Department of Electronics & Communication Engg.

Course Multimedia Communication -15EC741. **Sem.: 7th (2018-19)**

Course Coordinator:

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Module 1

- Multimedia Communication

1.1 Introduction

- “Multimedia” indicate that the information/data being transferred over the network may be composed of one or more of the following media types:
  - Text
  - Images
  - Audio
  - video

1.1 Introduction (cont.)

- TE: terminal equipments
- Server: contain a library of digitized movies/videos
- Set-top box: for users to access the server through TV set.
- A number of different types of networks.
- public switched telephone networks (PSTNs) - also known as general switched telephone networks (GSTNs).

1.2 Multimedia information representation

- Text: codeword
- Image: picture element (pixel)
- Audio and video: analog signals- the amplitude of the speech, audio, or video signal vary continuously with time.
- Digitization: bit rate - bit per second (bps)
- Speech signal: 64kbps
- Compression – reduce the bit rate.

1.3 Multimedia networks

- Telephone networks
- Data networks
- Broadcast television networks
- Integrated services digital networks
- Broadband multiservice networks

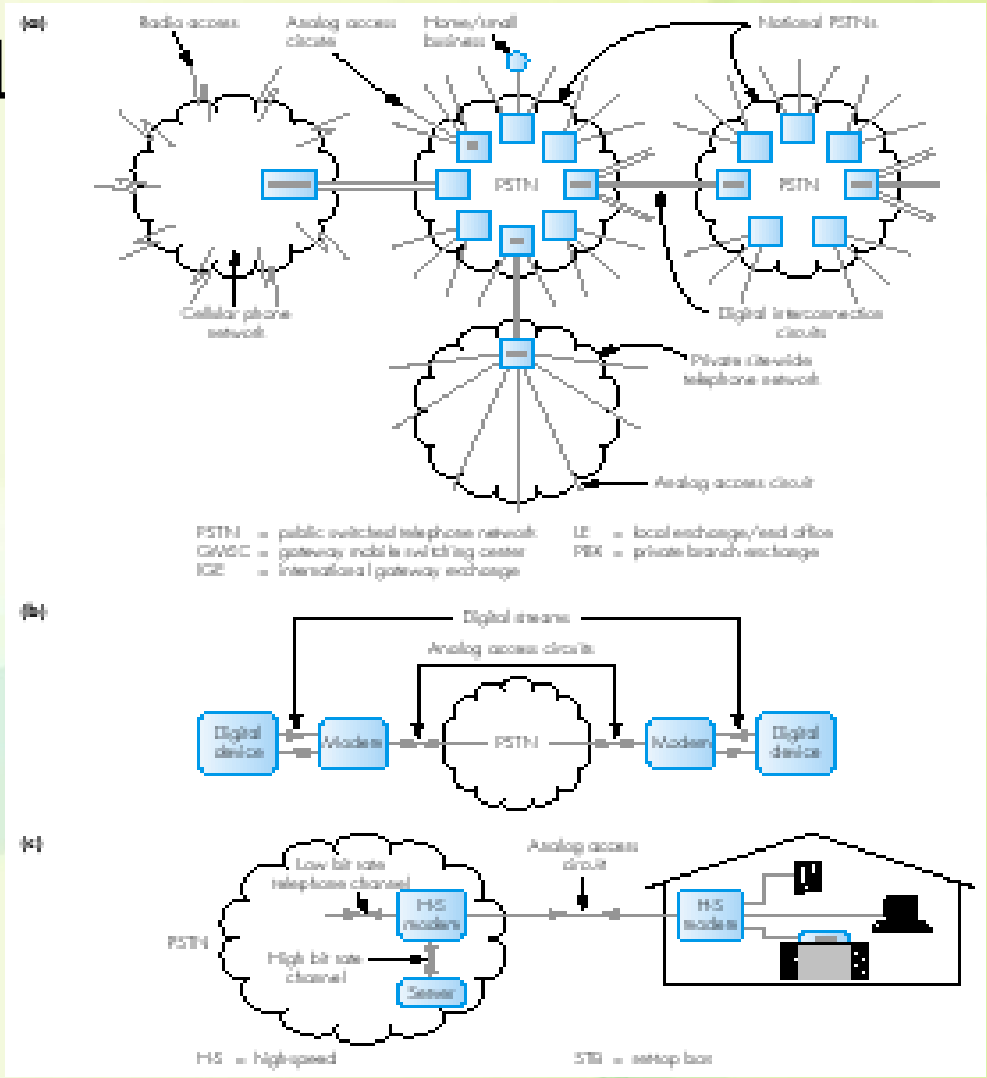
1.3.1 Telephone networks

- Public switched telephone network (PSTN)
  - The term “switched” is used to indicated that a subscriber can make a call to any other telephone that is connected to the total network.
  - POTS: plain old telephone service
- Local exchange/ end office
- PBX: Private branch exchange
- MSC: Mobile switching center
- IGE: International gateway exchange
- Telephone networks operate in what is called a circuit mode with analog signal.
- PSTN – now operate in a digital mode.

- Modem: transmit digital stream over analog access circuit.
- 56k bps modem (analog)
- ADSL: 1.5 M bps modem (digital)
- Cable modem: 10Mbps

1.3.1 Telephone networks (cont.)

- Figure 1.1

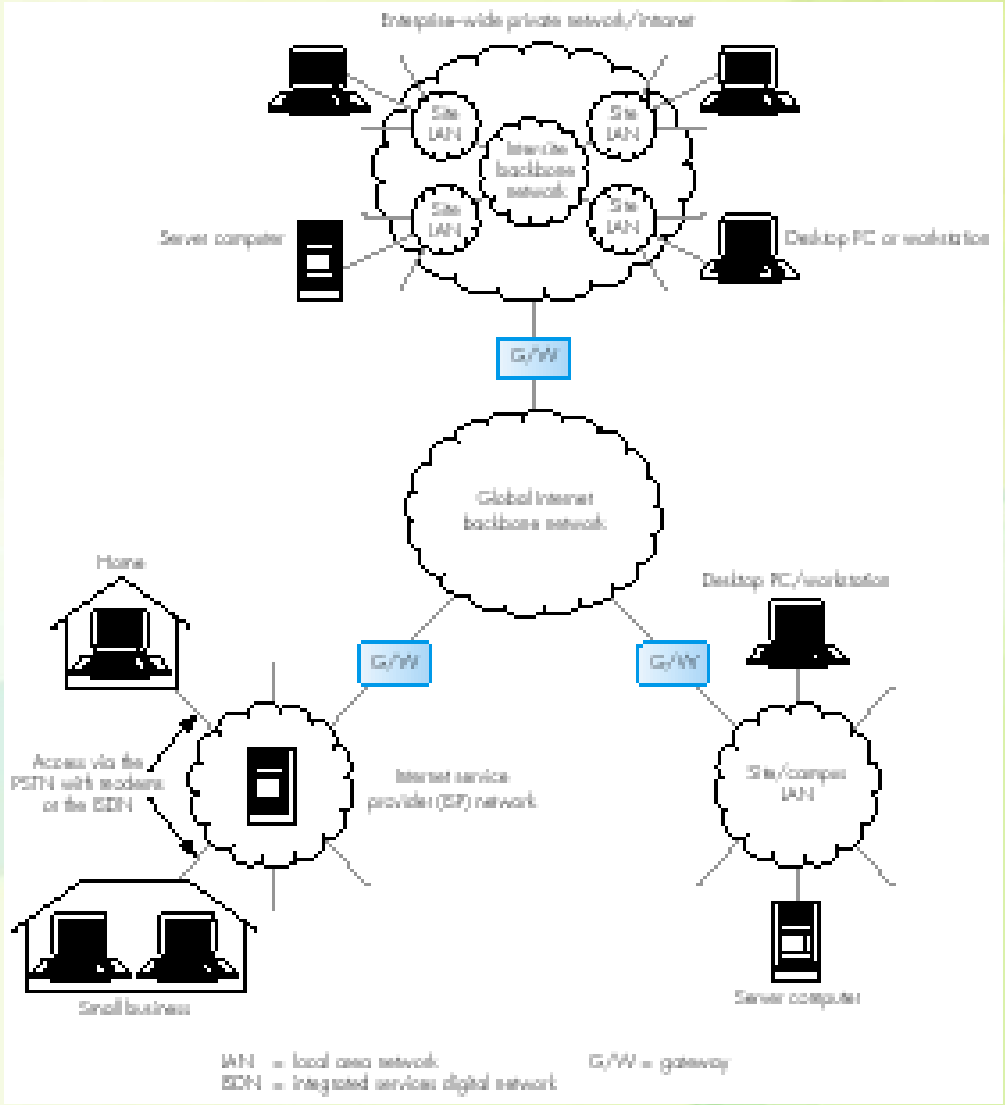


1.3.2 Data networks

- Provides basic data communication services such as electronic mail (email) and general file transfers.
- X.25 network (over PSTN) and the Internet.
- Open system interconnection: The Internet is using the same set of communication protocols (TCP/IP)

1.3.2 Data networks (cont.)

- Fig 1.2



1.3.2 Data networks (cont.)

- Internet service provider (ISP) network
- Integrated services digital network (ISDN)
- Enterprise-wide private network/ Intranet
- Inter site backbone network
- Internet backbone network
- Gateway/ Router
- All data networks operate in what is called a packet mode.
- Packet: an independent data block with the source and destination address.
- Now support multimedia

1.3.3 Broadcast television networks

- Support the diffusion if analog television (and radio) programs.
- Cable distribution network
- Satellite network
- Terrestrial broadcast network
- STB/Cable modem or PSTN modem
- Interactive television

