Overview

- Goal of this Course
- Grading
- Contents of the course
- Tentative Schedule
Mobile vs Wireless

- Mobile vs Stationary
- Wireless vs Wired
- Wireless ⇒ Media sharing issues
- Mobile ⇒ Routing, addressing issues
Goal of This Course

- Comprehensive course on wireless and mobile networking
- Broad coverage of key areas
- Intro to physical layer “Wireless Communication”
- Emphasis on Higher layers: Layers 2, 3, 4, …, 7
- Emphasize both present (Industry standards and products) and near future (Research)
- Graduate course: (Advanced Topics)
  - Less reliance on one textbook
  - Lot of independent reading and writing
  - Survey paper (Research techniques)
  - Peer-Reviews
Grading

- Midterm Exam (Best of 2) 30%
- Final Exam 30%
- Class participation 5%
- Homeworks 15%
- Project 20%
Supplementary Texts

All books are available in Olin Library as 2-hour Reserves.

Physical Layer:


WLAN+WPAN+WMAN:

Supplementary Texts (Cont)

WiMAX:

Cellular Networks:
Supplementary Texts (Cont)

Cellular Networks:

Sensor Networks:
Supplementary Texts (Cont)

Ad-Hoc Networks:

Security:
Networking Courses at WUSTL

- CSE 473s: Introduction to Computer Networks
- CSE 571S: Network Security
- CSE 573s: Protocols for Computer Networks
- CSE 574s: Wireless and Mobile Networking
- CSE 578S: Multimedia Computing and Networking
- CSE 777s: Research Seminar in Networking
Prerequisite: CSE473S

- Protocol Layers: ISO/OSI reference model
- Physical Layer: Nyquist/Shannon theorems, Coding, Manchester
- Transmission Media: UTP, Cat 5, Microwave, Radio
- Data Communication: Asynchronous vs synchronous, Baud, bit, and Hz, Half-Duplex vs Full-duplex, Modulation/Demodulation
- Packet Transmissions: Framing, Bit stuffing, byte stuffing
- Flow Control: On-Off, Window
- Error Detection: Parity, Checksum, Cyclic Redundancy Check
Prerequisites (Cont)

- Error Recovery: Start and Stop, Go back $n$, Selective Reject
- LANs: Aloha, CSMA/CD, Ethernet, IEEE 802.3
- LAN Addressing: Unicast vs multicast, Local vs Global
- LAN wiring: 10Base5, 10Base2, 10Base-T, 100Base-T4, 100Base-TX, 100Base-FX
- Extended LANs: Hubs, Bridges, Routers, Switches
- Routing: Distance Vector vs Link State, Spanning tree, source routing
- Network Layer: Connectionless vs connection oriented
Wireless Networking

Impact of Wireless on Networking:

1. Not tied to walls/infrastructure ⇒ Ad-hoc networking
2. Error-prone ⇒ Traffic Management
3. Frequent Disconnections ⇒ Resource Management
   Quality of Service for multimedia
4. Battery operated ⇒ Media access and networking while sleep
   ⇒ Time synchronization
5. Broadcast ⇒ Security
Mobile Networking

Impact of Mobility on Networking:
- Location
- Addressing
- Handoff
# Tentative Schedule

<table>
<thead>
<tr>
<th>Class</th>
<th>Day</th>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wednesday</td>
<td>1/20/2010</td>
<td>Course Overview</td>
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<tr>
<td>5</td>
<td>Wednesday</td>
<td>2/3/2010</td>
<td>Wireless Local Area Networks: Part I</td>
</tr>
<tr>
<td>6</td>
<td>Monday</td>
<td>2/8/2010</td>
<td>Wireless Local Area Networks: Part II</td>
</tr>
<tr>
<td>7</td>
<td>Wednesday</td>
<td>2/10/2010</td>
<td>Wireless Metropolitan Area Networks: Part I</td>
</tr>
<tr>
<td>8</td>
<td>Monday</td>
<td>2/15/2010</td>
<td>Wireless Metropolitan Area Networks: Part II</td>
</tr>
<tr>
<td>9</td>
<td>Wednesday</td>
<td>2/17/2010</td>
<td>Wireless Personal Area Networks: Part I</td>
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<tr>
<td>10</td>
<td>Monday</td>
<td>2/22/2010</td>
<td>Mid-Term Exam 1</td>
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## Tentative Schedule (Cont)

