

# Wireless Mobile & Multimedia Networking 7COM1076 Ad-hoc Networks 1

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# Outline

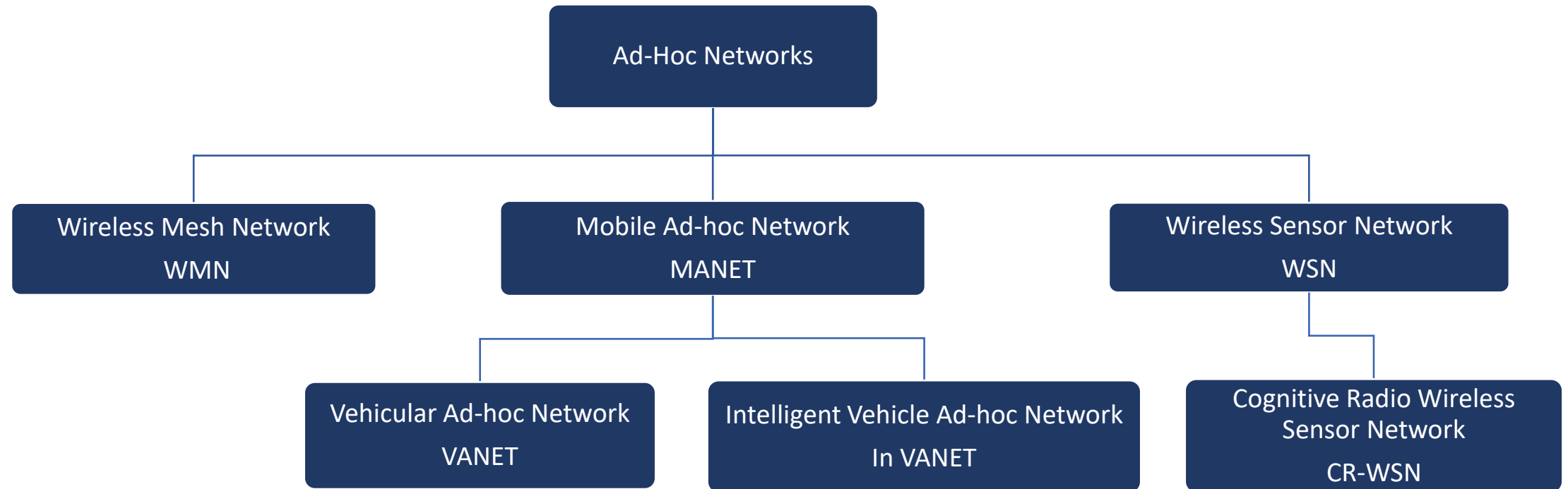
- ❑ **Ad-hoc Networks**
  - Introduction
  - Classification
  - MANET
  - Comparison with Cellular Networks
  - Applications
- ❑ **Routing Protocols**
  - Challenges in Routing
  - Mobility and Link breakage
  - Perfect routing
  - Classification of Routing Protocols

# Ad-hoc Networks – Introduction

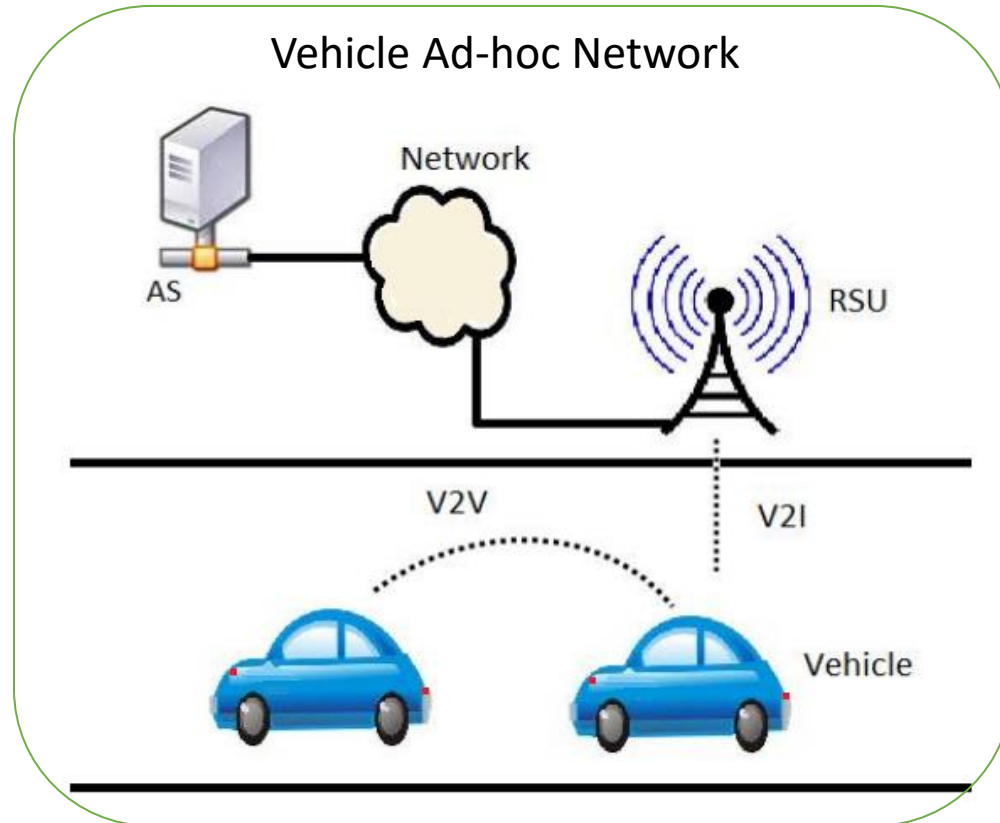
- ❑ Meaning of the word “Ad hoc” is “for this”, means “for this purpose only”, implies it is a special network for a particular application.
- ❑ The nodes are free to move randomly and organize themselves arbitrarily; the wireless network topology changes rapidly and unpredictably



