MULTIMEDIA COMMUNICATION -BEC613A

Module-1

Multimedia Communications

Contents

Module-1

Multimedia Communications:

- Introduction
- Multimedia information representation
- Multimedia networks
  - Telephone Networks
  - Data Networks
  - Broadcast Television Networks
  - Integrated Service Digital Network
  - Broadcast Multiservice Networks

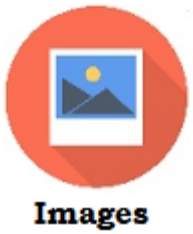
Contents

Module-1

- Multimedia applications
  - Interpersonal Communication
  - Interactive Application Over the internet
  - Entertainment Applications
- Application and networking terminology
  - Media Types
  - Communication Modes
  - Network Types
  - Multipoint Conferencing
  - Network QoS
  - Application Qos

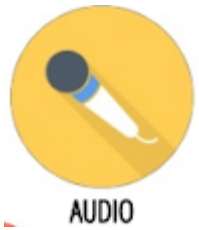
1. Introduction

Unformatted text,
Formatted text



Computer-generated,
Pictures

Multimedia



Speech, Music

Video clips, Movies

1.1 Introduction

Person to Person Communication

Terminal Equipment

Person to System Communication

PC

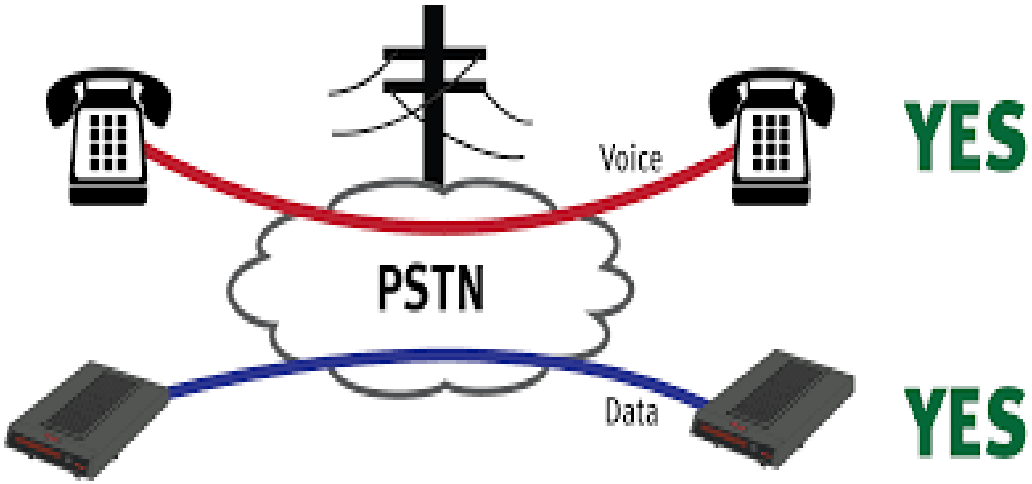
Server

Set-Top-Box (STB)

1.1 Introduction

PSTN Networks

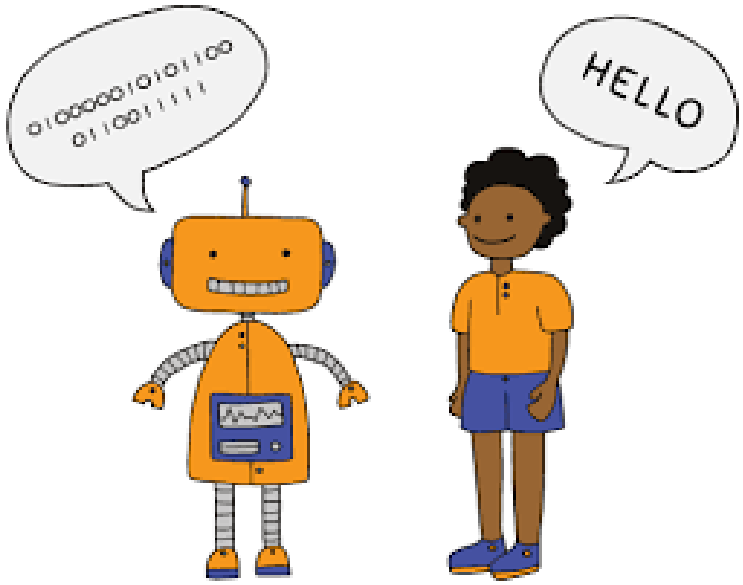
Data Networks

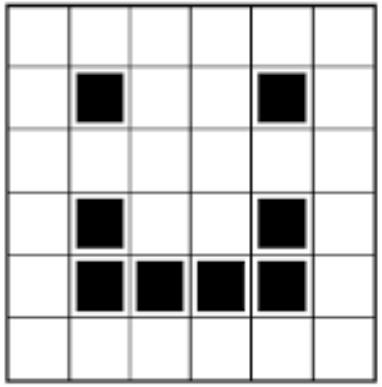


1.2 Multimedia Information Representation

Text

Character -> Bit-----Codeword





```
1 1 1 1 1 1
1 0 1 1 0 1
1 1 1 1 1 1
1 0 1 1 0 1
1 0 0 0 0 1
1 1 1 1 1 1
```

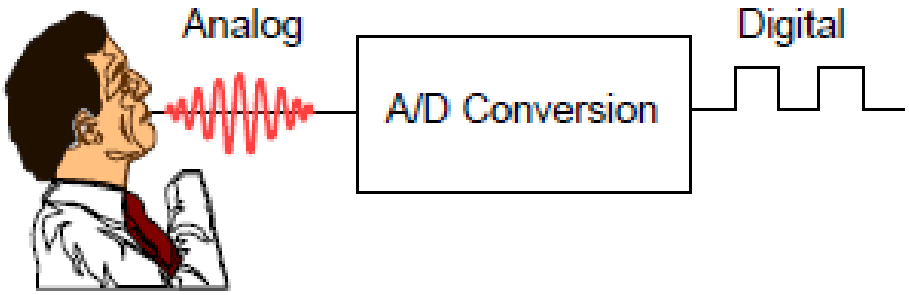
Image

Picture elements ->Fixed Number of Bits

1. 2 Multimedia Information Representation

Audio and Video

Analog Signal



1.2 Multimedia Information Representation

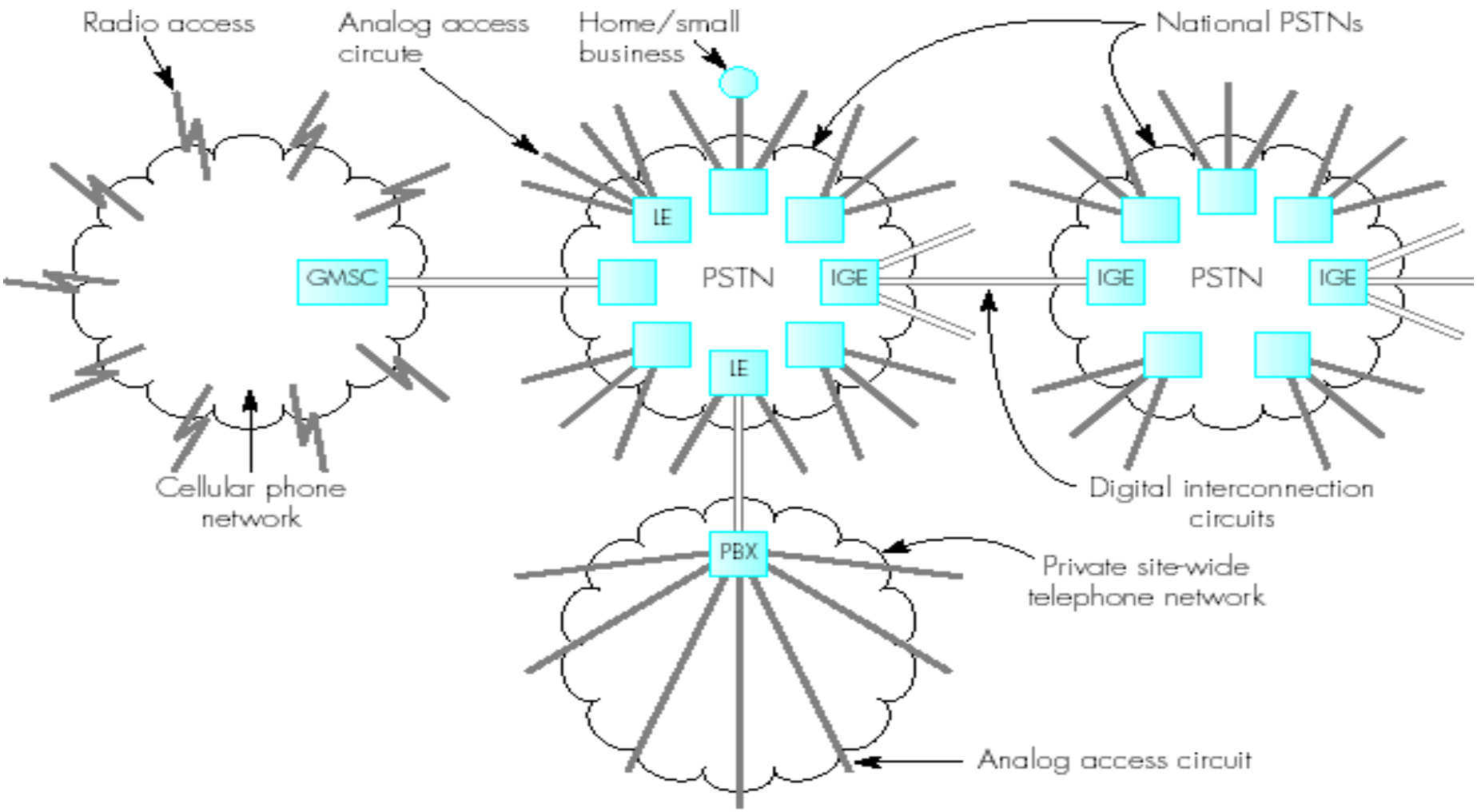
- Digital Representation
- Measured in bit per second (bps)
- Compression

1.3 Multimedia Networks

1. Telephone Networks
2. Data Networks
3. Broadcast Television Networks
4. Integrated Service Digital Network
5. Broadcast Multiservice Networks

1.3.1 Telephone Networks

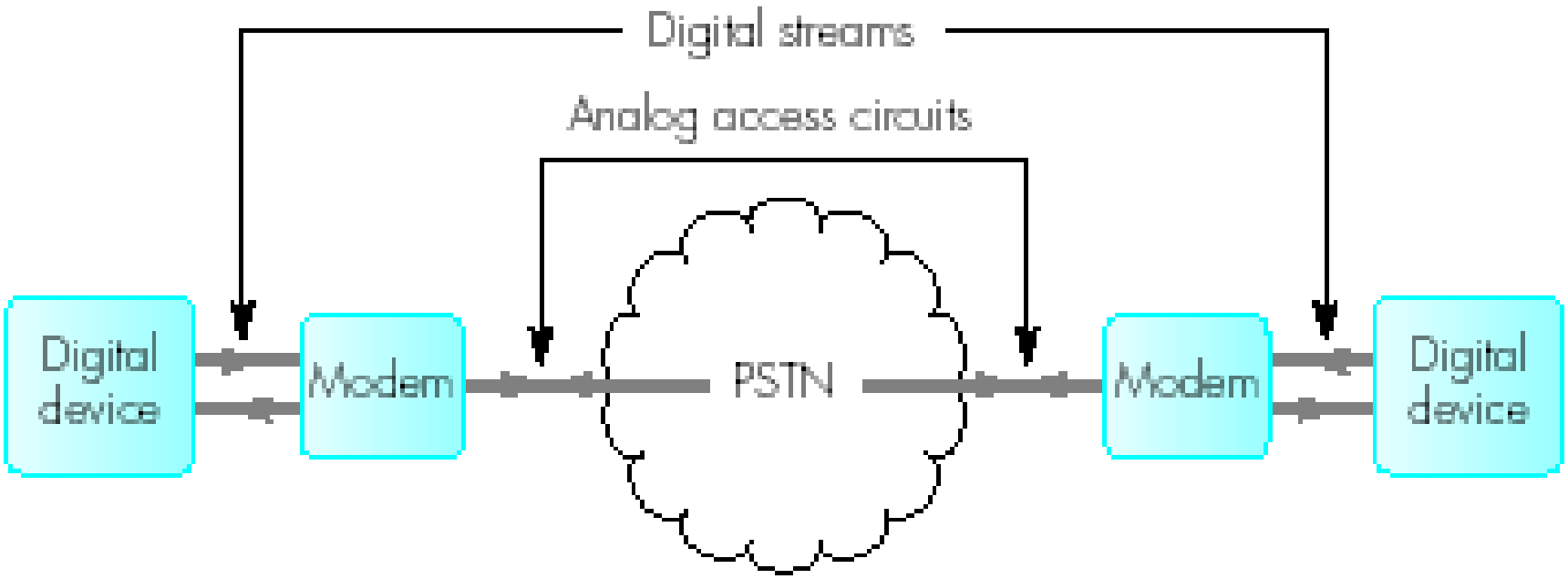
a. Network Components



PSTN = public switched telephone network
GMSC = gateway mobile switching center
IGE = international gateway exchange
LE = local exchange/end office
PBX = private branch exchange

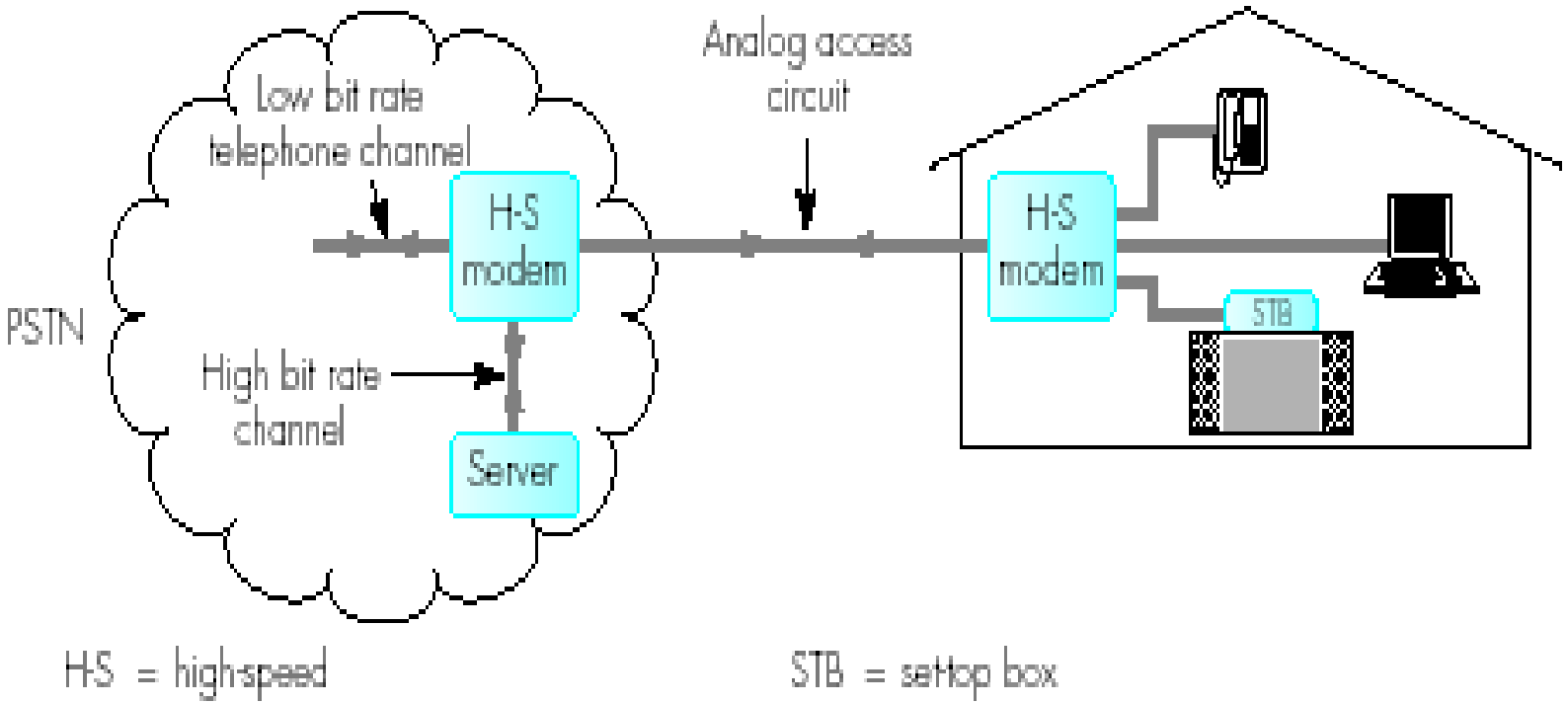
1.3.1 Telephone Networks

b. Digital Transmission Using Modems



1.3.1 Telephone Networks

C. Multiple Services via an H-S modem



1.3 Multimedia Networks

1. Telephone Networks
2. Data Networks
3. Broadcast Television Networks
4. Integrated Service Digital Network
5. Broadcast Multiservice Networks

1.3.2 Data Networks

- Designed to provide basic data communication--email and general file transfer,
- X.25 network and the Internet
- The Internet is made up of a vast collection of interconnected networks all of which operate using the same set of communication protocols.
- Communication protocol

  Agreed set of rules that are adhered to by all communication parties for the exchange of information.

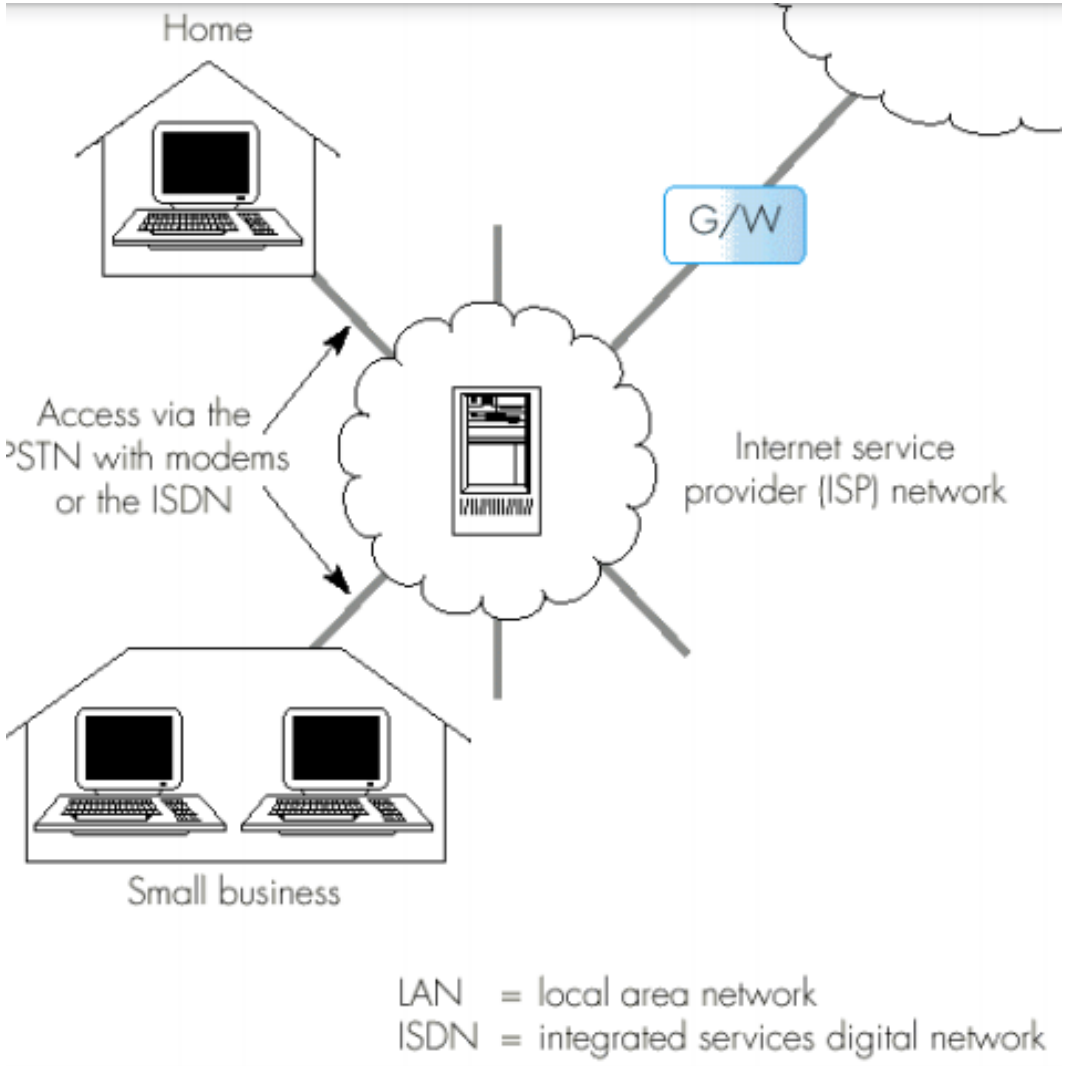
  Defines

  (i) the sequence of messages for the exchange of information and

  (ii) the syntax of these messages.

