SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

AN AUTONOMOUS INSTITUTION

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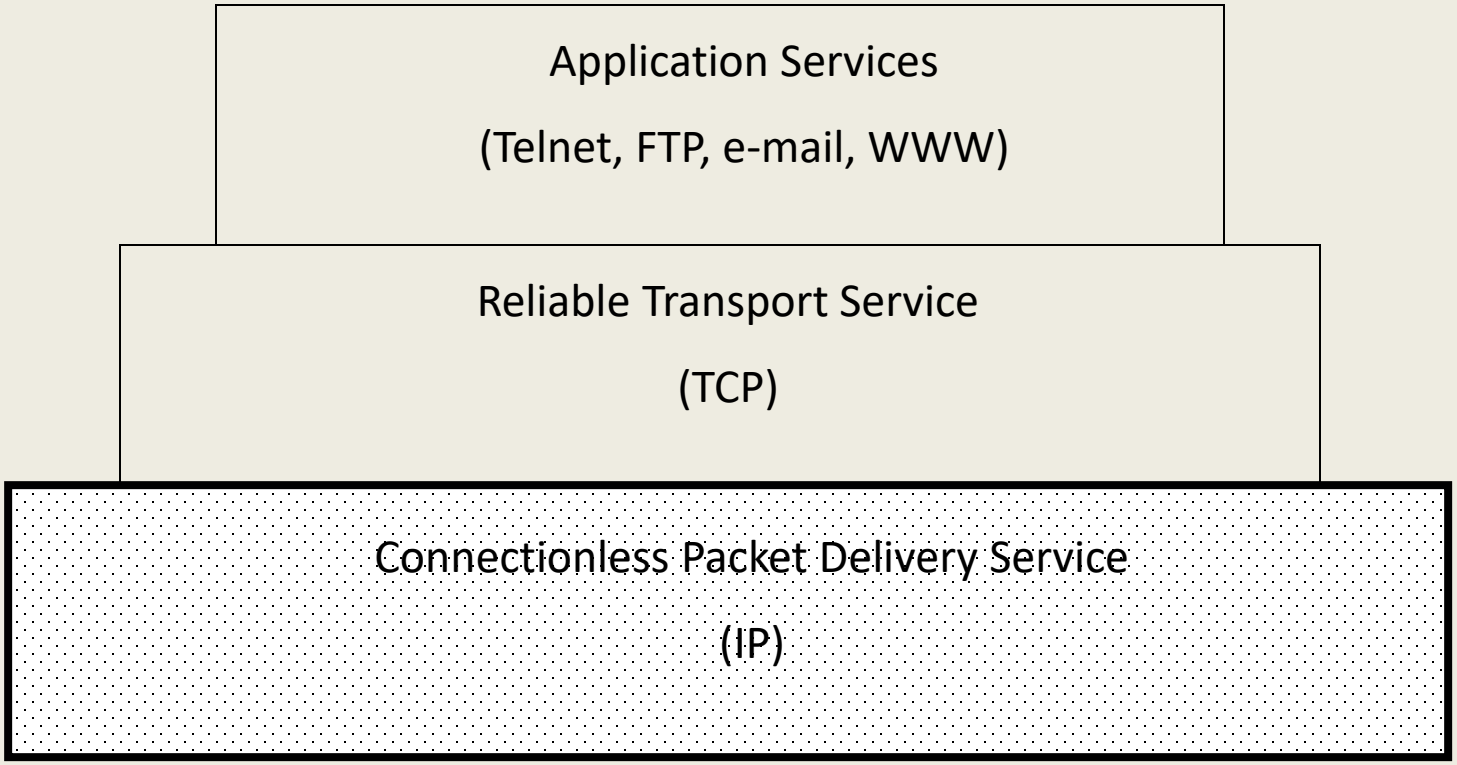
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

INTRODUCTION TO MOBILE COMPUTING

The Internet Protocol (IP)

