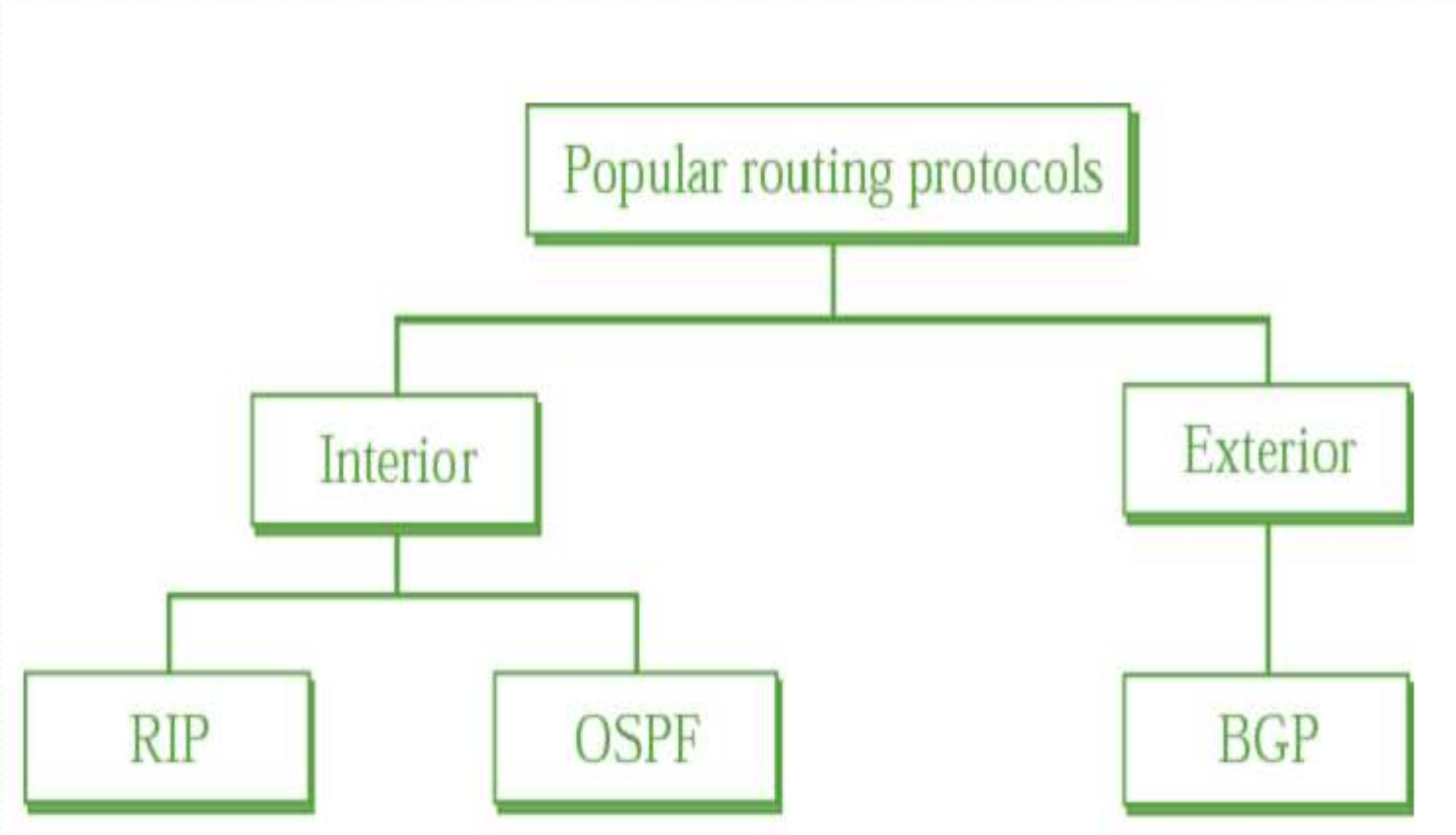
Open Shortest Path First (OSPF)

Respa Peter

Routing protocol

- A **routing protocol** specifies how routers communicate with each other
- Routing algorithms determine the specific choice of route.



- Suffered from problems of Distance Vector Protocol
  - ✓ ***Count to Infinity Problem***
  - ✓ ***Slow Convergence***
  - ✓ ***Large update packets***
  - ✓ ***Slow response to topological changes***

- Need for a Link State Protocol.

OSPF

- OSPF Open Shortest Path First is a link-state routing protocol that was developed in 1991.
- OSPF was developed as a replacement for the distance vector routing protocol RIP .
- Based on Bellman-Ford Algorithm
- Worked well in small systems

