Asi@Connect

TEIN CC
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OSPF

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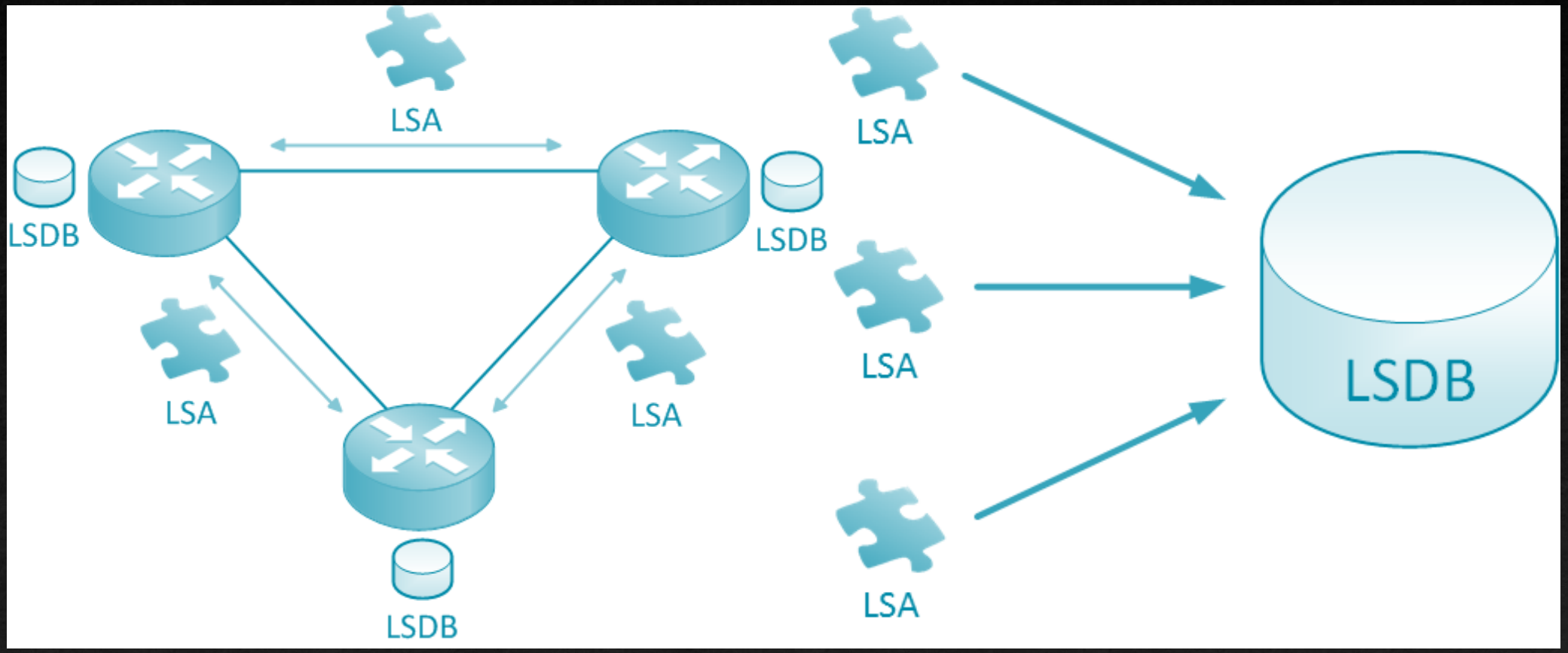
PSTU

