Chapter 1

Introduction to Multimedia

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★ What is the multimedia ?

Multimedia concerns the **representation** of mixed information—text, data, image, audio, and video—as digital signals.

⇨ local multimedia applications (Authoring)

Multimedia **communications** concerns the technology to **manipulate** and **control** the signals by computer and to transmit them across a networked communications channel.

⇨ networked multimedia applications

- Four characteristics of multimedia systems

  1. computer controlled (representation, product, store)

  2. integrated (computer, network, storage integrations)

  3. digital

  4. interactive (to final user)

1.1 The Internet and Multimedia Communication

- WWW $\rightarrow$ having experienced multimedia communication
- HTML document: text, image, speech, audio, video
- Deficiencies of the Internet for multimedia communication
- New Information Superhighway

  (not only wide-band network but also access control)

❑1.2 Continuous and Discrete Media

- continuous media (temporal media, time dependent)
  - audio, video, live TV broadcast, moving images
  - real-time, synchronization
- discrete media (time independent)
  - formatted / unformatted text, still images, graphics
  - time invariant

(not change if sent now or ten minutes from now)

❑1.3 Digital Signals

★ Why need to digitize information?

- easy to handle

  all digital information can be refereed to a sequence of bits and can be handled in the same way

- easy to recover (error free)

★ Digitize signal :

sampling and quantization + encoding

- 1.3.1 Sampling
  - measure analog signal at regular time intervals T

    {s(T), s(2T), ..., s(nT)}
  - frequency 1/T
  - Nyquist Theorem :

    sample frequency >= 2 ×max signal frequency

    e.g., speed signal 3kHz → sample rate at least 6kHz

- 1.3.2 Quantization and Encoding
  - represent the sampled values in a discrete set of values and encode them into a bit strings

