Introduction to Enterprise Networks

Spring 2025

Lab 4

OSPF - VRF

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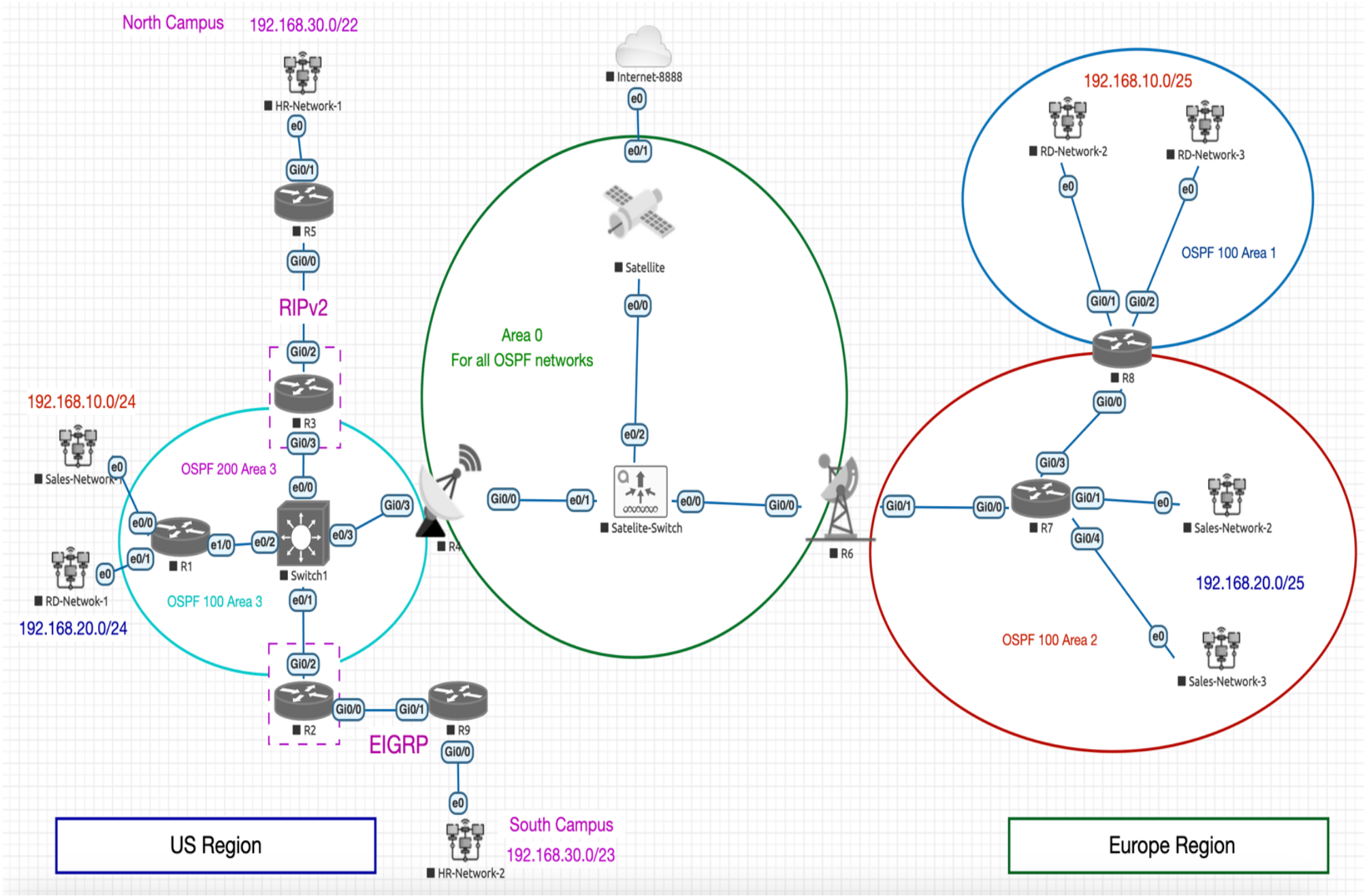

