# OSPF

Course Code: CSC 3116 Course Title: Computer Networks


**Dept. of Computer Science**
**Faculty of Science and Technology**

| **Lecturer No:** | Lab 8 | **Week No:** | 8 | **Semester:** | Spring 2020-21 |
|---|---|---|---|---|---|
| **Lecturer:** | *Dr. Md. Sohidul Islam, Email: sohidul@aiub.edu* | | | | |

# Lecture Outline


1. OSPF Theory
2. OSPF Configuration

# Topic Heading..

Topic sub heading..

| | EIGRP | OSPF |
|---|---|---|
| 1 | It supports maximum 255 routers in the network. However, the default is 100 routers. (highly scalable) | Supports unlimited number of routers |
| 2 | Fast convergence due to feasible successor | Fastest convergence speed due to the area concept |
| 3 | Cisco proprietary protocol and can be implemented only in Cisco routers. | Open standard protocol and can be implement in any router. |
| 4 | It calculates the metric In terms of bandwidth and delay (default). | It calculates the metric In terms of bandwidth only. |
| 5 | EIGRP works on DUAL(Diffusing Update Algorithm) Algorithm. | EIGRP works on Dijkstra Algorithm. |
| 6 | It maintains the best route and some other alternative routes for each destination. | It maintains the best route in routing table and all routes in database table. |
| 7 | It is basically use for medium to lager size organization in the network [1]. | It is basically use for lager size organization in the network [1]. |
| 8 | Administrative distance 90 | Administrative distance 110 |
| 9 | Easy to implement | The implementation is complicated |

# OSPF Theory

## OSPF Area

- An autonomous system (AS) is divided into one or more area.
- Each area is given an area ID
- An AS must have an area having ID 0 (zero) for multi-area OSPF. Such area is called backbone area.
- All areas of an AS must be connected to the backbone area.
- A router in an area exchanges routing information with the routers of its area only (by default)

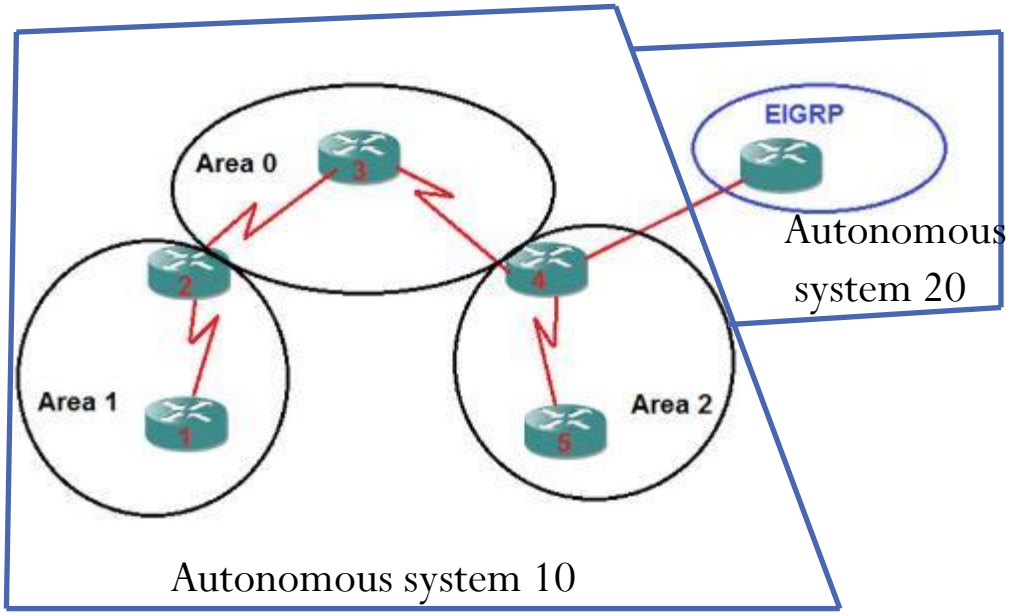



Fig. 1 Autonomous systems and area

# OSPF Theory....

## OSPF Routers

- Internal Router (IR): The router for which all its interface belong to one area. Router 1 and Router 5.
- Area Border Router (ABRs):The router that contains interfaces in more than one area. Router 2 and Router 4
- Backbone Router: The router that has all or at least one interface in Area 0. Router 3, Router 2 and Router 4.

