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Performance Based Survey of Routing Protocol in MANET

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Abstract*— Ad hoc network communication is one of the popular areas of research area in these days. The Mobile Ad-hoc Networks (MANET) is an infrastructure less network consisting of mobile nodes. MANET is a self configuring network and the topology of the network keeps on changing as the nodes move randomly and organize themselves in an arbitrarily manner. Routing is the one of the important factor to recognize the network performance. Routing mechanism will adaptively select routes using minimum cost routing and reputation routing schemes based on network condition to keep the network lifetime and maintain the ratio of successfully delivered packets. Many of the routing protocols are be present in MANET but which one is best for routing are measurable by many authors that has work on to measure the performance of routing protocol. In this paper we presents the survey of routing protocol to identified which kind of work is done in this field to improve and the performance of routing protocol.

Keywords: Mobile ad hoc networks, survey, routing protocols.

I. INTRODUCTION

Wireless networks are classified in two type's infrastructure network and infrastructure less (ad hoc) networks. Infrastructure network consists of a network with fixed and wired network. A mobile nodes work together with a bridge in the network (called base station) within its communication radius. The mobile unit can move geographically while it is communicating. When the nodes are in out of range of one base station, it connects with new base station and starts communicating through it. This is called handoff mechanism. Recently Bluetooth introduced a fresh type of wireless systems which is frequently known as a example of mobile ad-hoc networks. Mobile ad-hoc networks or "maintain temporary connection" networks control in the nonexistence of permanent infrastructure. Ad-hoc is a Latin word, which means "for this or for this only." Mobile ad-hoc network is an autonomous system of mobile nodes connected by mobile node operates as an end system and a router for all other nodes in the network. In a Mobile Ad Hoc Network [1] nodes move arbitrarily, therefore the network may experience rapid and unpredictable topology changes. Routing paths in MANETs potentially contain multiple hops, and every node in MANET has the responsibility to act as a router [2]. Routing in MANET has been a challenging task ever since the wireless networks came into existence. The figure 1 represents the example of ad hoc network communication. Here the sender A want to established connection to D through intermediate node B and C.

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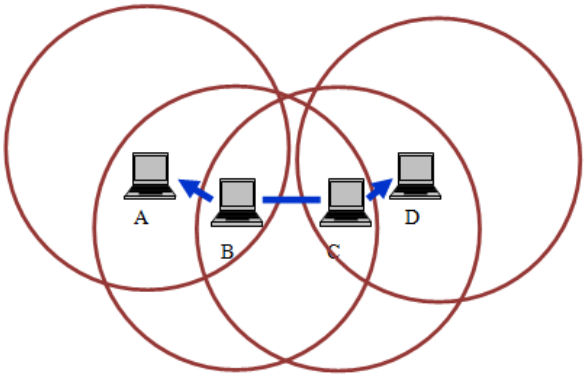

Fig2. Mobile Ad hoc Network

The major reason for this is the constant change in network topology because of high degree of node mobility. Here in fig 2 all nodes are try to communicate with each other for communication. The mobile ad hoc network (MANET) allows a more flexible communication model than traditional wire line networks since the user is not limited to a fixed physical location [1]. It is a new special network that does not have any fixed wired communication infrastructure or other network equipments.

II. ROUTING IN MANET

The Routing in a ad hoc network depends on many factors including topology maintenance, selection of intermediate nodes, beginning of request and reply mechanism and specific underlying characteristic that could serve as a heuristic in finding the path quickly and efficiently. The low resource availability in these networks demands efficient utilization and hence the motivation for optimal routing in ad hoc networks. Also, because of the highly dynamic nature of these networks imposes severe restrictions on routing protocols specifically designed for some conditions, thus motivating the study of protocols which aim at achieving routing stability and maintain strong connection.

1) Classification of routing protocols in MANET:-

The routing classifications in MANET are depend on routing strategy and network structure. According to the routing strategy the routing protocols can be describe as Table-driven and On demand, while depending on the network structure these are classified as flat routing, hierarchical routing and geographic position based routing. Basically the routing protocols can be classified into two parts:

a) Proactive (Table-Driven) Routing Protocols

The proactive routing protocols [2, 3] are similar to and come as a natural extension of those for the wired networks.

