CS305 · Computer Network

张闻城 / 12010324

Assignment 1

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Q1

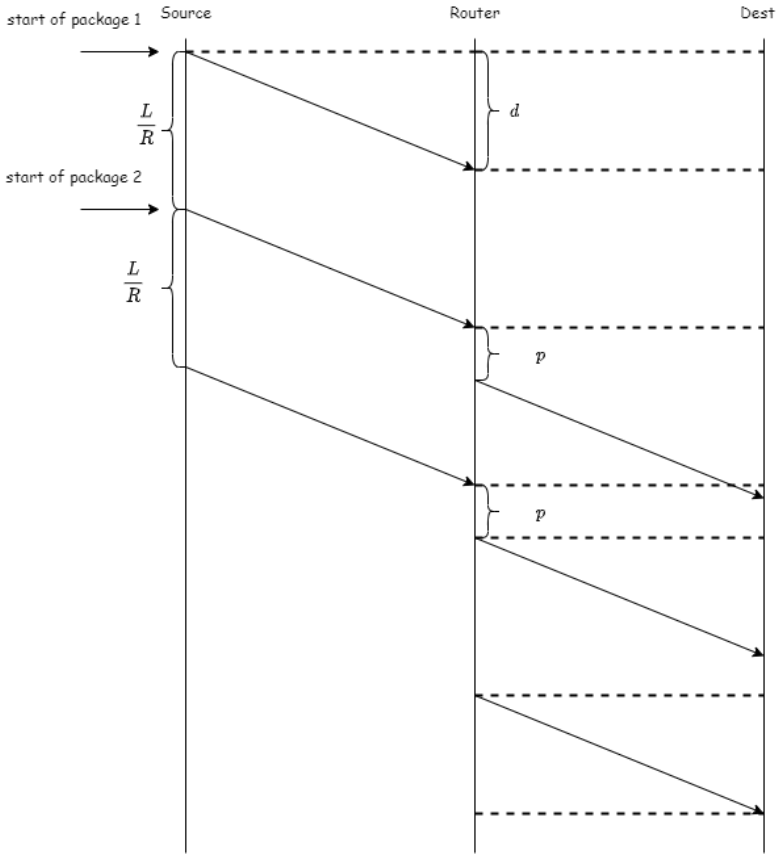
(a)

$$\begin{aligned}\text{end-to-end delay} &= \text{transmission delay} + \text{propagation delay} \\ &= K * \frac{L}{R} + K * d \\ &= K(\frac{L}{R} + d)\end{aligned}$$

(b)

$$\begin{aligned}\text{end-to-end delay} &= \text{circuit setup time} + \text{transmission delay} + \text{propagation delay} \\ &= \tau + L/(\frac{R}{M}) + Kd \\ &= \tau + \frac{LM}{R} + Kd\end{aligned}$$

(c) The process is listed below.



According to the figure, we can get that

$$\begin{aligned} t &= 2d + 3\frac{L}{R} + p \\ &= 405\mu s \end{aligned}$$

Q2

(a) avg queuing time = 0s. This is because before the package of next time slot arrives, the current package will be transmitted completely, so next package do not need to queue.

(b)

$$\begin{aligned} \text{avg queuing time} &= (0 + \frac{L}{R} + 2\frac{L}{R} + \cdots + (N-1)\frac{L}{R})/N \\ &= \frac{(N-1)L}{2R} \end{aligned}$$

When N $\rightarrow \infty$, avg queuing time $\rightarrow \infty$.

(c)

$$\begin{aligned} I_{(a)} &= \frac{La}{R} = \frac{L}{R}\frac{R}{L} = 1 \\ I_{(b)} &= \frac{La}{R} = \frac{L}{R}\frac{N}{NL/R} = 1 \end{aligned}$$

(a) is special case of (b).

