CMR INSTITUTE OF TECHNOLOGY

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Internal Assesment Test - I

Sub:	Multimedia Communication							Code:	18EC741 Elective
Date:	13/11/2021	Duration:	90 mins	Max Marks:	50	Sem:	VII	Branch:	ECE-A,B,C,D

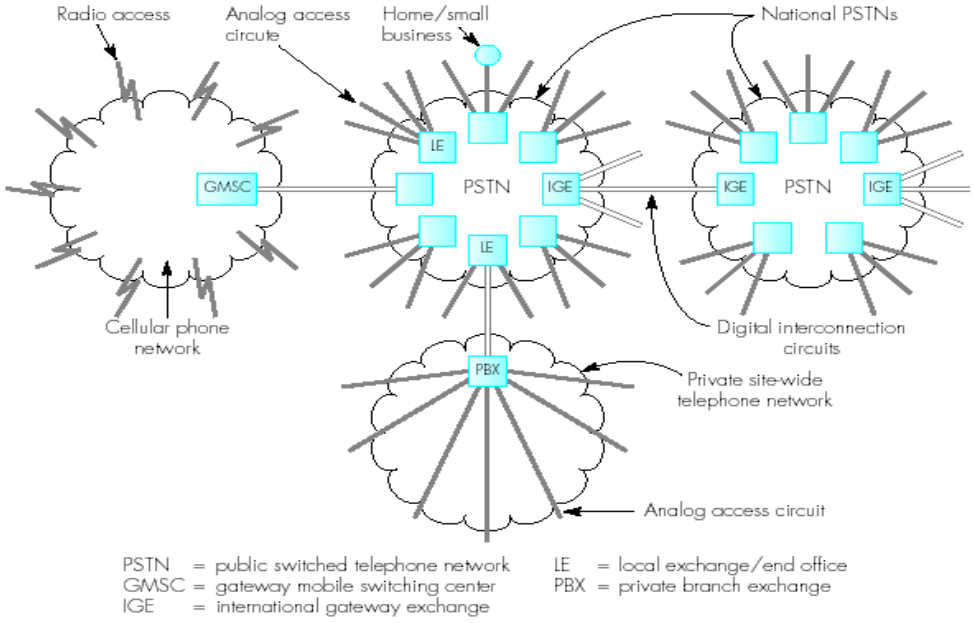
Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1.	List the five basic types of Communication network that are used to provide multimedia services Explain with a neat diagram (a)Telephone Network (b)Integrated Digital services network.	[10]	CO1	L1

Basic types of Communication network that are used to provide multimedia services

- **Telephone Networks** – Telephony.
- **Data Networks** – Data Communications.
- **Broadcast Television Networks** – Broadcast TV.
- **Integrated Services Digital Networks** (ISDN) – Multi service.
- **Broadband Multiservice Networks** – Multi service.

