

DIGITAL SWITCHING TELECOMMUNICATION

FINAL EXAMINATION

TIME ALLOCATION: 3 HOURS

INSTRUCTION TO STUDENTS: ATTEMPT ALL QUESTIONS

1. In switching systems, there are THREE types of communication transmission modes. State and explain them briefly. (5 Marks)
 - i. **Simplex:** this is one-way communication. A good example is the radio.
 - ii. **Half duplex:** This is two-way communication shared by a single channel. A good example is the walkie talkie.
 - iii. **Full duplex:** This is two-way communication simultaneously. A good example is the telephone.

2. In software architecture, there are two categories; System software and application software. Briefly define them mentioning examples. (5 Marks)

System Software is a set of programs that control and manage the operations of computer hardware. It also helps application programs to execute correctly. System Software are designed to control the operation and extend the processing functionalities of a computer system. System software makes the operation of a computer more fast, effective, and secure. Examples include: Operating systems such as windows, Linux, etc. **Application Software** is a program that does real work for the user but can only run after the system software has been installed and is running. It is mostly created to perform a specific task for a user. It is also known as an application package. This type of software is written using a high-level language like C, Java, etc. It is a user-specific and is designed to meet the requirements of the user. You can also install multiple Application Software on a single System Software. Example: Word-processing, Spreadsheet, Database, etc.

3. Define the following terms as they have been used in digital switching telecommunication. (10 Marks)
 - i. ISDN - ISDN or Integrated Services Digital Network is a circuit-switched telephone network system that transmits both data and voice over a digital line.

You can also think of it as a set of communication standards to transmit data, voice, and signaling.

- ii. Frequency - Frequency is the number of occurrences of a repeating event per unit of time. It is also referred to as temporal frequency, which emphasizes the contrast to spatial frequency and angular frequency. Frequency is measured in hertz (Hz) which is equal to one event per second. The period is the duration of time of one cycle in a repeating event, so the period is the reciprocal of the frequency.
- iii. LAN - A local area network (LAN) is a computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building. By contrast, a wide area network (WAN) not only covers a larger geographic distance, but also generally involves leased telecommunication circuits.
- iv. Topology – this is a simple or complex connection element or tandem with two or more connections being formed with two or more elements put in parallel. Uniformity specifies the homogeneity of elements involved in connection.
- v. Storage program control (SPC) exchange – Stored program control (SPC) is a telecommunications technology used for telephone exchanges controlled by a computer program stored in the memory of the switching system. SPC was the enabling technology of electronic switching systems (ESS) developed in the Bell System in the 1950s, and may be considered the third generation of switching technology.
- vi. Semaphore - a semaphore is a variable or abstract data type used to control access to a common resource by multiple processes and avoid critical section problems in a concurrent system such as a multitasking operating system. A trivial semaphore is a plain variable that is changed (for example, incremented or decremented, or toggled) depending on programmer-defined conditions. A useful way to think of a semaphore as used in a real-world system is as a record of how many units of a particular resource are available, coupled with operations to adjust that record safely (i.e., to avoid race conditions) as units are acquired or become free, and, if necessary, wait until a unit of the resource becomes available.
- vii. Attenuation - attenuation or, in some contexts, extinction is the gradual loss of flux intensity through a medium. For instance, dark glasses attenuate sunlight, lead attenuates X-rays, and water and air attenuate both light and sound at variable attenuation rates.
- viii. Satellite – This is a powerful long distance and point to multi-point communication system. It is basically an R.F. (radio frequency) repeater. In the context of spaceflight, a satellite is an object that has been intentionally placed into orbit. These objects are called artificial satellites to distinguish them from natural satellites such as Earth's Moon.

