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A REVIEW OF MOBILE AD HOC NETWORKING FEATURES & APPLICATIONS

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ABSTRACT: Compact computing and wireless technologies are growth of ad hoc network. Ad hoc network consists of versatile plane forms which are complimentary to move expeditiously. Ad hoc networks are multi-hop network that use wireless communication for transmission exclusive of any permanent transportation. An ad-hoc network is a local area network (LAN) that is builds impulsively as devices connect. Instead of relying on a base station to organize the flow of messages to each joint in the network, the entity network joints forward packets to and from each other. In Latin language, ad hoc exactly means "for this". This paper describes the character of Mobile Ad hoc Networks (MANETs), and their aspect with respect to conventional, hardwired packet networks. Whole life cycle of Ad hoc networks categorized into the three categories like first, second and the third generation. It then discusses important features & its challenges. Also discuss the issues during implementation of MANET and applications where it is used.

Keywords: DARPA, PRNET, CSMA, SURAN, WIDENS etc.

I. INTRODUCTION

1.1 HISTORICAL DEVELOPMENTS OF MANET:

The Mobile Ad hoc Network (MANET) was also known as Packet Radio Network (PAN) in year 1970s and it was sponsored by Defense Advanced Research Projects Agency (DARPA). DARPA had a project named Packet Radio which having a number of wireless terminal that may possibly communication with each other on battlefield. It is interesting to note that these early Packet Radio systems predict the Internet and really was part of the motivation of the original Internet Protocol suite [1]. A life cycle of Ad hoc networks can be categorized into three categories. First Generation at the time of 1972, PRNET was used on a trial basis to provide unusual networking capabilities in a combat environment using the arrangement with Arial Locations of Hazardous Atmospheres & CSMA approach for MAC and a kind of distance-vector routing & they were called Packet Radio Networks. In 1980s Second Generation of Ad hoc networks emerged, when the Ad hoc network systems were additional enhanced and implemented as a part of the SUARN program. This provided a packet-switched network to the mobile battlefield in a situation without transportation. This program proved to be helpful in improving the radios' performance by making them lesser, cheaper & bendable to electronic attacks [2]. In the 1990s Third generation, the concept of viable Ad hoc networks here with notebook computers & extra realistic communication equipments. At the same time, the idea of a group of mobile nodes was projected at several researchers meeting. Ad hoc networks word adopted by The IEEE 802.11 subcommittee and the research group of people had started to look into the opportunity of deploying Ad hoc networks in other areas of application.

1.2. BASIC CONCEPTS OF MOBILE AD HOC NETWORKS

An Ad hoc network is a collection of movable nodes, which forms a provisional network without the assist of centralized administration or standard support devices frequently available as predictable networks. These nodes normally have a restricted transmission range and, so, each node seeks the help of its adjacent nodes in onward packets and hence the nodes in an Ad hoc network are able to act as equally routers and hosts. Thus a node can forward packets among other nodes as well as run client applications. By nature these types of networks are appropriate for situation where either no fixed infrastructure exists. Ad hoc mobile networks include found a lot of applications in various fields like armed forces, urgent situation, and conferencing. Each of these application areas has their precise necessities for routing protocols. Since the network nodes are mobile, an Ad hoc network will normally contain a dynamic topology, which will have reflective effects on network characteristics. Network nodes will regularly be battery powered, which restrictions the capacity of CPU, memory, and bandwidth. This will require network functions that are resource efficient. Besides, the wireless media will also affect the behavior of the network due to irregular connection bandwidths resultant from comparatively high error rates. These unique desirable features pose several new challenges in the blueprint of wireless Ad hoc networking protocols. Network functions such as routing, address allocation, authorization and authentication necessity be considered to handle with a dynamic and unstable network topology. In order to set up routes between nodes, which are beyond than a single hop, specially configured routing protocols are occupied. The unique feature of these protocols is their talent to trace routes in spite of a dynamic topology. In the simplest scenarios, nodes could be able to communicate straight with each other, for example, when they are inside wireless broadcast range of each other. However, Ad hoc networks must also support communication between nodes that are

only not directly connected by a series of wireless hops through added nodes.