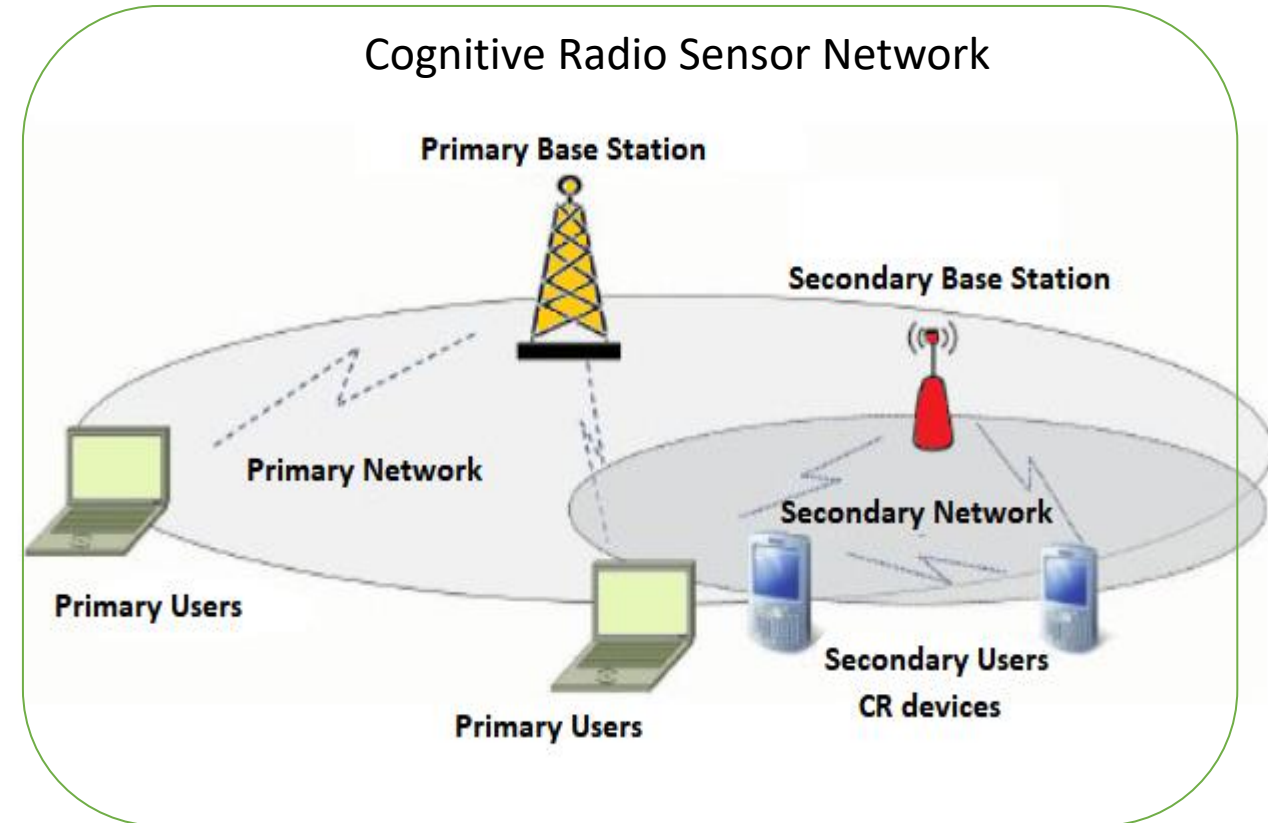
# Ad-hoc Networks - Classification



# Ad-hoc Networks



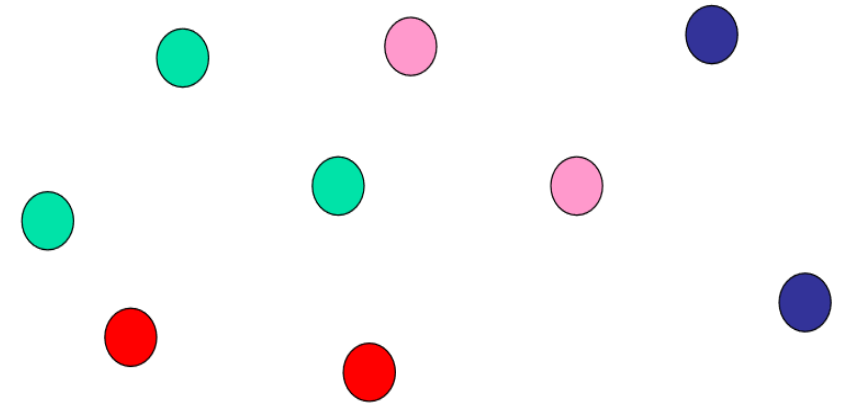
**VANETs** is a subset of MANETs with a unique characteristic of dynamic nature, frequently exchanges information, uses real time processing, self-organizing, and infrastructure less nature. It provides the ability of vehicle to communicate among nearby vehicle and road-side unit (RSUs)



Cognitive radios (CRs) are smart wireless radio devices that have the capability to sense, learn and adapt to the environment in real time. CRs are intelligent devices that can also make decisions based on what it has learned. CR technology is an advancement of software defined radios and it performs, sensing of the spectrum, altering of its operating parameters, and utilising the frequency band when it is unoccupied

