**CS 204: Computer Networks**

**Assignment**

**1. Define Virtual circuit and datagram switching. Compare Virtual circuit network with datagram network. Is Virtual circuit same as Physical connection. Comment.**

**Ans)** A virtual-circuit network is normally implemented in the data link layer, while a circuit-Switched network is implemented in the physical layer and a datagram network in the network layer.

A datagram network is analogous to sending a message as a series of postcards through the postal system. Each card is independently sent to the final destination( using the postal system ).To receive the whole message, the receiver must collect all the pstcards and sort them into the original order.

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| **Virtual Circuits** | **Datagram Network** |
| a)It is connection oriented simply meaning that there is a reservation of resources like buffers, CPU, bandwidth, etc. For the time in whick the newly setup VC is going to be used by a data transfer session | a)It is connectionless service. There is no need for reservation of resources as there is no dedicated path for a connection session |
| b)First packet goes and reserves resources for the subsequent packets which as a result follow the same oath for the whole connection time. | b)All packets are free to go to any path on any intermediate router which is dedicated on the go by dynamically changing routing tables on routers. |
| c)Since all the packets are going to follow the same path, a global header is required only for the first packet of the connection and othet packets generally dont require global headers. | c)Since every packet is free to choose any path, all packets must be associated with a header with proper information about the source and the upper layer data. |
| d)Since data follows a particular dedicated path, packets reach inorder to the destination. | d)The connectionless property makes data packets reach the destination in any order, means they need not reach in the order in which they were sent. |
| e)From the above points, it can be concluded that Virtual Circuits are highly reliable means of transfer. | e)The major drawback of Datagram packet Switching is if the buffer, CPU, and bandwidth are available then the only packet will be forwarded. Otherwise, Packet will discard. |
| f)It is used by the ATM( Asynchronous Transfer Mode ) Network,which is used for the telephone calls. | f)It is generally used the IP network, which is used for Data services like internet. |

Virtual circuit switching is a packet switching methodology where by a path is estavlished between the source and the final destination through which all the packets will be routed during a call. This path is called a Virtual circuit because to the user, the connection appears to be a dedicated physical circuit.

**2.In the context of Network Layer, what is Logical address and Physical address in computer networks? Why a mapping from logical address to physical address and vice versa is required? Explain the protocols which perform it.**

**Ans)**Logical Address of something generated by the central processing unit while a program is running is referred to as a Logical Address. The address is also referres to a virtual address. This is because it is used as a guideline for the architecture to understand where other things are positioned as it does not stay in the system hence variable.

A program that helps in finding the base address is required by the computer in order to find other locations within the system hence the logical address.

Physical Address is used to identify a physical location within the memory management unit which computes accordingto the correlating logical address. This address is not directly accessible or viewed by the user program hence a logical address needs to be mapped to it make it accessible with the aid of pointers which reveal location but not the code. Sets of all corresponding physical address existing within the logical address are called physical addrss space.

Address binding is the process of mapping fron one address space to another address space. Logical address is address generated by CPU during execution whereas physical address refers to location in memory unit ( the one that is located into memory ). note that user deals with only logical address( Virtual Address). The logical address undergoes translation by the MMU or address translation unit in particular. The output of this process is the appropriate physical address or the location of code/data in RAM.

The ARP protocol is a netework specific standard protocol. Its status is elective. The address resolution protocol is responsible for converting the higher level protocol addresses( IP addresses ) to physical network addresses.

1. **Discuss the various scenarios, where UDP is preferred to TCP.**

**Ans)**The User Datagram Protocol ( UDP ) is a transport layer protocol for use with the IP network layer protocol. It provides a best effort datagram service to an end system. UDP provides no guarantee for delivery and no protectino from duplication, but the simplicity of UDP reduces overhead from the protocol and can be adequate for some applications.

A computer may send UDP packets without first establishing a connection to a recipient. The computer completes the appropriate fields in the UDP header( PCI ) and forwards the data together with the header for transmission by the IP network layer.

