EE384A Homework Assignment 1

Transparent Bridging

Due date: 1/19/1999

Question 1

Consider a shared-medium network segment of capacity *C* bits/second. Assume that the medium access protocol is perfect, i.e., it is such that the aggregate traffic from all stations in the segment can reach *C* bits/second. Assume that the traffic offered by the stations in the segment is *T* bits/second. In this scenario, the maximum value of *T* the network can support is obviously $T = C$. Now, assume that this network segment is partitioned into two segments with a transparent bridge, in such a way that half of the traffic is offered to each segment, as depicted in Figure 1. Assume that a fraction α traffic on each segment is destined to stations in the other segment ($0 \le \alpha \le 1$).

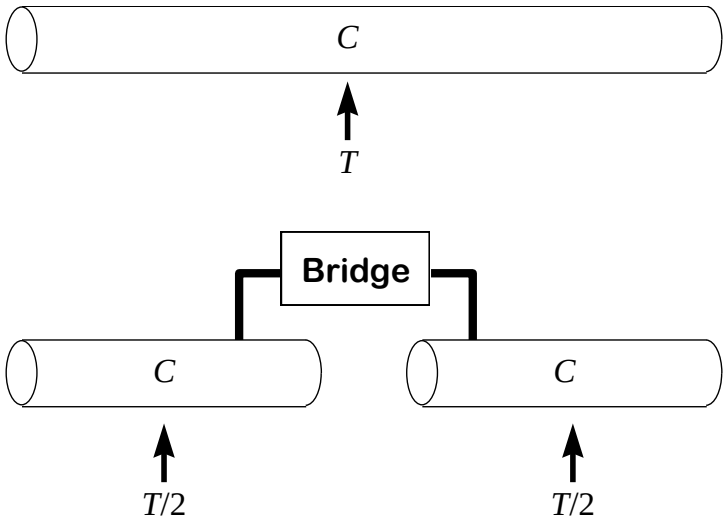

Figure 1

(a) Derive the maximum value of *T* as a function of *C* and α. Sketch a plot of maximum *T/C* as a function of α, for $0 \le \alpha \le 1$.
(b) Discuss the maximum value of *T* when $\alpha = 0$ and $\alpha = 1$.

Question 2.1

Figure 2 shows an extended LAN consisting of 7 LAN segments, s1 through s7, connected by 7 bridges, named B1 through B7. The ports on each bridge are also labeled. All bridges are transparent bridges following the IEEE 802.1d standard.

Consider that the network has just been deployed and that there are no active terminal stations yet. As you know, bridges exchange configuration BPDUs to configure themselves on a spanning tree. You are asked to explicitly show, as indicated in Figure 3, the relevant fields for all the BPDUs exchanged by the bridges. You are also asked to indicate the port status at each iteration. For the configuration BPDUs, the fields of interest are the Root Bridge ID, the Root Path Cost, the Transmitting Bridge, and the Port ID. For the port status, use RP for Root Port, DP for Designated Bridge for the Port, and B for Blocked. For simplicity in writing the solution, assume that all bridges are synchronized in their BPDU transmission and processing, i.e., in each iteration, all bridges exchange messages with their neighbors simultaneously, and then process the information simultaneously. If a port is not sending a BPDU at a particular iteration, just put a dash. Repeat until the spanning tree is found (you may want to reproduce Figure 3 for more iterations).

Finally, draw the spanning tree for the network.