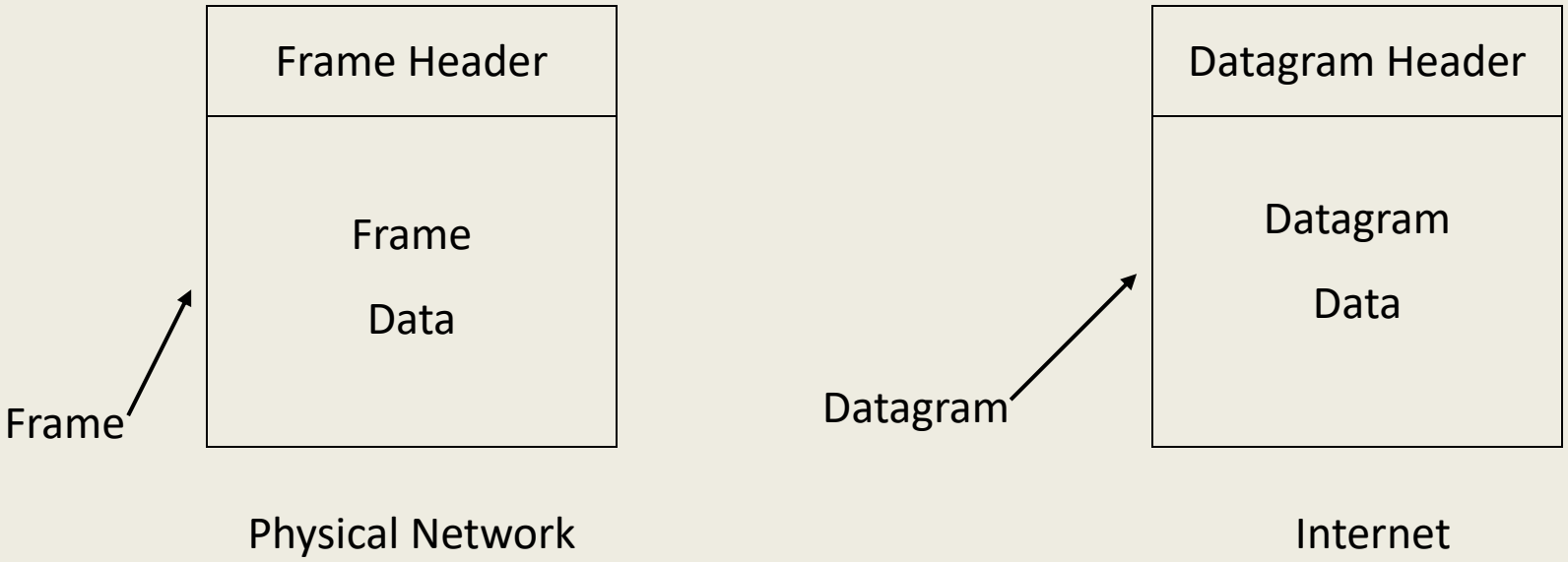


The Internet Protocol (IP)

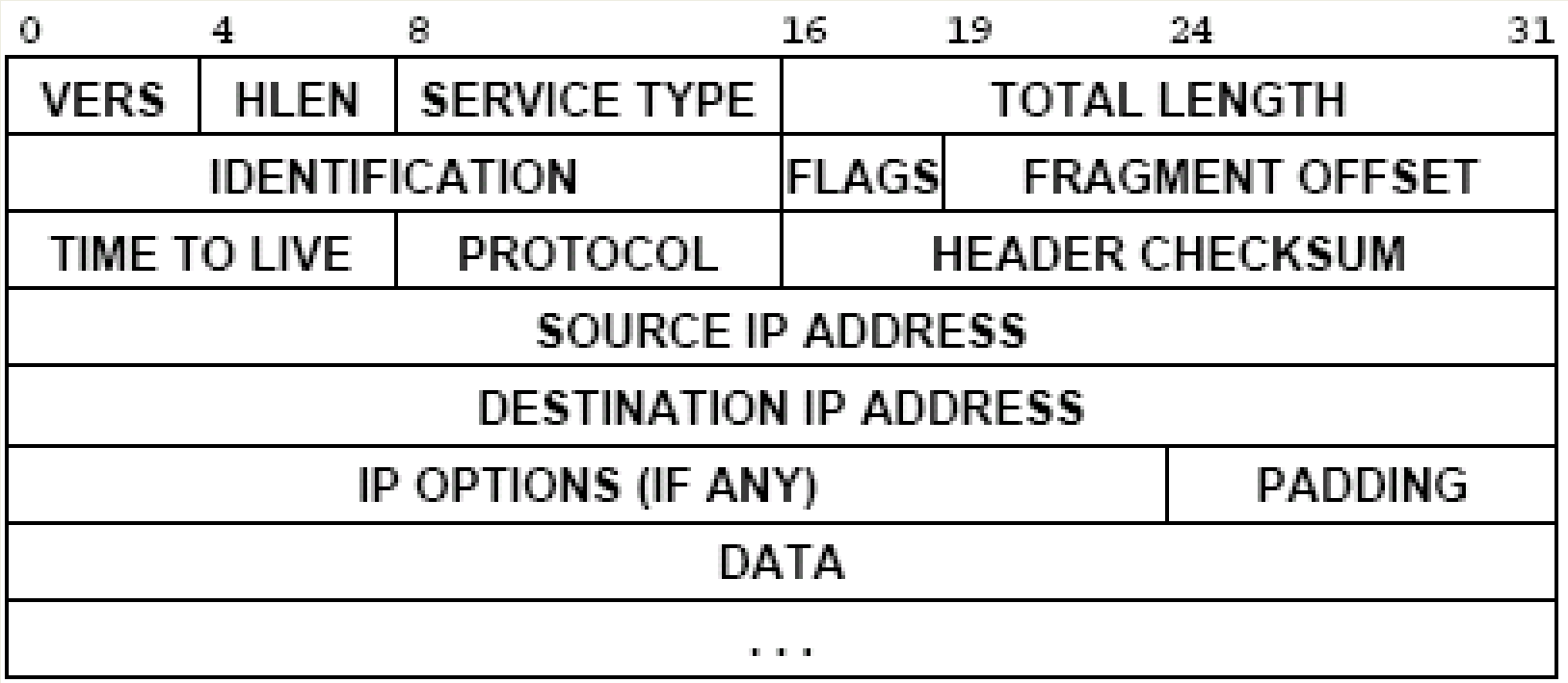
- Provides a packet delivery service which is:
  - Unreliable
  - Best-effort
  - Connectionless
- Defines the basic unit of data transfer
- Performs the routing function
- Includes a set of rules that embody the idea of unreliable packet delivery