<table>
<thead>
<tr>
<th>Class</th>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>11</td>
<td>Wednesday 2/24/2010</td>
<td>Wireless Personal Area Networks: Part II</td>
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<tr>
<td>12</td>
<td>Monday 3/1/2010</td>
<td>Wireless Cellular Networks: 1G and 2G</td>
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<tr>
<td>13</td>
<td>Wednesday 3/3/2010</td>
<td>Wireless Cellular Networks: 2.5G and 3G</td>
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<td></td>
<td>Monday 3/8/2010</td>
<td>Spring Break (No Class)</td>
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<tr>
<td></td>
<td>Wednesday 3/10/2010</td>
<td>Spring Break (No Class)</td>
</tr>
<tr>
<td>15</td>
<td>Wednesday 3/17/2010</td>
<td>The IP Multimedia Subsystem</td>
</tr>
<tr>
<td>16</td>
<td>Monday 3/22/2010</td>
<td>Femtocells</td>
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<tr>
<td>17</td>
<td>Wednesday 3/24/2010</td>
<td>Recent Advances in Cellular Networks: Part I</td>
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<tr>
<td>18</td>
<td>Monday 3/29/2010</td>
<td><strong>Mid-Term Exam 2</strong></td>
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## Tentative Schedule (Cont)

<table>
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<tr>
<th>Class</th>
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<th>Date</th>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>19</td>
<td>Wednesday</td>
<td>3/31/2010</td>
<td>Recent Advances in Cellular Networks: Part II</td>
</tr>
<tr>
<td>21</td>
<td>Wednesday</td>
<td>4/7/2010</td>
<td>Mobile IPv6</td>
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<tr>
<td>22</td>
<td>Monday</td>
<td>4/12/2010</td>
<td>Media Independent Handover</td>
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<tr>
<td>23</td>
<td>Wednesday</td>
<td>4/14/2010</td>
<td>TCP over Wireless</td>
</tr>
<tr>
<td>24</td>
<td>Monday</td>
<td>4/19/2010</td>
<td>Ad Hoc Networks: Issues and Routing</td>
</tr>
<tr>
<td>25</td>
<td>Wednesday</td>
<td>4/21/2010</td>
<td>Wireless Mesh and Multi-Hop Relay Networks</td>
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<td>27</td>
<td>Wednesday</td>
<td>4/28/2010</td>
<td>Radio Frequency Identifier (RFID)</td>
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<tr>
<td>28</td>
<td>Monday</td>
<td>5/3/2010</td>
<td>Final Exam</td>
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Project

- A survey paper on topic of your choice
  A list of topics will be provided in the class

- Stages:
  - Literature search
    - CD ROMs: Compendex, Books in Print, WWW
  - Reading
  - Writing

- Average 6 Hrs/week/person on project
- Average 9 Hrs/week/person on class
Projects Topics

- **Technologies**: Ultra-wideband, Smart Antennas, Optical Wireless, Software Defined Radios, Smart Antennas, Turbo Coding, RFID, Satellite Networks (What, Standards activities, Products, Features, Outlook, Applications)

- **Standards**: 802.11 WiFi, 802.15 PANs, 802.16 WiMAX, 802.20 Mobile Broadband, 802.21 Handover, 802.22 RAN, 4G, 3G, WiMAX (Standards Activities, MAC, Energy Management, QoS, Security, Packet Format, Products, Features, Outlook, Applications)

- **Wireless Products**: Wireless Access Points: Key features, Wireless Switches: Key features

Project Topics (Cont)

- **Network Layer**: Mobile Ad-hoc Networks, Energy Efficient Routing, Multicast routing, IPv6 over PANs, Ad-hoc network auto-configuration, Mobility for IPv4, Mobility for IPv6, Network Mobility, Signaling and Handoff in IPv6, Localization in Wi-Fi Networks, Localization in 3G, Localization in 4G, Wireless Mesh Networks

- **Transport Layer**: TCP over Wireless

- **Applications**: WAP, Mobile TV, Voice over Wireless, Mobile Multimedia, IP Telephony over Mobile Networks, Wireless Games, Medical Applications of Wireless, Multimedia over 802.11, Inter-Vehicular Wireless Communication


