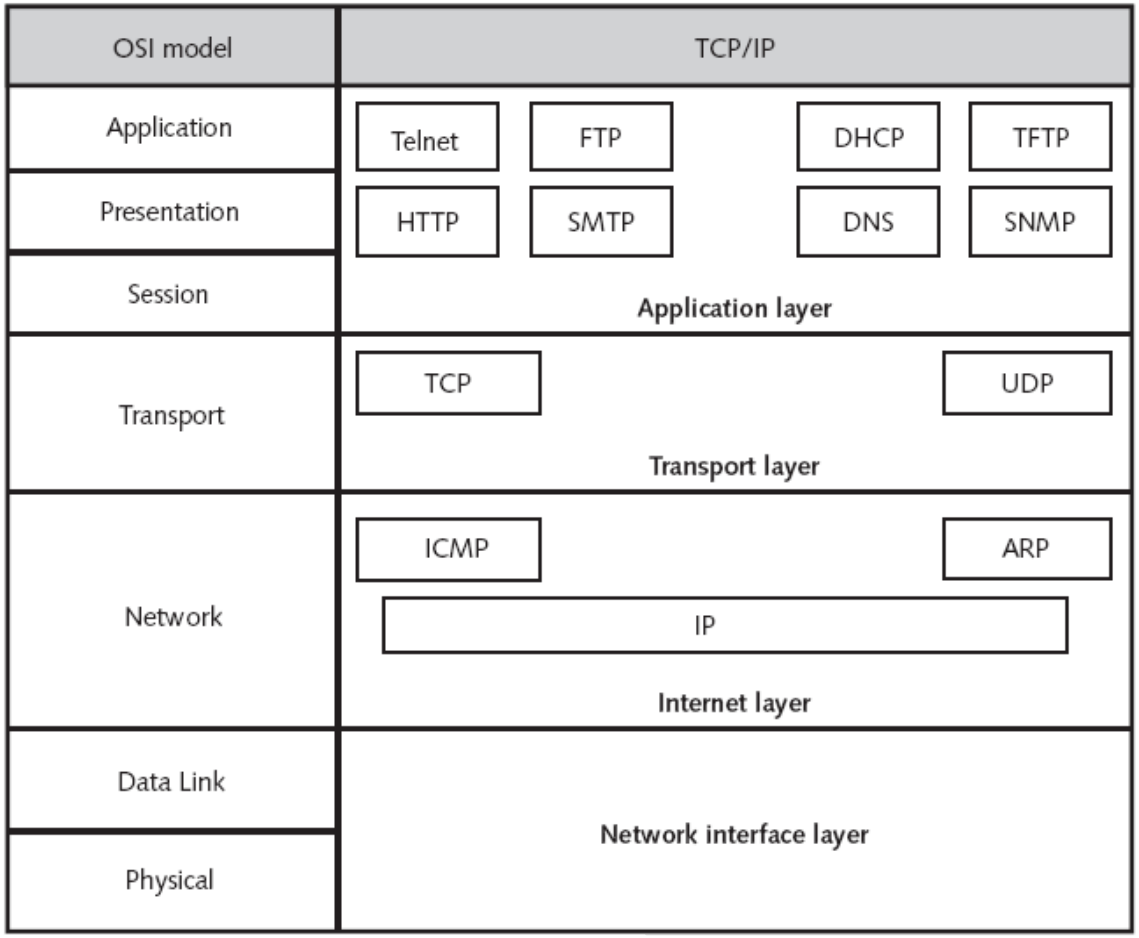
Network Layer/Internet Layer Protocols and Addressing

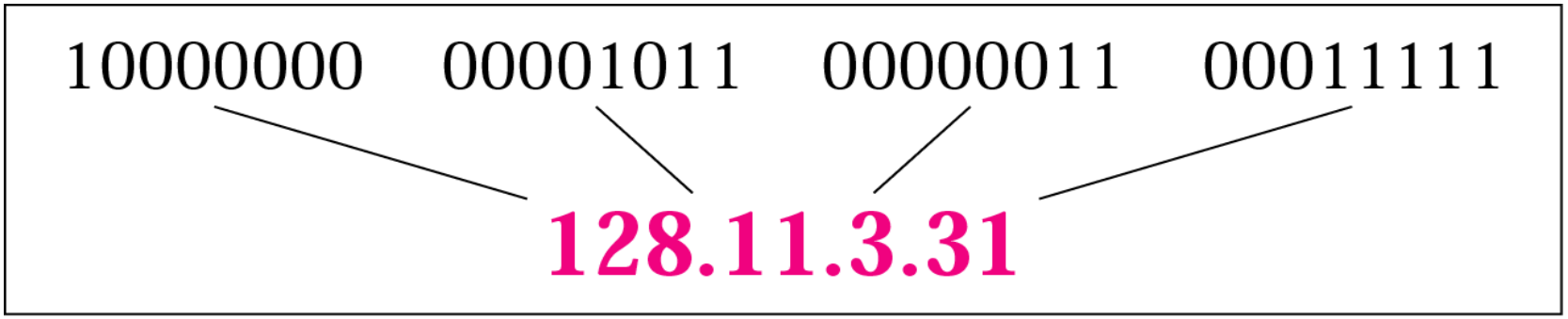
By,

Mr. Kumar Pudashine, (MEng, AIT, Bangkok)
CISA, CISM, CRISC, CNDA, CDCP, COBIT 5, CCNP (Enterprise), JNCIA, CEH v9, ITIL, ISO 27001:2013, AcitivIdentity Certified
Senior Section Chief, Network and Security
Agricultural Development Bank,
Kathmandu

