National Tsing Hua University, Hsinchu, Taiwan

CS 5263: Wireless Multimedia Networking Technologies and Applications

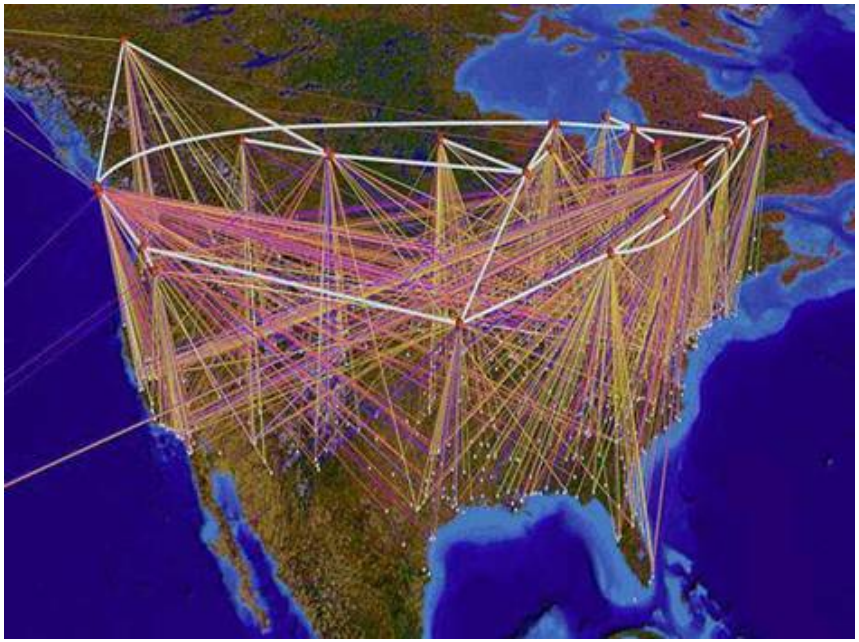
Introduction

Instructor: Cheng-Hsin Hsu

Acknowledgement: The instructor thanks Prof. Mohamed Hefeeda at Simon Fraser University for sharing his course materials

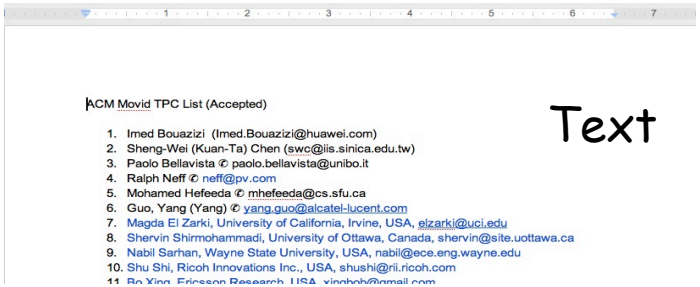
What is Networking?

- Multiple computers connected by communication channels for
  - Information sharing: WWW, Facebook, and BitTorrent
  - Resource sharing: X-Window and Cloud Computing



What is Multimedia?