Q3

- Application layer: The application layer is responsible for communication between applications running on two different end systems. The protocols used at the application layer include: **HTTP** (Hypertext Transfer Protocol), FTP (File Transfer Protocol), **SMTP** (Simple Mail Transfer Protocol), **DNS** (Domain Name System).
- Transport layer: The transport layer of the Internet carries application layer messages between application endpoints. Two protocols used in this layer is **TCP** (Transmission Control Protocol) and **UDP** (User Datagram Protocol).
- Network layer: The network layer is responsible for transferring datagram from one system to another on the network. Corresponding protocol is **IP** (Internet Protocol).
- Link layer: When a packet is being transferred over the internet, several intermediate devices are between the two end systems. These devices may be routers, switches, or other computers. The link layer is responsible for communication between one device and its immediate neighbor. One of the protocol used in this layer is **Ethernet**.

- Physical layer: The physical layer is responsible for breaking the data frame into bits, converting it into a form that can be transmitted over the physical communication line, and transferring it. Typical physical protocol is **IEEE 802.3**.

Q4

(a) HTTP message run on top of TCP.

TCP is better than UDP since it is reliable and stable, since TCP will establish a connection and ensure and do 3 handshakes to ensure the connection is established successfully, but UDP will not do so.

(b) It is a HTTP request message.

(c) It is a persistent connection since the request has a header named **Connection: Keep-Alive**.

(d) The corresponding entry in the cookie file of the browser is **identification_number=1150**.

To specify the cookie, header **Set-Cookie: identification_number=1150** should be included in the message

(e) status-line: **HTTP/1.1 200 OK**

The content of **cs453/index.html** will be included in entity body.

Q5

(a)

$$\begin{aligned}\Delta &= \frac{L}{R} \\ &= \frac{13}{300}s \\ \text{TotalAverageResponseTime} &= \text{AverageAccessDelay} + \text{AverageInternetDelay} \\ &= \frac{\Delta}{1-\Delta\beta} + 3s \\ &= 3.325s\end{aligned}$$

(b)

$$\begin{aligned}\text{TotalAverageResponseTime} &= \text{AverageAccessDelay} + \text{AverageInternetDelay} \\ &= 0.4 * 0s + 0.6 * (\frac{\Delta}{1-\Delta\beta * 0.6} + 3s) \\ &= 1.854s\end{aligned}$$

Q6

(a)

$$\begin{aligned} t_{(a)} &= \sum_{i=1}^{n} RTT_i + 2RTT_0 + 2RTT_0 * 10 \\ &= \sum_{i=1}^{n} RTT_i + 22RTT_0 \end{aligned}$$

(b)

$$\begin{aligned} t_{(b)} &= \sum_{i=1}^{n} RTT_i + 2RTT_0 + 2 * \lceil \frac{10}{4} \rceil RTT_0 \\ &= \sum_{i=1}^{n} RTT_i + 8RTT_0 \end{aligned}$$

(c)

$$\begin{aligned} t_{(c)} &= \sum_{i=1}^{n} RTT_i + 2RTT_0 + RTT_0 \\ &= \sum_{i=1}^{n} RTT_i + 3RTT_0 \end{aligned}$$

Q7

(a)
- HTTP is a pull request, while SMTP is a push request.
- SMTP restricts its file message should be encoded by ASCII, while HTTP does not.

(b) No. Since SMTP is a push protocol to send local e-mail to remote server.

(c) No. If so, Bob needs to keep his computer on at all times, which is unrealistic.

