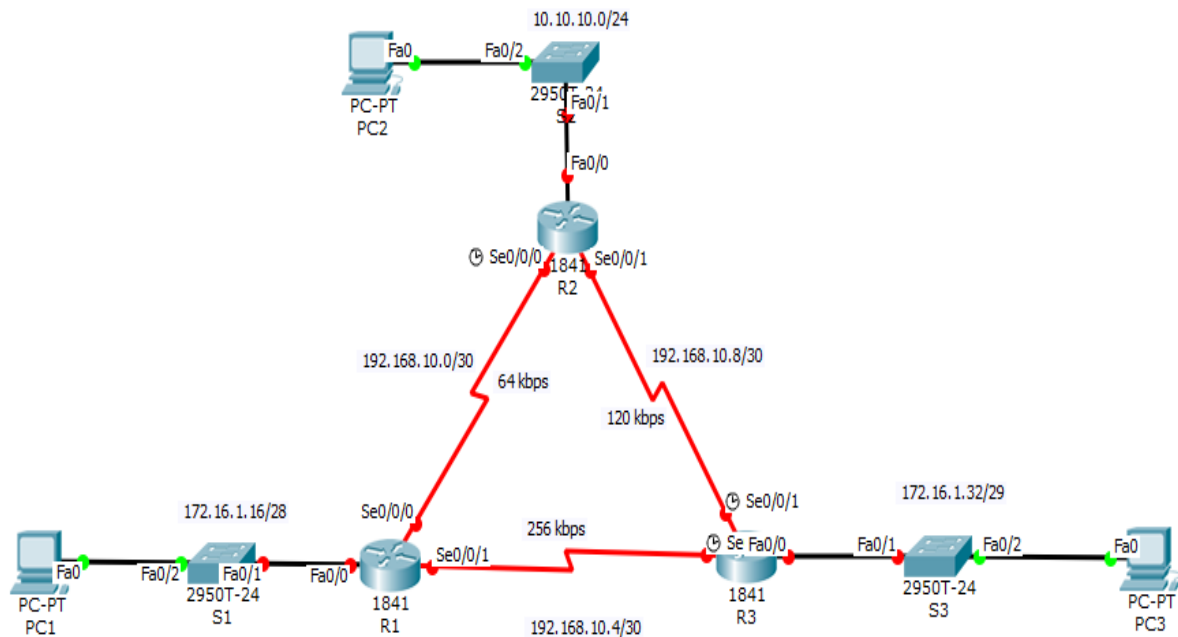# Lab: Basic OSPF Configuration Lab 1

Step 1: Configure the routers, Step 2: Disable DNS lookup and Step 3: Configure the interfaces on R1, R2, and R3

R1

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#no ip domain-lookup
R1(config)#int fa0/0
R1(config-if)#ip add 172.16.1.17 255.255.255.240
R1(config-if)#no shut

R1(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to
up

R1(config-if)#exit
R1(config)#
```

```
R1(config)#int s0/0/0
R1(config-if)#ip add 192.168.10.1 255.255.255.252
R1(config-if)#no shut

%LINK-5-CHANGED: Interface Serial0/0/0, changed state to down
R1(config-if)#exit
R1(config)#int s0/0/1
R1(config-if)#ip add 192.168.10.5 255.255.255.252
R1(config-if)#no shut

%LINK-5-CHANGED: Interface Serial0/0/1, changed state to down
R1(config-if)#exit
```

R2

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#no ip domain-lookup
R2(config)#int fa0/0
R2(config-if)#ip add 10.10.10.1 255.255.255.0
R2(config-if)#no shut

R2(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to
up
exit
R2(config)#int s0/0/0
R2(config-if)#ip add 192.168.10.2 255.255.255.252
R2(config-if)#no shut

R2(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up
exit
R2(config)#int
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

% Incomplete command.
R2(config)#int s0/0/1
R2(config-if)#ip add 192.168.10.9 255.255.255.252
R2(config-if)#no shut

%LINK-5-CHANGED: Interface Serial0/0/1, changed state to down
R2(config-if)#exit
R2(config)#
```

R3

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#no ip domain-lookup
Router(config)#hostname R3
R3(config)#int fa0/0
R3(config-if)#ip add 172.16.1.33 255.255.255.248
R3(config-if)#no shut

R3(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

R3(config-if)#exit
R3(config)#int s0/0/0
R3(config-if)#ip add 192.168.10.6 255.255.255.252
R3(config-if)#no shut

R3(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

R3(config-if)#exit
R3(config)#int s0/0/1
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

R3(config-if)#ip add 192.168.10.10 255.255.255.252
R3(config-if)#no shut

R3(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/1, changed state to up

R3(config-if)#exit
R3(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to up
```

Step 4: Verify IP addressing and interfaces

R1