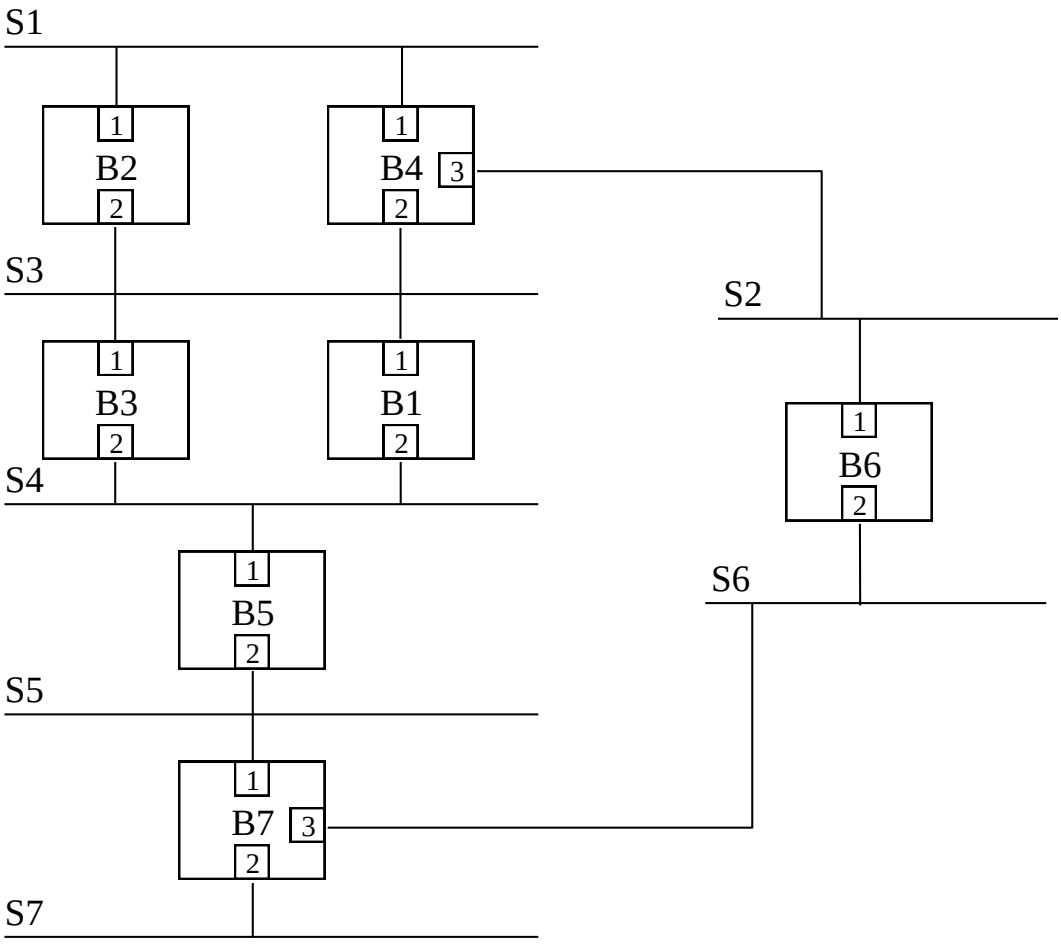

Figure 2

Figure 3: Configuration messages at first exchange of BPDUs

Bridge B1	Configuration BPDU <root bridge ID . root path cost . transmitting bridge ID . port ID>	Port State
Port 1 Port 2	B1.0.B1.1 B1.0.B1.2	Designated Port (DP) Designated Port (DP)

Bridge B2	Configuration BPDU <root bridge ID . root path cost . transmitting bridge ID . port ID>	Port State
Port 1 Port 2		

Bridge B3	Configuration BPDU <root bridge ID . root path cost . transmitting bridge ID . port ID>	Port State
Port 1 Port 2		

Bridge B4	Configuration BPDU <root bridge ID . root path cost . transmitting bridge ID . port ID>	Port State
Port 1 Port 2 Port 3		

Bridge B5	Configuration BPDU <root bridge ID . root path cost . transmitting bridge ID . port ID>	Port State
Port 1 Port 2		

Bridge B6	Configuration BPDU <root bridge ID . root path cost . transmitting bridge ID . port ID>	Port State
Port 1 Port 2		

Bridge B7	Configuration BPDU <root bridge ID . root path cost . transmitting bridge ID . port ID>	Port State
Port 1 Port 2 Port 3		

Question 2.2

Stations A, B, C and D are now added to the network as shown in Figure 4. We assume that the network configuration has stabilized and that each port that is not in the blocking state has by now entered the forwarding state.

(a) Consider now that station A sends a multicast packet. Show the forwarding database content (i.e., the station cache) in all 7 bridges as a result of A's transmission. Give the resulting number of packet transmissions in the entire network.

(b) Consider now that station B sends a series of packets to C and then C responds with one packet. Afterwards, station D sends a packet to station C. Show in Figure 6 the forwarding database contents in all bridges as a result of the above traffic activity.