Typically use UDP in applications where speed is more critical that reliability. For example, it may be better to use UDP in an application sending data from a fast acquisition where it is acceptable to lose some data points. You can also use UDP tp broadcast to any machines listening to the server.

1. **Two IITs located in different cities wish to have a jam session over a communications network.Find the maximum possible distance between the IITs if they are to interact in real-time, in the sense of experiencing the same delay in hearing each other as if they were 10 meters apart. The speed of sound is approximately 330 meters/second. Assume that the network transmits the sound at the speed of light in cable, 2.3 x 108 meters/second.**

**Ans)**The first step is to find the delay for the sound when the musicians are 10 meters apart:

t10 = 10/330 = 30.30 milliseconds

The maximum distance is the time required for a real-time experience times the cable speed: d = ( 2.3 x 100000000) x ( 30.30 x 1/1000) = 6,969 kilometers.

1. **In the 1950s, standard containers were developed for the transportation of goods. These standard containers could fit on a train car, on a truck, or in specially designed container ships. The standard size of the containers makes it possible to load and unload them much more quickly than using non-standard containers of different sizes. Draw an analogy to packet switching communications networks. In your answer identify what might constitute a container and speculate on the advantages that may come from standard-size information containers.**

**Ans)**In a packet-switching communications network, the component that is analogous to the container is a constant-sized packet( preferably of short length ) that can be used for the transport of information. Transmission systems and networks of various types can be designed to transfer information of given standardized size, much like trucks, trains, and shipps can be designed to carry standard containers. Packing and unpacking of fixed-sized units is simpler than packing and unpacking of variable-length units. Consequently, it is simpler to schedule the transfer of packets acress switches that use constantsize packets than across switches that make use of variable-length packets.

1. **Suppose that an interactive video game is accessed over a communication network. What requirements are imposed on the network if the network is connection-oriented? What if the network is connectionless?**

**Ans)**We suppose that the game involves the interaction between a player and a server across a network. To support an interactive video gamer over a communication network, whether connection-oriented or connectionless, must provide rea-time delivery of the players commands to the server, and of the servers responses to the player. With a connection oriented network, connections between player and the server transfer the sequence of commands and responces throughout the game with very little delat. In a connectionless network, user commands may be delivered to the other end with variable delay, out of sequence, or not at all. The users network software is responsible for ensuring the ordered and corect deliverey of game commands. In time delivery of commands cannot be assured.

1. **Explain why it is useful for application layer programs to have a "well-known" TCP port number?**

**Ans)**The well-known port numbers are the port numbers that are reserved for assignment by the Internet Corporation For Assigned Names and Numbers ( ICANN ) for use by the application end points that communicate using the Internet’s Transmission Control Protocol ( TCP ) or the User Datagram Protocol ( UDP ). Each kind of application has a designated port number.

The well known ports cover the range of possible port numbers from 0 to 1023. The registered ports are numbered from 1024 through 49151. The remaining ports, reffered to as dynamic ports or private ports, are numbered from 49152 through 65535.

On most systems, a well-known port number can only be used by a system process or by a program run by a privileged user. Before the arrival of ICANN the well-known port numbers were administered by the internet Assigned Numbers Authority( IANA ).

1. **What advantage does a circuit-switched network have over a packet-switched network? What advantages does TDM have over FDM in a circuit-switched network?**

**Ans)**Packet switching network is not suitable for real time services. In circuit switched network it can give end to end bandwidth during a call. In the packet switched network it cannot guarantee any end to end bandwidth. In circuit switched network Quality of service( Qos ) is guaranteed while in packet switched network it is not guaranteed and packet switched network might have delay and time insensitive.

Time division multiplexing ( TDM ) has an advantage over frequency division multiplexing ( FDM ) as it gives bandwidth saving and there is low interference between multiplexed signals.

