IPv6

Versions of IP

IPv0	March 1977 version	(deprecated)
IPv1	January 1978 version	(deprecated)
IPv2	February 1978 version A	(deprecated)
IPv3	February 1978 version B	(deprecated)
IPv4	September 1981 version	(current widespread)
IPv5 ST	Stream Transport	(not a new IP, little use)
IPv6	December 1998 version	(formerly SIP, SIPP)
IPv7 CATNIP	IPng evaluation	(formerly TP/IX; deprecated)
IPv8 Pip	IPng evaluation	(deprecated)
IPv9 TUBA	IPng evaluation	(deprecated)
IPv10 - 15	unassigned	

Deficiencies of IPv4

- Subnetting, Supernetting (Classless addressing), NAT is still a long term problem in Internet.
- Real time audio and video transmission. Reservation of resources is not provided by IPv4.
- No encryption and authentication of data.
- Address space is scarce -- 32 bits
- Rapid increase of Routing tables
  - 60,000 entries in the Internet now

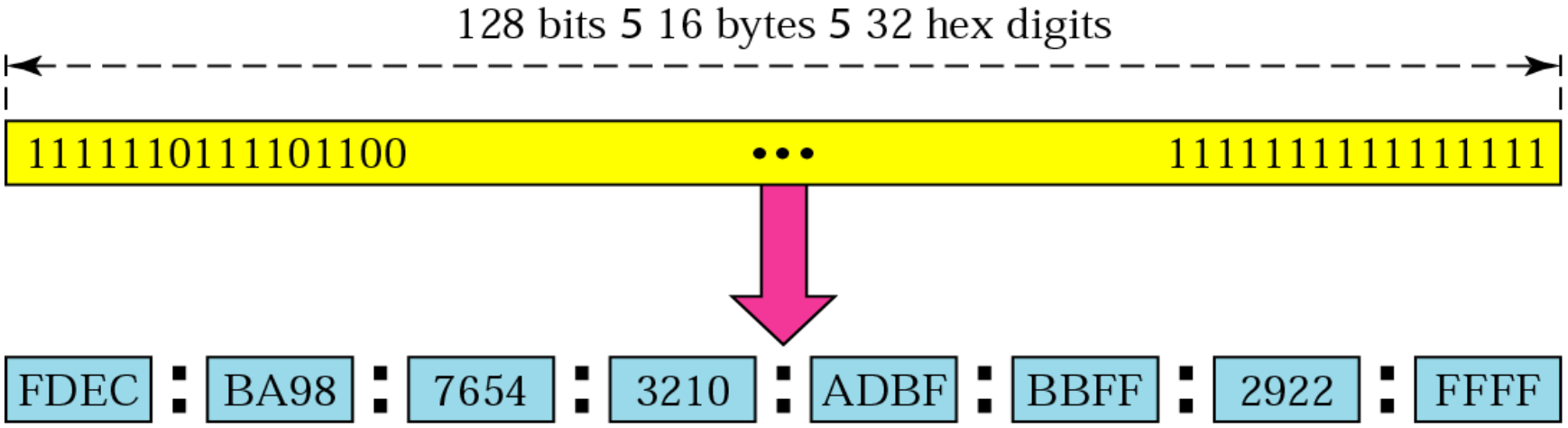
Features of IPv6

- Larger Address Space
- Aggregation-based address hierarchy
  - Efficient backbone routing
- Efficient and Extensible IP datagram
- Stateless Address Autoconfiguration
- Security (IPsec mandatory)
- Mobility

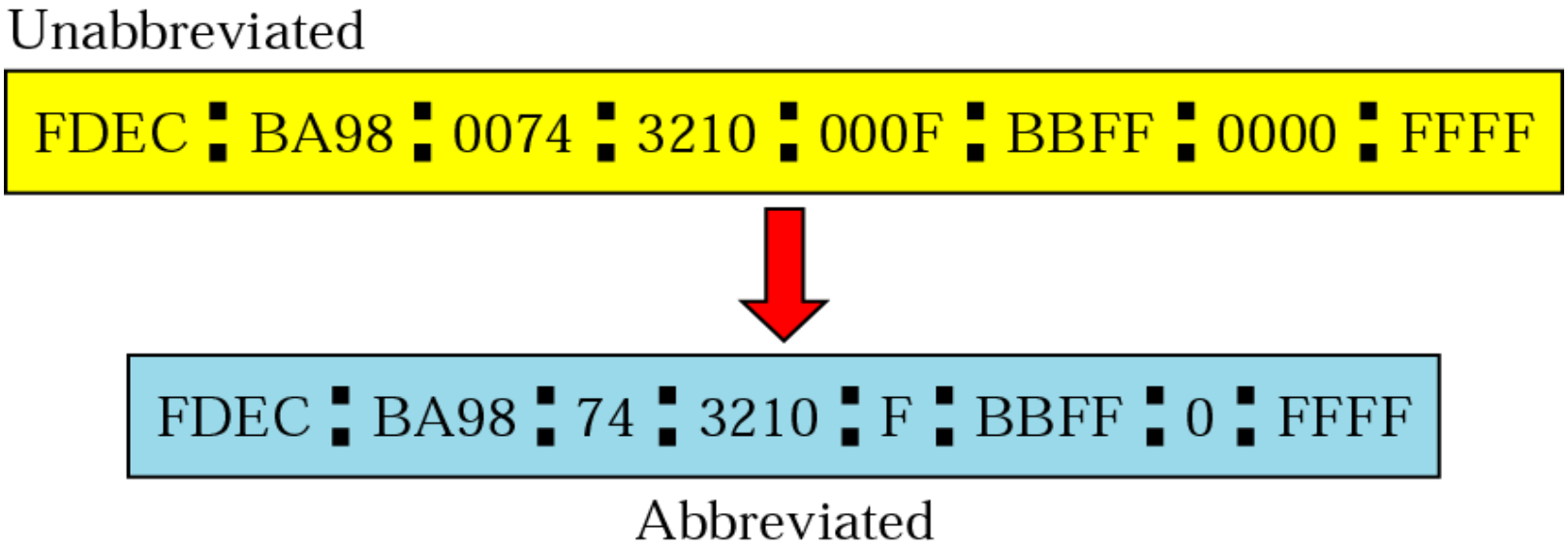
IPv6 Address Notation

- 128 bits or 16 bytes
- Basic rules
  - “:” in every 2 bytes
  - Hex digits
- shorthand
  - heading 0s in each block can be omitted
  - “0000” → “0”
  - “:0000 :” can be “::”

