SNS COLLEGE OF ENGINEERING

Coimbatore-35

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19EC701- **AdHoc Networks**

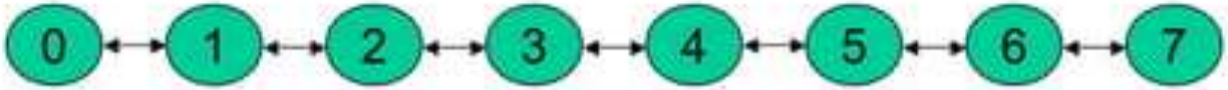
IV ECE / VII SEMESTER

UNIT 1 –INTRODUCTION

TOPIC 2 –Characteristics of ADHOC

Ad hoc Wireless Networks

- The principle behind ad hoc networking is multi-hop relaying in which messages are sent from the source to the destination by relaying through the intermediate hops (nodes).
- In multi-hop wireless networks, communication between two end nodes is carried out through a number of intermediate nodes whose function is to relay information from one point to another. A static string topology is an example of such network:

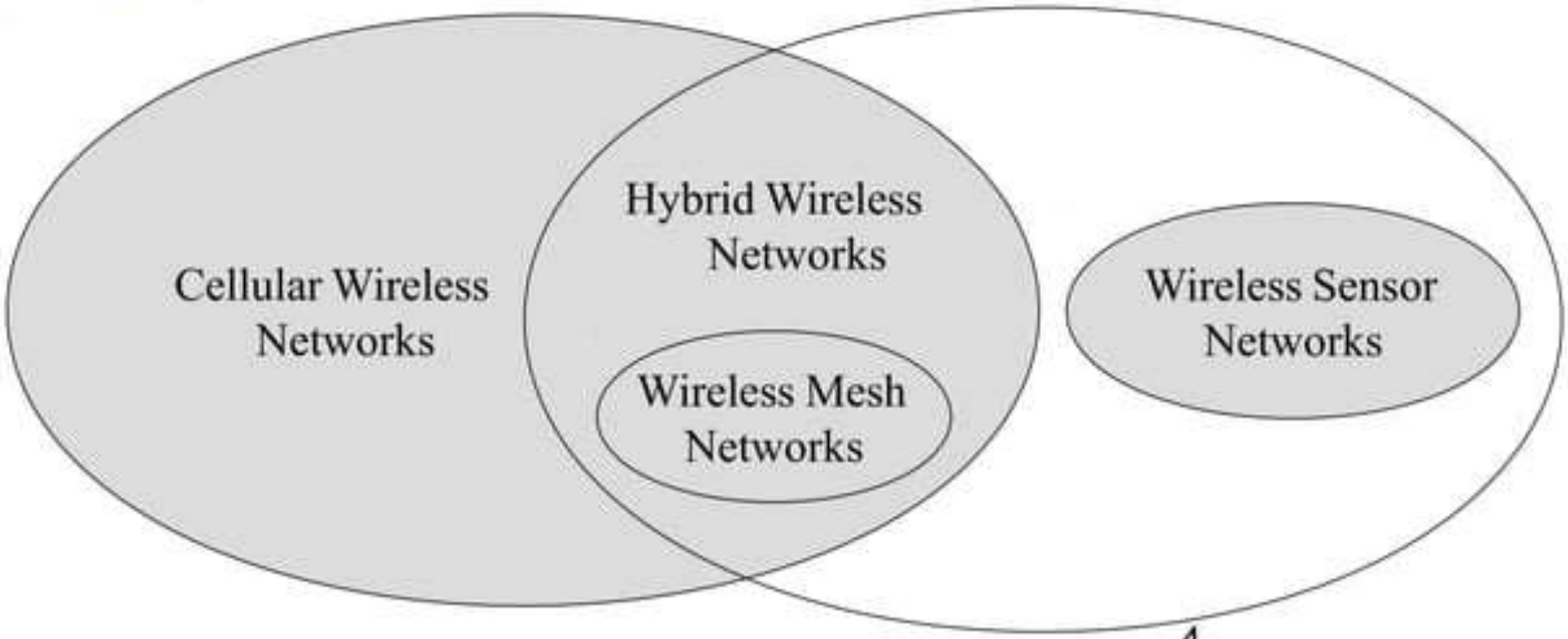


Ad hoc Wireless Networks

- Adhoc wireless network is a catogery of wireless network that utilize a multihop radio relaying and are compile of operating with out support of any fixed infrastructure
- It is a multihop
- Dynamic topology
- Self organized
- Self configure

Cellular and Ad Hoc Wireless Networks

- The following figure represents different wireless networks.
  - Infrastructure: cellular wireless networks
  - Ad hoc: wireless sensor networks
  - Hybrid: mesh networks



Comparisons between Cellular and Ad Hoc Wireless Networks

Cellular Networks	Ad Hoc Wireless Networks
Fixed infrastructure-based	Infrastructureless
Guaranteed bandwidth (designed for voice traffic)	Shared radio channel (more suitable for best-effort data traffic)
Centralized routing	Distributed routing
Circuit-switched (evolving toward packet switching)	Packet-switched (evolving toward emulation of circuit switching)