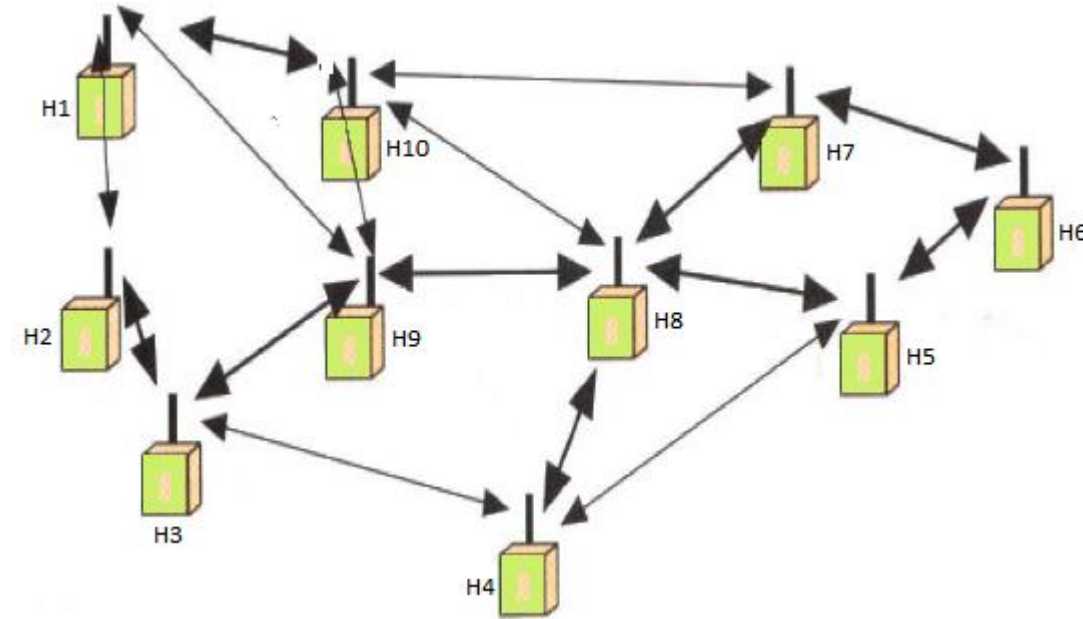
# Mobile Ad-hoc Networks (MANET)

- A MANET is an autonomous system of mobile nodes which are free to move about arbitrarily.
- It is a type of wireless network that does not require an infrastructure for deployment.
- It is a collection of isolated mobile nodes that are connected to each other in a **self-configurable**, **infrastructure-less**, **dynamic**, and **decentralized network**.
- Mobile nodes are equipped with wireless interfaces that utilize radio channels to communicate with each other, without the need for centralized management.
- A mobile node in a MANET acts as both an end system (host) and a router to participate in data routing within the network.



