CCIE Enterprise Infrastructure – A Complete Guide

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Table of Contents

Configuring Layer 2 Technologies – Ethernet Switching

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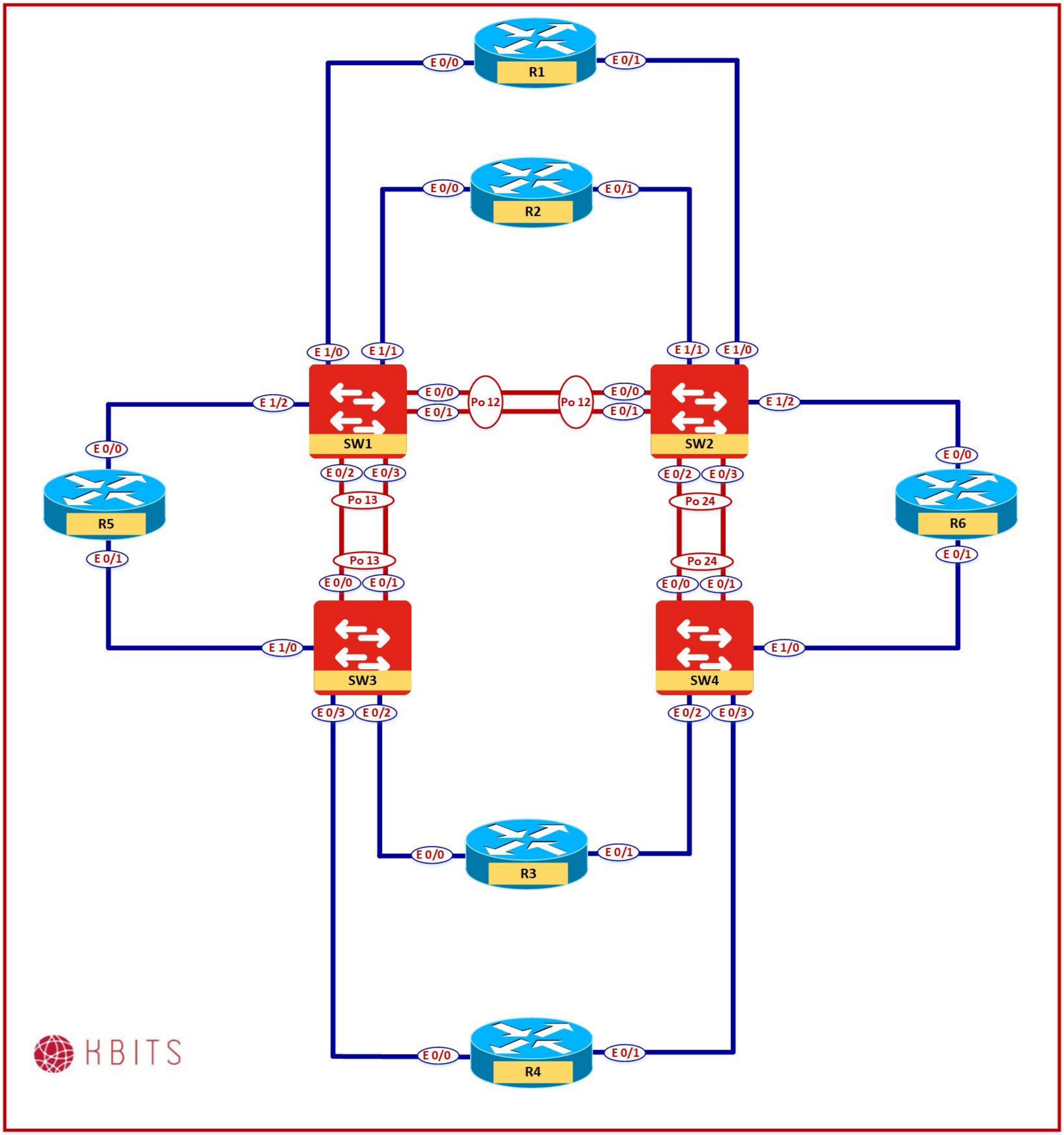
Configuring Layer 2 Technologies – Ethernet Switching

Lab 1 – Configuring Trunking – Dot1q

Physical Diagram



Task 1 – Configure Trunking between SW1 & SW3

- Configure the Links between SW1 & SW3 as trunks.
- SW1 ports E 0/2 & E 0/3 are connected to SW3 ports E 0/0 & E 0/1.
- Use Dot1q as the Trunk encapsulation mechanism.

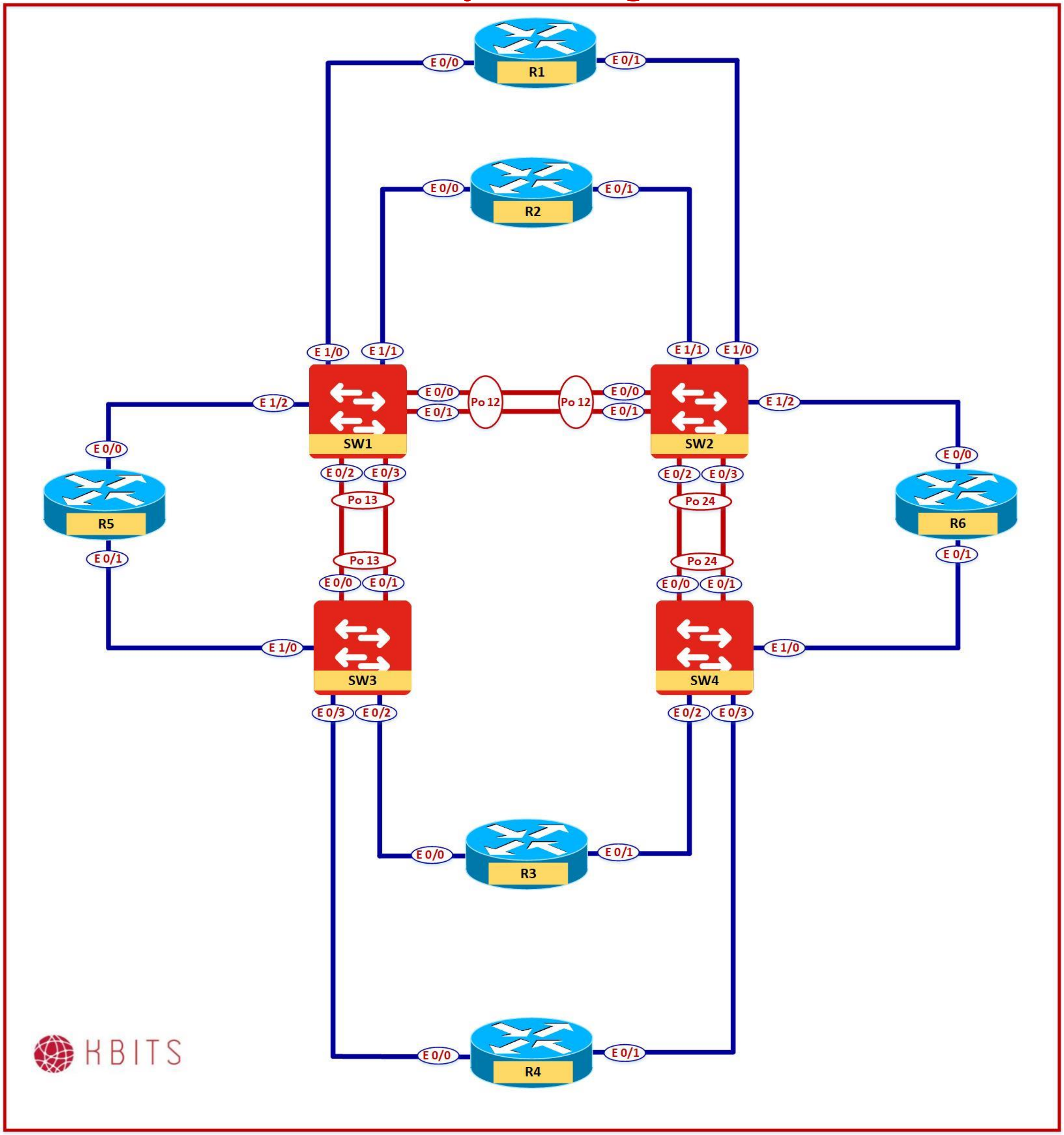
SW1 Hostname SW1 ! Interface range E 0/2-3 switchport trunk encapsulation dot1q switchport mode trunk
SW3 Hostname SW3 ! Interface range E 0/0-1 switchport trunk encapsulation dot1q switchport mode trunk

Task 2 – Verification

- Verify the Spanning-tree status on SW1 & SW3 by using the "**Show Spanning-tree"** command.
- What is the status of the ports on the Root Bridge?
- What is the status of the ports on the non-root bridge?

Lab 2 – Configuring Port Channels – Manual

Physical Diagram



Task 1 – Configure Port-Channels between SW1 & SW2

- Configure a Port-Channels between SW1 & SW2 using ports E 0/0 & E0/1 on both switches.
- The port-channel should not use a negotiation protocol.

SW1

```
Interface range E 0/0-1
 channel-group 12 mode on
 no shut
!
Interface port-channel 12
 switchport trunk encapsulation dot1q
 switchport mode trunk
```

SW2

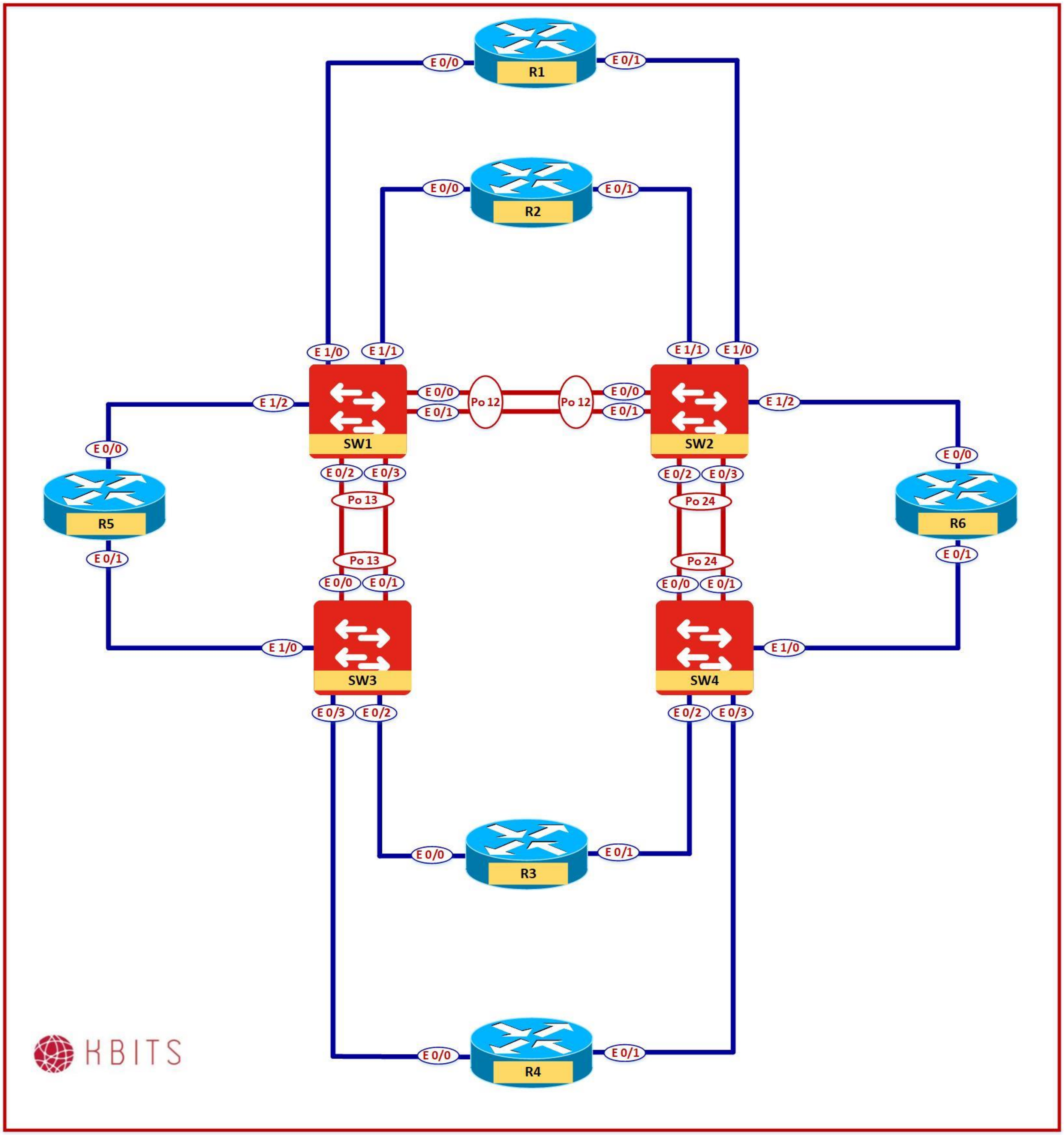
```
Interface range E 0/0-1
 channel-group 12 mode on
 no shut
!
Interface port-channel 12
 switchport trunk encapsulation dot1q
 switchport mode trunk
```

Task 2 – Verification

- Verify that the port channel is operational by using the "**Show etherchannel summary**" command.

Lab 3 – Configuring Port Channels – LACP

Physical Diagram



Task 1 – Configure Port-Channels between SW2 & SW4

- Configure a Port-Channels between SW2 & SW4 using ports E 0/0 & E0/1 on SW4 and ports E 0/2 & E 0/3 on SW2.
- Use an Industry Standard Port-channel negotiation protocol.
- Both switches should be able to initiate the negotiation.

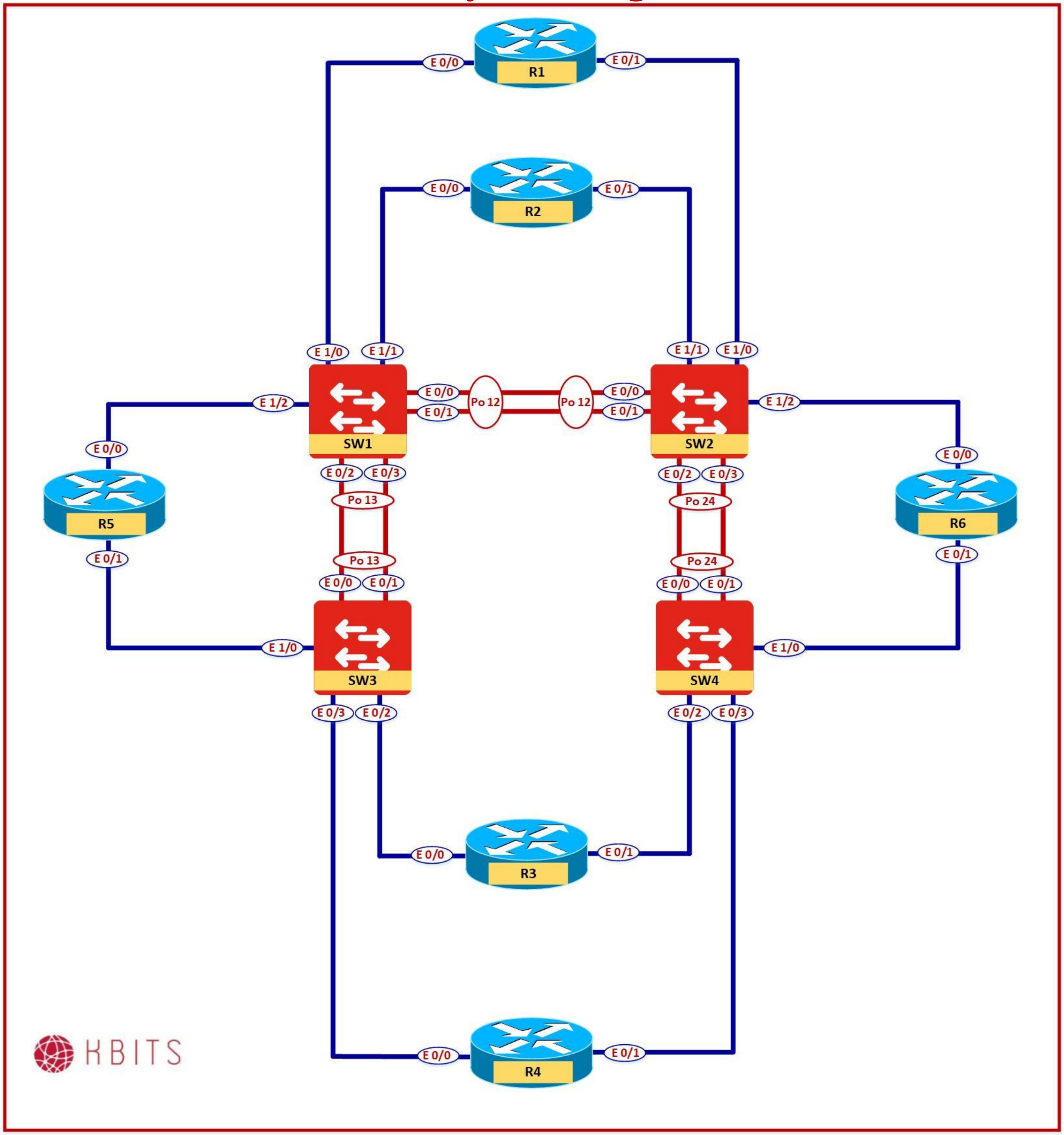
SW2 Interface range E 0/2-3 channel-group 24 mode active no shut ! Interface port-channel 24 switchport trunk encapsulation dot1q switchport mode trunk
SW4 Interface range E 0/0-1 channel-group 24 mode active no shut ! Interface port-channel 24 switchport trunk encapsulation dot1q switchport mode trunk

Task 2 – Verification

- Verify that the port channel is operational by using the "**Show etherchannel summary**" command.

Lab 4 – Configuring VLAN Trunking Protocol (VTP)

Physical Diagram



Task 1 – Configure SW1 as VTP Server

- Configure SW1 as the VTP Server in a Domain called KBITS.
- Configure VTP to use version 2.
- Configure a password of kbits@123.

SW1
vtp mode server vtp domain KBITS vtp version 2 vtp password kbits@123

Task 2 – Configure the other switches as VTP clients

- Configure SW2, SW3 & SW4 as the VTP Clients in a Domain called KBITS.
- Configure is with VTP v2.
- Configure a password of kbits@123.

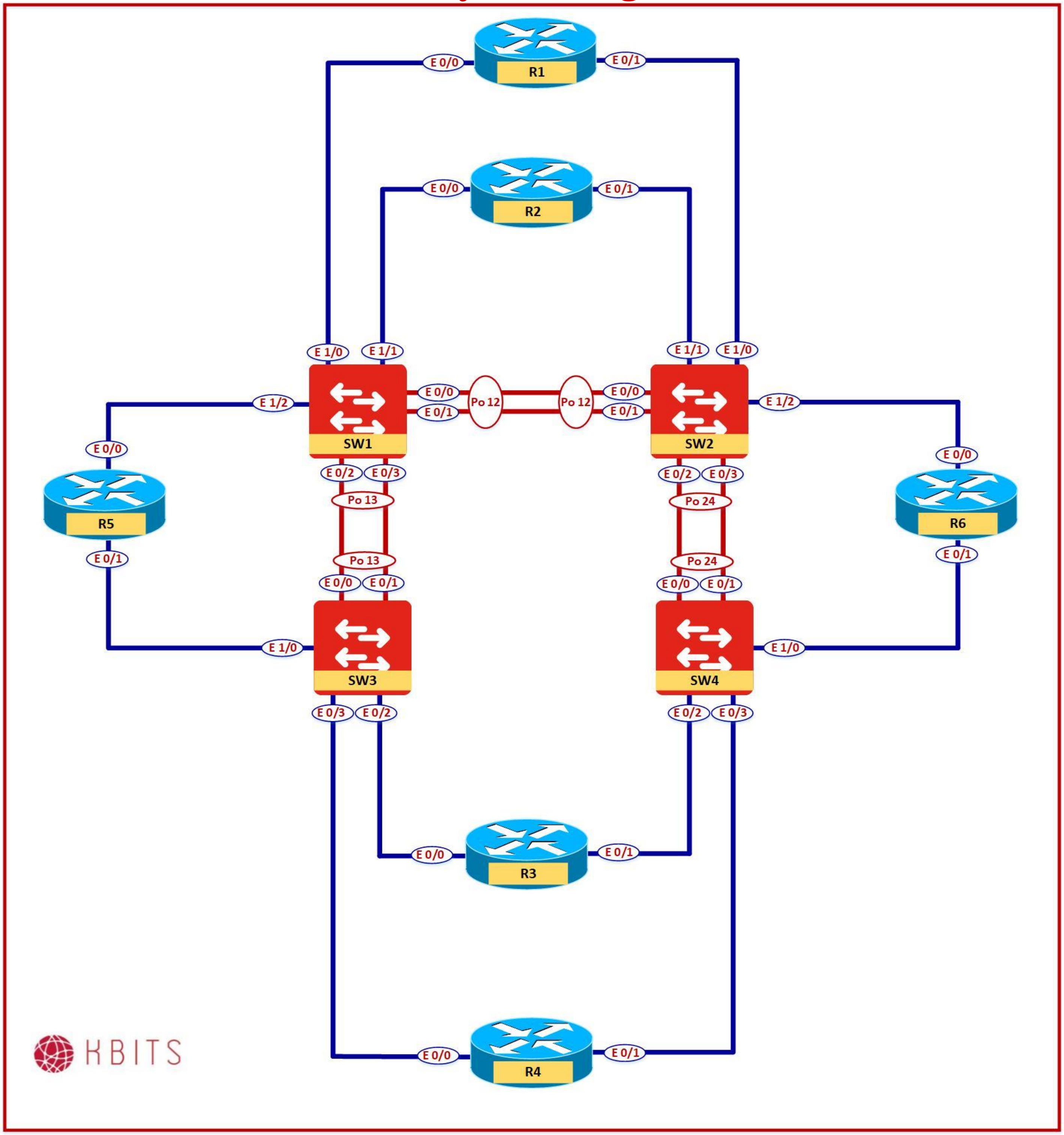
SW2
vtp domain KBITS vtp version 2 vtp password kbits@123 vtp mode client
SW3 vtp domain KBITS vtp version 2 vtp password kbits@123 vtp mode client
SW4 vtp domain KBITS vtp version 2 vtp password kbits@123 vtp mode client

Task 3 – Verification

- Verify the VTP Status on the devices using the "**Show vtp status**" command.

Lab 5 – Configuring VLAN

Physical Diagram



Task 1 – Configure VLANs on the VTP Server

- Configure the following VLANs: 10, 20, 30, 40, 50, 60, 70 & 80.

SW1

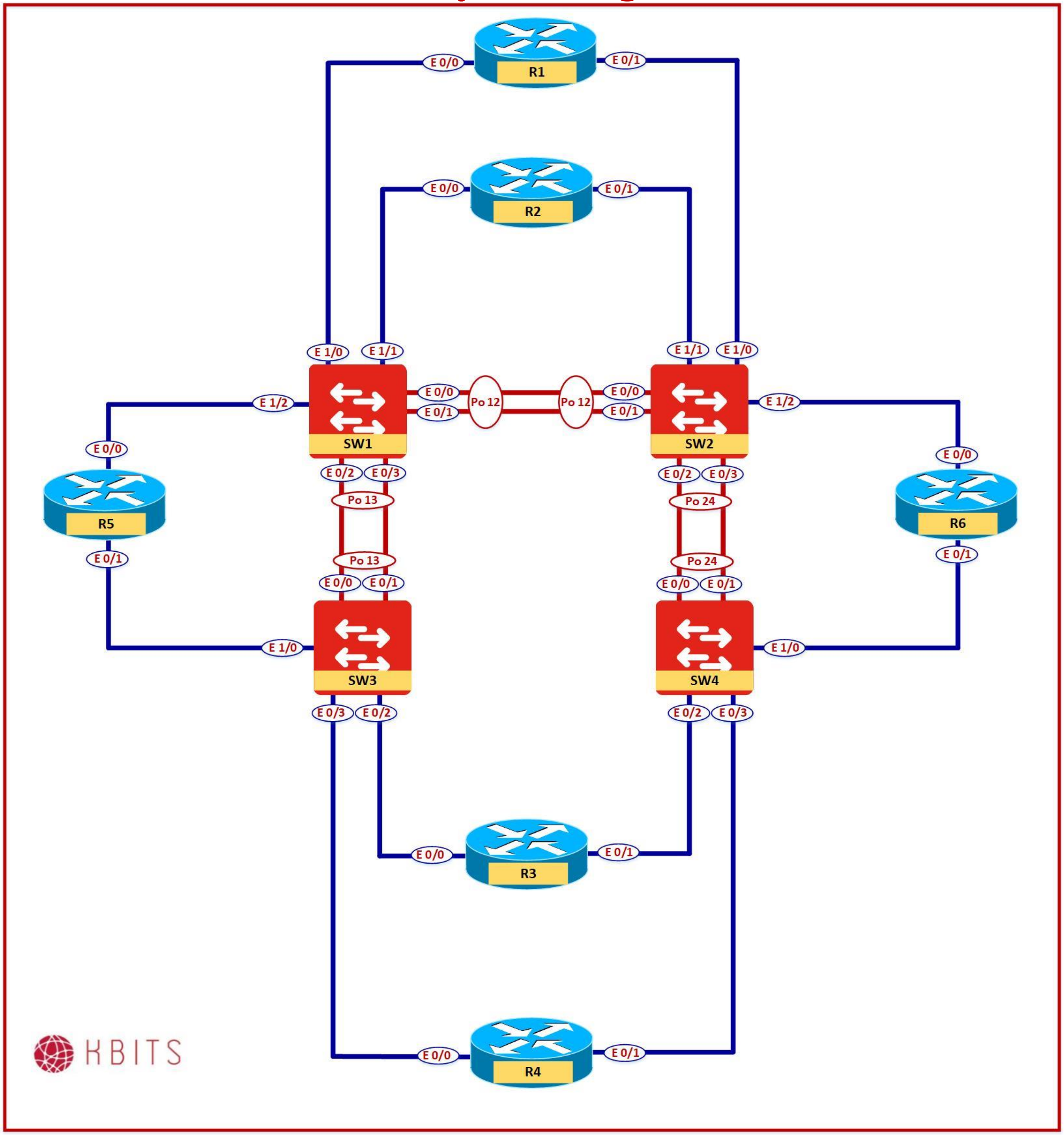
```
VLAN 10,20,30,40,50,60,70,80
```

Task 2 – Verification

- Verify the creation of the VLANs on the VTP Clients.

Lab 6 – Configuring PVSTP – Root Switch Selection

Physical Diagram



Task 1 – Configure Root Bridge selection for VLANs 1, 10, 20, 30 & 40

- Configure SW1 as the preferred Root Switch for VLANs 1,10,20,30,40 with SW2 as the backup Root Switch.
- Do not use the "Root Primary" or "Root Secondary" option to accomplish this step.

SW1 Spanning-tree vlan 1,10,20,30,40 priority 0
SW2 Spanning-tree vlan 1,10,20,30,40 priority 4096

Task 2 – Configure Root Bridge selection for VLANs 50, 60, 70 & 80

- Configure SW2 as the preferred Root Switch for VLANs 50,60,70,80 with SW1 as the backup Root Switch.
- Do not use the Priority command to accomplish this task.

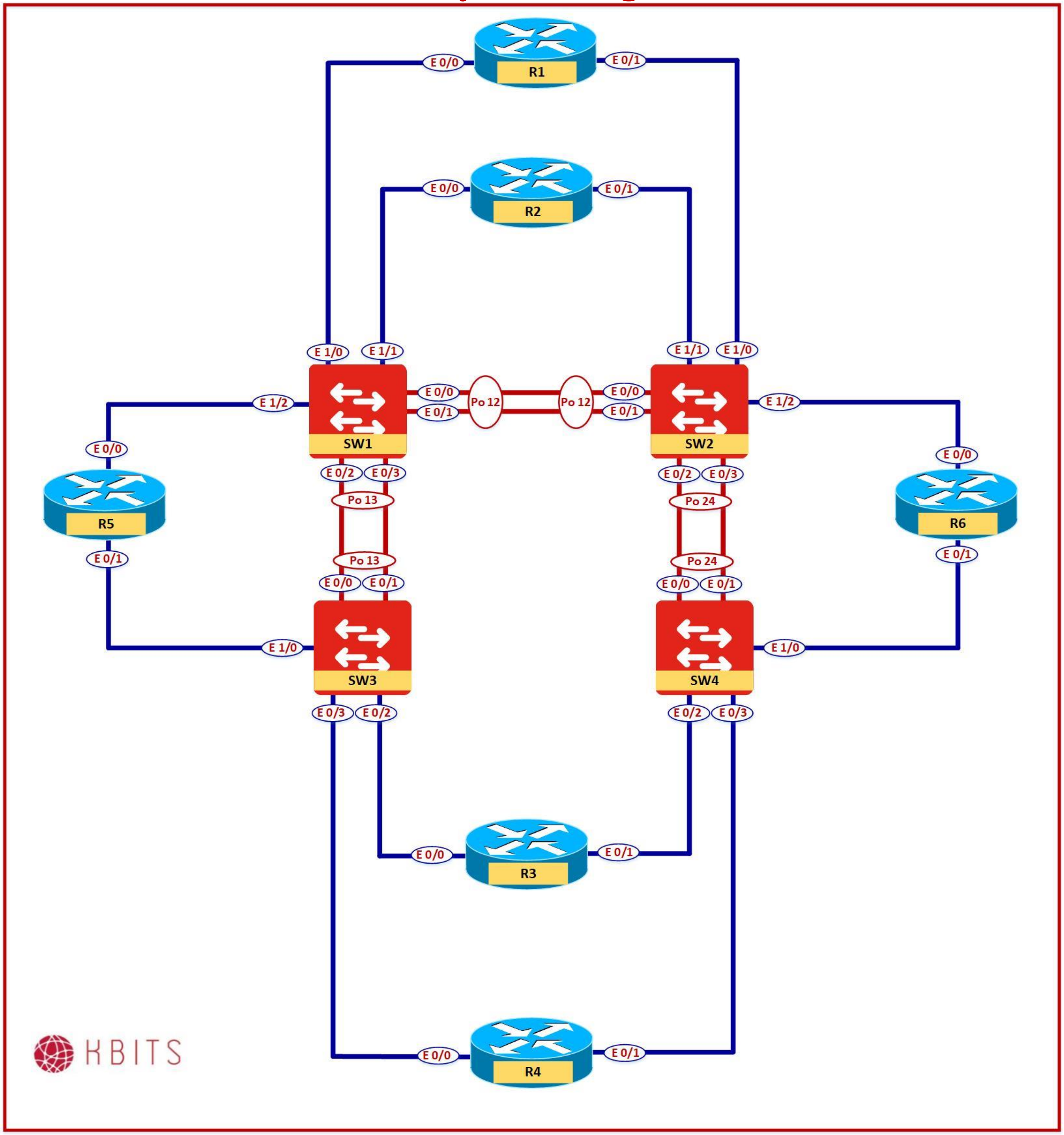
SW2 spanning-tree vlan 50,60,70,80 root primary
SW1 spanning-tree vlan 50,60,70,80 root secondary

Task 3 – Verification

- Verify the Root Bridge selection by using the "**Show spanning-tree vlan 10"** on SW1. It should be the root bridge.
- Verify the Root Bridge selection by using the "**Show spanning-tree vlan 50"** on SW1. It should be using the Port-channel towards SW2 as the root port.
- Verify the Root Bridge selection by using the "**Show spanning-tree vlan 50"** on SW2. It should be the root bridge.
- Verify the Root Bridge selection by using the "**Show spanning-tree vlan 10"** on SW2. It should be using the Port-channel towards SW1 as the root port.

Lab 7 – Configuring MST

Physical Diagram



Task 1 – Configure the switches for MSTP.

- Configure the switches to run MSTP.

SW1 spanning-tree mode mst
SW2 spanning-tree mode mst
SW3 spanning-tree mode mst
SW4 spanning-tree mode mst

Task 2 – Configure VTPv3 for MSTP.

- Configure the switches to run VTPv3.
- Configure SW1 to be Server for MST.
- You should be able to create VLANs only on SW1.
-

SW1 vtp version 3 vtp mode server mst ! vtp primary mst vtp primary vlan
SW2 vtp version 3 vtp mode client mst
SW3 vtp version 3 vtp mode client mst
SW4 vtp version 3 vtp mode client mst

Task 3 – Configure SW1 for MST Instances

- Configure MST configuration on SW1.
- MSTP name should be configured as "CCIE-EI".
- VLANS 10,20,30,40 should be in instance 1.
- VLANs 50,60,70,80 should be in instance 2.

SW1

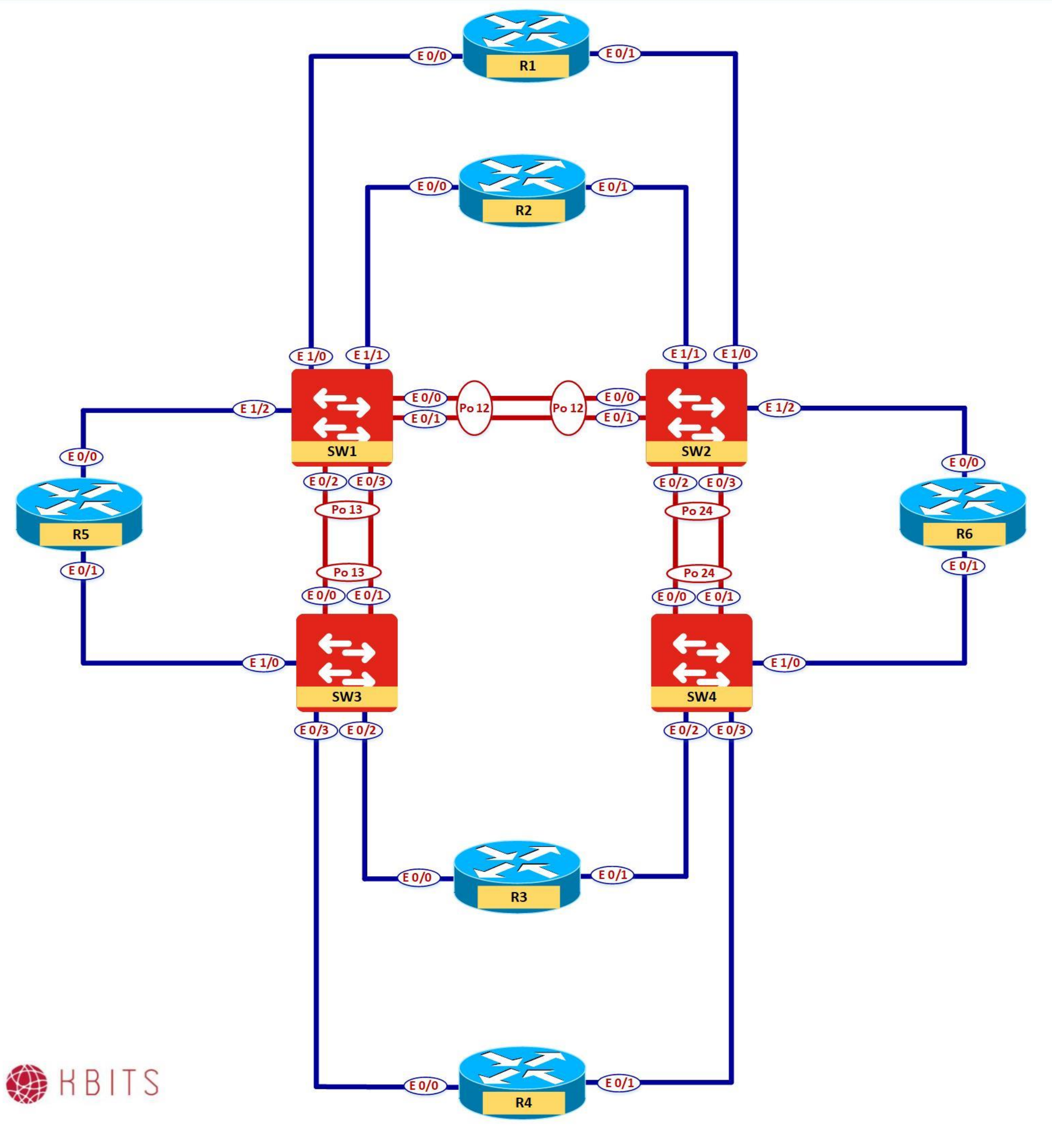
```
spanning-tree mst configuration
 name CCIE-EI
 instance 1 vlan 10,20,30,40
 instance 2 vlan 50,60,70,80
```

Task 4 – Verification

- Verify the Spanning-tree status by using the "**Show spanning-tree"** on the Switches. What is the Spanning-tree mode set to?
- Verify the creation of the MST Configuration and instances on the client switches by using the "**Show run | section spanning-tree**" command.

Lab 8 – Configuring MST – Root Switch Selection

Physical Diagram



Task 1 – Configure Root Bridge selection for MST 1

- Configure SW1 as the preferred Root Switch for MST 1 with SW2 as the backup Root Switch.
- Do not use the "Root Primary" or "Root Secondary" option to accomplish this step.

SW1 Spanning-tree mst 1 priority 0
SW2 Spanning-tree mst 1 priority 4096

Task 2 – Configure Root Bridge selection for MST 2

- Configure SW2 as the preferred Root Switch for MST 2 with SW1 as the backup Root Switch.
- Do not use the Priority command to accomplish this task.

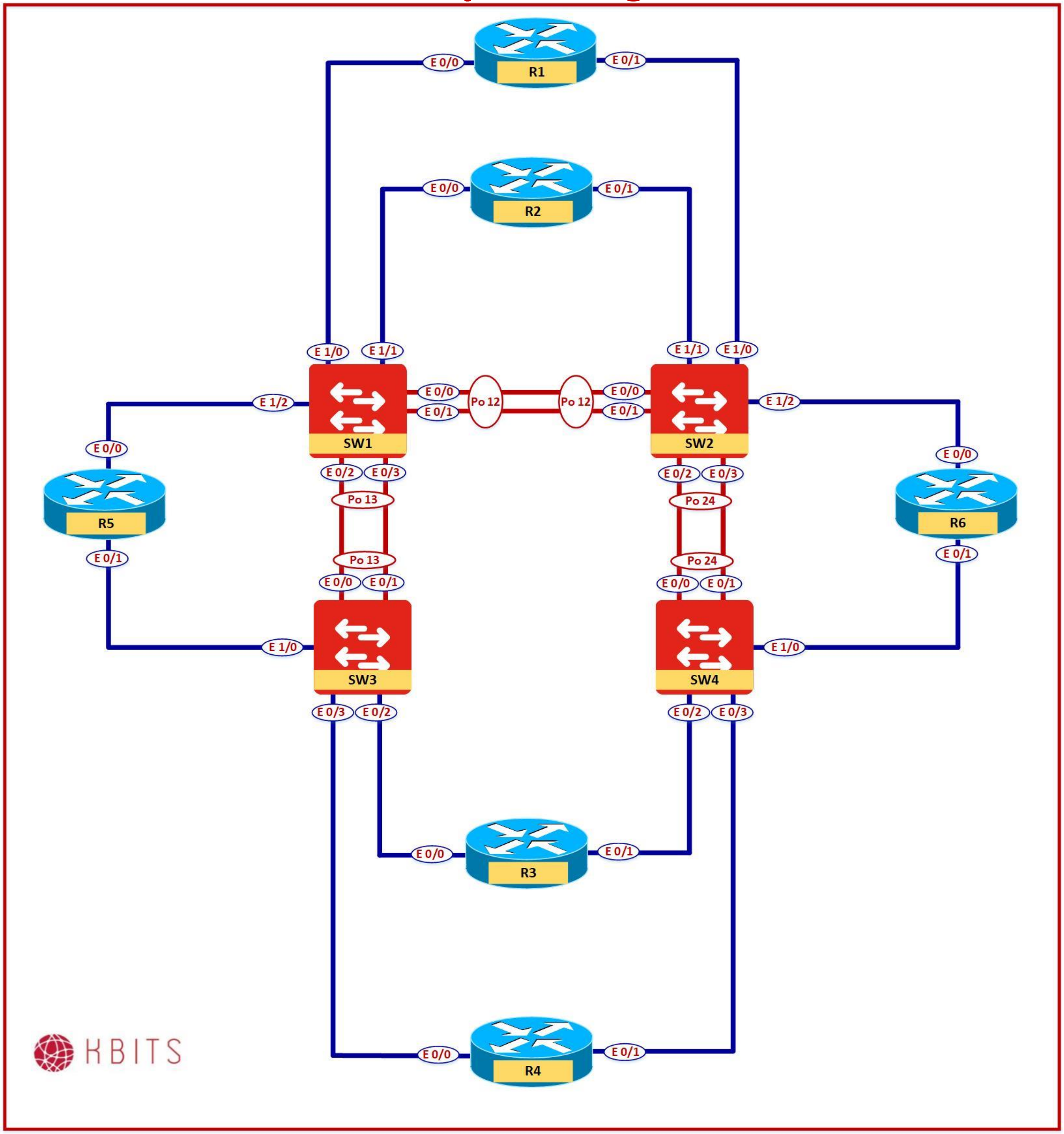
SW2 spanning-tree mst 2 root primary
SW1 spanning-tree mst 2 root secondary

Task 3 – Verification

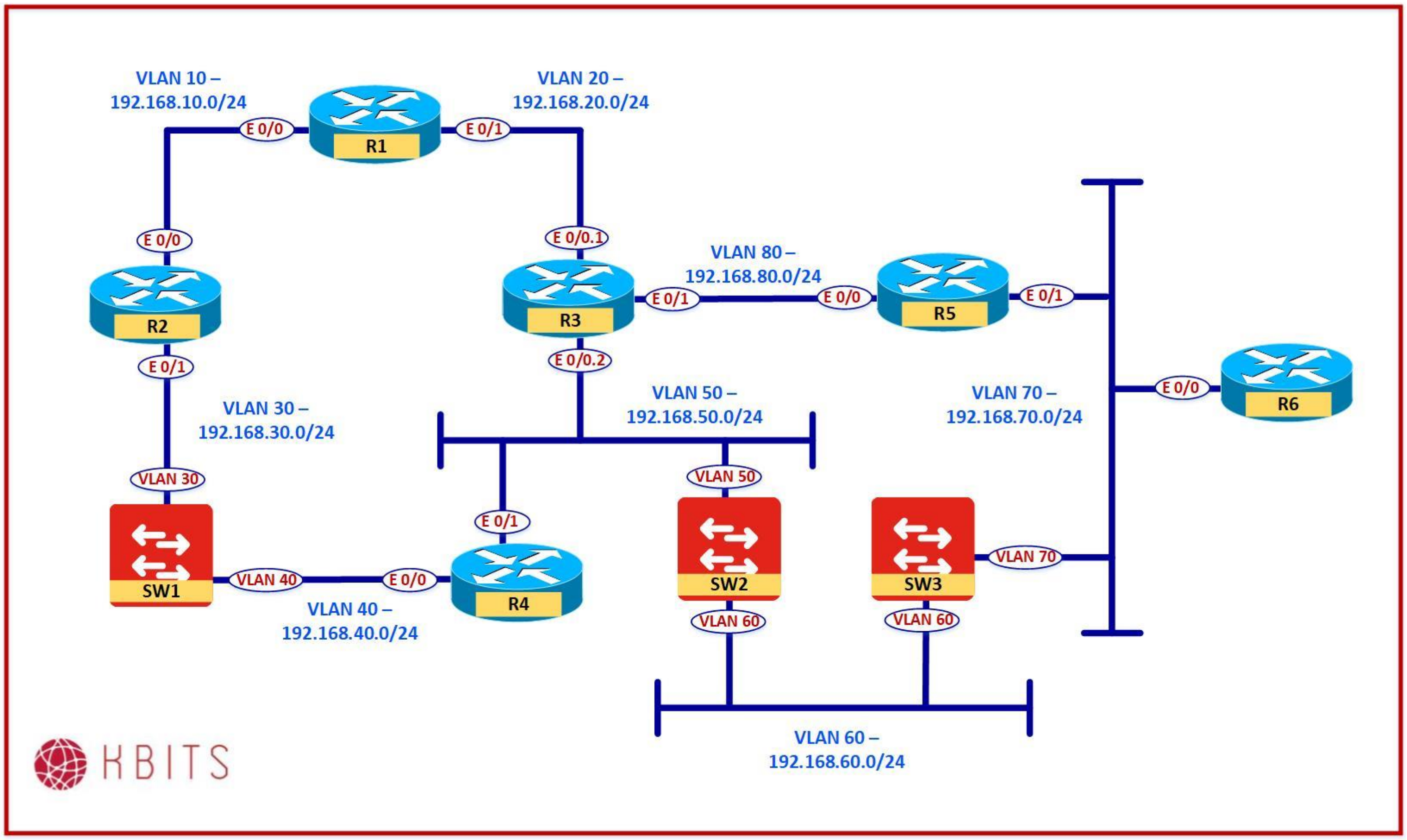
- Verify the Root Bridge selection by using the "**Show spanning-tree MST 1"** on SW1. It should be the root bridge.
- Verify the Root Bridge selection by using the "**Show spanning-tree MST 2"** on SW1. It should be using the Port-channel towards SW2 as the root port.
- Verify the Root Bridge selection by using the "**Show spanning-tree MST 2"** on SW2. It should be the root bridge.
- Verify the Root Bridge selection by using the "**Show spanning-tree MST 1"** on SW2. It should be using the Port-channel towards SW1 as the root port.

Lab 9 – Configuring Physical-To-Logical Mapping

Physical Diagram



Logical Diagram



Task 1 – Assign ports to VLAN 10 based on the Logical and Physical Diagram

- R1 & R2 physical ports are in VLAN 10.
- Assign the corresponding Switchports to VLAN 10 as Access Ports.

SW1

```
Interface range e 1/0-1
 switchport mode access
 switchport access vlan 10
```

Task 2 – Assign ports to VLAN 20 based on the Logical and Physical Diagram

- R1 has a physical port are in VLAN 20.
- Assign the corresponding Switchport to VLAN 20 as an Access Port.
- R3 has a sub-interface in VLAN 20.
- Configure the switchport for R3 as a Trunk as the corresponding port is a Sub-interface.

SW2 Interface e 1/0 switchport mode access switchport access vlan 20
SW3 Interface e 0/2 switchport trunk encapsulation dot1q switchport mode trunk

Task 3 – Assign ports to VLAN 30 based on the Logical and Physical Diagram

- R2 has a physical port are in VLAN 30.
- Assign the corresponding Switchport for R2 to VLAN 30 as an Access Port.
- SW1 has a L3 connection in VLAN 30. Use a SVI to connect to VLAN 30. Configure SW1 with an IP of .11.

SW2 Interface e 1/1 switchport mode access switchport access vlan 30
SW1 ip routing ! interface vlan 30 ip address 192.168.30.11 255.255.255.0 no shut

Task 4 – Assign ports to VLAN 40 based on the Logical and Physical Diagram

- R4 has a physical port are in VLAN 40.
- Assign the corresponding Switchport for R4 to VLAN 40 as an Access Port.
- SW1 has a L3 connection in VLAN 40. Use an SVI to connect to VLAN 40. Configure SW1 with an IP of .11.

SW3

```
Interface e 0/3
 switchport mode access
 switchport access vlan 40
```

SW1

```
ip routing
!
interface vlan 40
 ip address 192.168.40.11 255.255.255.0
 no shut
```

Task 5 – Assign ports to VLAN 50 based on the Logical and Physical Diagram

- R4 has a physical port are in VLAN 50.
- Assign the corresponding Switchport for R4 to VLAN 50 as an Access Port.
- SW2 has a L3 connection in VLAN 50. Use a SVI to connect to VLAN 50. Configure SW2 with an IP of .22.
- R3 has a sub-interface in VLAN 50. The switchport for R3 is already configured as a Trunk.

SW4

```
Interface e 0/3
 switchport mode access
 switchport access vlan 50
```

SW2

```
ip routing
!
interface vlan 50
 ip address 192.168.50.22 255.255.255.0
 no shut
```

Task 6 – Assign ports to VLAN 60 based on the Logical and Physical Diagram

- SW2 & SW3 have a L3 connection in VLAN 60. Use a SVI to connect the switches to VLAN 60. Configure SW2 with an IP of .22 and SW3 of .33.

SW2

```
ip routing
!
interface vlan 60
 ip address 192.168.60.22 255.255.255.0
 no shut
```

SW3

```
ip routing
!
interface vlan 60
 ip address 192.168.60.33 255.255.255.0
 no shut
```

Task 7 – Assign ports to VLAN 70 based on the Logical and Physical Diagram

- R5 & R6 have physical ports are in VLAN 70.
- Assign the corresponding Switchport for R5 & R6 to VLAN 70 as Access Ports.
- SW3 has a L3 connection in VLAN 70. Use a SVI to connect to VLAN 70. Configure SW3 with an IP of .33.

SW3

```
Interface e 1/0
 switchport mode access
 switchport access vlan 70
```

SW2

```
Interface e 1/2
 switchport mode access
 switchport access vlan 70
```

SW3

```
ip routing
!
```

```
interface vlan 70
 ip address 192.168.70.33 255.255.255.0
 no shut
```

Task 8 – Assign ports to VLAN 80 based on the Logical and Physical Diagram

- R3 & R5 have physical ports are in VLAN 80.
- Assign the corresponding Switchports for R3 & R5 to VLAN 80 as Access Ports.

SW1

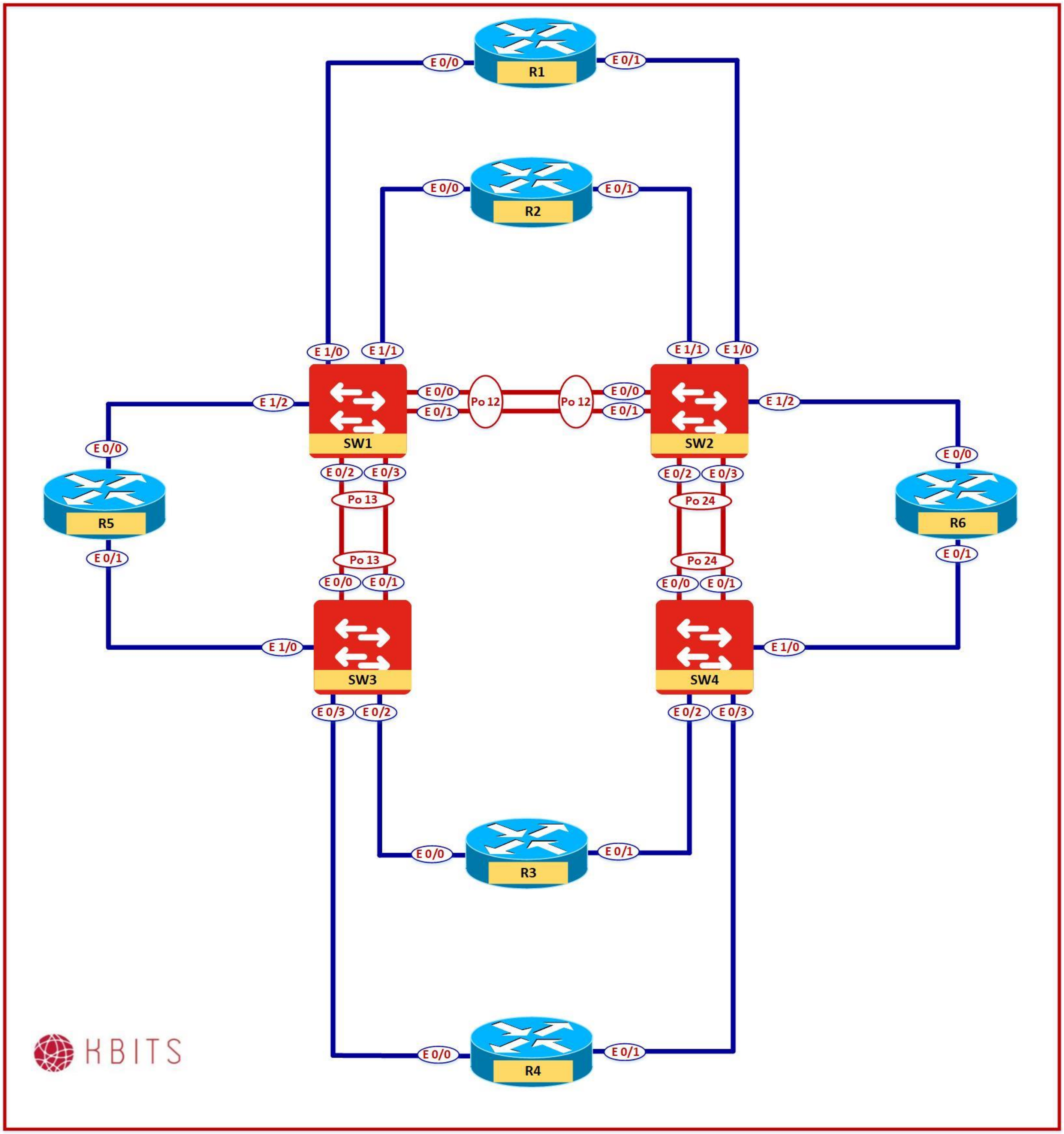
```
Interface e 1/2
 switchport mode access
 switchport access vlan 80
```

SW4

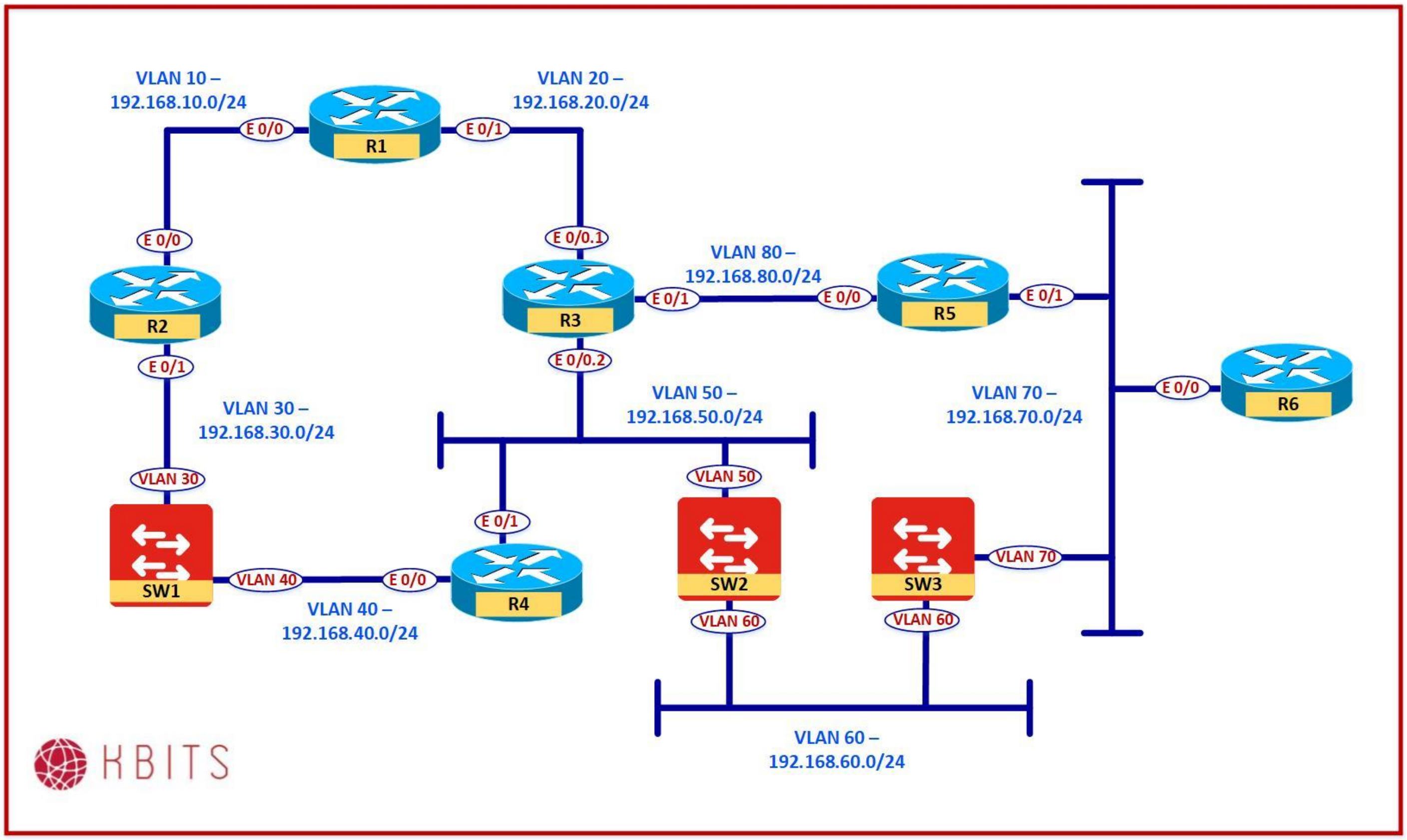
```
Interface e 0/2
 switchport mode access
 switchport access vlan 80
```

Lab 10 – Configuring the L3 Logical Topology

Physical Diagram



Logical Diagram



Interface Configuration

R1

Interface	IP Address	Subnet Mask
E 0/0	192.168.10.1	255.255.255.0
E 0/1	192.168.20.1	255.255.255.0
Loopback0	1.1.1.1	255.0.0.0

R2

Interface	IP Address	Subnet Mask
E 0/0	192.168.10.2	255.255.255.0
E 0/1	192.168.30.2	255.255.255.0
Loopback0	2.2.2.2	255.0.0.0

R3

Interface	IP Address	Subnet Mask
E 0/0.1	192.168.20.3	255.255.255.0
E 0/0.2	192.168.50.3	255.255.255.0
E 0/1	192.168.80.3	255.255.255.0
Loopback0	3.3.3.3	255.0.0.0

R4

Interface	IP Address	Subnet Mask
E 0/0	192.168.40.4	255.255.255.0
E 0/1	192.168.50.4	255.255.255.0
Loopback0	4.4.4.4	255.0.0.0

R5

Interface	IP Address	Subnet Mask
E 0/0	192.168.80.2	255.255.255.0
E 0/1	192.168.70.2	255.255.255.0
Loopback0	5.5.5.5	255.0.0.0

R6

Interface	IP Address	Subnet Mask
E 0/0	192.168.70.6	255.255.255.0
Loopback0	6.6.6.6	255.0.0.0

SW1

Interface	IP Address	Subnet Mask
VLAN 30	192.168.30.11	255.255.255.0
VLAN 40	192.168.40.11	255.255.255.0
Loopback0	11.11.11.11	255.0.0.0

SW2

Interface	IP Address	Subnet Mask
VLAN 50	192.168.50.22	255.255.255.0
VLAN 60	192.168.60.22	255.255.255.0
Loopback0	22.22.22.22	255.0.0.0

SW3

Interface	IP Address	Subnet Mask
VLAN 60	192.168.60.33	255.255.255.0
VLAN 70	192.168.70.33	255.255.255.0
Loopback0	33.33.33.33	255.0.0.0

Task 1 – Assign ports IP Addresses to L3 Devices

- Assign IP Addresses to the Devices based on the above table.
- SVIs on the Switches have been configured in the previous lab.

R1

```
Interface E 0/0
 ip address 192.168.10.1 255.255.255.0
 duplex full
 no shut
Interface E 0/1
 ip address 192.168.20.1 255.255.255.0
 duplex full
 no shut
Interface Loopback0
 ip address 1.1.1.1 255.0.0.0
```

R2

```
Interface E 0/0
 ip address 192.168.10.2 255.255.255.0
 duplex full
 no shut
Interface E 0/1
 ip address 192.168.30.2 255.255.255.0
 duplex full
 no shut
Interface Loopback0
 ip address 2.2.2.2 255.0.0.0
```

R3

```
Interface E 0/0
 no shut
 duplex full
Interface E0/0.1
 encapsulation dot1q 20
 ip address 192.168.20.3 255.255.255.0
```

Interface E0/0.2 encapsulation dot1q 50 ip address 192.168.50.3 255.255.255.0 ! Interface E 0/1 ip address 192.168.80.3 255.255.255.0 duplex full no shut Interface Loopback0 ip address 3.3.3.3 255.0.0.0
R4 Interface E 0/0 ip address 192.168.40.4 255.255.255.0 duplex full no shut Interface E 0/1 ip address 192.168.50.4 255.255.255.0 duplex full no shut Interface Loopback0 ip address 4.4.4.4 255.0.0.0
R5 Interface E 0/0 ip address 192.168.80.5 255.255.255.0 duplex full no shut Interface E 0/1 ip address 192.168.70.5 255.255.255.0 duplex full no shut Interface Loopback0 ip address 5.5.5.5 255.0.0.0
R6 Interface E 0/0 ip address 192.168.70.6 255.255.255.0 duplex full no shut Interface Loopback0 ip address 6.6.6.6 255.0.0.0
SW1 interface loop0

```
 ip address 11.11.11.11 255.0.0.0
```

SW2

```
interface loop0
 ip address 22.22.22.22 255.0.0.0
```

SW3

```
interface loop0
 ip address 33.33.33.33 255.0.0.0
```

Task 2 – Configure EIGRP as the Routing Protocol

- Configure EIGRP as the Routing Protocol to provide full connectivity.
- Use 100 as the Autonomous System.

R1

```
router eigrp 100
 network 192.168.10.0
 network 192.168.20.0
 network 1.0.0.0
```

R2

```
router eigrp 100
 network 192.168.10.0
 network 192.168.30.0
 network 2.0.0.0
```

R3

```
router eigrp 100
 network 192.168.20.0
 network 192.168.50.0
 network 192.168.80.0
 network 3.0.0.0
```

R4

```
router eigrp 100
 network 192.168.40.0
 network 192.168.50.0
 network 4.0.0.0
```

R5

```
router eigrp 100
 network 192.168.70.0
```

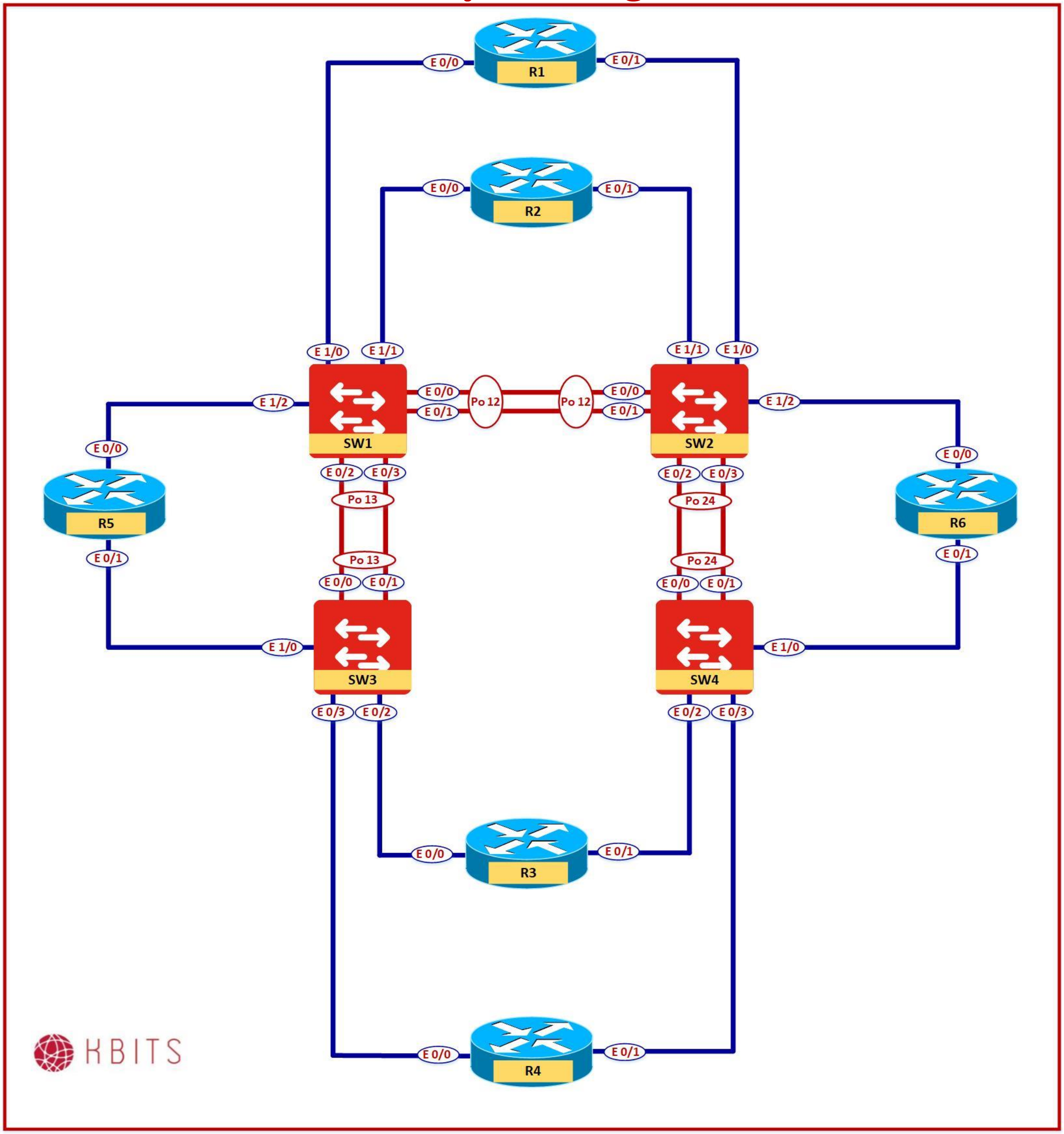
network 192.168.80.0 network 5.0.0.0
R6 router eigrp 100 network 192.168.70.0 network 6.0.0.0
SW1 router eigrp 100 network 192.168.30.0 network 192.168.40.0 network 11.0.0.0
SW2 router eigrp 100 network 192.168.50.0 network 192.168.60.0 network 22.0.0.0
SW3 router eigrp 100 network 192.168.70.0 network 192.168.60.0 network 33.0.0.0

Task 3 – Verification

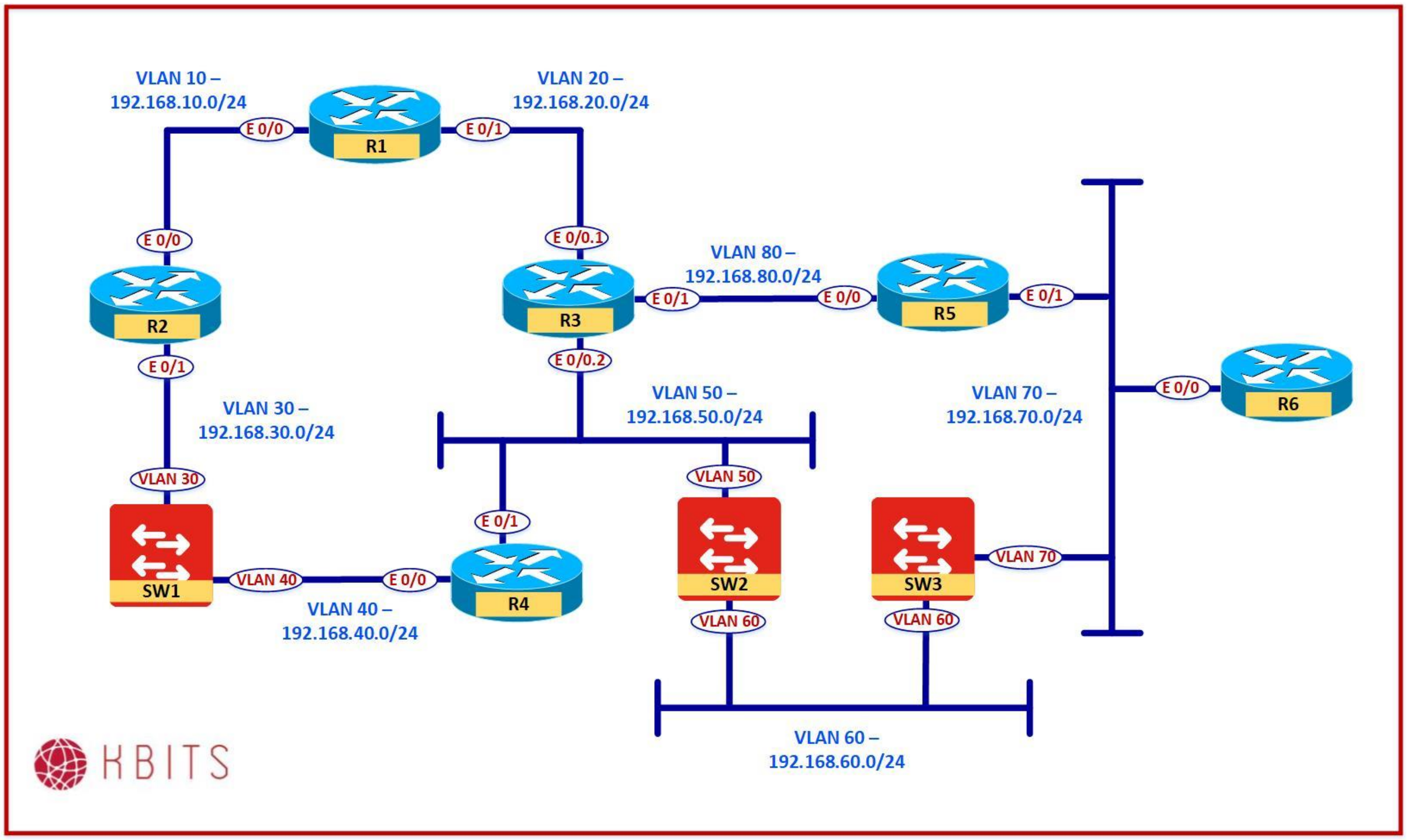
- Verify that all the Loopback routes are available in the Routing table and reachable.

Lab 11 – Configuring the Port Fast Feature

Physical Diagram



Logical Diagram



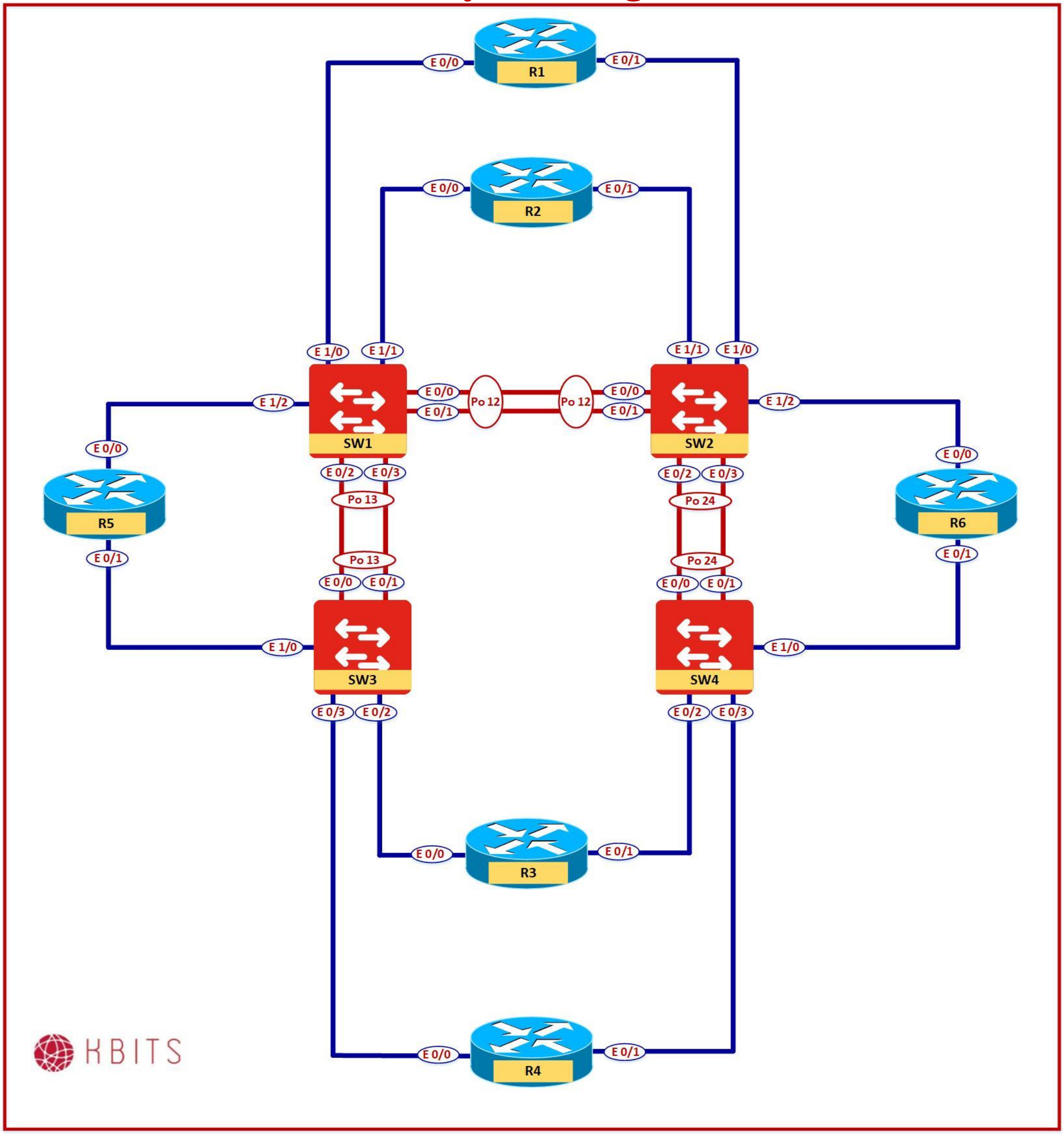
Task 1 – Configure PortFast

- Configuring all the ports that are connected towards the routers such that they bypass the STP Listening and Learning states.
- They should go into the STP Forwarding state immediately after been plugged in.

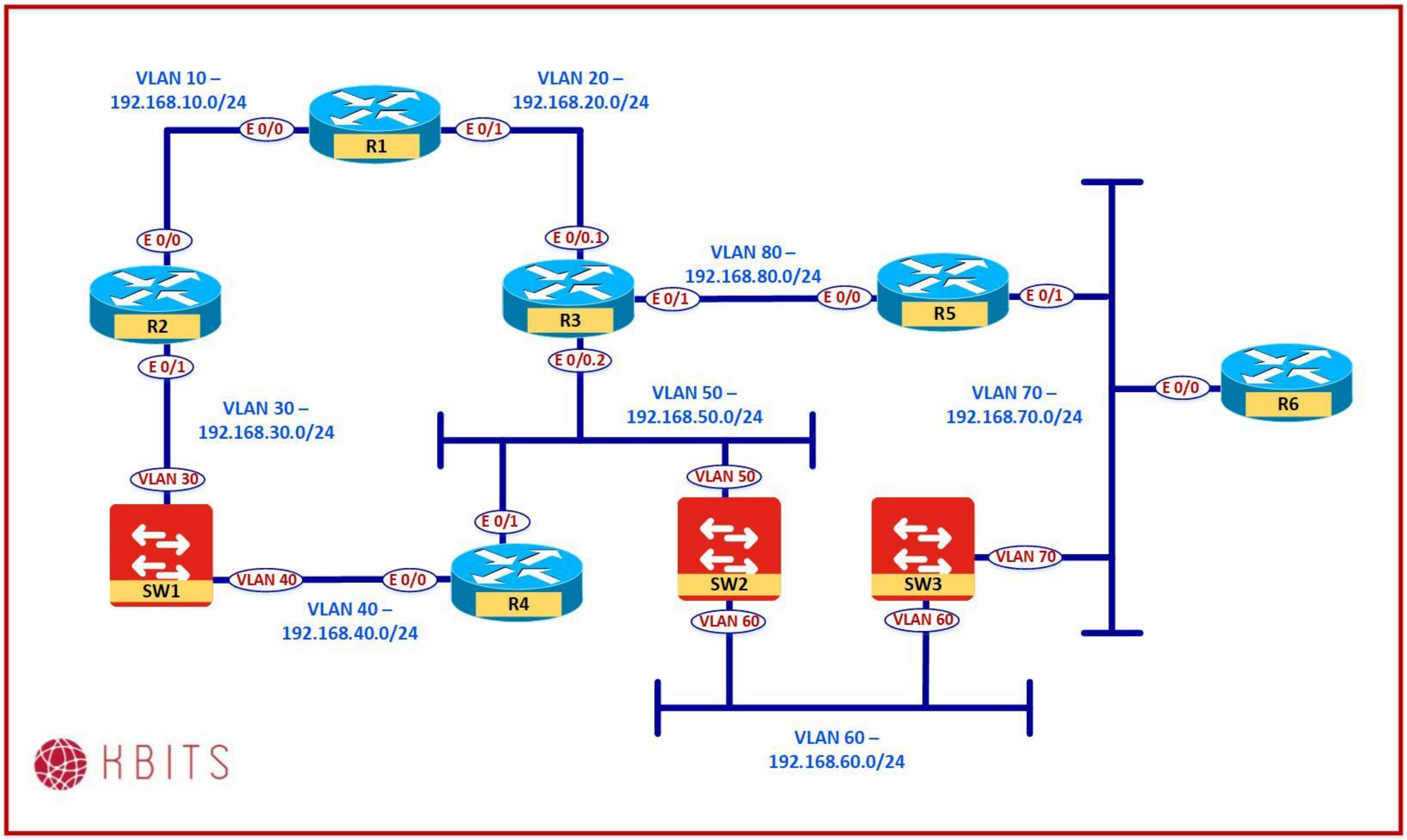
SW1 Interface range E 1/0-2 spanning-tree portfast
SW2 Interface range E 1/0-2 spanning-tree portfast
SW3 Interface range E 1/0, E 0/2-3 spanning-tree portfast
SW4 Interface range E 0/2-3 spanning-tree portfast

Lab 12 – Configuring the BPDU Guard Feature

Physical Diagram



Logical Diagram



Task 1 – Configure BPDU Guard

- Configure the switches such that if it receives a BPDU on a port that is configured as portfast, the port should be disabled.

SW1 Interface range E 1/0-2   spanning-tree bpduguard enable
SW2 Interface range E 1/0-2   spanning-tree bpduguard enable
SW3 Interface range E 1/0, E 0/2-3   spanning-tree bpduguard enable
SW4 Interface range E 0/2-3   spanning-tree bpduguard enable

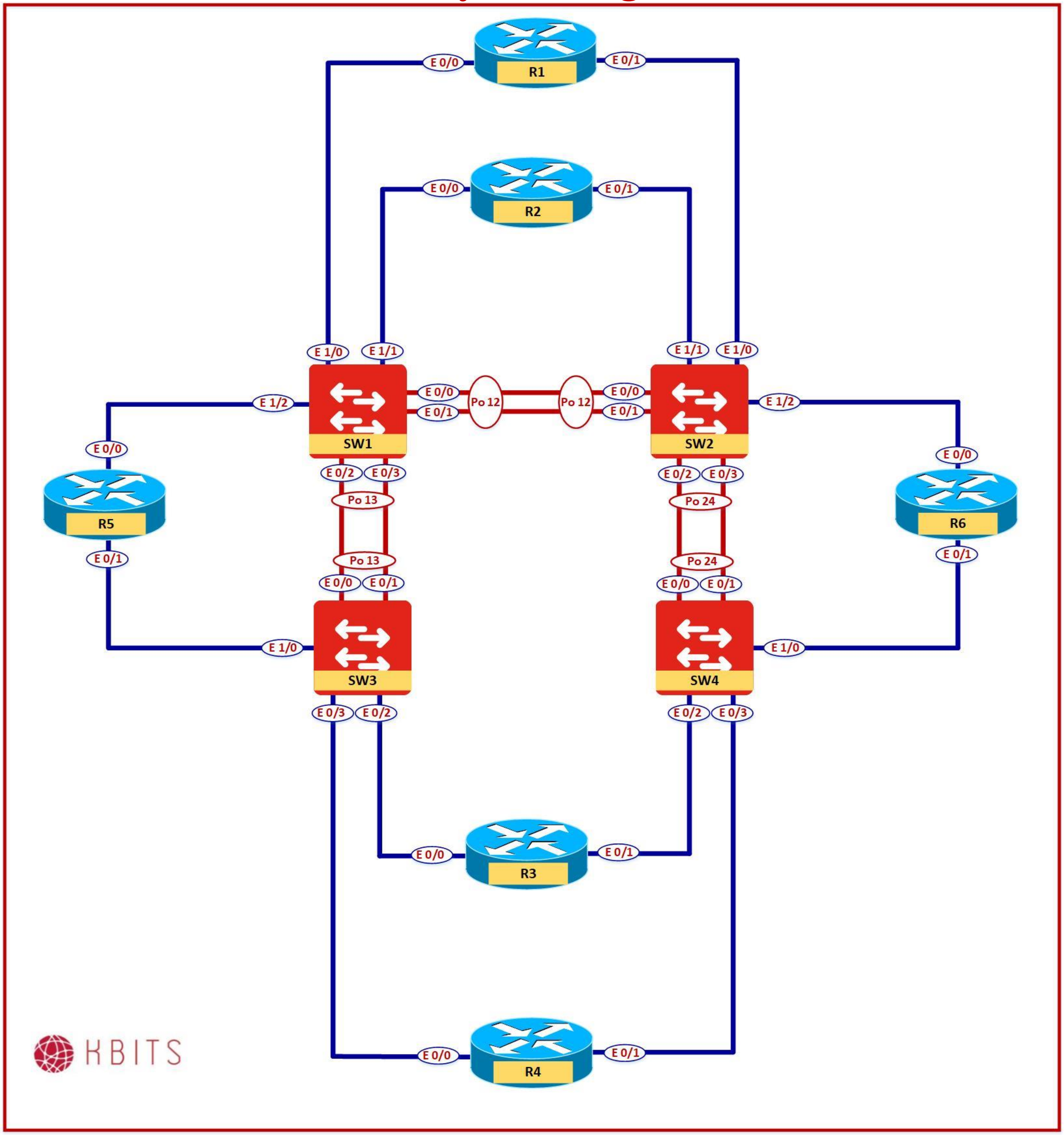
Task 2 – Configure BPDU Guard Automatic Recovery

- The Switch should attempt to bring an error disabled port up automatically if it has been error disabled because of the BPDU Guard feature. It should try to recover the port after 180 seconds of it been error disabled.

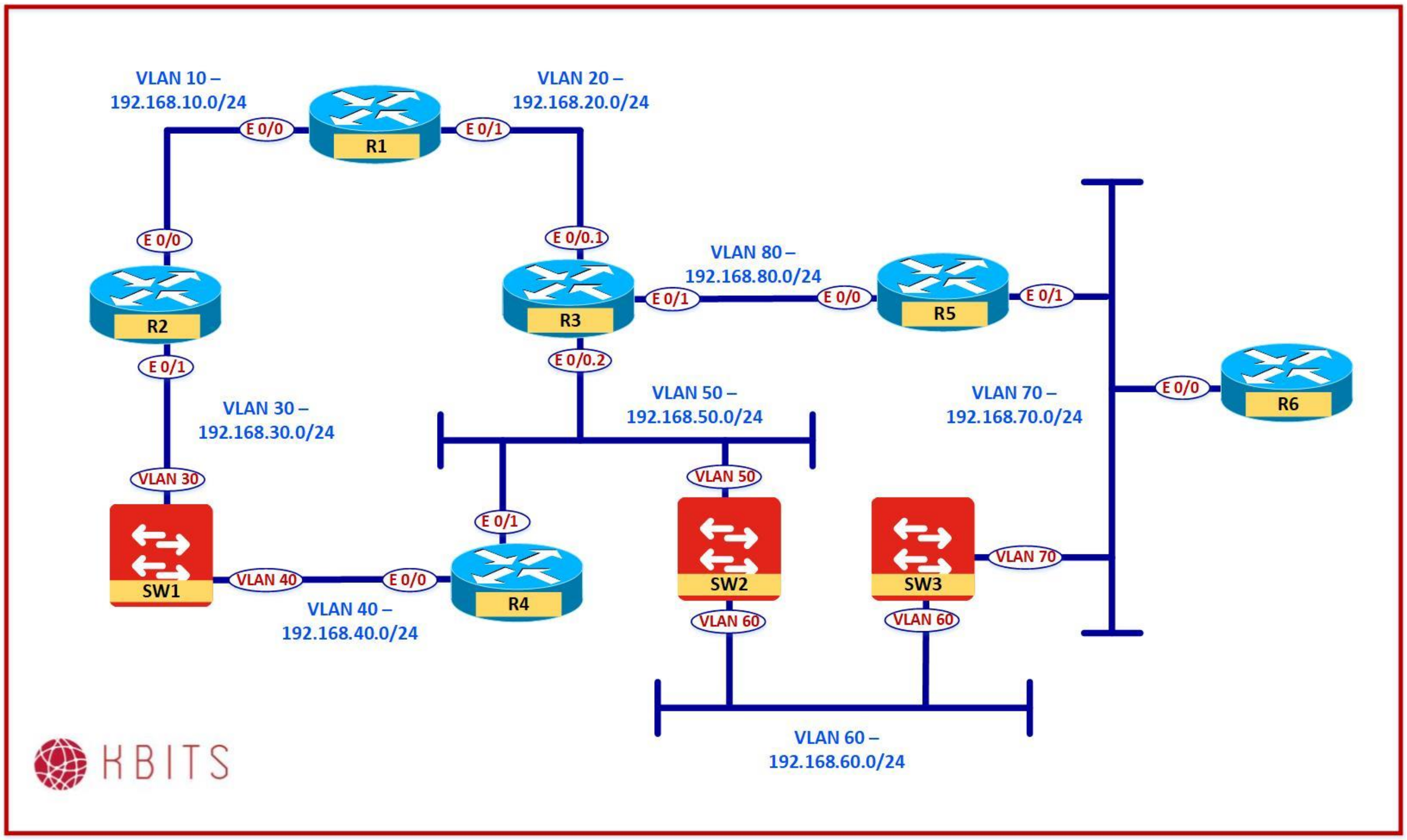
SW1 errdisable recovery cause bpduguard errdisable recovery interval 180
SW2 errdisable recovery cause bpduguard errdisable recovery interval 180
SW3 errdisable recovery cause bpduguard errdisable recovery interval 180
SW4 errdisable recovery cause bpduguard errdisable recovery interval 180

Lab 13 – Configuring VLAN ACLs

Physical Diagram



Logical Diagram



Task 1 – Configure a VLAN ACL

- You have been requested to implement the following Filtering policy on SW1:
  - Deny IGMP in VLAN 10
  - Deny TFTP in VLAN 20
  - Deny IGMP and TFTP in VLAN 30
  - There is a MAC address 0001.0012.2222 trying to attack VLAN 40. Block this MAC address from accessing any device in VLAN 40.

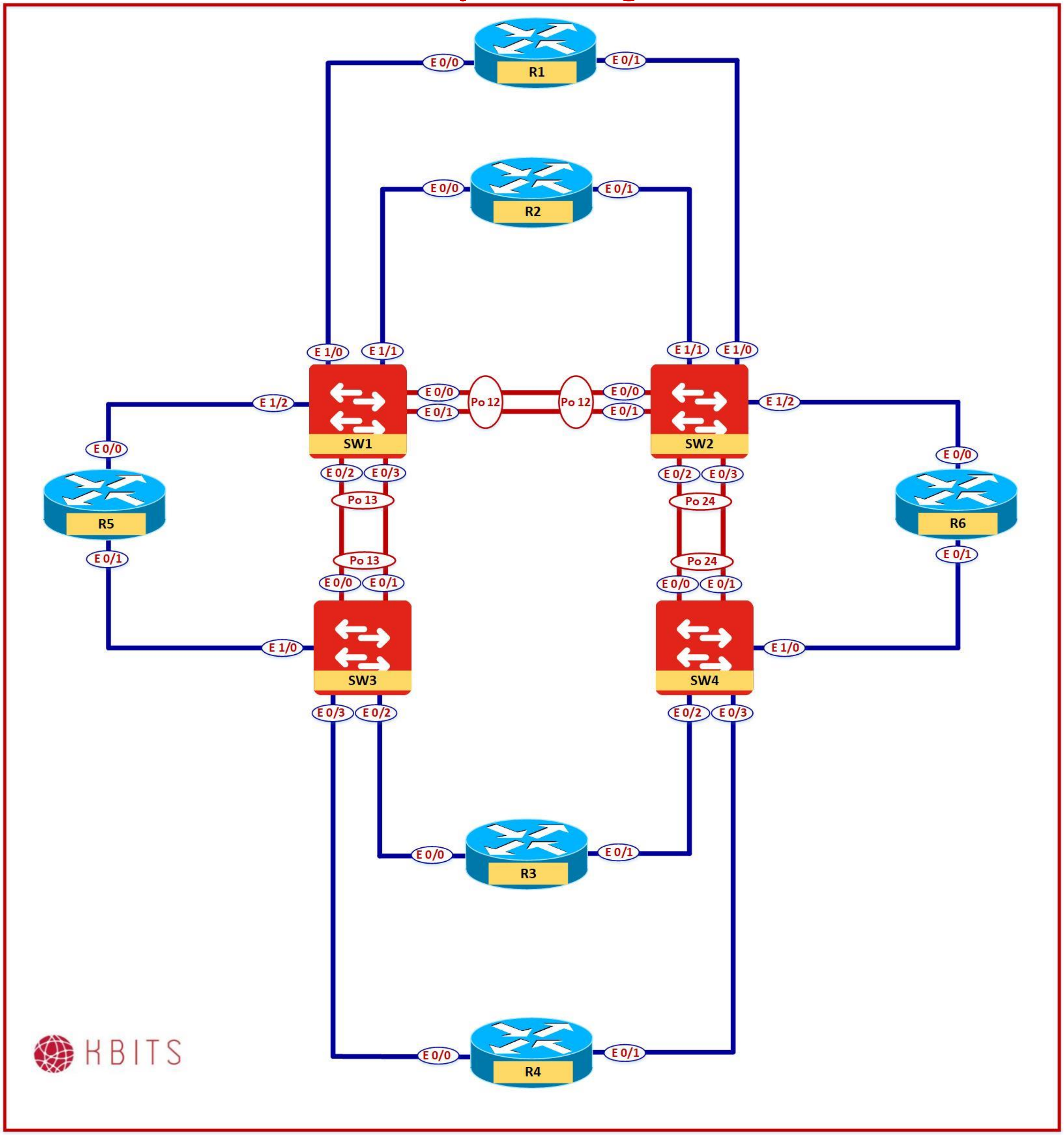
SW1

```
Access-list 101 permit igmp any any
!
Access-list 102 permit udp any any eq 69
!
Access-list 103 permit igmp any any
Access-list 103 permit udp any any eq 69
!
Mac access-list extended MAC-ACL
 Permit host 0001.0012.2222 any
!
Vlan access-map VLAN10 10
 Match ip addr 101
 Action drop
Vlan access-map VLAN10 100
!
Vlan access-map VLAN20 10
 Match ip addr 102
 Action drop
Vlan access-map VLAN20 100
!
Vlan access-map VLAN30 10
 Match ip addr 103
 Action drop
Vlan access-map VLAN30 100
!
Vlan access-map VLAN40 10
 Match mac address MAC-ACL
 Action drop
Vlan access-map VLAN40 100
!
Vlan filter VLAN10 vlan-list 10
```

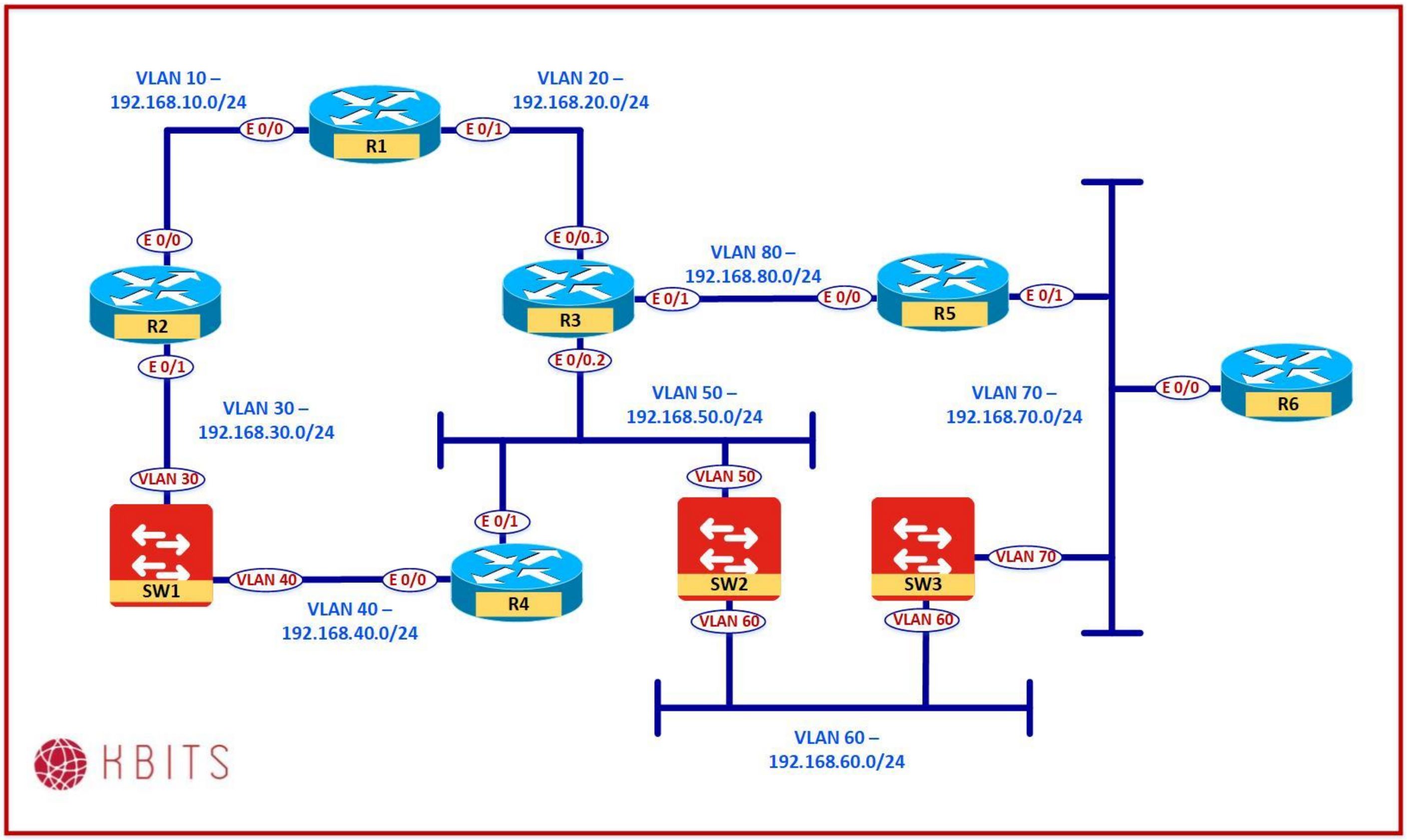
```
Vlan filter VLAN20 vlan-list 20
Vlan filter VLAN30 vlan-list 30
Vlan filter VLAN40 vlan-list 40
```

Lab 14 – Configuring Root Guard

Physical Diagram



Logical Diagram



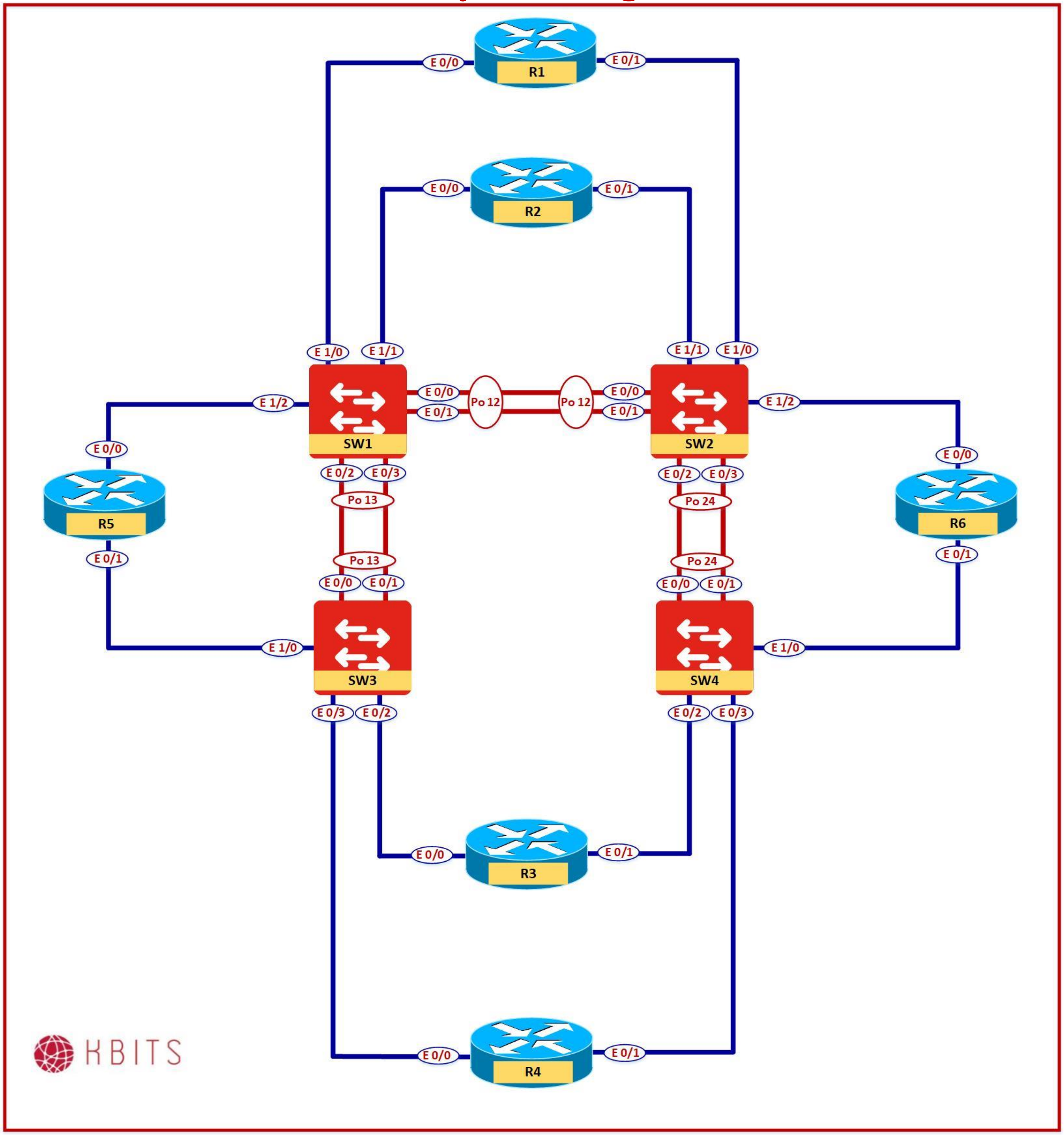
Task 1 – Configure Root Guard

- Configure the ports that connect SW1 to SW2 in such a way that if for some reason the spanning-tree causes the links towards SW3 or SW4 to be selected as root ports, the ports should transition to a root-inconsistent (blocked) state.

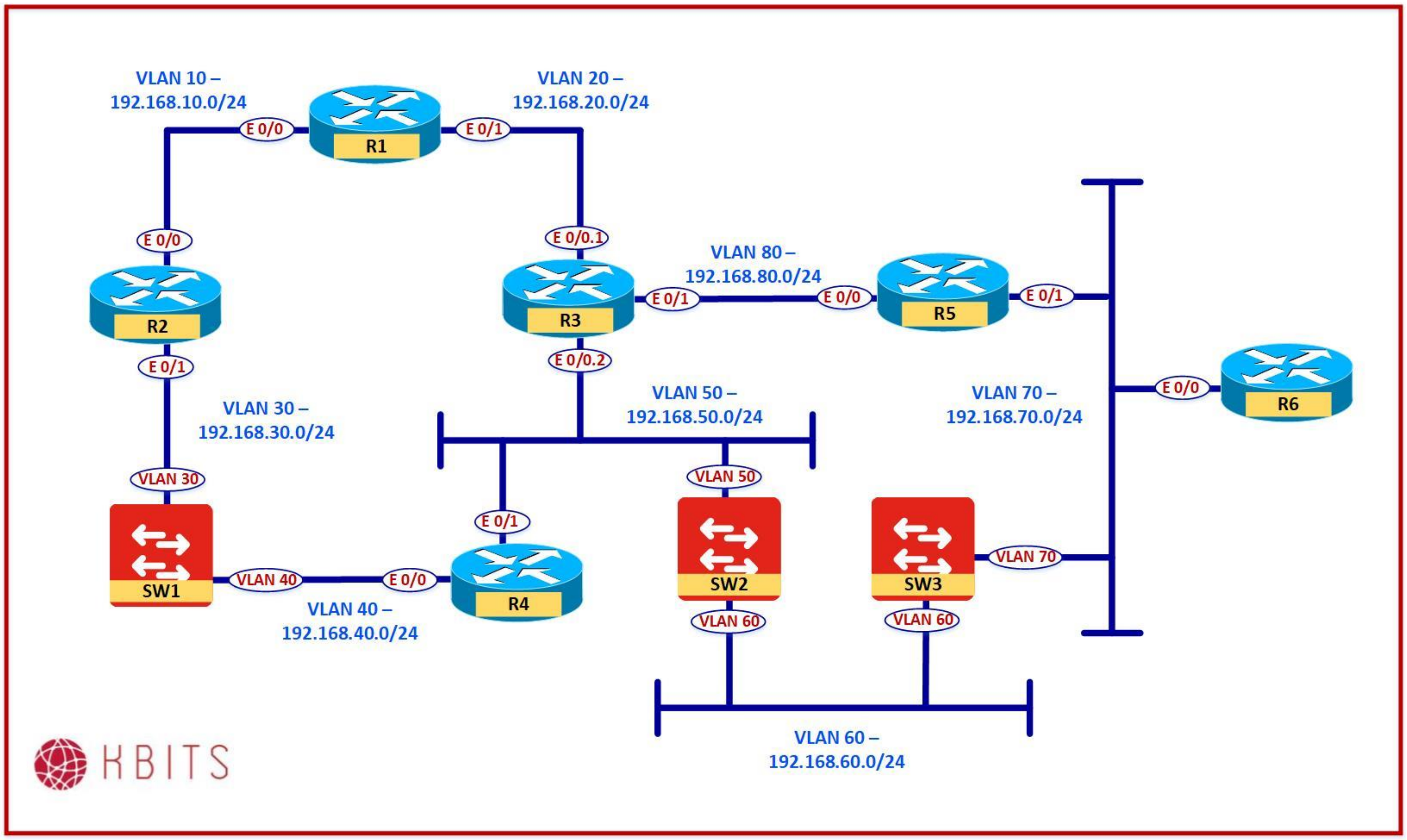
SW1 Interface range E 0/2-3 Description Connection towards SW3 Spanning-tree guard root
SW2 Interface port-channel24 Description Connection towards SW4 Spanning-tree guard root

Lab 15 – Configuring Port-Security

Physical Diagram



Logical Diagram



Task 1 – Configure Port Security – Static

- Configure the Router ports that connect SW1 in such a way that only the MAC to Port mappings is allowed on the specified ports:
  - R1 E0/0 MAC Address - Port E 1/0
  - R2 E0/0 MAC Address - Port E 1/1
  - R5 E0/0 MAC Address - Port E 1/2
- Find the MAC address of the Router Ports and statically enter them on SW1. (Use the **Show Interface** command on the individual router or use the **show mac address** command on SW1 to find the MAC address of the Router Ports.

SW1

```
Interface range E 1/0
 Description Connection towards R1
 Switchport port-security
 Switchport port-security mac xxxx.xxxx.xxxx (MAC address of R1)
!
Interface range E 1/1
```

```
 Description Connection towards R2
 Switchport port-security
 Switchport port-security mac xxxx.xxxx.xxxx (MAC address of R2)
!
Interface range E 1/2
 Description Connection towards R5
 Switchport port-security
 Switchport port-security mac xxxx.xxxx.xxxx (MAC address of R5)
```

Task 2 – Configure Port Security – Sticky

- Configure the Router ports that connect SW2 in such a way that only the MAC to Port mappings is allowed on the specified ports:
  - R1 E0/1 MAC Address - Port E 1/0
  - R2 E0/1 MAC Address - Port E 1/1
  - R6 E0/0 MAC Address - Port E 1/2
- SW2 should learn the MAC address dynamically and store it in the running configuration file.

SW2

```
Interface range E 1/0
 Description Connection towards R1
 Switchport port-security
 Switchport port-security mac sticky
!
Interface range E 1/1
 Description Connection towards R2
 Switchport port-security
 Switchport port-security mac sticky
!
Interface range E 1/2
 Description Connection towards R5
 Switchport port-security
 Switchport port-security mac sticky
```

Configuring EIGRP for IPv4 Networks

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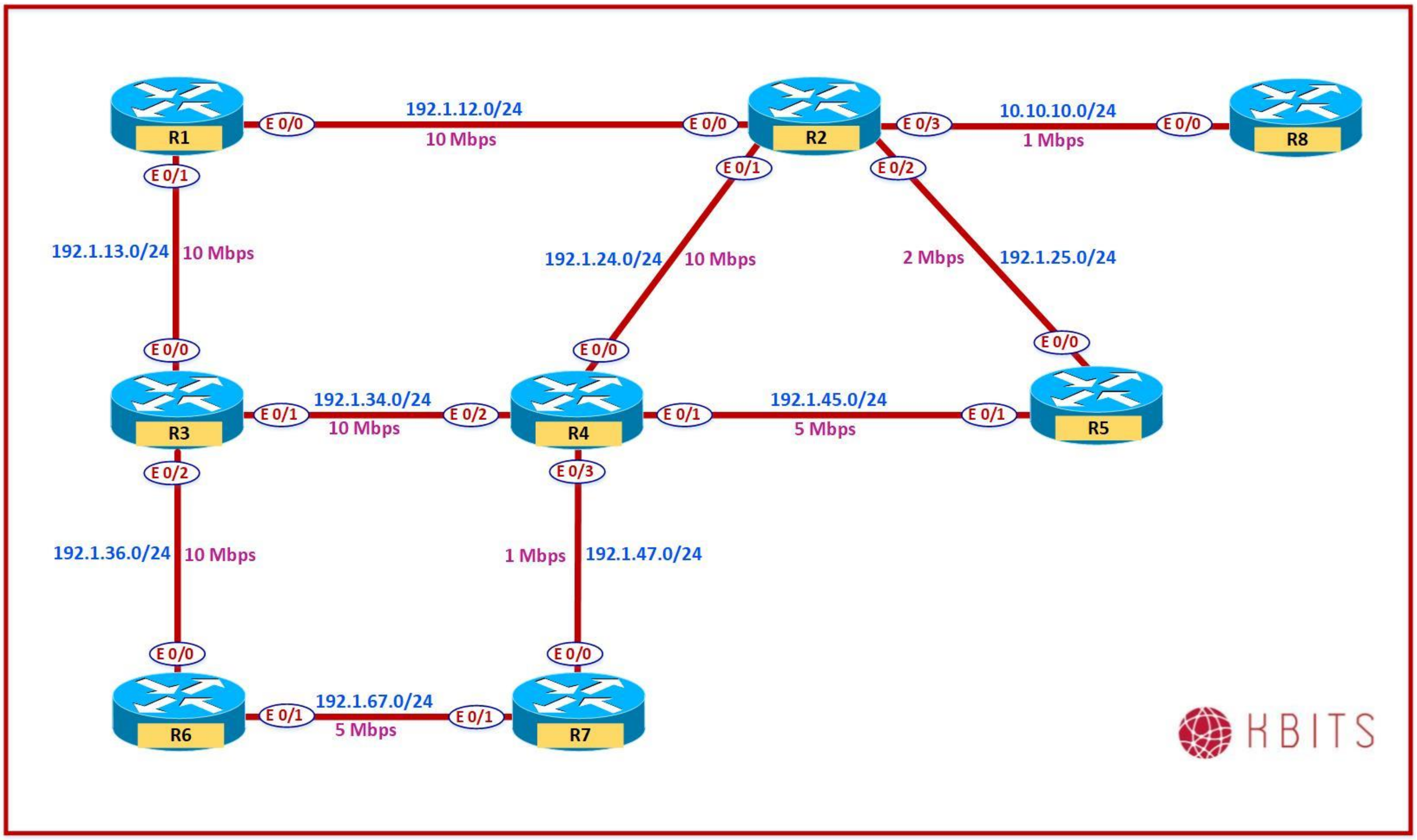
Configuring EIGRP

Lab 1 – Initializing EIGRP – Network Statement



Interface Configuration

R1

Interface	IP Address	Subnet Mask
E 0/0	192.1.12.1	255.255.255.0
E 0/1	192.1.13.1	255.255.255.0
Loopback1	101.1.4.1	255.255.255.0
Loopback2	101.1.5.1	255.255.255.0
Loopback3	101.1.6.1	255.255.255.0
Loopback4	101.1.7.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.24.2	255.255.255.0

E 0/2	192.1.25.2	255.255.255.0
E 0/3	10.10.10.2	255.255.255.0
Loopback1	202.1.4.1	255.255.255.0
Loopback2	202.1.5.1	255.255.255.0
Loopback3	202.1.6.1	255.255.255.0
Loopback4	202.1.7.1	255.255.255.0
Loopback5	10.1.4.1	255.255.255.0
Loopback6	10.1.5.1	255.255.255.0
Loopback7	10.1.6.1	255.255.255.0
Loopback8	10.1.7.1	255.255.255.0

R3

Interface	IP Address	Subnet Mask
E 0/0	192.1.13.3	255.255.255.0
E 0/1	192.1.34.3	255.255.255.0
E 0/2	192.1.36.3	255.255.255.0
Loopback1	203.1.4.1	255.255.255.0
Loopback2	203.1.5.1	255.255.255.0
Loopback3	203.1.6.1	255.255.255.0
Loopback4	203.1.7.1	255.255.255.0

R4

Interface	IP Address	Subnet Mask
E 0/0	192.1.24.4	255.255.255.0
E 0/1	192.1.45.4	255.255.255.0
E 0/2	192.1.34.4	255.255.255.0
E 0/3	192.1.47.4	255.255.255.0
Loopback1	104.1.8.1	255.255.255.0
Loopback2	104.1.9.1	255.255.255.0
Loopback3	104.1.10.1	255.255.255.0
Loopback4	104.1.11.1	255.255.255.0

R5

Interface	IP Address	Subnet Mask
E 0/0	192.1.25.5	255.255.255.0
E 0/1	192.1.45.5	255.255.255.0
Loopback1	205.1.4.1	255.255.255.0
Loopback2	205.1.5.1	255.255.255.0
Loopback3	205.1.6.1	255.255.255.0
Loopback4	205.1.7.1	255.255.255.0

R6

Interface	IP Address	Subnet Mask
E 0/0	192.1.36.6	255.255.255.0
E 0/1	192.1.67.6	255.255.255.0
Loopback1	101.1.60.1	255.255.255.0
Loopback2	101.1.61.1	255.255.255.0
Loopback3	101.1.62.1	255.255.255.0
Loopback4	101.1.63.1	255.255.255.0

R7

Interface	IP Address	Subnet Mask
E 0/0	192.1.47.7	255.255.255.0
E 0/1	192.1.67.7	255.255.255.0
Loopback1	101.1.72.1	255.255.255.0
Loopback2	101.1.73.1	255.255.255.0
Loopback3	101.1.74.1	255.255.255.0
Loopback4	101.1.75.1	255.255.255.0

R8

Interface	IP Address	Subnet Mask
E 0/0	10.10.10.8	255.255.255.0
Loopback1	10.1.8.1	255.255.255.0
Loopback2	10.1.9.1	255.255.255.0
Loopback3	10.1.10.1	255.255.255.0
Loopback4	10.1.11.1	255.255.255.0

Task 1 – Configure R1 in EIGRP AS 111.

- Configure the Interface based on the Interface Configuration Table.
- Run EIGRP in EIGRP 111.
- Configure the Network statement based on Major networks only.

R1

```
Hostname R1
!
Interface E 0/0
 ip address 192.1.12.1 255.255.255.0
 no shut
!
Interface E 0/1
 ip address 192.1.13.1 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 101.1.4.1 255.255.255.0
!
Interface Loopback2
 ip address 101.1.5.1 255.255.255.0
!
Interface Loopback3
 ip address 101.1.6.1 255.255.255.0
!
Interface Loopback4
 ip address 101.1.7.1 255.255.255.0
!
router eigrp 111
 network 192.1.12.0
 network 192.1.13.0
 network 101.0.0.0
```

Task 2 – Configure R2 in EIGRP AS 111.

- Configure the Interface based on the Interface Configuration Table.
- Run EIGRP in EIGRP 111.
- Configure the Network statement using a wild card mask for the Network 10.0.0.0. Use the Major networks for the rest of the networks.

R2

```
Hostname R2
!
Interface E 0/0
 ip address 192.1.12.2 255.255.255.0
 no shut
!
Interface E 0/1
 ip address 192.1.24.2 255.255.255.0
 no shut
!
Interface E 0/2
 ip address 192.1.25.2 255.255.255.0
 no shut
!
Interface E 0/3
 ip address 10.10.10.2 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 202.1.4.1 255.255.255.0
!
Interface Loopback2
 ip address 202.1.5.1 255.255.255.0
!
Interface Loopback3
 ip address 202.1.6.1 255.255.255.0
!
Interface Loopback4
 ip address 202.1.7.1 255.255.255.0
!
Interface Loopback5
 ip address 10.1.4.1 255.255.255.0
!
Interface Loopback6
 ip address 10.1.5.1 255.255.255.0
!
```

```
Interface Loopback7
 ip address 10.1.6.1 255.255.255.0
!
Interface Loopback8
 ip address 10.1.7.1 255.255.255.0
!
router eigrp 111
 network 192.1.12.0
 network 192.1.24.0
 network 192.1.25.0
 network 10.10.10.0 0.0.0.255
 network 10.1.0.0 0.0.255.255
 network 202.1.4.0
 network 202.1.5.0
 network 202.1.6.0
 network 202.1.7.0
```

Task 3 – Configure R3 in EIGRP AS 111.

- Configure the Interface based on the Interface Configuration Table.
- Run EIGRP in EIGRP 111.
- Configure the Network statement using a wild card mask to minimize the Network statements starting with 203.X.X.0. Use the Major networks for the rest of the networks.

R3

```
Hostname R3
!
Interface E 0/0
 ip address 192.1.13.3 255.255.255.0
 no shut
!
Interface E 0/1
 ip address 192.1.34.3 255.255.255.0
 no shut
!
Interface E 0/2
 ip address 192.1.36.3 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 203.1.4.1 255.255.255.0
!
```

```
Interface Loopback2
 ip address 203.1.5.1 255.255.255.0
!
Interface Loopback3
 ip address 203.1.6.1 255.255.255.0
!
Interface Loopback4
 ip address 203.1.7.1 255.255.255.0
!
router eigrp 111
 network 192.1.13.0
 network 192.1.34.0
 network 192.1.36.0
 network 203.1.0.0 0.0.255.255
```

Task 4 – Configure R4 in EIGRP AS 111.

- Configure the Interface based on the Interface Configuration Table.
- Run EIGRP in EIGRP 111.
- Configure the Network statement using a wild card mask to minimize the Network statements starting with 104.X.X.0. Use the Major networks for the rest of the networks.

R4

```
Hostname R4
!
Interface E 0/0
 ip address 192.1.24.4 255.255.255.0
 no shut
!
Interface E 0/1
 ip address 192.1.45.4 255.255.255.0
 no shut
!
Interface E 0/2
 ip address 192.1.34.4 255.255.255.0
 no shut
!
Interface E 0/3
 ip address 192.1.47.4 255.255.255.0
 no shut
!
Interface Loopback1
```

```
 ip address 104.1.8.1 255.255.255.0
!
Interface Loopback2
 ip address 104.1.9.1 255.255.255.0
!
Interface Loopback3
 ip address 104.1.10.1 255.255.255.0
!
Interface Loopback4
 ip address 104.1.11.1 255.255.255.0
!
router eigrp 111
 network 192.1.24.0
 network 192.1.34.0
 network 192.1.45.0
 network 192.1.47.0
 network 104.1.0.0 0.0.255.255
```

Task 5 – Configure R5 in EIGRP AS 111.

- Configure the Interface based on the Interface Configuration Table.
- Run EIGRP in EIGRP 111.
- Configure the Network statement using a wild card mask to minimize the Network statements starting with 205.X.X.0. Use the Major networks for the rest of the networks.

R5

```
Hostname R5
!
Interface E 0/0
 ip address 192.1.25.5 255.255.255.0
 no shut
!
Interface E 0/1
 ip address 192.1.45.5 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 205.1.4.1 255.255.255.0
!
Interface Loopback2
 ip address 205.1.5.1 255.255.255.0
!
Interface Loopback3
```

```
 ip address 205.1.6.1 255.255.255.0
!
Interface Loopback4
 ip address 205.1.7.1 255.255.255.0
!
router eigrp 111
 network 192.1.25.0
 network 192.1.45.0
 network 205.1.0.0 0.0.255.255
```

Task 6 – Configure R6 in EIGRP AS 111.

- Configure the Interface based on the Interface Configuration Table.
- Run EIGRP in EIGRP 111.
- Configure the Network statement using a wild card mask to minimize the Network statements starting with 101.X.X.0. Use the Major networks for the rest of the networks.

R6

```
Hostname R6
!
Interface E 0/0
 ip address 192.1.36.6 255.255.255.0
 no shut
!
Interface E 0/1
 ip address 192.1.67.6 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 101.1.60.1 255.255.255.0
!
Interface Loopback2
 ip address 101.1.61.1 255.255.255.0
!
Interface Loopback3
 ip address 101.1.62.1 255.255.255.0
!
Interface Loopback4
 ip address 101.1.63.1 255.255.255.0
!
router eigrp 111
 network 192.1.36.0
 network 192.1.67.0
```

```
network 101.1.0.0 0.0.255.255
```

Task 7 – Configure R7 in EIGRP AS 111.

- Configure the Interface based on the Interface Configuration Table.
- Run EIGRP in EIGRP 111.
- Configure the Network statement using a wild card mask to minimize the Network statements starting with 101.X.X.0. Use the Major networks for the rest of the networks.

R7

```
Hostname R7
!
Interface E 0/0
 ip address 192.1.47.7 255.255.255.0
 no shut
!
Interface E 0/1
 ip address 192.1.67.7 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 101.1.72.1 255.255.255.0
!
Interface Loopback2
 ip address 101.1.73.1 255.255.255.0
!
Interface Loopback3
 ip address 101.1.74.1 255.255.255.0
!
Interface Loopback4
 ip address 101.1.75.1 255.255.255.0
!
router eigrp 111
 network 192.1.47.0
 network 192.1.67.0
 network 101.1.0.0 0.0.255.255
```

Task 8 – Configure R8 in EIGRP AS 111.

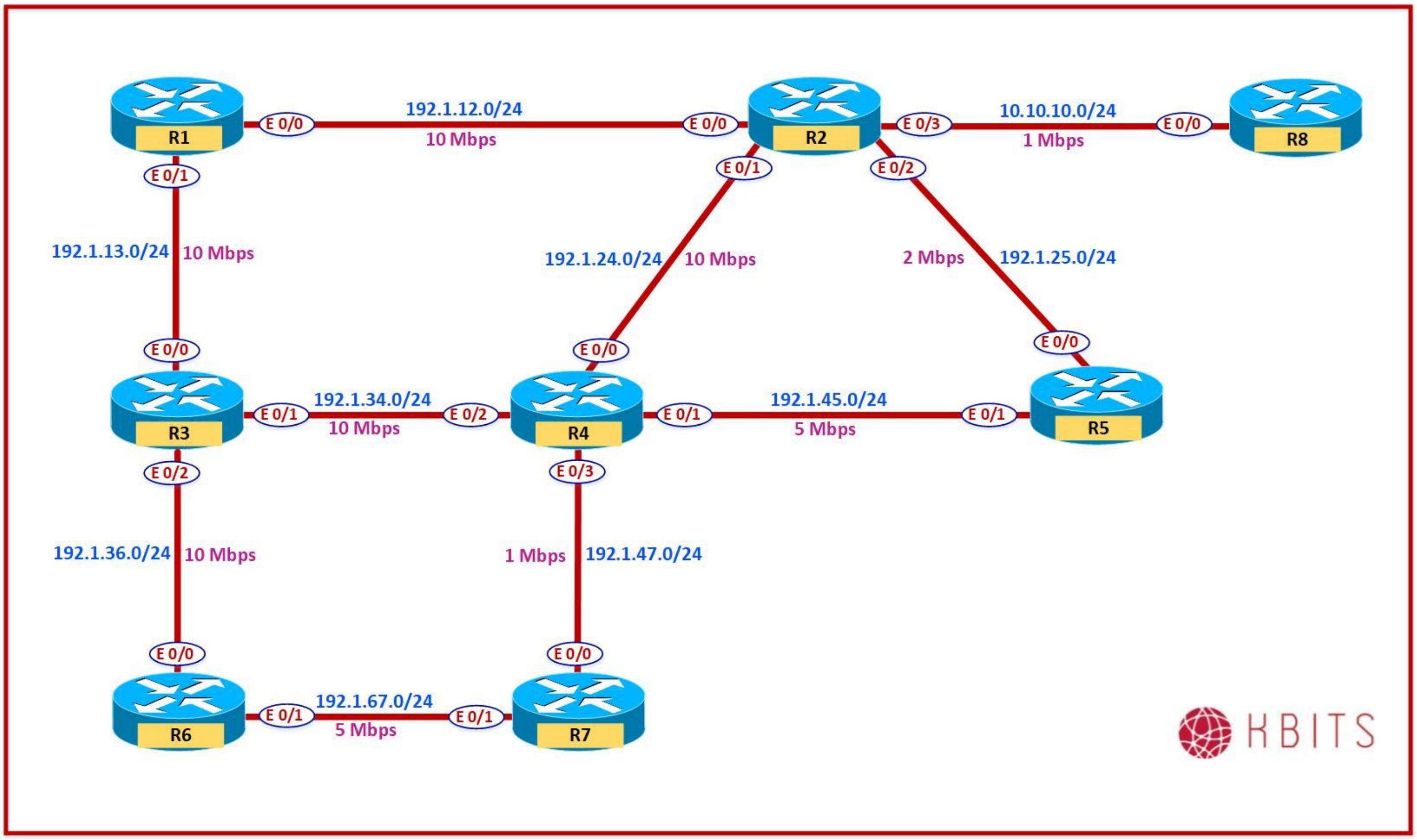
- Configure the Interface based on the Interface Configuration Table.
- Run EIGRP in EIGRP 111.
- Configure the Network statement such that all directly connected interfaces are enabled in EIGRP. This should also take care of any new interfaces configured in the future.

R8

```
Hostname R8
!
Interface E 0/0
 ip address 10.10.10.8 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 10.1.8.1 255.255.255.0
!
Interface Loopback2
 ip address 10.1.9.1 255.255.255.0
!
Interface Loopback3
 ip address 10.1.10.1 255.255.255.0
!
Interface Loopback4
 ip address 10.1.11.1 255.255.255.0
!
router eigrp 111
 network 0.0.0.0
```

Lab 2 – EIGRP – Passive Interfaces

Note: It builds on the topology created in the previous lab.



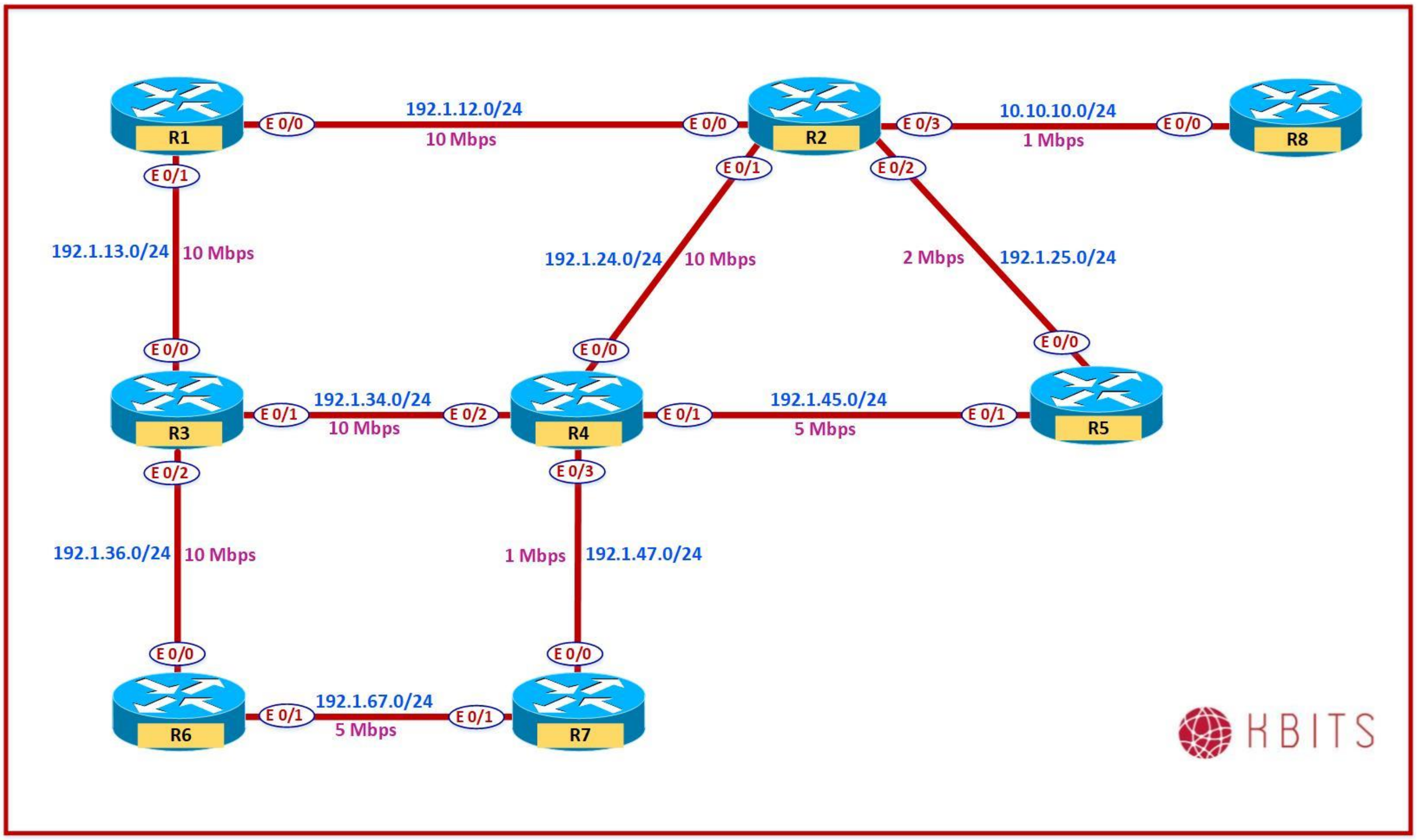
Task 1 – Configure Passive-Interface on Routers in EIGRP AS 111.

- Configure all routers in EIGRP 111 such that they do not send updates on links that do not have other routers, basically Loopbacks.
- Use the minimum number of passive interface commands to accomplish the task.

R1 router eigrp 111 passive-interface default no passive-interface E 0/0 no passive-interface E 0/1	**R2** router eigrp 111 passive-interface default no passive-interface E 0/0 no passive-interface E 0/1 no passive-interface E 0/2 no passive-interface E 0/3
R3 router eigrp 111 passive-interface default no passive-interface E 0/0 no passive-interface E 0/1 no passive-interface E 0/2	**R4** router eigrp 111 passive-interface default no passive-interface E 0/0 no passive-interface E 0/1 no passive-interface E 0/2 no passive-interface E 0/3
R5 router eigrp 111 passive-interface default no passive-interface E 0/0 no passive-interface E 0/1	**R6** router eigrp 111 passive-interface default no passive-interface E 0/0 no passive-interface E 0/1
R7 router eigrp 111 passive-interface default no passive-interface E 0/0 no passive-interface E 0/1	**R8** router eigrp 111 passive-interface default no passive-interface E 0/0

Lab 3 – EIGRP – Unicast Neighbors

Note: It builds on the topology created in the previous lab.



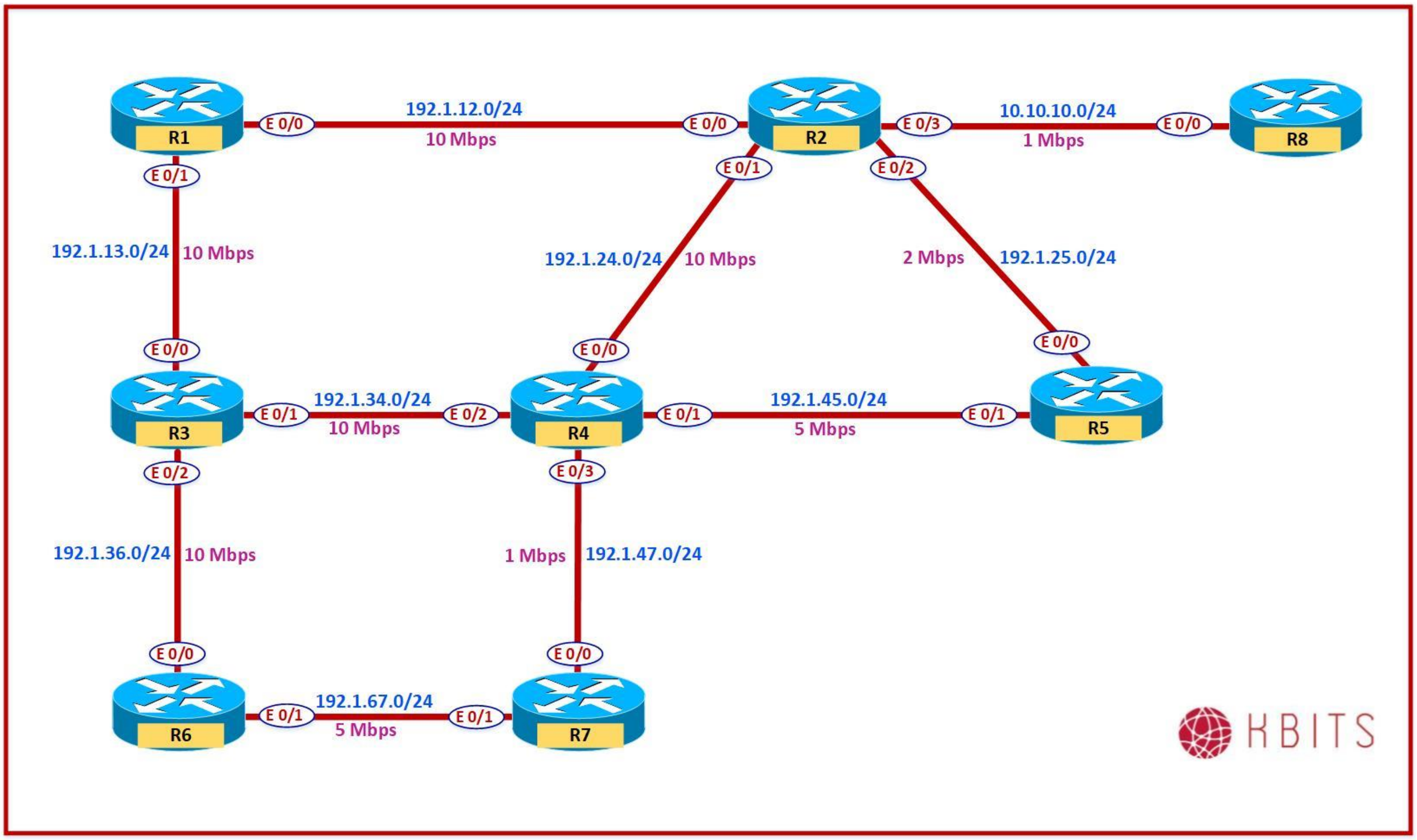
Task 1 – Configure Unicast EIGRP on specific interfaces in AS 111.

- Configure the neighbor relationship between R1 and R2 to be Unicast-based.
- Configure the neighbor relationship between R2 and R8 to be Unicast-based.

R1 router eigrp 111 neighbor 192.1.12.2 E0/0	**R2** router eigrp 111 neighbor 192.1.12.1 E0/0 neighbor 10.10.10.8 E0/3
R8 router eigrp 111 neighbor 10.10.10.2 E0/0	

Lab 4 – EIGRP – Metric Calculations

Note: It builds on the topology created in the previous lab.

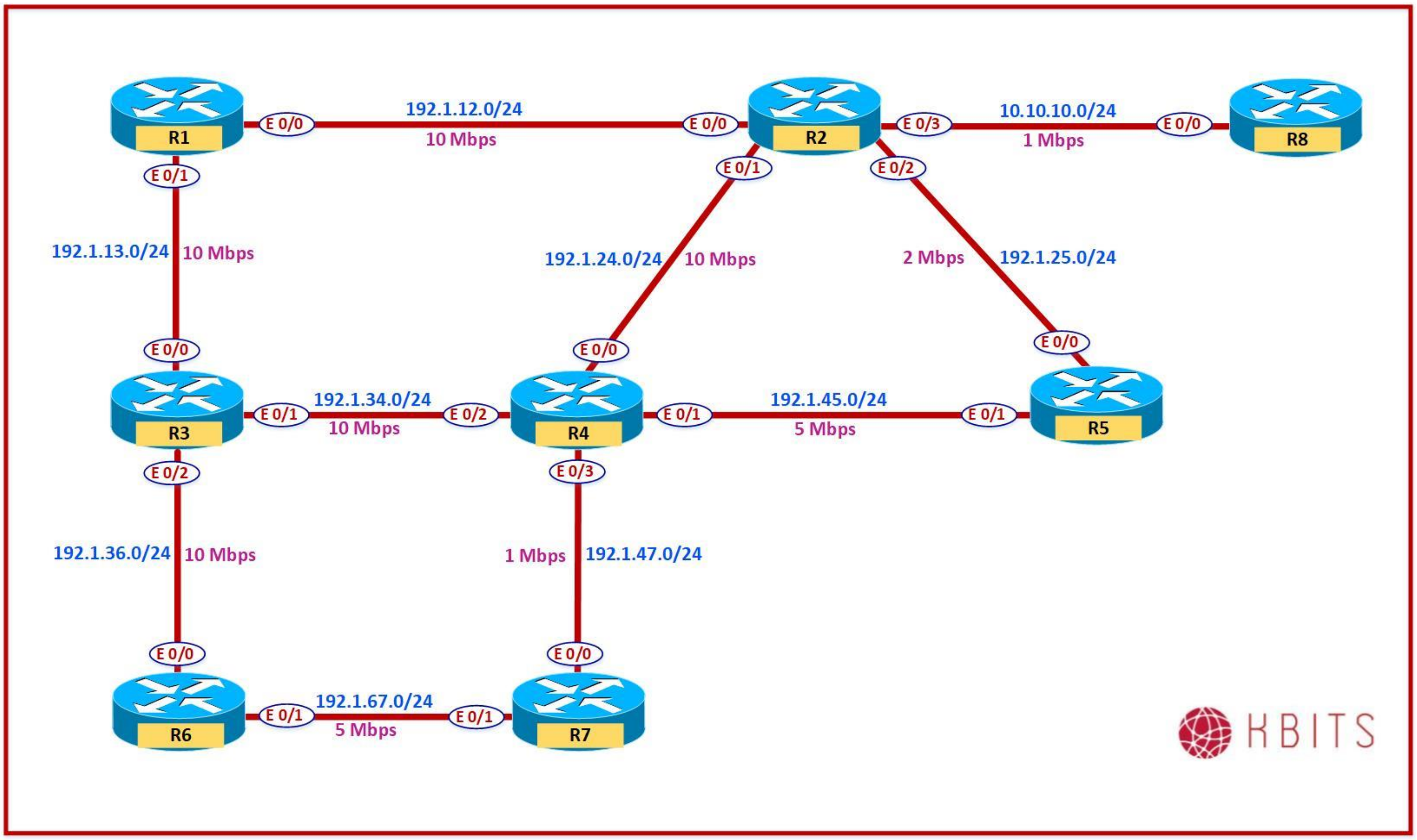


Task 1 – Configure interface bandwidth based on the topology diagram.

- Configure the Interfaces on the routers based on the bandwidth shown in the diagram. Don't change the delay.
- Calculate the metrics from R2 towards the 205.1.4.0/24 network. Make sure that it matches the values mentioned in the video.

R1 Interface E 0/0 Bandwidth 10000 Interface E 0/1 Bandwidth 10000	**R2** Interface E 0/0 Bandwidth 10000 Interface E 0/1 Bandwidth 10000 Interface E 0/2 Bandwidth 2000 Interface E 0/3 Bandwidth 1000
R3 Interface E 0/0 Bandwidth 10000 Interface E 0/1 Bandwidth 10000 Interface E 0/2 Bandwidth 10000	**R4** Interface E 0/0 Bandwidth 10000 Interface E 0/1 Bandwidth 5000 Interface E 0/2 Bandwidth 10000 Interface E 0/3 Bandwidth 1000
R5 Interface E 0/0 Bandwidth 2000 Interface E 0/1 Bandwidth 5000	**R6** Interface E 0/0 Bandwidth 10000 Interface E 0/1 Bandwidth 5000
R7 Interface E 0/0 Bandwidth 1000 Interface E 0/1 Bandwidth 5000	**R5** Interface E 0/0 Bandwidth 1000

Lab 5 – Load Balancing – Equal & Unequal Load Balancing



Task 1 – Verifying Equal Cost Load Balancing between R1, R2, R3 & R4.

- The Interface bandwidth between R1, R2, R3 & R4 is the same. This results in equal costs to get from diagonally across routers (R1-R4 and vice versa & R2-R3 and vice versa).
- Verify the dual path from R1 towards the loopbacks of R4 and vice versa.
- Verify the dual path from R2 towards the loopbacks of R3 and vice versa.

R1	**R2**
Show IP Route eigrp	Show IP Route eigrp

R3	R4
Show IP Route eigrp	Show IP Route eigrp

Task 2 – Configuring Unequal Load Balancing on R2

- Configure R2 to use both path towards the Loopback Interfaces of R5.
- Calculate the Variance and implement it on R2.
- This can be done by finding the Composite Metric for the Successor and Feasible successors in the EIGRP topology table.
- Divide the Feasible Successor Metric (1433600) by Sucessor Metric (691200).
- You will get a result of 2.07. Round up the number to 3.
- That is the variance.
- Verify the Traffic share count by using the Show Ip route command with the route option (show ip route 205.1.4.0)

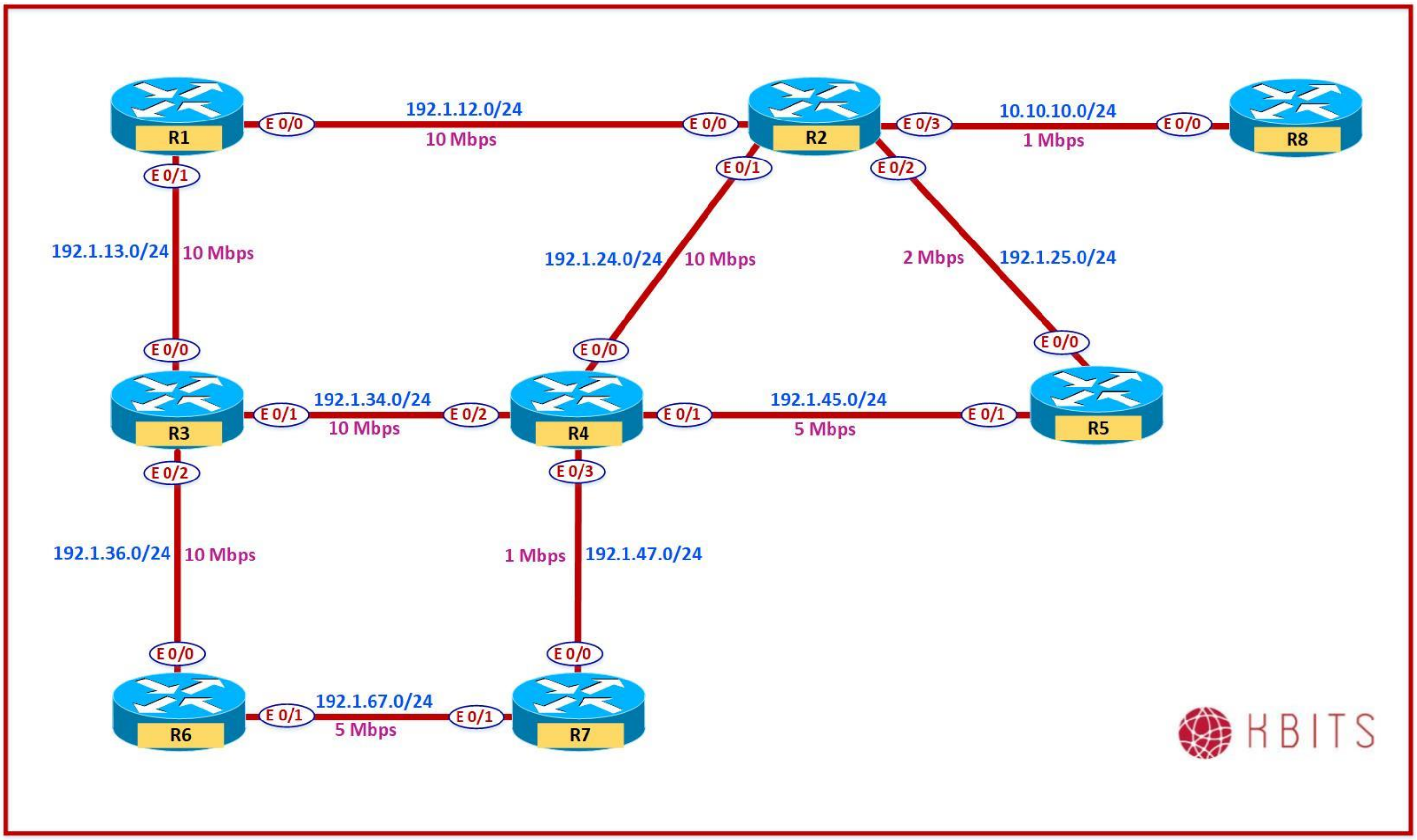
R2
Router eigrp 111 Variance 3

Task 3 – Configuring Unequal Load Balancing on R5

- Configure R5 to use both path towards the Loopback Interfaces of R2.
- Calculate the Variance and implement it on R5.
- This can be done by finding the Composite Metric for the Successor and Feasible successors in the EIGRP topology table.
- Divide the Feasible Successor Metric (1433600) by Sucessor Metric (691200).
- You will get a result of 2.07. Round up the number to 3.
- That is the variance.
- Verify the Traffic share count by using the Show Ip route command with the route option (show ip route 205.1.4.0)

R5
Router eigrp 111 Variance 3

Lab 6 – Route Summarization – Auto Summary



Task 1 – Configuring Auto-Summary on R1 & R6

R1	R6
Router eigrp 111 Auto-summary	Router eigrp 111 Auto-summary

Task 2 – Verifying the results of Auto-Summary

- Ping a R1 Loopback IP (101.1.4.1) from R6 or R7.
- Are you successful?
- What is the reason for that?

Task 3 – Configuring Auto-Summary on R2 & R8

R2	R8
Router eigrp 111 Auto-summary	Router eigrp 111 Auto-summary

Task 4 – Verifying Auto-Summarization between R2 & R8

- Are the Network 10.0.0.0/8 subnets summarized between R2 & R8?

Task 5 – Configuring the following Interfaces on R2 & R8 & Enable them in EIGRP 111.

R2	R8
Interface loopback401 Ip address 102.1.4.1 255.255.255.0 Interface loopback402 Ip address 102.1.5.1 255.255.255.0 Interface loopback403 Ip address 102.1.6.1 255.255.255.0 Interface loopback404 Ip address 102.1.7.1 255.255.255.0 ! Router eigrp 111 Network 102.0.0.0	Interface loopback401 Ip address 108.1.4.1 255.255.255.0 Interface loopback402 Ip address 108.1.5.1 255.255.255.0 Interface loopback403 Ip address 108.1.6.1 255.255.255.0 Interface loopback404 Ip address 108.1.7.1 255.255.255.0 ! Router eigrp 111 Network 108.0.0.0

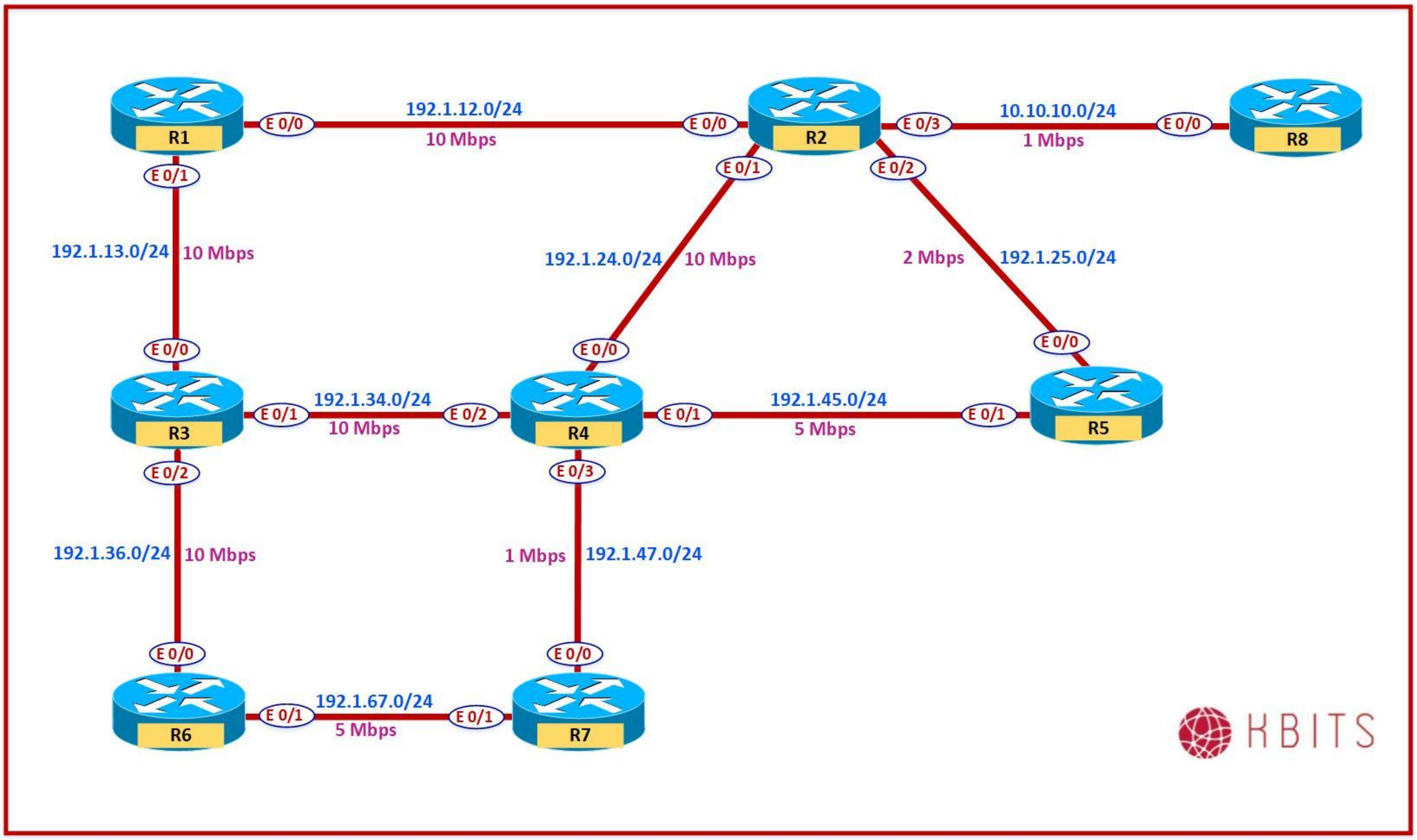
Task 6 – Verifying Auto-Summarization between R2 & R8

- Are the new Loopback Networks summarized between R2 & R8?
- Why?

Task 7 – Disable Auto-Summarization on R1, R2, R6 & R8

R1	R2
Router eigrp 111 No Auto-summary	Router eigrp 111 No Auto-summary
R6 Router eigrp 111 No Auto-summary	**R8** Router eigrp 111 No Auto-summary

Lab 7 – Route Summarization – Manual Summarization



Task 1 – Configuring Manual Summarization on R1 for all the 101.0.0.0/8 subnets using the Longest Summary Mask. Summarization should be configured towards all the neighbors.

```
R1

Interface E 0/0
 Ip summary-address eigrp 111 101.1.4.0 255.255.252.0
!
Interface E 0/1
 Ip summary-address eigrp 111 101.1.4.0 255.255.252.0
```

Task 2 – Configuring Manual Summarization on R2 for all the 10.0.0.0/8 subnets, 102.0.0.0/8 subnets & the 202.X.X.0/24 major networks using the Longest Summary Mask. Summarization should be configured towards all the neighbors.

```
R2

Interface E 0/0
 Ip summary-address eigrp 111 10.1.4.0 255.255.252.0
 Ip summary-address eigrp 111 102.1.4.0 255.255.252.0
 Ip summary-address eigrp 111 202.1.4.0 255.255.252.0

!
Interface E 0/1
 Ip summary-address eigrp 111 10.1.4.0 255.255.252.0
 Ip summary-address eigrp 111 102.1.4.0 255.255.252.0
 Ip summary-address eigrp 111 202.1.4.0 255.255.252.0
!
Interface E 0/2
 Ip summary-address eigrp 111 10.1.4.0 255.255.252.0
 Ip summary-address eigrp 111 102.1.4.0 255.255.252.0
 Ip summary-address eigrp 111 202.1.4.0 255.255.252.0
!
Interface E 0/3
 Ip summary-address eigrp 111 10.1.4.0 255.255.252.0
 Ip summary-address eigrp 111 102.1.4.0 255.255.252.0
 Ip summary-address eigrp 111 202.1.4.0 255.255.252.0
```

Task 3 – Configuring Manual Summarization on R3 for the 203.X.X.0/24 major networks using the Longest Summary Mask. Summarization should be configured towards all the neighbors.

```
R3

Interface E 0/0
 Ip summary-address eigrp 111 203.1.4.0 255.255.252.0
!
Interface E 0/1
 Ip summary-address eigrp 111 203.1.4.0 255.255.252.0
!
Interface E 0/2
 Ip summary-address eigrp 111 203.1.4.0 255.255.252.0
```

Task 4 – Configuring Manual Summarization on R4 for the 104.0.0.0/24 subnets using the Longest Summary Mask. Summarization should be configured towards all the neighbors.

```
R4

Interface E 0/0
 Ip summary-address eigrp 111 104.1.8.0 255.255.252.0
!
Interface E 0/1
 Ip summary-address eigrp 111 104.1.8.0 255.255.252.0
!
Interface E 0/2
 Ip summary-address eigrp 111 104.1.8.0 255.255.252.0
```

Task 5 – Configuring Manual Summarization on R5 for the 205.X.X.0/24 major networks using the Longest Summary Mask. Summarization should be configured towards all the neighbors.

```
R5

Interface E 0/0
 Ip summary-address eigrp 111 205.1.4.0 255.255.252.0
!
Interface E 0/1
 Ip summary-address eigrp 111 205.1.4.0 255.255.252.0
```

Task 6 – Configuring Manual Summarization on R6 for the 101.0.0.0/24 subnets using the Longest Summary Mask. Summarization should be configured towards all the neighbors.

```
R6

Interface E 0/0
 Ip summary-address eigrp 111 101.1.60.0 255.255.252.0
!
Interface E 0/1
 Ip summary-address eigrp 111 101.1.60.0 255.255.252.0
```

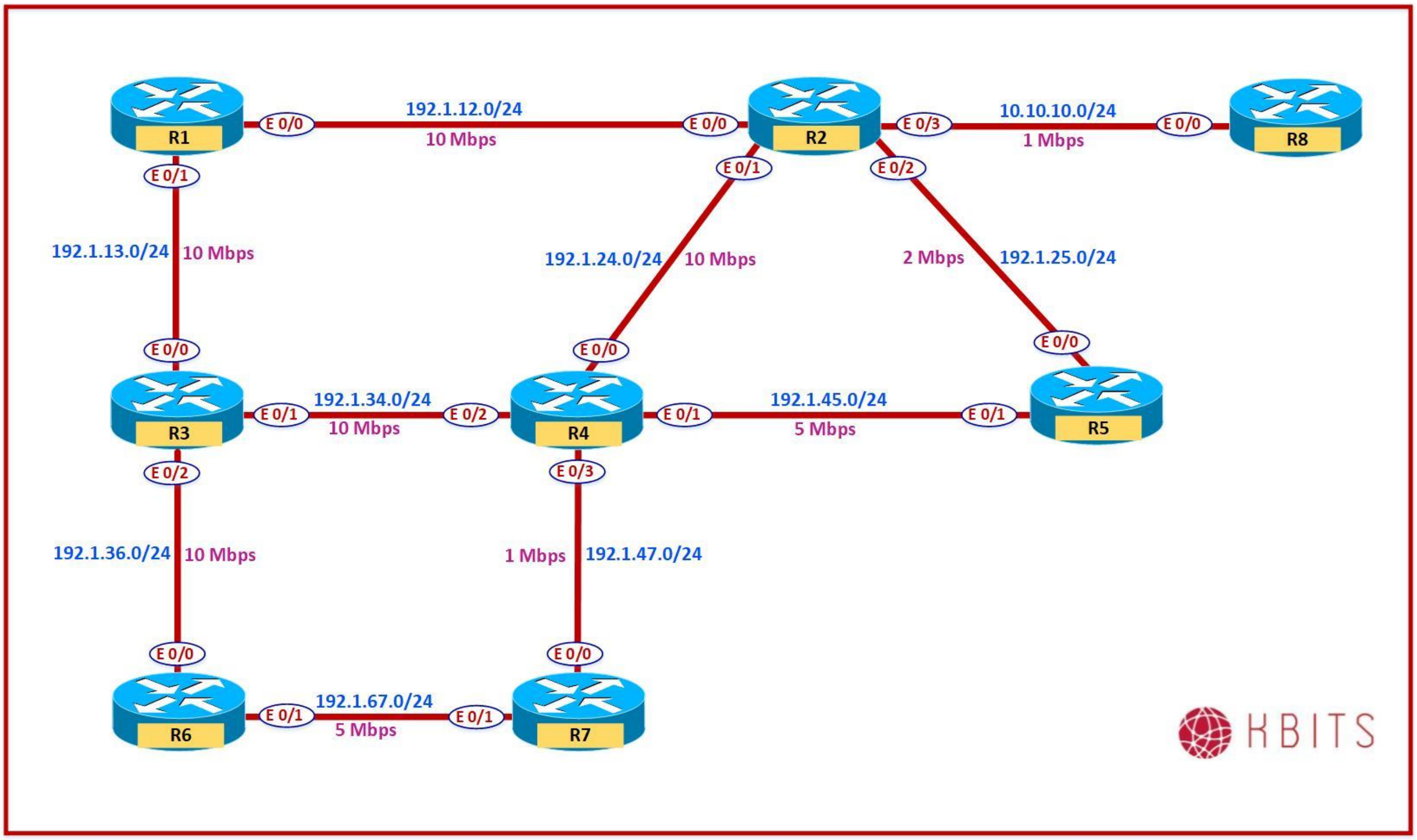
Task 7 – Configuring Manual Summarization on R7 for the 107.0.0.0/24 subnets using the Longest Summary Mask. Summarization should be configured towards all the neighbors.

```
R7

Interface E 0/0
 Ip summary-address eigrp 111 107.1.72.0 255.255.252.0
!
Interface E 0/1
 Ip summary-address eigrp 111 107.1.72.0 255.255.252.0
```

Task 8 – Configuring Manual Summarization on R8 for all the 10.0.0.0/8 subnets & the 108.0.0.0/8 subnets using the Longest Summary Mask. Summarization should be configured towards all the neighbors.

```
R8

Interface E 0/0
 Ip summary-address eigrp 111 10.1.8.0 255.255.252.0
 Ip summary-address eigrp 111 108.1.4.0 255.255.252.0
```

Lab 8 – Route Summarization – Leak Maps

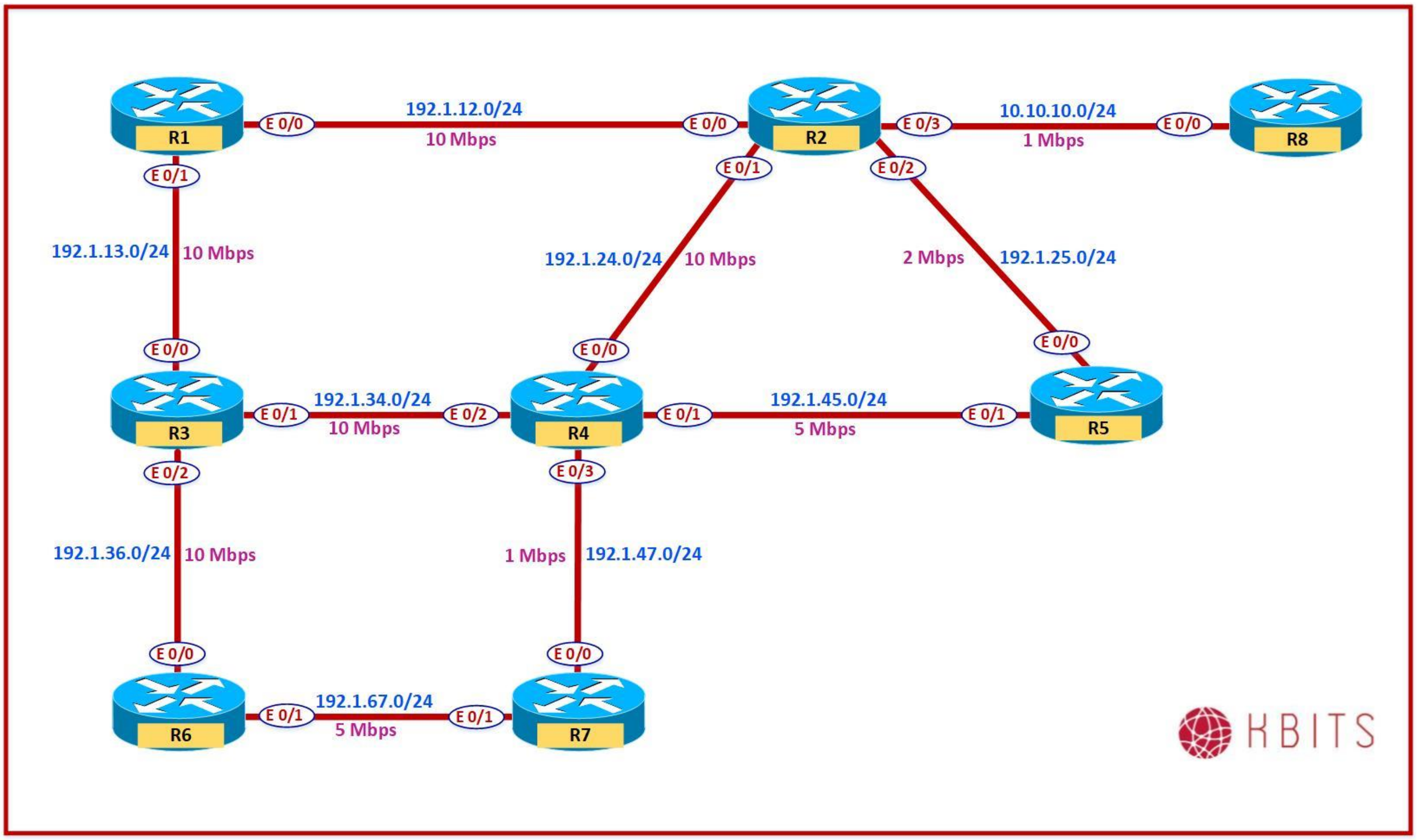


Task 1 – Configure R7 such that traffic for the 101.1.75.0/24 network from R3 should use R4 as the Next-Hop whereas the other networks should continue to use the Summary Route based on the best metric.

