

Multimedia im Netz

Heinrich Hußmann
Ludwig-Maximilians-Universität München
Wintersemester 2004/2005

A simple but important notice

- Im Hauptstudium sind viele aktuelle Materialien nur in englischer Sprache verfügbar.
- Programmiersprachen basieren auf englischem Vokabular.
- Austausch von Materialien zwischen Lehre und Forschung scheitert oft an der deutschen Sprache.
- Konsequenz:
 - Wesentliche Teile der Lehrmaterialien zu dieser Vorlesung (v.a. Folien) sind in englischer Sprache gehalten!
 - Der Unterricht findet (noch) in deutscher Sprache statt.

Multimedia in the Net

- Multimedia:
 - Combination of several (perception) media
 - For the purposes of this lecture: Combination of *time-independent* and *time-dependent* media, in particular usage of audio and video
 - » In chapter 2 also digital books (eBooks) partially covered
- “The Net”:
 - In the past: Various telecommunication networks
 - Nowadays and in the near future: Internet as integrating technology for various networking technologies
 - In the future: “next generation networks” – probably derived from Internet
- Multimedia in the Net:
 - Services involving a complex combination of perception media, with physically distributed service components
 - Service components: Software and/or hardware subsystems including user interfaces

What we will cover – and what not

- This lecture does *not* cover:
 - Detailed information on networking technologies and protocols (see Networking lectures)
- The focus of the lecture is on:
 - *Application*-level design of networked multimedia systems
 - Content-related base technologies (as a supplement to network-related base technologies)
 - Limited background information on selected network-related base technologies
- The tutorials for this lecture focus on:
 - Practical experience in the development of software for media transmission over a network
 - Practical experience in the design of complex networked multimedia services

Organisatorisches

- Unbedingt notwendige Vorkenntnisse:
 - Vordiplom in Medieninformatik oder Informatik
- Empfehlenswerte Vorkenntnisse:
 - Digitale Medien
 - Rechnernetze I
- Ergänzende Vorkenntnisse:
 - Medientechnik
 - Rechnernetze II

Outline (Preliminary)

1. Introduction and Motivation

- | | |
|---|--|
| 2. Digital Rights Management | Part I:
Content-Oriented
Base Technologies |
| 3. Cryptographic Techniques | |
| 4. Electronic Payment Systems | |
| 5. Multimedia Content Description | |
| 6. Streaming Architectures | Part II:
Multimedia
Distribution Services |
| 7. Multimedia Content Production and Management | |
| 8. Commercial Streaming Systems: An Overview | |
| 9. Web Radio and Web TV | |
| 10. Signaling Protocols for
Multimedia Communication | Part III:
Conversational
Multimedia Services |
| 11. IP Telephony | |
| 12. Multimedia Conferencing | |

Vorkenntnisse & Vernetzung

- Welche Vorkenntnisse bestehen aus anderen Lehrveranstaltungen?
 - Sicherheit / Vertraulichkeit / Verschlüsselung?
 - E-Commerce: Bezahlung, Geschäftsmodelle?
 - Streaming?
 - Conferencing?
 - ...
- Vernetzung mit Lehrveranstaltungen anderer Disziplinen
 - Kommunikationswissenschaft
 - Medienwirtschaft

1 Introduction and Motivation

1.1 A Recent Example (in German)

1.2 Types of Network-Based Multimedia Services



VON HANS-CHRISTIAN DIRSCHERL
11.10.2004 12:32

GEZ-Gebühr für PCs kommt



Ab April heißt es auch für PC-Benutzer "schon GEZahlt?" Ab dann nämlich ist für alle Rechner mit Internet-Zugang die volle GEZ-Gebühr von rund 17 Euro zu entrichten.

Betroffen sind alle privat genutzten Rechner, die über einen Zugang zum Internet verfügen. Bisher mussten PC-Benutzer dafür nicht bezahlen, nur Rechner mit Radio- oder TV-Karten waren gebührenpflichtig.