# MANET - Features

- Dynamic topologies / infrastructure-less
- Bandwidth constrained, variable capacity links
- Energy constrained operation
- Limited physical security
- Distributed administration/self-organized
- Multi-hop communications



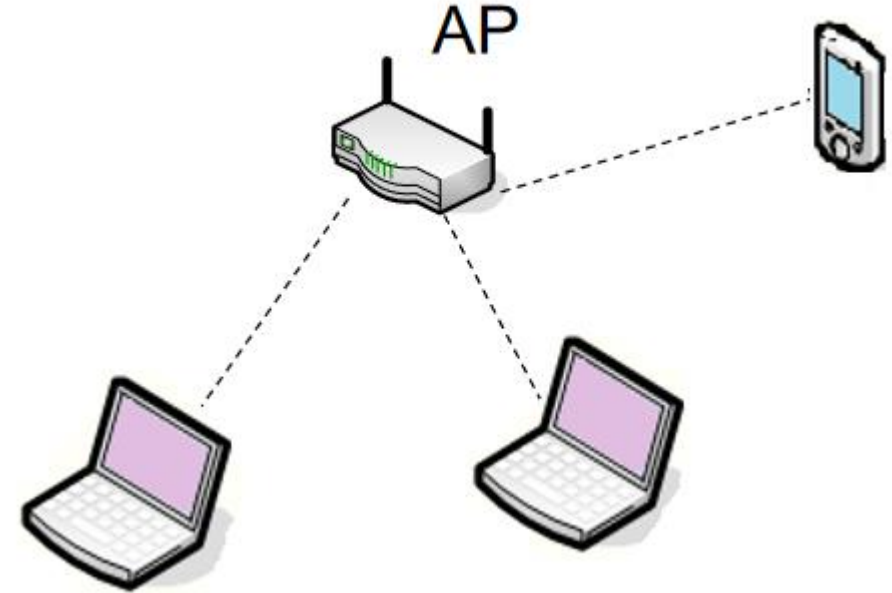
# Why MANET?

- Development in wireless communications
- Easy of deployment
- Speed of deployment
- Less dependent on infrastructure