R7

```
Access-list 77 permit 101.1.75.0 0.0.0.255
!
Route-map LM
 Match ip address 77
!
Interface E 0/0
Ip summary-address eigrp 111 101.1.72.0 255.255.252.0 leak-map LM
```

Lab 9 – Route Filtering using ACLs in EIGRP



Task 1
Configure the following Loopback Interfaces on R8:

Loopback 21: 178.1.1.1/24
Loopback 22: 178.1.2.1/24
Loopback 23: 178.1.3.1/24
Loopback 24: 178.1.4.1/24

Enable them in EIGRP 111

R8

```
Interface loopback401
 Ip address 178.1.1.1 255.255.255.0
Interface loopback402
 Ip address 178.1.2.1 255.255.255.0
Interface loopback403
 Ip address 178.1.3.1 255.255.255.0
Interface loopback404
 Ip address 178.1.4.1 255.255.255.0
!
Router eigrp 111
 Network 178.1.0.0
```

Task 2
R2 should block the 178.1.1.0/24 & 178.1.4.0/24 networks from coming in from R8.

R2

```
Access-list 1 deny 178.1.1.0 0.0.0.255
Access-list 1 deny 178.1.4.0 0.0.0.255
Access-list 1 permit any
!
Router EIGRP 111
  Distribute-list 1 in E 0/3
```

Task 3
Configure the following Loopback Interfaces on R3:

Loopback 21: 173.1.1.1/24
Loopback 22: 173.1.2.1/24
Loopback 23: 173.1.3.1/24
Loopback 24: 173.1.4.1/24
Loopback 25: 173.1.5.1/24

Loopback 26: 173.1.6.1/24
Loopback 27: 173.1.7.1/24
Loopback 28: 173.1.8.1/24

Enable them in EIGRP 111

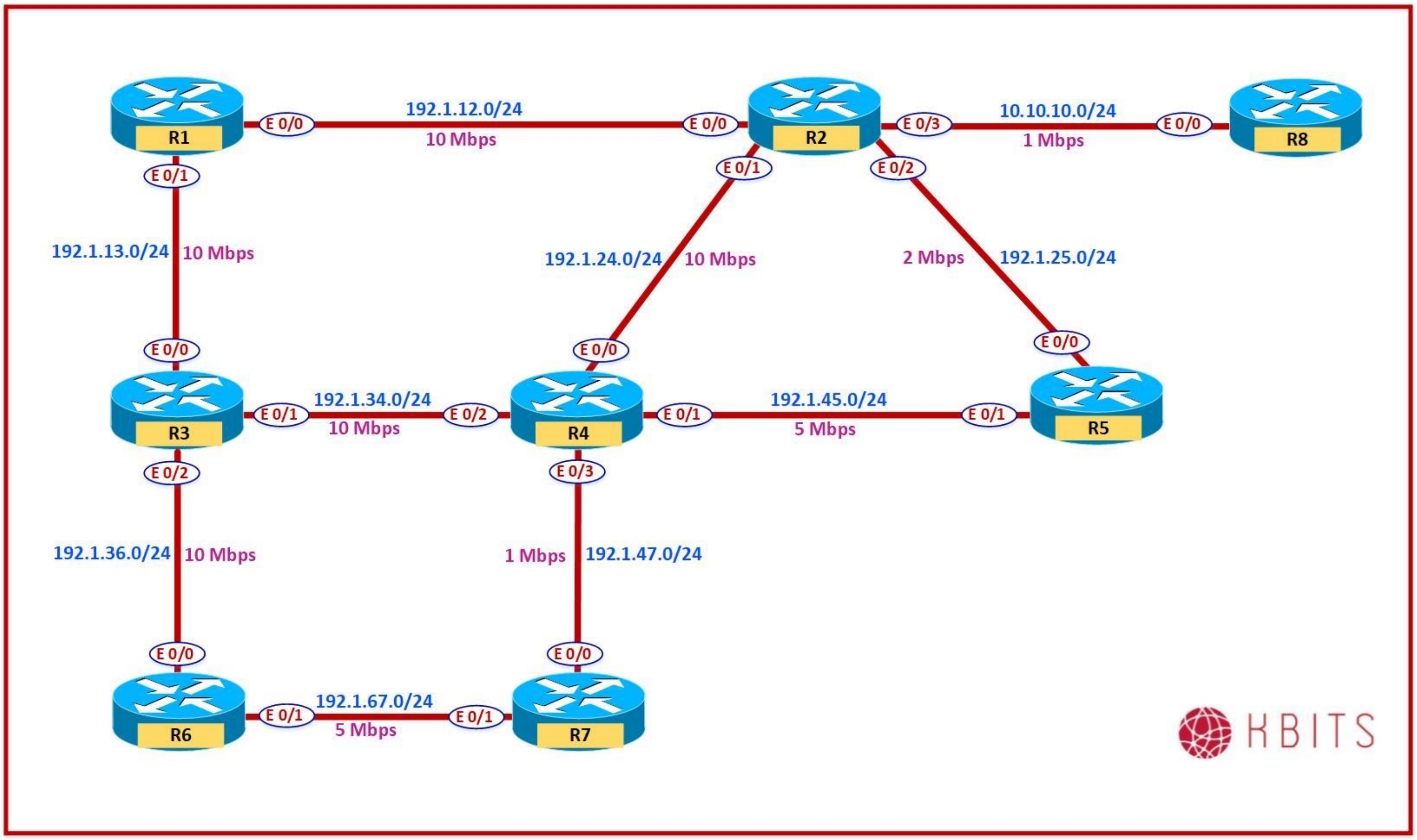
```
R3

Interface loopback401
 Ip address 173.1.1.1 255.255.255.0
Interface loopback402
 Ip address 173.1.2.1 255.255.255.0
Interface loopback403
 Ip address 173.1.3.1 255.255.255.0
Interface loopback404
 Ip address 173.1.4.1 255.255.255.0
Interface loopback405
 Ip address 173.1.5.1 255.255.255.0
Interface loopback406
 Ip address 173.1.6.1 255.255.255.0
Interface loopback407
 Ip address 173.1.7.1 255.255.255.0
Interface loopback408
 Ip address 173.1.8.1 255.255.255.0
!
Router eigrp 111
 Network 173.1.0.0
```

Task 4

R3 should only send routes from the 173.1.X.0 range that have an even number in the 3rd Octet to all its neighbors. Use the minimum number of lines possible to accomplish this task.

```
R3

Access-list 1 deny 173.1.1.0 0.0.254.255
Access-list 1 permit any
!
Router EIGRP 111
  Distribute-list 1 out
```

Lab 10 – Route Filtering using Prefix-Lists in EIGRP



Task 1

Configure the following Loopback Interfaces on R5 and advertise them under EIGRP 111:

Loopback 401: 175.50.1.1/24
Loopback 402: 175.50.2.1/24
Loopback 403: 175.50.3.1/24
Loopback 404: 205.1.1.33/27
Loopback 405: 205.1.1.65/28

R5

```
Interface loopback401
 Ip address 175.50.1.1 255.255.255.0
Interface loopback402
 Ip address 175.50.2.1 255.255.255.0
Interface loopback403
```

```
 Ip address 175.50.3.1 255.255.255.0
Interface loopback404
 Ip address 205.1.1.33 255.255.255.224
Interface loopback405
 Ip address 205.1.1.65 255.255.255.240
!
Router eigrp 111
 Network 175.50.0.0
 Network 205.1.1.0
```

Task 2

Configure R2 & R4 such that they receive prefixes with a prefix-length of 8 to 24 from R5. Do not configure the filtering on R5.

R2

```
ip prefix-list ABC permit 0.0.0.0/0 ge 8 le 24
!
Router EIGRP 111
 distribute-list prefix ABC in E0/2
```

R4

```
ip prefix-list ABC permit 0.0.0.0/0 ge 8 le 24
!
Router EIGRP 111
 distribute-list prefix ABC in E0/1
```

Task 3

Configure the following Loopback Interfaces on R6 and advertise them under EIGRP 111:

Loopback 401: 176.1.32.1/19
Loopback 402: 176.1.64.1/20
Loopback 403: 176.1.80.1/21
Loopback 403: 176.1.96.1/24

R6

```
Interface loopback401
 Ip address 176.1.32.1 255.255.224.0
Interface loopback402
 Ip address 176.1.64.1 255.255.240.0
Interface loopback403
 Ip address 176.1.80.1 255.255.248.0
```

```
Interface loopback404
 Ip address 176.1.96.1 255.255.255.0
!
Router eigrp 111
 Network 176.1.0.0
```

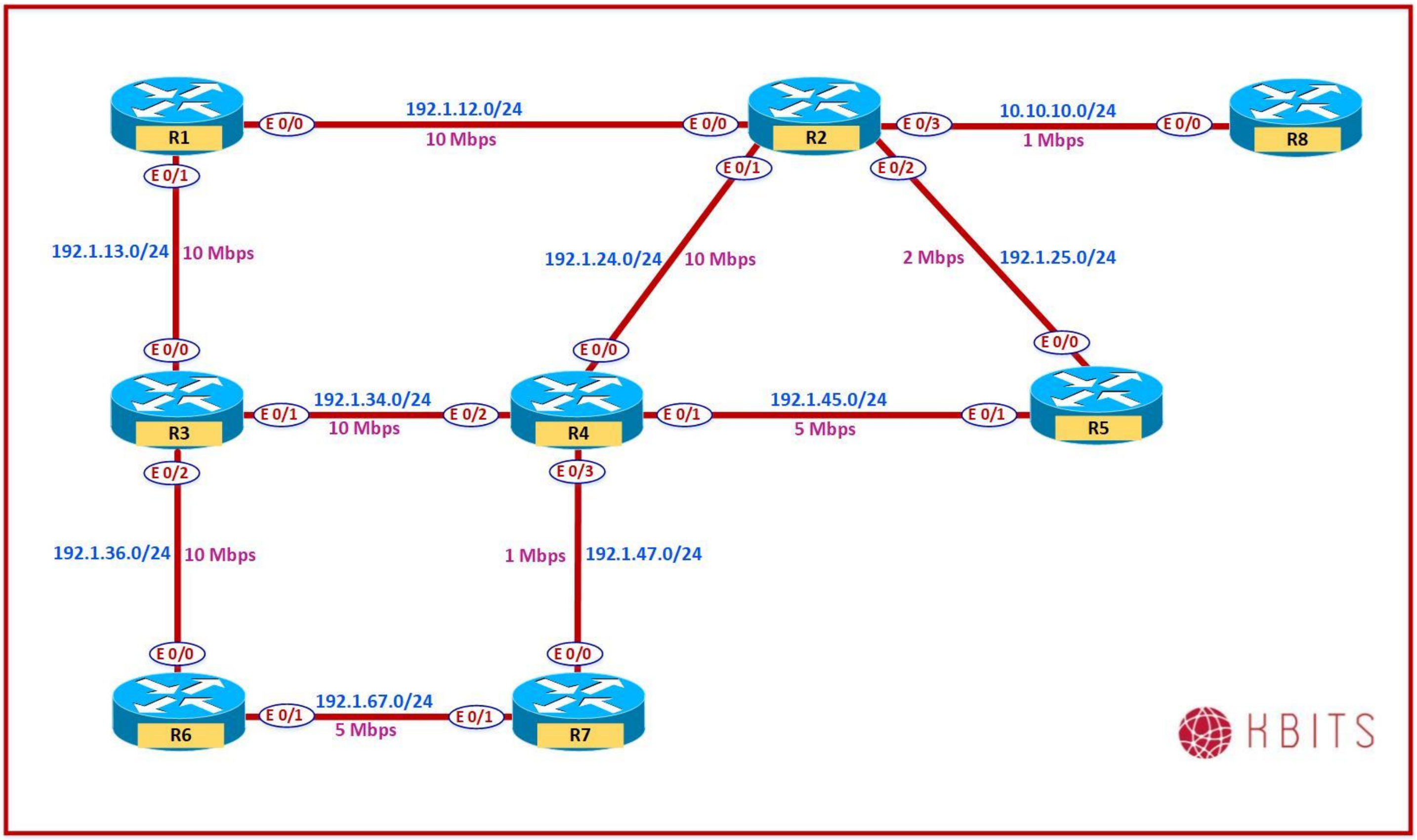
Task 4

Configure R6 such it does not send networks in the 176.1.0.0/16 major network range that have a mask greater than 20.

R6

```
ip prefix-list ABC deny 176.1.0.0/16 ge 21
ip prefix-list ABC permit 0.0.0.0/0 le 32
!
Router EIGRP 111
 distribute-list prefix ABC out
```

Lab 11 – Authenticating EIGRP Neighbors using MD5



Task 1

Configure MD5 authentication for all links between R1, R2, R3 & R4. Use Cisco@123 as the key-string with a key-id of 1.

R1

```
Key chain AUTH
 Key 1
  Key-string Cisco@123
!
Interface E 0/0
 Ip authentication key-chain eigrp 111 AUTH
 Ip authentication mode eigrp 111 MD5
!
Interface E 0/1
 Ip authentication key-chain eigrp 111 AUTH
 Ip authentication mode eigrp 111 MD5
```

R2

```
Key chain AUTH
 Key 1
  Key-string Cisco@123
!
Interface E 0/0
 Ip authentication key-chain eigrp 111 AUTH
 Ip authentication mode eigrp 111 MD5
!
Interface E 0/1
 Ip authentication key-chain eigrp 111 AUTH
 Ip authentication mode eigrp 111 MD5
```

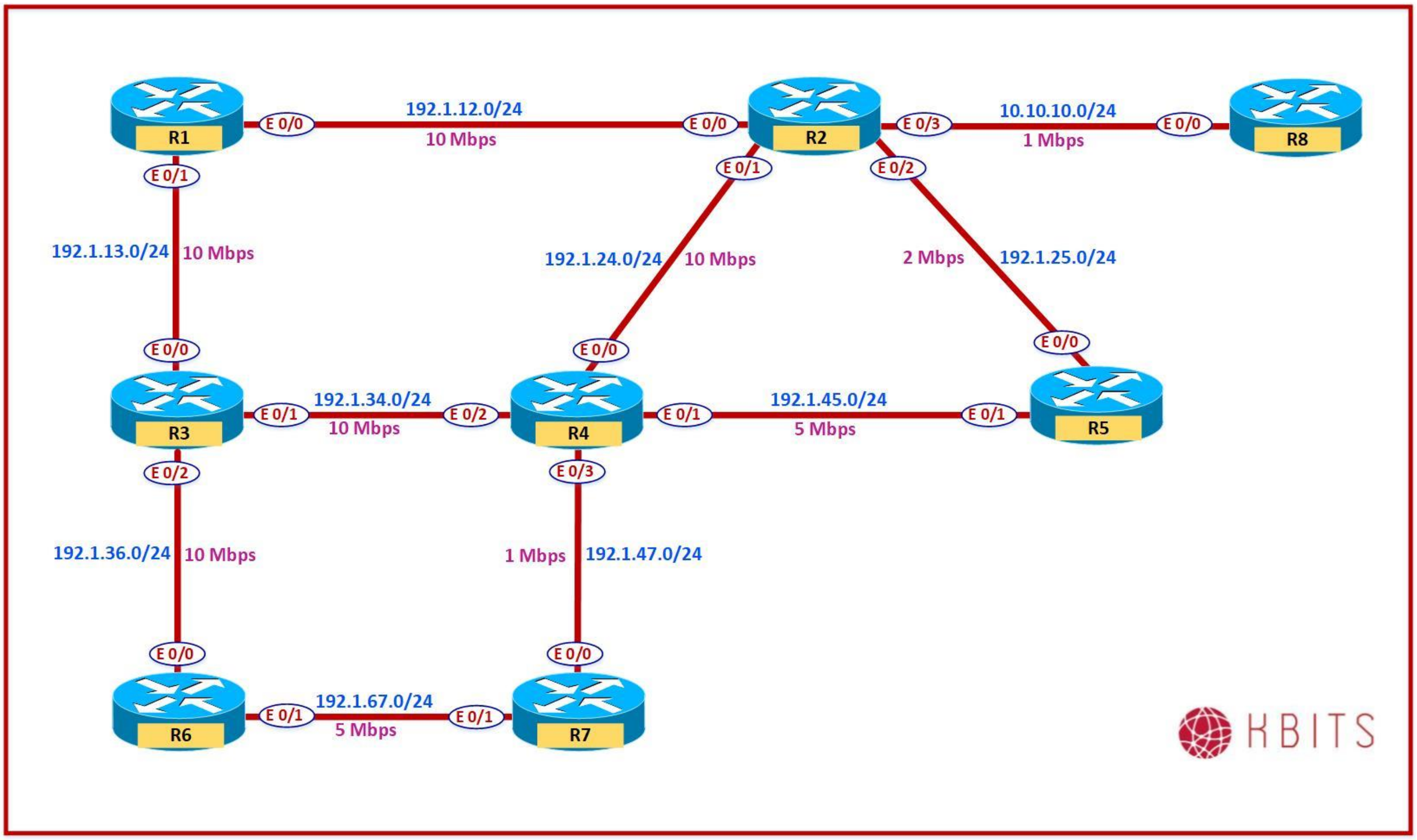
R3

```
Key chain AUTH
 Key 1
  Key-string Cisco@123
!
Interface E 0/0
 Ip authentication key-chain eigrp 111 AUTH
 Ip authentication mode eigrp 111 MD5
!
Interface E 0/1
 Ip authentication key-chain eigrp 111 AUTH
 Ip authentication mode eigrp 111 MD5
```

R4

```
Key chain AUTH
 Key 1
  Key-string Cisco@123
!
Interface E 0/0
 Ip authentication key-chain eigrp 111 AUTH
 Ip authentication mode eigrp 111 MD5
!
Interface E 0/2
 Ip authentication key-chain eigrp 111 AUTH
 Ip authentication mode eigrp 111 MD5
```

Lab 12 – Configuring a Basic Named Mode Configuration



Task 1 – Re-Configure R1, R2, R3, R4, R6 & R7 Using Named-Mode EIGRP.

- Re-configure EIGRP on the specified routers using EIGRP Named-Mode. Name the EIGRP process as KBITS. Continue to use AS as 111.
- Make sure to maintain the Summarization and Filtering Configurations previously configured on the Routers.
- Ignore configuring Neighbor Authentication as it will be done in a later lab.

R1
 	
No router eigrp 111
!
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
  network 101.0.0.0
  network 192.1.12.0
  network 192.1.13.0
  neighbor 192.1.12.2 Ethernet0/0
!
  af-interface default
   passive-interface default
!
 af-interface E0/0
   no passive-interface
   summary-address 101.1.4.0 255.255.252.0
!
 af-interface E0/1
   no passive-interface
   summary-address 101.1.4.0 255.255.252.0

R2
 	
No router eigrp 111
!
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
  network 10.1.4.0 0.0.0.255
  network 10.1.5.0 0.0.0.255
  network 10.1.6.0 0.0.0.255
  network 10.1.7.0 0.0.0.255
  network 10.10.10.0 0.0.0.255
  network 102.0.0.0
  network 192.1.12.0
  network 192.1.24.0
  network 192.1.25.0
  network 202.1.4.0
  network 202.1.5.0
  network 202.1.6.0
  network 202.1.7.0
  neighbor 192.1.12.1 Ethernet0/0
  neighbor 10.10.10.8 Ethernet0/3
!
 Topology base
  distribute-list 1 in Ethernet0/3

```
  distribute-list prefix ABC in Ethernet0/2
  variance 3
!
  af-interface default
   passive-interface default
!
 af-interface E0/0
   no passive-interface
   summary-address 10.1.4.0 255.255.252.0
   summary-address 102.1.4.0 255.255.252.0
   summary-address 202.1.4.0 255.255.252.0
!
 af-interface E0/1
   no passive-interface
   summary-address 10.1.4.0 255.255.252.0
   summary-address 102.1.4.0 255.255.252.0
   summary-address 202.1.4.0 255.255.252.0
!
 af-interface E0/2
   no passive-interface
   summary-address 10.1.4.0 255.255.252.0
   summary-address 102.1.4.0 255.255.252.0
   summary-address 202.1.4.0 255.255.252.0
!
 af-interface E0/3
   no passive-interface
   summary-address 10.1.4.0 255.255.252.0
   summary-address 102.1.4.0 255.255.252.0
   summary-address 202.1.4.0 255.255.252.0
```

R3

```
No router eigrp 111
!
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
  network 173.1.0.0
  network 192.1.13.0
  network 192.1.34.0
  network 192.1.36.0
  network 203.1.0.0 0.0.255.255
!
 Topology base
  distribute-list 1 out
!
 af-interface default
   passive-interface default
!
 af-interface E0/0
   no passive-interface
   summary-address 203.1.4.0 255.255.252.0
!
 af-interface E0/1
   no passive-interface
   summary-address 203.1.4.0 255.255.252.0
!
 af-interface E0/2
   no passive-interface
   summary-address 203.1.4.0 255.255.252.0
```

R4

```
No router eigrp 111
!
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
  network 104.1.0.0 0.0.255.255
  network 192.1.24.0
  network 192.1.34.0
  network 192.1.45.0
  network 192.1.47.0
!
 Topology base
  distribute-list prefix ABC in Ethernet0/1
!
 af-interface default
   passive-interface default
!
 af-interface E0/0
   no passive-interface
   summary-address 104.1.8.0 255.255.252.0
!
 af-interface E0/1
   no passive-interface
   summary-address 104.1.8.0 255.255.252.0
!
 af-interface E0/2
   no passive-interface
   summary-address 104.1.8.0 255.255.252.0
!
af-interface E0/3
   no passive-interface
   summary-address 104.1.8.0 255.255.252.0
```

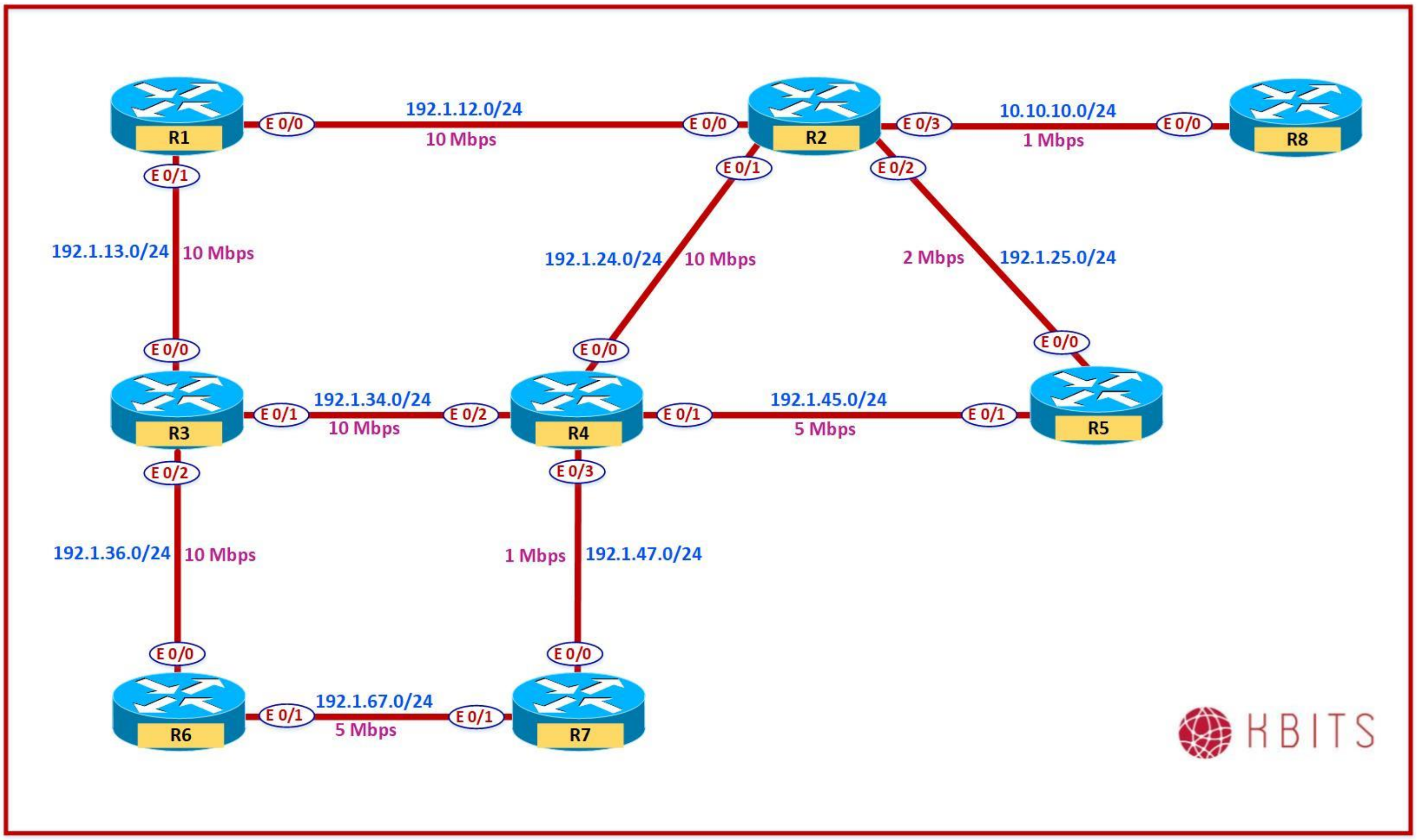
R6

```
No router eigrp 111
!
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
  network 101.1.0.0 0.0.255.255
  network 176.1.0.0
  network 192.1.36.0
  network 192.1.67.0
!
Topology base
  distribute-list prefix ABC out
!
af-interface default
   passive-interface default
!
af-interface E0/0
   no passive-interface
   summary-address 101.1.60.0 255.255.252.0
!
af-interface E0/1
   no passive-interface
   summary-address 101.1.60.0 255.255.252.0
```

R7

```
No router eigrp 111
!
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
  network 101.1.0.0 0.0.255.255
  network 192.1.47.0
  network 192.1.67.0
!
af-interface default
   passive-interface default
!
af-interface E0/0
   no passive-interface
   summary-address 101.1.72.0 255.255.252.0 leak-map LM
!
af-interface E0/1
   no passive-interface
   summary-address 101.1.72.0 255.255.252.0 leak-map LM
```

Lab 13 – Configuring Authentication - SHA



Task 1

Configure SHA authentication for all links between R1, R2, R3 & R4. Use Cisco@123 as the key-string.

R1

```
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
!
  Af-interface E 0/0
    authentication mode hmac-sha-256 Cisco@123
!
  Af-interface E 0/1
    authentication mode hmac-sha-256 Cisco@123
```

R2

```
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
!
  Af-interface E 0/0
    authentication mode hmac-sha-256 Cisco@123
!
  Af-interface E 0/1
    authentication mode hmac-sha-256 Cisco@123
```

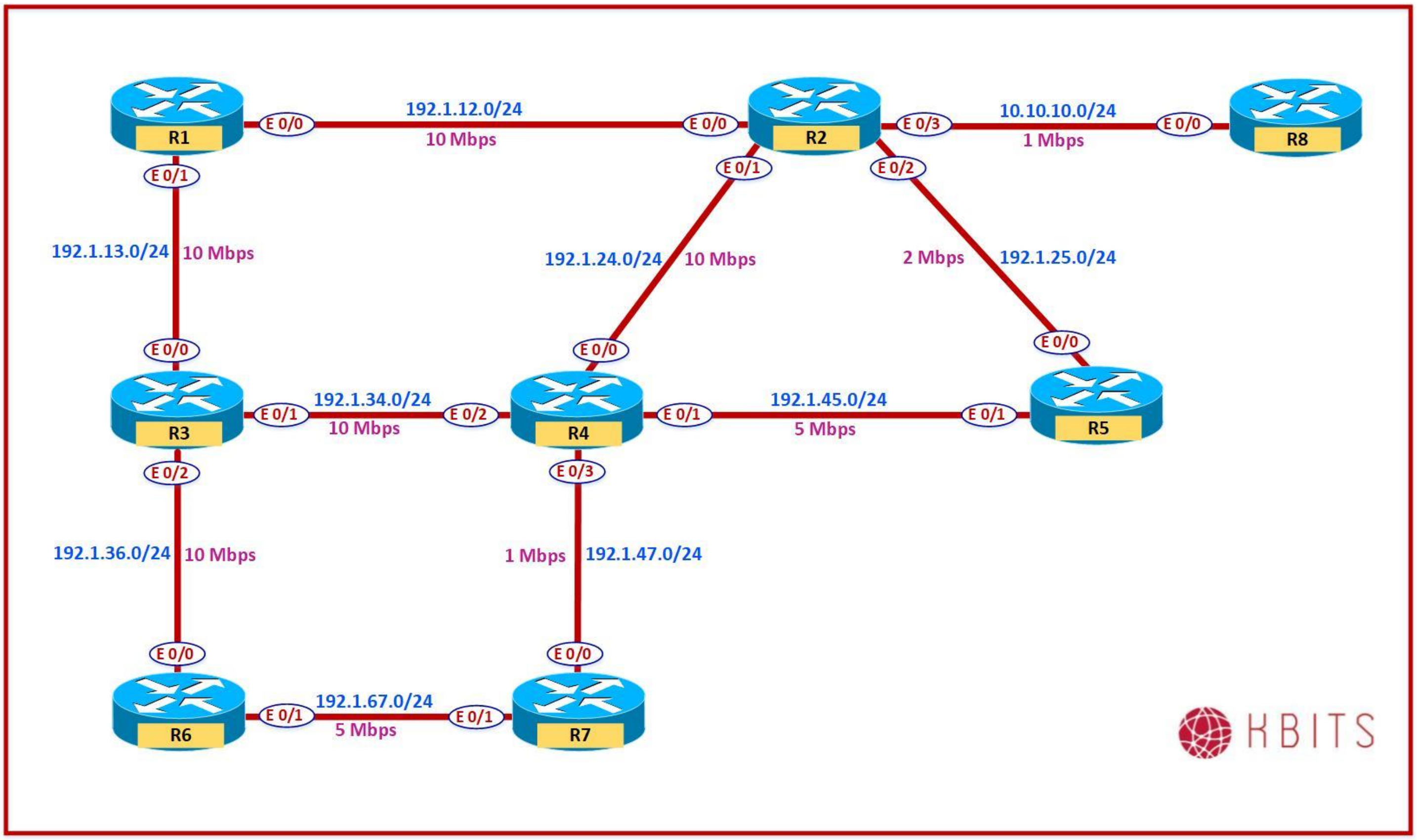
R3

```
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
!
  Af-interface E 0/0
    authentication mode hmac-sha-256 Cisco@123
!
  Af-interface E 0/1
    authentication mode hmac-sha-256 Cisco@123
```

R4

```
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
!
  Af-interface E 0/0
    authentication mode hmac-sha-256 Cisco@123
!
  Af-interface E 0/2
    authentication mode hmac-sha-256 Cisco@123
```

Lab 14 - Configuring Authentication – MD5



Task 1
Configure MD5 authentication between R4 & R7. Use a Key Chain name of R4R7 with a key string of 47 and a key string of Cisco@47.

R4

```
Key chain R4R7
 Key 47
  Key-string Cisco@47
!
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
!
  Af-interface E 0/3
    authentication mode md5
    authentication key-chain R4R7
```

R7

```
Key chain R4R7
 Key 47
  Key-string Cisco@47
!
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
!
  Af-interface E 0/0
    authentication mode md5
    authentication key-chain R4R7
```

Task 2
Configure MD5 authentication between R2 & R8. Use a Key Chain R2R8 with a key string of 28 and a key string of Cisco@28.

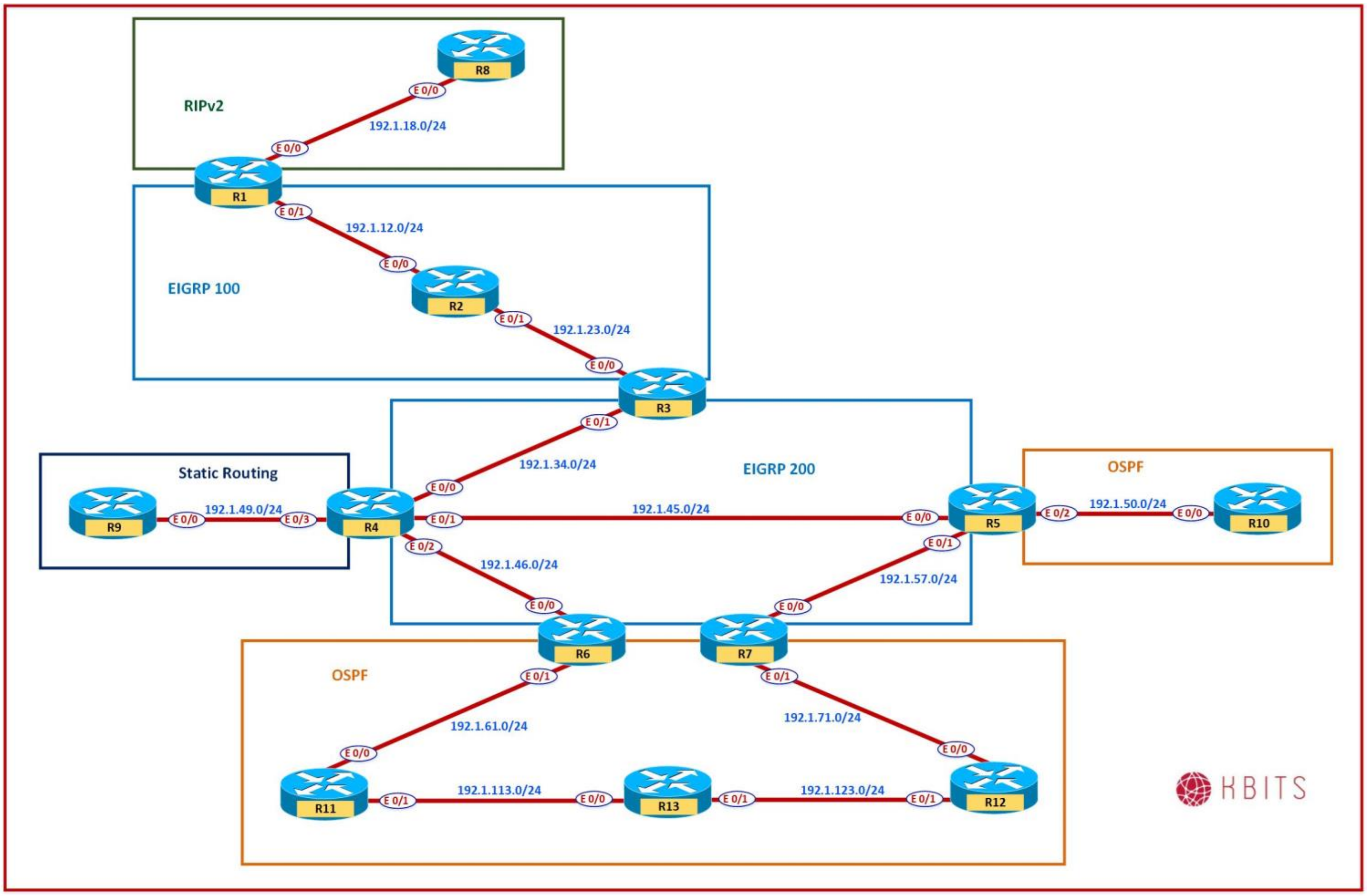
R2

```
Key chain R2R8
 Key 28
  Key-string Cisco@28
!
Router eigrp KBITS
 Address-family ipv4 autonomous-system 111
!
  Af-interface E 0/3
    authentication mode md5
    authentication key-chain R2R8
```

R8

```
Key chain R2R8
 Key 28
  Key-string Cisco@28
!
Router eigrp 111
 ip authentication mode eigrp 111 md5
 ip authentication key-chain eigrp 111 R4R7
```

Lab 15 – Configuring a Multi-Domain Network



Interface Configuration

R1

Interface	IP Address	Subnet Mask
E 0/0	192.1.12.1	255.255.255.0
E 0/1	192.1.18.1	255.255.255.0
Loopback1	201.1.4.1	255.255.255.0
Loopback2	201.1.5.1	255.255.255.0
Loopback3	201.1.6.1	255.255.255.0
Loopback4	201.1.7.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.23.2	255.255.255.0
Loopback1	202.1.4.1	255.255.255.0
Loopback2	202.1.5.1	255.255.255.0
Loopback3	202.1.6.1	255.255.255.0
Loopback4	202.1.7.1	255.255.255.0

R3

Interface	IP Address	Subnet Mask
E 0/0	192.1.23.3	255.255.255.0
E 0/1	192.1.34.3	255.255.255.0
Loopback1	203.1.4.1	255.255.255.0
Loopback2	203.1.5.1	255.255.255.0
Loopback3	203.1.6.1	255.255.255.0
Loopback4	203.1.7.1	255.255.255.0
Loopback5	10.1.32.1	255.255.255.0
Loopback6	10.1.33.1	255.255.255.0
Loopback7	10.1.34.1	255.255.255.0
Loopback8	10.1.35.1	255.255.255.0

R4

Interface	IP Address	Subnet Mask
E 0/0	192.1.34.4	255.255.255.0
E 0/1	192.1.45.4	255.255.255.0
E 0/2	192.1.46.4	255.255.255.0
E 0/3	192.1.49.4	255.255.255.0
Loopback1	204.1.4.1	255.255.255.0
Loopback2	204.1.5.1	255.255.255.0
Loopback3	204.1.6.1	255.255.255.0
Loopback4	204.1.7.1	255.255.255.0

R5

Interface	IP Address	Subnet Mask
E 0/0	192.1.45.5	255.255.255.0
E 0/1	192.1.57.5	255.255.255.0
E 0/2	192.1.50.5	255.255.255.0
Loopback1	205.1.4.1	255.255.255.0
Loopback2	205.1.5.1	255.255.255.0
Loopback3	205.1.6.1	255.255.255.0
Loopback4	205.1.7.1	255.255.255.0
Loopback5	10.1.56.1	255.255.255.0
Loopback6	10.1.57.1	255.255.255.0
Loopback7	10.1.58.1	255.255.255.0
Loopback8	10.1.59.1	255.255.255.0

R6

Interface	IP Address	Subnet Mask
E 0/0	192.1.46.6	255.255.255.0
E 0/1	192.1.61.6	255.255.255.0
Loopback1	206.1.4.1	255.255.255.0
Loopback2	206.1.5.1	255.255.255.0
Loopback3	206.1.6.1	255.255.255.0
Loopback4	206.1.7.1	255.255.255.0
Loopback5	10.1.60.1	255.255.255.0
Loopback6	10.1.61.1	255.255.255.0
Loopback7	10.1.62.1	255.255.255.0
Loopback8	10.1.63.1	255.255.255.0

R7

Interface	IP Address	Subnet Mask
E 0/0	192.1.57.7	255.255.255.0
E 0/1	192.1.71.7	255.255.255.0
Loopback1	207.1.4.1	255.255.255.0
Loopback2	207.1.5.1	255.255.255.0
Loopback3	207.1.6.1	255.255.255.0
Loopback4	207.1.7.1	255.255.255.0
Loopback5	10.1.72.1	255.255.255.0
Loopback6	10.1.73.1	255.255.255.0
Loopback7	10.1.74.1	255.255.255.0
Loopback8	10.1.75.1	255.255.255.0

R8

Interface	IP Address	Subnet Mask
E 0/0	192.1.18.8	255.255.255.0
Loopback1	10.1.80.1	255.255.255.0
Loopback2	10.1.81.1	255.255.255.0
Loopback3	10.1.82.1	255.255.255.0
Loopback4	10.1.83.1	255.255.255.0

R9

Interface	IP Address	Subnet Mask
E 0/0	192.1.49.9	255.255.255.0
Loopback1	10.1.96.1	255.255.255.0
Loopback2	10.1.97.1	255.255.255.0
Loopback3	10.1.98.1	255.255.255.0
Loopback4	10.1.99.1	255.255.255.0

R10

Interface	IP Address	Subnet Mask
E 0/0	192.1.50.10	255.255.255.0
Loopback1	101.1.100.1	255.255.255.0
Loopback2	101.1.101.1	255.255.255.0
Loopback3	101.1.102.1	255.255.255.0
Loopback4	101.1.103.1	255.255.255.0

R11

Interface	IP Address	Subnet Mask
E 0/0	192.1.61.11	255.255.255.0
E 0/1	192.1.113.11	255.255.255.0
Loopback1	10.1.112.1	255.255.255.0
Loopback2	10.1.113.1	255.255.255.0
Loopback3	10.1.114.1	255.255.255.0
Loopback4	10.1.115.1	255.255.255.0

R12

Interface	IP Address	Subnet Mask
E 0/0	192.1.71.12	255.255.255.0
E 0/1	192.1.123.12	255.255.255.0
Loopback1	10.1.120.1	255.255.255.0
Loopback2	10.1.121.1	255.255.255.0
Loopback3	10.1.122.1	255.255.255.0
Loopback4	10.1.123.1	255.255.255.0

R13

Interface	IP Address	Subnet Mask
E 0/0	192.1.113.13	255.255.255.0
E 0/1	192.1.123.13	255.255.255.0
Loopback1	10.1.132.1	255.255.255.0
Loopback2	10.1.133.1	255.255.255.0
Loopback3	10.1.134.1	255.255.255.0
Loopback4	10.1.135.1	255.255.255.0

Task 1 – Configure RIPv2 between R1 & R8.

- Run RIPv2 between R1 & R8.
- Enable all interfaces on R8 under RIPv2.
- Enable all interfaces on R1 under RIPv2 except the R1-R2 link (192.1.12.0/24 Network).
- Disable Auto-summary for both routers.

R1

```
router rip
 version 2
 no auto-summary
 network 192.1.18.0
 network 201.1.4.0
 network 201.1.5.0
 network 201.1.6.0
 network 201.1.7.0
```

R8

```
router rip
 version 2
 no auto-summary
 network 192.1.18.0
```

```
network network 10.0.0.0
```

Task 2 – Configure EIGRP 100 between R1, R2 & R3.

- Run EIGRP 100 between R1, R2 & R3.
- Enable the R1-R2 link in EIGRP 100 on R1.
- Enable all interface on R2 under EIGRP 100.
- Enable the R2-R3 link and all the 10.0.0.0/8 subnets on R3 under EIGRP 100.

R1

```
router eigrp 100
 network 192.1.12.0
```

R2

```
router eigrp 100
 network 192.1.12.0
 network 192.1.23.0
 network 202.1.4.0
 network 202.1.5.0
 network 202.1.6.0
 network 202.1.7.0
```

R3

```
router eigrp 100
 network 192.1.23.0
 network 10.0.0.0
```

Task 3 – Configure EIGRP 200 between R3, R4, R5, R6 & R7.

- Run EIGRP 200 between R3, R4, R5, R6 & R7.
- Enable the R3-R4 link & the 203.1.X.0/24 networks in EIGRP 200 on R3.
- Enable all interface on R4 under EIGRP 200 expext the R4-R9 Link. Enable Passive-interface on all interfaces except on E0/0, E0/1 & E0/2.
- Enable the R4-R5 & R5-R7 link and all the 10.0.0.0/8 subnets on R5 under EIGRP 200.
- Enable the R4-R6 link and all the 10.0.0.0/8 subnets on R6 under EIGRP 200.
- Enable the R5-R7 link and all the 10.0.0.0/8 subnets on R7 under EIGRP 200.

R3

```
router eigrp 100
 network 192.1.34.0
 network 203.1.4.0
 network 203.1.5.0
 network 203.1.6.0
 network 203.1.7.0
```

R4

```
router eigrp 200
 network 192.1.34.0
 network 192.1.45.0
 network 192.1.46.0
 network 204.1.4.0
 network 204.1.5.0
 network 204.1.6.0
 network 204.1.7.0
 passive-interface default
 no passive-interface E0/0
 no passive-interface E0/1
 no passive-interface E0/2
```

R5

```
router eigrp 200
 network 192.1.45.0
 network 192.1.57.0
 network 10.0.0.0
```

R6

```
router eigrp 200
 network 192.1.46.0
 network 10.0.0.0
```

R7

```
router eigrp 200
 network 192.1.57.0
 network 10.0.0.0
```

Task 4 – Configure Static Routing between R4 & R9.

- Configure a default route on R9 pointing towards R4.
- Create static routes on R4 for the R9 Loopback networks using R9 as the next-hop.

R4

```
Ip route 10.1.96.0 255.255.255.0 192.1.49.9
Ip route 10.1.97.0 255.255.255.0 192.1.49.9
Ip route 10.1.98.0 255.255.255.0 192.1.49.9
Ip route 10.1.99.0 255.255.255.0 192.1.49.9
```

R9

```
 Ip route 0.0.0.0 0.0.0.0 192.1.49.4
```

Task 5 – Configure OSPF in Area 0 between R5 & R10.

- Configure all interfaces on R10 under OSPF in Area 0.
- Configure the R5-R10 Link and the 205.1.X.0/24 networks on R5 under OSPF in Area 0.

R5 Router ospf 1 Router-id 0.0.0.5 Network 192.1.50.0 0.0.0.255 area 0 Network 205.1.4.0 0.0.0.255 area 0 Network 205.1.5.0 0.0.0.255 area 0 Network 205.1.6.0 0.0.0.255 area 0 Network 205.1.7.0 0.0.0.255 area 0
R10 Router ospf 1 Router-id 0.0.0.10 Network 192.1.50.0 0.0.0.255 area 0 Network 10.1.0.0 0.0.255.255 area 0

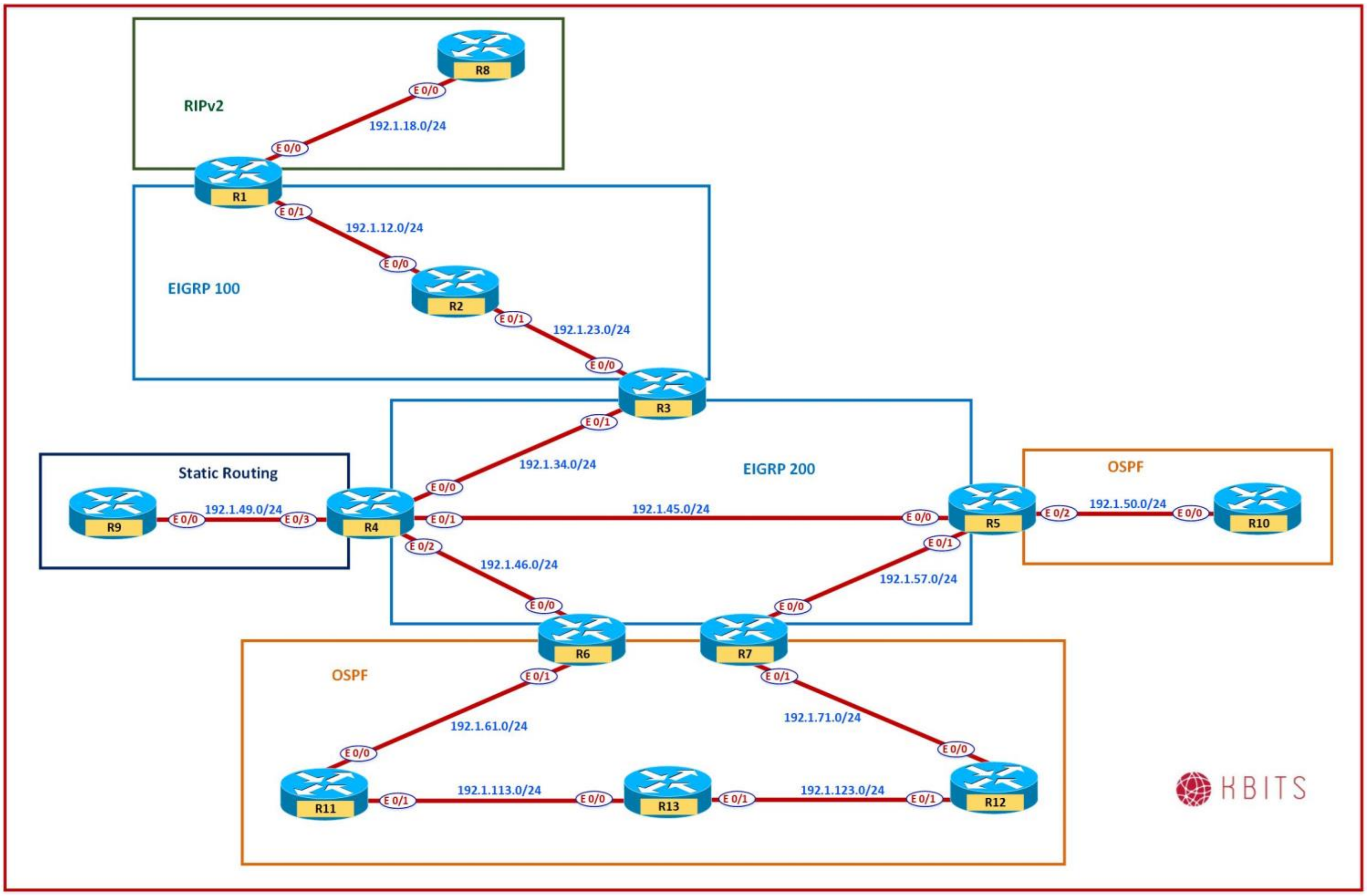
Task 6 – Configure OSPF in Area 0 between R6, R7, R11, R12 & R13.

- Configure the R6-R11 Link and the 206.1.X.0/24 networks on R6 under OSPF in Area 0.
- Configure all interfaces on R11 under OSPF in Area 0.
- Configure all interfaces on R12 under OSPF in Area 0.
- Configure all interfaces on R13 under OSPF in Area 0.
- Configure the R7-R12 Link and the 207.1.X.0/24 networks on R7 under OSPF in Area 0.

R6 Router ospf 1 Router-id 0.0.0.6 Network 192.1.61.0 0.0.0.255 area 0 Network 206.1.4.0 0.0.0.255 area 0 Network 206.1.5.0 0.0.0.255 area 0 Network 206.1.6.0 0.0.0.255 area 0 Network 206.1.7.0 0.0.0.255 area 0
R7 Router ospf 1 Router-id 0.0.0.7

Network 192.1.71.0 0.0.0.255 area 0 Network 207.1.4.0 0.0.0.255 area 0 Network 207.1.5.0 0.0.0.255 area 0 Network 207.1.6.0 0.0.0.255 area 0 Network 207.1.7.0 0.0.0.255 area 0
R11 Router ospf 1 Router-id 0.0.0.11 Network 192.1.61.0 0.0.0.255 area 0 Network 192.1.113.0 0.0.0.255 area 0 Network 10.1.0.0 0.0.255.255 area 0
R12 Router ospf 1 Router-id 0.0.0.12 Network 192.1.71.0 0.0.0.255 area 0 Network 192.1.123.0 0.0.0.255 area 0 Network 10.1.0.0 0.0.255.255 area 0
R13 Router ospf 1 Router-id 0.0.0.13 Network 192.1.113.0 0.0.0.255 area 0 Network 192.1.123.0 0.0.0.255 area 0 Network 10.1.0.0 0.0.255.255 area 0

Lab 16 – Redistrubuting Connected & Static Routes



Task 1

You would like to provide reachability between the Static Routing and EIGRP 200 domains. Configure Route Redistribution of Static Routes on R4. R9 is already configured with a Default Route towards R4.

```
R4

Router eigrp 200
 Redistribute static
```

Verification:

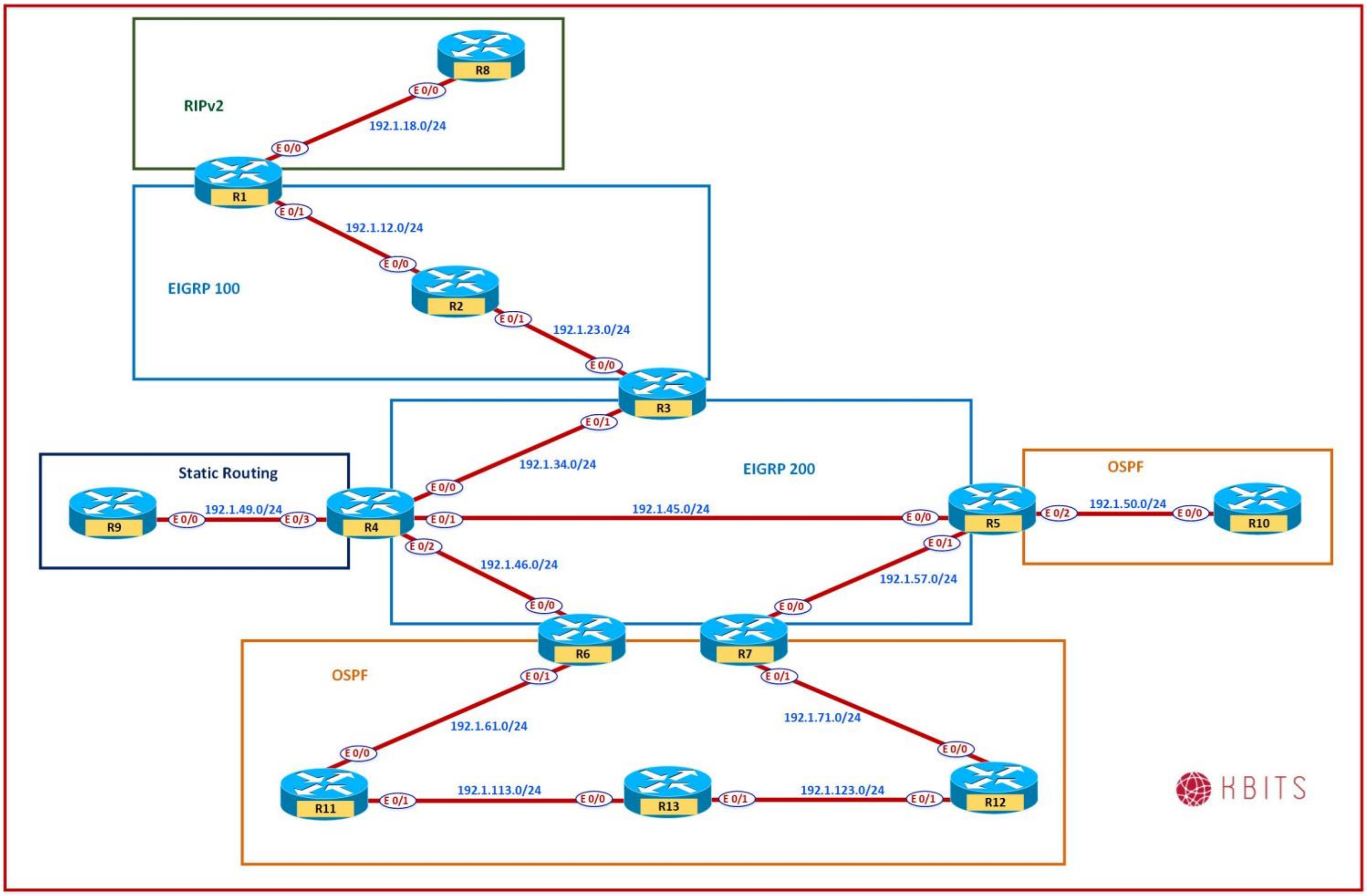
- Try Pinging 10.1.96.1 (R9's Loopback) from R5. Are you successful?

- Try Pinging 192.1.49.9 (R9's E0/0 IP) from R5. Are you successful?
- The reason is that 192.1.49.0/24 is a directly connected interface on R4. It is not enabled in EIGRP on R4. Redistribute Static does not include the Connected Route.
- Redistribute the connected route into EIGRP. Make sure to only redistribute the R4-R9 directly connected Interface.

R4

```
Route-map RC
 Match interface E0/3
!
Router eigrp 200
 Redistribute connected route-map RC
```

Lab 17 - Redistributing between RIP & EIGRP



Task 1

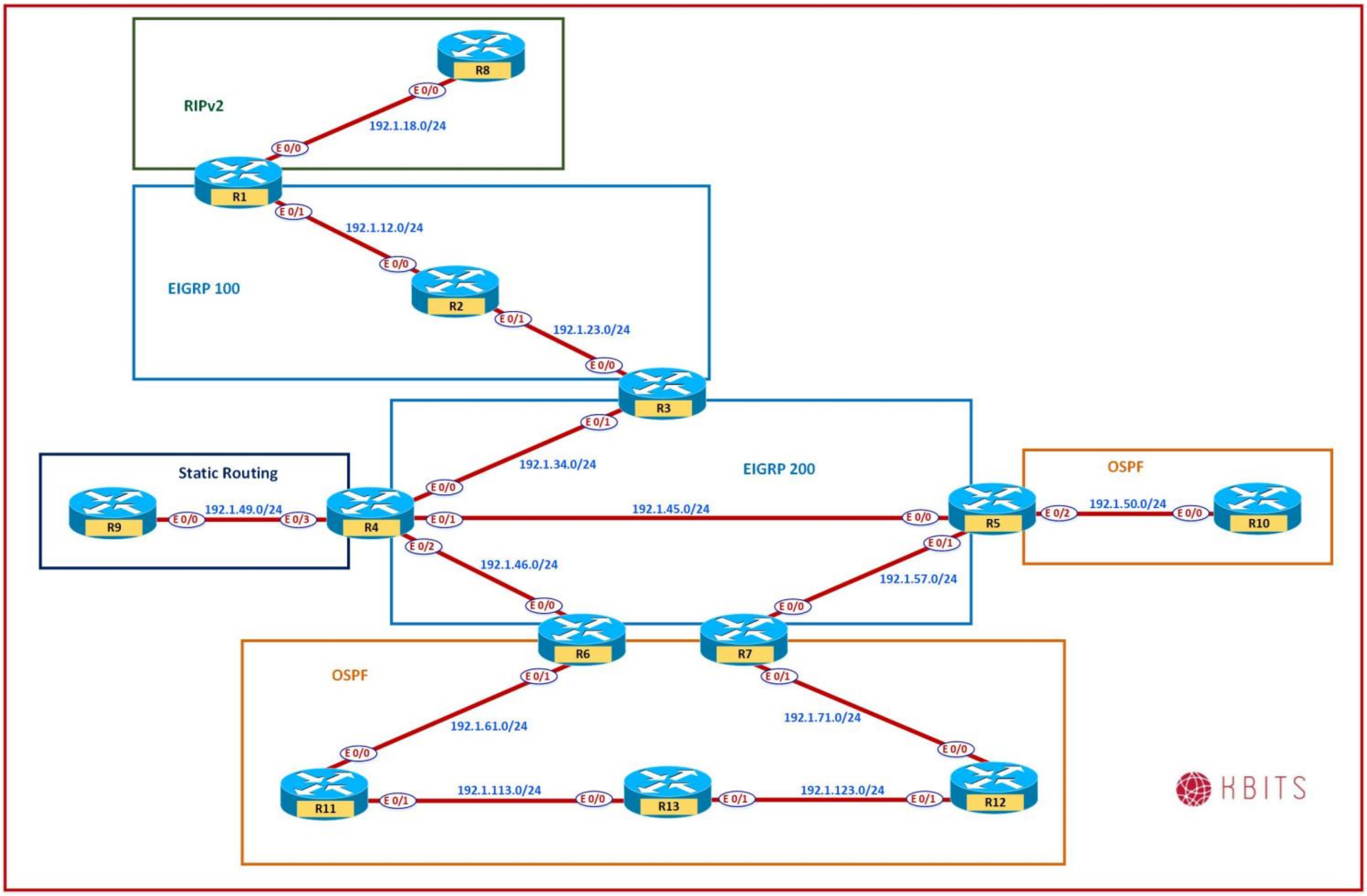
You would like to provide reachability between the RIPv2 and EIGRP 100 domains. Configure Mutual Route Redistribution of RIPv2 & EIGRP on R1. Use a metric of your choice.

R1

```
Router eigrp 100
 Redistribute rip metric 10000 1000 255 1 1500
!
Router rip
 Redistribute eigrp 100 metric 1

OR
```

```
Router eigrp 100
 Redistribute rip
 Default-metric 10000 1000 255 1 1500
!
Router rip
 Redistribute eigrp 100
 Default-metric 1
```

Lab 18 - Redistributing between 2 different EIGRP Autonomous-Systems



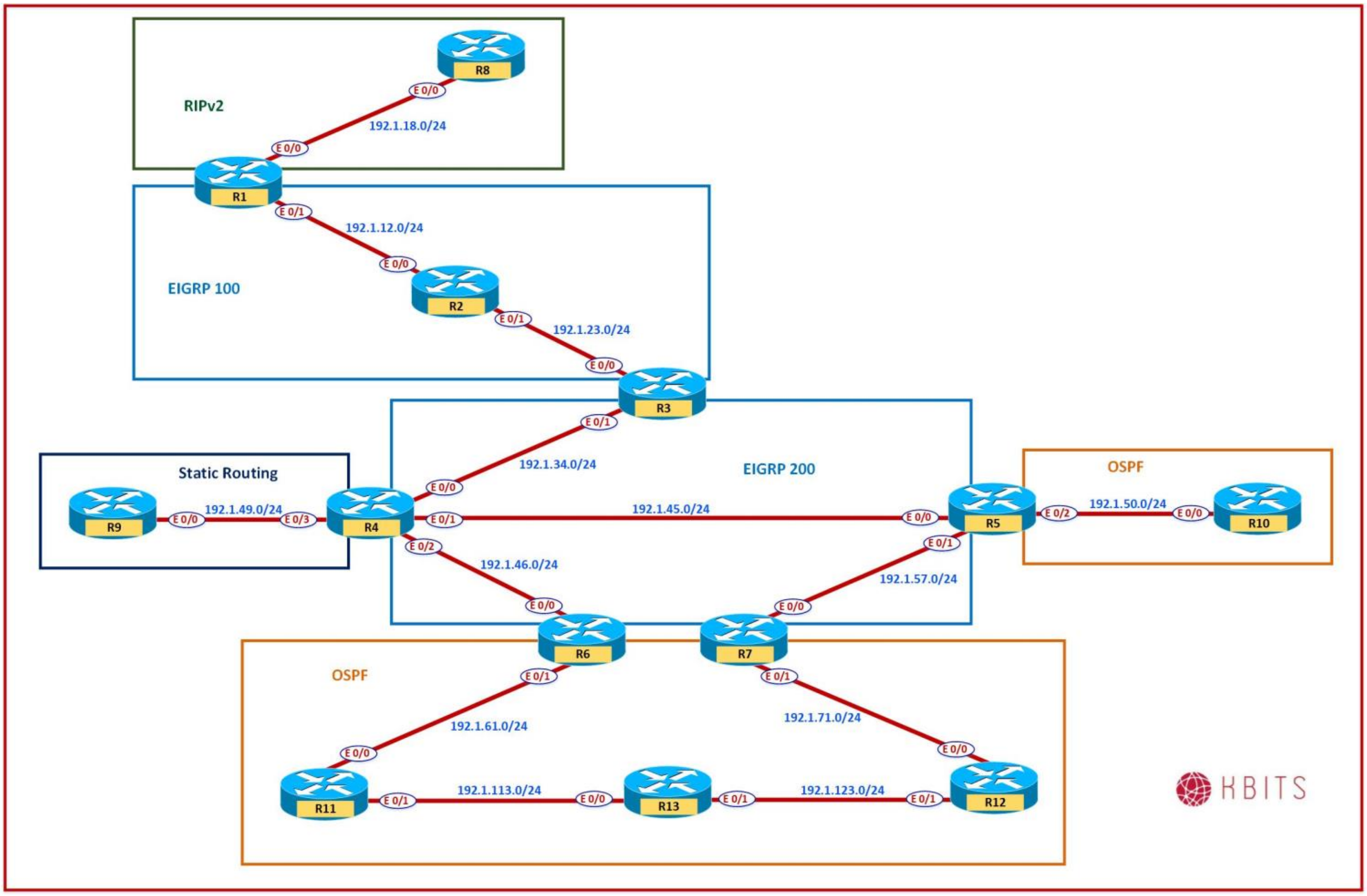
Task 1

You would like to provide reachability between the EIGRP 100 and EIGRP 200 domains. Configure Mutual Route Redistribution on R3 to redistribute between the 2 domains.

R3

```
Router eigrp 100
 Redistribute eigrp 200
!
Router eigrp 200
 Redistribute eigrp 100
```

Lab 19 - Redistributing between OSPF & EIGRP



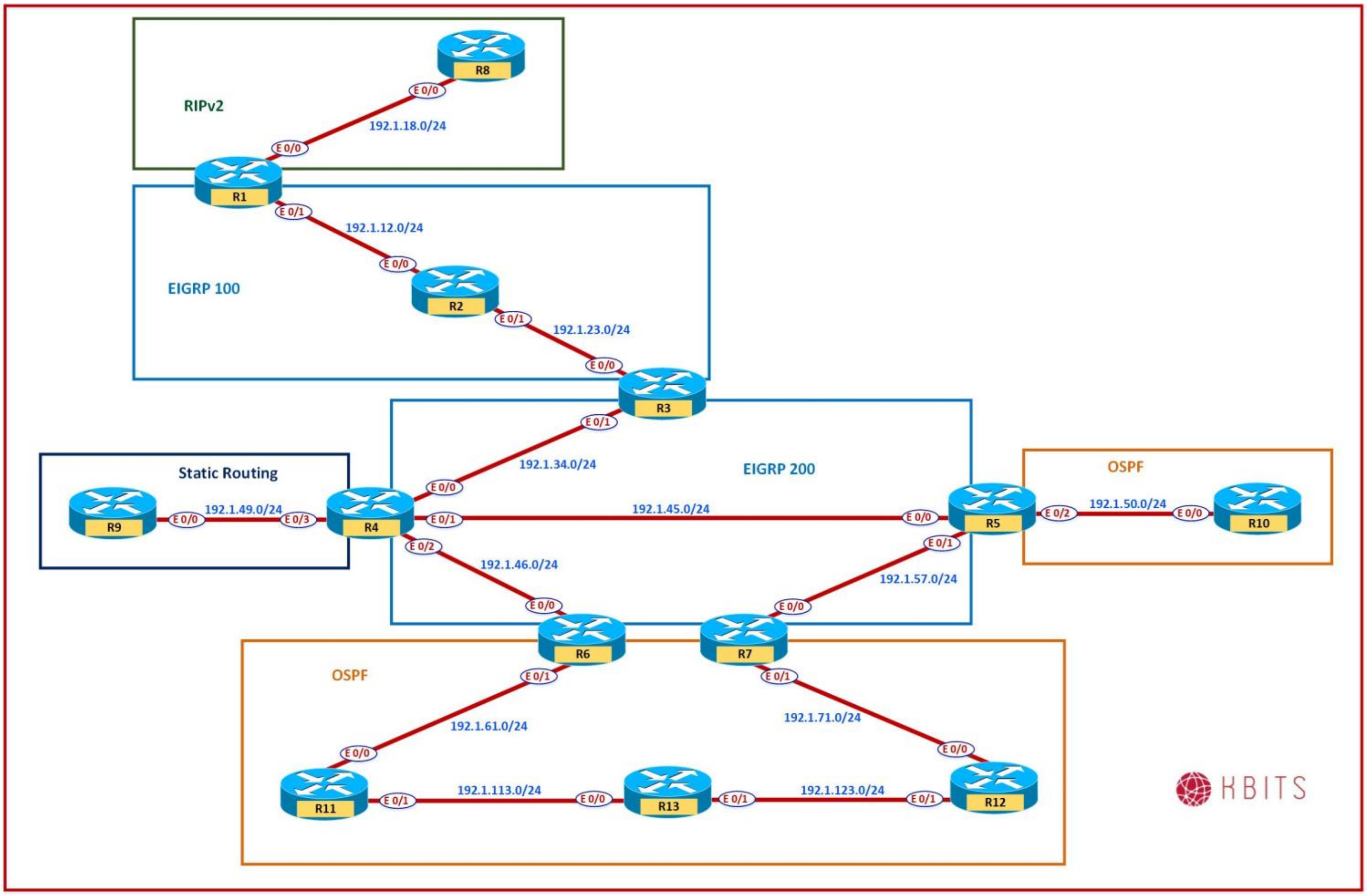
Task 1

You would like to provide reachability between the EIGRP 200 and OSPF by performing redistribution on R5. We will look at the redistribution for the bigger OSPF domain in a later lab.

R5

```
Router eigrp 200
 Redistribute ospf 1 metric 10 10 10 10 10
!
Router ospf 1
 Redistribute eigrp 200
```

Lab 20 – Redistribution with Route Filtering



Task 1

Networks 202.1.4.0/24 & 202.1.6.0/24 networks should not be redistributed into EIGRP 200. Re-configure Redistribution on R3 to fullfil the requirement.

R3

```
Access-list 1 deny 202.1.4.0 0.0.0.255
Access-list 1 deny 202.1.6.0 0.0.0.255
Access-list 1 permit any
!
Route-map E2E
 Match ip address 1
!
Router eigrp 200
```

```
 Redistribute eigrp 100 route-map E2E
```

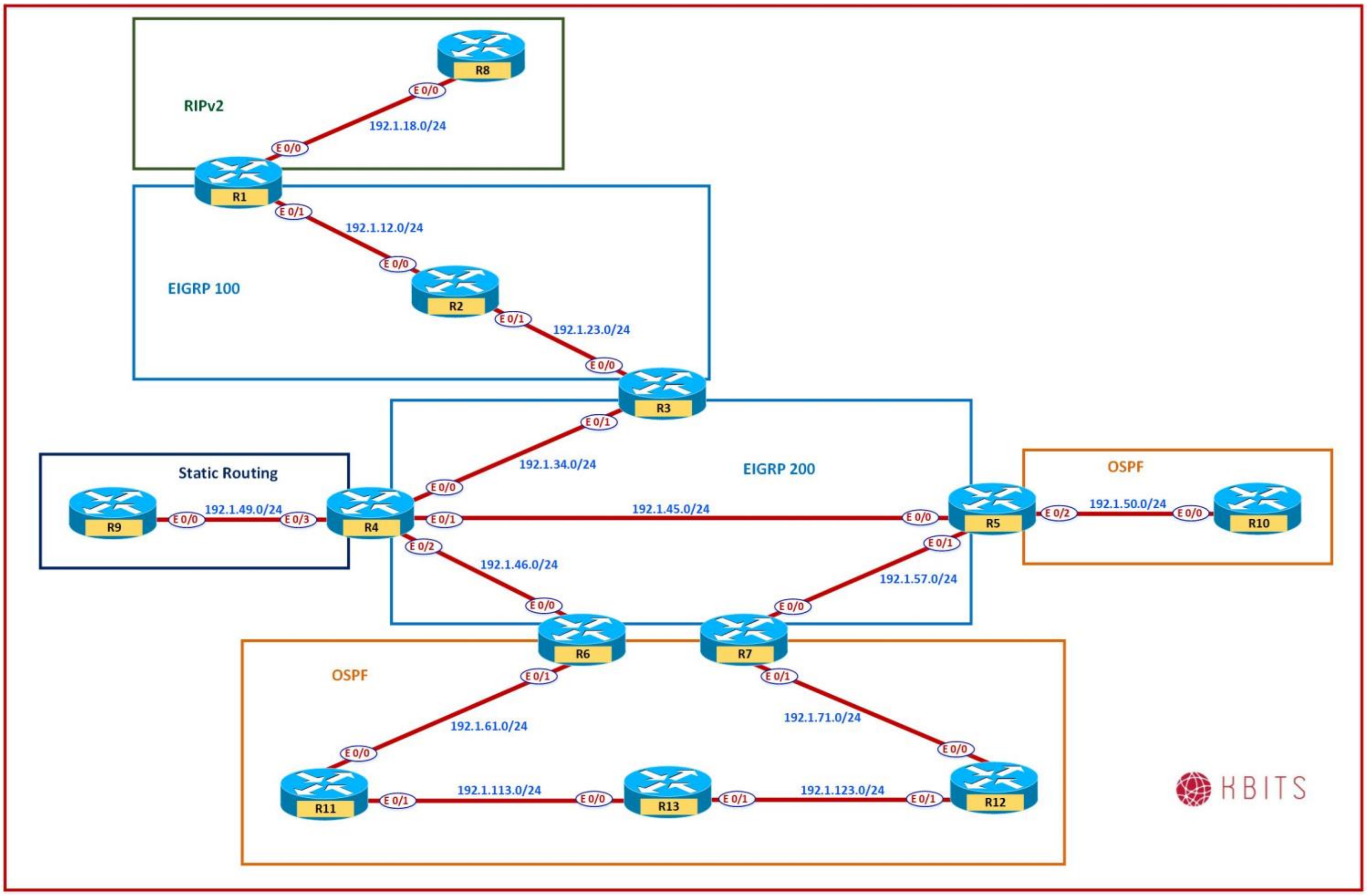
Task 2

Networks 10.1.97.0/24 & 10.1.98.0/24 networks should not be redistributed into EIGRP 200. Re-configure Redistribution on R4 to fullfil the requirement.

R4

```
Ip prefix-list PL1 deny 10.1.97.0/24
Ip prefix-list PL1 deny 10.1.98.0/24
Ip prefix-list PL1 permit 0.0.0.0/0 le 32
!
Route-map S2E
 Match ip address prefix PL1
!
Router eigrp 200
 Redistribute static route-map S2E
```

Lab 21 – Redistribution with Route Tagging



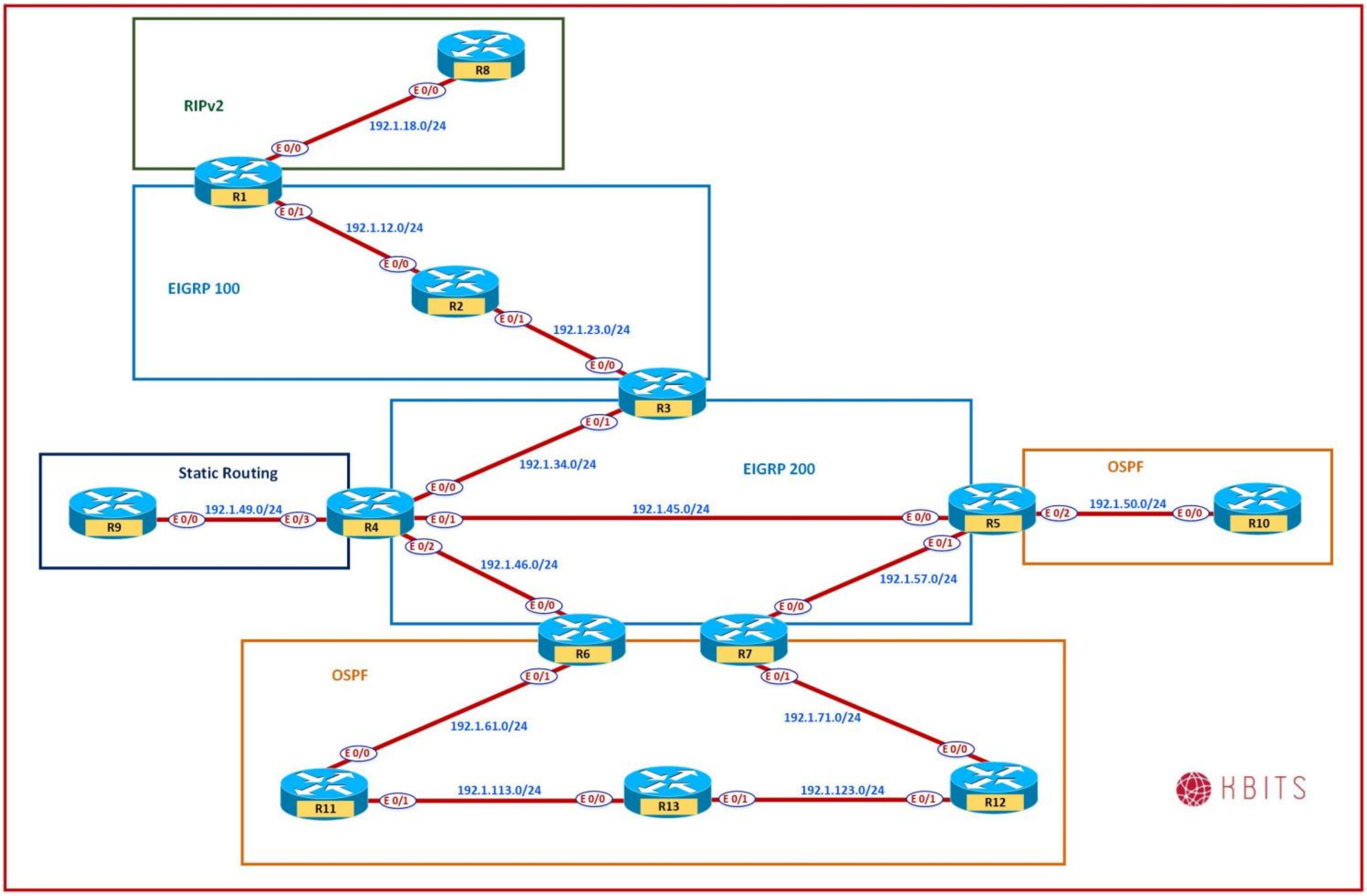
Task 1

You are required to block the RIPv2 routes from propagating into the OSPF domain connected to R5 and vice-versa. Use a Mechanism that ensures that if new routes are added into the RIP or OSPF domains, they continue to get blocked from propagating to each other without having to do any further configurations.

Blocking RIP to OSPF
R1 Route-map R2E Set tag 123 ! Router eigrp 100

Redistribute rip metric 1000 100 255 1 1500 route-map R2E
R5 Route-map E2O deny 10 Match tag 123 Route-map E2O permit 20 ! Router ospf 1 Redistribute eigrp 200 route-map E2O
Blocking OSPF to RIP
R5 Route-map O2E Set tag 456 ! Router eigrp 200 Redistribute ospf 1 metric 10 10 10 10 10 route-map O2E
R1 Route-map E2R deny 10 Match tag 456 Route-map E2R permit 20 ! Router rip Redistribute eigrp 100 route-map E2R

Lab 22 – Multi-Point Redistribution with Route Tagging



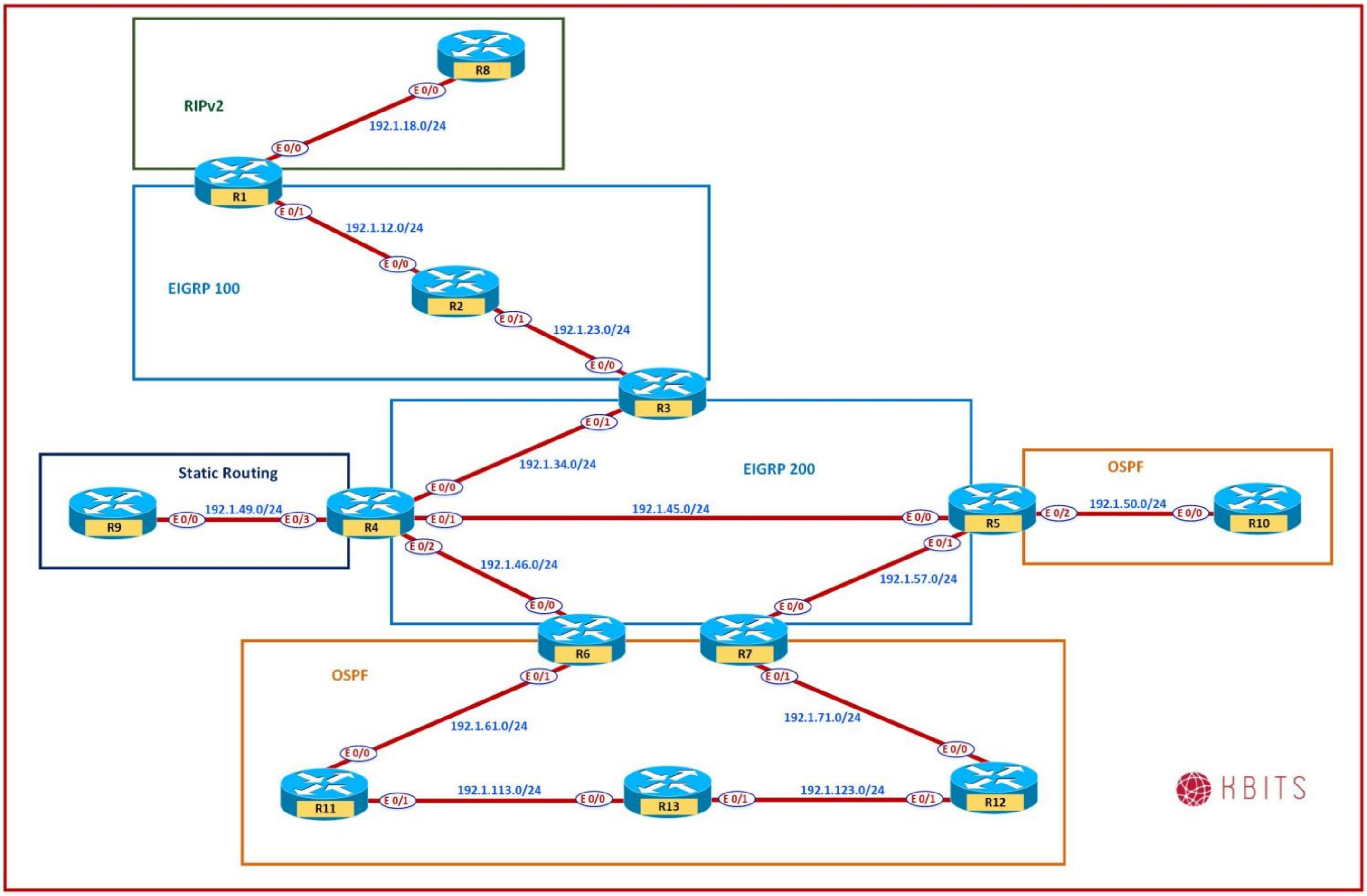
Task 1

EIGRP 200 & OSPF (Southbound) need to redundancy with Redistribution. Redistribution needs to be configured on R6 & R7. R6 should be the preferred router to connect the 2 domains. Make sure that the routes are blocked from coming back into the Source Domain.

Route-Maps to Block EIGRP Routes coming back into OSPF
R6 Route-map E2O permit 20 Set tag 111 ! Route-map O2E deny 10 Match tag 222

R7 Route-map E2O permit 20 Set tag 222 ! Route-map O2E deny 10 Match tag 111
Route-Maps to Block OSPF Routes coming back into EIGRP
R6 Route-map O2E permit 20 Set tag 333 ! Route-map E2O deny 10 Match tag 444
R7 Route-map E2O deny 10 Match tag 333 ! Route-map O2E permit 20 Set tag 444
Redistribute Commands
R6 Router eigrp 200 Redistribute ospf 1 metric 1000 100 255 1 1500 route-map O2E ! Router ospf 1 Redistribute eigrp 200 metric 20 route-map E2O
R7 Router eigrp 200 Redistribute ospf 1 metric 500 500 255 1 1500 route-map O2E ! Router ospf 1 Redistribute eigrp 200 metric 30 route-map E2O

Lab 23 – Configuring BFD for EIGRP



Task 1 – Configure BFD in AS 200

Configure routers in EIGRP in AS 200 such that all neighbor down events are detected in a Sub-second times to optimize reconvergence of a network. Use a BFD Hello Interval of 300 msec. The dead time should be 3 times the Hello Interval.

R3

```
interface Ethernet0/1
 bfd interval 300 min_rx 300 multiplier 3
!
Router eigrp 200
 Bfd interface e 0/1
```

R4

interface Ethernet0/0 bfd interval 300 min_rx 300 multiplier 3 ! interface Ethernet0/1 bfd interval 300 min_rx 300 multiplier 3 ! interface Ethernet0/2 bfd interval 300 min_rx 300 multiplier 3 ! Router eigrp 200 Bfd all-interface
R5 interface Ethernet0/0 bfd interval 300 min_rx 300 multiplier 3 ! interface Ethernet0/1 bfd interval 300 min_rx 300 multiplier 3 ! Router eigrp 200 Bfd all-interface
R6 interface Ethernet0/0 bfd interval 300 min_rx 300 multiplier 3 ! Router eigrp 200 Bfd interface E0/0
R7 interface Ethernet0/0 bfd interval 300 min_rx 300 multiplier 3 ! Router eigrp 200 Bfd interface E0/0

Configuring OSPF for IPv4 Networks

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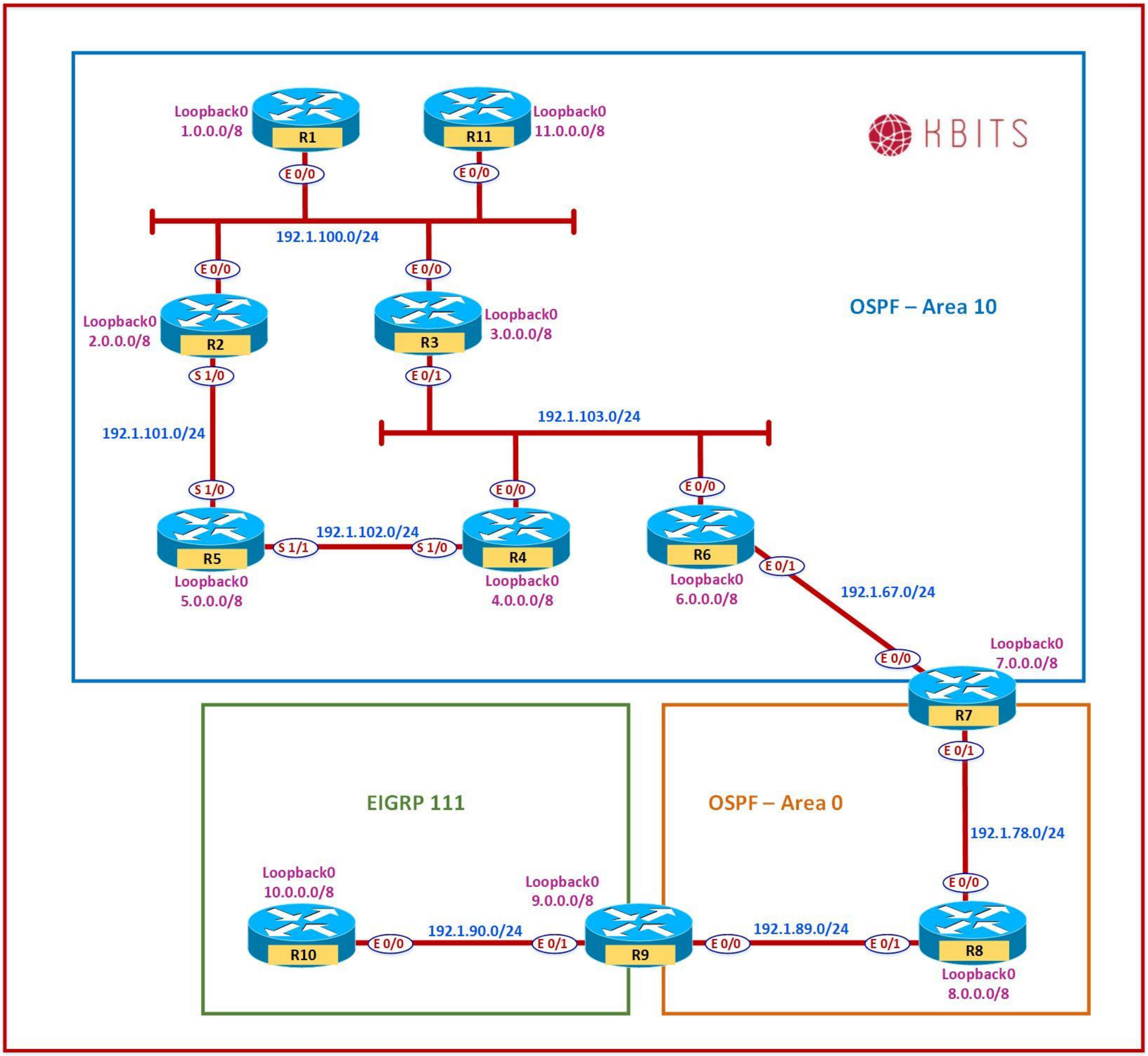
Configuring OSPF

Lab 1 – Configure OSPF on Ethernet – Area 10



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.0.0.0
E 0/0	192.1.100.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	2.2.2.2	255.0.0.0
E 0/0	192.1.100.2	255.255.255.0
S 1/0	192.1.101.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	3.3.3.3	255.0.0.0
E 0/0	192.1.100.3	255.255.255.0
E 0/1	192.1.103.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	4.4.4.4	255.0.0.0
E 0/0	192.1.103.4	255.255.255.0
S 1/0	192.1.102.4	255.255.255.0

R5

Interface	IP Address	Subnet Mask
Loopback 0	5.5.5.5	255.0.0.0
S 1/0	192.1.101.5	255.255.255.0
S 1/1	192.1.102.5	255.255.255.0

R6

Interface	IP Address	Subnet Mask
Loopback 0	6.6.6.6	255.0.0.0
E 0/0	192.1.103.6	255.255.255.0
E 0/1	192.1.67.6	255.255.255.0

R7

Interface	IP Address	Subnet Mask
Loopback 0	7.7.7.7	255.0.0.0

E 0/0	192.1.67.7	255.255.255.0
E 0/1	192.1.78.7	255.255.255.0

R8

Interface	IP Address	Subnet Mask
Loopback 0	8.8.8.8	255.0.0.0
E 0/0	192.1.78.8	255.255.255.0
E 0/1	192.1.89.8	255.255.255.0

R9

Interface	IP Address	Subnet Mask
Loopback 0	9.9.9.9	255.0.0.0
E 0/0	192.1.89.9	255.255.255.0
E 0/1	192.1.90.9	255.255.255.0

R10

Interface	IP Address	Subnet Mask
Loopback 0	10.10.10.10	255.0.0.0
E 0/0	192.1.90.10	255.255.255.0

R11

Interface	IP Address	Subnet Mask
Loopback 0	11.11.11.11	255.0.0.0
E 0/0	192.1.100.11	255.255.255.0

Task 1

Configure OSPF all the Broadcast Multi-Access (BMA) Ethernet network in Area 10. Enable OSPF on all loopbacks on all routers. Hard Code the Router-id based on the following:

R1 – 0.0.0.1
R2 – 0.0.0.2
R3 – 0.0.0.3
R4 – 0.0.0.4
R6 – 0.0.0.6
R7 – 0.0.0.7
R11 – 0.0.0.11

R1	R2
Router OSPF 1 Router-id 0.0.0.1 Network 1.0.0.0 0.255.255.255 area 10	Router OSPF 1 Router-id 0.0.0.2 Network 2.0.0.0 0.255.255.255 area 10

Network 192.1.100.0 0.0.0.255 area 10	Network 192.1.100.0 0.0.0.255 area 10
R3 Router OSPF 1 Router-id 0.0.0.3 Network 3.0.0.0 0.255.255.255 area 10 Network 192.1.100.0 0.0.0.255 area 10 Network 192.1.103.0 0.0.0.255 area 10	**R4** Router OSPF 1 Router-id 0.0.0.4 Network 4.0.0.0 0.255.255.255 area 10 Network 192.1.103.0 0.0.0.255 area 10
R6 Router OSPF 1 Router-id 0.0.0.6 Network 6.0.0.0 0.255.255.255 area 10 Network 192.1.103.0 0.0.0.255 area 10 Network 192.1.67.0 0.0.0.255 area 10	**R7** Router OSPF 1 Router-id 0.0.0.7 Network 7.0.0.0 0.255.255.255 area 10 Network 192.1.67.0 0.0.0.255 area 10

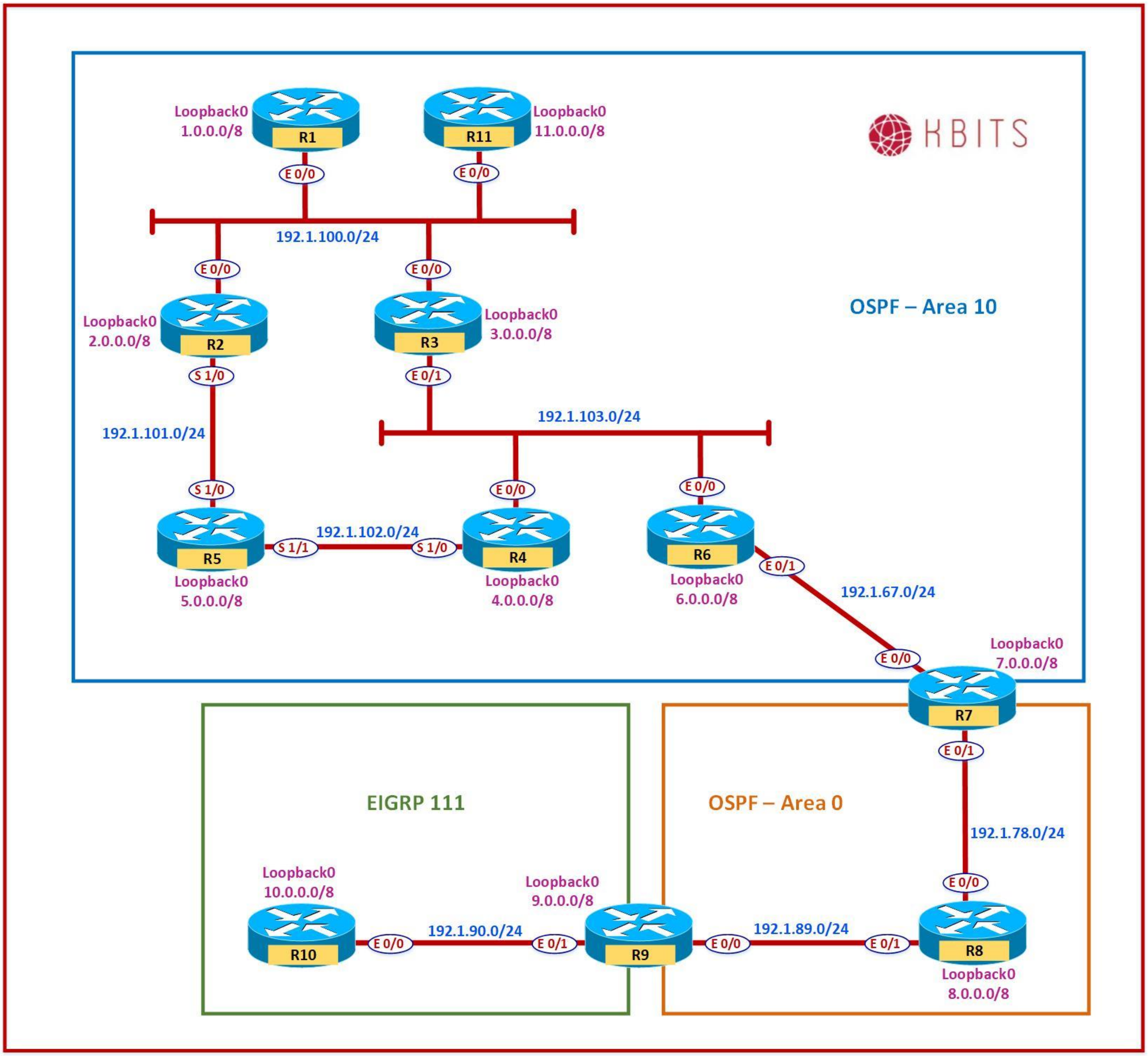
Task 2

Configure the routers such that R1 becomes the DR and R2 as the BDR on the 192.1.100.0/24 Network. R3 should be the DR & R4 should be the BDR for the 192.1.103.0/24 network.

R1 Interface E 0/0 Ip ospf priority 100	**R2** Interface E 0/0 Ip ospf priority 50
R3 Interface E 0/1 Ip ospf priority 100	**R4** Interface E 0/0 Ip ospf priority 50

Note: Issue the **Clear ip ospf process** command to reset the OSPF process for the change to take effect.

Lab 2 – Configuring OSPF on Serial Links – Area 10



Task 1

Run OSPF as your Routing Protocol on the Serial Networks between R2, R4 & R5 in Area 10. Enable OSPF on the Loopback interface on R5. Configure the Router ID of R5 as 0.0.0.5.

R2

```
router ospf 1
 network 192.1.101.0 0.0.0.255 area 10
```

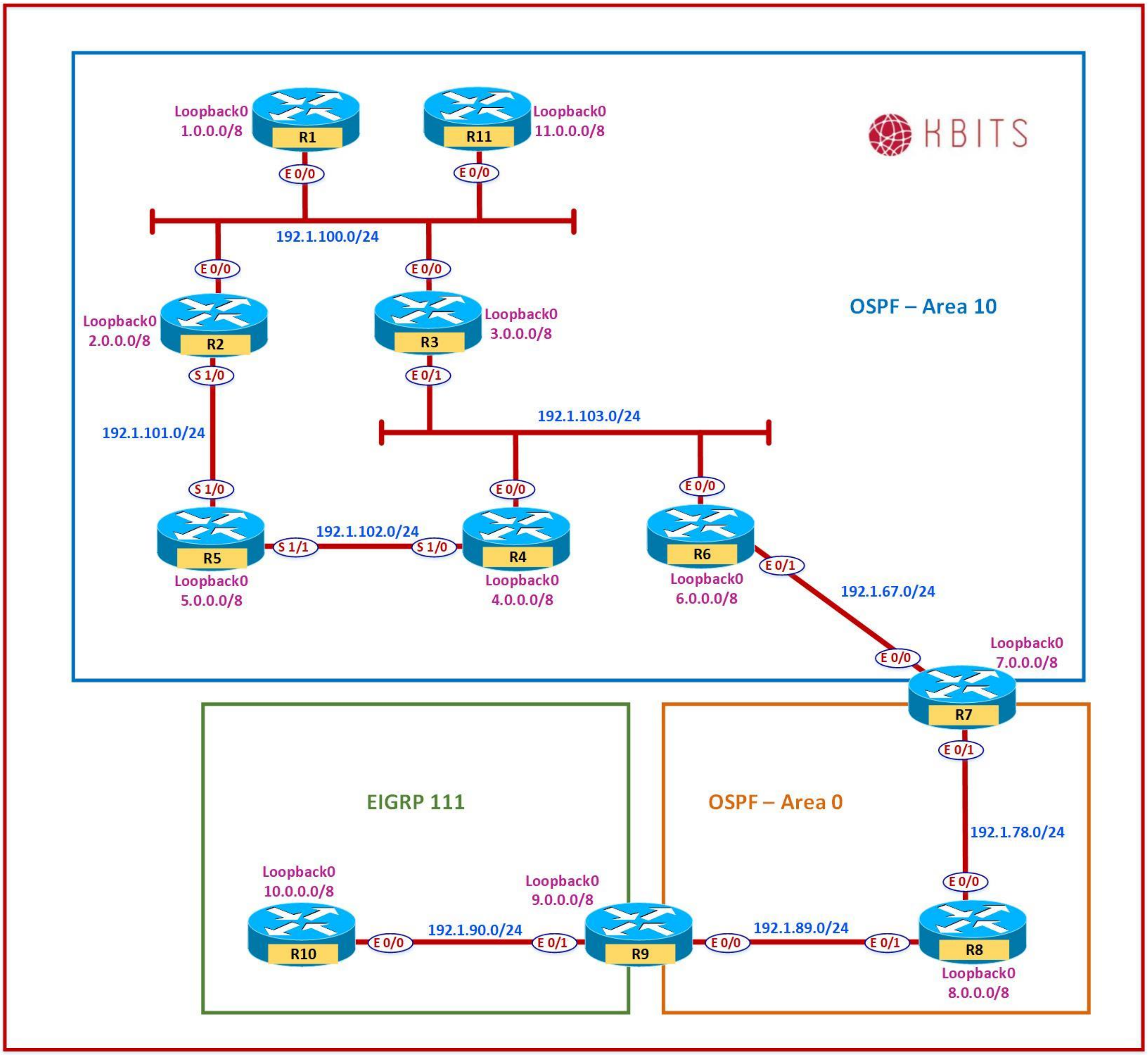
R4

```
router ospf 1
 network 192.1.102.0 0.0.0.255 area 10
```

R5

```
router ospf 1
 router-id 0.0.0.5
 network 5.0.0.0 0.255.255.255 area 10
 network 192.1.101.0 0.0.0.255 area 10
 network 192.1.102.0 0.0.0.255 area 10
```

Lab 3 – Configuring OSPF in Area 0



Task 1

Configure R7, R8 & R9 in Area 0. Don't enable the Loopback Interface of R9 in OSPF. The Router ID's for R8 & R9 should be 0.0.0.8 & 0.0.0.9 respectively. Make sure that the neighbor relationships in Area 0 are established bypassing the DR & BDR election wait time.

R7 router ospf 1 network 192.1.78.0 0.0.0.255 area 0 ! Interface E 0/1 Ip ospf network point-to-point
R8 router ospf 1 router-id 0.0.0.8 network 8.0.0.0 0.255.255.255 area 0 network 192.1.78.0 0.0.0.255 area 0 network 192.1.89.0 0.0.0.255 area 0 ! Interface E 0/0 Ip ospf network point-to-point ! Interface E 0/1 Ip ospf network point-to-point
R9 router ospf 1 router-id 0.0.0.9 network 192.1.89.0 0.0.0.255 area 0

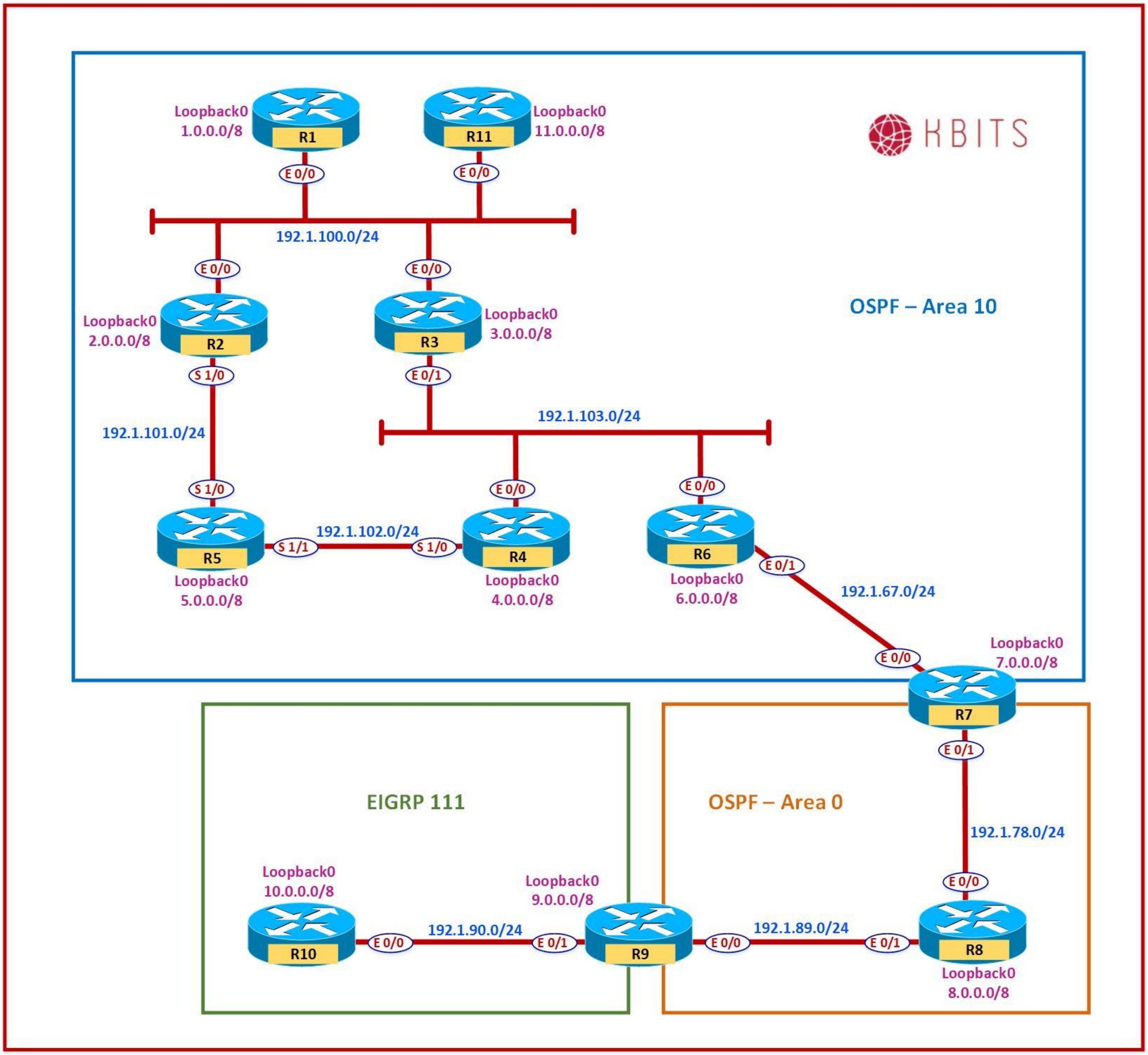
Task 2

Make sure that all OSPF Loopbacks networks appear with the Interface mask. They should not appear as a Host Route.

R1 Interface Loopback0 Ip ospf network point-to-point	**R2** Interface Loopback0 Ip ospf network point-to-point
R3 Interface Loopback0 Ip ospf network point-to-point	**R4** Interface Loopback0 Ip ospf network point-to-point
R5	**R6**

Interface Loopback0 Ip ospf network point-to-point	Interface Loopback0 Ip ospf network point-to-point
R7 Interface Loopback0 Ip ospf network point-to-point	**R8** Interface Loopback0 Ip ospf network point-to-point
R9 Interface Loopback0 Ip ospf network point-to-point	**R11** Interface Loopback0 Ip ospf network point-to-point

Lab 4 – Configuring Unicast-based OSPF

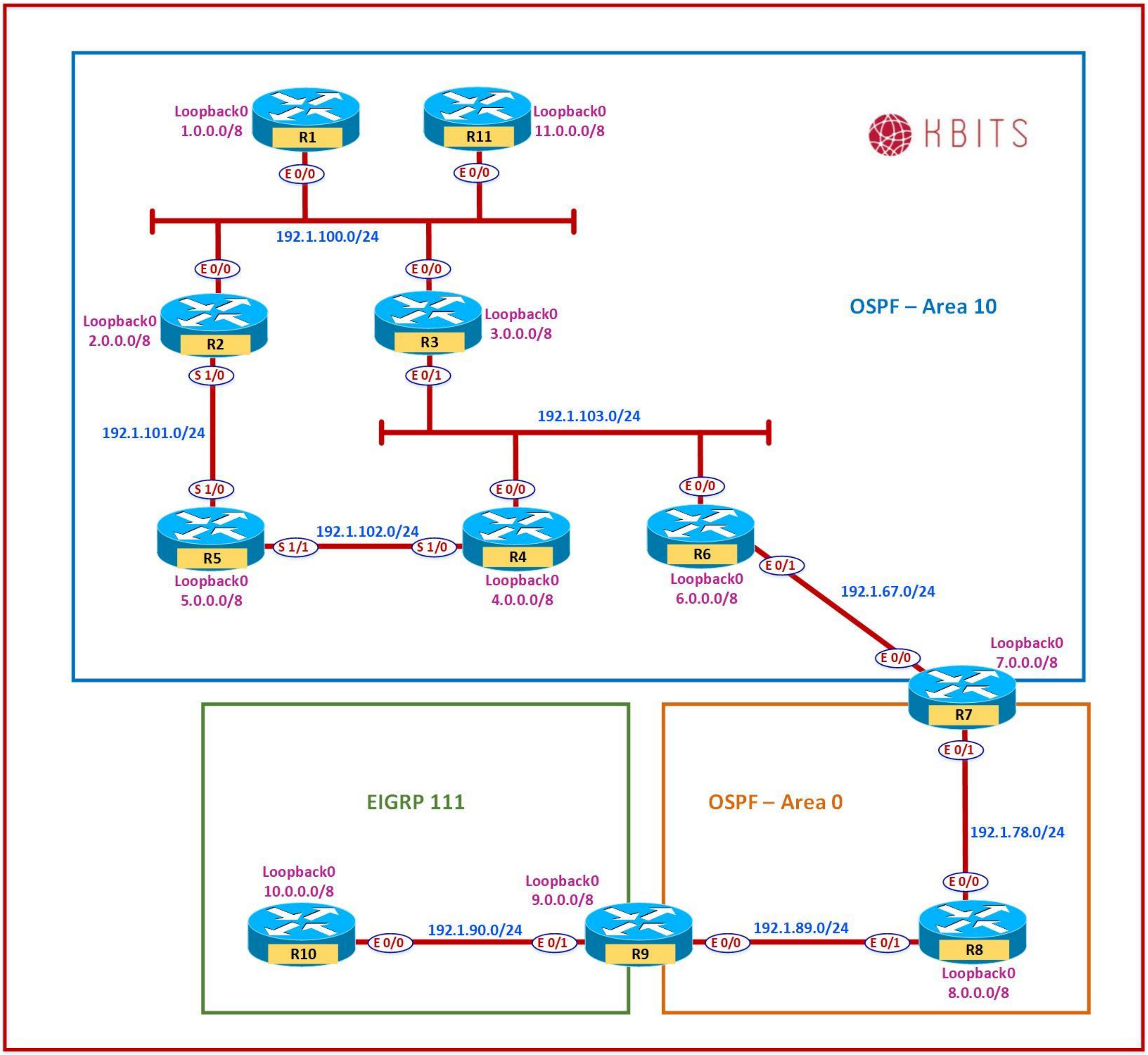


Task 1

Configure Unicast-based OSPF between R6 & R7.

R6 Interface E 0/1 Ip ospf network non-broadcast ! Router ospf 1 Neighbor 192.1.67.7
R6 Interface E 0/1 Ip ospf network non-broadcast ! Router ospf 1 Neighbor 192.1.67.6

Lab 5 – Configuring an OSPF ASBR



Task 1

Configure EIGRP in AS 111 between R9 & R10. Enable all loopbacks on the 2 routers in EIGRP.

R9 Router eigrp 111 Network 192.1.90.0 Network 9.0.0.0
R10 Router eigrp 111 Network 192.1.90.0 Network 10.0.0.0

Task 2

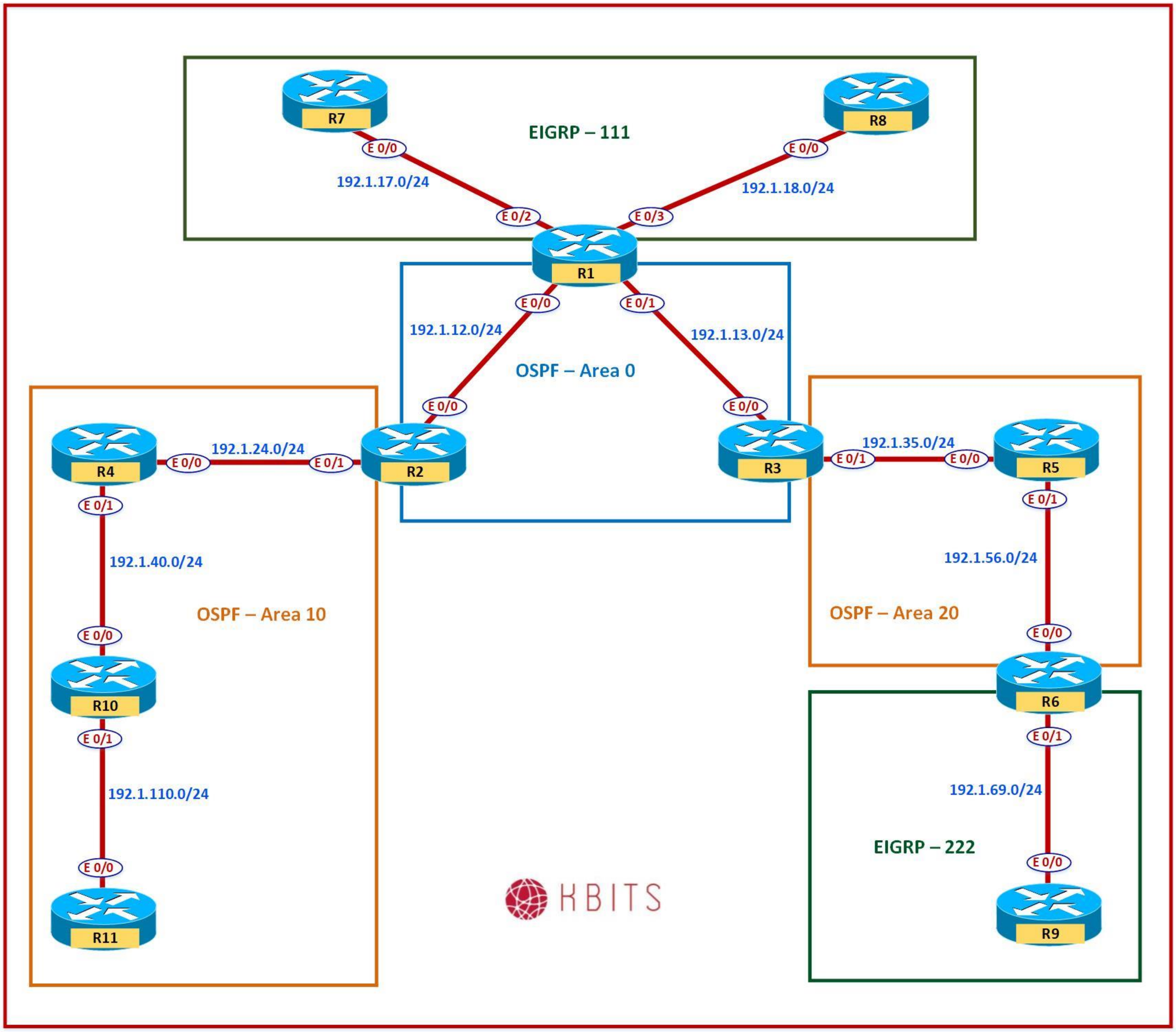
Configure Mutual Route Redistribution between OSPF & EIGRP on R9. Use Seed Metrics of your choice.

R9 Router eigrp 111 Redistribute ospf 1 metric 10 10 10 10 10 ! Router ospf 1 Redistribute eigrp 111 subnets

Verification:

Verify the OSPF Database for appropriate LSAs on the appropriate routers.

Lab 6 – Configuring a Multi-Area / Multi-Domain Topology



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.0.0.0
Loopback 1	11.11.11.11	255.0.0.0
E 0/0	192.1.12.1	255.255.255.0
E 0/1	192.1.13.1	255.255.255.0
E 0/2	192.1.17.1	255.255.255.0
E 0/3	192.1.18.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	2.2.2.2	255.0.0.0
Loopback 1	22.22.22.22	255.0.0.0
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.24.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	3.3.3.3	255.0.0.0
Loopback 1	33.33.33.33	255.0.0.0
E 0/0	192.1.13.3	255.255.255.0
E 0/1	192.1.35.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	4.4.4.4	255.0.0.0
Loopback 1	44.44.44.44	255.0.0.0
Loopback 11	105.1.4.1	255.255.255.0
Loopback 12	105.1.5.1	255.255.255.0
Loopback 13	105.1.6.1	255.255.255.0
Loopback 14	105.1.7.1	255.255.255.0
E 0/0	192.1.24.4	255.255.255.0
E 0/1	192.1.40.4	255.255.255.0

R5

Interface	IP Address	Subnet Mask
Loopback 0	5.5.5.5	255.0.0.0

Loopback 1	55.55.55.55	255.0.0.0
E 0/0	192.1.35.5	255.255.255.0
E 0/1	192.1.56.5	255.255.255.0

R6

Interface	IP Address	Subnet Mask
Loopback 0	6.6.6.6	255.0.0.0
Loopback 1	66.66.66.66	255.0.0.0
E 0/0	192.1.56.6	255.255.255.0
E 0/1	192.1.69.6	255.255.255.0

R7

Interface	IP Address	Subnet Mask
Loopback 0	7.7.7.7	255.0.0.0
Loopback 1	107.7.72.1	255.255.255.0
Loopback 2	107.7.73.1	255.255.255.0
Loopback 3	107.7.74.1	255.255.255.0
Loopback 4	107.7.75.1	255.255.255.0
E 0/0	192.1.17.7	255.255.255.0

R8

Interface	IP Address	Subnet Mask
Loopback 0	8.8.8.8	255.0.0.0
Loopback 1	88.88.88.88	255.0.0.0
E 0/0	192.1.18.8	255.255.255.0

R9

Interface	IP Address	Subnet Mask
Loopback 0	9.9.9.9	255.0.0.0
Loopback 1	99.99.99.99	255.0.0.0
E 0/0	192.1.69.9	255.255.255.0

R10

Interface	IP Address	Subnet Mask
Loopback 0	10.10.10.10	255.0.0.0
Loopback 11	100.1.1.1	255.0.0.0
Loopback 12	101.1.1.1	255.0.0.0
Loopback 13	102.1.1.1	255.0.0.0
Loopback 14	103.1.1.1	255.0.0.0
E 0/0	192.1.40.10	255.255.255.0

E 0/1	192.1.110.10	255.255.255.0

R11

Interface	IP Address	Subnet Mask
Loopback 0	111.111.111.111	255.255.255.0
E 0/0	192.1.110.11	255.255.255.0

Task 1

Configure OSPF in Area 0 between R1, R2 & R3. Besides the physical links, enable the Loopback 0 interfaces of all 3 routers in Area 0. Loopbacks should be advertised with the Interface Mask. Hard Code the Router-id based on the following:

R1 – 0.0.0.1
R2 – 0.0.0.2
R3 – 0.0.0.3

<table>
<tr>
<td>R1

Router OSPF 1
 Router-id 0.0.0.1
 Network 1.0.0.0 0.255.255.255 area 0
 Network 192.1.12.0 0.0.0.255 area 0
 Network 192.1.13.0 0.0.0.255 area 0
!
Interface Loopback0
 Ip ospf network point-to-point</td>
<td>R2

Router OSPF 1
 Router-id 0.0.0.2
 Network 2.0.0.0 0.255.255.255 area 0
 Network 192.1.12.0 0.0.0.255 area 0
!
Interface Loopback0
 Ip ospf network point-to-point</td>
</tr>
<tr>
<td>R3

Router OSPF 1
 Router-id 0.0.0.3
 Network 3.0.0.0 0.255.255.255 area 0
 Network 192.1.13.0 0.0.0.255 area 0
!
Interface Loopback0
 Ip ospf network point-to-point</td>
<td></td>
</tr>
</table>

Task 2

Configure OSPF in Area 10 between R2, R4, R10 & R11. Besides the physical links, enable the Loopback 1 interface on R2 and all the loopbacks of the other 3 routers in Area 10. Loopbacks should be advertised with the Interface Mask. Hard Code the Router-id based on the following:

R4 – 0.0.0.4
R10 – 0.0.0.10
R11 – 0.0.0.11

R10 Router OSPF 1 Router-id 0.0.0.10 Network 0.0.0.0 255.255.255.255 10 ! Interface Loopback0 Ip ospf network point-to-point ! Interface Loopback11 Ip ospf network point-to-point ! Interface Loopback12 Ip ospf network point-to-point ! Interface Loopback13 Ip ospf network point-to-point ! Interface Loopback14 Ip ospf network point-to-point	**R4** Router OSPF 1 Router-id 0.0.0.4 Network 4.0.0.0 0.255.255.255 area 10 Network 44.0.0.0 0.255.255.255 area 10 Network 105.0.0.0 0.255.255.255 area 10 Network 192.1.24.0 0.0.0.255 area 10 Network 192.1.40.0 0.0.0.255 area 10 ! Interface Loopback0 Ip ospf network point-to-point ! Interface Loopback1 Ip ospf network point-to-point ! Interface Loopback11 Ip ospf network point-to-point ! Interface Loopback12 Ip ospf network point-to-point ! Interface Loopback13 Ip ospf network point-to-point ! Interface Loopback14 Ip ospf network point-to-point
R2 Router OSPF 1 Network 192.1.24.0 0.0.0.255 area 10 Network 22.0.0.0 0.255.255.255 area 10 ! Interface Loopback1 Ip ospf network point-to-point	**R11** Router OSPF 1 Router-id 0.0.0.11 Network 111.0.0.0 0.255.255.255 area 10 Network 192.1.110.0 0.0.0.255 area 10 ! Interface Loopback0 Ip ospf network point-to-point

Task 3

Configure OSPF in Area 20 between R3, R5 & R6. Besides the physical links, enable the Loopback 0 interface on R3 & R6 and all the loopbacks on R5 in Area 20. Loopbacks should be advertised with the Interface Mask. Hard Code the Router-id based on the following:

R5 – 0.0.0.5
R6 – 0.0.0.6

R3	R5
Router OSPF 1 Network 192.1.35.0 0.0.0.255 area 20 Network 33.0.0.0 0.255.255.255 area 20 ! Interface Loopback1 Ip ospf network point-to-point	Router OSPF 1 Router-id 0.0.0.5 Network 5.0.0.0 0.255.255.255 area 20 Network 55.0.0.0 0.255.255.255 area 20 Network 192.1.35.0 0.0.0.255 area 20 Network 192.1.56.0 0.0.0.255 area 20 ! Interface Loopback0 Ip ospf network point-to-point ! Interface Loopback1 Ip ospf network point-to-point
R6 Router OSPF 1 Router-id 0.0.0.6 Network 6.0.0.0 0.255.255.255 area 20 Network 192.1.56.0 0.0.0.255 area 20 ! Interface Loopback0 Ip ospf network point-to-point	

Task 4

Configure EIGRP is AS 111 between R1, R7 & R8. Enable all loopbacks on R7 & R8 in EIGRP 111. Enable Loopback 1 on R1 in EIGRP 111.

R1	R7
Router EIGRP 111 Network 192.1.17.0 Network 192.1.18.0 Network 11.0.0.0	Router EIGRP 111 Network 192.1.17.0 Network 7.0.0.0 Network 107.0.0.0
R8 Router EIGRP 111 Network 192.1.18.0 Network 8.0.0.0 Network 88.0.0.0	

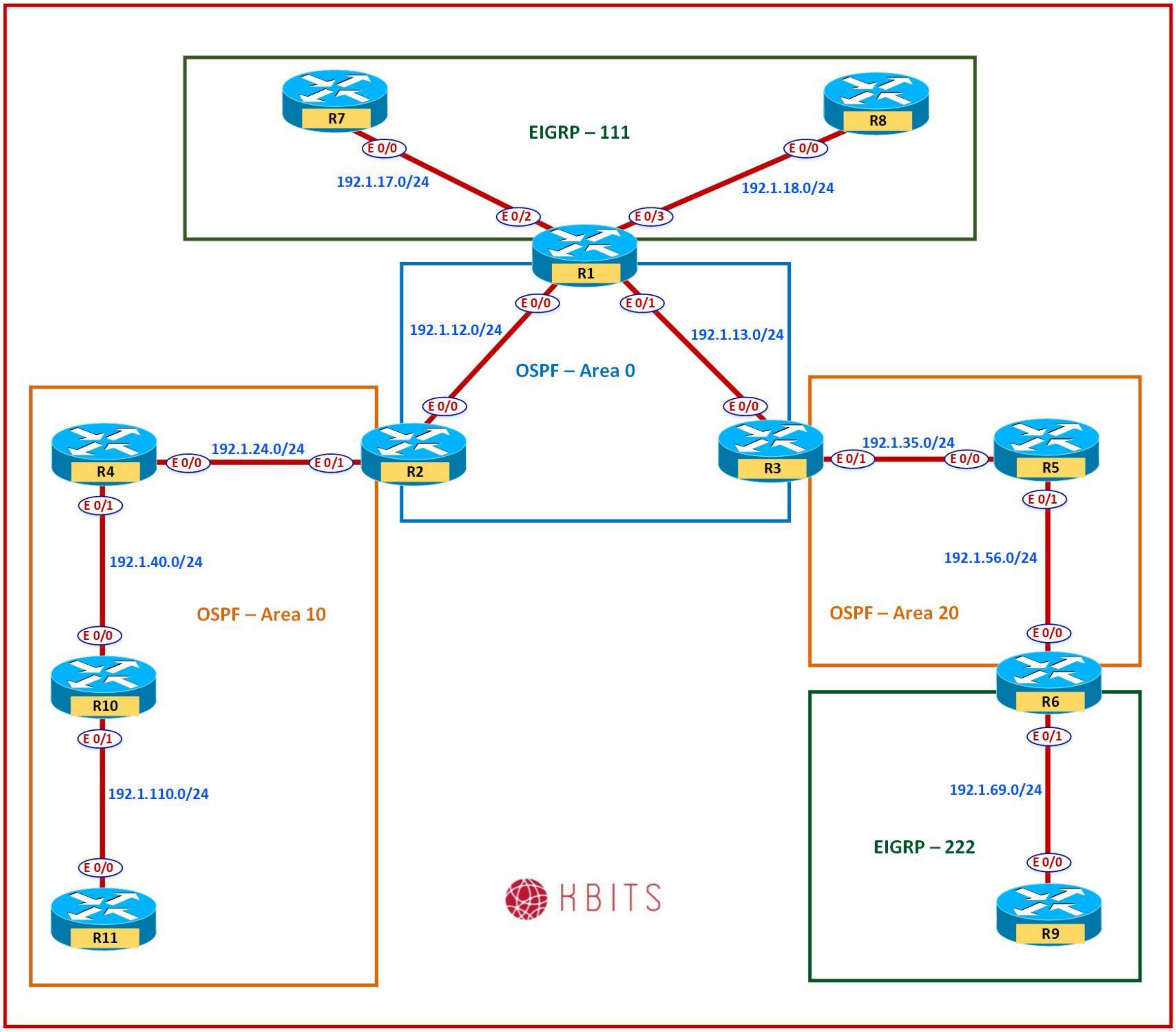
Task 5
Configure EIGRP is AS 222 between R6 & R9. Enable all loopbacks on R9 in EIGRP 222. Enable Loopback 1 on R6 in EIGRP 222.

R6	R9
Router EIGRP 222 Network 192.1.69.0 Network 66.0.0.0	Router EIGRP 222 Network 192.1.69.0 Network 9.0.0.0 Network 99.0.0.0

Task 6
Configure Mutual Redistribution between the appropriate routers to allow end-to-end connectivity between all routing domains. Use Seed metric of your choice.

R1	R6
Router ospf 1 Redistribute eigrp 111 subnets ! Router eigrp 111 Redistribute ospf 1 metric 10 10 10 10 10	Router ospf 1 Redistribute eigrp 222 subnets ! Router eigrp 222 Redistribute ospf 1 metric 10 10 10 10 10

Lab 7 – Configuring Inter-Area Route Summarization



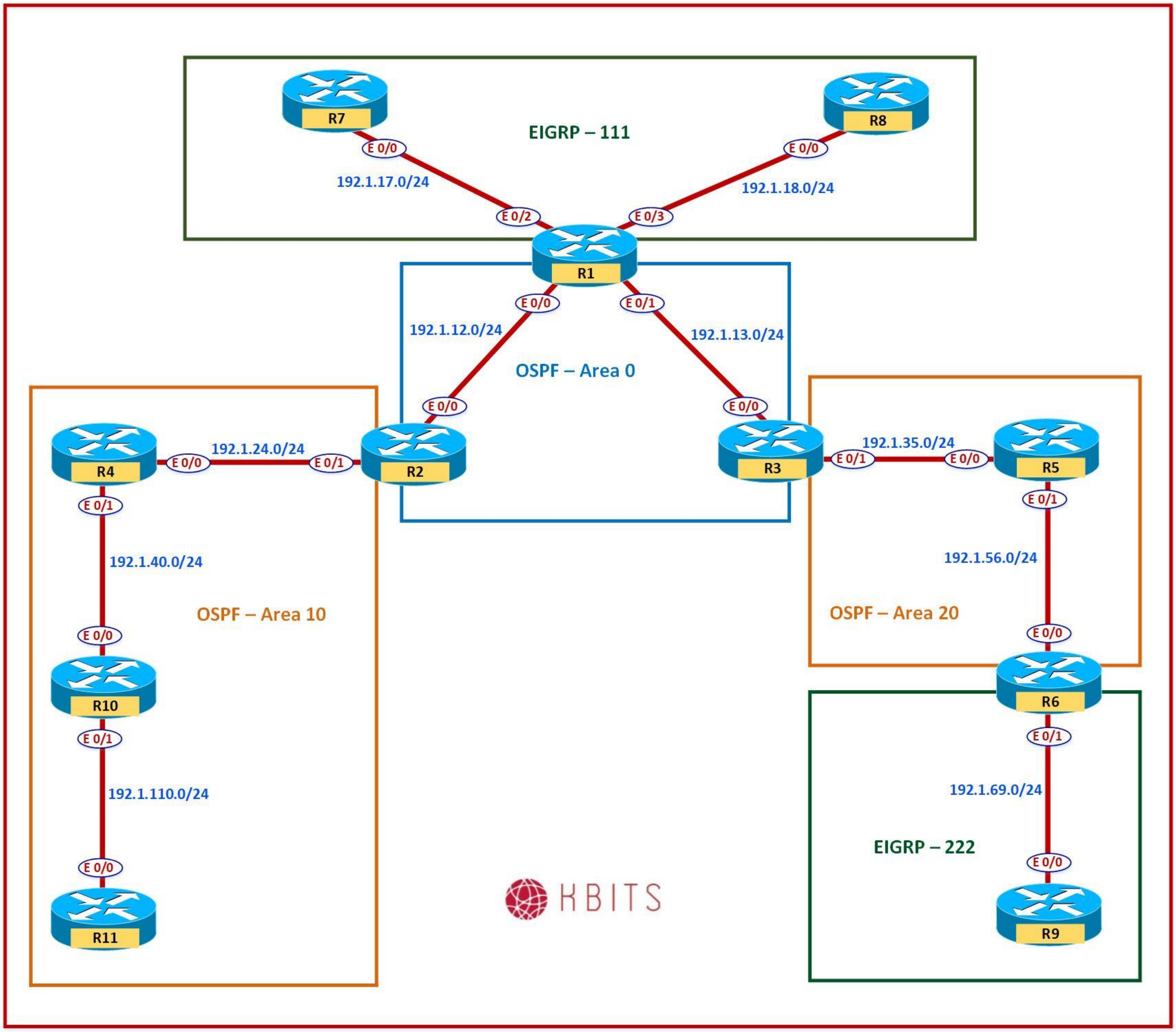
Task 1

Configure Route Summarization on the appropriate ABR to summarize all the R11 Loopbacks.

R2

```
Router ospf 1
 Area 10 range 111.111.100.0 255.255.252.0
```

Lab 8 – Configuring External Route Summarization



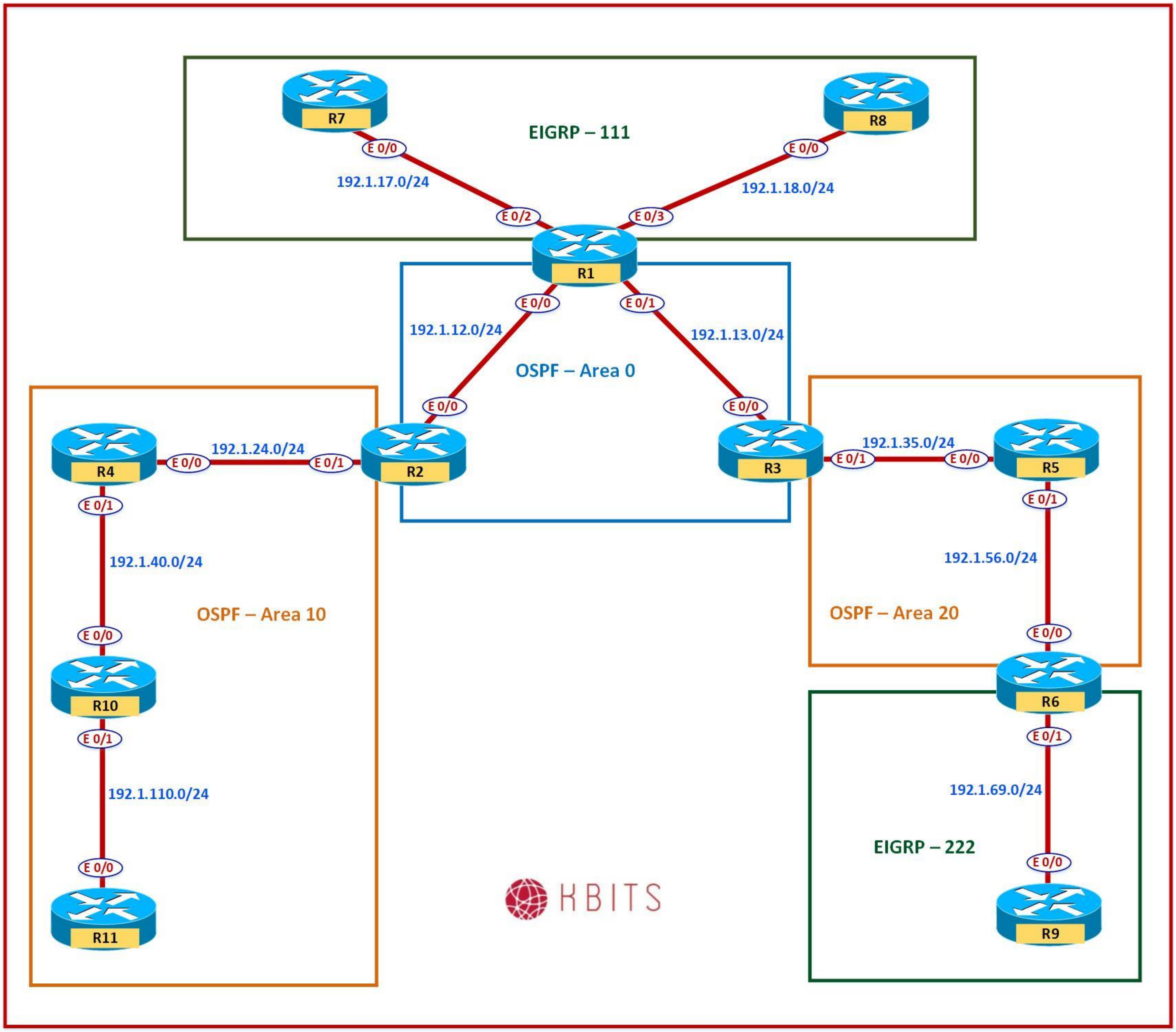
Task 1

Configure Route Summarization on the appropriate ASBR to summarize all the routes from the 107.0.0.0/8 major network towards OSPF. Use the longest mask for Route Summarization.

R1

```
Router ospf 1
 Summary-address 107.7.72.0 255.255.252.0
```

Lab 9 – Route Summarization and LSA Filtering



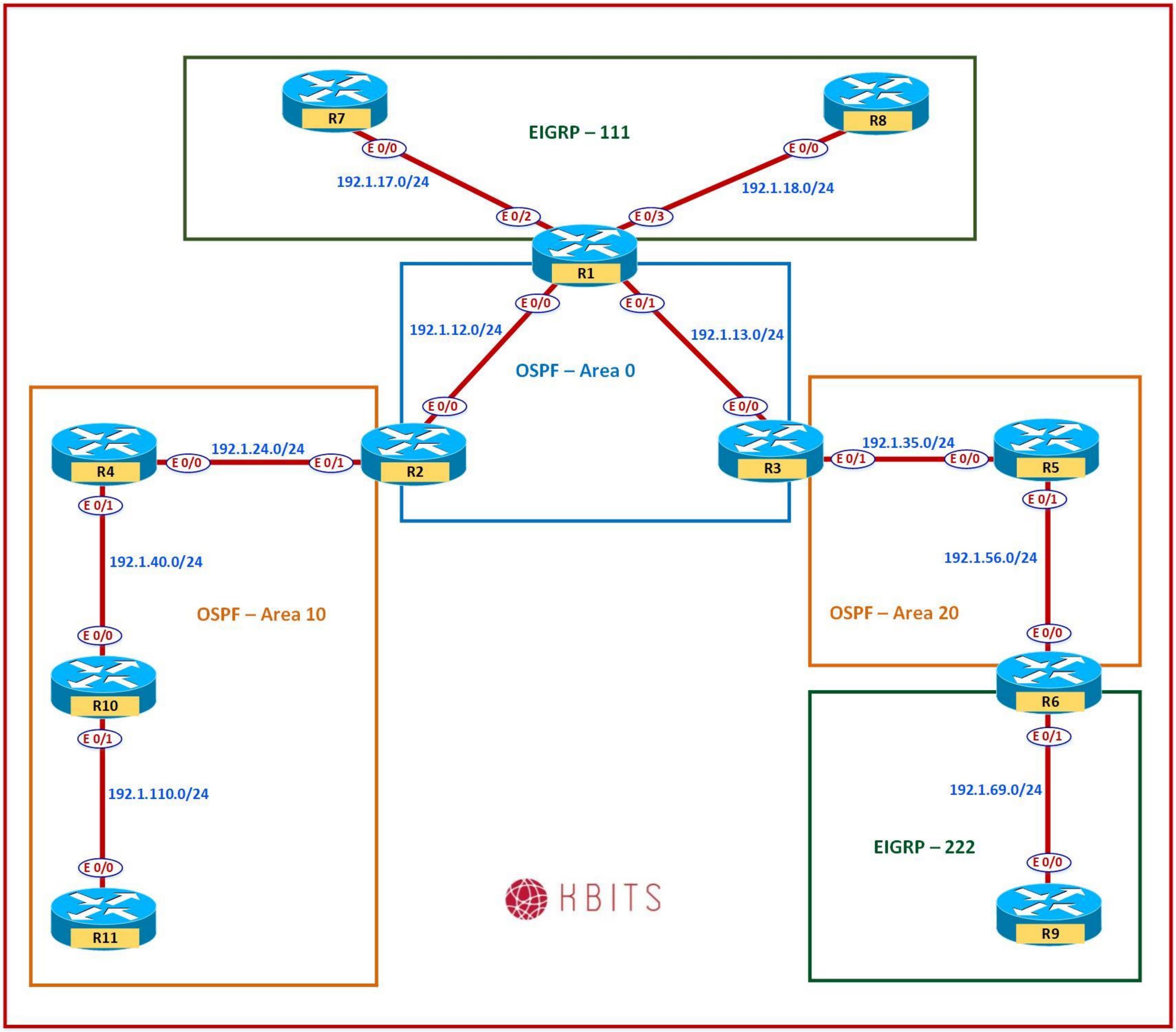
Task 1

Configure LSA Filtering such that network 4.0.0.0/8 is not allowed to leave Area 10.

R2

```
Ip prefix-list FILTER1 deny 4.0.0.0/8
Ip prefix-list FILTER1 permit 0.0.0.0/0 le 32
!
Router ospf 1
 Area 10 filter-list prefix FILTER1 out
```

Lab 10 – Configuring OSPF Authentication



Task 1

Configure the most secure authentication on all routers in Area's 0. Use a key of 1 and a key-string **ccie123**.

R1

```
interface E 0/0
 ip ospf authentication message-digest
 ip ospf message-digest-key 1 md5 ccie123
!
interface E 0/1
 ip ospf authentication message-digest
 ip ospf message-digest-key 1 md5 ccie123
```

R2

```
interface E 0/0
 ip ospf authentication message-digest
 ip ospf message-digest-key 1 md5 ccie123
```

R3

```
interface E 0/0
 ip ospf authentication message-digest
 ip ospf message-digest-key 1 md5 ccie123
```

Task 2

Configure text authentication on all routers in 10. Use a key-string **cisco**.

R2

```
interface E 0/1
 ip ospf authentication
 ip ospf authentication-key cisco
```

R4

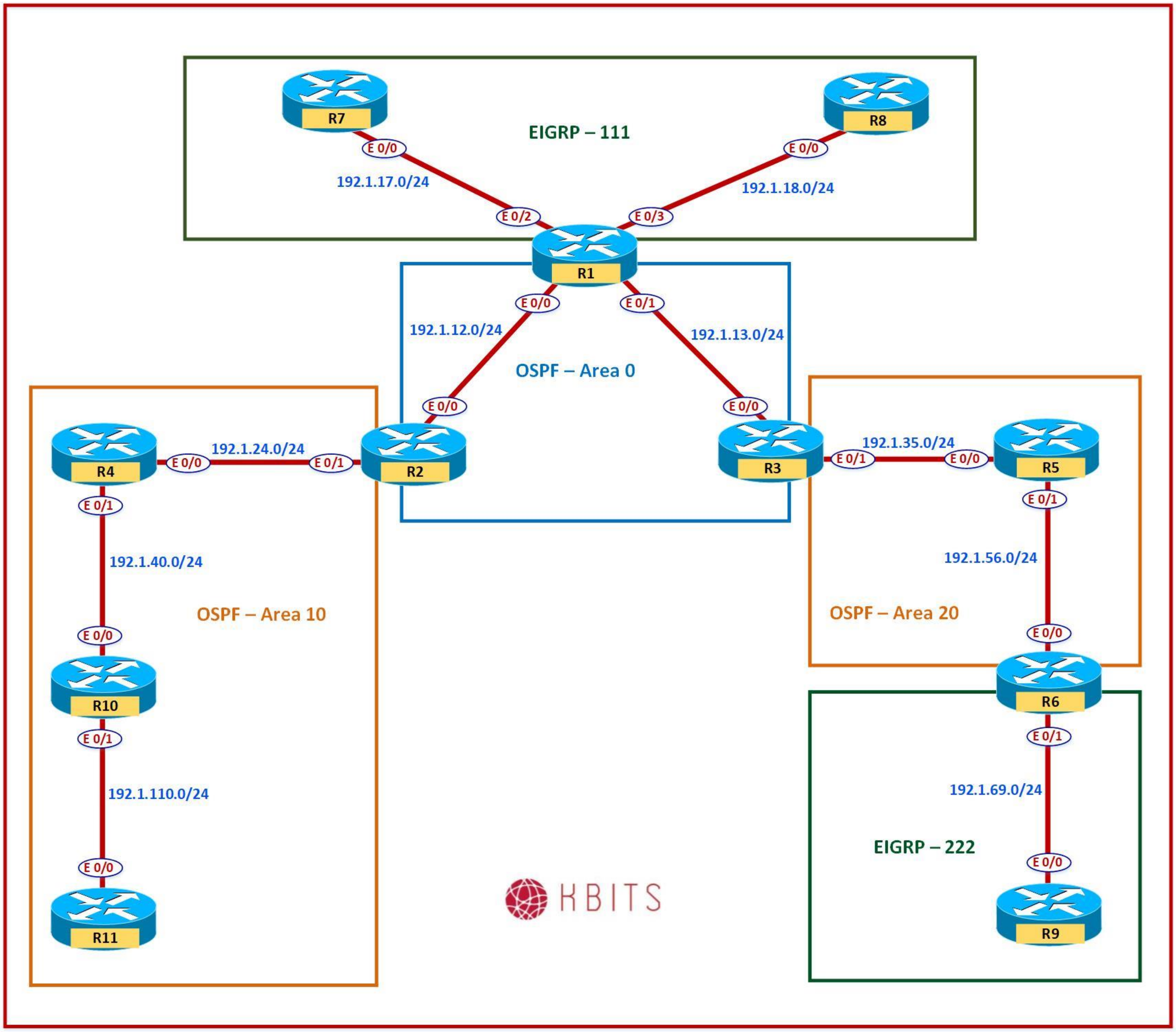
```
interface E 0/0
 ip ospf authentication
 ip ospf authentication-key cisco
!
interface E 0/1
 ip ospf authentication
 ip ospf authentication-key cisco
```

R10

```
interface E 0/0
 ip ospf authentication
```

ip ospf authentication-key cisco ! interface E 0/1 ip ospf authentication ip ospf authentication-key cisco
R11 interface E 0/0 ip ospf authentication ip ospf authentication-key cisco

Lab 11 – Configuring OSPF Area Types



Task 1

Configure Area 10 such that it does not receive any External Routes. It should maintain connectivity to the External Routes. **(Stub Area)**

R2	**R4**
Router ospf 1 Area 10 stub	Router ospf 1 Area 10 stub

R10	**R11**
Router ospf 1 Area 10 stub	Router ospf 1 Area 10 stub
Note: The ABR will block the External Routes from EIGRP 111 & EIGRP 222 from reaching Area 10 Internal Routers. R2 will inject a default route instead. This is a Stub Area. Verify it on R4, R10 & R11 by checking the Routing table.	

Task 2

This step is a continuation of Task 1. Area 10 should also block Inter-Area routes maintaining reachability to them. **(Totally Stubby Area)**

R2
Router ospf 1 Area 10 stub no-summary
Note: The ABR will block the Inter-Area Routes from getting propagating into Area 10. Instead R2 will inject a default route instead. This is a Totally Stubby Area. Verify it on R4, R10 & R11 by checking the Routing table.

Task 3

Configure Area 20 such that it does not receive any external routes from the backbone. The External routes from EIGRP 222 should continue to be received in Area 20 and propagated into the Backbone. **(NSSA Area)**

R3
Router ospf 1 Area 20 nssa
R5 Router ospf 1 Area 20 nssa
R6 Router ospf 1 Area 20 nssa
Note: The ABR will block the External routes from the Backbone (EIGRP). Area 20 will continue to receive the external routes from EIGRP 222 as N routes. These routes will continue to be propagated towards the backbone. The ABR will convert the N routes into E routes as it propagates it into the Backbone. You will loose reachability to the External Routes from the Backbone as the ABR

does not inject a default route in this configuration.

Task 4

This step is a continuation of Task 3. Configure Area 20 such that the previous requirement is maintained but Area 20 should also have reachability to the external routes from the backbone (EIGRP Routes). **(NSSA-Stub Area)**

R3

```
Router ospf 1
 Area 20 nssa default-information-originate
```

Note: This builds on the NSSA area by regaining reachability to the Backbone external routes. This is done by having the ABR injecting the default route into Area 20.

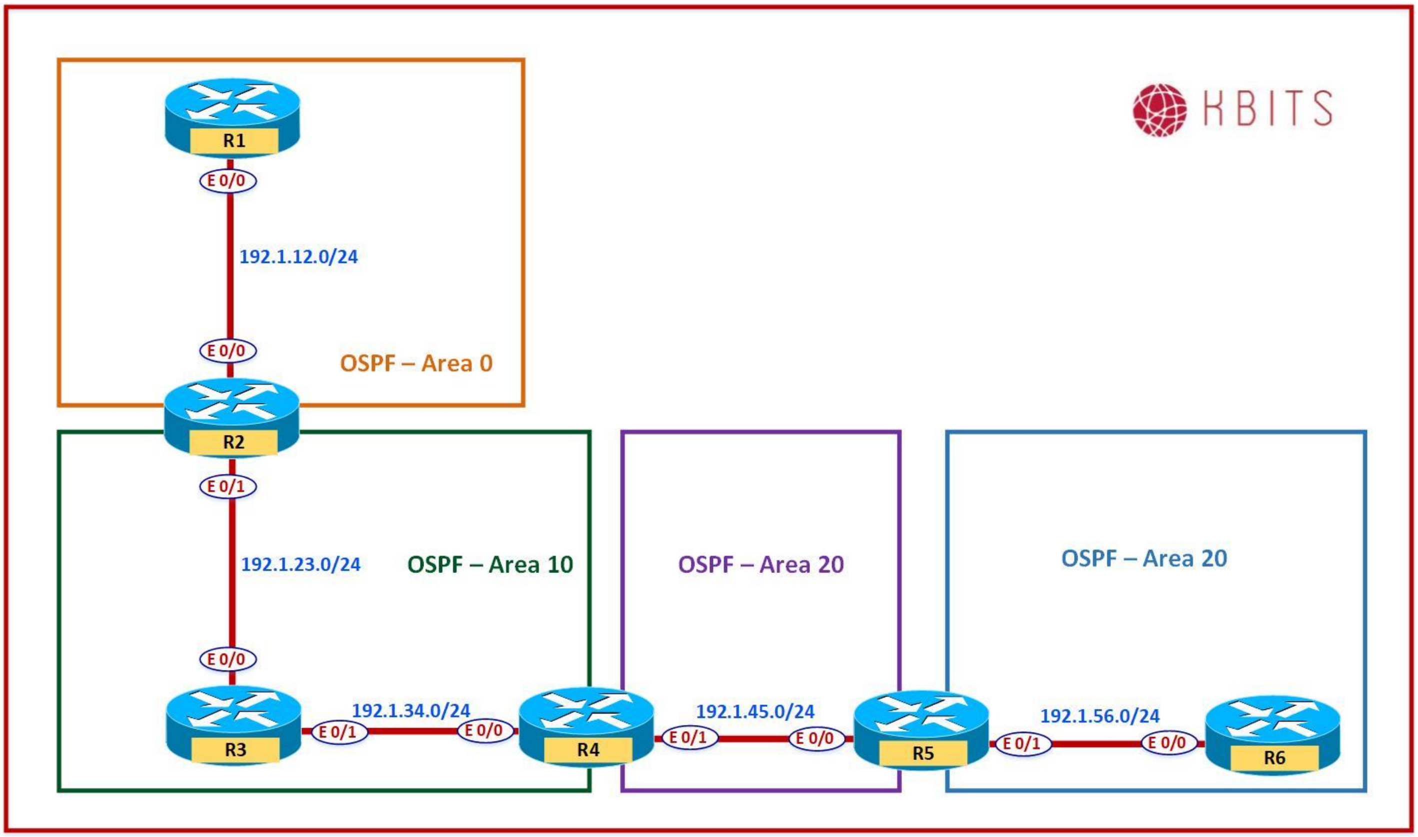
Task 5

Configure Area 20 such that the Inter-Area routes are also blocked in addition to the external routes from the backbone. **(NSSA-Totally Stubby Area)**

R3

```
Router ospf 1
 Area 20 nssa no-summary
```

Lab 12 – Configuring Virtual Link



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.0.0.0
E 0/0	192.1.12.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	2.2.2.2	255.0.0.0
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.23.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	3.3.3.3	255.0.0.0
E 0/0	192.1.23.3	255.255.255.0
E 0/1	192.1.34.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	4.4.4.4	255.0.0.0
E 0/0	192.1.34.4	255.255.255.0
E 0/1	192.1.45.4	255.255.255.0

R5

Interface	IP Address	Subnet Mask
Loopback 0	5.5.5.5	255.0.0.0
Loopback 1	55.55.55.55	255.0.0.0
E 0/0	192.1.45.5	255.255.255.0
E 0/1	192.1.56.5	255.255.255.0

R6

Interface	IP Address	Subnet Mask
Loopback 0	6.6.6.6	255.0.0.0
E 0/0	192.1.56.6	255.255.255.0

Task 1
Configure OSPF in Area 0 between R1 & R2. Besides the physical links, enable the Loopback 0 interfaces of both routers in Area 0. Loopbacks should be advertised with the Interface Mask. Hard Code the Router-id based on the following:

R1 – 0.0.0.1
R2 – 0.0.0.2

R1	R2
Router OSPF 1 Router-id 0.0.0.1 Network 1.0.0.0 0.255.255.255 area 0 Network 192.1.12.0 0.0.0.255 area 0 ! Interface Loopback0 Ip ospf network point-to-point	Router OSPF 1 Router-id 0.0.0.2 Network 2.0.0.0 0.255.255.255 area 0 Network 192.1.12.0 0.0.0.255 area 0 ! Interface Loopback0 Ip ospf network point-to-point

Task 2
Configure OSPF in Area 10 between R2, R3 & R4. Besides the physical links, enable the Loopback 0 interfaces of R3 in Area 10. Loopbacks should be advertised with the Interface Mask. Hard Code the Router-id based on the following:

R3 – 0.0.0.3
R4 – 0.0.0.4

R2	R3
Router OSPF 1 Network 192.1.23.0 0.0.0.255 area 10	Router OSPF 1 Router-id 0.0.0.3 Network 3.0.0.0 0.255.255.255 area 10 Network 192.1.23.0 0.0.0.255 area 10 Network 192.1.34.0 0.0.0.255 area 10 ! Interface Loopback0 Ip ospf network point-to-point
R4 Router OSPF 1 Router-id 0.0.0.4 Network 192.1.34.0 0.0.0.255 area 10 ! Interface Loopback0 Ip ospf network point-to-point	

Task 3

Configure OSPF in Area 20 between R4 & R5. Besides the physical links, enable the Loopback 0 interfaces of R4 & R5 in Area 20. Loopbacks should be advertised with the Interface Mask. Hard Code the Router-id based on the following:

R5 – 0.0.0.5

R4	R5
Router OSPF 1 Network 192.1.45.0 0.0.0.255 area 20 Network 4.0.0.0 0.255.255.255 area 20 ! Interface Loopback0 Ip ospf network point-to-point	Router OSPF 1 Router-id 0.0.0.5 Network 5.0.0.0 0.255.255.255 area 20 Network 192.1.45.0 0.0.0.255 area 20 ! Interface Loopback0 Ip ospf network point-to-point

Task 4

Configure a Virtual Link between the appropriate devices to allow Area 20 to communicate to the rest of the network.