Areas

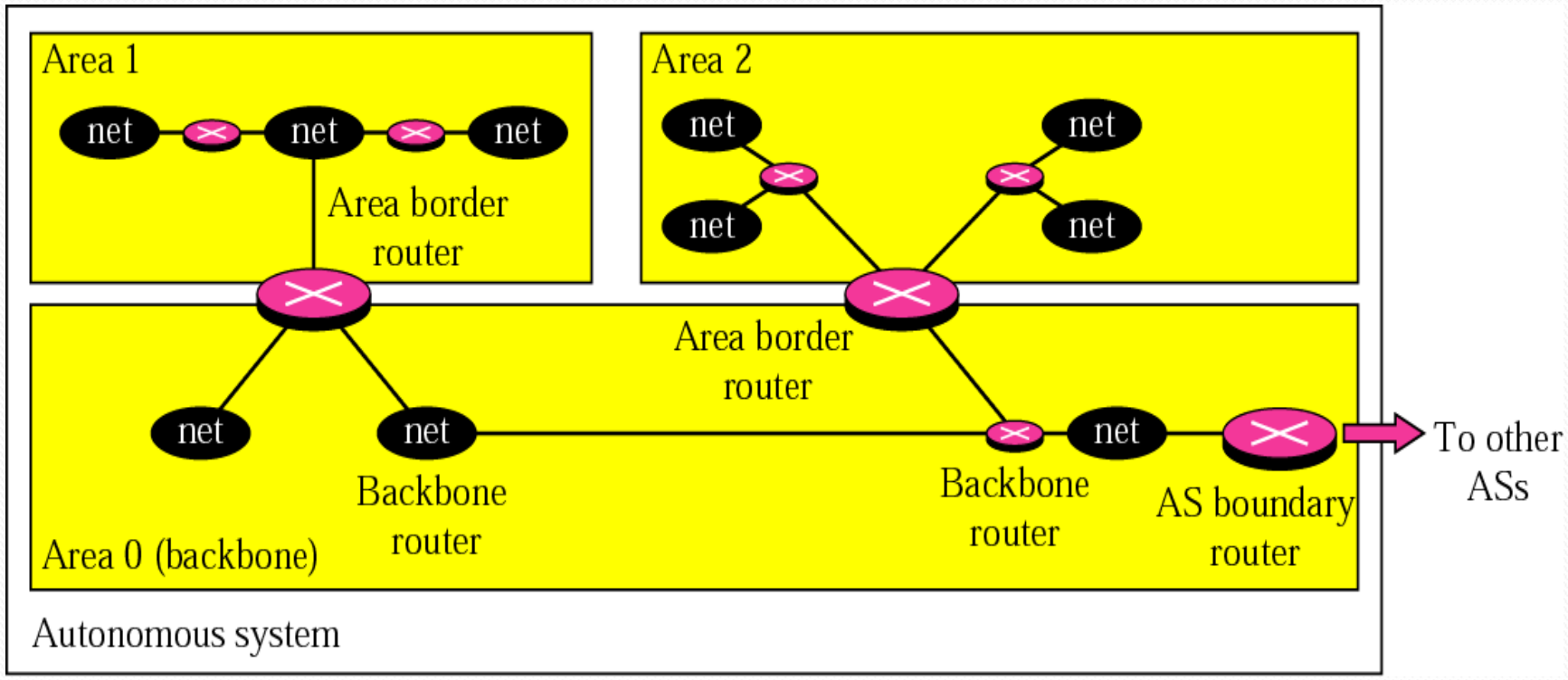
- An OSPF network can be divided into sub-domains called areas.
- An area is a logical collection of OSPF networks, routers, and links that have the same area identification.
- Areas limit the scope of route information distribution. It is not possible to do route update filtering within an area.

- The main benefit of creating areas is a reduction in the number of routes to propagate—by the filtering and the summarization of routes.
- Areas are identified by an area ID.
- All network inside an area must be connected.
- At the border of an area, special router called **area border routers**.
- It summarize the information and send to other areas

