

# Introduction

- What is multimedia
- Multimedia systems
- Quality of service
- Synchronization & orchestration
- Standards
- Applications
- Convergence
- Value chain

# What is multimedia?

1. Multiple media
2. Interaction
3. Time

# Multiple media

- Multiple media
  - + text
  - + graphics
  - + animation
  - + image
  - + audio
  - + video
- Natural vs. artificial sources

# Interaction

- Independent vs. networked applications
- Level of interaction
  - + user interface, application, and service
- Amount of interaction
  - + email, video-on-demand, video conference, video game, and virtual reality

# Time

- External synchronization of different media
  - + synchronous
  - + e.g., lip synchronization (i.e., audio and video)
- Internal timing within single medium
  - + isochronous
  - + e.g., video
- Usually applications have time dimension
  - + e.g., story line

# Hypermedia

- Multiple media
- Limited interaction
- No time dimension
- No synchronization
- Hyperlinks

# What are multimedia systems?

- New media types do not fit well with current information systems
- More efficiency and quality is required
- Systems have to be designed on higher abstraction level
- Global heterogeneous networks require also efficient implementation techniques

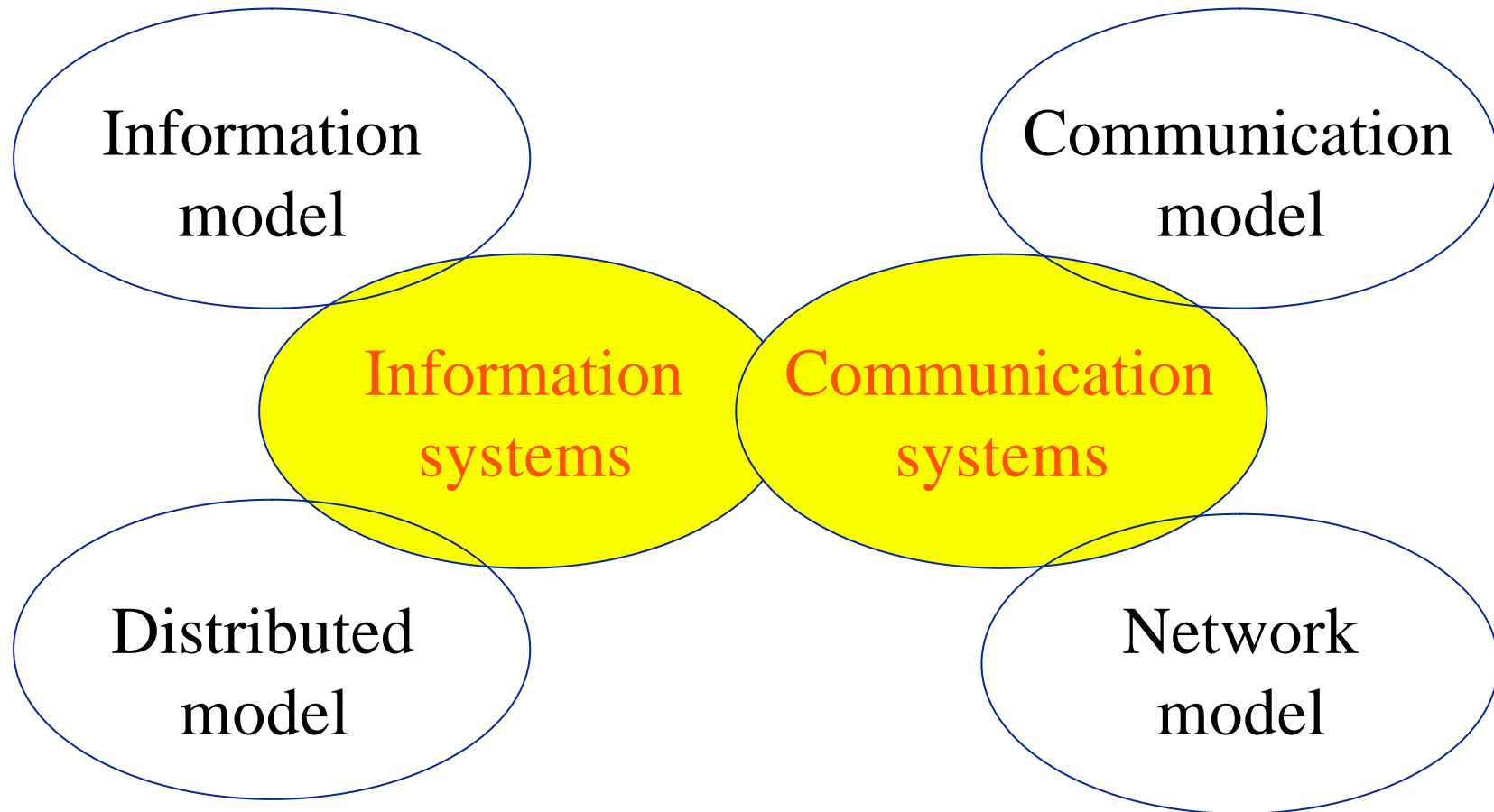
# Continuous media

- Audio and video are typical continuous media
- Data is composed of successive samples
- Samples have to be played within strict time limits
- Amount of data is huge
- This requires much from the information system
  - + processor (current processing power is not enough)
  - + file system (currently space consumption is optimized)
  - + network (now optimized for burst data)

# Required technologies

- Distributed objects
- Hypermedia documents
- Multimedia compression
- Programming languages (scripts)
- Interchange formats
- Programming interfaces
- Operating systems
- Network protocols and architectures

# Taxonomy



# Distributed model

|                       |  |
|-----------------------|--|
| Application           |  |
| Programming language  |  |
| Programming interface | User interface, media & system control, communications, objects  |
| Orchestration         | Resource allocation, synchronisation, meta scheduling            |
| Media                 | Distributed objects, hardware, conference, windowing, hypermedia |
| System                | Network protocols, file systems, real-time scheduling            |
