

S H A R I N G D E F A U L T R O U T E S

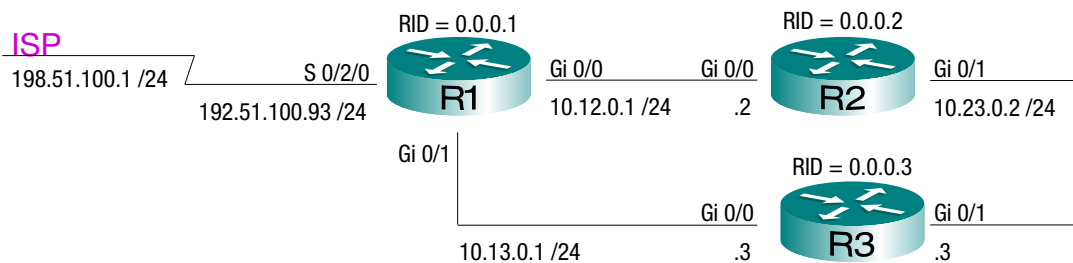
A default route can be statically defined on your edge router pointing to the internet [See also CCENT chap 18], ensuring that traffic to addresses that aren't part of your network leaves your network.

```
edge(config)# ip route 0.0.0.0 0.0.0.0 FastEthernet0/1 192.51.100.1
```

It's also possible for the edge router to learn the default route directly from the ISP through DHCP. Either way, only the edge router knows the default route. To get outbound traffic to the edge without a default static router on every router, you can ask OSPF to advertise the edge router's default route.

```
edge(config-router)# default-information originate [always]
```

Always tells OSPF to advertise the default even when the link is physically down.



```
1 R1# show ip route
2 Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
3         D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
4         N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
5         E1 - OSPF external type 1, E2 - OSPF external type 2
6         i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
7         ia - IS-IS inter area, * - candidate default, U - per-user static route
8         o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
9         + - replicated route, % - next hop override
```

```
10
11 Gateway of last resort is 198.51.100.1 to network 0.0.0.0
```

```
12
13 S*    0.0.0.0/0 [1/0] via 198.51.100.1, Serial0/2/0
```

On R1, the default gateway is simply a static default route

```
1 R2# show ip route ospf
```

Codes legend omitted

```
2
3 Gateway of last resort is 10.12.0.1 to network 0.0.0.0
```

```
4
5 O*E2  0.0.0.0/0 [110/1] via 10.12.0.1, 03:24:51, GigabitEthernet0/0
```

On R2 and R3, the default route is an OSPF route.

The E2 tells you that the route wasn't originally a directly connected network that OSPF discovered—it was originally a static route on R1 that we imported into OSPF

```
6
7
8 O    198.51.100.0/24 [110/1563] via 10.12.0.1, 00:03:10, GigabitEthernet0/0
```

On the other hand, the actual network used by the default gateway on R1 is a just a normal OSPF route

M E T R I C S

OSPF Cost = ReferenceBandwidth / InterfaceBandwidth

Reference Bandwidth—Defaults to 100 Mbps

Default Metrics—anything faster than fast Ethernet (100 Mb/s) will have the same metric. Notice that OSPF makes a guess about the speed based on the type of interface. You can override that choice with the "bandwidth" interface configuration (second bullet point below).

	SERIAL	ETHERNET	FAST ETHERNET	GIGABIT ETHERNET
Default BandWidth	1.544 Mb/s	10 Mb/s	100 Mb/s	1000 Mb/s
OSPF Cost	64	10	1	1

An interface's OSPF cost (metric) can be manually manipulated in three ways:

- Directly set the cost on an individual interface
- Manually set the bandwidth of an interface—useful when a 100 Mb/s Ethernet link actually leads to a much slower modem

```
R1(config-if)# bandwidth 64  
64 Kb/s (specified in kilobits)
```

