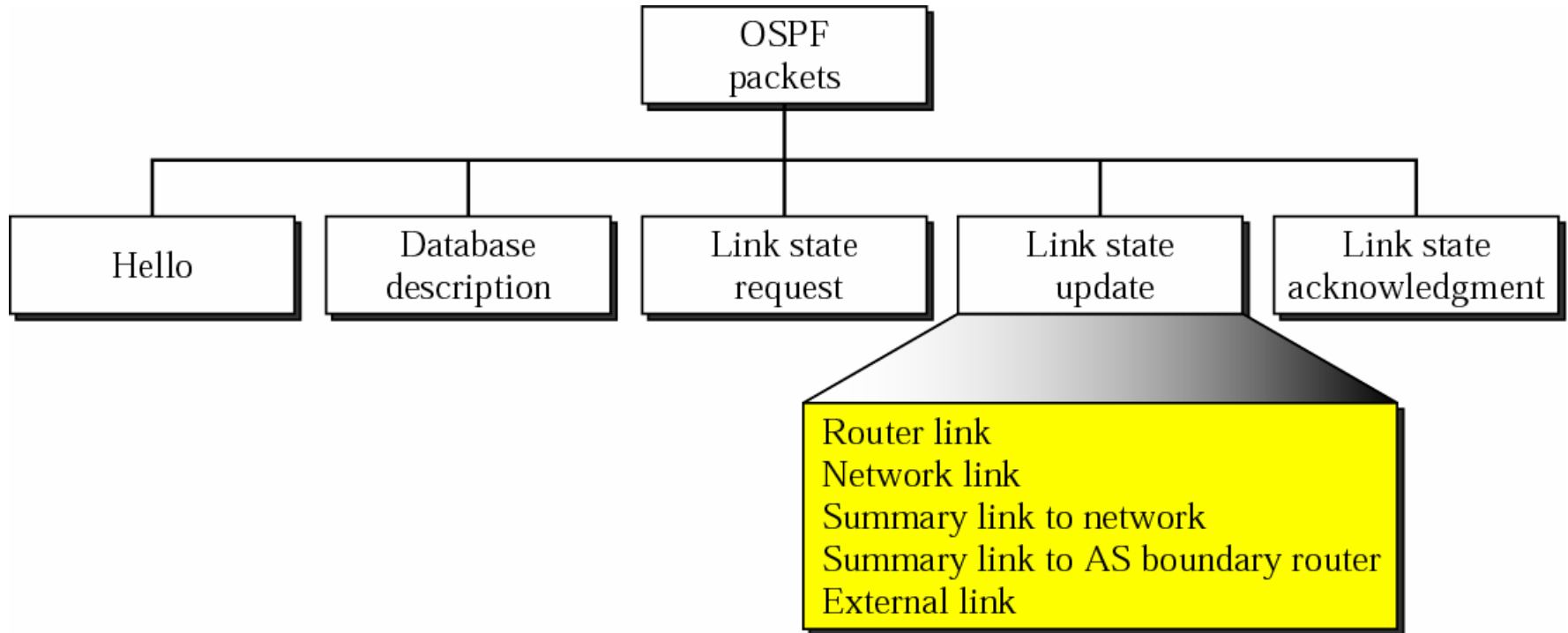# Chapter 13

Routing Protocols (RIP, OSPF, BGP) Part 3
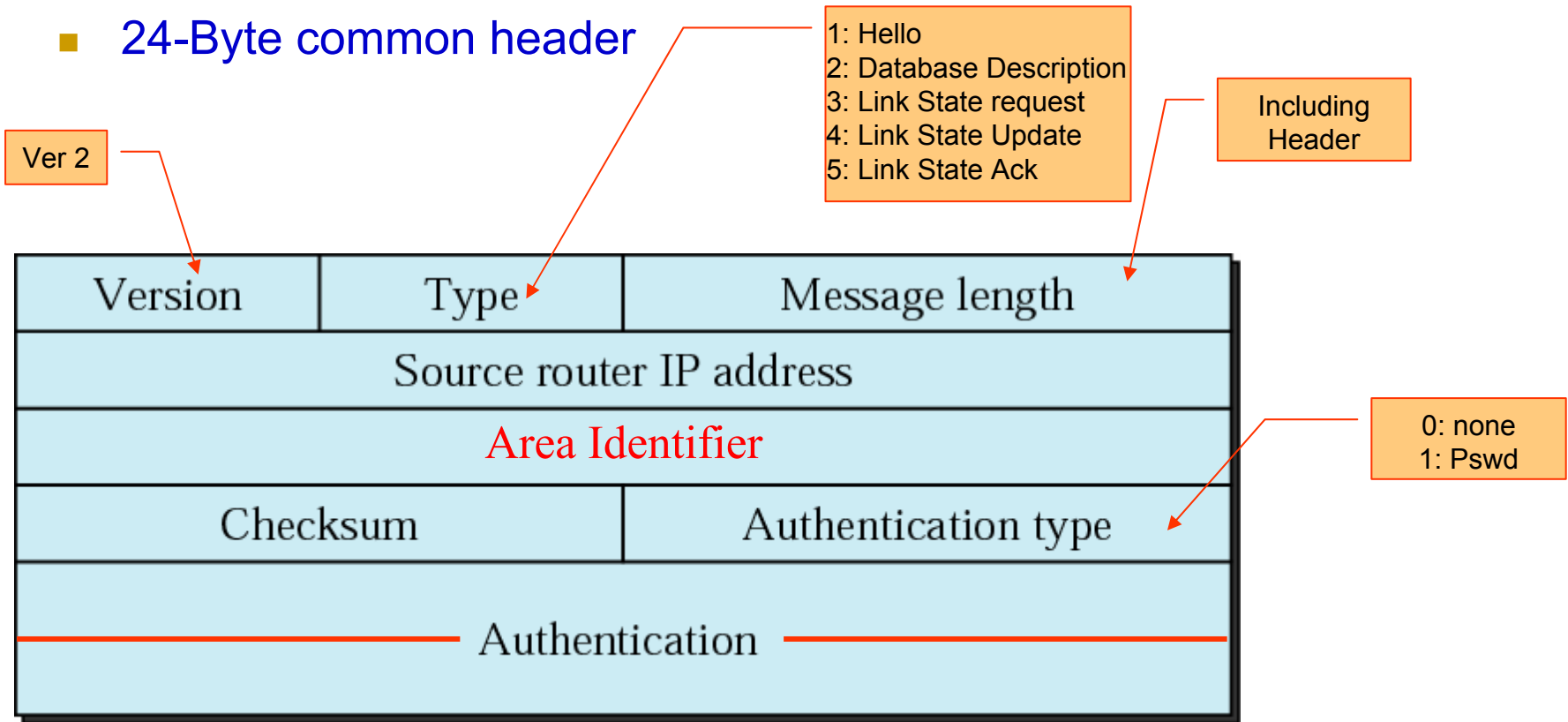
- ✓ **INTERIOR AND EXTERIOR ROUTING**
- ✓ **RIP**
- ✓ **OSPF**
- ➢ **BGP**

