# OSPF Config (Single Area)

In this lab, we'll go through the basic single-area OSPF configuration. OSPF area 0 consists of 4 routers, which we will configure so they form adjacencies with their neighbor router. You can follow along by downloading this OSPF Packet Tracer File and opening it in Cisco's Free Packet Tracer Simulator (*create a free account, enroll in one of the free courses and download the free software*).
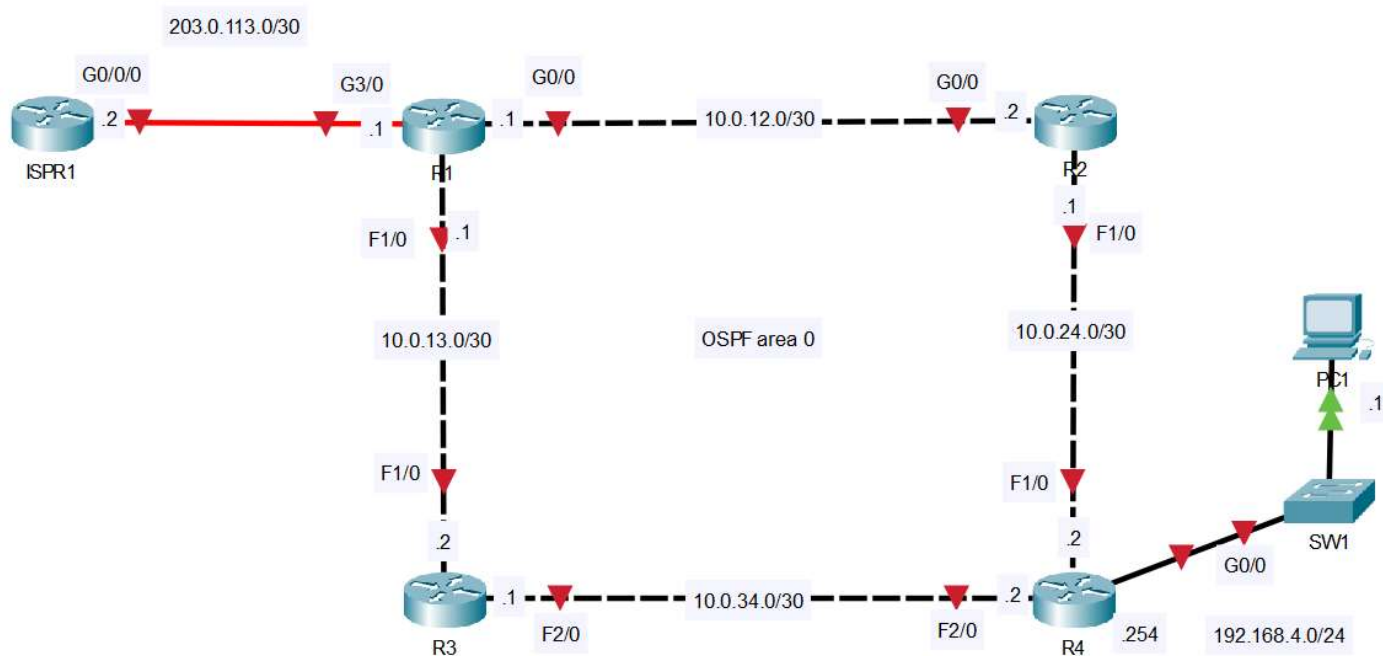
LAB STEPS:

1. Configure the appropriate hostnames and IP addresses on each device. Enable router interfaces. *(You don't have to configure ISPR1)*

Router1

```
Router>enable
Router#conf t
Router(config)#hostname R1

R1(config)#int g0/0
R1(config-if)#ip address 10.0.12.1 255.255.255.252
R1(config-if)#no shut

R1(config-if)#int f1/0
R1(config-if)#ip address 10.0.13.1 255.255.255.252
R1(config-if)#no shut

R1(config-if)#int g3/0
R1(config-if)#ip address 203.0.113.1 255.255.255.252
R1(config-if)#no shut
```

