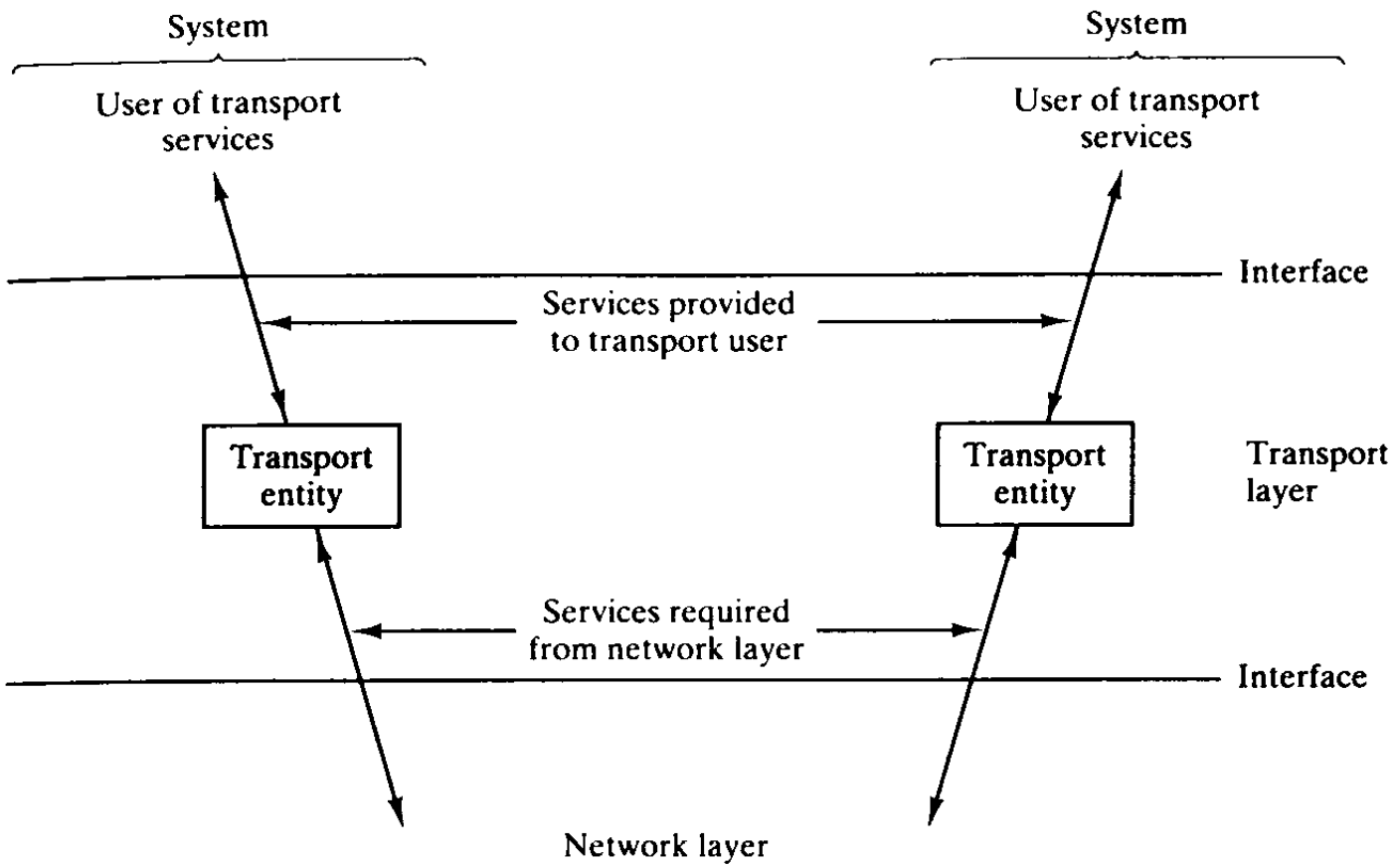
Chapter 7

Transport Protocols

Transport Protocols

- Key stone of the whole concept of computer communication architecture
- Upper levels protocols depend heavily on it
- Provides the end-to-end service of transferring data between users
- Relives applications and upper-layer protocols from the need to deal with the characteristics of intervening communication networks and services

Transport entities context



Transport Services

- Type of service
- Quality of service
- Data transfer
- User interface
- Connection management
- Expedited delivery
- Status reporting
- Security

Transport Services(2)

Type of service

- connection oriented
- connectionless (datagram)

Quality of service

Examples:

- acceptable error and loss levels
- desired average and maximum dekay
- desired average and minimum throughput
- priority levels

Examples:

- file transfer protocol – throughput
- transaction protocol (web browser, web-server) - low delay
- electronic e-mail – multiple priority levels

