CS6504

Mobile Computing

Dr. Ayman Abdel-Hamid

Computer Science Department

Virginia Tech

Mobile Ad Hoc Networks Introduction

Outline

- Introduction to MANETs
  - Notion
  - Communication Environment
  - Features and Requirements
  - MAC-layer protocols
  - Routing protocols
  - Security services

Notion

- MANET is a network architecture that can be rapidly deployed without relying on pre-existing fixed network infrastructure
- Lack of a centralized control entity
- Nodes can dynamically join and leave the network
  - Without warning
  - Without disruption to other nodes' communication
- Nodes can be highly mobile
  - Rapidly changing network topologies (time-varying network topology)
  - Rapidly varying presence or absence of links

MANET Applications

- Establishment of military communication during deployment of forces in unknown and hostile terrain
- Rescue missions in remote or rural areas
- National crisis where communication infrastructure in non-operational
- Commercial use (exhibitions, conferences, or sales presentations)
- Education (wall-free virtual classrooms)
- Sensor networks → Environmental monitoring (water pollution or hurricane warning)
- Short range ad hoc networks used to form Personal area networks (PAN) → e.g., Bluetooth

Communication Environment

- Nodes are equipped with portable communication devices
  - Limited battery life
- Connectivity between nodes is not a transitive relation
- Nodes identified by fixed IDs (e.g., IP address)
- In case no direct link exist between source and destination nodes
  - Use of multi-hop routing
  - The willingness of a node to forward traffic
  - Distributed Routing protocols needed to discover routes between source and destination
  - Fluctuating link capacity

Features and Requirements

- Must provide a high degree of reliability, survivability, availability, and manageability of the network
- Robust routing and mobility management algorithms
- Adaptive algorithms and protocols
- Low-overhead algorithms and protocols
- Multiple (distinct) routes
- Robust network architecture

MAC Layer Protocols for MANET

- MACA
- MACAW

Routing Protocols in a MANET

- Proactive
  - Continuously learn network topology by exchanging topological information among network nodes (route from source to destination is available immediately)
  - Cost of updating topology information may be very high
- Reactive
  - Rely on a query-reply dialog (on-demand)
  - Invoke a procedure to find a route to a destination (some sort of flooding the network with the route query)
  - May encounter excessive delays in the flooding process
- Hybrid
  - Combine aspects of proactive and reactive protocols
  - For example, proactively maintain topology of close neighbors, and reactively discover routes outside its neighborhood (controlled flooding)

Security Services in a MANET

- Traditional requirements of authentication, confidentiality, integrity, and non-repudiation
- Specific to MANET
  - Insecurity of wireless links
  - Energy constraints
  - Poor physical protection of nodes in a hostile environment
  - Vulnerability of statically configured security schemes
  - Establishing trust (no prior security association can be assumed)
    - ✓Rely on cryptographic keys
    - ✓Create trusted relationships between keys without aid of trusted third-party certification
  - Secure route-discovery and secure data forwarding