



Lecture 18- OSPF Cost & Reference Bandwidth



1 What is OSPF Cost?

In **Open Shortest Path First (OSPF)**, **Cost** is the metric used to choose the best path.

👉 It represents how “expensive” it is to send traffic through an interface.

✓ **Rule:**

Lower Cost = More Preferred Path



Daily Life Example

Imagine you are choosing a road to travel 🚗 :

- Highway (fast, smooth) → Low cost
- Small street (slow, traffic) → High cost

You will choose the fastest road.

👉 OSPF does the same thing inside a network.



2 OSPF Cost Formula

OSPF Cost = Reference Bandwidth / Interface Bandwidth

❖ **Default Reference Bandwidth:**

100 Mbps (100,000,000 bits/sec)

Example Table (Default Settings)

Interface Type	Bandwidth	OSPF Cost
Ethernet	10 Mbps	10
FastEthernet	100 Mbps	1
GigabitEthernet	1000 Mbps	0.1 → Rounded to 1
10G Ethernet	10,000 Mbps	0.01 → Rounded to 1

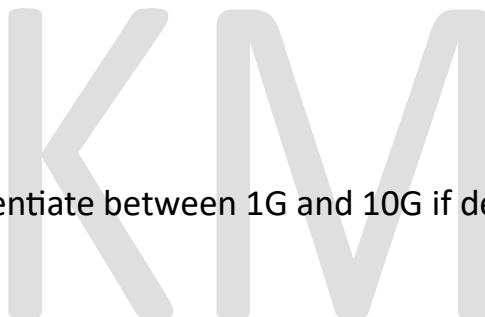
Important Problem

OSPF **cannot use decimal values.**

So:

- Gigabit = 1
- 10G = 1

 OSPF cannot differentiate between 1G and 10G if default reference bandwidth is used.



3 What is Reference Bandwidth?

Reference Bandwidth defines the maximum speed used to calculate OSPF cost.

Default:

100 Mbps

Why Change It?

Modern networks use:

- 1G
- 10G
- 40G

If you don't change it, OSPF treats all fast links as equal.

Cisco Command to Change It

(OSPF runs inside **Cisco IOS**)

```
router ospf 1  
auto-cost reference-bandwidth 10000
```

 $10000 = 10 \text{ Gbps}$

Very Important Rule

You must configure this on **ALL routers**.

If not → inconsistent cost calculation → routing issues.



Manually Setting OSPF Cost

You can override cost manually.

```
interface g0/1  
ip ospf cost 50
```

 Useful for traffic engineering.



5 Changing Interface Bandwidth (Optional)

You can modify bandwidth value:

```
interface g0/1  
bandwidth 10000
```

 Bandwidth value is in Kbps

- $10000 = 10 \text{ Mbps}$
- $1000000 = 1 \text{ Gbps}$

 This does NOT change actual speed.

 Only affects routing protocols.

6 Clear OSPF Process

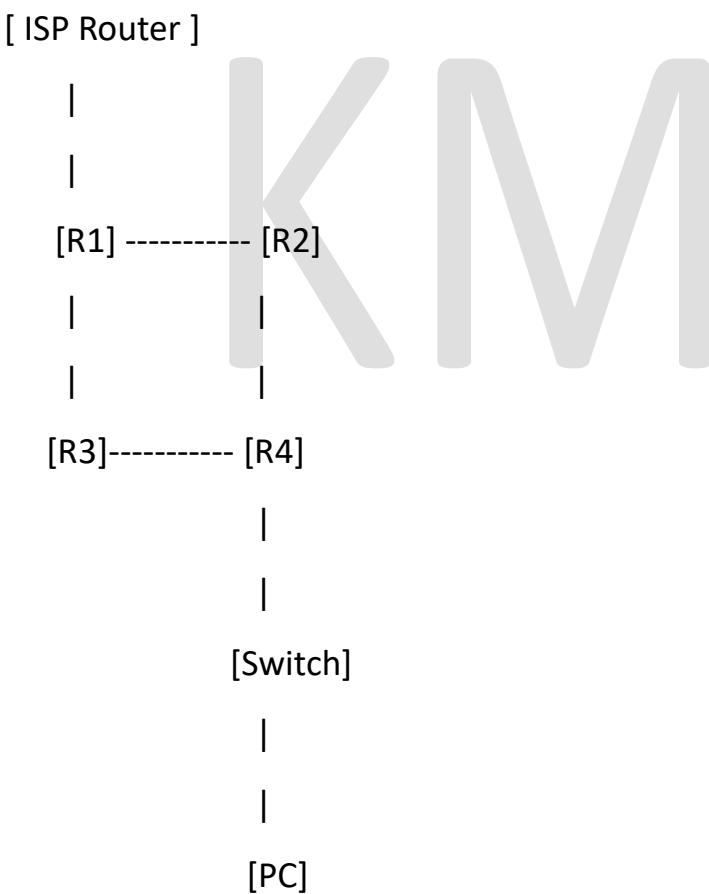
After major changes:

clear ip ospf process

Router restarts OSPF process.

