it into ISIS
- The expectation is that this new ISIS default route will replace the black-hole routes which we had created on the VSP8000s and that there is no change or impact to the OSPF route already announced into OSPF

Only injecting a default route into OSPF – Testing

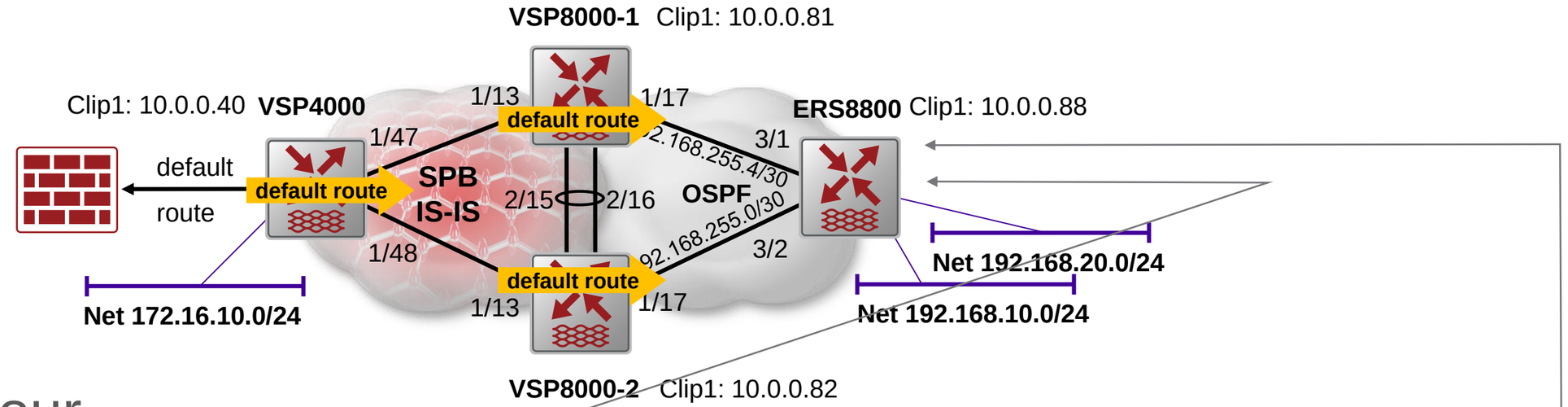



```
VSP8000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                      INTER
DST             MASK            NEXT               VRF/ISID          COST  FACE      PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         VSP4000            GlobalRouter      10    4051      ISIS 0   IBS  7
10.0.0.40       255.255.255.255 VSP4000            GlobalRouter      10    4051      ISIS 0   IBS  7
10.0.0.81       255.255.255.255 10.0.0.81          -                 1     0         LOC  0   DB   0
10.0.0.82       255.255.255.255 VSP8000-2          GlobalRouter      10    4051      ISIS 0   IBS  7
10.0.0.88       255.255.255.255 192.168.255.6      GlobalRouter      11    1/17      OSPF 0   IB   20
172.16.10.0     255.255.255.0   VSP4000            GlobalRouter      10    4051      ISIS 0   IBS  7
192.168.10.0    255.255.255.0   192.168.255.6      GlobalRouter      11    1/17      OSPF 0   IB   20
192.168.20.0    255.255.255.0   192.168.255.6      GlobalRouter      1     1/17      OSPF 0   IB   125
192.168.255.0   255.255.255.252 VSP8000-2          GlobalRouter      10    4051      ISIS 0   IBS  7
192.168.255.4   255.255.255.252 192.168.255.5      -                 1     1/17      LOC  0   DB   0
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                      INTER
DST             MASK            NEXT               VRF/ISID          COST  FACE      PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         VSP4000            GlobalRouter      10    4051      ISIS 0   IBS  7
10.0.0.40       255.255.255.255 VSP4000            GlobalRouter      10    4051      ISIS 0   IBS  7
10.0.0.81       255.255.255.255 VSP8000-1          GlobalRouter      10    4051      ISIS 0   IBS  7
10.0.0.82       255.255.255.255 10.0.0.82          -                 1     0         LOC  0   DB   0
10.0.0.88       255.255.255.255 192.168.255.2      GlobalRouter      11    1/17      OSPF 0   IB   20
172.16.10.0     255.255.255.0   VSP4000            GlobalRouter      10    4051      ISIS 0   IBS  7
192.168.10.0    255.255.255.0   192.168.255.2      GlobalRouter      11    1/17      OSPF 0   IB   20
192.168.20.0    255.255.255.0   192.168.255.2      GlobalRouter      1     1/17      OSPF 0   IB   125
192.168.255.0   255.255.255.252 192.168.255.1      -                 1     1/17      LOC  0   DB   0
192.168.255.4   255.255.255.252 VSP8000-1          GlobalRouter      10    4051      ISIS 0   IBS  7
```

- Note that we now have an ISIS default route to VSP4000
- This has replaced the default black-hole static route we had before

Only injecting a default route into OSPF – Testing



- We still have our default route announced into OSPF

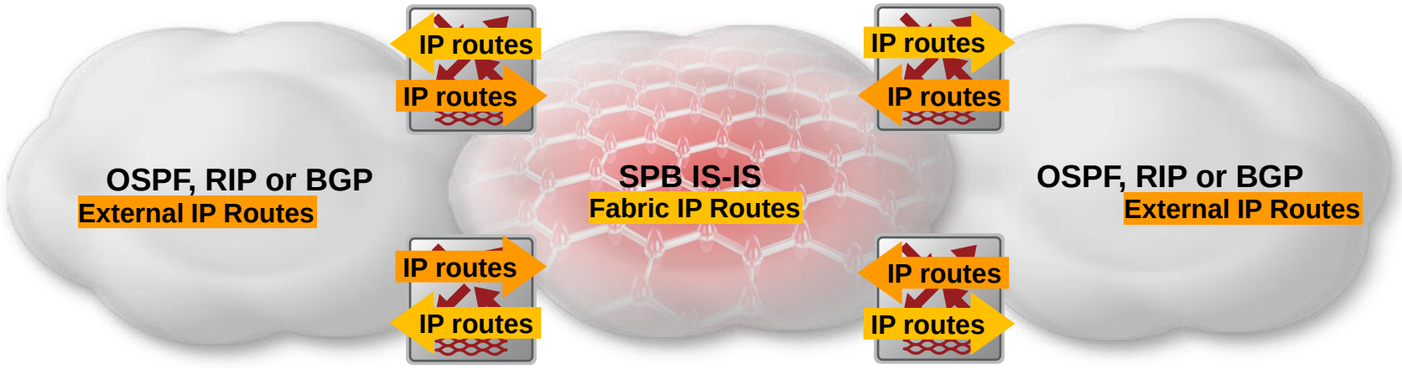
```
ERS8800:5#% show ip route
=============================================================================================
                                    IP Route - GlobalRouter
=============================================================================================
                                                          NH                INTER
DST             MASK            NEXT                    VRF         COST  FACE  PROT AGE TYPE PRF
---------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         192.168.255.1           GlobalRout~ 10    3/2   OSPF 0   IBE  125
0.0.0.0         0.0.0.0         192.168.255.5           GlobalRout~ 10    3/1   OSPF 0   IBE  125
10.0.0.88       255.255.255.255 10.0.0.88                -          1     0     LOC  0   DB   0
192.168.10.0    255.255.255.0   192.168.10.1             -          1     0     LOC  0   DB   0
192.168.20.0    255.255.255.0   192.168.20.1             -          1     0     LOC  0   DB   0
192.168.255.0   255.255.255.252 192.168.255.2            -          1     3/2   LOC  0   DB   0
192.168.255.4   255.255.255.252 192.168.255.6            -          1     3/1   LOC  0   DB   0
```

```
ERS8800:5#% show ip ospf ase
=============================================================================
                    OSPF AsExternal Lsas - GlobalRouter
=============================================================================
LSTYPE     LINKSTATEID     ADV_ROUTER      ETYPE  METRIC  ASE_FWD_ADDR    AGE  SEQ_
-----------------------------------------------------------------------------
AsExternal 0.0.0.0         10.0.0.81       2      10      0.0.0.0         785  0x8000000b 0xf072
AsExternal 0.0.0.0         10.0.0.82       2      10      0.0.0.0         1406 0x8000000a 0xec76
AsExternal 192.168.20.0    10.0.0.88       2      1       0.0.0.0         587  0x80000013 0x1906
```

Routing between ISIS (SPB) and other IP routing protocols with many redundant boundaries

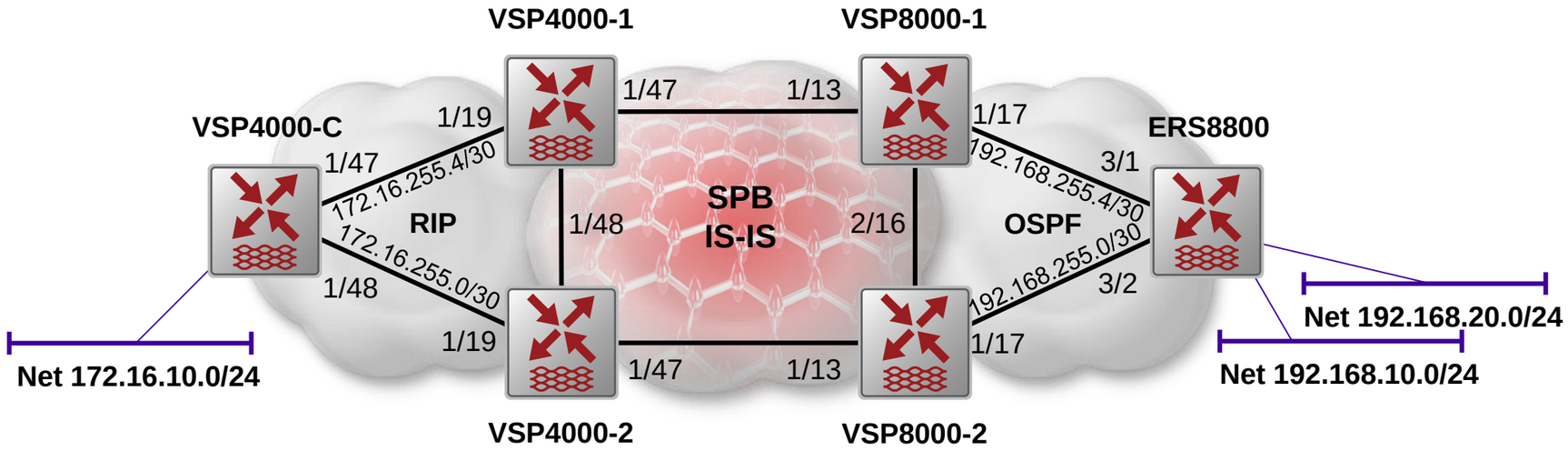
Leveraging IS-IS Accept policies + IS-IS External routes

Routing between ISIS (SPB) and other protocols with many boundaries



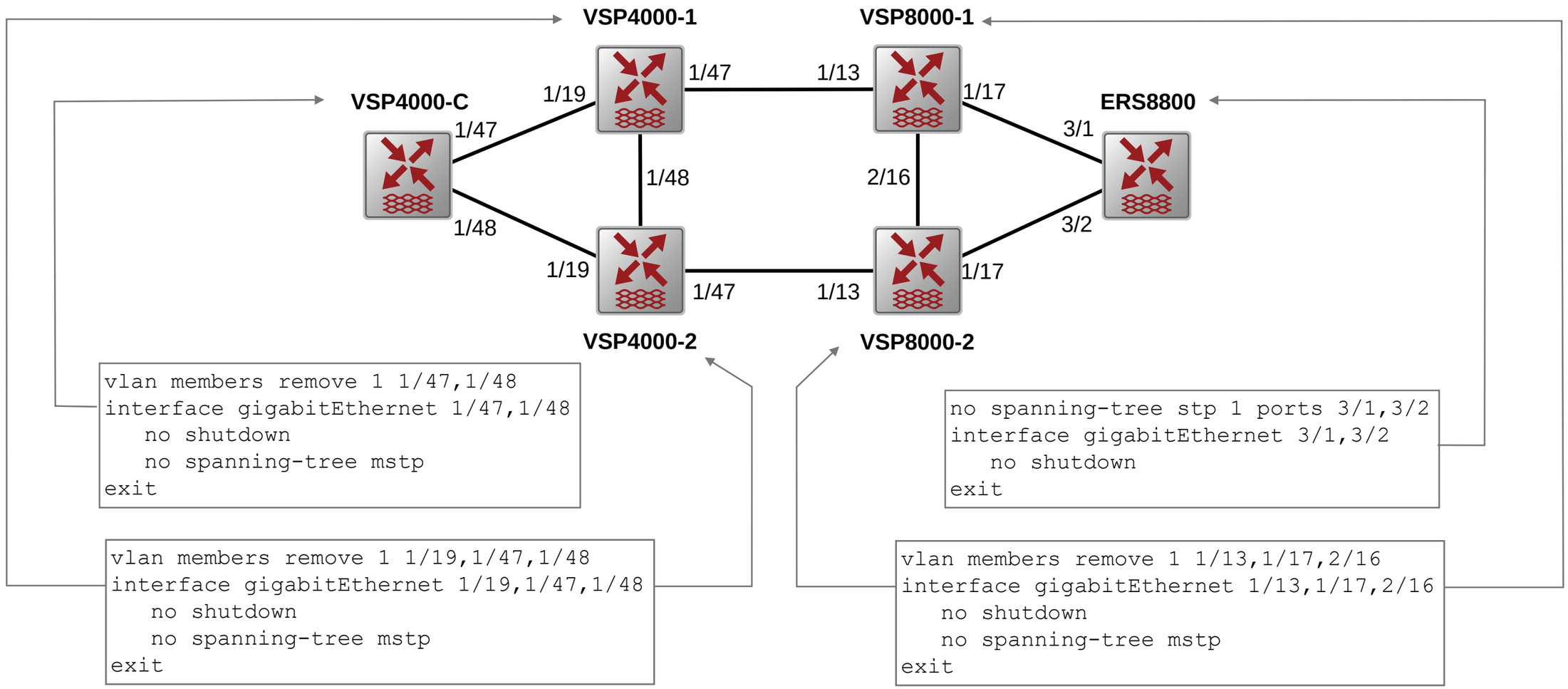
- We now have an SPB ISIS Core and a number (>1) of satellite networks running a different IP routing protocol
- GOAL = IP route across all the clouds
  - OSPF, RIP or BGP routes from all the satellite clouds are redistributed into ISIS
  - SPB (ISIS) Fabric IP routes are redistributed in the opposite direction
  - IP routes from one satellite cloud need to be redistributed into the other satellite clouds
  - Two border routers are used for redundancy on each boundary, and both can forward traffic at the same time
- CHALLENGE = not to get into routing loops where the IP routes redistributed by one router in one direction end up being re-redistributed to the same cloud where they came from by the other router on the same boundary
- These slides will use an OSPF Cloud on one side and a RIP one on the other; the same config and principles will equally work for BGP

Setup, Equipment & Software used

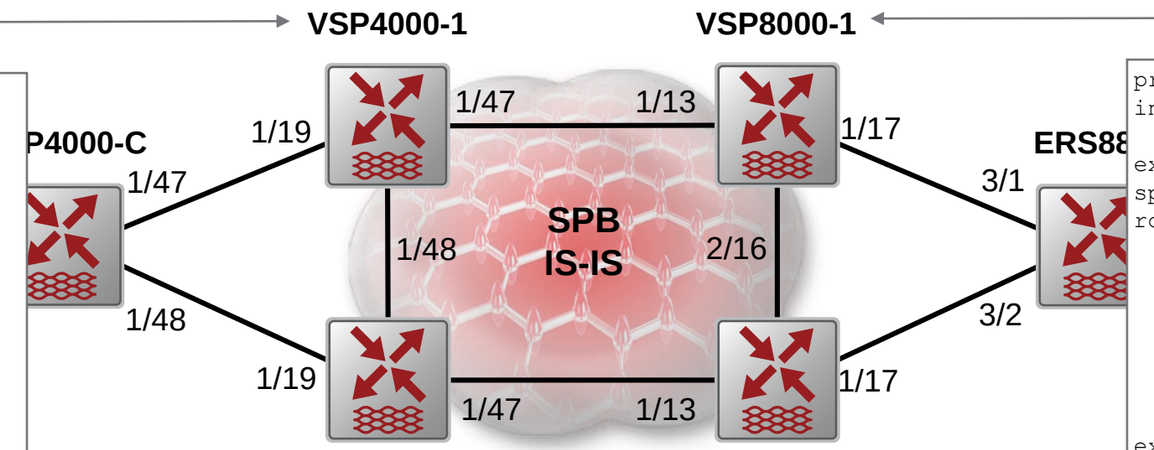


- VSP4000-C
  - VSP 4850GTS / 6.1.0.0_B021
- VSP4000-1, VSP4000-2
  - VSP 4850GTS-PWR+ / 6.1.0.0_B021
- ERS8800
  - 7.2.25.0GA
- VSP8000-1
  - VSP 8404 / 6.1.0.0_B021
    - Slot1 8424GT
    - Slot2 8418XSQ
- VSP8000-2
  - VSP 8242XSQ / 6.1.0.0_B021

Port Config



SPB Global Config



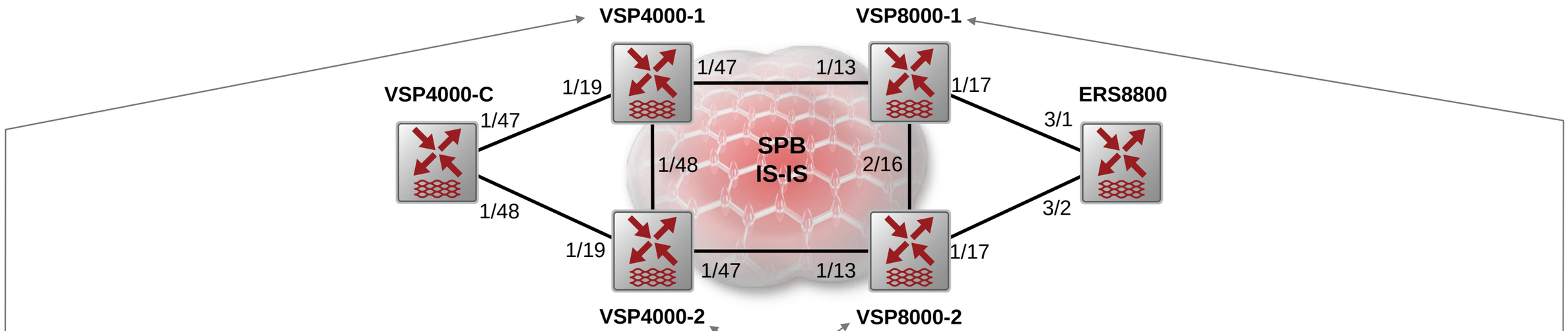

```
prompt VSP4000-1
interface loopback 1
   ip address 10.0.0.41/32
exit
spbm
router isis
   system-id 00bb.0000.4100
   manual-area 49.0000
   ip-source-address 10.0.0.41
   spbm 1
   spbm 1 nick-name 0.00.41
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 41
cfm spbm enable
```

```
prompt VSP4000-2
interface loopback 1
   ip address 10.0.0.42/32
exit
spbm
router isis
   system-id 00bb.0000.4200
   manual-area 49.0000
   ip-source-address 10.0.0.42
   spbm 1
   spbm 1 nick-name 0.00.42
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 42
cfm spbm enable
```

```
prompt VSP8000-1
interface loopback 1
   ip address 10.0.0.81/32
exit
spbm
router isis
   system-id 00bb.0000.8100
   manual-area 49.0000
   ip-source-address 10.0.0.81
   spbm 1
   spbm 1 nick-name 0.00.81
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 81
cfm spbm enable
```

```
prompt VSP8000-2
interface loopback 1
   ip address 10.0.0.82/32
exit
spbm
router isis
   system-id 00bb.0000.8200
   manual-area 49.0000
   ip-source-address 10.0.0.82
   spbm 1
   spbm 1 nick-name 0.00.82
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 82
cfm spbm enable
```

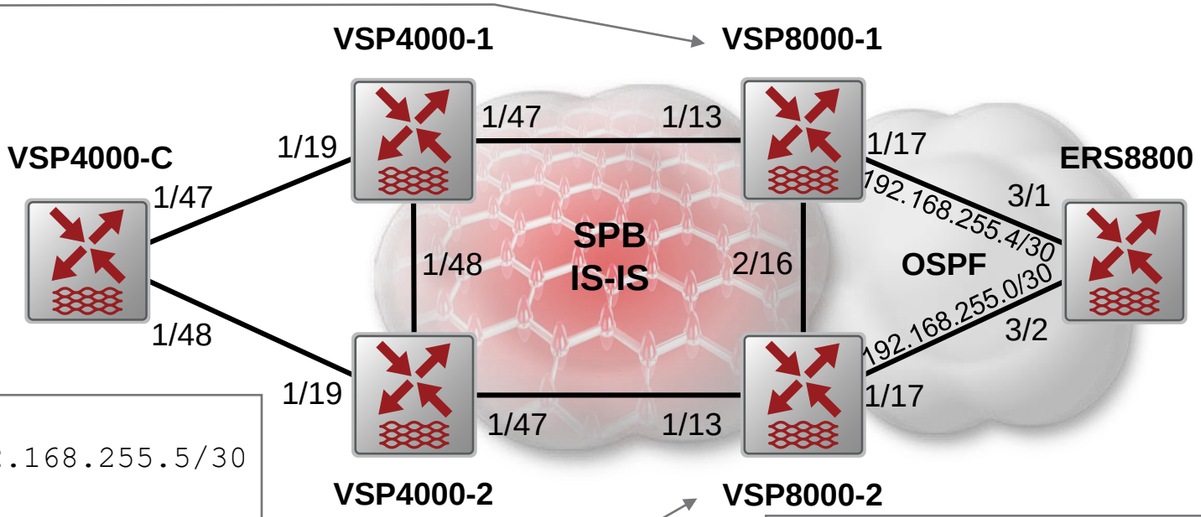
SPB Interface Config




```
interface GigabitEthernet 1/47,1/48
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

```
interface GigabitEthernet 1/13,2/16
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

OSPF Config

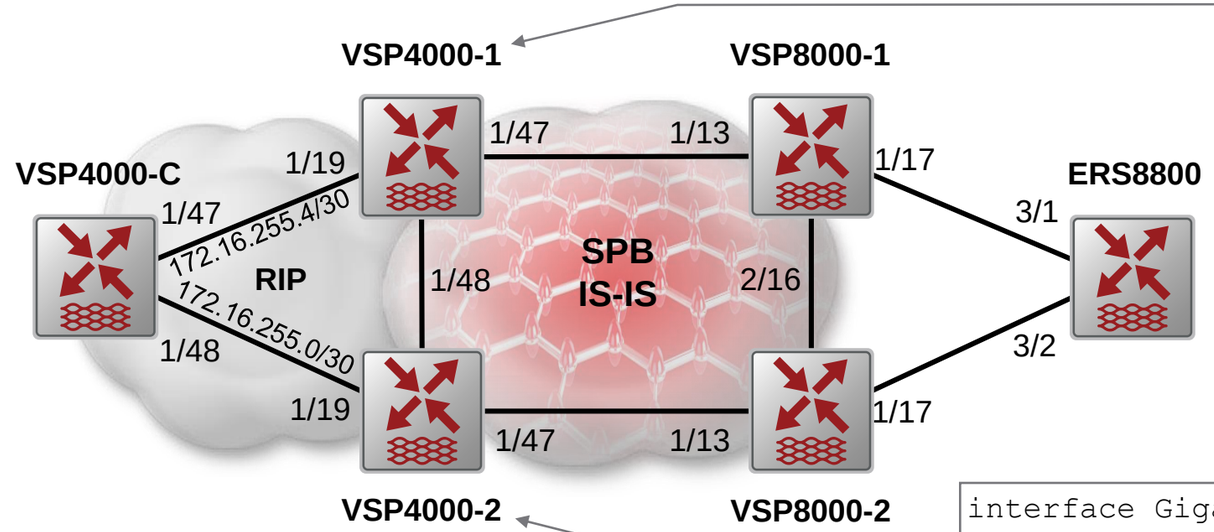



```
interface GigabitEthernet 1/17
   brouter vlan 3902 subnet 192.168.255.5/30
   ip ospf enable
exit
router ospf
   router-id 10.0.0.81
exit
router ospf enable
```

```
interface GigabitEthernet 1/17
   brouter vlan 3901 subnet 192.168.255.1/30
   ip ospf enable
exit
router ospf
   router-id 10.0.0.82
exit
router ospf enable
```

```
prompt ERS8800
interface GigabitEthernet 3/1,3/2
   brouter port 3/1 vlan 3902 subnet 192.168.255.6/30
   brouter port 3/2 vlan 3901 subnet 192.168.255.2/30
   ip ospf enable
exit
interface loopback 1
   ip address 10.0.0.88/32
   ip ospf
exit
router ospf
   router-id 10.0.0.88
exit
router ospf enable
```

RIP Config

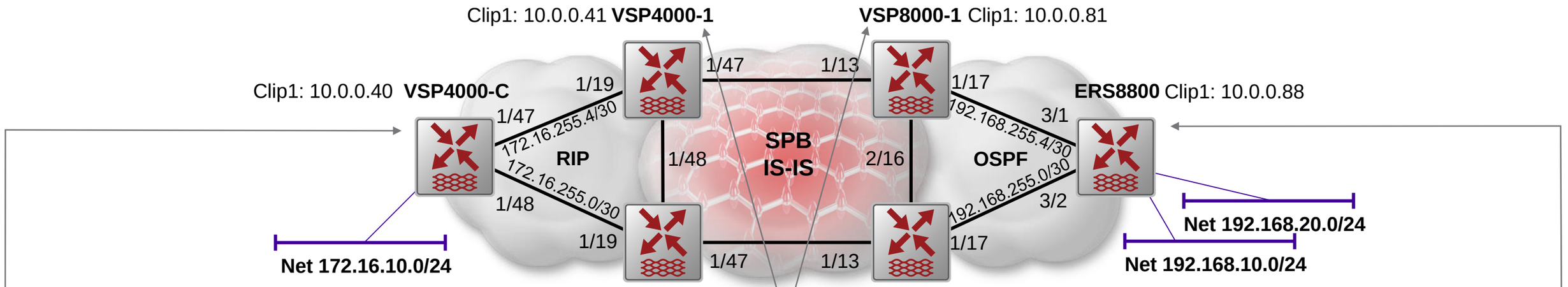



```
prompt VSP4000-C
interface GigabitEthernet 1/47,1/48
   brouter port 1/47 vlan 3902 subnet 172.16.255.6/30
   brouter port 1/48 vlan 3901 subnet 172.16.255.2/30
   ip rip enable
   ip rip receive version rip2
   ip rip send version rip2
exit
router rip enable
```

```
interface GigabitEthernet 1/19
   brouter vlan 3902 subnet 172.16.255.5/30
   ip rip enable
   ip rip receive version rip2
   ip rip send version rip2
exit
router rip enable
```

```
interface GigabitEthernet 1/19
   brouter vlan 3901 subnet 172.16.255.1/30
   ip rip enable
   ip rip receive version rip2
   ip rip send version rip2
exit
router rip enable
```

Test networks config using CLIPs



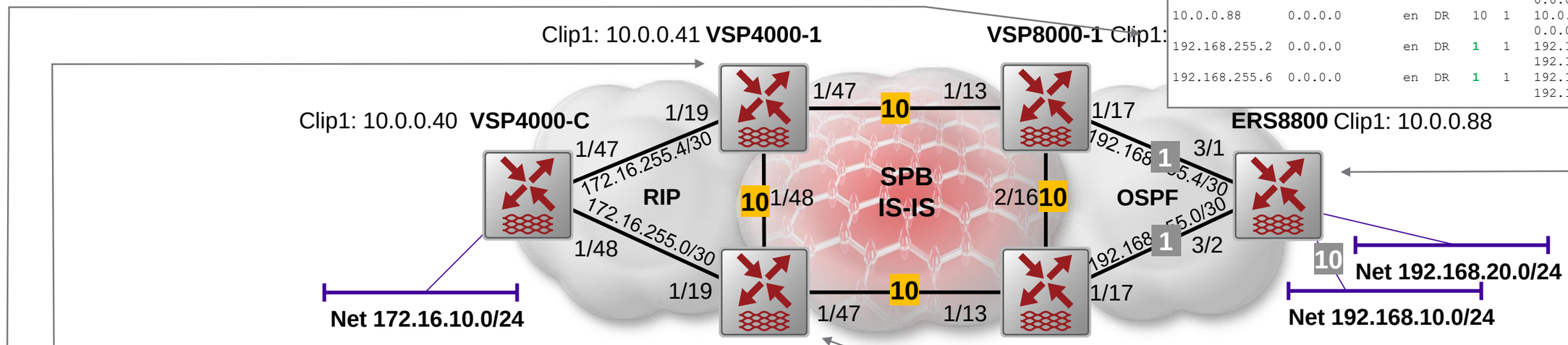

```
interface loopback 1
   ip address 10.0.0.40/32
exit
interface loopback 2
   ip address 172.16.10.1/24
exit
router rip
   redistribute direct
   redistribute direct enable
exit
ip rip apply redistribute direct
```

```
router isis
   redistribute direct
   redistribute direct enable
exit
isis apply redistribute direct
```

```
interface loopback 2
   ip address 192.168.10.1/24
   ip ospf
exit
interface loopback 3
   ip address 192.168.20.1/24
exit
router ospf
   as-boundary-router enable
   redistribute direct
   redistribute direct enable
exit
ip ospf apply redistribute direct
```

- Net 192.168.10.0/24 will be an OSPF intra-area route
- Net 192.168.20.0/24 will be an OSPF AS external route
- We also redistribute directs on the VSP8000 border routers since this will typically be the case anyway

ISIS and OSPF link metrics




```
ERS8800:5#% show ip ospf interface
================================================================================
                        OSPF Interface - GlobalRouter
================================================================================
INTERFACE       AREA           ADM IFST MET PRI DR/             TYPE AUTH      MTU
                ID                              BDR                  TYPE      IGNO
--------------------------------------------------------------------------------
192.168.10.1    0.0.0.0        en  DR   10  1   192.168.10.1    pass none      dis
                                                0.0.0.0
10.0.0.88       0.0.0.0        en  DR   10  1   10.0.0.88       pass none      dis
                                                0.0.0.0
192.168.255.2   0.0.0.0        en  DR   1   1   192.168.255.2   brdc none      dis
                                                192.168.255.1
192.168.255.6   0.0.0.0        en  DR   1   1   192.168.255.6   brdc none      dis
                                                192.168.255.5
```

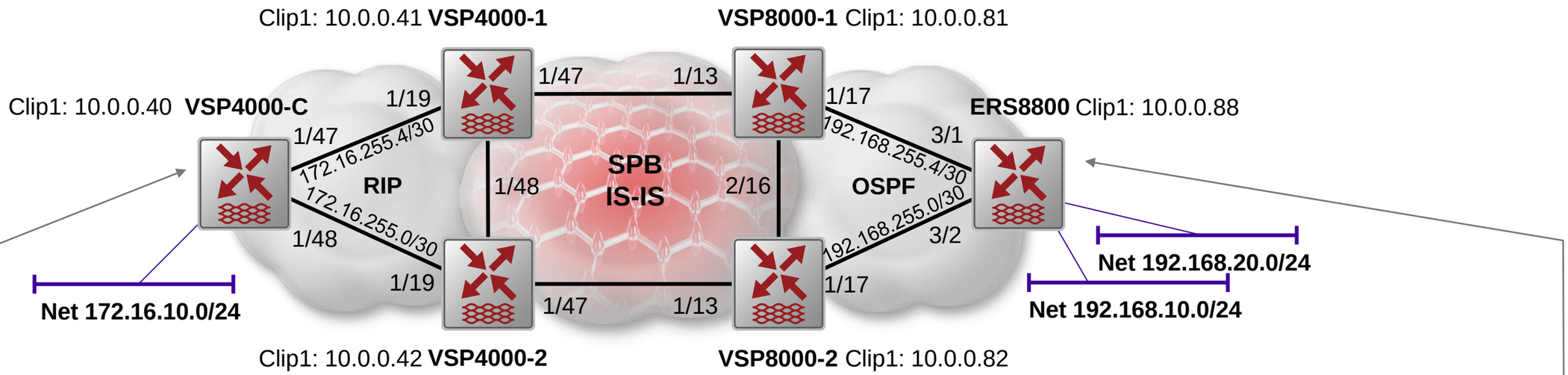
```
VSP4000-1:1#% show isis interface
================================================================================
                              ISIS Interfaces
================================================================================
IFIDX           TYPE    LEVEL     OP-STATE  ADM-STATE  ADJ    UP-ADJ  SPBM-L1-METRIC
--------------------------------------------------------------------------------
Port1/47        pt-pt   Level 1   UP        UP         1      1       10
Port1/48        pt-pt   Level 1   UP        UP         1      1       10
```

```
VSP8000-2:1#% show isis interface
================================================================================
                              ISIS Interfaces
================================================================================
IFIDX           TYPE    LEVEL     OP-STATE  ADM-STATE  ADJ    UP-ADJ  SPBM-L1-METRIC
--------------------------------------------------------------------------------
Port1/13        pt-pt   Level 1   UP        UP         1      1       10
Port2/16        pt-pt   Level 1   UP        UP         1      1       10

VSP8000-2:1#% show ip ospf interface
================================================================================
                        OSPF Interface - GlobalRouter
================================================================================
INTERFACE       AREA           ADM IFST MET PRI DR/             TYPE AUTH      MTU
                ID                              BDR                  TYPE      IGNO
--------------------------------------------------------------------------------
192.168.255.1   0.0.0.0        en  BDR  1   1   192.168.255.2   brdc none      dis
                                                192.168.255.1
```

```
VSP8000-1:1#% show isis interface
================================================================================
                              ISIS Interfaces
================================================================================
IFIDX           TYPE    LEVEL     OP-STATE  ADM-STATE  ADJ    UP-ADJ  SPBM-L1-METRIC
--------------------------------------------------------------------------------
Port1/13        pt-pt   Level 1   UP        UP         1      1       10
Port2/16        pt-pt   Level 1   UP        UP         1      1       10

VSP8000-1:1#% show ip ospf interface
================================================================================
                        OSPF Interface - GlobalRouter
================================================================================
INTERFACE       AREA           ADM IFST MET PRI DR/             TYPE AUTH      MTU
                ID                              BDR                  TYPE      IGNO
--------------------------------------------------------------------------------
192.168.255.5   0.0.0.0        en  BDR  1   1   192.168.255.6   brdc none      dis
                                                192.168.255.5
```

SIS NNI links use default SPBM L1-metric of 10
OSPF interface metrics at default 1 (for Gig Ethernet) and 10 for CLIPs
RIP is hop based, it has no link metrics

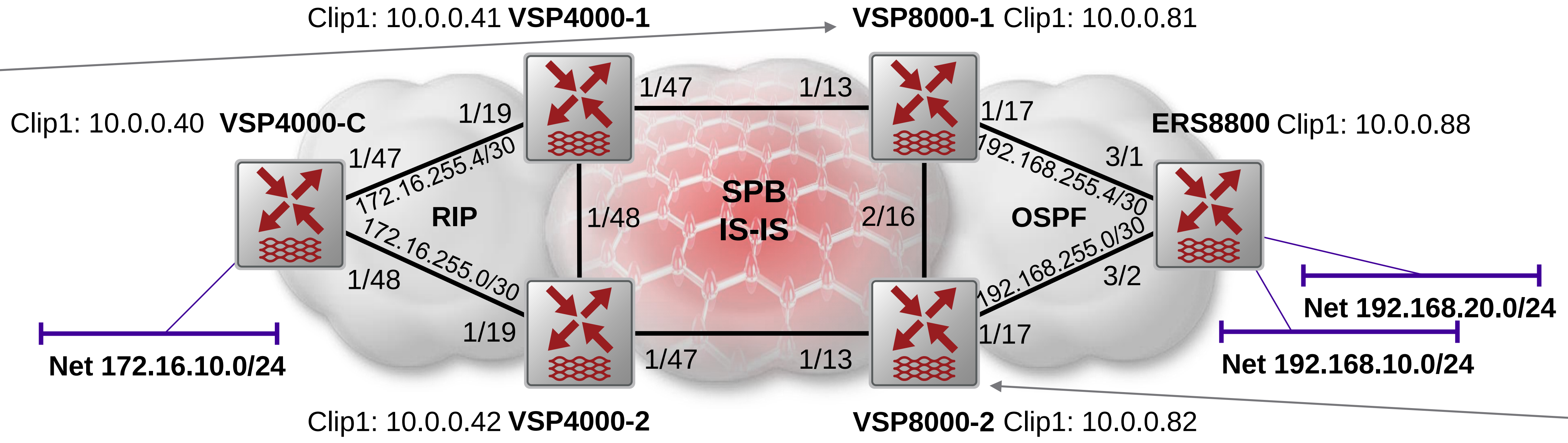
IP routes before ISIS ⇔ OSPF redistribution




```
VSP4000-C:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                NH                  INTER
DST             MASK            NEXT            VRF/ISID      COST  FACE     PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 10.0.0.40       -             1     0        LOC  0   DB   0
172.16.10.0     255.255.255.0   172.16.10.1     -             1     0        LOC  0   DB   0
172.16.255.0    255.255.255.252 172.16.255.2    -             1     1/48     LOC  0   DB   0
172.16.255.4    255.255.255.252 172.16.255.6    -             1     1/47     LOC  0   DB   0
```

```
ERS8800:5#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                NH                  INTER
DST             MASK            NEXT            VRF           COST  FACE     PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.88       255.255.255.255 10.0.0.88       -             1     0        LOC  0   DB   0
192.168.10.0    255.255.255.0   192.168.10.1    -             1     0        LOC  0   DB   0
192.168.20.0    255.255.255.0   192.168.20.1    -             1     0        LOC  0   DB   0
192.168.255.0   255.255.255.252 192.168.255.2   -             1     3/2      LOC  0   DB   0
192.168.255.4   255.255.255.252 192.168.255.6   -             1     3/1      LOC  0   DB   0
```

IP routes before ISIS ⇔ OSPF redistribution



VSP8000-1:1#% show ip route

IP Route - GlobalRouter

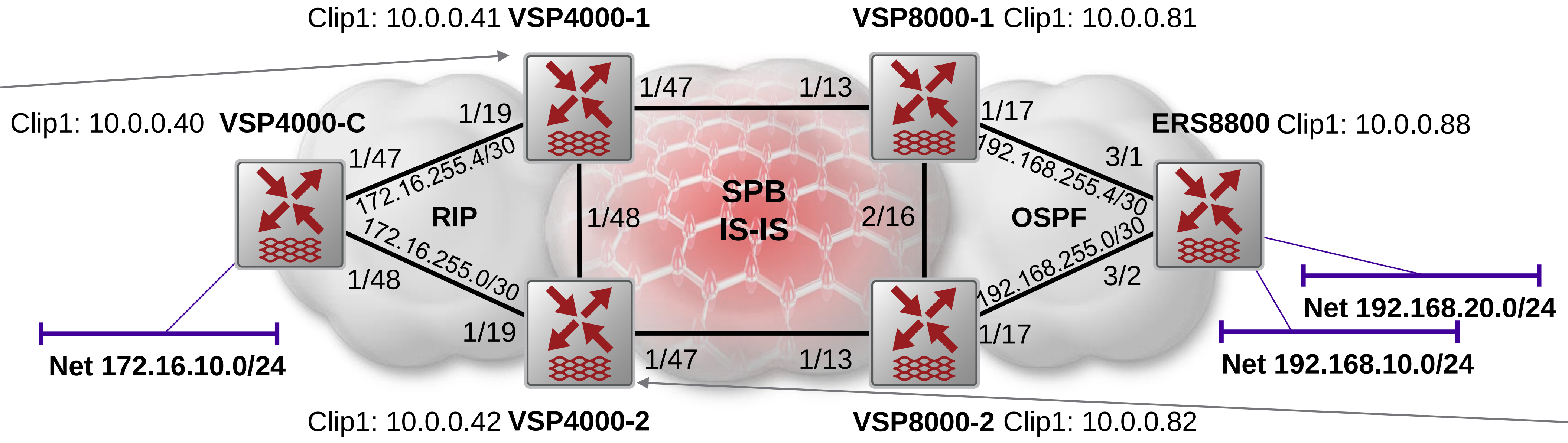
DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.41	255.255.255.255	VSP4000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.42	255.255.255.255	VSP4000-2	GlobalRouter	20	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	10.0.0.81	-	1	0	LOC	0	DB	0
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	255.255.255.255	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
172.16.255.0	255.255.255.252	VSP4000-2	GlobalRouter	20	4051	ISIS	0	IBS	7
172.16.255.4	255.255.255.252	VSP4000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.20.0	255.255.255.0	192.168.255.6	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.255.0	255.255.255.252	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.255.4	255.255.255.252	192.168.255.5	-	1	1/17	LOC	0	DB	0

VSP8000-2:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.41	255.255.255.255	VSP4000-1	GlobalRouter	20	4051	ISIS	0	IBS	7
10.0.0.42	255.255.255.255	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	10.0.0.82	-	1	0	LOC	0	DB	0
10.0.0.88	255.255.255.255	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
172.16.255.0	255.255.255.252	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
172.16.255.4	255.255.255.252	VSP4000-1	GlobalRouter	20	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.20.0	255.255.255.0	192.168.255.2	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.255.0	255.255.255.252	192.168.255.1	-	1	1/17	LOC	0	DB	0
192.168.255.4	255.255.255.252	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7

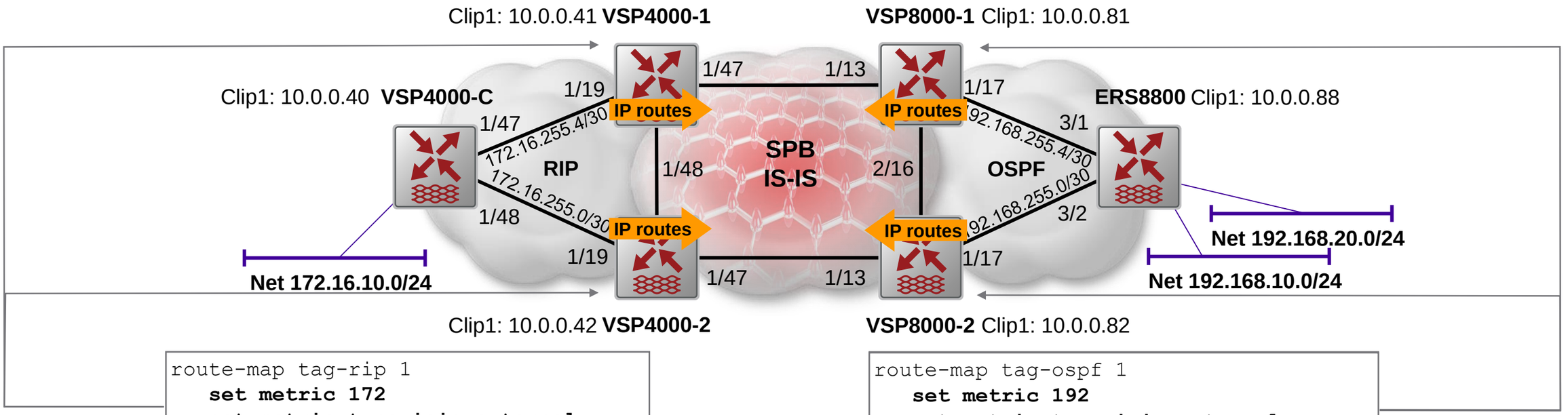
IP routes before ISIS ⬄ OSPF redistribution




```
VSP4000-1:1#% show ip route
=============================================================================================
                                IP Route - GlobalRouter
=============================================================================================
                                                  NH                     INTER
DST              MASK             NEXT             VRF/ISID        COST   FACE      PROT AGE TYPE PRF
---------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 172.16.255.6     GlobalRouter    2      1/19      RIP  3   IB   100
10.0.0.41        255.255.255.255 10.0.0.41        -               1      0         LOC  0   DB   0
10.0.0.42        255.255.255.255 VSP4000-2        GlobalRouter    10     4051      ISIS 0   IBS  7
10.0.0.81        255.255.255.255 VSP8000-1        GlobalRouter    10     4051      ISIS 0   IBS  7
10.0.0.82        255.255.255.255 VSP8000-2        GlobalRouter    20     4051      ISIS 0   IBS  7
172.16.10.0      255.255.255.0   172.16.255.6     GlobalRouter    2      1/19      RIP  3   IB   100
172.16.255.0     255.255.255.252 VSP4000-2        GlobalRouter    10     4051      ISIS 0   IBS  7
172.16.255.4     255.255.255.252 172.16.255.5     -               1      1/19      LOC  0   DB   0
192.168.255.0    255.255.255.252 VSP8000-2        GlobalRouter    20     4051      ISIS 0   IBS  7
192.168.255.4    255.255.255.252 VSP8000-1        GlobalRouter    10     4051      ISIS 0   IBS  7
```

```
VSP4000-2:1#% show ip route
=============================================================================================
                                IP Route - GlobalRouter
=============================================================================================
                                                  NH                     INTER
DST              MASK             NEXT             VRF/ISID        COST   FACE      PROT AGE TYPE PRF
---------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 172.16.255.2     GlobalRouter    2      1/19      RIP  9   IB   100
10.0.0.41        255.255.255.255 VSP4000-1        GlobalRouter    10     4051      ISIS 0   IBS  7
10.0.0.42        255.255.255.255 10.0.0.42        -               1      0         LOC  0   DB   0
10.0.0.81        255.255.255.255 VSP8000-1        GlobalRouter    20     4051      ISIS 0   IBS  7
10.0.0.82        255.255.255.255 VSP8000-2        GlobalRouter    10     4051      ISIS 0   IBS  7
172.16.10.0      255.255.255.0   172.16.255.2     GlobalRouter    2      1/19      RIP  9   IB   100
172.16.255.0     255.255.255.252 172.16.255.1     -               1      1/19      LOC  0   DB   0
172.16.255.4     255.255.255.252 VSP4000-1        GlobalRouter    10     4051      ISIS 0   IBS  7
192.168.255.0    255.255.255.252 VSP8000-2        GlobalRouter    10     4051      ISIS 0   IBS  7
192.168.255.4    255.255.255.252 VSP8000-1        GlobalRouter    20     4051      ISIS 0   IBS  7
```

RIP ➔ IS-IS ➔ OSPF Redistribution - Config

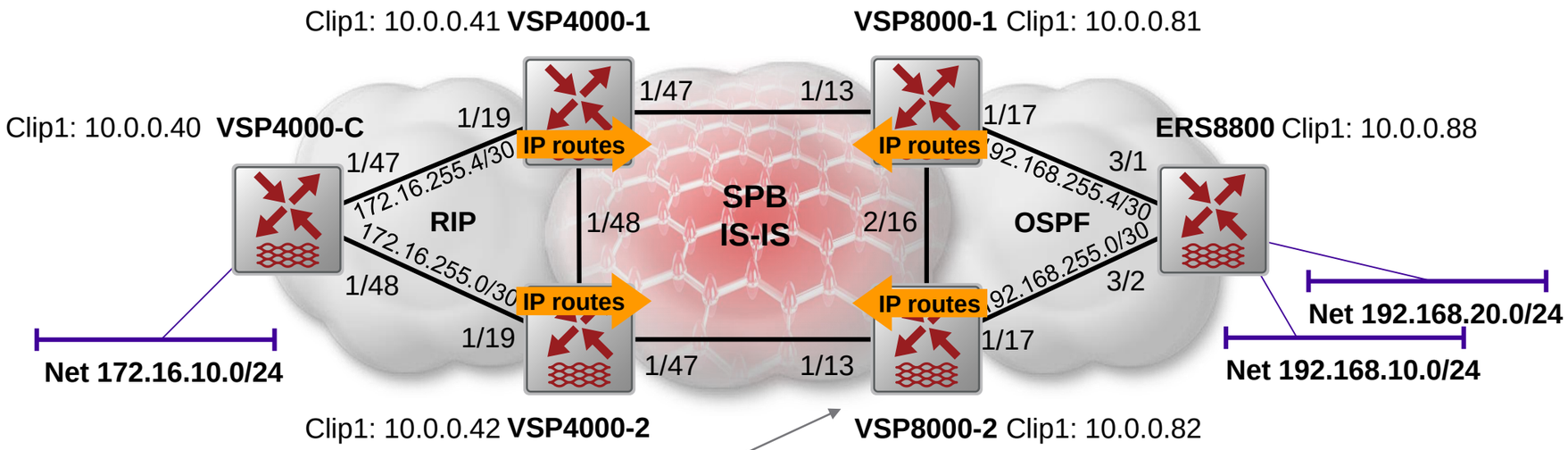



```
route-map tag-rip 1
   set metric 172
   set metric-type-isis external
   enable
exit
router isis
   redistribute rip
   redistribute rip route-map tag-rip
   redistribute rip enable
exit
isis apply redistribute rip
```

```
route-map tag-ospf 1
   set metric 192
   set metric-type-isis external
   enable
exit
router isis
   redistribute ospf
   redistribute ospf route-map tag-ospf
   redistribute ospf enable
exit
isis apply redistribute ospf
```

- We redistribute all RIP & OSPF routes into ISIS and make them of metric-type “External”
- We also set the metric value which will be associated with these routes in ISIS; we will use this to tag the routes

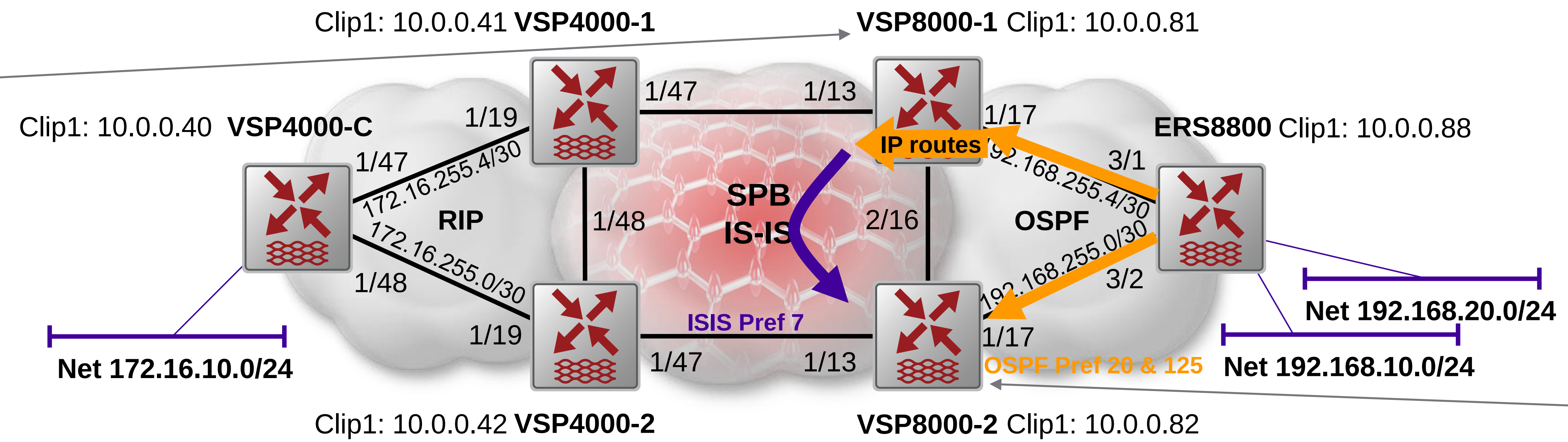
RIP ➔ IS-IS ➔ OSPF Redistribution - Checking