R2
router ospf 1 area 10 virtual-link 0.0.0.34
R4
router ospf 1 area 10 virtual-link 0.0.0.2

Task 5

Configure OSPF in Area 30 between R5 & R6. Besides the physical links, enable the Loopback 0 interface of R6 & Loopback 1 of R5 in Area 30. Loopbacks should be advertised with the Interface Mask. Hard Code the Router-id based on the following:

R6 – 0.0.0.6

R5	R6
Router OSPF 1 Network 192.1.56.0 0.0.0.255 area 30 Network 55.0.0.0 0.255.255.255 area 30 ! Interface Loopback1 Ip ospf network point-to-point	Router OSPF 1 Router-id 0.0.0.6 Network 6.0.0.0 0.255.255.255 area 30 Network 192.1.56.0 0.0.0.255 area 30 ! Interface Loopback0

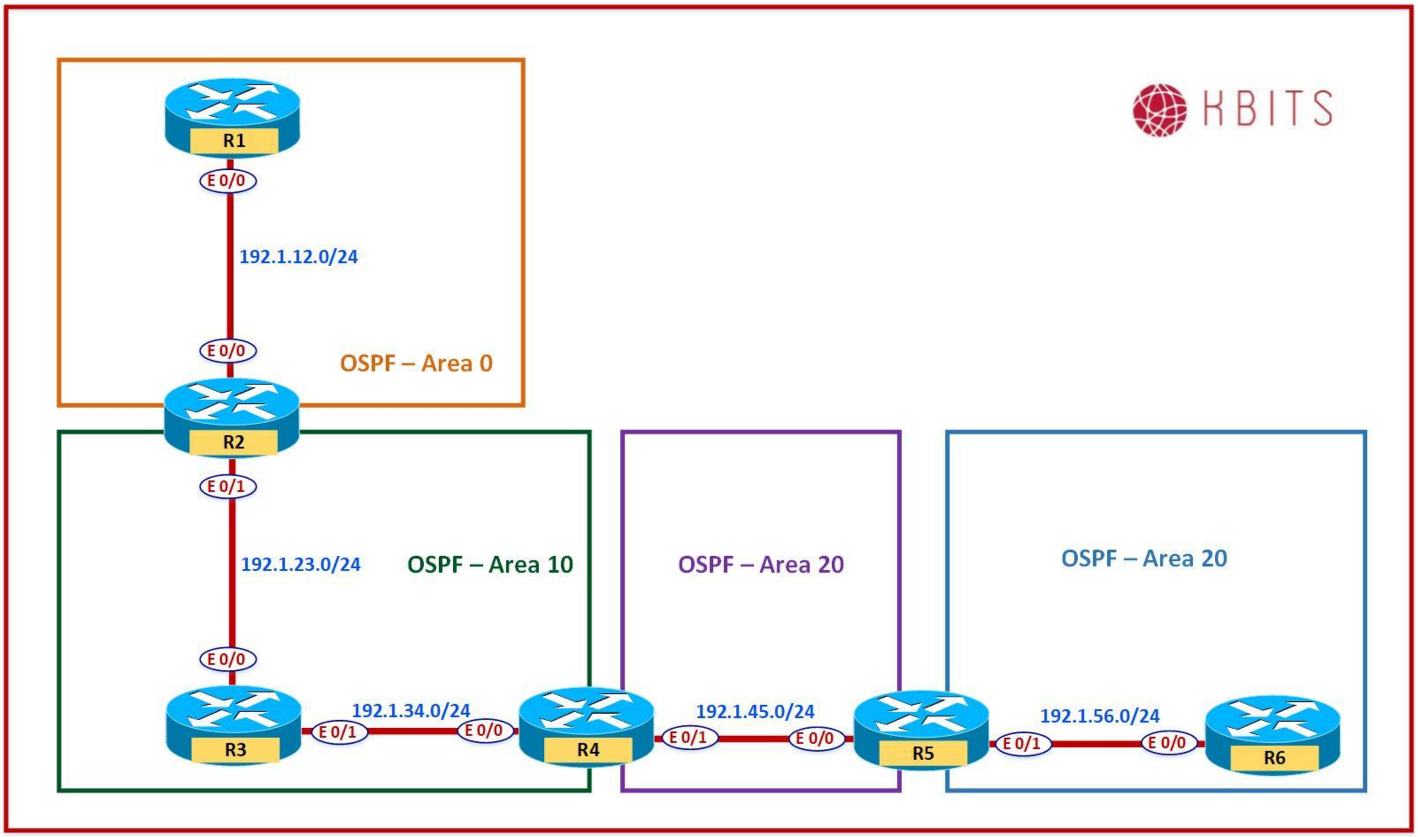
	Ip ospf network point-to-point

Task 6

Configure a Virtual Link between the appropriate devices to allow Area 30 to communicate to the rest of the network.

R4 router ospf 1   area 30 virtual-link 0.0.0.5
R5 router ospf 1 area 30 virtual-link 0.0.0.4

Lab 13 – Configuring BFD for OSPF



Task 1

Configure BFD between all routers in area 10. Configure the BFD Interface interval to be 300 for sending and receiving. A neighbor should be deemed dead is the router misses 3 hellos.

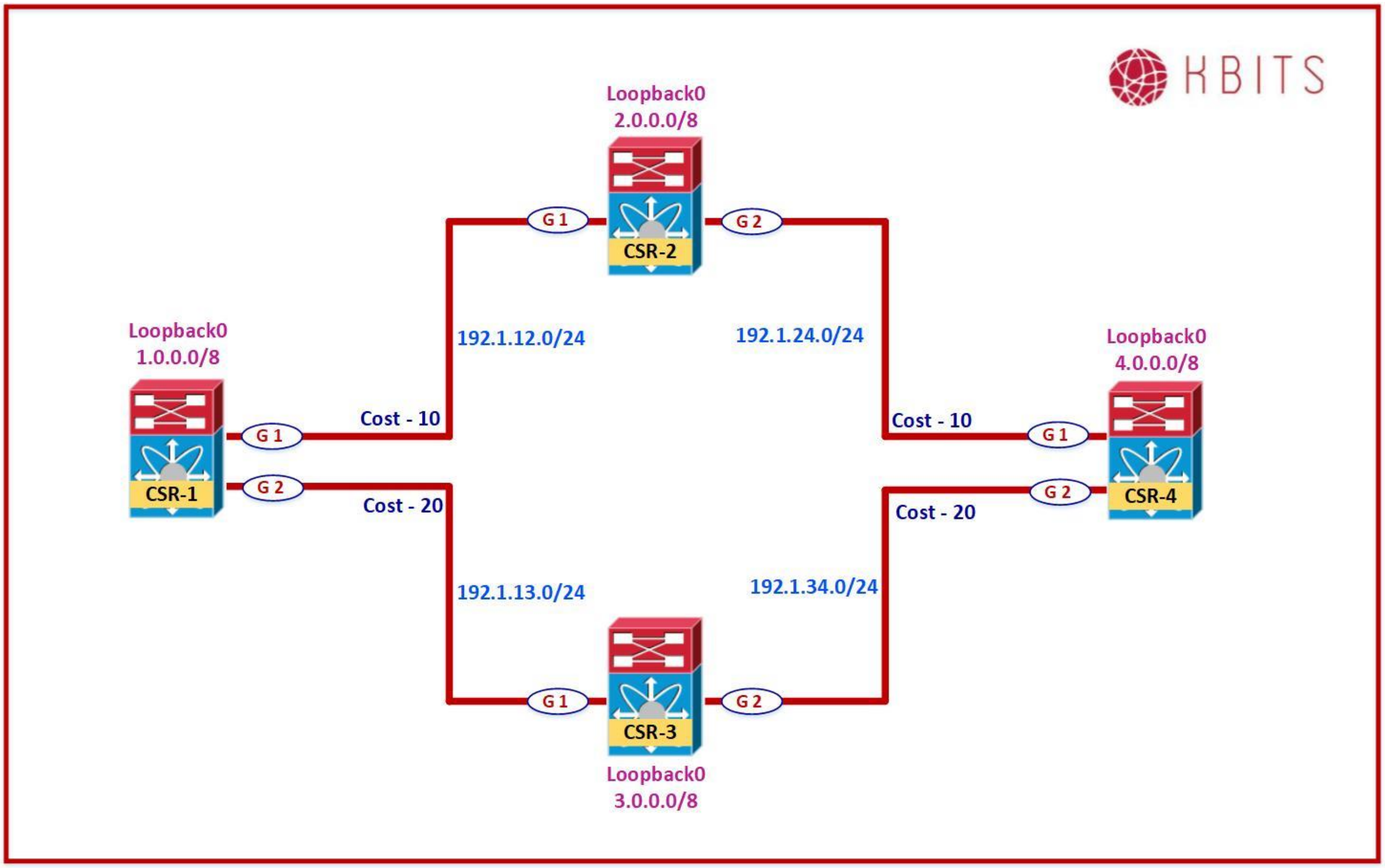
<table>
<tr>
<td>R2

Interface E 0/1
 bfd interval 300 min_rx 300 multiplier 3
!
Router ospf 1
 bfd all-interfaces</td>
<td>R3

Interface E 0/0
 bfd interval 300 min_rx 300 multiplier 3
!
Interface E 0/1
 bfd interval 300 min_rx 300 multiplier 3
!
Router ospf 1
 bfd all-interfaces</td>
</tr>
<tr>
<td>R4

Interface E 0/0
 bfd interval 300 min_rx 300 multiplier 3
!
Router ospf 1
 bfd all-interfaces</td>
<td></td>
</tr>
</table>

Lab 14 – Configuring IP FRR - OSPF



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.0.0.0
G 1	192.1.12.1	255.255.255.0
G 2	192.1.13.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	2.2.2.2	255.0.0.0
G 1	192.1.12.2	255.255.255.0
G 2	192.1.24.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	3.3.3.3	255.0.0.0
G 1	192.1.13.3	255.255.255.0
G 2	192.1.34.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	4.4.4.4	255.0.0.0
G 1	192.1.24.4	255.255.255.0
G 2	192.1.34.4	255.255.255.0

Task 1

Configure OSPF in Area 0 between R1, R2, R3 & R4. Besides the physical links, enable the Loopback 0 interfaces of all 4 routers in Area 0. Loopbacks should be advertised with the Interface Mask. Hard Code the Router-id based on the following:

R1 – 0.0.0.1
R2 – 0.0.0.2
R3 – 0.0.0.3
R4 – 0.0.0.4

R1

```
Router OSPF 1
 Router-id 0.0.0.1
 Network 1.0.0.0 0.255.255.255 area 0
 Network 192.1.12.0 0.0.0.255 area 0
 Network 192.1.13.0 0.0.0.255 area 0
!
Interface Loopback0
 Ip ospf network point-to-point
```

R2

```
Router OSPF 1
 Router-id 0.0.0.2
 Network 2.0.0.0 0.255.255.255 area 0
 Network 192.1.12.0 0.0.0.255 area 0
 Network 192.1.24.0 0.0.0.255 area 0
!
Interface Loopback0
 Ip ospf network point-to-point
```

R3

```
Router OSPF 1
 Router-id 0.0.0.3
 Network 3.0.0.0 0.255.255.255 area 0
 Network 192.1.13.0 0.0.0.255 area 0
 Network 192.1.34.0 0.0.0.255 area 0
!
Interface Loopback0
 Ip ospf network point-to-point
```

R4

```
Router OSPF 1
 Router-id 0.0.0.4
 Network 4.0.0.0 0.255.255.255 area 0
 Network 192.1.24.0 0.0.0.255 area 0
 Network 192.1.34.0 0.0.0.255 area 0
!
Interface Loopback0
 Ip ospf network point-to-point
```

Task 2

Configure the link cost based on the Diagram.

R1	**R2**
Interface Gig1 Ip ospf cost 10 ! Interface Gig2 Ip ospf cost 20	Interface Gig1 Ip ospf cost 10 ! Interface Gig2 Ip ospf cost 10
R3 Interface Gig1 Ip ospf cost 20 ! Interface Gig2 Ip ospf cost 20	**R4** Interface Gig1 Ip ospf cost 10 ! Interface Gig2 Ip ospf cost 20

Task 3

Verify the routing table and CEF on R1 for Network 4.0.0.0/8. It should have a single path via R2 (Lower cost)

R1
Show IP route 4.0.0.0 **Note:** It should have a single path via 192.1.12.2 Show ip cef 4.0.0.0 **Note:** It should have a single path via 192.1.12.2

Task 4

Enable Fast-reroute on all routers in area 0. Configure the Priority as low that creates the backup route for all networks in the OSPF Database.

R1 Router ospf 1 fast-reroute per-prefix enable area 0 prefix-priority low
R2 Router ospf 1 fast-reroute per-prefix enable area 0 prefix-priority low
R3 Router ospf 1 fast-reroute per-prefix enable area 0 prefix-priority low
R4 Router ospf 1 fast-reroute per-prefix enable area 0 prefix-priority low

Task 5

Verify the routing table and CEF on R1 for Network 4.0.0.0/8. It should have a repair path via R3 (higher cost) installed and ready in case the lower cost route goes down.

R1 Show IP route 4.0.0.0 **Note:** It should have a repair path via 192.1.13.3 Show ip cef 4.0.0.0 **Note:** It should have a repair path via 192.1.13.3

Configuring BGP

Authored By:

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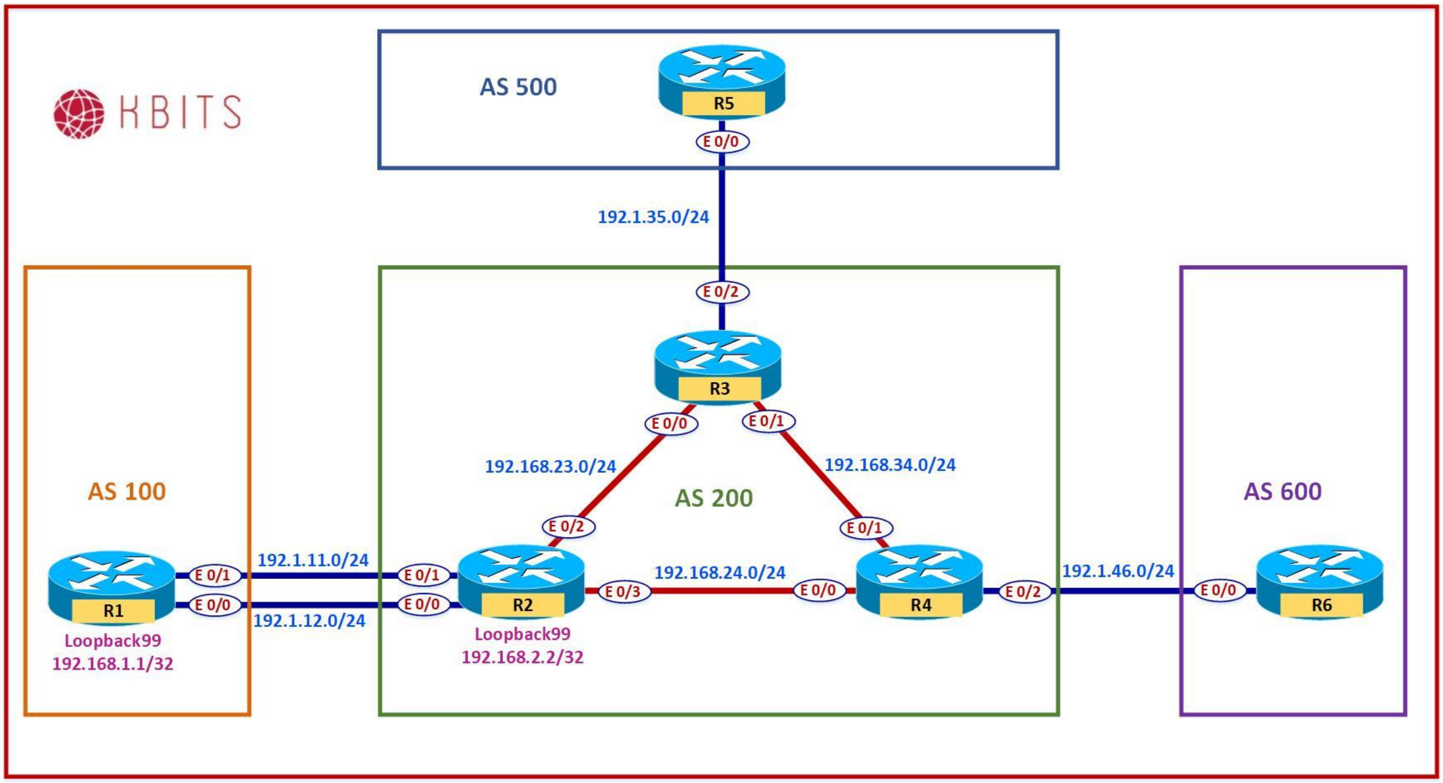
Configuring BGP

Lab 1 – Configuring eBGP



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.0.0.0
Loopback 1	11.1.1.1	255.255.255.0
Loopback 99	192.168.1.1	255.255.255.255
E 0/0	192.1.12.1	255.255.255.0
E 0/1	192.1.11.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	2.2.2.2	255.0.0.0
Loopback 1	22.2.2.2	255.255.255.0
Loopback 10	10.2.2.2	255.255.255.255
Loopback 99	192.168.2.2	255.255.255.255
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.11.2	255.255.255.0

E 0/2	192.168.23.2	255.255.255.0
E 0/3	192.168.24.2	255.255.255.0

R3

Interface	**IP Address**	**Subnet Mask**
Loopback 0	3.3.3.3	255.0.0.0
Loopback 1	33.3.3.3	255.255.255.0
Loopback 10	10.3.3.3	255.255.255.255
E 0/0	192.168.23.3	255.255.255.0
E 0/1	192.168.34.3	255.255.255.0
E 0/2	192.1.35.3	255.255.255.0

R4

Interface	**IP Address**	**Subnet Mask**
Loopback 0	4.4.4.4	255.0.0.0
Loopback 1	44.4.4.4	255.255.255.0
Loopback 10	10.4.4.4	255.255.255.255
E 0/0	192.168.24.4	255.255.255.0
E 0/1	192.168.34.4	255.255.255.0
E 0/2	192.1.46.4	255.255.255.0

R5

Interface	**IP Address**	**Subnet Mask**
Loopback 0	5.5.5.5	255.0.0.0
Loopback 1	55.5.5.5	255.255.255.0
E 0/0	192.1.35.5	255.255.255.0

R6

Interface	**IP Address**	**Subnet Mask**
Loopback 0	6.6.6.6	255.0.0.0
Loopback 1	66.6.6.6	255.255.255.0
E 0/0	192.1.46.6	255.255.255.0

Task 1

Configure a BGP neighbor relationship between R3 and R5. R3 should be in AS 200 and R5 should be in AS 500. Advertise the loopback networks in BGP. Hard-code the Router ID for the BGP routers as 33.33.33.33 for R3 and 55.55.55.55 for R5.

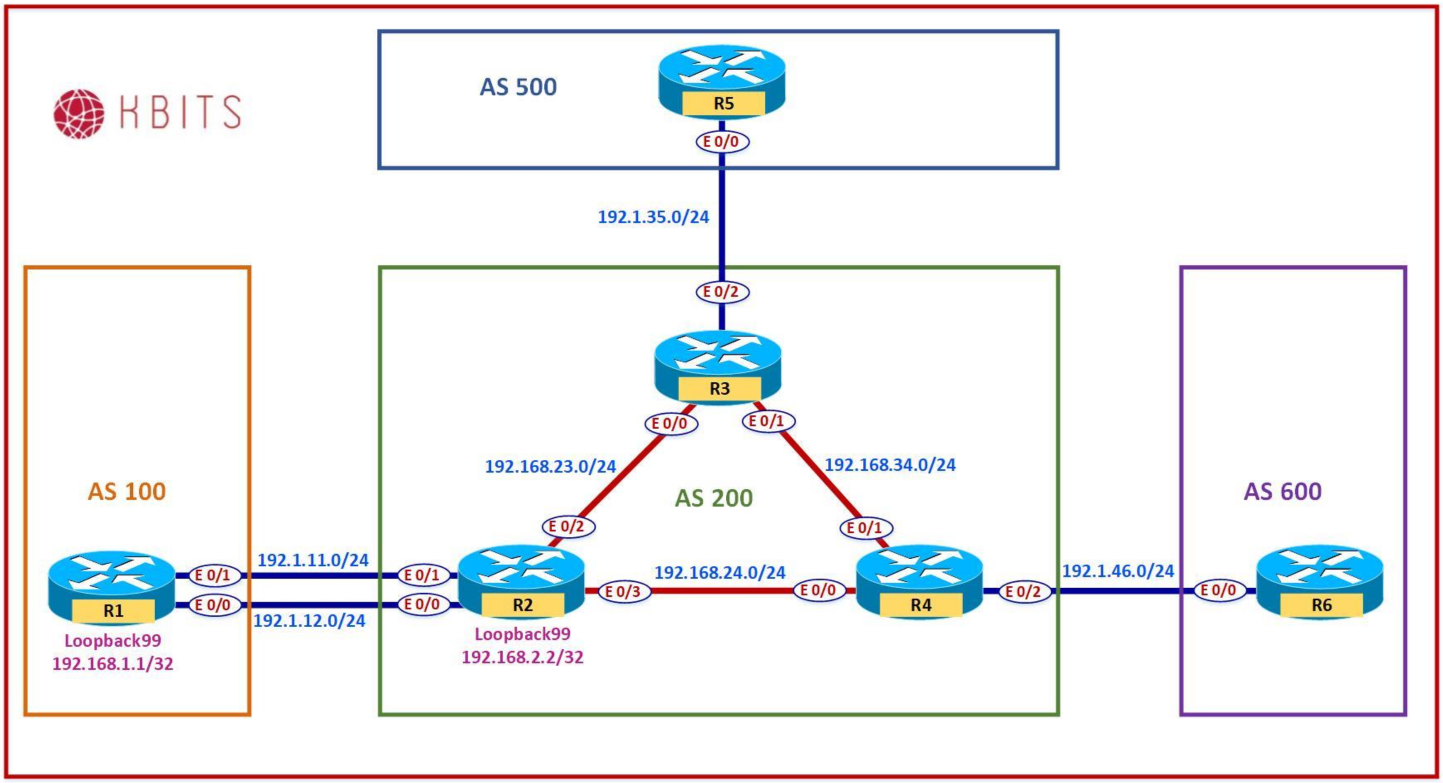
R3	**R5**
Router BGP 200 bgp router-id 33.33.33.33 Network 3.0.0.0 Network 33.3.3.0 mask 255.255.255.0 Neighbor 192.1.35.5 remote-as 500	Router BGP 500 bgp router-id 55.55.55.55 Network 5.0.0.0 Network 55.5.5.0 mask 255.255.255.0 Neighbor 192.1.35.3 remote-as 200

Task 2

Configure a BGP neighbor relationship between R4 and R6. R4 should be in AS 200 and R6 should be in AS 600. Advertise the loopback networks in BGP. Hard-code the Router ID for the BGP routers as 44.44.44.44 for R4 and 66.66.66.66 for R6.

R4	**R6**
Router BGP 200 bgp router-id 44.44.44.44 Network 4.0.0.0 Network 44.4.4.0 mask 255.255.255.0 Neighbor 192.1.46.6 remote-as 600	Router BGP 600 bgp router-id 66.66.66.66 Network 6.0.0.0 Network 66.6.6.0 mask 255.255.255.0 Neighbor 192.1.46.4 remote-as 200

Lab 2 – Configuring eBGP Multi-Hop



Task 1

Configure a Static route on R1 & R2 to reach each others Loopback 99 via the 2 directed connected links.

R1 Ip route 192.168.2.2 255.255.255.255 192.1.11.2 Ip route 192.168.2.2 255.255.255.255 192.1.12.2
R2 Ip route 192.168.1.1 255.255.255.255 192.1.11.1 Ip route 192.168.1.1 255.255.255.255 192.1.12.1

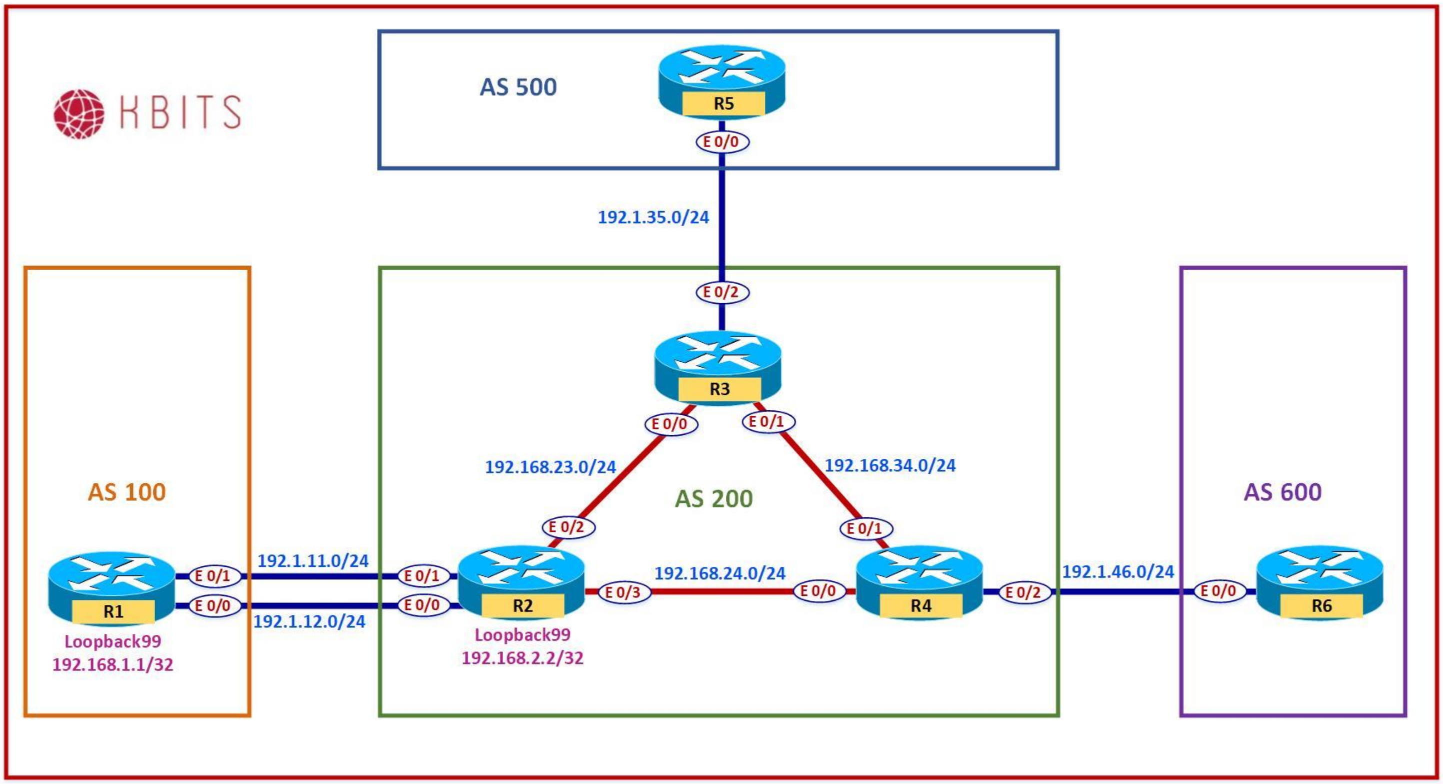
Task 2

Configure a BGP neighbor relationship between R1 & R2 in AS 100 & AS 200 respectively. Use Loopback99 address for the peering.

R1	**R2**
Router BGP 100	Router BGP 200

Neighbor 192.168.2.2 remote-as 200 Neighbor 192.168.2.2 ebgp-multihop	Neighbor 192.168.1.1 remote-as 100 Neighbor 192.168.1.1 ebgp-multihop

Lab 3 – Redistributing Networks into BGP



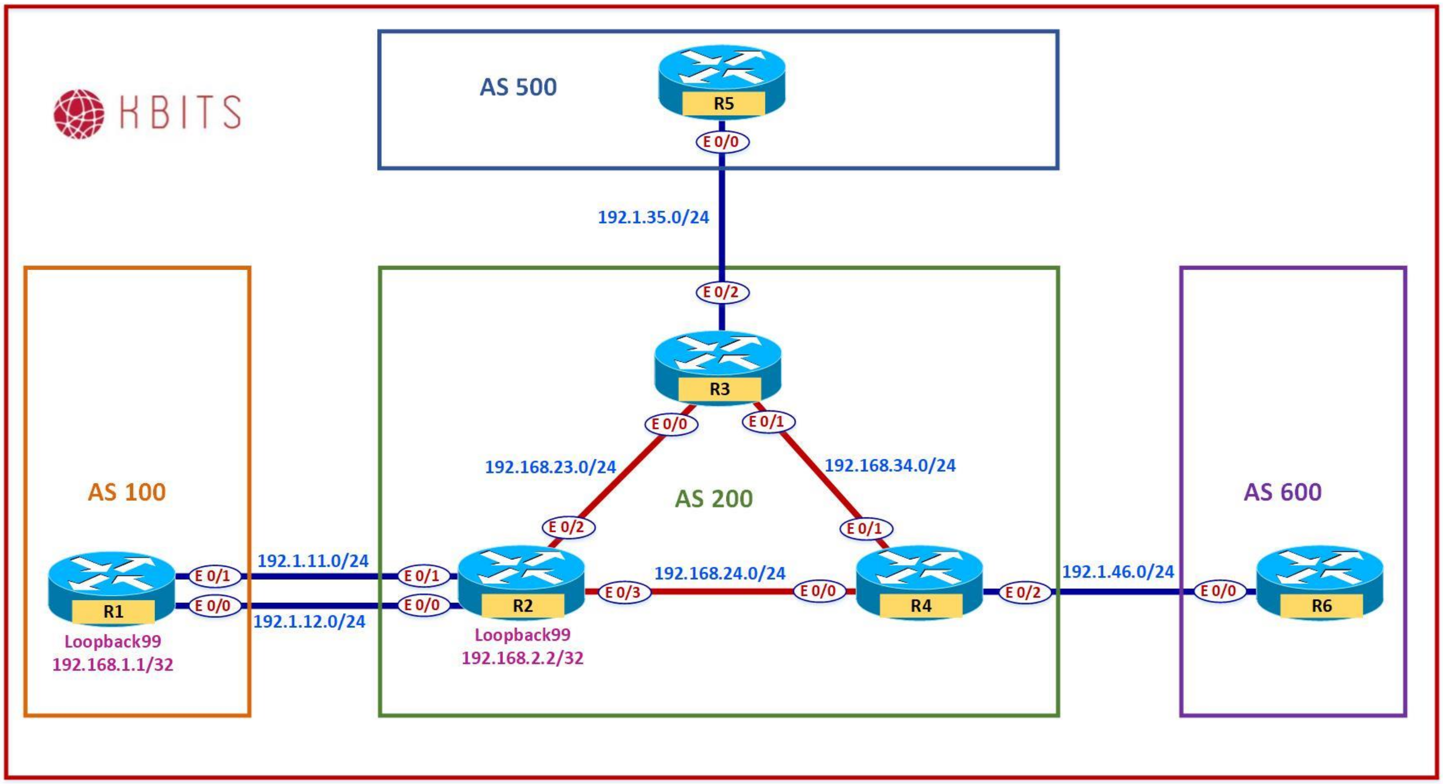
Task 1

Inject Loopback0 & Loopback1 networks on R1 into BGP. Make sure that the routes appear with an origin code of **"i"** in the BGP table.

R1

```
Ip prefix-list RC permit 1.0.0.0/8
Ip prefix-list RC permit 11.1.1.0/24
!
Route-map RC
 Match ip address prefix RC
 Set origin igp
!
Router bgp 100
 Redistribute connected route-map RC
```

Lab 4 – Configuring BGP Authentication

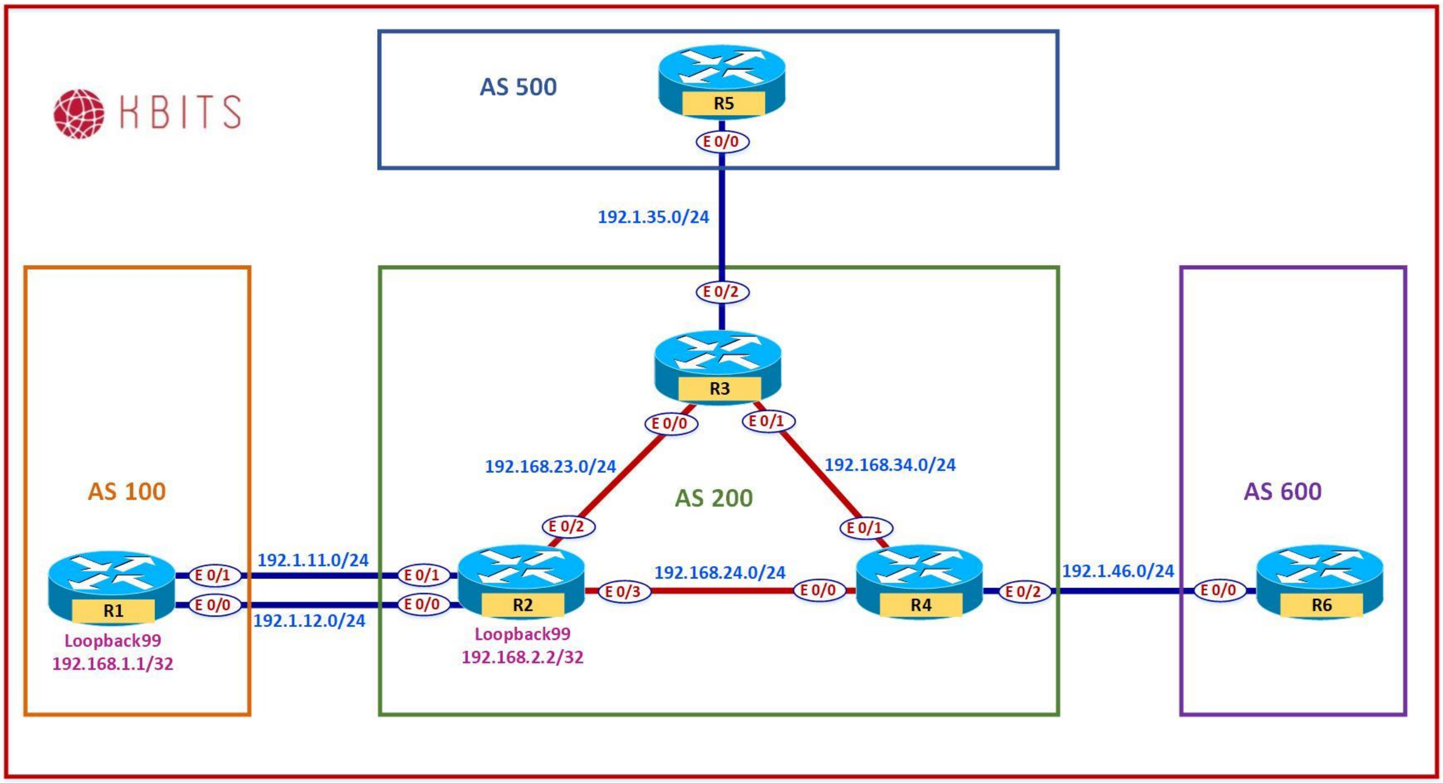


Task 1

Configure MD5 Authentication between all eBGP peers using a password of **ccie123.**

R1 Router BGP 100 Neighbor 192.168.2.2 password ccie123	**R2** Router BGP 200 Neighbor 192.168.2.2 password ccie123
R3 Router BGP 200 Neighbor 192.1.35.5 password ccie123	**R5** Router BGP 500 Neighbor 192.1.35.3 password ccie123
R4 Router BGP 200 Neighbor 192.1.46.6 password ccie123	**R6** Router BGP 600 Neighbor 192.1.46.4 password ccie123

Lab 5 – Configuring iBGP with Route Reflectors



Task 1

Configure IS-IS as the IGP to route the Loopback10 networks within AS 200. Configure IS-IS with a 24-bit metric. The IS-IS neighbors should maintain a Level-2 database only. Use the following for the NET address:

R2 – 49.0000.2222.2222.2222.00
R3 – 49.0000.3333.3333.3333.00
R4 – 49.0000.4444.4444.4444.00

R2	R3
Router isis Net 49.0000.2222.2222.2222.00 Is-type level-2 Metric-style wide ! Interface loopback10 Ip router isis	Router isis Net 49.0000.3333.3333.3333.00 Is-type level-2 Metric-style wide ! Interface loopback10 Ip router isis

! Interface E 0/2 Ip router isis ! Interface E 0/3 Ip router isis	! Interface E 0/0 Ip router isis ! Interface E 0/1 Ip router isis
R4 Router isis Net 49.0000.4444.4444.4444.00 Is-type level-2 Metric-style wide ! Interface loopback10 Ip router isis ! Interface E 0/0 Ip router isis ! Interface E 0/1 Ip router isis	

Task 2

Configure an iBGP neighbor relationship between R2 & R3. The neighbor relationship should be configured with redundancy in mind. Make sure that the eBGP routes are propagated and injected into the BGP table.

R2 Router BGP 200 Neighbor 10.3.3.3 remote-as 200 Neighbor 10.3.3.3 update-source loop10 Neighbor 10.3.3.3 next-hop-self	**R2** Router BGP 200 Neighbor 10.2.2.2 remote-as 200 Neighbor 10.2.2.2 update-source loop10 Neighbor 10.2.2.2 next-hop-self

Task 3

Configure an iBGP neighbor relationship between R3 & R4. The neighbor relationship should be configured with redundancy in mind. Make sure that the eBGP routes are propagated and injected into the BGP table.

R3 Router BGP 200 Neighbor 10.4.4.4 remote-as 200 Neighbor 10.4.4.4 update-source loop10 Neighbor 10.4.4.4 next-hop-self	**R4** Router BGP 200 Neighbor 10.3.3.3 remote-as 200 Neighbor 10.3.3.3 update-source loop10 Neighbor 10.3.3.3 next-hop-self

Verification:

- Make sure that AS 500 Loopbacks can reach the Loopback interfaces in AS 100, AS 200 & AS 600.

- Try the reachability between the AS 100 & AS 600 loopbacks? Are they reachable?

Task 4

Re-configure R3 such that it propagates the routes from R2 towards R4 and vice versa. Use Peer-group to accomplish this task.

R3

```
Router BGP 200
 No neighbor 10.2.2.2
 No neighbor 10.4.4.4
 Neighbor IBGP peer-group
 Neighbor IBGP remote-as 200
 Neighbor IBGP update-source Loopback10
 Neighbor IBGP next-hop-self
 Neighbor IBGP route-reflector-client
 Neighbor 10.2.2.2 peer-group IBGP
 Neighbor 10.4.4.4 peer-group IBGP
```

Verification:

- Try the reachability between the AS 100 & AS 600 loopbacks? Are they reachable?

- Trace a packet from R1 to R6 (1.1.1.1 to 6.6.6.6). What path does it take?

Task 5

You would like the RR to be an "inline RR". This is for the purpose of future Data Filtering. Configure R3 to accomplish this.

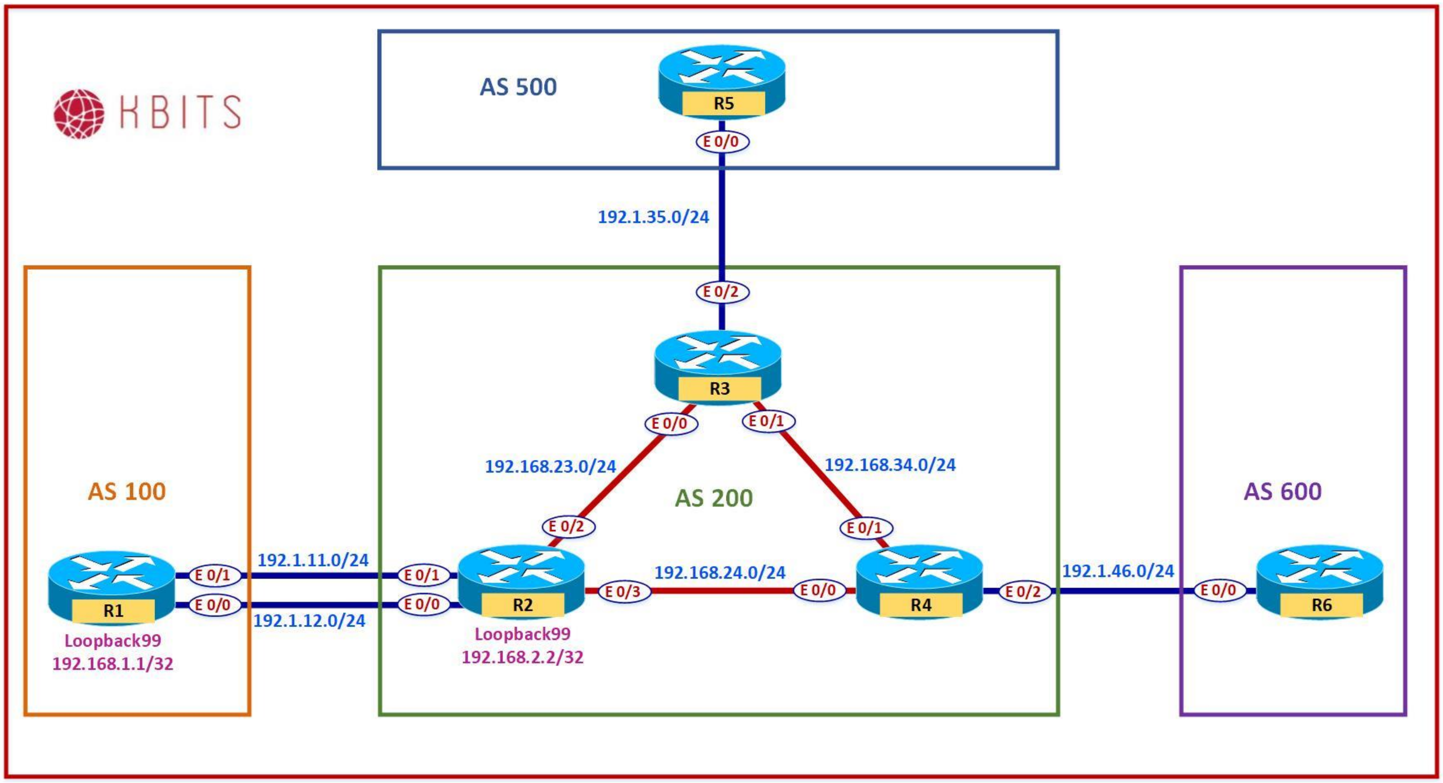
R3

```
Router BGP 200
 Neighbor IBGP next-hop-self all
```

Verification:

- Trace a packet from R1 to R6 (1.1.1.1 to 6.6.6.6). What path does it take?

Lab 6 – Route Filtering using ACLs



Task 1

Create the following Loopbacks on R2

Loopback 1 – 192.2.1.1/24
Loopback 2 – 192.2.2.1/24
Loopback 3 – 192.2.3.1/24
Loopback 4 – 192.2.4.1/24
Loopback 5 – 192.2.5.1/24
Loopback 6 – 192.2.6.1/24
Loopback 7 – 192.2.7.1/24
Loopback 8 – 192.2.8.1/24

R2

```
interface Loopback1
 ip address 192.2.1.1 255.255.255.0
!
interface Loopback2
 ip address 192.2.2.1 255.255.255.0
!
```

```
interface Loopback3
 ip address 192.2.3.1 255.255.255.0
!
interface Loopback4
 ip address 192.2.4.1 255.255.255.0
!
interface Loopback5
 ip address 192.2.5.1 255.255.255.0
!
interface Loopback6
 ip address 192.2.6.1 255.255.255.0
!
interface Loopback7
 ip address 192.2.7.1 255.255.255.0
!
interface Loopback8
 ip address 192.2.8.1 255.255.255.0
```

Task 2

Advertise the newly created routes in BGP. Do not use the network command to accomplish this. These routes should have an origin code of “igp”.

R2

```
Access-list 1 permit 192.2.1.1 0.0.0.255
Access-list 1 permit 192.2.2.1 0.0.0.255
Access-list 1 permit 192.2.3.1 0.0.0.255
Access-list 1 permit 192.2.4.1 0.0.0.255
Access-list 1 permit 192.2.5.1 0.0.0.255
Access-list 1 permit 192.2.6.1 0.0.0.255
Access-list 1 permit 192.2.7.1 0.0.0.255
Access-list 1 permit 192.2.8.1 0.0.0.255
!
Route-map RC permit 10
 Match address 1
 Set origin igp
!
Router bgp 200
 Redistribute connected route-map RC
```

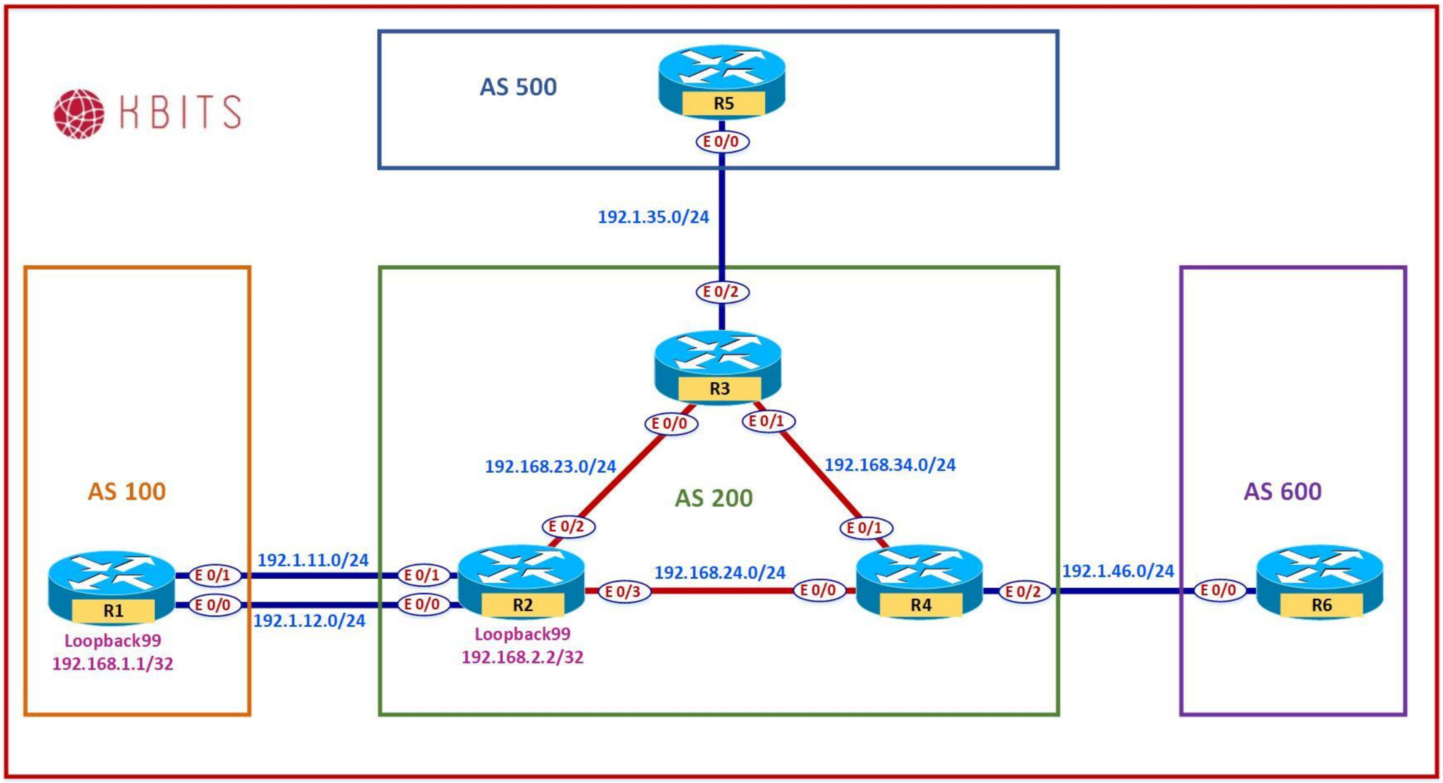
Task 3
Configure R2 such that it blocks all the 192.2.X.0 routes that have an odd number in the third octet from propagating outside the local AS. Use the distribute-list command to accomplish this task.

```
R2

Access-list 2 deny 192.2.1.0 0.0.254.255
Access-list 2 permit any
!
Router bgp 200
 Neighbor 192.168.1.1 distribute-list 2 out
```

Task 4
Configure R3 such that it blocks all the 192.2.X.0 routes that have an even number in the third octet from propagating from R2. Use the distribute-list command to accomplish this task.

```
R3

Access-list 1 deny 192.2.0.0 0.0.254.255
Access-list 1 permit any
!
Router bgp 200
 Neighbor 10.2.2.2 distribute-list 1 in
```

Lab 7 – Route Filtering using Prefix-Lists



Task 1

Create the following Loopbacks on R3

Loopback 1 – 150.3.16.1/20
Loopback 2 – 150.3.36.1/22
Loopback 3 – 150.3.40.1/22
Loopback 4 – 150.3.50.1/23
Loopback 5 – 150.3.65.1/24
Loopback 6 – 150.13.0.1/16
Loopback 7 – 150.14.64.1/18

R3

```
interface Loopback1
 ip address 150.3.16.1 255.255.240.0
!
interface Loopback2
 ip address 150.3.36.1 255.255.252.0
!
interface Loopback3
```

```
 ip address 150.3.40.1 255.255.252.0
!
interface Loopback4
 ip address 150.3.50.1 255.255.254.0
!
interface Loopback5
 ip address 150.3.65.1 255.255.255.0
!
interface Loopback6
 ip address 150.13.0.1 255.255.0.0
!
interface Loopback7
 ip address 150.14.64.1 255.255.192.0
```

Task 2

Advertise the newly created routes in BGP using the Network command.

R3

```
Router bgp 200
 Network 150.3.16.0 mask 255.255.240.0
 Network 150.3.36.0 mask  255.255.252.0
 Network 150.3.40.0 mask 255.255.252.0
 Network 150.3.50.0 mask  255.255.254.0
 Network 150.3.65.0 mask 255.255.255.0
 Network 150.13.0.0
 Network 150.14.64.0 mask 255.255.192.0
```

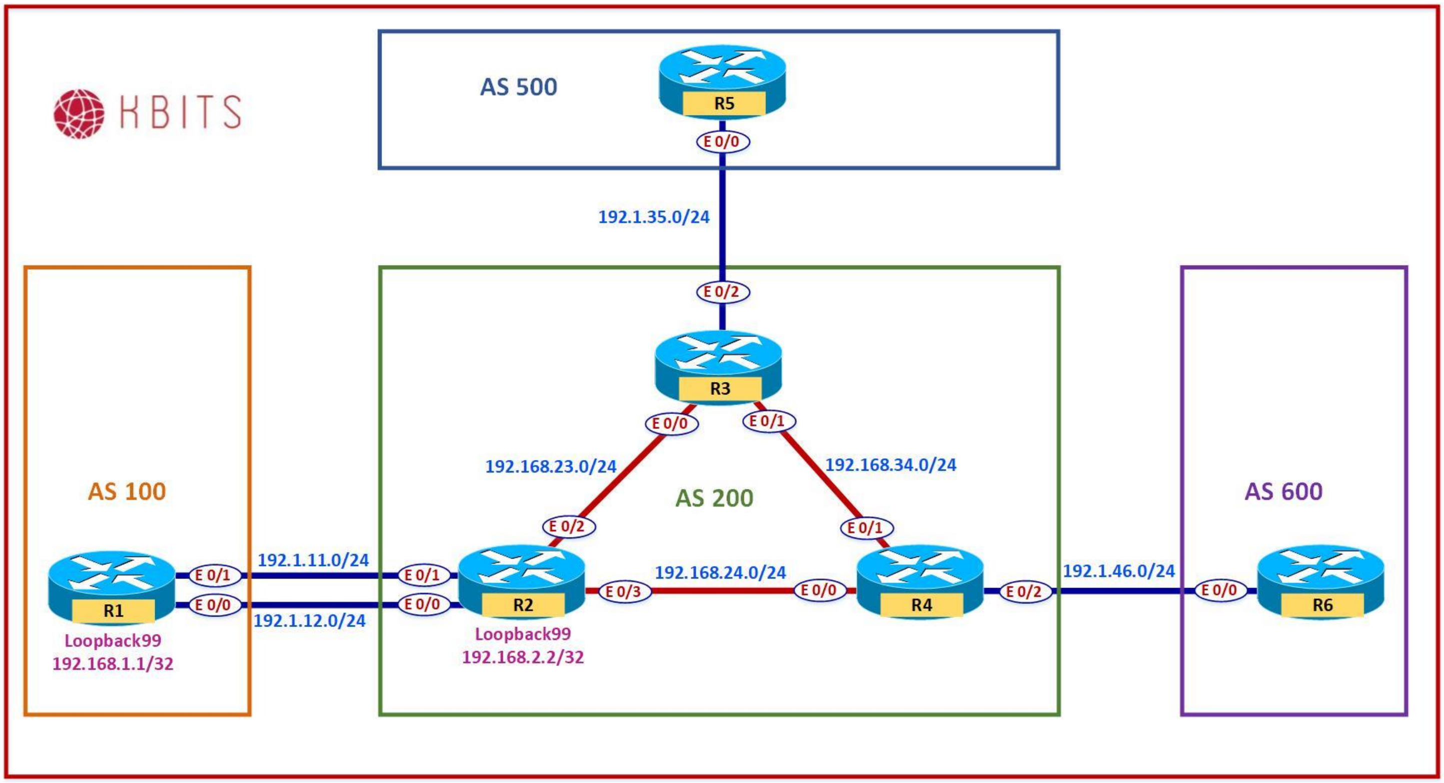
Task 3

Configure R2 such that it blocks all the 150.X.X.0 routes that have a subnet mask between 17 and 23 bits coming in from R3.

R2

```
IP Prefix-list PLIST1 deny 150.0.0.0/8 ge 17 le 23
IP Prefix-list PLIST1 permit 0.0.0.0/0 le 32
!
Router bgp 200
 Neighbor 10.3.3.3 prefix-list PLIST1 in
```

Lab 8 – Route Filtering using AS Path-Filter



Task 1
Configure BGP such that AS 500 does not use AS 200 as a transit AS. Configuration should be done in AS 500.

R5

```
Ip as-path access-list 1 permit ^200$
!
Router BGP 500
 Neighbor 192.1.35.3 filter-list 1 in
```

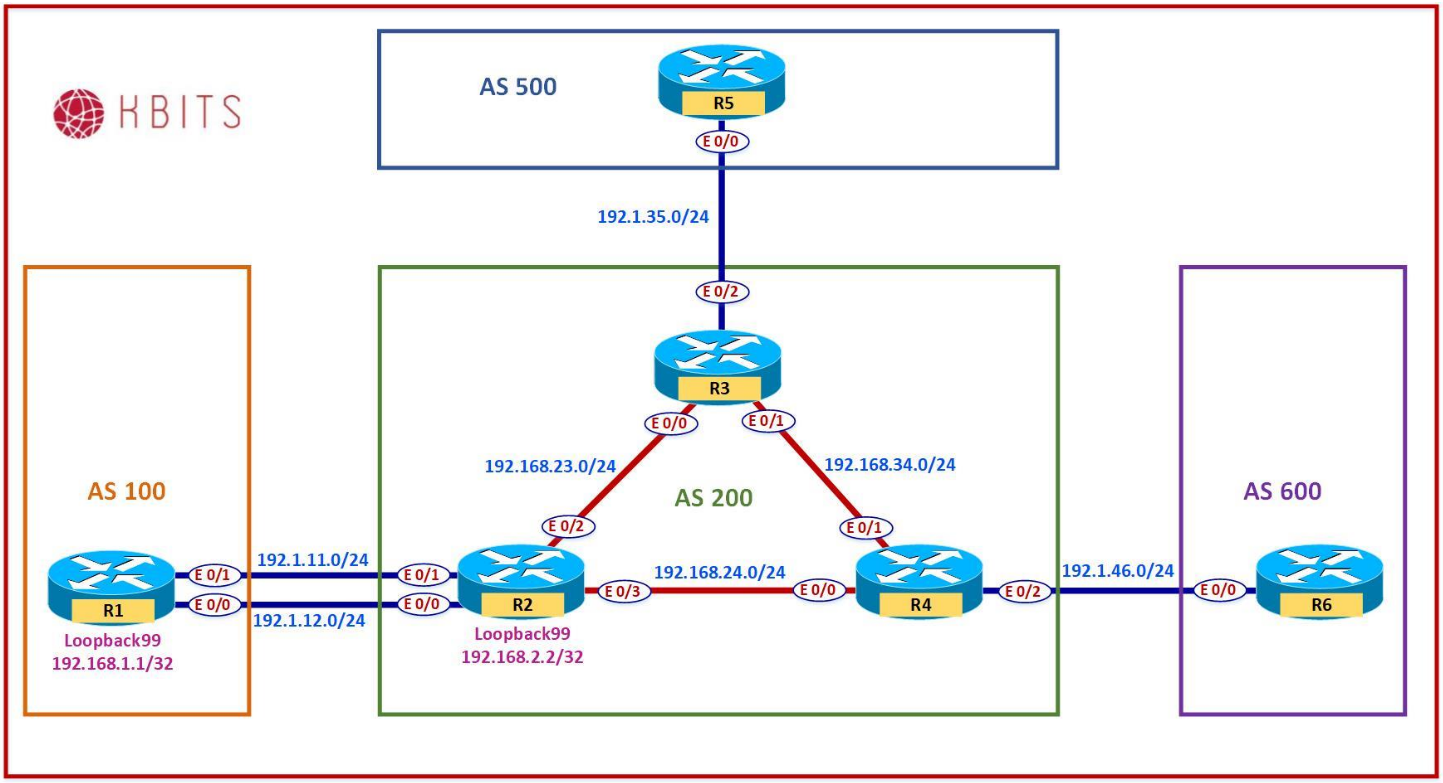
Task 2
Configure BGP such that AS 100 does not use AS 200 to get AS 500 routes. Configuration should be done in AS 200. You are only allowed a single line in the AS-path filter.

R2

```
Ip as-path access-list 1 permit ^$
```

```
!
Router BGP 200
 Neighbor 192.168.1.1 filter-list 1 out
```

Lab 9 – Configuring Route Aggregation – Summary Only



Task 1

Create the following Loopbacks on R3 and advertise them under BGP:

Loopback 1 – 203.1.4.1/24
Loopback 2 – 203.1.5.1/24
Loopback 3 – 203.1.6.1/24
Loopback 4 – 203.1.7.1/24

R3

```
interface Loopback1
 ip address 203.1.4.1 255.255.255.0
!
interface Loopback2
 ip address 203.1.5.1 255.255.255.0
!
interface Loopback3
 ip address 203.1.6.1 255.255.255.0
!
interface Loopback4
```

```
 ip address 203.1.7.1 255.255.255.0
!
Router BGP 200
 Network 203.1.4.0
 Network 203.1.5.0
 Network 203.1.6.0
 Network 203.1.7.0
```

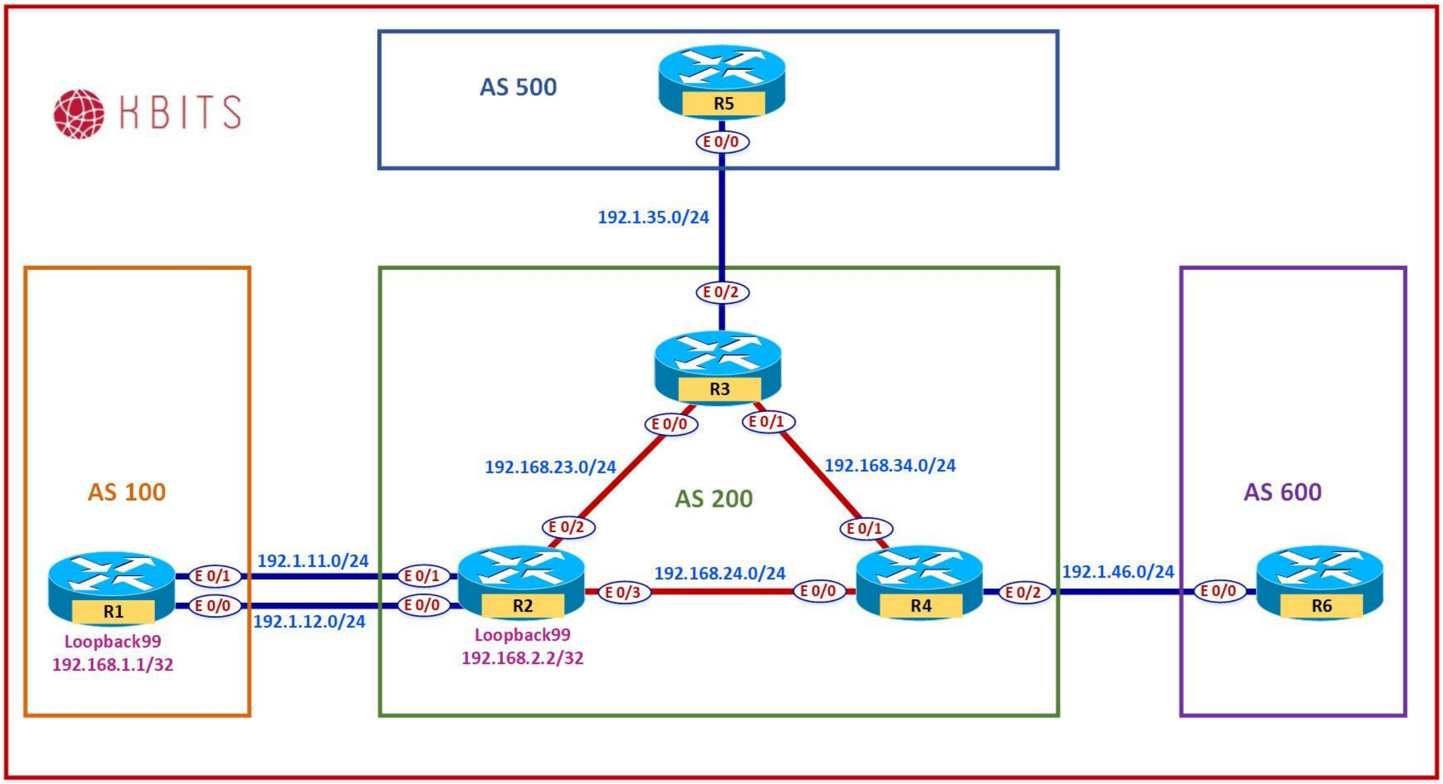
Task 2

Configure Route Aggregation on R3 such that these routes are summarized as a single route. Only the Summary route should be send to R3's neighbors.

R3

```
Router bgp 200
 Aggregate-address 203.1.4.0 255.255.252.0 summary-only
```

Lab 10 – Configuring Route Aggregation – Manual Filtering



Task 1

Create the following Loopbacks on R4 and advertise them under BGP:

Loopback 1 – 204.1.4.1/24
Loopback 2 – 204.1.5.1/24
Loopback 3 – 204.1.6.1/24
Loopback 4 – 204.1.7.1/24

R4

```
interface Loopback1
 ip address 204.1.4.1 255.255.255.0
!
interface Loopback2
 ip address 204.1.5.1 255.255.255.0
!
interface Loopback3
 ip address 204.1.6.1 255.255.255.0
```

```
!
interface Loopback4
 ip address 204.1.7.1 255.255.255.0
!
Router BGP 200
 Network 204.1.4.0
 Network 204.1.5.0
 Network 204.1.6.0
 Network 204.1.7.0
```

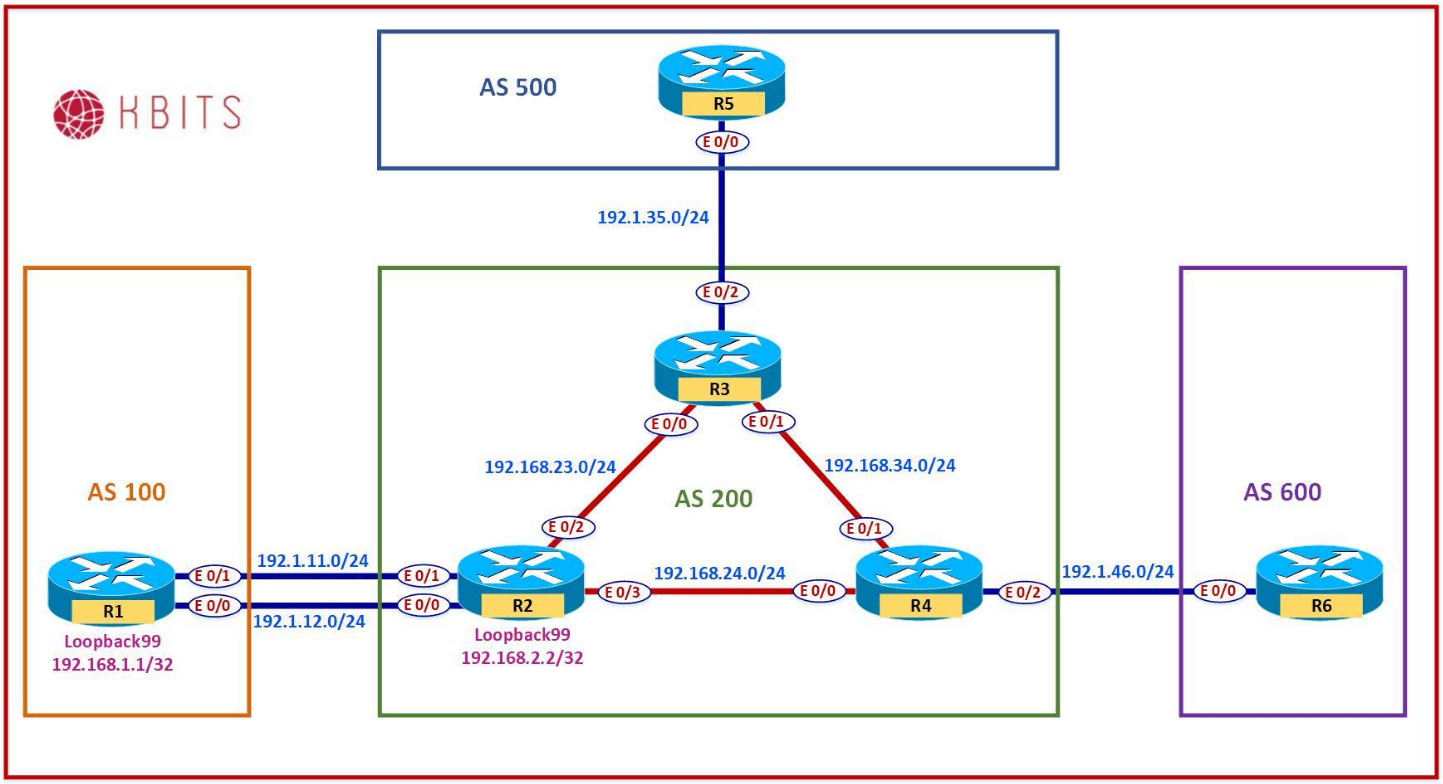
Task 2

Configure Route Aggregation on R4 such that these routes are summarized as a single route. Only the Summary Route should be sent towards the eBGP neighbor (R6). Only the Specific Routes should be sent towards the iBGP neighbor (R3). The routes should not be seen as suppressed on R4.

R4

```
IP Prefix-list PLIST-R6 deny 204.1.4.0/22 ge 24
IP Prefix-list PLIST-R6 permit 0.0.0.0/0 le 32
!
IP Prefix-list PLIST-R3 deny 204.1.4.0/22
IP Prefix-list PLIST-R3 permit 0.0.0.0/0 le 32
!
Router bgp 200
 Aggregate-address 204.1.4.0 255.255.252.0
 Neighbor 192.1.46.6 prefix-list PLIST-R6 out
 Neighbor 10.3.3.3 prefix-list PLIST-R3 out
```

Lab 11 – Configuring Route Aggregation – Suppress Maps



Task 1

Create the following Loopbacks on R2 and advertise them under BGP:

Loopback 1 – 202.1.4.1/24
Loopback 2 – 202.1.5.1/24
Loopback 3 – 202.1.6.1/24
Loopback 4 – 202.1.7.1/24

R2

```
interface Loopback1
 ip address 202.1.4.1 255.255.255.0
!
interface Loopback2
 ip address 202.1.5.1 255.255.255.0
!
interface Loopback3
 ip address 202.1.6.1 255.255.255.0
```

```
!
interface Loopback4
 ip address 202.1.7.1 255.255.255.0
!
Router BGP 234
 Network 202.1.4.0
 Network 202.1.5.0
 Network 202.1.6.0
 Network 202.1.7.0
```

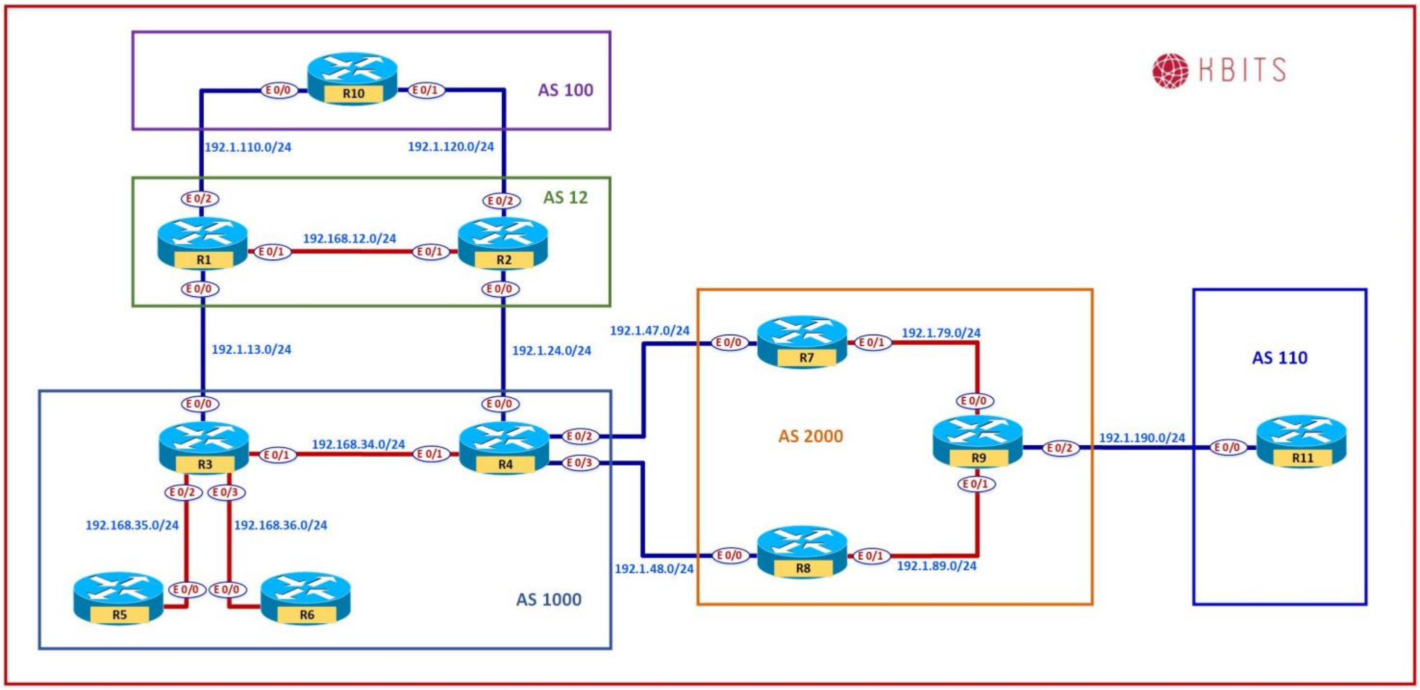
Task 2

Configure Route Aggregation on R2 such that these routes are summarized as a single route. Only the Summary route and the 202.1.5.0 route should be send to R2's neighbors. The other specific routes should be seen as suppressed on R2.

R2

```
Access-list 5 permit 202.1.5.0 0.0.0.255
!
Route-map SUPMAP deny 10
 Match address 5
Route-map SUPMAP permit 20
!
Router bgp 200
 Aggregate-address 202.1.4.0 255.255.252.0 supress-map SUPMAP
```

Lab 12 – Configuring Base BGP Topology – eBGP & iBGP



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.0.0.0
Loopback 1	11.1.1.1	255.255.255.0
Loopback 10	10.1.1.1	255.255.255.255
E 0/0	192.1.13.1	255.255.255.0
E 0/1	192.168.12.1	255.255.255.0
E 0/2	192.1.110.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	2.2.2.2	255.0.0.0
Loopback 1	22.2.2.2	255.255.255.0
Loopback 10	10.2.2.2	255.255.255.255
E 0/0	192.1.24.2	255.255.255.0
E 0/1	192.168.12.2	255.255.255.0
E 0/2	192.1.120.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	3.3.3.3	255.0.0.0
Loopback 1	33.3.3.3	255.255.255.0
Loopback 10	10.3.3.3	255.255.255.255
E 0/0	192.1.13.3	255.255.255.0
E 0/1	192.168.34.3	255.255.255.0
E 0/2	192.168.35.3	255.255.255.0
E 0/3	192.168.36.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	4.4.4.4	255.0.0.0
Loopback 1	44.4.4.4	255.255.255.0
Loopback 10	10.4.4.4	255.255.255.255
E 0/0	192.1.24.4	255.255.255.0
E 0/1	192.168.34.4	255.255.255.0
E 0/2	192.1.47.4	255.255.255.0
E 0/3	192.1.48.4	255.255.255.0

R5

Interface	IP Address	Subnet Mask
Loopback 0	5.5.5.5	255.0.0.0
Loopback 1	55.5.5.5	255.255.255.0
E 0/0	192.168.35.5	255.255.255.0

R6

Interface	IP Address	Subnet Mask
Loopback 0	6.6.6.6	255.0.0.0
Loopback 1	66.6.6.6	255.255.255.0
E 0/0	192.168.36.6	255.255.255.0

R7

Interface	IP Address	Subnet Mask
Loopback 0	7.7.7.7	255.0.0.0
Loopback 1	77.7.7.7	255.255.255.0
Loopback 10	10.7.7.7	255.255.255.255
E 0/0	192.1.47.7	255.255.255.0
E 0/1	192.168.79.7	255.255.255.0

R8

Interface	IP Address	Subnet Mask
Loopback 0	8.8.8.8	255.0.0.0
Loopback 1	88.8.8.8	255.255.255.0
Loopback 10	10.8.8.8	255.255.255.255
E 0/0	192.1.48.8	255.255.255.0
E 0/1	192.168.89.8	255.255.255.0

R9

Interface	IP Address	Subnet Mask
Loopback 0	9.9.9.9	255.0.0.0
Loopback 1	99.9.9.9	255.255.255.0
Loopback 10	10.9.9.9	255.255.255.255
E 0/0	192.168.79.9	255.255.255.0
E 0/1	192.168.89.9	255.255.255.0
E 0/2	192.1.190.9	255.255.255.0

R10

Interface	IP Address	Subnet Mask
Loopback 0	100.100.100.10	255.0.0.0
Loopback 1	101.101.101.10	255.255.255.0
E 0/0	192.1.110.10	255.255.255.0
E 0/1	192.1.120.10	255.255.255.0

R11

Interface	IP Address	Subnet Mask
Loopback 0	111.111.111.11	255.0.0.0
Loopback 1	112.112.112.11	255.255.255.0
E 0/0	192.1.190.11	255.255.255.0

Task 1

Configure eBGP neighbor relationships between R10 in AS 100 with R1 & R2 in AS 12. Advertise all public loopback networks in BGP.

R1	R2
Router BGP 12 Network 1.0.0.0 Network 11.1.1.0 mask 255.255.255.0 Neighbor 192.1.110.10 remote-as 100	Router BGP 12 Network 2.0.0.0 Network 22.2.2.0 mask 255.255.255.0 Neighbor 192.1.120.10 remote-as 100
R10 Router BGP 100 Network 100.0.0.0 Network 101.101.101.0 mask 255.255.255.0 Neighbor 192.1.110.1 remote-as 12 Neighbor 192.1.120.1 remote-as 12	

Task 2

Configure iBGP neighbor relationships between R1 & R2 in AS 12. Configure the neighbor relationship based on a private loopback address. Use EIGRP 12 as the underlay IGP.

R1	R2
Router eigrp 12 Network 192.168.12.0 Network 10.0.0.0 ! Router BGP 12 Neighbor 10.2.2.2 remote-as 12 Neighbor 10.2.2.2 update-source Lo10 Neighbor 10.2.2.2 next-hop-self	Router eigrp 12 Network 192.168.12.0 Network 10.0.0.0 ! Router BGP 12 Neighbor 10.1.1.1 remote-as 12 Neighbor 10.1.1.1 update-source Lo10 Neighbor 10.1.1.1 next-hop-self

Task 3

Configure eBGP neighbor relationships between R1 in AS 12 and R3 in AS 1000. Advertise all public loopback networks on R3 in BGP.

R1	R3
Router BGP 12 Neighbor 192.1.13.3 remote-as 1000	Router BGP 1000 Network 3.0.0.0 Network 33.3.3.0 mask 255.255.255.0 Neighbor 192.1.13.1 remote-as 12

Task 4

Configure eBGP neighbor relationships between R2 in AS 12 and R4 in AS 1000. Advertise all public loopback networks on R4 in BGP.

R2	R4
Router BGP 12 Neighbor 192.1.24.4 remote-as 1000	Router BGP 1000 Network 4.0.0.0 Network 44.4.4.0 mask 255.255.255.0 Neighbor 192.1.24.2 remote-as 12

Task 5

Configure iBGP neighbor relationships between R3 & R4 in AS 1000. Configure the neighbor relationship based on the physical link.

R3	R4
Router BGP 1000 Neighbor 192.168.34.4 remote-as 1000 Neighbor 192.168.34.4 next-hop-self	Router BGP 1000 Neighbor 192.168.34.3 remote-as 1000 Neighbor 192.168.34.3 next-hop-self

Task 6

Configure OSPF as the IGP to connect R3 to R6 in Area 0. Only enable OSPF on the R3-R6 physical link on R3. Enable OSPF on all interfaces on R6 in area 0. Configure Mutual Redistribution on R3 between OSPF and BGP

R3	R6
Router ospf 1 Network 192.168.36.0 0.0.0.255 area 0 Redistribute bgp 1000 ! Router bgp 1000 Redistribute ospf 1	Router ospf 1 Network 6.0.0.0 0.255.255.255 area 0 Network 66.0.0.0 0.255.255.255 area 0 Network 192.168.36.0 0.0.0.255 area 0

Task 7

Configure iBGP neighbor relationships between R3 & R5 in AS 1000. Configure the neighbor relationship based on the physical link.

R3	R5
Router BGP 1000 Neighbor 192.168.35.5 remote-as 1000 Neighbor 192.168.35.5 next-hop-self	Router BGP 1000 Neighbor 192.168.35.3 remote-as 1000 Neighbor 192.168.35.3 next-hop-self

Task 8

Configure eBGP neighbor relationships between R4 in AS 1000 with R7 & R8 in AS 2000. Advertise all public loopback networks in BGP on R7 & R8.

R7	R8
Router BGP 2000 Network 7.0.0.0 Network 77.7.7.0 mask 255.255.255.0 Neighbor 192.1.47.4 remote-as 1000	Router BGP 2000 Network 8.0.0.0 Network 88.8.8.0 mask 255.255.255.0 Neighbor 192.1.48.4 remote-as 1000
R4 Router BGP 1000 Neighbor 192.1.47.4 remote-as 2000 Neighbor 192.1.48.4 remote-as 2000	

Task 9

Configure iBGP neighbor relationships between R7, R8 & R9 in AS 2000. Advertise the public loopback addresses of R9 in BGP. Configure the neighbor relationship based on a private loopback address. Use IS-IS in area 49.0000 as the underlay IGP. Use System-ID on your choice. Configure R9 as the Route Reflector for R7 & R8. Do not configure a direct BGP peering between R7 & R8.

<table>
<tr>
<td>

R7

```
Router isis
 Net 49.0000.7777.7777.7777.00
 Is-type level-2
!
Interface E 0/1
 Ip router isis
!
Interface Loopback10
 Ip router isis
!
Router BGP 2000
 Neighbor 10.9.9.9 remote-as 2000
 Neighbor 10.9.9.9 update-source Lo10
 Neighbor 10.9.9.9next-hop-self
```

</td>
<td>

R8

```
Router isis
 Net 49.0000.8888.8888.8888.00
 Is-type level-2
!
Interface E 0/1
 Ip router isis
!
Interface Loopback10
 Ip router isis
!
Router BGP 2000
 Neighbor 10.9.9.9 remote-as 2000
 Neighbor 10.9.9.9 update-source Lo10
 Neighbor 10.9.9.9next-hop-self
```

</td>
</tr>
<tr>
<td colspan="2">

R9

```
Router isis
 Net 49.0000.9999.9999.9999.00
 Is-type level-2
!
Interface E 0/0
 Ip router isis
!
Interface E 0/1
 Ip router isis
!
Interface Loopback10
 Ip router isis
!
Router BGP 2000
 Network 9.0.0.0
 Network 99.9.9.0 mask 255.255.255.0
 Neighbor IBGP peer-group
 Neighbor IBGP remote-as 2000
```

</td>
</tr>
</table>

```
 Neighbor IBGP update-source Lo10
 Neighbor IBGP next-hop-self
 Neighbor IBGP route-reflector-client
 Neighbor 10.7.7.7 peer-group IBGP
 Neighbor 10.8.8.8 peer-group IBGP
```

Task 10

Configure eBGP neighbor relationships between R9 in AS 2000 and R11 in AS 110. Advertise all public loopback networks on R11 in BGP.

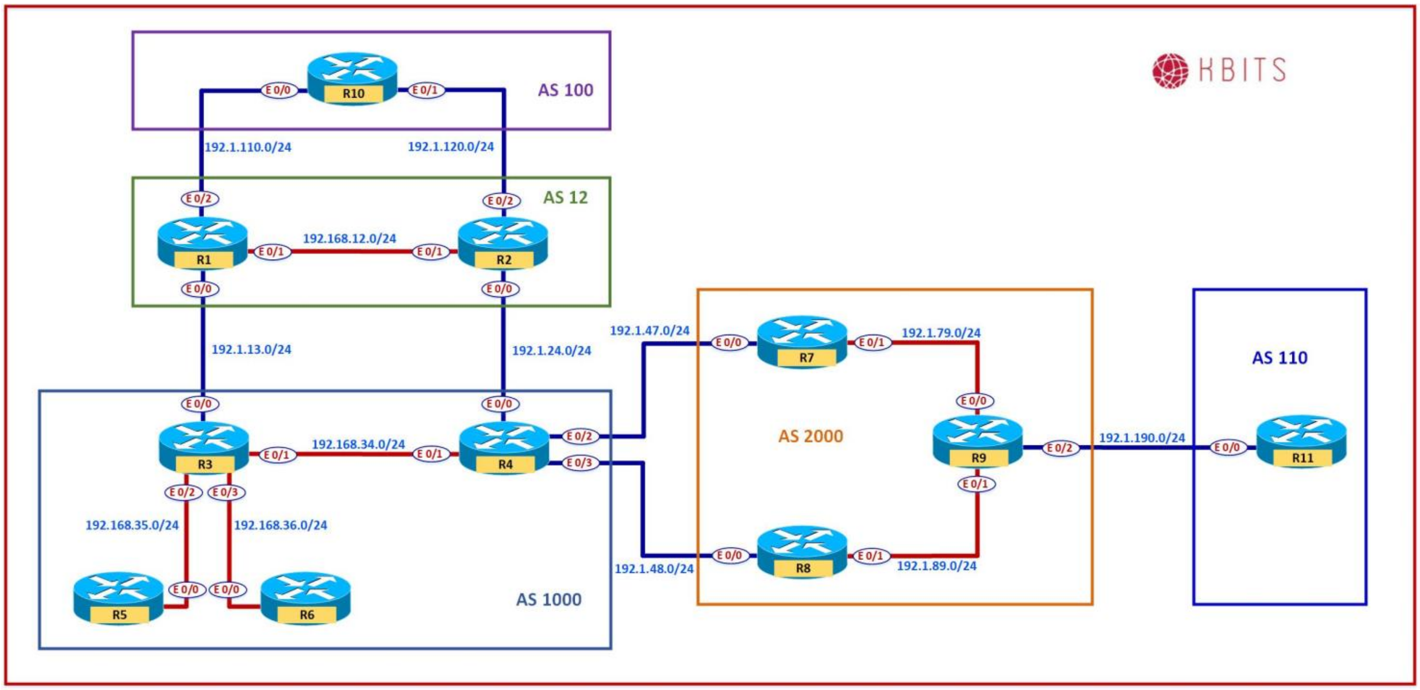
R9

```
Router BGP 2000
 Neighbor 192.1.190.11 remote-as 110
```

R11

```
Router BGP 110
 Network 111.0.0.0
 Network 112.112.112.0 mask 255.255.255.0
 Neighbor 192.1.190.9 remote-as 2000
```

Lab 13 – Configuring BGP Attributes – Local Preference



Task 1

Configure AS 2000 such that it prefers the Link between R4-R7 for traffic leaving AS 2000 towards AS 1000.

R7

```
route-map SETATT permit 10
 set local-preference 111
!
router bgp 2000
 neighbor 192.1.47.4 route-map SETATT in
```

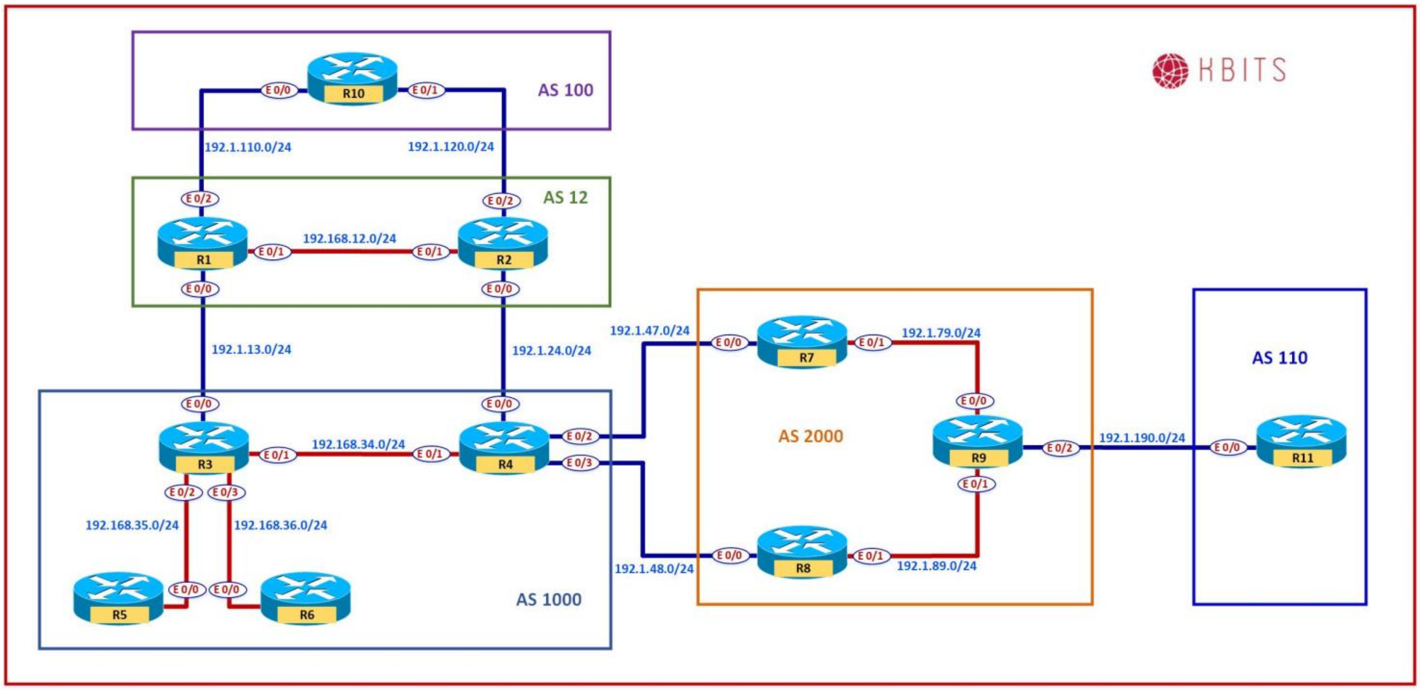
Task 2

Configure AS 2000 such that it prefers the Link between R4-R8 for traffic destined towards 1.4.1.0/24 & 1.4.2.0/24 leaving AS 2000 towards AS 1000. R4-R8 should be preferred link only for 1.4.1.0/24 & 1.4.2.0/24. The rest should continue to use R4-R7.

R8

```
ip prefix-list PL1 permit 1.4.1.0/24
ip prefix-list PL1 permit 1.4.2.0/24
!
route-map SETATT permit 10
 match ip address prefix PL1
 set local-preference 115
route-map SETATT permit 20
!
router bgp 2000
 neighbor 192.1.48.4 route-map SETATT in
```

Lab 14 – Configuring BGP Attributes – MED



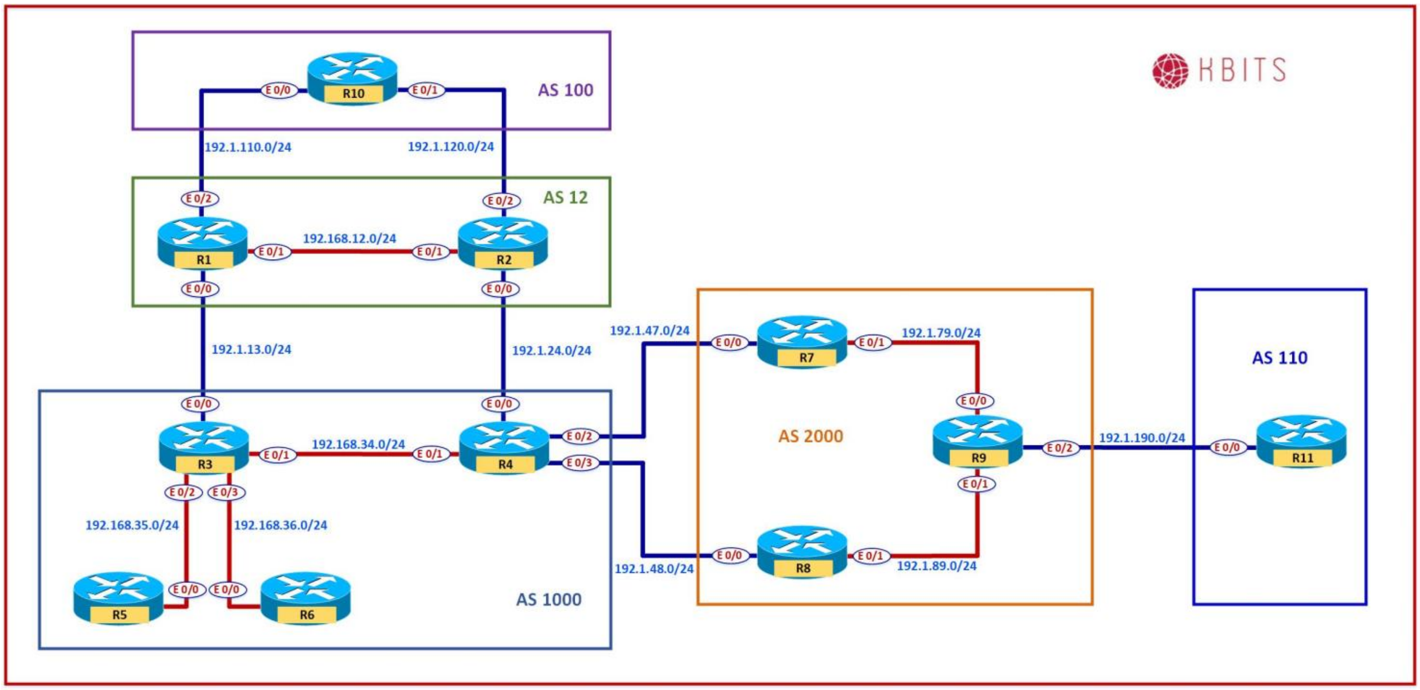
Task 1

Configure AS 2000 such that it prefers the Link between R4-R8 for traffic entering AS 2000 from AS 1000.

R7

```
route-map SETMED permit 10
 set metric 77
!
router bgp 2000
 neighbor 192.1.47.4 route-map SETMED out
```

Lab 15 – Configuring BGP Attributes – Weight



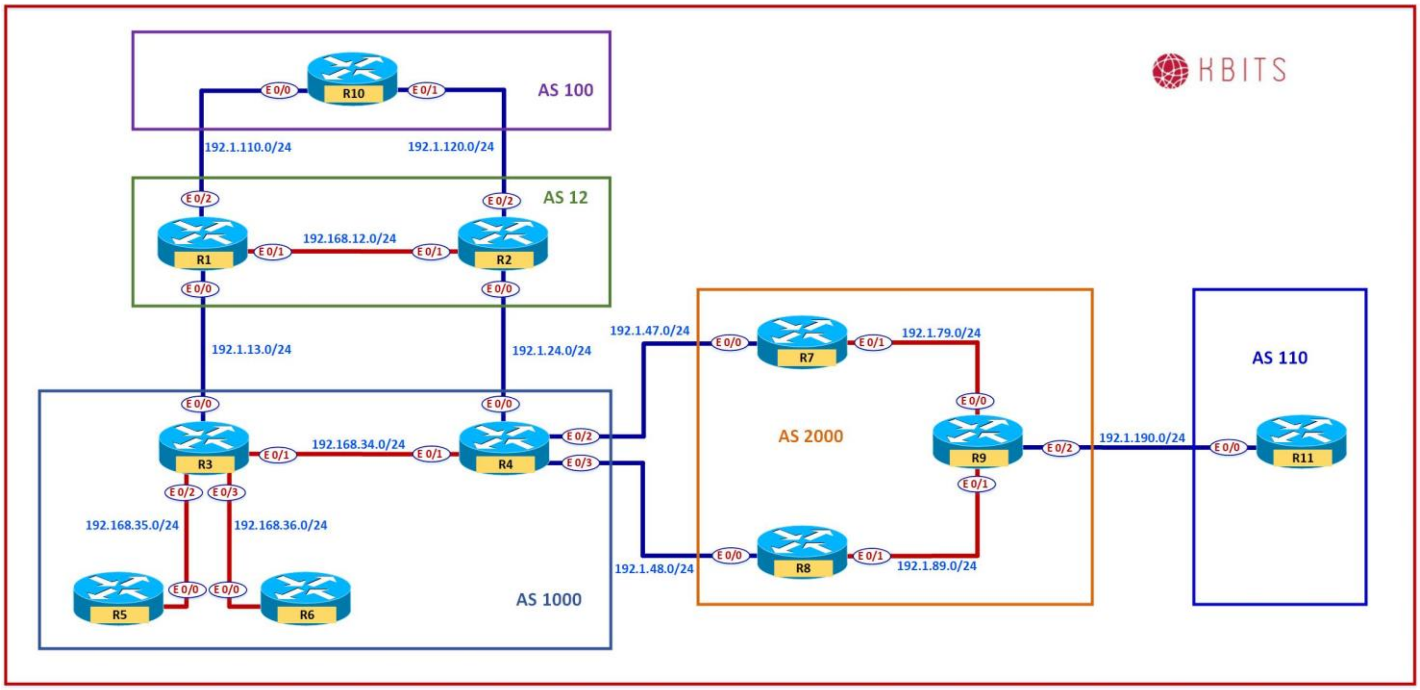
Task 1

Configure R8 such that all traffic towards AS1000 should use the Link between R4 & R8 as the preferred link. This should only affect the local router and not the rest of the AS.

R8

```
route-map SETWT
 set weight 88
!
router bgp 2000
 neighbor 192.1.48.4 route-map SETWT in
```

Lab 16 – Configuring BGP Attributes – AS-Path



Task 1

De-configure the Route-map from the previous 3 labs. This is done so that we can accomplish the same tasks using the AS-Path attribute

R7

```
No route-map SETATT
No route-map SETMED
!
router bgp 2000
 no neighbor 192.1.47.4 route-map SETATT in
 no neighbor 192.1.47.4 route-map SETMED out
```

R8

```
No route-map SETATT
No route-map SETWT
!
router bgp 2000
 no neighbor 192.1.48.4 route-map SETATT in
 no neighbor 192.1.48.4 route-map SETWT in
```

Task 2

Configure AS 2000 such that it prefers the Link between R4-R7 for traffic leaving AS2000 towards AS1000. Use the AS-Path attribute to accomplish this task.

R8

```
route-map SETAS permit 10
 set as-path prepend 1000
!
router bgp 2000
 neighbor 192.1.48.4 route-map SETAS in
```

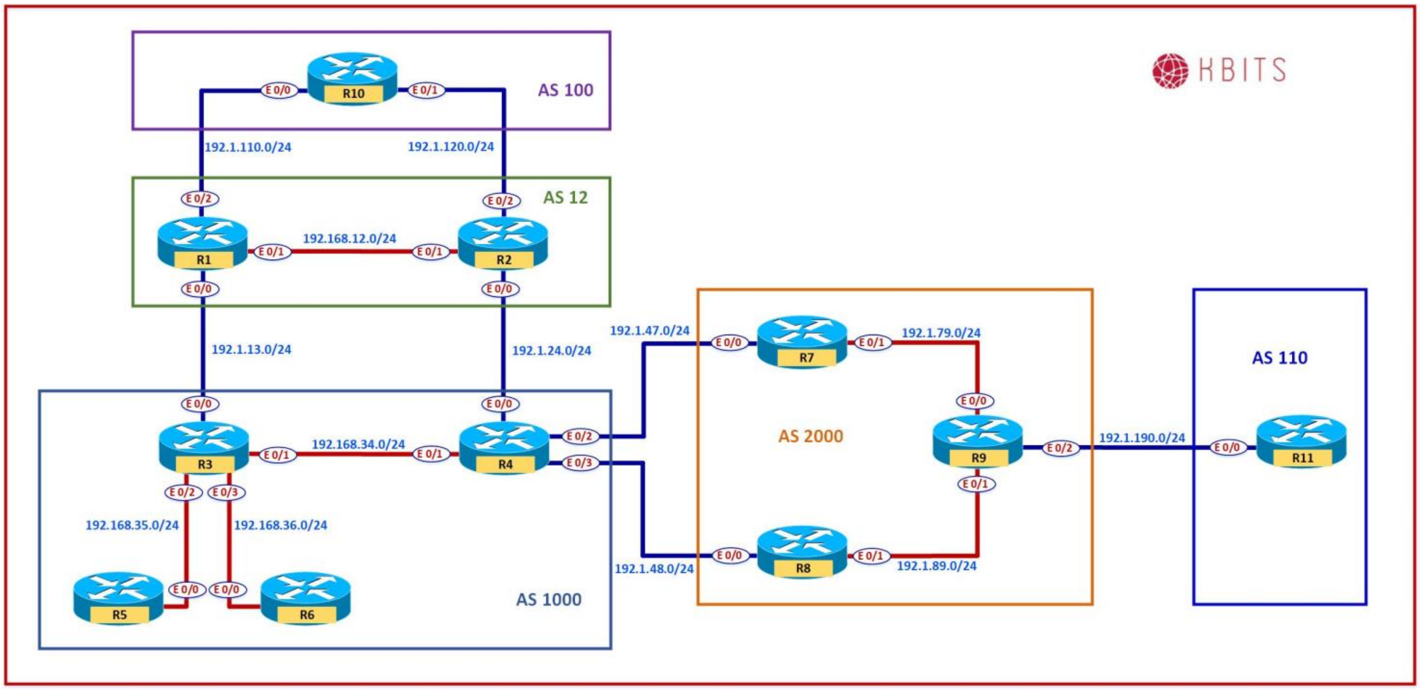
Task 3

Configure AS 2000 such that it prefers the Link between R4-R8 for traffic entering AS2000 from AS1000. Use the AS-Path attribute to accomplish this task.

R7

```
route-map SETAS permit 10
 set as-path prepend 2000
!
router bgp 2000
 neighbor 192.1.47.4 route-map SETAS out
```

Lab 17 – Configuring BGP Attributes – No-Export Community Attribute



Task 1

AS110 wants to limit the propagation of 111.0.0.0/8 network to AS2000 only. AS2000 should not export this route outside AS2000. Use the appropriate Community attribute to accomplish this.

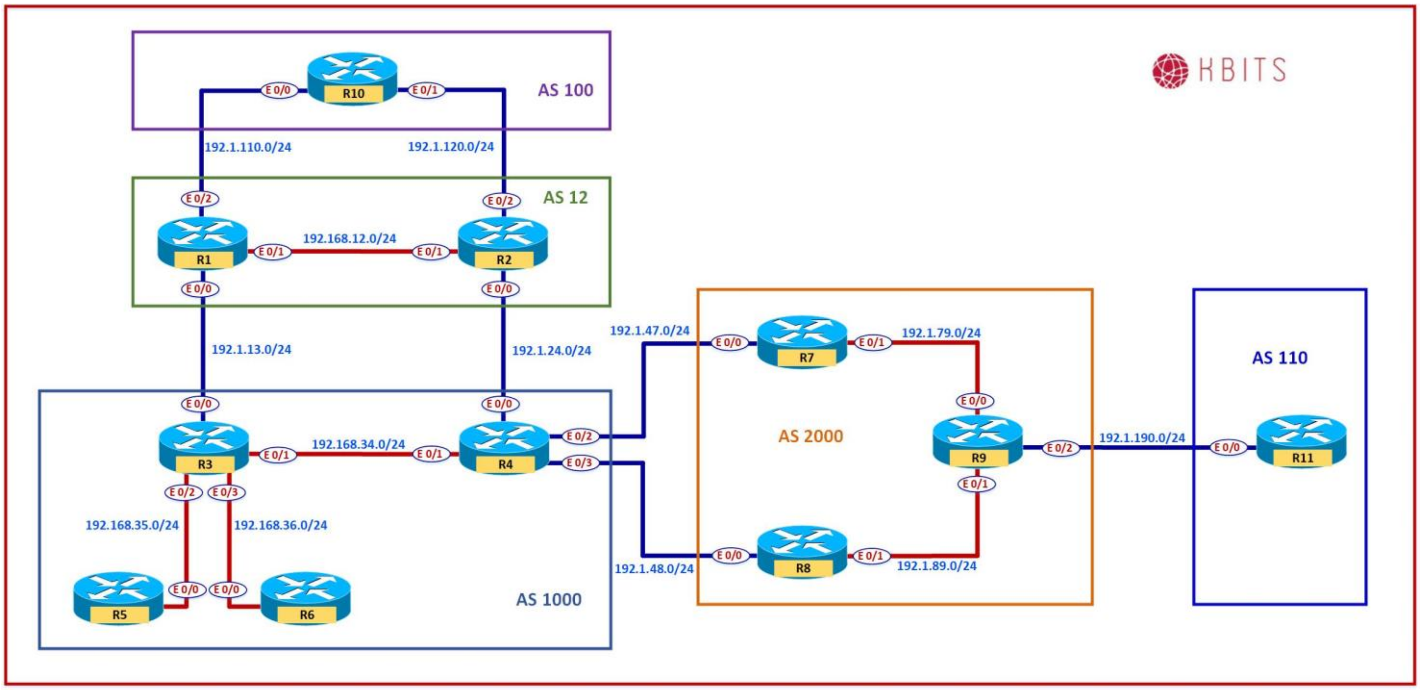
R11

```
ip prefix-list PL1 permit 111.0.0.0/8
!
route-map SETCOMM permit 10
 match ip address prefix PL1
 set community no-export
route-map SETCOMM permit 20
!
router bgp 110
 neighbor 192.1.190.9 route-map SETCOMM out
 neighbor 192.1.190.9 send-community standard
```

R9

```
router bgp 110
 neighbor 10.7.7.7 send-community standard
 neighbor 10.8.8.8 send-community standard
```

Lab 18 – Configuring BGP Attributes – No-Advertise Community Attribute



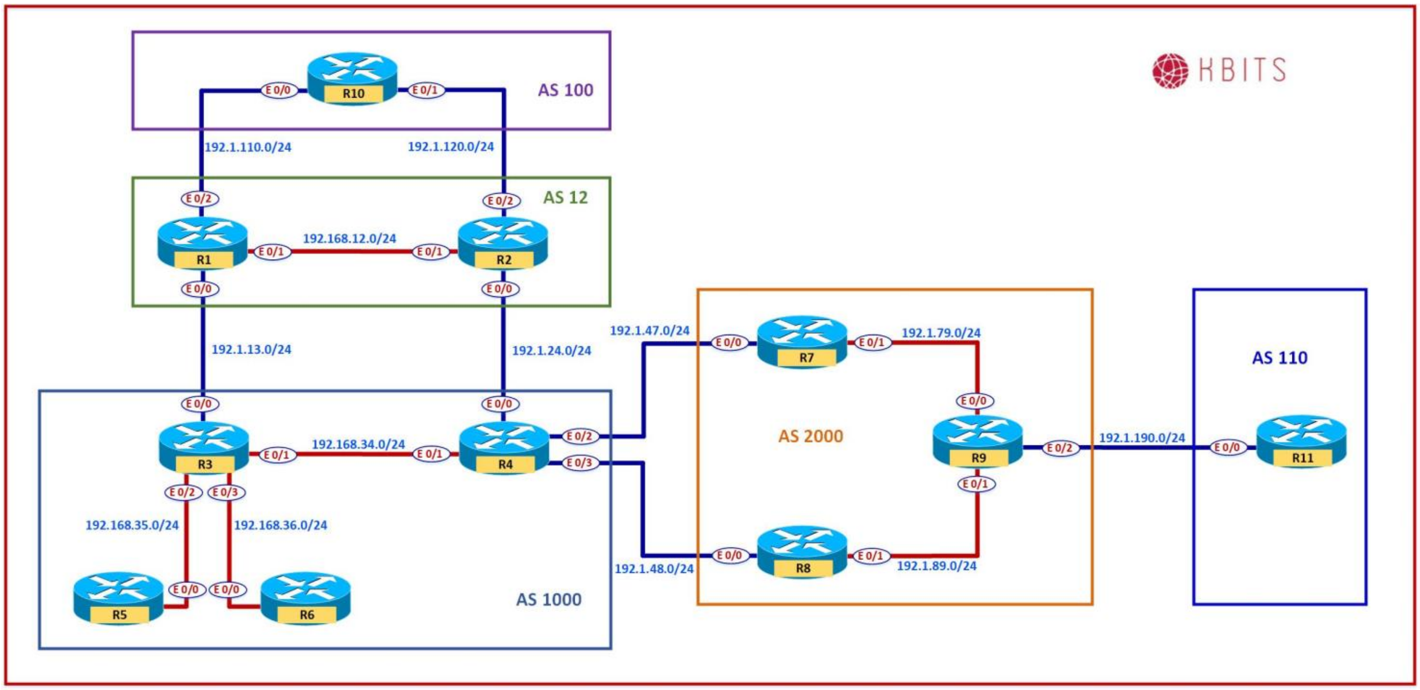
Task 1

AS110 wants to limit the propagation of 112.112.1112.0/24 network to R9 only. R9 should not forward this network to anyone including the iBGP Neighbors. Use the appropriate Community attribute to accomplish this.

R11

```
ip prefix-list PL2 permit 112.112.112.0/24
!
route-map SETCOMM permit 5
 match ip address prefix PL2
 set community no-advertise
```

Lab 19 – Configuring BGP Conditional Advertisement



Task 1

De-configure the Route-map from the previous 3 labs. This is done so that we have all the routes present for the next set of labs.

R8

```
no route-map SETAS
!
router bgp 2000
 no neighbor 192.1.48.4 route-map SETAS in
```

R7

```
no route-map SETAS permit
!
router bgp 2000
 no neighbor 192.1.47.4 route-map SETAS out
```

R11

```
no route-map SETCOMM
!
router bgp 110
 no neighbor 192.1.190.9 route-map SETCOMM out
```

Task 2

Configure a loopback on R7 and advertise it thru BGP. This will be used to check the status of R7 in a later step.

```
R7

Interface Loopback99
 ip address 10.77.77.77 255.255.255.255
!
router bgp 2000
 network 10.77.77.77 mask 255.255.255.255
```

Task 3

Configure a route-map on R8 to classify the route that will be conditionally advertised.

```
R8

ip prefix-list PL2 permit 111.0.0.0/8
ip prefix-list PL2 permit 112.112.112.0/24
!
route-map AMAP
 match ip address prefix PL2
```

Task 4

Configure a route-map on R8 to call an ACL that will indicate the absence of the 10.77.77.77/32 route.

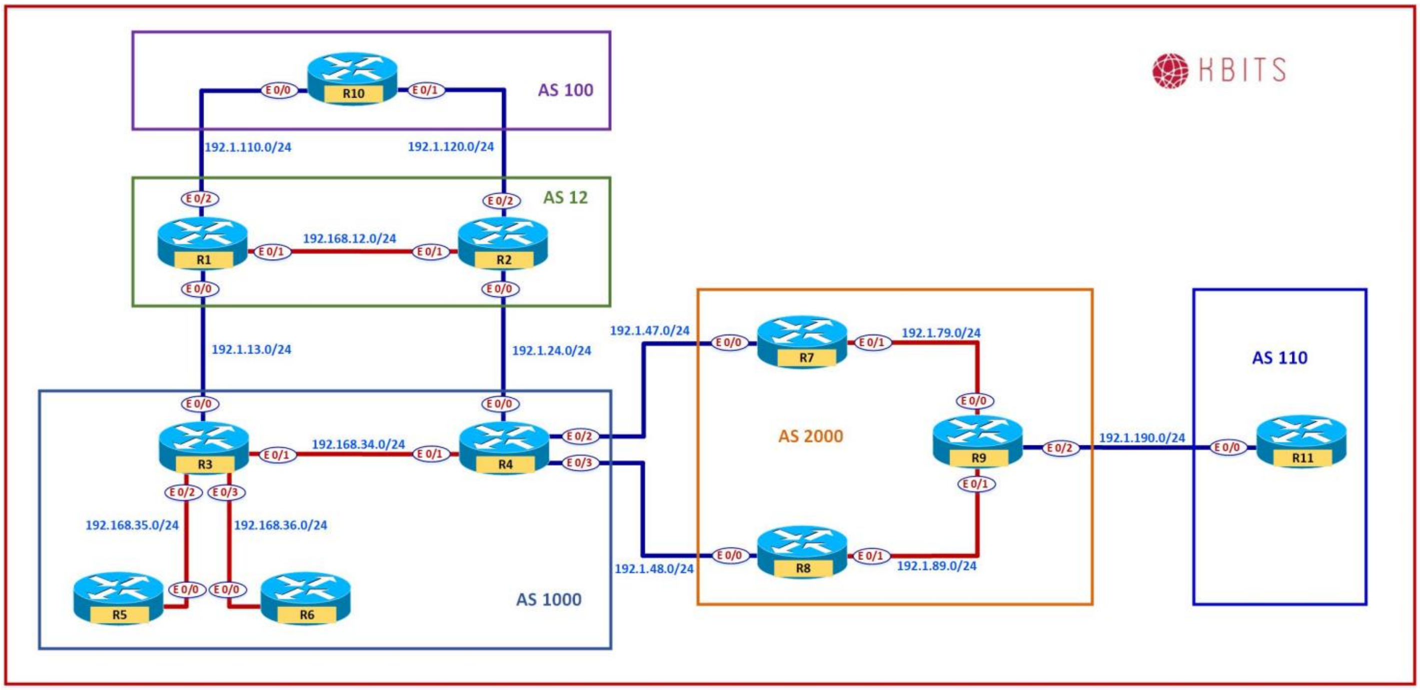
```
R8

ip prefix-list PL3 permit 10.77.77.77/32
!
route-map NEM
 match ip address prefix PL3
```

Task 5

Configure the Conditional Advertisement of the 111.0.0.0/8 & 112.112.112.0/24 routes from R8 to R4 only if R7 is down.

```
R8

router bgp 2000
 neighbor 192.1.48.4 advertise-map AMAP non-exist-map NEM
```

Lab 20 – Configuring BGP Multi-Path – eBGP – iBGP



Task 1

Configure R10 to allow it to inject multiple routes on the Links between R10-R1 & R10-R2 (eBGP Neighbors).

```
R10

Router bgp 100
 maximum-paths 2
```

Task 2

Configure R9 to allow it to inject multiple routes on the Links between R9-R7 & R9-R8 (iBGP Neighbors).

```
R9

Router bgp 2000
 maximum-paths ibgp 2
```

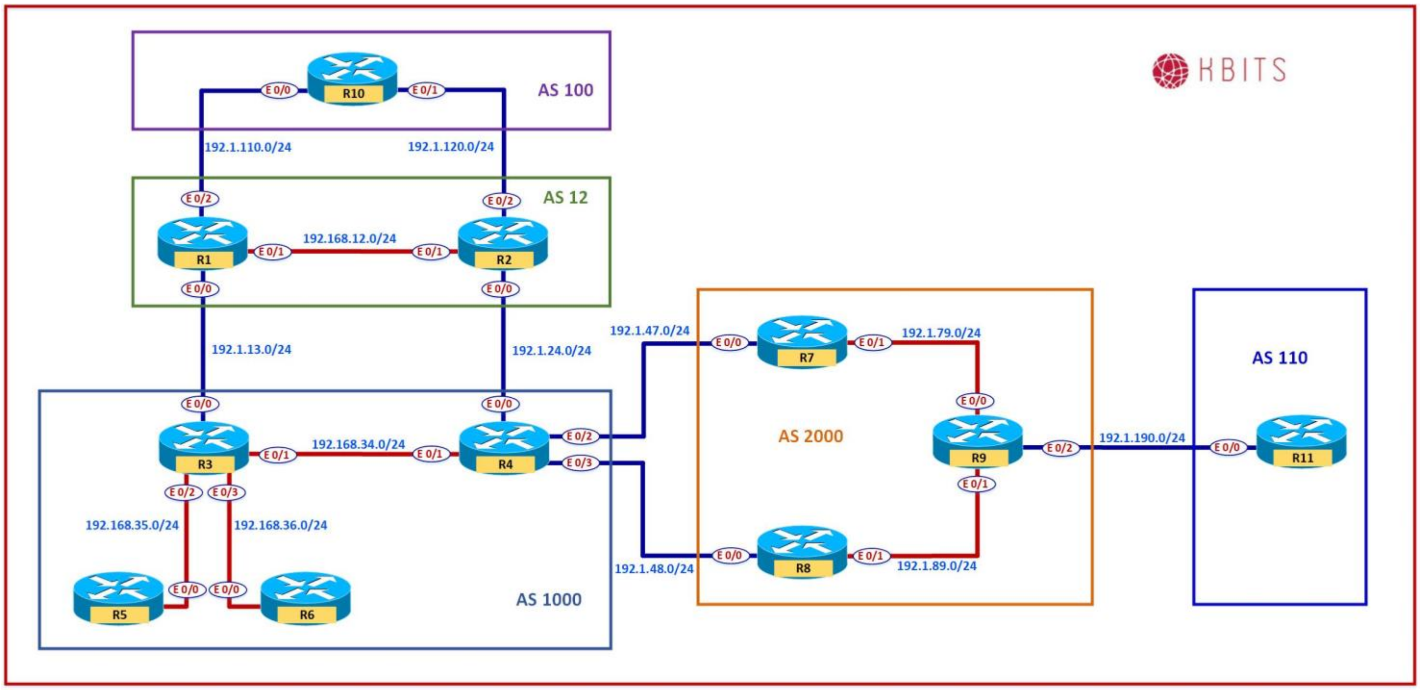
Task 2

Configure R3 to allow it to inject multiple routes on the Links between R1-R3(eBGP) & R3-R4 (iBGP Neighbors)

R3

```
Router bgp 1000
 maximum-paths eibgp 2
```

Lab 21 – Configuring to Redistribute iBGP Routes into IGP



Task 1

Check the routing table of R6. Does it have all the routes from AS2000 & AS110?

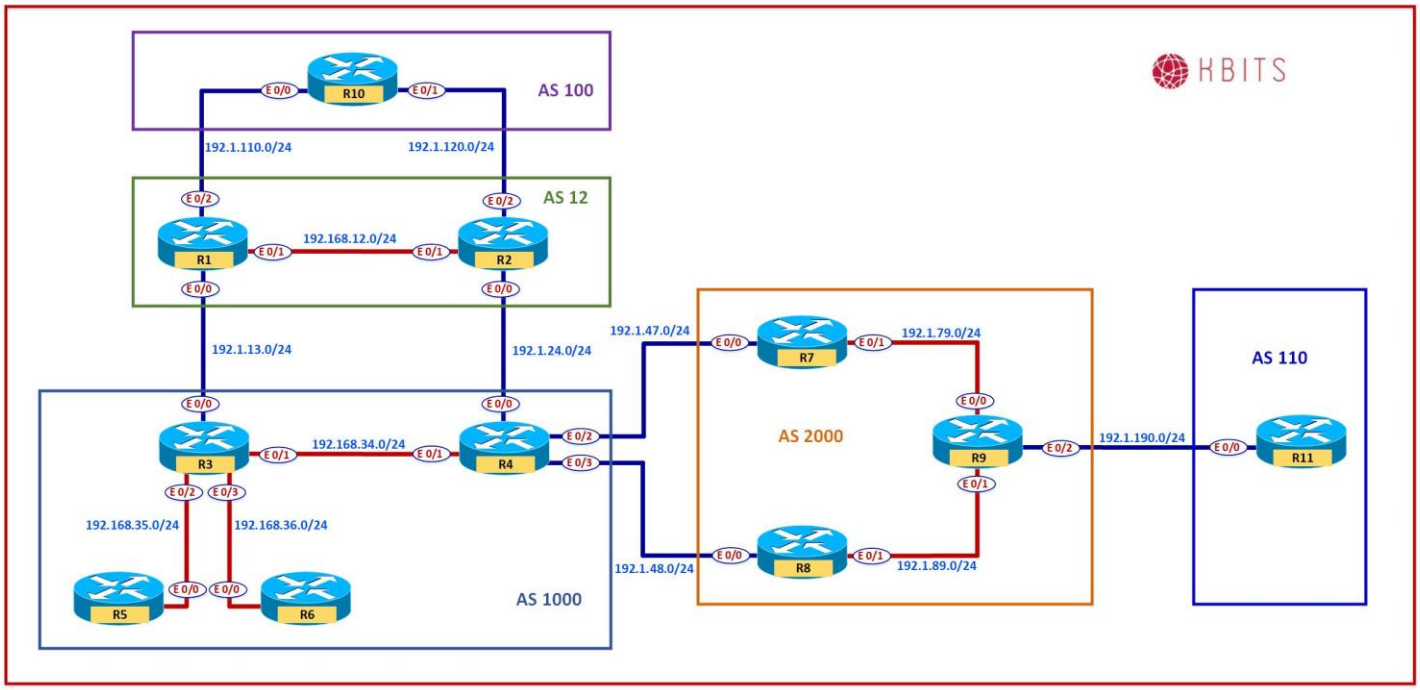
Task 2

Configure R3 to redistribute iBGP routes into IGP.

R3

```
router bgp 1000
 bgp redistribute-internal
```

Lab 22 – Configuring BGP Route Reflector with Next-Hop Changed



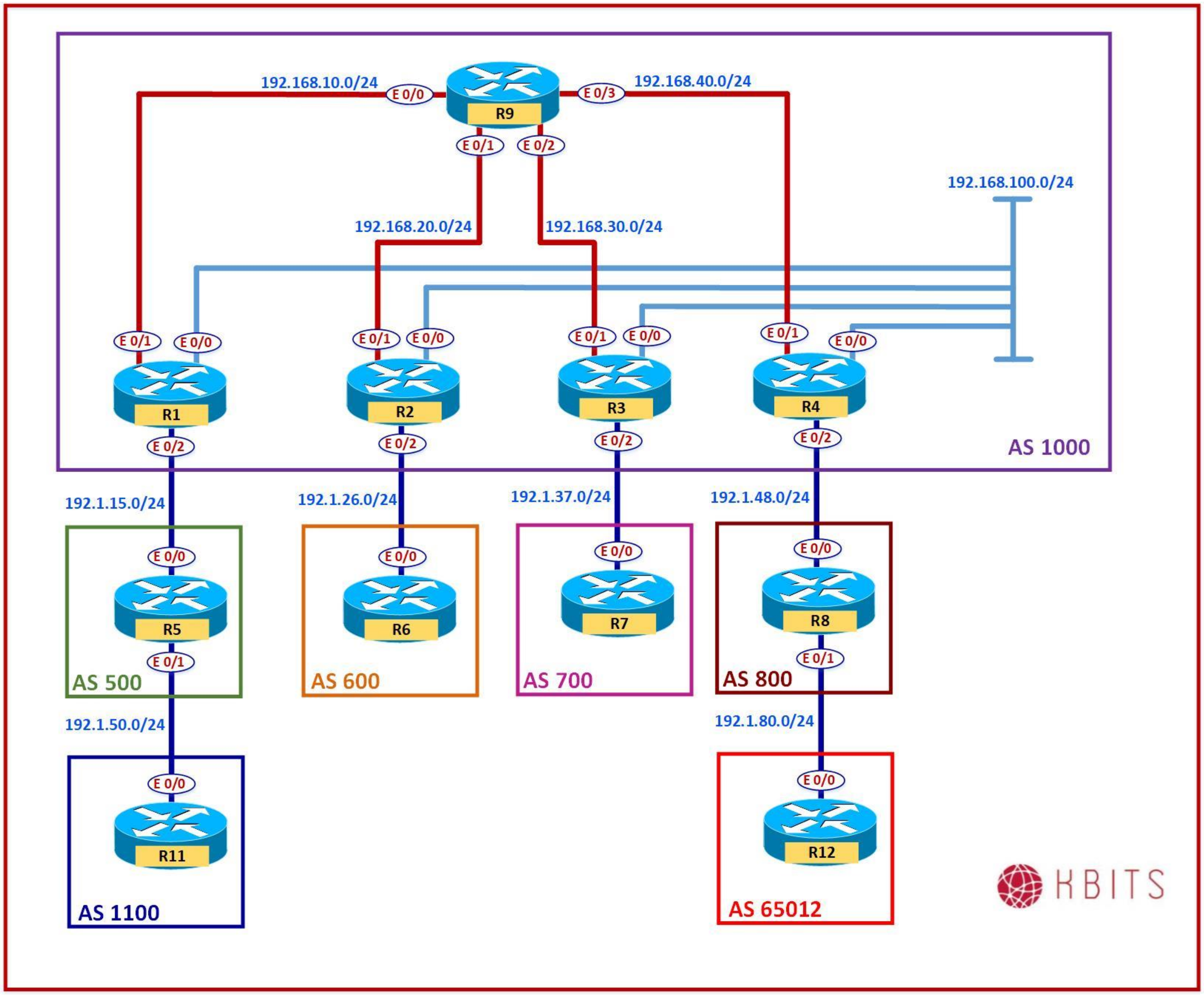
Task 1

Configure R3 as the Route Reflector between R4 & R5. Make sure to change the next-hop to R3.

R3

```
Router bgp 1000
 Neighbor 192.168.35.5 route-reflector-client
 Neighbor 192.168.35.5 next-hop-self all
 Neighbor 192.168.34.4 route-reflector-client
 Neighbor 192.168.34.4 next-hop-self all
```

Lab 23 – Configuring BGP Route Reflection based on Dynamic Neighbors



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.0.0.0
Loopback 10	10.1.1.1	255.255.255.255
E 0/0	192.168.100.1	255.255.255.0
E 0/1	192.168.10.1	255.255.255.0
E 0/2	192.1.15.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	2.2.2.2	255.0.0.0
Loopback 10	10.1.1.2	255.255.255.255
E 0/0	192.168.100.2	255.255.255.0
E 0/1	192.168.20.2	255.255.255.0
E 0/2	192.1.26.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	3.3.3.3	255.0.0.0
Loopback 10	10.1.1.3	255.255.255.255
E 0/0	192.168.100.3	255.255.255.0
E 0/1	192.168.30.3	255.255.255.0
E 0/2	192.1.37.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	4.4.4.4	255.0.0.0
Loopback 10	10.1.1.4	255.255.255.255
E 0/0	192.168.100.4	255.255.255.0
E 0/1	192.168.40.4	255.255.255.0
E 0/2	192.1.48.4	255.255.255.0

R5

Interface	IP Address	Subnet Mask
Loopback 0	5.5.5.5	255.0.0.0
E 0/0	192.1.15.5	255.255.255.0
E 0/1	192.1.50.5	255.255.255.0

R6

Interface	IP Address	Subnet Mask
Loopback 0	6.6.6.6	255.0.0.0
E 0/0	192.1.26.6	255.255.255.0

R7

Interface	IP Address	Subnet Mask
Loopback 0	7.7.7.7	255.0.0.0
E 0/0	192.1.37.7	255.255.255.0

R8

Interface	IP Address	Subnet Mask
Loopback 0	8.8.8.8	255.0.0.0
E 0/0	192.1.48.8	255.255.255.0
E 0/2	192.1.80.8	255.255.255.0

R9

Interface	IP Address	Subnet Mask
Loopback 10	10.1.1.9	255.255.255.255
E 0/0	192.168.10.9	255.255.255.0
E 0/1	192.168.20.9	255.255.255.0
E 0/2	192.168.30.9	255.255.255.0
E 0/3	192.168.40.9	255.255.255.0

R11

Interface	IP Address	Subnet Mask
Loopback 0	11.11.11.11	255.0.0.0
E 0/0	192.1.50.11	255.255.255.0

R12

Interface	IP Address	Subnet Mask
Loopback 0	12.12.12.12	255.0.0.0
E 0/0	192.1.80.12	255.255.255.0

Task 1

Configure EIGRP 1000 as the underlay IGP to route the Loopback 10 networks on the underlay networks.

R1 Router eigrp 1000 network 192.168.100.0 network 192.168.10.0 network 10.0.0.0	**R2** Router eigrp 1000 network 192.168.100.0 network 192.168.20.0 network 10.0.0.0
R3 Router eigrp 1000 network 192.168.100.0 network 192.168.30.0 network 10.0.0.0	**R4** Router eigrp 1000 network 192.168.100.0 network 192.168.40.0 network 10.0.0.0
R9 Router eigrp 1000 network 192.168.10.0 network 192.168.20.0 network 192.168.30.0 network 192.168.40.0 network 10.0.0.0	

Task 2

Configuring iBGP between the ASBR (R1,R2,R3 & R4) and the RR (R9) based on Loopbacks. Configure R9 such that it accepts neighbor requests from any router from the 10.1.1.0/24 subnet. Authenticate the neighbor relationship with a password of **ccie12353**. Advertise the Loopback 0 networks on ASBRs in BGP.

R1 Router BGP 1000 Network 1.0.0.0 Neighbor 10.1.1.9 remote-as 1000 Neighbor 10.1.1.9 update-source Lo10	**R2** Router BGP 1000 Network 2.0.0.0 Neighbor 10.1.1.9 remote-as 1000 Neighbor 10.1.1.9 update-source Lo10

Neighbor 10.1.1.9 next-hop-self Neighbor 10.1.1.9 password ccie12353	Neighbor 10.1.1.9 next-hop-self Neighbor 10.1.1.9 password ccie12353
R3 Router BGP 1000 Network 3.0.0.0 Neighbor 10.1.1.9 remote-as 1000 Neighbor 10.1.1.9 update-source Lo10 Neighbor 10.1.1.9 next-hop-self Neighbor 10.1.1.9 password ccie12353	**R4** Router BGP 1000 Network 4.0.0.0 Neighbor 10.1.1.9 remote-as 1000 Neighbor 10.1.1.9 update-source Lo10 Neighbor 10.1.1.9 next-hop-self Neighbor 10.1.1.9 password ccie12353
R9 router bgp 1000 neighbor IBGP peer-group neighbor IBGP remote-as 1000 neighbor IBGP update-source loopback10 neighbor IBGP route-reflector-client neighbor IBGP password ccie12353 bgp listen range 10.1.1.0/24 peer-group IBGP	

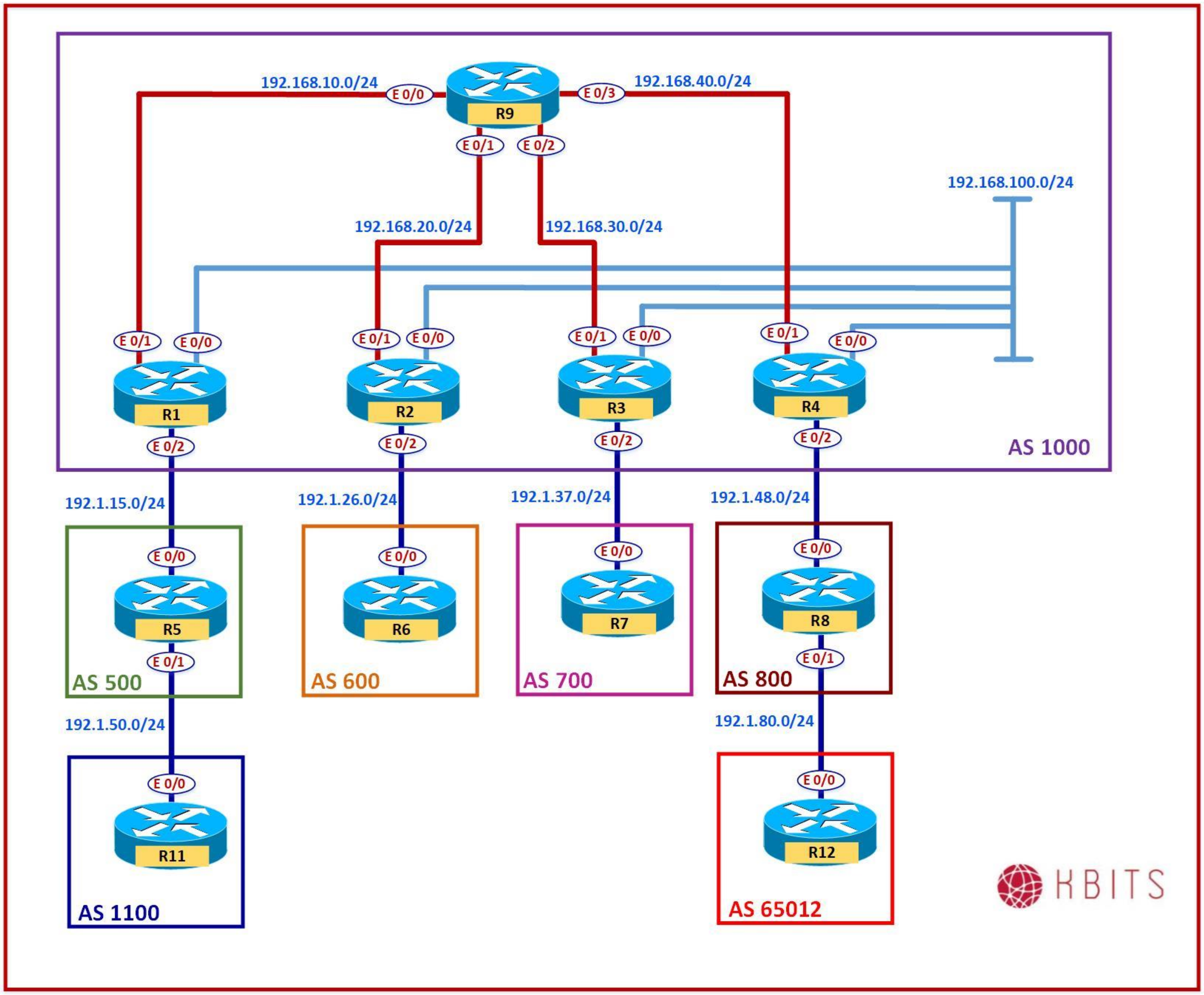
Task 3

Configuring eBGP neighbor relationship between AS 1000 and the connected ASs on the appropriate ASBRs. Advertise Loopack0 networks on R5, R6, R7 & R8.

R1 router bgp 1000 neighbor 192.1.15.5 remote-as 500
R2 router bgp 1000 neighbor 192.1.26.6 remote-as 600
R3 router bgp 1000 neighbor 192.1.37.7 remote-as 700
R4 router bgp 1000 neighbor 192.1.48.8 remote-as 800
R5 router bgp 500 network 5.0.0.0

neighbor 192.1.15.1 remote-as 1000
R6 router bgp 600 network 6.0.0.0 neighbor 192.1.26.2 remote-as 1000
R7 router bgp 700 network 7.0.0.0 neighbor 192.1.37.3 remote-as 1000
R8 router bgp 800 network 8.0.0.0 neighbor 192.1.48.4 remote-as 1000

Lab 24 – Working with Private AS Numbers



Task 1
Configure a relationship between the Customer (R12) and AS 800. The Customer should use AS 65012 as the AS #. Advertise the Loopback 0 network on R12.

R8

```
router bgp 800
 neighbor 192.1.80.12 remote-as 65012
```

R12

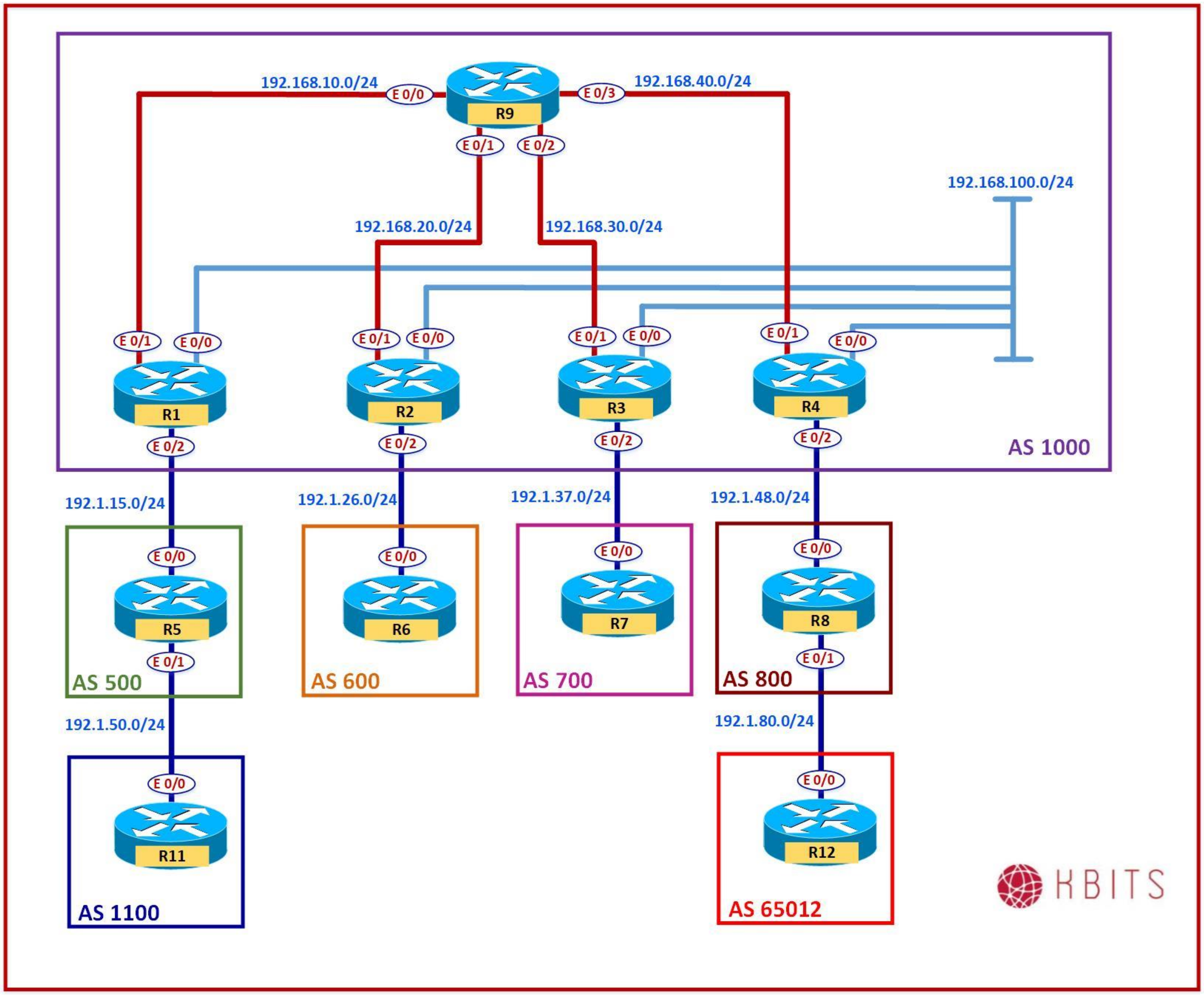
```
router bgp 65012
 neighbor 192.1.80.8 remote-as 800
 network 12.0.0.0
```

Task 2
Configure R8 such that it removes the Private AS # from the AS Path before propagating the route towards AS 1000

R8

```
router bgp 800
 neighbor 192.1.48.4 remove-private-as
```

Lab 25 – Configuring the Local-AS Command



Task 1

Configure a relationship between the Customer (R11) and AS 500. The Customer should use AS 65011 as the AS #. Advertise the Loopback 0 network on R11.

R5

```
router bgp 500
 neighbor 192.1.50.11 remote-as 65011
```

R11

```
router bgp 65011
 neighbor 192.1.50.5 remote-as 500
 network 11.0.0.0
```

Task 2

Configure R5 such that it removes the Private AS # from the AS Path before propagating the route towards AS 1000

R5

```
router bgp 500
 neighbor 192.1.15.1 remove-private-as
```

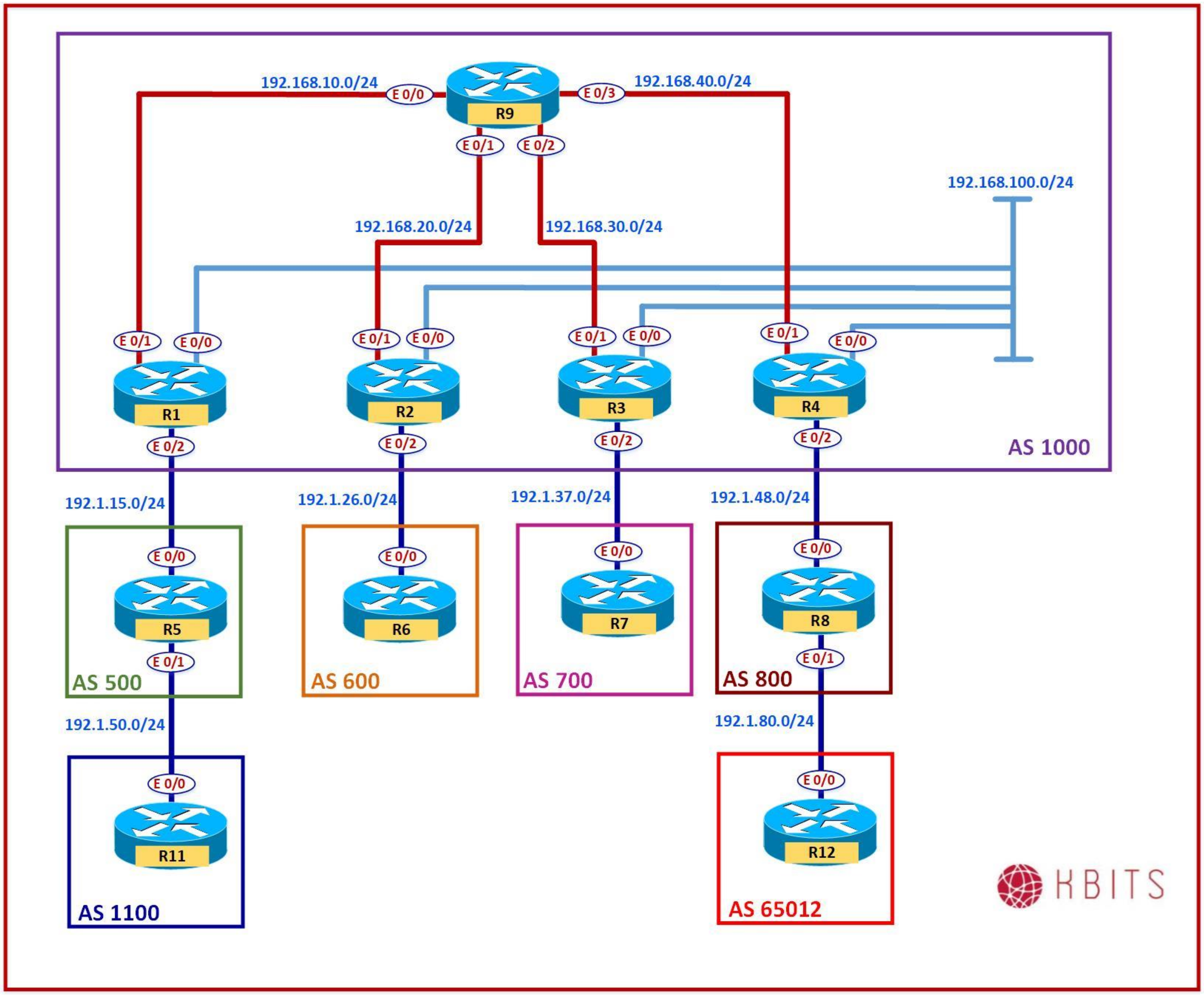
Task 3

R11 acquires and configures a new AS #. It is a Public AS# 110. R5 will change the neighbor relationship in a maintenance window after 5 days. In the meanwhile R11 needs to change the AS # to the new to establish a new neighbor relationship with a new SP. Allow R11 to establish both neighbor relationships.

R11

```
no router bgp 65011
router bgp 110
 network 1.11.1.0 mask 255.255.255.0
 neighbor 192.1.50.5 remote-as 500
 neigbhor 192.1.50.5 local-as 65011
```

Lab 26 – Configuring BFD for BGP



Task 1

Configure BFD using a send and receive interval of 350 ms. A neighbor is deemed dead if 3 hellos are missed. Configure it for the following eBGP neighbor relationships:

R1 - R5
R2 - R6
R3 - R7
R4 - R8

R1

```
Interface E 0/2
 bfd interval 350 min_rx 350 multiplier 3
!
router bgp 1000
 neighbor 192.1.15.5 fall-over bfd
```

R5

```
Interface E 0/0
 bfd interval 350 min_rx 350 multiplier 3
!
router bgp 500
 neighbor 192.1.15.1 fall-over bfd
```

R2

```
Interface E 0/2
 bfd interval 350 min_rx 350 multiplier 3
!
router bgp 1000
 neighbor 192.1.26.6 fall-over bfd
```

R6

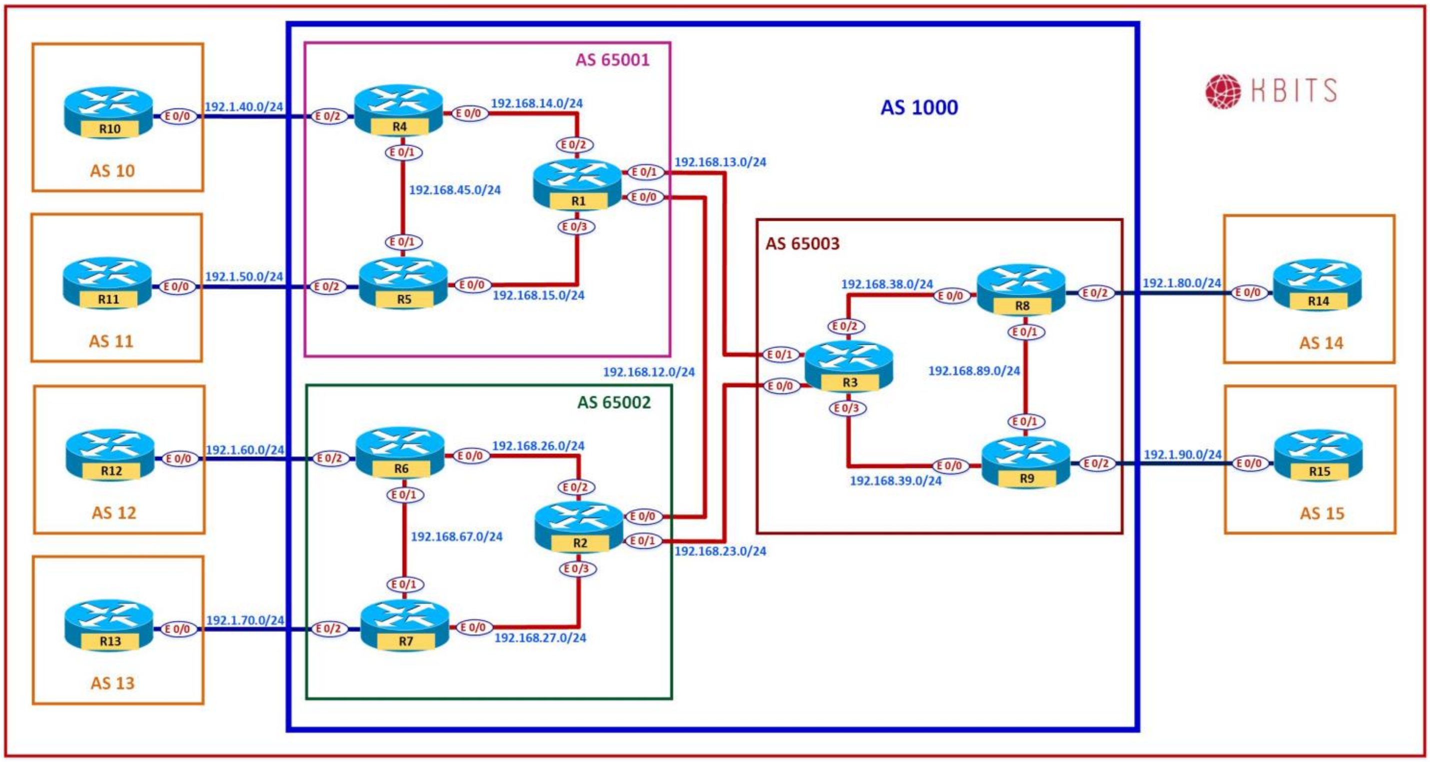
```
Interface E 0/0
 bfd interval 350 min_rx 350 multiplier 3
!
router bgp 600
 neighbor 192.1.26.2 fall-over bfd
```

R3

```
Interface E 0/2
 bfd interval 350 min_rx 350 multiplier 3
!
router bgp 1000
 neighbor 192.1.37.7 fall-over bfd
```

R7 Interface E 0/0 bfd interval 350 min_rx 350 multiplier 3 ! router bgp 700 neighbor 192.1.37.3 fall-over bfd
R4 Interface E 0/2 bfd interval 350 min_rx 350 multiplier 3 ! router bgp 1000 neighbor 192.1.48.8 fall-over bfd
R8 Interface E 0/0 bfd interval 350 min_rx 350 multiplier 3 ! router bgp 800 neighbor 192.1.48.4 fall-over bfd

Lab 27 – Configuring BGP Confederations



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.0.0.0
Loopback 10	172.16.1.1	255.255.255.255
E 0/0	192.168.12.1	255.255.255.0
E 0/1	192.168.13.1	255.255.255.0
E 0/2	192.168.14.1	255.255.255.0
E 0/3	192.168.15.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	2.2.2.2	255.0.0.0
Loopback 10	172.16.1.2	255.255.255.255
E 0/0	192.168.12.2	255.255.255.0
E 0/1	192.168.23.2	255.255.255.0

E 0/2	192.168.26.2	255.255.255.0
E 0/3	192.168.27.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	3.3.3.3	255.0.0.0
Loopback 10	172.16.1.3	255.255.255.255
E 0/0	192.168.23.3	255.255.255.0
E 0/1	192.168.13.3	255.255.255.0
E 0/2	192.168.38.3	255.255.255.0
E 0/3	192.168.39.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	4.4.4.4	255.0.0.0
Loopback 10	172.16.1.4	255.255.255.255
E 0/0	192.168.14.4	255.255.255.0
E 0/1	192.168.45.4	255.255.255.0
E 0/2	192.1.40.4	255.255.255.0

R5

Interface	IP Address	Subnet Mask
Loopback 0	5.5.5.5	255.0.0.0
Loopback 10	172.16.1.5	255.255.255.255
E 0/0	192.168.15.5	255.255.255.0
E 0/1	192.168.45.5	255.255.255.0
E 0/2	192.1.50.5	255.255.255.0

R6

Interface	IP Address	Subnet Mask
Loopback 0	6.6.6.6	255.0.0.0
Loopback 10	172.16.1.6	255.255.255.255
E 0/0	192.168.26.6	255.255.255.0
E 0/1	192.168.67.6	255.255.255.0
E 0/2	192.1.60.6	255.255.255.0

R7

Interface	IP Address	Subnet Mask
Loopback 0	7.7.7.7	255.0.0.0
Loopback 10	172.16.1.7	255.255.255.255
E 0/0	192.168.27.7	255.255.255.0
E 0/1	192.168.67.7	255.255.255.0
E 0/2	192.1.70.7	255.255.255.0

R8

Interface	IP Address	Subnet Mask
Loopback 0	8.8.8.8	255.0.0.0
Loopback 10	172.16.1.8	255.255.255.255
E 0/0	192.168.38.8	255.255.255.0
E 0/1	192.168.89.8	255.255.255.0
E 0/2	192.1.80.8	255.255.255.0

R9

Interface	IP Address	Subnet Mask
Loopback 0	9.9.9.9	255.0.0.0
Loopback 10	172.16.1.9	255.255.255.255
E 0/0	192.168.39.9	255.255.255.0
E 0/1	192.168.89.9	255.255.255.0
E 0/2	192.1.90.9	255.255.255.0

R10

Interface	IP Address	Subnet Mask
Loopback 0	100.100.100.100	255.0.0.0
E 0/0	192.1.40.10	255.255.255.0

R11

Interface	IP Address	Subnet Mask
Loopback 0	111.111.111.111	255.0.0.0
E 0/0	192.1.50.11	255.255.255.0

R12

Interface	IP Address	Subnet Mask
Loopback 0	112.112.112.112	255.0.0.0
E 0/0	192.1.60.12	255.255.255.0

R13

Interface	IP Address	Subnet Mask
Loopback 0	113.113.113.113	255.0.0.0
E 0/0	192.1.70.13	255.255.255.0

R14

Interface	IP Address	Subnet Mask
Loopback 0	114.114.114.114	255.0.0.0
E 0/0	192.1.80.14	255.255.255.0

R15

Interface	IP Address	Subnet Mask
Loopback 0	115.115.115.115	255.0.0.0
E 0/0	192.1.90.15	255.255.255.0

Task 1

Configure the underlay IGP as EIGRP in AS 1000 between R1, R2 & R3. These routers represent their respective Sub-AS's.

R1 router eigrp 1000 network 192.168.12.0 network 192.168.13.0 network 172.16.1.0 0.0.0.255	**R2** router eigrp 1000 network 192.168.12.0 network 192.168.23.0 network 172.16.1.0 0.0.0.255
R3 router eigrp 1000 network 192.168.13.0 network 192.168.23.0 network 172.16.1.0 0.0.0.255	

Task 2

Configure the underlay IGP as EIGRP in Sub-AS 65001 between R1, R4 & R5. Advertise the links with the Sub-AS and the Loopback 10 networks in EIGRP.

R1 router eigrp 65001 network 192.168.14.0 network 192.168.15.0 network 172.16.1.0 0.0.0.255	**R4** router eigrp 65001 network 192.168.14.0 network 192.168.45.0 network 172.16.1.0 0.0.0.255
R5 router eigrp 65001 network 192.168.15.0 network 192.168.45.0 network 172.16.1.0 0.0.0.255	

Task 3

Configure the underlay IGP as EIGRP in Sub-AS 65002 between R2, R6 & R7. Advertise the links with the Sub-AS and the Loopback 10 networks in EIGRP.

R1 router eigrp 65002 network 192.168.26.0 network 192.168.27.0 network 172.16.1.0 0.0.0.255	**R6** router eigrp 65002 network 192.168.26.0 network 192.168.67.0 network 172.16.1.0 0.0.0.255
R7 router eigrp 65002 network 192.168.27.0 network 192.168.67.0 network 172.16.1.0 0.0.0.255	

Task 4

Configure the underlay IGP as EIGRP in Sub-AS 65003 between R3, R8 & R9. Advertise the links with the Sub-AS and the Loopback 10 networks in EIGRP.

R3	R8
router eigrp 65003 network 192.168.38.0 network 192.168.39.0 network 172.16.1.0 0.0.0.255	router eigrp 65003 network 192.168.38.0 network 192.168.89.0 network 172.16.1.0 0.0.0.255
R9 router eigrp 65003 network 192.168.39.0 network 192.168.89.0 network 172.16.1.0 0.0.0.255	

Task 5

Configure AS 65001 with iBGP. Configure R1 as the RR. Set the relationship based on Loopback10. The Confederation Identifier is 1000. R1 is peering up only with 65002 in its confederation.

R1	
router bgp 65001 bgp confederation identifier 1000 bgp confederation peer 65002 network 1.0.0.0 neighbor IBGP peer-group neighbor IBGP remote-as 65001 neighbor IBGP update-source Loopback10 neighbor IBGP next-hop-self neighbor IBGP route-reflector-client neighbor 172.16.1.4 peer-group IBGP neighbor 172.16.1.5 peer-group IBGP	
R4 router bgp 65001 bgp confederation identifier 1000 network 4.0.0.0 neighbor 172.16.1.1 remote-as 65001 neighbor 172.16.1.1 update-source Lo10 neighbor 172.16.1.1 next-hop-self	**R5** router bgp 65001 bgp confederation identifier 1000 network 5.0.0.0 neighbor 172.16.1.1 remote-as 65001 neighbor 172.16.1.1 update-source Lo10 neighbor 172.16.1.1 next-hop-self

Task 6

Configure AS 65002 with iBGP. Configure R2 as the RR. Set the relationship based on Loopback10. The Confederation Identifier is 1000. R2 is peering up with 65001 & 65003 in its confederation.

R2

```
router bgp 65002
 bgp confederation identifier 1000
 bgp confederation peer 65001 65003
 network 2.0.0.0
 neighbor IBGP peer-group
 neighbor IBGP remote-as 65002
 neighbor IBGP update-source Loopback10
 neighbor IBGP next-hop-self
 neighbor IBGP route-reflector-client
 neighbor 172.16.1.6 peer-group IBGP
 neighbor 172.16.1.7 peer-group IBGP
```

R6

```
router bgp 65002
 bgp confederation identifier 1000
 network 6.0.0.0
 neighbor 172.16.1.2 remote-as 65002
 neighbor 172.16.1.2 update-source Lo10
 neighbor 172.16.1.2 next-hop-self
```

R7

```
router bgp 65002
 bgp confederation identifier 1000
 network 7.0.0.0
 neighbor 172.16.1.2 remote-as 65002
 neighbor 172.16.1.2 update-source Lo10
 neighbor 172.16.1.2 next-hop-self
```


Website: http://www.kbits.live; Email: kb@kbits.live

Task 7

Configure AS 65003 with iBGP. Configure R3 as the RR. Set the relationship based on Loopback10. The Confederation Identifier is 1000. R3 is peering up only with 65002 in its confederation.