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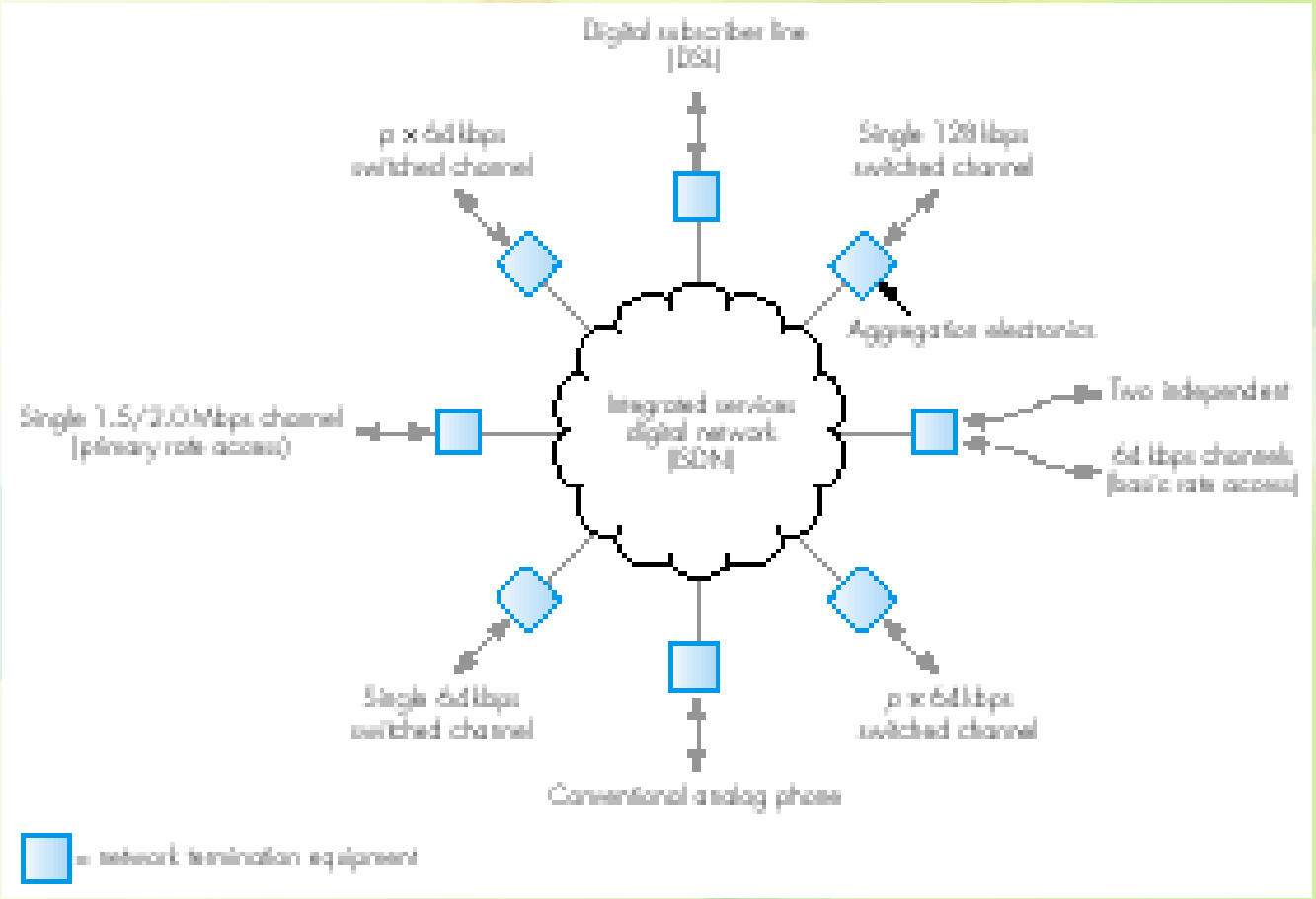
1.3.4 Integrated services digital networks

- Digital subscriber line (DSL): Converting access circuit from analog to digital.
- Providing two channels.
- Basic rate access or BRA – supports two 64 kbps channels.
- Aggregation function - synchronize the two separate 64 kbps bit streams into a single 128 kbps stream.
- Primary rate access or PRA - 1.5 or 2Mbps.
- P*64k bps

- Fig 1.4


Digital subscriber line (DSL)
p × 64 kbps switched channel
Single 128 kbps switched channel
Aggregation electronics
Integrated services digital network (ISDN)
Single 1.5/2.0 Mbps channel (primary rate access)
Two independent 64 kbps channels (basic rate access)
Single 64 kbps switched channel
p × 64 kbps switched channel
Conventional analog phone
= network termination equipment

1.3.5 Broadband multiservice networks

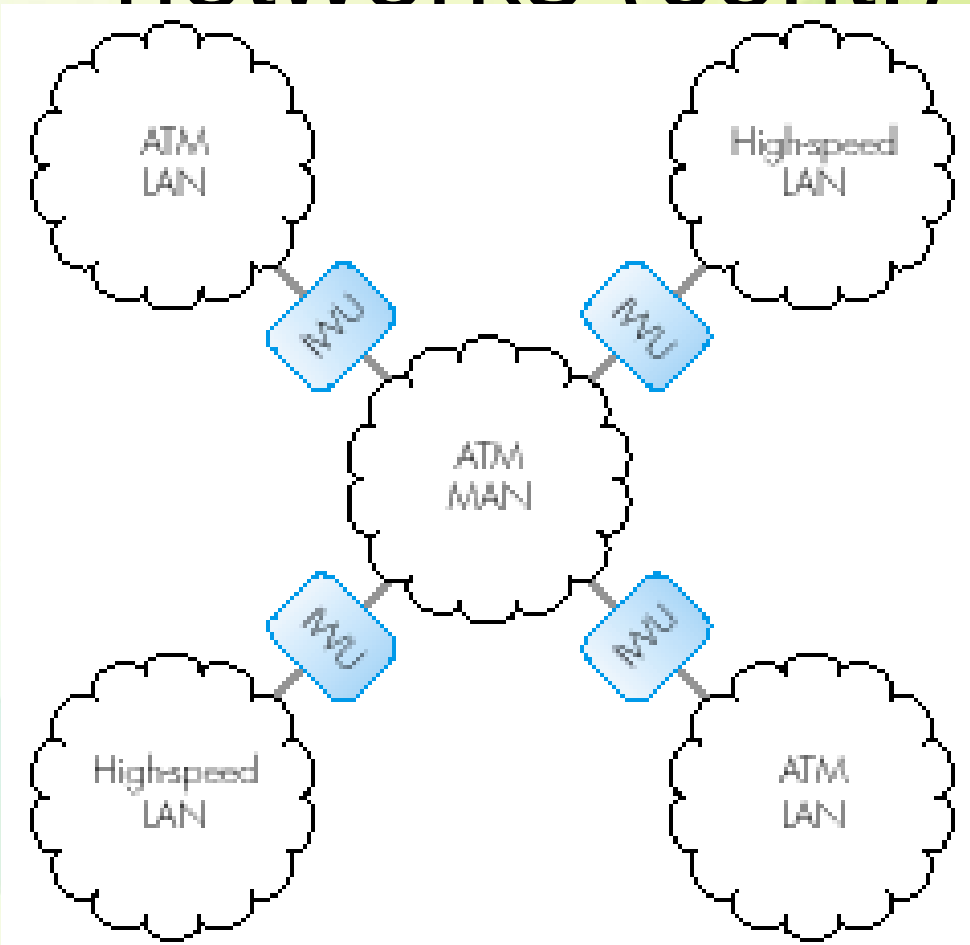
- Support a wide range of multimedia communication applications.
- “broadband” have bit rates in excess of the maximum bit rate of 2 Mbps – 30X64 kbps – provided by an ISDN (155M bps)
- Broadband integrated services digital networks or B-ISDN
- Narrowband ISDN or N-ISDN for old ISDN

1.3.5 Broadband multiservice networks (cont.)

- Provide flexible rates
- Using “cell” for transmission.
  - Easy to integrate traffic
  - Easy to be implemented
- This mode of transmission is known as the asynchronous transfer mode or ATM.
- ATM LAN
- ATM MAN
- Internetworking Legacy LAN

1.3.5 Broadband multicast networks (cont.)

- Fig 1.5



ATM = asynchronous transfer mode LAN = local area network
MAN = metropolitan area network
IWU = interworking unit

1.4 Multimedia applications

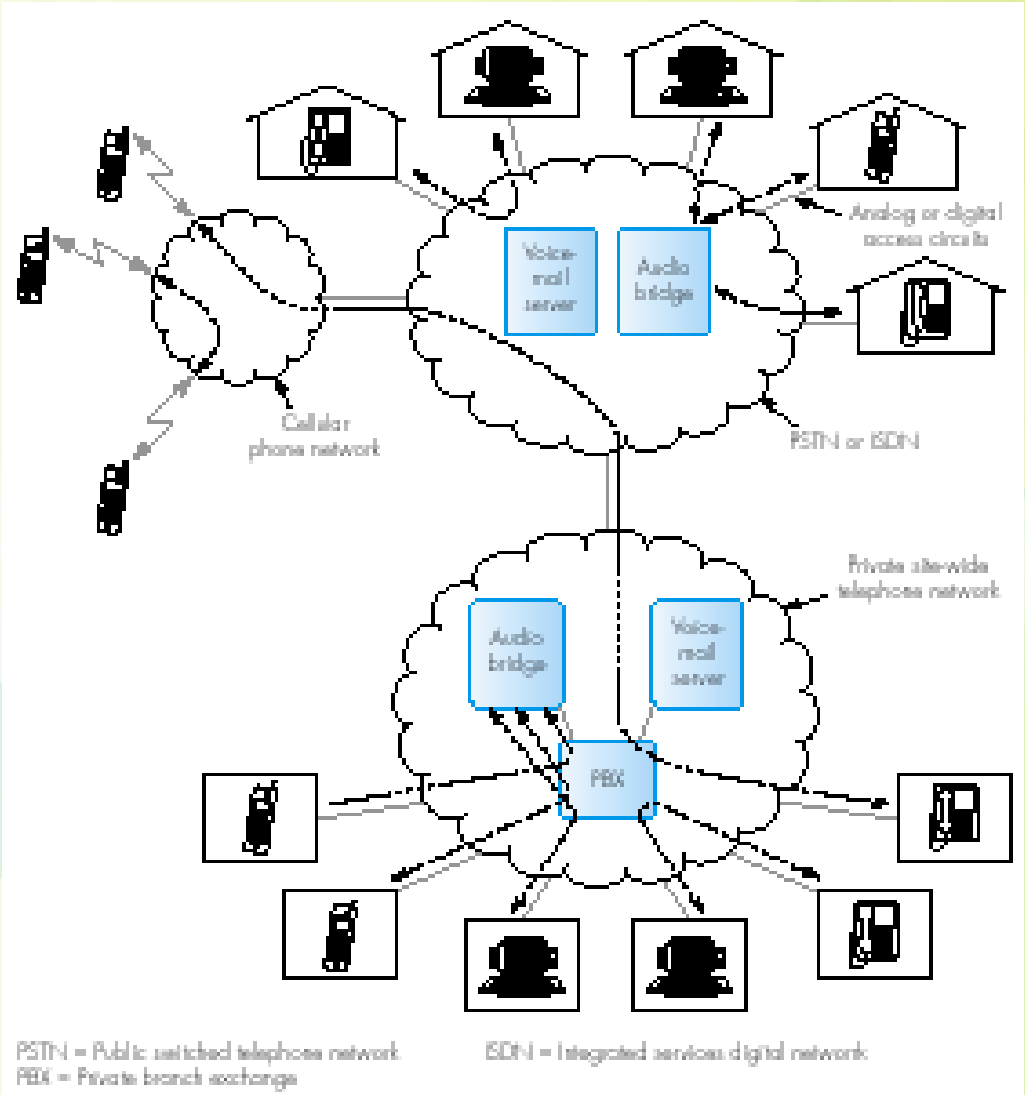
- Interpersonal communications
- Interactive applications over the Internet
- Entertainment applications

1.4.1 Interpersonal communications

- Interpersonal communications may involve speech, image, text, or video.
- Speech only – Telephony.
- Teleconferencing calls involve multiple interconnected telephones/PCs.
- Audio bridge: set up a conference call.