Für die **GEZ** war das offensichtlich ein Ärgernis. Ursprünglich war die GEZ-Gebühr erst für 2007 geplant, nach Berichten der Frankfurter Allgemeinen Zeitung kommt sie jetzt aber bereits zum 1. April 2005.

Firmen-PCs sind von dieser Regelung zunächst ausgenommen. Erst 2007 werden wahrscheinlich auch Unternehmen zur Kasse gebeten, wie diverse Medien berichten.

Wer bereits GEZ-Gebühren für seinen Fernseher berappt, muss nicht zusätzlich für den Rechner bezahlen.

Quelle:
PC-Welt/FAZ

ARD Im Netz

The screenshot shows the website radio.ard.de in a Mozilla Firefox browser window. The page layout includes a search bar at the top left, a navigation menu with categories like 'Nachrichten', 'Sport', 'Börse', 'Ratgeber', 'Boulevard', 'Kultur', and 'Kinder'. The main content area features several news items, including 'Wie die Klage eines kranken Tieres' and 'Ich bin einer, ich bin keiner'. A sidebar on the right lists various radio stations such as 'BlaBla Stadtradio (RBB)', 'Antenne Brandenburg (RBB)', 'B3 aktuell (BR)', and 'Bayern 1'. The browser's address bar shows 'http://www.ard.de/radio/'.

Technischer Hintergrund – Netzbezogen

- Breitbandige Netzinfrastruktur
- Multimedia-fähige Endgeräte (PCs)
- Realzeit-orientierte Übertragungsprotokolle über das Internet (“Streaming”)
 - --> Kap. 6
- Server-Leistung ausreichend für Realzeit-Audio und -Video-Ströme
 - Netze von Servern --> Kap. 6 und 8
- Infrastruktur zur automatischen Bereitstellung externer Audio- und Video-Quellen (z.B. Nachrichten, Live-Programm) über Streaming
 - --> Kap. 7 und 9
- Ergebnis: Web-Dienst umfasst reguläre Ausstrahlung von Rundfunksendungen
 - Allerdings: Explizite Kommunikation vom Empfänger zum Sender (request)
 - Eigentlich kein *broadcast*, sondern *multicast*

Rechtlich-ökonomischer Hintergrund

- Urheberrecht für Musik und Filme
 - Ausstrahlung (*broadcast*) von Inhalten verursacht Kosten
 - Agenturen zur Verwaltung von Urheberrechten (GEMA in Deutschland)
 - --> Kap. 2
- Finanzierung von Rundfunkanstalten
 - Öffentlich-rechtlich: Durch Gebühren von jedem, der ein Empfangsgerät bereithält
 - Privat: Durch Werbeeinnahmen
- Hält man durch Anschluß eines PCs an das Internet ein Rundfunk-Empfangsgerät für öffentlich-rechtlichen Rundfunk bereit?
 - Ja, bei der derzeitigen technischen Lösung ...
 - Allerdings auch für diverse andere Angebote, z.B. anderer Länder!
 - Warum müssen Nutzer der Dienste im Ausland nicht bezahlen?

Technischer Hintergrund - Inhaltsbezogen

- Kompression von (Audio-)Inhalten
 - Ermöglicht zusammen mit hohen Bandbreiten die Realisierung
- Verschlüsselung von Inhalten
 - Weit verbreitet bei Satelliten-TV
 - Für Internet-Inhalte ebenfalls möglich --> Kap. 2 und 3
- Identifikation von Inhalten
 - “Watermarking”, copy protection --> Kap. 2
- Identifikation von Benutzern
 - Digitale Identitäts-Zertifikate --> Kap. 3
- Bezahlung für Internet-Transaktionen
 - Elektronische Bezahlssysteme --> Kap. 4
 - Z.B. durch vorherige Registrierung oder durch anonymes “E-Cash”
- Technische Möglichkeit anderer Bezahlmodelle
- Die tatsächlichen Entscheidungen sind aber politisch motiviert.

