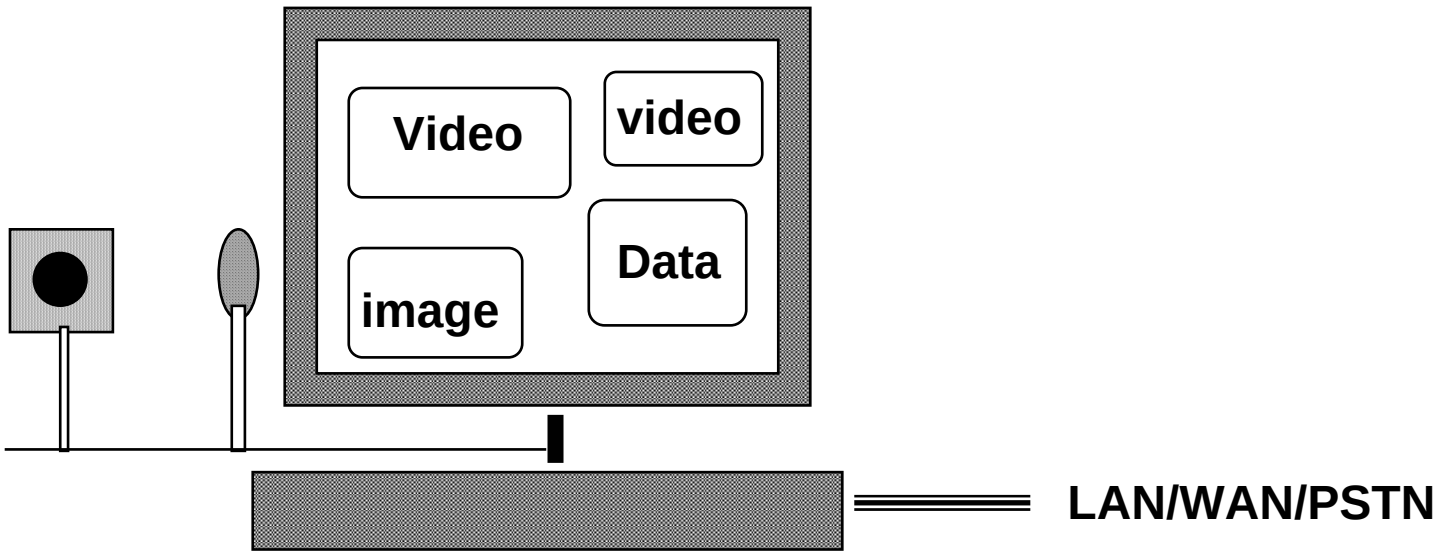
1.1 Introduction

- Multimedia

  . supports text, graphics, video, image, audio, etc

  . in one system with multiple input/output devices

  . multimedia services to be achieved via other systems



1.2 Multimedia information representation

- Multimedia data
  - blocks of digital data
  - represented by a fixed number of binary digits (bits)
- bit per seconds (bps)
  - a measurement unit for digital data communication
- Compression
  - digitalization progress to represent the multimedia types in a digital form
    - MPEG : Motion Picture Expert Group
    - JPEG : Joint Photographic Experts Group

Data Capabilities for Multimedia Services

- **Audio**
  - 1.4 Mbps (each sample: 16 bits, 44.1 KHz sampling rate)
  - stereo sound : 680 kbps, 340 kbps, or 170 kbps
- **Voice/Phone**
  - 48-352 kbps: 8 kHz/8bits (mono)
- **Video**
  - 27.7 MB/s: 640 x 480 x 24 pixels x 30 frames (24-bit color)
  - (220 Mbps) each sample: 8 bits, 13.5 MHz luminence
- **Image**
  - simple: 64 kB/image (uncompressed)
  - detailed: 7.5 MB/image (uncompressed) $\Rightarrow$ 60 Mbps
- **Text**
  - 1 MByte (500 page x 2 kBytes per page)

Bandwidth for Multimedia Service

Service Name	Bandwidth
Television & video service	2 Mbps - 600 Mbps
Video telephony	2 Mbps - 40 Mbps
Video Conferencing	2 Mbps - 130 Mbps
CATV	130 Mbps - 600 Mbps
HDTV	130 Mbps - 600 Mbps
Image	0.5 Mbps - 60 Mbps
Telemdecine (X-ray)	2 Mbps - 60 Mbps
Voice	48 kbps - 400 kbps
Audio (Stereo)	0.2 Mbps - 1.4 Mbps

MPEG 1, 2

- MPEG1
  : 디지털 저장 매체용 컬러 동화상 및 오디오의 압축/부호화 방식의 국제 표준

  전송속도 -> 1.5Mbps

Part1	Systems
Part2	Video
Part3	Audio
Part4	Conformance testing
Part5	Software simulation

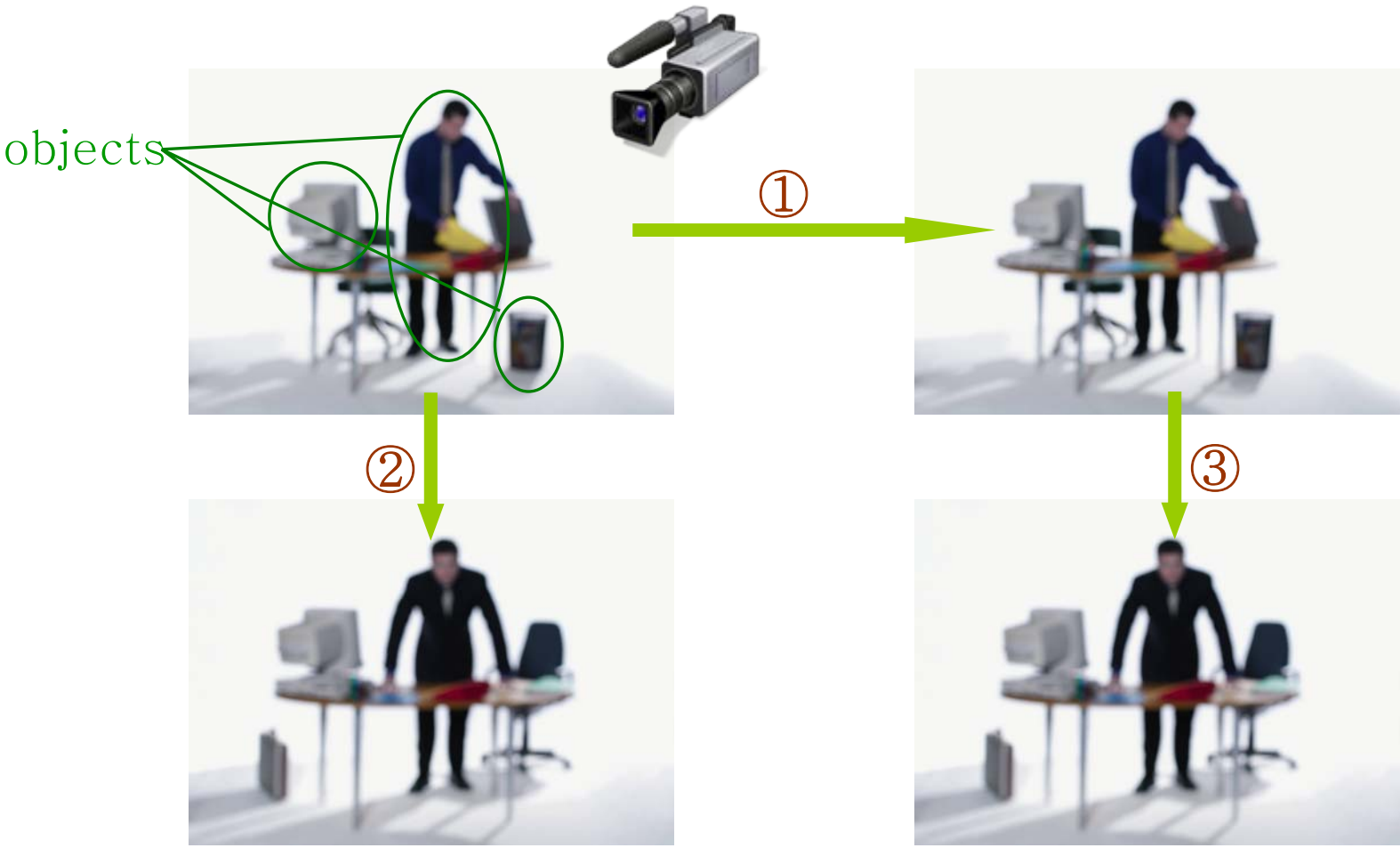
MP3 생성

- MPEG2 (고화질,고압축)
  : 디지털 TV방송, 통신, 저장 매체용 컬러 동화상 및 오디오의 압축/부호화 방식의 국제 표준

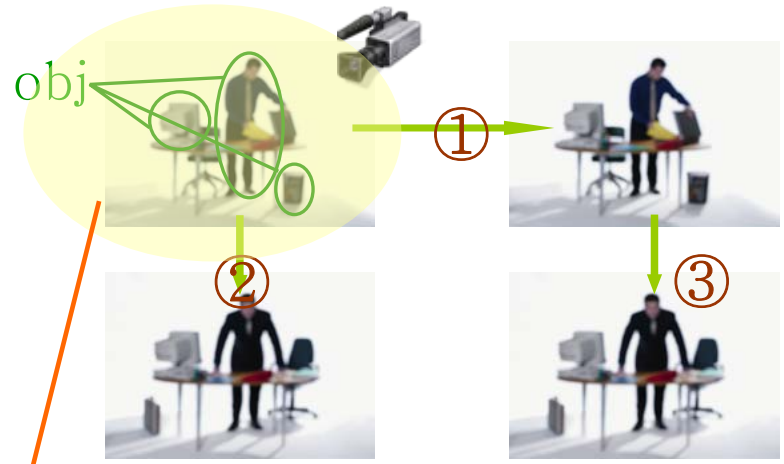
Part6	System Extension- DSM- CC
Part7	Advanced Audio Coding
Part8	VOID – (withdrawn)
Part9	System extension RTI
Part10	Conformace Extension
Part11	IPMP on MPEG2 - Systems

MPEG1에서 추가된 부분 :
데이터 전송 기술 (Transport Stream)

MPEG 4 원리



MPEG 4 원리



① 카메라로 촬영한 각각의 objects를 함수를 이용하여 압축하고 보여준다

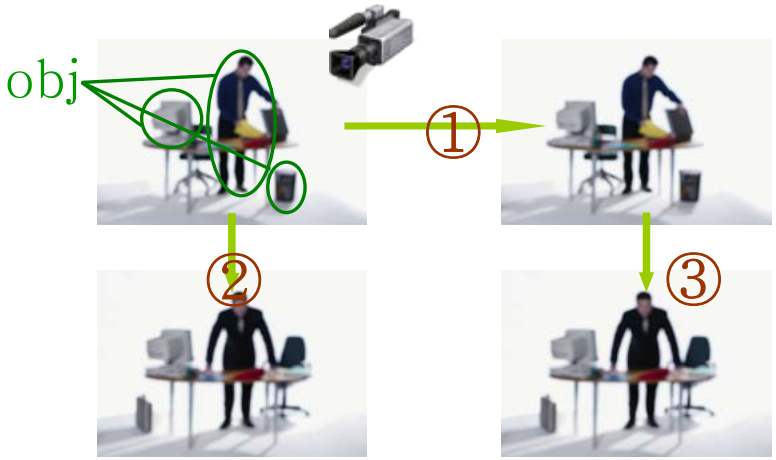
② 원본에서의 objects이 이동

③ 촬영하였던 장면에서 이동이 있었던 objects의 data에 관해서만 catch

모든 사물을 object 단위로 구별하여 코딩 => Individual coding

MPEG4 압축의 원리

MPEG 4



[결 론]

Object 단위로 coding을 분리

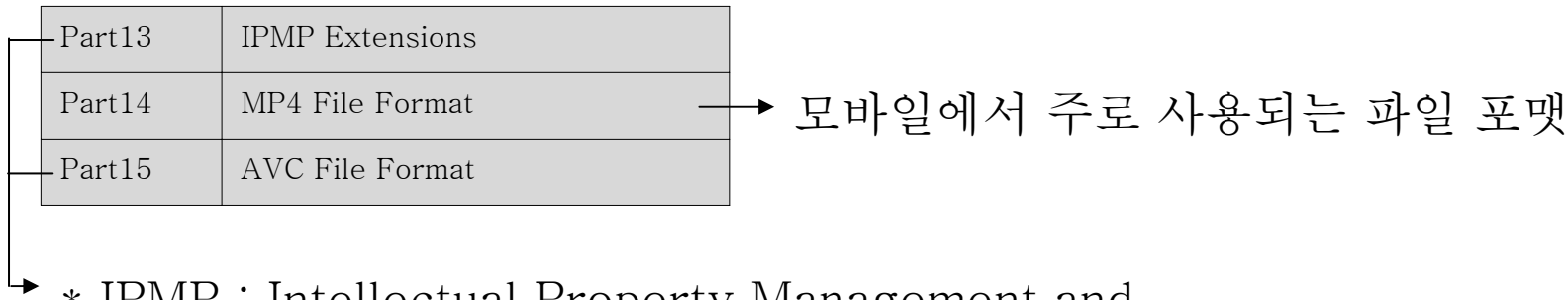
↓

압축을 더욱 높이고!
용량은 더욱 줄이고!

→ Object 단위로 player 실행

MPEG 4

- MPEG4
  - 멀티미디어 통신을 전제로 만들어지고 있는 영상압축 기술
  - 낮은 전송률로 동화상을 보내는 것을 전제로 개발된 데이터 압축 및 복원 기술에 대한 새로운 표준
  - MPEG4와 대응 되는 압축 Format은? H.264
  - MPEG21의 target code 가 바로 MPEG4이다.



* IPMP : Intellectual Property Management and Protection
* AVC : new generation of video coding algorithm

MPEG 7

- MPEG7

  - Multimedia Content Description Interface

  - 멀티미디어로 구성된 데이터베이스에서
    정보를 용이하게 탐색하여 추출할 수 있도록,
    표준화된 멀티미디어 정보 표현 방식을 제공하기 위한
    국제 표준 또는 그 표준화 그룹

  - MPEG 7에서는 특징 추출(feature extraction), 영상의 표현과
    압축 방식들에 대해서는 관여하지 않으며 이것은 MPEG 4 에서 담당.

  - MPEG7은 하나의 DB로 보여진다
    -> video에 대한 META DB의 형태이다.

  - MPEG7은 contents를 표현할 수 있다.

MPEG 21

- MPEG21

  - Multimedia Framework

  - MPEG21 sets out a vision for the future of an environment where delivery and use of all content types by different categories of users in multiple application domains will be possible.

  - 기술요소

    ① digital Item Declaration
    ② Digital Item Identification
    ③ Intellectual Property Management and Protection
    ④ Terminals and Networks
    ⑤ Digital Item Management and usage
    ⑥ Digital Item Representation
    ⑦ Event Reporting

1.3 Multimedia networks

- Telephone network
  - to provide a telephony service (PSTN)
- data network
  - to provide a data communication service (PSDN)
- broadcast television network (BN)
  - to provide a broadcast television service

- Internet (IP based Network)

- Integrated Services Digital Networks (ISDN)
  - to provide multiple service
- Broadband multi-service networks
  - Broadband-Integrated Services Digital Network (B-ISDN)
  - to provide multiple service

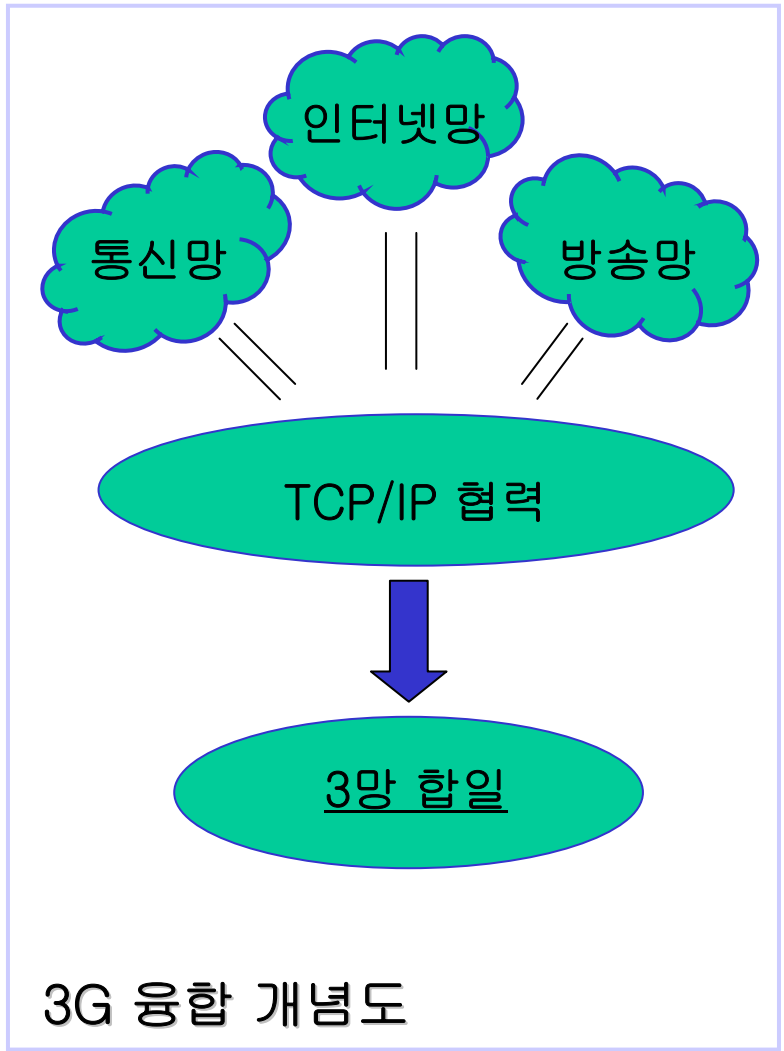
통신.방송.인터넷 한번에… "3망 융합' 급부상

디지털 타임스 2007년 3월 26일

3망 융합 = 통신, 방송,인터넷 등 3대 네트워크의 업무 융합 및 이들이 파생시킨 관리와 정책 방면의 통합적 추세를 일컫는 말이다. 3망 융합의 일차적인 목적은 사용자들에게 보다 신속하게 풍부한 정보를 서비스 하는 것이다. 어떤 업무에서 사용하는 문자나 음성, 데이터, 이미지, 영상 등은 멀티 매체 업무로 전환되며 사용자들은 단말기를 통해 각종 정보와 서비스를 받을 수 있게 된다.

네트워크 측면에서 3망 융합은 각각의 독립적인 네트워크를 종합적인 네트워크로 전환시킬 뿐 아니라 네트워크 성능과 자원 이용의 수준을 한 차원 업그레이드시킨다. 이런 점에서 3망 융합은 확실히 네트워크 업무발전의 필연적인 추세이자 전 세계 기술분야의 창조혁신을 위한 중요한 영역이다.