```
R1#show ip int brief
Interface              IP-Address      OK? Method Status                 Protocol

FastEthernet0/0        172.16.1.17     YES manual up                     up

FastEthernet0/1        unassigned      YES unset  administratively down  down

Serial0/0/0            192.168.10.1    YES manual up                     up

Serial0/0/1            192.168.10.5    YES manual up                     up

Vlan1                  unassigned      YES unset  administratively down  down
```

R2

```
R2#show ip int brief
Interface              IP-Address      OK? Method Status                 Protocol

FastEthernet0/0        10.10.10.1      YES manual up                     up

FastEthernet0/1        unassigned      YES unset  administratively down  down

Serial0/0/0            192.168.10.2    YES manual up                     up

Serial0/0/1            192.168.10.9    YES manual up                     up

Vlan1                  unassigned      YES unset  administratively down  down
```

R3
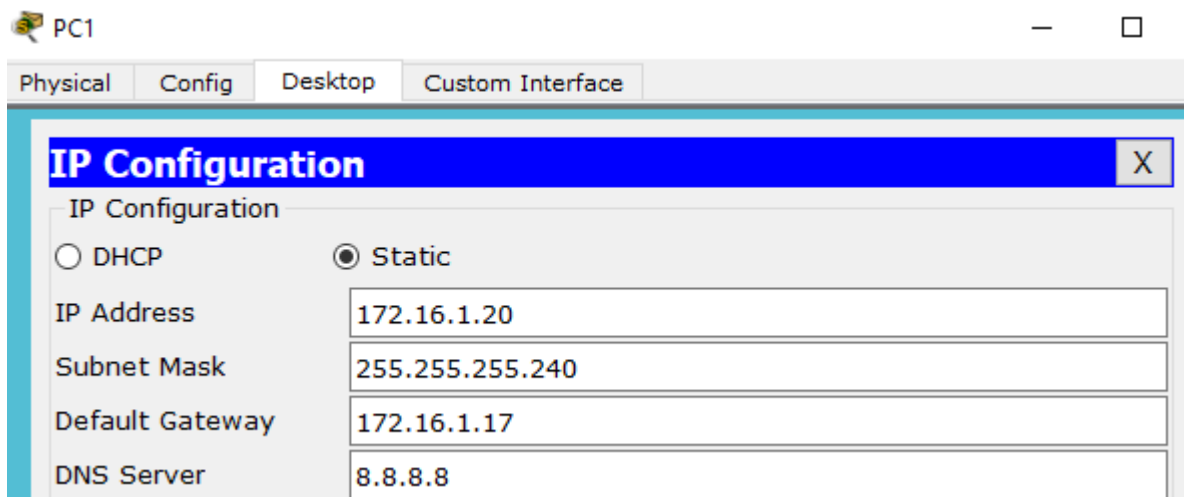
```
R3#show ip int brief
Interface              IP-Address      OK? Method Status                 Protocol