Router2

```
Router>enable
Router#conf t
Router(config)#hostname R2

R2(config)#int g0/0
R2(config-if)#ip address 10.0.12.2 255.255.255.252
R2(config-if)#no shut

R2(config-if)#int f1/0
R2(config-if)#ip address 10.0.24.1 255.255.255.252
R2(config-if)#no shut
```

Router3

Router>enable
Router#conf t
Router(config)#hostname R3

R3(config-if)#int f1/0
R3(config-if)#ip address 10.0.13.2 255.255.255.252
R3(config-if)#no shut

R3(config-if)#int f2/0
R3(config-if)#ip address 10.0.34.1 255.255.255.252
R3(config-if)#no shut

Router4

Router>enable
Router#conf t
Router(config)#hostname R4

R4(config)#int f1/0
R4(config-if)#ip address 10.0.24.2 255.255.255.252
R4(config-if)#no shut

R4(config-if)#int f2/0
R4(config-if)#ip address 10.0.34.2 255.255.255.252
R4(config-if)#no shut

R4(config-if)#int g0/0
R4(config-if)#ip address 192.168.4.254 255.255.255.0
R4(config-if)#no shut

Now all 4 routers within the OSPF area have new hostnames, ip addresses, and have been enabled via the *no shutdown* command. You can verify that your ip address have been properly configured and enabled by using the *show ip interface brief* command.

2. Configure a loopback interface on each router (1.1.1.1/32 for R1, 2.2.2.2/32 for R2, etc.)

A loopback is a virtual address and is always in an up/up state.
(below I'm creating the loopback interface using a lowercase L and a zero…not a ten)

Router1

R1(config)#int l0

%LINK-5-CHANGED: Interface Loopback0, changed state to up

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

R1(config-if)#ip address 1.1.1.1 255.255.255.255

R1(config-if)#do show ip int brief

Interface IP-Address OK? Method Status Protocol
GigabitEthernet0/0 10.0.12.1 YES manual up up
FastEthernet1/0 10.0.13.1 YES manual up up
FastEthernet2/0 unassigned YES unset administratively down down
GigabitEthernet3/0 203.0.113.1 YES manual up up
Loopback0 1.1.1.1 YES manual up up

Router2

R2(config)#int l0

%LINK-5-CHANGED: Interface Loopback0, changed state to up

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

R2(config-if)#ip address 2.2.2.2 255.255.255.255

Router3

R3(config)#int l0

%LINK-5-CHANGED: Interface Loopback0, changed state to up

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

R3(config-if)#ip address 3.3.3.3 255.255.255.255

Router4

R4(config)#int l0

%LINK-5-CHANGED: Interface Loopback0, changed state to up

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

R4(config-if)#ip address 4.4.4.4 255.255.255.255

Verify loopback in two ways:

R1(config-if)#do show ip interface brief   (doesn't show mask)
R1(config-if)#do show interface l0   (does show mask)

3. Configure OSPF on each router:
– Enable OSPF on each interface (including loopback interfaces).
– (Do not enable OSPF on R1's Internet link)
– Configure passive interfaces where appropriate (including loopback interfaces).

Router4

R4(config)#router ospf 4
R4(config-router)#network 0.0.0.0 255.255.255.255 area 0
R4(config-router)#passive-interface g0/0
R4(config-router)#passive-interface l0

The *router ospf 4* command above, enters OSPF mode and assigns an OSPF Process ID of 4.
The process id is only significant to the local router. Other routers do not care about it, so they do not have to be the same on other routers.

The *network 0.0.0.0 255.255.255.255 area 0* command activates OSPF on all interfaces at once. Remember: the *network* command uses a Wildcard Mask, so the 255.255.255.255 above is like a Subnet/Mask of 0.0.0.0

The two *passive-interface* cmds make interfaces g0/0 and the loopback l0 passive, (therefore not transmitting OSPF messages)

Router3

R3(config-if)#router ospf 3
R3(config-router)#network 10.0.13.2 0.0.0.0 area 0
R3(config-router)#network 10.0.34.1 0.0.0.0 area 0
R3(config-router)#net 3.3.3.3 0.0.0.0 area 0
R3(config-router)#passive-interface l0

This time, we activated OSPF on all 3 interfaces one by one. We also only needed to make the loopback interface passive because the other two interfaces need to transmit OSPF messages.

