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A Study of Diverse Wireless Network

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Abstract—*Wireless network refers to any type of computer network that is not connected by cables of any kind. It is a method by which homes, telecommunications networks and enterprise installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. This article presents overviews of different wireless networks. It also discusses some characteristics difference of Mobile Ad Hoc Network, Wireless Sensor Networks and Wireless Mesh Network and compared each other with in the area of routing protocols, topology, traffic, inter-path interference, link capacity and channel diversity***.**

Keywords —*iMANET, MANETs, VANET, WMNs, WSNs*

I. Introduction

Wireless telecommunications refers to the transfer of information between two or more computers that are not physically connected. Distances can be short, such as a few meters for television remote control, or as far as thousands or even millions of kilometers for deep-space radio communications. It includes various types of fixed, mobile, and portable applications, including two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Wireless cellular systems have been in use since 1980s. We have seen their evolutions to first, second and third generation's wireless systems. Wireless systems operate with the aid of a centralized supporting structure such as an access point. These access points assist the wireless users to keep connected with the wireless system, when they roam from one place to the other. Wireless telecommunications networks are generally implemented and administered using a transmission system called radio waves. This implementation takes place at the physical level (layer) of the OSI model network structure.

II. Wireless Ad-Hoc Network

A wireless ad-hoc network is a decentralized type of wireless network. Ad-hoc is a Latin word, which means "for this or for this only." The network is ad hoc because it does not rely on a preexisting infrastructure, such as routers in wired networks or access points in managed (infrastructure) wireless networks. Instead, each node participates in routing by forwarding data for other nodes, and so the determination of which nodes forward data is made dynamically based on the network connectivity. In addition to the classic routing, ad hoc networks can use flooding for forwarding the data.

An ad hoc network typically refers to any set of networks where all devices have equal status on a network and are free to associate with any other ad hoc network devices in link range. Very often, ad hoc network refers to a mode of operation of IEEE 802.11 wireless networks.

It also refers to a network device's ability to maintain link status information for any number of devices in a 1 link (aka "hop") range, and thus this is most often a Layer 2 activity. Because this is only a Layer 2 activity, ad hoc networks alone may not support a route able IP network environment without additional Layer 2 or Layer 3 capabilities.

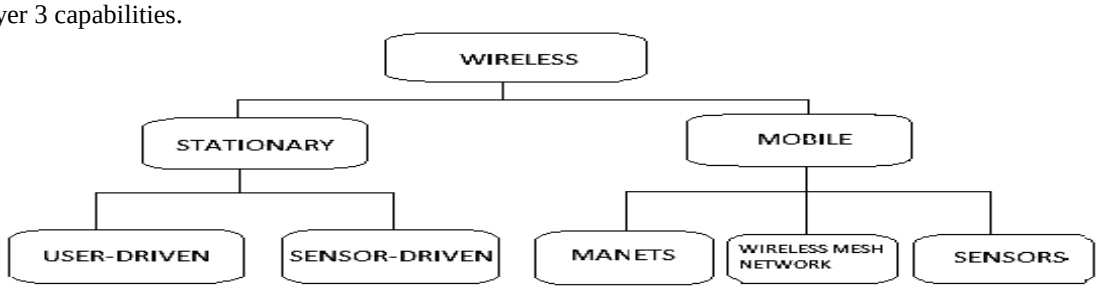

Fig 1: Hierarchy of Wireless Networks

III. Manet

Mobile ad-hoc network is an autonomous system of mobile nodes connected by wireless links; each node operates as an end system and a router for all other nodes in the network. Nodes in mobile ad-hoc network are free to move and organize themselves in an arbitrary fashion. Each user is free to roam about while communication with others. The path between each pair of the users may have multiple links and the radio between them can be heterogeneous. This allows an association of various links to be a part of the same network.

The popular IEEE 802.11 "WI-FI" protocol is capable of providing ad-hoc network facilities at low level, when no access point is available. However in this case, the nodes are limited to send and receive information but do not route anything across the network. Mobile ad-hoc networks can operate in a standalone fashion or could possibly be connected to a larger network such as the Internet.