- Here we check the IP routes present in the ISIS LSDB
  - This command could have been executed on any VOSS switch which is part of the SPB Fabric
- We can see that the routes are External and have metrics set to 172 for RIP routes and 192 for OSPF routes
  - We shall be using the metric field as a numerical tag for these routes
  - The metric itself is unimportant in this use case, provided that both border nodes importing the same route set the same metric for it

```
VSP8000-2:1#% show isis lsdb ip-unicast
================================================================================
                          ISIS IP-UNICAST-ROUTE SUMMARY
================================================================================
                                PREFIX          METRIC    TLV   LSP   HOST
I-SID     ADDRESS               LENGTH  METRIC  TYPE      TYPE  FRAG  NAME
--------------------------------------------------------------------------------
-         10.0.0.41             32      1       Internal  135   0x3   VSP4000-1
-         172.16.255.4          30      1       Internal  135   0x3   VSP4000-1
-         10.0.0.40             32      172     External  135   0x3   VSP4000-1
-         172.16.10.0           24      172     External  135   0x3   VSP4000-1
-         10.0.0.42             32      1       Internal  135   0x3   VSP4000-2
-         172.16.255.0          30      1       Internal  135   0x3   VSP4000-2
-         10.0.0.81             32      1       Internal  135   0x2   VSP8000-1
-         192.168.255.4         30      1       Internal  135   0x2   VSP8000-1
-         10.0.0.88             32      192     External  135   0x2   VSP8000-1
-         192.168.10.0          24      192     External  135   0x2   VSP8000-1
-         192.168.20.0          24      192     External  135   0x2   VSP8000-1
-         10.0.0.82             32      1       Internal  135   0x2   VSP8000-2
-         192.168.255.0         30      1       Internal  135   0x2   VSP8000-2
```

IS-IS 🡐 OSPF Redistribution - Checking



VSP8000-1:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000-1	GlobalRouter	172	4051	ISIS	0	IBS	7
10.0.0.41	255.255.255.255	VSP4000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.42	255.255.255.255	VSP4000-2	GlobalRouter	20	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	10.0.0.81	-	1	0	LOC	0	DB	0
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	255.255.255.255	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
172.16.10.0	255.255.255.0	VSP4000-1	GlobalRouter	172	4051	ISIS	0	IBS	7
172.16.255.0	255.255.255.252	VSP4000-2	GlobalRouter	20	4051	ISIS	0	IBS	7
172.16.255.4	255.255.255.252	VSP4000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	192.168.255.6	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.20.0	255.255.255.0	192.168.255.6	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.255.0	255.255.255.252	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.255.4	255.255.255.252	192.168.255.5	-	1	1/17	LOC	0	DB	0

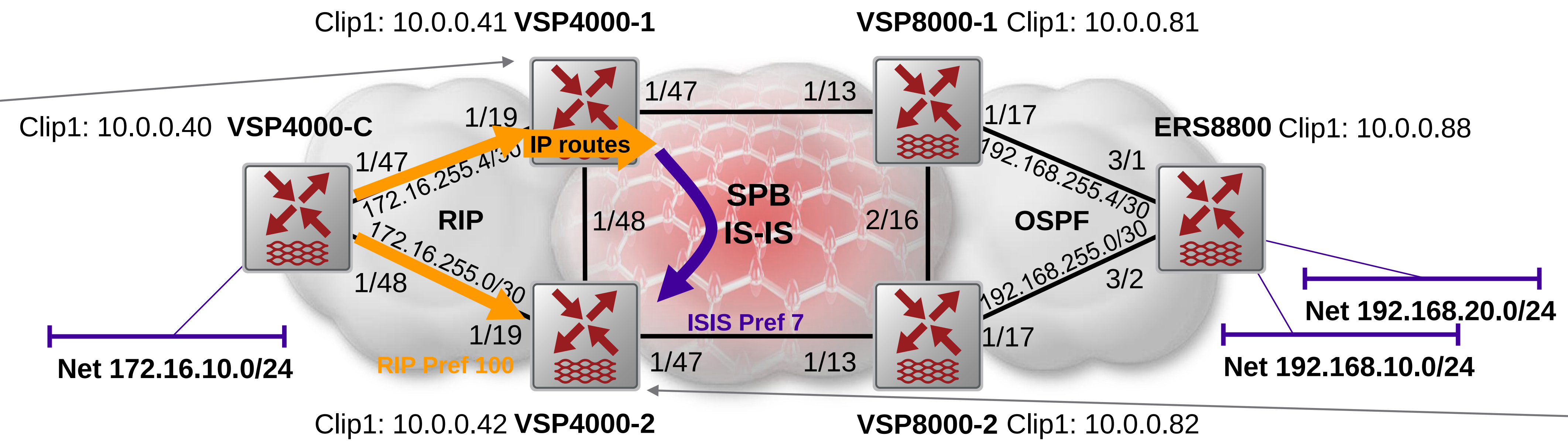
VSP8000-2:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000-1	GlobalRouter	172	4051	ISIS	0	IBS	7
10.0.0.41	255.255.255.255	VSP4000-1	GlobalRouter	20	4051	ISIS	0	IBS	7
10.0.0.42	255.255.255.255	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	10.0.0.82	-	1	0	LOC	0	DB	0
10.0.0.88	255.255.255.255	VSP8000-1	GlobalRouter	192	4051	ISIS	0	IBS	7
172.16.10.0	255.255.255.0	VSP4000-1	GlobalRouter	172	4051	ISIS	0	IBS	7
172.16.255.0	255.255.255.252	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
172.16.255.4	255.255.255.252	VSP4000-1	GlobalRouter	20	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	VSP8000-1	GlobalRouter	192	4051	ISIS	0	IBS	7
192.168.20.0	255.255.255.0	VSP8000-1	GlobalRouter	192	4051	ISIS	0	IBS	7
192.168.255.0	255.255.255.252	192.168.255.1	-	1	1/17	LOC	0	DB	0
192.168.255.4	255.255.255.252	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7

- This is the same problem we dealt with in the previous section

RIP ➔ IS-IS Redistribution - Checking

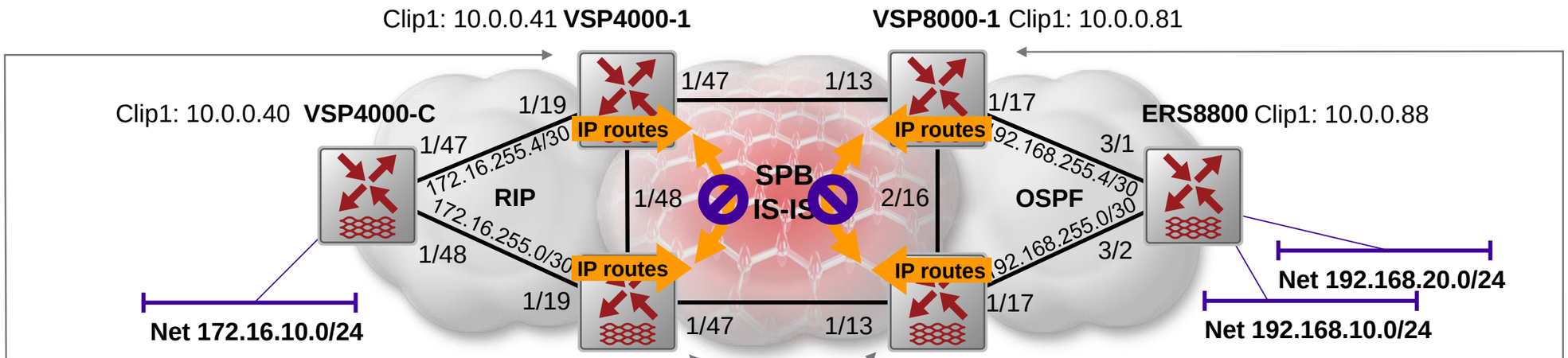



```
VSP4000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                          INTER
DST              MASK             NEXT             VRF/ISID         COST       FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  172.16.255.6     GlobalRouter     2          1/19      RIP   8    IB    100
10.0.0.41        255.255.255.255  10.0.0.41        -                1          0         LOC   0    DB    0
10.0.0.42        255.255.255.255  VSP4000-2        GlobalRouter     10         4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  VSP8000-1        GlobalRouter     10         4051      ISIS  0    IBS   7
10.0.0.82        255.255.255.255  VSP8000-2        GlobalRouter     20         4051      ISIS  0    IBS   7
10.0.0.88        255.255.255.255  VSP8000-1        GlobalRouter     192        4051      ISIS  0    IBS   7
172.16.10.0      255.255.255.0    172.16.255.6     GlobalRouter     2          1/19      RIP   8    IB    100
172.16.255.0     255.255.255.252  VSP4000-2        GlobalRouter     10         4051      ISIS  0    IBS   7
172.16.255.4     255.255.255.252  172.16.255.5     -                1          1/19      LOC   0    DB    0
192.168.10.0     255.255.255.0    VSP8000-1        GlobalRouter     192        4051      ISIS  0    IBS   7
192.168.20.0     255.255.255.0    VSP8000-1        GlobalRouter     192        4051      ISIS  0    IBS   7
192.168.255.0    255.255.255.252  VSP8000-2        GlobalRouter     20         4051      ISIS  0    IBS   7
192.168.255.4    255.255.255.252  VSP8000-1        GlobalRouter     10         4051      ISIS  0    IBS   7
```

```
VSP4000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                          INTER
DST              MASK             NEXT             VRF/ISID         COST       FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  VSP4000-1        GlobalRouter     172        4051      ISIS  0    IBS   7
10.0.0.41        255.255.255.255  VSP4000-1        GlobalRouter     10         4051      ISIS  0    IBS   7
10.0.0.42        255.255.255.255  10.0.0.42        -                1          0         LOC   0    DB    0
10.0.0.81        255.255.255.255  VSP8000-1        GlobalRouter     20         4051      ISIS  0    IBS   7
10.0.0.82        255.255.255.255  VSP8000-2        GlobalRouter     10         4051      ISIS  0    IBS   7
10.0.0.88        255.255.255.255  VSP8000-1        GlobalRouter     192        4051      ISIS  0    IBS   7
172.16.10.0      255.255.255.0    VSP4000-1        GlobalRouter     172        4051      ISIS  0    IBS   7
172.16.255.0     255.255.255.252  172.16.255.1     -                1          1/19      LOC   0    DB    0
172.16.255.4     255.255.255.252  VSP4000-1        GlobalRouter     10         4051      ISIS  0    IBS   7
192.168.10.0     255.255.255.0    VSP8000-1        GlobalRouter     192        4051      ISIS  0    IBS   7
192.168.20.0     255.255.255.0    VSP8000-1        GlobalRouter     192        4051      ISIS  0    IBS   7
192.168.255.0    255.255.255.252  VSP8000-2        GlobalRouter     10         4051      ISIS  0    IBS   7
192.168.255.4    255.255.255.252  VSP8000-1        GlobalRouter     20         4051      ISIS  0    IBS   7
```

- This is the same problem we dealt with in the previous section

RIP ➔ IS-IS ➔ OSPF Redistribution - Fixing

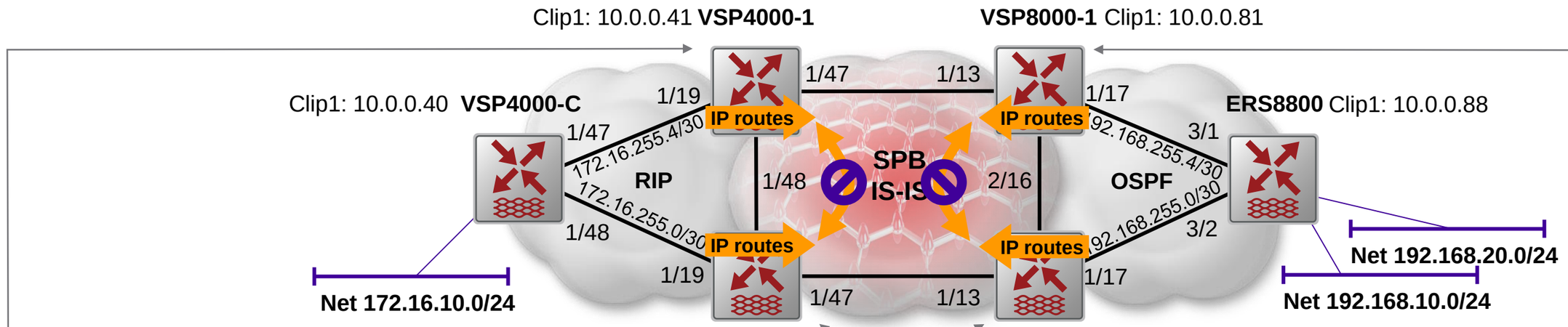



```
route-map "peer-tag-rip" 1
   match metric-type-isis external
   match metric 172
   set ip-preference 130
   enable
exit
router isis
   accept route-map "peer-tag-rip"
exit
isis apply accept
```

```
route-map "peer-tag-ospf" 1
   match metric-type-isis external
   match metric 192
   set ip-preference 130
   enable
exit
router isis
   accept route-map "peer-tag-ospf"
exit
isis apply accept
```

- This ISIS Accept policy ensures that a border router in charge of ISIS ➔➔ OSPF/RIP redistribution will only accept from his border peer ISIS “External” routes with a modified preference of 130 (instead of SPB’s default preference 7)
  - OSPF routes have preference levels ranging between 20, 25,120 or 125 (depending on OSPF route type) and RIP always has preference 100
- Hence we are ensuring that a border router will never install ISIS External routes from its border peer as long as it has the original OSPF/RIP routes
- NOTE that the same configuration would equally work if 3 or more border routers were used on a given boundary

RIP ➔ IS-IS ➔ OSPF Redistribution – Checking accept policy




```
VSP4000-1:1#% show ip isis accept
================================================================================
                        Isis Accept - GlobalRouter
================================================================================
ADV_RTR  I-SID    ISID-LIST                       ENABLE POLICY       BACKBONE
                                                                      POLICY
--------------------------------------------------------------------------------
-        -        -                               -      peer-tag-rip
```

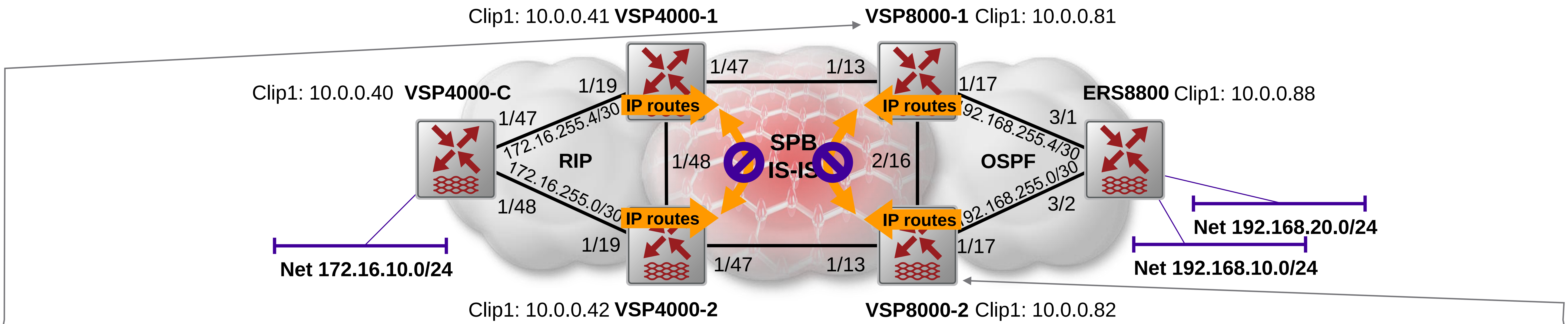
```
VSP4000-2:1#% show ip isis accept
================================================================================
                        Isis Accept - GlobalRouter
================================================================================
ADV_RTR  I-SID    ISID-LIST                       ENABLE POLICY       BACKBONE
                                                                      POLICY
--------------------------------------------------------------------------------
-        -        -                               -      peer-tag-rip
```

```
VSP8000-1:1#% show ip isis accept
================================================================================
                        Isis Accept - GlobalRouter
================================================================================
ADV_RTR  I-SID    ISID-LIST                       ENABLE POLICY       BACKBONE
                                                                      POLICY
--------------------------------------------------------------------------------
-        -        -                               -      peer-tag-ospf
```

```
VSP8000-2:1#% show ip isis accept
================================================================================
                        Isis Accept - GlobalRouter
================================================================================
ADV_RTR  I-SID    ISID-LIST                       ENABLE POLICY       BACKBONE
                                                                      POLICY
--------------------------------------------------------------------------------
-        -        -                               -      peer-tag-ospf
```

- What the default accept policy looks like, with a route-map assigned; no need to enable it

IS-IS 🡐 OSPF Redistribution – Checking again

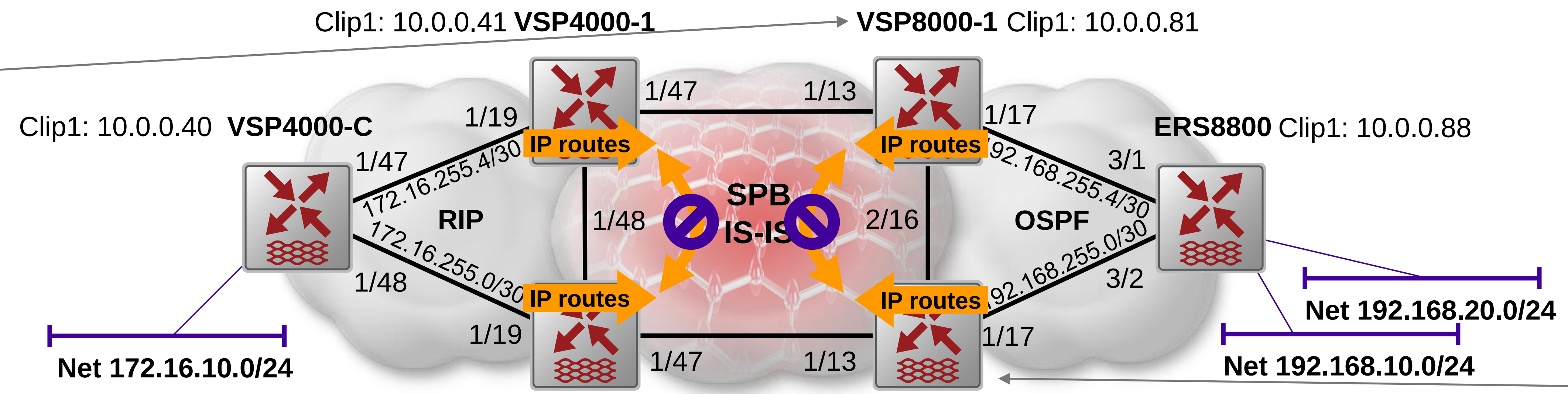



```
VSP8000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                          INTER
DST              MASK             NEXT             VRF/ISID           COST     FACE     PROT  AGE  TYPE  PRF
--------------------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  VSP4000-1        GlobalRouter       172      4051     ISIS  0    IBS   7
10.0.0.41        255.255.255.255  VSP4000-1        GlobalRouter       10       4051     ISIS  0    IBS   7
10.0.0.42        255.255.255.255  VSP4000-2        GlobalRouter       20       4051     ISIS  0    IBS   7
10.0.0.81        255.255.255.255  10.0.0.81        -                  1        0        LOC   0    DB    0
10.0.0.82        255.255.255.255  VSP8000-2        GlobalRouter       10       4051     ISIS  0    IBS   7
10.0.0.88        255.255.255.255  192.168.255.6    GlobalRouter       11       1/17     OSPF  0    IB    20
172.16.10.0      255.255.255.0    VSP4000-1        GlobalRouter       172      4051     ISIS  0    IBS   7
172.16.255.0     255.255.255.252  VSP4000-2        GlobalRouter       20       4051     ISIS  0    IBS   7
172.16.255.4     255.255.255.252  VSP4000-1        GlobalRouter       10       4051     ISIS  0    IBS   7
192.168.10.0     255.255.255.0    192.168.255.6    GlobalRouter       11       1/17     OSPF  0    IB    20
192.168.20.0     255.255.255.0    192.168.255.6    GlobalRouter       1        1/17     OSPF  0    IB    125
192.168.255.0    255.255.255.252  VSP8000-2        GlobalRouter       10       4051     ISIS  0    IBS   7
192.168.255.4    255.255.255.252  192.168.255.5    -                  1        1/17     LOC   0    DB    0
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                          INTER
DST              MASK             NEXT             VRF/ISID           COST     FACE     PROT  AGE  TYPE  PRF
--------------------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  VSP4000-1        GlobalRouter       172      4051     ISIS  0    IBS   7
10.0.0.41        255.255.255.255  VSP4000-1        GlobalRouter       20       4051     ISIS  0    IBS   7
10.0.0.42        255.255.255.255  VSP4000-2        GlobalRouter       10       4051     ISIS  0    IBS   7
10.0.0.81        255.255.255.255  VSP8000-1        GlobalRouter       10       4051     ISIS  0    IBS   7
10.0.0.82        255.255.255.255  10.0.0.82        -                  1        0        LOC   0    DB    0
10.0.0.88        255.255.255.255  192.168.255.2    GlobalRouter       11       1/17     OSPF  0    IB    20
172.16.10.0      255.255.255.0    VSP4000-1        GlobalRouter       172      4051     ISIS  0    IBS   7
172.16.255.0     255.255.255.252  VSP4000-2        GlobalRouter       10       4051     ISIS  0    IBS   7
172.16.255.4     255.255.255.252  VSP4000-1        GlobalRouter       20       4051     ISIS  0    IBS   7
192.168.10.0     255.255.255.0    192.168.255.2    GlobalRouter       11       1/17     OSPF  0    IB    20
192.168.20.0     255.255.255.0    192.168.255.2    GlobalRouter       1        1/17     OSPF  0    IB    125
192.168.255.0    255.255.255.252  192.168.255.1    -                  1        1/17     LOC   0    DB    0
192.168.255.4    255.255.255.252  VSP8000-1        GlobalRouter       10       4051     ISIS  0    IBS   7
```

- Looking good now for both VSP8000 border routers
- Note that we have both VSP4000s announcing the same ISIS External routes (for RIP) with the same prefix-cost, which means on the VSP8000s the system-id is used as a tie breaker and hence the next hop is always VSP4000-1 (in orange); we could enable IP ECMP

IS-IS ← OSPF Redistribution – Checking accepted ISIS External routes

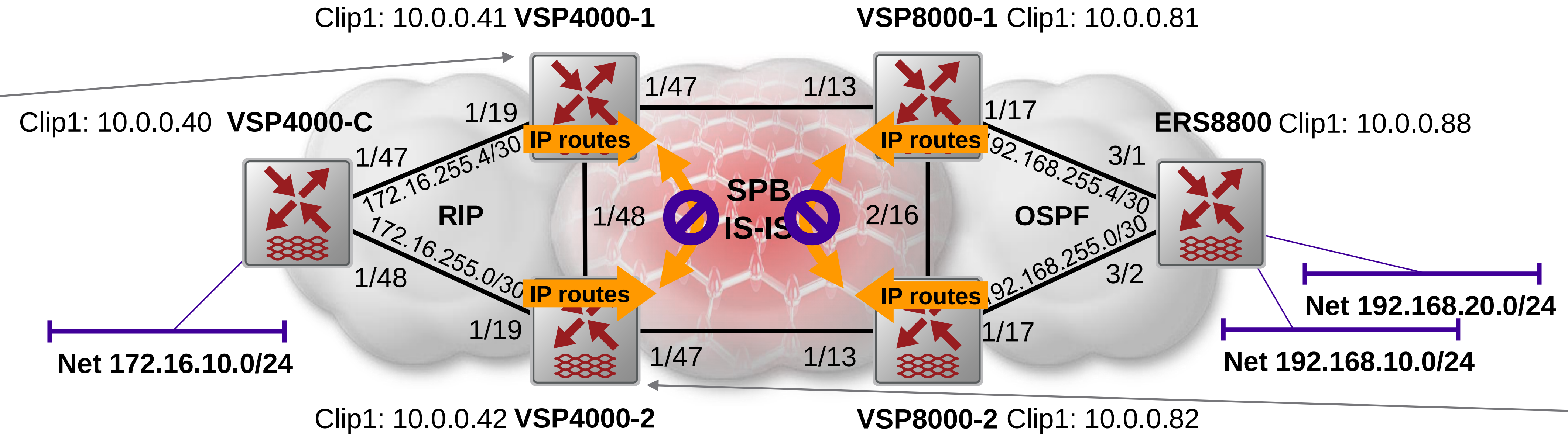



```
VSP8000-1:1#% show ip route alternative
==========================================================================================
                                  IP Route - GlobalRouter
==========================================================================================
                                                  NH                       INTER
DST              MASK            NEXT             VRF/ISID         COST    FACE     PROT AGE TYPE PRF
------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 VSP4000-1        GlobalRouter     172     4051     ISIS 0   IBS  7
10.0.0.41        255.255.255.255 VSP4000-1        GlobalRouter     10      4051     ISIS 0   IBS  7
10.0.0.42        255.255.255.255 VSP4000-2        GlobalRouter     20      4051     ISIS 0   IBS  7
10.0.0.81        255.255.255.255 10.0.0.81        -                1       0        LOC  0   DB   0
10.0.0.82        255.255.255.255 VSP8000-2        GlobalRouter     10      4051     ISIS 0   IBS  7
10.0.0.88        255.255.255.255 192.168.255.6    GlobalRouter     11      1/17     OSPF 0   IB   20
10.0.0.88        255.255.255.255 VSP8000-2        GlobalRouter     192     4051     ISIS 0   IAS  130
172.16.10.0      255.255.255.0   VSP4000-1        GlobalRouter     172     4051     ISIS 0   IBS  7
172.16.255.0     255.255.255.252 VSP4000-2        GlobalRouter     20      4051     ISIS 0   IBS  7
172.16.255.4     255.255.255.252 VSP4000-1        GlobalRouter     10      4051     ISIS 0   IBS  7
192.168.10.0     255.255.255.0   192.168.255.6    GlobalRouter     11      1/17     OSPF 0   IB   20
192.168.10.0     255.255.255.0   VSP8000-2        GlobalRouter     192     4051     ISIS 0   IAS  130
192.168.20.0     255.255.255.0   192.168.255.6    GlobalRouter     1       1/17     OSPF 0   IB   125
192.168.20.0     255.255.255.0   VSP8000-2        GlobalRouter     192     4051     ISIS 0   IAS  130
192.168.255.0    255.255.255.252 VSP8000-2        GlobalRouter     10      4051     ISIS 0   IBS  7
192.168.255.0    255.255.255.252 192.168.255.6    GlobalRouter     2       1/17     OSPF 0   IA   20
192.168.255.4    255.255.255.252 192.168.255.5    -                1       1/17     LOC  0   DB   0
```

```
VSP8000-2:1#% show ip route alternative
==========================================================================================
                                  IP Route - GlobalRouter
==========================================================================================
                                                  NH                       INTER
DST              MASK            NEXT             VRF/ISID         COST    FACE     PROT AGE TYPE PRF
------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 VSP4000-1        GlobalRouter     172     4051     ISIS 0   IBS  7
10.0.0.41        255.255.255.255 VSP4000-1        GlobalRouter     20      4051     ISIS 0   IBS  7
10.0.0.42        255.255.255.255 VSP4000-2        GlobalRouter     10      4051     ISIS 0   IBS  7
10.0.0.81        255.255.255.255 VSP8000-1        GlobalRouter     10      4051     ISIS 0   IBS  7
10.0.0.82        255.255.255.255 10.0.0.82        -                1       0        LOC  0   DB   0
10.0.0.88        255.255.255.255 192.168.255.2    GlobalRouter     11      1/17     OSPF 0   IB   20
10.0.0.88        255.255.255.255 VSP8000-1        GlobalRouter     192     4051     ISIS 0   IAS  130
172.16.10.0      255.255.255.0   VSP4000-1        GlobalRouter     172     4051     ISIS 0   IBS  7
172.16.255.0     255.255.255.252 VSP4000-2        GlobalRouter     10      4051     ISIS 0   IBS  7
172.16.255.4     255.255.255.252 VSP4000-1        GlobalRouter     20      4051     ISIS 0   IBS  7
192.168.10.0     255.255.255.0   192.168.255.2    GlobalRouter     11      1/17     OSPF 0   IB   20
192.168.10.0     255.255.255.0   VSP8000-1        GlobalRouter     192     4051     ISIS 0   IAS  130
192.168.20.0     255.255.255.0   192.168.255.2    GlobalRouter     1       1/17     OSPF 0   IB   125
192.168.20.0     255.255.255.0   VSP8000-1        GlobalRouter     192     4051     ISIS 0   IAS  130
192.168.255.0    255.255.255.252 192.168.255.1    -                1       1/17     LOC  0   DB   0
192.168.255.4    255.255.255.252 VSP8000-1        GlobalRouter     10      4051     ISIS 0   IBS  7
192.168.255.4    255.255.255.252 192.168.255.2    GlobalRouter     2       1/17     OSPF 0   IA   20
```

- Here we see that the border VSP8000s learn from each other the already redistributed OSPF routes as ISIS External routes, but our Accept policy ensures they get a preference of 130 (in orange) which ensures that these will not displace the preferred OSPF route (in green) and remain thus as alternative routes

RIP ➔ IS-IS Redistribution – Checking again

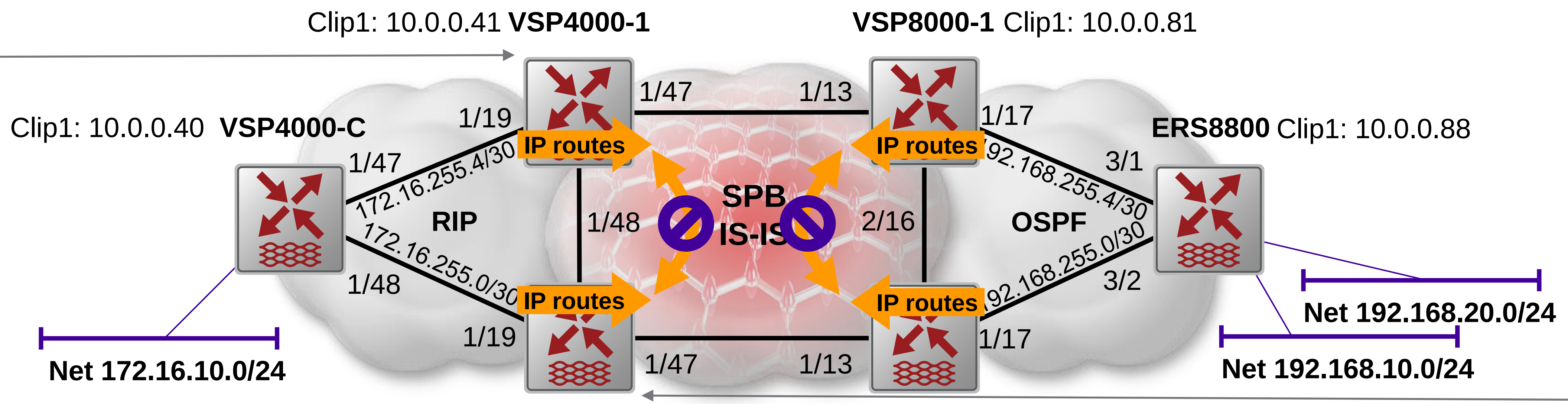



```
VSP4000-1:1#% show ip route
==========================================================================================
                                 IP Route - GlobalRouter
==========================================================================================
                                                   NH              INTER
DST            MASK            NEXT               VRF/ISID       COST  FACE      PROT AGE TYPE PRF
------------------------------------------------------------------------------------------
10.0.0.40      255.255.255.255 172.16.255.6       GlobalRouter   2     1/19      RIP  1   IB   100
10.0.0.41      255.255.255.255 10.0.0.41          -              1     0         LOC  0   DB   0
10.0.0.42      255.255.255.255 VSP4000-2          GlobalRouter   10    4051      ISIS 0   IBS  7
10.0.0.81      255.255.255.255 VSP8000-1          GlobalRouter   10    4051      ISIS 0   IBS  7
10.0.0.82      255.255.255.255 VSP8000-2          GlobalRouter   20    4051      ISIS 0   IBS  7
10.0.0.88      255.255.255.255 VSP8000-1          GlobalRouter   192   4051      ISIS 0   IBS  7
172.16.10.0    255.255.255.0   172.16.255.6       GlobalRouter   2     1/19      RIP  1   IB   100
172.16.255.0   255.255.255.252 VSP4000-2          GlobalRouter   10    4051      ISIS 0   IBS  7
172.16.255.4   255.255.255.252 172.16.255.5       -              1     1/19      LOC  0   DB   0
192.168.10.0   255.255.255.0   VSP8000-1          GlobalRouter   192   4051      ISIS 0   IBS  7
192.168.20.0   255.255.255.0   VSP8000-1          GlobalRouter   192   4051      ISIS 0   IBS  7
192.168.255.0  255.255.255.252 VSP8000-2          GlobalRouter   20    4051      ISIS 0   IBS  7
192.168.255.4  255.255.255.252 VSP8000-1          GlobalRouter   10    4051      ISIS 0   IBS  7
```

```
VSP4000-2:1#% show ip route
==========================================================================================
                                 IP Route - GlobalRouter
==========================================================================================
                                                   NH              INTER
DST            MASK            NEXT               VRF/ISID       COST  FACE      PROT AGE TYPE PRF
------------------------------------------------------------------------------------------
10.0.0.40      255.255.255.255 172.16.255.2       GlobalRouter   2     1/19      RIP  7   IB   100
10.0.0.41      255.255.255.255 VSP4000-1          GlobalRouter   10    4051      ISIS 0   IBS  7
10.0.0.42      255.255.255.255 10.0.0.42          -              1     0         LOC  0   DB   0
10.0.0.81      255.255.255.255 VSP8000-1          GlobalRouter   20    4051      ISIS 0   IBS  7
10.0.0.82      255.255.255.255 VSP8000-2          GlobalRouter   10    4051      ISIS 0   IBS  7
10.0.0.88      255.255.255.255 VSP8000-1          GlobalRouter   192   4051      ISIS 0   IBS  7
172.16.10.0    255.255.255.0   172.16.255.2       GlobalRouter   2     1/19      RIP  7   IB   100
172.16.255.0   255.255.255.252 172.16.255.1       -              1     1/19      LOC  0   DB   0
172.16.255.4   255.255.255.252 VSP4000-1          GlobalRouter   10    4051      ISIS 0   IBS  7
192.168.10.0   255.255.255.0   VSP8000-1          GlobalRouter   192   4051      ISIS 0   IBS  7
192.168.20.0   255.255.255.0   VSP8000-1          GlobalRouter   192   4051      ISIS 0   IBS  7
192.168.255.0  255.255.255.252 VSP8000-2          GlobalRouter   10    4051      ISIS 0   IBS  7
192.168.255.4  255.255.255.252 VSP8000-1          GlobalRouter   20    4051      ISIS 0   IBS  7
```

- Looking good now for both VSP4000 border routers
- Note that we have both VSP8000s announcing the same ISIS External routes (for OSPF) with the same prefix-cost, which means on the VSP4000s the system-id is used as a tie breaker and hence the next hop is always VSP8000-1 (in orange); ; we could enable IP ECMP

RIP ➔ IS-IS Redistribution – Checking accepted ISIS External routes

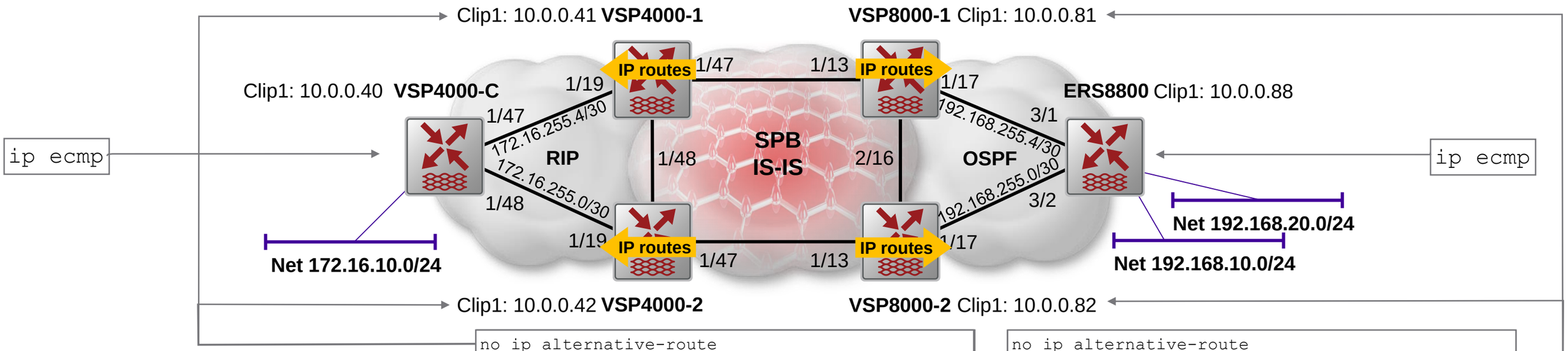



```
VSP4000-1:1#% show ip route alternative
================================================================================================
                                  IP Route - GlobalRouter
================================================================================================
                                                 NH                        INTER
DST              MASK             NEXT           VRF/ISID         COST     FACE     PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 172.16.255.6    GlobalRouter     2        1/19     RIP  13  IB   100
10.0.0.40        255.255.255.255 VSP4000-2       GlobalRouter     172      4051     ISIS 0   IAS  130
10.0.0.41        255.255.255.255 10.0.0.41       -                1        0        LOC  0   DB   0
10.0.0.42        255.255.255.255 VSP4000-2       GlobalRouter     10       4051     ISIS 0   IBS  7
10.0.0.81        255.255.255.255 VSP8000-1       GlobalRouter     10       4051     ISIS 0   IBS  7
10.0.0.82        255.255.255.255 VSP8000-2       GlobalRouter     20       4051     ISIS 0   IBS  7
10.0.0.88        255.255.255.255 VSP8000-1       GlobalRouter     192      4051     ISIS 0   IBS  7
172.16.10.0      255.255.255.0   172.16.255.6    GlobalRouter     2        1/19     RIP  13  IB   100
172.16.10.0      255.255.255.0   VSP4000-2       GlobalRouter     172      4051     ISIS 0   IAS  130
172.16.255.0     255.255.255.252 VSP4000-2       GlobalRouter     10       4051     ISIS 0   IBS  7
172.16.255.0     255.255.255.252 172.16.255.6    GlobalRouter     2        1/19     RIP  13  IA   100
172.16.255.4     255.255.255.252 172.16.255.5    -                1        1/19     LOC  0   DB   0
192.168.10.0     255.255.255.0   VSP8000-1       GlobalRouter     192      4051     ISIS 0   IBS  7
192.168.20.0     255.255.255.0   VSP8000-1       GlobalRouter     192      4051     ISIS 0   IBS  7
192.168.255.0    255.255.255.252 VSP8000-2       GlobalRouter     20       4051     ISIS 0   IBS  7
192.168.255.4    255.255.255.252 VSP8000-1       GlobalRouter     10       4051     ISIS 0   IBS  7
```

```
VSP4000-2:1#% show ip route alternative
================================================================================================
                                  IP Route - GlobalRouter
================================================================================================
                                                 NH                        INTER
DST              MASK             NEXT           VRF/ISID         COST     FACE     PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 172.16.255.2    GlobalRouter     2        1/19     RIP  8   IB   100
10.0.0.40        255.255.255.255 VSP4000-1       GlobalRouter     172      4051     ISIS 0   IAS  130
10.0.0.41        255.255.255.255 VSP4000-1       GlobalRouter     10       4051     ISIS 0   IBS  7
10.0.0.42        255.255.255.255 10.0.0.42       -                1        0        LOC  0   DB   0
10.0.0.81        255.255.255.255 VSP8000-1       GlobalRouter     20       4051     ISIS 0   IBS  7
10.0.0.82        255.255.255.255 VSP8000-2       GlobalRouter     10       4051     ISIS 0   IBS  7
10.0.0.88        255.255.255.255 VSP8000-1       GlobalRouter     192      4051     ISIS 0   IBS  7
172.16.10.0      255.255.255.0   172.16.255.2    GlobalRouter     2        1/19     RIP  8   IB   100
172.16.10.0      255.255.255.0   VSP4000-1       GlobalRouter     172      4051     ISIS 0   IAS  130
172.16.255.0     255.255.255.252 172.16.255.1    -                1        1/19     LOC  0   DB   0
172.16.255.4     255.255.255.252 VSP4000-1       GlobalRouter     10       4051     ISIS 0   IBS  7
172.16.255.4     255.255.255.252 172.16.255.2    GlobalRouter     2        1/19     RIP  8   IA   100
192.168.10.0     255.255.255.0   VSP8000-1       GlobalRouter     192      4051     ISIS 0   IBS  7
192.168.20.0     255.255.255.0   VSP8000-1       GlobalRouter     192      4051     ISIS 0   IBS  7
192.168.255.0    255.255.255.252 VSP8000-2       GlobalRouter     10       4051     ISIS 0   IBS  7
192.168.255.4    255.255.255.252 VSP8000-1       GlobalRouter     20       4051     ISIS 0   IBS  7
```

- Here we see that the border VSP4000s learn from each other the already redistributed RIP routes as ISIS External routes, but our Accept policy ensures they get a preference of 130 (in orange) which ensures that these will not displace the preferred RIP route (in green) and remain thus as alternative routes

RIP ← IS-IS → OSPF Redistribution - Config

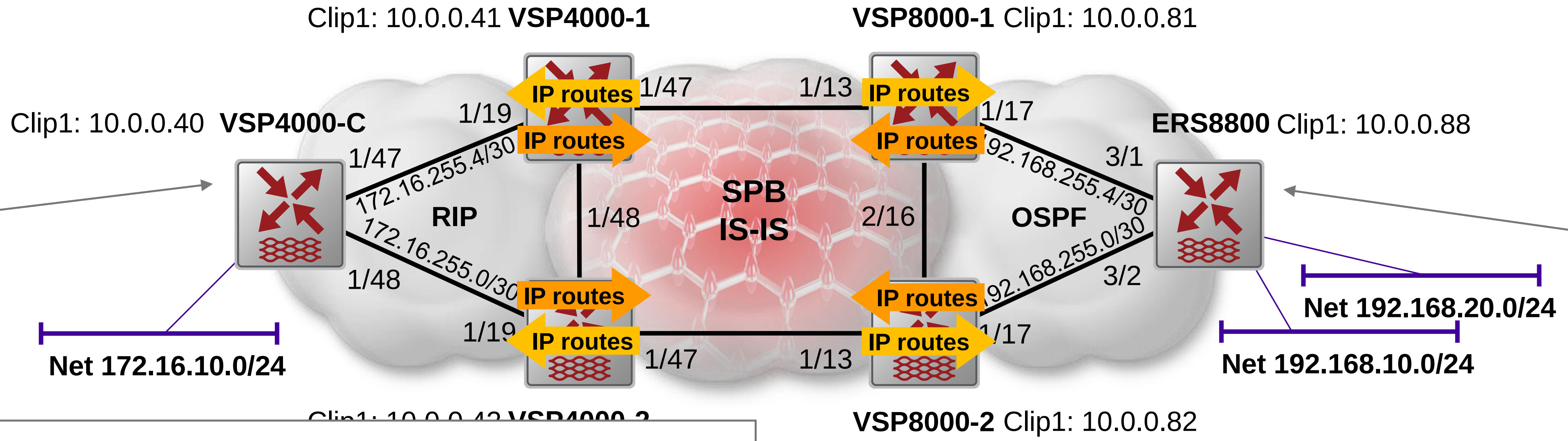


- In the reverse direction, we now redistribute all IS-IS routes into OSPF and RIP
  - NOTE: We disable IP alternative route, for the same reasons explained in previous setup
- The VSP8000 route-map policy ensures that all ISIS routes except the ISIS External routes with metric tag 192 (indicating they originated from OSPF) are redistributed to OSPF; likewise for the VSP4000 route-map policy but for RIP tag metric 172

```
no ip alternative-route
route-map isis-non-tag-rip 1
   match metric-type-isis external
   match metric 172
   no permit
   enable
exit
route-map isis-non-tag-rip 2
   enable
exit
router rip
   redistribute isis
   redistribute isis route-map isis-non-tag-rip
   redistribute isis enable
exit
ip rip apply redistribute isis
```

```
no ip alternative-route
route-map isis-non-tag-ospf 1
   match metric-type-isis external
   match metric 192
   no permit
   enable
exit
route-map isis-non-tag-ospf 2
   enable
exit
router ospf
   as-boundary-router enable
   redistribute isis
   redistribute isis route-map isis-non-tag-ospf
   redistribute isis enable
exit
ip ospf apply redistribute isis
```

RIP ← IS-IS → OSPF Redistribution - Checking



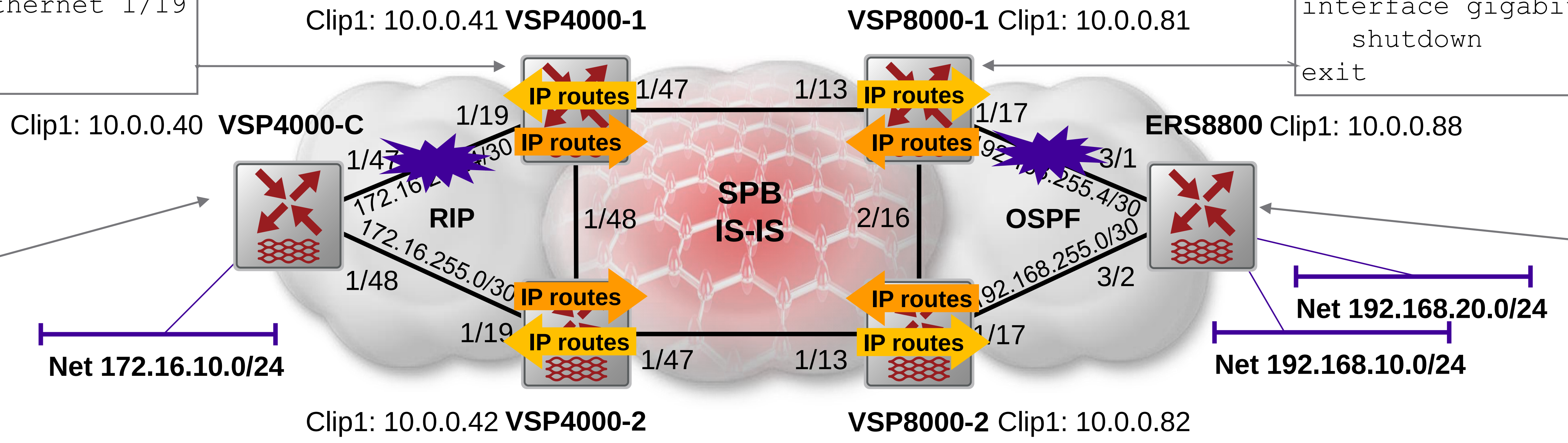

```
VSP4000-C:1#% show ip route
==========================================================================================
                              IP Route - GlobalRouter
==========================================================================================
                                                    NH                       INTER
DST             MASK            NEXT                VRF/ISID        COST     FACE      PROT AGE TYPE PRF
------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 10.0.0.40           -               1        0         LOC  0   DB   0
10.0.0.41       255.255.255.255 172.16.255.1        GlobalRouter    2        1/48      RIP  20  IB   100
10.0.0.42       255.255.255.255 172.16.255.5        GlobalRouter    2        1/47      RIP  27  IB   100
10.0.0.81       255.255.255.255 172.16.255.5        GlobalRouter    2        1/47      RIP  27  IBE  100
10.0.0.81       255.255.255.255 172.16.255.1        GlobalRouter    2        1/48      RIP  20  IBE  100
10.0.0.82       255.255.255.255 172.16.255.5        GlobalRouter    2        1/47      RIP  27  IBE  100
10.0.0.82       255.255.255.255 172.16.255.1        GlobalRouter    2        1/48      RIP  20  IBE  100
10.0.0.88       255.255.255.255 172.16.255.5        GlobalRouter    2        1/47      RIP  27  IBE  100
10.0.0.88       255.255.255.255 172.16.255.1        GlobalRouter    2        1/48      RIP  20  IBE  100
172.16.10.0     255.255.255.0   172.16.10.1         -               1        0         LOC  0   DB   0
172.16.255.0    255.255.255.252 172.16.255.2        -               1        1/48      LOC  0   DB   0
172.16.255.4    255.255.255.252 172.16.255.6        -               1        1/47      LOC  0   DB   0
192.168.10.0    255.255.255.0   172.16.255.5        GlobalRouter    2        1/47      RIP  27  IBE  100
192.168.10.0    255.255.255.0   172.16.255.1        GlobalRouter    2        1/48      RIP  20  IBE  100
192.168.20.0    255.255.255.0   172.16.255.5        GlobalRouter    2        1/47      RIP  27  IBE  100
192.168.20.0    255.255.255.0   172.16.255.1        GlobalRouter    2        1/48      RIP  20  IBE  100
192.168.255.0   255.255.255.252 172.16.255.5        GlobalRouter    2        1/47      RIP  27  IBE  100
192.168.255.0   255.255.255.252 172.16.255.1        GlobalRouter    2        1/48      RIP  20  IBE  100
192.168.255.4   255.255.255.252 172.16.255.5        GlobalRouter    2        1/47      RIP  27  IBE  100
192.168.255.4   255.255.255.252 172.16.255.1        GlobalRouter    2        1/48      RIP  20  IBE  100
```

```
ERS8800:5#% show ip route
==========================================================================================
                              IP Route - GlobalRouter
==========================================================================================
                                                    NH                  INTER
DST             MASK            NEXT                VRF          COST   FACE  PROT AGE TYPE PRF
------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 192.168.255.1       GlobalRout~  172    3/2   OSPF 0   IBE  125
10.0.0.40       255.255.255.255 192.168.255.5       GlobalRout~  172    3/1   OSPF 0   IBE  125
10.0.0.41       255.255.255.255 192.168.255.5       GlobalRout~  10     3/1   OSPF 0   IB   125
10.0.0.42       255.255.255.255 192.168.255.1       GlobalRout~  10     3/2   OSPF 0   IB   125
10.0.0.81       255.255.255.255 192.168.255.1       GlobalRout~  10     3/2   OSPF 0   IB   125
10.0.0.82       255.255.255.255 192.168.255.5       GlobalRout~  10     3/1   OSPF 0   IB   125
10.0.0.88       255.255.255.255 10.0.0.88           -            1      0     LOC  0   DB   0
172.16.10.0     255.255.255.0   192.168.255.1       GlobalRout~  172    3/2   OSPF 0   IBE  125
172.16.10.0     255.255.255.0   192.168.255.5       GlobalRout~  172    3/1   OSPF 0   IBE  125
172.16.255.0    255.255.255.252 192.168.255.1       GlobalRout~  10     3/2   OSPF 0   IB   125
172.16.255.4    255.255.255.252 192.168.255.5       GlobalRout~  10     3/1   OSPF 0   IB   125
192.168.10.0    255.255.255.0   192.168.10.1        -            1      0     LOC  0   DB   0
192.168.20.0    255.255.255.0   192.168.20.1        -            1      0     LOC  0   DB   0
192.168.255.0   255.255.255.252 192.168.255.2       -            1      3/2   LOC  0   DB   0
192.168.255.4   255.255.255.252 192.168.255.6       -            1      3/1   LOC  0   DB   0
```

