

# Multimedia Technology

A Graduate Course

Winter Semester 2003/2004

Prof. Dr. Wolfgang Effelsberg  
University of Mannheim

Prof. Dr. Ralf Steinmetz  
Darmstadt University of Technology

# Table of Content (1)

## 1. Introduction

- 1.1 What is a multimedia system?
- 1.2 Fundamentals and terminology

## 2. Compression Algorithms for Multimedia Data Streams

- 2.1 Fundamentals of data compression
- 2.2 Compression of still images
- 2.3 Video compression
- 2.4 Audio compression
- 2.5 Animations

## 3. Quality of Service

- 3.1 Motivation
- 3.2 Characteristics of Real-time / Multimedia Systems
- 3.3 QoS – Definition
- 3.4 Resources
- 3.5 Providing QoS
- 3.6 QoS Architectures

## Table of Content (2)

### **4. Multimedia Communication**

- 4.1 Network technology, as it is today
- 4.2 Quality of Service in networks
- 4.3 Multicast
- 4.4 Media scaling and media filtering

### **5. Optical Memory**

- 5.1 Overview
- 5.2 History
- 5.3 Fundamentals
- 5.4 Laser Vision
- 5.5 CD-DA: Compact Disk Digital Audio
- 5.6 CD-ROM: Compact Disk – Read Only Memory
- 5.7 CD-ROM/XA: CD-ROM Extended Architecture
- 5.8 Further CD-ROM-based developments
- 5.9 CD-WO: Compact Disk Write Once
- 5.10 CD-MO: Compact Disk Magneto-Optical
- 5.11 DVD: Digital Video Disk

## Table of Content (3)

### **6. Media Server**

- 6.1 Media Server Architecture
- 6.2 Storage Devices and Disk Layout
- 6.3 Disk Controller and RAID
- 6.4 Storage Management and Disk Scheduling
- 6.5 File Systems, Video File Servers

### **7. Operating System Support**

- 7.1 Real-time operation
- 7.2 Scheduling algorithms
- 7.3 Device management

### **8. Automatic Content Analysis**

- 8.1 Basic parameters for video analysis
- 8.2 Deriving video semantics
- 8.3 Basic parameters for audio analysis
- 8.4 Deriving audio semantics
- 8.5 Application examples

## Table of Content (4)

### 9. Digital Watermarking

- 9.1 Security in multimedia systems
- 9.2 Watermarks: History, types and applications
- 9.3 Robust watermarks
- 9.4 Open problems
- 9.5 Fragile watermarks: Protecting the integrity of documents

# Recommended Reading (1)

(ordered by relevance for this course)

1. R. Steinmetz: Multimedia-Technologie – Grundlagen, Komponenten und Systeme. 3. Auflage, Springer Verlag, Heidelberg, Berlin, New York, 2000 (English version to appear soon)
2. F. Kuo, W. Effelsberg, J.J. Garcia-Luna-Aceves: Multimedia Communications – Protocols and Applications. Prentice Hall, Upper Saddle River, 1998
3. W. Effelsberg, R. Steinmetz: Video Compression Techniques. dpunkt.Verlag, Heidelberg, 1998
4. K. Froitzheim: Multimedia-Kommunikation. dpunkt.Verlag, Heidelberg, 1997 (in German)
5. W. B. Pennebaker, J. L. Mitchell: JPEG Still Image Compression Standard. Van Nostrand Reinhold, New York, 1993

## Recommended Reading (2)

6. J. L. Mitchell, W. B. Pennebaker, Ch. E. Fogg, D. J. LeGall: MPEG Video Compression Standard. Chapman&Hall, New York, 1996
7. Michael F. Barnsley, Lyman P. Hurd: Bildkompression mit Fraktalen. Vieweg-Verlag, Wiesbaden, 1996
8. All issues of the "IEEE Multimedia Magazine"
9. All issues of the "Multimedia Systems Journal,, (ACM / Springer-Verlag)
10. All issues of the journal "Multimedia Tools and Applications" (Kluwer Academic Publishers)

# Acknowledgement

We would like to thank our colleagues  
Lars Wolf, Carsten Vogt, Jörg Liebeherr  
and Jana Dittmann for allowing us to use some  
of their transparencies in this course.  
Their support is gratefully acknowledged.



