Mobile Ad hoc Networking

Based on Advanced topics in Distributed systems presentation, Mobile Ad hoc Networking, Dr.-In Matthias Hollick, Prof. Dr.-Ing Ralf Steinmetz., 2006.

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Basics about MANET?

- Historical successor of packet radio networks.
- Self organizing, mobile and wireless nodes.
- Absence of infrastructure.
- Multi-hop routing necessary.
- Systems are both terminals (end systems) and routers (nodes).
- Constraints:
  - Dynamics.
  - Energy.
  - Bandwidth.
  - Link asymmetry.

Applications

- Military applications
  - Battlefield communication (soldiers, tanks,…).
  - Smart dust (sensor networks to detect chemical or biological threats).

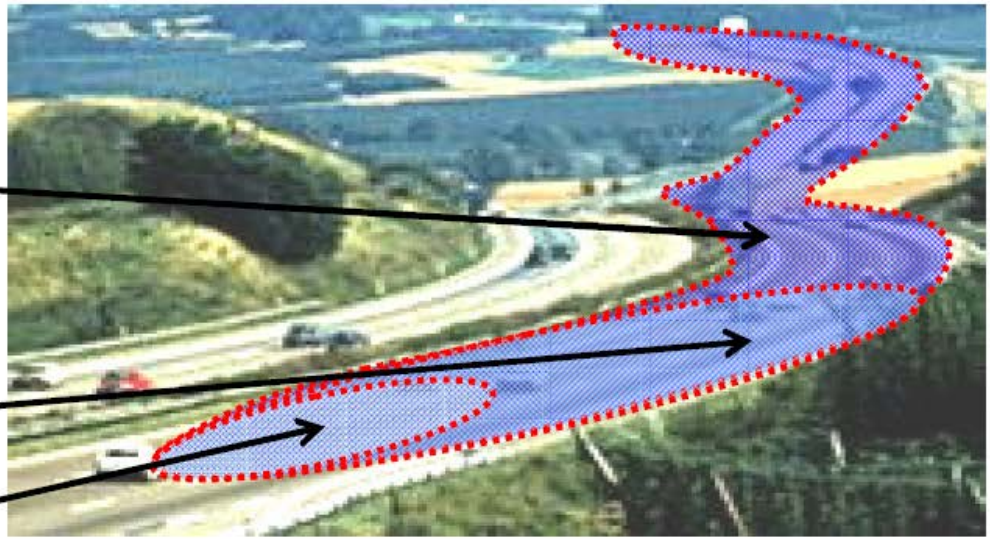
Applications

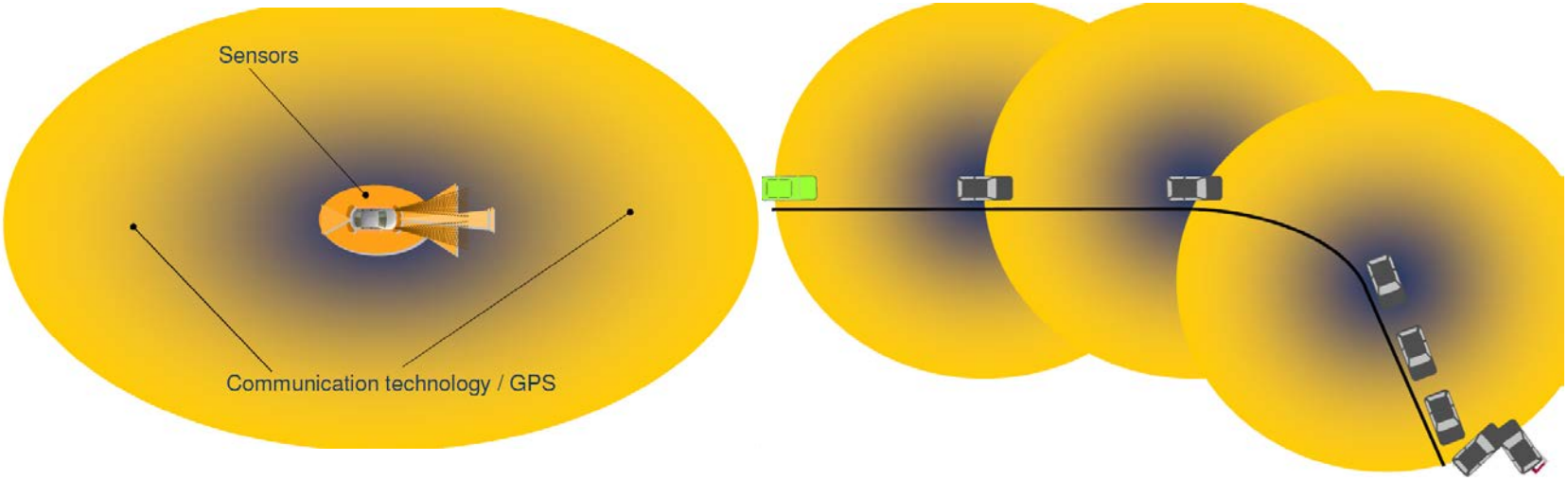
- Civilian Applications:
  - Vehicular environment (telematics, car to car communication, taxi cab network,..).
  - Entertainment (file sharing, gaming, .., in train, car, plane, school,..).
  - Event support (conferences, sport-events, meetings, lectures,…).
  - Home Networking (VCR,DVD, home entertainment,).
  - Disaster recovery (emergency services, ambulance, police).
  - Smart dust (sensor networks for civilian applications)