- ix. Baud rate – This is the maximum rate of signal transitions that can be supported by a channel. It's the close measure of information throughput or the effective information data transfer rate from sender to receiver.
 - x. Transmission medium – this is the platform that allows the transport of data from one place to the other. It includes communication channels, path, links, trunks and circuits. Transmission medium may be a telephone line, coaxial cable, twisted pair, fibre cable, radio waves (free space), micro wave links, satellite links etc.
4. State FIVE factors associated with the production of switching software (10 Marks)
- i. Complexity and size of the software
 - ii. Long working life required
 - iii. Real time operation
 - iv. Stringent reliability and availability
 - v. Software portability
5. There are THREE different types of telephone networks. State and discuss them briefly (10 Marks)
- i. A landline network where the telephones must be directly wired into a single telephone exchange. This is known as the public switched telephone network (PSTN).
 - ii. A wireless network where the telephone is mobile and can move around anywhere within the coverage area.
 - iii. A private network where a closed group of telephones are connected primarily to each other and use a gateway to reach the outside world. This is usually used inside companies and call centers and is called a private branch exchange. (PBX).
6. State Five ways in which a telecommunication network may be categorized into: (5 marks)
- i. Subscriber end instruments
 - ii. Subscriber loop systems
 - iii. Switching systems
 - iv. Transmission systems
 - v. Signaling systems
7. State FIVE merits and FIVE demerits of Geostationary satellite. (20 Marks)
- Merits
- i. No tracking is required by geostationary satellites.

- ii. Multiple access points are available in satellite communication.
- iii. 24-hour communication can be achieved with the help of satellites.
- iv. The signal quality of satellite communication is higher.
- v. To put more information on the carrier a broad band can be used.
- vi. Satellite communication is used for long distance communication or across oceans.
- vii. Low transmitting power and low receiver sensitivity is required by the satellite in close elliptical orbits.

Demerits

1. The transmitter and receiver used in satellite communication require high power, most sensitive transmitters and large diameter antennas.
 2. Satellite communication is disturbed by solar activities and cyclones in the space.
 3. Due to ageing effect, the efficiency of satellite components decreases.
 4. The longer propagation times is one of a disadvantage of satellite communication.
 5. The cost for initial design and launching of the satellite in the orbit is extremely high.
8. Signaling systems link a variety of switching systems, transmission systems and subscriber equipment in a telecommunication network to enable the network function as a whole. State the THREE forms of signaling that are involved in a telecommunication network. (5 Marks)
- i. Subscriber loop signaling
 - ii. Intra-exchange or register signaling
 - iii. Intra-exchange or inter-register signaling
9. Discuss the open system inter-connection (OSI) model. List and briefly explain the seven layers in the model. (30 Marks)
- This was developed by the international organization for standardization ISO. The ISO developed OSI for networking. It is an open system, a set of protocols, that allows two computers to communicate with each other regardless of their design, manufacture or CPU type. The OSI model defines seven distinct levels in its communication model. These levels or layers have a set of specific functions they perform. The layers are as follows
- i. 7. Application layer – performs information processing such as file transfer, email and teletext. It also details and applies specific information about data being exchanged.
 - ii. 6. Presentation layer – Defines the format of data to be sent: ASCII, data encryption, data compression etc.

- iii. 5. Session layer – it does the management of connections between programs. Sets up a session between two applications by determining the type of communication such as duplex, half duplex, synchronization etc.
- iv. 4. Transport layer – this layer is focused on the delivery sequence of packets. Ensuring data gets to the destination and manages error control, flow control and quality of service.
- v. 3. Network layer – This layer is focused on the format of individual data packets. Sets up connection, disconnects connections, provides routing and multiplexing.
- vi. 2. Datalink layer – Manages framing, error detection and retransmission of message. It also manages the access to and control of transmission medium.
- vii. 1. Physical layer – Manages medium and signal formed of raw but information. It also manages the electrical interface (type of signal), mechanical interface (type of connection), and converts electrical signals to bits. It also transmits and receives electrical signals.

NOTE: The seven layers of the OSI are grouped into three layers. Layers 1, 2 and 3 are called the network support layer. Layer 4 is called the transport layer (which also the transport layer in the OSI Model) and finally layers 5, 6, and 7 are called support layers.