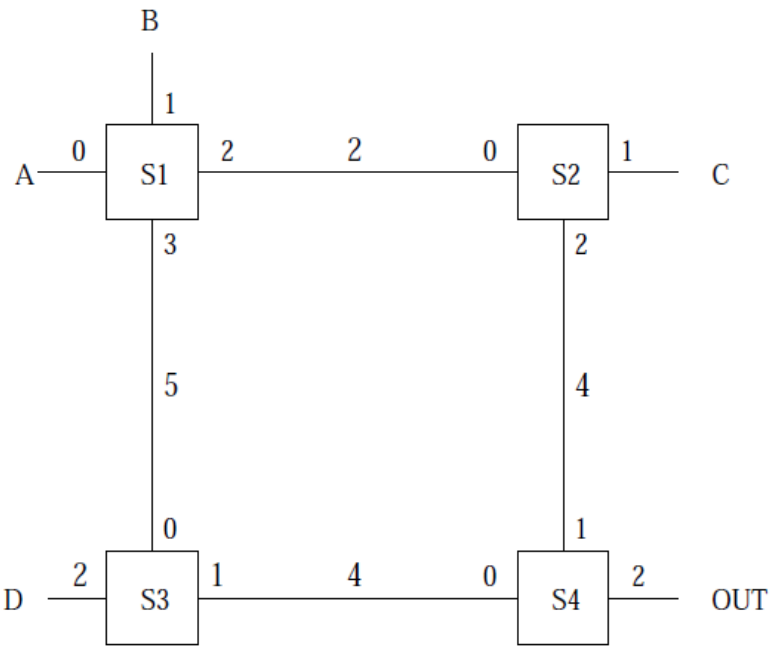
CS/ECE 438: Communication Networks for Computers Spring 2010
Problem Set 4 Due: start of class, Wednesday, March 12th.

Packet-Switched Networks

Assigned reading: Peterson and Davie: Chapter 3 – 4. All problems carry equal weight. Please show all your work.

1. Datagram Forwarding

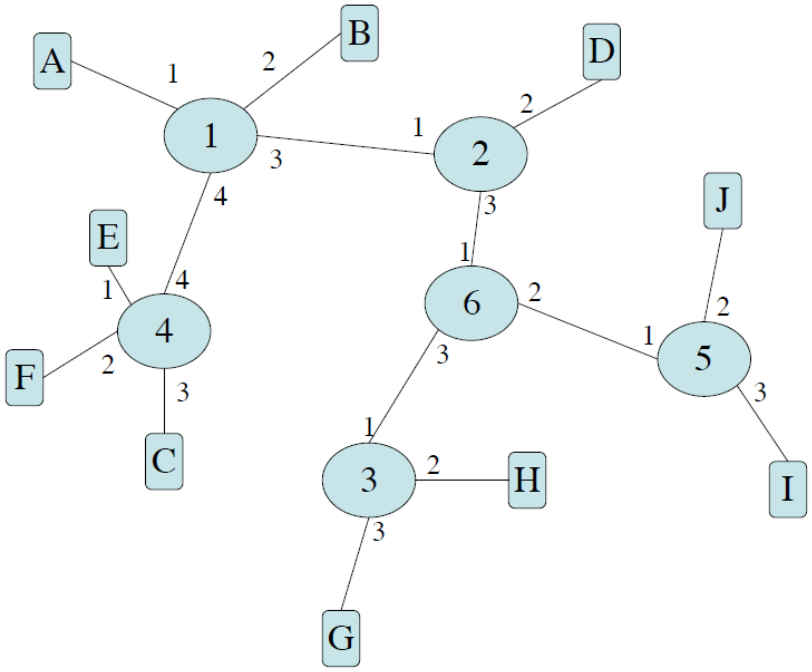
Consider the network shown.



Give the datagram routing tables for the switches S1-S4. Each switch should have a "default" routing entry which leads toward OUT. The links are labeled with relative costs; your tables should cause each packet to be forwarded along the lowest-cost path to its destination.

2. Virtual Circuits

Consider the network shown, where hosts A through J are connected by virtual circuit routers 1 through 6.

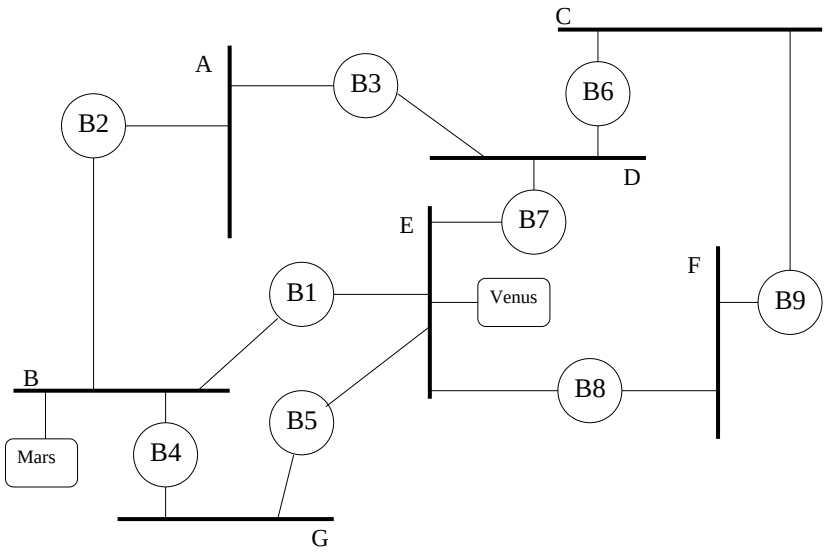


Assume that each VC may have a different VCID on each link, and VCIDs are assigned starting at 0 and using the next available ID. Suppose that there are virtual circuits established between: A → J, B → G, E → D, F → I, B → C, in that order.

a. Show the forwarding table at router number 6.
b. Suppose there is an additional virtual circuit formed from J to F. Show the virtual circuit IDs that a packet will use traveling along that virtual circuit.

3. Spanning Tree Algorithm for Intelligent Bridges

Suppose the Perlman spanning tree algorithm and the bridge learning algorithm for forwarding are used for the network shown below.



a. Indicate which bridge is root, which ports are root ports (i.e. the preferred port for reaching the root bridge), which bridge is the designated bridge for each LAN, and which ports are designated ports (i.e. the ports that connect some LAN to its given designated bridge). Hint: bridges that are not designated bridges for any LAN, and ports that are not either root ports or designated ports do not play a role in the routing of packets. The remaining bridges together with the LANs form a spanning tree.

b. Suppose after the configuration is complete, host Mars attaches to LAN B and host Venus attaches to LAN E. Suppose Mars sends a message to Venus, then Venus sends a message to Mars, then Mars sends a second message to Venus. For each of the three messages, indicate which LANs the message is heard on.

4. Performance of a Workstation as a Switch

Consider a workstation-based switch with an I/O bus speed of 1.2Gbps and a memory bandwidth of 4Gbps, using network adaptors with direct memory access (DMA).

a. Suppose there are N links going into the switch and N going out, with each link being a simplex 45 Mbps T3 link. How large can N be without exceeding the I/O bus speed or memory bandwidth?
b. Suppose the workstation switching speed is such that it can forward packets at the rate of 20,000 packets per second. Determine the switch throughput in bits per second as a function of the packet size. At what packet size does the bus bandwidth become the limiting factor?