VEHICLE COMMUNICATION

communication
better than the driver

sensors
as good as the driver

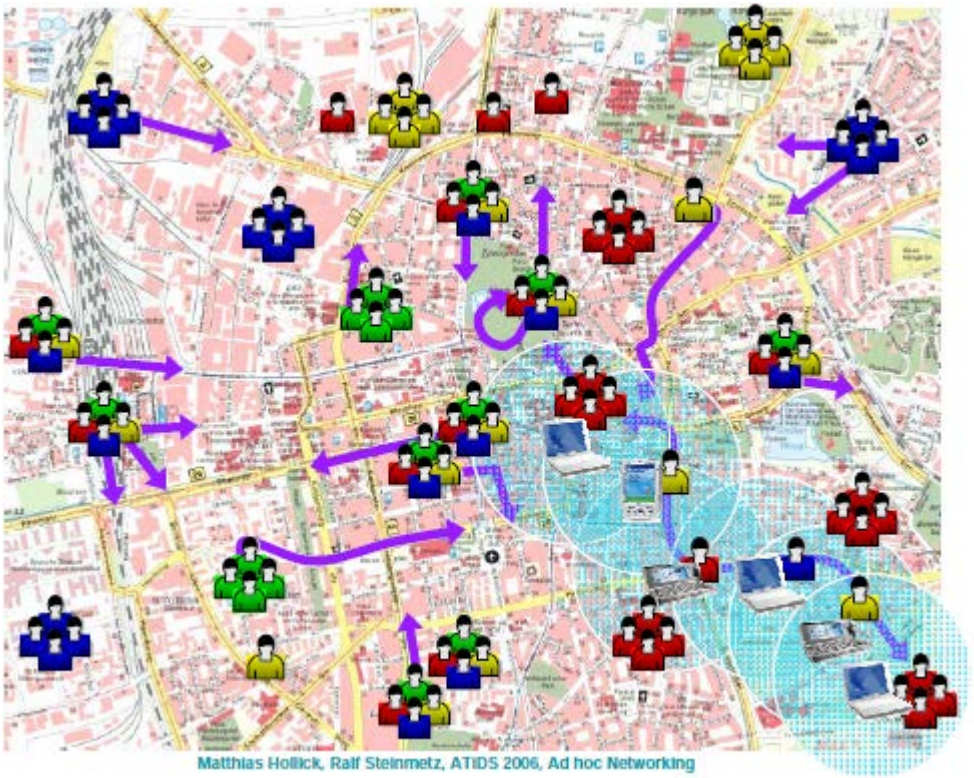




VEHICLE COMMUNICATION

- Physical layer for C2C-CC:
  - IEEE 802.11p (Wireless Access for Vehicular Environment WAVE).
  - Frequency band: 75Mhz around 5.9GHz.
  - Maximum Transmit power: 33dBm.
  - Transmit power control: shall be supported with minimum 3dBm.
  - Data rates: 3, 4.5, 6, 9, 12, 18, 24, 27Mbps. Default 6Mbps.
  - Antenna: Not yet defined (August 2007).
  - Communication mode: Half-duplex and Broadcast.
  - Frequency modulation: OFDM.