R3

```
router bgp 65003
 bgp confederation identifier 1000
 bgp confederation peer 65002
 network 3.0.0.0
 neighbor IBGP peer-group
 neighbor IBGP remote-as 65003
 neighbor IBGP update-source Loopback10
 neighbor IBGP next-hop-self
 neighbor IBGP route-reflector-client
 neighbor 172.16.1.8 peer-group IBGP
 neighbor 172.16.1.9 peer-group IBGP
```

R8

```
router bgp 65003
 bgp confederation identifier 1000
 network 8.0.0.0
 neighbor 172.16.1.3 remote-as 65003
 neighbor 172.16.1.3 update-source Lo10
 neighbor 172.16.1.3 next-hop-self
```

R9

```
router bgp 65003
 bgp confederation identifier 1000
 network 9.0.0.0
 neighbor 172.16.1.3 remote-as 65003
 neighbor 172.16.1.3 update-source Lo10
 neighbor 172.16.1.3 next-hop-self
```

Task 8

Configure eBGP neighbor relationships with Remote-AS's (10,11,12,13 & 14). Use the appropriate ASBR to configure the relationship. Have the Remote AS's advertise the Loopback0 interface network.

R4 router bgp 65001 neighbor 192.1.40.10 remote-as 10	**R10** router bgp 10 network 100.0.0.0 neighbor 192.1.40.4 remote-as 1000
R5 router bgp 65001 neighbor 192.1.50.11 remote-as 11	**R11** router bgp 11 network 111.0.0.0 neighbor 192.1.50.5 remote-as 1000
R6 router bgp 65002 neighbor 192.1.60.12 remote-as 12	**R12** router bgp 12 network 112.0.0.0 neighbor 192.1.60.6 remote-as 1000
R7 router bgp 65002 neighbor 192.1.70.13 remote-as 13	**R13** router bgp 13 network 113.0.0.0 neighbor 192.1.70.7 remote-as 1000
R8 router bgp 65003 neighbor 192.1.80.14 remote-as 14	**R14** router bgp 14 network 114.0.0.0 neighbor 192.1.80.8 remote-as 1000
R9 router bgp 65003 neighbor 192.1.90.15 remote-as 15	**R15** router bgp 15 network 115.0.0.0 neighbor 192.1.90.9 remote-as 1000

Task 9

Configure eBGP neighbor relationships between the Confederation Peers. (R1-R2) & (R2-R3). These are eBGP neighbor relationships that are on Loopbacks. Make sure to allow the ebgp-multihop.

R1 router bgp 65001 neighbor 172.16.1.2 remote-as 65002 neighbor 172.16.1.2 update-source Loopback10 neighbor 172.16.1.2 next-hop-self neighbor 172.16.1.2 ebgp-multihop
R2 router bgp 65002 neighbor 172.16.1.1 remote-as 65001 neighbor 172.16.1.1 update-source Loopback10 neighbor 172.16.1.1 next-hop-self neighbor 172.16.1.1 ebgp-multihop neighbor 172.16.1.3 remote-as 65003 neighbor 172.16.1.3 update-source Loopback10 neighbor 172.16.1.3 next-hop-self neighbor 172.16.1.3 ebgp-multihop
R3 router bgp 65003 neighbor 172.16.1.2 remote-as 65002 neighbor 172.16.1.2 update-source Loopback10 neighbor 172.16.1.2 next-hop-self neighbor 172.16.1.2 ebgp-multihop

Verification:

Use Ping to verify end-to-end reachability between AS's 10,11,12,13 & 14 via AS 1000.

Configuring IPv6

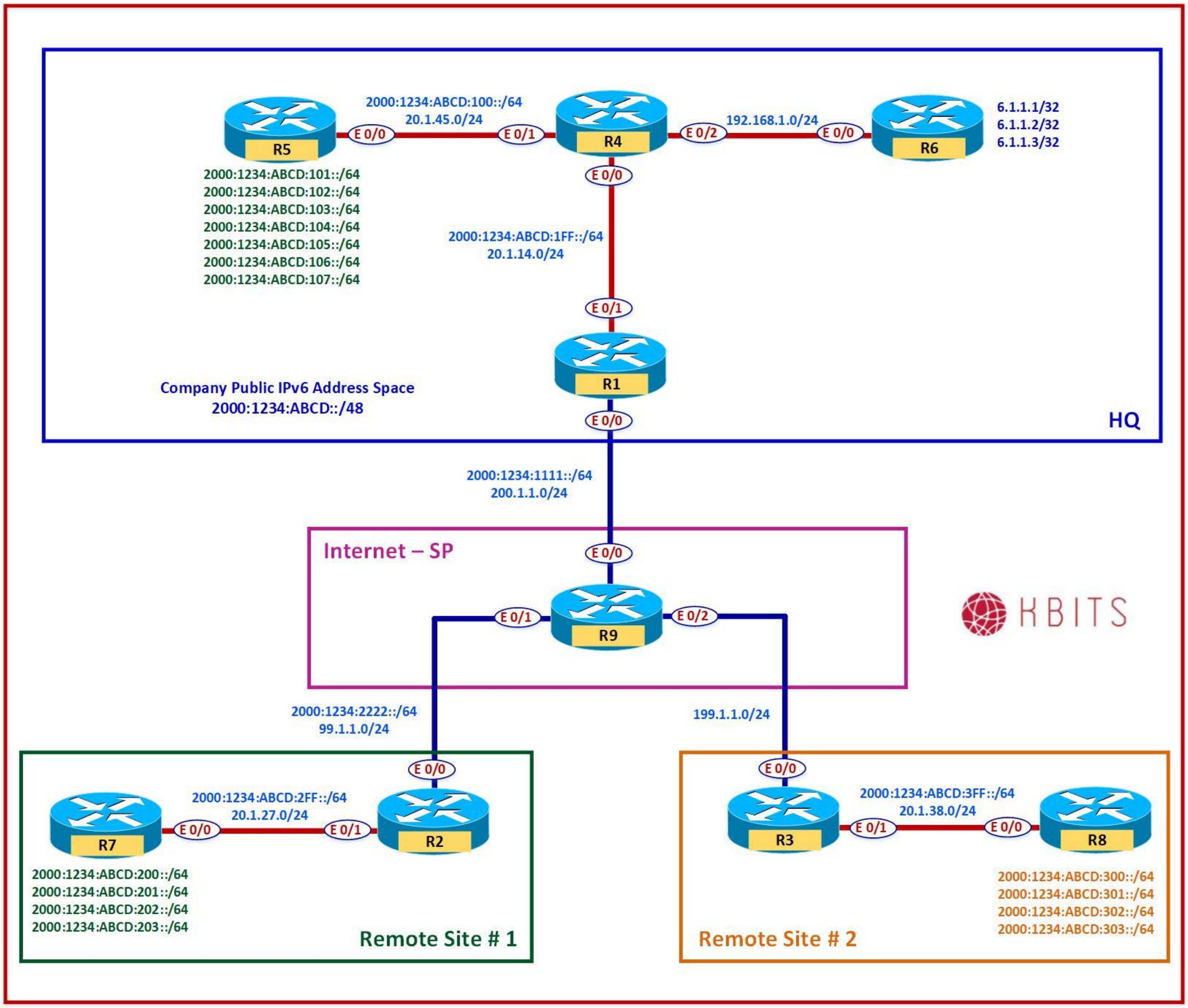
Authored By:

Khawar Butt
CCIE # 12353
Hepta CCIE#12353
CCDE # 20110020

Configuring IPv6

Website: http://www.kbits.live; Email: kb@kbits.live

Lab 1 – Configuring IPv6 Addressing



Task 1

Configure Headquarters with IPv6 addressing based on the Network Diagram. The Network between R4 & R6 will remain as IPv4 only. Configure the rest of the routers with IPv6 addressing based on the Network Diagram. Configure a default route on the Edge Router (R1) towards the ISP.

R1

```
ipv6 unicast-routing
!
Interface E 0/0
 ipv6 address 2000:1234:1111::1/64
 no shut
!
Interface E 0/1
 ipv6 address 2000:1234:ABCD:01FF::1/64
 no shut
!
ipv6 route ::/0 2000:1234:1111::9
```

R4

```
ipv6 unicast-routing
!
Interface E 0/0
 ipv6 address 2000:1234:ABCD:01FF::4/64
 no shut
!
Interface E 0/1
 ipv6 address 2000:1234:ABCD:0100::4/64
 no shut
```

R5

```
ipv6 unicast-routing
!
Interface E 0/0
 ipv6 address 2000:1234:ABCD:0100::5/64
 no shut
!
Interface Loopback1
 ipv6 address 2000:1234:ABCD:0101::5/64
!
Interface Loopback2
 ipv6 address 2000:1234:ABCD:0102::5/64
!
Interface Loopback3
```

```
 ipv6 address 2000:1234:ABCD:0103::5/64
!
Interface Loopback4
 ipv6 address 2000:1234:ABCD:0104::5/64
!
Interface Loopback5
 ipv6 address 2000:1234:ABCD:0105::5/64
!
Interface Loopback6
 ipv6 address 2000:1234:ABCD:0106::5/64
!
Interface Loopback7
 ipv6 address 2000:1234:ABCD:0107::5/64
```

Task 2

Configure **Site#1** with IPv6 addressing based on the Network Diagram. Configure a default route on the Edge Router (R2) towards the ISP.

R2

```
Interface E 0/0
 ipv6 address 2000:1234:2222::2/64
 no shut
!
Interface E 0/1
 ipv6 address 2000:1234:ABCD:02FF::2/64
 no shut
!
ipv6 route ::/0 2000:1234:2222::9
```

R7

```
ipv6 unicast-routing
!
Interface E 0/0
 ipv6 address 2000:1234:ABCD:02FF::7/64
 no shut
!
Interface Loopback1
 ipv6 address 2000:1234:ABCD:0200::7/64
!
Interface Loopback2
 ipv6 address 2000:1234:ABCD:0201::7/64
!
Interface Loopback3
 ipv6 address 2000:1234:ABCD:0202::7/64
```

```
!
Interface Loopback4
 ipv6 address 2000:1234:ABCD:0203::7/64
```

Task 3
Configure **Site#2** with IPv6 addressing based on the Network Diagram.

R3

```
ipv6 unicast-routing
!
Interface E 0/1
 ipv6 address 2000:1234:ABCD:03FF::3/64
 no shut
```

R8

```
ipv6 unicast-routing
!
Interface E 0/0
 ipv6 address 2000:1234:ABCD:03FF::8/64
 no shut
!
Interface Loopback1
 ipv6 address 2000:1234:ABCD:0300::8/64
!
Interface Loopback2
 ipv6 address 2000:1234:ABCD:0301::8/64
!
Interface Loopback3
 ipv6 address 2000:1234:ABCD:0302::8/64
!
Interface Loopback4
 ipv6 address 2000:1234:ABCD:0303::8/64
```

Task 4
Configure IPv4 IP Addresses based on the network diagram. Configure Static Routing to provide full reachability for IPv4 networks. You are allowed to use static routes.

R1

```
Interface E 0/0
 Ip address 200.1.1.1 255.255.255.0
 No shut
!
```

```
Interface E 0/1
 Ip address 20.1.14.1 255.255.255.0
 No shut
!
Ip route 0.0.0.0 0.0.0.0 200.1.1.9
Ip route 20.1.45.0 255.255.255.0 20.1.14.4
Ip route 6.1.1.0  255.255.255.0 20.1.14.4
```

R2

```
Interface E 0/0
 Ip address 99.1.1.2 255.255.255.0
 No shut
!
Interface E 0/1
 Ip address 20.1.27.2 255.255.255.0
 No shut
!
Ip route 0.0.0.0 0.0.0.0 99.1.1.9
```

R3

```
Interface E 0/0
 Ip address 199.1.1.3 255.255.255.0
 No shut
!
Interface E 0/1
 Ip address 20.1.38.3 255.255.255.0
 No shut
!
Ip route 0.0.0.0 0.0.0.0 199.1.1.9
```

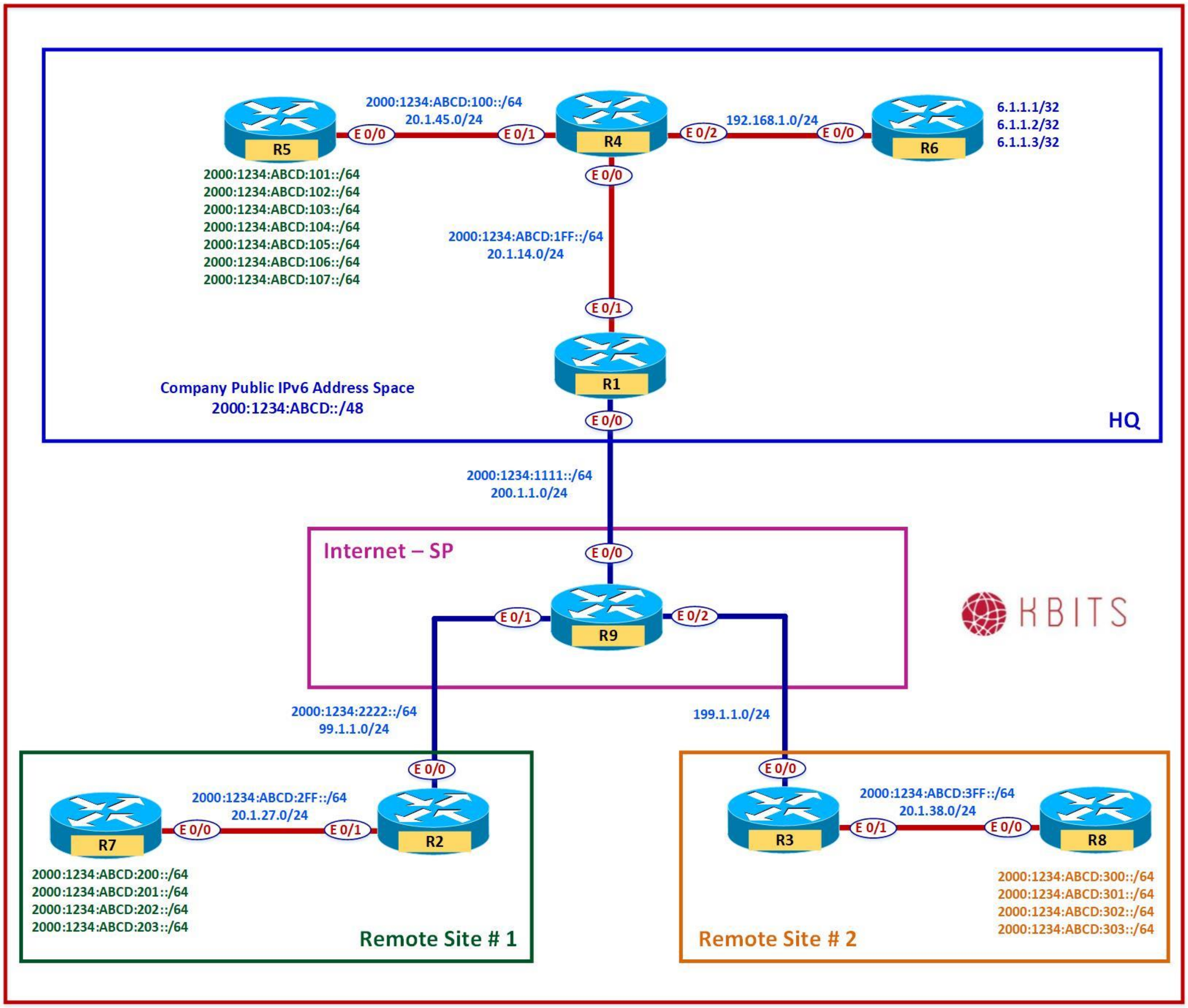
R4

```
Interface E 0/0
 Ip address 20.1.14.4 255.255.255.0
 No shut
!
Interface E 0/1
 Ip address 20.1.45.4 255.255.255.0
 No shut
!
Interface E 0/2
 Ip address 192.168.1.4 255.255.255.0
 No shut
!
Ip route 0.0.0.0 0.0.0.0 20.1.14.1
Ip route 6.1.1.0 255.255.255.0 192.168.1.6
```

R5 Interface E 0/0 Ip address 20.1.45.5 255.255.255.0 No shut ! Ip route 0.0.0.0 0.0.0.0 20.1.45.4
R6 Interface E 0/0 Ip address 192.168.1.6 255.255.255.0 No shut ! Interface Loo1 Ip address 6.1.1.1 255.255.255.255 ! Interface Loo2 Ip address 6.1.1.2 255.255.255.255 ! Interface Loo3 Ip address 6.1.1.3 255.255.255.255 ! Ip route 0.0.0.0 0.0.0.0 192.168.1.4 ! Line vty 0 4 Password cisco Login Transport input all
R7 Interface E 0/0 Ip address 20.1.27.7 255.255.255.0 No shut ! Ip route 0.0.0.0 0.0.0.0 20.1.27.2
R8 Interface E 0/0 Ip address 20.1.38.8 255.255.255.0 No shut ! Ip route 0.0.0.0 0.0.0.0 20.1.38.3
R9 Interface E 0/0

```
 Ip address 200.1.1.9 255.255.255.0
 No shut
!
Interface E 0/1
 Ip address 99.1.1.9 255.255.255.0
 No shut
!
Interface E 0/2
 Ip address 199.1.1.9 255.255.255.0
 No shut
!
Ip route 20.1.14.0 255.255.255.0 200.1.1.1
Ip route 20.1.45.0 255.255.255.0 200.1.1.1
Ip route 6.1.1.0 255.255.255.0 200.1.1.1
Ip route 20.1.27.0 255.255.255.0 99.1.1.2
Ip route 20.1.38.0 255.255.255.0 199.1.1.3
```

Lab 2 – Configuring OSPFv3



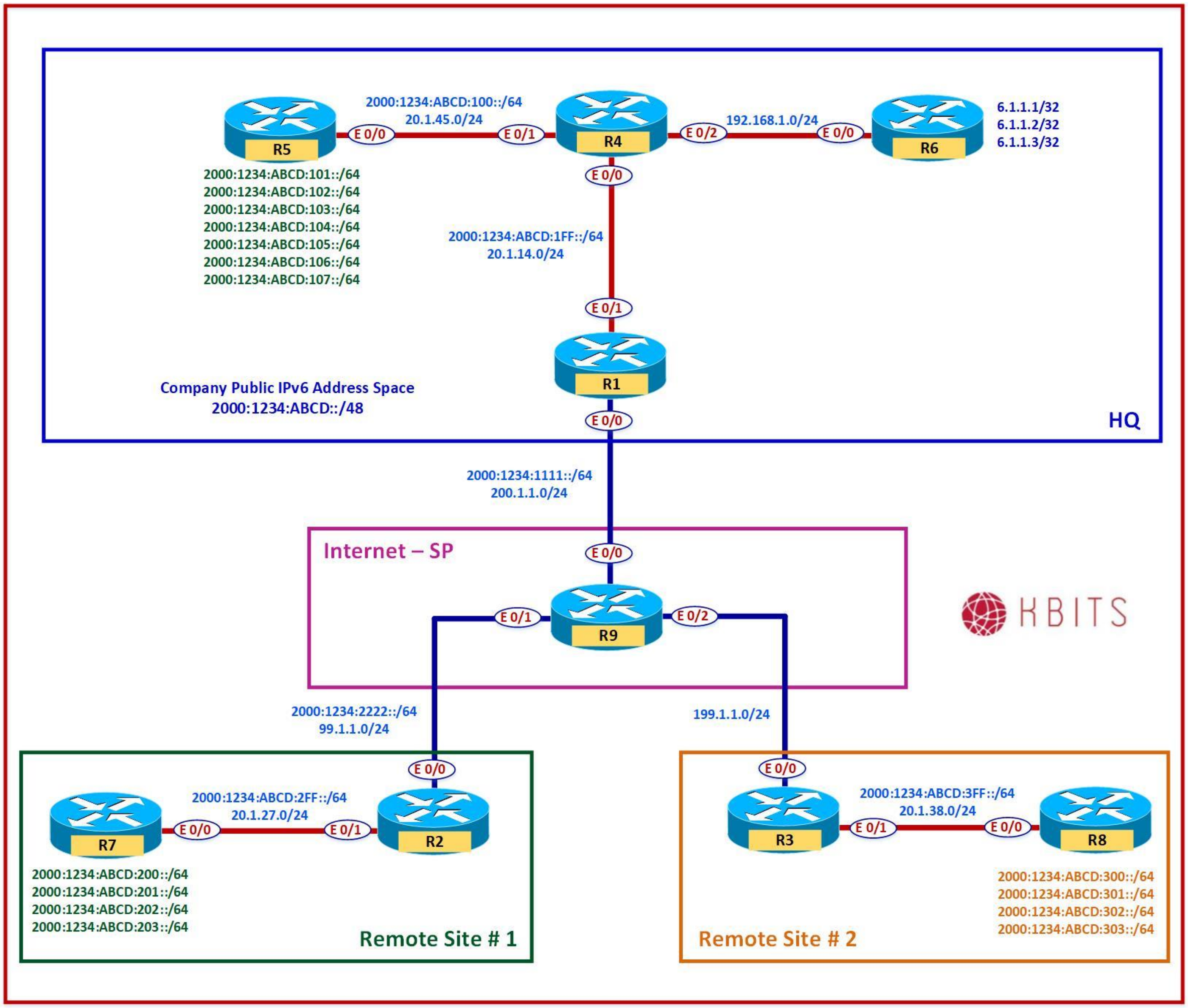
Task 1

Configure Headquarters with OSPFv3 within the HQ Site. Use X.X.X.X. as the router-id. (X stands for the Router #). Enable all the IPv6 addresses within the HQ site in OSPF. Have R1 inject a default route towards R4. The loopback interfaces should appear in the routing table using the interface mask.

R1 ipv6 router ospf 1 router-id 1.1.1.1 default-information originate always ! Interface E 0/1 ipv6 ospf 1 area 0
R4 ipv6 router ospf 1 router-id 4.4.4.4 ! Interface E 0/0 ipv6 ospf 1 area 0 ! Interface E 0/1 ipv6 ospf 1 area 0
R5 ipv6 router ospf 1 router-id 5.5.5.5 ! Interface E 0/0 ipv6 ospf 1 area 0 ! Interface Loopback 1 ipv6 ospf 1 area 0 ipv6 ospf network point-to-point ! Interface Loopback 2 ipv6 ospf 1 area 0 ipv6 ospf network point-to-point ! Interface Loopback 3 ipv6 ospf 1 area 0 ipv6 ospf network point-to-point ! Interface Loopback 4

```
 ipv6 ospf 1 area 0
 ipv6 ospf network point-to-point
!
Interface Loopback 5
 ipv6 ospf 1 area 0
 ipv6 ospf network point-to-point
!
Interface Loopback 6
 ipv6 ospf 1 area 0
 ipv6 ospf network point-to-point
!
Interface Loopback 7
 ipv6 ospf 1 area 0
 ipv6 ospf network point-to-point
```

Lab 3 – Configuring EIGRP for IPv6



Task 1

Configure EIGRP 222 within Site#1. Use X.X.X.X. as the router-id. (X stands for the Router #). Enable all the IPv6 addresses within Site#1 in EIGRP. Configure a default route on R7 towards R2.

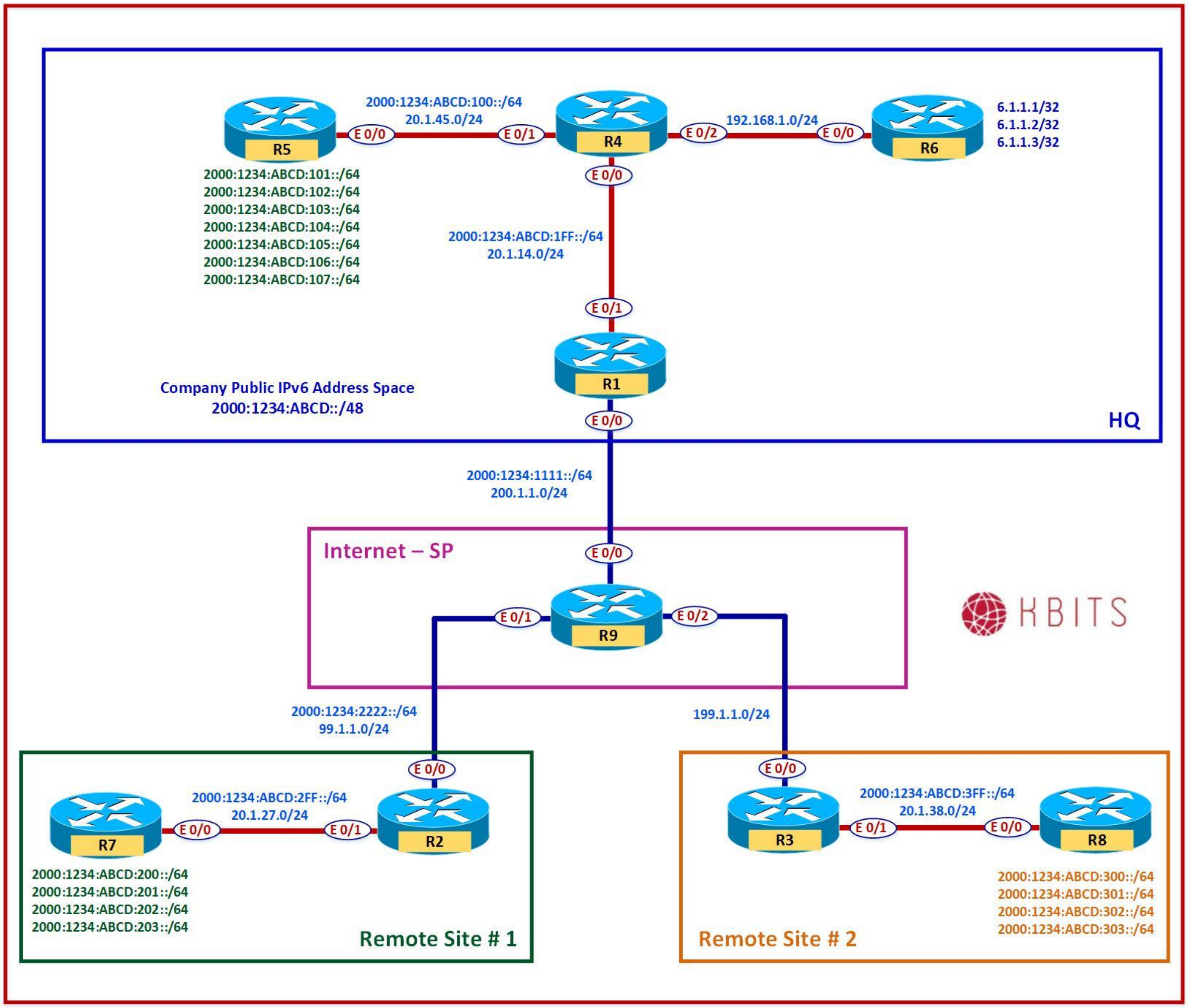
R2

```
ipv6 router eigrp 222
 router-id 2.2.2.2
!
Interface E 0/1
 ipv6 eigrp 222
```

R7

```
ipv6 router eigrp 222
 router-id 7.7.7.7
!
Interface E 0/0
 ipv6 eigrp 222
!
Interface Loopback 1
 ipv6 eigrp 222
!
Interface Loopback 2
 ipv6 eigrp 222
!
Interface Loopback 3
 ipv6 eigrp 222
!
Interface Loopback 4
 ipv6 eigrp 222
!
Ipv6 route ::/0 2000:1234:ABCD:02FF::2
```

Lab 4 – Configuring IS-IS for IPv6

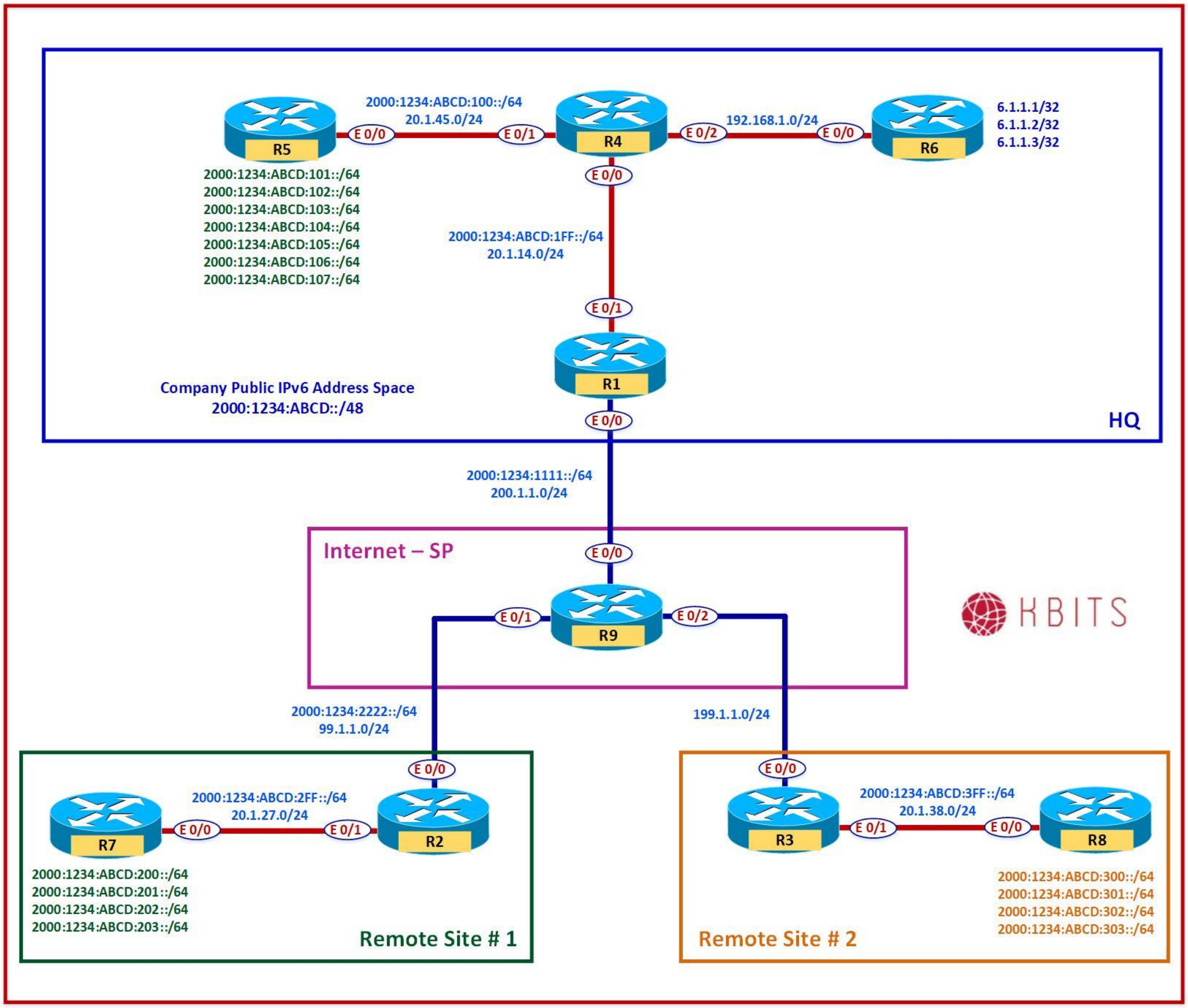


Task 1

Configure IS-IS within Site#1 based on the diagram. Use XXXX.XXXX.XXXX. as the System-id. (X stands for the Router #). Enable all the IPv6 addresses within Site#1 in IS-IS. Configure the Routers as Level-2 Routers with a metric-style of wide. Configure a default route on R7 towards R2.

R3 router isis net 49.0000.3333.3333.3333.00 is-type level-2-only metric-style wide ! address-family ipv6   multi-topology ! Interface E 0/1 Ipv6 router isis
R8 router isis net 49.0000.8888.8888.8888.00 is-type level-2-only metric-style wide ! address-family ipv6   multi-topology ! Interface E 0/0 Ipv6 router isis ! Interface Loopback 1 Ipv6 router isis ! Interface Loopback 2 Ipv6 router isis ! Interface Loopback 3 Ipv6 router isis ! Interface Loopback 4 Ipv6 router isis ! Ipv6 route ::/0 2000:1234:ABCD:03FF::3

Lab 5 – Configuring BGP for IPv6



Task 1

Configure BGP between R1 & R9. Configure R1 in AS 111. Redistribute the internal networks to BGP and vice versa.

R1

```
router bgp 111
 neighbor 2000:1234:1111::9 remote-as 1000
 address-family ipv6
  neighbor 2000:1234:1111::9 activate
  redistribute ospf 1
!
ipv6 router ospf 1
 redistribute bgp 111
```

R9

```
router bgp 1000
 neighbor 2000:1234:1111::1 remote-as 111
 address-family ipv6
  neighbor 2000:1234:1111::1 activate
```

Task 2

Configure BGP between R2 & R9. Configure R2 in AS 222. Redistribute the internal networks to BGP and vice versa.

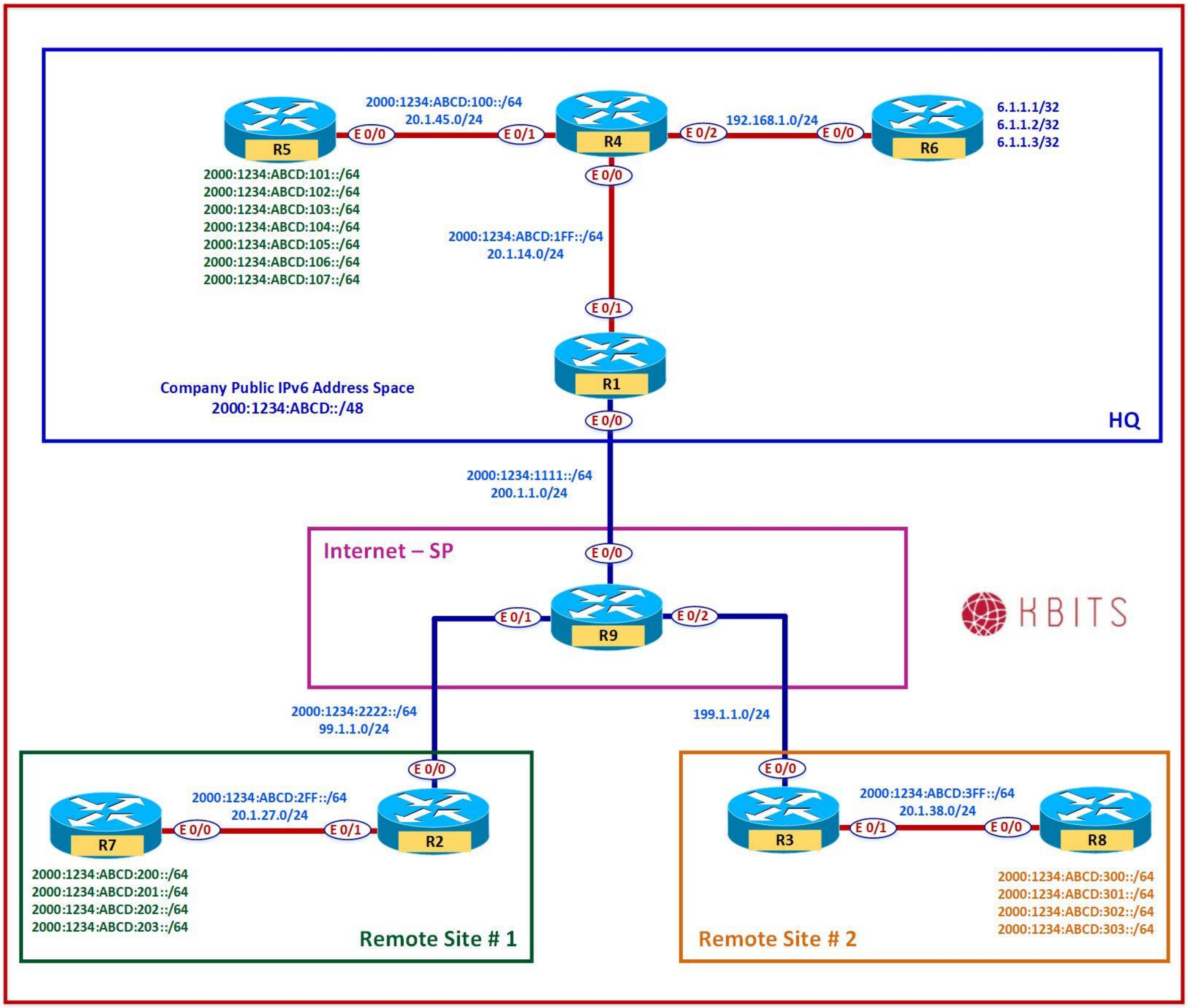
R2

```
router bgp 111
 neighbor 2000:1234:2222::9 remote-as 1000
 address-family ipv6
  neighbor 2000:1234:2222::9 activate
  redistribute eigrp 222
!
ipv6 router eigrp 222
 redistribute bgp 222 metric 10 10 10 10 10
```

R9

```
router bgp 1000
 neighbor 2000:1234:2222::2 remote-as 222
 address-family ipv6
  neighbor 2000:1234:2222::2 activate
```

Lab 6 – Configuring IPv6IP Tunneling



Task 1
Configure a IPv6IP tunnel to connect R1 to R3. Use the 2000:1234:ABCD:01FE::/64 as the Tunnel Network. Enable the Tunnel Interface in OSPF.

R1

```
Interface tunnel 1
 tunnel source 200.1.1.1
 tunnel destination 199.1.1.3
 tunnel mode ipv6ip
 ipv6 address 2000:1234:ABCD:01FE::1/64
 ipv6 ospf 1 area 0
```

R3

```
Interface tunnel 1
 tunnel source 199.1.1.3
 tunnel destination 200.1.1.1
 tunnel mode ipv6ip
 ipv6 address 2000:1234:ABCD:01FE::3/64
 ipv6 ospf 1 area 0
```

Task 2
Configure route redistribution on R3 between OSPF and IS-IS.

R3

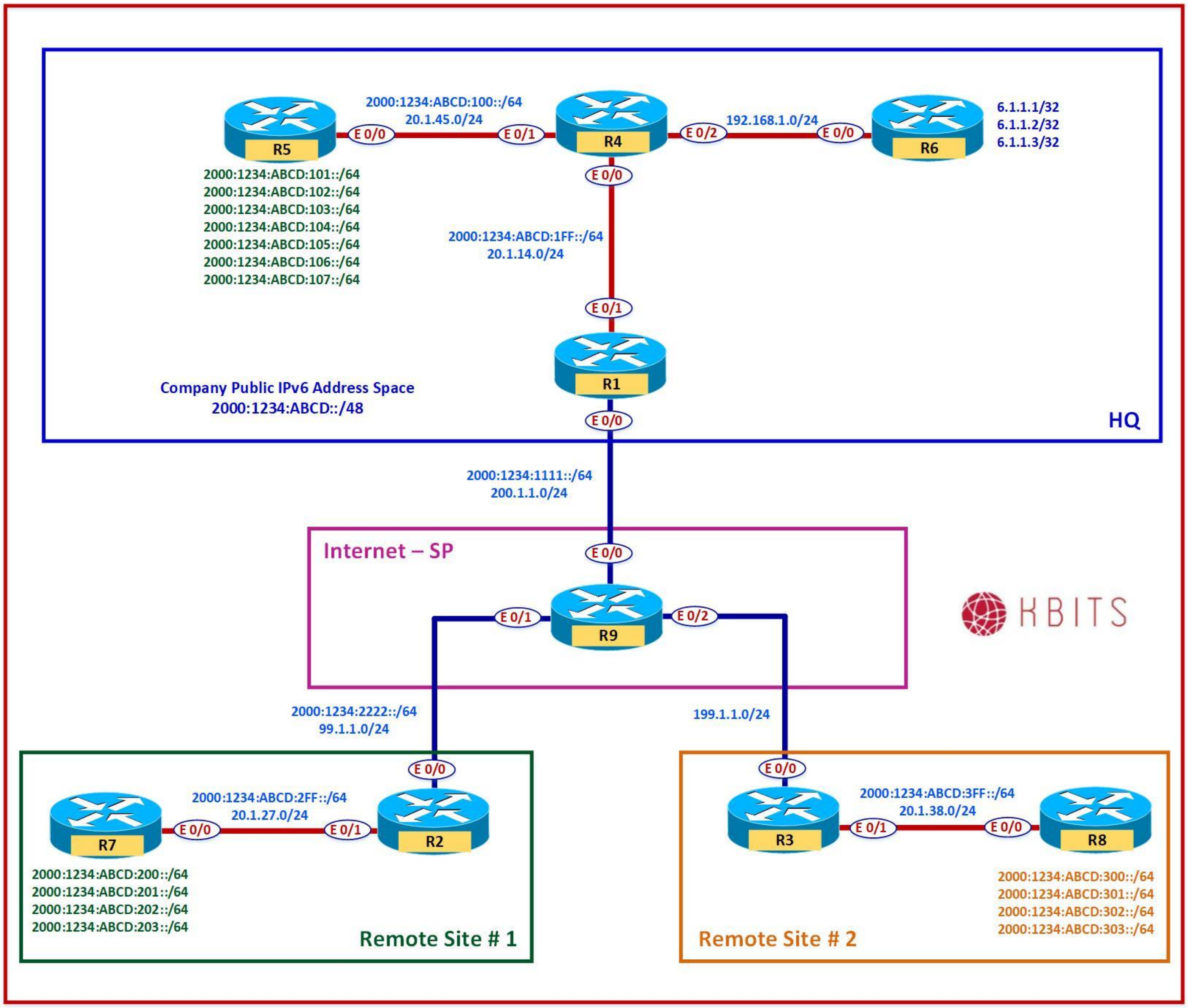
```
Ipv6 router ospf 1
 Redistribute isis
!
Router isis
 Address-family ipv6 unicast
  Redistribute ospf 1
```

Task 3
Configure route redistribution on R1 between OSPF and BGP for external OSPF routes as well.

R1

```
Router bgp 111
 Address-family ipv6
  Redistribute ospf 1 match internal external
```

Lab 7 – Configuring NAT64



Task 1
Enable NAT64 on all Interfaces on R4.

R4

```
Interface E0/0
 nat64 enable
!
Interface E0/1
 nat64 enable
!
Interface E0/2
 nat64 enable
```

Task 2
Dedicate an IPv6 network prefix for NAT64

R4

```
nat64 prefix stateful 2000:1234:ABCD:0400::/64
```

Task 3
Inject the NAT64 into the IPv6 network by creating a Null 0 route for it and redistributing it into BGP. Allow this route to redistributed into BGP on R1.

R4

```
ipv6 route 2000:1234:ABCD:400::/64 Null0
ipv6 router ospf 1
 redistribute static
```

R1

```
Router bgp 111
 Address-family ipv6
  Redistribute ospf 1 match internal external
```

Task 4

Configure Static NAT for IPv4 Servers. Translate to the following:

- 6.1.1.1 – 2000:1234:ABCD:0400::1
- 6.1.1.2 – 2000:1234:ABCD:0400::2
- 6.1.1.2 – 2000:1234:ABCD:0400::3

R4

```
nat64 v4v6 static 6.1.1.1 2000:1234:ABCD:0400::1
nat64 v4v6 static 6.1.1.2 2000:1234:ABCD:0400::2
nat64 v4v6 static 6.1.1.3 2000:1234:ABCD:0400::3
```

Task 5

Configure Dynamic PAT for your networks (2000:1234:ABCD::/64 to a pool of 10.10.10.1 & 10.10.10.2.

R4

```
ipv6 access-list IPV6LIST
 permit ip 2000:1234:ABCD::/48 any
!
nat64 v4 pool V4POOL 10.10.10.1 10.10.10.2
!
nat64 v6v4 list IPV6LIST pool V4POOL overload
```

Configuring Virtual Private Networks (VPNs)

Authored By:

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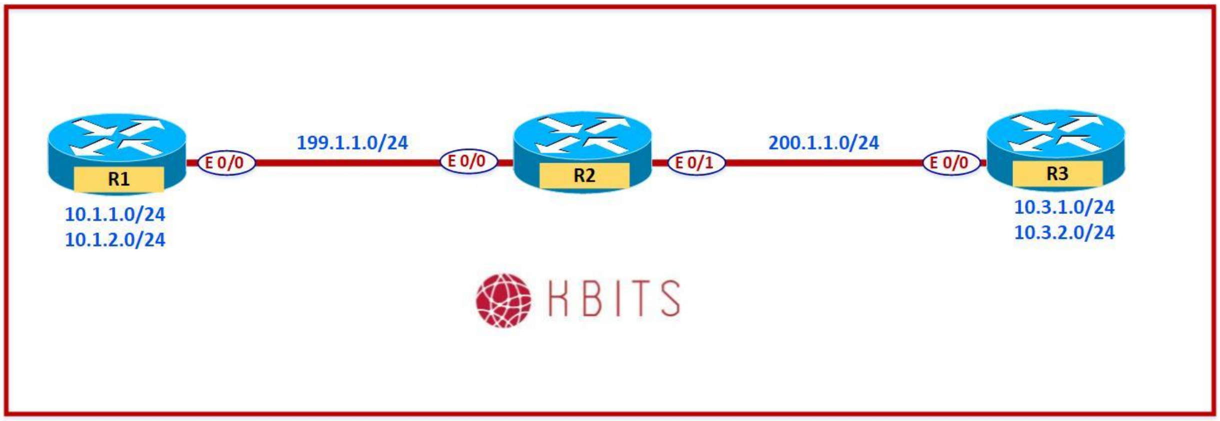
Hepta CCIE#12353
CCDE # 20110020

Configuring Virtual Private Networks (VPNs)

Lab 1 – Point-to-Point GRE



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	10.1.1.1	255.255.255.0
Loopback 1	10.1.2.1	255.255.255.0
E 0/0	199.1.1.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
E 0/0	199.1.1.2	255.255.255.0
E 0/1	200.1.1.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	10.3.1.1	255.255.255.0
Loopback 1	10.3.2.1	255.255.255.0
E 0/0	200.1.1.3	255.255.255.0

Task 1

Configure Defaut routes on R1 & R2 pointing towards R2 (ISP).

R1	R3
Ip route 0.0.0.0 0.0.0.0 199.1.1.2	Ip route 0.0.0.0 0.0.0.0 200.1.1.2

Task 2

Configure a Point-to-Point GRE tunnel between R1 and R3. Use 192.168.13.0/24 as the Tunnel Network IP.

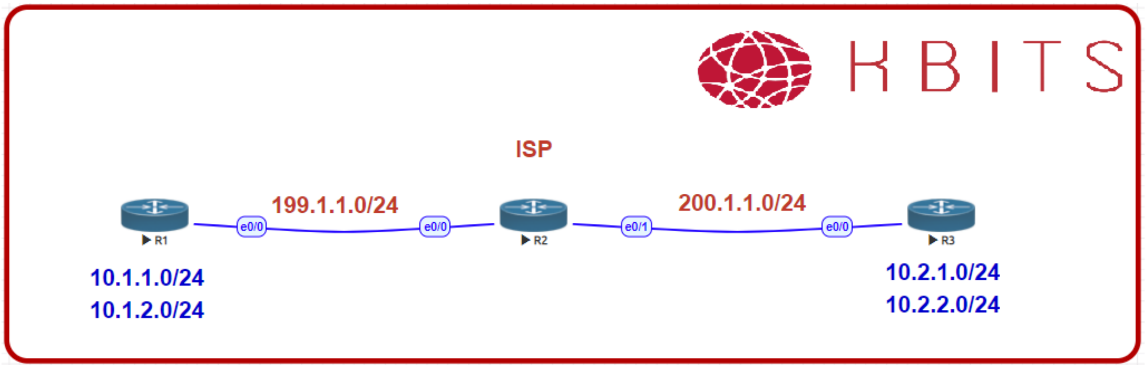
R1 Interface Tunnel 1 Ip add 192.168.13.1 255.255.255.0 Tunnel source 199.1.1.1 Tunnel destination 200.1.1.3
R3 Interface Tunnel 1 Ip add 192.168.13.3 255.255.255.0 Tunnel source 200.1.1.3 Tunnel destination 199.1.1.1

Task 3

Configure EIGRP in AS 13 to route the internal networks (Loopbacks) on the GRE Tunnel between R1 and R3.

R1 Router EIGRP 13 No auto-summary Network 192.168.13.0 Network 10.0.0.0
R3 Router EIGRP 13 No auto-summary Network 192.168.13.0 Network 10.0.0.0

Lab 2 – Encrypting GRE Tunnels Using IPSec



Task 1

Configure IPSec to encrypt the traffic passing thru the GRE tunnel. Make sure the packet does not duplicate the IP addresses in the Header. Use the following parameters for the IPSec Tunnel:

- ISAKMP Parameters
  - Authentication : Pre-shared
  - Encryption : 3DES
  - Group : 2
  - Hash : MD5
  - Pre-Shared Key : **cisco**
- IPSec Parameters
  - Encryption : ESP-3DES
  - Authentication : ESP-SHA-HMAC

R1

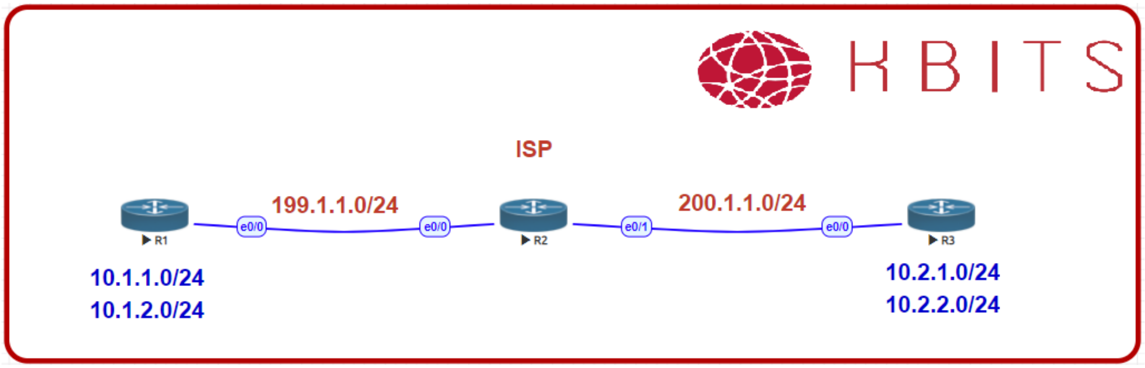
```
Crypto isakmp policy 10
 Authentication pre-share
 Hash md5
 Group 2
 Encryption 3des
!
Crypto isakmp key cisco address 200.1.1.3
!
crypto ipsec transform-set t-set esp-3des esp-sha-hmac
 mode transport
!
crypto ipsec profile IPSEC
 set transform-set t-set
!
Interface Tunnel 1
```

```
 Tunnel protection ipsec profile IPSEC
```

R3

```
Crypto isakmp policy 10
 Authentication pre-share
 Hash md5
 Group 2
 Encryption 3des
!
Crypto isakmp key cisco address 199.1.1.1
!
crypto ipsec transform-set t-set esp-3des esp-sha-hmac
 mode transport
!
crypto ipsec profile IPSEC
 set transform-set t-set
!
Interface Tunnel 1
 Tunnel protection ipsec profile IPSEC
```

Lab 3 – Configuring a Native IPSec Tunnel Interface

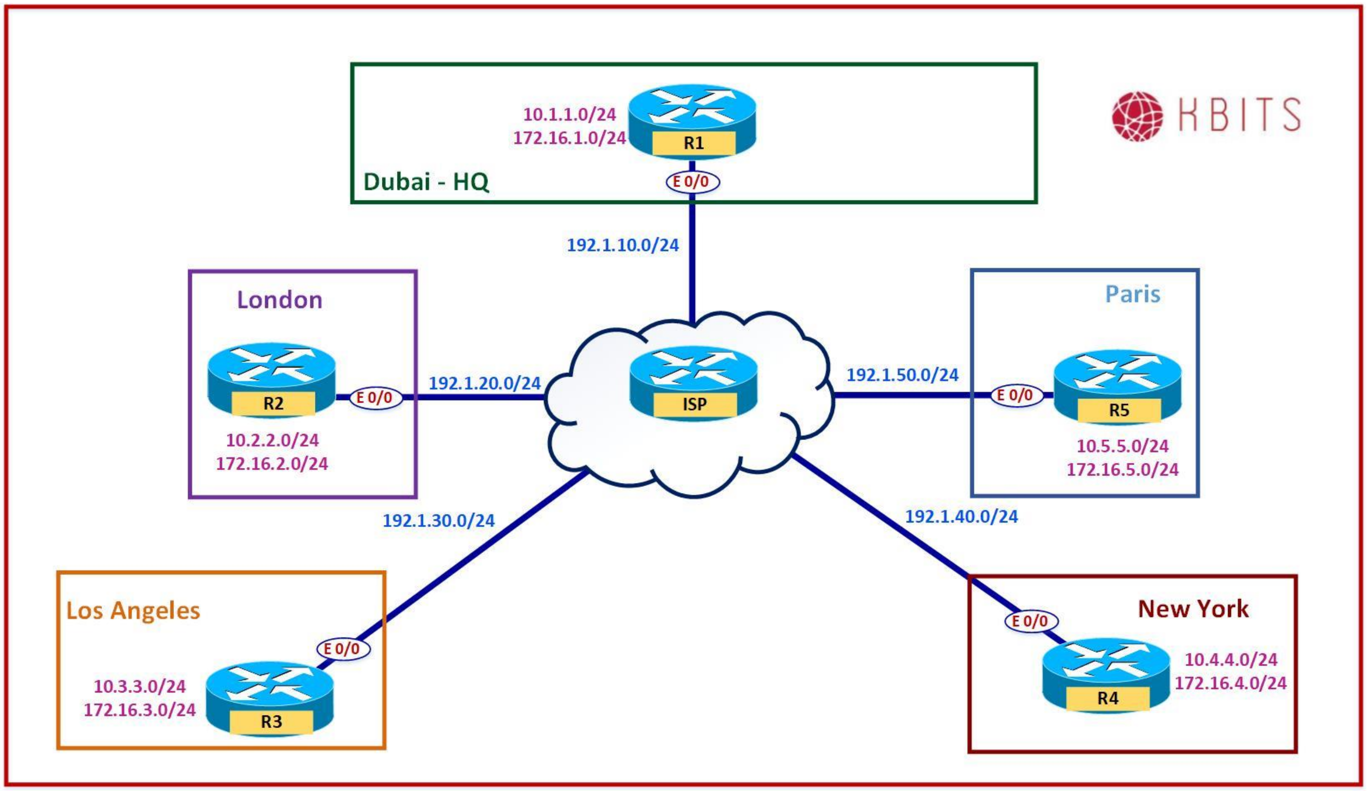


Task 1

Convert the Existing GRE/IPSec tunnel into a Native IPSec tunnel by changing the Tunnel mode to IPSec.

R1 Interface Tunnel 1 Tunnel mode ipsec ipv4
R3 Interface Tunnel 1 Tunnel mode ipsec ipv4

Lab 4 – Configuring a mGRE VPN



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	10.1.1.1	255.255.255.0
Loopback 1	172.16.1.1	255.255.255.0
E 0/0	192.1.10.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	10.2.2.2	255.255.255.0
Loopback 1	172.16.2.2	255.255.255.0
E 0/0	192.1.20.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	10.3.3.3	255.255.255.0
Loopback 1	172.16.3.3	255.255.255.0
E 0/0	192.1.30.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	10.4.4.4	255.255.255.0
Loopback 1	172.16.4.4	255.255.255.0
E 0/0	192.1.40.4	255.255.255.0

R5

Interface	IP Address	Subnet Mask
Loopback 0	10.5.5.5	255.255.255.0
Loopback 1	172.16.5.5	255.255.255.0
E 0/0	192.1.50.5	255.255.255.0

ISP

Interface	IP Address	Subnet Mask
E 0/0	192.1.10.6	255.255.255.0
E 0/1	192.1.20.6	255.255.255.0
E 0/2	192.1.30.6	255.255.255.0
E 0/3	192.1.40.6	255.255.255.0
E 1/0	192.1.50.6	255.255.255.0

Task 1

Configure Defaut routes on R1 – R5 pointing towards ISP.

R1 Ip route 0.0.0.0 0.0.0.0 192.1.10.6	**R2** Ip route 0.0.0.0 0.0.0.0 192.1.20.6
R3 Ip route 0.0.0.0 0.0.0.0 192.1.30.6	**R4** Ip route 0.0.0.0 0.0.0.0 192.1.40.6
R5 Ip route 0.0.0.0 0.0.0.0 192.1.50.6	

Task 2

Configure a MultiPoint GRE tunnel between R1, R2, R3, R4 & R5. Use 192.168.1.0/24 as the Tunnel Network IP. The NHRP mapping will be done in the next Task. Use the following parameters for your MGRE Tunnel:

- NHRP Parameters
    - NHRP ID – 100
    - NHRP Authentication key – cisco
- Tunnel Parameters
    - Tunnel Authentication Key : 100

R1 Interface Tunnel 1 Ip address 192.168.1.1 255.255.255.0 Ip nhrp network-id 100 Ip nhrp authentication cisco Tunnel source E 0/0 Tunnel mode gre multipoint Tunnel key 1234
R2 Interface Tunnel 1 Ip address 192.168.1.2 255.255.255.0 Ip nhrp network-id 100 Ip nhrp authentication cisco Tunnel source E 0/0 Tunnel mode gre multipoint Tunnel key 100
R3 Interface Tunnel 1 Ip address 192.168.1.3 255.255.255.0 Ip nhrp network-id 100 Ip nhrp authentication cisco Tunnel source E 0/0 Tunnel mode gre multipoint Tunnel key 100
R4 Interface Tunnel 1 Ip address 192.168.1.4 255.255.255.0 Ip nhrp network-id 100 Ip nhrp authentication cisco Tunnel source E 0/0

```
 Tunnel mode gre multipoint
 Tunnel key 100
```

R5

```
Interface Tunnel 1
 Ip address 192.168.1.5 255.255.255.0
 Ip nhrp network-id 100
 Ip nhrp authentication cisco
 Tunnel source E 0/0
 Tunnel mode gre multipoint
 Tunnel key 100
```

Task 3

Configure NHRP Mapping allowing all devices to connect to each other directly for Unicast traffic. Configure Multicast mappings in such a way that all devices use R1 as the routing hub.

R1

```
Interface Tunnel 1
 Ip nhrp map 192.168.1.2 192.1.20.2
 Ip nhrp map 192.168.1.3 192.1.30.3
 Ip nhrp map 192.168.1.4 192.1.40.4
 Ip nhrp map 192.168.1.5 192.1.50.5
 Ip nhrp map Multicast 192.1.20.2
 Ip nhrp map Multicast 192.1.30.3
 Ip nhrp map Multicast 192.1.40.4
 Ip nhrp map Multicast 192.1.50.5
```

R2

```
Interface Tunnel 1
 Ip nhrp map 192.168.1.1 192.1.10.1
 Ip nhrp map 192.168.1.3 192.1.30.3
 Ip nhrp map 192.168.1.4 192.1.40.4
 Ip nhrp map 192.168.1.5 192.1.50.5
 Ip nhrp map Multicast 192.1.10.1
```

R3

```
Interface Tunnel 1
 Ip nhrp map 192.168.1.1 192.1.10.1
 Ip nhrp map 192.168.1.2 192.1.20.2
 Ip nhrp map 192.168.1.4 192.1.40.4
 Ip nhrp map 192.168.1.5 192.1.50.5
 Ip nhrp map Multicast 192.1.10.1
```

R4

```
Interface Tunnel 1
 Ip nhrp map 192.168.1.1 192.1.10.1
 Ip nhrp map 192.168.1.2 192.1.20.2
 Ip nhrp map 192.168.1.3 192.1.30.3
 Ip nhrp map 192.168.1.5 192.1.50.5
 Ip nhrp map Multicast 192.1.10.1
```

R5

```
Interface Tunnel 1
 Ip nhrp map 192.168.1.1 192.1.10.1
 Ip nhrp map 192.168.1.2 192.1.20.2
 Ip nhrp map 192.168.1.3 192.1.30.3
 Ip nhrp map 192.168.1.4 192.1.40.4
 Ip nhrp map Multicast 192.1.10.1
```

Task 4

Configure EIGRP in AS 100 to route the internal networks (Loopbacks) on the GRE Tunnel on all the MGRE Routers. Disable Split horizon on R1 to allow it propagate routes from the Spoke routers to the other spoke routers.

Note: You might need to bounce the Tunnel interface to make the Routing work. Bring up the Hub router before the Spoke Routers.

R1

```
Router EIGRP 100
 No auto-summary
 Network 192.168.1.0
 Network 10.0.0.0
!
Interface Tunnel 1
 No ip split-hoirzon eigrp 100
 Shut
 No shut
```

R2

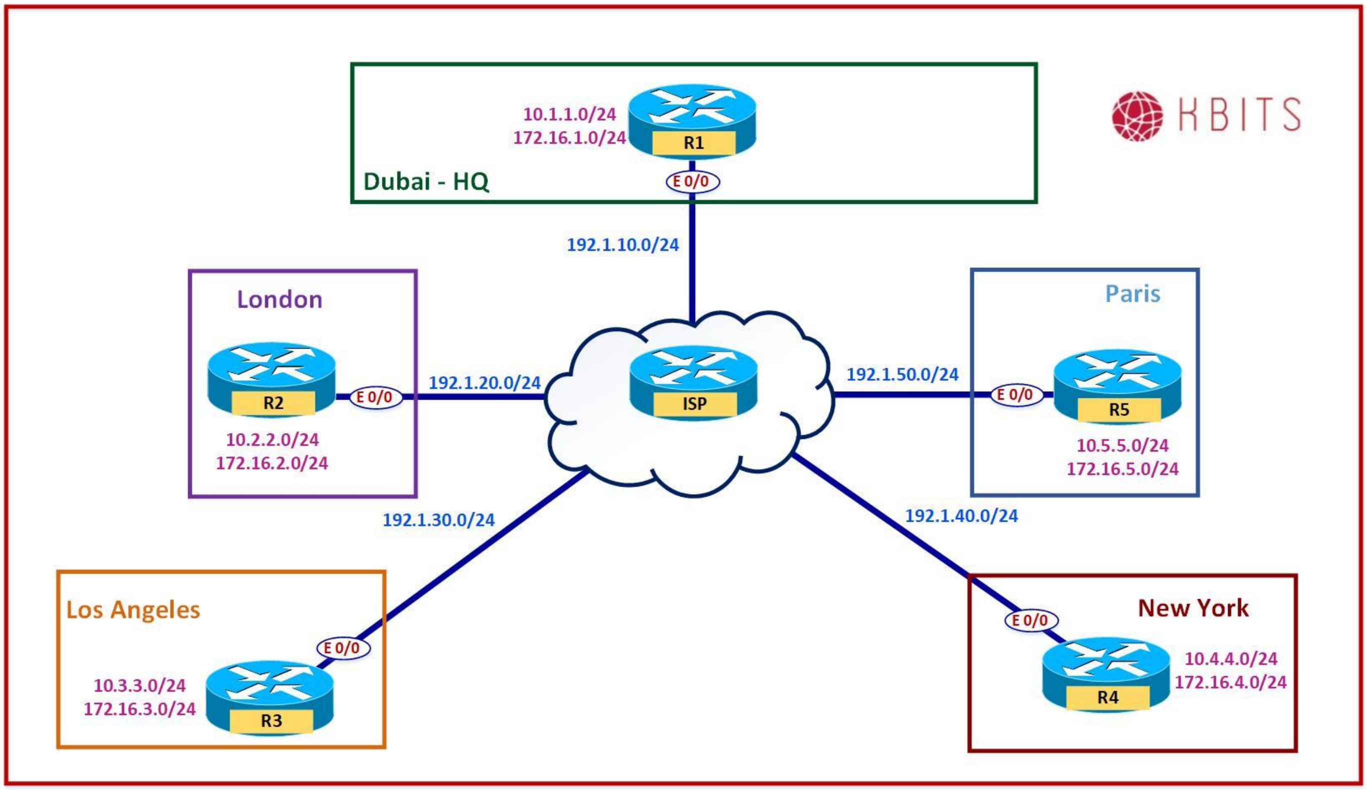
```
Router EIGRP 100
 No auto-summary
 Network 192.168.1.0
 Network 10.0.0.0
```

R3

```
Router EIGRP 100
 No auto-summary
```

Network 192.168.1.0 Network 10.0.0.0
R4 Router EIGRP 100 No auto-summary Network 192.168.1.0 Network 10.0.0.0
R5 Router EIGRP 100 No auto-summary Network 192.168.1.0 Network 10.0.0.0

Lab 5 – Configuring DMVPN – Phase I



Task 1

De-Configure the Tunnels created in the previous Lab.

R1 No Interface Tunnel 1	**R2** No Interface Tunnel 1
R3 No Interface Tunnel 1	**R4** No Interface Tunnel 1
R5 No Interface Tunnel 1	

Task 2

Configure a MultiPoint GRE tunnel between R1, R2, R3 & R4. Use 192.168.1.0/24 as the Tunnel Network IP. Tunnel:

- NHRP Parameters
  - NHRP ID – 100
  - NHRP Authentication key – cisco
  - NHS : R1
  - Routing Hub: R1 [Configure the multicast mapping to accommodate routing protocols]
- Tunnel Parameters
  - Tunnel Authentication Key : 100

R1 Interface Tunnel 1 Ip address 192.168.1.1 255.255.255.0 Ip nhrp network-id 100 Ip nhrp authentication cisco Ip nhrp map multicast dynamic Tunnel source E 0/0 Tunnel mode gre multipoint Tunnel key 100
R2 Interface Tunnel 1 Ip address 192.168.1.2 255.255.255.0 Ip nhrp network-id 100 Ip nhrp authentication cisco Ip nhrp nhs 192.168.1.1 Ip nhrp map 192.168.1.1 192.1.10.1 Ip nhrp map multicast 192.1.10.1 Tunnel source E 0/0 Tunnel mode gre multipoint Tunnel key 100
R3 Interface Tunnel 1 Ip address 192.168.1.3 255.255.255.0 Ip nhrp network-id 100 Ip nhrp authentication cisco Ip nhrp nhs 192.168.1.1 Ip nhrp map 192.168.1.1 192.1.10.1 Ip nhrp map multicast 192.1.10.1 Tunnel source E 0/0

```
 Tunnel mode gre multipoint
 Tunnel key 100
```

R4

```
Interface Tunnel 1
 Ip address 192.168.1.4 255.255.255.0
 Ip nhrp network-id 100
 Ip nhrp authentication cisco
 Ip nhrp nhs 192.168.1.1
 Ip nhrp map 192.168.1.1 192.1.10.1
 Ip nhrp map multicast 192.1.10.1
 Tunnel source E 0/0
 Tunnel mode gre multipoint
 Tunnel key 100
```

Task 3

Configure EIGRP in AS 100 to route the internal networks (Loopbacks) on the GRE Tunnel on all the MGRE Routers. Disable Split horizon on R1 to allow it propagate routes from the Spoke routers to the other spoke routers.

R1

```
Interface Tunnel 1
 No ip split-horizon eigrp 100
!
Router EIGRP 100
 No auto-summary
 Network 192.168.1.0
 Network 10.0.0.0
```

R2

```
Router EIGRP 100
 No auto-summary
 Network 192.168.1.0
 Network 10.0.0.0
```

R3

```
Router EIGRP 100
 No auto-summary
 Network 192.168.1.0
 Network 10.0.0.0
```

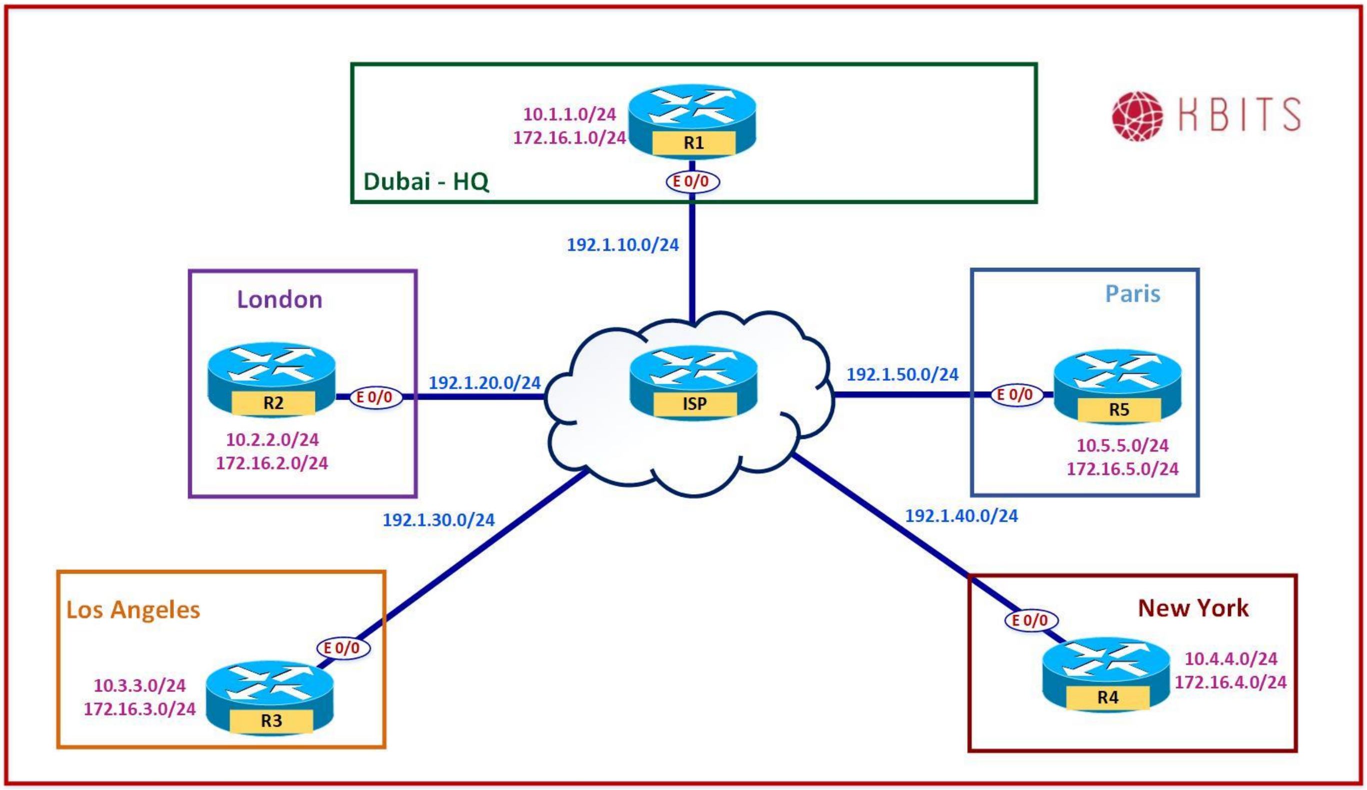
R4

```
Router EIGRP 100
 No auto-summary
```

```
Network 192.168.1.0
Network 10.0.0.0
```

Note: The default behavior of EIGRP is to change the Next-hop to itself while propagating the spoke routes to other spokes. The result is that the spokes will use the hub route as the next hop for all spoke-to-spoke traffic. **This is DMVPN Phase I [Hub-n-Spoke forwarding]**

Lab 6 – Configuring DMVPN – Phase II



Task 1

Disable the Hub from changing the next-hop attribute on the hub.

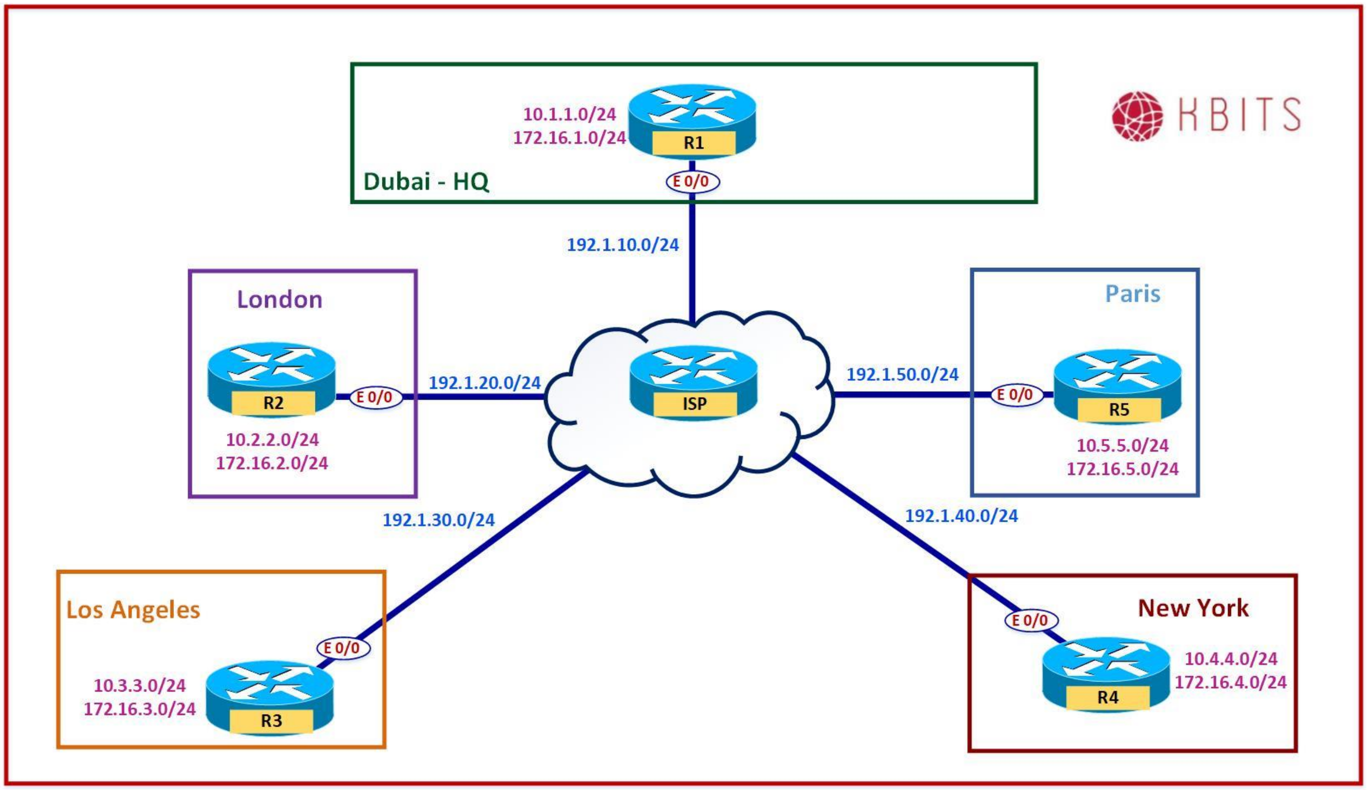
R1

```
Interface Tunnel 1
 No ip next-hop-self eigrp 100
```

Note: Check the Routing table. The next-hop attribute for the Spoke-routes is unchanged by the hub and is directly pointing to the spoke Tunnel IP. This causes the spokes to do a NHRP resolution directly for the spoke. Although the resolution packet will go thru the hub, the actual packet will take the direct path. Use the traceroute command to verify this.

This is DMVPN Phase II. In this phase, the spoke-to-spoke traffic is forwarded directly between the spokes. Phase II is accomplished by tweaking the Routing protocol behavior.

Lab 7 – Configuring DMVPN – Phase III



Task 1

Change the Next-hop back to Self. All routes should again have a next-hop pointing to the Hub [DMVPN Phase I]

R1

```
Interface Tunnel 1
 ip next-hop-self eigrp 100
```

Task 2

Configure NHRP Redirection on the Hub such that the Hub should push down a dynamic mapping to the spokes for the spoke internal routes. Configure the spokes to accept the mapping.

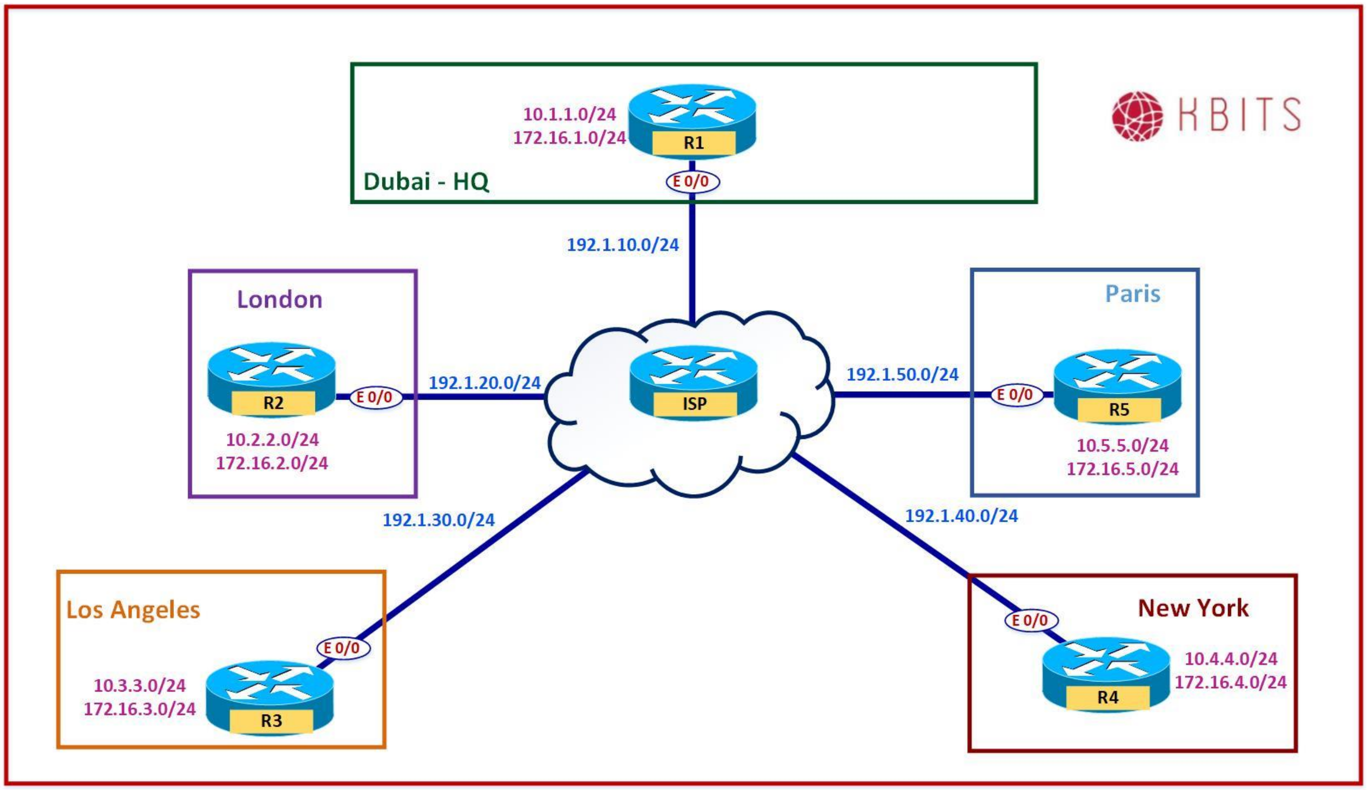
R1 Interface Tunnel 1 Ip nhrp redirect
R2 Interface Tunnel 1 Ip nhrp shortcut
R3 Interface Tunnel 1 Ip nhrp shortcut
R4 Interface Tunnel 1 Ip nhrp shortcut

Note: Check the Routing table. The next-hop attribute is pointing to the hun. Do a traceroute from the R2 to R4. You will notice the first trace goes thru the hub. This is due to the routing table pointing towards the Hub. The hub detects that the spokes are both connected on the same tunnel interface, hence sends a NHRP redirect message to both of them. The NHRP redirect message contains the mapping for the destination public IP for the internal networks.

The subsequent packets will be forwarded directly from spoke to spoke. If you check the routing table entry, it still points to the Hub. If you check the NHRP table, you will see an entry for the destination spoke network with the Spoke public IP.

This is DMVPN Phase III. In this phase, the spoke-to-spoke traffic is forwarded directly between the spokes. Phase III is accomplished by using NHRP redirect messages to override the routing table.

Lab 8 – Configuring a Dual-Hub DMVPN



Task 1

Configure a Static Tunnel between R1 and R5. R5 should be configured with a Tunnel IP address of 192.168.1.5/24 using the Tunnel parameters specified on the other routers (R1 – R4 – Lab 5). Enable EIGRP on R5.

R5

```
Interface Tunnel 1
 Ip address 192.168.1.5 255.255.255.0
 Ip nhrp network-id 100
 Ip nhrp authentication cisco
 Ip nhrp map 192.168.1.1 192.1.10.1
 Ip nhrp map multicast 192.1.10.1
 Tunnel source E 0/0
 Tunnel mode gre multipoint
 Tunnel key 100
 No ip split-horizon eigrp 100
!
router eigrp 100
 Network 192.168.1.0
 Network 10.0.0.0
```

R1 Interface Tunnel1 Ip nhrp map 192.168.1.5 192.1.50.5 Ip nhrp map multicast 192.1.50.5

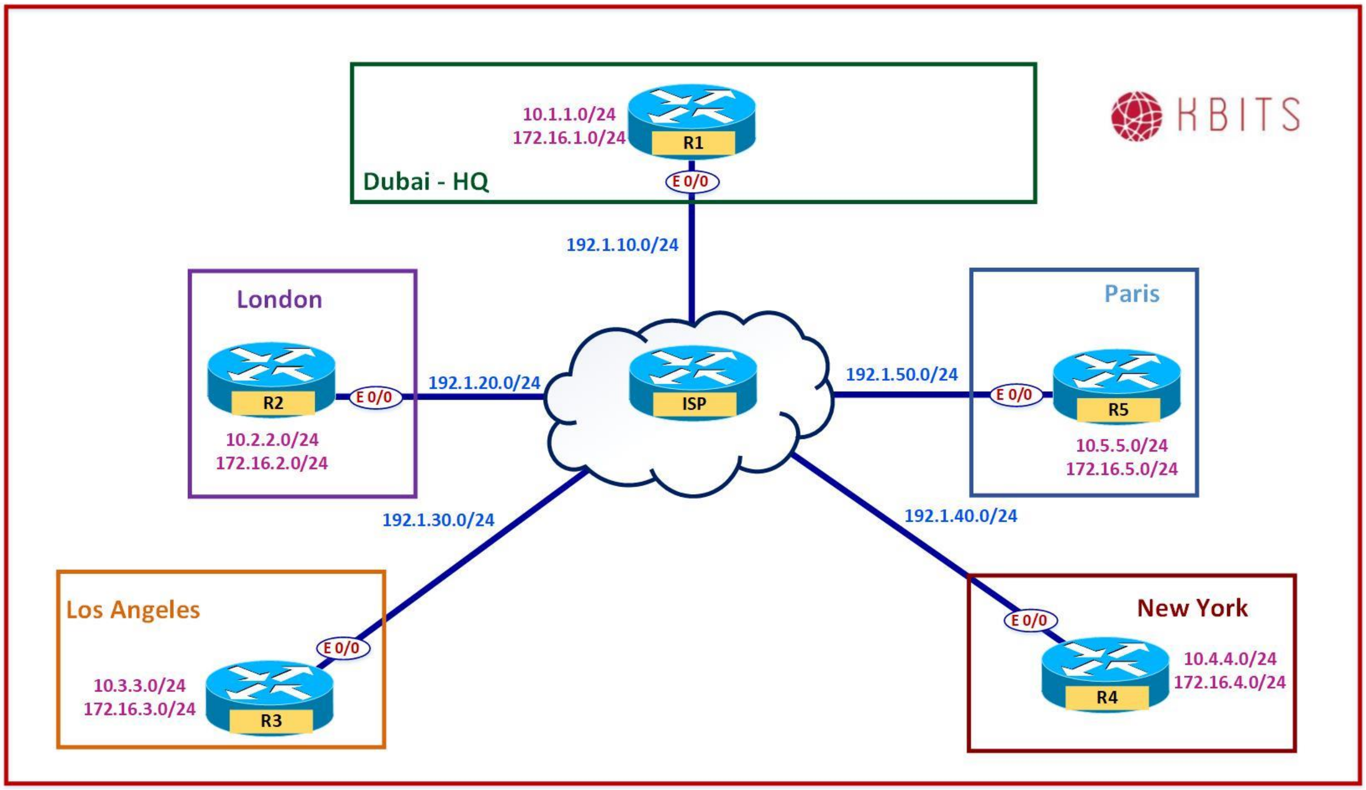
Task 2

Configure R5 as another NHS in your network. Configure R2, R3 & R4 to use R5 as the NHS Server and a Routing hub as well.

R2 Interface Tunnel1 Ip nhrp nhs 192.168.1.5 Ip nhrp map 192.168.1.5 192.1.50.5 Ip nhrp map multicast 192.1.50.5
R3 Interface Tunnel1 Ip nhrp nhs 192.168.1.5 Ip nhrp map 192.168.1.5 192.1.50.5 Ip nhrp map multicast 192.1.50.5
R4 Interface Tunnel1 Ip nhrp nhs 192.168.1.5 Ip nhrp map 192.168.1.5 192.1.50.5 Ip nhrp map multicast 192.1.50.5
R5 Interface Tunnel 1 Ip nhrp map multicast dynamic No ip split-horizon eigrp 100 Ip nhrp redirect

Note: You should now see routes from both Routing hubs. Although, it sees 2 entries, the Data path will be direct due to Phase III.

Lab 9 – Encrypting the DMVPN Traffic using IPSec



Task 1

Configure IPSec to encrypt the traffic passing thru the tunnel. Make sure the packet does not duplicate the IP addresses in the Header. Use the following parameters for the IPSec Tunnel:

- ISAKMP Parameters
    - Authentication : Pre-shared
    - Encryption : 3DES
    - Group : 2
    - Hash : MD5
    - Pre-Shared Key : **cisco**
- IPSec Parameters
    - Encryption : ESP-3DES
    - Authentication : ESP-SHA-HMAC

R1 Crypto isakmp policy 10 Authentication pre-share Hash md5 Group 2 Encryption 3des ! Crypto isakmp key cisco address 0.0.0.0 ! crypto ipsec transform-set t-set esp-3des esp-sha-hmac mode transport ! crypto ipsec profile IPSEC set transform-set t-set ! Interface Tunnel 1 Tunnel protection ipsec profile IPSEC
R2 Crypto isakmp policy 10 Authentication pre-share Hash md5 Group 2 Encryption 3des ! Crypto isakmp key cisco address 0.0.0.0 ! crypto ipsec transform-set t-set esp-3des esp-sha-hmac mode transport ! crypto ipsec profile IPSEC set transform-set t-set ! Interface Tunnel 1 Tunnel protection ipsec profile IPSEC
R3 Crypto isakmp policy 10 Authentication pre-share Hash md5 Group 2 Encryption 3des !

```
Crypto isakmp key cisco address 0.0.0.0
!
crypto ipsec transform-set t-set esp-3des esp-sha-hmac
 mode transport
!
crypto ipsec profile IPSEC
 set transform-set t-set
!
Interface Tunnel 1
 Tunnel protection ipsec profile IPSEC
```

R4

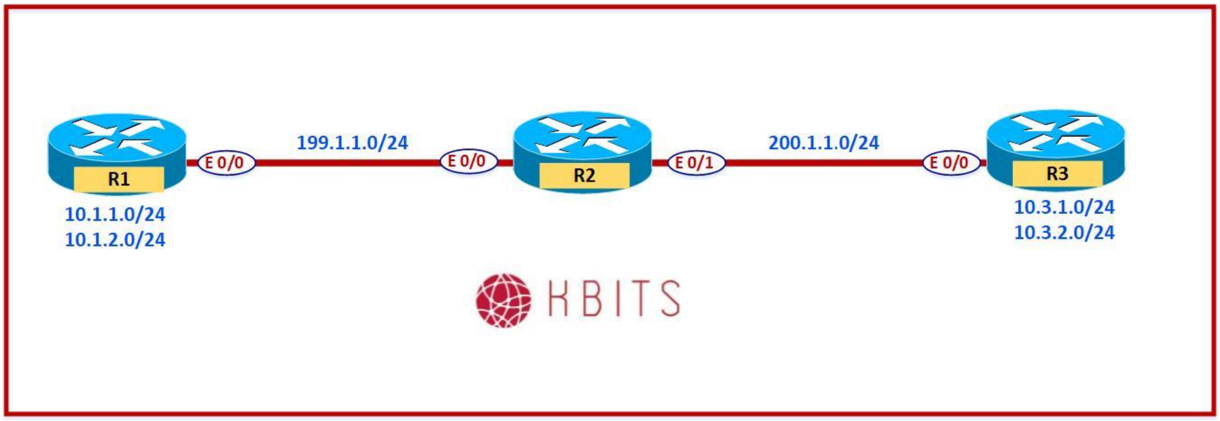
```
Crypto isakmp policy 10
 Authentication pre-share
 Hash md5
 Group 2
 Encryption 3des
!
Crypto isakmp key cisco address 0.0.0.0
!
crypto ipsec transform-set t-set esp-3des esp-sha-hmac
 mode transport
!
crypto ipsec profile IPSEC
 set transform-set t-set
!
Interface Tunnel 1
 Tunnel protection ipsec profile IPSEC
```

R5

```
Crypto isakmp policy 10
 Authentication pre-share
 Hash md5
 Group 2
 Encryption 3des
!
Crypto isakmp key cisco address 0.0.0.0
!
crypto ipsec transform-set t-set esp-3des esp-sha-hmac
 mode transport
!
crypto ipsec profile IPSEC
 set transform-set t-set
!
Interface Tunnel 1
```

```
Tunnel protection ipsec profile IPSEC
```

Lab 10 – Configuring Flex VPN – Point-to-Point



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	10.1.1.1	255.255.255.0
Loopback 1	10.1.2.1	255.255.255.0
E 0/0	199.1.1.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
E 0/0	199.1.1.2	255.255.255.0
E 0/1	200.1.1.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	10.3.1.1	255.255.255.0
Loopback 1	10.3.2.1	255.255.255.0
E 0/0	200.1.1.3	255.255.255.0

Task 1

Configure Defaut routes on R1 & R2 pointing towards R2 (ISP).

R1	R3
Ip route 0.0.0.0 0.0.0.0 199.1.1.2	Ip route 0.0.0.0 0.0.0.0 200.1.1.2

Task 2

Configure a Site-to-Site Flex VPN to encrypt traffic from 10.1.X.0/24 networks on R1 (Loopback 0 & Loopback 1) to the 10.3.X.0/24 on R3 (Loopback 0 & Loopback 1). Do not create a Static VTI on R1. It should be created dynamically based on an incoming connection from R3.

Task 3

Use the following Parameters for the Tunnel between R1 and R3:

- IKEv2 Proposal Parameters
  - Integrity: SHA1
  - Encryption: 3DES
  - Group: 2
  - Authentication: Pre-share
  - Pre-Shared Key: **cisco**
- IPSec Parameters
  - Encryption: ESP-3DES
  - Authentication: ESP-MD5-HMAC
- Tunnel IP Address:
  - IP Address for Virtual-template on R1: 192.168.1.1/24
  - Tunnel Interface on R3: 192.168.1.3/24

R1

```
int Loopback11
 ip add 192.168.1.1 255.255.255.0
!
int virtual-template 1 type tunnel
 ip unnumbered Loopback11
 tunnel source 199.1.1.1
 tunnel mode ipsec ipv4
!
crypto ikev2 proposal PROP_1
 integrity sha1
 group 2
 encryption 3des
!
```

```
crypto ikev2 policy POL_1
 proposal PROP_1
!
crypto ikev2 keyring KR_R3
 peer R3
   address 0.0.0.0
   pre-shared local cisco
   pre-shared remote cisco
!
crypto ikev2 profile PROF_1
 match identity remote address 0.0.0.0
 authentication remote pre-share
 authentication local pre-share
 keyring local KR_R3
!
crypto ipsec transform-set ABC esp-3des esp-md5-hmac
!
crypto ipsec profile ABC
 set transform-set ABC
 set ikev2-profile PROF_1
!
int virtual-template 1 type tunnel
 tunnel protection ipsec  profile ABC
!
crypto ikev2 profile PROF_1
 virtual-template 1
!
router eigrp 100
 network 10.0.0.0
 network 192.168.1.0
```

R3

```
crypto ikev2 proposal PROP_1
 integrity sha1
 group 2
 encryption 3des
!
crypto ikev2 policy POL_1
 proposal PROP_1
!
crypto ikev2 keyring KR_R1
 peer R1
   address 199.1.1.1
   pre-shared local cisco
   pre-shared remote cisco
```

```
!
crypto ikev2 profile PROF_1
 match identity remote address 199.1.1.1 255.255.255.255
 authentication remote pre-share
 authentication local pre-share
 keyring local KR_R1
!
crypto ipsec transform-set ABC esp-3des esp-md5-hmac
!
crypto ipsec profile ABC
 set transform-set ABC
 set ikev2-profile PROF_1
!
int tunnel 1
 ip add 192.168.1.3 255.255.255.0
 tunnel source E 0/0
 tunnel destination 199.1.1.1
 tunnel mode ipsec ipv4
 tunnel protection ipsec profile ABC
!
router eigrp 100
 network 10.0.0.0
 network 192.168.1.0
```

Configuring MPLS-based Networking

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Configuring MPLS-based Networking

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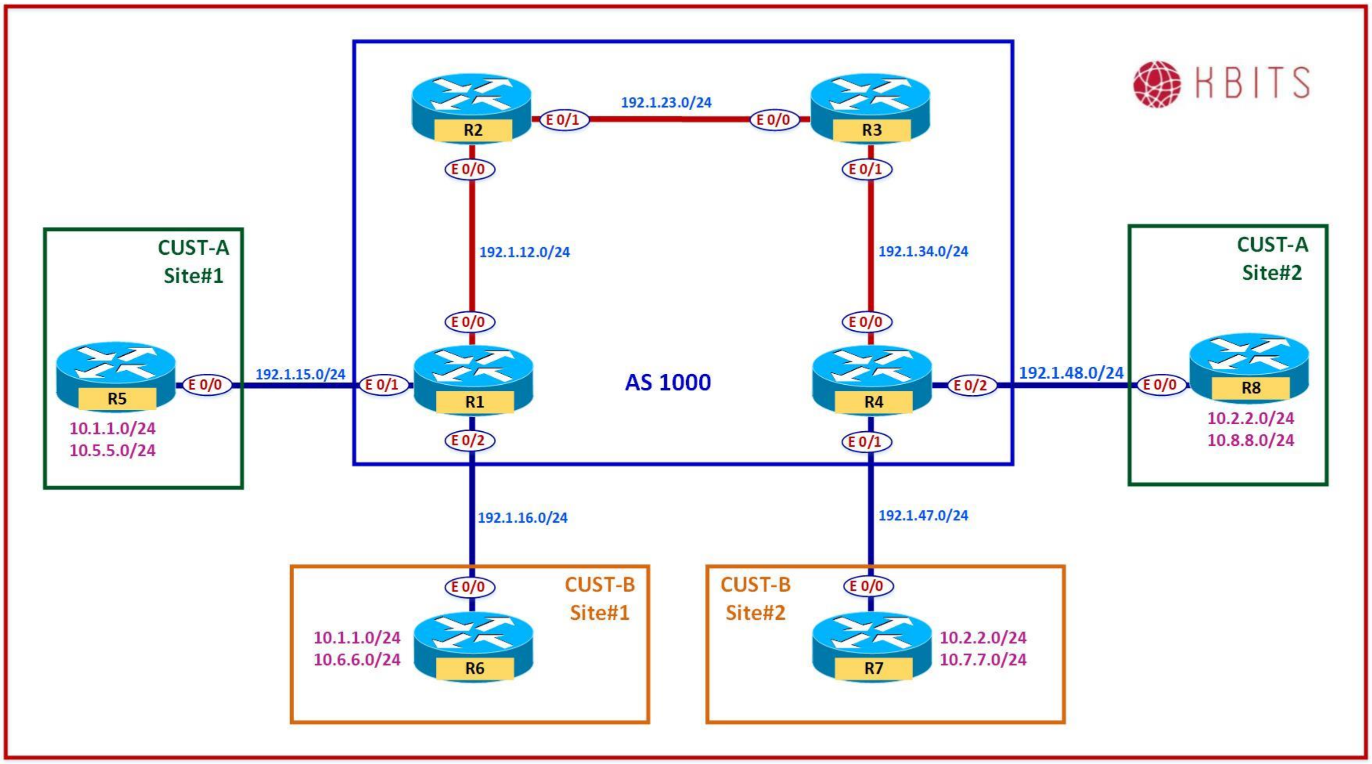
Lab 1 – Configuring MPLS Unicast Routing



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.255.255.255
E 0/0	192.1.12.1	255.255.255.0
E 0/1	192.1.15.1	255.255.255.0
E 0/2	192.1.16.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback 0	2.2.2.2	255.255.255.255
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.23.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	3.3.3.3	255.255.255.255
E 0/0	192.1.23.3	255.255.255.0
E 0/1	192.1.34.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	4.4.4.4	255.255.255.255
E 0/0	192.1.34.4	255.255.255.0
E 0/1	192.1.47.4	255.255.255.0
E 0/2	192.1.48.4	255.255.255.0

R5

Interface	IP Address	Subnet Mask
Loopback 0	10.5.5.5	255.255.255.0
E 0/0	192.1.15.5	255.255.255.0

R6

Interface	IP Address	Subnet Mask
Loopback 0	10.6.6.6	255.255.255.0
E 0/0	192.1.16.6	255.255.255.0

R7

Interface	IP Address	Subnet Mask
Loopback 0	10.7.7.7	255.255.255.0
E 0/0	192.1.47.7	255.255.255.0

R8

Interface	IP Address	Subnet Mask
Loopback 0	10.8.8.8	255.255.255.0
S 0/0	192.1.48.8	255.255.255.0

Task 1

Configure OSPF between all the SP routers (R1, R2, R3, R4). Use x.x.x.x as the router-id, where x is the Router number. Advertise all Internal links in OSPF in area 0.

R1 Router ospf 1 Router-id 1.1.1.1 Network 1.1.1.1 0.0.0.0 area 0 Network 192.1.12.0 0.0.0.255 area 0	**R2** Router ospf 1 Router-id 2.2.2.2 Network 2.2.2.2 0.0.0.0 area 0 Network 192.1.12.0 0.0.0.255 area 0 Network 192.1.23.0 0.0.0.255 area 0
R3 Router ospf 1 Router-id 3.3.3.3 Network 3.3.3.3 0.0.0.0 area 0 Network 192.1.23.0 0.0.0.255 area 0 Network 192.1.34.0 0.0.0.255 area 0	**R4** Router ospf 1 Router-id 4.4.4.4 Network 4.4.4.4 0.0.0.0 area 0 Network 192.1.34.0 0.0.0.255 area 0

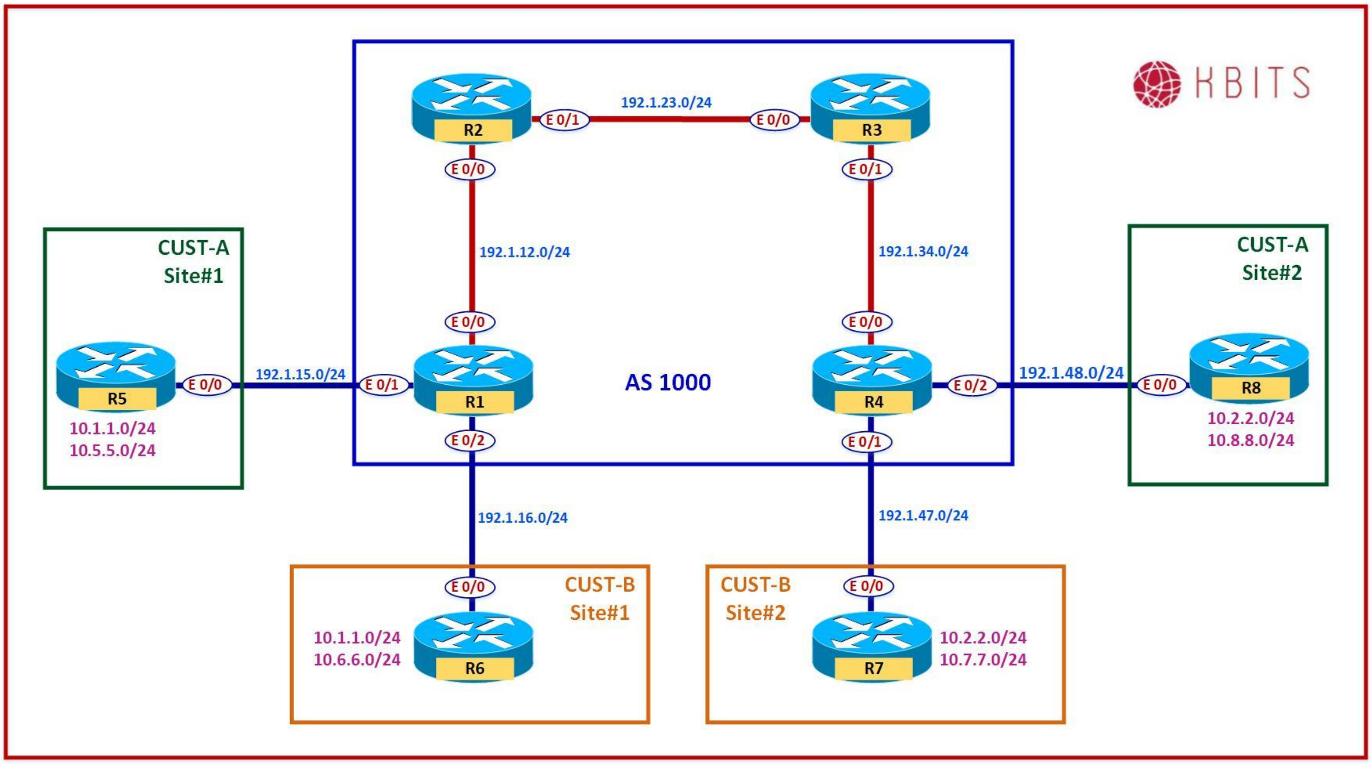
Task 2

Configure MPLS on all the physical links in the SP Network. Use LDP to distribute labels. The LDP neighbour relationships should be formed based on the most reliable interface. The Labels should be assigned from the range X00 – X99, where X is the router number.

R1 Mpls ldp router-id Loopback0 ! Mpls label range 100 199 ! Interface E 0/0 Mpls ip	**R2** Mpls ldp router-id Loopback0 ! Mpls label range 200 299 ! Interface E 0/0 Mpls ip ! Interface E 0/1 Mpls ip
R3 Mpls ldp router-id Loopback0 ! Mpls label range 300 399 ! Interface E 0/0 Mpls ip	**R4** Mpls ldp router-id Loopback0 ! Mpls label range 400 499 ! Interface E 0/0 Mpls ip

! Interface E 0/1 Mpls ip	

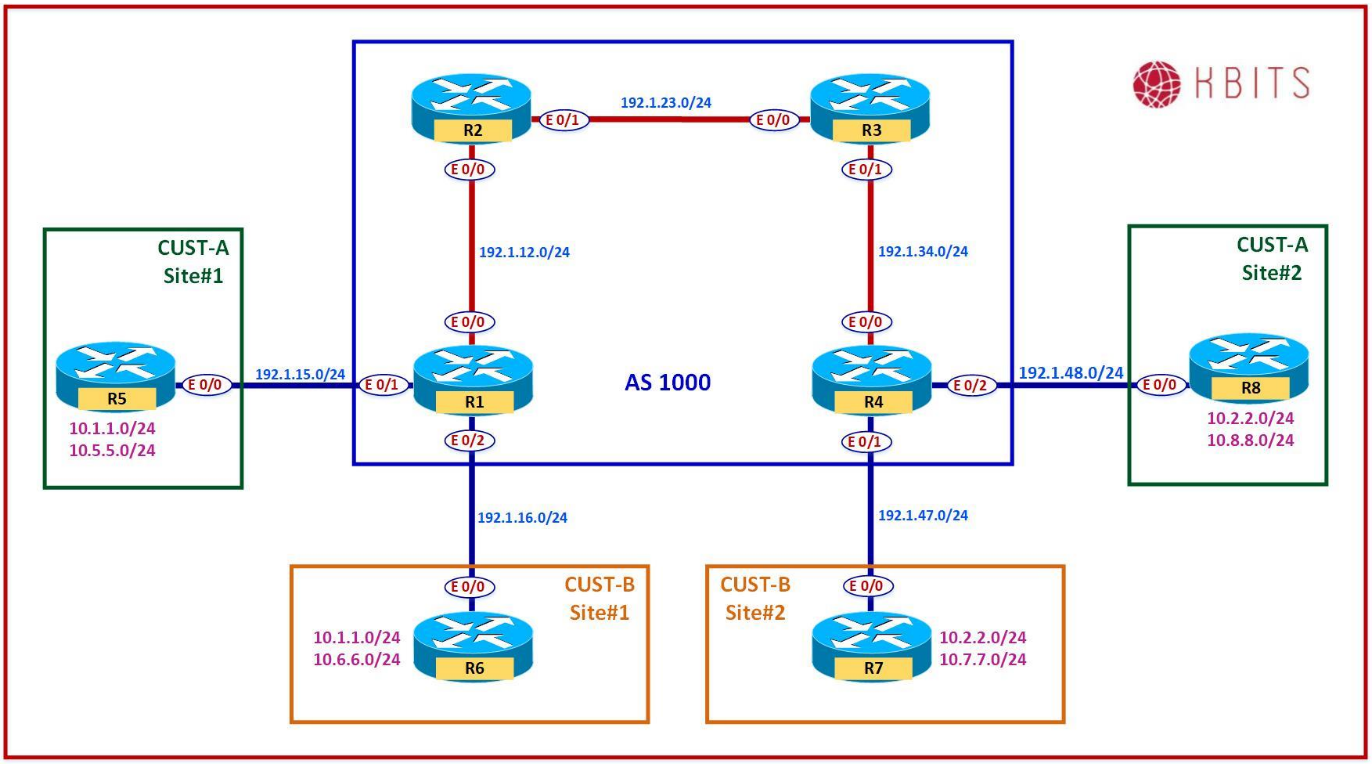
Lab 2 – Authenticating LDP Peers



Task 1
All LDP neighbor relationships should be authenticated using a password of **ccie12353**.

R1 Mpls ldp password required Mpls ldp neighbor 2.2.2.2 password ccie12353
R2 Mpls ldp password required Mpls ldp neighbor 1.1.1.1 password ccie12353 Mpls ldp neighbor 3.3.3.3 password ccie12353
R3 Mpls ldp password required Mpls ldp neighbor 2.2.2.2 password ccie12353 Mpls ldp neighbor 4.4.4.4 password ccie12353
R4 Mpls ldp password required Mpls ldp neighbor 3.3.3.3 password ccie12353

Lab 3 – Configuring MPLS VPN – PE-CE using Static Routing



Note:

Save the Configs on all the routers. **Do not save the configs during the labs.** At the completion of this lab, **reload the routers without saving**. This will allow you to do the next lab based on the same topology.

Task 1

Configure a VPNv4 (MP-iBGP) neighbor relationship between R1 and R4.

R1 Router BGP 1000 Neighbor 4.4.4.4 remote-as 1000 Neighbor 4.4.4.4 update-source loopback0 ! Address-family vpnv4 Neighbor 4.4.4.4 activate
R4 Router BGP 1000 Neighbor 1.1.1.1 remote-as 1000 Neighbor 1.1.1.1 update-source loopback0 ! Address-family vpnv4 Neighbor 1.1.1.1 activate

Task 2

Configure a VRF **Cust-A** with a RD value of 1000:1 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-A sites on R1 and R4.

R1	**R4**

Vrf definition Cust-A
 rd 1000:1
 address-family ipv4
  route-target both 1000:1
!
Interface E 0/1
 vrf forwarding Cust-A
 Ip address 192.1.15.1 255.255.255.0
 No shut
	Vrf definition Cust-A
	 rd 1000:1
	 address-family ipv4
	  route-target both 1000:1
	!
	Interface E 0/2
	 vrf forwarding Cust-A
	 Ip address 192.1.48.4 255.255.255.0
	 No shut

Task 3

Configure a static route on R1 in the Cust-A vrf to reach the 10.5.5.0 on R5. Inject this route into BGP such that it should be reachable from Cust-A VRF on R4. Configure a default Route on R5 towards R1.

R1

```
ip route vrf Cust-A 10.5.5.0 255.255.255.0 192.1.15.5
!
Router BGP 1000
!
Address-family ipv4 vrf Cust-A
 Redistribute static
```

R5

```
ip route 0.0.0.0 0.0.0.0 192.1.15.1
```

Task 4

Configure a static route on R4 in the Cust-A vrf to reach the 10.8.8.0 on R8. Inject this route into BGP such that it should be reachable from Cust-A VRF on R1. Configure a default Route on R8 towards R4.

R4

```
ip route vrf Cust-A 10.8.8.0 255.255.255.0 192.1.48.8
!
Router BGP 1000
!
Address-family ipv4 vrf Cust-A
 Redistribute static
```

R8

```
ip route 0.0.0.0 0.0.0.0 192.1.48.4
```

Task 5

Configure a VRF **Cust-B** with a RD value of 1000:2 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-B sites on R1 and R4.

R1

```
Vrf definition Cust-B
 rd 1000:2
 address-family ipv4
  route-target both 1000:2
!
Interface E 0/2
 Ip vrf forwarding Cust-B
 Ip address 192.1.16.1 255.255.255.0
 No shut
```

R4

```
Vrf definition Cust-B
 rd 1000:2
 address-family ipv4
  route-target both 1000:2
!
Interface E 0/1
 Ip vrf forwarding Cust-B
 Ip address 192.1.47.4 255.255.255.0
 No shut
```

Task 6

Configure a static route on R1 in the Cust-B vrf to reach the 10.6.6.0 on R6. Inject this route into BGP such that it should be reachable from Cust-B VRF on R4. Configure a default Route on R6 towards R1.

R1 ip route vrf Cust-B 10.6.6.0 255.255.255.0 192.1.16.6 ! Router BGP 1000 ! Address-family ipv4 vrf Cust-B Redistribute static
R6 ip route 0.0.0.0 0.0.0.0 192.1.16.1

Task 7

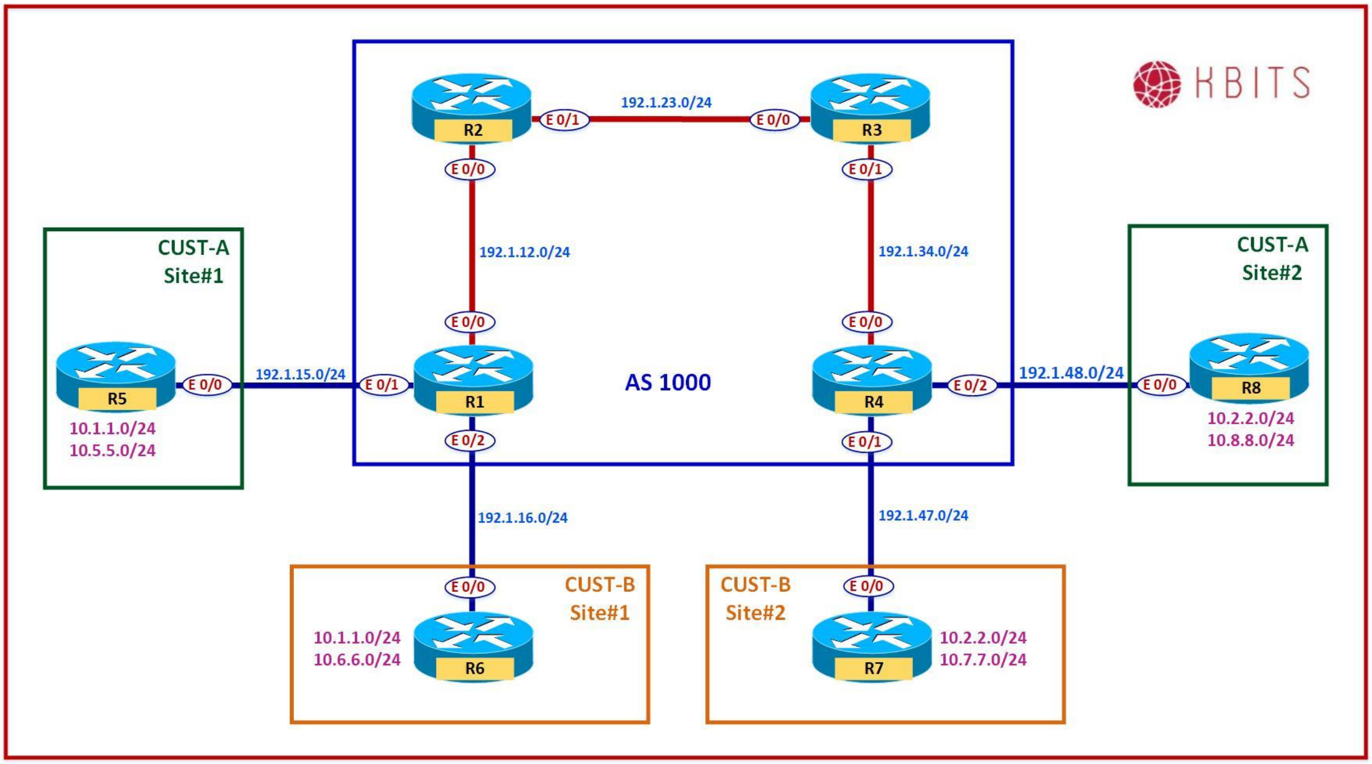
Configure a static route on R4 in the CUST-B vrf to reach the 10.7.7.0 on R7. Inject this route into BGP such that it should be reachable from CUST-B VRF on R1. Configure a default Route on R7 towards R4.

R4 ip route vrf Cust-B 10.7.7.0 255.255.255.0 192.1.47.7 ! Router BGP 1000 ! Address-family ipv4 vrf Cust-B Redistribute static
R7 ip route 0.0.0.0 0.0.0.0 192.1.47.4

NOTE:

Reload the Routers without saving the configs. This will setup the topology for the next lab.

Lab 4 – Configuring MPLS VPN – PE-CE using EIGRP



Note:

Save the Configs on all the routers. **Do not save the configs during the labs**. At the completion of this lab, **reload the routers without saving**. This will allow you to do the next lab based on the same topology.

Task 1

Configure a VPNv4 neighbor relationship between R1 and R4.

R1

```
Router BGP 1000
 Neighbor 4.4.4.4 remote-as 1000
 Neighbor 4.4.4.4 update-source loopback0
!
Address-family vpnv4
 Neighbor 4.4.4.4 activate
```

R4

```
Router BGP 1000
 Neighbor 1.1.1.1 remote-as 1000
 Neighbor 1.1.1.1 update-source loopback0
!
Address-family vpnv4
 Neighbor 1.1.1.1 activate
```

Task 2

Configure a VRF **Cust-A** with a RD value of 1000:1 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-A sites on R1 and R4.

R1

```
Vrf definition Cust-A
 rd 1000:1
 address-family ipv4
  route-target both 1000:1
!
Interface E 0/1
 vrf forwarding Cust-A
 Ip address 192.1.15.1 255.255.255.0
 No shut
```

R4

```
Vrf definition Cust-A
 rd 1000:1
 address-family ipv4
  route-target both 1000:1
!
Interface E 0/2
 vrf forwarding Cust-A
 Ip address 192.1.48.4 255.255.255.0
 No shut
```

Task 3

Configure EIGRP 100 as the Routing Protocol between R5 and R1-vrf Cust-A. Advertise all the routes on R5 in EIGRP. Advertise the VRF link in EIGRP on R1 under the appropriate address family. Make sure the VRF Cust-A on R4 has reachability to routes learned from R5.

R1

```
Router EIGRP 1
!
Address-family ipv4 vrf Cust-A Autonomous-system 100
 Network 192.1.15.0
 Redistribute BGP 1000 metric 10 10 10 10 10
!
Router BGP 1000
!
Address-family ipv4 vrf Cust-A
 Redistribute eigrp 100
```

R5

```
Router EIGRP 100
 Network 192.1.15.0
 Network 10.0.0.0
```

Task 4

Configure EIGRP 100 as the Routing Protocol between R4 and R8-vrf CUST-A. Advertise all the routes on R8 in EIGRP. Advertise the VRF link in RIP on R4 under the appropriate address family. Make sure the VRF CUST-A on R1 has reachability to routes learned from R8.

R4

```
Router EIGRP 1
!
Address-family ipv4 vrf Cust-A Autonomous-system 100
 Network 192.1.48.0
 Redistribute BGP 1000 metric 10 10 10 10 10
!
Router BGP 1000
!
Address-family ipv4 vrf Cust-A
 Redistribute eigrp 100
```

R8

```
Router EIGRP 100
 Network 192.1.48.0
 Network 10.0.0.0
```

Task 5

Configure a VRF **Cust-B** with a RD value of 1000:2 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-B sites on R1 and R4.

R1	R4

Vrf definition Cust-B
 rd 1000:2
 address-family ipv4
  route-target both 1000:2
!
Interface E 0/2
 Ip vrf forwarding Cust-B
 Ip address 192.1.16.1 255.255.255.0
 No shut
	Vrf definition Cust-B
	 rd 1000:2
	 address-family ipv4
	  route-target both 1000:2
	!
	Interface E 0/1
	 Ip vrf forwarding Cust-B
	 Ip address 192.1.47.4 255.255.255.0
	 No shut

Task 6

Configure EIGRP 200 as the Routing Protocol between R6 and R1-vrf Cust-B. Advertise all the routes on R6 in EIGRP 200. Advertise the VRF link in EIGRP on R1 under the appropriate address family. Make sure the VRF Cust-B on R4 has reachability to routes learned from R6.

R1

```
Router EIGRP 1
!
Address-family ipv4 vrf Cust-B Autonomous-system 200
 Network 192.1.16.0
 Redistribute BGP 100 metric 10 10 10 10 10
!
Router BGP 1000
!
Address-family ipv4 vrf Cust-B
 Redistribute eigrp 200
```

R6

```
Router EIGRP 200
 Network 192.1.16.0
 Network 10.0.0.0
```

Task 7

Configure EIGRP 222 as the Routing Protocol between R7 and R4-vrf Cust-B. Advertise all the routes on R7 in EIGRP 222. Advertise the VRF link in EIGRP on R4 under the appropriate address family. Make sure the VRF Cust-B on R1 has reachability to routes learned from R7.

R4

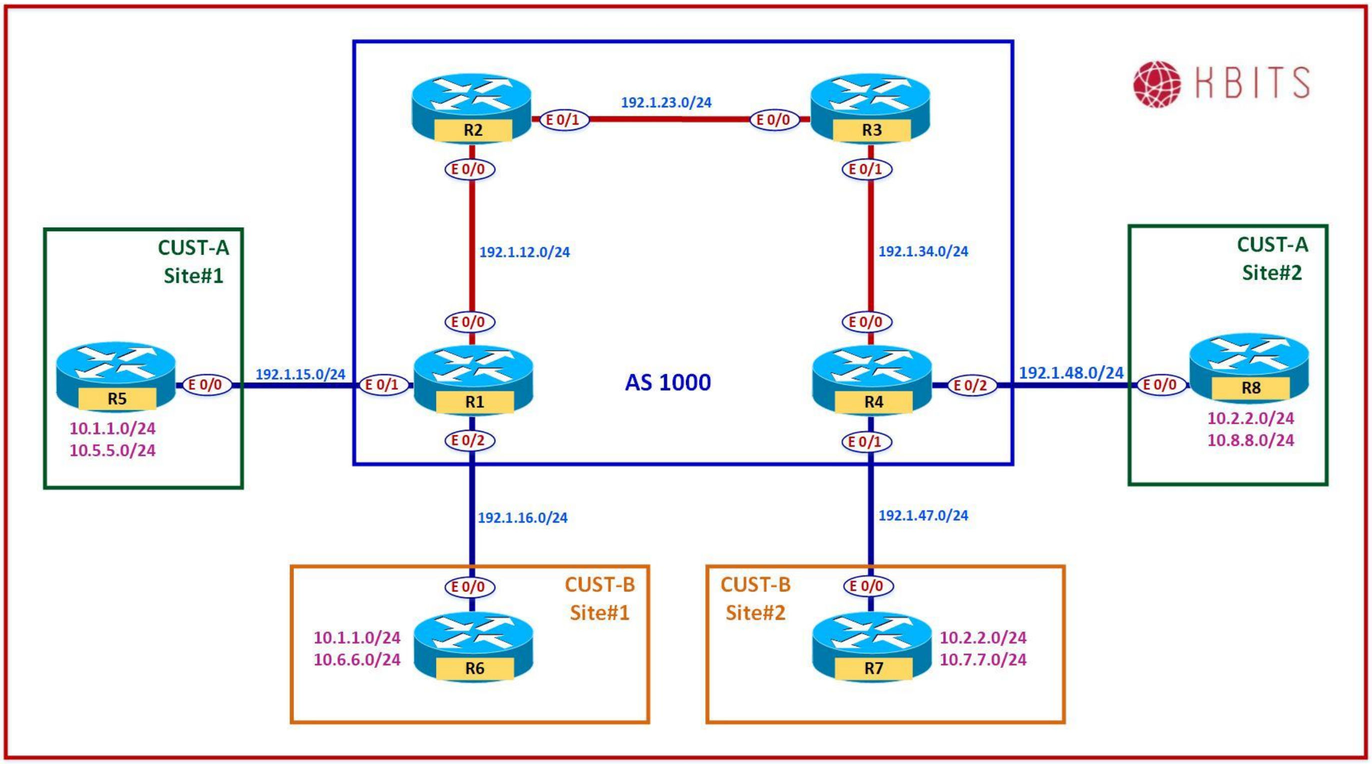
```
Router EIGRP 1
!
Address-family ipv4 vrf Cust-B Autonomous-system 222
 Network 192.1.47.0
 Redistribute BGP 1000 metric 10 10 10 10 10
!
Router BGP 1000
!
Address-family ipv4 vrf Cust-B
 Redistribute eigrp 2222
```

R7

```
Router EIGRP 222
 Network 192.1.47.0
 Network 10.0.0.0
```

NOTE:
Reload the Routers without saving the configs. This will setup the topology for the next lab.

Lab 5 – Configuring MPLS VPN – PE-CE using BGP – 1



Note:

Save the Configs on all the routers. **Do not save the configs during the labs**. At the completion of this lab, **reload the routers without saving**. This will allow you to do the next lab based on the same topology.

Task 1

Configure a VPNv4 neighbor relationship between R1 and R4.

R1
Router BGP 1000 Neighbor 4.4.4.4 remote-as 1000 Neighbor 4.4.4.4 update-source loopback0 ! Address-family vpnv4 Neighbor 4.4.4.4 activate
R4
Router BGP 1000 Neighbor 1.1.1.1 remote-as 1000 Neighbor 1.1.1.1 update-source loopback0 ! Address-family vpnv4 Neighbor 1.1.1.1 activate

Task 2

Configure a VRF **Cust-A** with a RD value of 1000:1 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-A sites on R1 and R4.

R1	R4

Vrf definition Cust-A
 rd 1000:1
 address-family ipv4
  route-target both 1000:1
!
Interface E 0/1
 vrf forwarding Cust-A
 Ip address 192.1.15.1 255.255.255.0
 No shut
	Vrf definition Cust-A
	 rd 1000:1
	 address-family ipv4
	  route-target both 1000:1
	!
	Interface E 0/2
	 vrf forwarding Cust-A
	 Ip address 192.1.48.4 255.255.255.0
	 No shut

Task 3

Configure BGP as the Routing Protocol between R5 and R1-vrf Cust-A. Advertise all the routes on R5 in BGP. Configure R5 with an AS # of 65005. Configure the BGP neighbor relationship on R1 for the Cust-A VRF. Make sure the VRF Cust-A on R4 has reachability to routes learned from R5.

R1 Router BGP 1000 ! Address-family ipv4 vrf Cust-A Neighbor 192.1.15.5 remote-as 65005
R5 Router bgp 65005 Network 10.5.5.0 mask 255.255.255.0 Neighbor 192.1.15.1 remote-as 1000

Task 4

Configure BGP as the Routing Protocol between R8 and R4-vrf Cust-A. Advertise all the routes on R8 in BGP. Configure R8 with an AS # of 65008. Configure the BGP neighbor relationship on R4 for the Cust-A VRF. Make sure the VRF Cust-A on R1 has reachability to routes learned from R8.

R4 Router BGP 1000 ! Address-family ipv4 vrf Cust-A Neighbor 192.1.48.8 remote-as 65008
R8 Router 65008 Network 10.8.8.0 mask 255.255.255.0 Neighbor 192.1.48.4 remote-as 1000

Task 5

Configure a VRF **Cust-B** with a RD value of 1000:2 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-B sites on R1 and R4.

R1	R4

Vrf definition Cust-B
 rd 1000:2
 address-family ipv4
  route-target both 1000:2
!
Interface E 0/2
 Ip vrf forwarding Cust-B
 Ip address 192.1.16.1 255.255.255.0
 No shut
	Vrf definition Cust-B
	 rd 1000:2
	 address-family ipv4
	  route-target both 1000:2
	!
	Interface E 0/1
	 Ip vrf forwarding Cust-B
	 Ip address 192.1.47.4 255.255.255.0
	 No shut

Task 6

Configure BGP as the Routing Protocol between R6 and R1-vrf Cust-B. Advertise all the routes on R6 in BGP. Configure R6 with an AS # of 65006. Configure the BGP neighbor relationship on R1 for the Cust-B VRF. Make sure the VRF Cust-B on R4 has reachability to routes learned from R6.

R1
Router BGP 1000 ! Address-family ipv4 vrf Cust-B Neighbor 192.1.16.6 remote-as 65006
R6
Router bgp 65006 Network 10.6.6.0 mask 255.255.255.0 Neighbor 192.1.16.1 remote-as 1000

Task 7

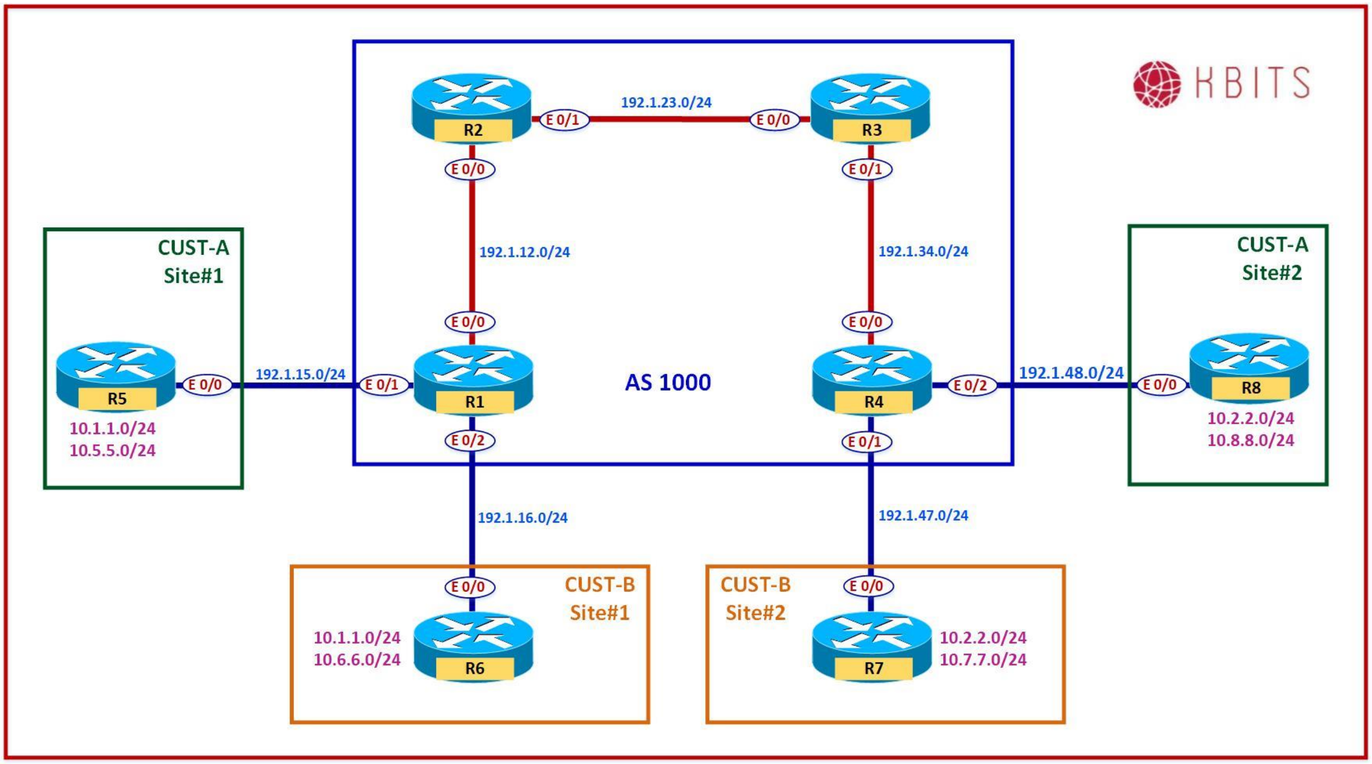
Configure BGP as the Routing Protocol between R7 and R4-vrf Cust-B. Advertise all the routes on R7 in BGP. Configure R7 with an AS # of 65007. Configure the BGP neighbor relationship on R4 for the Cust-B VRF. Make sure the VRF Cust-B on R1 has reachability to routes learned from R7.

R4 Router BGP 1000 ! Address-family ipv4 vrf Cust-B Neighbor 192.1.47.7 remote-as 65007
R7 Router bgp 65007 Network 10.7.7.0 mask 255.255.255.0 Neighbor 192.1.47.4 remote-as 1000

NOTE:

Reload the Routers without saving the configs. This will setup the topology for the next lab.

Lab 6 – Configuring MPLS VPN – PE-CE using BGP – 2



Note:
Save the Configs on all the routers. **Do not save the configs during the labs**. At the completion of this lab, **reload the routers without saving**. This will allow you to do the next lab based on the same topology.

Task 1

Configure a VPNv4 neighbor relationship between R1 and R4.

R1

```
Router BGP 1000
 Neighbor 4.4.4.4 remote-as 1000
 Neighbor 4.4.4.4 update-source loopback0
!
Address-family vpnv4
 Neighbor 4.4.4.4 activate
```

R4

```
Router BGP 1000
 Neighbor 1.1.1.1 remote-as 1000
 Neighbor 1.1.1.1 update-source loopback0
!
Address-family vpnv4
 Neighbor 1.1.1.1 activate
```

Task 2

Configure a VRF **Cust-A** with a RD value of 1000:1 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-A sites on R1 and R4.

R1

```
Vrf definition Cust-A
 rd 1000:1
 address-family ipv4
  route-target both 1000:1
!
Interface E 0/1
 vrf forwarding Cust-A
 Ip address 192.1.15.1 255.255.255.0
 No shut
```

R4

```
Vrf definition Cust-A
 rd 1000:1
 address-family ipv4
  route-target both 1000:1
!
Interface E 0/2
 vrf forwarding Cust-A
 Ip address 192.1.48.4 255.255.255.0
 No shut
```

Task 3

Configure BGP as the Routing Protocol between R5 and R1-vrf Cust-A. Advertise all the routes on R5 in BGP. Configure R5 with an AS # of 65001. Configure the BGP neighbor relationship on R1 for the Cust-A VRF. Make sure the VRF Cust-A on R4 has reachability to routes learned from R5.

R1

```
Router BGP 1000
!
Address-family ipv4 vrf Cust-A
 Neighbor 192.1.15.5 remote-as 65001
```

R5

```
Router bgp 65001
 Network 10.5.5.0 mask 255.255.255.0
 Neighbor 192.1.15.1 remote-as 1000
```

Task 4

Configure BGP as the Routing Protocol between R8 and R4-vrf Cust-A. Advertise all the routes on R8 in BGP. Configure R8 with an AS # of 65001. Configure the BGP neighbor relationship on R4 for the Cust-A VRF. Make sure the VRF Cust-A on R1 has reachability to routes learned from R8.

R4

```
Router BGP 1000
!
Address-family ipv4 vrf Cust-A
 Neighbor 192.1.48.8 remote-as 65001
```

R8

```
Router 65001
 Network 10.8.8.0 mask 255.255.255.0
 Neighbor 192.1.48.4 remote-as 1000
```

Task 5

Configure the PE's (R1 & R4) such that R5 routes are injected into R8's BGP table and vice versa.

R1 Router BGP 1000 ! Address-family ipv4 vrf Cust-A Neighbor 192.1.15.5 as-override
R4 Router BGP 1000 ! Address-family ipv4 vrf Cust-A Neighbor 192.1.48.8 as-override

Task 6

Configure a VRF **Cust-B** with a RD value of 1000:2 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-B sites on R1 and R4.

R1	**R4**

Vrf definition Cust-B
 rd 1000:2
 address-family ipv4
  route-target both 1000:2
!
Interface E 0/2
 Ip vrf forwarding Cust-B
 Ip address 192.1.16.1 255.255.255.0
 No shut
	Vrf definition Cust-B
	 rd 1000:2
	 address-family ipv4
	  route-target both 1000:2
	!
	Interface E 0/1
	 Ip vrf forwarding Cust-B
	 Ip address 192.1.47.4 255.255.255.0
	 No shut

Task 7

Configure BGP as the Routing Protocol between R6 and R1-vrf Cust-B. Advertise all the routes on R6 in BGP. Configure R6 with an AS # of 65002. Configure the BGP neighbor relationship on R1 for the Cust-B VRF. Make sure the VRF Cust-B on R4 has reachability to routes learned from R6.

R1

```
Router BGP 1000
!
Address-family ipv4 vrf Cust-B
 Neighbor 192.1.16.6 remote-as 65002
```

R6

```
Router bgp 65002
 Network 10.6.6.0 mask 255.255.255.0
 Neighbor 192.1.16.1 remote-as 1000
```

Task 8

Configure BGP as the Routing Protocol between R7 and R4-vrf Cust-B. Advertise all the routes on R7 in BGP. Configure R7 with an AS # of 65002. Configure the BGP neighbor relationship on R4 for the Cust-B VRF. Make sure the VRF Cust-B on R1 has reachability to routes learned from R7.

R4

```
Router BGP 1000
!
Address-family ipv4 vrf Cust-B
 Neighbor 192.1.47.7 remote-as 65002
```

R7

```
Router bgp 65002
 Network 10.7.7.0 mask 255.255.255.0
 Neighbor 192.1.47.4 remote-as 1000
```

Task 9

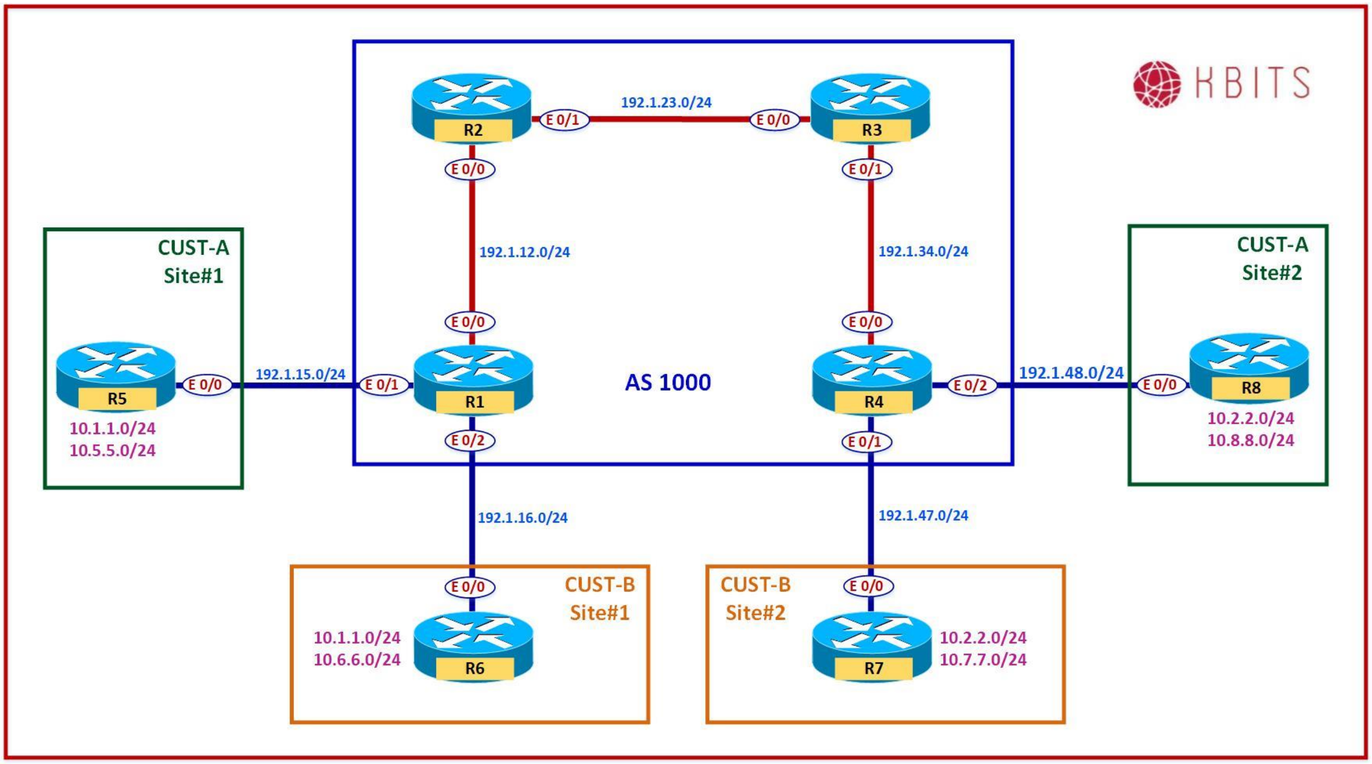
Configure the CE's (R6 & R7) to allow routes from the remote site to be injected into BGP.

R6 Router BGP 65002 Neighbor 192.1.16.1 allowas-in
R7 Router BGP 65002 Neighbor 192.1.47.4 allowas-in

NOTE:

Reload the Routers without saving the configs. This will setup the topology for the next lab.

Lab 7 – Configuring MPLS VPN – PE-CE using OSPF



Note:

Save the Configs on all the routers. **Do not save the configs during the labs**. At the completion of this lab, **reload the routers without saving**. This will allow you to do the next lab based on the same topology.

Task 1

Configure a VPNv4 neighbor relationship between R1 and R4.

R1 Router BGP 1000 Neighbor 4.4.4.4 remote-as 1000 Neighbor 4.4.4.4 update-source loopback0 ! Address-family vpnv4 Neighbor 4.4.4.4 activate
R4 Router BGP 1000 Neighbor 1.1.1.1 remote-as 1000 Neighbor 1.1.1.1 update-source loopback0 ! Address-family vpnv4 Neighbor 1.1.1.1 activate

Task 2

Configure a VRF **Cust-A** with a RD value of 1000:1 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-A sites on R1 and R4.

R1	**R4**

Vrf definition Cust-A
 rd 1000:1
 address-family ipv4
  route-target both 1000:1
!
Interface E 0/1
 vrf forwarding Cust-A
 Ip address 192.1.15.1 255.255.255.0
 No shut
	Vrf definition Cust-A
	 rd 1000:1
	 address-family ipv4
	  route-target both 1000:1
	!
	Interface E 0/2
	 vrf forwarding Cust-A
	 Ip address 192.1.48.4 255.255.255.0
	 No shut

Task 3

Configure OSPF as the PE-CE Routing protocol in Area 0 between R1 & R5. Advertise all networks on R5 in OSPF. Enable the R1-R5 link on R1 under the Cust-A VRF. Use OSPF process ID 58 on R1. Make sure the VRF Cust-A on R4 has reachability to routes learned from R5.

R1

```
Router ospf 58 vrf Cust-A
 Network 192.1.15.0 0.0.0.255 area 0
 Redistribute bgp 1000
!
Router bgp 1000
 Address-family ipv4 vrf Cust-A
 Redistribute ospf 58
```

R5

```
Router ospf 1
 Network 10.5.5.0 0.0.0.255 area 0
 Network 192.1.15.0 0.0.0.255 area 0
```

Task 4

Configure OSPF as the PE-CE Routing protocol in Area 0 between R4 & R8. Advertise all networks on R8 in OSPF. Enable the R4-R8 link on R4 under the Cust-A VRF. Use OSPF process ID 58 on R4. Make sure the VRF Cust-A on R1 has reachability to routes learned from R8.

R4

```
Router ospf 58 vrf Cust-A
 Network 192.1.48.0 0.0.0.255 area 0
 Redistribute bgp 1000
!
Router bgp 1000
 Address-family ipv4 vrf Cust-A
 Redistribute ospf 58
```

R8

```
Router ospf 1
 Network 10.8.8.0 0.0.0.255 area 0
 Network 192.1.48.0 0.0.0.255 area 0
```

Task 5

Configure a VRF **Cust-B** with a RD value of 1000:2 on R1 and R4. Use the same extended community for your Route-target import and export. Assign this VRF to the links that connect to Cust-B sites on R1 and R4.

R1	R4
Vrf definition Cust-B rd 1000:2 route-target both 1000:2 ! Interface E 0/2 Ip vrf forwarding Cust-B Ip address 192.1.16.1 255.255.255.0 No shut	Vrf definition Cust-B rd 1000:2 route-target both 1000:2 ! Interface E 0/1 Ip vrf forwarding Cust-B Ip address 192.1.47.4 255.255.255.0 No shut

Task 6

Configure OSPF as the PE-CE Routing protocol in Area 0 between R1 & R6. Advertise all networks on R6 in OSPF. Enable the R1-R6 link on R1 under the Cust-B VRF. Use OSPF process ID 6 on R1. Make sure the VRF Cust-B on R4 has reachability to routes learned from R6.

R1
Router ospf 6 vrf Cust-B Network 192.1.16.0 0.0.0.255 area 0 Redistribute bgp 1000 ! Router bgp 1000 Address-family ipv4 vrf Cust-B Redistribute ospf 6
R6
Router ospf 1 Network 10.6.6.0 0.0.0.255 area 0 Network 192.1.16.0 0.0.0.255 area 0

Task 7

Configure OSPF as the PE-CE Routing protocol in Area 0 between R4 & R7. Advertise all networks on R7 in OSPF. Enable the R4-R7 link on R4 under the Cust-B VRF. Use OSPF process ID 7 on R4. Make sure the VRF Cust-B on R1 has reachability to routes learned from R7.

R4

```
Router ospf 7 vrf Cust-B
 Network 192.1.47.0 0.0.0.255 area 0
 Redistribute bgp 1000
!
Router bgp 1000
 Address-family ipv4 vrf Cust-B
 Redistribute ospf 7
```

R7

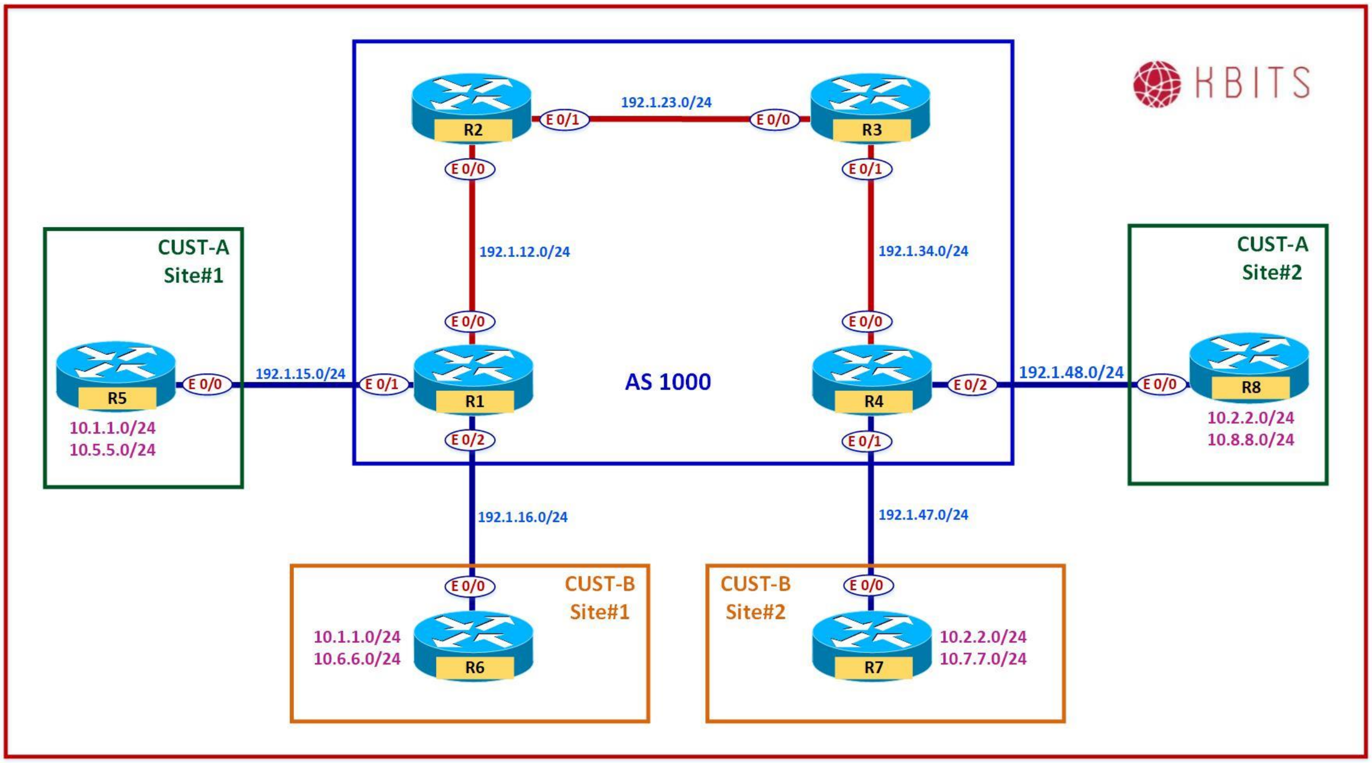
```
Router ospf 1
 Network 10.7.7.0 0.0.0.255 area 0
 Network 192.1.47.0 0.0.0.255 area 0
```

NOTE:

For the Cust-A VRF, the OSPF routes form the other site appears as O IA (Inter-Area) routes. This is since PE Routers are using the same process ID (58). The MPLS network is treated as the OSPF Super-Backbone.

For the Cust-B VRF, the OSPF routes form the other site appears as O E2 (External) routes. This is since PE Routers are using different Process ID for the Address Family OSPF process.

Lab 8 – Configuring MPLS VPN – PE-CE using OSPF – Domain-ID



Task 1

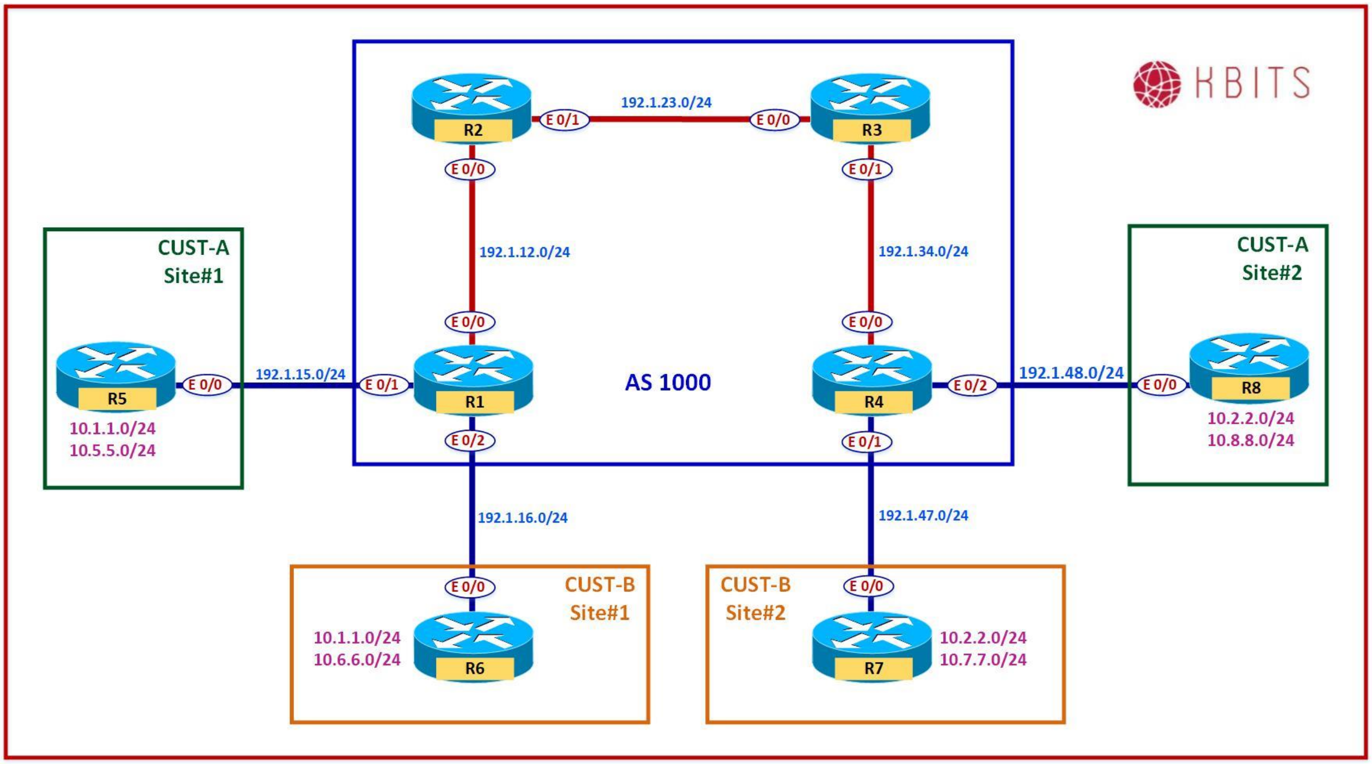
Configure a Domain-id under OSPF for Cust-B VRF on R1 and R4 as 0.0.0.67 to ensure that OSPF routes are injected as O IA routes on the Customer Routers.

R1 Router ospf 6 vrf Cust-B Domain-id 0.0.0.67
R4 Router ospf 7 vrf Cust-B Domain-id 0.0.0.67

NOTE:

For the Cust-B VRF, the OSPF routes from the other site now appear as O IA routes.

Lab 9 – Configuring MPLS VPN – PE-CE using OSPF – Sham-Link



Task 1

Configure a Link between R6 and R7 as 10.67.67.0/24. Advertise this link in OSPF. E 0/1 on both routers to connect. As this is a backup (backdoor) link, set the cost on both sides to be 1000.

R6	**R7**
Interface E 0/1 Ip address 10.67.67.6 255.255.255.0 Ip ospf cost 1000 No shut ! Router OSPF 1 Network 10.67.67.0 0.0.0.255 area 0	Interface E 0/1 Ip address 10.67.67.6 255.255.255.0 Ip ospf cost 1000 No shut ! Router OSPF 1 Network 10.67.67.0 0.0.0.255 area 0

Task 2

Configure a new loopback each on R1 and R4. This newly created loopback should be part of vrf Cust-B. Advertise this loopback under BGP for the Cust-B vrf. The Loopback information is as follows:

- R1 – Loopback 67 – 172.16.67.1/32
- R4 – Loopback 67 – 172.16.67.4/32

R1

```
Interface Loopback 67
 Ip vrf forwarding Cust-B
 Ip address 172.16.67.1 255.255.255.255
!
Router BGP 1000
!
Address-family ipv4 vrf Cust-B
 Network 172.16.67.1 mask 255.255.255.255
```

R4

```
Interface Loopback 67
 Ip vrf forwarding Cust-B
 Ip address 172.16.67.4 255.255.255.255
!
Router BGP 1000
!
Address-family ipv4 vrf Cust-B
 Network 172.16.67.4 mask 255.255.255.255
```

Task 3

Traffic between Cust-B Sites should be using the new link (Back door) although the cost is much higher than the MPLS cloud. You would like the traffic to go thru the MPLS link instead. Configure a Sham-Link between R1 and R4 based on the new Loopbacks created in the previous step.

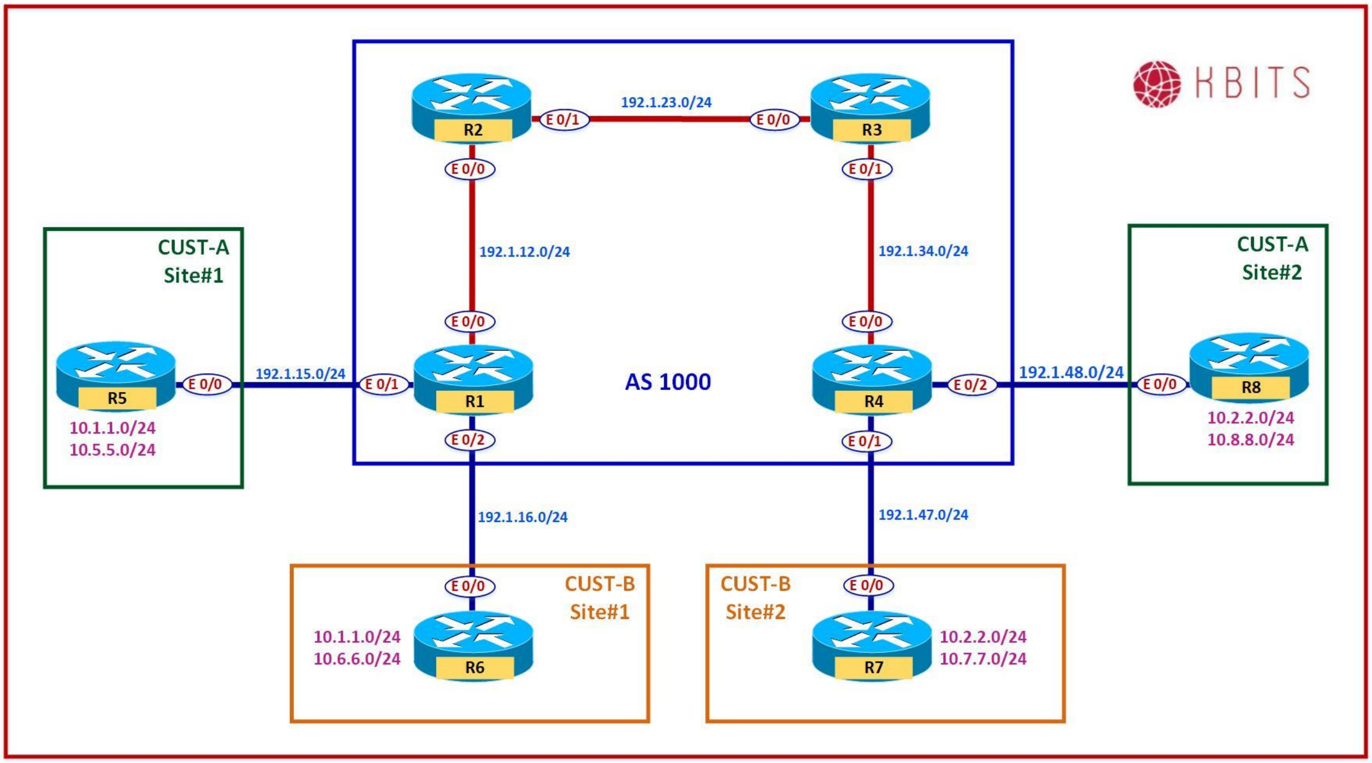
R1

```
Router ospf 6 vrf Cust-B
 area 0 sham-link 172.16.67.1 172.16.67.4
```

R4

```
Router ospf 8 vrf Cust-B
 area 0 sham-link 172.16.67.4 172.16.67.1
```

Lab 10 – Configuring MPLS VPN Extranets



Task 1

Configure R1 such that it sets the RT for the 10.5.5.0/24 route in the Cust-A vrf using a Route-Target of 1000:99. These routes will be later imported into Cust-B.