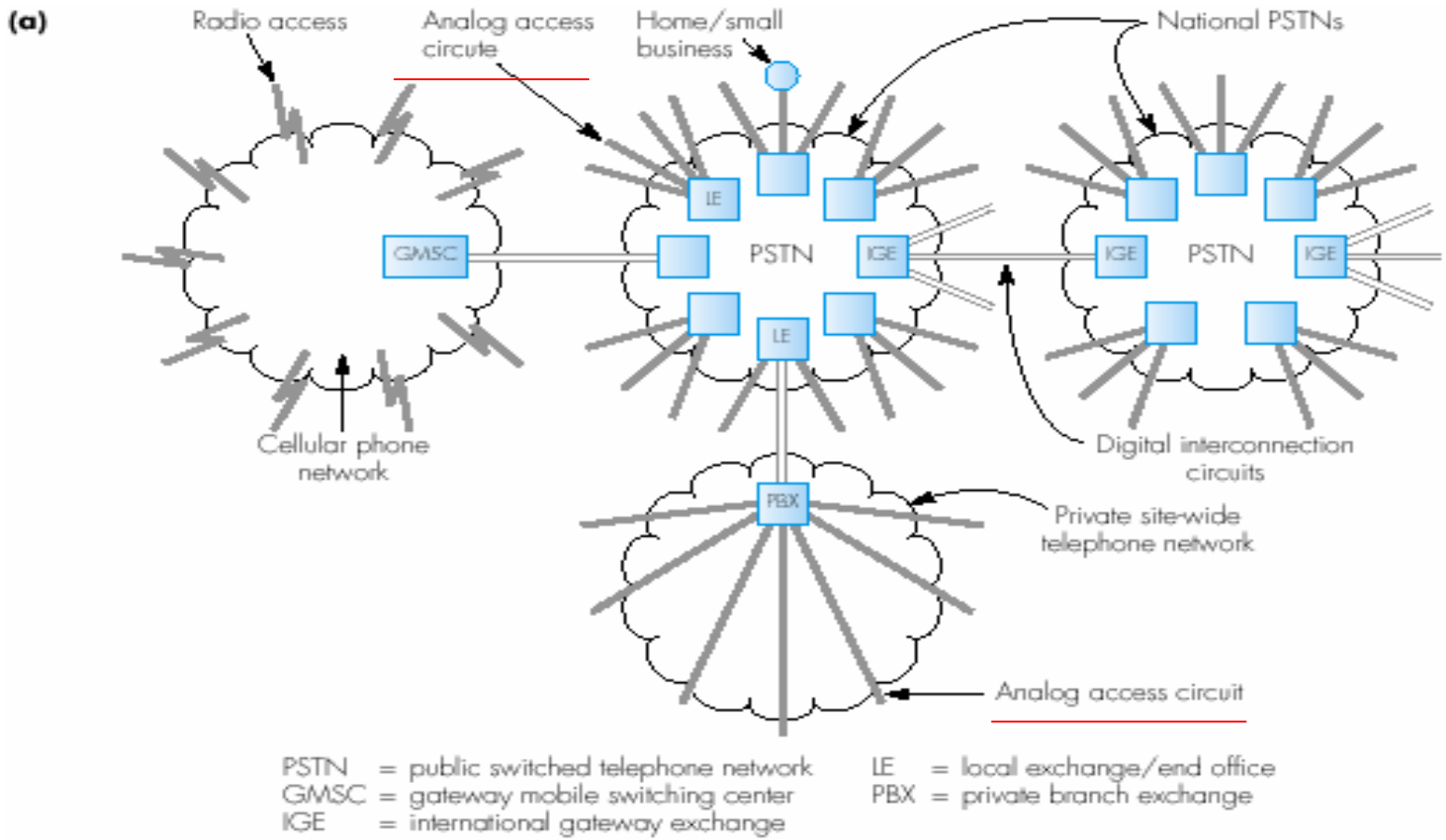
신식산업부가 최근 공포한 '2007년 업무요점' 에서는 올해 3망 융합의 기초적 연구와 관리부처와의 교류 등에 힘쓰기로 했다. 또 '11·5 규획' 기간(2006~2010년) 동안 통신 기초설비를 갖추고 적극적으로 3망 융합을 추진하도록 했다.



3G 융합 개념도

1.3.1 Telephone networks (1)

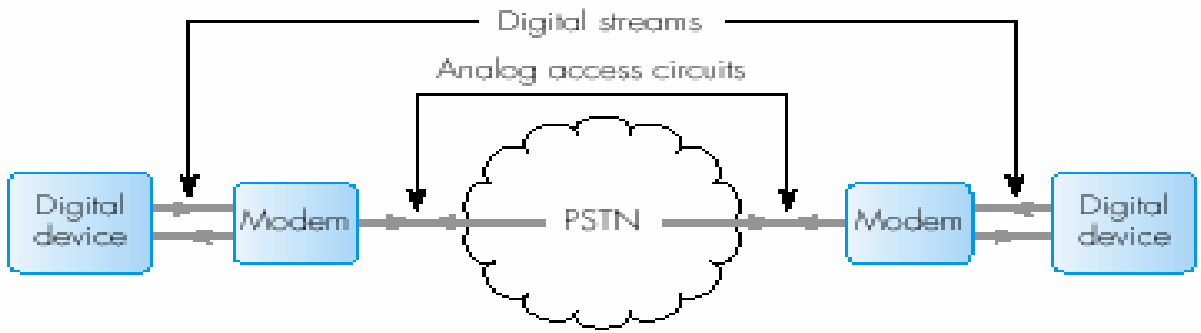
- Network components
  - *circuit mode, access circuits*



1.3.1 Telephone networks (2)

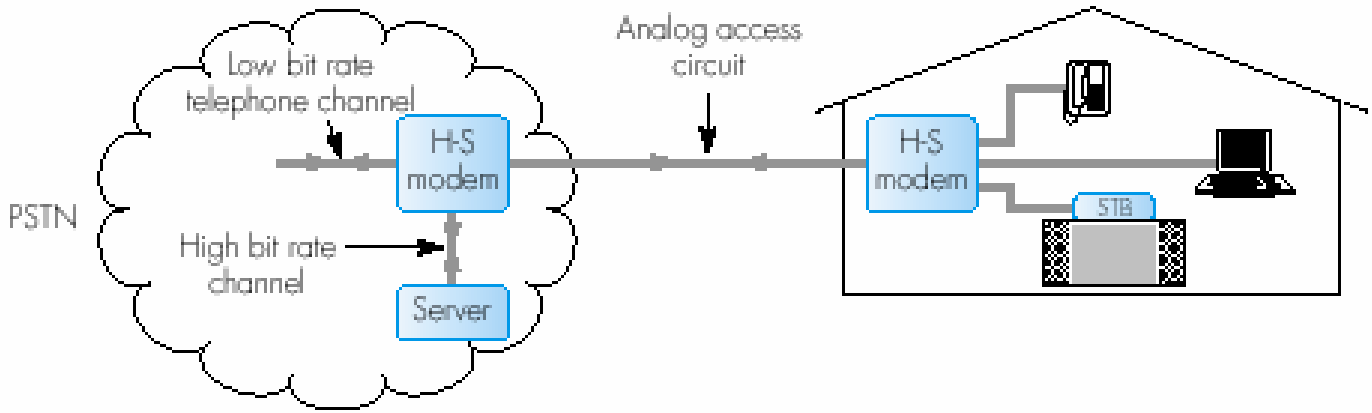
- Digital transmission using modems

(b)



- Multiple services via an high speed modem

(c)



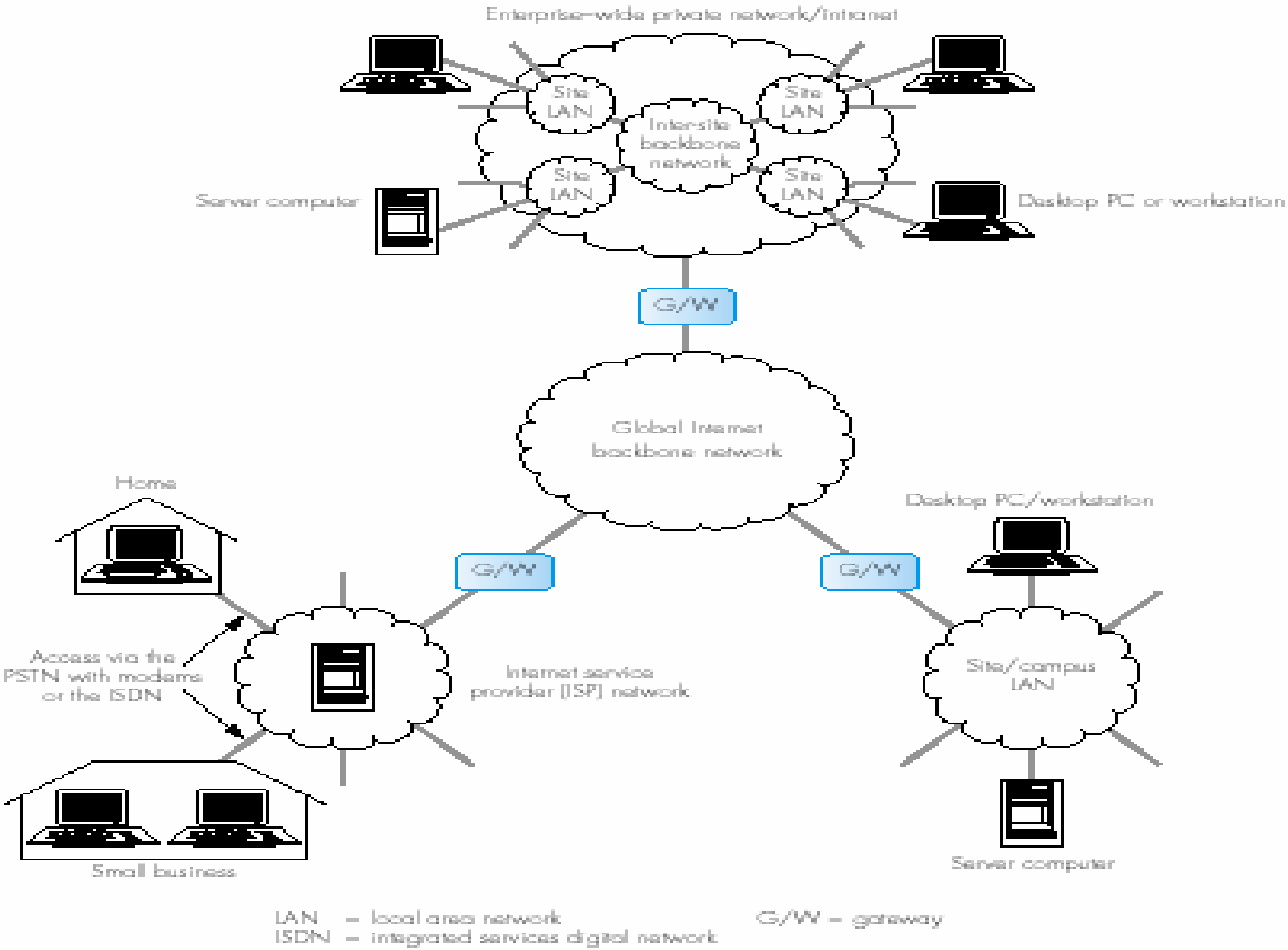
1.3.2 Data networks (1)

- Provide data communication services
  - electronic mail, file transfer

- connected digital devices such as Handhold device, PCs, Servers
  - *packet mode :*
    - *packet is a container*

      = head + block of data + addresses
- two type of data network
  - X.25 network
    - low bit rate --> unsuitable for most MM applications
  - Internet
    - open systems interconnection

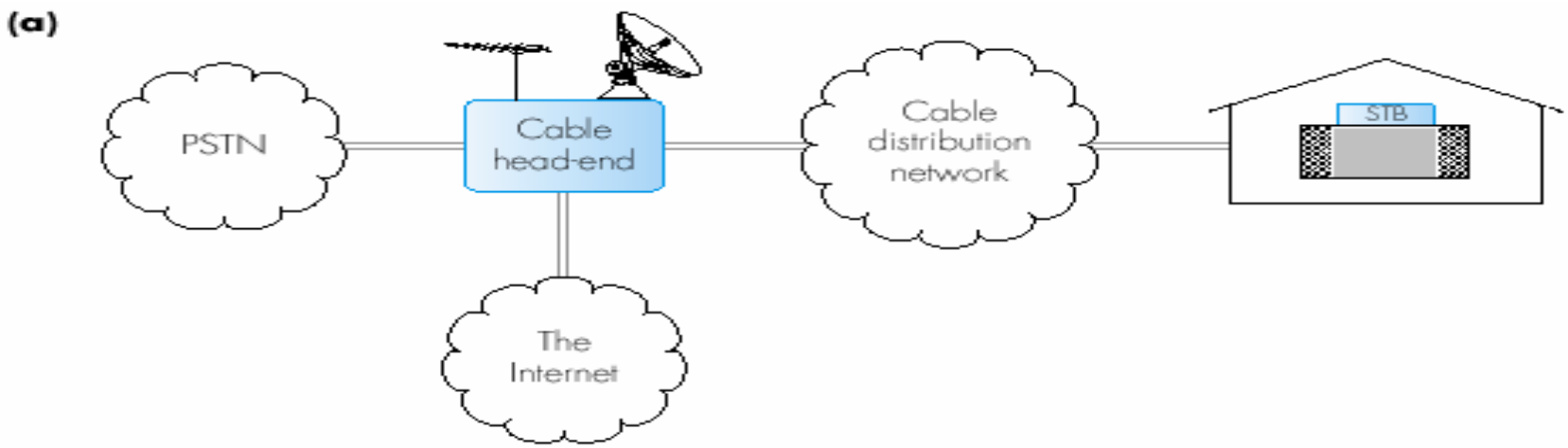
- A selection of the network types connected to the Internet



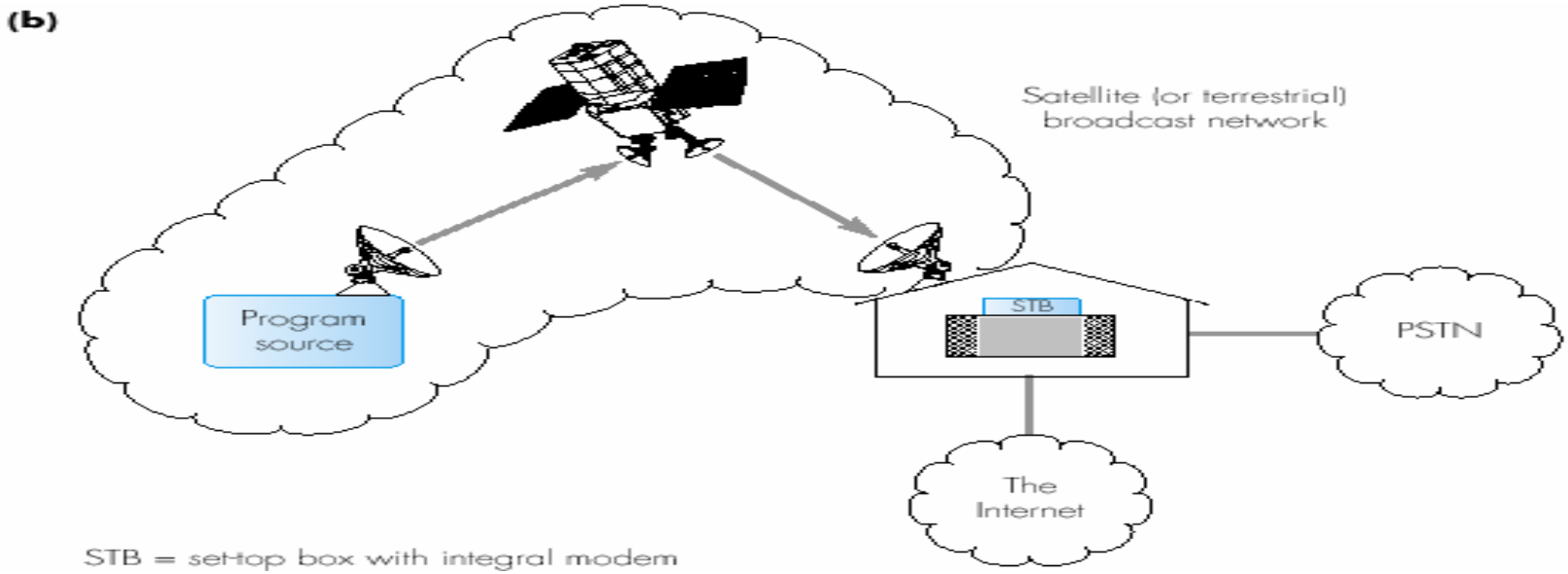
1.3.3 Broadcast television networks

- Cable networks
- Satellite/terrestrial broadcast networks
  - set-top box :
    - controls of the television channel
    - access to other services
    - includes a cable modem/high-speed modem
    - supports an interactive mode

- Cable networks



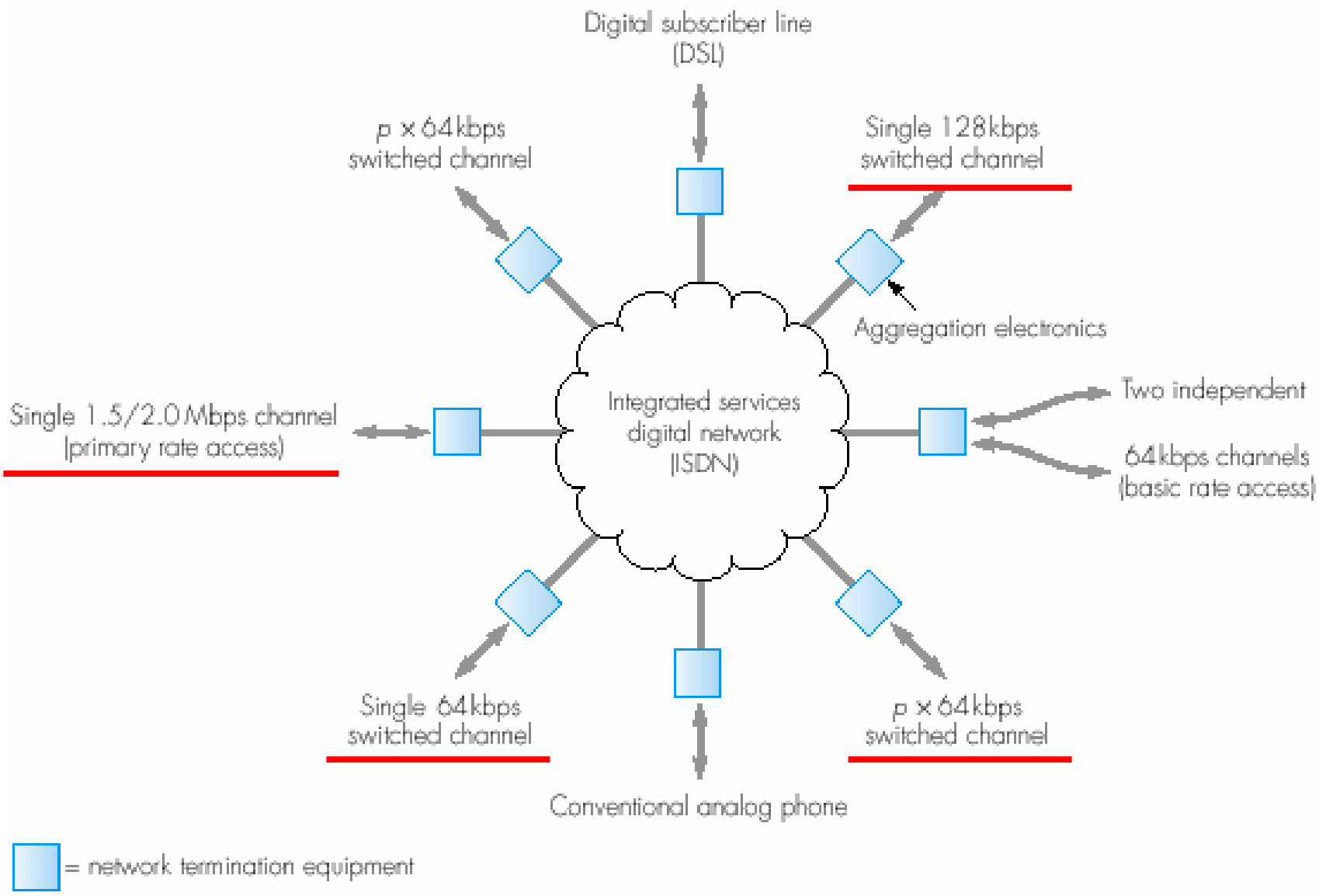
- Satellite/terrestrial broadcast networks



1.3.4 Integrated services digital networks

- Deployed in the early 1980s
  - to provide PSTN users with the capability of having additional services: (ex, video conference, video phone)
  - two telephone lines:
    - two different telephone calls in simultaneously or
    - a telephone call and a data call
    - full data call
- two type lines
  - BRA (Basic rate access)
    - two channel : 128kbps
  - PRA (Primary rate access)
    - 20 or 30 channel : 1.5 Mbps (T1) or 2Mbps (E1)
- cf: Digital subscriber line (DSL)