| Hardware              | Network, memory system, coding & decoding                        |

# Information model

- Common multimedia document model does not exist
  - + XML is the closest thing
- Hyperlinks are minimum requirement
- Other key requirements:
  - + definition of time dimension
  - + interactivity
  - + functional components (e.g., scripts)

# Network model

- Integrated services networks
- Public telephone networks
  - + ISDN
  - + BISDN (Cell Relay, ATM)
- Internet
  - + streams
  - + bandwidth reservation
  - + multicast

# Communication model

- Computer telephony and communications are converging
- Current OSI and TCP/IP model do not suit well to multiparty multimedia communications
- Current applications (email, windowing) do not integrate well
- In the future, there is no space for separate solutions

# Quality of service

- Quality of Service (QoS) parameters
- Some applications require certain level of QoS
- For others best effort is enough
- The application requests certain level of QoS
- Service provider checks whether the resources are available, and grants the QoS
- Control takes care of internal (*isochronous*) and external (*intramedia*) synchronization

# Quality of Service (QoS)

- Data transfer requirements are defined with QoS parameters:
- User negotiates the QoS parameters with the service provider
- This process is done on highest protocol layer
- Parameters are distributed to the lowest protocol layers

# QoS Parameters

- Capacity
- Delay
- Jitter
- Error rate
- Guaranteed vs. best effort

# Use of QoS parameters

- Four methods to measure QoS levels:
  - + exact value (buffering is difficult)
  - + estimation (modeling)
  - + threshold (fuzzy limits)
  - + observation (QoS classes are defined based on measures)
- Methods are required to define and negotiate the QoS parameters between different parties and protocol layers

# Multimedia system control

- Exact internal and external synchronization requires constant control
  - + retrieval, transfer, processing, and presentation
- Resource control requires sharing of information between different parties
- Conducting different control units is called orchestration

# Synchronization

- Continuous media synchronization:
  - + synchronization has to be done within strict time limits
  - + if necessary, samples can be repeated or skipped
- Synchronization is more accurate on lower levels
- Delays have to be as constant as possible
- Otherwise more buffering is required

