CENG461/ELEC514

Design and Analysis of Communication Networks

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- Course web: http://www.ece.uvic.ca/~cai/461-outline.html

About you

- Please let me know your questions, suggestions, comments, opinion, and expectation on the lectures, assignments, projects, and the course.
  - **Help me to help you.**
  - **Student representative?**

Assessment for CENG 461

- Assignments 10%
- Midterm 20%, Oct. 24 (Thursday)
- Presentation 20%
- Final 50%

Assessment for ELEC 514

- Assignments 10%
- Presentation 10%
- Midterm 20%, Oct. 24
- Final 30%
- Project report 30%

Presentation and Project Report

- Start early, choose your topic before midterm and submit a one-page proposal to me on/before Nov. 1.
- Topics: applying the analytical methods learned from the course to solve a realistic problem. I'll prepare a few sample problems, and students are encouraged to find your own problems.
- Up-to three students can form a group for the presentation and project.
- Presentation date: Nov. 28, 11:30am – 2:30pm ?
- Each ELEC514 group should submit a project report, highlighting each member's own contributions in the group project. The information related to project report: http://www.ece.uvic.ca/~cai/514-project.html

Prerequisites

- Elementary probability and statistics (STAT 254 or 260 or equivalent)
- CENG 460 or CSc 450 are not prerequisites; they *may* be taken concurrently.

Optional Textbooks

- Analysis of Computer and Communication Networks, by Fayez Gebali, Springer 2008.

Reference Books

- A. Leon Garcia and I. Widjaja, *Communication Networks*, McGraw Hill, 2003, Second Edition.
- Dimitri Bertsekas and Robert Gallager, *Data Networks*, Prentice Hall, Second Edition, 1992.
- Leonard Kleinrock, Richard Gail, *Queueing Systems: Problems and Solutions*, Wiley, March 1996. ISBN: 0-471-55568-1.
- M. Schwartz, *Broadband Integrated Networks*, Prentice Hall PTR, New Jersey, 1996, 0-13-519240-4.

Why taking this course?

- **Does Mother Nature throw dice?**

→ Uncertainty is universal due to

- Finite resolution measurements
- Uncontrollable, unpredictable variations
- Simplification in Math/Physics modeling
- Uncertainty principle in Quantum mechanics
- Introduced in operations of the system purposely
- ……

- Engineering systems have to operate well in the face of uncertainty

- Examples

- Probability and random process are basic tools to model, understand and control uncertainty

  - Understanding the concepts is the key
  - The math is actually not difficult

This course begins with a thorough review of probability theory, and discusses in-depth the random process theory; then we apply the theories to model and study the performance of

– computer communication networks
– and other systems
  - Google search engine, page rank
  - …...

Course Topics

1. Computer communication networking
2. Probability and random process
3. Markov chains
4. Queuing analysis
5. Modeling of flow control protocols

Course Topics (2)

6. Modeling of error control protocols
7. Modeling of media access control protocols
8. Traffic modeling

- Course notes and schedule are available
  http://www.ece.uvic.ca/~cai/461-schedule.html
  User Name:
  Password:

Why taking the course? (cont'd)

- How to use networks
  - not as a network user
  - but as a network engineer!
    - improve network efficiency, reliability, quality of services (QoS)
- How to design/analyze/engineer/improve network protocols
  - Why modeling and analysis?
- Get a job in …...?

- Prepare for grad school?
  - Avg starting salaries in 2013 for new grads (US):
    Electrical: BSEE $61,420; MSEE $72,340; PhD $88,970.
    Computer: BS/MS/PhD: $61,270/$70,850/$89,440
  - Advanced degrees are in the high demand by both Fortune 500s and start-ups.
- Tools/methodologies for lifetime?
  - How to formulate, model complicated problems, and apply techniques to solve them?
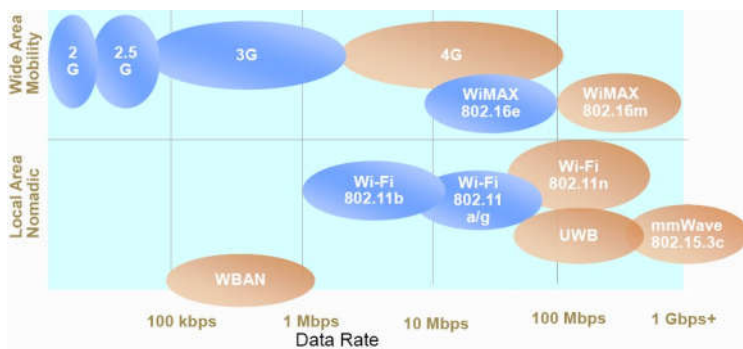 - How to deal with uncertainty, in daily life, in career life?

Q & A

1. If two dice are rolled, find Pr{their sum =7}.
2. Two cards are taken from a deck of 52 cards randomly without replacement. Find the probability that both cards are Ace.
3. Flip a coin five times. Find Pr{two Heads and three Tails}.
4. On the average, half of babies are female, x% of female babies are underweight, and y% of male babies are underweight. Given a baby is underweight, what is the probability that the baby is a female?

