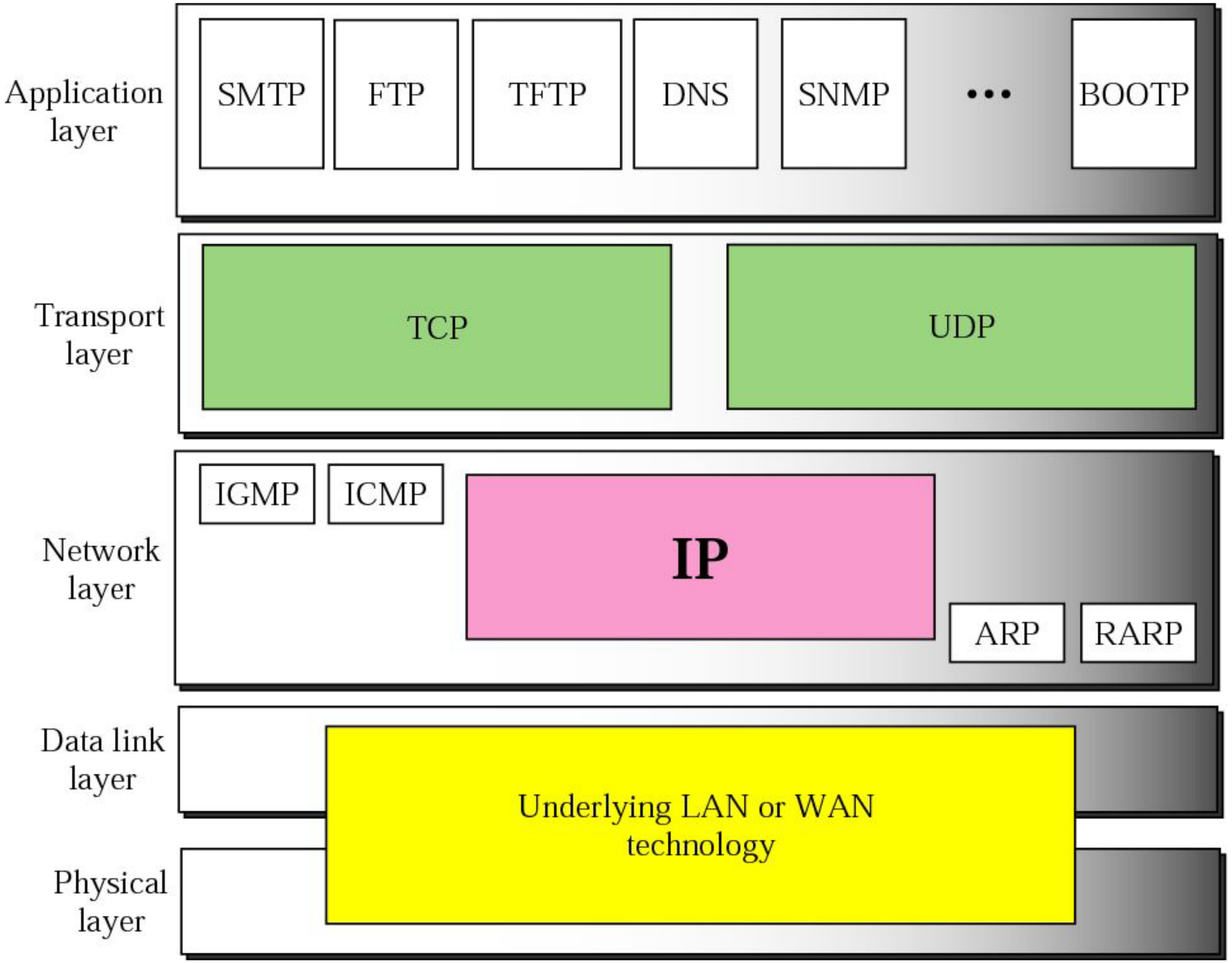
Computer Network(CSC 503)