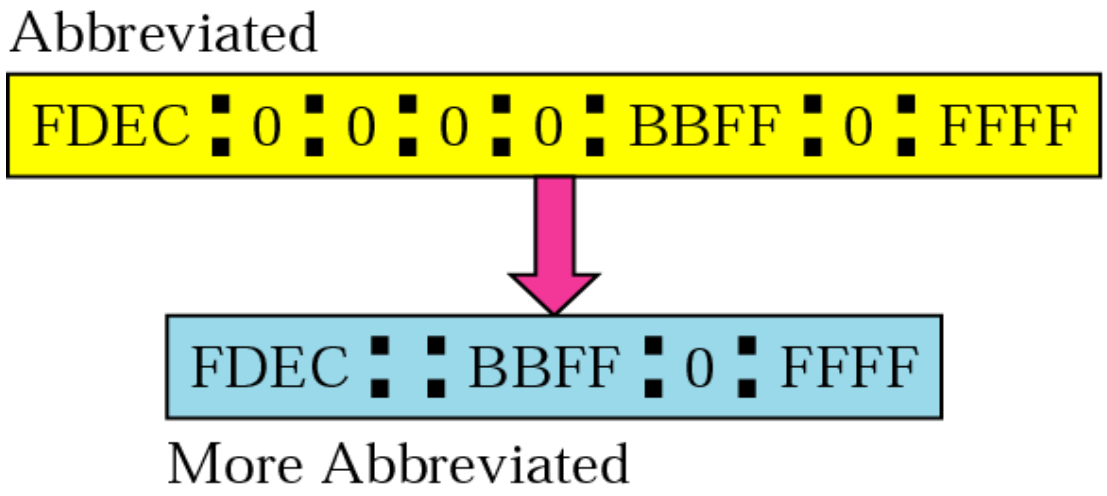
IPv6 Address Notation



Abbreviated Address



Abbr add. with consecutive 0s



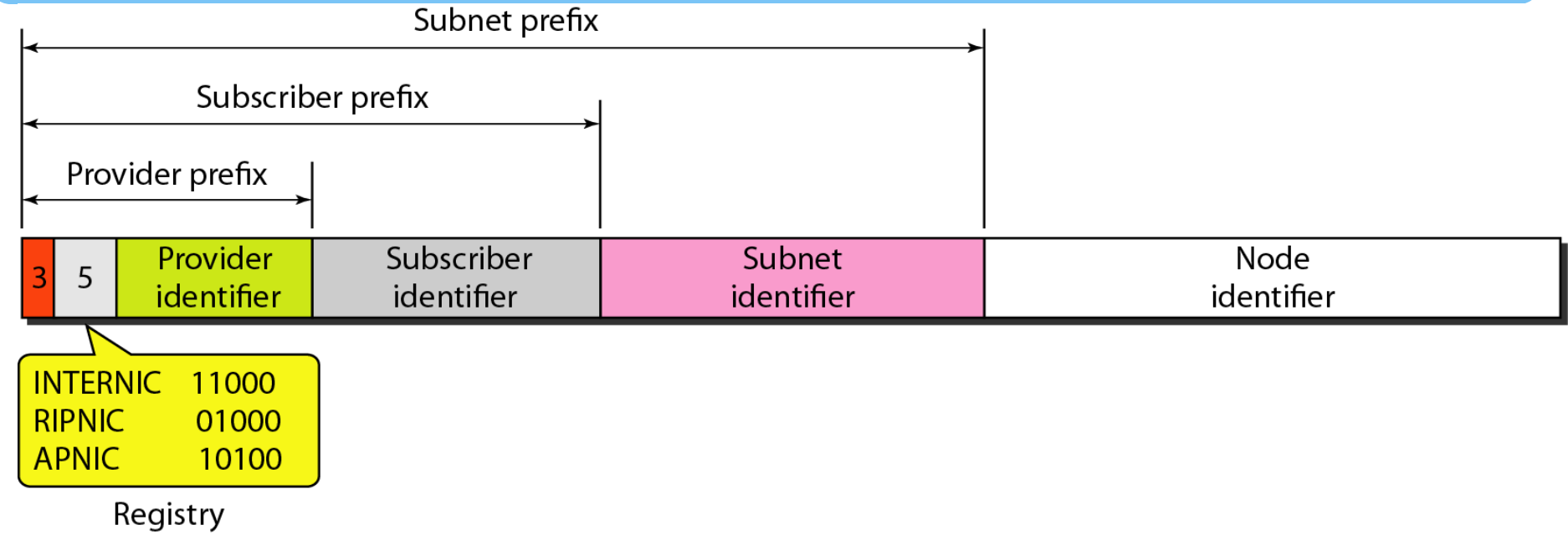
Type prefixes for IPv6 addresses

Type Prefix	*Type*	*Fraction*
0000 0000	Reserved	1/256
0000 0001	Unassigned	1/256
0000 001	ISO network addresses	1/128
0000 010	IPX (Novell) network addresses	1/128
0000 011	Unassigned	1/128
0000 1	Unassigned	1/32
0001	Reserved	1/16
001	Reserved	1/8
010	**Provider-based unicast addresses**	**1/8**