1 Introduction and Motivation

1.1 A Recent Example (in German)

1.2 Types of Network-Based Multimedia Services

Literature:

I. Venieris, H. Hussmann: Intelligent Broadband Networks,
Chapter 1, John Wiley 1998

Term: Multimedia Service

- *Service*: In the context of this lecture, always a telecommunication service, i.e. an offer to users for satisfying communication demands in a physically separated situation.
- *Multimedia service*: [A telecommunication service] that handles several types of media in a synchronized way from the user's point of view. A multimedia service may involve multiple parties, multiple connections, and the addition or deletion of resources and users within a single communication session.
ITU-T Recommendation F.700 "Framework recommendation for audiovisual multimedia services"

Terms: Party, End System etc.

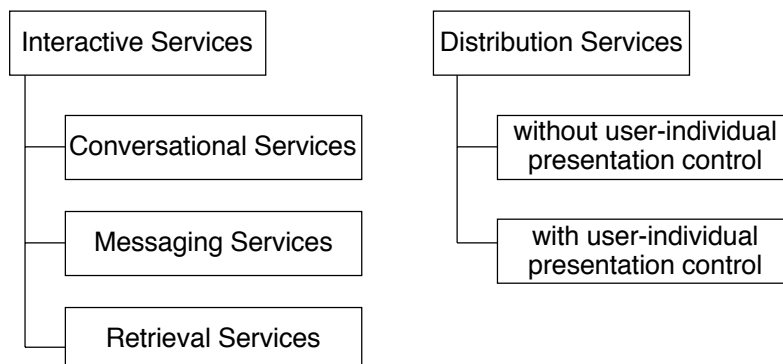
- *Party*: An organisation or a human being involved in the offer and use of a multimedia service
- *Service Provider*: An organisation which offers some part or the whole of a multimedia service
- *End system*: A physical device which is connected to the network and takes part in a multimedia service by exchanging information with other end systems over the network
- *Terminal*: An end system which is directly operated by a human user
Common term in the traditional telecommunication world: Customer Premises Equipment (CPE)
- *Server*: An end system which is operated by a service provider as a part of the service offering. Usually designed to interact with many terminals at the same time.

Terms: Content, Content Provider

- *Content*: Information which is of interest to at least one of the communicating parties. In the case of multimedia services: mostly audio-visual information in digitized form. Often content is associated with copyright restrictions for its distribution.
 - Examples: Live video source of a sports event, recorded piece of music in MP3 format
- *Content Provider*: An organization which takes responsibility for the provision of content for a multimedia service. In the presence of copyright restrictions, and when timeliness of content is an issue, appropriate *content management* can be a major concern for the content provider.
 - Examples: TV broadcast stations, movie distribution companies, news agencies

A Classification of Multimedia Services

- According to ITU-T recommendation I.211 “B-ISDN Service Aspects”



Interactive: Conversational, Messaging, Retrieval

- Conversational Services:
 - Multimedia information exchanged between terminals in a synchronous fashion (reception temporally coupled with sending)
 - Source of multimedia information: terminal
 - May use intermediate servers or may be realized on terminals only
- Messaging Services:
 - Multimedia information exchanged between terminals in an asynchronous fashion (reception temporally decoupled from sending)
 - Source of multimedia information: terminal or external
 - Servers involved for intermediate storage of messages
- Retrieval Services:
 - Multimedia information available on servers for download or streaming
 - Source of multimedia information often external (from content providers)
 - Usually a star-shaped configuration: One server provides content to many terminals

Content Delivery: Quality of Service

- Content Delivery can be performed in varying *Quality of Service (QoS)* depending on the capabilities of the underlying network technology
 - Bandwidth, delay, jitter
 - Buffer sizes
- Mainly relevant for conversational, retrieval and distribution services
- Live-Content Service:
 - Source information (e.g. from cameras) transmitted with minimal latency
- Buffered-Content Service:
 - Source information (e.g. from cameras) transmitted with latency acceptable for a human end-user
 - Higher latency possible in retrieval services than conversational services
- Stored-Content Service:
 - Source information (from an arbitrary source) downloaded completely from storage before consumption, no consideration of the temporal relationship between content creation and consumption

