香港城市大學
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CS5222 Computer Networks & Internets Assignment 1

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Chapter 1

1 P6

- **a):**
  - $d_{prop} = \frac{m}{s}$
- **b):**
  - $d_{trans} = \frac{L}{R}$
- **c):**
  - $d_{end-to-en} = d_{trans} + d_{prop} = \frac{L}{R} + \frac{m}{s}$
- **d):**
  - At time $t = \mathrm{d}_{trans}$, the last bit of the packet has just left the transmitting host A.
- **e):**
  - The first bit of the packet on the link way to Host B, has not yet reached host B.
- **f):**
  - The first bit has already arrived at the Host B.
- **g):**
  - suppose $d_{prop} = \frac{m}{s} = d_{trans} = \frac{L}{R}$
  - so $m = s \cdot \frac{L}{R} = \left(2.5 \cdot 10^8 \frac{m}{s}\right) \cdot \frac{120\ bits}{56 \cdot \frac{10^3\ bit}{s}} \approx 535.714\ km$

2 P31

- **a):**
  - Suppose Message size (M) & Link rate (R)
    - Message size→$M = 8 \cdot 10^6 bits$
    - Link rate →$R = 2 \cdot 10^6 bps$
  - **Time to move the message to the first switch:**$\frac{M}{R} = \frac{8 \cdot 10^6 bits}{2 \cdot 10^6 bps} = 4\ sec$
  - **Total time to reach the destination:** $Total\ time = 3 \cdot \frac{M}{R} = 3 \cdot \frac{8 \cdot 10^6 bits}{2 \cdot 10^6 bps} = 12\ sec$
- **b):**
  - Suppose each segmented Message size (M) & Link rate (R)
    - Message size→$M = 1 \cdot 10^4 bits$
    - Link rate →$R = 2 \cdot 10^6 bps$
  - **Time to move the first packet to the first switch**: $T_1 = \frac{M}{L} = \frac{1 \cdot 10^4 bits}{2 \cdot 10^6 bps} = 0.005\ sec$

- **Time to move the second packet to the first switch**$T_2 = T_1 + \frac{M}{R} = 0.005\ sec + \frac{1 \cdot 10^4 bits}{2 \cdot 10^6 bp} = 0.01 sec$

- **c):**
  - Suppose each segmented Message size (M) & Link rate (R)
    - Message size→$M = 1 \cdot 10^4 bits$
    - Link rate →$R = 2 \cdot 10^6 bps$
  - Time to send all packets to the first switch: $T_1 = \frac{800 \cdot M}{R} = \frac{800 \cdot 10^4 bits}{2 \cdot 10^6 bps} = 4\ sec$
    - At t=4 s, the last packet has just left the source. It still needs to go through the two switches, traversing the remaining two links
  - Time to send the last packet to the remaining two links: $T_2 = 2 \cdot \frac{M}{R} = 2 \cdot \frac{1 \cdot 10^4 bits}{2 \cdot 10^6 bps} = 0.01\ sec$
  - $Total\ time = T_1 + T_2 = 4\ sec + 0.01\,\mathrm{sec} = 4.01\ sec$
  - Comparison this result and comment:
    - The total time using message segmentation (4.01 s) is much faster than without segmentation (12 s)
    - When the first small packet reaches a switch, it can be immediately forwarded without waiting for the entire large message to arrive. This allows multiple links to work in parallel.
- **d):**
  - Error control and reliability
    - If an error occurs during transmission causing part of the message to be corrupted, we just need to retransmitted the corrupted small packet rather than the entire message.
  - Resource sharing
    - In a multi-user network where the link is shared, small packets allow data from different users to be interleaved during transmission. This prevents a single user from monopolizing the link when sending a large file.
- **e):**
  - **Additional expenses**
    - Each packet requires its own header, which contains information such as source address, destination address, sequence number, etc. When a large message is divided into many small packets, the total size of these headers consumes additional expenses.
  - **Increase complexity**
    - The receiver needs to reassemble all packets according to their sequence numbers to reconstruct the original message.
    - Any packet in the network may be lost, so both the sender and receiver need mechanisms to detect and retransmit lost packets.

Chapter 2

1 P17

- **a):**

```
C: list
S: 1 498
S: 2 912
S: .
C: retr 1
S: blah blah ...
.........blah
S: .
C: dele 1
C: quit
```

- **b):**

```
C: list
S: 1 498
S: 2 912
S: .
C: retr 1
S: blah blah ...
.........blah
S: .
C: quit
S: +OK
```

- **c):**

```
S: +OK
C: user chen xian
S: +OK
C: pass 59790558
S: +OK
C: list
S: 1 498
S: 2 912
S: .
C: quit
S: +OK
```

2 Question

- **a):**

- Hypertext Transfer Protocol (HTTP)
  - Purpose: Facilitates communication between clients and servers.
- WebSocket Protocol
  - Purpose: Enables full-duplex communication channels over a single TCP connection.
- RTP (Real-time Transport Protocol)
  - Purpose: Specifically designed for end-to-end transmission of real-time data, such as audio and video streaming.

- **b):**
  - Zoom based on a Client-Server architecture
    - In a multi-participant meeting, if a P2P architecture was used, each participant would need to send their own audio and video streams directly to every other participant. This would put enormous pressure on upload bandwidth. In the client-server model, each participant only needs to send their stream to Zoom's server, which then mixes or forwards all streams to the other participants. This greatly reduces the burden on individual clients, making large meetings with hundreds or even thousands of participants possible.
- **c):**
  - Zoom primarily uses UDP (User Datagram Protocol)
    - Low Latency: Video conferencing requires extremely low latency.
    - Tolerance for Minor Packet Loss: In real-time audio and video transmission, losing a few packets may only cause slight visual artifacts or minor sound glitches.
- **d):**
  - No. Students' computer don't need to obtain the IP address of the lecture's computer.
    - As mentioned in b), Zoom adopts a client-server mode. The lecturer's computer and all students' computers only connect to Zoom's central server and exchange data with it.