R1

```
access-list 55 permit 10.5.5.0 0.0.0.255
!
route-map EM-CustA permit 10
 match ip address 55
 set extcommunity rt  1000:99
```

Task 2

Configure R1 such that it sets the RT for the 10.6.6.0/24 route in the Cust-B vrf using a Route-Target of 1000:99. These routes will be later imported into Cust-A.

R1

```
access-list 66 permit 10.6.6.0 0.0.0.255
!
route-map EM-CustB permit 10
 match ip address 66
 set extcommunity rt  1000:99
```

Task 3

Configure R1 Cust-A & Cust-B vrf's to export routes using the Route-map create in the previous steps. Also import the common RT to allow routes to be inter-exchanged between them.

R1

```
Vrf definition Cust-A
 Address-family ipv4
  Export map  EM-CustA
  Route-target import 1000:99
!
Vrf definition Cust-B
 Address-family ipv4
  Export map  EM-CustB
  Route-target import 1000:99
```

Task 4

Configure R4 such that it sets the RT for the 10.8.8.0/24 route in the Cust-A vrf using a Route-Target of 1000:99. These routes will be later imported into Cust-B.

R4

```
access-list 88 permit 10.8.8.0 0.0.0.255
!
route-map EM-CustA permit 10
 match ip address 88
 set extcommunity rt  1000:99
```

Task 5

Configure R4 such that it sets the RT for the 10.7.7.0/24 route in the Cust-B vrf using a Route-Target of 1000:99. These routes will be later imported into Cust-A.

R4

```
access-list 77 permit 10.7.7.0 0.0.0.255
!
route-map EM-CustB permit 10
 match ip address 77
 set extcommunity rt  1000:99
```

Task 6

Configure R4 Cust-A & Cust-B vrf's to export routes using the Route-map create in the previous steps. Also import the common RT to allow routes to be inter-exchanged between them.

R4

```
Vrf definition Cust-A
 Address-family ipv4
  Export map EM-CustA
  Route-target import 1000:99
!
Vrf definition Cust-B
 Address-family ipv4
  Export map EM-CustB
  Route-target import 1000:99
```

NOTE:

Reload the Routers without saving the configs. This will setup the topology for the next lab.

Implementing SD-WAN

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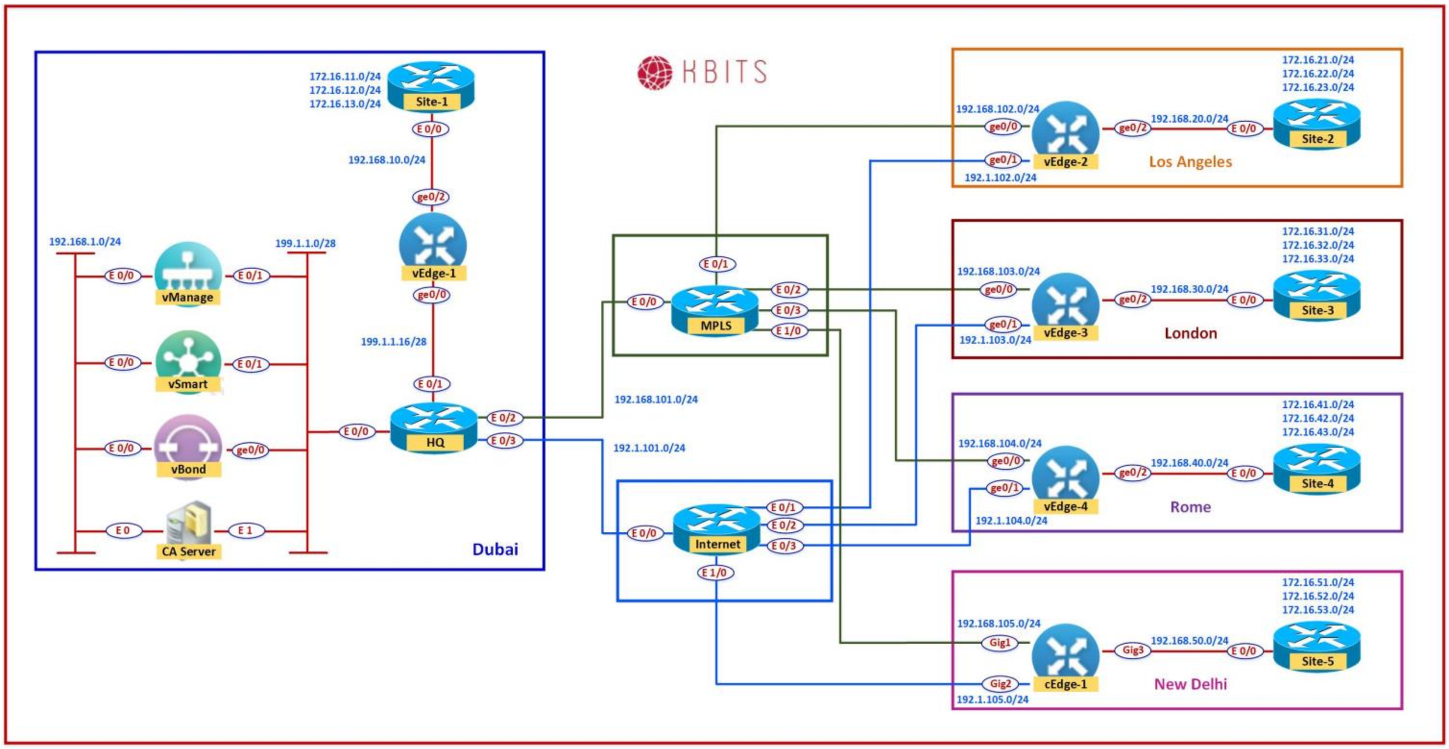
Implementing SD-WAN

Lab 1 – Configuring the WAN Components



Interface Configuration

HQ

Interface	IP Address	Subnet Mask
E 0/0	199.1.1.14	255.255.255.240
E 0/1	199.1.1.30	255.255.255.240
E 0/2	192.168.101.1	255.255.255.0
E 0/3	192.1.101.1	255.255.255.0

MPLS Cloud

Interface	IP Address	Subnet Mask
E 0/0	192.168.101.254	255.255.255.0
E 0/1	192.168.102.254	255.255.255.0
E 0/2	192.168.103.254	255.255.255.0
E 0/3	192.168.104.254	255.255.255.0
E 1/0	192.168.105.254	255.255.255.0

Internet Cloud

Interface	IP Address	Subnet Mask
E 0/0	192.1.101.254	255.255.255.0
E 0/1	192.1.102.254	255.255.255.0
E 0/2	192.1.103.254	255.255.255.0
E 0/3	192.1.104.254	255.255.255.0
E 1/0	192.1.105.254	255.255.255.0

Task 1 – HQ Router Configuration

- Configure the Interfaces based on the Logical Diagram
- Configure OSPF as the IGP to communicate with the MPLS Cloud. Enable all the interfaces.
- Make sure OSPF only sends and receives OSPF packets on the link towards the MPLS Cloud using the Passive-interface command.
- Configure a default route on the router towards the Internet. The IP Address of the Internet Router is 192.1.101.254
- Configure BGP between vEdge1(199.1.1.17) in 65001 and HQ router. Redistrubute OPSF into BGP.

HQ Router

```
Hostname HQ
!
Interface E 0/0
 ip address 199.1.1.14 255.255.255.240
 no shut
!
Interface E 0/1
 ip address 199.1.1.30 255.255.255.240
 no shut
!
Interface E 0/2
 ip address 192.168.101.1 255.255.255.0
 no shut
!
Interface E 0/3
 ip address 192.1.101.1 255.255.255.0
 no shut
!
router ospf 1
 network 192.168.101.0 0.0.0.255 area 0
 network 199.1.1.0 0.0.0.255 area 0
 passive-interface default
 no passive-interface E0/2
!
Router bgp 65001
 Neighbor 192.1.1.17 remote-as 65001
 Redistribute ospf 1
!
ip route 0.0.0.0 0.0.0.0 192.1.101.254
```

Task 2 – MPLS Cloud Router Configuration

- Configure the Interfaces based on the Logical Diagram.
- Configure OSPF as the IGP on all the interfaces.

MPLS Cloud Router

```
no ip domain-lookup
!
line con 0
 exec-timeout 0 0
 logging synchronous
!
hostname MPLS
!
interface Ethernet0/0
 ip address 192.168.101.254 255.255.255.0
 no shut
!
interface Ethernet0/1
 ip address 192.168.102.254 255.255.255.0
 no shut
!
interface Ethernet0/2
 ip address 192.168.103.254 255.255.255.0
 no shut
!
interface Ethernet0/3
 ip address 192.168.104.254 255.255.255.0
 no shut
!
interface Ethernet1/0
 ip address 192.168.105.254 255.255.255.0
 no shut
!
router ospf 1
 network 192.168.101.0 0.0.0.255 area 0
 network 192.168.102.0 0.0.0.255 area 0
 network 192.168.103.0 0.0.0.255 area 0
 network 192.168.104.0 0.0.0.255 area 0
 network 192.168.105.0 0.0.0.255 area 0
```

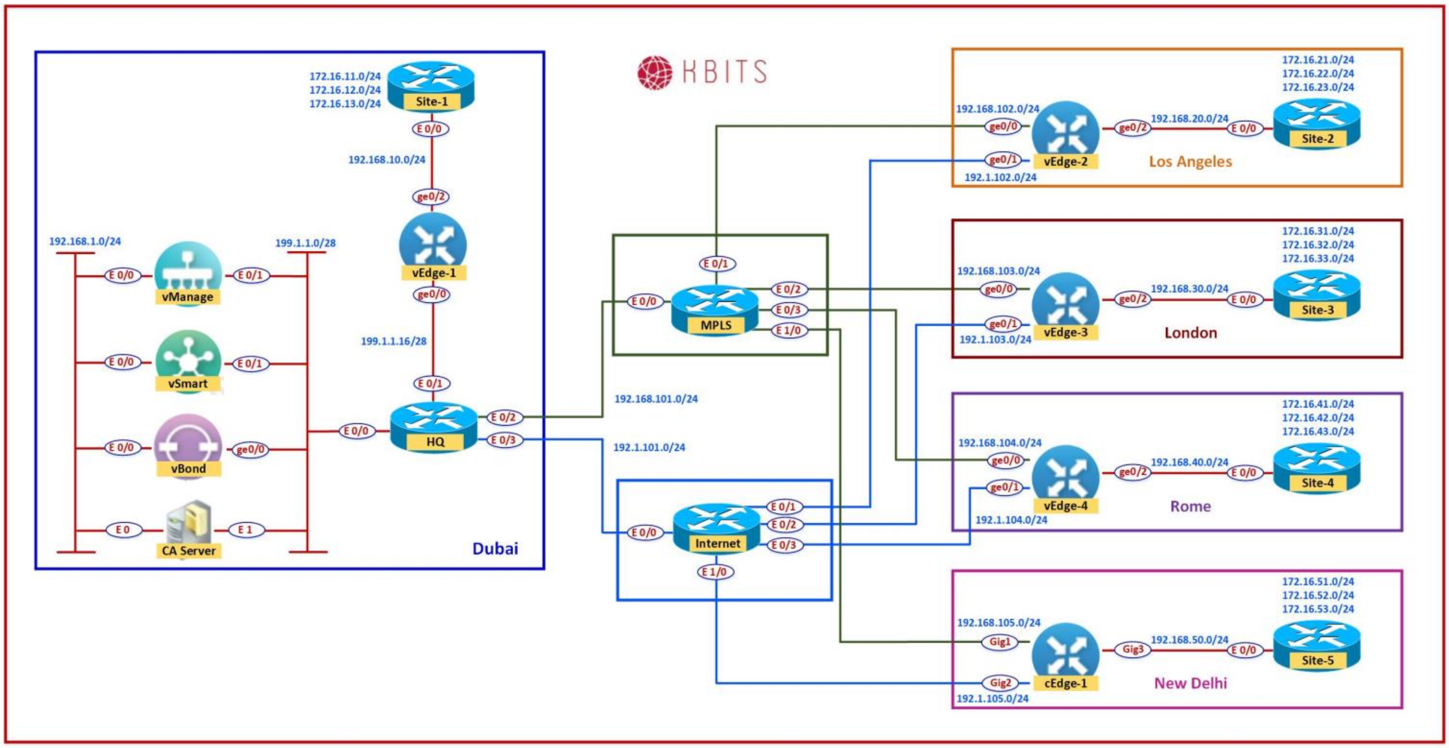
Task 3 – Internet Cloud Router Configuration

- Configure the Interfaces based on the Logical Diagram
- Configure a Static Route on the Router for the 199.1.1.0/24 network. The Next Hop should point towards the Internet IP of the HQ Router.

Internet Cloud Router

```
no ip domain lookup
!
line con 0
 exec-timeout 0 0
 logging synchronous
!
hostname Internet
!
interface Ethernet0/0
 ip address 192.1.101.254 255.255.255.0
 no shut
!
interface Ethernet0/1
 ip address 192.1.102.254 255.255.255.0
 no shut
!
interface Ethernet0/2
 ip address 192.1.103.254 255.255.255.0
 no shut
!
interface Ethernet0/3
 ip address 192.1.104.254 255.255.255.0
 no shut
!
interface Ethernet1/0
 ip address 192.1.105.254 255.255.255.0
 no shut
!
ip route 199.1.1.0 255.255.255.0 192.1.101.1
```

Lab 2 - Installing the Enterprise Certificate Server



Task 1 – Configure the Interfaces

First Ethernet Interface:

IP Address: 192.168.1.5
Subnet Mask: 255.255.255.0

Third Ethernet Interface:

IP Address: 199.1.1.5
Subnet Mask: 255.255.255.240
Default Gateway: 199.1.1.14

Task 2 – Configure the Timezone and Time

Configure the appropiate Timezone and Time on the Windows Server.

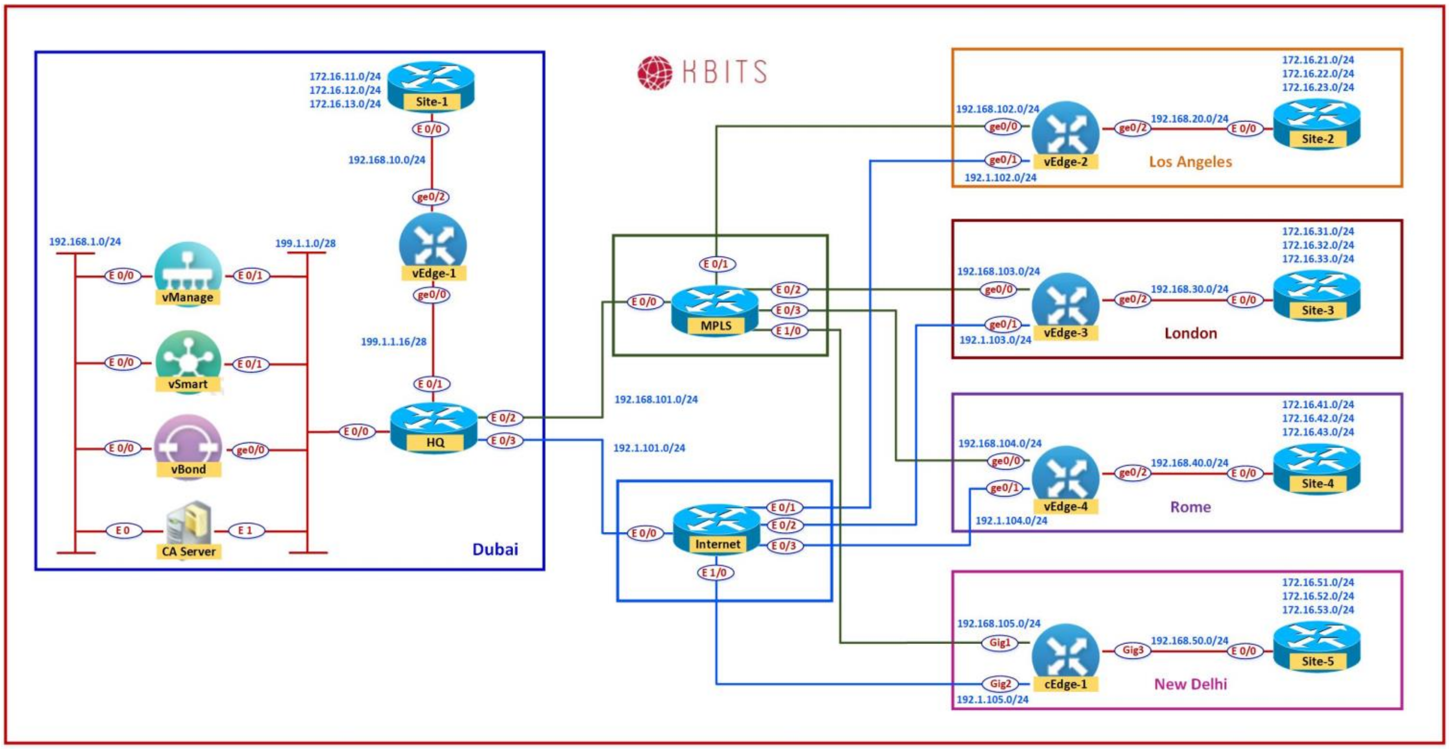
Task 3 – Installing the Enterprise Root Certificate Server

- Open **Server Manager**
- Click **Roles**
- Click **Add Roles**
- Click **Next**
- Select the "**Active Directory Certificate Services**" and click **Next**
- Click Next
- Select "**Certification Authority Web Enrollment**" and click Next
- Leave it as Standalone and click **Next**
- Leave it as Root CA and click **Next**
- Leave "Create a new private key" and click **Next**
- Leave the default for the Cryptography for CA and click **Next**
- Set the Common name as **KBITS-CA** and click **Next**
- Leave the default for the Validity Period and click **Next**
- Click **Next**
- Click **Install**

Task 4 – Install WinSCP

- **Double-click** the WinSCP Installation file.
- Do a Default Installation.

Lab 3 – Initializing vManage – CLI



Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vManage1
  - Organization: KBITS
  - System-IP: 10.1.1.101
  - Site ID: 1
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vManage

```
config
!
system
 host-name vManage1
 system-ip 10.1.1.101
 site-id 1
```

```
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
 commit
```

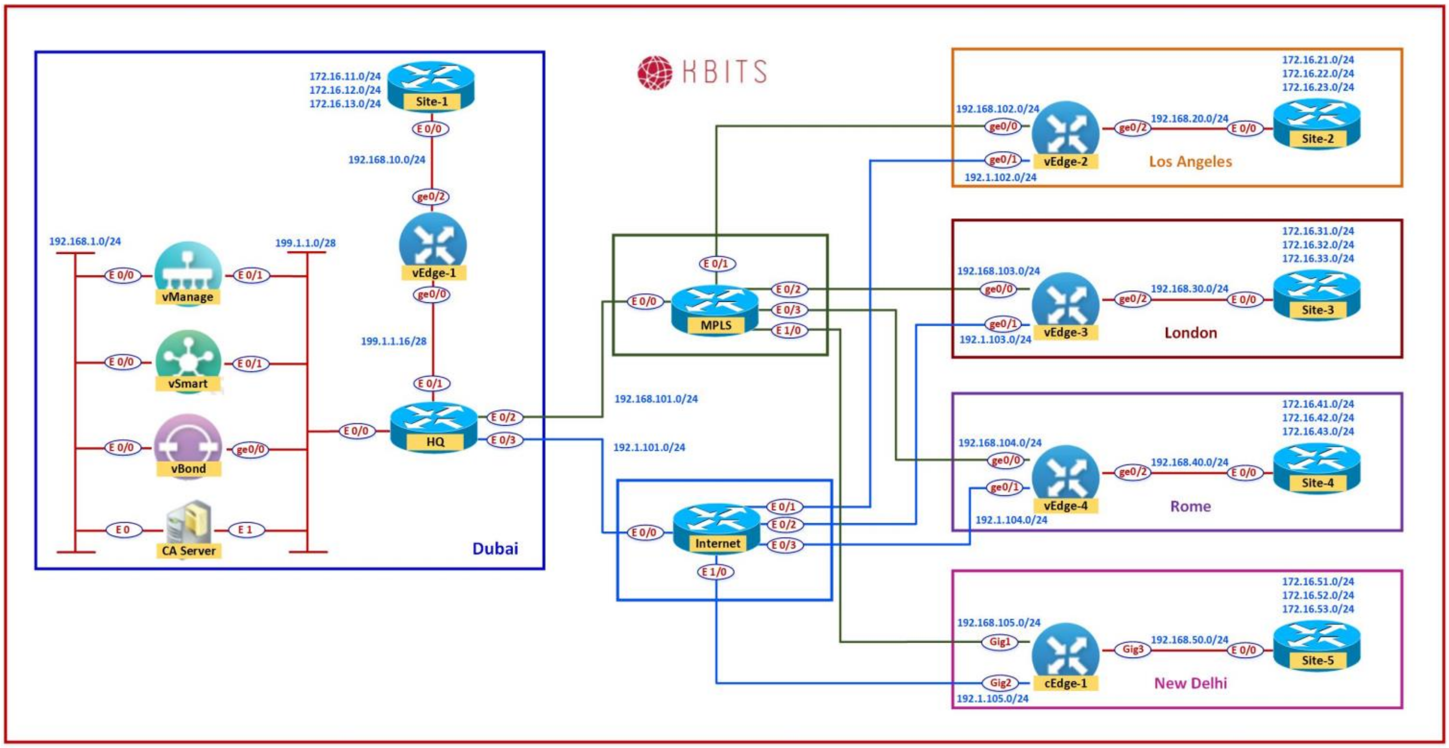
Task 2 – Configured the vpn parameters

- Configure the VPN parameters based on the following:
    - vpn 0
        - Interface eth1
        - IP Address: 199.1.1.1/28
        - Tunnel Interface
        - Tunnel Services (NetConf, SSHD)
        - Default Route: 199.1.1.14
    - vpn 512
        - Interface eth0
        - IP Address: 192.168.1.1/24

vManage

```
config
!
vpn 0
 no interface eth0
 interface eth1
  ip address 199.1.1.1/28
  tunnel-interface
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 199.1.1.14
!
vpn 512
 interface eth0
  ip address 192.168.1.1/24
  no shut
!
commit
```

Lab 4 – Initializing vManage - GUI



Task 1 – Organization name & vBond Address

- Log into the vManage from the Server by browsing to https://192.168.1.1:8443 using a username of **admin** and a password of **admin.**
- Navigate to **Administration** -> **Settings**
- Click **Edit** on the Organization name and set it to **KBITS**. Confirm the Organization name. Click **OK.**
- Click **Edit** on the **vBond** address and change it to 199.1.1.3. Confirm and click **OK**.

Task 2 – Configure Controller Authorization as Enterprise Root and Download the Root Certificate.

- Browse to http://192.168.1.5/certsrv
- Click **"Download Root Certificate".**
- Select **"Base 64"**.
- Click "**Download CA Certificate".**
- Open Explorer and navigate to the downloads folder.
- Change the name of the Downloaded file "**Certnew**" to "**RootCert**".
- Open the "**RootCert.cer**" file using Notepad.
- Copy using **CTRL-A** and **CTRL-C**.
- In vManage, Navigate to **Administration -> Settings -> Controller Certiticate Authorization.**
- Change the "**Certificate Signing by:**" to "**Enterprise Root Certificate**".
- Paste the RootCert.cer that you had copied by using **CTRL-V.**
- Set the CSR Parameters with the Organization name, City, State, Country. Set the Time to 3 Years and save.

Task 3 – Generate a CSR for vManage

- Navigate to **Configuration -> Certificates -> Controllers -> vManage -> Generate CSR.**
- It will open a window with the CSR. Copy by using **CTRL-A** and **CTRL-C.**

Task 4 – Request a Certificate from the CA Server

- Browse to http://192.168.1.5/certsrv
- Click **"Request a Certificate".**

- Select **“Advanced”**.

- Paste the CSR in the box by using **CTRL-V** and click **Submit.**

Task 5 – Issue the Certificate from the CA Server

- Open Server Manager and navigate to **Active Directory Certificate Server -> KBITS-CA -> Pending Requests.**

- Right-Click the request and click “**Issue”.**

Task 6 – Downloading the Issued Certificate

- Browse to http://192.168.1.5/certsrv

- Click **“Check on Pending request”.**

- The issued certificate link will show up. Click on the link.

- Select “**Base 64”** and click “**Download”**

- Open Explorer and navigate to the downloads folder.

- Change the name of the Downloaded file “**Certnew**” to “**vManage**”.

- Open the “**vManage.cer**” file using Notepad.

- Copy using **CTRL-A** and **CTRL-C**.

Task 6 – Installing the Identity Certificate for vManage

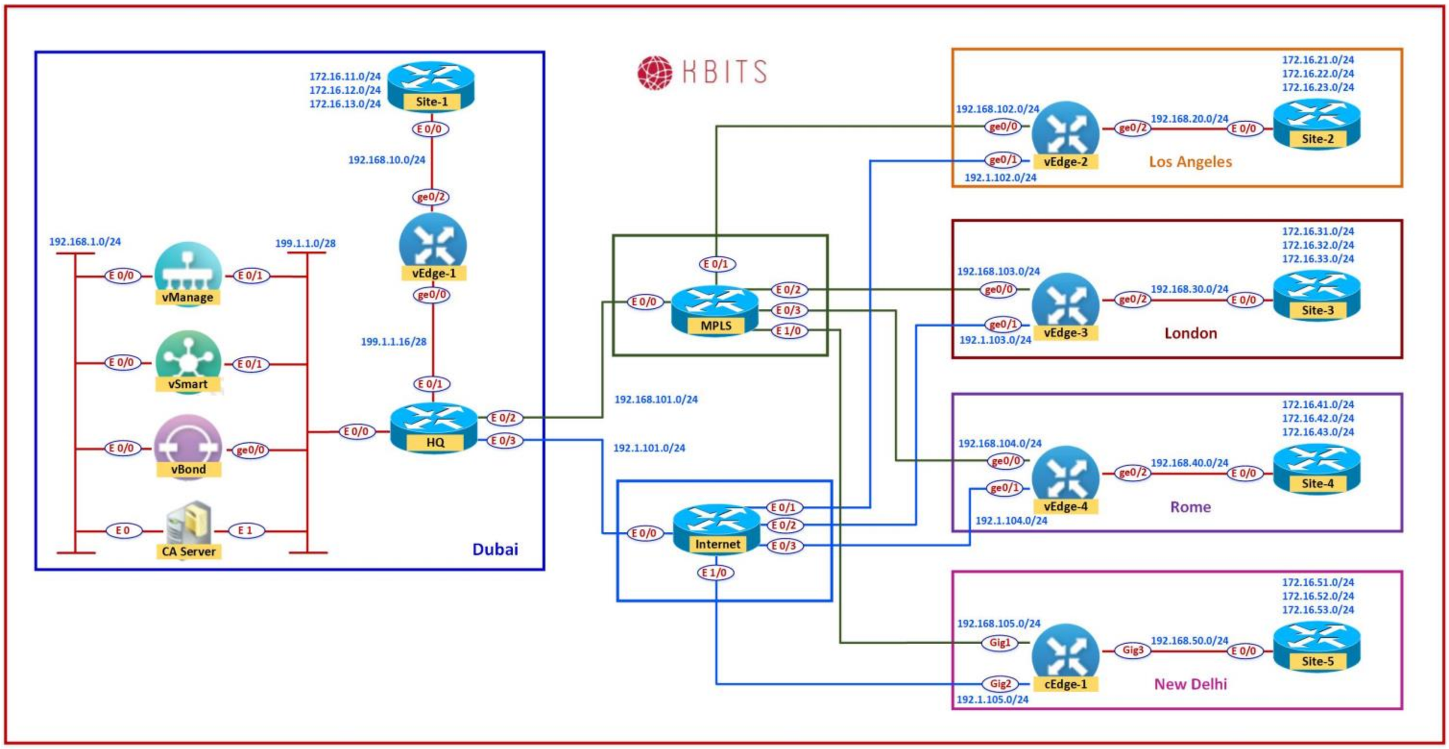
- In vManage, Navigate to **Configuration -> Certificates -> Controllers**

- Click on the **“Install”** button at the top right corner

- Paste the Certificate (CTRL-V).

- The Identity certificate should be installed on vManage.

Lab 5 – Initializing vBond – CLI



Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vBond1
  - Organization: KBITS
  - System-IP: 10.1.1.103
  - Site ID: 1
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vBond

```
config
!
system
 host-name vBond1
 system-ip 10.1.1.103
 site-id 1
 organization-name KBITS
```

```
 clock timezone Asia/Muscat
 vbond 199.1.1.3 local
!
commit
```

Task 2 – Configured the vpn parameters

- Configure the VPN parameters based on the following:

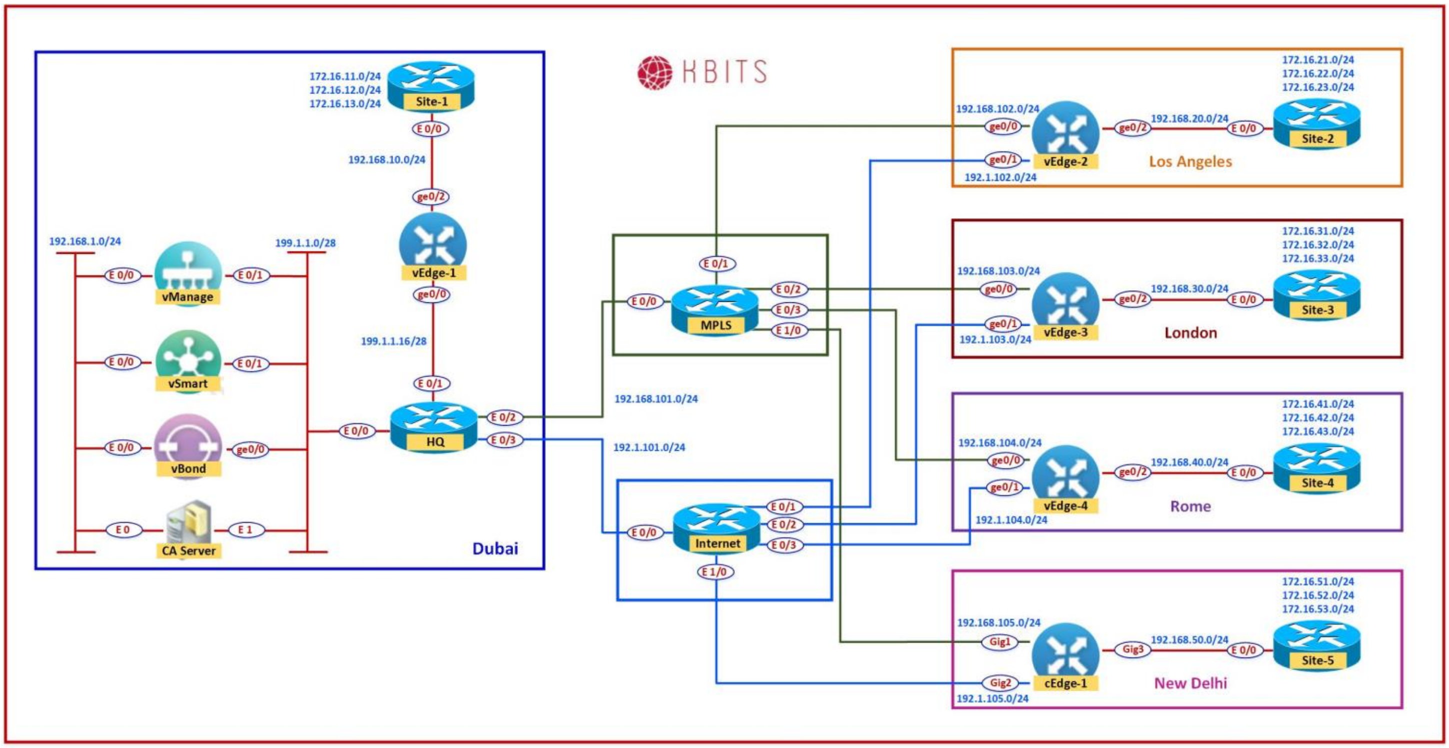
  - vpn 0
    - Interface ge0/0
    - IP Address: 199.1.1.3/28
    - Tunnel Interface
    - Tunnel Services (NetConf, SSHD)
    - Encapsulation: IPSec
    - Default Route: 199.1.1.14

  - vpn 512
    - Interface eth0
    - IP Address: 192.168.1.3/24

vBond

```
config
!
vpn 0
 interface ge0/0
  ip address 199.1.1.3/28
  tunnel-interface
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 199.1.1.14
!
vpn 512
 interface eth0
  ip address 192.168.1.3/24
  no shut
!
commit
```

Lab 6 – Initializing vBond - GUI



Task 1 – Add vBond to vManage

- Navigate to **Configuration -> Devices -> Controllers -> Add Controllers -> vBond** and specify the following to add the vBond in vManage.

  - IP Address: **199.1.1.3**
  - Username: **Admin**
  - Password: **Admin**
  - Check Generate CSR
  - Click **OK**

Task 2 – View the generated CSR for vBond and Copy it

- Navigate to **Configuration -> Certificates -> Controllers -> vBond -> View CSR.**

- It will open a window with the CSR. Copy by using **CTRL-A** and **CTRL-C.**

Task 3 – Request a Certificate from the CA Server

- Browse to http://192.168.1.5/certsrv
- Click **"Request a Certificate".**
- Select **"Advanced"**.
- Paste the CSR in the box by using **CTRL-V** and click **Submit.**

Task 4 – Issue the Certificate from the CA Server

- Open Server Manager and navigate to **Active Directory Certificate Server -> KBITS-CA -> Pending Requests.**
- Right-Click the request and click "**Issue".**

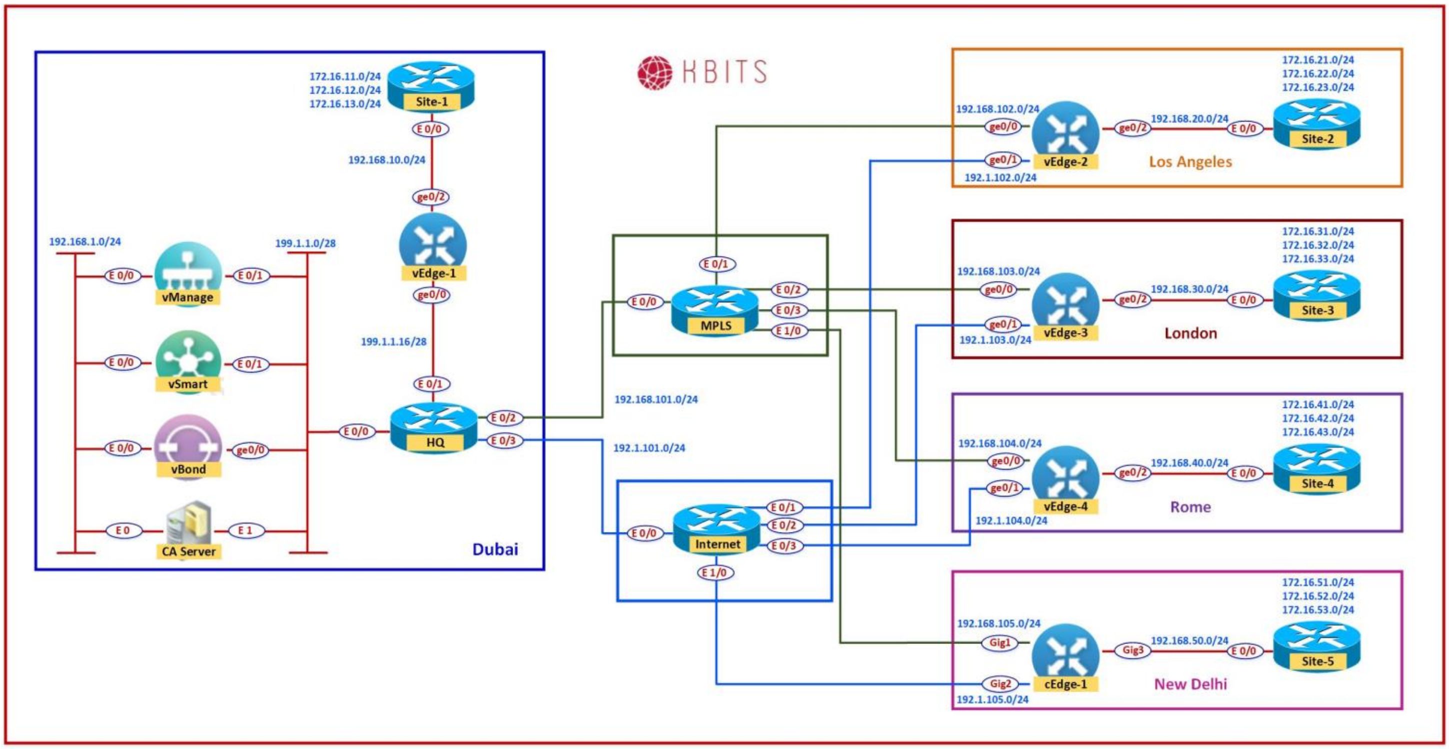
Task 6 – Downloading the Issued Certificate

- Browse to http://192.168.1.5/certsrv
- Click **"Check on Pending request".**
- The issued certificate link will show up. Click on the link.
- Select "**Base 64"** and click "**Download"**
- Open Explorer and navigate to the downloads folder.
- Change the name of the Downloaded file "**Certnew**" to "**vBond**".
- Open the "**vBond.cer**" file using Notepad.
- Copy using **CTRL-A** and **CTRL-C**.

Task 6 – Installing the Identity Certificate for vManage

- In vManage, Navigate to **Configuration -> Certificates -> Controllers**
- Click on the **"Install"** button at the top right corner
- Paste the Certificate (CTRL-V).
- The Identity certificate should be installed for vBond and pushed to it.

Lab 7 – Initializing vSmart – CLI



Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vSmart1
  - Organization: KBITS
  - System-IP: 10.1.1.102
  - Site ID: 1
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vSmart

```
config
!
system
 host-name vSmart1
 system-ip 10.1.1.102
 site-id 1
 organization-name KBITS
```

```
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configured the vpn parameters

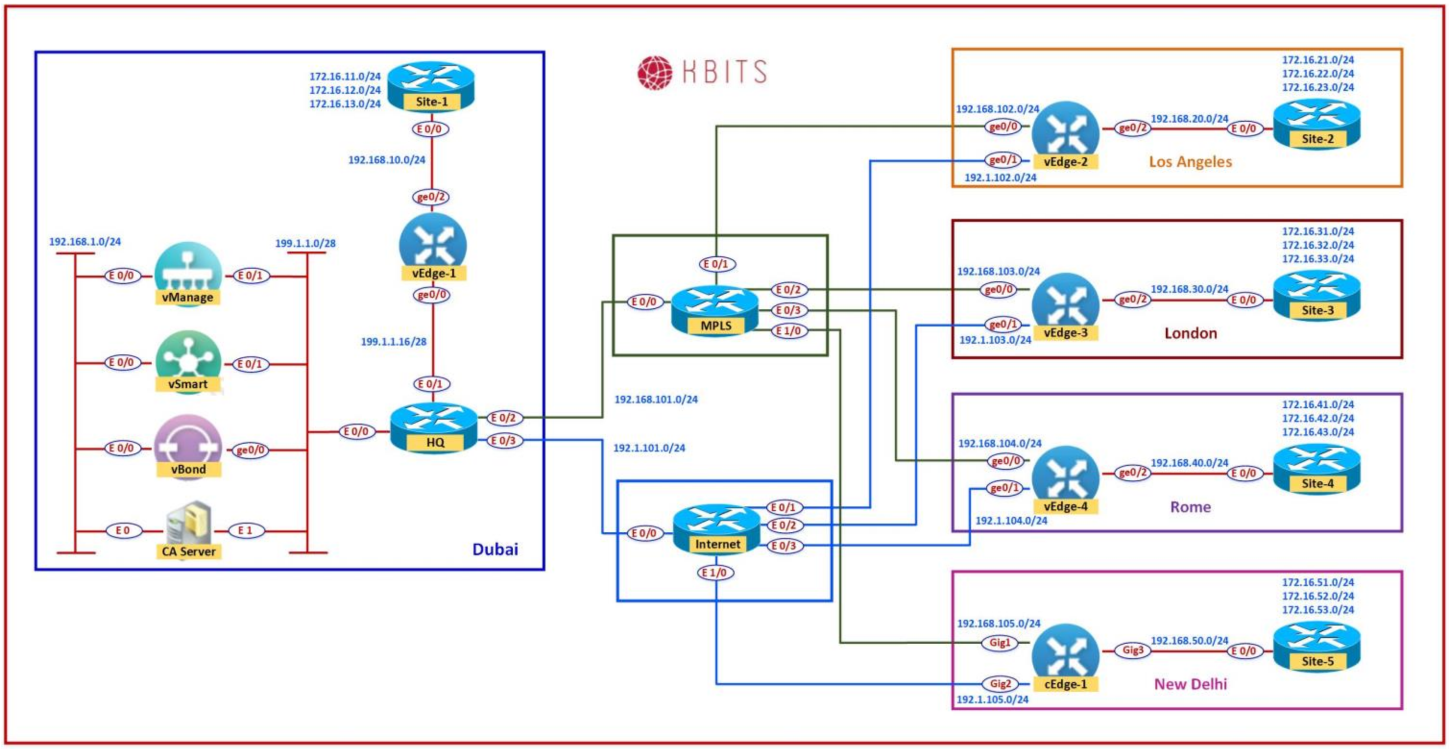
- Configure the VPN parameters based on the following:
    - vpn 0
        - Interface Eth1
        - IP Address: 199.1.1.2/28
        - Tunnel Interface
        - Tunnel Services (NetConf, SSHD)
        - Default Route: 199.1.1.14

- vpn 512
    - Interface eth0
    - IP Address: 192.168.1.2/24

vSmart

```
config
!
vpn 0
 no interface eth0
 interface eth1
  ip address 199.1.1.2/28
  tunnel-interface
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 199.1.1.14
!
vpn 512
 interface eth0
  ip address 192.168.1.2/24
  no shut
!
commit
```

Lab 8 – Initializing vSmart - GUI



Task 1 – Add vSmart to vManage

- Navigate to **Configuration -> Devices -> Controllers -> Add Controllers -> vSmart** and specify the following to add the vBond in vManage.
  - IP Address: **199.1.1.2**
  - Username: **Admin**
  - Password: **Admin**
  - Check Generate CSR
  - Click **OK**

Task 2 – View the generated CSR for vSmart and Copy it

- Navigate to **Configuration -> Certificates -> Controllers -> vSmart -> View CSR.**
- It will open a window with the CSR. Copy by using **CTRL-A** and **CTRL-C.**

Task 3 – Request a Certificate from the CA Server

- Browse to http://192.168.1.5/certsrv
- Click **"Request a Certificate".**
- Select **"Advanced"**.
- Paste the CSR in the box by using **CTRL-V** and click **Submit.**

Task 4 – Issue the Certificate from the CA Server

- Open Server Manager and navigate to **Active Directory Certificate Server -> KBITS-CA -> Pending Requests.**
- Right-Click the request and click "**Issue".**

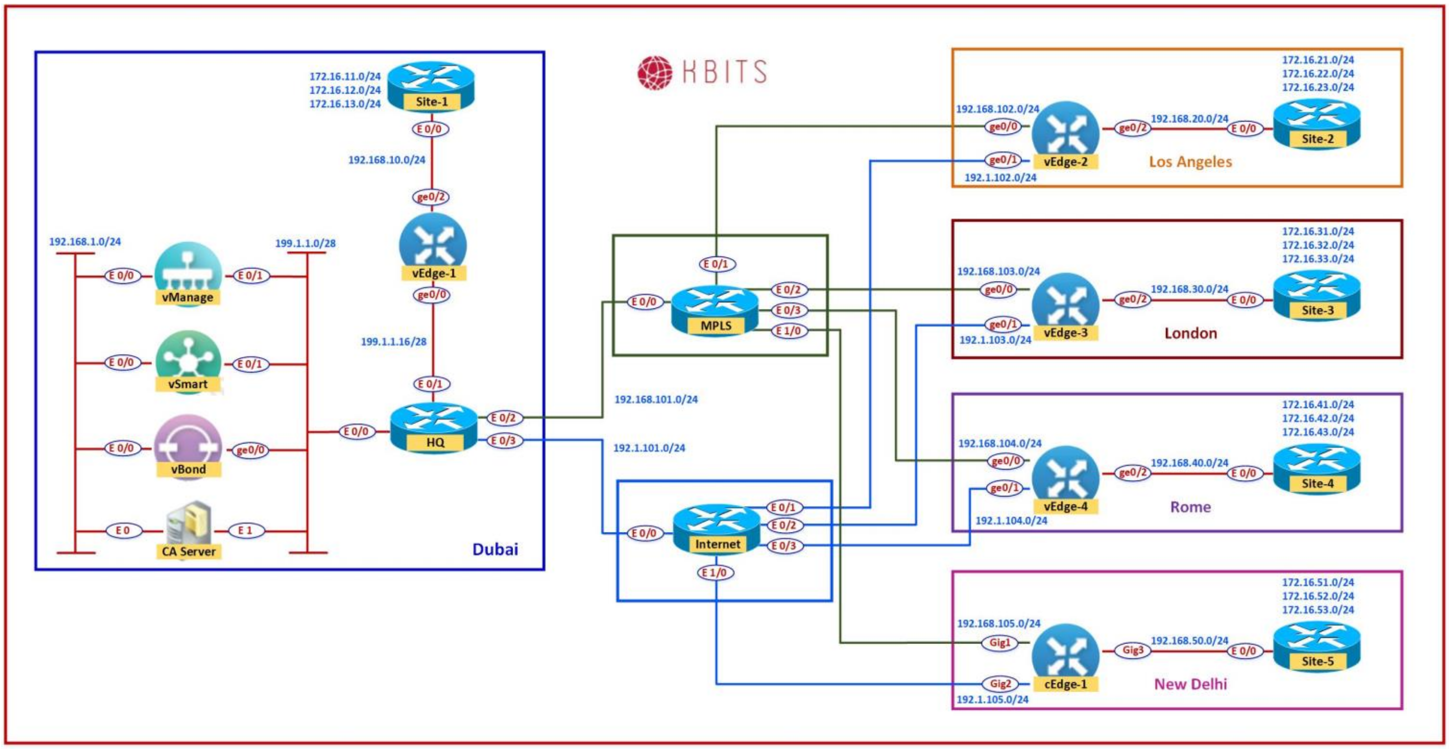
Task 6 – Downloading the Issued Certificate

- Browse to http://192.168.1.5/certsrv
- Click **"Check on Pending request".**
- The issued certificate link will show up. Click on the link.
- Select "**Base 64"** and click "**Download"**
- Open Explorer and navigate to the downloads folder.
- Change the name of the Downloaded file "**Certnew**" to "**vSmart**".
- Open the "**vSmart.cer**" file using Notepad.
- Copy using **CTRL-A** and **CTRL-C**.

Task 6 – Installing the Identity Certificate for vManage

- In vManage, Navigate to **Configuration -> Certificates -> Controllers**
- Click on the **"Install"** button at the top right corner
- Paste the Certificate (CTRL-V).
- The Identity certificate should be installed for vSmart and pushed to it.

Lab 9 – Initializing vEdge – CLI



Task 1 – Upload the WAN Edge List

- On the vManage Main windows, Naviagte to **Configuration -> Devices**. Click on "**Upload WAN Edge List**".

- Select the file you downloaded from the PNP Portal. Upload it and check the **Validate** option.

vEDGE-1

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vEdge1
  - Organization: KBITS
  - System-IP: 10.2.2.201
  - Site ID: 1
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vEdge1

```
config
!
system
 host-name vEdge1
 system-ip 10.2.2.201
 site-id 1
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configure the vpn parameters

- Configure the VPN parameters based on the following:
  - vpn 0
    - Interface ge0/0
    - IP Address: 199.1.1.17/28
    - Tunnel Interface
    - Encapsulation IPSec
    - Tunnel Services (NetConf, SSHD)
    - Default Route: 199.1.1.30
  - vpn 512
    - Interface eth0
    - IP Address: DHCP Client

vEdge1

```
config
!
vpn 0
 interface ge0/0
  ip address 199.1.1.17/28
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 199.1.1.30
!
```

```
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
commit
```

vEDGE-2

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vEdge2
  - Organization: KBITS
  - System-IP: 10.2.2.202
  - Site ID: 2
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vEdge-2

```
config
!
system
 host-name vEdge2
 system-ip 10.2.2.202
 site-id 2
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configure the vpn parameters

- Configure the VPN parameters based on the following:
  - vpn 0
    - Interface ge0/0
    - IP Address: 192.168.102.2/24
    - Tunnel Interface
    - Encapsulation IPSec
    - Tunnel Services (NetConf, SSHD)

- Default Route: 192.168.102.254

- vpn 512
  - Interface eth0
  - IP Address: DHCP Client

```
vEdge2

config
!
vpn 0
 interface ge0/0
  ip address 192.168.102.2/24
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 192.168.102.254
!
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
 !
commit
```

vEDGE-3

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vEdge3
  - Organization: KBITS
  - System-IP: 10.2.2.203
  - Site ID: 3
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: **Default username**: admin **Default password**: admin

```
vEdge-3

config
```

```
!
system
 host-name vEdge3
 system-ip 10.2.2.203
 site-id 3
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configure the vpn parameters

- Configure the VPN parameters based on the following:
  - vpn 0
    - Interface ge0/0
    - IP Address: 192.168.103.3/24
    - Tunnel Interface
    - Encapsulation IPSec
    - Tunnel Services (NetConf, SSHD)
    - Default Route: 192.168.103.254
  - vpn 512
    - Interface eth0
    - IP Address: DHCP Client

vEdge3

```
config
!
vpn 0
 interface ge0/0
  ip address 192.168.103.3/24
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 192.168.103.254
!
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
 !
```

```
commit
```

vEDGE-4

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vEdge4
  - Organization: KBITS
  - System-IP: 10.2.2.204
  - Site ID: 4
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: **Default username**: admin **Default password**: admin

vEdge-4

```
config
!
system
 host-name vEdge4
 system-ip 10.2.2.204
 site-id 4
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configure the vpn parameters

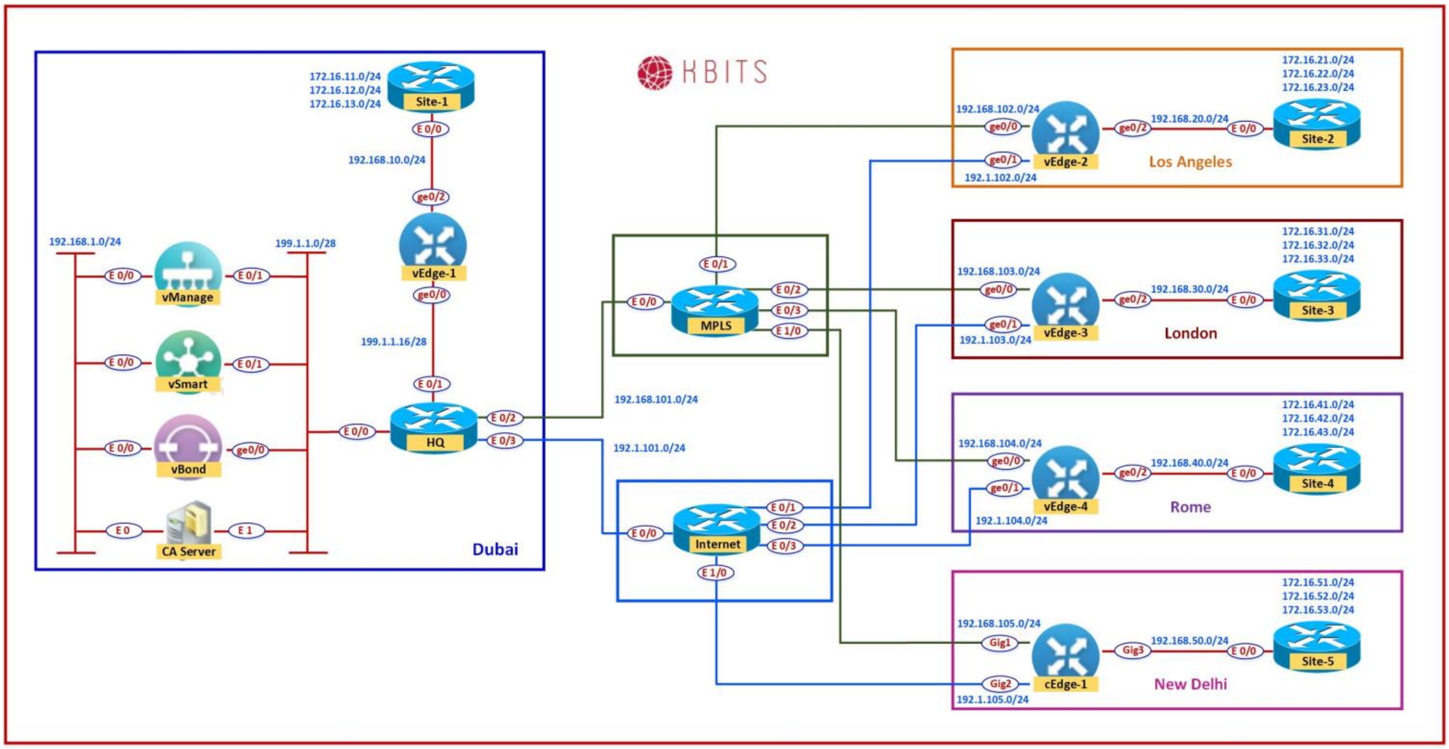
- Configure the VPN parameters based on the following:
  - vpn 0
    - Interface ge0/0
    - IP Address: 192.168.104.4/24
    - Tunnel Interface
    - Encapsulation IPSec
    - Tunnel Services (NetConf, SSHD)
    - Default Route: 192.168.104.254
  - vpn 512
    - Interface eth0

- IP Address: DHCP Client

vEdge4

```
config
!
vpn 0
 interface ge0/0
  ip address 192.168.104.4/24
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 192.168.104.254
!
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
 !
commit
```

Lab 10 – Registering vEdges in vManage



vEDGE-1

Task 1 – Upload the Root Certificate to the vEdge

- On the Windows Server, open **WINSCP** application.
- **Connect** to vEdge1 using the following information:
  - IP Address : 199.1.1.17
  - Protocol - SFTP
  - Username : admin
  - Password : admin
- Copy the **RootCert.cer** file from the Downloads folder to the **/home/admin** folder on the vEdge1

Task 2 – Install the Root Certificate on vEdge1

- Connect to the console of vEdge1 and issue the following command:

request root-cert-chain install /home/admin/RootCert.cer

Task 3 - Activate vEdge on vManage

- Navigate to **Configuration -> Devices**

- Note and use the **Chassis Number** and **Token number** for the 1st vEdge from vManage.

- Use the information from the previous step in the following command on the vEdge1 console.

  request vedge-cloud activate chassis-number **XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

vEDGE-2

Task 1 – Upload the Root Certificate to the vEdge

- On the Windows Server, open **WINSCP** application.

- **Connect** to vEdge1 using the following information:

    - IP Address : 192.168.102.2
    - Protocol - SFTP
    - Username : admin
    - Password : admin

- Copy the **RootCert.cer** file from the Downloads folder to the **/home/admin** folder on the vEdge2

Task 2 – Install the Root Certificate on vEdge2

- Connect to the console of vEdge2 and issue the following command:

  request root-cert-chain install /home/admin/RootCert.cer

Task 3 - Activate vEdge on vManage

- Navigate to **Configuration -> Devices**

- Note and use the **Chassis Number** and **Token number** for the 2nd vEdge from vManage.

- Use the information from the previous step in the following command on the vEdge2 console.

  request vedge-cloud activate chassis-number **XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

vEDGE-3

Task 1 – Upload the Root Certificate to the vEdge

- On the Windows Server, open **WINSCP** application.
- **Connect** to vEdge1 using the following information:
  - IP Address : 192.168.103.3
  - Protocol - SFTP
  - Username : admin
  - Password : admin
- Copy the **RootCert.cer** file from the Downloads folder to the **/home/admin** folder on the vEdge3

Task 2 – Install the Root Certificate on vEdge3

- Connect to the console of vEdge3 and issue the following command:

  request root-cert-chain install /home/admin/RootCert.cer

Task 3 - Activate vEdge on vManage

- Navigate to **Configuration -> Devices**
- Note and use the **Chassis Number** and **Token number** for the 3rd vEdge from vManage.
- Use the information from the previous step in the following command on the vEdge3 console.

  request vedge-cloud activate chassis-number **XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

vEDGE-4

Task 1 – Upload the Root Certificate to the vEdge

- On the Windows Server, open **WINSCP** application.

- **Connect** to vEdge1 using the following information:

  - IP Address : 192.168.104.4
  - Protocol - SFTP
  - Username : admin
  - Password : admin

- Copy the **RootCert.cer** file from the Downloads folder to the **/home/admin** folder on the vEdge4

Task 2 – Install the Root Certificate on vEdge4

- Connect to the console of vEdge4 and issue the following command:

  request root-cert-chain install /home/admin/RootCert.cer

Task 3 - Activate vEdge on vManage

- Navigate to **Configuration -> Devices**

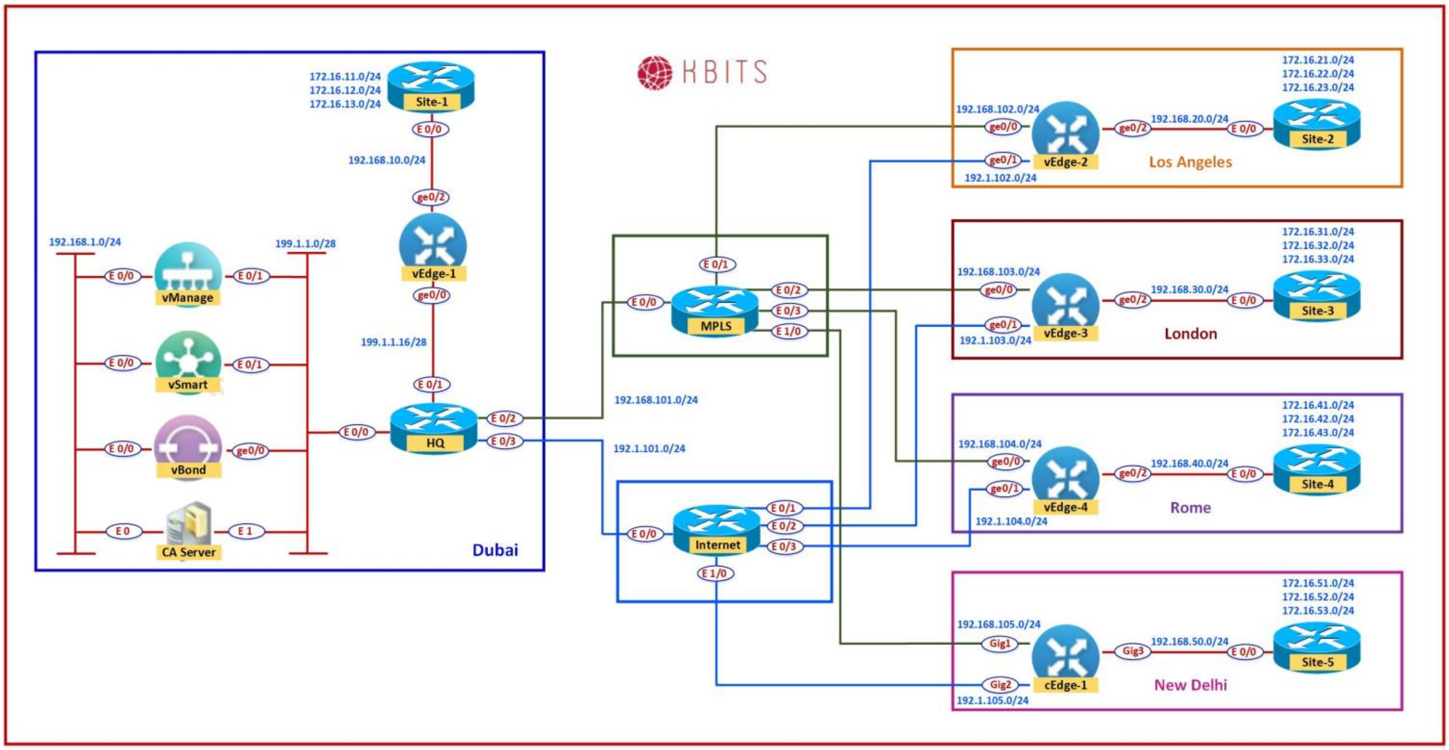
- Note and use the **Chassis Number** and **Token number** for the 4th vEdge from vManage.

- Use the information from the previous step in the following command on the vEdge4 console.

  request vedge-cloud activate chassis-number **XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

Lab 11 – Initializing cEdge – CLI



cEDGE-1

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : cEdge5
  - Organization: KBITS
  - System-IP: 10.2.2.205
  - Site ID: 5
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

cEdge1

```
config-transaction
!
hostname cEdge1
!
```

```
system
 system-ip 10.2.2.205
 site-id 5
 organization-name KBITS
 vbond 199.1.1.3
 exit
!
clock timezone GST 4
commit
```

Task 2 – Configure the Interface and Tunnel Parameters

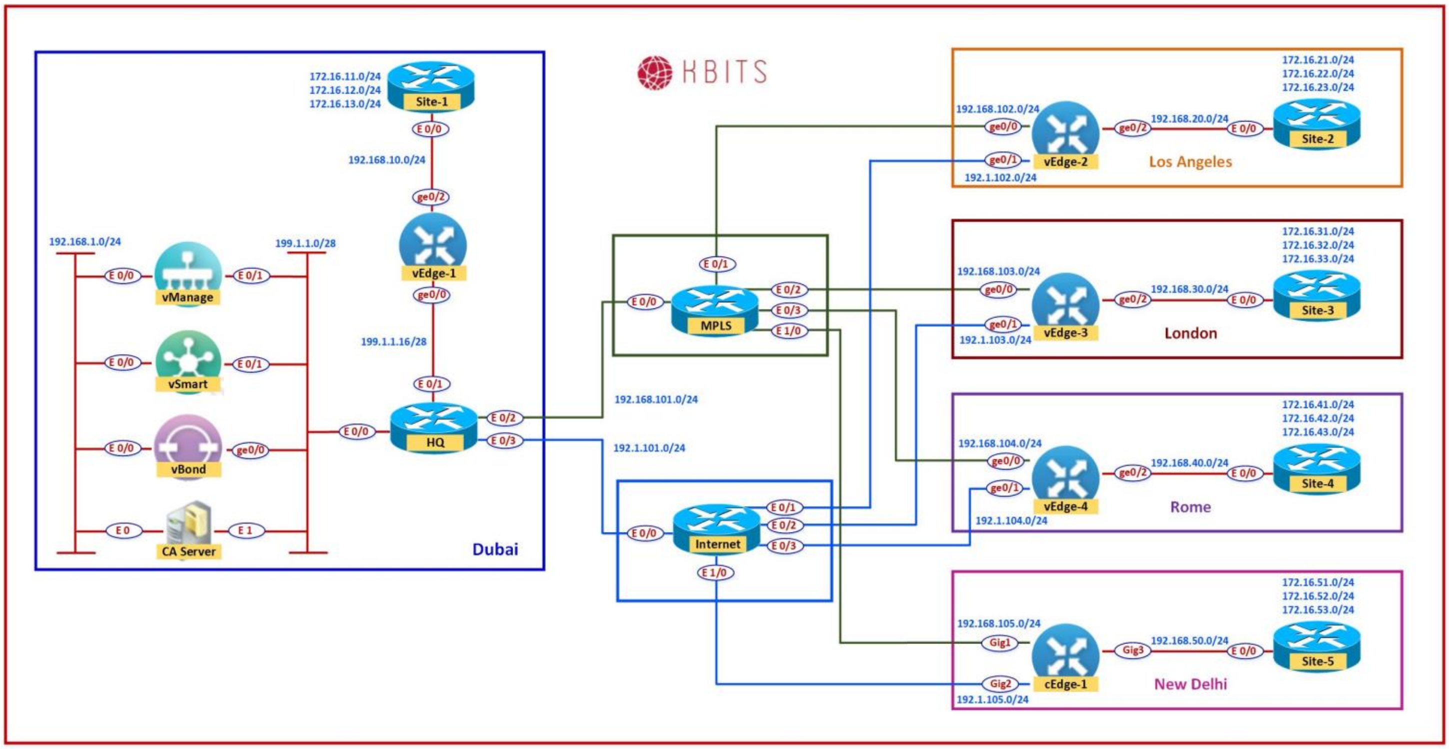
- Configure the Interface parameters based on the following:
  - GigabitEthernet1 Parameters
    - IP Address: 192.168.105.5/24
    - Default Route: 192.168.105.254
  - Tunnel Parameters Parameters
    - Tunnel Interface: Tunnel1
    - Tunnel Source: GigabitEthernet1
    - Tunnel Mode: SDWAN
  - SDWAN Interface Parameters
    - Interface: GigabitEthernet1
    - Encapsulation: IPSec
    - Color: default
    - Tunnel Services (All, NetConf, SSHD)

cEdge1

```
config-transaction
!
interface GigabitEthernet1
 no shutdown
 ip address 192.168.105.5 255.255.255.0
!
ip route 0.0.0.0 0.0.0.0 192.168.105.254
!
interface Tunnel1
 no shutdown
 ip unnumbered GigabitEthernet1
 tunnel source GigabitEthernet1
 tunnel mode sdwan
exit
!
sdwan
```

```
 interface GigabitEthernet1
  tunnel-interface
   encapsulation ipsec
   color default
   allow-service all
   allow-service sshd
   allow-service netconf
  exit
 exit
commit
```

Lab 12 – Registering cEdges in vManage



cEDGE-1

Task 1 – Upload the Root Certificate to the cEdge

- Open the **TFTP Application** on the Windows Server.
- Configure the Default Folder as the **Downloads** Folder and using the 199.1.1.5 as the TFTP Interface.
- Connect to the console of cEdge1 and copy the RootCert.cer file to flash: using the following command:

  copy tftp://199.1.1.5/RootCert.cer flash:

Task 2 – Install the Root Certificate on cEdge1

- Connect to the console of cEdge1 and issue the following command:

  request platform software sdwan root-cert-chain install bootflash:Root.cer

Task 3 - Activate cEdge on vManage

- Navigate to **Configuration -> Devices**

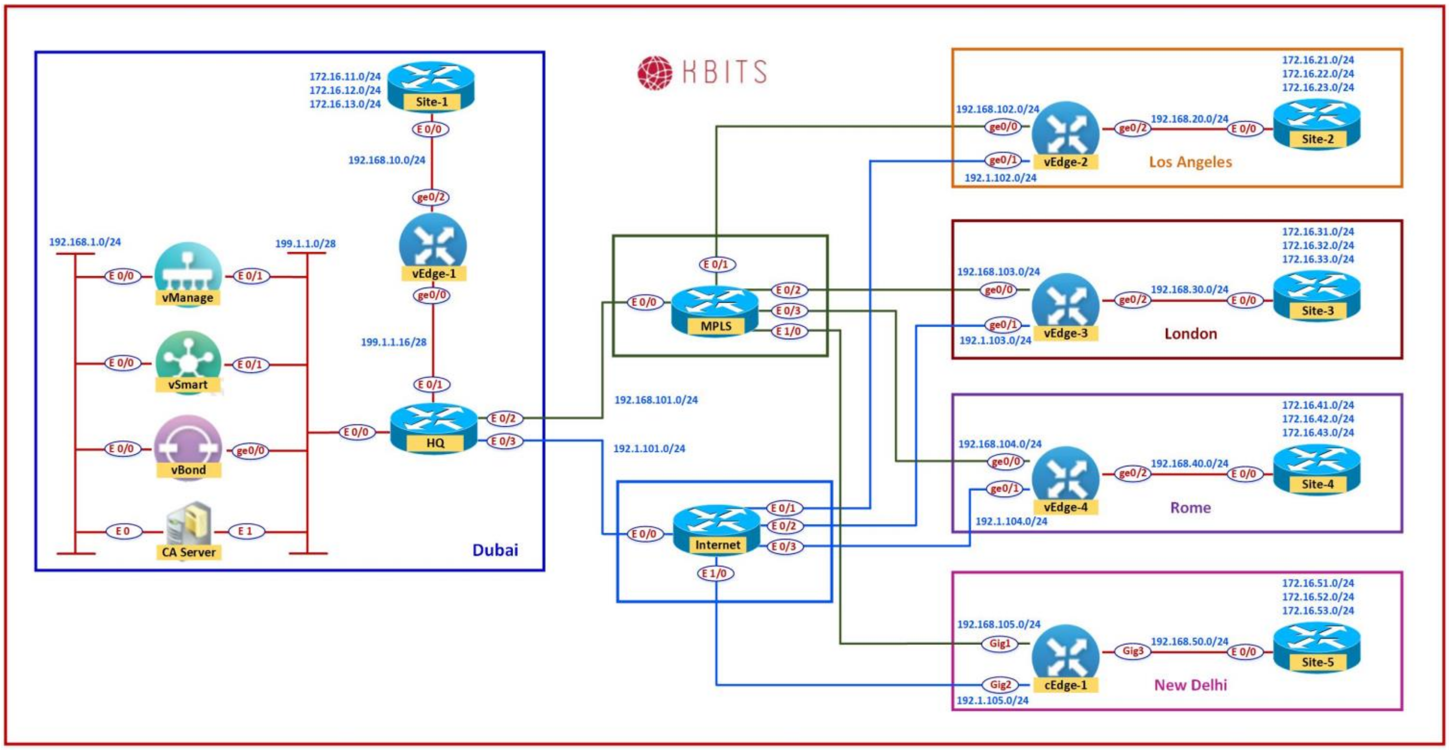
- Note and use the **Chassis Number** and **Token number** for the 1st CSR Device from vManage.

- Use the information from the previous step in the following command on the cEdge1 console.

  request platform software sdwan vedge_cloud activate chassis-number **CSR-XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

Lab 13 – Configuring Feature Template – System



Task 1 – Configure the System Template to be used by all vEdge-Cloud Devices

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Basic Information -> System**

- Configure the System parameters based on the following:

  - Template Name : **VE-System**
  - Description : **VE-System**
  - Site ID -> Device Specific
  - System IP ->Device Specific
  - Hostname -> Device Specific
  - Timezone -> Global : **Asia/Muscat**
  - Console Baud Rate -> **Default**

- Click **Save** to save the Template.

Task 2 – Configure the System Template to be used by all cEdge-Cloud Devices

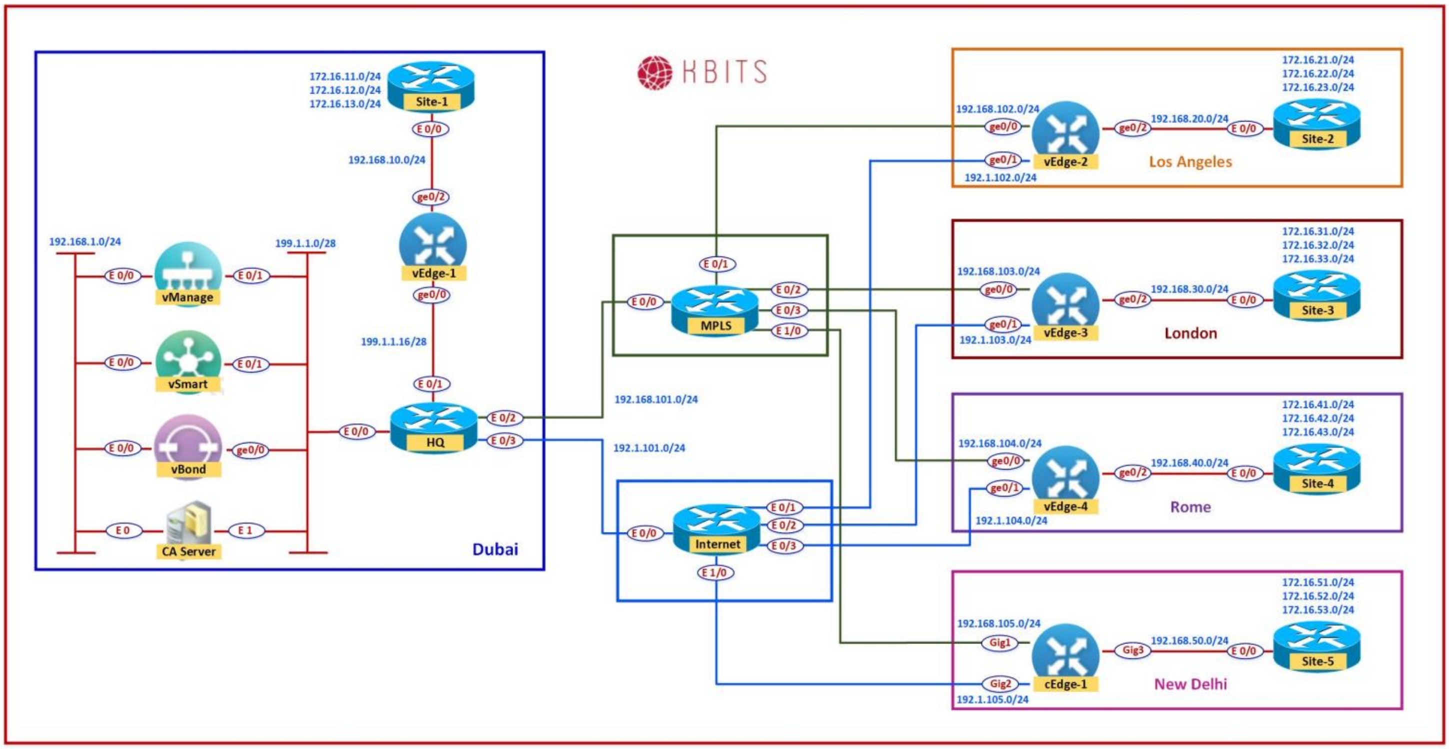
- In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR Cloud -> Basic Information -> System**

- Configure the System parameters based on the following:

    - Template Name : **CE-System**
    - Description : **CE-System**
    - Site ID -> Device Specific
    - System IP ->Device Specific
    - Hostname -> Device Specific
    - Timezone -> Global : **Asia/Muscat**
    - Console Baud Rate -> **Default**

- Click **Save** to save the Template.

Lab 14 – Configuring Feature Template – Banner



Task 1 – Configure the Banner Template to be used by all vEdge-Cloud Devices

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Basic Information -> Banner**

- Configure the Banner parameters based on the following:

  - Template Name : **VE-Banner**
  - Description : **VE-Banner**
  - Banner: KBITS Authorized Users Only !!!!!!!!!!!
  - MOTD: Welcome of SD-WAB !!!!!!!!!!!!!

- Click **Save** to save the Template.

Task 2 – Configure the Banner Template to be used by all cEdge-Cloud Devices

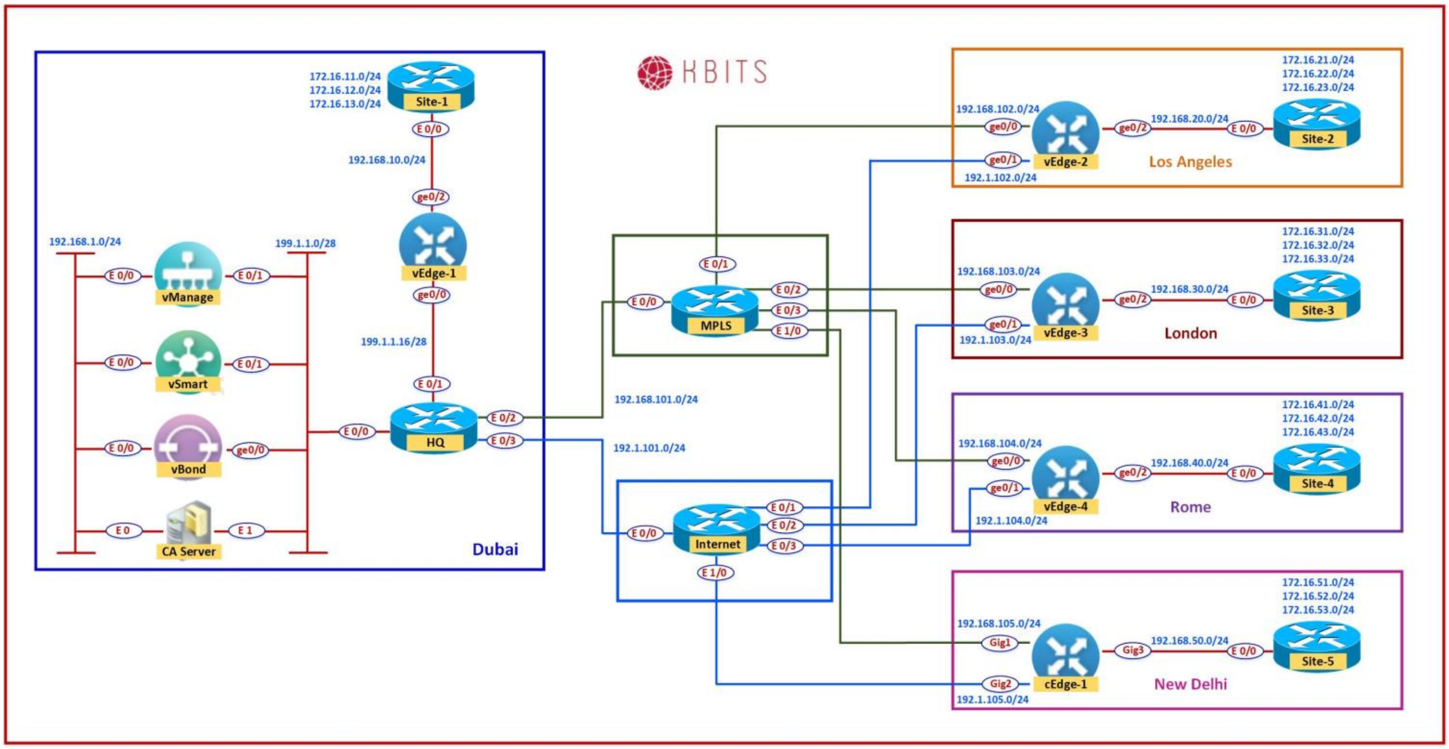
- In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR Cloud -> Basic Information -> Banner**

- Configure the Banner parameters based on the following:

  - Template Name : **CE-Banner**
  - Description : **CE-Banner**
  - Banner: KBITS Authorized Users Only !!!!!!!!!!!
  - MOTD: Welcome of SD-WAB !!!!!!!!!!!!!

- Click **Save** to save the Template.

Lab 15 - Configuring Feature Templates - VPN & VPN Interfaces for VPN 0 & 512 — Branch Site(vEdges)



Task 1 – Configure a VPN Template to be used by all Branch vEdge-Cloud Devices for VPN 0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPN-VPN0**
  - Description : **BR-VE-VPN-VPN0**

  Basic Configuration
  - VPN -> Global : **0**
  - Name -> Global : **Transport VPN**

  IPv4 Route
  - Prefix -> Global : 0.0.0.0/0
  - Next Hop -> Device Specific (Label: **DEF-GW**)

- Click **Save** to save the Template.

Task 2 – Configure a VPN Template to be used by all Branch vEdge-Cloud Devices for VPN 512

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPN-VPN512**
  - Description : **BR-VE-VPN-VPN512**

  Basic Configuration
  - VPN -> Global : **512**
  - Name -> Global : **MGMT VPN**

- Click **Save** to save the Template.

Task 3 – Configure a VPN Interface Template to be used by all Branch vEdge-Cloud Devices for VPN 0 for Interface G0/0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPNINT-VPN0-G0**
  - Description : **BR-VE-VPNINT-VPN0-G0**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/0**
  - IPv4 Address -> Static -> Device Specific (Label: **G0**)

  Tunnel
  - Tunnel Inteface -> Global : **On**
  - Color -> Global : **MPLS**

  Allow Service
  - NETCONF -> Global : **On**
  - SSH -> Global : **On**
  - OSPF -> Global : **On**

- Click **Save** to save the Template.

Task 4 – Configure a VPN Interface Template to be used by all Branch vEdge-Cloud Devices for VPN 0 for Interface G0/1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPNINT-VPN0-G1**
  - Description : **BR-VE-VPNINT-VPN0-G1**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/1**
  - IPv4 Address -> Static -> Device Specific (Label: **G1**)

  Tunnel
  - Tunnel Inteface -> Global : **On**
  - Color -> Global : **BIZ-Internet**

  Allow Service
  - NETCONF -> Global : **On**
  - SSH -> Global : **On**

Click **Save** to save the Template.

Task 5 – Configure a VPN Interface Template to be used by all Branch vEdge-Cloud Devices for VPN 512 for Interface Eth0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

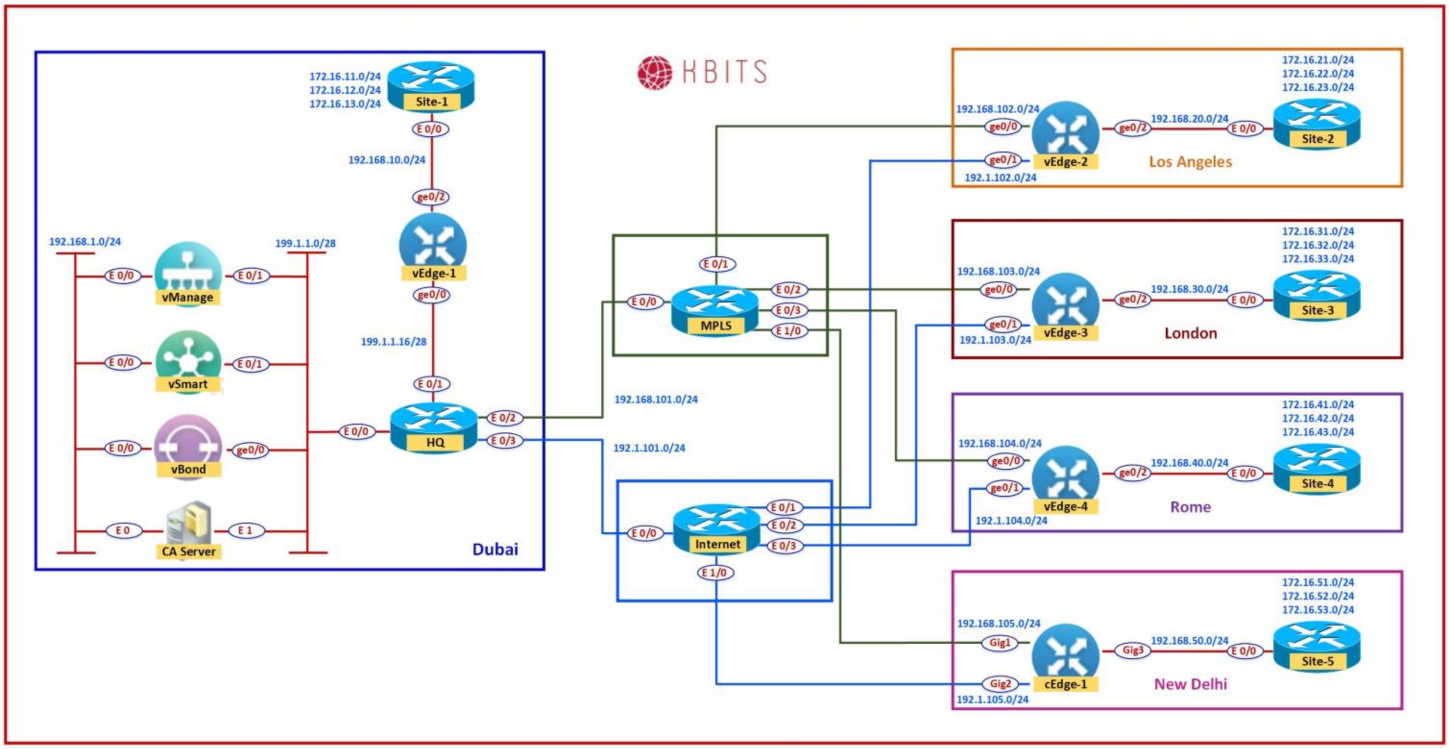
- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPNINT-VPN512-E0**
  - Description : **BR-VE-VPNINT-VPN512-E0**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **eth0**
  - IPv4 Address -> Dynamic

- Click **Save** to save the Template

Lab 16 - Configuring Feature Templates – External Routing - OSPF for VPN 0 – Branch Site(vEdges)



Task 1 – Configure a OSPF Template to be used by all Branch vEdge-Cloud Devices for VPN 0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Other Templates -> OSPF**

- Configure the OSPF parameters based on the following:

  - Template Name : **BR-VE-OSPF-VPN0**
  - Description : **BR-VE-OSPF-VPN0**

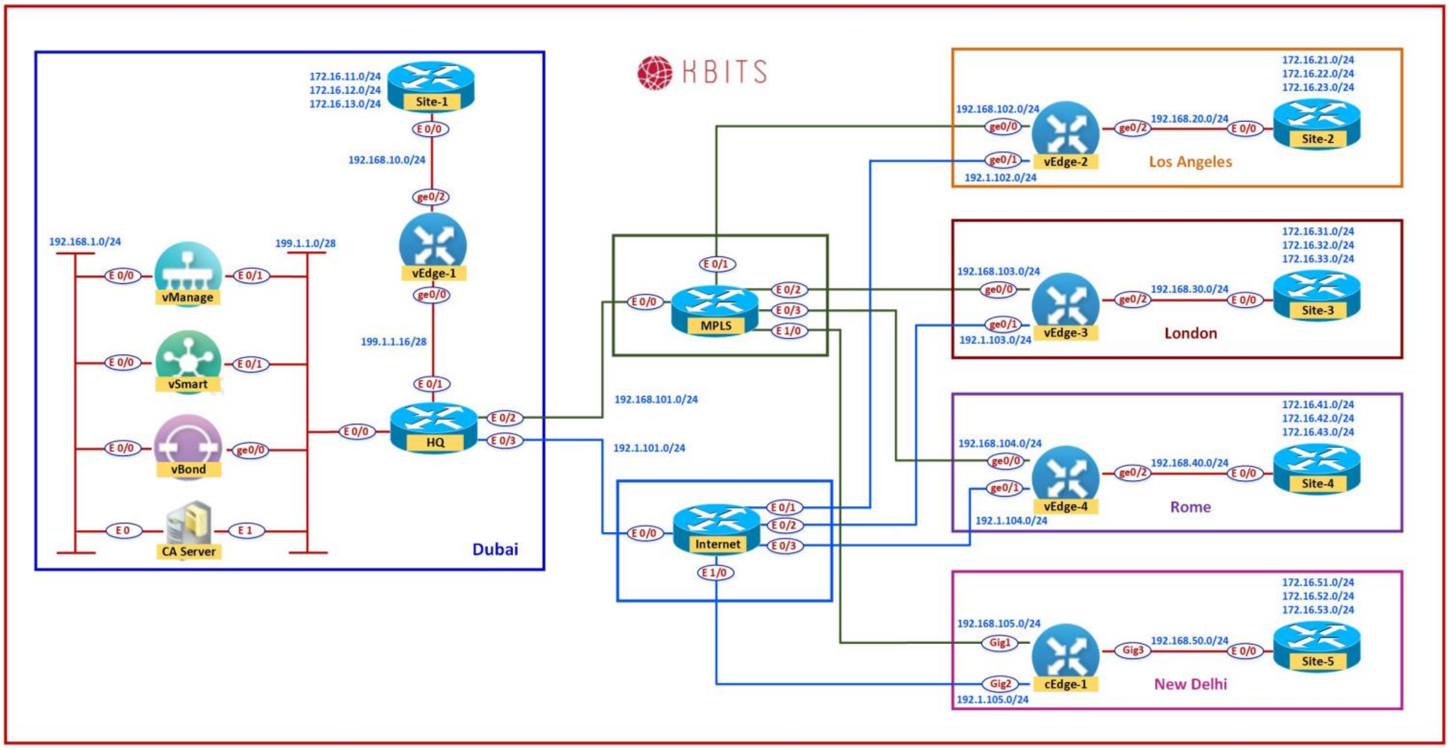
  Area Configuration
  - Area Number -> Global : **0**
  - Area Type -> Default

  Interface Configuration
  - Interface Name: ge0/0

  Advanced
  - OSPF Network Type: Point-to-Point

- Click **Add** to add the Interface and Click **Add** to add OSPF.
- Click **Save** to save the Template.

Lab 17 - Configuring and Deploying Device Templates for vEdge – Branch Site(vEdge2)



Task 1 – Configure a Device Template for Branch vEdge Devices.

- In vManage, Navigate to Configuration -> **Templates -> Device -> Create Template -> vEdge Cloud**

- Configure the Device Template based on the following:

  - Template Name : **BR-VE-TEMP**
  - Description : **BR-VE-TEMP**

  Basic Information
  - System -> **VE-System**

  Transport & Management
  - VPN 0 : **BR-VE-VPN-VPN0**
  - VPN Interface : **BR-VE-VPNINT-VPN0-G0**
  - VPN Interface : **BR-VE-VPNINT-VPN0-G1**
  - OSPF : **BR-VE-OSPF-VPN0**

- VPN 512 : **BR-VE-VPN-VPN512**
- VPN Interface : **BR-VE-VPNINT-VPN512-E0**

➤ Click **Save** to save the Template.

Task 2 – Attach vEdge2 to the Device Template

➤ In vManage, Navigate to Configuration -> **Templates -> Device -> BR-VE-TEMP.**

➤ Click on "**…**" towards the right-hand side.

➤ Click **Attach Devices.**

➤ Select **vEdge2** and click the " **->** " button.

➤ Click **Attach**.

Task 3 – Configure the Variable Parameters for the Feature Templates

➤ **vEdge2** will appear in the window.

➤ Click on "**…**" towards the right-hand side.

➤ Click **Edit Device Template.**

➤ Configure the variables based on the following:

- Default Gateway for VPN0 (**DEF-GW**) : **192.1.102.254**
- Interface IP for ge0/1 (**G1**) :**192.1.102.2/24**
- Interface IP for ge0/0 (**G0**) :**192.168.102.2/24**
- Hostname : **vEdge-2**
- System IP : **10.2.2.202**
- Site ID : **2**

➤ Click **Update.**

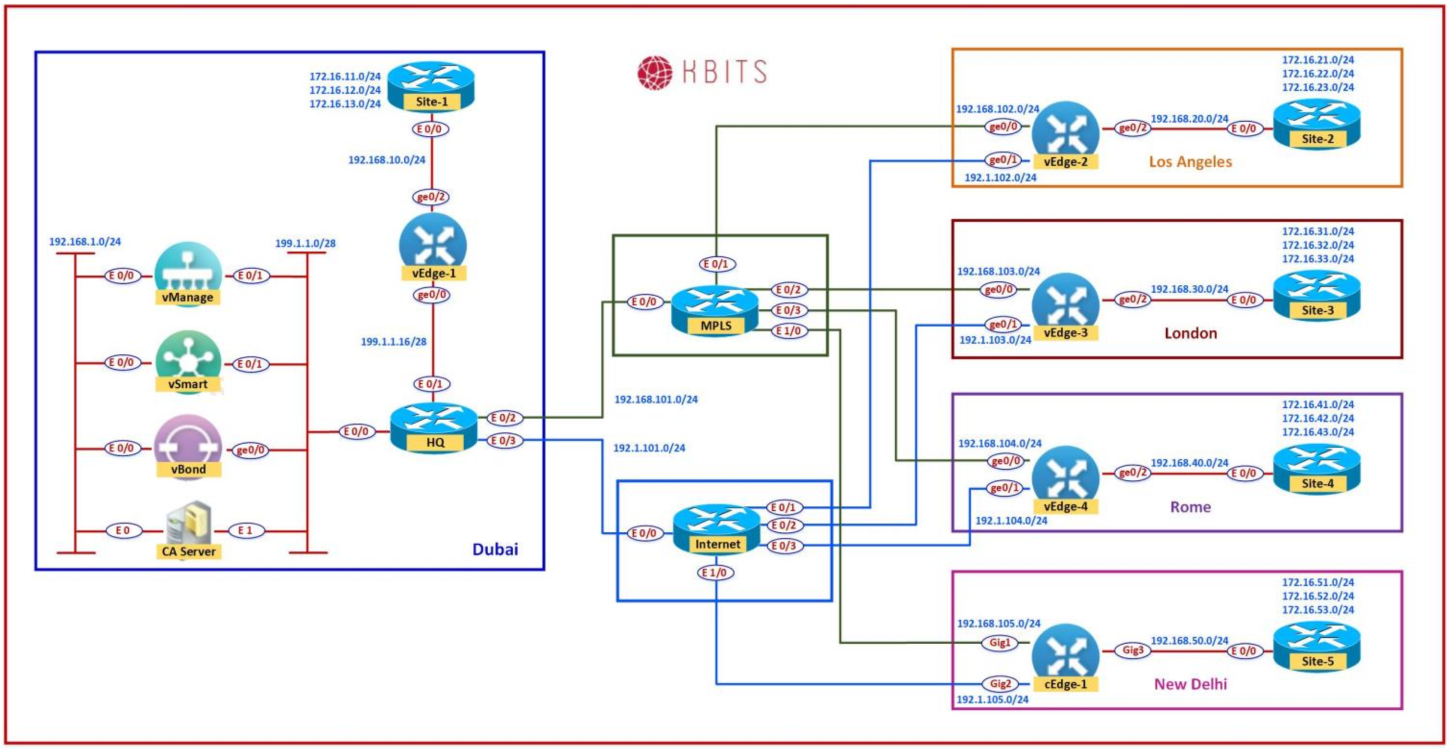
➤ Verify the Configuration & Click **Configure Devices.**

➤ Wait for it to update the device. It should come back with Status of **Success**.

➤ Verify the configuration on **vEdge2**. You can do that by verify OSPF Neighbor relationship with the MPLS Router by issuing the **Show ospf neighbor** command on **vEdge2.**

- Type **Show Ip route** on **vEdge2** to verify that you are receiving OSPF routes from the MPLS Router.

Lab 18 - Configuring Internal Routing Protocols on the Internal Routing Devices – HQ & All Branches



Interface Configuration

Site-1

Interface	IP Address	Subnet Mask
E 0/0	192.168.11.11	255.255.255.0
Loopback1	172.16.11.1	255.255.255.0
Loopback2	172.16.12.1	255.255.255.0
Loopback3	172.16.13.1	255.255.255.0

Site-2

Interface	IP Address	Subnet Mask
E 0/0	192.168.20.22	255.255.255.0
Loopback1	172.16.21.1	255.255.255.0
Loopback2	172.16.22.1	255.255.255.0
Loopback3	172.16.23.1	255.255.255.0
Loopback4	172.16.234.2	255.255.255.255

Site-3

Interface	IP Address	Subnet Mask
E 0/0	192.168.30.33	255.255.255.0
Loopback1	172.16.31.1	255.255.255.0
Loopback2	172.16.32.1	255.255.255.0
Loopback3	172.16.33.1	255.255.255.0
Loopback4	172.16.234.3	255.255.255.255

Site-4

Interface	IP Address	Subnet Mask
E 0/0	192.168.40.44	255.255.255.0
Loopback1	172.16.41.1	255.255.255.0
Loopback2	172.16.42.1	255.255.255.0
Loopback3	172.16.43.1	255.255.255.0
Loopback4	172.16.234.4	255.255.255.255

Site-5

Interface	IP Address	Subnet Mask
E 0/0	192.168.50.55	255.255.255.0
Loopback1	172.16.51.1	255.255.255.0
Loopback2	172.16.52.1	255.255.255.0
Loopback3	172.16.53.1	255.255.255.0

Task 1 – Internal Site Router Configurations

- Configure the Interfaces based on the Logical Diagram
- Configure OSPF as the IGP to communicate with the vEdge/cEdge devices. Enable all the interfaces under OSPF.
- Configure the Loopback Interfaces as OSPF Network Point-to-point Interfaces.

Site-1

```
no ip domain-loo
line con 0
 logg sync
 no exec-timeout
!
Hostname Site-1
!
Interface E 0/0
 ip address 192.168.10.254 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 172.16.11.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback2
 ip address 172.16.12.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback3
 ip address 172.16.13.1 255.255.255.0
 ip ospf network point-to-point
!
router ospf 1
 network 192.168.11.0 0.0.0.255 area 0
 network 172.16.0.0 0.0.255.255 area 0
```

Site-2

```
no ip domain-loo
line con 0
 logg sync
 no exec-timeout
!
Hostname Site-2
!
Interface E 0/0
 ip address 192.168.20.254 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 172.16.21.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback2
 ip address 172.16.22.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback3
 ip address 172.16.23.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback4
 ip address 172.16.234.2 255.255.255.255
 ip ospf network point-to-point
!
router ospf 1
 network 192.168.20.0 0.0.0.255 area 0
 network 172.16.0.0 0.0.255.255 area 0
```

Site-3

```
no ip domain-loo
line con 0
 logg sync
 no exec-timeout
!
Hostname Site-3
!
Interface E 0/0
 ip address 192.168.30.254 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 172.16.31.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback2
 ip address 172.16.32.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback3
 ip address 172.16.33.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback4
 ip address 172.16.234.3 255.255.255.255
 ip ospf network point-to-point
!
router ospf 1
 network 192.168.30.0 0.0.0.255 area 0
 network 172.16.0.0 0.0.255.255 area 0
```

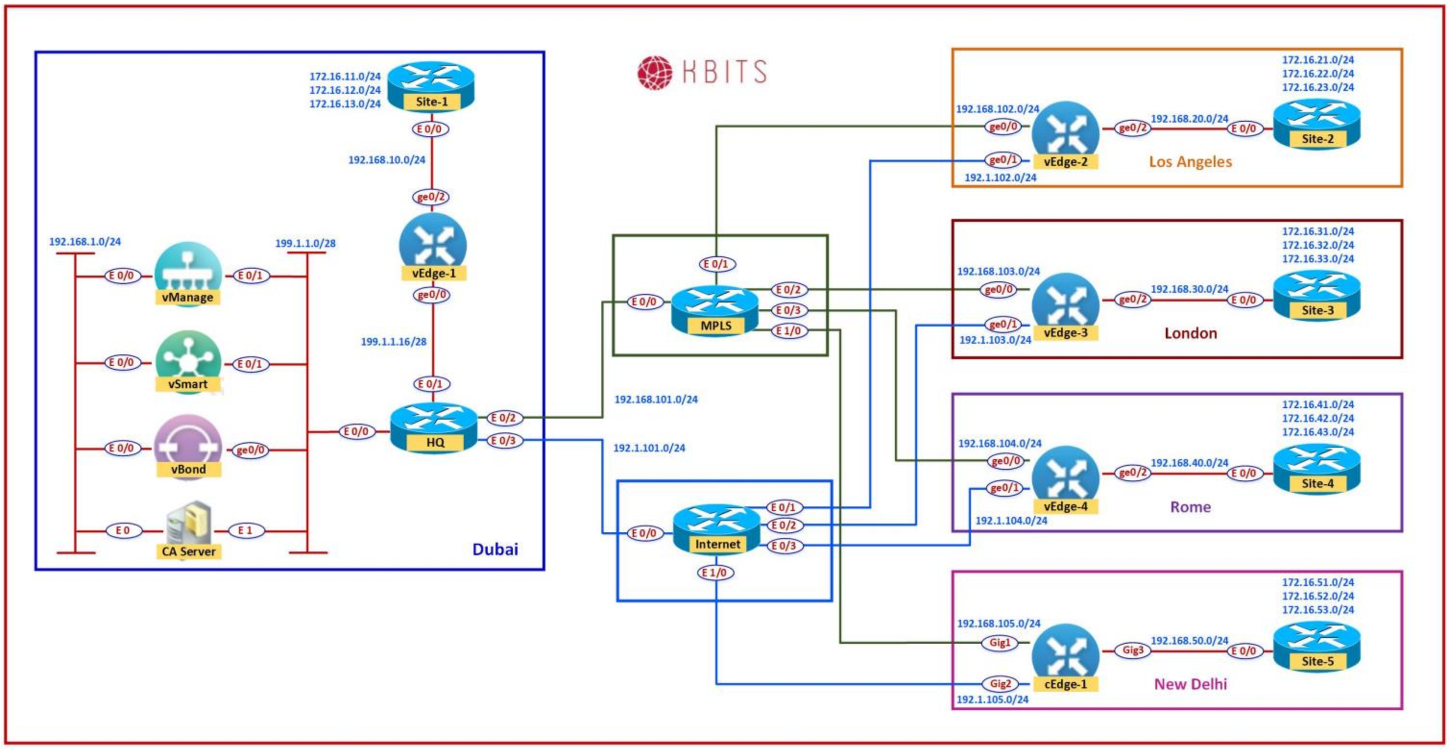
Site-4

```
no ip domain-loo
line con 0
 logg sync
 no exec-timeout
!
Hostname Site-4
!
Interface E 0/0
 ip address 192.168.40.254 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 172.16.41.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback2
 ip address 172.16.42.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback3
 ip address 172.16.43.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback4
 ip address 172.16.234.4 255.255.255.255
 ip ospf network point-to-point
!
router ospf 1
 network 192.168.40.0 0.0.0.255 area 0
 network 172.16.0.0 0.0.255.255 area 0
```

Site-5

```
no ip domain-loo
line con 0
 logg sync
 no exec-timeout
!
Hostname Site-5
!
Interface E 0/0
 ip address 192.168.50.254 255.255.255.0
 no shut
!
Interface Loopback1
 ip address 172.16.51.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback2
 ip address 172.16.52.1 255.255.255.0
 ip ospf network point-to-point
!
Interface Loopback3
 ip address 172.16.53.1 255.255.255.0
 ip ospf network point-to-point
!
router ospf 1
 network 192.168.50.0 0.0.0.255 area 0
 network 172.16.0.0 0.0.255.255 area 0
```

Lab 19 - Configuring Feature Templates – Service VPN – VPN, VPN Interface and Internal Routing – Branch Site(vEdges)



Task 1 – Configure a VPN Template to be used by all Branch vEdge-Cloud Devices for VPN 1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPN-VPN1**
  - Description : **BR-VE-VPN-VPN1**

  Basic Configuration
  - VPN -> Global : **1**
  - Name -> Global : **Data VPN**

- Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by all Branch vEdge-Cloud Devices for VPN 1 for Interface G0/2

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPNINT-VPN1-G2**
  - Description : **BR-VE-VPNINT-VPN1-G2**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/2**
  - IPv4 Address -> Static -> Device Specific (Label: **G2**)

- Click **Save** to save the Template.

Task 3 – Configure a OSPF Template to be used by all Branch vEdge-Cloud Devices for VPN 1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Other Templates -> OSPF**

- Configure the OSPF parameters based on the following:

  - Template Name : **BR-VE-OSPF-VPN1**
  - Description : **BR-VE-OSPF-VPN1**

  Redistribution
  - Protocol : **OMP**

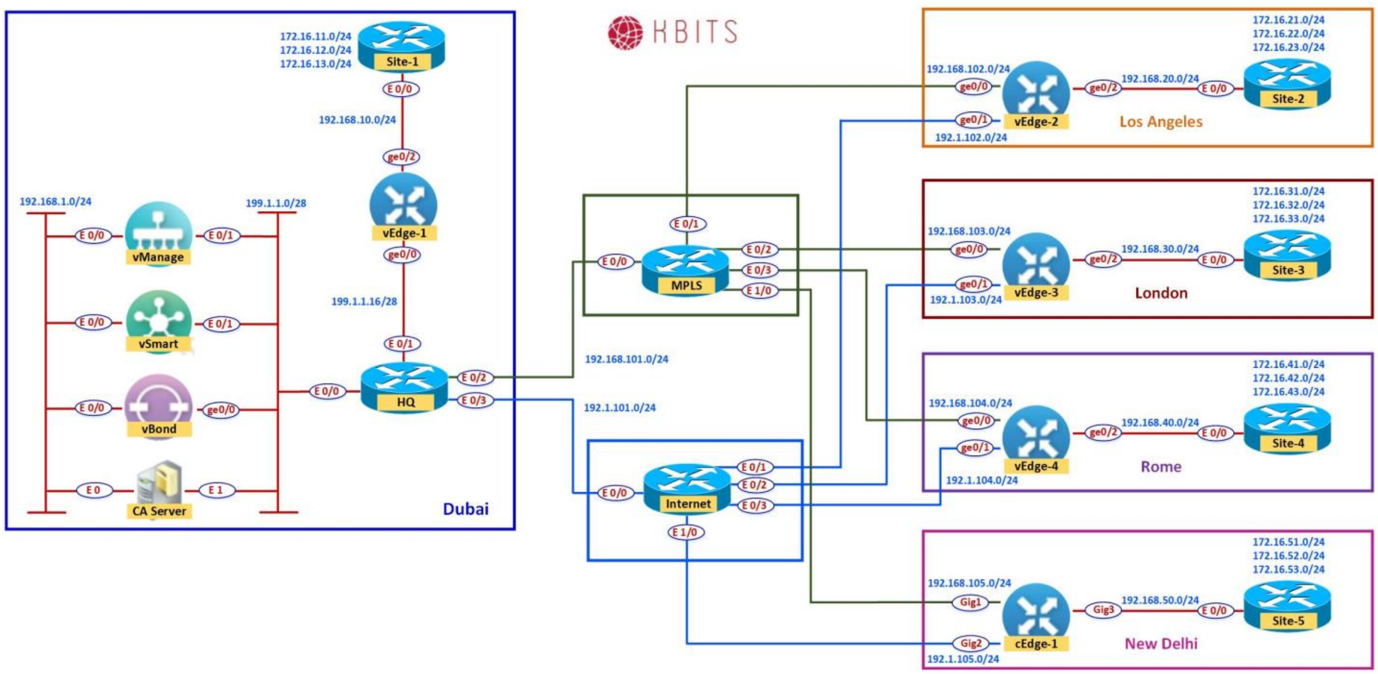
  Area Configuration
  - Area Number -> Global : **0**
  - Area Type -> Default

  Interface Configuration
  - Interface Name: ge0/2

- Click **Add** to add the Interface and Click **Add** to add OSPF.

- Click **Save** to save the Template.

Lab 20 - Implementing a Service VPN using Templates – Branch Site(vEdge2)



Task 1 – Edit the BR-VE-TEMP Device Template for Brance vEdge Devices.

- In vManage, Navigate to Configuration -> **Templates -> Device -> BR-VE-TEMP -> "…" -> Edit**

- Edit the BR-VE-TEMP Device Template based on the following:

  Service VPN
  - VPN 1 : **BR-VE-VPN-VPN1**
  - VPN Interface : **BR-VE-VPNINT-VPN1-G2**
  - OSPF : **BR-VE-OSPF-VPN1**

- Click **Save** to save the Template.

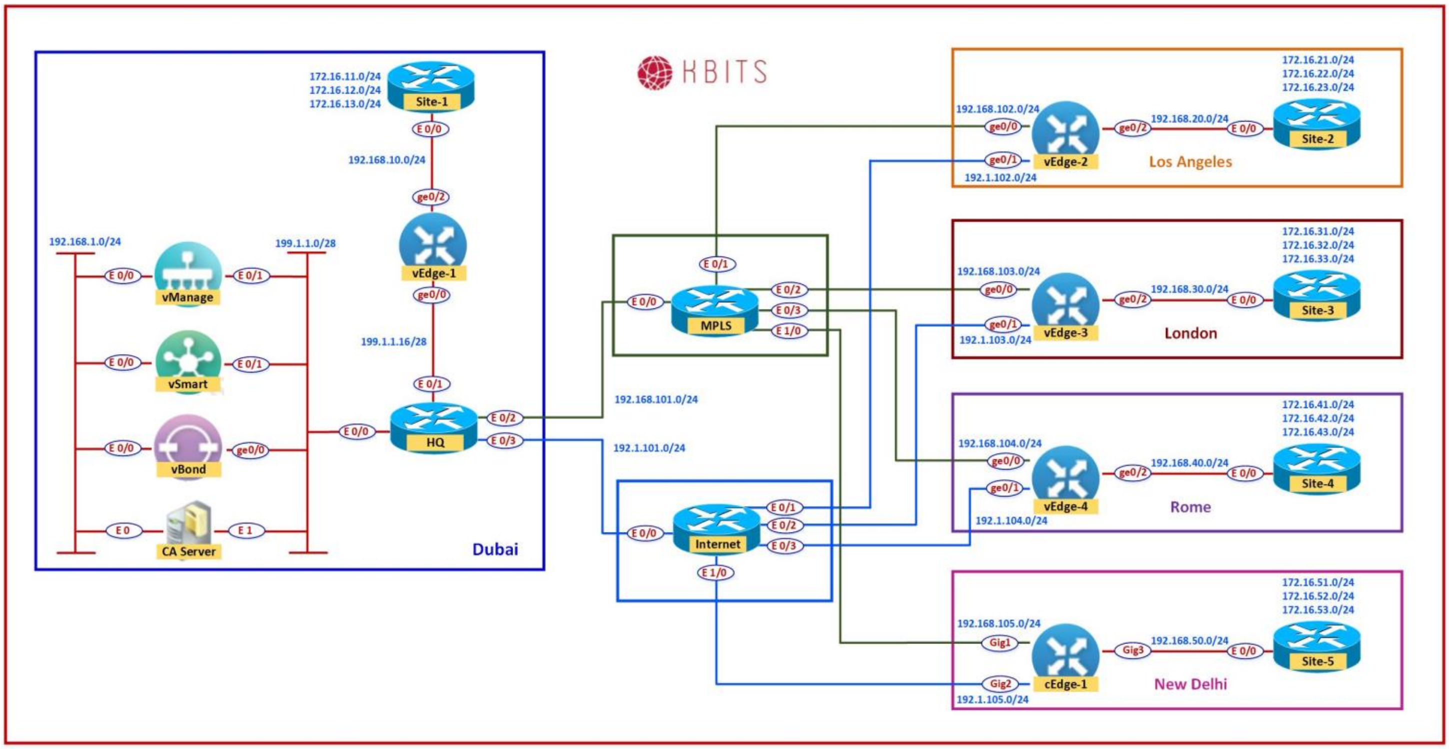
Task 2 – Configure the Variable Parameters for the Feature Templates

- **vEdge2** will appear in the window.

- Click on "**…**" towards the right-hand side & click **Edit Device Template.**

- Configure the variables based on the following:
    - Interface IP for ge0/2 (**G2**) :**192.168.20.2/24**
- Click **Update.**
- Verify the Configuration & Click **Configure Devices.**
- Wait for it to update the device. It should come back with Status of **Success**.
- Verify the configuration on **vEdge2**. You can do that by verify OSPF Neighbor relationship with the Site-2 Router by issuing the **Show ospf neighbor** command on **vEdge2.**
- Type **Show Ip route** on **vEdge2** to verify that you are receiving OSPF routes from the Internal Site Router.

Lab 21 - Pushing Template to configure other Branch Sites - – Branch Site(vEdge3 & vEdge4)



Task 1 – Attach the BR-VE-TEMP Device Template for Brance vEdge Devices.

- In vManage, Navigate to Configuration -> **Templates -> Device -> BR-VE-TEMP -> "…" -> Attach Devices.**
- Click **Attach Devices.**
- Select **vEdge3** & **vEdge4** and click the " **->** " button.
- Click **Attach**.
- **vEdge3** & **vEdge4** will appear in the window.
- Click on "**…**" towards the right-hand side for both devices, one at a time click **Edit Device Template.**
- Configure the variables based on the following:

vEdge-3

- Interface IP for ge0/2 (**G2**) :**192.168.30.3/24**
- Default Gateway for VPN0 (**DEF-GW**) : **192.1.103.254**
- Interface IP for ge0/1 (**G1**) :**192.1.103.3/24**
- Interface IP for ge0/0 (**G0**) :**192.168.103.3/24**
- Hostname : **vEdge-3**
- System IP : **10.2.2.203**
- Site ID : **3**

➢ Click **Update.**

vEdge-4

- Interface IP for ge0/2 (**G2**) :**192.168.40.4/24**
- Default Gateway for VPN0 (**DEF-GW**) : **192.1.104.254**
- Interface IP for ge0/1 (**G1**) :**192.1.104.4/24**
- Interface IP for ge0/0 (**G0**) :**192.168.104.4/24**
- Hostname : **vEdge-4**
- System IP : **10.2.2.204**
- Site ID : **4**

➢ Click **Update.**

➢ Verify the Configuration & Click **Configure Devices.**

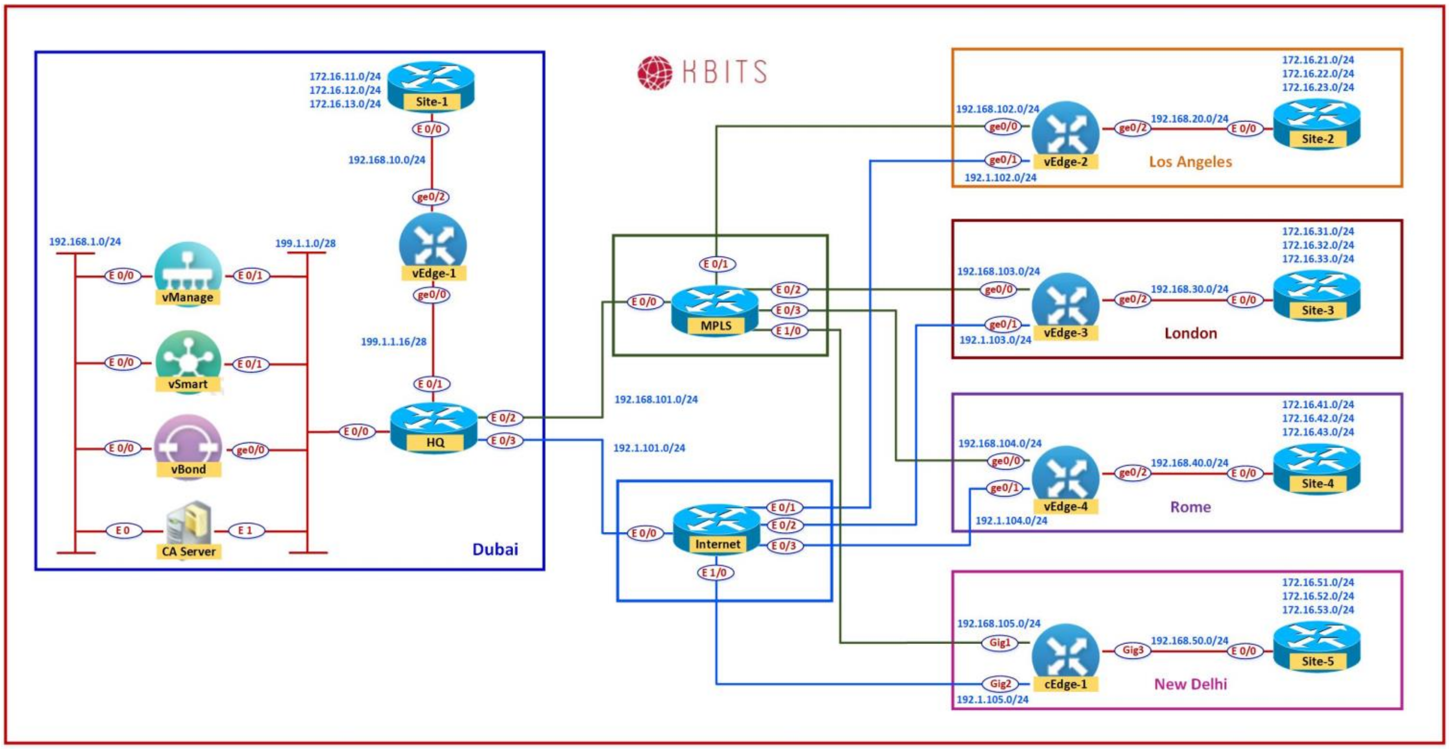
➢ Wait for it to update the device. It should come back with Status of **Success**.

➢ Verify the configuration on **vEdge3** & **vEdge4**. You can do that by verify OSPF Neighbor relationship with the Internal Site Router by issuing the **Show ospf neighbor** command on the **vEdges.**

➢ Type **Show Ip route** on **Internal Site Routers** to verify that you are receiving OSPF routes from the other Sites.

➢ Verify reachability between the sites by Pinging the Internal Loopback to Loopback networks.

Lab 22 – Configuring Feature Templates for HQ-Site(vEdge1) – VPNs, VPN Interfaces, External & Internal Routing



VPN 0

Task 1 – Configure a VPN Template for HQ vEdge-Cloud Devices for VPN 0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **HQ-VE-VPN-VPN0**
  - Description : **HQ-VE-VPN-VPN0**

  Basic Configuration
  - VPN -> Global : **0**
  - Name -> Global : **Transport VPN**

IPv4 Route

- Prefix -> Global : 0.0.0.0/0
- Next Hop -> Global: **199.1.1.30**

➢ Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by HQ vEdge-Cloud Devices for VPN 0 for Interface G0/0

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

➢ Configure the VPN parameters based on the following:

- Template Name : **HQ-VE-VPNINT-VPN0-G0**
- Description : **HQ-VE-VPNINT-VPN0-G0**

Basic Configuration

- Shutdown -> Global : **No**
- Interface Name -> Global : **ge0/0**
- IPv4 Address -> Static -> Global: **199.1.1.17**

Tunnel

- Tunnel Inteface -> Global : **On**
- Color -> Default

Allow Service

- NETCONF -> Global : **On**
- SSH -> Global : **On**
- BGP -> Global: **On**

➢ Click **Save** to save the Template.

Task 3 – Configure a BGP Template to be used by HQ vEdge-Cloud Devices for VPN 0

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Other Templates -> BGP**

➢ Configure the BGP parameters based on the following:

- Template Name : **HQ-VE-BGP-VPN0**
- Description : **HQ-VE-BGP-VPN0**

Basic Configuration

- Shutdown -> Global : **No**

- AS Number -> Global : **65001**

  Neighbor
- Adddress -> Global : **199.1.1.30**
- Remote AS -> Global : **65001**
- Address Family -> Global : **On**
- Address Family -> Global : **IPv4-Unicast**

➢ Click **Add** to add the Neighbor and Click **Add** to add BGP Neighbor.

➢ Click **Save** to save the Template.

VPN 512

Task 1 – Configure a VPN Template to be used by HQ vEdge-Cloud Devices for VPN 512

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

➢ Configure the VPN parameters based on the following:

- Template Name : **HQ-VE-VPN-VPN512**
- Description : **HQ-VE-VPN-VPN512**

  Basic Configuration
- VPN -> Global : **512**
- Name -> Global : **MGMT VPN**

➢ Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by HQ vEdge-Cloud Devices for VPN 512 for Interface Eth0

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

➢ Configure the VPN parameters based on the following:

- Template Name : **HQ-VE-VPNINT-VPN512-E0**
- Description : **HQ-VE-VPNINT-VPN512-E0**

  Basic Configuration
- Shutdown -> Global : **No**
- Interface Name -> Global : **eth0**
- IPv4 Address -> Dynamic

- Click **Save** to save the Template

VPN 1

Task 1 – Configure a VPN Template for HQ vEdge-Cloud Devices for VPN 1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **HQ-VE-VPN-VPN1**
  - Description : **HQ-VE-VPN-VPN1**

  Basic Configuration
  - VPN -> Global : **1**
  - Name -> Global : **Data VPN**

- Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by HQ vEdge-Cloud Devices for VPN 1 for Interface G0/2

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **HQ-VE-VPNINT-VPN1-G2**
  - Description : **HQ-VE-VPNINT-VPN1-G2**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/2**
  - IPv4 Address -> Static -> Global: **192.168.10.1/24**

- Click **Save** to save the Template.

Task 3 – Configure a OSPF Template to be used by HQ vEdge-Cloud Devices for VPN 1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Other Templates -> OSPF**

- Configure the OSPF parameters based on the following:

    - Template Name : **HQ-VE-OSPF-VPN1**
    - Description : **HQ-VE-OSPF-VPN1**

    Redistribution
    - Protocol : **OMP**

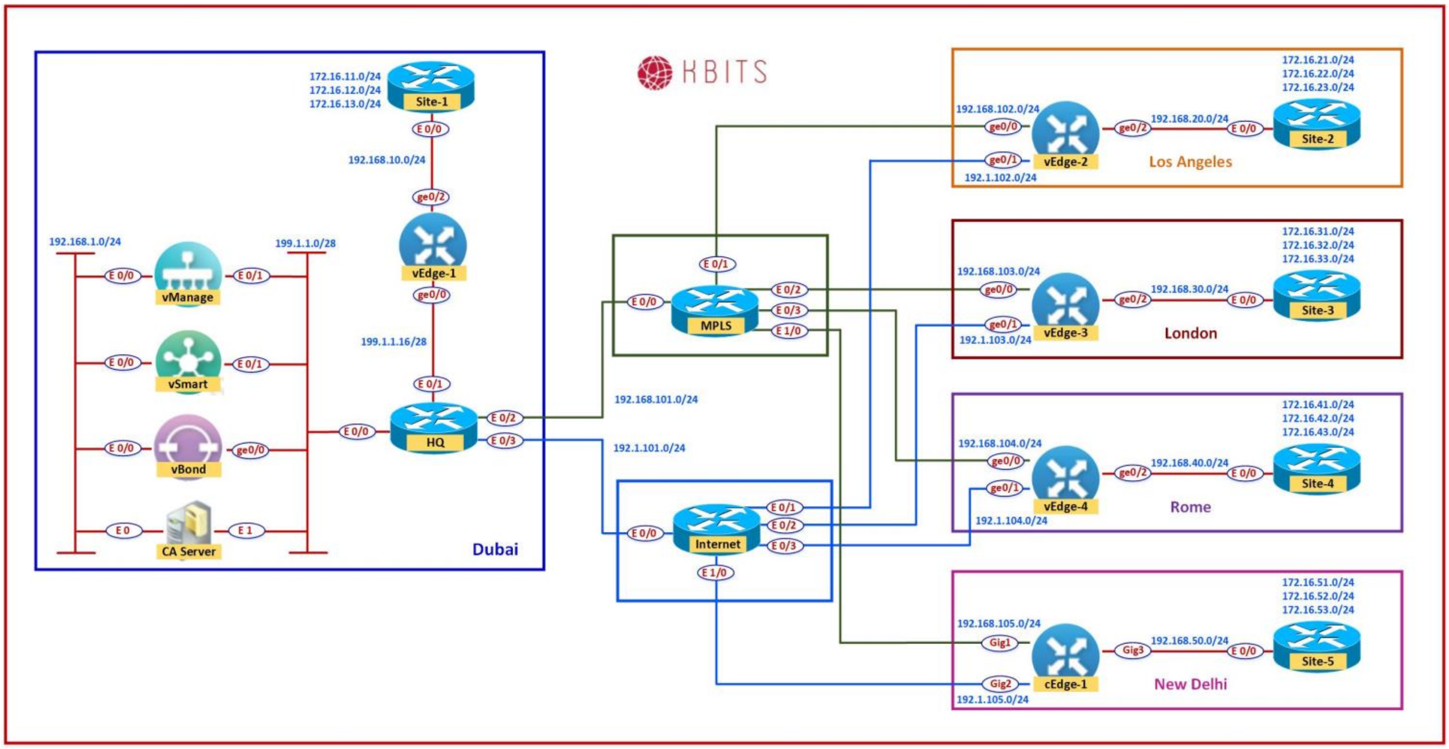
    Area Configuration
    - Area Number -> Global : **0**
    - Area Type -> Default

    Interface Configuration
    - Interface Name: ge0/2

- Click **Add** to add the Interface and Click **Add** to add OSPF.

- Click **Save** to save the Template.

Lab 23 - Configuring Device Templates for HQ-Site(vEdge1) to deploy VPN 0, 1 and 512.



Task 1 – Configure a Device Template for HQ vEdge Devices.

- In vManage, Navigate to Configuration -> **Templates -> Device -> Create Template -> vEdge Cloud**

- Configure the Device Template based on the following:

  - Template Name : **HQ-VE-TEMP**
  - Description : **HQ-VE-TEMP**

  Basic Information
  - System -> **VE-System**

  Transport & Management
  - VPN 0 : **HQ-VE-VPN-VPN0**
  - VPN Interface : **HQ-VE-VPNINT-VPN0-G0**
  - BGP : **HQ-VE-BGP-VPN0**

  - VPN 512 : **HQ-VE-VPN-VPN512**

- VPN Interface : **HQ-VE-VPNINT-VPN512-E0**

Service VPN

- VPN 1 : **HQ-VE-VPN-VPN1**
- VPN Interface : **HQ-VE-VPNINT-VPN1-G2**
- OSPF : **HQ-VE-OSPF-VPN1**

- Click **Save** to save the Template.

Task 2 – Attach vEdge1 to the Device Template

- In vManage, Navigate to Configuration -> **Templates -> Device -> HQ-VE-TEMP.**

- Click on "**…**" towards the right-hand side.

- Click **Attach Devices.**

- Select **vEdge1** and click the " **->** " button.

- Click **Attach**.

Task 3 – Configure the Variable Parameters for the Feature Templates

- **vEdge1** will appear in the window.

- Click on "**…**" towards the right-hand side.

- Click **Edit Device Template.**

- Configure the variables based on the following:

  - Hostname : **vEdge-1**
  - System IP : **10.2.2.201**
  - Site ID : **1**

- Click **Update.**

- Verify the Configuration & Click **Configure Devices.**

- Wait for it to update the device. It should come back with Status of **Success**.

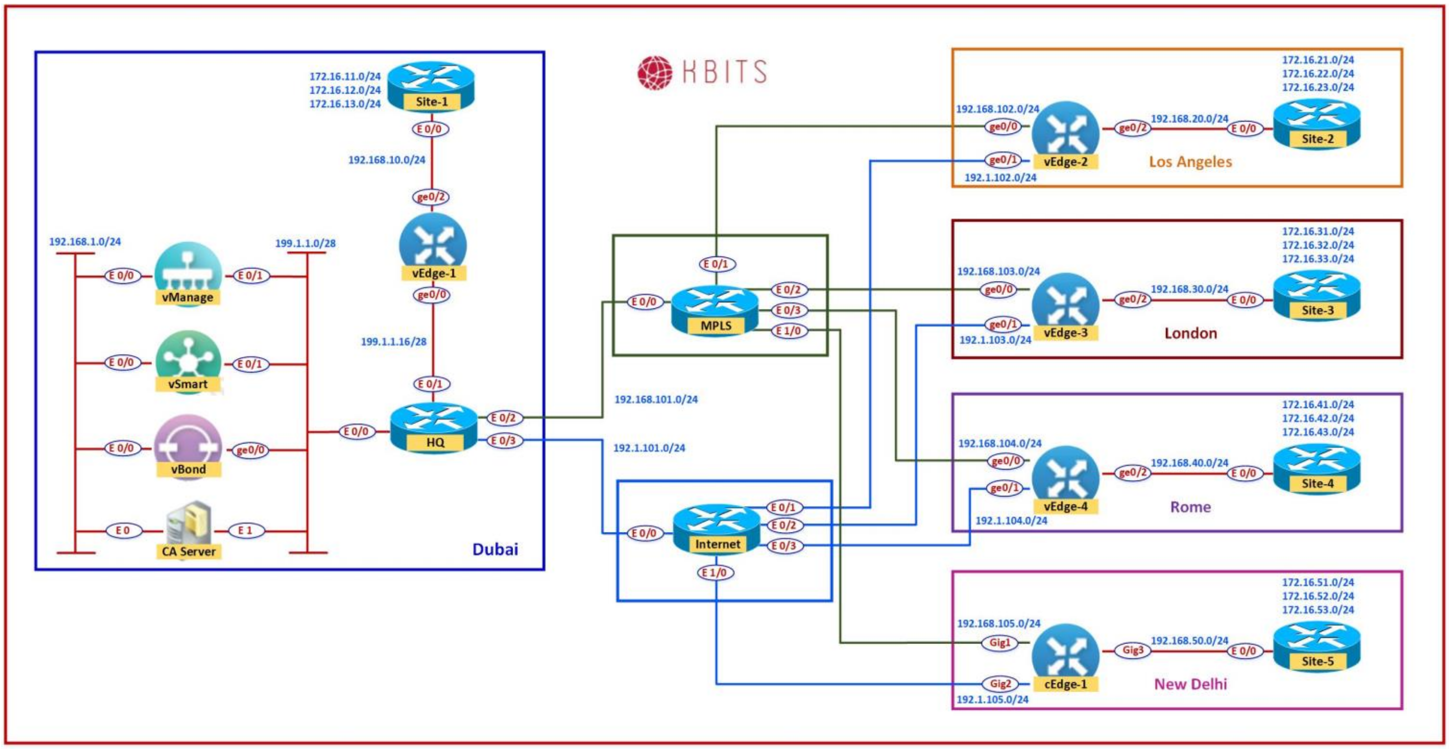
- Verify the configuration on **vEdge1**. You can do that by verify OSPF Neighbor relationship with the Internal Router by issuing the **Show ospf neighbor** command on **vEdge1.**

- Type **Show Ip route** on **vEdge2** to verify that you are receiving OSPF routes from the MPLS Router.

- Type **Show Ip route** on **Internal Site Routers** to verify that you are receiving OSPF routes from the other Sites.

- Verify reachability between the sites by Pinging the Internal Loopback to Loopback networks.

Lab 24 – Configuring Feature Templates for CSR – VPNs, VPN Interfaces, External & Internal Routing



VPN 0

Task 1 – Configure a VPN Template by CSR for VPN 0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR1000v -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-CSR-VPN-VPN0**
  - Description : **BR-CSR -VPN-VPN0**

  Basic Configuration
  - VPN -> Global : **0**
  - Name -> Global : **Transport VPN**

  IPv4 Route
  - Prefix -> Global : 0.0.0.0/0

- Next Hop -> Device Specific

- Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by CSR for VPN 0 for Interface GigabitEthernet1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR1000v -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-CSR-VPNINT-VPN0-G1**
  - Description : **BR-CSR-VPNINT-VPN0-G1**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **GigabitEthernet1**
  - IPv4 Address -> Static -> Device Specific (Label: **G1**)

  Tunnel
  - Tunnel Inteface -> Global : **On**
  - Color -> Global: **mpls**

  Allow Service
  - NETCONF -> Global : **On**
  - SSH -> Global : **On**
  - OSPF -> Global : **On**

- Click **Save** to save the Template.

Task 3 – Configure a VPN Interface Template to be used by CSR for VPN 0 for Interface GigabitEthernet2

- In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR1000v -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-CSR-VPNINT-VPN0-G2**
  - Description : **BR-CSR-VPNINT-VPN0-G2**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **GigabitEthernet2**
  - IPv4 Address -> Static -> Device Specific (Label: **G2**)

Tunnel

- Tunnel Inteface -> Global : **On**
- Color -> Global: **biz-internet**

Allow Service

- NETCONF -> Global : **On**
- SSH -> Global : **On**

➢ Click **Save** to save the Template.

Task 4 – Configure a OSPF Template to be used by CSR for VPN 0

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR1000v -> Other Templates -> OSPF**

➢ Configure the OSPF parameters based on the following:

- Template Name : **BR-CSR-OSPF-VPN0**
- Description : **BR-CSR-OSPF-VPN0**

Area Configuration

- Area Number -> Global : **0**
- Area Type -> Default

Interface Configuration

- Interface Name: **GigabitEthernet1**
- OSPF Network Type: **Point-to-Point**

➢ Click **Add** to add the Interface and Click **Add** to add OSPF.

➢ Click **Save** to save the Template.

VPN 512

Task 1 – Configure a VPN Template to be used by CSR for VPN 512

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR1000v -> VPN -> VPN**

➢ Configure the VPN parameters based on the following:

- Template Name : **BR-CSR-VPN-VPN512**
- Description : **BR-CSR-VPN-VPN512**

Basic Configuration

- VPN -> Global : **512**
- Name -> Global : **MGMT VPN**

➢ Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by CSR for VPN 512 for Interface GigabitEthernet4

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR1000v -> VPN -> VPN Interface Ethernet**

➢ Configure the VPN parameters based on the following:

- Template Name : **BR-CSR-VPNINT-VPN512-G4**
- Description : **BR-CSR-VPNINT-VPN512-G4**

Basic Configuration

- Shutdown -> Global : **No**
- Interface Name -> Global : **GigabitEthernet4**
- IPv4 Address -> Dynamic

➢ Click **Save** to save the Template

VPN 1

Task 1 – Configure a VPN Template for CSR for VPN 1

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR1000v -> VPN -> VPN**

➢ Configure the VPN parameters based on the following:

- Template Name : **BR-CSR-VPN-VPN1**
- Description : **BR-CSR-VPN-VPN1**

Basic Configuration

- VPN -> Global : **1**
- Name -> Global : **Data VPN**

➢ Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by CSR for VPN 1 for Interface G3

- In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-CSR-VPNINT-VPN1-G3**
  - Description : **BR-CSR-VPNINT-VPN1-G3**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **GigabitEthernet3**
  - IPv4 Address -> Static -> Device Specific (Label: **G3**)

- Click **Save** to save the Template.

Task 3 – Configure a OSPF Template to be used by CSR for VPN 1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> CSR -> Other Templates -> OSPF**

- Configure the OSPF parameters based on the following:

  - Template Name : **BR-CSR-OSPF-VPN1**
  - Description : **BR-CSR-OSPF-VPN1**

  Redistribution
  - Protocol : **OMP**

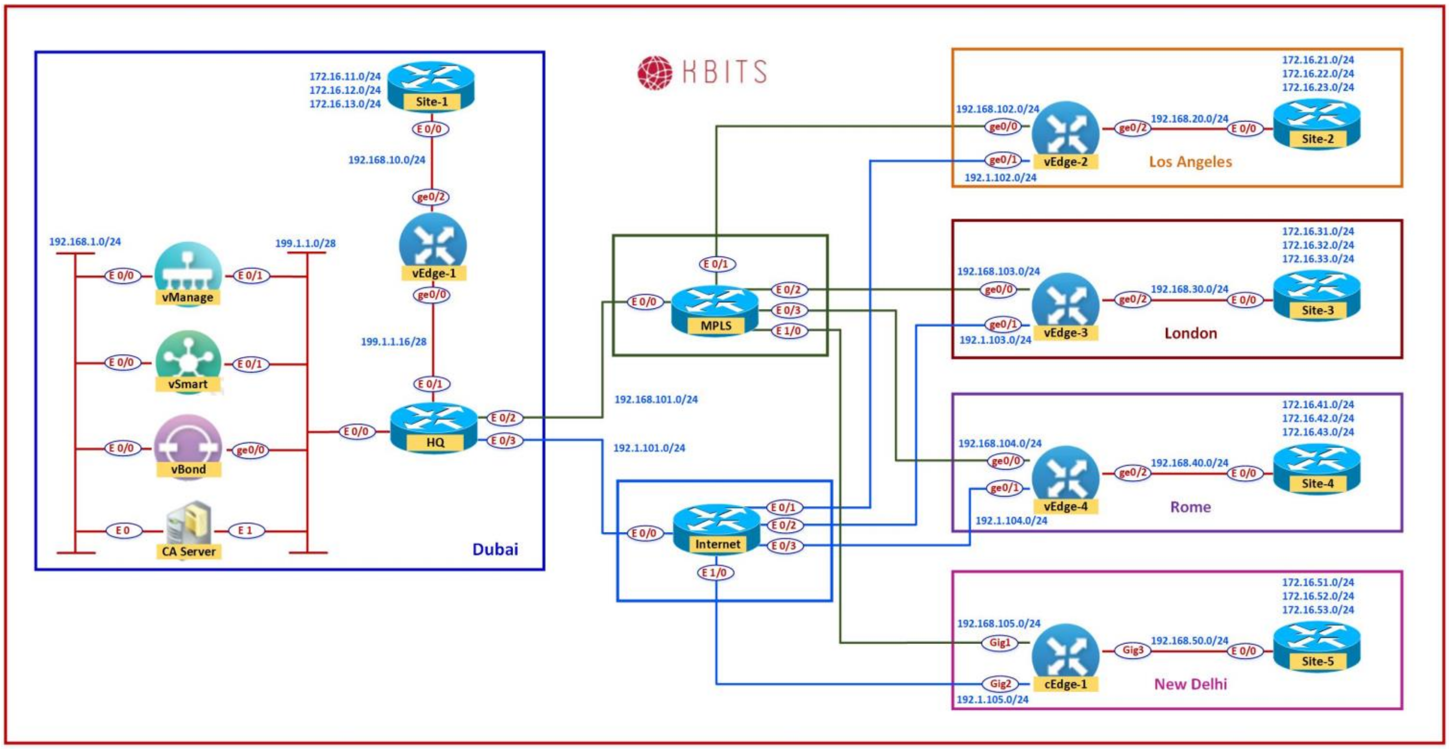
  Area Configuration
  - Area Number -> Global : **0**
  - Area Type -> Default

  Interface Configuration
  - Interface Name: **GigabitEthernet3**

- Click **Add** to add the Interface and Click **Add** to add OSPF.

- Click **Save** to save the Template.

Lab 25 - Configuring Device Templates for CSR to deploy VPN 0, 1 and 512



Task 1 – Configure a Device Template for CSR Branch Devices.

- In vManage, Navigate to Configuration -> **Templates -> Device -> Create Template -> CSR1000v**

- Configure the Device Template based on the following:

  - Template Name : **BR-CSR-TEMP**
  - Description : **BR-CSR-TEMP**

  Basic Information
  - System -> **CE-System**

  Transport & Management
  - VPN 0 : **BR-CSR-VPN-VPN0**
  - VPN Interface : **BR-CSR-VPNINT-VPN0-G1**
  - VPN Interface : **BR-CSR-VPNINT-VPN0-G2**
  - OSPF : **BR-CSR-OSPF-VPN0**

  - VPN 512 : **BR-CSR-VPN-VPN512**

- VPN Interface : **BR-CSR-VPNINT-VPN512-E0**

Service VPN
- VPN 1 : **BR-CSR-VPN-VPN1**
- VPN Interface : **BR-CSR-VPNINT-VPN1-G3**
- OSPF : **BR-CSR-OSPF-VPN1**

➢ Click **Save** to save the Template.

Task 2 – Attach cEdge1 to the Device Template

➢ In vManage, Navigate to Configuration -> **Templates -> Device -> BR-CSR-TEMP.**

➢ Click on "**...**" towards the right-hand side.

➢ Click **Attach Devices.**

➢ Select **cEdge1** and click the " **->** " button.

➢ Click **Attach**.

Task 3 – Configure the Variable Parameters for the Feature Templates

➢ **cEdge1** will appear in the window.

➢ Click on "**...**" towards the right-hand side.

➢ Click **Edit Device Template.**

➢ Configure the variables based on the following:

- Interface IP for GigabitEthernet3 (**G3**) :**192.168.50.5/24**
- Default Gateway for VPN0 (**DEF-GW**): **192.1.105.254**
- Interface IP for GigabitEthernet2 (**G2**) :**192.1.105.5/24**
- Interface IP for GigabitEthernet1 (**G1**) :**192.168.105.5/24**
- Hostname : **cEdge-1**
- System IP : **10.2.2.205**
- Site ID : **5**

➢ Click **Update.**

➢ Verify the Configuration & Click **Configure Devices.**

- Wait for it to update the device. It should come back with Status of **Success**.

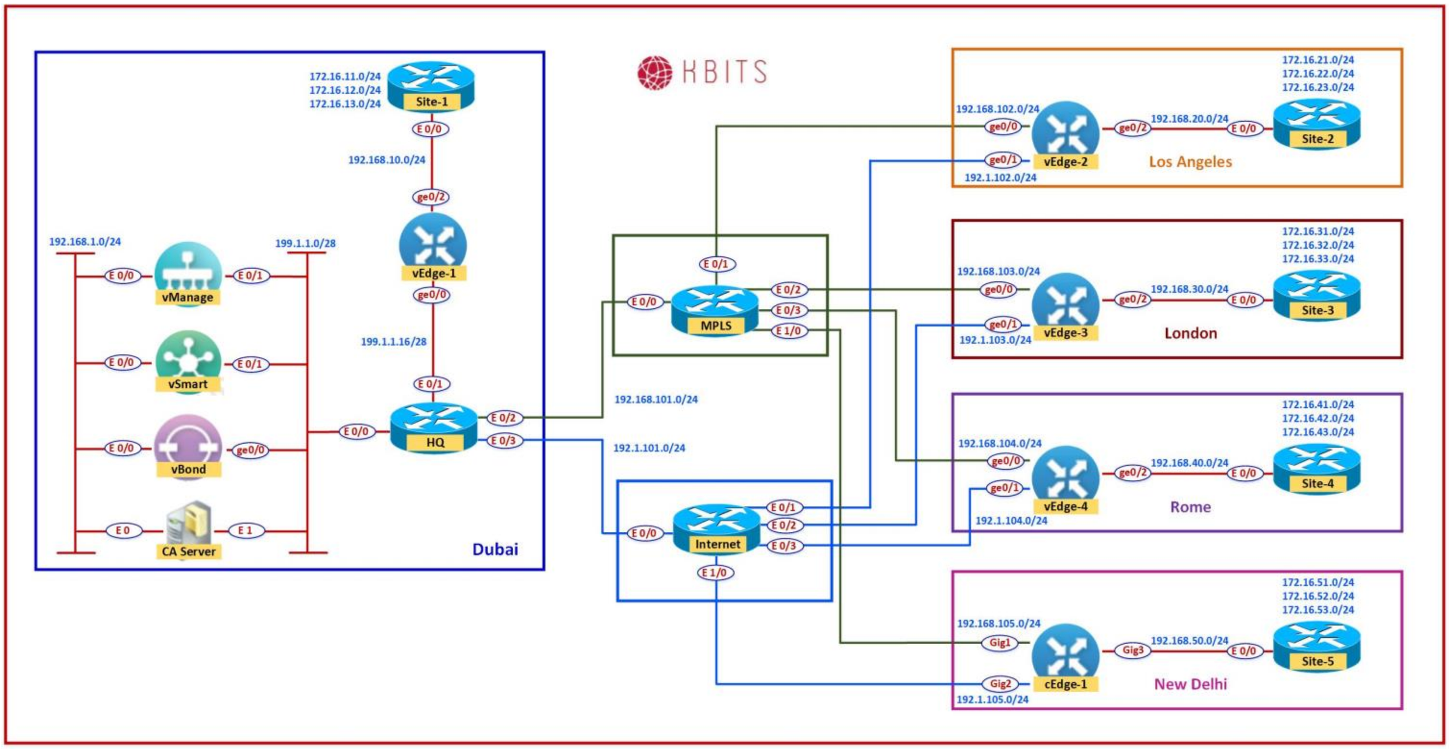
- Verify the configuration on **cEdge1**. You can do that by verify OSPF Neighbor relationship with the Internal Router by issuing the **Show ip ospf neighbor** command on **cEdge1.**

- Type **Show Ip route** on **cEdge1** to verify that you are receiving OSPF routes from the MPLS Router.

- Type **Show Ip route** on **Internal Site Routers** to verify that you are receiving OSPF routes from the other Sites.

- Verify reachability between the sites by Pinging the Internal Loopback to Loopback networks.

Lab 26 - Configuring and Deploying Feature and Device Templates for vSmart Controllers



Task 1 – Configure a VPN Template to be used by vSmart Controllers for VPN 0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vSmart -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **vSmart-VPN-VPN0**
  - Description : **vSmart-VPN-VPN0**

  Basic Configuration
  - VPN -> Global : **0**
  - Name -> Global : **Transport VPN**

  IPv4 Route
  - Prefix -> Global : **0.0.0.0/0**
  - Next Hop -> Global : **199.1.1.14**

- Click **Save** to save the Template.

Task 2 – Configure a VPN Template to be used by vSmart Controllers for VPN 512

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vSmart -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **vSmart -VPN-VPN512**
  - Description : **vSmart -VPN-VPN512**

  Basic Configuration
  - VPN -> Global : **512**
  - Name -> Global : **MGMT VPN**

- Click **Save** to save the Template.

Task 3 – Configure a VPN Interface Template to be used by vSmart Controllers for VPN 0 for Interface Eth1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vSmart -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **vSmart-VPNINT-VPN0-E1**
  - Description : **vSmart-VPNINT-VPN0-E1**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **eth1**
  - IPv4 Address -> Static -> Device Specific (Label: **E1**)

  Tunnel
  - Tunnel Inteface -> Global : **On**
  - Color -> default

  Allow Service
  - NETCONF -> Global : **On**
  - SSH -> Global : **On**

- Click **Save** to save the Template.

Task 4 – Configure a VPN Interface Template to be used vSmart Controllers for VPN 512 for Interface Eth0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vSmart -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **vSmart-VPNINT-VPN512-E0**
  - Description : **vSmart-VPNINT-VPN512-E0**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **eth0**
  - IPv4 Address -> Static -> Device-Specific (Label: **E0**)

- Click **Save** to save the Template

Task 5 – Configure a Device Template for vSmart Controllers.

- In vManage, Navigate to Configuration -> **Templates -> Device -> Create Template -> vSmart**

- Configure the Device Template based on the following:

  - Template Name : **vSmart-TEMP**
  - Description : **vSmart-TEMP**

  Basic Information
  - System -> **VE-System**

  Transport & Management
  - VPN 0 : **vSmart-VPN-VPN0**
  - VPN Interface : **vSmart-VPNINT-VPN0-E1**

  - VPN 512 : **vSmart-VPN-VPN512**
  - VPN Interface : **vSmart-VPNINT-VPN512-E0**

- Click **Save** to save the Template.

Task 6 – Attach vSmart to the Device Template

- In vManage, Navigate to Configuration -> **Templates -> Device -> vSmart-TEMP**

- Click on "**...**" towards the right-hand side.

- Click **Attach Devices.**

- Select **vSmart** and click the " **->** " button.

- Click **Attach**.

Task 7 – Configure the Variable Parameters for the Feature Templates

- **vSmart** will appear in the window.

- Click on "**...**" towards the right-hand side.

- Click **Edit Device Template.**

- Configure the variables based on the following:

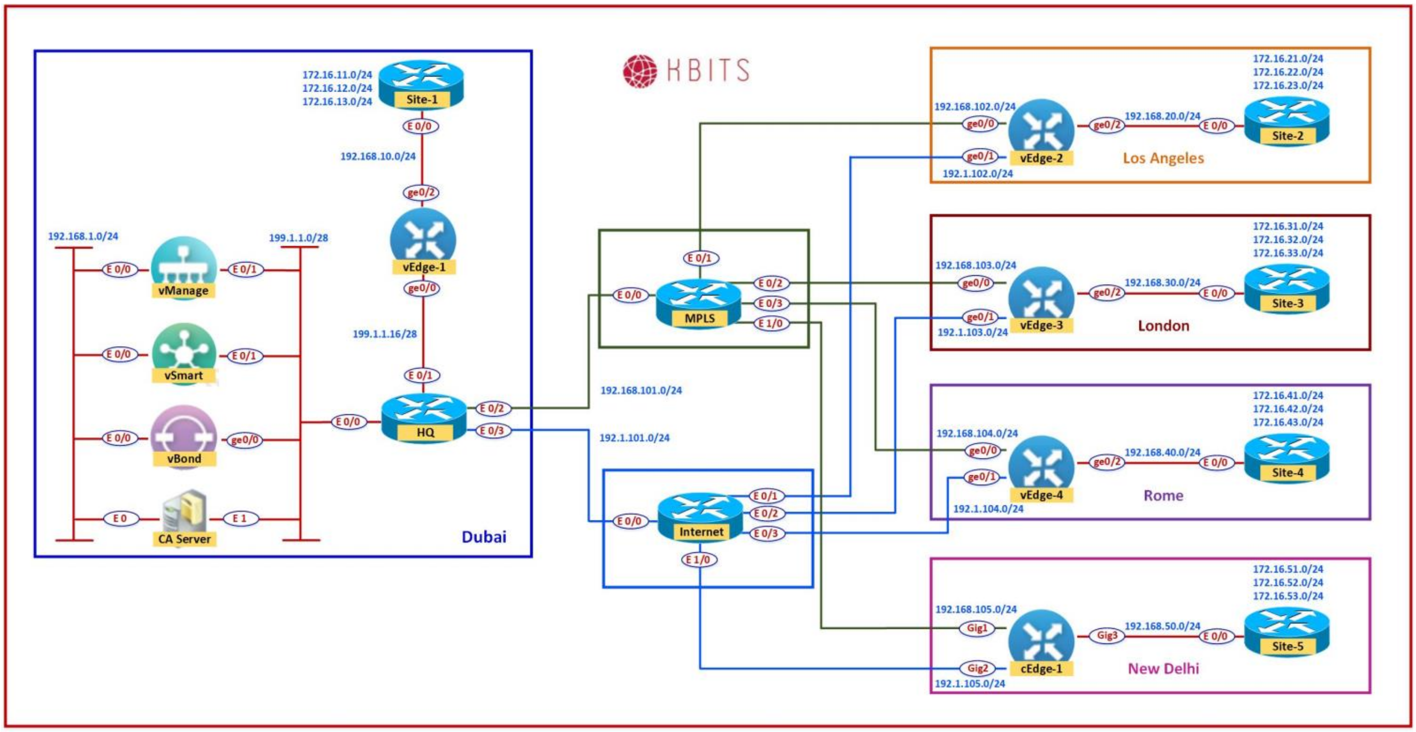
    - Interface IP for Eth1 (**E1**) :**199.1.1.2/28**
    - Interface IP for Eth0 (**E0**) :**192.168.1.2/24**
    - Hostname : **vSmart-1**
    - System IP : **10.1.1.102**
    - Site ID : **1**

- Click **Update.**

- Verify the Configuration & Click **Configure Devices.**

- Wait for it to update the device. It should come back with Status of **Success**.

Lab 27 - Configuring Application Aware Policies using Telnet and Web



Requirements:

- Los Angeles & London Sites should use the MPLS Transport for Telnet Traffic and the Biz-Internet Transport for Web Traffic.
- Telnet Should have a SLA based on the following:
    - Loss – 5%
    - Latency – 200
    - Jitter – 100ms
- Web Should have a SLA based on the following:
    - Loss – 10%
    - Latency – 500
    - Jitter – 100ms
- Create the following Sites:
    - Dubai – 1
    - LA – 2
    - London – 3
    - Rome – 4
    - DEL – 5
    - Branches – 2 – 4

- Create the VPN for VPN ID 1.

Task 1 – Configure Groups of Interests/List that will be used for Telnet & Web Application Aware Routing (AAR) Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Lists.**

- Click **SLA Class** and select **New SLA Class list.** Create 2 SLA Lists based on the following:

  - Name : **SLA-Telnet**
  - Loss : **5%**
  - Latency : **200**
  - Jitter : **100ms**

  - Name : **SLA-Web**
  - Loss : **10%**
  - Latency : **500**
  - Jitter : **100ms**

- Click **VPN** and select **New VPN list.** Create 1 VPN list based on the following:

  - Name : **VPN1**
  - ID : **1**

- Click **Site** and select **New Site list.** Create 6 Sites based on the following:

  - Name : **Dubai**
  - Site ID : **1**

  - Name : **LA**
  - Site ID : **2**

  - Name : **LA**
  - Site ID : **3**

  - Name : **Rome**
  - Site ID : **4**

  - Name : **ND**
  - Site ID : **5**

  - Name : **Branches**
  - Site ID : **6**

Task 2 – Configure an AAR policy based on the Requirements

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Traffic Policy.**

- Configure 2 App Routes based on the following:

    - Policy Name : **TELNET-WEB-Policy**
    - Description : **TELNET-WEB-Policy**

    Telnet Sequence
    Match Conditions:
    - Protocol : **6**
    - Port : **23**

    Action
    - SLA Class List: **SLA-Telnet**
    - Color : **mpls**
    - Backup Preferred Color: **biz-internet**

    - Click **Save Match and Actions** to save the Sequence.

    Web Sequence
    Match Conditions:
    - Protocol : **6**
    - Port : **80**

    Action
    - SLA Class List: **SLA-Web**
    - Color : **biz-internet**
    - Backup Preferred Color: **mpls**

    - Click **Save Match and Actions** to save the Sequence.

    - **Save the Policy.**

Task 3 – Create a Centralized Policy and call the Traffic Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Add Centralized Policy**

- Click **Next** on the **"Group of Interests"** page as we have already created the required lists.

- Click **Next** on the **"Topology and VPN Membership"** page as we are not using any Control Policies.

- Click **Add Policy** on the **"Configure Traffic Rules"** page. Make sure you are on the **Application Aware Routing** tab.

- Click "**Import Existing"** and select the **TELNET-WEB-POLICY** from the drop-down list and click **Import**.

- Click **Next** to move to the "**Apply Policy to Sites and VPNs**" Page.

- Click the "**Appliacation-Aware Policy"** tab.

- The **TELNET-WEB-Policy** will be there. Click "**New Site List and VPN List"** button.

- Select **LA** and **London** in the Site List.

- Select **VPN1** in the Site List.

- Click **Add.**

- Assign the Policy a name and Desription based on the following:

    - Policy Name : **Main-Central-Policy**
    - Description : **Main-Central-Policy**

- Click the **Save Policy** button towards the button.

- Activate the policy.

- Wait for it to push the policy to the reachable vSmart Controller(s).

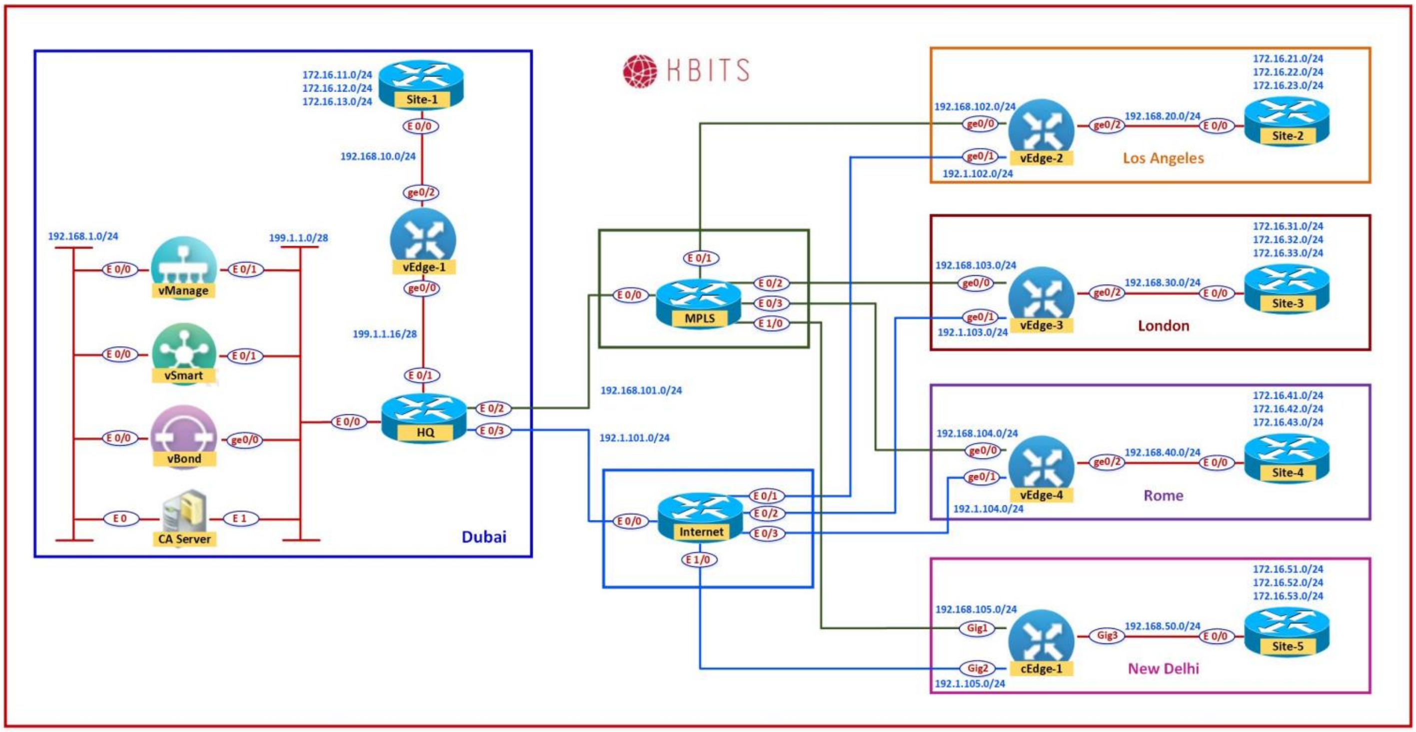
- Verify the policy by using the **Monitor -> Network -> vEdge2 -> Troubleshooting -> Simulate Flows** Tool.

- Telnet from Los Angeles or London should only use the **mpls** transport.

- Web from Los Angeles or London should only use the **biz-internet** transport.

- Normal Ping from Los Angeles or London should use both the Transports.

Lab 28 - Configuring Application Aware Policies using Chat Applications



Requirements:

- Rome should use the Internet Transport for AOL-Messenger, MSN Messenger & Whatsapp Messenger application. It should not use the MPLS Transport at all.
- The Chat applications should have a SLA based on the following:
  - Loss – 10%
  - Latency – 600
  - Jitter – 100ms

Task 1 – Configure Groups of Interests/List that will be used for Chat-based Application Aware Routing (AAR) Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Lists.**

- Click **Applications** and select **New Application list.** Create a policy based on the following:

  - Name : **Chat-Apps**
  - Apps: Aol-Messenger, MSN-Messenger & WhatsApp Messenger

- Click **SLA Class** and select **New SLA Class list.** Create a policy based on the following:

  - Name : **SLA-CHATS**
  - Loss : **25%**
  - Latency : **600**
  - Jitter : **100ms**

Task 2 – Configure an AAR policy based on the Requirements

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Traffic Policy.**

- Configure 1 App Routes based on the following:

  - Policy Name : **CHAT-Policy**
  - Description : **CHAT-Policy**

  Telnet Sequence
  Match Conditions:
  - Application List: **Chat-Apps**

  Action
  - SLA Class List: **SLA-CHATS**
  - Color : **mpls**
  - Backup Preferred Color: **biz-internet**

  - Click **Save Match and Actions** to save the Sequence.

  - **Save the Policy.**

Task 3 – Modify the existing Centralized Policy "Main-Central-Policy" and call the Traffic Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Main-Central-Policy -> Click "…" -> Edit.**

- Click **Traffic Rules** on the **Top** of the page.

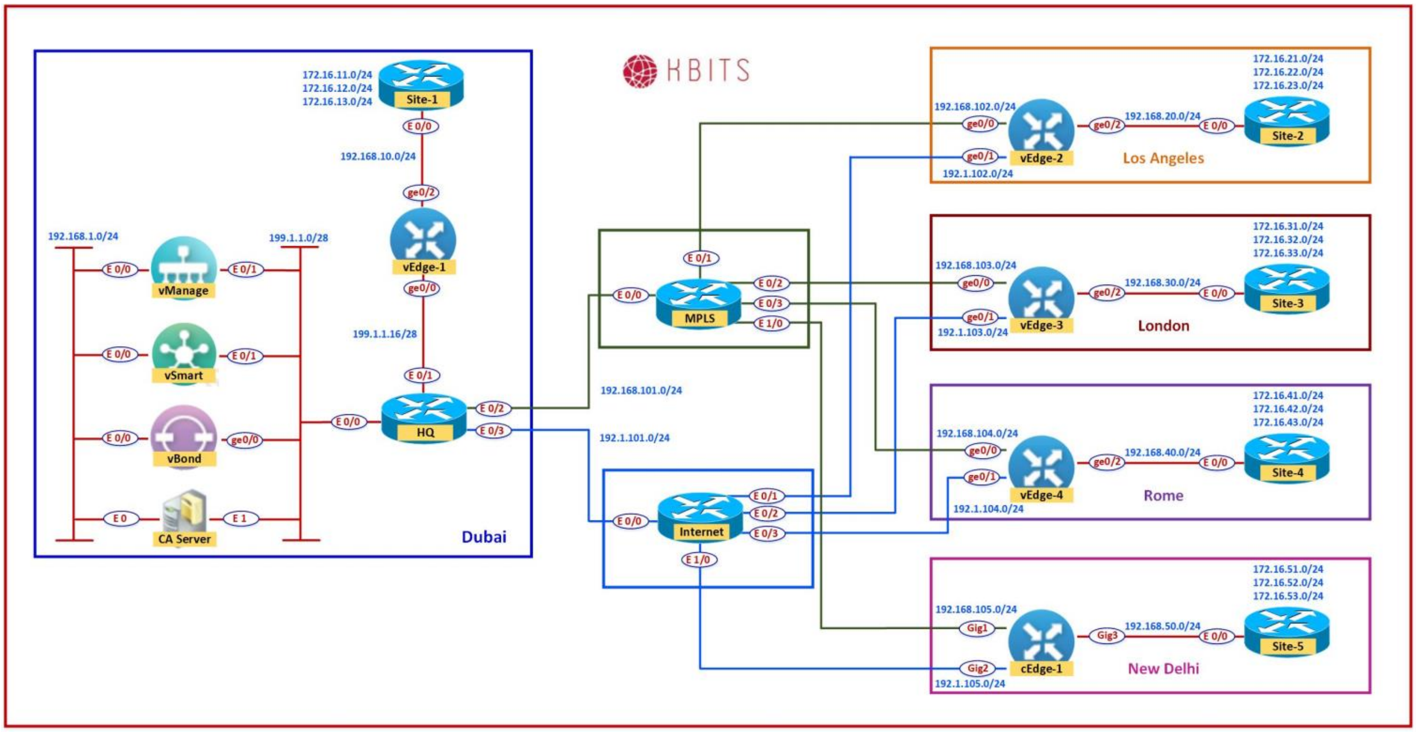
- Click **Add Policy**.

- Click "**Import Existing"** and select the **CHAT-POLICY** from the drop-down list and click **Import**.

- Click **Policy Application** on the **Top** of the page.

- Click the “**Appliacation-Aware Policy”** tab.
- The **CHAT-Policy** will be there. Click “**New Site List and VPN List”** button.
- Select **Rome** in the Site List.
- Select **VPN1** in the Site List.
- Click **Add.**
- Click the **Save Policy** button towards the button.
- Wait for it to push the policy to the reachable vSmart Controller(s).
- Verify the policy by using the **Monitor -> Network -> vEdge3 -> Troubleshooting -> Simulate Flows** Tool.
- Normal Ping from Rome should use both the Transports.
- Use **Aol-messenger** as the appliacation and simulate from Rome. It should only use the **biz-internet** transport.
- Use **Aol-messenger** as the appliacation and simulate from Los Angeles or London. It should use both the Transports.

Lab 29 - Manipulating Traffic flow using TLOCs



Requirements:

- New Delhi should only use the MPLS TLOC as the preferred color while communicating to Los Angeles. The Internet TLOC should be a backup TLOC.

Task 1 – Configure Groups of Interests/List that will be used for Traffic Engineering Policy for New Delhi

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Lists.**

- Click **TLOCs** and select **New TLOC list.** Create a policy based on the following:

    - Name : **LA-TLOC-MPLS-INT**
    - TLOC#1:
        - IP Address: 10.2.2.202
        - Color: MPLS
        - Encapsulation: IPSec

- Preference: 500
- TLOC#2:
  - IP Address: 10.2.2.202
  - Color: Biz-internet
  - Encapsulation: IPSec
  - Preference: 400

Task 2 – Configure Control/Topology policy based on the Requirements

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Topology.**

- Configure 1 Route Policy based on the following:

  - Policy Name : **LA-MPLS-INT**
  - Description : **LA-MPLS-INT**

  Route Sequence
  Match Conditions:
  - Site List: **LA**
  - VPN List: **VPN1**

  Action
  - TLOC/TLOC List: **LA-MPLS-INT**
  - Click **Save Match and Actions** to save the Sequence.

  Default Sequence
  Action
  - Accept

  - Click **Save Match and Actions** to save the Sequence.

  - Save the Policy

Task 3 – Modify the existing Centralized Policy "Main-Central-Policy" and call the Topology Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Main-Central-Policy -> Click "…" -> Edit.**

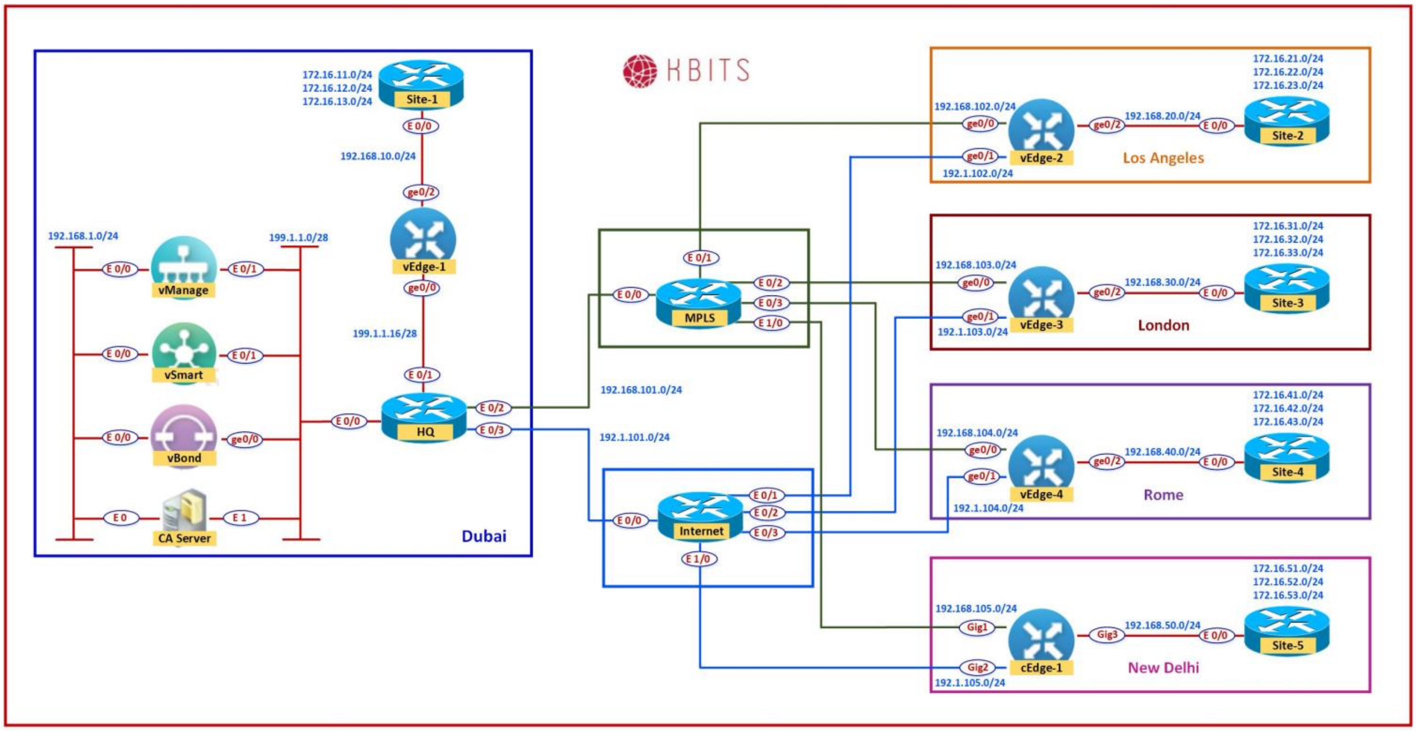
- Click **Topology** on the **Top** of the page.

- Click **Add Topology**.

- Click "**Import Existing".** Choose the Custom Policy option and select the **LA-MPLS-INT** from the drop-down list and click **Import**.

- Click **Policy Application** on the **Top** of the page.
- Click the "**Topology"** tab.
- The **LA-MPLS-INT-Policy** will be there. Click "**New Site"** button.
- Select **ND** in the Outbound Site List.
- Click **Add.**
- Click the **Save Policy** button towards the button.
- Wait for it to push the policy to the reachable vSmart Controller(s).
- Verify by using the **Show IP route vpn 1** command on the ND cEdge (cEdge1).
- It should only have 1 TLOC for Los Angeles routes (10.2.2.202 – MPLS), whereas it will have 2 TLOCs for London (10.2.2.203-MPLS, 10.2.2.203-Biz-Internet).

Lab 30 - Configuring Route Filtering



Requirements:

- The 172.16.234.2/32, 172.16.234.3/24 & 172.16.234.4/24 should not be propagated to the Dubai Site.

Task 1 – Configure Groups of Interests/List that will be used for Route Filtering Policy for Dubai

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Lists.**

- Click **Prefix** and select **New Prefix list.** Create a policy based on the following:

  - Name : **PL-234**
  - Prefix List Entry: **172.16.234.0/24 le 32**

- Click **Site** and select **New Site list.** Create a policy based on the following:

  - Name : **Dubai**
  - Site ID : **1**

Task 2 – Configure Control/Topology policy based on the Requirements

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Topology.**

- Configure 1 Route Policy based on the following:

  - Policy Name : **PREF-234-NOT-2-DXB**
  - Description : **PREF-234-NOT-2-DXB**

  Route Sequence
  Match Conditions:
  - Prefix List: **PL-234**
  Action: Reject

  - Click **Save Match and Actions** to save the Sequence.

  Default Sequence
  Action
  - Accept

  - Click **Save Match and Actions** to save the Sequence.

  - Save the Policy

Task 3 – Modify the existing Centralized Policy "Main-Central-Policy" and call the Topology Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Main-Central-Policy -> Click "…" -> Edit.**

- Click **Topology** on the **Top** of the page.

- Click **Add Topology**.

- Click "**Import Existing"** and select the **PREF-234-NOT-2-DXB** from the drop-down list and click **Import**.

- Click **Policy Application** on the **Top** of the page.

- Click the "**Topology"** tab.

- The **PREF-234-NOT-2-DXB** will be there. Click "**New Site"** button.

- Select **Dubai** in the Outbound Site List.

- Click **Add.**

- Click the **Save Policy** button towards the button.

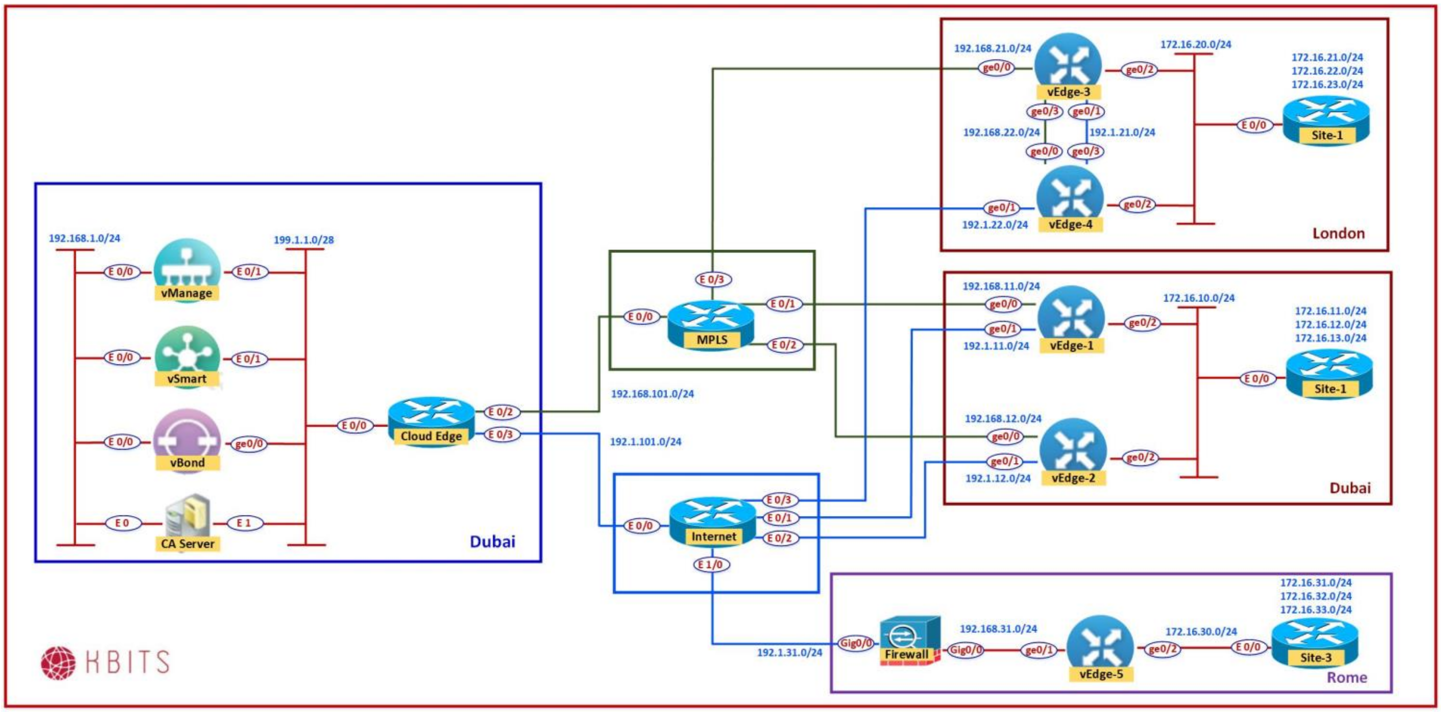
- Wait for it to push the policy to the reachable vSmart Controller(s).

- Verify by using the **Show IP route vpn 1** command on the Dubai vEdge (vEdge1).

- It should all the routes from the Branches except the 172.16.234.X/32 routes.

- These routes should be present in the vEdge2, vEdge3, vEdge4 and cEdge1 routers. You can use the **Show IP route vpn 1** command to verify.

Lab 31 – Configuring A Hub-n-Spoke Topology using a TLOC



Policy Requirements:

- Los Angeles & London Sites are communicating to each other directly. You can verify this by checking the routes. The routes should be pointing directly at the TLOCs of the Branch Sites directly.

- All traffic between the sites should be forwarded via the HQ Site Dubai. Use a TLOC list to accomplish this task.

Task 1 – Configure Groups of Interests/List that will be used for Hub-n-Spoke

- Click **TLOC** and select **New TLOC list.** Create 1 policies based on the following:
  - Name : **TLOC-Dubai**
  - **TLOCs**
    - 10.2.2.201 – default – IPSec

Task 2 – Configure a Topology based on the Requirements

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Topology -> Add Topology -> Custom ->**

- Configure the topology based on the following:

  - Policy Name : **Hub-n-Spoke**
  - Description : **Hub-n-Spoke**

  Route Sequence- London
  Match Conditions:
  - Site: London

  Action
  - TLOC: **TLOC-List = Dubai-TLOC**

  - Click **Save Match and Actions** to save the Sequence.

  Route Sequence- Los Angeles
  Match Conditions:
  - Site: LA

  Action
  - TLOC: **TLOC-List = Dubai-TLOC**

  - Click **Save Match and Actions** to save the Sequence.

  Default
  Action
  - Accept

  Click **Save Match and Actions**
  - Click **Save Match and Actions** to save the Sequence.

  - **Save Control Policy.**

Task 3 – Create a Centralized Policy and call the Traffic Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Main-Central-Policy -> Click "…" -> Edit.**

- Click the Topology button at the top and click "**Import Existing",** Select **Custom** and select the **Hub-n-Spoke** from the drop-down list and click **Import**. Click **Next.**

- On the application page, the **Hub-n-Spoke** policy will be there. Click "**New Site"** button.

- Select **LA** and **London** in the Outbound Site List.

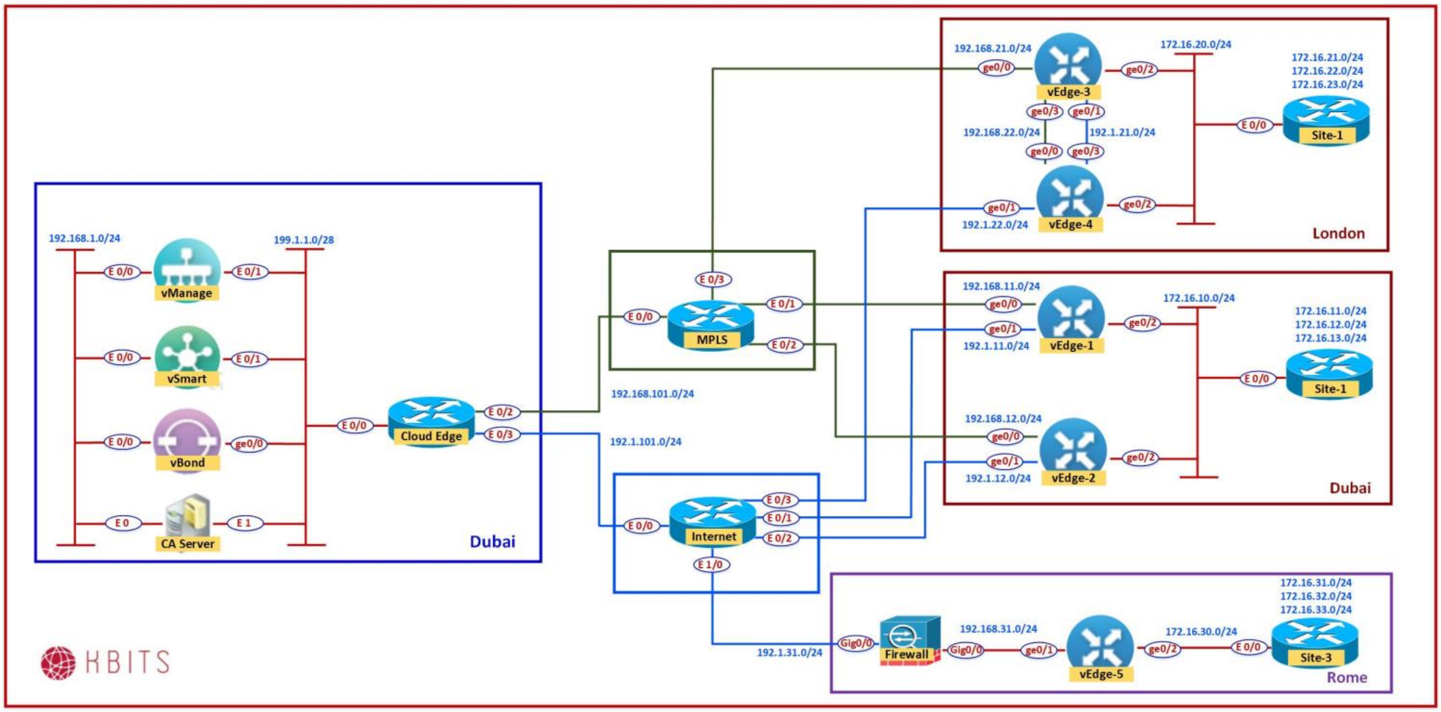
- Click **Add.**

- Click the **Save Policy** button towards the button.

- Wait for it to push the policy to the reachable vSmart Controller(s).

- You can verify this by doing checking the routes. The routes should be pointing directly at the TLOCs of Dubai and all traffic will be forwarded thru Dubai.

Lab 32 – Configuring Direct Internet Access (DIA)



Policy Requirements:

- ➢ LA, London & Rome Sites should be able to exit to the Internet using Interface PAT.
- ➢ Configure the Interface PAT on the ge0/1 interface of the 3 sits.

Task 1 – Configure the Internet facing Interface for NAT for ge0/1

- ➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> BR-VE-VPNINT-VPN0-G1** template and click to Edit the template.
- ➢ Enable NAT:

  NAT Section
  - o NAT -> Global : **On**

Task 2 – Configure a Traffic Data Policy to perform NAT

- Create a Data Prefix List by Navigating to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Lists -> Data Prefix List** based on the following:

  - Name : **CORP-NETS**
  - Prefix: 172.16.0.0/16

- Create a Traffic Data Policy by Navigating to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Traffic Policy -> Traffic Data** based on the following:

  - Policy Name : **NAT-Branches**
  - Description : **NAT-Branches**

  Route Sequence#1 (Custom)
  Match Conditions:
  - Source Data Prefix: CORP-NETS
  - Destination Data Prefix: CORP-NETS

  Action
  - Accept

  - Click **Save Match and Actions** to save the Sequence.

  Route Sequence#2 (Custom)
  Match Conditions:
  - Source Data Prefix: CORP-NETS

  Action
  - NAT VPN

  - Click **Save Match and Actions** to save the Sequence.

  Default
  Action
  - Accept

  Click **Save Match and Actions**
  - Click **Save Match and Actions** to save the Sequence.

  - **Save Traffic Policy.**

Task 3 – Modify the Centralized Policy and call the Traffic Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Main-Central-Policy -> Click "…" -> Edit.**

- Click the **Traffic button** at the top. Click **Traffic Data** and click "**Import Existing",** Select **Custom** and select the **NAT-Branches** from the drop-down list and click **Import**. Click **Next.**

- On the application page, the **NAT-Branches** policy will be under the **Traffic Data** section. Click "**New Site"** button.

- Select **LA, London & Rome** in the Site List.

- Select **VPN1** in the Site List.

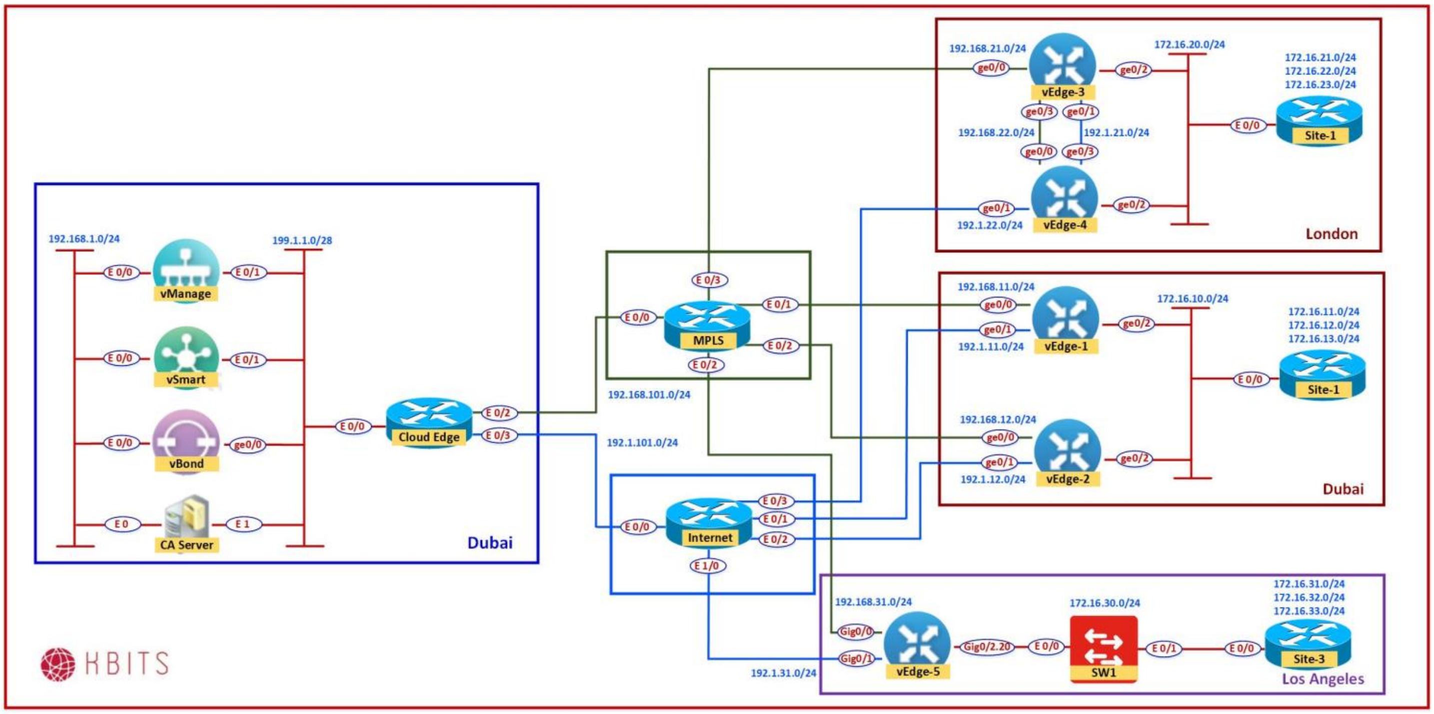
- Click **Add.**

- Click the **Save Policy** button towards the button.

Task 4 – Configure default routes on the Internal Routers

  - Configure default routes on the internal routers in LA, London & Rome pointing towards their respective vEdges.

Site-2 Ip route 0.0.0.0 0.0.0.0 192.168.20.2
Site-3 Ip route 0.0.0.0 0.0.0.0 192.168.30.3
Site-4 Ip route 0.0.0.0 0.0.0.0 192.168.40.4



Interface Configuration

Cloud Edge

Interface	IP Address	Subnet Mask
VLAN 199	199.1.1.14	255.255.255.240
E 1/0	192.1.100.1	255.255.255.0
E 1/1	192.168.100.1	255.255.255.0

MPLS Cloud

Interface	IP Address	Subnet Mask
E 0/0	192.168.100.254	255.255.255.0
E 0/1	192.168.11.254	255.255.255.0
E 0/2	192.168.12.254	255.255.255.0
E 0/3	192.168.21.254	255.255.255.0

Internet Cloud

Interface	IP Address	Subnet Mask
E 0/0	192.1.100.254	255.255.255.0
E 0/1	192.1.11.254	255.255.255.0
E 0/2	192.1.12.254	255.255.255.0
E 0/3	192.1.22.254	255.255.255.0
E 1/0	192.1.31.254	255.255.255.0

WAN Setup

Task 1 – Cloud Edge Router Configuration

- Configure the Interfaces based on the Logical Diagram
- Configure OSPF as the IGP to communicate with the MPLS Cloud. Enable all the interfaces.
- Make sure OSPF only sends and receives OSPF packets on the link towards the MPLS Cloud using the Passive-interface command.
- Configure a default route on the router towards the Internet. The IP Address of the Internet Router is 192.1.100.254

Cloud Edge Router

