Overview of The Multimedia Networks

Instructor: Hamid R. Rabiee
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Multimedia Networking

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✧ **Hours:**
  ✧ Class hours: Saturdays & Mondays (15:00 to 16:30)
  ✧ Exercise hours: Saturdays 12:00 to 13:15, Room 201

✧ **Course web page:** [http://ce.sharif.edu/courses/90-91/2/ce873-1/](http://ce.sharif.edu/courses/90-91/2/ce873-1/)
Course Textbooks (References)


Lecture Outlines

- Course Introduction (Syllabus)
- Course Outline
- Why Multimedia Networking?
Course Introduction

✧ The course goal:
  ✧ This course is primarily concerned with the problems that arise when carrying audio/video contents over the modern communication networks

✧ The course will:
  ✧ Present an overview of current/future multimedia applications and architectures
  ✧ Discuss deployment problems
  ✧ Discuss Multimedia Network Design and study solutions
  ✧ Examine emerging technologies and open research problems related to multimedia networking
Course Introduction

✧ **Prerequisites:**

✧ Signal and Systems, Multimedia Systems, Computer Networks
✧ Background in Computer Systems Performance Evaluation (e.g., Simulation, Experimental, or Analytical approaches)
✧ Experience with Matlab and GNU/Linux.

✧ **Simulation Tool: OpNet**

✧ **Style:**

✧ Both slides and whiteboard

✧ **Reading List:**

✧ Recommended books and papers
✧ Slides
✧ Handouts
Course Introduction

줘 Evaluation:

◊ Homework & Mini - Projects
  ◊ About 5 series of homework and mini - projects
  ◊ 40 (Points)

◊ Quiz
  ◊ About 12 number of quizzes
  ◊ 10 (Points)

◊ Midterm written exam
  ◊ 25 (Points)

◊ Final written exam
  ◊ 35 (Points)

◊ Total:
  ◊ 110 (Points)
Course Outline

✧ Introduction

✧ Fundamentals of Multimedia
  ✧ Background information similar to the ones covered in the Multimedia Systems

✧ Fundamentals of Next Generation Networks

✧ Quality of Service
  ✧ Principles (e.g. Admission Control and Shaping/Policing)
  ✧ QoS Architecture (Integrated services; Differentiated services)
  ✧ Traffic engineering (Fair Scheduling)
  ✧ Flow and congestion control (Buffer Management)
  ✧ Error correction & concealment
Course Outline

- Multimedia over IP (IP multicast)
- Multimedia over Overlay networks
- Multimedia Applications
- Multimedia Protocols
  - Signaling Protocols (SIP, H.323), Streaming (Real-time) Protocols (RTP, RTCP)
- IP Multimedia Subsystem (IMS)
- Multimedia over Wireless/ sensor network
- Multimedia Networking Applications
  - Digital TV, Voice Over IP, IPTV, Audio/video Conferencing, Interactive Multiplier Games, Application-Level Framing, Video Servers
Course Outline

✧ Multimedia Network Security
  ✧ Encryption, digital signatures, authentication, IP security
  ✧ Digital watermarking security features in multimedia compression standards, secure media streaming

✧ Content Networks

✧ Convergence Networks

✧ Hot Research Topics
Why Multimedia Networking?

✧ The use of IP-based Internet is growing, both in business & home usage
  ✧ Growth of networked multimedia applications on the Internet
  ✧ A balance of digital broadcasting with multimedia streaming over IP networks
✧ IP network, especially Internet, is becoming a very attractive channel for multimedia communications.
  ✧ Dedicated networks and ATM are not widely available to bulk of users
  ✧ There are many applications for Internet multimedia:
    ✧ Internet telephone, Internet TV, video conferencing, network games, remote corroboration, media rich social networks, …
✧ IP uses packet switching
  ✧ Suitable for unexpected burst of data without establishing an explicit connection
  ✧ Bandwidth is shared and so data can be sent at any time
Networked Multimedia Applications

Wireless Browsing

Music Streaming

Movies Streaming

Information Search

Finance, Brokerage

Digital Photos

The Internet cloud

VoIP

Video Conference

E-mail

Digital Media Lab - Sharif University of Technology
Networked Multimedia Applications

- Multimedia Extended Email
- World Wide Web
- Video Distribution Services
- Video Conferencing
- Interactive Distributed Games
- Virtual Reality
- E-Learning
- Instant Messaging

- Sometimes there may be only one media, but similar requirements:
  - Image Distribution, Telephony, Radio, Jukebox Services, Document Archives
Classes of Internet Multimedia Apps

