CS 268: Ad Hoc Routing

Kevin Lai

Feb 20, 2002

Ad Hoc Motivation

- Internet goal: decentralized control
  - someone still has to deploy routers and set routes
- Ad Hoc routing
  - every node is a router
  - better wireless coverage
  - better fault tolerance (e.g. node bombed, stepped on, exhausted power)
  - no configuration (e.g. temporary association)
  - dedicated router costs money

Routing

- DSDV: hop-by-hop distance vector
- TORA: Temporally-Ordered Routing Algorithm
- DSR: Dynamic Source Routing
- AODV: Ad Hoc On-Demand Distance Vector

DSDV

- hop-by-hop distance vector
- Routing table contains entries for every other reachable node (!)
- Nodes pass their routing tables to neighbors periodically
- Routing tables are updates using standard distance vector algorithm
- Old routes are ignored using sequence numbers
- O(n) routing state / node, O(nk) communication size / node / period
  - k = average node degree

TORA

- Temporally-Ordered Routing Algorithm
- Interested in finding multiple routes from S$\rightarrow$D
- Find routes on demand
- Flood query to find destination
- Flood query response to form multiple routes
- O(m) routing state / node, O(nk) communication / node / route update
  - m = nodes communicated with, worst case O(n)

DSR

- Dynamic Source Routing
- Packet headers contain entire route
- Flood query to find destination
- Intermediate nodes don’t have to maintain routing state
  - nodes listen for and cache queries, responses as optimization
  - nodes gratuitously sends response packets to shorten paths when they hear packets with sub-optimal routes
- Some kind of retransmission?
- O(m) routing state / nodes, O(nk) communication / node / route update
  - much smaller constant than other protocols
- $O(n^{1/k})$ space required in header

AODV

- Ad Hoc On-Demand Distance Vector
- Flood query to find destination
- Reply is sent directly back to source
- Intermediate nodes listen for reply to set up routing state
- State is refreshed periodically
- O(m) routing state / node, O(nk) communication / node / route update

Results

- Avoid synchronization in timers
- TORA does not scale to 50 nodes at all
  - suffers control traffic congestion collapse
- DSDV fails to deliver packets when movement is frequent
  - only maintains one route/destination
- AODV has high routing overhead when movement is frequent
  - combination of DSDV maintenance of state + flooding of DSR
- DSR does well compared to others
  - designed by authors $\rightarrow$ not surprising
  - [LJC+00] shows congestion collapse beyond 300 nodes

Related Work

- more scalable routing [LJC+00]
  - separate addressing from naming
  - assume everyone has GPS
  - do Cartesian routing
  - separate scalable, efficient, fault tolerant service to map from names to addresses
- how to deal with selfish users? [MGL+00]
  - listen to neighbors to make sure they are forwarding
  - convey black list information back to source
  - route around selfish nodes
- how to prevent overload of nodes:
  - bandwidth exhaustion [LBC+01]
  - power exhaustion [CJB+01]

Conclusions

- proliferation of wireless network interfaces provide ready market
- ad hoc provides less configuration, more fault tolerance, better coverage, lower cost
- many interesting and unsolved problems