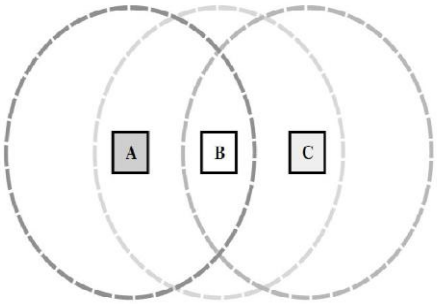

Figure 1.1: A Mobile Ad hoc network of nodes, where nodes A and C must determine the route through B in order to communicate.

For example, in Fig 1.1, to set up communication between nodes A and C the network have to join the help of node B to relay packets among them. The circles point to the insignificant range of each node's broadcasting transceiver. Nodes A and C are not in direct transmission range of each other, since A's circle does not cover C. In general, an Ad hoc network is a network in which every node is ability of a router and every node is ability of mobile. The presence of wireless communication and mobility make an Ad hoc network unlike a conventional wired network and requires that the routing protocols used in an Ad hoc network be based on fresh and dissimilar principles. Routing protocols for conventional wired networks are designed to support terrific numbers of nodes, but they suppose that the comparative situation of the nodes will generally remain unchanged.

II. FEATURES OF MOBILE AD HOC NETWORKS

The MANET has the subsequent features:

Autonomous Terminal

In MANET, each movable terminal is a self-governing node, which could function as both a host and a router. In other words, beside the essential processing capability as a host, the movable nodes can also perform switching functions as a router. So usually end points and switches are identical in MANET.

Distributed Operation

Since there is no background network for the middle control of the network operations, the control and management of the network is distributed among the terminals. The nodes involved in a MANET should collaborate with themselves and each node acts as a relay as needed to implement functions like security & routing.

Multihop Routing

The fundamental category of Ad hoc Routing algorithms can be single-hop and multihop, based on dissimilar link layer characteristic and routing protocols. Single-hop MANET is simpler than multihop in terms of structure and achievement, with the smaller cost of functionality and applicability. When delivering data packets from a source to its destination away of the straight wireless transmission range, the packets should be forwarded via one or more intermediate nodes.

Dynamic Network Topology

because the nodes are mobile, the network topology may change rapidly and randomly and the connectivity between the terminals can vary with time. MANET should adapt to the traffic and propagation conditions as well as the flexibility order of the mobile network nodes. The mobile nodes in the network dynamically set up routing among themselves as they move about, forming their individual network on the fly. Moreover, a user in the MANET may not only function within the Ad hoc network, but can need access to open fixed network (e.g. Internet).

Fluctuating Link Capacity

The nature of high bit-error rates of wireless connection might be massive in a MANET. One end-to-end pathway can be shared by a number of sessions. The channel above which the terminals communicate is related to noise, fading, and interference, and has less bandwidth than a wired network. In some scenarios, the path between any pair of users can cross multiple wireless links and the link themselves can be heterogeneous.

Light Weight Terminals

In most of the cases, the MANET nodes are mobile devices with less CPU processing capability, small memory size, and low power storage. Such devices need optimized algorithms and mechanisms that implement the computing and communicating functions.

III. CHALLENGES OF MOBILE AD HOC NETWORKS

Ad hoc networking has been a popular field of study during the last few years. Approximately every feature of the network has been explored in one way or other at different level of problem. Yet, no final resolution to any of the problems is found or, at least, agreed upon. On the contrary, more questions have happen. The topics that need to be determined are as follows

- Scalability
- Routing
- Quality of service
- Client server model shift
- Security
- Energy conservation
- Node cooperation
- Interoperation

The approach to tackle above aspects has been not compulsory and probable update solutions have been discussed. In present research work one of the aspects "the routing" has been re-evaluate for appropriate protocol performing improved under dynamic condition of network.

IV. ISSUES TO BE CONSIDERED WHEN DEPLOYING MANET

The following are some of the main routing issues to be considered when deploying MANETs

Unpredictability of Environment: Ad hoc networks may be deployed in unknown terrains, dangerous conditions, and

even aggressive environments where the actual destruction of a node may be imminent. Depending on the environment, node breakdown may happen frequently.