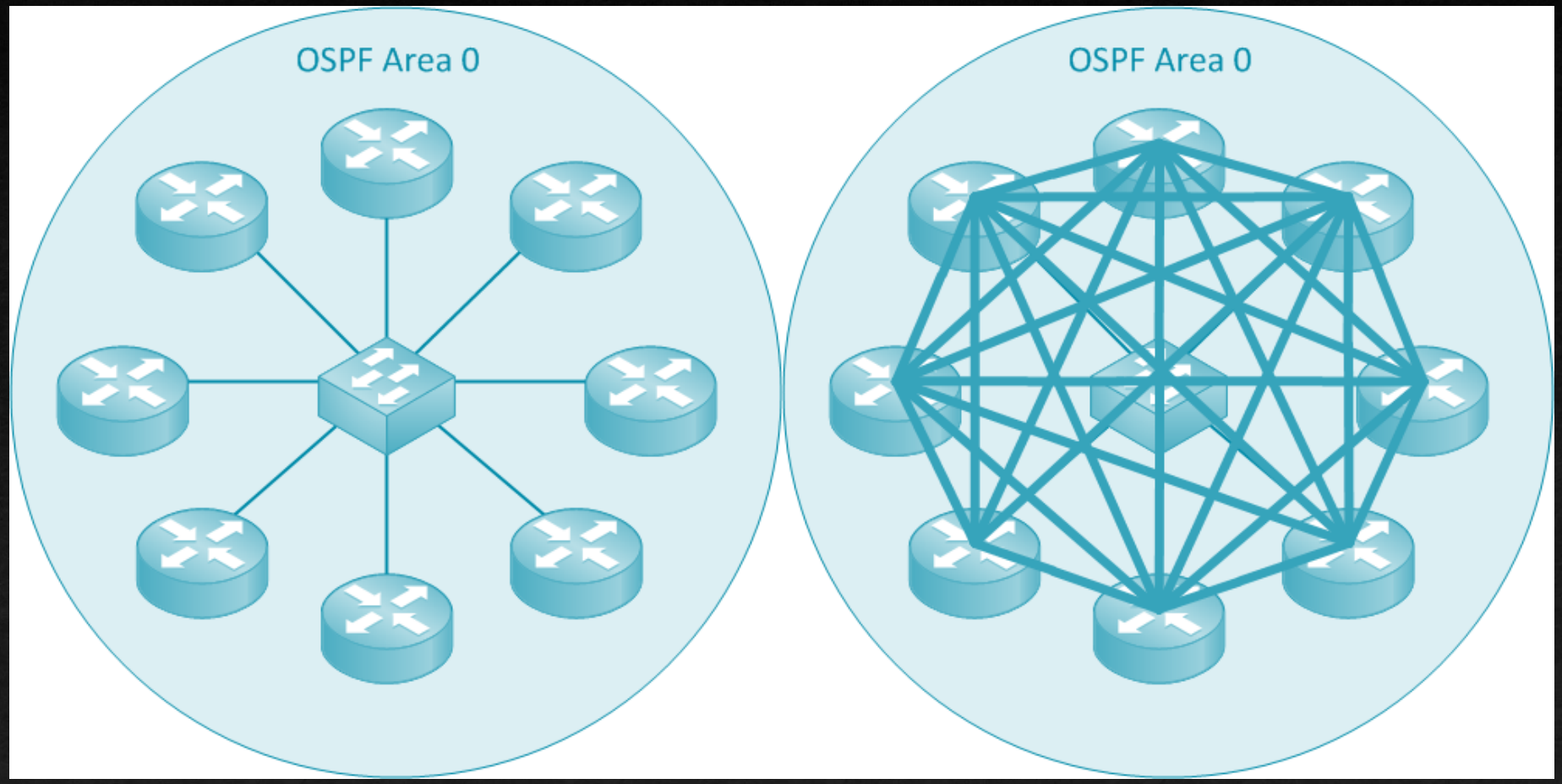
OSPF in Short

- Routing information is shared through Link-state updates (LSAs)
- It's a link state protocol
- It uses SPF (shortest path first) or dijkistra algorithm
- Unlimited hop count
- Metric is cost (cost=10 ^8/B.W.)
- Administrative distance is 110
- It is a classless routing protocol. It sends the subnet mask in the routing update.
- It supports VLSM and CIDR
- It supports only equal cost load balancing
- Introduces the concept of Area's to ease management and control traffic
- Provides hierarchical network design with multiple different areas
- Must have one area called as area 0
- All the areas must connect to area 0
- Scales better than Distance Vector Routing protocols.
- Supports Authentication
- Updates are sent through multicast address 224.0.0.5
- Faster convergence.

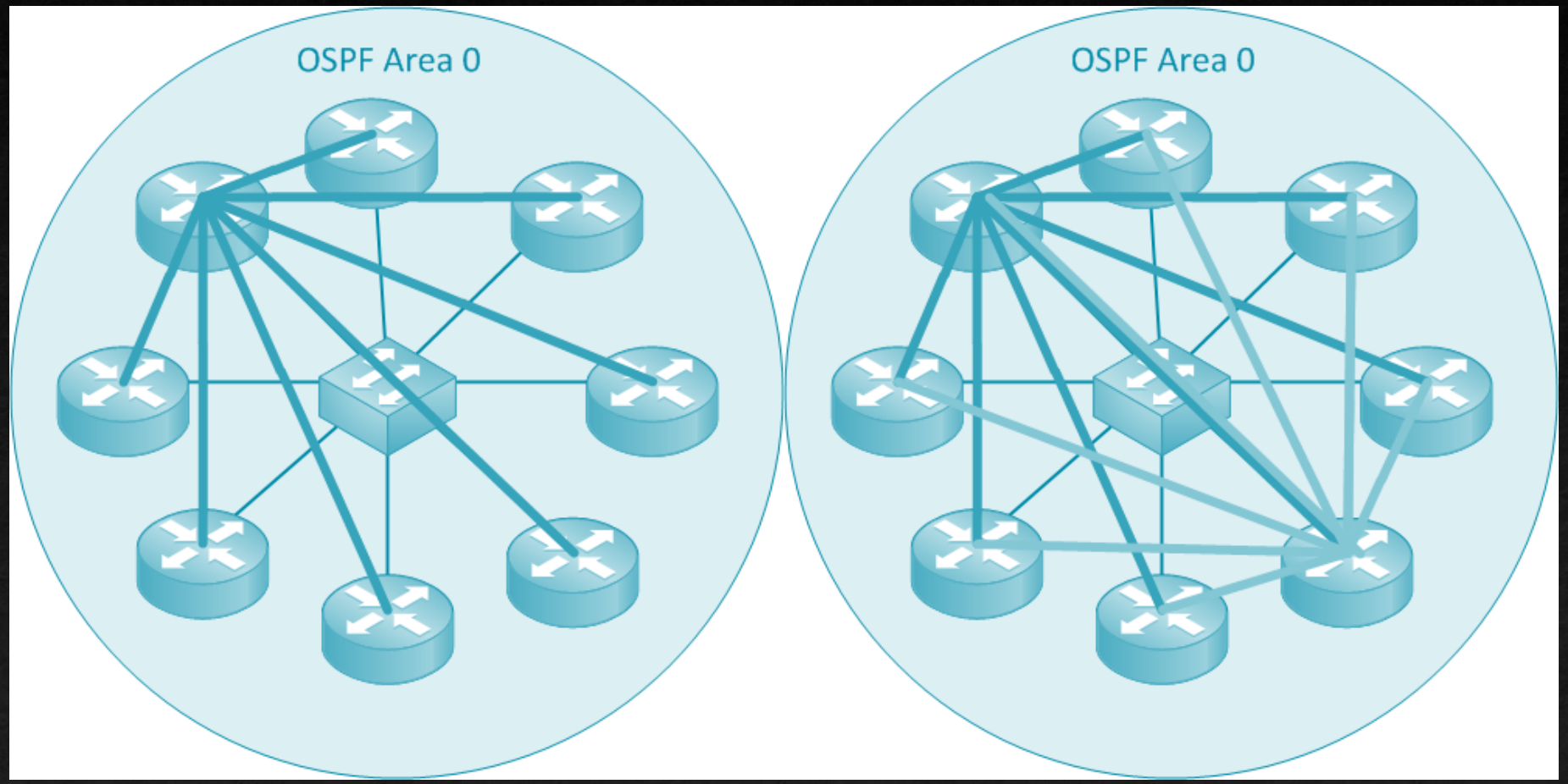
OSPF Intro



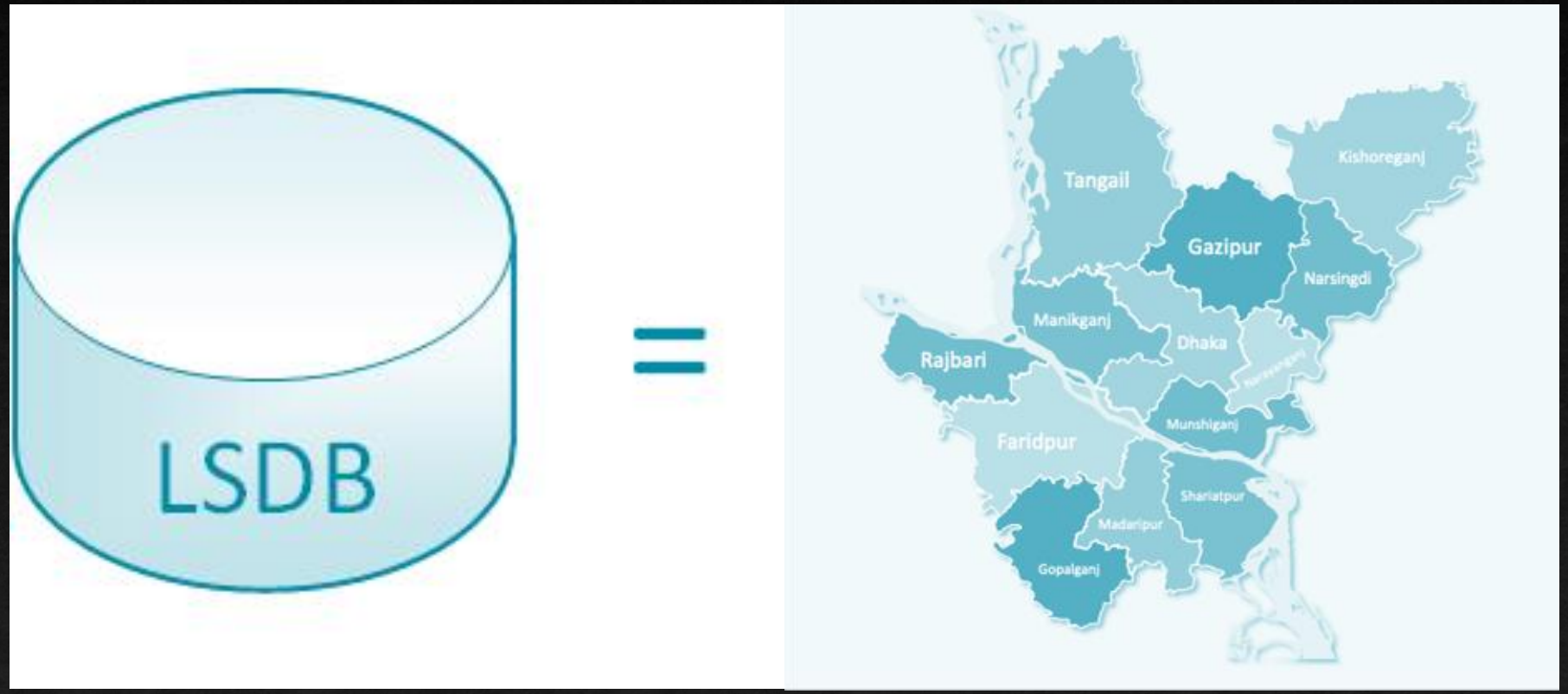
OSPF intro(Cont.)