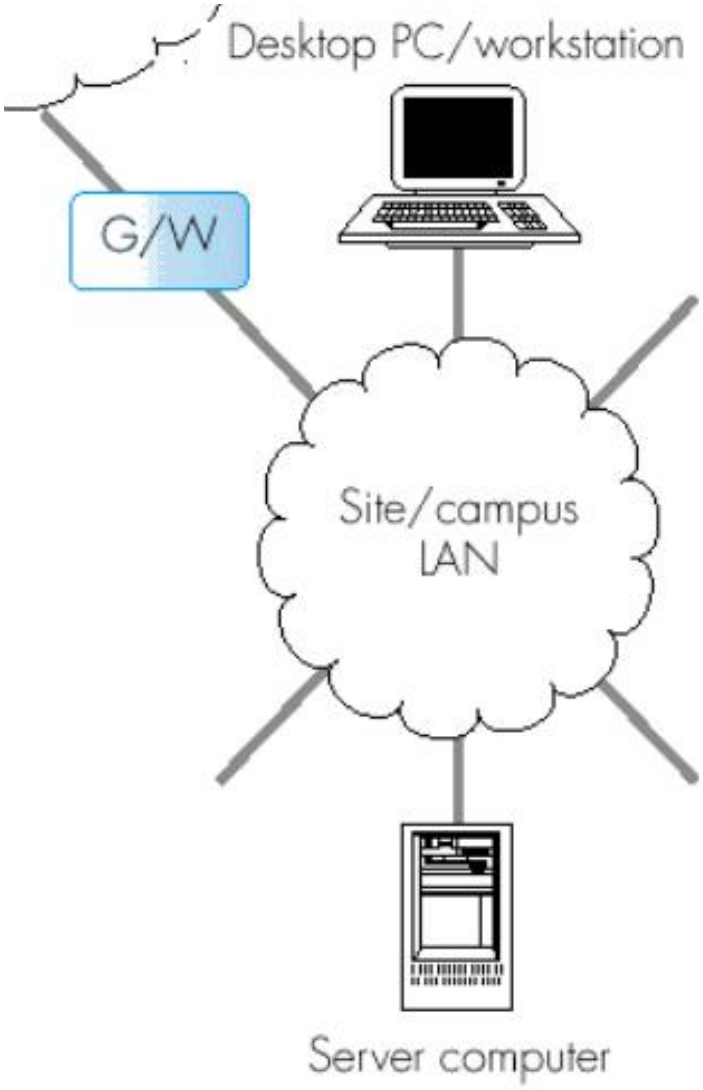
1.3.2 Data Networks

Selection of the network types connected to the internet



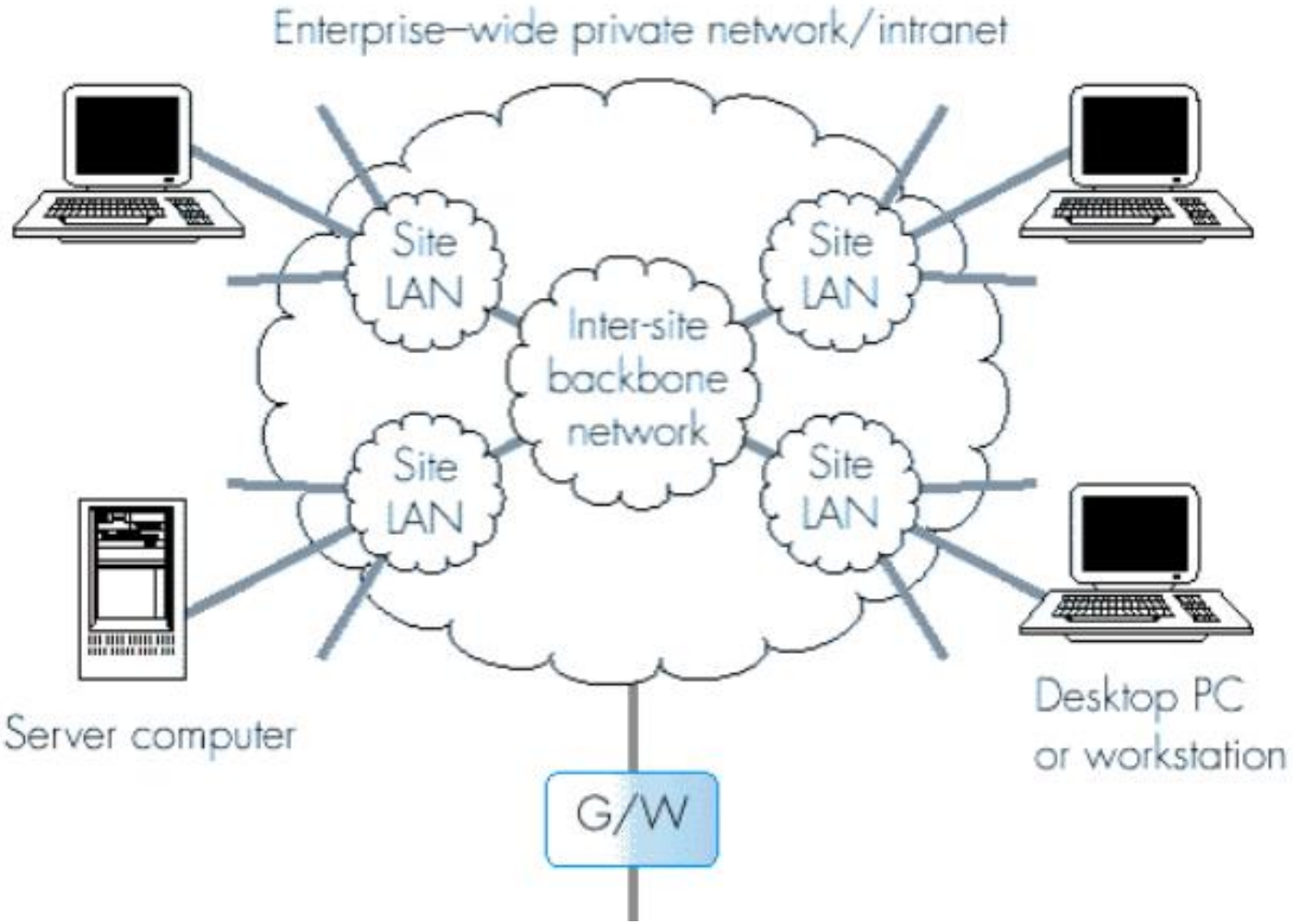
1.3.2 Data Networks

Selection of the network types connected to the internet



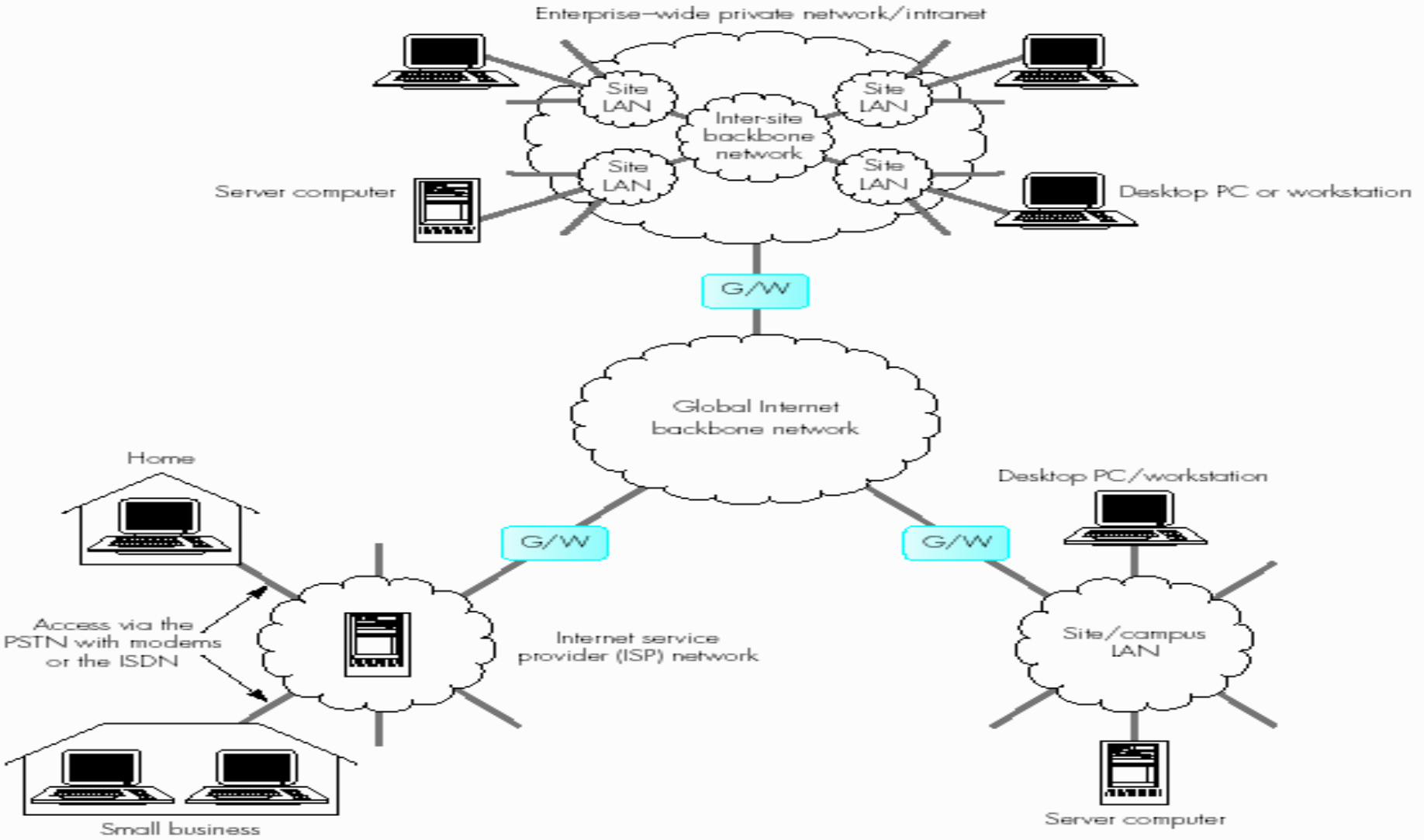
1.3.2 Data Networks

Selection of the network types connected to the internet



1.3.2 Data Networks

Selection of the network types connected to the internet



1.3.2 Data Networks

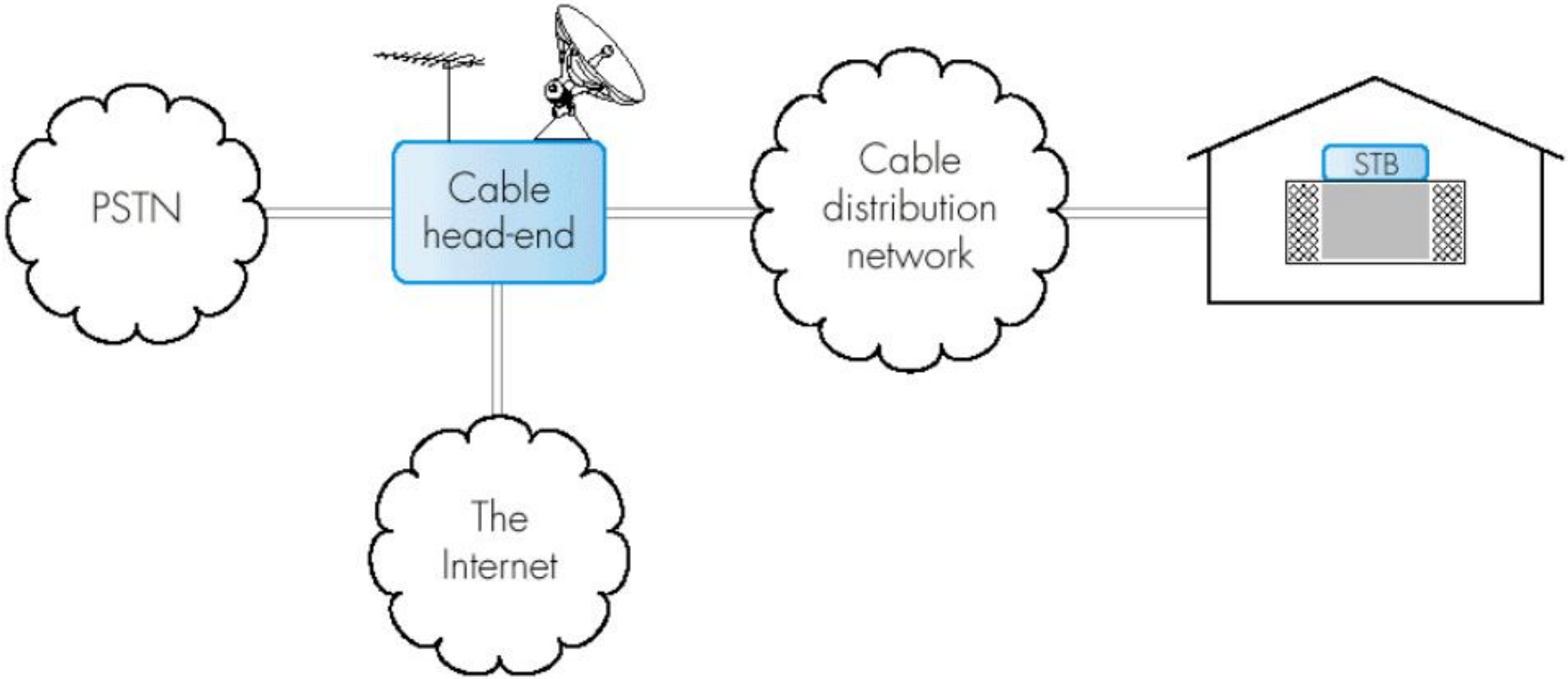
- All data networks operate in packet mode.
- A packet is a container for a block of data and the information for routing the packet to the destination through the network.
- This mode is used because the format of the data associated with data applications is normally in the form of discrete blocks of text or binary data with varying time intervals between each block.

1.3.3 Broadcast Television Networks

- Support the diffusion of analog television (and radio) programs throughout wide geographical areas.
- Broadcast media include
  - Cable distribution network : for a town or city
  - Satellite network / Terrestrial broadcast network : for larger areas

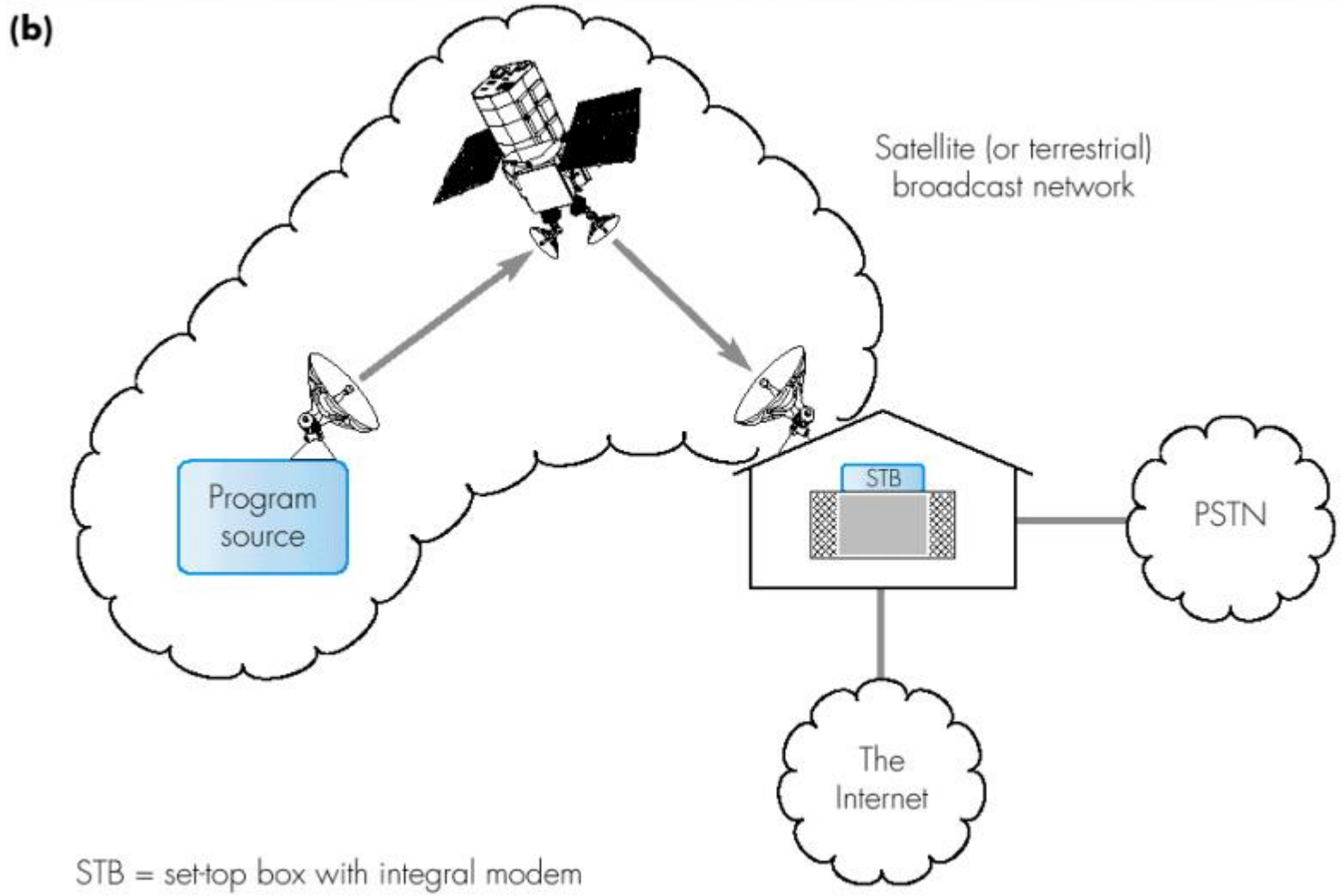
1.3.3 Broadcast Television Networks

Cable Network



1.3.3 Broadcast Television Networks

Satellite network / Terrestrial broadcast network



1.3.4 Integrated Service Digital Network

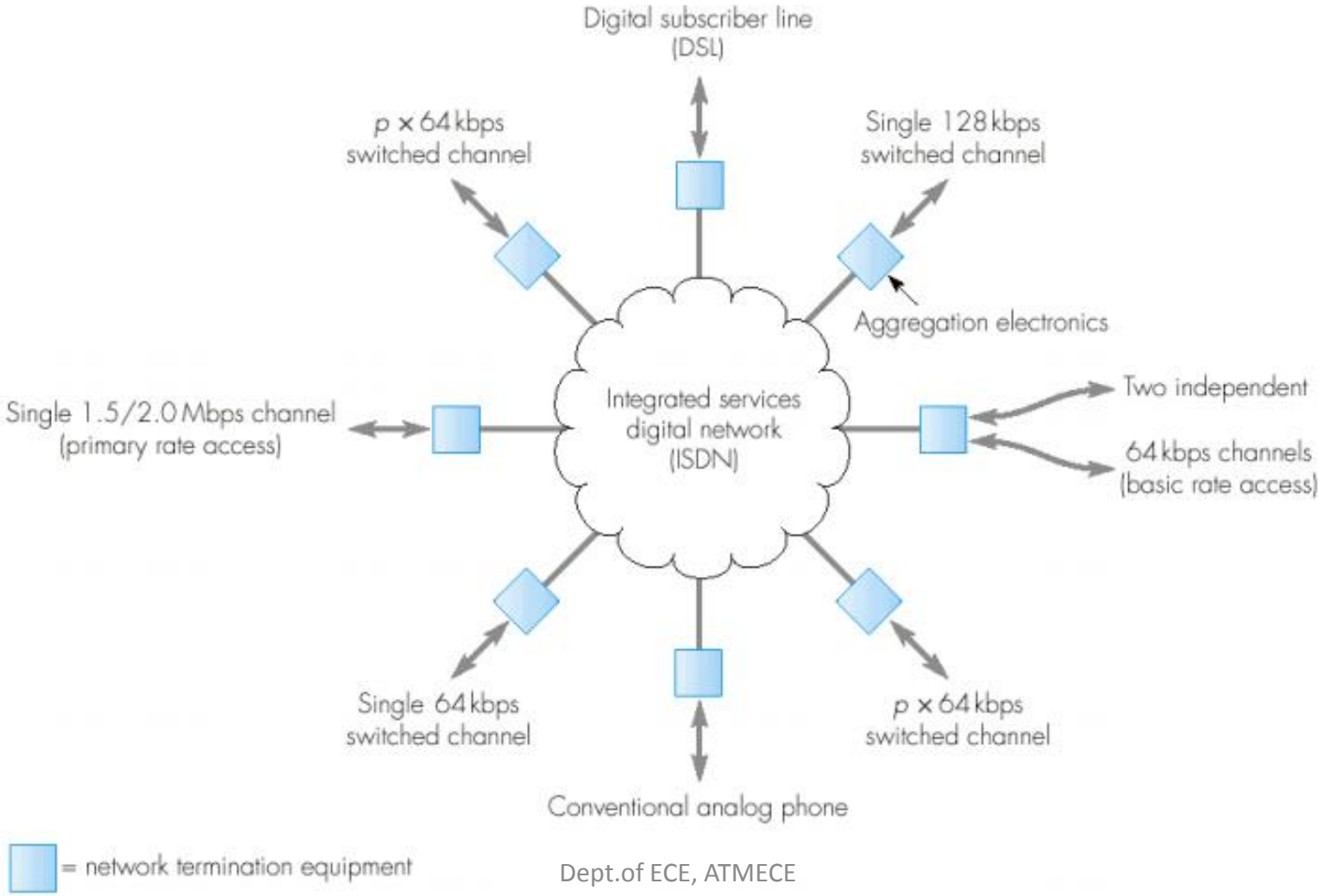
- Designed to provide PSTN users with the capability of having additional service
- This was achieved by

  (i) Converting the access circuits that connect user equipment to the network into an all-digital form

  (ii) Providing 2 separate communication channels over these circuits.