- Alternative services provided by an ISDN

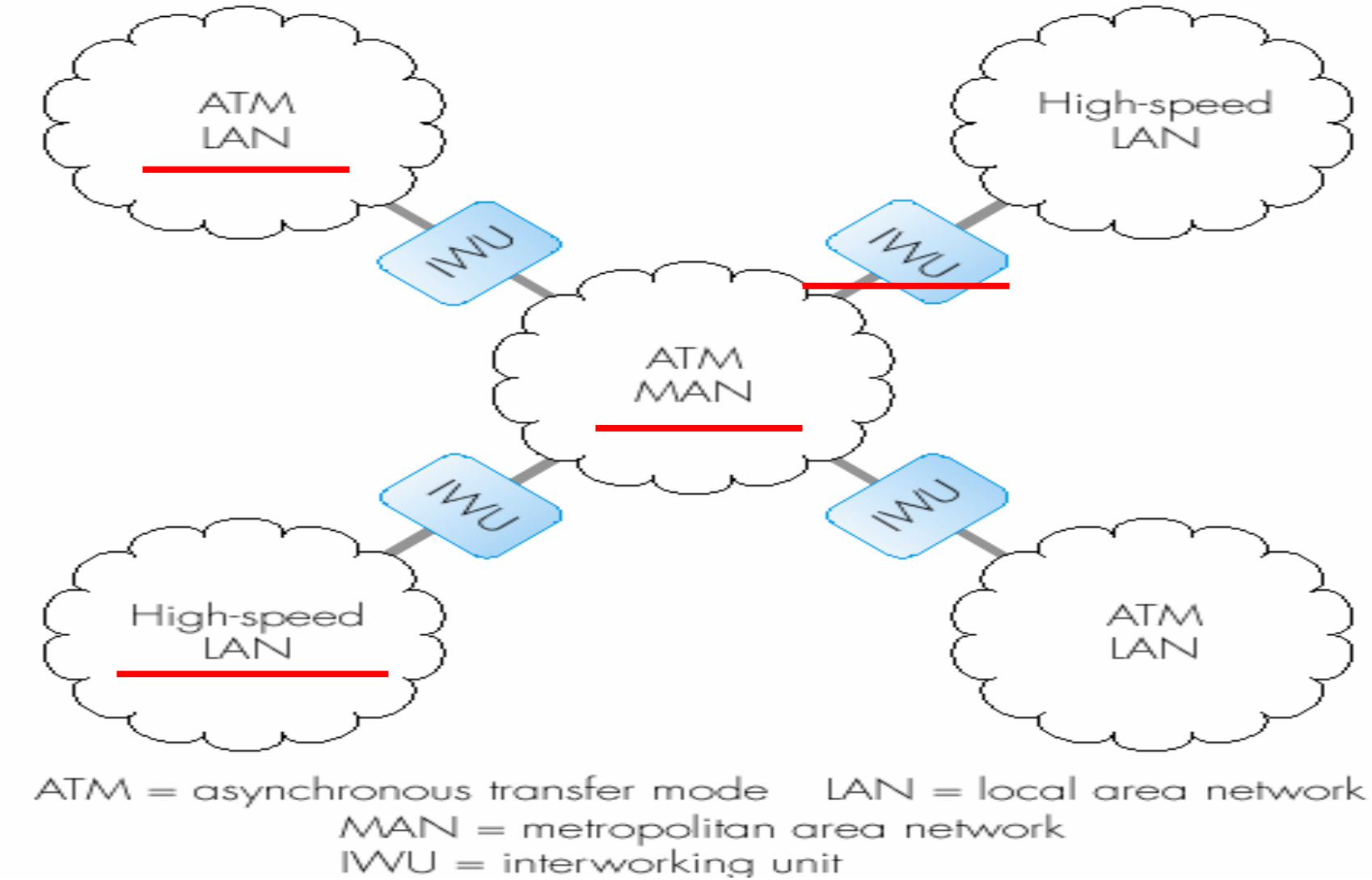


1.3.5 Broadband multi-service networks

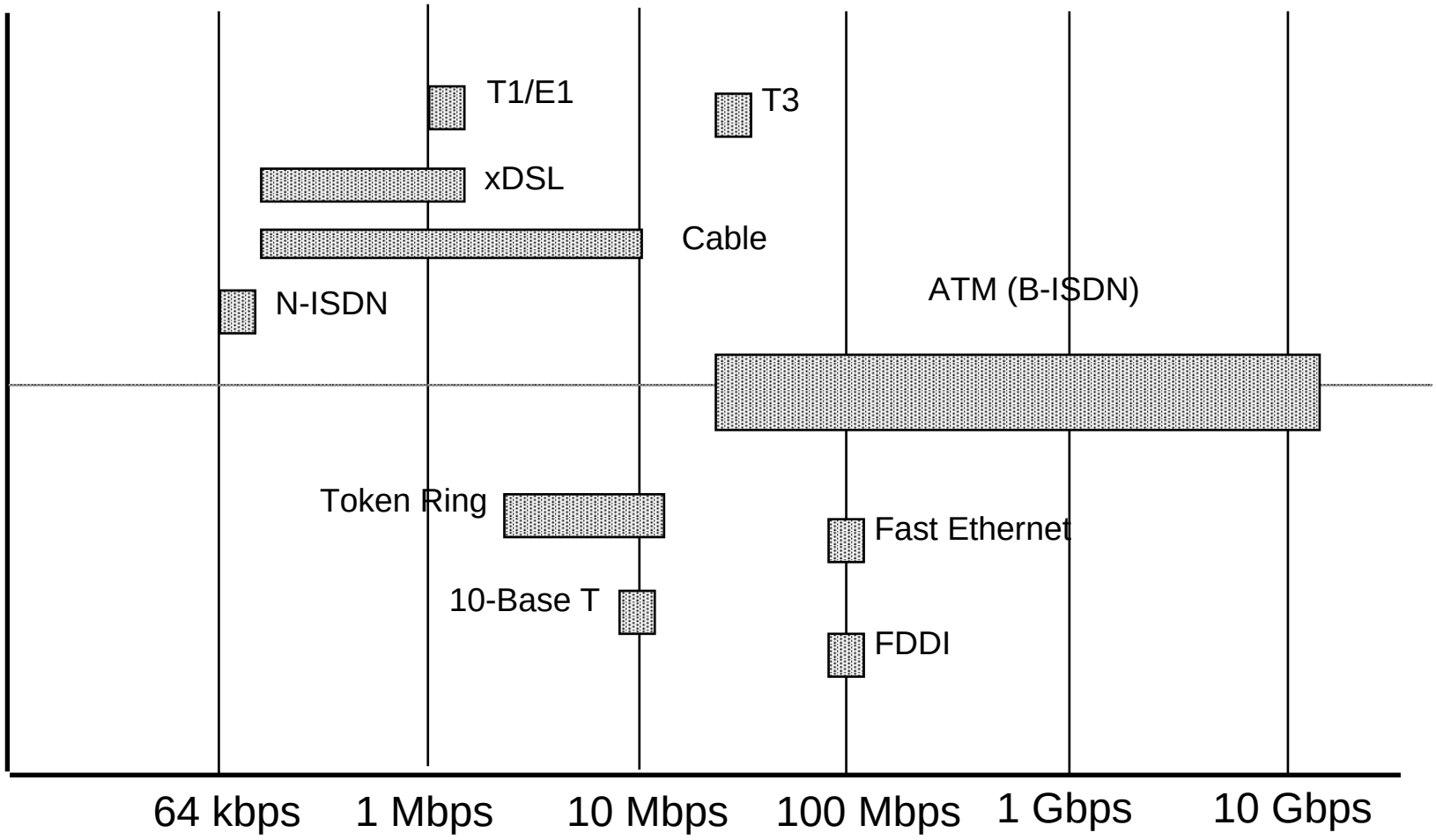
- Designed in the mid-1980s to support a wide range of MM Communication Applications

- Broadband
  - have bit rates in **excess of the max bit rate of 2 Mbps**
  - called B-ISDN (so, ISDN is Narrowband ISDN)
    - to support high quality video transmission
      - cf: compression of data
    - to support multiple service
      - audio, video, text simultaneously
  - basic transmission mode
    - Asynchronous transfer mode (ATM)
      - *cell(54bytes) switching networks*

- Example of ATM broadband multi-service network



Networking Technologies

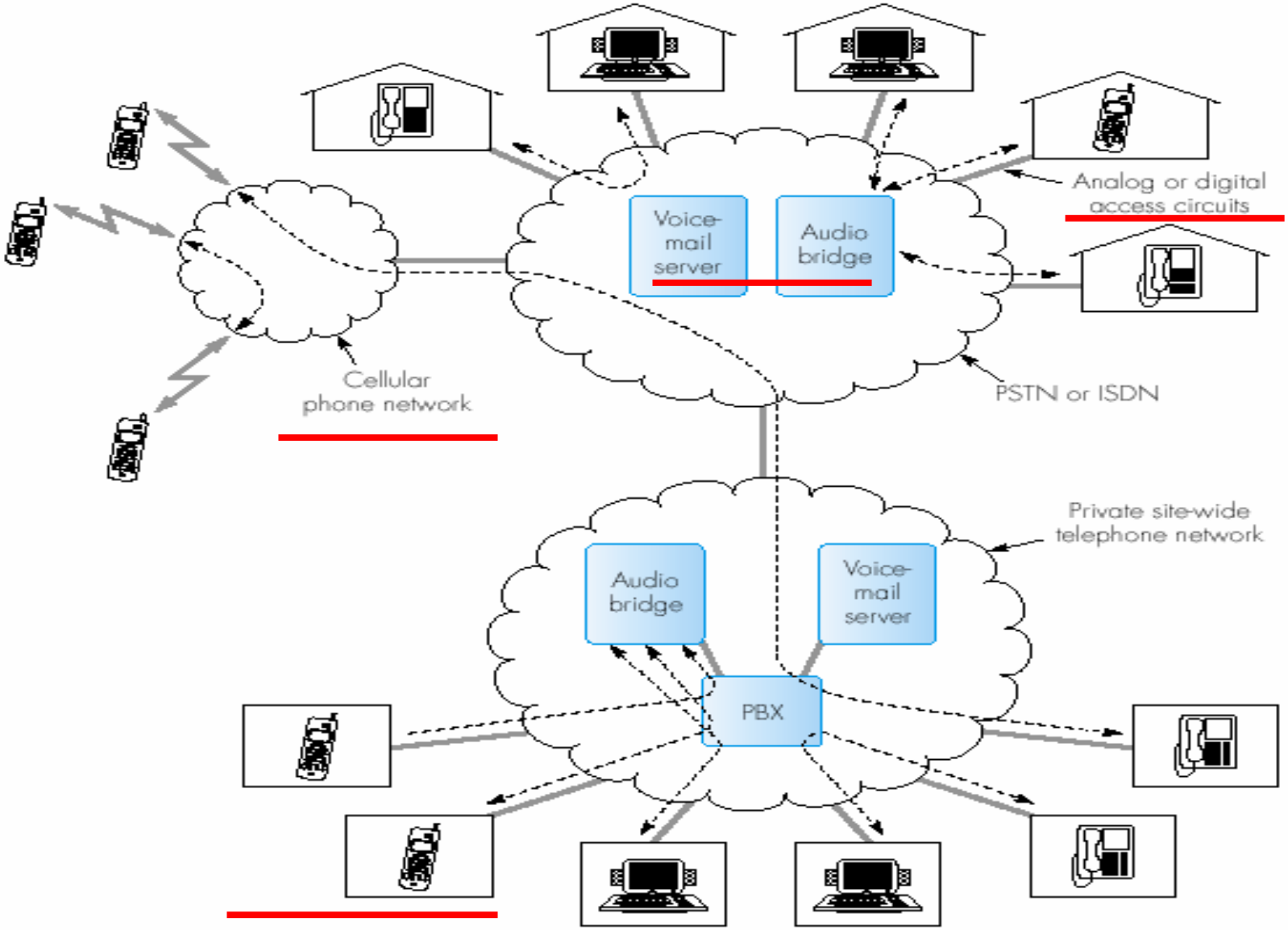


1.4 Multimedia applications

- Category
  - interpersonal communication
    - a single type of medium
      - speech, Image, Text only
    - two or more media types are integrated together
      - Text and images, speech and video, multimedia
  - interactive applications over Internet
  - entertainment applications

Speech only (1)

- Computer Telephony Integration (CTI)
  - using PCs instead of conventional telephones
- Voice-mail teleconferencing


Voice-mail server
Audio bridge
Analog or digital access circuits
Cellular phone network
PSTN or ISDN
Private site-wide telephone network
Audio bridge
Voice-mail server
PBX
PSTN = Public switched telephone network
PBX = Private branch exchange
ISDN = Integrated services digital networrk

Speech only (2)

- PC-to-PC telephone call
  - voice over IP (VoIP)

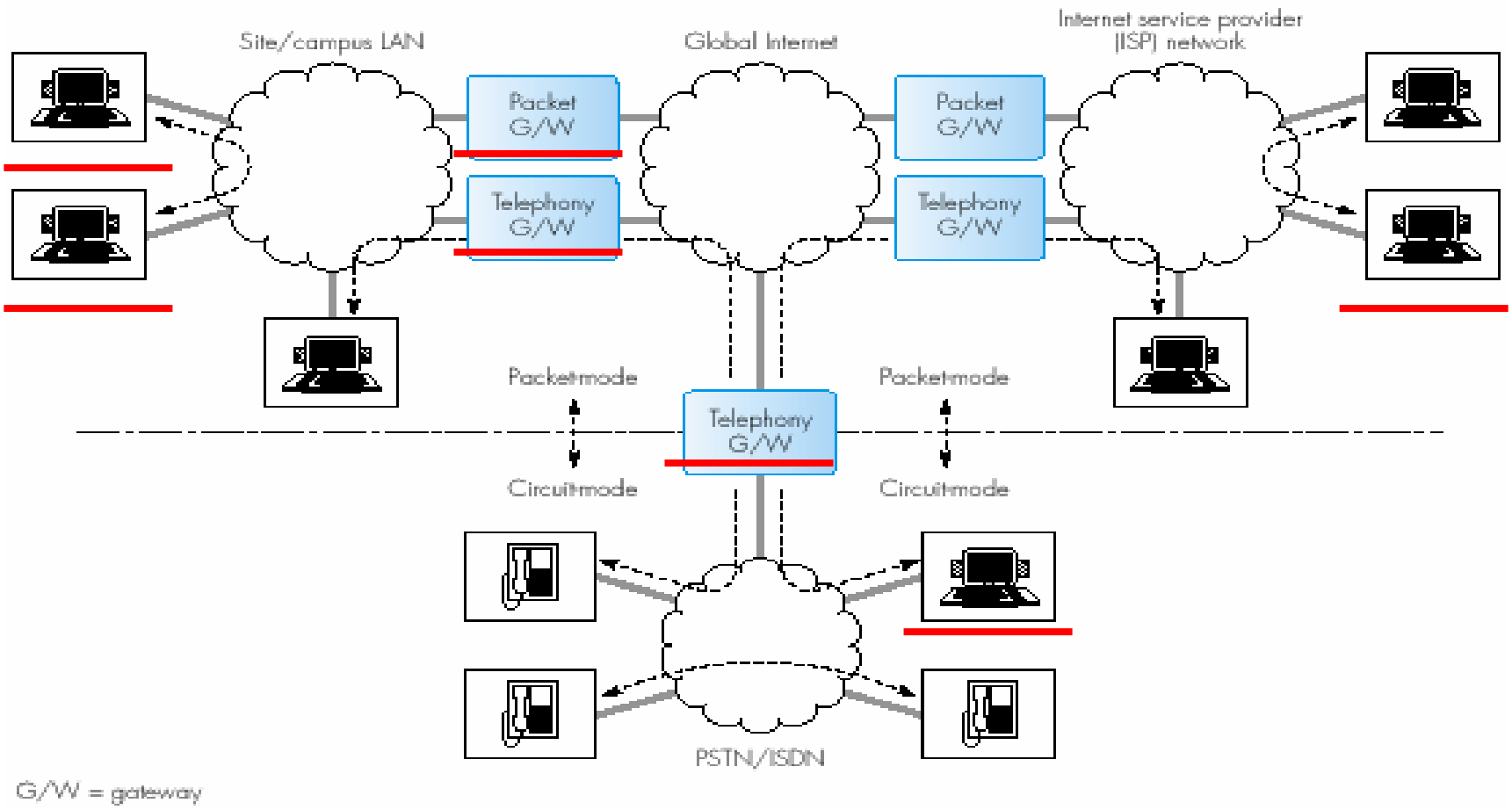
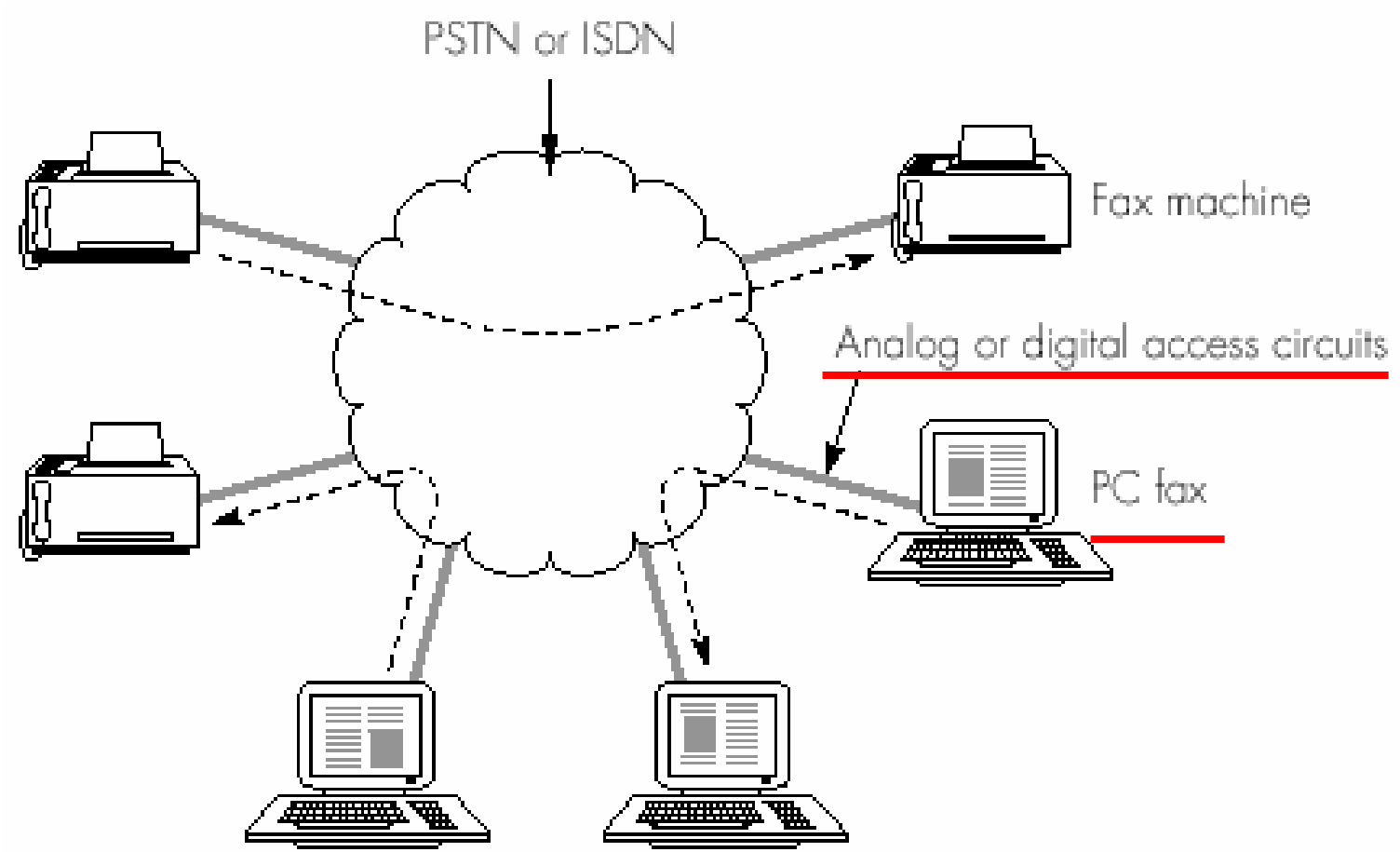


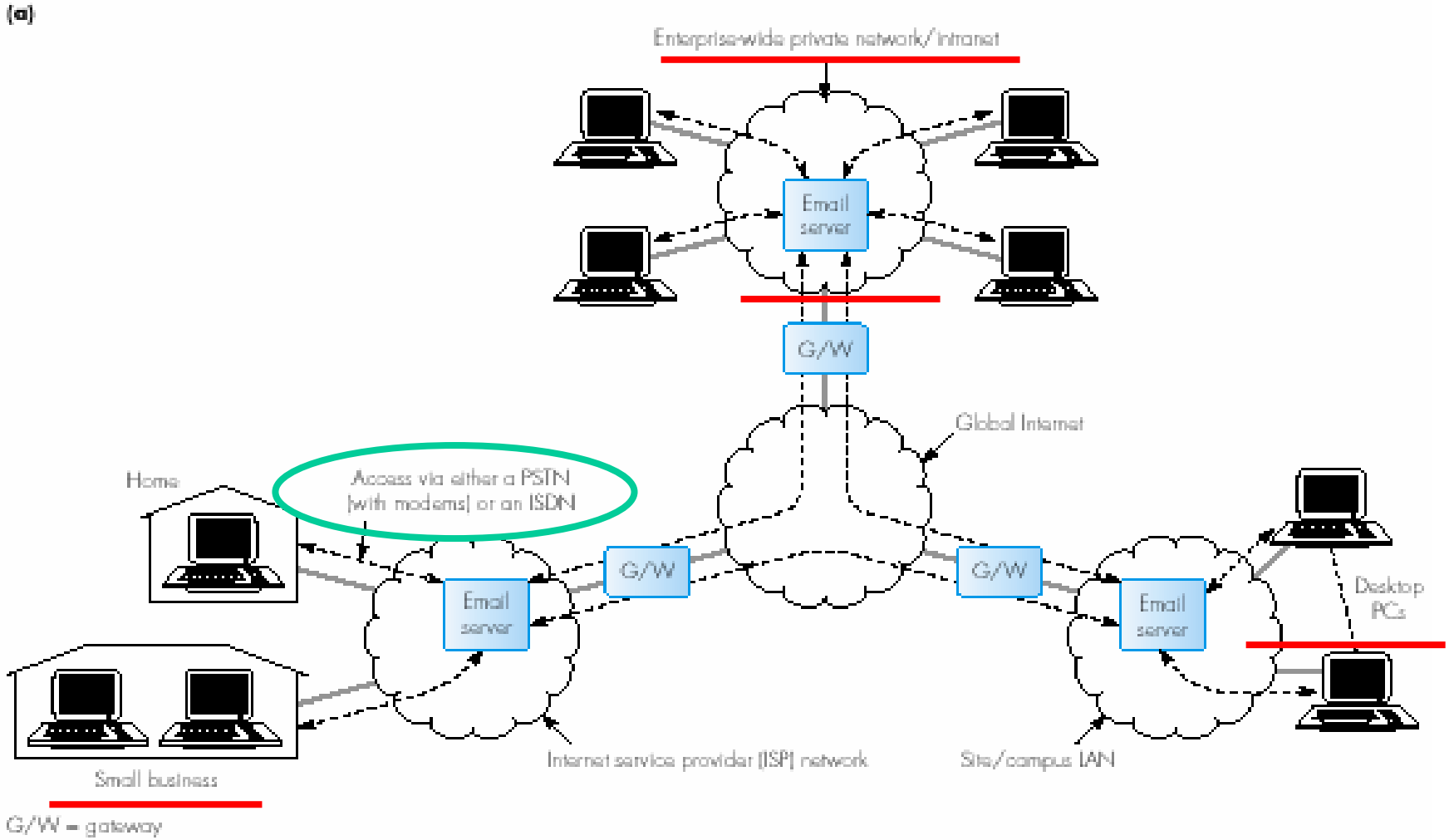
Image only

- Facsimile (Fax)



