Various Routing Protocols for Routing in MANET- A Survey

***Rachana Barfa**
****Pratibha Nagaich**

ABSTRACT

A mobile ad-hoc network is an assortment of wireless mobile hosts, which establishes a momentary network without any assist of centralized administrator. The characteristics of an ad-hoc network can be explored on the base of routing protocols. The dynamic topology is the vital characteristic in which nodes frequently change their position. In the ad-hoc networks, there are mobile nodes such as personal digital assistance (PDA), smart phone and laptops; they have limited operational resources like battery power and bandwidth. Thus the control traffic is to be minimized, which is the main responsibility of routing protocols by selecting the shortest path and controlling the traffic. In this study work we focus on performance issues of routing protocols Optimized Link State Routing (OLSR), Ad Hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR), and Temporally Ordered Routing Algorithm (TORA) in mobility and standalone ad-hoc networks.

Keywords:- MANET, Performance Evaluation, Routing Protocols, Ad-hoc Network and Routing Challenges.

*Rachana Barfa, Student, Sagar Institute of research and technology Indore, rachanabarfa@gmail.com
**Pratibha Nagaich, Assistant Professor, Sagar Institute of research and technology Indore, Pratibha.nagaich@trubainstitute.ac.in

I. INTRODUCTION:

A form of wireless network where each node communicates with other node using multi-hop links without stationary infrastructure is called Ad-hoc network. According to [1], an Ad hoc network is crew of wireless mobile nodes that creates a network without any assist of centralized administrator. It uses multi-hope point-to-point (P2P) routing as an alternative of stationary network communication to offer network connectivity [2]. In such circumstances, due to partial range of mobile host in wireless transmission, each node needs to join up other node in order to communicate with each other and to reach to the destination if located far away. This communication involves the mechanism of finding paths from one end node to other through which data can be transferred.

Routing in ad-hoc networks has been a challenging task ever since the wireless networks came into existence. The major reason for this is the nature of ad-hoc networks where network topologies cannot be static [3]. The non-static nature of Ad-hoc networks raises various performance challenges for routing protocols.

The conceptual framework of routing involves decision as to what appropriate optimal routing paths should be taken for transferring the data (packets) through an internetwork. The first concept, i.e. determining an optimal path, is a very complex activity while the later one, i.e. forwarding data through selected path, is a straight forward activity [4]. In order to exchange information between different nodes, routing needs to be done by using different routing protocols. Therefore efficient routing protocols are key components of successful, reliable and proficient communications. Efficient routing protocol means that an optimal route selection is done by the protocol in different scenarios to improve the overall network performance [5].

1.1 Aims

The aim of this work is to assess the relative performance of routing protocols for the considered mobile ad-hoc network and to identify their performance challenges. The outcome for this study is in the form of quantitative results of efficiency of the routing protocols with reference to performance metrics.

II. BACKGROUND

Tourism MANET has a dynamic nature, which makes it ideal for different applications. This kind of network is more suitable in emergencies such as natural disasters due to quick deployment and minimal configuration. MANET is becoming more popular in the advance technology deployment devices such as mobile phones, MP3 players, and Wi-Fi capable laptops etc.

A panoptic research has been conducted on the performance of routing protocols by using NS2 network simulator. Different simulation environment and methods provide different results for the routing protocols of Mobile Ad-hoc Networks. However, there is still need to view in a broader way the effects of routing protocols that are not considered in the specific environment [10].

2.1 Literature Review

In [11] NS2 is used for the performance comparison of AODV, TORA, DSR, and DSDV. They concluded that generally, AODV outperforms TORA and DSR. The performance of simple link state protocols DSR and AODV has been studied in [12]. The conclusion of this comparison is that the DSR and AODV perform better when the network load is normal and if the traffic load is heavy the link state outperforms reactive protocol OLSR. In order to study the simulation affects on the performance another author has analyzed the DSDV and DSR [13].

The GloMoSim Simulator is used for the performance evaluation of DSR and On-demand protocol AODV [14]. The conclusion is that AODV outperforms DSR when the source sends data to different destinations and AODV suffers degradation in the average packet delivery rate when the sources send the data to a common destination. They point out the problems that may occur when common gateways are used and provided solutions to minimize this effect. In our project we use different simulation environment to analyze the similar situation of MANET when nodes send data to a common destination.

2.2 Wireless Network Types

The system that receives and transmits data over the air is referred to as wireless network. It has two main types, one is infrastructure network and the other is infrastructure-less or ad-hoc network.