Shilpa Ingoley

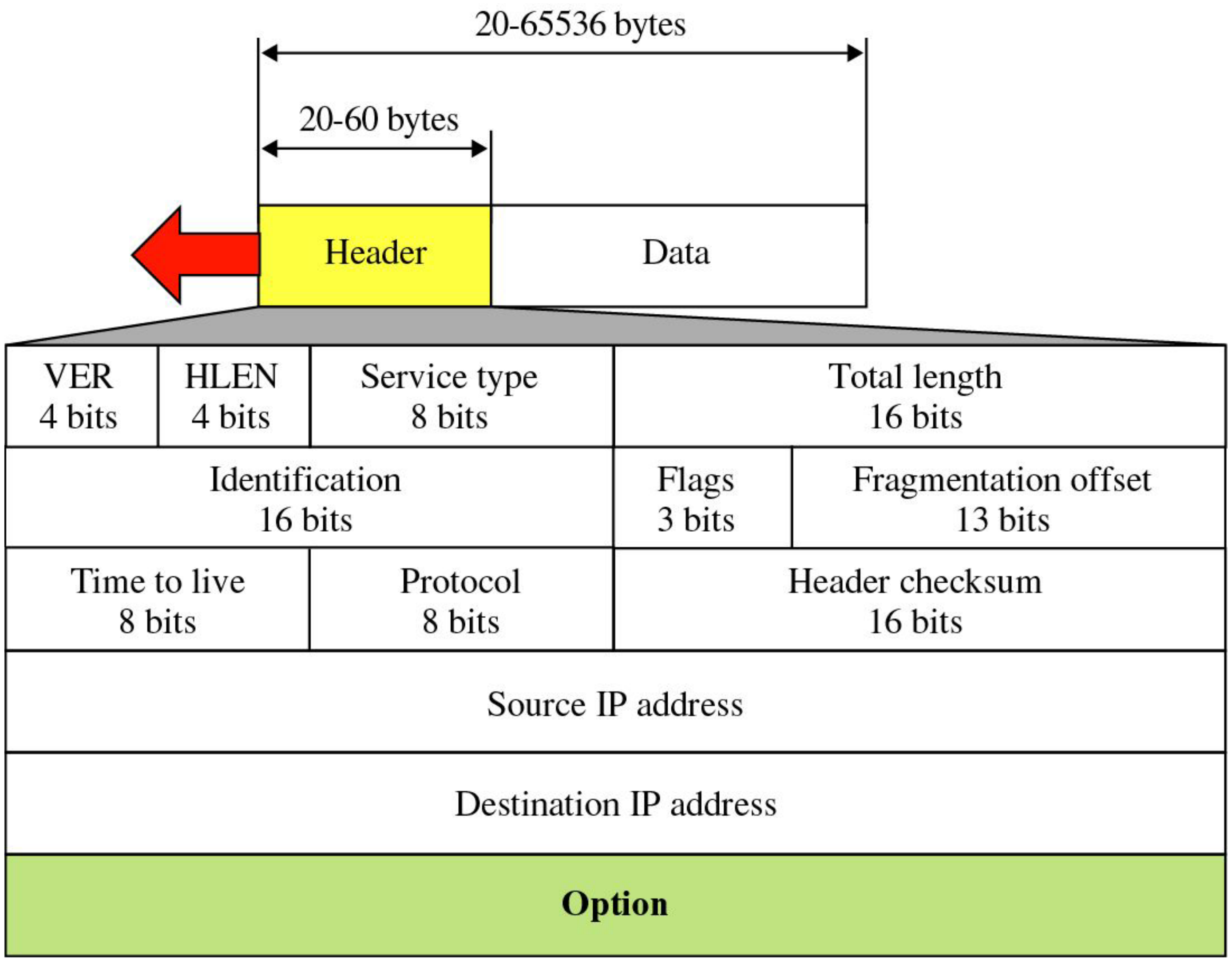
Lecture 25

Position of IP in TCP/IP protocol suite

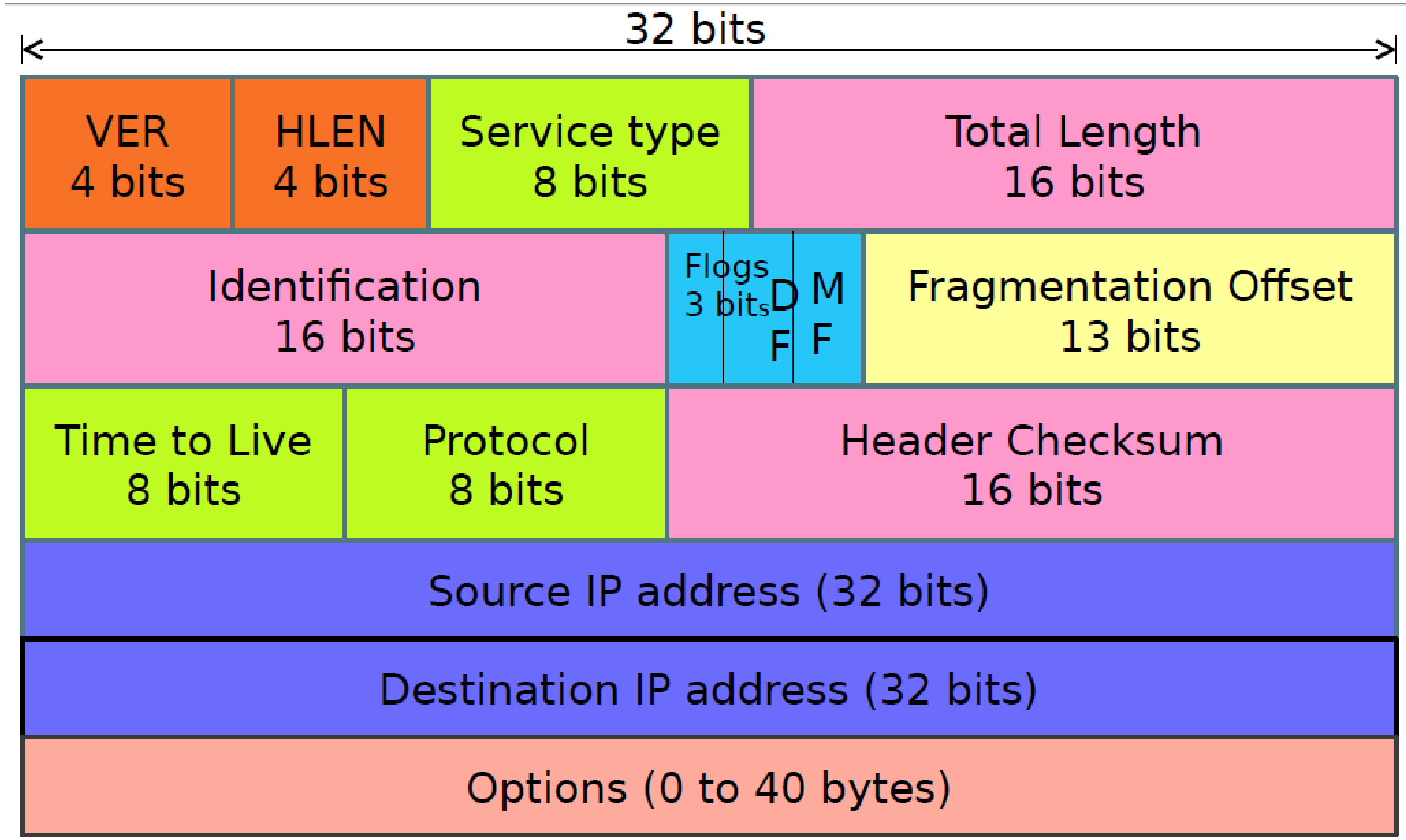


IPV4 Header

DATAGRAM



IPV4 Header


32 bits
VER
4 bits
HLEN
4 bits
Service type
8 bits
Total Length
16 bits
Identification
16 bits
Flogs
3 bits
D
F
M
F
Fragmentation Offset
13 bits
Time to Live
8 bits
Protocol
8 bits
Header Checksum
16 bits
Source IP address (32 bits)
Destination IP address (32 bits)
Options (0 to 40 bytes)

IPV4 Header-Fields

- **1. Version Number(VER)**: This 4-bit field defines the version of the IP

- **2. Header Length(HLEN):**

❑ It is a 4-bit field defines the total length of the datagram header in 4-byte words

❑ The total length of the header is divided by 4 and that value is inserted in this field

❑ The receiver needs to multiply the value of this field by 4 to find the total length

- **3. Service Type**: This is a 8-bit field used to distinguish between different classes of service

Contd…

- **4.Total Length**: This 16-bit field defines total length i.e. header plus data of the datagram in bytes
- Length of the data=total length-(HLEN)*4
- Max. length is 65,535 bytes(2^16-1)

- **5. Identification:**
- It is needed by the destination field to determine which datagram a newly arrived fragment belongs to
- All fragments of a datagram contain the same identification value

Contd…

- **6. Flags:** This is a 3 bit field. One unused bit field and two 1-bit fields.
- DF: Don't fragment (by default it is set to 0 means fragment will be done)
  - MF: More Fragments (all fragments except the last one is set to 1 i.e. MF=1 only)
- **7. Fragmentation offset:** It is a 13-bit field which determines where in the current datagram, this fragment belongs to
  - Maximum number of fragments per datagram
- =2^13=8192

Contd…

- **8. Time to Live**: This is a 8-bit field which is used to control the maximum number of hops (routers) visited by the datagram
- The time is counted in seconds
- At each hop it is decremented
- When a source host sends the datagram, it stores a number in this field which is approximately two times the maximum number of routers between two hosts
- Each router that processes the datagram decrements this number by one
- If this value after being decremented is zero, the router discards the datagram

Contd…

- **9.Protocol:** It is a 8-bit field which tells the network layer to which transport process, the complete assembled datagram must be given to.
- It can be TCP or UDP
- **10. Header checksum:** It is a 16-bit field which checks the header only.
- It needs to be re-calculated at each hop
- **11. Source IP address:** It is a 32-bit field which defines the IP address of the source
- **12. Destination IP address:** It is a 32-bit field which defines the IP address of the destination

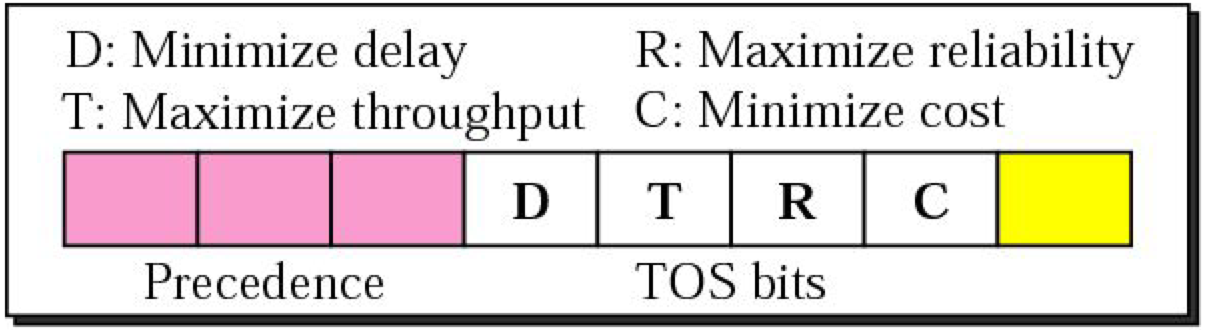
Contd…

- **Options :** Options can be of variable length. A datagram can have upto 40 bytes of options which are used for network testing and debugging.
- For example:
- Timestamp: Makes each router append its address and timestamp
- Record route: makes each router append its
- IP address
- Security: Specifies how secret the datagram is

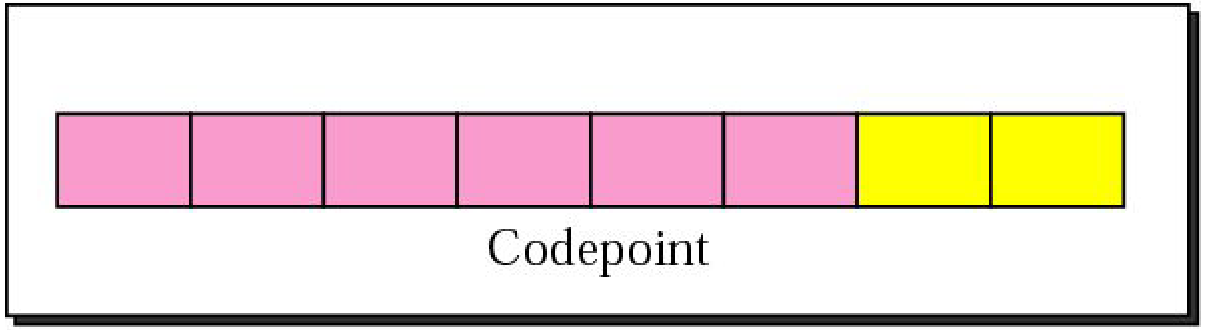
Contd…

- **Data :** Data or Payload is the packet coming from other protocols that use the service of IP.
- If a datagram is considered to be a package that needs to be sent from one host to another then:
- Payload is the content of that package
- Header is the information that is written on the package

Service Type or Differentiated Services



Service Type



Differentiated Services

The precedence subfield is not used in version 4.

