UNIT - II

* MOBILE AD-HOC NETWORKS (MANETs)
* WIRELESS SENSOR NETWORKS
* Enabling technologies for WSNs.
* Issue and challenges in Wireless Sensor networks.

INTRODUCTION

A Mobile Ad hoc Network (MANET) An ad hoc network formed as needed, Does not require support from any existing network infrastructure

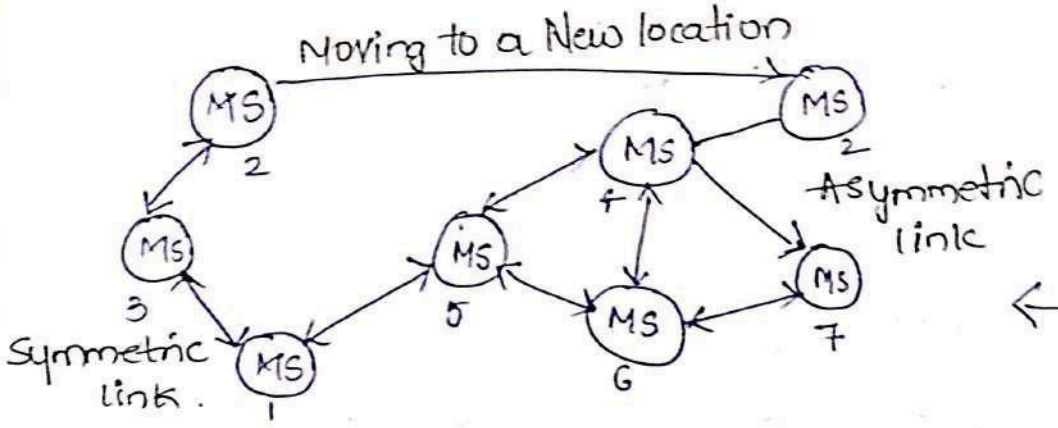
Formal def. of MANET: An autonomous system of mobile nodes or MSs (also serving as routers) connected by wireless links, the union of which forms a communications network modeled in the form of an arbitrary communication graph.

* Autonomous => does not require support from any existing network infrastructure But might be able to use such support if available such support might be available from time to time Support could be an internet gateway or some stations notice how different from cellular network requires

infrastructure (BS, MSC, backbone network, etc)
=> not ad hoc.

Characteristics of MANETS:

* Dynamically changing topology, changing in an unpredictable manner since nodes are free to move.
* limited power available to nodes (eg., a battery)
* usually communicates only with neighboring nodes Among other reasons, to save power
  Peer-to-peer.
* No more or less "Important" nodes.
* Information transmission via store-and-forward (fig) using multi-hop-routing.
* MSs also serve as routers.



Asymmetric = unidirectional - when xmission power of nodes on its ends is different (eg., MS4 stronger than MS7

As nodes move:

* connectivity changes.
* Topology information must be updated.

  Eg. MS2 changes attachment: from MS3 to MS4

mmunication characteristics for MANETs:

* Each node equipped with a wireless transmitter and a receiver with an appropriate antenna impossible to have all nodes within each other's radio range.
* When the nodes are close by, they can communicate directly.
* If direct comm. => no routing needed.

wireless connectivity modeled by a random multi-hop graph exists between the nodes.

characteristics of Ad HOC Networks.

Dynamic topologies:

Network topology may change dynamically as the nodes are free to move.

* Bandwidth-constrained, variable capacity links wireless links have typically lower capacity than wired Realized throughput of wireless communication is lower than the radio's maximum transmission rate link capacity is relatively low => ~~too~~ congestion is common.
* Energy-constrained operation Nodes in ad-hoc network may rely on batteries or other limited energy sources.
* Energy conservation may be a dominant design factor.

Characteristics of Ad Hoc Networks – cont'd

* limited physical security More prone Physical security threats than wired networks. Incl. stealing mobile ad hoc devices
* Many attacks, incl. Eavesdropping, Spoofing, and Dos attacks are easier.
* Decentralized network control Eliminates single points of failure.
* Scalability problems: As network get large.

Design issues of a wireless sensor network

* There are a lot of challenges placed by the deployment of sensor network which are a superset of those found in wireless ad hoc network.
* Sensor nodes communicates over wireless, lossy lines with no infrastructure.
* An additional challenge is related to the limited, usually non-renewable energy supply of the sensor nodes.
* In order to maximize the lifetime of the network, the protocols need to be designed from the beginning with the objective of efficient management of the energy resources.

Fault Tolerance.