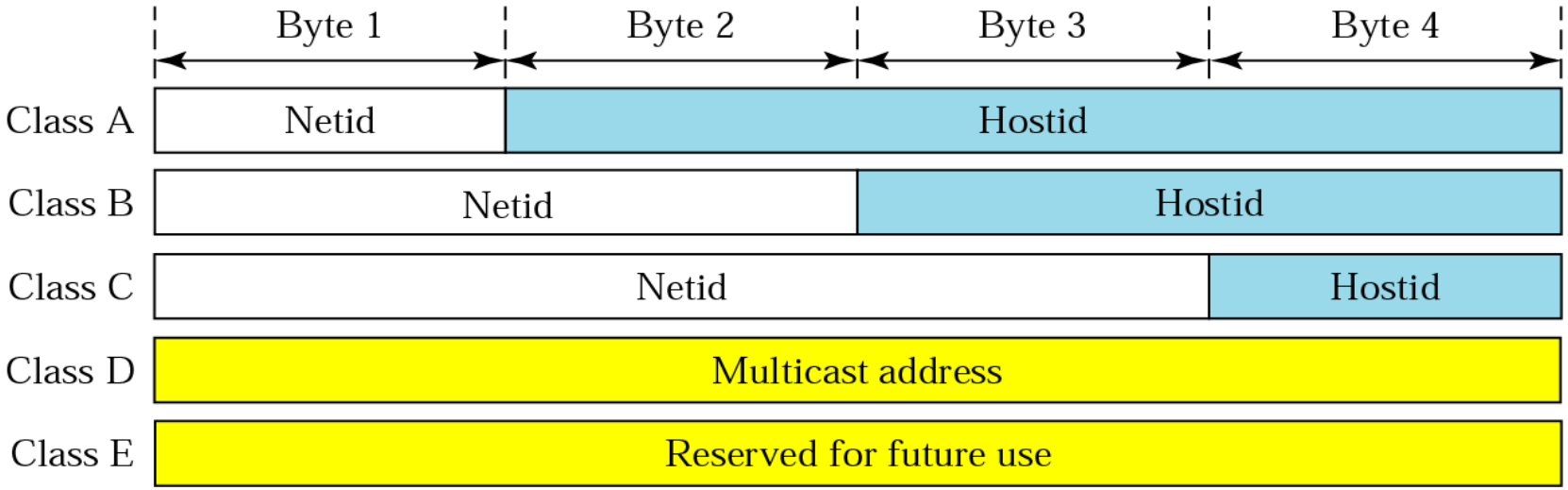
OSI Model Compared to TCP/IP



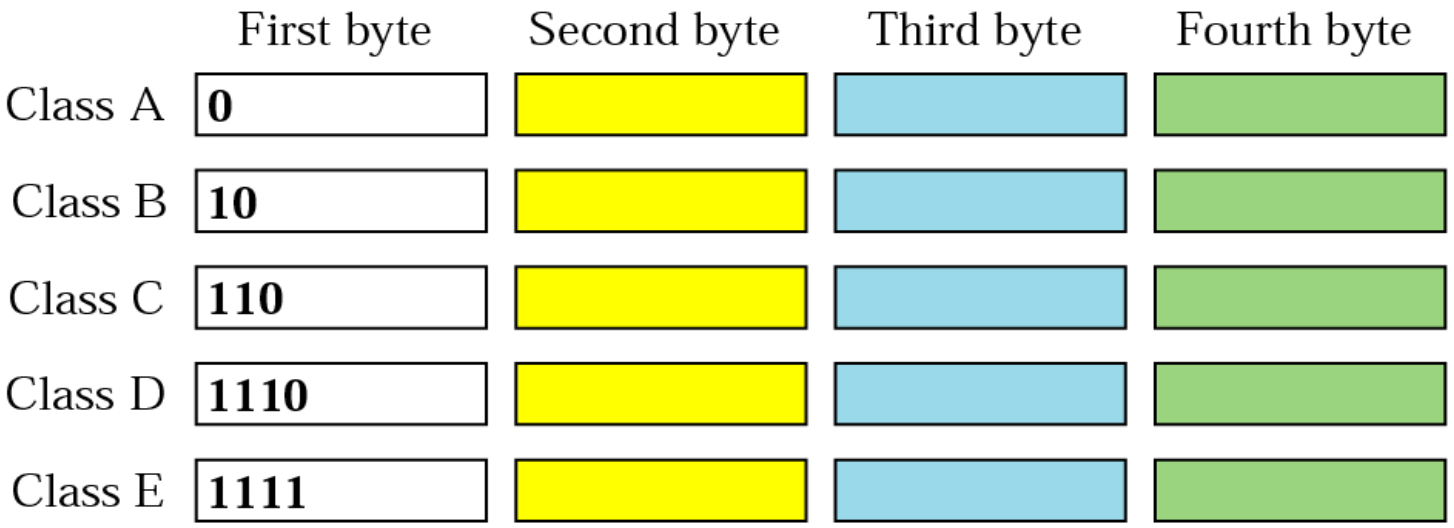
IP Address : Representation in Dotted Decimal Notation



IP Address : Two Levels of Hierarchy



IP Address : Classes ??



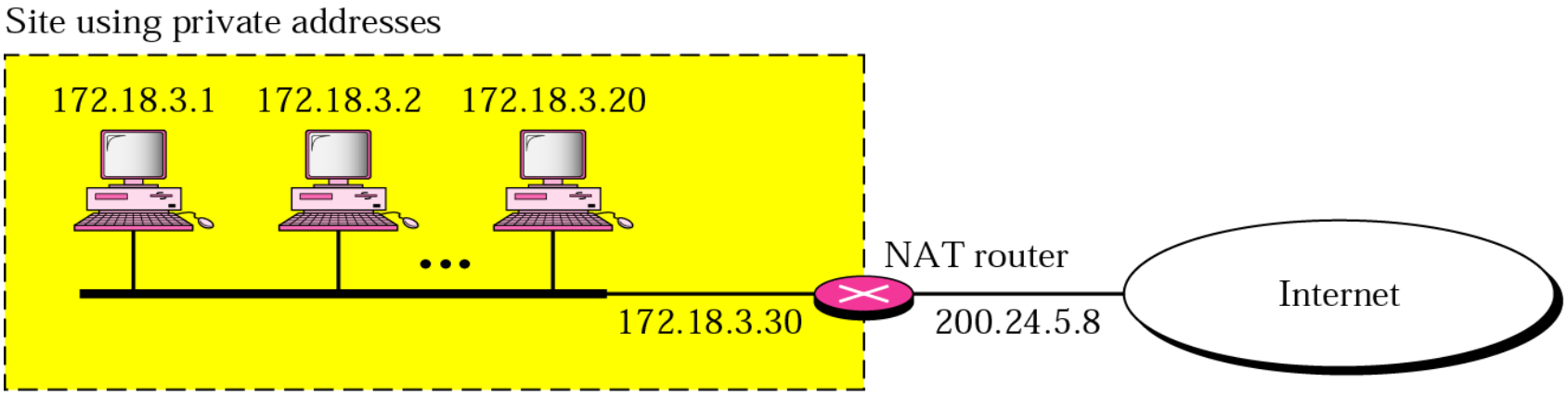
IP Address : Subnet and Subnet Mask

Class	Default Subnet	Subnet Mask
Class A	/8	255.0.0.0
Class B	/16	255.255.0.0
Class C	/24	255.255.255.0

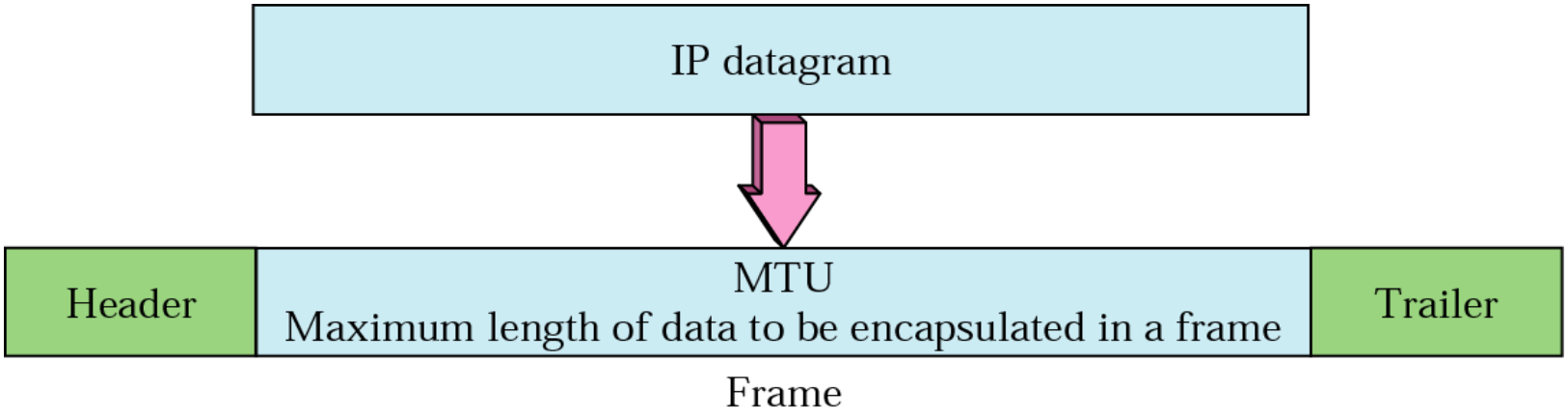
IP Address : Private IP Address Space

Range	Total Hosts
10.0.0.0 - 10.255.255.255	2^{24}
172.16.0.0 - 172.31.255.255	2^{20}
192.168.0.0 - 192.168.255.255	2^{16}

