Computer Networks Principles

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Open book — Be concise and justify your answers

Duration: 2h

1 IP and Routing

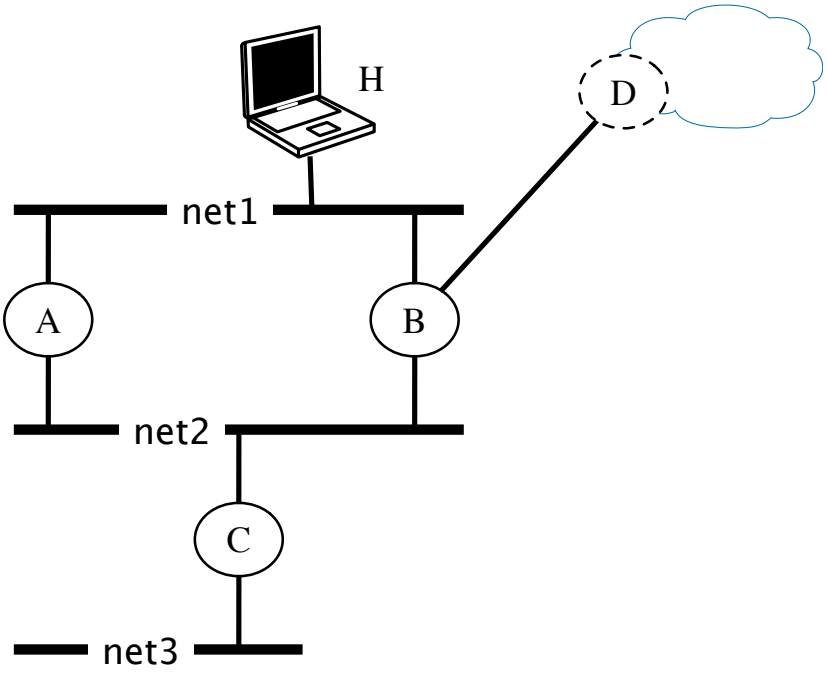

Figure 1: —

We consider the network in Figure 1. Our address range is defined by the prefix 10.1.0/21.

1.1) We neglect the link from B to D for now. Allocate Network addresses to net 1 to net 3, using the entire address range and allocating more addresses to net3 (2 points).

1.2) How many client would you be able to connect on net 2?

1.3) What is the broadcast address of net 3?

1.4) Propose adequate values for the addresses of H, A, B and C (2 points).

1.5) Assuming the addresses of D is 192.168.0.1, what should be the routing table of B?

1.6) Propose a routing table for H.

1.7) Make a time diagram of the packets exchanged (including ARP) if H sends a single ICMP echo-request packet towards an unused IP address in net3. Assume all ARP tables are empty etc. Please clearly represent all the recipients of each frame. (The host will retry 3 times an ARP request before it gives up.) (2 points)

2 Link layer

2.1) Assuming that net 2 is a single switch, is it possible that C receives a broadcast frame sent from B, whereas A does not? Make a time diagram (2 points)

2.2) What if it was a hub?

2.3) And if it was at least 2 switches connected with each other?

3 TCP

Figure 2 is the **incomplete** time diagram of a TCP exchange. B is an IP router and all links are full duplex. At time t_1, the congestion window `cwnd` of A is of size 3 MSS, and the last received acknowledgment allowed to send the x, y and z segments at that time. For the sake of simplicity, we will suppose that `cwnd` does not change over time. The receiver, C, sends an acknowledgment for **every other** segment correctly received. We also suppose that the `delayed ack` timer is large enough to not interfere. (You may draw directly on the figures – write your name on the sheet, then!)