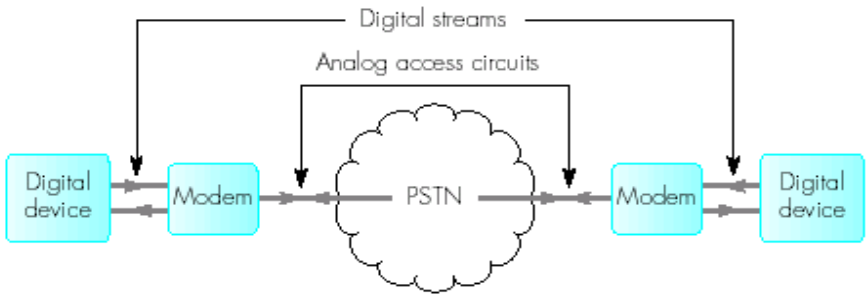
(a)Telephone Network



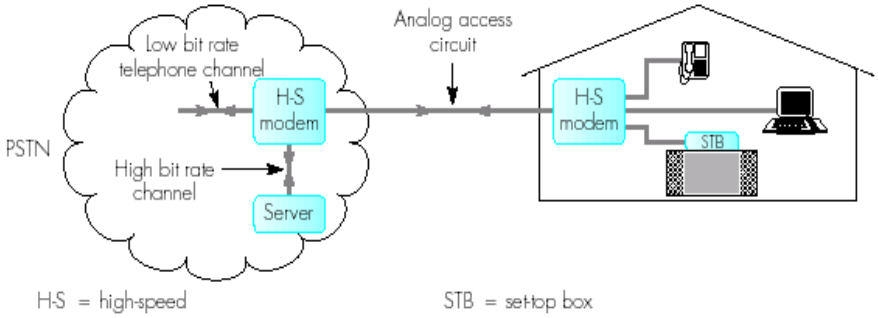
- PSTN – **(public switched telephone network**) - collection of interconnected voice-oriented public telephone networks, both commercial and government-owned.
- The term **switched** means a subscriber can make a call to any other telephone on the 'total' network. Telephones in the home or in a small business are connected directly to their nearest **local exchange/end office.**
- Telephones in a large office are connected to a private switching office - **private branch exchange** (**PBX)**
- PBX provides free service between two telephones that are connected to it. PBX is a telephone system within an enterprise that switches calls between enterprise users on local lines while allowing all users to share a certain number of external phone lines. PBX - save the cost of requiring a line for each user to the telephone company's central office. PBX is connected to the local exchange and this enables phones connected to the PBX to make calls through PSTN too.
- **Cellular phone networks** – Provides service to mobile subscribers.
- The switches used in a cellular phone network are known as **Mobile Switching**

Centers (MSCs**).** International calls are routed to and switched by **international gateway exchanges** (IGEs).

- **Digital Transmission using Modem**



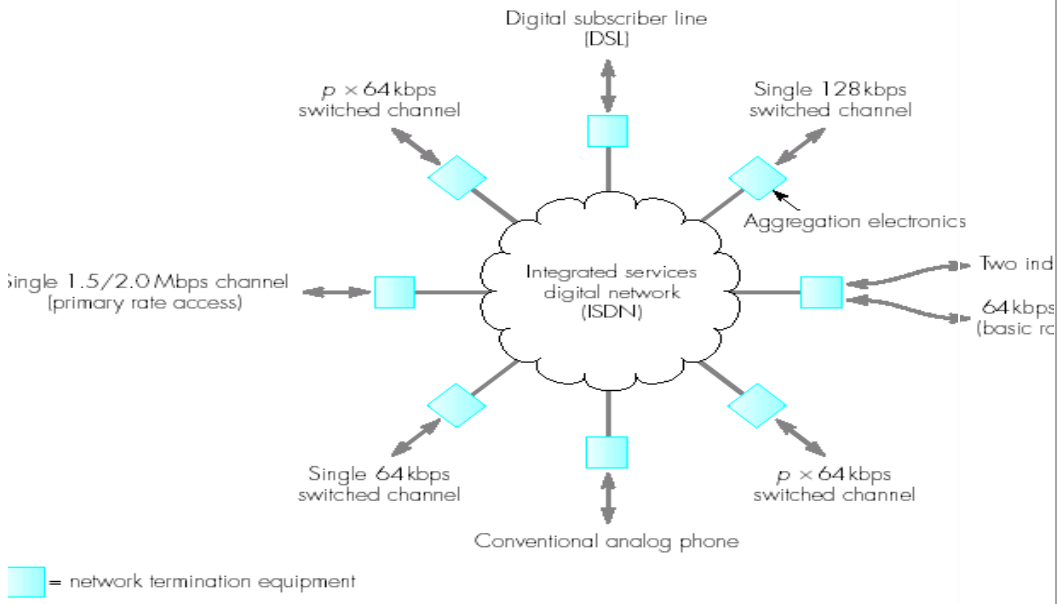
- **Circuit mode –** Telephone networks operate in this mode - a separate circuit is set up through the network for each call for the duration of the call.
- **Access Circuits** – Link the telephone handsets to a PSTN/PBX and carry two-way analogue signals associated with a call**.**
- **Multi Services via H-S Modem**



- **Modem –** device needed for transmission of digital bits through analog access circuits. - converts D to A at source, A to D at destination. - call set-up and termination.
- Earlier supported 300bps. Due to advanced DSP -56kbps. With high bit-rate channels, high resolution audio and video can be accessed for entertainment services.

