International Journal of Scientific Research Engineering & Technology (IJSRET)
Volume 2 Issue 12 pp 881-885 March 2014 www.ijsret.org ISSN 2278 – 0882

A Study on Mobile Ad hoc Networks and the Routing Protocols

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ABSTRACT
Mobile Ad-hoc NETwork (MANET) is a self-configurable, Infrastructure less, autonomous and self-healing system of nodes using wireless links. MANETs fall into the category of wireless networks in which each device can act as a source, destination and a moving router and can communicates with other devices in its range. In this paper we are concerned to discuss about MANET and their routing protocols.

Index terms: MANET, Reactive, Proactive, Hybrid, Geographical, Multipath routing protocols.

I. INTRODUCTION
The earliest of MANETs were called "packet-radio" networks, first sponsored by the United States (U.S.) Defense Advanced Research Projects Agency (DARPA) in the early 1970s. It is interesting to note that some early packet-radio systems predated the Internet and, indeed, were part of the motivation of the original Internet protocol (IP) suite. Later DARPA experiments included the Survivable Radio Network (SURAN) project, which took place in the 1980s. The third wave of academic activity on Wireless Ad-Hoc Networks started in the 1990s, especially with the wide usage of inexpensive 802.11 radio cards for personal computers [3].

As the necessity of exchanging and sharing of data increases, users demand ubiquitous, easy connectivity, and fast networks whether they are at work, at home, or on the move. Moreover, these users are interested in interconnecting all their personal electronic devices (PEDs) in an *ad hoc* fashion. This type of network is referred to as Mobile Ad hoc NETwork (MANET) [6]. Wherever there is no infrastructure or it is expensive to deploy a network easily, under such conditions MANET's are very helpful. Some of the applications of MANETs are military, industry, research, etc. Mobile ad hoc networks (MANETs) are composed of a set of stations (nodes) communicating through wireless channels, without any fixed backbone support. Applications of MANETs are not just limited to, military operations, security, emergency, and rescue operations; they are used in environment which offers very limited availability of network topology and time.

One of the major challenges in MANET is frequent changes in the network topology. Since the network is mobile, the mobile hosts introduce new challenges compared to wireless and wired network during design and implementation stage. The challenges in the network lies in considering the special characteristics of the MANET and make balanced use of computation and communication resources. Most of the available literature in this emerging technology concentrates on physical and networking aspects of the subject. One of the important requirements for successful deployment of MANET is the careful evaluation of performance and finding out alternative algorithms, and routing protocols prior to their implementation [2]. In light of this, the purpose of this paper is to focus on aspects of mobile ad hoc networking and their routing protocols. Fig. 1 shows a typical MANET arrangement.

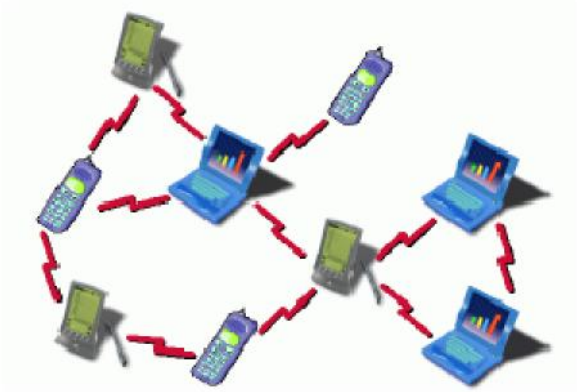

Fig. 1: A typical MANET arrangement.

II. CHARACTERISTICS

Regardless of the application, there are certain critical features or characteristics that can determine the efficiency and effectiveness of the Ad hoc Networks. These characteristics are:

A. Mobility
Mobile Ad hoc Networks are self-configuring network of nodes connected in wireless links. Rapid deployment in areas with no infrastructure often implies that the users must explore an area and form teams that in turn coordinate among themselves to create a network to complete a task or a mission. We can have individual random mobility, group mobility,

motion along preplanned routes, etc. The mobility model can have major impact on the selection of a routing scheme and can thus influence performance.