Type prefixes for IPv6 addresses

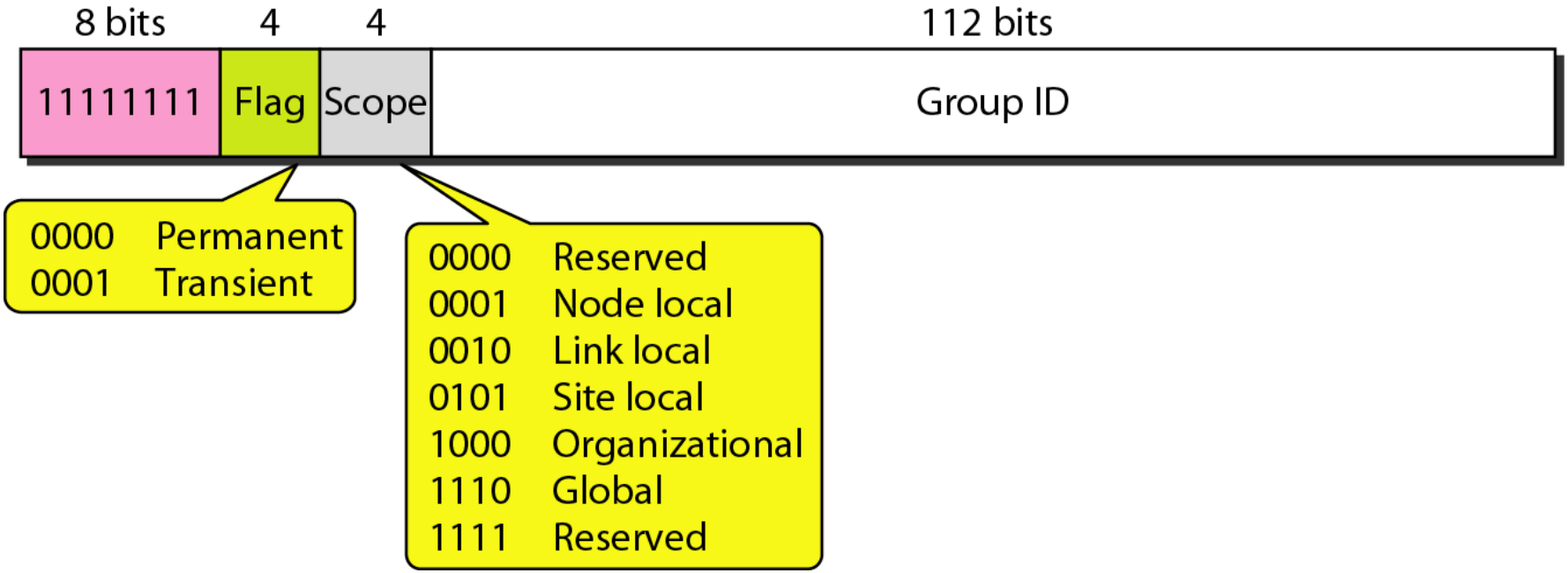
Type Prefix	*Type*	*Fraction*
011	Unassigned	1/8
100	Geographic-based unicast addresses	1/8
101	Unassigned	1/8
110	Unassigned	1/8
1110	Unassigned	1/16
1111 0	Unassigned	1/32
1111 10	Unassigned	1/64
1111 110	Unassigned	1/128
1111 1110 0	Unassigned	1/512
1111 1110 10	Link local addresses	1/1024
1111 1110 11	Site local addresses	1/1024
1111 1111	Multicast addresses	1/256

Provider-Based Unicast Address

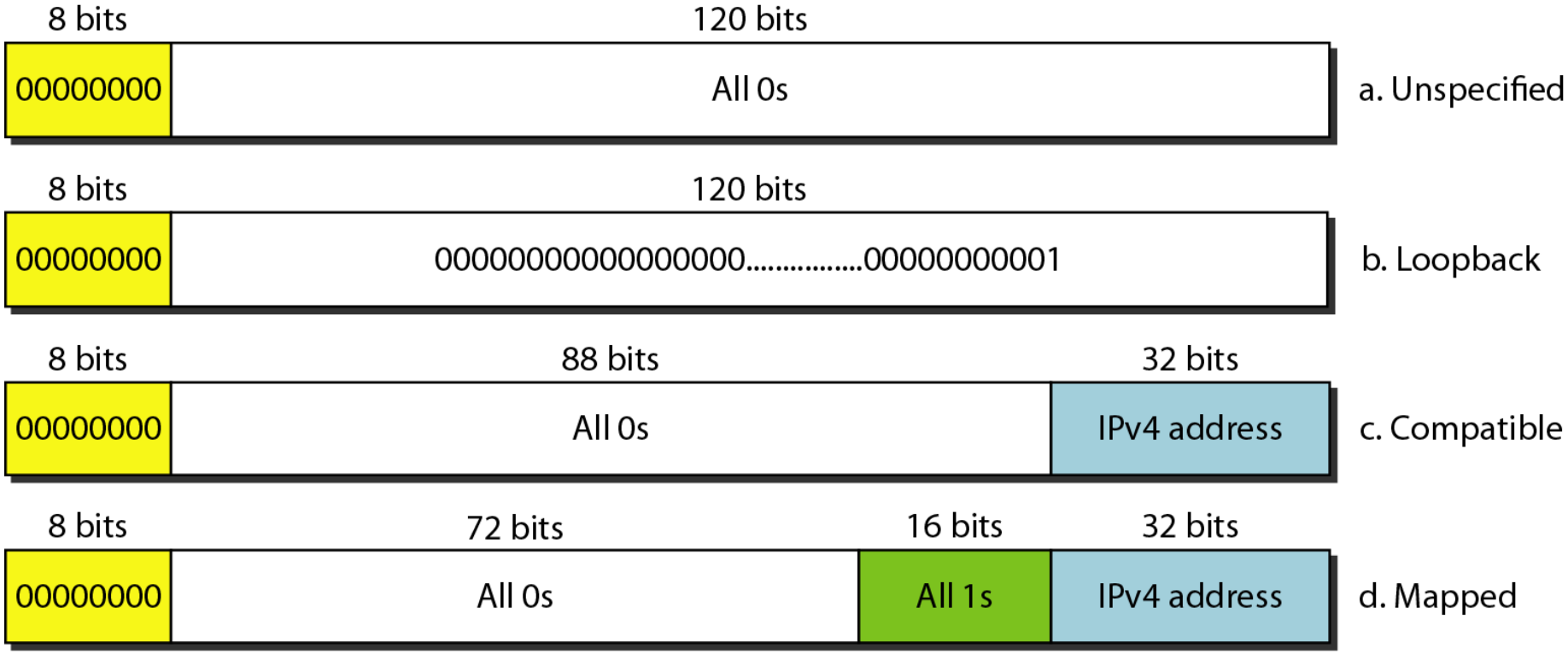


- Type Identifier- 3 bit field
- Registry id: 5 bit field
- Provider id: 16 bit(ISP)
- Subscriber id: 24 bit (organization)
- Subnet id: 32 bit (subnet)
- Node Identifier- 48 bit field (MAC Address)

