Control Overhead Reduction Survey for AODV and DSR Routing Protocol in MANET

Shivani Yadav[1], Mehajabeen Fatima[2]
[1]*SIRT-S, Bhopal*
[2]*SIRT-S, Bhopal*
(E-mail: [1]syshivani@gmail.com ,[2]mehajabeen.fatima@gmail.com)

***Abstract*—** MANET is a collection of wireless nodes that may be dynamically setup anyplace. Broadcasting is that the fundamental and efficient information dissemination mechanism for route discovery in reactive routing protocols that ends up in drawback known as the broadcast storm that causes redundant retransmission and will increase control overhead. Routing overhead includes control messages i.e. RREQ, RREP, RERR, HELLO. The bandwidth is limited and data packet and overhead uses same bandwidth so we've to reduce the overhead. In this paper overhead for AODV (with HELLO) and DSR routing protocol are investigated for mobility.

***Keywords*—** *MANET, Routing protocol, Routing overhead, AODV, DSR*

I. INTRODUCTION

In Ad-hoc networks, nodes communicate with each other using multi-hop links. There is no fixed infrastructure or base station for communication. Every node acts as a router for packets forwarding and receiving to/from other nodes. Routing in Ad-hoc networks has been a difficult task due to high mobility, increased overhead, high congestion.

A. LIMITATIONS OF MANET

The node in mobile network has mobile nature; the network tends to change its topology very frequently. This mobile nature of the nodes could generate several security and other problems in MANET-

Routing Overhead: In wireless ad-hoc networks, nodes often change their location within network. Thus, some stale routes are generated in the routing table that results in unnecessary routing overhead [8].

Packet loss because of transmission errors: There are several reasons of packet loss problem in MANET. Packet loss could happen because of mobility of nodes, bit rate error, because of interference [8].

Limited communication bandwidth: The bandwidth available for wireless networks is usually low than that of wired networks. The throughput of those networks is usually low due various noises, fading effects.

Security: It is one of the most important issues in mantes. All major networking tasks like routing and packet information are done by nodes itself that are mobile. Any attacker will easily attack on the network and can acquire the information [11].

Lower data rate: One of biggest drawback of ad-hoc networks is reduced data rates. Data rate of wired communication is higher than wireless communication.

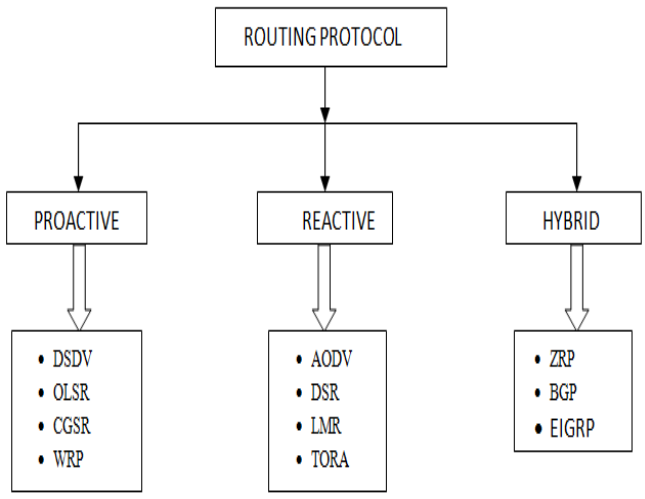
Energy limitation: A MANET network permits mobile nodes to communicate in the absence of a fixed infrastructure. Therefore, they operate with on battery power, which is limited.

B. ROUTING PROTOCOL

The routing concept basically involves two activities: first of all, determining optimal routing paths and secondly, transferring the data groups (called packets) through an internetwork. The later concept is termed as packet switching that is straight forward, and also the path determination could be very complex.

Classification of Routing Protocol

Routing protocols will be classified into three types: Proactive routing protocol, Reactive routing protocol and Hybrid protocols.



C. ADHOC ON DEMAND DISTANCE VECTOR PROTOCOL

AODV is a routing protocol for ad hoc mobile networks with large numbers of mobile nodes. The protocol's algorithm creates routes between nodes only when the routes are requested by the source nodes, giving the network the flexibility to allow nodes to enter and leave the network at will. Routes are used only as long as data packets are transferred from the source to the destination. If the source stops sending packets, the path can time out and break.