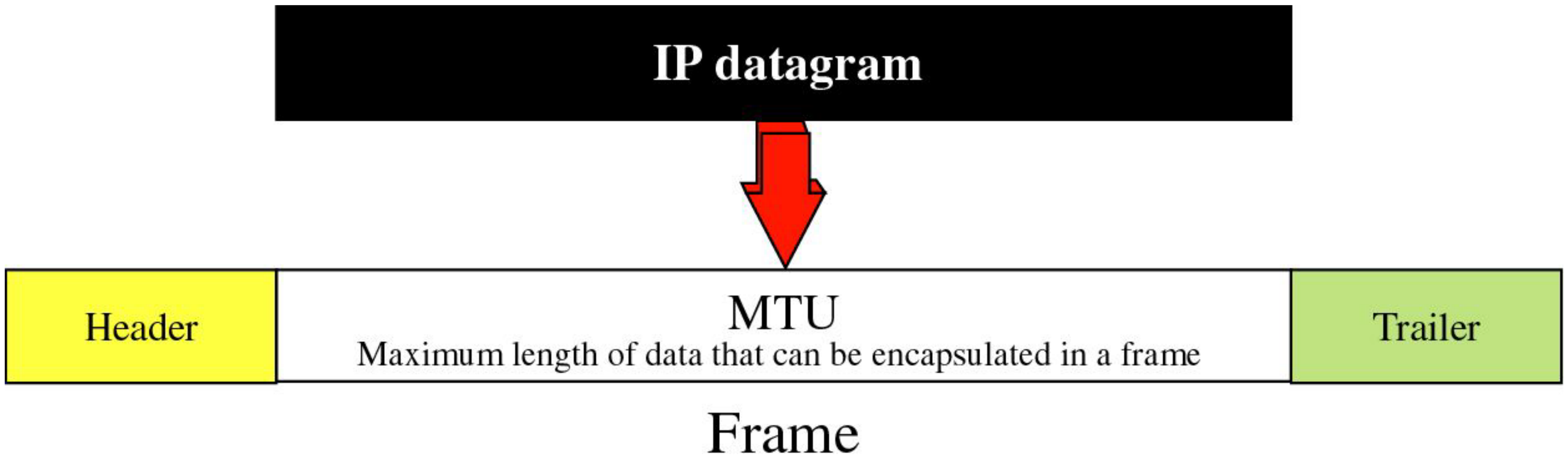
The total length field defines the total length of the datagram including the header.

Protocol field

Value	Protocol
1	ICMP
2	IGMP
6	TCP
17	UDP
89	OSPF

FRAGMENTATION

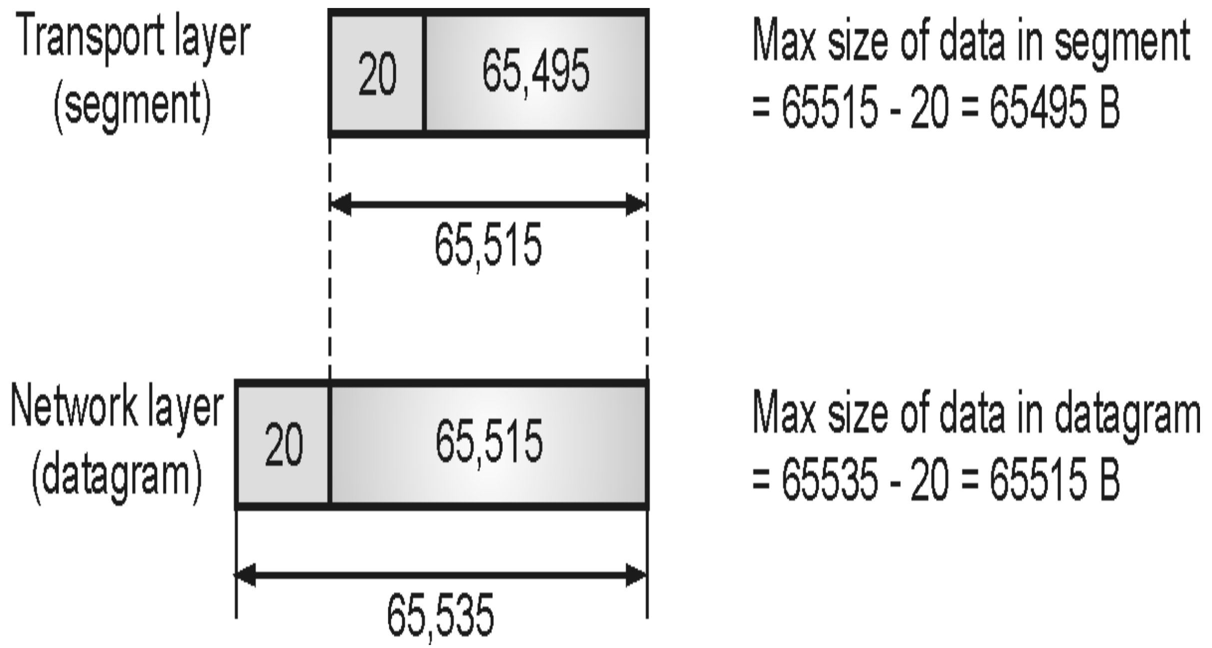
- **MTU**



MTU

Protocol	MTU
Hyperchannel	65535
Token Ring(16 Mbps)	17914
Token Ring(4 Mbps)	4464
FDDI	4352
Ethernet	1500
X.25	576
PPP	296

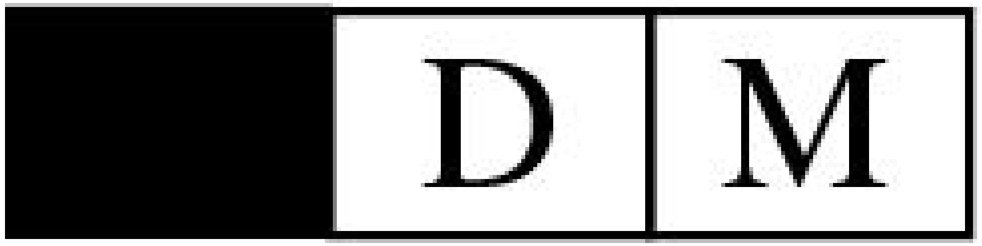
Contd…


Transport layer
(segment)
20
65,495
65,515
Max size of data in segment
= 65515 - 20 = 65495 B
Network layer
(datagram)
20
65,515
65,535
Max size of data in datagram
= 65535 - 20 = 65515 B

