



Lecture 17- OSPF (Open Shortest Path First)



1 What is OSPF?

Open Shortest Path First (OSPF) is a **Link-State Dynamic Routing Protocol** used in medium to large networks to automatically find the best path to reach all networks.

👉 It is widely used in enterprise environments.



Key Features of OSPF

Feature	Description
⌚ Protocol Type	Link-State
⌚ LSA Refresh Timer	30 Minutes
🌐 Metric	Cost
💻 Algorithm	Dijkstra SPF
🔢 Administrative Distance	110
🌐 Open Standard	Yes (Multi-vendor support)
📦 Protocol Number	89
🌐 Convergence	Fast
⌚ Updates	Only on change or 30 mins



Why Use OSPF?

- ✓ Automatically learns routes
- ✓ Fast convergence
- ✓ Scalable for large networks

- ✓ Supports VLSM & CIDR
 - ✓ Open standard (works with all vendors)
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Real-Life Example

Imagine Google Maps 

- It collects all road information.
- Calculates shortest path.
- Updates when road changes.

 OSPF works exactly like that inside network.

2 How OSPF Works (Step-by-Step Flow)

OSPF uses **LSA (Link State Advertisement)** system.

◆ Working Process:

- 1 Routers send **Hello packets** (every 10 seconds)
 - 2 Discover neighbors
 - 3 Form adjacency
 - 4 Share LSAs
 - 5 Build LSDB
 - 6 Run SPF algorithm
 - 7 Install best path into routing table
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OSPF Multicast Address

OSPF uses:

- **224.0.0.5** → All OSPF routers
- **224.0.0.6** → DR/BDR routers

Why multicast?

Instead of sending updates to each router separately, multicast sends to a group.

- 👉 Saves bandwidth
 - 👉 Improves efficiency
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3 OSPF vs EIGRP Comparison

Feature	OSPF	EIGRP
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Type	Link-State	Hybrid
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Algorithm	Dijkstra	SPF DUAL
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Metric	Cost	Bandwidth + Delay
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AD	110	90
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Standard	Open	Cisco Proprietary
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Updates	LSAs	Partial
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👉 OSPF is vendor-neutral.

4 Important OSPF Terms

LSA (Link State Advertisement)

Information packet describing router links.

LSDB (Link State Database)

Complete topology database collected from LSAs.

Cost Formula

$$\text{Cost} = 100,000,000 / \text{Bandwidth (bps)}$$

Higher bandwidth → Lower cost → Preferred path.

Router ID (RID)

Unique 32-bit identifier.

Selection order:

-  1 Manually configured
 -  2 Highest Loopback IP
 -  3 Highest Physical IP
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5 OSPF Packet Types (Exam Important)

Type Name Purpose

- 1 Hello Discover neighbors
- 2 DBD Summary of LSDB
- 3 LSR Request missing LSA
- 4 LSU Send LSAs
- 5 LSAck Acknowledge



6 OSPF Areas

Area 0 (Backbone)

Main area. All areas must connect to it.

Regular Area

Normal area.

Stub Area

Blocks external routes.

Totally Stubby

Receives only default route.

NSSA

Allows limited external routes.

OSPF Tables

Table	Purpose
 Neighbor Table	List of neighbors
 LSDB	Topology database
 Routing Table	Best paths

Passive Interface (Very Important)

Command:

`passive-interface g0/2`

Why use it?

- ✓ Stop sending Hello packets
 - ✓ Prevent unnecessary neighbor formation
 - ✓ Improve security
 - ✓ Used for LAN/PC interfaces
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OSPF Configuration (Cisco IOS)

OSPF runs inside **Cisco IOS**

Basic Configuration:

```
router ospf 1  
network 192.168.1.0 0.0.0.255 area 0
```



Complete OSPF Lab

Topology Structure



Each router connected to:

- 1 Switch
- 1 PC

All in Area 0.



IP Addressing Summary



Router-to-Router Links (/30)

Link Network

R1–R2 10.0.12.0/30

R1–R3 10.0.13.0/30

R2–R4 10.0.24.0/30

R3–R4 10.0.34.0/30

LAN Networks

Router LAN Network

R1 172.16.1.0/28
R2 192.168.2.0/24
R3 192.168.3.0/25
R4 192.168.4.0/24



PC IP Configuration

PC	IP	Subnet	Gateway
PC1	172.16.1.1	255.255.255.240	172.16.1.14
PC2	192.168.2.1	255.255.255.0	192.168.2.254
PC3	192.168.3.1	255.255.255.128	192.168.3.126
PC4	192.168.4.1	255.255.255.0	192.168.4.254



