OSPF Exercises

All participants will work within a group as a team. Each group has three routers and four switches to work with.

These exercises are divided into several components:

1. Basic Router Configuration
2. Static Routing
3. Dynamic routing with OSPF
4. First hop redundancy using HSRP

There is a certain dependency between the labs as the exercises progress. Make sure to maintain your configuration unless otherwise instructed. All exercises will use a common IP addressing scheme and network topology.

As you go through the exercises all the examples are given from the point of view of R11, the border router in group 1. Make sure that you take the examples and adapt them to your own router, network topology and addressing scheme.

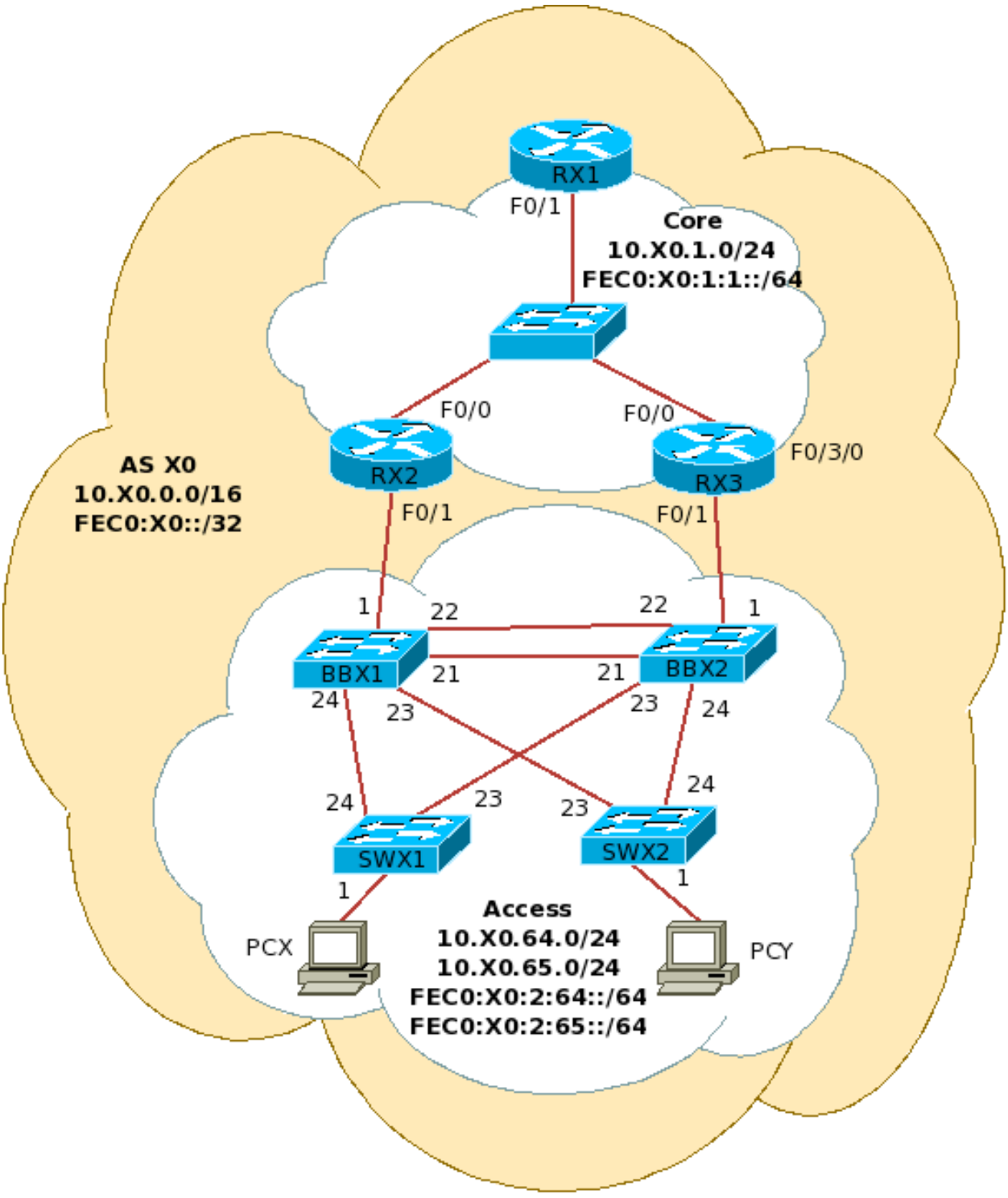
Address Space Allocation

Group 1: 10.10.0.0/16	ASN: 10
Group 2: 10.20.0.0/16	ASN: 20
Group 3: 10.30.0.0/16	ASN: 30
Group 4: 10.40.0.0/16	ASN: 40
Group 5: 10.50.0.0/16	ASN: 50

Each group will then further partition their space:

10.X0.1.0/24	FEC0:X0:1:1::/64	- Core Network
10.X0.64.0/24	FEC0:X0:2:64::/64	- Data Subnet (VLAN 64)
10.X0.65.0/24	FEC0:X0:2:65::/64	- VOIP Subnet (VLAN 65)
10.X0.254.0/24	FEC0:X0:0:FE::/64	- Router Loopback Subnet
10.X0.255.0/24	FEC0:X0:0:FF::/64	- Switch MGMT Subnet (VLAN 255)

With X being your group number (1,2,3,4,5)


RX1
F0/1
Core
10.X0.1.0/24
FEC0:X0:1:1::/64
F0/0
F0/0
F0/3/0
RX2
RX3
AS X0
10.X0.0.0/16
FEC0:X0::/32
F0/1
F0/1
1
22
22
1
BBX1
BBX2
21
21
24
23
23
24
24
23
23
24
SWX1
SWX2
1
1
PCX
PCY
Access
10.X0.64.0/24
10.X0.65.0/24
FEC0:X0:2:64::/64
FEC0:X0:2:65::/64

Basic Router Configuration