OSPF intro(Cont.)



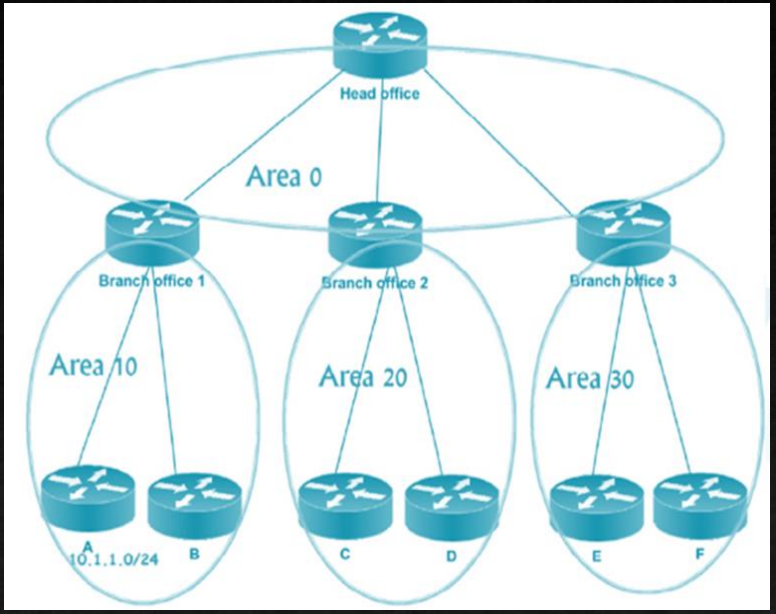
OSPF intro(Cont.)



Concept of Area

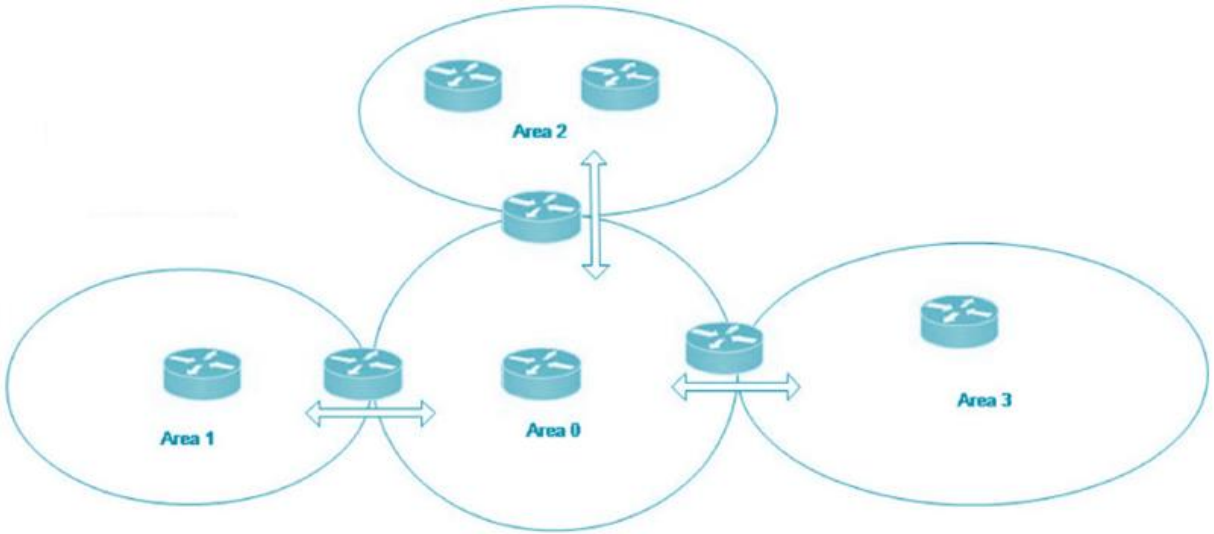
- Area is logical grouping of Routers
- All the routers maintain same database within the same Area
- Any change impact all the routers with the same area.

- Impact:
  - Minimizes size of database
  - Restrict any changes with in that area. (not flood outside area)
  - Routers with in the same area participate in Algorithm