Router Configuration

R1 Configuration

```
enable
conf t
hostname R1

int g0/0
ip address 10.0.12.1 255.255.255.252
no shutdown
```

```
int g0/1
ip address 10.0.13.1 255.255.255.252
no shutdown
```

```
int g0/2
ip address 172.16.1.14 255.255.255.240
no shutdown
```

```
router ospf 1
network 10.0.12.0 0.0.0.3 area 0
network 10.0.13.0 0.0.0.3 area 0
network 172.16.1.0 0.0.0.15 area 0
passive-interface g0/2
```

R2 Configuration

```
enable
conf t
hostname R2
```

```
int g0/0
ip address 10.0.12.2 255.255.255.252
no shutdown
```

```
int g0/1
ip address 10.0.24.1 255.255.255.252
no shutdown
```

```
int g0/2
ip address 192.168.2.254 255.255.255.0
no shutdown
```

```
router ospf 1
network 10.0.12.0 0.0.0.3 area 0
network 10.0.24.0 0.0.0.3 area 0
network 192.168.2.0 0.0.0.255 area 0
passive-interface g0/2
```

R3 Configuration

```
enable  
conf t  
hostname R3
```

```
int g0/0  
ip address 10.0.34.1 255.255.255.252  
no shutdown
```

```
int g0/1  
ip address 10.0.13.2 255.255.255.252  
no shutdown
```

```
int g0/2  
ip address 192.168.3.126 255.255.255.128  
no shutdown
```

```
router ospf 1  
network 10.0.13.0 0.0.0.3 area 0  
network 10.0.34.0 0.0.0.3 area 0  
network 192.168.3.0 0.0.0.127 area 0  
passive-interface g0/2
```

R4 Configuration

```
enable  
conf t  
hostname R4
```

```
int g0/0  
ip address 10.0.24.2 255.255.255.252  
no shutdown
```

```
int g0/1  
ip address 10.0.34.2 255.255.255.252  
no shutdown
```

```
int g0/2  
ip address 192.168.4.254 255.255.255.0  
no shutdown
```

```
router ospf 1  
network 10.0.24.0 0.0.0.3 area 0  
network 10.0.34.0 0.0.0.3 area 0  
network 192.168.4.0 0.0.0.255 area 0  
passive-interface g0/2
```

How To Verify OSPF

From Router:

```
show ip route  
show ip ospf neighbor  
show ip ospf interface  
show ip protocols  
show ip ospf database  
ping <destination>  
traceroute <destination>
```

From PC:

- ping other PC IP
- tracert (in PC command prompt)

If ping works → OSPF working successfully 

🏁 Final Understanding

OSPF:

- Shares topology
 - Calculates best path
 - Uses cost metric
 - Fast convergence
 - Uses multicast
 - Works in areas
 - Uses SPF algorithm
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COMPLETE SUMMARY

★ What is OSPF?

OSPF (Open Shortest Path First) is a **Link-State Dynamic Routing Protocol** used in medium to large enterprise networks to automatically determine the best path for data transmission.

- Open standard (multi-vendor supported)
- Fast convergence
- Protocol Number: 89
- Administrative Distance: 110
- Metric Used: Cost
- Algorithm: Dijkstra SPF
- LSA refresh: Every 30 minutes



Why OSPF is Used?

- Automatically learns routes
- Fast failure recovery
- Supports VLSM & CIDR
- Highly scalable
- Vendor-neutral

It is widely used in enterprise networks.

📍 Real-Life Example

Think of **Google Maps** 🌎

It:

- Collects all road data
- Calculates shortest path

- Updates when road changes

👉 OSPF works the same way inside a network.

⌚ 2 How OSPF Works (Step-by-Step)

OSPF uses **LSA (Link State Advertisement)** mechanism.

◆ Process Flow:

- 1 Routers send **Hello packets** (every 10 seconds)
- 2 Discover neighbors
- 3 Form adjacency
- 4 Exchange LSAs
- 5 Build LSDB
- 6 Run SPF algorithm
- 7 Install best route in routing table

💡 OSPF Multicast Addresses

OSPF uses:

- 224.0.0.5 → All OSPF routers
- 224.0.0.6 → DR/BDR routers

🧐 Why Multicast?

- ✓ Saves bandwidth
- ✓ Efficient updates
- ✓ Sends once to group instead of individually

✖ 3 OSPF vs EIGRP

Feature	OSPF	EIGRP
---------	------	-------

Type	Link-State	Hybrid
------	------------	--------

Algorithm	Dijkstra	SPF	DUAL
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Feature	OSPF	EIGRP
Metric	Cost	Bandwidth + Delay
AD	110	90
Standard	Open	Cisco Proprietary
Updates	LSAs	Partial

👉 OSPF is vendor-neutral.