3.1) Complete figure 2 for the emission of the next four segments (a, b, c, d)(and all they give rise to). Please indicate which successful packet reception each acknowledgement refers to. (2 points)

3.2) Complement figure 3 supposing that, at time t_1, A's congestion window is large enough to saturate link B-C. From your sketch, what is the minimal `cwnd` for saturating link B-C? (In this question, please to not assume that we use delayed ACKs.) (2 points)

3.3) If the `cwnd` is effectively larger than that, where do the packets go/stack up? And then, if the `cwnd` grows even bigger, what happens next? (2 points)

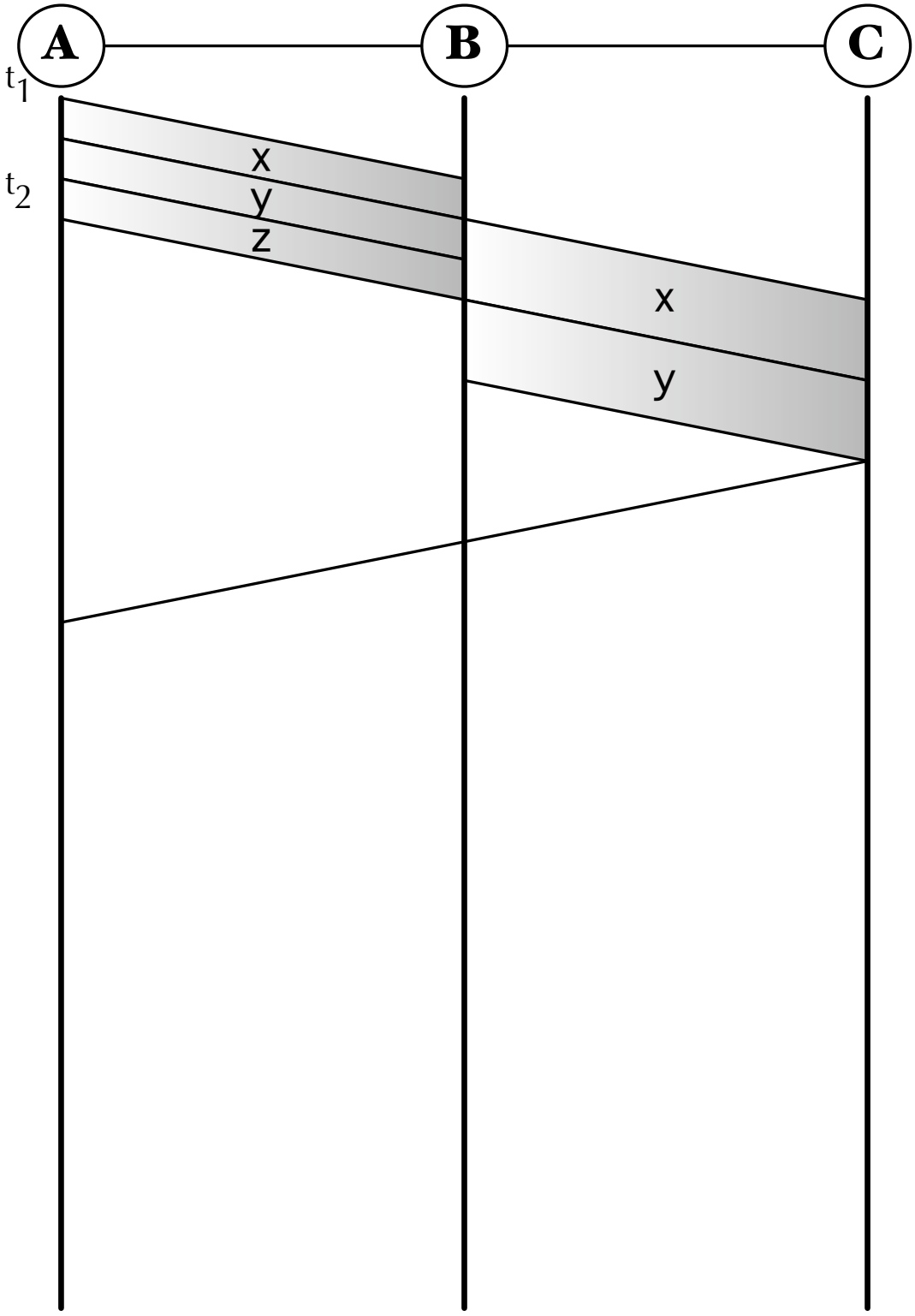

Figure 2: time diagram.

