Computer Networking

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Practice for Quiz 1

1. Lenght = 1000 bytes
Link = 2.5 km
propagation speed = $2.5 \cdot 10^8$ m/s
transmission rate = 2 mbps

The delay Δ_1 is the propagation delay d_{prop}

$$d_{prop} = \frac{d}{v}$$

$d = 2.5$ km
$v = 2.5 \cdot 10^8$

$$\therefore \quad \frac{2.5 \cdot 10^3}{2.5 \cdot 10^8} = 10^{-5} \text{ s}$$

$$\Rightarrow \quad 10^{-2} \cdot 10^{-3} \text{ s}$$

$$= \quad 10 \cdot 10^{-6} = 10 \mu s$$

2. $d_{Trans} = \frac{L}{R}$

$L = 1000 \cdot 8$
$R = 2$ mbps

$$\therefore \quad \frac{8 \cdot 10^3}{2 \cdot 10^6} \text{ s}$$

$$\Rightarrow \quad 4 \cdot 10^{-3} \text{ s}$$

3. The approximate end-to-end throughput R_t is $R_2 = 2$ mbps

4.

Layer	Unit of information
Application Layer	Message
Transport Layer	Segment
Networking Layer	Packet
Link Layer	Frame
Physical Layer	bit

$d_{tx,1hop} = \frac{L}{R}$

Example
- $L = 1500$ bits
- $R = 100$ bits

$$d_{tx,1hop} = \frac{1500 \text{ bits}}{100 \cdot 10^6 \text{ bits/s}} = 15 \cdot 10^{-6} \text{ s} = 15 \mu s$$

$d_{tx,1hop} = \frac{L}{R}$

Example
- $L = 32$ Kbits
- $R = 100$ Mbs

$$d_{tx,1hop} = \frac{32 \cdot 10^3 \text{ bits}}{100 \cdot 10^6 \text{ bits/s}} = 32 \cdot 10^{(3-2-6)} \text{ s} = 3.2 \mu s$$

- $d_{tx,e2e} = ?$
- $R_1 = 100$ Mbps
- $R_2 = 1000$ Mbps
- $R_3 = 10$ Mbps
- $L = 16000$ bits

$$d_{tx,e2e} = \sum_{i=1}^{n} \frac{L}{R_i} = \frac{L}{R_1} + \frac{L}{R_2} + \frac{L}{R_3}$$

$$= \frac{16000 \text{ bits}}{100 \cdot 10^6 \text{ bits/sec}} + \frac{16000 \text{ bits}}{1000 \cdot 10^6 \text{ bits/sec}} + \frac{16000 \text{ bits}}{10 \cdot 10^6 \text{ bits/sec}}$$

$$= 160 \cdot 10^{-6} \text{ s} + 16 \cdot 10^{-6} \text{ s} + 1600 \cdot 10^{-6} \text{ s}$$

$$= 1776 \mu s$$

$$\frac{[16 \cdot 10^{12} \text{ bits}] \cdot 8}{256 \cdot 10^3 \text{ bit/s}}$$

$$\frac{128 \cdot 10^{12} \text{ bit}}{256 \cdot 10^3 \text{ bit/s}}$$

$$\frac{128 \cdot 10^9 \text{ bit}}{256 \text{ bit/s}} \Rightarrow 0.5 \cdot 10^9 \text{ s}$$

10 h

1 → 60

10 →

600

Last Year's Midterm

1. R1 = Transmission Rates between the sending host and the switch
   R2 = Transmission Rates between the switch and the recieving host
   L = Packet of length

$$\Delta_{end\text{-}to\text{-}end} = \frac{L}{R_1} + \frac{L}{R_2}$$

2. Host A $\xrightarrow{64\ Mbps}$ Host B

propogation speed $v = 3 \times 10^8\ m/s$

Propogation Delay $= \frac{d}{v}$

$P \cdot v = d$

$1\ \mu s \cdot 300\ \mu s = 300\ \mu s$

3

Users sharing 3Mbps link
R 1.5 Mbps

2 users can be shared. Since circuit switching takes all the resource it needs

7. 01001101 , 01001001 , 01000100

Review Questions

DNS & HTTP DELAYS

1. $RTT_1 = 5\ ms$, $RTT_2 = 8\ ms$, $RTT_3 = 39\ ms$, $RTT_7 = 11\ ms$, $RTT_{HTTP} = 26\ ms$

$$\Delta_{TOT} = RTT_0 + RTT_1 + RTT_2 + RTT_3 + RTT_7 + [2 \cdot RTT_{HTTP}]$$
$$= 5 + 8 + 39 + 11 + [2 \cdot 26]$$
$$= 115\ ms$$