1.3.4 Integrated Service Digital Network

Alternative Service Provided by ISDN



1.3.5 Broadband multiservice networks

- To support a wide range of multimedia communication applications.
- "Broadband" --it can support a bit rate higher than an ISDN can support (>2Mbps).
- This type of network is also known as broadband ISDN

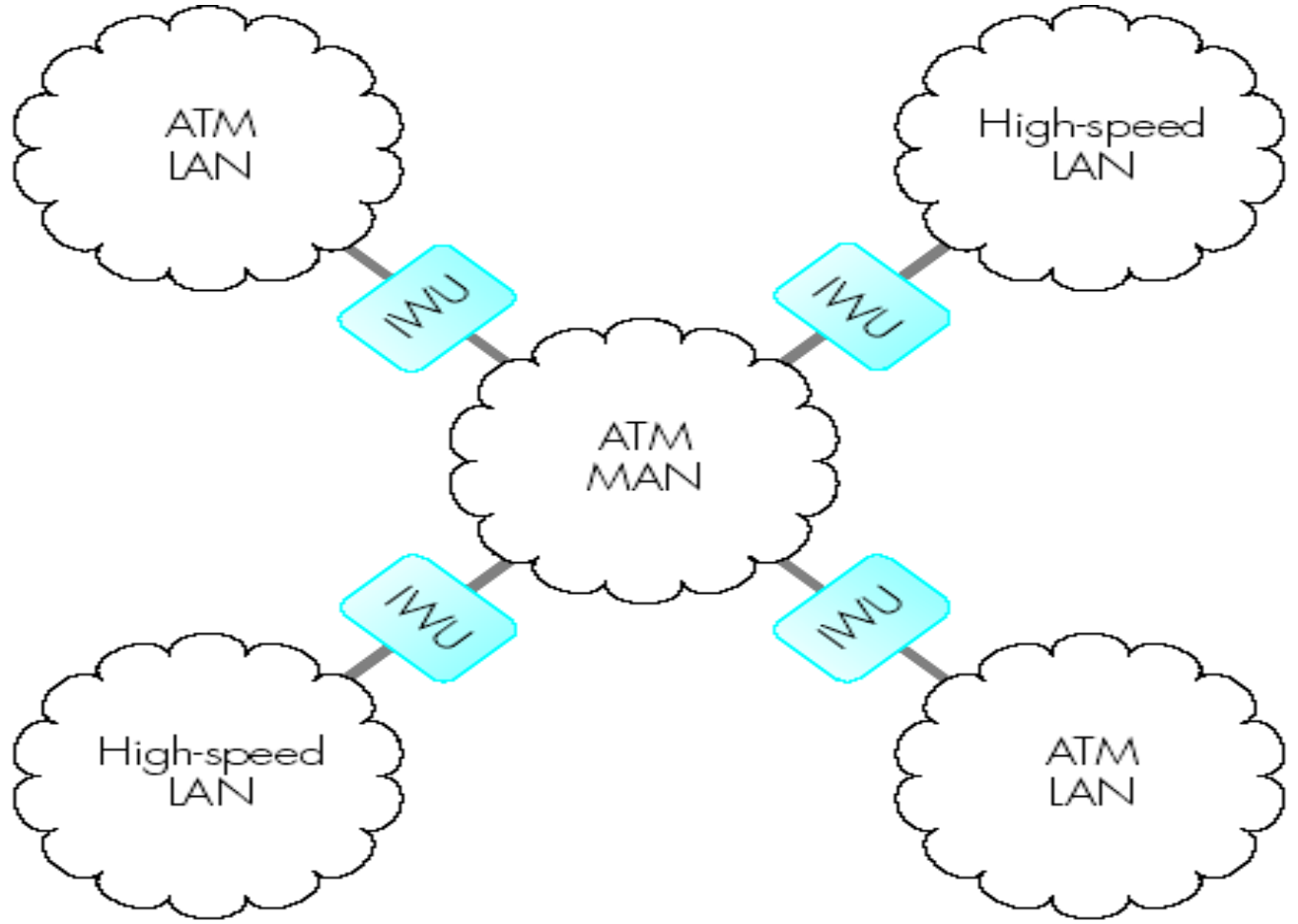
  (B-ISDN)
- Switching and transmission methods that are used in these networks are more flexible as they are designed to support multiple services.

1.3.5 Broadband multiservice networks

- All media types are converted into digital form and integrated together, and the resulting stream is divided into fixed-sized packets known as cells.
- Different multimedia applications generate cell streams of different rates and hence the rate of transfer of cells through the network varies.
- This mode of transmission is known as asynchronous transfer mode (ATM)

1.3.5 Broadband multiservice networks

Example of an ATM broad band multiservice Network



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

1.4 Multimedia Applications

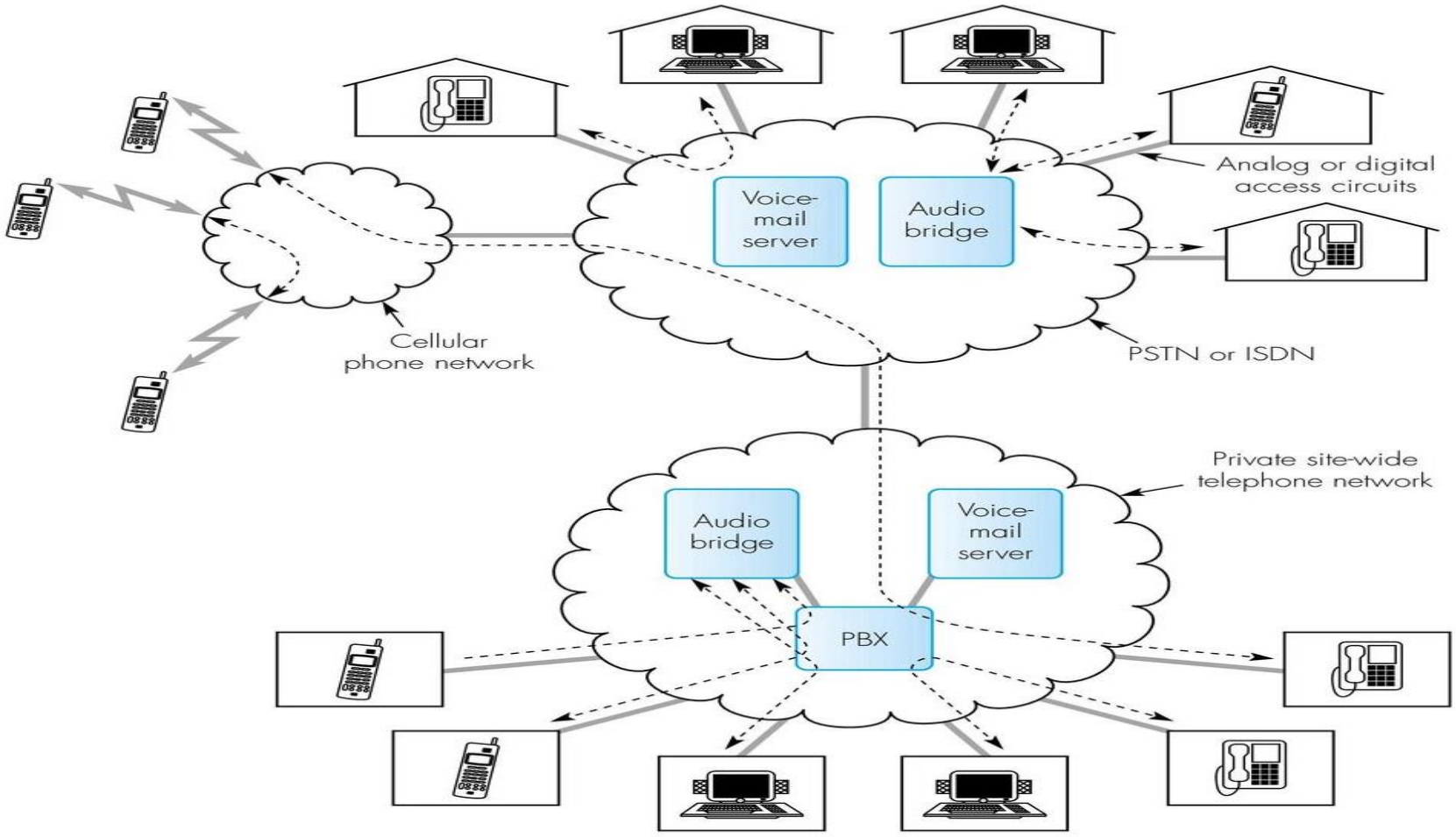
1. Interpersonal Applications
2. Interactive Applications Over the Internet
3. Entertainment Applications

1.4 .1 Interpersonal Applications

1. Speech only
2. Image Only
3. Text only
4. Text and Images
5. Speech and Video

Speech Only Interpersonal Communication

Public and Private Switched Telephone Network



PSTN = Public switched telephone network
PBX = Private branch exchange

ISDN = Integrated services digital networrk

Speech Only Interpersonal Communication

Telephony Over The Internet

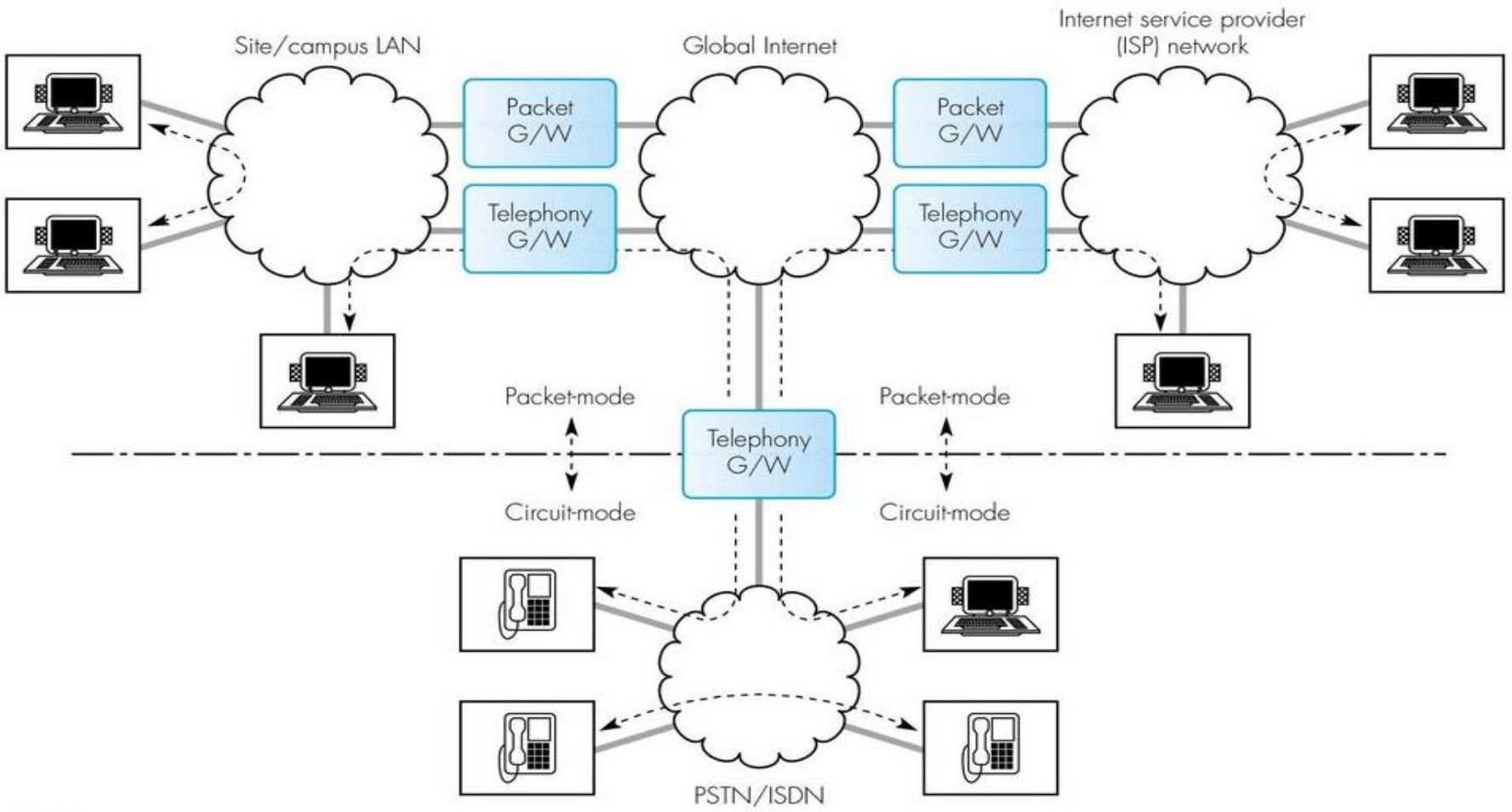
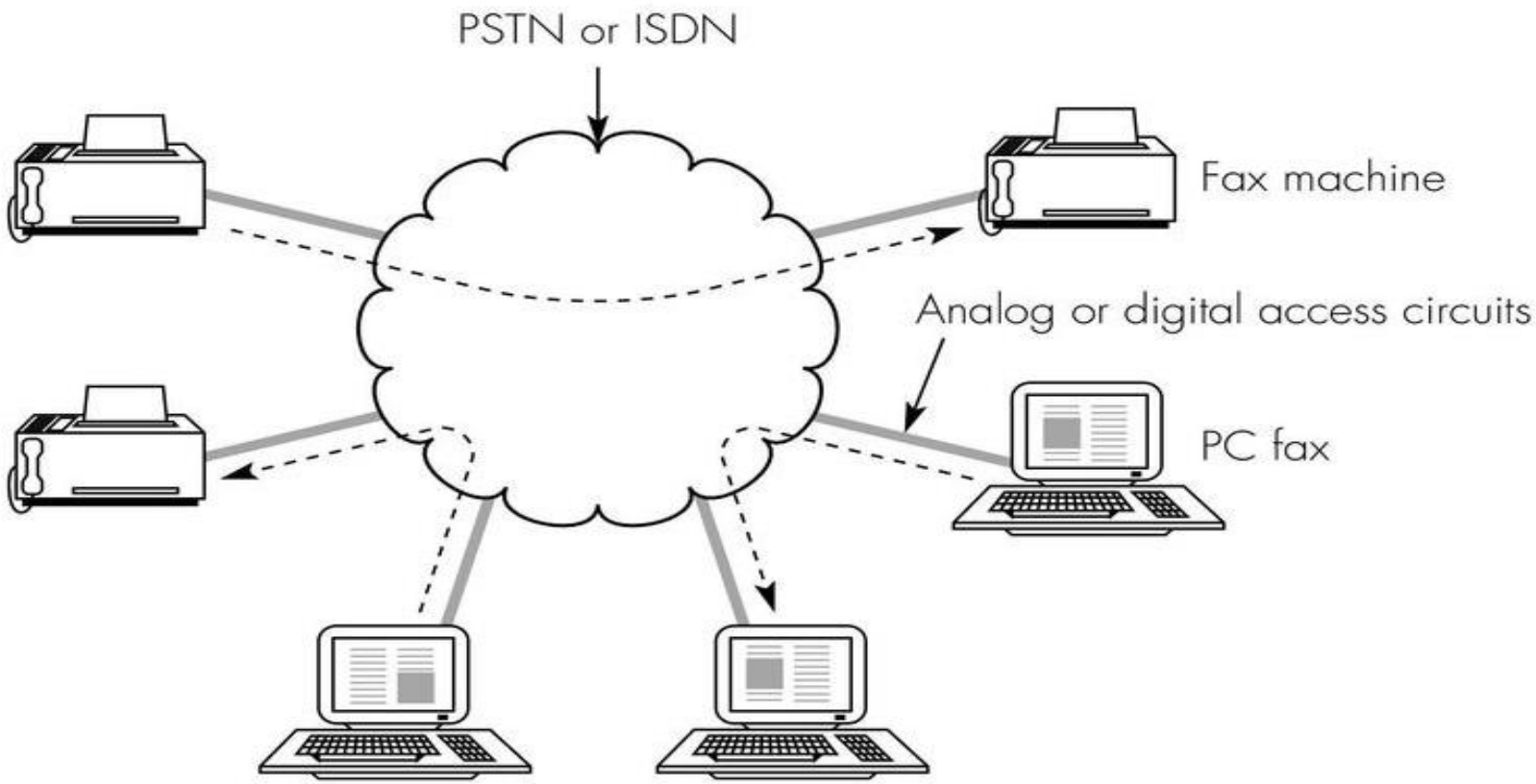