Types of OSPF packets

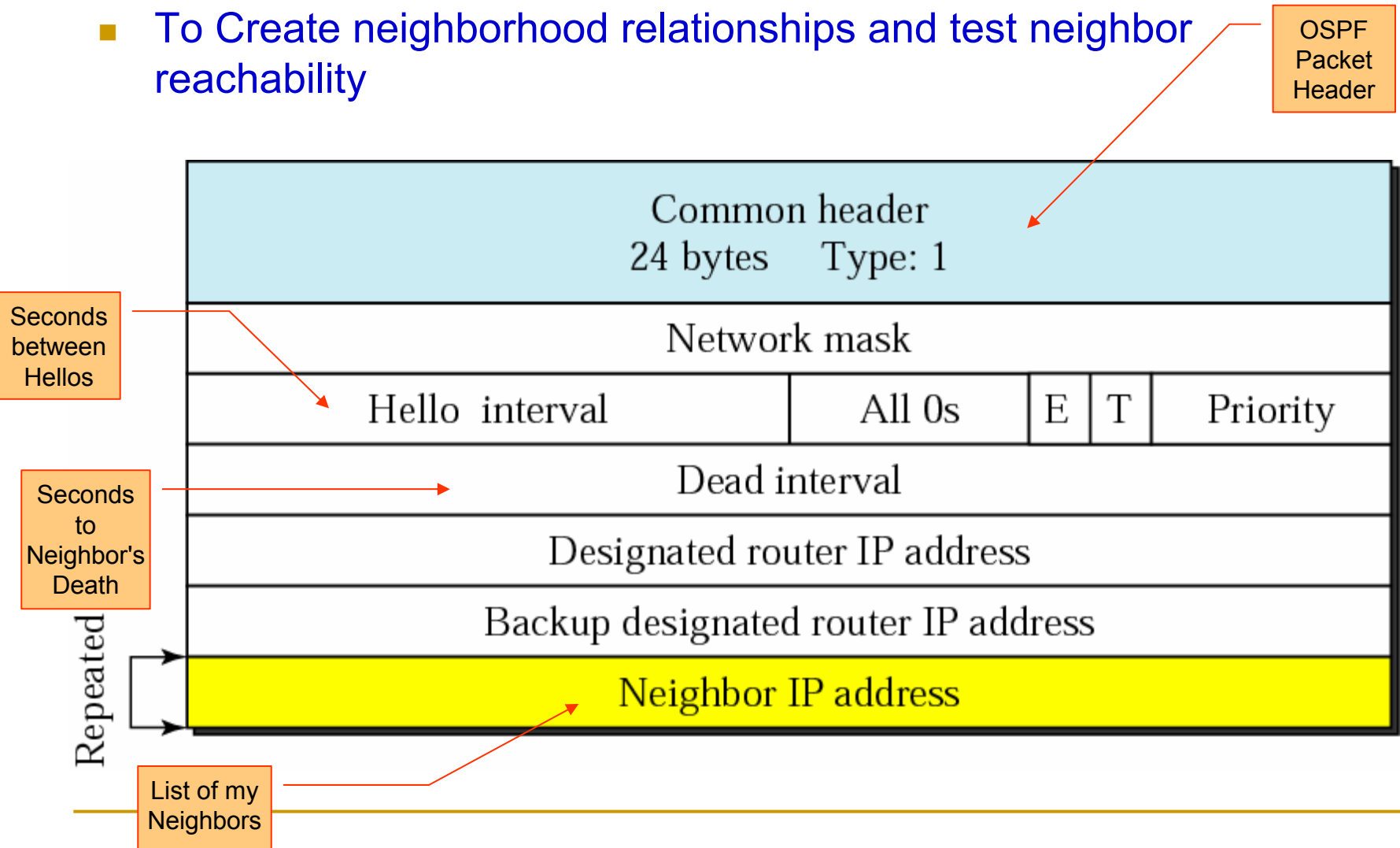© Adapted for use at JMU by Mohamed Aboutabl, 2003

OSPF Packet Header

- ## 24-Byte common header

1: Hello
2: Database Description
3: Link State request
4: Link State Update
5: Link State Ack

Including Header

Ver 2

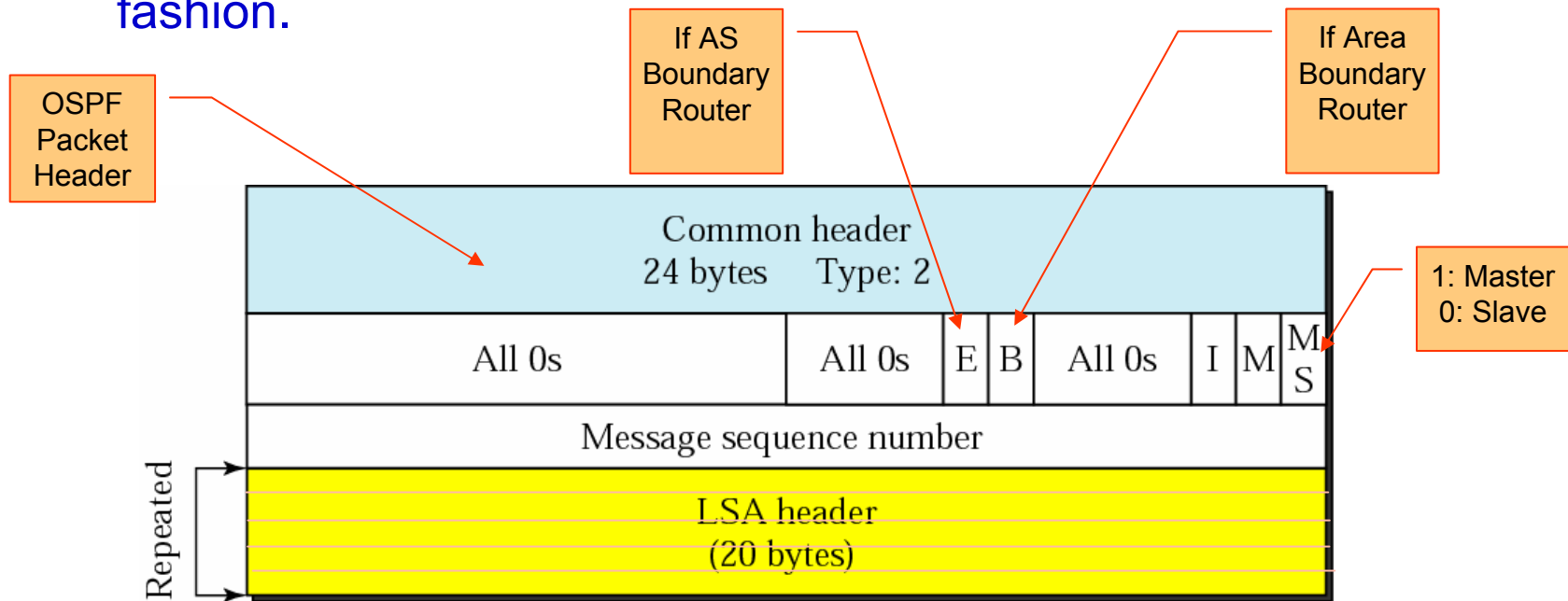| Version	Type	Message length
Source router IP address		
Area Identifier		
Checksum		Authentication type
Authentication		

0: none
1: Pswd

OSPF Packet 1: Hello packet

- First step in Link State Routing
- To Create neighborhood relationships and test neighbor reachability

