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

Wireless/ Mobile Networks
- MANET (Mobile Ad-hoc NETworks)
  - Routing
- Loss Issues versus Congestion
- Wired to Wireless
- Power Issues
- Protocol Issues
  - TCP
  - 802.11 Protocols
- Performance of MAC layer

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

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. httperf, netperf, pathchar, tcpdump)
• 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

Security and Firewalls
• IPSec
• Kerberos
• Denial of Service attacks
• Viruses, Worms and Wormholes
• Firewalls
• Intrusion Detection
• VPN’s (Virtual Private Networks)

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

Basic Routing
• Distance Vector, Link State
  - RIP, OSPF
• BGP
  - instability and flapping

Multicast Routing
- Mbone
- Multicast Layering
- Multicast Protocols
  - DVMRP, MOSPF, CBT, PIM-SM, ECMP, RSVP
- Reliable Multicast
- Secure Multicast
• Multimedia Routing
- **Overlay Networks** - Application Level Multicast

**Differentiated Services (Diffserv)**
- Absolute differential services
- Edge node architectures
- GPS (Generalized Processor Sharing)
- Per flow state information
- Proportional differential services
- **QoS Issues**
- Relative differential services

**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