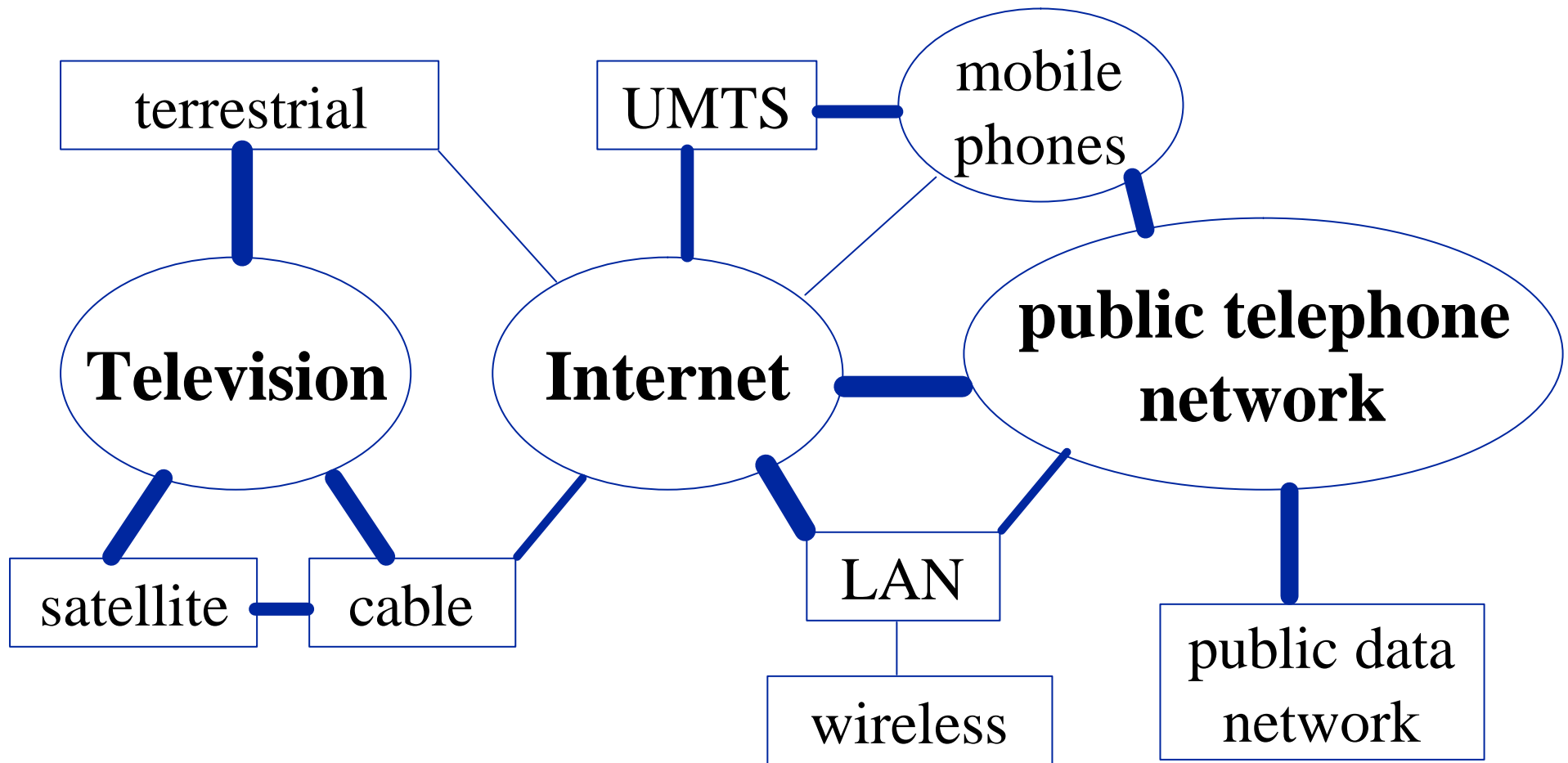
# Orchestration

- Directing several resource control units at the same time
- Each resource control unit controls its own resource
- For example:
  - + file system: access to files
  - + network: traffic control
  - + memory: buffer consumption
  - + processing: scheduling of threads and processes