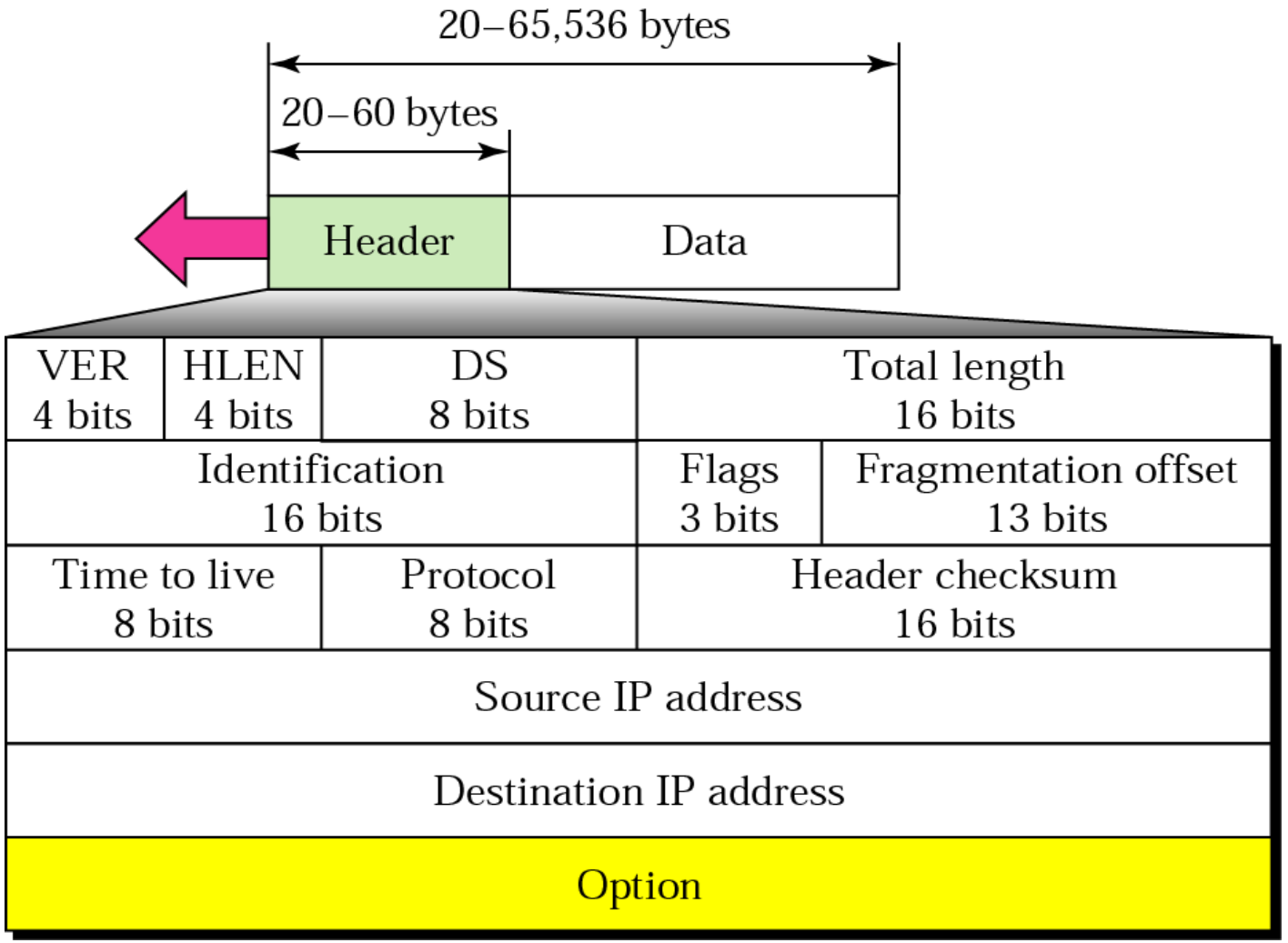
NAT : Network Address Translation



MTU : Maximum Transmission Unit



IPV4 Frame Format



IPV4 Frame Format: Description

- VER => Defines the Version of IP.
- HLEN => Header Length
- DS => Differentiated Service. Defines the Class of Packet for QoS.
- Total Length => Length of Data = Total Length-Header Length.

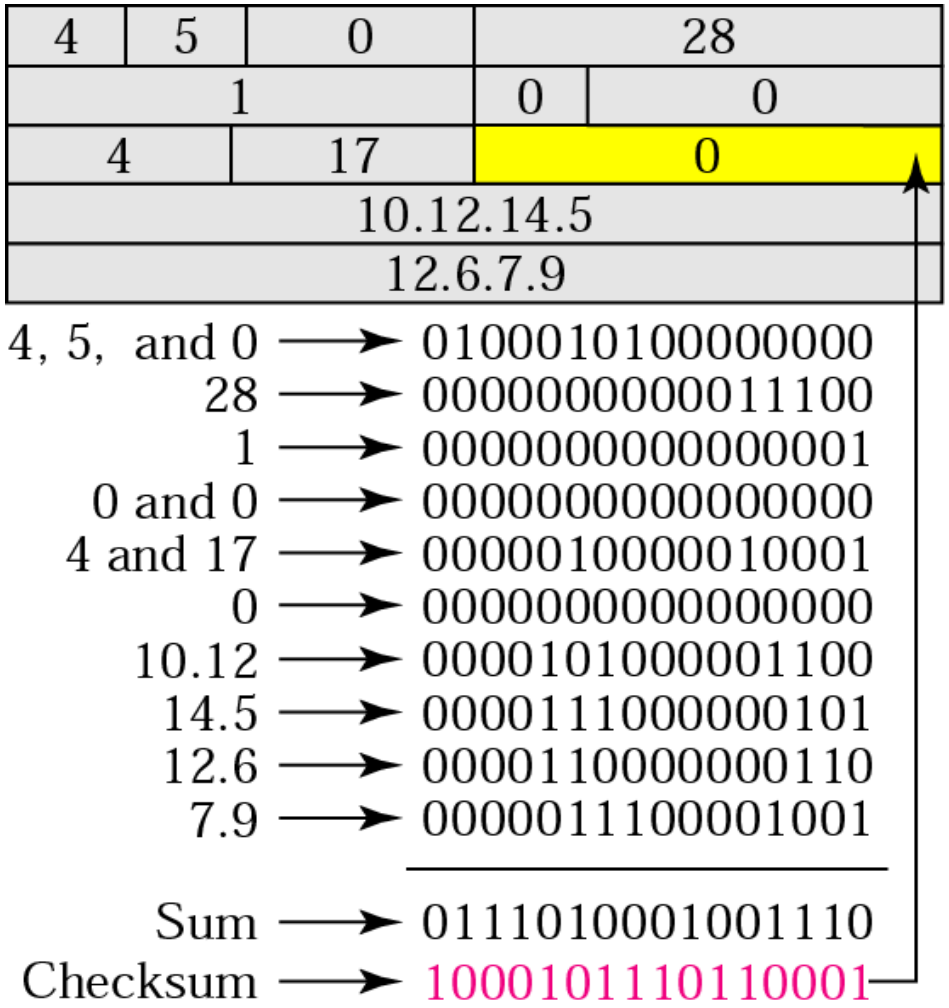
- Identification
  - When datagram is Fragmented => Identification copied to all.
  - All Fragments have the same Identification.
  - Helps in Reassembling the datagram.