OSPF Packet Header

Common header 24 bytes   Type: 1

Network mask

Seconds between Hellos

Hello interval	All 0s	E	T	Priority

Dead interval

Seconds to Neighbor's Death

Designated router IP address

Backup designated router IP address

Repeated

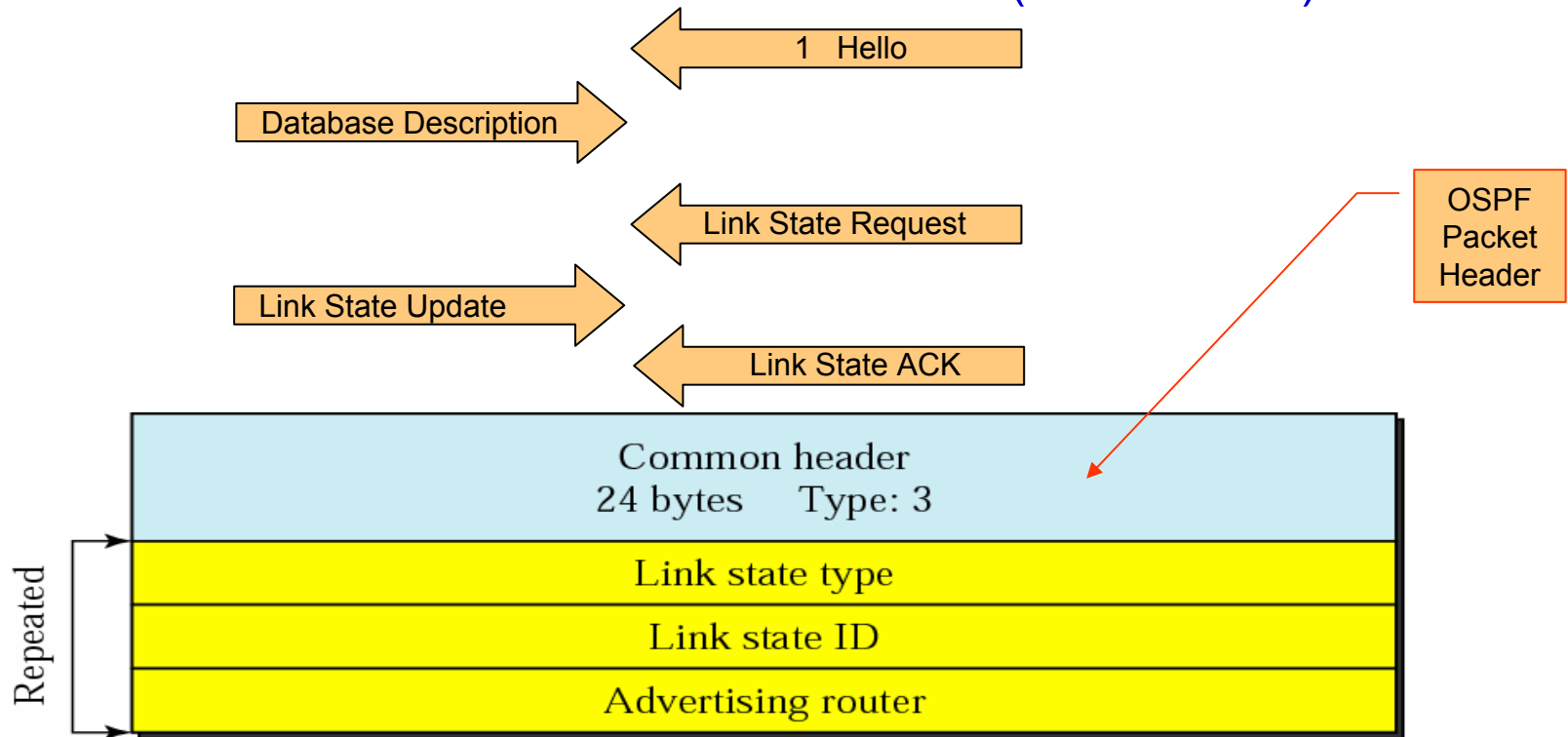| Neighbor IP address |
|---|

List of my Neighbors

4

OSPF Packet 2: Database Description packet

- Sent by a router when it hears from a neighbor (via *Hello*s) for the first time, informing the new router of the outline of the existing network topology.

- Could be very long, so it may be divided into several messages.

- The new router may later request information on specific links.

- Two routers could exchange their DD packets in a master/slave fashion.

OSPF Packet Header

If AS Boundary Router

If Area Boundary Router

1: Master
0: Slave

| Common header 24 bytes Type: 2							
All 0s	All 0s	E	B	All 0s	I	M	M S
Message sequence number							
LSA header (20 bytes)							

Repeated

OSPF Packet 3: Link State Request packet

- Sent by a router that needs information about a specific route or routes.
  - For example, by a new router after receiving a Database Description packet.
- Contains 3 fields from the route advertisement (LSA header)

←	1 Hello
Database Description →	
←	Link State Request
Link State Update →	
←	Link State ACK

OSPF Packet Header

Common header 24 bytes   Type: 3
Link state type
Link state ID
Advertising router

Repeated

OSPF Packet 4: Link State Update packet

- The heart of OSPF: used by a router to advertise the states of its links.

  - May carry multiple Link State Advertisements (**LSA**s) of different types: router LSA, network LSA, summary link to network LSA, summary link to AS border router LSA, external LSA
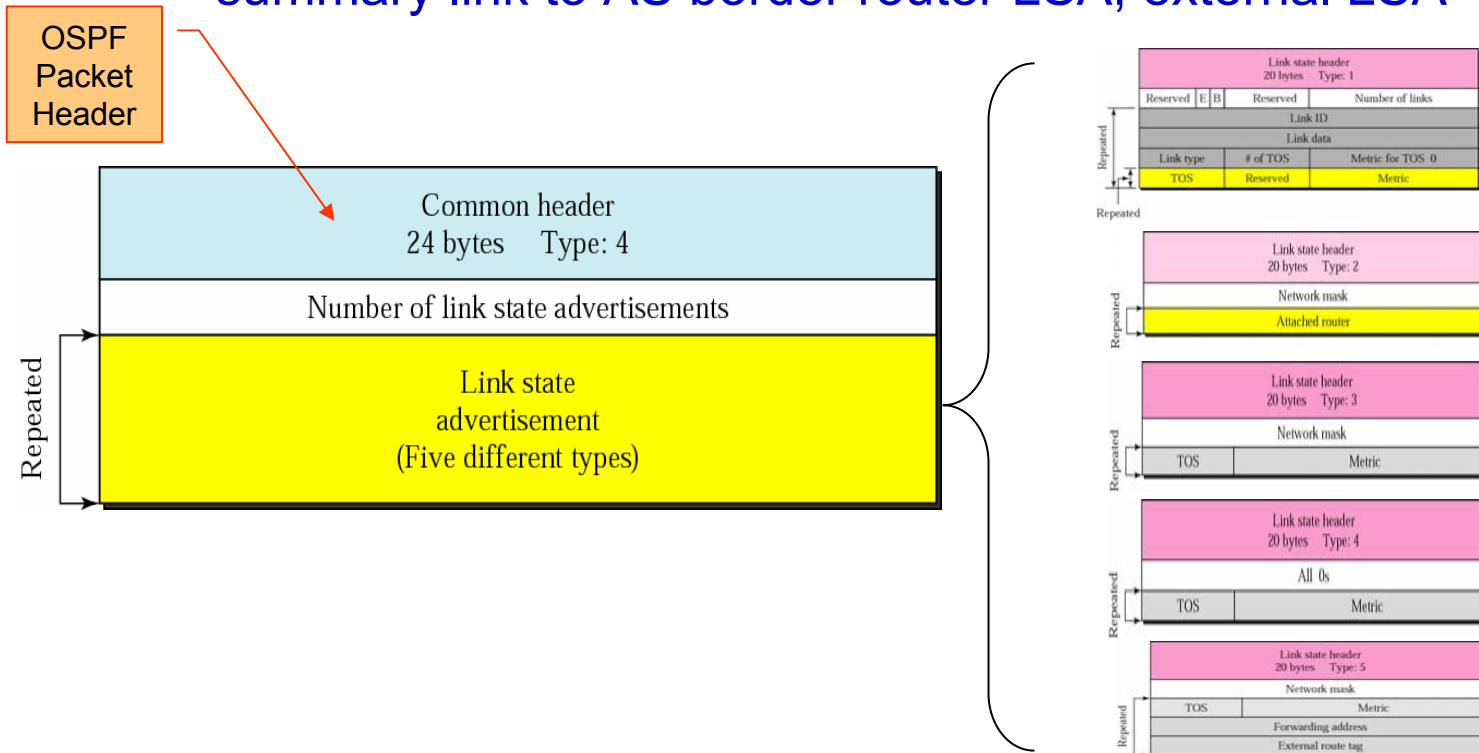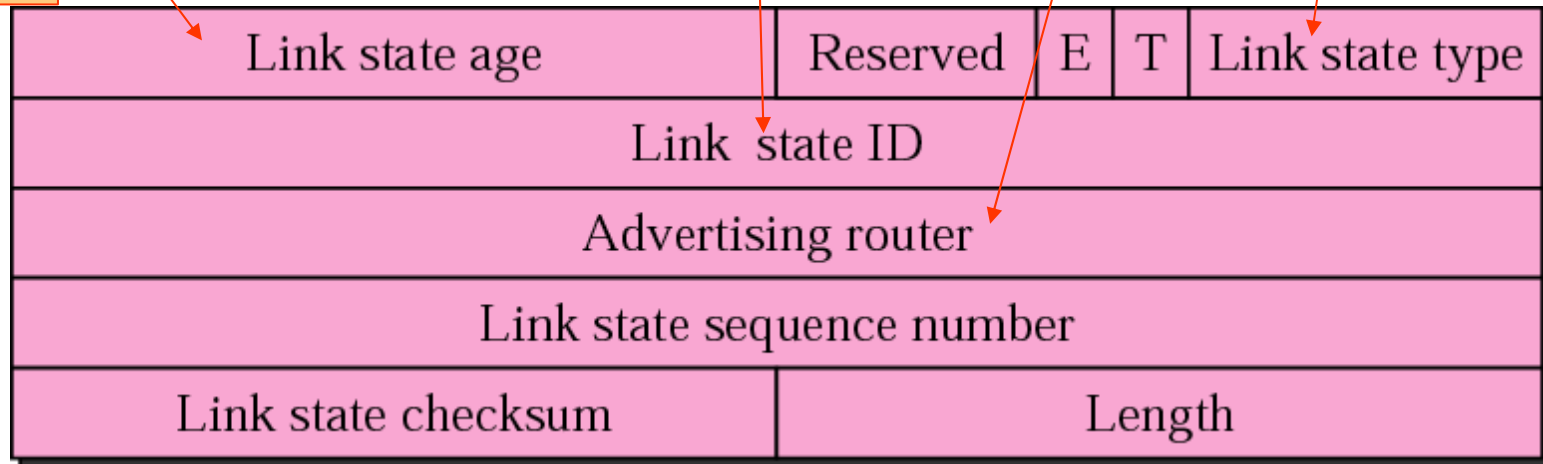
LSA Common Header