  e.g., quantized by 3-bit code ⇨ 8 distinct grade level

  See Figure 1-2 pp.4

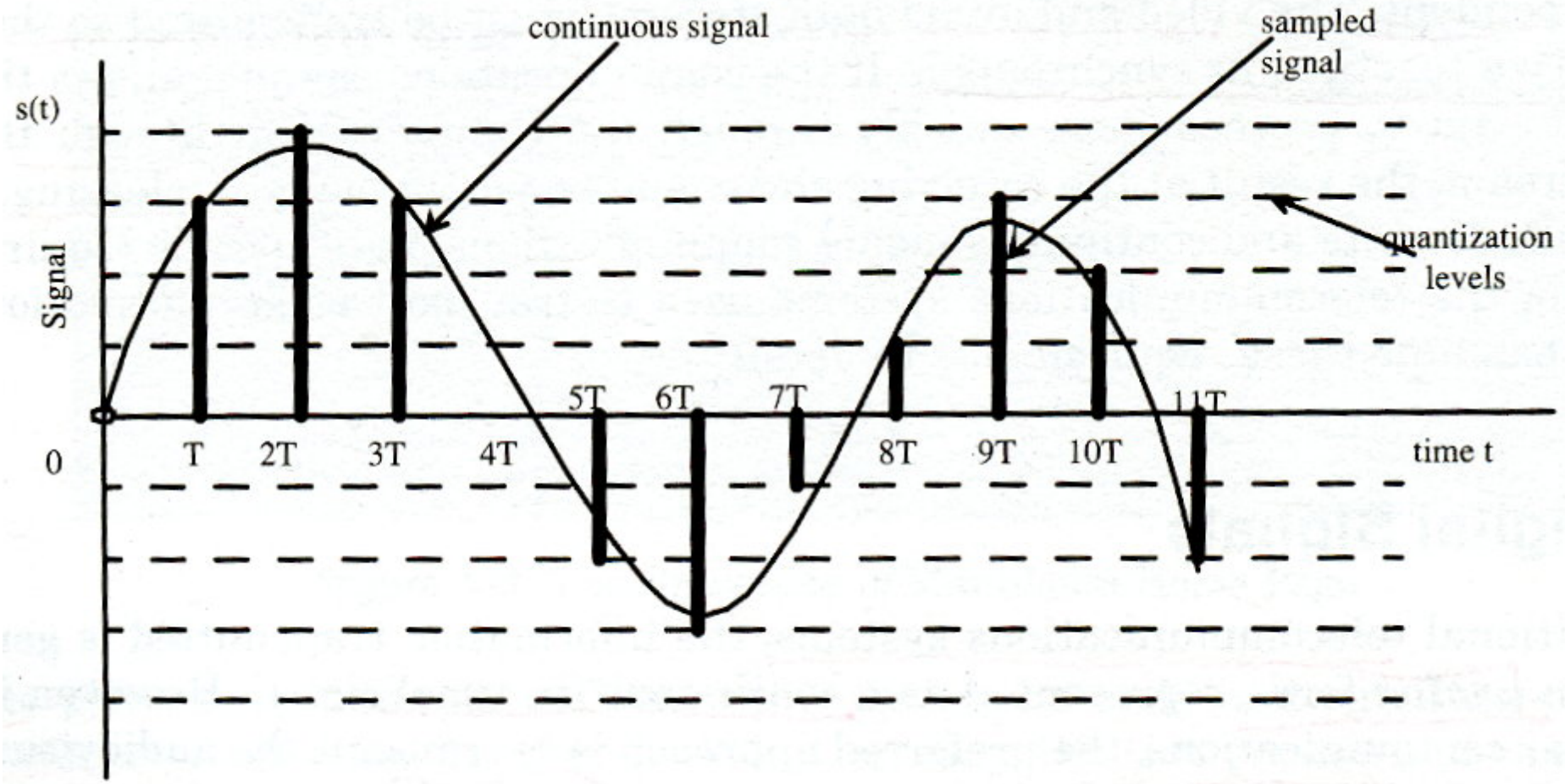

Figure 1–2 Analog Signal, Sampled and Quantized

- 1.3.3 Bit rate

  encoded bit rate = sampling rate $\times$# quantization bit

- the bit rate of telephone speech with

  sampling rate 8kHz and using 8-bit quantizer= 8000$\times$8 =64kbps

- the bit rate of compact audio disk for **stereo** with sampling rate 44.1kHz and using 16-bit quantizer = 44100$\times$16 $\times$**2** =1410kbps

  See Table 1-1 pp.5

Format	Sampling rate (kHz)	Bandwidth (kHz)	Frequency Range (Hz)	Bit rate (kbps)
Telephony	8.0	3.0	200 - 3,200	64
Teleconferencing	16.0	7.0	50 - 7,000	256
Compact disk	44.1	20.0	20 -20,000	1,410
Dig Audio Tape	48.0	20.0	20 - 20,000	1,536

Table 1–1 Digital Audio Formats [6]

❑1.4 Still images

- pixel: smallest single unit whose color or brightness can be controlled
- 8-bit pixel can represent 256 different brightness (mono) or color and brightness (color) values
- Number of bits : for an image with resolution 1024×768 and 24-bit pixel, is $1024 \times 768 \times 24 = 18.874$Mbits
- Transmission time = 18874000/14400 = 21.84 min

★ How to improve ?

1. Send the image over a fast channel (T1=1.544Mbps)
2. Reduce the number of ***bits per pixel*** (24→16***bpp***)
3. Reduce the resolution (fewer pixel / line or line / picture)
4. Remove the redundancy in the display

⇨ image compression combine approaches 2, 3 and 4

1.5 Text and Graphics

- Plain text: 64(line)×80(chars)×8-bit
- Formatted text : 64(line)×80(chars)×16-bit
- Graphics (pixel) ⇔ image (pixel)
  - revisable
  - object

    two points→line

    center and radius→circle
  - computer made
  - less storage
  - not revisable
  - bitmaps
  - real world (capture)
  -

- 1.6 Moving Graphics and Image
  - temporal sequences of graphical pictures; frames
  - frame rate (# of frame/sec)

  —25~30 fps (at least 16 fps for smooth motion)
  - Number of bits per second:

  360(pixels)×288(line)×24(bit)×30(frame rate)

  =74.65Mbps

1.7 Encoding and Decoding

- analog ⇨ A/D ⇨ digital signal
- digital ⇨ D/A ⇨ analog signal

See Fig. 1-3

- data compression
  - lossless
  - lossy (distortion)