- Flags
  - 3 Bits => Reserved, MF and DF
  - DF => Don't Fragment.
  - MF => More Fragment.

IPV4 Frame Format: Description

- Fragmentation Offset => Offset value of Fragment.
- TTL => Time To Live. If TTL =0 Then Packet is discarded.
- Protocol
  - Defines Higher Layer Protocols.
  - Higher Layer Protocols => TCP, UDP.
- Checksum => Computes Checksum
- Source IP Address => IP Address of Source Machine.
- Destination IP Address => IP Address of Destination Machine.
- Option => Optional Field Used for Network Testing and debugging.

Header Checksum Calculation



Question ??

- The Existing network of Pokhara University (172.16.1.0/24) is to be divided into network of 4 different schools. Among 4 schools two schools need to be subdivided into 2 different departments.

- Provide a complete IP Address Plan which includes Network Address, Broadcast Address, Usable IP Pool, Subnet Mask and Wildcard Mask.

???

Question ??

- The Asia Pacific Network Information Center (APNIC) has to provide service to 8 Local ISPs from the network pool of 17.10.0.0/20. From the available pool each Local ISP has to provide service to their Six (6) dedicated clients.

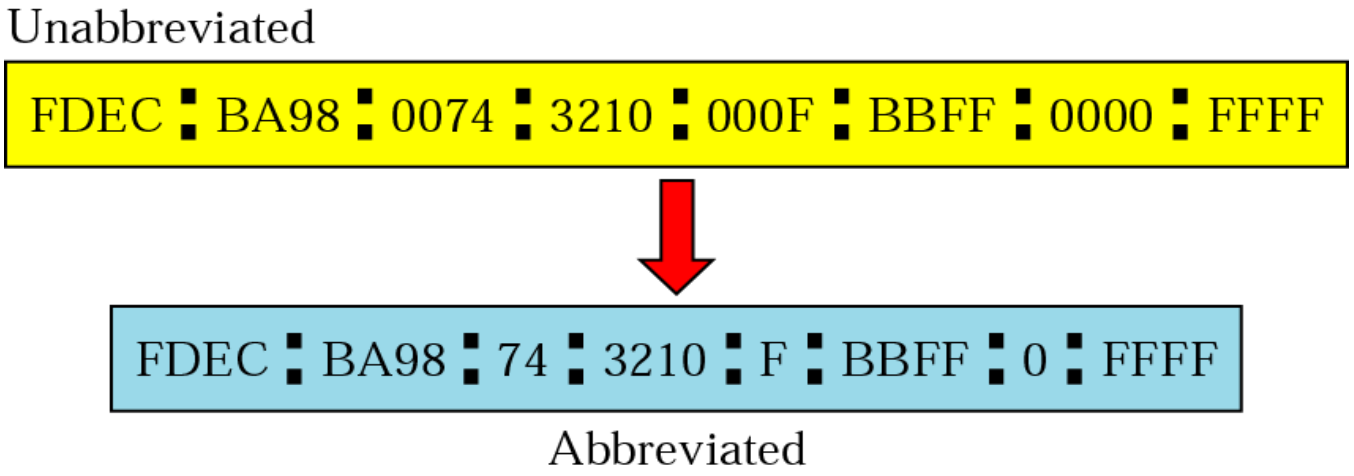
- Design the complete IP Address Plan which includes IP Pool, Usable IP Pool and Subnet Mask for each network.

???

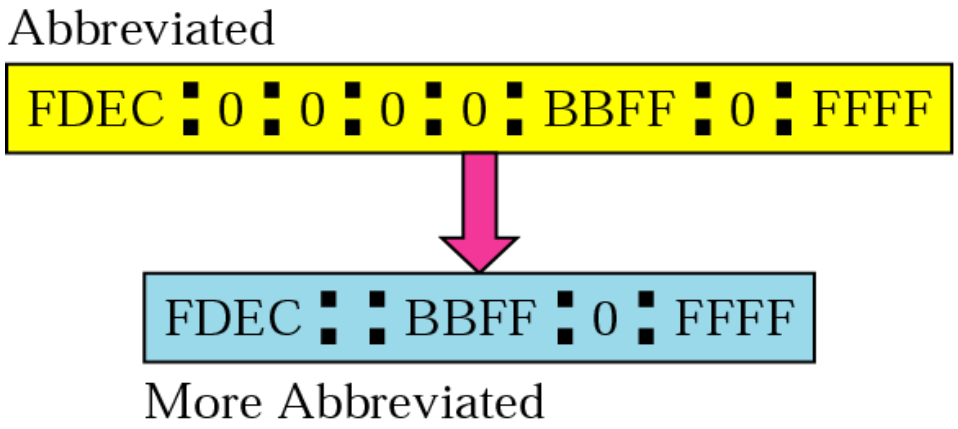
IPV6 : Internet Protocol Version 6

- It is Known as Internetworking Protocol Next Generation (IPng).
- It is suitable for Fast growing Internet.
- It is also suitable for Next Generation Networks (NGN).
- Features
  - ✓ Larger Address Space (128 Bit Address Space).
  - ✓ Supports Resource Allocation via Flow Control Field.
  - ✓ Supports More Security.
  - ✓ Better Header Format (Base Header and Extension Header)

