TCP

12강

Transmission Control Protocol

- Most frequently used transport layer protocol
  - The most complex Internet protocol

- Service model and characteristics
  - Connection-oriented
  - Reliable
  - In-order delivery
  - Full-duplex

TCP service model

- Connection-oriented: data exchange possible only after "connection" is set up
- Reliable: retransmission will be done if data packet is not acknowledged
- In-order delivery: in the order the user process provided
- Full-duplex: two data channels are open in one connection

TCP

- TCP sees user data as a stream of bytes
  - No predetermined boundaries
  - Segmentation is performed by TCP
    - Each packet is called "segment"
- Segment size can be adjusted by PMTU discovery
  - ICMP notifies TCP if ICMP error (packet too big but DF set) arrives
- Maximum segment size (MSS) = MTU - 40

TCP

- TCP header format = 20 bytes + options (max 40 bytes)
  - Source port, dest port
  - Sequence number
  - Ack number
  - Header length (In units of 4 bytes)
  - 8 flags
  - Window size
  - Checksum
  - Urgent pointer
  - Options

Sequence number

- Each byte has one 32-bit number
- SYN and FIN segments consume a sequence number
- "Randomly chosen"
  - So that no one can guess
  - Security reason
    - Hijacking possible if the choice is guessed
- The first byte in each segment

Acknowledgement number

- If x is ACK number, it means
  - The receiver has up to (x-1) bytes, so expects x next
  - X-1 is the sequence number of the last consecutive bytes the receiver has got
- TCP sender can flush up to (x-1) in the sending socket buffer upon ACK(x)

Header length

- Like in IP
- Basic TCP header is 20 bytes
  - "5"
  - Options can come after this
  - TCP options are very useful

Flags

- CWR, ECE: congestion control use
- URG: urgent pointer, means there are urgent bytes came into the byte stream
- ACK: always on except in the first SYN segment
- PSH: "push", today it only means that there is no data byte in the sending socket buffer after this segment (i.e. not functional)

Flags

- RST: "reset", kills the TCP connection
  - Not really a reset (going back to the initial state)
- SYN: "synchronize" 3 pieces of information to establish the connection
  - Later in connection set up
- FIN: "finish"
  - Hangs up the connection in a graceful manner

Window size

- Actually it is the available receive socket buffer space
  - For flow control
- Must be interpreted with respect to the ACK number
  - E.g. 3500 bytes from ACK number 12780

TCP checksum

- The Internet checksum
- Covers the entire TCP segment
  - Header
  - Body
- As in UDP, uses "pseudo-header"
- Mandatory in TCP

Urgent pointer

- Points at the last byte of the urgent data in the byte stream
  - Offset to the position
- In TCP, urgent data cannot preempt preceding normal data
  - They should be served in the same way as other normal bytes
- TCP does not know what kind of urgent data it is; it just knows it's urgent