Ad Hoc Networks - Performance

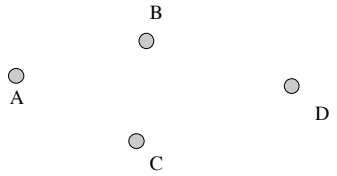
- Josh Broch, David A. Maltz, David B. Johnson, Yih-Chun Hu, and Jorjeta Jetcheva, ``A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols". Proc. of MobiCom '98, Oct. 1998
- Jinyang Li, Charles Blake, Douglas S. J. De Couto, Hu Imm Lee, and Robert Morris, "Capacity of Ad Hoc Wireless Networks", Mobicom 2001
  - Mobicom is *the* mobile computing conference

NS2 network simulator

- Need a tool to accurately model wireless networks so that we can validate network protocols
- Ns2 is a discrete event network simulator from LLNL/Vint
- The next step would be to actually validate these models
  - Harder because actual devices take a while to mass produce and replaying events are harder

Simulation parameter: Transmission model

- Wireless range is not a idealized disk
  - Attenuates at $1/r^2$ for short distances and after reference distance is $1/r^4$
  - Depending on the transmission power and the receivers sensitivity, nodes may receive data (or interfere with other traffic). Interference radius is larger
  - Depends on terrain, height of the wireless device etc



Simulation Parameter: Movement model

- Random waypoint model: Remains stationary for pause interval, modes to another location and remains stationary and so on
- Communication Traffic Model:
  - CBR - Constant bit rate traffic
  - VBR - Variable bit rate traffic
  - Random
  - TCP traffic: learns “congestion” from dropped packets
- Access control issues: Used 64 byte packets to reduce interference

- Performance comparison of TORA, AODV, DSR and DSDV
  - Packet delivery ratio: Ratio of number of packets originated in source and delivered in sink
  - Routing overhead: number of routing packets
  - Path optimality: difference between number of hops taken and shortest path

- [discussion from paper]

Capacity of ad-hoc networks

- Theoretically, 802.11b networks have a bandwidth of 11 Mbps. Overhead of framing, headers etc. Typically receive ~5 Mbps throughput
- World is not a idealized disk and so the interference disk radius can prevent traffic between nodes further out
- Kumar et al. showed that the end-to-end throughput $O(1/\sqrt{n})$

Chain of nodes

- Interference can reduce throughput
- Greeding forwarding makes it worst
- Nodes in the “middle” experience more interference
- IEEE MAC RTS/CTS can make it worse for certain nodes that have backed off exponentially even when the link is idle
- Lattice of nodes
  - Fully coordinated with traffic going horizontally or vertically
  - Cross traffic is a problem
  - Random placement can create hot-spots in center
- More local traffic helps (instead of random nodes)