Non-Interactive: Distribution

- Without user-individual presentation control:
 - Simple broadcast (or multicast) of information
 - Replacement of other distribution media (e.g. radio) by digital networks
- With user-individual presentation control:
 - Limited interactivity realized by broadcast/multicast
 - Example: “Near Video-on-Demand”
 - » Staggered broadcast of multiple transmissions of the same content (Similar concepts in Digital TV, e.g. Premiere in Germany)
 - » User can switch between transmission instances

Network Classes: Single Technology vs. Internet

- Single-Technology Network
 - Usually run by a single network operator and interworking with other networks of the same technology
 - Traditional telecommunication networks: POTS, ISDN, X.25, SDH, ...
 - Advanced multi-service telecommunication networks:
 - » Broadband ISDN (B-ISDN): ATM technology
- Inter-Network:
 - Virtual overlay network across various technologies
 - Most famous: IP-based global inter-network = The Internet

Other Network Classifications

- Fixed vs. wireless network
- Personal-area, local-area, metropolitan-area, wide-area network
- Data communication, speech communication, multi-service network
- Public network vs. private network

End System Classification

- General purpose end system
 - PC, PDA (Personal Digital Assistant)
- Special purpose end system
 - Mobile phone
 - IP telephone
 - Set Top Box (STB)
 - IP radio?
- Hybrid end system
 - E.g. multimedia mobile phone (with camera and music player)
- Services may address a single class of end systems or several groups

A "SIP Phone"

- IP-based phones, connected e.g. over Ethernet
- SIP = Session Initiation Protocol (see chapters 10, 11)

Mitel 5055 SIP Phone

The Mitel 5055 SIP Phone is a full-featured, standards-based business telephone that delivers superior audio quality and session initiation protocol (SIP) services to the end-user's desktop. The 5055 SIP Phone is a versatile, highly interoperable phone that can function as a standalone product connected to a hosted solution, as part of a Mitel communications solution, or in PBX environments that support SIP. As a SIP-compliant appliance, it is interoperable with all voice, data, video and Internet applications and services that are SIP-enabled and/or provide full SIP protocol support.



“History” of Networked Multimedia

- **1964:** AT&T introduces Picturephone at the World's Fair, New York
 - **1983:** The Internet as we know it is created on January 1st when a standard networking protocol (TCP/IP) is adopted by all ARPANET users.
 - **1984:** ITU-T recommendation I.120 about ISDN
 - **1986:** ITU defines ATM as the basis for Broadband ISDN
 - **1986:** PictureTel's \$80,000 VC system, \$100 per hour lines
 - **1990:** CCITT standard H.320 for ISDN conferencing
 - **1990-1997:** Experimental multimedia services over Broadband ISDN (ATM)
 - **1991:** The World Wide Web makes its debut on the Internet.
 - **1992:** World's first Mbone audio cast (vat), 23rd IETF, San Diego
 - **1993:** CU-SeeMe v0.40 for Macintosh (with multipoint conferencing)
 - **1995:** RealAudio brings streaming audio to Web users. Streaming video soon follows.
 - **1999:** Napster debuts, allowing users to download (and share) their favorite MP3s
- Parallel streams: Telephony, specialized networks (ATM), Internet

Service Examples (1)

- Interactive, conversational services (live or minimally buffered)
 - Over single-technology, fixed/wireless, wide-area, speech communication network: telephony and phone conferencing
 - The same over Internet: “IP telephony”
 - Over single-technology multi-service network “ISDN”, covering audio-visual information: ISDN videoconferencing (H.320)
 - Over Internet, covering audio-visual information: IP multimedia conferencing (H.320-based or SIP-based)
 - » May include more than just audio-visual communication channels, e.g. shared “whiteboard”, application sharing or even more advanced collaboration (e.g. joint editing of 3D models)
- For all conversational services:
 - Number of participants ≥ 2
 - Complex star configurations for participants ≥ 3