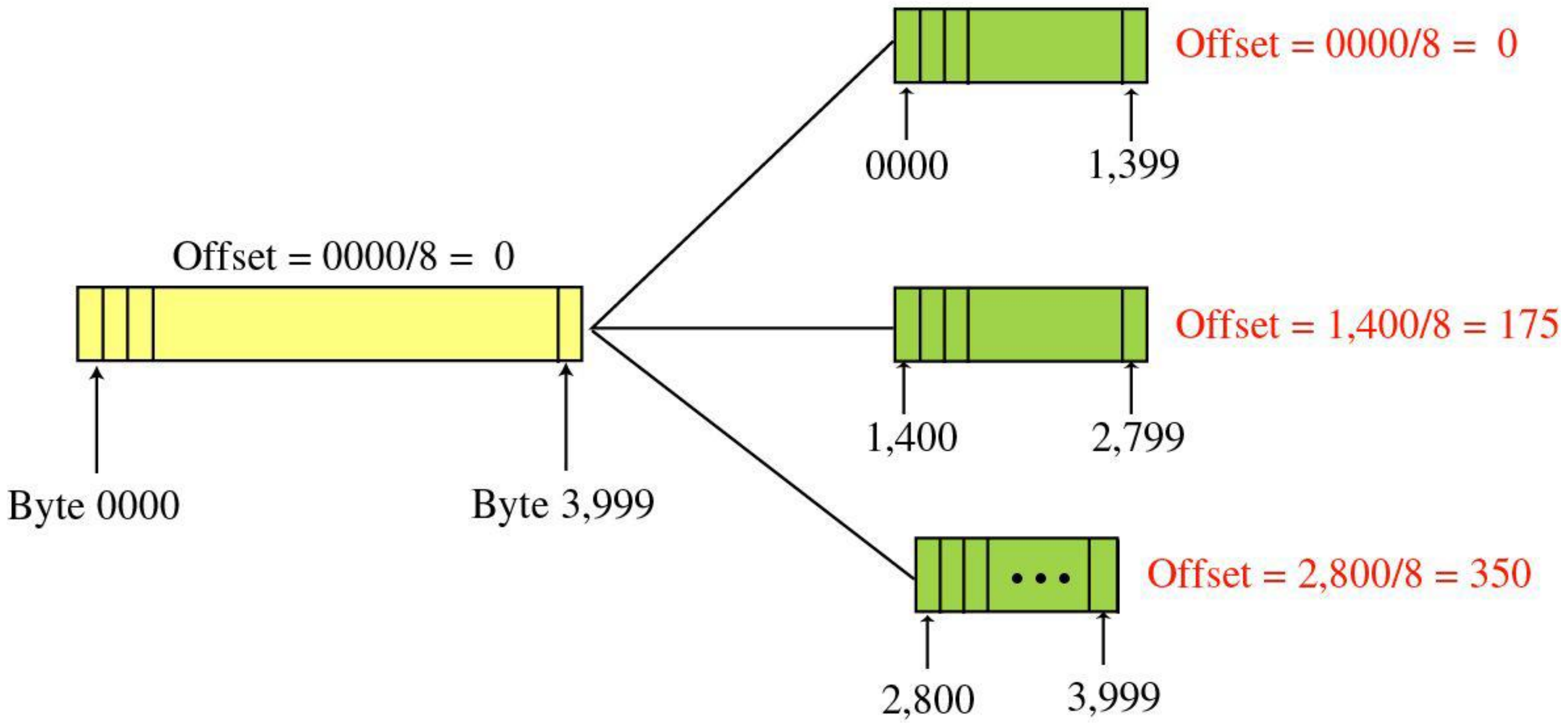
Flag field

D: Do not fragment

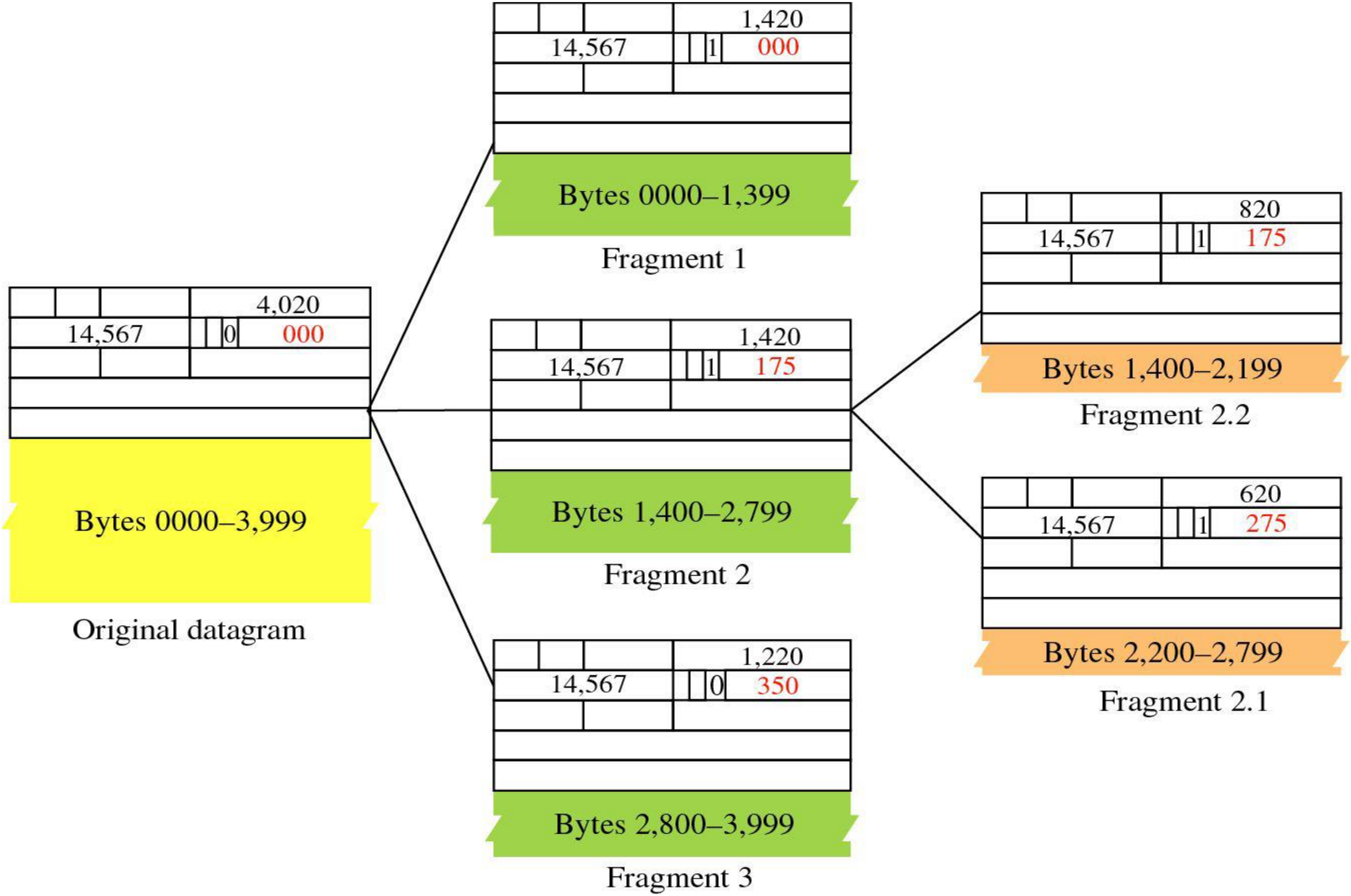
M: More fragments



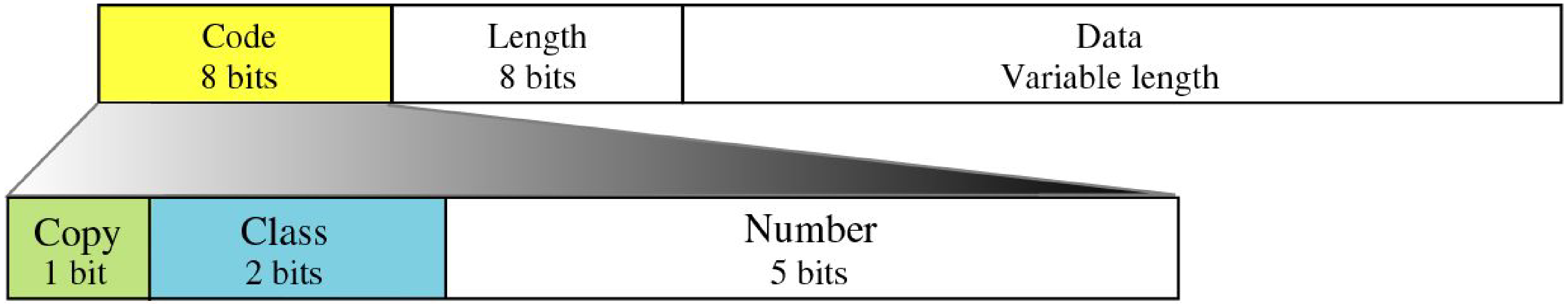
Fragmentation offset calculation



Contd…


4,020
14,567
0
000
Bytes 0000–3,999
Original datagram
1,420
14,567
1
000
Bytes 0000–1,399
Fragment 1
1,420
14,567
1
175
Bytes 1,400–2,799
Fragment 2
1,220
14,567
0
350
Bytes 2,800–3,999
Fragment 3
820
14,567
1
175
Bytes 1,400–2,199
Fragment 2.2
620
14,567
1
275
Bytes 2,200–2,799
Fragment 2.1

