Some Key facts about MANET

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Mobile versus Wireless Environments

- Mobile environments
  - Implies limited lifetime of topology information, link changes
    - Such information has to be updated in order to remain valid
    - Such information has to precise
  - Hence, the more frequent the topology information is updated, the better the node mobility may be managed
- Wireless environments
  - Implies limited capacity in the network to accommodate extra control traffic
  - Experience variable error rate
- Mobility management vs. Network resource utilization
- Reliable information vs. Unreliable medium

Performance of Ad Hoc Networks

- Critical factors affecting the performance of an ad hoc network
  - Number of nodes in the network
  - Network size and density [perkins]
  - Mobility model and rate [camp]
  - Traffic pattern and load [li]
  - Unidirectional links
  - Load balancing
  - Terrestrial limitations

Capacity of Fixed Ad Hoc Networks

- Gupta and Kumar demonstrated that for n fixed nodes with random traffic pattern forming a wireless network, the per-node capacity is:

$$\Theta(1/\sqrt{n \log n})$$

- Meaning that the throughput per node decreases at:

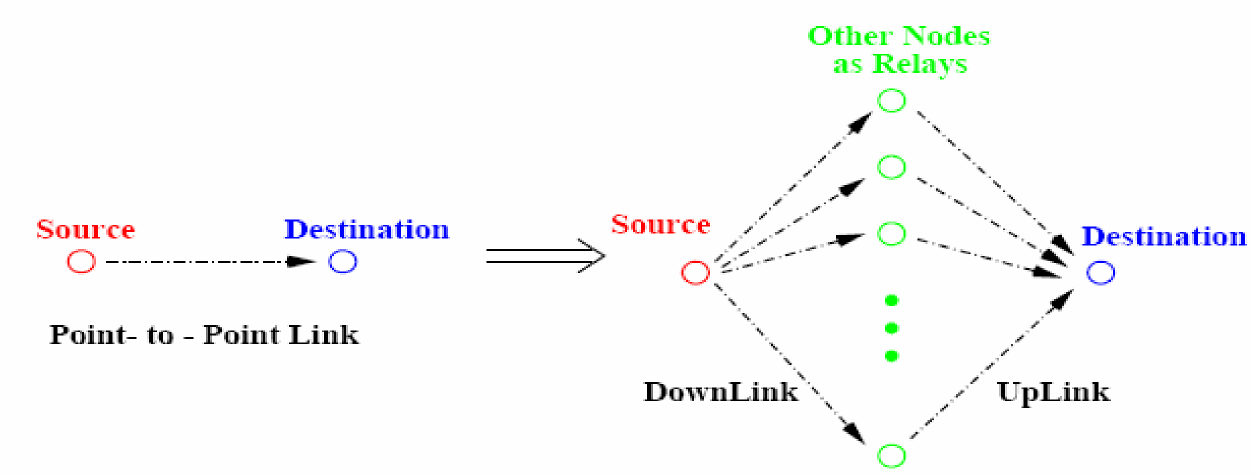
$$\Theta(1/\sqrt{n})$$

- Therefore in a wireless environment with no mobility, the total efficiency benefits from the number of nodes, but the performance per node decreases with the number of nodes.

Capacity of Mobile Ad Hoc Networks

- Grossglauser and Tse showed that mobility can improve the capacity
  - Idea: the occurrence of *multiuser diversity via relaying* increases with mobility

  - Communicate only when source and destination are nearest neighbors to each other
    - This happens only for O(1/n) of the time
  - Otherwise, communicate via relays
    - Source distributes packets to as many different nodes as possible in his vicinity; these nodes relay the packet to the final destination whenever they get close to the destination



Multiuser Diversity via Relaying

- Throughput is gained at the expense of delay
- Mobility should be exploited for delay-tolerant applications
- Notes:
  - The expected path length remains constant
  - The multiuser diversity via relaying requires the information about the neighboring nodes and its results depends strictly on the movement model

- Multiuser diversity [knopp95]
  - The long term throughput can be maximized by scheduling at any one time only the user with the strongest channel [knopp95]
    - Opportunistic scheduling stratey

Effect of Traffic Pattern and Mobility Model

- Jinyang Li et al. showed that random traffic pattern causes a tendency for more packets to be routed through the center of the network than along the edges, which limits the capacity of the network
  - The less local the traffic pattern is, the faster per node capacity degrade with the size of network
  - Need for load balancing mechanics
- Camp et al. demonstrate that the performance of an ad hoc network protocol can vary significantly with different mobility models
  - The choice of mobility model may require a specific traffic pattern which significantly influence protocol performance