FastEthernet0/0        172.16.1.33     YES manual up                     up

FastEthernet0/1        unassigned      YES unset  administratively down  down

Serial0/0/0            192.168.10.6    YES manual up                     up

Serial0/0/1            192.168.10.10   YES manual up                     up

Vlan1                  unassigned      YES unset  administratively down  down
```

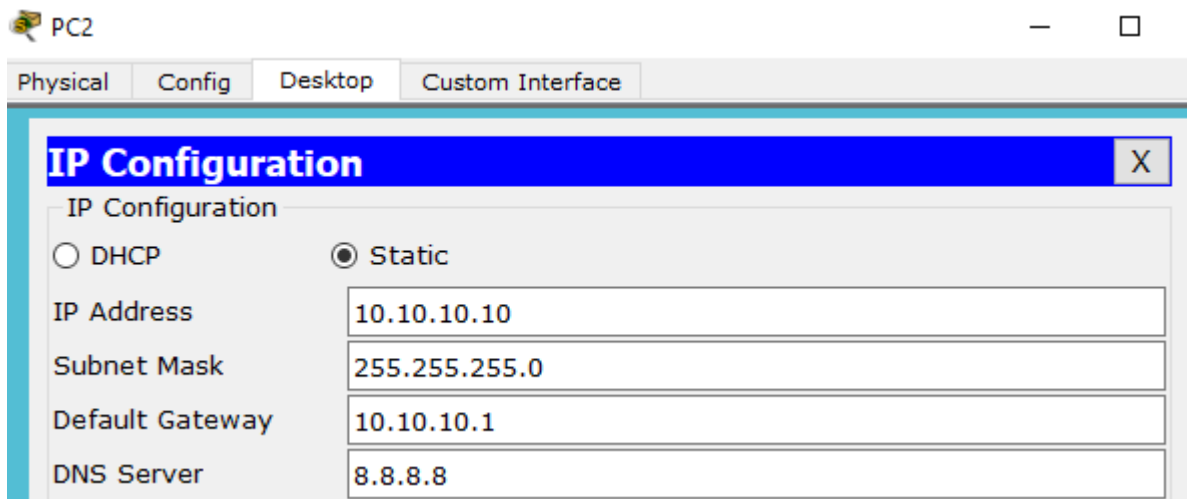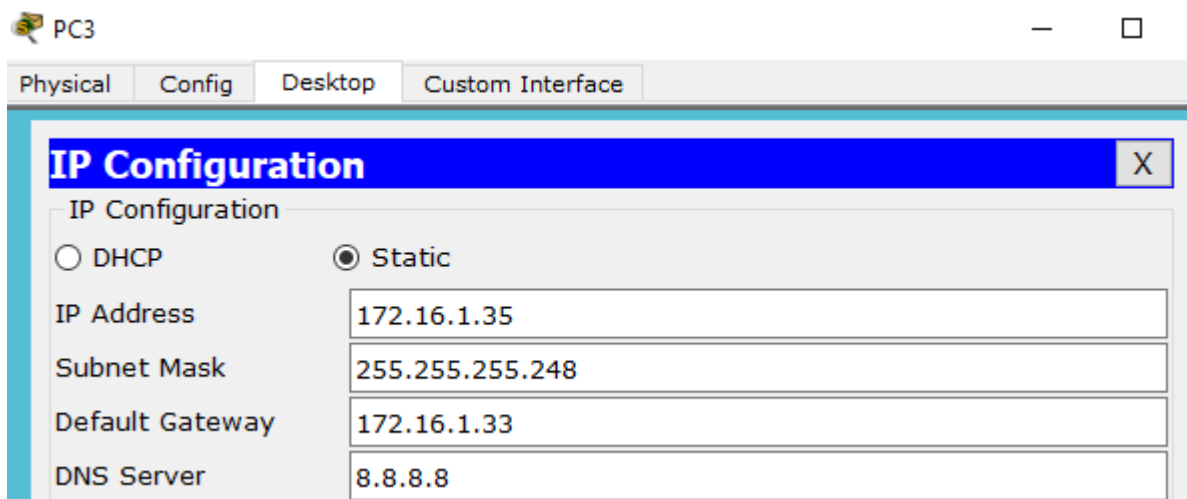## Step 5: Configure Ethernet interfaces of PC1, PC2, and PC3

PC1

PC2

PC2

IP Configuration

IP Configuration

○ DHCP   ◉ Static

IP Address	10.10.10.10
Subnet Mask	255.255.255.0
Default Gateway	10.10.10.1
DNS Server	8.8.8.8

PC3

IP Configuration

IP Configuration

○ DHCP   ◉ Static

IP Address	172.16.1.35
Subnet Mask	255.255.255.248
Default Gateway	172.16.1.33
DNS Server	8.8.8.8

Task: Configure OSPF on the R1 Router

R1

```
R1>en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#router ospf 1
R1(config-router)#network 172.16.1.16 0.0.0.15 area 0
R1(config-router)#network 192.168.10.0 0.0.0.3 area 0
R1(config-router)#network 192.168.10.4 0.0.0.3 area 0
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
```

R2

```
R2>EN
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#router ospf 1
R2(config-router)#network 10.10.10.0 0.0.0.255 area 0
R2(config-router)#network 192.168.10.0 0.0.0.3 area 0
R2(config-router)#
00:45:22: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.5 on Serial0/0/0 from LOADING
to FULL, Loading Done

R2(config-router)#network 192.168.10.8 0.0.0.3 area 0
R2(config-router)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
```

R3

```
R3>en
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#router ospf 1
R3(config-router)#network 172.16.1.32 0.0.0.7 area 0
R3(config-router)#network 192.168.10.4 0.0.0.3 area 0
R3(config-router)#
00:36:52: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.5 on Serial0/0/0 from LOADING
to FULL, Loading Done

R3(config-router)#network 192.168.10.8 0.0.0.3 area 0
R3(config-router)#
00:37:19: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.9 on Serial0/0/1 from LOADING
to FULL, Loading Done

R3(config-router)#end
R3#
%SYS-5-CONFIG_I: Configured from console by console
```

Task: Configure OSPF Router IDs

Step 1: Examine the current router IDs in the topology

```
R3#show ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.10.10
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.1.32 0.0.0.7 area 0
    192.168.10.4 0.0.0.3 area 0
    192.168.10.8 0.0.0.3 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.10.5         110        00:06:03
    192.168.10.9         110        00:05:36
    192.168.10.10        110        00:05:36
  Distance: (default is 110)
```