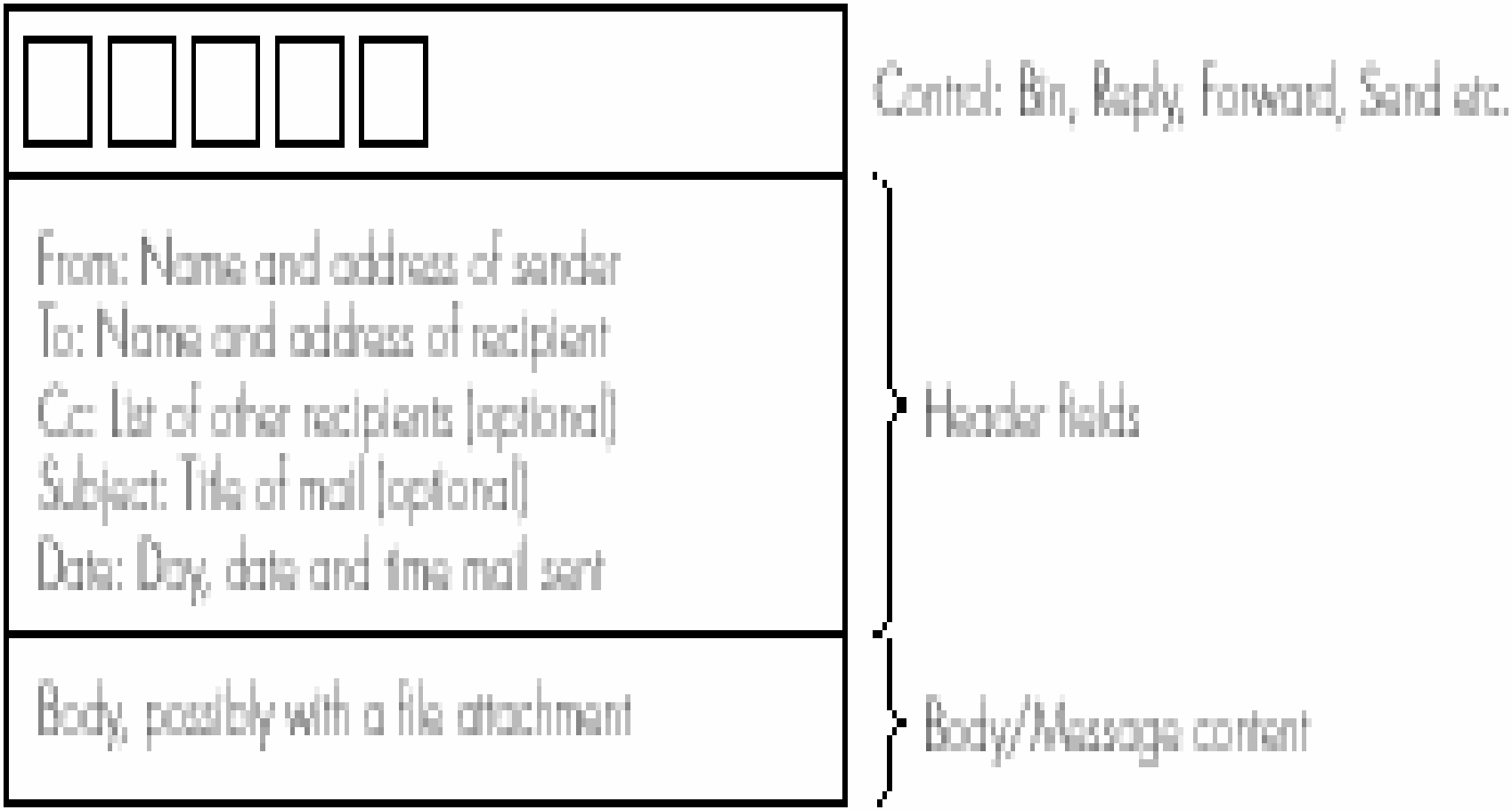
Text only

- E-mail service (mailbox)



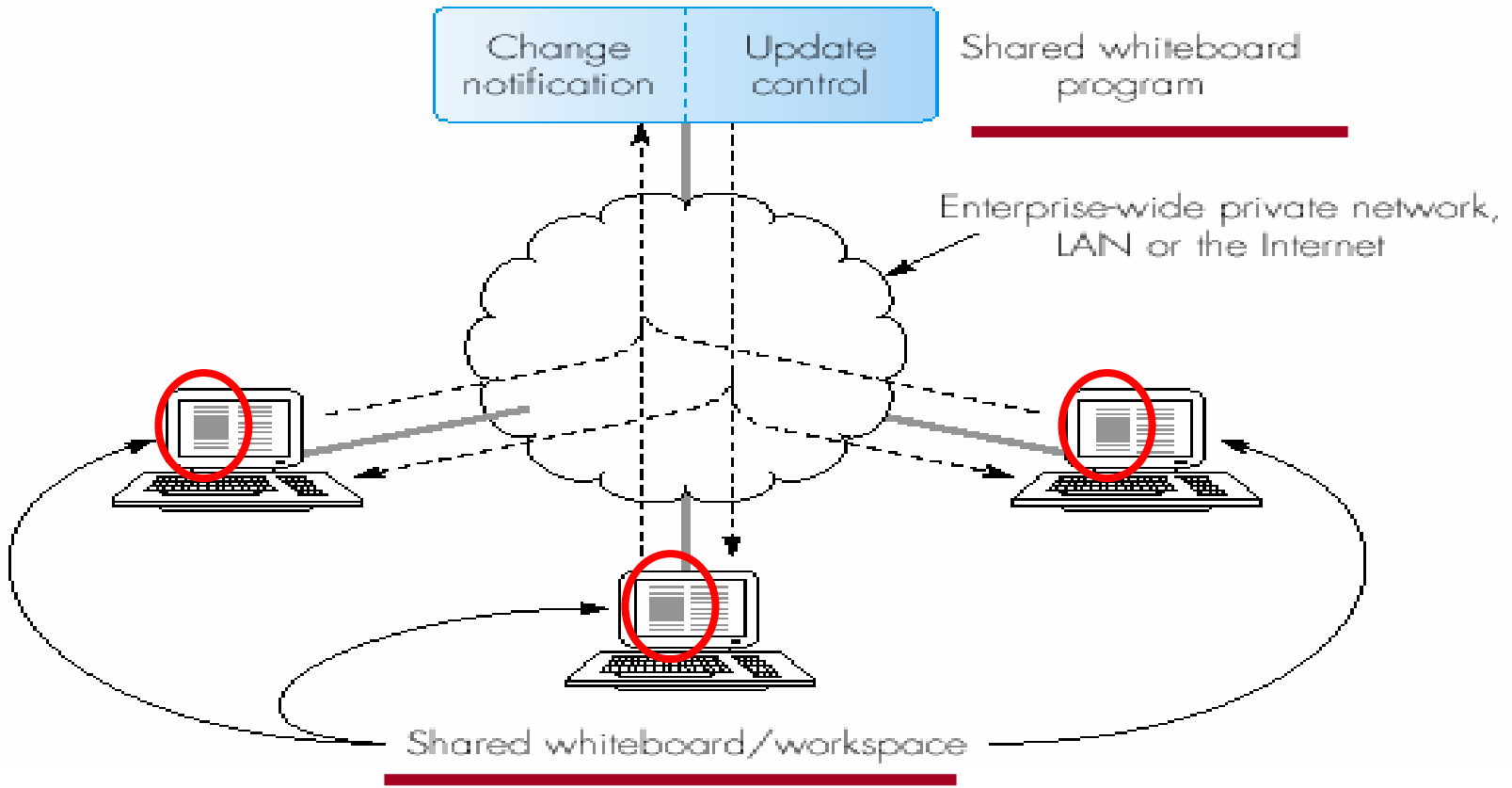
- Example of E-mail service

(b)



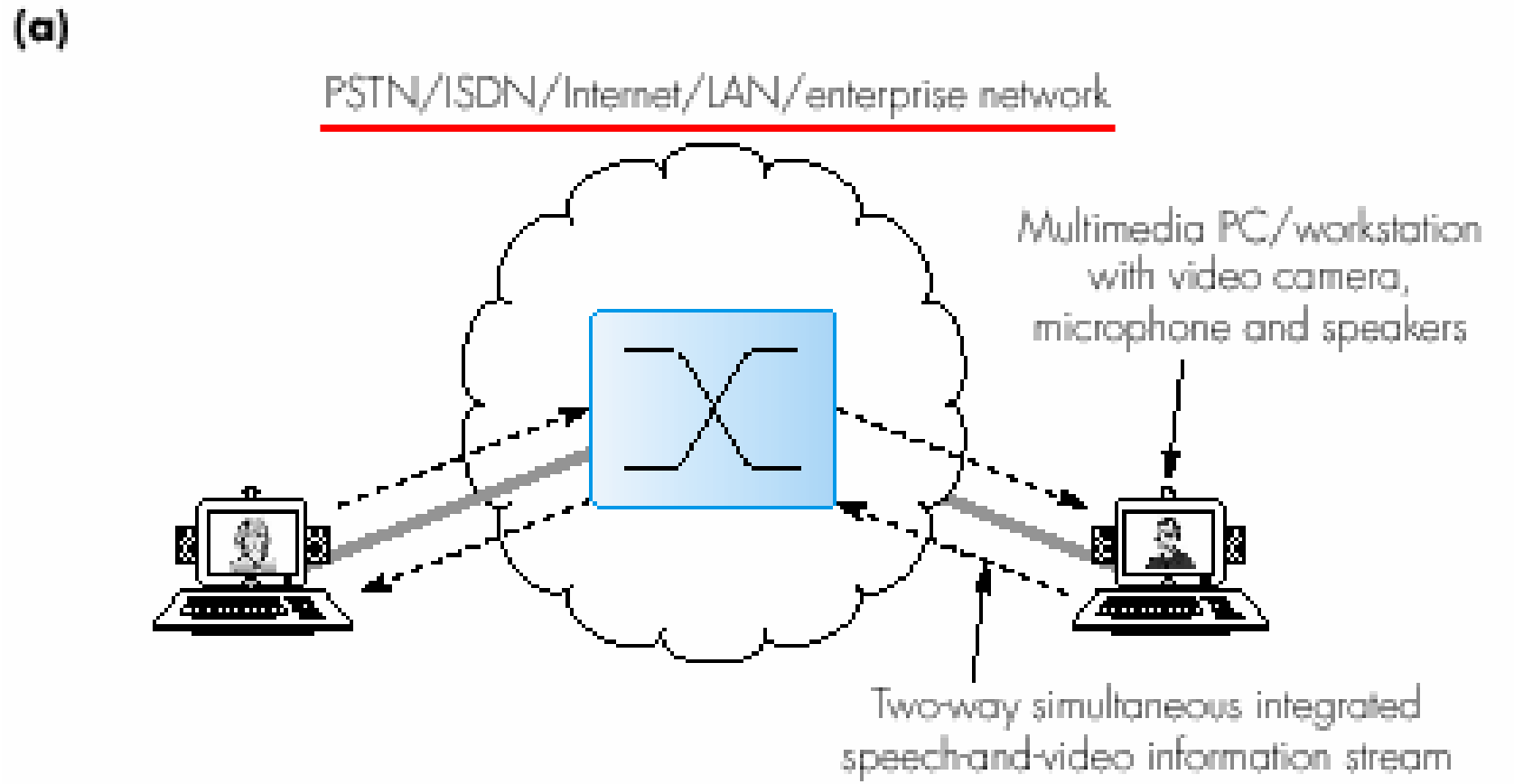
Text and images

- Computer-supported cooperative working (CSCW)
  - see *IEEE multimedia, Vol.7, No. 4, 2000*
  - example : shared whiteboard

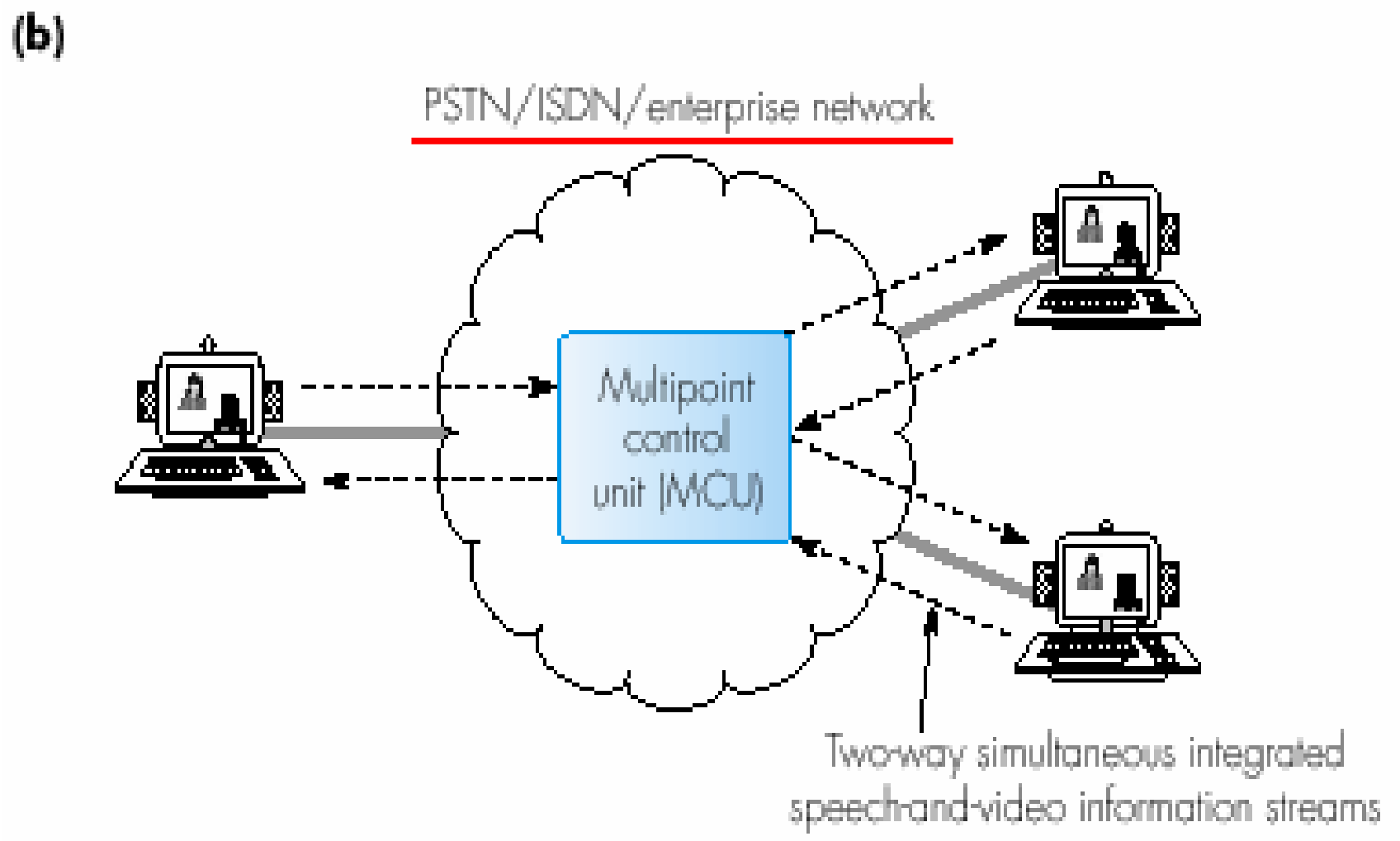


Speech and video (1)

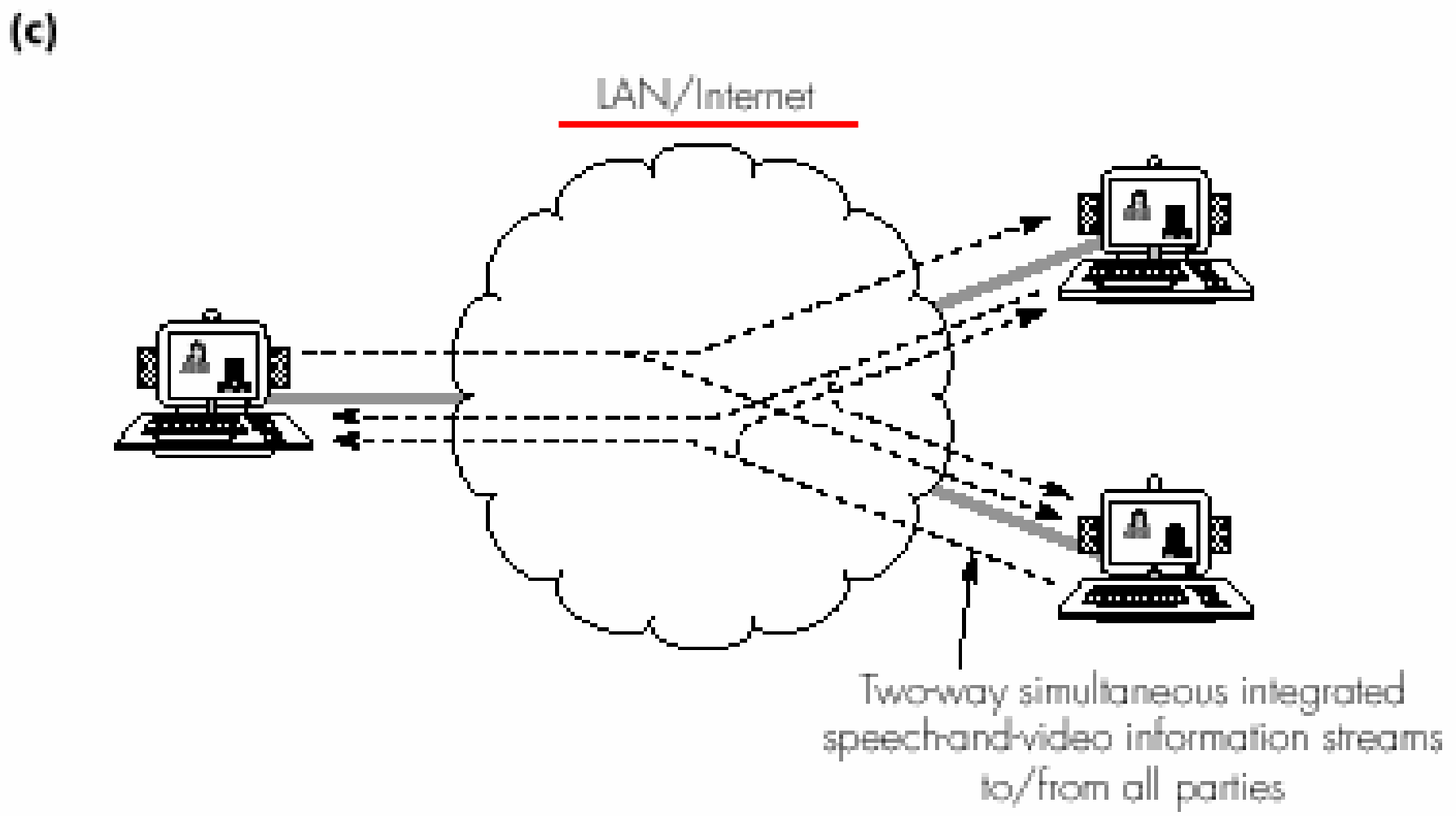
- Video telephony : Two-party video telephone call