Data transfer

- full duplex service must be provided

Transport Services(3)

User interface

- standardized?
- mechanism to prevent
  - -TS user from swamping the transport entity with data
  - - transport entity from swamping a TS user with data
- timing and significance of confirmations

Connection management

- connection oriented – transport entity responsible with establishment and terminating connections
  - - symmetric connection establishment procedure

Transport Services(4)

Expedited delivery

- similar to priority classes
- supersede data transmitted previously
- is in the nature of an interrupt mechanism and is used to transfer occasional urgent data

Status reporting

- allows the TS user to obtain or to be notified with
  - conditions or attributes of the transport entity or transport connection

Examples:

- performance charact. – throughput, mean delay…
- addresses (network, transport)
- class of protocol in use
- current timer values

degradation in requested quality of service….

Transport Services(5)

Security

- a variety of security services
- encryption/decryption on demand
- routing through secure links or nodes

TRANSPORT PROTOCOLS

- Transmission Control Protocol
  - Connection oriented
  - RFC 793
- User Datagram Protocol (UDP)
  - Connectionless
  - RFC 768

TCP Services

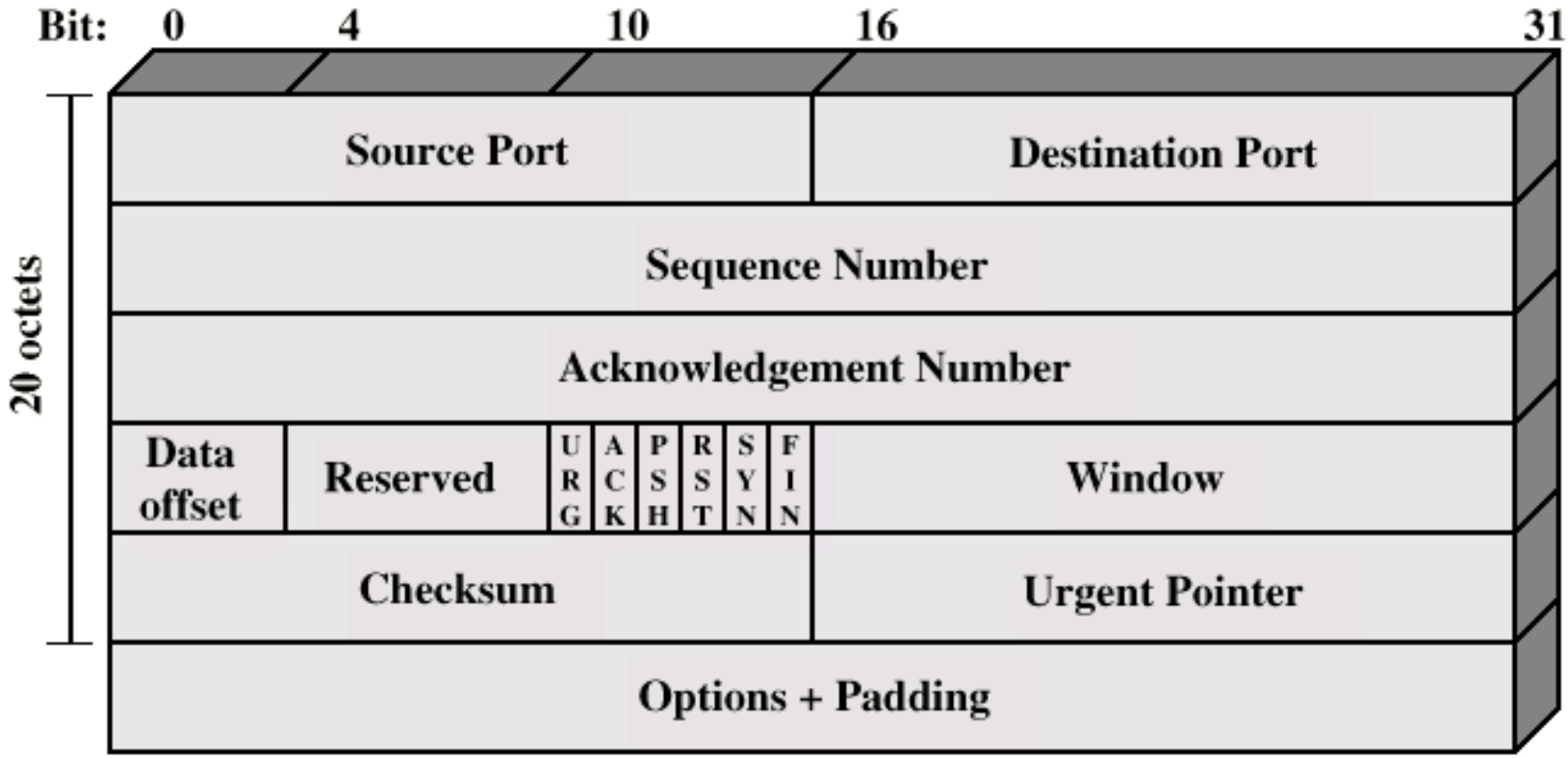
a) Reliable communication between pairs of processes