```
R3#show ip ospf
 Routing Process "ospf 1" with ID 192.168.10.10
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 External flood list length 0
    Area BACKBONE(0)
        Number of interfaces in this area is 3
        Area has no authentication
        SPF algorithm executed 5 times
        Area ranges are
        Number of LSA 3. Checksum Sum 0x01e247
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
R3#show ip ospf int

FastEthernet0/0 is up, line protocol is up
  Internet address is 172.16.1.33/29, Area 0
  Process ID 1, Router ID 192.168.10.10, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 192.168.10.10, Interface address 172.16.1.33
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:09
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.6/30, Area 0
  Process ID 1, Router ID 192.168.10.10, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:05
  Index 2/2, flood queue length 0
```

Step 2: Use loopback addresses to change the router IDs of the routers in the topology.

R1

```
R1(config)#int loopback 0
R1(config-if)#ip add 10.1.1.1 255.255.255.255
R1(config-if)#exit
R1(config)#exit
```

R2

```
R2(config-if)#int loopback 0
R2(config-if)#ip address 10.2.2.2 255.255.255.255
R2(config-if)#exit
R2(config)#exit
```

R3

```
R3(config-if)#int loopback 0
R3(config-if)#ip address 10.3.3.3 255.255.255.255
R3(config-if)#exit
R3(config)#exit
```

Step 3: Reload the routers to force the new Router IDs to be used.

R1

```
R1>en
R1#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
R1#reload
Proceed with reload? [confirm]
System Bootstrap, Version 12.3(8r)T8, RELEASE SOFTWARE (fc1)
Initializing memory for ECC
```

R2

```
R2#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
R2#reload
Proceed with reload? [confirm]
System Bootstrap, Version 12.3(8r)T8, RELEASE SOFTWARE (fc1)
Initializing memory for ECC
```

R3

```
R3#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
R3#reload
Proceed with reload? [confirm]
System Bootstrap, Version 12.3(8r)T8, RELEASE SOFTWARE (fc1)
Initializing memory for ECC
```

Step 4: Use the show ip ospf neighbors command to verify that the router IDs have changed.

R1

```
R1#show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
10.3.3.3          0   FULL/  -        00:00:39    192.168.10.6    Serial0/0/1
10.2.2.2          0   FULL/  -        00:00:36    192.168.10.2    Serial0/0/0
R1#
```

R2

```
R2#show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
10.1.1.1          0   FULL/  -        00:00:38    192.168.10.1    Serial0/0/0
10.3.3.3          0   FULL/  -        00:00:30    192.168.10.10   Serial0/0/1
```

R3

```
R3>en
R3#show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
10.2.2.2          0   FULL/  -        00:00:39    192.168.10.9    Serial0/0/1
10.1.1.1          0   FULL/  -        00:00:39    192.168.10.5    Serial0/0/0
```

Step 5: Use the router-id command to change the router ID on the R1 router.

R1

```
R1(config)#router ospf 1
R1(config-router)#router-id 10.4.4.4
R1(config-router)#Reload or use "clear ip ospf process" command, for this to take effect

R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#clear ip ospf process
Reset ALL OSPF processes? [no]: yes

R1#
```

Step 6: Use the show ip ospf neighbor command on router R2 to verify that the router ID of R1 has been changed.

```
R2#show ip ospf neighbor


Neighbor ID     Pri   State          Dead Time   Address         Interface
10.4.4.4          0   FULL/  -       00:00:33    192.168.10.1    Serial0/0/0
10.3.3.3          0   FULL/  -       00:00:35    192.168.10.10   Serial0/0/1
R2#
```

Step 7: Remove the configured router ID with the no form of the router-id command.

```
R1(config)#router ospf 1
R1(config-router)#router-id 10.4.4.4
```

Step 8: Restart the OSPF process using the clear ip ospf process command.

```
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#clear ip ospf process
Reset ALL OSPF processes? [no]: yes

R1#
```

Task: Verify OSPF Operation

Step 1: On the R1 router, Use the show ip ospf neighbor command to view the information about the OSPF neighbor routers R2 and R3

```
R1#show ip ospf neighbor


Neighbor ID     Pri   State          Dead Time   Address         Interface
10.3.3.3          0   FULL/  -       00:00:33    192.168.10.6    Serial0/0/1
10.2.2.2          0   FULL/  -       00:00:30    192.168.10.2    Serial0/0/0
```

Step 2: On the R1 router, use the show ip protocols command to view information about the routing protocol operation.