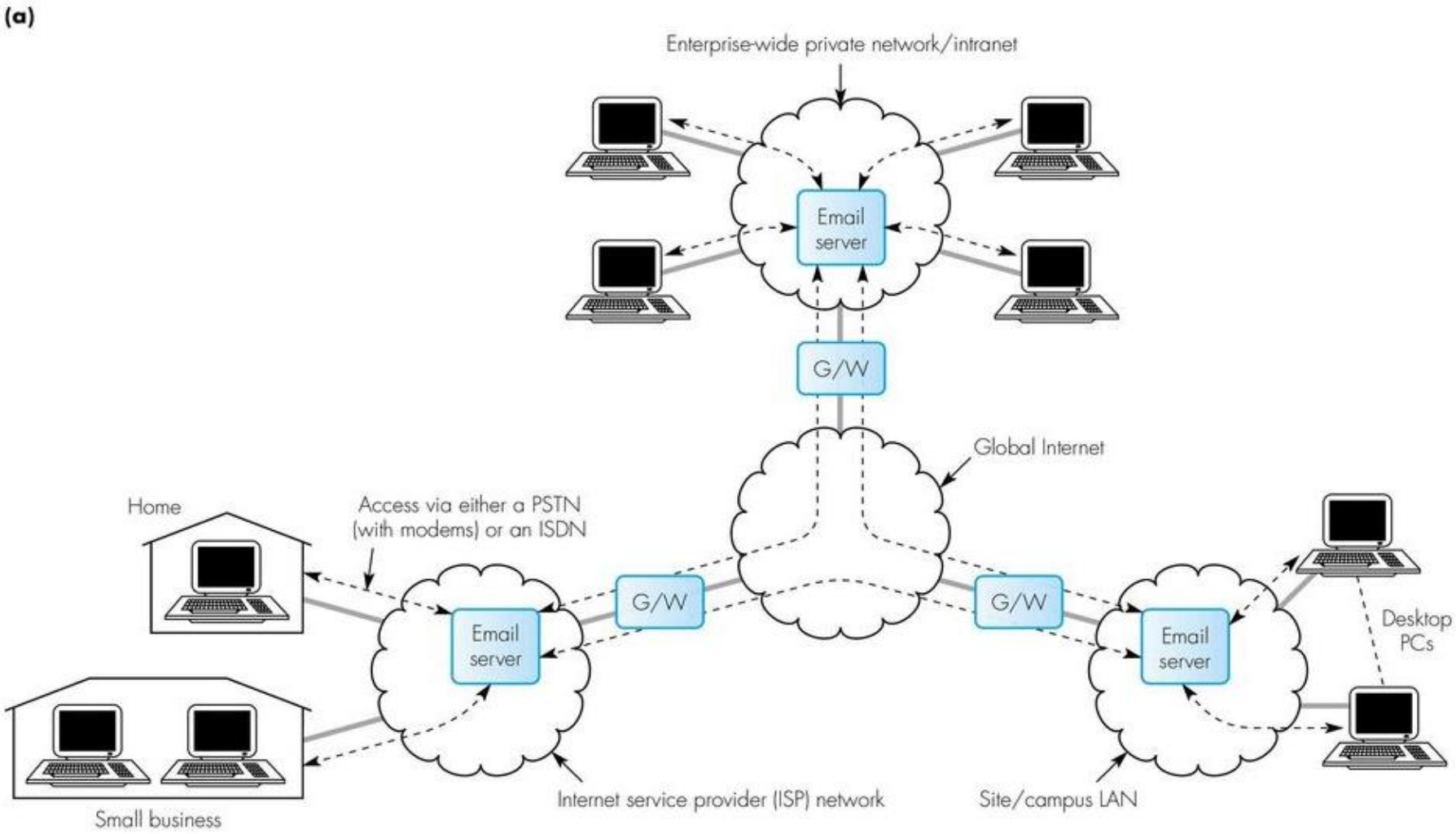
Image only Interpersonal Communication

Facsimile (fax) Example



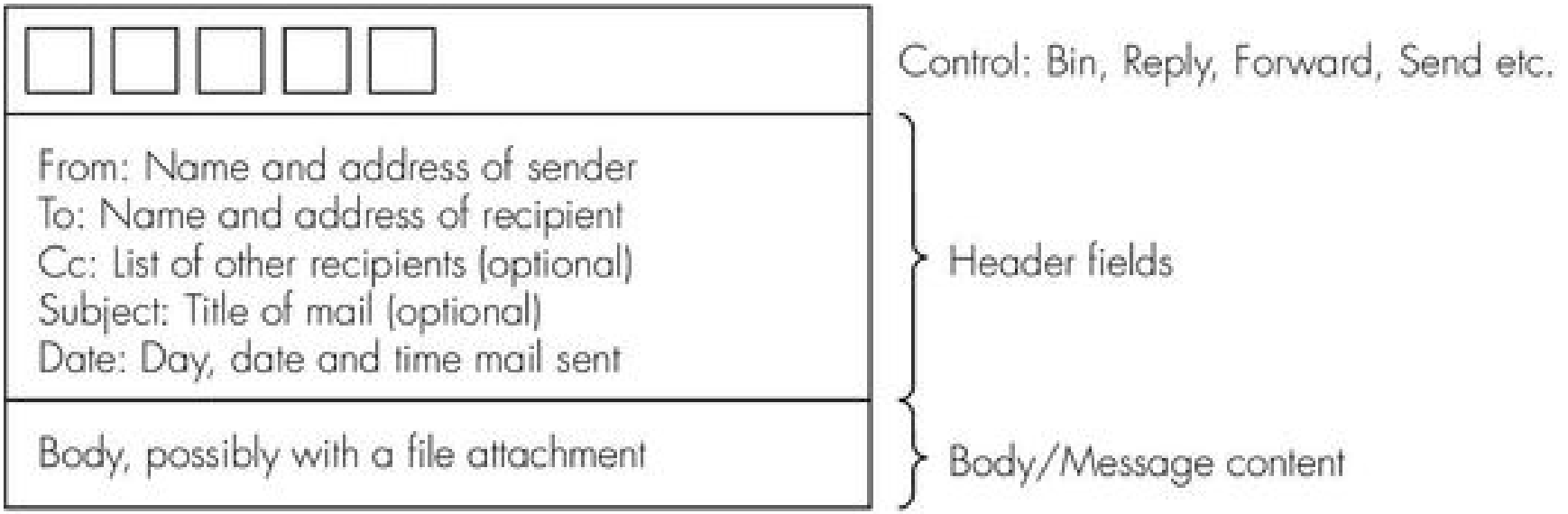
Text only Electronic Mail (Email)

Email Transfer Example

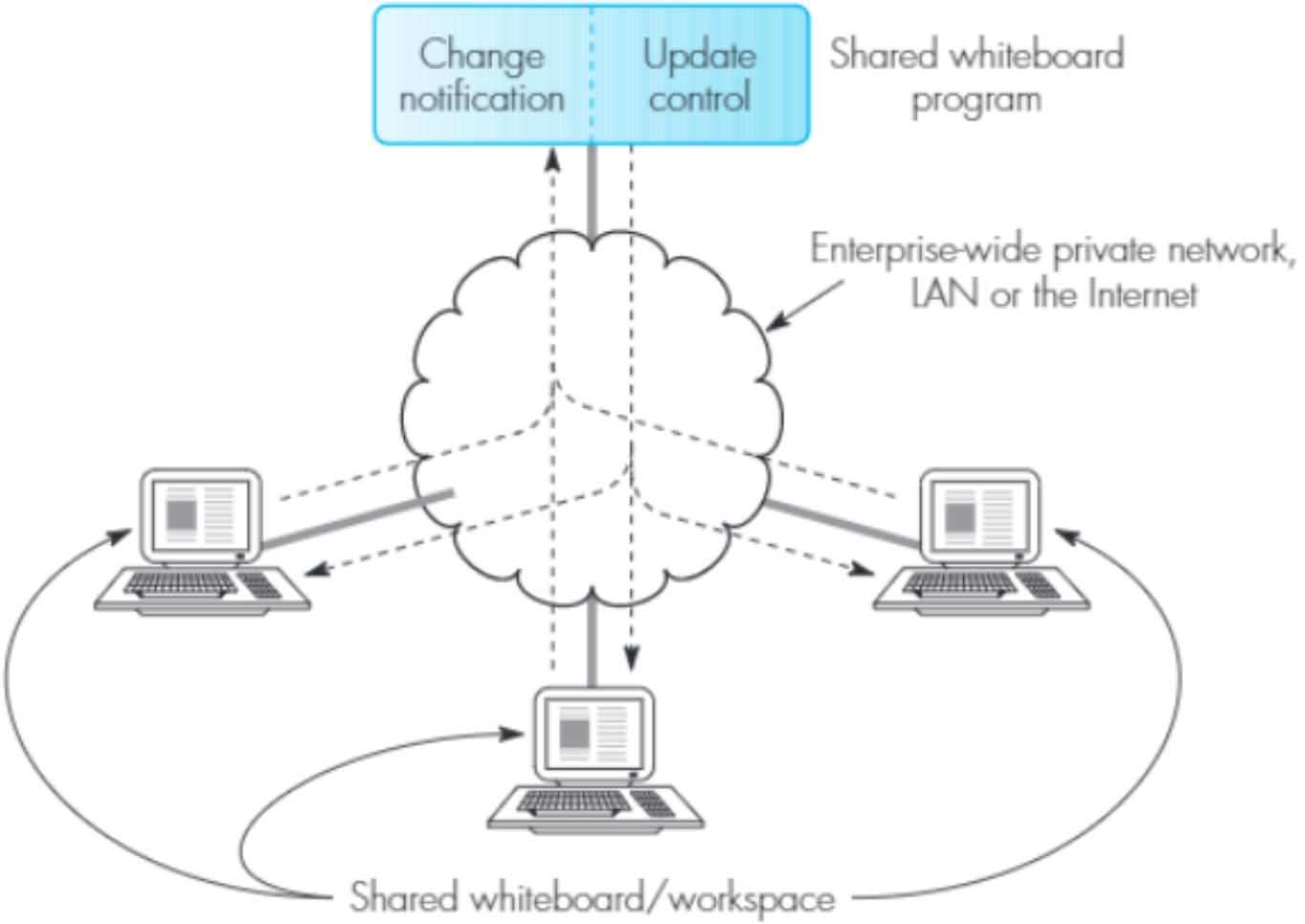


Text only Electronic Mail (Email)

Example Email Message Format



Text and Image
Computer Supported Cooperative Working (CSCW)

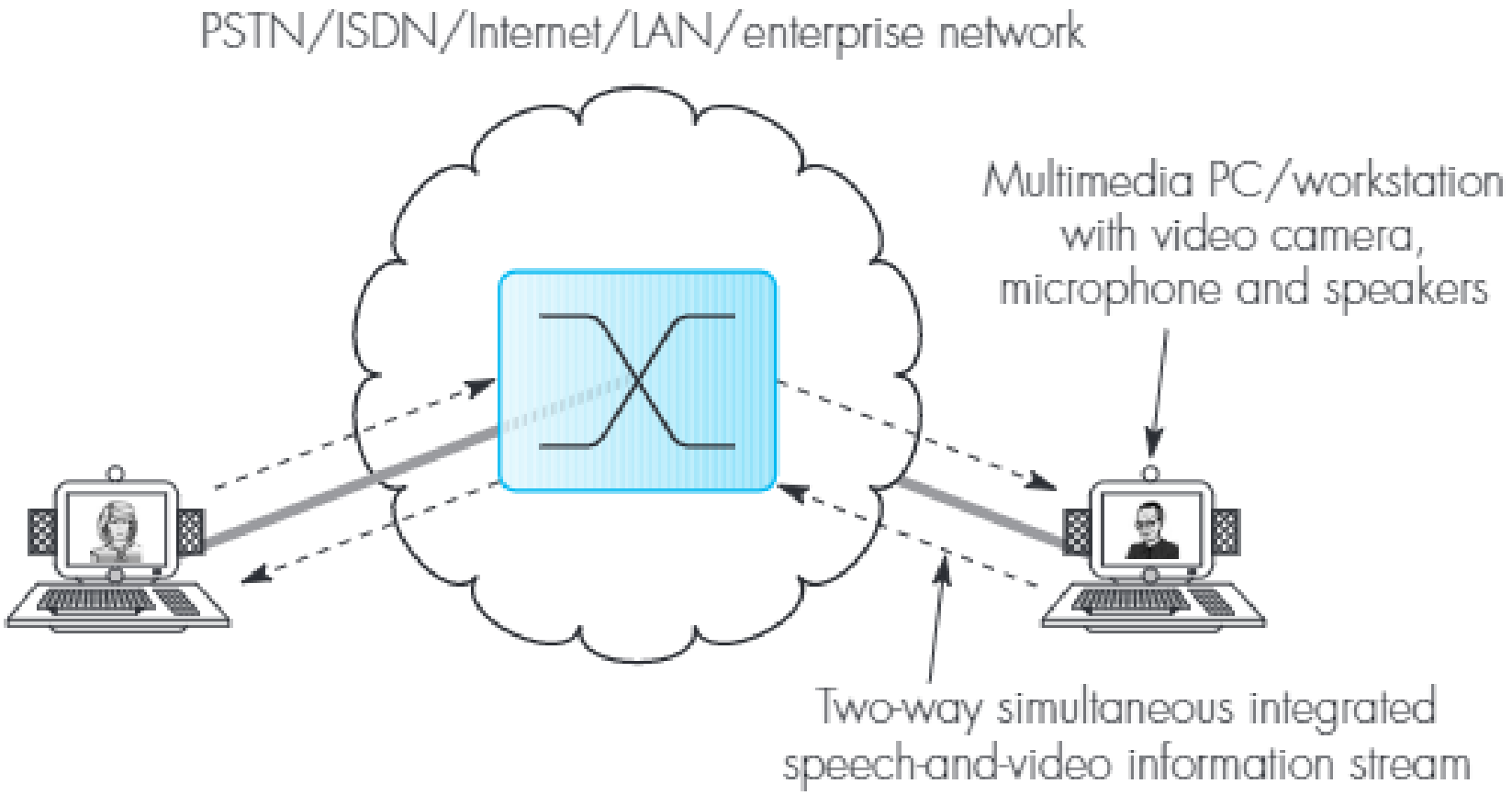


1.4 .1 Interpersonal Applications

1. Speech only
2. Image Only
3. Text only
4. Text and Images
5. Speech and Video

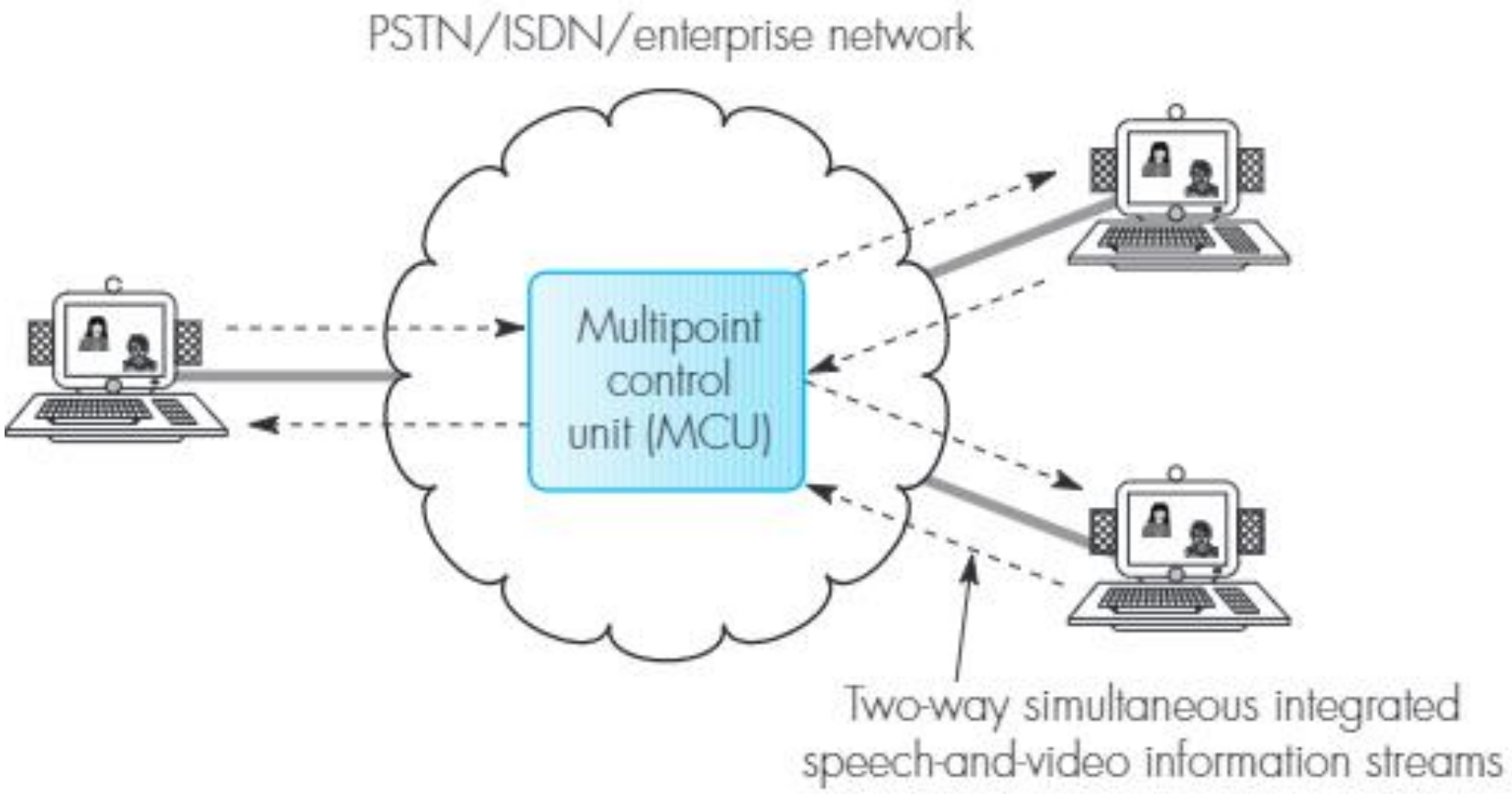
Speech Video Interpersonal Communications

Two Party video telephone call



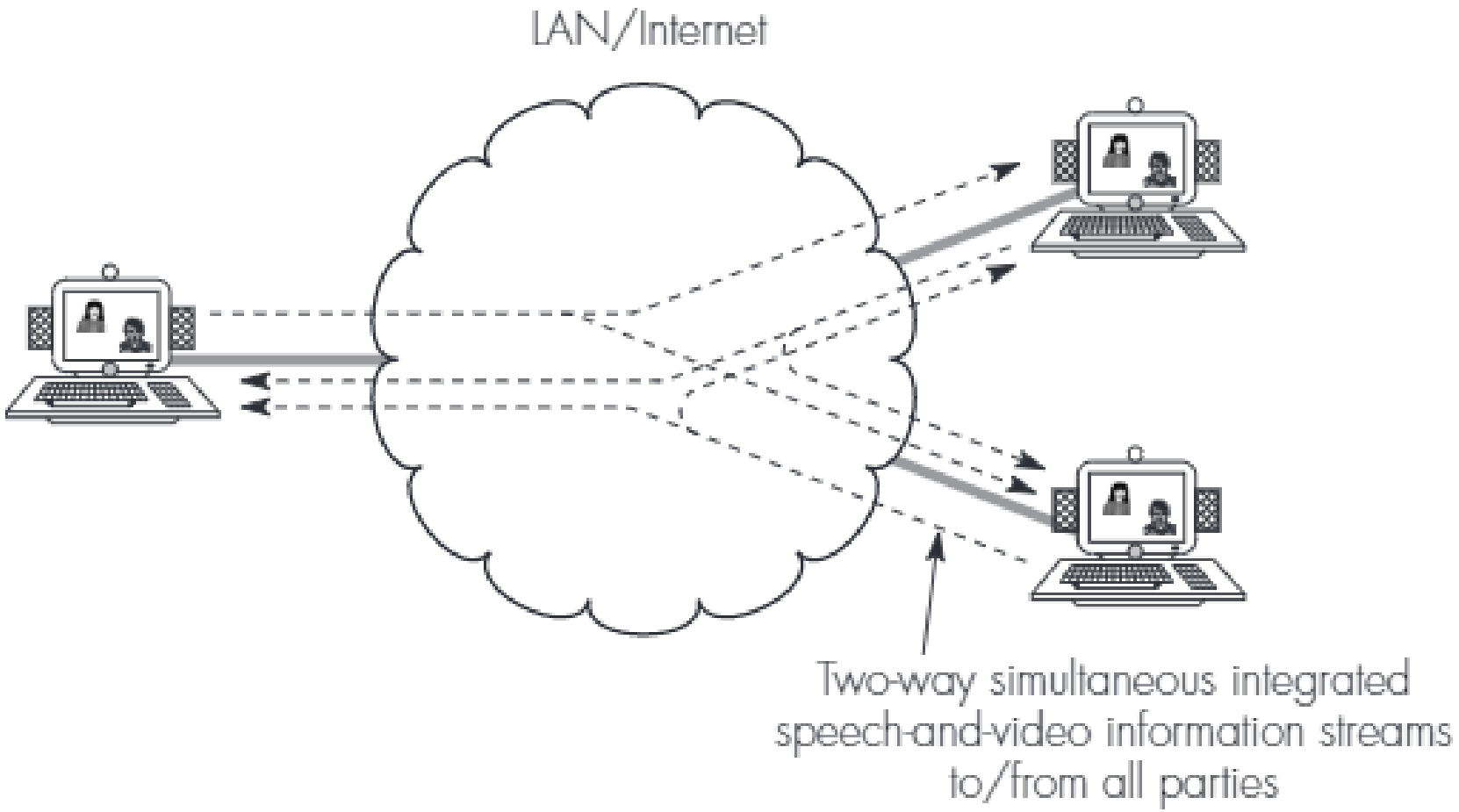
Speech Video Interpersonal Communications