- **Management**: Radio Spectrum Management
## Project Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Task</th>
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</thead>
<tbody>
<tr>
<td>Mon 2/17/10</td>
<td>Topic Selection</td>
</tr>
<tr>
<td>Mon 3/01/10</td>
<td>References Due</td>
</tr>
<tr>
<td>Mon 3/15/10</td>
<td>Outline Due</td>
</tr>
<tr>
<td>Mon 4/05/10</td>
<td>First Draft Due</td>
</tr>
<tr>
<td>Mon 4/12/10</td>
<td>Reviews Due</td>
</tr>
<tr>
<td>Mon 4/19/10</td>
<td>Final Report Due</td>
</tr>
</tbody>
</table>
Project Requirements

- Recent Developments: Last 3 to 5 years
  ⇒ Generally not in books
- Comprehensive Survey:
  Technical Papers, Industry Standards, Products
- Will be published on my website,
  Better ones may be submitted to magazines or journals
- No copyright violations:
  ⇒ You need to re-draw all figures
  ⇒ You need to summarize all ideas in your *own* words
  ⇒ Cannot copy any part of text or figure unmodified
  ⇒ Short quotes ok
  ⇒ Any unmodified figures need permissions
Any infringement will result in forfeiture of grades even after graduation.
Office Hours

- Monday: 11:00 to 12:00 noon
  Wednesday: 11:00 to 12:00 noon

- Office: Bryan 523

- Teaching Assistant: Subharthi Paul, Jolly 509
  spaul@wustl.edu
  Thursday 12 noon-1PM in Jolly 509
  Sunday 5-6PM in Bryan 516
Frequently Asked Questions

- Yes, I do use “curve”. Your grade depends upon the performance of the rest of the class.
- All homeworks are due on the following Monday unless specified otherwise.
- Any late submissions, if allowed, will *always* have a penalty.
- Exams consist of numerical as well as multiple-choice (true-false) questions.
- There is negative grading on incorrect multiple-choice questions. Grade: +1 for correct. -1/(n-1) for incorrect.
- Everyone including the graduating students are graded the same way.
Summary

- There will be a lot of self-reading and writing
- Goal: To prepare you for a career in wireless networking
- Get ready to work hard
Project Homework 1

- Search web pages, books, and journal articles from ACM Digital Library, Applied Science, Compendex, ABI/INFORM Complete, and Knovel databases at Olin Library for one of the following topics:
  - Networking Trends
  - Wireless Networking Trends
  - Mobile Networking Trends

- On the web try the following search points:
  - http://library.wustl.edu/findart.html
  - http://library.wustl.edu/fulltext/
  - http://scholar.google.com
  - http://books.google.com
Project Homework 1 (Cont)

- http://www.scirus.com/srsapp/
- http://searchnetworking.techtarget.com/bestWebLinks/
- See also http://www.searchengineguide.com/pages/Science/

- Ignore all entries dated 2005 or before. Also ignore all entries that do not indicate trends in the title. List others in the following format (up to 5 each):
  - Author, “Title,” publisher, year. (for 5 books)
  - “Title,” URL [One line description] (for 5 web pages)
  - Author, “Title,” source (for 5 technical/magazine articles)

- Serially number the references and submit electronically to jain@cse.wustl.edu. The mail should have a subject field of “CSE 574S Homework 1” (Please note the subject carefully)

- Make a list of other interesting search points and share with the class.
Quiz 0: Prerequisites

True or False?
T  F

☐  ☐ Datalink refers to the 2nd layer in the ISO/OSI reference model

☐  ☐ Cat 5 unshielded twisted pair cable is better than Cat 3 cable.

☐  ☐ Finding path from one node to another in a large network is a transport layer function.

☐  ☐ It is impossible to send 3000 bits/second through a wire which has a bandwidth of 1000 Hz.
Quiz 0 (Cont)

- Bit stuffing is used so that characters used for framing do not occur in the data part of the frame.
- For long delay paths, on-off flow control is better than window flow control.
- Ethernet uses a CSMA/CD access method.
- 10Base2 runs at 2 Mbps.
- The packets sent in a connection-oriented network are called datagrams.
- Spanning tree algorithm is used to find a loop free path in a network.

Marks = Correct Answers ___ - Incorrect Answers ___
Student Questionnaire

- Name: ________________________________
- Email: _______________________________
- Phone: ______________________________
- Degree: _________  Expected Date: __________
- Technical Interest Areas:
  ______________________________________
  ______________________________________
- Prior networking related courses/activities:
  ______________________________________
  ______________________________________
- Prior wireless networking related courses/activities:
  ______________________________________
  ______________________________________