Department:	Electronics and Communication Engineering	Date:	
Level:	5	Day:	
Semester:	Frist	Time allowed:	1.5 h
Subject:	Communication Networks	Full marks:	20 marks
Subject Code:	CEE503	No of pages:	1

ANSWER MODEL

Question1 (10 marks)

1) Task of data transfer is broken up into some modules

— Why?

— How do these modules interact?

Answer to Why? – Same reason as dividing a big program into smaller functions. It is difficult to attack big problems as a whole.

Answer to interaction question? – Modules have a layered structure. Each layer (module) provides service to upper layer and expects service from lower layer.

2) LAN connections can only operate in a local area which is usually not any bigger then a house, or a floor in an office building. Typically a LAN will consist of only a handful of clients, but can have upwards of a hundred.One of the major advantages with LANs are the speeds they can reach. With a LAN, it isn't uncommon to see technology ready for 1Gbps (1 gigabit per second). **Example:** If you were to download all 3 816 000 English articles off of Wikipedia it would take just over 13 hours to do so, where as a WAN would take 16 days to do the same. A LAN can operate up to 30x faster then a WAN. Another advantage to having a LAN connection is the cost. It is relatively cheap to have as it tends to require less hassle to set up and less advanced infrastructure to keep it running. This is mainly due to the technological components of a LAN, which brings me to the next difference.

3) Suppose a computer is moved from one department to another. Does the physical address need to change? Does the IP address need to change?

Does it make a difference if the computer is a laptop? **[3 marks – 1 for each question]**

Solution:

The physical address does not change (1). It is globally unique to the computer's NIC card.

The IP address may need to be changed (1) to reflect a new subnetwork id and host id.

The situation is the same for laptops.(1)

<u>Question2 (10marks):</u>

1) Suppose an application layer entity wants to send an L-byte message to its peer process, using an existing TCP connection. The TCP segment consists of the message plus 20 bytes of header. The segment is encapsulated into an IP packet that has an additional 20 bytes of header. The IP packet in turn goes inside an Ethernet frame that has 18 bytes of header and trailer. What percentage of the transmitted bits in the physical layer correspond to message information, if L = 100 bytes, 500 bytes, 1000 bytes? **[3 marks – 1 mark each]**

Solution:

TCP/IP over Ethernet allows data frames with a payload size up to 1460 bytes. Therefore, L = 100, 500 and 1000 bytes are within this limit.

The message overhead includes:

- TCP: 20 bytes of header
- IP: 20 bytes of header
- Ethernet: total 18 bytes of header and trailer.

Therefore

L = 100 bytes, 100/158 = 63% efficiency (1).

L = 500 bytes, 500/558 = 90% efficiency (1).

L = 1000 bytes, 1000/1058 = 95% efficiency (1).

The Open Systems Interconnect (OSI) model has seven layers. This article describes and explains them, beginning with the 'lowest' in the hierarchy (the physical) and proceeding to the 'highest' (the application). The layers are stacked this way:

- Application
- Presentation
- Session
- Transport
- Network
- Data Link
- Physical

PHYSICAL LAYER

The physical layer, the lowest layer of the OSI model, is concerned with the transmission and reception of the unstructured raw bit stream over a physical medium. It describes the electrical/optical, mechanical, and functional interfaces to the physical medium, and carries the signals for all of the higher layers. It provides:

- Data encoding: modifies the simple digital signal pattern (1s and 0s) used by the PC to better accommodate the characteristics of the physical medium, and to aid in bit and frame synchronization. It determines:
  - What signal state represents a binary 1
  - How the receiving station knows when a "bit-time" starts
  - How the receiving station delimits a frame

- Physical medium attachment, accommodating various possibilities in the medium:

  - Will an external transceiver (MAU) be used to connect to the medium?
  - How many pins do the connectors have and what is each pin used for?
- Transmission technique: determines whether the encoded bits will be transmitted by baseband (digital) or broadband (analog) signaling.
- Physical medium transmission: transmits bits as electrical or optical signals appropriate for the physical medium, and determines:

  - What physical medium options can be used
  - How many volts/db should be used to represent a given signal state, using a given physical medium

DATA LINK LAYER

The data link layer provides error-free transfer of data frames from one node to another over the physical layer, allowing layers above it to assume virtually error-free transmission over the link. To do this, the data link layer provides:

- Link establishment and termination: establishes and terminates the logical link between two nodes.
- Frame traffic control: tells the transmitting node to "back-off" when no frame buffers are available.
- Frame sequencing: transmits/receives frames sequentially.
- Frame acknowledgment: provides/expects frame acknowledgments. Detects and recovers from errors that occur in the physical layer by retransmitting non-acknowledged frames and handling duplicate frame receipt.
- Frame delimiting: creates and recognizes frame boundaries.