Videoconferencing Using MCU



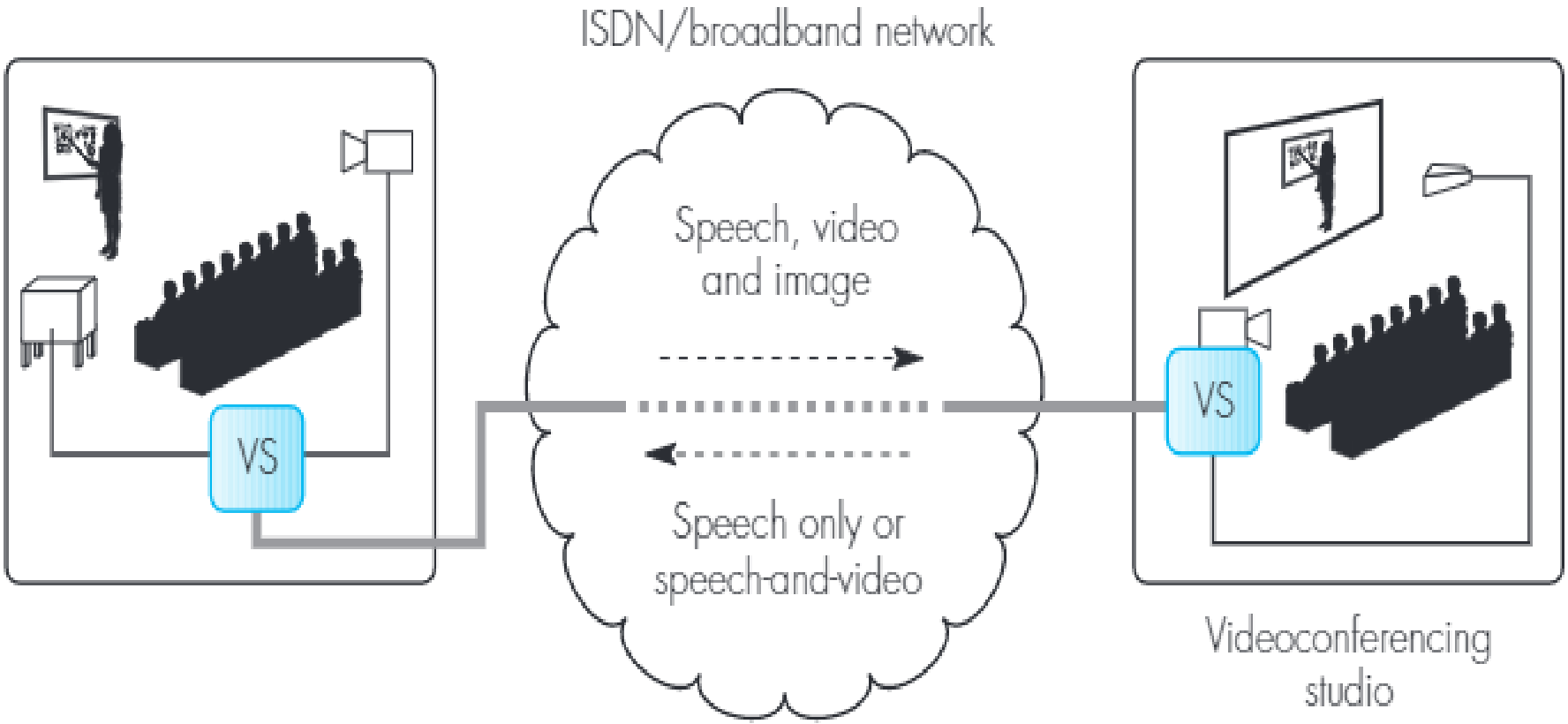
Speech Video Interpersonal Communications

Videoconferencing Using Broadcast Network



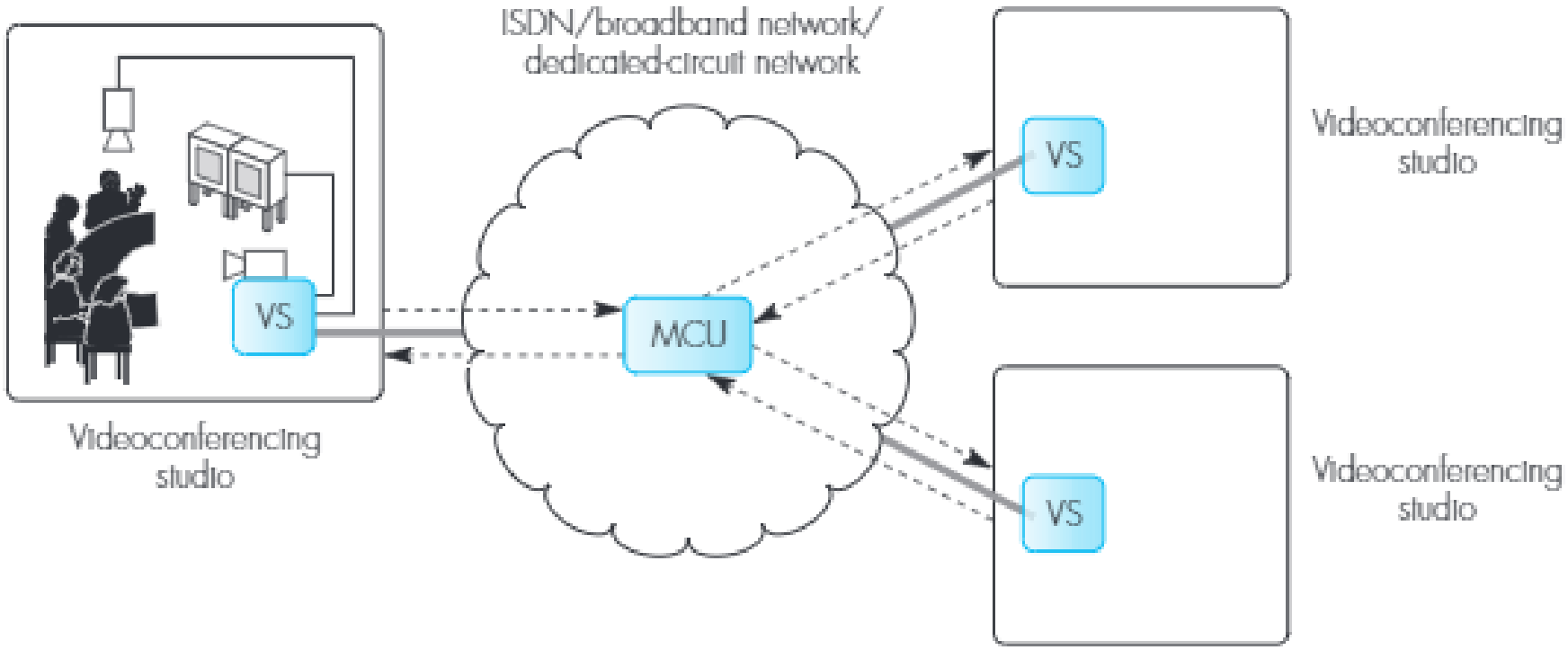
Speech Video Interpersonal Communications

Remote Lecture

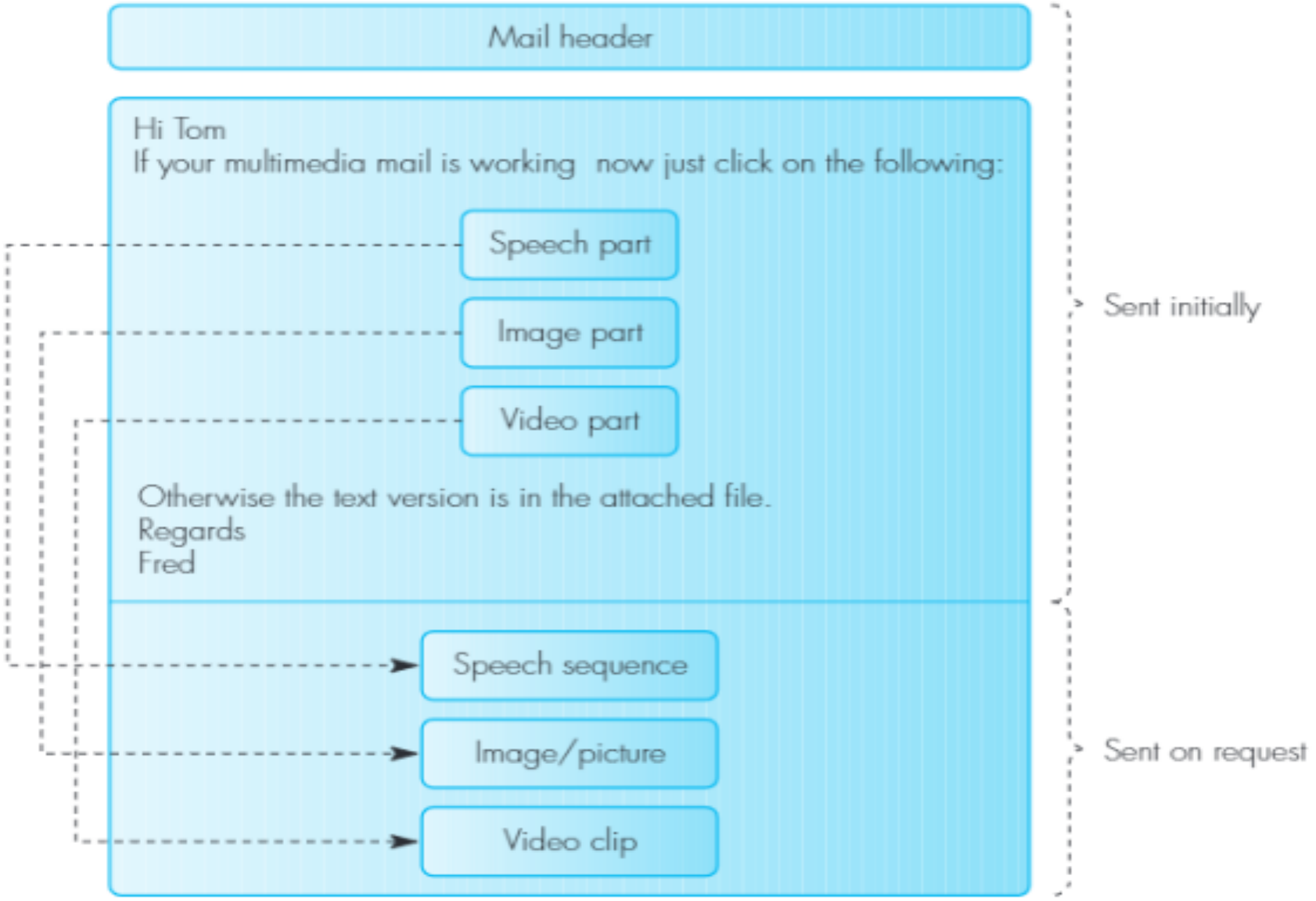


Speech Video Interpersonal Communications

Multiparty (Group) Videoconferencing

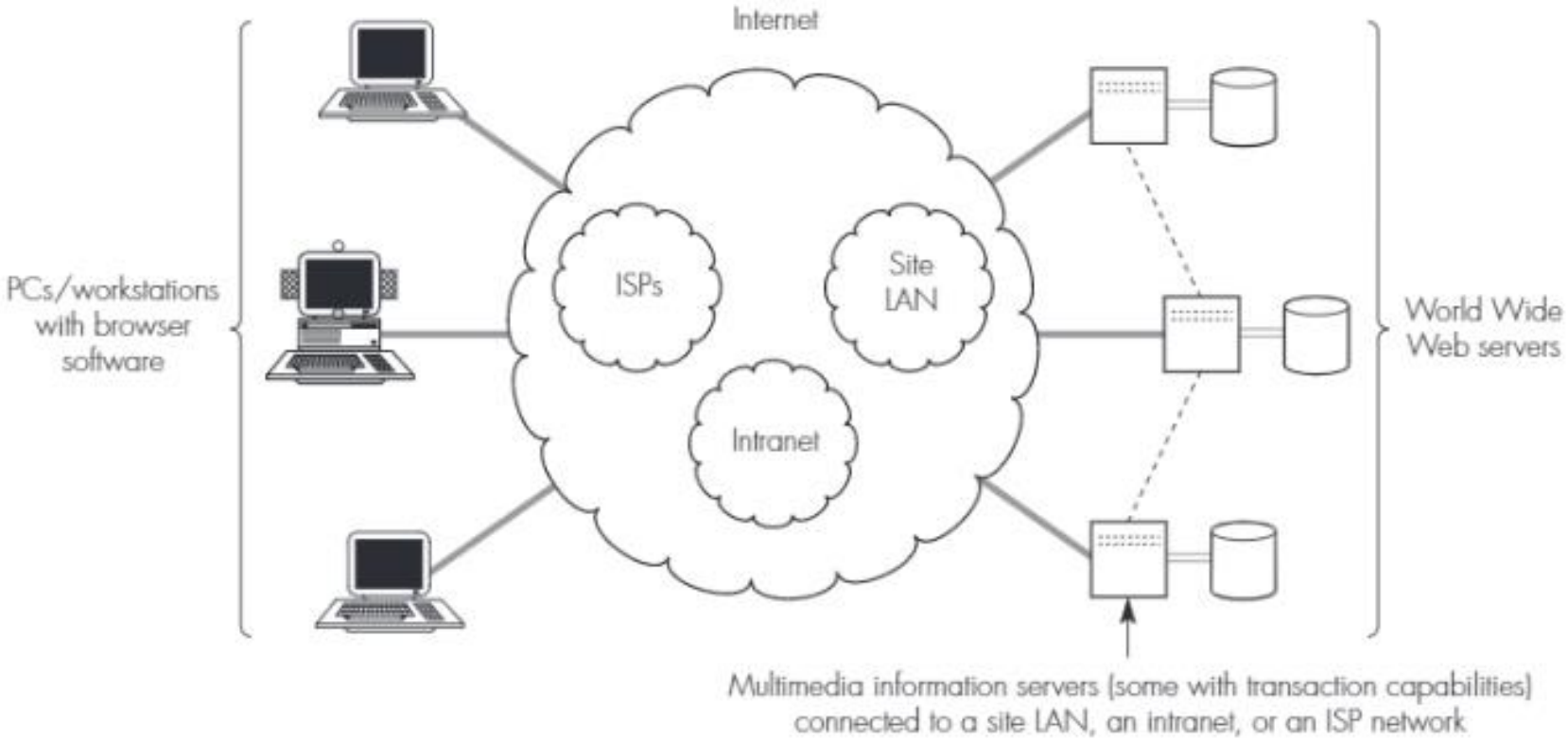


Multimedia Electronic Mail Structure



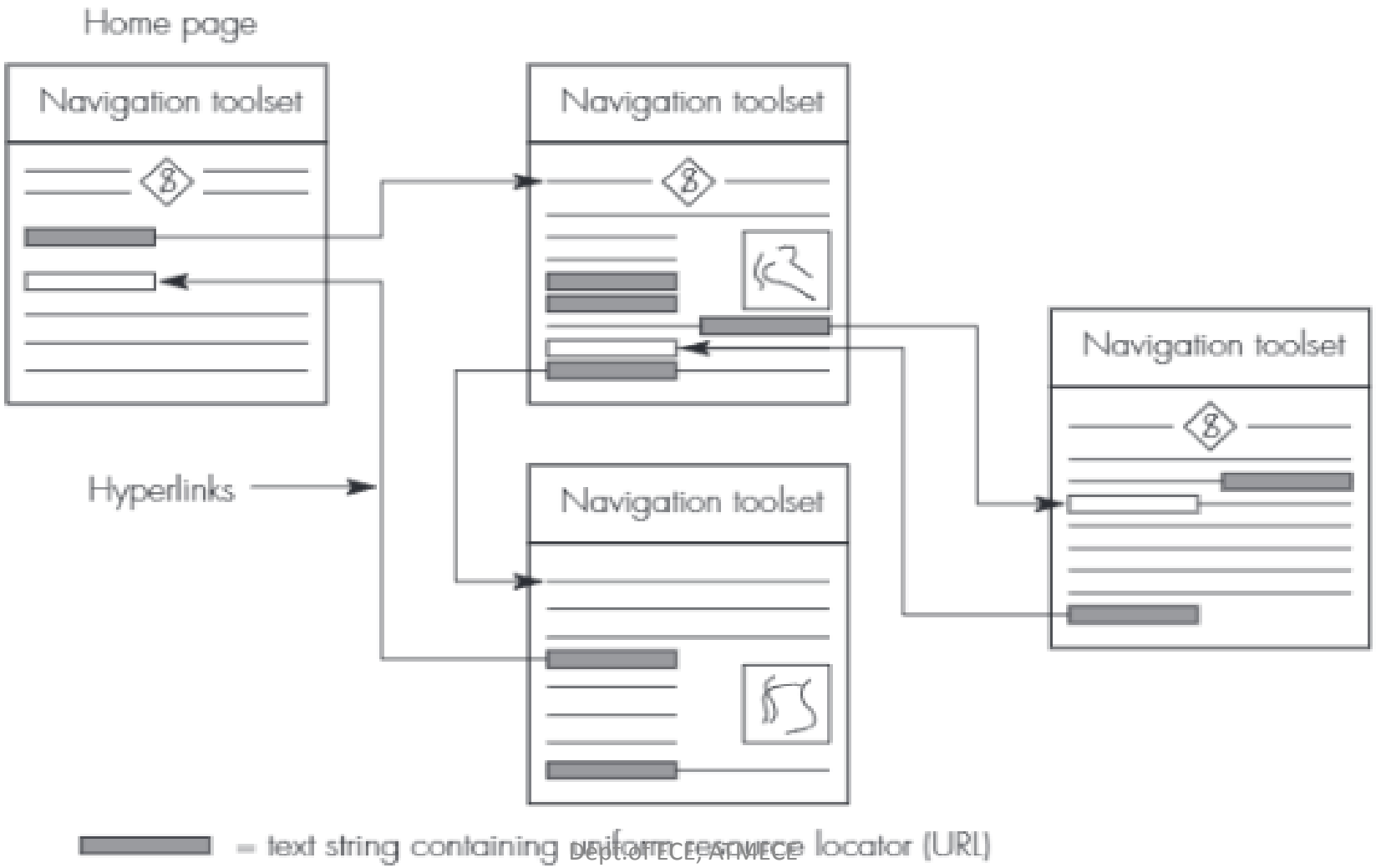
1.4.2 Interactive Applications Over the Internet