OSPF Cost LAB

Topology Structure



Network Addressing

Router Links

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

R1–ISPR 203.0.113.0/30

LAN Network

Router LAN

R4 192.168.4.0/24

PC IP:

- IP: 192.168.4.1
 - Mask: 255.255.255.0
 - Gateway: 192.168.4.254
-



LAB Questions & Stepwise Solution

Question 1

Configure hostnames and IP addresses.

R1 Configuration

```
enable  
conf t  
hostname R1
```

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

```
int fa1/0  
ip address 10.0.13.1 255.255.255.252  
no shutdown
```



R2 Configuration

```
enable  
conf t  
hostname R2
```

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

```
int fa1/0  
ip address 10.0.24.1 255.255.255.252  
no shutdown
```

R3 Configuration

```
enable  
conf t  
hostname R3
```

```
int fa1/0  
ip address 10.0.13.2 255.255.255.252  
no shutdown
```

```
int fa2/0  
ip address 10.0.34.1 255.255.255.252  
no shutdown
```

R4 Configuration

```
enable  
conf t  
hostname R4
```



```
int g0/0  
ip address 192.168.4.254 255.255.255.0  
no shutdown
```

```
int fa1/0  
ip address 10.0.24.2 255.255.255.252  
no shutdown
```

```
int fa2/0  
ip address 10.0.34.2 255.255.255.252  
no shutdown
```

 **Question 2**

Configure Loopback Interfaces

R1

```
int loopback0  
ip address 1.1.1.1 255.255.255.255
```

R2

```
int loopback0  
ip address 2.2.2.2 255.255.255.255
```

R3

```
int loopback0  
ip address 3.3.3.3 255.255.255.255
```

R4

```
int loopback0  
ip address 4.4.4.4 255.255.255.255
```

 **Question 3**

Enable OSPF & Configure Passive Interfaces

R1

```
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 203.0.113.0 0.0.0.3 area 0  
passive-interface loopback0
```

R2

```
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
passive-interface loopback0
```

R3

```
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
passive-interface loopback0
```

R4

```
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 g0/0
passive-interface loopback0
```

Question 4

Configure Reference Bandwidth (Make FastEthernet cost 100)

On ALL Routers

```
router ospf 1
auto-cost reference-bandwidth 10000
```

How To Check Interface Cost

show ip ospf interface g0/0

You will see:

- Cost
 - Hello timer
 - Dead timer
 - Neighbor info
-

Important Show Commands

✓ Show Full Configuration

show running-config

Shows:

- Interfaces
 - Routing
 - OSPF
 - IPs
 - Passwords
-



✓ Show Only OSPF Section

show running-config | section ospf

Useful for:

- Router ID
- Reference bandwidth
- Passive interfaces
- Network statements
- Manual cost



How To Verify LAB

From Router:

```
show ip route  
show ip ospf neighbor  
show ip ospf interface  
show ip ospf database  
ping 4.4.4.4  
traceroute 4.4.4.4
```

From PC:

```
ping 1.1.1.1  
tracert 1.1.1.1
```

If working → OSPF cost functioning correctly



Final Understanding

OSPF Cost:

- Determines best path
- Based on bandwidth
- Lower cost wins
- Default reference = 100 Mbps
- Must update for modern networks
- Can manually override
- Must be consistent across all routers

☒ Real World Importance

In enterprise networks:

- Multiple redundant links exist
 - OSPF cost decides traffic direction
 - Helps load balancing
 - Helps backup path selection
 - Prevents slow link usage
-





1 COMPLETE SUMMARY

★ What is OSPF Cost?

In **OSPF (Open Shortest Path First)**, **Cost** is the metric used to determine the best path.

👉 It represents how “expensive” it is to send traffic through an interface.

✓ Golden Rule:

Lower Cost = Better Path

Higher Cost = Less Preferred Path

🚗 Real-Life Example

Think of choosing a road:

- 🚙 Highway → Fast → Low cost
- ⚡ Small busy road → Slow → High cost

You choose the fastest road.

👉 OSPF does the same inside a network.

★ 2 OSPF Cost Formula

OSPF Cost = Reference Bandwidth / Interface Bandwidth

📌 Default Reference Bandwidth

100 Mbps (100,000,000 bps)

This was fine for old networks but not for modern high-speed networks.

Default Cost Table

Interface	Bandwidth	OSPF Cost
Ethernet	10 Mbps	10
FastEthernet	100 Mbps	1
GigabitEthernet	1000 Mbps	0.1 → Rounded to 1
10G Ethernet	10,000 Mbps	0.01 → Rounded to 1

⚠ Big Problem

OSPF does **NOT support decimal values.**

So:

- Gigabit = Cost 1
- 10G = Cost 1

👉 OSPF cannot differentiate between 1G and 10G using default reference bandwidth.

This causes **suboptimal routing decisions.**

3 What is Reference Bandwidth?

Reference Bandwidth is the maximum bandwidth value used in cost calculation.

Default:

100 Mbps

Why We Must Change It?

