SET 4573: Data Communication and Switching System

Chapter 7: Internetworking

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Principles of Internetworking

- Communication Network
  - provide data transfer service to the devices in the network
- Internet
  - a collection of communication networks interconnected by router
- End system
  - devices connected to the communication network to support user applications (e.g. workstations, servers)
- Intermediate system
  - devices used to connect 2 or more networks (e.g. switches, routers, gateways)

Issues in Internetworking

- Different addressing schemes
  - need for global address (e.g. IP address)
- Different maximum packet size
  - need fragmentation
- Different network access mechanisms
  - need encapsulation
  - e.g. Ethernet, Token Ring, Frame Relay, PPP

Protocol Functions

- These are among the functions of protocol
  - Packet encapsulation
  - Packet fragmentation and reassembly
  - Link connection control
  - Flow control & error control
  - Devices addressing

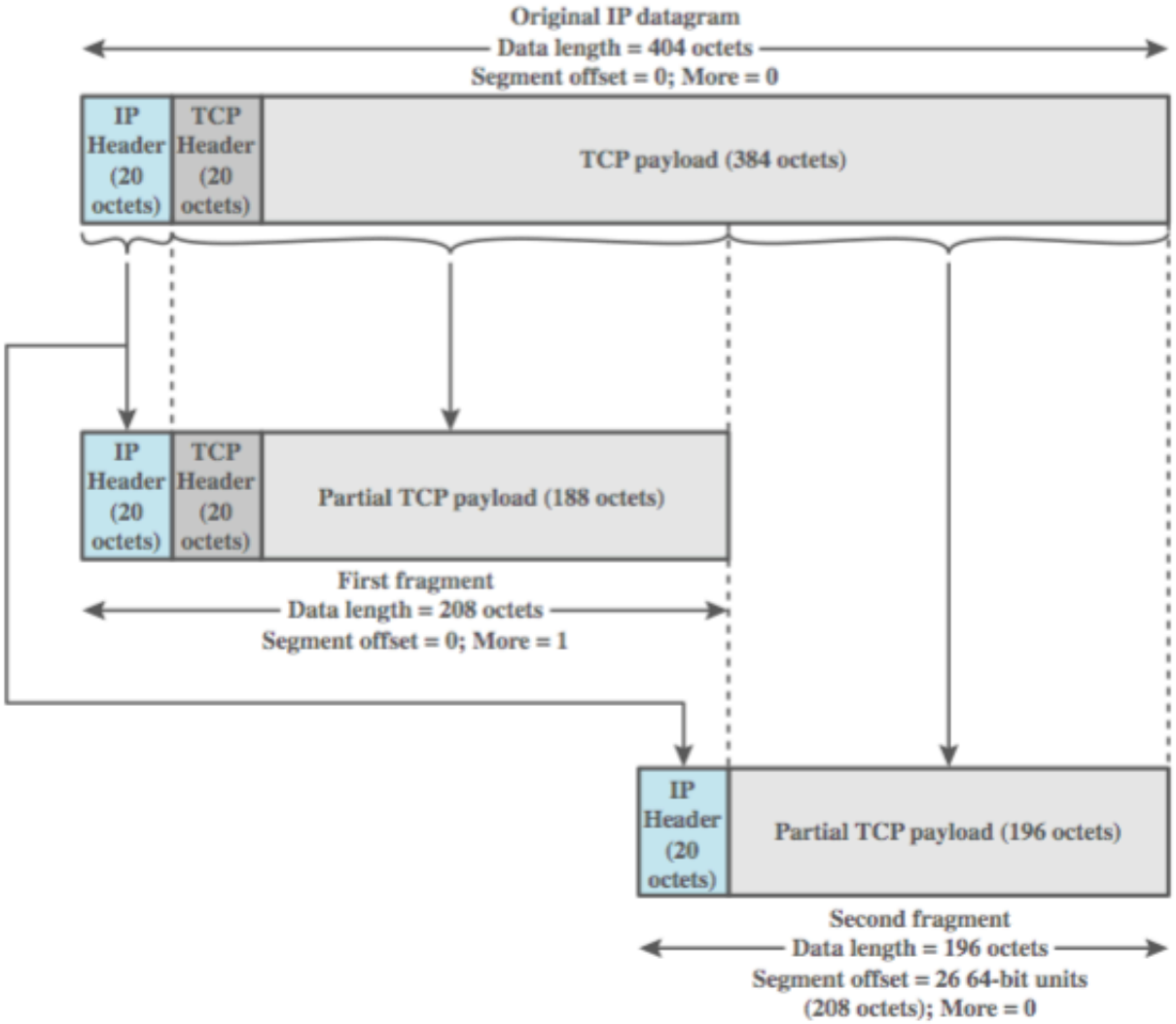
Encapsulation

- Data usually transferred in blocks called packet or PDU (Protocol Data Unit)
- Have three categories of control information
  - addressing
  - error-detecting function
  - protocol control
- Encapsulation is the addition of 'control information' to data packets
- It is included in the header of the packets