- Videoconference using an MCU



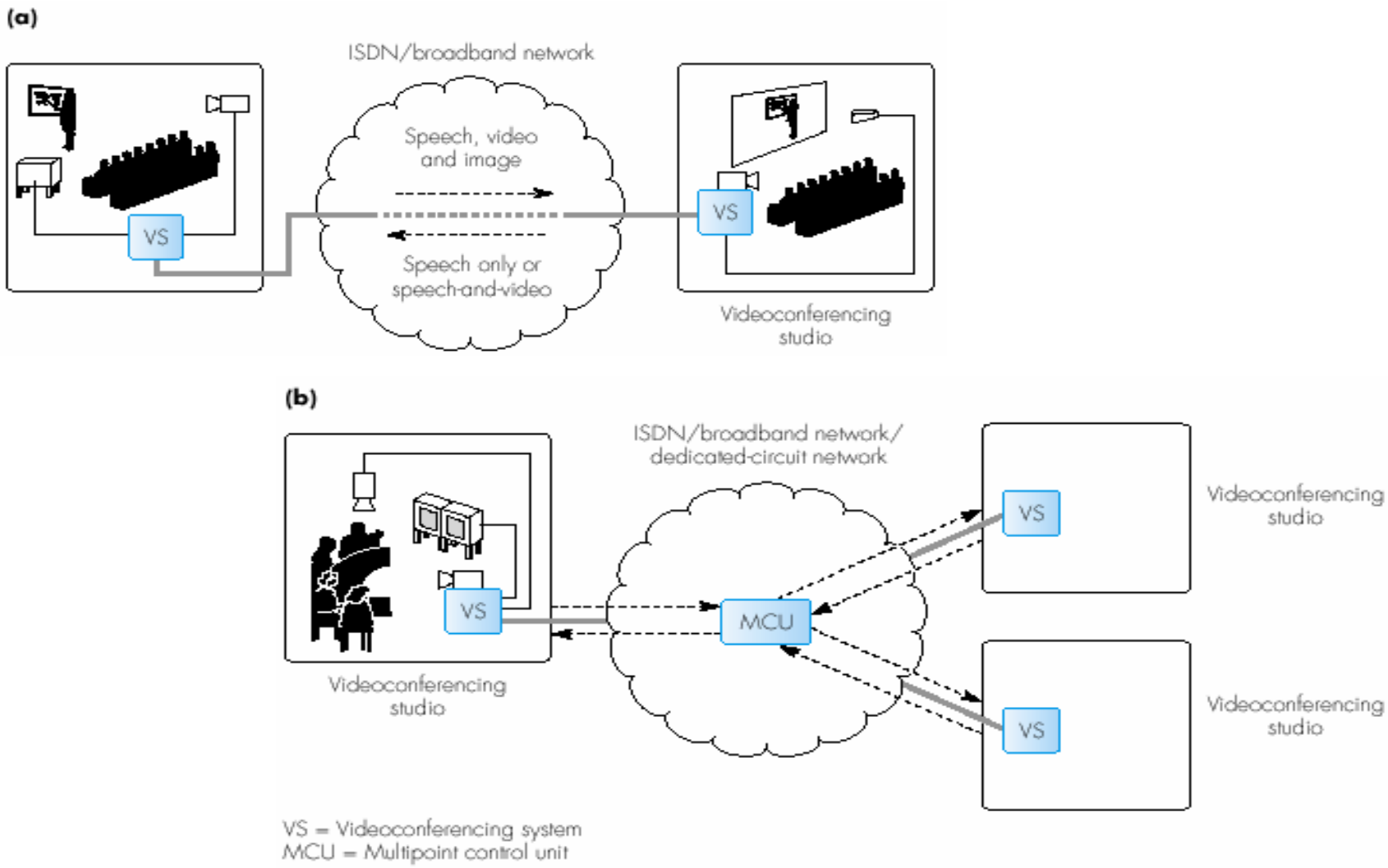
- Videoconference using a broadcast network



- The Java Media Framework API (JMF) enables audio, video and other time-based media to be added to applications and applets built on Java technology. This optional package, which can capture, playback, stream, and transcode multiple media formats, extends the Java 2 Platform, Standard Edition (J2SE) for multimedia developers by providing a powerful toolkit to develop scalable, cross-platform technology.

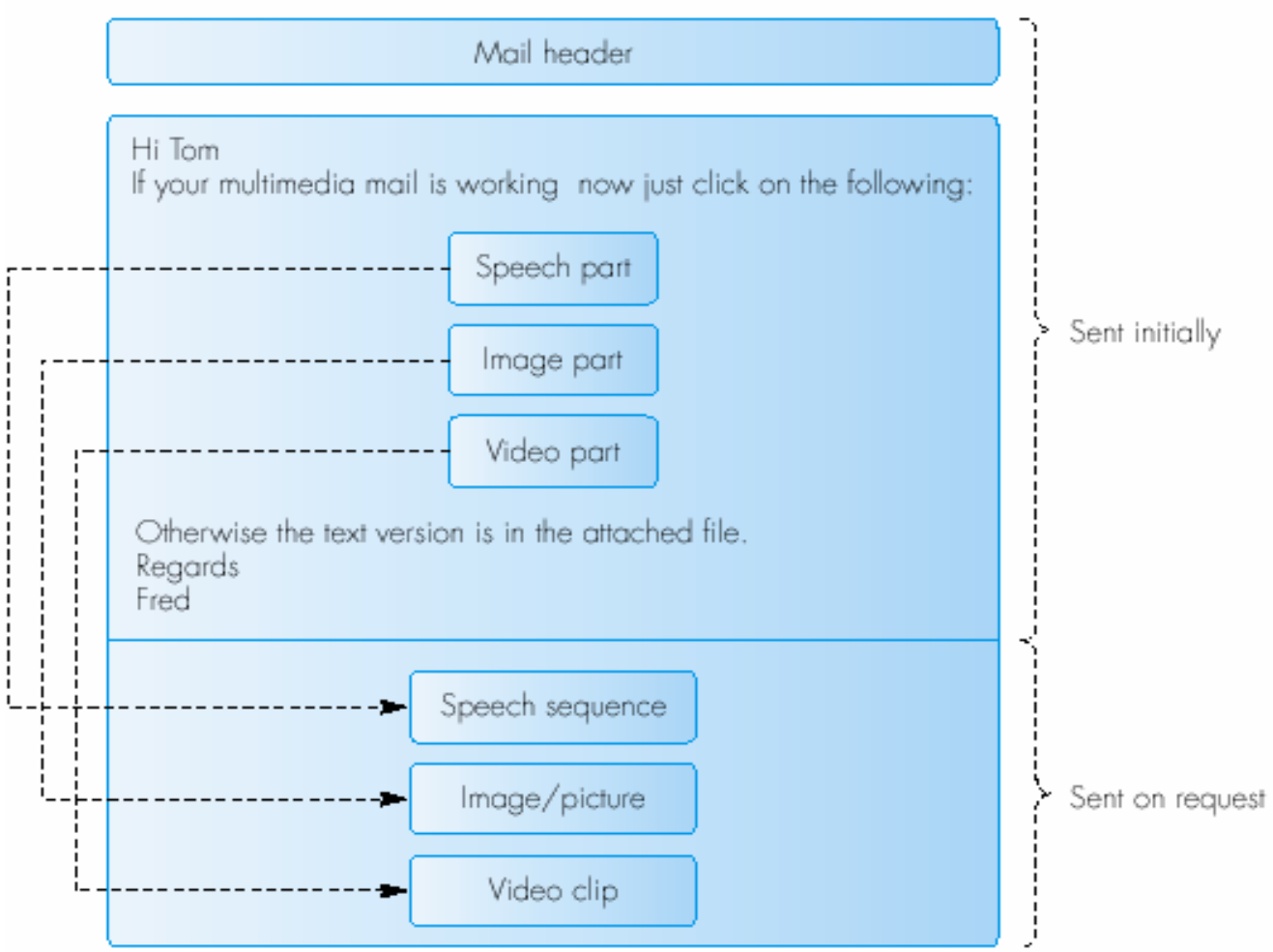
Speech and video (2)

- Remote lecture and video conferencing



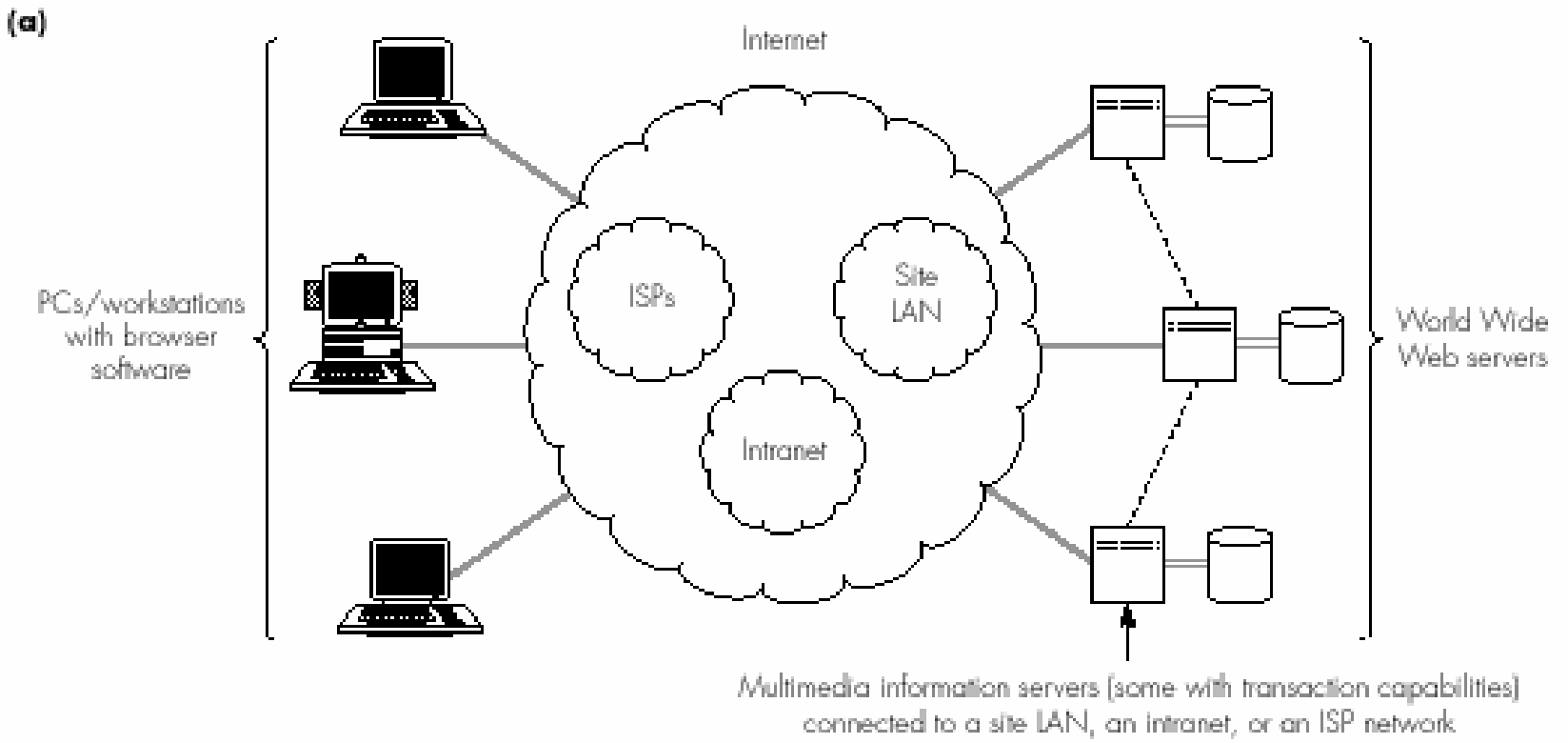
Multimedia

- Multimedia mail

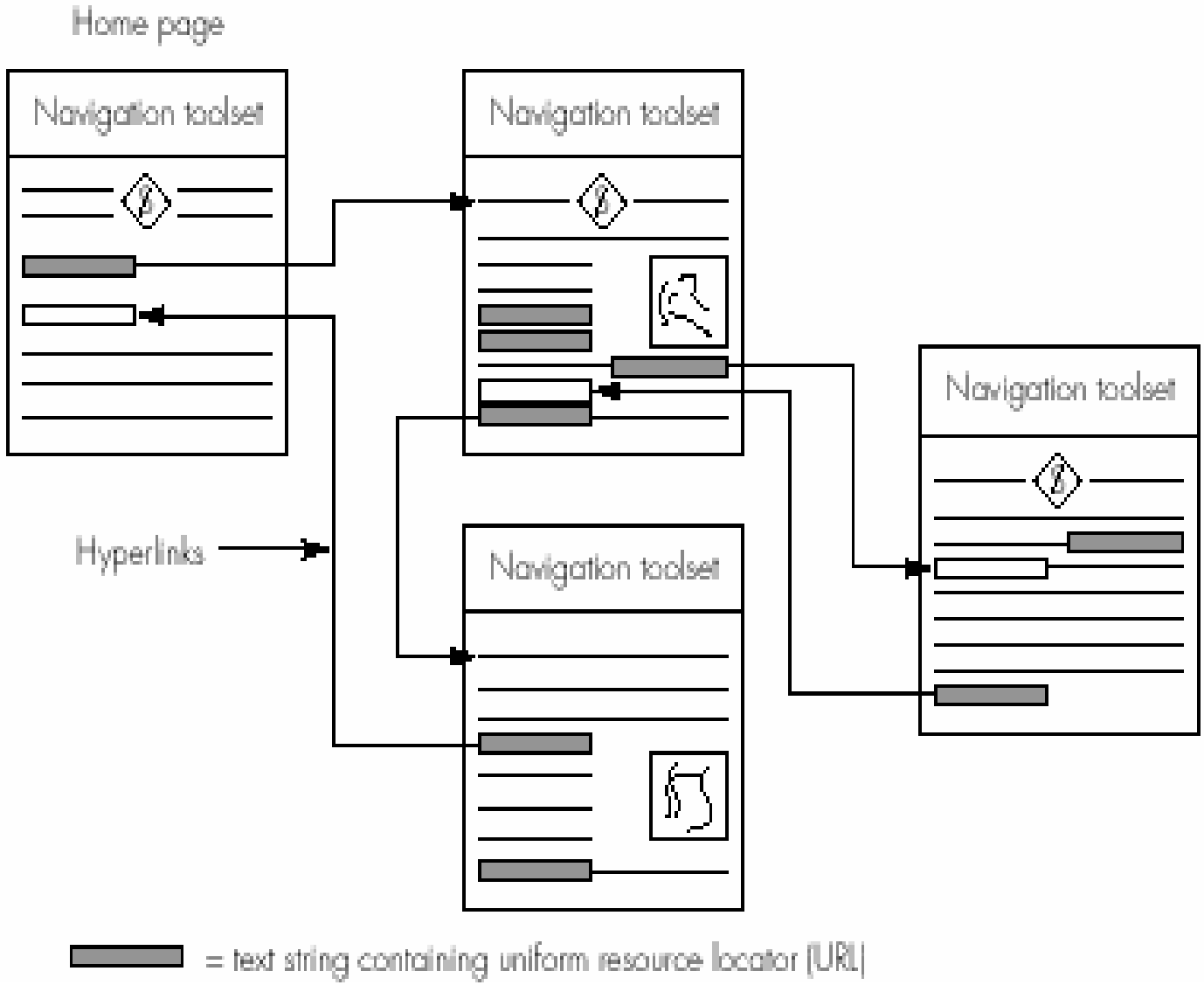


Interactive applications over Internet

- World Wide Web (WWW)
- Hyper links : HTML
  - major application : E-business/Internet-business

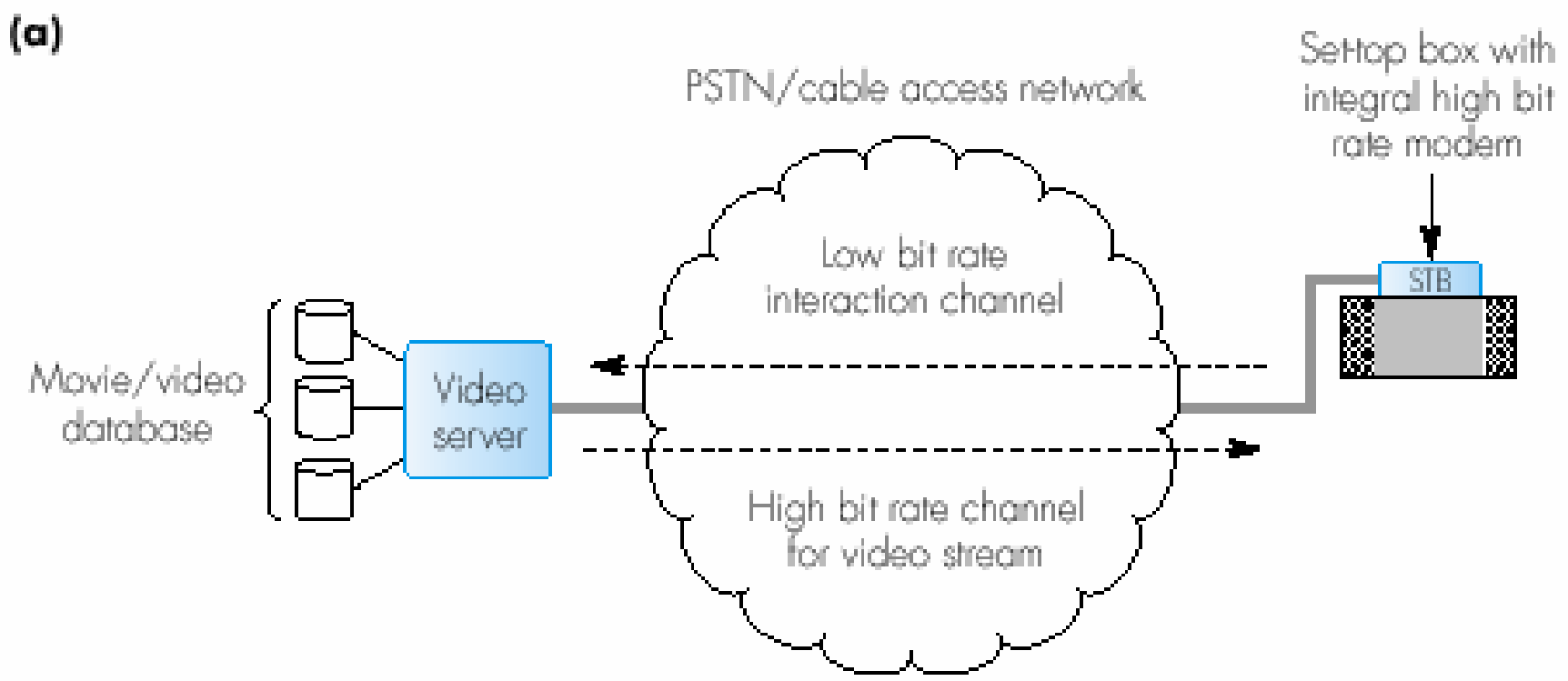


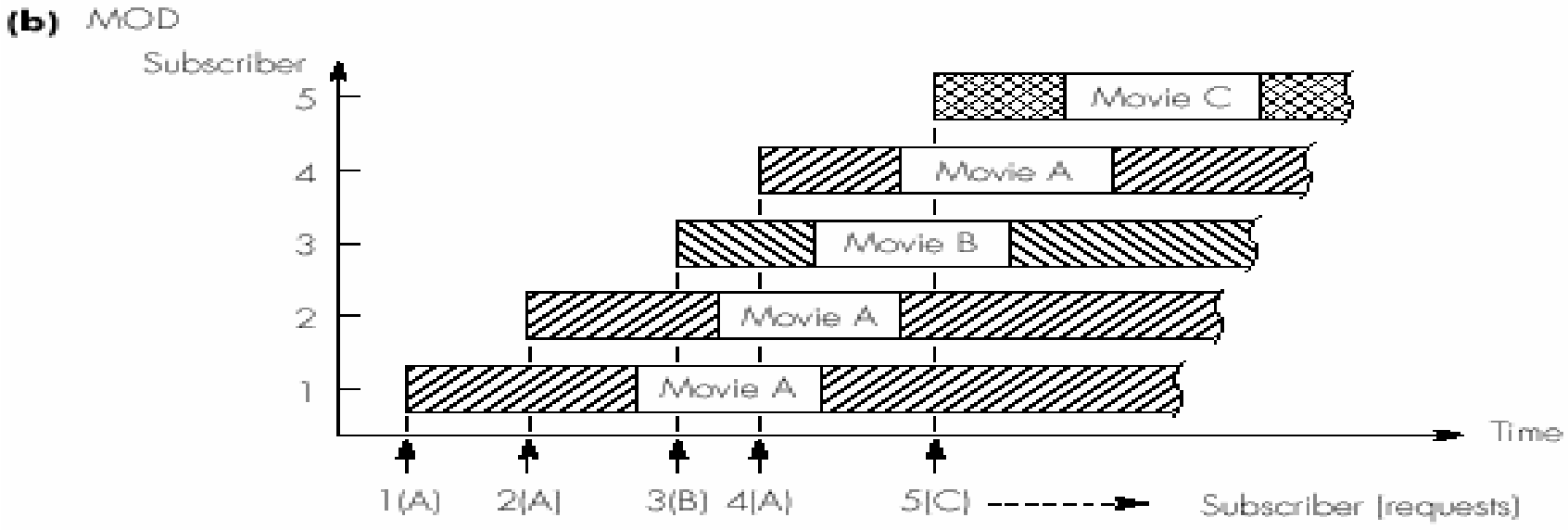
(b)

