

OSPF (Open Shortest Path First) - Detailed Notes

1. What is OSPF?

OSPF (Open Shortest Path First) is a **link-state routing protocol** used within a single Autonomous System (AS). It is classified as an **Interior Gateway Protocol (IGP)** and is designed to be scalable, efficient, and fast-converging.

Protocol Type: Link-State

Administrative Distance: 110

Metric Used: Cost

Open Standard: Supported by multiple vendors (not just Cisco)

Routing Protocol Number: 89 (used in IP header)

2. OSPF Key Concepts

Concept	Description
Link-State	Routers advertise the state of their own links to all routers in the area.
LSAs	Link-State Advertisements, used to share routing and topology info.
LSDB	Link-State Database containing the complete network topology.
SPF Algorithm	Dijkstra's Shortest Path First algorithm used to calculate the best path.
Router ID (RID)	Unique identifier for each router in OSPF, looks like an IPv4 address.
Area	Logical grouping to simplify large OSPF networks. Area 0 is the backbone.

3. OSPF Packet Types

Type	Name	Purpose
1	Hello	Discover and maintain neighbor relationships
2	Database Description	Summary of LSDB contents
3	LSR (Link State Request)	Request more recent LSAs from neighbors
4	LSU (Link State Update)	Send updated LSAs
5	LSAck	Acknowledge receipt of LSAs

4. OSPF Neighbor Formation Process (Adjacency)

Down: No Hello packets received.

Init: Hello packet received; router ID noted.

2-Way: Bidirectional communication established.
ExStart: Master-slave relationship established.
Exchange: Routers exchange Database Description packets.
Loading: Routers request more recent LSAs.
Full: LSDBs are fully synchronized.

5. OSPF Areas

Area 0 (Backbone Area): All other areas must connect to Area 0.
Regular Area: Normal OSPF area.
Stub Area: Doesn't receive external routes.
Totally Stubby Area: Receives only a default route.
NSSA (Not-So-Stubby Area): Allows limited external routing.

6. OSPF Cost Calculation

Cost = 100,000,000 / Bandwidth (in bps)

Higher bandwidth = lower cost = better route.

Interface Type	Bandwidth (Mbps)	Cost
FastEthernet	100	1
Ethernet	10	10
Gigabit Ethernet	1000	
10 Gigabit Ethernet		

7. Router ID Selection

Manually configured Router ID.
Highest Loopback IP address.
Highest active physical interface IP.

8. OSPF Tables

Neighbor Table: Stores information about OSPF neighbors.
Topology Table (LSDB): Stores all received LSAs.
Routing Table: Stores best routes calculated by SPF.

9. OSPF LSA Types

LSA Type	Description
Type 1	Router LSA (Within an Area)
Type 2	Network LSA (DR generated for multi-access nets)
Type 3	Summary LSA (ABRs send to other areas)

- Type 4 ASBR Summary LSA
- Type 5 External LSA (sent by ASBRs for external routes)
- Type 7 NSSA LSA (Used in Not-So-Stubby Areas)

10. Designated Router (DR) and BDR

Used in multi-access networks (like Ethernet):

DR: Sends and receives LSAs on behalf of all routers.

BDR: Backup to DR.

Reduces OSPF traffic in broadcast networks.

11. OSPF Configuration Example (Cisco IOS)

```
R1(config)# router ospf 1
R1(config-router)# router-id 1.1.1.1
R1(config-router)# network 192.168.1.0 0.0.0.255 area 0
```

12. OSPF Advantages

- Fast convergence
- Loop-free topology
- Supports VLSM and CIDR
- Scalable with area-based design

13. OSPF Show and Troubleshooting Commands

```
show ip ospf neighbor
show ip ospf interface
show ip ospf
show ip ospf database
```