1.4.1 Interpersonal communications (cont.)

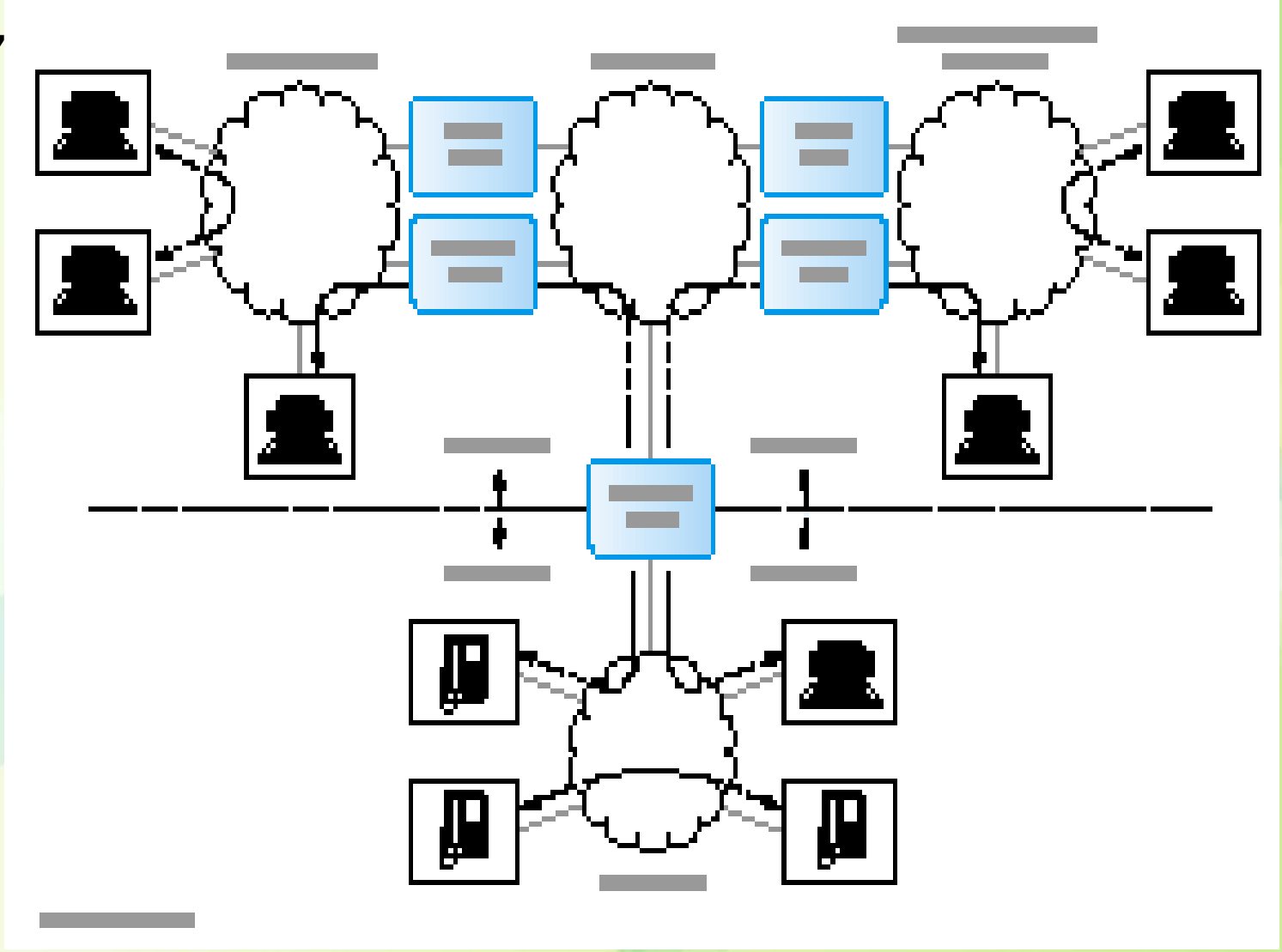
- Fig 1.6



- The Internet is also used to support telephony.
- VoIP (voice over IP): telephony over Internet.
- Telephony gateway: establishing a connection from PC to PSTN/ISDN telephone
  - PC connect to a preallocated TGW A
  - TGW A get the phone number from PC and find a TGW B which is nearest to the called party
  - TGW A connects to TGW B
  - TGW B makes a PSTN/ISDN phone call to the called party
  - Signal back to PC and then start the call

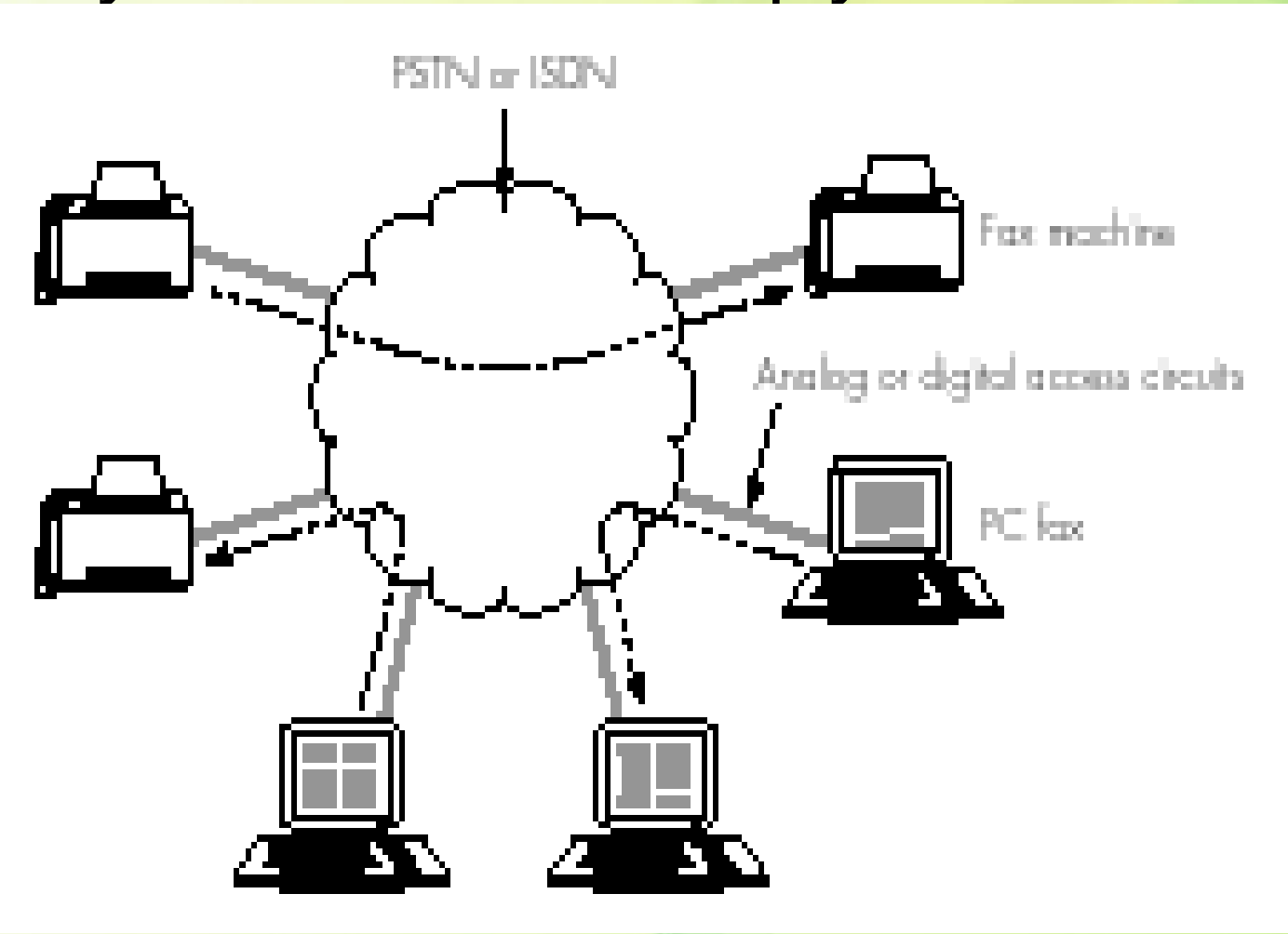
1.4.1 Interpersonal communications (cont.)

- Fig 1.7



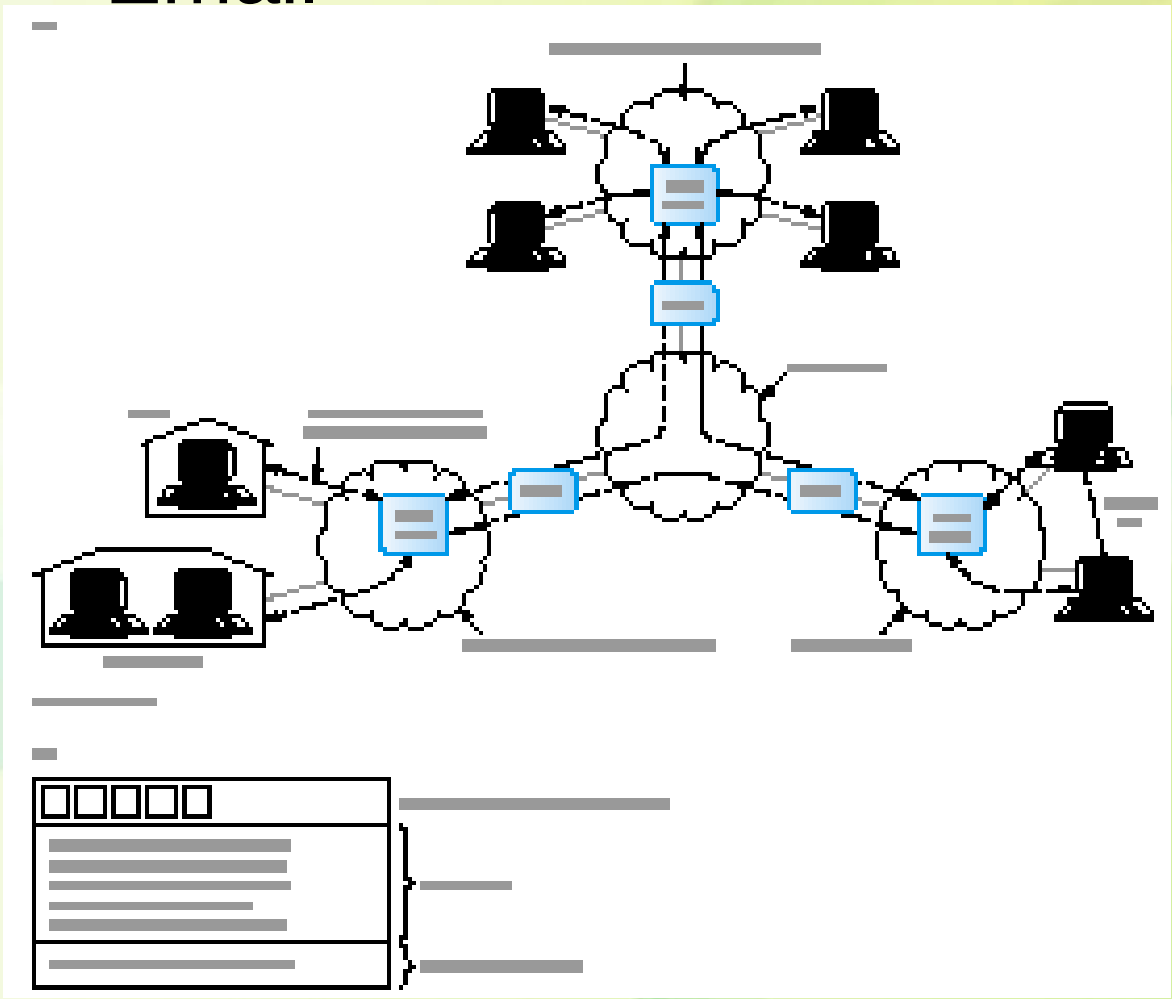
1.4.1 Interpersonal communications (cont.)

