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A STUDY ON MOBILE AD HOC NETWORKS PROTOCOLS WITH THEIR APPLICATIONS

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ABSTRACT

Mobile Ad Hoc Network (MANET) is a collection of two or more devices or nodes or terminals with wireless communications and networking capability that communicate with each other without the aid of any centralized administrator also the wireless nodes that can dynamically form a network to exchange information without using any existing fixed network infrastructure. The Ad Hoc Network must be able to adapt to changing network of this type at any time. and we talk in details in this paper all the information of Mobile Ad Hoc Network which include the History of ad hoc, wireless ad hoc, wireless mobile approaches and types of mobile ad Hoc networks, and then we present more than 13 types of the routing Ad Hoc Networks protocols have been proposed. In this paper, the more representative of routing protocols, analysis of individual characteristics and advantages and disadvantages to collate and compare, and present the all applications or the Possible Service of Ad Hoc Networks

KEYWORDS

Wireless Ad Hoc Networks, Mobility, Ad Hoc Network Routing Protocols, Wireless Mobile Approaches, MANET, mobile ad-hoc sensor network, QoS, Ah Hoc Applications.

1. INTRODUCTION

With the widespread rapid development of computers and the wireless communication, the mobile computing has already become the field of computer communications in high-profile link. Mobile Ad Hoc Network (MANET) is a completely wireless connectivity through the nodes constructed by the actions of the network, which usually has a dynamic shape and a limited bandwidth and other features, network members may be inside the laptop, Personal Digital Assistant (PDA), mobile phones, MP3 players, and digital cameras and so on. On the Internet, the original Mobility (mobility) is the term used to denote actions hosts roaming in a different domain; they can retain their own fixed IP address, without the need to constantly changing, which is Mobile IP technology. Mobile IP nodes in the main action is to deal with IP address management, by Home Agent and Foreign Agent to the Mobile Node to packet Tunneling, the Routing and fixed networks are no different from the original; however, Ad Hoc Network to be provided by Mobility is a fully wireless, can be any mobile network infrastructure, without a base station, all the nodes can be any link, each node at the same time take Router work with the Mobile IP completely different levels of Mobility. Early use of the military on the Mobile Packet Radio Networked in fact can be considered the predecessor of MANET, with the IC technology advances, when the high-tech communication equipment, the size, weight continuously decreases, power consumption is getting low, Personal Communication System (Personal Communication System, PCS) concept evolved, from the past few years the rapid popularization of mobile phones can be seen to communicate with others anytime, anywhere, get the latest information, or exchange the required information is no longer a dream, And we have

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gradually become an integral part of life.

2. RELATED BACKGROUND

Nowadays, the information technology will be mainly based on wireless technology, the conventional mobile network and cellular are still, in some sense, limited by their need for infrastructure for instance based station, routers and so on. For the Mobile Ad Hoc Network, this final limitation is eliminated, and the Ad Hoc Network are the key in the evolution of wireless network and the Ad Hoc Network are typically composed of equal node which communication over wireless link without any central control. Although military tactical communication is still considered as the primary application for Ad Hoc Networks and commercial interest in this type of networks continues to grow. And all the applications such as rescue mission in time of natural disasters, law enforcement operation, and commercial as rescue and in the sensor network are few commercial examples, but in this time it's become very important in our life and they become use it.

3. WIRELESS AD HOC NETWORKS

MANET is a collection of two or more devices or nodes or terminals with wireless communications and networking capability that communicate with each other without the aid of any centralized administrator also the wireless nodes that can dynamically form a network to exchange information without using any existing fixed network infrastructure. All the nodes or devises responsible to organize themselves dynamically the communication between the each other and to provide the necessary network functionality in the absence of fixed infrastructure or we can call it ventral administration, It implies that maintenance, routing and management, etc. have to be done between all the nodes. This case Called Peer level Multi Hopping and that is the main building block for Ad Hoc Network. Therefore, Ad Hoc Networks form sort of clusters to the effective implementation of such a complex process. In the following figure 1 will shows some nodes forming ad hoc networks, and there are some nodes more randomly in different direction and different speeds.