We'll do the exact same thing on Router 2.

Router2

R2(config-if)#router ospf 2
R2(config-router)#net 10.0.0.0 0.0.255.255 area 0
R2(config-router)#net 2.2.2.2 0.0.255.255 area 0
R2(config-router)#passive-interface l0

Router1

R1(config-if)#router ospf 1
R1(config-router)#net 10.0.12.0 0.0.0.3 area 0
R1(config-router)#net 10.0.13.0 0.0.0.3 area 0
R1(config-router)#net 1.1.1.1 0.0.0.0 area 0
R1(config-router)#passive-interface l0

Above we need to "**Enable OSPF on R1 (except on the Internet link)**".
Why not on the Internet Link? Because to advertise a Default Route to the other routers later, there's no need for the other routers to know about the Point-to-Point connection between ISPR1 and R1. Example: if R2 needs to reach a server over the internet, it only needs to know to send the traffic to R1. So only activate OSPF on R1s: g0/0, f1/0 and loopback interfaces.

4. Configure R1 as an ASBR that advertises a default route into the OSPF domain.

Router1

R1(config-router)#default-information originate
R1(config-router)#exit
R1(config)#ip route 0.0.0.0 0.0.0.0 203.0.113.2

VERIFY YOUR OSPF CONFIGURATION USING THESE *SHOW COMMANDS* FOR OSPF:

```
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 1.1.1.1
  It is an autonomous system boundary router
  Redistributing External Routes from,
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.0.12.0 0.0.0.3 area 0
    10.0.13.0 0.0.0.3 area 0
    1.1.1.0 0.0.0.3 area 0
  Passive Interface(s):
    Loopback0
  Routing Information Sources:
    Gateway          Distance      Last Update
    1.1.1.1               110      00:07:11
    2.2.2.2               110      00:09:29
    3.3.3.3               110      00:09:21
    4.4.4.4               110      00:07:18
  Distance: (default is 110)

R1#
```

show ip protocols

```
R1#show ip ospf ?
  <1-65535>        Process ID number
  border-routers   Border and Boundary Router Information
  database         Database summary
  interface        Interface information
  neighbor         Neighbor list
  virtual-links    Virtual link information
  <cr>
R1#show ip ospf database
             OSPF Router with ID (1.1.1.1) (Process ID 1)

                 Router Link States (Area 0)

Link ID          ADV Router       Age         Seq#        Checksum Link count
2.2.2.2          2.2.2.2          980         0x80000005 0x00ebcd 2
3.3.3.3          3.3.3.3          972         0x80000007 0x00c4b7 3
4.4.4.4          4.4.4.4          849         0x80000009 0x0001d7 4
1.1.1.1          1.1.1.1          842         0x80000006 0x00724e 3

                 Net Link States (Area 0)
Link ID          ADV Router       Age         Seq#        Checksum
10.0.34.2        4.4.4.4          1099        0x80000005 0x004e47
10.0.12.2        2.2.2.2          980         0x80000001 0x00972e
10.0.13.2        3.3.3.3          972         0x80000001 0x007748
10.0.24.2        4.4.4.4          849         0x80000006 0x00dacb

                 Type-5 AS External Link States
Link ID          ADV Router       Age         Seq#        Checksum Tag
0.0.0.0          1.1.1.1          814         0x80000001 0x00fecf 1
R1#
```

show ip ospf database

```
R1#show ip ospf neighbor


Neighbor ID     Pri   State        Dead Time   Address       Interface
2.2.2.2          1    FULL/DR      00:00:30    10.0.12.2     GigabitEthernet0/0
3.3.3.3          1    FULL/DR      00:00:38    10.0.13.2     FastEthernet1/0
R1#
```

