

# OSPF

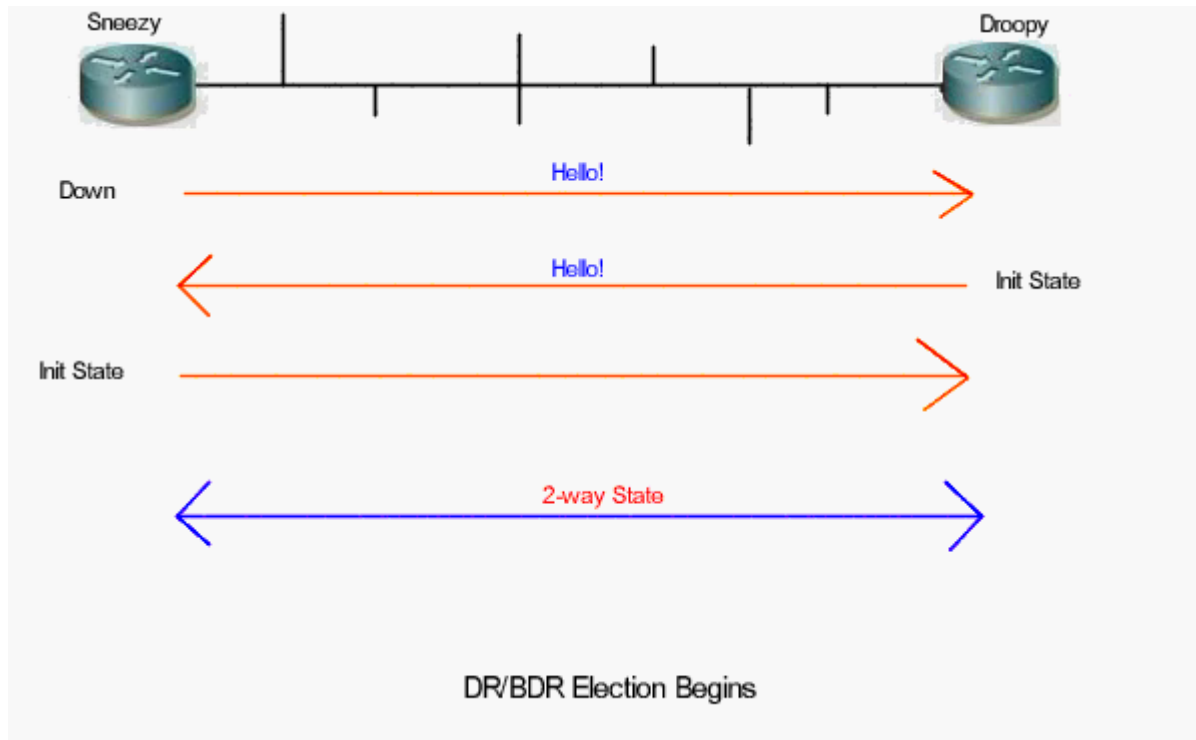
## LINK-STATE ROUTING PROTOCOLS

- TWO TYPES:
  - IS-IS
  - OSPF
- MAINTAIN THREE TABLES:
  - NEIGHBOR TABLE
  - TOPOLOGY TABLE
  - ROUTING TABLE
- USE DIJKSTRA'S SHORTEST PATH FIRST (SPF) ALGORITHM
- SEND TRIGGERED UPDATES TO ANNOUNCE NETWORK CHANGES
- SEND PERIODIC UPDATES (LS REFRESH) ON LONG INTERVALS

