The Price of Mobility in AdHoc Networks

Dr Kim Blackmore
Department of Engineering
Australian National University
What is a MANET?

➤ Ad-Hoc: no central administration.
   All nodes can act as routers and hosts.
   Nodes independently and spontaneously form a network.

➤ MANET: All nodes are mobile and use wireless interfaces to send packet data.

➤ Dynamic network topology
Routing

- Wired network well established
  Guarantee optimally efficient routes

- Cellular network — rely on fixed infrastructure
  Location management
  Handoff management
  Optimality vs overhead

- Adopting wired protocols to MANETs doesn’t work
  Repeatedly recalculating optimal routes
Conventional Protocols

- Link State Routing
- Distance Vector Routing
- Source Routing
Classification of MANET routing protocols

- Multi-channel or Single-channel
- Static or Adaptive
- Centralized or Distributed
- Uniform or Non-uniform
- Topology-based or Destination-based
- Proactive or Reactive
- Cost function: hop count; bandwidth; energy; degree of association stability
A list of MANET Routing Protocols

- CGSR - Clusterhead Gateway Switched Routing
- DSR - Dynamic Source Routing
- DSDV - Destination Sequenced Distance Vector
- WRP - Wireless Routing Protocol
- AODV - AdHoc On-Demand Distance Vector
- TORA - Temporally Ordered Routing Algorithm
- OLSR - Optimized Link State Routing
- ZRP - Zone Routing Protocol
- CEDAR - Core Extraction Distributed Ad hoc Routing
Evaluating Routing Algorithms

➤ Simulate
  ➤ NS-2
  ➤ GloMoSim
  ➤ MAISIE
  ➤ OPNET Modeler

➤ Study how performance changes as network behaviour gets more complicated.
  ➤ Performance Metrics
  ➤ Topological Change (also Traffic Change)
  ➤ Mobility Metrics
Performance Metrics

- Packet Delivery Ratio = Throughput
- Protocol Overhead
- Average End-to-End Delay
Topological change for simulations

Simulations test routing protocol under a particular dynamic topology.

Topological change is determined by

1. Nodes moving

2. Multipath Fading of channels between nodes

3. Time varying noise and interference

Common to consider only node movement, and assume free-space propagation between nodes.

Links are assumed to be on or off, and bidirectional.
Clearly DSR is the winner…

Mobility Models

➤ Random Walk Mobility Model

➤ Random AdHoc Mobility Model

➤ Random Waypoint Mobility Model

➤ Gauss-Markov Mobility Models

➤ City Section Mobility Models

➤ Freeway Mobility Model

➤ Reference Point Group Model

➤ Swarm mobility models
Which protocol has the highest throughput?

Which protocol has the lowest overhead?

Mobility Metrics

➤ Node Degree
➤ Relative Speed
➤ Spatial Dependence
➤ Temporal Dependence
➤ Link Duration
➤ Link Availability
➤ Link Available time
➤ Path Duration...
What makes a good mobility metric?

- Computable in a distributed environment without global network knowledge.
- A good indicator of protocol performance
- Feasible to compute (in terms of node resources)
- Independent of any specific protocol
- Computable in real network implementations
Does link duration quantify topological change

Which protocol has the highest packet delivery ratio?

The Price of Mobility in AdHoc Networks
More problems with simulations

Different simulators do not give the same results.

Beyond simulation

Entropy imposes a minimum overhead.

This restricts the capacity of the network, and thus the maximum throughput.

Should give theoretical bounds on the potential performance of AdHoc networks, to use for benchmarking simulation results.

See poster ”On entropy measures for dynamic network topologies: Limits to MANET”, Roy Timo, Kim Blackmore and Leif Hanlen.

See also ”Path availability in mobile ad hoc networks”, Sanlin Xu, Kim Blackmore and Haley Jones.