Option format

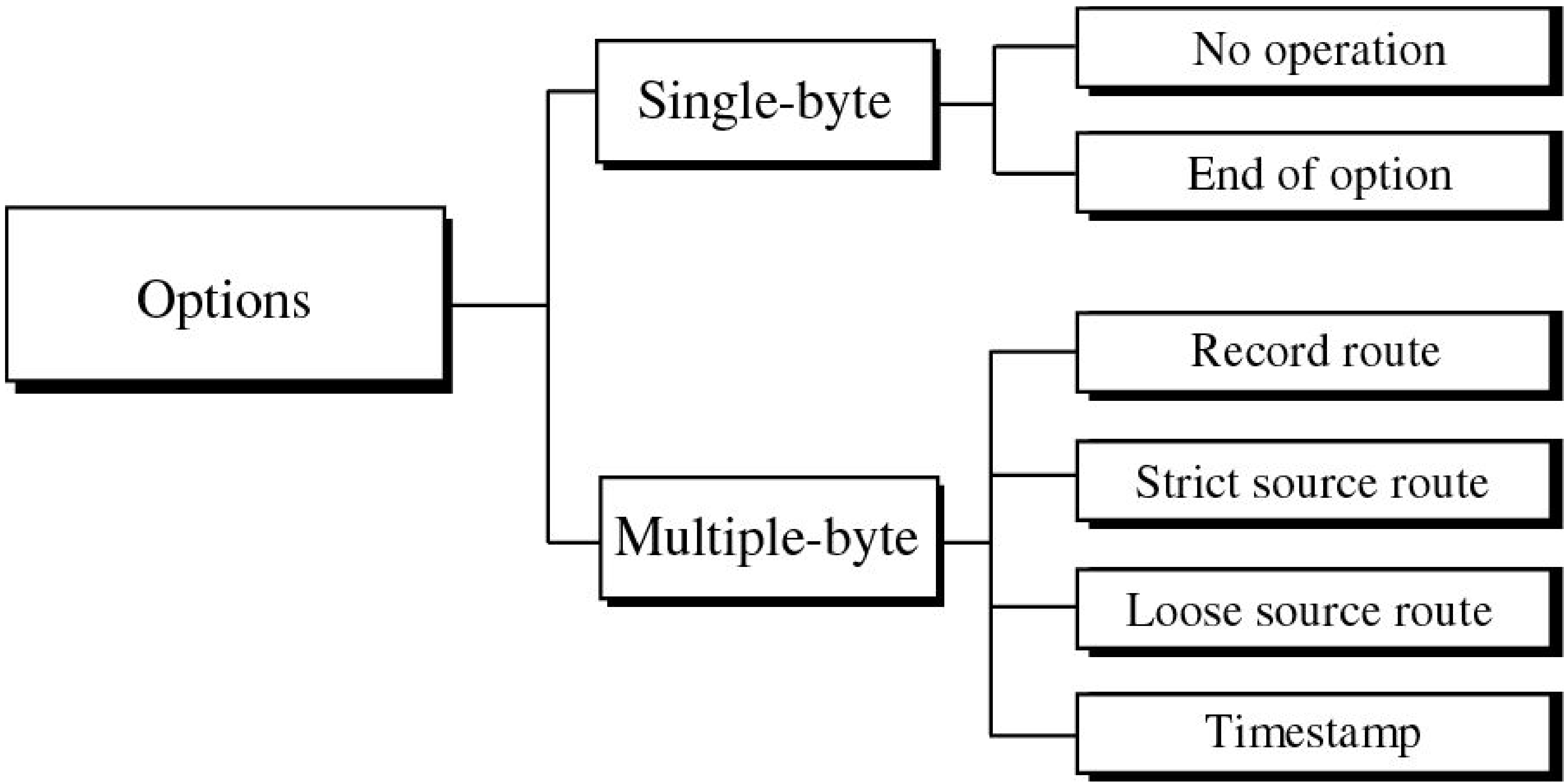


Copy
0 Copy only in first fragment
1 Copy into all fragments

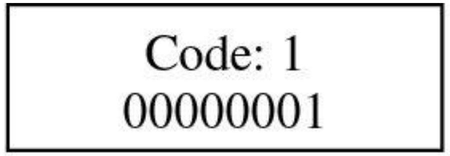
Class
00 Datagram control
01 Reserved
10 Debugging and management
11 Reserved

Number
00000 End of option
00001 No operation
00011 Loose source route
00100 Timestamp
00111 Record route
01001 Strict source route