Seamless connectivity (low call drops during handoffs)	Frequent path breaks due to mobility
High cost and time of deployment	Quick and cost-effective deployment
Reuse of frequency spectrum through geographical channel reuse	Dynamic frequency reuse based on carrier sense mechanism
Easier to employ bandwidth reservation	Bandwidth reservation requires complex medium access control protocols

Cellular Networks	Ad Hoc Wireless Networks
Application domains include mainly civilian and commercial sectors	Application domains include battlefields, emergency search and rescue operations, and collaborative computing
High cost of network maintenance (backup power source, staffing, etc.)	Self-organization and maintenance properties are built into the network
Mobile hosts are of relatively low complexity	Mobile hosts require more intelligence (should have a transceiver as well as routing/switching capability)
Major goals of routing and call admission are to maximize the call acceptance ratio and minimize the call drop ratio	Main aim of routing is to find paths with minimum overhead and also quick reconfiguration of broken paths
Widely deployed and currently in the third generation of evolution	Several issues are to be addressed for successful commercial deployment even though widespread u7œexists in defense

Applications of Ad hoc Wireless Networks

Military applications

Ad hoc wireless networks is useful in establishing communication in a battle field.

Collaborative and Distributed Computing

A group of people in a conference can share data in ad hoc networks.

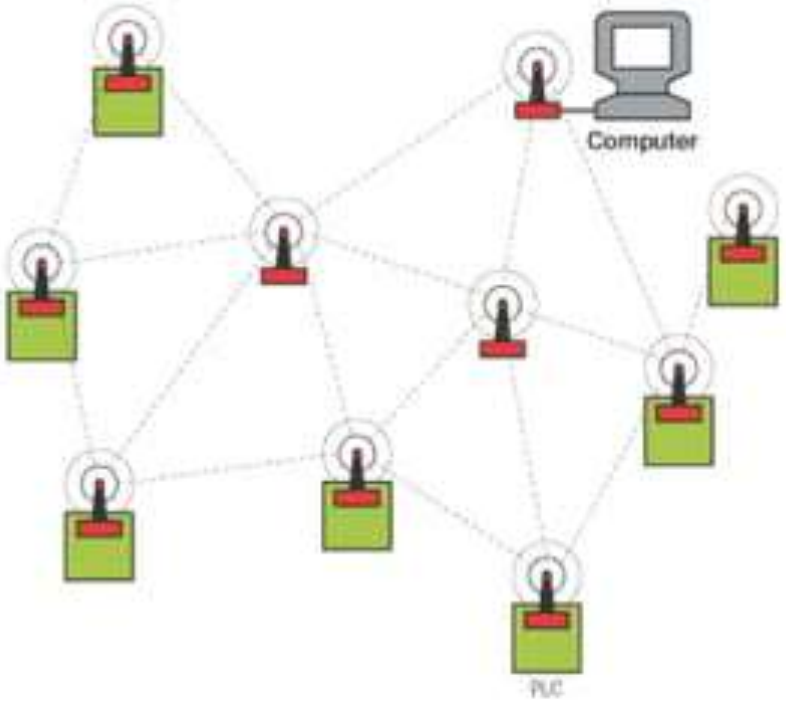
Streaming of multimedia objects among the participating nodes.