💡 4 Important OSPF Concepts

🧱 LSA (Link State Advertisement)

Information about router links shared with others.

🧩 LSDB (Link State Database)

Complete topology database created from LSAs.

All routers in same area have identical LSDB.

🎯 Cost Formula

Cost = $100,000,000 / \text{Bandwidth (bps)}$

Higher bandwidth → Lower cost → Preferred path.

ID Router ID (RID)

Unique 32-bit identifier.

Selection priority:

- 1 Manual configuration
- 2 Highest Loopback IP
- 3 Highest Physical IP



5 OSPF Packet Types (Exam Important)

Type Name Purpose

- 1 Hello Discover neighbors
 - 2 DBD Database summary
 - 3 LSR Request missing LSA
 - 4 LSU Send LSAs
 - 5 LSAck Acknowledge
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6 OSPF Areas

Area 0 (Backbone)

Main area. All areas must connect to Area 0.

Regular Area

Normal OSPF area.

Stub Area

Blocks external routes.

Totally Stubby Area

Receives only default route.

NSSA (Not So Stubby Area)

Allows limited external routes.



7 OSPF Tables

Table	Purpose
👤 Neighbor Table	List of neighbors
✖ LSDB	Topology database
📍 Routing Table	Best calculated paths



8 Passive Interface (Very Important)

Command:

```
passive-interface g0/2
```

Why Use?

- ✓ Stop Hello packets
- ✓ Prevent unnecessary adjacency
- ✓ Improve security
- ✓ Used for LAN interfaces



9 Basic OSPF Configuration (Cisco IOS)

OSPF runs inside **Cisco IOS**

```
router ospf 1  
network 192.168.1.0 0.0.0.255 area 0
```

Q & A

Q 1 What is OSPF?

Answer:

OSPF is a link-state dynamic routing protocol that uses Dijkstra's SPF algorithm to calculate the shortest path in an IP network.

Q 2 Why is OSPF called Link-State?

Because routers share link information (LSAs) and build a complete topology database.

Q 3 What metric does OSPF use?

Cost.

Q 4 What is the cost formula?

Cost = $100,000,000 / \text{Bandwidth}$

Q 5 What is Administrative Distance of OSPF?

110.

Q 6 What is Router ID?

32-bit unique identifier for OSPF router.

Q 7 How is Router ID selected?

1. Manual
 2. Highest Loopback IP
 3. Highest Physical IP
-

Q 8 What is LSDB?

Database containing entire network topology.

Q 9 What is LSA?

Link State Advertisement packet sharing link information.

Q 10 What multicast addresses does OSPF use?

224.0.0.5 and 224.0.0.6

Q 1 1 What is Area 0?

Backbone area. All areas must connect to it.

Q 1 2 What is Stub Area?

Area that blocks external routes.

Q 1 3 What is Passive Interface?

Interface that does not send Hello packets but advertises network.

Q 1 4 Difference between OSPF and EIGRP?

OSPF is open standard link-state protocol; EIGRP is Cisco hybrid protocol.

Q 1 5 How does OSPF achieve fast convergence?

By maintaining full topology database and recalculating SPF quickly.

Q 1 6 What are OSPF packet types?

Hello, DBD, LSR, LSU, LSAck.

Q 1 7 How do you verify OSPF?

show ip route
show ip ospf neighbor
show ip ospf database

Q 1 8 Why use /30 in router-to-router links?

To conserve IP addresses.

Q 1 9 What happens if Hello packets stop?

Neighbor adjacency drops.

Q 2 0 What is Convergence?

Time taken for routers to update routing tables after change.

Q 2 1 Why OSPF preferred in enterprise?

Scalable, fast, vendor-neutral.

Q 2 2 What is the role of SPF algorithm?

Calculates shortest path tree.

Q 2 3 What happens every 30 minutes in OSPF?

LSA refresh.

Q 2 4 What table stores neighbors?

Neighbor Table.

Q 2 5 What table stores best routes?

Routing Table.

FINAL CONCLUSION

OSPF is:

-  Open standard
-  Fast converging
-  Link-state protocol
-  Uses SPF algorithm
-  Uses multicast
-  Works in areas
-  Maintains LSDB



For interview success, you must clearly explain:

- ✓ Working process
- ✓ Cost calculation
- ✓ Router ID selection
- ✓ LSA & LSDB
- ✓ Area types
- ✓ Packet types
- ✓ Passive interface
- ✓ Verification commands

If you confidently explain these, interviewer will understand you have strong networking foundation 💪 🔥