## TECHNICAL OVERVIEW OF OSPF

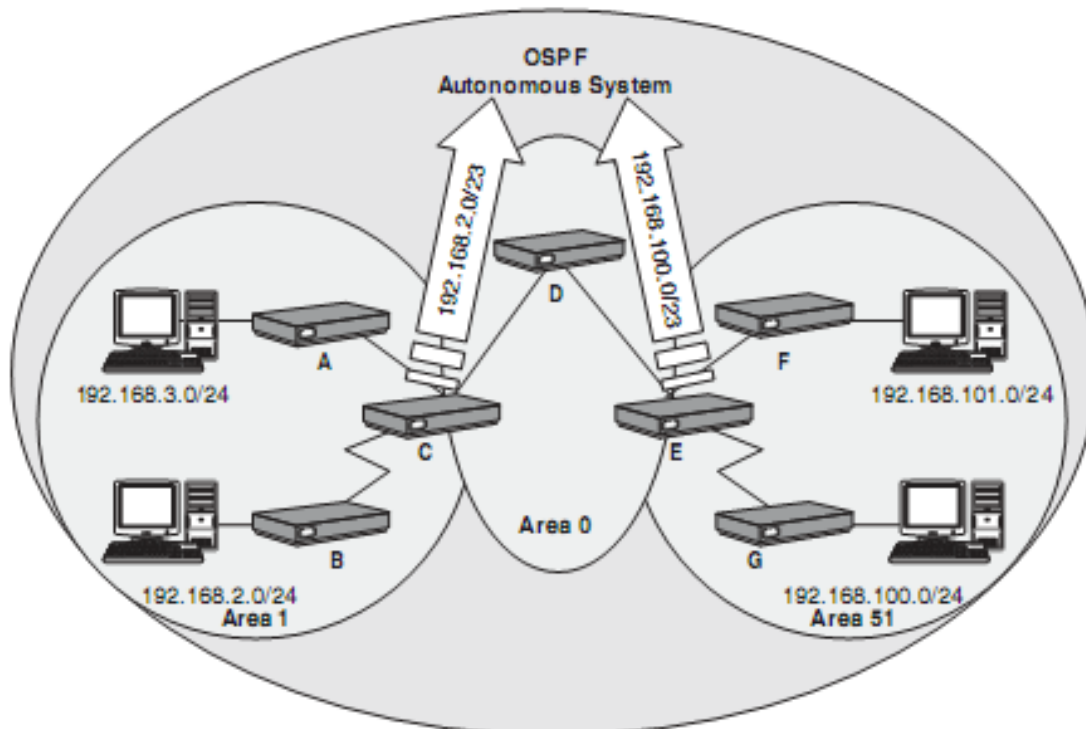
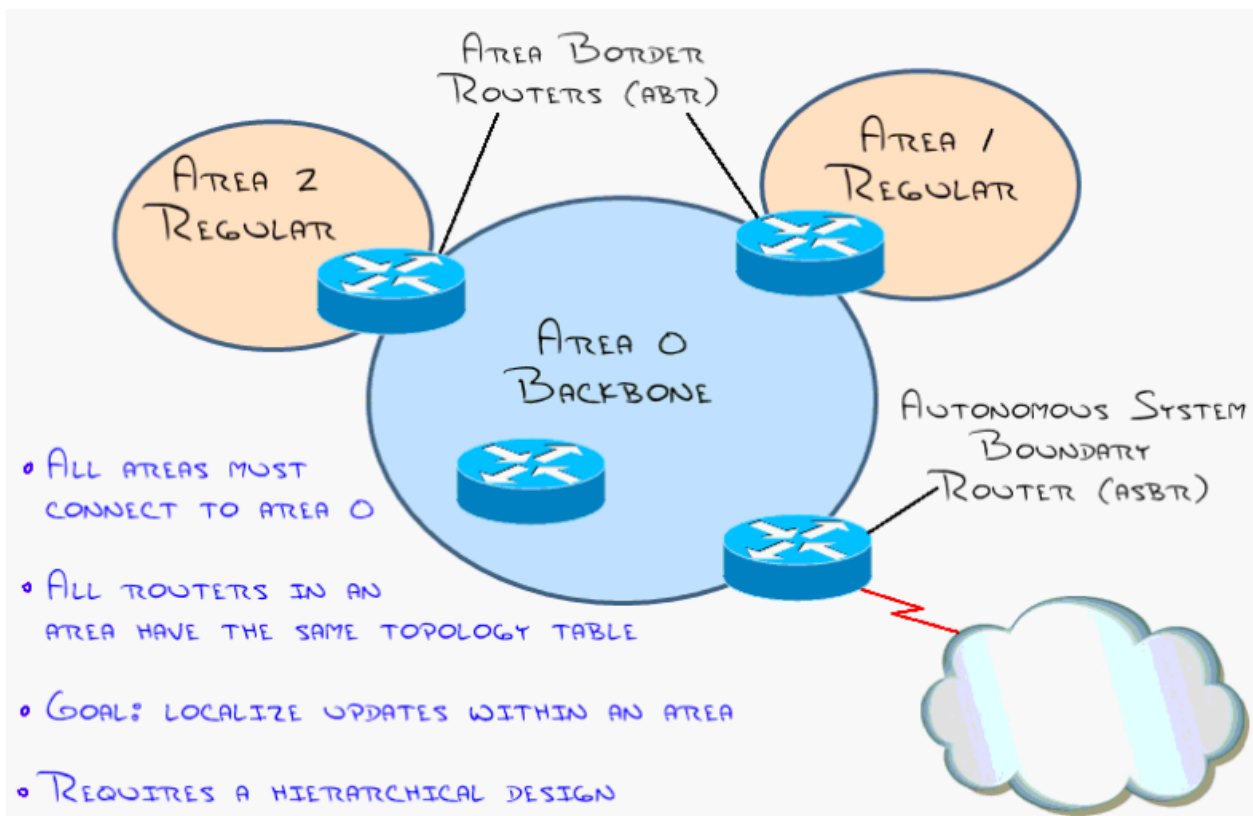
(ROUTER STARTUP PROCESS)