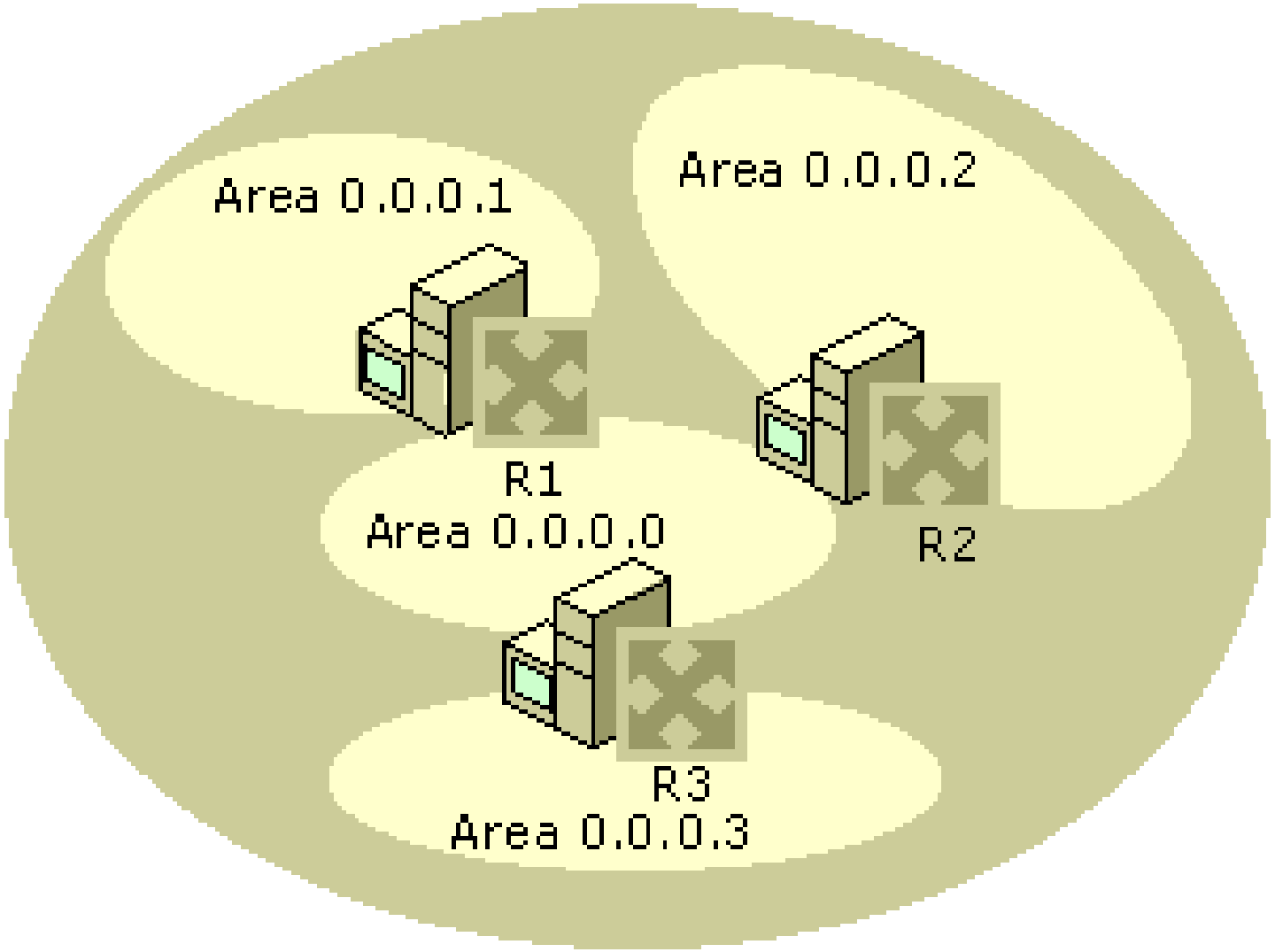
Backbone Area

- **A backbone area**—which combines a set of independent areas into a single domain.
- The backbone has the reserved area ID of 0.0.0.0. The OSPF backbone area is also known as area 0.
- The backbone acts as a hub for inter-area transit traffic and the distribution of routing information between areas
- Each non-backbone area must be directly connected to the backbone area.
- The backbone area must not be partitioned—divided into smaller pieces—under any failure conditions

- The backbone serves as primary area and the other areas as secondary areas.
- The router inside backbone area is known as ***backbone routers***.



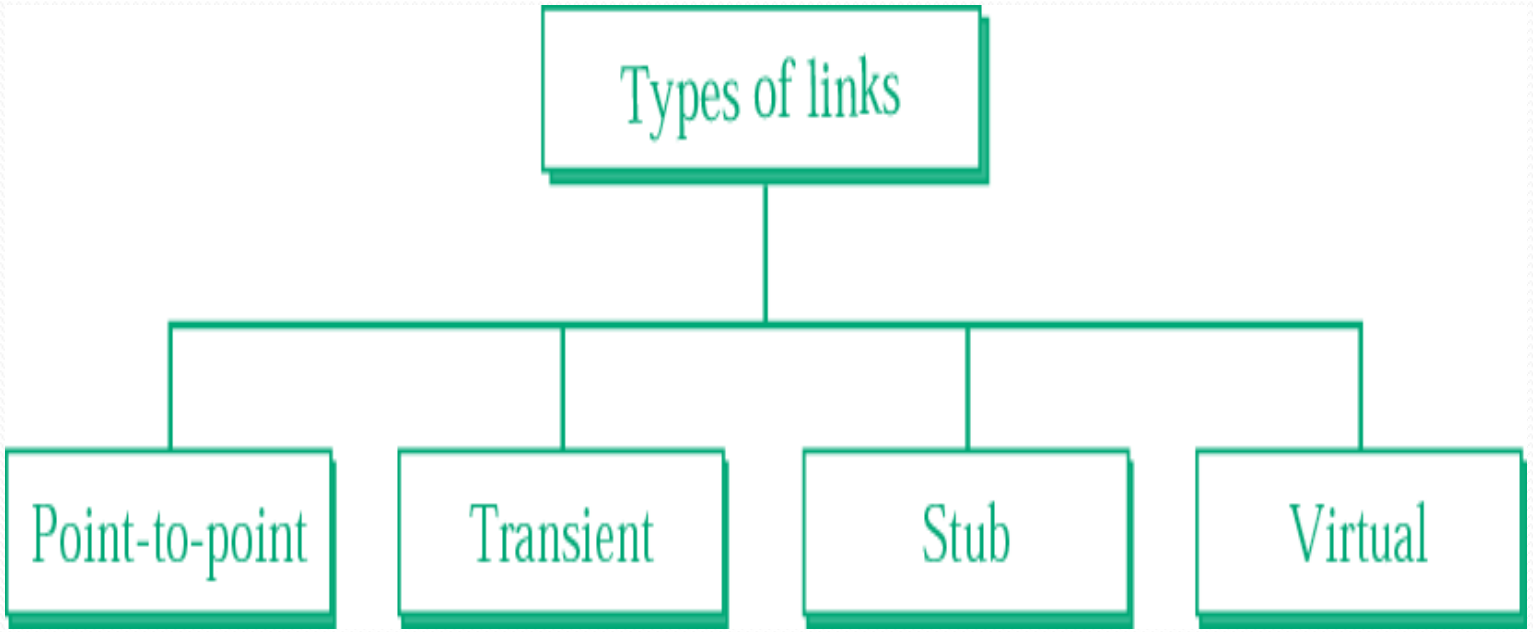
Autonomous System (AS)



OSPF (type of links)

- In OSPF , a connection called a link.

- Four types of links have been defined they are:



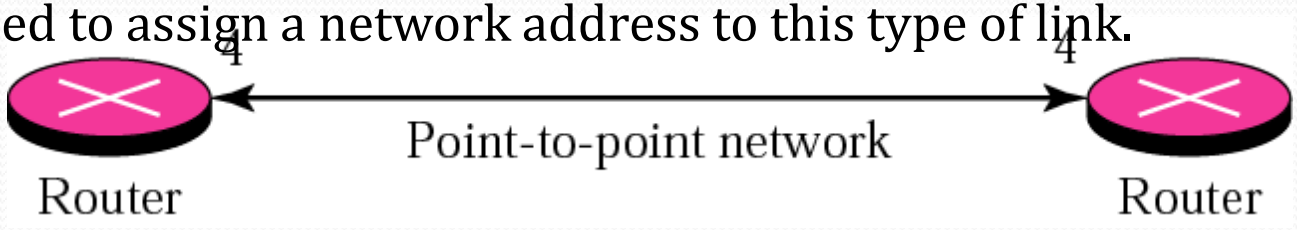
❖ *Point-to-Point Link*

❑A point-to-point link is a dedicated link that connects exactly two communication facilities.

❑It connect two routers without any other host or router in between.

Eg : Telephone line .