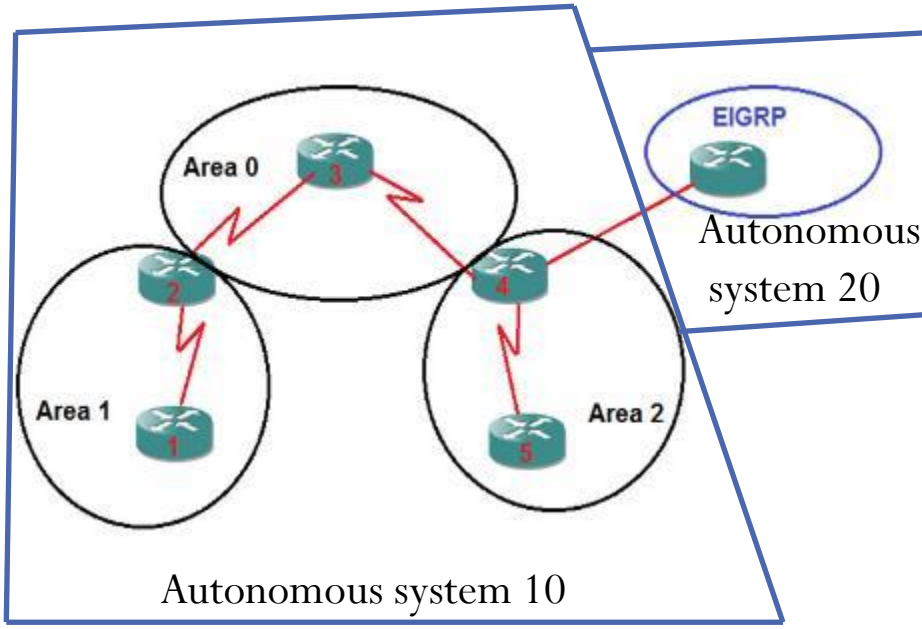



Fig. 1 Autonomous systems and area

- Autonomous System Boundary Router (ASBR): The routers with connection to a separate autonomous system. R4 in the example is connected to EIGRP [4].

# OSPF Theory....

OSPF data structure and packets

- Link state advertisement (LSA)
  - A data structure with some specific information about the networks [2].
  - Depending on its type, it holds information about
    - a router's interfaces,
    - all routers attached to network,
    - summary routing information of an area,
    - all routers of an AS.
- Link state database (LSDB)
  - A collection of all LSAs known to a router
  - In a convergent network, all routers of a network have the same LSDB.

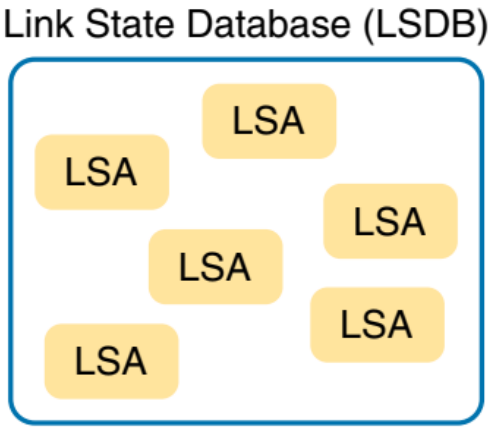



Fig. 2 LSA & LSDB relationship

# OSPF Theory....

OSPF data structure and packets


- Hello

  Used to build and maintain neighbor relationships.
- DBD – Database Description

  List of LSAs contained in a LSDB. This packet type is circulated when two routers are initially exchanging their link-state databases.
- Link State Request (LSR)

  Used to request complete information about a link learned from another router.
- Link State Update (LSU)

  Used to send one or LSA(s)
- Links State Acknowledgement (LSAck)