```
R1#show ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 10.4.4.4
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.1.16 0.0.0.15 area 0
    192.168.10.0 0.0.0.3 area 0
    192.168.10.4 0.0.0.3 area 0
  Routing Information Sources:
    Gateway           Distance      Last Update
    10.1.1.1              110        00:29:43
    10.2.2.2              110        00:00:14
    10.3.3.3              110        00:00:11
    10.4.4.4              110        00:00:11
    192.168.10.5         110        00:54:24
    192.168.10.9         110        00:42:01
    192.168.10.10        110        00:30:26
  Distance: (default is 110)
```

Task: Examine OSPF Routes in the Routing Tables

```
R1>en
R1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.1.1/32 is directly connected, Loopback0
O       10.10.10.0/24 [110/65] via 192.168.10.2, 00:44:24, Serial0/0/0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.16/28 is directly connected, FastEthernet0/0
O       172.16.1.32/29 [110/65] via 192.168.10.6, 00:43:42, Serial0/0/1
     192.168.10.0/30 is subnetted, 3 subnets
C       192.168.10.0 is directly connected, Serial0/0/0
C       192.168.10.4 is directly connected, Serial0/0/1
O       192.168.10.8 [110/128] via 192.168.10.2, 00:43:42, Serial0/0/0
                     [110/128] via 192.168.10.6, 00:43:42, Serial0/0/1
R1#
```

Task: Configure OSPF Cost

Step 1: Use the show ip route command on the R1 router to view the OSPF cost to reach the 10.10.10.0/24 network.

```
R1>en
R1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.1.1/32 is directly connected, Loopback0
O       10.10.10.0/24 [110/65] via 192.168.10.2, 00:44:24, Serial0/0/0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.16/28 is directly connected, FastEthernet0/0
O       172.16.1.32/29 [110/65] via 192.168.10.6, 00:43:42, Serial0/0/1
     192.168.10.0/30 is subnetted, 3 subnets
C       192.168.10.0 is directly connected, Serial0/0/0
C       192.168.10.4 is directly connected, Serial0/0/1
O       192.168.10.8 [110/128] via 192.168.10.2, 00:43:42, Serial0/0/0
                     [110/128] via 192.168.10.6, 00:43:42, Serial0/0/1
```

Step 2: Use the show interfaces serial0/0/0 command on the R1 router to view the bandwidth of the Serial 0/0/0 interface.

```
R1#show int s0/0/0
Serial0/0/0 is up, line protocol is up (connected)
  Hardware is HD64570
  Internet address is 192.168.10.1/30
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
```

Step 3: Use the bandwidth command to change the bandwidth of the serial interfaces of the R1 and R2 routers to the actual bandwidth, 64 kbps.

R1

```
R1(config)#int s0/0/0
R1(config-if)#bandwidth 64
R1(config-if)#int s0/0/1
R1(config-if)#bandwidth 64
```

R2

```
R2(config)#int s0/0/0
R2(config-if)#bandwidth 64
R2(config-if)#int s0/0/1
R2(config-if)#bandwidth 64
```

Step 4: Use the show ip ospf interface command on the R1 router to verify the cost of the serial links

```
R1#show ip ospf interface

FastEthernet0/0 is up, line protocol is up
  Internet address is 172.16.1.17/28, Area 0
  Process ID 1, Router ID 10.4.4.4, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 10.4.4.4, Interface address 172.16.1.17
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:07
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.1/30, Area 0
  Process ID 1, Router ID 10.4.4.4, Network Type POINT-TO-POINT, Cost:
1562
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
 --More-- |                                                              \
```

Step 5: Use the ip ospf cost command to configure the OSPF cost on the R3 router.

```
R3(config)#int s0/0/0
R3(config-if)#ip ospf cost 1562
R3(config-if)#int s0/0/1
R3(config-if)#ip ospf cost 1562
```

Step 6: Use the show ip ospf interface command on the R3 router to verify that the cost of the link the cost of each of the Serial links is now 1562.

```
R3#show ip ospf int

FastEthernet0/0 is up, line protocol is up
  Internet address is 172.16.1.33/29, Area 0
  Process ID 1, Router ID 10.3.3.3, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 10.3.3.3, Interface address 172.16.1.33
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:02
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.6/30, Area 0
  Process ID 1, Router ID 10.3.3.3, Network Type POINT-TO-POINT, Cost: 1562
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
 --More-- |
```

Task: Redistribute an OSPF Default Route

Step 1: Configure a loopback address on the R1 router to simulate a link to an ISP

```
R1(config)#int loopback1

R1(config-if)#
%LINK-5-CHANGED: Interface Loopback1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback1, changed
state to up

R1(config-if)#ip add 172.30.1.1 255.255.255.252
```

Step 2: Configure a static default route on the R1 router.

```
R1(config)#router ospf 1
R1(config-router)#default-information originate
```

Step 4: View the routing table on the R2 router to verify that the static default route is being redistributed via OSPF.