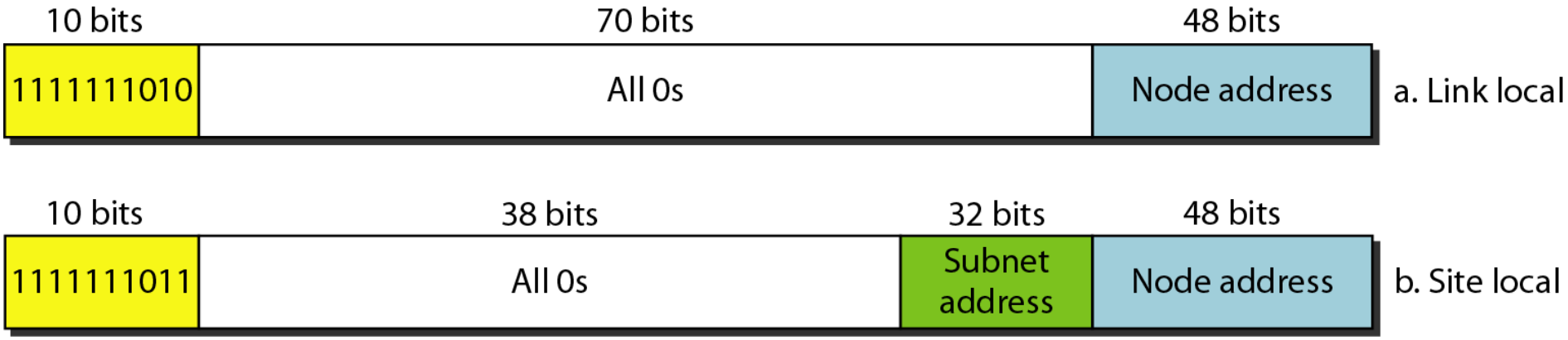
Multicast address



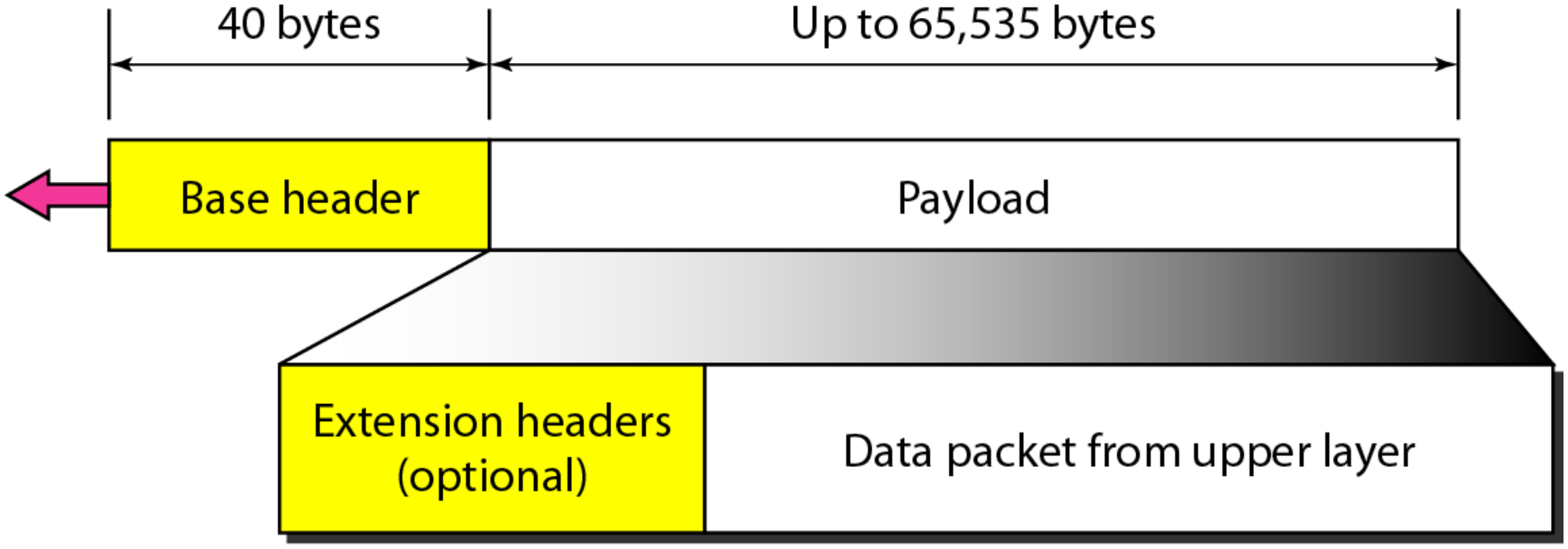
Reserved addresses



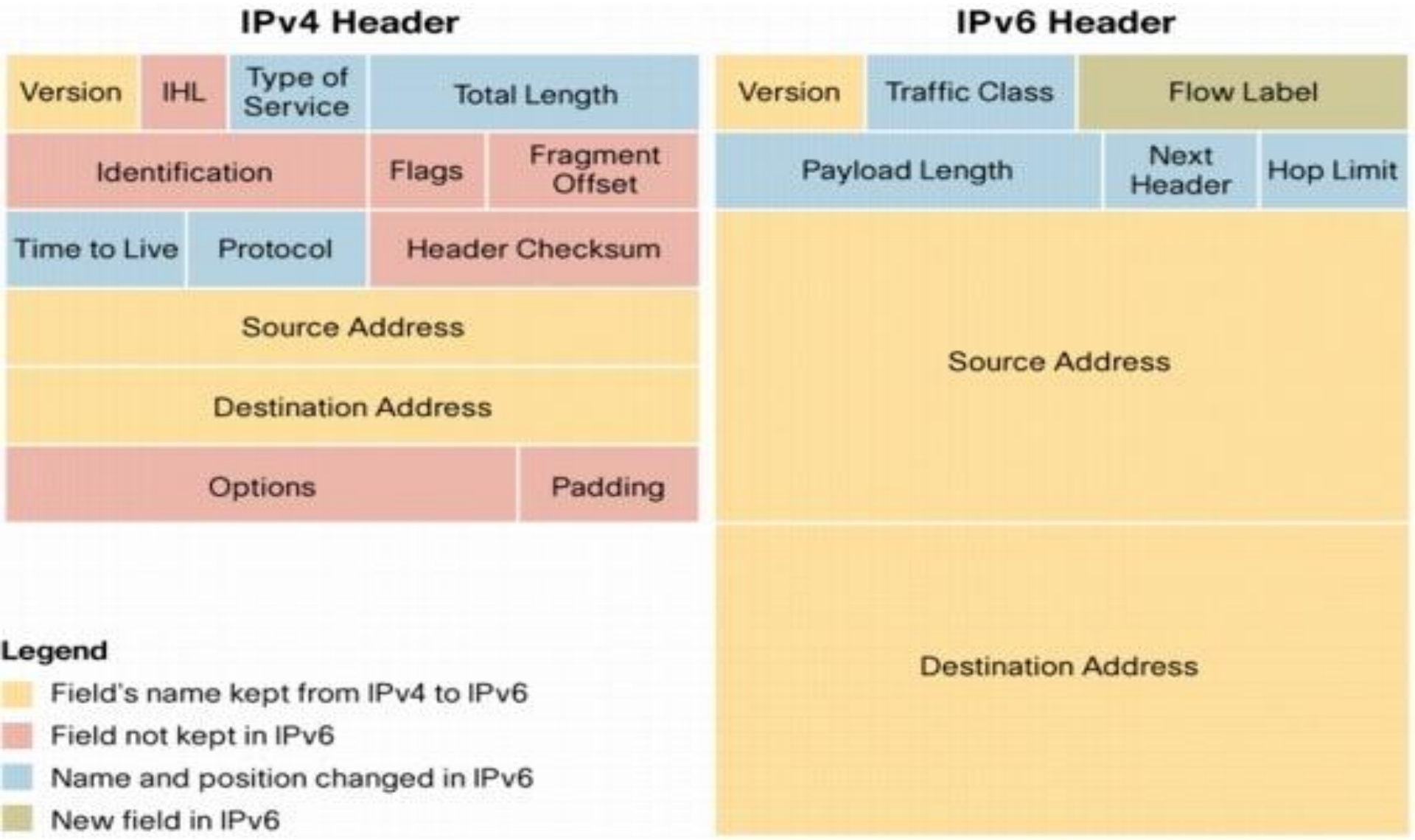
Local addresses



IPv6 Header


40 bytes
Up to 65,535 bytes
Base header
Payload
Extension headers (optional)
Data packet from upper layer