- Media, or content, in various forms, including



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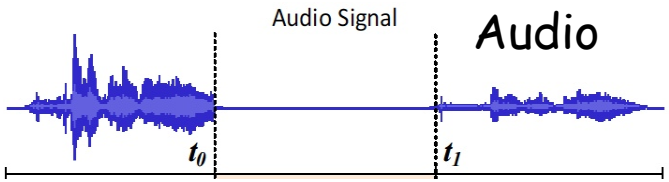
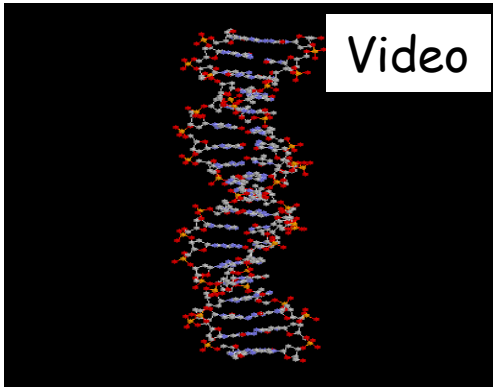
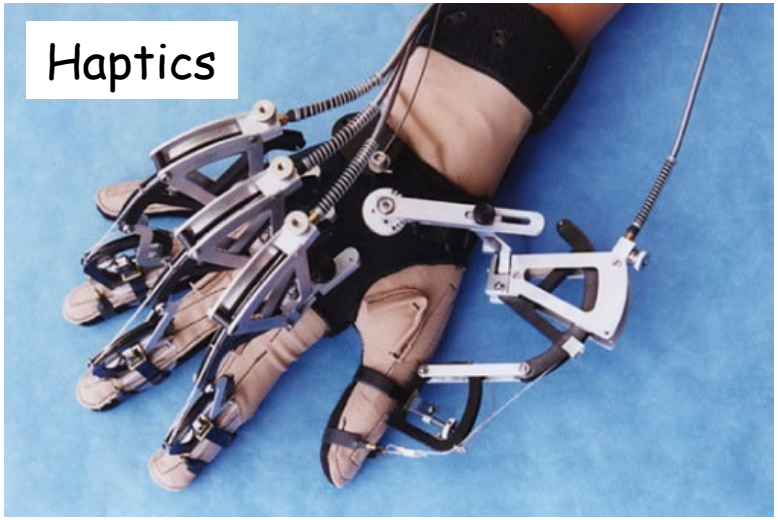
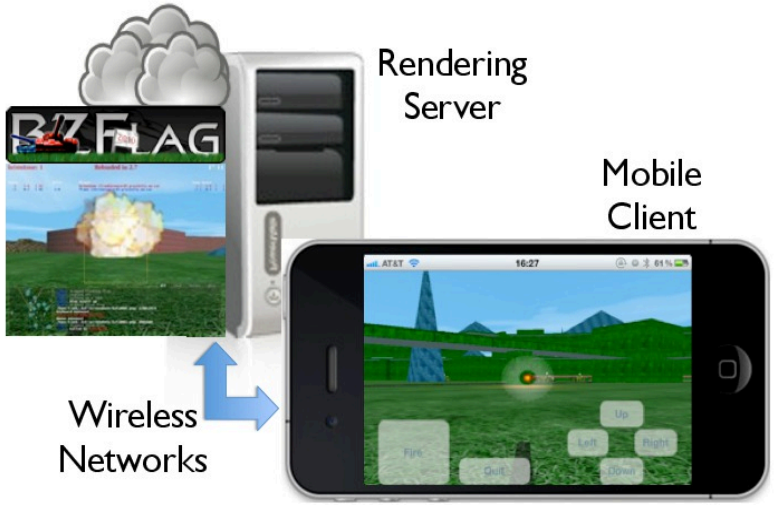






What is Multimedia Networks, Then?

