Advanced Computer Networks
Topics and Research Areas

Congestion Control
- TCP {responsive flows}
  - Versions - Tahoe, Reno, NewReno, Vegas, Westwood
  - Approaches
    • RED (Random Early Detection)
    • FRED (Fair RED)
    • ECN (Explicit Congestion Notification)
    • Blue
    • PI Controller
    • REM
    • AVQ
    • XCP
  - Traffic Types
    • FTP
    • Short, Web traffic
    • UDP {unresponsive flows}
      - TCP Friendly
      - Streaming Traffic (Audio and/or Video)
      - Approaches
        • CSFQ
        • SFB

Streaming Media
- Streaming Protocols
- Congestion techniques
- Repair (FEC)
- Compression

Web Technologies
- HTTP 1.1
- Web caching
- Web proxies
- Content Delivery Networks
- Web performance

Wireless/ Mobile Networks
- MANET (Mobile Ad-hoc NETworks)
- Loss Issues versus congestion
- Wired to Wireless
- Power Issues
Differentiated Services (Diffserv)
- Absolute differential services
- Edge node architectures
- GPS (Generalized Processor Sharing)
- Per flow state information
- Proportional differential services
- \textit{QoS Issues}
- Relative differential services
- VPNS (Virtual Private Networks)

Security and Firewalls
- IPSec
- Kerberos
- Denial of Service attacks
- Firewalls
- Intrusion Detection
- VPN’s

Basic Routing
- Distance Vector, Link State
  - RIP, OSPF
- \textit{BGP}
  - instability and flapping

Multicast Routing
- Mbone
- Multicast Layering
- Multicast Protocols
  - DVMRP, MOSPF, CBT, PIM-SM, ECMP, RSVP
- Reliable Multicast
- Secure Multicast
- Multimedia Routing

- \textit{Overlay Networks} - Application Level Multicast

Benchmarking and Performance Studies for Networks
- Benchmarks for network performance and “tuning”
- Benchmarks specifically for routers
  - issues in "wire speed" routing
  - bias in routers for certain type messages
- End-to-end delay measurements
- The state of current network measurement tools (e.g. httpperf, netperf, pathchar, tcpcap)
- Measuring whether TCP can deliver bandwidth for "new applications"
• Measuring high performance technologies (Gigabit Ethernet, ATM)
• Estimating RTT of a flow for TCP and link characteristics
  - packet pair techniques

**Network Simulators**
• **NS-2** simulations
• **NIST** tools

**Future of the Internet**
• Internet2
• IPv6
• Internet topology studies

**Networking Technology Differences**
• Internetworking basics
  - Repeaters, bridges, hubs, routers, switches
• Faster routers/switches
  - Fast IP lookup
• ATM basics
• Advanced ATM topics
  - IP over ATM
  - Admission Control for ATM
  - Congestion Control mechanisms for ATM
  - Quality of Service for ATM
• Switching in IP networks
  - CSR, IP switches, Tag switching, ARIS, MPLS, MPOA

**Network Management**
• SNMP
  - Scalability on SNMP-based tools
  - Integrating network management tools
• SNMPv3

**Miscellaneous**
MPLS
Keying and Rekeying Issues
End point admission control
NAT Issues
Using Qbone
Packet Classification
Topology Discovery in LANs
IP Traceback