(b)Integrated Digital services network.

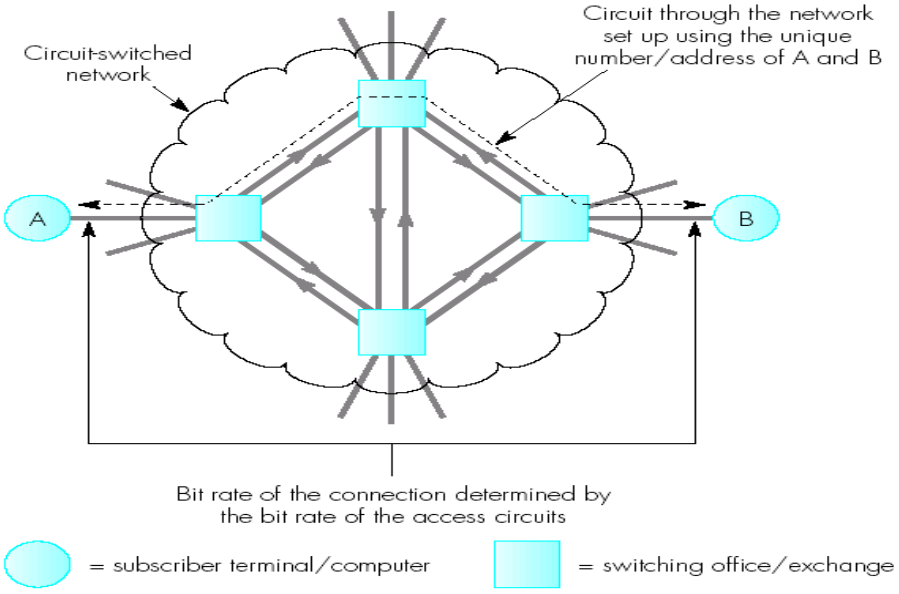
- Started at early 1980s to provide PSTN users the capability to have additional services.
- Access circuit in ISDN are converted to all digital form – **DSL Digital Subscriber Line.** 2 separate communication channel in access circuit - either **2 different telephone calls simultaneously / telephone + data call.** ADC circuits are placed inside a digital phone & they are placed inside network termination equipment in analog phone.
- **Basic rate access -** DSL of ISDN supports 2 channels each **64kbps** – analog speech BR = 64kbps - used as: either **2 independent 64kbps channels.** else **1 combined 128kbps channel**
- **Aggregation** function - synchronizes 2 separate 64kbps channels.
- **Primary rate access -** Single higher BR channel of **1.5Mbps/2Mbps.**
- ISDN supports single switched channel of px64kbps, where p=1,2,3,….30. Due to high digitization cost, ISDN service cost is higher than PSTN service. DSL (Digital Subscriber Line) is a technology for bringing high-bandwidth information to homes and small businesses over ordinary copper telephone lines. If home/small business is close to telephone company central office with DSL service - continuous transmission of motion video, audio, and even 3-D effects can be received. Individual connections provides -1.544 Mbps - 512 kbps **downstream** & 128 Kbps **upstream**.



[07] | CO1 | L1

2.(a) Explain the working principle of circuit-mode and packet-mode of operation of multimedia networks. List out salient features of each type of networks.