```
Hostname Cloud Edge
!
Vlan 199
!
Interface range E 0/0-3
 Switchport mode access
 Switchport access vlan 199
!
Interface VLAN 199
 ip address 199.1.1.14 255.255.255.240
 no shut
!
Interface E 1/0
 ip address 192.1.100.1 255.255.255.240
 no shut
!
Interface E 1/1
 ip address 192.168.100.1 255.255.255.0
 no shut
!
router ospf 1
 network 192.168.100.0 0.0.0.255 area 0
 network 199.1.1.0 0.0.0.255 area 0
 passive-interface default
 no passive-interface E 1/1
!
ip route 0.0.0.0 0.0.0.0 192.1.100.254
```

Task 2 – MPLS Cloud Router Configuration

- Configure the Interfaces based on the Logical Diagram.
- Configure OSPF as the IGP on all the interfaces.

MPLS Cloud Router

```
no ip domain-lookup
!
line con 0
 exec-timeout 0 0
 logging synchronous
!
hostname MPLS
!
interface Ethernet0/0
 ip address 192.168.100.254 255.255.255.0
 no shut
!
interface Ethernet0/1
 ip address 192.168.11.254 255.255.255.0
 no shut
!
interface Ethernet0/2
 ip address 192.168.12.254 255.255.255.0
 no shut
!
interface Ethernet0/3
 ip address 192.168.21.254 255.255.255.0
 no shut
!
interface Ethernet1/0
 ip address 192.168.31.254 255.255.255.0
 no shut
!
router ospf 1
 network 192.168.100.0 0.0.0.255 area 0
 network 192.168.11.0 0.0.0.255 area 0
 network 192.168.12.0 0.0.0.255 area 0
 network 192.168.21.0 0.0.0.255 area 0
 network 192.168.31.0 0.0.0.255 area 0
```

Task 3 – Internet Cloud Router Configuration

- Configure the Interfaces based on the Logical Diagram
- Configure a Static Route on the Router for the 199.1.1.0/24 network. The Next Hop should point towards the Internet IP of the HQ Router.

Internet Cloud Router

```
no ip domain lookup
!
line con 0
 exec-timeout 0 0
 logging synchronous
!
hostname Internet
!
interface Ethernet0/0
 ip address 192.1.100.254 255.255.255.0
 no shut
!
interface Ethernet0/1
 ip address 192.1.11.254 255.255.255.0
 no shut
!
interface Ethernet0/2
 ip address 192.1.12.254 255.255.255.0
 no shut
!
interface Ethernet0/3
 ip address 192.1.22.254 255.255.255.0
 no shut
!
interface Ethernet1/0
 ip address 192.1.31.254 255.255.255.0
 no shut
!
ip route 199.1.1.0 255.255.255.0 192.1.100.1
ip route 192.1.21.0 255.255.255.0 192.1.22.4
```

Server Setup

Task 1 – Configure the Interfaces

First Ethernet Interface:

IP Address: 192.168.1.5
Subnet Mask: 255.255.255.0

Third Ethernet Interface:

IP Address: 199.1.1.5
Subnet Mask: 255.255.255.240
Default Gateway: 199.1.1.14

Task 2 – Configure the Timezone and Time

Configure the appropiate Timezone and Time on the Windows Server.

Task 3 – Installing the Enterprise Root Certificate Server

- Open **Server Manager**
- Click **Roles**
- Click **Add Roles**
- Click **Next**
- Select the "**Active Directory Certificate Services**" and click **Next**
- Click Next
- Select "**Certification Authority Web Enrollment**" and click Next
- Leave it as Standalone and click **Next**
- Leave it as Root CA and click **Next**
- Leave "Create a new private key" and click **Next**
- Leave the default for the Cryptography for CA and click **Next**
- Set the Common name as **KBITS-CA** and click **Next**
- Leave the default for the Validity Period and click **Next**
- Click **Next**
- Click **Install**

Task 4 – Install WinSCP

- **Double-click** the WinSCP Installation file.
- Do a Default Installation.

Controller Setup – vManage

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
    - Host-name : vManage1
    - Organization: KBITS
    - System-IP: 10.1.1.101
    - Site ID: 1
    - vbond Address: 199.1.1.3
    - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vManage

```
config
!
system
 host-name vManage1
 system-ip 10.1.1.101
 site-id 1
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configured the vpn parameters

- Configure the VPN parameters based on the following:
    - vpn 0
        - Interface eth1
        - IP Address: 199.1.1.1/28
        - Tunnel Interface
        - Tunnel Services (NetConf, SSHD)
        - Default Route: 199.1.1.14

- vpn 512
  - Interface eth0
  - IP Address: 192.168.1.1/24

```
vManage

config
!
vpn 0
 no interface eth0
 interface eth1
  ip address 199.1.1.1/28
  tunnel-interface
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 199.1.1.14
!
vpn 512
 interface eth0
  ip address 192.168.1.1/24
  no shut
!
commit
```

Task 3 – Organization name & vBond Address

- Log into the vManage from the Server by browsing to https://192.168.1.1:8443 using a username of **admin** and a password of **admin.**

- Navigate to **Administration** -> **Settings**

- Click **Edit** on the Organization name and set it to **KBITS**. Confirm the Organization name. Click **OK.**

- Click **Edit** on the **vBond** address and change it to 199.1.1.3. Confirm and click **OK**.

Task 4 – Configure Controller Authorization as Enterprise Root and Download the Root Certificate.

- Browse to http://192.168.1.5/certsrv
- Click **"Download Root Certificate".**
- Select **"Base 64"**.
- Click "**Download CA Certificate".**
- Open Explorer and navigate to the downloads folder.
- Change the name of the Downloaded file "**Certnew**" to "**RootCert**".
- Open the "**RootCert.cer**" file using Notepad.
- Copy using **CTRL-A** and **CTRL-C**.
- In vManage, Navigate to **Administration -> Settings -> Controller Certiticate Authorization.**
- Change the "**Certificate Signing by:**" to "**Enterprise Root Certificate**".
- Paste the RootCert.cer that you had copied by using **CTRL-V.**
- Set the CSR Parameters with the Organization name, City, State, Country. Set the Time to 3 Years and save.

Task 5 – Generate a CSR for vManage

- Navigate to **Configuration -> Certificates -> Controllers -> vManage -> Generate CSR.**
- It will open a window with the CSR. Copy by using **CTRL-A** and **CTRL-C.**

Task 6 – Request a Certificate from the CA Server

- Browse to http://192.168.1.5/certsrv
- Click **"Request a Certificate".**
- Select **"Advanced"**.

- Paste the CSR in the box by using **CTRL-V** and click **Submit.**

Task 7 – Issue the Certificate from the CA Server

- Open Server Manager and navigate to **Active Directory Certificate Server -> KBITS-CA -> Pending Requests.**

- Right-Click the request and click "**Issue".**

Task 8 – Downloading the Issued Certificate

- Browse to http://192.168.1.5/certsrv

- Click **"Check on Pending request".**

- The issued certificate link will show up. Click on the link.

- Select "**Base 64"** and click "**Download"**

- Open Explorer and navigate to the downloads folder.

- Change the name of the Downloaded file "**Certnew**" to "**vManage**".

- Open the "**vManage.cer**" file using Notepad.

- Copy using **CTRL-A** and **CTRL-C**.

Task 9 – Installing the Identity Certificate for vManage

- In vManage, Navigate to **Configuration -> Certificates -> Controllers**

- Click on the **"Install"** button at the top right corner

- Paste the Certificate (CTRL-V).

- The Identity certificate should be installed on vManage.

Controller Setup – vBond

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:

    - Host-name : vBond1
    - Organization: KBITS
    - System-IP: 10.1.1.103
    - Site ID: 1
    - vbond Address: 199.1.1.3
    - Timezone: Based on the appropriate Timezone

Note: **Default username**: admin **Default password**: admin

vBond

```
config
!
system
 host-name vBond1
 system-ip 10.1.1.103
 site-id 1
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3 local
!
commit
```

Task 2 – Configured the vpn parameters

- Configure the VPN parameters based on the following:

    - vpn 0
        - Interface ge0/0
        - IP Address: 199.1.1.3/28
        - Tunnel Interface
        - Tunnel Services (NetConf, SSHD)
        - Encapsulation: IPSec
        - Default Route: 199.1.1.14

- vpn 512
    - Interface eth0
    - IP Address: 192.168.1.3/24

vBond

```
config
!
vpn 0
 interface ge0/0
  ip address 199.1.1.3/28
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 199.1.1.14
!
vpn 512
 interface eth0
  ip address 192.168.1.3/24
  no shut
!
 Commit
```

Task 3 – Add vBond to vManage

- Navigate to **Configuration -> Devices -> Controllers -> Add Controllers -> vBond** and specify the following to add the vBond in vManage.

  - IP Address: **199.1.1.3**
  - Username: **Admin**
  - Password: **Admin**
  - Check Generate CSR
  - Click **OK**

Task 4 – View the generated CSR for vBond and Copy it

- Navigate to **Configuration -> Certificates -> Controllers -> vBond -> View CSR.**

- It will open a window with the CSR. Copy by using **CTRL-A** and **CTRL-C.**

Task 5 – Request a Certificate from the CA Server

- Browse to http://192.168.1.5/certsrv
- Click **"Request a Certificate".**
- Select **"Advanced"**.
- Paste the CSR in the box by using **CTRL-V** and click **Submit.**

Task 6 – Issue the Certificate from the CA Server

- Open Server Manager and navigate to **Active Directory Certificate Server -> KBITS-CA -> Pending Requests.**
- Right-Click the request and click "**Issue".**

Task 7 – Downloading the Issued Certificate

- Browse to http://192.168.1.5/certsrv
- Click **"Check on Pending request".**
- The issued certificate link will show up. Click on the link.
- Select "**Base 64"** and click "**Download"**
- Open Explorer and navigate to the downloads folder.
- Change the name of the Downloaded file "**Certnew**" to "**vBond**".
- Open the "**vBond.cer**" file using Notepad.
- Copy using **CTRL-A** and **CTRL-C**.

Task 8 – Installing the Identity Certificate for vManage

- In vManage, Navigate to **Configuration -> Certificates -> Controllers**
- Click on the **"Install"** button at the top right corner
- Paste the Certificate (CTRL-V).
- The Identity certificate should be installed for vBond and pushed to it.

Controller Setup – vSmart

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:

    - Host-name : vSmart1
    - Organization: KBITS
    - System-IP: 10.1.1.102
    - Site ID: 1
    - vbond Address: 199.1.1.3
    - Timezone: Based on the appropriate Timezone

Note: **Default username**: admin **Default password**: admin

vSmart

```
config
!
system
 host-name vSmart1
 system-ip 10.1.1.102
 site-id 1
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configured the vpn parameters

- Configure the VPN parameters based on the following:

    - vpn 0
        - Interface Eth1
        - IP Address: 199.1.1.2/28
        - Tunnel Interface
        - Tunnel Services (NetConf, SSHD)
        - Default Route: 199.1.1.14

- vpn 512
    - Interface eth0
    - IP Address: 192.168.1.2/24

```
vSmart

config
!
vpn 0
 no interface eth0
 interface eth1
  ip address 199.1.1.2/28
  tunnel-interface
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 199.1.1.14
!
vpn 512
 interface eth0
  ip address 192.168.1.2/24
  no shut
!
commit
```

Task 3 – Add vSmart to vManage

- Navigate to **Configuration -> Devices -> Controllers -> Add Controllers -> vSmart** and specify the following to add the vBond in vManage.

  - IP Address: **199.1.1.2**
  - Username: **Admin**
  - Password: **Admin**
  - Check Generate CSR
  - Click **OK**

Task 4 – View the generated CSR for vBond and Copy it

- Navigate to **Configuration -> Certificates -> Controllers -> vSmart -> View CSR.**

- It will open a window with the CSR. Copy by using **CTRL-A** and **CTRL-C.**

Task 5 – Request a Certificate from the CA Server

- Browse to http://192.168.1.5/certsrv

- Click **“Request a Certificate”.**
- Select **“Advanced”**.
- Paste the CSR in the box by using **CTRL-V** and click **Submit.**

Task 6 – Issue the Certificate from the CA Server

- Open Server Manager and navigate to **Active Directory Certificate Server -> KBITS-CA -> Pending Requests.**
- Right-Click the request and click “**Issue”.**

Task 7 – Downloading the Issued Certificate

- Browse to http://192.168.1.5/certsrv
- Click **“Check on Pending request”.**
- The issued certificate link will show up. Click on the link.
- Select “**Base 64”** and click “**Download”**
- Open Explorer and navigate to the downloads folder.
- Change the name of the Downloaded file “**Certnew**” to “**vSmart**”.
- Open the “**vSmart.cer**” file using Notepad.
- Copy using **CTRL-A** and **CTRL-C**.

Task 8 – Installing the Identity Certificate for vManage

- In vManage, Navigate to **Configuration -> Certificates -> Controllers**
- Click on the **“Install”** button at the top right corner
- Paste the Certificate (CTRL-V).
- The Identity certificate should be installed for vSmart and pushed to it.

WAN Edge Setup – (CLI)

Task 1 – Upload the WAN Edge List

- On the vManage Main windows, Naviagte to **Configuration -> Devices**. Click on "**Upload WAN Edge List**".
- Select the file you downloaded from the PNP Portal. Upload it and check the **Validate** option.

vEDGE-1

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vEdge1
  - Organization: KBITS
  - System-IP: 10.2.2.201
  - Site ID: 1
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vEdge1

```
config
!
system
 host-name vEdge1
 system-ip 10.2.2.201
 site-id 1
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configure the vpn parameters

- Configure the VPN parameters based on the following:
  - vpn 0
    - Interface ge0/0
    - IP Address: 192.168.11.1/24
    - Tunnel Interface
    - Encapsulation IPSec
    - Tunnel Services (NetConf, SSHD)
    - Default Route: 192.168.11.254
  - vpn 512
    - Interface eth0
    - IP Address: DHCP Client

vEdge1

```
config
!
vpn 0
  interface ge0/0
  ip address 192.168.11.1/24
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 192.168.11.254
!
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
commit
```

vEDGE-2

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
    - Host-name : vEdge2
    - Organization: KBITS
    - System-IP: 10.2.2.202
    - Site ID: 1
    - vbond Address: 199.1.1.3
    - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vEdge-2

```
config
!
system
 host-name vEdge2
 system-ip 10.2.2.202
 site-id 1
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configure the vpn parameters

- Configure the VPN parameters based on the following:
    - vpn 0
        - Interface ge0/0
        - IP Address: 192.168.12.2/24
        - Tunnel Interface
        - Encapsulation IPSec
        - Tunnel Services (NetConf, SSHD)
        - Default Route: 192.168.12.254
    - vpn 512
        - Interface eth0
        - IP Address: DHCP Client

vEdge2

```
config
!
vpn 0
 interface ge0/0
  ip address 192.168.12.2/24
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 192.168.102.254
!
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
 !
commit
```

vEDGE-3

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
    - Host-name : vEdge3
    - Organization: KBITS
    - System-IP: 10.2.2.203
    - Site ID: 2
    - vbond Address: 199.1.1.3
    - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vEdge-3

```
config
!
system
 host-name vEdge3
 system-ip 10.2.2.203
 site-id 2
 organization-name KBITS
```

```
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configure the vpn parameters

- Configure the VPN parameters based on the following:
  - vpn 0
    - Interface ge0/0
    - IP Address: 192.168.21.3/24
    - Tunnel Interface
    - Encapsulation IPSec
    - Tunnel Services (NetConf, SSHD)
    - Default Route: 192.168.21.254
  - vpn 512
    - Interface eth0
    - IP Address: DHCP Client

vEdge3

```
config
!
vpn 0
 interface ge0/0
  ip address 192.168.21.3/24
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 192.168.21.254
!
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
 !
commit
```

vEDGE-4

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vEdge4
  - Organization: KBITS
  - System-IP: 10.2.2.204
  - Site ID: 2
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vEdge-4

```
config
!
system
 host-name vEdge4
 system-ip 10.2.2.204
 site-id 2
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configure the vpn parameters

- Configure the VPN parameters based on the following:
  - vpn 0
    - Interface Ge0/1
    - IP Address: 192.1.22.4/24
    - Tunnel Interface
    - Encapsulation IPSec
    - Tunnel Services (NetConf, SSHD)
    - Default Route: 192.168.22.254
  - vpn 512
    - Interface eth0
    - IP Address: DHCP Client

vEdge4

```
config
!
vpn 0
 no interface ge0/0
 interface ge0/1
  ip address 192.1.22.4/24
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 192.1.22.254
!
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
 !
commit
```

vEDGE-5

Task 1 – Configuring the System Component

- Configure the System parameters based on the following:
  - Host-name : vEdge5
  - Organization: KBITS
  - System-IP: 10.2.2.205
  - Site ID: 3
  - vbond Address: 199.1.1.3
  - Timezone: Based on the appropriate Timezone

Note: Default username: admin **Default password**: admin

vEdge-5

```
config
!
system
 host-name vEdge5
 system-ip 10.2.2.205
 site-id 3
```

```
 organization-name KBITS
 clock timezone Asia/Muscat
 vbond 199.1.1.3
!
commit
```

Task 2 – Configure the vpn parameters

- Configure the VPN parameters based on the following:
  - vpn 0
    - Interface Ge0/0
    - IP Address: 192.168.31.5/24
    - Tunnel Interface
    - Encapsulation IPSec
    - Tunnel Services (NetConf, SSHD)
    - Default Route: 192.168.31.254
  - vpn 512
    - Interface eth0
    - IP Address: DHCP Client

vEdge5

```
config
!
vpn 0
 interface ge0/0
  ip address 192.168.31.5/24
  tunnel-interface
   encapsulation ipsec
   allow-service netconf
   allow-service sshd
   no shut
 ip route 0.0.0.0/0 192.168.31.254
!
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
 !
commit
```

WAN Edge Setup – vManage (GUI)

vEDGE-1

Task 1 – Upload the Root Certificate to the vEdge

- On the Windows Server, open **WINSCP** application.

- **Connect** to vEdge1 using the following information:

  - IP Address : 192.168.11.1
  - Protocol - SFTP
  - Username : admin
  - Password : admin

- Copy the **RootCert.cer** file from the Downloads folder to the **/home/admin** folder on the vEdge1

Task 2 – Install the Root Certificate on vEdge1

- Connect to the console of vEdge1 and issue the following command:

  request root-cert-chain install /home/admin/RootCert.cer

Task 3 - Activate vEdge on vManage

- Navigate to **Configuration -> Devices**

- Note and use the **Chassis Number** and **Token number** for the 1st vEdge from vManage.

- Use the information from the previous step in the following command on the vEdge1 console.

  request vedge-cloud activate chassis-number **XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

vEDGE-2

Task 1 – Upload the Root Certificate to the vEdge

- On the Windows Server, open **WINSCP** application.

- **Connect** to vEdge2 using the following information:

  - IP Address : 192.168.12.2
  - Protocol - SFTP
  - Username : admin
  - Password : admin

- Copy the **RootCert.cer** file from the Downloads folder to the **/home/admin** folder on the vEdge2

Task 2 – Install the Root Certificate on vEdge2

- Connect to the console of vEdge2 and issue the following command:

  request root-cert-chain install /home/admin/RootCert.cer

Task 3 - Activate vEdge on vManage

- Navigate to **Configuration -> Devices**

- Note and use the **Chassis Number** and **Token number** for the 2nd vEdge from vManage.

- Use the information from the previous step in the following command on the vEdge2 console.

  request vedge-cloud activate chassis-number **XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

vEDGE-3

Task 1 – Upload the Root Certificate to the vEdge

- On the Windows Server, open **WINSCP** application.

- **Connect** to vEdge3 using the following information:

  - IP Address : 192.168.21.3
  - Protocol - SFTP
  - Username : admin
  - Password : admin

- Copy the **RootCert.cer** file from the Downloads folder to the **/home/admin** folder on the vEdge3

Task 2 – Install the Root Certificate on vEdge3

- Connect to the console of vEdge3 and issue the following command:

  request root-cert-chain install /home/admin/RootCert.cer

Task 3 - Activate vEdge on vManage

- Navigate to **Configuration -> Devices**

- Note and use the **Chassis Number** and **Token number** for the 3rd vEdge from vManage.

- Use the information from the previous step in the following command on the vEdge3 console.

  request vedge-cloud activate chassis-number **XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

vEDGE-4

Task 1 – Upload the Root Certificate to the vEdge

- On the Windows Server, open **WINSCP** application.

- **Connect** to vEdge4 using the following information:

    - IP Address : 192.1.22.4
    - Protocol - SFTP
    - Username : admin
    - Password : admin

- Copy the **RootCert.cer** file from the Downloads folder to the **/home/admin** folder on the vEdge4

Task 2 – Install the Root Certificate on vEdge4

- Connect to the console of vEdge4 and issue the following command:

  request root-cert-chain install /home/admin/RootCert.cer

Task 3 - Activate vEdge on vManage

- Navigate to **Configuration -> Devices**

- Note and use the **Chassis Number** and **Token number** for the 4th vEdge from vManage.

- Use the information from the previous step in the following command on the vEdge4 console.

  request vedge-cloud activate chassis-number **XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

vEDGE-5

Task 1 – Upload the Root Certificate to the vEdge

- On the Windows Server, open **WINSCP** application.

- **Connect** to vEdge5 using the following information:

    - IP Address : 192.168.31.5
    - Protocol - SFTP
    - Username : admin
    - Password : admin

- Copy the **RootCert.cer** file from the Downloads folder to the **/home/admin** folder on the vEdge5

Task 2 – Install the Root Certificate on vEdge5

- Connect to the console of vEdge5 and issue the following command:

  request root-cert-chain install /home/admin/RootCert.cer

Task 3 - Activate vEdge on vManage

- Navigate to **Configuration -> Devices**

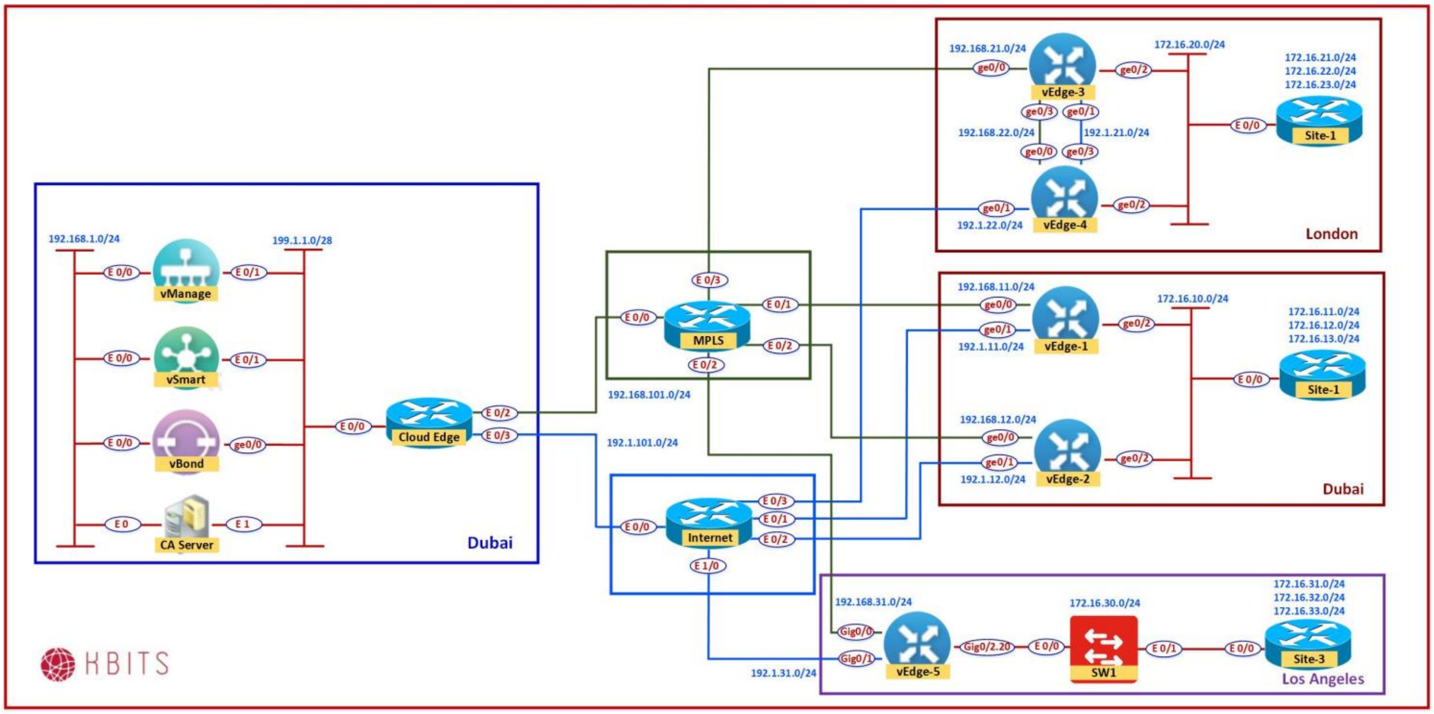
- Note and use the **Chassis Number** and **Token number** for the 5th vEdge from vManage.

- Use the information from the previous step in the following command on the vEdge5 console.

  request vedge-cloud activate chassis-number **XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX** token **XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

- You should see the vEdge in the vManage console with a Certificate issued.

Lab 34 – Configuring Los Angeles Site using Sub-interfaces



vEdge5 Templates Creation

System

Task 1 – Configure the System Template to be used by all vEdge-Cloud Devices

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Basic Information -> System**

- Configure the System parameters based on the following:

    - Template Name : **VE-System**
    - Description : **VE-System**
    - Site ID -> Device Specific
    - System IP ->Device Specific
    - Hostname -> Device Specific
    - Timezone -> Device Specific
    - Console Baud Rate -> **Default**

- Click **Save** to save the Template.

VPN 0

Task 1 – Configure a VPN Template to be used by all BR3 vEdges (vEdge5) for VPN0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **BR3-VE-VPN-VPN0**
  - Description : **BR3-VE-VPN-VPN0**

  Basic Configuration
  - VPN -> Global : **0**
  - Name -> Global : **Transport VPN**

  IPv4 Route
  - Prefix -> Global : 0.0.0.0/0
  - Next Hop -> Device Specific (Label : **DEF-GW**)

- Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by all BR3 vEdge-Cloud Devices for VPN 0 for Interface G0/0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR3-VE-VPNINT-VPN0-G0**
  - Description : **BR3-VE-VPNINT-VPN0-G0**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/0**
  - IPv4 Address -> Static -> Device Specific (**G0**)

  Tunnel
  - Tunnel Inteface -> Global : **On**
  - Color -> Global : **mpls**

    Allow Service
  - NETCONF -> Global : **On**

- SSH -> Global : **On**
- OSPF -> Global: **On**

➢ Click **Save** to save the Template.

Task 3 – Configure a VPN Interface Template to be used by all BR3 vEdge-Cloud Devices for VPN 0 for Interface G0/1

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

➢ Configure the VPN parameters based on the following:

- Template Name : **BR3-VE-VPNINT-VPN0-G1**
- Description : **BR3-VE-VPNINT-VPN0-G1**

Basic Configuration

- Shutdown -> Global : **No**
- Interface Name -> Global : **ge0/1**
- IPv4 Address -> Static -> Device Specific (**G1**)

Tunnel

- Tunnel Inteface -> Global : **On**
- Color -> Global : **Biz-internet**

Allow Service

- NETCONF -> Global : **On**
- SSH -> Global : **On**

➢ Click **Save** to save the Template.

VPN512

Task 1 – Configure a VPN Template to be used by all Branch vEdge-Cloud Devices for VPN 512

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

➢ Configure the VPN parameters based on the following:

- Template Name : **BR-VE-VPN-VPN512**
- Description : **BR-VE-VPN-VPN512**

Basic Configuration

- VPN -> Global : **512**

- Name -> Global : **MGMT VPN**

➢ Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by all Branch vEdge-Cloud Devices for VPN 512 for Interface Eth0

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

➢ Configure the VPN parameters based on the following:

- Template Name : **BR-VE-VPNINT-VPN512-E0**
- Description : **BR-VE-VPNINT-VPN512-E0**

Basic Configuration
- Shutdown -> Global : **No**
- Interface Name -> Global : **eth0**
- IPv4 Address -> Dynamic

➢ Click **Save** to save the Template

VPN 20

Task 1 – Configure a VPN Template to be used by LA vEdge-Cloud Device for VPN 20

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

➢ Configure the VPN parameters based on the following:

- Template Name : **BR-VE-VPN-VPN20-LA**
- Description : **BR-VE-VPN-VPN20-LA**

Basic Configuration
- VPN -> Global : **20**
- Name -> Global : **Data VPN**

➢ Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by LA vEdge-Cloud Device for VPN 20 for Interface G0/2

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPNINT-VPN20-G2-LA**
  - Description : **BR-VE-VPNINT-VPN20-G2-LA**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/2**

- Click **Save** to save the Template.

Task 3 – Configure a VPN Interface Template to be used by LA vEdge-Cloud Device for VPN 20 for Interface G0/2.20

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPNINT-VPN20-G2.20-LA**
  - Description : **BR-VE-VPNINT-VPN20-G2.20-LA**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/2.20**
  - IP Address: Static: -> Device Specific (Label: **G2.20**)

  Advanced Configuration
  - IP MTU -> Global : **1496**

- Click **Save** to save the Template.

Task 4 – Configure a OSPF Template to be used by LA vEdge-Cloud Device for VPN 20

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Other Templates -> OSPF**

- Configure the OSPF parameters based on the following:

  - Template Name : **BR-VE-OSPF-VPN20-LA**
  - Description : **BR-VE-OSPF-VPN20-LA**

  Redistribution
  - Protocol : **OMP**

  Area Configuration
  - Area Number -> Global : **0**
  - Area Type -> Default

  Interface Configuration
  - Interface Name: ge0/2.20

- Click **Add** to add the Interface and Click **Add** to add OSPF.

- Click **Save** to save the Template.

vEdge5 Templates Deployment

Task 1 – Configure a Device Template for BR3 vEdge Devices.

- In vManage, Navigate to Configuration -> **Templates -> Device -> Create Template -> vEdge Cloud**

- Configure the Device Template based on the following:

  - Template Name : **BR3-VE-TEMP-LA**
  - Description : **BR3-VE-TEMP-LA**

  Basic Information
  - System -> **VE-System**

  Transport & Management
  - VPN 0 : **BR3-VE-VPN-VPN0**
  - VPN Interface : **BR3-VE-VPNINT-VPN0-G0**
  - VPN Interface : **BR-VE-VPNINT-VPN20-G2-LA**

  - VPN 512 : **BR-VE-VPN-VPN512**
  - VPN Interface : **BR-VE-VPNINT-VPN512-E0**

  Service VPN
  - VPN 20 : **BR-VE-VPN-VPN20-LA**
  - VPN Interface : **BR-VE-VPNINT-VPN20-G2-LA**
  - OSPF: **BR-VE-OSPF-VPN20-LA**

- Click **Save** to save the Template.

Task 2 – Attach vEdge5 to the Device Template

- In vManage, Navigate to Configuration -> **Templates -> Device -> BR3-VE-TEMP.**

- Click on "**…**" towards the right-hand side.

- Click **Attach Devices.**

- Select **vEdge5** and click the " **->** " button.

- Click **Attach**.

Task 3 – Configure the Variable Parameters for the Feature Templates

- **vEdge5** will appear in the window.

- Click on "**...**" towards the right-hand side.

- Click **Edit Device Template.**

- Configure the variables based on the following:

  - Default Gateway for VPN0 (**DEF-GW**): **192.1.31.254**
  - Interface IP for ge0/0 (**G0**):**192.168.31.5/24**
  - Interface IP for ge0/1 (**G1**) :**192.1.31.5/24**
  - Interface IP for ge0/2.20 (**G2.20**) :**172.16.30.5/24**
  - Timezone: **America/Los_Angeles**
  - Hostname : **vEdge-5**
  - System IP : **10.2.2.205**
  - Site ID : **3**

- Click **Update.**

- Verify the Configuration & Click **Configure Devices.**

- Wait for it to update the device. It should come back with Status of **Success**.

Site-3 Internal Site Configuration

Site-3 Internal Switch

```
No ip domain-lookup
!
Hostname SW1
!
Vlan 20
!
Interface E 0/0
 Switchport trunk encapsulation dot1q
 Switchport mode trunk
 No shut
!
Interface E 0/1
 Switchport mode trunk
 Switchport access vlan 20
 No shut
```

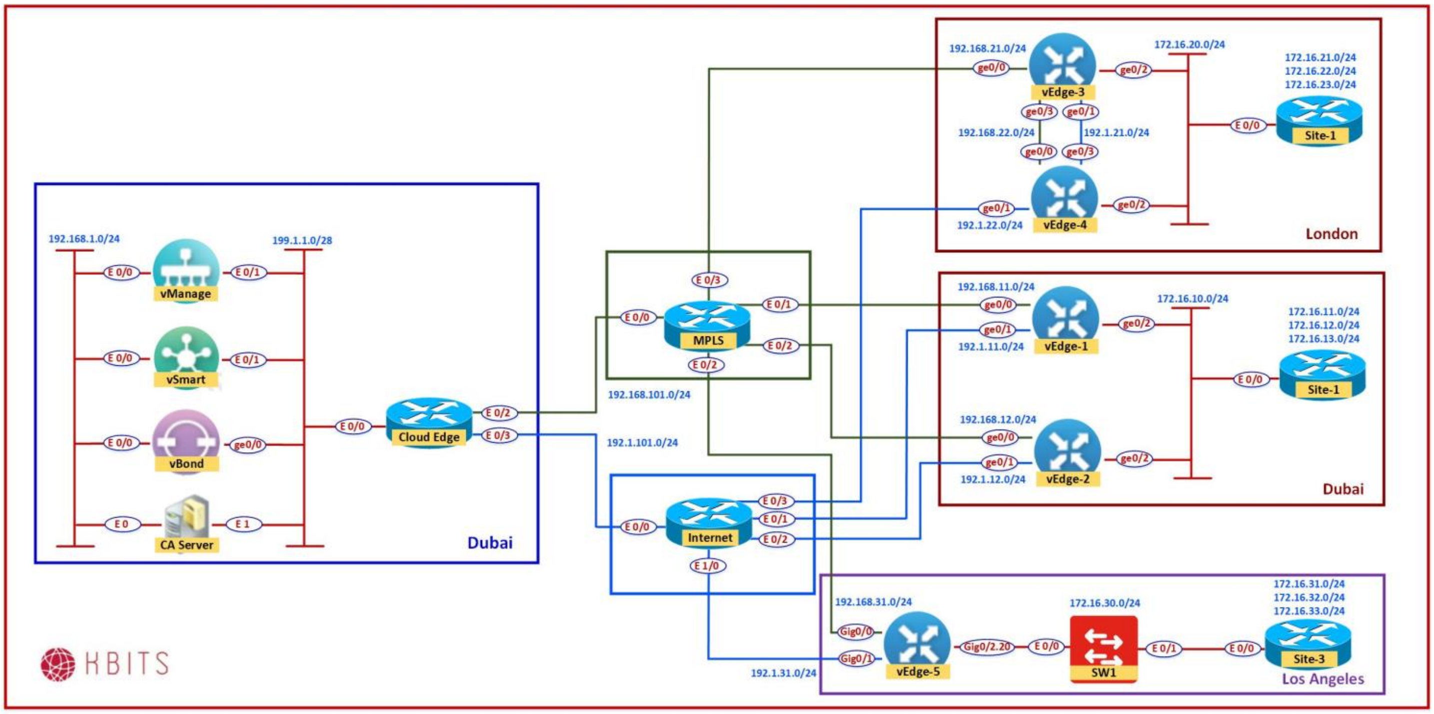
Site-3 Internal Router

```
No ip domain-lookup
!
Hostname R3
!
Interface E 0/0
 Ip address 172.16.30.254 255.255.255.0
 Ip mtu 1496
 No shut
!
Interface loopback1
 Ip address 172.16.31.1 255.255.255.0
 Ip ospf network point-to-point
!
Interface loopback2
 Ip address 172.16.32.1 255.255.255.0
 Ip ospf network point-to-point
!
Interface loopback3
 Ip address 172.16.33.1 255.255.255.0
 Ip ospf network point-to-point
!
Router ospf 1
 Network 172.16.0.0 0.0.255.255 area 0
```

Verification

- Verify the configuration on **vEdge5**. You can do that by verify OSPF Neighbor relationship with the MPLS Router by issuing the **Show ospf neighbor** command on **vEdge5.**

Lab 35 – Configuring TLOC Extensions



vEdge3 Templates Creation

VPN 0

Task 1 – Configure a VPN Template to be used by BR2 vEdges for VPN0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **BR2-VE-VPN-VPN0**
  - Description : **BR2-VE-VPN-VPN0**

  Basic Configuration
  - VPN -> Global : **0**
  - Name -> Global : **Transport VPN**

  IPv4 Route
  - Prefix -> Global : 0.0.0.0/0
  - Next Hop -> Device Specific

- Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by all BR2 vEdge-Cloud Devices for VPN 0 for Interface G0/0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

    - Template Name : **BR2-VE-VPNINT-VPN0-G0**
    - Description : **BR2-VE-VPNINT-VPN0-G0**

    Basic Configuration
    - Shutdown -> Global : **No**
    - Interface Name -> Global : **ge0/0**
    - IPv4 Address -> Static -> Device Specific (Label: **G0**)

    Tunnel
    - Tunnel Inteface -> Global : **On**
    - Color -> Global : **Mpls**

    Allow Service
    - NETCONF -> Global : **On**
    - SSH -> Global : **On**

- Click **Save** to save the Template.

Task 3 – Configure a VPN Interface Template to be used by all BR2 vEdge-Cloud Devices for VPN 0 for Interface G0/1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

    - Template Name : **BR2-VE-VPNINT-VPN0-G1**
    - Description : **BR2-VE-VPNINT-VPN0-G1**

    Basic Configuration
    - Shutdown -> Global : **No**
    - Interface Name -> Global : **ge0/1**
    - IPv4 Address -> Static -> Device Specific (Label: **G1**)

    Tunnel

- Tunnel Inteface -> Global : **On**
- Color -> Global : **Biz-Internet**

  Allow Service
- NETCONF -> Global : **On**
- SSH -> Global : **On**

➢ Click **Save** to save the Template.

Task 4 – Configure a Template that will be used for TLOC-Extension on BR2 vEdges

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

➢ Configure the VPN parameters based on the following:

- Template Name : **BR2-VE-VPNINT-VPN0-TLOC-G3**
- Description : **BR2-VE-VPNINT-VPN0-TLOC-G3**

  Basic Configuration
- Shutdown -> Global : **No**
- Interface Name -> Global : **ge0/3**
- IPv4 Address -> Static -> Device Specific (Label: **G3**)

  Advanced
- TLOC Extension: Device Specific (Label: **TLOC**)

➢ Click **Save** to save the Template.

Task 5 – Configure a OSPF Template to be used by vEdge3 for VPN 0

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Other Templates -> OSPF**

➢ Configure the OSPF parameters based on the following:

- Template Name : **BR2-VE-vEdge3-OSPF-VPN0**
- Description : **BR-VE-vEdge3-OSPF-VPN0**

  Area Configuration
- Area Number -> Global : **0**
- Area Type -> Default

  Interface Configuration
- Interface Name: **ge0/0**
- Interface Name: **ge0/3**

- Click **Save** to save the Template.

VPN 10

Task 1 – Configure a VPN Template to be used by Dubai & London vEdge-Cloud Devices for VPN 10

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPN-VPN10-DXB-LON**
  - Description : **BR-VE-VPN-VPN20- DXB-LON**

  Basic Configuration
  - VPN -> Global : **10**
  - Name -> Global : **Data VPN**

- Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by Dubai & London vEdge-Cloud Devices for VPN 10 for Interface G0/2

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR-VE-VPNINT-VPN20-G2-DXB-LON**
  - Description : **BR-VE-VPNINT-VPN20-G2- DXB-LON**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/2**

- Click **Save** to save the Template.

Task 3 – Configure a OSPF Template to be used by Dubai & London vEdge-Cloud Devices for VPN 10

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Other Templates -> OSPF**

- Configure the OSPF parameters based on the following:

  - Template Name : **BR-VE-OSPF-VPN10-DXB-LON**
  - Description : **BR-VE-OSPF-VPN10-DXB-LON**

  Redistribution
  - Protocol : **OMP**

  Area Configuration
  - Area Number -> Global : **0**
  - Area Type -> Default

  Interface Configuration
  - Interface Name: ge0/2

- Click **Add** to add the Interface and Click **Add** to add OSPF.

- Click **Save** to save the Template.

vEdge3 Templates Deployment

Task 1 – Configure a Device Template for BR2 vEdge3.

- In vManage, Navigate to Configuration -> **Templates -> Device -> Create Template -> vEdge Cloud**

- Configure the Device Template based on the following:

  - Template Name : **BR2-VE-vEdge3-TEMP**
  - Description : **BR2-VE-vEdge3-TEMP**

  Basic Information
  - System -> **VE-System**

  Transport & Management
  - VPN 0 : **BR2-VE-VPN-VPN0**
  - VPN Interface : **BR2-VE-VPNINT-VPN0-G0**
  - VPN Interface : **BR2-VE-VPNINT-VPN0-G1**
  - VPN Interface : **BR2-VE-VPNINT-VPN0-TLOC-G3**
  - OSPF: **BR2-VE-vEdge3-OSPF-VPN0**

  - VPN 512 : **BR-VE-VPN-VPN512**
  - VPN Interface : **BR-VE-VPNINT-VPN512-E0**

  Service VPN
  - VPN 10 : **BR-VE-VPN-VPN10-DXB-LON**

- VPN Interface : **BR-VE-VPNINT-VPN20-G2-DXB-LON**
- OSPF: **BR-VE-OSPF-VPN10-DXB-LON**

➢ Click **Save** to save the Template.

Task 2 – Attach vEdge3 to the Device Template

➢ In vManage, Navigate to Configuration -> **Templates -> Device -> BR2-VE-vEdge3-TEMP**

➢ Click on "**...**" towards the right-hand side.

➢ Click **Attach Devices.**

➢ Select **vEdge3** and click the " **->** " button.

➢ Click **Attach**.

Task 3 – Configure the Variable Parameters for the Feature Templates

➢ **vEdge3** will appear in the window.

➢ Click on "**...**" towards the right-hand side.

➢ Click **Edit Device Template.**

➢ Configure the variables based on the following:

- Default Gateway for VPN0 (**DEF-GW**) : **192.1.21.4**
- Interface IP for ge0/0 (**G0**) :**192.168.21.3/24**
- Interface IP for ge0/1 (**G1**) :**192.1.21.3/24**
- Interface IP for ge0/2 (**G2**) :**172.16.20.3/24**
- Interface IP for ge0/3 (**G3**):**192.168.22.3/24**
- TLOC Extension (**TLOC**): **ge0/0**
- Timezone: **Europe/London**
- Hostname : **vEdge-3**
- System IP : **10.2.2.203**
- Site ID : **2**

➢ Click **Update.**

➢ Verify the Configuration & Click **Configure Devices.**

➢ Wait for it to update the device. It should come back with Status of **Success**.

vEdge4 Templates Creation

VPN 0

Task 1 – Configure a OSPF Template to be used by vEdge4 for VPN 0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Other Templates -> OSPF**

- Configure the OSPF parameters based on the following:

  - Template Name : **BR2-VE-vEdge4-OSPF-VPN0**
  - Description : **BR-VE-vEdge4-OSPF-VPN0**

  Area Configuration
  - Area Number -> Global : **0**
  - Area Type -> Default

  Interface Configuration
  - Interface Name: **ge0/0**

- Click **Save** to save the Template.

vEdge4 Templates Deployment

Task 1 – Configure a Device Template for BR2 vEdge4.

- In vManage, Navigate to Configuration -> **Templates -> Device -> Create Template -> vEdge Cloud**

- Configure the Device Template based on the following:

  - Template Name : **BR2-VE-vEdge4-TEMP**
  - Description : **BR2-VE-vEdge4-TEMP**

  Basic Information
  - System -> **VE-System**

  Transport & Management
  - VPN 0 : **BR2-VE-VPN-VPN0**
  - VPN Interface : **BR2-VE-VPNINT-VPN0-G0**
  - VPN Interface : **BR2-VE-VPNINT-VPN0-G1**
  - VPN Interface : **BR2-VE-VPNINT-VPN0-TLOC-G3**
  - OSPF: **BR2-VE-vEdge4-OSPF-VPN0**

- VPN 512 : **BR-VE-VPN-VPN512**
- VPN Interface : **BR-VE-VPNINT-VPN512-E0**

Service VPN

- VPN 10 : **BR-VE-VPN-VPN10-DXB-LON**
- VPN Interface : **BR-VE-VPNINT-VPN20-G2-DXB-LON**
- OSPF: **BR-VE-OSPF-VPN10-DXB-LON**

➢ Click **Save** to save the Template.

Task 2 – Attach vEdge4 to the Device Template

➢ In vManage, Navigate to Configuration -> **Templates -> Device -> BR2-VE-vEdge4-TEMP**

➢ Click on "**…**" towards the right-hand side.

➢ Click **Attach Devices.**

➢ Select **vEdge4** and click the " **->** " button.

➢ Click **Attach**.

Task 3 – Configure the Variable Parameters for the Feature Templates

➢ **vEdge4** will appear in the window.

➢ Click on "**…**" towards the right-hand side.

➢ Click **Edit Device Template.**

➢ Configure the variables based on the following:

- Default Gateway for VPN0 (**DEF-GW**) : **192.1.22.254**
- Interface IP for ge0/0 (**G0**) :**192.168.22.4/24**
- Interface IP for ge0/1 (**G1**) :**192.1.22.4/24**
- Interface IP for ge0/2 (**G2**) :**172.16.20.4/24**
- Interface IP for ge0/3 (**G3**) :**192.1.21.4/24**
- TLOC Extension (**TLOC**): **ge0/1**
- Timezone: **Europe/London**
- Hostname : **vEdge-4**
- System IP : **10.2.2.204**
- Site ID : **2**

➢ Click **Update.**

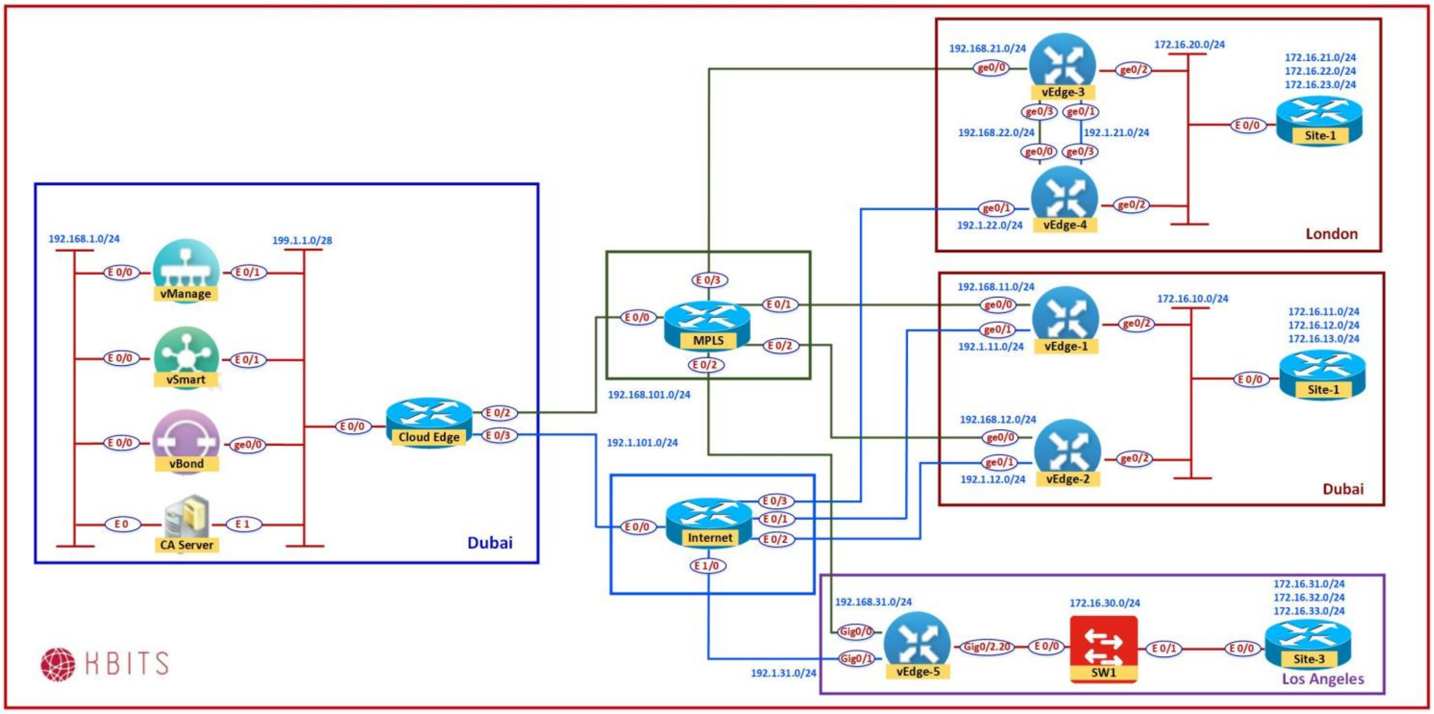
- Verify the Configuration & Click **Configure Devices.**
- Wait for it to update the device. It should come back with Status of **Success**.

Site-2 Internal Router Configuration

Site-2 Internal Router

```
No ip domain-lookup
!
Hostname R2
!
Interface E 0/0
 Ip address 172.16.20.254 255.255.255.0
 No shut
!
Interface loopback1
 Ip address 172.16.21.1 255.255.255.0
 Ip ospf network point-to-point
!
Interface loopback2
 Ip address 172.16.22.1 255.255.255.0
 Ip ospf network point-to-point
!
Interface loopback3
 Ip address 172.16.23.1 255.255.255.0
 Ip ospf network point-to-point
!
Router ospf 1
 Network 172.16.0.0 0.0.255.255 area 0
```

Lab 36 – Load Balancing using Multiple vEdges



vEdge1 Templates Creation

VPN 0

Task 1 – Configure a VPN Template to be used by BR2 vEdges for VPN0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN**
- Configure the VPN parameters based on the following:
  - Template Name : **BR1-VE-VPN-VPN0**
  - Description : **BR1-VE-VPN-VPN0**

  Basic Configuration
  - VPN -> Global : **0**
  - Name -> Global : **Transport VPN**

  IPv4 Route
  - Prefix -> Global : 0.0.0.0/0
  - Next Hop -> Device Specific (Label: **DEF-GW**)

- Click **Save** to save the Template.

Task 2 – Configure a VPN Interface Template to be used by all BR1 vEdge-Cloud Devices for VPN 0 for Interface G0/0

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR1-VE-VPNINT-VPN0-G0**
  - Description : **BR1-VE-VPNINT-VPN0-G0**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/0**
  - IPv4 Address -> Static -> Device Specific (Label: **G0**)

  Tunnel
  - Tunnel Inteface -> Global : **On**
  - Color -> Global : **Mpls**

  Allow Service
  - NETCONF -> Global : **On**
  - SSH -> Global : **On**
  - OSPF -> Global: **On**

- Click **Save** to save the Template.

Task 3 – Configure a VPN Interface Template to be used by all BR1 vEdge-Cloud Devices for VPN 0 for Interface G0/1

- In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> VPN -> VPN Interface Ethernet**

- Configure the VPN parameters based on the following:

  - Template Name : **BR1-VE-VPNINT-VPN0-G1**
  - Description : **BR1-VE-VPNINT-VPN0-G1**

  Basic Configuration
  - Shutdown -> Global : **No**
  - Interface Name -> Global : **ge0/1**
  - IPv4 Address -> Static -> Device Specific (Label: **G1**)

Tunnel

- Tunnel Inteface -> Global : **On**
- Color -> Global : **Biz-Internet**

Allow Service

- NETCONF -> Global : **On**
- SSH -> Global : **On**

➢ Click **Save** to save the Template.

Task 4 – Configure a OSPF Template to be used by all BR1 vEdge-Cloud Devices for VPN 0

➢ In vManage, Navigate to Configuration -> **Templates -> Feature -> vEdge Cloud -> Other Templates -> OSPF**

➢ Configure the OSPF parameters based on the following:

- Template Name : **BR1-VE-OSPF-VPN0**
- Description : **BR1-VE-OSPF-VPN0**

Area Configuration

- Area Number -> Global : **0**
- Area Type -> Default

Interface Configuration

- Interface Name: **ge0/0**

➢ Click **Save** to save the Template.

vEdge1&2 Templates Deployment

Task 1 – Configure a Device Template for BR2 vEdges.

- In vManage, Navigate to Configuration -> **Templates -> Device -> Create Template -> vEdge Cloud**

- Configure the Device Template based on the following:

  - Template Name : **BR1-VE-TEMP**
  - Description : **BR1-VE-TEMP**

  Basic Information
  - System -> **VE-System**

  Transport & Management
  - VPN 0 : **BR1-VE-VPN-VPN0**
  - VPN Interface : **BR1-VE-VPNINT-VPN0-G0**
  - VPN Interface : **BR1-VE-VPNINT-VPN0-G1**
  - OSPF: **BR1-VE-OSPF-VPN0**

  - VPN 512 : **BR-VE-VPN-VPN512**
  - VPN Interface : **BR-VE-VPNINT-VPN512-E0**

  Service VPN
  - VPN 10 : **BR-VE-VPN-VPN10-DXB-LON**
  - VPN Interface : **BR-VE-VPNINT-VPN20-G2-DXB-LON**
  - OSPF: **BR-VE-OSPF-VPN10-DXB-LON**

- Click **Save** to save the Template.

Task 2 – Attach vEdge1 & 2 to the Device Template

- In vManage, Navigate to Configuration -> **Templates -> Device -> BR2-VE-TEMP**

- Click on "**…**" towards the right-hand side.

- Click **Attach Devices.**

- Select **vEdge1 & vEdge2** and click the " **->** " button.

- Click **Attach**.

Task 3 – Configure the Variable Parameters for the Feature Templates

- **vEdge1 & vEdge2** will appear in the window.
- Click on "**...**" towards the right-hand side.
- Click **Edit Device Template.**
- Configure the variables based on the following:

vEdge1

- Default Gateway for VPN0 (**DEF-GW**) : **192.1.11.254**
- Interface IP for ge0/0 (**G0**) :**192.168.11.1/24**
- Interface IP for ge0/1 (**G1**):**192.1.11.1/24**
- Interface IP for ge0/2 (**G2**):**172.16.10.1/24**
- Timezone: **Asia/Dubai**
- Hostname : **vEdge-1**
- System IP : **10.2.2.201**
- Site ID : **1**

vEdge2

- Default Gateway for VPN0 (**DEF-GW**) : **192.1.12.254**
- Interface IP for ge0/0 (**G0**) :**192.168.12.2/24**
- Interface IP for ge0/1 (**G1**) :**192.1.12.2/24**
- Interface IP for ge0/2 (**G2**):**172.16.10.2/24**
- Timezone: **Asia/Dubai**
- Hostname : **vEdge-2**
- System IP : **10.2.2.202**
- Site ID : **1**

- Click **Update.**
- Verify the Configuration & Click **Configure Devices.**
- Wait for it to update the device. It should come back with Status of **Success**.

Site-1 Internal Router Configuration

Site-1 Internal Router

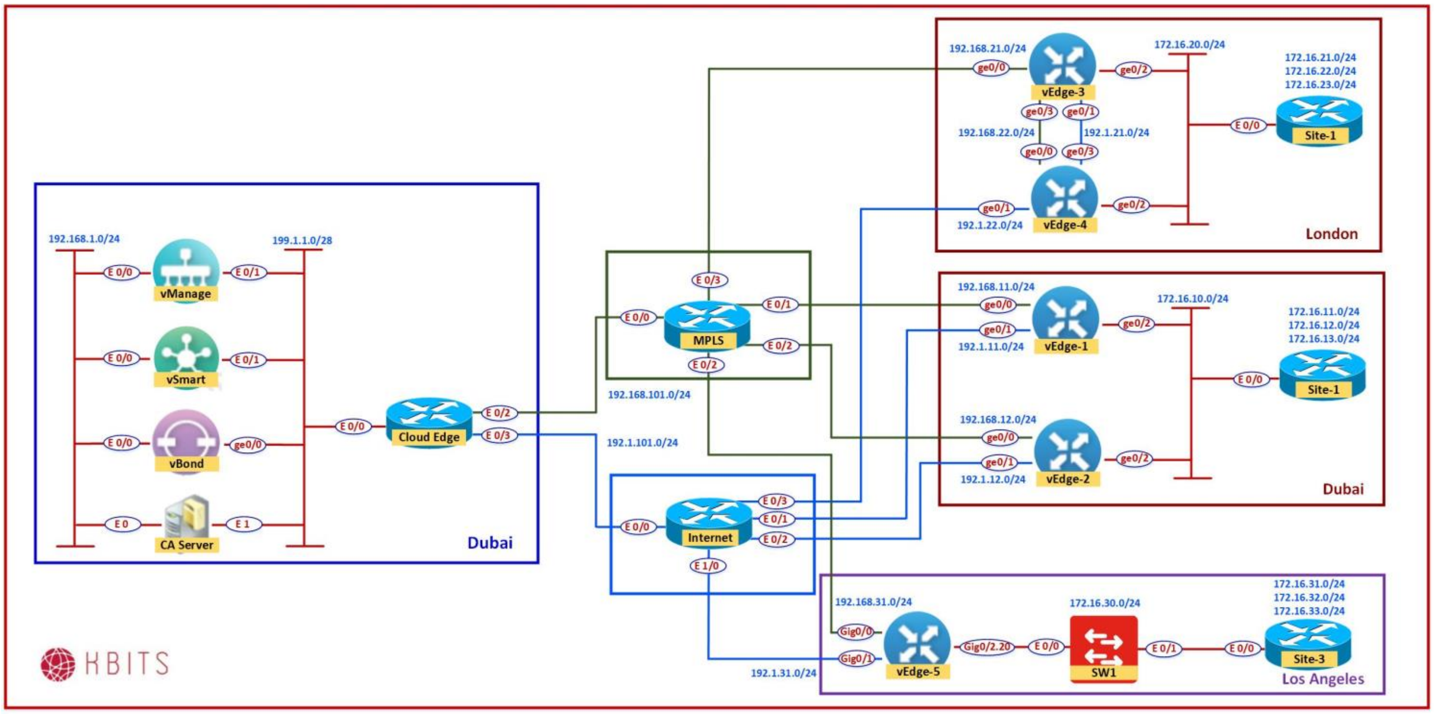
```
No ip domain-lookup
!
```

```
Hostname R1
!
Interface E 0/0
 Ip address 172.16.10.254 255.255.255.0
 No shut
!
Interface loopback1
 Ip address 172.16.11.1 255.255.255.0
 Ip ospf network point-to-point
!
Interface loopback2
 Ip address 172.16.12.1 255.255.255.0
 Ip ospf network point-to-point
!
Interface loopback3
 Ip address 172.16.13.1 255.255.255.0
 Ip ospf network point-to-point
!
Router ospf 1
 Network 172.16.0.0 0.0.255.255 area 0
```

Verification

- Verify the configuration on **vEdge1 & vEdge2**. You can do that by verify OSPF Neighbor relationship with the MPLS Router by issuing the **Show ospf neighbor** command on **vEdge1 & vEdge2.**

Lab 37 – Route Leaking between VPNs 10 & 20



vSmart Template Creating & Applying

Task 1 – Configure vSmart as a Template

- Log into the vSmart from the CLI.
- Type the **Show run** command to display the entire Running-Config file.
- Highlight and copy the running config.
- Navigate to the **Configuration -> Templates -> Device Template** to create a template for the vSmart using the CLI Template.
- Paste the Config from the CLI Runing Config (**CTRL-V**).
- Give the Template the following Name & Description.
  - Template Name : **VS-DEV-TEMP**
  - Description : **VS-DEV-TEMP**
- Click **Save** to save the Template.

Task 2 – Attach the vSmart to the VS-DEV-TEMP

- In vManage, Navigate to Configuration -> **Templates -> Device -> VS-DEV-TEMP**
- Click on "**…**" towards the right-hand side.
- Click **Attach Devices.**
- Select the **vSmart** and click the " **->** " button.
- Click **Attach**.
- Click **Update.**
- Verify the Configuration & Click **Configure Devices.**
- Wait for it to update the device. It should come back with Status of **Success**.

Route Leaking between VPN 10 & 20

Requirements:

- Configure a Policy to Route Leaking the following networks between VPN 10 & VPN 20.
  - VPN -10 – 172.16.11.0/24 & 172.16.21.0/24
  - VPN -20 – 172.16.31.0/24

- Create the following Sites:
  - DXB-LON – 1-2
  - LA – 3

- Create VPN ID's for VPN 10 & 20.

- Create the appropriate Prefix Lists

Task 1 – Configure Groups of Interests/List that will be used for Routing Leaking Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Lists.**

- Click **Prefix** and select **New Prefix list.** Create 2 Prefix Lists based on the following:

  - Name : **VPN-10-Routes**
  - Prefixes : 172.16.11.0/24 & 172.16.21.0/24

  - Name : **VPN-20-Routes**
  - Prefixes : 172.16.31.0/24

- Click **VPN** and select **New VPN list.** Create 2 VPN lists based on the following:

  - Name : **VPN10**
  - ID : **10**

  - Name : **VPN20**
  - ID : **20**

- Click **Site** and select **New Site list.** Create 2 Sites based on the following:

  - Name : **DXB-LON**
  - Site ID : **1-2**

  - Name : **LA**
  - Site ID : **3**

Task 2 – Configure an Route Leaking policy based on the Requirements

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Topology.**

- Configure a Route Leaking Policy based on the following:

  - Policy Name : **Route-Leaking-10-20**
  - Description : **Route-Leaking-10-20**

  Sequence#1
  Match Conditions:
  - Site : **DXB-LON**
  - Prefix : **VPN-10-Routes**

  Action
  - Export To: **VPN-20**

  - Click **Save Match and Actions** to save the Sequence.

  Sequence#2
  Match Conditions:
  - Site : **LA**
  - Prefix : **VPN-20-Routes**

  Action
  - Export To: **VPN-10**

  - Click **Save Match and Actions** to save the Sequence.

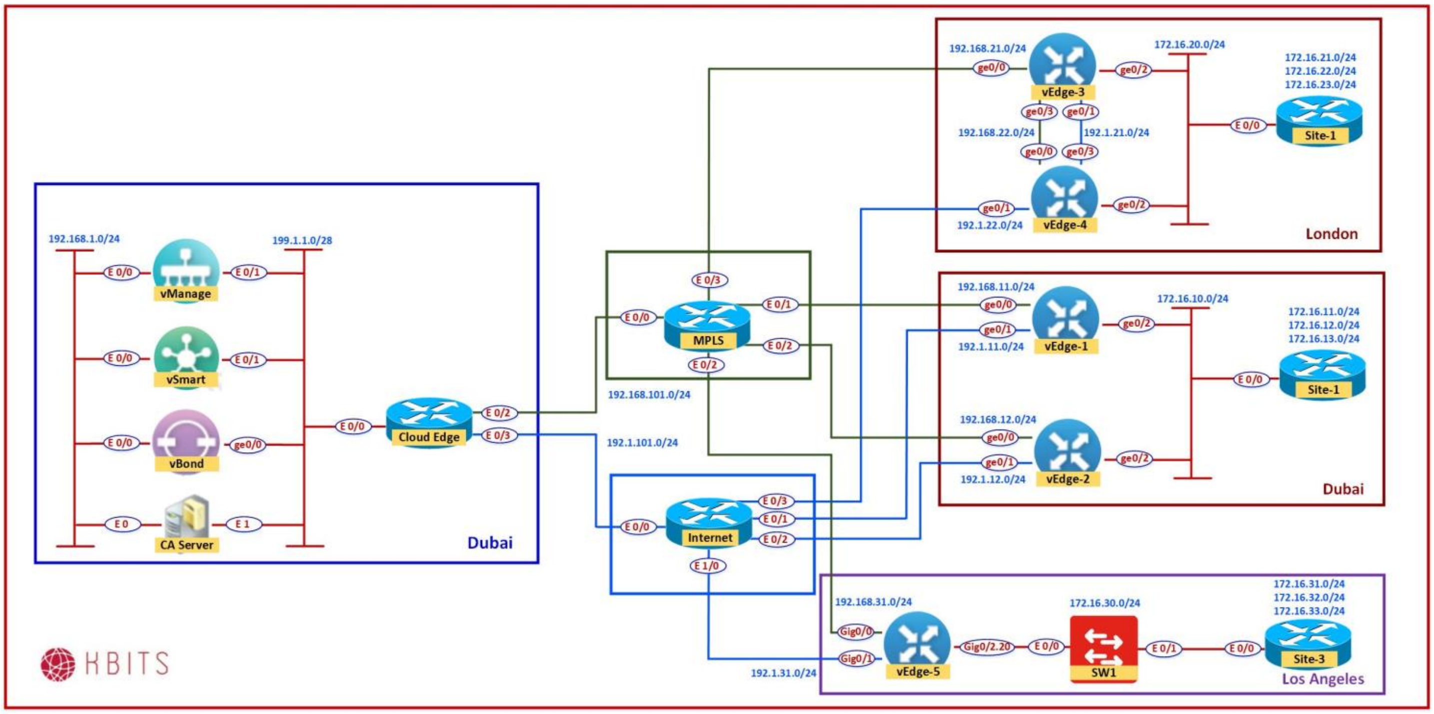
  Default
  Action: Accept

  - **Save the Policy.**

Task 3 – Create a Centralized Policy and call the Traffic Policy

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Centralized Policy -> Add Centralized Policy**
- Click **Next** on the **"Group of Interests"** page as we have already created the required lists.
- Click **Add Policy** on the **"Topology and VPN Membership"** page
- Click "**Import Existing"** and select the **Route-Leaking-10-20** from the drop-down list and click **Import**.
- Click **Next** to move to the "**Apply Policy to Sites and VPNs**" Page.
- Click the "**Topology"** tab.
- The **Route-Leaking-10-20** will be there. Apply the policy : **Inbound** towards DXB-LON & LA Sites
- Assign the Policy a name and Desription based on the following:
  - Policy Name : **Main-Central-Policy**
  - Description : **Main-Central-Policy**
- Click the **Save Policy** button towards the button.
- Activate the policy.
- Wait for it to push the policy to the reachable vSmart Controller(s).

Lab 38 - Implementing QoS - Configuring Custom Options



Requirements:

- Create 3 Class maps and assign them to queues based on the following:
  - Name: **CM-Priority** – **Queue**: 0
  - Name: **CM-Web** – **Queue:** 1
  - Name: **CM-Best-Effort** – Queue: 2

Task 1 – Create the Class-maps and apply it to a Queue

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Localized Policy -> Lists**

- Click **Class Map** and select **New Class Map.** Create 3 Class-Maps based on the following:

  - Name : **CM-Priority**
  - Queue : **0**

  - Name : **CM-Web**
  - Site ID : **1**

  - Name : **CM-Best-Effort**
  - Site ID : **2**

Task 2 – Create a Classification ACL to link the Traffic to the appropriate Class Maps

- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Localized Policy -> Lists**

- Click **Access Lists** and select **Add IPv4 ACL.** Create an ACL with a name of QOS-ACL with the following "Traffic to Class Map" Mappings

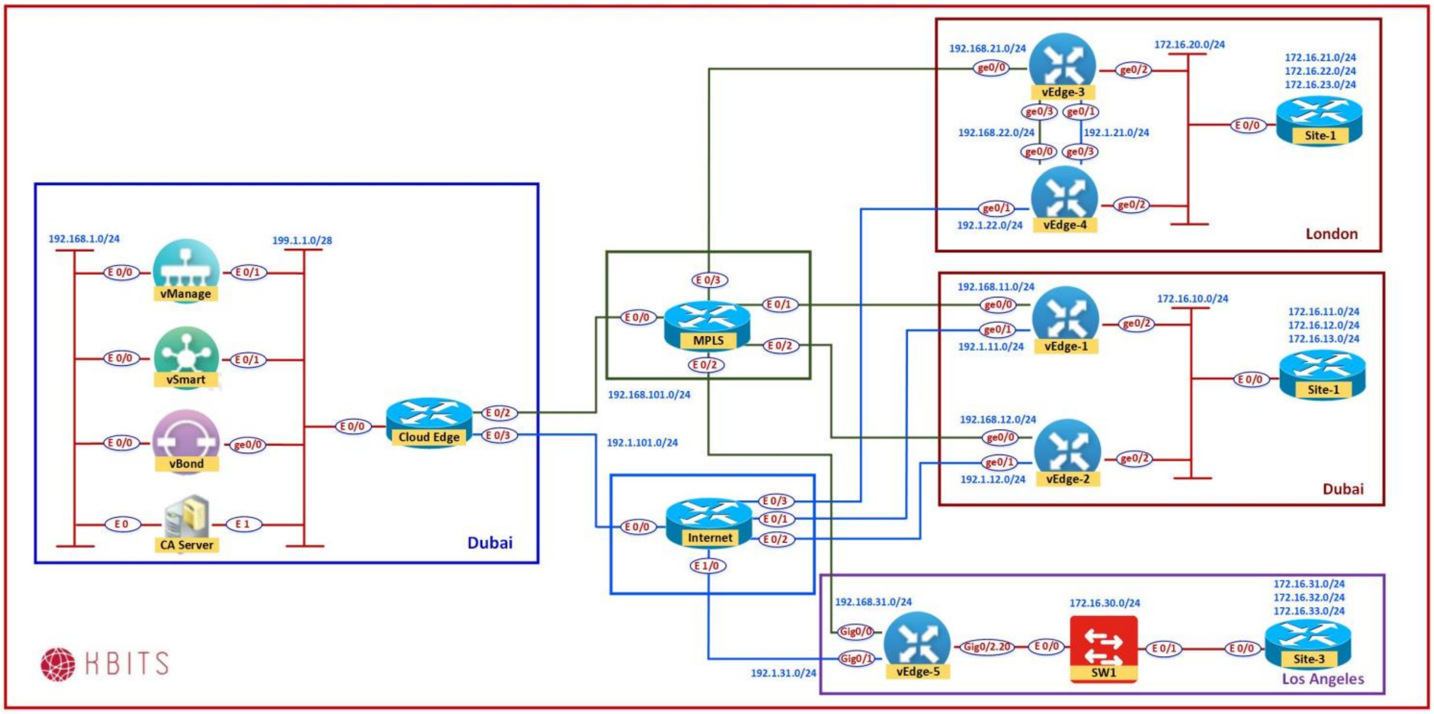
  - Traffic: **DSCP – 46**
  - Class-Map: **CM-Priority**

  - Traffic: **TCP/22 & 23**
    Class-Map: **CM-Priority**

  - Traffic: **TCP/80 & 443**
  - Class-Map: **CM-Web**

  - Traffic: **Rest**
  - Class-Map: **CM-Best-Effort**

Lab 39 - Implementing QoS - Configuring the Scheduler



Requirements:

➢ Configure the Queue characteristics in the Forwarding Class based on the following:

- **Queue 1**
  - Bandwidth reservation - **30%**
  - Scheduling - **wrr**
  - Drop - **Random Early Detection**

- **Queue 2**
  - Bandwidth reservation - **30%**
  - Scheduling - **wrr**
  - Drop - **Tail**

Task 1 – Create the Forwarding Class based on the above requirements

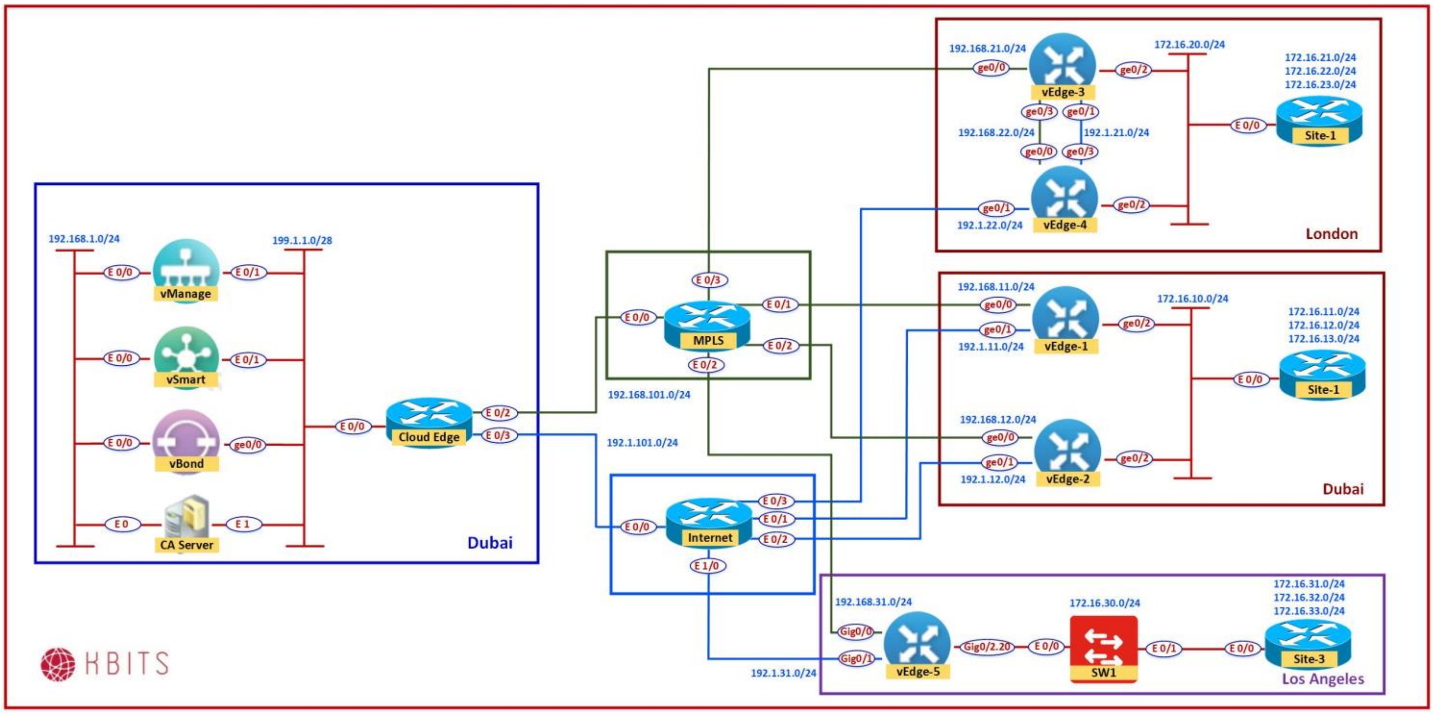
- In vManage, Navigate to **Configuration -> Policies -> Custom Options -> Localized Policy -> Forwarding Class/Qos**

- Click **Add Qos Map** and select **Create New.** Create a new Qos Map called **QOS-MAP** based on the following:

  - **Queue 1**
    - Bandwidth reservation - **30%**
    - Scheduling - **wrr**
    - Drop - **Random Early Detection**

  - **Queue 2**
    - Bandwidth reservation - **30%**
    - Scheduling - **wrr**
    - Drop - **Tail**

Lab 40 - Implementing QoS - Configure & apply the Localized Policies



Task 1 – Create a new Local Policy

- In vManage, Navigate to **Configuration -> Policies -> Localized Policy**
- Click **Next** on the **"Group of Interests"** page as we have already created the required lists.
- Click **Import Qos Map** on the **"Forwarding Class"** page.
- Click "**Import QoS Map". ** Select **QOS-MAP** from the drop-down list and click **Import**. Click **Next.**
- Click **Add IPv4 Access List** on the **"ACL Page"** page.
- Select **QOS-ACL** from the drop-down list and click **Import**. Click **Next.**
- The **Next** on the "**Route Policy"** page.
- Assign the Policy a name and Desription based on the following:
  - Policy Name : **QOS-POLICY**

- Description : **QOS-POLICY**

- Click the **Save Policy** button towards the button.

Task 2 – Apply the new policy to the Dubai Device Template

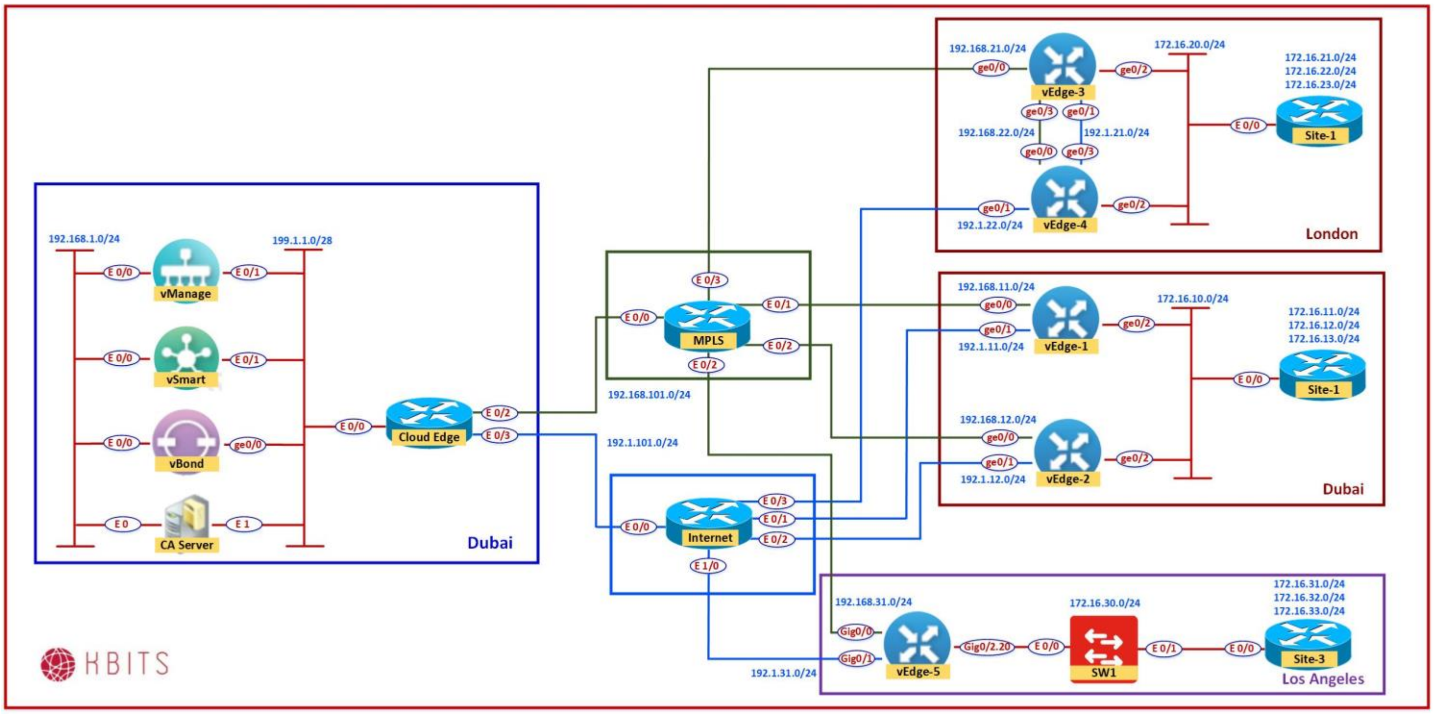
- In vManage, Navigate to **Configuration -> Templates -> Device Templates -> BR1-DEV-TEMP**

- Click **Edit**

- Configure the Localized Policy as **QOS-POLICY**

- Follow the prompts to update the 2 vEdges in BR1 (Dubai)

Lab 41 - Implementing QoS - Configure the Interface parameters using Templates



Task 1 – Apply the QOS-ACL to the "BR-VE-VPNINT-VPN1-G2-DXB-LON" template

- In vManage, Navigate to **Configuration -> Templates -> Feature Template -> BR-VE-VPNINT-VPN20-G2-DXB-LON -> Edit -> ACL/QoS**
- Enable the "**Ingress ACL – Ipv4**" globally.
- Specify the IPv4 Ingress Access List as **QOS-ACL.**

Task 2 – Apply the QOS-MAP & Shaper to the "BR1-VE-VPNINT-VPN0-G0" template

- In vManage, Navigate to **Configuration -> Templates -> Feature Template -> BR1-VE-VPNINT-VPN0-G0 -> Edit -> ACL/QoS**
- Specify the Shaping Rate (Kbps) as **500000**
- Specify the QoS MAP as **QOS-MAP**

Task 3 – Apply the QOS-MAP & Shaper to the "BR1-VPNINT-G1" template

- In vManage, Navigate to **Configuration -> Templates -> Feature Template -> BR1-VE-VPNINT-VPN0-G1 -> Edit -> ACL/QoS**
- Specify the Shaping Rate (Kbps) as **200000**
- Specify the QoS MAP as **QOS-MAP**

Implementing SDA

Authored By:

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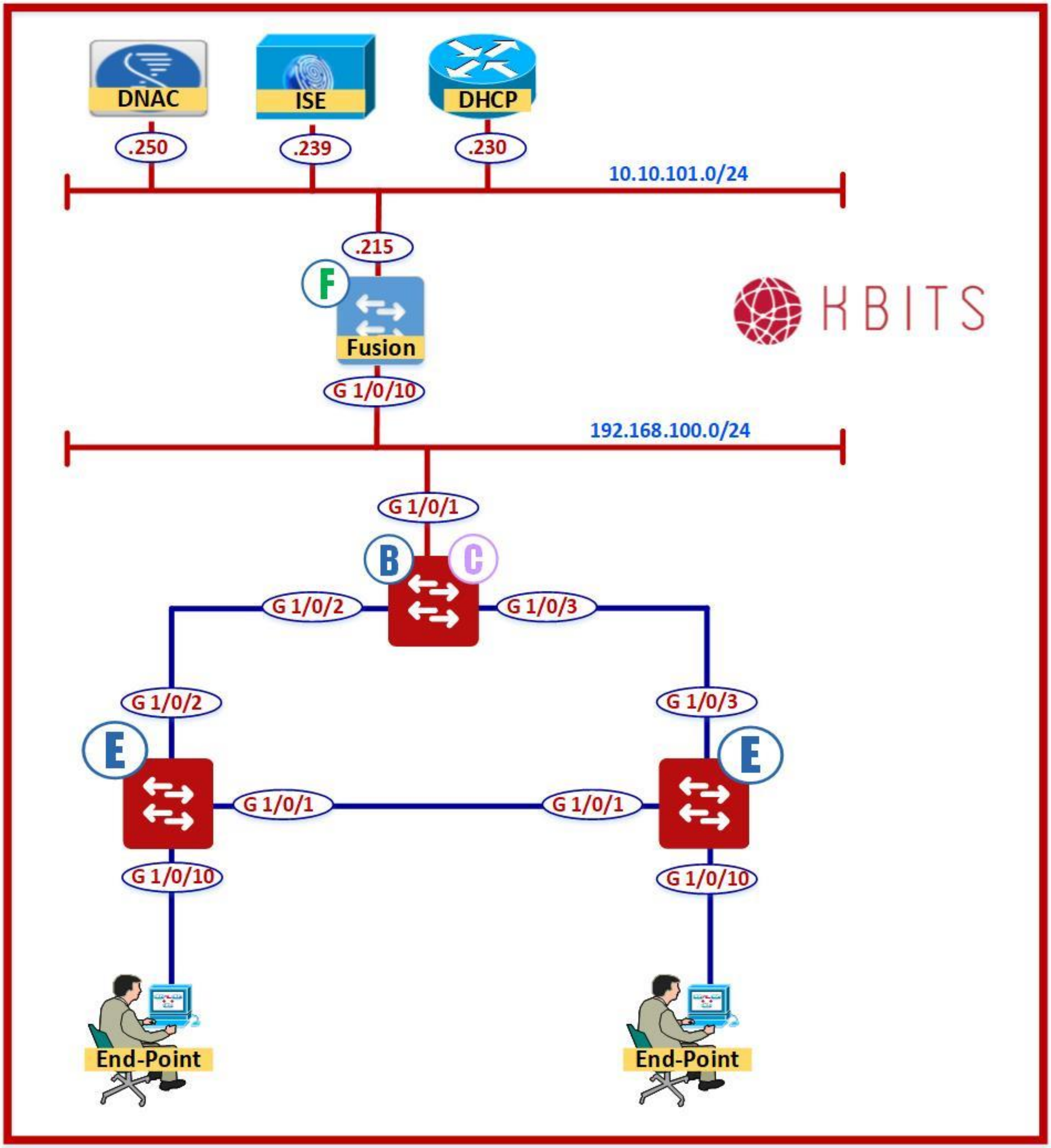
CCIE # 12353
Hepta CCIE#12353
CCDE # 20110020

Implementing SDA

Lab 1 – Configuring DNAC & ISE Integration



Task 1 – Turn on the Service on ISE

RADIUS

Administration -> System -> Settings -> Protocols -> RADIUS

- Uncheck "Reject RADIUS requests from clients with repeated failures"
- Uncheck "Suppress repeated failed clients".
- Uncheck "Suppress repeated successful authentications"
- Click Save

ERS

Administration -> System -> Settings -> ERS Settings

- Check Enable ERS for Read/Write
- Click Save

pxGrid

Administration -> System -> Deployment -> DNAC-ISE

- Check to enable the following:
  - **pxGrid**
- **Save**

2. Configure DNAC to communicate to ISE

Settings (Icon) -> System Settings -> Settings -> Authentication & Policy Servers -> Add

- ➔ Server IP Address: 10.10.101.239
- ➔ Shared Secret: Cisco@123
- ➔ Cisco ISE Server: Slide to Enable
- ➔ Username: admin
- ➔ Password: Cisco@123
- ➔ FQDN: dnac-ise.kbits.local
- ➔ Subsriber Name: DNAC-KBITS

Click Apply

3. Verify and Approve the Integration on ISE

Administration -> pxGrid Services

- ➔ Click on Total Pending and Approve All

Note: Need to see "Connected via XMPP dna-ise.kbits.local"

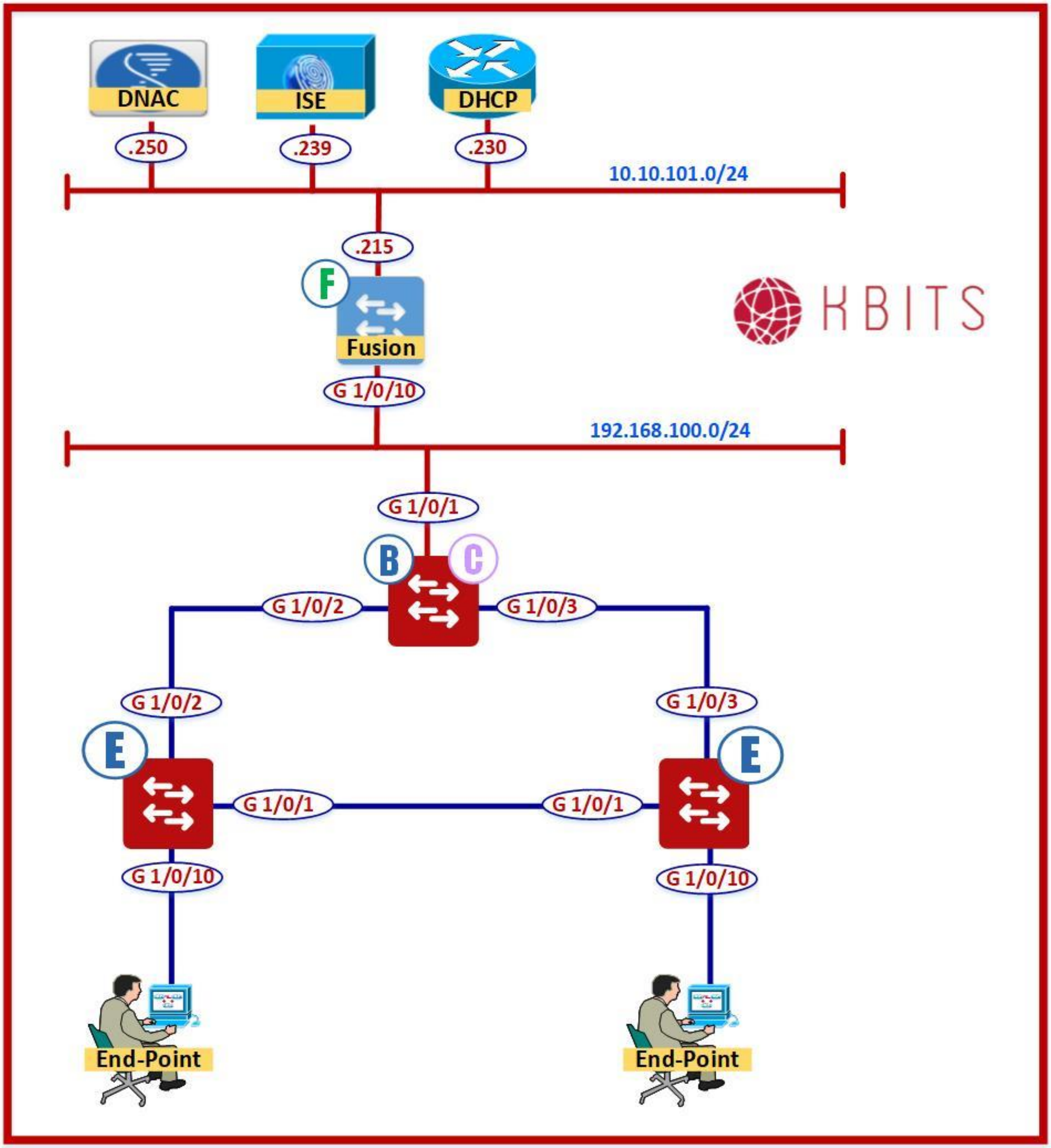
4. Migrate Policy Data from ISE into DNAC

Policy -> Group-Based Access Control -> Scalable Groups -> Start Migration (In Message)

- ➔ **Yes to accept**

Note: Wait for the Integration to complete

Lab 2 - Configuring Border Switch Initial Configuration



Task 1 – Configure Connectivity towards Fusion Router

9300CB

```
no ip domain lookup
!
line con 0
 logg sync
 no exec-timeout
!
hostname 9300CB
!
Interface Gig 1/0/1
 switchport mode trunk
!
vlan 199
!
ip routing
!
interface VLAN 199
 ip address 192.168.100.2 255.255.255.0
 no shut
!
ip route 0.0.0.0 0.0.0.0 192.168.100.1
```

Task 2 – Configure Telnet/SSH Credentials

9300CB

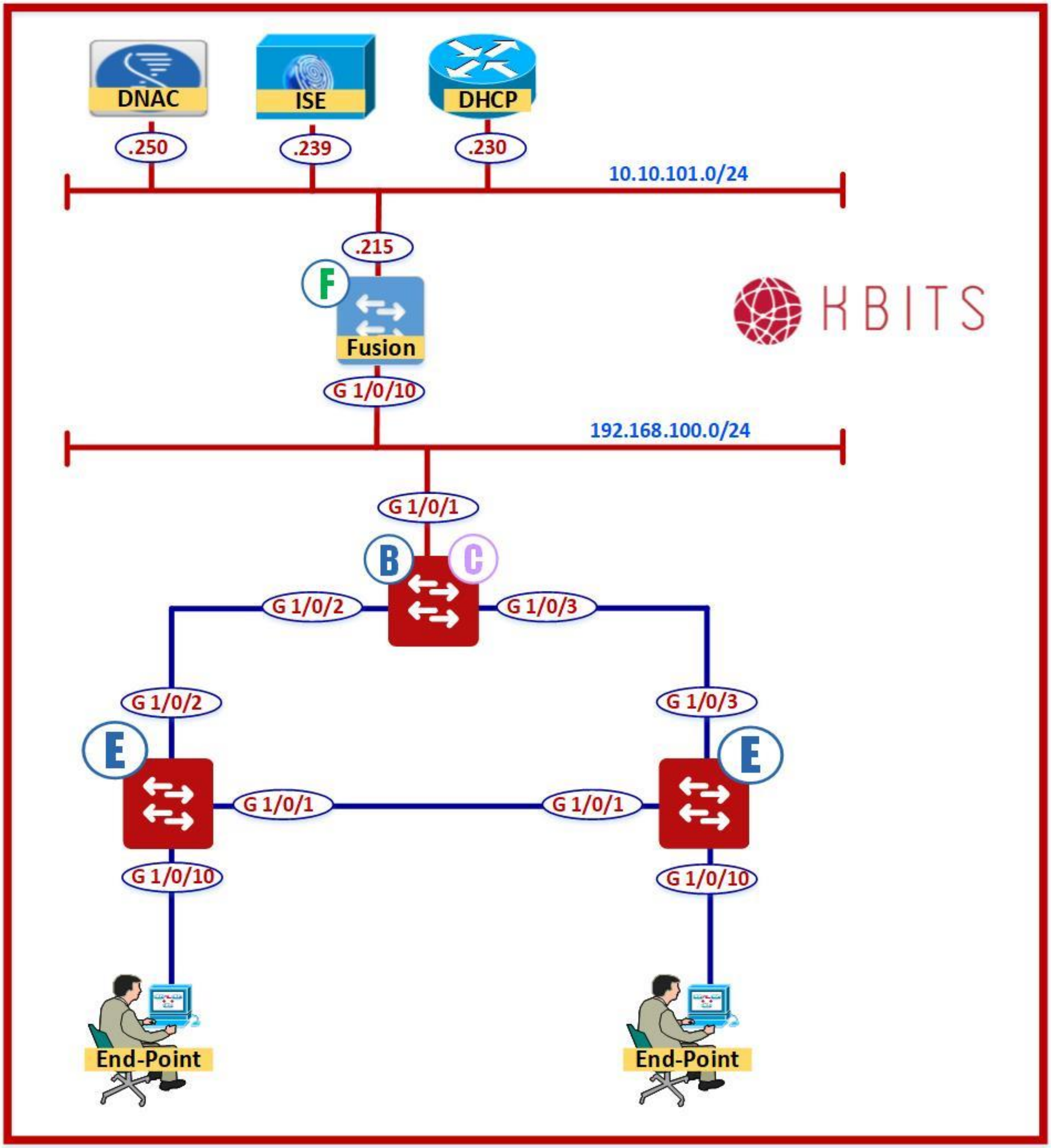
```
username kbits privilege 15 secret Cisco@123
!
line vty 0 4
 login local
```

Task 3 – Configure SNMP Parameters for RO & RW Communities

9300CB

```
snmp-server community RO ro public
snmp-server community RW rw private
```

Lab 3 - Configuring Fusion Router Initial Configuration

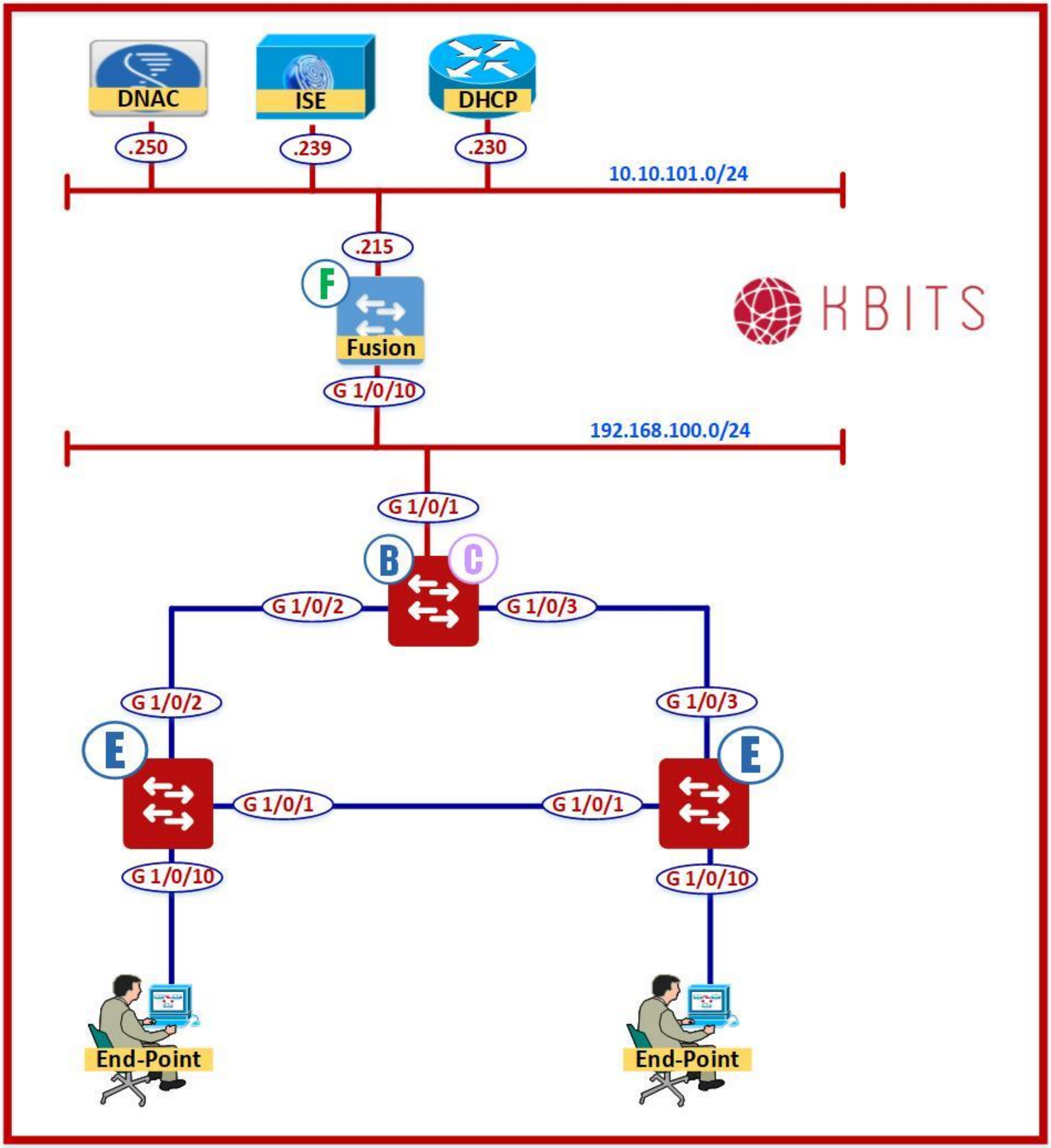


Task 1 – Configure Connectivity towards Fusion Router using VLAN 199

Fusion Router

```
hostname Fusion
!
Interface Gig 1/0/10
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
vlan 199
!
ip routing
!
interface VLAN 199
 ip address 192.168.100.1 255.255.255.0
 no shut
```

Lab 4 – DNAC Design - Network Hierarchy – Site & Building



Task 1 – Add an Area under Global

Desgin -> Network Hierarchy -> Add Site -> Add Area

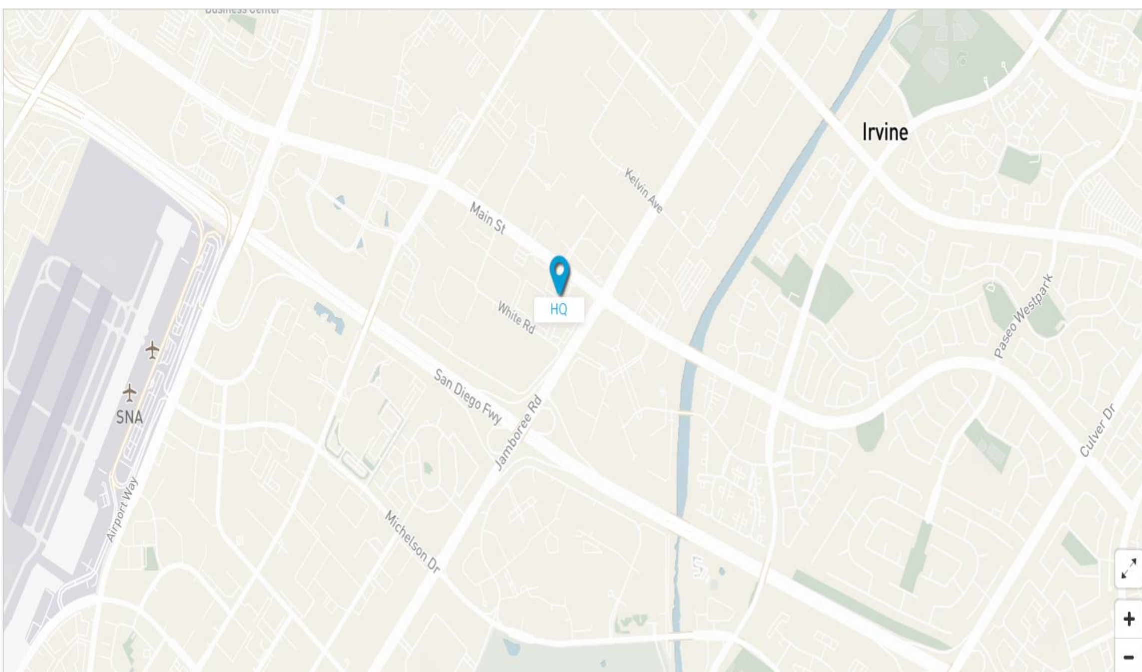
- ➔ Area Name: **Los Angeles**
- ➔ Parent: **Global**

Task 2 – Add a Building under Los Angeles

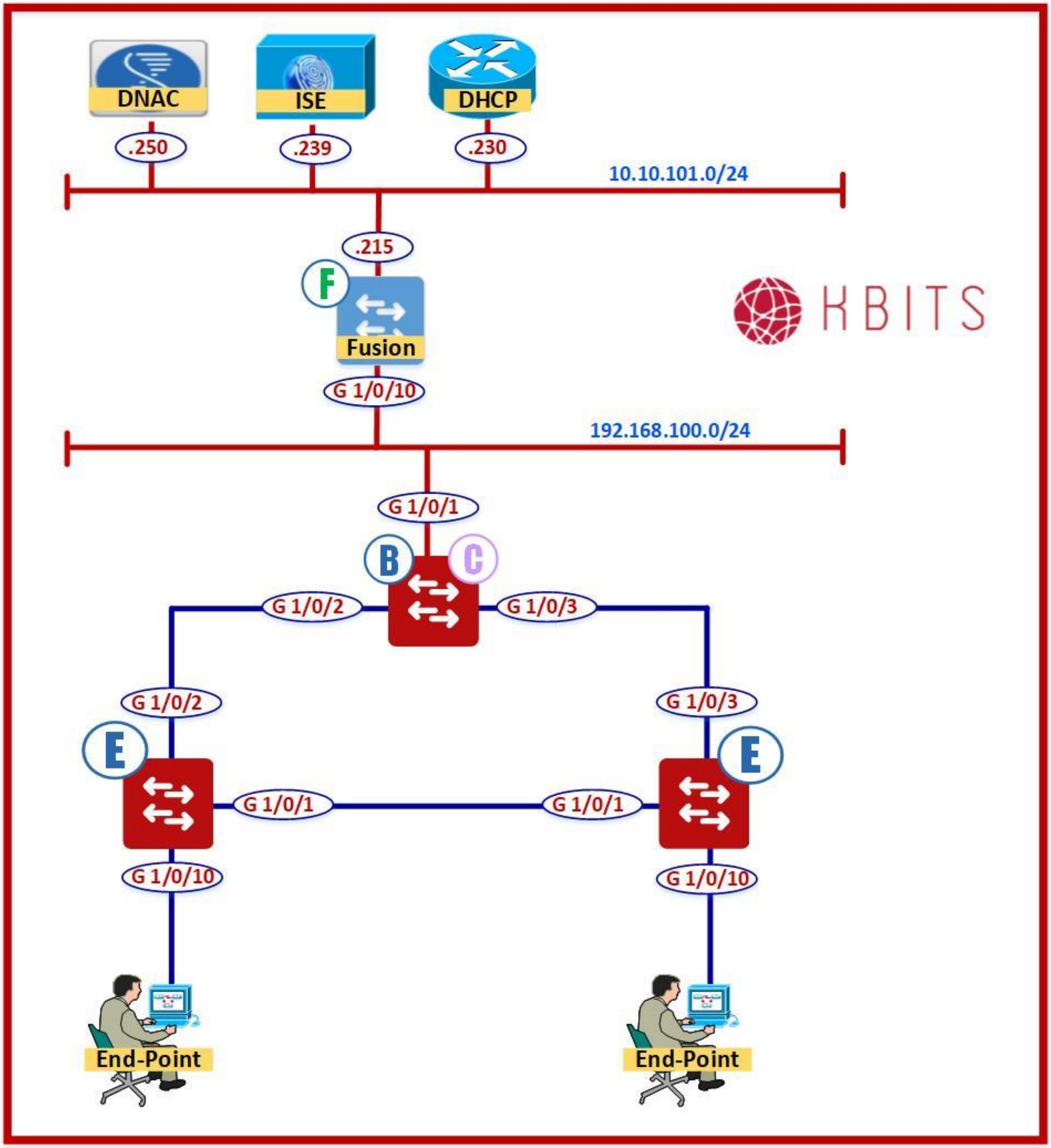
Desgin -> Network Hierarchy -> Add Site -> Add Building

- ➔ Building Name: **HQ**
- ➔ Parent: **Los Angeles**
- ➔ Address: **2640 Main Street, Irvine, California 92614, US**

- ➔ **Click Save**



Lab 5 – DNAC Design – Server Configuration – AAA, NTP etc



Task 1 – Add ISE & NTP Server to Network Settings

Desgin -> Network Settings -> Network -> Add

- ➔ Click ISE
- ➔ Click NTP
- ➔ **Click OK**

Task 2 – Add ISE Parameters

- ➔ Check Client/Endpoint

CLIENT/ENDPOINT

- ➔ Servers: **ISE**
- ➔ Protocols: **RADIUS**

- ➔ Client/Endpoint: **10.10.101.239 (Select from Drop-Down)**
- ➔ IP Address (Pri.): **10.10.101.239 (Select from Drop-Down)**

3. Add DHCP Server

- ➔ DHCP: **10.10.101.230**

4. Add NTP Server

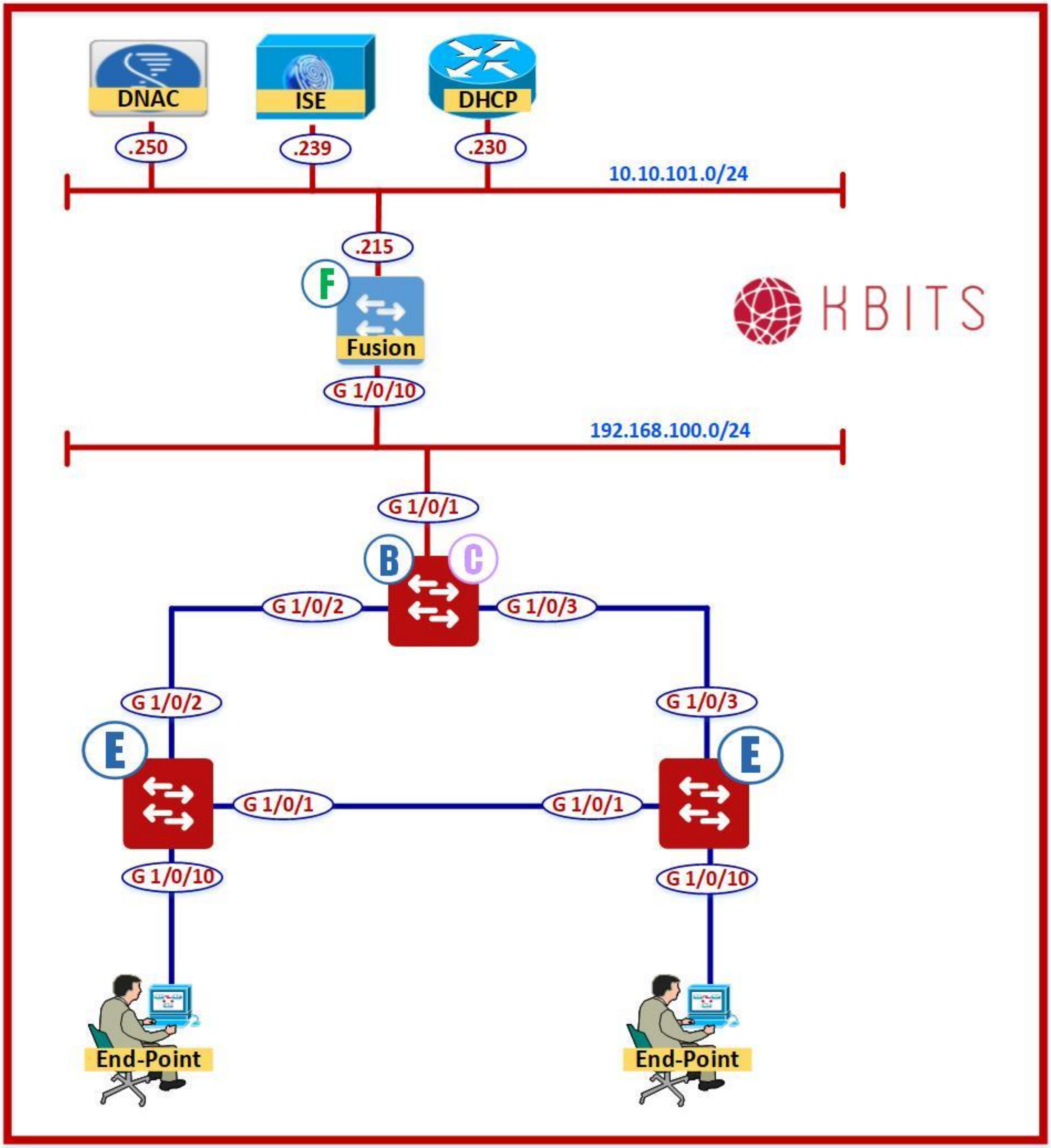
- ➔ NTP: **10.10.101.230**

5. Time Zone

- ➔ Time Zone: **PST8PDT**

➔ **Click Save**

Lab 6 – DNAC Design - Device Credentials



1. Configuring CLI Credentials

Design -> Network Settings -> Device Credentials

Note: Click to make sure you are setting it at the Global Level

CLI Credentials

- ➔ Name: **FabricAdmin**
- ➔ Username: **kbits**
- ➔ Password: **Cisco@123**
- ➔ Enable Password: **Cisco@123**

- ➔ **Click Save**

2. Configuring SNMP Credentials

Select SNMPV2C Read -> Click Add

- ➔ Type: **SNMP v2c**
- ➔ Community Type: **Read**

- ➔ Name: **RO**
- ➔ Community: **public**

Select SNMPV2C Write -> Click Add

- ➔ Type: **SNMP v2c**
- ➔ Community Type: **Write**

- ➔ Name: **RW**
- ➔ Community: **private**

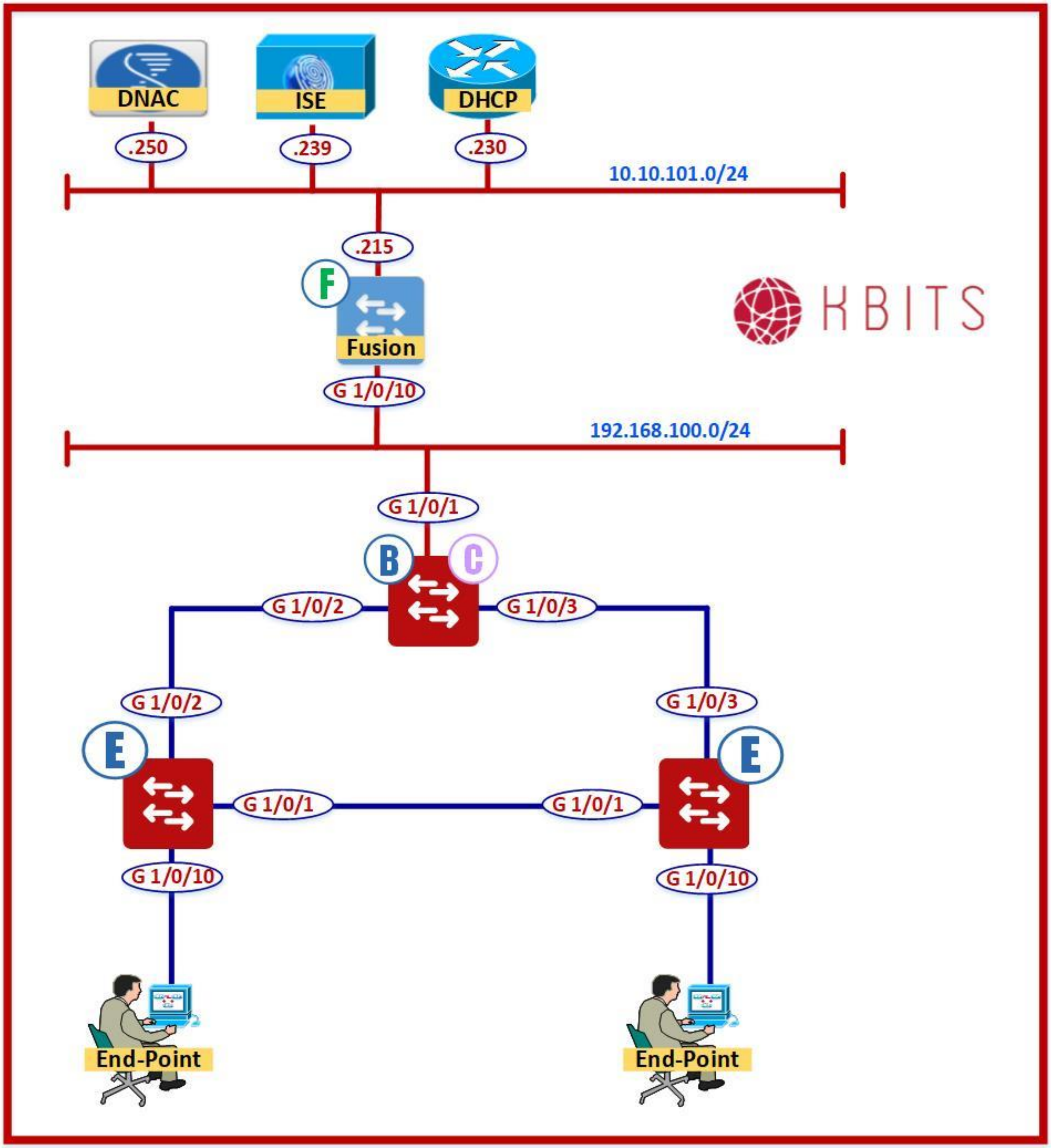
3. Delete exising CLI Admin

- ➔ **Click Save**

- ➔ Delete the existing CLI Admin

- ➔ **Click Save**

Lab 7 – DNAC Design - IP Address Pools



1. Configuring Overlay Global Level Pool

Design -> Network Settings -> IP Address Pools

Note: Click to make sure you are setting it at the Global Level

- ➔ Click on **Add**

- ➔ Name: **LA_OVERLAY_POOL**
- ➔ Type: **Generic**
- ➔ IP Addres Space: **(IPv4)**
- ➔ Subnet: **172.16.0.0**
- ➔ Prefix-length: **/16**

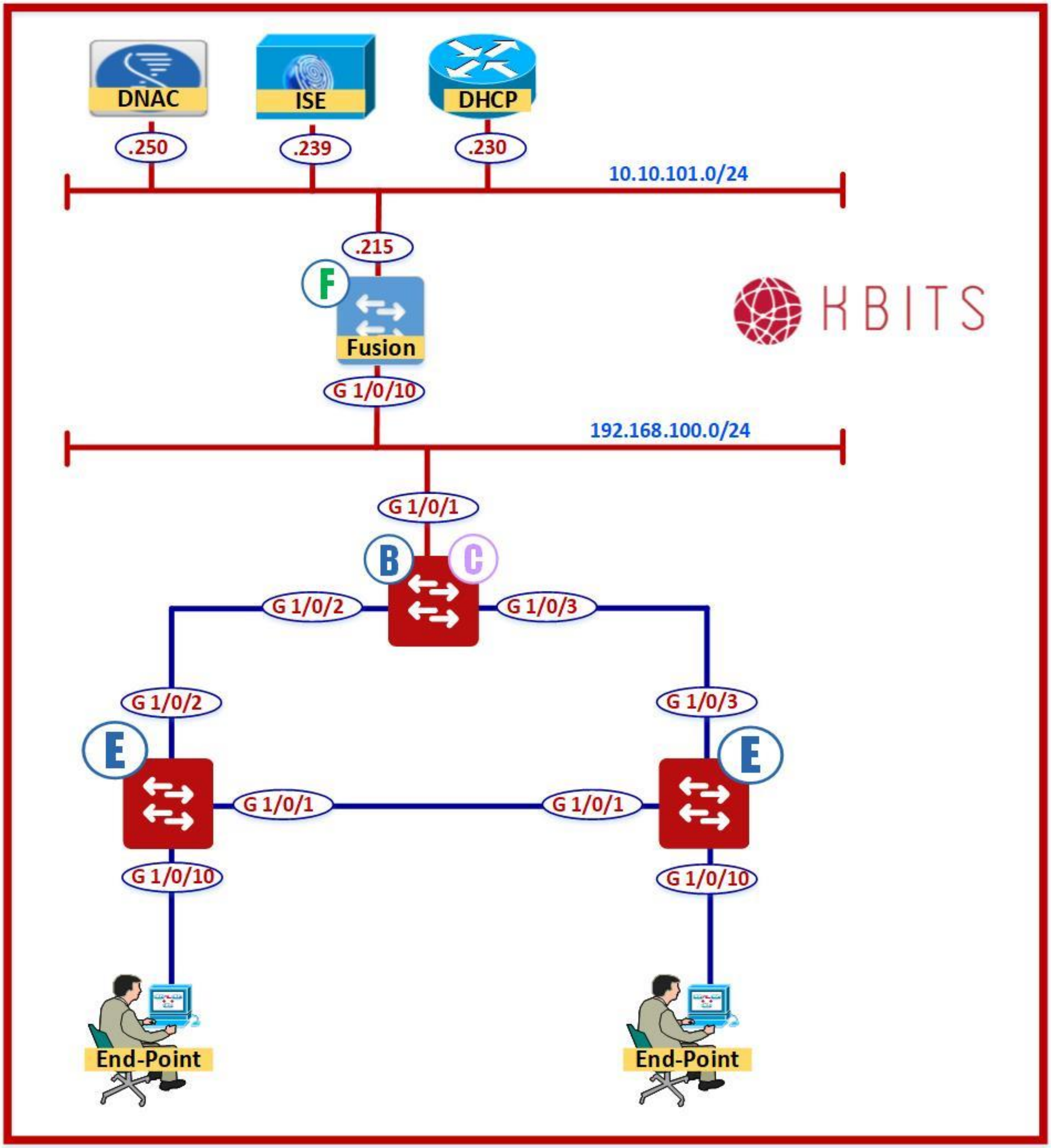
- ➔ **Click Save**

- ➔ Click on **Add**

- ➔ Name: **LA_UNDERLAY_POOL**
- ➔ Type: **Generic**
- ➔ IP Addres Space: **(IPv4)**
- ➔ Subnet: **172.20.0.0**
- ➔ Prefix-length: **/16**

- ➔ **Click Save**

Lab 8 – Manual Underlay Configuration – Fabric Skinny Configuration



Task 1 – Configurig the Underlay Network for IP connectivity

9300CB Interface Gig 1/0/2 no switchport ip address 192.168.11.1 255.255.255.0 no shut ! Interface Gig 1/0/3 no switchport ip address 192.168.22.1 255.255.255.0 no shut ! interface Loopback999 ip address 192.168.1.1 255.255.255.255 no shut
9300E1 Ip routing ! Interface Gig 1/0/2 no switchport ip address 192.168.11.2 255.255.255.0 no shut ! interface Loopback999 ip address 192.168.1.2 255.255.255.255 no shut
9300E2 Ip routing ! Interface Gig 1/0/3 no switchport ip address 192.168.22.3 255.255.255.0 no shut ! interface Loopback999 ip address 192.168.1.3 255.255.255.255 no shut

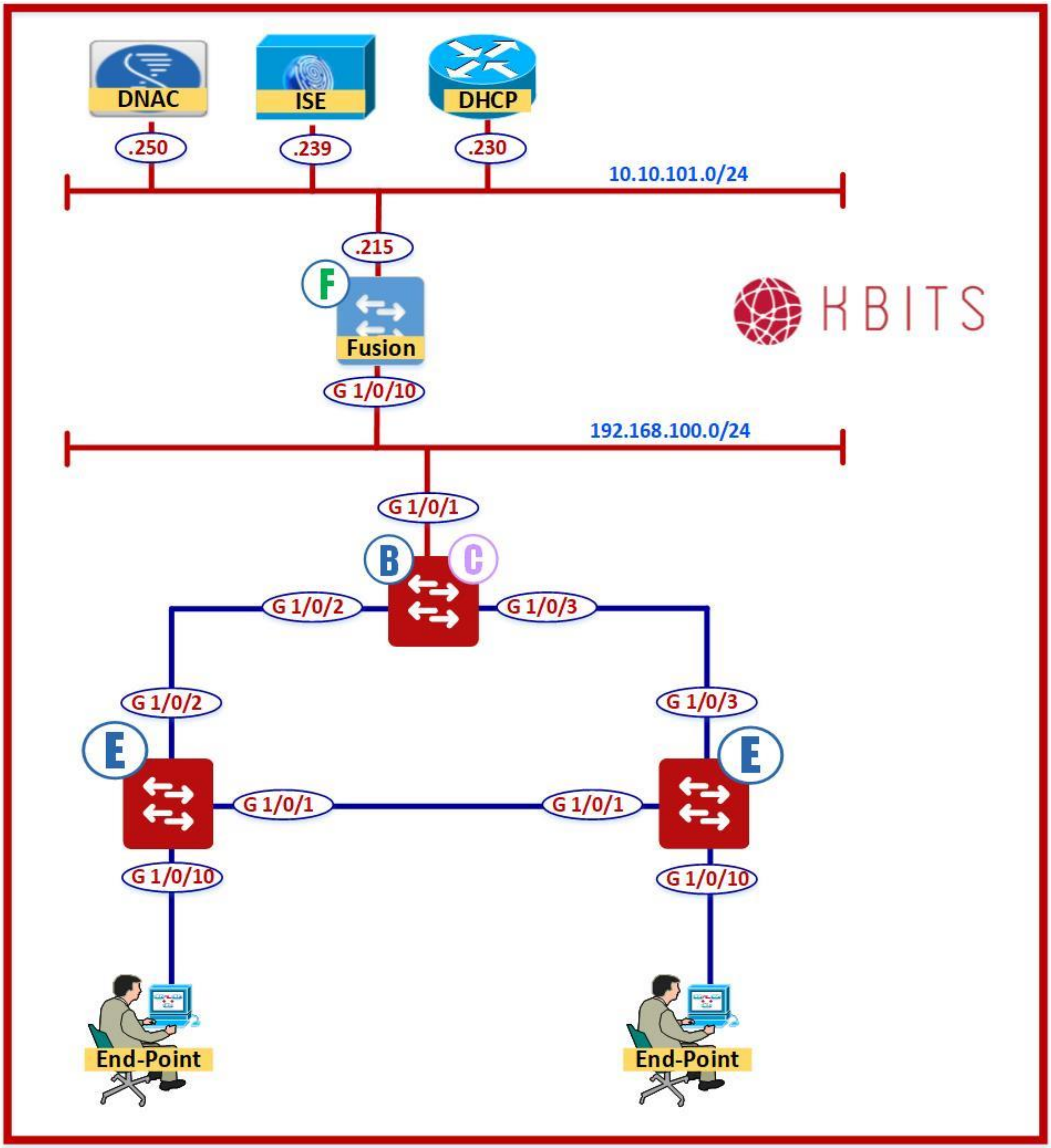
Task 2 – Configure Telnet/SSH Credentials

9300E1 username kbits privilege 15 secret Cisco@123 ! line vty 0 4 login local
9300E2 username kbits privilege 15 secret Cisco@123 ! line vty 0 4 login local

Task 3 – Configure SNMP Parameters for RO & RW Communities

9300E1 snmp-server community RO ro public snmp-server community RW rw private
9300E2 snmp-server community RO ro public snmp-server community RW rw private

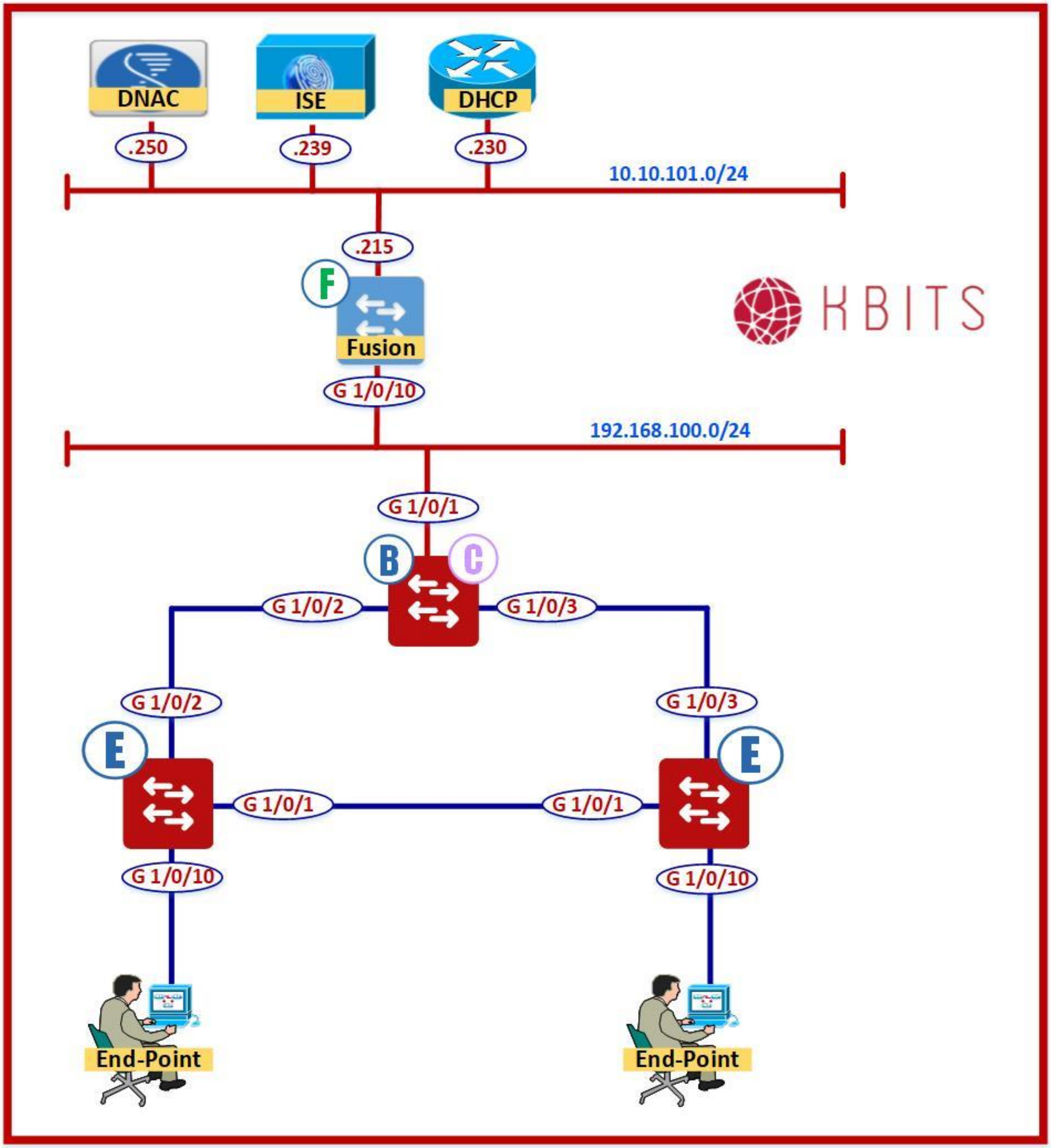
Lab 9 – Manual Underlay Configuration – Configuring IGP - OSPF



Task 1 – Configurig the Underlay Network IGP as OSPF to route the Loopback Networks.

Fusion Router Router ospf 1 Router-id 0.0.0.100 Network 192.168.100.0 0.0.0.255 area 0 Network 10.10.101.0 0.0.0.255 area 0 Passive-interface vlan 101
9300CB Router ospf 1 Router-id 0.0.0.1 Network 192.168.1.0 0.0.0.255 area 0 Network 192.168.11.0 0.0.0.255 area 0 Network 192.168.22.0 0.0.0.255 area 0 Network 192.168.100.0 0.0.0.255 area 0
9300E1 Router ospf 1 Router-id 0.0.0.2 Network 192.168.1.0 0.0.0.255 area 0 Network 192.168.11.0 0.0.0.255 area 0
9300E2 Router ospf 1 Router-id 0.0.0.3 Network 192.168.1.0 0.0.0.255 area 0 Network 192.168.22.0 0.0.0.255 area 0

Lab 10 – Manual Underlay Configuration – Device Discovery & Provisioning



1. Discover the Underlay

Tools -> Discovery -> Add Discovery

Note: Click to make sure you are setting it at the Global Level

- ➔ Discovery Name: **UnderLay**

IP Address/Range

- ➔ Discovery Type: **IP Address/Range**
- ➔ IP Addres Space: **192.168.1.1 – 192.168.1.3**

Credentials

- ➔ CLI: **kbits/FabricAdmin**

- ➔ SNMPv2c Read: **RO**
- ➔ SNMPv2c Write: **RW**
- ➔ Uncheck **SNMPv3**

- ➔ **Click Discover** to Start Discovery

Note: Wait for the Fabric devices to the discovered

2. Assign the Underlay Devices to the Site

Provision -> Unassigned Devices -> Inventory

- ➔ Select the **9300CB, 9300E1 & 9300E2**

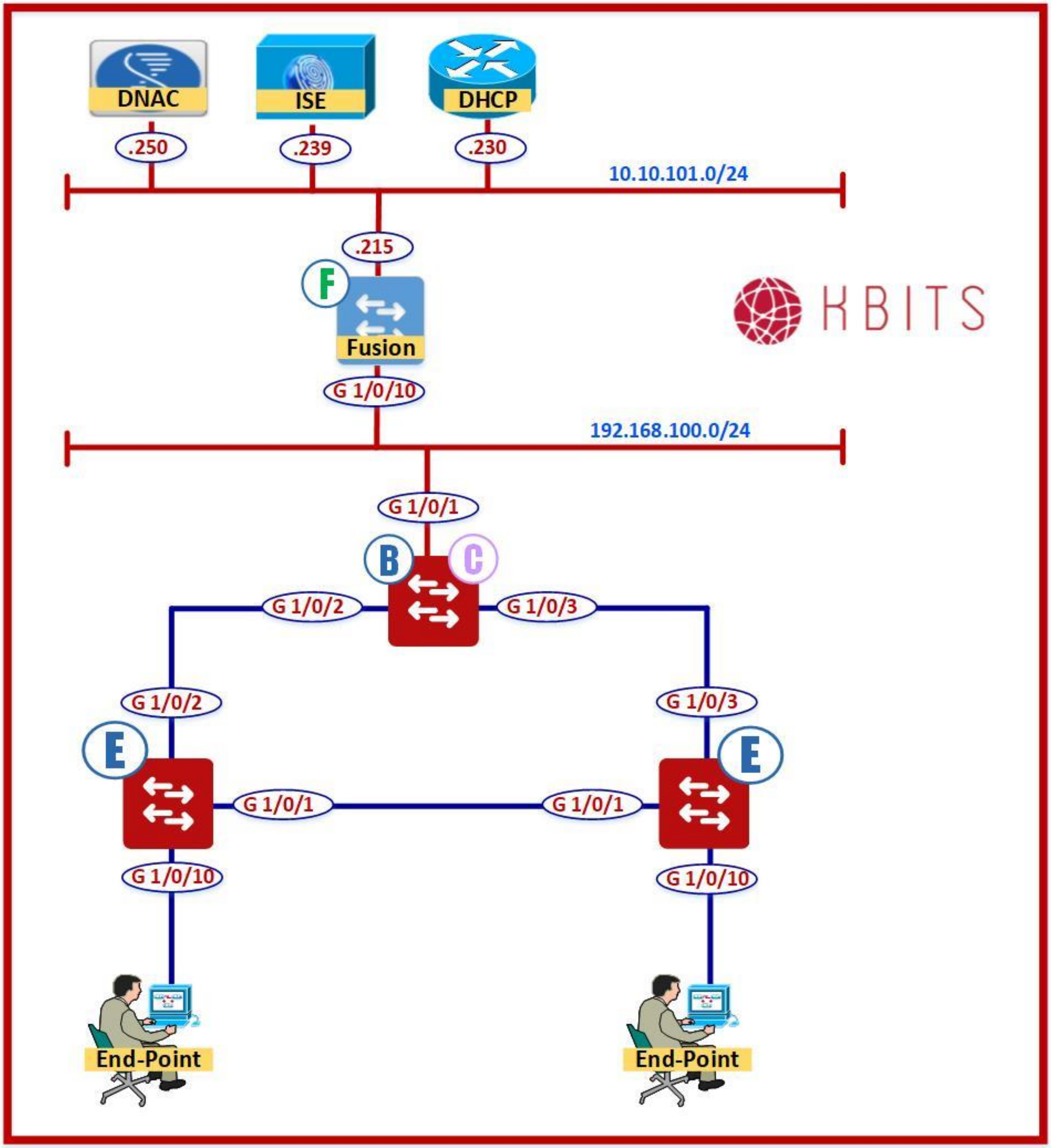
- ➔ Click **Actions -> Provision -> Assign Device to Site**

- ➔ **Select -> Global -> Los Angeles -> HQ**

- ➔ **Click Assign**

Note: The Switches will move under HQ

Lab 11 – LAN Automation – Seed Device Configuration & Discovery



Task 1 – Configure Connectivity towards Fusion Router

9300CB