B. Multihopping

A multihop network is a network where the path from source to destination traverses through several other nodes. Ad hoc nets often exhibit multiple hops for obstacle negotiation, spectrum reuse, and energy conservation. Battlefield covert (secured) operations also favour a sequence of short hops to reduce detection by the enemy.

C. *Self-organization*

The ad hoc network must autonomously determine its own configuration parameters including: addressing, routing, clustering, position identification, power control, etc. In some cases, special nodes (e.g., mobile backbone nodes) can coordinate their motion and dynamically distribute in the geographic area to provide coverage of disconnected islands.

D. *Energy conservation*

Most ad hoc nodes (e.g., laptops, PDAs, sensors, etc.) have limited power supply and no capability to generate their own power (e.g., solar panels). Energy efficient protocol design (e.g., MAC, routing, resource discovery, etc) is critical for longevity of the mission.

E. *Scalability:*

In some applications (e.g., large environmental sensor fabrics, battlefield deployments, urban vehicle grids, etc) the ad hoc network can grow to several thousand nodes. For wireless "infrastructure" networks scalability is simply handled by a hierarchical construction. The limited mobility of infrastructure networks can also be easily handled using Mobile IP or local handoff techniques. In contrast, because of the more extensive mobility and the lack of fixed references, pure ad hoc networks do not tolerate mobile IP or a fixed hierarchy structure. Thus, mobility, jointly with large scale is one of the most critical challenges in ad hoc design.

F. *Security*

The challenges of wireless security are well known. A lot of the work done in general wireless infrastructure networks extends to the ad hoc domain. The ad hoc networks, however, are even more vulnerable to attacks than the infrastructure counterparts. Both active and passive attacks are possible. An active attacker tends to disrupt operations Due to the complexity of the ad hoc network protocols these active attacks are by far more difficult to detect/fold in ad hoc than infrastructure nets. Passive attacks are unique of ad hoc nets, and can be even more insidious than the active ones. The active attacker is eventually discovered and physically disabled/eliminated. The passive attacker is never discovered by the network. Like a "bug", it is placed in a sensor field or at a street corner. It monitors data and control traffic patterns and thus infers the motion of rescue teams in an urban environment, the redeployment of troops in the field or the evolution of a particular mission. This information is relayed back to the enemy headquarters via special communications channels (eg, satellites or UAVs) with low energy and low probability of detection. Defence from passive attacks require powerful novel encryption techniques coupled with careful network protocol designs.

G. *Connection to the Internet*

As earlier discussed, there is merit in extending the infrastructure wireless networks opportunistically with ad hoc appendices. For instance, the reach of a domestic wireless LAN can be extended as needed (to the garage, the car parked in the street, the neighbor's home, etc) with portable routers. These opportunistic extensions are becoming increasingly important and in fact are the most promising evolution pathway to commercial applications. The integration of ad hoc protocols with infrastructure standards is thus becoming a hot issue. [3]

III. DESIGN ISSUES

The main reason for designing a MANET is to establish a communication network and communicate with each other without any fixed infrastructure in a wireless medium. In an electromagnetic propagation of frequencies higher than 100MHz are limited by the propagation distance. Therefore, for a mobile hosts to communicate with each other beyond the transmission range needs Multihop routing protocol. In this Multihop routing, the transmission of a message from one host to another is done through intermediate nodes. MANETs inherit all the problems related to mobile computing and wireless networking and also few issues due to lack of infrastructure. The unique design challenges that need to be considered are deployment, coverage, connectivity, and so on.

A. Deployment

1) Deployment of the network is dynamic and due to network mobility life time is very less.
2) MANETs are cost effective, because no cost of laying cables and maintenance.

3) Minimal configurations are enough to deploy a partial functioning network.
4) Deployment is adaptable according to the application requirements.