# Nodes in WLAN

☐ Infrastructure mode

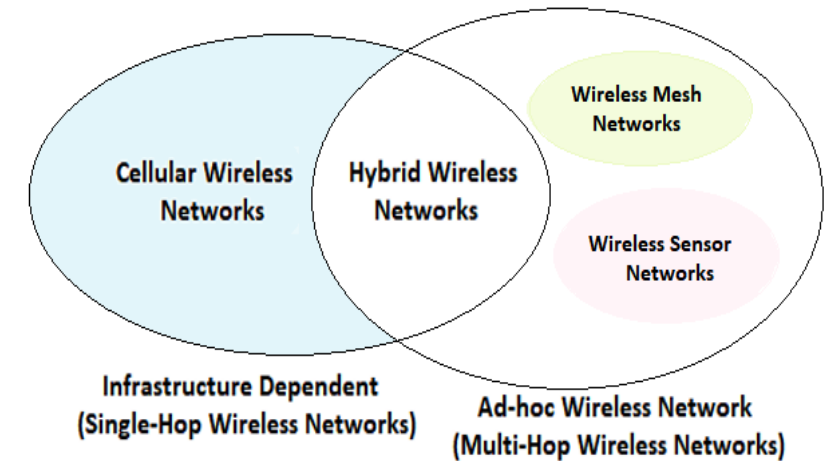


☐ Ad-hoc mode

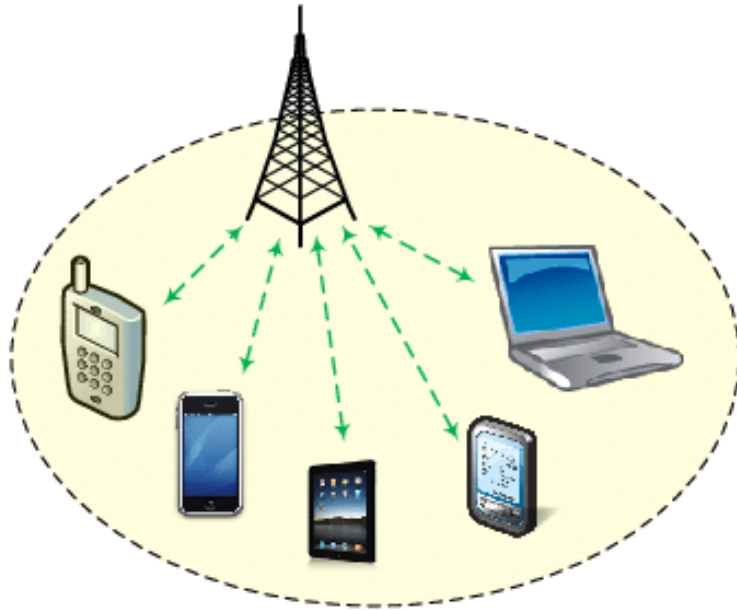


# Ad-hoc Network Vs Cellular Network

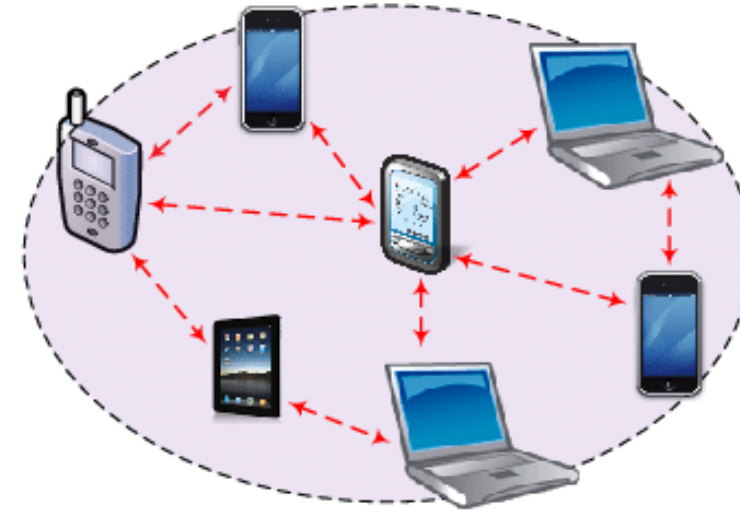
- Fixed infrastructure-based vs. infrastructure-less
- Single-hop wireless links vs. Multi-hop wireless links
- Centralized administration vs. distributed administration
- Guaranteed bandwidth vs. shared radio channel
- High cost & time of deployment vs. quick & cost-effective deployment



# Ad-hoc Network Vs Cellular Network



Infrastructure-based wireless networks

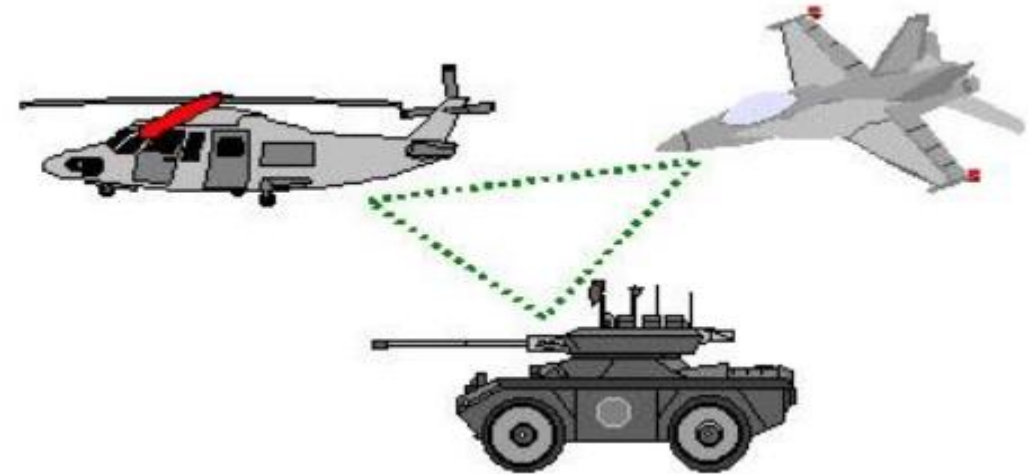


Wireless ad hoc networks

# Applications of Ad-hoc Wireless Networks

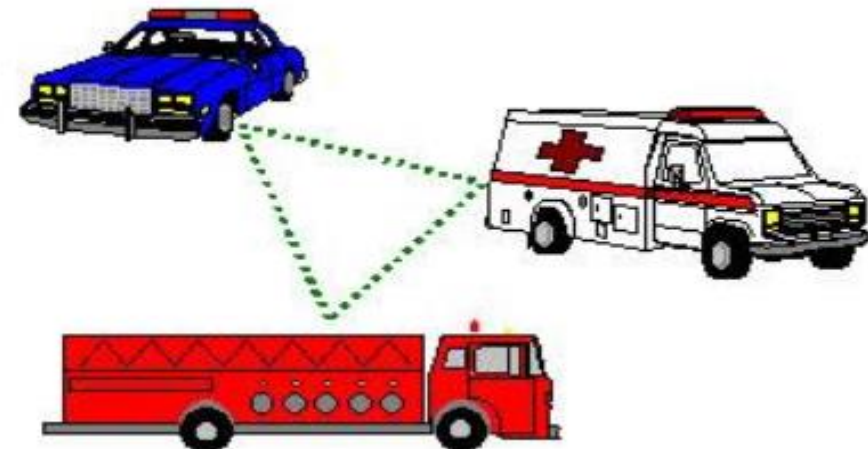
## ➤ Military Applications

- Inhospitable terrain
- Efficient & quick communication
- Secure multimedia multicasting
- High power transceivers