  Used to acknowledge the reception of an LSA

# OSPF Theory....

Neighbor discovery

Parameters need to be identical for two routers to become neighbors

- Network mask—*net mask of the sending router*
- Subnet number —derived using the subnet mask and each router's interface Internet Protocol (IP) address
- Area ID—*area ID of the sending interface*
- Hello interval—*how often Hello packets are transmitted*
- Dead interval—*how long to wait for Hello packets before terminating neighbor*
- Authentication type and password—*optional*
- Stub area flag—*specifies the type of stub area, if applicable* [3]

*Hello packet contains all these information*

# OSPF Theory....

## DR and BDR

- Point-to-point network

  A network in an area connecting only two routers directly.

- Broadcast network

  A network in an area connecting more than two routers

- Designated router (DR)

  In a broad cast network, a router with the highest priority .

  If the priorities tie, the router having the highest RID

  All database exchange is done via DR

- Backup Designated router (BDR)

  In a broad cast network, a router with the second highest priority .

  If the priorities tie, the router having the second highest RID

  If the DR fails, the BDR takes over.

- DROTHER: The router which is neither DR nor BDR [2]

# OSPF Theory....

DR and BDR....

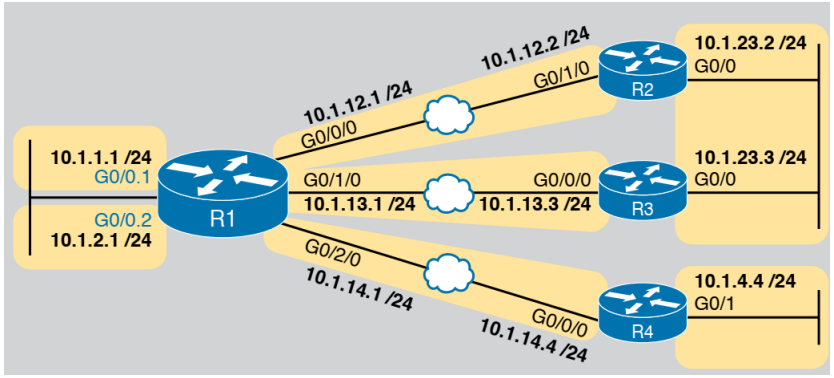



Fig. 5 point-to-point network

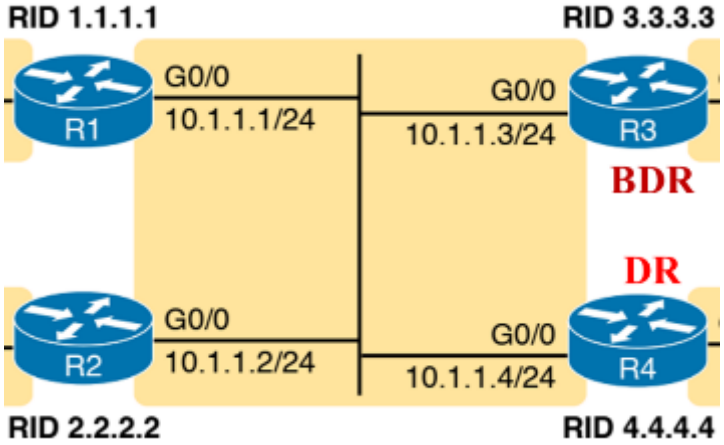



Fig. 6 Broadcast network , DR and BDR election

# Configuration

## Wildcard mask

- Used to specify a range of network addresses.
- Inverted subnet mask
- Used in EIGRP, OSPF and Access-List.

- How to get wildcard mask of an IP address?

  Subtract the subnet mask from 255.255.255.255

- What does each bit of a wildcard mask mean?

  0 : All IP address in the range must match the bit

  1 : Different IP address in the range can have different value in the bit position

# Configuration….

Wildcard mask….

- Only 192.168.3.0

  All bits must match.