2.3 Infrastructure Networks

A network with a fixed physical layout is called an infrastructure network. A central device is responsible for connecting all communicating devices through wireless or wired link. This central device is referred to as Access Point (AP), which is responsible for the management of network operations such as network security implementation, IP configuration. If a device is using wireless technique for connecting to AP, it can connect to any AP, which is in its wireless range depending on the security authorization from AP.

In the WiFi or cellular networks, which are infrastructure-based wireless networks, the wireless link has one-hop or multiple –hop up to the base station and the remaining routing is done with wired infrastructure. The bandwidth, topology, switching and routing resources of infrastructure networks are provisioned to ensure best result to the expected traffic [16].

2.4 Ad-hoc Network

A network is installed without fixed physical layouts, which are generally deployed in emergencies, or battlefield communication on temporary basis. When there is not an infrastructure network available or it is cost effective and devices need to connect for communication, multiple nodes are connected wirelessly. In these devices one or more devices act like nodes as well as routers [16].

Such a network is very easy to deploy and flexible, because devices are not bound to any agreement to stay connected. It can be categorized in following two types

- Static Ad-hoc Networks (SANET)
- Mobile Ad-hoc Networks (MANET)

2.5 Mobile Ad-hoc Networks

The MANET is collection of mobile clients and servers connected by wireless links. In this type of networks there is no fixed and centralized infrastructure. The nodes can freely move without care of topology [7].

As the MANET has limited bandwidth and mobile nodes, it needs to consider the issues of limited bandwidth, unreliable communication, topology change and energy efficiency of nodes while designing the MANET. The mobile nodes act as both hosts and routers as it can route and accept the traffic from neighbor nodes [17]. The challenges of self-configuration are announced when the network grows and also there are frequent re-associations and connection tearing.

In order to cope with the MANET dynamic nature, ad-hoc routing protocols like AODV, TORA, DSR, OLSR, ZRP and WRP are developed [15]. The traffic routing in the network and the battery power utilization of participating node are used to determine the effectiveness of routing protocol.

2.6 MANET Application

The self configuration and flexibility of MANET makes it suitable for a wide-range of applications. They can be implemented where there is no landline infrastructure and during the natural disasters like earthquake, in the area of flood, air plane or train crash area. They can also be used to extend the communication services as on airports hotspots. In the conferences communication the MANET is commonly used. Low cost of deployment and self-configuration makes it ideal nominee for such applications [15]. Some applications of ad-hoc network are Emergency Services in disaster recovery, Conferencing, Embedded Computing Applications, Sensor Dust, Home Networking, Personal Area Networks and Bluetooth, Automotive/ PC Interaction [16].

During the natural disaster, Wireless Interoperability for Microwave Access (WIMAX), a radio link is established in one area and MANET is established for the coverage extension to the affected areas. In this condition the nodes that are away from the base station depend on the intermediate nodes during the communication. The figure below shows the deployment of MANET on the radio link WIMAX.