North Campus
192.168.30.0/22
HR-Network-1
e0
Gi0/1
R5
Gi0/0
RIPv2
Gi0/2
R3
Gi0/3
192.168.10.0/24
OSPF 200 Area 3
Sales-Network-1
e0/0
e0/1
R1
e1/0
e0/2
e0/3
Switch1
Gi0/3
RD-Netwok-1
OSPF 100 Area 3
192.168.20.0/24
e0/1
Gi0/2
R2
Gi0/0
Gi0/1
R9
EIGRP
Gi0/0
e0
HR-Network-2
South Campus
192.168.30.0/23
US Region
Internet-8888
e0
e0/1
Satellite
e0/0
Area 0
For all OSPF networks
e0/2
Satelite-Switch
Gi0/0
e0/1
e0/0
Gi0/0
R4
R6
192.168.10.0/25
RD-Network-2
RD-Network-3
e0
OSPF 100 Area 1
Gi0/1
Gi0/2
R8
Gi0/0
Gi0/3
Gi0/1
Gi0/0
R7
Gi0/1
e0
Sales-Network-2
Gi0/4
192.168.20.0/25
OSPF 100 Area 2
e0
Sales-Network-3
Europe Region

In the continuation of the second lab scenario, this time we intend to upgrade the GlobalTech company network to the OSPF protocol and expand it globally.

This time, the two departments, **Sales** and **R&D**, are connected to each other's branches in different geographical zones using the **OSPF** protocol. The link between the two zones is connected via a ground station- satellite communication. However, the HR department is still using its old fashioned **RIPv2** and **EIGRP** protocols and since it is not logical for the infrastructure to have both RIP and OSPF protocols everywhere, and on top of that the data from HR is highly sensitive, therefore it must be isolated from any other traffic in the network by using a separate Virtual Routing Forwarding.

The main goal of this lab is to enable end to end connectivity between different parts of the company using OSPF and making a seamless connection between the two HR locations via two different protocols.

*** All Network icons in the diagram are just loopback adapters and there is no need to connect a PC to the network. You just need to specify the loopback source when pinging from one network to another.

*** Internet-8888 is a loopback address.

*** All nodes on the diagram are simple IOS or IOL routers and switches. Different images are used for a better understanding. Satellite-Switch is an L2 switch. Switch1 is an MLS. Satellites are IOS routers.

*** Areas marked with dashed squares should be capable of multitype protocol understandings. Including RIPv2, OSPF and EIGRP based on the networks they connected to.

*** Like the previous lab Use IP range 10.0.0.0/8 to assign IP addressing to all links between routers, use optimally. Assure that IP addresses on different areas and its loopbacks are derived from a single major block.

*** Pay attention to the size of the networks. Configure subnets based on the CIDRs shown in the diagram. For example, Sales-Network in the US region is /24 while in Europe region is /25.

*** Switch 1 should be a Layer2 switch for the global routing table for OSPF 100 and a Layer3 router for the VRF for OSPF 200. Use an MLS.

1. Sales and R&D OSPF configuration:

- **Enable OSPF 100 on the Sales and R&D network in both US and Europe regions.**

Initial OSPF setup commands for R1,R2,R3,R4:

```
router ospf 100
network 10.0.0.16 0.0.0.7 area 3
!
```

- Only Sales-Networks and R&D Networks are OSPF 100. Configure the two networks in area 3 in the US region.

  Loopback config for R1:

  ```
  interface Loopback10
  ip address 192.168.10.1 255.255.255.0
  !
  interface Loopback20
  ip address 192.168.20.1 255.255.255.0
  !
  ```

- Configure Sales-Networks in area 2 and R&D-Networks in area 1 in the Europe region.
  - Paste commands and screenshots

  R7 config:

  ```
  router ospf 100
  network 10.0.0.8 0.0.0.3 area 2
  network 10.0.0.12 0.0.0.3 area 2
  network 192.168.20.0 0.0.0.255 area 2
  !
  ```

  R6 config:

  ```
  router ospf 100
  network 10.0.0.8 0.0.0.3 area 2
  !
  ```

  R8 config:

  ```
  router ospf 100
  network 10.0.0.12 0.0.0.3 area 2
  !
  ```

- R4 operates in both areas 3 and 0 in the US region.

  R4 OSPF config:

  ```
  router ospf 100
  network 10.0.0.0 0.0.0.7 area 0
  network 10.0.0.16 0.0.0.7 area 3
  ```

- R7 operates only in area 2 in the Europe region.