Testing failure on border router OSPF/RIP link

```
interface gigabitEthernet 1/19
   shutdown
exit
```

```
interface gigabitEthernet 1/17
   shutdown
exit
```



VSP4000-C:1#% show ip route

IP Route - GlobalRouter

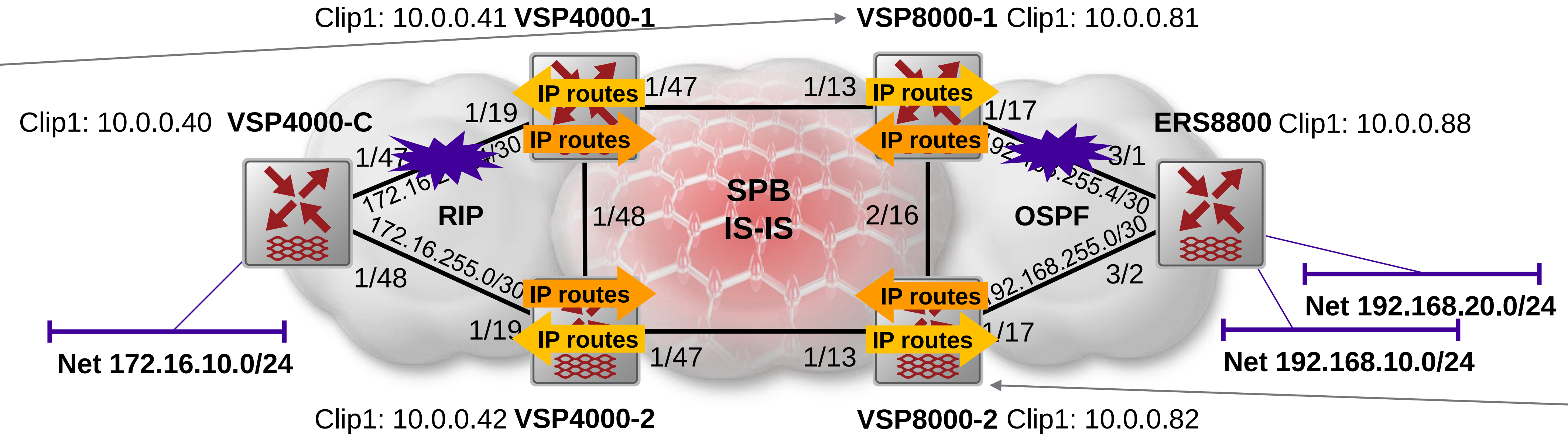
DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	10.0.0.40	-	1	0	LOC	0	DB	0
10.0.0.41	255.255.255.255	172.16.255.1	GlobalRouter	2	1/48	RIP	14	IB	100
10.0.0.81	255.255.255.255	172.16.255.1	GlobalRouter	2	1/48	RIP	14	IB	100
10.0.0.82	255.255.255.255	172.16.255.1	GlobalRouter	2	1/48	RIP	14	IB	100
10.0.0.88	**255.255.255.255**	**172.16.255.1**	**GlobalRouter**	**2**	**1/48**	**RIP**	**14**	**IB**	**100**
172.16.10.0	255.255.255.0	172.16.10.1	-	1	0	LOC	0	DB	0
172.16.255.0	255.255.255.252	172.16.255.2	-	1	1/48	LOC	0	DB	0
192.168.10.0	**255.255.255.0**	**172.16.255.1**	**GlobalRouter**	**2**	**1/48**	**RIP**	**14**	**IB**	**100**
192.168.20.0	**255.255.255.0**	**172.16.255.1**	**GlobalRouter**	**2**	**1/48**	**RIP**	**14**	**IB**	**100**
192.168.255.0	255.255.255.252	172.16.255.1	GlobalRouter	2	1/48	RIP	14	IB	100
192.168.255.4	255.255.255.252	172.16.255.1	GlobalRouter	2	1/48	RIP	14	IB	100

ERS8800:5#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	**255.255.255.255**	**192.168.255.1**	**GlobalRout~**	**172**	**3/2**	**OSPF**	**0**	**IB**	**125**
10.0.0.41	255.255.255.255	192.168.255.1	GlobalRout~	20	3/2	OSPF	0	IB	125
10.0.0.42	255.255.255.255	192.168.255.1	GlobalRout~	10	3/2	OSPF	0	IB	125
10.0.0.81	255.255.255.255	192.168.255.1	GlobalRout~	10	3/2	OSPF	0	IB	125
10.0.0.88	255.255.255.255	10.0.0.88	-	1	0	LOC	0	DB	0
172.16.10.0	**255.255.255.0**	**192.168.255.1**	**GlobalRout~**	**172**	**3/2**	**OSPF**	**0**	**IB**	**125**
172.16.255.0	255.255.255.252	192.168.255.1	GlobalRout~	10	3/2	OSPF	0	IB	125
192.168.10.0	255.255.255.0	192.168.10.1	-	1	0	LOC	0	DB	0
192.168.20.0	255.255.255.0	192.168.20.1	-	1	0	LOC	0	DB	0
192.168.255.0	255.255.255.252	192.168.255.2	-	1	3/2	LOC	0	DB	0

Testing failure on border router OSPF/RIP link



VSP8000-1:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000-2	GlobalRouter	172	4051	ISIS	0	IBS	7
10.0.0.41	255.255.255.255	VSP4000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.42	255.255.255.255	VSP4000-2	GlobalRouter	20	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	10.0.0.81	-	1	0	LOC	0	DB	0
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	255.255.255.255	VSP8000-2	GlobalRouter	192	4051	ISIS	0	IBS	130
172.16.10.0	255.255.255.0	VSP4000-2	GlobalRouter	172	4051	ISIS	0	IBS	7
172.16.255.0	255.255.255.252	VSP4000-2	GlobalRouter	20	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	VSP8000-2	GlobalRouter	192	4051	ISIS	0	IBS	130
192.168.20.0	255.255.255.0	VSP8000-2	GlobalRouter	192	4051	ISIS	0	IBS	130
192.168.255.0	255.255.255.252	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7

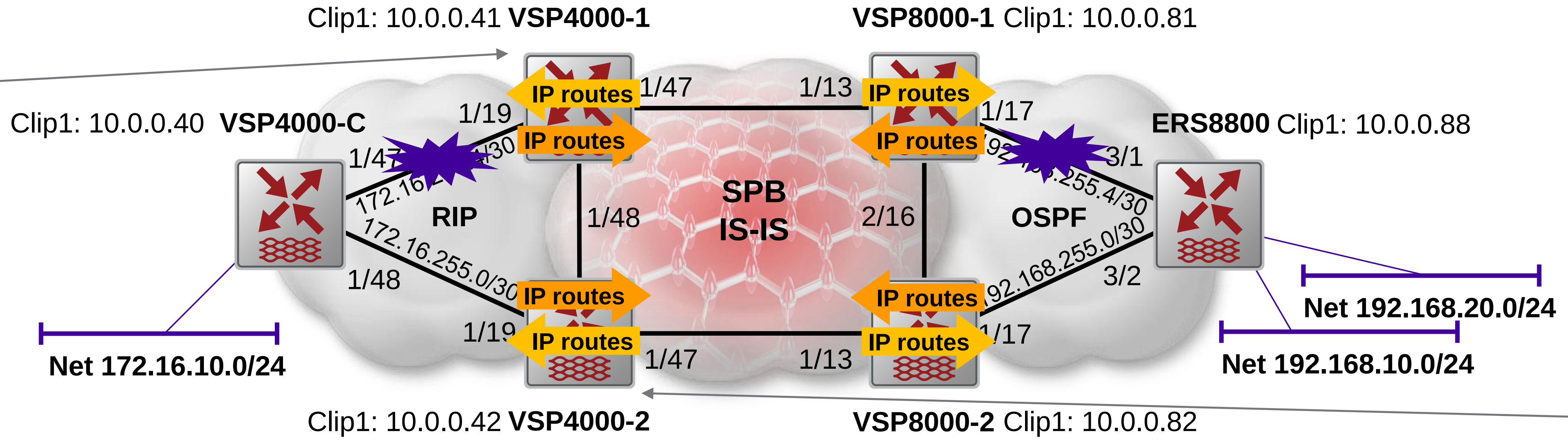
VSP8000-2:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.41	255.255.255.255	VSP4000-1	GlobalRouter	20	4051	ISIS	0	IBS	7
10.0.0.42	255.255.255.255	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	10.0.0.82	-	1	0	LOC	0	DB	0
10.0.0.88	255.255.255.255	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
172.16.10.0	255.255.255.0	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
172.16.255.0	255.255.255.252	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	192.168.255.2	GlobalRouter	11	1/17	OSPF	0	IB	20
192.168.20.0	255.255.255.0	192.168.255.2	GlobalRouter	1	1/17	OSPF	0	IB	125
192.168.255.0	255.255.255.252	192.168.255.1	-	1	1/17	LOC	0	DB	0

- Note that now VSP8000-1 has installed the ISIS External routes from VSP8000-2

Testing failure on border router OSPF/RIP link



VSP4000-1:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	VSP4000-2	GlobalRouter	172	4051	ISIS	0	IBS	130
10.0.0.41	255.255.255.255	10.0.0.41	-	1	0	LOC	0	DB	0
10.0.0.42	255.255.255.255	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	20	4051	ISIS	0	IBS	7
10.0.0.88	255.255.255.255	VSP8000-2	GlobalRouter	192	4051	ISIS	0	IBS	7
172.16.10.0	255.255.255.0	VSP4000-2	GlobalRouter	172	4051	ISIS	0	IBS	130
172.16.255.0	255.255.255.252	VSP4000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	VSP8000-2	GlobalRouter	192	4051	ISIS	0	IBS	7
192.168.20.0	255.255.255.0	VSP8000-2	GlobalRouter	192	4051	ISIS	0	IBS	7
192.168.255.0	255.255.255.252	VSP8000-2	GlobalRouter	20	4051	ISIS	0	IBS	7

VSP4000-2:1#% show ip route

IP Route - GlobalRouter

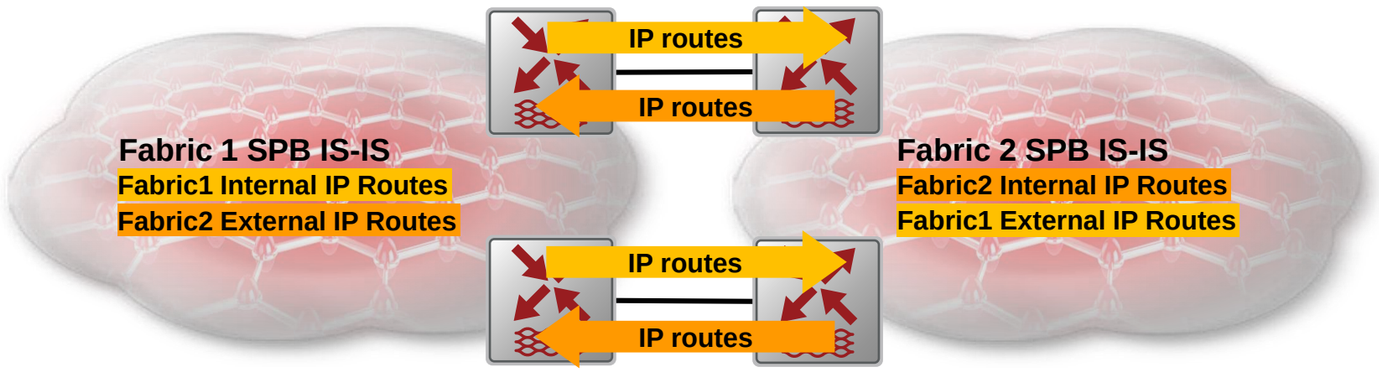
DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	172.16.255.2	GlobalRouter	2	1/19	RIP	7	IB	100
10.0.0.41	255.255.255.255	VSP4000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.42	255.255.255.255	10.0.0.42	-	1	0	LOC	0	DB	0
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	20	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	255.255.255.255	VSP8000-2	GlobalRouter	192	4051	ISIS	0	IBS	7
172.16.10.0	255.255.255.0	172.16.255.2	GlobalRouter	2	1/19	RIP	7	IB	100
172.16.255.0	255.255.255.252	172.16.255.1	-	1	1/19	LOC	0	DB	0
192.168.10.0	255.255.255.0	VSP8000-2	GlobalRouter	192	4051	ISIS	0	IBS	7
192.168.20.0	255.255.255.0	VSP8000-2	GlobalRouter	192	4051	ISIS	0	IBS	7
192.168.255.0	255.255.255.252	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7

- Note that now VSP4000-1 has installed the ISIS External routes from VSP4000-2

IP Routing between separate ISIS (SPB) Fabrics

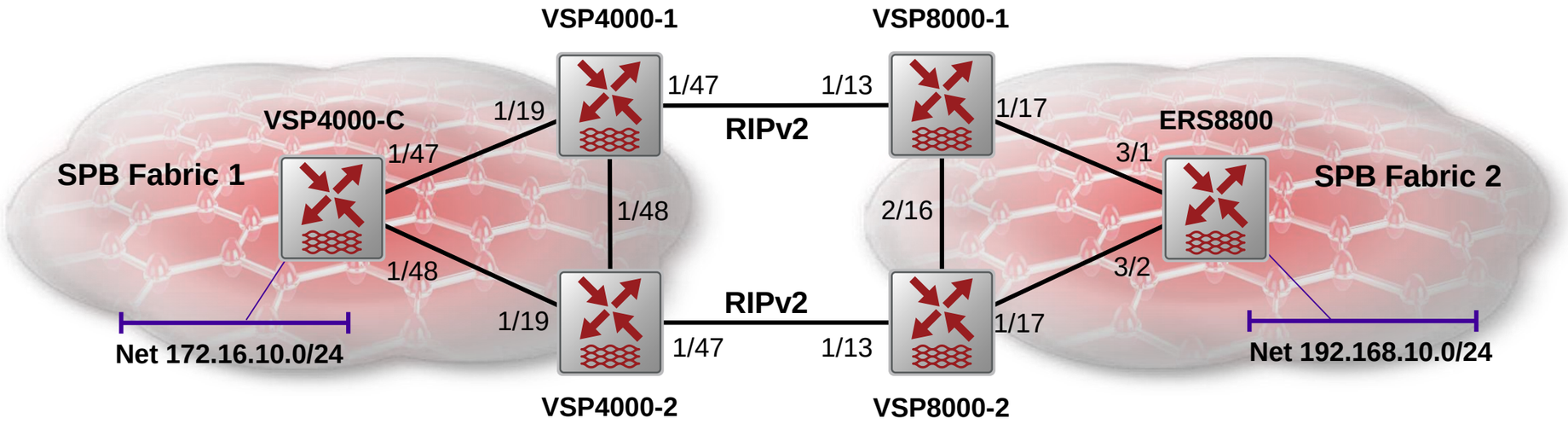
Leveraging IS-IS Accept policies + IS-IS External routes

IP Routing between separate ISIS (SPB) Fabrics



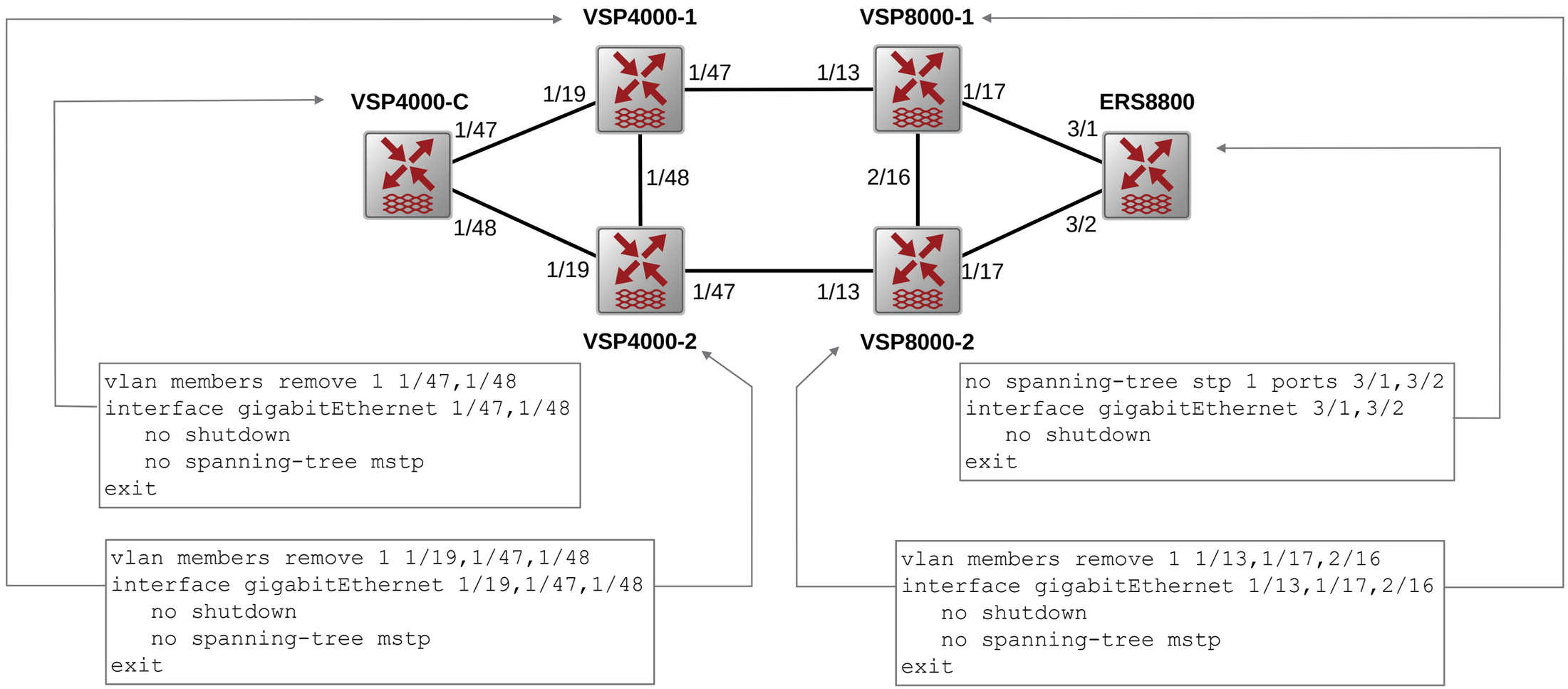
- GOAL = IP route between the 2 SPB Fabrics
  - An SPB node can only belong to a single Fabric, hence the boundary will be the interconnecting links
  - We run RIPv2 on the these links as this provides an effective and simpler approach than using BGP
    - Assuming that both Fabrics are under the same administrative domain; if not, then BGP might be more appropriate
  - Two border routers are used for redundancy on each boundary, and both can forward traffic at the same time
- CHALLENGE = not to get into routing loops where the IP routes redistributed over one border link in one direction end up being re-redistributed to the same SPB Fabric where they came from over the other border link

Setup, Equipment & Software used

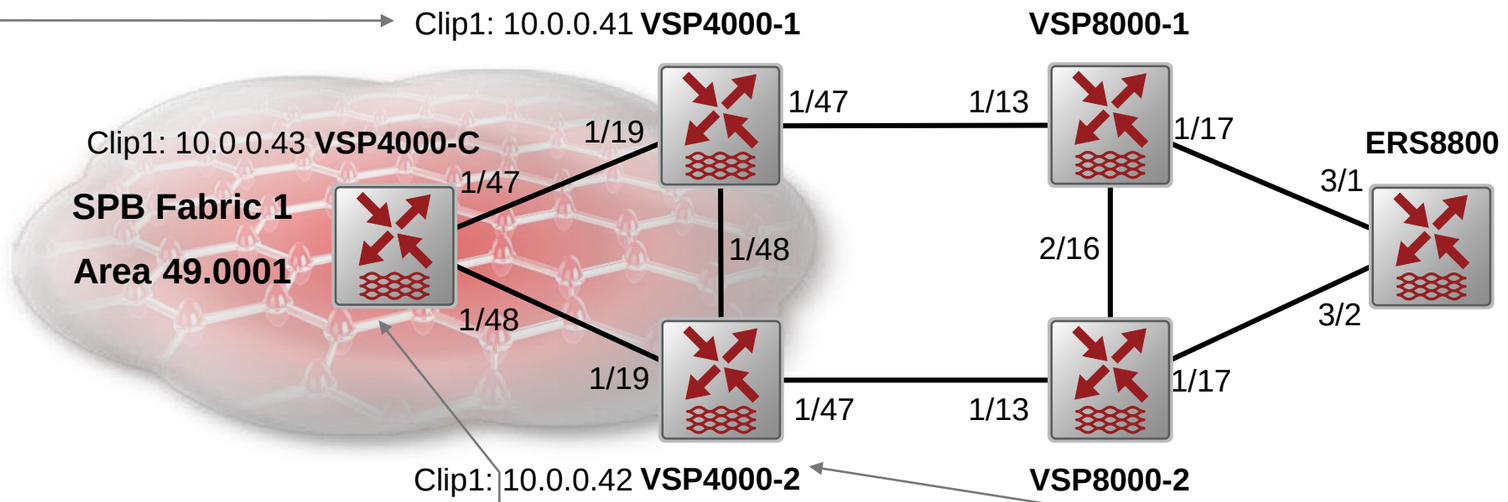


- VSP4000-C
  - VSP 4850GTS / 6.1.0.0_B021
- VSP4000-1, VSP4000-2
  - VSP 4850GTS-PWR+ / 6.1.0.0_B021
- ERS8800
  - 7.2.25.0GA
- VSP8000-1
  - VSP 8404 / 6.1.0.0_B021
    - Slot1 8424GT
    - Slot2 8418XSQ
- VSP8000-2
  - VSP 8242XSQ / 6.1.0.0_B021

Port Config



SPB Fabric1 Global Config



- We assign different ISIS Areas to the two SPB Fabrics
- Will come handy once we support multi-area SPB

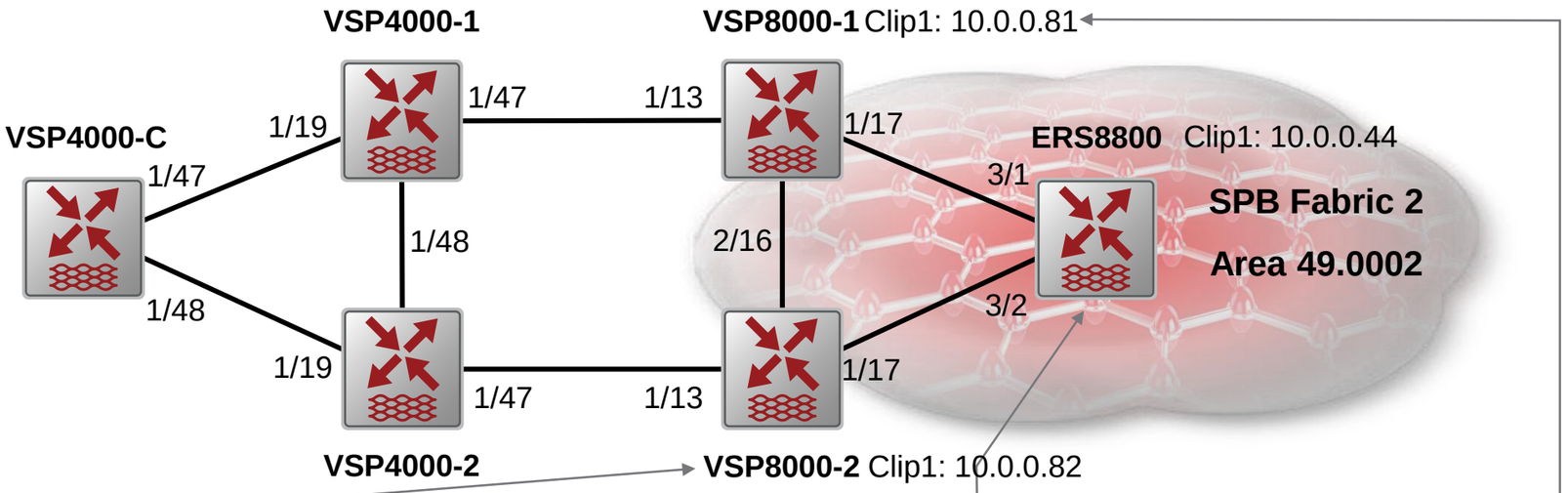
```
prompt VSP4000-1
interface loopback 1
   ip address 10.0.0.41/32
exit
spbm
router isis
   system-id 00bb.0000.4100
   manual-area 49.0001
   ip-source-address 10.0.0.41
   spbm 1
   spbm 1 nick-name 0.00.41
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 41
cfm spbm enable
```

```
prompt VSP4000-C
interface loopback 1
   ip address 10.0.0.43/32
exit
spbm
router isis
   system-id 00bb.0000.4300
   manual-area 49.0001
   ip-source-address 10.0.0.43
   spbm 1
   spbm 1 nick-name 0.00.43
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 43
cfm spbm enable
```

```
prompt VSP4000-2
interface loopback 1
   ip address 10.0.0.42/32
exit
spbm
router isis
   system-id 00bb.0000.4200
   manual-area 49.0001
   ip-source-address 10.0.0.42
   spbm 1
   spbm 1 nick-name 0.00.42
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 42
cfm spbm enable
```

SPB Fabric2 Global Config

- We assign different ISIS Areas to the two SPB Fabrics
- Will come handy once we support multi-area SPB

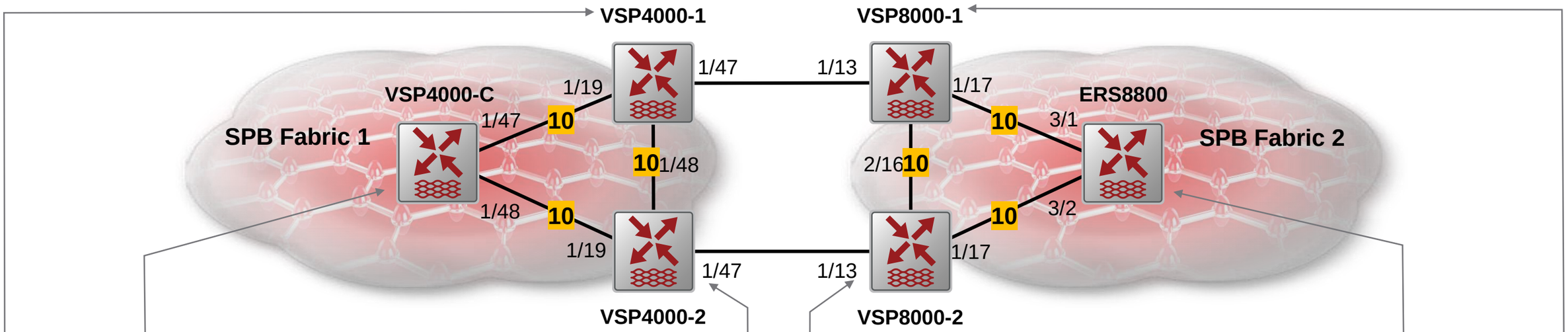



```
prompt VSP8000-2
interface loopback 1
   ip address 10.0.0.82/32
exit
spbm
router isis
   system-id 00bb.0000.8200
   manual-area 49.0002
   ip-source-address 10.0.0.82
   spbm 1
   spbm 1 nick-name 0.00.82
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 82
cfm spbm enable
```

```
prompt ERS8800
interface loopback 1
   ip address 10.0.0.88/32
exit
spbm
router isis
   system-id 00bb.0000.8800
   manual-area 49.0002
   ip-source-address 10.0.0.88
   spbm 1
   spbm 1 nick-name 0.00.88
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 88
cfm spbm enable
```

```
prompt VSP8000-1
interface loopback 1
   ip address 10.0.0.81/32
exit
spbm
router isis
   system-id 00bb.0000.8100
   manual-area 49.0002
   ip-source-address 10.0.0.81
   spbm 1
   spbm 1 nick-name 0.00.81
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 81
cfm spbm enable
```

SPB Interface Config




```
interface GigabitEthernet 1/47,1/48
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

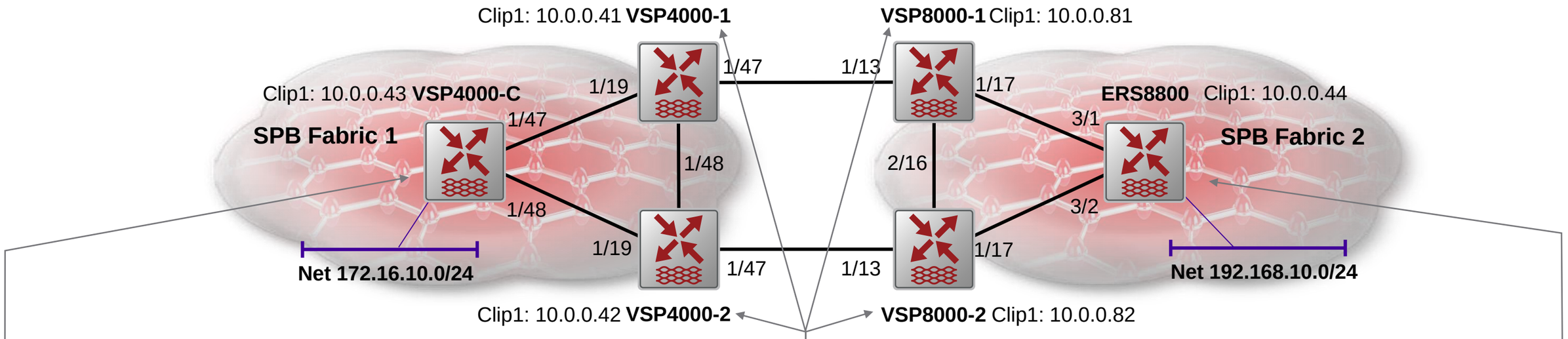
```
interface GigabitEthernet 3/1,3/2
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

```
interface GigabitEthernet 1/19,1/48
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

```
interface GigabitEthernet 1/17,2/16
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

- All ISIS NNI links use default SPBM L1-metric of 10

Test networks config using CLIPs



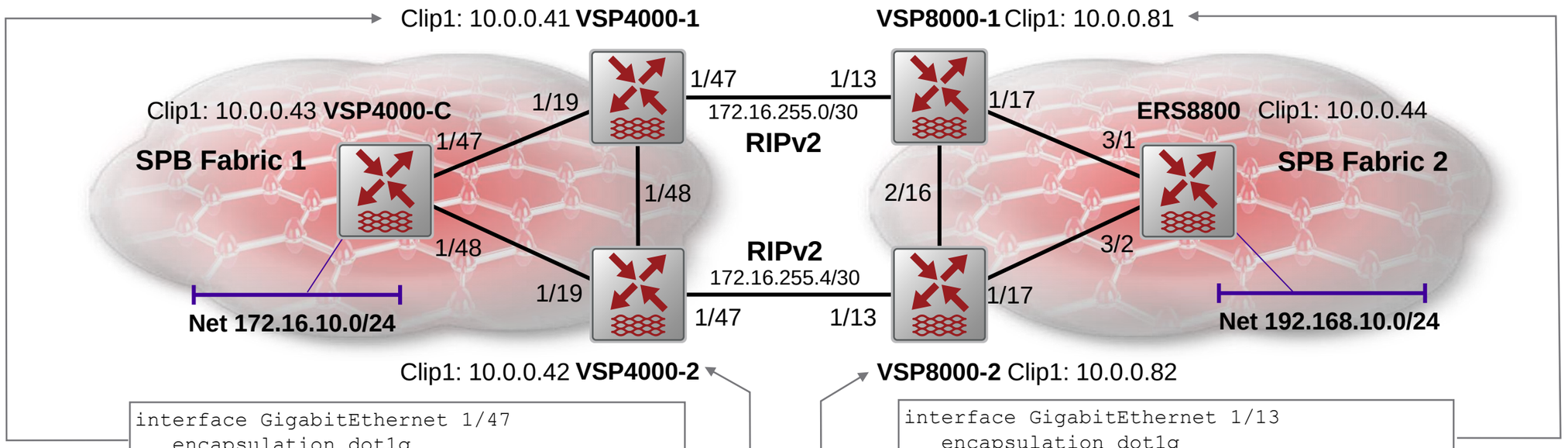

```
interface loopback 2
   ip address 172.16.10.1/24
exit
router isis
   redistribute direct
   redistribute direct enable
exit
isis apply redistribute direct
```

```
router isis
   redistribute direct
   redistribute direct enable
exit
isis apply redistribute direct
```

```
interface loopback 2
   ip address 192.168.10.1/24
exit
router isis
   redistribute direct
   redistribute direct enable
exit
isis apply redistribute direct
```

- We also redistribute directs on the boundary border routers since this will typically be the case anyway

RIP config




```
interface GigabitEthernet 1/47
   encapsulation dot1q
   brouter vlan 3900 subnet 172.16.255.1/30
   ip rip enable
   ip rip receive version rip2
   ip rip send version rip2
exit
router rip enable
```

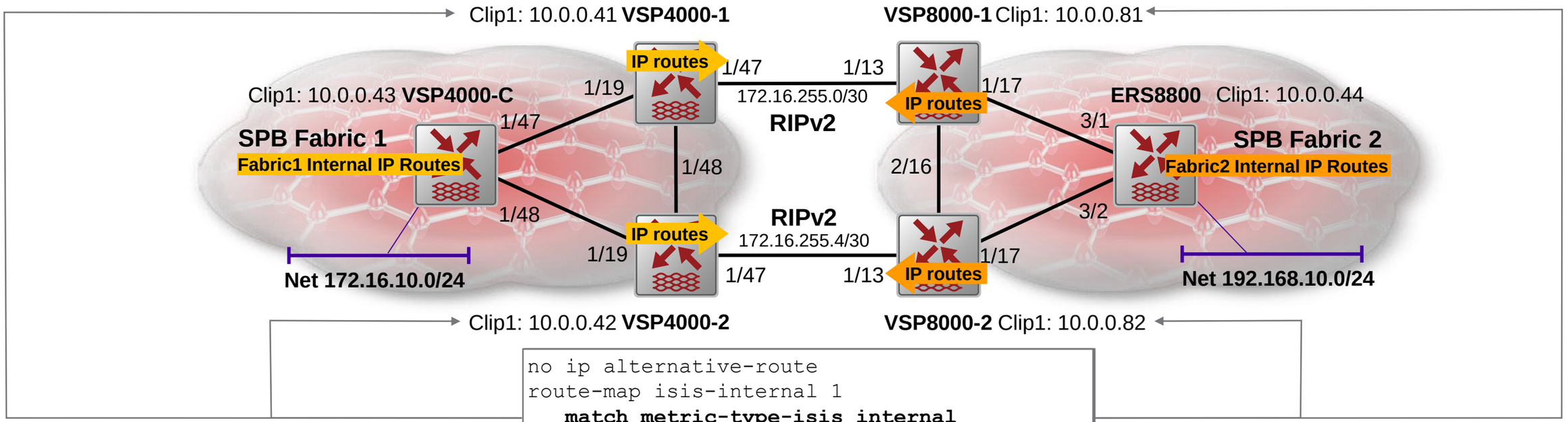
```
interface GigabitEthernet 1/47
   encapsulation dot1q
   brouter vlan 3900 subnet 172.16.255.5/30
   ip rip enable
   ip rip receive version rip2
   ip rip send version rip2
exit
router rip enable
```

```
interface GigabitEthernet 1/13
   encapsulation dot1q
   brouter vlan 3900 subnet 172.16.255.2/30
   ip rip enable
   ip rip receive version rip2
   ip rip send version rip2
exit
router rip enable
```

```
interface GigabitEthernet 1/13
   encapsulation dot1q
   brouter vlan 3900 subnet 172.16.255.6/30
   ip rip enable
   ip rip receive version rip2
   ip rip send version rip2
exit
router rip enable
```

- Setting tagging on the RIP links, as we might have to have multiple RIP interfaces if multiple routing domains (VRFs / L3VSNs) were in use

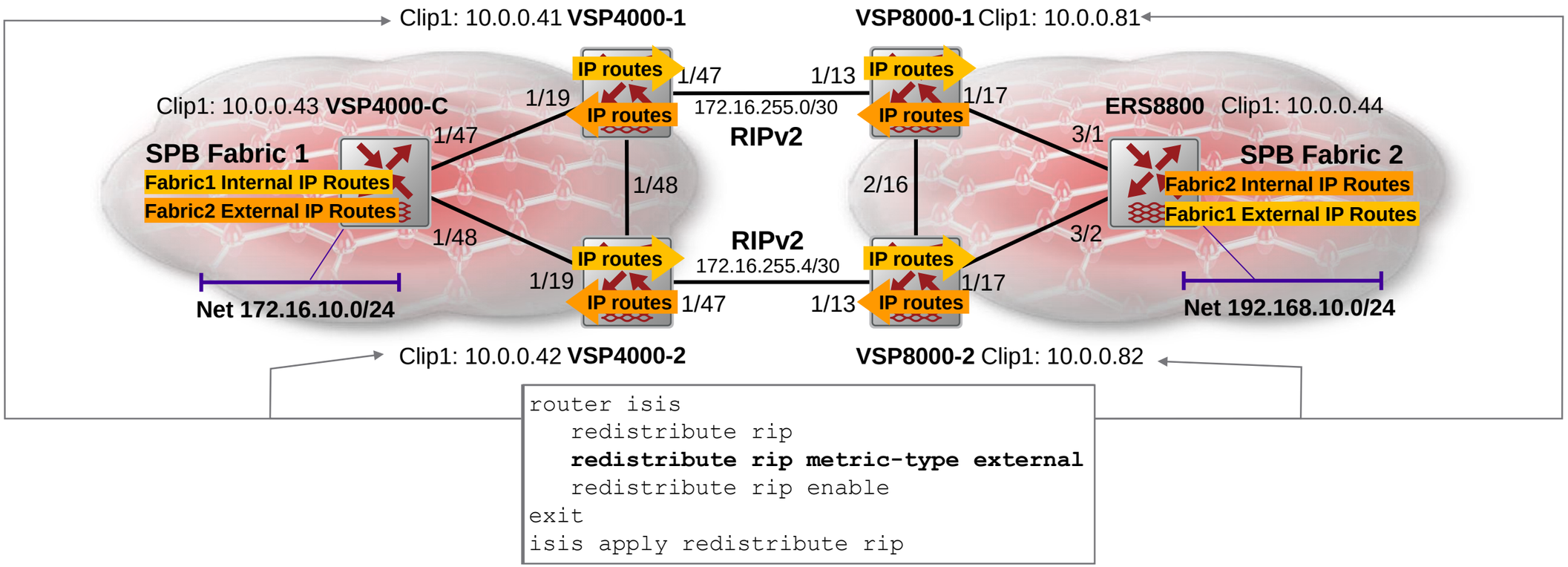
IS-IS ➔ RIP Redistribution - Config




```
no ip alternative-route
route-map isis-internal 1
   match metric-type-isis internal
   enable
exit
router rip
   redistribute isis
   redistribute isis route-map isis-internal
   redistribute isis enable
   redistribute direct
   redistribute direct enable
exit
ip rip apply redistribute isis
ip rip apply redistribute direct
```

- We redistribute only ISIS Internal routes to the RIP border links
- We also redistribute direct routes, as the border nodes might have some (here the CLIPs)

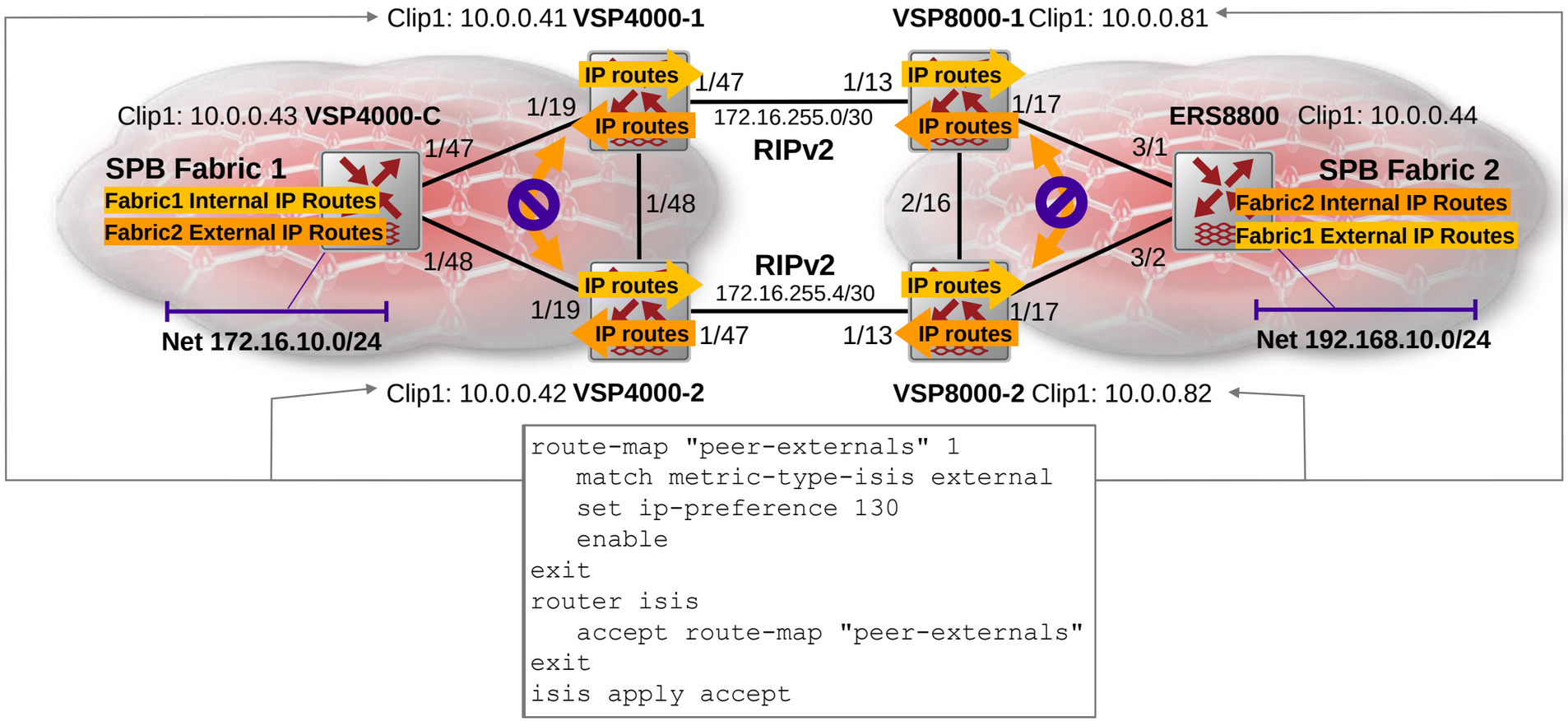
IS-IS ← RIP Redistribution - Config




```
router isis
   redistribute rip
   redistribute rip metric-type external
   redistribute rip enable
exit
isis apply redistribute rip
```

- We redistribute only RIP routes into ISIS as External routes

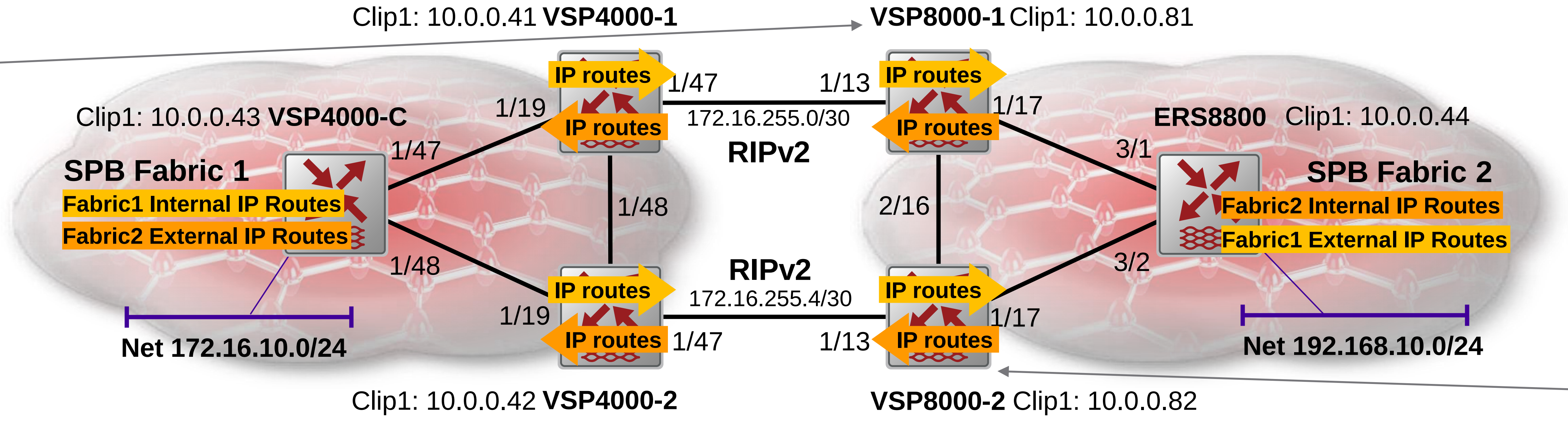
Preventing route reflection of ISIS Externals




```
route-map "peer-externals" 1
   match metric-type-isis external
   set ip-preference 130
   enable
exit
router isis
   accept route-map "peer-externals"
exit
isis apply accept
```

- Bump up the preference value (decrease preference) for ISIS External routes received from peer border router so that they will never replace the same RIP route if available

IS-IS ←→ RIP Redistribution - Checking



VSP8000-1:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.41	255.255.255.255	172.16.255.1	GlobalRouter	2	1/13	RIP	0	IB	100
10.0.0.42	255.255.255.255	172.16.255.1	GlobalRouter	2	1/13	RIP	0	IB	100
10.0.0.43	255.255.255.255	172.16.255.1	GlobalRouter	2	1/13	RIP	0	IB	100
10.0.0.81	255.255.255.255	10.0.0.81	-	1	0	LOC	0	DB	0
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.88	255.255.255.255	ERS8800	GlobalRouter	10	4051	ISIS	0	IBS	7
172.16.10.0	255.255.255.0	172.16.255.1	GlobalRouter	2	1/13	RIP	0	IB	100
172.16.255.0	255.255.255.252	172.16.255.2	-	1	1/13	LOC	0	DB	0
172.16.255.4	255.255.255.252	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
192.168.10.0	255.255.255.0	ERS8800	GlobalRouter	10	4051	ISIS	0	IBS	7

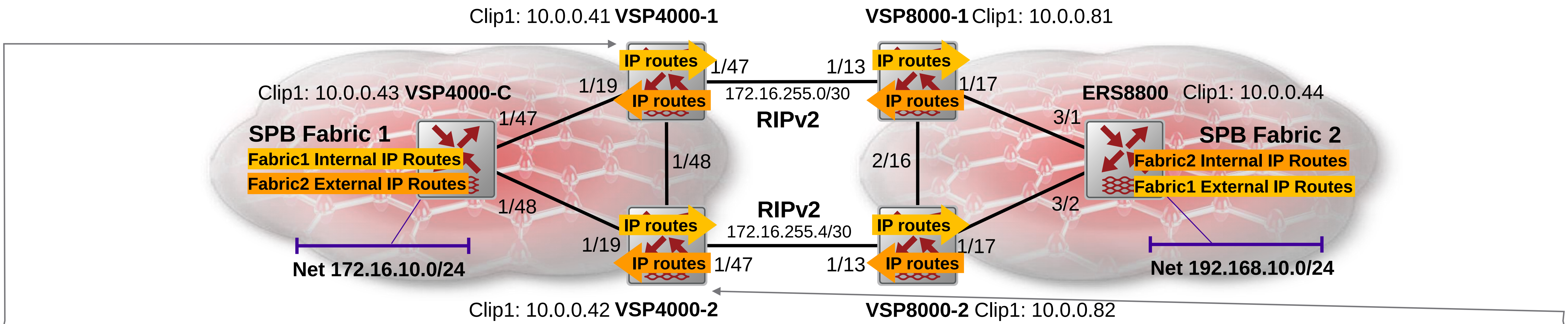
VSP8000-2:1#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.41	255.255.255.255	172.16.255.5	GlobalRouter	2	1/13	RIP	4	IB	100
10.0.0.42	255.255.255.255	172.16.255.5	GlobalRouter	2	1/13	RIP	4	IB	100
10.0.0.43	255.255.255.255	172.16.255.5	GlobalRouter	2	1/13	RIP	4	IB	100
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	10.0.0.82	-	1	0	LOC	0	DB	0
10.0.0.88	255.255.255.255	ERS8800	GlobalRouter	10	4051	ISIS	0	IBS	7
172.16.10.0	255.255.255.0	172.16.255.5	GlobalRouter	2	1/13	RIP	4	IB	100
172.16.255.0	255.255.255.252	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
172.16.255.4	255.255.255.252	172.16.255.6	-	1	1/13	LOC	0	DB	0
192.168.10.0	255.255.255.0	ERS8800	GlobalRouter	10	4051	ISIS	0	IBS	7