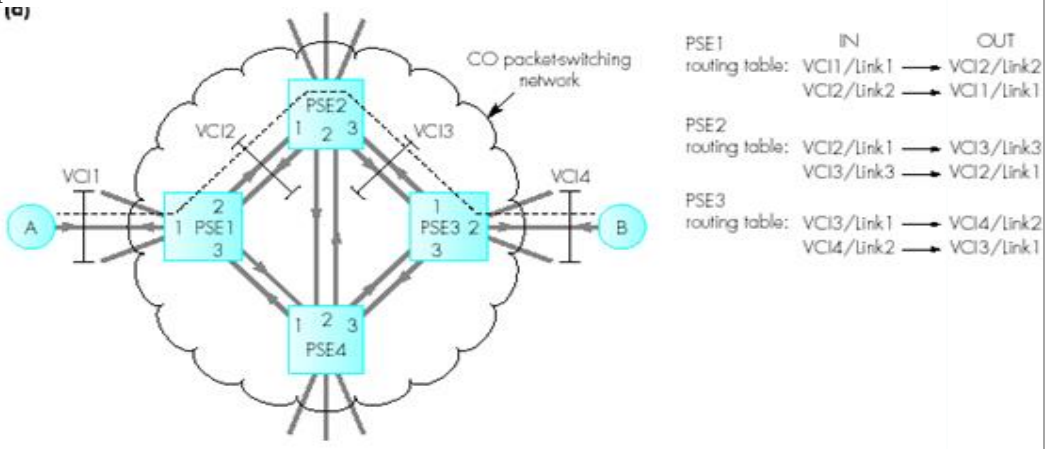
circuit-mode



- **Circuit mode** -operates in a time-dependent manner and consists of interconnected set of switching offices/exchanges to which the subscriber terminals/computers are connected.
- **Step1: S**ource must set up the connection first through the network.
- **Step2:** Each subscriber terminal has a **unique network wide address** and to make a call the source first enters this no. of the receiver.
- **Step3**: Local switching office uses this no. to set up a connection. Depending on the availability of the receiver the connection is established.
- **Step4**: At the end of information exchange the call is terminated by the source / receiver.

- **Signalling messages** – messages associated with the setting up & clearing of a connection.
- **Call/Connection setup delay** – delay associated with the connection procedures.
- Examples of Circuit-mode operation – PSTN & ISDN
  - PSTN – setup delay few sec - international connections.
  - ISDN – setup delay ranges 10s of msec – 100s of msec.

packet-mode



- **Connection Oriented (CO)** - connection is established prior to information interchange.
- Connection utilizes only a variable portion of the BW of each link and known as **virtual circuit (VC)**
- VC setup - source terminal sends a call request control packet to the local PSE which contains source & destination addresses and **virtual circuit identifier (VCI).** Each PSE maintains a table that specifies the outgoing link used to reach the network address. On receipt of the call request the PSE uses the destination address within the packet to determine the outgoing link. The next free identifier (VCI) for this link is selected and two entries are made in the routing table – IN & OUT VCI link
- E.g. - X.25 (text) and ATM (multimedia)

(b) Derive the maximum block size that should be used over a channel which has mean BER probability of 10^{-4} if the probability of a block containing an error and hence being discarded is to be 10^{-1}. [03] CO1 L3

Derive the maximum block size that should be used over a channel which has a mean BER probability of 10^{-4} if the probability of a block containing an error – and hence being discarded – is to be 10^{-1}.

Answer:

$$P_B = 1 - (1 - P)^N$$

Hence $0.1 = 1 - (1 - 10^{-4})^N$ and $N = 950$ bits

Alternatively, $P_B = N \times P$

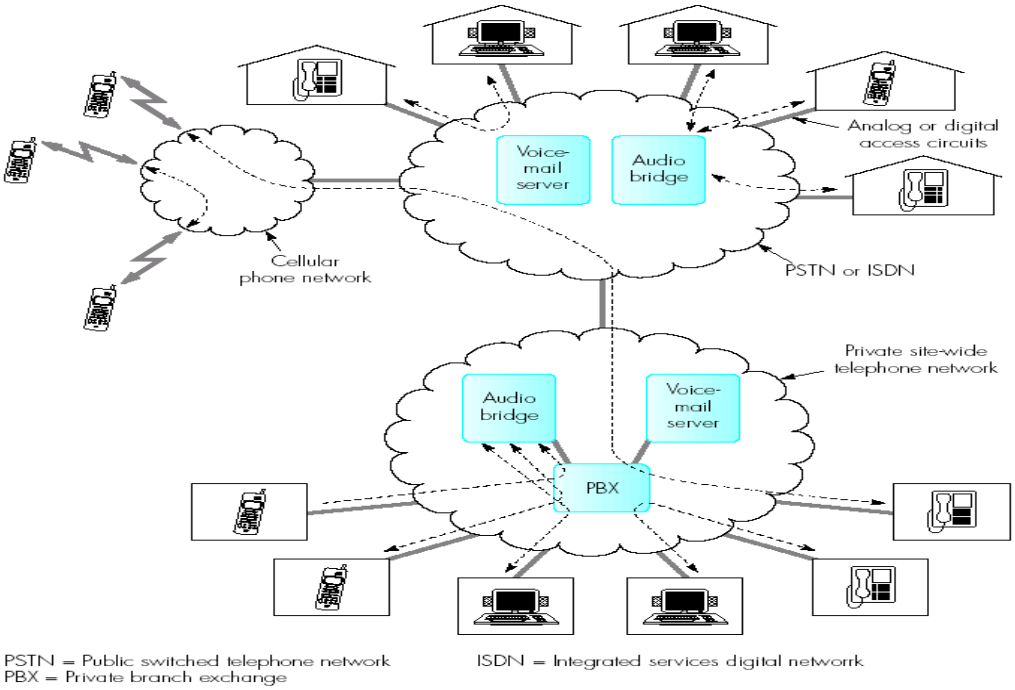
Hence $0.1 = N \times 10^{-4}$ and $N = 1000$ bits

Marks

OBE

CO RBT

3.	With a neat diagram, explain how voice mail and teleconferencing is supported in relation to speech only interpersonal communication involving both public (PSTN/ISDN) and private network. Also, explain the role of voice mail server and audio bridge.	[10]	CO1	L1



- Traditional interpersonal communication - telephones connected to PSTN/ISDN/PBX. Multimedia PC with a microphone and speakers - used to make telephone calls through PC. Requirements – telephone interface card and associated software - technology is computer telephony integration (CTI).
- Advantages - users can create own private directory of numbers and can initiate a call by selecting the desired no. on the PC screen. Access circuits require more capacity/**bandwidth.**
- **Voice mail**: Used when the called party is unavailable. A spoken message - voice mail is saved in the voice mailbox, which is present at a central voice mail server – this message can be read by the owner next time they contact the server.
- **Teleconferencing**: Involves multiple interconnected telephones/PCs. Each person can talk to all the others involved in the call - **conference call / teleconferencing call / audio-conferencing call**. Requires - central unit - **audio bridge** - provides the necessary support to set up the call automatically. Internet telephony initially supported PC-to-PC communications - technology is extend to PC-to-telephony.

4.(a)	Derive the time to transmit the following digitized images at both 64Kbps and 1.5Mbps networks. A 640×480×8 VGA-compatible image a 1024×768×24 SVGA-compatible image.	[4]	CO2	L3

Solution

The size of each image in bit is as follows

- a VGA image = 640×480×8 = 2.46Mbits
- an SVGA image = 1024×768×24 =18.88Mbits

The time to transmit each image is given as follows

- at 64Kbps : VGA = 2.46Mbits/64Kbps = $[2.46\times10^6]/[64\times10^3]$ = 38.4 sec.
  SVGA = $[18.88\times10^6]/[64\times10^3]$ = 295 sec.
- at 1.5Mbps: VGA = 2.46Mbits/1.5Mbps = $[2.46\times10^6]/[1.5\times10^6]$ = 1.64 sec.
  SVGA = $[18.88\times10^6]/[1.5\times10^6]$ = 12.59 sec.