Mobile ad-hoc networks can turn the dream of getting connected "anywhere and at any time" into reality. Typical application examples include a disaster recovery or a military operation. Not bound to specific situations, these networks may equally show better performance in other places. As an example, we can imagine a group of peoples with laptops, in a business meeting at a place where no network services is present. They can easily network their machines by forming an ad-hoc network. This is one of the many examples where these networks may possibly be used.

3.1 VANET

(Vehicular Ad-hoc Networks) is a technology that uses moving cars as nodes in a network to create a mobile network. (VANETs) are used for communication among vehicles and between vehicles and roadside equipment VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 metres of each other to connect and, in turn, create a network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes.

3.2 iMANET

Internet Based Mobile Ad-hoc Networks ad-hoc networks that link mobile nodes and fixed Internet-gateway nodes. In such type of networks normal ad-hoc routing algorithms don't apply directly. Internet-based Mobile Ad Hoc Networking is an emerging technology that supports self-organizing, mobile networking infrastructures, and is one which appears well-suited for use in future commercial and military applications. This article presents an overview of Mobile Ad Hoc Networking technology and current Internet Engineering Task Force standardization efforts in this regard. It gives long-term rationale for following an Internet Protocol-based networking approach in these mobile wireless systems. It also discusses some current limitations of the technology and gives several areas for future work.

IV. Wireless Mesh Network

A wireless mesh network (WMN) is a communications network made up of radio nodes organized in a mesh topology. Wireless mesh networks often consist of mesh clients, mesh routers and gateways. The mesh clients are often laptops, cell phones and other wireless devices while the mesh routers forward traffic to and from the gateways which may but need not connect to the Internet. The coverage area of the radio nodes working as a single network is sometimes called a mesh cloud. Access to this mesh cloud is dependent on the radio nodes working in harmony with each other to create a radio network. A mesh network is reliable and offers redundancy. When one node can no longer operate, the rest of the nodes can still communicate with each other, directly or through one or more intermediate nodes. The animation below illustrates how wireless mesh networks can self form and self heal. Wireless mesh networks can be implemented with various wireless technology including 802.11, 802.15, 802.16, cellular technologies or combinations of more than one type. A wireless mesh network can be seen as a special type of wireless ad-hoc network. A wireless mesh network often has a more planned configuration, and may be deployed to provide dynamic and cost effective connectivity over a certain geographic area.

4.1 NETWORK STRUCTURE ARCHITECTURE

Wireless mesh architecture is a first step towards providing cost effective and dynamic high-bandwidth networks over a specific coverage area. Wireless mesh architectures infrastructure is, in effect, a router network minus the cabling between nodes. It's built of peer radio devices that don't have to be cabled to a wired port like traditional WLAN access points (AP) do. Mesh architecture sustains signal strength by breaking long distances

into a series of shorter hops. Intermediate nodes not only boost the signal, but cooperatively make forwarding decisions based on their knowledge of the network, i.e. perform routing.

Wireless mesh networks have a relatively stable topology except for the occasional failure of nodes or addition of new nodes. The path of traffic, being aggregated from a large number of end users, changes infrequently. Practically all the traffic in an infrastructure mesh network is either forwarded to or from a gateway, while in ad hoc networks or client mesh networks the traffic flows between arbitrary pairs of nodes.

4.2 MANAGEMENT

This type of infrastructure can be decentralized (with no central server) or centrally managed (with a central server), both are relatively inexpensive, and very reliable and resilient, as each node needs only transmit as far as the next node. Nodes act as routers to transmit data from nearby nodes to peers that are too far away to reach in a single hop, resulting in a network that can span larger distances.