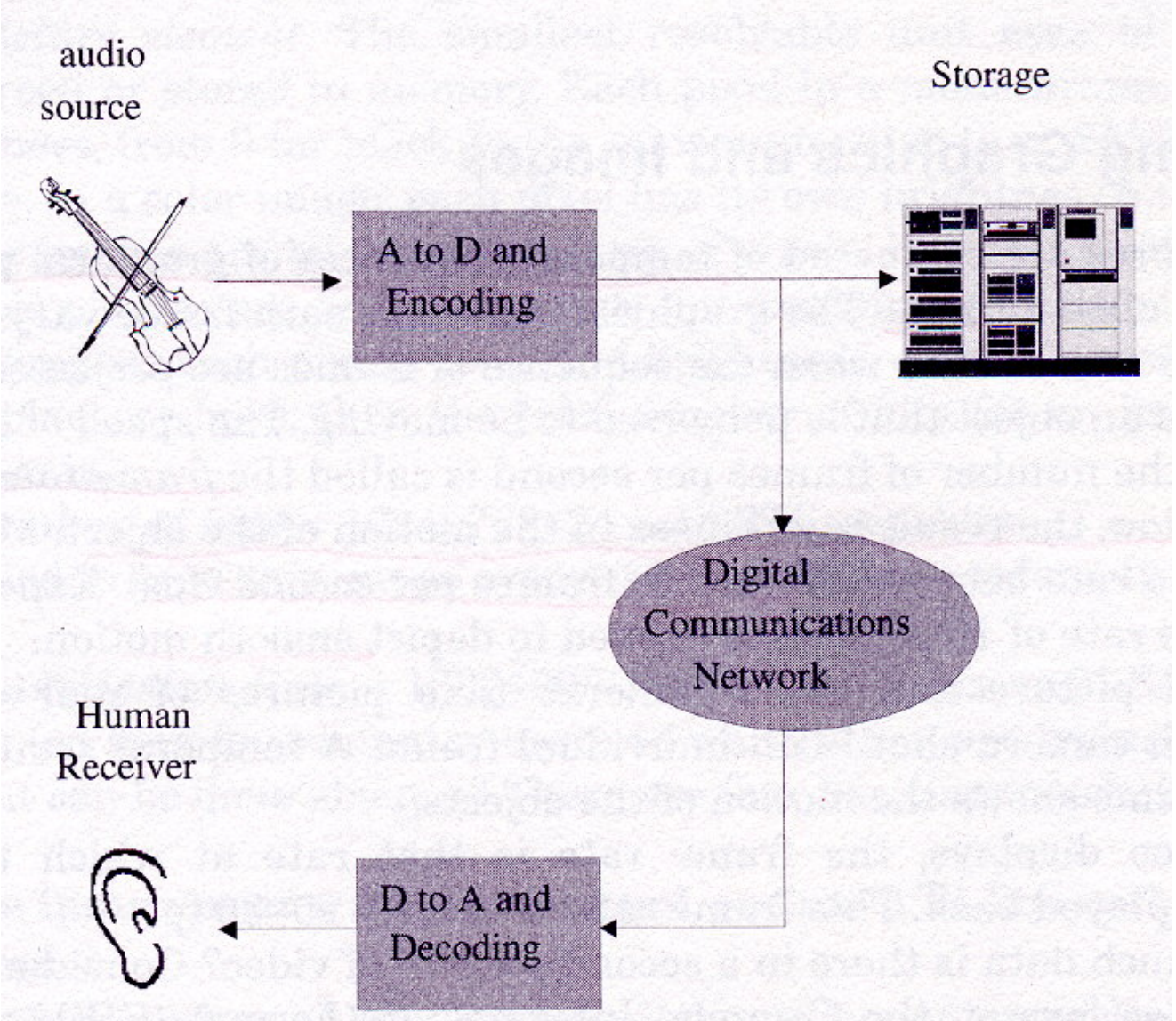

Figure 1–3 Encoding/Decoding for Digital Transmission

- ❖ compression method varies according to different media
- ❖ evaluation of compression method based on human audiovisual
  - ∗ speech: frequency bound 40~1600Hz
    - ⇨ filter the signal exceed the range
  - ∗ video: 24→16bpp or 30fps →16 fps

❑1.8 Bandwidth vs. Compression

- Compression

  telephone speech standard bit rate 64Kbps (1972) $\rightarrow$ 32Kbps (1984) $\rightarrow$ 16Kbps (1992) $\rightarrow$ 8Kbps (19??)

