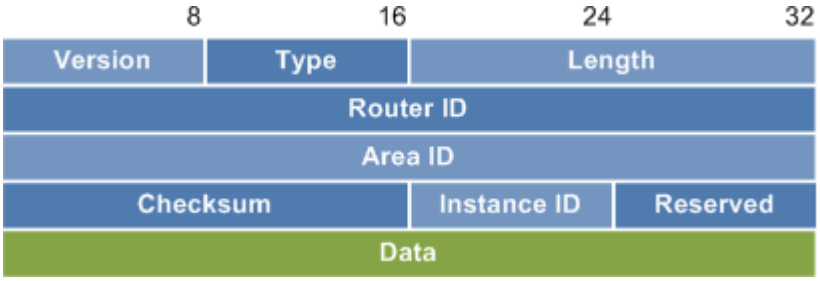
OSPF · Part 1

Protocol Header



Metric Formula

$$\text{cost} = \frac{100{,}000{,}000\text{bps}^*}{\textit{link speed}}$$

* modifiable with 'ospf auto-cost reference-bandwidth'

Link State Advertisements

Type 1	**Router Link** · Lists a router's neighbors and its cost to each; flooded throughout an area
Type 2	**Network Link** · Generated by a DR; lists all routers on an adjacent segment; flooded throughout an area
Type 3	**Network Summary** · Generated by an ABR and sent between areas; point of summarization
Type 4	**ASBR Summary** · Injected by an ABR into the backbone to advertise the presence of an ASBR
Type 5	**External Link** · Generated by an ASBR and flooded throughout the AS to advertise a route external to OSPF
Type 7	**NSSA External Link** · Generated by an ASBR in a not-so-stubby area; converted into a type 5 LSA by the ABR

DR/BDR Election

· The DR serves as a common point for all adjacencies on a multiaccess segment

· The BDR also maintains adjacencies with all routers in case the DR fails

· Election does not occur on point-to-point or multipoint links

· Default priority (0-255) is 1; highest priority wins; 0 cannot be elected

· DR preemption will not occur unless the current DR is reset

Virtual Links

· Tunnel formed to join two areas across an intermediate

· Both end routers must share a common area

· At least one end must reside in area 0

· Cannot traverse stub areas

· Temporary solution; not considered best practice

Troubleshooting

`show ip route`	`show ip ospf border-routers`
`show ip protocols`	`show ip ospf virtual-links`
`show ip ospf interface`	`debug ip packet`
`show ip ospf neighbor`	`debug ip ospf events`
`show ip ospf database`	`debug ip ospf adjacency`

Attributes

Type	Link-State
Algorithm	Dijkstra
Metric	Cost (Bandwidth)
AD	110
Standard	RFC 2328, 2740
Protocols	IP
Transport	IP 89
Authentication	Plaintext, MD5
AllSPF Address	224.0.0.5
AllDR Address	224.0.0.6

Adjacency States

1	Down	**4**	Exstart
2	Attempt	**5**	Exchange
3	Init	**6**	Loading
4	2-Way	**8**	Full

Router Types

Internal Router · All interfaces reside within the same area

Backbone Router · A router with an interface in area 0 (the backbone)

Area Border Router (ABR) · Connects two or more areas

AS Boundary Router (ASBR) · Connects to additional routing domains; typically located in the backbone

Area Types

Standard Area · Default OSPF area type

Stub Area · External summary route (type 5) LSAs are replaced by the ABR with a default route

Totally Stubby Area · A stub area which also replaces summary (type 3 and 4) LSAs with a default route

Not So Stubby Area (NSSA) · A stubby area containing an ASBR; type 5 LSAs are converted to type 7 within the area