Next lecture

- Briefly review networking concepts

My Research Interests

- **Ubiquitous networking:**
  - Wireless/wireline interworking
  - Topology control, medium access control, resource and mobility management
  - Cross-layer design

    for wireless cellular systems, local area networks (WLANs or WiFi), personal area networks (WPANs), body area networks (WBANs), sensor networks, mesh and ad hoc networks

Evolution of Wireless Communication Technologies


Wireless Mesh Topology
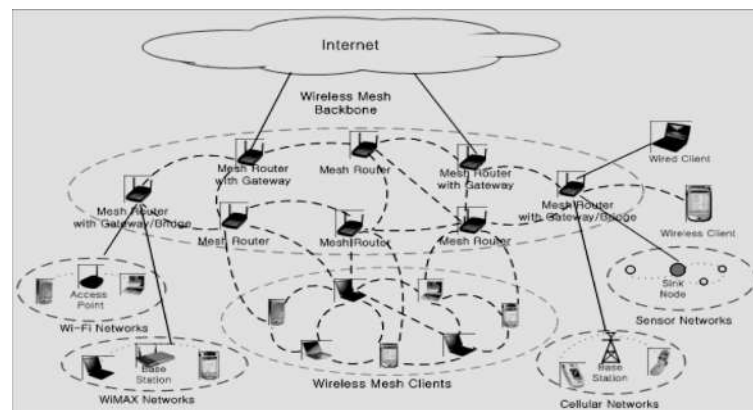
Wireless mesh networks with heterogeneous wireless components: WiFi, WiMAX, Cellular, Mesh, Sensor Networks, *etc.*

Wireless Internet Access@ Airport My (Previous) Experience

- Canada:

   Victoria: 15 min free internet.

   Calgary: 15 min free internet.

   Vancouver: very good quality free internet.

   Toronto: free internet, acceptable quality

- USA:

   Houston: free 45 internet, bad quality

   Seattle: good quality free internet (2 hr).

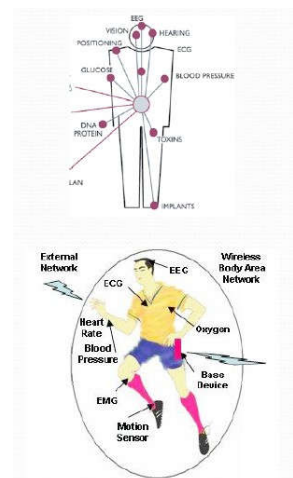## Broadband Home and Personal Area Networks
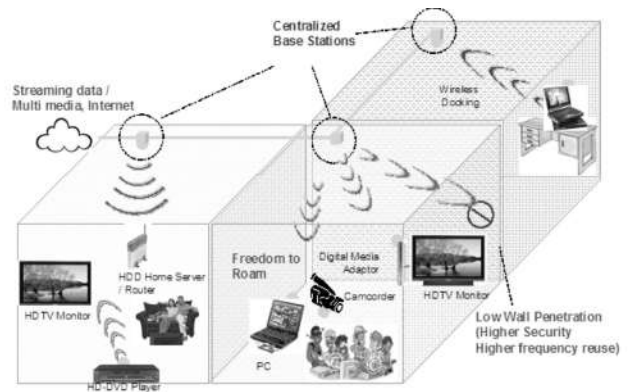
Home and personal area networks based on the state-of-the-art wireless technologies: ultra-wide band, millimeter wave, *etc.*

Intelligent Transportation Systems

Wireless inter-vehicle Ad Hoc networks for future intelligent transportation systems.

Wireless Body Area Network

- WBAN sensors:
  - wearable sensor: EEG, ECG, EMG, Blood pressure, Glucose level, etc.
  - implant sensor: insulin pump, etc.
- Using WPAN/Cellular/… to connect to the Internet
- Support remote health care

Green Networking for Sustainable Society

- Limited, un-renewable natural resources
- Ever-increasing demand for health and wealth
- How to achieve sustainability?
  - Green communication networking technologies
  - Supporting green applications
 - Smart grid applications

Smart Grid
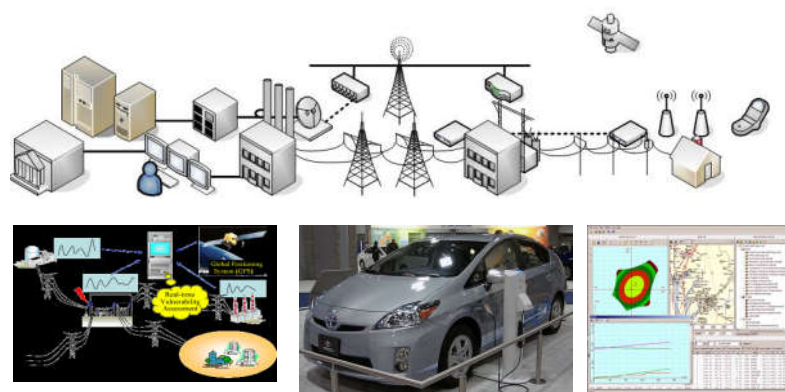
Advanced sensing and measurement, advanced energy storage, advanced pattern recognition and decision, ...

Research Interests (2)

- **Content/multimedia distribution networking:**
  - Distributed multimedia delivery system design and performance analysis

Scalable Streaming Project

https://sites.google.com/site/svchttpstreaming/demo
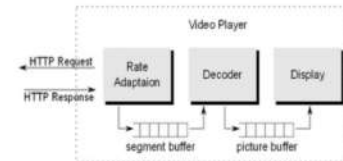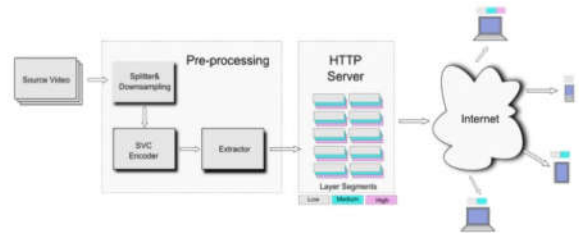
Research Interests (3)

- Network security issues
  - Secure communications in ad hoc networks
  - Electronic micropayment
  - Denial of service, IP traceback
  - ...