  See. Table 1-2 for International compression standards and Fig. 1-4 for the current compression limits pp.10

- Bandwidth
  - ISDN $\rightarrow$ Broadband-ISDN
  - V.34 (33.6Kbps) $\rightarrow$ V.90 (64Kbps)
  - LAN (10Mbps) $\rightarrow$ ATM (622Mbps)
  - 1100 Gbps over optical fibers

Standard	Bit rate	Application
G.721	32 kbps	Telephony
G.728	16 kbps	Telephony
G.722	48-64 kbps	Teleconferencing
MPEG-1 (audio)	128-384 kbps	2-channel audio
MPEG-2 (audio)	320 kbps	5-channel audio
JBIG	0.05-0.10 bpp	Binary images
JPEG	0.25-8.0 bpp	Still images
MPEG-1,2 (video)	1-8 Mbps	Video
Px64	64-1,536 kbps	Videoconferences
HDTV	17 Mbps	Advanced TV

Table 1–2 International Standards for Telephony, Audio, and Video [8]

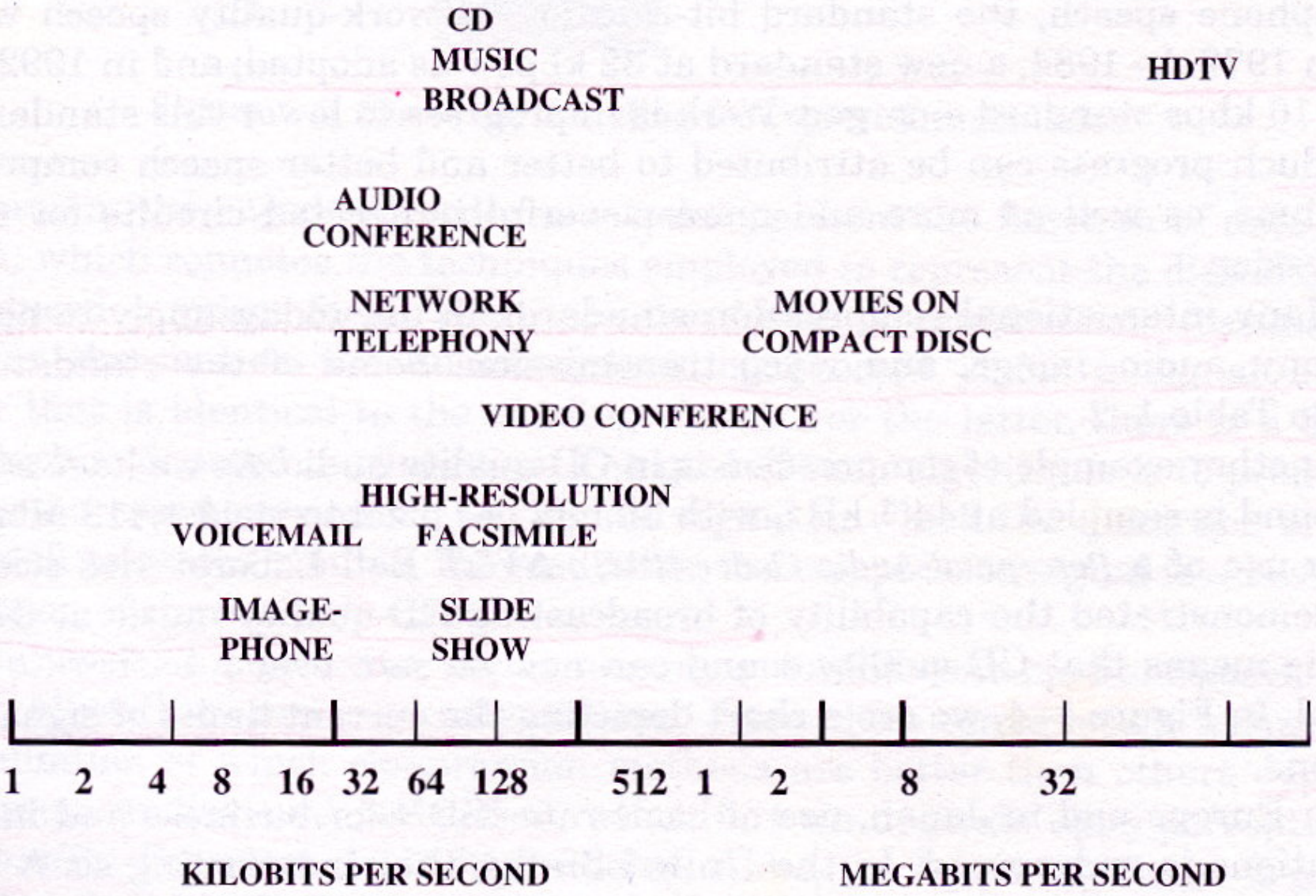

Figure 1–4 Signal Compression Capabilities [7]