- Image only – facsimile or simply fax.
- Fig 1.8



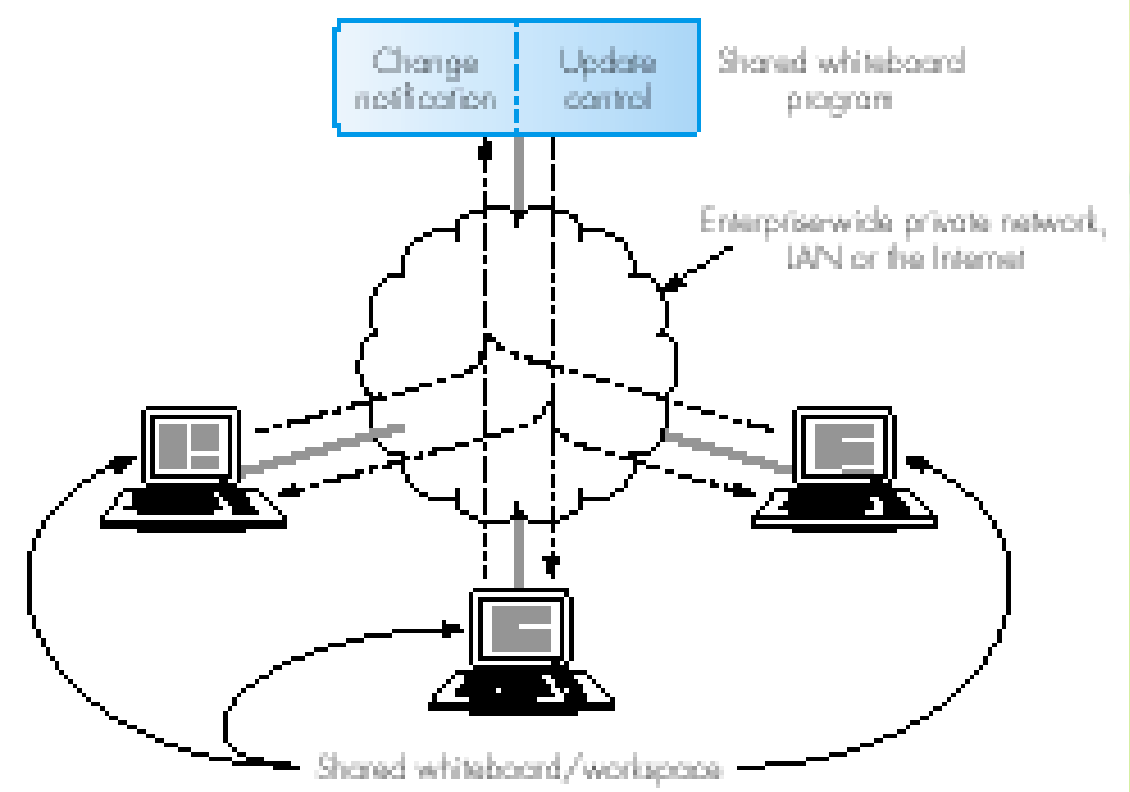
1.4.1 Interpersonal communications (cont.)

- Text only – Email
- Fig 1.9



1.4.1 Interpersonal communications (cont.)

- Text and images - computer-supported cooperative working (CSCW).
- Shared whiteboard: change-notification and update-control
- Fig 1.10

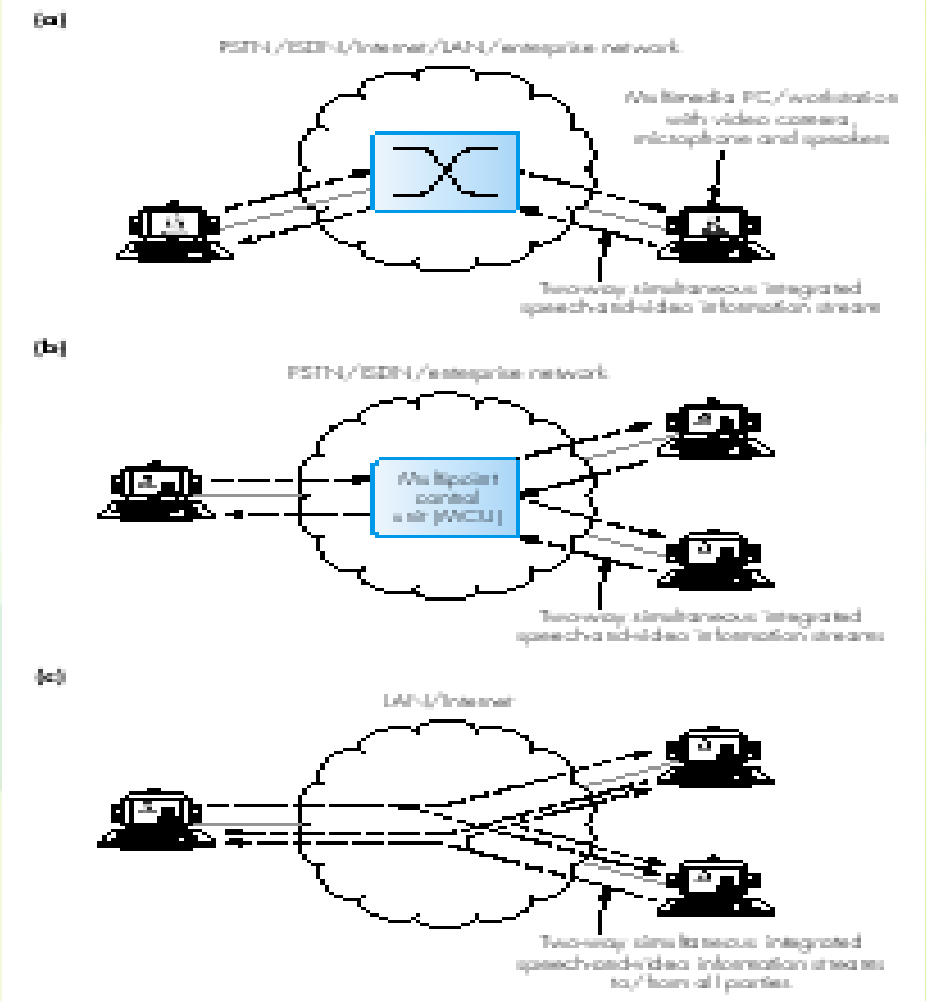


1.4.1 Interpersonal communications (cont.)

- Speech and video – video telephony
- Two-party video telephone call
- Videoconferencing with MCU (PSTN/ISDN/E-net)
  - The integrated speech-and-video information stream from each participant is sent to the MCU which then selects just a single information stream send to each participant.
- Videoconferencing with a broadcast channel (LAN/Internet)
  - Multicasting - all transmissions from any of the PCs/workstations belonging to a predefined multicast group are received by all the other members of the group.

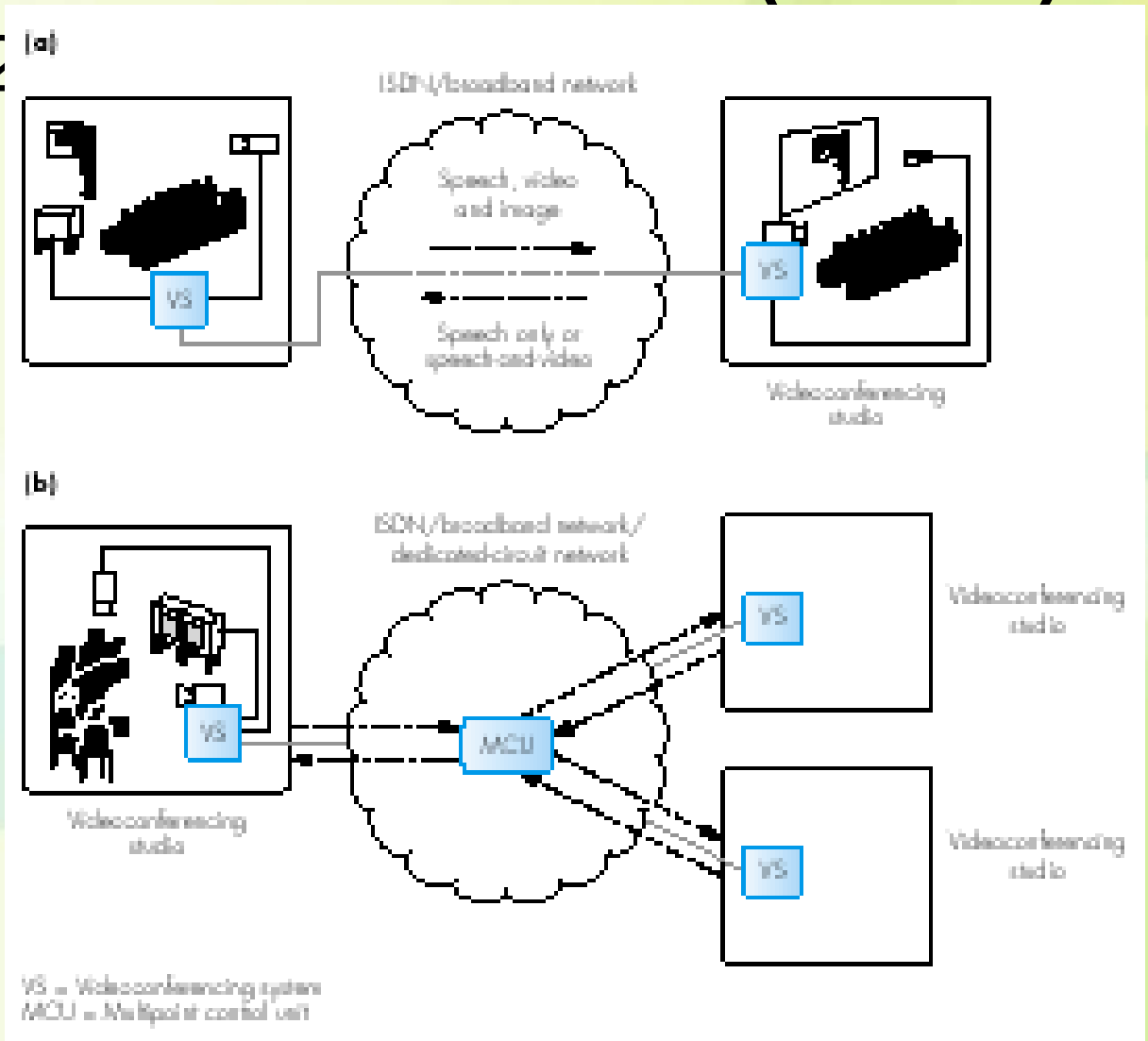
1.4.1 Interpersonal communications (cont.)

