

| Protocol Header | | | |
|-----------------|------|-------------|----------|
| 8 | 16 | 24 | 32 |
| Version | Type | Length | |
| Router ID | | | |
| Area ID | | | |
| Checksum | | Instance ID | Reserved |
| Data | | | |

| 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 |

Link State Advertisements

Router Link (Type 1)
Lists neighboring routers and the cost to each; flooded within an area

Network Link (Type 2)
Generated by a DR; lists all routers on an adjacent segment; flooded within an area

Network Summary (Type 3)
Generated by an ABR and advertised among areas

ASBR Summary (Type 4)
Injected by an ABR into the backbone to advertise the presence of an ASBR within an area

External Link (Type 5)
Generated by an ASBR and flooded throughout the AS to advertise a route external to OSPF

NSSA External Link (Type 7)
Generated by an ASBR in a not-so-stubby area; converted into a type 5 LSA by the ABR when leaving the area

Metric Formula

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

* modifiable with
ospf auto-cost reference-bandwidth

| Adjacency States | |
|------------------|-------------------|
| 1 Down | 5 Exstart |
| 2 Attempt | 6 Exchange |
| 3 Init | 7 Loading |
| 4 2-Way | 8 Full |

| Router Types | Area Types |
|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Internal Router All interfaces reside within the same area | Standard Area Default OSPF area type |
| Backbone Router A router with an interface in area 0 (the backbone) | Stub Area External link (type 5) LSAs are replaced with a default route |
| Area Border Router (ABR) Connects two or more areas | Totally Stubby Area Type 3, 4, and 5 LSAs are replaced with a default route |
| AS Boundary Router (ASBR) Connects to additional routing domains; typically located in the backbone | Not So Stubby Area (NSSA) A stub area containing an ASBR; type 5 LSAs are converted to type 7 within the area |

| DR/BDR Election |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> 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 |

External Route Types

E1 · Cost to the advertising ASBR plus the external cost of the route

E2 (Default) · Cost of the route as seen by the ASBR

Virtual Links

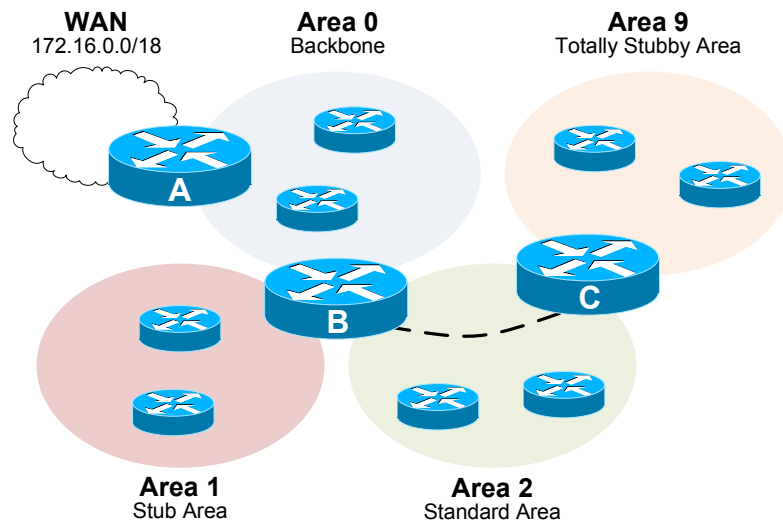
- Tunnel formed to join two areas across an intermediate
- Both end routers must share a common area
- At least one end must reside in area 0
- Cannot traverse stub areas

| Troubleshooting | |
|-----------------------------|-----------------------------|
| show ip [route protocols] | show ip ospf border-routers |
| show ip ospf interface | show ip ospf virtual-links |
| show ip ospf neighbor | debug ip ospf [...] |

Network Types

| | Nonbroadcast (NBMA) | Multipoint Broadcast | Multipoint Nonbroadcast | Broadcast | Point-to-Point |
|---------------------------|---------------------|----------------------|-------------------------|-----------|----------------|
| DR/BDR Elected | 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 |
| Defined By | RFC 2328 | RFC 2328 | Cisco | Cisco | Cisco |
| Supported Topology | Full Mesh | Any | Any | Full Mesh | Point-to-Point |

Configuration Example



Router A

```

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
  
```

Router B

```

interface Ethernet0/0
  description Area 0
  ip address 192.168.0.2 255.255.255.0
  ip ospf 100 area 0
!
interface Ethernet0/1
  description Area 2
  ip address 192.168.2.1 255.255.255.0
  ip ospf 100 area 2
  ! Optional MD5 authentication configured
  ip ospf authentication message-digest
  ip ospf message-digest-key 1 md5 FooBar
  ! Give B priority in DR election
  ip ospf priority 100
!
interface Ethernet0/2
  description Area 1
  ip address 192.168.1.1 255.255.255.0
  ip ospf 100 area 1
!
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
  
```

Router C

```

interface Ethernet0/0
  description Area 9
  ip address 192.168.9.1 255.255.255.0
  ip ospf 100 area 9
!
interface Ethernet0/1
  description Area 2
  ip address 192.168.2.2 255.255.255.0
  ip ospf 100 area 2
  ! Optional MD5 authentication configured
  ip ospf authentication message-digest
  ip ospf message-digest-key 1 md5 FooBar
  ! Give C 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
  
```