IP Datagrams

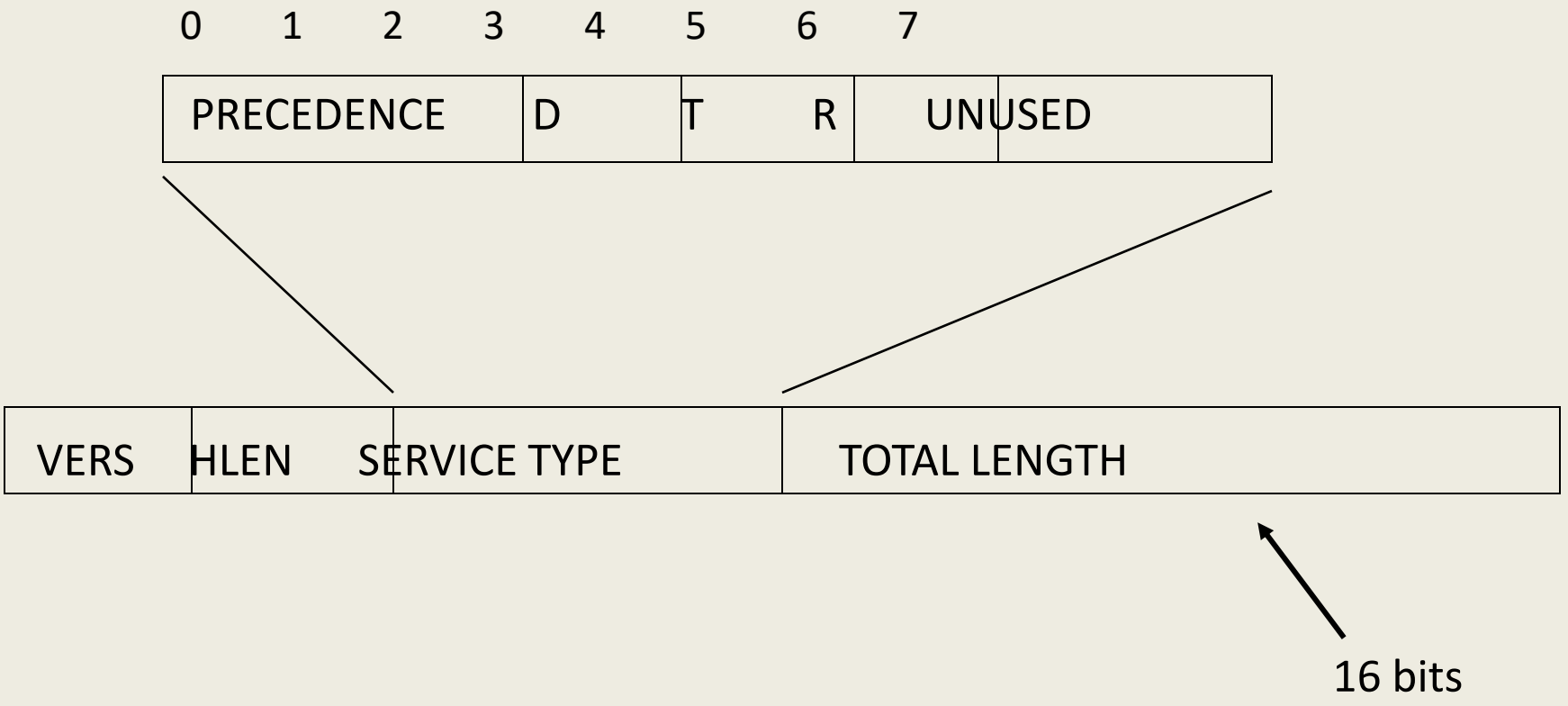
- The basic unit of data transfer



IP Datagram Format



IP Datagram Service Type Field



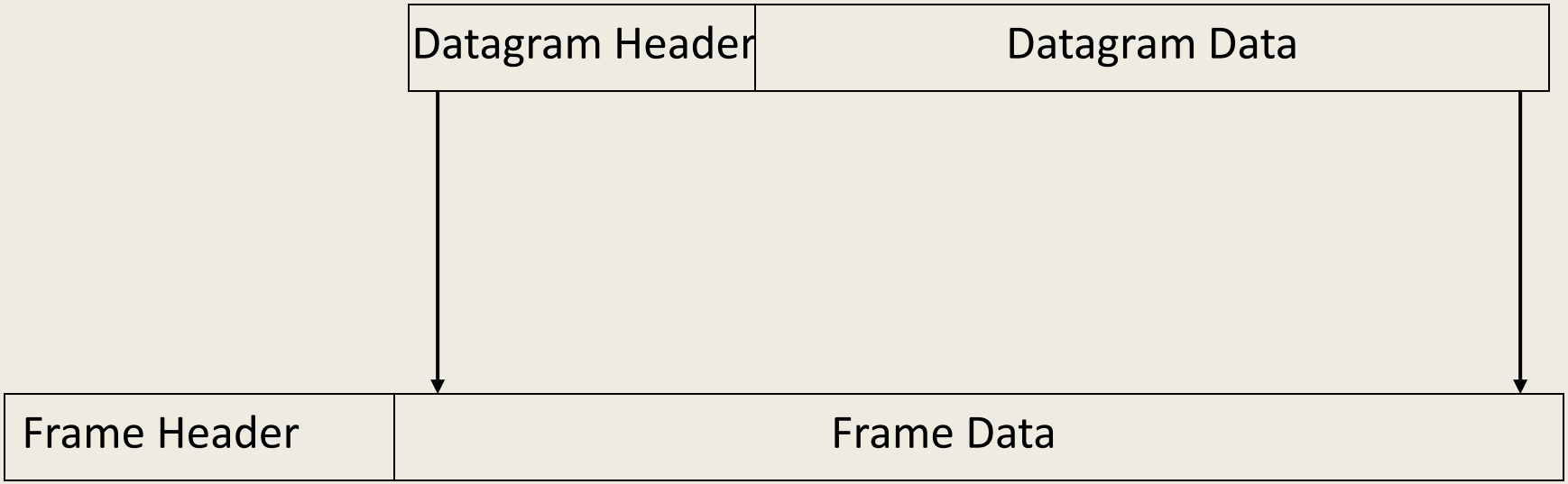
IP Datagram Service Type Field

- In the 1990's the meaning of the service type field was redefined:

- For backwards compatibility:
  - When the last three codepoint bits are zero, the first three bits represent 8 classes of service (0 = least important, …, 7 = most important)

IP Datagram Encapsulation

- Datagrams must move from machine to machine via physical networks



- What if a datagram won't fit in a frame?

