1. Please compare the WSN and cellular network and wireless ad hoc network.

Answer:

Differences between Wireless Adhoc Network and Wireless Sensor Network:

1. Wireless Adhoc Network:

A wireless ad-hoc network is a wireless network deployed without any framework or infrastructure. This incorporates wireless mesh networks, mobile ad-hoc networks, and vehicular ad-hoc networks. It's history could be traced back to the Defense Advanced Research Project Agency (DARPA) and Packet Radio Networks (PRNET) which evolved into the Survival Adaptive Radio Networks (SARNET) program. Wireless ad-hoc networks, in particular mobile ad-hoc networks (MANET), are growing very fast as they make communication simpler and progressively accessible. In any case, their conventions or protocols will in general be hard to structure due to topology dependent behavior of wireless communication, and their distributed and adaptive operations to topology dynamism. They are allowed to move self-assertively at any time. So, the network topology of MANET may change randomly and rapidly at unpredictable times. This makes routing difficult because the topology is continually changing and nodes cannot be expected to have steady data storage.

Applications:

Data Mining

Military battlefield

Commercial Sector

Personal area network or Bluetooth.

2. Wireless Sensor Network:

A wireless sensor network can be characterized as a system of devices, indicated as nodes which can detect the environment and impart the data accumulated from the monitored field (e.g., a zone or volume) through remote or wireless connections. It can be depicted as a system of nodes that agreeably sense and may control the environment enabling association between people or computers and the surrounding environment. The information is sent, possibly through different jumps, to a sink (indicated as a controller or monitor) that can utilize it locally or is associated with different systems (e.g., The Internet) through a portal. The nodes can be fixed or moving.

Applications:

Environmental Monitoring

Health Care

Positioning and Monitoring

The Wireless Sensor Networks (WSN) part first:

1)These devices have the processing capability, they contain small micro-controllers (8bit -16 bit), they have the sensing ability (Temp, pressure, etc), and they have the communicating ability.

2)These are very small devices; they range from the size of a grain of sand all the way up to the dimension of a shoe-box.

3)Have small and limited power capacity.

4)The nodes (sensor) are inexpensive.

5)Nodes remain unattended (You can't go to a wild forest again once you have deployed these from a helicopter), they are designed for a prolonged lifetime.

6)The node density is high.

7)Networks are highly redundant.

8)Transmission range is small (3 to 30 meters).

9)Limited resources like: Memory and processing.

10)Data moves from many nodes to the Gateway.

On the other hand, Wireless ad hoc network (WANET) they have the following properties:

1)They have no sensing ability.

2)They are larger in size, for example: Laptops and PDA's.

3)Power sources have larger capacity.

4)Compared to WSN they are Expensive.

5)Unlike WSN they don't remain unattended. Battery can be replaced.

6)Node density is low.

7)They have less redundant networks.

8)Transmission range is large (10 to 500 meters).

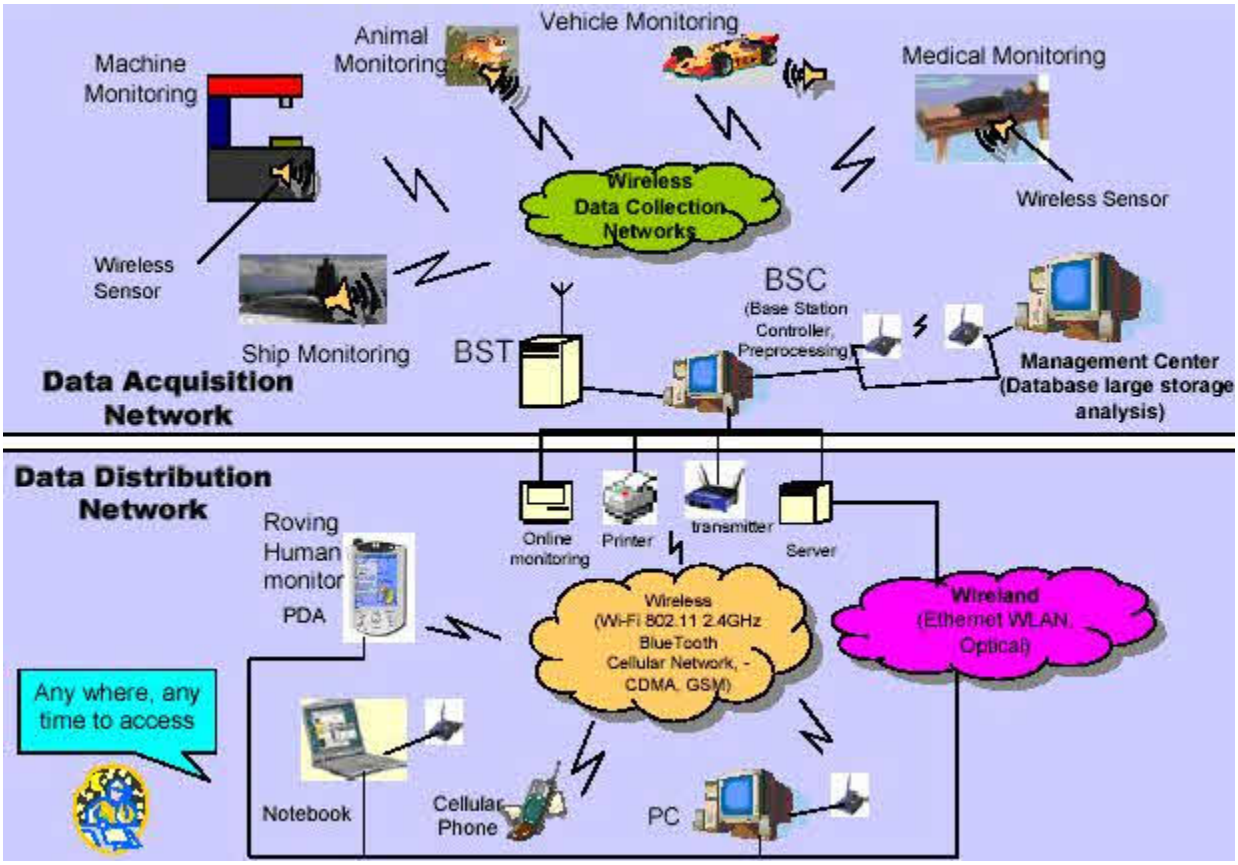
9)Memory size is big, and the processing power is Higher.

10)Data moves from one device to many (Broadcasting).

2. Please describe the constitution of WSN and how it works in the application scenario.

Answer:

A Wireless sensor network can be defined as a network of devices that can communicate the information gathered from a monitored field through wireless links. The data is forwarded through multiple nodes, and with a gateway, the data is connected to other networks like wireless Ethernet.



Applications of wireless sensor network:

Wireless sensor networks have gained considerable popularity due to their flexibility in solving problems in different application domains and have the potential to change our lives in many different ways.

Military applications: Wireless sensor networks be likely an integral part of military command, control, communications, computing, intelligence, battlefield surveillance, reconnaissance and targeting systems.

Area monitoring: In area monitoring, the sensor nodes are deployed over a region where some phenomenon is to be monitored. When the sensors detect the event being monitored (heat, pressure etc), the event is reported to one of the base stations, which then takes appropriate action.

Transportation: Real-time traffic information is being collected by WSNs to later feed transportation models and alert drivers of congestion and traffic problems.

Health applications: Some of the health applications for sensor networks are supporting interfaces for the disabled, integrated patient monitoring, diagnostics, and drug administration in hospitals, tele-monitoring of human physiological data, and tracking & monitoring doctors or patients inside a hospital.

Environmental sensing: The term Environmental Sensor Networks has developed to cover many applications of WSNs to earth science research. This includes sensing volcanoes, oceans, glaciers, forests etc. Some other major areas are listed below:

- Air pollution monitoring
- Forest fires detection
- Greenhouse monitoring
- Landslide detection

Structural monitoring: Wireless sensors can be utilized to monitor the movement within buildings and infrastructure such as bridges, flyovers, embankments, tunnels etc enabling Engineering practices to monitor assets remotely with out the need for costly site visits.

Industrial monitoring: Wireless sensor networks have been developed for machinery condition-based maintenance (CBM) as they offer significant cost savings and enable new functionalities. In wired systems, the installation of enough sensors is often limited by the cost of wiring.

Agricultural sector: using a wireless network frees the farmer from the maintenance of wiring in a difficult environment. Irrigation automation enables more efficient water use and reduces waste.

Structure of a wireless sensor network:

Structure of a Wireless Sensor Network includes different topologies for radio communications networks. A short discussion of the network topologies that apply to wireless sensor networks are outlined below:

Star network (single point-to-multipoint):

A star network is a communications topology where a single base station can send and/or receive a message to a number of remote nodes. The remote nodes are not permitted to send messages to each other. The advantage of this type of network for wireless sensor networks includes simplicity, ability to keep the remote node's power consumption to a minimum. It also allows low latency communications between the remote node and the base station. The disadvantage of such a network is that the base station must be within radio transmission range of all the individual nodes and is not as robust as other networks due to its dependency on a single node to manage the network.

Mesh network:

A mesh network allows transmitting data to one node to other node in the network that is within its radio transmission range. This allows for what is known as multi-hop communications, that is, if a node wants to send a message to another node that is out of radio communications range, it can use an intermediate node to forward the message to the desired node. This network topology has the advantage of redundancy and scalability. If an individual node fails, a remote node still can communicate to any other node in its range, which in turn, can forward the message to the desired location. In addition, the range of the network is not necessarily limited by the range in between single nodes; it can simply be extended by adding more nodes to the system. The disadvantage of this type of network is in power consumption for the nodes that implement the multi-hop communications are generally higher than for the nodes that don't have this capability, often limiting the battery life. Additionally, as the number of communication hops to a destination increases, the time to deliver the message also increases, especially if low power operation of the nodes is a requirement.

Hybrid star – Mesh network:

A hybrid between the star and mesh network provides a robust and versatile communications network, while maintaining the ability to keep the wireless sensor nodes power consumption to a minimum. In this network topology, the sensor nodes with lowest power are not enabled with the ability to forward messages. This allows for minimal power consumption to be maintained. However, other nodes on the network are enabled with multi-hop capability, allowing them to forward messages from the low power nodes to other nodes on the network. Generally, the nodes with the multi-hop capability are higher power, and if possible, are often plugged into the electrical mains line. This is the topology implemented by the up and coming mesh networking standard known as ZigBee.

Applications of WSN:

Internet of Things (IOT)

Surveillance and Monitoring for security, threat detection

Environmental temperature, humidity, and air pressure

Noise Level of the surrounding

Medical applications like patient monitoring

Agriculture

Landslide Detection

Challenges of WSN:

Quality of Service

Security Issue

Energy Efficiency

Network Throughput

Performance

Ability to cope with node failure

Cross layer optimisation

Scalability to large scale of deployment

Components of WSN:

Sensors:

Sensors in WSN are used to capture the environmental variables and which is used for data acquisition. Sensor signals are converted into electrical signals.

Radio Nodes:

It is used to receive the data produced by the Sensors and sends it to the WLAN access point. It consists of a microcontroller, transceiver, external memory, and power source.

WLAN Access Point:

It receives the data which is sent by the Radio nodes wirelessly, generally through the internet.

Evaluation Software:

The data received by the WLAN Access Point is processed by a software called as Evaluation Software for presenting the report to the users for further processing of the data which can be used for processing, analysis, storage, and mining of the data.