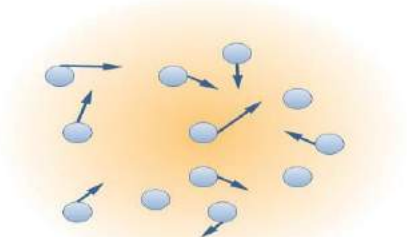

Figure 1. Ad Hoc Network: Nodes mover randomly in different direction and different speeds

4. Wireless Mobile Approaches

The past decade the Mobile Network is the only one much important computational techniques to support computing and widespread, also advances in both software techniques and the hardware techniques have resulted in mobile hosts and wireless networking common and miscellaneous.

4.1. Infrastructure Wireless Networks

In this architecture that allow the wireless station to make a communication between each other, and this type relies on the third fixed party and we call it a Base Station, as shows in this figure 2, At this point, the communicating nodes do not need to know anything about the route from one to another. All that matters is that the both the source and the destination nodes are within the transmission range for the Base Station and then if there's any one loses this condition, the communication will frustration or abort.

Figure .2. Shows of the infrastructure network

4.2 Infrastructureless Wireless Networks:

The mobile wireless network As is well known a Ad Hoc Network MANETs, As has been previously defined in the Bidder is a collection of two or more devices or nodes or terminals with wireless communications and networking capability.

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In figure 3 we will see a small example for the Ad Hoc networks, to explain the work for the Ad Hoc network.

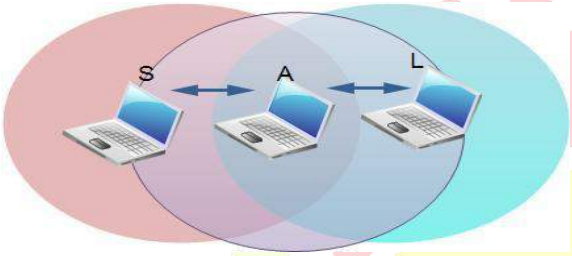

Figure 3. Illustration of the infrastructureless networks (Ad Hoc Networks)

This figure illustrates the modus operandi of Ad Hoc networks, there's a three nodes Ad Hoc Network (S, A, L), the source node (S) need to make a communication with the destination node
(L) and both of them (S, L) not in the same transmission range of each others, here both they must use the node (A)to send/ receive or forewords the Packets from source to the destination that means from node to another node.(R) is a node work as host and router in the same time .
Also as we know the definition for the router is an entity that determines the path to be used in order to forward a packet towards its last destination. And then the router chooses the next node to which a packet should be forwarded according to its current understanding of the state of the network.

5. Types of Ad hoc network

The wireless Ad Hoc Network divided into two main types, firstly quasi-static Ad Hoc Network secondly, Mobile Ad Hoc Network (MANET). In the quasi-static Ad Hoc network the nodes may be portable or static, because the power controls and link failures, the resulting network topology may be so active. The Sensor Network is an example for the quasi -static Ad Hoc Network [14]. In the Mobile Ad Hoc network (MANET) here the entire network may be mobile and the nodes may move fast relative to each other. And now we will discuss both of them.

5.1 Mobile Ad Hoc Networking (MANET)

Mobile Ad hoc Networking (MANET) is a group of independent network mobile devices that are connected over various wireless links. It is relatively working on a constrained bandwidth. The network topologies are dynamic and may vary from time to time. Each device must act as a router for transferring any traffic among each other. This network can operate by itself or incorporate into large area network (LAN).

There are three types of MANET. It includes Vehicular Ad hoc Networks (VANETs), Intelligent Vehicular Ad hoc Networks (InVANETs) and Internet Based Mobile Ad hock Networks (iMANET).

5.2 Mobile Ad Hoc Sensor Network

A mobile ad-hoc sensor network follows a broader sequence of operational, and needs a less complex setup procedure compared to typical sensor networks, which communicate directly with the centralized controller. A mobile ad-hoc sensor or Hybrid Ad Hoc Network includes a number of sensor spreads in a large geographical area.
The Wireless ad-hoc sensor networks [16] are now getting in style to researchers. This is due to the new features of these networks were either unknown or at least not systematized in the past. There are many benefits of this network, it includes:

- Use to build a large-scale networks
- Implementing sophisticated protocols
- Reduce the amount of communication (wireless) required to perform tasks by distributed and/or local precipitations.
- Implementation of complex power saving modes of operation depending on the environment and the state of the network.

6. The Traffic Types in the Ad Hoc Networks

The Traffic Types in the Ad Hoc Networks are so different from the infrastructure wireless network, and then now we will see these types. The first one Peer to Peer (P2P) the second remote to remote and lastly dynamic traffic. So now we will discuss every one [19].

