



## Mobile Ad Hoc Network

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## Agenda

- Definition
- Challenges
- Routing Protocols
- Research topics

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## Definition of Mobile Ad Hoc Network (I)

- Outside the communication range
  - Need relay node
  - Forwarding packet
- Self-organizing
- Adaptive/Topologies
- Diversity of mobile devices

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## Definition of Ad Hoc Mobile Network (II)

- Ad Hoc networks have no predefined structure.
- Machines may join and leave the network at any time
- Machines are mobile; movement is entirely unrestricted
- Each machine forwards data packets for other machines in the network

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## Definition of Mobile Ad Hoc Network (III)

- MANET: Mobile Ad Hoc Network
  - Set of mobile nodes
    - communicate with each other
    - roam around at will
  - No supporting base stations
  - No guarantee of direct connection to desired destination (single-hop)
  - Use intermediate nodes for communication by relaying packets (multi-hop)

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## Definition of Mobile Ad Hoc Network (III)

- MANET Applications:
  - Immediate network deployment
    - Battlefields
    - Major disaster areas
    - Sensor networks
  - Areas without base stations
  - Areas where fixed network structures are unavailable

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## Ad Hoc Networking Key Points

- Dynamic topology
- No global topology information
- Nodes have fixed transmission ranges
- Depends on relaying of messages for delivery
- Network partitions can occur
- Collision avoidance (no collision detection)
- Shared transmission medium

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## Challenges

- Spectrum Allocation (ISM Band)
- Media Access
  - No centralized : TDMA cannot use
  - Mobility
  - Access without collision
- Routing
  - Link break often
  - Topology change

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## Challenges

- Multicasting
  - Tree formation might not work?
- Energy Efficiency
  - battery
  - Packet forwarding
- TCP Performance
  - Connection oriented assumes node to be static
  - Packet loss and long RTT
- Service Location
- Security and Privacy

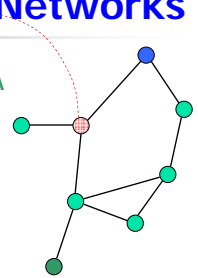
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## Issues in Ad Hoc Networks

How to get information from A to B when everything in between is moving???

And what about...

- Delay
- Throughput
- Energy Consumption
- Path reliability



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## Routing Protocols

- (Abolhasan, Dutkiewicz and Wysocki, 2003):
- **Global/proactive** –the routes to all the destinations are determined at the start up and maintained by using periodic route update process;
- **On-demand/reactive** –the routes are determined when they are required by the source using a route discovery process;
- **Hybrid** –combine the basic properties of the first two classes of protocols into one.

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## Proactive

- Destination-sequenced distance vector (DSDV)
- Wireless routing protocol (WRP)
- Global state routing (GSR)
- Fisheye state routing (FSR)
- Source-tree adaptive routing (STAR)
- Distance routing algorithm for mobility (DREAM)
- Cluster-head gateway switch routing (CGSR)

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## Reactive

- AODV
- Dynamic source routing (DSR)
- Routing on-demand acyclic multi-path (ROAM)
- Light-weight mobile routing (LMR)
- Temporally ordered routing algorithm (TORA)
- Associativity-base routing (ABR)
- Signal stability adaptive (SSA)
- Cluster-based routing protocol (CBRP)

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## Hybrid

- Zone routing protocol (ZRP)
- Zone-based hierarchical link state (ZHLS)
- Distributed spanning trees based routing protocol (DST)
- Distributed dynamic routing (DDR)
- Scalable location update routing protocol (SLURP)

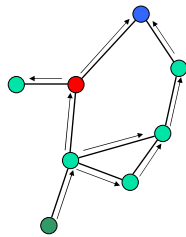
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## Flooding

Flooding is the simplest of all routing protocols.

- Send all information to everybody
  - If data is received that is not for you, send it to all of your neighbors!
- Robust
  - Destination is guaranteed to receive data
- Resource Intensive
  - Data is sent to many nonessential nodes
  - Network performance drops quickly under increasing load

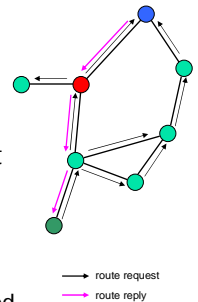


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## Dynamic Source Routing (DSR)

- To find a route, the network is flooded with route request packets
- Each packet records its path
- The destination receives the first route request and returns a full path to the source
- The source sends data over the returned path
  - The discovered route can be saved for future use



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## DSR

- Dynamically discover source route
  - broadcast route request
    - outward propagation to destination or cached route
  - destination or intermediate node with cached route returns source route
    - source chooses route based on number of hops

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## DSR

- Routing
  - sender lists route in packet header
    - routing information is not maintained by intermediate nodes
- Route maintenance
  - route error messages

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## Modified DSR

- Route information determined by the current network conditions
  - number of hops
  - congestion
  - node energy
- Other considerations
  - fairness
  - number of route requests

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## Current routing protocols

- many do not consider energy conservation
  - lead to partitions
  - shorten network life
  - fairness to intermediate nodes not incorporated
  - fail to work well in both sparse and dense networks

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## Open Research Topics

- Energy Aware Routing
  - Each computer has a limited power supply which needs to be conserved
- Multipath Routing
  - The more paths used to send information, the more reliable the transmission
- Clustering (Hierarchical Routing)
  - Dynamic management of subnetworks

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## More Research Topics

- Topology Control
  - Adjustment of transmission power to simplify routing
- Internetworking
  - Managing communications between wired and wireless networks
- Heterogeneous Networks
  - Different devices on the network have different capabilities
- Content Aware Networks
  - Location of services within the network
    - Printers

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