Overview

- Definition
- State-of-the-Art
- Approach
- Time Plan

Definition / 1: Wireless Mesh Network

"Wireless Backbone" instead of cables
- Less cost
- Faster deployment
- Better upgradability

Application areas:
- Military
- Disaster areas / emergency response
- Civilian: access network to the Internet

Definition / 2: Field of Research

Ad-Hoc Networks
Sensor Networks
Wireless Mesh Networks (WMNs)

Less mobility, less topology & route changes
No battery power constraints, but standard Internet protocols

Definition / 3: The Problem

Routing:
- Hop-count is a bad metric:
  - Links vary over time
  - Far links are usually worse than short links

MAC Interaction:
- Hidden node problem
- Exposed terminal problem
- Flow-in-the-middle problem

State-of-the-Art / 1: Protocol types

- Reactive (on-demand)
  - Build route when flow starts
  - Destroy route when flow ends
  - Drawback: route setup delay
  - Good for frequent route changes

- Pro-active
  - Build route in advance
  - Keep routes up-to-date (communicate changes)
  - Drawback: communication overhead
  - Good when routes change seldom

- Hybrid
State-of-the-Art / 2: Protocols

"Classical":
- **OLSR** - Optimized Link State Routing protocol pro-active, RFC 3626 (Clausen, Jaquet, 2003), used in firmwares
- **AODV** - Ad-hoc On-Demand Distance Vector reactive, RFC 3561 (Perkins, Royer, Das, 2003)
- **DSDV** - Dynamic Destination-Sequenced Distance Vector pro-active, one of the oldest (Perkins, 1994)
- **DSR** - Dynamic Source Routing reactive (Johnson, 1994)

Nature inspired:

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Ant-based Algorithms / 1

- Inspired by nature: behavior of ants
- Single ants are quite stupid, but the whole system exhibits "intelligent" behavior
- Ant Colony Routing (ACR) – distributed version of Ant-based Algorithm, eg.: AntNet by Di Caro and Dorigo, 1998
- AntHocNet for MANETs by Di Caro, Ducatelle, Gambardella, 2004:
  - AntNet concept + Extensions
  - Hybrid routing approach: reactive/pro-active

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Ant-based Algorithms / 2

1. Whenever an ant moves, it lays a pheromone trail
2. To find its way, an ant:
   - Follows existing trails if there are any. Probability for choosing a trail is proportional to amount of pheromone on the trail.
   - Walks randomly if there are no trails.
3. Pheromone evaporates over time -> unused trails vanish.

- **Trail following (state transition rule)** determines how the ant chooses its way depending on link cost and amount of pheromone found on the trails
- **Trail laying (pheromone update rule)** determines how the pheromone is updated
- **Evaporation (evaporation rule)** determines how fast pheromone evaporates

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Ant-based Algorithms / 3

- **Forward ants**: regularly created, choose next link based on transition rule:
  \[ P = \text{Trans(pheromone, link cost)} \]

- **Backward ants**: created when forward ant reaches destination node, travels back to from where it came, updates pheromone amounts and measured link costs at all nodes on way back

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My Approach

- **Simulation with ns-2 simulator**
- **Find new algorithm:**
  - Based on ant concept
  - Probably hybrid between classical and ant-based
  - Probably hybrid proactive/reactive routing approach – WMNs are less mobile than MANETs
  - Use better cross-layer info to determine link costs
  - Reduce number of ants by observing TCP traffic in the network (possible?)
**Time Plan**

- **04/2007**: WTS’07 conference – RNG-paper
- **05/2007**: Evaluation of ns-2 wireless models (several available; lab student available)
- **-08/2007**: Define and implement algorithm in ns2; write chapter that describes algorithm
- **-12/2007**: Performance evaluation; publish 2 papers about algorithm
- **-05/2008**: Finish Thesis

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**Thank You!**