Emergency Operations

Ad hoc wireless networks are useful in emergency operations such as search and rescue, and crowd control.

A **Wireless Mesh Network** is a mesh network that is built upon wireless communications and allows for continuous connections and reconfiguration around blocked paths by "hopping" from node to node until a connection can be established.

Wireless Mesh Networks



In a wireless mesh network, multiple nodes cooperate to relay a message to its destination. The mesh topology enhances the overall reliability of the network, which is particularly important when operating in harsh industrial environments.

Wireless Mesh Networks

- The investment required in wireless mesh networks is much less than in the cellular network counterparts.
- The possible deployment scenarios include:
  - Residential zones (where broadband Internet connectivity is required)
  - Highways (where a communication facility for moving automobiles is required)
  - Business zones (where an alternate communication system to cellular networks is required)
  - Important civilian regions (where a high degree of service availability is required)
  - University campuses (where inexpensive campus-wide network coverage can be provided)

It operates at 2.4 GHz or 5 GHz

Data rates of 2 Mbps to 60 Mbps can be supported

Wireless Sensor Networks

- Wireless Sensor Networks are a special category of ad hoc networks that are used to provide a wireless communication infrastructure among the sensors deployed in a specific application domain.
- A sensor network is a collection of a large number of sensor nodes that are deployed in a particular region.
- Distinct properties of wireless sensor networks:
  - Mobility of nodes are not needed in all cases in wireless sensor networks.
  - The size of the network is much larger than that in a typical ad hoc wireless network.
  - The density of nodes in a sensor network varies with the domain of application.
  - The power constraints in sensor networks are much more stringent than those in ad hoc wireless networks.

Wireless Sensor Networks

- Distinct properties of wireless sensor networks:
  - The power source can be classified into three categories:
    - Replenishable power resource
    - Non- Replenishable power source
    - Regenerative power source.

Hybrid Wireless Networks

- Hybrid Wireless Networks
  - Multi-hop cellular networks (MCNs) allows the transmission through the base stations or multi-hop of mobile nodes.
  - Integrated cellular ad hoc relay (iCAR) is a system that combines conventional cellular technology with Ad hoc Relay Station (ARS) technology. In this system cellular stations will relay or reroute calls from the congested cell to an adjacent one that is not congested.
- Advantages
  - Higher capacity than cellular networks
  - Increased flexibility and reliability in routing
  - Better coverage and connectivity

Issues in Ad hoc Wireless Networks

Medium access scheme

- **Distributed operation** is required.
- **Synchronization** is required in TDMA-based systems.
- **Hidden terminals** are nodes hidden from a sender.
- **Exposed terminals** are exposed nodes preventing a sender from sending.
- **Throughput** needs to be maximized.
- **Access delay** should be minimized.
- **Fairness** refers to provide an equal share to all competing nodes.
- **Real-time traffic support** is required for voice, video, and real-time data.
- **Resource reservation** is required for QoS.
- **Ability to measure resource availability** handles the resources.
- **Capability for power control** reduces the energy consumption.
- **Adaptive rate control** refers to the variation in the data bit rate.
- **Use of directional antennas** has advantages including increased spectrum reuse, reduced interference, and reduced power consump1t5ion.