Firstly, Peer to peer: communication between two nodes in the same area, that means which are within one hop. Network traffic (in bits per second) is usually fixed. **Secondly**, remote to remote: Communication between two nodes beyond a single hop, but maintain a stable route between them. This may be the result of a number of Nodes, to stay

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within the range of each other in one area or may move as a group. Finally, Dynamic traffic: its will happened when the nodes are movie dynamically around and then the routers must be reconstructed.

6.1 Infrastructures Wireless LAN

In this kind of network as we shows in the figure 4, the network in any architecture will be an access point; its function is one or more of the wireless local area network and the existing cable network systems to link, so that stations within the wireless local area network and external nodes can connect with each other.

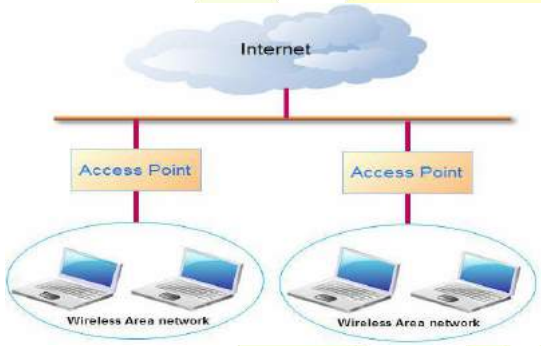

Figure 4. Infrastructure wireless LAN Architecture.

6.2 Ad Hoc Wireless LAN

That means it's without or relies on infrastructures wireless local area network, which only targeted at local area network within the framework of each machine is able to be linked up into networks, shows the figure 5 for Ad Hoc Wireless network.

Figure 5. Wireless Ad Hoc Network

7. The fundamentals for the Mobile Ad Hoc Networks:

According for example to IETF RFC 2501, MANET has characteristics can be divided into the following sections:

7.1 Dynamic topologies: nodes can move freely, network topology may change rapidly, restructuring, but also may also have symmetric and asymmetric links.

7.2 Bandwidth-constrained, variable capacity links Compared with the wired network environment, the capacity of the wireless link itself is relatively small, but also susceptible to external noise, interference, and signal attenuation effects.

7.3 Energy-constrained operation A laptop or handheld computers are often used batteries to provide power, how to save electricity in the context of depletion of system design is also
necessary to consider the point.

7.4 Limited physical security Network Security With the network deeply embedded in our daily lives and the benefits have become increasingly important in the wireless network to provide security support is also an important issue.

8. Ad Hoc Network Routing Protocol Performance Issues

As the MANET with the traditional wired, fixed networks have many different characteristics, so to design a suitable routing protocol for MANET operating environment must also consider the different directions, the following sub-qualitative and quantitative aspects of the discussion:

8.1 on the qualitative aspects, can be divided into

8.1.1 *Distribution operation*: due to the existence of MANET where there is no prerequisite for the construction of the underlying network, so routing can not rely on a particular node to operate.

8.1.2 *Loop-freedom*: all the routing protocol should be consistent with the characteristics; we must ensure the normal work in order to avoid waste of bandwidth.

8.1.3 *Demand-based operation*: In order to reduce the burden on each node, if the link is not so much the demand should be considered when using On-demand approach to the establishment of the path, and only when the need for a particular path query, the establishment of the path.

8.1.4 *Proactive operation*: with the On-demand

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concept of the contrary, if the network resources fairly adequate, proactive table-driven approach could speed up the path to the establishment of speed.

8.1.5 *Security*: Because it is the wireless environment, to how to ensure the security of the connection can not be ignored will be part of network security is also a MANET from theory to implementation of the key challenges.

8.1.7 *Unidirectional link support:* MANET nodes have heterogeneous characteristics, and some may be notebook computers, and some may be PDA, and some might be even smaller devices, in this environment, the transmission characteristics of asymmetric more significant than the wired environment.

8.2 On the quantity, can be divided into

8.2.1 *End-to-end data throughput and delay*: data transmission rate and delay in the case that every routing protocol must take into account the focus should be how to find the best path? Is the maximum bandwidth or minimum latency, or the link to the most stable? Considered more likely to make more complicated routing protocol, but it is possible to significantly improve the transmission quality.

