Config

```
R1(config)#router ospf 10
R1(config-router)#router-id 0.0.0.1
```
Do router-id first, before relationships are formed using it
```
R3(config-router)#do clear ip ospf process
```
Necessary if change router-id after ospf already has relationships
```
R1(config-router)#network 10.12.0.0 0.0.0.3 area 0
R1(config-router)#network 10.13.0.0 0.0.0.255 area 0
```

Router# show ip ospf

Tells process number and router-id, which areas exist, and how many interfaces in each area.

```
R2(config-router)#do sho ip ospf
 Routing Process "ospf 3" with ID 0.0.0.2
 Start time: 00:23:49.368, Time elapsed: 00:22:27.224
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 Supports Link-local Signaling (LLS)
 Supports area transit capability
 It is an area border router
 Router is not originating router-LSAs with maximum metric
 Initial SPF schedule delay 5000 msecs
 Minimum hold time between two consecutive SPFs 10000 msecs
 Maximum wait time between two consecutive SPFs 10000 msecs
 Incremental-SPF disabled
 Minimum LSA interval 5 secs
 Minimum LSA arrival 1000 msecs
 LSA group pacing timer 240 secs
 Interface flood pacing timer 33 msecs
 Retransmission pacing timer 66 msecs
 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 2. 2 normal 0 stub 0 nssa
 Number of areas transit capable is 0
 External flood list length 0
    Area BACKBONE(0)
        Number of interfaces in this area is 2
        Area has no authentication
        SPF algorithm last executed 00:00:10.560 ago
        SPF algorithm executed 7 times
        Area ranges are
        Number of LSA 6. Checksum Sum 0x02B7F8
        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
    Area 1
        Number of interfaces in this area is 1
        Area has no authentication
        SPF algorithm last executed 00:00:10.564 ago
        SPF algorithm executed 2 times
        Area ranges are
        Number of LSA 6. Checksum Sum 0x046598
        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
```

Router# show ip ospf interface [brief]

Tells area for each interface, interface costs, and whether the (self) router is a DR or BDR on that link (or just p2p).

```
R2# sho ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Fa0/1        3     0               10.23.0.2/24       1     DR    1/1
Se0/0        3     0               10.12.0.2/30       1562  P2P   1/1
Fa0/0        3     1               10.25.0.2/24       1     BDR   1/1

R2# sho ip ospf interface
FastEthernet0/1 is up, line protocol is up
  Internet Address 10.23.0.2/24, Area 0
  Process ID 3, Router ID 0.0.0.2, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 0.0.0.2, Interface address 10.23.0.2
  Backup Designated router (ID) 0.0.0.3, Interface address 10.23.0.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:07
  Supports Link-local Signaling (LLS)
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 0.0.0.3  (Backup Designated Router)
  Suppress hello for 0 neighbor(s)
Serial0/0 is up, line protocol is up
  Internet Address 10.12.0.2/30, Area 0
  Process ID 3, Router ID 0.0.0.2, Network Type POINT_TO_POINT, Cost: 1562
  Transmit Delay is 1 sec, State POINT_TO_POINT
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 0.0.0.1
  Suppress hello for 0 neighbor(s)
FastEthernet0/0 is up, line protocol is up
  Internet Address 10.25.0.2/24, Area 1
  Process ID 3, Router ID 0.0.0.2, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 0.0.0.5, Interface address 10.25.0.5
  Backup Designated router (ID) 0.0.0.2, Interface address 10.25.0.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:08
  Supports Link-local Signaling (LLS)
  Index 1/3, 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 0.0.0.5  (Designated Router)
  Suppress hello for 0 neighbor(s)
```

Router# show ip ospf interface fa0/1

Tells own interface address, who the DR & BDR are for the link (may be self), using router-id and the interface address on that router. If we happen to be DR or BDR, it will tell us in the "State" field.

```
R2# show ip ospf interface fa0/1
FastEthernet0/1 is up, line protocol is up
  Internet Address 10.23.0.2/24, Area 0
  Process ID 3, Router ID 0.0.0.2, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 0.0.0.2, Interface address 10.23.0.2
  Backup Designated router (ID) 0.0.0.3, Interface address 10.23.0.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:03
  Supports Link-local Signaling (LLS)
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 0.0.0.3  (Backup Designated Router)
  Suppress hello for 0 neighbor(s)

R3# show ip ospf interf fa0/1
FastEthernet0/1 is up, line protocol is up
  Internet Address 10.23.0.3/24, Area 0
  Process ID 3, Router ID 0.0.0.3, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 0.0.0.2, Interface address 10.23.0.2
  Backup Designated router (ID) 0.0.0.3, Interface address 10.23.0.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:03
  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 0.0.0.2  (Designated Router)
  Suppress hello for 0 neighbor(s)
```