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In proactive routing, each node has maintain a tables that contain the latest information of the routes or other nodes to any node in the network. Each row has the next hop for reaching a node/subnet and the cost of this route. Various table-driven protocols differ in the way the information about a change in topology is propagated through all nodes in the network. There exist some differences between the protocols that come under this category depending on the routing information being updated in each routing table. Furthermore, these routing protocols maintain different number of tables. The proactive protocols are not suitable for larger networks, as they need to maintain node entries for each and every node in the routing table of every node. This causes more overhead in the routing table leading to consumption of more bandwidth. Examples of such schemes are the conventional routing schemes like DSDV.

- **Destination-Sequenced Distance Vector** Destination-Sequenced Distance Vector (DSDV) [2] is a traditional table-driven protocol for MANET. To solve the routing loop problem, it was invented by C. Perkins and P. Bhagwat in 1994. Routes are established based on constant control traffic and they are available all the time. Each node maintains one or more tables that contain route information to other nodes in the network. Nodes continuously update the tables to provide fresh view of whole network. Updates are so frequent that the advertisement must be made regularly enough to make sure that every node can almost always find every other node in the network. The data that is broadcast by the mobile node contains its new sequence number, destination address, number of hops needed to reach destination and sequence number of the information received for the destination.

The fundamental issue with DSDV is creation and maintenance of the tables. These tables need to be frequently updated by transmission of packets, even in traffic condition. Moreover, until updates about changes in topology are not sent across the network, DSDV does not function. In a large network with high density, mobile nodes often create broken links. Maintenance and updating of tables as well as advertising the updations would be significantly complex in this kind of network. DSDV is effective for ad-hoc network with small number of mobile hosts with limited changes in network topology. Improved forms of DSDV have been suggested, but commercial implementation of the traditional DSDV has not been done.

b) Reactive (On-Demand) Protocols

The reactive routing protocol is also known as on-demand routing protocol [2, 4] since they don't maintain routing information or routing activity at the network nodes if there is no communication. These protocols take a every time established routing approach for routing. They do not maintain or constantly update their route tables with the latest route topology. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet. The route discovery usually occurs by flooding the route request packets throughout the network. Examples of reactive routing protocols are the ad hoc on-demand distance vector routing (AODV).

- **Ad-Hoc On Demand Distance Vector**

Ad-hoc On Demand Distance Vector (AODV) is a reactive protocol that reacts on demand. It is probably the most well-known protocol in MANET. It is a modification of DSDV. The demand on available bandwidth is significantly less than other proactive protocols as AODV doesn't require global periodic advertisements. It enables multi-hop, self-starting and dynamic routing in MANETs. In networks with large number of mobile nodes AODV is very efficient as it relies on dynamically establishing route table entries at intermediate nodes. AODV never produces loops as there cannot be any loop in the routing table of any node because of the concept of sequence number counter borrowed from DSDV. Sequence numbers serve as time stamps and allow nodes to compare how fresh information they have for other nodes in the network. The main advantage of AODV is its least congested route instead of the shortest path.

c) Hybrid routing protocol:-

Since proactive and reactive protocols each work best in oppositely different scenarios, hybrid method uses the combination of both the routing techniques. It is used to find a balance between both protocols. Proactive operations are restricted to small domain, whereas, reactive protocols are used for locating nodes outside those domains [3]. Examples of hybrid protocols are (TORA)

- **Temporally-Ordered Routing Algorithm**

Temporally-Ordered Routing Algorithm (TORA) [5] is made to find routes on demand. It tries to achieve high scalability. It creates and maintains directed acyclic graph rooted at the destination node. TORA can establish routes rapidly and can provide multiple routes for a single destination. It doesn't give Shortest-Path Algorithm too much of importance. Instead it uses longer paths to avoid finding of new routes. TORA minimizes communication over as it reacts only when needed and does not react to every topological change as well as it localizes scope of failure reactions.