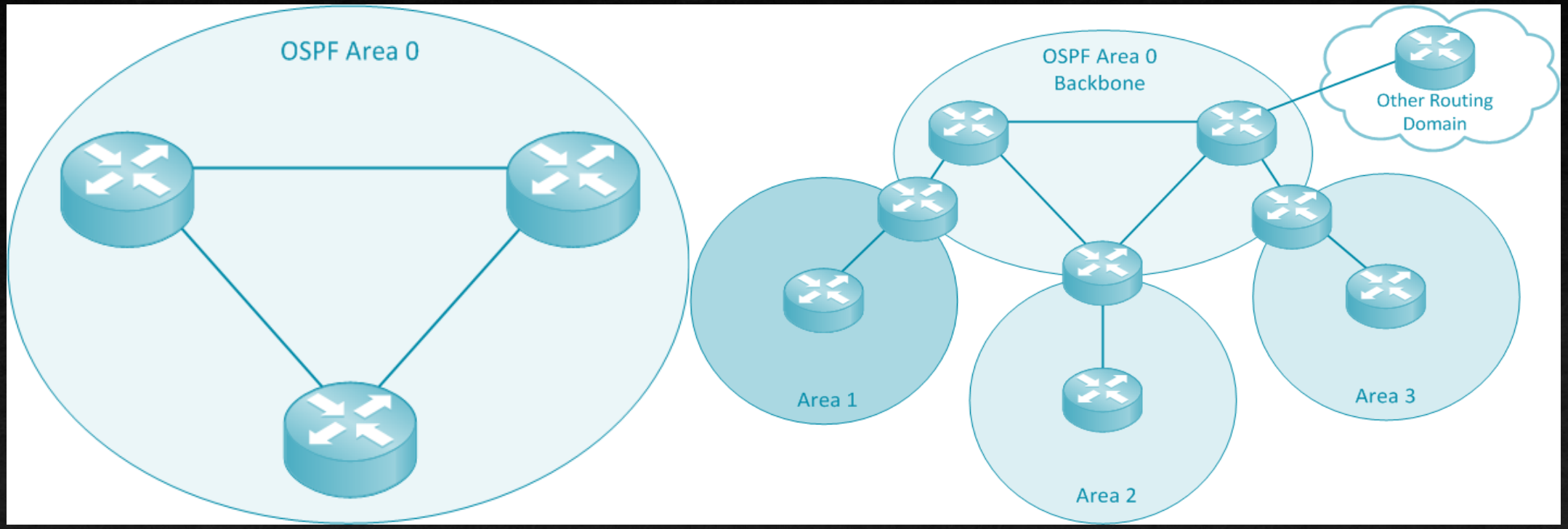


OSPF area design Rules

- Must have on area called as area 0 (called backbone area)
- All the no-backbone areas must connect to area 0. (Area 0 must be transit area)
- At least one-Area Border Router (connecting two or more area)
- Interface of both routers facing must be in the same area.



Area Terminology



Link-State Packets (LSPs)

- There are five types of OSPF Link-State Packets (LSPs).
  - Hello: are used to establish and maintain adjacency with other OSPF routers. They are also used to elect the Designated Router (DR) and Backup Designated Router (BDR) on multi-access networks (like Ethernet or Frame Relay).
  - Database Description (DBD or DD): contains an abbreviated list of the sending router's link-state database and is used by receiving routers to check against the local link-state database
  - Link-State Request (LSR): used by receiving routers to request more information about any entry in the DBD
  - Link-State Update (LSU): used to reply to LSRs as well as to announce new information. LSUs contain seven different types of Link-State Advertisements (LSAs)
  - Link-State Acknowledgement (LSAck): sent to confirm receipt of an LSU message

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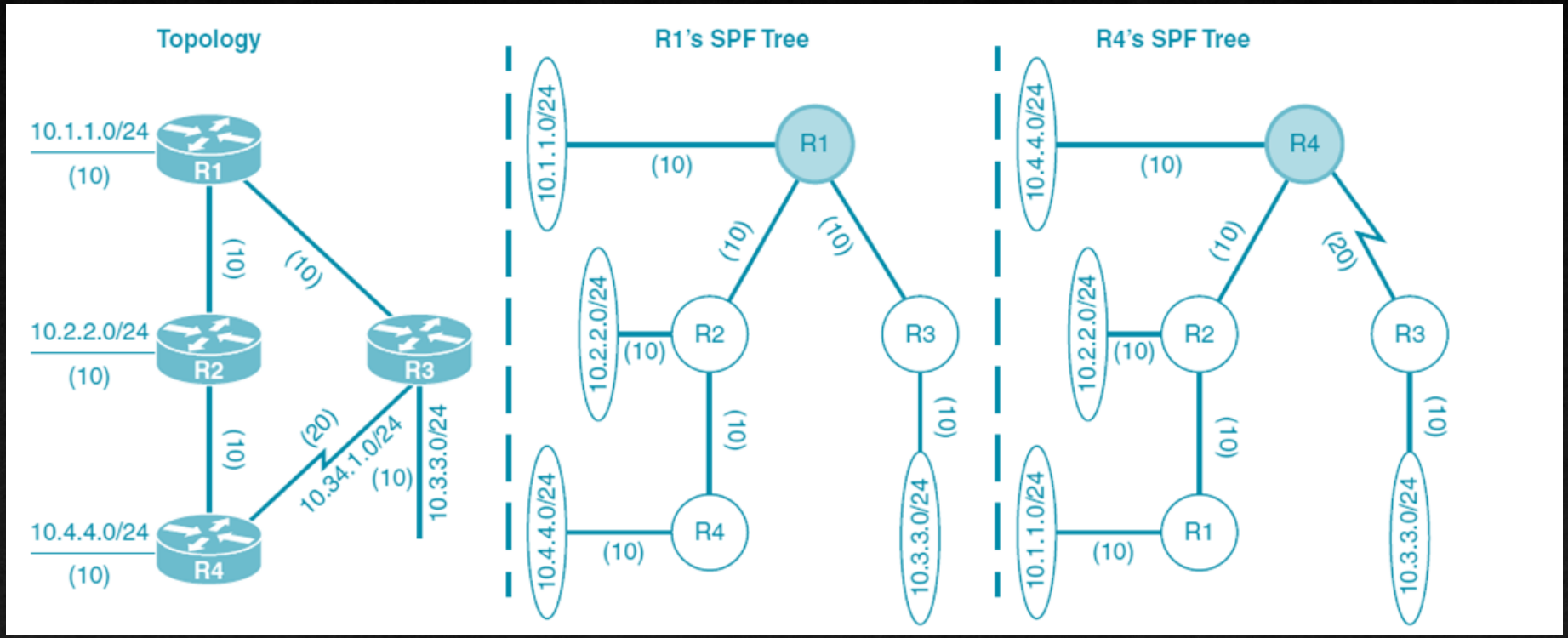
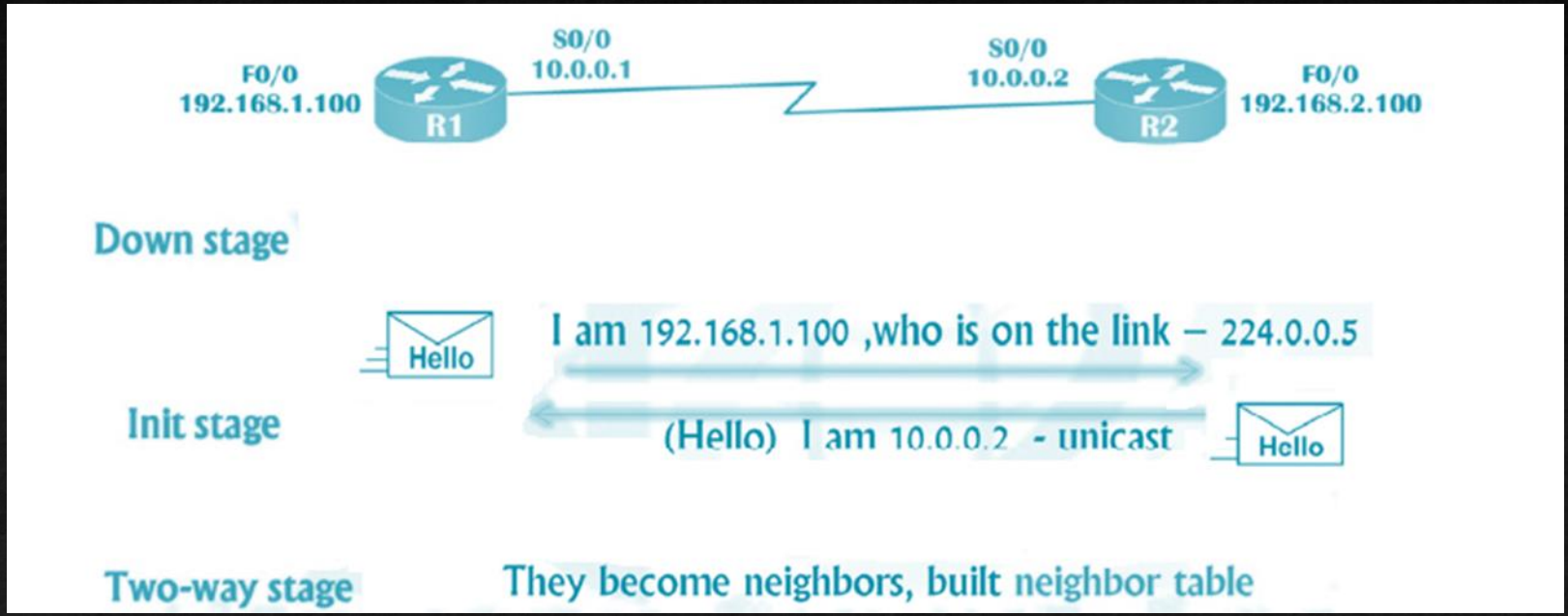
SFP Tree