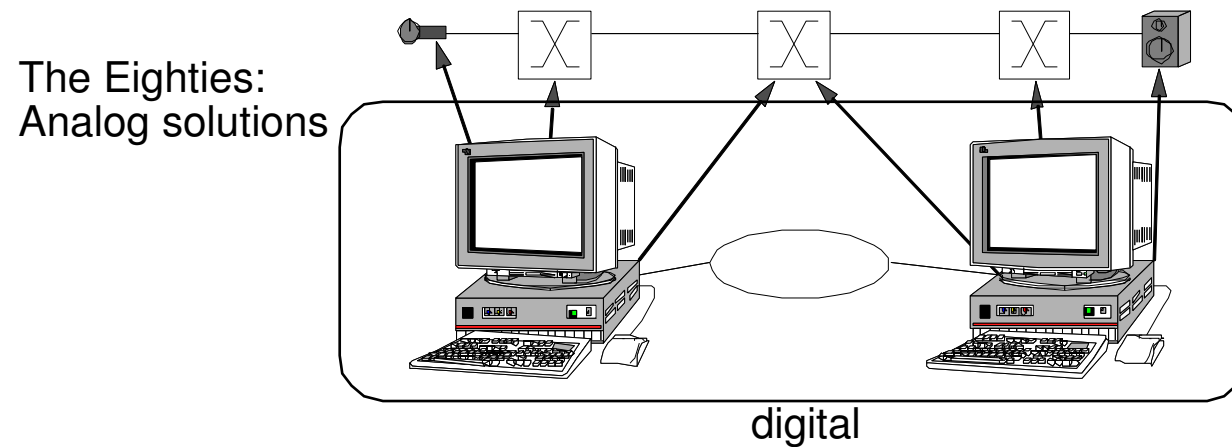
# 1. Introduction

## 1.1. What is a multimedia system?

A multimedia system supports the integrated storage, transmission and representation of the discrete media types text, graphics and image and the continuous media types audio and video on a digital computer.

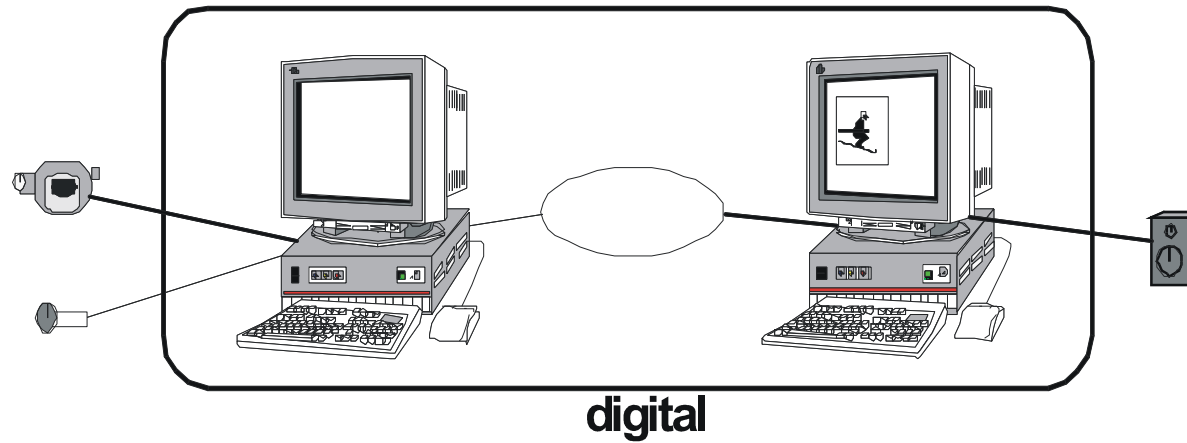
# A Hybrid (analog/digital) Multimedia System

Early multimedia system, around 1985



Computers control the analog media streams, e.g., via cross-connect switches.

# Digital Multimedia System



The media streams are digital. They can be processed (e.g., compressed/decompressed, analyzed) in the computer.

# Time-Independent and Time-Dependent Media

## Time-Independent Media

- Information is not related to timing of the data stream
- All „classic“ media in the computer, such as:
  - **text**
  - **graphics** (line drawings, vector graphic)
  - **image** (photo, pixel graphics).