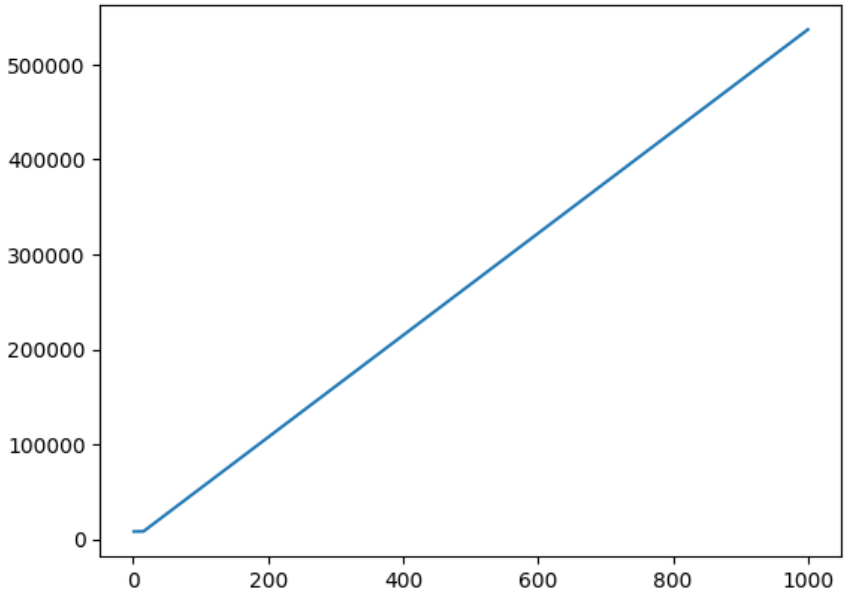
Not good, since mail sending may be fail, which requires the sender to re-send again, which not simple and humanized.

(d) Yes. UDP has a limitation of datagram length (512 bytes), so when the datagram is longer than 512 bytes, TCP will be used to transmit datagram.

Q8

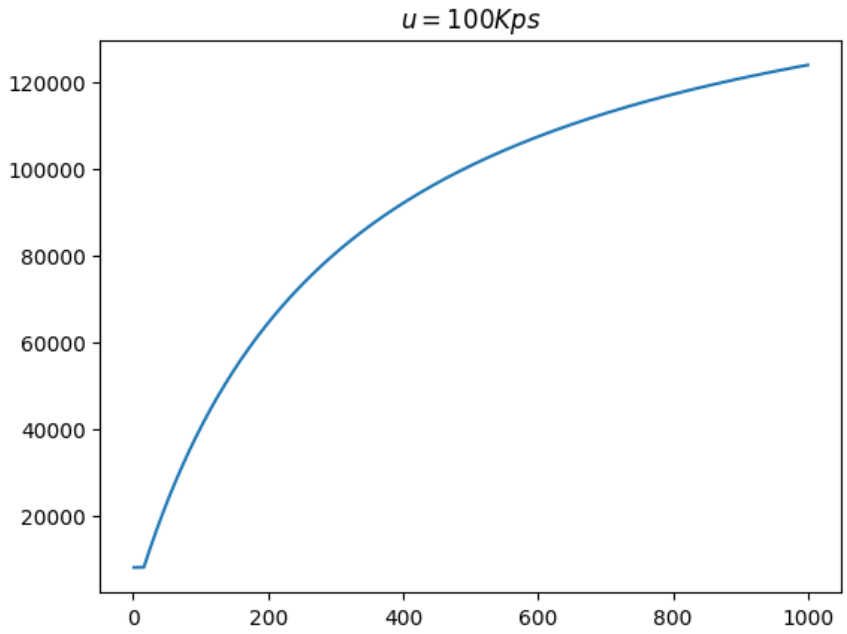
(a)

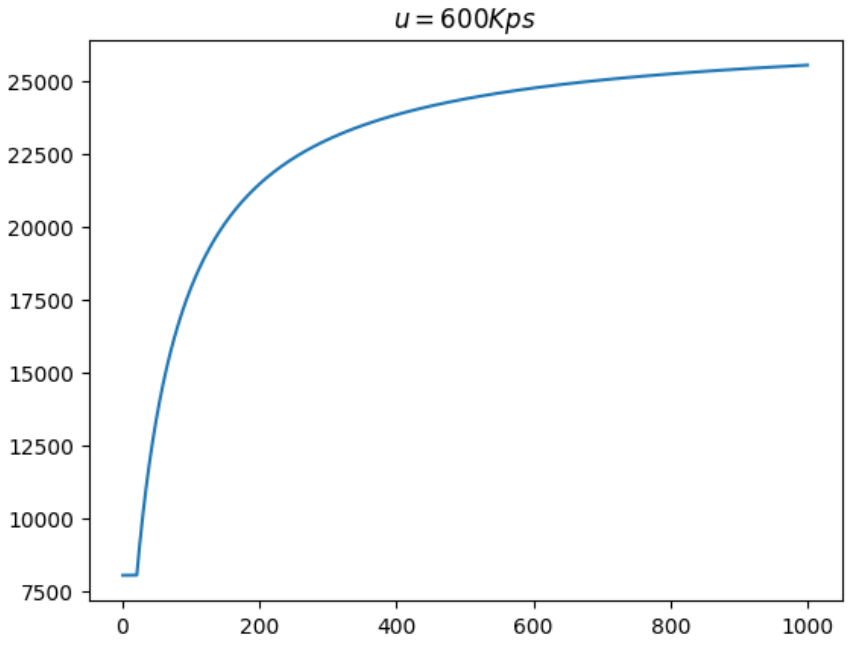
$$D_{CS} = max\{\frac{NF}{u_s}, \frac{F}{d}\}$$