❑No need to assign a network address to this type of link.



Router - Nodes

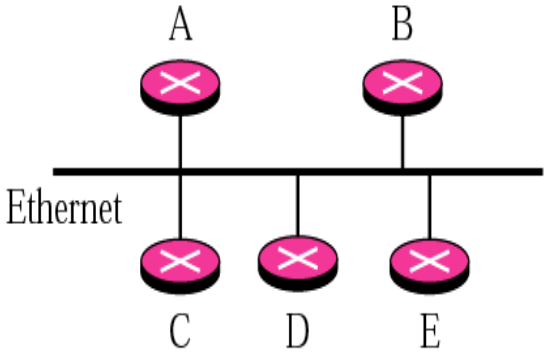
Link – Bidirectional edge

❖ *Transient link*

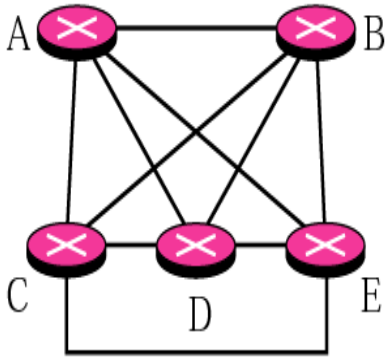
•Several routers attached to it.

•Data can enter or retrive through any routers.

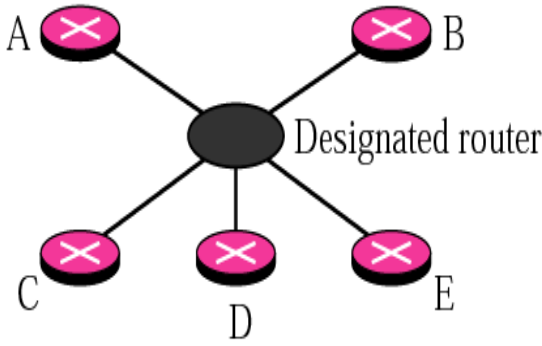
•Each routers have many no: of neighbors.



a. Transient network



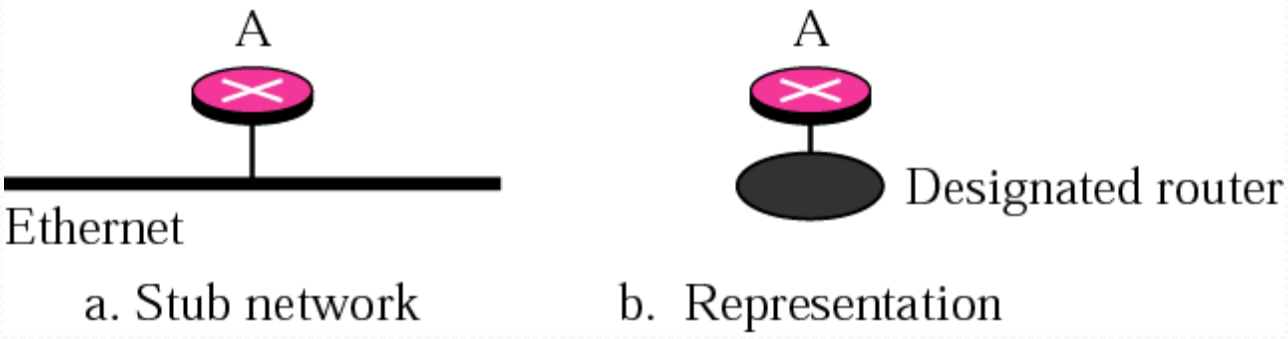
b. Unrealistic representation



c. Realistic representation

❖ *Stub Link*

- Connected only to one router.
- Data enter and leave through this single router.
- Only one direction