Sensor nodes are vulnerable and frequently deployed in dangerous environment.

* Nodes can fail due to hardware problems or physical damage or by exhausting their energy supply.
* We expect the node failures to be much higher than the one normally considered in wired or infrastructure based wireless network.
* The protocols deployed in a sensor network should be able to detect these failures as soon as possible and be robust enough to handle a relatively large number of failures while maintaining the overall functionality of the network. Different deployment environments pose different fault tolerance requirements.

Scalability:

* Sensor network vary in scale from several nodes to potentially several hundred thousand.
* In addition, the deployment desity is also variable. For collecting high-resolution data, the node desity might reach the level where a node has several thousand neighbours in their transmission range.
* The protocols deployed in sensor network need to be scalable to these levels and be able to maintain adequate performance.

Production Costs: Because many deployment models consider the sensor nodes to be disposable devices, sensor network can compete with traditional information gathering approaches only if the individual sensor nodes can be produced very cheaply. The target price envisioned for a sensor node should ideally be less than $1.

Hardware constraints: At minimum, every sensor node needs to have a sensing unit, a processing unit, a transmission unit, and a power supply.

* optionally, the nodes may have several built-in sensors or additional devices such as a localization system to enable location-aware routing.
* However, every additional functionality comes with additional cost and increases the power consumption and physical size of the node
* Thus, additional functionality needs to be always balanced against cost and low-power requirements.

Sensor Network topology:

* Although WSNs have evolved in many aspects, they continue to be network with constrained resources in terms of energy, computing power, memory, and communications capabilities.

these constraints, energy consumption is of paramount importance, which is demonstrated by the large number of algorithms, techniques and protocols that have been developed to save energy, and thereby extend the lifetime of the network.

Transmission Media

* The communication between the nodes is normally implemented using radio comm. over the popular ISM bands.
* However, some sensor network use optical or infrared comm., with the latter having the advantage of being robust and virtually interference free.

Power consumption

* As we have already seen, many of the challenges of sensor network revolve around the limited power resources.
* The size of the nodes limits the size of the battery.
* The software and hardware design needs to carefully consider the issues of efficient energy use.
* For instance, data compression might reduce the amount of energy used for radio transmission, but uses additional energy for computation and/or filtering.

* The energy policy also depends on the -cation. In some applications, it might acceptable to turn off a subset of to in order to conserve energy while other applications require all nodes oper -ating simultaneously.

WIRELESS SENSOR NETWOR (WSN) Vs. MOBILE AD-HOC NETWORK (MANET)

	WSN	MANET
SIMILARITY	Wireless	Multi-hop networking
SECURITY	symmetric key cryptography	public key cry-tography
ROUTING	support specialized traffic pattern. cannot afford to have too many nodes states and packet overhead.	support any node pairs some source routing and distance vector protocol incur heavy control traffic.
RESOURCE	Tighter resources (power, processor speed, bandwith)	Not as tight.

P.T.O

ISSUES AND CHALLENGES IN WIRELESS SENSOR (S) NETWORKS.

ISSUES IN WIRELESS SENSOR NETWORKS.

There are different issues occured in wireless sensor networks like design issues, topology issues, and other issues. The design issues in different types of wireless sensor networks mainly include.

- low latency
- fault
- coverage problems
- Transmission Media
- Scalability

The topology issues: of wireless sensor networks include the following.

- sensor Holes
- Geographic Routing
- coverage Topology.

The Major issues of a wireless sensor Network include the following. These issues mainly affect the design and performance of the WSN.

- operating system and Hardware for WSN
- Middleware
- characteristics of wireless Radio
- communication
- Transport Layer

- Schemes for medium Access
- Deployment
- Localization.
- Sensor Networks programming Models
- Synchronization
- Architecture
- calibration
- Database centric and querying
- Network Layer
- Data Dissemination and Data Aggregation

challenges in Wireless Sensor Network.

The protocols and algorithms that have been proposed for traditional wireless ad-hoc network are therefore not well suited for the application requirements of the sensor network. To illustrate this point, differences between sensor network and traditional network are outlined as:

* energy
* Redundancy
* System lifetime
* Scalability
* Adaptability
* Application Awareness
* Lack of Global Identification
* Storage, Search and Retrieval

ta centric processing.
roduction cost
Node Deployment
* In-Network Processing
* Latency.
* fault tolerance

Challenges of WSN

The different challenges in WSNs include the following:

- fault performance
- scalability
- production cost
- operation Environment
- quality of service
- Data Aggregation
- Data compression
- Data Latency.

fault performance

Some sensor nodes stop working because of power loss, so physical damage may occur. This shouldn't affect the sensor network's overall performance, so this is known as the issue of fault tolerance.

* fault tolerance is nothing but the ability to maintain the functionalities of the sensor network without any interruption because of the failures of sensor nodes.

Stability:

The number of nodes used in the area may be in the order of thousands hundreds and routing schemes should be scalable enough for responding to events.

~~Production cost~~ Operation Environment:

The arrangement of sensor networks can be done within large machinery, under the ocean, in the field of chemically or biologically contaminated. in homes, battlefields, connected to fast-moving vehicles, animals, for monitoring in forests etc.,

Quality of service:

The quality of service which needs by the application could be energy efficiency, lifetime length, and reliable data.

Data Aggregation:

The combination of data from various sources with different functions like average, max, min is known as data aggregation

Data compression.

The data reduction is known as data compression.

uction cost:

The sensor networks include a number sensor nodes where a single node price very significant to validate the cost of the overall network and thus each sensor nodes price must be kept low.

Characteristic requirements:

TYPE OF SERVICE:

* conventional comm. network is evident.
* it moves bits from one place to another.
* New paradigms of using such a network are required, along with new interface and new ways of thinking about the service of a network.

QUALITY OF SERVICE:

* Traditional quality of service requirements.
* Bounded delay or minimum bandwidth are irrelevant when applications are tolerant to latency.
* Very high reliability requirements
* The packet delivery ratio is an insufficient metric.

FAULT TOLERANCE:

* To tolerate node failure, redundant deployment is necessary.

* using more nodes than would be strictly necessary if all nodes functioned correctly.

LIFETIME:

* lifetime of a WSN becomes a very important figure of merit.
* Investing more energy can increase quality but decrease lifetime.
* Definition of lifetime depends on the application at hand.

WIDE RANGE OF DENSITIES:

* The number of nodes per unit area, the density of the network can vary considerably.
* Different applications will have very different node densities.
* Density can vary over time and space because nodes fail or move.

PROGRAMMABILITY:

* Necessary for the nodes to process information
* React flexibly on changes in their tasks.
* These nodes should be programmable, and their programming must be changeable during operation when new tasks become important.
* A fixed way of information processing in insufficient.

SUSTAINABILITY:

i) has to monitor its own health and adapts to change operational parameters or to choose different trade-offs.

* The network has to maintain itself.
* Able to interact with external maintenance mechanisms to ensure its extended operation at a required quality.

Required Mechanism:

* Multihop wireless communication
* Energy-efficient operation
* Auto-configuration
* collaboration and in-network processing
* Data centric
* Locality
* Exploit trade-offs.

Enabling technologies for wireless sensor networks:

* Wireless sensor networks are distributed devices with sensor which are used to monitor environmental and physical conditions.
* WSN consists of number of nodes, routers and a coordinator.
* Endnotes have several sensors attached to them and notes can also act as routers.

* Routers are responsible for routing data packets from endnotes to the coordinator.
* The coordinator collects data from all the notes it also acts as a Gateway which connects WSN to the internet.

SOME EXAMPLES OF WSN USED IN IOT SYSTEM:

* Weather monitoring systems use WSNs in which the nodes collect temperature humidity which is aggregated and analysed.
* Indoor air quality monitoring system use WSNs to collect data on the indoor air quality and concentration of various gases.
* Soil moisture monitoring systems used WSNs to monitor soil moisture at various locations.
* Surveillance systems used WSNs for collecting surveillance data & structural health monitoring systems used WSNs to monitor the health of buildings bridges.
* WSNs are enabled by wireless communication protocol such as IEEE 802.15.4. Zigbee is one of the most popular wireless Technology.

* power of WSN lies in the ability to deploy large number of low cost and low power sensing notes for continuous monitoring of environmental and physical conditions
* WSNs are self-organizing networks. Since WSNs have large number of nodes manual configuration for each nodes is not possible.
* The self-organizing capability of WSN make the network robust.
* In case of failure of some notes or addition of new notes to the network, network can configure itself.

ENABLING TECHNOLOGIES FOR WIRELESS SENSOR NETWORKS :

* Building such wireless sensor networks has only become possible with some fundamental advances in enabling technologies.
* first and foremost among these technologies is the miniaturization of hardware.

* These three basic parts of a sensor node have to accompained by power supply,
  - Depending on application.
  - High capacity batteries that last for long times, that is.
  - That can efficiently provide small amounts of current.
* Sensors node also has a device for energy scavenging. recharging the battery with energy gathered from the environment.