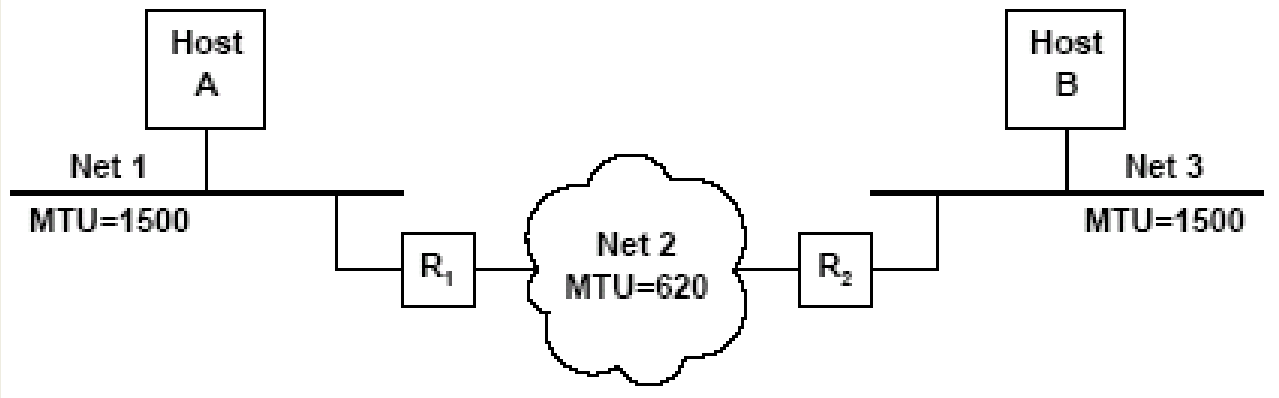
Maximum Transfer Unit (MTU)

- Each physical networking technology limits the amount of data that can fit in a frame
  - Ethernet: 1500 octets
  - FDDI: 4470 octets
- This is called the network's MTU
- Limiting datagrams to fit in the smallest possible MTU would make travelling across networks with a larger MTU inefficient
- Allowing datagrams to be larger than a network's MTU means that datagrams will not always fir in a single frame

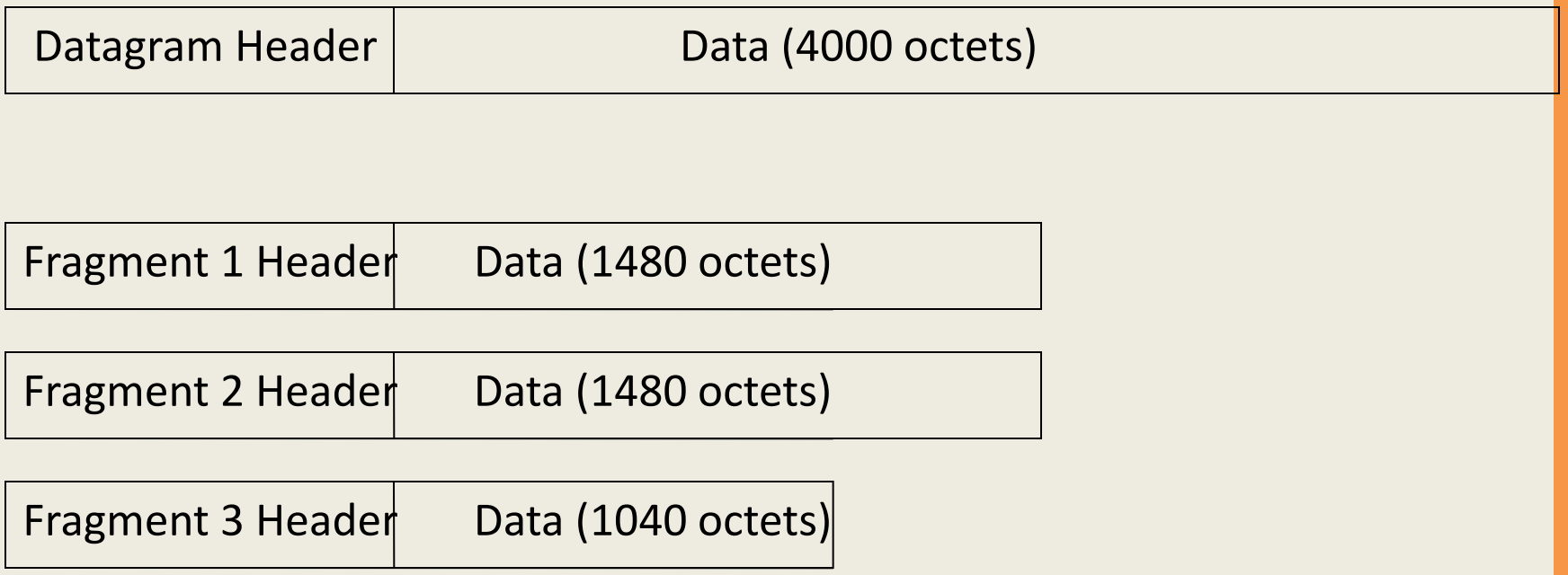
Datagram Fragmentation

- Divide datagrams too large to fit in one frame into pieces called **fragments**
- Each fragment should fit into one frame
- Transport fragments over physical network
- Reassemble fragments into the complete datagram