Type 1: router IP
Type 2: IP of DR
Type 3: network address
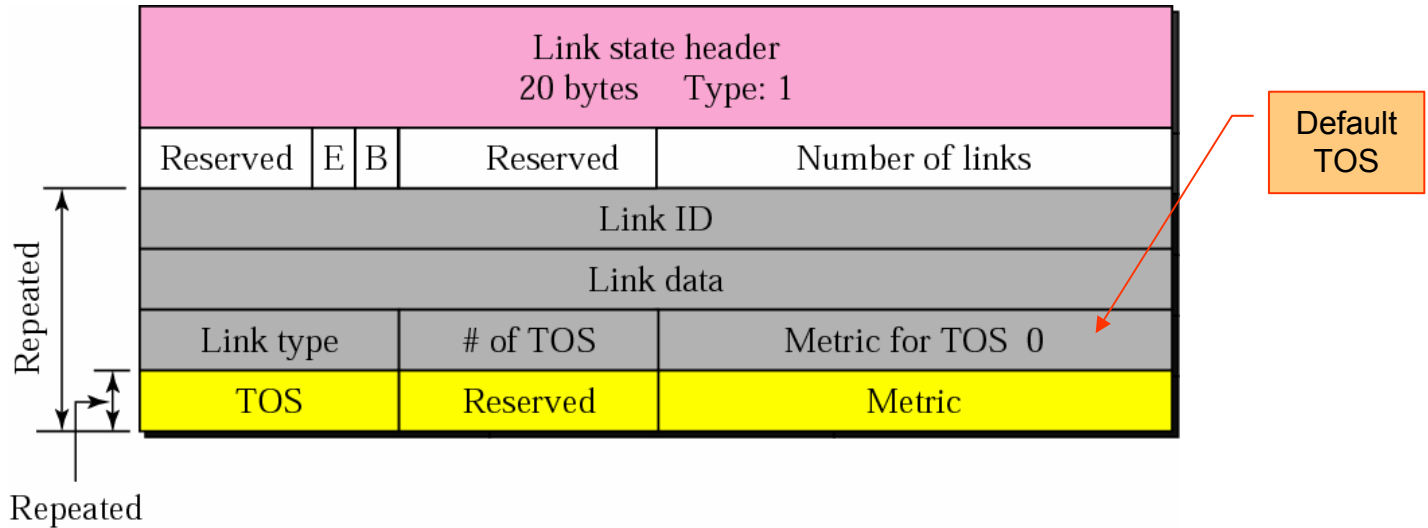Type 4: IP of ASBR
Type 5: net add of external network

1: router link
2: network link
3: sum lnk to net
4: sum lnk to ASBR
5: external link

Seconds since created

IP

Link state age		Reserved	E	T	Link state type
Link state ID					
Advertising router					
Link state sequence number					
Link state checksum		Length			

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LSA 1: Router Link

- **Advertises ALL links of a TRUE router**

Repeated	Link state header 20 bytes Type: 1			
	Reserved	E	B	Reserved	Number of links
	Link ID			
	Link data			
	Link type	# of TOS	Metric for TOS 0
	TOS	Reserved	Metric

Default TOS

Repeated

Link Type	Link ID	Link Data
1: Point-to-Point to another router	Address of neighbor router	Interface number
2: Connection to any-to-any network	Address of designated router	Router address
3: Connection to stub network	Network Address	Network Mask
4: Virtual Link	Address of neighbor router	Router Address

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Example 5

Solution

Give the router link LSA sent by router 10.24.7.9

This router has three links: two of type 1 (point-to-point) and one of type 3 (stub network). The router link LSA is shown
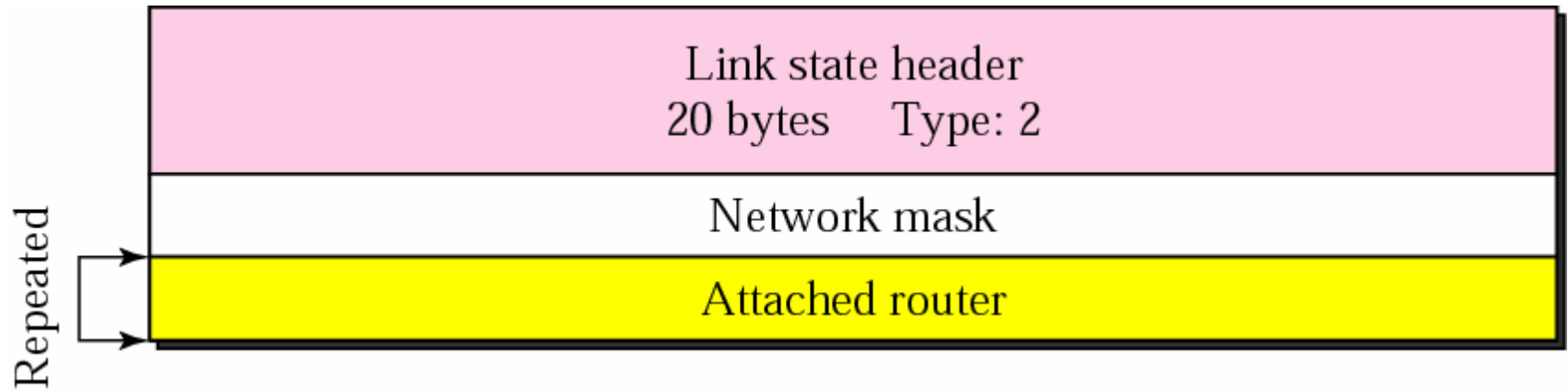
LSA 2: Network Link

Example 6

Give the network link LSA

|		
10.24.7.14	10.24.7.15	10.24.7.16
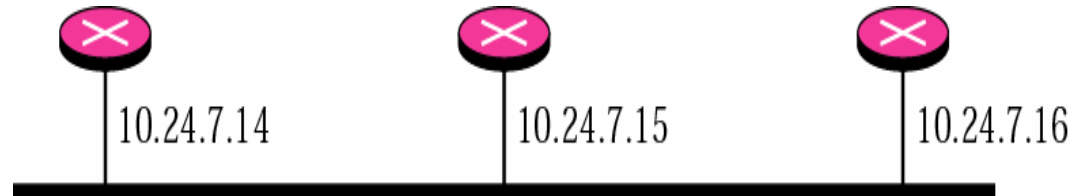
Solution

- The network, for which the network link advertises, has three routers attached. The LSA shows the mask and the router addresses.

- Note that only one of the routers, the designated router, advertises the network link.