Topology
10.1.1.0/24
(10)
R1
(10)
(10)
10.2.2.0/24
(10)
R2
R3
(10)
(20)
10.34.1.0/24
(10)
10.3.3.0/24
10.4.4.0/24
(10)
R4
R1's SPF Tree
10.1.1.0/24
(10)
R1
(10)
(10)
10.2.2.0/24
(10)
R2
R3
(10)
(10)
10.4.4.0/24
(10)
R4
10.3.3.0/24
R4's SPF Tree
10.4.4.0/24
(10)
R4
(10)
(20)
10.2.2.0/24
(10)
R2
R3
(10)
(10)
10.1.1.0/24
(10)
R1
10.3.3.0/24

OSPF Process

- Down
- init
- 2 way
- Exstart
- Exchange
- Loading
- Full

OSPF Process(Cont.)



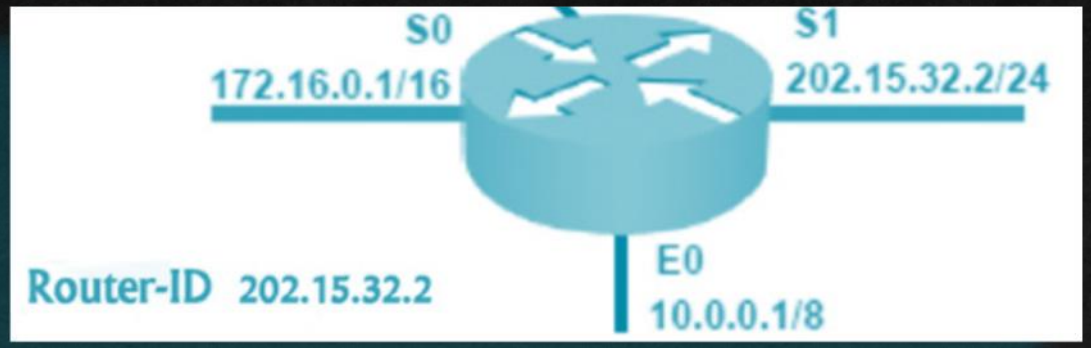
OSPF Hello Packet

Hello Packet

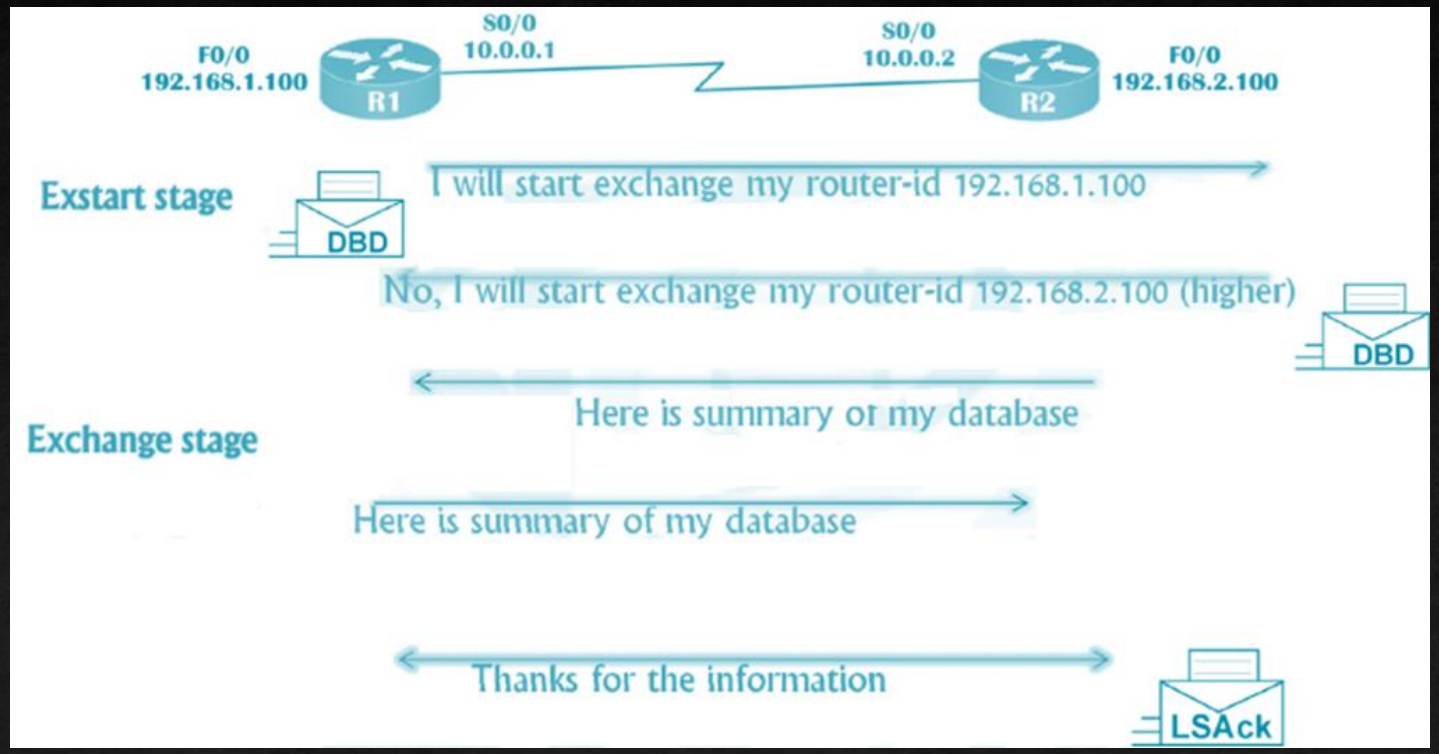
- Router ID
- Hello / Dead Interval *
- Neighbors
- Area ID *
- Router Priority
- DR IP Address
- BDR IP Address
- Authentication
- Password *
- Stub Area Flag *