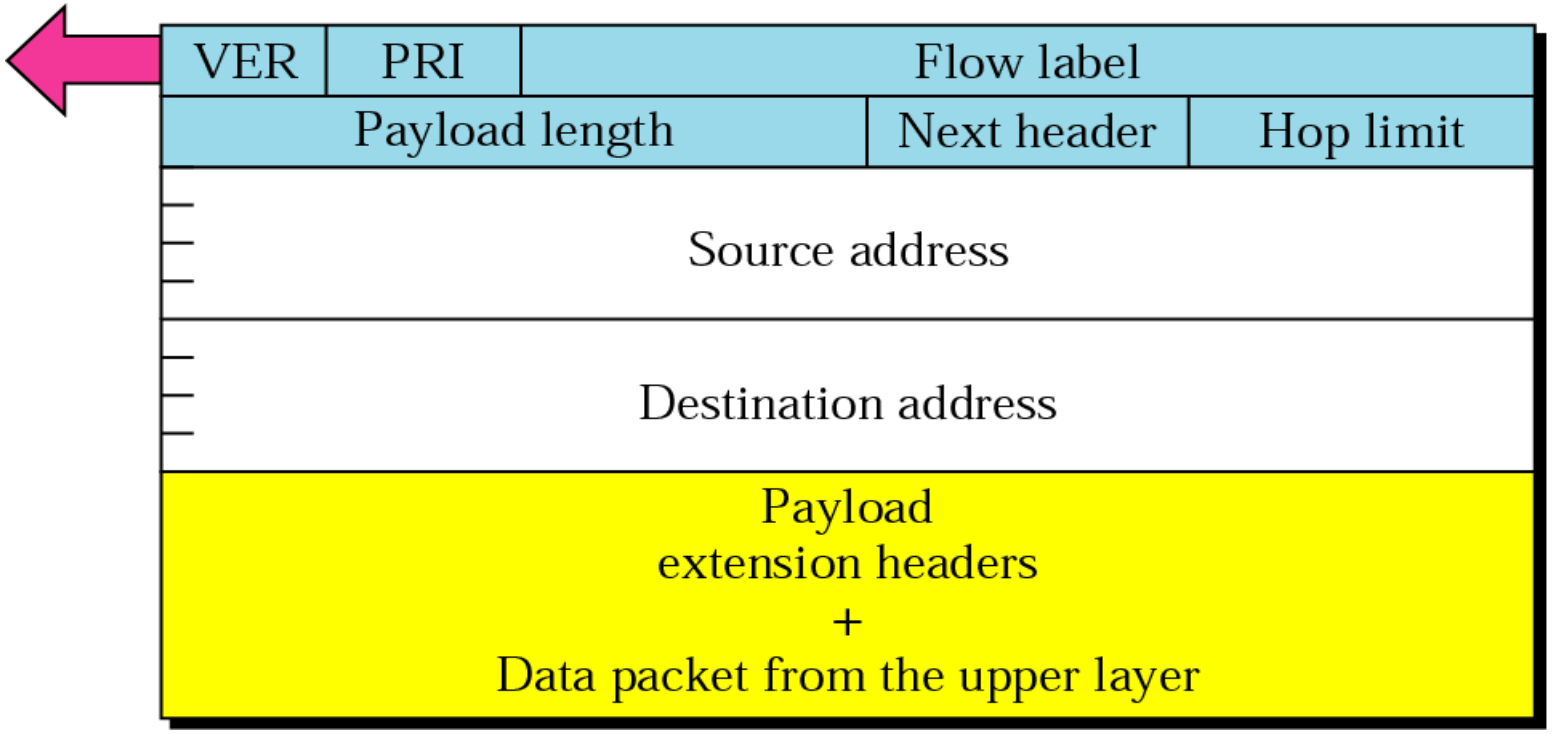
IPV6 : 128 Bit Addressing Scheme



IPV6 : Abbreviated Address



IPV6 : Header Format (Base Header + Extension Header)



IPV6 : Header Format Description

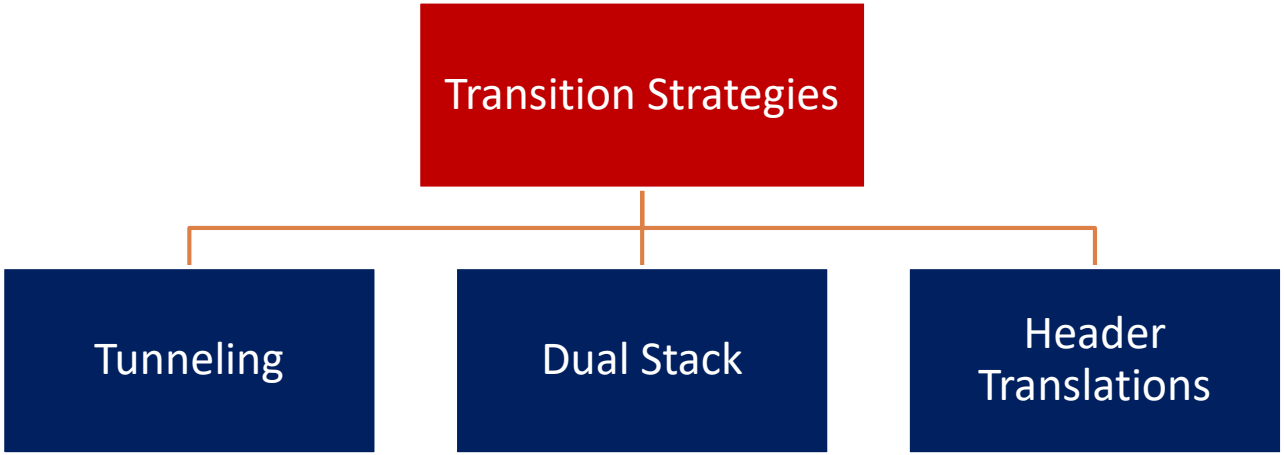
- VER (4 Bits) => Specifies the Version of IPV6.
- Priority (4 Bits) => Defines the Priority of Packet.
- Flow Label (24 Bits) => Used for Resource Reservation.

- Payload Length (16 Bits)
  Total Length of IP Datagram Excluding Base Header.

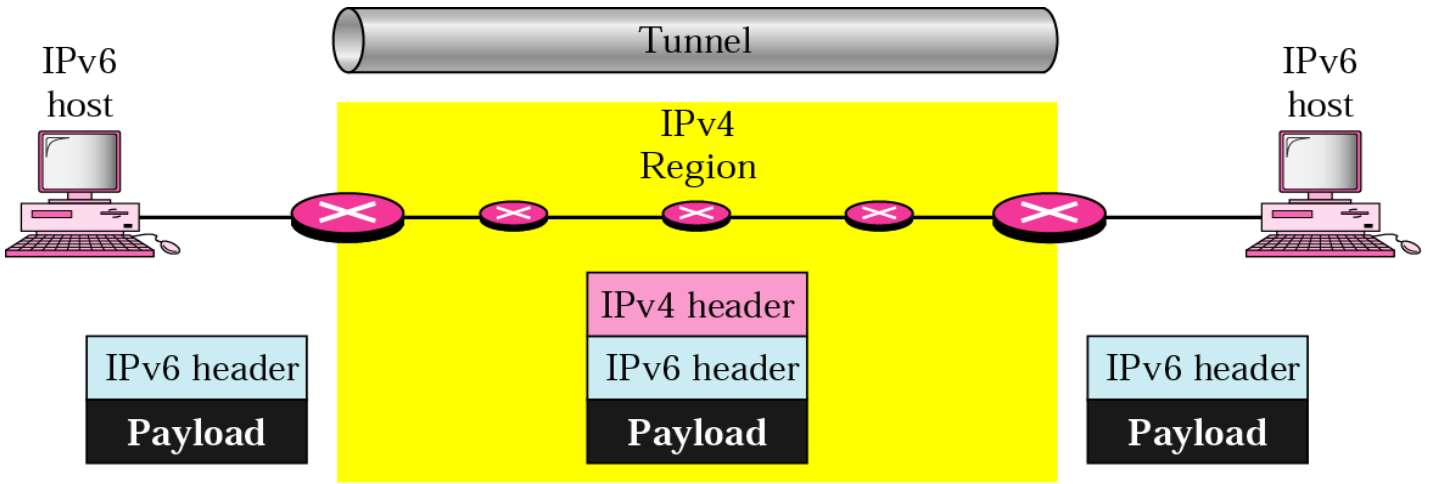
- Next Header (8 Bits)
  Provides Information about Extension Header.

- Hop Limit (8 Bits) => Same as TTL in IPV4.
- Source Address => 128 Bit Source IPV6 Address
- Destination Address => 128 Bit Destination IPV6 Address