OSPF Header	Type: 4
LSA Header	Type: 2
255.255.255.0	
10.24.7.14	
10.24.7.15	
10.24.7.16	

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LSA 3: Summary Link to Network

- Used by Area Border Router to inform the area about networks from outside the area

- One network advertised per an LSA

- The IP of the advertising Designated Router (found in the LSA header) & Network Mask = Network Address

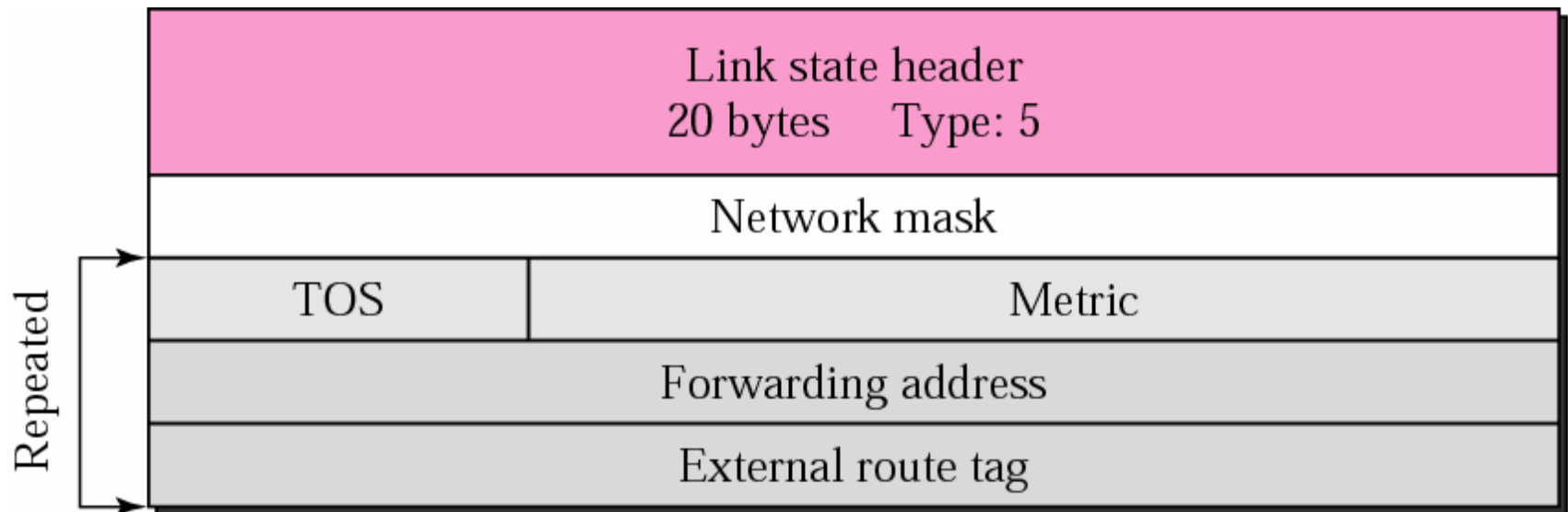　　　　13　　　　© Adapted for use at JMU by Mohamed Aboutabl, 2003
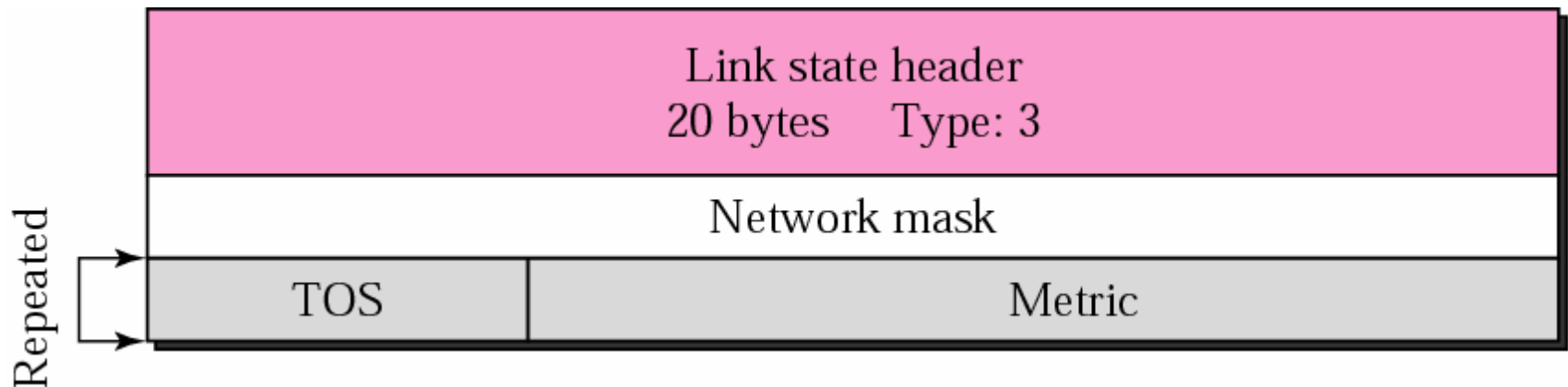
LSA 4: Summary Link to AS Boundary Router

- Generated by Area Border Routers to flood their areas
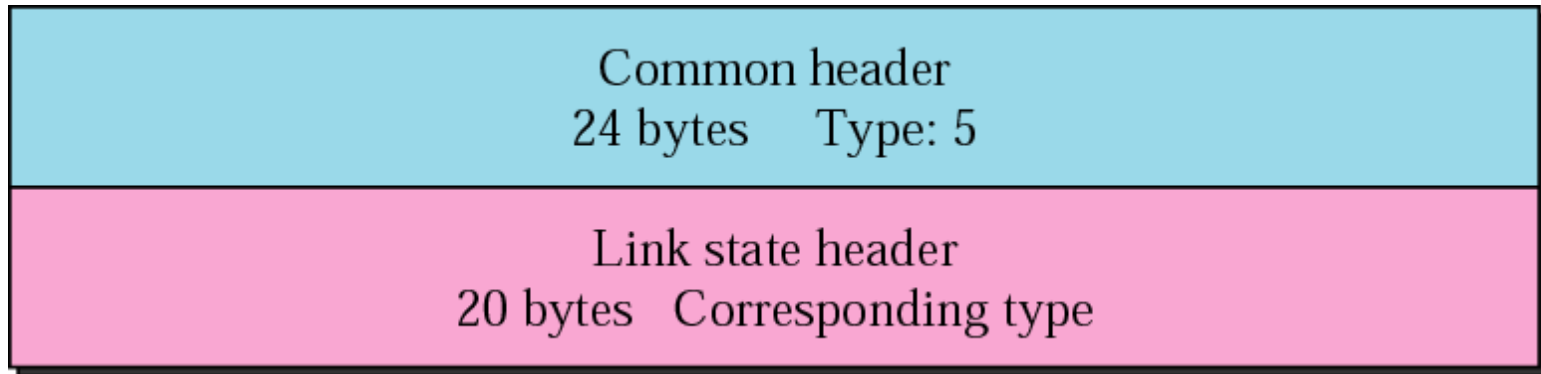- Announces the network to which the ASBR is connected.

     © Adapted for use at JMU by Mohamed Aboutabl, 2003
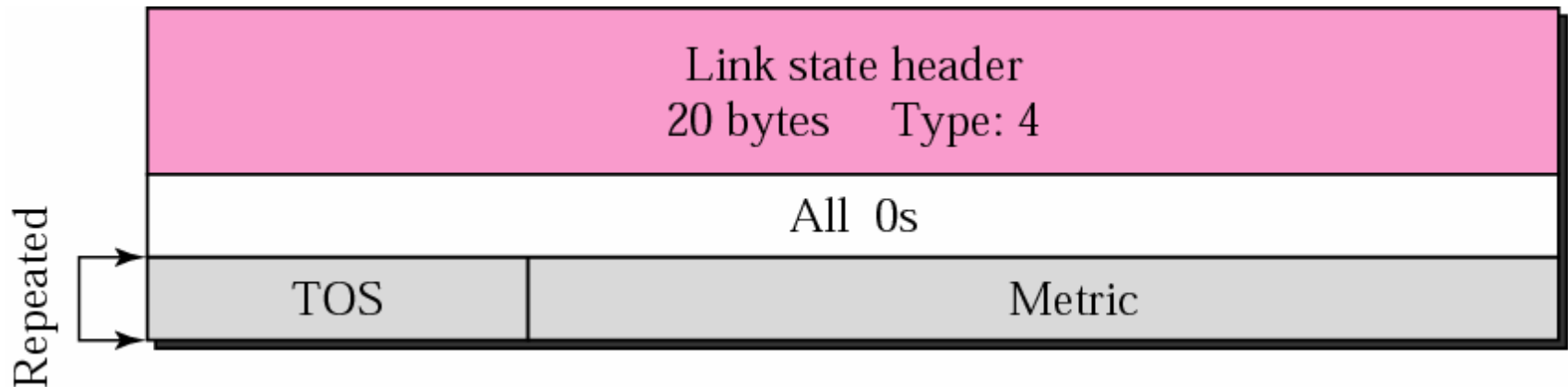
LSA 5: External Link