- ① OSPF SENDS HELLO PACKET TO 224.0.0.5 (ALL OSPF ROUTERS)
- ② NEIGHBOR EVALUATES PACKET, MAY OR MAY NOT FORM NEIGHBOR
- ③ LINK-STATE DATA EXCHANGED (LSDB)
- ④ NEW INFO. RECORDED AND FLOODED
- ⑤ WHEN DATABASE COMPLETE, SPF ALGORITHM RUNS
- ⑥ VALID ROUTES ENTER THE ROUTING TABLE



**Table 9-2** *OSPF Neighbor States and Their Meanings*

Neighbor State	Meaning
Down	A known neighbor is no longer reachable, often because of an underlying interface failure.
Init	An interim state in which a Hello has been heard from the neighbor, but that Hello does not list the router's RID as having been seen yet.
Two-way	The neighbor has sent a Hello that lists the local router's RID in the list of seen routers, also implying that neighbor verification checks all passed.
Full	Both routers know the exact same LSDB details and are fully adjacent.





HELLO MESSAGES SENT ON CHOSEN INTERFACES

ONCE EVERY 10 SECONDS ON BROADCAST/P-2-P NETWORKS  
ONCE EVERY 30 SECONDS ON NBMA NETWORKS

\* = MUST MATCH

CONTAINS ALL SORTS OF INFORMATION:

ROUTER ID

NEIGHBORS\*

HELLO AND DEAD TIMERS (\*)