B. Coverage

1) Coverage depends on the range of communication.
2) If the network is covered in a wider area sufficient coverage has to be provided for effective transmission.
3) There are chances of mixed architecture of fixed and static entities in a network like Home networking, So coverage area is determined based on the applications also.

C. Connectivity

1) Since MANETs have mobile hosts whose topology changes instantly. Connectivity plays a very important role.
2) If all these nodes lie within the transmission range of each other, the network is said to be *fully* connected.
3) But in practice, this fully connected network does not exist. So Multihop routing is required.
4) The protocols are designed to keep the network structure *stable* as long as possible. [1]

IV. ROUTING PROTOCOLS

Efficient, dynamic routing is one of the key challenges in mobile ad hoc networks. In the recent past, this problem was addressed by many research efforts, resulting in a large body of literature. We survey various proposed approaches for routing in mobile ad hoc networks such as (Fig. 2 --- Routing protocols):

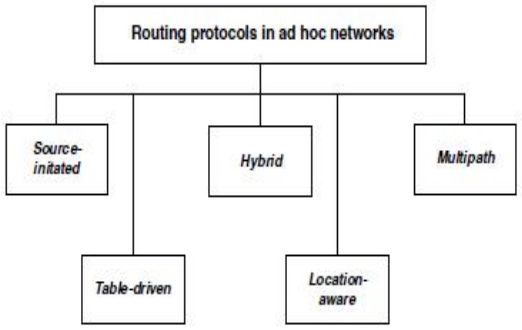

Fig. 2: Routing protocols

A. Source-initiated (reactive or on-demand),
B. Table-driven (proactive),
C. Hybrid,
D. Location-aware (geographical),
E. Multipath,

A. Source-Initiated Protocols (Reactive or on-demand)

Source-initiated routing represents a class of routing protocols where the route is created only when the source requests a route to a destination. Thus, the control packets are broadcasted only when the source is being initiated. So, the broadcast overhead is reduced. In these protocols, there are two phases to establish routes to destination. These two phases are route discovery and route maintenance. A route discovery procedure is invoked when the route is requested by the source and a special route request packets are flooded to the network starting with the immediate neighbors. Once a route is formed or multiple routes are obtained to the destination, the route discovery process comes to an end. Since the nature of the ad hoc network is highly mobile, the topology of the network is changed often. When the route to destination is broken, the route maintenance phase is started to keep route available. The disadvantage of this method is, it suffers from large end to end delay to have route available before sending data packets in large networks. An example of reactive routing protocol is Dynamic Source Routing (DSR).

B. Table-Driven Protocols (Proactive)

Table-driven protocols always maintain up-to-date information of routes from each node to every other node throughout the network. Routing information is stored in a routing table in each of the nodes and route updates are propagated throughout the network to keep the routing information as recent as possible. Different protocols keep track of different routing state information; however, each has the common goal of reducing route maintenance overhead as much as possible. When a source node wants to send data to a destination node, it searches the routing table to find a destination node's data match. The advantage of such a method is that the route is already known. But the disadvantage is that the control packets overhead are large since they are sent periodically to maintain all routes although not all routes will be necessarily used. Thus these types of protocols are not suitable for highly dynamic networks due to the extra control overhead generated to keep the routing tables consistent and fresh for each node in the network. An example of Table–driven or proactive routing protocol

is Destination Sequenced Distance Vectored (DSDV) routing.

C. Hybrid Protocols

Hybrid routing schemes combine the power of on-demand and table-driven routing protocols. Table-driven (Static routing) is generally used at the border or out of the network where route changes are not frequent while in the core of the network on-demand routing has more significance. These schemes create a bridge between the two major types of routing protocols, and the overall performance obtained can be further improved. For example, one of the Hybrid routing protocols is Zone Routing Protocol (ZRP). Here, each node defines two zones: the inside zone and the outside zone. Each node maintains a neighbor table with n mobile nodes hops. These mobile nodes are considered to be in the inside zone of the node. Thus, the hybrid protocols act as table-driven protocols in the inside zone and reactive protocols in the outside zone. Each node periodically broadcasts control packets in the inside zone to build a routing table for all mobile nodes in the inside zone. When a node wishes to send data to a destination node that resides in the outside zone, it uses a reactive protocol (Soure-initiated). Thus, a route discovery phase is invoked to establish the route to the destination node.