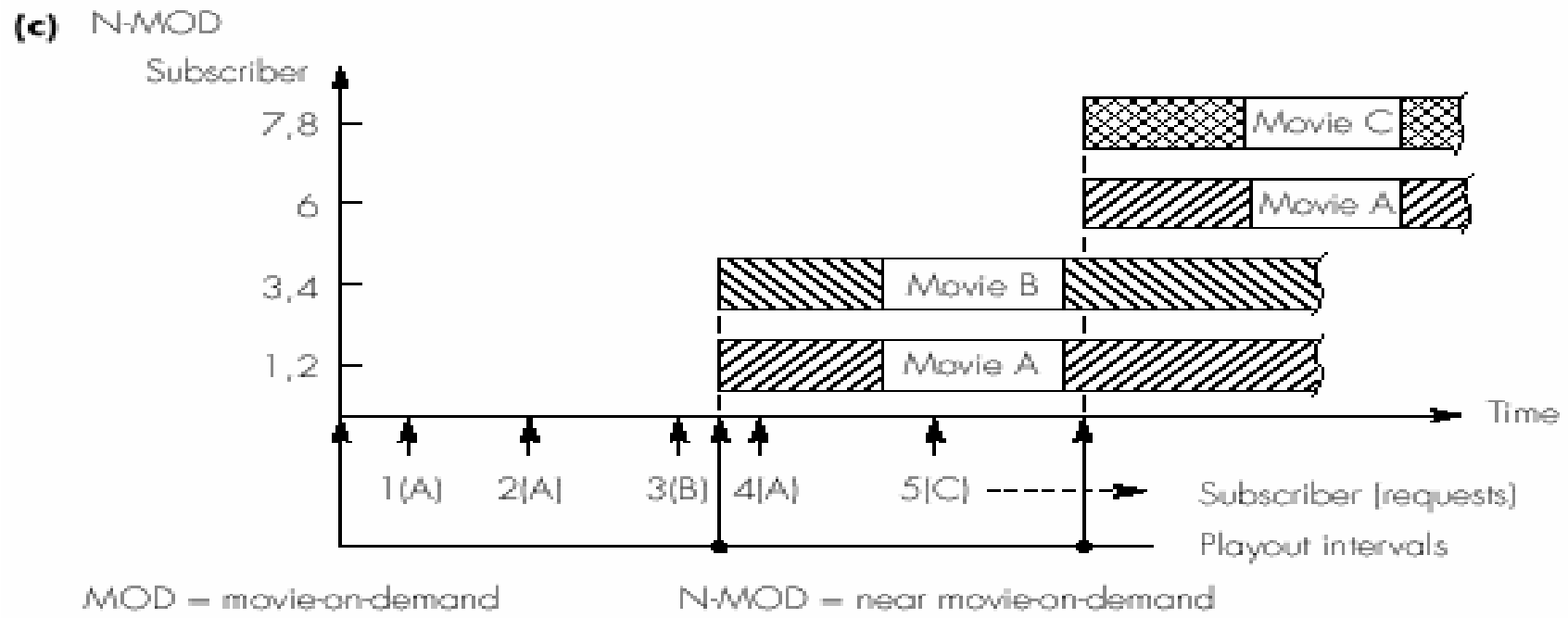

Home page
Navigation toolset
Navigation toolset
Navigation toolset
Navigation toolset
Hyperlinks
= text string containing uniform resource locator (URL)

Entertainment applications

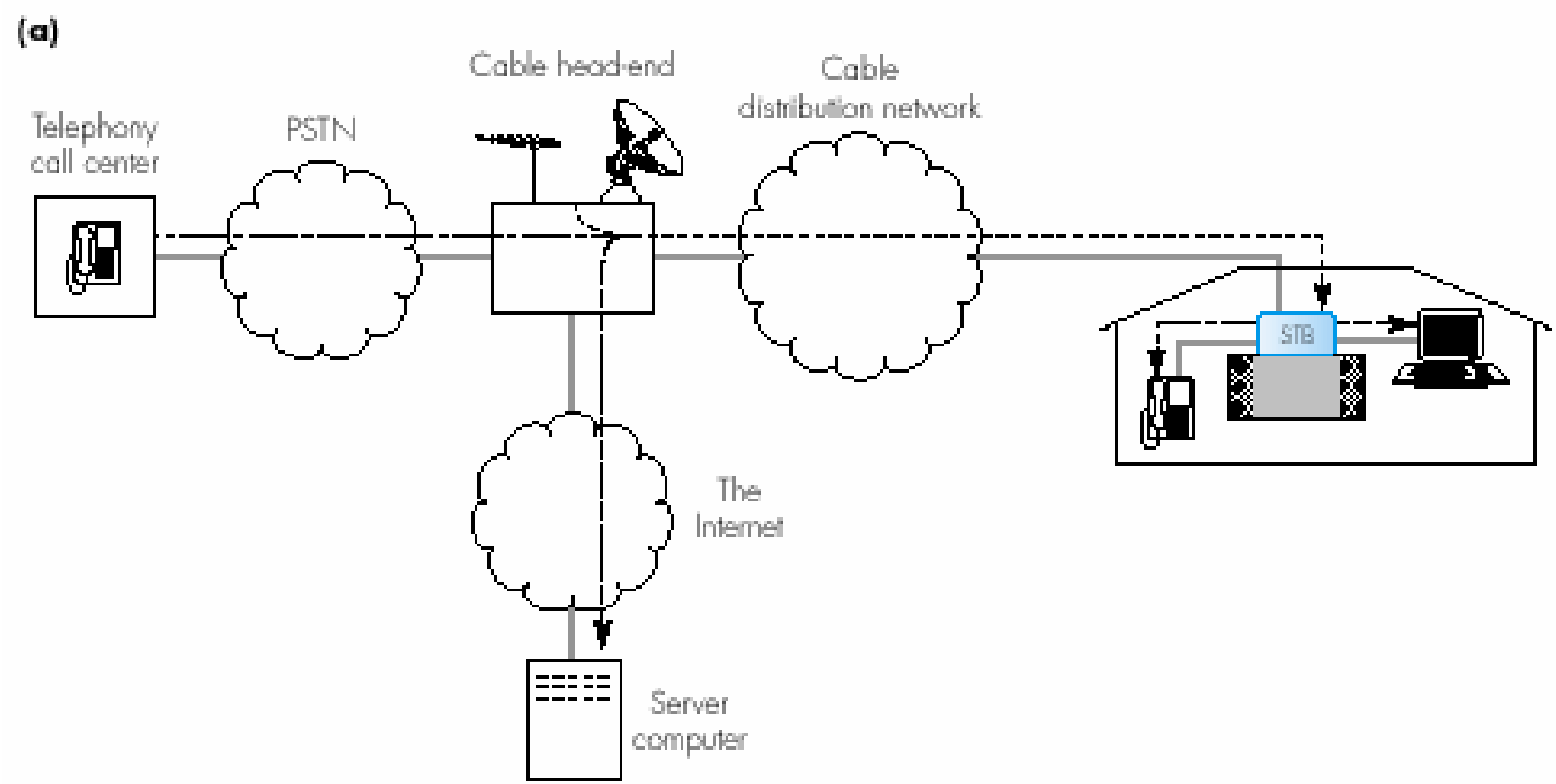
- Movie/video-on-demand
- Interactive Television



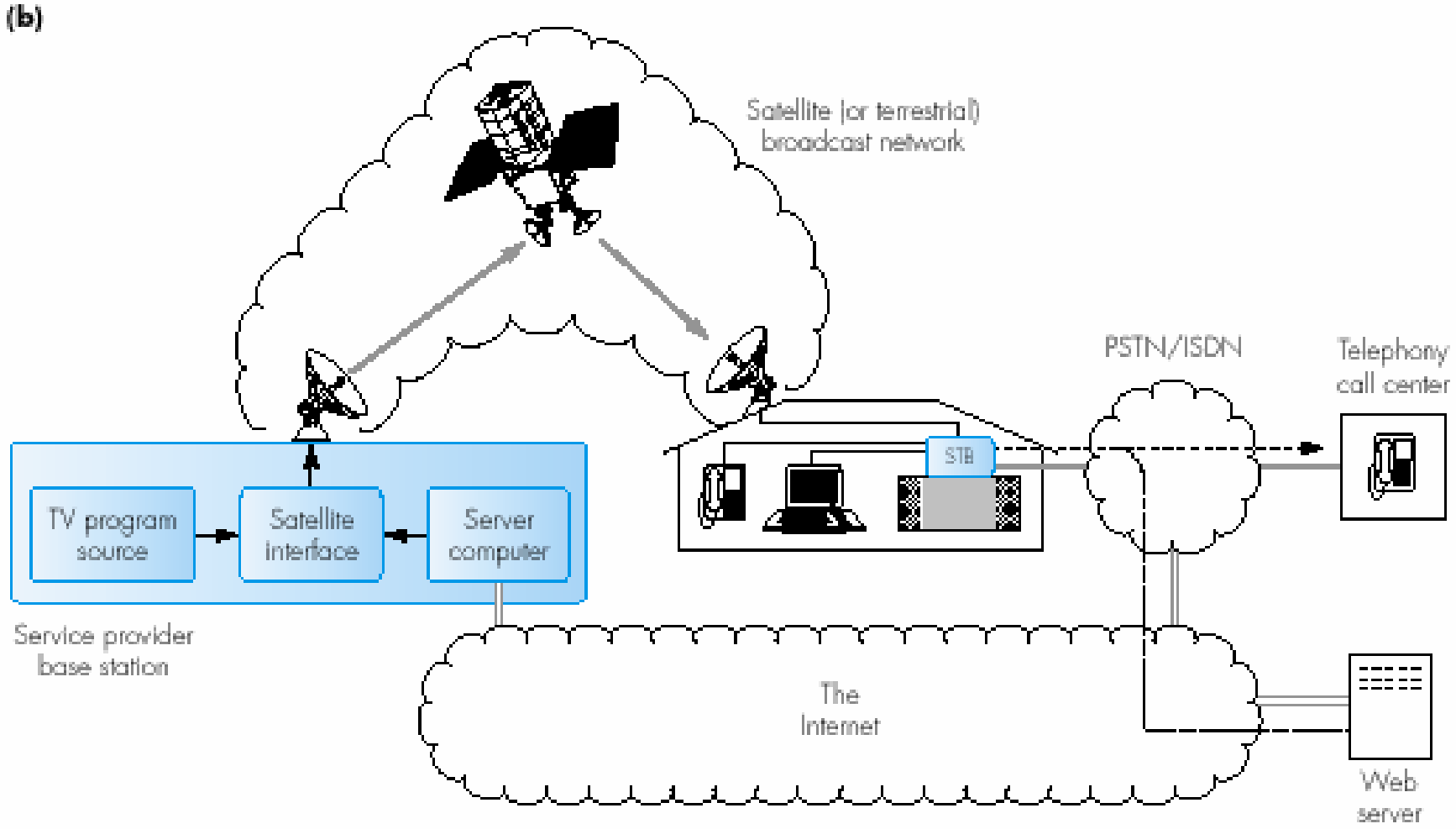

(b) MOD
Subscriber
5
4
3
2
1
Movie C
Movie A
Movie B
Movie A
Movie A
Time
1(A)
2(A)
3(B)
4(A)
5(C)
Subscriber [requests]


(c) N-MOD
Subscriber
7,8
6
3,4
1,2
Movie C
Movie A
Movie B
Movie A
Time
1(A)
2(A)
3(B)
4(A)
5(C)
Subscriber [requests]
Playout intervals
MOD = movie-on-demand
N-MOD = near movie-on-demand

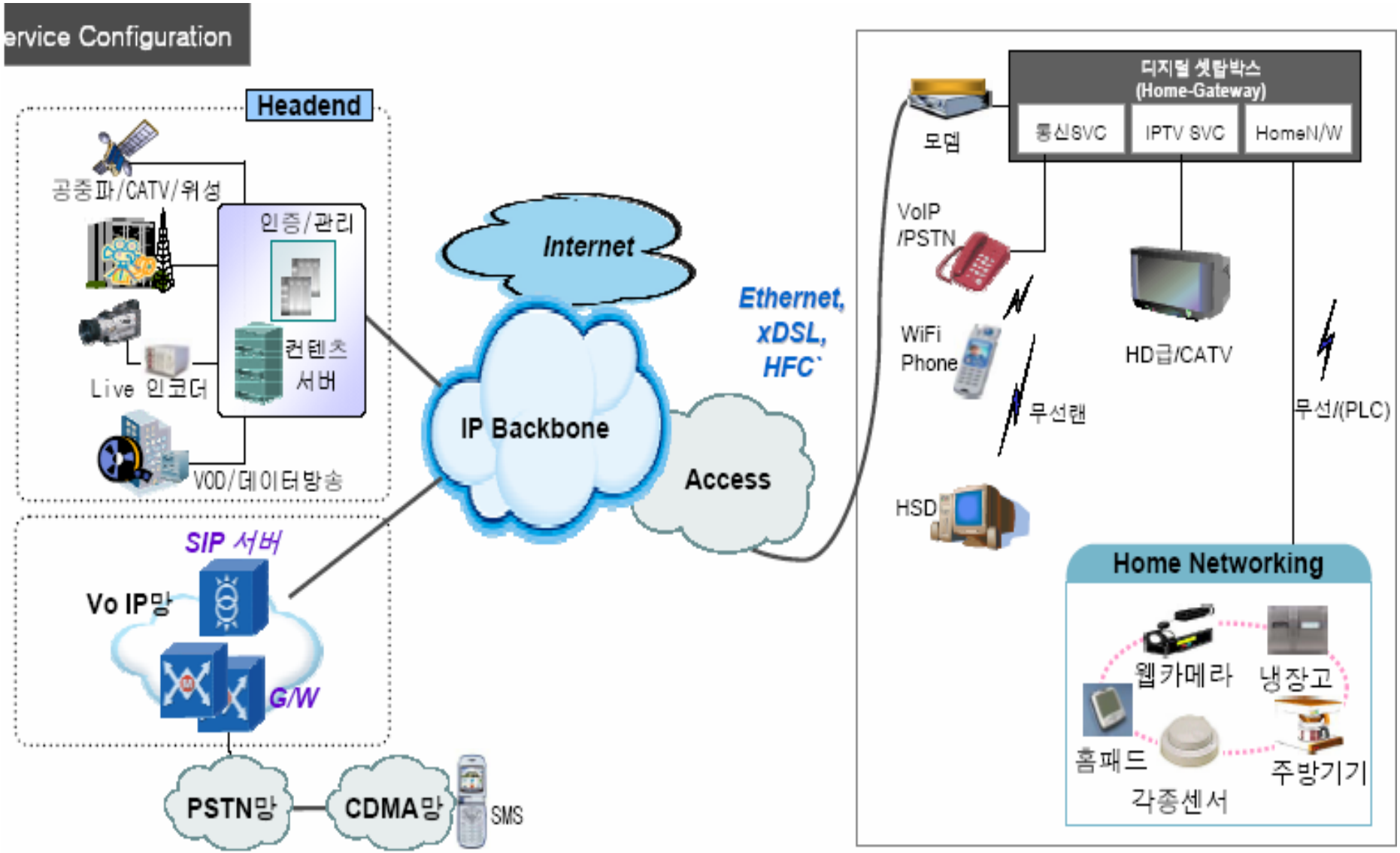
- Interactive Television (1)

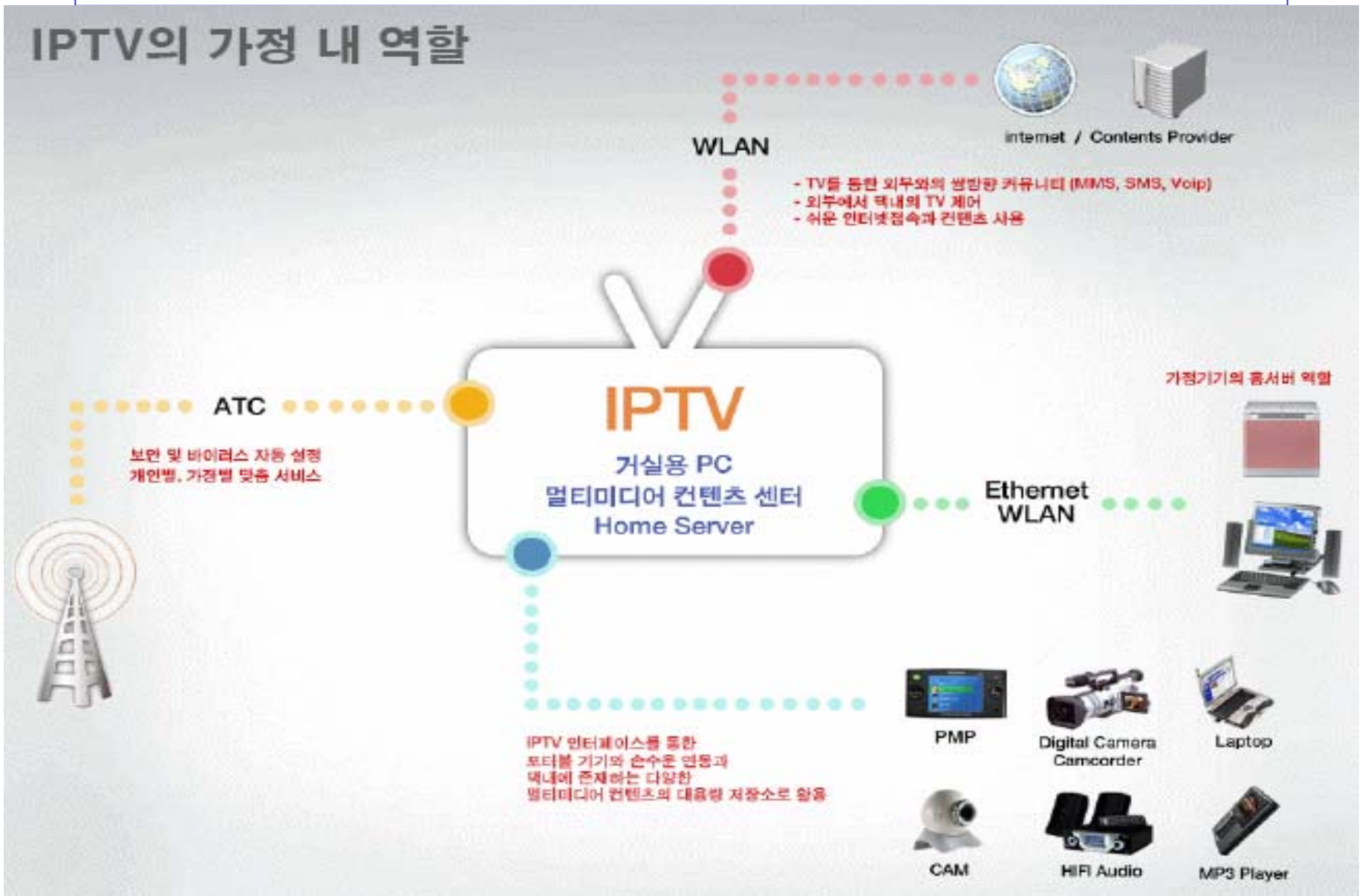


- Interactive Television (2)