ROUTER PRIORITY

NETWORK MASK\*

DR / BDR IP ADDRESS

AREA ID\*

AUTHENTICATION PASSWORD\*

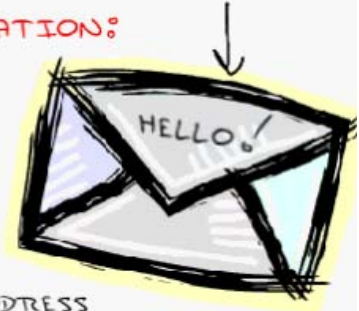
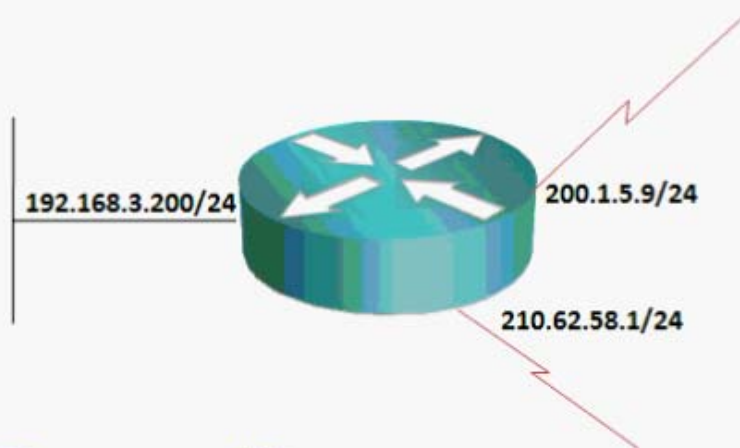


Table 9-3 OSPF Design Terminology

Term	Description
Area Border Router (ABR)	An OSPF router with interfaces connected to the backbone area and to at least one other area.
Autonomous System Border Router (ASBR)	An OSPF router that connects to routers that do not use OSPF for the purpose of exchanging external routes into and out of the OSPF domain.
Backbone router	A router in one area, the backbone area.
Internal router	A router in a single nonbackbone area.
Area	A set of routers and links that share the same detailed LSDB information, but not with routers in other areas, for better efficiency.
Backbone area	A special OSPF area to which all other areas must connect. Area 0.



## THE OSPF ROUTER ID:

- IDENTIFIES THE ROUTER TO OSPF NEIGHBORS
- HIGHEST PHYSICAL INTERFACE AT STARTUP
- LOOPBACK INTERFACES BEAT PHYSICAL
- NEW ROUTER-ID COMMAND BEATS ALL

## OSPF Metrics

When OSPF routers run the Dijkstra algorithm to calculate the best route to reach destination subnets, they use the lowest cumulative cost to reach that network. The path cost is calculated by taking  $10^8$  divided by the bandwidth in bps. Table 12.1 lists some of the common path costs associated with their respective bandwidths.

**TABLE 12.1 Cost Values Based on Bandwidth**

Bandwidth	OSPF Cost
56kbps	1785
64kbps	1562
T1 (1.544Mbps)	64
E1 (2.048Mbps)	48
Ethernet (10Mbps)	10
Fast Ethernet (100Mbps)	1
Gigabit Ethernet (1000Mbps)	1

## OSPF NETWORK TYPES

### ◦ BROADCAST, MULTI-ACCESS NETWORKS

- EXAMPLE: ETHERNET, TOKEN RING
- SINGLE OPERATION MODE
- DR/BDR ELECTION, 10 SEC. HELLOS, DUAL MULTICAST ADD.

### ◦ POINT-TO-POINT NETWORKS

- EXAMPLE: T1 CAS, ISDN BRI/PRI
- SINGLE OPERATION MODE
- NO DR/BDR, 10 SEC. HELLOS, SINGLE MULTICAST ADD.