IPv4 vs IPv6 Header



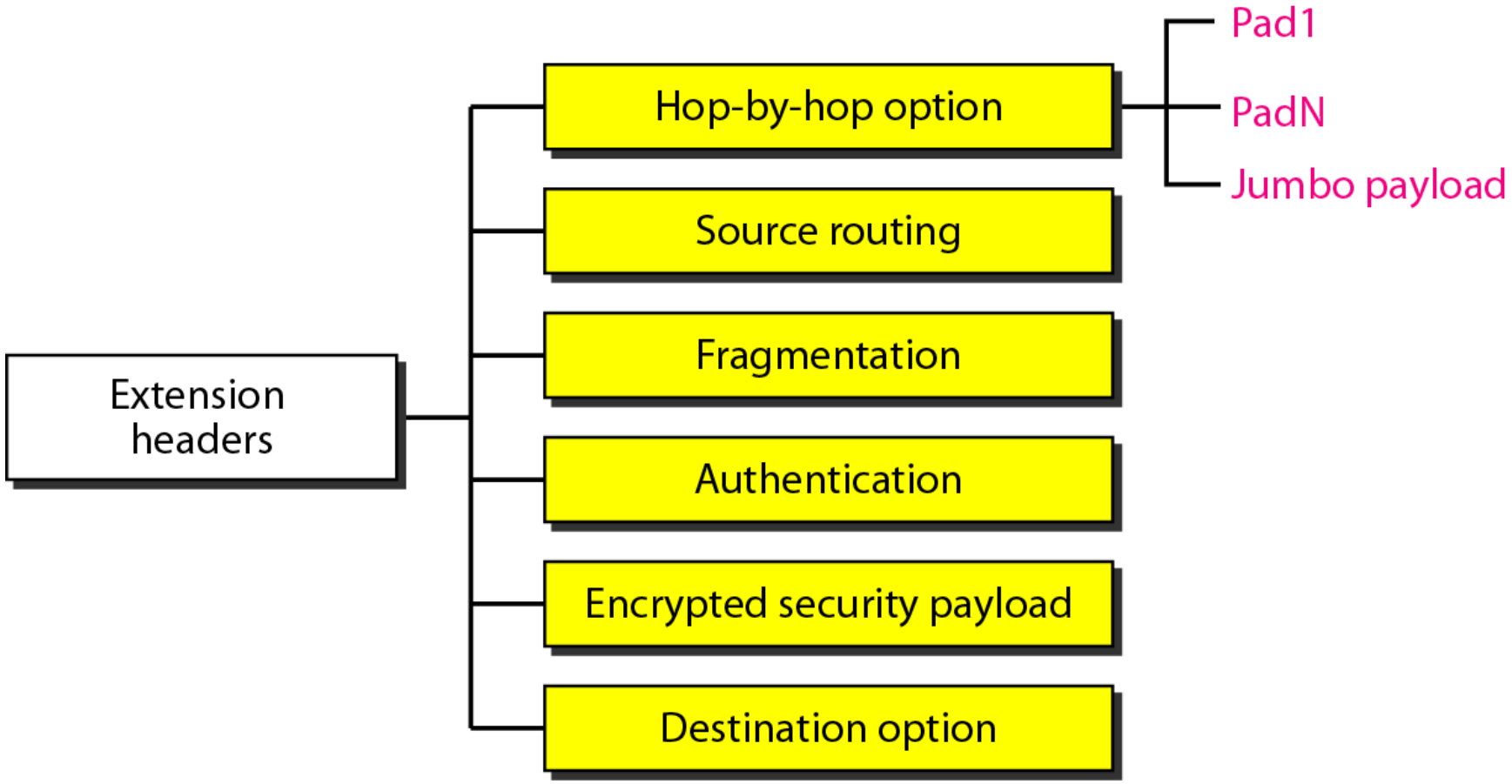
IPv4 vsIPv6

- Streamlined
  - Fragmentation fields moved out of base header
  - IP options moved out of base header
  - Header Checksum eliminated
  - Header Length field eliminated
  - Length field excludes IPv6 header
- Revised
  - Time to Live → Hop Limit
  - Protocol → Next Header (TCP/UDP)
  - Type of Service → Traffic Class/Priority (Used in congestion control)
  - Addresses increased 32 bits → 128 bits
- Extended
  - Flow Label field added (special handling for a particular flow of data)

Major Improvements of IPv6 Header

- No option field: Replaced by extension header. Result in a fixed length, 40-byte IP header.
- No header checksum: Result in fast processing.
- No fragmentation at intermediate nodes: Result in fast IP forwarding.

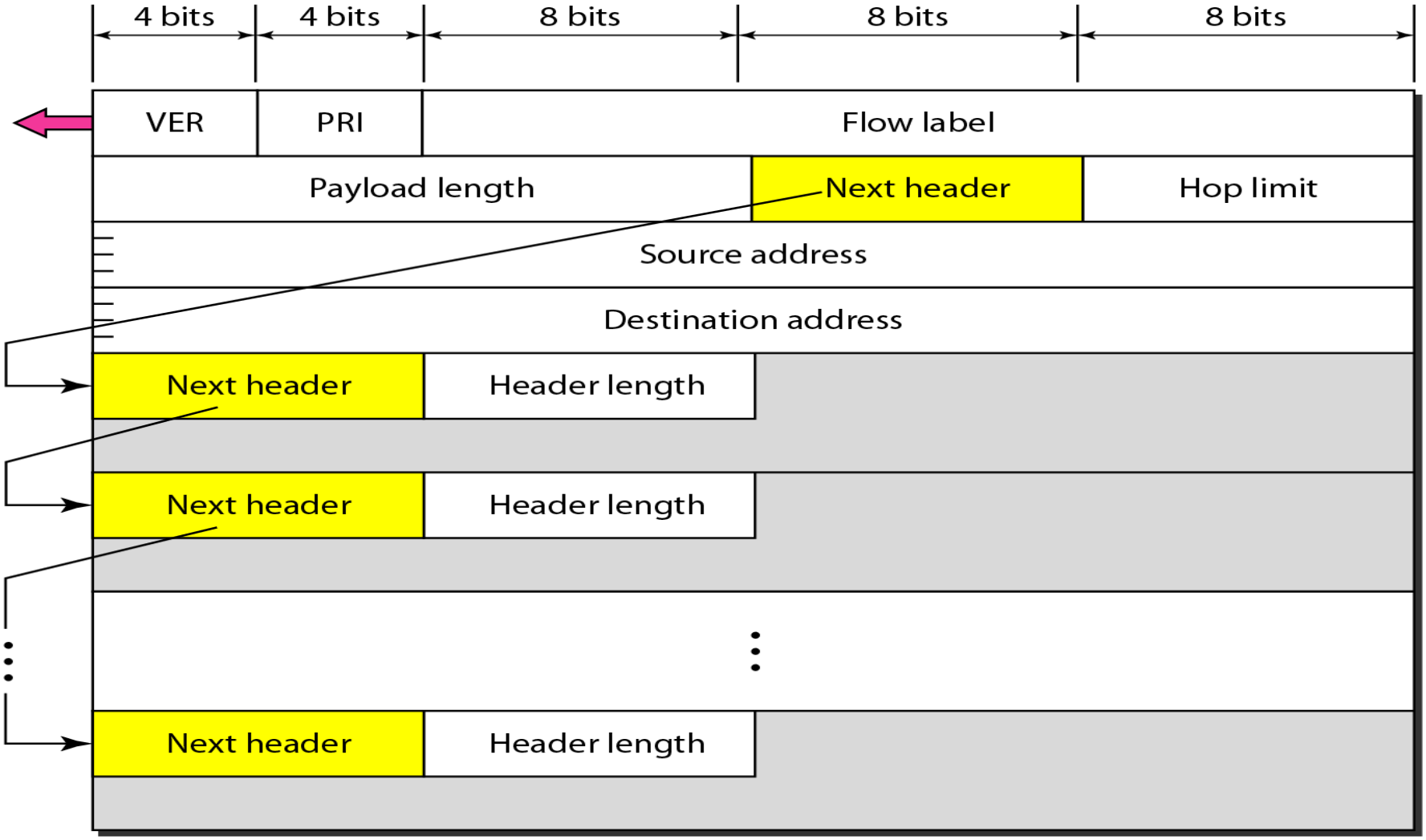
Extension header types



Extension Headers

- Hop-by-Hop Option – Special options that require hop-by-hop processing
- Source Routing – Extended routing, like IPv4 loose list of routers to visit
- Fragmentation – Fragmentation and reassembly
- Authentication – Integrity and authentication, security
- Encryption – Confidentiality
- Destination Options – Optional information to be examined by the destination node