1. Name the router.

```
enable
config terminal
hostname R11
```

2. Configure authentication

```
service password-encryption
enable secret nsrc
username nsrc password nsrc
line vty 0 4
 login local
```

3. Configure logging

```
no logging console
logging buffered 8192 debugging
```

4. Deactivate domain name resolution.

```
no ip domain-lookup
```

5. Make sure the router understands CIDR. This is the default setting in recent IOS versions, but just in case.

```
ip subnet-zero
ip classless
```

6. Disable source routing.

```
no ip source-route
```

7. Activate IPv6 routing.

```
ipv6 unicast-routing
```

8. Save the configuration.

```
write memory
```

9. Configure your interfaces.

R11:

```
interface FastEthernet0/1
 ip address 10.10.1.1 255.255.255.0
```

```
 description Link to Core
 ipv6 enable
 ipv6 address FEC0:10:1:1::1/64
 no ip redirects
 no ip directed-broadcast
 no ip proxy-arp
 no shutdown
```

From the point of view of R12 & R13 where you will use VLANs:

R12:

```
interface FastEthernet0/1
 no ip address
 no shutdown
 interface FastEthernet0/1.64
 encapsulation dot1Q 64
 ip address 10.10.64.2 255.255.255.0
 description Link VLAN 64
 ipv6 enable
 ipv6 address FEC0:10:2:64::2/64
 no ip redirects
 no ip directed-broadcast
 no ip proxy-arp
 no shutdown
```

R13:

```
interface FastEthernet0/1
 no ip address
 no shutdown
 interface FastEthernet0/1.64
 encapsulation dot1Q 64
 ip address 10.10.64.3 255.255.255.0
 description Link VLAN 64
 ipv6 enable
 ipv6 address FEC0:10:2:64::3/64
 no ip redirects
 no ip directed-broadcast
 no ip proxy-arp
 no shutdown
```

Do the same for VLANs 65 and 255.