```
R1#
R1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.1.1/32 is directly connected, Loopback0
O       10.10.10.0/24 [110/1563] via 192.168.10.2, 00:17:08, Serial0/0/0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.16/28 is directly connected, FastEthernet0/0
O       172.16.1.32/29 [110/1563] via 192.168.10.6, 00:17:08, Serial0/0/1
     172.30.0.0/30 is subnetted, 1 subnets
C       172.30.1.0 is directly connected, Loopback1
     192.168.10.0/30 is subnetted, 3 subnets
C       192.168.10.0 is directly connected, Serial0/0/0
C       192.168.10.4 is directly connected, Serial0/0/1
O       192.168.10.8 [110/3124] via 192.168.10.2, 00:09:33, Serial0/0/0
 --More--
```

Task: Configure Additional OSPF Features

Step 1: Use the auto-cost reference-bandwidth command to adjust the reference bandwidth value.

R1

```
R1(config-router)#auto-cost reference-bandwidth 10000
% OSPF: Reference bandwidth is changed.
        Please ensure reference bandwidth is consistent across all routers.
```

R2

```
R2(config-router)#auto-cost reference-bandwidth 10000
% OSPF: Reference bandwidth is changed.
        Please ensure reference bandwidth is consistent across all routers.
```

R3

```
R3(config-router)#auto-cost reference-bandwidth 10000
% OSPF: Reference bandwidth is changed.
        Please ensure reference bandwidth is consistent across all routers.
```

Step 2: Examine the routing table on the R1 router to verify the change in the OSPF cost metric

```
R1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.1.1/32 is directly connected, Loopback0
O       10.10.10.0/24 [110/6576] via 192.168.10.2, 00:03:01, Serial0/0/0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.16/28 is directly connected, FastEthernet0/0
O       172.16.1.32/29 [110/6576] via 192.168.10.6, 00:02:11, Serial0/0/1
     172.30.0.0/30 is subnetted, 1 subnets
C       172.30.1.0 is directly connected, Loopback1
     192.168.10.0/30 is subnetted, 3 subnets
C       192.168.10.0 is directly connected, Serial0/0/0
C       192.168.10.4 is directly connected, Serial0/0/1
O       192.168.10.8 [110/12952] via 192.168.10.2, 00:02:51, Serial0/0/0
R1#
```

Step 3: Use the show ip ospf neighbor command on R1 to view the Dead Time counter.

```
Neighbor ID     Pri   State         Dead Time   Address       Interface
10.3.3.3          0   FULL/  -      00:00:36    192.168.10.6  Serial0/0/1
10.2.2.2          0   FULL/  -      00:00:33    192.168.10.2  Serial0/0/0
R1#
```

Step 4: Configure the OSPF Hello and Dead intervals.

```
R1(config)#int s0/0/0
R1(config-if)#ip ospf hello-interval 5
R1(config-if)#ip ospf dead-interval 20
R1(config-if)#
01:36:10: %OSPF-5-ADJCHG: Process 1, Nbr 10.2.2.2 on Serial0/0/0 from FULL to DOWN,
Neighbor Down: Dead timer expired

01:36:10: %OSPF-5-ADJCHG: Process 1, Nbr 10.2.2.2 on Serial0/0/0 from FULL to DOWN,
Neighbor Down: Interface down or detached
```

Step 5: Modify the Dead Timer and Hello Timer intervals.

```
R2(config)#int s0/0/0
R2(config-if)#ip ospf hello-interval 5
R2(config-if)#ip ospf dead-interval 20
R2(config-if)#
01:27:14: %OSPF-5-ADJCHG: Process 1, Nbr 10.4.4.4 on Serial0/0/0 from LOADING to
FULL, Loading Done
```

Step 5: Use the show ip ospf interface serial0/0/0 command to verify that the Hello Timer and Dead Timer intervals have been modified.

```
R2#show ip ospf interface serial0/0/0

Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.2/30, Area 0
  Process ID 1, Router ID 10.2.2.2, Network Type POINT-TO-POINT, Cost: 6476
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 5, Dead 20, Wait 20, Retransmit 5
    Hello due in 00:00:01
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 10.4.4.4
  Suppress hello for 0 neighbor(s)
```

Step 6: Use the show ip ospf neighbor command on R1 to verify that the neighbor adjacency with R2 has been restored.