- Fig 1.11



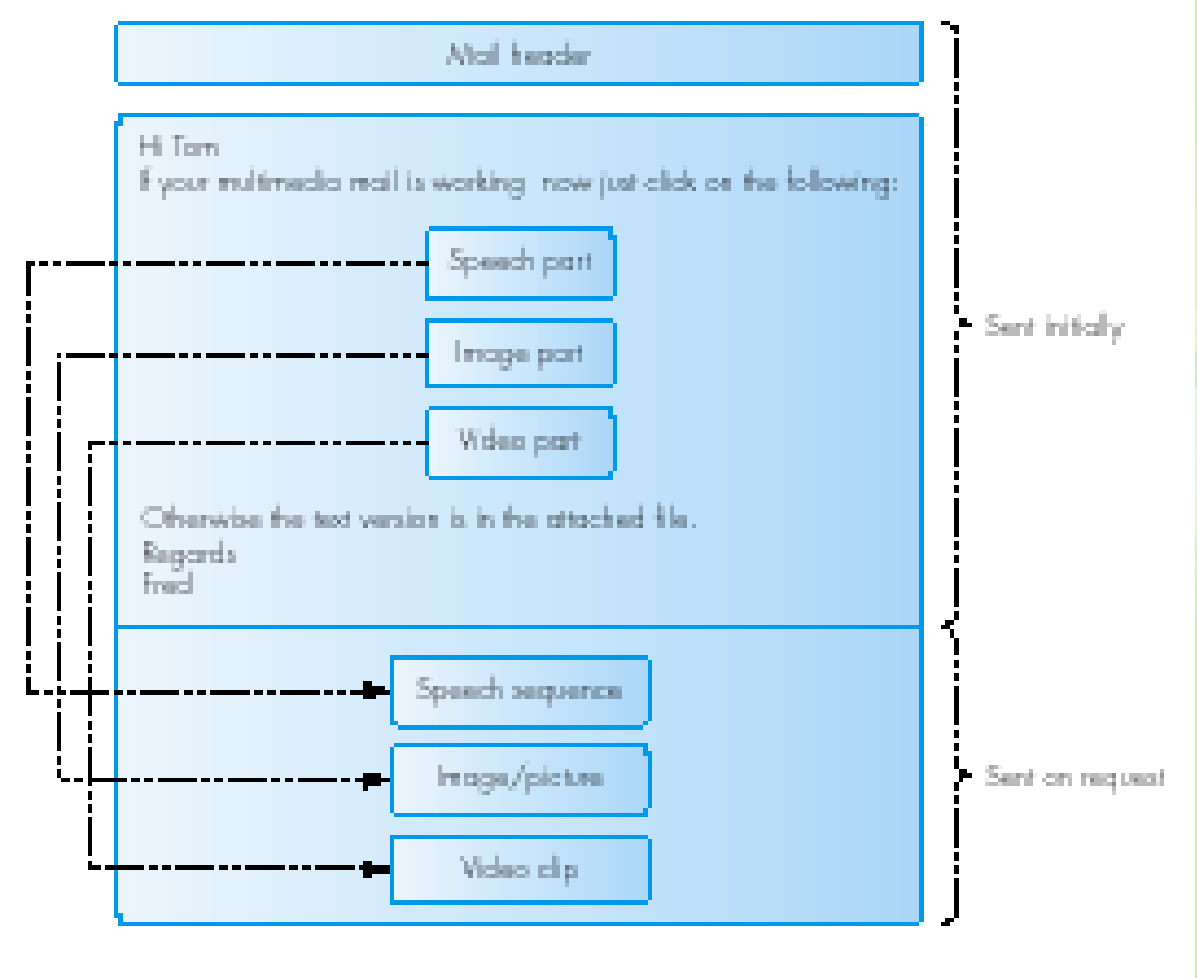
1.4.1 Interpersonal communications (cont.)

- Fig 1.12



1.4.1 Interpersonal communications (cont.)

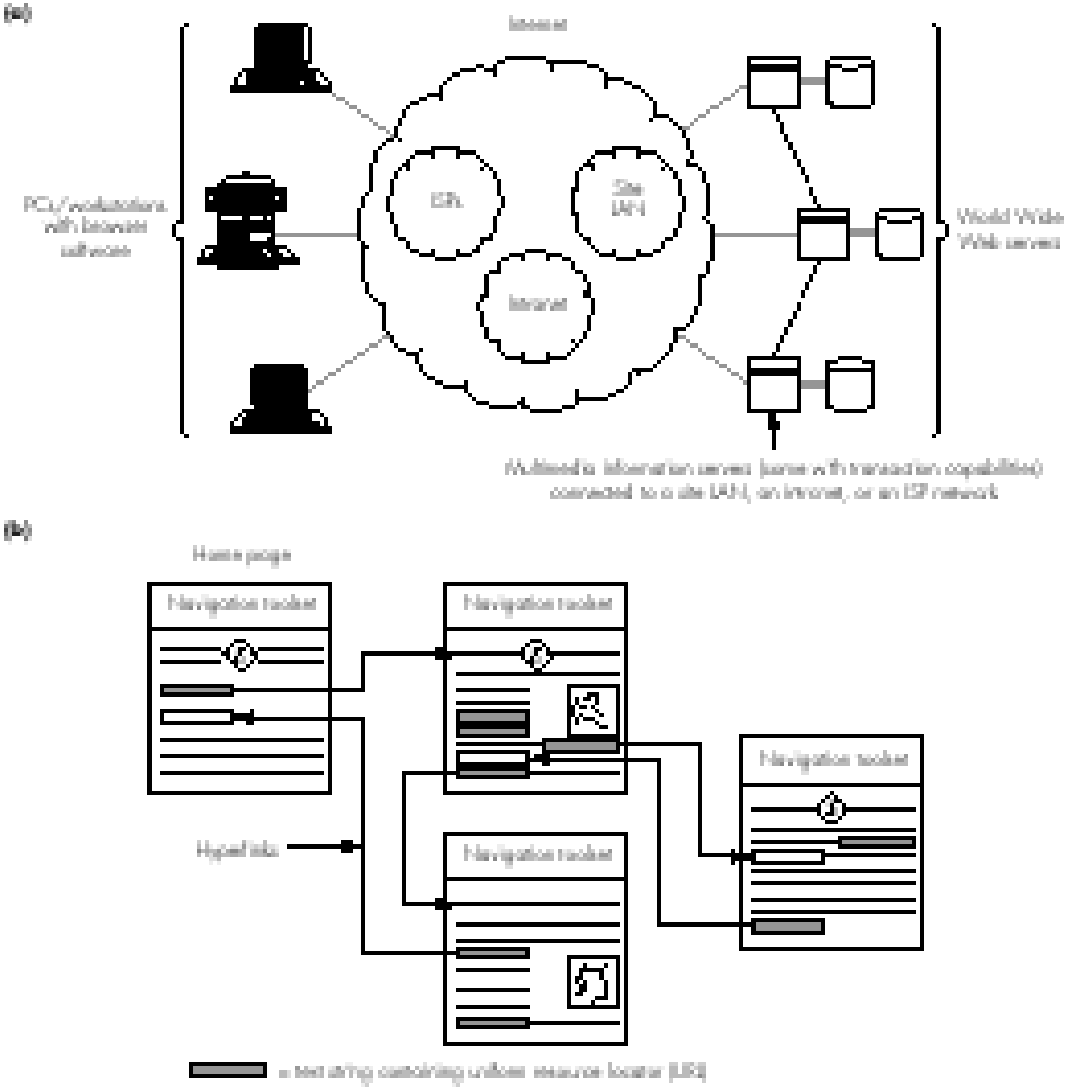
- Multimedia - Voice-mail, Multimedia mail
- Fig 1.13



1.4.2 Interactive applications over the Internet

- WWW
  - page
  - Hyperlink
  - HTML: hypertext markup language
  - Browser
  - URL: uniform resource locator

Fig 1.14


(a)
Internet
PCs/workstations with Internet software
LAN
Site LAN
Intranet
World Wide Web servers
(b)
Home page
Navigation toolkit
Navigation toolkit
Navigation toolkit
Navigation toolkit
Hyperlinks