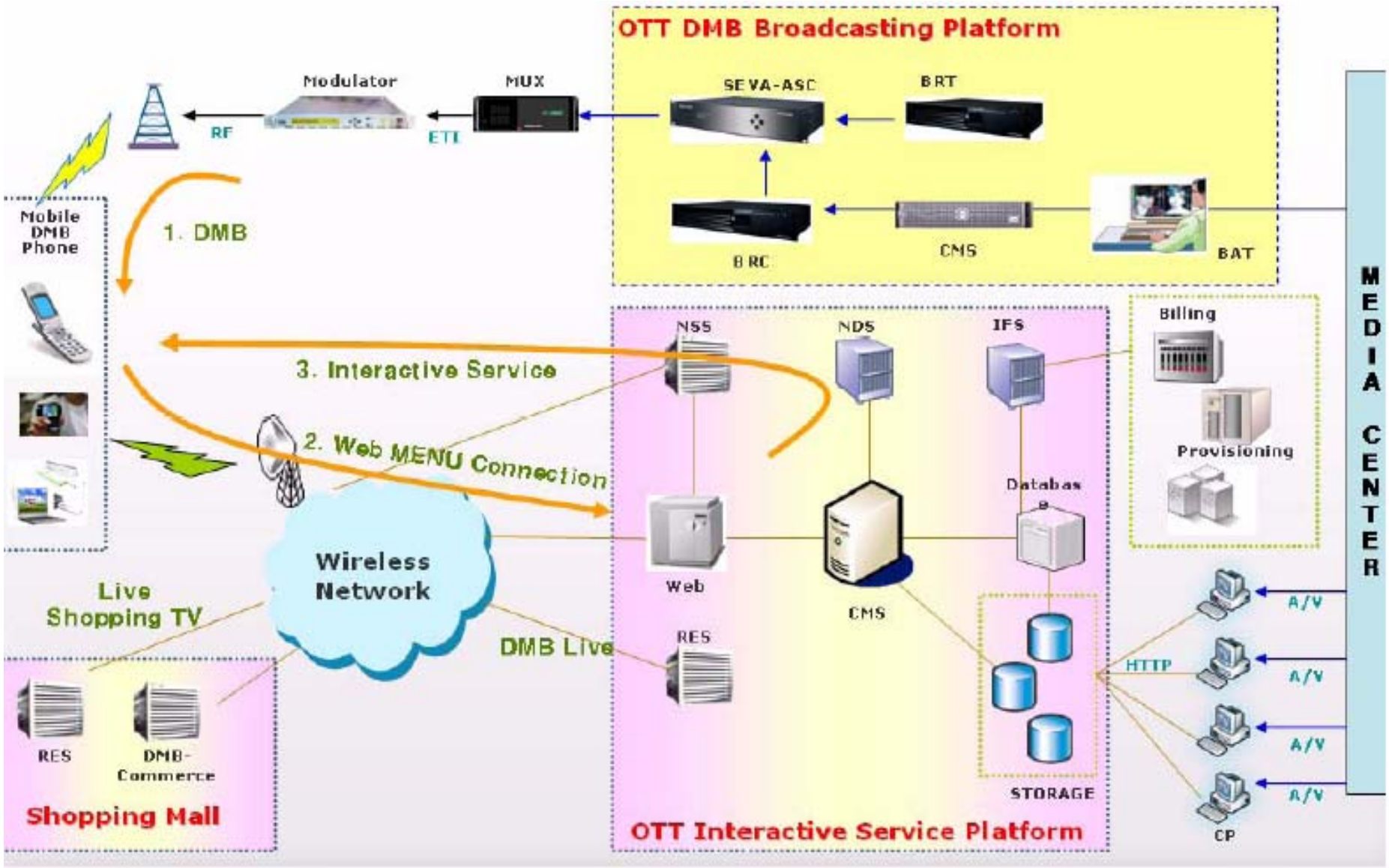


IPTV 서비스 형태


ervice Configuration
Headend
공중파/CATV/위성
인증/관리
컨텐츠 서버
Live 인코더
VOD/데이터방송
Internet
IP Backbone
Access
Ethernet, xDSL, HFC`
SIP 서버
Vo IP망
G/W
PSTN망
CDMA망
SMS
디지털 셋탑박스 (Home-Gateway)
통신SVC
IPTV SVC
HomeN/W
모뎀
VoIP /PSTN
WiFi Phone
무선랜
HSD
HD급/CATV
무선/(PLC)
Home Networking
웹카메라
냉장고
홈패드
각종센서
주방기기

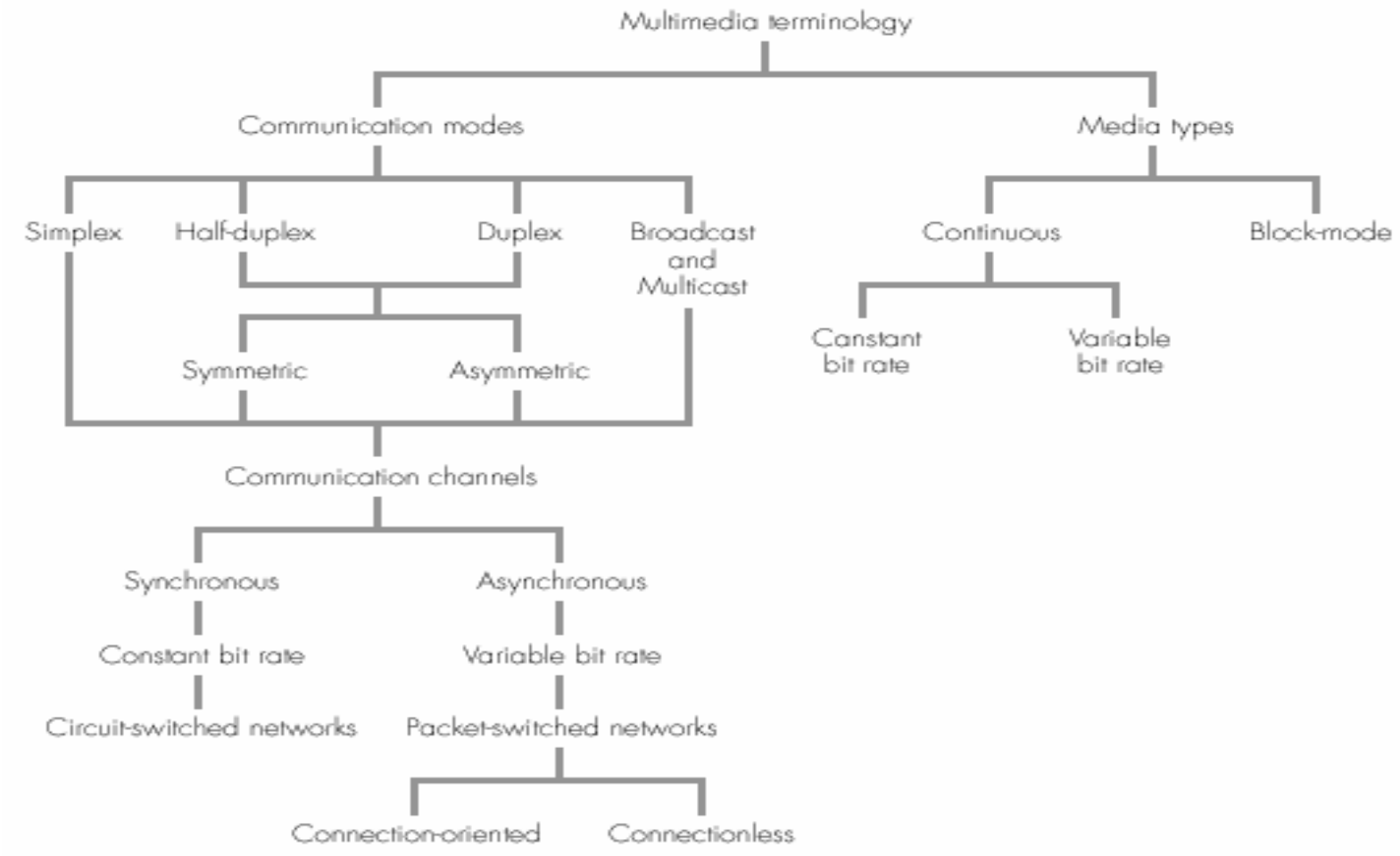

IPTV의 가정 내 역할
WLAN
Internet / Contents Provider
- TV를 통한 외부와의 쌍방향 커뮤니티 (MMS, SMS, Voip)
- 외부에서 댁내의 TV 제어
- 쉬운 인터넷접속과 컨텐츠 사용
ATC
보안 및 바이러스 자동 설정
개인별, 가정별 맞춤 서비스
IPTV
거실용 PC
멀티미디어 컨텐츠 센터
Home Server
가정기기의 홈서버 역할
Ethernet
WLAN
IPTV 인터페이스를 통한
모터블 기기와 손수준 연동과
댁내에 존재하는 다양한
멀티미디어 컨텐츠의 대용량 저장소로 활용
PMP
Digital Camera
Camcorder
Laptop
CAM
HiFi Audio
MP3 Player

DMB Service Systems

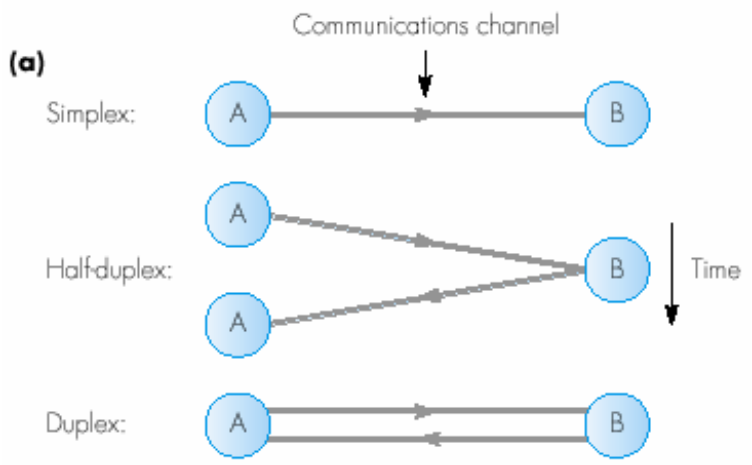


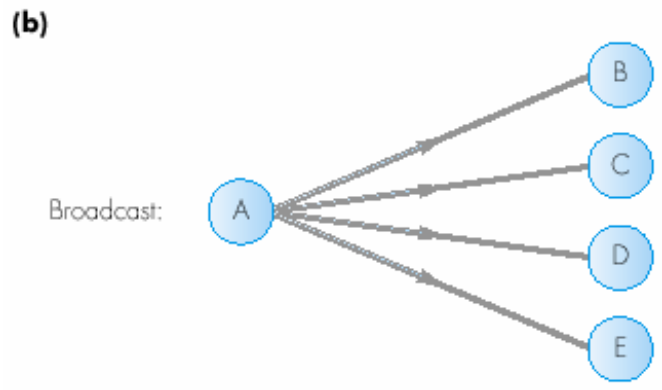
1.5 Application and networking terminology

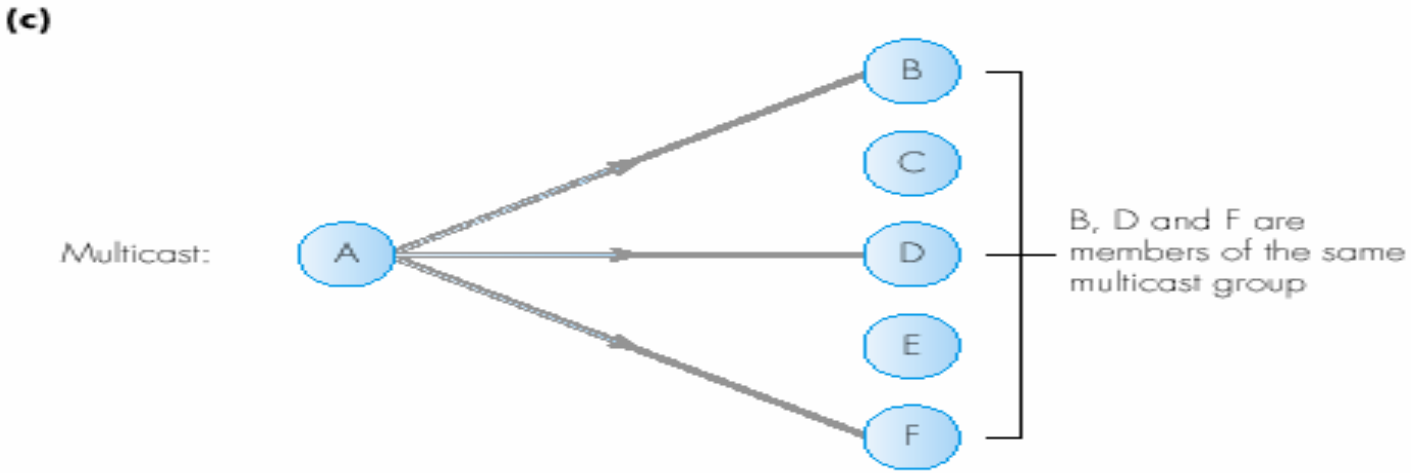
- Media types



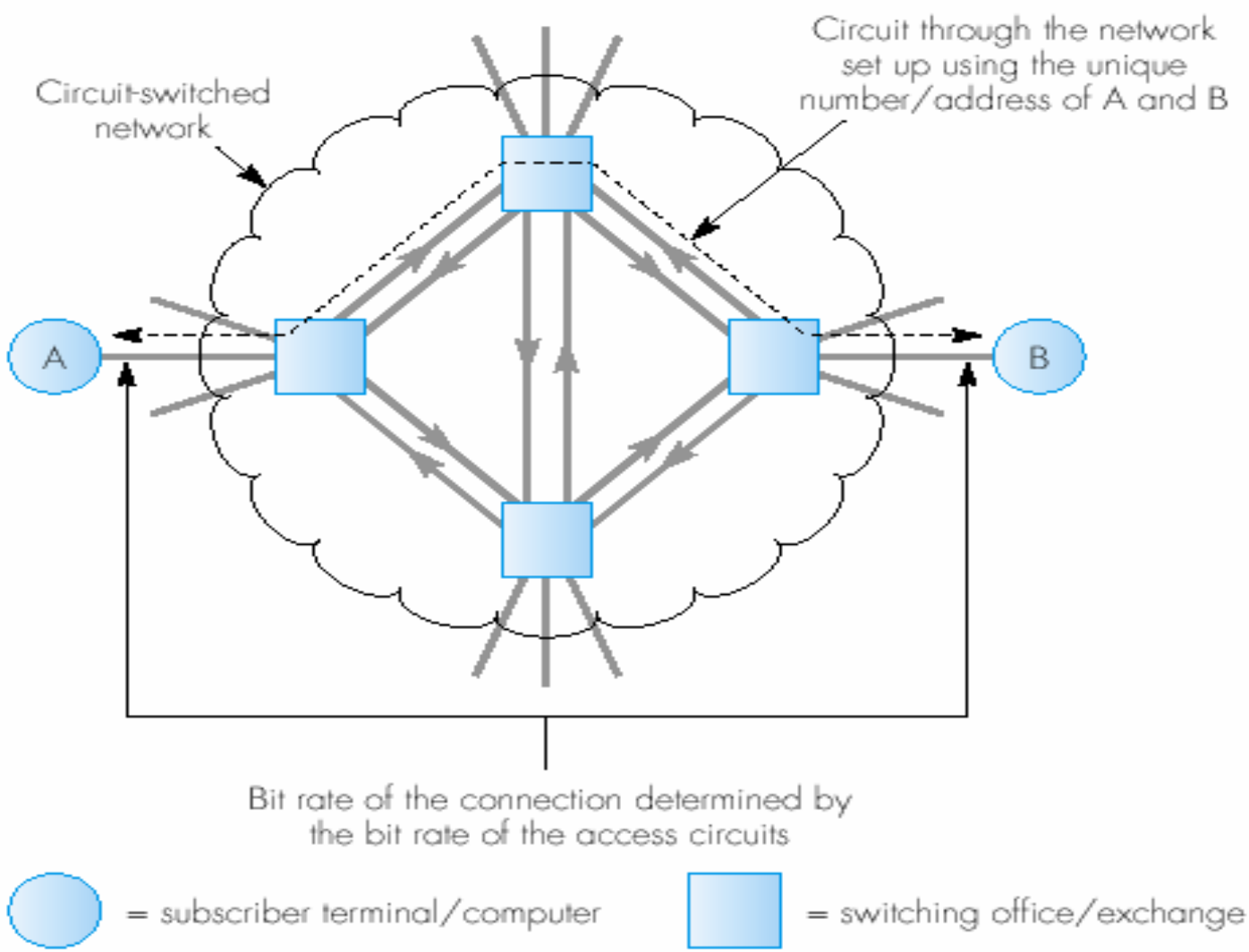
- Communication modes



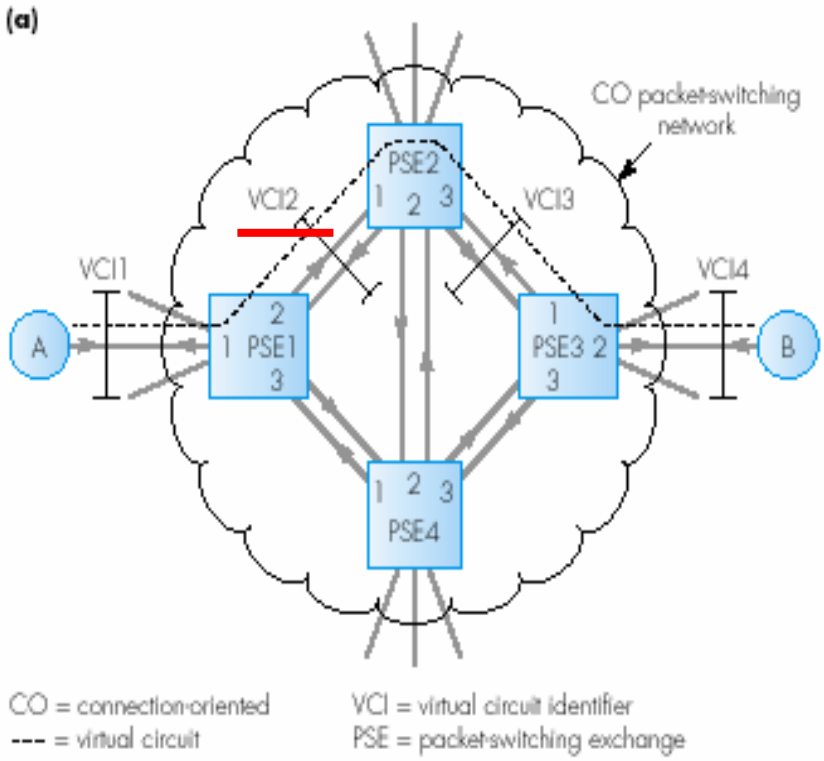




- Network types : Circuit-switched network



- Network types : packet-switched network



PSE 1 routing table:

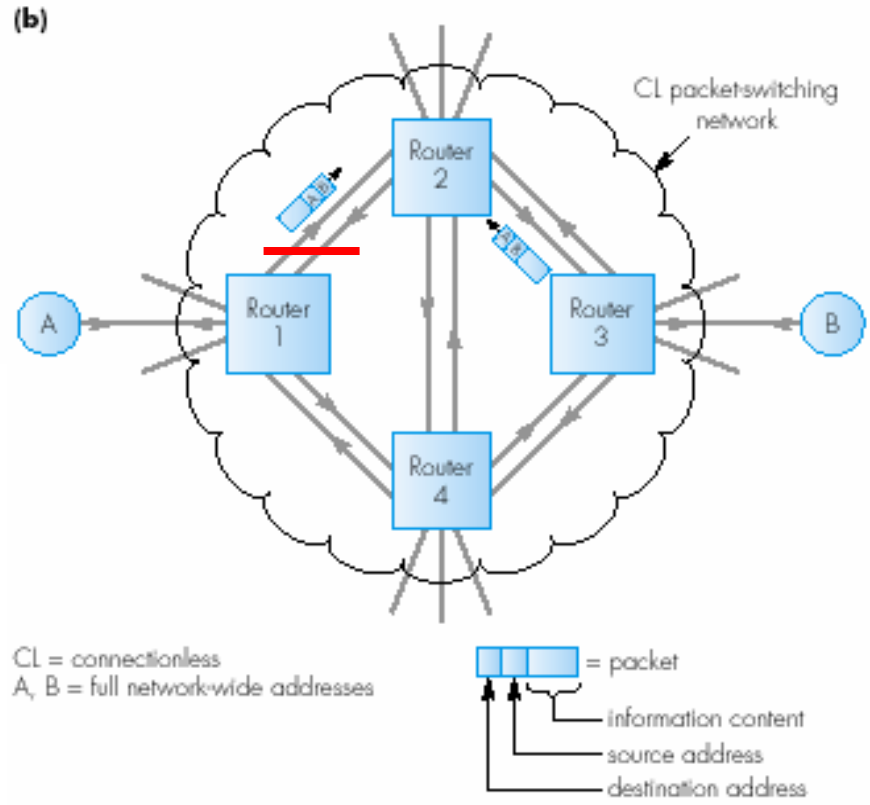
IN	OUT
VCI1/Link1	VCI2/Link2
VCI2/Link2	VCI1/Link1

PSE 2 routing table:

IN	OUT
VCI2/Link1	VCI3/Link3
VCI3/Link3	VCI2/Link1

PSE 3 routing table:

IN	OUT
VCI3/Link1	VCI4/Link2
VCI4/Link2	VCI3/Link1



1.5.5 Network QoS

- QoS : Quality of Service
  - bandwidth or delay time
- QoS in Circuit-switched network
  - the bit rate
  - the mean bit error rate
  - the transmission delay
- QoS in 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

- BER : bit error rate
  - the probability of a bit being corrupted during its transmission across the channel in a defined time interval.
  - BER of 10^{-3} : 1000 bit 중에서 1 bit이 손상된 경우
  - the probability of a block containing a bit error
    - $P_B = 1 - (1 - P)^N$,

      where P is a probability of BER and

      N is the number of bits in a block
- Unreliable service vs. Reliable service
  - Best-try or Best-effort service
- Transmission Delay
- Propagation delay (Example 1.2)