(b)	Write brief note on (i) Digitized picture. (ii) Colour mixing.	[6]	CO2	L1

(i) Digitized picture

Black & White picture –2 bit image – either black – bit 1 or white – bit 0. 1 bits per pixel.
Grayscale image - 8bit image. 8bits per pixel – **256** different levels of gray per pixel – varying between black & white.
Pixel depth: No. of bits per pixel that determines the range of different colours that can be produced.

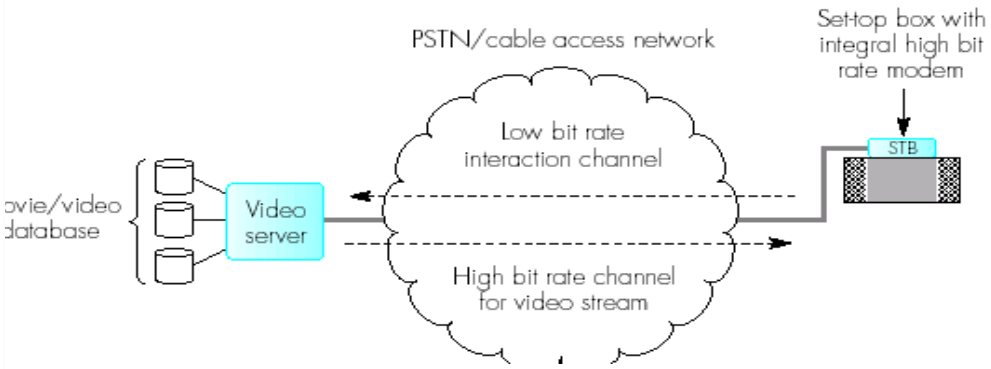
(ii) Colour mixing

- **Colour picture – colour principles –** human eye can see only a **single colour,** when 3 primary colours are mixed and displayed simultaneously. 3 primary colours – **RED GREEN BLUE** 3 secondary colours – **CYAN MEGANTA YELLOW**
- **Colour gamut** – whole spectrum of colours, can be produced by different proportions of **RGB.**
- **Additive colour mixing** - for producing colour image on a black surface – display applications.
- **Subtractive colour mixing** - for producing colour image in white surface - printing applications.

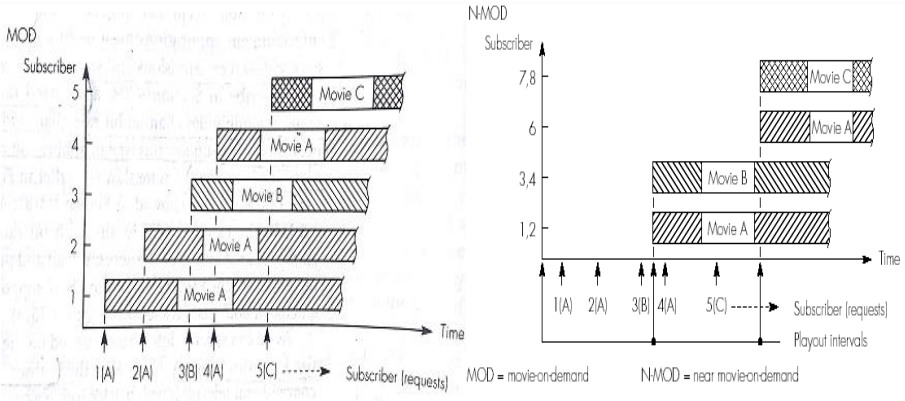
RGB To CMY **CMY To RGB**

$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix} \qquad \begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} C \\ M \\ Y \end{bmatrix}$$