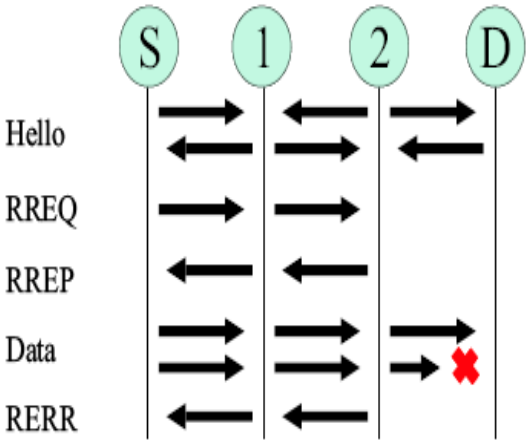


Figure1: AODV protocol

Advantages of AODV

Maximum utilization of the bandwidth: The algorithm makes sure that the nodes that are not in the active path don't maintain information regarding this route. When a node receives the RREQ and sets a reverse path in its routing table and propagates the RREQ to its neighbors, if it doesn't receive any RREP from its neighbors for this request, it removes the routing information that it has recorded.

Simple: it is simple with each node behaving as a router, maintaining a simple routing table, and the source node initiating path discovery request, making the network self-starting.

Managing up with dynamic topology and broken links: when the nodes in the network move from their places and also the topology is changed or the links in the active path are broken, the intermediate node that discovers this link breakage propagates an RERR packet and the source node re-initializes the path discovery if it still needs the route. This ensures quick response to broken links.

Limitations/Disadvantages of AODV

Overhead on the bandwidth: When an RREQ travels from node to node in route discovery process; it sets up the reverse path in itself with the addresses of all the nodes through which it's passing and it carries all this information about path.

High route discovery latency: AODV is a reactive routing protocol. This means that AODV doesn't discover a route until a flow is initiated. This route discovery latency result will be high in large-scale mesh networks.

D. DYNAMIC SOURCE ROUTING PROTOCOL

The Dynamic supply Routing protocol (DSR) is an easy and efficient routing protocol designed specifically to be used in multi-hop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. The protocol is composed of the two main mechanisms of "Route Discovery" and "Route Maintenance", that work together to allow nodes to find and maintain routes to arbitrary destinations in the ad hoc network [9].

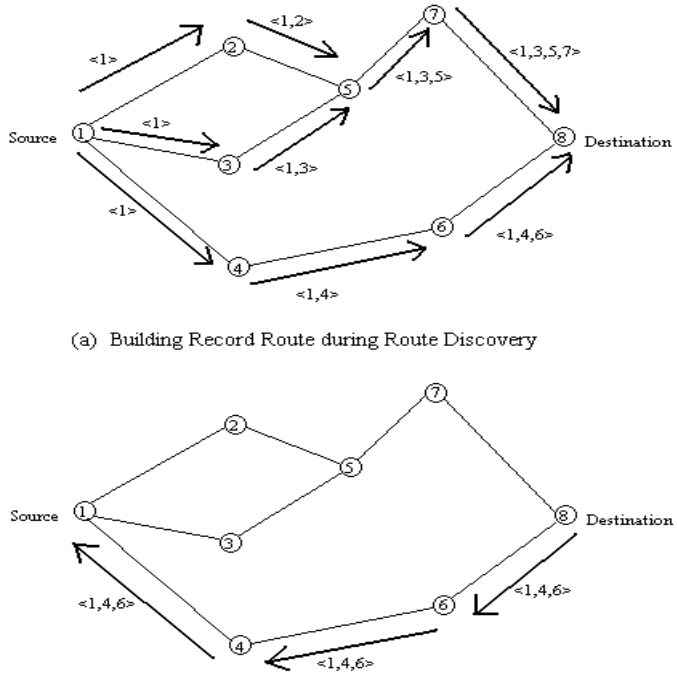


Figure2: DSR diagram

Advantages and disadvantages of DSR

The intermediate node utilizes the route cache information efficiently to reduce the control overhead. DSR has information of multiple routes. The route discovery and maintenance optimization techniques further eliminate the propagation and dissemination of control messages. DSR does not employ any local repair of a broken link and as any intermediate node can respond with a RREP message to a RERR message based on its route cache there is a possibility for unstable routes in the network [12].

DSR was designed for a network with a limited number of nodes. The networks with high mobility will cause frequent link breaks that results in high routing control overhead.

For route discovery control messages are used. There are four packet control overhead in AODV and DSR they are as follows:

E. CONTROL PACKETS

Four types of packet control are utilized by the routing protocol for route discovery process. These control packets are used to control the processes involved in route discovery, maintenance, and broadcasting.

1) Route request packet (RREQ)

When one node needs to send a message to another node for which it does not already have a route it broadcasts a Route Request (RREQ) message. By sending RREQ the node is asking the network how to get to the destination [1].