## Time-Dependent Media

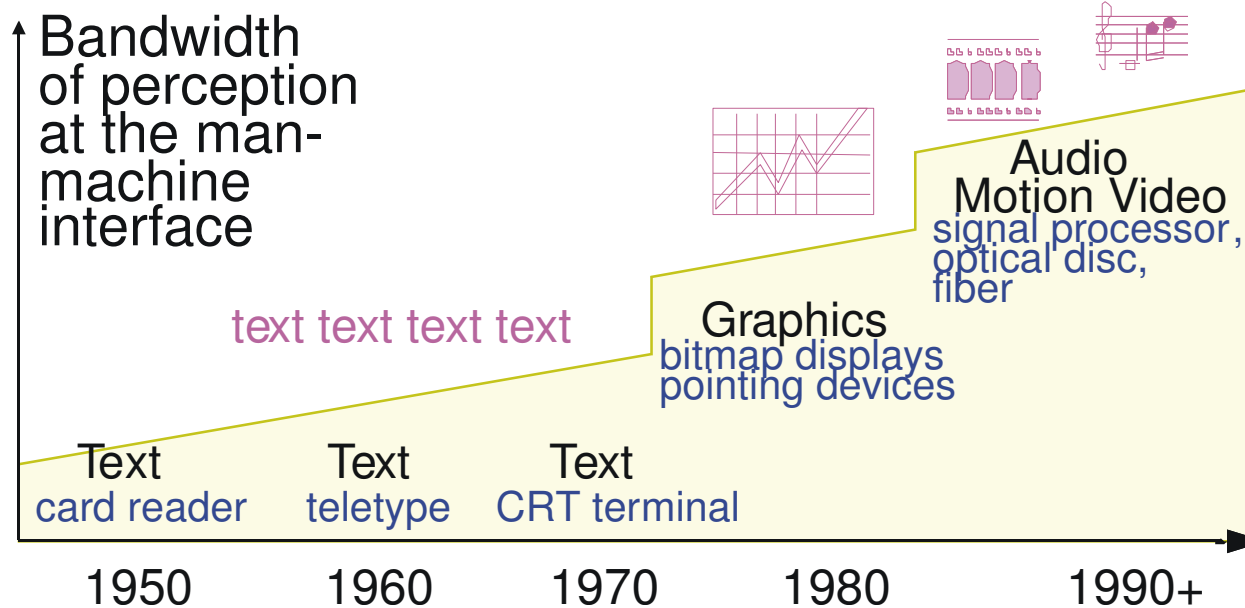
- Information is time-related, must be shown to the user at specific points in time
- **Continuous data streams**
  - Data appears in regular intervals
- Examples:
  - **Audio** (continuous)
  - **Video** (continuous)
  - **An animation** (not a continuous stream, but time-dependent)
  - An **interactive game** on the Internet (not a continuous stream, but has real-time requirements)

# Our Definition of Multimedia

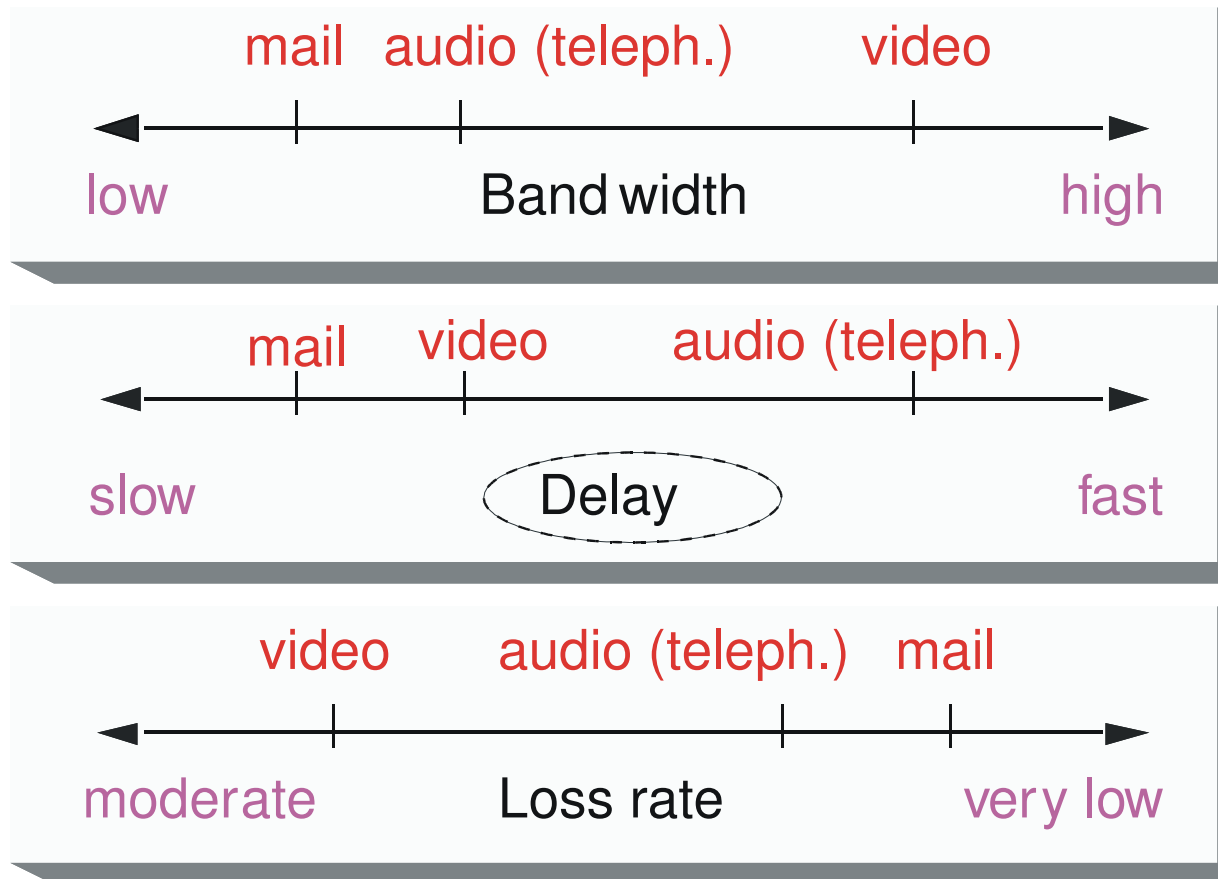
A **multimedia system** is characterized by the