- Looking good

IS-IS ←→ RIP Redistribution - Checking

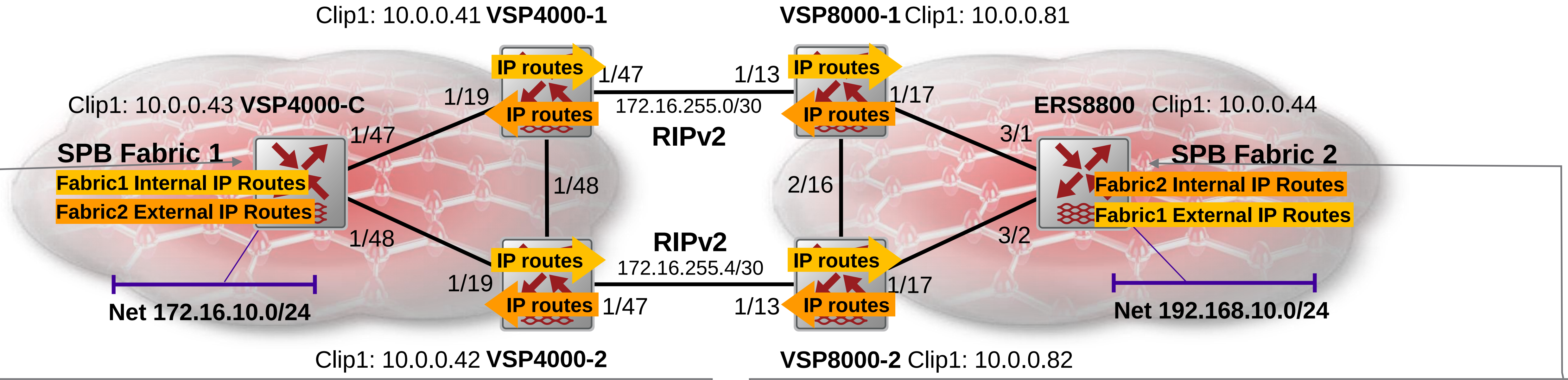



```
VSP4000-1:1#% show ip route
================================================================================
                          IP Route - GlobalRouter
================================================================================
                                              NH                    INTER
DST             MASK            NEXT          VRF/ISID        COST  FACE     PROT  AGE  TYPE  PRF
--------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 10.0.0.41     -               1     0        LOC   0    DB    0
10.0.0.42       255.255.255.255 VSP4000-2     GlobalRouter    10    4051     ISIS  0    IBS   7
10.0.0.43       255.255.255.255 VSP4000-C     GlobalRouter    10    4051     ISIS  0    IBS   7
10.0.0.81       255.255.255.255 172.16.255.2  GlobalRouter    2     1/47     RIP   7    IB    100
10.0.0.82       255.255.255.255 172.16.255.2  GlobalRouter    2     1/47     RIP   7    IB    100
10.0.0.88       255.255.255.255 172.16.255.2  GlobalRouter    2     1/47     RIP   7    IB    100
172.16.10.0     255.255.255.0   VSP4000-C     GlobalRouter    10    4051     ISIS  0    IBS   7
172.16.255.0    255.255.255.252 172.16.255.1  -               1     1/47     LOC   0    DB    0
172.16.255.4    255.255.255.252 VSP4000-2     GlobalRouter    10    4051     ISIS  0    IBS   7
192.168.10.0    255.255.255.0   172.16.255.2  GlobalRouter    2     1/47     RIP   7    IB    100
```

```
VSP4000-2:1#% show ip route
================================================================================
                          IP Route - GlobalRouter
================================================================================
                                              NH                    INTER
DST             MASK            NEXT          VRF/ISID        COST  FACE     PROT  AGE  TYPE  PRF
--------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 VSP4000-1     GlobalRouter    10    4051     ISIS  0    IBS   7
10.0.0.42       255.255.255.255 10.0.0.42     -               1     0        LOC   0    DB    0
10.0.0.43       255.255.255.255 VSP4000-C     GlobalRouter    10    4051     ISIS  0    IBS   7
10.0.0.81       255.255.255.255 172.16.255.6  GlobalRouter    2     1/47     RIP   5    IB    100
10.0.0.82       255.255.255.255 172.16.255.6  GlobalRouter    2     1/47     RIP   5    IB    100
10.0.0.88       255.255.255.255 172.16.255.6  GlobalRouter    2     1/47     RIP   5    IB    100
172.16.10.0     255.255.255.0   VSP4000-C     GlobalRouter    10    4051     ISIS  0    IBS   7
172.16.255.0    255.255.255.252 VSP4000-1     GlobalRouter    10    4051     ISIS  0    IBS   7
172.16.255.4    255.255.255.252 172.16.255.5  -               1     1/47     LOC   0    DB    0
192.168.10.0    255.255.255.0   172.16.255.6  GlobalRouter    2     1/47     RIP   5    IB    100
```

- Looking good

IS-IS ←→ RIP Redistribution - Checking

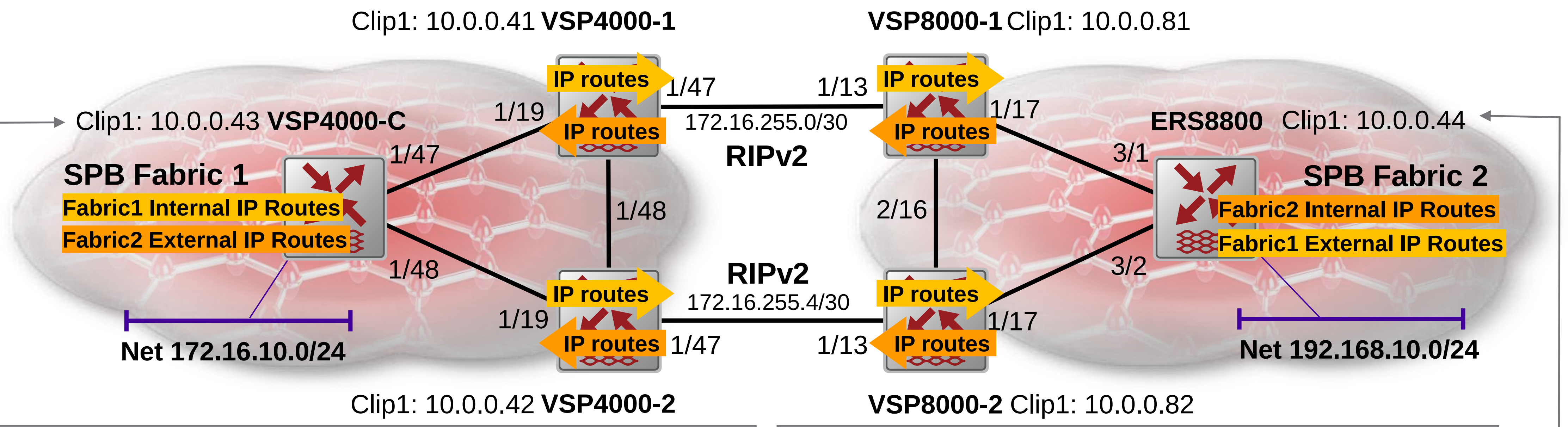



```
VSP4000-C:1#% show ip route
==========================================================================================
                                   IP Route - GlobalRouter
==========================================================================================
                                                NH                       INTER
DST             MASK            NEXT            VRF/ISID         COST    FACE     PROT AGE TYPE PRF
-----------------------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 VSP4000-1       GlobalRouter     10      4051     ISIS 0   IBS  7
10.0.0.42       255.255.255.255 VSP4000-2       GlobalRouter     10      4051     ISIS 0   IBS  7
10.0.0.43       255.255.255.255 10.0.0.43       -                1       0        LOC  0   DB   0
10.0.0.81       255.255.255.255 VSP4000-1       GlobalRouter     2       4051     ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP4000-1       GlobalRouter     2       4051     ISIS 0   IBS  7
10.0.0.88       255.255.255.255 VSP4000-1       GlobalRouter     2       4051     ISIS 0   IBS  7
172.16.10.0     255.255.255.0   172.16.10.1     -                1       0        LOC  0   DB   0
172.16.255.0    255.255.255.252 VSP4000-1       GlobalRouter     10      4051     ISIS 0   IBS  7
172.16.255.4    255.255.255.252 VSP4000-2       GlobalRouter     10      4051     ISIS 0   IBS  7
192.168.10.0    255.255.255.0   VSP4000-1       GlobalRouter     2       4051     ISIS 0   IBS  7
```

```
ERS8800:5#% show ip route
==========================================================================================
                                   IP Route - GlobalRouter
==========================================================================================
                                                NH                  INTER
DST             MASK            NEXT            VRF           COST  FACE   PROT AGE TYPE PRF
-----------------------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 VSP8000-1       GlobalRout~   10    4051   ISIS 0   IBS  7
10.0.0.42       255.255.255.255 VSP8000-1       GlobalRout~   10    4051   ISIS 0   IBS  7
10.0.0.43       255.255.255.255 VSP8000-1       GlobalRout~   10    4051   ISIS 0   IBS  7
10.0.0.81       255.255.255.255 VSP8000-1       GlobalRout~   10    4051   ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP8000-2       GlobalRout~   10    4051   ISIS 0   IBS  7
10.0.0.88       255.255.255.255 10.0.0.88        -            1     0      LOC  0   DB   0
172.16.10.0     255.255.255.0   VSP8000-1       GlobalRout~   10    4051   ISIS 0   IBS  7
172.16.255.0    255.255.255.252 VSP8000-1       GlobalRout~   10    4051   ISIS 0   IBS  7
172.16.255.4    255.255.255.252 VSP8000-2       GlobalRout~   10    4051   ISIS 0   IBS  7
192.168.10.0    255.255.255.0   192.168.10.1     -            1     0      LOC  0   DB   0
```

- Looking good; we could enable IP ECMP on these nodes
- Note that the ERS8800 is able to handle ISIS External routes, just that it handles them in the same way as ISIS Internal routes

IS-IS ←→ RIP Redistribution - Checking



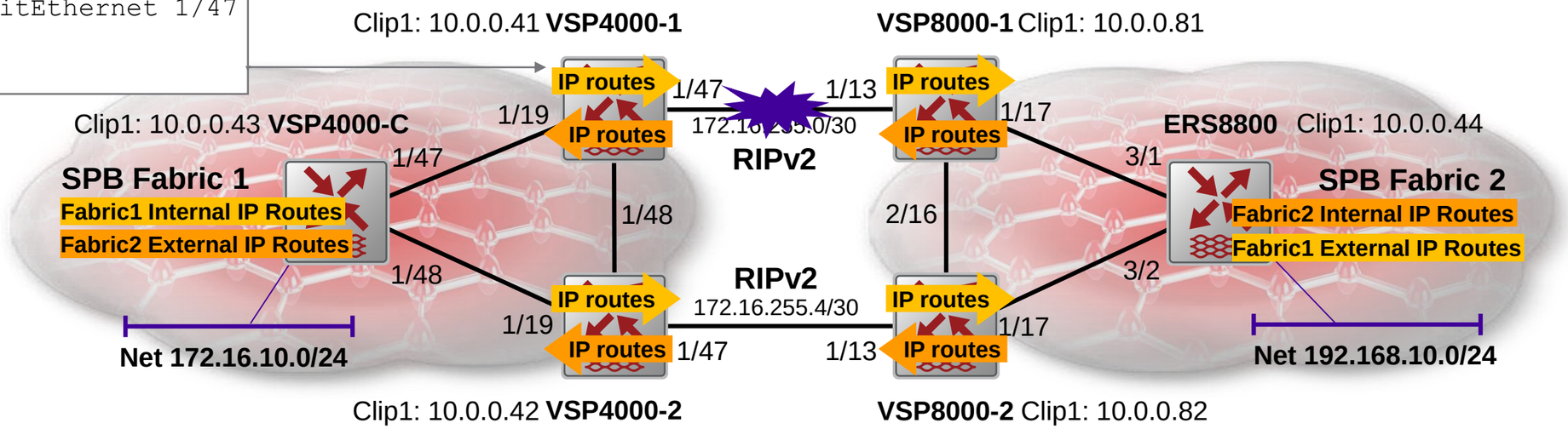

```
VSP4000-C:1#% show isis spbm ip-unicast-fib all
==================================================================================================================================
                                                  SPBM IP-UNICAST FIB ENTRY INFO
==================================================================================================================================
          VRF      DEST                                                OUTGOING         SPBM       PREFIX      PREFIX      IP ROUTE
VRF       ISID     ISID     Destination       NH BEB              VLAN INTERFACE        COST       COST        TYPE        PREFERENCE
----------------------------------------------------------------------------------------------------------------------------------
GRT       -        -        10.0.0.41/32      VSP4000-1           4051 1/47             10         1           Internal    7
GRT       -        -        10.0.0.41/32      VSP4000-1           4052 1/47             10         1           Internal    7
GRT       -        -        10.0.0.42/32      VSP4000-2           4051 1/48             10         1           Internal    7
GRT       -        -        10.0.0.42/32      VSP4000-2           4052 1/48             10         1           Internal    7
GRT       -        -        10.0.0.81/32      VSP4000-1           4051 1/47             10         2           External    7
GRT       -        -        10.0.0.81/32      VSP4000-1           4052 1/47             10         2           External    7
GRT       -        -        10.0.0.81/32      VSP4000-2           4051 1/48             10         2           External    7
GRT       -        -        10.0.0.81/32      VSP4000-2           4052 1/48             10         2           External    7
GRT       -        -        10.0.0.82/32      VSP4000-1           4051 1/47             10         2           External    7
GRT       -        -        10.0.0.82/32      VSP4000-1           4052 1/47             10         2           External    7
GRT       -        -        10.0.0.82/32      VSP4000-2           4051 1/48             10         2           External    7
GRT       -        -        10.0.0.82/32      VSP4000-2           4052 1/48             10         2           External    7
GRT       -        -        10.0.0.88/32      VSP4000-1           4051 1/47             10         2           External    7
GRT       -        -        10.0.0.88/32      VSP4000-1           4052 1/47             10         2           External    7
GRT       -        -        10.0.0.88/32      VSP4000-2           4051 1/48             10         2           External    7
GRT       -        -        10.0.0.88/32      VSP4000-2           4052 1/48             10         2           External    7
GRT       -        -        172.16.255.0/30   VSP4000-1           4051 1/47             10         1           Internal    7
GRT       -        -        172.16.255.0/30   VSP4000-1           4052 1/47             10         1           Internal    7
GRT       -        -        172.16.255.4/30   VSP4000-2           4051 1/48             10         1           Internal    7
GRT       -        -        172.16.255.4/30   VSP4000-2           4052 1/48             10         1           Internal    7
GRT       -        -        192.168.10.0/24   VSP4000-1           4051 1/47             10         2           External    7
GRT       -        -        192.168.10.0/24   VSP4000-1           4052 1/47             10         2           External    7
GRT       -        -        192.168.10.0/24   VSP4000-2           4051 1/48             10         2           External    7
GRT       -        -        192.168.10.0/24   VSP4000-2           4052 1/48             10         2           External    7
```

```
ERS8800:5#% show isis spbm ip-unicast-fib all
==================================================================================================
                                   SPBM IP-UNICAST FIB ENTRY INFO
==================================================================================================
                                                                 OUTGOING      SPBM          PREFIX
VRF       ISID      Destination       NH BEB                VLAN INTERFACE     COST          COST
--------------------------------------------------------------------------------------------------
GRT       -         10.0.0.41/32      VSP8000-1             4051 3/1           10            2
GRT       -         10.0.0.41/32      VSP8000-1             4052 3/1           10            2
GRT       -         10.0.0.41/32      VSP8000-2             4051 3/2           10            2
GRT       -         10.0.0.41/32      VSP8000-2             4052 3/2           10            2
GRT       -         10.0.0.42/32      VSP8000-1             4051 3/1           10            2
GRT       -         10.0.0.42/32      VSP8000-1             4052 3/1           10            2
GRT       -         10.0.0.42/32      VSP8000-2             4051 3/2           10            2
GRT       -         10.0.0.42/32      VSP8000-2             4052 3/2           10            2
GRT       -         10.0.0.43/32      VSP8000-1             4051 3/1           10            2
GRT       -         10.0.0.43/32      VSP8000-1             4052 3/1           10            2
GRT       -         10.0.0.43/32      VSP8000-2             4051 3/2           10            2
GRT       -         10.0.0.43/32      VSP8000-2             4052 3/2           10            2
GRT       -         10.0.0.81/32      VSP8000-1             4051 3/1           10            1
GRT       -         10.0.0.81/32      VSP8000-1             4052 3/1           10            1
GRT       -         10.0.0.82/32      VSP8000-2             4051 3/2           10            1
GRT       -         10.0.0.82/32      VSP8000-2             4052 3/2           10            1
GRT       -         172.16.10.0/24    VSP8000-1             4051 3/1           10            2
GRT       -         172.16.10.0/24    VSP8000-1             4052 3/1           10            2
GRT       -         172.16.10.0/24    VSP8000-2             4051 3/2           10            2
GRT       -         172.16.10.0/24    VSP8000-2             4052 3/2           10            2
GRT       -         172.16.255.0/30   VSP8000-1             4051 3/1           10            1
GRT       -         172.16.255.0/30   VSP8000-1             4052 3/1           10            1
GRT       -         172.16.255.4/30   VSP8000-2             4051 3/2           10            1
GRT       -         172.16.255.4/30   VSP8000-2             4052 3/2           10            1
```

- Note, ERS8800 cannot make the difference between ISIS External and Internal routes

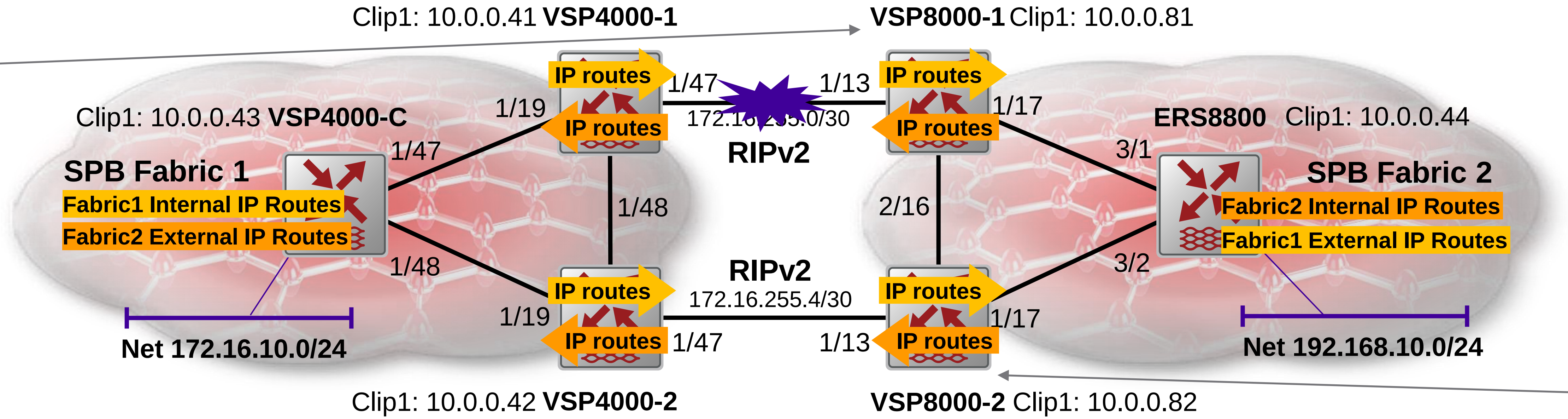
Testing failure on border RIP link

```
interface gigabitEthernet 1/47
   shutdown
exit
```



- RIP is not known as being fast to converge
- But in this deployment model, RIP is running over a single link and failure of that link immediately removes all RIP routes on the Fabric boundary node, so the solution provides sub-second failover anyway
- Link restoration is also quick as a RIP update will immediately be sent as soon as the RIP link is restored

Testing failure on border RIP link

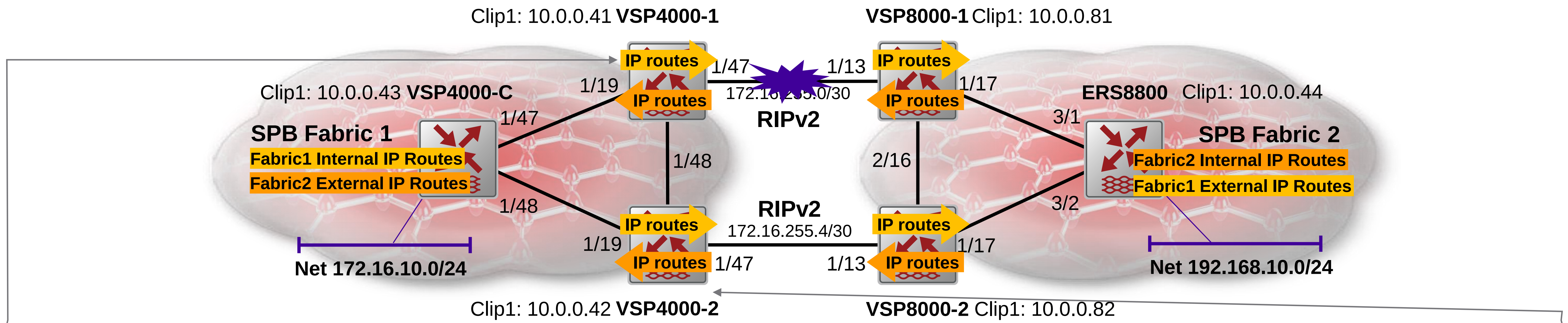



```
VSP8000-1:1#% show ip route
================================================================================
                              IP Route - GlobalRouter
================================================================================
                                          NH                        INTER
DST             MASK            NEXT            VRF/ISID        COST  FACE      PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 VSP8000-2       GlobalRouter    2     4051      ISIS 0   IBS  130
10.0.0.42       255.255.255.255 VSP8000-2       GlobalRouter    2     4051      ISIS 0   IBS  130
10.0.0.43       255.255.255.255 VSP8000-2       GlobalRouter    2     4051      ISIS 0   IBS  130
10.0.0.81       255.255.255.255 10.0.0.81       -               1     0         LOC  0   DB   0
10.0.0.82       255.255.255.255 VSP8000-2       GlobalRouter    10    4051      ISIS 0   IBS  7
10.0.0.88       255.255.255.255 ERS8800         GlobalRouter    10    4051      ISIS 0   IBS  7
172.16.10.0     255.255.255.0   VSP8000-2       GlobalRouter    2     4051      ISIS 0   IBS  130
172.16.255.4    255.255.255.252 VSP8000-2       GlobalRouter    10    4051      ISIS 0   IBS  7
192.168.10.0    255.255.255.0   ERS8800         GlobalRouter    10    4051      ISIS 0   IBS  7
```

```
VSP8000-2:1#% show ip route
================================================================================
                              IP Route - GlobalRouter
================================================================================
                                          NH                        INTER
DST             MASK            NEXT            VRF/ISID        COST  FACE      PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 172.16.255.5    GlobalRouter    2     1/13      RIP  9   IB   100
10.0.0.42       255.255.255.255 172.16.255.5    GlobalRouter    2     1/13      RIP  9   IB   100
10.0.0.43       255.255.255.255 172.16.255.5    GlobalRouter    2     1/13      RIP  9   IB   100
10.0.0.81       255.255.255.255 VSP8000-1       GlobalRouter    10    4051      ISIS 0   IBS  7
10.0.0.82       255.255.255.255 10.0.0.82       -               1     0         LOC  0   DB   0
10.0.0.88       255.255.255.255 ERS8800         GlobalRouter    10    4051      ISIS 0   IBS  7
172.16.10.0     255.255.255.0   172.16.255.5    GlobalRouter    2     1/13      RIP  9   IB   100
172.16.255.4    255.255.255.252 172.16.255.6    -               1     1/13      LOC  0   DB   0
192.168.10.0    255.255.255.0   ERS8800         GlobalRouter    10    4051      ISIS 0   IBS  7
```

- VSP8000-1 is now installing the ISIS External (from RIP) routes from VSP8000-2

Testing failure on border RIP link

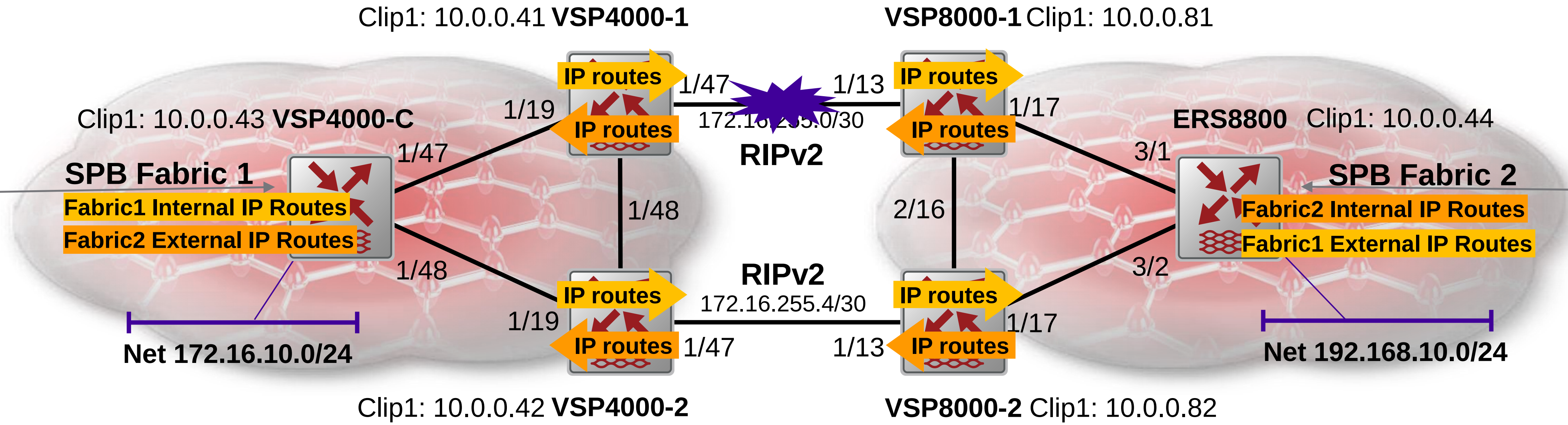



```
VSP4000-1:1#% show ip route
====================================================================================================
                                     IP Route - GlobalRouter
====================================================================================================
                                                    NH                       INTER
DST             MASK            NEXT                VRF/ISID         COST    FACE      PROT AGE TYPE PRF
----------------------------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 10.0.0.41           -                1       0         LOC  0   DB   0
10.0.0.42       255.255.255.255 VSP4000-2           GlobalRouter     10      4051      ISIS 0   IBS  7
10.0.0.43       255.255.255.255 VSP4000-C           GlobalRouter     10      4051      ISIS 0   IBS  7
10.0.0.81       255.255.255.255 VSP4000-2           GlobalRouter     2       4051      ISIS 0   IBS  130
10.0.0.82       255.255.255.255 VSP4000-2           GlobalRouter     2       4051      ISIS 0   IBS  130
10.0.0.88       255.255.255.255 VSP4000-2           GlobalRouter     2       4051      ISIS 0   IBS  130
172.16.10.0     255.255.255.0   VSP4000-C           GlobalRouter     10      4051      ISIS 0   IBS  7
172.16.255.4    255.255.255.252 VSP4000-2           GlobalRouter     10      4051      ISIS 0   IBS  7
192.168.10.0    255.255.255.0   VSP4000-2           GlobalRouter     2       4051      ISIS 0   IBS  130
```

```
VSP4000-2:1#% show ip route
====================================================================================================
                                     IP Route - GlobalRouter
====================================================================================================
                                                    NH                       INTER
DST             MASK            NEXT                VRF/ISID         COST    FACE      PROT AGE TYPE PRF
----------------------------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 VSP4000-1           GlobalRouter     10      4051      ISIS 0   IBS  7
10.0.0.42       255.255.255.255 10.0.0.42           -                1       0         LOC  0   DB   0
10.0.0.43       255.255.255.255 VSP4000-C           GlobalRouter     10      4051      ISIS 0   IBS  7
10.0.0.81       255.255.255.255 172.16.255.6        GlobalRouter     2       1/47      RIP  13  IB   100
10.0.0.82       255.255.255.255 172.16.255.6        GlobalRouter     2       1/47      RIP  13  IB   100
10.0.0.88       255.255.255.255 172.16.255.6        GlobalRouter     2       1/47      RIP  13  IB   100
172.16.10.0     255.255.255.0   VSP4000-C           GlobalRouter     10      4051      ISIS 0   IBS  7
172.16.255.4    255.255.255.252 172.16.255.5        -                1       1/47      LOC  0   DB   0
192.168.10.0    255.255.255.0   172.16.255.6        GlobalRouter     2       1/47      RIP  13  IB   100
```

- VSP4000-1 is now installing the ISIS External (from RIP) routes from VSP4000-2

Testing failure on border RIP link

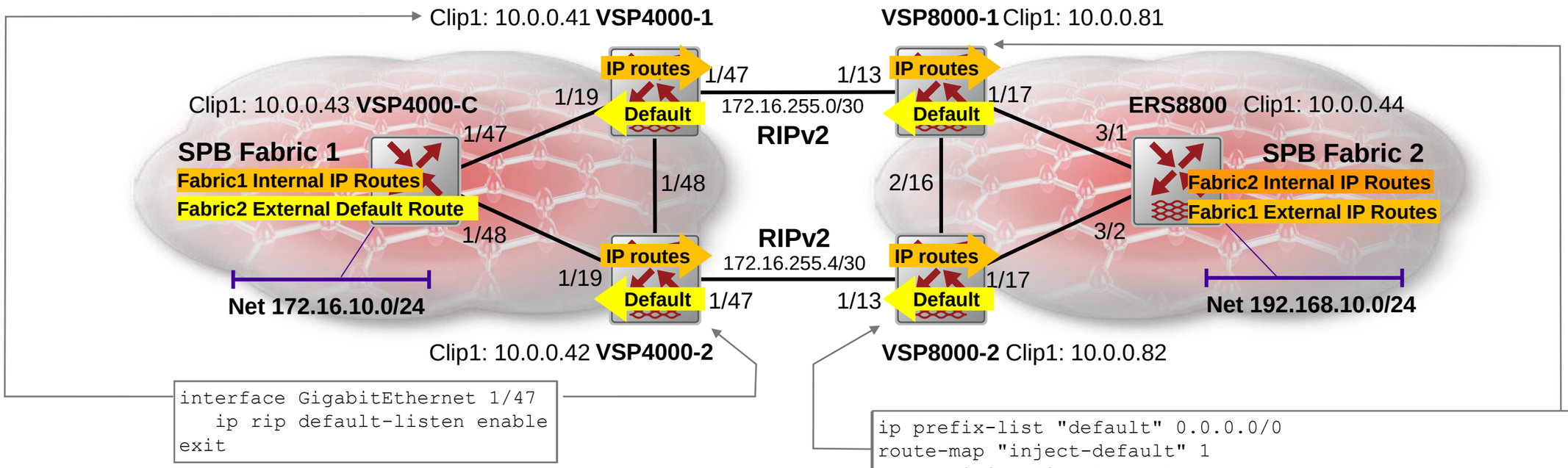



```
VSP4000-C:1#% show ip route
================================================================================
                               IP Route - GlobalRouter
================================================================================
                                          NH                     INTER
DST             MASK            NEXT              VRF/ISID        COST  FACE     PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 VSP4000-1         GlobalRouter    10    4051     ISIS 0   IBS  7
10.0.0.42       255.255.255.255 VSP4000-2         GlobalRouter    10    4051     ISIS 0   IBS  7
10.0.0.43       255.255.255.255 10.0.0.43         -               1     0        LOC  0   DB   0
10.0.0.81       255.255.255.255 VSP4000-2         GlobalRouter    2     4051     ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP4000-2         GlobalRouter    2     4051     ISIS 0   IBS  7
10.0.0.88       255.255.255.255 VSP4000-2         GlobalRouter    2     4051     ISIS 0   IBS  7
172.16.10.0     255.255.255.0   172.16.10.1       -               1     0        LOC  0   DB   0
172.16.255.4    255.255.255.252 VSP4000-2         GlobalRouter    10    4051     ISIS 0   IBS  7
192.168.10.0    255.255.255.0   VSP4000-2         GlobalRouter    2     4051     ISIS 0   IBS  7
```

```
ERS8800:5#% show ip route
================================================================================
                               IP Route - GlobalRouter
================================================================================
                                                  NH                INTER
DST             MASK            NEXT              VRF           COST FACE  PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.41       255.255.255.255 VSP8000-2         GlobalRout~   10   4051  ISIS 0   IBS  7
10.0.0.42       255.255.255.255 VSP8000-2         GlobalRout~   10   4051  ISIS 0   IBS  7
10.0.0.43       255.255.255.255 VSP8000-2         GlobalRout~   10   4051  ISIS 0   IBS  7
10.0.0.81       255.255.255.255 VSP8000-1         GlobalRout~   10   4051  ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP8000-2         GlobalRout~   10   4051  ISIS 0   IBS  7
10.0.0.88       255.255.255.255 10.0.0.88          -            1    0     LOC  0   DB   0
172.16.10.0     255.255.255.0   VSP8000-2         GlobalRout~   10   4051  ISIS 0   IBS  7
172.16.255.4    255.255.255.252 VSP8000-2         GlobalRout~   10   4051  ISIS 0   IBS  7
192.168.10.0    255.255.255.0   192.168.10.1       -            1    0     LOC  0   DB   0
```

- Looking good

Redistributing Default route in one direction - Config

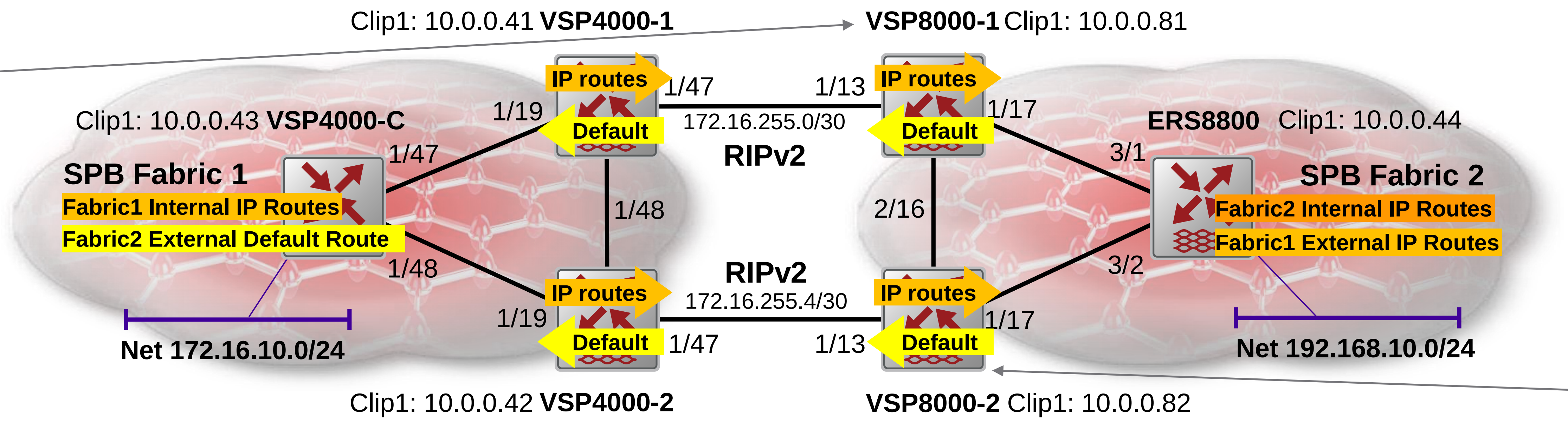



```
interface GigabitEthernet 1/47
   ip rip default-listen enable
exit
```

```
ip prefix-list "default" 0.0.0.0/0
route-map "inject-default" 1
   set injectlist "default"
   enable
exit
router rip
   redistribute isis route-map "inject-default"
   no redistribute direct
exit
ip rip apply redistribute isis
ip route 0.0.0.0 0.0.0.0 255.255.255.255 weight 65535 preference 8
interface GigabitEthernet 1/13
   ip rip default-supply enable
exit
```

- The route-map policy will match any (ISIS) route but replace it with (inject) a default route
  - If VSP8000 remains isolated and has no ISIS routes it will cease to announce a default route
- We are also taking the pre-caution of configuring a corresponding default static black-hole route on the VSP8000s with a preference of 8
  - If a valid ISIS default route exists, this will have a higher preference of 7 and will replace the static black-hole default route
  - If a valid ISIS default route does not exist, then any traffic received from the other fabric which cannot be handled via more specific routes, will be dropped on the VSP8000s
- We also delete the RIP redistribution of direct routes, as we no longer needed it now
- And RIP interfaces need to be configured to supply default route on one side and accept it on the other

Redistributing Default route in one direction - Checking

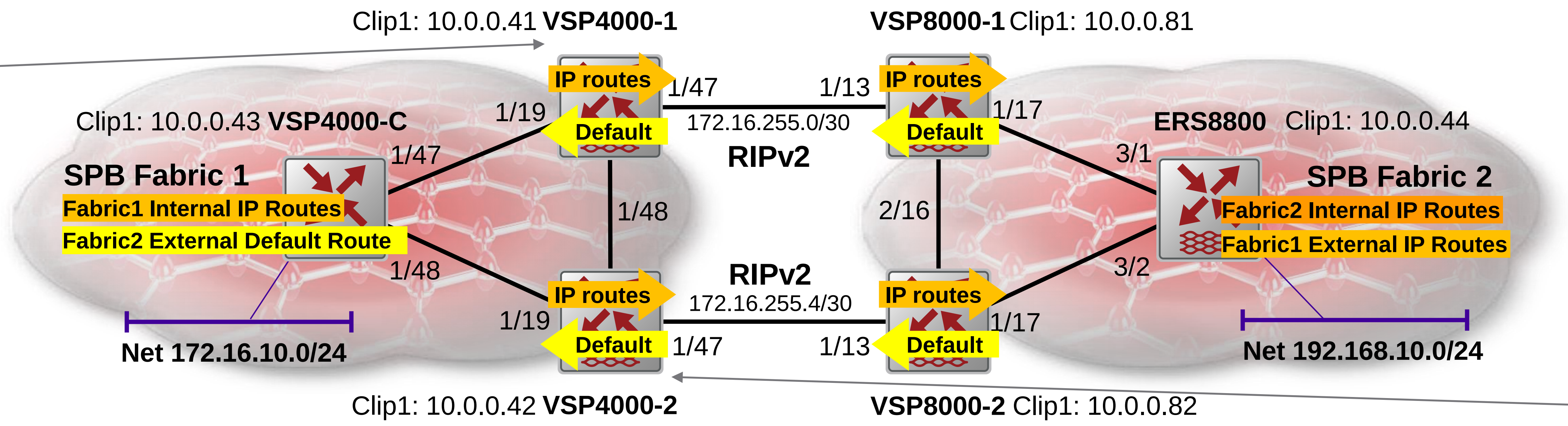



```
VSP8000-1:1#% show ip route
================================================================================================
                                   IP Route - GlobalRouter
================================================================================================
                                                    NH                         INTER
DST            MASK            NEXT                 VRF/ISID        COST       FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
0.0.0.0        0.0.0.0         255.255.255.255      -               65535      0         STAT  0    IB    8
10.0.0.41      255.255.255.255 172.16.255.1         GlobalRouter    2          1/13      RIP   8    IB    100
10.0.0.42      255.255.255.255 172.16.255.1         GlobalRouter    2          1/13      RIP   8    IB    100
10.0.0.43      255.255.255.255 172.16.255.1         GlobalRouter    2          1/13      RIP   8    IB    100
10.0.0.81      255.255.255.255 10.0.0.81            -               1          0         LOC   0    DB    0
10.0.0.82      255.255.255.255 VSP8000-2            GlobalRouter    10         4051      ISIS  0    IBS   7
10.0.0.88      255.255.255.255 ERS8800              GlobalRouter    10         4051      ISIS  0    IBS   7
172.16.10.0    255.255.255.0   172.16.255.1         GlobalRouter    2          1/13      RIP   8    IB    100
172.16.255.0   255.255.255.252 172.16.255.2         -               1          1/13      LOC   0    DB    0
172.16.255.4   255.255.255.252 VSP8000-2            GlobalRouter    10         4051      ISIS  0    IBS   7
192.168.10.0   255.255.255.0   ERS8800              GlobalRouter    10         4051      ISIS  0    IBS   7
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                   IP Route - GlobalRouter
================================================================================================
                                                    NH                         INTER
DST            MASK            NEXT                 VRF/ISID        COST       FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
0.0.0.0        0.0.0.0         255.255.255.255      -               65535      0         STAT  0    IB    8
10.0.0.41      255.255.255.255 172.16.255.5         GlobalRouter    2          1/13      RIP   8    IB    100
10.0.0.42      255.255.255.255 172.16.255.5         GlobalRouter    2          1/13      RIP   8    IB    100
10.0.0.43      255.255.255.255 172.16.255.5         GlobalRouter    2          1/13      RIP   8    IB    100
10.0.0.81      255.255.255.255 VSP8000-1            GlobalRouter    10         4051      ISIS  0    IBS   7
10.0.0.82      255.255.255.255 10.0.0.82            -               1          0         LOC   0    DB    0
10.0.0.88      255.255.255.255 ERS8800              GlobalRouter    10         4051      ISIS  0    IBS   7
172.16.10.0    255.255.255.0   172.16.255.5         GlobalRouter    2          1/13      RIP   8    IB    100
172.16.255.0   255.255.255.252 VSP8000-1            GlobalRouter    10         4051      ISIS  0    IBS   7
172.16.255.4   255.255.255.252 172.16.255.6         -               1          1/13      LOC   0    DB    0
192.168.10.0   255.255.255.0   ERS8800              GlobalRouter    10         4051      ISIS  0    IBS   7
```

- There is no default ISIS route in Fabric2, so the black-hole defaults are active

Redistributing Default route in one direction - Checking

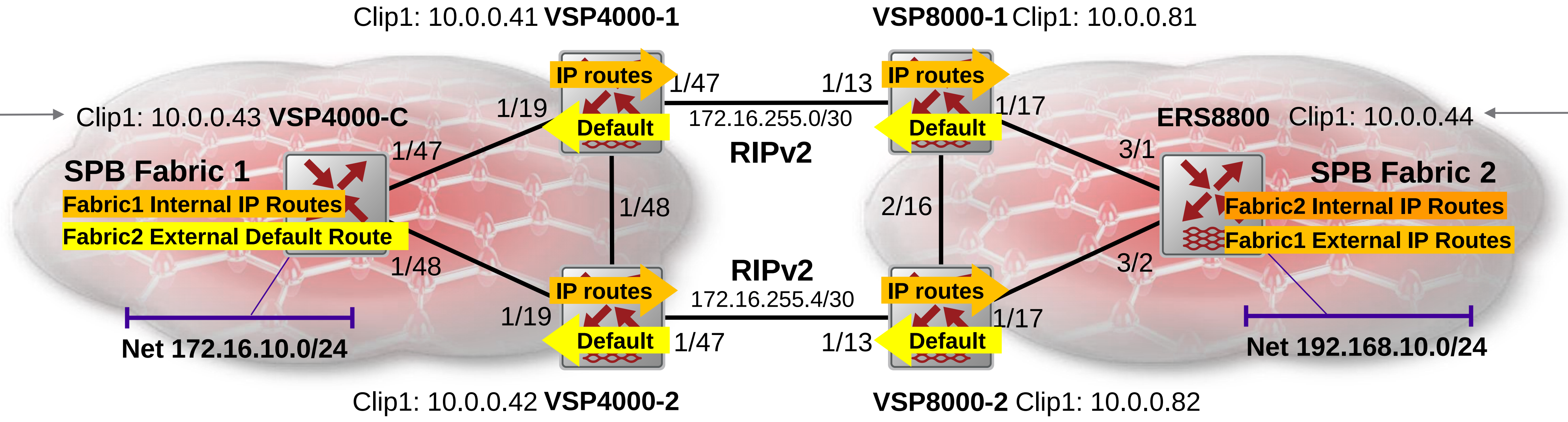



```
VSP4000-1:1#% show ip route
================================================================================================
                                   IP Route - GlobalRouter
================================================================================================
                                                    NH                          INTER
DST            MASK            NEXT                 VRF/ISID           COST     FACE      PROT  AGE  TYPE  PRF
-------------------------------------------------------------------------------------------------------------
0.0.0.0        0.0.0.0         172.16.255.2         GlobalRouter       2        1/47      RIP   22   IB    100
10.0.0.41      255.255.255.255 10.0.0.41            -                  1        0         LOC   0    DB    0
10.0.0.42      255.255.255.255 VSP4000-2            GlobalRouter       10       4051      ISIS  0    IBS   7
10.0.0.43      255.255.255.255 VSP4000-C            GlobalRouter       10       4051      ISIS  0    IBS   7
172.16.10.0    255.255.255.0   VSP4000-C            GlobalRouter       10       4051      ISIS  0    IBS   7
172.16.255.0   255.255.255.252 172.16.255.1         -                  1        1/47      LOC   0    DB    0
172.16.255.4   255.255.255.252 VSP4000-2            GlobalRouter       10       4051      ISIS  0    IBS   7
```

```
VSP4000-2:1#% show ip route
================================================================================================
                                   IP Route - GlobalRouter
================================================================================================
                                                    NH                          INTER
DST            MASK            NEXT                 VRF/ISID           COST     FACE      PROT  AGE  TYPE  PRF
-------------------------------------------------------------------------------------------------------------
0.0.0.0        0.0.0.0         172.16.255.6         GlobalRouter       2        1/47      RIP   10   IB    100
10.0.0.41      255.255.255.255 VSP4000-1            GlobalRouter       10       4051      ISIS  0    IBS   7
10.0.0.42      255.255.255.255 10.0.0.42            -                  1        0         LOC   0    DB    0
10.0.0.43      255.255.255.255 VSP4000-C            GlobalRouter       10       4051      ISIS  0    IBS   7
172.16.10.0    255.255.255.0   VSP4000-C            GlobalRouter       10       4051      ISIS  0    IBS   7
172.16.255.0   255.255.255.252 VSP4000-1            GlobalRouter       10       4051      ISIS  0    IBS   7
172.16.255.4   255.255.255.252 172.16.255.5         -                  1        1/47      LOC   0    DB    0
```

- Fabric1 border nodes are now learning just a default route from RIP

Redistributing Default route in one direction - Checking

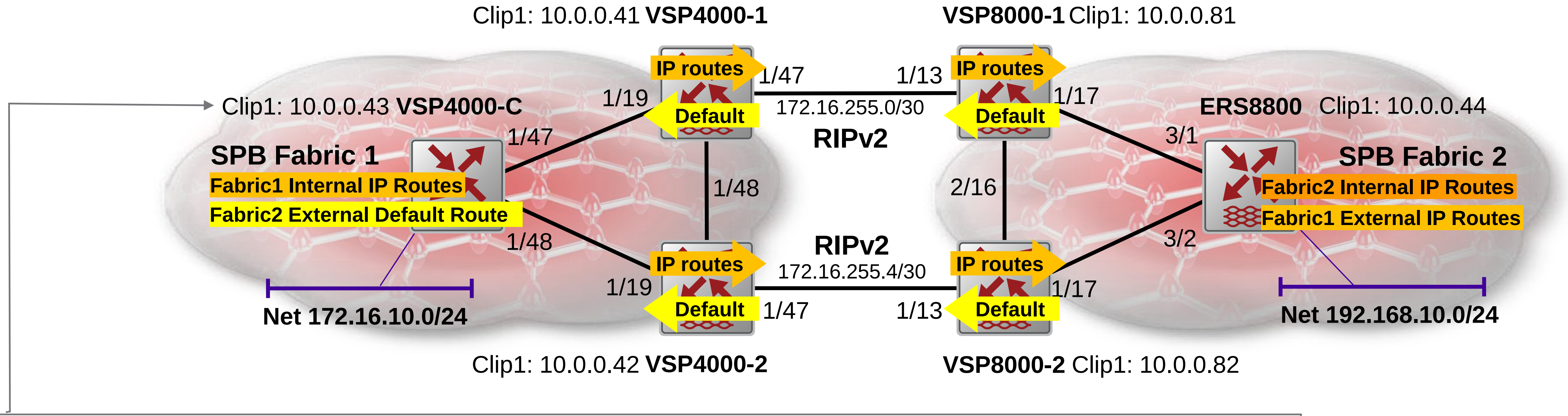



```
VSP4000-C:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                        INTER
DST              MASK             NEXT             VRF/ISID          COST    FACE     PROT  AGE TYPE PRF
--------------------------------------------------------------------------------------------------------
0.0.0.0          0.0.0.0          VSP4000-1        GlobalRouter      2       4051     ISIS  0   IBS  7
10.0.0.41        255.255.255.255  VSP4000-1        GlobalRouter      10      4051     ISIS  0   IBS  7
10.0.0.42        255.255.255.255  VSP4000-2        GlobalRouter      10      4051     ISIS  0   IBS  7
10.0.0.43        255.255.255.255  10.0.0.43        -                 1       0        LOC   0   DB   0
172.16.10.0      255.255.255.0    172.16.10.1      -                 1       0        LOC   0   DB   0
172.16.255.0     255.255.255.252  VSP4000-1        GlobalRouter      10      4051     ISIS  0   IBS  7
172.16.255.4     255.255.255.252  VSP4000-2        GlobalRouter      10      4051     ISIS  0   IBS  7
```

```
ERS8800:5#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                  INTER
DST              MASK             NEXT             VRF           COST  FACE   PROT  AGE TYPE PRF
------------------------------------------------------------------------------------------------
10.0.0.41        255.255.255.255  VSP8000-1        GlobalRout~   10    4051   ISIS  0   IBS  7
10.0.0.42        255.255.255.255  VSP8000-1        GlobalRout~   10    4051   ISIS  0   IBS  7
10.0.0.43        255.255.255.255  VSP8000-1        GlobalRout~   10    4051   ISIS  0   IBS  7
10.0.0.81        255.255.255.255  VSP8000-1        GlobalRout~   10    4051   ISIS  0   IBS  7
10.0.0.82        255.255.255.255  VSP8000-2        GlobalRout~   10    4051   ISIS  0   IBS  7
10.0.0.88        255.255.255.255  10.0.0.88         -            1     0      LOC   0   DB   0
172.16.10.0      255.255.255.0    VSP8000-1        GlobalRout~   10    4051   ISIS  0   IBS  7
172.16.255.0     255.255.255.252  VSP8000-1        GlobalRout~   10    4051   ISIS  0   IBS  7
172.16.255.4     255.255.255.252  VSP8000-2        GlobalRout~   10    4051   ISIS  0   IBS  7
192.168.10.0     255.255.255.0    192.168.10.1      -            1     0      LOC   0   DB   0
```

- Fabric1 nodes now have a default route
- Fabric2 has no default ISIS route (it could, but this was not done in this setup)

Redistributing Default route in one direction - Checking



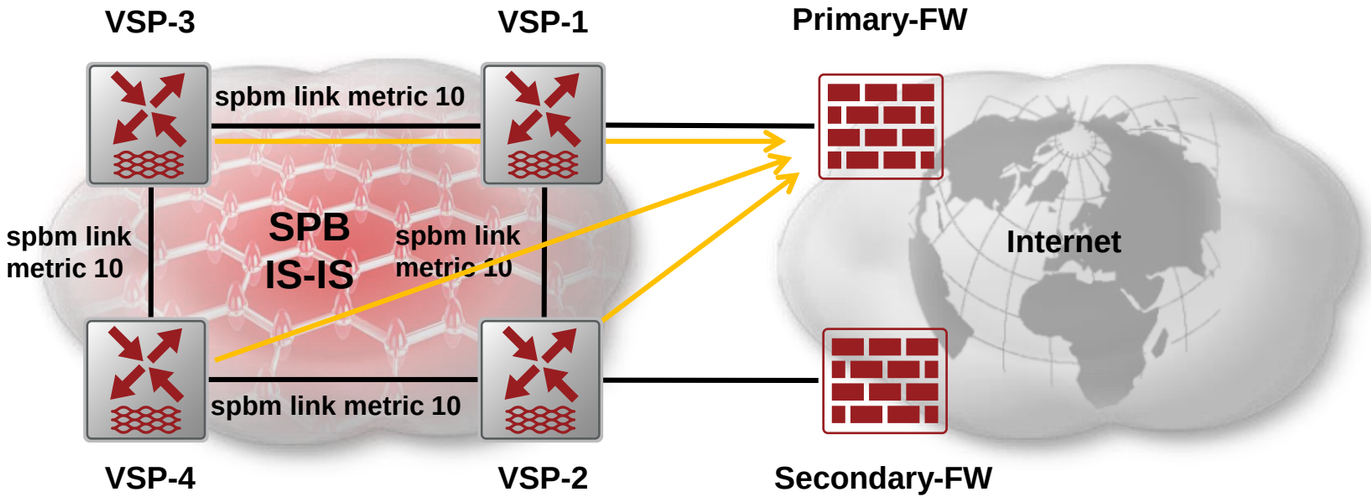

```
VSP4000-C:1#% show isis spbm ip-unicast-fib all
================================================================================================================================
                                              SPBM IP-UNICAST FIB ENTRY INFO
================================================================================================================================
          VRF      DEST                                                OUTGOING         SPBM      PREFIX    PREFIX    IP ROUTE
VRF       ISID     ISID     Destination        NH BEB             VLAN INTERFACE        COST      COST      TYPE      PREFERENCE
--------------------------------------------------------------------------------------------------------------------------------
GRT       -        -        0.0.0.0/0          VSP4000-1          4051 1/47             10        2         External  7
GRT       -        -        0.0.0.0/0          VSP4000-1          4052 1/47             10        2         External  7
GRT       -        -        0.0.0.0/0          VSP4000-2          4051 1/48             10        2         External  7
GRT       -        -        0.0.0.0/0          VSP4000-2          4052 1/48             10        2         External  7
GRT       -        -        10.0.0.41/32       VSP4000-1          4051 1/47             10        1         Internal  7
GRT       -        -        10.0.0.41/32       VSP4000-1          4052 1/47             10        1         Internal  7
GRT       -        -        10.0.0.42/32       VSP4000-2          4051 1/48             10        1         Internal  7
GRT       -        -        10.0.0.42/32       VSP4000-2          4052 1/48             10        1         Internal  7
GRT       -        -        172.16.255.0/30    VSP4000-1          4051 1/47             10        1         Internal  7
GRT       -        -        172.16.255.0/30    VSP4000-1          4052 1/47             10        1         Internal  7
GRT       -        -        172.16.255.4/30    VSP4000-2          4051 1/48             10        1         Internal  7
GRT       -        -        172.16.255.4/30    VSP4000-2          4052 1/48             10        1         Internal  7
```