- Generated by AS Border Router to flood its Autonomous System
- Announces an out-of-the AS network to the entire AS.
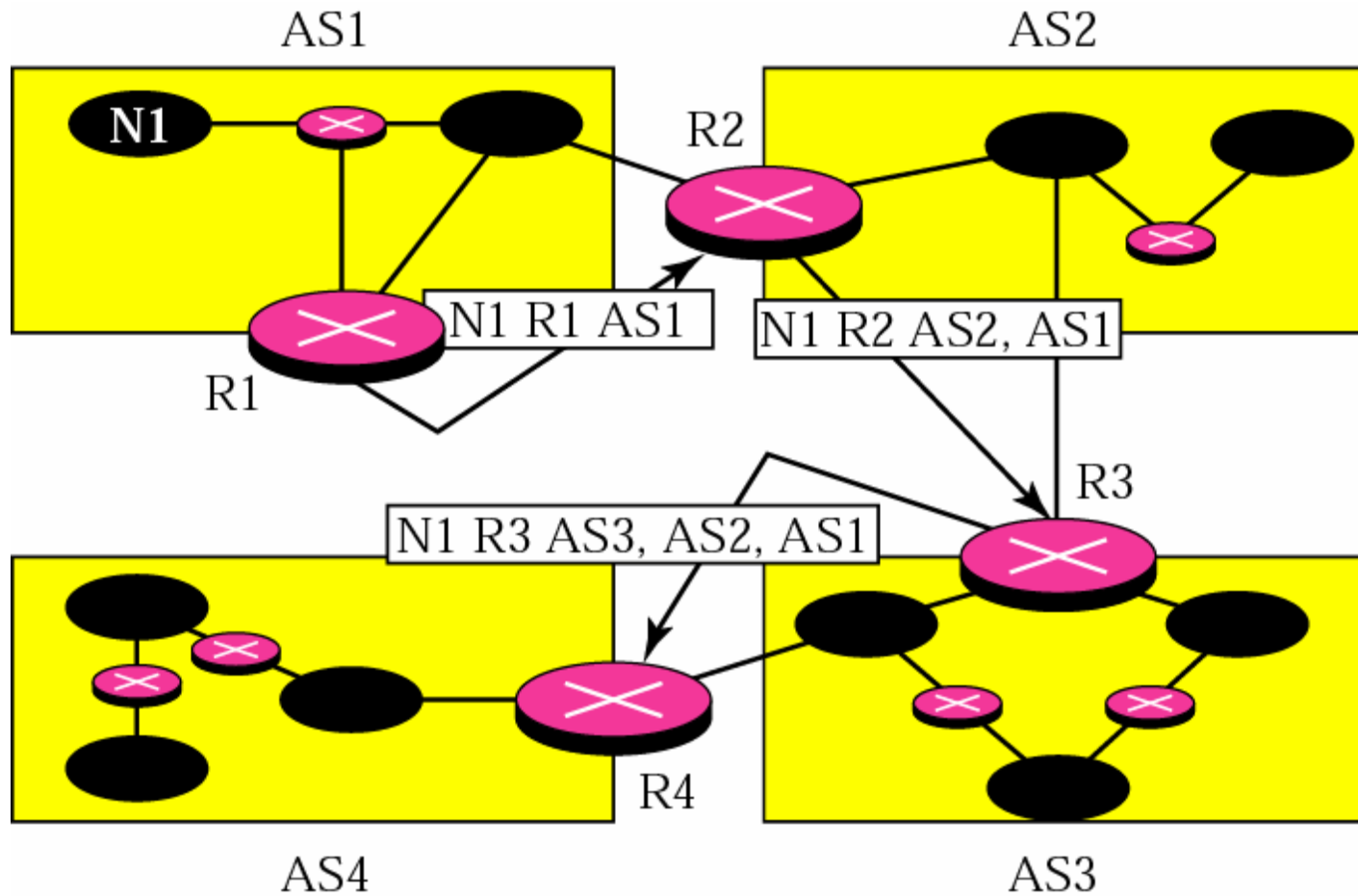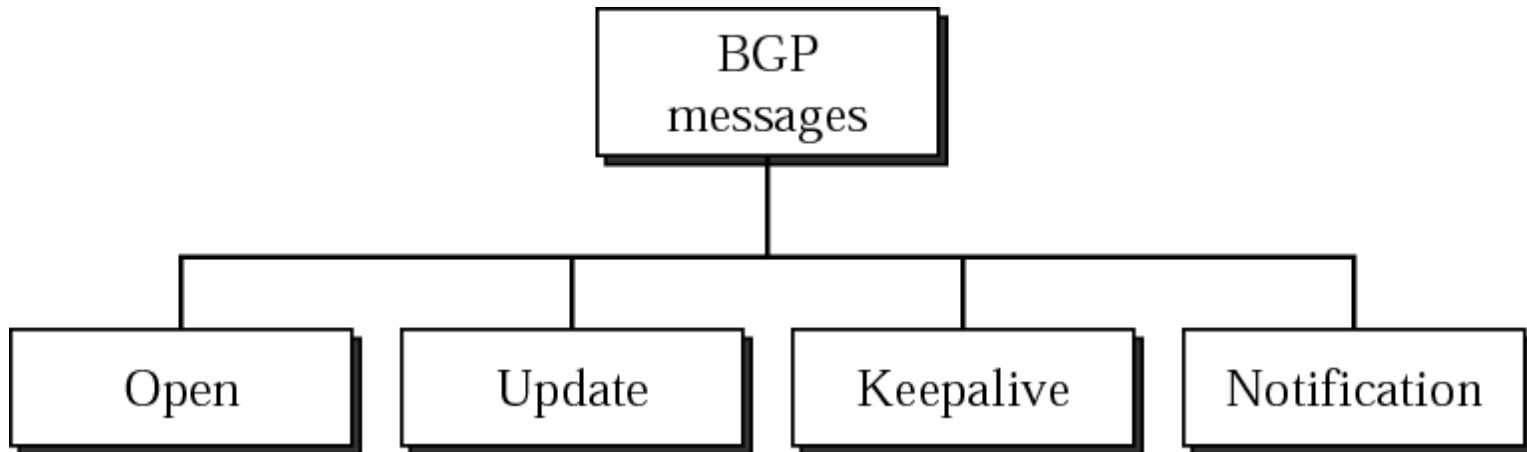
OSPF Packet 5: Link State Acknowledgment packet

Common header
24 bytes   Type: 5

Link state header
20 bytes   Corresponding type

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OSPF Ecapsulation

- OSPF packets are encapsulated in IP datagrams.
- They contain their own ACK mechanism for flow/error control
  - No need for a transport layer protocol to service them