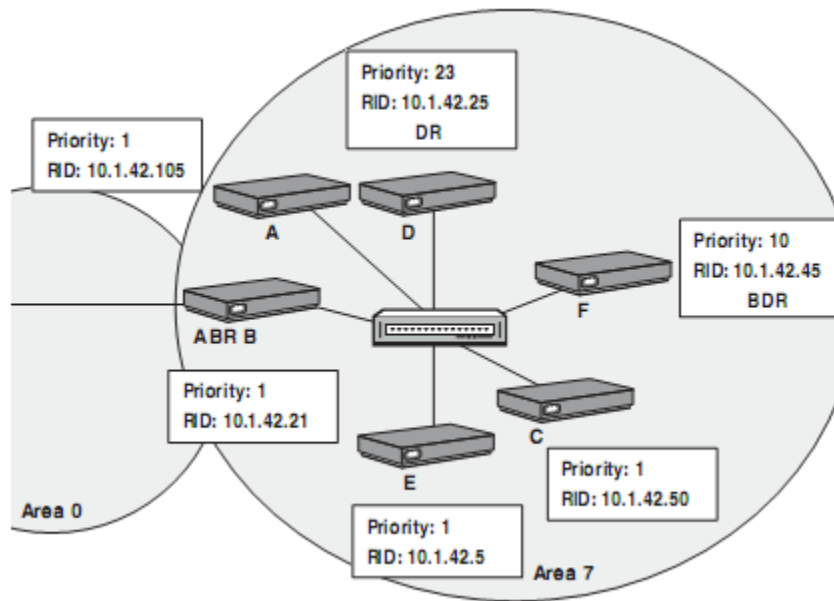
### ◦ NON-BROADCAST MULTI-ACCESS (NBMA) NETWORKS

- EX. FRAME RELAY, ATM
- FIVE MODES OF OPERATION

## DR/BDR election

When a DR and BDR are elected (in case the DR fails), routing updates are minimized, because the update is sent only to the DR and the BDR. The DR then is responsible for updating the rest of the topology. The election is determined by the following:

1. **Highest interface priority:** An arbitrary number you can configure on an interface-by-interface basis. The default is 1. A value of 0 renders the device ineligible for DR and BDR election.
2. **Highest router ID:** In the event of a tie, the highest router ID is the tiebreaker.



manner in which OSPF routers propagate LSAs and LSUs. Rather than broadcast this information as RIPv1 does, OSPF sends updates to two different reserved multicast addresses. The multicast address, 224.0.0.6, is reserved for the DR and BDR. When a router needs to send an update in a broadcast or nonbroadcast topology, it sends the LSU to 224.0.0.6, which only the DR and BDR process. The DR then sends the LSU to the multicast address of 224.0.0.5, which is the address to which all OSPF routers listen for updates and hello messages.

So now when Router B detects the link failure, it multicasts its LSU to 224.0.0.6, which only Router D and Router F process. Because Router D is the DR, it disseminates the update to everyone else in the topology by sending the update to 224.0.0.5.

## Notes

Router OSPF "process id" (it doesn't have to be the same on all routers, but its better to be the same to remember it better)

Default-information originate ( to distribute the default route to other routers via OSPF )

## Troubleshooting

Show ip protocols

Show ip ospf interface

Show ip ospf neighbor

Debug ip ospf adjacency



RouterA>show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.42.100	10	FULL/DR	00:00:39	192.168.1.6	Serial0/0

Albuquerque#show ip ospf interface

Serial0/1 is up, line protocol is up

Internet Address 10.1.6.1/24, Area 0

Process ID 1, Router ID 10.1.6.1, Network Type POINT\_TO\_POINT, Cost: 64

Transmit Delay is 1 sec, State POINT\_TO\_POINT,

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

Hello due in 00:00:07

Index 2/3, flood queue length 0

Next 0x0(0)/0x0(0)

Last flood scan length is 2, 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 10.1.6.3

Suppress hello for 0 neighbor(s)

Ethernet0/0 is up, line protocol is up

Internet Address 10.1.1.1/24, Area 0

Process ID 1, Router ID 10.1.6.1, Network Type BROADCAST, Cost: 10

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 10.1.6.1, Interface address 10.1.1.1

No backup designated router on this network

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

Hello due in 00:00:08

Index 1/1, flood queue length 0

Next 0x0(0)/0x0(0)

Last flood scan length is 0, maximum is 0

Last flood scan time is 0 msec, maximum is 0 msec

Neighbor Count is 0, Adjacent neighbor count is 0

Suppress hello for 0 neighbor(s)