- We can see default route is advertised as an External ISIS route

Routing towards a Primary Firewall

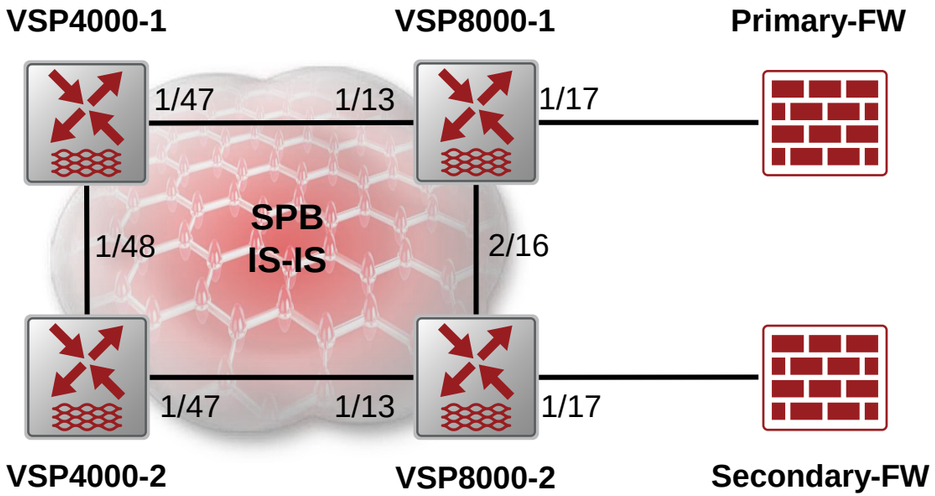
Leveraging IS-IS External routes

Routing to a Primary Firewall



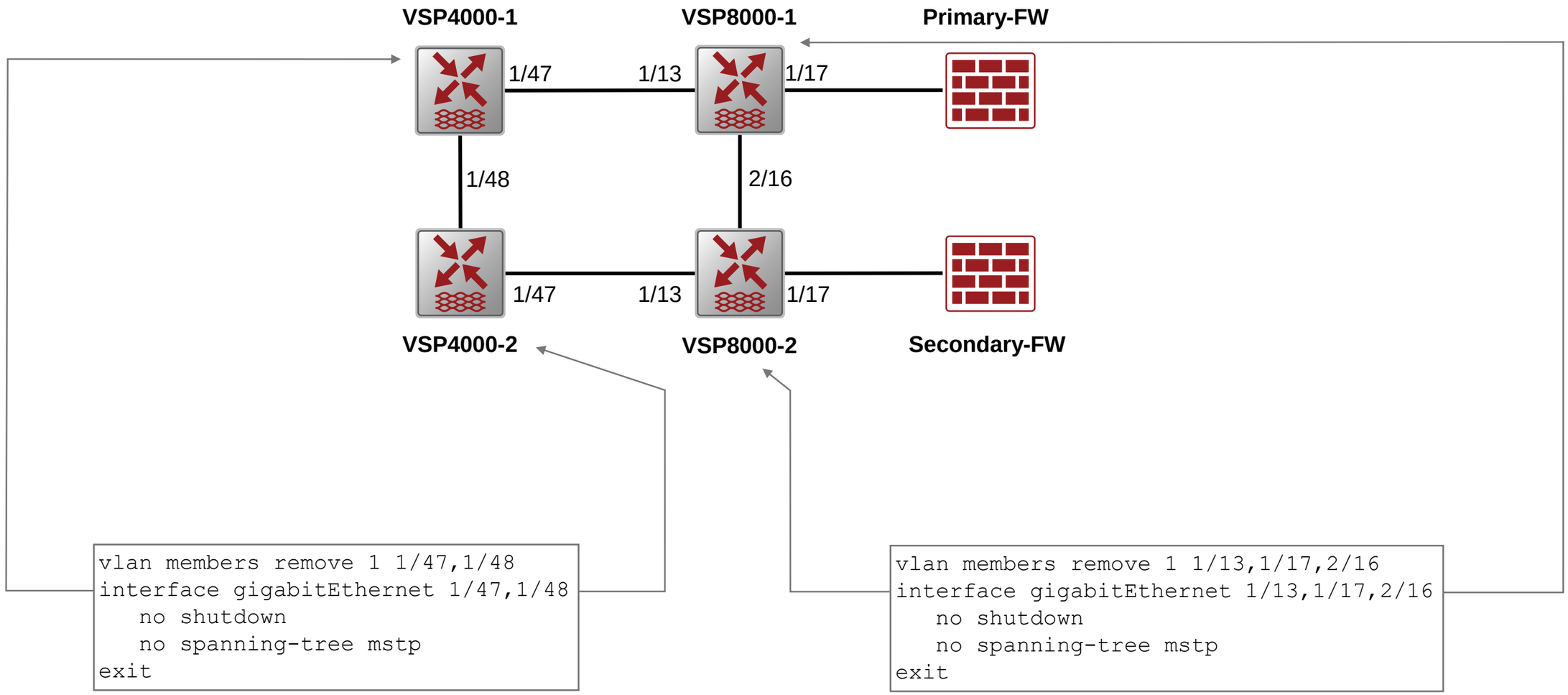
- Both Primary and Secondary FWs advertise the same IP route(s)
  - Typically a default route
- The goal is to make all SPB Fabric nodes always go to the Primary FW (even if the Secondary FW, connected to VSP-2 is on an SPB shortest path)
- This is not possible using ISIS “Internal” IP routes, because the IP route with the lowest SPB internal metric (SPB path to VSP-1 vs SPB path to VSP-2) will always be preferred
  - Even if the Primary FW IP route metric is made lower (on VSP-1) than the metric used for the same route to the Secondary FW (on VSP-2)
  - ➔ VSP-4 will always prefer to go to VSP-2, because a shorter SPB path than going to VSP-1

Setup, Equipment & Software used

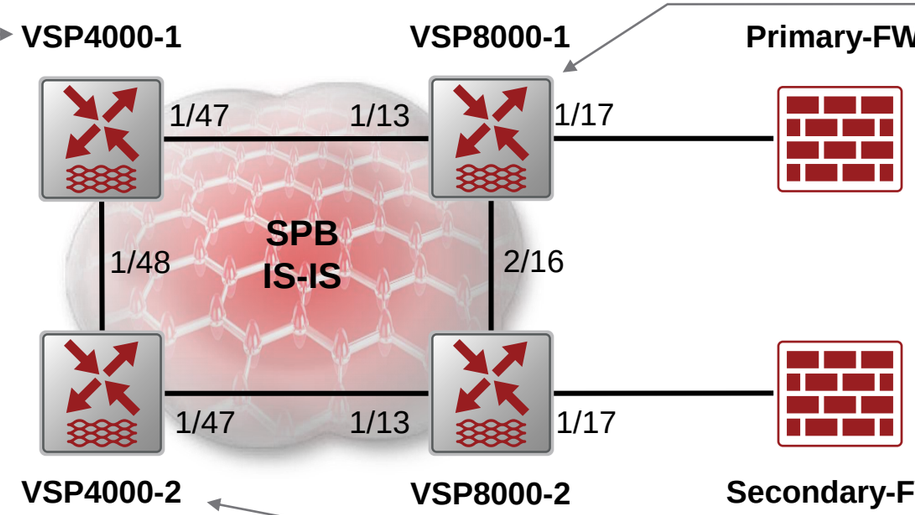


- VSP4000-1, VSP4000-2
  - VSP 4850GTS-PWR+ / 6.1.0.0_B021
- VSP8000-1
  - VSP 8404 / 6.1.0.0_B021
    - Slot1 8424GT
    - Slot2 8418XSQ
- VSP8000-2
  - VSP 8242XSQ / 6.1.0.0_B021

Port Config



SPB Global Config



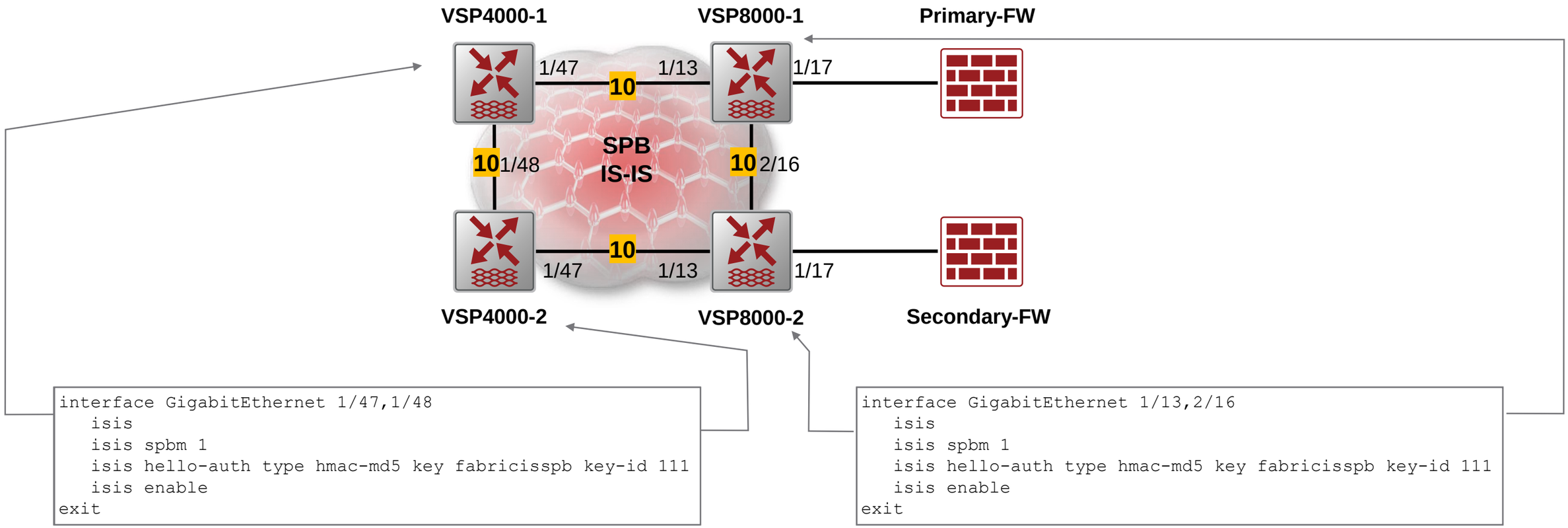

```
prompt VSP4000-1
interface loopback 1
   ip address 10.0.0.41/32
exit
spbm
router isis
   system-id 00bb.0000.4100
   manual-area 49.0000
   ip-source-address 10.0.0.41
   spbm 1
   spbm 1 nick-name 0.00.41
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 41
cfm spbm enable
```

```
prompt VSP8000-1
interface loopback 1
   ip address 10.0.0.81/32
exit
spbm
router isis
   system-id 00bb.0000.8100
   manual-area 49.0000
   ip-source-address 10.0.0.81
   spbm 1
   spbm 1 nick-name 0.00.81
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 81
cfm spbm enable
```

```
prompt VSP4000-2
interface loopback 1
   ip address 10.0.0.42/32
exit
spbm
router isis
   system-id 00bb.0000.4200
   manual-area 49.0000
   ip-source-address 10.0.0.42
   spbm 1
   spbm 1 nick-name 0.00.42
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 42
cfm spbm enable
```

```
prompt VSP8000-2
interface loopback 1
   ip address 10.0.0.82/32
exit
spbm
router isis
   system-id 00bb.0000.8200
   manual-area 49.0000
   ip-source-address 10.0.0.82
   spbm 1
   spbm 1 nick-name 0.00.82
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 82
cfm spbm enable
```

SPB Interface Config

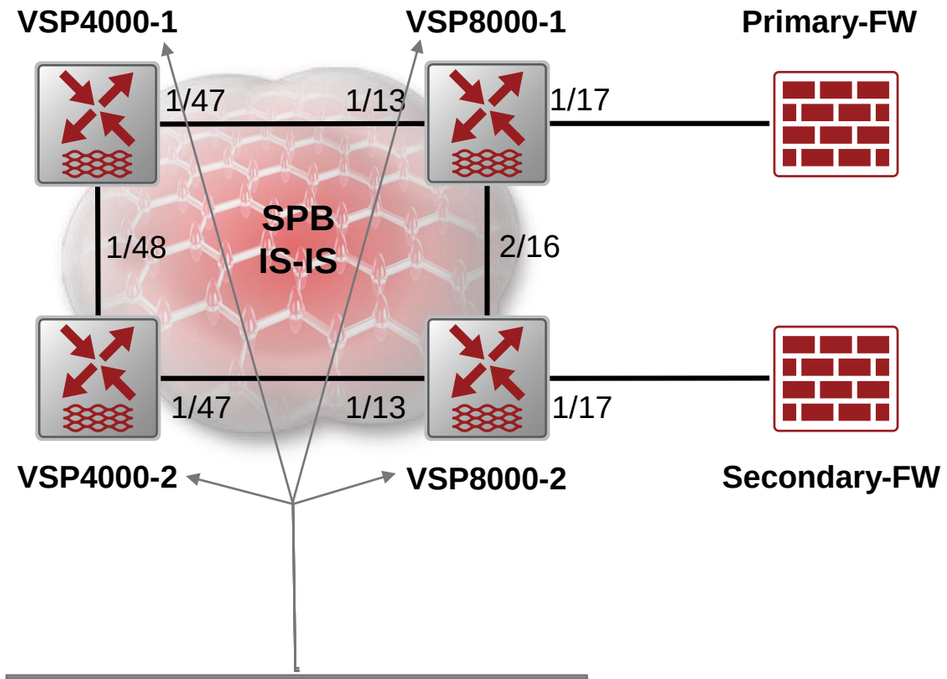



```
interface GigabitEthernet 1/47,1/48
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

```
interface GigabitEthernet 1/13,2/16
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

- All ISIS NNI links use default SPBM L1-metric of 10

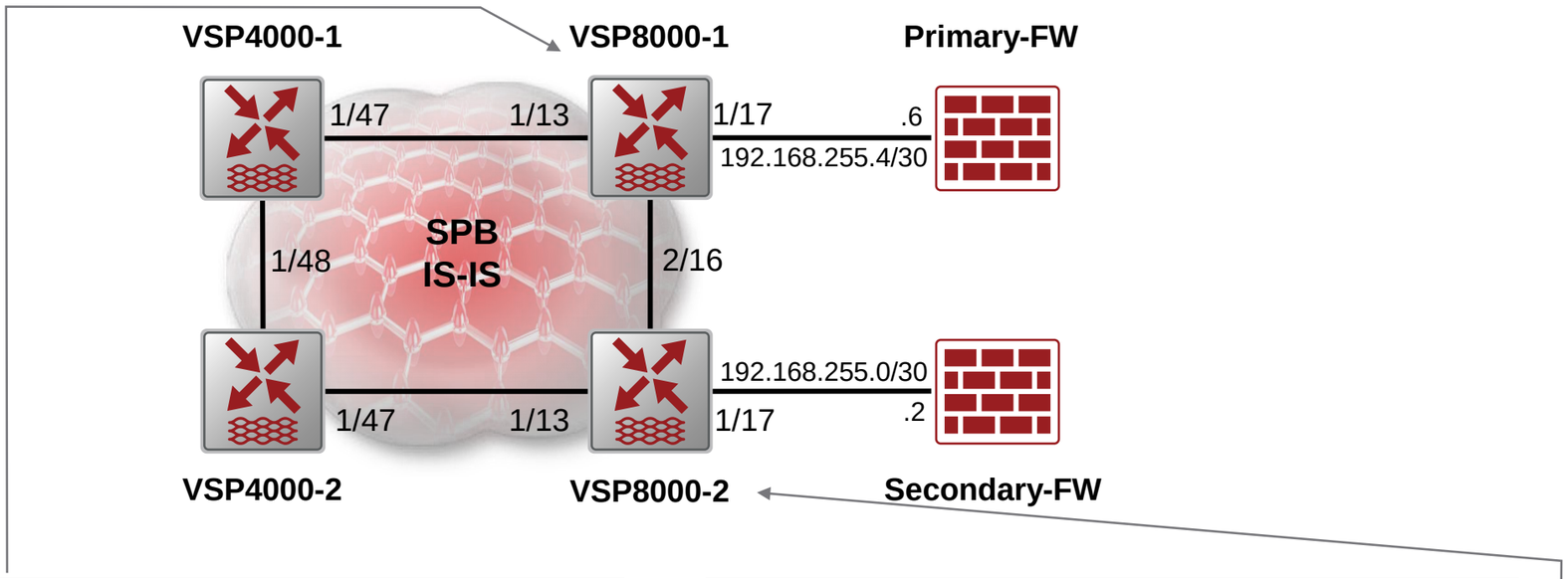
IP Shortcuts Direct Redistribution




```
router isis
   redistribute direct
   redistribute direct enable
exit
isis apply redistribute direct
```

- Redistribution of direct routes will most likely be in place, so we enable it

Firewalls Static Route ➔ ISIS External Route

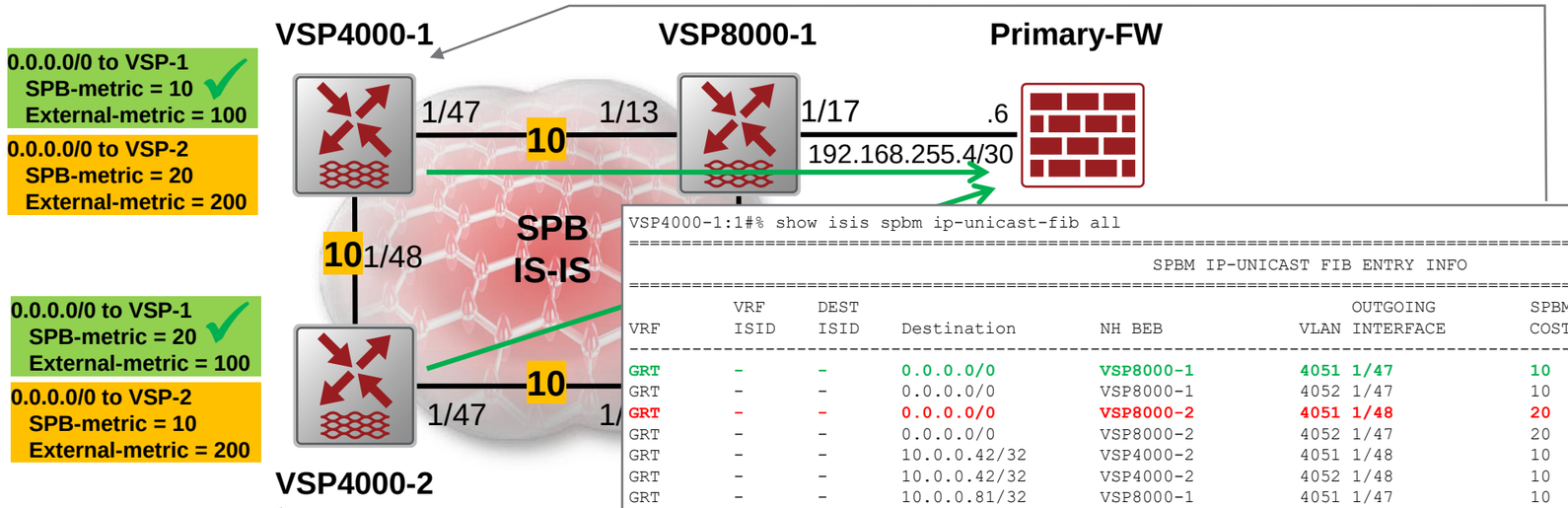



```
interface GigabitEthernet 1/17
   brouter vlan 3901 subnet 192.168.255.5/30
exit
ip route 0.0.0.0 0.0.0.0 192.168.255.6 weight 100
router isis
   redistribute static
   redistribute static metric-type external
   redistribute static enable
exit
isis apply redistribute static
```

```
interface GigabitEthernet 1/17
   brouter vlan 3901 subnet 192.168.255.1/30
exit
ip route 0.0.0.0 0.0.0.0 192.168.255.2 weight 200
router isis
   redistribute static
   redistribute static metric-type external
   redistribute static enable
exit
isis apply redistribute static
```

- We create a default static route
- And we redistributed into ISIS as an “External” route

Firewalls Static Route ➔ ISIS External Route - Checking



VSP4000-1:1#% show isis spbm ip-unicast-fib all

SPBM IP-UNICAST FIB ENTRY INFO

VRF	VRF ISID	DEST ISID	Destination	NH BEB	VLAN	OUTGOING INTERFACE	SPBM COST	PREFIX COST	PREFIX TYPE	IP ROUTE PREFERENCE
GRT	-	-	0.0.0.0/0	VSP8000-1	4051	1/47	10	100 ✓	External	7
GRT	-	-	0.0.0.0/0	VSP8000-1	4052	1/47	10	100	External	7
GRT	-	-	0.0.0.0/0	VSP8000-2	4051	1/48	20	200	External	7
GRT	-	-	0.0.0.0/0	VSP8000-2	4052	1/47	20	200	External	7
GRT	-	-	10.0.0.42/32	VSP4000-2	4051	1/48	10	1	Internal	7
GRT	-	-	10.0.0.42/32	VSP4000-2	4052	1/48	10	1	Internal	7
GRT	-	-	10.0.0.81/32	VSP8000-1	4051	1/47	10	1	Internal	7
GRT	-	-	10.0.0.81/32	VSP8000-1	4052	1/47	10	1	Internal	7
GRT	-	-	10.0.0.82/32	VSP8000-2	4051	1/48	20	1	Internal	7
GRT	-	-	10.0.0.82/32	VSP8000-2	4052	1/47	20	1	Internal	7
GRT	-	-	192.168.255.0/30	VSP8000-2	4051	1/48	20	1	Internal	7
GRT	-	-	192.168.255.0/30	VSP8000-2	4052	1/47	20	1	Internal	7
GRT	-	-	192.168.255.4/30	VSP8000-1	4051	1/47	10	1	Internal	7
GRT	-	-	192.168.255.4/30	VSP8000-1	4052	1/47	10	1	Internal	7

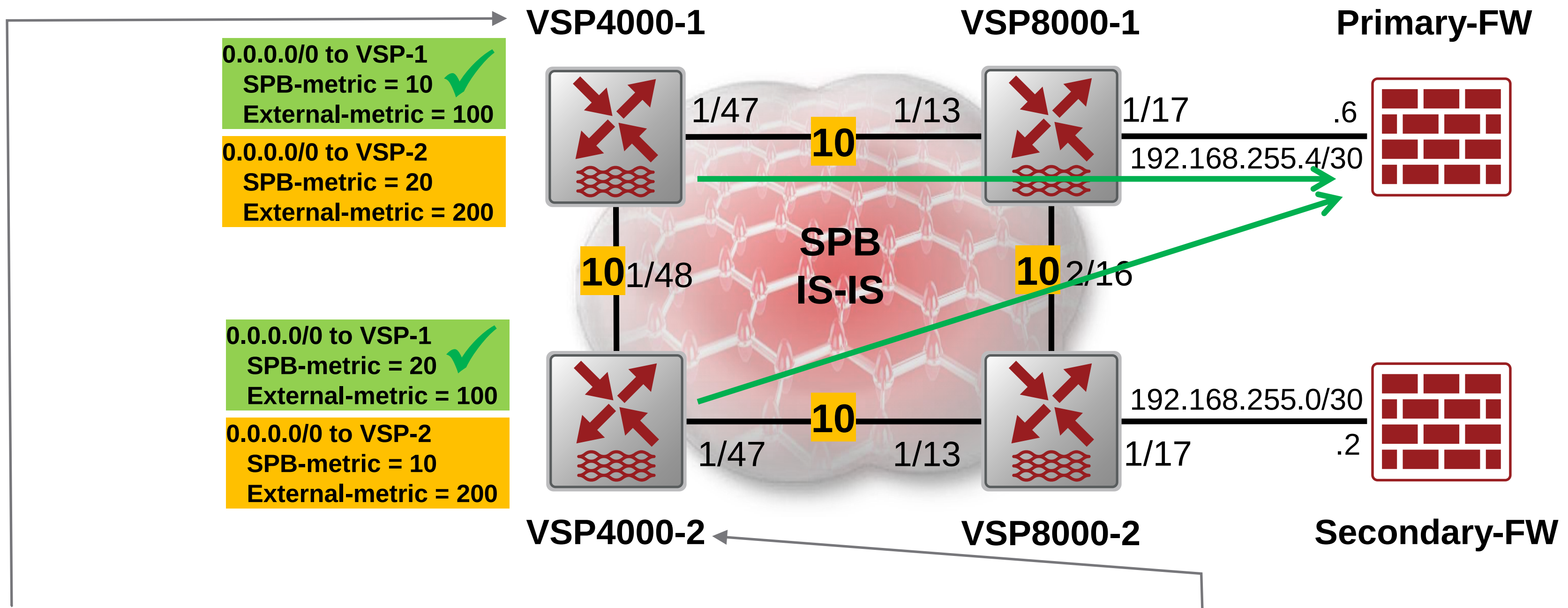
VSP4000-2:1#% show isis spbm ip-unicast-fib all

SPBM IP-UNICAST FIB ENTRY INFO

VRF	VRF ISID	DEST ISID	Destination	NH BEB	VLAN	OUTGOING INTERFACE	SPBM COST	PREFIX COST	PREFIX TYPE	IP ROUTE PREFERENCE
GRT	-	-	0.0.0.0/0	VSP8000-1	4051	1/48	20	100 ✓	External	7
GRT	-	-	0.0.0.0/0	VSP8000-1	4052	1/47	20	100	External	7
GRT	-	-	0.0.0.0/0	VSP8000-2	4051	1/47	10	200	External	7
GRT	-	-	0.0.0.0/0	VSP8000-2	4052	1/47	10	200	External	7
GRT	-	-	10.0.0.41/32	VSP4000-1	4051	1/48	10	1	Internal	7
GRT	-	-	10.0.0.41/32	VSP4000-1	4052	1/48	10	1	Internal	7
GRT	-	-	10.0.0.81/32	VSP8000-1	4051	1/48	20	1	Internal	7
GRT	-	-	10.0.0.81/32	VSP8000-1	4052	1/47	20	1	Internal	7
GRT	-	-	10.0.0.82/32	VSP8000-2	4051	1/47	10	1	Internal	7
GRT	-	-	10.0.0.82/32	VSP8000-2	4052	1/47	10	1	Internal	7
GRT	-	-	192.168.255.0/30	VSP8000-2	4051	1/47	10	1	Internal	7
GRT	-	-	192.168.255.0/30	VSP8000-2	4052	1/47	10	1	Internal	7
GRT	-	-	192.168.255.4/30	VSP8000-1	4051	1/48	20	1	Internal	7
GRT	-	-	192.168.255.4/30	VSP8000-1	4052	1/47	20	1	Internal	7

- We can see here that the VSP4000s are seeing both default routes as External
- The External route with the lowest Prefix-cost wins
  - The internal SPB cost is ignored

Firewalls Static Route ➔ ISIS External Route - Checking

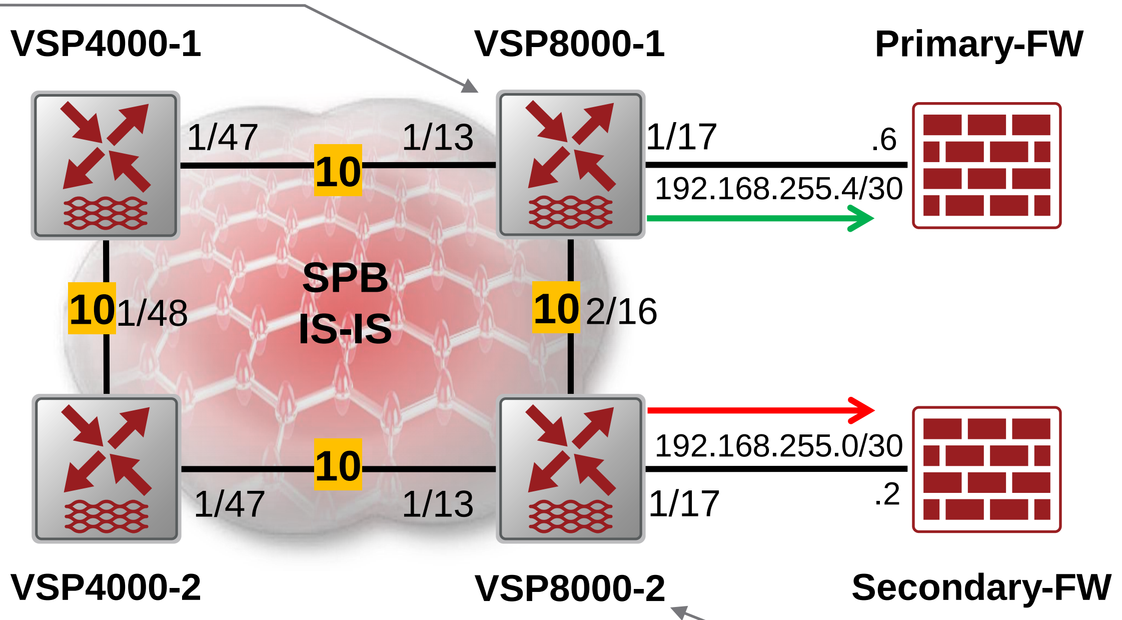



```
VSP4000-1:1#% show ip route
======================================================================================================
                                       IP Route - GlobalRouter
======================================================================================================
                                                    NH                            INTER
DST              MASK             NEXT              VRF/ISID          COST        FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------------
0.0.0.0          0.0.0.0          VSP8000-1         GlobalRouter      100         4051      ISIS  0    IBS   7
10.0.0.41        255.255.255.255  10.0.0.41         -                 1           0         LOC   0    DB    0
10.0.0.42        255.255.255.255  VSP4000-2         GlobalRouter      10          4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  VSP8000-1         GlobalRouter      10          4051      ISIS  0    IBS   7
10.0.0.82        255.255.255.255  VSP8000-2         GlobalRouter      20          4051      ISIS  0    IBS   7
192.168.255.0    255.255.255.252  VSP8000-2         GlobalRouter      20          4051      ISIS  0    IBS   7
192.168.255.4    255.255.255.252  VSP8000-1         GlobalRouter      10          4051      ISIS  0    IBS   7
```

```
VSP4000-2:1#% show ip route
======================================================================================================
                                       IP Route - GlobalRouter
======================================================================================================
                                                    NH                            INTER
DST              MASK             NEXT              VRF/ISID          COST        FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------------
0.0.0.0          0.0.0.0          VSP8000-1         GlobalRouter      100         4051      ISIS  0    IBS   7
10.0.0.41        255.255.255.255  VSP4000-1         GlobalRouter      10          4051      ISIS  0    IBS   7
10.0.0.42        255.255.255.255  10.0.0.42         -                 1           0         LOC   0    DB    0
10.0.0.81        255.255.255.255  VSP8000-1         GlobalRouter      20          4051      ISIS  0    IBS   7
10.0.0.82        255.255.255.255  VSP8000-2         GlobalRouter      10          4051      ISIS  0    IBS   7
192.168.255.0    255.255.255.252  VSP8000-2         GlobalRouter      10          4051      ISIS  0    IBS   7
192.168.255.4    255.255.255.252  VSP8000-1         GlobalRouter      20          4051      ISIS  0    IBS   7
```

- Which gives us the desired routing table
- Note that the cost (in orange) associated with the chosen route is the External metric
  - In software versions prior to 6.1.0.0 and 5.1.1.4 the Internal SPB-metric would show as cost in the routing table

Firewalls Static Route ➔ ISIS External Route - Checking

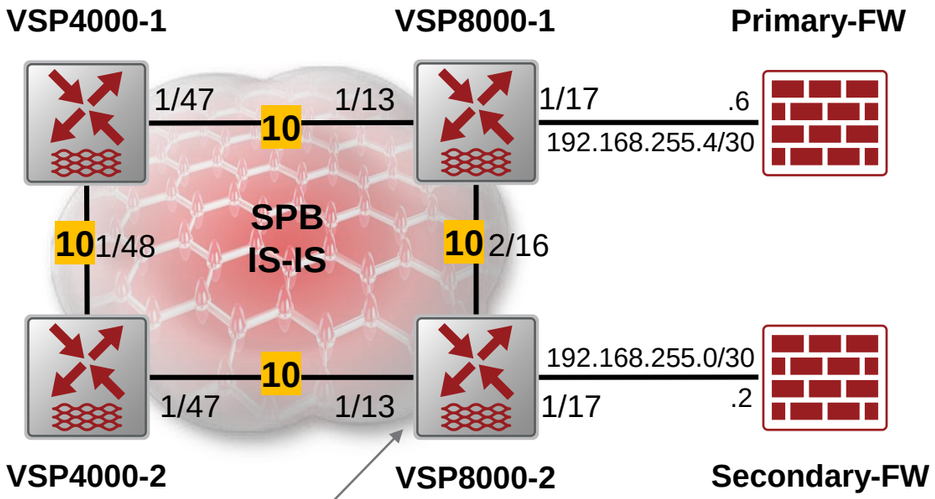



```
VSP8000-1:1#% show ip route
================================================================================================
                                  IP Route - GlobalRouter
================================================================================================
                                                   NH                      INTER
DST             MASK            NEXT               VRF/ISID         COST   FACE     PROT  AGE TYPE PRF
------------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         192.168.255.6      GlobalRouter     100    1/17     STAT  0   IB    5
10.0.0.41       255.255.255.255 VSP4000-1          GlobalRouter     10     4051     ISIS  0   IBS   7
10.0.0.42       255.255.255.255 VSP4000-2          GlobalRouter     20     4051     ISIS  0   IBS   7
10.0.0.81       255.255.255.255 10.0.0.81          -                1      0        LOC   0   DB    0
10.0.0.82       255.255.255.255 VSP8000-2          GlobalRouter     10     4051     ISIS  0   IBS   7
192.168.255.0   255.255.255.252 VSP8000-2          GlobalRouter     10     4051     ISIS  0   IBS   7
192.168.255.4   255.255.255.252 192.168.255.5      -                1      1/17     LOC   0   DB    0
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                  IP Route - GlobalRouter
================================================================================================
                                                   NH                      INTER
DST             MASK            NEXT               VRF/ISID         COST   FACE     PROT  AGE TYPE PRF
------------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         192.168.255.2      GlobalRouter     200    1/17     STAT  0   IB    5
10.0.0.41       255.255.255.255 VSP4000-1          GlobalRouter     20     4051     ISIS  0   IBS   7
10.0.0.42       255.255.255.255 VSP4000-2          GlobalRouter     10     4051     ISIS  0   IBS   7
10.0.0.81       255.255.255.255 VSP8000-1          GlobalRouter     10     4051     ISIS  0   IBS   7
10.0.0.82       255.255.255.255 10.0.0.82          -                1      0        LOC   0   DB    0
192.168.255.0   255.255.255.252 192.168.255.1      -                1      1/17     LOC   0   DB    0
192.168.255.4   255.255.255.252 VSP8000-1          GlobalRouter     10     4051     ISIS  0   IBS   7
```

- We still have a little problem in that VSP8000-2 prefers its static route
  - This may or may not be a problem
- Static routes by default have a higher preference (5) than ISIS (7)
- We could just decrease the preference of the VSP8000-2 static route (give it a pref > 7)

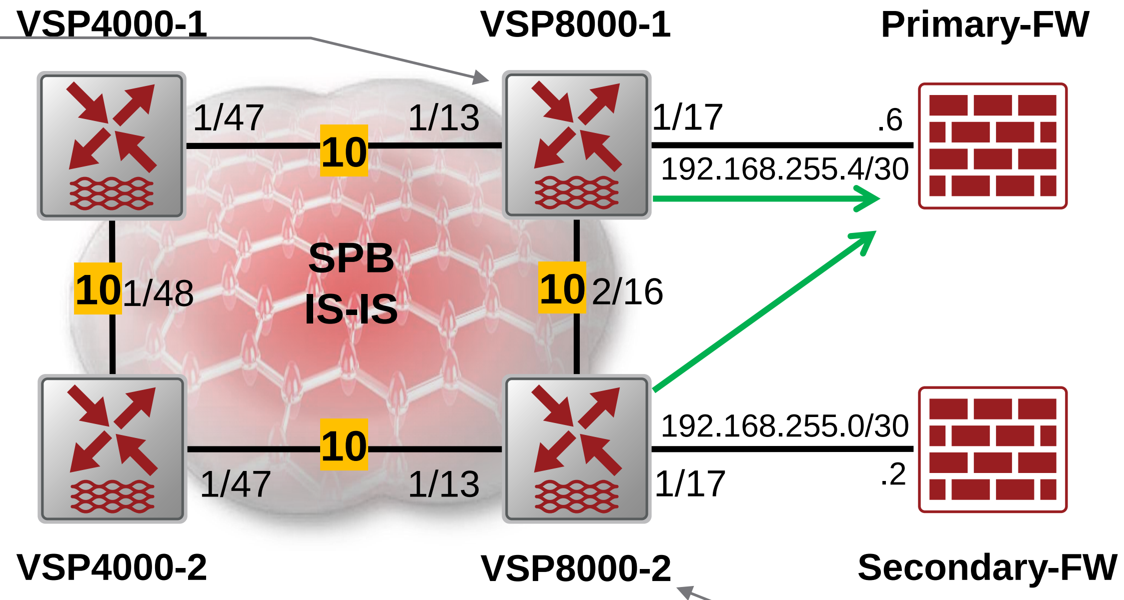
Firewalls Static Route ➔ ISIS External Route




```
route-map pref-prim-fw 1
   match metric-type-isis external
   set ip-preference 4
   enable
exit
router isis
   accept adv-rtr 0.00.81 route-map pref-prim-fw
   accept adv-rtr 0.00.81 enable
exit
isis apply accept
```

- Instead we are going to demonstrate how we can use an ISIS Accept policy on VSP8000-2 to increase the preference for only the ISIS External routes we receive from VSP8000-1
  - We force the preference to 4 which is < Static's 5
- This approach is also better if we are learning the default route from the Firewalls using OSPF instead of Static routes

Firewalls Static Route ➔ ISIS External Route - Checking

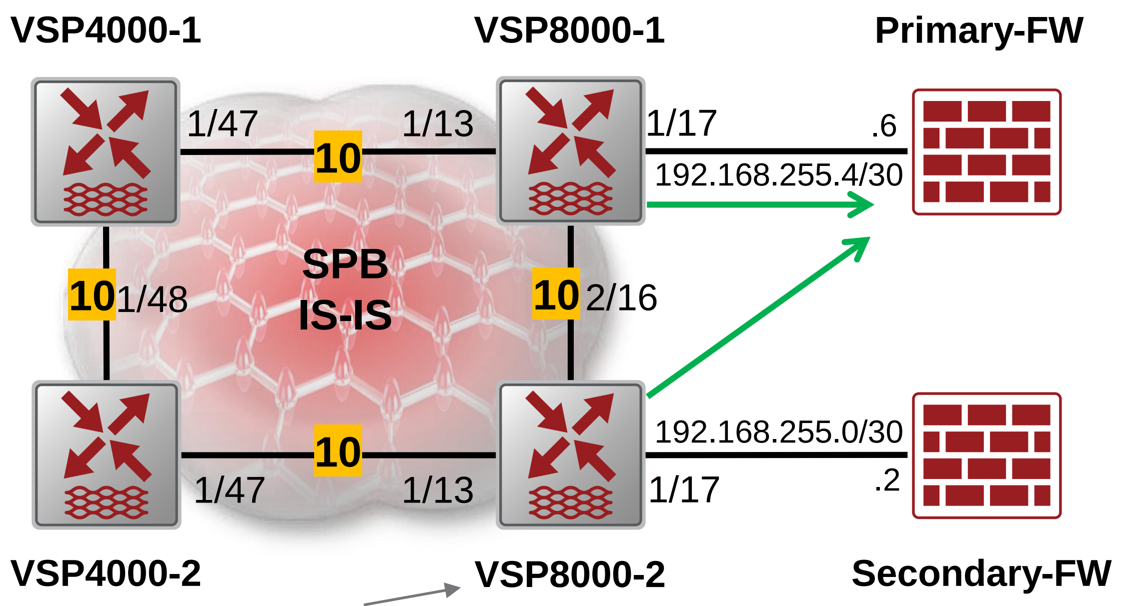



```
VSP8000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                     INTER
DST              MASK             NEXT             VRF/ISID        COST   FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
0.0.0.0          0.0.0.0          192.168.255.6    GlobalRouter    100    1/17      STAT  0    IB    5
10.0.0.41        255.255.255.255  VSP4000-1        GlobalRouter    10     4051      ISIS  0    IBS   7
10.0.0.42        255.255.255.255  VSP4000-2        GlobalRouter    20     4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  10.0.0.81        -               1      0         LOC   0    DB    0
10.0.0.82        255.255.255.255  VSP8000-2        GlobalRouter    10     4051      ISIS  0    IBS   7
192.168.255.0    255.255.255.252  VSP8000-2        GlobalRouter    10     4051      ISIS  0    IBS   7
192.168.255.4    255.255.255.252  192.168.255.5    -               1      1/17      LOC   0    DB    0
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                     INTER
DST              MASK             NEXT             VRF/ISID        COST   FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
0.0.0.0          0.0.0.0          VSP8000-1        GlobalRouter    100    4051      ISIS  0    IBS   4
10.0.0.41        255.255.255.255  VSP4000-1        GlobalRouter    20     4051      ISIS  0    IBS   7
10.0.0.42        255.255.255.255  VSP4000-2        GlobalRouter    10     4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  VSP8000-1        GlobalRouter    10     4051      ISIS  0    IBS   7
10.0.0.82        255.255.255.255  10.0.0.82        -               1      0         LOC   0    DB    0
192.168.255.0    255.255.255.252  192.168.255.1    -               1      1/17      LOC   0    DB    0
192.168.255.4    255.255.255.252  VSP8000-1        GlobalRouter    10     4051      ISIS  0    IBS   7
```

- Looking good
- In fact, by doing this, VSP8000-2 is now no longer redistributing a default route into ISIS (because its Static route is not active anymore)

Firewalls Static Route ➔ ISIS External Route - Checking

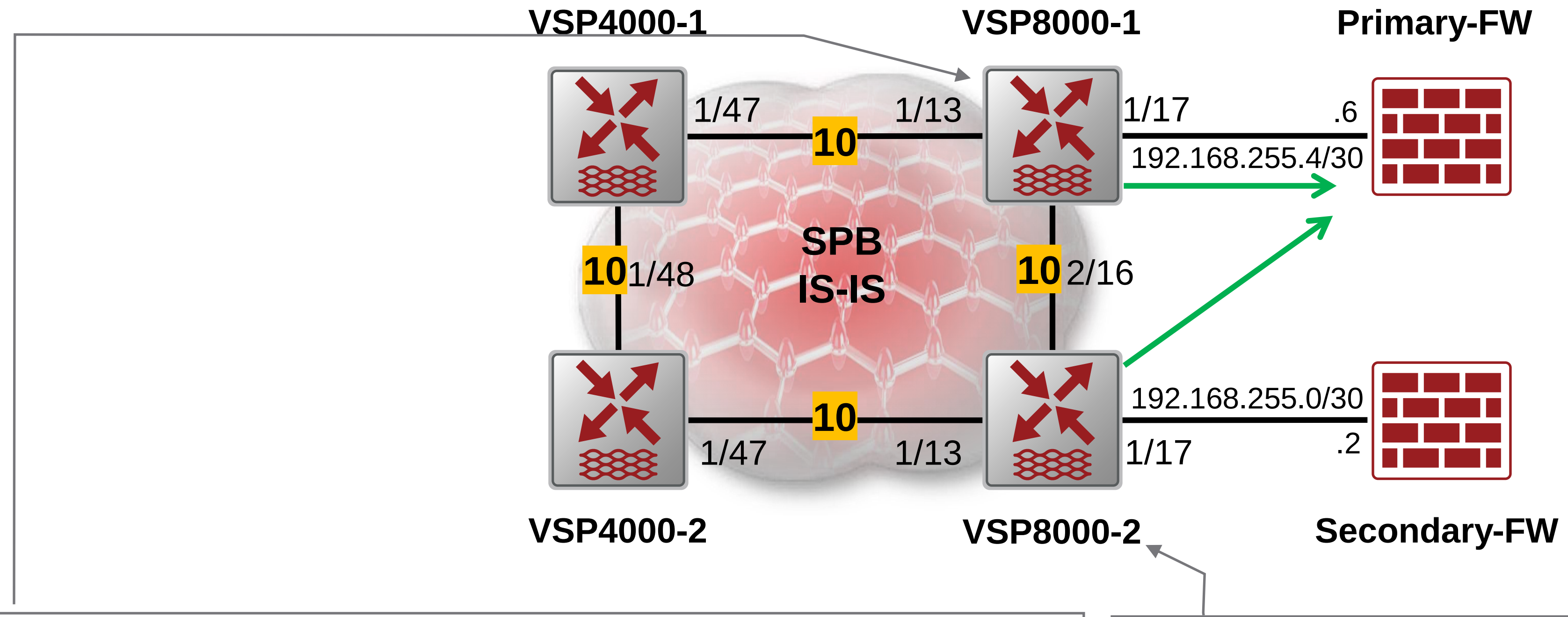



```
VSP4000-1:1#% show isis lsdb ip-unicast
================================================================================
                     ISIS IP-UNICAST-ROUTE SUMMARY
================================================================================
                           PREFIX          METRIC    TLV    LSP    HOST
I-SID      ADDRESS         LENGTH  METRIC  TYPE      TYPE   FRAG   NAME
--------------------------------------------------------------------------------
-          10.0.0.41       32      1       Internal  135    0x2    VSP4000-1
-          10.0.0.42       32      1       Internal  135    0x2    VSP4000-2
-          10.0.0.81       32      1       Internal  135    0x2    VSP8000-1
-          192.168.255.4   30      1       Internal  135    0x2    VSP8000-1
-          0.0.0.0         0       100     External  135    0x2    VSP8000-1
-          10.0.0.82       32      1       Internal  135    0x2    VSP8000-2
-          192.168.255.0   30      1       Internal  135    0x2    VSP8000-2
```

```
VSP8000-2:1#% show isis spbm ip-unicast-fib all
==================================================================================================================================
                                                  SPBM IP-UNICAST FIB ENTRY INFO
==================================================================================================================================
          VRF       DEST                                              OUTGOING              SPBM      PREFIX    PREFIX    IP ROUTE
VRF       ISID      ISID      Destination       NH BEB          VLAN  INTERFACE             COST      COST      TYPE      PREFERENCE
----------------------------------------------------------------------------------------------------------------------------------
GRT       -         -         0.0.0.0/0         VSP8000-1       4051  2/16                  10        100       External  4
GRT       -         -         0.0.0.0/0         VSP8000-1       4052  2/16                  10        100       External  4
GRT       -         -         10.0.0.41/32      VSP4000-1       4051  1/13                  20        1         Internal  7
GRT       -         -         10.0.0.41/32      VSP4000-1       4052  2/16                  20        1         Internal  7
GRT       -         -         10.0.0.42/32      VSP4000-2       4051  1/13                  10        1         Internal  7
GRT       -         -         10.0.0.42/32      VSP4000-2       4052  1/13                  10        1         Internal  7
GRT       -         -         10.0.0.81/32      VSP8000-1       4051  2/16                  10        1         Internal  7
GRT       -         -         10.0.0.81/32      VSP8000-1       4052  2/16                  10        1         Internal  7
GRT       -         -         192.168.255.4/30  VSP8000-1       4051  2/16                  10        1         Internal  7
GRT       -         -         192.168.255.4/30  VSP8000-1       4052  2/16                  10        1         Internal  7
```

- Here we see that there is only one default ISIS External route now and VSP8000-2 is accepting it

Firewalls Static Route ➔ ISIS External Route - Checking

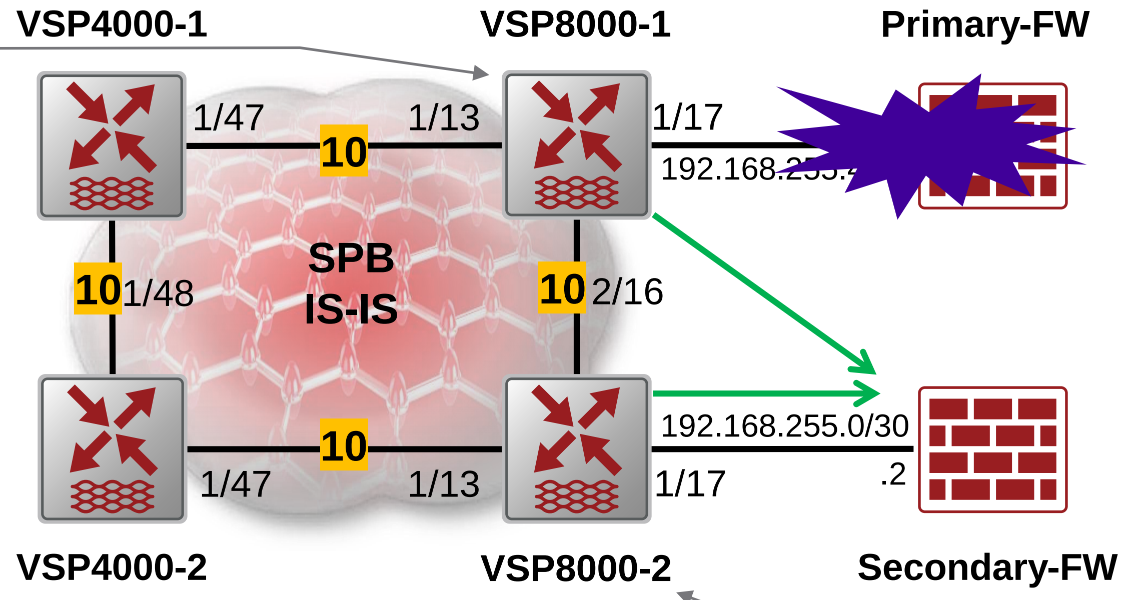



```
VSP8000-1:1#% show ip route alternative
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                         INTER
DST              MASK             NEXT             VRF/ISID          COST     FACE      PROT AGE  TYPE PRF
------------------------------------------------------------------------------------------------
0.0.0.0          0.0.0.0          192.168.255.6    GlobalRouter      100      1/17      STAT 0    IB    5
10.0.0.41        255.255.255.255  VSP4000-1        GlobalRouter      10       4051      ISIS 0    IBS   7
10.0.0.42        255.255.255.255  VSP4000-2        GlobalRouter      20       4051      ISIS 0    IBS   7
10.0.0.81        255.255.255.255  10.0.0.81        -                 1        0         LOC  0    DB    0
10.0.0.82        255.255.255.255  VSP8000-2        GlobalRouter      10       4051      ISIS 0    IBS   7
192.168.255.0    255.255.255.252  VSP8000-2        GlobalRouter      10       4051      ISIS 0    IBS   7
192.168.255.4    255.255.255.252  192.168.255.5    -                 1        1/17      LOC  0    DB    0
```

```
VSP8000-2:1#% show ip route alternative
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                   NH                         INTER
DST              MASK             NEXT             VRF/ISID          COST     FACE      PROT AGE  TYPE PRF
------------------------------------------------------------------------------------------------
0.0.0.0          0.0.0.0          VSP8000-1        GlobalRouter      100      4051      ISIS 0    IBS   4
0.0.0.0          0.0.0.0          192.168.255.2    GlobalRouter      200      1/17      STAT 0    IA    5
10.0.0.41        255.255.255.255  VSP4000-1        GlobalRouter      20       4051      ISIS 0    IBS   7
10.0.0.42        255.255.255.255  VSP4000-2        GlobalRouter      10       4051      ISIS 0    IBS   7
10.0.0.81        255.255.255.255  VSP8000-1        GlobalRouter      10       4051      ISIS 0    IBS   7
10.0.0.82        255.255.255.255  10.0.0.82        -                 1        0         LOC  0    DB    0
192.168.255.0    255.255.255.252  192.168.255.1    -                 1        1/17      LOC  0    DB    0
192.168.255.4    255.255.255.252  VSP8000-1        GlobalRouter      10       4051      ISIS 0    IBS   7
```