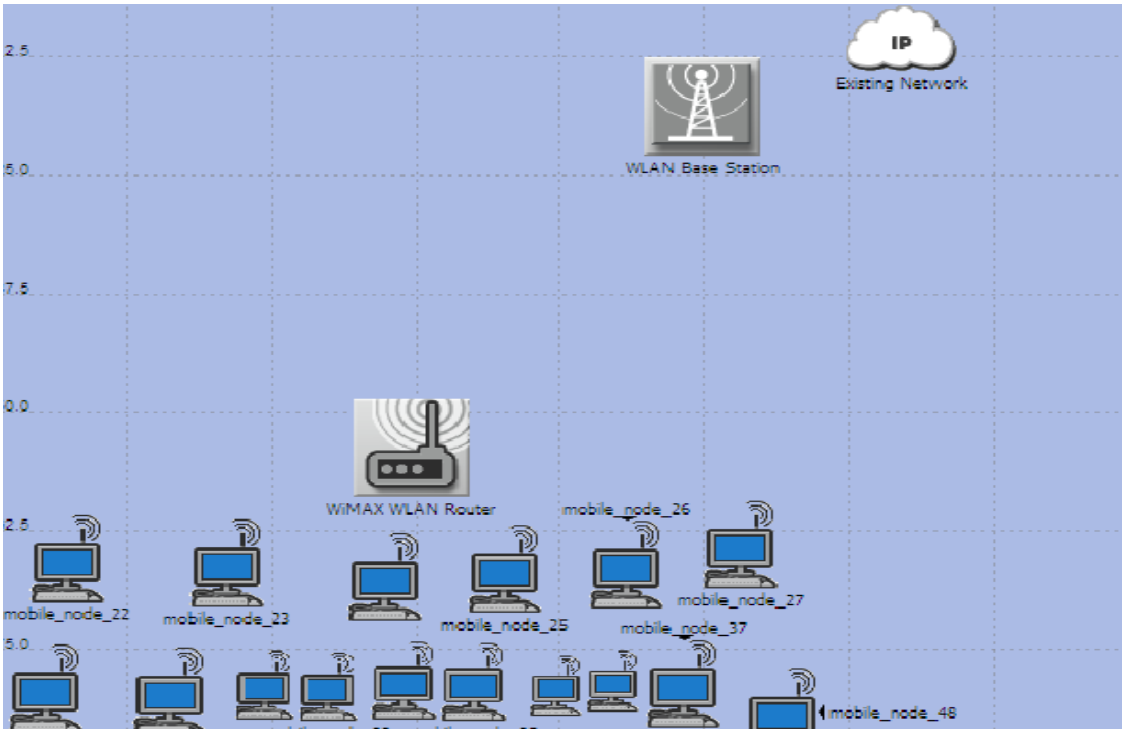

Figure 1: A Scenario of MANET Application

In the figure above there is a natural disaster hit area, where a radio link WIMAX, mobile nodes and a WLAN router forms a MANET in order to cover the whole area for communication. The WLAN router transforms between the WIMAX protocols, communication backbone and the ad-hoc protocols.

III. ROUTING PROTOCOLS IN MANETS

In this section, we describe the key concepts of ad hoc routing protocols. We describe two classes of routing protocols, first the proactive routing protocols in which we study the OLSR, we then explain the reactive ad-hoc routing protocols in which we study the AODV, DSR and TORA.

The function of ad hoc routing protocol is to control the node decisions when routing packets between devices in MANET. When a node joins or tries to join the network it does not know about the network topology. By announcing its presence or by listening from the neighbor nodes it discover the topology. In a network route discovery process depends on the routing protocol implementation.

For wireless ad hoc networks, several routing protocols have been designed and all these protocols are classified under two major fields of protocols called reactive or proactive. An ad hoc routing protocol with combination of these two is called a hybrid protocol [18].

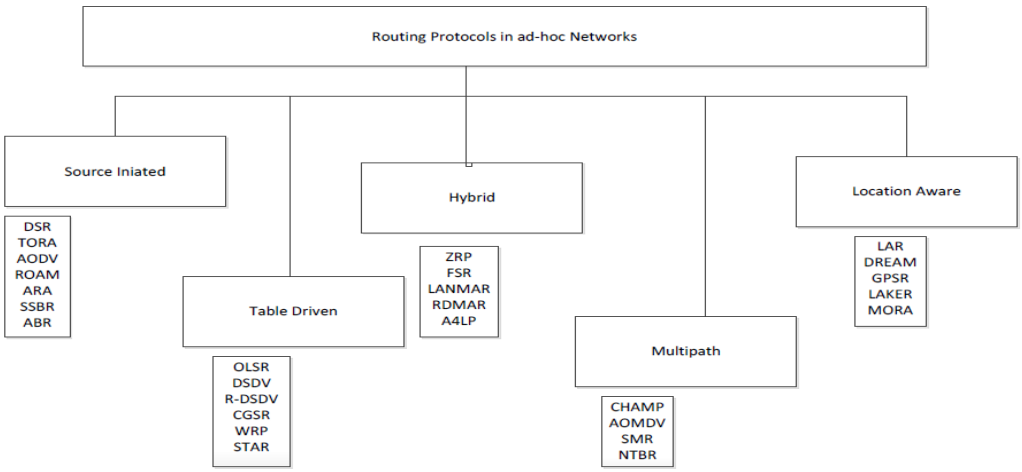

Figure 2: Ad-hoc Routing Protocols' Categories [16]

3.1 Types of Routing

There are two basic types of routing

1. Dynamic Routing
2. Static Routing

Dynamic Routing: The routing is done by the router. Taking decisions based on predefined scenario is called dynamic routing. In this routing the routing of traffic depends on the routing table. At run time the remote resource's location is decided. In this type of routing when the topology changes the router can exchange the information. The routers also know about the network and the topology information is added in the routing table of routers [19]. This routing is flexible; it has the ability to reduce the traffic overload. Different paths are used to forward the data packets from source to destination.