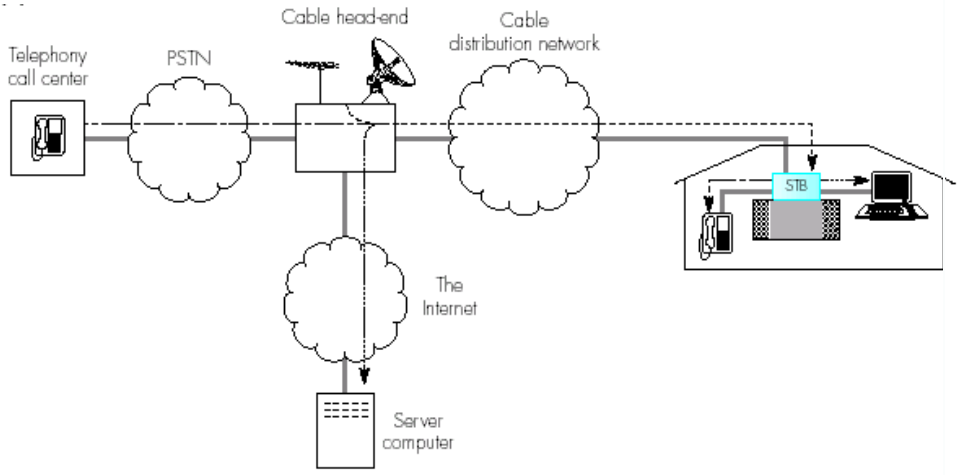
5.	Explain with neat diagrams, the entertainment applications of multimedia communication.	[10]	CO1	L1



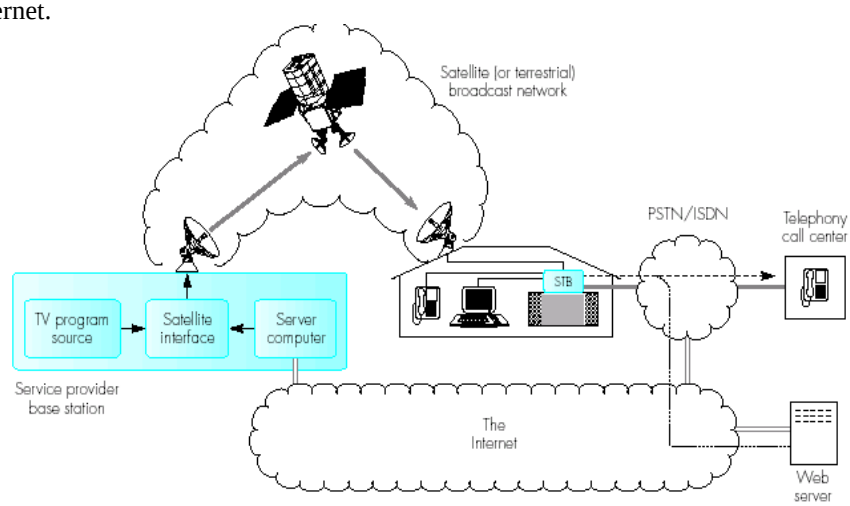
- The entertainment applications require higher quality/ resolution for video and audio since wide-screen televisions and stereophonic sound are often used.
- Digitized video with sound requires bit rate – **1.5Mbps** – network must support – PSTN with high bit rate modem. Subscriber terminal - TV with a selection device for interaction purpose. User interactions are relayed to the server through a set-top-box (STB) with a high speed modem.
- **Movie-on-demand/Video-on-demand.**
- Using menu, user can browse through the library of movies/videos and initiate the showing of a selected movie at any time. User can control showing of the movie – play, pause, etc. Server must be capable of playing out simultaneously a large no. of video streams equal to the no. of users. Require high speed information flow from the server (multi-movies + multi-copies).



- **N-MOD** - to avoid the heavy load, requests for a particular movie are not played immediately. Requests are **queued** until the start of the next play-out time. Reduces bandwidth and cost.