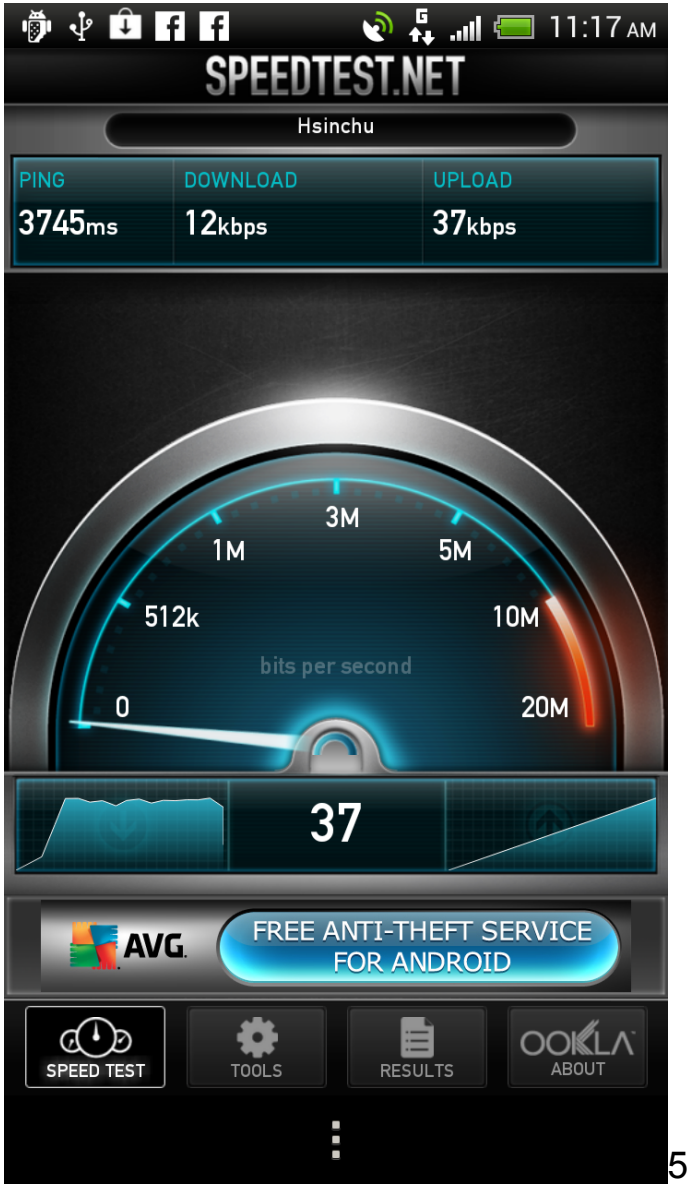
- Distributed multimedia applications
  - Versus local multimedia applications, such as BlueRay
  - Examples: video streaming, video conferencing, mobile TV, rich-content emails



Mobile Cloud Games

Challenges

- Multimedia contents are
  - Large: Batman video consists of 820 frames in 720p (1280x720) resolution. It plays in 16.4 s, but has a staggering size of 1.1 GB. Took my NTHU network 130 s to download!
  - Real-time requirements: for continuous playouts!
- The current Internet is
  - Bandwidth limited
  - Best-of-effort: packets may be late, lost, and corrupted



Challenges (cont.)

- Networked multimedia applications have stringent requirements on
  - Delay: real-time
  - Quality: user experience, related to: (i) video quality, (ii) playout continuity, (iii) synchronization, and (iv) loss robustness, to name a few
- Conflicts (or tradeoffs) between
  - Content size and network bandwidth
  - Real-time requirements and best-effort networks
- Heterogeneous devices and networks ← How to make everyone happy?

Tons of research problems and industrial applications

About the Course

- Time: Tuesdays 3:00 – 6: 00 p.m
- Location: EECS 129
- TA: Ching-Ling Fan (yibin1220 at gmail.com), EECS 742
- Format:
  - The lectures will be given in English
  - All written reports, assignments, and slides must be in English
  - Students are encouraged to give oral presentations in English
  - In-class discussion, questions, and comments can be in Mandarin
- Course Website, please read carefully:

  http://nmsl.cs.nthu.edu.tw/index.php/courses

Course Objectives

- Open-ended
  - You are free to work on any aspects in multimedia and/or networking

- Understand fundamentals of networked multimedia systems
- Get familiar with Android programming
- Know current research issues in multimedia systems
- Develop research skills through hands-on experiences (term projects)
- Have fun

Tentative Scope

- 50% lectures on networking and image/video background
  - Overview on Computer Network
  - Wireless networks
  - Multimedia networking (WebRTC)
  - Digital Image and Color Models
  - Overview on Video Coding
  - Scalable Video Coding (H.265/SVC)
  - Video Quality Metric
- 50% lectures on advanced topics through paper reading and term projects
  - Each student will pick a direction/research project

Android Tutorials

- Tentative topics
  1. Environment setup: My First Android Project
  2. Basic User Interface: Activity and Action Bar
  3. Advanced User Interface: Fragment and Layout
  4. Multithreading: Handler and Asynctask
  5. Data Management: Content Provider and Database
  6. Networking: WiFi and Bluetooth
  7. Multimedia: Exo Player and Camera
  8. Integration: Facebook API
- Eight times, each last for 30 mins (could be longer, depending on how many questions we get from the students)
- You need to bring your own laptop for the tutorials

Android Tutorials (cont.)