Static Routing: This kind of routing is done by administrators, who do it manually in order to send the packets of data in the desired destination. This setting cannot be changed. At design time the location of remote resources is defined. The routes of the network are configured manually and there are no routing tables build or used. The routers are bound to do which the administrator has informed it.

3.2 Proactive Routing Protocols

The purpose of proactive routing protocol is to maintain and build routing information for all nodes and it works independently of the router [20]. This is achieved by periodically transmitting the control messages. These protocols continuously broadcast control messages even if there is no data flow, due to this reason these protocols are not bandwidth efficient. The proactive routing

protocols have its advantages and disadvantages. One of the main advantages is that nodes can easily establish a session and can get routing information. When there is link failure its restructure process is slow, the nodes handles too much data for the route maintenance, which is the drawback of proactive routing protocols.

3.2.1 Optimized Link State Routing

OSR is proactive routing protocol for wireless ad-hoc networks that is used in mobile ad-hoc networks. WIMAX Mesh (Backhaul) also uses this protocol. OLSR has got the name because of its proactive nature. In order to discover their neighbors, the nodes get information of topology being used in the network by topology control (TC) and hello packets. Packets are not broadcasted by all nodes. Packets are only routed by multipoint relay (MPR) nodes. Source to destination routes are established well before their use.

There is a routing table kept by each node. These routing tables create higher routing overhead for OLSR compared to other reactive routing protocols. With the increase in number of routes the overhead not increases because new routes are not establishes when needed. It only decreases the delay for route discovery.

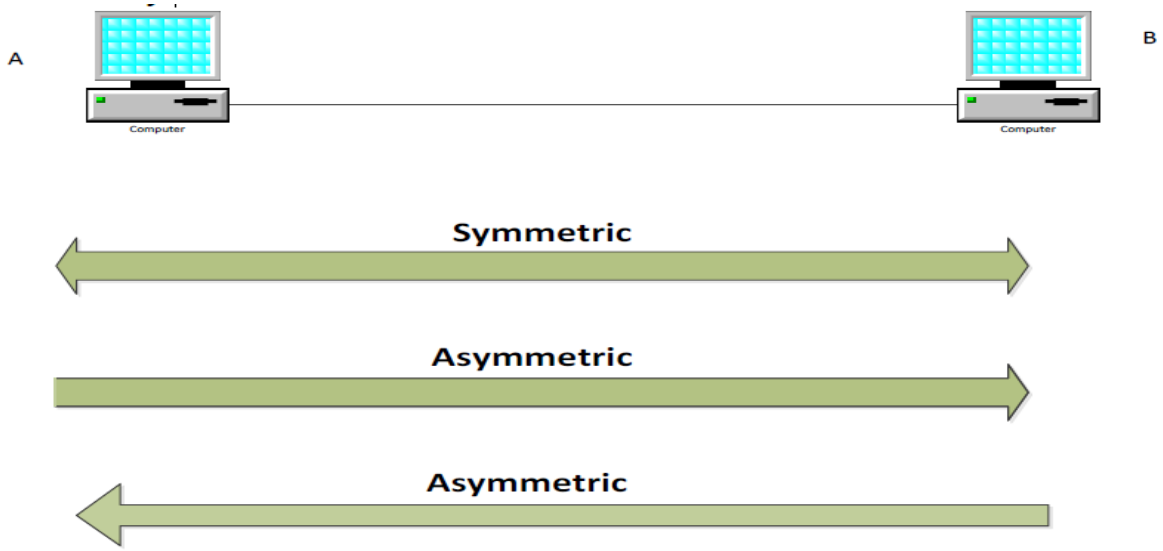

Figure 3: HELLO Message in MANET using OLSR

In OLSR, at predetermined interval Hello messages are periodically sent to the neighbor nodes in order to determine the link status. For instance, if node A and B are neighbors, Hello message is sent to node B by node A and if the message is successfully received by a node B then the link is called asymmetric. This is also true for node B if it sends a Hello message to node A. For two way communication the link is called symmetric as shown in figure 3.2. The information of neighboring nodes is contained by Hello messages. A node is built in network with a routing

table, which contains the information of multiple hope neighbors. After the symmetric connections are established, a minimal number of MPR nodes are selected to broadcast TC messages at a predetermined interval [20]. The information of selected MPR nodes is contained by TC message. Routing calculations are also handled by TC messages.

3.3 Reactive Routing Protocols

These protocols are bandwidth efficient. The routes are built on demand, which is accomplished by sending requests for routes in the network. The disadvantage of reactive routing protocols is that it offers high latency while finding the routes [21]. In our thesis we have considered DSR, AODV, and TORA.

