

Lecture 45: Mobile Adhoc Network (MANET): Limitations, VANETs, and Comparison with Cellular Systems

Wireless Technologies

DI05011011: Mobile Communication

Agenda for Today

- 1. Recap of MANET Basics
- 2. Limitations and Challenges of MANET
- 3. Security Issues in MANETs
- 4. Introduction to VANETs (Vehicular Adhoc Networks)
- 5. Comparison: MANET vs Cellular Networks (Architecture)
- 6. Comparison: MANET vs Cellular (Routing & Cost)
- 7. Summary of MANETs
- 8. Course Conclusion

Limitations and Challenges of MANETs

- Despite their flexibility, MANETs face significant challenges:
- **1. Limited Battery Power:** Nodes act as routers. Forwarding packets for other nodes drains battery quickly.
- **2. Bandwidth Constraints:** Wireless links have lower capacity than wired backbones. Frequent routing updates consume valuable bandwidth.
- **3. Dynamic Topology:** Rapid node movement causes routes to break frequently, leading to packet drops and high latency.
- **4. Hidden Terminal Problem:** Collisions occur easily without centralized coordination (AP).

Security Issues in MANETs

- MANETs are highly vulnerable to security attacks:
- **No Centralized Firewalls:** Without a central server, authenticating nodes and enforcing security policies is very difficult.
- **Eavesdropping:** Wireless medium is open to interception.
- **Black Hole Attack:** A malicious node advertises it has the shortest path to all destinations, intercepts the traffic, and drops the packets.
- **Node Compromise:** If an attacker physically captures a node (e.g., in military scenarios), they can disrupt the entire network from within.

A Specialized MANET: VANET

- **Vehicular Adhoc Network (VANET)** is a sub-class of MANET where the nodes are moving vehicles.
- **Characteristics:**
 - - Extremely high mobility (cars moving at 120 km/h).
 - - No battery constraints (cars have large alternators/batteries).
 - - Predictable movement (cars follow roads and lanes).
- **Applications:**
 - - Accident warnings (car ahead brakes hard, alerts cars behind instantly).
 - - Traffic congestion updates.
 - - Automated toll collection and intersection control.

Comparison: MANET vs. Cellular Networks

- **Architecture & Infrastructure:**

- — Feature — Cellular Networks — MANET —
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- — **Infrastructure** — Centralized (Base Stations, MSC) — Decentralized (No infrastructure) —
- — **Topology** — Fixed backbone, Single-hop to BS — Highly dynamic, Multi-hop P2P —
- — **Node Roles** — End terminals only — Both end terminals and routers —
- — **Single Point of Failure** — Yes (if BS goes down) — No (self-healing, routes around failures) —

Comparison: MANET vs. Cellular Networks

- **Routing, Cost, and Deployment:**

- — Feature — Cellular Networks — MANET —
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- — **Routing** — Determined by fixed switches/MSC — Computed by end nodes (AODV/DSR) —
- — **Deployment Time** — Months/Years (planning, licensing) — Instant (seconds/minutes) —
- — **Cost** — Extremely high (billions of dollars) — Minimal (only cost of devices) —
- — **Bandwidth** — High and guaranteed (licensed) — Variable and limited (unlicensed) —
- — **Security** — High (SIM auth, telecom backbone) — Low (difficult to trust peers) —

- While MANETs offer unparalleled flexibility and instant deployment, they suffer from power, routing overhead, and security challenges.
- They are not a replacement for cellular networks, but a complementary technology for specific scenarios (military, disaster, V2V).
- Cellular networks trade massive infrastructure costs for reliability, security, and high bandwidth.

- Congratulations on completing Mobile Communication!
- **Unit 1 & 2:** You learned the foundations of Cellular concepts, GSM, and CDMA.
- **Unit 3:** You explored the internal hardware and OS of mobile devices.
- **Unit 4:** You understood the shift to high-speed IP data with 4G LTE and 5G.
- **Unit 5:** You expanded your view to Wi-Fi, RFID, Zigbee, and Adhoc networks.
- You now understand how the wireless world connects!