  WCM: All bits 0. (00000000.00000000.00000000.00000000)

  WCM: 0.0.0.0

- IP address range: 192.168.3.0 to 192.168.3.255

  Match first three block (24 bits) and fourth block can take any value

  WCM: 0.0.0.255

- IP address range: 192.168.3.4 to 192.168.3.13

  11000000.10101000.00000011.00000100

  11000000.10101000.00000011.00001101

  First 28 bits same.

  Match first 28 bits; make them all zero

  Make rest of the bits 1

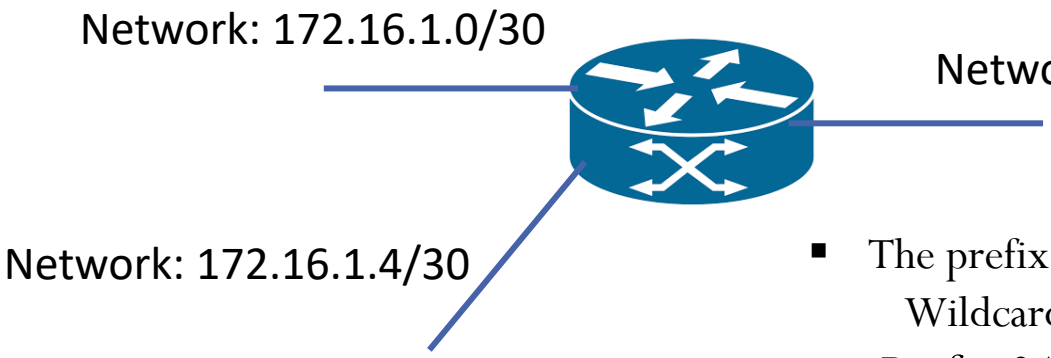
  00000000.0000000.00000000.00001111

  WCM: 0.0.0.15

Actual IP range: 192.168.3.0 to 192.168.3.15 under WCM: 0.0.0.15

# Configuration….

Commands




- The prefix 30 means subnet mask: 255.255.255.252
  Wildcard mask: 0.0.0.3
- Prefix 24 indicates subnet mask: 255.255.255.0
  Wildcard mask: 0.0.0.255

**OSPF Configuration**

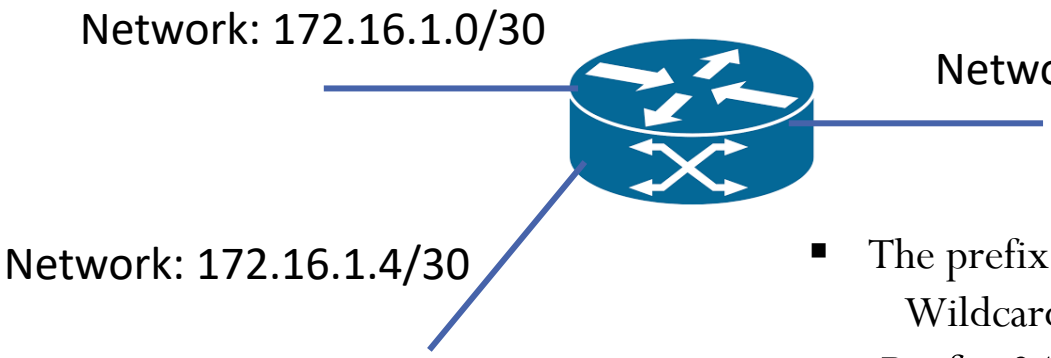
R1(config)# router ospf *process_id*

R1(config-router)#network *network_IP WCM* area *area_id*

Process ID is an integer. Not all routers need to have the same process ID.

# Configuration….

Commands….