8.2.2 *Route Acquisition time:* While the table-driven generally higher than on-demand performance good, but many of the former to pay the price, which, if properly designed, for
example, there is more commonly used in the path cache, or a certain fixed path , can improve the path to the establishment of time.

8.2.3 *Percentage Out-of-order delivery:* real-time data for this part of the more stringent requirements, and general information will not affect how and upper TCP cooperation is also IP routing work.

8.2.4 *Efficiency:* the simplest method, the smallest control overhead done the most complete, most powerful feature is a common goal for all routing protocol.

9. Types of Ad Hoc Protocols

Ad Hoc Network routing protocols is divided to three type of routing protocols, which that depending on a different of routing protocols [20-26].

9.1 Oriented routing table (Table-driven)

It is an active routing environment in which the intervals between the wireless nodes will send medical information with more paths. Each wireless node is on the basis of information gathered recently to change its route table. When the network topology change makes the original path is invalid, or the establishment of any new path, all nodes will receive updates on the status path.

9.2 Demand-driven (On-demand)

When needed to send packets only it began to prepare to send the routing table. When a wireless node needs to send data to another wireless node, the source client node will call a path discovery process, and stored in the registers of this path. The path discovery procedure can cause delays and the average delay time is longer [27].

9.3 Hybrid

It is an improvement of the abovementioned two, or the combination of other equipment, such as global positioning system (GPS) and other equipment, participate in the study of mechanisms to facilitate the routing of the quick search, and data transmission.[28,29]

However, there are already more than 13 kinds of the above routing protocol have been proposed, following the more representative for several separate presentations, and to compare their individual differences lie. And then we will discuss about everyone and we will show the way to works everyone works.

10. The compare between Proactive versus Reactive and then Clustering and Hierarchical Routing

10.1 Proactive versus Reactive Approaches

Ad hoc routing protocols can be classified as into two types; proactive or On Demand (reactive) base on each own strategy [56]. Proactive protocols demand nodes in a wireless ad hoc network to keep track of routes to all possible destinations.

10.2 Clustering and Hierarchical Routing

Scalability is one of the major tribulations in ad hoc networking. The term scalability in ad hoc networks can be defined as the network's capability to provide an acceptable level of service to packets even in the presence of a great number of nodes in the network.

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11. Existing Ad Hoc Protocols

For the Ad Hoc network there are more than 13 kinds of the above routing protocol have been proposed, following the more representative for several separate presentation, and to compare between them, and for more dilates about existing ad hoc network protocols [62].

11.1 Destination-Sequenced Distance-Vector Routing (DSDV)

Destination-Sequenced Distance-Vector Routing [30, 61] is based on traditional Bellman-Ford routing algorithms were developed by the improvement, and a routing table-based protocol.

11.2 Global State Routing (GSR)

Global State Routing (GSR) [58] is almost the same as DSDV, because it has the idea of link state routing but it makes a progress by decreasing the flooding of routing messages.

11.3Cluster head Gateway Switch Routing (CGSR)

Cluster head Gateway Switch Routing [31] is to build from the DSDV above a routing protocol, using a cluster head to manage a group of action nodes.

11.4 Wireless Routing Protocol (WRP)

Wireless Routing Protocol [32] makes use of the routing table at each node in the record to complete the routing, and DSDV with CGSR difference is that.

11.5 Fisheye State Routing (FSR)

Fisheye State Routing (FSR) [59] is an enhancement of GSR. The large size of update messages in GSR dissipates a substantial amount of network bandwidth.

11.6 Ad Hoc On-Demand Distance Vector Routing (AODV)

Ad Hoc On-Demand Distance Vector Routing using distance-vector concept [33,34,35], but in several different ways and the above is that, AODV does not maintain a routing table.

11.7 Dynamic Source Routing (DSR)

Dynamic Source Routing [37,38,39] As the name suggests is the use of the concept of source routing, the routing information that is directly recorded in the inside of each packet, but to be in the MANET environment, the use of such a special.

11.8 Temporally Ordered Routing Algorithm (TORA)

Temporally Ordered Routing Algorithm [40, 41] (TORA). concept of link reversal will be used in MANETS become a kind of decentralized routing algorithms, from the beginning need to route the data sender to the destination.

11.9 Cluster Based Routing protocol (CBRP)

In Cluster Based Routing protocol (CBRP) [60], all the nodes are separated into clusters. In order to arrange the cluster, the following algorithm is used. When a node comes up, it will go into the "undecided" state and broadcasts a Hello message.