Example 1.1

Derive the maximum block size

the probability of a block containing an error is to be 10^{-1}

over a channel which has a mean BER probability of 10^{-4}

- Answer

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

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

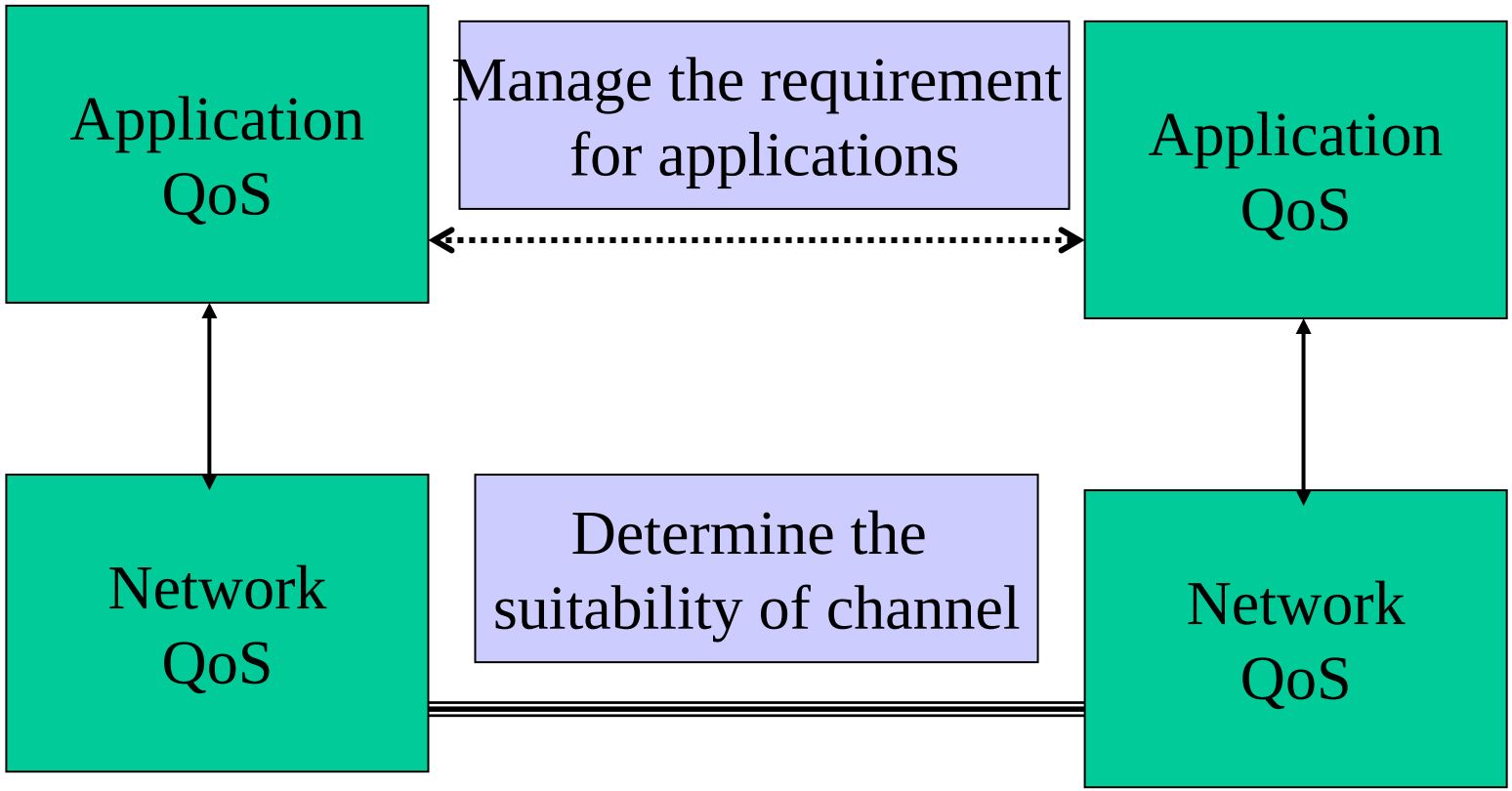
the maximum block size is 950 bits

1.5.6 Application QoS

- Application itself has QoS parameters
  - image resolution and size
  - video service: digitization format and refresh rate

- The require 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

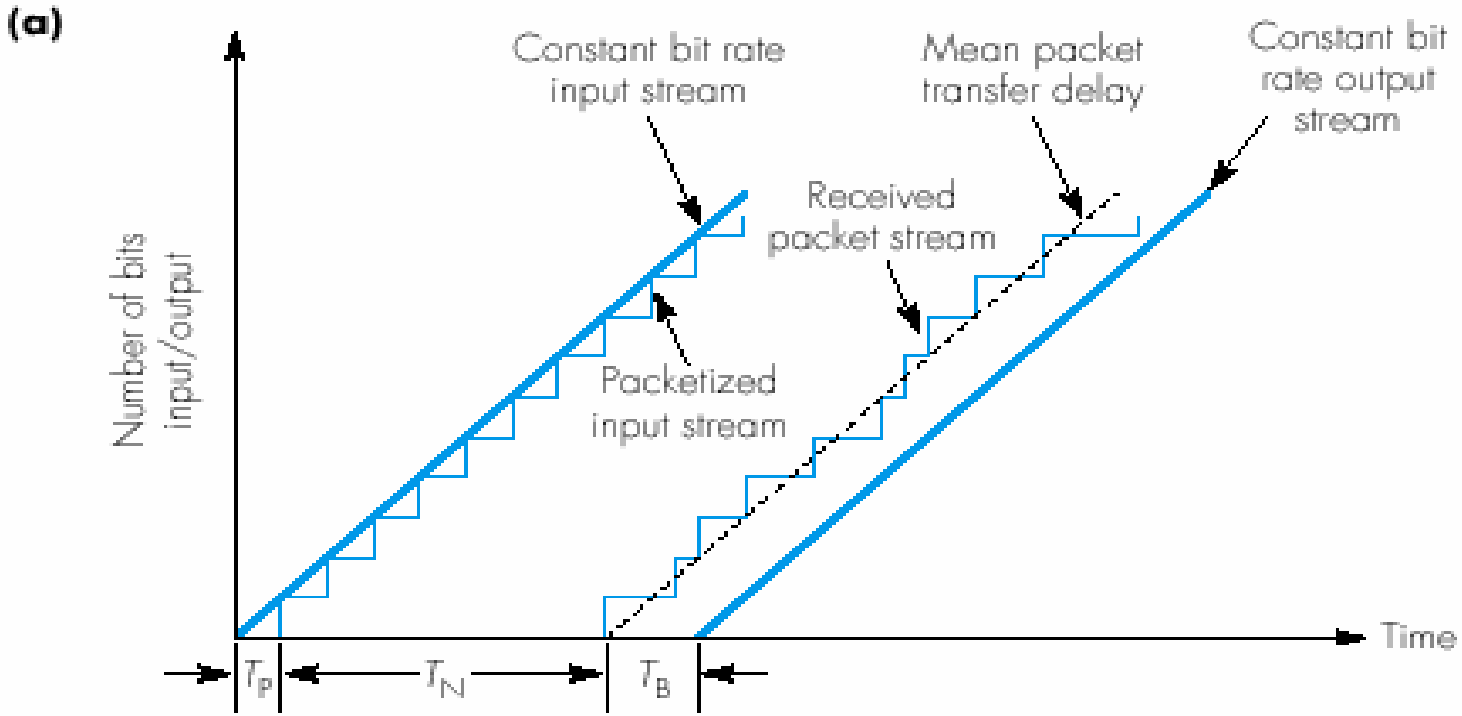
  - Buffering to resolve the Jitter (delay)


Application QoS
Manage the requirement for applications
Application QoS
Network QoS
Determine the suitability of channel
Network QoS

- Example : the file size is 100 Mbps

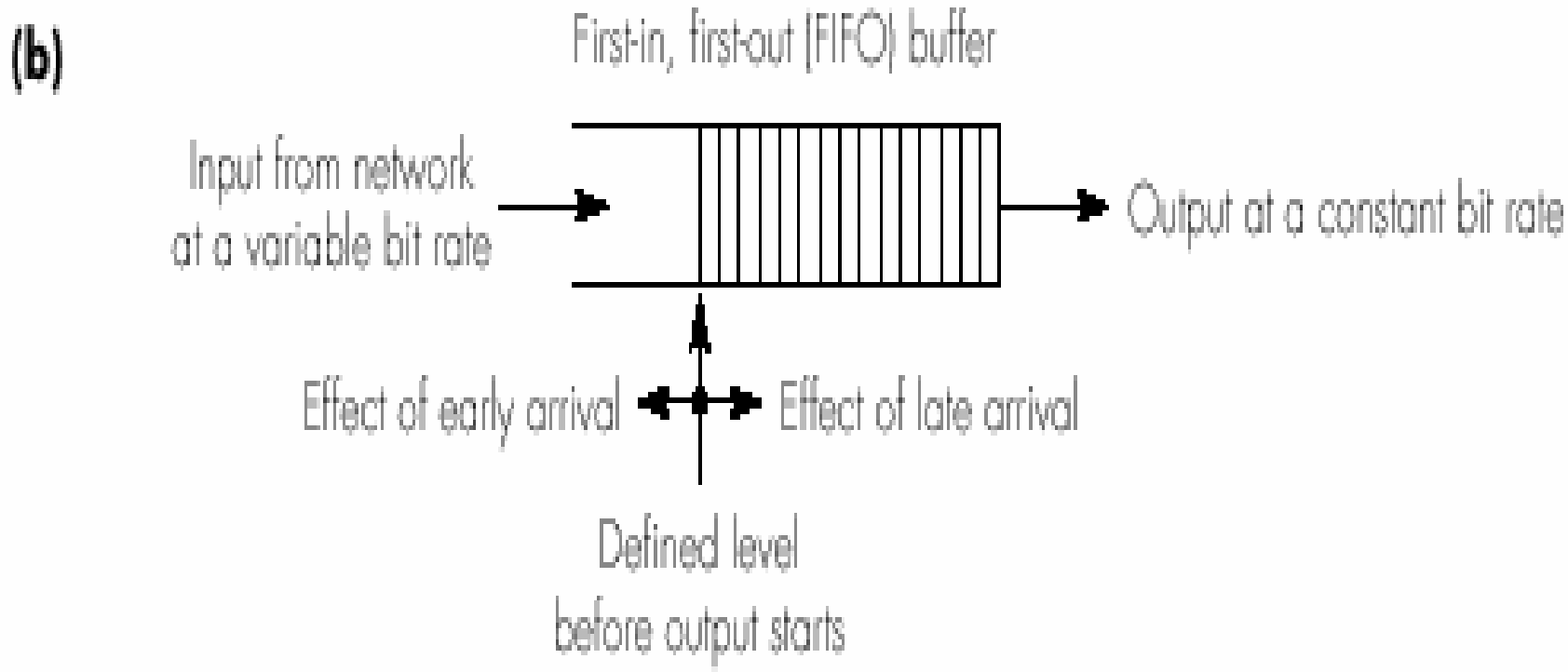
Transmission media	Transmission speed	Transmission tiime
PSTN		
HSDPA		
Wibro		
ADSL		
T1 Line		
T3 Line		
E1 Line		

Transmission of a constant bit rate stream



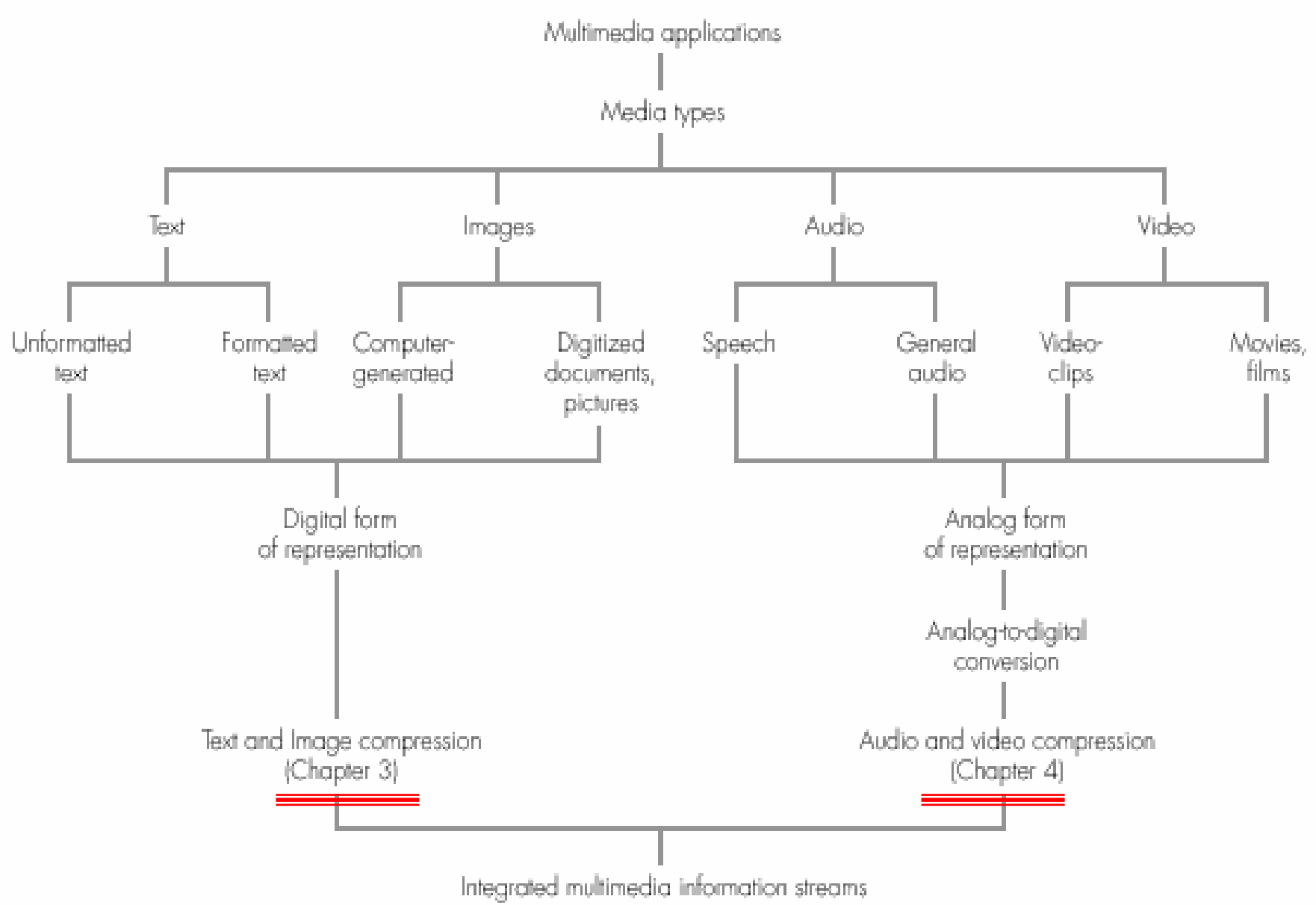
T_P = packetization delay
T_N = mean network packet transfer delay
= transmission delay + mean store-and-forward delay
T_B = buffering delay at destination (to overcome worst-case jitter)
T_T = total input-to-output delay
= $T_P + T_N + T_B$
Jitter = variation in store-and-forward delay about the mean

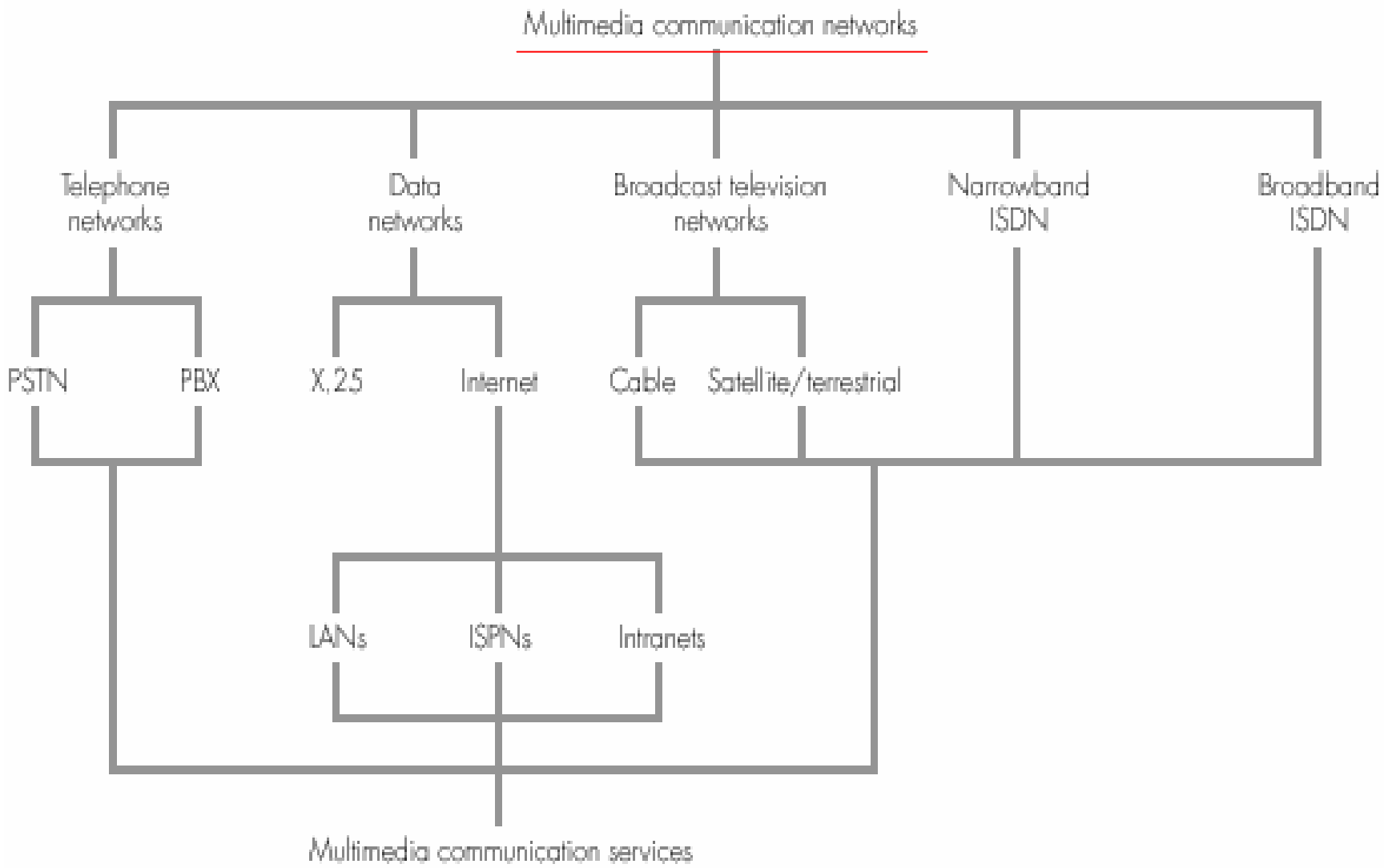
(a) Timing schematic



(b) FIFO Buffer operation

Media Types used in Multimedia Applications





PSTN = public switched telephone network
PBX = private branch exchange
ISDN = integrated services digital network

LANs = local area networks
ISPNs = internet service provider networks


Telephone networks
Telephony (fixed and mobile)
Voice-mail
Facsimile (fax)
Access to the Internet
Video telephony
Speech and videoconferencing
Entertainment (video-on-demand, interactive TV)
The Internet
Email and file transfers
Multimedia mail
Speech and video telephony
Videoconferencing
Information retrieval and electronic commerce
Cable networks
Analog/digital audio and television
CD and video/movie on demand
Interactive TV
Access to the PSTN
Access to the Internet
Satellite and terrestrial broadcast networks
Analog/digital audio and television broadcast
Near video/movie-on-demand
Interactive television
Narrowband ISDN
Digital telephony and fax
Video telephony and conferencing
LAN interconnection
Access to the Internet
Broadband ISDN
ATM LANs
ATM MANs
ATM backbone networks
All interpersonal and interactive applications
High-speed network interconnection

Multimedia Applications

Category	Media	Applications
Interpersonal Communications	Speech	Telephony, voice-mail, Teleconferencing
	Image	Facsimile
	Text	Electronic mail
	Text and Image	Computer-supported cooperative working(CSCW)
	Speech and Video	Video telephony, video mail, Videoconferencing
	Text, Image, Audio and Video	Multimedia electronic mail, multiparty video games etc.
Interactive Application over The Internet	Text, Image, Audio and Video	Information retrieval (news, weather, Books magazines, video games, Product literature etc)
Entertainment Services	Audio and Video	Audio/CD-on-demand
		Movie/Video-on-demand
		Near movied/video-on-demand
		Analog and digital television broadcasts
		Interactive television