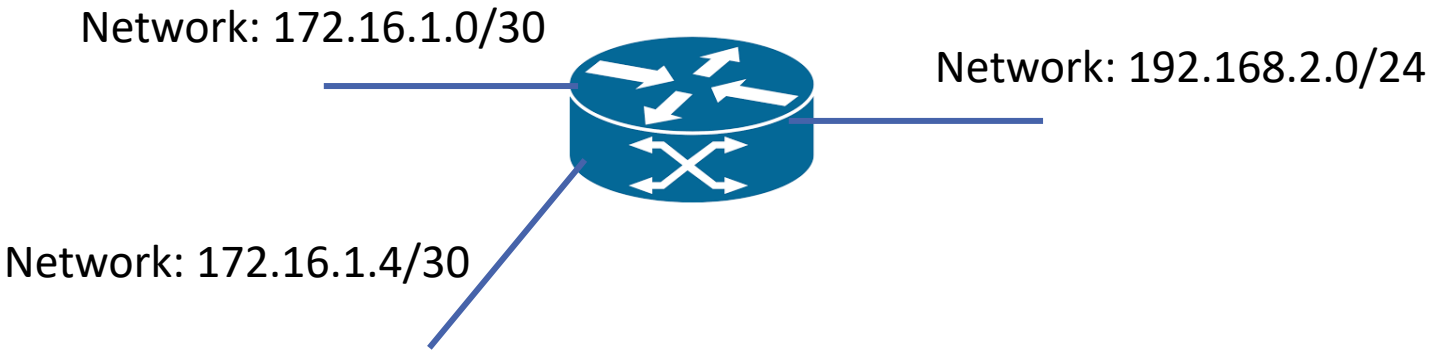



- The prefix 30 means subnet mask: 255.255.255.252
  Wildcard mask: 0.0.0.3
- Prefix 24 indicates subnet mask: 255.255.255.0
  Wildcard mask: 0.0.0.255

```
R1(config)# router ospf 10
R1(config)# router –id  1.1.1.1
R1(config-router)#network 192.168.2.0    0.0.0.255  area 0
R1(config-router)#network 172.16.1.0   0.0.0.3  area 0
R1(config-router)#network 172.16.1.4    0.0.0.3  area 0
```

# Configuration….

Commands….




```
R1(config)# router ospf 10
R1(config-router)#network 192.168.2.0   0.0.0.255  area 0
R1(config-router)#network 172.16.1.0   0.0.0.255  area 0
```

ospf protocol will be used in any network of area 0 which is connected to the router, having network IP address with first three octets 172.16.1 [2]

# Topic Heading..

Commands….

TABLE II Command for verifying configuration [2]

| Command | Description |
|---|---|
| **show ip ospf neighbor** [*type number*] | Lists brief output about neighbors, identified by neighbor router ID, including current state, with one line per neighbor; optionally, limits the output to neighbors on the listed interface. |
| **show ip ospf neighbor** *neighbor-ID* | Lists the same output as the **show ip ospf neighbor** detail command, but only for the listed neighbor (by neighbor RID). |
| **show ip ospf database** | Lists a summary of the LSAs in the database, with one line of output per LSA. It is organized by LSA type (first type 1, then type 2, and so on). |
| **show ip route** | Lists all IPv4 routes. |
| **show ip route ospf** | Lists routes in the routing table learned by OSPF. |
| **show ip route** *ip-address mask* | Shows a detailed description of the route for the listed subnet/mask. |
| **clear ip ospf process** | Resets the OSPF process, resetting all neighbor relationships and also causing the process to make a choice of OSPF RID. |

# References


[1] Computer Networking Class, https://computernetworkingclass.blogspot.com…/2016/08/comparison-between-rip-eigrp-igrp-and.html, [Accessed: May 2, 2020].

[2] W. Odom, Official Cert Gudie CCNA 200-301 Volume 1, Pearson Education, Inc., USA, 2020, pp. 449-497.

[3] J. Macfarlane, *Network Routing Basics*, Wiley Publications. Inc., USA, 2006, pp. 254.

[4] OSPF, "http://www.certiology.com/cisco-certifications/ccna/ccna-routing-and-switching/free-cisco-ccna-study-guide/ospf.html, [Accessed: May 2, 2020]..

# Books

**1. Official Cert Guide CCNA 200-301 , vol. 1**, *W. Odom*, Cisco Press, First Edition, 2019, USA.

**2. CCNA Routing and Switching**, *T. Lammle*, John Wily & Sons, Second Edition, 2016, USA.