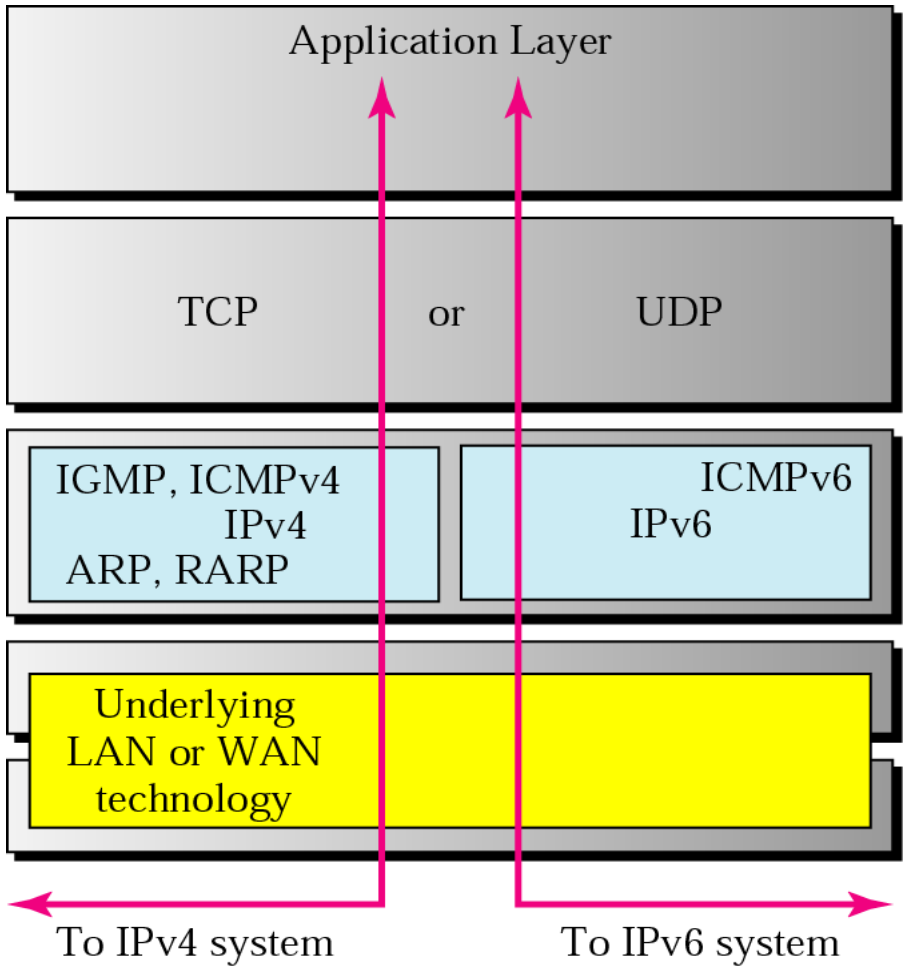
IPV6 Transition Strategies



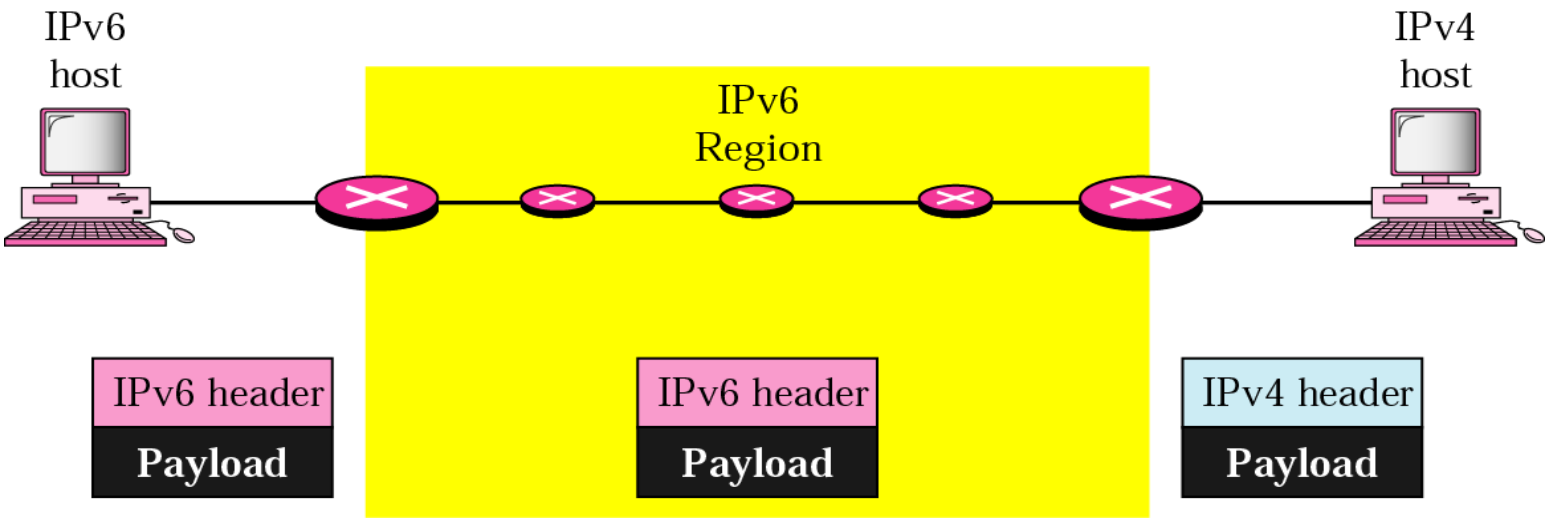
IPV6 Transition : Tunneling



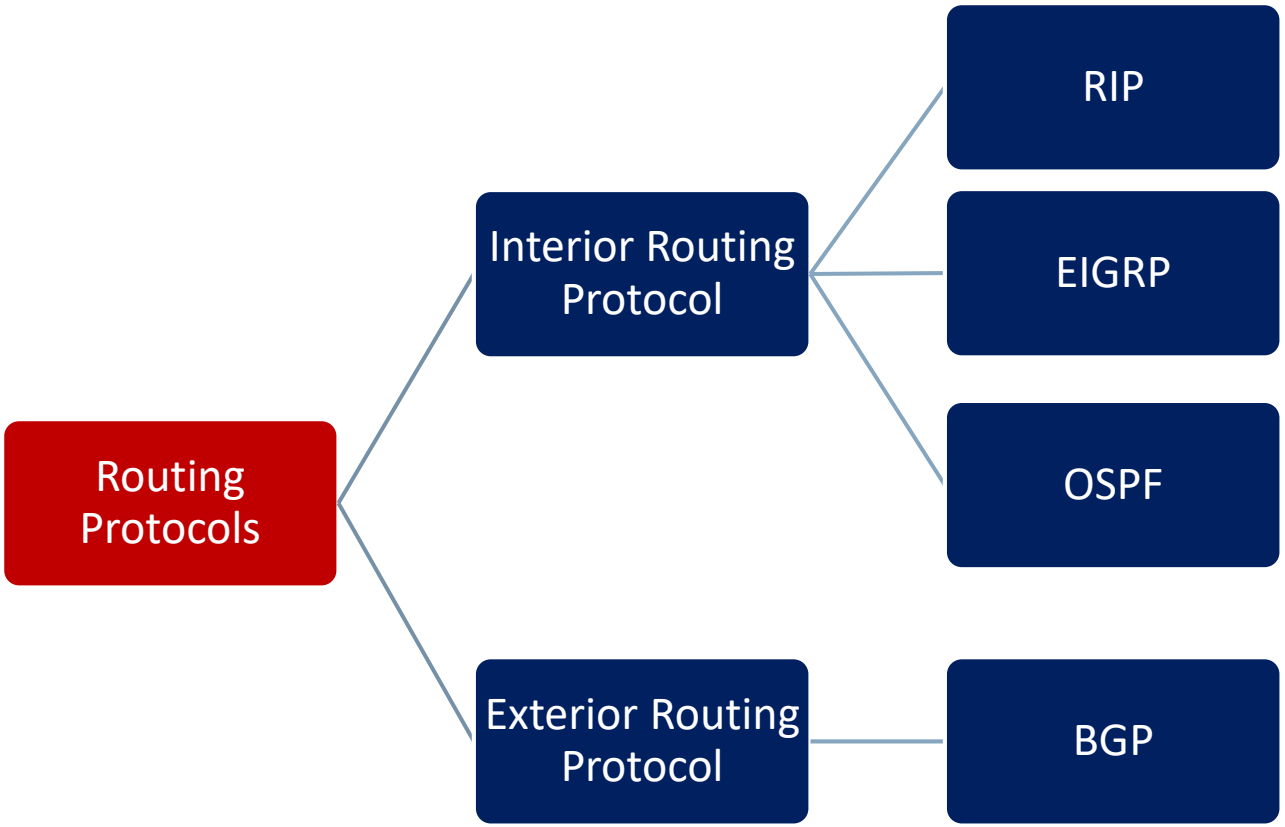
IPV6 Transition : Dual Stack



IPV6 Transition : Header Translation



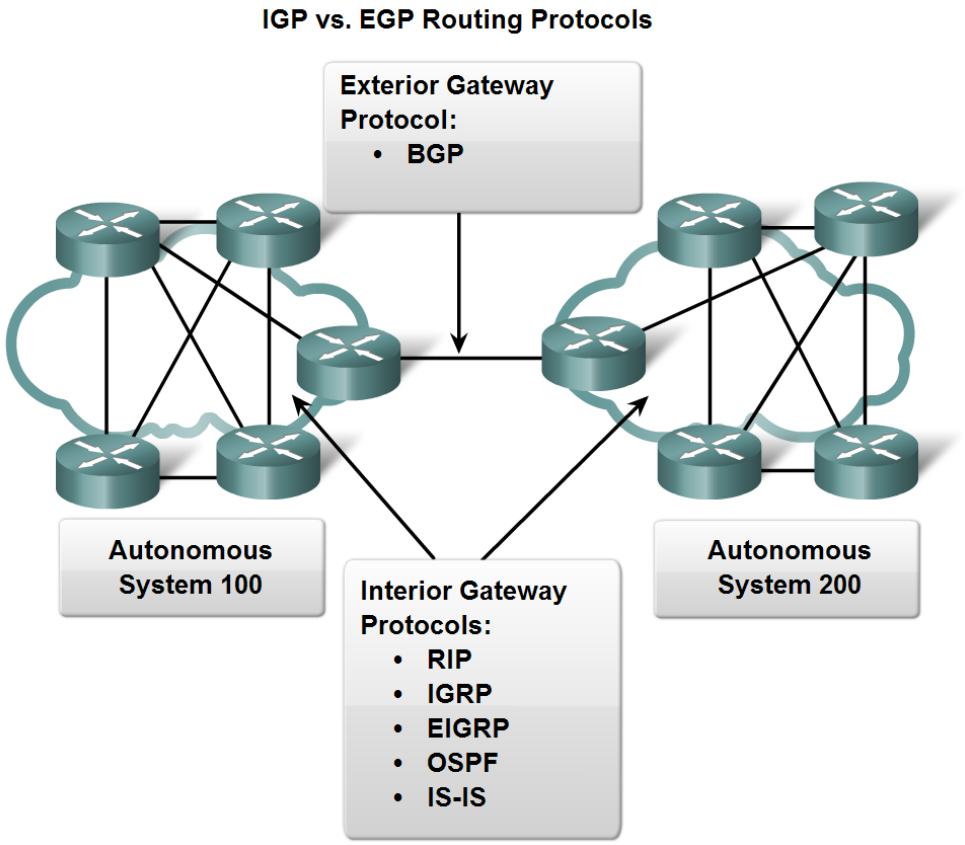
Routing Protocols: Approaches ??



