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Disciplina de Redes de Computadores (CK0249)
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Lista de Exercícios da Unidade 3
Camada de Transporte

1) Consider two network entities: A and B, which are connected by a perfect bi-directional channel (that is, any message sent will be received correctly; the channel will not corrupt, lose, or re-order packets). A and B are to deliver data messages to each other in an alternating manner: first A must deliver a message to B, then B must deliver a message to A, then A must deliver a message to B, and so on. Draw a FSM specification for this protocol (one FSM for A and one FSM for B). Don't worry about a reliability mechanism here; the main point is to create a FSM specification that reflects the synchronized behavior of the two entities. You should use the following events and actions, which have the same meaning as protocol rdt1.0, shown on the text-book:

```
rdt_send(data), packet = make_pkt(data),
udt_send(packet), rdt_rcv(packet), extract (packet,data),
deliver_data(data).
```

Make sure that your protocol reflects the strict alternation of sending between A and B. Also, be sure to indicate the initial states for A and B in your FSM description.

2) Let's modify the protocol in Question 2: After receiving a data message from the other entity, an entity should send an explicit acknowledgement back to the other side. An entity should not send a new data item until after it (i) has received an ACK for its most recently sent message, (ii) has received a data message from the other entity, and (iii) ACKed that message received from the other entity. Draw the FSM specification for this modified protocol. You may use the new function that was introduced in protocol rdt2.0, shown on the textbook: `udt_send(ACK)`. You may want to use (but do not have to, depending on your solution) the following event as well: `rdt_rcv(rcvpkt) && isACK(rcvpkt)`, which indicates the receipt of an ACK packet (as in rdt2.0 in the textbook), and `rdt_rcv(rcvpkt) && is-DATA(rcvpkt)`, which indicates the receipt of a data packet.

3) Host A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 144. Suppose that Host A then sends two segments to Host B back-to-back. The first and second segments contain 20 and 40 bytes of data, respectively. In the first segment, the sequence number is 145, source port number is 303, and the destination port number is 80. Host B sends an acknowledgement whenever it receives a segment from Host A.

a) In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?

b) If the first segment arrives before the second segment, in the acknowledgement of the first arriving segment, what is the acknowledgment number, the source port number, and the destination port number?

c) If the second segment arrives before the first segment, in the acknowledgement of the first arriving segment, what is the acknowledgment number?

4) Host A and B are directly connected with a 100 Mbps link. There is one TCP connection between the two hosts, and Host A is sending an enormous file to Host B over this connection. Host A can send application data into the link at 50 Mbps but Host B can read out of its TCP receive buffer at a maximum rate of 10 Mbps. Describe the effect of TCP flow control.

5) Suppose that in TCP, the sender window is of size N, the base of the window is at sequence number x, and the sender has just sent a complete window's worth of segments. Let RTT be the sender-to-receiver-to-sender round-trip time, and let MSS be the segment size.

a) Is it possible that there are ACK segments in the receiver-to-sender channel for segments with sequence numbers lower than x? Justify your answer.

b) Assuming no loss, what is the throughput (in packets/sec) of the sender-to-receiver connection?

c) Suppose TCP is in its congestion avoidance phase. Assuming no loss, what is the window size after the N segments are ACKed?

Referências

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[2] TANENBAUM, A. S. e WETHERALL, D.; "Redes de Computadores"; 5.^{a} edição; 2011.

[3] STALLINGS, W.; "Data and Computer Communications"; 8.^{a} edição; 2007.