  R7 OSPF config:

  ```
  router ospf 100
  ```

network 10.0.0.8 0.0.0.3 area 2
network 10.0.0.12 0.0.0.3 area 2
network 192.168.20.0 0.0.0.255 area 2

- R8 operates in both areas 1 and 2 in the Europe region.

R8 OSPF config:
router ospf 100
network 10.0.0.12 0.0.0.3 area 2
network 192.168.10.0 0.0.0.127 area 1

- Verify DR-BDR for area 0 (The backbone area). Make R6 DR and the satellite BDR.

```
R4#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
8.8.8.8         100   FULL/BDR        00:00:35    10.0.0.2        GigabitEthernet0/0
10.0.0.9        200   FULL/DR         00:00:37    10.0.0.3        GigabitEthernet0/0
10.0.0.19         1   2WAY/DROTHER    00:00:32    10.0.0.19       GigabitEthernet0/1
10.0.0.20         1   FULL/BDR        00:00:35    10.0.0.20       GigabitEthernet0/1
192.168.20.1      1   FULL/DR         00:00:39    10.0.0.17       GigabitEthernet0/1
R4#
```

R10 OSPF config:
Int gi0/0
ip ospf priority 100
router ospf 100
network 10.0.0.0 0.0.0.7 area 0
R6 OSPF config:
Int g0/1
ip ospf priority 200
router ospf 100
network 10.0.0.0 0.0.0.7 area 0
network 10.0.0.8 0.0.0.3 area 2

- Do we need a DR-BDR election in area 3? Why?
  - **For ospf 100 we do because there are multiple devices connected to each other via a switch, and we need a DR and BDR to send LSA updates. For ospf 200, we do not as they are P2P links.**
- Verify that R4 is the DR and R3 is the BDR for the devices connected to Switch1. If it is other than this, change the config to make R4 DR and R3 BDR.
  - Paste screenshots showing DR-BDR in area 3
  - Paste screenshots showing full neighborship between routers connected to Switch1

```
R1#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
10.0.0.18       200   FULL/DR         00:00:31    10.0.0.18       GigabitEthernet0/1
10.0.0.19       100   FULL/BDR        00:00:33    10.0.0.19       GigabitEthernet0/1
10.0.0.20         1   2WAY/DROTHER    00:00:37    10.0.0.20       GigabitEthernet0/1
R1#
```

Here we see the results of DR-BDR in area3. We also see full neighborships between routers connected to switch1 via R1 neighborship table.

- What is an ABR? Which router in area 3 is an ABR. Why?
  An Area Border Router is a router in OSPF that connects two different areas together. R4 is an ABR because it connects Area 0 and Area 3 together.
- Look at the OSPF 100 database, what parts does it consist of? What types of LSAs can you find within all areas? 0, 1, 2 and 3.

```
          OSPF Router with ID (10.0.0.18) (Process ID 100)

              Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
1.1.1.1         1.1.1.1         2     (DNA) 0x80000003 0x00A257 1
8.8.8.8         8.8.8.8         1734        0x800000FB 0x00825C 1
10.0.0.9        10.0.0.9        174         0x800000FC 0x00715A 2
10.0.0.18       10.0.0.18       366         0x800000FE 0x00D50E 1

              Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
10.0.0.3        10.0.0.9        1744        0x800000FD 0x006070

              Summary Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
10.0.0.8        1.1.1.1         7     (DNA) 0x80000001 0x009A8D
10.0.0.8        10.0.0.9        992         0x800000FA 0x002AF5
10.0.0.12       1.1.1.1         7     (DNA) 0x80000001 0x0068BC
10.0.0.12       10.0.0.9        711         0x80000001 0x00FF15
10.0.0.16       10.0.0.18       366         0x800000FA 0x008B87
192.168.10.1    10.0.0.18       366         0x800000FA 0x00B8F7
192.168.11.1    1.1.1.1         7     (DNA) 0x80000001 0x004082
192.168.20.1    10.0.0.18       366         0x800000FA 0x004A5C
192.168.21.1    1.1.1.1         7     (DNA) 0x80000001 0x00DBDB
192.168.21.1    10.0.0.9        992         0x800000FA 0x007539

              Router Link States (Area 3)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.0.0.18       10.0.0.18       366         0x80000101 0x00546C 1
10.0.0.19       10.0.0.19       567         0x80000100 0x00516E 1
10.0.0.20       10.0.0.20       1143        0x800000FF 0x00526B 1
192.168.20.1    192.168.20.1    1148        0x80000100 0x009257 3

              Net Link States (Area 3)

Link ID         ADV Router      Age         Seq#       Checksum
10.0.0.18       10.0.0.18       366         0x800000FB 0x003DF2

              Summary Net Link States (Area 3)

Link ID         ADV Router      Age         Seq#       Checksum
10.0.0.0        10.0.0.18       366         0x800000FB 0x002AF7
10.0.0.8        10.0.0.18       366         0x800000FB 0x00FB19
10.0.0.12       10.0.0.18       710         0x80000001 0x00D337
192.168.11.1    10.0.0.18       168         0x80000001 0x00B5F1
192.168.21.1    10.0.0.18       366         0x800000FB 0x00475C
R4#
```

```
Area 0 database summary
  LSA Type      Count    Delete   Maxage
  Router        4        0        0
  Network       1        0        0
  Summary Net   10       0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
    Prefixes redistributed in Type-7  0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Subtotal      15       0        0

Area 3 database summary
  LSA Type      Count    Delete   Maxage
  Router        4        0        0
  Network       1        0        0
  Summary Net   5        0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
    Prefixes redistributed in Type-7  0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Subtotal      10       0        0

Process 100 database summary
  LSA Type      Count    Delete   Maxage
  Router        8        0        0
  Network       2        0        0
  Summary Net   15       0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Type-5 Ext    0        0        0
    Prefixes redistributed in Type-5  0
  Opaque AS     0        0        0
  Non-self      14
  Total         25       0        0
R4#
```