- On VSP8000-2 we can see the static route ready as an alternative route
- In this case it suits us; should the default ISIS route disappear then the local static route will replace it immediately

Primary Firewall failure

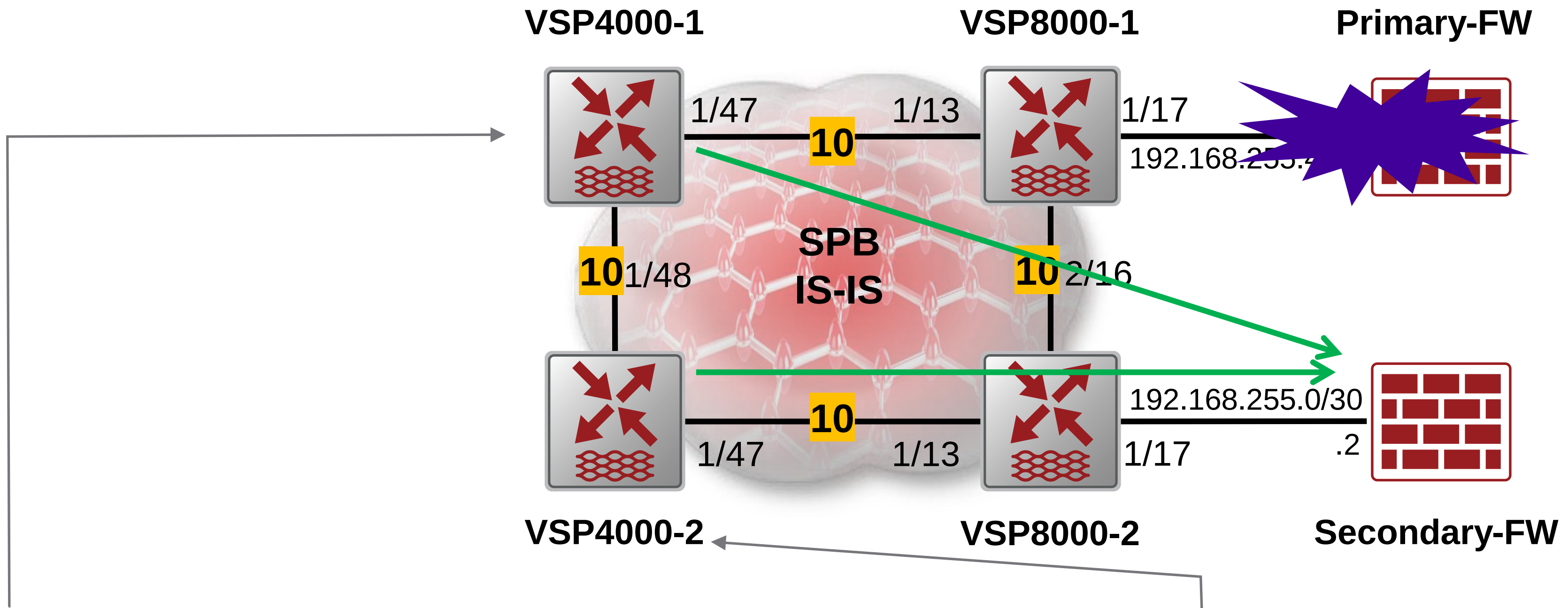



```
VSP8000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                  NH                       INTER
DST              MASK             NEXT            VRF/ISID        COST     FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
0.0.0.0          0.0.0.0          VSP8000-2       GlobalRouter    200      4051      ISIS  0    IBS   7
10.0.0.41        255.255.255.255  VSP4000-1       GlobalRouter    10       4051      ISIS  0    IBS   7
10.0.0.42        255.255.255.255  VSP4000-2       GlobalRouter    20       4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  10.0.0.81       -               1        0         LOC   0    DB    0
10.0.0.82        255.255.255.255  VSP8000-2       GlobalRouter    10       4051      ISIS  0    IBS   7
192.168.255.0    255.255.255.252  VSP8000-2       GlobalRouter    10       4051      ISIS  0    IBS   7
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                  NH                       INTER
DST              MASK             NEXT            VRF/ISID        COST     FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
0.0.0.0          0.0.0.0          192.168.255.2   GlobalRouter    200      1/17      STAT  0    IB    5
10.0.0.41        255.255.255.255  VSP4000-1       GlobalRouter    20       4051      ISIS  0    IBS   7
10.0.0.42        255.255.255.255  VSP4000-2       GlobalRouter    10       4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  VSP8000-1       GlobalRouter    10       4051      ISIS  0    IBS   7
10.0.0.82        255.255.255.255  10.0.0.82       -               1        0         LOC   0    DB    0
192.168.255.0    255.255.255.252  192.168.255.1   -               1        1/17      LOC   0    DB    0
```

- Immediate switchover
- Restoration is also immediate

Primary Firewall failure




```
VSP4000-1:1#% show ip route
==================================================================================================
                                    IP Route - GlobalRouter
==================================================================================================
                                                    NH                      INTER
DST             MASK            NEXT                VRF/ISID        COST    FACE     PROT AGE TYPE PRF
--------------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         VSP8000-2           GlobalRouter    200     4051     ISIS 0   IBS  7
10.0.0.41       255.255.255.255 10.0.0.41           -               1       0        LOC  0   DB   0
10.0.0.42       255.255.255.255 VSP4000-2           GlobalRouter    10      4051     ISIS 0   IBS  7
10.0.0.81       255.255.255.255 VSP8000-1           GlobalRouter    10      4051     ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP8000-2           GlobalRouter    20      4051     ISIS 0   IBS  7
192.168.255.0   255.255.255.252 VSP8000-2           GlobalRouter    20      4051     ISIS 0   IBS  7
```

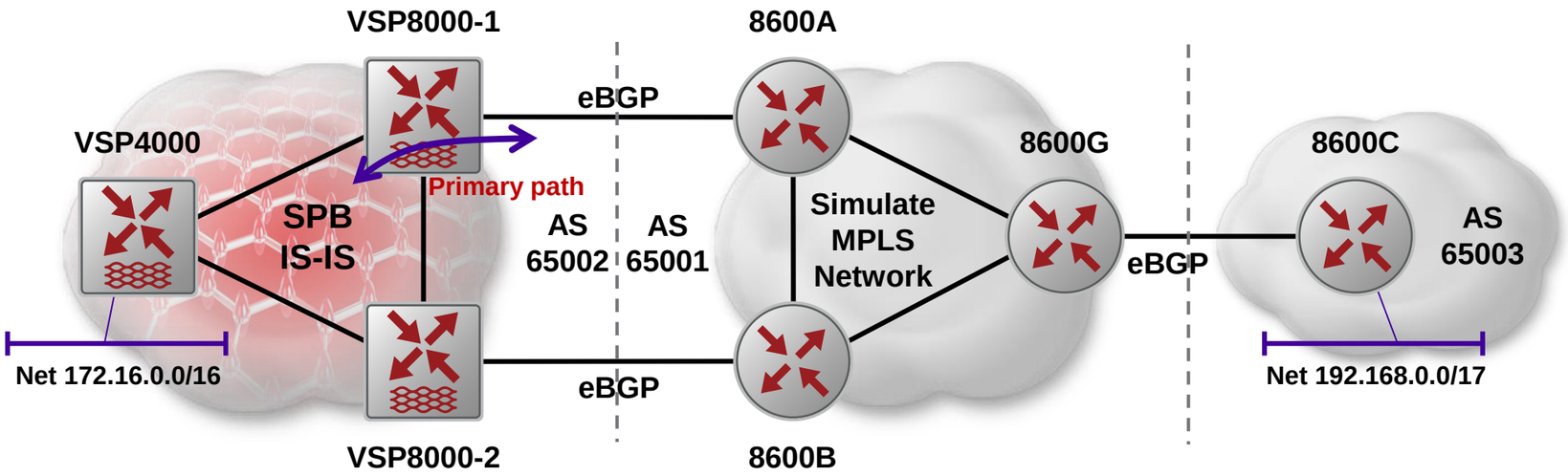
```
VSP4000-2:1#% show ip route
==================================================================================================
                                    IP Route - GlobalRouter
==================================================================================================
                                                    NH                      INTER
DST             MASK            NEXT                VRF/ISID        COST    FACE     PROT AGE TYPE PRF
--------------------------------------------------------------------------------------------------
0.0.0.0         0.0.0.0         VSP8000-2           GlobalRouter    200     4051     ISIS 0   IBS  7
10.0.0.41       255.255.255.255 VSP4000-1           GlobalRouter    10      4051     ISIS 0   IBS  7
10.0.0.42       255.255.255.255 10.0.0.42           -               1       0        LOC  0   DB   0
10.0.0.81       255.255.255.255 VSP8000-1           GlobalRouter    20      4051     ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP8000-2           GlobalRouter    10      4051     ISIS 0   IBS  7
192.168.255.0   255.255.255.252 VSP8000-2           GlobalRouter    10      4051     ISIS 0   IBS  7
```

- Immediate switchover
- Restoration is also immediate

Routing between ISIS (SPB) and BGP(MPLS) using Primary & Backup paths

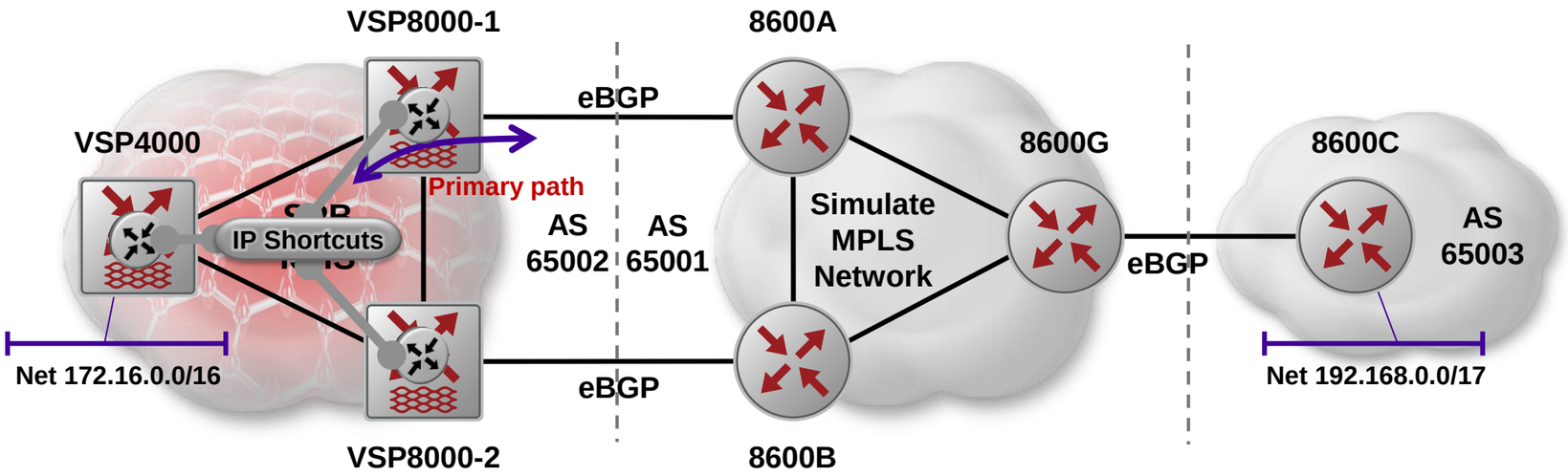
Leveraging IS-IS Accept policies + IS-IS External routes
(a)with GRT & iBGP
(b) with VRFs & no iBGP

Connecting SPB Fabric to BGP/MPLS Core



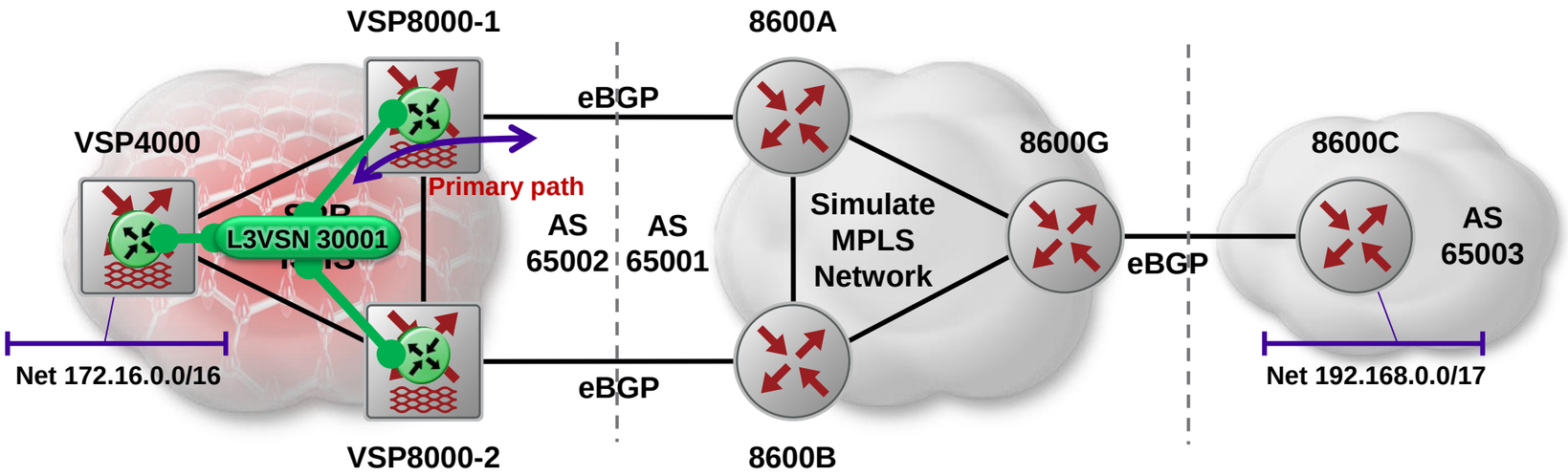
- It is desired that all traffic flowing between the SPB cloud and the BGP cloud follow the Primary path over VSP8000-1 and that the path over VSP8000-2 only be used in case of failure of the Primary path
- Configuration should avoid spelling out individual subnets in redistribution route-maps
  - I.e. if new BGP or ISIS subnets appear, there should be no need to reconfigure the redistribution on the border routers
- (a) Case where SPB GRT IP Shortcuts are used
  - Following BGP by the book, and using iBGP with local-pref attribute between VSP8000-1 & VSP8000-2
- (b) Case where SPB VRF L3VSN is used
  - We lack iBGP support on VRFs; so here we have to use a different approach in order to avoid BGP routes from distant ASes (here 65003) being reflected back into the MPLS core network

Connecting SPB Fabric to BGP/MPLS Core – Case (a)



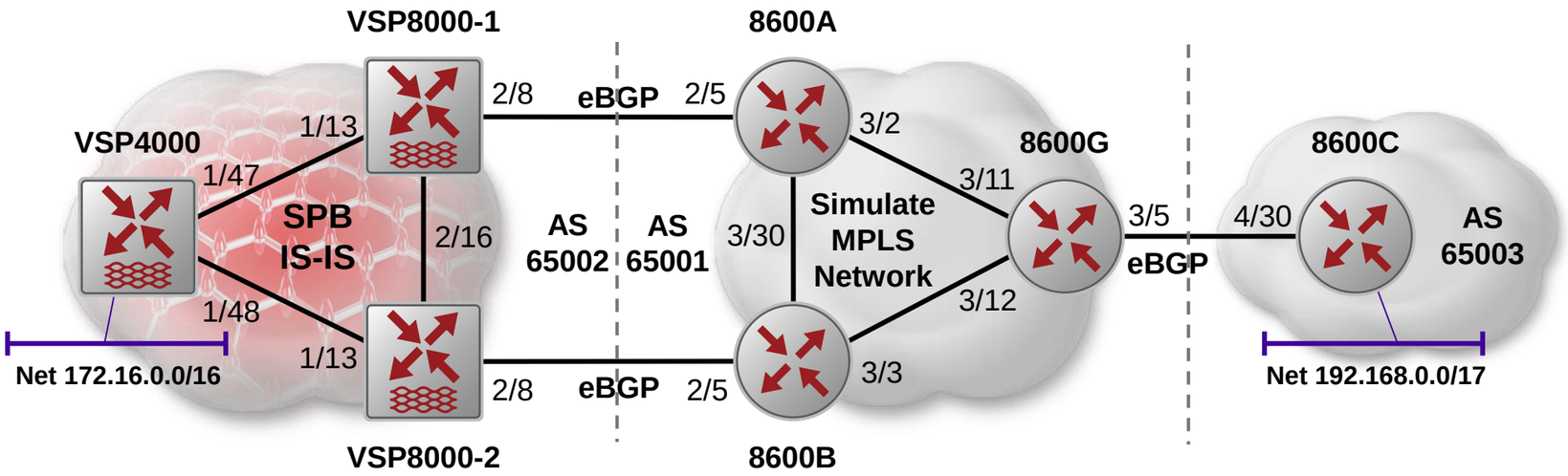
- Case (a)
  - The SPB nodes will be redistributing BGP routes into IP Shortcuts and vice versa
  - VSP8000-1 and VSP8000-2 will have an iBGP peering to each other
  - The BGP nodes have a single routing instance in all cases and in this setup 8600A, 8600B & 8600G are simulating a BGP/MPLS network

Connecting SPB Fabric to BGP/MPLS Core – Case (b)



- Case (b)
  - The SPB nodes will be redistributing BGP routes into a VRF extended via L3VSN
  - There cannot be any iBGP peering on a VRF, as we lack this support today
  - The BGP nodes have a single routing instance in all cases and in this setup 8600A, 8600B & 8600G are simulating a BGP/MPLS network

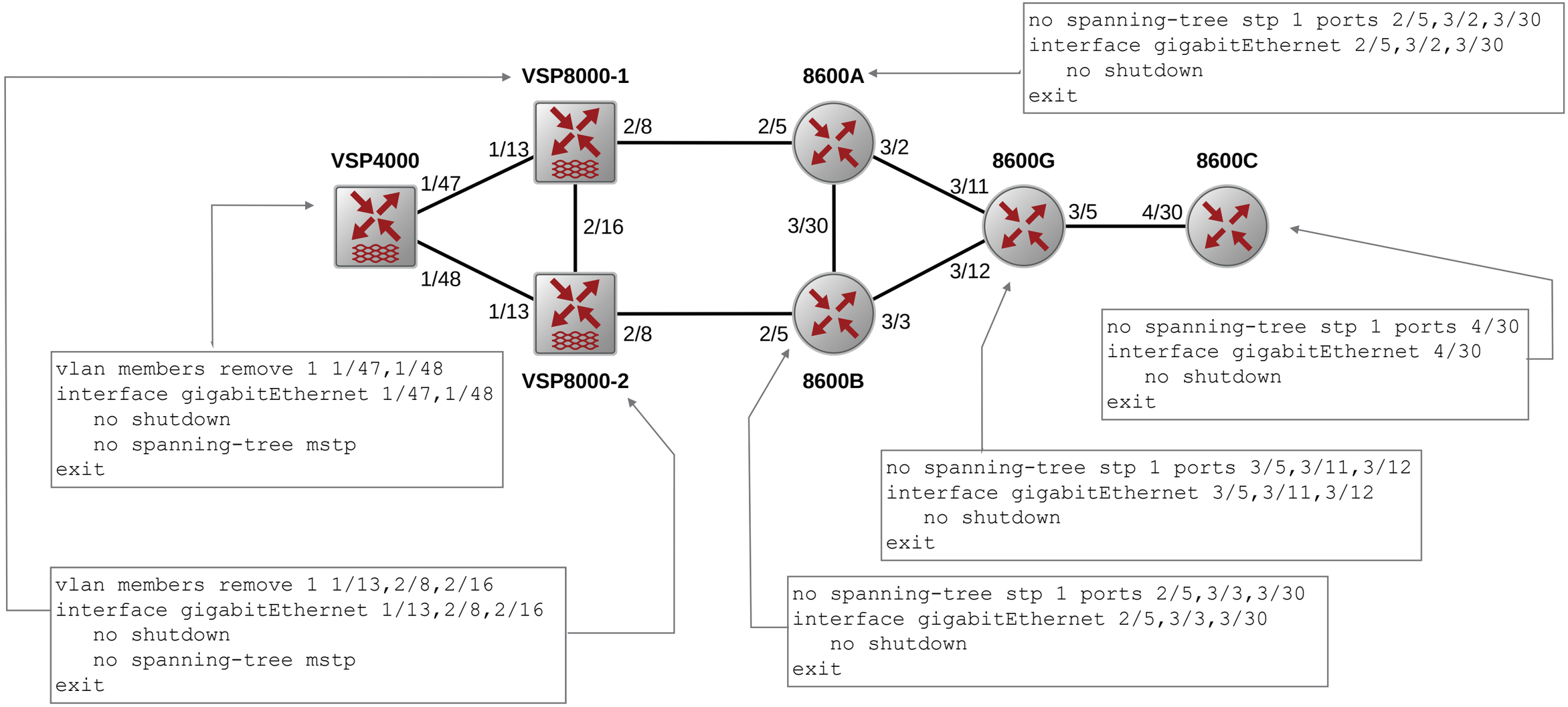
Setup, Equipment & Software used



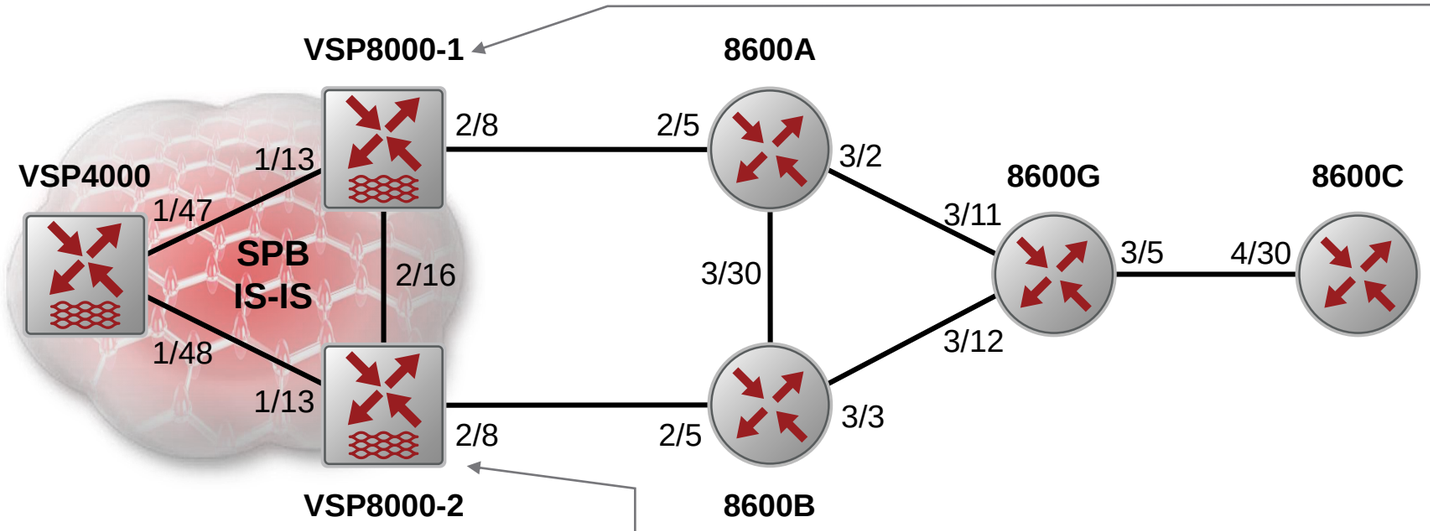
- VSP4000
  - VSP 4850GTS / 6.1.0.0_B021
- 8600A, 8600B, 8600G, 8600C
  - 7.2.25.0GA

- VSP8000-1
  - VSP 8404 / 6.1.0.0_B021
    - Slot1 8424GT
    - Slot2 8418XSQ
- VSP8000-2
  - VSP 8242XSQ / 6.1.0.0_B021

Port & MLT Config



SPB Global Config

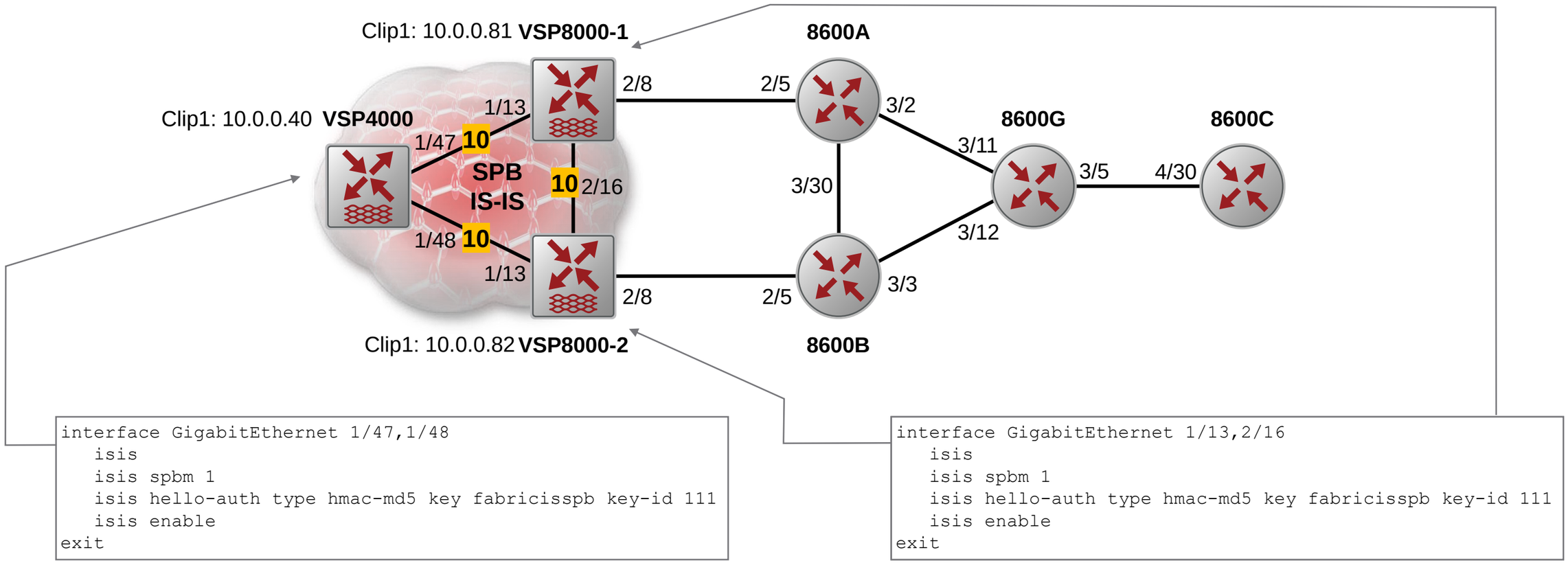



```
prompt VSP4000
interface loopback 1
   ip address 10.0.0.40/32
exit
spbm
router isis
   system-id 00bb.0000.4000
   manual-area 49.0000
   ip-source-address 10.0.0.40
   spbm 1
   spbm 1 nick-name 0.00.40
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 40
cfm spbm enable
```

```
prompt VSP8000-2
interface loopback 1
   ip address 10.0.0.82/32
exit
spbm
router isis
   system-id 00bb.0000.8200
   manual-area 49.0000
   ip-source-address 10.0.0.82
   spbm 1
   spbm 1 nick-name 0.00.82
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 82
cfm spbm enable
```

```
prompt VSP8000-1
interface loopback 1
   ip address 10.0.0.81/32
exit
spbm
router isis
   system-id 00bb.0000.8100
   manual-area 49.0000
   ip-source-address 10.0.0.81
   spbm 1
   spbm 1 nick-name 0.00.81
   spbm 1 b-vid 4051-4052 primary 4051
   spbm 1 ip enable
exit
vlan create 4051 name "B-VLAN-1" type spbm-bvlan
vlan create 4052 name "B-VLAN-2" type spbm-bvlan
router isis enable
cfm spbm mepid 81
cfm spbm enable
```

SPB Interface Config

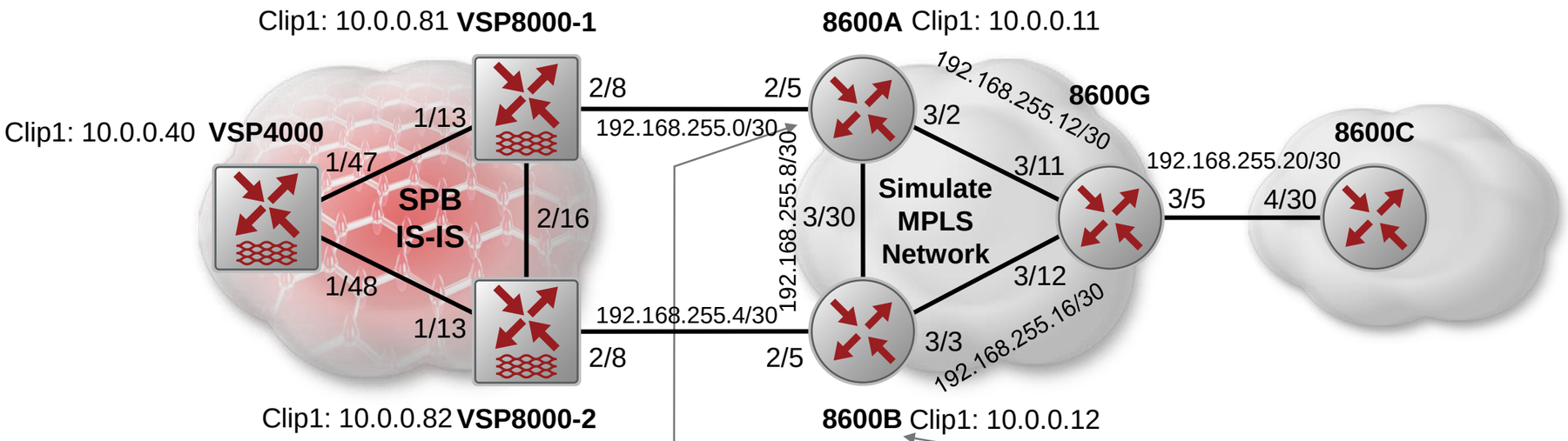



```
interface GigabitEthernet 1/47,1/48
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

```
interface GigabitEthernet 1/13,2/16
   isis
   isis spbm 1
   isis hello-auth type hmac-md5 key fabricisspb key-id 111
   isis enable
exit
```

- All ISIS NNI links use default SPBM L1-metric of 10

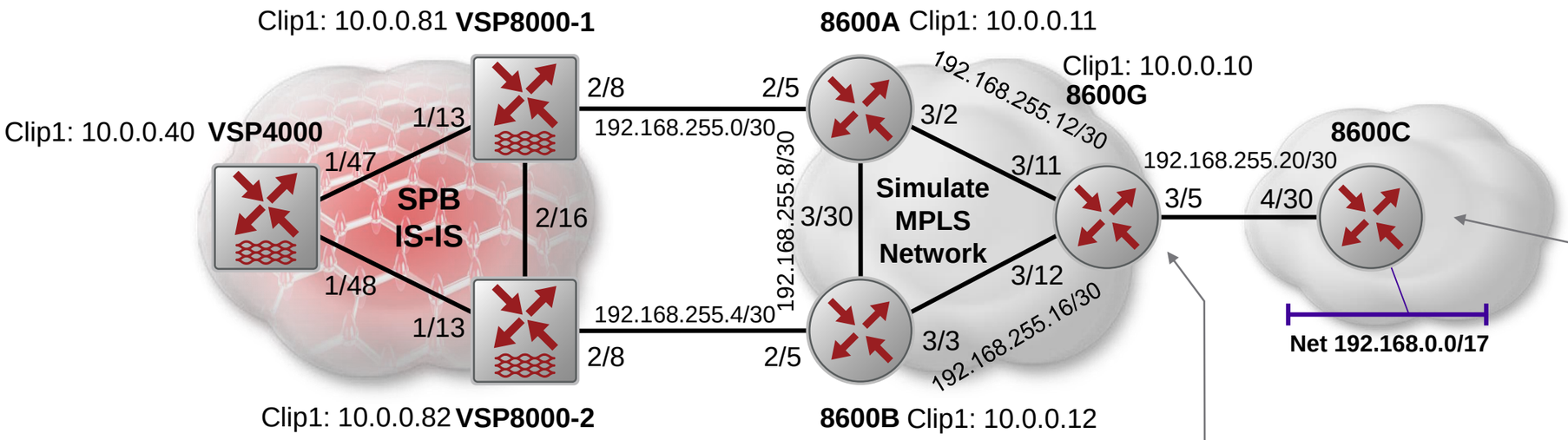
IGP (OSPF) Config




```
interface loopback 1
   ip address 10.0.0.11/32
   ip ospf
exit
interface GigabitEthernet 2/5,3/2,3/30
   brouter port 2/5 vlan 2500 subnet 192.168.255.1/30
   brouter port 3/30 vlan 2508 subnet 192.168.255.9/30
   brouter port 3/2 vlan 2512 subnet 192.168.255.13/30
   ip ospf port 3/2,3/30 enable
exit
router ospf
   router-id 10.0.0.11
exit
router ospf enable
```

```
interface loopback 1
   ip address 10.0.0.12/32
   ip ospf
exit
interface GigabitEthernet 2/5,3/3,3/30
   brouter port 2/5 vlan 2504 subnet 192.168.255.5/30
   brouter port 3/30 vlan 2508 subnet 192.168.255.10/30
   brouter port 3/3 vlan 2516 subnet 192.168.255.17/30
   ip ospf port 3/3,3/30 enable
exit
router ospf
   router-id 10.0.0.12
exit
router ospf enable
```

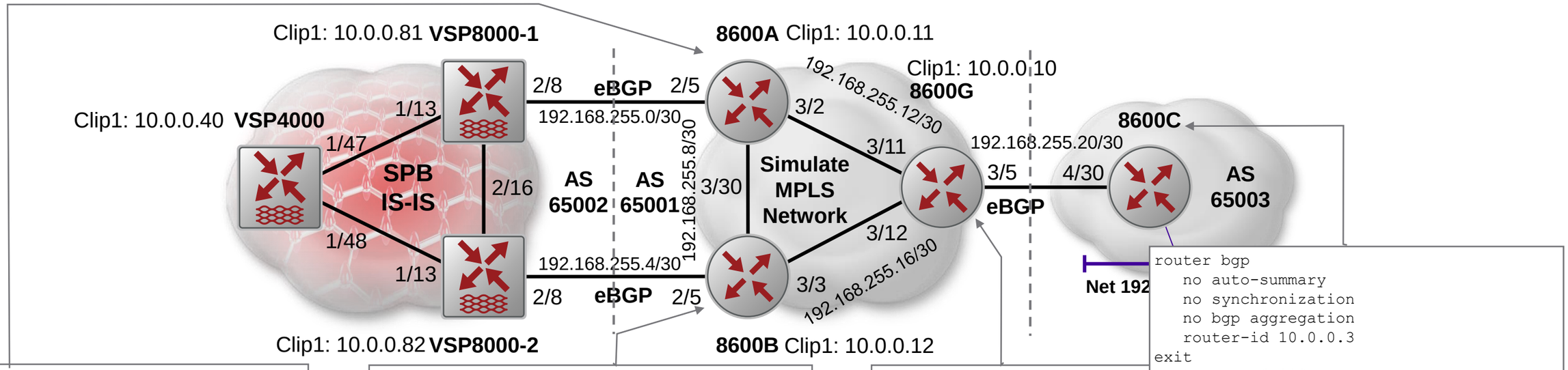
IGP (OSPF) Config cont




```
interface loopback 1
   ip address 10.0.0.10/32
   ip ospf
exit
interface GigabitEthernet 3/11,3/12,3/5
   brouter port 3/11 vlan 2512 subnet 192.168.255.14/30
   brouter port 3/12 vlan 2516 subnet 192.168.255.18/30
   brouter port 3/5 vlan 2520 subnet 192.168.255.21/30
   ip ospf port 3/11,3/12 enable
exit
router ospf
   router-id 10.0.0.10
exit
router ospf enable
```

```
interface loopback 1
   ip address 192.168.0.1/17
exit
interface GigabitEthernet 4/30
   brouter vlan 2520 subnet 192.168.255.22/30
exit
```

BGP Config



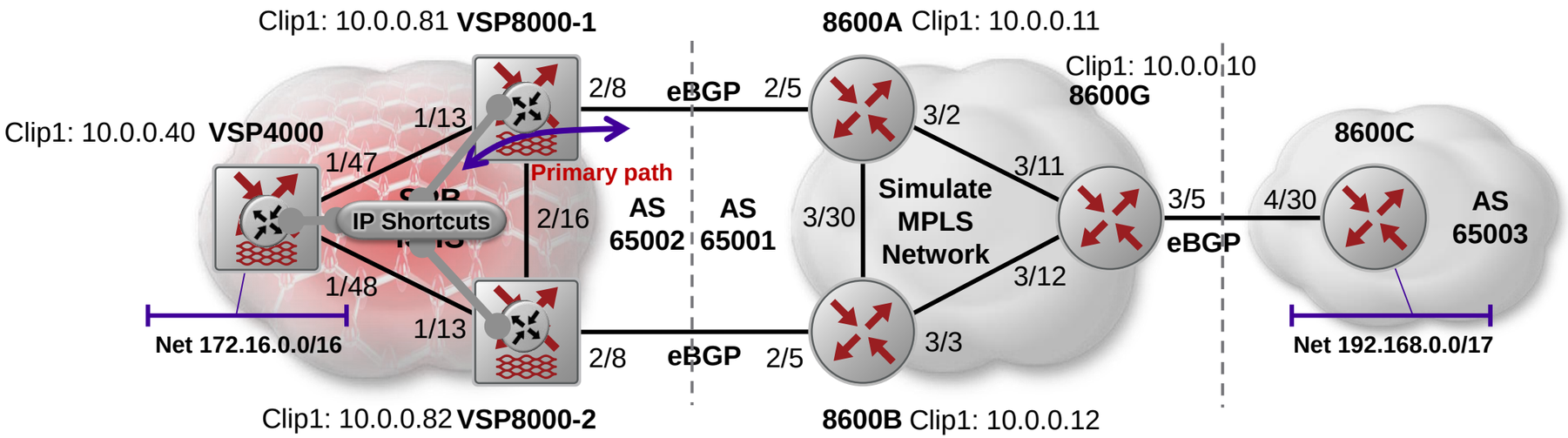

```
router bgp
   no auto-summary
   no synchronization
   no bgp aggregation
   router-id 10.0.0.11
exit
router bgp 65001 enable
router bgp
   neighbor 192.168.255.2
   neighbor 192.168.255.2 remote-as 65002
   neighbor 192.168.255.2 enable
   neighbor 10.0.0.12
   neighbor 10.0.0.12 remote-as 65001
   neighbor 10.0.0.12 update-source 10.0.0.11
   neighbor 10.0.0.12 next-hop-self enable
   neighbor 10.0.0.12 enable
   neighbor 10.0.0.10
   neighbor 10.0.0.10 remote-as 65001
   neighbor 10.0.0.10 update-source 10.0.0.11
   neighbor 10.0.0.10 next-hop-self enable
   neighbor 10.0.0.10 enable
exit
```

```
router bgp
   no auto-summary
   no synchronization
   no bgp aggregation
   router-id 10.0.0.12
exit
router bgp 65001 enable
router bgp
   neighbor 192.168.255.6
   neighbor 192.168.255.6 remote-as 65002
   neighbor 192.168.255.6 enable
   neighbor 10.0.0.11
   neighbor 10.0.0.11 remote-as 65001
   neighbor 10.0.0.11 update-source 10.0.0.12
   neighbor 10.0.0.11 next-hop-self enable
   neighbor 10.0.0.11 enable
   neighbor 10.0.0.10
   neighbor 10.0.0.10 remote-as 65001
   neighbor 10.0.0.10 update-source 10.0.0.12
   neighbor 10.0.0.10 next-hop-self enable
   neighbor 10.0.0.10 enable
exit
```

```
router bgp
   no auto-summary
   no synchronization
   no bgp aggregation
   router-id 10.0.0.10
exit
router bgp 65001 enable
router bgp
   neighbor 192.168.255.22
   neighbor 192.168.255.22 remote-as 65003
   neighbor 192.168.255.22 enable
   neighbor 10.0.0.11
   neighbor 10.0.0.11 remote-as 65001
   neighbor 10.0.0.11 update-source 10.0.0.10
   neighbor 10.0.0.11 next-hop-self enable
   neighbor 10.0.0.11 enable
   neighbor 10.0.0.12
   neighbor 10.0.0.12 remote-as 65001
   neighbor 10.0.0.12 update-source 10.0.0.10
   neighbor 10.0.0.12 next-hop-self enable
   neighbor 10.0.0.12 enable
exit
```

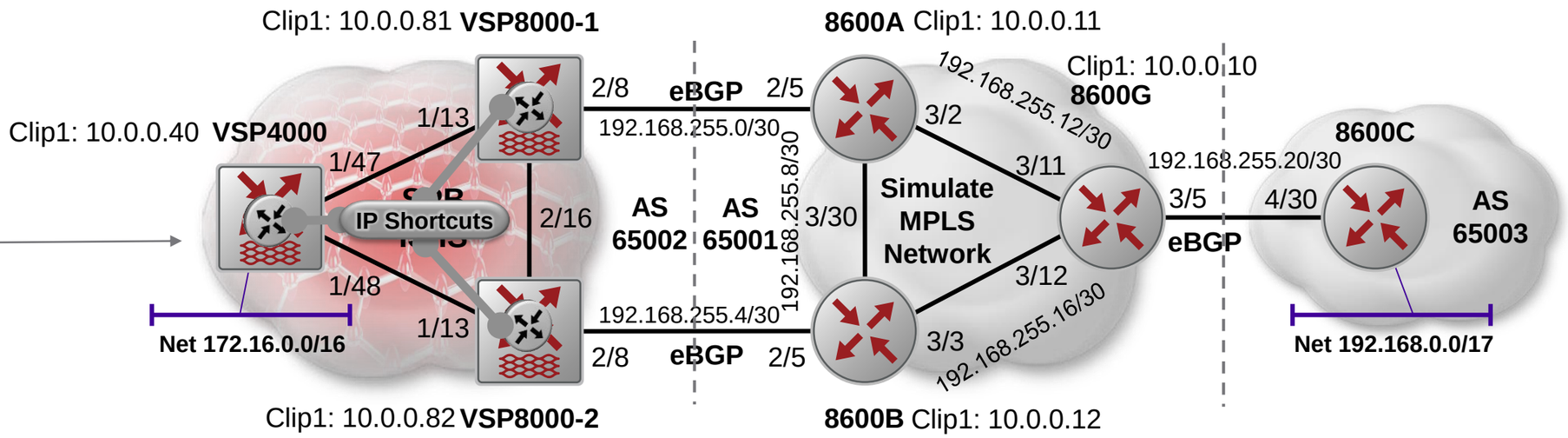
```
router bgp
   no auto-summary
   no synchronization
   no bgp aggregation
   router-id 10.0.0.3
exit
router bgp 65003 enable
router bgp
   network 192.168.0.0/17
   neighbor 192.168.255.21
   neighbor 192.168.255.21 remote-as 65001
   neighbor 192.168.255.21 enable
exit
```

Forcing paths with BGP and SPB – Case (a) GRT IP Shortcuts



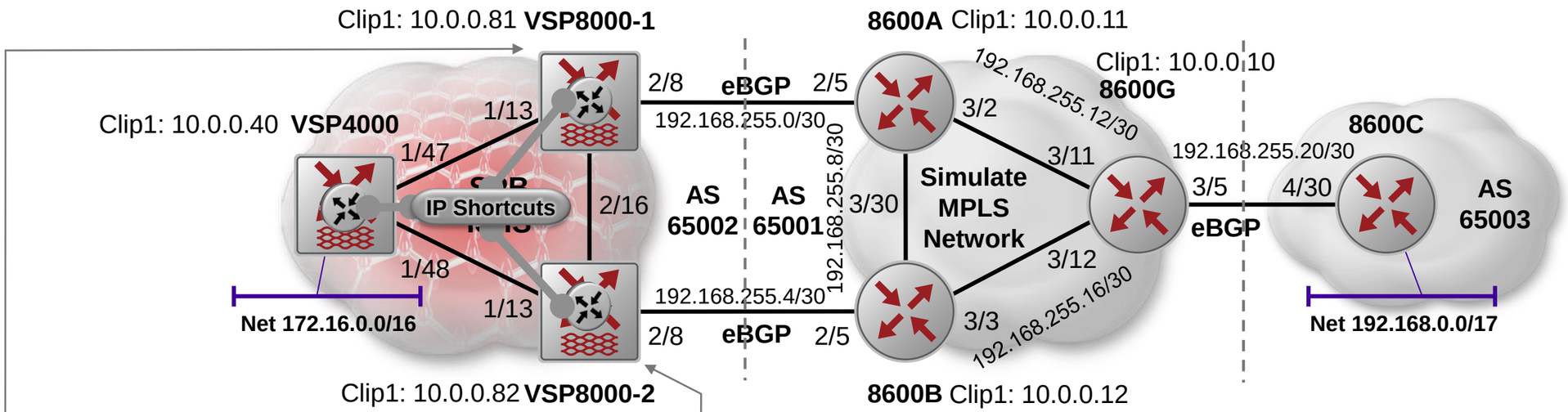
- We are now going to look at the case where BGP is redistributed into SPB GRT IP Shortcuts

Case (a) GRT IP Shortcuts – Redistribution Config




```
interface loopback 2
   ip address 172.16.0.41/16
exit
router isis
   redistribute direct
   redistribute direct enable
exit
isis apply redistribute direct
```

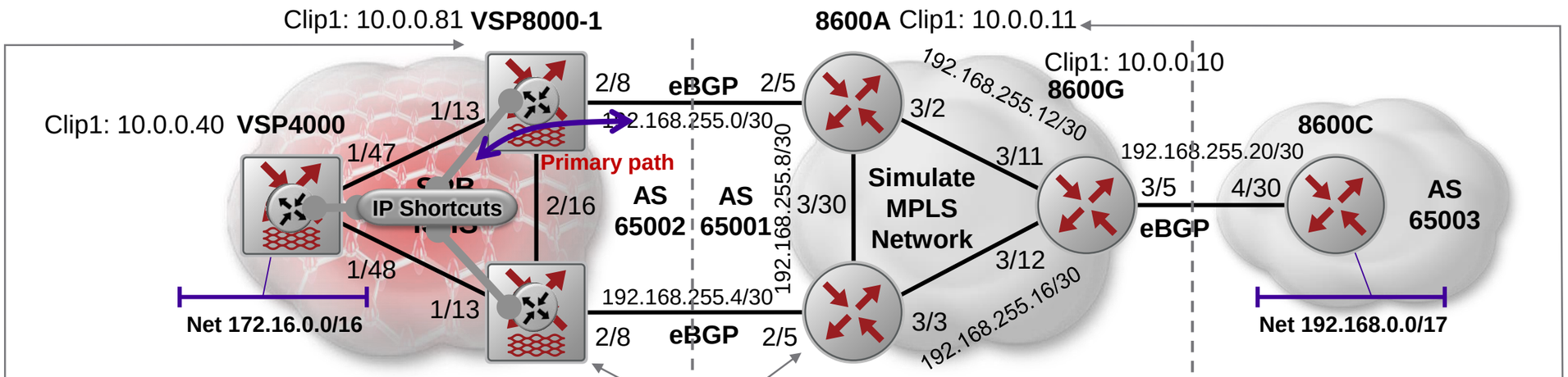
Case (a) GRT IP Shortcuts – BGP Config




```
interface GigabitEthernet 2/8
   brouter vlan 2500 subnet 192.168.255.2/30
exit
router bgp
   no auto-summary
   no synchronization
   no bgp aggregation
   router-id 10.0.0.81
exit
router bgp 65002 enable
router bgp
   neighbor 192.168.255.1
   neighbor 192.168.255.1 remote-as 65001
   neighbor 192.168.255.1 enable
   neighbor 10.0.0.82
   neighbor 10.0.0.82 remote-as 65002
   neighbor 10.0.0.82 update-source 10.0.0.81
   neighbor 10.0.0.82 next-hop-self enable
   neighbor 10.0.0.82 enable
exit
```

```
interface GigabitEthernet 2/8
   brouter vlan 2504 subnet 192.168.255.6/30
exit
router bgp
   no auto-summary
   no synchronization
   no bgp aggregation
   router-id 10.0.0.82
exit
router bgp 65002 enable
router bgp
   neighbor 192.168.255.5
   neighbor 192.168.255.5 remote-as 65001
   neighbor 192.168.255.5 enable
   neighbor 10.0.0.81
   neighbor 10.0.0.81 remote-as 65002
   neighbor 10.0.0.81 update-source 10.0.0.82
   neighbor 10.0.0.81 next-hop-self enable
   neighbor 10.0.0.81 enable
exit
```

Case (a) GRT IP Shortcuts – BGP Local-Preference




