Chapter 1
CS 391 Computer Networking
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P1

Request Format

All requests from client are in the same format

```
REQUEST Bank Server Protocol/1.0
CARD <card_number>
PASSWORD <password>
TRADE <trading_volume>
END REQUEST
```

There is no doubt about *card_number* and *password*. And here is some explanation about *trading_volume*. *trading_volume* is change of the amount of money in the account after this request. That is if a user try to withdraw $100, the *trading_volume* will be -100. On the contrary, if a user try to put in $50, the *trading_volume* will be 50. When $trading\_volume = 0$, this request will only query the balance in the account.

Response Format

```
RESPONSE Bank Server Protocol/1.0
CODE <return_code>
MESSAGE <return_msg>
END RESPONSE
```

Here is a list for *return_code* and *return_msg* in different conditions.

Table 1 Response Code and Message.

return_code	return_msg	remark
0	OK	no error
1	Login Failed	card number or password error
2	Withdraw Failed	do not have enough money
3	Unknown Errors	other error occupied

P2

According to Equation 1.1, a single packet through N links cost $N\frac{L}{R}$. The next packet send out after the first one in delay $\frac{L}{R}$, and the P^{th} packet send out after $(P-1)\frac{L}{R}$. Hence, the total delay will be

$$d_{end\_to\_end} = (N+P-1)\frac{L}{R}$$

P6

a. $d_{prop} = m/s$

b. $d_{trans} = L/R$

c. $d_{end\_to\_end} = d_{prop} + d_{trans} = m/s + L/R$

d. The last bit has just recent sent out from Host A.

e. The first bit is on the way to Host B.

f. The first bit has already received by Host B.

g. According to the problem, $d_{prop} = d_{trans}$. That is $m/s = L/R$. Hence

$$m = s\frac{L}{R} = 5.36 \cdot 10^5 \text{meters}$$

P9

a. $N_{circuit} = R/a = 10000$.

b. The probability will be

$$P(n > N) = \sum_{n=N+1}^{M} \binom{M}{n} \cdot p^n \cdot (1-p)^{M-n}$$

P14

a. $d_{total} = d_{queue} + d_{trans} = IL/R(1-I) + L/R = \frac{L}{R(1-I)} = \frac{L}{R-La}$

b. According $I = La/R$. Let $x = L/R$, there is $d_{total} = \frac{x}{1-ax}$. Here is plot.

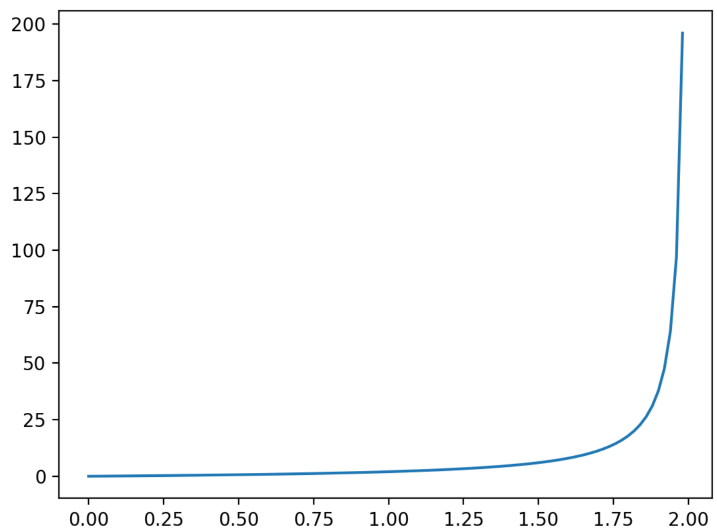

Figure 1: Delay function of L/R with $a = 0.5$

P16

The transmission delay $d_{trans} = 10$ msec, and total delay $d = 20$ msec. On average, there is only one packet is being transmitted. Then $N = 11$.

According to Little's formula, $N = a \cdot d$. Hence,

$$a = \frac{N}{d} = 550 \text{ packets/sec}$$

P25

a. The bandwidth-delay product $R \cdot d_{prop} = R \cdot m/s = 0.16$ Mb

b. There are at most 0.16 Mb in this link at any given time no matter how large the file is. (In this case, the file must be larger than 0.16 Mb)

c. The bandwidth-delay product determines the maximum number of bits that will be in the link at any time.

d. $Width_{bit} = m/(R \cdot d_{prop}) = s/R = 125$meters, which is longer than a football field.

e. $Width_{bit} = \min(m/(R \cdot d_{prop}), m) = \min(m/(R \cdot m/s), m) = \min(s/R, m)$