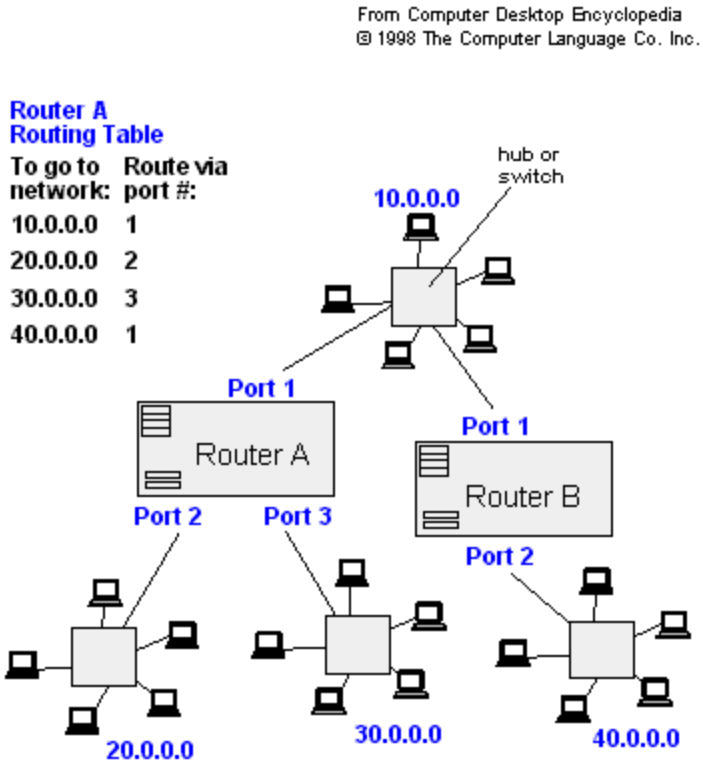
Motivation for MANET in a City



Matthias Hollick, Ralf Steinmetz, ATIDS 2006, Ad hoc Networking

Routing

- Routing in TCP/IP

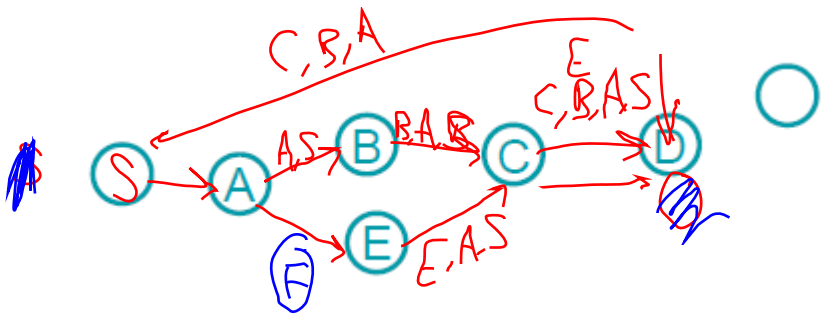


Routing in MANET

- Specialized ad hoc routing:
  - To deal with topology dynamics induced by mobility.
  - To reach nodes that are not direct neighbors.
  - To match the characteristics of wireless communication.
  - To support spontaneous formation of the network.
  - To operate without fixed infrastructure.
  - All end-systems are also acting as routers.
- Some or all are the basis for MANET routing protocols.

Routing protocols

- Ad hoc On demand Distance Vector Protocol (AODV):
  - All nodes are treated equal.
  - Based on distance vector principle.
  - Route discovery cycle for route finding, using flooding.
  - No overhead on data packets.