OSPF router ID

- Used to identify the router inside the OSPF database
- OSPF identify using same ID in all directions
- Default uses highest IP address of active physical interface



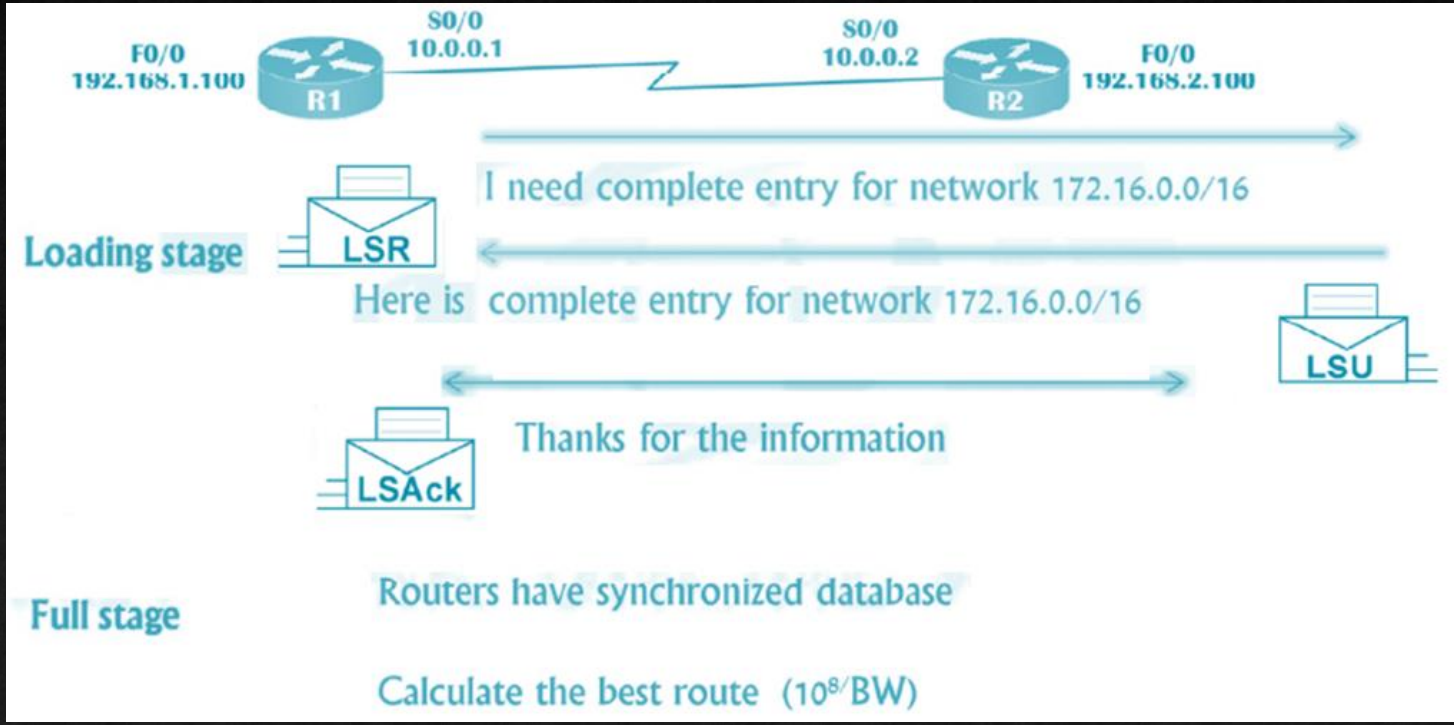
OSPF Process(Cont.)



OSPF Tables

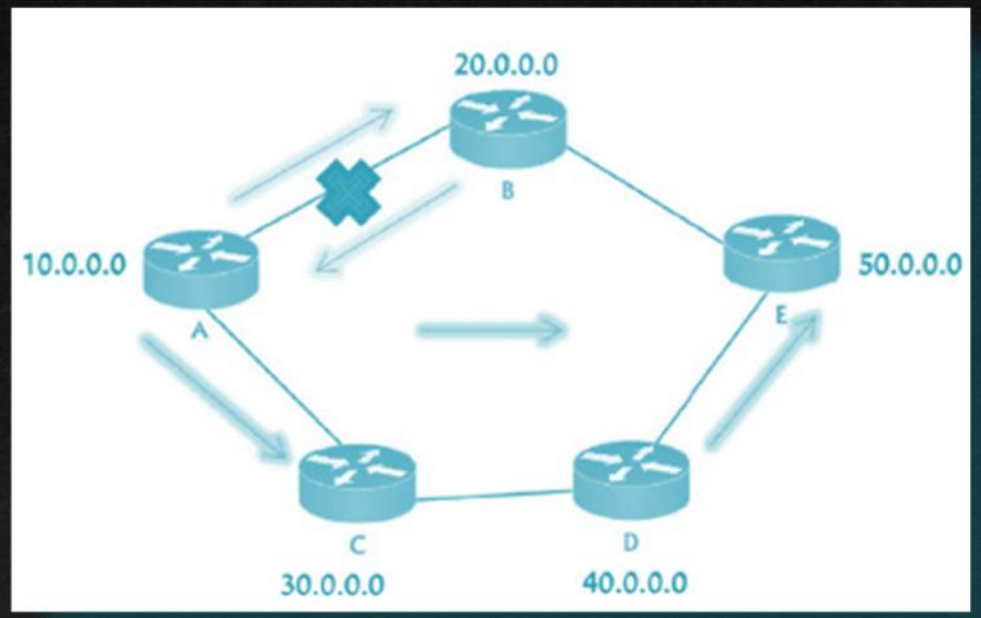
- Neighbor Table
  - Contains list of directly connected routes
  - # show ip ospf neighbor
- Routing Table
  - The best route to destination
  - # show ip route
- Database table
  - Referred to as LSDB (link state database)
  - Contains information about all the possible routes to the networks with in the area
  - # show ip ospf database

OSPF Process(Cont.)