Unreliability of Wireless Medium: Communication through the wireless medium is unpredictable and subject to errors. Also, due to varying environmental conditions such as high levels of stormy weather, the quality of the wireless link may be unpredictable.

Resource-Constrained Nodes: Nodes in a MANET are usually battery powered as well as limited in storage and processing capabilities. Furthermore, they may be situated in areas where it is not possible to revitalize and thus have restricted lifetimes. Because of these boundaries, they should have algorithms which are energy efficient as well as operating with partial processing and memory resources. The available bandwidth of the wireless medium may also be restricted because nodes may not be able to give up the energy consumed by operating at full connection speed.

Dynamic Topology: In an Ad hoc network may change continuously due to the mobility of nodes. As nodes shift in and out of range of each other, some associations break while new links between nodes are created.

As a result of these issues, MANETs are flat to several types of faults including the following-

Transmission Errors: The unreliability of the wireless medium and the unpredictability of the environment may lead to transmitted packets being distorted and thus received packet errors.

Node Failures: Nodes may fail at any time due to different types of unsafe conditions in the environment. They may also drop out of the network either voluntarily or when their energy supply is depleted.

Link Failures: Node failures due to changing ecological conditions may cause links between nodes to break. Link failures cause the source node to discover new routes through other links.

Route Breakages: When the network topology changes due to link failures and link additions to the network, routes become out-of-date and thus incorrect. Depending upon the network transport protocol, packets promote through decayed routes may either ultimately be dropped or be delayed.

Congested Nodes or Links: Topology of the network & the character of the routing protocol, certain nodes or links could become more utilized. This will direct to either bigger delays or packet loss.

V. APPLICATIONS OF AD HOC NETWORKS

Ad hoc networks are suited for use in situations where an infrastructure is unavailable or to deploy one is not cost effective. The following are some of the important applications.

BUSINESS APPLICATIONS

One of many capable uses of mobile Ad hoc networks is in some business location, where the need for joint computing may be more important outer the office environment than inside, such as in a business gathering outer the office to short clients on a given task. Work has been going on to introduce the basic concepts of game theory and its function in telecommunications. The client-server model suffers the following major drawbacks: a user cannot work where there is no Internet infrastructure, or when the connection is too bad, or when the server is not available. Another drawback is that it limits the clients from randomly announcing, discovering and joining a networked.

Military Applications

Military applications have provoked early research on Ad hoc networks. The ability to quickly set up a network among military units in aggressive country without any infrastructure support can provide responsive forces with a considerable planned advantage on the battlefield. For instance, each soldier can carry a mobile device that represents one of the mobile nodes in an Ad hoc network linking all soldiers, tanks, and other vehicles as shown in Fig 1.2. Recent advances in robotics have also motivated the idea of automated battlefields in which unmanned fighting vehicles are sent into battle. Supporting military applications requires self-organizing mechanisms that provide robust and reliable communication in dynamic battle situations.

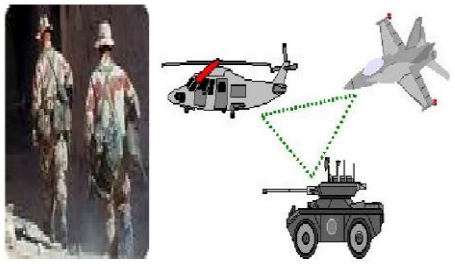

Fig 1.2 Recent advances in robotics

EMERGENCY OPERATIONS

Another promising application area for Ad hoc networks is emergency services, including search and rescue and disaster recovery operations. As an example of search and rescue, consider an airline that attaches small wireless devices to the life jackets under each seat. Suppose that the plane has mechanical problems and has to make an emergency landing in the water. Once search and rescue teams arrive at the landing site, they are provided with detailed information about the location of the sufferers through the transponders. As a result, the rescue teams can more effectively locate and reach the victims. The mobile devices could also monitor the essential signs of victims, such as heart rate or breathing rate, to prioritize the rescue of victims that are still alive. A European project called Wireless Deployable Network System (WIDENS) determined their work on this field. WIDENS have an idea that using Ad hoc network to interoperate with existing Trans-European Trunked Radio (TETRA) network which is used for public safety.