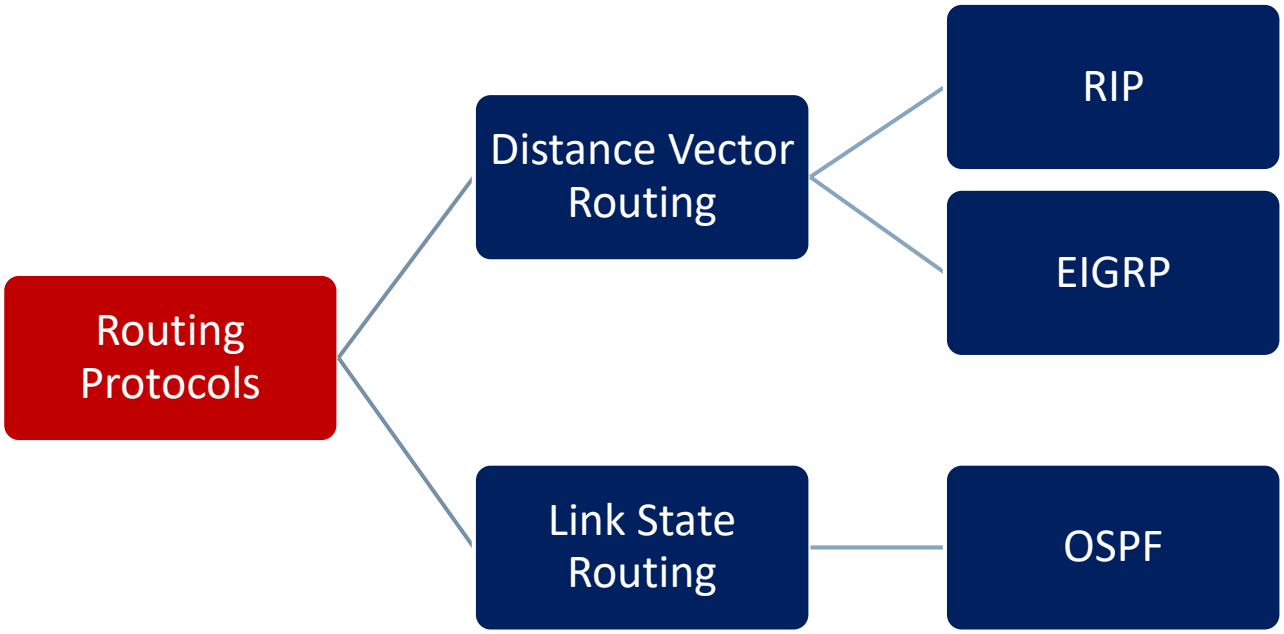
Routing Protocols

- Interior Gateway Routing Protocols
  - ✓ Used for Routing Inside an Autonomous System (AS).
  - ✓ AS => Network under Common Administration.
  - ✓ Examples => RIP, EIGRP and OSPF
- Exterior Gateway Routing Protocols
  - ✓ Used for Routing between Autonomous System (AS)