D. Location-Aware Protocols (Geographic)

Location-aware routing schemes in mobile ad hoc networks assume that the individual nodes are aware of the locations of all the nodes within the network. These are also called as Position-Based Routing. The best and easiest technique is the use of the Global Positioning System (GPS) to determine exact coordinates of these nodes in any geographical location. This location information is then utilized by the routing protocol to determine the routes. There are two methods of forwarding data packets in position-based routing: greedy forwarding and directional flooding. In greedy forwarding, the next hop node is the closest in distance to destination. Greedy Perimeter Stateless Routing Protocol (GPSR) uses the greedy forwarding. In the directional flooding, the source node floods data packets in a geographical area towards the direction of the destination node. Location Aided Routing (LAR) uses directional forwarding flooding.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad (1)$$

$$\theta = \tan^{-1} \frac{(y_2 - y_1)}{(x_2 - x_1)} \qquad (2)$$

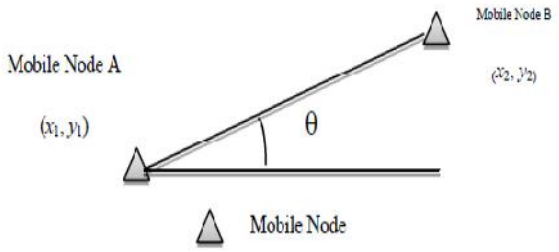

Fig. 3: Position-based routing protocol that uses GPS to determine mobile nodes (*x*, *y*) positions.

In the position-based routing protocols, node uses a directional antenna or GPS system to estimate its (x, y) position. If GPS is used, every node knows it's (x, y) position assuming z = 0. Fig. 3 shows two mobile nodes with their positions determined using GPS. The positions of the two mobile nodes in Fig. 1 are (x1, y1) and (x2, y2) respectively. Using Fig. 1, the distance d between the two mobile nodes is calculated using (1). The angle θ is defined as shown in Fig. 3 and is calculated using (2).

E. Multipath Protocols

Multipath routing protocols create multiple routes from source to destination. The main advantage of finding out multiple paths is that the bandwidth between links can be used more effectively and with greater reliability. It also helps during times of the network congestion, i.e., if any one route is being blocked by other node through congestion, the other route can be traced out and reach the destination node. Multiple paths are generated either by the source by initiating on demand routing or by using a predefined proactive approach. These are of greater significance because routes generally get disconnected quickly due to node mobility. For example in *CacHing and Multipath Routing Protocol (CHAMP)* each node maintains two caches: (a) a route cache containing forwarding information about the route and (b) a route request cache that contains the recently received and processed route requests. Initially the source mobile host sends the message through multiple paths. If any of the node which is closer to the destination cannot send the data packet to the destination. Then the node which is nearby, holding the route cache information along with a buffer to store packets of the node can send the information to the destination. A new route discovery is initiated when there is no available route. The destination replies back with a corresponding route reply packet. There may be multiple routes of equal length established, for each forwarded packet from the source. [4] [1]

V. APPLICATIONS

With the increase of portable devices as well as progress in wireless communication, MANET is gaining importance with the increasing widespread applications. The set of applications for MANETs is diverse, ranging from large-scale, mobile, highly dynamic networks to small, static networks that are constrained by power sources. Typical applications are:

A. Military battlefield

In future battlefield operations, autonomous agents such as Unmanned Ground Vehicles (UGVs) and Unmanned Airborne Vehicles (UAVs) will be projected to the forefront for intelligence, surveillance, strike, enemy antiaircraft suppression, damage assessment, search and rescue and other tactical operations. The agents will be organized in clusters (teams) of small unmanned ground, sea and airborne vehicles in order to launch complex missions that comprise several such teams.