1. **Suppose end system A wants to send a large file to end system B. At a very high level, describe how end system A creates packets from the file. When one of these packets arrives to a router, what information in the packet does the router use to determine the link onto which the packet is forwarded? Why is packet switching in the Internet analogous to driving from one city to another and asking directions along the way?**

**Ans)**At first System A breaks larger files into smalll fragments known as chunks. Then it adds header for each chunk so as to make each chunk appears like different packets to each other. Header file in chunks contain IP address of receiver of system B. Switch system uses IP present in header to determine link to the destination host.

1. **Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer:**
2. **Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?**
3. **Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?**

**Ans)**Circuit switched network would be more appropriate. Because the data is transmitted at a steady rate. In circuit switched network the packets are sent in a particular path with some delay.

Congestion control is not needed. Because there is no congestion occurring as the packets go through various paths.

**11. Consider a router buffer preceding an outbound link. In this problem, you will use Little’s formula, a famous formula from queuing theory. Let N denote the average number of packets in the buffer plus the packet being transmitted. Let a denote the rate of packets arriving at the link. Let d denote the average total delay (i.e., the queuing delay plus the transmission delay) experienced by a packet. Little’s formula is N = a.d). Suppose that on average, the buffer contains 10 packets, and the average packet queuing delay is 10 msec. The link’s transmission rate is 100 packets/sec. Using Little’s formula, what is the average packet arrival rate, assuming there is no packet loss?**

**Ans)**N = a\*d a = N/d

Average number of packets N = 10

a = l = 100 packet/sec d = l + q = 0.02sec q = 10msec = 0.01sec

a = 10 packets/0.02 = 500 packets/sec

1. **When a file is transferred between two computers, two acknowledgement strategies are possible. In the first one, the file is chopped up into packets, which are individually acknowledged by the receiver, but the file transfer as a whole is not acknowledged. In the second one, the packets are not acknowledged individually, but the entire file is acknowledged when it arrives. Discuss these two approaches.**

**Ans)**If the network tends to lose packets, it is better to acknowledge each one separately, so the lost packets can be transmitted. On the other hand, if the network is highly reliable, sending one acknowledgement at the end of the entire transfer saves bandwidth in the normal case( but the entire file to be retransmitted if even a single packet is lost.)

1. **A process on host 1 has been assigned port p, and a process on host 2 has been assigned port**

**q. Is it possible for there to be two or more TCP connections between these two ports at the same time?**

**Ans)**No. A connection is identified only by its sockets. Thus, ( 1, p ) - ( 2, q ) is the only possible connection between those two ports.

**14. Consider the following figure. Assume that we know the bottleneck link along the path from the server to the client is the first link with rate Rs bits/sec. Suppose we send a pair of packets back to back from the server to the client, and there is no other traffic on this path. Assume each packet of size L bits, and both links have the same propagation delay dprop.**

1. **What is the packet inter-arrival time at the destination? That is, how much time elapses from when the last bit of the first packet arrives until the last bit of the second packet arrives?**
2. **Now assume that the second link is the bottleneck link (i.e., Rc < Rs). Is it possible that the second packet queues at the input queue of the second link? Explain. Now suppose that the server sends the second packet T seconds after sending the first packet. How large must T be to ensure no queuing before the second link? Explain.**

**Ans)**Size of packet = L bits

Rate at which the firstlink transfers = RS bits/sec Let the packet be a1 and a2.

The time taken for packet a1 to reach( t1 ) = L/RS + d prop.

The time taken for packet a2 to reach( t2 ) = L/RS + L/RS + d prop

The inner – arrival time = t2 – t1

= L/RS.

b)Let packet a1 is transmitted at time = 0

Time taken for packet a1 to reach the destination ( t1 ) = L/RS + L/RC + d prop

Time taken for packet a2 to reach the destination ( t2 ) = L/RS + L/RC + d prop

Given that RC < RS

=> L/RC < L/RC and t2 < t1

Let T be the time to wait for second packet to be sent after sending first packet.

T2 = T + L/RS + L/RS + d prop as we know queuing should not occur

t2 >= t1

T + L/RS + L/RS + d prop >= L/RS + L/RC + d prop

T >+ L/RC - L/RS