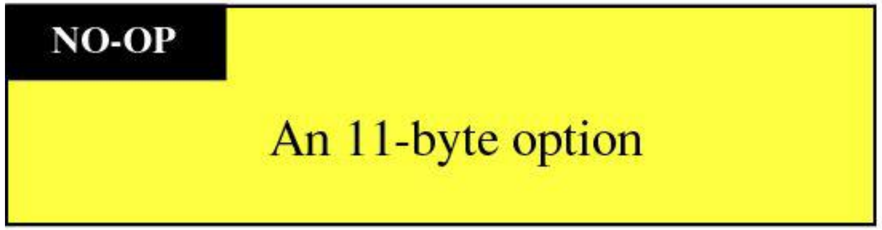
Categories of options



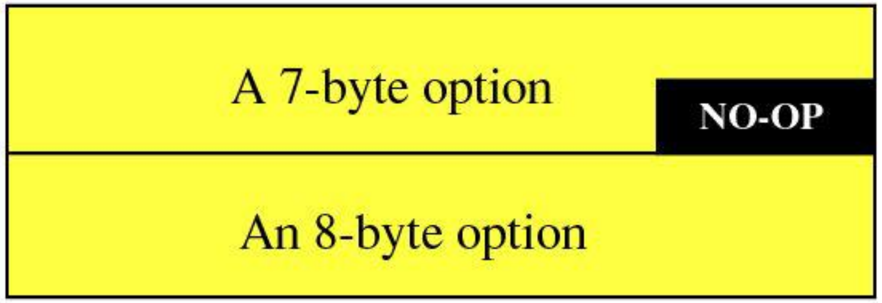
No operation option



a. No operation option

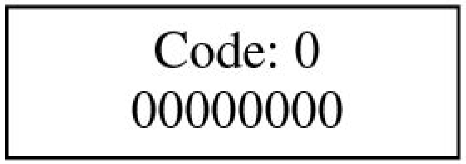


b. Used to align beginning of an option



c. Used to align the next option

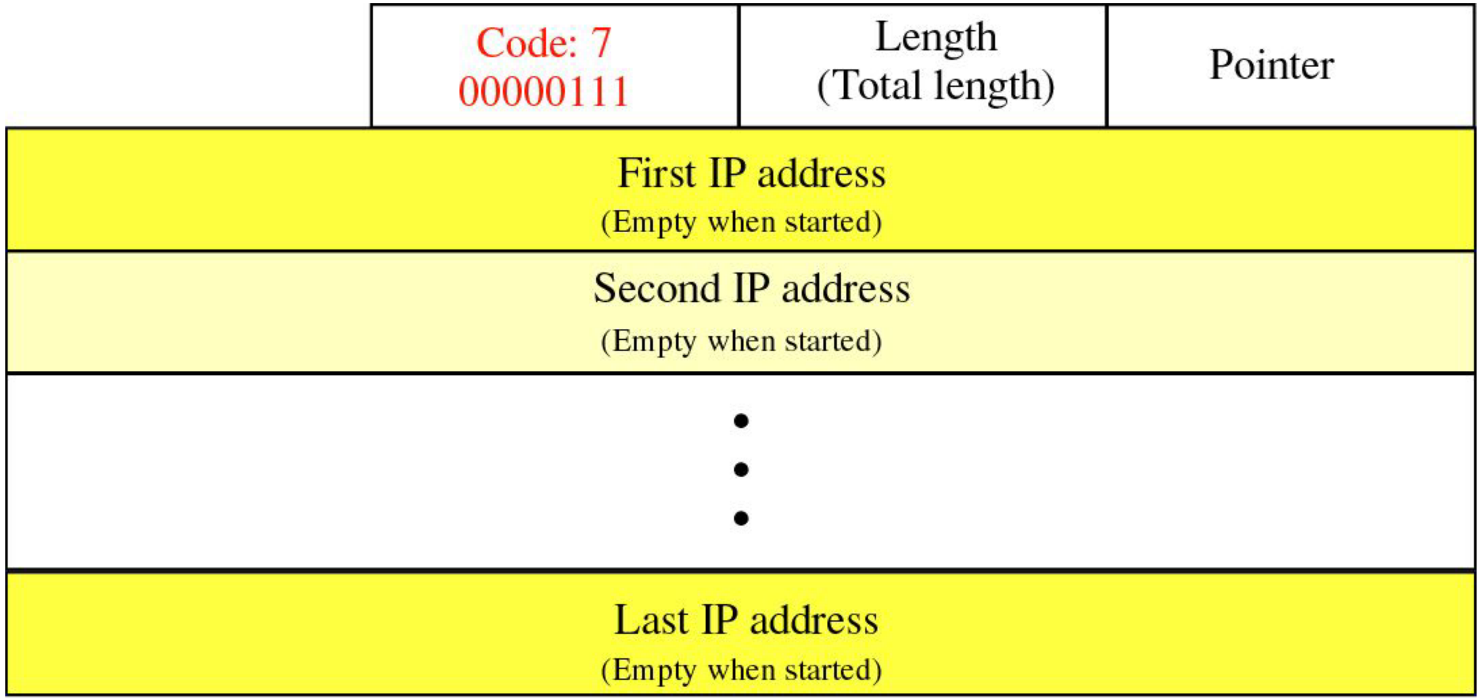
End of option option



a. End of option

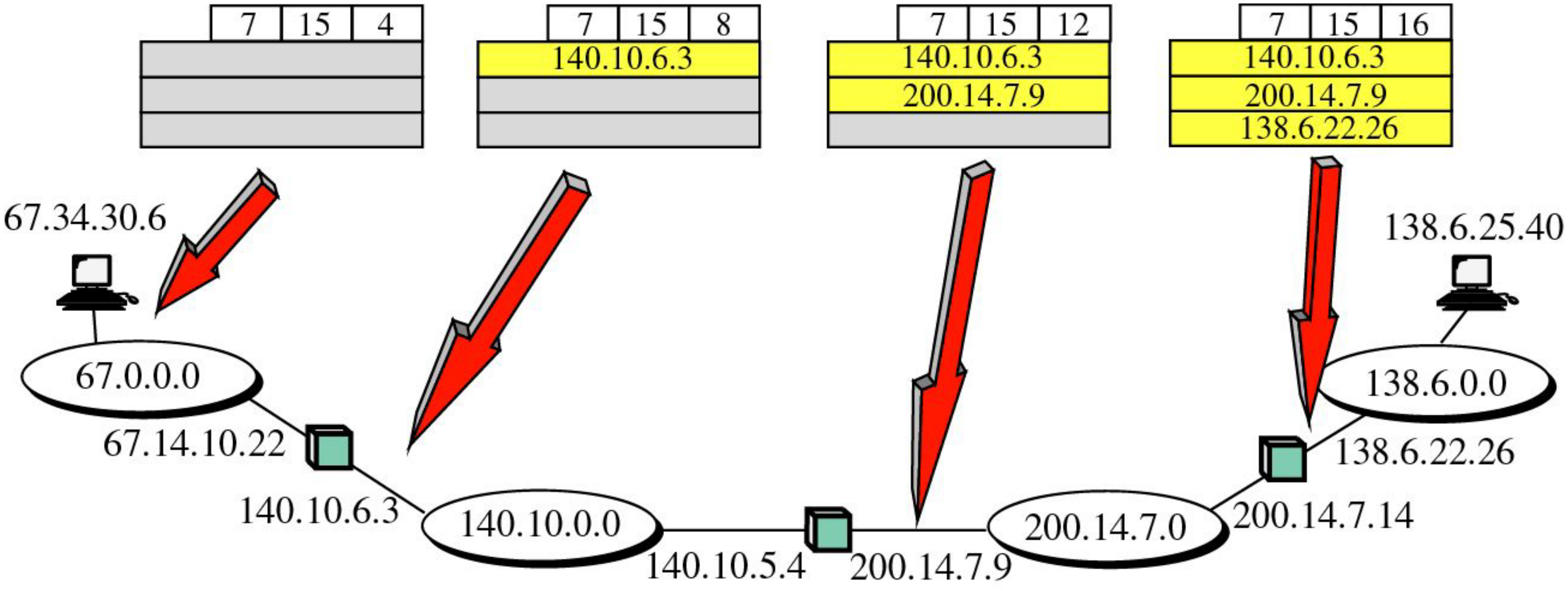
b. Used for padding

Record route option

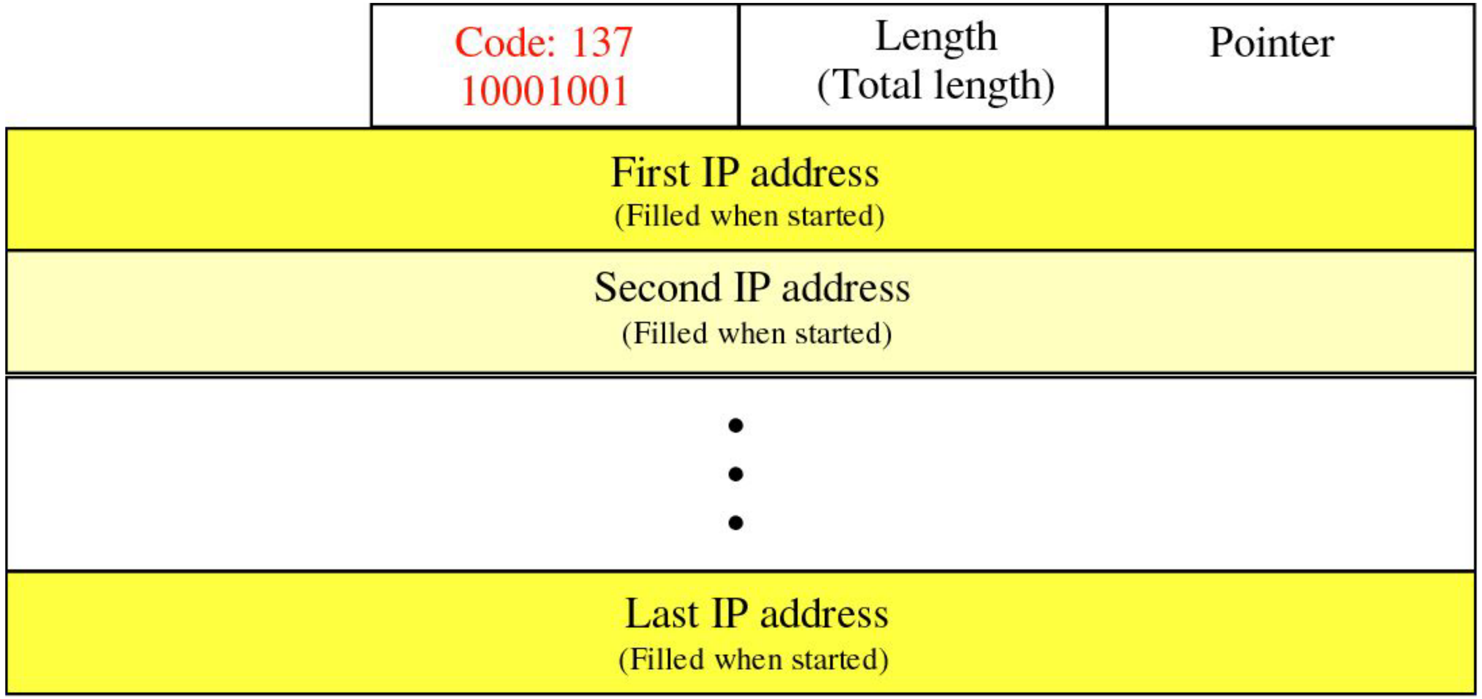


- Records the ip address of the routers that handle the datagram
- Can list upto nine routers