OSPF Convergence

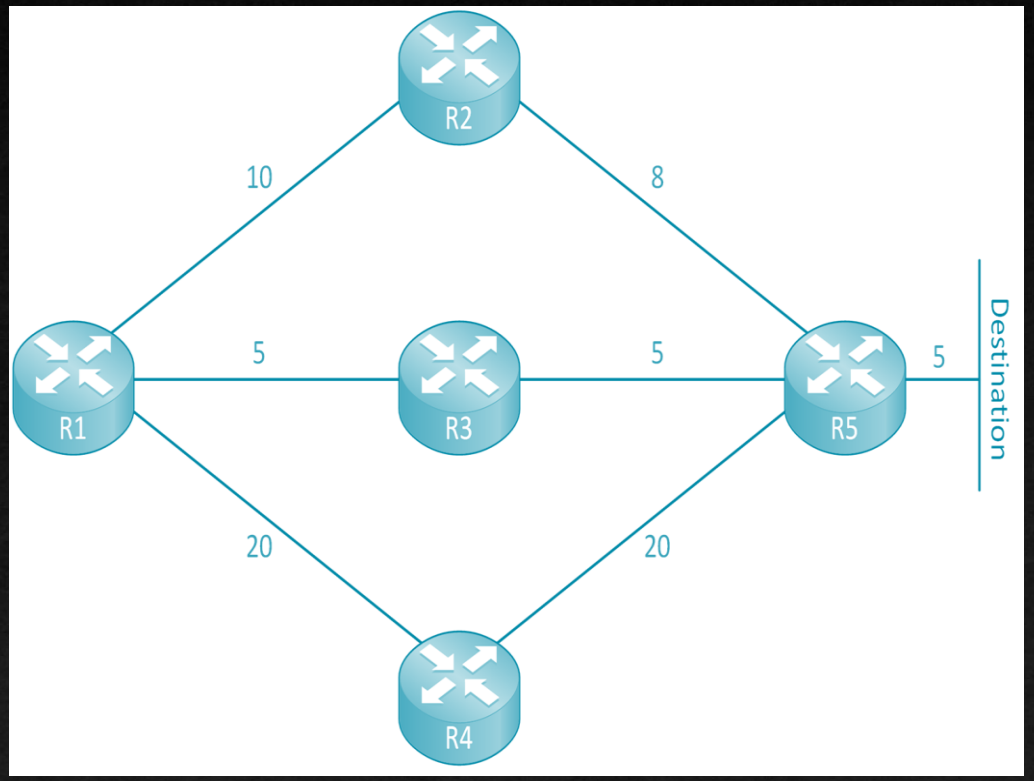
- Incremental updates
- Periodically send hello packets are sent every 10 seconds (dead-40 sec)
- Convergence rate is fast (40 sec)

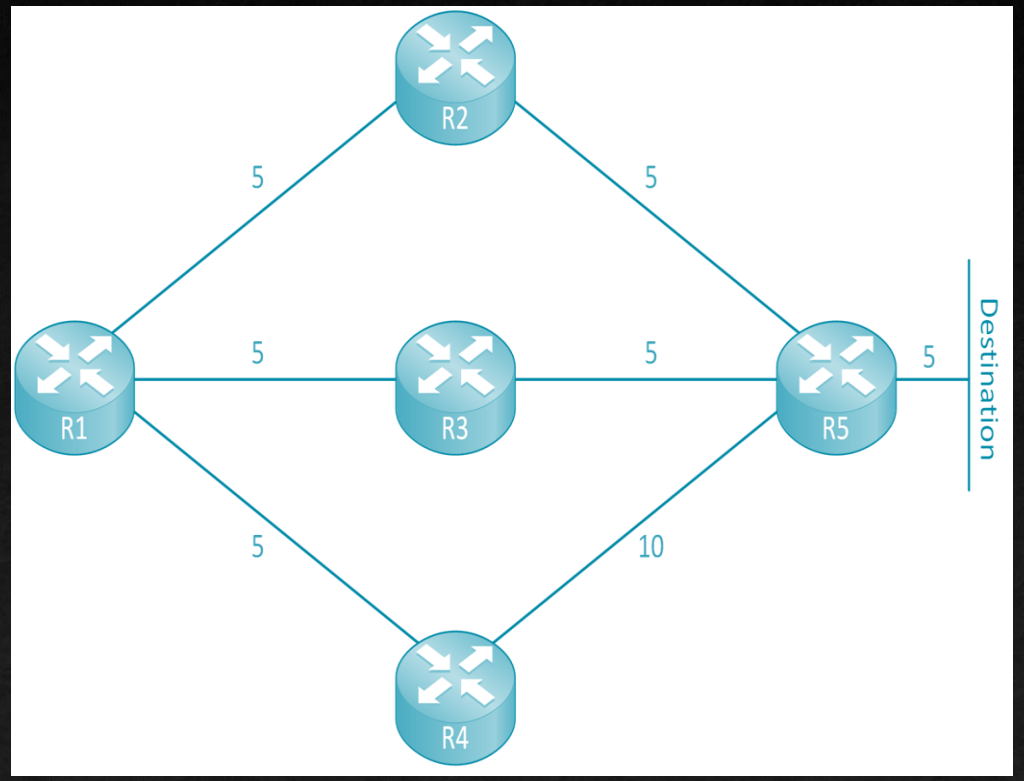


OSPF Hello Packets

Data Field	Description
Router ID (RID)	A unique 32-bit ID within an OSPF domain.
Authentication Options	A field that allows secure communication between OSPF routers to prevent malicious activity. Options are none, plaintext, or Message Digest 5 (MD5) authentication.
Area ID	The OSPF area that the OSPF interface belongs to. It is a 32-bit number that can be written in dot-decimal format (0.0.1.0) or decimal (256).
Interface Address Mask	The network mask for the primary IP address for the interface out which the hello is sent.
Interface Priority	The router interface priority for DR elections.
Hello Interval	The time interval, in seconds, at which a router sends out hello packets on the interface.
Dead Interval	The time interval, in seconds, that a router waits to hear a hello from a neighbor router before it declares that router down.
Designated Router and Backup Designated Router	The IP address of the DR and backup DR (BDR) for that network link.
Active Neighbor	A list of OSPF neighbors seen on that network segment. A router must have received a hello from the neighbor within the dead interval.

OSPF Path Calculation





OSPF LoadBalancing Criteria

- Paths must have an equal cost.
- OSPF adds paths with an equal cost in the routing table.
- The default value is a maximum of 4 equal-cost paths.
- The maximum value is 32 equal-cost paths (this could depend on your platform and/or IOS version though)
- To make paths equal cost, change the “cost” of a link.

OSPF Configuration

- The configuration process for OSPF occurs mostly under the OSPF process, but some OSPF options go directly on the interface configuration submode.
- The OSPF process ID is locally significant but is generally kept the same for operational consistency.
- OSPF is enabled on an interface using two methods:
  - OSPF network statement
  - Interface-specific configuration

OSPF Configuration (Cont.)