- Change the reference bandwidth that OSPF uses for its calculations. This is helpful to differentiate the different interface speeds above 100 Mb/s. It is set per-router, but best practice is to make all routers in an area match. Cisco goes further, recommending that all routers in an enterprise match.

```
R1(config)# router ospf 3  
R1(config-router)# auto-cost reference-bandwidth ?  
<1-4294967> The reference bandwidth in terms of Mbits per second
```

```
R1(config-router)# auto-cost reference-bandwidth 1000  
% OSPF: Reference bandwidth is changed.  
Please ensure reference bandwidth is consistent across all routers.
```

L O A D B A L A N C I N G

When OSPF calculates more than one route to the same destination to have the same best cost, it will offer all of them to the routing table, up to the configured maximum (default 4 on any router model you're likely to use).

```
1 R1# show ip route ospf  
2 Codes legend omitted  
3  
4 Gateway of last resort is 198.51.100.1 to network 0.0.0.0  
5  
6 10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks  
7 O 10.23.0.0/24 [110/2] via 10.13.0.3, 00:42:56, GigabitEthernet0/1  
8 [110/2] via 10.12.0.2, 00:43:06, GigabitEthernet0/0
```

You can change and view the maximum number of equal-cost paths that are placed in the routing table as shown below (maximum 16). Notice that you need to use the command "show ip protocols" to see the current value, not "show ip ospf."

```
1 R1(config)# router ospf 3
2 R1(config-router)# maximum-paths 6
3 R1(config-router)# do show ip protocols
4 *** IP Routing is NSF aware ***
5
6 Routing Protocol is "ospf 3"
7   Outgoing update filter list for all interfaces is not set
8   Incoming update filter list for all interfaces is not set
9   Router ID 0.0.0.1
10  It is an autonomous system boundary router
11  Redistributing External Routes from,
12  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
13  Maximum path: 6
14  Routing for Networks:
15    10.0.0.0 0.255.255.255 area 0
16    198.51.100.0 0.0.0.255 area 0
17  Passive Interface(s):
18    Serial0/2/0
19  Routing Information Sources:
20    Gateway          Distance      Last Update
21    0.0.0.3           110          00:03:34
22  Distance: (default is 110)
```

DIRECTLY INVOLVING INTERFACES

In OSPF, it's actually possible to directly instruct individual interfaces to participate instead of indirectly involving them with a "network" statement.

```
1 R1(config)# interface gi0/0
2 R1(config-if)# ip ospf 3 area 0
```

The operation of OSPF is exactly the same, but some of the troubleshooting commands will show hints that you directly configured the interfaces instead of relying on network statements.

```
1 R1# show ip protocols
2 Routing Protocol is "ospf 3"
3   Router ID 0.0.0.1
4
5   Several lines omitted
6   Maximum path: 4
7   Routing for Networks:
8   Routing on Interfaces Configured Explicitly (Area 0):
9     GigabitEthernet0/1
10    GigabitEthernet0/0
11  Passive Interface(s):
12    Serial0/2/0
13
14  A few more lines were omitted.
```

When using network statements, it looks more like:

```
1   Maximum path: 4
2   Routing for Networks:
3     10.0.0.0 0.255.255.255 area 0
4     198.51.100.0 0.0.0.255 area 0
5   Passive Interface(s):
6     Serial0/2/0
```

This command output slightly changes too. With interface enabling:

```
1 R1# show ip ospf interface gi0/0
2 GigabitEthernet0/0 is up, line protocol is up
3   Internet Address 10.12.0.1/24, Area 0, Attached via Interface Enable
4   Process ID 3, Router ID 0.0.0.1, Network Type BROADCAST, Cost: 1
```

And with network statements:

```
1 R1# show ip ospf interface gi0/0
2 GigabitEthernet0/0 is up, line protocol is up
3   Internet Address 10.12.0.1/24, Area 0, Attached via Network Statement
4   Process ID 3, Router ID 0.0.0.1, Network Type BROADCAST, Cost: 1
```