Issues in Ad hoc Wireless Networks

Routing

- Mobility
- Bandwidth constraint
- Error-prone and shared channel: wireless channel (10^{-5} to 10^{-3}), wired channel (10^{-12} to 10^{-9})
- Location-dependent contention depends on the number of nodes.
- Other resource constraints such as computing power, battery power
- Minimum route acquisition delay
- Quick route reconfiguration
- Loop-free routing
- Distributed routing approach
- Minimum control overhead
- Scalability
- Provisioning of QoS
- Support for time-sensitive traffic: hard real-time and soft real-time traffic
- Security and privacy

Issues in Ad hoc Wireless Networks

MULTICASTING

- Provisioning of multiple links among the nodes in an ad hoc network results in a mesh-shaped structure. The mesh-shaped multicast routing structure work well in a high-mobility environment.
- The issues in multicast routing protocols are:
  - **Robustness**: It must be able to recover and reconfigure quickly.
  - **Efficiency**: It should make a minimum number of transmissions to deliver a packet.
  - **Control overhead**: It demands minimal control overhead.
  - **Quality of service**: QoS support is essential.
  - **Efficient group management** needs to be performed with minimal exchange of control messages.
  - **Scalability**: It should be able to scale for a large network.
  - **Security** is important.

Issues in Ad hoc Wireless Networks

TRANSPORT LAYER PROTOCOL

- The objectives of the transport layer protocols include:
  - Setting up and maintaining end-to-end connections
  - Reliable end-to-end delivery of data packets
  - Flow control
  - Congestion control
- Connectionless transport layer protocol (UDP), unaware of high contention, increases the load in the network.
- **Pricing** Schemes need to incorporate service compensation.

  finding the costilier path for the destination
- **Quality of Service** Provisioning
  - QoS parameters based on different applications
  - QoS-aware routing uses QoS parameters to find a path.
  - QoS framework is a complete system that aims at providing the promised services to each users.

Issues in Ad hoc Wireless Networks

Self-Organization is required in ad hoc wireless networks:

- Neighbor discovery
- Topology organization
- Topology reorganization

Security

- Denial of service
- Vulnerable to attacks than wired networks
- 2 types of attacks

Passive attacks :to obtain information transacted in the network with out disrupting (stops) the operation

Active attacks :attacks disrupt the operation of the network

Attacks that are executed by nodes outside the network are called external attack

Attacks that are performed by nodes belonging to the same network are called internal attack

Issues in Ad hoc Wireless Networks

Addressing and Service Discovery is essential because of absence of a centralized coordinator.

Energy Management

- Transmission power management: The radio frequency (RF) hardware design should ensure minimum power consumption.
- Battery energy management is aimed at extending the battery life.
- Processor power management: The CPU can be put into different power saving modes.
- Devices power management: Intelligent device management can reduce power consumption of a mobile node.

Scalability is expected in ad hoc wireless networks.

Issues of Ad hoc Wireless Internet

Gateways

Gateway nodes are the entry points to the wired Internet and generally owned and operated by a service provider.

Perform the following tasks: keeping track of the end users, band-width fairness, address, and location discovery.

Address mobility

Solutions such as Mobile IP can be used.

Routing

Specific routing protocols for ad hoc networks are required.

Transport layer protocol

Split approaches that use traditional wired TCP for the wired part and a specialized transport layer protocol for the ad hoc wireless network part.

Load balancing

Load balancing techniques are essential to distribute the load

Issues of Ad hoc Wireless Internet

- Pricing/billing
  - It is important to introduce pricing/billing strategies for the ad hoc wireless internet.
- Provisioning of security
  - It is essential to include security mechanisms in the ad hoc wireless Internet.
- QoS support
  - Voice over IP (VoIP) and multimedia applications require the QoS support.
- Service, address, and location discovery
  - **Service discovery** refers to the activity of discovering or identifying the party which provides a particular service or resource.
  - **Address discovery** refers to the services such as address resolution protocol (ARP) or domain name service (DNS).
  - **Location discovery** refers to different activities such as detecting the location of a particular mobile node.