b) Across variety of reliable and unreliable networks and internets

c) Two labeling facilities

- Data stream push
  - TCP user can require transmission of all data up to push flag
  - Receiver will deliver in same manner
  - Avoids waiting for full buffers
- Urgent data signal
  - Indicates urgent data is upcoming in stream
  - User decides how to handle it

TCP Header


Bit:
0
4
10
16
31
20 octets
Source Port
Destination Port
Sequence Number
Acknowledgement Number
Data offset
Reserved
URG
ACK
PSH
RST
SYN
FIN
Window
Checksum
Urgent Pointer
Options + Padding

TCP Header

TCP segment – single type of protocol data unit

Fields:

- source port
- destination port
- sequence no
- acknowledgement no
- data offset
- reserved
- flags
  - URG: urgent field pointer field significant
  - ACK: acknow.. Field significant
  - RST: reset the connection

TCP Header

- flags
    - SYN: synchronize the sequence no
    - FIN: no more data from sender
- Window flow control credits allocation, in octets
- Checksum
- Urgent pointer – points to the last octet in a sequence of urgent data; alow the receiver to know how much urgent data is coming
- Options: specifies the maximum segment size that will be accepted

Items Passed to IP

TCP passes some parameters down to IP

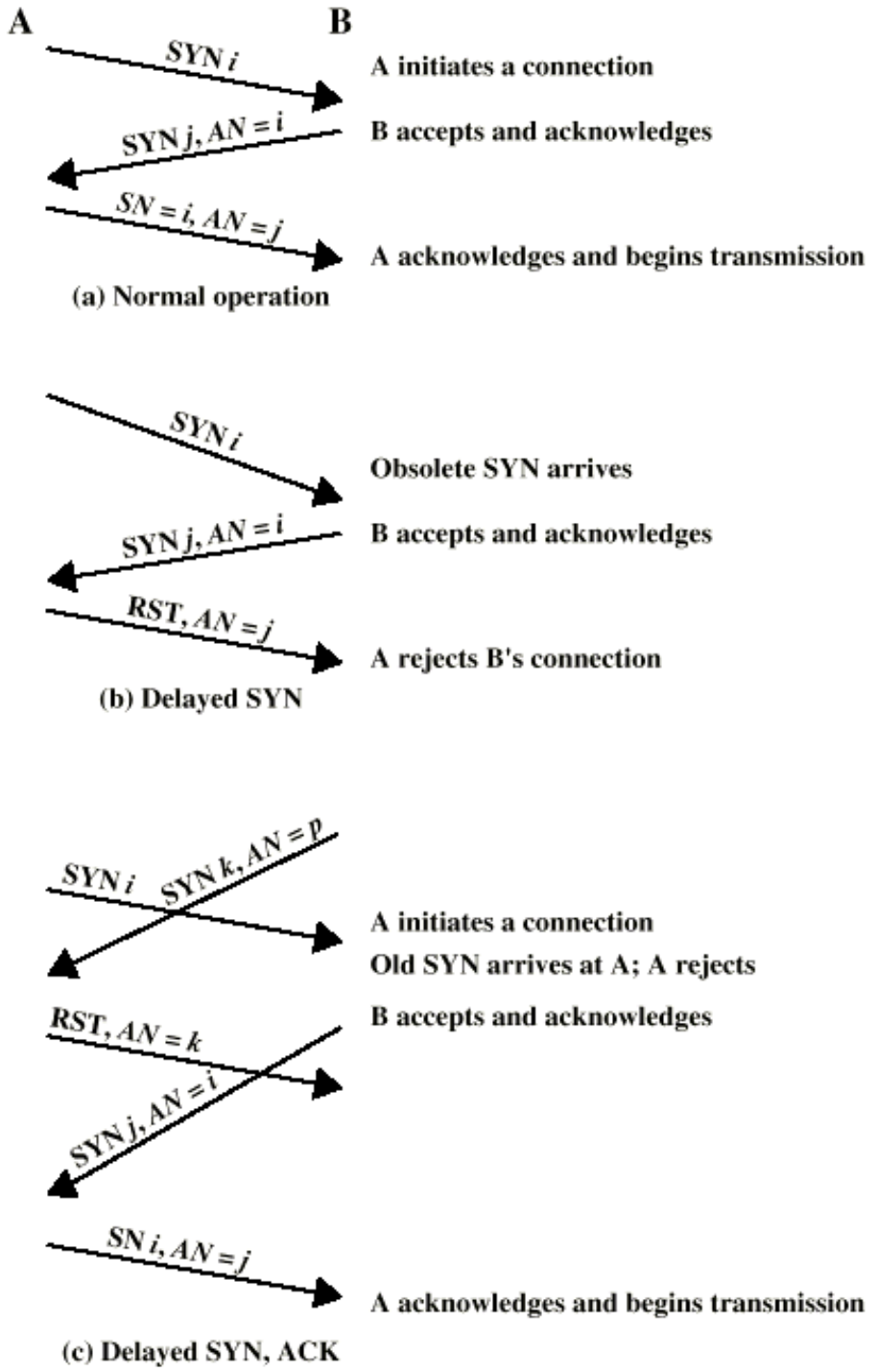
- Precedence
- Normal delay/low delay
- Normal throughput/high throughput
- Normal reliability/high reliability
- Security