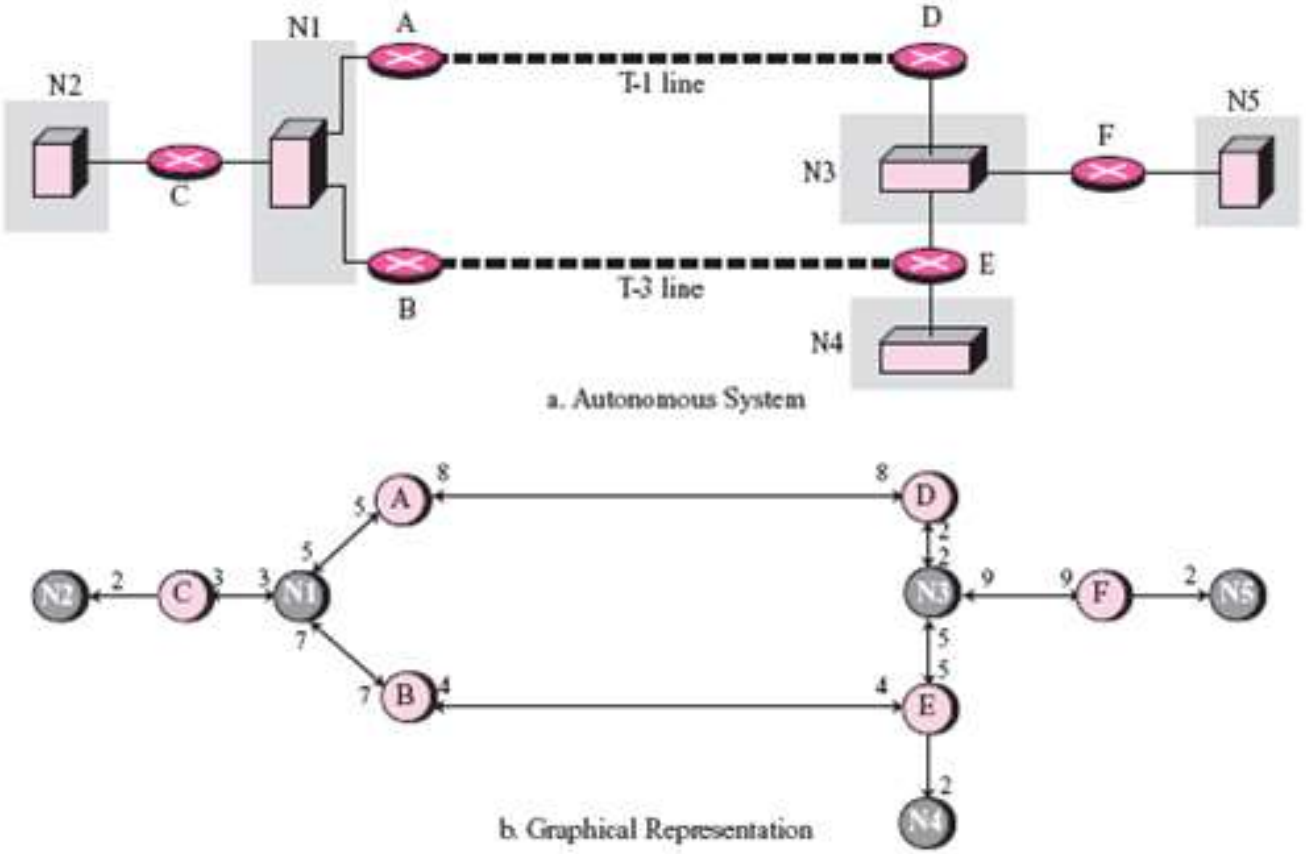
❖ *Virtual Link*

- When link between two routers are broken, the administrator create a virtual link between them

Using a longer path, which pass through several routers.

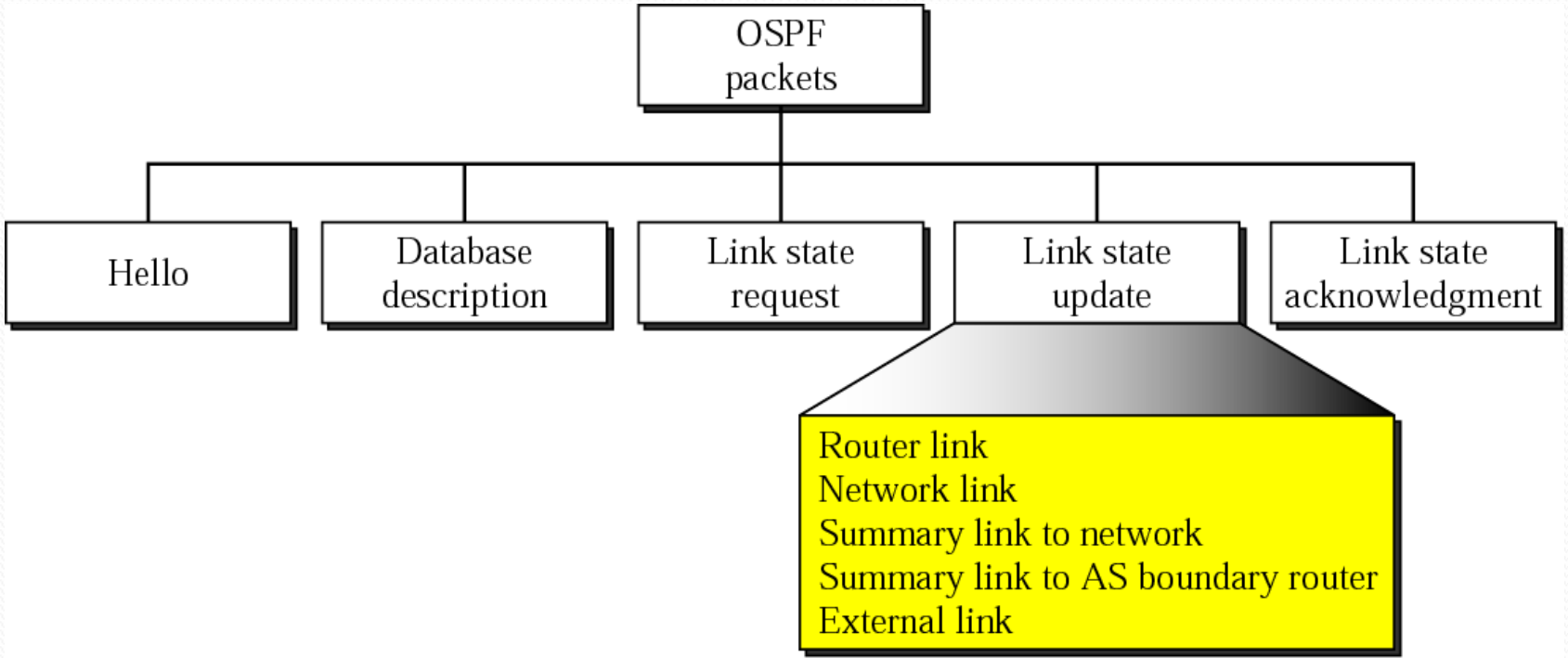
Graphical Representation

- An AS can represent graphically.