2) Route reply packet (RREP)

A RREP packet is sent by the node to the source node if the said node is the destination or if it has a route set to the destination node. The node that receives the first RREQ packet will check if it has a route to the desired node. Then, it sends back the RREP packet to the source node.

3) Route error packet (RERR)

RERR message is broadcast for broken links. Generated directly by a node or passed on when received from another node. If the node which finds the broken route is incapable of setting up another route to the destination, then it will find a new route by sending a RERR packet to the sender node.

4) HELLO packet

Only in AODV protocol, the node broadcasts a Hello packet to acquire information about its neighbours. The Hello packet is broadcasted by the node in one hop to update its information and ensure that all its neighbours are included. Moreover, the hello packet is a way to make sure that the neighbour link is still working.

II. LITERATURE REVIEW

In MANET both routing and data packet share the same network bandwidth most of the times, and hence routing packet are considered overhead in the network. This overhead is called routing overhead. A good routing protocol should incur lesser routing protocol. Routing overhead arises due to control message dissemination process (RREQ, RREP, RACK and RERR) in MANET.

Nabil Nissar, Najib Naja and Abdellah Jamali[2] has introduced a novel routing algorithm SAODV signal strength based AODV) which has improved the conventional AODV protocol efficiency especially in terms of routing overhead by reducing the number of route discovery message. In higher mobility SAODV will have a lower probability of route failure due to link breakages. In this algorithm if the network is dense then nodes forward RREQ packet to another nodes with a signal strength value that is greater than a predefined threshold.

Preetha K G, A Unnikrishnan[5] has compared AODV and DSR routing algorithm with a new technique DBR (Domination set Based Routing) which has studied about the overhead reduction, delay reduction and reduce packet loss. In their study the route is established through the members in the domination set only. Domination nodes connect to all nodes quickly thus it is easy to get the destination within no time. This proposed algorithm works well in large networks also. The new proposed technique DBR has better performance than AODV and DSR.

Sachidananda S. Joshi∗ and Sangappa Ramachandra Biradar[3] has proposed a framework of novel routing technique in order to jointly address the problem pertaining to routing overhead and energy drainage among the mobile nodes. This routing technique is different from the conventional routing technique. In this technique problem of overhead is reduced by using improved signal strength. A new topology constructed from communication district inspite of using conventional rectangular-based simulation approach. The entire mechanism of interaction between the mobile nodes and auxiliary nodes ensures lowest routing overhead that indirectly controls the energy dissipation in mobile adhoc network.

Ehssan et al [11] has proposed a new scheme to prevent broadcast storms during path discovery operation. A new algorithm was also proposed which reduced the frequency of flood request which has increased the link duration of selected path. The basic concept behind the proposed scheme is to broadcast only specific and well-defined packets, referred to as "best packets" by reducing rebroadcasts. Rebroadcast packets contains lifetime field will determine the expiration parameters for the RREQ packet so that the packet is not indefinitely rebroadcasted over the entire network. When the lifetime of a packet is up, it is dropped.

Suparna et al [10] has proposed a new routing Least Overhead Routing Protocol (LORP) which has overcome the disadvantage of on demand routing. Due to mobility of the nodes the link can break whenever a node is moved. So, maintaining information about a large number of nodes is wastage of resource. In this new routing protocol each node maintains only its neighbor's information, instead of maintaining information about each mobile node. Thus a large number of overhead is reduced by maintain the table of neighbor nodes.

Raphael Ernst, Sascha Alexander Jopen and Tobias Bartelt[6] had reduced the OLSR HELLO format. HELLO message is used to indicate the presence of a node with HELLO message a REFRESH message is also used. A REFRESH message does not include any addresses. Instead of regular HELLOs, a node broadcasts REFRESHs when there was no change to the node's link set this allows nodes to verify that their neighbor is still available and that the topology has not changed. Nodes could receive a REFRESH without knowing the referenced HELLO in two cases: (1) they are a new neighbor for the sender, or (2) the referred message was lost. We propose to send a new message called

REQUEST in both cases to indicate that incomplete information was received.

Ni et al[14] has identified an important issue in a MANET, the broadcast storm problem. Several schemes, namely probabilistic, counter-based, distance-based, location-based, and cluster-based schemes, have been proposed to alleviate this problem. As compared to the basic flooding approach, a simple counter-based scheme can eliminate many redundant rebroadcasts when the host distribution is dense. If location information is available through devices such as GPS receivers, the location-based scheme is the best choice because the scheme can eliminate even more redundant rebroadcasts.