Service Examples (2)

- Interactive, messaging services:
 - Over single-technology, wireless speech/multi-service network GSM: Multimedia Messaging Service MMS
 - Over Internet, based on E-Mail standards (SMTP, POP, IMAP, MIME etc.): Multimedia E-Mail attachments
 - Over Internet, based on Web technology: Digital photo print service

Service Examples (3)

- Interactive, retrieval services:
 - Over single-technology, wireless speech/multi-service network GSM: download of ringing tones or games
 - Over Internet, buffered content:
 - » Web-based video surveillance service
 - Over single-technology, multi-service network B-ISDN (=ATM):
 - » Early prototypes of Video-on-Demand
 - Over Internet, stored content:
 - » Picture databases
 - » Music download (P2P networks, iTunes Music Store etc)
 - » Video-on-Demand (e.g. T-Online Vision)

Advanced Multimedia Services for Residential Users



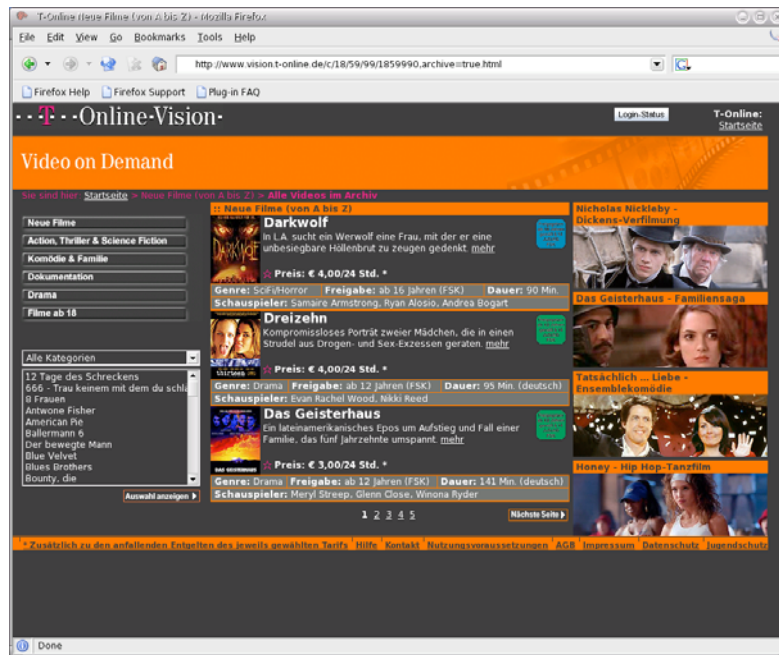
Feldversuch
München
Mai-Juli 1996

Video-on-Demand
ATM over
TV cable network



Video
on
Demand

2004



Service Examples (4)

- Distribution of live content (no presentation control):
 - Over Internet:
 - » Video streaming from sport events, speeches, concerts, ...
 - » Web radio and Web TV
- Distribution with presentation control / limited interaction:
 - Web radio with interactive playlists

Convergence of Networks and Services

- Migration of originally single-technology services towards IP-based Internetworks
 - E.g. GPRS service for GSM networks
 - E.g. IP services over DSL
 - Single-technology services only relevant for QoS reasons
- Integration of network technologies
 - E.g. multiple network interfaces in laptop: WLAN, Ethernet, Modem, GPRS/UMTS Modem, plus local interfaces (USB, FireWire) and periphery (CD, DVD, ...)
 - High-level services bridge across the various ways of network access
 - » E.g. music download service
 - » Complex issue: Synchronization among used devices (e.g. computers and portable music players)
- Final goal: User perceives service as *ubiquitous*, and does not have to care about access technologies