```
no ip domain lookup
!
line con 0
 logg sync
 no exec-timeout
!
hostname 9300CB
!
Interface Gig 1/0/1
 switchport mode trunk
!
vlan 199
!
ip routing
!
interface VLAN 199
 ip address 192.168.100.2 255.255.255.0
 no shut
!
ip route 0.0.0.0 0.0.0.0 192.168.100.1
```

Task 2 – Configure Telnet/SSH Credentials

9300CB

```
username kbits privilege 15 secret Cisco@123
!
line vty 0 4
 login local
```

Task 3 – Configure SNMP Parameters for RO & RW Communities

9300CB
snmp-server community RO ro public snmp-server community RW rw private

2. Discover the Seed Device

Tools -> Discovery -> Add Discovery

Note: Click to make sure you are setting it at the Global Level

- ➔ Discovery Name: **SEED-DEVICE**

  IP Address/Range

- ➔ Discovery Type: **IP Address/Range**
- ➔ IP Addres Space: **192.168.100.2 – 192.168.100.2**

  Credentials

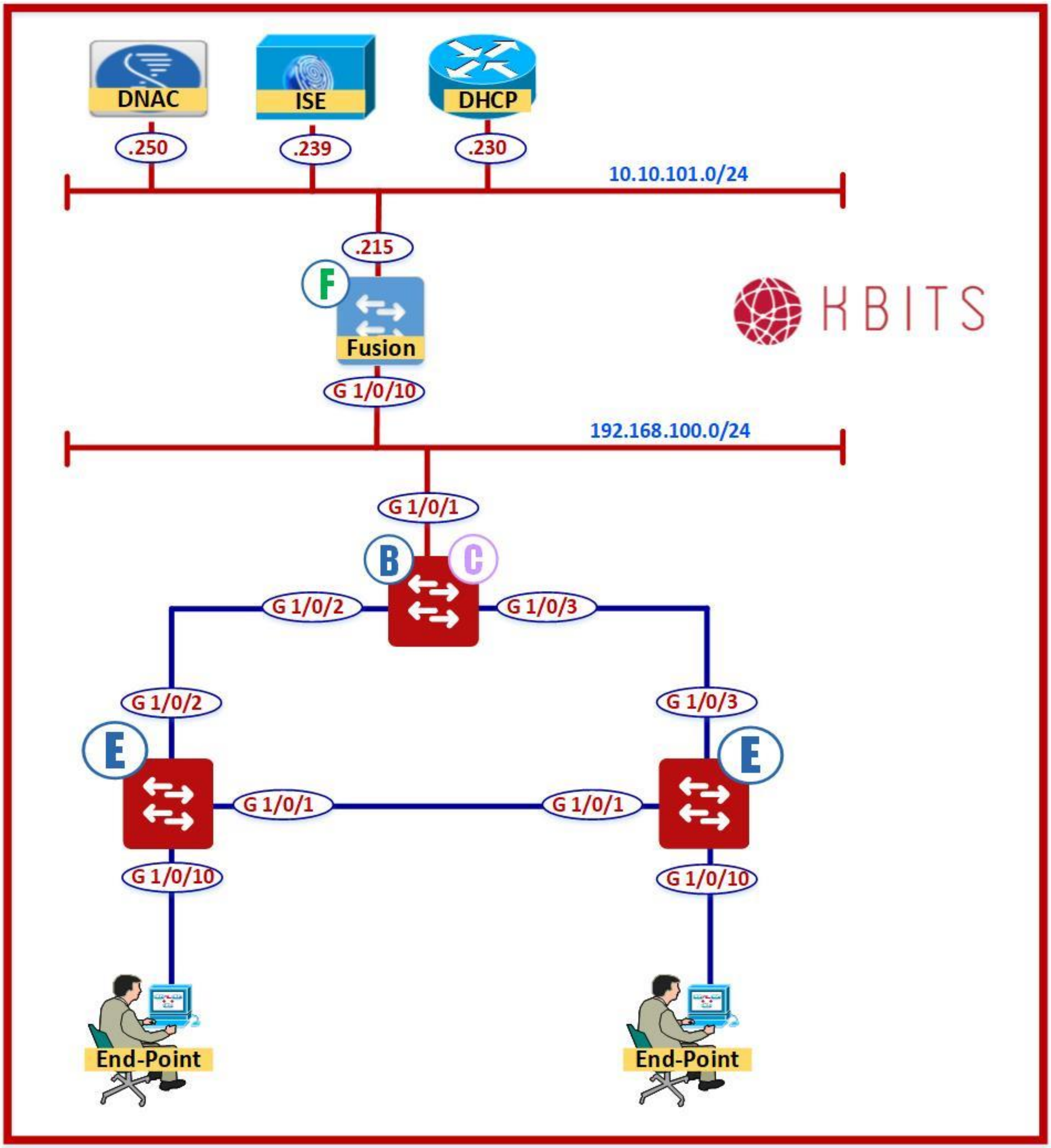
- ➔ CLI: **kbits/FabricAdmin**

- ➔ SNMPv2c Read: **RO**
- ➔ SNMPv2c Write: **RW**
- ➔ Uncheck **SNMPv3**

- ➔ **Click Discover** to Start Discovery

Note: Wait for the 9300CB to be discovered

Lab 12 – LAN Automation – Seed Device Assignment



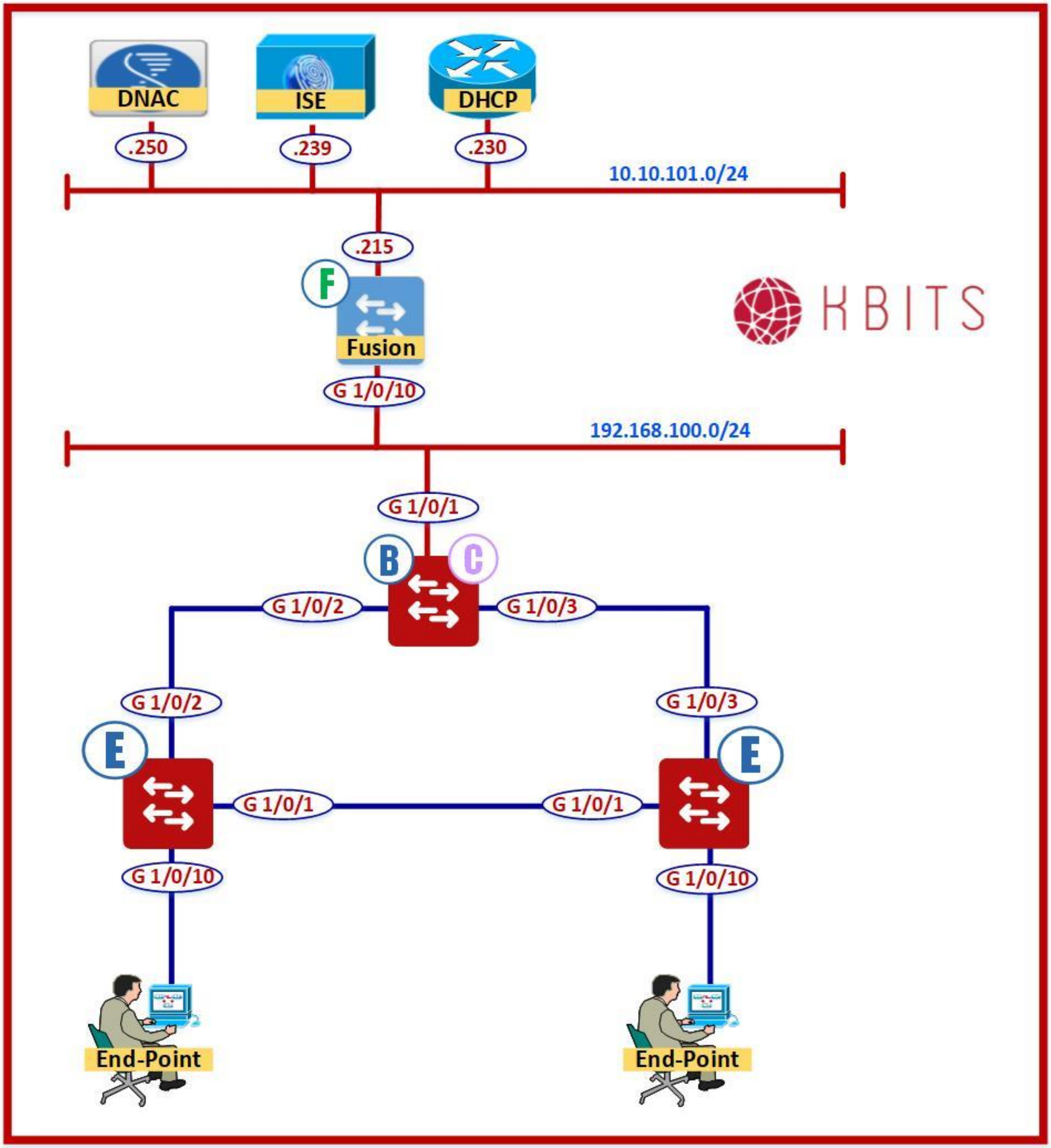
1. Assign the Seed Device

Provision -> Unassigned Devices -> Inventory

- ➔ Select the **9300CB**
- ➔ Click **Actions -> Provision -> Assign Device to Site**
- ➔ **Select -> Global -> Los Angeles -> HQ**
- ➔ **Click Assign**

Note: The Switch will move under HQ

Lab 13 – LAN Automation – Implementing LAN Automation



Task1 - Reserve a Pool for LAN AUTOMATION for the HQ Site

Design -> Network Settings -> IP Address Pools -> Global -> Los Angeles -> HQ

- ➔ Click **Reserve**

- ➔ IP Addrss Pool Name: **LAN_AUTOMATION_HQ**
- ➔ Type: **LAN**
- ➔ IPv4 Global Pool: **172.20.0.0/24**

- ➔ Select **UNDERLAY_GLOBAL**

- ➔ Prefix Length: **/24**
- ➔ IPv4 Subnet: **172.20.1.0**

- ➔ **Click Save**

Task 2 – Configure the Device Credentials for HQ

Design -> Network Settings -> Device Credentials -> Global -> Los Angeles -> HQ

- ➔ Select CLI Credentials: **FabricAdmin**
- ➔ Select SNMP Credentials: SNMPV2C Read : **RO**
- ➔ Select SNMP Credentials: SNMPV2C Write : **RW**

- ➔ **Click Save**

Task 3 – Configure the Fusion Router with a Static Route for the LAN Automation Pool pointing towards the Seed/Border Device

Fusion Router
Ip route 172.20.0.0 255.255.0.0 192.168.100.2

Task 4 - Initiate LAN AUTOMATION

Provision -> Inventory -> Action -> Provision -> LAN AUTOMATION -> Start

- ➔ Primary Site: **Global/Los Angeles/HQ**
- ➔ Primary Device: **9300CB**
- ➔ Selected Ports of Primary Device: **Gig1/0/2 & Gig1/0/3**

- ➔ Discoverd Device Site: **HQ**
- ➔ IP Pool: **LAN_AUTOMATION_HQ**
- ➔ IS-IS Domain Password: **Cisco@123**

- ➔ **Click Save to Initiate LAN Automation**

Task 5 - Discover the Devices

Provision -> Inventory -> Action -> Provision -> LAN AUTOMATION Status

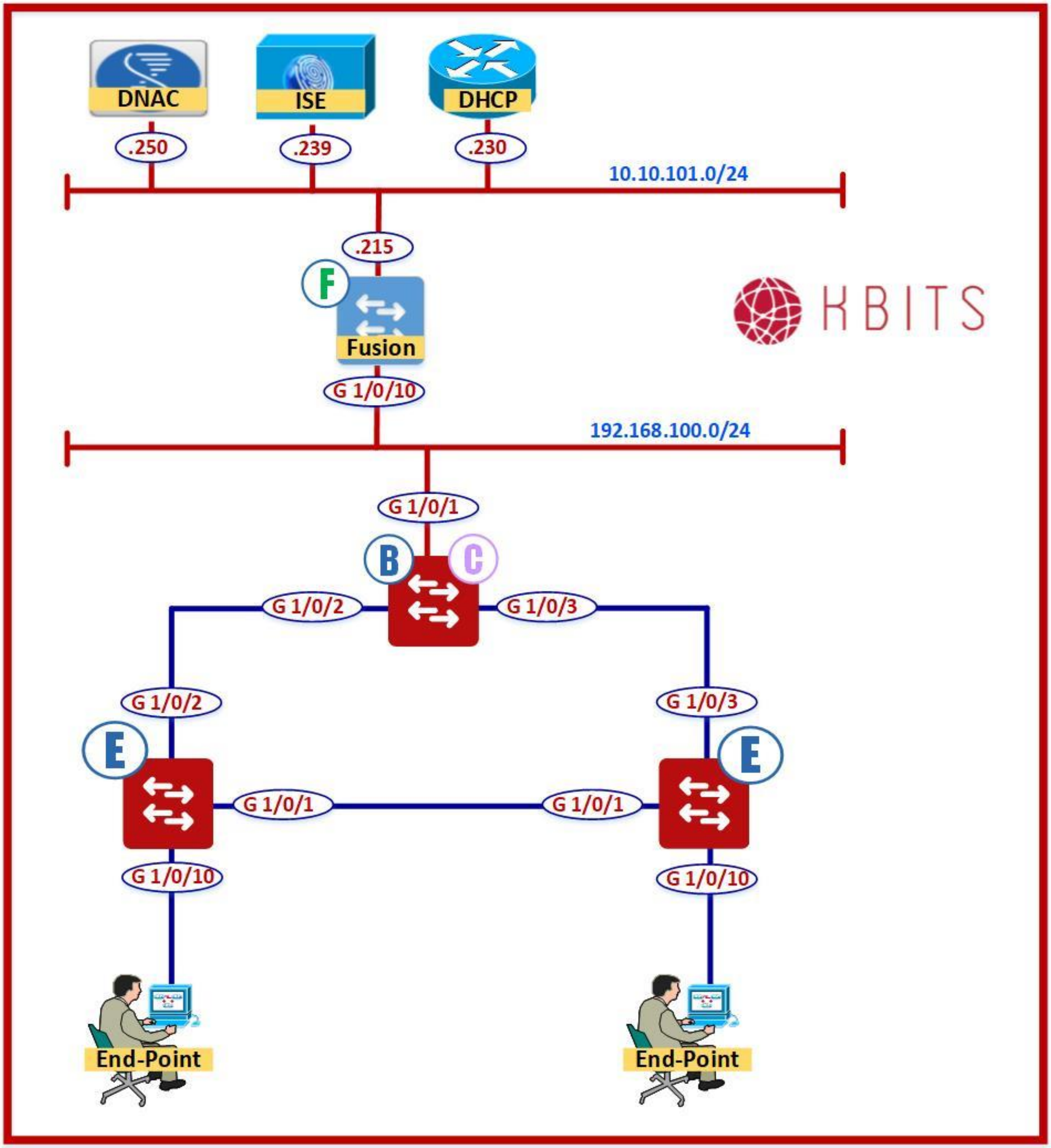
- ➔ Click on **Devices** to verify the devices

- ➔ Wait until the switches are **Managed**

- ➔ Click **Stop** to stop **LAN AUTOMATION**

Note: The devices should show up as "Managed" & "Access"

Lab 14 – LAN Automation – Provisioning the devices to HQ Site



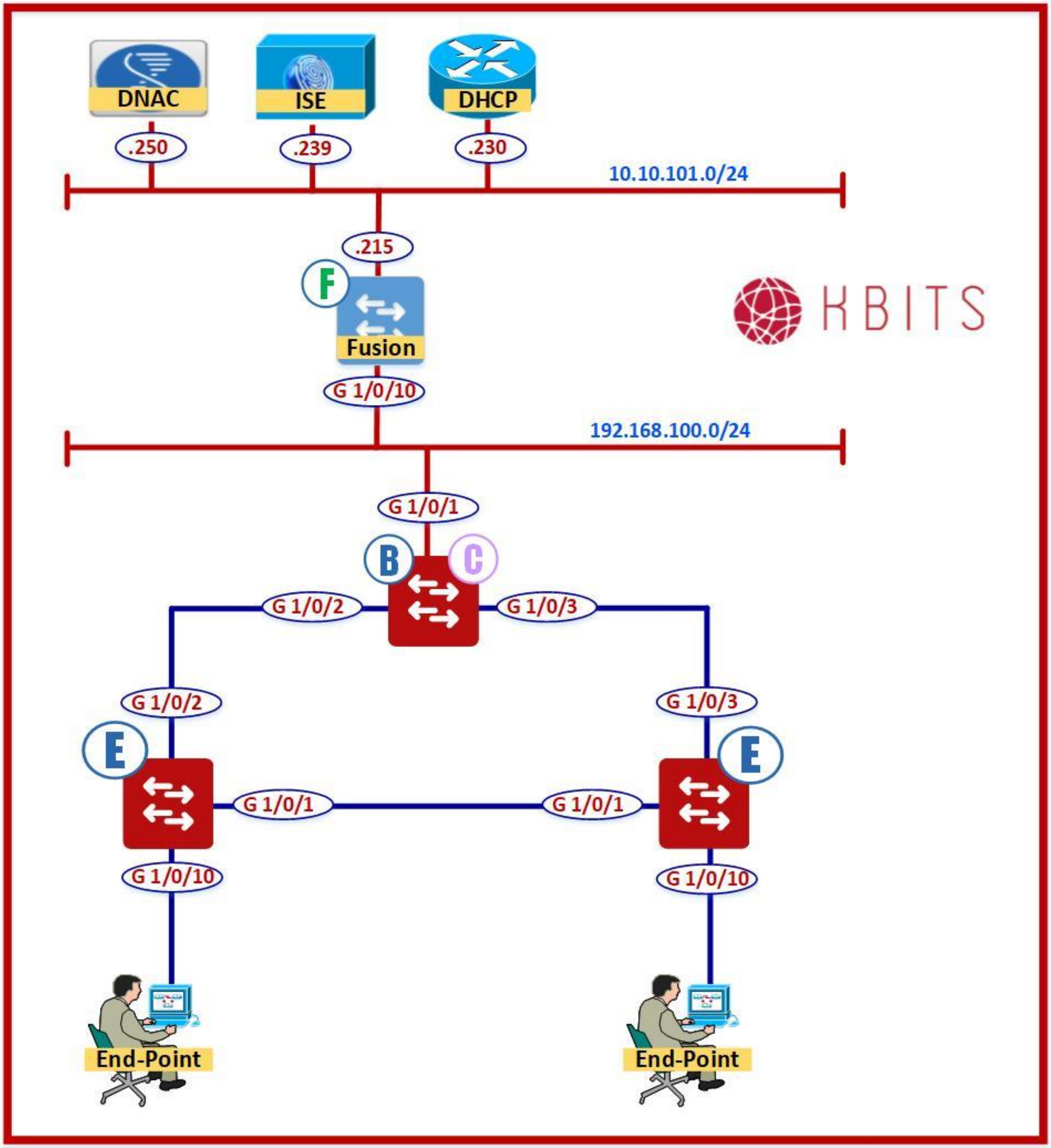
Task 1 – Provision the devices as HQ Devices

Provision -> Global -> Los Angeles -> HQ

- ➔ Select **“All” the devices**
- ➔ Click **Action -> Provision -> Provision the device**
- ➔ **Select -> Global -> Los Angeles -> HQ** & Check "**Apply to all devices**"
- ➔ **Click Assign**

Note: The devices are now available for Device Role Assignment under the HQ Fabric

Lab 15 – Reserve the IP Pools for HQ Site for Overlay & Underlay



Task 1 – Configure the pools for the IT Department/VN from the OVERLAY_GLOBAL Pool

Design -> Network Settings -> IP Address Pools -> HQ

- ➔ Name: **IT-DATA-1-POOL**
- ➔ Prefix Length: **/24**
- ➔ IPv4 Subnet: **172.16.1.0**
- ➔ Default GW: **172.16.1.254**
- ➔ DHCP Server: **10.10.101.230**

- ➔ Name: **IT-DATA-2-POOL**
- ➔ Prefix Length: **/24**
- ➔ IPv4 Subnet: **172.16.2.0**
- ➔ Default GW: **172.16.2.254**
- ➔ DHCP Server: **10.10.101.230**

- ➔ Name: **IT-VOICE-1-POOL**
- ➔ Prefix Length: **/24**
- ➔ IPv4 Subnet: **172.16.101.0**
- ➔ Default GW: **172.16.101.254**
- ➔ DHCP Server: **10.10.101.230**

Task 2 – Configure the pools for the SALES Department/VN from the OVERLAY_GLOBAL Pool

Design -> Network Settings -> IP Address Pools -> HQ

- ➔ Name: **SALES-DATA-1-POOL**
- ➔ Prefix Length: **/24**
- ➔ IPv4 Subnet: **172.16.3.0**
- ➔ Default GW: **172.16.3.254**
- ➔ DHCP Server: **10.10.101.230**

- ➔ Name: **SALES-DATA-2-POOL**
- ➔ Prefix Length: **/24**
- ➔ IPv4 Subnet: **172.16.4.0**
- ➔ Default GW: **172.16.4.254**
- ➔ DHCP Server: **10.10.101.230**

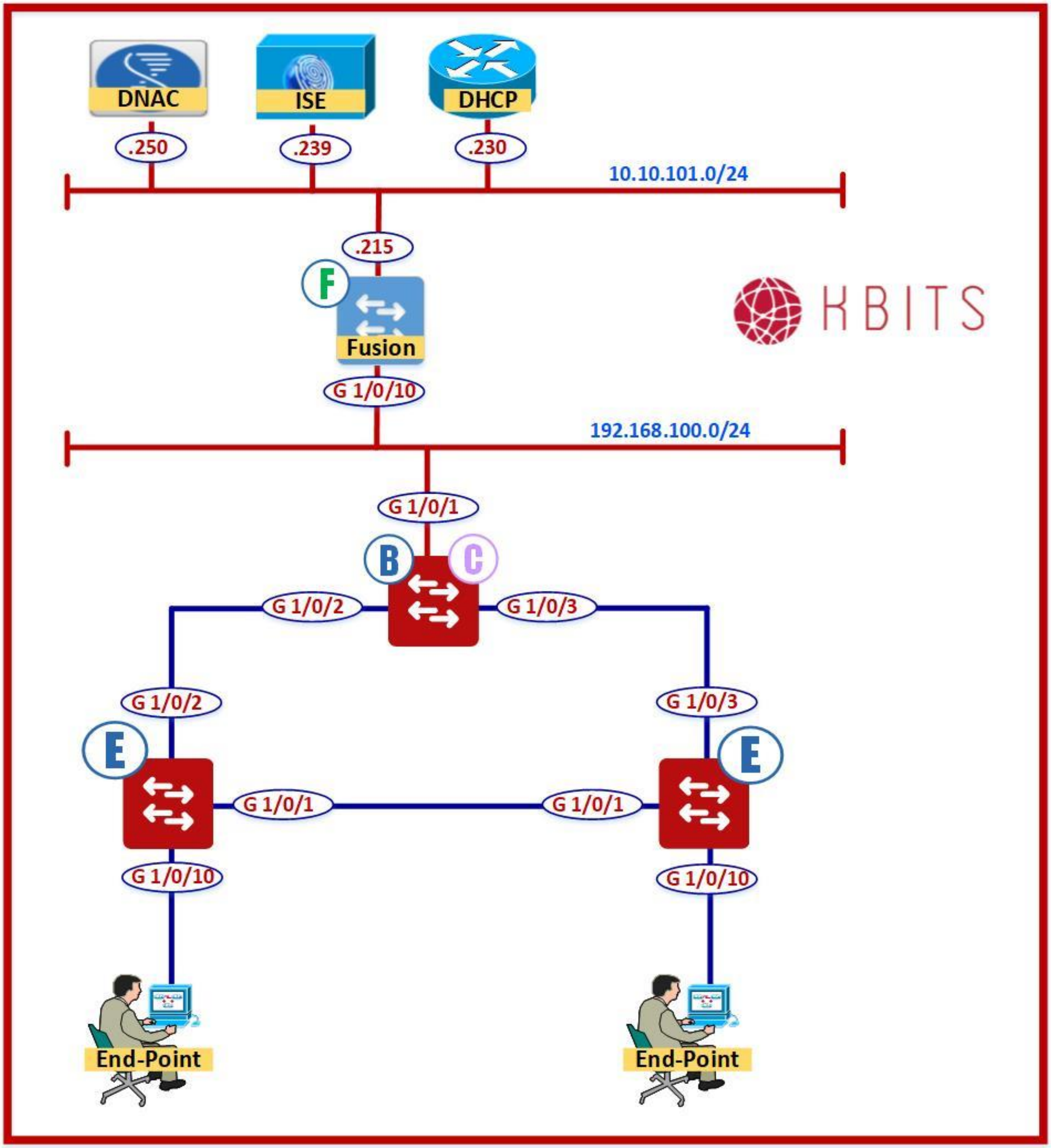
- ➔ Name: **SALES-VOICE-1-POOL**
- ➔ Prefix Length: **/24**
- ➔ IPv4 Subnet: **172.16.102.0**
- ➔ Default GW: **172.16.102.254**
- ➔ DHCP Server: **10.10.101.230**

Task 3 – Configure the pool for L3HANDOFF from the UNDERLAY_GLOBAL Pool

Design -> Network Settings -> IP Address Pools -> HQ

- ➔ Name: **L3HANDOFF_POOL**
- ➔ Prefix Length: **/24**
- ➔ IPv4 Subnet: **172.20.2.0/24**

Lab 16 – Create VNs for the Fabric



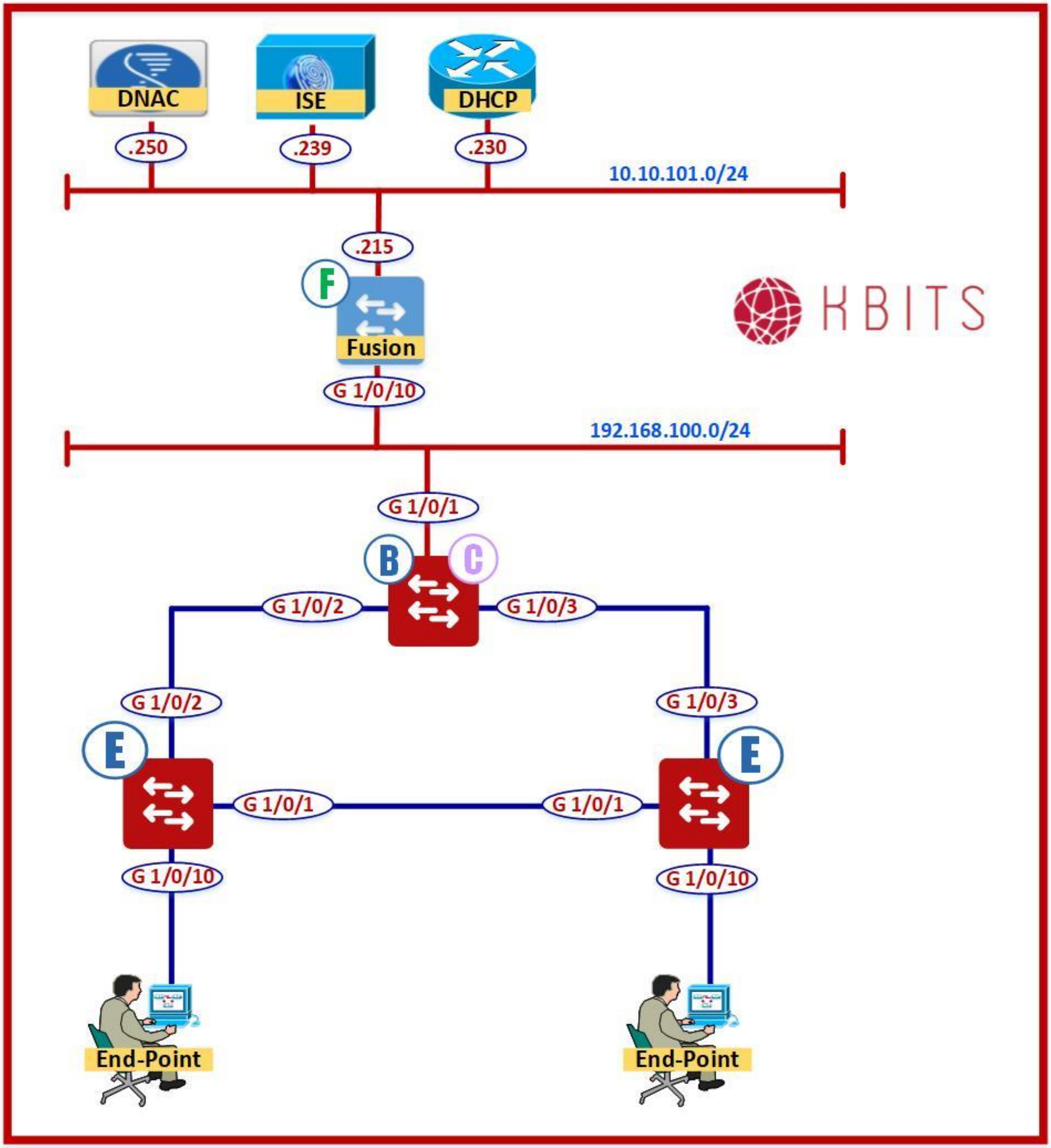
Task 1 – Create the VNs that wil be used in the Fabric

Policy -> Virtual Network -> Add

Add the following VNs

- ➔ Name: **IT_VN**
- ➔ Name: **SALES_VN.**

Lab 17 - Create the Transit Network – (L3 Handoff)



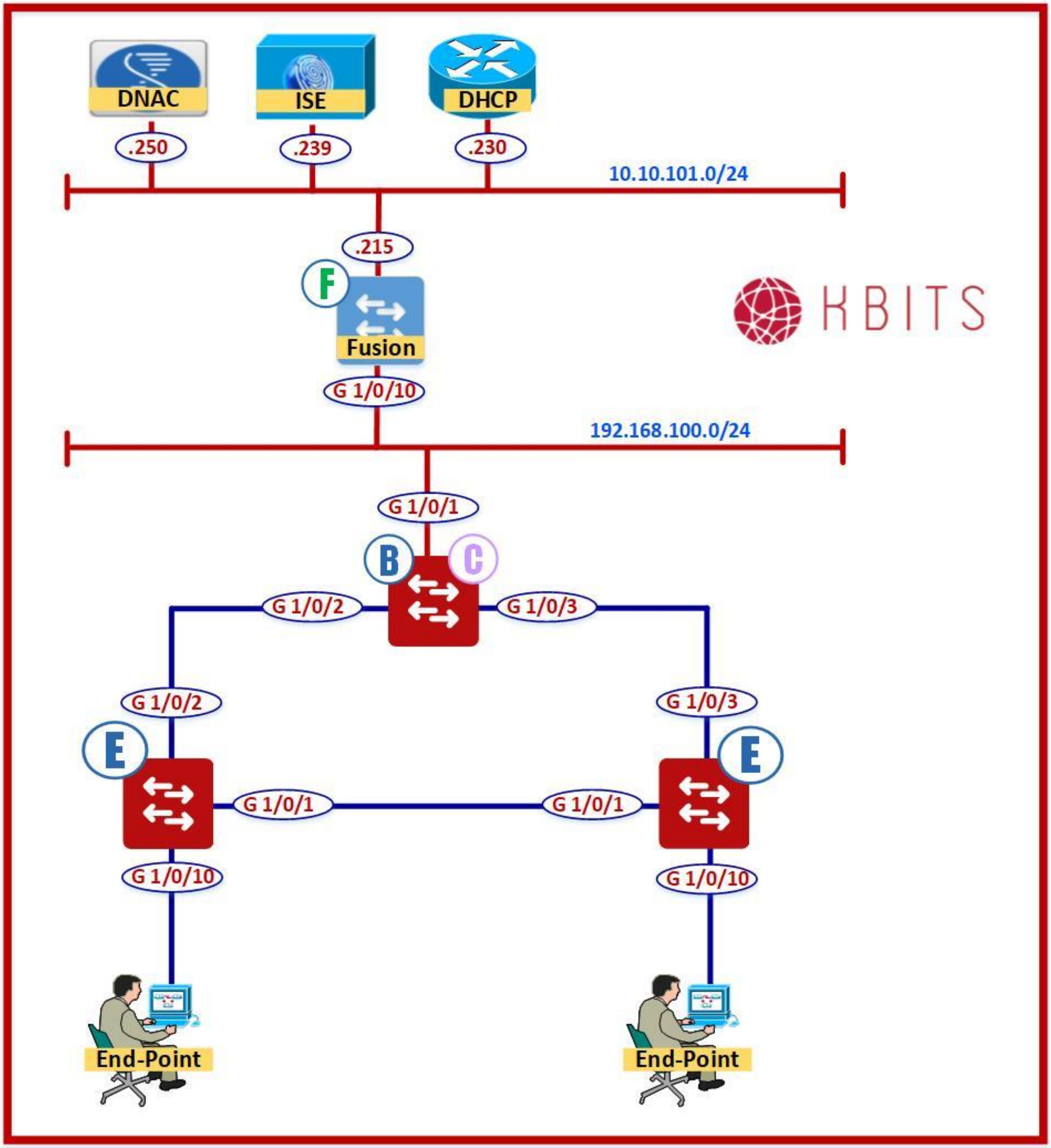
Task 1 – Configure the Transit Network (L3 Handoff)

Provision -> Fabric -> Add Transit/Peer Network

- ➔ Name: **L3HANDOFF**
- ➔ Transit/Type: **IP-Based**
- ➔ Protocol: **BGP**
- ➔ Type: **ASPlain**
- ➔ AS #: **65001 (Fusion Router AS)**

- ➔ **Click Save**

Lab 18 - Configure Host Onboarding



Task 1 – Create the Fabric

Provision -> Fabric -> Add Fabric

- ➔ Name: **HQ_FABRIC**
- ➔ Add all except for Default
- ➔ Click **Add**

Task 2 – Configuring Host Onboarding

Provision -> Fabric -> HQ-FABRIC -> Los Angeles -> HQ

Authentication Template

- ➔ Select "**Closed Authentication**"
- ➔ Click to set it as the "**Default**"

Virtual Network – IT_VN

- ➔ Select: **IT_VN**
- ➔ Add the following Pools:

- ➔ IP Address Pool: **IT-DATA-1-POOL**
- ➔ Authentication Policy: **IT-DATA-1**
- ➔ Traffic Type: **Data**

- ➔ IP Address Pool: **IT-DATA-2-POOL**
- ➔ Authentication Policy: **IT-DATA-2**
- ➔ Traffic Type: **Data**

- ➔ IP Address Pool: **IT-VOICE-1-POOL**
- ➔ Authentication Policy: **IT-VOICE-1**
- ➔ Traffic Type: **Voice**

- ➔ **Click Save**

Note: The "Authentication Policy" is linked to the ISE Authentication Profile

Virtual Network – SALES_VN

- ➔ Select: **SALES_VN**
- ➔ Add the following Pools:

- ➔ IP Address Pool: **SALES-DATA-1-POOL**
- ➔ Authentication Policy: **SALES-DATA-1**
- ➔ Traffic Type: **Data**

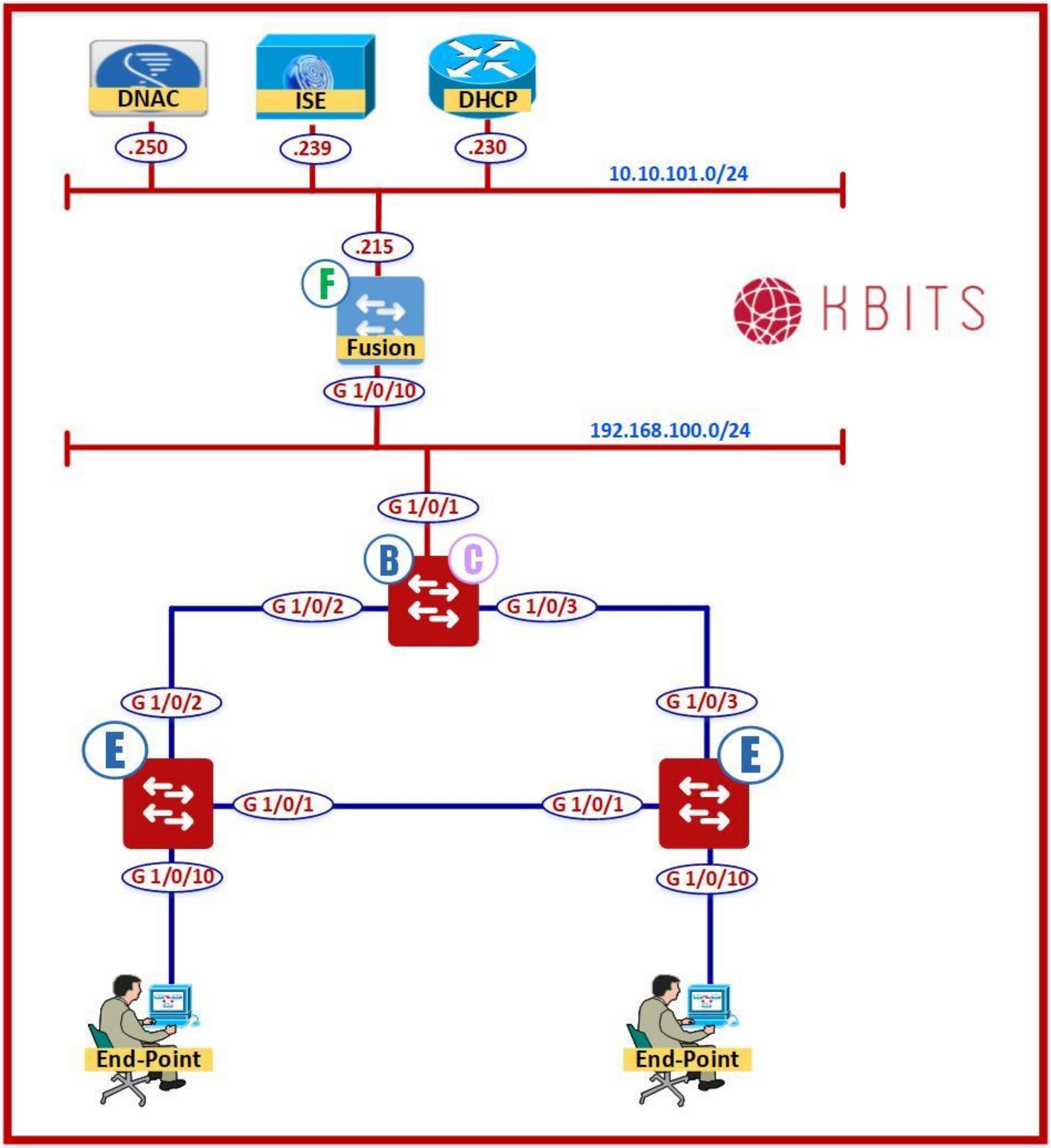
- ➔ IP Address Pool: **SALES-DATA-2-POOL**
- ➔ Authentication Policy: **SALES-DATA-2**
- ➔ Traffic Type: **Data**

- ➔ IP Address Pool: **SALES-VOICE-1-POOL**
- ➔ Authentication Policy: **SALES-VOICE-1**
- ➔ Traffic Type: **Voice**

- ➔ **Click Save**

Note: The "Authentication Policy" is links to the ISE Authentication Profile

Lab 19 - Configuring & Provisioning the Control / Border Devices



Task 1 – Provision the 9300CB as the Control and Border Device

Fabric -> HQ_FABRIC -> Los Angeles -> HQ

- ➔ Select **9300CB**

- ➔ Slide to select **Control**
- ➔ Slide to select **Border**

- ➔ **Border L3Handoff Configuration Parameters:**

- ➔ **Select Type ASPLAIN**
- ➔ Local AS: **65002**

- ➔ Default to all Virtual Networks = **Checked**

- ➔ **Uncheck** the Do not import External Routes

- ➔ Pool: **L3HANDOFF_POOL**
- ➔ Click **Add**

- ➔ Select **L3HANDOFF**
- ➔ Click "**Add**" to add the Interface **G 1/0/1**

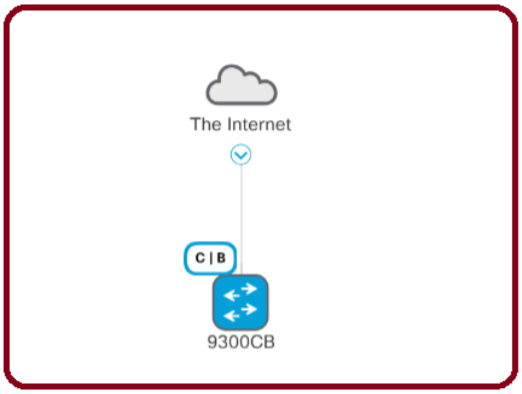
- ➔ Select all the **VNs**

- ➔ **Click Save & Add**

- ➔ **Click Add**

- ➔ **Click Save**

Note: The Device should turn Blue indicating that it is in the Fabric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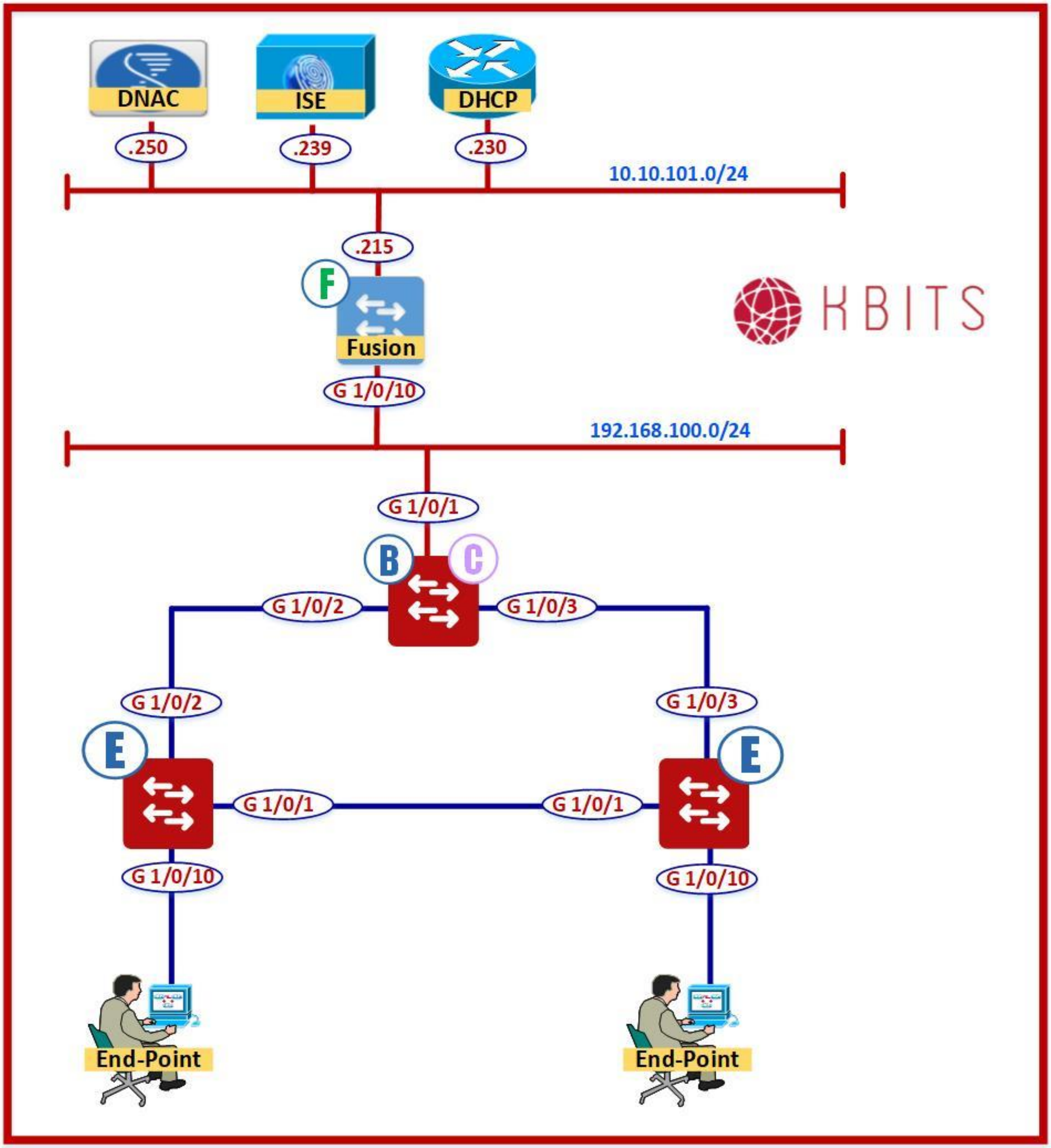
Lab 20 - Configuring & Provisioning the Fabric Edge Devices



Task 1 – Provision the HQ-1 as the Fabric Edge Node

Fabric -> HQ_FABRIC -> Los Angeles -> HQ

➔ Select **HQ-1**

➔ Slide to select **Edge**

➔ **Click Add**

Task 2 – Provision the HQ-2 as the Fabric Edge Node

Fabric -> HQ_FABRIC -> Los Angeles -> HQ

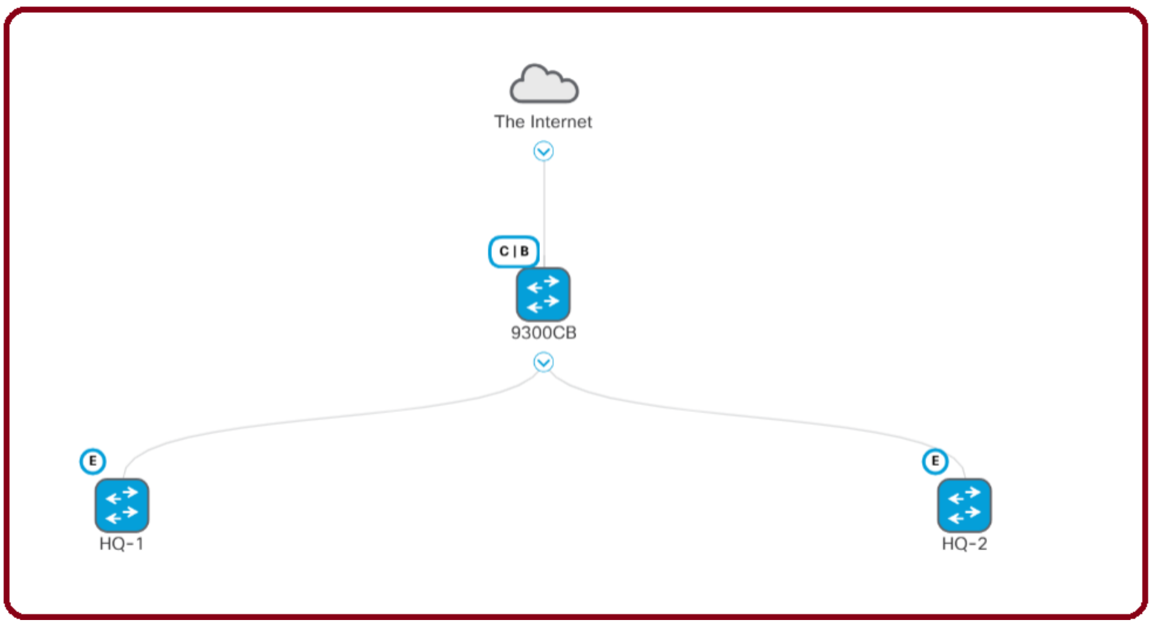
➔ Select **HQ-2**

➔ Slide to select **Edge**

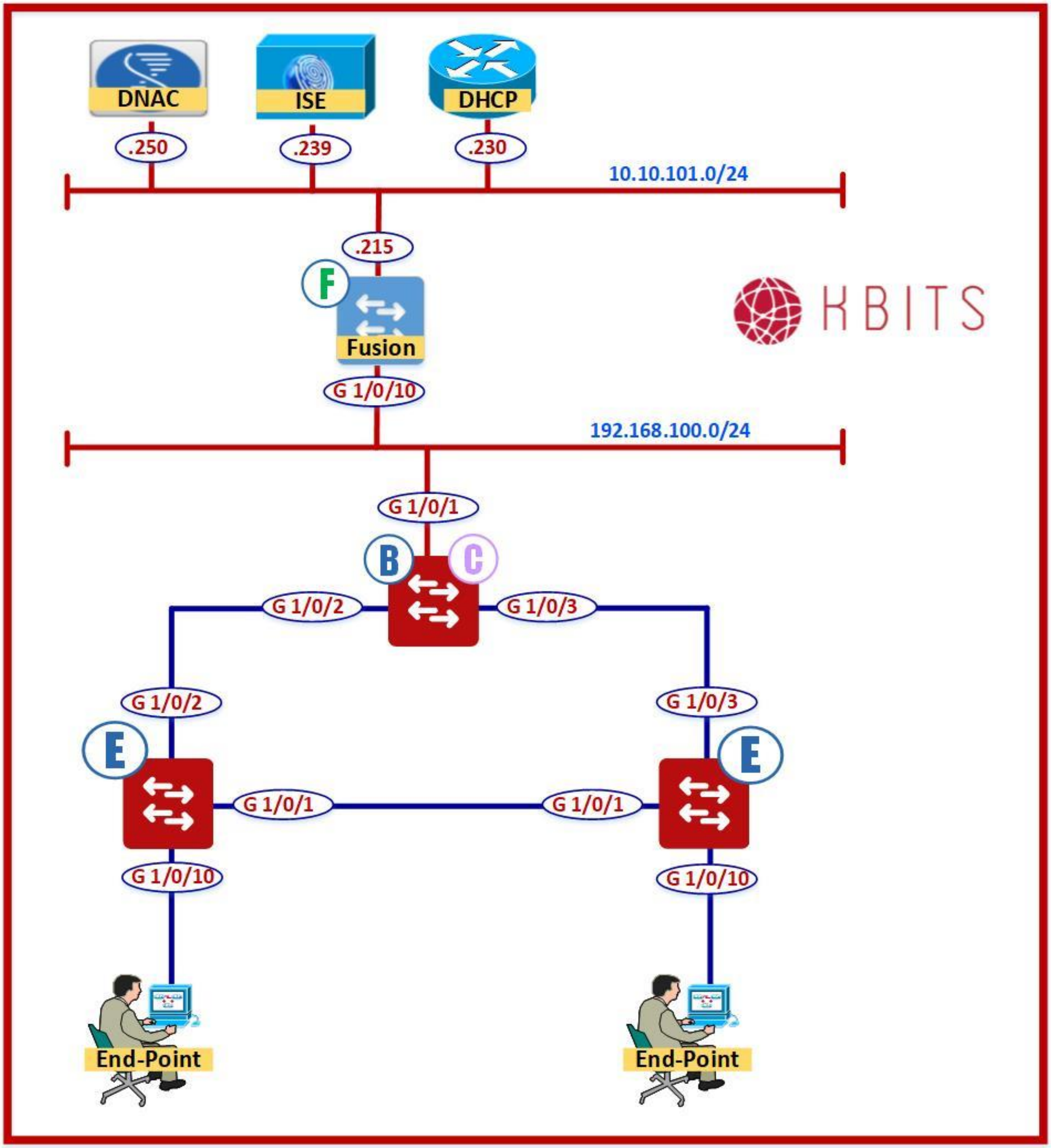
➔ **Click Add**

➔ **Click Save**

Note: The Device should turn Blue indicating that it is in the Fabric



Lab 21 - Configure the Fusion Router – VRF, SVI, BGP & Route Leaking



Task 1 – Configure the VRFs to match the Border Interfaces

Fusion Router

```
vrf definition IT_VN
 rd 1:4099
 !
 address-family ipv4
  route-target export 1:4099
  route-target import 1:4099
 exit-address-family

!
vrf definition SALES_VN
 rd 1:4100
 !
 address-family ipv4
  route-target export 1:4100
  route-target import 1:4100
 exit-address-family
```

2. Configure the Interfaces to match the Border Interfaces

Fusion Router

```
vlan 3001-3003
!!! You might need to enable VTP Transparent Mode to make it work
!
interface Vlan3001
 description vrf interface to External router
 ip address 172.20.2.2 255.255.255.252
 no shut
!
interface Vlan3002
 description vrf interface to External router
 vrf forwarding IT_VN
 ip address 172.20.2.6 255.255.255.252
 no shut
!
interface Vlan3003
 description vrf interface to External router
 vrf forwarding SALES_VN
 ip address 172.20.2.10 255.255.255.252
 no shut
```

3. Configure BGP between Fusion & Border

Fusion Router

```
router bgp 65001
 neighbor 172.20.2.1 remote-as 65002
 neighbor 172.20.2.1 update-source Vlan3001
 !
 address-family ipv4
  neighbor 172.20.2.1 activate
  neighbor 172.20.2.1 default-originate
  network 10.10.101.0 mask 255.255.255.0
!
 address-family ipv4 vrf SALES_VN
  neighbor 172.20.2.9 remote-as 65002
  neighbor 172.20.2.9 update-source Vlan3003
  neighbor 172.20.2.9 activate
  neighbor 172.20.2.9 default-originate
  network 10.10.101.0 mask 255.255.255.0
!
address-family ipv4 vrf IT_VN
  neighbor 172.20.2.5 remote-as 65002
  neighbor 172.20.2.5 update-source Vlan3002
  neighbor 172.20.2.5 activate
  neighbor 172.20.2.5 default-originate
  network 10.10.101.0 mask 255.255.255.0
```

4. Configure Route Leaking from Global into VRFs

Fusion Router

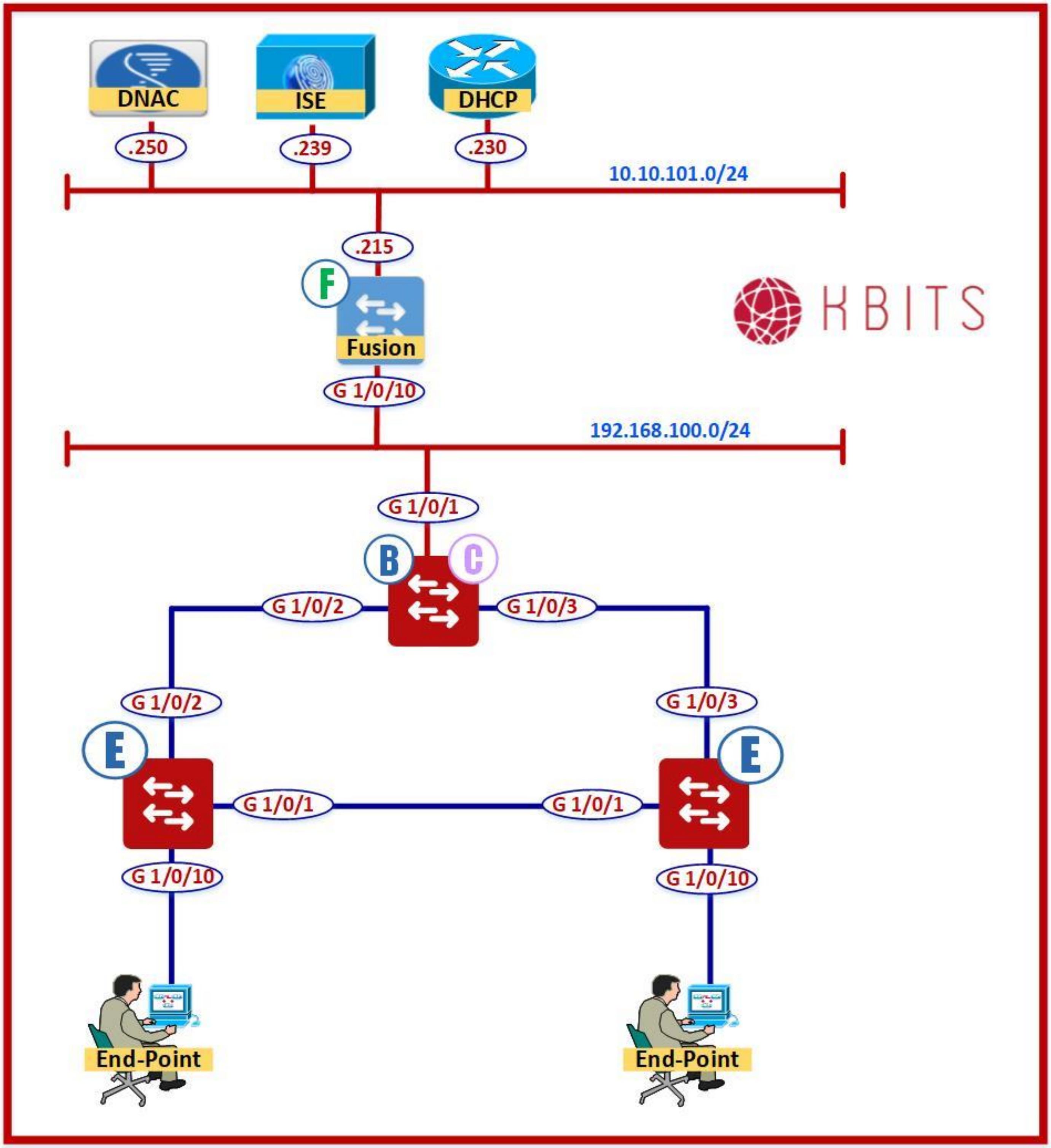
```
ip prefix-list GLOBAL seq 5 permit 10.10.101.0/24
!
route-map GLOBAL permit 10
 match ip address prefix-list GLOBAL
!
vrf definition IT_VN
 address-family ipv4
  import ipv4 unicast map GLOBAL
!
vrf definition SALES_VN
 address-family ipv4
  import ipv4 unicast map GLOBAL
```

5. Configure Route Leaking from VRF into Global

Fusion Router

```
ip route 172.16.1.0 255.255.255.0 Vlan3002
ip route 172.16.2.0 255.255.255.0 Vlan3002
ip route 172.16.3.0 255.255.255.0 Vlan3003
ip route 172.16.4.0 255.255.255.0 Vlan3003
ip route 172.20.2.4 255.255.255.252 Vlan3002
ip route 172.20.2.8 255.255.255.252 Vlan3003
ip route 172.16.101.0 255.255.255.0 Vlan3002
ip route 172.16.102.0 255.255.255.0 Vlan3003
```

Lab 22 – Configure User & Groups on ISE



Task 1 – Configure User Identity Groups in ISE

Administration -> Identity Management -> Groups -> User Identity Groups -> Create

- ➔ Name: **IT-DATA-1**
- ➔ Name: **IT-DATA-2**
- ➔ Name: **IT-VOICE**
- ➔ Name: **SALES-DATA-1**
- ➔ Name: **SALES-DATA-2**
- ➔ Name: **SALES-VOICE**

Task 2 – Configure Users on ISE & Assign them to the appropriate Groups

Administration -> Identity Management -> Identities -> Create

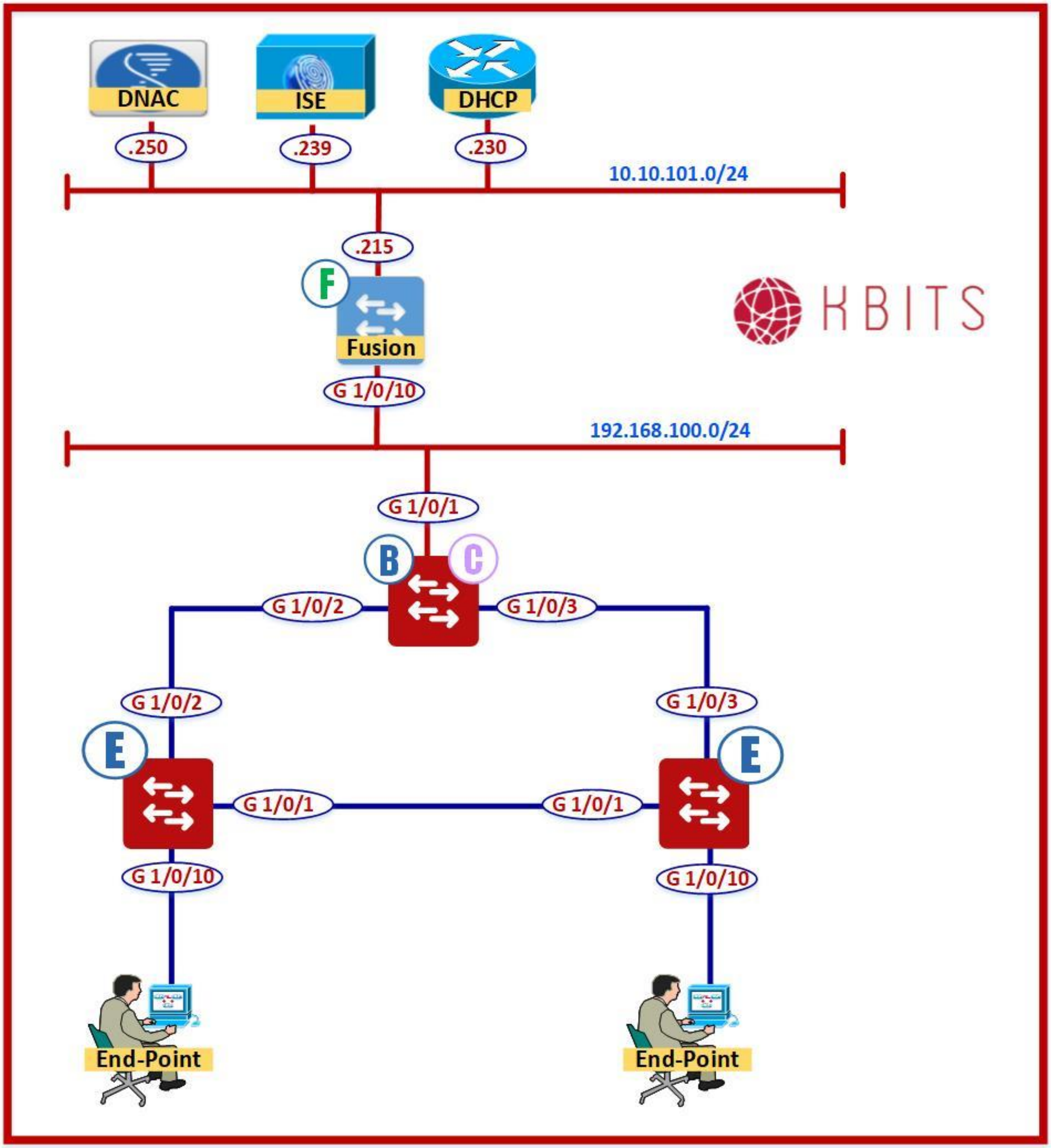
- ➔ Name: **IT1**
- ➔ Password: **Cisco@123**
- ➔ Group: **IT-DATA-1**

- ➔ Name: **IT2**
- ➔ Password: **Cisco@123**
- ➔ Group: **IT-DATA-2**

- ➔ Name: **SALES1**
- ➔ Password: **Cisco@123**
- ➔ Group: **SALES-DATA-1**

- ➔ Name: **SALES2**
- ➔ Password: **Cisco@123**
- ➔ Group: **SALES-DATA-2**

Lab 23 - Configure Authorization Profiles for the DNAC VNs



Task 1 – Configure the Authorization Profiles to link the Authorization Profile name in DNAC for the VNs & Pools

Policy -> Policy Elements -> Results -> Authorization -> Authorization Profile -> Create

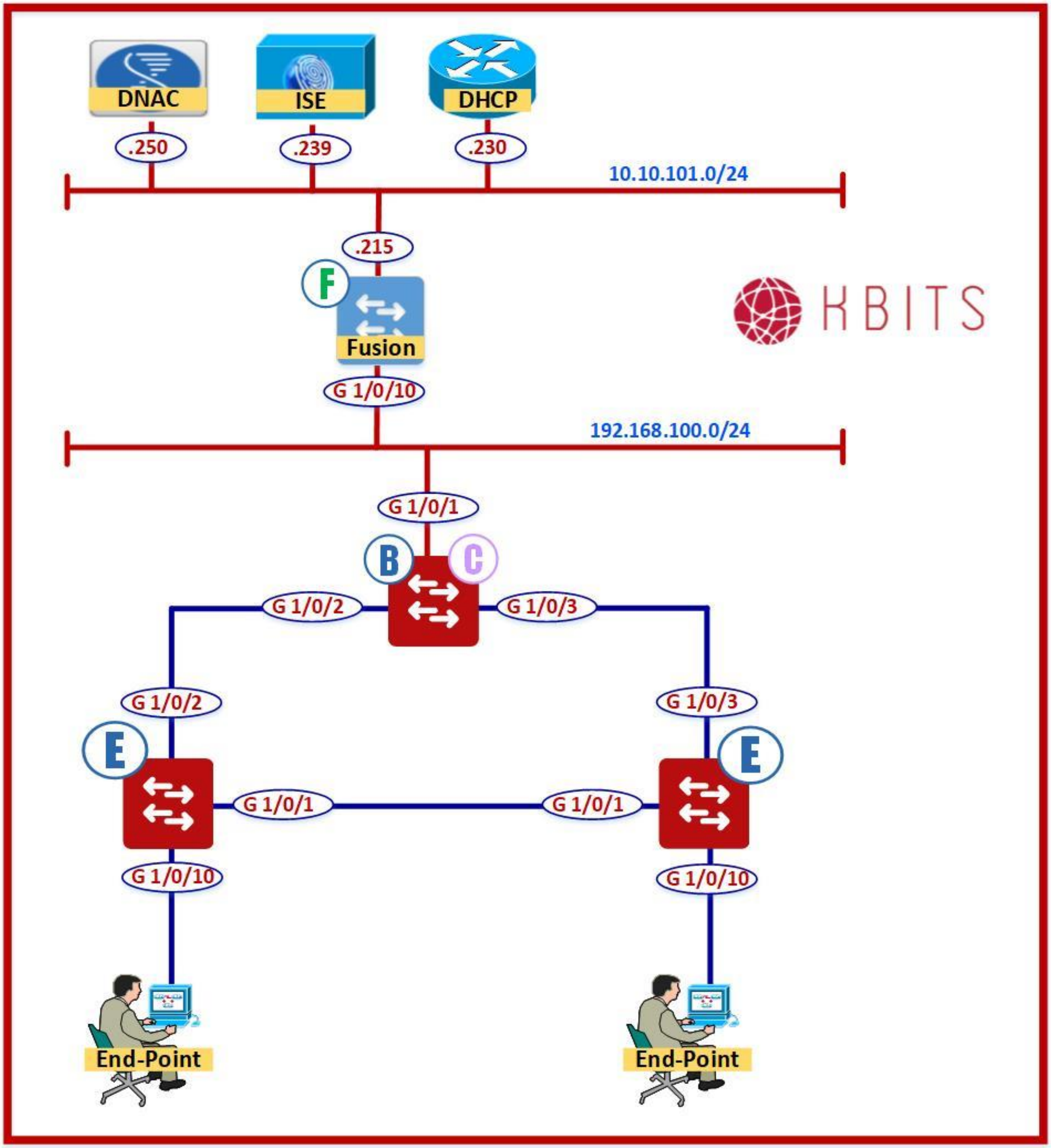
- ➔ Name: **IT-DATA-1-PROF**
- ➔ VLAN: **IT-DATA-1 (Copy from DNAC)**

- ➔ Name: **IT-DATA-2-PROF**
- ➔ VLAN: **IT-DATA-2 (Copy from DNAC)**

- ➔ Name: **SALES-DATA-1-PROF**
- ➔ VLAN: **SALES-DATA-1 (Copy from DNAC)**

- ➔ Name: **SALES-DATA-2-PROF**
- ➔ VLAN: **SALES-DATA-2 (Copy from DNAC)**

Lab 24 - Configure Authorization Policies for the DNAC VNs



Task 1 – Configure the Authorization Policies to assign the IT & SALES Groups appropriate profiles for 802.1x authentication

Policy -> Policy Sets -> default -> Authorization Policies -> Insert at the Top

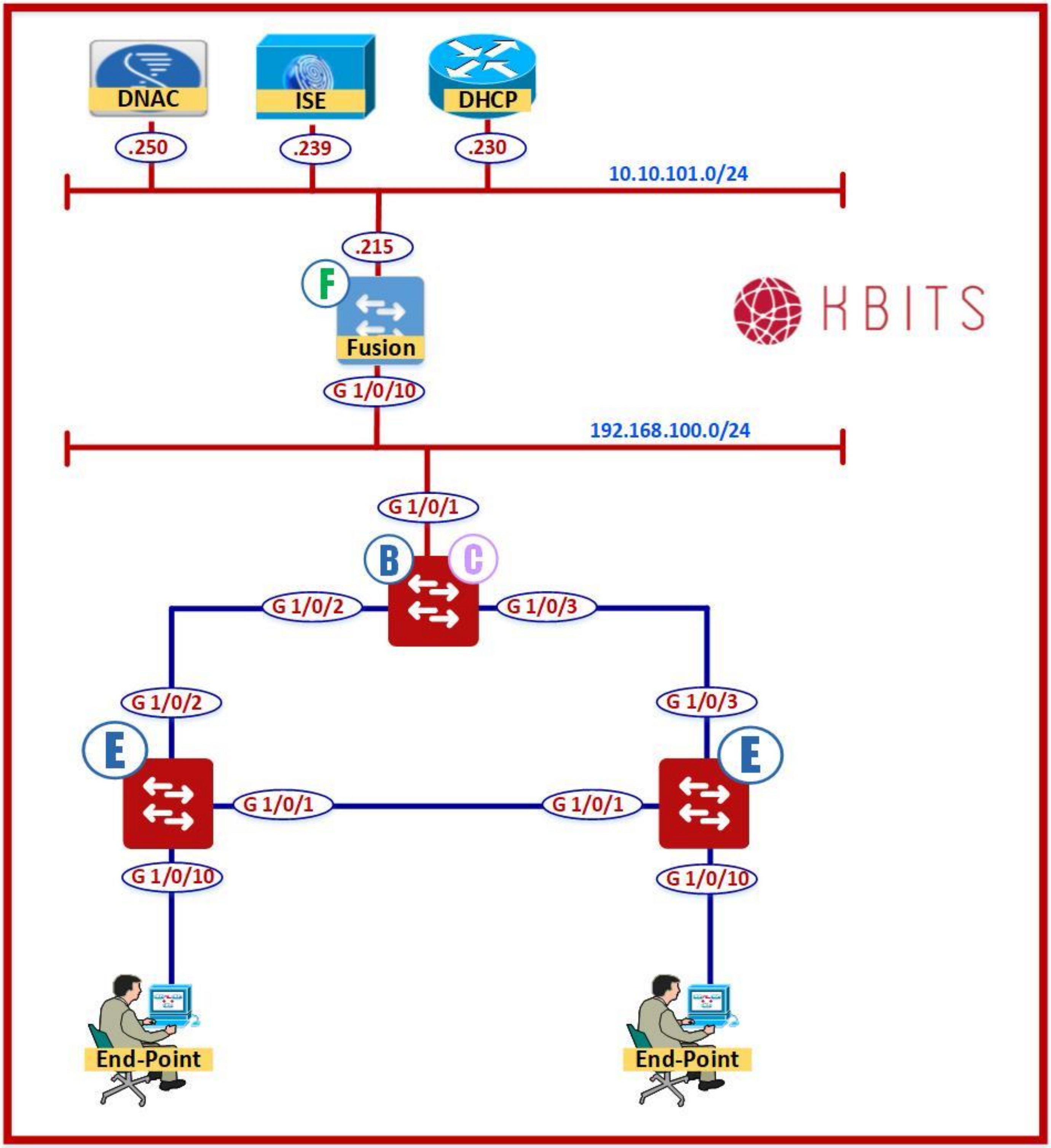
- ➔ Name: **IT-DATA-1-POLICY**
- ➔ Identity Group: **IT-DATA-1**
- ➔ Authentication Method: **Wired_802.1x**
- ➔ Permission: **IT-DATA-1-PROF**

- ➔ Name: **IT-DATA-2-POLICY**
- ➔ Identity Group: **IT-DATA-2**
- ➔ Authentication Method: **Wired_802.1x**
- ➔ Permission: **IT-DATA-2-PROF**

- ➔ Name: **SALES-DATA-1-POLICY**
- ➔ Identity Group: **SALES-DATA-1**
- ➔ Authentication Method: **Wired_802.1x**
- ➔ Permission: **SALES-DATA-1-PROF**

- ➔ Name: **SALES-DATA-2-POLICY**
- ➔ Identity Group: **SALES-DATA-2**
- ➔ Authentication Method: **Wired_802.1x**
- ➔ Permission: **SALES-DATA-2-PROF**

Lab 25 - Configure the DHCP Server to provide IP Configuration to Clients



Task 1 – Configure the Exclusions for the 4 Data Pools

Access Server

```
ip dhcp excluded-address 172.16.1.1 172.16.1.50
ip dhcp excluded-address 172.16.1.254
ip dhcp excluded-address 172.16.2.1 172.16.2.50
ip dhcp excluded-address 172.16.2.254
ip dhcp excluded-address 172.16.3.1 172.16.3.50
ip dhcp excluded-address 172.16.3.254
ip dhcp excluded-address 172.16.4.1 172.16.4.50
ip dhcp excluded-address 172.16.4.254
```

Task 2 – Configure the 4 Data Pools with the default gateway being the Last IP in the network

Access Server

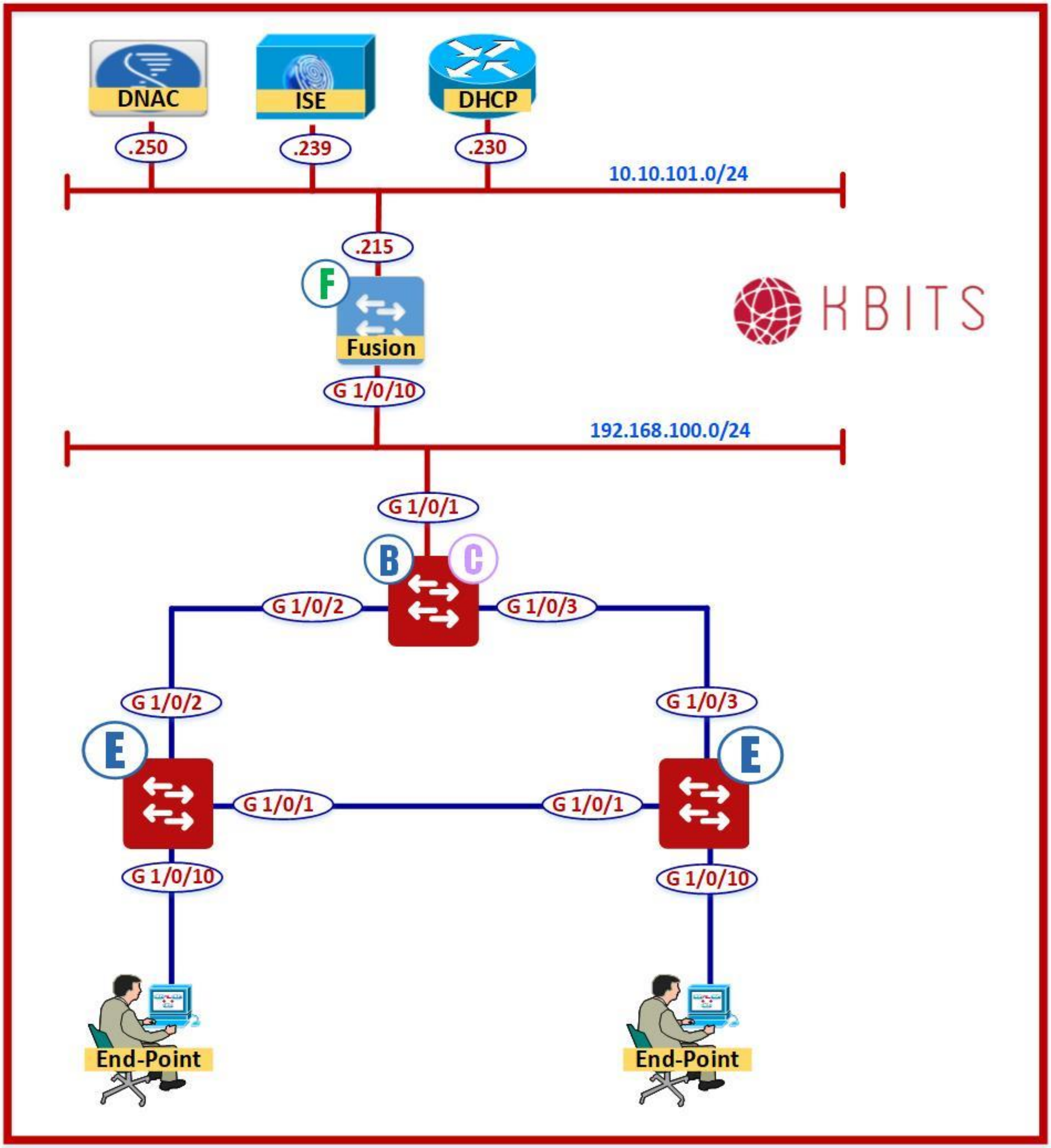
```
ip dhcp pool IT-DATA-1
  network 172.16.1.0 255.255.255.0
  default-router 172.16.1.254
!
ip dhcp pool IT-DATA-2
  network 172.16.2.0 255.255.255.0
  default-router 172.16.2.254
!
ip dhcp pool SALES-DATA-1
  network 172.16.3.0 255.255.255.0
  default-router 172.16.3.254
!
ip dhcp pool SALES-DATA-2
  network 172.16.4.0 255.255.255.0
  default-router 172.16.4.254
```

Task 3 – Configure static Routes for the Overlay Data networks pointing towards the Fusion Router

Access Server

```
ip route 172.16.0.0 255.255.0.0 10.10.101.215
ip route 172.20.0.0 255.255.0.0 10.10.101.215
```

Lab 26 – Verifying Macro Segmentation



Task 1 – Devices within the same VN should be able to communicate to each other

- ➔ Configure the Native Windows supplicant on **ES1** to log in using **IT1** credentials.
- ➔ Configure the Native Windows supplicant on **ES2** to log in using **IT2** credentials.

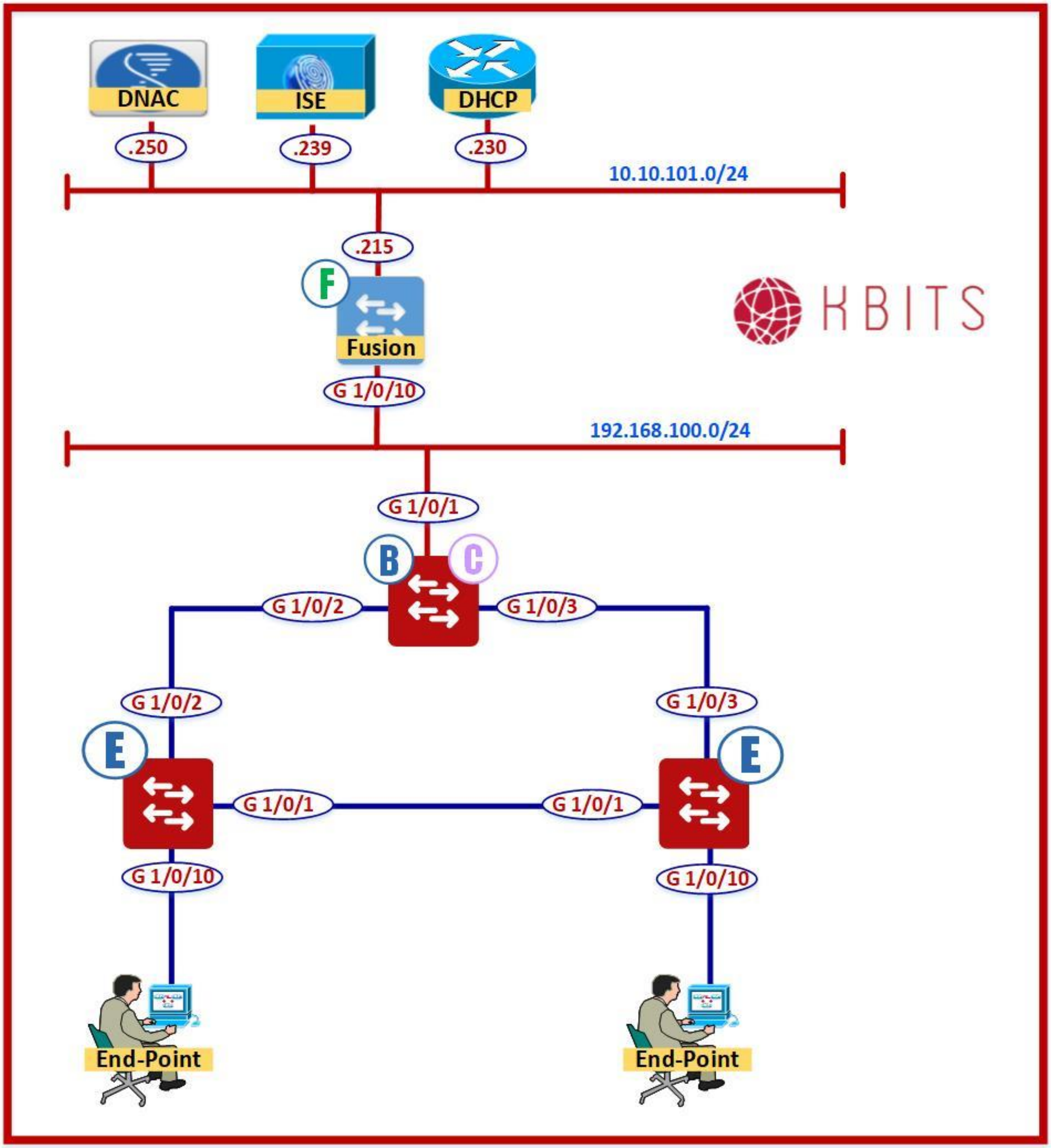
Verification: They should be in 2 different subnets but should be able to communicate to each other.

Task 2 – Devices in 2 different segments should not be able to communicate to each other

- ➔ Change the credentials on **ES2** to **SALES1**.

Verification: They should not be able to communicate to each other as they are in 2 different VNs.

Lab 27 – Micro Segmenation – Creating SGTs



Task 1 – Configure SGT for IT Subnets on DNAC

Policy -> Group Based Access Control -> Scalabe Groups -> Create

- ➔ Name: **IT_DATA_1**
- ➔ SGT: **6001**
- ➔ VN: **IT_VN**

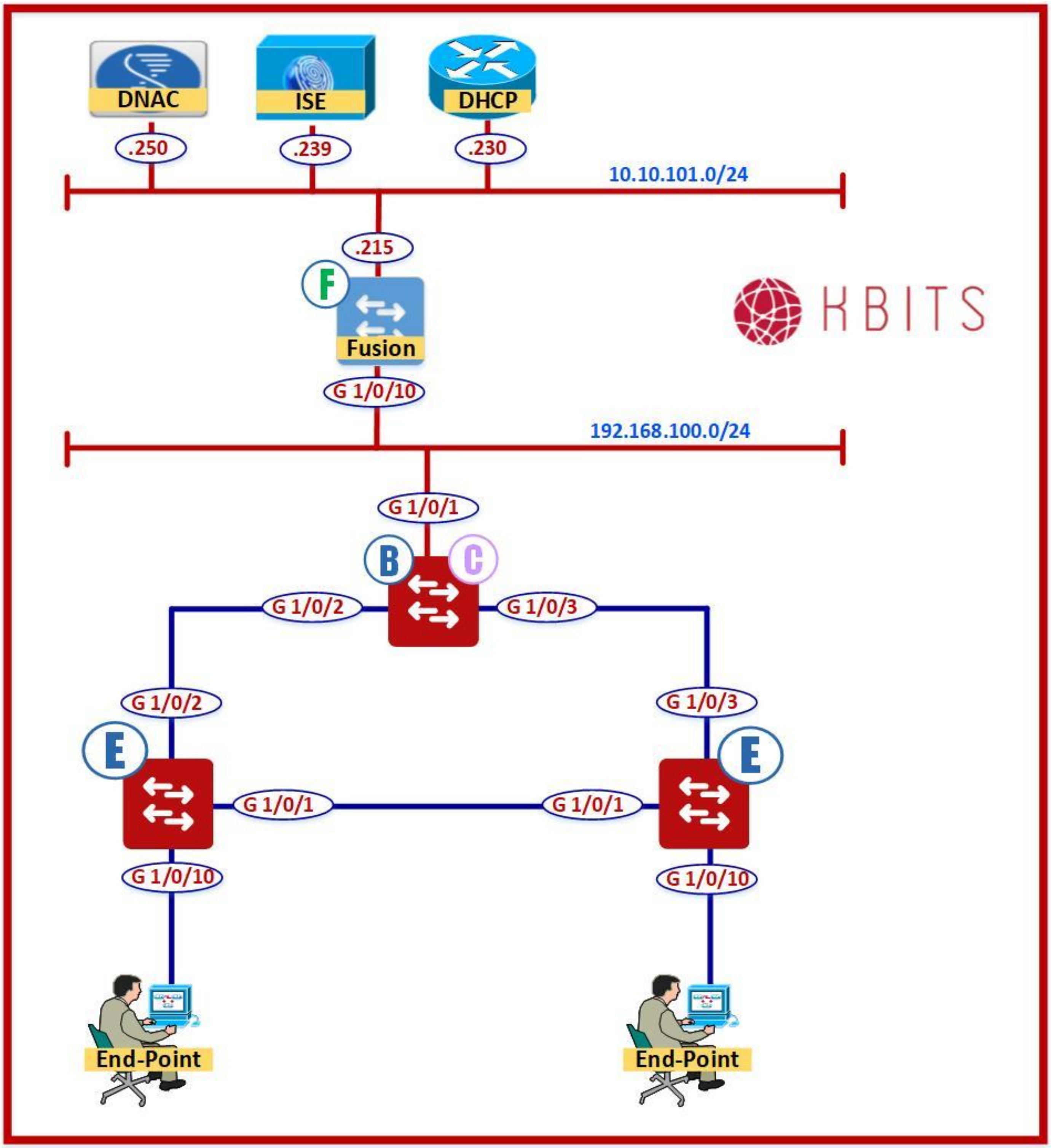
- ➔ Name: **IT_DATA_2**
- ➔ SGT: **6002**
- ➔ VN: **IT_VN**

Task 2 – Verify the SGTs are propagated to ISE

Work Centers -> TrustSe -> Components -> Security Groups

The IT_DATA_1 & IT_DATA_2 SGTs should be available in ISE

Lab 28 – Micro Segmenation – Assigning SGTS via Authorization Policies on ISE



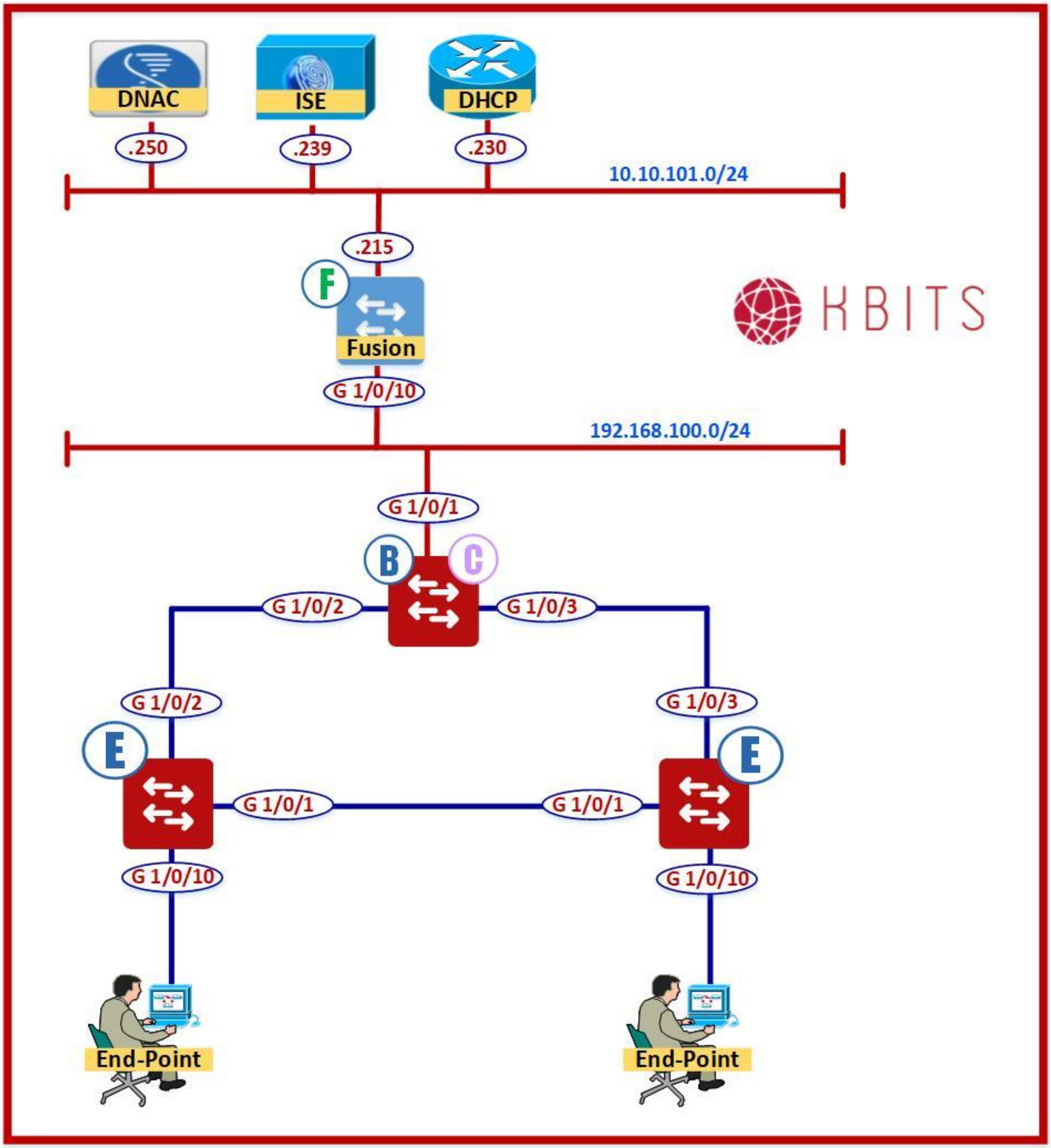
Task 1 – Re-configure the Authorization Policies to assign the IT_DATA1 & IT_DATA2 Groups appropriate SGT in addition to the Authorization profiles

Policy -> Policy Sets -> default -> Authorization Policies -> Edit the following Policies

- ➔ Name: **IT-DATA-1-POLICY**
- ➔ Identity Group: **IT_DATA-1**
- ➔ Authentication Method: **Wired_802.1x**
- ➔ Permission: **IT-DATA-1-PROF**
- ➔ Security Group: **IT_DATA_1**

- ➔ Name: **IT-DATA-2-POLICY**
- ➔ Identity Group: **IT_DATA-2**
- ➔ Authentication Method: **Wired_802.1x**
- ➔ Permission: **IT-DATA-2-PROF**
- ➔ Security Group: **IT_DATA_2**

Lab 29 - Micro Segmenation – Using Default Contract to Block all communications between SGTs



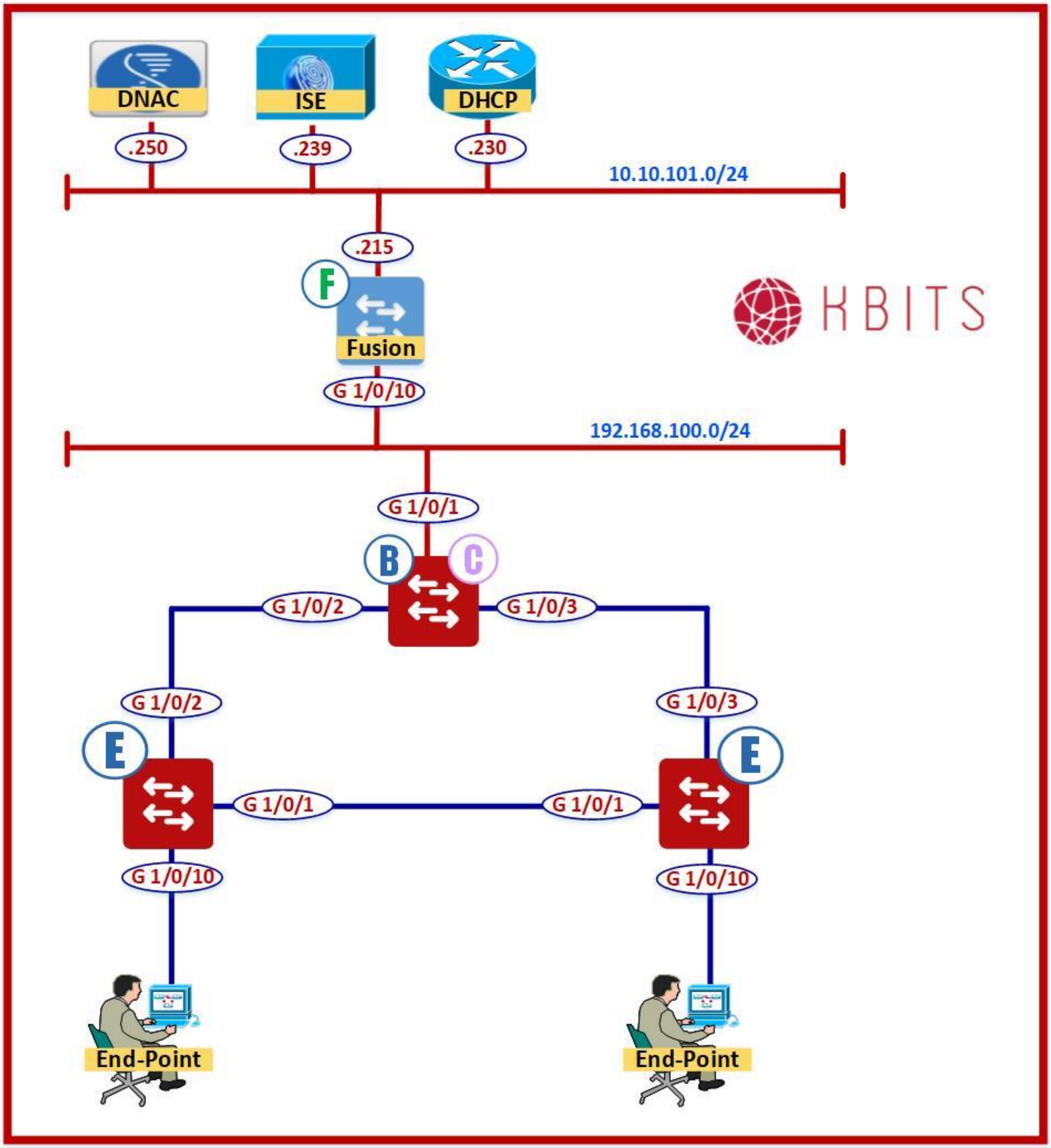
Task 1 – Configure the SG Access Contract such that all traffic from IT-DATA1 to IT-DATA2 gets denied using the built-in Deny IP contract.

- Click **Policy -> Group-Based Access Control -> Access Contracts -> Create Access Contact**
- Click on the Policy Matrix box that intersects **IT_DATA_1 & IT_DATA_2.**
- Click "**Change Contract**".
- Select "**Deny IP"**.
- Click **Change** & **Save.** Click **Deploy** to implement the policy.

Verification:

- ➔ Configure the Native Windows supplicant on **ES1** to log in using **IT1** credentials.
- ➔ Configure the Native Windows supplicant on **ES2** to log in using **IT2** credentials.
- ➔ Verify that the SG ACL is applied on the Egress Switch (9300E2) using the **show cts role-based-permissions** command.
- ➔ Ping ES2 from ES1. The ping should not work.

Lab 30 - Micro Segmenation – Creating a SG ACL - Contract



Task 1 – Remove the Contract between IT-DATA1 & IT-DATA2

- Click **Policy -> Group-Based Access Control -> Policies**

- Click on the Policy Matrix box that intersects **IT_DATA_1 & IT_DATA_2.**

- Click "**Set it Default:Permit IP**"

- Click **Change** & **Save.**

- Click **Deploy** to implement the policy.

Task 2 – Create a Custom SG ACL (Access Contract) to only allow the following traffic from IT-DATA_2 to IT-DATA_1:

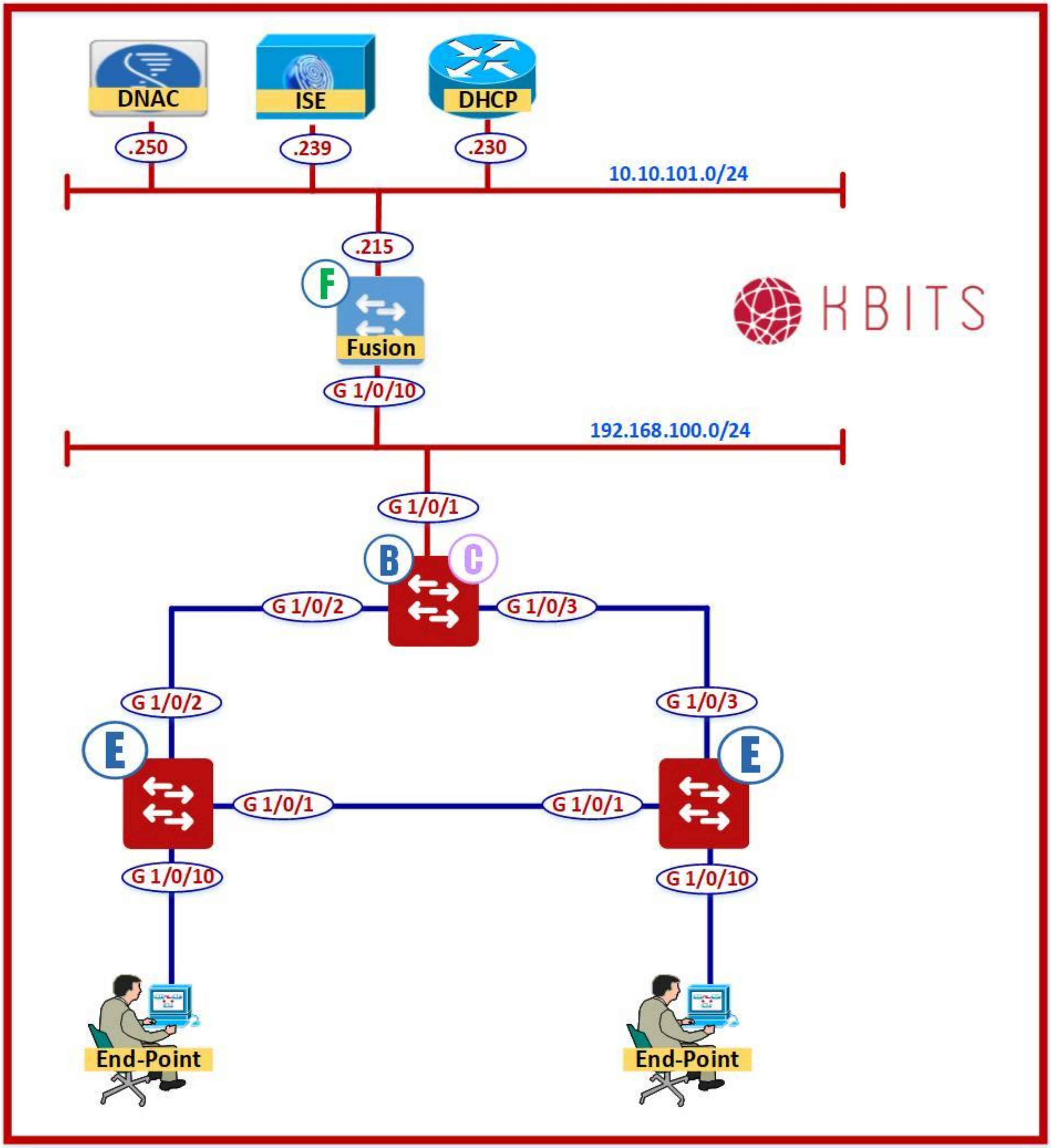
- **Permit - TCP - 80,443**
- **Permit - CIFS**

- Click **Policy -> Group-Based Access Control -> Access Contracts -> Create Access Contracts**

➔ Name: **IT_DATA_2_TO_IT_DATA_1**
➔ Rules:
  - 1. Permit – TCP/80
  - 2. Permit – TCP/443
  - 3. Permit – CIFS
  - Default Action: Deny

- Click **Save.**

Lab 31 - Micro Segmenation – Applying & Verifying a Custom SG-ACL - Contract



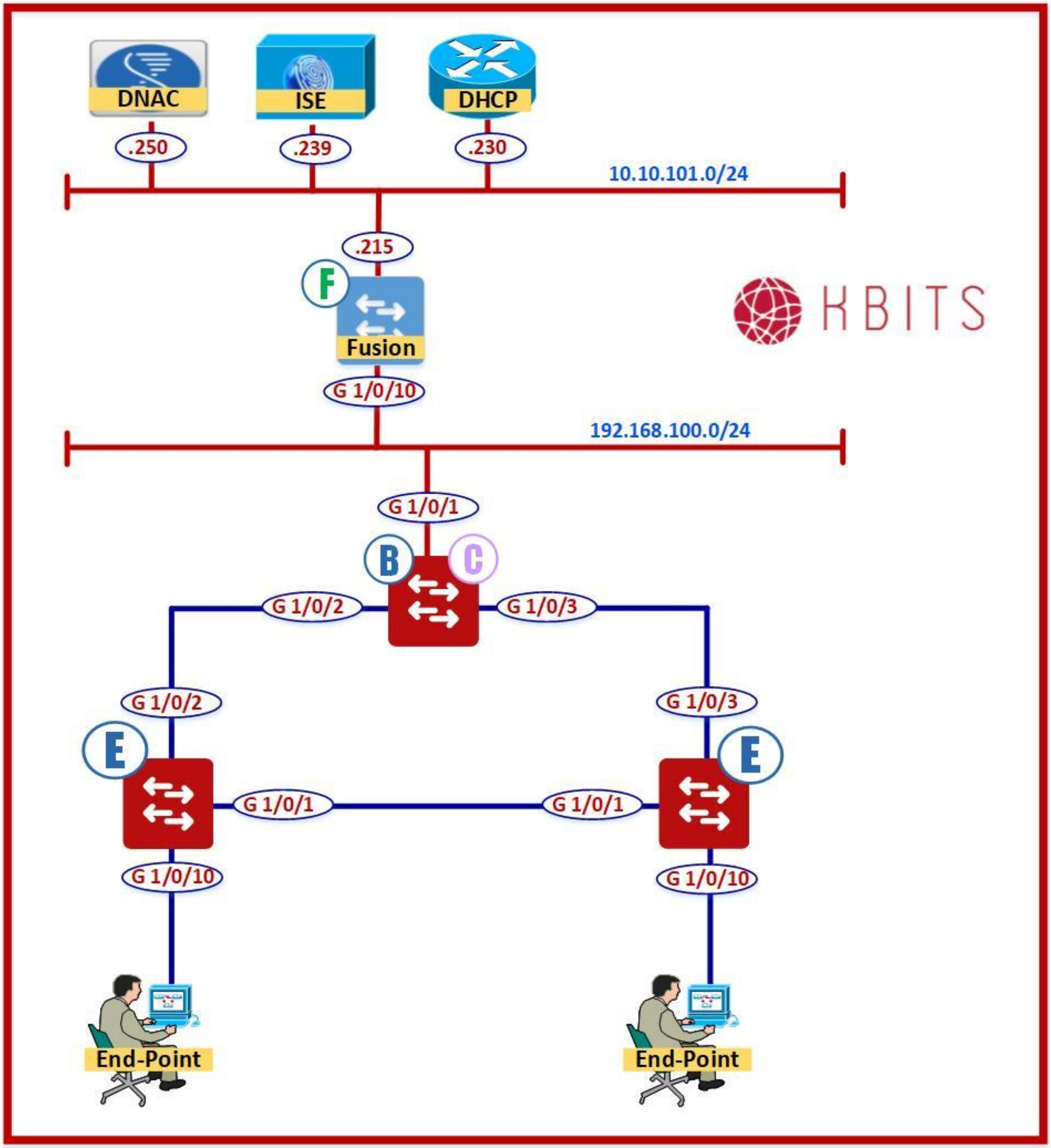
Task 1 – Configure the SG Access Contract such that all traffic from IT-DATA1 to IT-DATA2 controlled by the Custom contract created in the previous lab

- Click **Policy -> Group-Based Access Control -> Access Contracts -> Create Access Contact**
- Click on the Policy Matrix box that intersects **IT_DATA_2 & IT_DATA_1.**
- Click “**Change Contract**”.
- Select “**IT_DATA2_2_TO_IT_DATA1”**.
- Click **Change** & **Save.** Click **Đeploy** to implement the policy.

Verification:

- Configure the Native Windows supplicant on **ES1** to log in using **IT1** credentials.
- Configure the Native Windows supplicant on **ES2** to log in using **IT2** credentials.
- Verify that the SG ACL is applied on the Egress Switch (9300E2) using the **show cts role-based-permissions** command.
- Ping ES2 from ES1. The ping should not work.
- Browse to a shared folder on ES2. It should work.

Lab 32 – Configurig L2 Handoff



Task 1 – Configure the Existing VN for L2 Flooding

- Click on **Provision -> Fabric -> HQ_Fabric -> Host Onboarding -> Virtual Networks -> IT_VN -> Select IT-VN-DATA1 -> Click Action**.
- Click to "**Enable L2 Flooding**"
- Check the "**Common Pool"** Checkbox
- Click **Save** & **Save** & **Cancel.**

Task 2 – Configure the Border as VTP Transparent

Border Switch Vtp mode transparent

Task 3 – Configure L2 Handoff

Click **Provision -> Fabric -> HQ_Fabric -> Fabric Infrastructure -> Click Border -> Click Configure -> Select Layer 2 Hand off -> Click IT_VN.**

- Select the "**Interface G 1/0/1"** as the L2 Handoff Link.
- Specify the VLAN as **555** for **IT-VN-DATA1**
- Click **Save** and **Add**
- Click **Add**
- Click **Save** and **Apply**

Task 4 – Configure L2 Network in the Non-Fabric Devices (Fusion Router)

- Configure the Fusion Router/Switch with a VLAN **555**.
- Create a SVI Interface for VLAN 555 with an IP Addres of 172.16.1.70/24.

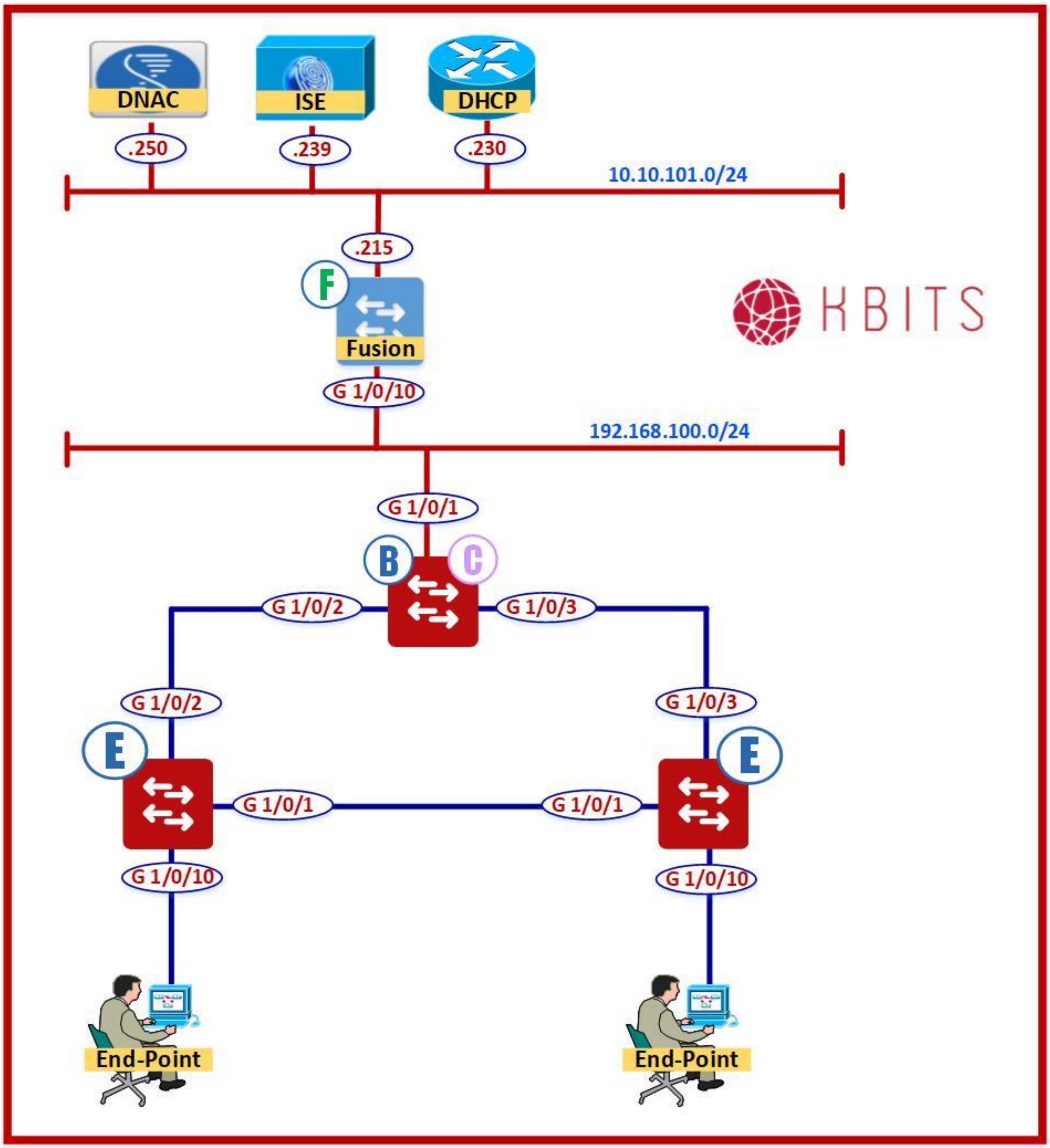
Fusion Router

```
Vlan 555
!
Interface vlan 555
 Ip add 172.16.1.55 255.255.255.0
 No shut
```

Task 5 – Verifying L2Handoff

- Login from the PC as IT1 (IT-DATA-1).
- You should be able to connect to the Fusion router on 172.16.1.55.

Lab 33 – Configuring Templates



Task 1 – Create a template with the following:

- Click **Tools -> Template Editor -> "+" -> Create Template**

- Name: **Basic**
- Project: **Cloud DayN Templates**
- Device Type: **Switches & Hubs**
- Software Type: **IOS-XE**
- Click **Save**

Task 2 – Configure the parameters within the template:

- Click **Tools -> Template Editor -> Cloud DayN Templates -> Basic**

- Banner MOTD: **Authorized Users Only**

  Banner MOTD ^Authorized Users Only^

- Click **Action -> Save**.

- Click **Action -> Commit**.

Task 3 – Assign the Template

- Click **Design -> Network Profiles -> Add -> Switching -> DayN Template -> "+" -> Switches & Hubs -> Basic (Under Templates)**

- Profile Name: **BannerProfile**

- Click **Save**.

- Click **Action -> Commit**.

- Click **Assign.**

- Assign it across the Global, Los Angeles & HQ.

Task 4 – Provision the Template

- Click **Provision -> HQ -> Select all the Switches**
- Click **Action -> Provision Device -> Assign to All Devices.**
- Click **Push these templates even if its deployed before**
- Click **Next**
- Click **Deploy** & **Apply.**

IP Services & Security

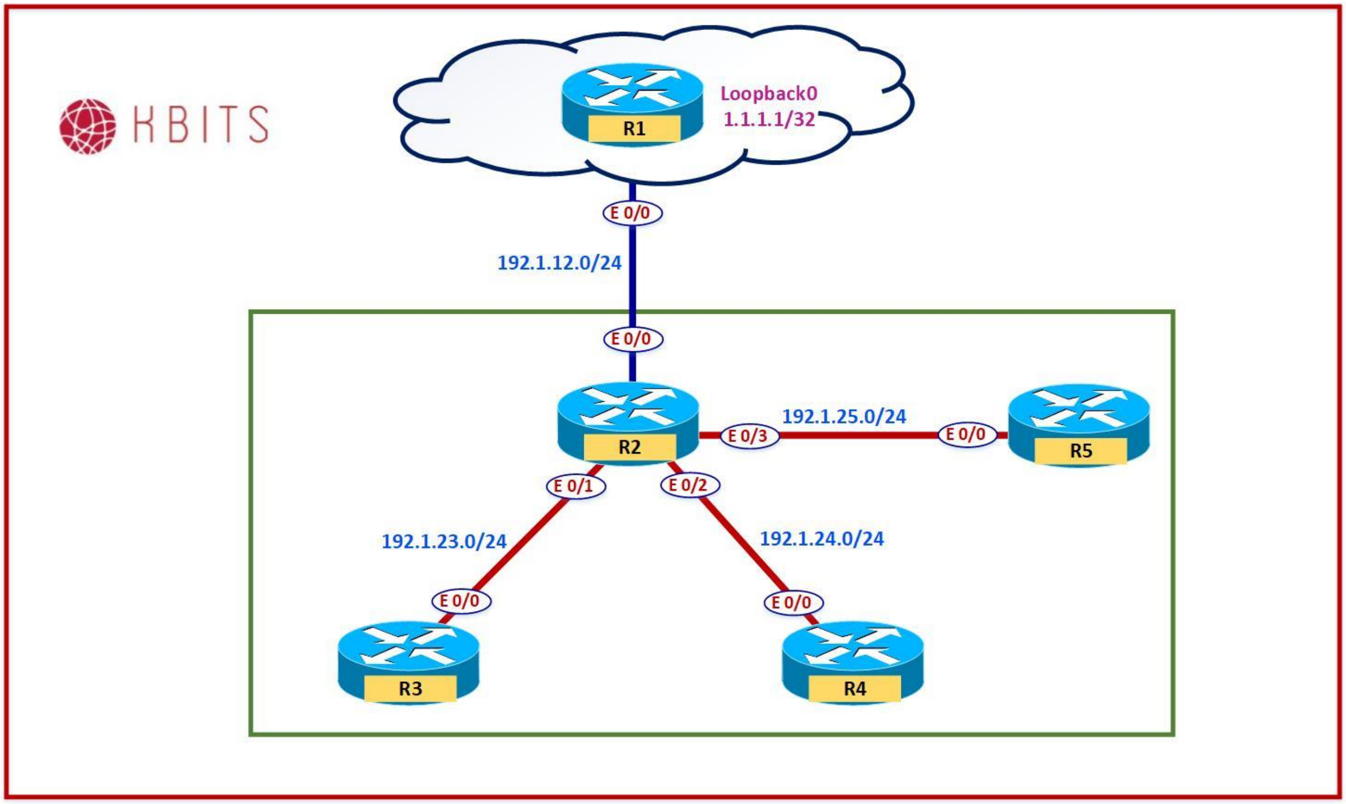
Authored By:

Khawar Butt
CCIE # 12353
Hepta CCIE#12353
CCDE # 20110020

IP Services & Security

Website: http://www.kbits.live; Email: kb@kbits.live

Lab 1 – Zone-Based Firewalls



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	11.1.1.1	255.255.255.255
E 0/0	192.1.12.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.23.2	255.255.255.0
E 0/2	192.1.24.2	255.255.255.0
E 0/3	192.1.25.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
E 0/0	192.1.23.2	255.255.255.0

R4

Interface	IP Address	Subnet Mask
E 0/0	192.1.24.2	255.255.255.0

R5

Interface	IP Address	Subnet Mask
E 0/0	192.1.25.2	255.255.255.0

Task 1

Configure Default Routes on R3, R4 & R5 pointing towards R2. Configure a default route on R2 pointing towards R1. Configure Statice Routes on R1 for the 192.1.23.0/24, 192.1.24.0/24 & 192.1.25.0/24 networks with R2 as the next hop.

R1 Ip route 192.1.23.0 255.255.255.0 199.1.12.2 Ip route 192.1.24.0 255.255.255.0 199.1.12.2 Ip route 192.1.25.0 255.255.255.0 199.1.12.2	**R2** Ip route 0.0.0.0 0.0.0.0 192.1.12.1
R3 Ip route 0.0.0.0 0.0.0.0 192.1.23.2	**R4** Ip route 0.0.0.0 0.0.0.0 192.1.24.2
R5 Ip route 0.0.0.0 0.0.0.0 192.1.25.2	

Task 2

Configure R2 as a Zone-Based Firewall. Create the following zones on R2:

- zone security OUTSIDE
- zone security INSIDE
- zone security DMZ

R2 zone security OUTSIDE zone security INSIDE zone security DMZ

Task 3

Assign the Interfaces to zones based on the diagram.

R2

```
Interface E 0/0
 zone-member security OUTSIDE
!
Interface E 0/1
 zone-member security INSIDE
Interface E 0/2
 zone-member security INSIDE
!
Interface E 0/3
 zone-member security DMZ
```

Task 4
Configure a Zone-pair policy to allow the following traffic to successfully communicate from the INSIDE zone to the OUTSIDE zone.

- HTTP
- HTTPS
- SMTP
- FTP
- DNS
- TFTP
- Telnet
- SSH
- ICMP

R2

```
class-map type inspect match-any CM-I-O
 match protocol http
 match protocol https
 match protocol smtp
 match protocol ftp
 match protocol dns
 match protocol tftp
 match protocol ssh
 match protocol Telnet
 match protocol icmp
!
policy-map type inspect PM-I-O
 class CM-I-O
  inspect
!
zone-pair security I-O source INSIDE destination OUTSIDE
 service-policy type inspect PM-I-O
```

Task 5
RDP (TCP/3389) should also be allowed to communicate from INSIDE to OUTSIDE.

R2

```
Ip port-map user-RDP port tcp 3389
!
class-map type inspect match-any CM-I-O
 match protocol user-rdp
```

Task 6

Configure a Zone-pair policy to allow the following traffic to successfully communicate from the INSIDE zone to the DMZ zone.

- HTTP
- HTTPS
- SMTP
- DNS
- Telnet
- SSH
- ICMP

R2

```
class-map type inspect match-any CM-I-D
 match protocol http
 match protocol https
 match protocol smtp
 match protocol dns
 match protocol ssh
 match protocol Telnet
 match protocol icmp
!
policy-map type inspect PM-I-D
 class CM-I-D
  inspect
!
zone-pair security I-D source INSIDE destination DMZ
 service-policy type inspect PM-I-D
```

Task 7

Configure a Zone-pair policy to allow the following traffic to successfully communicate from the OUTSIDE zone to the DMZ zone.

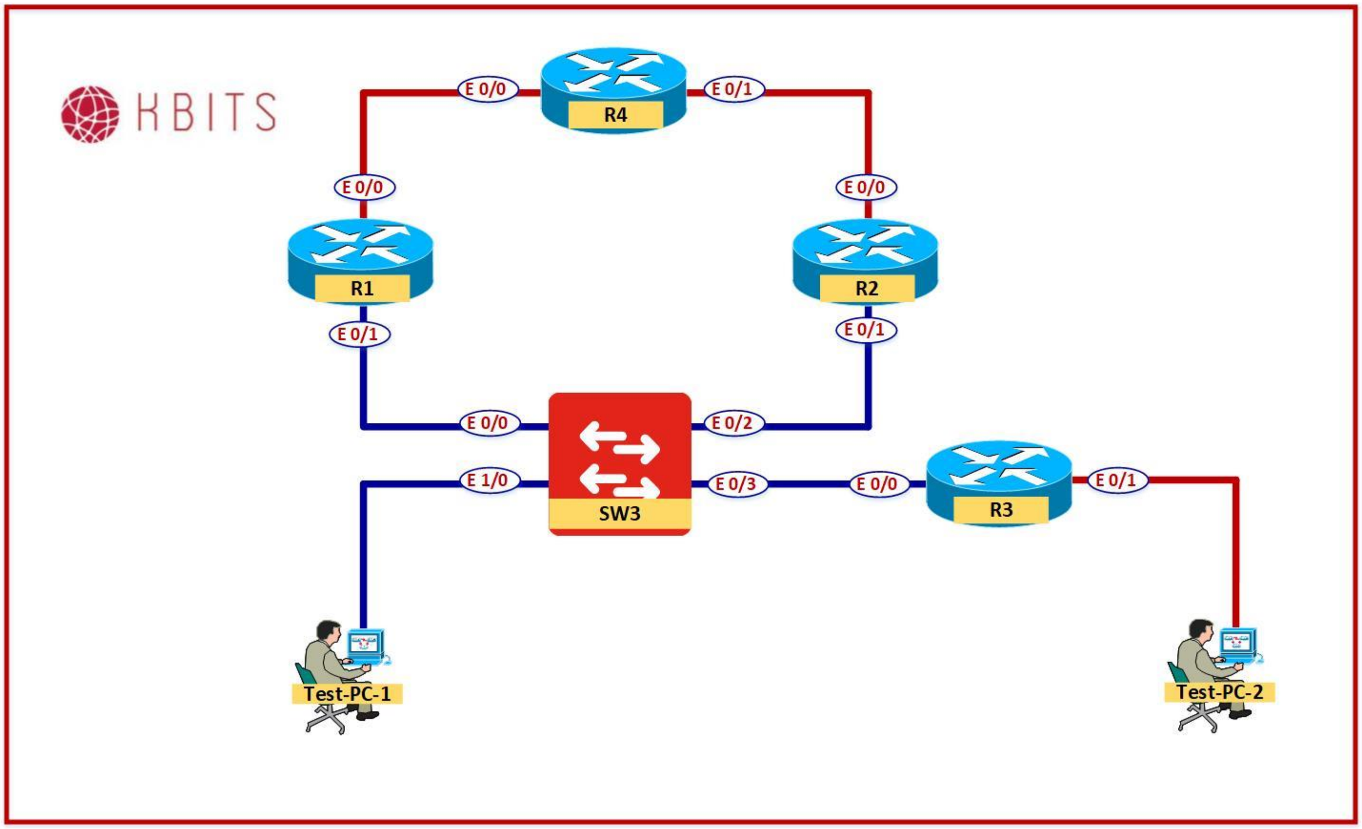
- HTTP – 192.1.25.11
- DNS – 192.1.25.12
- SMTP – 192.1.25.13
- Telnet – 192.1.25.5

R2

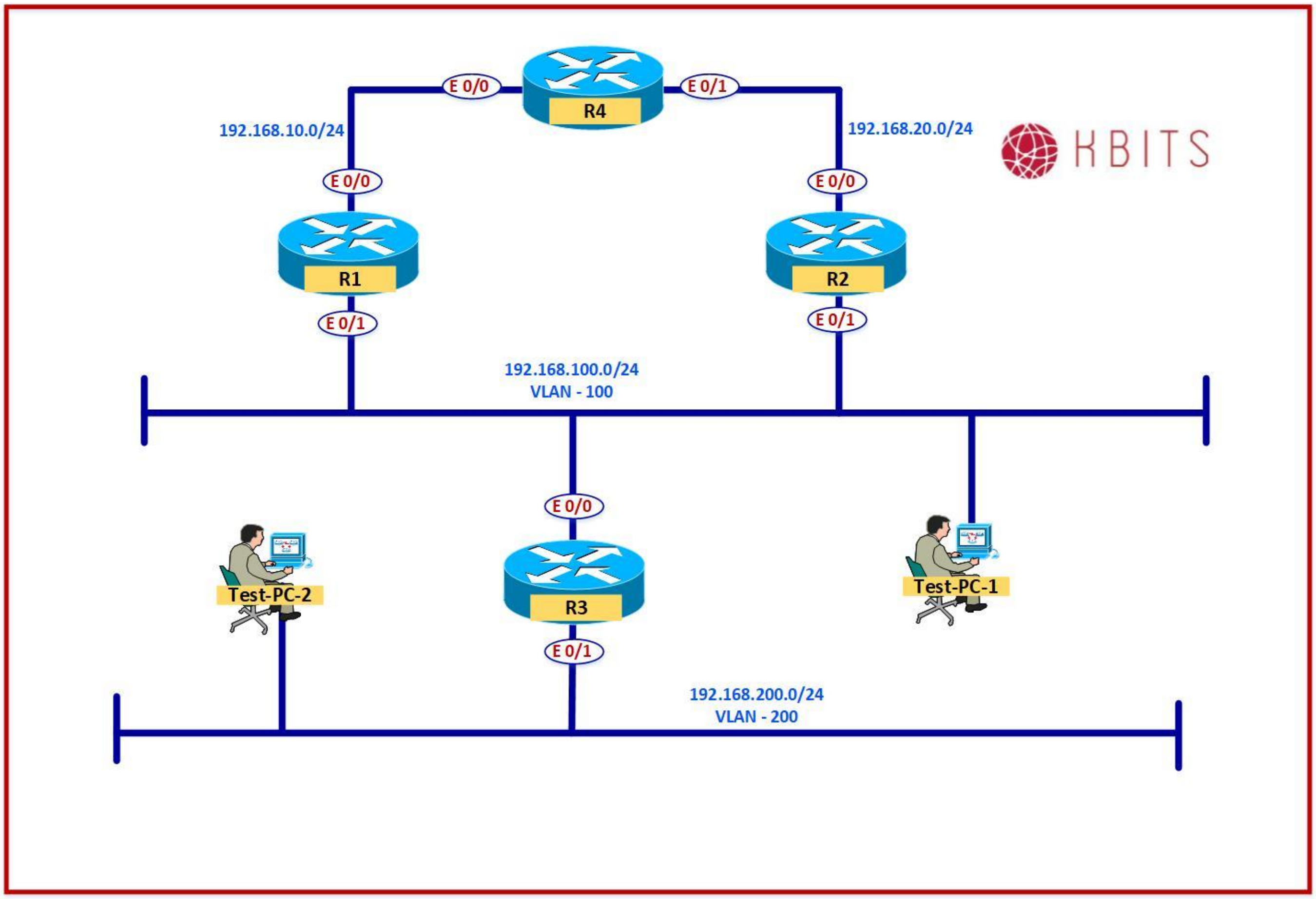
```
access-list 101 permit ip any host 192.1.25.11
access-list 102 permit ip any host 192.1.25.12
access-list 103 permit ip any host 192.1.25.13
access-list 104 permit ip any host 192.1.25.5
!
class-map type inspect match-all CM-O-D-WEB
 match protocol http
 match access-group 101
!
class-map type inspect match-all CM-O-D-DNS
 match protocol dns
 match access-group 102
!
class-map type inspect match-all CM-O-D-MAIL
 match protocol smtp
 match access-group 103
!
class-map type inspect match-all CM-O-D-R5
 match protocol telnet
 match access-group 104

policy-map type inspect PM-O-D
 class CM-O-D-WEB
  inspect
 class CM-O-D-DNS
  inspect
 class CM-O-D-MAIL
  inspect
 class CM-O-D-R5
  inspect

zone-pair security O-D source OUTSIDE destination DMZ
 service-policy type inspect PM-O-D
```

Lab 2 – Configuring FHRP – HSRP

Physical Topology



Logical Topology



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
E 0/0	192.168.10.1	255.255.255.0
E 0/1	192.168.100.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
E 0/0	192.168.20.2	255.255.255.0
E 0/1	192.168.100.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
E 0/0	192.168.100.3	255.255.255.0
E 0/1	192.168.200.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
E 0/0	192.168.10.4	255.255.255.0
E 0/1	192.168.20.4	255.255.255.0
Loopback 0	10.4.4.4	255.255.255.255

Task 1

Create a VLAN 100 on SW-100. Assign all port on SW-100 to VLAN 100.

SW1

```
Vlan 100
!
Interface range E 0/0-3, E1/0-3
 Switchport mode access
 Switchport access vlan 100
```

Task 2

Configure EIGRP in AS 100 between R1, R2, R3 & R4. Enable EIGRP on all interfaces on all routers.

R1

```
Router eigrp 100
 Network 192.168.10.0
 Network 192.168.100.0
```

R2

```
Router eigrp 100
 Network 192.168.20.0
 Network 192.168.100.0
```

R3

```
Router eigrp 100
 Network 192.168.100.0
 Network 192.168.200.0
```

R4

```
Router eigrp 100
 Network 192.168.10.0
 Network 192.168.20.0
 Network 10.4.4.0 0.0.0.255
```

Task 3

Configure Multigroup HSRP between R1 and R2 on the 192.168.100.0 segment. Use the following parameters for Group 1.

- Group ID: 1
- Virtual IP: 192.168.100.254
- Priority: R1 (105); R2 (100 – Default)
- Preemption: Enabled on both
- Authentication: MD5 using a key of kbits@123

R1

```
Interface E 0/1
 Standby version 2
 Standby 1 ip 192.168.100.254
 Standby 1 priority 105
 Standby 1 preempt
 Standby 1 authentication md5 key-string kbits@123
```

R2

```
Interface E 0/1
 Standby version 2
 Standby 1 ip 192.168.100.254
 Standby 1 preempt
 Standby 1 authentication md5 key-string kbits@123
```

Task 4

Configure HSRP to track the E 0/0 interface. If it goes down on the active HSRP router for this group, it should decrement the priority by 20 and the other router should become the Active HSRP router.

R1

```
track 11 interface ethernet 0/0 line-protocol
!
Interface E 0/1
 standby 1 track 11 decrement 20
```

R2

```
track 11 interface ethernet 0/0 line-protocol
!
Interface E 0/1
 standby 1 track 11 decrement 20
```

Task 5

Configure HSRP between R1 and R2 on the 192.168.100.0 segment. Use the following parameters for Group 2.

- Group ID: 2
- Virtual IP: 192.168.100.253
- Priority: R2 (105); R1 (100 – Default)
- Preemption: Enabled on both
- Authentication: MD5 using a key of kbits@123

R1 Interface E 0/1 Standby 2 ip 192.168.100.253 Standby 2 preempt Standby 2 authentication md5 key-string kbits@123
R2 Interface E 0/1 Standby 2 ip 192.168.100.253 Standby 2 priority 105 Standby 2 preempt Standby 2 authentication md5 key-string kbits@123

Task 6

HSRP is tracking E 0/0 interface using a Track ID of 11. If E 0/0 goes down on the active HSRP router for this group, it should decrement the priority by 20 and the other router should become the Active HSRP router.

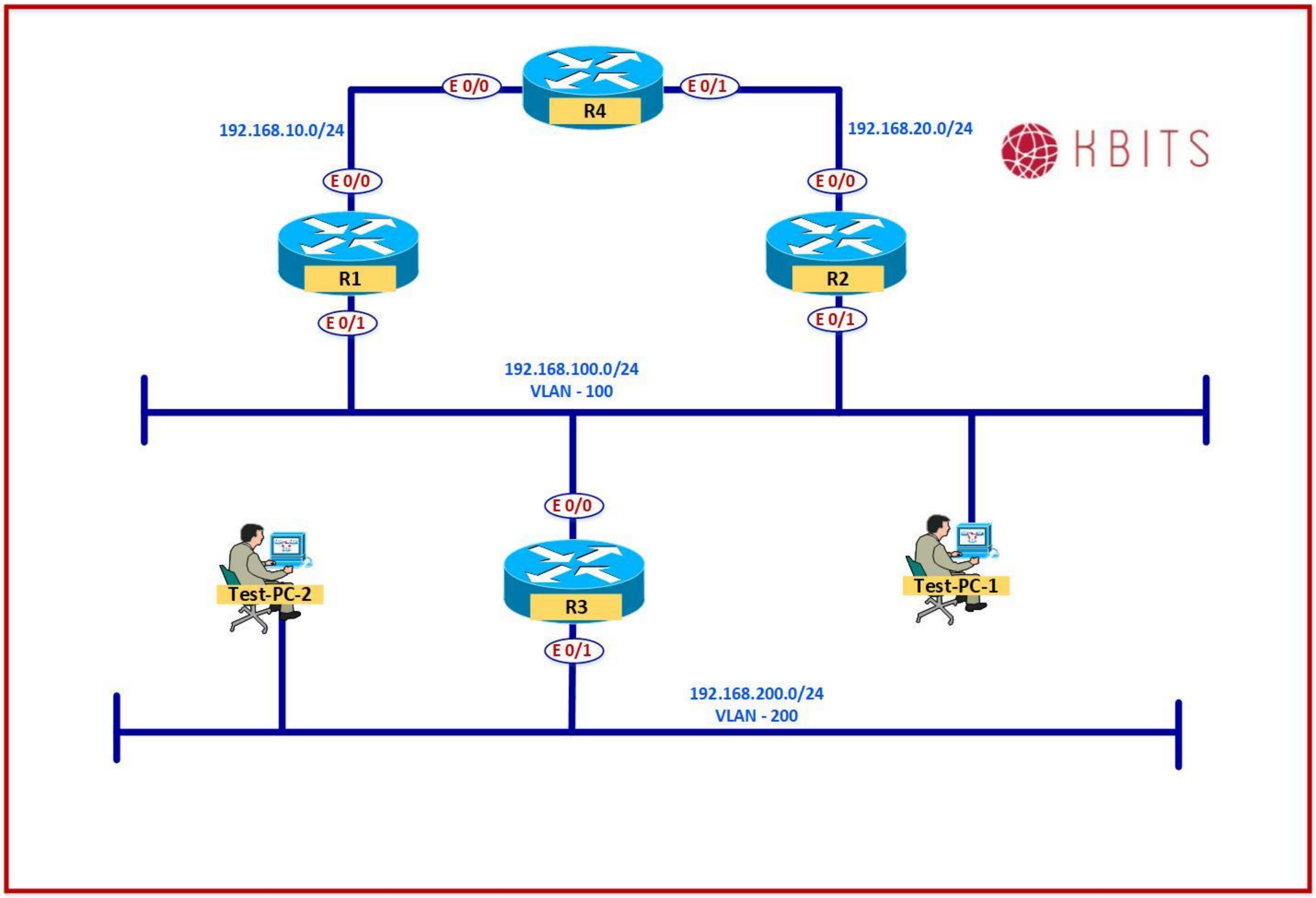
R1 Interface E 0/1 standby 2 track 11 decrement 20
R2 Interface E 0/1 standby 2 track 11 decrement 20

Verification:

Verify the HSRP status by issuing the "**Show standby brief"** command on both routers.

Lab 3 – Configuring FHRP – VRRP

Logical Topology



Task 1

De-Configure HSRP on R1 & R2.

R1	R2
Interface E 0/1 No standby 1 No Standby 2 No standby version 2	Interface E 0/1 No standby 1 No Standby 2 No standby version 2

Task 2

Configure VRRP between R1 and R2 on the 192.168.100.0 segment. Use the following parameters for Group 1.

- Group ID: 1
- Virtual IP: 192.168.100.254
- Priority: R1 (105); R2 (100 – Default)
- Preemption: Enabled on both
- Authentication: MD5 using a key of kbits@123

R1 Interface E 0/1 vrrp 1 ip 192.168.100.254 vrrp 1 priority 105 vrrp 1 authentication md5 key-string kbits@123
R2 Interface E 0/1 vrrp 1 ip 192.168.100.254 vrrp 1 authentication md5 key-string kbits@123

Task 3

Tracking is enabled for E 0/0 interface based on the previous lab using a Track ID of 11. If E 0/0 goes down on the Master VRRP router for this group, it should decrement the priority by 20 and the other router should become the Master router.

R1 Interface E 0/1 vrrp 1 track 11 decrement 20
R2 Interface E 0/1 vrrp 1 track 11 decrement 20

Task 4

Configure VRRP between R1 and R2 on the 192.168.100.0 segment. Use the following parameters for Group 2.

- Group ID: 2
- Virtual IP: 192.168.100.253
- Priority: R2 (105); R1 (100-Default)
- Preemption: Enabled on both

- Authentication: MD5 using a key of kbits@123

R1 Interface E 0/1 vrrp 2 ip 192.168.100.253 vrrp 2 authentication md5 key-string kbits@123
R2 Interface E 0/1 vrrp 2 ip 192.168.100.253 vrrp 2 priority 105 vrrp 2 authentication md5 key-string kbits@123

Task 5

Tracking is enabled for E 0/0 interface based on the previous lab using a Track ID of 11. If E 0/0 goes down on the Master VRRP router for this group, it should decrement the priority by 20 and the other router should become the Master router.

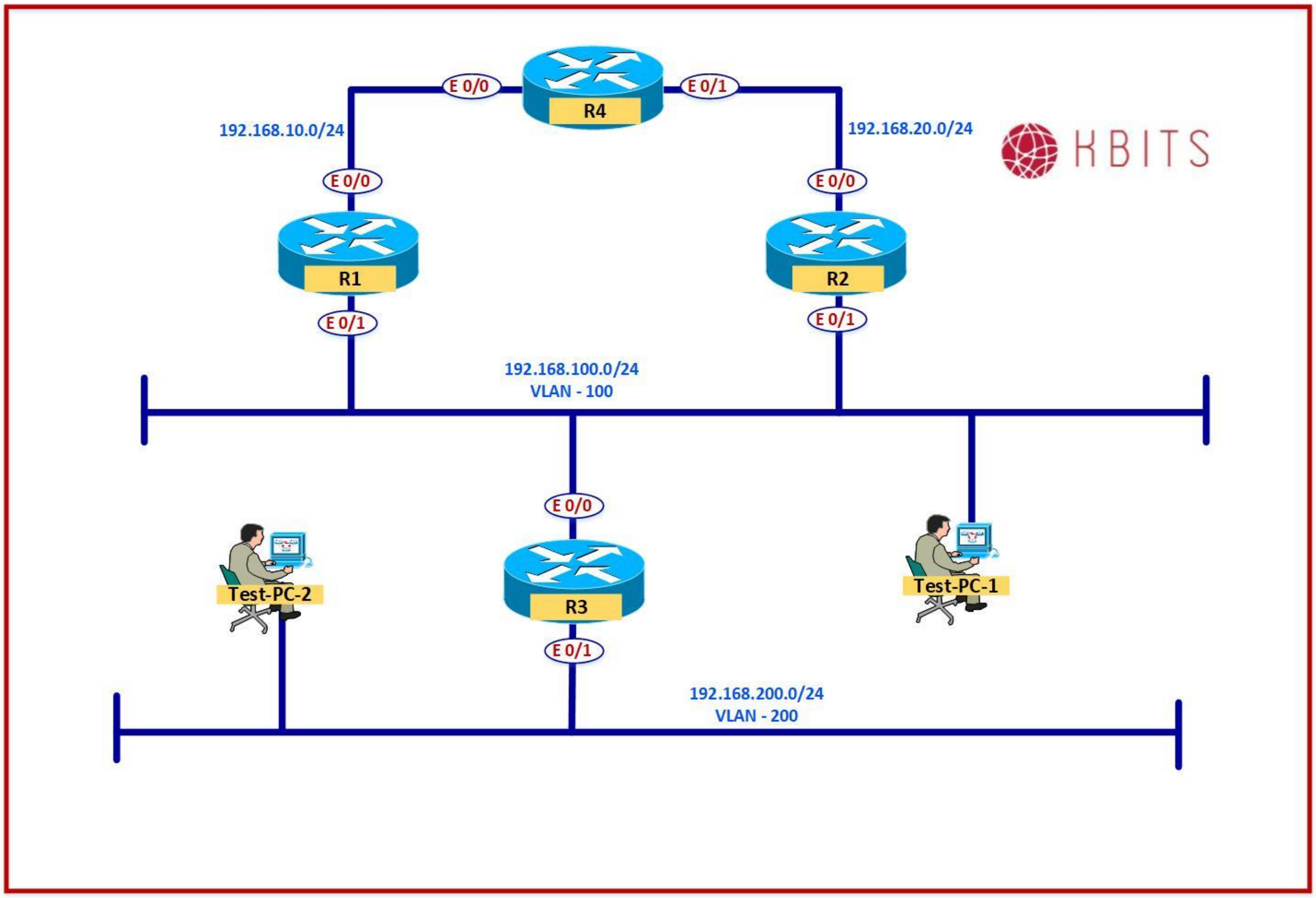
R1 Interface E 0/1 vrrp 2 track 11 decrement 20
R2 Interface E 0/1 vrrp 2 track 11 decrement 20

Verification:

Verify the HSRP status by issuing the "**Show standby brief"** command on both routers.

Lab 4 – Configuring DHCP Server

Logical Topology



Task 1

Configure R1 as the DHCP Server a scope for network 192.168.100.0/24 using the following parameters:

- Excluded Addresses:
  - 192.168.100.1 – 192.168.100.20
  - 192.168.100.251 – 192.168.100.254
- Default Gateway: 192.168.100.253
- DNS Server: 192.168.100.2

R1

```
Ip dhcp excluded-address 192.168.100.1 192.168.100.20
Ip dhcp excluded-address 192.168.100.251 192.168.100.254
!
Ip dhcp pool POOL-100
```

```
Network 192.168.100.0 /24
Default-router 192.168.100.253
Dns-server 192.168.100.2
```

Task 2

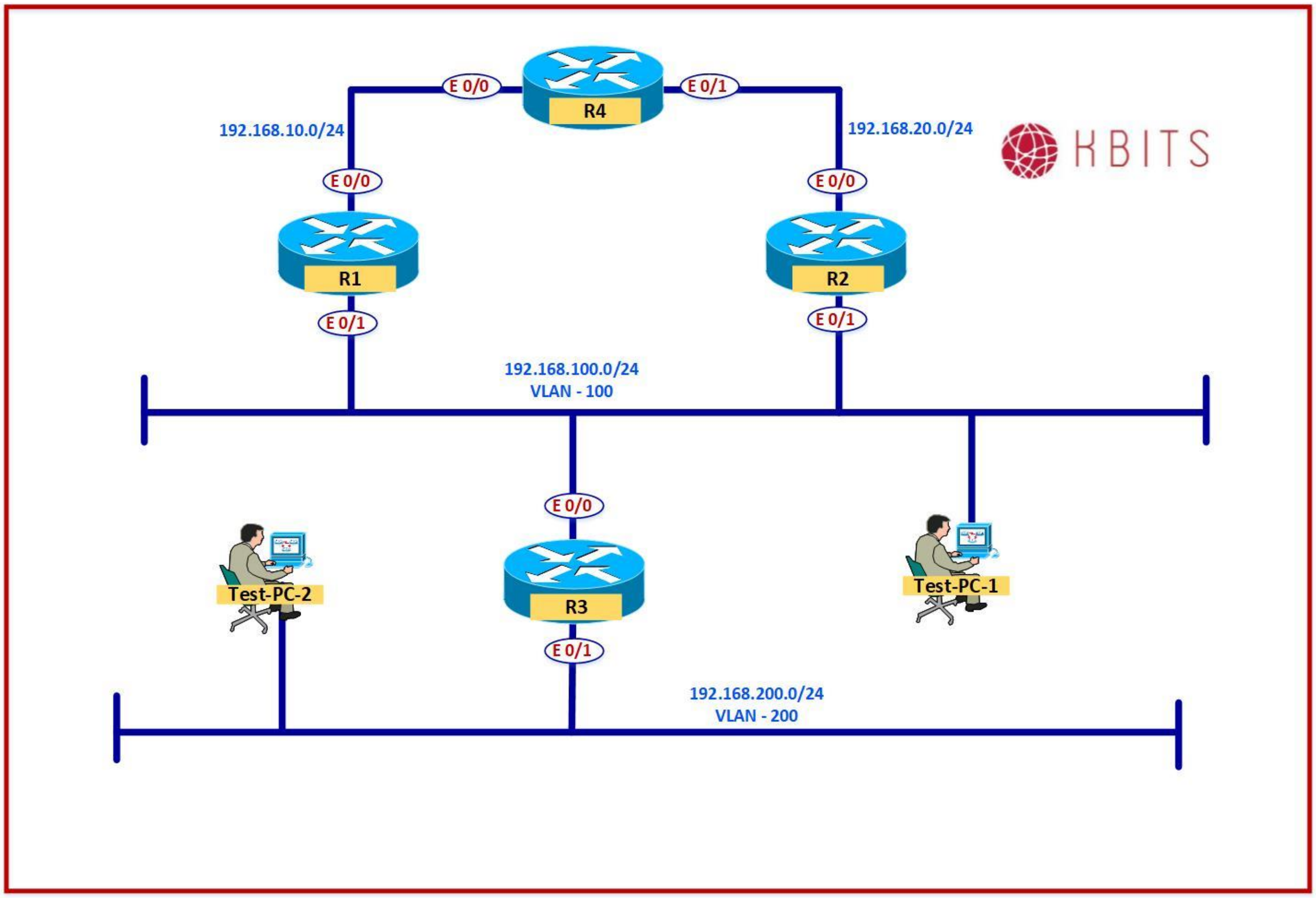
Configure PC-1 to receive an IP Address automatically (DHCP).

Verification:

Verify the configuration on the PC using the "**IPConfig"** command. Also, use the "**Tracert 10.4.4.4"** command to check the flow of traffic. It should use R2 as it should be the Master router for Standby group 2 (**Default Router: 192.168.100.253**)

Lab 5 – Configuring DHCP Relay Agent

Logical Topology



Task 1

Configure R1 as the DHCP Server a scope for network 192.168.200.0/24 using the following parameters:

- Excluded Addresses:
  - 192.168.200.1 – 192.168.200.20
- Default Gateway: 192.168.200.3
- DNS Server: 192.168.100.2

R1

```
Ip dhcp excluded-address 192.168.200.1 192.168.200.20
!
Ip dhcp pool POOL-200
 Network 192.168.200.0 /24
 Default-router 192.168.200.3
```

```
 Dns-server 192.168.100.2
```

Task 2

Configure R3 as a DHCP Relay Agent. It should forward DHCP broadcast requests towards R1. Make sure to only forward DHCP Server and Client Broadcasts towards R1.

R3

```
No Ip forward-protocol udp 37
No Ip forward-protocol udp 49
No Ip forward-protocol udp 53
No Ip forward-protocol udp 69
No Ip forward-protocol udp 137
No Ip forward-protocol udp 138
!
Interface E 0/1
 Ip helper-address 192.168.100.1
```

Task 3

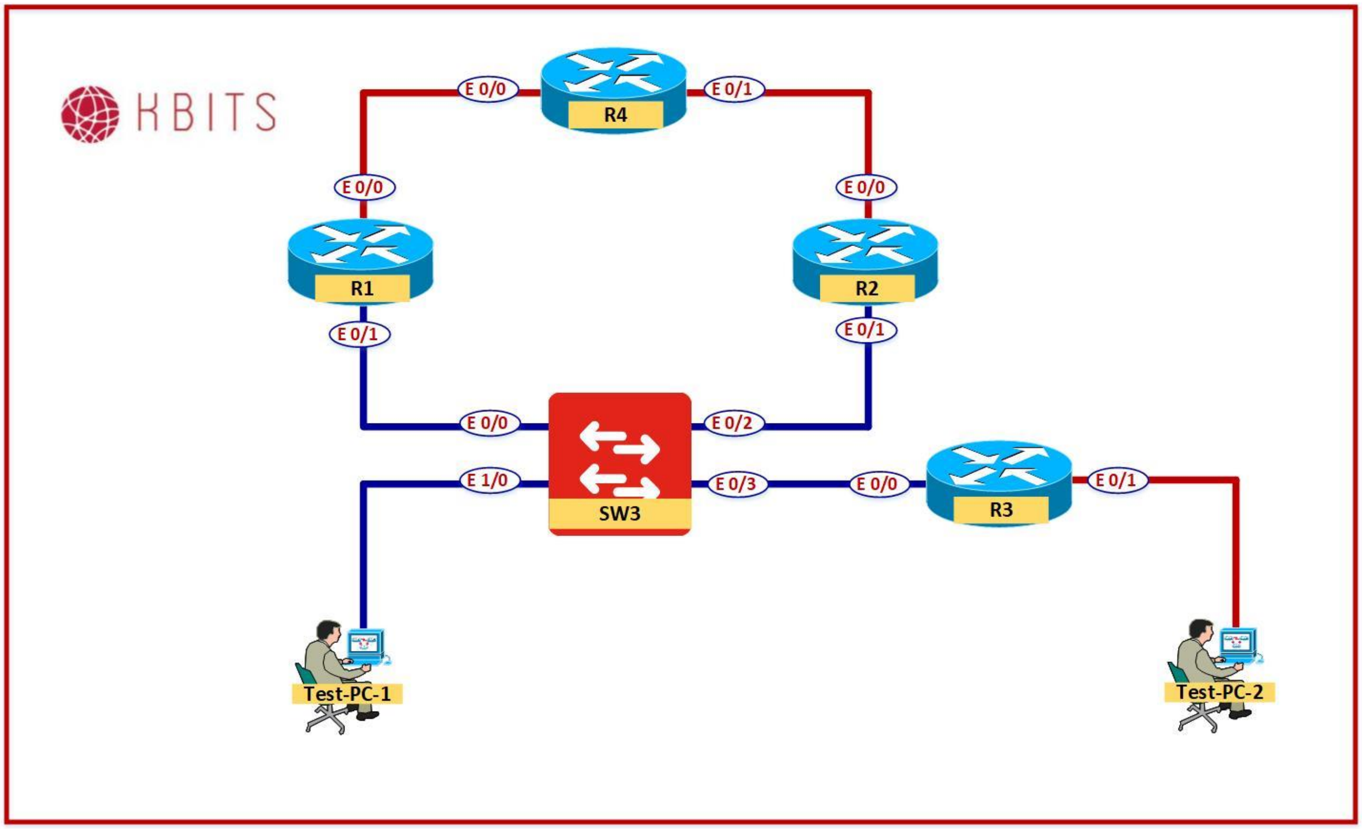
Configure PC-2 to receive an IP Address automatically (DHCP).

Verification:

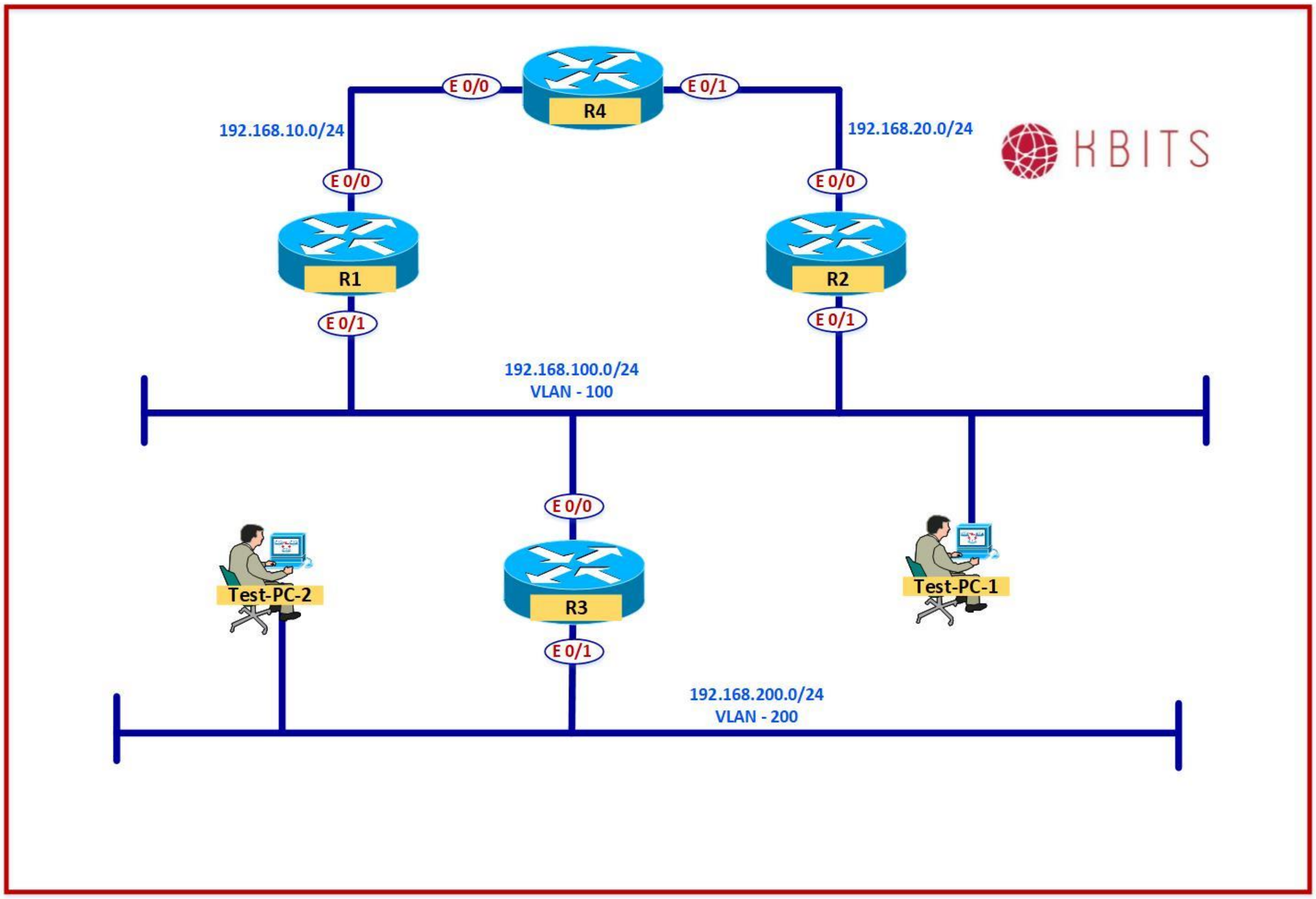
Verify the configuration on the PC using the "**IPConfig"** command. Also, use the "**Ping 10.4.4.4"** command to check connectivity towards R4.

Lab 6 – Configuring DHCP Snooping

Physical Topology



Logical Topology



Task 1
R1 is the only DHCP Server in the environment. It does not support Option-82. Configure SW-100 such that it only allows DHCP replies from R1 in VLAN 100.

SW-100

```
Ip dhcp snooping
Ip dhcp snooping vlan 100
no ip dhcp snooping information option
!
Interface E 0/0
 Ip dhcp snooping trust
```

Task 2
Configure the port on SW-100 connected towards R3 E0/0 also as a trusted port as it is acting as a DHCP Relay Agent.