Routing Protocols: Example

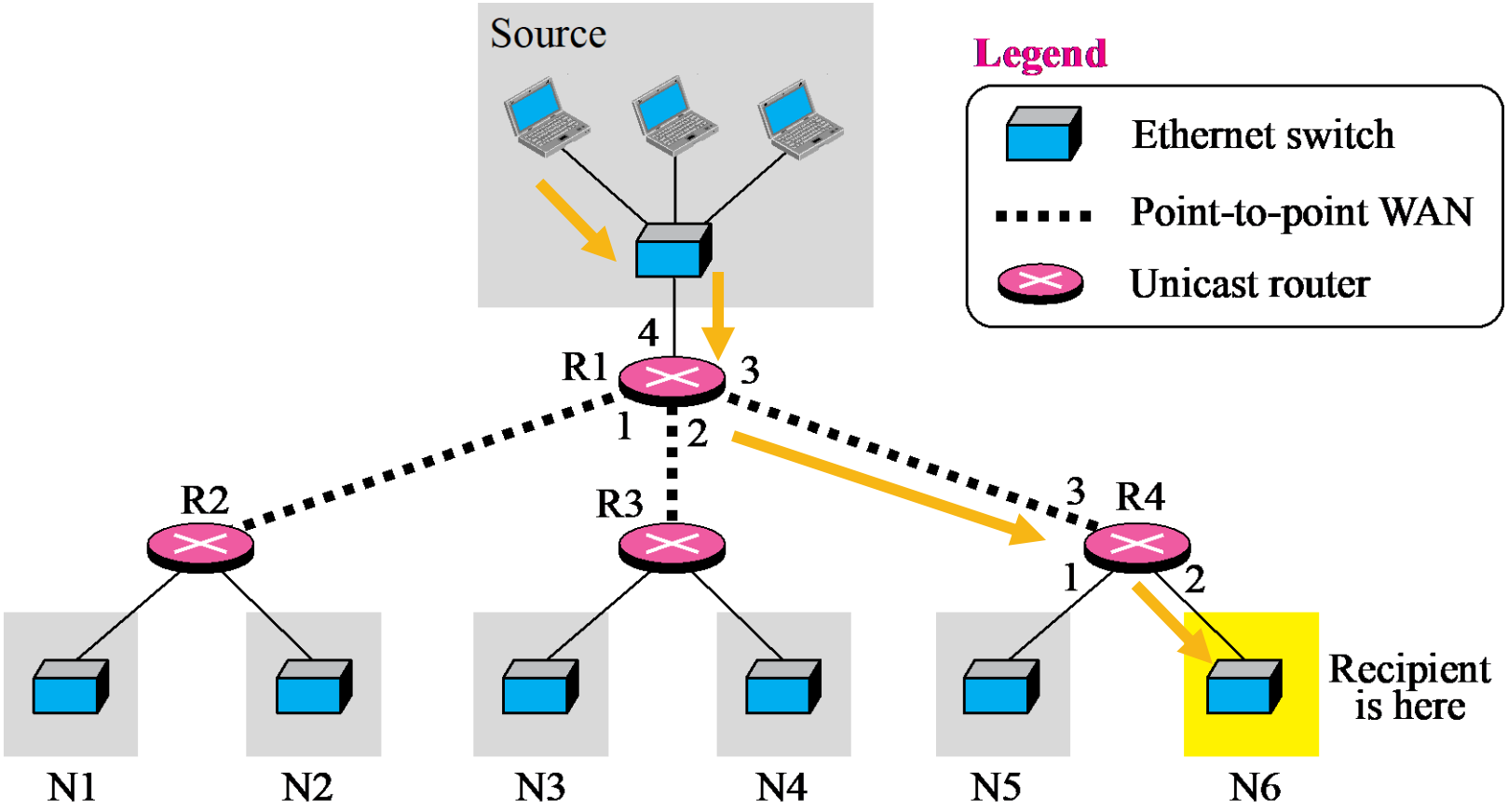


Routing Protocols: Classification



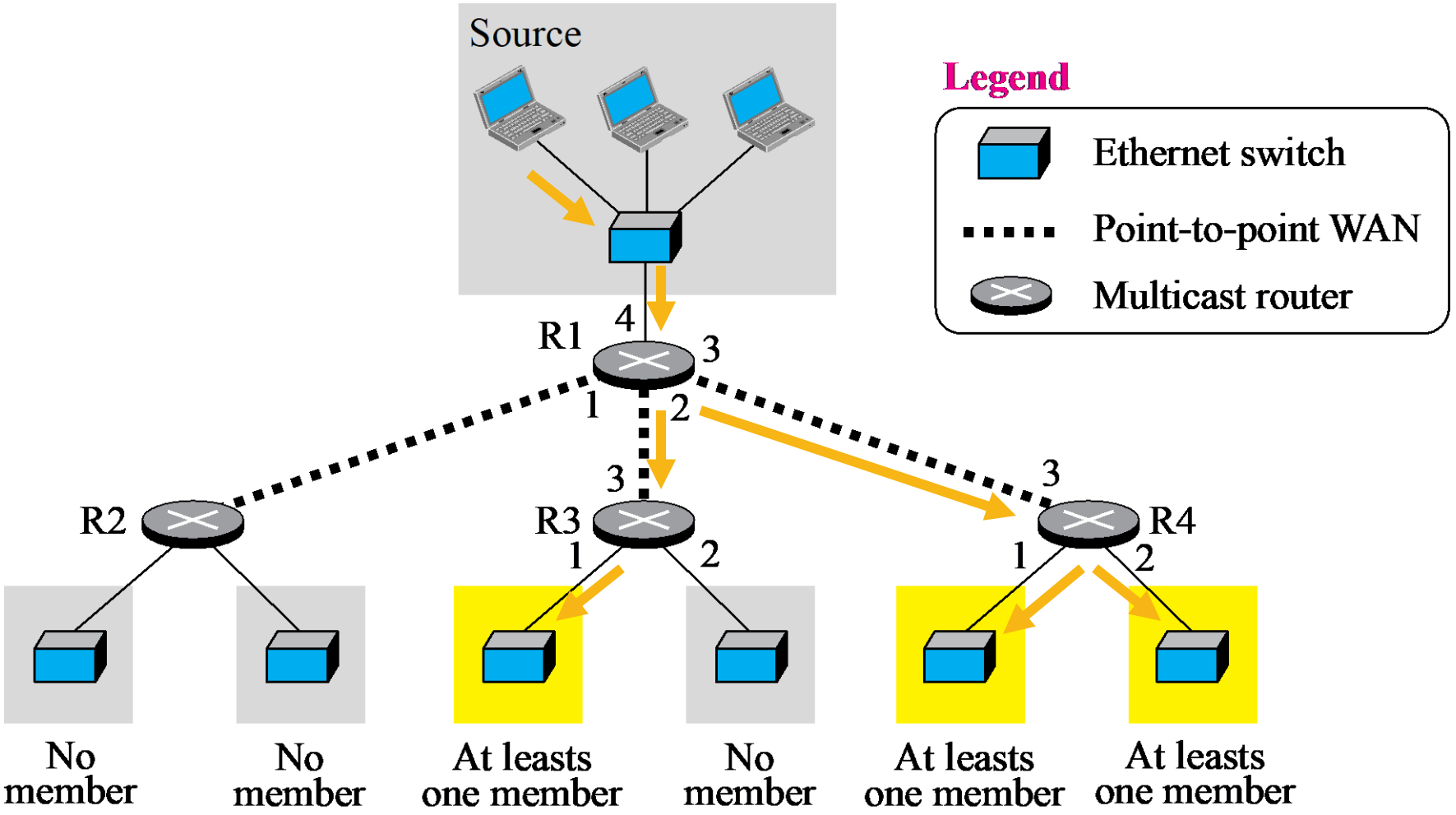
Routing Protocols

- Distance Vector Routing Protocols
  - ✓ Incomplete View of Topology.
  - ✓ Routes are advertised as Vectors of Distance and Direction.
  - ✓ Generally Periodic Updates.
- Link State Routing Protocols
  - ✓ Complete View of Network Topology.
  - ✓ Updates are Not Periodic. (Bounded and Triggered Updates).


Source
Legend
Ethernet switch
Point-to-point WAN
Unicast router
4
R1
3
1
2
R2
R3
3
R4
1
2
Recipient
is here
N1
N2
N3
N4
N5
N6

Note

In unicasting, the router forwards the received datagram through only one of its interfaces.


Source
Legend
Ethernet switch
Point-to-point WAN
Multicast router
R1
R2
R3
R4
4
3
1
2
3
3
1
2
1
2
No member
No member
At leasts one member
No member
At leasts one member
At leasts one member

Note

In multicasting, the router may forward the received datagram through several of its interfaces.

Note

Emulation of multicasting through multiple unicasting is not efficient and may create long delays, particularly with a large group.

Thank You