Modern networks use:

- 1 Gbps
- 10 Gbps

- 40 Gbps

If we don't change it:

👉 OSPF treats all high-speed links equally.

🔧 Cisco Command to Change Reference Bandwidth

```
router ospf 1  
auto-cost reference-bandwidth 10000
```

👉 $10000 = 10 \text{ Gbps}$ (value in Mbps)

⚠ VERY IMPORTANT RULE

You must configure this on **ALL routers in the OSPF domain**.

If not:

- ✗ Inconsistent cost calculation
 - ✗ Routing loops
 - ✗ Traffic instability
- 

⭐ 4 Manually Setting OSPF Cost

You can override cost manually:

```
interface g0/1  
ip ospf cost 50
```

⌚ Why?

- Traffic engineering
 - Backup path preference
 - Avoid slow links
-

★ 5 Changing Interface Bandwidth (Optional Method)

```
interface g0/1  
bandwidth 10000
```

⚠ Value is in Kbps

- $10000 = 10 \text{ Mbps}$
 - $1000000 = 1 \text{ Gbps}$
-

! Important:

Changing bandwidth:

- ✗ Does NOT change physical speed
 - ✓ Only affects routing protocol calculations
-

★ 6 Clear OSPF Process

After major changes:

```
clear ip ospf process
```

- 👉 Restarts OSPF process
 - 👉 Recalculates SPF
 - 👉 Rebuilds adjacency
-

💡 LAB Summary

- 4 routers connected
- Loopback interfaces configured
- Passive interfaces configured
- Reference bandwidth changed
- OSPF enabled in Area 0
- Verified using show commands

Important Verification Commands

show ip ospf interface
show ip ospf neighbor
show ip ospf database
show ip route
show running-config
show running-config | section ospf
ping
traceroute

Real-World Importance

In enterprise networks:

- Multiple redundant links exist
 - OSPF cost decides traffic direction
 - Used for load balancing
 - Used for backup path selection
 - Prevents slow link usage
-

🏁 FINAL CONCLUSION

OSPF Cost is:

- 📊 The decision-making metric in OSPF
- 📈 Lower value = better path
- 📊 Calculated using reference bandwidth
- ⚠ Default 100 Mbps is outdated
- 🔐 Must update reference bandwidth in modern networks
- ✎ Can manually override for traffic engineering
- 🛡 Requires consistent configuration across all routers

👉 In real enterprise environments, incorrect cost configuration can cause major routing inefficiencies.

A network engineer must always:

- Understand cost calculation
 - Update reference bandwidth
 - Keep consistency
 - Verify after changes
 - Use manual cost carefully
-

Q & A

Q 1 What is OSPF Cost?

Answer:

OSPF Cost is the metric used by OSPF to determine the best path. Lower cost paths are preferred.

Q 2 What is the formula for OSPF Cost?

Cost = Reference Bandwidth / Interface Bandwidth

Q 3 What is default reference bandwidth in OSPF?

100 Mbps.

Q 4 Why is default reference bandwidth a problem today?

Because modern networks use 1G, 10G, or higher speeds, and default value cannot differentiate high-speed links.

Q 5 Why does OSPF round Gigabit cost to 1?

Because OSPF does not support decimal values.

Q 6 What happens if reference bandwidth is not changed?

OSPF treats 1G and 10G links equally → inefficient routing.

Q 7 How do you change reference bandwidth?

```
router ospf 1  
auto-cost reference-bandwidth <value>
```

Q 8 On how many routers should reference bandwidth be configured?

On ALL routers in the OSPF domain.

Q 9 What happens if reference bandwidth is inconsistent?

- Different cost calculations
 - Routing instability
 - Possible loops
-

Q 10 How can you manually set OSPF cost?

interface g0/1

ip ospf cost 50

Q 1 1 Why manually set OSPF cost?

For traffic engineering or backup path control.

Q 1 2 Does changing bandwidth change physical speed?

No. It only affects routing protocol calculations.

Q 1 3 What command resets OSPF process?

clear ip ospf process

Q 1 4 What is traffic engineering in OSPF?

Manually adjusting cost to control traffic flow.

Q 1 5 How do you verify OSPF interface cost?

show ip ospf interface

Q 1 6 How to check only OSPF configuration?

show running-config | section ospf

Q 1 7 If two paths have same cost, what happens?

OSPF performs Equal Cost Load Balancing (ECMP).

Q 1 8 What unit is used in bandwidth command?

Kbps.

Q 1 9 What is the benefit of updating reference bandwidth in enterprise networks?

- Accurate path selection
- Better performance
- Proper load balancing

Q 2 0 What is the real-world impact of wrong cost configuration?

- Traffic over slow links
- Congestion
- High latency
- SLA violations

 **Golden Tip**

When interviewer asks about OSPF Cost, you should confidently say:

"OSPF cost is calculated using reference bandwidth divided by interface bandwidth. The default reference bandwidth is 100 Mbps, which is outdated for modern networks. Therefore, we must change it across all routers to ensure

accurate path selection. Lower cost paths are preferred, and manual cost can be used for traffic engineering."