```
no router bgp enable
router bgp
   bgp default local-preference 200
exit
router bgp 65002 enable
```

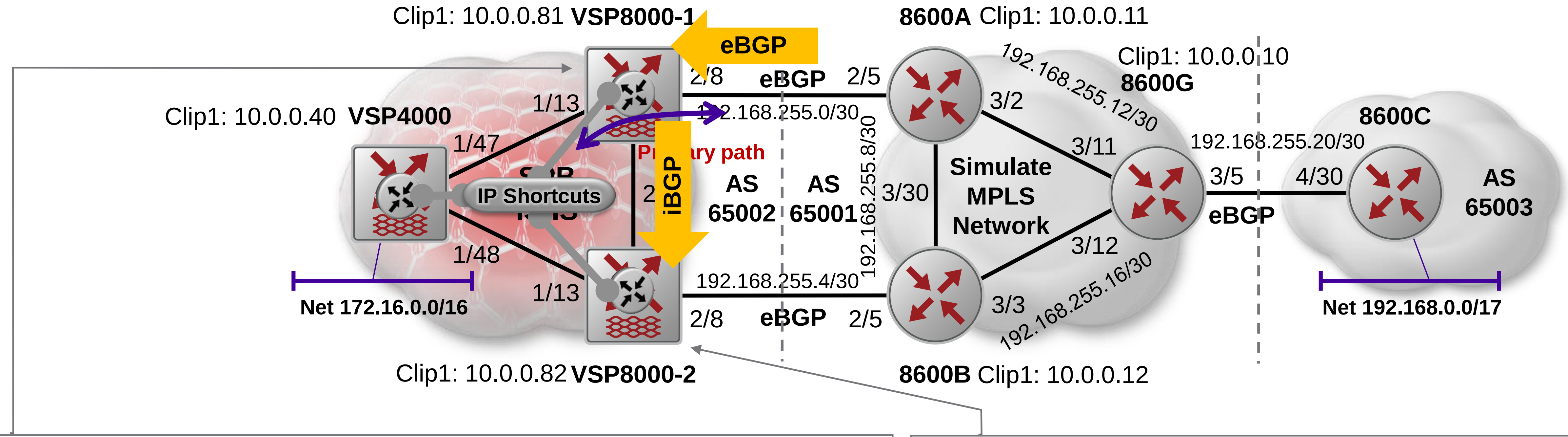
```
no router bgp enable
router bgp
   bgp default local-preference 200
exit
router bgp 65001 enable
```

```
no router bgp enable
router bgp
   bgp default local-preference 20
exit
router bgp 65002 enable
```

```
no router bgp enable
router bgp
   bgp default local-preference 20
exit
router bgp 65001 enable
```

- BGP local-PREF is by default set to 100 (higher value is higher preference)
- So we increase it on VSP8000-1 & 8600A and decrease it on VSP8000-2 and 8600B

Case (a) GRT IP Shortcuts – BGP Local-Preference - Checking

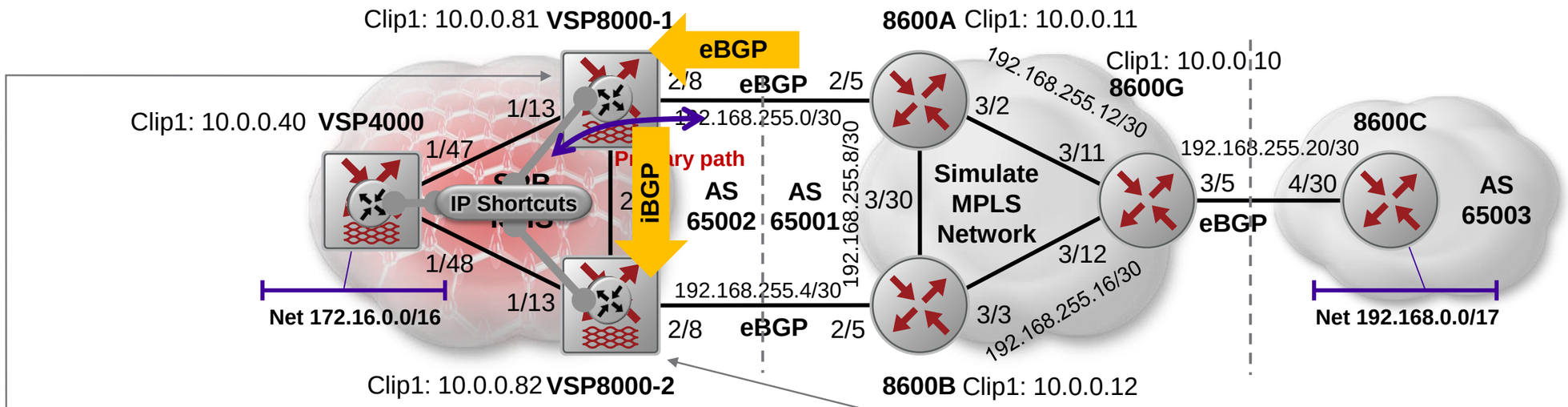



```
VSP8000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                    NH                    INTER
DST              MASK             NEXT              VRF/ISID         COST  FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  VSP4000           GlobalRouter     10    4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  10.0.0.81         -                1     0         LOC   0    DB    0
10.0.0.82        255.255.255.255  VSP8000-2         GlobalRouter     10    4051      ISIS  0    IBS   7
172.16.0.0       255.255.0.0      VSP4000           GlobalRouter     10    4051      ISIS  0    IBS   7
192.168.0.0      255.255.128.0    192.168.255.1     GlobalRouter     2     2/8       BGP   0    IB    45
192.168.255.0    255.255.255.252  192.168.255.2     -                1     2/8       LOC   0    DB    0
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                    NH                    INTER
DST              MASK             NEXT              VRF/ISID         COST  FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  VSP4000           GlobalRouter     10    4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  VSP8000-1         GlobalRouter     10    4051      ISIS  0    IBS   7
10.0.0.82        255.255.255.255  10.0.0.82         -                1     0         LOC   0    DB    0
172.16.0.0       255.255.0.0      VSP4000           GlobalRouter     10    4051      ISIS  0    IBS   7
192.168.0.0      255.255.128.0    VSP8000-1         GlobalRouter     2     4051      BGP   0    IBS   175
192.168.255.4    255.255.255.252  192.168.255.6     -                1     2/8       LOC   0    DB    0
```

- Our BGP local-pref attribute config is working as expected
- VSP8000-1 has an eBGP route (pref = 45) while VSP8000-2 has an iBGP route (pref = 175)

Case (a) GRT IP Shortcuts – BGP Local-Preference - Checking

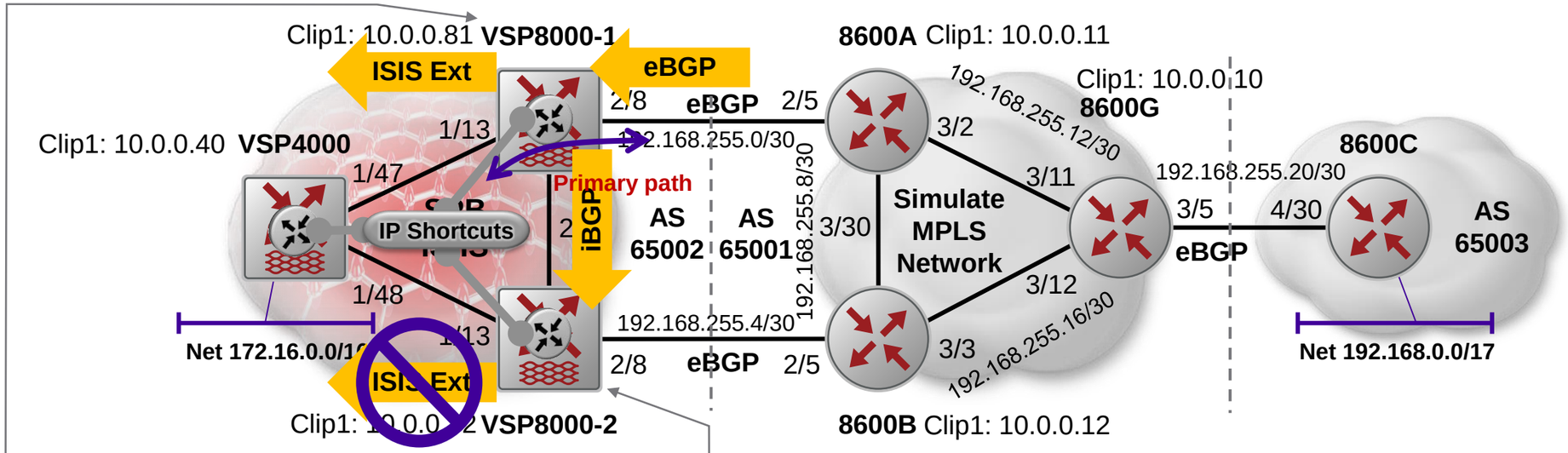



```
VSP8000-1:1#% show ip bgp route
================================================================================
                          BGP Routes - GlobalRouter
================================================================================
The total number of bgp routes in this Vrf are 2
NETWORK/MASK       PEER REM ADDR    NEXTHOP ADDRESS ORG LOC PREF
--------------------------------------------------------------------------------
192.168.0.0/17     192.168.255.1    192.168.255.1   IGP 200 ✓
        AS_PATH: (65001 65003)
192.168.0.0/17     10.0.0.82        10.0.0.82       IGP 20
        AS_PATH: (65001 65003)
```

```
VSP8000-2:1#% show ip bgp route
================================================================================
                          BGP Routes - GlobalRouter
================================================================================
The total number of bgp routes in this Vrf are 2
NETWORK/MASK       PEER REM ADDR    NEXTHOP ADDRESS ORG LOC PREF
--------------------------------------------------------------------------------
192.168.0.0/17     10.0.0.81        10.0.0.81       IGP 200 ✓
        AS_PATH: (65001 65003)
192.168.0.0/17     192.168.255.5    192.168.255.5   IGP 20
        AS_PATH: (65001 65003)
```

- Our BGP local-pref attribute config is working as expected
- VSP8000-1 selects the eBGP route while VSP8000-2 selects the iBGP route

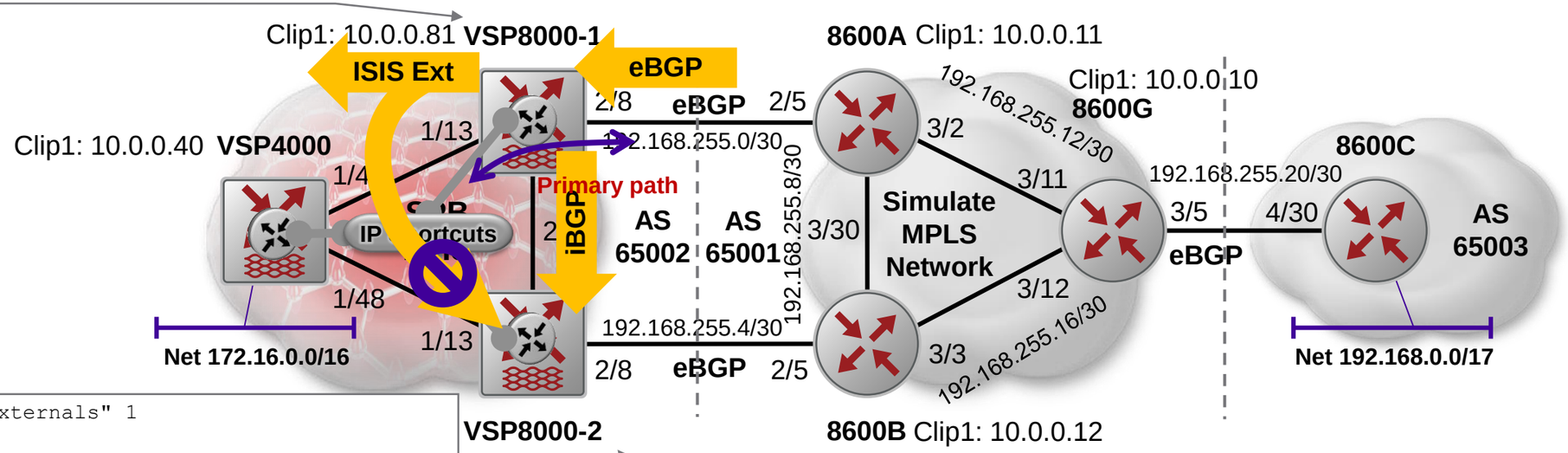
Case (a) GRT IP Shortcuts – ISIS ← eBGP Redistribution




```
route-map "ebgp-routes" 1
   permit
   match protocol ebgp
   set metric-type-isis external
   enable
exit
router isis
   redistribute bgp
   redistribute bgp route-map "ebgp-routes"
   redistribute bgp enable
exit
isis apply redistribute bgp
```

- In the target design, we will expect VSP8000-1 to hold eBGP routes into the MPLS backbone while VSP8000-2 will have those same routes as iBGP pointing back to VSP8000-1
  - And if VSP8000-1 fails, then VSP8000-2 will have eBGP routes into the MPLS backbone
- Therefore, it makes sense for the VSP8000s to only redistribute into ISIS eBGP routes (and not iBGP ones)
- We also make sure that those eBGP routes get redistributed into ISIS as “External” routes

Case (a) GRT IP Shortcuts – Reject ISIS Externals from iBGP peer

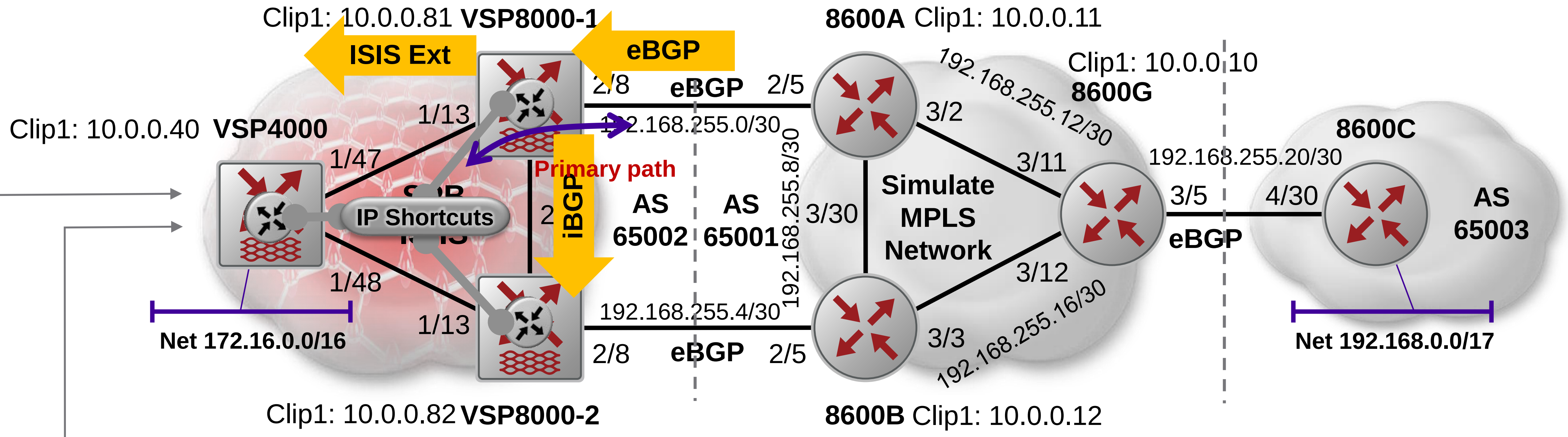



```
route-map "reject-externals" 1
   no permit
   match metric-type-isis external
   enable
exit
router isis
   accept adv-rtr 0.00.82
   accept adv-rtr 0.00.82 route-map "reject-externals"
   accept adv-rtr 0.00.82 enable
exit
isis apply accept
```

```
route-map "reject-externals" 1
   no permit
   match metric-type-isis external
   enable
exit
router isis
   accept adv-rtr 0.00.81
   accept adv-rtr 0.00.81 route-map "reject-externals"
   accept adv-rtr 0.00.81 enable
exit
isis apply accept
```

- In this use case we have not had to modify the protocol priorities
- We don’t want the VSP8000s to accept ISIS External routes from each other, as these would otherwise replace the iBGP routes we want; so we reject them via an Accept policy

Case (a) GRT IP Shortcuts – ISIS ← eBGP Redistribution - Checking

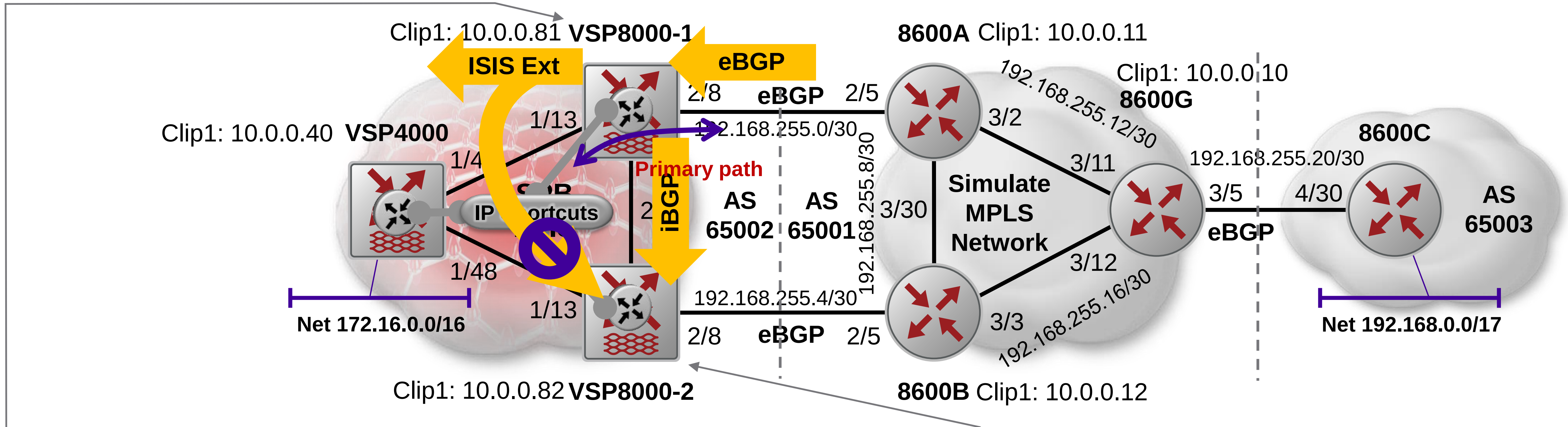



```
VSP4000:1#% show ip route
=============================================================================================
                                 IP Route - GlobalRouter
=============================================================================================
                                                NH                 INTER
DST             MASK            NEXT            VRF/ISID       COST   FACE      PROT AGE TYPE PRF
---------------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 10.0.0.40       -              1      0         LOC  0   DB   0
10.0.0.81       255.255.255.255 VSP8000-1       GlobalRouter   10     4051      ISIS 0   IBS  7
10.0.0.82       255.255.255.255 VSP8000-2       GlobalRouter   10     4051      ISIS 0   IBS  7
172.16.0.0      255.255.0.0     172.16.0.41     -              1      0         LOC  0   DB   0
192.168.0.0     255.255.128.0   VSP8000-1       GlobalRouter   2      4051      ISIS 0   IBS  7
```

```
VSP4000:1#% show isis spbm ip-unicast-fib all
=====================================================================================================
                                     SPBM IP-UNICAST FIB ENTRY INFO
=====================================================================================================
          VRF      DEST                                          OUTGOING          SPBM     PREFIX   PREFIX    IP ROUTE
VRF       ISID     ISID     Destination         NH BEB           VLAN INTERFACE    COST     COST     TYPE      PREFERENCE
-----------------------------------------------------------------------------------------------------
GRT       -        -        10.0.0.81/32        VSP8000-1        4051 1/47         10       1        Internal  7
GRT       -        -        10.0.0.81/32        VSP8000-1        4052 1/47         10       1        Internal  7
GRT       -        -        10.0.0.82/32        VSP8000-2        4051 1/48         10       1        Internal  7
GRT       -        -        10.0.0.82/32        VSP8000-2        4052 1/48         10       1        Internal  7
GRT       -        -        192.168.0.0/17      VSP8000-1        4051 1/47         10       2        External  7
GRT       -        -        192.168.0.0/17      VSP8000-1        4052 1/47         10       2        External  7
```

- Looking good
- VSP4000 is learning the route from VSP8000-1 only and as an ISIS External route

Case (a) GRT IP Shortcuts – ISIS 🡐 eBGP Redistribution - Checking

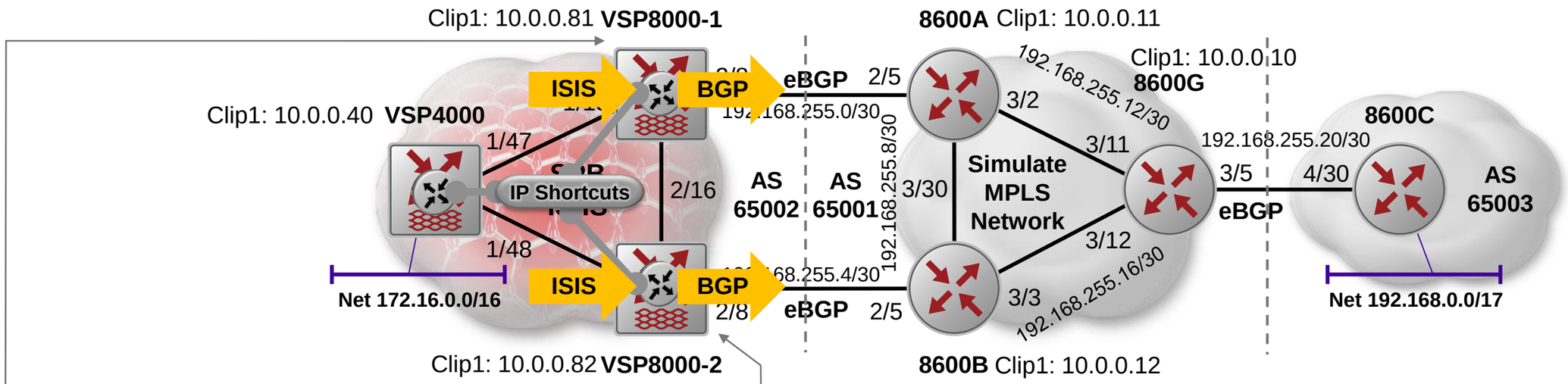



```
VSP8000-1:1#% show ip route
=====================================================================================
                                IP Route - GlobalRouter
=====================================================================================
                                                 NH                        INTER
DST             MASK            NEXT             VRF/ISID         COST     FACE      PROT AGE TYPE PRF
-------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 VSP4000          GlobalRouter     10       4051      ISIS 0   IBS  7
10.0.0.81       255.255.255.255 10.0.0.81        -                1        0         LOC  0   DB   0
10.0.0.82       255.255.255.255 VSP8000-2        GlobalRouter     10       4051      ISIS 0   IBS  7
172.16.0.0      255.255.0.0     VSP4000          GlobalRouter     10       4051      ISIS 0   IBS  7
192.168.0.0     255.255.128.0   192.168.255.1    GlobalRouter     2        2/8       BGP  0   IB   45
192.168.255.0   255.255.255.252 192.168.255.2    -                1        2/8       LOC  0   DB   0
```

```
VSP8000-2:1#% show ip route
=====================================================================================
                                IP Route - GlobalRouter
=====================================================================================
                                                 NH                        INTER
DST             MASK            NEXT             VRF/ISID         COST     FACE      PROT AGE TYPE PRF
-------------------------------------------------------------------------------------
10.0.0.40       255.255.255.255 VSP4000          GlobalRouter     10       4051      ISIS 0   IBS  7
10.0.0.81       255.255.255.255 VSP8000-1        GlobalRouter     10       4051      ISIS 0   IBS  7
10.0.0.82       255.255.255.255 10.0.0.82        -                1        0         LOC  0   DB   0
172.16.0.0      255.255.0.0     VSP4000          GlobalRouter     10       4051      ISIS 0   IBS  7
192.168.0.0     255.255.128.0   VSP8000-1        GlobalRouter     2        4051      BGP  0   IBS  175
192.168.255.4   255.255.255.252 192.168.255.6    -                1        2/8       LOC  0   DB   0
```

- Also looking good, and same as before
- VSP8000-2 still has an iBGP route (pref = 175) which means that our ISIS Accept policy to reject the ISIS External routes from iBGP peer is working

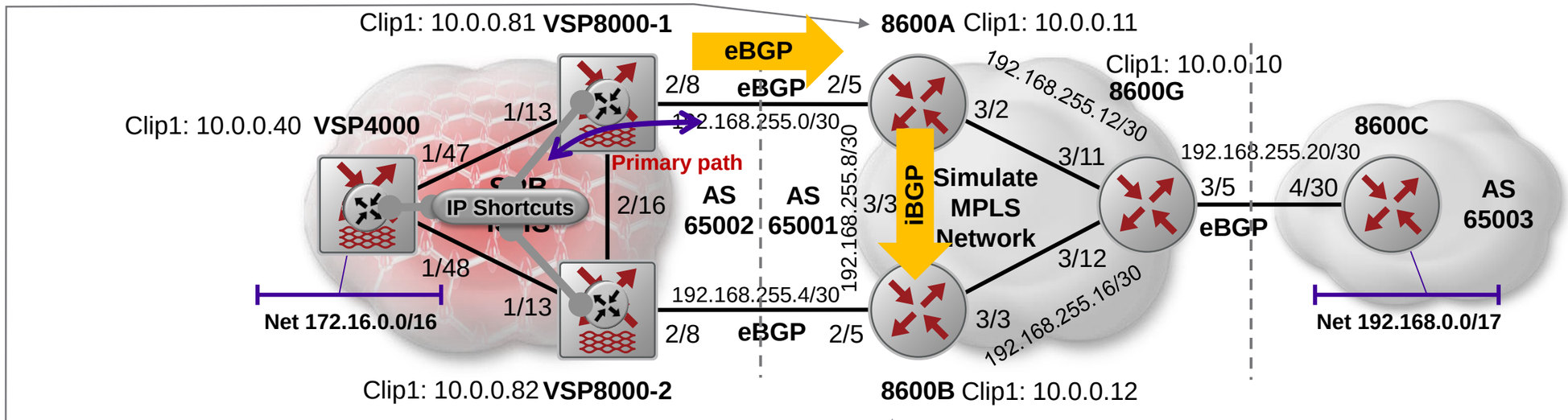
Case (a) GRT IP Shortcuts – ISIS ➔ eBGP Redistribution




```
ip prefix-list host-routes 0.0.0.0/0 ge 32 le 32
route-map except-host-routes 1
   match network host-routes
   no permit
   enable
exit
route-map except-host-routes 2
   permit
   enable
exit
router bgp
   redistribute isis
   redistribute isis route-map except-host-routes
   redistribute isis enable
exit
ip bgp apply redistribute isis
```

- Given the precautions we have taken in the previous two slides, it is now safe to simply redistribute ISIS routes into BGP
- That is because we are now sure that any ISIS routes installed on the VSP8000s are ISIS routes from the wider SPB Fabric (and not routes originating from BGP)
- We associate a route-map to suppress BGP redistribution of ISIS host routes
  - The VSP mgmt loopback IPs; it is unlikely these would need advertising and even if they did, it would be better to summarize them

Case (a) GRT IP Shortcuts – ISIS ➔ eBGP Redistribution - Checking

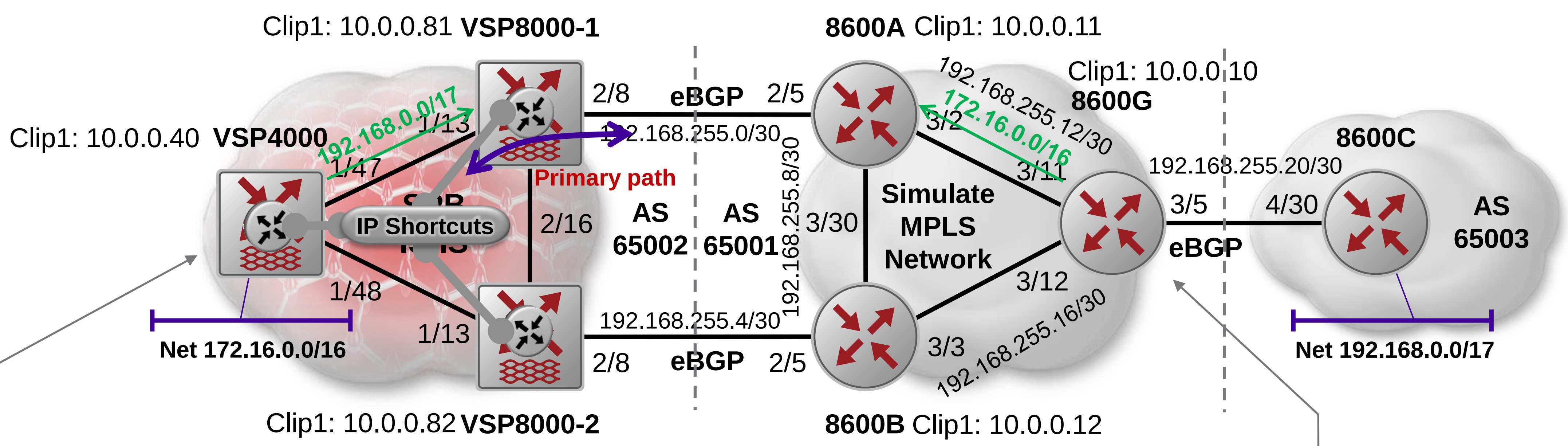



```
8600A:5#% show ip bgp route
================================================================================
                          BGP Routes - GlobalRouter
================================================================================
The total number of routes is 3
NETWORK/MASK       PEER REM ADDR   NEXTHOP ADDRESS ORG LOC PREF
--------------------------------------------------------------------------------
172.16.0.0/16      192.168.255.2   192.168.255.2   INC 200
        AS_PATH: (65002)
172.16.0.0/16      10.0.0.12       10.0.0.12       INC 20
        AS_PATH: (65002)
192.168.0.0/17     10.0.0.10       10.0.0.10       IGP 100
        AS_PATH: (65003)
```

```
8600B:5#% show ip bgp route
================================================================================
                          BGP Routes - GlobalRouter
================================================================================
The total number of routes is 3
NETWORK/MASK       PEER REM ADDR   NEXTHOP ADDRESS ORG LOC PREF
--------------------------------------------------------------------------------
172.16.0.0/16      10.0.0.11       10.0.0.11       INC 200
        AS_PATH: (65002)
172.16.0.0/16      192.168.255.6   192.168.255.6   INC 20
        AS_PATH: (65002)
192.168.0.0/17     10.0.0.10       10.0.0.10       IGP 100
        AS_PATH: (65003)
```

- Looking good

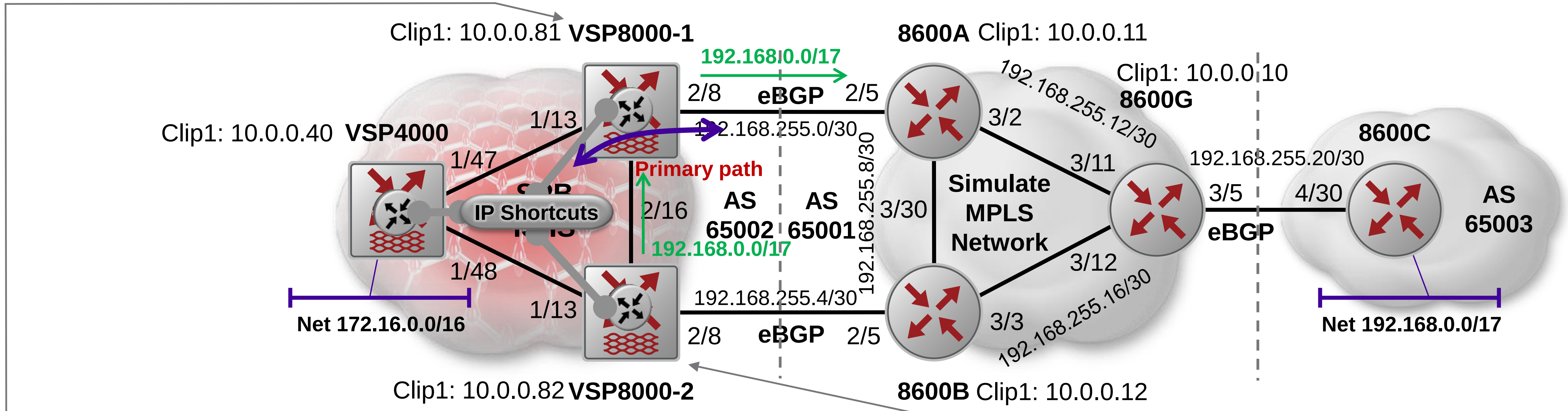
Case (a) GRT IP Shortcuts – Final Checking




```
VSP4000:1#% show ip route
=================================================================================================
                                      IP Route - GlobalRouter
=================================================================================================
                                                     NH                         INTER
DST              MASK             NEXT               VRF/ISID         COST      FACE    PROT  AGE TYPE  PRF
-------------------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255 10.0.0.40           -                1         0       LOC   0   DB    0
10.0.0.81        255.255.255.255 VSP8000-1           GlobalRouter     10        4051    ISIS  0   IBS   7
10.0.0.82        255.255.255.255 VSP8000-2           GlobalRouter     10        4051    ISIS  0   IBS   7
172.16.0.0       255.255.0.0      172.16.0.41        -                1         0       LOC   0   DB    0
192.168.0.0      255.255.128.0    VSP8000-1          GlobalRouter     2         4051    ISIS  0   IBS   7
```

```
8600G:5#% show ip route
==========================================================================================
                                 IP Route - GlobalRouter
==========================================================================================
                                                 NH                 INTER
DST              MASK             NEXT            VRF          COST  FACE  PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------
10.0.0.10        255.255.255.255 10.0.0.10        -            1     0     LOC   0    DB    0
10.0.0.11        255.255.255.255 192.168.255.13   GlobalRout~  11    3/11  OSPF  0    IB    20
10.0.0.12        255.255.255.255 192.168.255.17   GlobalRout~  11    3/12  OSPF  0    IB    20
172.16.0.0       255.255.0.0      192.168.255.13  GlobalRout~  1     3/11  BGP   0    IB    175
192.168.0.0      255.255.128.0    192.168.255.22  GlobalRout~  1     3/5   BGP   0    IB    45
192.168.255.8    255.255.255.252 192.168.255.13   GlobalRout~  2     3/11  OSPF  0    IB    20
192.168.255.12   255.255.255.252 192.168.255.14   -            1     3/11  LOC   0    DB    0
192.168.255.16   255.255.255.252 192.168.255.18   -            1     3/12  LOC   0    DB    0
192.168.255.20   255.255.255.252 192.168.255.21   -            1     3/5   LOC   0    DB    0
```

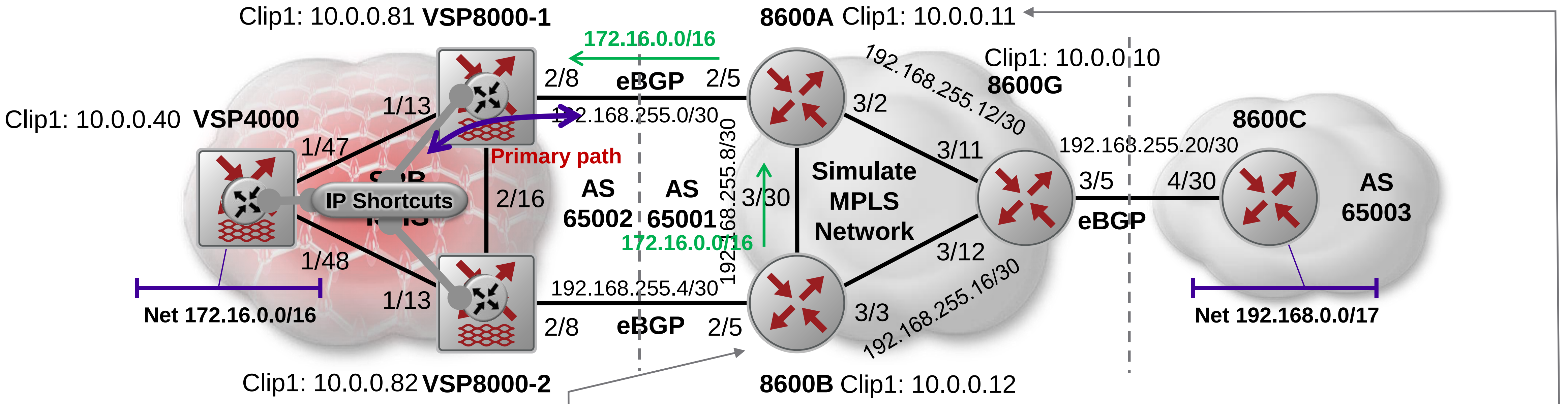
Case (a) GRT IP Shortcuts – Final Checking




```
VSP8000-1:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                 NH                        INTER
DST              MASK             NEXT                VRF/ISID          COST    FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  VSP4000             GlobalRouter      10      4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  10.0.0.81           -                 1       0         LOC   0    DB    0
10.0.0.82        255.255.255.255  VSP8000-2           GlobalRouter      10      4051      ISIS  0    IBS   7
172.16.0.0       255.255.0.0      VSP4000             GlobalRouter      10      4051      ISIS  0    IBS   7
192.168.0.0      255.255.128.0    192.168.255.1       GlobalRouter      2       2/8       BGP   0    IB    45
192.168.255.0    255.255.255.252  192.168.255.2       -                 1       2/8       LOC   0    DB    0
```

```
VSP8000-2:1#% show ip route
================================================================================================
                                    IP Route - GlobalRouter
================================================================================================
                                                 NH                        INTER
DST              MASK             NEXT                VRF/ISID          COST    FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
10.0.0.40        255.255.255.255  VSP4000             GlobalRouter      10      4051      ISIS  0    IBS   7
10.0.0.81        255.255.255.255  VSP8000-1           GlobalRouter      10      4051      ISIS  0    IBS   7
10.0.0.82        255.255.255.255  10.0.0.82           -                 1       0         LOC   0    DB    0
172.16.0.0       255.255.0.0      VSP4000             GlobalRouter      10      4051      ISIS  0    IBS   7
192.168.0.0      255.255.128.0    VSP8000-1           GlobalRouter      2       4051      BGP   0    IBS   175
192.168.255.4    255.255.255.252  192.168.255.6       -                 1       2/8       LOC   0    DB    0
```

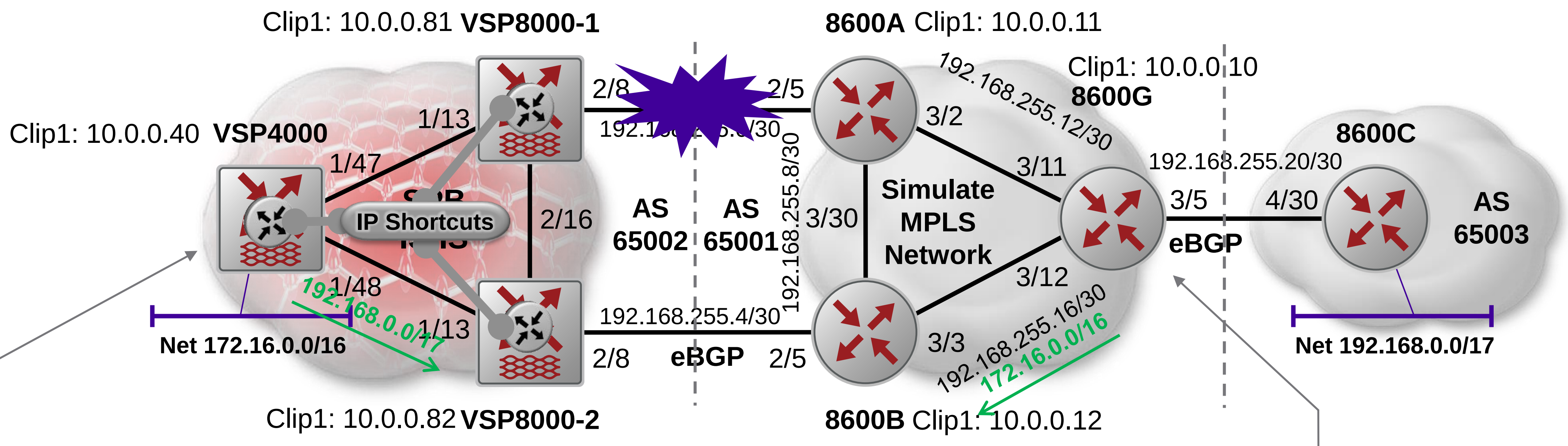
Case (a) GRT IP Shortcuts – Final Checking




```
8600B:5#% show ip route
==================================================================================
                              IP Route - GlobalRouter
==================================================================================
                                                      NH               INTER
DST            MASK           NEXT                    VRF         COST FACE  PROT AGE TYPE PRF
----------------------------------------------------------------------------------
10.0.0.10      255.255.255.255 192.168.255.18         GlobalRout~ 11    3/3  OSPF 0   IB   20
10.0.0.11      255.255.255.255 192.168.255.9          GlobalRout~ 11    3/30 OSPF 0   IB   20
10.0.0.12      255.255.255.255 10.0.0.12              -           1     0    LOC  0   DB   0
172.16.0.0     255.255.0.0     192.168.255.9          GlobalRout~ 1     3/30 BGP  0   IB   175
192.168.0.0    255.255.128.0   192.168.255.18         GlobalRout~ 1     3/3  BGP  0   IB   175
192.168.255.4  255.255.255.252 192.168.255.5          -           1     2/5  LOC  0   DB   0
192.168.255.8  255.255.255.252 192.168.255.10         -           1     3/30 LOC  0   DB   0
192.168.255.12 255.255.255.252 192.168.255.18         GlobalRout~ 2     3/3  OSPF 0   IB   20
192.168.255.16 255.255.255.252 192.168.255.17         -           1     3/3  LOC  0   DB   0
```

```
8600A:5#% show ip route
==================================================================================
                              IP Route - GlobalRouter
==================================================================================
                                                      NH               INTER
DST            MASK           NEXT                    VRF         COST FACE  PROT AGE TYPE PRF
----------------------------------------------------------------------------------
10.0.0.10      255.255.255.255 192.168.255.14         GlobalRout~ 11    3/2  OSPF 0   IB   20
10.0.0.11      255.255.255.255 10.0.0.11              -           1     0    LOC  0   DB   0
10.0.0.12      255.255.255.255 192.168.255.10         GlobalRout~ 11    3/30 OSPF 0   IB   20
172.16.0.0     255.255.0.0     192.168.255.2          GlobalRout~ 1     2/5  BGP  0   IB   45
192.168.0.0    255.255.128.0   192.168.255.14         GlobalRout~ 1     3/2  BGP  0   IB   175
192.168.255.0  255.255.255.252 192.168.255.1          -           1     2/5  LOC  0   DB   0
192.168.255.8  255.255.255.252 192.168.255.9          -           1     3/30 LOC  0   DB   0
192.168.255.12 255.255.255.252 192.168.255.13         -           1     3/2  LOC  0   DB   0
192.168.255.16 255.255.255.252 192.168.255.14         GlobalRout~ 2     3/2  OSPF 0   IB   20
```

Case (a) GRT IP Shortcuts – Testing Failover



VSP4000:1#% show ip route

IP Route - GlobalRouter

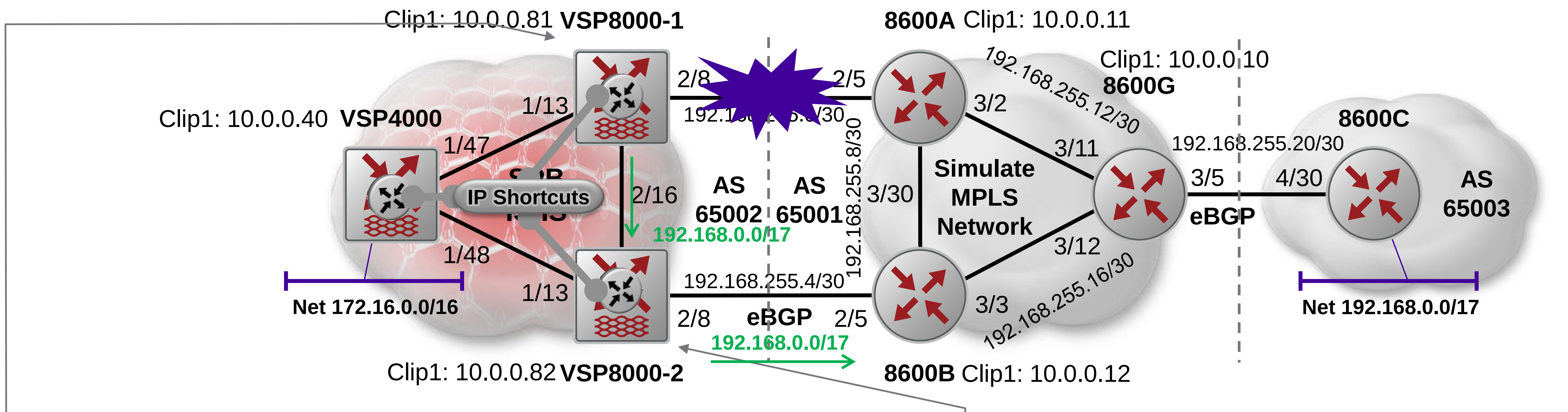
DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.40	255.255.255.255	10.0.0.40	-	1	0	LOC	0	DB	0
10.0.0.81	255.255.255.255	VSP8000-1	GlobalRouter	10	4051	ISIS	0	IBS	7
10.0.0.82	255.255.255.255	VSP8000-2	GlobalRouter	10	4051	ISIS	0	IBS	7
172.16.0.0	255.255.0.0	172.16.0.41	-	1	0	LOC	0	DB	0
192.168.0.0	255.255.128.0	VSP8000-2	GlobalRouter	2	4051	ISIS	0	IBS	7

8600G:5#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.10	255.255.255.255	10.0.0.10	-	1	0	LOC	0	DB	0
10.0.0.11	255.255.255.255	192.168.255.13	GlobalRout~	11	3/11	OSPF	0	IB	20
10.0.0.12	255.255.255.255	192.168.255.17	GlobalRout~	11	3/12	OSPF	0	IB	20
172.16.0.0	255.255.0.0	192.168.255.17	GlobalRout~	1	3/12	BGP	0	IB	175
192.168.0.0	255.255.128.0	192.168.255.22	GlobalRout~	1	3/5	BGP	0	IB	45
192.168.255.8	255.255.255.252	192.168.255.13	GlobalRout~	2	3/11	OSPF	0	IB	20
192.168.255.12	255.255.255.252	192.168.255.14	-	1	3/11	LOC	0	DB	0
192.168.255.16	255.255.255.252	192.168.255.18	-	1	3/12	LOC	0	DB	0
192.168.255.20	255.255.255.252	192.168.255.21	-	1	3/5	LOC	0	DB	0

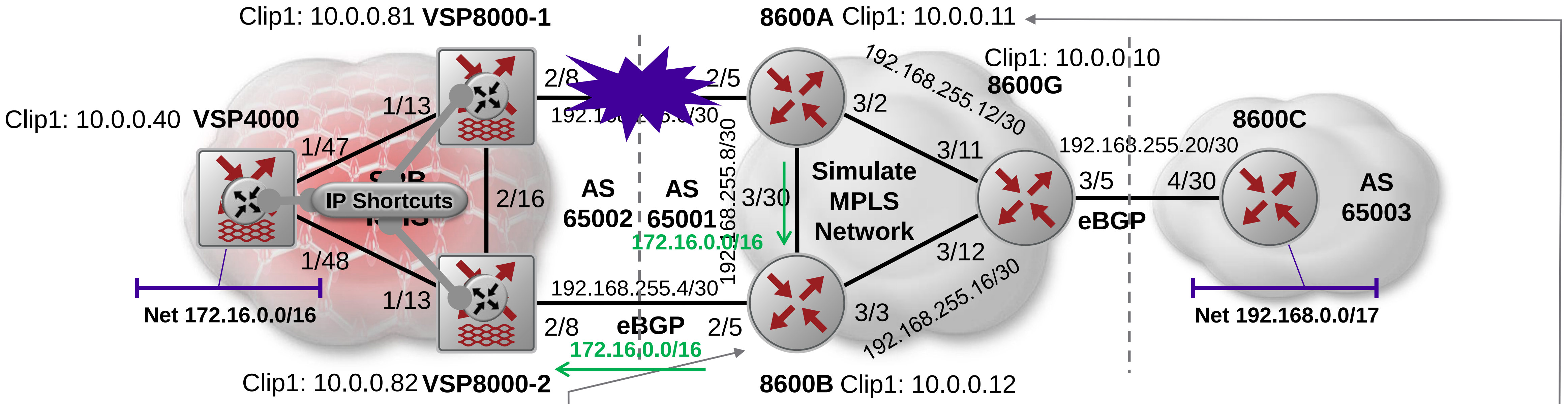
Case (a) GRT IP Shortcuts – Testing Failover




```
VSP8000-1:1#% show ip route
==========================================================================================
                                IP Route - GlobalRouter
==========================================================================================
                                              NH                          INTER
DST            MASK            NEXT              VRF/ISID        COST     FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------
10.0.0.40      255.255.255.255 VSP4000           GlobalRouter    10       4051      ISIS  0    IBS   7
10.0.0.81      255.255.255.255 10.0.0.81         -               1        0         LOC   0    DB    0
10.0.0.82      255.255.255.255 VSP8000-2         GlobalRouter    10       4051      ISIS  0    IBS   7
172.16.0.0     255.255.0.0     VSP4000           GlobalRouter    10       4051      ISIS  0    IBS   7
192.168.0.0    255.255.128.0   VSP8000-2         GlobalRouter    2        4051      BGP   0    IBS   175
```

```
VSP8000-2:1#% show ip route
==========================================================================================
                                IP Route - GlobalRouter
==========================================================================================
                                              NH                          INTER
DST            MASK            NEXT              VRF/ISID        COST     FACE      PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------
10.0.0.40      255.255.255.255 VSP4000           GlobalRouter    10       4051      ISIS  0    IBS   7
10.0.0.81      255.255.255.255 VSP8000-1         GlobalRouter    10       4051      ISIS  0    IBS   7
10.0.0.82      255.255.255.255 10.0.0.82         -               1        0         LOC   0    DB    0
172.16.0.0     255.255.0.0     VSP4000           GlobalRouter    10       4051      ISIS  0    IBS   7
192.168.0.0    255.255.128.0   192.168.255.5     GlobalRouter    2        2/8       BGP   0    IB    45
192.168.255.4  255.255.255.252 192.168.255.6     -               1        2/8       LOC   0    DB    0
```

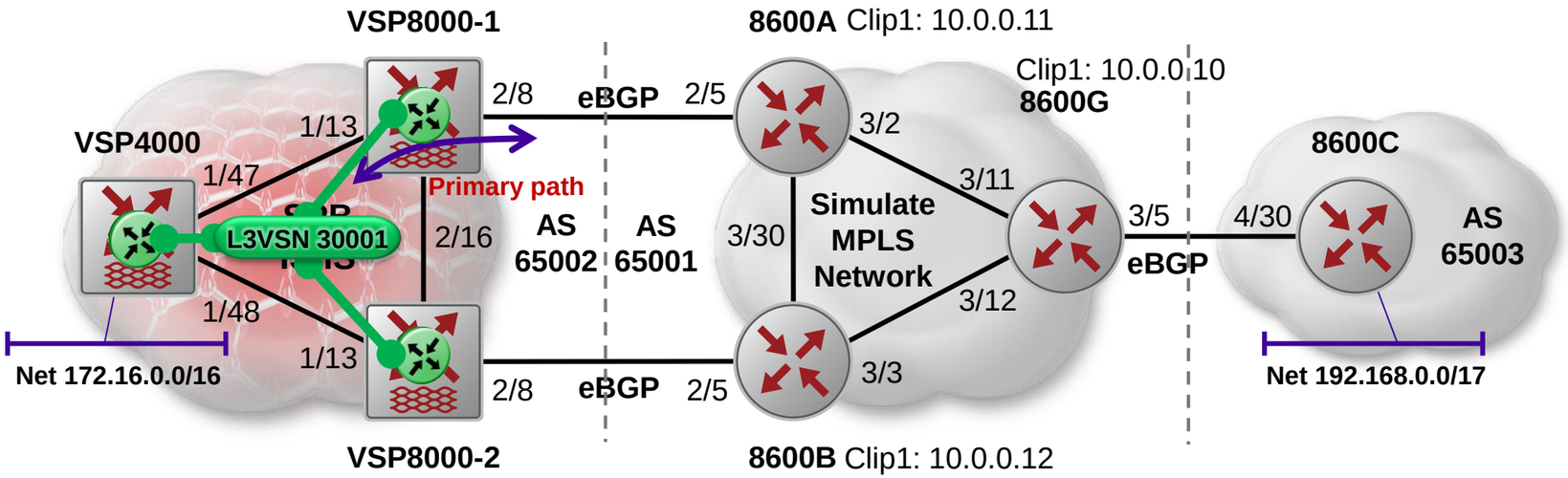
Case (a) GRT IP Shortcuts – Testing Failover