## ➤ Emergency Operations

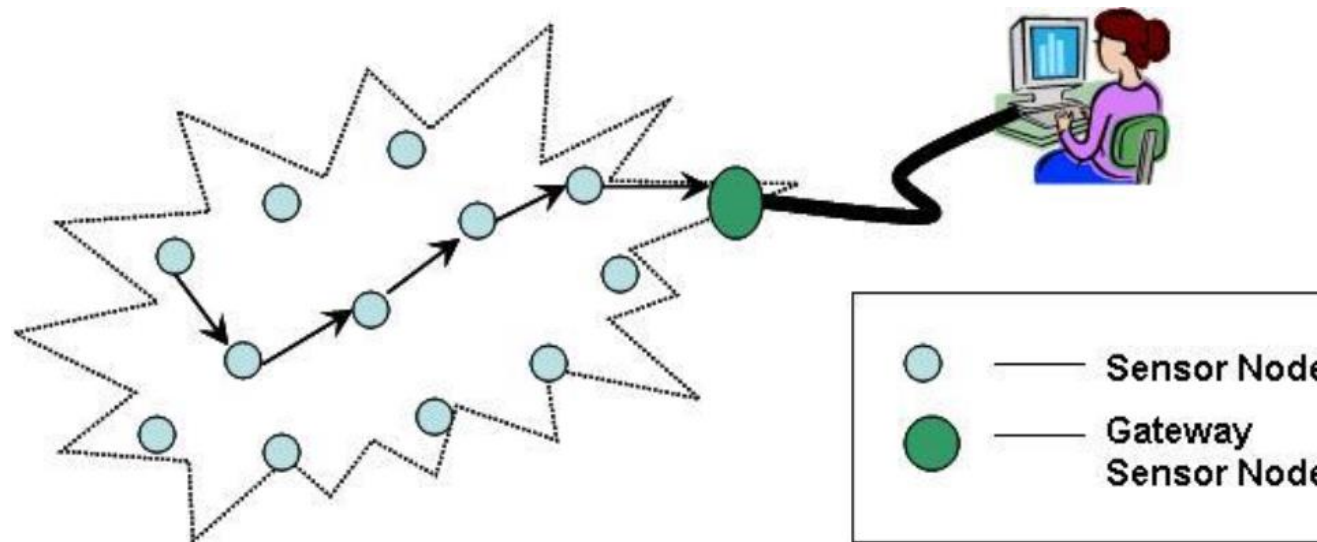
- Self-configuration
- Minimal overhead
- Freedom and flexibility of mobility
- Quick deployment
- Real-time communication capability
- Fault-tolerant communication paths



# Applications of Ad-hoc Wireless Networks (cont.)

## ➤ Wireless Sensor Networks

- Tiny sensor nodes
- Capable of sensing environmental factors such as temperature, humidity and nuclear radiation.
- Processing of the data gathered
- Communicate the processed data to the monitoring station through the network