Interactions with a World Wide Web server



1.4.2 Interactive Applications Over the Internet

hypertext linkages between the pages of a set of documents



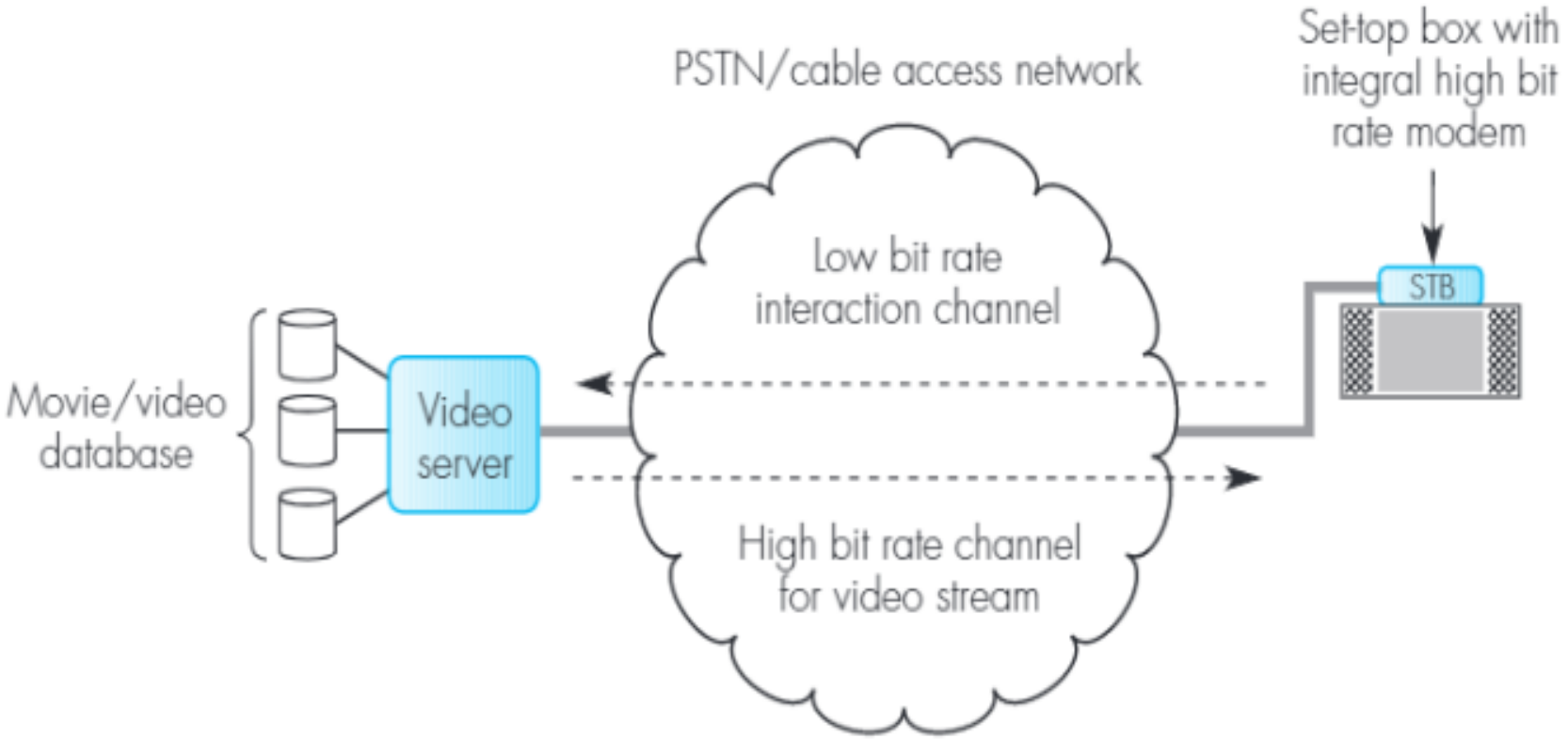
1.4.3 Entertainment Applications

- **Movie/Video on Demand**
- **Interactive Television**

1.4.3 Entertainment Applications

Interactions with a video server

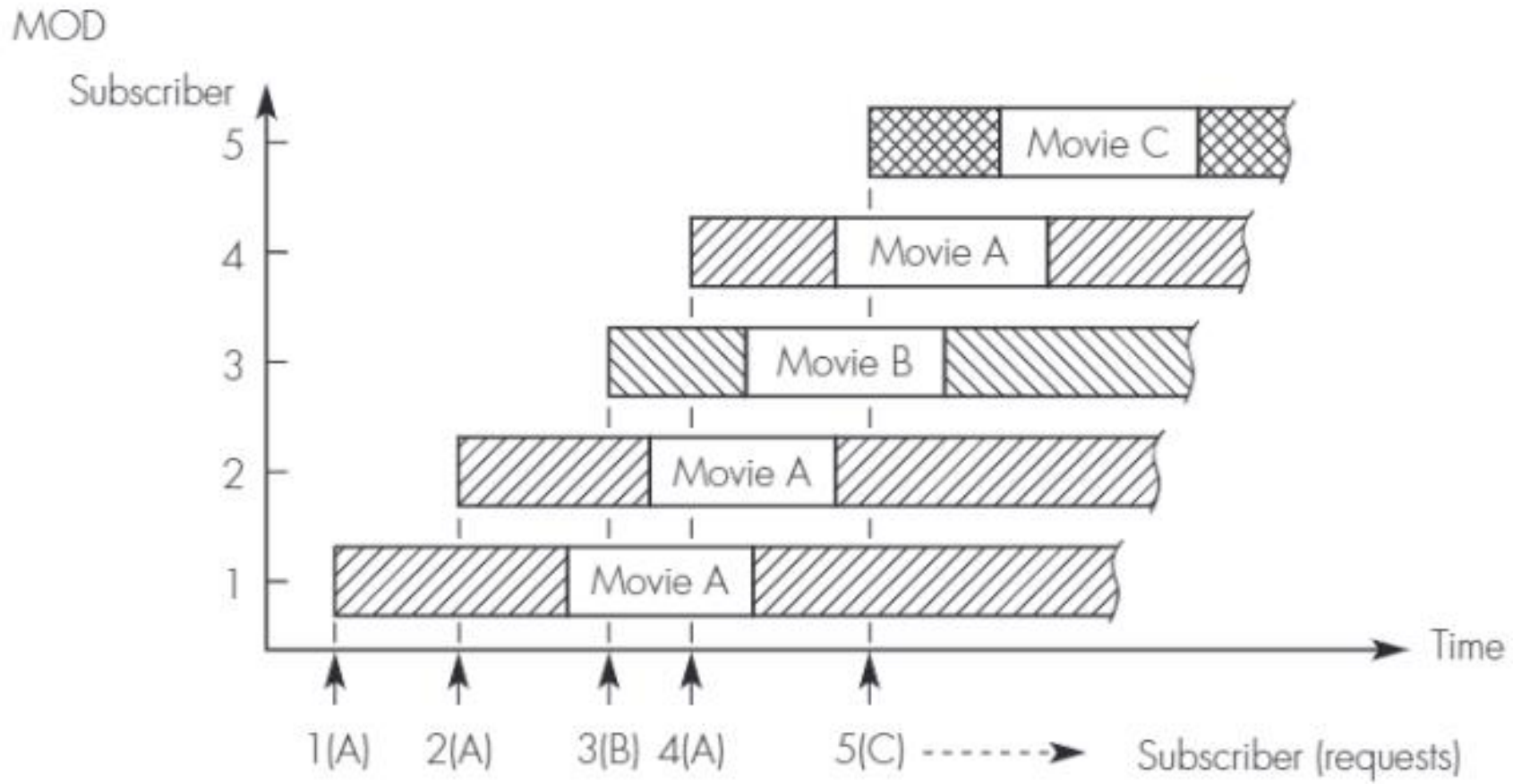
Networking Schematic



1.4.3 Entertainment Applications

Interactions with a video server

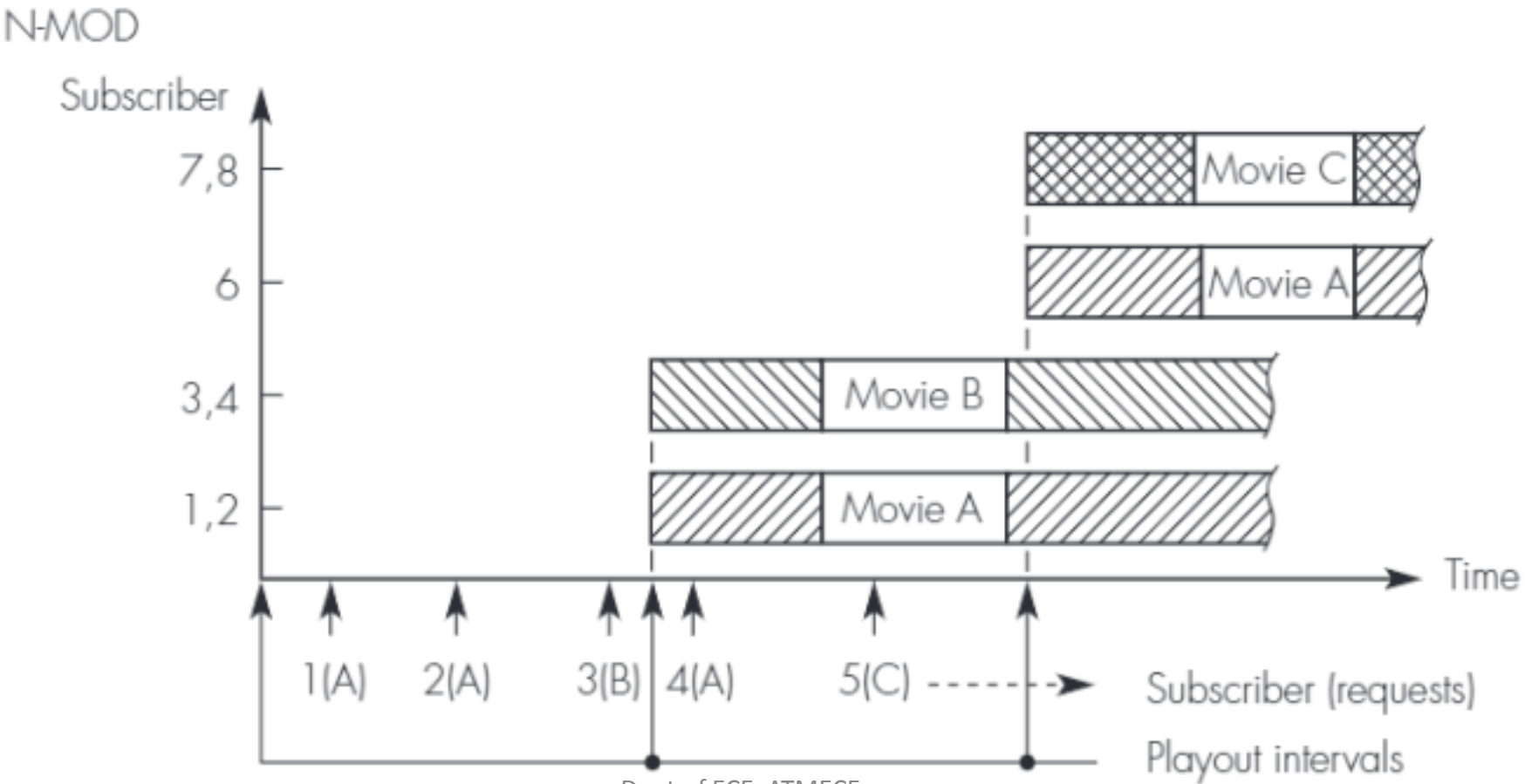
Movie/Video on Demand



1.4.3 Entertainment Applications

Interactions with a video server

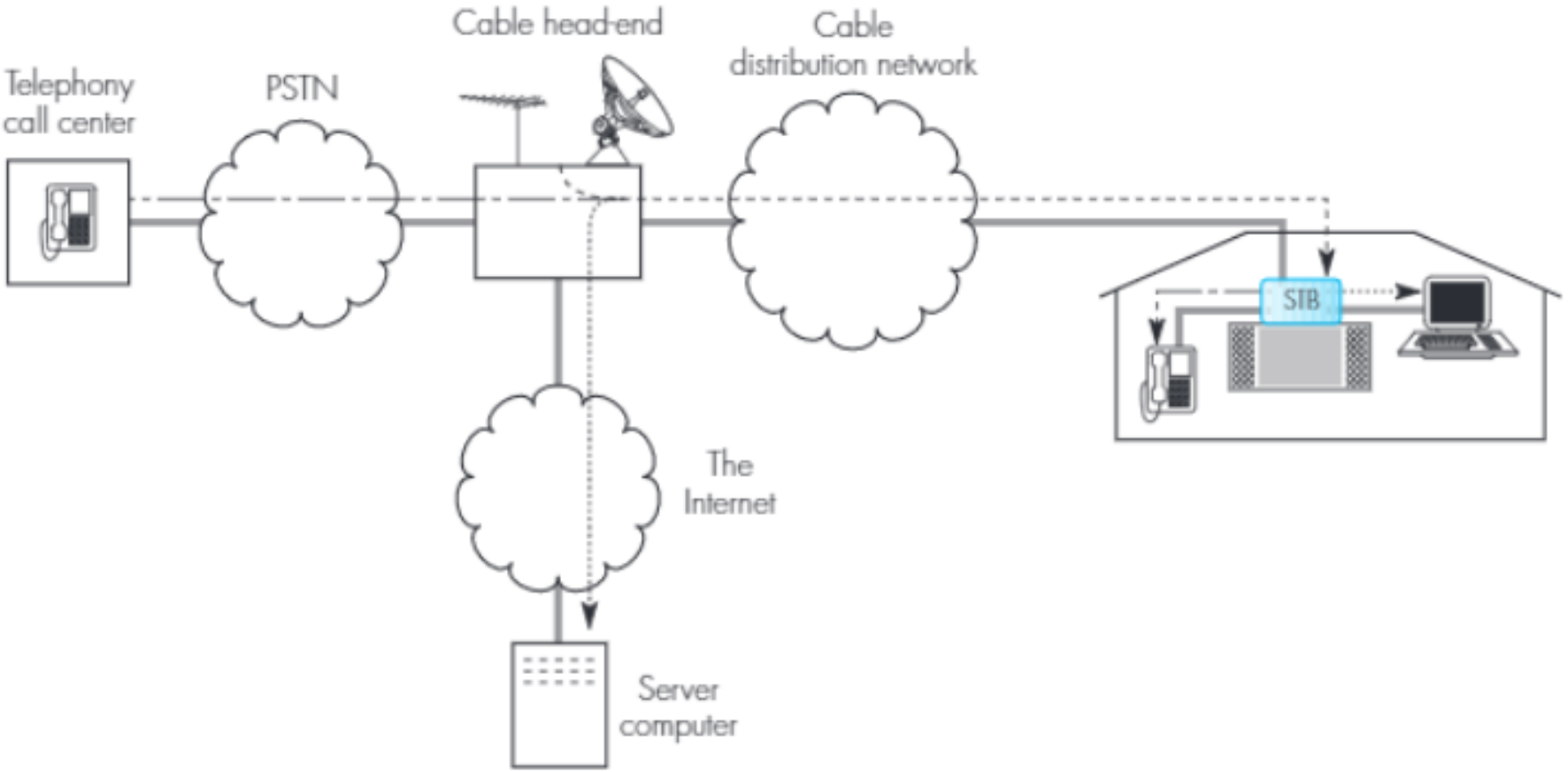
Near Movie-on-Demand.



