ECE 544: Communication Networks II, Spring 2019

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). 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. Sumit Maheshwari (sumitm@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 1/26), website: www.winlab.rutgers.edu/comnet2. Register for the mailing list at: https://groups.google.com/a/winlab.rutgers.edu/forum/#!forum/comnet2

Grading Policy:

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<tr>
<th>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----- 1/25 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----- 2/1 Shared Media Protocols and LAN Switching

MAC:
- 802.3 Ethernet,
- 802.11 Wireless LAN

Ethernet Bridges and LAN switching:
- learning bridge
- spanning tree
- multicast

ATM
- Cell format, SAR
- VPI/VCI, signaling

L3----- 2/8 Software Defined Networks (SDN)
- SDN architecture – control & data paths, controller
- OpenFlow specification
- Examples of SDN network implementations – Mininet, etc.

L4----- 2/15  Internet Protocol (IP) Basics
- IP address
- ARP
- DHCP
- ICMP
- intra-domain routing (RIP, OSPF)

L5------2/22  Internet Protocol (IP) Advanced
- subnets
- classless inter-domain routing (CIDR)
- inter-domain routing (BGP)
- IPv6, IP QoS (diff serve, RSVP)

L6-------3/1  IP Multicast
- DVMRP
- PIM
- Reliable Multicast

L7------3/8  Network Hardware and Software
- Wireless (802.11, WiMax, LTE)
- Switches (Ethernet, MPLS, OpenFlow)
- IP Routers
- Network software basics (OS, drivers, protocols, management)
- Socket programming intro

3/15  Mid-term exam

L8------3/29  Protocol Project tutorial & standards meeting
(2-3 additional meetings to be scheduled as needed)

L7------4/5  Quality of Service (QoS)
- Traffic Shaping
- Flow Control
- Admission Control
- RSVP
- IP Diff Serve
- IP Int Serve and ATM QoS

L9------4/12  Transport layer protocols
- UDP
- TCP
- RTP

L10------4/19  Mobility protocols
- mobile IP
- ad-hoc routing, DTN
- alternative approaches

L11------4/26  Security protocols
- DES
- RSA
- public key
- PGP
- IPsec

L12-------5/3  Next-Generation Networks
- Overlay Networks & Content delivery networks (CDN)
- Future Internet architecture (NDN and MobilityFirst)

---- Final Exam (date to be confirmed)

Course Projects:

1. Network Architecture project due on 3/29 (instructions to be given separately)

2. Routing protocol prototyping project due on 4/30 (instructions to be given separately)