

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

### Metric Formula

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

\* 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** · Generated by an ASBR to advertise its presence; passed between areas
  - 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

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

### Adjacency States

<b>1</b>	Down	<b>4</b>	Exstart
<b>2</b>	Attempt	<b>5</b>	Exchange
<b>3</b>	Init	<b>6</b>	Loading
<b>4</b>	2-Way	<b>8</b>	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

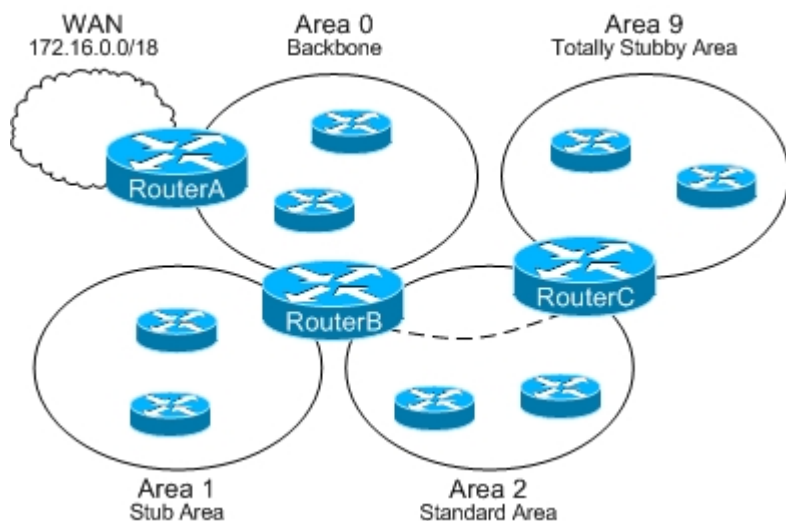
- ### Area Types
- Standard Area** · Default OSPF area type
  - Stub Area** · External summary route (type 5) LSAs are replaced by the ABR with a default route
  - Totally Stubby Area** · A stub area which also replaces summary (type 3 and 4) LSAs with a default route
  - Not So Stubby Area (NSSA)** · 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

## Network Types

	Nonbroadcast (NBMA)	Multipoint Broadcast	Multipoint Nonbroadcast	Broadcast	Point-to-Point
<b>DR/BDR Elected</b>	Yes	No	No	Yes	No
<b>Neighbor Discovery</b>	No	Yes	No	Yes	Yes
<b>Hello/Dead Timers</b>	30/120	30/120	30/120	10/40	10/40
<b>Standard</b>	RFC 2328	RFC 2328	Cisco	Cisco	Cisco
<b>Supported Topology</b>	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
!
```