1.4.3 Entertainment applications

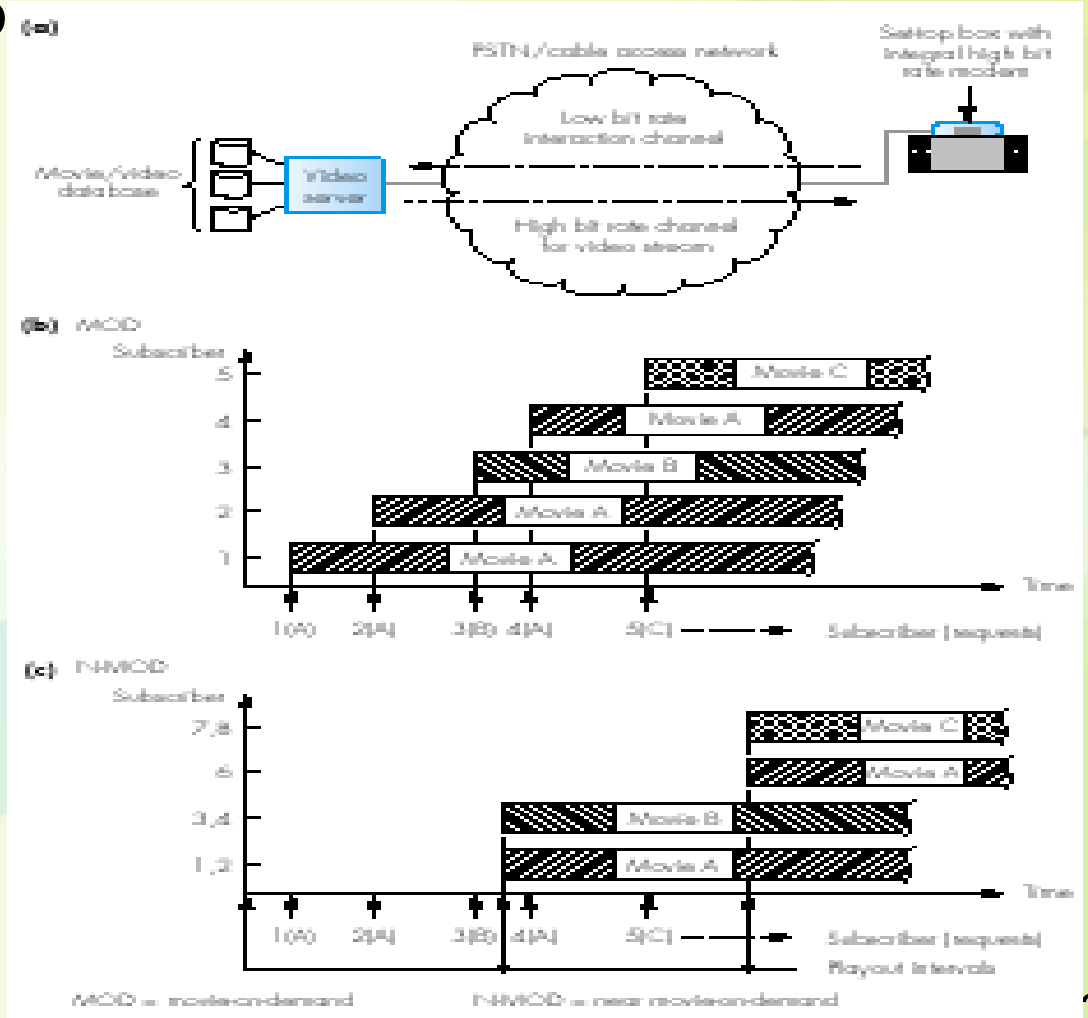
- Movie/video-on-demand
- Interactive television

1.4.3 Entertainment applications (cont.)

- Movie/video-on-demand
  - Movie-on-demand (MOD) or video-on-demand (VOD)
  - VCR-quality video:1.5 Mbps
  - Set-top box
  - A subscriber can initiate the showing of a movie selected from a large library of movies at any time of the day or night.
  - High server throughput

1.4.3 Entertainment applications (cont.)

- Fig 1.15

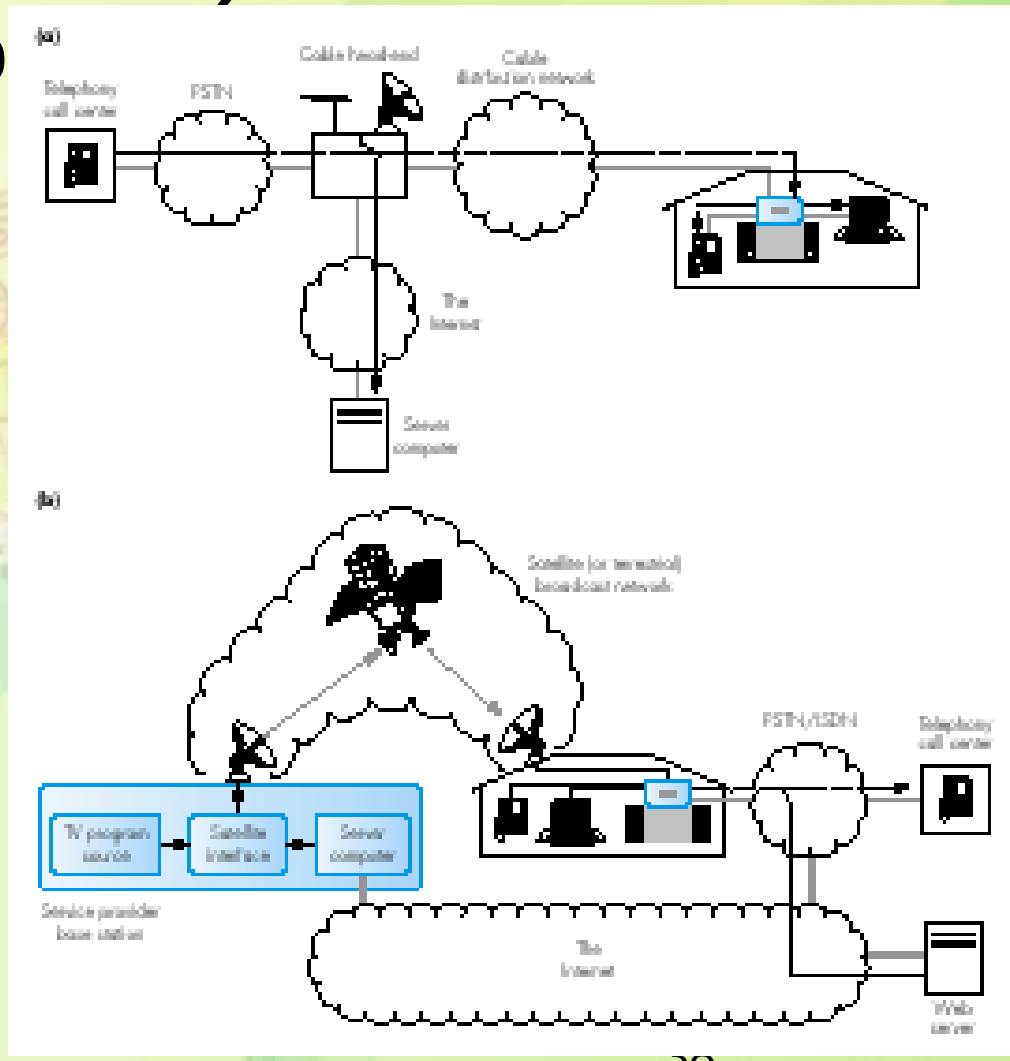


1.4.3 Entertainment applications (cont.)

- All requests for the same movie which are made during the period up too the next playout time are satisfied simultaneously by the server outputting a single video stream.
- Near movie-on-demand or N-MOD:
  - Requests are served in a batch mode.
  - A server outputs a single video stream for those requests requesting the same video.
  - Viewer, however, is unable to control the playout of the movie.
  - Homework here!

1.4.3 Entertainment applications (cont.)

- Interactive televisio
  - Fig 1.16

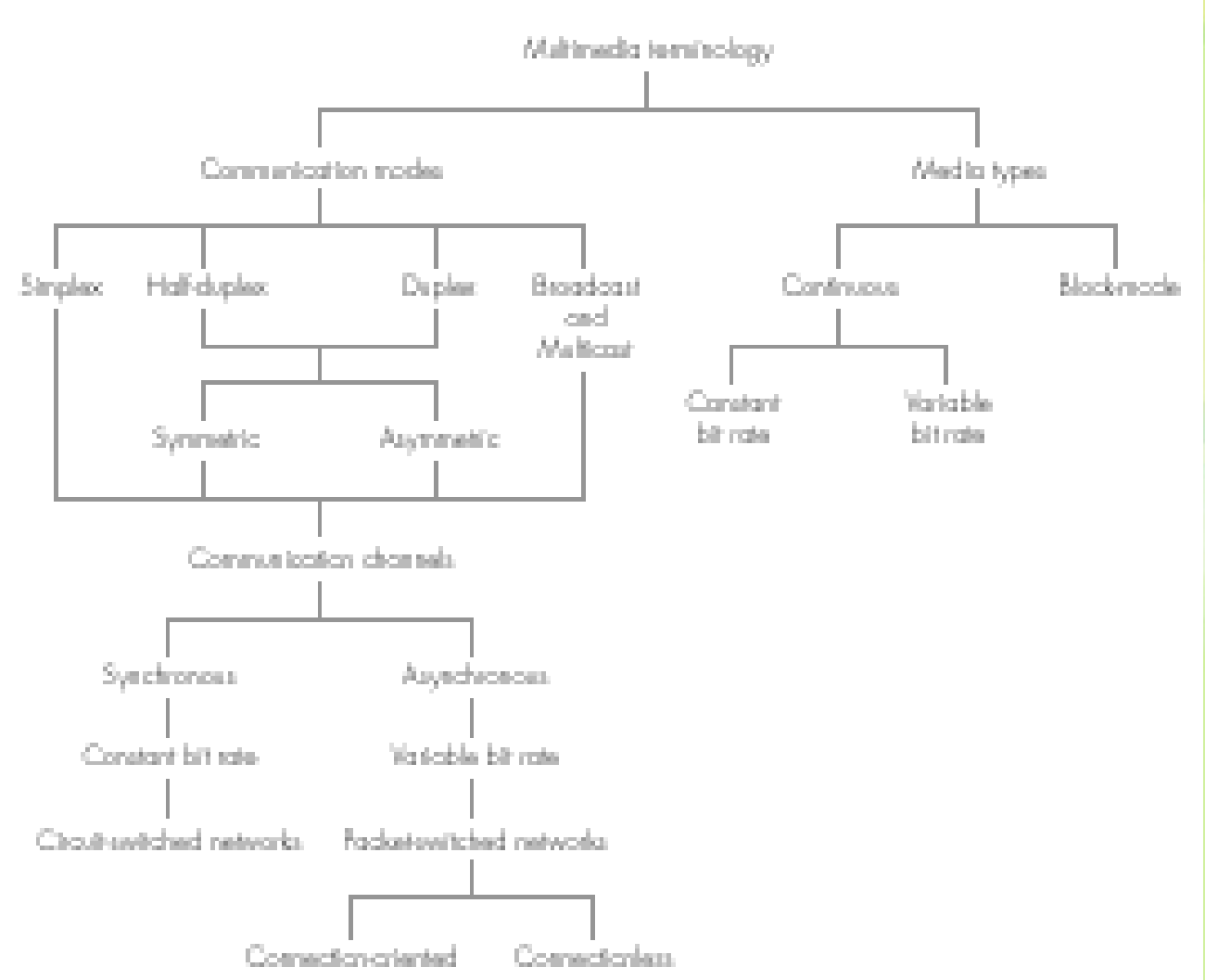


1.4.3 Entertainment applications (cont.)

- STB – the subscriber is able to gain access to all the services provided through the PSTN and the Internet.