B. Commercial sector

MANETs can be used in emergency/rescue operations for disaster relief efforts, for example, in fire, flood, or earthquake where in, rapid deployment of a communication network is needed. Others include, ship-to-ship ad hoc communication, law enforcement, etc.

C. Creating personal network

MANET can simplify the intercommunication between various mobile devices like personal digital assistant (PDA), a laptop, and a cellular phone. Such MANET extends the access to the internet or other networks by mechanisms such as Wireless Local Area Network (WLAN), Wireless Personal Area Network (WPAN), General Packet Radio Services (GPRS), and Universal Mobile Telecommunications System (UMTS).

D. Local level

MANETs can autonomously link an instant and temporary multimedia network using notebook computers or palmtop computers to spread and share information among participants at a conference or classroom. Home networks where devices can communicate directly to share information. This can also be formed as message-oriented application through internet.

E. Automotive/PC Interaction

The interaction between many wireless devices (laptop, PDA, and so on) being used in the car for different purposes can create an ad hoc network in order to carry out tasks more efficiently. An example can be finding the best possible mechanic shop to fix a car problem in a new city on the way to a meeting. [8] [1]

VI. CONCLUSION

A MANET is one of the most innovative and challenging areas of wireless networking. This is tending to become increasingly present in our day to day life. While considering the different networks and topologies, an ad hoc network is becoming a key step in the next-generation evolution of wireless data communication. In this paper we have concentrated on various design issues and the characteristics of MANET which are very essential parameters and also the routing protocols which needs to be taken care in the design of wireless network.

REFERENCES

[1] Azzedine Boukerche, “Algorithms and protocols for wireless and mobile ad hoc networks”, University of Ottawa, Canada, John Wiley & Sons, Inc., Hoboken, New Jersey,2009, p-p 129-164.

[2] Prasant Mohapatra, Srikanth V. Krishnamurthy University of California, Davis and University of California, Riverside, “AD HOC NETWORKS *Technologies and Protocols*”, ©2005 Springer Science & Business Media, Inc.

[3] Mohammed A. Abdala and Areej K. Al-Zuhairy, “Integration of Smart Antenna System in Mobile Ad Hoc Networks”, International Journal of Machine Learning and Computing, Vol. 3, No. 4, August 2013.

[4] Mohammad A. Mikki,” Energy Efficient Location Aided Routing Protocol for Wireless MANETs”, (IJCSIS) International Journal of Computer Science and Information Security Vol. 4, No. 1 & 2, 2009.

[5] Salman Naseer, S.A Hussain, I Raza, S R Chaudry, J. S. Mirza, M. H. Raza, “Mobile Ad-hoc Network Routing Protocols: A Simulation and Performance Analysis Using Multimedia Traffic”, Journal of Basic and Applied Scientific Research, J. Basic. Appl. Sci. Res., 2(10)9925-9930, 2012 © 2012, TextRoad Publication.

[6] Constantine A. Balanis, Panayiotis I. Ioannides,” Introduction to Smart Antennas”, Lecture #5, Copyright © 2007 by Morgan & Claypool.

[7] V.K.Taksande, Dr.K.D.Kulat, “Performance Comparison of DSDV, DSR, AODV Protocol with IEEE 802.11 MAC for Chain Topology for Mobile Ad-hoc Network using NS-2”, IJCA Special Issue on “2nd National Conference- Computing, Communication and Sensor Network” CCSN, 2011.

[8] Dr. Sunilkumar S. Manvi, Mahabaleshwar S. Kakkasageri, “Wireless and Mobile Networks Concepts and protocols”, Wiley India Pvt.Ltd, 2011, ch 8.