There are three main phases of the route establishment algorithm first is Route Creation, second is Route Maintenance and the third one is Route Erasure. In the Route Creation phase, the query packet is flooded all over the network and if routes exist, an update packet is sent back. In the Route Maintenance phase update packets re-orient the route composition. The route erasure phase involves flooding of a broadcast clear packet all over the network to erase invalid routes. I future to simulate the protocol, size of network, rate of topological change and network connectivity should be kept in mind.

III. MANET ROUTING PROTOCOL EXPECTATIONS

MANET routing protocols are creating routes in a dynamically changing network with low bandwidth, low power and resource constrained nodes. Murthy and Manoj discuss in detail the designing goals of MANET routing protocols [6]. These protocols are designed with the following primary expectations:

1. Provide stable loop free connectivity,
2. Reduced control overhead,
3. Quickly Respond to dynamic changes in node mobility.
4. Have scalability and distributed routing,
5. Support QoS traffic prioritization, and
6. Providing secure routing.

Traditional link state protocols generate periodic broadcasts of link state messages.

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IV. RELATED WORK

This section represents the previous work that has been done in this field. Many of the researches are do work in this field are described in this section.

The performances of protocol are analyzed using varying network load, mobility and network size [3]. However, the aspect of scenario which was not considered important to compare the performances of AODV and DSR [2] was considered in this paper. Solutions to support Internet connectivity for a MANET have considered the ad-hoc routing protocols AODV and DSR with multiple mobile internet gateways.

Mobile IP and AODV (MIPMANET) considered internet connectivity [7]. The internet connectivity may frequently create scenarios of multiple sources with constant bit rate traffic leading to common destination. In this paper, the performance of AODV and DSR are compared in constrained scenarios for getting conclusions

Sree Ranga Raju, et al [8] compared the performance of DSR, AODV and ZRP, especially focusing on ZRP and the impact of some of its most important attributes to the network performance. They found that the performance of ZRP was not up to the task and it performed poorly throughout all the simulation sequences.

Ayyaswamy Kathirvel, et al [9] compared the performance of DSR, AODV, FSR and ZRP with respect to propagation model. Reactive routing protocols (AODV and DSR) have got good packet delivery ratio. When compared with proactive and hybrid routing protocols, hybrid routing protocol have got next higher packet delivery ratio. Similarly reactive routing protocols have got less delay.

Bashar et al [10] analysis with less size of the network the performance of comparison .in this paper also the explain the DSR gives high throughput and packet delivery ration in all size networks. Anuj K. Gupta et. al. [11] On-demand routing protocols with identical loads and environment conditions and evaluates their relative performance with respect to the two performance metrics: average End-to-End delay and packet delivery ratio and investigates various simulation scenarios with varying pause times.

Muazzam Ali Khan Khattak et. al. [12] analyze different performance parameters of three well known Ad-hoc network routing protocols (AODV, DSDV, DSR) with varying node density and velocity, under reliable TCP and unreliable UDP transport layer protocols.

The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks [13] [14]. AODV is capable of both unicast and multicast routing [15]. It is an on demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. It maintains these routes as long as they are needed by the sources. Additionally, AODV forms trees which connect multicast group members. The trees are composed of the group members and the nodes needed to connect the members. AODV uses sequence numbers to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes.

Runcai Huang et al. [16], have compared the DSDV, DSR and AODV Protocols using ns-2 simulator. They have compared the three routing protocols in Ad hoc network with respect to packet delivery fraction and end-to-end time delay. In simulation environment, they have constructed a random node moving scene, the scope of the scene was 1000m×1000m, the scene includes 50 nodes and the traffic type was CBR (constant Bit Rate). That AODV protocol is more reliable, as its packet delivery fraction is higher than DSDV and DSR and has lower end-to-end time delay than DSDV and DSR. While DSR has highest end-to-end time delay among the three routing protocols.