TCP Mechanisms (1)

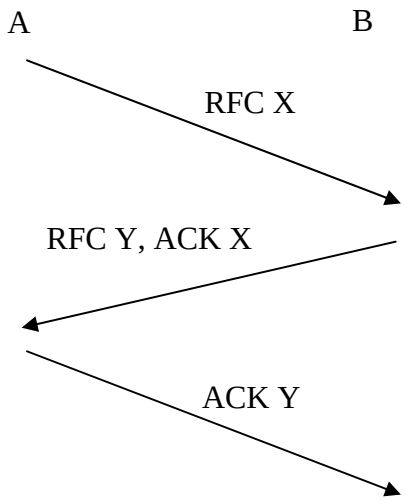
a) Connection establishment

- Three way handshake
- Between pairs of ports
- One port can connect to multiple destinations

Three Way Handshake: Examples



Connection establishment



TCP Mechanisms (2)

Data transfer

- Logical stream of octets
- Octets numbered modulo 223
- Flow control by credit allocation of number of octets
- Data buffered at transmitter and receiver

TCP Mechanisms (3)

Connection termination

- Graceful close
- TCP users issues CLOSE primitive
- Transport entity sets FIN flag on last segment sent
- Abrupt termination by ABORT primitive
  - Entity abandons all attempts to send or receive data
  - RST segment transmitted

Implementation Policy Options

- Send
- Deliver
- Accept
- Retransmit
- Acknowledge

Send

a) If no push or close TCP entity transmits at its own convenience

b) Data buffered at transmit buffer

c) May construct segment per data batch

d) May wait for certain amount of data

Deliver

a) In absence of push, deliver data at own convenience

b) May deliver as each in order segment received

c) May buffer data from more than one segment

Accept

a) Segments may arrive out of order

b) In order

- Only accept segments in order
- Discard out of order segments

c) In windows

- Accept all segments within receive window

Retransmit

a) TCP maintains queue of segments transmitted but not acknowledged

b) TCP will retransmit if not ACKed in given time

- First only
- Batch
- Individual

Acknowledgement

a) Immediate
b) Cumulative

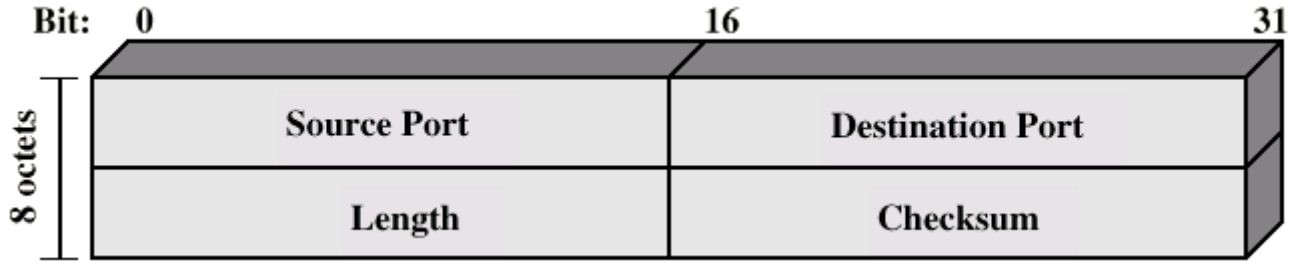
UDP

a) User datagram protocol
b) RFC 768
c) Connectionless service for application level procedures
   - Unreliable
   - Delivery and duplication control not guaranteed
d) Reduced overhead
e) e.g. network management

UDP Uses

a) Inward data collection
b) Outward data dissemination
c) Request-Response
d) Real time application

UDP Header


Bit:
0
16
31
8 octets
Source Port
Destination Port
Length
Checksum