- **Here is what we are looking at. The database summary shows Router, Network, and Summary databases which relate to LSA 1,2 and 3s.**

- **Reachability:**
  - Ping from a Sales network in area 3 to another Sales-Network in area 2.
    - Paste screenshot showing the result

```
R1#traceroute 192.168.21.1
Type escape sequence to abort.
Tracing the route to 192.168.21.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.0.0.18 0 msec 0 msec 0 msec
  2 10.0.0.3 0 msec 0 msec 0 msec
  3 10.0.0.10 0 msec 0 msec *
R1#
```

```
R1#ping 192.168.21.1 source 192.168.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.21.1, timeout is 2 seconds:
Packet sent with a source address of 192.168.10.1
!!!!!
```

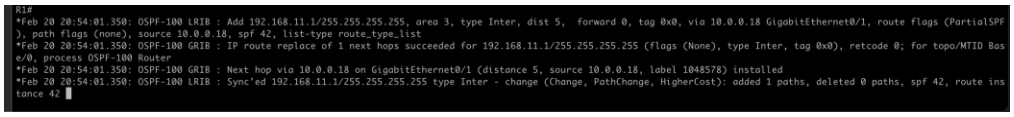
- Ping from one R&D-Network in area 3 to another R&D-Network in area 1. Was the ping successful? Why? How can you fix it?

```
R1#traceroute 192.168.11.1
Type escape sequence to abort.
Tracing the route to 192.168.11.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.0.0.18 0 msec 0 msec 0 msec
  2 10.0.0.3 0 msec 0 msec 0 msec
  3 10.0.0.10 0 msec 0 msec 0 msec
  4 10.0.0.14 0 msec 0 msec *
R1#
```

```
R1#ping 192.168.11.1 source 192.168.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.11.1, timeout is 2 seconds:
Packet sent with a source address of 192.168.10.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
R1#
```

Initially, the ping was not successful. The reason was that area 1 was directly connected to area 2 and not to area 0. We cannot reach area 1 unless it is directly connected to area 0 OR we set up a virtual link to make area 1 it is going through area 0 when it is first going through area 2. I set up a virtual link between R6 and R8, then the ping worked.

- Configure R1 and R8 in such a way that both R&D-Networks in the two US and Europe regions can ping each other.
  - Paste commands used + debug messages showing a new OSPF neighbor detected on one of the routers.



So because I created that virutal link, we can now see the messages from R1 indicating we have a route to the 11.1 network which is RD-netwokr on R8.

- R7 is connected via a point-to-point link to R6 and R8. Do they have any DR-BDR election on this link when you configure OSPF? Why?