OSPF Packets

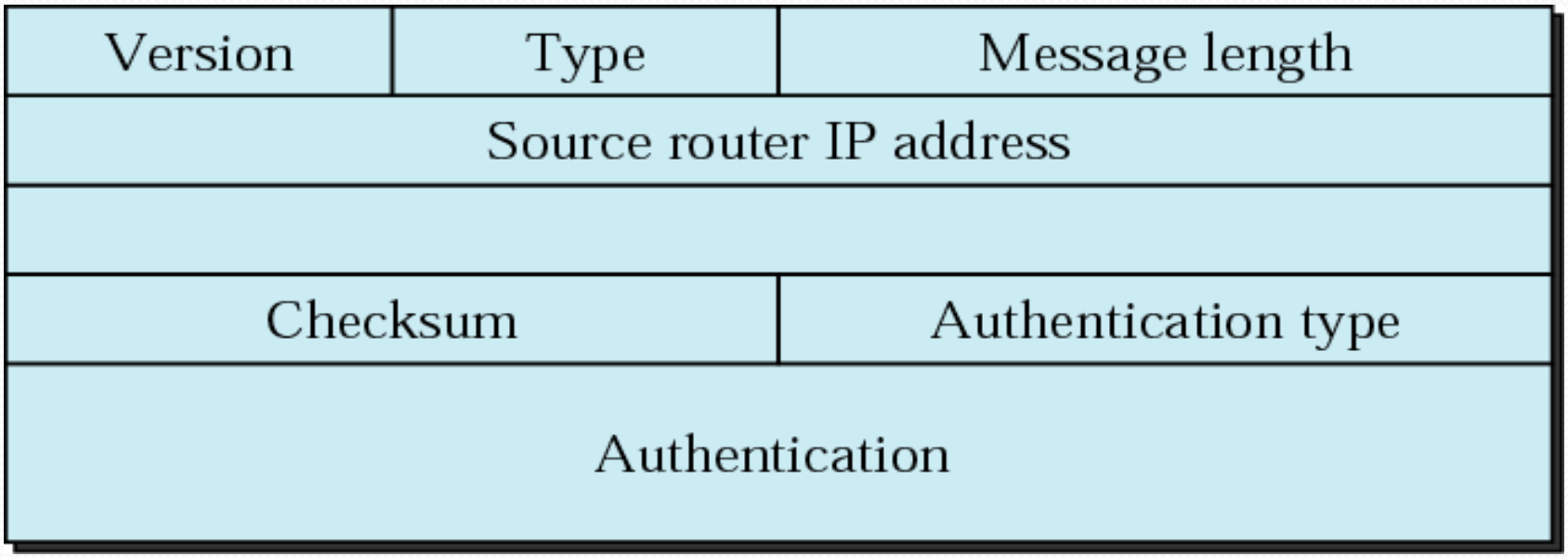
- It uses five different packets:
  - *hello*
  - *database description*
  - *link state acknowledgment*



OSPF Packet Type	Description
Type 1 - Hello	Establishes and maintains adjacency information with neighbors
Type 2 - Database description packet (DBD)	Describes the content of the link-state database on an OSPF router
Type 3 - Link-state request (LSR)	Requests specific pieces of a link-state database
Type 4 - Link-state update (LSU)	Transports link-state advertisements (LSAs) to neighbor routers
Type 5 - Link-state acknowledgement (LSAck)	Acknowledges receipt of a neighbor's LSA

Common Header

- All packets have common headers.



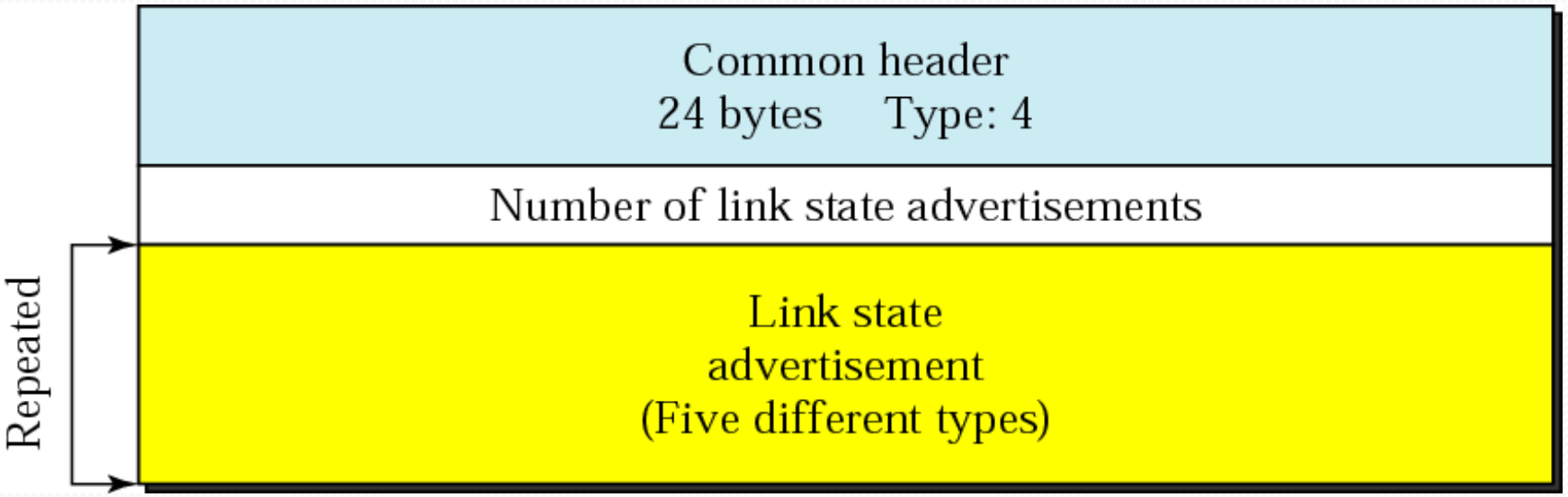
Version	8 bit field define the version of OSPF protocol
Type	8 bit field Define type of packet
Message length	16 bit field, define length of total length including header
Source router IP address	32 bit field define IP address of router that send packets
Area identification	32 bit field
Checksum	Used for error detection on entire packet excluding authentication type and authentication data field
Authentication type	16 bit Define authentication protocol used in this area; two types 0 – none 1 – password
Authentication	64 bit

Link State Update Packet

LS Type: Indicates the type of link this LSA describes:

Value	Link Type	Description
1	*Router-LSA*	Link to a router
2	*Network-LSA*	Link to a network
3	*Summary-LSA (IP Network)*	When areas are used, summary information generated about a network.
4	*Summary-LSA (ASBR)*	When areas are used, summary information about a link to an AS boundary router.
5	*AS-External-LSA*	An external link outside the autonomous system.

