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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 (M**obile **A**d-hoc **NET**works**)**
- 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
- ***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
- ***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

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

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 Managment
- 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