 © Adapted for use at JMU by Mohamed Aboutabl, 2003
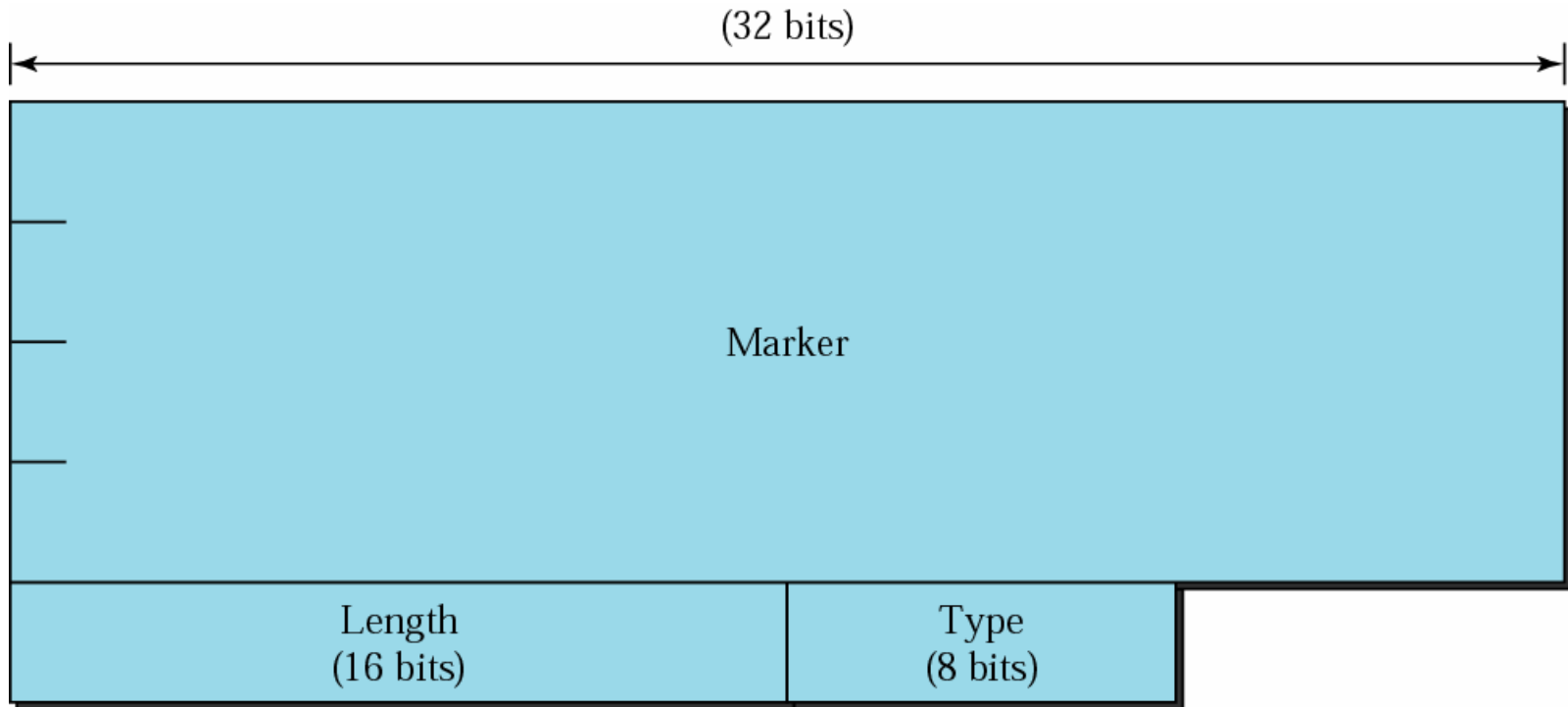
Path vector packets

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Types of BGP messages

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BGP Packet Header

20

BGP Open Message

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BGP Update Message

Common header
19 bytes   Type: 2

Unfeasible routes length

Unfeasible routes length

Withdrawn routes
(Variable length)

Path attributes length

Path attributes
(Variable length)