- Heart of the OSPF operation.
- Used by a router to advertise the state of its links.



•Each update packet contain several different LSAs.

•All having same general headers

Link state age	Received	E	T	Link state type
Link state ID				
Advertisement Router				
Link state Sequence number				
Link state checksum	Length			

Other Packets

A. OSPF Hello Protocol

Network Mask		
Hello Interval	Options	Router Priority
Dead Interval		
Designated Router		
Backup Designated Router		
Neighbor Router ID		
Neighbor Router ID		
(additional Neighbor Router ID fields can be added to the end of the header, if necessary)		

➢**Hello subprotocol** is intended to perform the following tasks within OSPF:

✓Dynamic neighbor discovery

✓Detect unreachable neighbors

✓Ensure two-way communications between neighbors

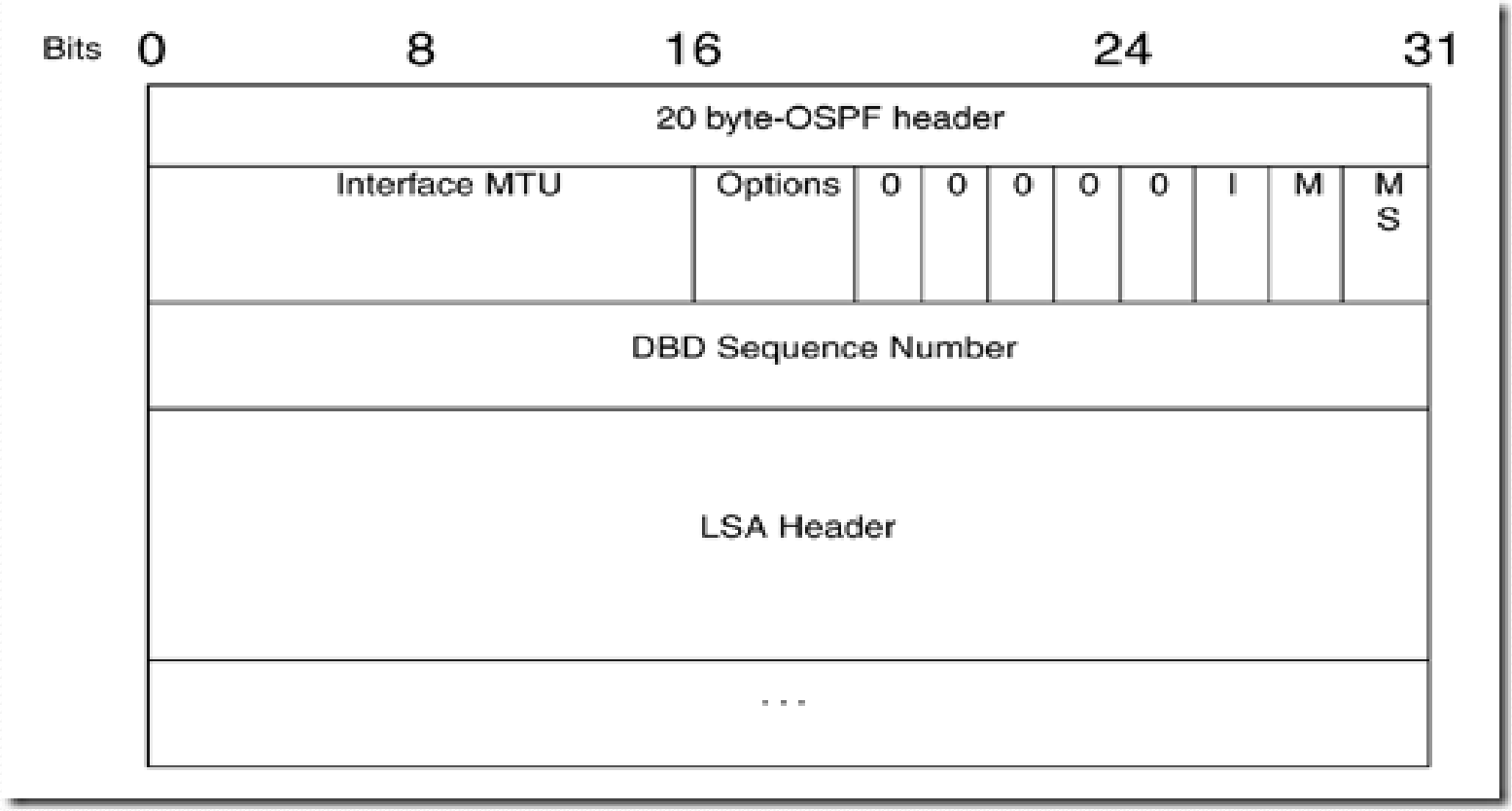
✓Ensure correctness of basic interface parameters between neighbors

✓Provide necessary information for the election of the Designated and Backup Designated routers on a LAN segment (coming)

B. Database Description Message

- Is used mostly during the database exchange
- The first DBD packet is used to elect the master and slave relationship and to set the initial sequence number elected by the master.
- The router with the highest router ID becomes the master and initiates the database synchronization.
- The master sends the sequence number, and the slave acknowledges it.
- After the master and the slave are elected, the database synchronization starts; in this process, the headers of all the LSAs are exchanged with neighbors.

➢The DBD packet format.



I Bit— When set to 1, this means that this is the first packet in DBD exchange.

M Bit— When set to 1, this means that more packets will follow.

MS Bit— Use this for master and slave. When this bit is set, it means that the router is a master in the DBD exchange process. If this bit is set to 0, it means that the router is the slave.

