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CSIS 202-1008

**Week 6 Homework**

**Review Questions:**

R1) A network-layer packet is called a datagram. The difference between a router and link-layer switch is that a router bases its forwarding on the value in the network-layer field whereas a link-layer switch bases its forwarding on the values in the fields of the link-layer frame.

R2) The two most important network-layer functions of a datagram network are that it uses a prefix to determine a packet’s interface in its forwarding table and that its forwarding table can be modified at any time. On the other hand, the key network-layer functions of a virtual-circuit network is that a connection state information is maintained, the forwarding table is only modified after a connection is made or removed and messages are passed between virtual-circuits with signaling protocols.

R3) Routing involves all of a network’s routers to determine paths for packets from the source to destination whereas, forwarding is the transfer of a packet from an incoming link to an outgoing link within a single router.

R4) Both datagram and virtual circuit networks use forwarding tables with the difference between them being that a datagram network uses a link interface in which it uses the longest prefix matching rule to determine the link interface for a packet and he forwarding table can be modified at any time. Virtual-circuit networks use virtual circuit numbers tied to each packet to determine the incoming and outgoing interface and its forwarding table can only be modified when a connection is made or removed.

R5) A network layer can provide services such as in-order delivery (ATM CBR or ABR), guaranteed delivery (ATM CBR), constant speeds (ATM CBR), maximum speeds (ATM ABR), security for files.

R6) Services that would benefit from an ATM CBR service model include: media streaming, video conferencing, skype, screen sharing.

R7) Each input port stores a shadow copy of the forwarding table as deciding forwarding points can be done locally allowing packets to be moved faster. In a router, packets have to be directed by the Nano-second and thus software is to slow and hardware level forwarding is necessary.

R8) Switching via memory: The simplest form of switching that was handled via the CPU that stored an arriving packet into the CPU’s memory where it extracted a destination which it used to direct the packet to its proper output port. Its forwarding throughput was limited to (# packets per second) / 2.

Switching via a bus: In this form of switching input and output ports are directly tied together via a shared bus in which the input port sends packets directly to the output port. This results in the input port sending its packet to all output ports and the correct output port actually accepting the packet.

Switching via an interconnection network: This form of switching uses crossbars (where each vertical and horizontal bus meet) to send packets. It requires 2N buses connecting N input ports and N output ports. As a result, it can also send multiple packets at once as long as two input ports aren’t trying to send to the same output port. Thus this form is the only one able to send multiple packets in parallel.

R9) Packet loss can occur in the input port when the switch fabric speed is not fast enough or there is too small of a buffer to hold the incoming packets. Creating a buffer that is the size of the Round Trip Time times the link capacity (RTT \* C) will prevent packet loss without needing an infinite buffer size.

R10) Packet loss can occur in the output port when one or more input ports are moving files into the switch fabric faster than the output port can send packets. This can most commonly occur when there are more than one input ports trying to send packets through a single output port. Increasing the switch fabric speed would only make the packet loss more prevalent as files will be transferred from the inputs ports to the output port at a higher rate, causing further congestion.

R11) HOL blocking or head-of-the-line blocking occurs in the input port and occurs when a packet in an input queue must wait to be transferred due to another packet in the queue ahead of it waiting to be transferred. The packet may be cleared to be transferred already, but if the packet ahead of it hasn’t gone it cannot.

R12) Routers don’t have their own IP addresses, but rather their interfaces do. Each interface has an IP address for each host the router is connected to.

R13) IP address 223.1.3.27 to Binary is 11011111 00000001 00000011 00011011

R14) IP Address: 192.168.1.1

Network Mask: 255.255.255.0

Default Gateway: 192.168.1.1

IP Address of local DNS Server: 192.168.1.1

R15) An IP datagram moving from a source host to a destination host and passes through 3 routers, it will travel over 8 interfaces and during this time, 3 forwarding tables will be indexed.

R16) 100% of the datagram will be overhead as the IP payload and TCP header each use 20 bytes and the datagram is only 40 bytes.

R17) Host B will understand whether to send the segment through TCP or UDP by searching the datagram’s header’s protocol field to see if it contains a value of 6 (TCP) or 17 (UDP).

R18) The five PCs in the home network get their IP addresses assigned to them the same way the router does, through DHCP. Furthermore, the router does use NAT as each of the individual IP addresses of the five PCs are most likely used somewhere else in the world and thus having a NAT would allow them to contain their own individual IP addresses.

R19) Differences between the IPv4 and IPv6 header fields include the removal of header length, change of TOS field to the new Traffic Class field, datagram length being changed to Payload length with a fixed 40-byte datagram header, a Next header that identifies the protocol to use, a Hop limit, new 128 bit (instead of 32 bit) source and destination addresses, and a Flow label. Fragmentation and reassembly are removed as well as the header checksum.

R20) When IPv6 tunnels through IPv4 routers it could be thought of that IPv6 is treating the tunnel as a link-layer protocol in the sense that the tunnel is acting as a layer to transfer data between two IPv6 nodes.

**Practice Problems:**

P1) a) If routers were to fail often, a datagram network would be favored as in a datagram network only a source host and destination host are needed. With a datagram network the source puts a destination in the packet and sends it into the network whereas, a VC requires a specified path with checks.

b) If a fixed capacity was required for a source to send to a destination a VC network would be favored. In a VC network each router along the path are aware of each other and could be reserved to only send the packets from the source to destination.

c) In a scenario where routers and links never fail and the routing paths remain constant, a VC network would provide more traffic control overhead as it can maintain a connection between routers between a destination and source and each router knows the path being taken. Furthermore, signaling messages are sent between the routers to maintain their status.

P6) The reason for the subtlety in terminology when referring to a network-layer service as a *connection service* is due to the fact that a connection service deals directly with the connection between networks. On the other hand, the term *connection-orientated service* is used when describing a transport-layer service because it deals with the connection between hosts within a network, but not the network connection itself.

P18) IP address blocks and location for:

CSU San Bernardino – 48; San Bernardino, CA; 92407, within 10mi

CSU San Marcos – 16; San Marcos, CA; 92069, within 20mi

CSU Long Beach – 16; Long Beach, CA; 90803, within 20mi

Whois services alone cannot determine the geographical location of a specific IP address as they can only provide as much information as is provided (City, Title of search group, etc.), however with the aid of other sites such as Maxmind, the IP addresses found using Whois services can provide a geographical location of a specific IP address.