show ip ospf neighbor

5. Check the routing tables of R2, R3, and R4. What default route(s) were added?

Router2

```
R2#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 10.0.12.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
O       1.1.1.1 [110/2] via 10.0.12.1, 00:21:36, GigabitEthernet0/0
     2.0.0.0/32 is subnetted, 1 subnets
C       2.2.2.2 is directly connected, Loopback0
     3.0.0.0/32 is subnetted, 1 subnets
O       3.3.3.3 [110/3] via 10.0.12.1, 00:21:46, GigabitEthernet0/0
                [110/3] via 10.0.24.2, 00:21:46, FastEthernet1/0
     4.0.0.0/32 is subnetted, 1 subnets
O       4.4.4.4 [110/2] via 10.0.24.2, 01:19:55, FastEthernet1/0
     10.0.0.0/30 is subnetted, 4 subnets
C       10.0.12.0 is directly connected, GigabitEthernet0/0
O       10.0.13.0 [110/2] via 10.0.12.1, 00:21:46, GigabitEthernet0/0
C       10.0.24.0 is directly connected, FastEthernet1/0
O       10.0.34.0 [110/2] via 10.0.24.2, 01:19:55, FastEthernet1/0
O    192.168.4.0/24 [110/2] via 10.0.24.2, 01:19:55, FastEthernet1/0
O*E2 0.0.0.0/0 [110/1] via 10.0.12.1, 00:19:11, GigabitEthernet0/0
```

Router3

```
R3#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 10.0.13.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
O       1.1.1.1 [110/2] via 10.0.13.1, 00:24:48, FastEthernet1/0
     3.0.0.0/32 is subnetted, 1 subnets
C       3.3.3.3 is directly connected, Loopback0
     4.0.0.0/32 is subnetted, 1 subnets
O       4.4.4.4 [110/2] via 10.0.34.2, 01:27:22, FastEthernet2/0
     10.0.0.0/30 is subnetted, 4 subnets
O       10.0.12.0 [110/2] via 10.0.13.1, 00:24:58, FastEthernet1/0
C       10.0.13.0 is directly connected, FastEthernet1/0
O       10.0.24.0 [110/2] via 10.0.34.2, 01:23:07, FastEthernet2/0
C       10.0.34.0 is directly connected, FastEthernet2/0
O    192.168.4.0/24 [110/2] via 10.0.34.2, 01:27:22, FastEthernet2/0
O*E2 0.0.0.0/0 [110/1] via 10.0.13.1, 00:22:23, FastEthernet1/0
```