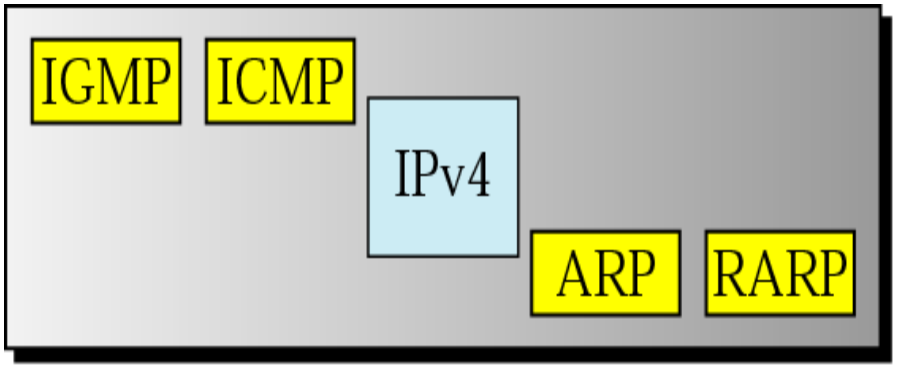
Extension Headers



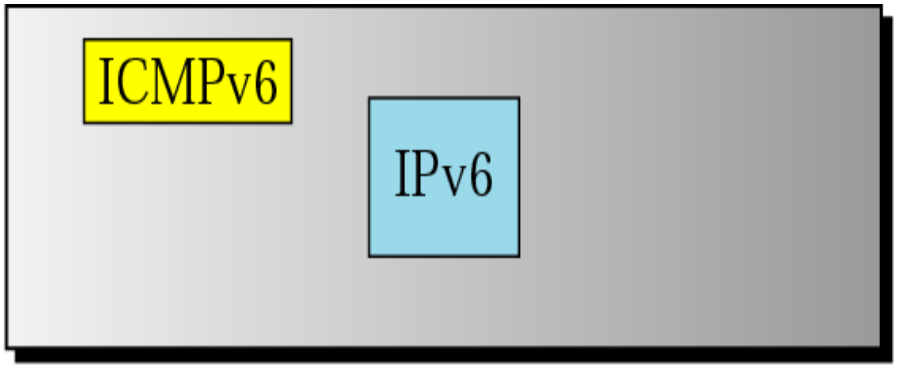
Next header codes for IPv6

Code	*Next Header*
0	Hop-by-hop option
2	ICMP
6	TCP
17	UDP
43	Source routing
44	Fragmentation
50	Encrypted security payload
51	Authentication
59	Null (no next header)
60	Destination option