1.5 Application and networking terminology

- Fig 1.17

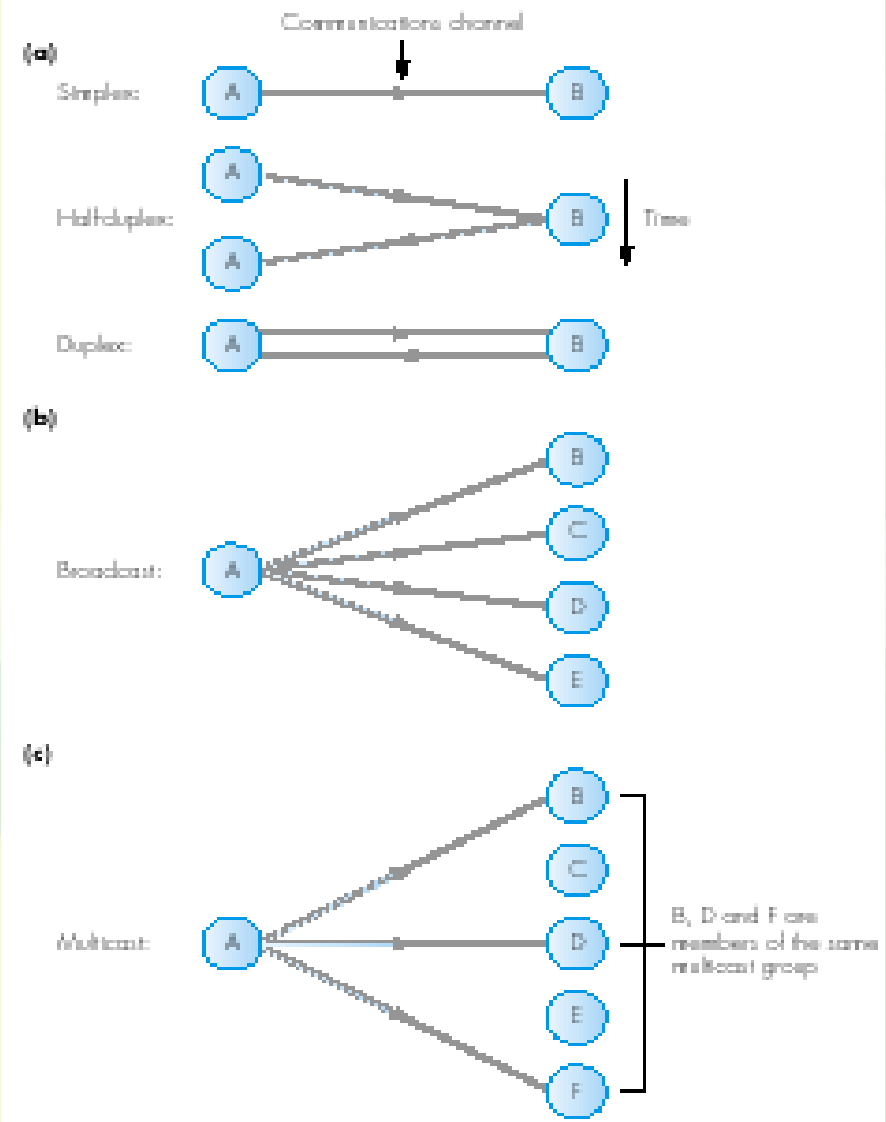


1.5.1 Media types

- Continuous media: real-time media
  - the information stream is generated by the source continuously in a time-dependent way.
  - Streaming - The information streams is played out directly as it is received.
  - Audio and video
  - Constant bit rate (CBR) or a variable bit rate (VBR)
- Block-mode media
  - A single block of information that is created in a time-independent way.
  - Text and image.
  - Round-trip delay (RTD): in a few seconds.

1.5.2 Communication modes

- Fig 1.18



- Symmetric: the bit rate associated with flow in each direction is the same. E.g., videoconference.
- Asymmetric: if different. E.g., VOD

1.5.3 Network types

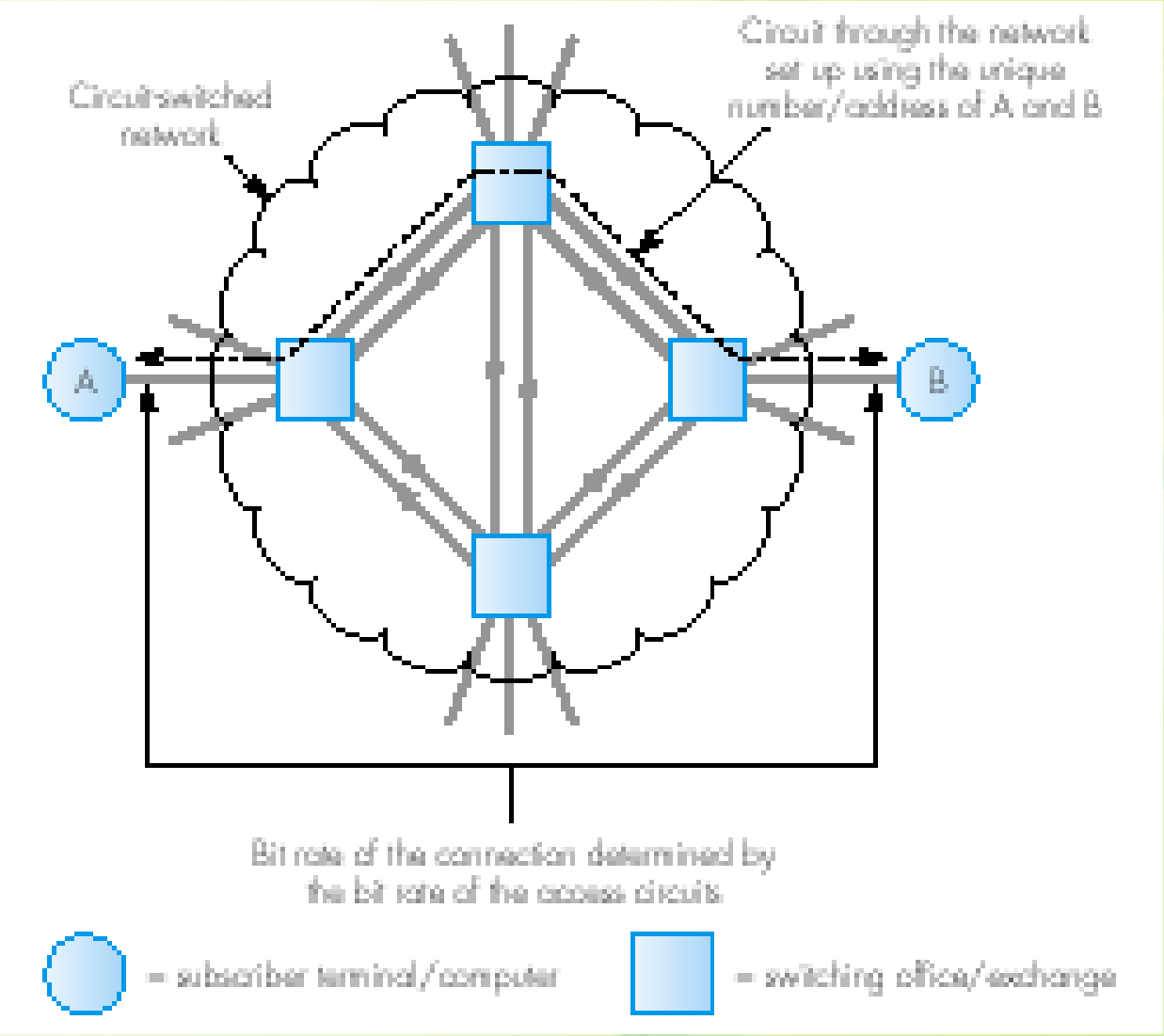
- Circuit mode: synchronous communications channel since it provides a constant bit rate service at a specified rate.
- Packet mode: asynchronous communications channel since it provides a variable bit rate service, the actual rate being determined by the (variable) transfer rate of packets across the network.

1.5.3 Network types (cont.)

- Circuit mode
  - Circuit-switched network
  - Signaling message: the messages associated with the setting up and clearing of a connection.
  - Call/connection setup delay
  - ISDN/PSTN