Fragmentation and Reassembly

- Protocol exchanges data between two entities
- Fragmentation is the process of breaking data packets into smaller packets
- Why?
  - certain network only accepts packets of a minimum size
  - more efficient for error control & retransmission of packets
  - fairer access to shared facilities
  - smaller buffers needed

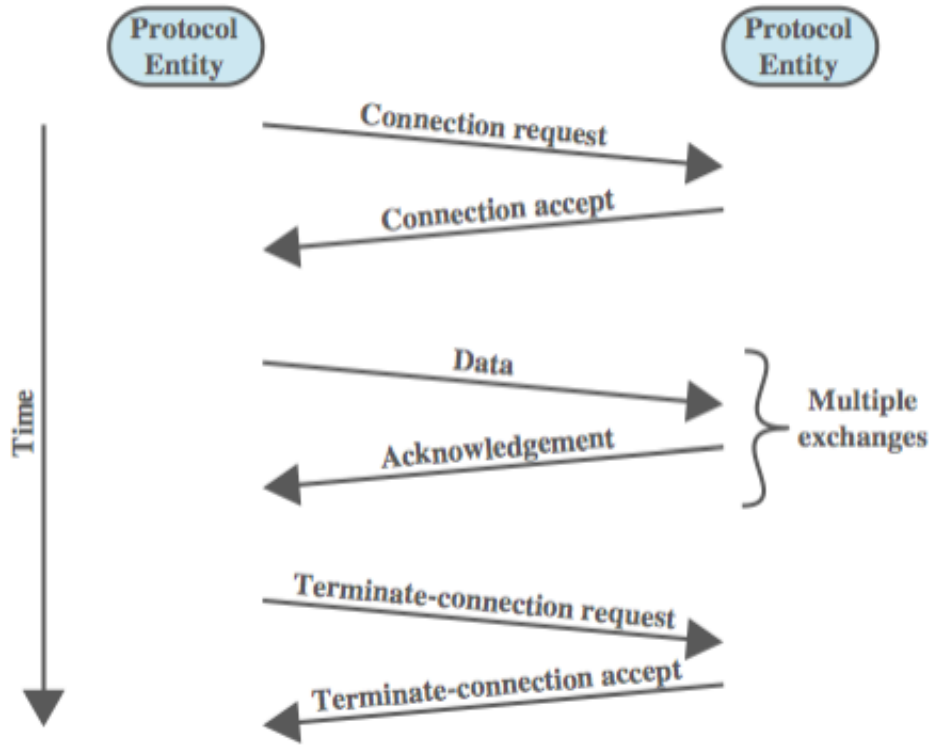
Fragmentation Example



Link Connection Control

- Two techniques of link connection control
- Connectionless
  - Each packets is treated independently
  - No connection establishment
- Connection-oriented
  - Involves a logical association, or connection, established between entities
  - Involves three phases of processes
    - connection establishment
    - data transfer
    - connection termination

Phases of Connection-Oriented



Flow Control

- The receiving entity limits amount and rate of data sent and received to avoid overflow
- Types of flow control
  - stop-and-wait
    - Window size is 1
    - Each packet has to be acknowledged individually
  - sliding window
    - Window size bigger than 1
    - More packets can be sent simultaneously without waiting for acknowledgment
    - More efficient protocol

Error Control

- To avoid the loss or damage of data packets
- Implemented as separate error detection and retransmission functions
  - sender inserts error-detecting code in packets
  - receiver checks code on incoming packets
  - if there is error, discard the packets
  - if transmitter doesn't get acknowledgment in reasonable time (timeout), retransmit the packets
- The function is performed at various protocol layers

Addressing Level

- Each devices has a unique address
- Hardware-level address
  - MAC address or Ethernet address (48 bit address)
- Network-level address to route the packets
  - IP address or internet address (32 or 128 bit address)
- at destination data must routed to some process
  - TCP/IP port
    - http: port 80
    - ftp: port 21 & 22
    - smtp: port 25

Address Resolution Protocol (ARP)

- Each devices has ARP table
  - to record IP/MAC address mapping
  - to recognize each other addresses
  - ARP exploit the broadcast property of local network to get IP and MAC addresses

Internetworking Devices

- Bridge
  - works at data link layer to interconnect the same local network
- Router
  - works at network layer to interconnect different networks
- Gateway
  - translates information between network data format or network architecture