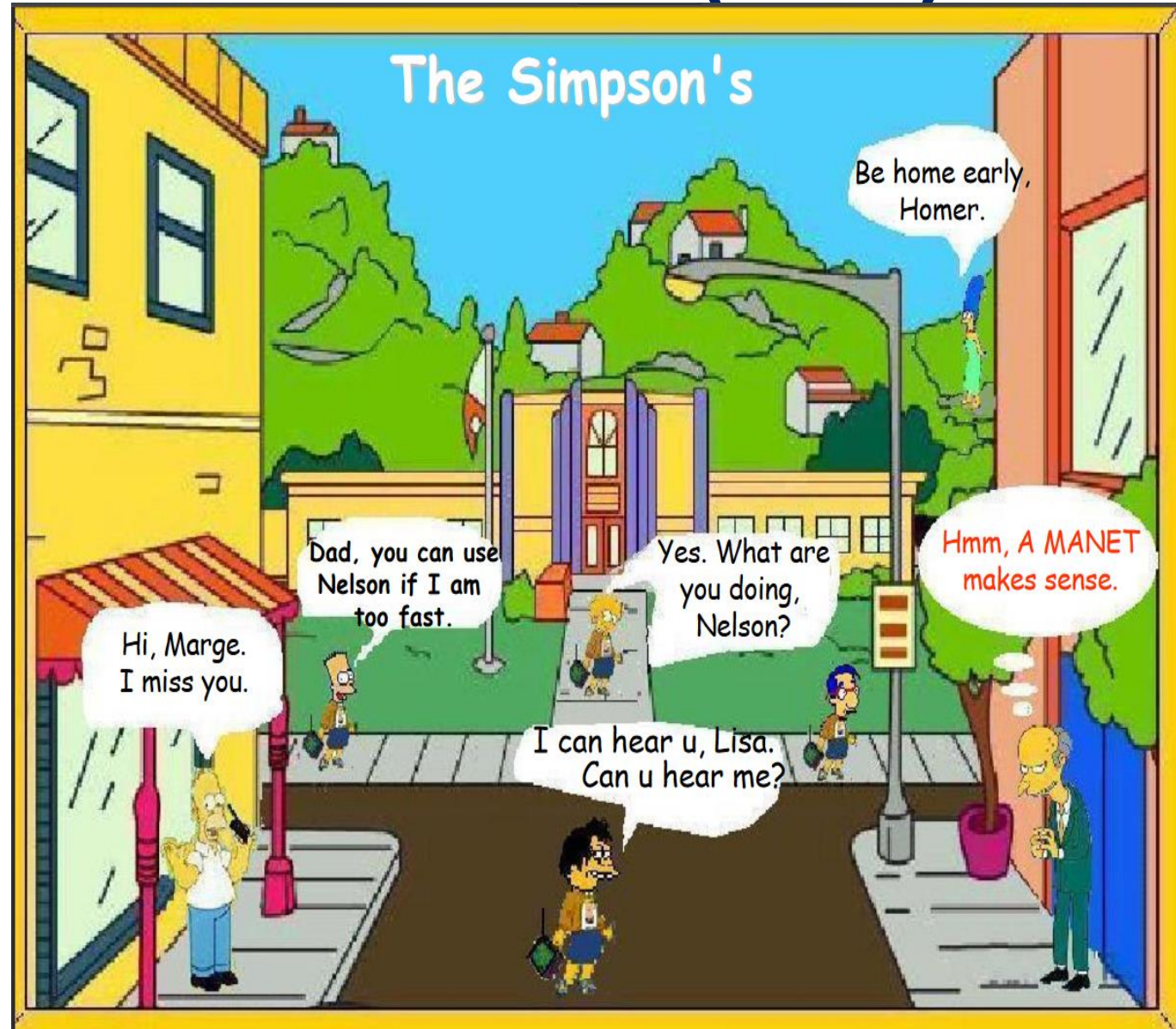




# Applications of Ad-hoc Wireless Networks (cont.)

## ➤ Collaborative and Distributed Computing

- Temporary communication infrastructure
- Minimal configuration
- Requires reliable multicast routing
- Level of security is not high
- High reliability of data transfer
- Desired receivers must have the replica of the transmitted file.