1.5.3 Network types (cont.)

- Fig 1.19

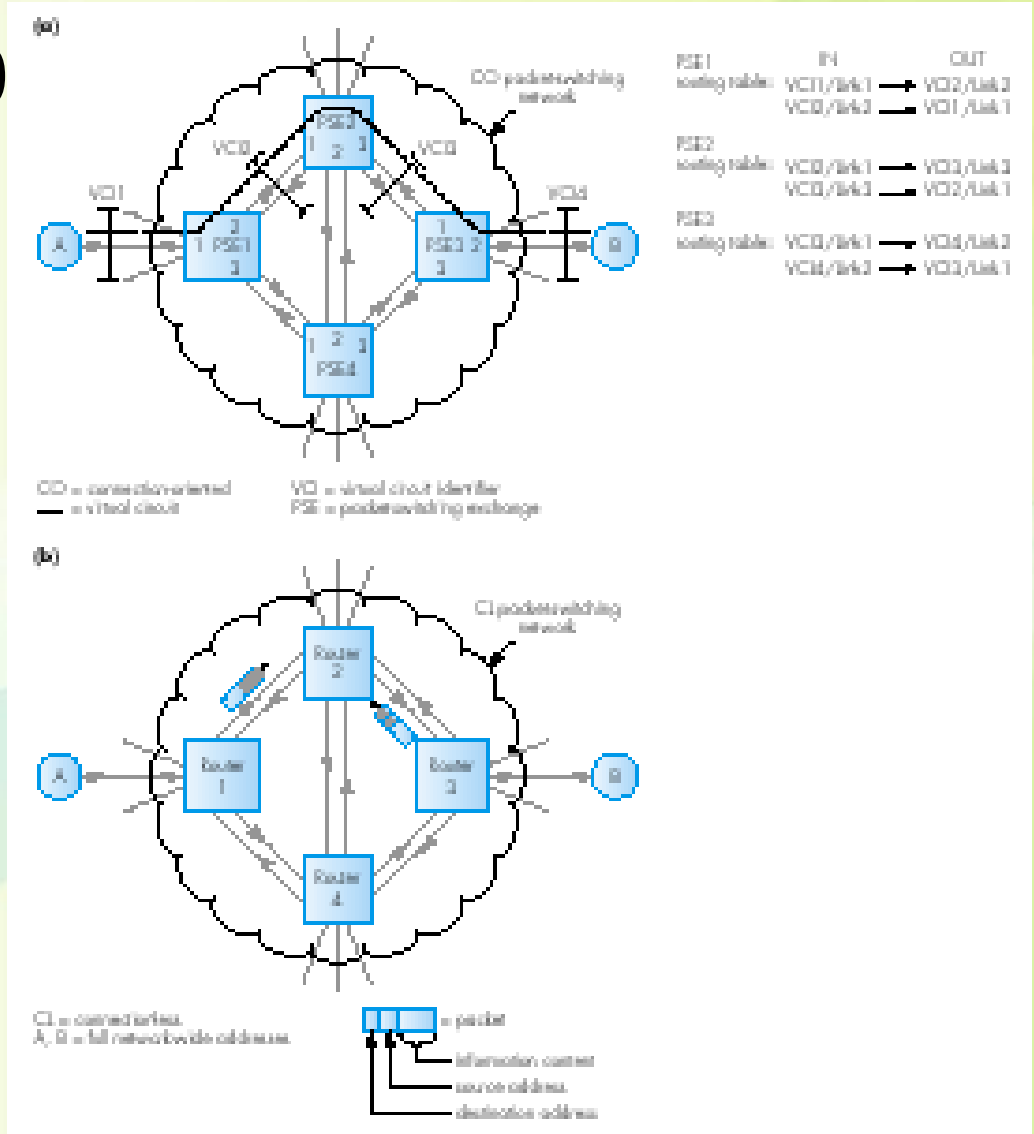


1.5.3 Network types (cont.)

- Packet mode
  - Packet-switch network
  - Connection-oriented (CO)
    - Virtual connection/circuit
    - Routing table
    - Virtual circuit identifier (VCI)
    - Only VCI is used in the packet header rather than network-wide address
  - connectionless (CL)
    - Each packet carries full source and destination addresses for routing.

1.5.3 Network types (cont.)

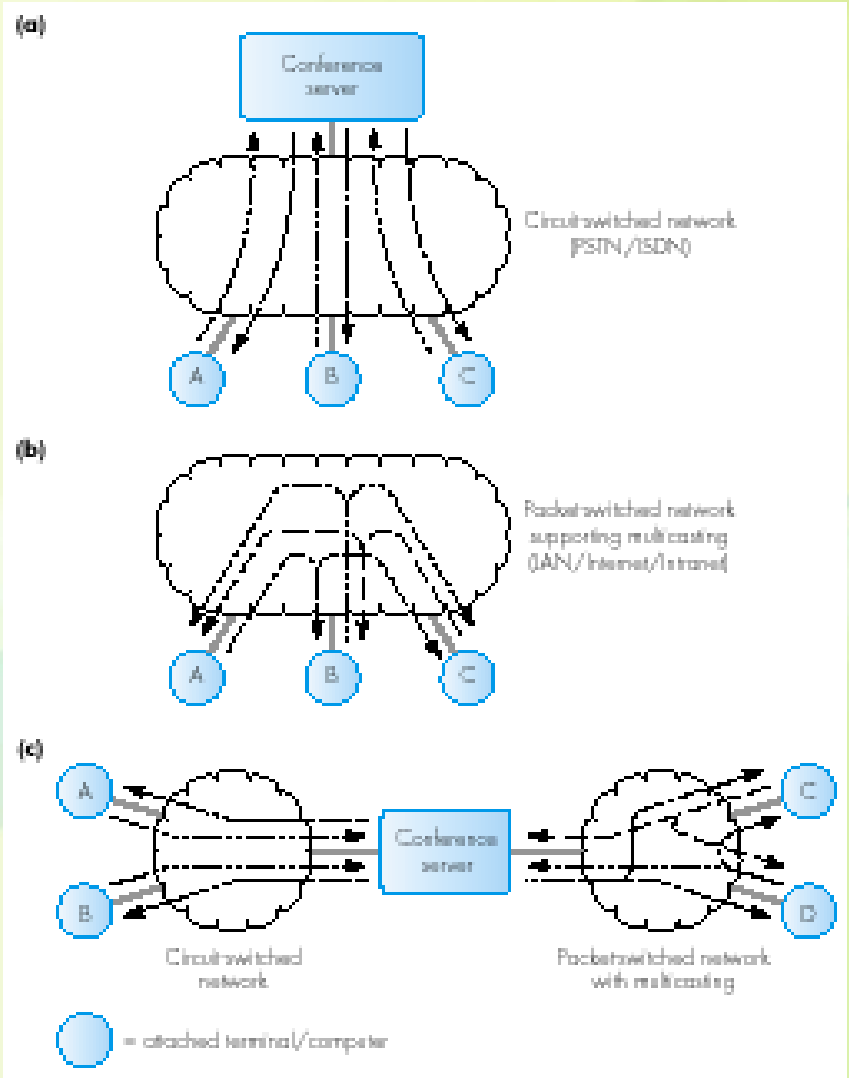
- Fig 1.20



- Best-effort service
- Store-and-forward
  - Delay in output queue.
  - Mean packet transfer delay
  - Delay variation/jitter
- X.25 and ATM: connection-oriented packet-switching network
- ATM: fast packet-switching/cell switching networks.

1.5.4 Multipoint conferencing

- Fig 1.21



1.5.4 Multipoint conferencing

- The centralized mode is used with circuit-switched networks such as a PSTN or an ISDN.
- The decentralized mode is used with packet-switched networks that support multicast communications.
- Hybrid mode
- Audio bridge
- MCU: multipoint control+multi point processor
- Voice-activated switching mode
- Continuous-presence mode

1.5.5 Network Qos

- Network Quality of Service (QoS): the operational parameters associates with a communications channel through a network.
- They determine the suitability of the channel in relation to its use for a particular application.

1.5.5 Network Qos (cont.)

- Circuit-switched network
  - The Bit rate
  - The mean bit error rate (BER)
    - the probability of a bit being corrupted during its transmission across the channel in a defined time interval.
    - $1-(1-P)^N$: prob. Of having at least one bit error.
  - The transmission delay
    - associated with codec delays (transmission time), plus the propagation delay ($2*10^8$m/s).
    - Ex.

1.5.5 Network Qos (cont.)

- Packet-switched network
  - The maximum packet size
  - The mean packet transfer rate
  - The mean packet error rate
  - The mean packet transfer delay
  - The worst-case jitter
  - The transmission delay

1.5.6 Application QoS

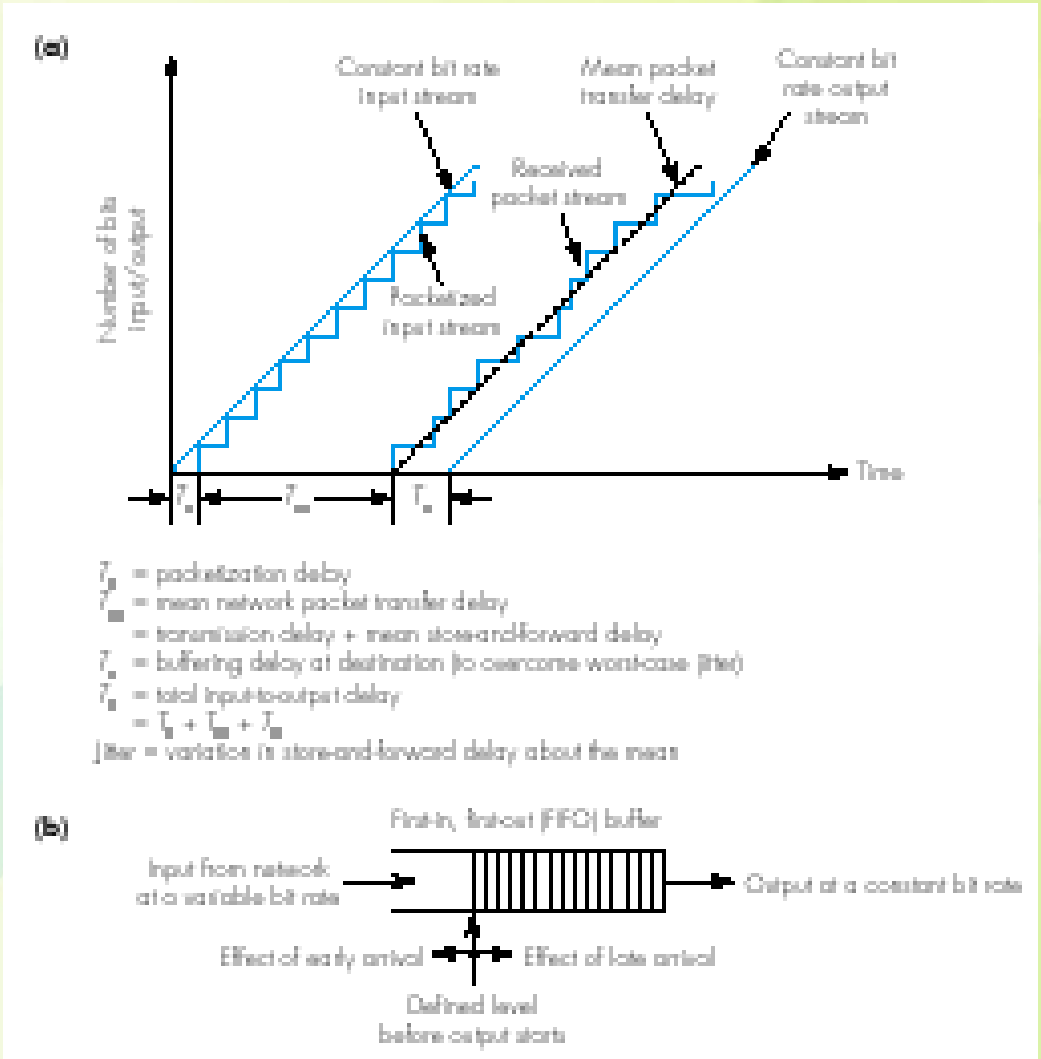
- For example, the parameters may include a minimum image resolution and size.
- The application QoS parameters that relate to the network include:
  - The required bit rate or mean packet transfer rate
  - The maximum startup delay
  - The maximum end-to-end delay
  - The maximum delay variation/jitter
  - The maximum round-trip delay

1.5.6 Application QoS (cont.)

- The startup delay defines the amount of time that elapses between an application making a request to start a session and confirmation being received from the application at the destination.
- To overcome the effect of jitter a technique known as buttering is used.
- Service classes
- Each service class is a specific set of QoS parameters and a network can either meet this set of parameters or not.
- The packets relating to each class are given a different priority.

1.5.6 Application QoS (cont.)

- Fig 1.22



Queries ...?