10. Do some ping tests.

```
R11# ping 10.10.1.2
R11# ping 10.10.1.3
R11# ping FEC0:10:1:1::2
R11# ping FEC0:10:1:1::3
```

and then verify the output of the following commands

```
show arp                      : Shows ARP cache
show interface <int>          : Shows interface state and configuration
show ip interface             : Shows interface IP state and config
```

```
show ipv6 neighbors           : Shows IPv6 neighbors
show ipv6 interface <int>     : Shows interface state and configuration
show ipv6 interface           : Shows interface state and configuration
```

11. Create loopback interface.

R11:

```
interface loopback 0
 ip address 10.10.254.1 255.255.255.255
 ipv6 address FEC0:10:0:FE::1/128
```

12. Verify and save the configuration.

```
R11# show running-config
R11# write memory
```

Static Routing

1. Try pinging the addresses within your AS.

```
R11# ping 10.10.1.2
R11# ping 10.10.1.3
R11# ping 10.10.254.2
R11# ping 10.10.254.3
R11# ping 10.10.64.2
R11# ping 10.10.64.3
R11# ping 10.10.65.2
R11# ping 10.10.65.3
R11# ping 10.10.255.2
R11# ping 10.10.255.3
R11# ping ipv6 FEC0:10:1:1::2
R11# ping ipv6 FEC0:10:1:1::3
R11# ping ipv6 FEC0:10:0:FE::2
R11# ping ipv6 FEC0:10:0:FE::3
R11# ping ipv6 FEC0:10:2:64::2
R11# ping ipv6 FEC0:10:2:64::3
R11# ping ipv6 FEC0:10:2:65::2
R11# ping ipv6 FEC0:10:2:65::3
R11# ping ipv6 FEC0:10:0:FF::2
R11# ping ipv6 FEC0:10:0:FF::3
```

What is happening? Why can't we ping some of the addresses?

2. Create static routes.

R11:

```
ip route 10.10.254.2 255.255.255.255 10.10.1.2
ip route 10.10.254.3 255.255.255.255 10.10.1.3
```

```
ip route 10.10.64.0 255.255.255.0 10.10.1.2
ip route 10.10.64.0 255.255.255.0 10.10.1.3
ip route 10.10.65.0 255.255.255.0 10.10.1.2
ip route 10.10.65.0 255.255.255.0 10.10.1.3
ipv6 route FEC0:10:0:FE::2/128 FEC0:10:1:1::2
ipv6 route FEC0:10:0:FE::3/128 FEC0:10:1:1::3
ipv6 route FEC0:10:2:64::/64 FEC0:10:1:1::2
ipv6 route FEC0:10:2:64::/64 FEC0:10:1:1::3
ipv6 route FEC0:10:2:65::/64 FEC0:10:1:1::2
ipv6 route FEC0:10:2:65::/64 FEC0:10:1:1::3
ipv6 route FEC0:10:0:FF::/64 FEC0:10:1:1::2
ipv6 route FEC0:10:0:FF::/64 FEC0:10:1:1::3
```

Repeat the ping tests now. What happens when a new network is added?

3. **Save the configuration.**

```
R11# write memory
R11# show running-config
R11# show startup-config
```

Dynamic Routing with OSPF

1. **Configure a new OSPF routing process.**

```
router ospf 100
 log-adjacency-changes

ipv6 router ospf 100
 log-adjacency-changes
```

2. **Configure OSPF on the interfaces where adjacencies need to be established, and also on interfaces whose networks need to be advertised.**

Notice that we are configuring authentication for the OSPF adjacencies. This is important.

```
R11:

interface FastEthernet0/1
 ip ospf 100 area 0
 ip ospf authentication message-digest
 ip ospf authentication-key 7 09627D3B3A
 ipv6 ospf 100 area 0
 ipv6 ospf authentication ipsec spi 500 md5
1234567890abcdef1234567890abcdef
```

```
interface loopback 0
 ip ospf 100 area 0
 ipv6 ospf 100 area 0
```

3. **STOP -- Checkpoint.**

```
show ip ospf neighbor               : show adjacencies
show ipv6 ospf neighbor
```

a. How many adjacencies do you see listed? Are they all necessary?
b. Tell OSPF which interfaces do not need to establish adjacencies

R12:

```
router ospf 100
 passive-interface FastEthernet0/1.64
 passive-interface FastEthernet0/1.65
 passive-interface FastEthernet0/1.255

ipv6 router ospf 100
 passive-interface FastEthernet0/1.64
 passive-interface FastEthernet0/1.65
 passive-interface FastEthernet0/1.255
```

4. **STOP -- Checkpoint.**

```
show ip route           : show routes in routing table
show ip ospf            : shows general OSPF information
show ip ospf interface  : shows the status of OSPF in an interface

show ipv6 route
show ipv6 ospf
show ipv6 ospf interface
```

Which routes are preferred?