11.10 Associativity Based Routing (ABR)

Associativity Based Routing [42, 43, 44] is primarily designed to focus on the MANET where links between nodes, unstable relations, and therefore uses the concept of associativity stability, is used to indicate a node relative to the adjacent node, link stability ABR also designed the path when the link failure, when the reconstruction method.

11.11 Signal Stability Routing (SSR)

Signal Stability Routing and ABR also added a link to the consideration of stability, is divided into Dynamic Routing Protocol with Static Routing Protocol in two parts. DRP and ABR, as the use of adjacent nodes in each other to define the beacon transmission links are stable, but the DRP only record is strong or weak, that is, a qualitative classification of links, rather than the ABR quantified associatively tick down the value.

11.12 Core-Extraction Distributed Ad hoc Routing algorithm (CEDAR)

Core-Extraction Distributed Ad hoc Routing algorithm with the above in several different parts of routing protocol is the core use [45]. The original Core is used in the Core Based Tree (CBT), the used to indicate where one or more network nodes are given a special feature may be a relay point for all paths, or the management of certain special features exclusive, In CEDAR, MANET where some of the

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nodes have been selected for storage of local area link state, and is responsible for calculating the node within the region and select a path.

11.13 Zone Routing Protocol (ZRP)

Zone Routing Protocol combines the path to the establishment of two kinds of reactive and proactive way [46] on the one hand enables the network to keep the record inside a node near the node routing information when a node wants to communicate with neighboring nodes in the path when you can get immediate information, but if you want to, and distant node links, only allow web of a small number of nodes involved in routing.

Quality of Service

13. Application in Ad hoc Networks

Ad Hoc Network became so important in our circle life, because can be applied anywhere where there is little or without communication infrastructure or may be the existing infrastructure is expensive to use. Also the Ad Hoc Networking allows to nodes or devices to keep the connections to the network for as long as it's easy to add and to remove to the end of the network.

13.1 Military battlefield. Military equipment currently is equipped with the state of the art computer equipment. Ad hoc networking help the military with the commonplace network technology to maintain information network between military personnel's, vehicles, and military information head quarters.

13.2 Commercial sector. Ad hoc network can be applied in emergency or rescue operations for disaster relief efforts for example in fire, flood, or earthquake and so on.

With the rapid development of Internet technology, when people for the Best effort service is no longer satisfied, how to get more bandwidth, how to reduce the mistakes, how to reduce the delay phenomenon, making Quality of Service (QoS) related research, including the Integrated Service (RSVP), Differentiated Service, etc…

12. Application in Ad hoc Networks

Ad Hoc Network became so important in our circle life, because can be applied anywhere where there is little or without communication infrastructure or may be the existing infrastructure is expensive to use.

Emergency rescue operations will go to places where communications are impermissible.

13.3 Local level. Ad hoc networks can autonomously link immediate and temporary multimedia network by using notebook or palmtop computers to distribute and allocate information among conference or classroom participants. Besides, it can also be applied for home networks where devices can be link.

13.4 Personal Area Network (PAN) . Short-range MANET can simplify the intercommunication between a lot of mobile devices such as a PDA, a laptop, and a cellular phone and there are a lot of new devices in this for MANETs. Wired cables can easily be replaced with wireless connections. Ad hoc network enhances the access to the Internet or other networks by means of Wireless LAN (WLAN), GPRS, and UMTS. The PAN is an upcoming application field of MANET for the future computing technology.

14. CONCLUSIONS

In this paper we presented an exhaustive survey about the Mobile Ad Hoc Network (MANET) we distinct the characteristics of traditional wired networks, wireless ad hoc networks, wireless mobile approaches and types of ad hoc network as well as all the existing ad hoc protocols, and we comparison between the different papers, most of its conclusions pointed to a phenomenon, not a routing protocol can adapt to all environments, whether it is Table-Driven, On-Demand or a mixture of two kinds, are limited by the network characteristics; even though the same part of the Agreement On-Demand also due to the differences in the mode of operation

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applicable to different types of network. Also we discussed in this paper the relevant Ad Hoc Network on a multicast (Multicasting), Applications on Ad Hoc Networks, QoS and other topics will be able to see the latest research results, can be expected is that the Ad Hoc Network needs and applications will start to appear in recent years, Ad Hoc Network-related research have become the current Internet trends One of the most anticipated technology.

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