HOME, OFFICE, AND EDUCATIONAL APPLICATIONS

Ad hoc networks also have applications in home and office environments. The simplest and most direct application of Ad hoc networks in both homes and offices is the networking

of laptops, PDAs and other WLAN-enabled devices in the absence of a wireless base station. Another home application that falls within the Personal Area Network (PAN) class is wire replacement through wireless links, as in Bluetooth. All outside edge devices can connect to a computer through wireless Bluetooth links, eliminating the need for wired connections. Ad hoc networks can also enable streaming of video and audio among wireless nodes in the absence of any base station. For instance, *Ultra-Wideband (UWB)* provides a sufficiently high bandwidth (in the order of Gb/s) to support several multimedia streams. *Ultra-Wideband (UWB)*-equipped nodes can autonomously set up an Ad hoc network to stream high quality video and audio between several computers through wireless *Ultra-Wideband (UWB)* connections. Educational and recreational activities can also benefit from Ad hoc networks. For example, students attending a classroom can use their laptops to obtain the latest class material from a professor's laptop as the class progresses. Universities and campus settings, Virtual classrooms, Ad hoc communications during meetings or lectures are some of the educational applications of Ad hoc networks. On the recreational side, the mobility and traveling nature of Ad hoc networks enables better-off multi-user games that can incorporate user mobility and proximity into the virtual game environment.

VEHICULAR AD HOC NETWORK [VANET]

VANET is a form of Mobile Ad hoc network, to offer communications in the middle of nearby vehicles and between vehicles and nearby fixed equipment, usually explain as roadside equipment. The main goal of VANET is make available safety and comfort for passengers. To this end a special electronic device will be located inside each vehicle which will offer Ad hoc Network connectivity for the passengers. This network tends to control without any infrastructure or inheritance client and server communication. Each vehicle prepared with VANET device will be a node in the Ad hoc network and can receive and relay others messages through the wireless network. Most of the concerns of interest to MANETS are of interest in VANETS, but the details differ. Rather than affecting at random, vehicles tend to go in an organized fashion. The connections with roadside equipment can likewise be characterized quite accurately and lastly, most vehicles are restricted in their range of motion, for example by being constrained to follow a paved high way.

WIRELESS SENSOR NETWORKS

Advances in processor, memory and radio technology will allow small and low-priced nodes capable of sensing, communication and computation. Networks of such nodes called wireless sensor networks can coordinate to perform distributed sensing of environmental phenomena.

Wireless sensor networks can be considered as special case of mobile Ad hoc networks (MANET) with reduced or no mobility. WSNs were mainly aggravated by military applications. Later on the civilian application domain of wireless sensor networks have been measured, such as environmental and variety monitoring, disaster management, smart home production and healthcare etc. These WSNs may consist of heterogeneous and mobile sensor nodes, the network topology may be as easy as a star topology; the scale and thickness of a network varies depending on the application.

WIRELESS MESH NETWORKS

Wireless mesh networks are Ad hoc wireless networks, which are formed to provide communication infrastructure using mobile or fixed nodes/users. The mesh topology offers choice path for data transmission from the source to the destination. It gives quick re-configuration once the firstly selected path fails. Wireless mesh network must be skilled of self-organization and self-maintenance. The main advantages of wireless mesh networks are high speed, low price, quick deployment, high scalability, and high accessibility. It works on 2.4 GHz and 5 GHz frequency bands, depends on the physical layer use. For example, if IEEE 802.11a is used, the speed can be up to 54 Mbps. An application case of wireless mesh network might be a wireless mesh networks in a housing zone, which the radio relay devices are built on top of the rooftops. In this situation, once one of the nodes in this residential area is ready with the wired connection to the Internet, this node might be the gateway node. Others could connect to the Internet from this node. Other possible deployments are highways, industry zones, and institution of higher education campus.

VI. CONCLUSION

The main goal of this paper was to express that MANET. Ad hoc wireless networks are formed to provide communication using mobile and Ad hoc Mobile networks have issues Aries during implementation of MANET. This review aims to discover ad hoc network function, features and as well mentions about a variety of challenging issues.

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