3.3.1 Ad hoc On-demand Distance Vector (AODV)

In ad-hoc network AODV is a loop free protocol. It has the characteristic of self-starting in the mobile node environment. Route Maintenance and Route Discovery are its important mechanisms [6]. If a link gets failed, a notification is sent to the affected nodes and therefore, this invalidates the routes via failed link. It requires less memory overhead and establishes unicast routes between source and destination therefore the network utilization is minimal. AODV has low overhead and its on-demand nature does not burden the network. Routing traffic is minimal because routes are built on network demand. There is no need to keep information of those routes that are not being used by the network. When two nodes want to make a connection, the multi hop routes are built between mobile nodes by AODV. AODV uses destination sequence number (DSN) in order to avoid from counting to infinity. This feature distinguishes it from other algorithms. Sequence number based optimal routes are also selected by AODV [22].

3.3.2 Dynamic Source Routing (DSR)

The DSR, simple and efficient routing protocol is designed for multi-hop wireless ad-hoc networks. Using DSR, there is no need for administration or existing network infrastructure and the network is completely self-configuration and self-organizing. It is not table driven like AODV but it has on-demand characteristics and based on source routing [23]. The source routing is a technique in which the source of the packet determines the complete sequence of nodes through which to forward the data packets. The source routing has the advantage that there is no need to maintain the routing information by the intermediate hops. Due to routing decision of source it is different from link-state routing and table-driven routing [23].

IV. CONCLUSION

This study work report has the study, from this study, it is concluded that routing protocols plays very important role in the telecommunication and seamless communication. Different protocols has different qualities, the selection of a suitable protocol definitely increase the performance of network.

REFERENCES

1. David B.Johnson, David A. Maltz, "Dynamic Source Routing in Ad-hoc Wireless Network", Computer Science Department Carnegie Mellon University.
2. Dr. F. Scott, Dr. A. Luiz Dr. J. Ira and Dr. P. Charles, "Mobile Ad hoc network Routing Protocols Methodologies and Applications", Department of Computer Engineering ,Blacksburg Virginia, March 19, 2004.
3. "Mobile Ad Hoc Networks", http://w3.antd.nist.gov/wahn_mahn.shtml. [Accessed: April,28, 2010]
4. K. Gorantala, "Routing Protocols in Mobile Ad-hoc Networks", Department of Computer Science, Umeå University, June 15, 2006.
5. H. Jeroen, L. Benoit, M. Ingrid, D. Bart, and D. Piet, "Routing in mobile Ad hoc Networks", Department of Information Technology (INTEC), Broadband Communication Networks (IBCN).
6. Dr. G. Aditya, S. Ajaii, "Performance of Mobile Ad-hoc Network using AODV Protocol", Departmetn of Electronics & Communication Engineering, Department of Information Technology, Maulana Azad National Institute of Technology, Bhopal, India- 462051.
7. D.B. Johnson, D.A. Maltz, J. Broch, "The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks", Computer Science Department Carnegie Mellon University.
8. L. Kwan Hui, "Performance Enhancement of Temporally-Ordered Routing Algorithm", School of Computer Science and Software Engineering, The University of Western Australia, 2007.
9. T. Andreas, "Implementing and Extending the Optimized Link State Routing Protocol", Unik University of Graduate Center, University of Oslo, August 1st, 2004.
10. N. Bained, M. Jason, "Performance Evaluation of Routing Protocols in Mobile Ad-hoc Networks", School of Engineering, Blekinge Institute of Technology, January 2009.
11. K. Zoorush, K. Ziaratiand , V. Nazari Talooki "Performance Comparison of Routing Protocols for Mobile ad-hoc Networks" Asia-Pacific Conference on Communications, APCC, 2006, pp. 1 – 5
12. M. Zorzi, Bertocchi, G. Mazzini and P. Bergamo "Performance Comparison of routing protocols for Ad hoc networks", IEEE Global Telecommunications Conference, GLOBECOM, 2003, pp. 1033 – 1037
13. Mohamed I. Youssef, Mohamed M. Zahra and Amr M. Hassan "Evaluation of ad-hoc Routing Protocols in Real Simulation Environments", The 2006 International Conference on Computer Engineering and Systems, 2006, pp. 288 – 293
14. "The GloMoSim Simulator", http://pcl.cs.ucla.edu/projects/glomosim/, last viewed: 2010-08-27.