ECE 544: Communication Networks II, Spring 2016

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 Instructor: Prof. D. Raychaudhuri (ray@winlab.rutgers.edu) Office Hours: by appointment (send email to request), WINLAB Tech Center C103 & CORE 501. Teaching Assistant (for software 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 1/30), website: www.winlab.rutgers.edu/comnet2 . Register for the mailing list at: http://lists.winlab.rutgers.edu/listinfo/comnet2

Grading Policy:

- Midterm exam (25%)
- Final exam (35%)
- Network architecture paper (10%) Protocol project and report (25%)
- Class participation & homework (5%)

Course Outline: (some topics may not be covered in sequence or may be omitted; includes some guest lectures)

L1----- 1/22 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----- 1/29 Network Architecture discussion & project instructions
Shared Media Protocols and LAN’s
MAC:
- 802.3 Ethernet,
- 802.11 Wireless LAN

L3----- 2/5 Switched Networks (Ethernet, ATM)
- Ethernet Bridges and LAN switching:
  - learning bridge
  - spanning tree
  - multicast
- ATM
  - Cell switching (ATM)
  - Cell format, SAR
  - VPI/VCI, signaling
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 serve, RSVP)

IP Multicast
- DVMRP
- PIM
- Reliable Multicast

Network Hardware and Software-Defined Networks
- Wireless (802.11, WiMax, LTE), Switches (Ethernet, OF), Routers (P, MPLS)
- Network software basics (OS, drivers, sockets, protocols, management)
- Intro to SDN and OpenFlow

3/11 Mid-term exam

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

Extra Meeting on Protocol Standards (TBD, 3/29 or 3/30)

Quality of Service (QoS)
- Traffic Shaping
- Flow Control
- Admission Control
- Congestion Control
- RSVP, IntServ
- IP Diff Serve

Transport layer protocols
- UDP
- TCP
- RTP

Mobility protocols
- mobile IP
- ad-hoc routing, DTN
- alternative approaches

Security protocols
- DES
- RSA
- public key
- PGP
- IPsec

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

--- Final Exam (likely date 5/6, to be confirmed)

Course Projects:

1. Network Architecture project due on 3/25 (instructions to be given separately) – two week extension to 4/8

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