❑1.9 Project TeleTeaching

an example for networked multimedia application

(distance-learning)

See Fig. 1-5 pp. 13

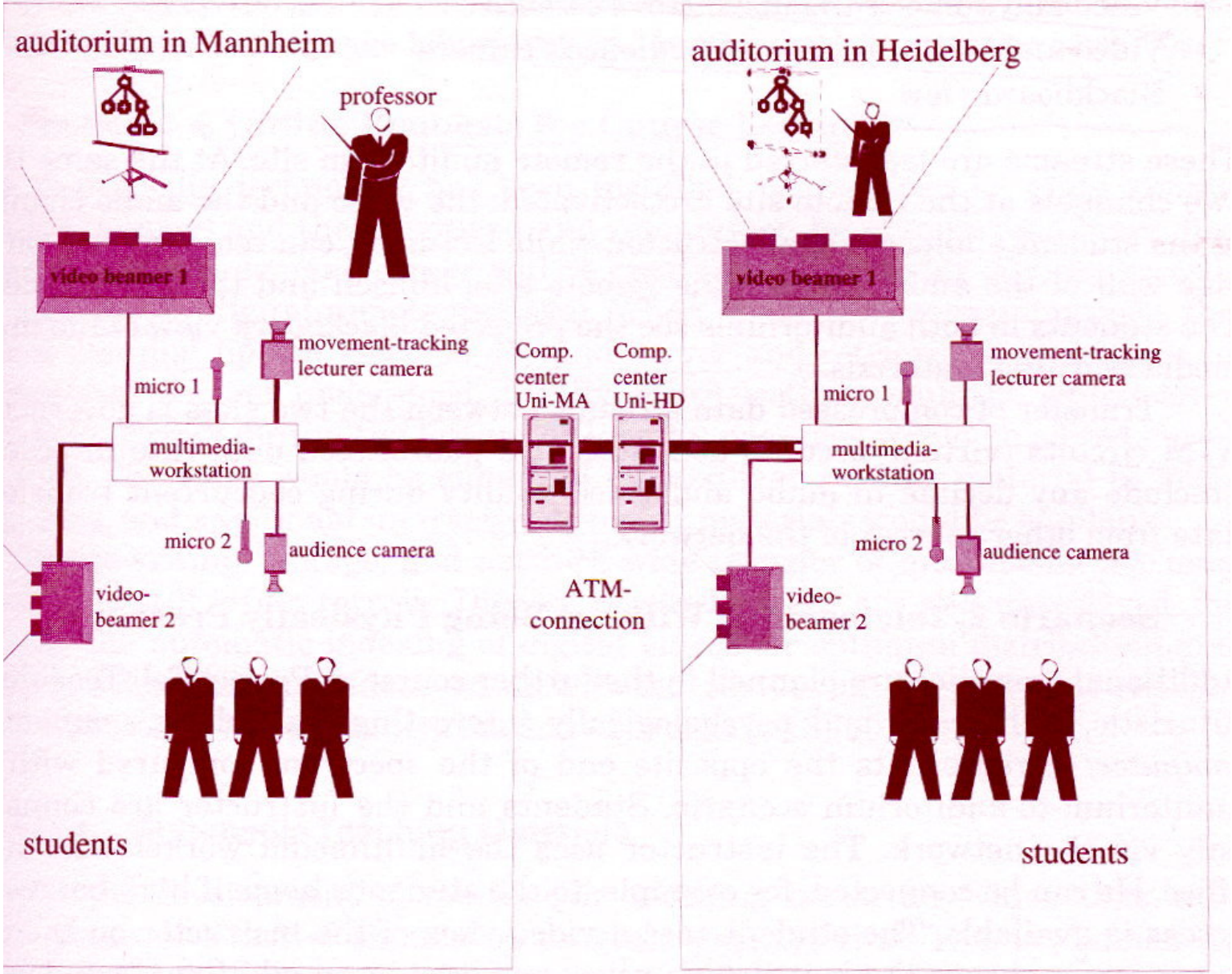

Figure 1–5 TeleteachingInfrastructure

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