1.4.3 Entertainment Applications

Interactive television

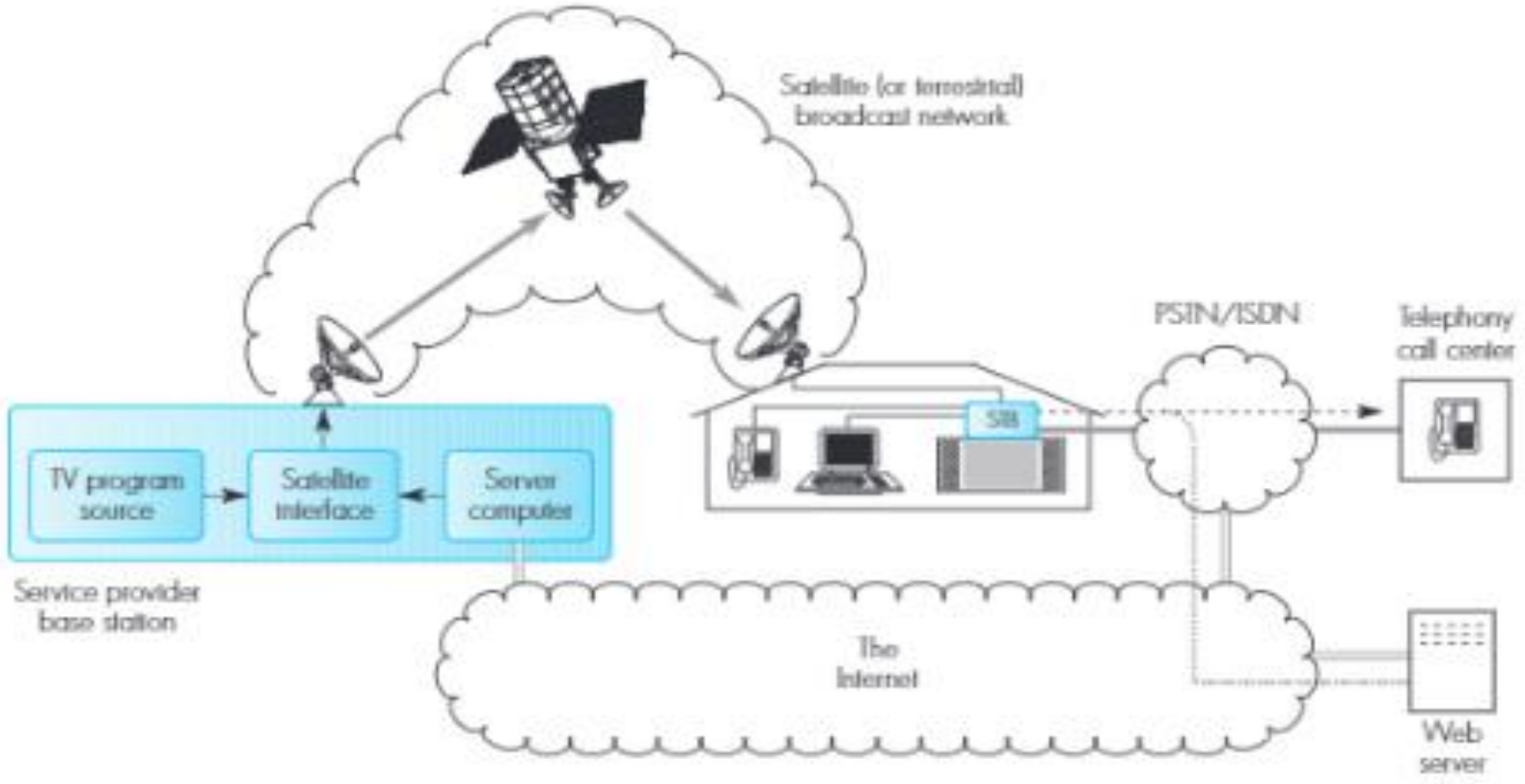
Cable Distribution Network



1.4.3 Entertainment Applications

Interactive television

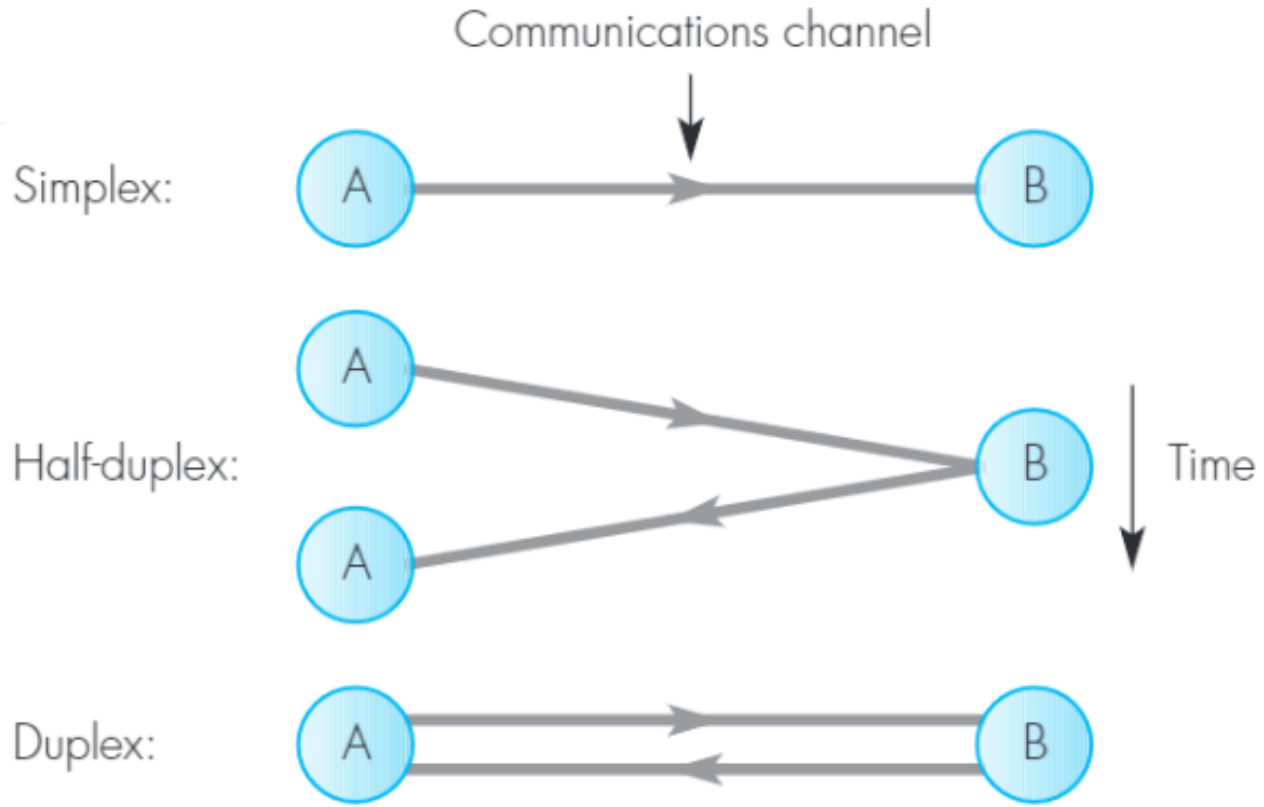
Satellite/Terrestrial Broadcast Network



1.5 Application & Networking Terminology

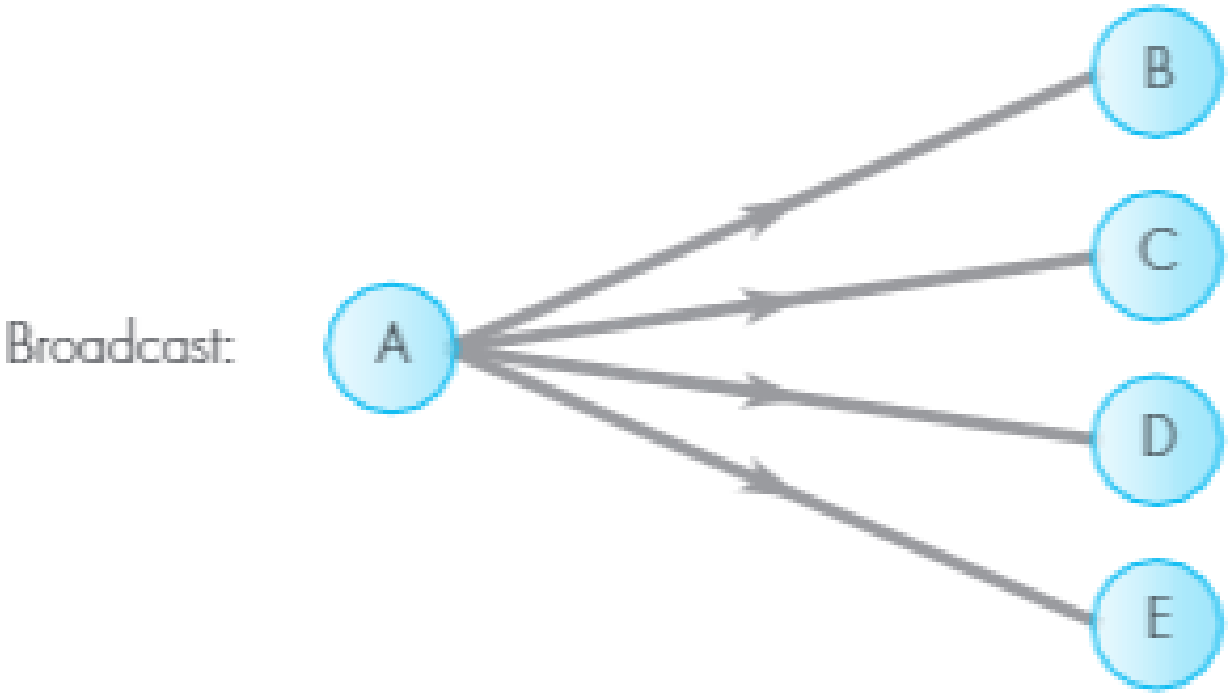
1.5 Application & Networking Terminology

Communication Modes: Unicast



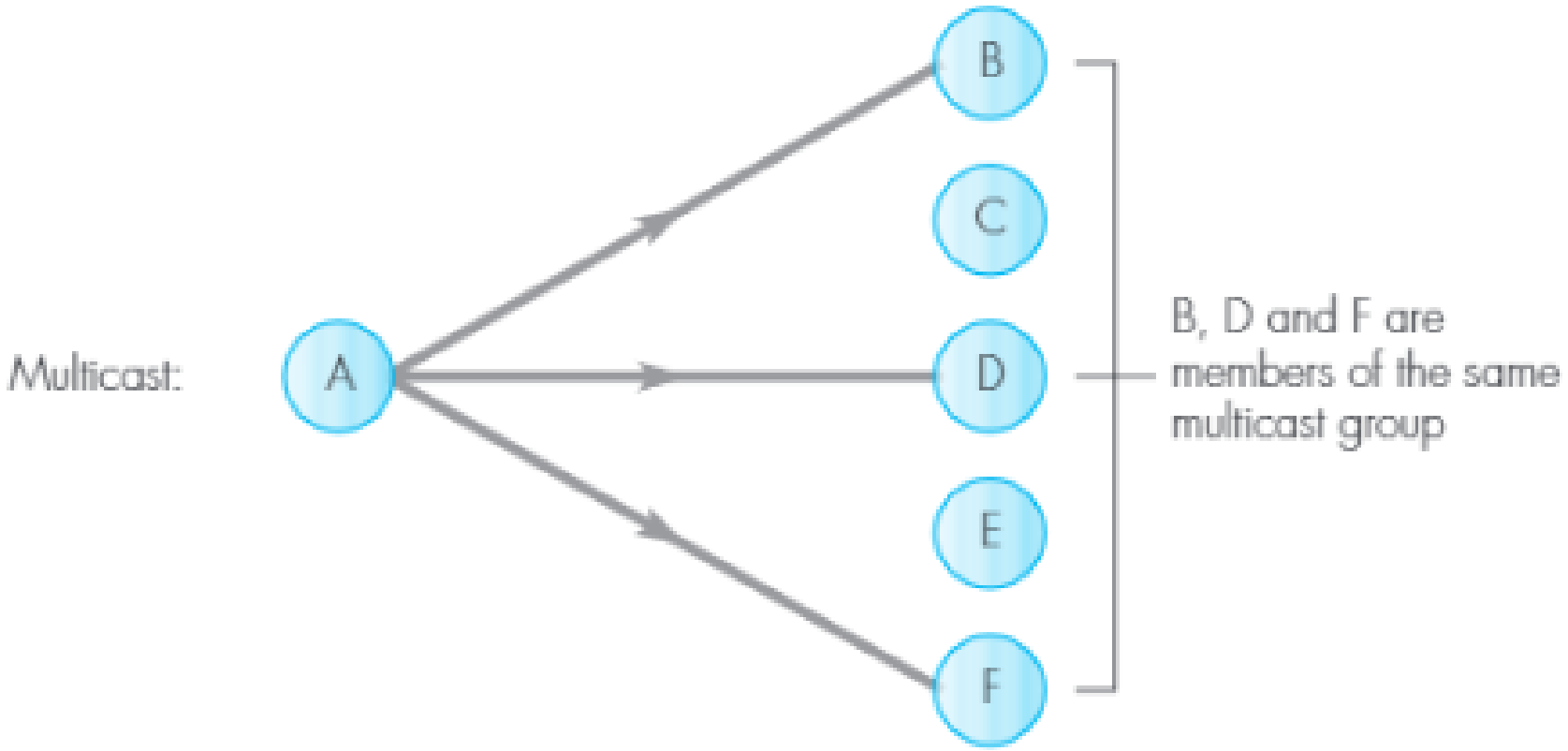
1.5 Application & Networking Terminology

Communication Modes: Broadcast



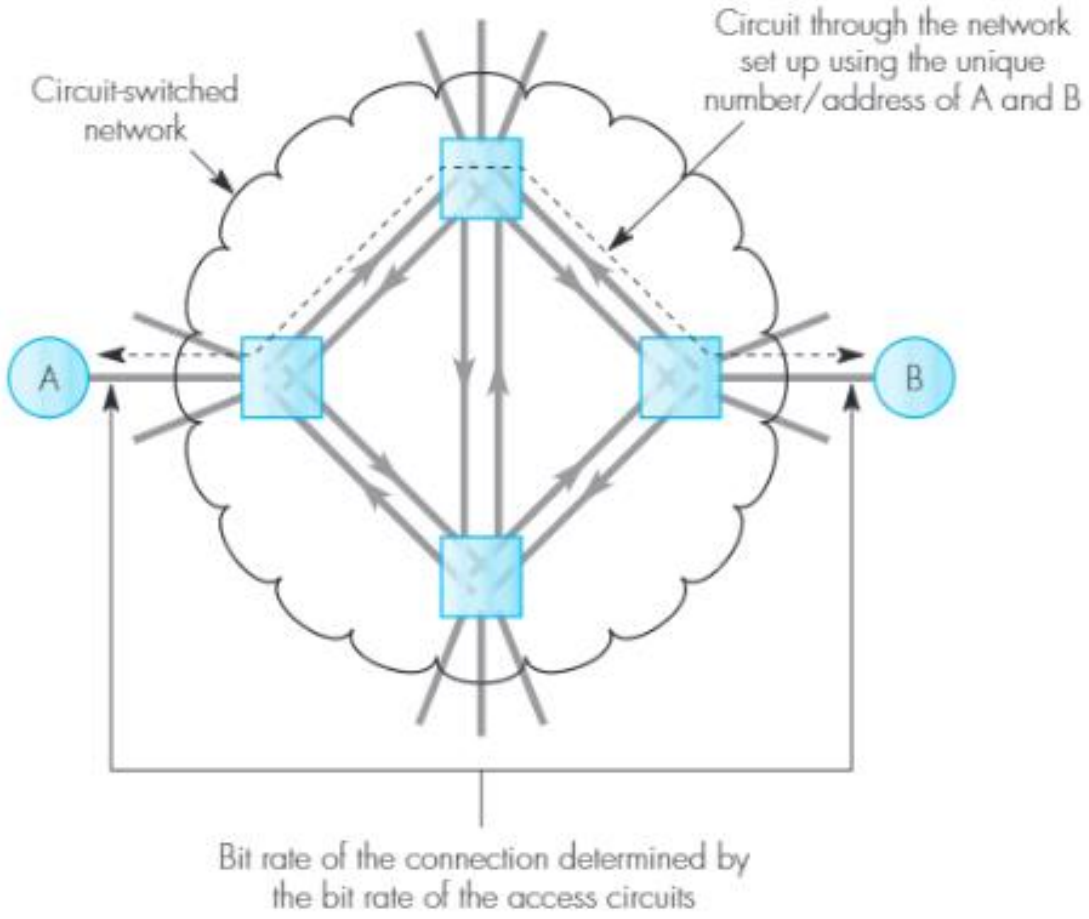
1.5 Application & Networking Terminology

Communication Modes: Multicast



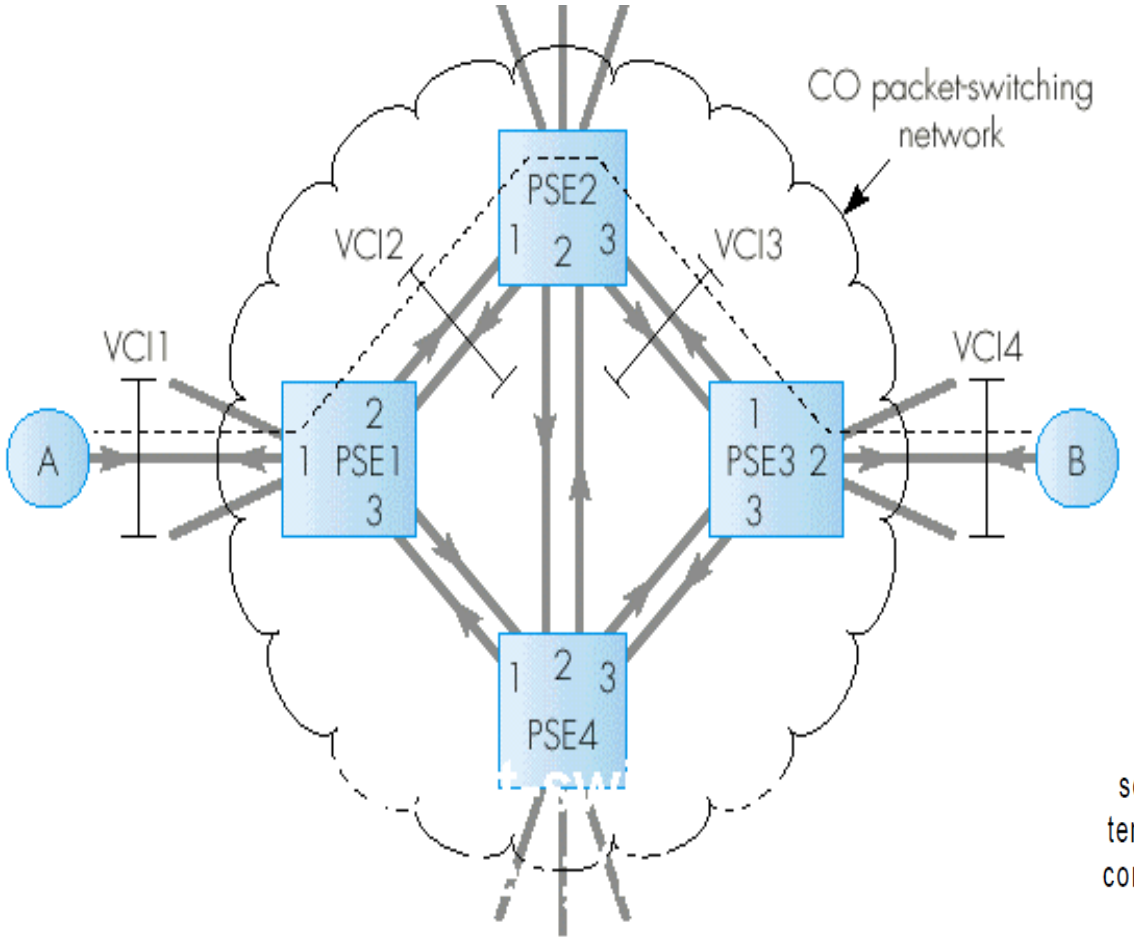
1.5 Application & Networking Terminology

Network Types: Circuit Mode



1.5 Application & Networking Terminology

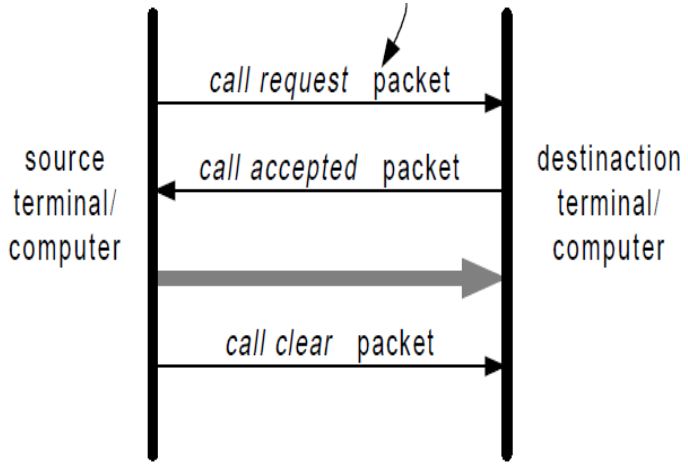
Network Types: Packet Mode-Connection Oriented



	IN	OUT
PSE1 routing table:	VCI1/Link1	VCI2/Link2
	VCI2/Link2	VCI1/Link1
PSE2 routing table:	VCI2/Link1	VCI3/Link3
	VCI3/Link3	VCI2/Link1
PSE3 routing table:	VCI3/Link1	VCI4/Link2
	VCI4/Link2	VCI3/Link1

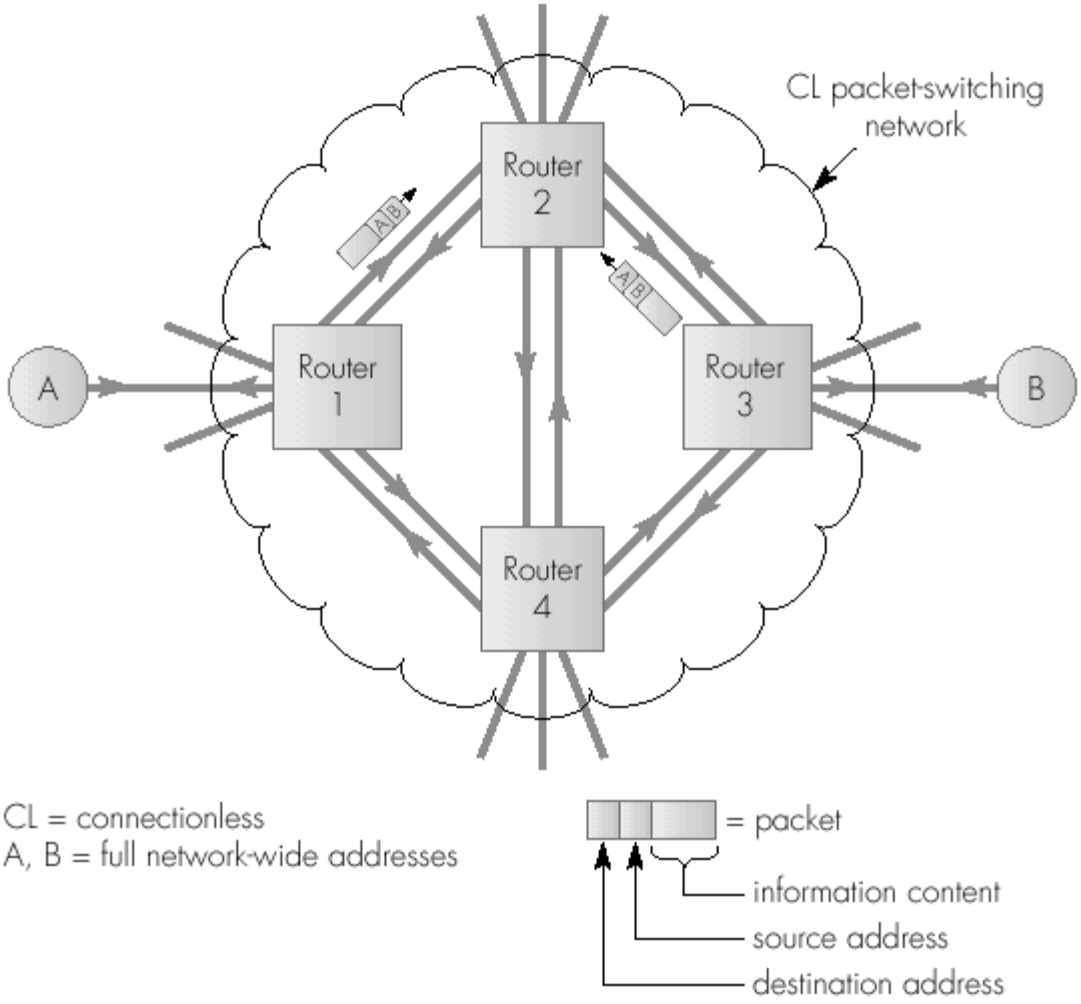
CO = connection-oriented
--- = virtual circuit