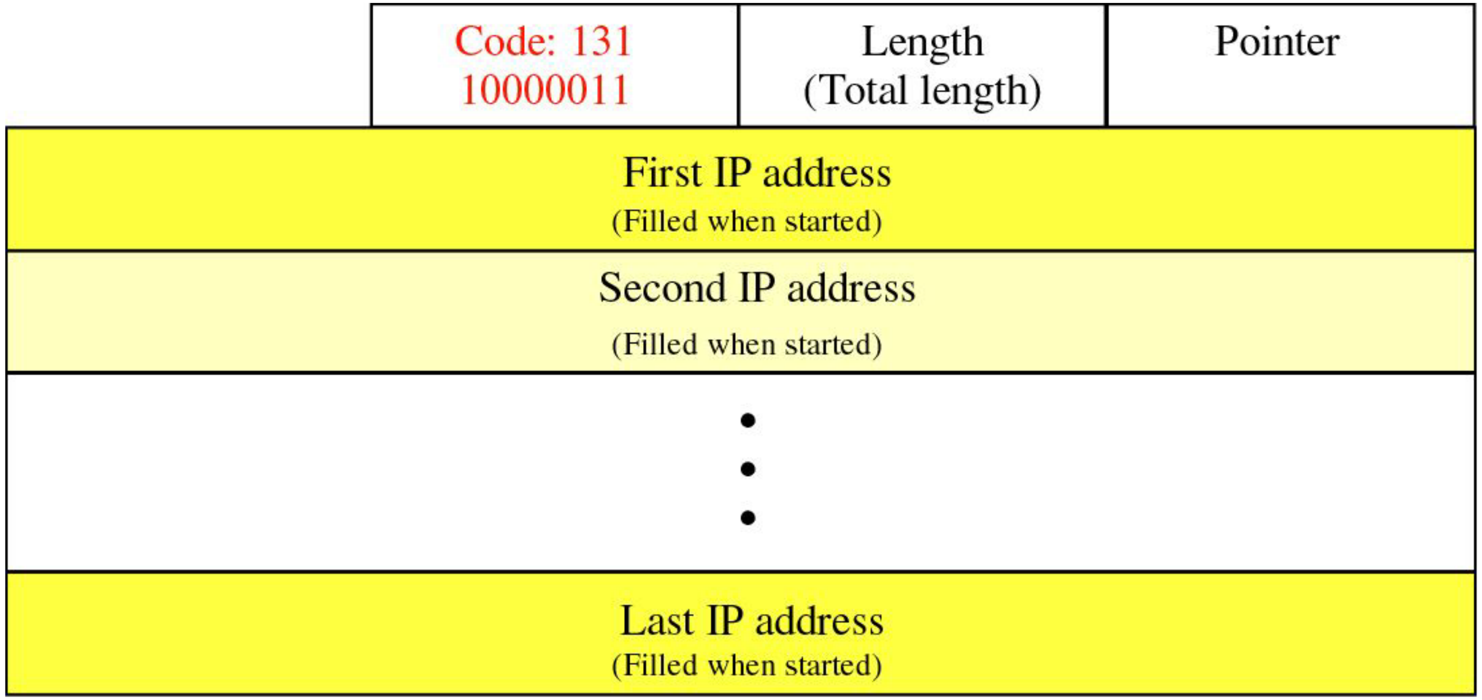
Record route concept



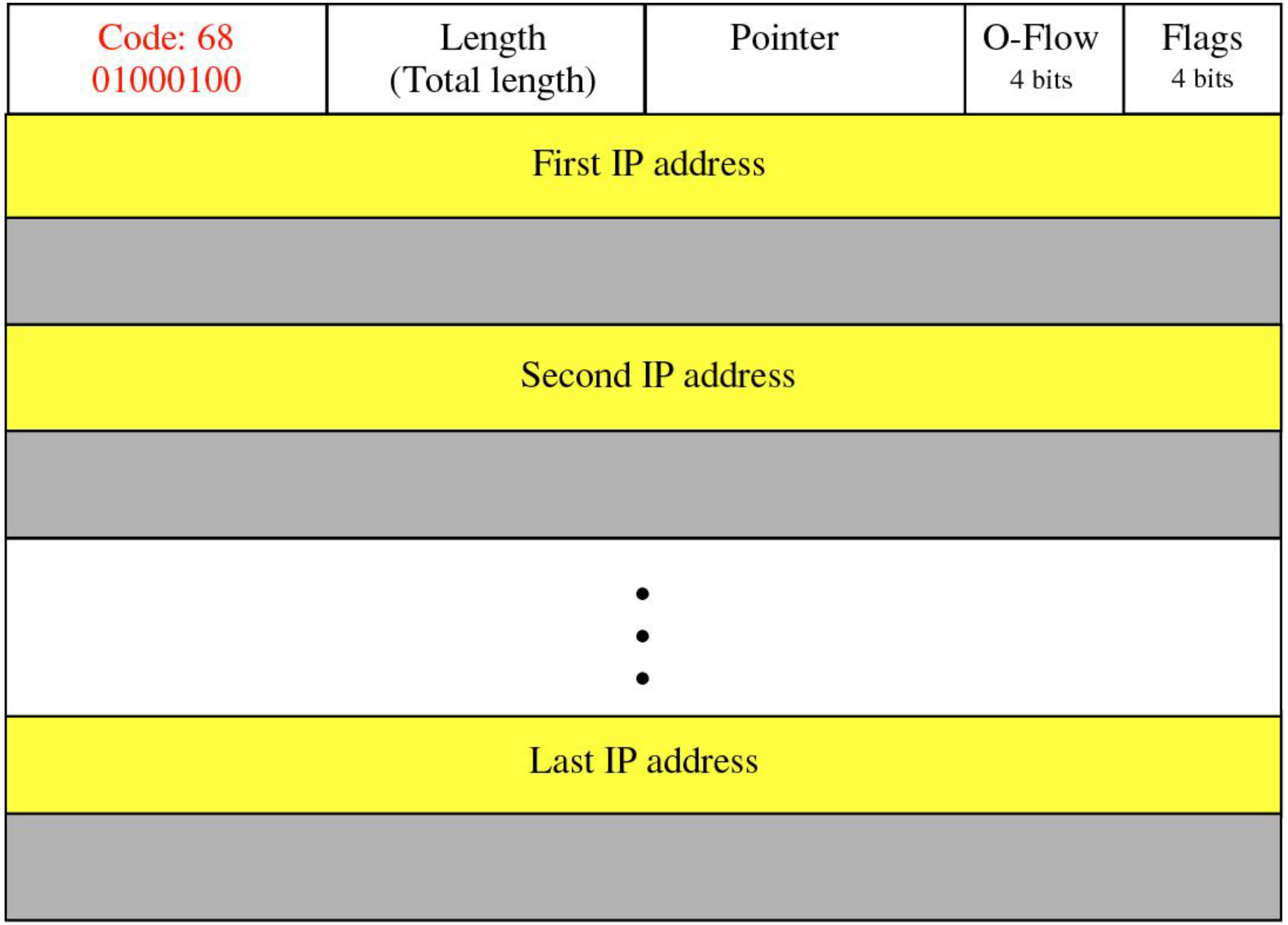
Strict source route **option**



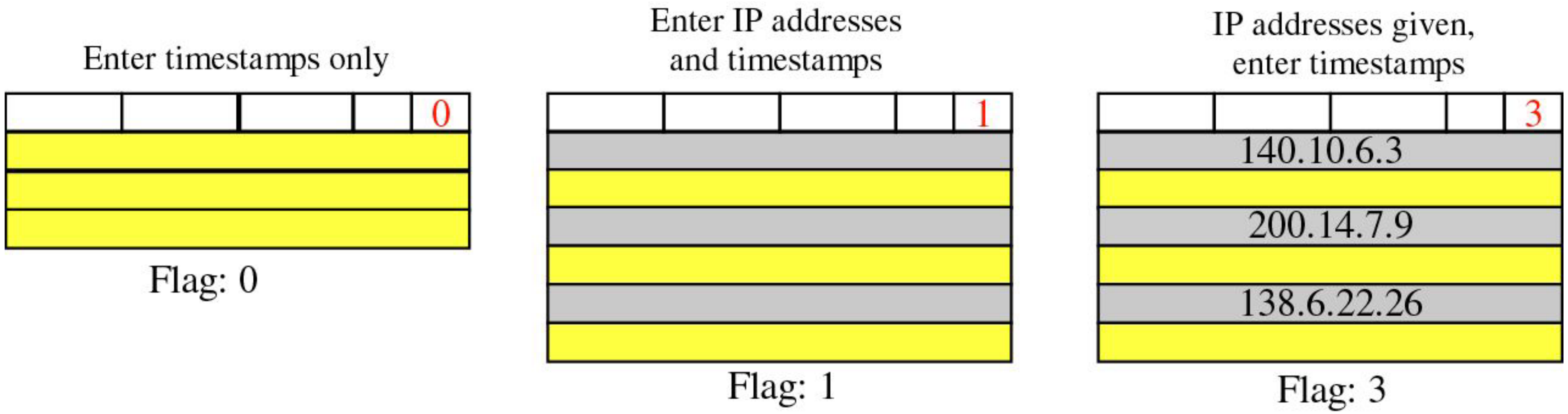
Loose source route option



Timestamp option



Use of flag in timestamp

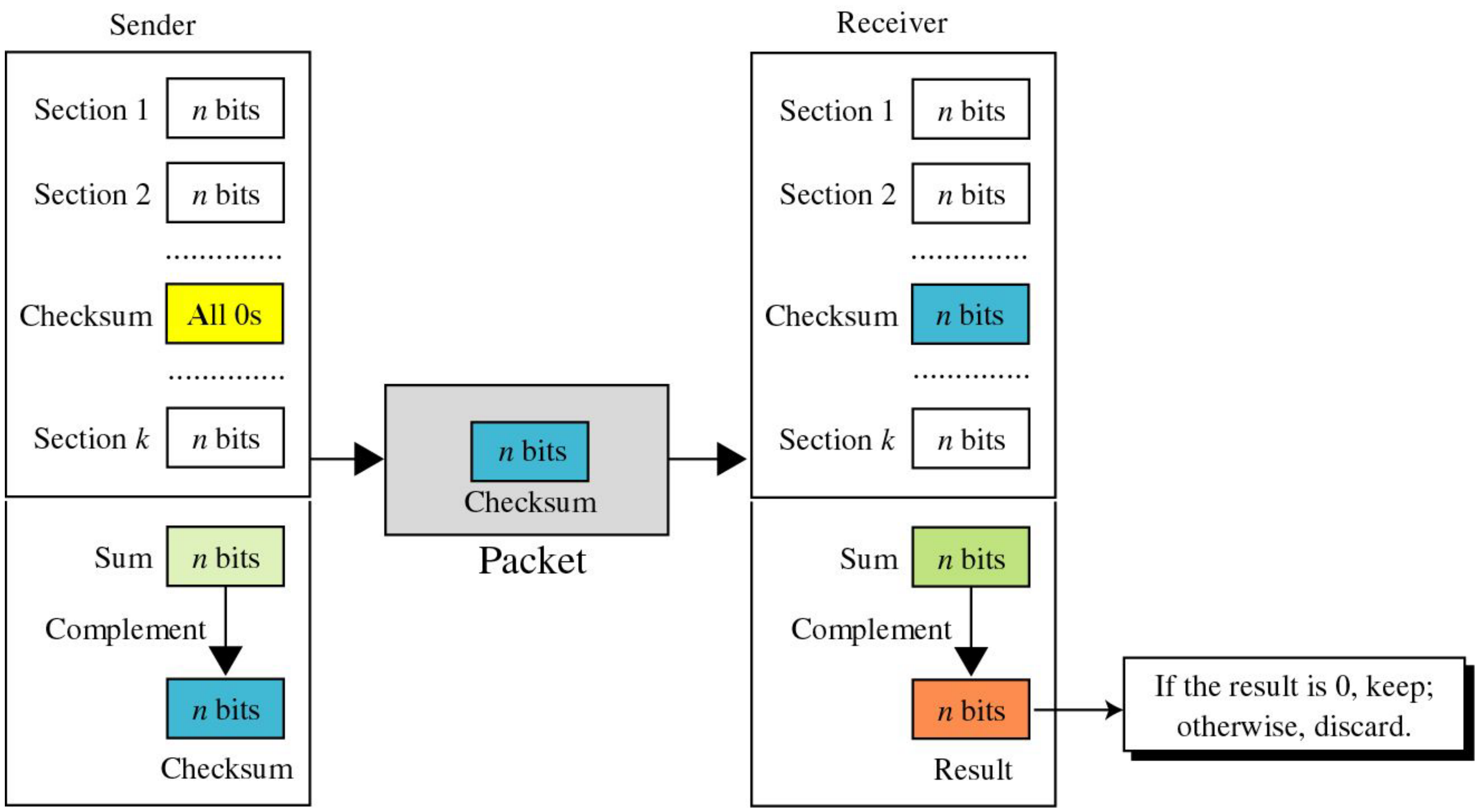


CHECKSUM

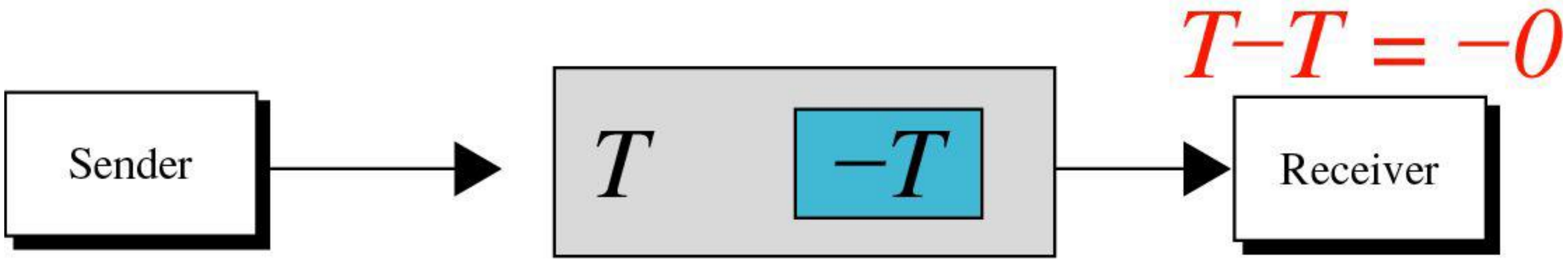
To create the checksum the sender does the following:

1. *The packet is divided into k sections, each of n bits.*
2. *All sections are added together using one's complement arithmetic.*
3. *The final result is complemented to make the checksum.*

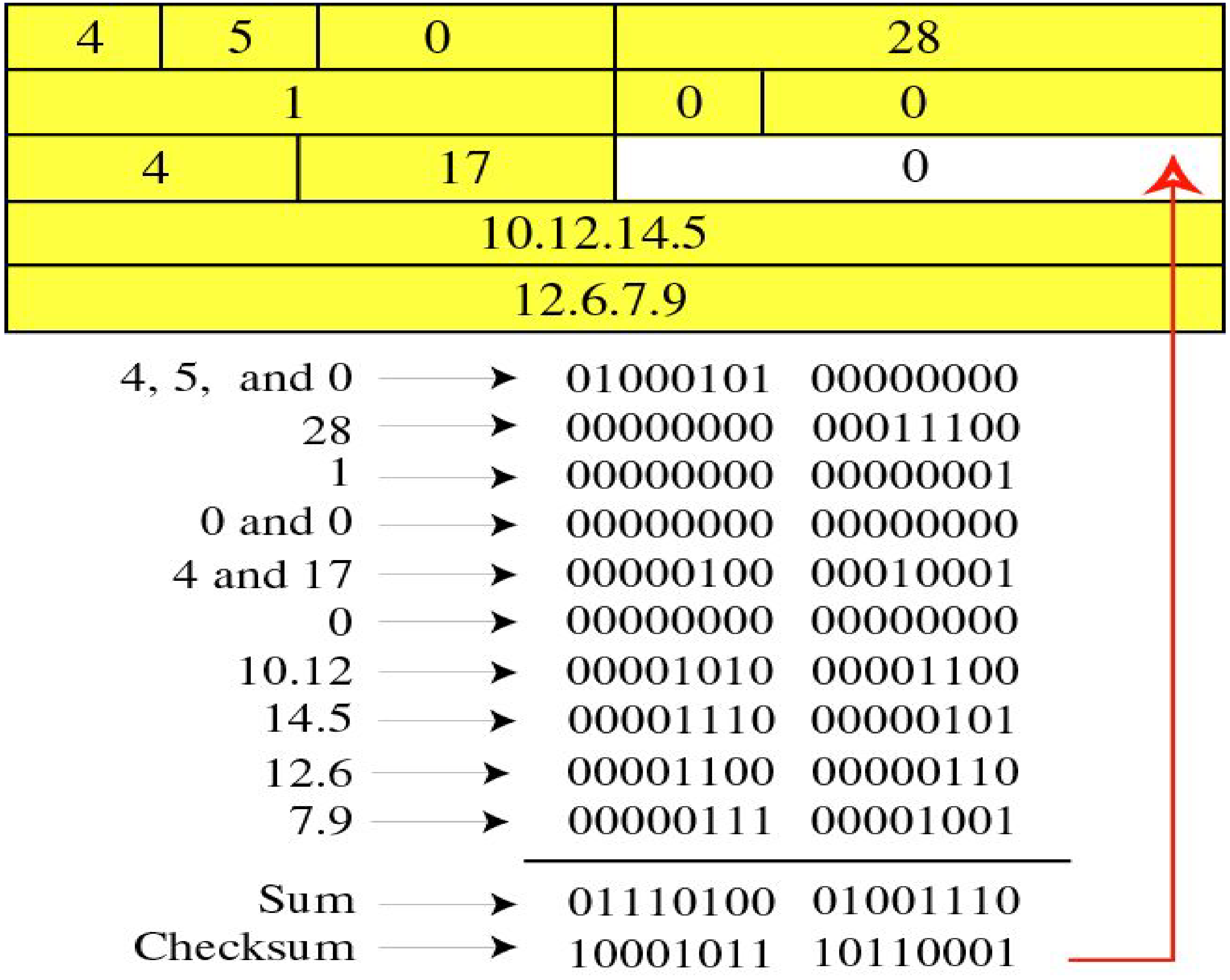
Checksum concept



Checksum in one's complement arithmetic



Example of checksum calculation in binary



Example of checksum calculation in hexadecimal