- Tentative programming projects
  1. A Bluetooth chat app with a Bluetooth devices discovery logger
  2. Split display showing news data from different sources
  3. An Image gallery that fetches images from the web and maintains a small local database

Textbooks References

- References
  - **[KR12]** Kurose and Rose, **Computer Networking: A top-down Approach Featuring the Internet**, Addison Wesley, 2012
  - **[Burg09]** Burg, **The Science of Digital Media**, Prentice Hall, 2009
  - **[SC07]** Schaar and Chou (editors), **Multimedia over IP and Wireless Networks: Compression, Networking, and Systems**, Elsevier, 2007 ← **ecopy available at the library**
  - **[WOZ02] Wang, Ostermann, Zhang, Video Processing and Communications, Prentice Hall, 2002**
  - **Research papers found at IEEE Xplore, ACM Digital Library, and Google Scholar**

Grading

- No homework
- No final exam
- Pop quizzes: 10%
  - No make up exams will be given. Always email the instructor if you have to skip a lecture to avoid missing the points in pop quizzes
- Programming Projects: 30%
  - Three Android programming projects
- Term Project: 60%
  - Goal: Produce a workshop paper by end of the semester. Always discuss with the instructor about how to make this happen during the semester!

Grading (cont.)

- Deliverables of Term Project:
  - Paper presentations (15%)
  - Technical reports (5% proposal, 10% mid-term, 20% final)
  - Peer-review performance (5% bonus)
- The new peer-review process
  - The technical reports and mid-term reports will be reviewed by peers
  - The reviewers need to prepare a few slides to criticize the assigned report
  - Each report will be reviewed by three students
  - The reviewers' performance is evaluated by the instructor.

Sample Term Projects

- 3D game streaming system for stereoscopic videos.
- Microdrone video streaming system for senior/pet safety.
- WebRTC based mobile streaming for Quality-of-Experience study.
- 2D/3D mesh streaming for distributed rendering.
- Video analytics using Spark Streaming for IoT and smartcity applications.
- Multimedia fog computing systems.

Time Allocation

Week: Day	Lecture (3:30 - 4:45 p.m.)	Student Presenter and Paper Title (4:45 - 5:30 p.m.)	Android Tutorial (5:30 p.m. - 6:00 p.m.) or Progress Reports	Deadline
1: Feb 16	Introduction			
2: Feb 23	Networking Overview [KR08, Ch. 1]		Android #1: Environment setup: My First Android Project PDF	
3: Mar 1	Networking Overview [KR08, Ch. 1]		Android #2: Basic User Interface: Activity and Action Bar PDF	
4: Mar 8	Wireless Networks [KR08, Ch. 6]			Proposal
5: Mar 15	Wireless Networks [KR08, Ch. 6]		Android #3: The Lifecycle of Acticity PDF	
6: Mar 22	Multimedia Networking [KR08, Ch. 7]	Proposal (All Students)	Proposal Reviews	
7: Mar 29	Multimedia Networking [KR08, Ch. 7]		Android #4: Fragments and Layouts PDF	
8: Apr 5	Holiday, No Lecture			
9: Apr 12	Digital Image [Burg09, Ch. 1]		Android #5: Data Management: Content Provider and Database PDF	
10: Apr 19	Color Model [Burg09, Ch. 2]		Android #6: Networking: WiFi and Bluetooth PDF	
11: Apr 26	Basics of Video Coding [Burg09, Ch. 7] [SC07, Ch. 2]			Mid-term report

Questions?