Datagram Fragmentation (cont)

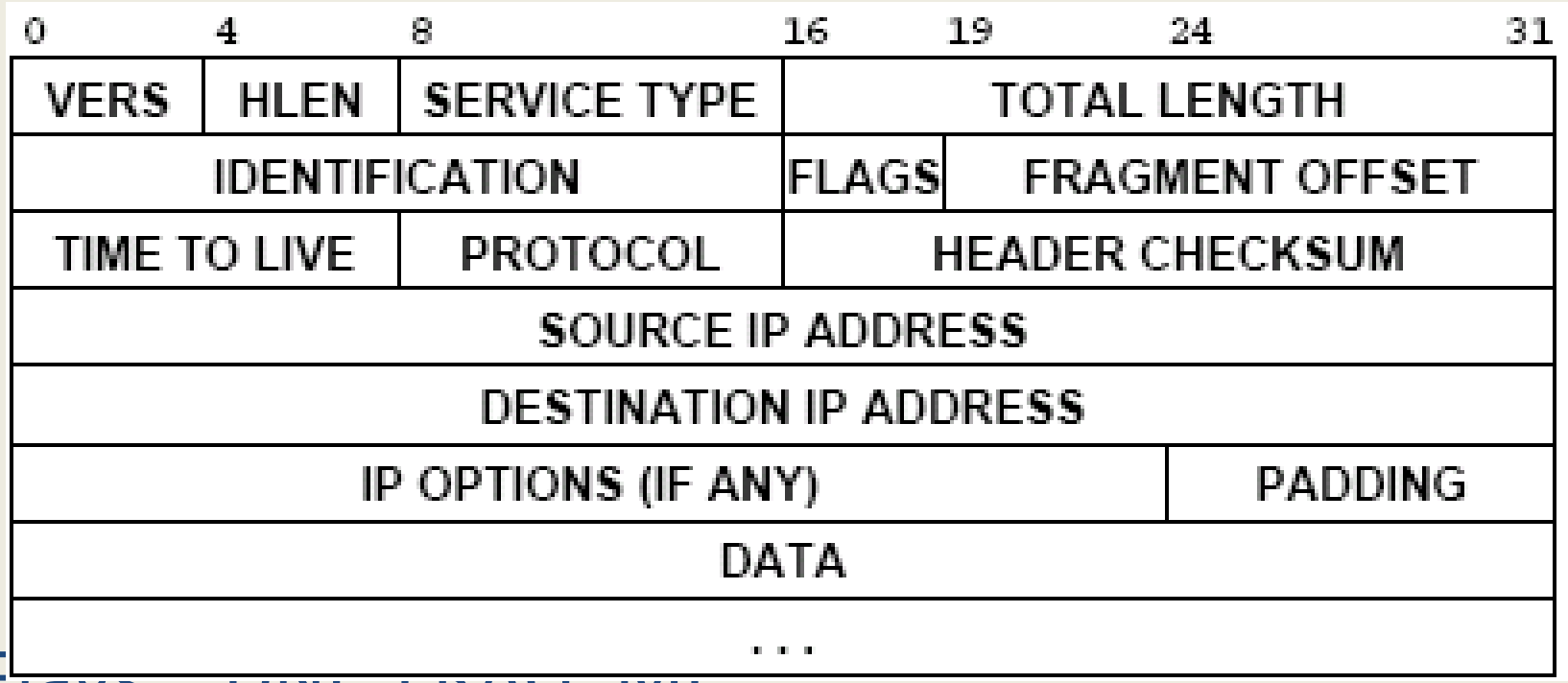


Datagram Fragmentation Example



- Fragment headers duplicate datagram's header (except for FLAGS field)

Datagram Format



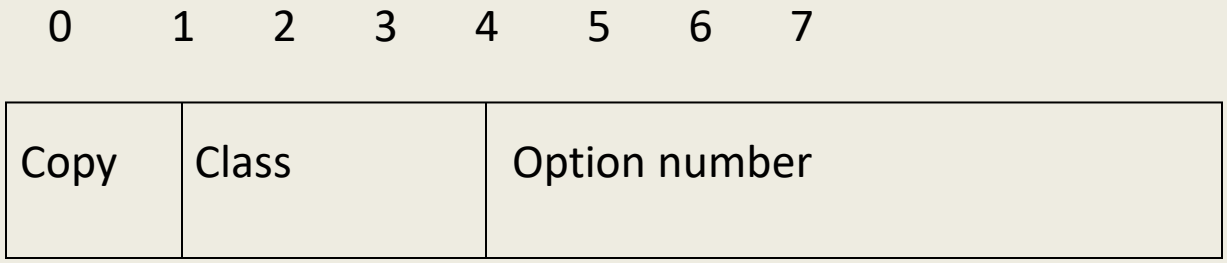
Flags – DNF, FRAG, MF

Reassembly of Fragments

- Should fragments be reassembled after crossing one network or should we wait until the fragments arrive at their final destination to reassemble them?
- Advantages?
- Disadvantages?