# Standards

- Networked multimedia requires that the different components of the system fit together
- Compatibility can be guaranteed with standards
- Standards are defined by standardization committees, commercial interest groups, and individual manufacturers
- Official vs. de facto standards
- Calls for proposals (competition) and making de facto standards official is becoming more common

# Standardization areas



# Standard classification

| User             | Function             | ISO/ITU | Group    | Company   |
|------------------|----------------------|---------|----------|-----------|
| Maker            | Structural documents | SGML    | HTML     |           |
| Producer         | Distributed objects  |         | CORBA    | DCOM      |
| Manufacturer     | Interchange format   | MHEG    | MIME     | Quicktime |
| Network provider | network              | ATM     | Ethernet |           |
| Publisher        | Media format         | MPEG    | MIDI     | DVI       |

# Multimedia application areas

- Distance education
- Electronic commerce
- News, entertainment
- Location information systems
- Healthcare
- Communications

# Distance education

- Utilization of communications as teaching tool
- Hyper- and multimedia as learning material
- Communication between teacher and pupils
- Administration routines
- Education + Entertainment = Edutainment
- Flexible learning
- Examples: virtual universities

# Electronic commerce

- Much more than just electronic payments
- Application areas: banks, publishing, shopping, entertainment, etc
- Utilization areas: sales, marketing, production, delivery, administration
- Examples: banks, auction sites, electronic book, record, and ticket offices

# News and entertainment

- Publishing in Internet
- Content: news, articles, services, entertainment
- Income sources: advertising, subscription, and added value services
- Objectives: marketing, making customers familiar with new media, more personalized content
- Examples: media company and operator portals

# Location information systems

- Electronic maps and added value services
- Content: maps, drawings, pictures
- Use: archives, planning, information retrieval
- Implementation: database, network, personal computers
- Example: yellow pages, directories

# Healthcare

- Electronic healthcare services
- Application areas: information, call-center, patient information systems, diagnosis
- Implementation: distributed information systems, computer network, end user terminals (PC, www, mobile terminals)
- Challenges: amount of data, quality requirements, easy to use, data security

# Communications

- Intelligent telephone services
- Application areas: Internet calls, video telephony, video conferencing, group work, shared workspaces
- Implementation: ITU-T, Internet and de facto standards
- Problems: costs, quality of service, usability

# Convergence

## 1. Computers

+ multimedia-PC

## 2. Communications

+ telephony, added value service, data traffic, Internet

## 3. Entertainment

+ radio, television, peripherals, interactive services

# Markets

|           |                               |  |
|-----------|-------------------------------|--|
| Computers | Communications                | Entertainment  |
| LAN & WAN | Wireline and wireless network | Satellite, cable, and terrestrial television network |

# Convergence

| video conference | video telephony | interactive TV  |
|------------------|-----------------|-----------------|
| laptop PC        | mobile phone    | television, VCR |
| computers        | communications  | entertainment   |
| LAN & WAN        | telephone       | TV networks     |
| Ethernet         | POTS, ISDN      | analogue cable  |
| FDDI, ATM        | B-ISDN          | FTTC/FTTH       |

# End user terminals

- Also end user terminals are converging
- Same applications can be used in different kinds of terminals
- Ubiquitous computing
- Terminals:
  - + Multimedia PC
  - + Set-Top-Box (STB)
  - + 3. generation mobile phones (UMTS)

# Multimedia PC

- Standard features:
  - + sound card + speakers
  - + 3D graphics card + DVD + MPEG2
  - + network connection
  - + USB (Firewire)
- Trend: User interface is integrated with Internet
  - + www browser as platform for applications
  - + www browser = windows

# Set-Top-Box

- **Standard features:**
  - + digital television decoding
  - + conditional access
- **Additional features:**
  - + Multimedia Home Platform (MHP) Java environment
  - + Internet connection, www browser
  - + xDSL or cable modem
  - + hard disk

# 3. generation mobile phones

- evolution: GSM, GPRS, EDGE, UMTS
- Standard features:
  - + wideband connections
  - + calendar, address book, calculator, games, etc.
  - + information synchronization, IrDA
  - + Internet (iMode, WAP, basic XHTML)
- Additional features:
  - + Bluetooth
  - + speech and character recognition