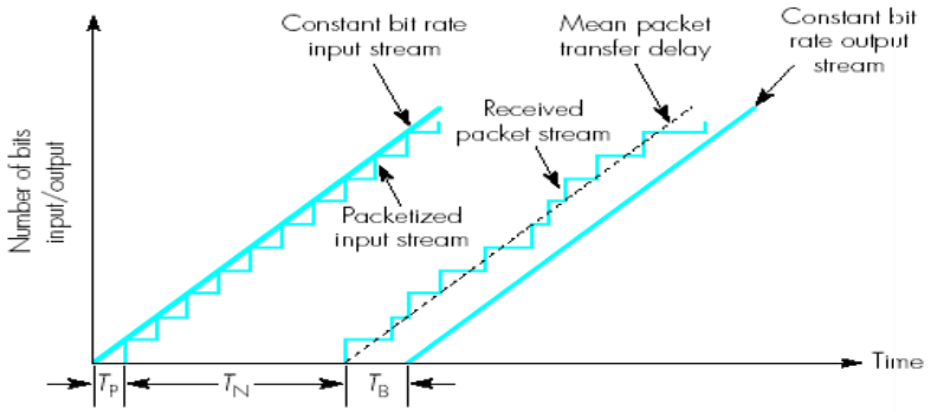
- Broadcast TV network includes cable, satellite & terrestrial networks. The set-top box (STB) provides both a low bit rate connection to the PSTN and a high bit rate connection to the internet.



- The STB associated requires a high-speed modem to provide the connections to the PSTN and the Internet

6. Explain the following: [10] CO1 L1
a) Network QoS parameters b) Application QoS parameters

- a) **Network Quality of Service parameters -** Operational parameters associated with a communication channel through a network that determine the suitability of the channel for use in a particular application.
- N-QoS is different for circuit & packet switched network.
- **Circuit-switched network –**
  - **1.Bit Rate -** (BER) - probability of a bit being corrupted during its transmission in a defined time interval for a defined no. of bits.
  - E.g.–BER=10^{-3}– 1 bit is corrupted for every 1000 bits transmitted. Important for financial information -data is divided into blocks with maximum size determined by mean BER of the channel.
  - Probability of a block containing bit error **– P_B=1- (1– P)^N,** P = probability of BER ; N = no. of bits in a block.
  - **2.Mean Bit Error Rate –** mean of the bit error rate
  - **3.Transmission Delay –** network interface delay + signal propagation delay from source to destination.
- **Packet-switched network-**
  - **1. Maximum packet size**
  - **2. Mean packet transfer rate -** avg no. of packets transferred across the network per sec.
  - **3. Mean Packet error rate -** probability of a received packet containing one or more bit errors.
  - **4. Worst case jitter -** variation about the mean.
  - **5. Transmission delay**.
- Most networks (circuit & packet switched) provide an **unreliable service** which is also known as a best-try or best-effort service. If the application accepts only error free blocks then it is necessary for the sending terminal to divide the source information into blocks of a defined maximum size and the destination to detect any missing blocks. When a block is missing then the destination must request for a copy of the block from the source. The service is then called **a reliable service.** The application quality of service is different from the network QoS. E.g.- image application parameters - minimum image resolution, size; video - digitization format, refresh rate.
- **Application QoS – Parameters**
  - The required bit rate or mean packet transfer rate.
  - The maximum start-up delay
  - The maximum end-to-end delay
  - The maximum delay variation/jitter
  - The maximum round-trip delay
- Large file transfer from server to home computer using the packet switched (PW) & circuit switched (CS) networks. - **PSTN (28.8kbps)** & **ISDN (64/128kbps)** operate in CS mode and provide constant bit rate channel. Cable modem operate in PS mode - BR of shared channel = **27Mbps**



T_P = packetization delay
T_N = mean network packet transfer delay
= transmission delay + mean store-and-forward delay
T_B = buffering delay at destination (to overcome worst-case jitter)
T_T = total input-to-output delay
= $T_P + T_N + T_B$
Jitter = variation in store-and-forward delay about the mean

- Transmission of a constant BR stream over a packet switched network.
- **Start-up delay -** amount of time that elapses between an application making a request to start a session and the confirmation being received at the destination. To overcome the effect of jitter a technique known as buffering is used. By retaining a defined no. of packets in a memory buffer at the destination before play-out of the information bit stream is started.
- To determine whether a particular network can meet the QoS requirements of an application a no. of standard application service classes have been defined. Each service class has an associated set of QoS parameters defined. For networks that support different service classes (internet), the packets relating to each class are assigned a different priority. Real time streams have higher priority than packets relating to email.