For each packet transmitted, indicate the number of unnecessary packet transmissions undertaken due to the lack of knowledge about the destination station's location.

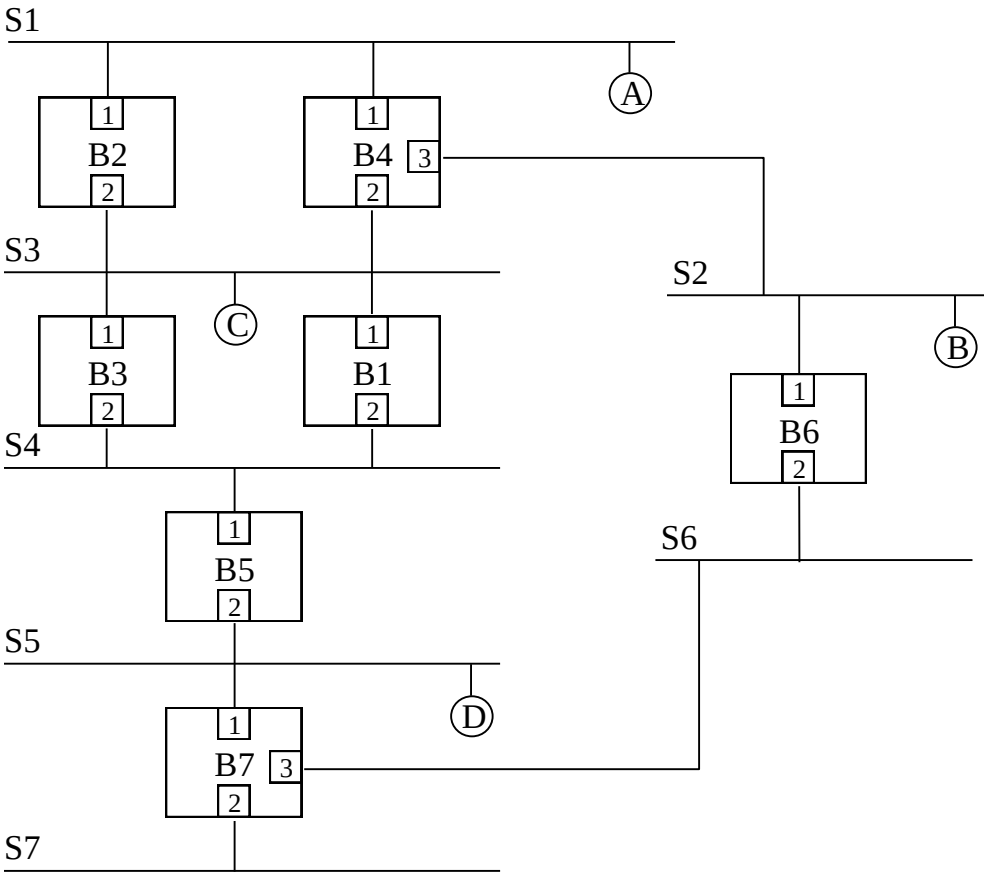

Figure 4: Added stations A, B, C and D

Bridge Number	Station Address	Port Number
B1		
B2		
B3		
B4		
B5		
B6		
B7		

Figure 5: Bridges' forwarding database for (a)

Bridge Number	Station Address	Port Number
B1		
B2		
B3		
B4		
B5		
B6		
B7		

Figure 6: Bridges' forwarding databases for (b)

Question 2.3

Assume that the original network is in its stable state, reached at the end of question 2.1, so that each port is either in the forwarding or in the blocking state. Ignore stations A, B, C and D for this question. A new bridge, with identification number B0, is added to the network between segments S1 and S7, as shown in Figure 7.

We assume that the transmission and processing of BPDUs are synchronized, as we did in question 2.1. Show in Figure 8 all the BPDUs exchanged between the bridges until the steady state is reached. It is assumed that steady state is reached in a period of time which is much less than the forward delay. As before, show the port state; remember to indicate whether the port is forwarding or listening, for designated ports and root ports. Show the topology at steady state, and indicate whether this topology is disconnected. Show any disconnections in Figure 7. Finally, show the spanning tree attained once the forward delay has elapsed and the listening ports go into the forwarding state.

