ECE 465: Computer Network Protocols and Applications
Homework 1
Solution
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Chapter 1 Review Questions

3. A networking program usually has two programs, each running on a different host, communicating with each other. The program that initiates the communication is the client. Typically, the client program requests and receives services from the server program.

8. In a packet switched network, the packets from different sources flowing on a link do not follow any fixed, pre-defined pattern. In TDM circuit switching, each host gets the same slot in a revolving TDM frame.

9. At time $t_0$ the sending host begins to transmit. At time $t_1 = L/R_1$, the sending host completes transmission and the entire packet is received at the router (no propagation delay). Because the router has the entire packet at time $t_1$, it can begin to transmit the packet to the receiving host at time $t_1$. At time $t_2 = t_1 + L/R_2$, the router completes transmission and the entire packet is received at the receiving host (again, no propagation delay). Thus, the end-to-end delay is $L/R_1 + L/R_2$.

Chapter 1 Problems

Problem 1.

There is no single right answer to this question. Many protocols would do the trick. Here's a simple answer below:

Messages from ATM machine to Server

<table>
<thead>
<tr>
<th>Msg name</th>
<th>purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELO &lt;userid&gt;</td>
<td>Let server know that there is a card in the ATM machine</td>
</tr>
<tr>
<td></td>
<td>ATM card transmits user ID to Server</td>
</tr>
<tr>
<td>PASSWD &lt;passwd&gt;</td>
<td>User enters PIN, which is sent to server</td>
</tr>
<tr>
<td>BALANCE</td>
<td>User requests balance</td>
</tr>
<tr>
<td>WITHDRAWL &lt;amount&gt;</td>
<td>User asks to withdraw money</td>
</tr>
<tr>
<td>BYE</td>
<td>user all done</td>
</tr>
</tbody>
</table>

Messages from Server to ATM machine (display)

<table>
<thead>
<tr>
<th>Msg name</th>
<th>purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASSWD</td>
<td>Ask user for PIN (password)</td>
</tr>
</tbody>
</table>
OK  last requested operation (PASSWD, WITHDRAWL)
    OK
ERR  last requested operation (PASSWD, WITHDRAWL)
in ERROR
AMOUNT <amt>  sent in response to BALANCE request
BYE  user done, display welcome screen at ATM

Correct operation:

client                          server

HELO (userid)  -------------->  (check if valid userid)
        <---------------  PASSWD
PASSWD <passwd>  -------------->  (check password)
        <---------------  OK (password is OK)
BALANCE  -------------->
        <---------------  AMOUNT <amt>
WITHDRAWL <amt>  -------------->  check if enough $ to cover withdrawal
        <---------------  OK
ATM dispenses $
BYE  -------------->
        <---------------  BYE

In situation when there's not enough money:

HELO (userid)  -------------->  (check if valid userid)
        <---------------  PASSWD
PASSWD <passwd>  -------------->  (check password)
        <---------------  OK (password is OK)
BALANCE  -------------->
        <---------------  AMOUNT <amt>
WITHDRAWL <amt>  -------------->  check if enough $ to cover withdrawal
        <---------------  ERR (not enough funds)
error msg displayed
no $ given out
BYE  -------------->
        <---------------  BYE

Problem 3.

a) We can $n$ connections between each of the four pairs of adjacent switches. This gives a maximum of $4n$ connections.
b) We can $n$ connections passing through the switch in the upper-right-hand corner and another $n$ connections passing through the switch in the lower-left-hand corner, giving a total of $2n$ connections.

Problem 5.
a) The time to transmit one packet onto a link is $(L + h)/R$. The time to deliver the packet over Q links is $Q(L + h)/R$. Thus the total latency is $t_s + Q(L + h)/R$.

b) $Q(L + 2h)/R$

c) Because there is no store-and-forward delays at the links, the total delay is $t_s + (h + L)/R$. 