Solutions to Homework#2

1. The following table is cumulative; at each part the VCI tables consist of the entries at that part and also all previous entries.

Exercise part	Switch	Input		Output	
		Port	VCI	Port	VCI
(a)	1	2	0	1	0
	2	3	0	0	0
	3	0	0	3	0
(b)	1	3	0	1	1
	2	3	1	1	0
	4	3	0	1	0
(c)	2	2	0	0	1
	3	0	1	2	0
(d)	1	0	0	1	2
	2	3	2	0	2
	3	0	2	3	1
(e)	2	1	1	0	3
	3	0	3	1	0
	4	2	0	3	1
(f)	1	1	3	2	1
	2	1	2	3	3
	4	0	0	3	2

15. When A sends to C, all bridges see the packet and learn where A is. However, when C then sends to A, the packet is routed directly to A and B4 does not learn where C is. Similarly, when D sends to C, the packet is routed by B2 towards B1 only, and B1 does not learn where D is.

B1:	A-interface:	A	B2-interface:	C (not D)		
B2:	B1-interface:	A	B3-interface:	C	B4-interface:	D
B3:	B2-interface:	A,D	C-interface:	C		
B4:	B2-interface:	A (not C)	D-interface:	D		

17. (a) When X sends to Z the packet is forwarded on all links; all bridges learn where X is. Y's network interface would see this packet.

(b) When Z sends to X, all bridges already know where X is, so each bridge forwards the packet only on the link towards X, that is, B3→B2→B1→X. Since the packet traverses all bridges, all bridges learn where Z is. Y's network interface would not see the packet as B2 would only forward it on the B1 link.

(c) When Y sends to X, B2 would forward the packet to B1, which in turn forwards it to X. Bridges B2 and B1 thus learn where Y is. B3 and Z never see the packet.

(d) When Z sends to Y, B3 does not know where Y is, and so retransmits on all links; W's network interface would thus see the packet. When the packet arrives at B2, though, it is retransmitted only to Y (and not to B1) as B2 does know where Y is from step (c). All bridges already knew where Z was, from step (b).

21. (a) If the bridge forwards all spanning-tree messages, then the remaining bridges would see networks D,E,F,G,H as a single network. The tree produced would have B2 as root, and would disable the following links:

from B5 to A (the D side of B5 has a direct connection to B2)
from B7 to B
from B6 to either side

(b) If B1 simply drops the messages, then as far as the spanning-tree algorithm is concerned the five networks D-H have no direct connection, and in fact the entire extended LAN is partitioned into two disjoint pieces A-F and G-H. Neither piece has any redundancy alone, so the separate spanning trees that would be created would leave all links active. Since bridge B1 still presumably *is* forwarding other messages, all the original loops would still exist.

24. A 53-byte ATM cell has 5 bytes of headers, for an overhead of about 9.4% for ATM headers alone.

When a 512-byte packet is sent via AAL3/4, we first encapsulate it in a 520-byte CS-PDU. This is then segmented into eleven 44-byte pieces and one trailing 36-byte piece. These in turn are encapsulated into twelve ATM cells, each of which having 9 bytes of ATM+AAL3/4 headers. This comes to $9 \times 12 = 108$ bytes of header overhead, plus the 8 bytes added to the CS-PDU, plus $44 - 36 = 8$ bytes of padding for the last cell. The total overhead is 124 bytes,

which we could also have arrived at as $12 \times 53 - 512$; as a percentage this is 124/(512+124) = 19.5%.

When the packet is sent via AAL5, we first form the CS-PDU by appending 8 AAL5 trailer bytes, preceded by another 8 bytes of padding. We then segment into *eleven* cells, for a total overhead of $8 + 8 + 11 \times 5 = 71$ bytes, or 71/(512+71) = 12.1%.

39. (a) After the upgrade the server—switch link is the only congested link. For a busy Ethernet the contention interval is roughly proportional to the number of stations contending, and this has now been reduced to two. So performance should increase, but only slightly.

(b) Both token ring and a switch allow nominal 100% utilization of the bandwidth, so differences should be negligible. The only systemic difference might be that with the switch we no longer have ring latency to worry about, but for rings that are enclosed in hubs, this should be infinitesimal.

(c) A switch makes it impossible for a station to eavesdrop on traffic not addressed to it. On the other hand, switches tend to cost more than hubs, per port.