```
R1#show ip ospf neighbor


Neighbor ID       Pri   State           Dead Time   Address
Interface
10.3.3.3            0    FULL/   -       00:00:36    192.168.10.6
Serial0/0/1
10.2.2.2            0    FULL/   -       00:00:19    192.168.10.2
Serial0/0/0
R1#
```

==Giải thích dòng lệnh==

En vào chế độ đặc quyền

Conf t: vào chế độ cấu hình

Hostname: cấu hình tên thiết bị

Các lệnh show dùng để kiểm tra cấu hình OSPF

- show ip protocol
- show ip route
- show ip ospf
- show ip ospf interface
- show ip ospf neighbor detail

Ip default-gateway: gán default-gateway

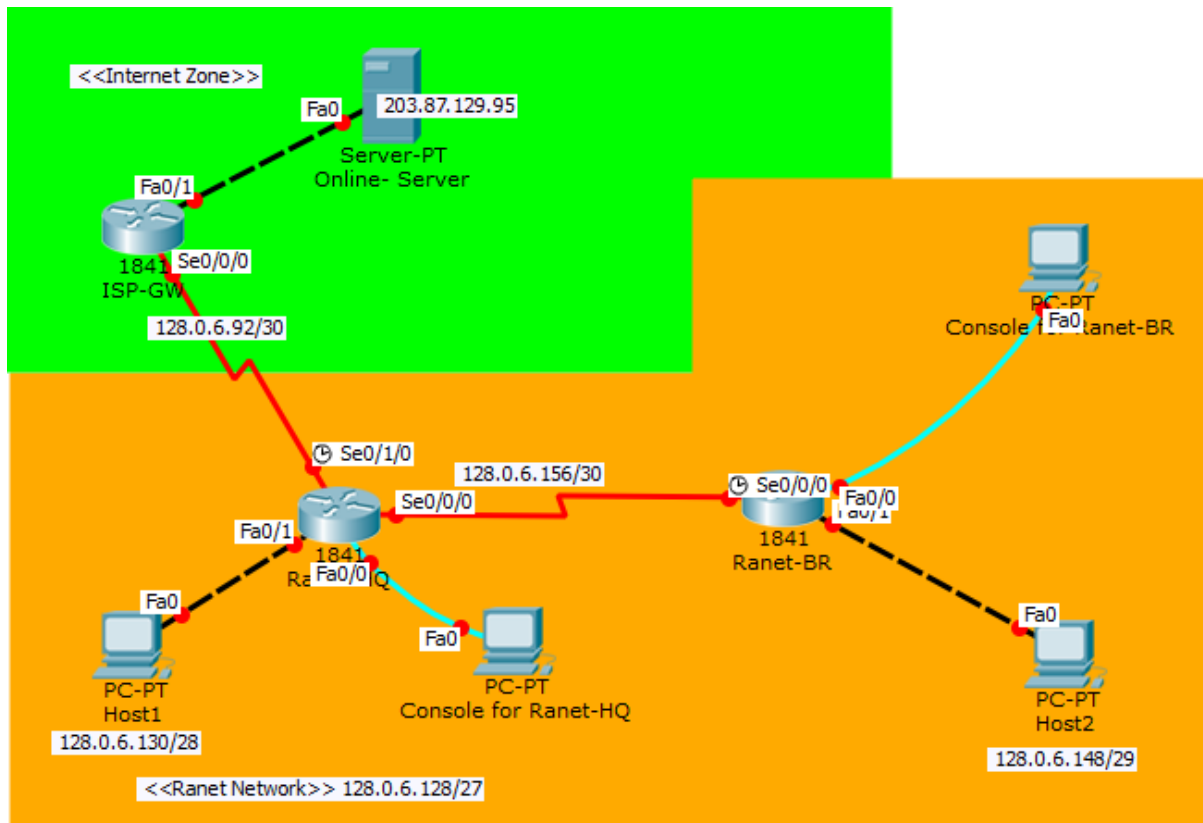*Int f0/0 và ip add*: để gán ip cho fastEthernet 0/0

Int s0/0/0 và ip add: để gán ip cho serial 0/0/0

No shutdown để bật interface

Show ip int brief: để show các ip interface

Router ospf 10: bật ospf

Lab: Basic OSPF Configuration Lab 2

Ranet-HQ config:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname Raner-HQ
Raner-HQ(config)#int fa0/0
Raner-HQ(config-if)#no shut

Raner-HQ(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

Raner-HQ(config-if)#ip add 128.0.6.142 255.255.255.240
Raner-HQ(config-if)#int s0/0/0
Raner-HQ(config-if)#no shut

%LINK-5-CHANGED: Interface Serial0/0/0, changed state to down
Raner-HQ(config-if)#ip add 128.0.6.157 255.255.255.252
Raner-HQ(config-if)#int s0/1/0
Raner-HQ(config-if)#no shut

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to down
Raner-HQ(config-if)#ip add 128.0.6.94 255.255.255.252
Raner-HQ(config-if)#exit
```

```
Raner-HQ(config)#int loopback 0

Raner-HQ(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

Raner-HQ(config-if)#ip add 1.1.0.1 255.255.255.0
Raner-HQ(config-if)#exit
Raner-HQ(config)#router ospf 1
Raner-HQ(config-router)#network 128.0.6.128 0.0.0.15 area 0
Raner-HQ(config-router)#network 128.0.6.156 0.0.0.3 area 0
Raner-HQ(config-router)#ex
Raner-HQ(config)#ip route 0.0.0.0 0.0.0.0 se0/1/0
Raner-HQ(config)#end
Raner-HQ#
%SYS-5-CONFIG_I: Configured from console by console

Raner-HQ#sh ip protocol

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.1.0.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    128.0.6.128 0.0.0.15 area 0
    128.0.6.156 0.0.0.3 area 0
  Routing Information Sources:
    Gateway          Distance      Last Update
    1.1.0.1               110        00:01:23
  Distance: (default is 110)
Raner-HQ#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
Raner-HQ#

Raner-HQ#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.0.0 is directly connected, Loopback0
Raner-HQ#
```

```
Raner-HQ#sh ip ospf
 Routing Process "ospf 1" with ID 1.1.0.1
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 External flood list length 0
    Area BACKBONE(0) (Inactive)
        Number of interfaces in this area is 0
        Area has no authentication
        SPF algorithm executed 2 times
        Area ranges are
        Number of LSA 1. Checksum Sum 0x0061fc
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
 --More-- |
```

