

# Computer Networks Homework set I

Due date: March 28, 2016

1. Give the full name of the following acronyms. (a) ISP (b) ICP (c) TDM (d) ADSL
2. What are the five layers in the Internet protocol stack?
3. Consider sending a packet from a sending host to a receiving host over a fixed route. List the delay components in the end-to-end delay.
4. With guided media, the waves are guided along a solid medium. With unguided media, the waves propagate in the atmosphere and in outer space. Give three examples of guided media and one example of unguided media.
5. Suppose Host A wants to send a large file to Host B. This path from Host A to Host B has three links, of rates  $R_1 = 500\text{kbps}$ ,  $R_2 = 3\text{Mbps}$ , and  $R_3 = 1\text{Mbps}$ . Suppose the file is 6 million bytes. Roughly, how long will it take to transfer the file to Host B (use message switching)?
6. Suppose two hosts, A and B, are separated by 20,000 kilometers and are connected by a direct link of  $R = 1\text{ Mbps}$ . Suppose the propagation speed over the link is  $2 \times 10^8$  meters/sec.
  - (a) Calculate the "bandwidth-delay product,"  $R \cdot t_{prop}$ .
  - (b) Consider sending a file of 400,000 bits from host A to host B. Suppose the file is sent continuously as one big message. What is the maximum number of bits that will be in the link at any given time.
  - (c) Provide an interpretation of the bandwidth-delay product.
  - (d) What is the width (in meters) of a bit in the link?
  - (e) Derive a general expression for the width of a bit in terms of the propagation speed  $s$ , the bandwidth  $R$ , and the length of the link  $m$ .

# 詳解

- ① (a) Internet Service Provider (b) Internet Content Provider  
 (c) Time Division Multiplexing (d) Asymmetric Digital Subscriber Line
- ② 1. Physical 2. Data Link 3. Network 4. Transport 5. Application
- ③ ~~1. 晶片延遲~~ 2. 排隊延遲 ~~3. 頻寬延遲~~ ~~4. 距離延遲~~ processing delay.  
propagation delay.  
- 6 Transmission delay.
- ④ Guided media: 光纖、同軸電纜、雙絞線  
 unguided media: 2G、3G、4G
- ⑤ A  $\frac{500\text{ kbps} = 0.5\text{ Mbps}}{3\text{ Mbps} + 1\text{ Mbps}}$  B  $6\text{ million bytes} = 6 \times 10^9\text{ bytes} = 6000\text{ MB}$   
 $48000 \div 0.5 + 48000 \div 3 + 48000 \div 1 = 96000 + 16000 + 48000 = 160000\text{ sec}$  - 10
- ⑥  $t_{\text{prop}} = \frac{20000\text{ km}}{2 \times 10^8\text{ m/s}} = \frac{20000000\text{ m}}{2 \times 10^8\text{ m/s}} = 0.1\text{ s}$  ③  $\frac{6\text{ MB}}{500\text{ kbps}} + \frac{6\text{ MB}}{3\text{ Mbps}} + \frac{6\text{ MB}}{1\text{ Mbps}} = \frac{6 \times 8}{2.5} + \frac{6 \times 8}{3} + \frac{6 \times 8}{1} = 160\text{ (s)}$
- (a)  $1 \frac{\text{Mb}}{\text{s}} \times 0.1\text{ s} = 0.1\text{ Mb}$  (b)  $400000\text{ bits} = 0.4\text{ Mb} > 0.1\text{ Mb}$  A:  $0.1\text{ Mb}$
- (c) 網路線路裡可以容納的檔案大小 (d)  $\frac{20000\text{ km}}{0.1\text{ Mb}} = \frac{20000000\text{ m}}{100000\text{ b}} = 200\text{ m/b}$
- (e)  $s = \frac{\text{meter}}{\text{sec}}$   $R = \frac{\text{bit}}{\text{sec}}$   $m = \text{meter}$   $\frac{m \cdot s}{R} = \frac{\text{meter} \cdot \text{sec} \times \text{meter}}{\text{bit} / \text{sec}} = \frac{\text{meter}^2}{\text{bit}}$  A:  $\frac{m \cdot s}{R} \frac{1}{R}$