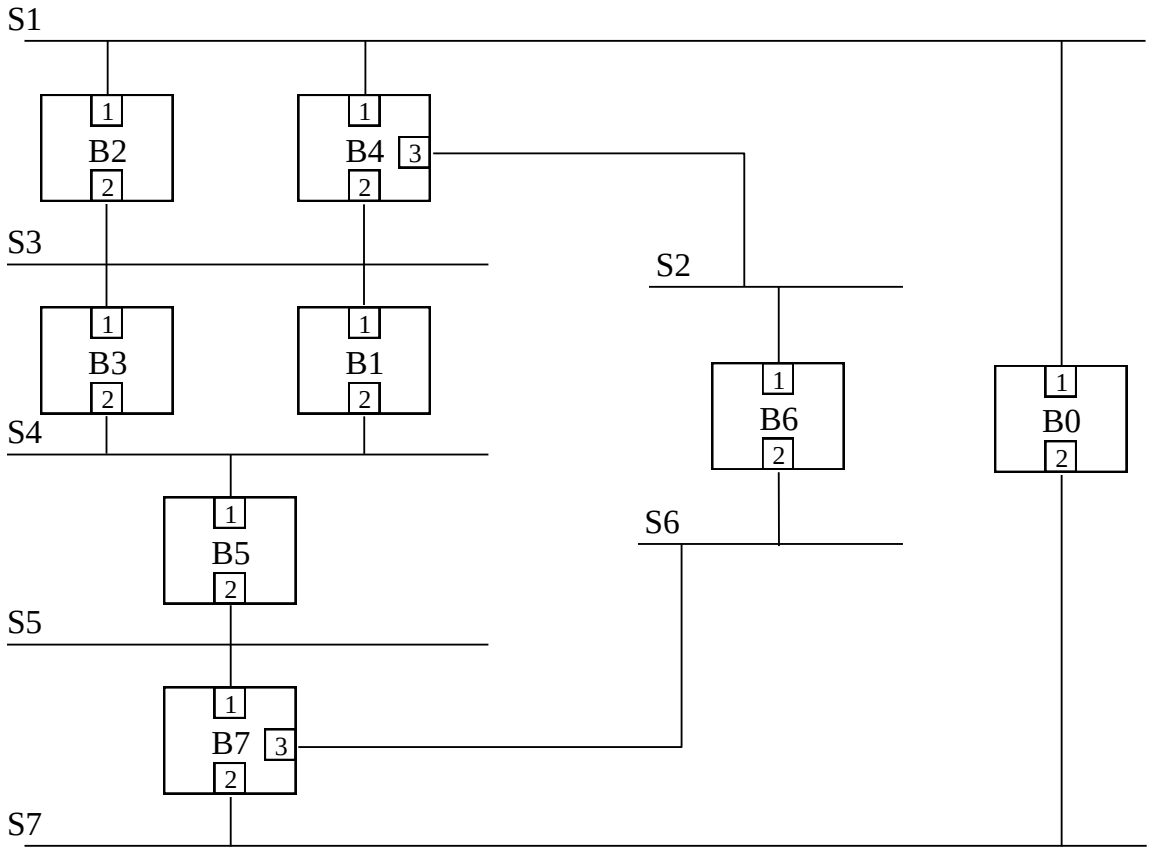

Figure 7: Adding a new bridge to the topology

Figure 8: Configuration messages at first exchange of BPDUs

Bridge B0	Configuration BPDU <root bridge ID . root path cost . transmitting bridge ID . port ID>	Port State
Port 1 Port 2		

Bridge B1	Configuration BPDU	Port State
Port 1 Port 2		

Bridge B2	Configuration BPDU	Port State
Port 1 Port 2		

Bridge B3	Configuration BPDU	Port State
Port 1 Port 2		

Bridge B4	Configuration BPDU	Port State
Port 1 Port 2 Port 3		

Bridge B5	Configuration BPDU	Port State
Port 1 Port 2		

Bridge B6	Configuration BPDU	Port State
Port 1 Port 2		

Bridge B7	Configuration BPDU	Port State
Port 1 Port 2 Port 3		