```
8600B:5#% show ip route
================================================================================
                          IP Route - GlobalRouter
================================================================================
                                                   NH            INTER
DST            MASK           NEXT                 VRF       COST FACE  PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.10      255.255.255.255 192.168.255.18      GlobalRout~ 11   3/3  OSPF 0   IB   20
10.0.0.11      255.255.255.255 192.168.255.9       GlobalRout~ 11   3/30 OSPF 0   IB   20
10.0.0.12      255.255.255.255 10.0.0.12           -           1    0    LOC  0   DB   0
172.16.0.0     255.255.0.0    192.168.255.6        GlobalRout~ 1    2/5  BGP  0   IB   45
192.168.0.0    255.255.128.0  192.168.255.18       GlobalRout~ 1    3/3  BGP  0   IB   175
192.168.255.4  255.255.255.252 192.168.255.5       -           1    2/5  LOC  0   DB   0
192.168.255.8  255.255.255.252 192.168.255.10      -           1    3/30 LOC  0   DB   0
192.168.255.12 255.255.255.252 192.168.255.18      GlobalRout~ 2    3/3  OSPF 0   IB   20
192.168.255.16 255.255.255.252 192.168.255.17      -           1    3/3  LOC  0   DB   0
```

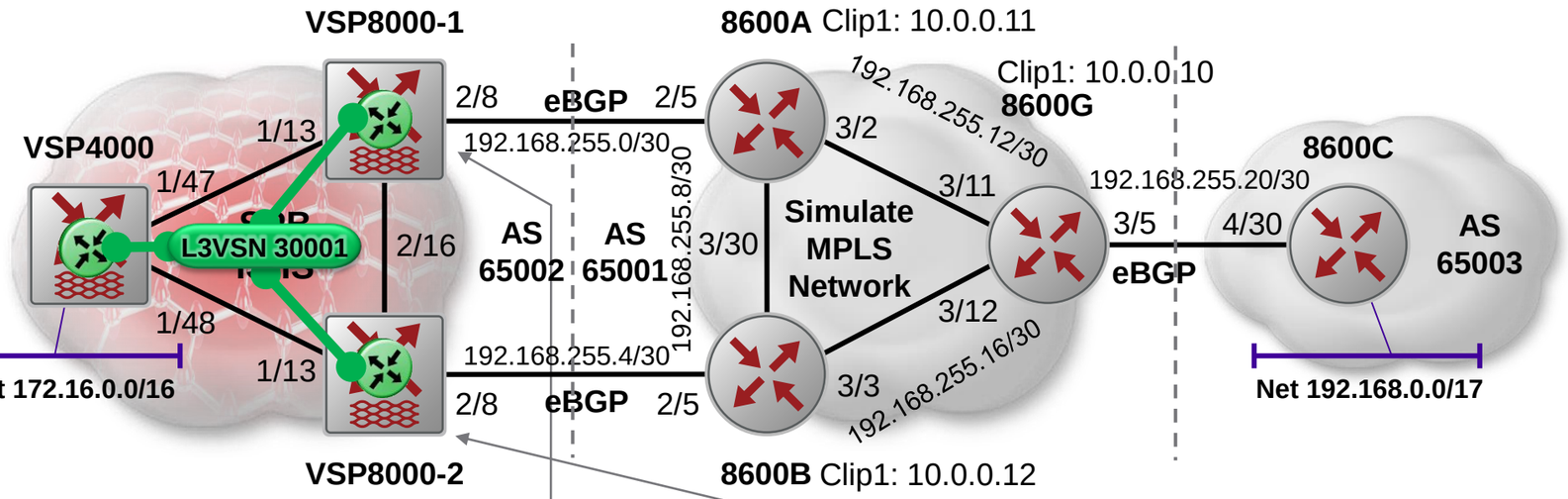
```
8600A:5#% show ip route
================================================================================
                          IP Route - GlobalRouter
================================================================================
                                                   NH            INTER
DST            MASK           NEXT                 VRF       COST FACE  PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.10      255.255.255.255 192.168.255.14      GlobalRout~ 11   3/2  OSPF 0   IB   20
10.0.0.11      255.255.255.255 10.0.0.11           -           1    0    LOC  0   DB   0
10.0.0.12      255.255.255.255 192.168.255.10      GlobalRout~ 11   3/30 OSPF 0   IB   20
172.16.0.0     255.255.0.0    192.168.255.10       GlobalRout~ 1    3/30 BGP  0   IB   175
192.168.0.0    255.255.128.0  192.168.255.14       GlobalRout~ 1    3/2  BGP  0   IB   175
192.168.255.8  255.255.255.252 192.168.255.9       -           1    3/30 LOC  0   DB   0
192.168.255.12 255.255.255.252 192.168.255.13      -           1    3/2  LOC  0   DB   0
192.168.255.16 255.255.255.252 192.168.255.14      GlobalRout~ 2    3/2  OSPF 0   IB   20
```

Forcing paths with BGP and SPB – Case (b) VRF L3VSN



- We are now going to look at the case where BGP is redistributed into SPB VRF L3VSN

Case (b) VRF L3VSN – VRF & IPVPN Config



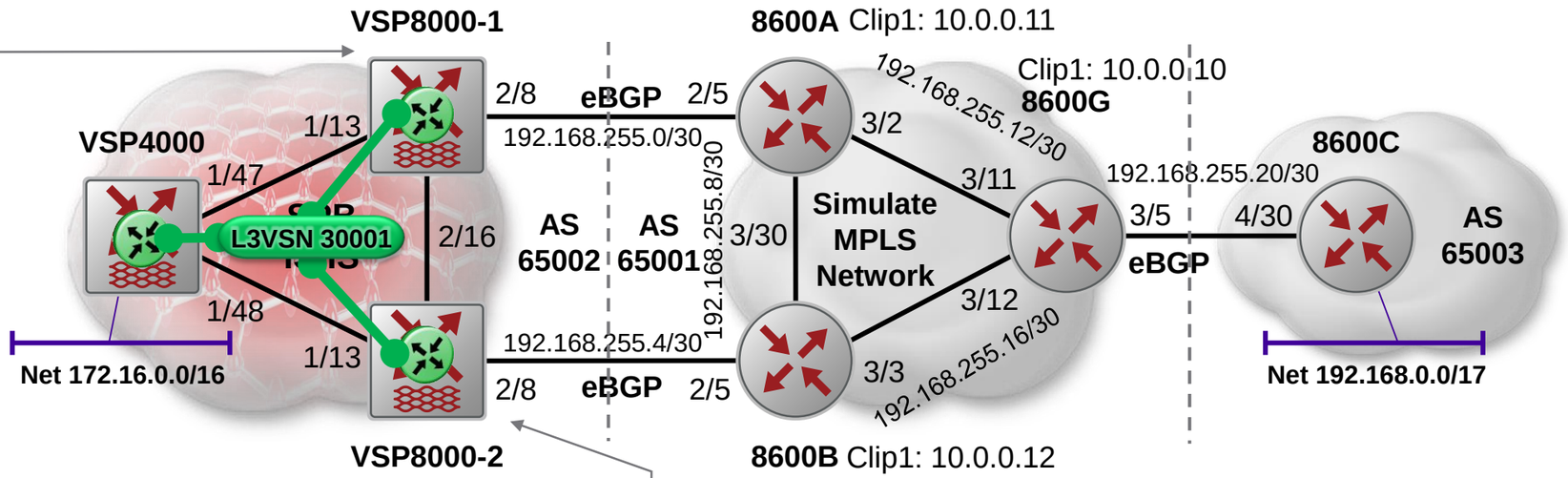

```
ip vrf green
interface loopback 3
   ip address 172.16.0.41/16 vrf green
exit
router vrf green
   ipvpn
   i-sid 30001
   ipvpn enable
   isis redistribute direct
   isis redistribute direct enable
exit
isis apply redistribute direct vrf green
```

```
ip vrf green
interface GigabitEthernet 2/8
   vrf green
   brouter vlan 2500 subnet 192.168.255.2/30
exit
router vrf green
   ipvpn
   i-sid 30001
   ipvpn enable
exit
```

```
ip vrf green
interface GigabitEthernet 2/8
   vrf green
   brouter vlan 2504 subnet 192.168.255.6/30
exit
router vrf green
   ipvpn
   i-sid 30001
   ipvpn enable
exit
```

- Since we cannot have iBGP peerings with VRFs, no real need to create VRF CLIPs on the VSP8000s

Case (b) VRF L3VSN – BGP Config

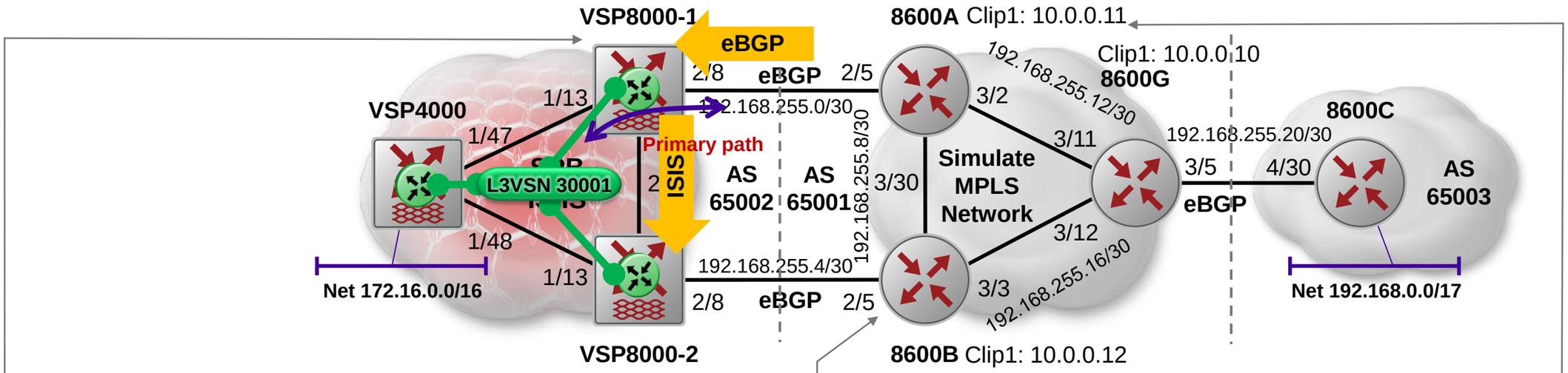



```
router bgp 65002
router vrf green
   ip bgp
   no ip bgp auto-summary
   no ip bgp synchronization
   no ip bgp aggregation
   ip bgp router-id 192.168.255.2
   ip bgp enable
   ip bgp neighbor 192.168.255.1
   ip bgp neighbor 192.168.255.1 remote-as 65001
   ip bgp neighbor 192.168.255.1 enable
exit
```

```
router bgp 65002
router vrf green
   ip bgp
   no ip bgp auto-summary
   no ip bgp synchronization
   no ip bgp aggregation
   ip bgp router-id 192.168.255.6
   ip bgp enable
   ip bgp neighbor 192.168.255.5
   ip bgp neighbor 192.168.255.5 remote-as 65001
   ip bgp neighbor 192.168.255.5 enable
exit
```

- We only have 1 BGP interface and 1 single eBGP peering
- So we use that IP interface as BGP router-id

Case (b) VRF L3VSN – Instead of BGP Local-Preference




```
router vrf green
   ip route preference protocol spbm-level1 50
exit
```

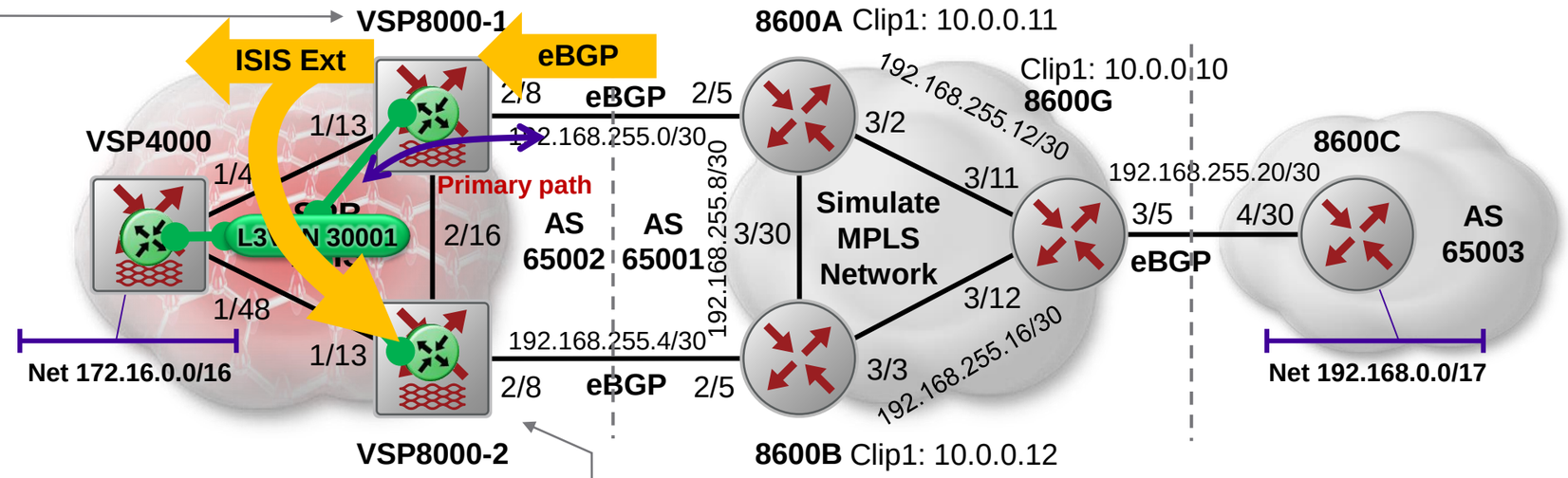
```
no router bgp enable
router bgp
   bgp default local-preference 200
exit
router bgp 65001 enable
```

```
no router bgp enable
router bgp
   bgp default local-preference 20
exit
router bgp 65001 enable
```

- We don't have iBGP support on VRFs so we cannot leverage BGP local-preference
- Instead we will play with protocol priorities and on VSP8000-1 we will decrease the ISIS preference below eBGP. This will ensure that:
  - VSP8000-1 will prefer eBGP over ISIS
  - VSP8000-2 will still prefer ISIS over eBGP

- BGP local-preference is by default set to 100
- So we increase it on 8600A and decrease it on 8600B

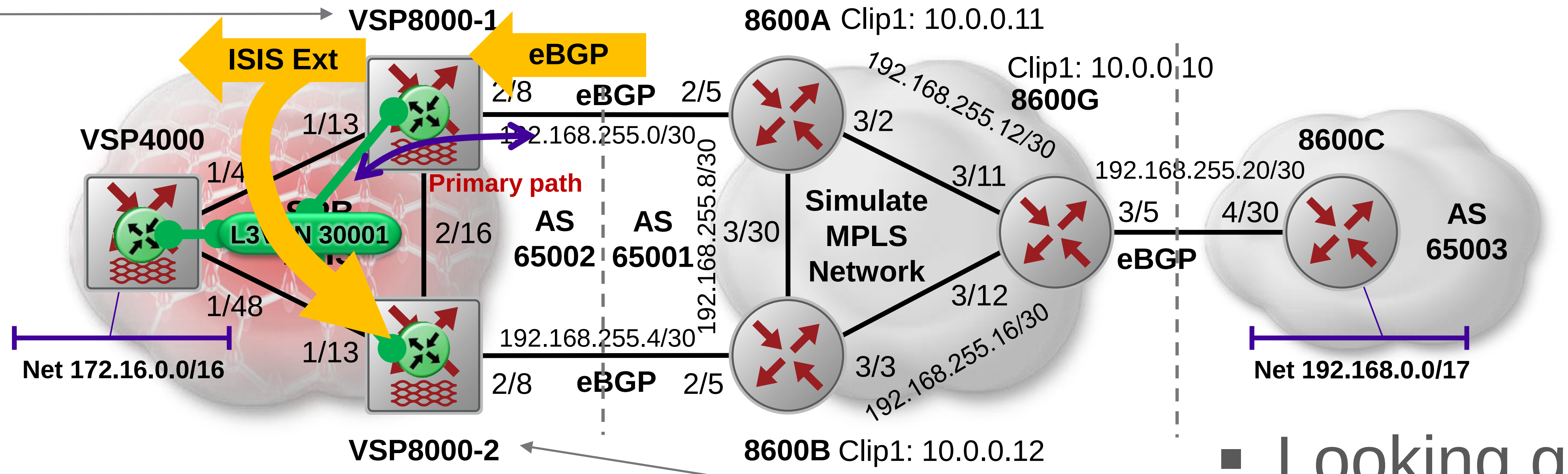
Case (b) VRF L3VSN – ISIS ➔ eBGP Redistribution




```
router vrf green
   isis redistribute bgp
   isis redistribute bgp metric-type external
   isis redistribute bgp enable
exit
isis apply redistribute bgp vrf green
```

- We redistribute BGP into ISIS as External route types
- We configure this on both VSP8000s
- However, since VSP8000-2 still prefers ISIS over BGP, as soon as the VSP8000-1 ISIS announces the BGP routes, VSP8000-2 will replace its BGP route with an ISIS one

Case (b) VRF L3VSN – ISIS 🡐 eBGP Redistribution - Checking

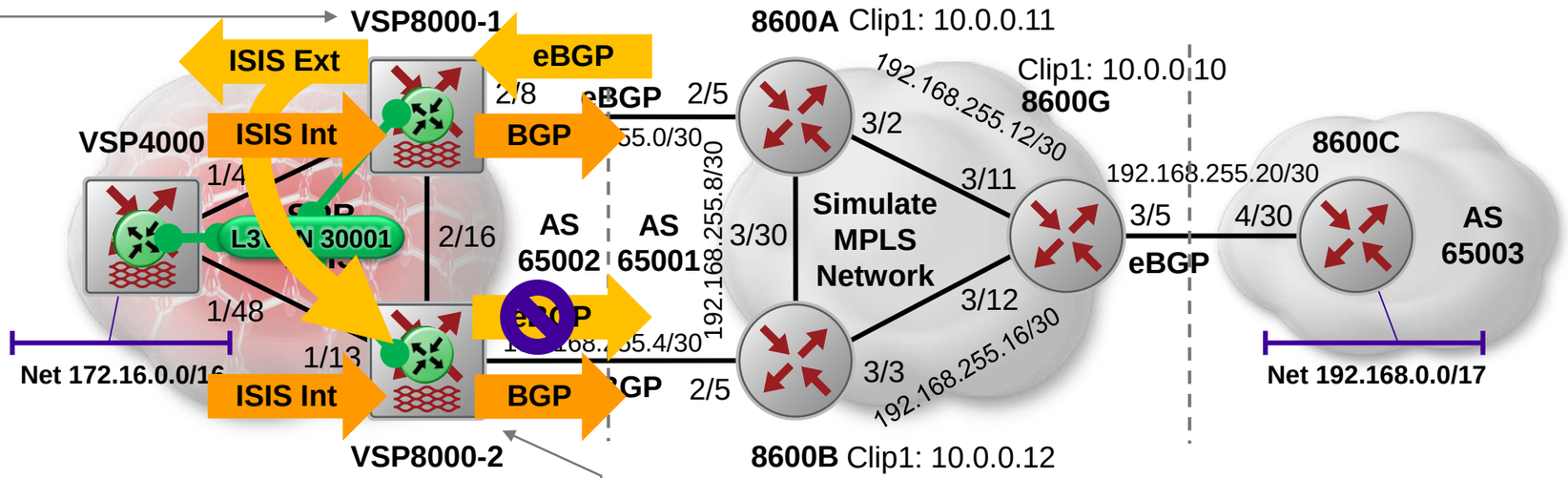


- Looking good

```
VSP8000-1:1#% show ip route vrf green
================================================================================================
                                     IP Route - VRF green
================================================================================================
                                                  NH                      INTER
DST              MASK            NEXT             VRF/ISID         COST   FACE    PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
172.16.0.0       255.255.0.0     VSP4000          green            10     4051    ISIS 0   IBSV 50
192.168.0.0      255.255.128.0   192.168.255.1    green            2      2/8     BGP  0   IB   45
192.168.255.0    255.255.255.252 192.168.255.2    -                1      2/8     LOC  0   DB   0

VSP8000-1:1#% show ip bgp route vrf green
===============================================================================================
                            BGP Routes - VRF green
===============================================================================================
The total number of bgp routes in this Vrf are 1
NETWORK/MASK       PEER REM ADDR   NEXTHOP ADDRESS ORG LOC PREF
-----------------------------------------------------------------------------------------------
192.168.0.0/17     192.168.255.1   192.168.255.1   IGP 100
        AS_PATH: (65001 65003)
```

```
VSP8000-2:1#% show ip route vrf green
================================================================================================
                                     IP Route - VRF green
================================================================================================
                                                  NH                      INTER
DST              MASK            NEXT             VRF/ISID         COST   FACE    PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
172.16.0.0       255.255.0.0     VSP4000          green            10     4051    ISIS 0   IBSV 7
192.168.0.0      255.255.128.0   VSP8000-1        green            2      4051    ISIS 0   IBSV 7
192.168.255.4    255.255.255.252 192.168.255.6    -                1      2/8     LOC  0   DB   0

VSP8000-2:1#% show ip bgp route vrf green
===============================================================================================
                            BGP Routes - VRF green
===============================================================================================
The total number of bgp routes in this Vrf are 1
NETWORK/MASK       PEER REM ADDR   NEXTHOP ADDRESS ORG LOC PREF
-----------------------------------------------------------------------------------------------
192.168.0.0/17     192.168.255.5   192.168.255.5   IGP 100
        AS_PATH: (65001 65003)
```

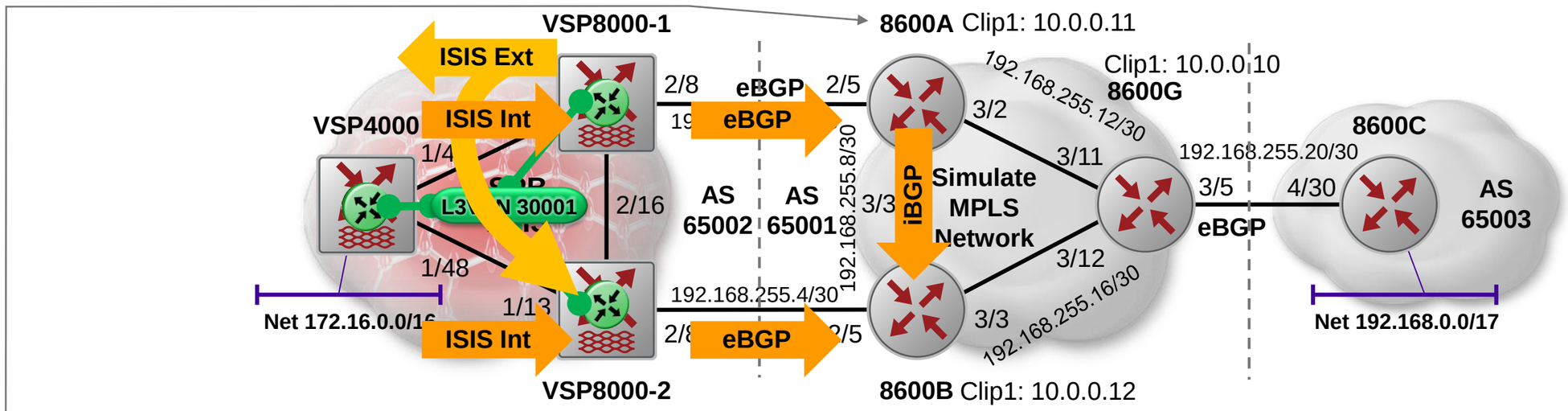
Case (b) VRF L3VSN – ISIS ➔ eBGP Redistribution




```
router vrf green
   route-map isis-internal 1
      match metric-type-isis internal
      enable
   exit
   ip bgp redistribute isis
   ip bgp redistribute isis route-map isis-internal
   ip bgp redistribute isis enable
exit
ip bgp apply redistribute isis vrf green
```

- We are now faced with redistributing ISIS routes into BGP
- We want to redistribute ONLY ISIS Internal routes
- We do NOT want to redistribute the ISIS External route which VSP8000-2 has pointing to VSP8000-1

Case (b) VRF L3VSN – ISIS ➔ eBGP Redistribution - Checking

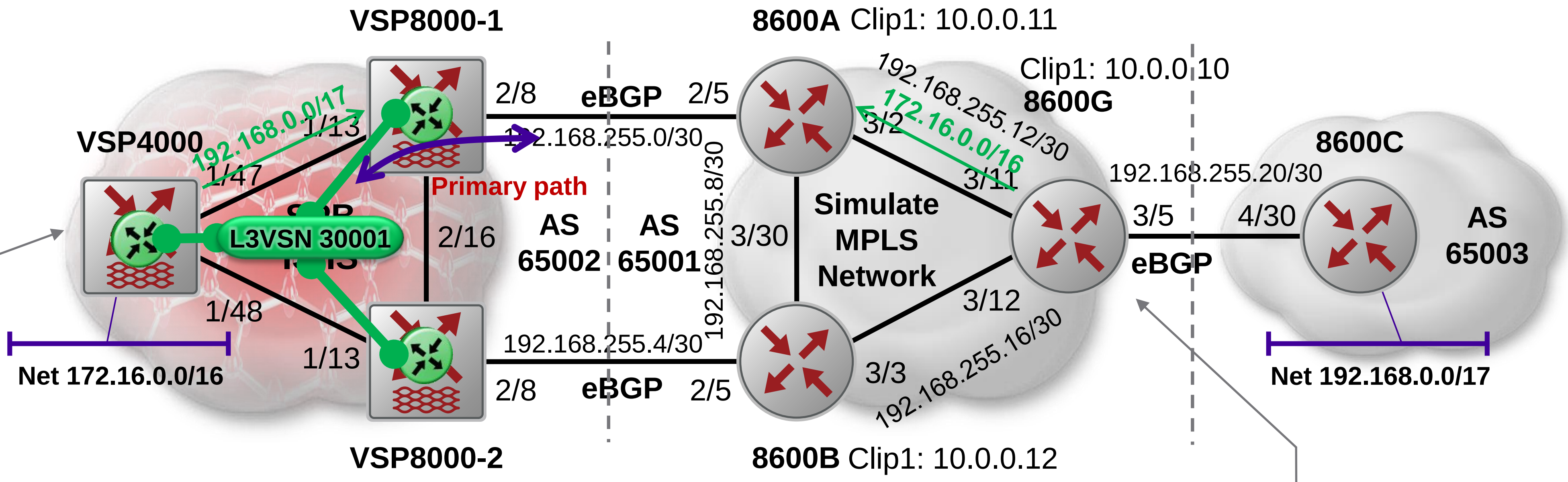



```
8600A:5#% show ip bgp route
================================================================================
                          BGP Routes - GlobalRouter
================================================================================
The total number of routes is 3
NETWORK/MASK       PEER REM ADDR    NEXTHOP ADDRESS ORG LOC PREF
--------------------------------------------------------------------------------
172.16.0.0/16      192.168.255.2    192.168.255.2   INC 200
        AS_PATH: (65002)
172.16.0.0/16      10.0.0.12        10.0.0.12       INC 20
        AS_PATH: (65002)
192.168.0.0/17     10.0.0.10        10.0.0.10       IGP 100
        AS_PATH: (65003)
```

```
8600B:5#% show ip bgp route
================================================================================
                          BGP Routes - GlobalRouter
================================================================================
The total number of routes is 3
NETWORK/MASK       PEER REM ADDR    NEXTHOP ADDRESS ORG LOC PREF
--------------------------------------------------------------------------------
172.16.0.0/16      10.0.0.11        10.0.0.11       INC 200
        AS_PATH: (65002)
172.16.0.0/16      192.168.255.6    192.168.255.6   INC 20
        AS_PATH: (65002)
192.168.0.0/17     10.0.0.10        10.0.0.10       IGP 100
        AS_PATH: (65003)
```

- Looking good

Case (b) VRF L3VSN – Final Checking



VSP4000:1#% show ip route vrf green

IP Route - VRF green

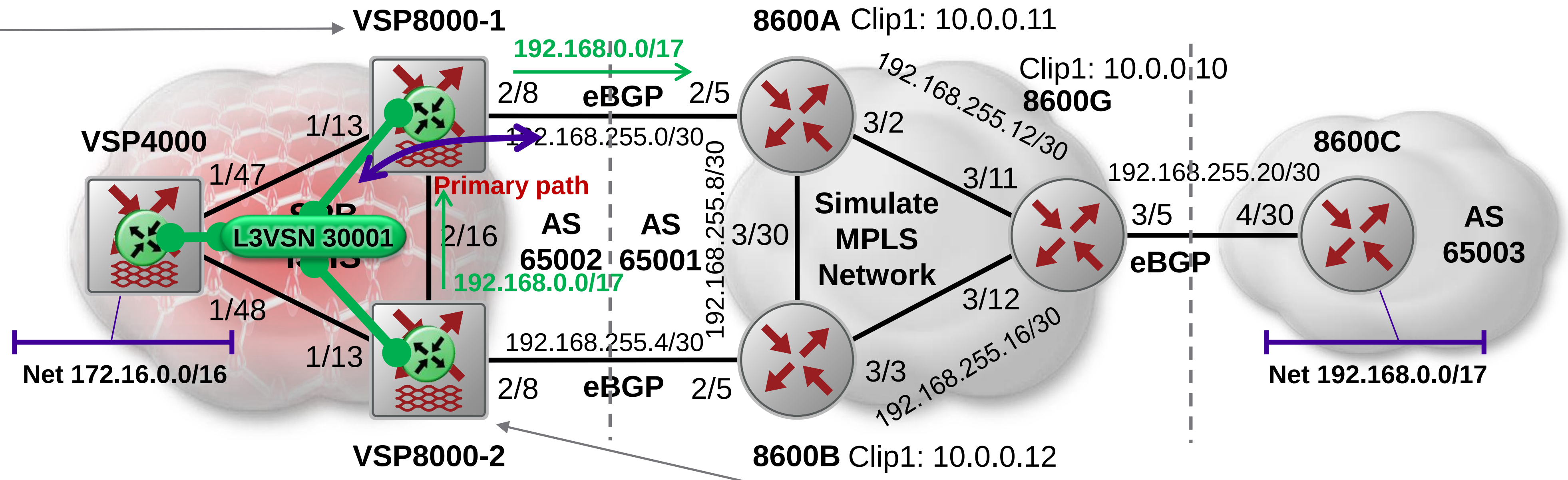
DST	MASK	NEXT	NH VRF/ISID	COST	INTER FACE	PROT	AGE	TYPE	PRF
172.16.0.0	255.255.0.0	172.16.0.41	-	1	0	LOC	0	DB	0
192.168.0.0	255.255.128.0	VSP8000-1	green	2	4051	ISIS	0	IBSV	7

8600G:5#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.10	255.255.255.255	10.0.0.10	-	1	0	LOC	0	DB	0
10.0.0.11	255.255.255.255	192.168.255.13	GlobalRout~	11	3/11	OSPF	0	IB	20
10.0.0.12	255.255.255.255	192.168.255.17	GlobalRout~	11	3/12	OSPF	0	IB	20
172.16.0.0	255.255.0.0	192.168.255.13	GlobalRout~	1	3/11	BGP	0	IB	175
192.168.0.0	255.255.128.0	192.168.255.22	GlobalRout~	1	3/5	BGP	0	IB	45
192.168.255.8	255.255.255.252	192.168.255.13	GlobalRout~	2	3/11	OSPF	0	IB	20
192.168.255.12	255.255.255.252	192.168.255.14	-	1	3/11	LOC	0	DB	0
192.168.255.16	255.255.255.252	192.168.255.18	-	1	3/12	LOC	0	DB	0
192.168.255.20	255.255.255.252	192.168.255.21	-	1	3/5	LOC	0	DB	0

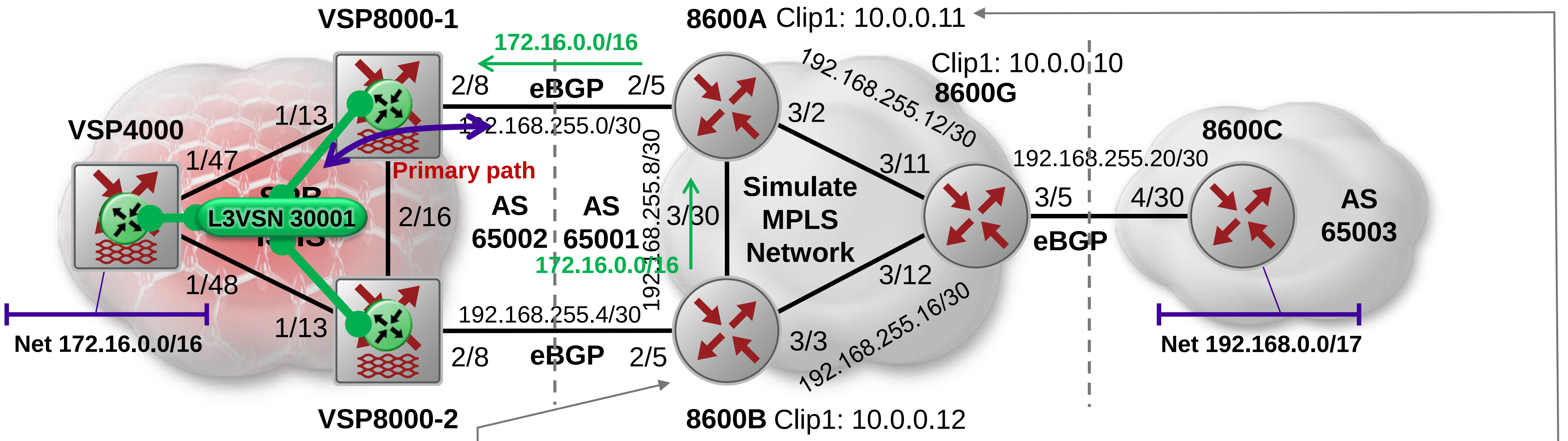
Case (b) VRF L3VSN – Final Checking




```
VSP8000-1:1#% show ip route vrf green
================================================================================================
                                     IP Route - VRF green
================================================================================================
                                                NH                          INTER
DST             MASK            NEXT            VRF/ISID            COST    FACE        PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
172.16.0.0      255.255.0.0     VSP4000         green               10      4051        ISIS 0   IBSV 50
192.168.0.0     255.255.128.0   192.168.255.1   green               2       2/8         BGP  0   IB   45
192.168.255.0   255.255.255.252 192.168.255.2   -                   1       2/8         LOC  0   DB   0
```

```
VSP8000-2:1#% show ip route vrf green
================================================================================================
                                     IP Route - VRF green
================================================================================================
                                                NH                          INTER
DST             MASK            NEXT            VRF/ISID            COST    FACE        PROT AGE TYPE PRF
------------------------------------------------------------------------------------------------
172.16.0.0      255.255.0.0     VSP4000         green               10      4051        ISIS 0   IBSV 7
192.168.0.0     255.255.128.0   VSP8000-1       green               2       4051        ISIS 0   IBSV 7
192.168.255.4   255.255.255.252 192.168.255.6   -                   1       2/8         LOC  0   DB   0
```

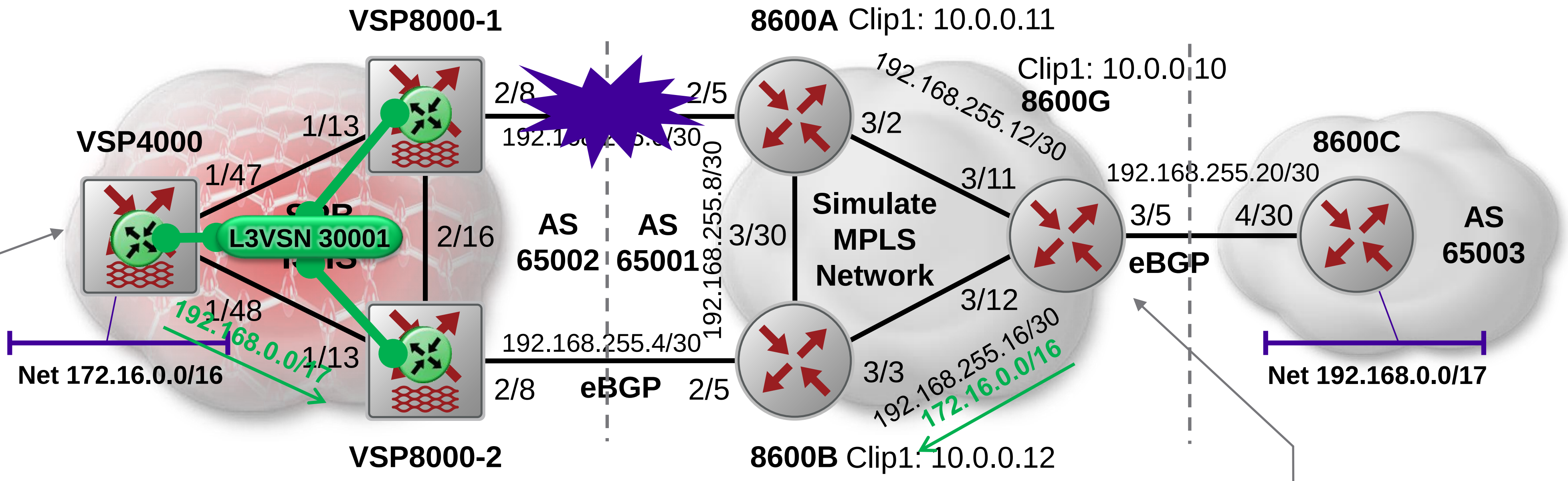
Case (b) VRF L3VSN – Final Checking




```
8600B:5#% show ip route
================================================================================
                           IP Route - GlobalRouter
================================================================================
                                                  NH                INTER
DST              MASK             NEXT            VRF          COST FACE  PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.10        255.255.255.255 192.168.255.18  GlobalRout~ 11     3/3  OSPF 0   IB   20
10.0.0.11        255.255.255.255 192.168.255.9   GlobalRout~ 11     3/30 OSPF 0   IB   20
10.0.0.12        255.255.255.255 10.0.0.12        -          1    0     LOC  0   DB   0
172.16.0.0       255.255.0.0     192.168.255.9   GlobalRout~ 1      3/30 BGP  0   IB   175
192.168.0.0      255.255.128.0   192.168.255.18  GlobalRout~ 1      3/3  BGP  0   IB   175
192.168.255.4    255.255.255.252 192.168.255.5    -          1      2/5  LOC  0   DB   0
192.168.255.8    255.255.255.252 192.168.255.10   -          1      3/30 LOC  0   DB   0
192.168.255.12   255.255.255.252 192.168.255.18  GlobalRout~ 2      3/3  OSPF 0   IB   20
192.168.255.16   255.255.255.252 192.168.255.17   -          1      3/3  LOC  0   DB   0
```

```
8600A:5#% show ip route
================================================================================
                           IP Route - GlobalRouter
================================================================================
                                                  NH                INTER
DST              MASK             NEXT            VRF          COST FACE  PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.10        255.255.255.255 192.168.255.14  GlobalRout~ 11     3/2  OSPF 0   IB   20
10.0.0.11        255.255.255.255 10.0.0.11        -          1    0     LOC  0   DB   0
10.0.0.12        255.255.255.255 192.168.255.10  GlobalRout~ 11     3/30 OSPF 0   IB   20
172.16.0.0       255.255.0.0     192.168.255.2   GlobalRout~ 1      2/5  BGP  0   IB   45
192.168.0.0      255.255.128.0   192.168.255.14  GlobalRout~ 1      3/2  BGP  0   IB   175
192.168.255.0    255.255.255.252 192.168.255.1    -          1      2/5  LOC  0   DB   0
192.168.255.8    255.255.255.252 192.168.255.9    -          1      3/30 LOC  0   DB   0
192.168.255.12   255.255.255.252 192.168.255.13   -          1      3/2  LOC  0   DB   0
192.168.255.16   255.255.255.252 192.168.255.14  GlobalRout~ 2      3/2  OSPF 0   IB   20
```

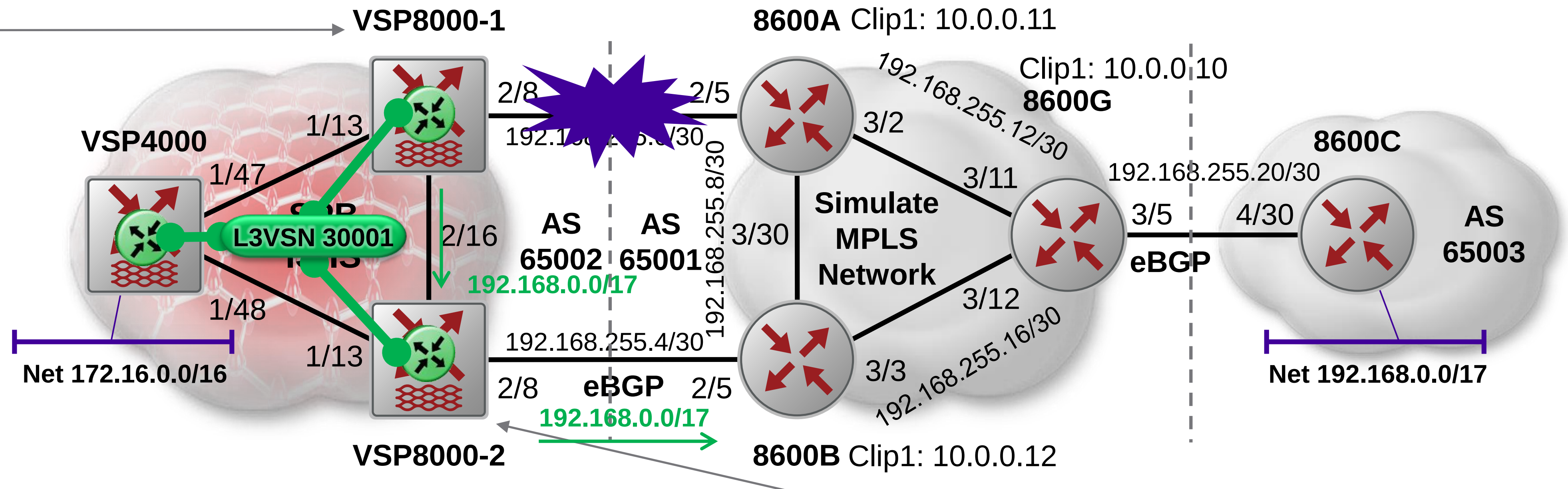
Case (b) VRF L3VSN – Testing Failover




```
VSP4000:1#% show ip route vrf green
================================================================================
                              IP Route - VRF green
================================================================================
                                             NH                INTER
DST            MASK           NEXT           VRF/ISID     COST  FACE   PROT AGE TYPE PRF
--------------------------------------------------------------------------------
172.16.0.0     255.255.0.0    172.16.0.41    -            1     0      LOC  0   DB   0
192.168.0.0    255.255.128.0  VSP8000-2      green        2     4051   ISIS 0   IBSV 7
```

```
8600G:5#% show ip route
================================================================================
                         IP Route - GlobalRouter
================================================================================
                                                NH               INTER
DST             MASK            NEXT            VRF         COST FACE PROT AGE TYPE PRF
--------------------------------------------------------------------------------
10.0.0.10       255.255.255.255 10.0.0.10       -           1    0    LOC  0   DB   0
10.0.0.11       255.255.255.255 192.168.255.13  GlobalRout~ 11   3/11 OSPF 0   IB   20
10.0.0.12       255.255.255.255 192.168.255.17  GlobalRout~ 11   3/12 OSPF 0   IB   20
172.16.0.0      255.255.0.0     192.168.255.17  GlobalRout~ 1    3/12 BGP  0   IB   175
192.168.0.0     255.255.128.0   192.168.255.22  GlobalRout~ 1    3/5  BGP  0   IB   45
192.168.255.8   255.255.255.252 192.168.255.13  GlobalRout~ 2    3/11 OSPF 0   IB   20
192.168.255.12  255.255.255.252 192.168.255.14  -           1    3/11 LOC  0   DB   0
192.168.255.16  255.255.255.252 192.168.255.18  -           1    3/12 LOC  0   DB   0
192.168.255.20  255.255.255.252 192.168.255.21  -           1    3/5  LOC  0   DB   0
```

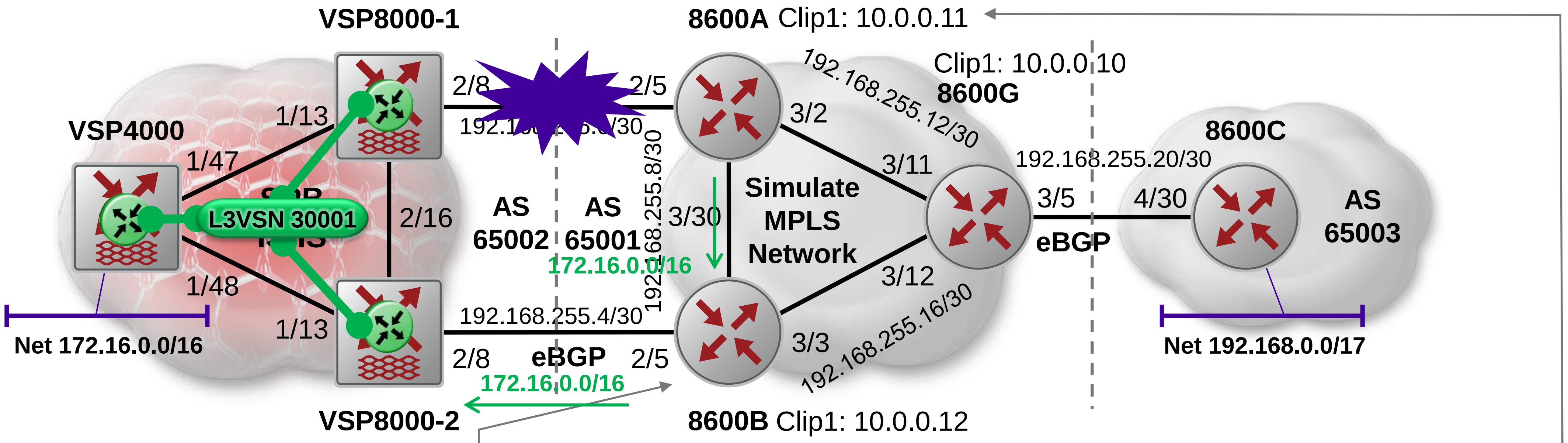
Case (b) VRF L3VSN – Testing Failover




```
VSP8000-1:1#% show ip route vrf green
================================================================================================
                                     IP Route - VRF green
================================================================================================
                                                 NH                INTER
DST            MASK           NEXT               VRF/ISID   COST   FACE     PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
172.16.0.0     255.255.0.0    VSP4000            green      10     4051     ISIS  0    IBSV  50
192.168.0.0    255.255.128.0  VSP8000-2          green      2      4051     ISIS  0    IBSV  50
```

```
VSP8000-2:1#% show ip route vrf green
================================================================================================
                                     IP Route - VRF green
================================================================================================
                                                 NH                INTER
DST            MASK           NEXT               VRF/ISID   COST   FACE     PROT  AGE  TYPE  PRF
------------------------------------------------------------------------------------------------
172.16.0.0     255.255.0.0    VSP4000            green      10     4051     ISIS  0    IBSV  7
192.168.0.0    255.255.128.0  192.168.255.5      green      2      2/8      BGP   0    IB    45
192.168.255.4  255.255.255.252 192.168.255.6     -          1      2/8      LOC   0    DB    0
```

Case (b) VRF L3VSN – Testing Failover



8600B:5#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.10	255.255.255.255	192.168.255.18	GlobalRout~	11	3/3	OSPF	0	IB	20
10.0.0.11	255.255.255.255	192.168.255.9	GlobalRout~	11	3/30	OSPF	0	IB	20
10.0.0.12	255.255.255.255	10.0.0.12	-	1	0	LOC	0	DB	0
172.16.0.0	**255.255.0.0**	**192.168.255.6**	**GlobalRout~**	**1**	**2/5**	**BGP**	**0**	**IB**	**45**
192.168.0.0	255.255.128.0	192.168.255.18	GlobalRout~	1	3/3	BGP	0	IB	175
192.168.255.4	255.255.255.252	192.168.255.5	-	1	2/5	LOC	0	DB	0
192.168.255.8	255.255.255.252	192.168.255.10	-	1	3/30	LOC	0	DB	0
192.168.255.12	255.255.255.252	192.168.255.18	GlobalRout~	2	3/3	OSPF	0	IB	20
192.168.255.16	255.255.255.252	192.168.255.17	-	1	3/3	LOC	0	DB	0

8600A:5#% show ip route

IP Route - GlobalRouter

DST	MASK	NEXT	NH VRF	COST	INTER FACE	PROT	AGE	TYPE	PRF
10.0.0.10	255.255.255.255	192.168.255.14	GlobalRout~	11	3/2	OSPF	0	IB	20
10.0.0.11	255.255.255.255	10.0.0.11	-	1	0	LOC	0	DB	0
10.0.0.12	255.255.255.255	192.168.255.10	GlobalRout~	11	3/30	OSPF	0	IB	20
172.16.0.0	**255.255.0.0**	**192.168.255.10**	**GlobalRout~**	**1**	**3/30**	**BGP**	**0**	**IB**	**175**
192.168.0.0	255.255.128.0	192.168.255.14	GlobalRout~	1	3/2	BGP	0	IB	175
192.168.255.8	255.255.255.252	192.168.255.9	-	1	3/30	LOC	0	DB	0
192.168.255.12	255.255.255.252	192.168.255.13	-	1	3/2	LOC	0	DB	0
192.168.255.16	255.255.255.252	192.168.255.14	GlobalRout~	2	3/2	OSPF	0	IB	20

Thank You

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