III. MOTIVATION

From above papers it is concluded that overhead will be increased due to broadcast or flooding of control messages, transmission power, node density, mobility, packet size. Above paper also discussed about different techniques like novel technique in paper 2 which is an improved AODV i.e. SAODV, in paper 5 DBR technique in which route discovery is through domination nodes for overhead reduction. In this paper we concentrate on overhead analysis for mobility.

IV. PERFORMANCE PARAMETR

(1)Throughput: A throughput of the network is the average rate at which message is successfully delivered between a receiver and sender. It is also referred to as the ratio of the sum of data packet received from its sender to the time the last packet reaches its destination.

Throughput= (Total No.of Successful Packets Received in Bits)/(Total Simulation Time in Sec)

(2)End to end delay: The average end to end delay defined as the time taken in delivery of data packets from the source node to the destination node. To calculate the average end-to-end delay, add delay of each successful data packet delivery and divide that sum by the number of successfully received data packets.

Average End to End Delay= (∑(Received Time-Sent Time))/(Total Data Packet Received)

(3)Average jitter: Jitter is the variation in the time between packets arriving, caused by network congestion, timing drifts, or route changes. It should be less for a routing protocol to perform better.

Average Jitter= (Sum of all the data packet transferred)/(N(total packet number))

(4) Routing Overhead: Routing overhead is defined as the number of routing control packets, including Route Request and Route Reply. The overhead will increase when high mobility, less battery power in the network.

Routing Overhead= (Total Routing Packets Sent)/(Total Data Packets Received)

V. RESULT AND ANALYSIS

The work is implemented using Qualnet 5.0.2. The performance of AODV and DSR are compared. It has been observed that AODV is better than DSR at higher mobility in terms of routing overhead. The simulation parameters are listed in the Table1.

Table1

SIMULATION PARAMETERS	**VALUE**
SIMULATOR	QUALNET 5.0.2
Topology size	1500*1500
Movement model	Random Way Point
Pause time	10s
Node speed	10s,15s,20s,25s,30s
No. of node	50
Traffic type	CBR
No. of CBR connection	10
Packet size	512 byte
Simulation time	900s
Routing Protocol	AODV, DSR

In this paper overhead reduction is done by varying speed. QoS parameters like average throughput, average end to end delay and average jitter are observed and tabulated in Table2.

Table2

Speed	Average Throughput		Average End to End Delay		Average Jitter	
	AODV	DSR	AODV	DSR	AODV	DSR
10	3307.4	3973.1	0.098	0.17	0.0582	0.0763
15	2321.5	3314.1	0.086	0.117	0.0489	0.0625
20	2546.7	2672.2	0.077	0.191	0.0438	0.0899
25	3048.9	2546.3	0.0865	0.206	0.0461	0.121
30	2828.2	2239	0.0891	0.532	0.0585	0.253

Here the simulation indicates that when the speed is low throughput of DSR is better than AODV as DSR utilizes the

route cache information. At higher mobility, due to high overhead in DSR performance is deteriorated in comparison of AODV. Average end to end delay of DSR is more than AODV. Average jitter value of DSR is more than AODV.

ROUTING OVERHEAD VALUES

There are various packets in routing overhead. Some are considered in this paper. Control message are used for route request. RREP, RREQ is used for route discovery. RERR is when the node leaves network.

Table3

Speed	No. of RREP initiated as destination		No. of RREQ packet initiated		No. of RREP as intermediate		No. of RERR packets initiated	
	AODV	DSR	AODV	DSR	AODV	DSR	AODV	DSR
10	4.24	0.34	4.68	0.6	8.12	7.84	5.76	28.74
15	4.22	0.32	4.76	0.68	7.88	8	5.4	13.54
20	3.72	0.46	4.44	1.26	7.28	20.26	4.5	16.36
25	3.58	0.78	4.36	1.7	7.44	29.72	5.78	60.12
30	4.14	0.62	4.6	1.88	8.2	28.66	5.7	50.72

SUM of ROUTING OVERHEAD

This table3 is the sum of the control messages considered above.