Router4

```
R4#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 10.0.24.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
O       1.1.1.1 [110/3] via 10.0.24.1, 00:25:32, FastEthernet1/0
                [110/3] via 10.0.34.1, 00:25:32, FastEthernet2/0
     3.0.0.0/32 is subnetted, 1 subnets
O       3.3.3.3 [110/2] via 10.0.34.1, 01:27:45, FastEthernet2/0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
     10.0.0.0/30 is subnetted, 4 subnets
O       10.0.12.0 [110/2] via 10.0.24.1, 00:25:52, FastEthernet1/0
O       10.0.13.0 [110/2] via 10.0.34.1, 00:25:42, FastEthernet2/0
C       10.0.24.0 is directly connected, FastEthernet1/0
C       10.0.34.0 is directly connected, FastEthernet2/0
C    192.168.4.0/24 is directly connected, GigabitEthernet0/0    2 Default Routes
O*E2 0.0.0.0/0 [110/1] via 10.0.24.1, 00:23:07, FastEthernet1/0   that will Load
               [110/1] via 10.0.34.1, 00:23:07, FastEthernet2/0   Balance
```
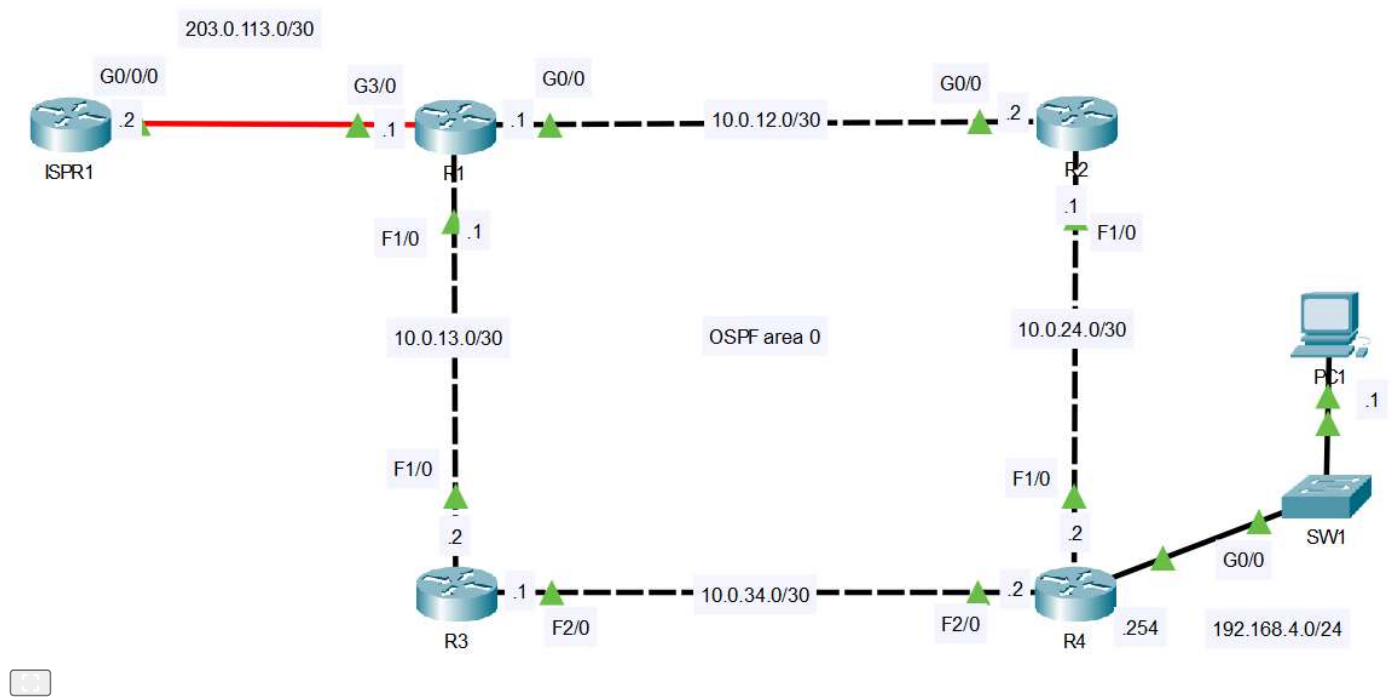
When we issue the show ip route command, we see a default route now in the routing table:

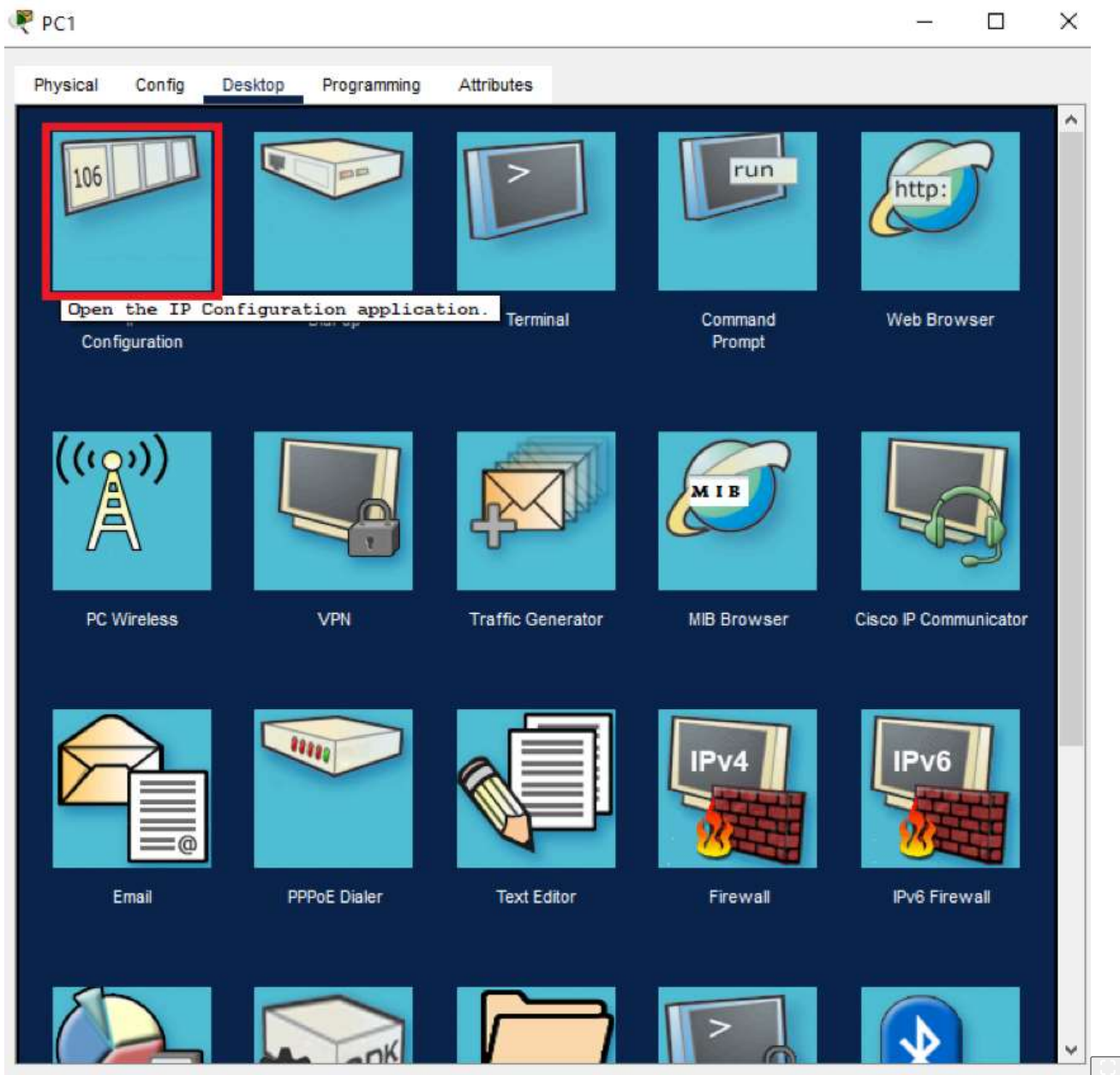O*E2 0.0.0.0/0 [110/1] via 10.0. 13.1, FastEthernet 1/0

These default routes are being advertised by Router 1 to all other routers in the OSPF area.

Notice R4's routing table has two default route entries and will be equally load-balanced between the two routes.

Now all devices should be able to communicate with each other. To verify this, let's give PC1 an IP address, a default gateway and try to communicate with the external router ISPR1:

203.0.113.0/30

G0/0/0   G3/0   G0/0   G0/0

.2   .1   .1   10.0.12.0/30   .2

ISPR1   R1   R2

F1/0   .1   .1   F1/0

10.0.13.0/30   OSPF area 0   10.0.24.0/30

PC1   .1

F1/0   F1/0

.2   .2   SW1

.1   10.0.34.0/30   .2   G0/0

R3   F2/0   F2/0   R4   .254   192.168.4.0/24

1. Go to PC1's Desktop tab and select Configuration.
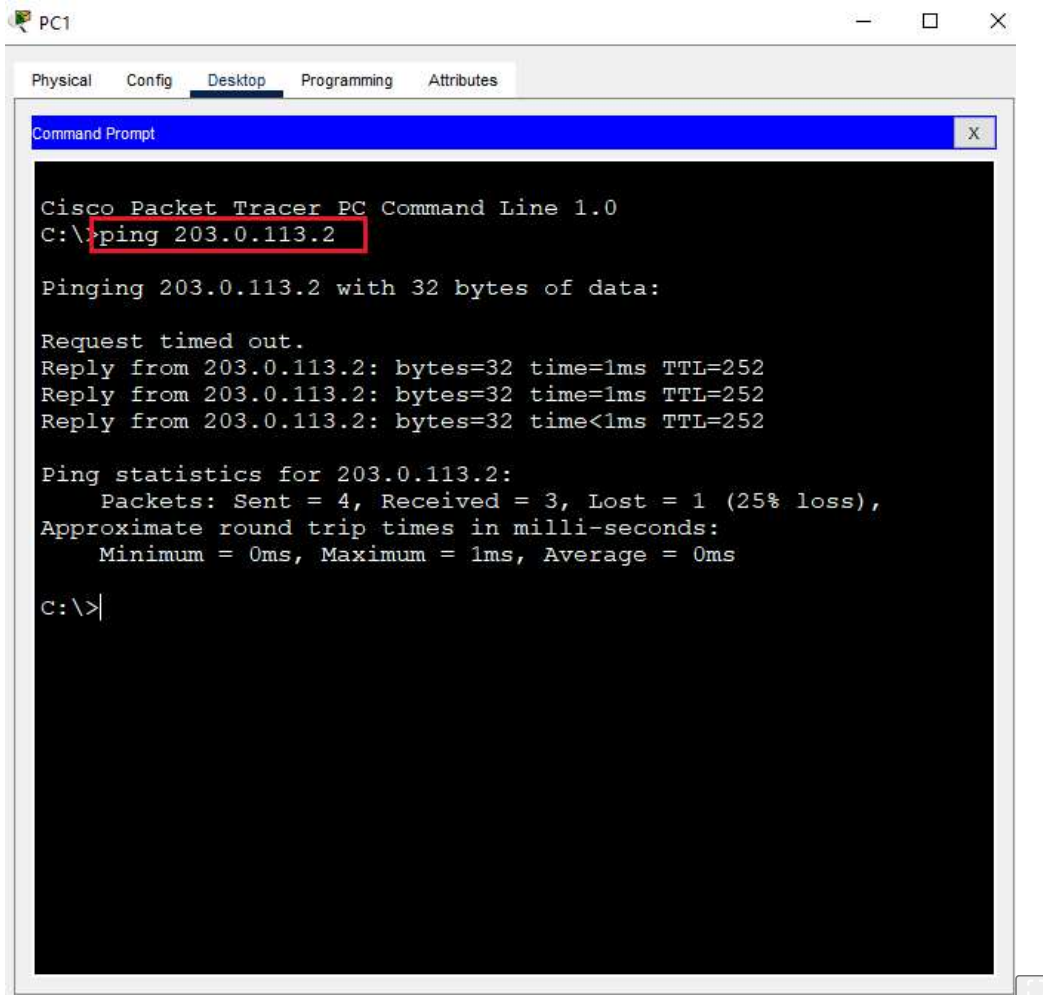
2. Enter *192.168.4.1* as the IPv4 address, *255.255.255.0* as the Subnet Mask, and R4's G0/0 interface *192.168.4.254* as a Default Gateway.

3. Open PC1's Command Prompt

```
PC1                                                    —   □   ✕

Physical   Config   Desktop   Programming   Attributes

Command Prompt                                                    X

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 203.0.113.2

Pinging 203.0.113.2 with 32 bytes of data:

Request timed out.
Reply from 203.0.113.2: bytes=32 time=1ms TTL=252
Reply from 203.0.113.2: bytes=32 time=1ms TTL=252
Reply from 203.0.113.2: bytes=32 time<1ms TTL=252

Ping statistics for 203.0.113.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

4. Enter *ping 203.0.113.2* in PC1's command prompt.