5. **Remove the old static route entries.**

```
no ip route 10.10.254.2 255.255.255.255 10.10.1.2
…
```

6. **STOP -- Checkpoint.**

```
show ip route                 : show routes in routing table
show ipv6 route
```

How many routes do you have for each access network? Which route is preferred?

7. **Load balance the traffic for the different networks by using OSPF link costs.**

    a. Check each interface's cost

```
R12#show ip ospf interface fastEthernet 0/1.64
```

    b. If you did the Layer 2 exercises and used MSTP to load balance traffic for the different VLANs, make sure that you assign OSPF link costs accordingly to avoid unnecessary hops.

R12:

```
interface fastEthernet 0/1.255
 ip ospf cost 5
 ipv6 ospf cost 5
```

First Hop Redundancy

We will be using HSRP for this exercise. All the examples are presented from the point of view of R12 & R13.

1. Configure HSRP for the interfaces

```
interface FastEthernet0/1.64
R12(config-if)# standby version 2
R12(config-if)# standby 1 ip 10.10.64.1
R12(config-if)# standby 2 ipv6 FE80::1

interface FastEthernet0/1.64
R13(config-if)# standby version 2
R13(config-if)# standby 1 ip 10.10.64.1
R13(config-if)# standby 2 ipv6 FE80::1
```

Do the same for VLANs 65 and 255.

2. STOP – Checkpoint. Verify the active router

```
show standby FastEthernet0/1.64          : Shows HSRP status
```

a. Which is the active router?
b. Which is the standby router?
c. What is the address for the virtual IP?
d. What is the virtual MAC (Ethernet) address?
e. Ping from the workstations out towards the border
f. Traceroute from the workstations towards the border

3. **Change the interface's HSRP priority for one of the routers serving subnet 10.X0.64.0/24**

    a. If you did the Layer 2 exercises and used MSTP to load balance traffic for the different VLANs, make sure that you assign the HSRP priorities accordingly to achieve symmetric routing

```
interface FastEthernet0/1.64
 standby 1 priority 110
```

4. **STOP – Checkpoint.** Verify the active router

```
show standby FastEthernet0/1.64          : Shows HSRP status
```

a. Which is the active router?
b. Which is the standby router?
c. What is the address for the virtual IP?
d. What is the virtual MAC (Ethernet) address?
e. Ping from the workstations out towards the border
f. Traceroute from the workstations towards the border

5. **Modify other HSRP parameters**

```
interface FastEthernet0/1.64
 standby 1 preempt delay minimum 0
 standby 1 timers 3 10
 standby 1 authentication md5 key-string NSRC
 standby 2 preempt delay minimum 0
 standby 2 timers 3 10
 standby 2 authentication md5 key-string NSRC
```

Do the same for VLANs 65 and 255.

6. **Track the status of the uplink interface**

```
interface FastEthernet0/1.64
 standby 1 track FastEthernet0/0 20
 standby 2 track FastEthernet0/0 20
```

Do the same for VLANs 65 and 255.

7. **STOP – Checkpoint**

```
show standby FastEthernet0/1.64          : Shows HSRP status
```

a. Ping from the workstations out towards the border
b. Traceroute from the workstations towards the border

Shut down the interface FastEthernet0/0 for the active router and answer the following questions

c. Which is the active router?
d. Which is the standby router?
e. What happened to your ping?

8. Save the configuration and checkpoint.

```
R11# write memory
R11# show running-config
R11# show startup-config
```

Notes:

- Old OSPF syntax for adding IPv4 networks (before IOS 12.3):

```
router ospf 100
 network 10.10.1.0 0.0.0.255 area 0
 network 10.10.254.1 0.0.0.0 area 0
 network 10.10.255.1 0.0.0.0 area 0
```