Asma Tuteja et al. [17], have compared the routing protocols DSDV, AODV and DSR using network simulator NS2. They have compared the performance of three protocols.

Lu Han et al. [18] described “Wireless Ad-Hoc Networks” that Mobile Ad-hoc Networks (MANET) are a fundamentally flawed architecture. The most important thing for the networks is security. It is even important for Wireless Ad hoc Networks because its applications are in military. The MANET cannot appropriately solve the problem of the security. Routing is also a big problem. All the routing protocols for Wireless Ad hoc Networks are need patches. No suitable and stable routing protocols until now. Energy consumption problem still cannot be solved even much of efforts have been done to it. All these prove that the Wireless Ad hoc Networks is a flawed architecture.

Humayun Bakht et al. [19]. mentioned “Routing Protocols for Mobile Ad-hoc Network” that The Mobile ad-hoc network (MANET) is deployed in applications such as disaster recovery and distributed collaborative computing. Existing protocols for ad-hoc network can generally be categorized into pro-active and re-active protocols types. It is a well known fact that most of these protocols have certain weaknesses. Some of the main problem includes limitation like limited area to a particular scenario i.e. does not perform well in all environments like Lack of analytical studies that is not sufficient work has been done to evaluate their performance with respect to other techniques of similar types. Some of the known and famous routing schemes like as DSDV, AODV, and ZRP.

Mrs. Razan et al. [20]. defined “Evaluation for Variant Manet Routing Protocols” first describes the characteristics of Mobile Ad hoc Networks (MANETs), and their Routing protocol. AODV, DSR, OLSR, TORA, GRP these protocols with respect to three performance matrices Delay, Network, Load and Throughput. M.Sreerama et al. [21]. Mentioned “Evaluation of Manet Routing Protocols Using Various Mobility Models” that an ad hoc network is often defined as an “infrastructure less” network, meaning a network without the usual routing infrastructure like fixed routers and routing backbones. khan et al. [22] conclude that when the MANET setup for a small amount of time, then AODV is better because of low initial packet loss. DSR is not prefers because of its packet loss. On the other hand if we have to use the MANET for a longer duration so we can use both protocols, because after sometimes both have the same behavior. AODV have very good packet receiving ratio in comparison to DSR. At the end, they concluded that the combined performance of both AODV and DSR routing protocol could be the best solution for routing in MANET. In [23], Bindra et al. evaluate the performance of AODV and DSR routing protocol for a scenario of Group Mobility Model such as military battlefield. They used Reference Point Group Mobility (RPGM) Model for their scenario. They concluded that in Group mobility model with CBR traffic sources, AODV is better than DSR but when TCP traffic used, DSR perform better in stressful situation like high load or high mobility.

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DSR routing load is always less than AODV in all type of traffic. Average end-to-end delay of AODV is less than DSR in both type of traffic. Over all the performance of AODV is better than DSR in CBR traffic and real time delivery of data. But DSR perform better in TCP traffic under limitation of bandwidth.

In [24], Barakovic et al. compared performances of three routing protocols: DSDV, AODV and DSR. They analyzed these routings with different load and mobility scenarios with Network Simulator version 2 (NS-2). They concluded that in low mobility and low load scenarios, all three protocols react in a similar way, but when mobility or load is increasing, DSR outperforms AODV and DSDV.

In [25], Sathish et al. do a performance comparison of DSR, AODV, FSR and ZRP routing protocols for mobile Ad-hoc networks. Performance of these routing protocols is evaluated with some metrics such as average end to end delay, packet delivery ratio, throughput and average jitter. This simulation shows that DSR has best performance than AODV, in terms of packet delivery ratio and throughput as a function of pause time.

In [26], Kaushik et al. compared three routing protocols DSDV, AODV and DSR. They concluded that AODV performs predictably because it delivers the data at node with low mobility virtually, and it has problem when node mobility increases. But DSR was very good in situation that node has mobility and DSDV performs almost as well as DSR, but it needs many routing overhead packets. As far as packet delay and dropped packets ratio are concerned, DSR/AODV performs better than DSDV with large number of nodes. So for real time traffic AODV is preferred over DSR and DSDV. For less number of nodes and less mobility, DSDV's performance is better.