Comparison of network layers in version 4 and version 6

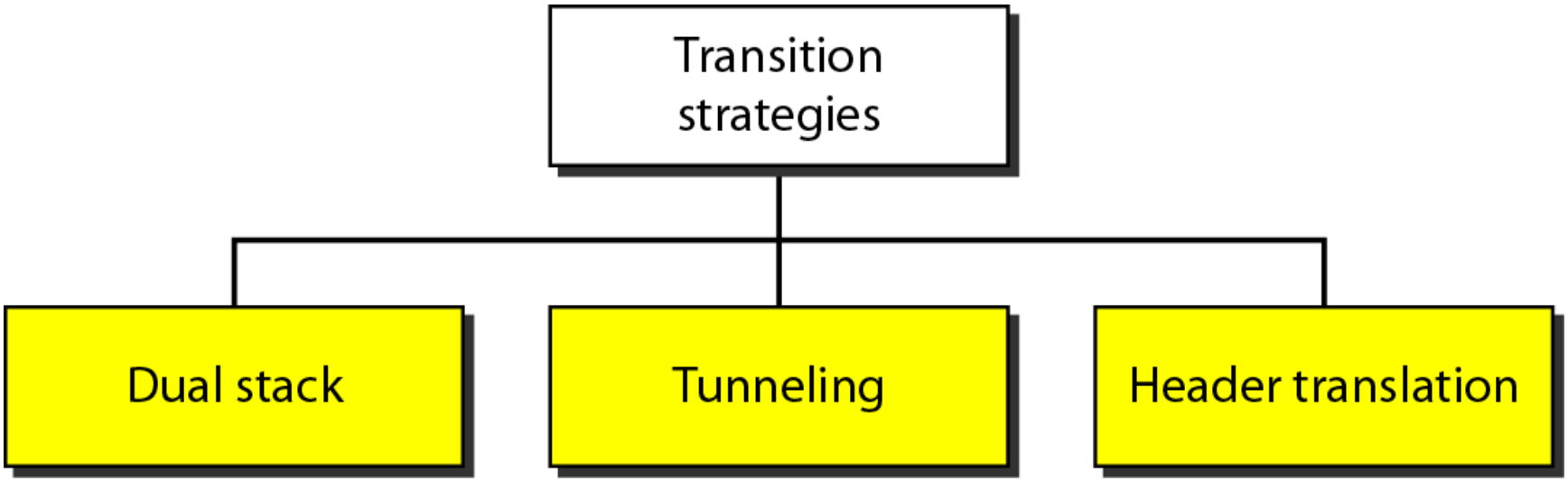


Network layer in version 4

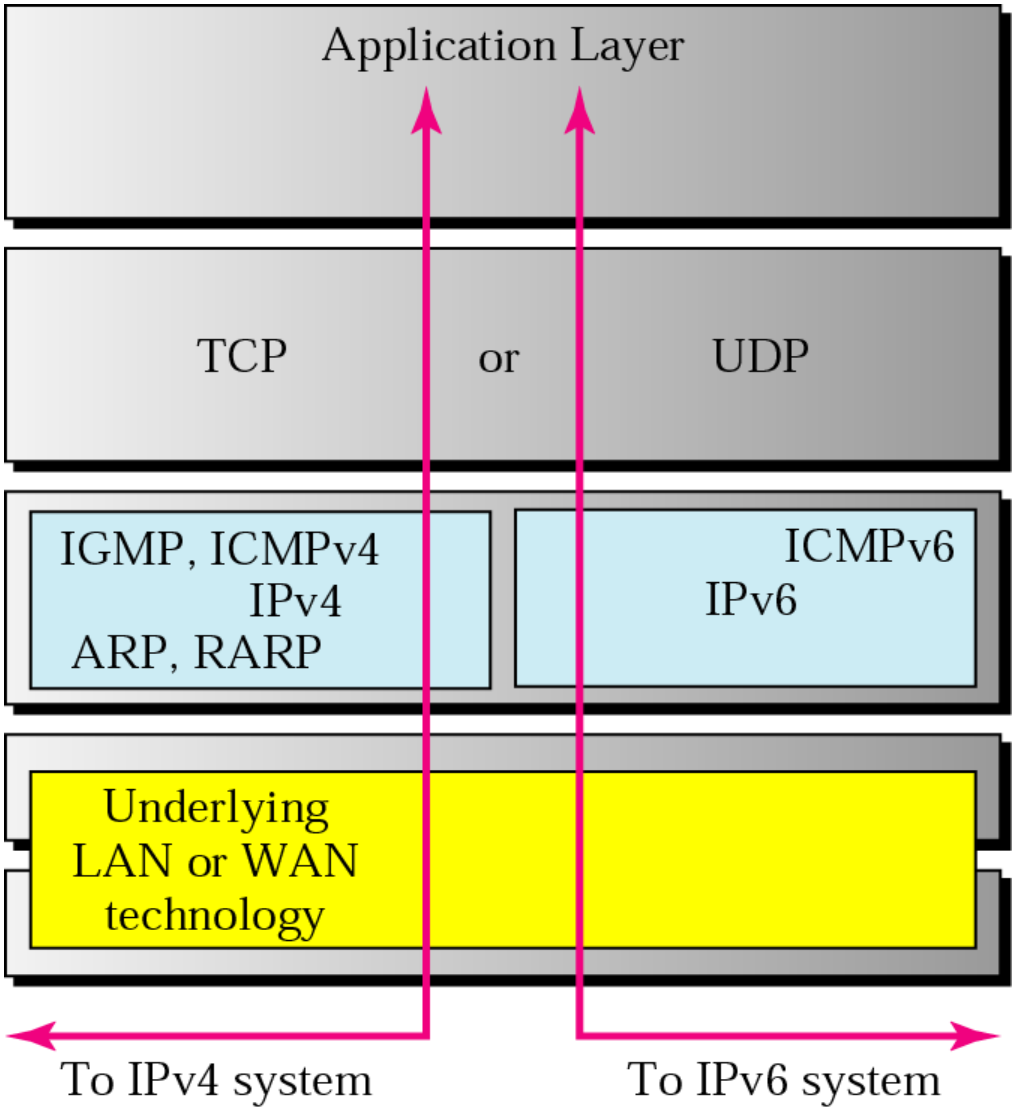


Network layer in version 6

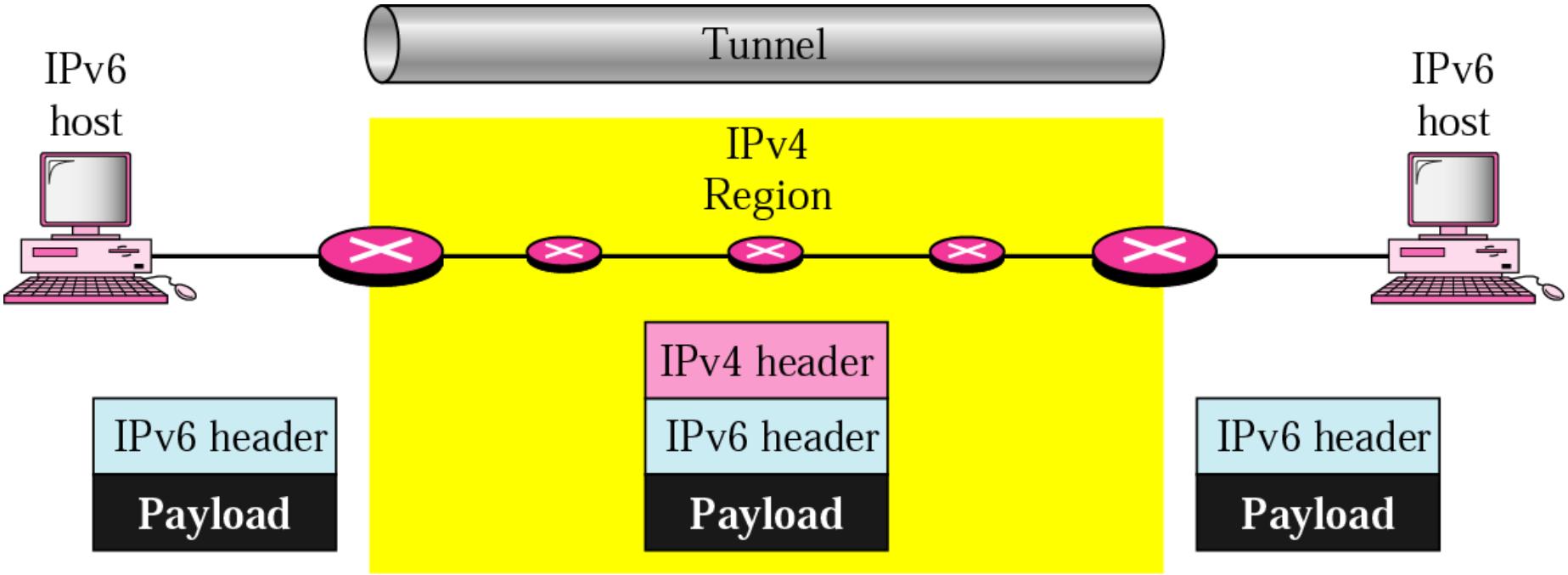
Three transition strategies



Dual Stack


Application Layer
TCP
or
UDP
IGMP, ICMPv4
IPv4
ARP, RARP
ICMPv6
IPv6
Underlying
LAN or WAN
technology
To IPv4 system
To IPv6 system

Tunneling


Tunnel
IPv6
host
IPv6
host
IPv4
Region
IPv4 header
IPv6 header
Payload
IPv6 header
Payload
IPv6 header
Payload

Header translation