# Challenging Issues for Ad-hoc Networks

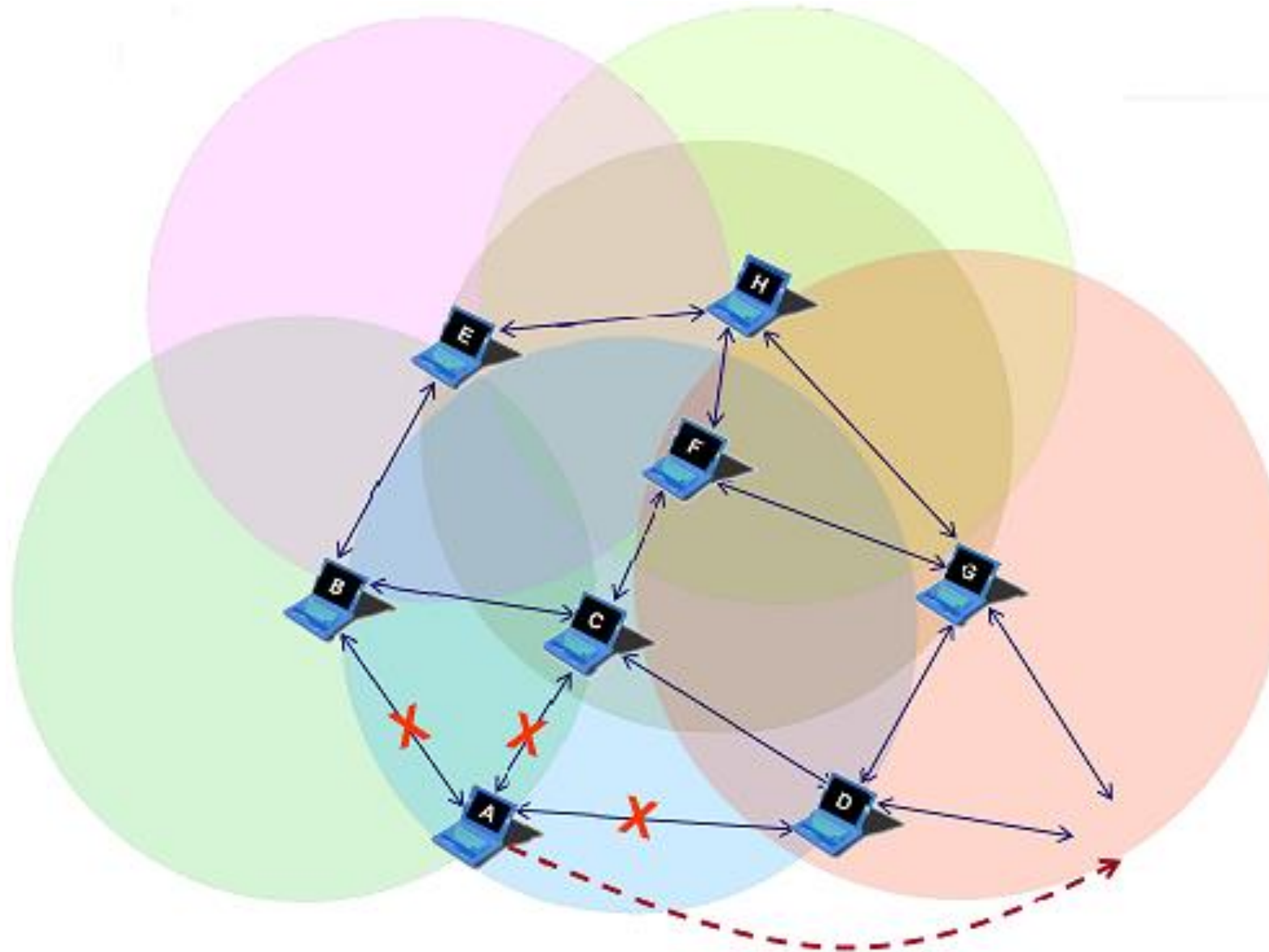
- Medium access scheme
  - Hidden terminal problem
  - Exposed terminal problem
  - Throughput
  - Fairness
- Routing
  - Dynamic topology
  - Route breakage due to node mobility
- Transport layer protocol
  - TCP performs poorly in MANETs
- Quality of service provisioning
- Security
- Energy management

# Challenges in Routing

- Mobility
  - Frequent path breaks
  - Packet collisions
- Bandwidth constraint
- Error-prone and shared channel
  - Bit error rate (BER) for wireless links: of the order of  $10^{-5}$  to  $10^{-3}$
  - BER for wired links:  $10^{-12}$  to  $10^{-9}$
- Location-dependant contention
- Traffic-dependant contention



# Mobility and Link Breakage



# Major Requirements of a Perfect Routing Protocol

- Minimum route acquisition delay
- Quick route reconfiguration/maintenance
- Loop-free routing
- Distributed Routing Approach
- Minimum control overhead
- Scalability
- QoS support
- Secure

# Classification of Routing Protocols

Broadly classified based on the following:

- Routing information update mechanism
- Routing topology
- Use of temporal information for routing
- Utilization of specific resources

# Classification of Routing Protocols (cont.)

- Based on routing information update mechanism
  - Proactive or table –driven routing protocols
  - Reactive or on-demand routing protocol
  - Hybrid protocol
- Based on the Routing Topology
  - Flat topology routing protocols
  - Hierarchical topology routing protocols
- Based on Utilization of Specific Resources
  - Power
  - Location
  - Temporal information

# Table Driven Vs. On-demand

- Proactive / table driven protocols
  - Every node maintains the network topology information in the form of routing tables by periodically exchanging routing information.
  - Whenever a node requires a path to a destination, it runs an appropriate path-finding algorithm on the topology information it maintains.
  
- Reactive/on-demand routing protocols
  - Nodes do not maintain the network topology information, nor exchange routing information periodically.
  - The protocols obtain the necessary path when it is required, by using a connection establishment.

# Table-Driven Routing Protocols

- Idea adapted from the routing protocols for wired network.
  - Natural approach
- Each node needs to exchange information periodically with others.
  - Is it good for ad hoc networks?
- Each node knows the global topology information in the form of tables at every node.
  - Is it good for ad hoc networks?

# References

- ❑ Ad Hoc Wireless Networks, architectures and protocols. C. Siva Ram Murthy and B. S. Manoj, 1<sup>st</sup> edition.
  - Sections 5.1, 5.2, and their subsections.
- ❑ RFC 2501.
  - <http://www.ietf.org/rfc/rfc2501.txt>

Thank you | Any Questions?



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