Router# show ip ospf neighbor

This is about ourselves. Serial lines will show "FULL/ -" because they don't have DRs and BDRs.

```
R3# sho ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
0.0.0.2           1   2WAY/DROTHER    00:00:36    10.23.0.2       FastEthernet0/1
0.0.0.1           1   2WAY/DROTHER    00:00:38    10.13.0.1       FastEthernet0/0
R3#
*Mar  1 00:29:10.555: %OSPF-5-ADJCHG: Process 3, Nbr 0.0.0.2 on FastEthernet0/1
from LOADING to FULL, Loading Done
*Mar  1 00:29:10.555: %OSPF-5-ADJCHG: Process 3, Nbr 0.0.0.1 on FastEthernet0/0
from LOADING to FULL, Loading Done
R3# sho ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
0.0.0.2           1   FULL/DR         00:00:38    10.23.0.2       FastEthernet0/1
0.0.0.1           1   FULL/DR         00:00:36    10.13.0.1       FastEthernet0/0
```

Router# show ip ospf database

Each of the three sections will repeat for each area on an ABR (Area Border Router). R1 is in area 0. The summary records, 10.5.0.0 and 10.25.0.0 in the third section, represent networks (where a DR is elected) in a different area, area 1. Note that R1 is not the ABR—the database matches on all routers in area 0. The ABR has a separate database for area 1 and it's show command would repeat the three sections for twice, once for area 0 and once for 1.

```
R1#sho ip ospf database

            OSPF Router with ID (0.0.0.1) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
0.0.0.1         0.0.0.1         1698        0x8000000B 0x0059F5 4
0.0.0.2         0.0.0.2         1905        0x8000000C 0x0040F3 4
0.0.0.3         0.0.0.3         1552        0x8000000B 0x00325E 2

                Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
10.13.0.1       0.0.0.1         1698        0x80000008 0x00967F
10.23.0.2       0.0.0.2         1905        0x80000008 0x0018F0

                Summary Net Link States (Area 0)
```

External Summaries from area 1

```
Link ID         ADV Router      Age         Seq#       Checksum
10.5.0.1        0.0.0.2         380         0x80000005 0x00C064
10.25.0.0       0.0.0.2         379         0x80000005 0x00CF43
```

Router# show ip route

IA routes are external to our ospf area 0. Note that 10.25.0.0 is considered external (area 1), even though one end of it is on the ABR. An interface can only be in one area, so if we make the mistake of declaring that interface to be area 0 on the ABR and 1 on the other end, we'll lose the ABR-ness of that router along with the inter-area (area 1) routes like 10.5.0.1/24 on the area 0 end.

```
R1# sho ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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, 5 subnets, 3 masks
C       10.12.0.0/30 is directly connected, Serial0/0
C       10.13.0.0/24 is directly connected, FastEthernet0/0
O IA    10.5.0.1/32 [110/4] via 10.13.0.3, 00:00:03, FastEthernet0/0
O IA    10.25.0.0/24 [110/3] via 10.13.0.3, 01:00:25, FastEthernet0/0
O       10.23.0.0/24 [110/2] via 10.13.0.3, 01:00:25, FastEthernet0/0
```

Load Balancing

Equal-cost only. A router might choose to load-balance per-packet or per-destination IP address, depending on the router.

```
R2(config-router)#maximum-paths 6
```

Default is 4.

Setting Interface Costs

Note: This will affect costs in ONE direction only. The route cost is the sum of outgoing interface costs

```
R3(config)#interf fa0/0
R3(config-if)#ip ospf cost 5
```

You can also set the bandwidth and allow the calculations to happen normally.

```
R3(config-if)#no ip ospf cost 5
R3(config-if)#bandwidth 10000
                        ^^^^^  This is in 1000s of bps, i.e.10 megabits per second.  Cost will be 10 (100 mbps / bw )
R2(config-router)#auto-cost reference-bandwidth 100     Change the numerator (100 IS the default)
```