

## **Topics and Research Areas**

### **Congestion Control**

- TCP {responsive flows}
  - Old and Newer Versions - Tahoe, Reno, NewReno, Vegas, Westwood, BIC, Cubic, Compound
  - Approaches
    - RED (Random Early Detection)
    - FRED (Fair RED)
    - ECN (Explicit Congestion Notification)
    - Blue
    - PI Controller
    - REM
    - AVQ
    - XCP
  - Traffic Types
    - FTP
    - Short, Web traffic
    - Peer-to-Peer (P2P)
    - Video
- UDP {unresponsive flows}
  - TCP Friendly
  - Streaming Traffic (Audio and/or Video)
  - Approaches
    - CSFQ
    - SFB
- DCCP

### **Basic Routing**

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

### **Multicast Routing**

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

**Overlay Networks** - Application Level Multicast

**Wireless Networks**

- MANET (Mobile Ad-hoc NETWORKs)
  - Routing
  - VANET (Vehicular Ad Hoc Networks) and Traffic models
- Infrastructure with Access Points
  - 802.11 Protocols
  - MAC layer Performance
  - Wireless Loss versus Congestion
  - Dynamic Rate Adaptation
  - Home Wireless Issues
- RFID
- Cross-Layering Protocols
- Mesh Networks
- GNU Radio
- Cognitive Radio
- MIMO
  - cooperative, distributed, hierarchical
- Cellular Networks
  - 3G
  - 4G LTE
  - WIMAX
- Location detection
- Network Coding
- Interference Modeling

**Wireless Sensor Networks (WSNs)**

- Zigbee (IEEE 802.15.4)
- TinyOS
- Contiki
  - IETF 6LoWPAN (Sensor Protocol Stack)
- Clustering
- Power Issues
  - Power-Aware MAC Protocols
  - Power Control Protocols
- Performance Issues
  - Network Lifetime, delay, throughput
- Two-Tier
- Indoor versus Outdoor Applications
- Body Area Networks
- Sensor Security Issues

**Network Simulators**

- **NS-3** simulations

- **NS-2** simulations
- **OPNET**
- **Cooja** simulations
- **NIST** tools
- **MatLab** Tools
- Wireless Simulators
  - OMNET++
  - GloMoSim

**Security and Firewalls**

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

**Streaming Multimedia**

- Streaming Protocols
- Scaling
- Repair (FEC)
- Quality of Service
- Compression

**Benchmarking and Performance Measurement**

- 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, 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
- Benchmarking Wireless Networks

**Web Technologies**

- HTTP 1.1
- Web caching

- Web proxies
- Content Delivery Networks
- Web performance

**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
- 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**

Cloud Networking Issues

End point admission control

NAT Issues

Packet Classification