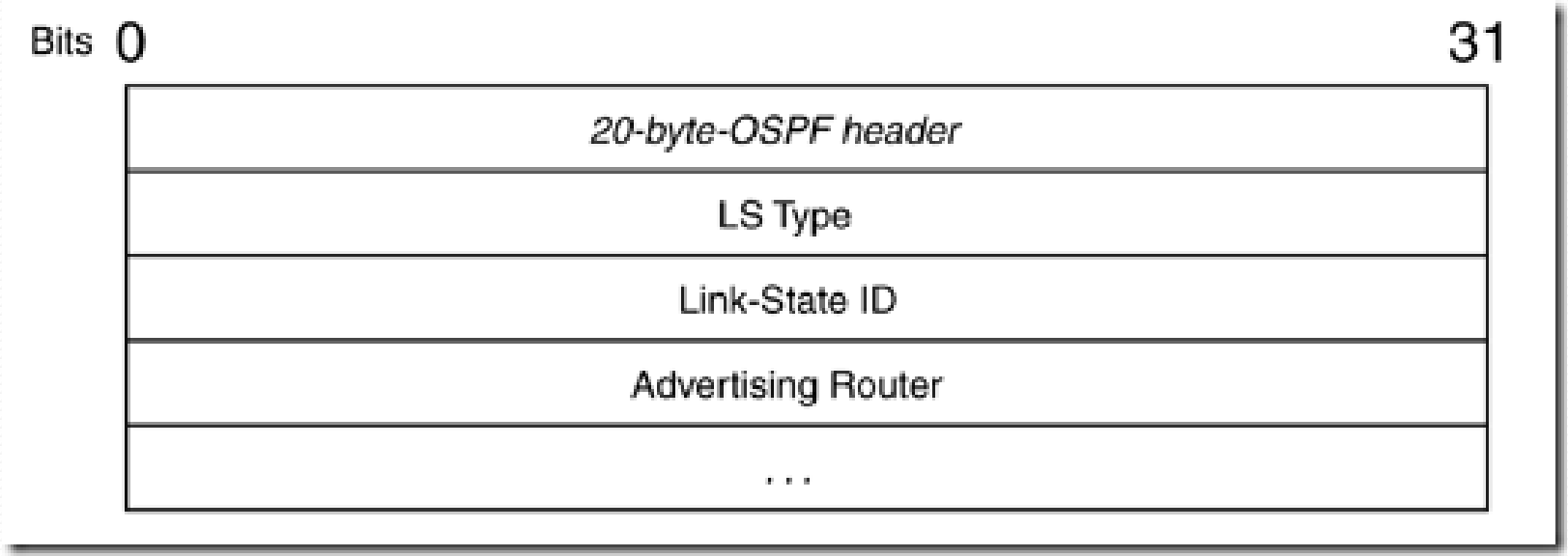
DBD Sequence Number— This field contains a unique value set by the master. This sequence number is used during database exchange. Only a master can increment the sequence number.

LSA Header— This field consists of a list of the link-state database headers.

C. Link-State Request Packets

- A link-state request packet, is sent if part of the database is missing or out-of-date.
- The link-state request packet is used to retrieve that precise piece of database information that is missing.
- Link-state packets are also used after the DBD exchange is finished to request the LSAs that have been seen during the DBD exchange.

Fig illustrates the link-state request packet format.



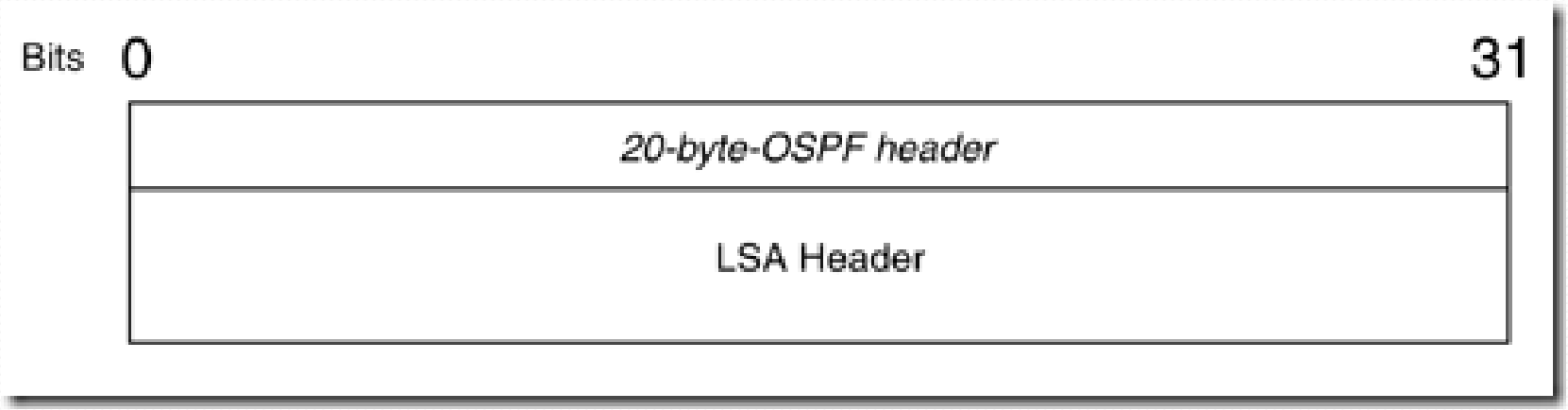
LS Type— Identifies what type of LSA is being requested.

Link-State ID— Represents the link-state ID of that specific LSA. Link-state ID is discussed later in this chapter.

Advertising Router— Contains the router ID of the router that is originating this LSA.

D. Link-State Acknowledgment Packet

- The link-state acknowledgment packet, is used to acknowledge each LSA.
- This packet is sent in response to link-state update packets.
- Multiple LSAs can be acknowledged in a single link-state acknowledgment packet.
- This packet is responsible for the reliable delivery of link-state update packets.
- Figure illustrates the link-state acknowledgment packet format.


Bits
0
31
20-byte-OSPF header
LSA Header

Thank You