Ranet-BR config:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname Ranet-BR
Ranet-BR(config)#int fa0/0
Ranet-BR(config-if)#ip add 128.0.6.150 255.255.255.248
Ranet-BR(config-if)#no shut

Ranet-BR(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

Ranet-BR(config-if)#int s0/0/0
Ranet-BR(config-if)#no sh

Ranet-BR(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

Ranet-BR(config-if)#clock
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

Ranet-BR(config-if)#int s0/0/0
Ranet-BR(config-if)#no sh

Ranet-BR(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

Ranet-BR(config-if)#clock
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

% Incomplete command.
Ranet-BR(config-if)#clock rate 6400
Unknown clock rate
Ranet-BR(config-if)#ip add 128.0.6.158 255.255.255.252
Ranet-BR(config-if)#ex
Ranet-BR(config)#int loopback 0

Ranet-BR(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
```

```
. ................. ..........
Ranet-BR(config-if)#clock rate 6400
Unknown clock rate
Ranet-BR(config-if)#ip add 128.0.6.158 255.255.255.252
Ranet-BR(config-if)#ex
Ranet-BR(config)#int loopback 0

Ranet-BR(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

Ranet-BR(config-if)#ip add 1.1.1.1 255.255.255.0
Ranet-BR(config-if)#ex
Ranet-BR(config)#router ospf 100
Ranet-BR(config-router)#network 128.0.6.144 0.0.0.7 area 0
Ranet-BR(config-router)#network 128.0.6.156 0.0.0.3 area 0
Ranet-BR(config-router)#ex
Ranet-BR(config)#ip route 0.0.0.0
00:05:35: %OSPF-5-ADJCHG: Process 100, Nbr 10.1.1.1 on Serial0/0/0 from LOADING to
FULL, Loading Done

Ranet-BR#sh ip protocol

Routing Protocol is "ospf 100"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.1.1.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    128.0.6.144 0.0.0.7 area 0
    128.0.6.156 0.0.0.3 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.1               110      00:00:33
    10.1.1.1             110      00:00:33
  Distance: (default is 110)

Ranet-BR#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     128.0.0.0/30 is subnetted, 1 subnets
C       128.0.6.156 is directly connected, Serial0/0/0
S*   0.0.0.0/0 is directly connected, Serial0/0/0
Ranet-BR#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
Ranet-BR#
```

```
Ranet-BR#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     128.0.0.0/30 is subnetted, 1 subnets
C       128.0.6.156 is directly connected, Serial0/0/0
S*   0.0.0.0/0 is directly connected, Serial0/0/0
Ranet-BR#
```

Host1 — □ ✕

| Physical | Config | Desktop | Custom Interface |

IP Configuration [X]

IP Configuration
○ DHCP   ◉ Static

IP Address	128.0.6.130
Subnet Mask	255.255.0.0
Default Gateway	1.1.0.1
DNS Server	

Host2 — □ ✕

| Physical | Config | Desktop | Custom Interface |

IP Configuration [X]

IP Configuration
○ DHCP   ◉ Static

IP Address	128.0.6.148
Subnet Mask	255.255.0.0
Default Gateway	1.1.1.1
DNS Server	

Giải thích dòng lệnh

En vào chế độ đặc quyền

Conf t: vào chế độ cấu hình

Hostname: cấu hình tên thiết bị

Các lệnh show dùng để kiểm tra cấu hình OSPF

- show ip protocol
- show ip route

- show ip ospf
- show ip ospf interface
- show ip ospf neighbor detail

Ip default-gateway: gán default-gateway

Int f0/0 và ip add: để gán ip cho fastEthernet 0/0

Int s0/0/0 và ip add: để gán ip cho serial 0/0/0

No shutdown để bật interface

Show ip int brief: để show các ip interface

Router ospf 10: bật ospf