They technically do, with the highest IP getting the DR election and BDR respectively. The reason why the election still happens is because the connection is ethernet, and communication within a domain is Layer 2. So they have no idea that they are connected because of the L2 addressing.

- Adjust the OSPF config on R7 to tell OSPF that only two routers are connected on this link.
  - Paste command/commands used + screenshots showing new DR and BDR status.

```
R7(config-if)#ip ospf network point-to-point
R7(config-if)#do show ip ospf nei
% Ambiguous command:  "do show ip ospf nei"
R7(config-if)#do show ip ospf nei

Neighbor ID     Pri   State           Dead Time   Address         Interface
1.1.1.1           1   FULL/BDR        00:00:34    10.0.0.14       GigabitEthernet0/1
10.0.0.9          0   FULL/  -        00:00:35    10.0.0.9        GigabitEthernet0/0
R7(config-if)#
```

So when I issued the command above for R7 and also did it for R6, the state became full, but the DR/BDR election went away. Everything is working as it should.

- Look at the OSPF database on R6. Briefly explain different types of LSAs on this router

```
R6#show ip ospf database da
R6#show ip ospf database database-summary

            OSPF Router with ID (10.0.0.9) (Process ID 100)

Area 0 database summary
  LSA Type      Count    Delete   Maxage
  Router        4        0        0
  Network       1        0        0
  Summary Net   10       0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
    Prefixes redistributed in Type-7  0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Subtotal      15       0        0

Area 2 database summary
  LSA Type      Count    Delete   Maxage
  Router        3        0        0
  Network       1        0        0
  Summary Net   5        0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
    Prefixes redistributed in Type-7  0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Subtotal      9        0        0

Process 100 database summary
  LSA Type      Count    Delete   Maxage
  Router        7        0        0
  Network       2        0        0
  Summary Net   15       0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Type-5 Ext    0        0        0
    Prefixes redistributed in Type-5  0
  Opaque AS     0        0        0
  Non-self      14
  Total         24       0        0
R6#
```

Router: LSAs from individual routers.

Network: LSAs generated for multi-access networks with a designated router (DR).

Summary Net: LSAs generated by area border routers (ABRs) to summarize networks between areas.

- Make sure you have end-to-end connectivity on all networks.

Done as shown above from screenshots!

2. Virtual Routing Forwarding (VRF):

- The HR department has old fashioned networks on the two campuses in the US region. It also has sensitive data that must be isolated from other networks. Therefore, configure a VRF on R2 and R3 to separate the HR-Network traffic. The North campus speaks RIPv2, and the South campus speaks EIGRP.

*** Links connected to switch1 only understand OSPF. Therefore, you need another OSPF protocol that works only for the HR VRF and has no interference with the main OSPF for the Sales and R&D networks.

- Redistribute routes wherever needed to make an end-to-end connectivity for the two HR campuses.
  - Paste commands used + screenshots

```
R2:
interface GigabitEthernet0/0
ip vrf forwarding HR
ip address 10.0.0.25 255.255.255.252
duplex auto
speed auto
media-type rj45
!
interface GigabitEthernet0/1.30
encapsulation dot1Q 30
ip vrf forwarding HR
ip address 10.0.0.29 255.255.255.252
!
router eigrp 200
!
address-family ipv4 vrf HR autonomous-system 200
 redistribute ospf 200 metric 10 10 10 10 1500
 network 10.0.0.24 0.0.0.3
exit-address-family
!
router ospf 200 vrf HR
router-id 10.0.0.29
redistribute eigrp 200 subnets
network 10.0.0.28 0.0.0.3 area 3
!

R3:
interface GigabitEthernet0/0
ip vrf forwarding HR
ip address 10.0.0.37 255.255.255.252
duplex auto
speed auto
media-type rj45
!
interface GigabitEthernet0/1.20
```

```
encapsulation dot1Q 20
ip vrf forwarding HR
ip address 10.0.0.33 255.255.255.252
!
router ospf 200 vrf HR
router-id 10.0.0.33
redistribute rip subnets
network 10.0.0.32 0.0.0.3 area 3
!
router rip
no auto-summary
!
address-family ipv4 vrf HR
 redistribute ospf 200 metric 3
 network 10.0.0.0
 no auto-summary
 version 2
exit-address-family
!
```

