ECE 544: Communication Networks II, Spring 2014

This course is intended to provide an in-depth and practical understanding of modern computer networks that constitute the Internet. The scope includes network architecture, key technologies, layer 2 and layer 3 protocols, and examples of specific systems. Emphasis will be on network protocols and related software implementation. The course includes a hands-on “clean-slate” network prototyping project involving specification, standardization and software implementation.

Meeting Time: Fridays, 3:45-6:30PM, Hill 116

Course Instructors: Prof. D. Raychaudhuri (ray@winlab.rutgers.edu) and Dr. Daniel Reininger (dan@semandex.net). Office Hours: 2:00-3:30 Fri by appt (send email to request), WINLAB Tech Center C103 & CORE 501. Teaching Assistant (for prototyping project): Mr. Francesco Bronzino (bronzino@winlab.rutgers.edu).

Text: Peterson & Davie, “Computer Networks: A Systems Approach”, Morgan Kaufman, 4th or 5th ed. This is a required textbook used for about 60-70% of the material covered. Additional reading materials to be distributed or downloaded, including IEEE standard specs (e.g. 802.3 and 802.11), Internet RFC’s (e.g. 793, 768 & 791), and papers on specific systems.

Course Information: comnet2 mailing list comnet2@winlab.rutgers.edu (to be activated by 1/31), website: www.winlab.rutgers.edu/comnet2. Register for the mailing list at: http://lists.winlab.rutgers.edu/listinfo/comnet2.

Grading Policy:

<table>
<thead>
<tr>
<th>Course Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Midterm exam</td>
<td>25%</td>
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<tr>
<td>Final exam</td>
<td>35%</td>
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<tr>
<td>Network architecture paper</td>
<td>10%</td>
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<tr>
<td>Protocol project and report</td>
<td>25%</td>
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<tr>
<td>Class participation &amp; homework</td>
<td>5%</td>
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Course Outline: (some topics may not be covered in sequence or may be omitted; includes some guest lectures)

L1----- 1/24  Introduction
- What is a network?
- Different types of networks
- How to specify requirements
- Protocol layering and OSI architecture
- Network API’s/sockets & software issues

Overview of Networking Fundamentals
- Network topologies
- Packet formats
- Resource Sharing
- Packet forwarding & routing
- Flow & congestion control
- Transport layer
- QoS, performance evaluation basics

L2----- 1/31  Top down network design
Network architecture paper guidelines
Shared Media Protocols, MAC:
- 802.3 Ethernet,
- 802.5 Token Ring
- 802.11 Wireless LAN

Bridges and LAN switching:
- learning bridge
- spanning tree
- multicast
Switched Networks
- Advanced topics in Ethernet, OpenFlow
- Cell switching (ATM)
- Cell format, SAR
- VPI/VCI, signaling
- QoS control

Internet Protocol (IP) Basics
- IP address
- ARP
- DHCP
- ICMP
- intra-domain routing (RIP, OSPF)

Internet Protocol (IP) Advanced
- subnets
- classless inter-domain routing (CIDR)
- inter-domain routing (BGP)
- IPv6, IP QoS (diff serv, RSVP)

IP Multicast
- DVMRP
- PIM
- Reliable Multicast
- Pub/Sub, Content Delivery Networks (CDN)

Network Hardware and Software
- Wireless (802.11, 3G, WiMax)
- Switches (Ethernet, ATM/MPLS, OpenFlow)
- IP Routers
- Network software basics (OS, drivers, protocols, management)
- Socket programming intro

Mid-term exam

Spring Break (no class)

Protocol Project tutorial & standards meeting
(2-3 additional meetings to be scheduled as needed)

Transport layer protocols
- UDP
- TCP
- RTP

Quality of Service (QoS)
- Traffic Shaping
- Flow Control
- Admission Control
- RSVP
- IP Diff Serve
- IP Int Serve and ATM QoS

Mobility protocols
- Mobile IP
- ad-hoc routing, DTN
- Alternative approaches

Security and privacy protocols
- DES, RSA, public key, PGP, IPsec
- Network protocol vulnerabilities and exploits
- Intrusion Detection Systems & Firewalls
- Invisible Internet Protocol (I2P), Onion Routing

Advanced Topics
- Information Centric Networks (ICN)
- High-throughput distributed messaging systems and big data networks
• Future Internet architecture

---- Final Exam (between 5/6-10, specific date TBA)

Course Projects:

1. Network Architecture project due on 3/24 (instructions to be given separately)

2. Routing protocol prototyping project due on 4/25 (instructions to be given separately)
   Possible aspects/topics for consideration

3. Optional Extra Credit Projects due 5/6 (instructions to be given separately)