2. $$RTT_0 + RTT_1 + RTT_2 + RTT_3 + [2 \cdot RTT_{HTTP}] + [2 \cdot 7 \cdot RTT_{HTTP}]$$
$$\Rightarrow 5 + 8 + 39 + 11 + [2 \cdot 26] + [14 \cdot 26]$$
$$\Rightarrow 479\ ms$$

3. $$RTT_0 + RTT_1 + RTT_2 + RTT_3 + [2 \cdot RTT_{HTTP}] + [2 \cdot RTT_{HTTP}] + [2 \cdot RTT_{HTTP}]$$
$$\Rightarrow 63 + 52 + 52 + 52$$
$$\Rightarrow 219\ ms$$

4. $$RTT_0 + RTT_1 + RTT_2 + RTT_3 + [2 \cdot RTT_{HTTP}] + RTT_{HTTP} + RTT_{HTTP}$$
$$\Rightarrow 63 + 52 + 26 + 26$$
$$\Rightarrow 167\ ms$$

INTERNET CHECKSUM

$B_1 = 01011100$
$B_2 = 01100101$

(a)
$$\begin{array}{r} 01011100 \\ + \ 01100101 \\ \hline 11000001 \\ 00111110 \end{array}$$
1s complement

(b)
$$\begin{array}{r} 01011100 \\ + \ 01100101 \\ \hline 11000001 \\ 00111110 \end{array}$$
1s complement

PIPELINING & CHANNEL UTILIZATION

$RTT = 30\ ms$
$R = 1\ Gbps$
$L = 1500\ bytes$
$U = 0.98$
$N =$ size of the window

$$U = \frac{N \cdot \Delta_{tx}}{RTT + \Delta_{tx}}$$

$$\frac{U[RTT + \Delta_{tx}]}{\Delta_{tx}} = N$$

$$\Delta_{tx} = \frac{1}{R} = \frac{1500 \cdot 8}{10^9} =$$

CN Assignment 2

Calculating the IP subnet:

51.128.82.195 30

30 → 255.255.255.252

↓ Into Binary Number

11111111 . 11111111 . 11111111 . 11111100

∴ 51.128.82.192

256
- 252
004

∴ 4+4 = 8
4+4+4 = 12
4+4+4+4 = 16
4·5 = 20
4·6 = 24
4·7 = 32
4·48 = 192

161 ms 0.088 278 ms

(1 - 0.088) ·

Textbook Questions

CHAPTER 1

Section 1.1

R1. There is no difference between a host and an end system. End systems include

R3. Standards are important because so that developers could make networking systems or products which would interprotate.

SECTION 1.3

R11. At time $t0$ the sending host begins to transmit. At time $t1 = \frac{L}{R_1}$, the sending host completes transmission and the entire packet is received at the router. At time $t_2 = t_1 + \frac{L}{R_2}$. Thus the end-to-end delay is $\frac{L}{R_1} + \frac{L}{R_2}$

R13. 2 users can be supported because each user requires half of the link bandwidth.

SECTION 1.4

R16. The delay components are processing delays, transmission delays, propagation delays and queing delay. Only queing delay is variable.

R18. $L = 1{,}000$ bytes

$D = 2{,}500$ km

$P = 2.5 \cdot 10^8$ m/s

$R = 2$ Mbps

$$\Delta_{Propagation} = \frac{D}{P} = \frac{2{,}500 \times 10^3 \text{ m}}{2.5 \cdot 10^8 \text{ m/s}}$$

$$= 100 \times 10^5 \text{ msec}$$

R19. $R_1 = 500$ kbps $R_2 = 2$ Mbps $R_3 = 1$ Mbps

Chapter 2

SECTION 2.1

$32 \cdot 10^3$ bits

$\gg$

$4 \cdot 10^3$

4000 4032

DIJKSTRA'S LINK STATE ALGORITHM

1.	N'	(D_v, P_v)	(D_x, P_x)	(D_w, P_w)	(D_y, P_y)	(D_z, P_z)
	u	3, u	8, u	4, u	∞	∞
	uv		5, v	4, u	∞	∞
	uvw		5, v		10, w	5, z