S1:

```
vlan 20
name top_200
!
vlan 30
name bot_200
!
interface Vlan20
ip vrf forwarding HR
ip address 10.0.0.34 255.255.255.252
!
interface Vlan30
ip vrf forwarding HR
ip address 10.0.0.30 255.255.255.252
!
router ospf 200 vrf HR
router-id 1.2.3.4
log-adjacency-changes
network 10.0.0.28 0.0.0.3 area 3
network 10.0.0.32 0.0.0.3 area 3
!
```

R5:

```
interface Loopback10
ip address 192.168.28.1 255.255.252.0
!
interface GigabitEthernet0/0
ip address 10.0.0.38 255.255.255.252
duplex auto
speed auto
media-type rj45
!
router rip
version 2
network 10.0.0.0
network 192.168.28.0
no auto-summary
!
```

R9:

```
interface Loopback10
ip address 192.168.32.1 255.255.254.0
!
interface GigabitEthernet0/0
ip address 10.0.0.26 255.255.255.252
duplex auto
speed auto
media-type rj45
!
router eigrp 200
network 10.0.0.24 0.0.0.3
network 192.168.32.0 0.0.1.255
!
```

Proof of connection showing loopback of R9 to loopback of R5:

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
R9#ping 192.168.28.1 source 192.168.32.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.28.1, timeout is 2 seconds:
Packet sent with a source address of 192.168.32.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R9#trace
R9#traceroute 192.168.28.1
Type escape sequence to abort.
Tracing the route to 192.168.28.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.0.0.25 0 msec 0 msec 0 msec
  2 10.0.0.30 4 msec 28 msec 4 msec
  3 10.0.0.33 0 msec 0 msec 0 msec
  4 10.0.0.38 0 msec 0 msec *
```

- What is the role of an ASBR? Look at the diagram. Which routers are the ASBRs in the network? Why?
  Paste screenshots of the database of the ASBR routers you found. What entries are added to the database?
  R3 and R2 are the ASBRs in the network because they are running different routing protocols other than OSPF.

```
          OSPF Router with ID (10.0.0.29) (Process ID 200)

Area 3 database summary
  LSA Type      Count    Delete   Maxage
  Router        3        0        0
  Network       2        0        0
  Summary Net   0        0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
    Prefixes redistributed in Type-7  0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Subtotal      5        0        0

Process 200 database summary
  LSA Type      Count    Delete   Maxage
  Router        3        0        0
  Network       2        0        0
  Summary Net   0        0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Type-5 Ext    4        0        0
      Prefixes redistributed in Type-5  2
  Opaque AS     0        0        0
  Non-self      5
  Total         9        0        0
R2#
```

```
          OSPF Router with ID (10.0.0.33) (Process ID 200)

Area 3 database summary
  LSA Type      Count    Delete   Maxage
  Router        3        0        0
  Network       2        0        0
  Summary Net   0        0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
    Prefixes redistributed in Type-7  0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Subtotal      5        0        0

Process 200 database summary
  LSA Type      Count    Delete   Maxage
  Router        3        0        0
  Network       2        0        0
  Summary Net   0        0        0
  Summary ASBR  0        0        0
  Type-7 Ext    0        0        0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Type-5 Ext    4        0        0
      Prefixes redistributed in Type-5  2
  Opaque AS     0        0        0
  Non-self      6
  Total         9        0        0
R3#
```

You can see the entries are Type 5 LSAs that are added into the database.

3. Internet Connection:

- There is a Sky-Link internet connectivity in the backbone area. The goal of this objective is to make sure all networks have access to the Internet via the satellite connection. (You can use a loopback address 8.8.8.8/8 for this Internet connection). NOTE: static routes per device are not allowed, Nor running OSPF on 8.8.8.8.. distribute rather dynamically.

- What approach did you follow to fulfil this requirement?
  - Paste commands used + screenshots showing all networks have access to Sky-Link internet connection.