✧ Streaming stored media
  ✧ Stored on server
  ✧ Examples: pre-recorded songs, famous lectures, video-on-demand

✧ Streaming live media
  ✧ “Captured” from live camera, radio, T.V.
  ✧ 1-way communication, maybe multicast
  ✧ Examples: concerts, radio broadcasts, lectures

✧ Real-time interactive media
  ✧ 2-way communication
  ✧ Examples: Internet phone, video conference
A Sample Framework of Media Delivery

- Audio
- Video
- Animation

**Media Encoding**

- Proprietary Format
- Multicast capable
- More Robust
- Access to Storage
- Relieves Web Server

**Media Server**

- Send Stream to Clients
  - Standalone player
  - Java based player
  - Browser plug-in player
  - Appliance

**Clients**

- Send Request to Servers
  - Decode
  - Buffer
  - Sync.

**Web Server**

- Send Request to Media Server

To hear or view a media file without downloading it

Note: P2P applications and Services increasing
Multimedia Expectations

✧ Multimedia Expectations from a Communication Network

✧ Traffic Requirements
  ✧ limits on real-time parameters (delay, jitter)
  ✧ bandwidth and reliability
  ✧ synchronization

✧ Functional Requirements
  ✧ support for multimedia services such as multicasting, security, mobility and session management

✧ More about media & multimedia on next session
Main Problems in Multimedia Applications

✧ Supporting multimedia applications over a computer network renders the application *distributed*.

✧ **Multimedia Transmission over Wireless/Wired networks**
  ✧ Convergence on Wireless, Multimedia, and Internet
Main Problems in Multimedia Applications

✧ Multimedia data is huge
  ✧ Audio, Images, graphics, and video

✧ Wireless/Internet lacks performance guarantee
  ✧ Best effort service, no QoS provision by itself
  ✧ Packet loss, congestion, latency, delay jitters
  ✧ Errors in wireless links

✧ Internet is heterogeneous
  ✧ Varying network conditions, user preferences, device capabilities

✧ Question: How to Enable EFFICIENT, ROBUST, UBIQUITOUS Delivery?
Multimedia Networking Issues

◊ Network Issues
◇ Availability and Performance of Network Bandwidth
◇ Reliability of Transport and Performance
◇ Availability of "Media-aware" Middleware
◇ Availability and Performance of Applications
◇ Required standards for data exchange in heterogeneous environments
◇ Security and copyright Issues
◇ Wireless networks issues
◇ Integration of wired and wireless heterogeneous networking systems

◊ Media Issues
◇ Huge amount of data
◇ Different formats of media (need for Coders & Decoders, Different Applications, transmission protocols, ...)
◇ Issues for real-time transport of streaming multimedia
◇ Quality of media
Two basic Approaches

- Network-Centric
- End-system Based
Network - Centric Based Solutions

✧ **Network - Centric**

✧ **Packet Classification**
  ✧ Packet is marked based on the Type of Service

✧ **Packet Scheduling**
  ✧ choose next packet to send on link

✧ **Integrated Services: flow based**
  ✧ architecture for providing QOS guarantees in IP networks for individual application sessions

✧ **Differentiated Services: packet based**
  ✧ Mark IP packet to specify treatment

✧ **Multi Protocol Label Switching: flow+ packet based**
  ✧ A forwarding scheme that tags packets with labels
End-System Based Solutions

✧ End-System Based
  ✧ Compression
    ✧ Layered and scalable coding
      ✧ Base layer, enhancement layers
      ✧ MPEG: SNR, spatial, temporal scalability
      ✧ MPEG-4 fine granularity scalability (FGS), and H.264
    ✧ MPEG Scalable Video Coding (SVC)
  ✧ Media distribution
  ✧ Media synchronization
  ✧ Multimedia network protocol
End-System Based Solutions

✧ End-system Based

✧ QoS Control

✧ Congestion Control

✧ Source-based rate control, Receiver-based rate control, Hybrid rate control

✧ Rate-adaptive source encoding

✧ Rate shaping

✧ Error Control

✧ FEC, retransmission (ARQ), error-resilient encoding, error concealment
Next Session

Multimedia Networking
References


✧ Jenq-Neng Hwang, “Introduction to multimedia networking”, Cambridge University Press,
The following graduate students have helped to prepare the slides for this course:

- Mostafa Salehi
- Fatemeh Dabiran
- Hoda Ayatollahi