```
SW-100

Interface E 0/3
 Ip dhcp snooping trust
```

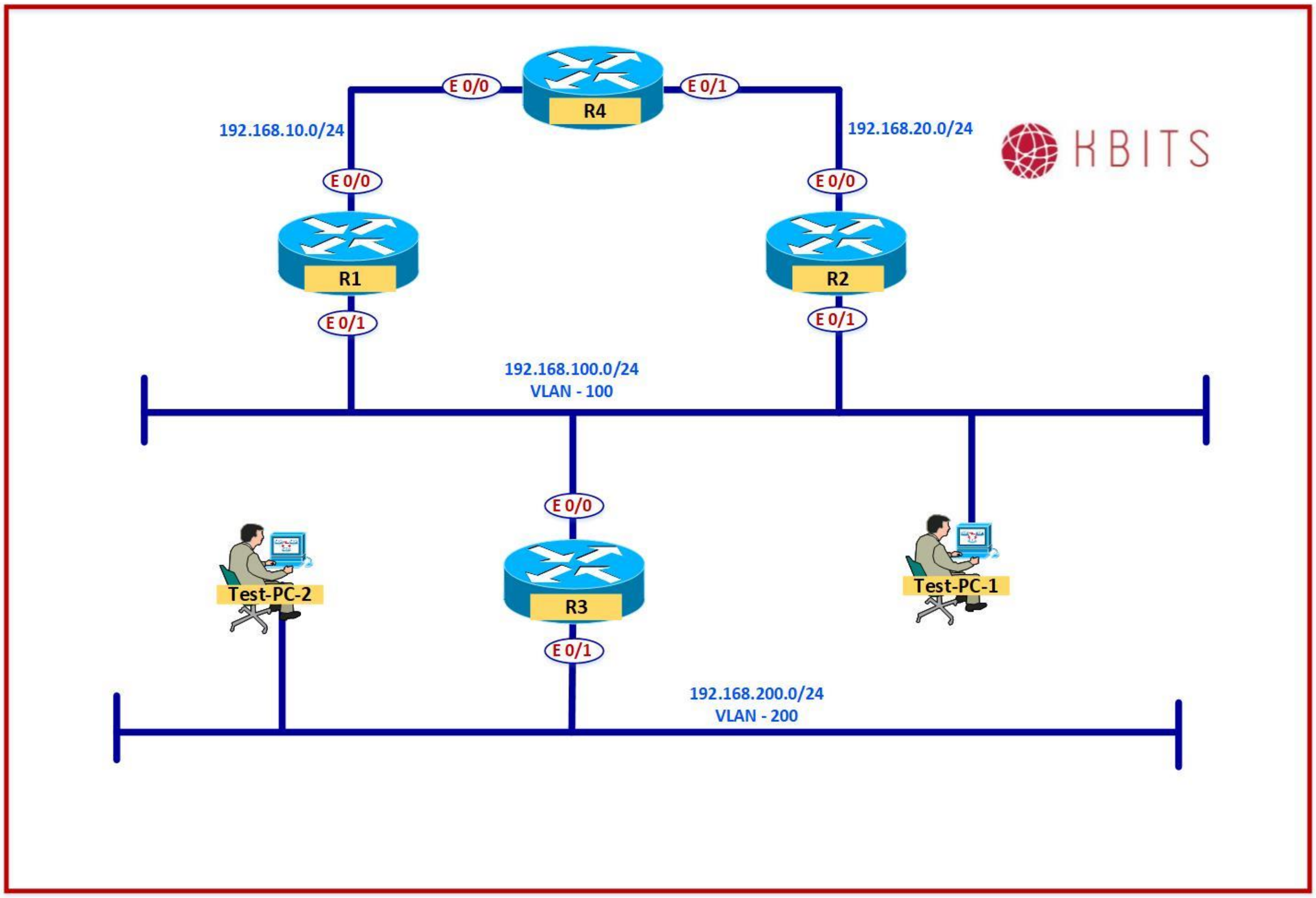
Task 3
Use the "**IPConfig /release"** command to release the assigned address on PC-1 & PC-2.

Use the "**IPConfig /renew"** command to renew the Address release.

Verification:
You should be assigned addresses from the DHCP Server.

Lab 7 – Configuring NTP

Logical Topology



Task 1

R4 is in Dubai. Dubai is 4 hours ahead of GMT. Configure the Timezone on R4. Set the time based on Dubai. Configure R4 as the NTP Master with a stratum of 4. It should use Loopback0 as the NTP Source.

R4

```
Clock timezone GST 4
Do clock set 9:30:00 4 Mar 2021
!
Ntp master 4
Ntp source Loopback0
```

Task 2
Configure R1 & R2 are in New York. Configure them with a timezone with an offset of -5. They should point to R4 Loopback0 as the NTP Server.

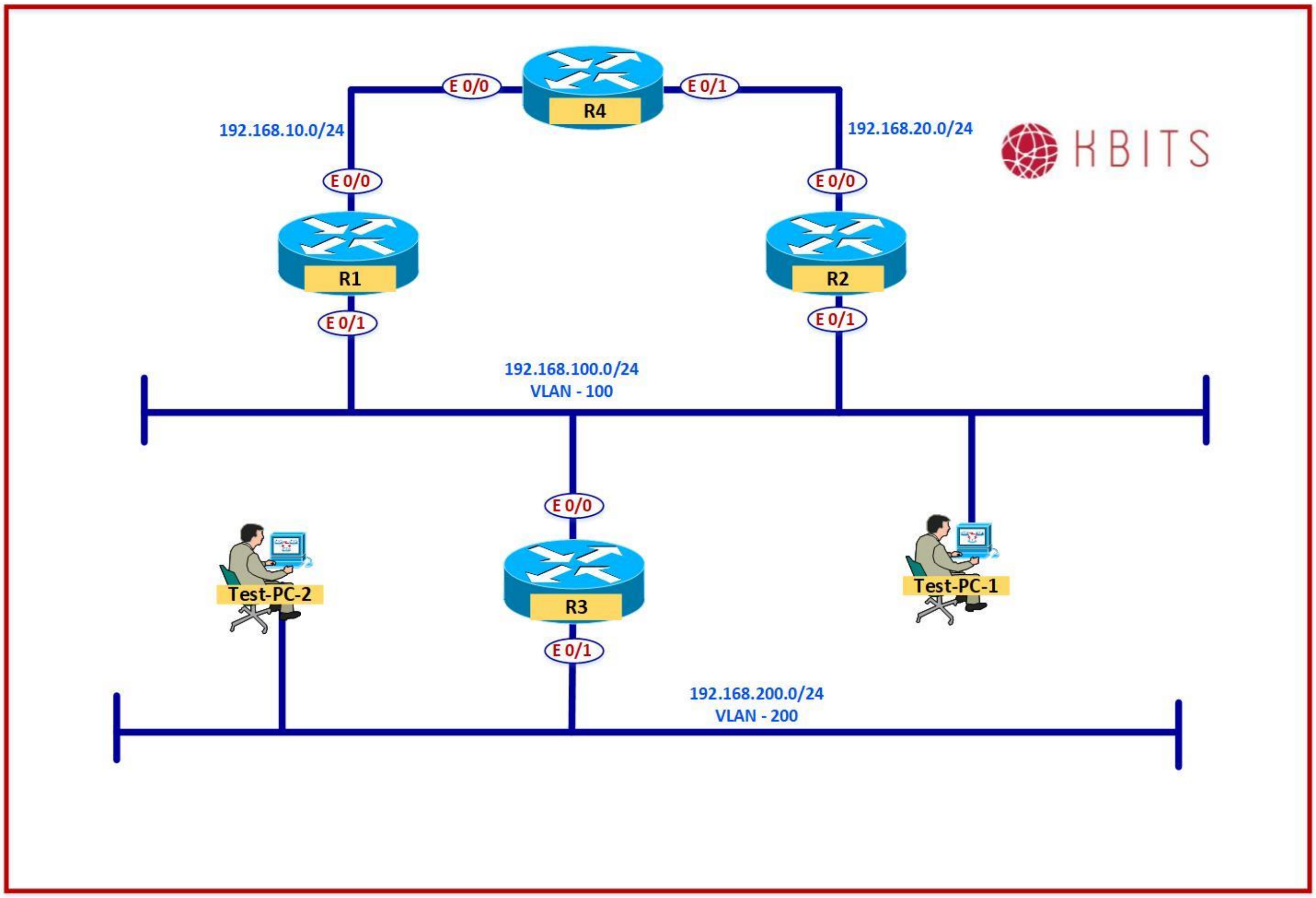
R1 Clock timezone EST -5 ! NTP Server 10.4.4.4
R2 Clock timezone EST -5 ! NTP Server 10.4.4.4

Task 3
Authenticate the NTP Associations between the routers using a Key of 11 and key-string of kbits@123.

R4 Ntp authenticate Ntp authentication-key 11 md5 kbits@123 Ntp trusted-key 11
R1 Ntp authenticate Ntp authentication-key 11 md5 kbits@123 Ntp trusted-key 11 Ntp server 10.4.4.4 key 11
R2 Ntp authenticate Ntp authentication-key 11 md5 kbits@123 Ntp trusted-key 11 Ntp server 10.4.4.4 key 11

Lab 8 – Configuring AAA Services

Logical Topology



Task 1

Configure R1, R2, R3, and R4 to communicate with ISE for AAA Services. ISE will be located at 192.168.100.10. R4 should use the Loopback 0 interface to communicate to ISE. All the devices should use a secret key of kbits@123.

R1 Aaa new-model ! Tacacs server ISE Address ipv4 192.168.100.10 key kbits@123
R2 Aaa new-model !

Tacacs server ISE Address ipv4 192.168.100.10 key kbits@123
R3 Aaa new-model ! Tacacs server ISE Address ipv4 192.168.100.10 key kbits@123
R4 Aaa new-model ! Tacacs server ISE Address ipv4 192.168.100.10 key kbits@123 ! Ip tacacs source-interface Loopback0

Task 2

Create a username **admin1** with a password of **admin1** in the local database. Assign it a privilege level of 15. This needs to be configured on all the routers.

R1 Username admin1 privilege 15 password admin1
R2 Username admin1 privilege 15 password admin1
R3 Username admin1 privilege 15 password admin1
R4 Username admin1 privilege 15 password admin1

Task 3

Configure a TACACS Group called ISE-SVRS. Assign ISE to this group. This needs to be configured on all the routers.

R1 aaa group server tacacs+ ISE-SVRS server name ISE1
R2 aaa group server tacacs+ ISE-SVRS server name ISE1
R3 aaa group server tacacs+ ISE-SVRS server name ISE1
R4 aaa group server tacacs+ ISE-SVRS server name ISE1

Task 4

Configure all routers to use ISE-SVRS for login authentication. Use a Named-list called T-AUTHEN. T-AUTHEN should use ISE-SVRS as the primary authentication and Local Database for fallback authentication. Enable Telnet & SSH on the Routers and have them use T-AUTHEN for authentication.

R1 Aaa authentication login T-AUTHEN group ISE-SVRS local ! Line vty 0 4 Transport input telnet ssh Login authentication T-AUTHEN
R2 Aaa authentication login T-AUTHEN group ISE-SVRS local ! Line vty 0 4 Transport input telnet ssh Login authentication T-AUTHEN
R3 Aaa authentication login T-AUTHEN group ISE-SVRS local !

Line vty 0 4 Transport input telnet ssh Login authentication T-AUTHEN
R4 Aaa authentication login T-AUTHEN group ISE-SVRS local ! Line vty 0 4 Transport input telnet ssh Login authentication T-AUTHEN

Task 5

Configure all routers to use the ISE-SVRS for Exec authorization. Use a named list called T-AUTHOR. T-AUTHOR should use ISE-SVRS as the primary exec authorization and Local Database for fallback authorization. Have Telnet & SSH use T-AUTHOR for authorization.

R1 Aaa authorization exec T-AUTHOR group ISE-SVRS local ! Line vty 0 4 Authorization exec T-AUTHOR
R2 Aaa authorization exec T-AUTHOR group ISE-SVRS local ! Line vty 0 4 Authorization exec T-AUTHOR
R3 Aaa authorization exec T-AUTHOR group ISE-SVRS local ! Line vty 0 4 Authorization exec T-AUTHOR
R4 Aaa authorization exec T-AUTHOR group ISE-SVRS local ! Line vty 0 4 Authorization exec T-AUTHOR

Task 6

Configure all routers to use the ISE-SVRS for Exec & Command level 15 accounting. Use a named list called T-ACCT. T-ACCT should use ISE-SVRS for both Exec & Command Level 15 accounting. Have Telnet & SSH use T-AUTHOR for accounting.

R1

```
Aaa accounting exec T-ACCT start-stop group ISE-SVRS
Aaa accounting command 15 T-ACCT start-stop group ISE-SVRS

!
Line vty 0 4
 Accounting exec T-ACCT
 Accounting command 15 T-ACCT
```

R2

```
Aaa accounting exec T-ACCT start-stop group ISE-SVRS
Aaa accounting command 15 T-ACCT start-stop group ISE-SVRS

!
Line vty 0 4
 Accounting exec T-ACCT
 Accounting command 15 T-ACCT
```

R3

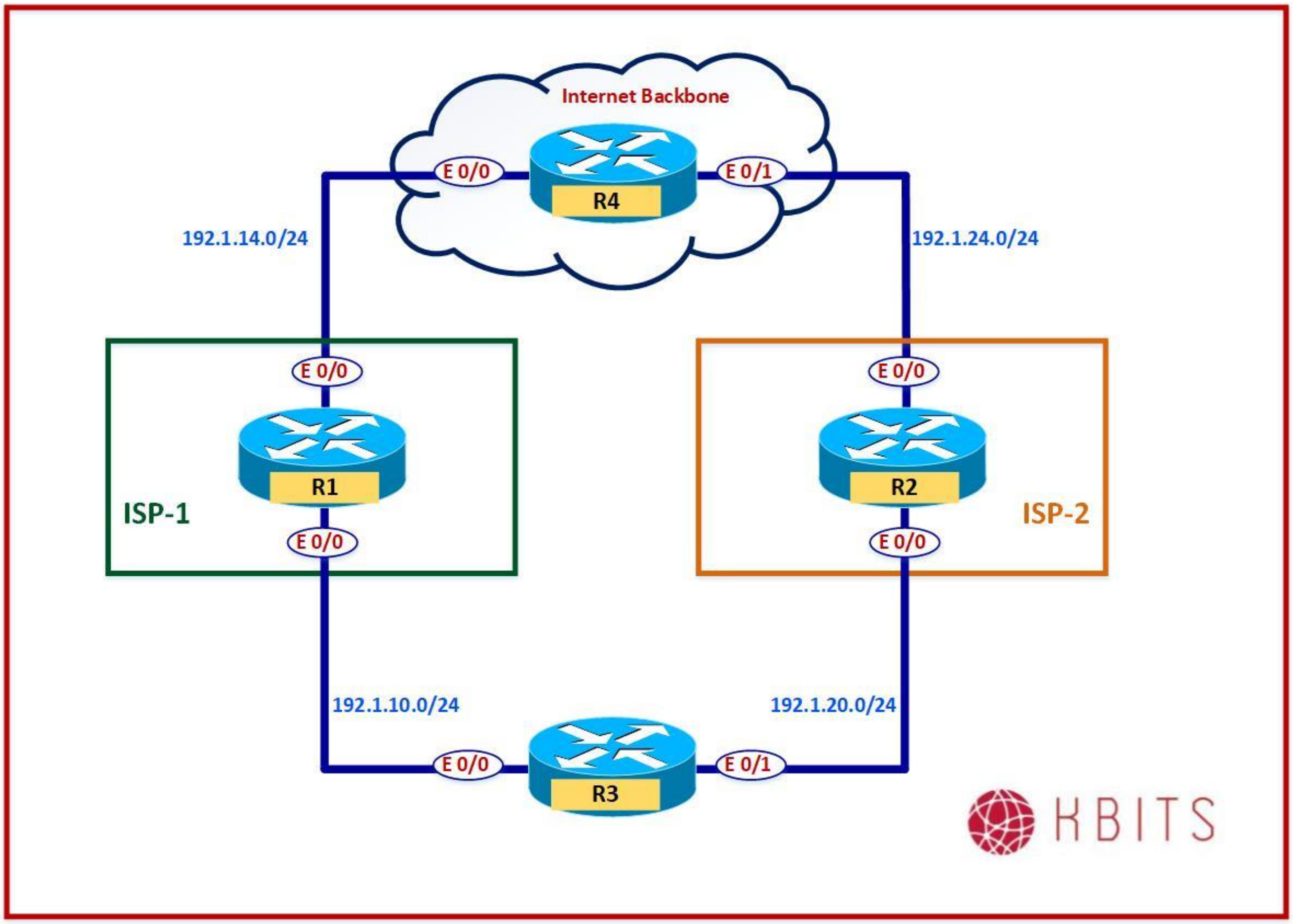
```
Aaa accounting exec T-ACCT start-stop group ISE-SVRS
Aaa accounting command 15 T-ACCT start-stop group ISE-SVRS

!
Line vty 0 4
 Accounting exec T-ACCT
 Accounting command 15 T-ACCT
```

R4

```
Aaa accounting exec T-ACCT start-stop group ISE-SVRS
Aaa accounting command 15 T-ACCT start-stop group ISE-SVRS

!
Line vty 0 4
 Accounting exec T-ACCT
 Accounting command 15 T-ACCT
```

Lab 9 – Configuring IP SLA

Logical Topology



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
E 0/0	192.1.14.1	255.255.255.0
E 0/1	192.1.10.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
E 0/0	192.1.24.2	255.255.255.0
E 0/1	192.1.20.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
E 0/0	192.1.10.3	255.255.255.0
E 0/1	192.1.20.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
E 0/0	192.1.14.4	255.255.255.0
E 0/1	192.1.24.4	255.255.255.0
Loopback 0	4.2.2.2	255.255.255.255
Loopback 199	199.1.1.1	255.255.255.0

Task 1

Configure EIGRP in AS 111 between R1, R2 & R4. Enable all interfaces on all 3 routers in EIGRP. Configure the E 0/1 interfaces on R1 & R2 as passive-interfaces.

R1 Router eigrp 111 Network 192.1.10.0 Network 192.1.14.0 Passive-interface E 0/1	**R2** Router eigrp 111 Network 192.1.20.0 Network 192.1.24.0 Passive-interface E 0/1
R4 Router eigrp 111 Network 192.1.14.0 Network 192.1.24.0 Network 4.0.0.0 Network 199.1.1.0	

Task 2

Configure and enable an SLA object on R3 with the following parameters:

- SLA Object #: 33
- Destination IP: 4.2.2.2
- Source-IP: 192.1.10.1
- Protocol: ICMP Echo
- Frequent: 20

Create a host route for 4.2.2.2 via R1.

R3

```
Ip route 4.2.2.2 255.255.255.255 192.1.10.1
!
ip sla 33
 icmp-echo 4.2.2.2 source-ip 192.1.10.3
 frequency 20
!
ip sla schedule 33 start-time now life forever
```

Task 3

Configure a Track object 33. It have a state of "**UP**" based on the state of SLA 33.

R3

```
track 33 ip sla 33 state
```

Task 4

Configure floating default static routes via R1 or R2. R1 should be used as the preferred default route if track object 33 has a state of "**UP**".

R3

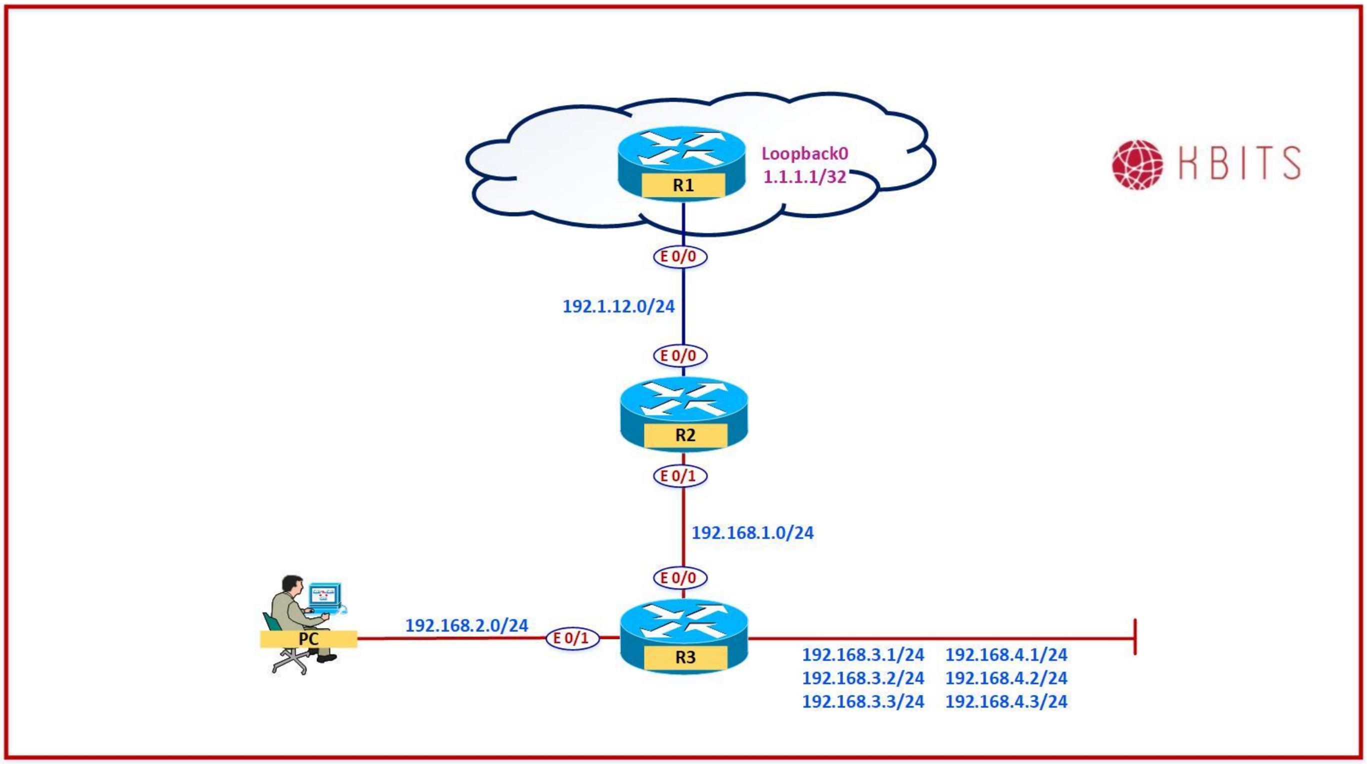
```
Ip route 0.0.0.0 0.0.0.0 192.1.10.1 track 33
Ip route 0.0.0.0 0.0.0.0 192.1.20.2 5
```

Verification:

- Verify that the Default Route installed in the routing table is via R1. Verify the connectivity by pinging 199.1.1.1.
- Shut the E0/0 Interface on R1.
- Check the Track state on R3.
- Verify that the Default Route installed in the routing table is via R2. Verify the connectivity by pinging 199.1.1.1.
- Bring up the E0/0 Interface on R1.
- Check the Track state on R3.
- Verify that the Default Route installed in the routing table is via R1. Verify the connectivity by pinging 199.1.1.1.

Lab 10 – Configuring Dynamic NAT

Logical Topology



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
E 0/0	192.1.12.1	255.255.255.0
Loopback0	1.1.1.1	255.255.255.255

R2

Interface	IP Address	Subnet Mask
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.168.1.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
E 0/0	192.168.1.3	255.255.255.0
E 0/1	192.168.2.3	255.255.255.0
Loopback0	192.168.3.1	255.255.255.255
Loopback1	192.168.3.2	255.255.255.255
Loopback2	192.168.3.3	255.255.255.255
Loopback3	192.168.4.1	255.255.255.255
Loopback4	192.168.4.2	255.255.255.255
Loopback5	192.168.4.3	255.255.255.255

Task 1

Configure a Default routes on R2 pointing towards R1. Configure a Default routes on R3 pointing towards R2.

R2

```
Ip route 0.0.0.0 0.0.0.0 192.1.12.1
```

R3

```
Ip route 0.0.0.0 0.0.0.0 192.168.1.2
```

Task 2

Configure Routing for Internal networks between R2 & R3. Use EIGRP in AS 111 as the routing protocol.

R2

```
Router eigrp 111
 Network 192.168.1.0
```

R3

```
Router eigrp 111
 Network 192.168.1.0
 Network 192.168.2.0
 Network 192.168.3.0
 Network 192.168.4.0
```

Task 3

Configure a pool of 192.1.10.51 thru 192.1.10.254 on R2. The pool will be used by the 192.168.2.0/24 network. Use POOL1 as the name of the pool. Configure an ACL to classify the outbound traffic. Create a Static Route on R1 for the 192.1.10.0/24 network pointing towards R2.

R1

```
Ip route 192.1.10.0 255.255.255.0 192.1.12.2
```

R2

```
Ip nat pool POOL1 192.1.10.51 192.1.10.254 netmask 255.255.255.0
!
Access-list 101 permit ip 192.168.2.0 0.0.0.255 any
```

Task 4

Configure R2 for NAT. Enable the E 0/0 interface as the Outside interface for NAT. Enable the E 0/1 interface as the Inside interface for NAT.

R2

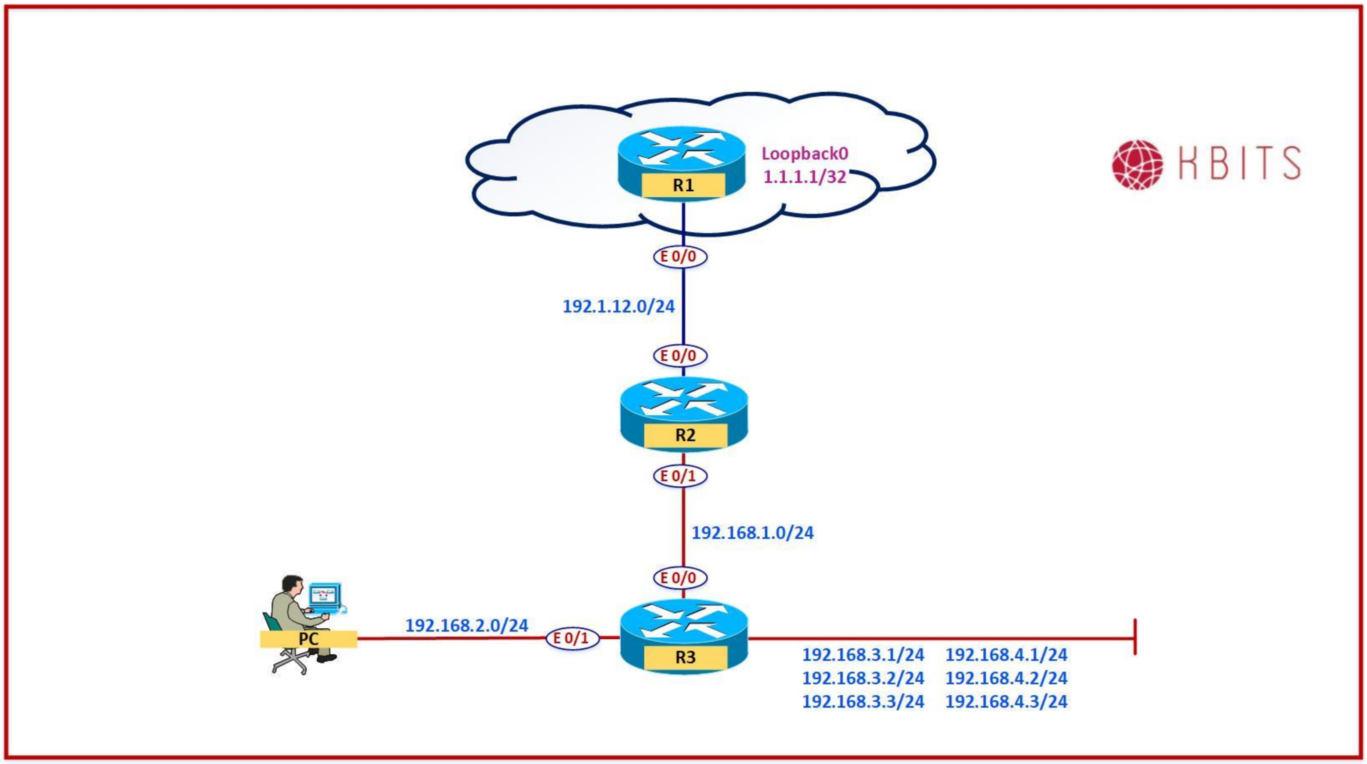
```
Ip nat inside source list 101 pool POOL1
!
Interface E 0/0
 Ip nat outside
!
Interface E 0/1
 Ip nat inside
```

Verification:

- Telnet to 1.1.1.1 from PC-1.
- Type "**show user**" to verify the ip address used to telnet in.
- Verify the translation table on R2 by using the "**show ip nat translations**" command.

Lab 11 – Configuring Dynamic PAT

Logical Topology



Task 1

Configure a PAT Pool of 192.1.10.11 & 192.1.10.12 on R2. The pool will be used by the 192.168.1.0/24 network. Use POOL2 as the name of the pool. This pool should use Dynamic PAT. Configure an ACL to classify the outbound traffic.

R2

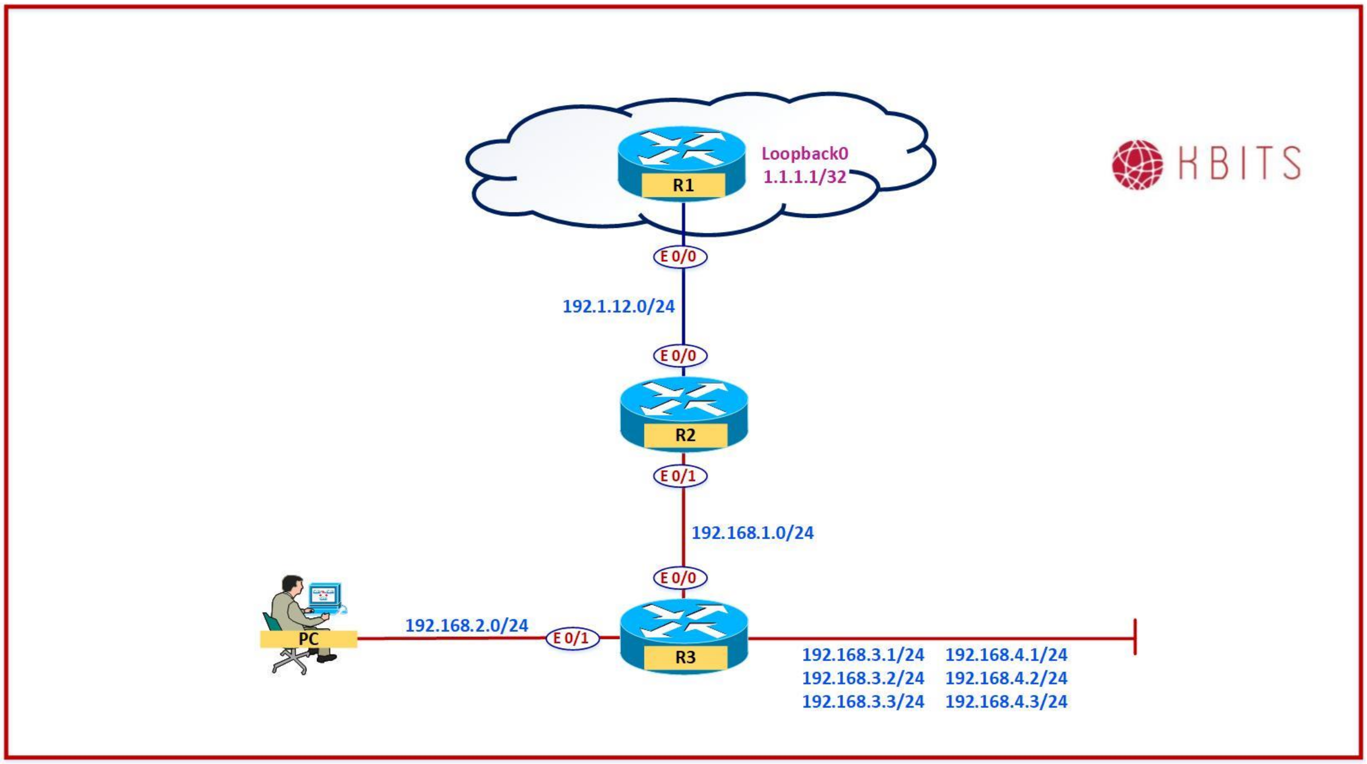
```
Ip nat pool POOL2 192.1.10.11 192.1.10.12 netmask 255.255.255.0
!
Access-list 102 permit ip 192.168.1.0 0.0.0.255 any
!
Ip nat inside source list 102 pool POOL2 overload
```

Verification:

- Telnet to 1.1.1.1 from R3.
- Type “**show user**” to verify the ip address used to telnet in.
- Verify the translation table on R2 by using the “**show ip nat translations**” command.

Lab 12 – Configuring Static NAT

Logical Topology



Task 1

Configure Static NAT on R2 based on the following:

- 192.168.3.1 – 192.1.10.31
- 192.168.3.2 – 192.1.10.32
- 192.168.3.3 – 192.1.10.33

R2

```
Ip nat inside source static 192.168.3.1 192.1.10.31
Ip nat inside source static 192.168.3.2 192.1.10.32
Ip nat inside source static 192.168.3.3 192.1.10.33
```

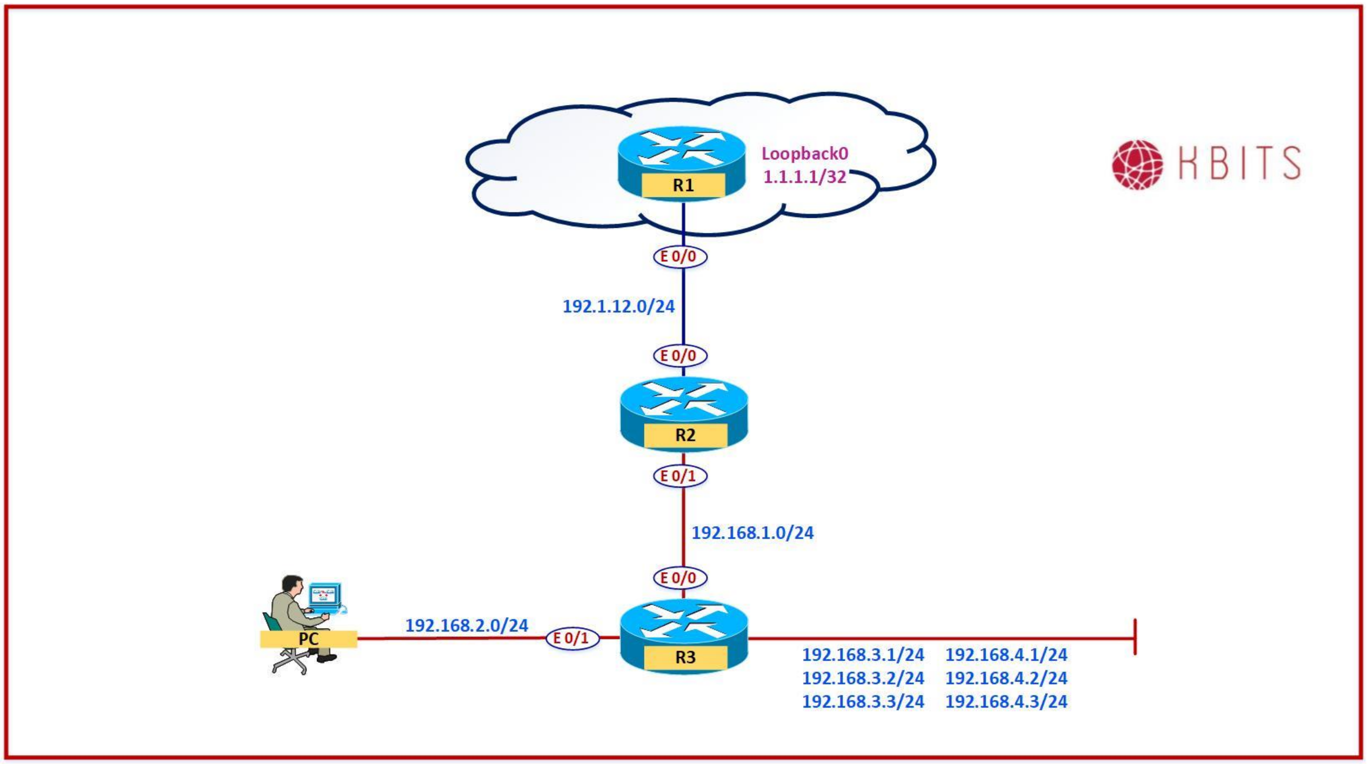
Verification:

- Telnet to 192.1.10.31, 192.1.10.32 & 192.1.10.33 from R1.

- Verify the translation table on R2 by using the "**show ip nat translations**" command.

Lab 13 – Configuring Static PAT

Logical Topology



Task 1

Configure Static PAT on R2 based on the following:

- 192.168.4.1 – 192.1.10.25 – TCP/80
- 192.168.4.2 – 192.1.10.25 – TCP/25
- 192.168.4.3 – 192.1.10.25 – TCP/23
- 192.168.4.3 – 192.1.10.25 – UDP/53

R2

```
ip nat inside source static tcp 192.168.4.1 80 192.1.10.25 80
ip nat inside source static tcp 192.168.4.2 25 192.1.10.25 25
ip nat inside source static tcp 192.168.4.3 23 192.1.10.25 23
ip nat inside source static udp 192.168.4.3 53 192.1.10.25 53
```

Verification:

- Telnet to 192.1.10.25 from R1.
- Verify the translation table on R2 by using the "**show ip nat translations**" command.

Quality of Service (QoS)

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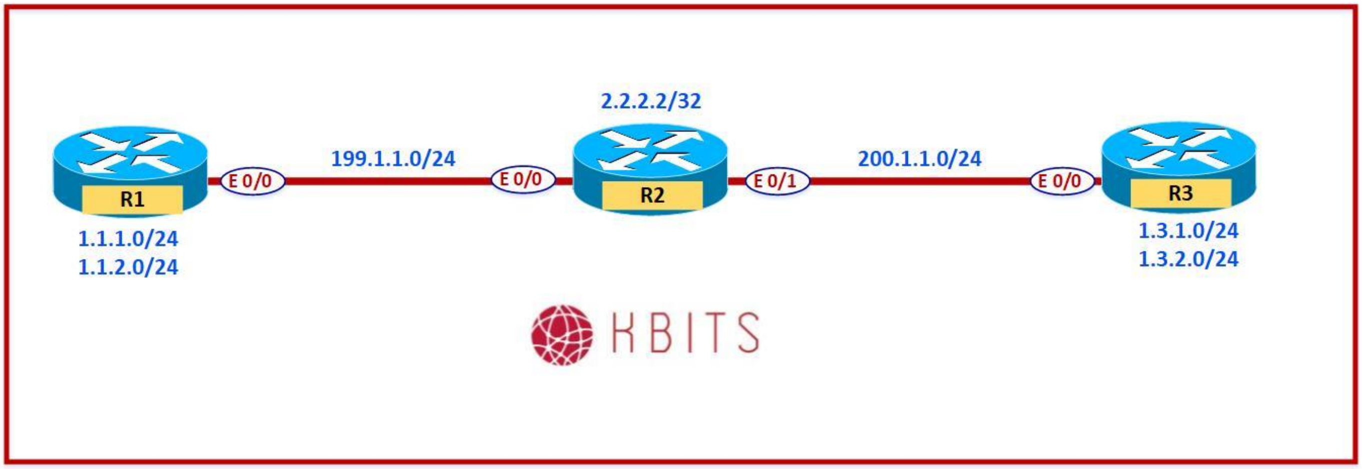
Quality of Service (QoS)

Lab 1 – Configuring Policing



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.255.255.0
Loopback 1	1.1.2.1	255.255.255.0
E 0/0	199.1.1.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
E 0/0	199.1.1.2	255.255.255.0
E 0/1	200.1.1.2	255.255.255.0
Loopback0	2.2.2.2	255.255.255.255

R3

Interface	IP Address	Subnet Mask
Loopback 0	1.3.1.1	255.255.255.0
Loopback 1	1.3.2.1	255.255.255.0
E 0/0	200.1.1.3	255.255.255.0

Task 1

Configure Defaut routes on R1 & R3 pointing towards R2 (ISP). Configure a Static Route on R2 for 1.1.0.0/16 network pointing towards R1. Configure a Static Route on R2 for 1.3.0.0/16 network point towards R3.

R1 Ip route 0.0.0.0 0.0.0.0 199.1.1.2	**R3** Ip route 0.0.0.0 0.0.0.0 200.1.1.2
R2 Ip route 1.1.0.0 255.255.0.0 199.1.1.1 Ip route 1.3.0.0 255.255.0.0 200.1.1.3	

Task 2

Configure R1 for Rate Limiting (Policing) for traffic originating from the 1.1.1.0/24 network going towards the Internet using the following parameters:

- ICMP traffic should be limited to 450 kbps
- FTP traffic should be limited to 2 mbps

R1

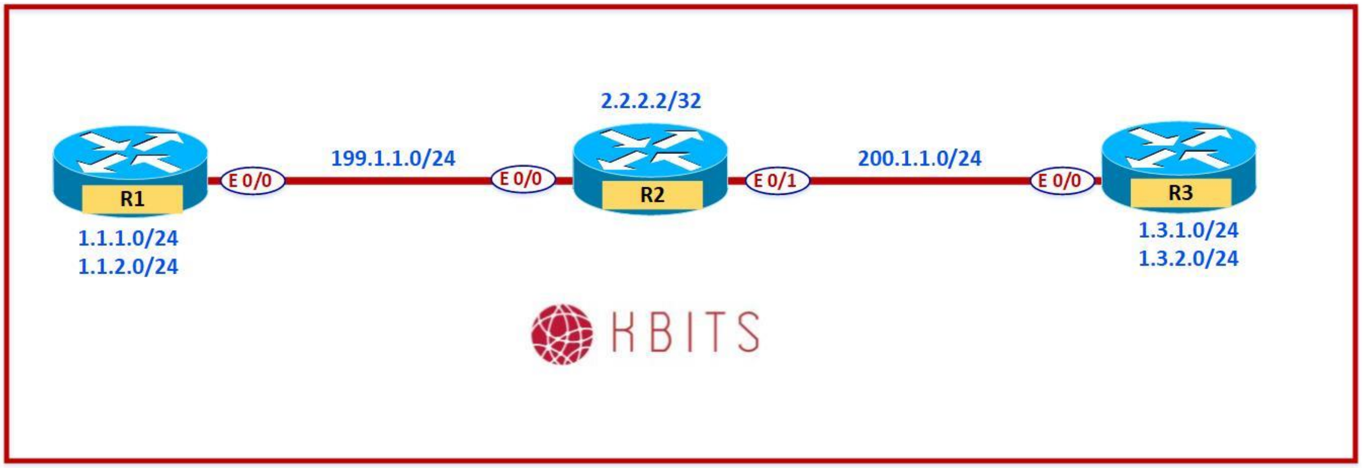
```
Access-list 101 permit icmp 1.1.1.0 0.0.0.255 any
!
Access-list 102 permit tcp 1.1.1.0 0.0.0.255 any eq 21
Access-list 102 permit tcp 1.1.1.0 0.0.0.255 any eq 20
!
Class-map CM-ICMP
 Match access-group 101
!
Class-map CM-FTP
 Match access-group 102
!
Policy-map PM-QOS
 Class CM-ICMP
   Police 450000
 Class CM-FTP
   Police 2000000
!
Interface E 0/0
 Service-policy output PM-QOS
```

Verification:

- Ping 2.2.2.2 from R1 using a source of 1.1.1.1.

- Verify the QoS Policy on R1 by using the "**show policy-map interface E 0/0**" command. You should see hit counts on the Policy for ICMP Policing.

Lab 2 – Configuring Congestion Management with Bandwidth Reservation



Task 1

Configure R3 Ethernet interface for Bandwidth Reservation using the following:

- HTTP and HTTPS traffic = Reserve 30% of the Bandwidth
- Telnet Traffic = Reserve 10% of the Bandwidth

R3

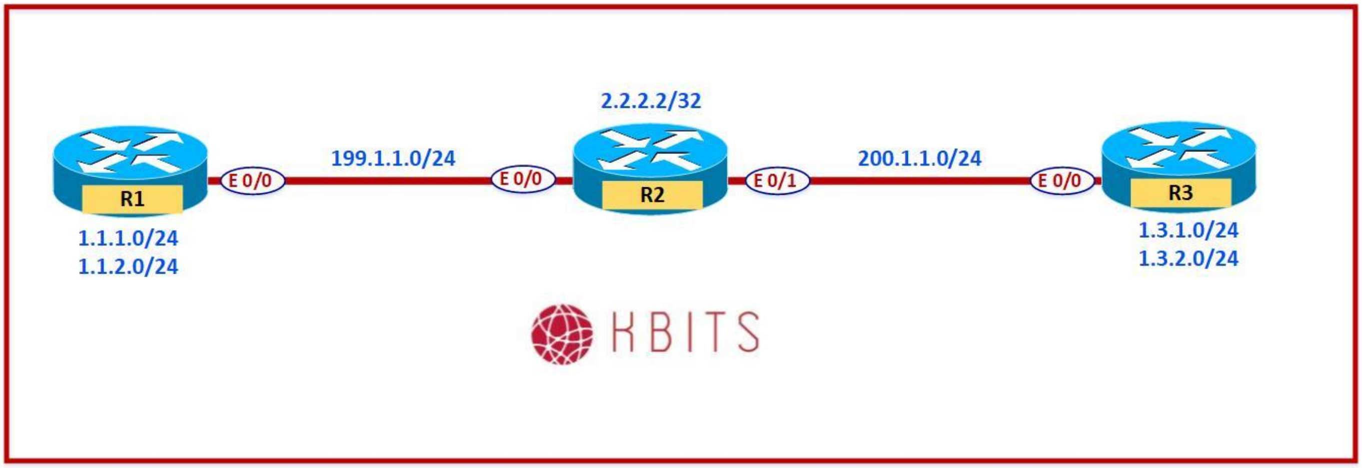
```
Access-list 111 permit tcp any any eq 80
Access-list 111 permit tcp any any eq 443
!
Access-list 112 permit tcp any any eq 23
!
class-map CM-WEB
 match access-group 111
!
class-map CM-TELNET
 match access-group 112
!
policy-map PM-QOS
 class CM-TELNET
   bandwidth percent 10
 class CM-WEB
   bandwidth percent 30
!
Interface E 0/0
 Service-policy output PM-QOS
```

Verification:

- Telnet into 2.2.2.2 from R3 using a source of 1.3.1.1.

- Verify the QoS Policy on R3 by using the "**show policy-map interface E 0/0**" command. You should see hit counts on the Policy for the Telnet Policy.

Lab 3 – Configuring Congestion Management with Low-Latency Queuing (LLQ)



Task 1

Configure R3 Ethernet interface for LLQ using the following:

- SSH Traffic = 15% of the bandwidth. SSH traffic should use LLQ.

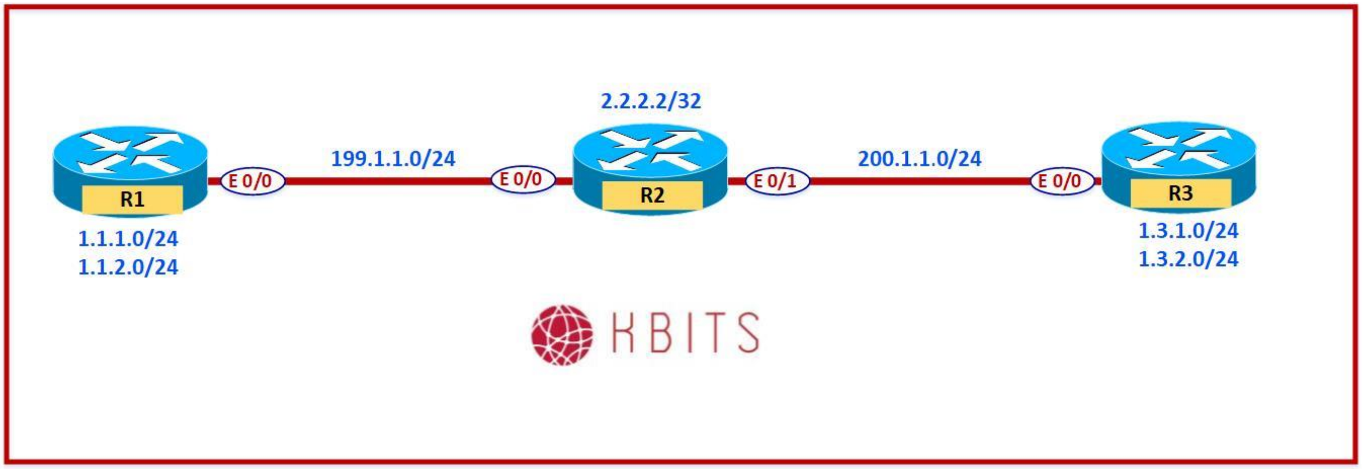
R3

```
Access-list 113 permit tcp any any eq 22
!
class-map CM-SSH
 match access-group 113
!
policy-map PM-QOS
 class CM-SSH
   priority percent 15
```

Verification:

- SSH into 2.2.2.2 from R3 using a source of 1.3.1.1.
- Verify the QoS Policy on R3 by using the "**show policy-map interface E 0/0**" command. You should see hit counts on the Policy for the SSH Policy.

Lab 4 – Classifying Traffic Using NBAR



Task 1

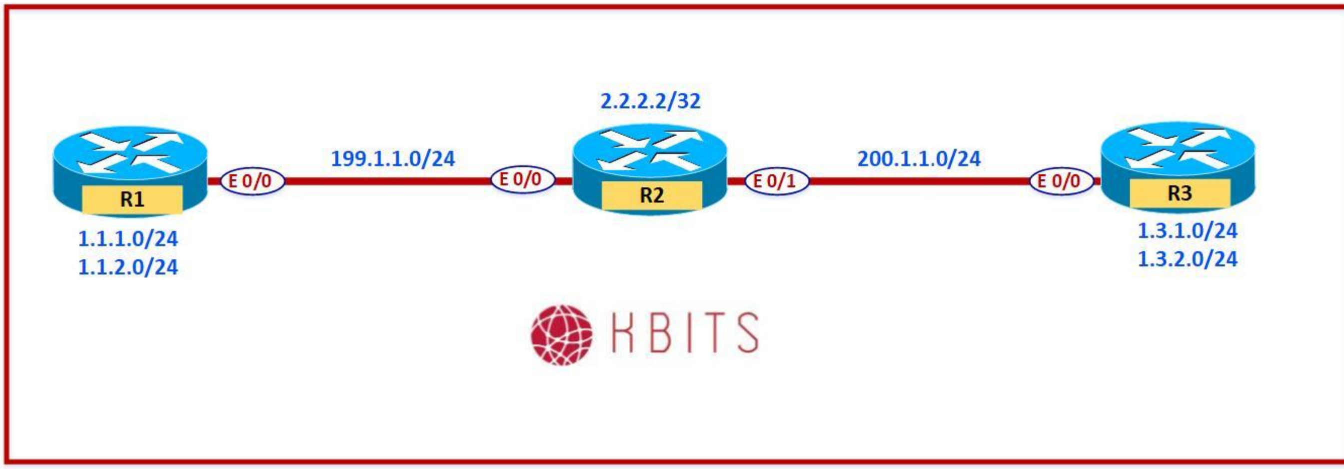
Configure R1 Ethernet interface for QoS using the following criteria:

- Configure Policing such that HTTP downloading is policed at 100 kbps for *.gif or *.jpg files.

R1

```
class-map match-any CM-WEB-P2P
 match protocol http url "*.gif"
 match protocol http url "*.jpg"
!
policy-map PM-QOS
 class CM-WEB-P2P
  police 100000
```

Lab 5 Configuring Shaping



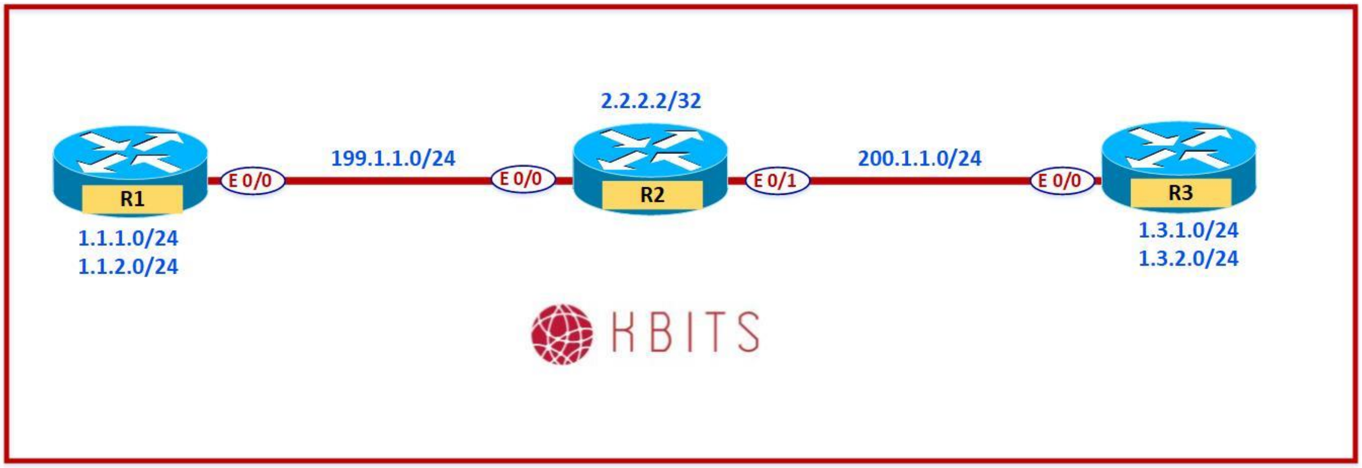
Task 1

Configure R1 such that all FTP or TFTP traffic going towads 1.3.0.0/16 network should have a minimum reserved bandwidth of 256 kbps and should be shaped to the 512 kbps.

R1

```
Access-list 115 permit tcp any 1.3.0.0 0.0.255.255 eq 20
Access-list 115 permit tcp any 1.3.0.0 0.0.255.255 eq 21
Access-list 115 permit udp any 1.3.0.0 0.0.255.255 eq 69
!
Class-map match-any CM-FT
 Match access-group 115
!
Policy-map PM-QOS
 Class CM-FT
   Bandwidth 256
   Shape average 512000
```

Lab 6 – Configuring Advanced Class Maps



Task 1

Any traffic that is destined to either of the URLs specified below should be prioritized from the 1.3.2.0/24 network should be prioritized going towards the Internet. Set the priority percent to 20.

- Cisco.com
- Kbits.live

R3

```
Access-list 116 permit ip 1.3.2.0 0.0.0.255 any
!
Class-map match-any CM-URLS
 Match protocol http url "*Cisco.com*"
 Match protocol http url "*Kbits.live*"
!
Class-map match-all CM-NESTING
 Match class-map CM-URLS
 Match access-group 116
!
Policy-map PM-QOS
 Class CM-NESTING
  Priority percent 20
```

Multicast Routing

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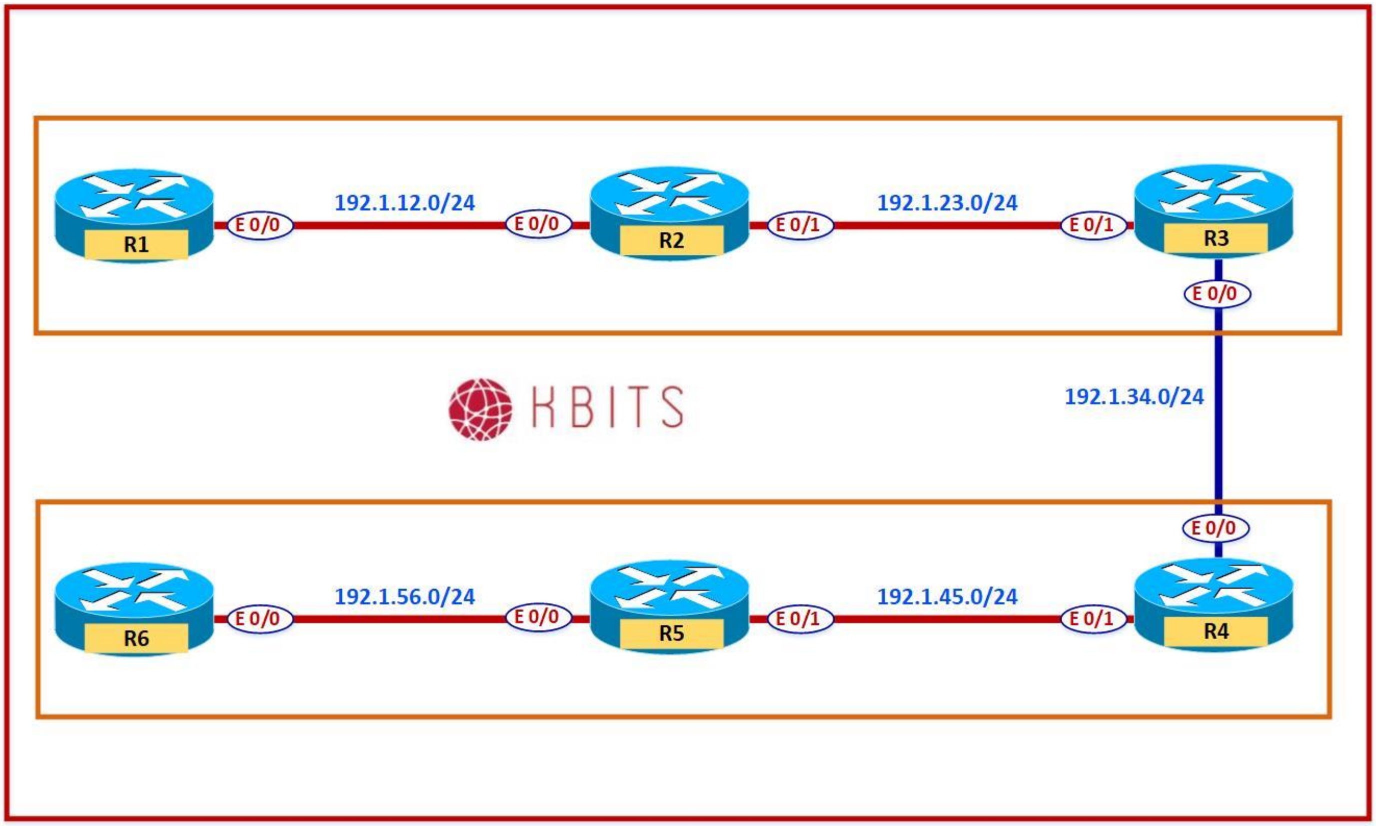
Multicast-Routing

Lab 1 – Configuring PIM – Dense-Mode



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.255.255.0
Loopback 1	1.1.2.1	255.255.255.0
E 0/0	192.1.12.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback0	1.2.1.1	255.255.255.0
Loopback1	1.2.2.1	
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.23.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	1.3.1.1	255.255.255.0
Loopback 1	1.3.2.1	255.255.255.0
E 0/0	192.1.23.3	255.255.255.0

Task 1

Configure EIGRP as the Routing protocol in AS 111 between R1, R2 & R3. Enable all interfaces on all 3 routers in EIGRP.

R1	R3
Router eigrp 111 Network 192.1.12.0 Network 1.0.0.0	Router eigrp 111 Network 192.1.23.0 Network 1.0.0.0
R2 Router eigrp 111 Network 192.1.12.0 Network 192.1.23.0 Network 1.0.0.0	

Task 2

Configure PIM dense mode on the routers.

R1	R3
Ip multicast-routing ! Int E 0/0 Ip pim dense-mode ! Int Loopback0 Ip pim dense-mode Int Loopback1 Ip pim dense-mode	Ip multicast-routing ! Int E 0/0 Ip pim dense-mode ! Int Loopback0 Ip pim dense-mode Int Loopback1 Ip pim dense-mode
R2 Ip multicast-routing ! Int E 0/0 Ip pim dense-mode ! Int E 0/1 Ip pim dense-mode ! Int Loopback0	

Ip pim dense-mode ! Int Loopback1 Ip pim dense-mode	

Task 3

Configure R1 & R3 to join the multicast group 224.1.1.3 on the Loopback 0 interfaces.

R1	R3
Int Loopback 0 Ip igmp join-group 224.1.1.3	Int Loopback 0 Ip igmp join-group 224.1.1.3

Task 4

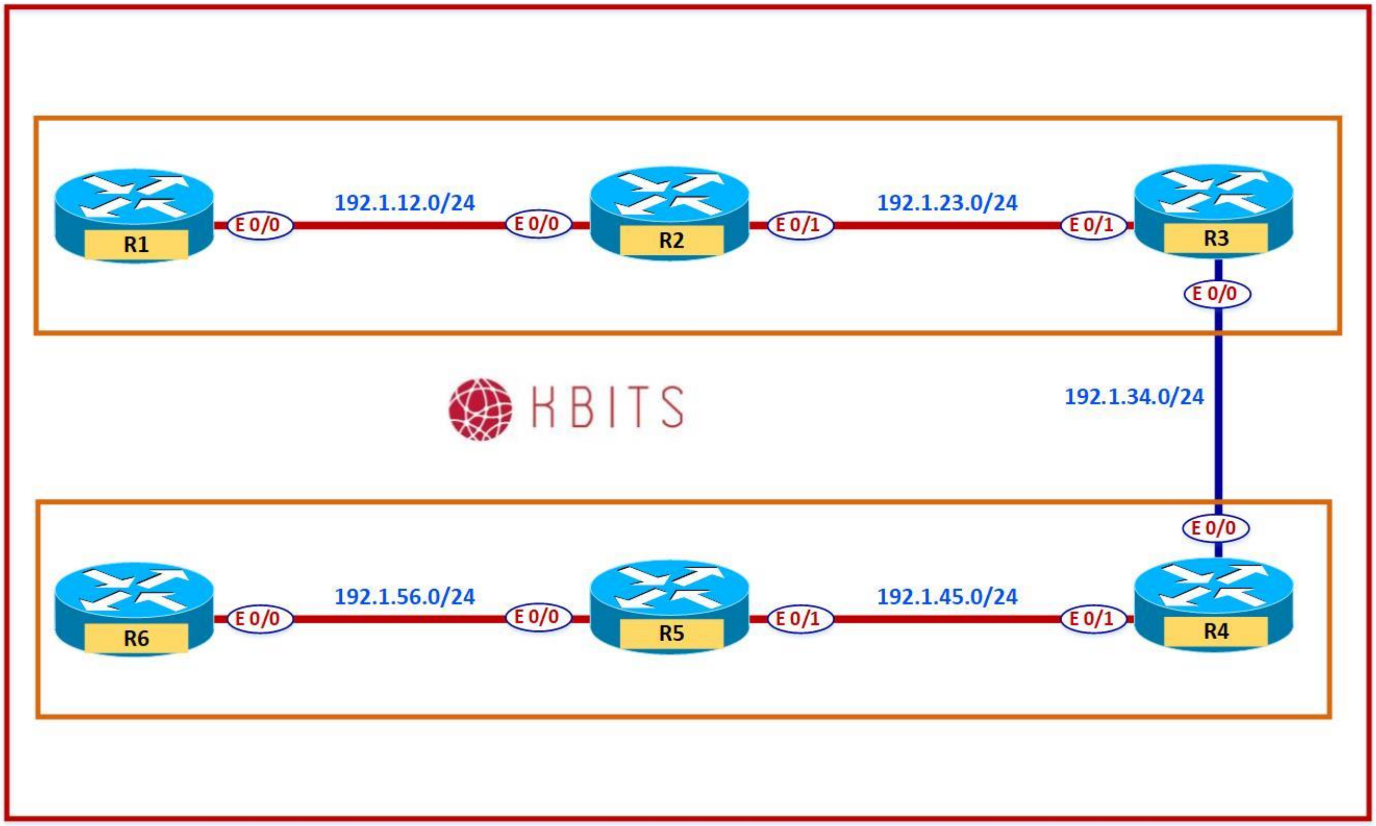
Configure R1, R2 & R3 to join the multicast group 224.1.2.3 on the Loopback 1 interfaces.

R1	R3
Int Loopback 1 Ip igmp join-group 224.1.2.3	Int Loopback 0 Ip igmp join-group 224.1.2.3
R2 Int Loopback 1 Ip igmp join-group 224.1.2.3	

Verification:

- Ping 224.1.1.3 from R2. You should receive a reply from R1 & R3.
- Ping 224.1.2.3 from R2. You should receive a reply from all 3 routers.

Lab 2 – Configuring PIM – Sparse-Mode using Single Static RP



Task 1

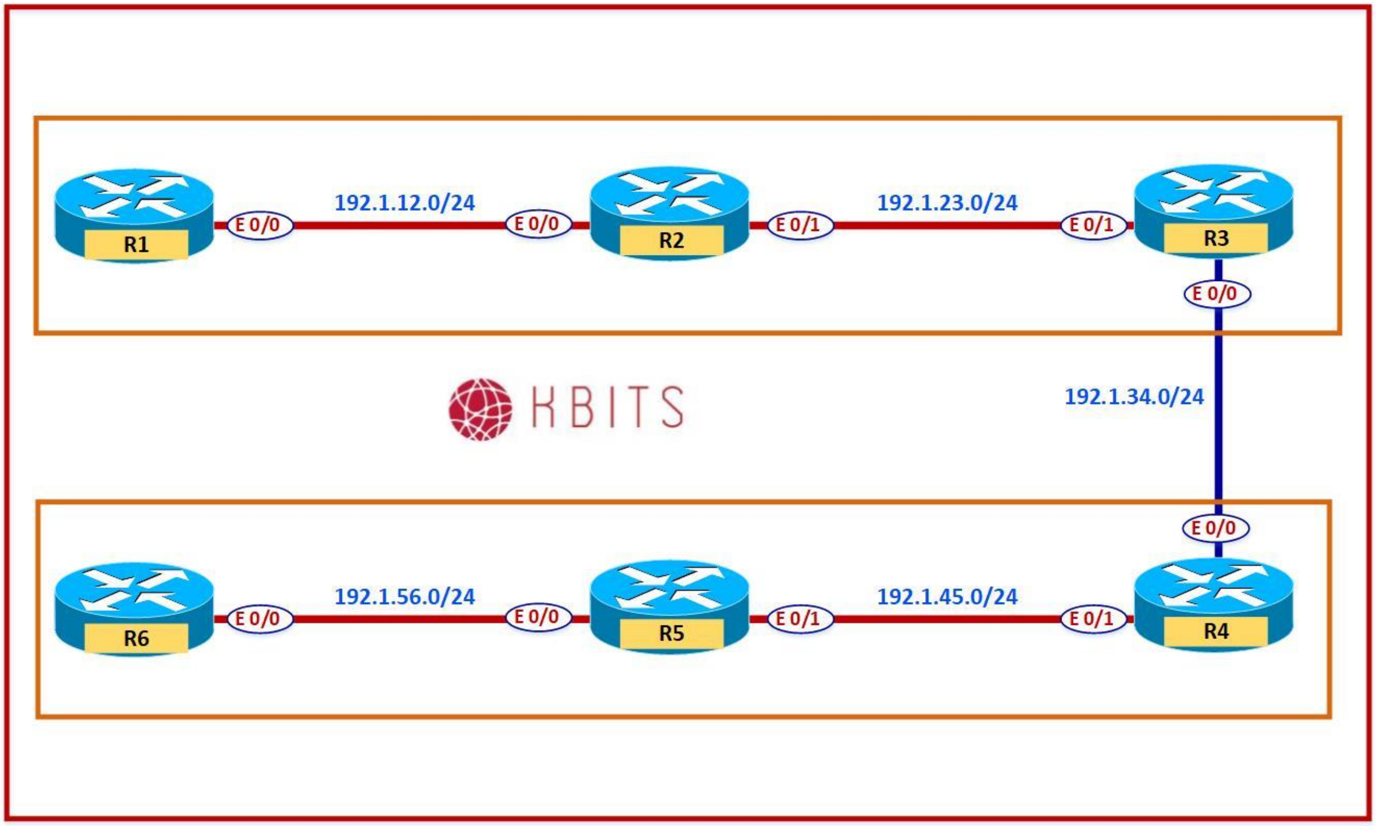
Configure R2 to be the RP for all groups. Use the Loopback0 as the IP Address of the RP.

R1 Interface loopback0 Ip pim sparse-mode ! Interface loopback1 Ip pim sparse-mode ! Int E 0/0 Ip pim sparse-mode ! Ip pim rp-address 1.2.1.1	**R2** Interface loopback0 Ip pim sparse-mode ! Interface loopback1 Ip pim sparse-mode ! Int E 0/0 Ip pim sparse-mode ! Int E 0/1 Ip pim sparse-mode ! Ip pim rp-address 1.2.1.1
R3 Interface loopback0 Ip pim sparse-mode ! Interface loopback1 Ip pim sparse-mode ! Int E 0/0 Ip pim sparse-mode ! Ip pim rp-address 1.2.1.1	

Verification:

- Ping 224.1.1.3 from R2. You should receive a reply from R1 & R3.
- Ping 224.1.2.3 from R2. You should receive a reply from all 3 routers.

Lab 3 – Configuring PIM – Sparse-Mode using Multiple Static RP



Task 1

De-configure R2 (1.2.1.1) as the Static RP on all 3 Routers.

R1 No ip pim rp-address 1.2.1.1	**R2** No ip pim rp-address 1.2.1.1
R3 No ip pim rp-address 1.2.1.1	

Task 2

Configure R1 to be the RP for Multicast groups 224.1.1.3, and R2 to be the RP for the groups 224.1.2.3. These two RPs should use their Loopback 0 interface for this purpose.

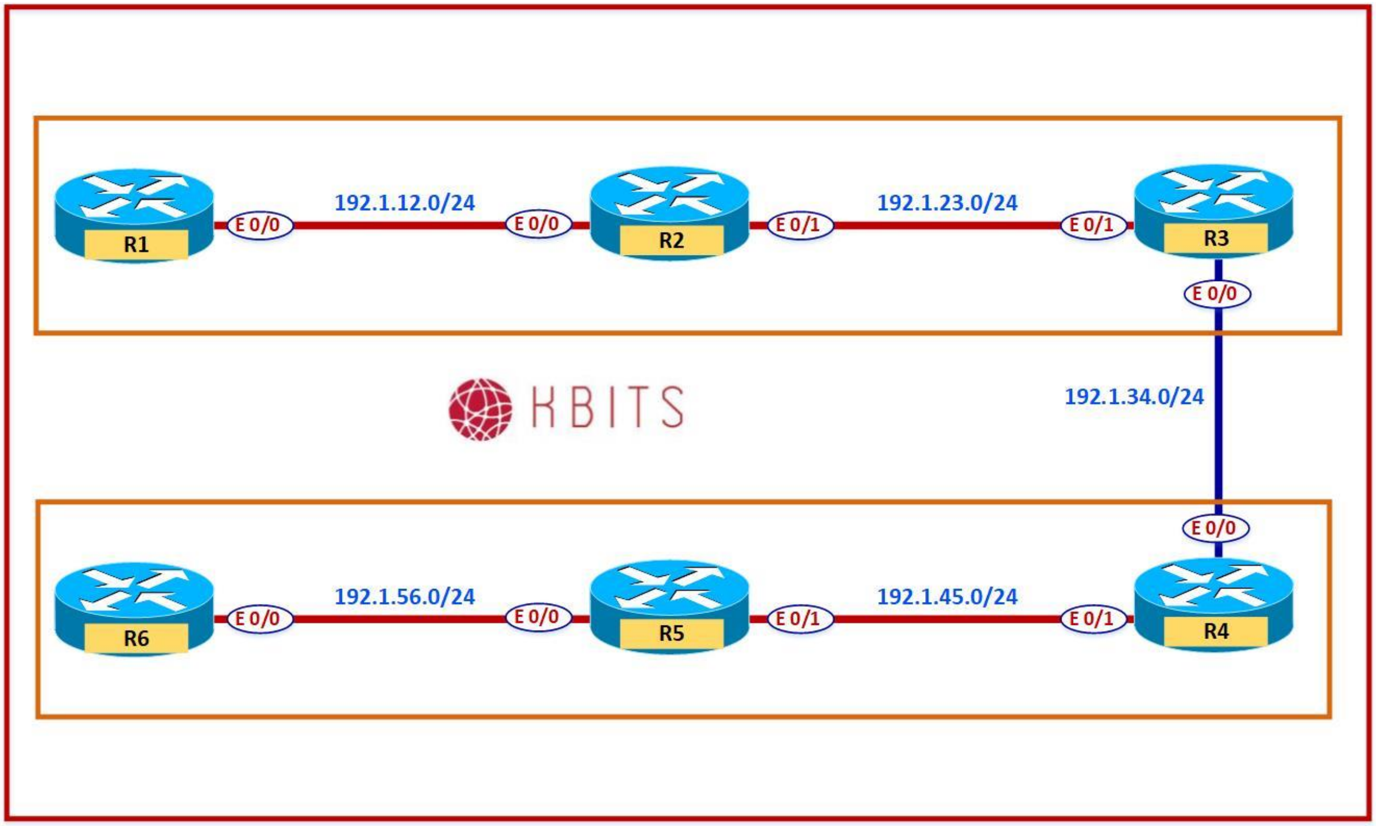
R1 Access-list 10 permit 224.1.1.3	**R2** Access-list 10 permit 224.1.1.3

Access-list 20 permit 224.1.2.3 ! Ip pim rp-address 1.1.1.1 10 Ip pim rp-address 1.2.1.1 20	Access-list 20 permit 224.1.2.3 ! Ip pim rp-address 1.1.1.1 10 Ip pim rp-address 1.2.1.1 20!
R3 Access-list 10 permit 224.1.1.3 Access-list 20 permit 224.1.2.3 ! Ip pim rp-address 1.1.1.1 10 Ip pim rp-address 1.2.1.1 20	

Verification:

- Type "**Show ip pim rp mapping**" to verify the RP assignment.
- Ping 224.1.1.3 from R2. You should receive a reply from R1 & R3.
- Ping 224.1.2.3 from R2. You should receive a reply from all 3 routers.

Lab 4 – Configuring PIM – Sparse-Mode using Dense-Mode for Fallback



Task 1

Configure R1 Loopback 0 and R3 loopback 0 to to join the following Multicast groups:

R1 – 224.11.11.1, 224.11.11.2, 224.11.11.3
R3 – 224.33.33.1, 224.33.33.2, 224.33.33.3

R1	**R3**	
Interface Loopback0 Ip igmp join-group 224.11.11.1 Ip igmp join-group 224.11.11.2 Ip igmp join-group 224.11.11.3	Interface Loopback0 Ip igmp join-group 224.33.33.1 Ip igmp join-group 224.33.33.2 Ip igmp join-group 224.33.33.3	

Verification:

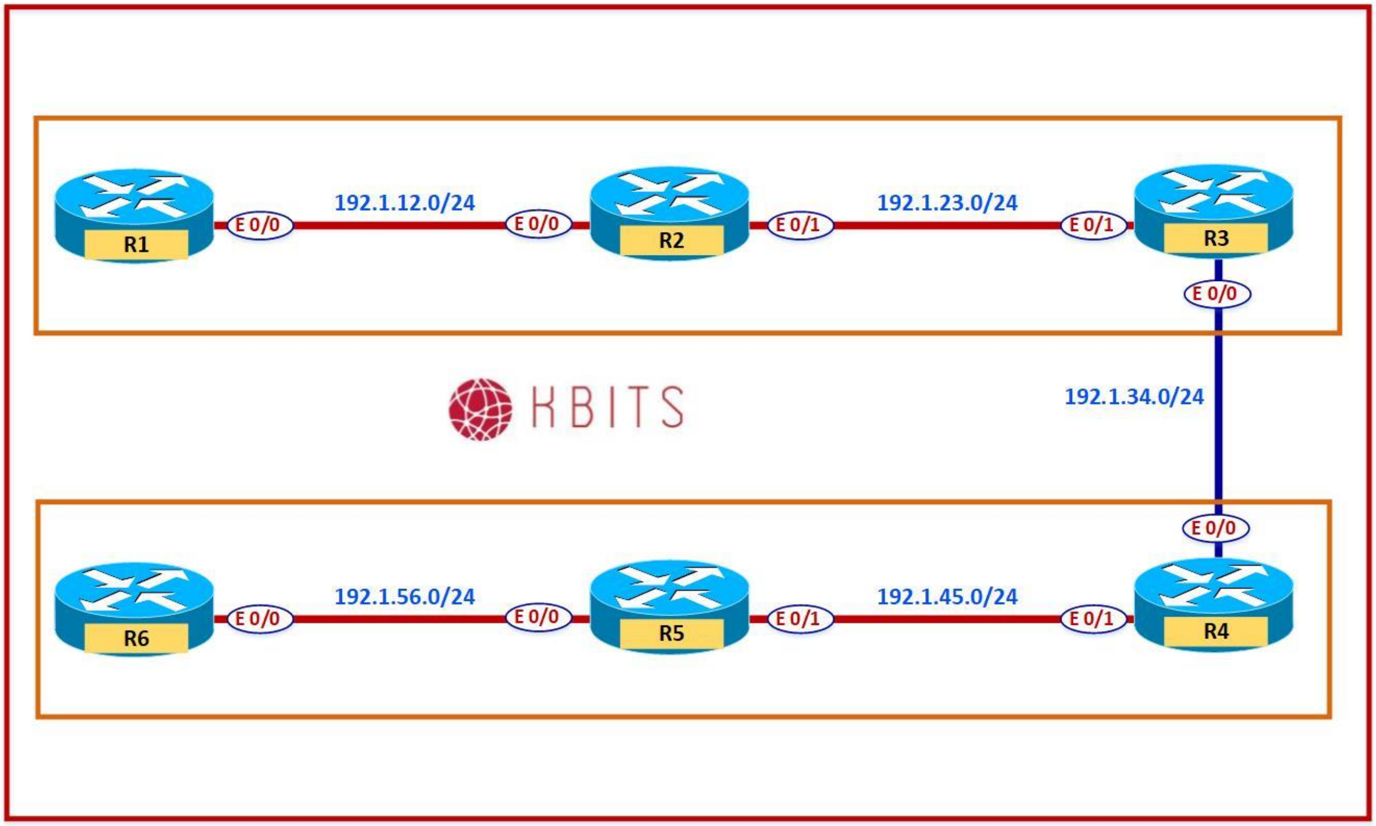
- Ping any of the new joined Multicast groups from R2. Are you receiving a reply?

Task 2

Configure PIM on the physical and loopback interfaces in such a way that all routers have access to all the multicast groups, including the ones that are not configured for RP's.

R1 Interface F 0/0 Ip pim sparse-dense-mode ! Interface Loopback0 Ip pim sparse-dense-mode	**R2** Interface F 0/0 Ip pim sparse-dense-mode ! Interface F 0/1 Ip pim sparse-dense-mode
R3 Interface F 0/0 Ip pim sparse-dense-mode ! Interface F 0/1 Ip pim sparse-dense-mode	

Lab 5 – Configuring PIM – Sparse Mode – Auto RP



Task 1

De-configure R1 & R2 as the Static RP on all 3 Routers.

R1 Ip pim rp-address 1.1.1.1 10 Ip pim rp-address 1.2.1.1 20	**R2** Ip pim rp-address 1.1.1.1 10 Ip pim rp-address 1.2.1.1 20
R3 Ip pim rp-address 1.1.1.1 10 Ip pim rp-address 1.2.1.1 20	

Task 2

Configure BSR for RP Election and Announcements. Configure R1 & R3 as RP-Candidates. They should use their Loopback0 to send their RP-Candidate announcements. The announcements should be sent every 10 seconds with a TTL of 5. Configure R2 as the Mapping Agent. It should also use it's Loopback 0.

R2 Ip pim send-rp-discovery scope 5
R1 Ip pim send-rp-announce loopback0 scope 5 interval 10
R3 Ip pim send-rp-announce loopback0 scope 5 interval 10

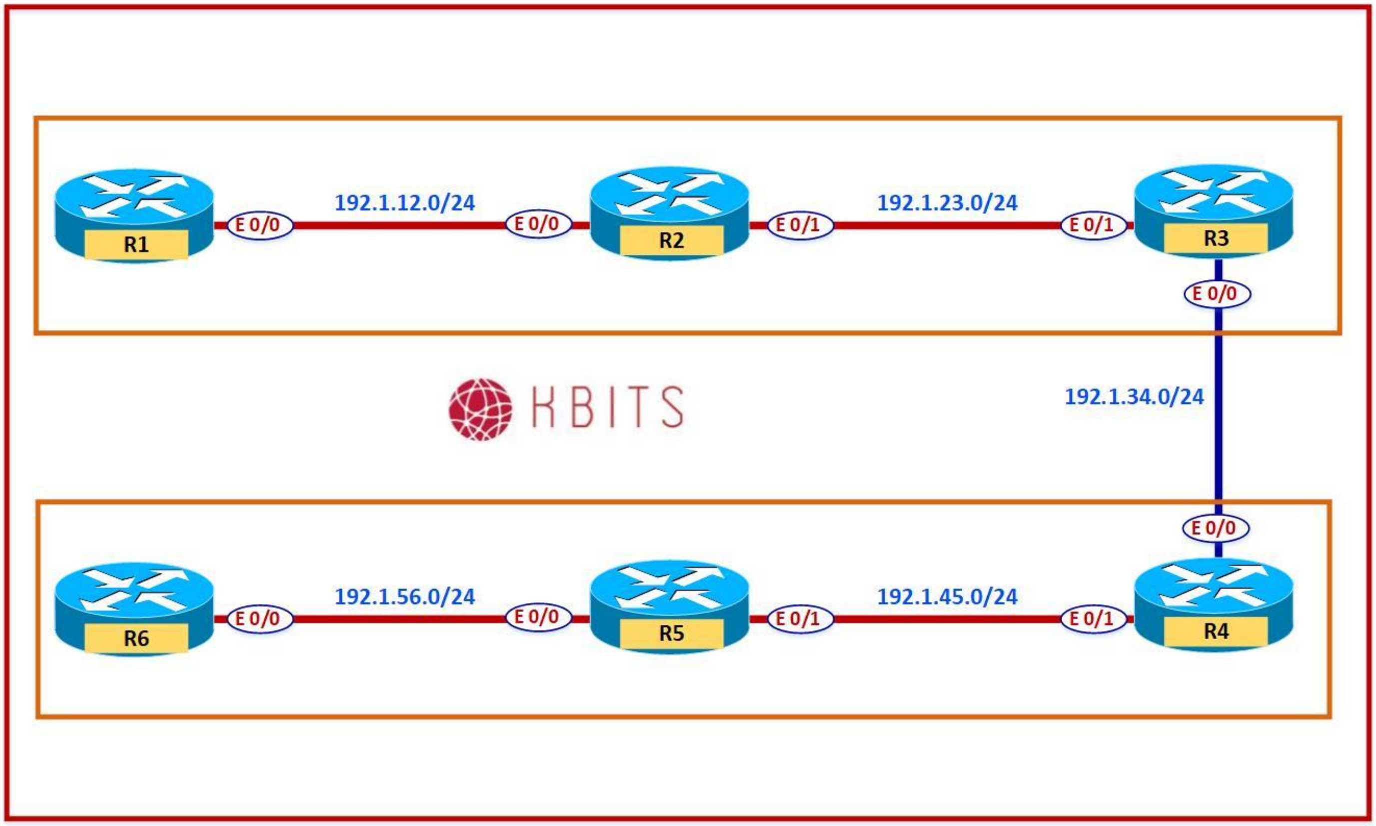
Verification:

- Type "**Show ip pim rp mapping**" to verify the RP assignment. Who has been elected as the RP? What method was used for the election and announcement?

- Ping 224.1.1.3 from R2. You should receive a reply from R1 & R3.

- Ping 224.1.2.3 from R2. You should receive a reply from all 3 routers.

Lab 6 – Configuring PIM – Sparse Mode – BSR



Task 1

De-configure Auto-RP on all 3 Routers.

R2 No Ip pim send-rp-discovery scope 5
R1 No Ip pim send-rp-announce loopback0 scope 5 interval 10
R3 No Ip pim send-rp-announce loopback0 scope 5 interval 10

Task 2

Configure BSR for RP Election and Announcements. Configure R1 & R3 as RP-Candidates. They should use their Loopback0 to send their RP-Candidate announcements. R1 should be the preferred RP. Configure R2 as the Mapping Agent (BSR Candidate). It should also use it's Loopback 0.

R2 ip pim bsr-candidate Loopback0
R1 ip pim rp-candidate Loopback0 priority 0
R3 ip pim rp-candidate Loopback0 priority 10

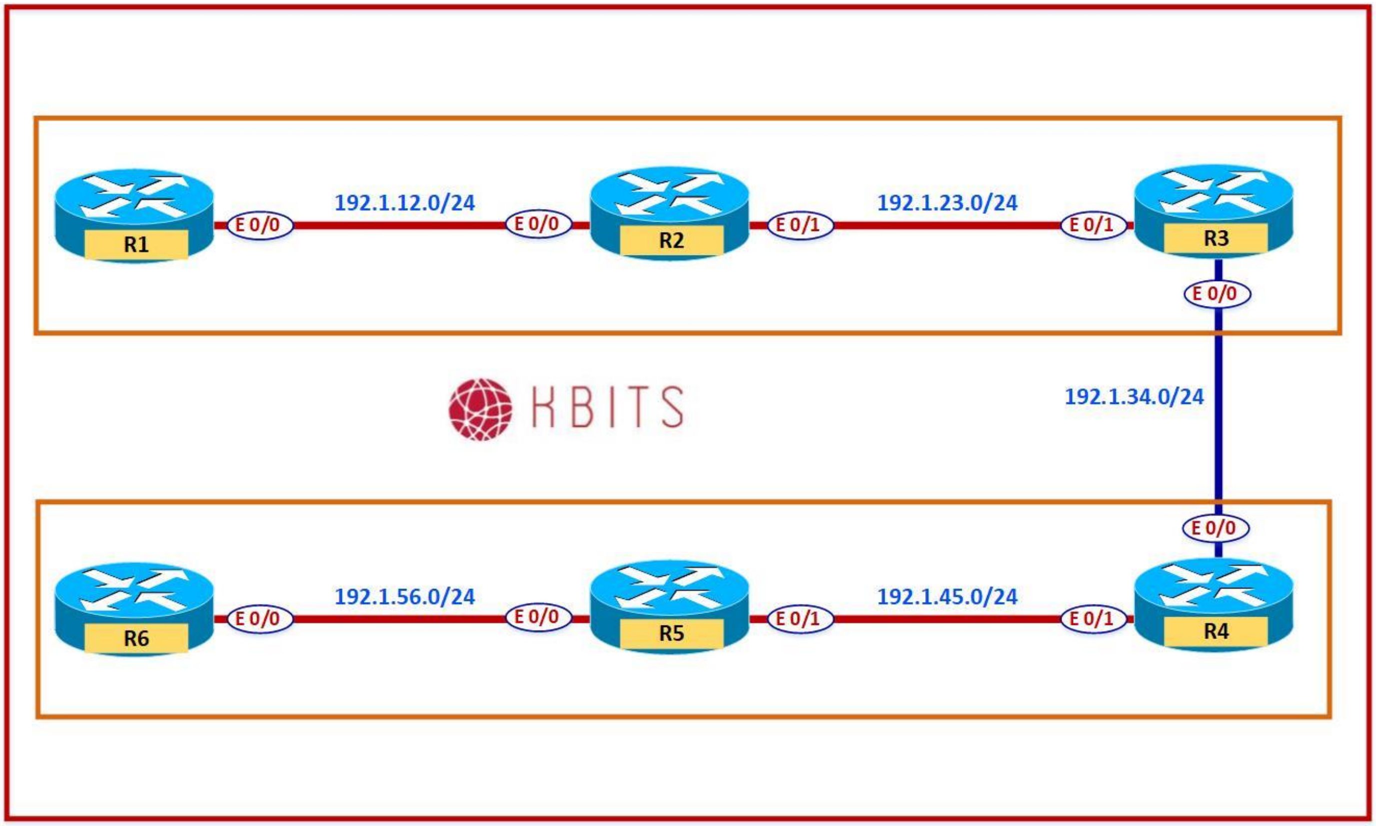
Verification:

- Type "**Show ip pim rp mapping**" to verify the RP assignment. Who has been elected as the RP? What method was used for the election and announcement?

- Ping 224.1.1.3 from R2. You should receive a reply from R1 & R3.

- Ping 224.1.2.3 from R2. You should receive a reply from all 3 routers.

Lab 7 – Configuring MSDP



R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.255.255.0
E 0/0	192.1.12.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.23.2	255.255.255.0
Loopback 0	1.2.1.1	255.255.255.0

R3

Interface	IP Address	Subnet Mask
E 0/1	192.1.23.3	255.255.255.0
E 0/0	192.1.34.3	255.255.255.0
Loopback 0	1.3.1.1	255.255.255.0

R4

Interface	IP Address	Subnet Mask
E 0/0	192.1.34.4	255.255.255.0
E 0/1	192.1.34.4	255.255.255.0
Loopback 0	1.4.1.1	255.255.255.0

R5

Interface	IP Address	Subnet Mask
E 0/0	192.1.45.5	255.255.255.0
E 0/1	192.1.56.5	255.255.255.0
Loopback 0	1.5.1.1	255.255.255.0

R6

Interface	IP Address	Subnet Mask
E 0/0	192.1.56.6	255.255.255.0
Loopback 0	1.6.1.1	255.255.255.0

Task 1
Configure EIGRP 100 on all routers and advertise all the directly connected networks.

R1 Router EIGRP 100 Network 1.0.0.0 Network 192.1.12.0	**R2** Router EIGRP 100 Network 1.0.0.0 Network 192.1.12.0 Network 192.1.23.0
R3 Router EIGRP 100 Network 1.0.0.0 Network 192.1.23.0 Network 192.1.34.0	**R4** Router EIGRP 100 Network 1.0.0.0 Network 192.1.34.0 Network 192.1.45.0
R5 Router EIGRP 100 Network 1.0.0.0 Network 192.1.45.0 Network 192.1.56.0	**R6** Router EIGRP 100 Network 1.0.0.0 Network 192.1.56.0

Task 2
Enable Multicast Routing on R1, R2 & R3 using PIM Sparse-Mode on all the interfaces. They should be configured to use R3 Loopback 0 as the RP address for all Multicast groups. Configure R1, R2 & R3 to join 224.1.2.3 & 224.12.34.56 on the Loopback 0 interfaces.

R1 Ip multicast-routing ! Interface Loopback 0 Ip pim sparse-mode Ip igmp join-group 224.1.2.3 Ip igmp join-group 224.12.34.56 ! Interface E 0/0 Ip pim sparse-mode ! Ip pim rp-address 1.3.1.1	**R2** Ip multicast-routing ! Interface Loopback 0 Ip pim sparse-mode Ip igmp join-group 224.1.2.3 Ip igmp join-group 224.12.34.56 ! Interface E 0/0 Ip pim sparse-mode ! Interface E 0/1 Ip pim sparse-mode ! Ip pim rp-address 1.3.1.1

R3	
Ip multicast-routing ! Interface Loopback 0 Ip pim sparse-mode Ip igmp join-group 224.1.2.3 Ip igmp join-group 224.12.34.56 ! Interface E 0/0 Ip pim sparse-mode ! Interface E 0/1 Ip pim sparse-mode ! Ip pim rp-address 1.3.1.1	

Verification:

- Type "**Show ip pim rp mapping**" to verify the RP assignment.
- Ping 224.1.2.3 & 224.12.34.56 from R1, R2 & R3. You should receive a reply from all 3 routers (R1, R2 & R3).

Task 3

Enable Multicast Routing on R4, R5 & R6 using PIM Sparse-Mode on all the interfaces. They should be configured to use R4 Loopback 0 as the RP address for all Multicast groups. Configure R4, R5 & R6 to join 224.4.5.6 & 224.12.34.56 on the Loopback 0 interfaces.

R4	R5
Ip multicast-routing ! Interface Loopback 0 Ip pim sparse-mode Ip igmp join-group 224.4.5.6 Ip igmp join-group 224.12.34.56 ! Interface E 0/0 Ip pim sparse-mode ! Interface E 0/1 Ip pim sparse-mode ! Ip pim rp-address 1.4.1.1	Ip multicast-routing ! Interface Loopback 0 Ip pim sparse-mode Ip igmp join-group 224.4.5.6 Ip igmp join-group 224.12.34.56 ! Interface E 0/0 Ip pim sparse-mode ! Interface E 0/1 Ip pim sparse-mode ! Ip pim rp-address 1.4.1.1

R6	
Ip multicast-routing ! Interface Loopback 0 Ip pim sparse-mode Ip igmp join-group 224.4.5.6 Ip igmp join-group 224.12.34.56 ! Interface E 0/0 Ip pim sparse-mode ! Interface E 0/1 Ip pim sparse-mode ! Ip pim rp-address 1.4.1.1	

Verification:

- Type "**Show ip pim rp mapping**" to verify the RP assignment.
- Ping 224.4.5.6 & 224.12.34.56 from R4, R5 & R6. You should receive a reply from R4, R5 & R6 only.

Task 4

Configure a MSDP peering between the 2 RPs, R3 & R4 based on the loopback interfaces.

R3
Ip msdp peer 4.4.4.4 connect-source Loopback 0
R4 Ip msdp peer 3.3.3.3 connect-source Loopback 0

Verification:

- Type "**Show ip msdp peer**" to verify that the connection is up.
- Ping 224.12.34.56 from any router. You should receive a reply from all routers.

Automation & Python Programming

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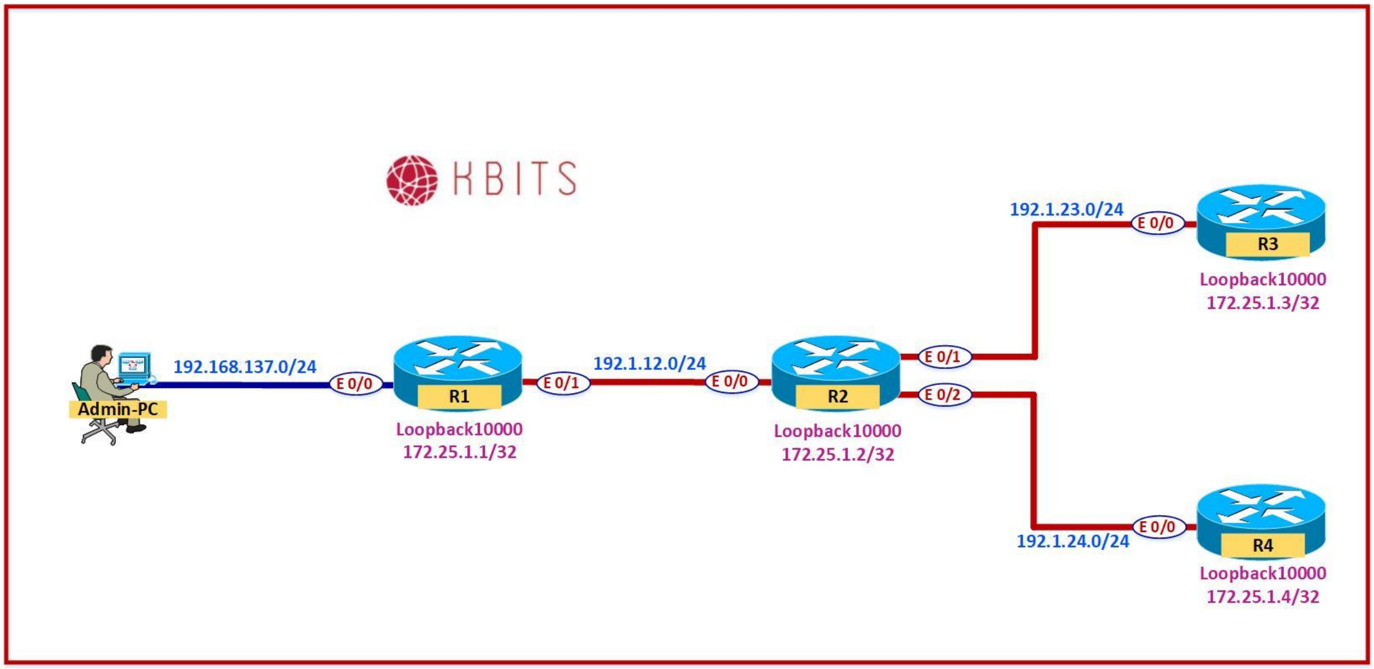
Automation & Python Programming

Lab 1 – Configuring EEM – Controlling Interface Shutdown



Interface IP Address Configuration

R1

Interface	IP Address	Subnet Mask
Loopback 0	1.1.1.1	255.255.255.0
Loopback10000	172.25.1.1	255.255.255.255
E 0/0	192.168.137.111	255.255.255.0
E 0/1	192.1.12.1	255.255.255.0

R2

Interface	IP Address	Subnet Mask
Loopback0	1.2.1.1	255.255.255.0
Loopback10000	172.25.1.2	255.255.255.255
E 0/0	192.1.12.2	255.255.255.0
E 0/1	192.1.23.2	255.255.255.0
E 0/2	192.1.24.2	255.255.255.0

R3

Interface	IP Address	Subnet Mask
Loopback 0	1.3.1.1	255.255.255.0
Loopback10000	172.25.1.3	255.255.255.255
E 0/0	192.1.23.3	255.255.255.0

R4

Interface	IP Address	Subnet Mask
Loopback 0	1.4.1.1	255.255.255.0
Loopback10000	172.25.1.4	255.255.255.255
E 0/0	192.1.24.4	255.255.255.0

Task 1

Configure EIGRP as the Routing protocol in AS 111 between R1, R2, R3 & R4. Enable all interfaces on all 3 routers in EIGRP.

R1 Router eigrp 111 Network 192.1.12.0 Network 192.168.137.0 Network 1.0.0.0 Network 172.25.0.0	**R2** Router eigrp 111 Network 192.1.12.0 Network 192.1.23.0 Network 192.1.24.0 Network 1.0.0.0 Network 172.25.0.0
R3 Router eigrp 111 Network 192.1.23.0 Network 1.0.0.0 Network 172.25.0.0	**R4** Router eigrp 111 Network 192.1.24.0 Network 1.0.0.0 Network 172.25.0.0

Task 2

Configure Telnet & SSH Access on all the routers. Create a user “khawar” with a password of “cisco”. Assign it a privilege level of 15.

R1 Ip domain-name kbits.live Crypto key generate rsa modulus 1024 ! Username khawar privilege 15 password cisco ! Line vty 0 4 Login loca Transport input telnet ssh
R2 Ip domain-name kbits.live Crypto key generate rsa modulus 1024 ! Username khawar privilege 15 password cisco ! Line vty 0 4 Login loca Transport input telnet ssh
R3 Ip domain-name kbits.live Crypto key generate rsa modulus 1024 ! Username khawar privilege 15 password cisco ! Line vty 0 4 Login loca Transport input telnet ssh
R4 Ip domain-name kbits.live Crypto key generate rsa modulus 1024 ! Username khawar privilege 15 password cisco ! Line vty 0 4 Login loca Transport input telnet ssh

Task 3

Configure an EEM Applet that will make sure that the E 0/0 interface on R1 is never administratively Shutdown. The Applet should a message stating “This is a critical interface. Please don't shut it”. It should send this console message after bringing the interface back up.

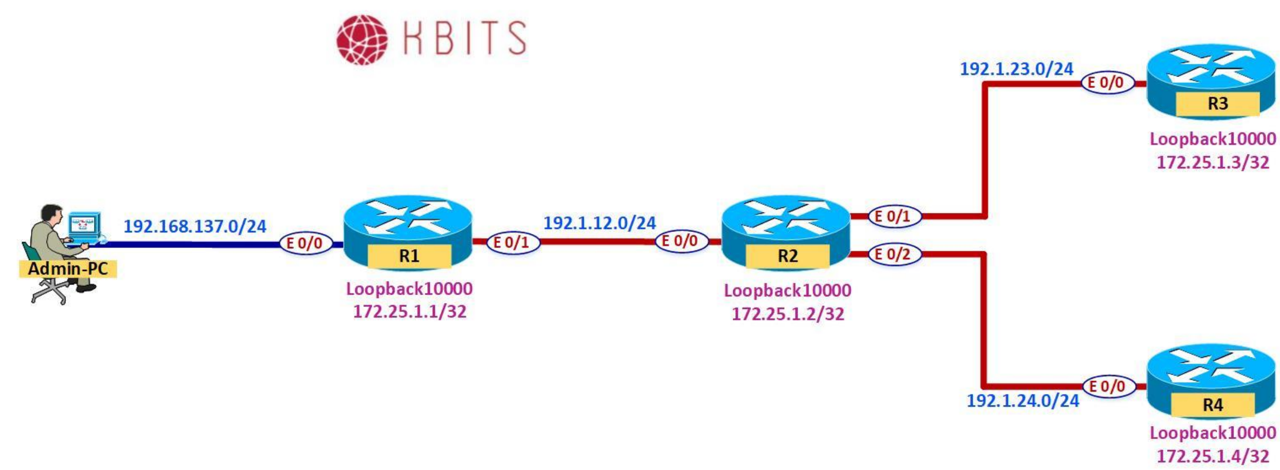
R1

```
event manager applet INTER-RESET-E0/0
 event syslog pattern "Interface Ethernet0/0, changed state to administratively down"
 action 1.0 cli command "enable"
 action 2.0 cli command "conf t"
 action 3.0 cli command "interface E0/0"
 action 4.0 cli command "no shut"
 action 5.0 syslog msg "This is a critical interface. Please don't shut it"
```

Verification:

- Shut the E 0/0 interface down on R1.
- The EEM Applet should bring the interface back up and display the message on the console.

Lab 2 – Configuring EEM – E-Mailing Errors to Administrators



Task 1

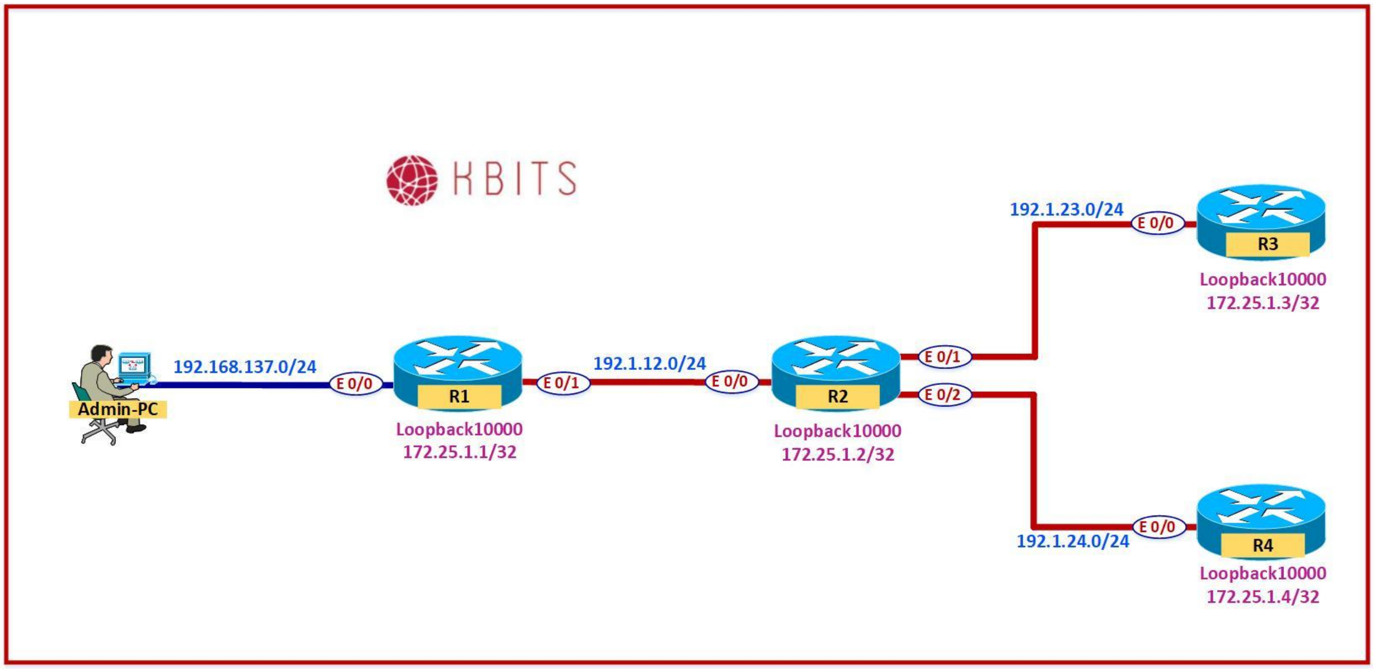
Configure an EEM Applet on R2 such it notifies the Support Team that the EIGRP neighbor relationship with R1 has gone down in EIGRP AS 111. Use the following parameters for the applet:

- Syslog Message Pattern: "EIGRP-IPv4 111: Neighbor 192.1.12.1 (Ethernet0/0) is down"
- Mail Server: 192.1.12.25
- Support Team E-mail: errors@kbits.live
- Router E-mail: R2@kbits.live
- Subject: "EIGRP IS DOWN" body "Please fix EIGRP"

R2

```
event manager applet EIGRP_DOWN
 event syslog pattern " EIGRP-IPv4 111: Neighbor 192.1.12.1 (Ethernet0/0) is down:
holding time expired
 action 1.0 cli command "enable"
 action 2.0 mail server "192.1.12.25" to "errors@kbits.live" from "R2@kbits.live"
subject "EIGRP IS DOWN" body "Please fix EIGRP"
```

Lab 3 – Retrieving Information from Routers Using Python – Interactive



Task 1

Configure a Python Script that allows you to input a show command and retrieves the information from R1 and displays it on the console. Use the following to write the script.

- Use the "Telnet" function from the **telnetlib** library.
- Create a variable called **cmd** to receive the input using the "input" function.
- Host IP: **172.25.1.1**
- Login Username: **khawar**
- Password: **cisco**

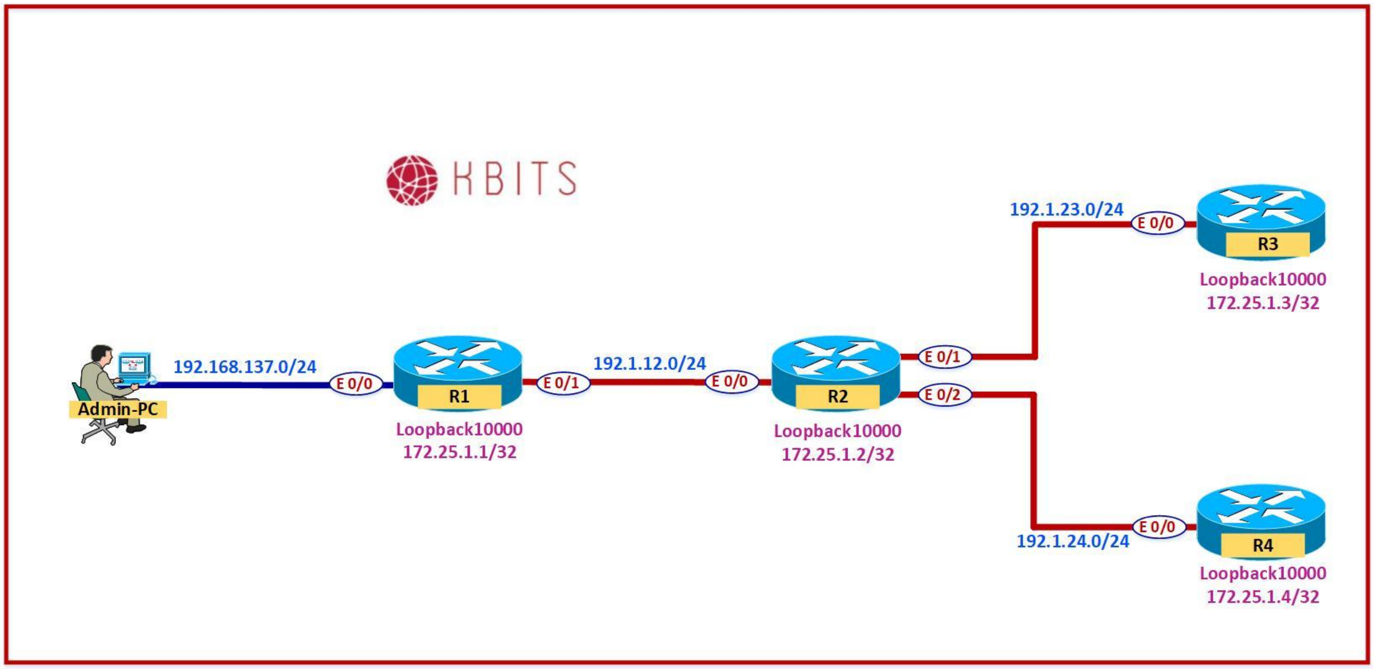
Admin PC

```
from telnetlib import Telnet

cmd = input('Enter the Command : ')

ab = Telnet('172.25.1.1')
ab.write(b'khawar\n')
ab.write(b'cisco\n')
ab.write(b'term len 0\n')
ab.write(cmd.encode('ascii') + b'\n')
ab.write(b'exit\n')

print (ab.read_all().decode('ascii'))
```

Verification:

- Save the script as Lab3.py.
- Run the script. It will prompt you for the Command. Type a command of your choice (Example: **show ip interface brief**)
- Verify the output on the console.

Lab 4 – Configuring Network Devices Using Python



Task 1

Configure a Python Script that allows you to configure a Loopback Interface on R1 and displays the Interface that was created by using the "**Show ip interface brief**" command. Use the following to write the script.

- Use the "Telnet" function from the **telnetlib** library.
- Host IP: **172.25.1.1**
- Login Username: **khawar**
- Password: **cisco**
- Interface: Loopback99
- IP Address: 99.99.99.99/8

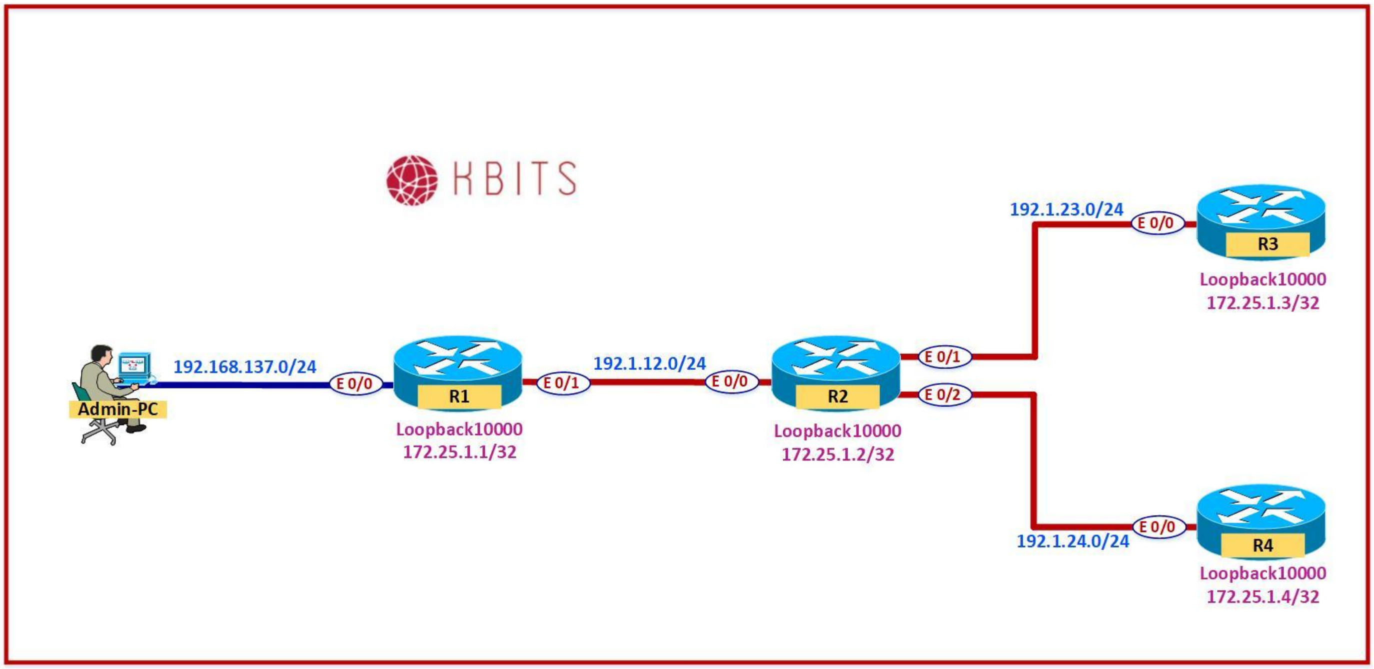
Admin PC

```
from telnetlib import Telnet

ab = Telnet('172.25.1.1')
ab.write(b'khawar\n')
ab.write(b'cisco\n')
ab.write(b'config t\n')
ab.write(b'Interface Loopback99\n')
ab.write(b'ip address 99.99.99.99 255.0.0.0\n')
ab.write(b'end\n')
ab.write(b'sh ip int brief\n')
ab.write(b'exit\n')
print (ab.read_all().decode('ascii'))
```

Verification:

- Save the script as Lab4.py.
- Run the script.
- Verify the output on the console.

Lab 5 – Configuring Network Devices Using Python – Interactive Config



Task 1

Configure a Python Script that allows you to input the Interface and IP Address that needs to be configured on R1. Display the Interface that was created by using the "**Show ip interface** brief" command. Use the following to write the script.

- Use the "Telnet" function from the **telnetlib** library.
- Create a variable called **Interface** to receive the interface name using the "input" function.
- Create a variable called **Ipaddr** to receive the IP Address to be configured using the "input" function.
- Create a variable called **SMask** to receive the Subnet mask using the "input" function.
- Host IP: **172.25.1.1**
- Login Username: **khawar**
- Password: **cisco**

Admin PC

```
from telnetlib import Telnet

Interface = input('What Interface would you like to configure : ')
Ipaddr = input('Specify the IP Address : ')
SMask = input('Specify the Subnet mask : ')

ab = Telnet('172.25.1.1')
ab.write(b'khawar\n')
ab.write(b'cisco\n')
ab.write(b'config t\n')
ab.write(b'Interface ' + Interface.encode('ascii') + b'\n')
ab.write(b'IP Address ' + Ipaddr.encode('ascii') + b' ' + SMask.encode('ascii') + b'\n')
ab.write(b'end\n')
ab.write(b'sh ip int brief\n')
ab.write(b'exit\n')
print (ab.read_all().decode('ascii'))
```

Verification:

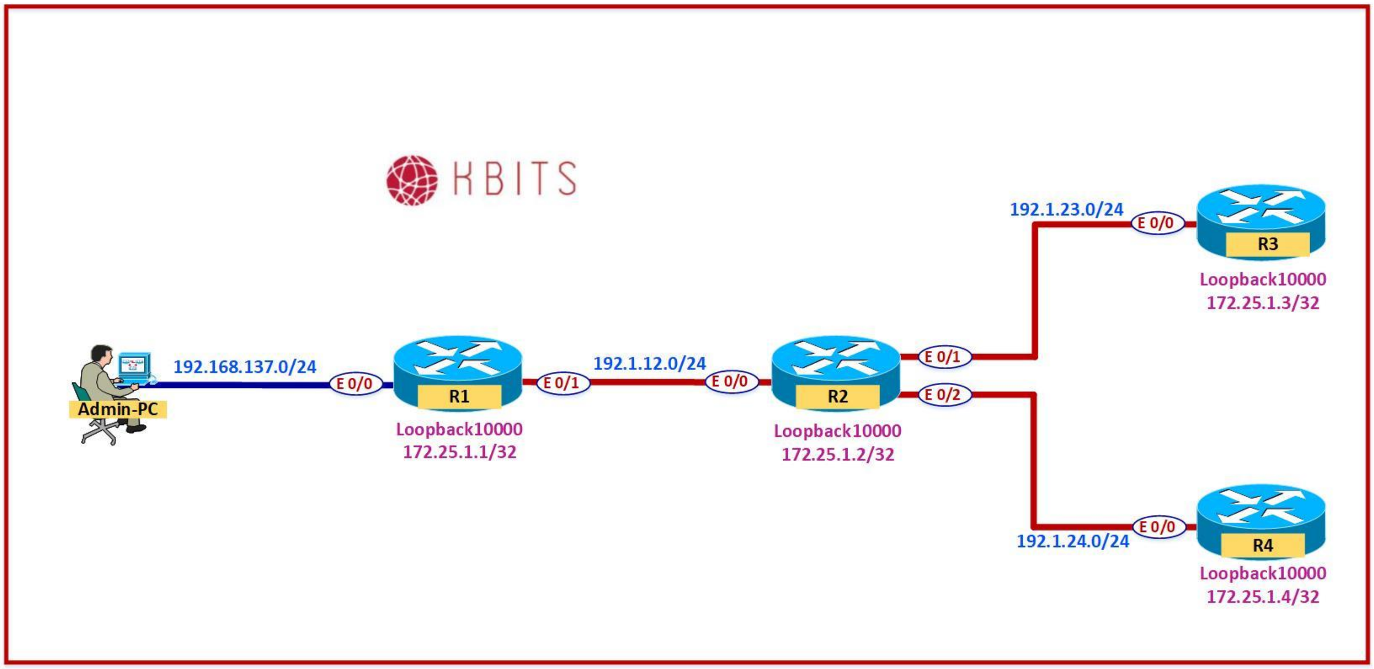
- Save the script as Lab5.py.

- Run the script. Specify the following:

  - Interface Name: **Loopback55**
  - IP Address: **55.1.1.1**
  - Subnet Mask: **255.0.0.0**

- Verify the output on the console.

Lab 6 – Configuring Network Devices Using Python – Interactive Login & Configuration



Task 1

Configure a Python Script that allows you to input the Interface and IP Address that needs to be configured on a Host that you specify. Allow the user to specify the Username and password as well. Display the Interface that was created by using the "**Show ip interface** brief" command. Use the following to write the script.

- Use the "Telnet" function from the **telnetlib** library.
- Create a variable called **HOST** to receive the IP Address of the host using the "input" function.
- Create a variable called **USER** to receive the Username using the "input" function.
- Use the "getpass" function to retrieve the password and store it in a variable called **PASS**. Import the getpass function.
- Create a variable called **Interface** to receive the interface name using the "input" function.
- Create a variable called **Ipaddr** to receive the IP Address to be configured using the "input" function.
- Create a variable called **SMask** to receive the Subnet mask using the "input" function.

Admin PC

```
from telnetlib import Telnet
import getpass

HOST = input('Specify the Hostname : ')
USER = input('Specify the Username: ')
PASS = getpass.getpass()
Interface = input('What Interface would you like to configure : ')
Ipaddr = input('Specify the IP Address : ')
SMask = input('Specify the Subnet mask : ')

ab = Telnet(HOST)
ab.write(USER.encode('ascii') + b'\n')
ab.write(PASS.encode('ascii') + b'\n')

ab.write(b'config t\n')
ab.write(b'Interface ' + Interface.encode('ascii') + b'\n')
ab.write(b'IP Address ' + Ipaddr.encode('ascii') + b' ' + SMask.encode('ascii') + b'\n')
ab.write(b'end\n')
ab.write(b'sh ip int brief\n')
ab.write(b'exit\n')
print (ab.read_all().decode('ascii'))
```

Verification:

- Save the script as Lab6.py.

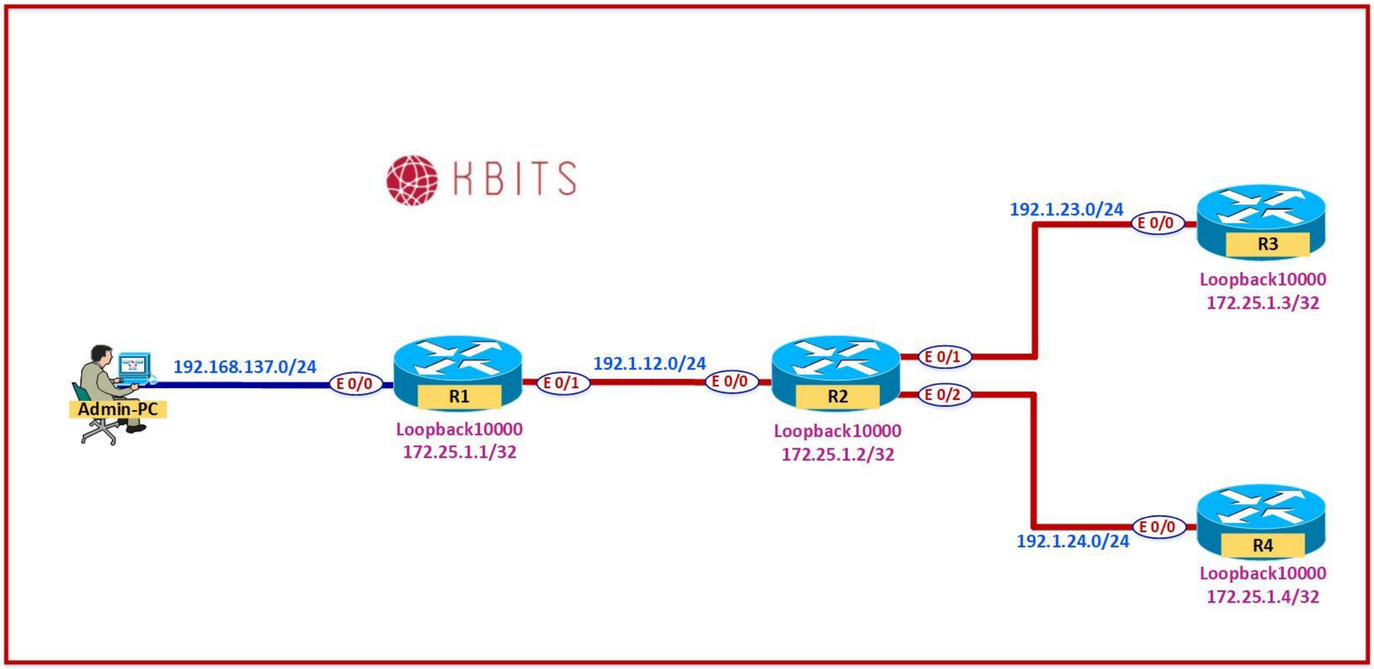
- Run the script. Use Debug mode if you are using PyCharm as it has an issue with the getpass() function.

- Specify the following:

  - Hostname: **172.25.1.2**
  - Username: **khawar**
  - Password: **cisco**
  - Interface Name: **Loopback55**
  - IP Address: **55.2.2.2**
  - Subnet Mask: **255.0.0.0**

- Verify the output on the console.

Lab 7 – Initialize the Router using a Python Script – Netmiko Library



Task 1

Configure a Python Script that allows you to set a banner on R1 using SSH. Also configure the "logging sync" command for the Console line. Display the banner within the running-config using the "**Show running | inc banner**" command. Use the following to write the script.

- Use the "ConnectHandler" function from the **netmiko** library.
- Host IP: **172.25.1.1**
- Login Username: **khawar**
- Password: **cisco**

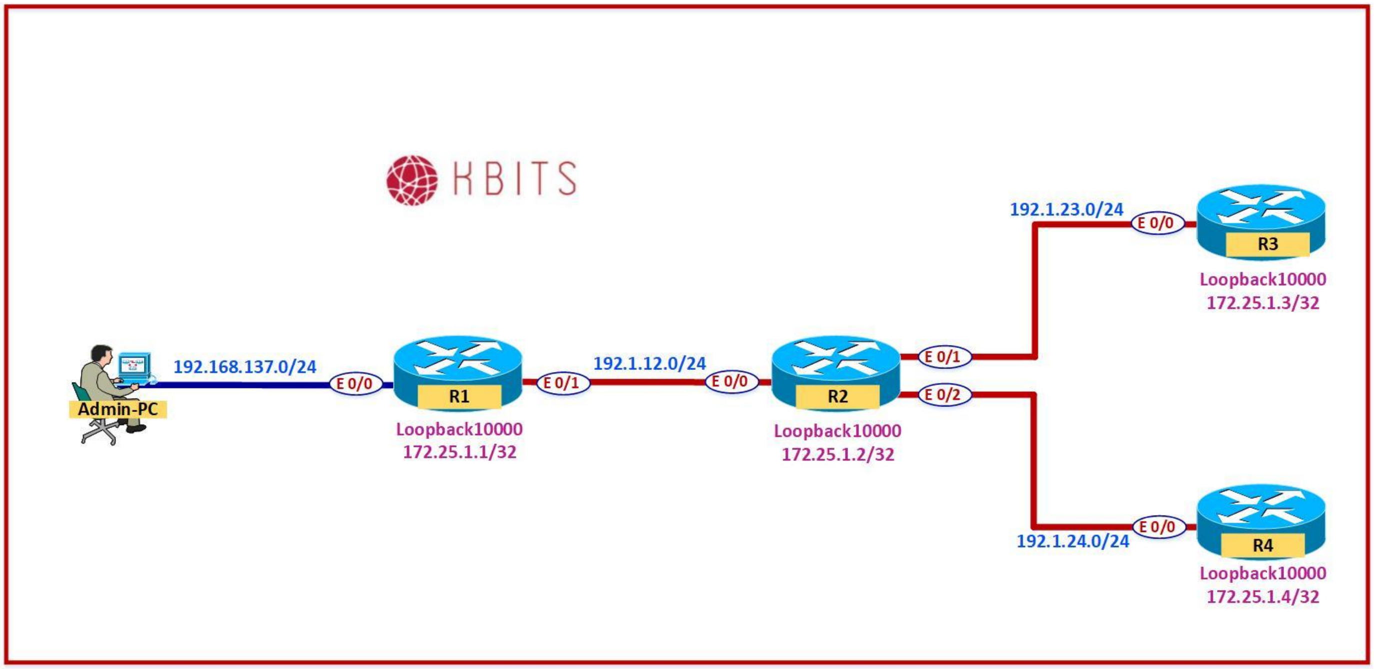
Admin PC

```
from netmiko import ConnectHandler

ABC = {
    'device_type': 'cisco_ios',
    'host':   172.25.1.1,
    'username': 'khawar',
    'password': 'cisco',
}
MYSSH = ConnectHandler(**ABC)

config_commands = [ 'banner motd #Authorized KBITS.LIVE Users Only#',
                    'line con 0',
                    ' logg sync'
                    ]
output = MYSSH.send_config_set(config_commands)
output = MYSSH.send_command('show runn | inc banner')
print(output)
```

Verification:

- Save the script as Lab7.py.
- Run the script.
- Verify the output on the console.

Lab 8 – Initialize the Router using a Python Script – Netmiko Library (Interactive)



Task 1

Configure a Python Script that allows you specify the Host that you would like to Initialize. Allow the user to specify the Username and password as well. Display the banner that was created by using the "**Show running | inc banner**" command. Use the following to write the script.

- Use the "ConnectHandler" function from the **netmiko** library.
- Create a variable called **HOST** to receive the IP Address of the host using the "input" function.
- Create a variable called **user** to receive the Username using the "input" function.
- Use the "getpass" function to retrieve the password.
- Configure the following commands within the script:

```
banner motd #Authorized KBITS.LIVE Users Only#
 line con 0
  logg sync
  no exec-timeout
```

Admin PC

```
from netmiko import ConnectHandler
from getpass import getpass

HOST = input("Enter Hostname: ")
user = input("Enter your SSH username: ")

ABC = {
    'device_type': 'cisco_ios',
    'host':   HOST,
    'username': user,
    'password': getpass(),
    'port' : 22,          # optional, defaults to 22
    'secret': 'cisco',     # optional, defaults to ''
}
myconnect = ConnectHandler(**ABC)

config_commands = [ 'banner motd #Authorized KBITS.LIVE Users Only#',
                    'line con 0',
                    ' logg sync',
                    ' no exec-timeout' ]
output = myconnect.send_config_set(config_commands)
output = myconnect.send_command('show runn | inc banner')
print(output)
```

Verification:

- Save the script as Lab8.py.

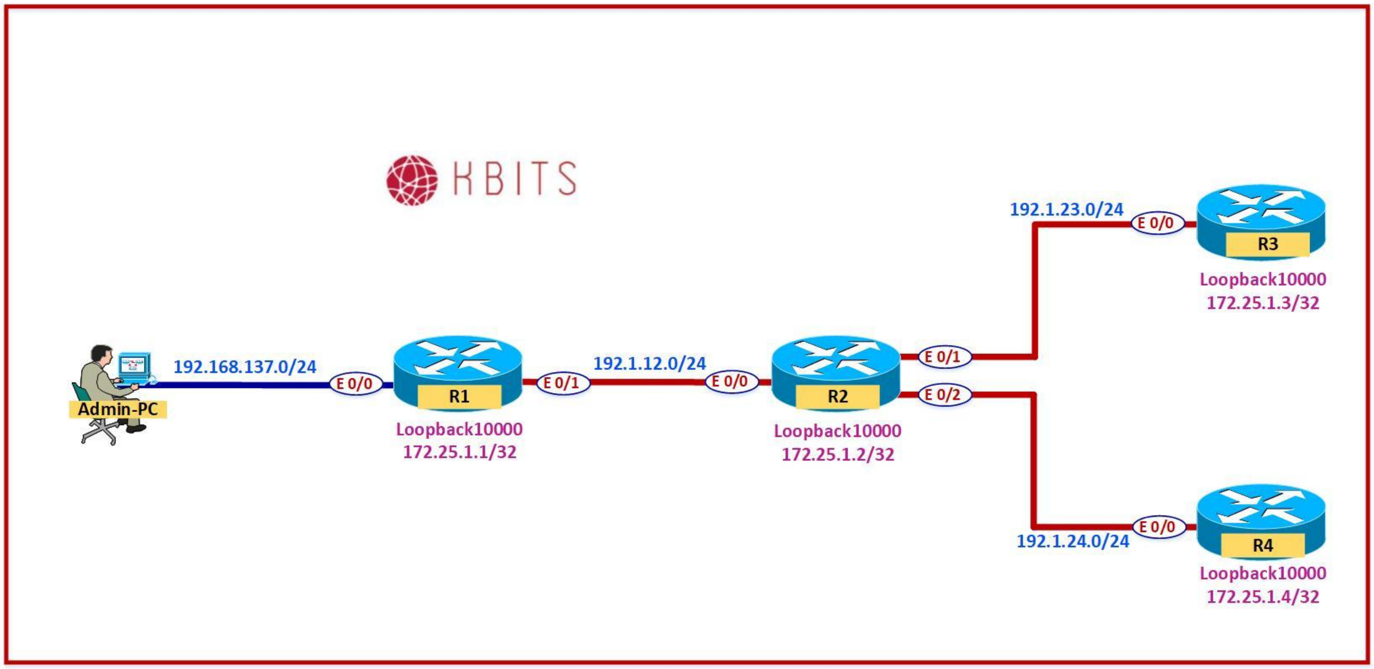
- Run the script. Use Debug mode if you are using PyCharm as it has an issue with the getpass() function.

- Specify the following:

  - Hostname: **172.25.1.3**
  - Username: **khawar**
  - Password: **cisco**

- Verify the output on the console.

Lab 9 – Retreiving Information from Multiple Routers – Netmiko Library



Task 1

Configure a Python Script that allows you to retrieve the Interfaces and their status from a list of devices specified in a text file. Display the interfaces to the console using the "**Show ip interface brief**" command. Use the following to write the script.

- Use the "ConnectHandler" function from the **netmiko** library.
- Create a file called devices.txt with the loopback10000 IP Addresses for R1 – R4.
- Login Username: **khawar**
- Password: **cisco**

Content of the "devices.txt" File

```
172.25.1.1
172.25.1.2
172.25.1.3
172.25.1.4
```

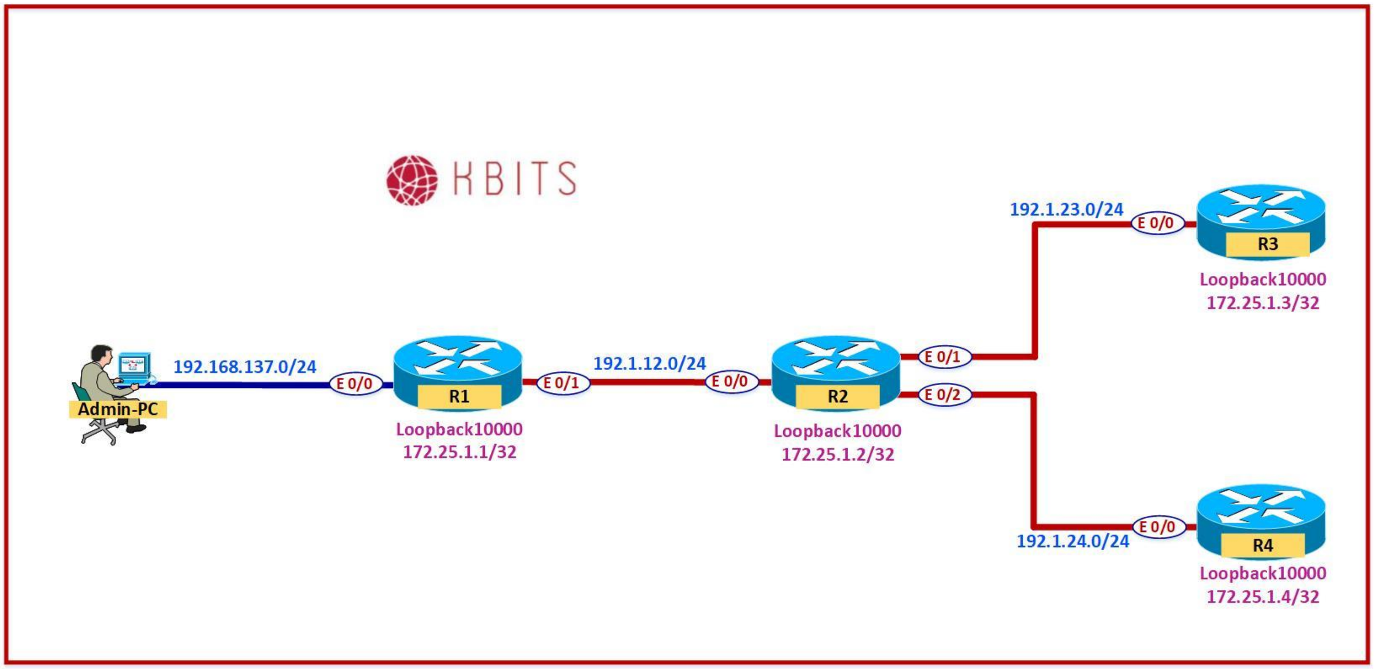
Admin PC

```
from netmiko import ConnectHandler

with open('devices.txt') as routers:
    for IP in routers:
        Router = {
            'device_type': 'cisco_ios',
            'ip': IP,
            'username': 'khawar',
            'password': 'cisco'
        }

        net_connect = ConnectHandler(**Router)

        print('Connecting to ' + IP)
        print('-' * 79)
        output = net_connect.send_command('sh ip int brief')
        print(output)
        print()
        print('-' * 79)

net_connect.disconnect()
```

Verification:

- Save the script as Lab9.py.
- Run the script.
- Verify the output on the console.

Lab 10 – Backing up Configuration of a single Router – Netmiko Library



Task 1

Configure a Python Script that allows you to retrieve the running config file of R1 and store it on your PC. Use the following to write the script.

- Use the "ConnectHandler" function from the **netmiko** library.
- Host: 172.25.1.1
- Login Username: **khawar**
- Password: **cisco**

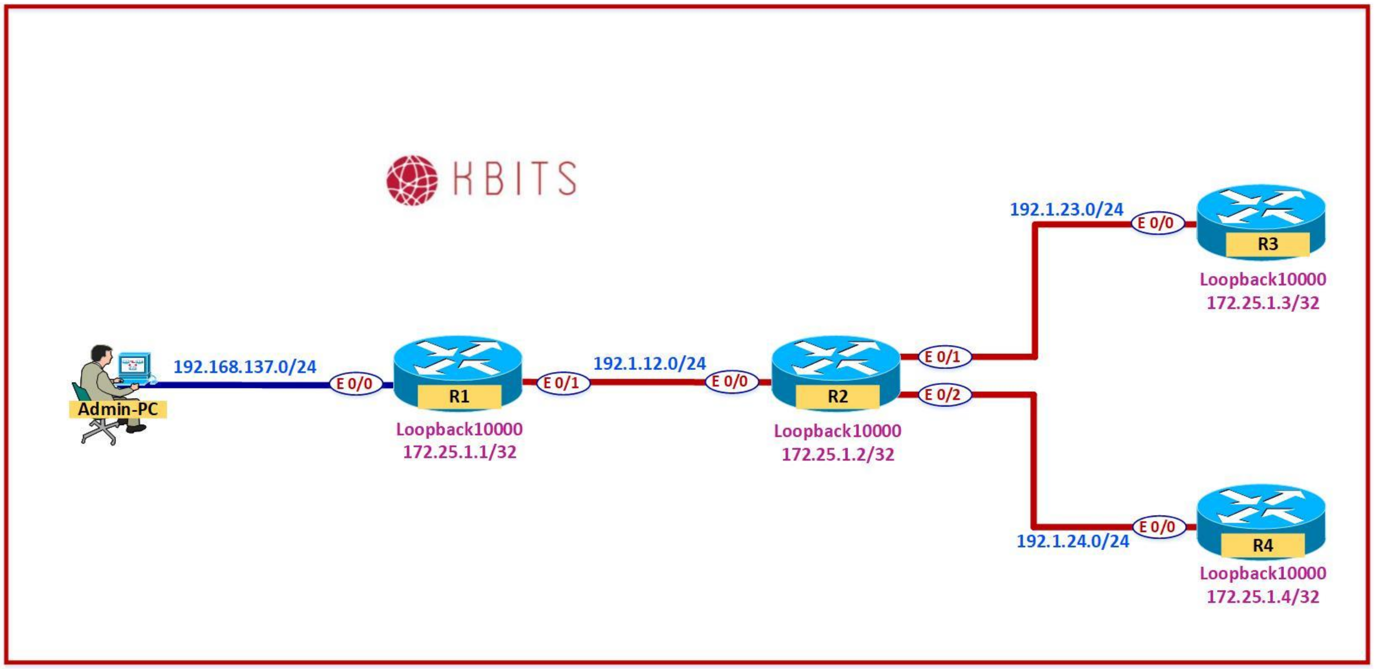
Admin PC

```
from netmiko import ConnectHandler

ROUTER = {
    'device_type': 'cisco_ios',
    'ip': '172.25.1.1',
    'username': 'khawar',
    'password': 'cisco'
}

net_connect = ConnectHandler(**ROUTER)

hostname = net_connect.send_command('show run | i host')
hostname.split(" ")
hostname,device = hostname.split(" ")
print ("Backing up " + device)

filename = device + '.txt'

showrun = net_connect.send_command('show run')
log_file = open(filename, "w")
log_file.write(showrun)
log_file.write("\n")

net_connect.disconnect()
```

Verification:

- Save the script as Lab10.py.
- Run the script.
- Verify that the file R1.txt is created in your folder.

Lab 11 – Backing up Configuration of Multiple Routers – Netmiko Library



Task 1

Configure a Python Script that allows you to backup the running configuration of a list of devices specified in a text file. It should store the configurations using the Device Name of the Router.

- Use the "ConnectHandler" function from the **netmiko** library.
- Host: Use the devices.txt created in Lab 9
- Login Username: **khawar**
- Password: **cisco**

Content of the "devices.txt" File

```
172.25.1.1
172.25.1.2
172.25.1.3
172.25.1.4
```

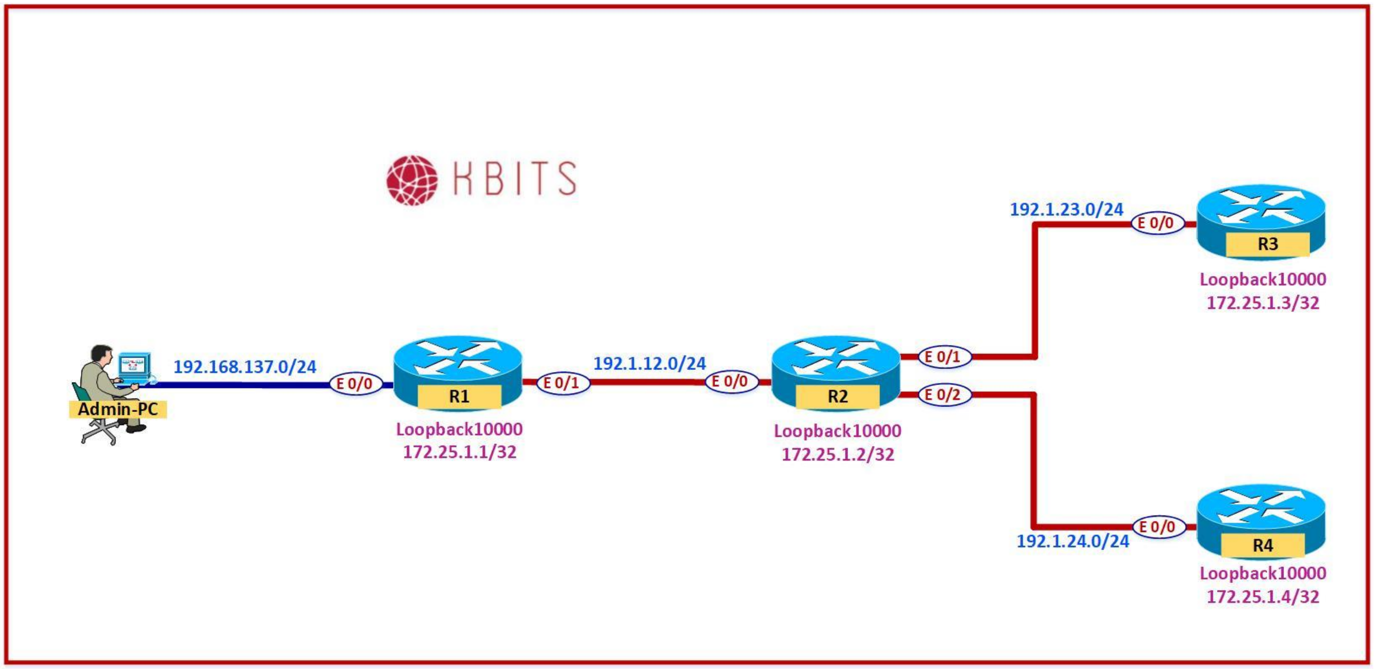
Admin PC

```
from netmiko import ConnectHandler

with open('devices.txt') as routers:
    for IP in routers:
        Router = {
            'device_type': 'cisco_ios',
            'ip': IP,
            'username': 'khawar',
            'password': 'cisco'
        }

        net_connect = ConnectHandler(**Router)

        hostname = net_connect.send_command('show run | i host')
        hostname.split(" ")
        hostname,device = hostname.split(" ")
        print ("Backing up " + device)

        filename = device + '-Backup.txt'

        showrun = net_connect.send_command('show run')
        log_file = open(filename, "w")
        log_file.write(showrun)
        log_file.write("\n")

net_connect.disconnect()
```

Verification:

- Save the script as Lab11.py.
- Run the script.
- Verify that the files are created for all the routers in your folder.

Lab 12 – Configuring Multiple Devices – Netmiko Library



Task 1

Configure a Python Script that allows you to configure a set of devices using configuration files.

- Use the “ConnectHandler” function from the **netmiko** library.
- Host: Use the devices.txt created in Lab 9.
- Create the configuration files for the routers based on the table below.
- Login Username: **khawar**
- Password: **cisco**

Content of the “devices.txt” File 172.25.1.1 172.25.1.2 172.25.1.3 172.25.1.4
Content of the “R1.txt” File config terminal ! interface loo11 ip address 150.1.1.1 255.255.255.255 ! banner motd "Authorized KBITS Users Only!!!!!!!!!!" ! Wr
Content of the “R2.txt” File config terminal ! interface loo11 ip address 150.1.1.2 255.255.255.255 ! banner motd "Authorized KBITS Users Only!!!!!!!!!!" ! Wr
Content of the “R3.txt” File config terminal ! interface loo11 ip address 150.1.1.3 255.255.255.255 ! banner motd "Authorized KBITS Users Only!!!!!!!!!!" !

Wr
Content of the “R4.txt” File config terminal ! interface loo11 ip address 150.1.1.4 255.255.255.255 ! banner motd "Authorized KBITS Users Only!!!!!!!!!!" ! wr

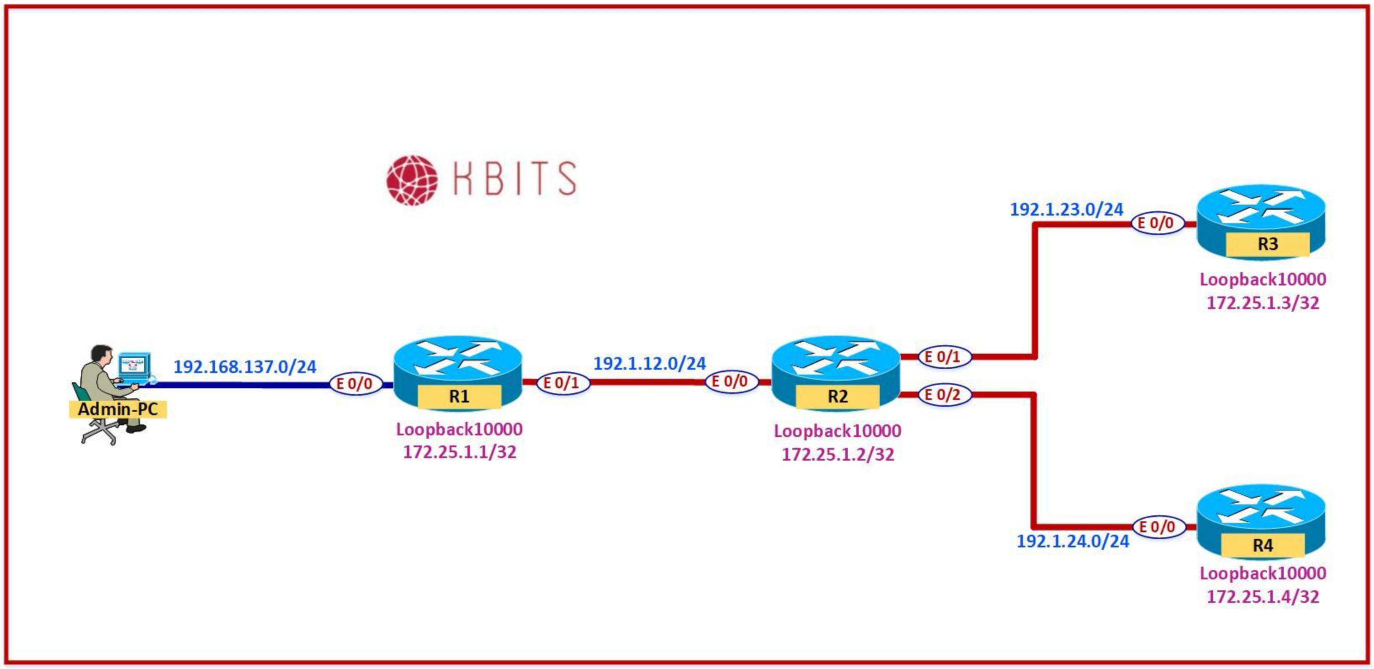
Admin PC

```
from netmiko import ConnectHandler

with open('devices.txt') as routers:
    for IP in routers:
        Router = {
            'device_type': 'cisco_ios',
            'ip': IP,
            'username': 'khawar',
            'password': 'cisco'
        }
        net_connect = ConnectHandler(**Router)
        hostname = net_connect.send_command('show run | i host')
        hostname.split(" ")
        hostname, devicename = hostname.split(" ")
        cmdfile=devicename + ".txt"
        net_connect.send_config_from_file(cmdfile)
        print(devicename + ' Configured')
        net_connect.disconnect()
```

Verification:

- Save the script as Lab12.py.
- Run the script.
- Verify the configuration on the Routers.

Lab 13 – Configuring Multiple Devices – Netmiko Library (Interactive)



Task 1

Configure a Python Script that allows you to configure a set of devices using configuration files.

- Use the "ConnectHandler" function from the **netmiko** library.
- Allow the User to input the name of the devices file along with the SSH Username and Password.
- Create the configuration files for the routers based on the table below.
- Login Username: **khawar**
- Password: **cisco**

Content of the "devices.txt" File 172.25.1.1 172.25.1.2 172.25.1.3 172.25.1.4
Content of the "R1.txt" File config terminal ! mpls ldp router-id loopback0 ! Interface E 0/1 mpls ip ! wr
Content of the "R2.txt" File config terminal ! mpls ldp router-id loopback0 ! Interface E 0/0 mpls ip ! Interface E 0/1 mpls ip ! Interface E 0/2 mpls ip ! wr
Content of the "R3.txt" File

```
config terminal
!
mpls ldp router-id loopback0
!
Interface E 0/0
 mpls ip
!
wr
```

Content of the “R4.txt” File

```
config terminal
!
mpls ldp router-id loopback0
!
Interface E 0/0
 mpls ip
!
wr
```

Admin PC

```
from netmiko import ConnectHandler
import getpass

print('Please name the Configuration File based on the Hostname.txt format\n')
HOSTS = input("Enter the name of file for Device List: ")
user = input("Enter your SSH username: ")
PASS = getpass.getpass()
print('\n')

with open(HOSTS) as routers:
    for IP in routers:
        Router = {
            'device_type': 'cisco_ios',
            'ip': IP,
            'username': user,
            'password': PASS,
            'port': 22
        }

        net_connect = ConnectHandler(**Router)
        hostname = net_connect.send_command('show run | i host')
        hostname.split(" ")
        hostname, devicename = hostname.split(" ")
        cmdfile=devicename + ".txt"
        net_connect.send_config_from_file(cmdfile)
```

```
print(devicename + ' Configured')
net_connect.disconnect()
```

Verification:

- Save the script as Lab13.py.
- Run the script. Use Debug mode if you are using PyCharm as it has an issue with the getpass() function.
- Verify the configuration on the Routers.