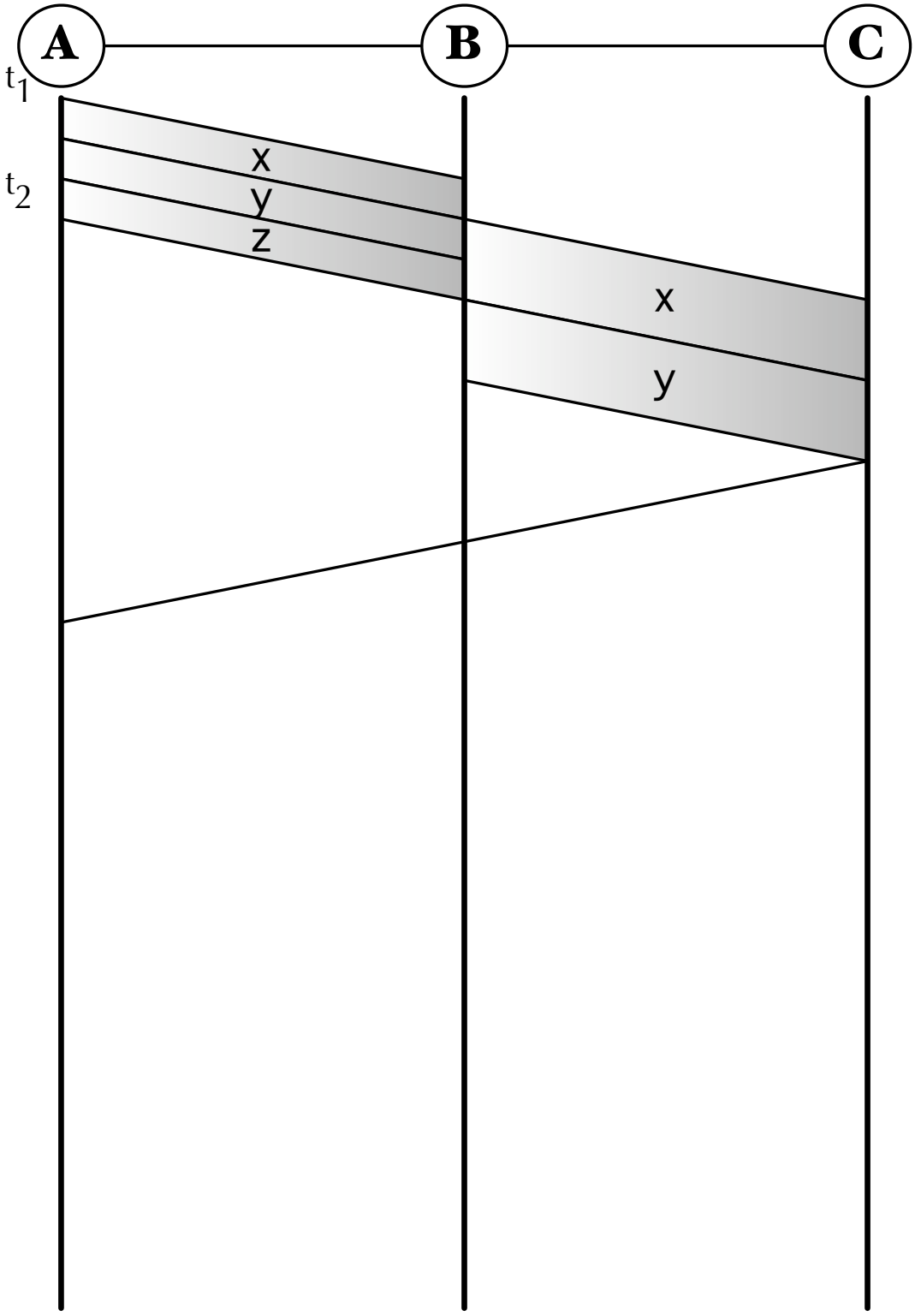

Figure 3: time diagram–Maximum utilization of link B-C.