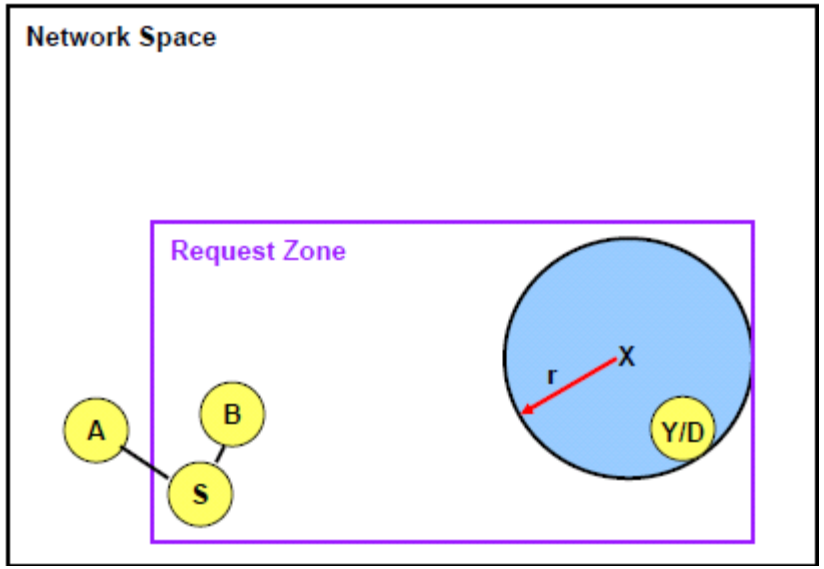


Routing protocols

- Location-Aided routing (LAR).
  - Exploits location information to limit scope of flooding for route requests. (may be obtained from GPS).
  - Expected Zone is determined as a region that is expected to hold the current location of the destination node D.
  - Only nodes within the request zone forward route requests.

S = Source node, D = Destination node
X = last known location of node D, at time t0
Y = location of node D at current time t1, unknown to sender S

r = (t1 - t0) * estimate of D's speed

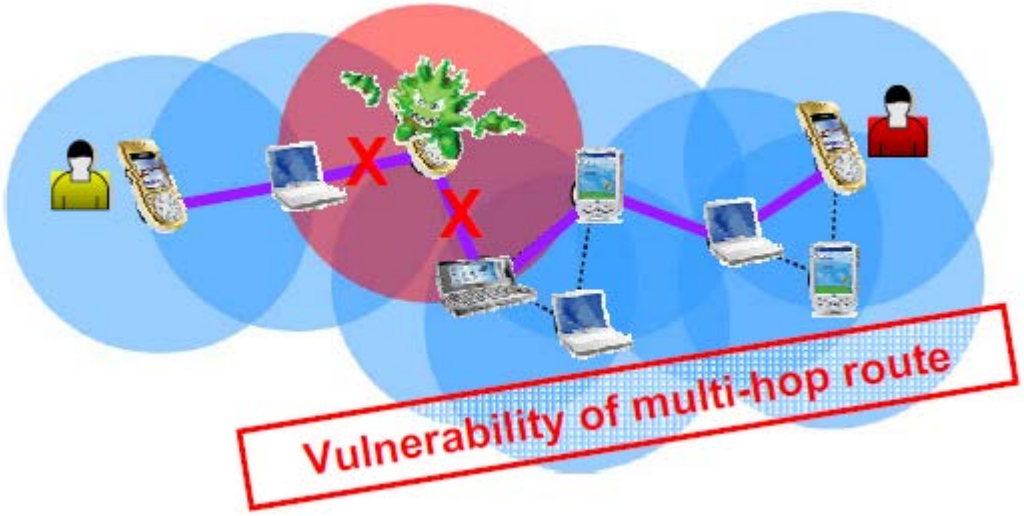


Routing protocols

- LAR summary- Advantages:
  - Reduces the scope of route request flood.
  - Reduces overhead of route discovery.
- LAR summary- Disadvantages:
  - Nodes need to know heir physical locations.
  - Does not take into account possible existence of obstruction for radio transmissions.

