

Homework 1

1. The distance between the sender and the receiver is 2000km, and the data rate on the media is 2×10^8 m/s. Calculate the transmission delay and propagation delay in the following two cases: (i) The data length is 10^7 bit and the data transmission rate is 100Kbps; (ii) The data length is 10^4 bit and the data transmission rate is 1Gbps. According to the results above, when do the transmission and the propagation delay become dominant in the total delay, respectively?

· 解. (i)

- transmission delay: $td = \frac{10^7 \text{ bit}}{100 \text{ Kbps}} = \frac{10^7}{100 \times 10^3} s = 100s$
- propagation delay: $pd = \frac{2000 \times 10^3 m}{2 \times 10^8 \text{ m/s}} = 0.01s$

(ii)

- transmission delay: $td = \frac{10^4 \text{ bit}}{1 \text{ Gbps}} = \frac{10^4}{10^9} s = 10^{-5} s$
- propagation delay: $pd = \frac{2000 \times 10^3 m}{2 \times 10^8 \text{ m/s}} = 0.01s$

Clearly we can see that transmission delay becomes dominant when **the data (packet) length is large and the transmission rate is low**, for it takes a long time to push all the bits into the link; and propagation delay becomes dominant when **the data (packet) length is small and the transmission rate is high**, for it transmits all the bits into the link quickly compared to the time it takes for a bit to propagate from the sender to the receiver.

2. What are two reasons for using layered protocols? What is one possible disadvantage of using layered protocols?

· 解.

1. Considering that Computer Network is such a complicated system, dividing it into several layers can manage to decompose the problems into smaller, subsidiary problems, which are easier to solve.
2. Each layer can be designed and updated independently, as long as the interfaces between layers are maintained. (Upper layers just utilize the services provided by lower layers without needing to know the details of their implementation.)
 - ONE DISADVANTAGE: The overhead of layering can lead to inefficiencies, as each layer may add its own headers.
3. In some networks, the data link layer handles transmission errors by requesting that damaged frames be retransmitted. If the probability of a frame's being damaged is p , what is the mean number of transmissions required to send a frame? Assume that acknowledgments are never lost.
 - 解. Every submission is a Bernoulli trial with success probability $1 - p$. The number of trials until the first success follows a **geometric distribution**. The expected number of trials (transmissions) to get the first success is given by $E(X) = \frac{1}{1-p}$.
4. What is the main difference between TCP and UDP?

- 解. TCP is **connection-oriented**, providing **reliable** data transfer with **segment** being sent in sequence, while UDP is connectionless, offering a faster(best-effort) but less reliable service without guaranteed delivery and transmitting **datagram**.
5. How long was a bit in the original 802.3 standard in meters, which uses a transmission speed of 10 Mbps? Assume the propagation speed in coax is 2/3 the speed of light in vacuum.
- 解. Bit time = $\frac{1}{\text{transmission speed}} = \frac{1}{10 \times 10^6} s = 10^{-7} s$
Bit Length = Bit time \times Propagation speed = $10^{-7} \times \frac{2}{3} \times 3 \times 10^8 \frac{m}{s} = 20m$
1. List one advantage and one disadvantage of having international standards for network protocols.
- 解.
 - ▶ ADVANTAGE: Interoperability between different vendors' equipment and software, facilitating global communication and data exchange.
 - ▶ DISADVANTAGE: The standardization process can be slow, potentially delaying the adoption of new technologies and innovations.
1. Which layers are common in the OSI model and TCP/IP model?
- 解. Network Layer, Transport Layer, Application Layer(in TCP/IP this layer is composed of Application, Presentation and Session layers in OSI model)