- Method:1
  - Router(config)# router ospf PROCESS_ID
  - Router(config-router)# network INTERFACE_IP WC_MASK area AREA_ID

  Example:
  Router(config)# router ospf 1
  Router(config)# network 10.1.2.1 0.0.0.0 area 0
- Method 2:
  - Router(config)# interface INT_NAME
  - Router(config-if)# ip ospf PROCESS-ID area AREA_ID

  Example:
  Router(config)#interface se1/0
  Router(config-if)# ip ospf 1 area 0

OSPF Verification

- Show ip protocols
- show ip ospf interface
- show ip ospf interface brief
- Show ip ospf database
- show ip ospf neighbor
- show ip route ospf

OSPF Neighborship

- An OSPF neighbor is a router that shares a common OSPF-enabled network link.
- OSPF routers discover other neighbors through the OSPF hello packets.
- An adjacent OSPF neighbor is an OSPF neighbor that shares a synchronized OSPF database.
- Each OSPF process maintains a table for adjacent OSPF neighbors and the state of each router.

Requirements for Adjacency

- The following list of requirements must be met for an OSPF neighborship to be formed:
  - The RIDs must be unique between the two devices. To prevent errors, they should be unique for the entire OSPF routing domain.
  - The interfaces must share a common subnet. OSPF uses the interface's primary IP address when sending out OSPF hellos. The network mask (netmask) in the hello packet is used to extract the network ID of the hello packet.
  - The interface maximum transmission unit (MTU) must match because the OSPF protocol does not support fragmentation.
  - The area ID must match for that segment.
  - The need for a DR must match for that segment.
  - OSPF hello and dead timers must match for that segment.
  - The authentication type and credentials (if any) must match for that segment.
  - Area type flags must be identical for that segment (stub, NSSA, and so on).

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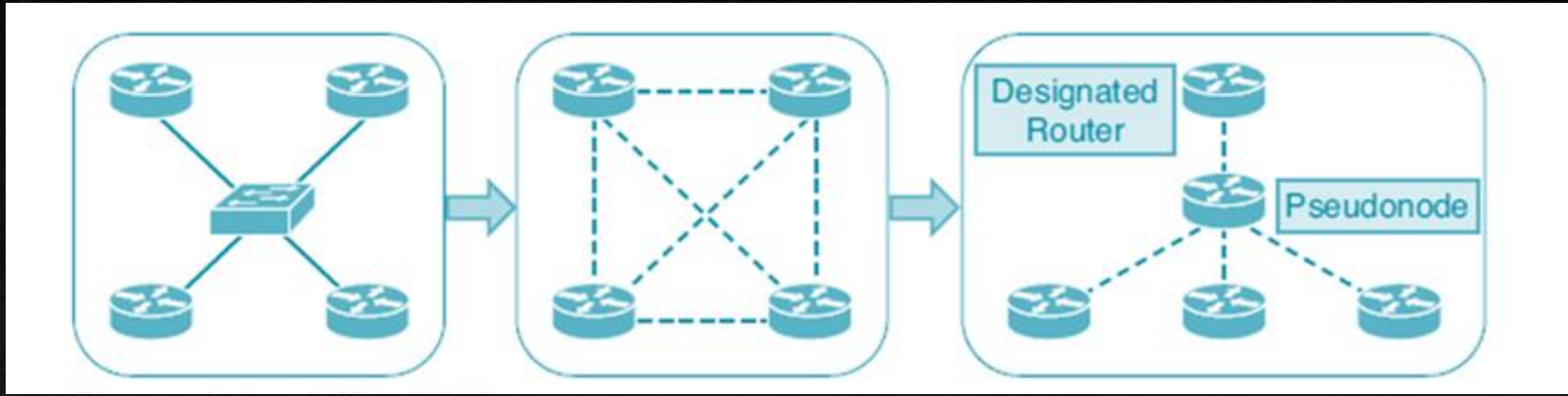
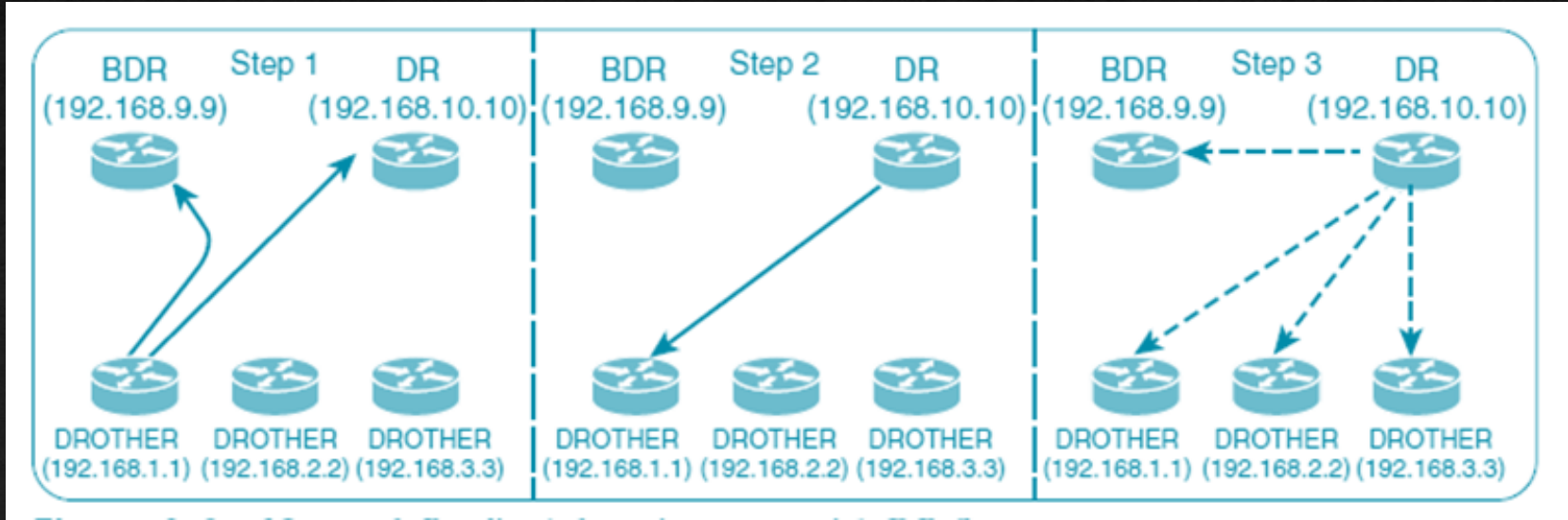
DR and BDR Concept

- Multi-access networks such as Ethernet (LANs) and Frame Relay networks allow more than two routers to exist on a network segment.
- Additional routers flood more LSAs on the segment, and OSPF traffic becomes excessive as OSPF neighbor adjacencies increase.
- The Designated Router (DR) reduces the number of OSPF adjacencies on a multi-access network segment because routers form full OSPF adjacencies only with the DR and not each other.

DR and BDR Concept (Cont.)





OSPF LSA TYPE

LSA TYPE	COMMON Name
1	Router
2	Network
3	Net Summary
4	ASBR Summary
5	AS External
6	Group Membership
7	NSSA External
8	External Attributes
9-11	Opaque

QnA