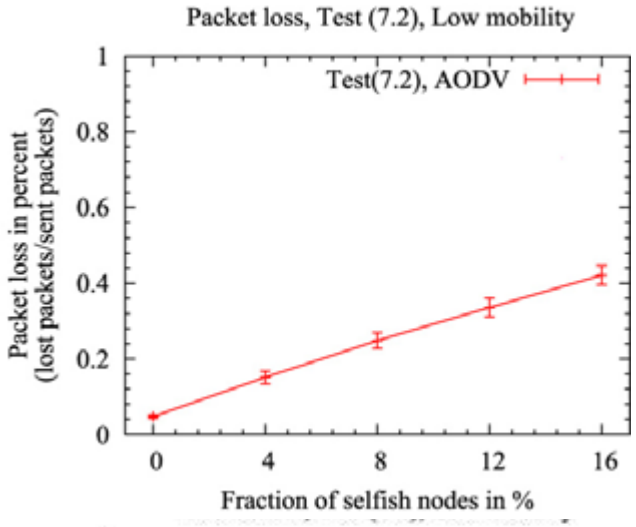
Security

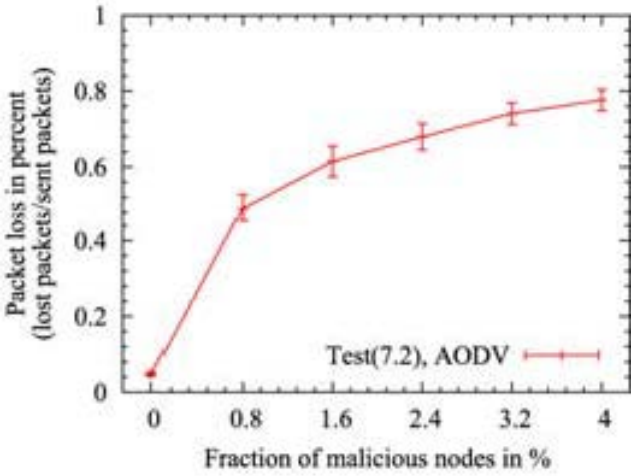
- Node misbehavior scenario.

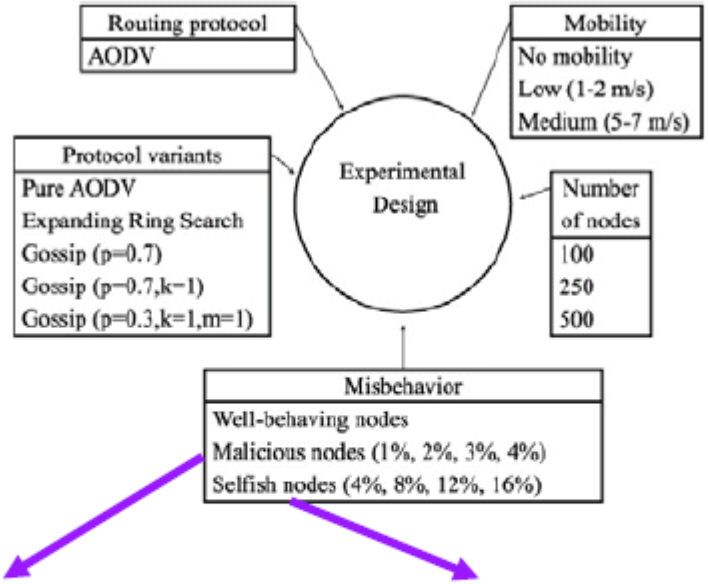


Security

- Experiment:







Malicious Nodes

- Inject false information or remove packets from the network (here black holes)

Selfish Nodes

- Optimize their own gain, neglecting welfare of other nodes

Q&A


Somebody sent me a text ...
What did he write?
Drive, fool!
It's green!

REFERENCES

1. Advanced topics in Distributed systems, Mobile Ad hoc Networking, Dr.-In Matthias Hollick, Prof. Dr.-Ing Ralf Steinmetz., 2006.
2. Car 2 car communication consortium, Manifesto, Overview of the C2C-CC system, August 2007.