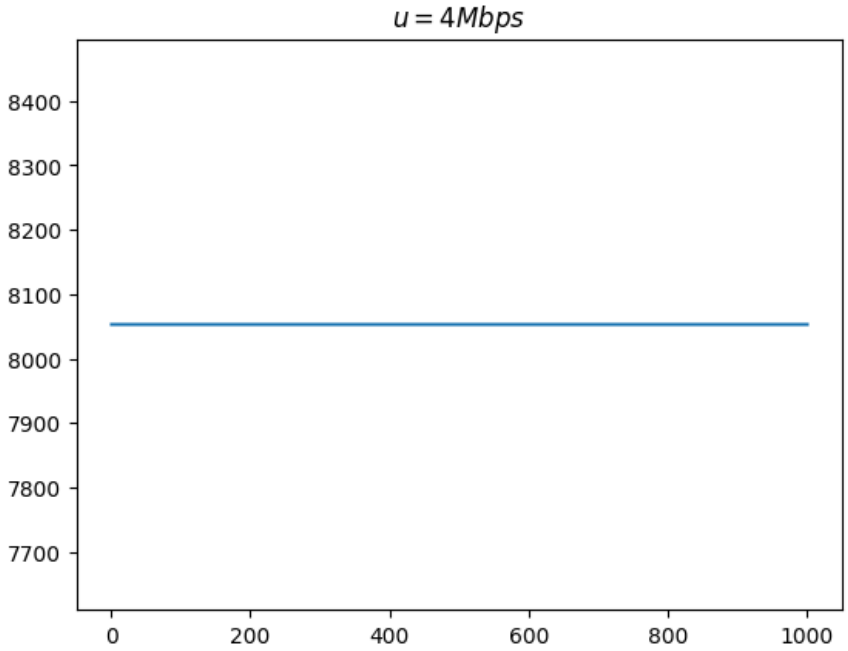


(b)

$$D_{P2P} = max\{\frac{F}{u_s}, \frac{F}{d}, \frac{NF}{u_s + Nu}\}$$







Q9

(a) Set transmit rate to all peers to the same value, $\frac{u_s}{N}$.

Since $\frac{u_s}{N} \leq d_{min}$, download rate of peers is $\frac{u_s}{N}$. Thus total cost is $F/\frac{u_s}{N} = \frac{NF}{u_s}$.

(b) Set transmit rate to all peers to the same value, $\frac{F}{d_{min}}$.

Since $u_s/N \geq d_{min}$, the total time is determined by peers' download rate. Total download rate is Nd_{min}, thus distribution time is $\frac{F}{d_{min}}$.

(c) • The server must transmit one copy of the file to each of the N peers. Thus the server must

transmit NF bits. Since the server's upload rate is u_s, the time to distribute the file must be at least $\frac{NF}{u_s}$.

- d_{min} denote the download rate of the peer with the lowest download rate. The peer with the lowest download rate cannot obtain all F bits of the file in less than $\frac{F}{d_{min}}$ seconds. Thus the minimum distribution time is at least $\frac{F}{d_{min}}$.

Putting these two observations together, we obtain

$$D_{CS} = max\{\frac{NF}{u_s}, \frac{F}{d_{min}}\}$$