4.3 APPLICATIONS

Mesh networks may involve either fixed or mobile devices. The solutions are as diverse as communication needs, for example in difficult environments such as emergency situations, tunnels, oil rigs, battlefield surveillance, high speed mobile video applications on board public transport or real time racing car telemetry. An important possible application for wireless mesh networks is VoIP. By using a Quality of Service scheme, the wireless mesh may support local telephone calls to be routed through the mesh.
Some current applications:

- U.S. military forces are now using wireless mesh networking to connect their computers, mainly ruggedized laptops, in field operations.
- Electric meters now being deployed on residences transfer their readings from one to another and eventually to the central office for billing without the need for human meter readers or the need to connect the meters with cables.
- The laptops in the One Laptop per Child program use wireless mesh networking to enable students to exchange files and get on the Internet even though they lack wired or cell phone or other physical connections in their area.
- The 66-satellite Iridium constellation operates as a mesh network, with wireless links between adjacent satellites. Calls between two satellite phones are routed through the mesh, from one satellite to another across the constellation, without having to go through an earth station. This makes for a smaller travel distance for the signal, reducing latency, and also allows for the constellation to operate with far fewer earth stations that would be required for 66 traditional communications satellites.
- The Commotion Wireless Project proposes building a 'device-as-infrastructure' distribution encrypted communications platform.

4.4 OPERATION

The principle is similar to the way packets travel around the wired Internet— data will hop from one device to another until it reaches its destination. Dynamic routing algorithms implemented in each device allow this to happen. To implement such dynamic routing protocols, each device needs to communicate routing information to other devices in the network. Each device then determines what to do with the data it receives — either pass it on to the next device or keep it, depending on the protocol. The routing algorithm used should attempt to always ensure that the data takes the most appropriate (fastest) route to its destination.

V. Mobile Sensor Networks

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. A wireless sensor network in which the nodes are mobile. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is

similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

Table 1. Characteristic difference of wireless networks

S.no.	Characteristics	MANET	WSNs	WMNs
1.	Topology	Mobile	Static	Static
2.	Traffic	Any pair of nodes	Sensor to Sink	Mobile node to network gateway
3.	Inter-paths Interference	Yes	Yes	Yes
4.	Link capacity	Varying	Varying	Varying
5.	Channel Diversity	No	No	Yes

Table 2: Routing Protocols in wireless network

S.no.	Networks	Routing protocols	Proactive	On-Demand	Flat	Hierarchical	Location-aware	metrics	Mobility
1	MANET	DSDV	X		X		N	H	Y
		DSR		X	X		N	H	Y
		OLSR	X		X		N	H	Y
		AODV		X	X		N	H	Y
2.	WSNs	GPSR	X		X		Y	D	Y
		LEACH	X			X	N	E	Y
		SPIN	X		X		N	E	N
3.	WMNs	MSR	X	X	X		N	P	Y
x-Availability Y-Yes H-Hops D-Distance E-Energy P-Proprietary									

5.1 STANDARDS AND SPECIFICATIONS

Several standards are currently either ratified or under development by organizations including WAVE2M for wireless sensor networks. There are a number of standardization bodies in the field of WSNs. The IEEE focuses on the physical and MAC layers; the Internet Engineering Task Force works on layers 3 and above. In addition to these, bodies such as the International Society of Automation provide vertical solutions, covering all protocol layers.

Standards are used far less in WSNs than in other computing systems which make most systems incapable of direct communication between different systems. However predominant standards commonly used in WSN communications include:

- WirelessHART
- IEEE 1451
- ZigBee / 802.15.4

5.2 HARDWARE

One major challenge in a WSN is to produce low cost and tiny sensor nodes. There are an increasing number of small companies producing WSN hardware and the commercial situation can be compared to home computing in the 1970s. Many of the nodes are still in the research and development stage, particularly their software. Also inherent to sensor network adoption is the use very low power methods for data acquisition.

5.3 SOFTWARE

Energy is the scarcest resource of WSN nodes, and it determines the lifetime of WSNs. WSNs are meant to be deployed in large numbers in various environments, including remote and hostile regions, where ad-hoc communications are a key component. For this reason, algorithms and protocols need to address the following issues:

- Lifetime maximization
- Robustness and fault tolerance
- Self-configuration

VI. Future Work

Wireless systems operate with the aid of a centralized supporting structure such as an access point. These access points assist the wireless users to keep connected with the wireless system, when they roam from one place to the other. Wireless telecommunications networks are generally implemented and administered using a transmission system called radio waves.

This implementation takes place at the physical level (layer) of the OSI model network structure. In future different types of wireless networks used in communication. Further MANET categorised into VANET and iManet. We can also do deep study of routing protocols MANET, WSMs, WMSs.

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