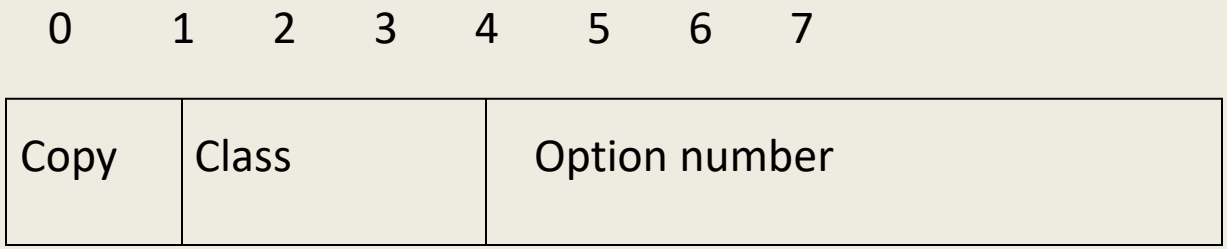
Internet Datagram Options

- Used for network testing and debugging
- Variable length field (depending on what options are selected)



- Classes:
  - 0: Datagram or network control
  - 1: Reserved for future use
  - 2: Debugging and measurement
  - 3: Reserved for future use

Internet Datagram Options (cont)



- Class 0 option numbers:
  - 0: End of options list
  - 1: No operation
  - 2: Security and handling restrictions
  - 3: Loose source routing
  - 7: Record route
  - 8: Stream identifier
  - 9: Strict source routing

Class 2 option numbers:

- 4: Internet timestamp

The Record Route Option

- Source creates an empty list of IP addresses in the header
- Set Record route option
- Each router that handles the datagram appends its IP address to the list
- Destination machine can extract and process the route information

Source Route Option

- Sender dictates a path through the internet over which the datagram **must** travel
- Sender lists IP addresses (in order) of the route the datagram should take
- Sender sets the source route option

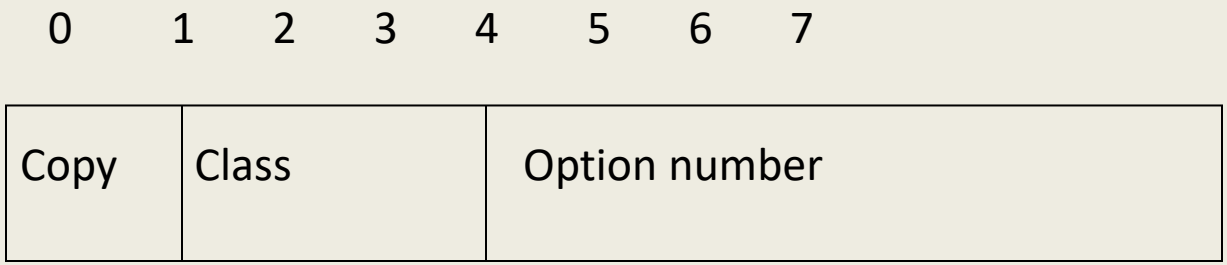
Source Route Option (cont)

- Strict source routing - the path between two successive addresses in the list must consist of a single physical network
- Loose source routing
  - The datagram must follow the sequence of IP addresses in the list
  - Allows multiple network hops between successive addresses on the list

The Timestamp Option

- Sender creates an empty list in the header
- Sender enables the timestamp option
- Each router that handles the datagram appends to the list its:
  - IP address
  - Local timestamp (in Universal Time)

Processing Options During Fragmentation



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Processing Options During Fragmentation (cont)

- When fragmenting a datagram a router:
  - Replicates some IP options in all fragments
    - Example?
  - Replicates some IP options in only one fragment
    - Example?

