ECE 564: Advanced Topics in Computer Networks  
Fall 2014

Tentative Topics

Note: The list below is tentative. Some of these topics may be covered in more depth than others, depending on time.

1 Introduction

• About the literature of computer networking
• Review of some basic concepts in computer networks
• Telecommunications and network standards

2 Network Simulation

• Csim overview
• Statistical issues in designing simulation experiments

3 Quality of Service and Multimedia Networking

• Application requirements
• QoS metrics and nature of QoS guarantees
• Statistical multiplexing
• Supporting end-to-end QoS (QoS accumulation)
• QoS frameworks in TCP/IP networks
  – RSVP and Integrated Services
  – Differentiated Services
• Real-Time Protocol (RTP) and RTP Control Protocol (RTCP)
• Session Initiation Protocol (SIP)
• Real-time Streaming Protocol (RTSP)
4 Traffic/Congestion Control

- Reactive control vs. preventive control
- Call (connection) admission control
- Traffic policing
  - Traffic descriptors and \((\sigma, \rho)\) envelope
  - Token-bucket algorithm
  - Composite policing mechanisms
  - GCRA algorithm
- Scheduling and buffer management
  - Delay-based and loss-based priority mechanisms
  - Active queue management
  - Scheduling in wireless networks

5 Flow Control

- First-generation flow control mechanisms
- Second-generation flow control mechanisms
- Rate vs. window-based flow control
- TCP flow control mechanism
- TCP over wireless networks

6 Fairness

- Max-min fairness
- Proportional fairness

7 Traffic Modeling

- Traffic burstiness
- Measures of burstiness
- Short-range dependent (SRD) vs. long-range dependence (LRD)
- Self-similarity/fractals in network traffic
- Representative traffic models
  - Renewal models
  - Markov-based models
  - Fluid models
  - Fractional Gaussian noise (fGN) and fractional-ARIMA (F-ARIMA) models
  - \(M/G/\infty\) modes (time permitting)
8 Routing in Wired Networks

- Distance-vector and link-state routing
- Hierarchical routing
- Constraint-based routing
- IP-based routing protocols
  - RIP (intra-domain routing)
  - OSPF (intra-domain routing)
  - BGP (inter-domain routing)

9 Wireless Local Area Networks (WLANs)

- CSMA/CA and IEEE 802.11 protocols
- Bluetooth
- Channel access issues

10 Mobile Ad Hoc Networks (MANETs)

- Applications and deployment scenarios
- Channel access issues (hidden & exposed terminal problems)
- Power and rate controls in MANETs
- Topology control
- MAC protocols
  - Protocols for MANETs with omnidirectional antennas
  - Protocols for MANETs with directional antennas
  - Protocols for MANETs with MIMO capabilities
  - Protocols for MANETs with CDMA capabilities
- MANET routing protocols:
  - Proactive protocols (OLSR, DSDV)
  - Reactive protocols (DSR, AODV)
  - Routing protocols for MANETs with “smart” antennas
- Multi-channel wireless networks
11 Cognitive Radio Networks and Dynamic Spectrum Access

- Spectrum scarcity and under-utilization
- Opportunistic access
- OSA architectures and standards
- Channel access protocols
- Routing protocols
- Spectrum sensing
- Security issues

12 Sensor Networks (*time permitting*)

- Applications and deployment scenarios
- MAC issues and protocols
- Clustering techniques
- Coverage and connectivity
- Addressing and localization
- Data-centric routing
- Data aggregation
- Tools for sensors and sensor-networking research

13 Wireless Mesh Networks (*time permitting*)

- IEEE 802.16 protocol
- Protocols for WMNs
- Integration of WLANs and WMNs

14 Web Caching and Prefetching (*time permitting*)

- Client-based caching
- Cache replacement policies
- Prefetching mechanisms