- Frame error checking: checks received frames for integrity.
- Media access management: determines when the node "has the right" to use the physical medium.

NETWORK LAYER

The network layer controls the operation of the subnet, deciding which physical path the data should take based on network conditions, priority of service, and other factors. It provides:

- Routing: routes frames among networks.
- Subnet traffic control: routers (network layer intermediate systems) can instruct a sending station to "throttle back" its frame transmission when the router's buffer fills up.
- Frame fragmentation: if it determines that a downstream router's maximum transmission unit (MTU) size is less than the frame size, a router can fragment a frame for transmission and re-assembly at the destination station.
- Logical-physical address mapping: translates logical addresses, or names, into physical addresses.
- Subnet usage accounting: has accounting functions to keep track of frames forwarded by subnet intermediate systems, to produce billing information.

Communications Subnet

The network layer software must build headers so that the network layer software residing in the subnet intermediate systems can recognize them and use them to route data to the destination address.

This layer relieves the upper layers of the need to know anything about the data transmission and intermediate switching technologies used to connect systems. It establishes, maintains and terminates connections across the intervening communications facility (one or several intermediate systems in the communication subnet).

In the network layer and the layers below, peer protocols exist between a node and its immediate neighbor, but the neighbor may be a node through which data is routed, not the destination station. The source and destination stations may be separated by many intermediate systems.

TRANSPORT LAYER

The transport layer ensures that messages are delivered error-free, in sequence, and with no losses or duplications. It relieves the higher layer protocols from any concern with the transfer of data between them and their peers.

The size and complexity of a transport protocol depends on the type of service it can get from the network layer. For a reliable network layer with virtual circuit capability, a minimal transport layer is required. If the network layer is unreliable and/or only supports datagrams, the transport protocol should include extensive error detection and recovery.

The transport layer provides:

- Message segmentation: accepts a message from the (session) layer above it, splits the message into smaller units (if not already small enough), and passes the smaller units down to the network layer. The transport layer at the destination station reassembles the message.
- Message acknowledgment: provides reliable end-to-end message delivery with acknowledgments.

- Message traffic control: tells the transmitting station to "back-off" when no message buffers are available.
- Session multiplexing: multiplexes several message streams, or sessions onto one logical link and keeps track of which messages belong to which sessions (see session layer).

Typically, the transport layer can accept relatively large messages, but there are strict message size limits imposed by the network (or lower) layer. Consequently, the transport layer must break up the messages into smaller units, or frames, prepending a header to each frame.

The transport layer header information must then include control information, such as message start and message end flags, to enable the transport layer on the other end to recognize message boundaries. In addition, if the lower layers do not maintain sequence, the transport header must contain sequence information to enable the transport layer on the receiving end to get the pieces back together in the right order before handing the received message up to the layer above.

End-to-end layers

Unlike the lower "subnet" layers whose protocol is between immediately adjacent nodes, the transport layer and the layers above are true "source to destination" or end-to-end layers, and are not concerned with the details of the underlying communications facility. Transport layer software (and software above it) on the source station carries on a conversation with similar software on the destination station by using message headers and control messages.

SESSION LAYER

The session layer allows session establishment between processes running on different stations. It provides:

- Session establishment, maintenance and termination: allows two application processes on different machines to establish, use and terminate a connection, called a session.
- Session support: performs the functions that allow these processes to communicate over the network, performing security, name recognition, logging, and so on.

PRESENTATION LAYER

The presentation layer formats the data to be presented to the application layer. It can be viewed as the translator for the network. This layer may translate data from a format used by the application layer into a common format at the sending station, then translate the common format to a format known to the application layer at the receiving station.

The presentation layer provides:

- Character code translation: for example, ASCII to EBCDIC.
- Data conversion: bit order, CR-CR/LF, integer-floating point, and so on.
- Data compression: reduces the number of bits that need to be transmitted on the network.
- Data encryption: encrypt data for security purposes. For example, password encryption.

APPLICATION LAYER

The application layer serves as the window for users and application processes to access network services. This layer contains a variety of

commonly needed functions

- Resource sharing and device redirection
- Remote file access

- Remote printer access
- Inter-process communication
- Network management
- Directory services
- Electronic messaging (such as mail)
- Network virtual terminals