ECE 423/544: Computer & Communication Networks/Communication Networks II, Spring 2020

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 how they fit into the end-to-end Internet architecture. The course includes a hands-on "clean-slate" network prototyping project involving protocol design and software implementation.

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

Course Instructors: Prof. D. Raychaudhuri (ray@winlab.rutgers.edu). Office Hours: by appointment (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 75% 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:
Midterm exam (25%), Final exam (35%)
Network architecture paper – additional assignment for ECE544 students (10%)
Protocol project and report - for ECE423 students (35%), – for ECE544 students (25%)
Class participation & homework (5%)

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

L1----- 1/24 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 Shared Media Protocols and LAN Switching
MAC:
- 802.3 Ethernet (CSMA/CD)
- 802.11 Wireless LAN (CSMA/CA)
Ethernet Bridges and LAN switching:
- learning bridge
- spanning tree
- multicast
ATM
- Architecture, Cell format, SAR
- VPI/VCI, signaling
L3----- 2/7 Software Defined Networks (SDN)
  - SDN architecture – control & data paths, controller
  - OpenFlow specification
  - Examples of SDN network implementations – Mininet, etc.

L4----- 2/14 Internet Protocol (IP) Basics
  - IP address
  - ARP
  - DHCP
  - ICMP
  - intra-domain routing (RIP, OSPF)

L5-----2/21 Internet Protocol (IP) Advanced
  - subnets
  - classless inter-domain routing (CIDR)
  - inter-domain routing (BGP)
  - IPv6, IP QoS (diff serve, RSVP)

L6-----2/28 IP Multicast
  - DVMRP
  - PIM
  - Reliable Multicast

L7-----3/6 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

3/13  Mid-term exam

L8------3/27 Protocol Project tutorial & standards meeting
(2-3 additional meetings to be scheduled as needed)

L7------4/3 Protocol Project (cont.) and Quality of Service (QoS)
  - Traffic Shaping
  - Flow Control
  - Admission Control
  - RSVP
  - IP Diff Serve

L9------4/10 Transport layer protocols
  - UDP, RTP
  - TCP specification
  - TCP flow & error control examples

L10------4/17 Mobility protocols
  - Mobile network architecture
  - mobile IP
  - ad-hoc routing, DTN
  - alternative approaches

L11------4/24 Security protocols
  - DES
  - RSA
  - public key
  - PGP
  - IPsec

L12------5/1 Review and 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 3/27 (instructions to be given separately)

2. Network prototyping project due on 5/1 (instructions to be given separately)