```
router ospf 100
default-information originate always
!
ip route 8.8.8.8 255.255.255.255 10.0.0.2
!
```

These are the commands I used on R4 to make this happen. I made sure there was a route to the sky link and did a default-info og always which redistributes this route to all OSPF connections.

4. Summarization:

- What is the purpose of having multiple areas? Why didn't we use only one single area (area 0) for the entire network? Look at the OSPF database on R1, Compare it with the database on the satellite. Are the number of entries in both areas the same? If yes, then why did we make multiple areas.

  The purpose of having multiple areas is to reduce traffic in each area and the LSAs that are exchanged. If we had a huge area 0 the calculation of OSPF would take forever and would never converge.

  Configure your OSPF 100 in such a way that the OSPF databases on all areas only keep the minimum number of entries. (The number of LSAs ideally should be one route/lsa per remote area, and all entries for local networks within a particular area)

  Paste screenshots of the databases in area 3 and 0 before and after summarization. Paste commands.

```
R10#show ip ospf database database-summary

            OSPF Router with ID (8.8.8.8) (Process ID 100)

Area 0 database summary
  LSA Type      Count    Delete   Maxage
  Router        4        0        0
  Network       1        0        0
  Summary Net   9        0        0
  Summary ASBR  1        0        0
  Type-7 Ext    0        0        0
    Prefixes redistributed in Type-7  0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Subtotal      15       0        0

Process 100 database summary
  LSA Type      Count    Delete   Maxage
  Router        4        0        0
  Network       1        0        0
  Summary Net   9        0        0
  Summary ASBR  1        0        0
  Type-7 Ext    0        0        0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Type-5 Ext    1        0        0
      Prefixes redistributed in Type-5  0
  Opaque AS     0        0        0
  Non-self      15
  Total         16       0        0
R10#
```

```
R10#show ip ospf database database-summary

            OSPF Router with ID (8.8.8.8) (Process ID 100)

Area 0 database summary
  LSA Type      Count    Delete   Maxage
  Router        4        0        0
  Network       1        0        0
  Summary Net   10       0        0
  Summary ASBR  1        0        0
  Type-7 Ext    0        0        0
    Prefixes redistributed in Type-7  0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Subtotal      16       0        0

Process 100 database summary
  LSA Type      Count    Delete   Maxage
  Router        4        0        0
  Network       1        0        0
  Summary Net   10       0        0
  Summary ASBR  1        0        0
  Type-7 Ext    0        0        0
  Opaque Link   0        0        0
  Opaque Area   0        0        0
  Type-5 Ext    1        0        0
      Prefixes redistributed in Type-5  0
  Opaque AS     0        0        0
  Non-self      16
  Total         17       0        0
```

R10 database when doing: area 2 range 10.0.0.8 255.255.255.248 on R6. As you can see, my ip addressing was not as efficient so I couldn't summarize that many networks, but it shows that doing this range command will group these networks into one, reducing the amount of

summary networks that the LSA database has at R10.

```
  Summary ASBR  1         0         0
  Type-7 Ext    0         0         0
  Opaque Link   0         0         0
  Opaque Area   0         0         0
  Type-5 Ext    1         0         0
      Prefixes redistributed in Type-5  0
  Opaque AS     0         0         0
  Non-self      13
  Total         29        2         2
R4(config-router)#do show ip ospf data data

           OSPF Router with ID (10.0.0.18) (Process ID 100)

Area 0 database summary
  LSA Type      Count    Delete   Maxage
  Router        4         0         0
  Network       1         0         0
  Summary Net   10        1         1
  Summary ASBR  1         0         0
  Type-7 Ext    0         0         0
    Prefixes redistributed in Type-7  0
  Opaque Link   0         0         0
  Opaque Area   0         0         0
  Subtotal      16        1         1

Area 3 database summary
  LSA Type      Count    Delete   Maxage
  Router        4         0         0
  Network       1         0         0
  Summary Net   6         0         0
  Summary ASBR  0         0         0
  Type-7 Ext    0         0         0
    Prefixes redistributed in Type-7  0
  Opaque Link   0         0         0
  Opaque Area   0         0         0
  Subtotal      11        0         0

Process 100 database summary
  LSA Type      Count    Delete   Maxage
  Router        8         0         0
  Network       2         0         0
  Summary Net   16        1         1
  Summary ASBR  1         0         0
  Type-7 Ext    0         0         0
  Opaque Link   0         0         0
  Opaque Area   0         0         0
  Type-5 Ext    1         0         0
      Prefixes redistributed in Type-5  0
  Opaque AS     0         0         0
  Non-self      13
  Total         28        1         1
R4(config-router)#
```

Above is a screen shot of Area 3 ABR seeing the reduction in total counts of LSAs from 29 to 28.