Network layer reachability information
(Variable length)
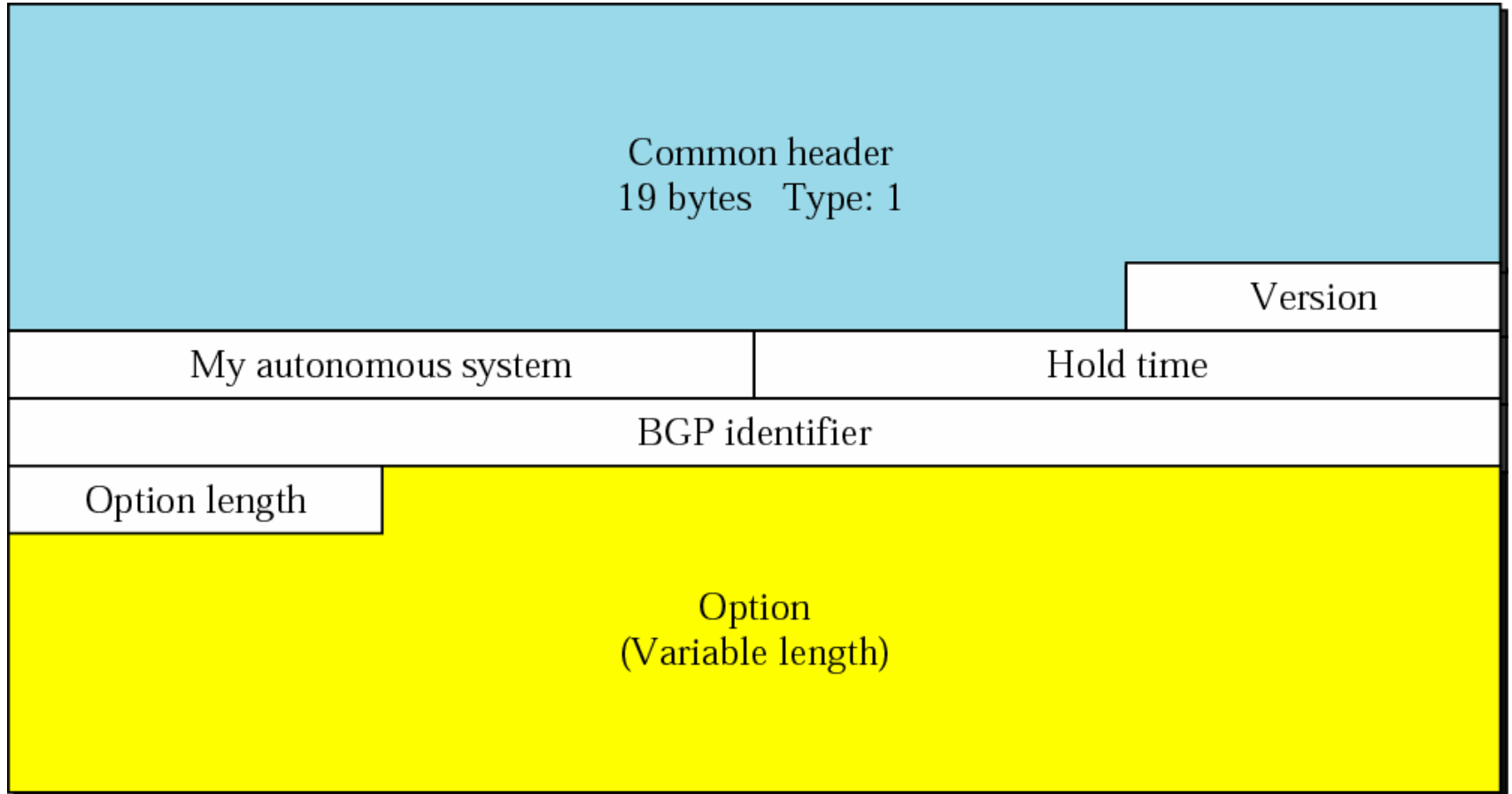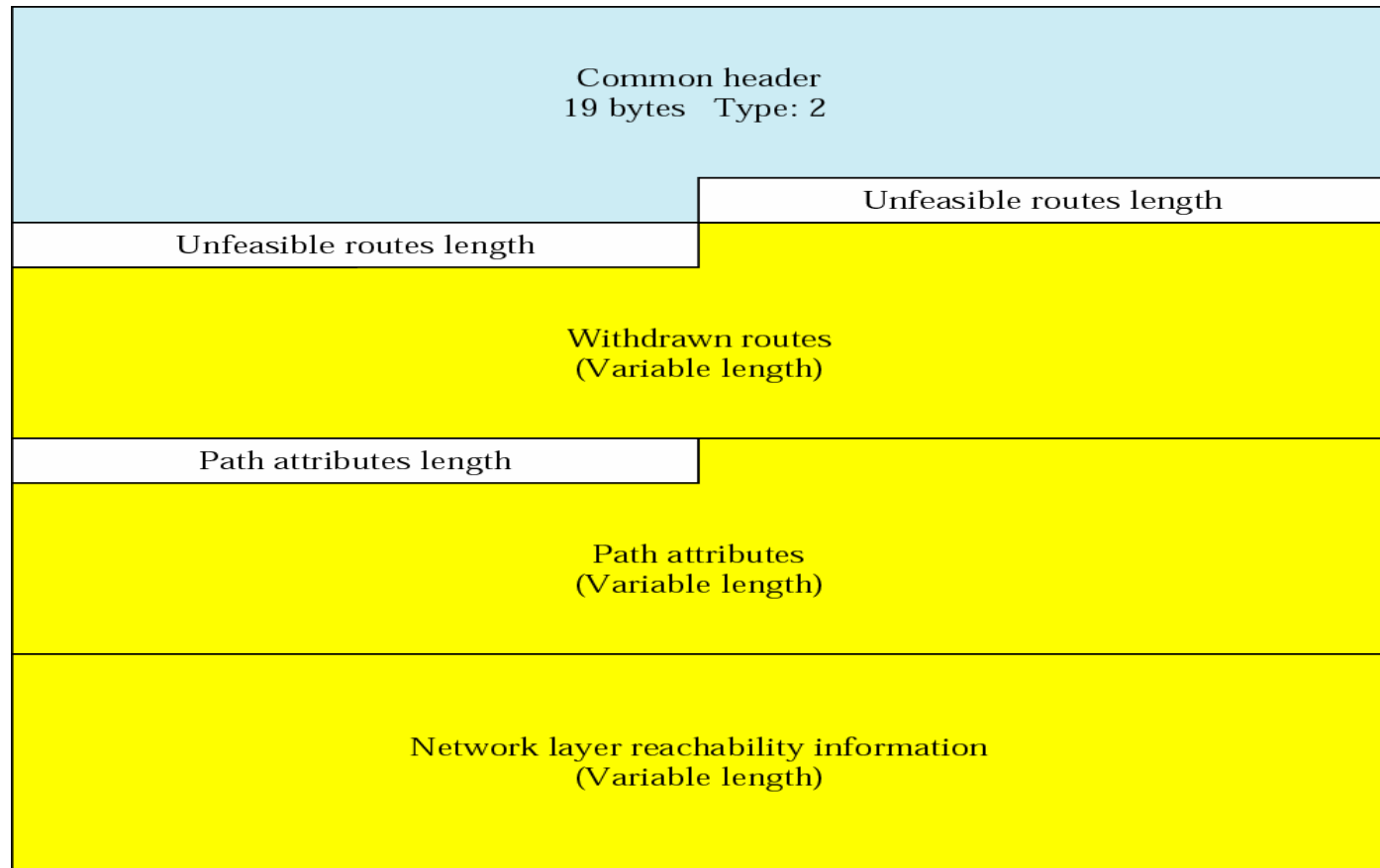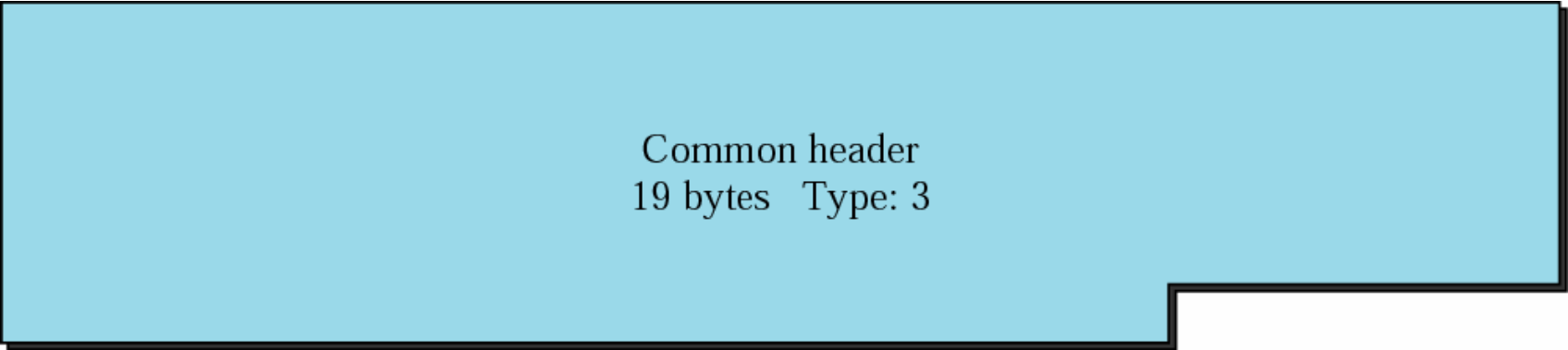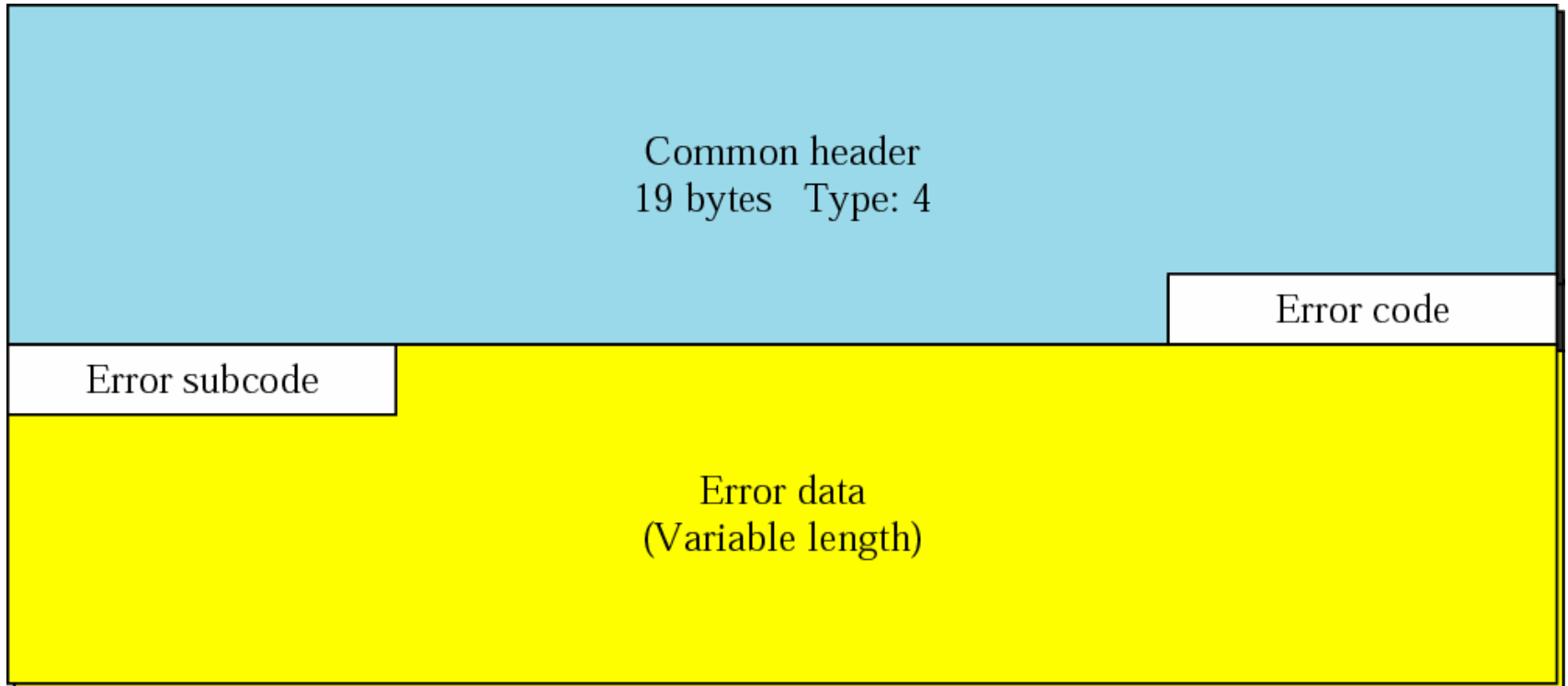
BGP KeepAlive Message

Common header
19 bytes   Type: 3

BGP Notification Message

BGP Encapsulation

- BGP uses the services of TCP on port 179.

Homework

Problems: