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Wireless Networks Past, Present and Future: A Technical Review

Umang

Department Of IT, I.T.S, Ghaziabad, India

*Corresponding Author: Umangsingh@its.edu.in

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Abstract— Wireless Network provides transmission of information over miles of distance without requiring wires, coaxial cables and fibres etc. It focuses on establishment of communication among devices. Such type of communication can be done through Single hop or Multi hop basis. In this attempt, brief introduction of wireless network is presented. In this paper, classification of wireless network is also discussed based on different features and its types. Further, presented work also highlights Mobile Adhoc Networks along with its specialized new concept known as FANETs (Flying Adhoc Networks). In this attempt, design issues for MAC protocol and comparison between MANETs & FANETs is also discussed. This attempt is very much beneficial for beginners of this domain.

Keywords-Wireless Networks, Classifications, WMN, WSN, MANETs, FANETs

I. INTRODUCTION

Communication comes from Latin word "Communi Care". It means transformation of information send to the receiver should be accurate as send by sender. In today's scenario advantage of communicating devices are increasing rapidly in Education System. Thus there is need to establish efficient system for communicating among devices which are located at distant and will to send and receive test in different formats (text, image, audio, video etc).

Traditionally, "Computer Network is collection of interrelated, independent and autonomous collection of nodes". In this network, communicating nodes takes the responsibility to transfer the data from sender node to receiver nodes. Such Communication can be done through with or without physical media. Cables, Optical Fibers are well known example to transfer the data through physical media where as radio waves are used in absence of physical media. In today's scenario, smooth communication is required to maintain good connectivity among the nodes which are present in the network [1-3].

In these networks, good communication is provided through:

- (i) Sharing of available resources
- (ii) Improved reliability of services and cost effectiveness.

So, there is need of two important components for effective communication among devices which are residing at distant location:

- i) Distributed Applications
- ii) Network Infrastructure

At one side, In Distributed Applications, nodes are located at different corners and are communicated through the Internet. On the other side, Network Infrastructure can be connected through wired or wireless. In this paper, Section I presents introduction Section 2 discusses brief classification of Wireless Networks. Section 3 presents Air bone Adhoc Networks along with comparison of MANETS. Section 4 concludes the work.

II. CLASSIFICATION OF WIRELESS NETWORKS

Wireless Networks are collection of nodes where communication is done through radio waves. Wireless devices having access points are known as Infrastructure based networks and devices having no access point are known as Infrastructure less Networks. In these networks, connectivity can be established either through single hop or multiple hop communication.

2.1 Single Hop Communication Networks: Single hop communication is established when two nodes are directly communicating to each other and multi hop communication maintains communication of nodes through other nodes in between. Virtual Classrooms, Entertainment, Virtual Conferencing are examples of these kind of networks. In Such networks, communication can be established either through infra structure network or infrastructure less. In Single Hop Concept, Wi Fi(Wireless Fidelity), WLAN(Wireless Local Area Network), Wi-Max and Cellular Networks are examples of Infrastructure based Single Hop Wireless Networks and Bluetooth, Adhoc

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LANs, Wi Fi Hot Spots etc are examples of Infrastructure less Single hop Wireless Networks.

2.2 Multi Hop Communication Networks: In Multi hop Concept, Communicating Nodes are not directly connected to each other. Intermediate nodes play an important role to**ii**) establish communication between sender and receiver node.

Wireless Mesh Network, Wireless Sensor Networks (WSN) are examples of Infrastructure less networks and MANET, VANET (Vehicular Adhoc Networks)[5], iVANET(Intelligent Vehicular Adhoc Networks) and FANET(Flying Adhoc Networks)as mentioned in Fig.2.



Fig.1: Classification of Wireless Networks

In Single wireless hop networks, Wi-Fi is connected through Wi-Fi routers for establishing the communication. In Cellular Networks, network is distributed over land zones call cells or base station. The base station provides cell which is useful in transmission of data (voice, data and others) from one end to another. Each cell may have different set of frequency which is used to overcome interference, noise and provide good services quality in each cell where as in multi hop wireless network, there exist two kinds of Networks (i) Wireless Mesh Networks (ii) Wireless Sensor Networks(WSN).

i) Wireless Sensor Networks are collection of sensor nodes which are combination of radio transceiver, microcontroller and energy source. Important components of this network are communicating part, processing part and its sensing ability like temperature, sound, pressure etc. Size of networks may vary from sand granules as minimum and shoe box size as maximum. These networks are cheaper as compared to other networks, having limited batteries, high density, and high redundancy, limited like memory and processing capability and small transmission range (3m-30 m)[4].

ii) Wireless Mesh Networks are collection of nodes. Such nodes are connected through peer to peer devices (like mesh client, mesh routers and mesh gateways) by forming mesh topology into network. In WMN, Nodes have limited movement, so there are minimum chances of disconnection. However, in case of high mobility, if route fails due to disconnection between nodes then alternative route can be formed without any delay[1].

iii) Mobile Adhoc Networks: In MANETs, nodes that enter with in radio range of each can easily form without any need of pre configuration or human support. Mobile ad hoc network is a association of mobile nodes having no any fixed support infrastructure. In this network, Connection and disconnection is controlled by the parameter distance among nodes. Due to frequent movement of nodes, connections are disconnected very frequently which increases the problem of frequent topology change in network. Nodes can easily enter or leave the network without affecting the operation of other nodes. "Setting up fixed network Infrastructure for communication among a group of soldier in enemy territories may not be possible."

Parameter Used	WSN	WMANETs
Important Components	Sensing Ability, Communicating Part, Processing Part	Communicating and Processing Part "No Sensing Part"
Size	Small	Larger
Power Capacity	Small Batteries	Large Batteries
Cost	Cheaper	Expensive Comparatively
Density	High	Low
Redundancy	High	Low
Resources	Limited like Memory and Processing Capability	Big Memory Size Higher Processing Capability
Transmission Range	Small	Large

Table 1: Comparison between WSN and MANETs

MANETs needs following parameters to establish reliable and strong communication:

- Require Secure Communication
- Require Support of reliable and secure multimedia multicasting
- Support of Multicast routing

2.3 Applications of MANETs:

- i. Tactical Operations
 - Military
 - Automated Battlefield
- ii. Collaborative & Distributive Computing
 - Conferences
- iii. Emergency Operations
 - Search & Rescue
 - Crowd Control
 - Disaster Scenario
- iv. Sensor Based Applications
 - Weather Monitoring
- v. Entertainment
 - Games

2.4 Designing Issues of MAC Protocol in MANETs

- Mechanism should attempt to minimize the delay.
- Ability to provide an equal or weighted share of the bandwidth to all computing nodes.
- Mechanism for throughput enhancement
 - Minimize the occurrence of collisions
 - Maximize Channel Utilization
- Minimizing Control Overhead
- Time sensitive traffic support
- Ability to measure resource availability of each node
- Mechanism to provide available bandwidth to every node.
- Good routing protocol should be able to handle
- Path breaks
- Packet Collisions
- Transient Loops
- Difficulty in Resource Reservation
- Distribution of Network Load uniformly across the network.
- Quick perform Route reconfiguration due to unpredictable change in topology.
- threats and vulnerabilities
- Support hard and soft real time traffic
- Use of Directional Antenna
 - Reduction in interference and Power Consumption

III. AIRBONE AD HOC NETWORKS

These are also known as Flying Adhoc Networks. These networks are group of Unmanned Aerial Vehicles (UAVs)[6] for communication among nodes without any access point but at least one node need to connect to a ground base or satellite. These UAVs are also known as Driverless Aircraft(Also behave like as Auto Pilot). In such networks, two types of pattern concept are important (i) Mobility

Pattern (ii) Traffic Pattern. FANETs are new form of MANETs which is only applicable for Multi UAVs. Aerial Robot Team, Aerial Sensor Network are good examples of FANETs.



Fig.2 Pictorial view of MANETs, VANETs and FANETs

Movement pattern and traffic pattern are important factor in these three networks. MANETs moves on certain terrain where as VANETs moves on roads and Highways. Further, Specialized MANET known **FANETs** requires predetermined path. In these networks, Global path maintenance is an important factor. If path changes due to environmental factors then path would be recalculated. In FANETs, size of UAVs and coordination among UAVs are challenging issues which are unsolved till the date. However, research is going to explore the possibilities for efficient communication without formation of pre existing structure in the sky.



Fig.3 Formation of Air bone Adhoc Networks

Fig 3(a) represents 7 UAVs in the Adhoc Network. UAV1 is connected to Ground Controller through its transmission range and work as base UAV for communication. Let say UAVy move out from transmission range of UAVx then Communication break occurs network may be divided into two parts. But due to presence of ground controller this type of disconnection will not take place. Ground controller will send the target location to UAV so that it will return to back to its original place after receiving instructions (As mentioned in Fig 3(b). FANETs faces issues related to UAV size and efficient communication among them.

IV. DIFFERENCE BETWEEN FANETS & MANETS

From the research findings, following issues are identified [6-7]:

International Journal of Computer Sciences and Engineering

- Node Mobility: As compared to MANETs, FANETs have High Speed among UAVs
- **Reliable Protocol:** Both protocols are reliable however FANETs provides effective results in case of time critical and emergency scenarios.
- **Mobility Model:** In FANETs, Flight plan is determined and at each step if there is change then recalculation for the Map takes place and comparatively better than MANETs. Thus Random Way Point Mobility Model is not applicable.
- Node Density: In FANETs, there is Sparse Density with large distances between UAVs where as MANET can maintain both i.e. Dense and Sparse.
- **Network Topology:** FANETs deals frequent break and require higher speed as compared to MANET.
- **Power Consumption and Network life time:** Network life time is an important issue. Communication hardware used in FANETs is powered by UAV energy itself which is not used in MANETs. So FANETs have extra battery life support due to add on hardware configuration.
- **Localization:** In FANETs, It is mandatory to update localization of each UAV information with small interval of time where as in MANETs, it is not so. Further, In FANETs, Each UAV must be containing a GPS and Initial measurable unit(IMU) to broadcast his location to all UAV in the network at any time.
- **Computational Power:** In MANETs the nodes can act as routers. Due to size and limited energy constraints, the nodes have only limited computational power. In FANETs, application specific devices with high computational power can be used. Most of UAVs have sufficient computational power due to use of Hardware Miniaturization Tendency. But still there is issue of size and weight in Mini UAV and have very limited payload capacity.
- **Bandwidth Requirement:** In FANETs, the objective is to collect data of targeted places (in form of images or videos) in surveillance and monitoring applications which must be relayed from UAV to the command control center with a strict delay bound and it requires high bandwidth. In addition to this, collected data must have high resolution.

V. CONCLUSION

This work presents proliferation of wireless technologies in real life applications along with its existing networks. Discussed work is categorized based on Single hop and Multi hop Communication. Research related design issues are also discussed into an account. Further, specialized MANET known as Air bone network (Flying Adhoc Networks (FANETs) is also briefed along with its working principles. It has been found that Flying (Specialized) Ad hoc networks are specially designed for emergency and sensitive applications where time is critical factor. Single UAV cannot form FANETs. For formation of FANETs, there is need of multi UAVs for such networks.

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Author Prfile

Dr. Umang is renowned for her keen interest in the area of Mobile Adhoc Networks. Dr. Umang, IBM RAD Certified "Associate Developer" holds a PhD in Computer Application after her MCA and presently a Associate Professor in Dept of IT at I.T.S, Ghaziabad. Dr. Umang has experience of more than 14 Years in Academics and her interest includes IoT, Cyber Crimes, Cyber Security, Mobile Computing, Information



Security and Software Engineering. She is involve in active research and has been guiding Ph.D students in the area of Mobile Technology. She has published about 40+ Research Papers in reputed Journals & Conferences,03 Book Chapters, edited 03 Conference Proceedings, 02 Convention Proceedings, 02 Souvenir indexed with SCI, Scopus, Google Scholar, Thomas Reuters, DBLP credited to her name She has been associated with several Professional societies including IEEE, ACM, CSI etc. Dr. Umang has been delivering invited talks, guest talks at prominent places and organizations including Indian Air Force. Dr. Umang has received "Young Active Member award" for year 2007-2008 from Computer Society of India and Young Faculty in Science(Computer Application) from Venus International Foundation in July, 2017.