IP – Security Issues

- Destination IP address is used to route a datagram to its final destination
- Source IP address identifies the sender so that the receiver knows where to send a reply
- **IP spoofing** – sender of a datagram inserts the address of another machine (or a nonexistent machine) in the source address field
  - Prevent the receiver from determining the host from which an attack datagram originated
  - Make the message appear to have originated from a trusted machine
  - Want reply sent to a another (victim) host

Teardrop

- Tool enabled attackers to crash vulnerable remote systems by sending a certain type of fragmented IP datagram
  - Normal datagram fragments do not overlap
  - Teardrop created fragments that did overlap
  - Some implementations of the TCP/IP IP fragmentation re-assembly code do not properly handle overlapping IP fragments
    - Windows and some Linux kernels
  - Caused system to crash
  - Fixed by software patches

Summary

- The Internet Protocol (IP):
  - Provides a packet delivery service which is:
    - Unreliable
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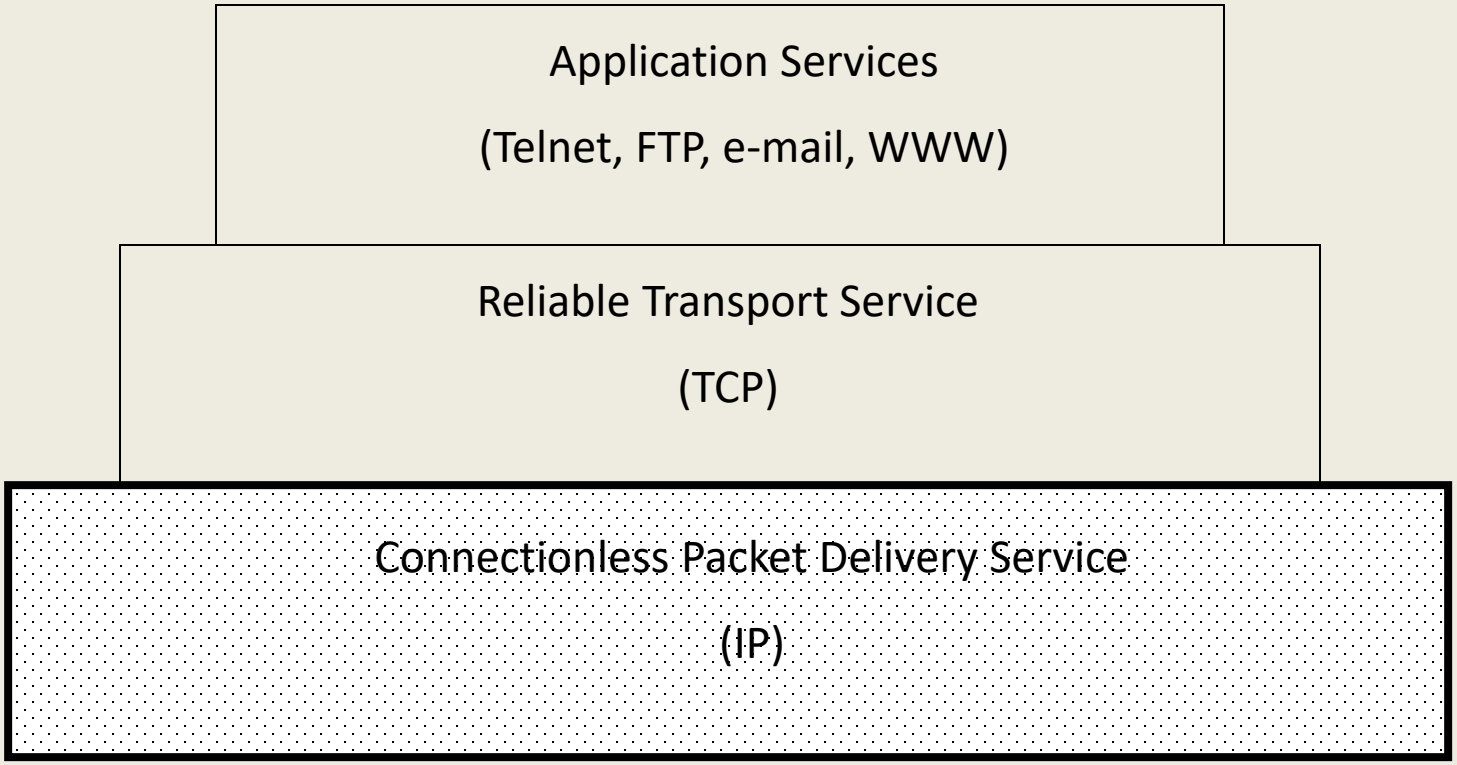
Summary (cont)



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