# Comparison

|                   | MM-PC | STB | UMTS |
|-------------------|-------|-----|------|
| processor         | +++   | ++  | +    |
| memory            | +++   | ++  | +    |
| mass memory       | +++   | +/- | -    |
| video             | ++    | +++ | +    |
| broadcast channel | ++    | +++ | +    |
| return channel    | +     | +   | +    |

# Value chain

Telephone

Cable and  
satellite TV

Producer

Packager

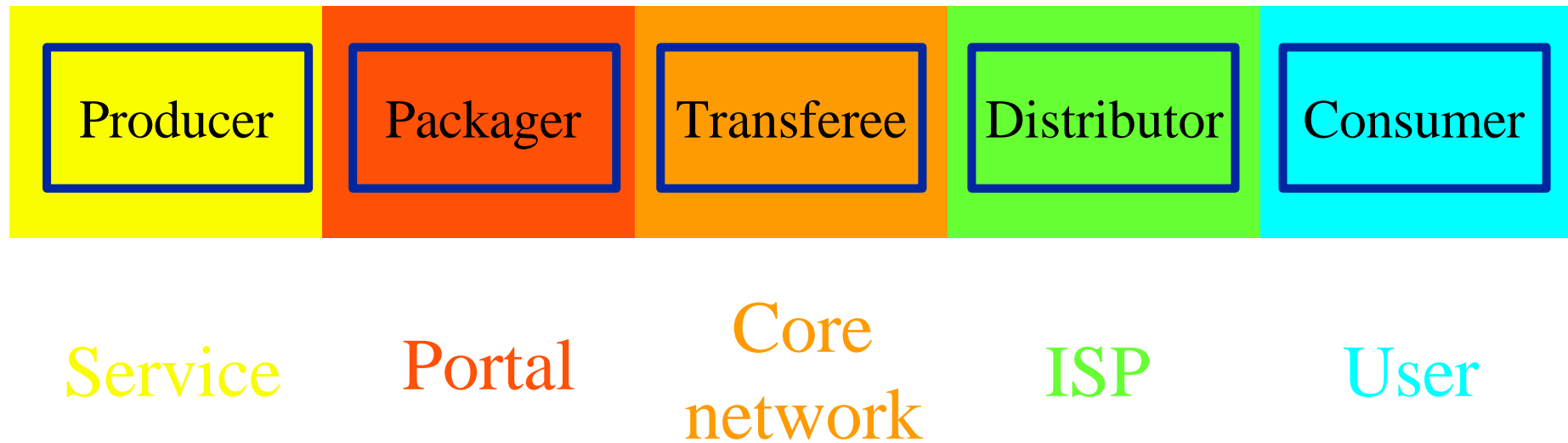
Transferee

Distributor

Consumer

Terrestrial television

# Internet value chain



# Telephone

- Local and long distance calls are no longer good income sources
- Wireless communication is more important
  - + significant part of telephone and data traffic
- Multimedia requires big investments
  - + routers and modem have to be installed near customers
- Optical fiber part of standard infrastructure
  - + who will install all optical fibers

# Cable and satellite TV

- Interactivity is new challenge
  - + cable network has to be bi-directional
  - + modems
- Digital technology increases capacity
  - + new services
- New terminals
  - + who is the owner of set-top-boxes?
  - + who takes care of software updating?

# Terrestrial TV

- Current capacity is not enough in competition
- Production and transmission has to be disintegrated
- New transmission channels
- How to convince consumers to get set-top-boxes
- How to make interactive services easy to use?
- Which are the killer applications?

# Content producers

- Whether to specialize or become content packager?
- Which distribution channels should be used?
- How to manage each distribution channels distinct features?

# Equipment manufacturers

- Entertainment and computer technology is converging
- Where to get the software and communications expertise?
- How to manage the shorter product life spans?
  - + design
  - + production
  - + marketing

# Public officials

- **Operating licenses**
  - + telecommunication
  - + radio & TV
- **Consumer protection**
  - + personal identification
  - + anonymity
  - + electronic commerce
- **Ownership**
  - + copyright protection
  - + encryption
- **Side effects**
  - + electronic crime