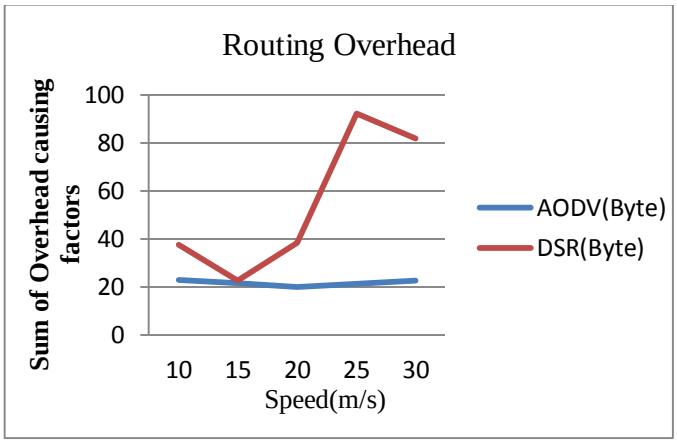
Table3

Speed(m/s)	AODV(Byte)	DSR(Byte)
10	22.8	37.52
15	21.66	22.54
20	19.94	38.34
25	21.16	92.32
30	22.64	81.88

The above table has the total control overhead value in AODV and DSR.

The graph1 shows the graph of the sum of routing control overhead.

Graph1



In above graph it can be concluded that AODV has less overhead than DSR. As the mobility increases the overhead in DSR has a large variation in overhead, overhead is increased. The large overhead seen in DSR is a result of the excessive link-breakages due to the selection of random unstable paths, and hence the re-broadcasting of control (RREQ) messages for discovery of new paths. As the speed of nodes increase, the number of links and hence path breaks increase, consequently resulting in higher control overhead.

VI. CONCLUSION AND FUTURE SCOPE

Here, successfully evaluated the performance of routing protocols i.e. DSR and AODV under different speed of the nodes. Even though at higher mobility, AODV has reduced lot of overheads as compared to DSR and gave excellent performance. These results shows that, AODV protocol is better than DSR and works efficiently on or before the specific speed which is 20m/s, so we can consider it the best speed for this routing protocol. As overhead depends upon transmission power, number of nodes and packet size, thus we will focus on reducing packet size of control message.

REFRENCES

[1] Haider Alani and Raed Alsaqour, "ROUTING DISCOVERY SCHEME FOR HIGH MOBILITY IN MANET", ARPN Journal of Engineering and Applied Sciences, VOL. 12, NO. 2, JANUARY 2017

[2] Nabil Nissar*, Najib Naja, Abdellah Jamali," A Neighbor Signal Strength based Coverage for Reducing Routing Overhead in Mobile Ad Hoc Networks",IEEE(2016)

[3] Sachidananda S. Joshi∗ and Sangappa Ramachandra Biradar," Communication Framework or Jointly Addressing Issues of Routing Overhead and Energy Drainage in MANET", Twelfth International Multi-Conference on Information Processing-2016 (IMCIP-2016), Elsevier(2016) pp 57 – 63

[4] Sanabani, M., et al., "A reverse and enhanced aodv routing protocol for manets", ARPN Journal of Engineering and Applied Sciences, 2014. 9(2): p. 153-159

[5] Preetha K Ga,*, A Unnikrishnana, "Improving the Routing Performance of Mobile Ad hoc Networks Using Domination Set", International Conference on Information and Communication Technologies (ICICT 2014),Elsevier(2014), pp 1209 – 1215

[6] Raphael Ernst, Sascha Alexander Jopen and Tobias Bartelt," Reducing MANET Neighborhood Discovery Overhead", IEEE(2014)

[7] Saloni Sharma, Anuj Kumar Gupta, "A Comprehensive Review of Security Issues in Manets", International Journal of Computer Applications (0975 – 8887) Volume 69– No.21, May 2013

[8] Aarti, Dr. S. S. Tyagi," Study of MANET: Characteristics, Challenges, Application and Security Attacks", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 5, May 2013

[9] David B. Johnson David A. Maltz Josh Broch," DSR: The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks", Carnegie Mellon University Pittsburgh, PA 15213-3891

[10] Suparna DasGupta, Soumyabrata Saha," LORP: Least Overhead Routing Protocol for MANET",IEEE conference(2010)

[11] Ehssan Sakhaee†, Tarik Taleb‡, Abbas Jamalipour†, Nei Kato,‡and Yoshiaki Nemoto‡,"A Novel Scheme to Reduce Control Overhead and Increase Link Duration in Highly Mobile Ad Hoc Networks",IEEE(2007)

[12] Rajiv Misra, "Performance comparison of AODV/DSR Routing protocols in constrained situation" IEEE journal 2005

[13] M. Abolhasan, T. Winsock, E. Dutkiewicz, "A review of routing protocols for mobile ad hoc networks", Elsevier Ad Hoc Networks Journal 2 (1) (2004) 1–22

[14] Sze-Yao Ni, Yu-Chee Tseng, Yuh-Shyan Chen, and Jang-Ping Sheu," The Broadcast Storm Problem in a Mobile Ad Hoc Network" Department of Computer Science and Information Engineering National Central University (1999)