- **integrated**
  - production,
  - processing,
  - storage,
  - representation,
  - and transmission
- **of several time-dependent and time-independent media streams.**

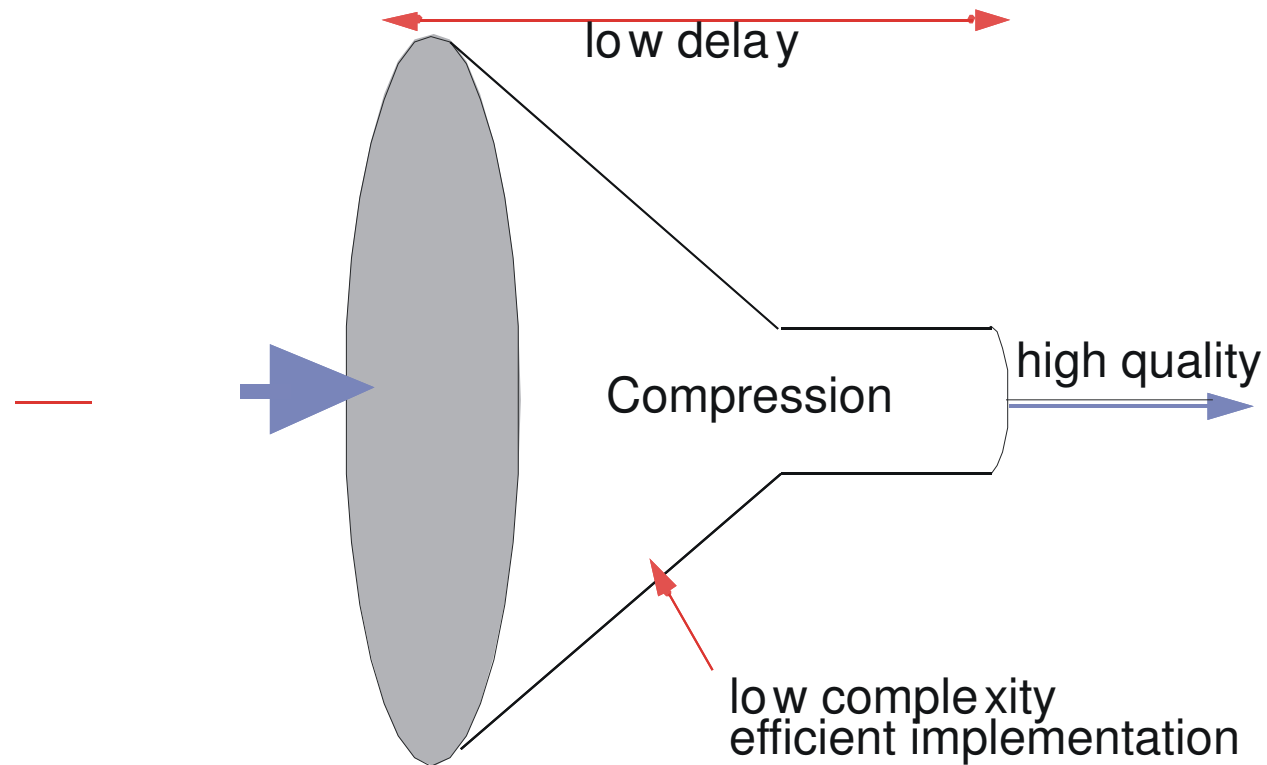
# History of Bandwidth in Computer Networks



## Network Requirements of Different Types of Data Streams



# Goals of Compression



The compression of multimedia data streams saves

- storage space
- transmission bandwidth.



# Architecture of a Multimedia Workstation