VCI = virtual circuit identifier
PSE = packet-switching exchange



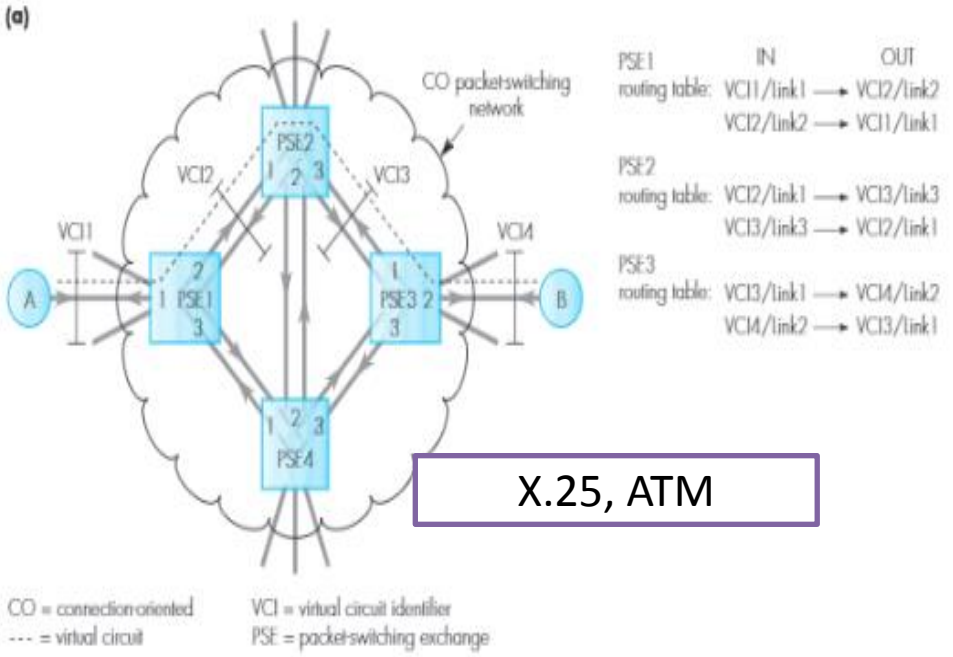
1.5 Application & Networking Terminology

Network Types: Packet Mode-Connectionless

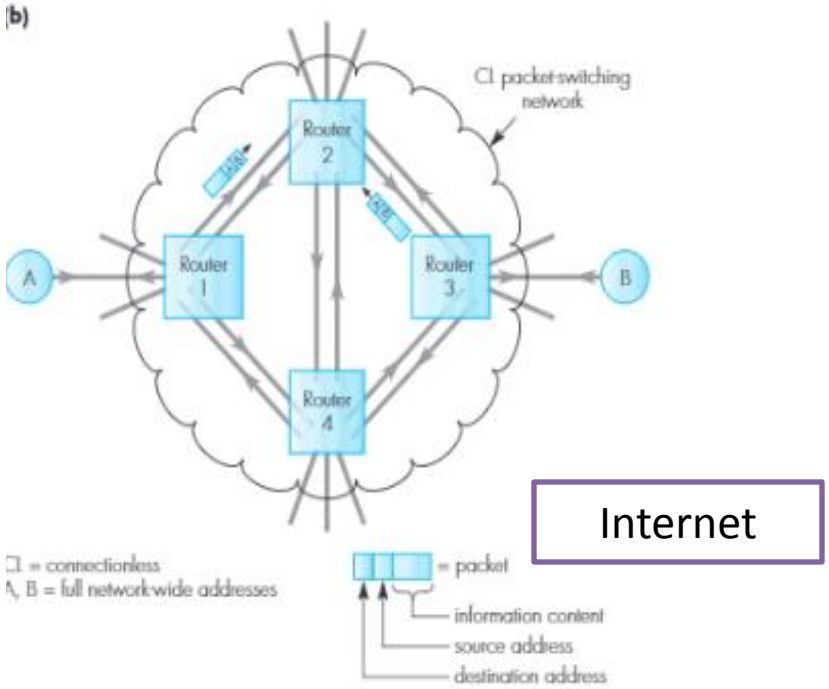


1.5 Application & Networking Terminology

Network Types



X.25, ATM



Internet

- *Best-effort service*
- *Mean packet transfer delay*
- *Delay variation* or *jitter*

1.5 Application & Networking Terminology

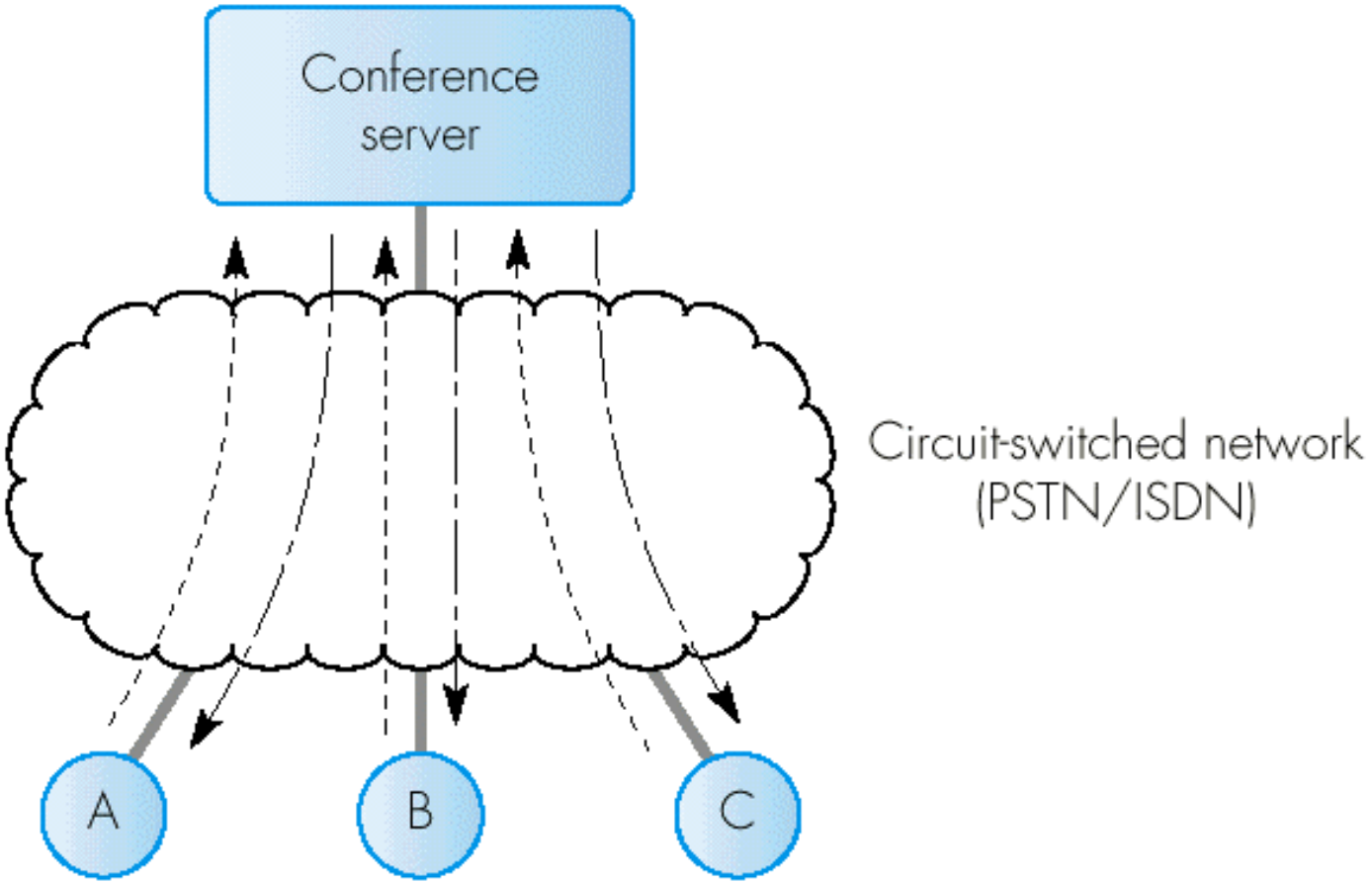
Multipoint conferencing

It's implemented in one of the 2 ways:

- Centralized and
- Decentralized

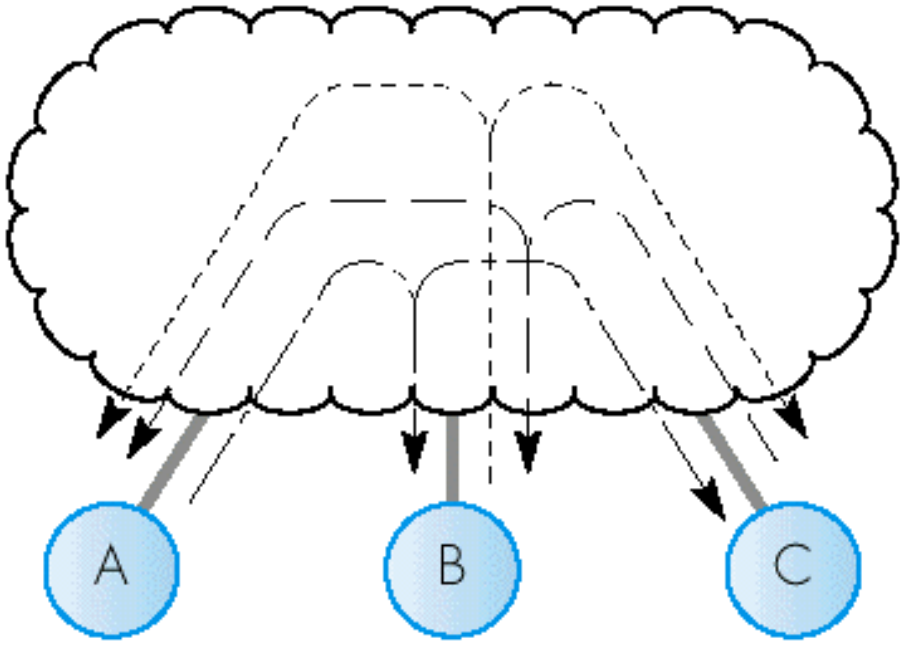
1.5 Application & Networking Terminology

Multipoint conferencing: Centralized



1.5 Application & Networking Terminology

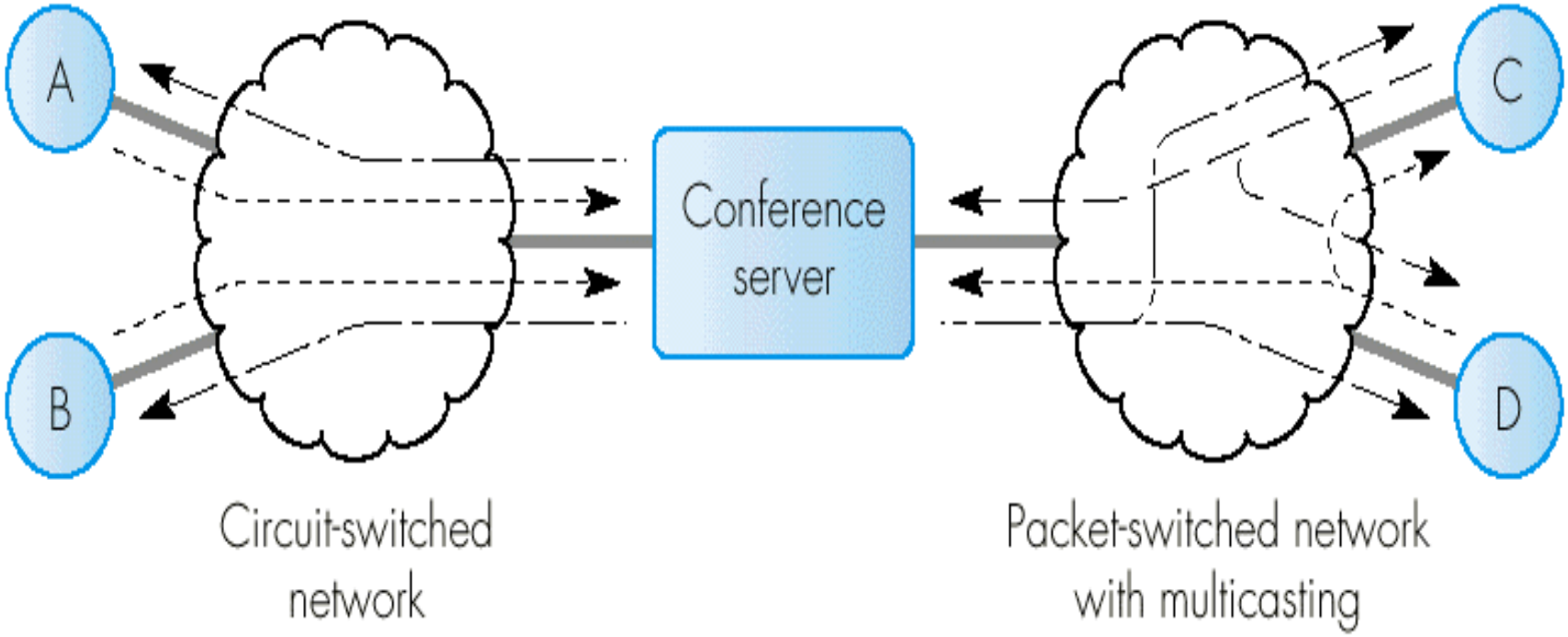
Multipoint conferencing: Decentralized



Packet-switched network supporting multicasting (LAN/Internet/Intranet)

1.5 Application & Networking Terminology

Multipoint conferencing: Hybrid



1.5 Application & Networking Terminology

Network *Quality of Service* (QoS)

Circuit-switched network

- The bit rate
- The mean bit error rate
- The transmission delay

1.5 Application & Networking Terminology

Network *Quality of Service* (QoS)

Circuit-switched network

- If the probability of BER is **P** and number of bits in a block is **N**, then assuming random errors, the probability of a block containing a bit error PB is given by:

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

which is approx N X P (if N X P < 1)

1.5 Application & Networking Terminology

Network *Quality of Service* (QoS)

Circuit-switched network

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

1.5 Application & Networking Terminology

Network *Quality of Service* (QoS)

Circuit-switched network

- *Unreliable service* (best-effort service)
- *Reliable service*
- *Transmission delay*

1.5 Application & Networking Terminology

Network *Quality of Service* (QoS)

Circuit-switched network

Determine the propagation delay associated with the following communication channels:

(i) a connection through a private telephone network of 1 km,

(ii) a connection through a PSTN of 200 km,

(iii) a connection over a satellite channel of 50 000 km.

Assume that the velocity of propagation of a signal in the case of (i) and (ii) is 2×10^8 ms^{-1} and in the case of (iii) 3×10^8 ms^{-1}.

Answer:

Propagation delay T_p = physical separation/velocity of propagation

(i) $$T_p = \frac{10^3}{2 \times 10^8} = 5 \times 10^{-6} \text{s}$$

(ii) $$T_p = \frac{200 \times 10^3}{2 \times 10^8} = 10^{-3} \text{s}$$

(iii) $$T_p = \frac{5 \times 10^7}{3 \times 10^8} = 1.67 \times 10^{-1} \text{s}$$

1.5 Application & Networking Terminology

Network *Quality of Service* (QoS)

Packet-switched network

The QoS parameters associated with a packet- switched network include:

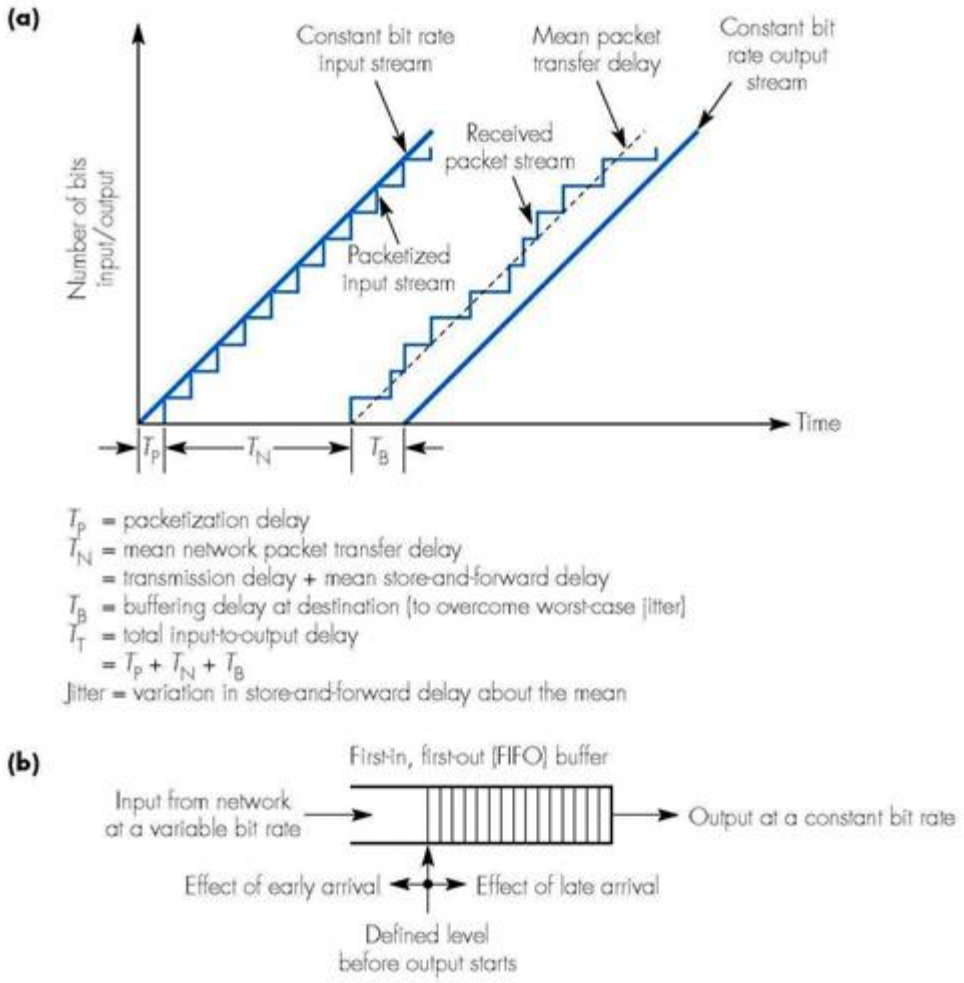
- The maximum packet size
- The mean packet transfer rate
- The mean packer error rate
- The mean packet transfer delay
- The worst-case jitter
- The transmission delay (Tp = distance/speed)

1.5 Application & Networking Terminology

Application QoS

- Depending on types of application, the QoS parameters 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 Application & Networking Terminology



1.5 Application & Networking Terminology

A packet-switched network with a worst-case jitter of 10 ms is to be used for a number of applications each of which involve a constant bit rate information stream. Determine the minimum amount of memory that is required at the destination and a suitable packet size for each of the following input bit rates. It can be assumed that the mean packet transfer rate of the network exceeds the equivalent input bit rate in each case.

(i) 64 kbps

(ii) 256 kbps

(iii) 1.5 Mbps.

Answer:

(i) At 64 kbps, 10 ms = 640 bits
Hence choose a packet size of, say, 800 bits with a FIFO buffer of 1600 bits – 2 packets – and start playout of the bitstream after the first packet has been received.

(ii) At 256 kbps, 10 ms = 2560 bits
Hence choose a packet size of, say, 2800 bits with a FIFO buffer of 4800 bits.

(iii) At 1.5 Mbps, 10 ms = 15000 bits
Hence choose a packet size of, say, 16000 bits with a FIFO buffer of 32000 bits.

Notice that if the computed packet size exceeds the network maximum packet size, then the equivalent number of packets must be sent before playout starts. For example, if the maximum network packet size was 8000 bits, then for case (iii) above playout would not start until two packets have been received and the FIFO buffer should hold four packets.

SUMMARY

- The different types of media that are used in multimedia applications
- The different types of communication networks that are used to support these applications
- A selection of the different types of application