External Route Types

E1 · Cost of the path to the originating ASBR is added to the route cost

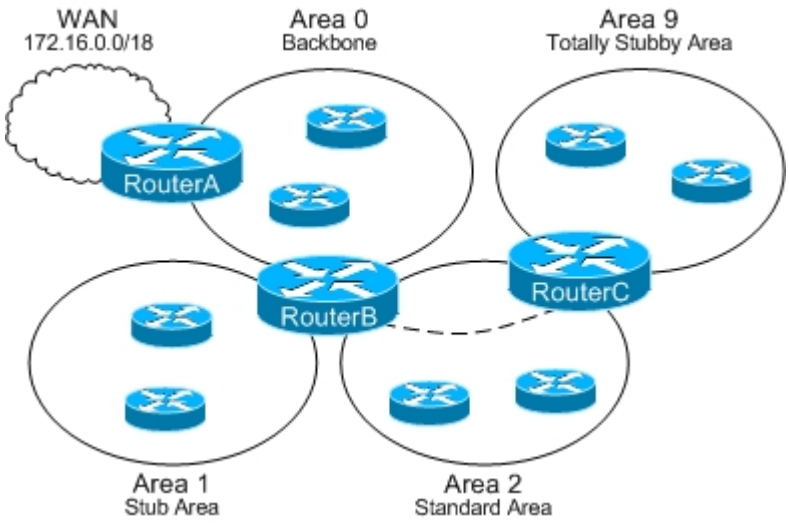
E2 (default) · Only the cost of the route as seen by the ASBR is considered

OSPF · Part 2

Network Types

	Nonbroadcast (NBMA)	Multipoint Broadcast	Multipoint Nonbroadcast	Broadcast	Point-to-Point
DR/BDR Eelected	Yes	No	No	Yes	No
Neighbor Discovery	No	Yes	No	Yes	Yes
Hello/Dead Timers	30/120	30/120	30/120	10/40	10/40
Standard	RFC 2328	RFC 2328	Cisco	Cisco	Cisco
Supported Topology	Full Mesh	Any	Any	Full Mesh	Point-to-Point

Configuration Example



RouterA

```
interface Serial0/0
 description WAN Link
 ip address 172.16.34.2 255.255.255.252
!
interface FastEthernet0/0
 description Area 0
 ip address 192.168.0.1 255.255.255.0
!
interface Loopback0
! Used as router ID
 ip address 10.0.34.1 255.255.255.0
!
router ospf 100
! Advertising the WAN cloud to OSPF
 redistribute static subnets
 network 192.168.0.0 0.0.0.255 area 0
!
! Static route to the WAN cloud
ip route 172.16.0.0 255.255.192.0 172.16.34.1
```

RouterB

```
interface Ethernet0/0
 description Area 0
 ip address 192.168.0.2 255.255.255.0
!
interface Ethernet0/1
 description Area 2
 ip address 192.168.2.1 255.255.255.0
! Optional MD5 authentication configured
 ip ospf authentication message-digest
 ip ospf message-digest-key 1 md5 FooBar
! Give RouterB priority in DR election
 ip ospf priority 100
!
interface Ethernet0/2
 description Area 1
 ip address 192.168.1.1 255.255.255.0
!
interface Loopback0
 ip address 10.0.34.2 255.255.255.0
!
router ospf 100
! Define area 1 as a stub area
 area 1 stub
! Virtual link from area 0 to area 9
 area 2 virtual-link 10.0.34.3
 network 192.168.0.0 0.0.0.255 area 0
 network 192.168.1.0 0.0.0.255 area 1
 network 192.168.2.0 0.0.0.255 area 2
```

RouterC

```
interface Ethernet0/0
 description Area 9
 ip address 192.168.9.1 255.255.255.0
!
interface Ethernet0/1
 description Area 2
 ip address 192.168.2.2 255.255.255.0
! Optional MD5 authentication configured
 ip ospf authentication message-digest
 ip ospf message-digest-key 1 md5 FooBar
! Give RouterC second priority (BDR) in election
 ip ospf priority 50
!
!
!
!
!
interface Loopback0
 ip address 10.0.34.3 255.255.255.0
!
router ospf 100
! Define area 9 as a totally stubby area
 area 9 stub no-summary
! Virtual link from area 9 to area 0
 area 2 virtual-link 10.0.34.2
 network 192.168.2.0 0.0.0.255 area 2
 network 192.168.9.0 0.0.0.255 area 9
!
```