In [27], performance of AODV, OLSR and DSR was analyzed using NS2. The protocols were tested using the same parameters with high CBR traffic flow and random mobility. Performance of protocols with respect to scalability has also analyzed. In this research results showed that, AODV and OLSR experienced higher packet delay and network load compared to DSR. But, both OLSR and AODV performed very reliably when segment delay is considered. DSR has high end-to-end delay due to formation of temporary loops within the network. Throughput was considered as the main factor in evaluation. According to this factor DSR is performed worst. However, AODV showed better efficiency compared to OLSR and DSR.

In [28], Shah et al. compared the performance of DSDV, AODV and DSR routing protocols under different network load, mobility, and network size. According to simulation results from ns -2 network simulator, they concluded that both AODV and DSR perform better than DSDV, under high mobility because of their on demand behavior.

There is an associated lifetime value for every entry in the routing table. Suppose that some routes are not applied within their lifetime period, so these routes are expired and should be dropped from the table. But if routes are used, the lifetime period is updated so those routes are not expired. When a source node wants to send data to some destination, first it searches the routing table; if it can find it, it will use it. Otherwise, it must start a route discovery to find a route [29]. It is also Route Error (RERR) message that used to notify the other nodes about some failures in other nodes or links [30].

Kumar Sharma et al.[31] had a behavioral study of Routing Protocols by using NS-2 simulator. After their analysis in different situations of network, they concluded that AODV perform better than DSDV and DSR in terms of throughput and average delay, while DSR is the best in case of Packet delivery ratio. Finally by considering all the aspect, AODV was better.

In [32], Maashri et al. analyzed the performance of DSR, AODV and OLSR routing protocols. They used NS-2. They concluded that DSR has superior performance in terms of data packet delivery ratio, throughput and end-to- end delay at the speeds of less than 10 m/s compared to AODV and OLSR. But, OLSR performed weak in the presence of a statistically self-similar traffic at high mobility especially in terms of data packet delivery ratio, overhead and delay. Also in AODV, low end-to-end delay was observed.

In [33], Usop et al. decided to choose the best routing protocol when implementing the routing protocols in the target mobile grid application. They compared DSDV, DSR and AODV with ns-2 simulator. Results show that DSR have a dramatic decrease in performance when mobility is high. However the AODV and DSDV perform well when mobility is high.

In [34] Kumari et al. concluded that in Freeway Mobility Model with CBR traffic sources, AODV performs better than OLSR and DSDV. Routing overhead of DSDV is always less than AODV and OLSR. DSDV gives better throughput with CBR traffic. With TCP traffic sources, OLSR gives better result than AODV and DSDV, but with higher routing overhead and end-end delay. Throughput of OLSR is also better with TCP traffic.

In [35] Performance of AODV, TORA and DSDV protocols is evaluated under both CBR and TCP traffic pattern. Extensive Simulation is done using NS-2. In this simulation results shows that Reactive protocols perform better in terms of packet delivery ratio and average end-to-end delay.

V. CONCLUSION

Mobile ad hoc networks (MANETs) have been recently used in the area where fixed network infrastructure are not available or wireless ad hoc connection might be required. The network is formed by a group of nodes coming together. The nodes can join and leave the network at any time and are free to move in the certain network area. Hence, the size and topology of the network is dynamic and unpredictable in nature. It is a difficult problem to find a routing protocol which can maximize the network lifetime and reliably deliver data and routing packets in the network. There are several research works previously trying to take the issues into consideration that has consider in this paper. This paper has presents the survey of routing protocols to recognizes the behavior and performance of routing protocol on the basis of performance and also studies the performance of protocol that has measure by researchers. This survey gives the idea about what kind of work is remaining and it is possible to enhance the existing work.

In future our simulation work will illustrates the performance of three routing protocols AODV, DSR and DSDV and also try to enhance the performance of any proactive and reactive routing protocols.

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