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Performance Enhancement in MANET Using Enhanced AODVv2-02 for Data Transmission

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Abstract: *In MANET, each node operates not only as an end system but as a router also to forward packet. Nodes are free to be move with more or less relative speed in random direction. There is no long term ensured path from one node to another node. The basic operations of the AODVv2 protocol are route discovery and route maintenance. Route discovery is performed by multicasts a Route Request Message (RREQ) to find route towards destination and these RREQ message is retransmitted again and again whenever any node wants to transmit packets to another node in the network, but it creates unnecessary signaling traffic and interference. In order to avoid this retransmission of redundant or duplicate RREQ Messages, AODVv2-02 maintains Received RREQ table, so that no two RREQ messages are comparable if they are generated by same AODVv2-02 router for same destination.*

Keywords: *MANET, Classification in MANET's, AODV, DSR, DSDV, TORA.*

I. INTRODUCTION

1.1 Mobile Ad-hoc Networks (MANET)

A Mobile Ad-hoc Network (MANET) is an infrastructure less and self-governing network of mobile nodes, in which all participating nodes can freely transmit the packets through wireless transmission media to any remote node in the network. The MANET does not require any fix infrastructure such as base station. Each mobile node is an independent node, which could function both as host and router.

In MANET, each node operates not only as an end system but as a router also to forward packet. Nodes are free to be move with more or less relative speed in random direction. There is no long term ensured path from one node to another node. MANET have very progressive use in emergency scenarios like military operations & disaster relief operation where there is need of immediate communication network whenever some major event, or some temporary requirement like conference & meetings at new place where there is no pre-existing network infrastructure available.

1.2 Advantages of MANET

Mobile Ad-Hoc network (MANET) possesses the following advantages:

It provides access to information and services regardless of the geographic position. All the nodes are independent and free from any central network administration. It is self-configuring network in which nodes may also act as routers.

1. It is less expensive as compared to wired network.
2. It is scalable - accommodates addition of more nodes.
3. It provides improved flexibility.
4. It is a robust network due to decentralized administration.
5. This type of network can be set up at any place and time.

1.3 Disadvantages of MANET

Some of the disadvantages of MANET are as follows:

1. Limited resources and physical security.
2. Intrinsic mutual interest vulnerable to attacks.
3. Lack of authorization facilities.
4. Volatile network topology makes it hard to detect malicious nodes.
5. Security protocols for wired networks cannot work for ad hoc networks.

1.4 Classification of MANET Routing Protocols

The MANET routing protocols can be classified in many ways, but mostly this classification depends on routing strategy and network structure. The MANET does not require any fix infrastructure such as base station. In MANET, each node operates not only as an end system but as a router also to forward packet. According to the routing strategy these routing protocols can be categorized as Table-driven, On-demand and Hybrid as shown in the figure 1.2 below.

1.4.1 Table-Driven Routing Protocols (Proactive)

These types of protocol maintain route information from one node to every other node in the network. Each node maintains a routing table which contains routing information of the entire network. Each node updates its routing table regularly so that every node knows the route in advance. Whenever any node wants to send a message to another node then its path is already known.
Examples of table-driven routing protocols are:

- Optimized Link State Routing (OLSR)
- Destination-Sequenced Distance Vector (DSDV)
- Fish-eye State Routing (FSR)

1.4.2 On-Demand Routing Protocols (Reactive)

In reactive protocols, there is no need to maintain any routing information between nodes in the network, when there is no communication or the network is idle whenever any node wants to send packets to another node in the network. This process runs until routing information is determined or all possible permutations have been investigated.
Examples of table-driven routing protocols are:

- Ad-hoc On-Demand Distance Vector (AODV)
- Dynamic Source routing protocol (DSR)
- Dynamic MANET on-demand routing protocol (DYMO)

1.4.3 Hybrid Routing Protocols

Hybrid protocols integrate the features of both proactive as well as reactive protocols [4]. It is a combination of proactive and reactive routing and is based upon distance vector protocol but also contain many features and advantage of link state protocol. Examples of table-driven routing protocols are:

- Zone Routing Protocol (ZRP)
- Cluster-head Gateway Switch Routing Protocol (CGSR)

1.4.4 Comparison of MANET Routing Protocol

In this section we have presented a comparison between existing MANET routing protocols [6]. Table 1.1 below provides an overall comparison of the three categories of routing protocols.

Table 1.1: Comparison of three categories of MANET routing protocols

Parameters	**Table-Driven (Pro-active)**	**On-Demand (Reactive)**	**Hybrid**
Routing Overhead	High	Low	Medium
Route Availability	Always Available	Computed as per need	Depends on location of destination
Delay	Low	High	Low for local destinations and high for Inter-zone
Periodic Route Updates	Required Always	Not Required	Used inside each zone
Storage Requirements	High	Dependent on no. of routes maintained or needed	Depends on size of each zone
Routing Information	Keep stored in table	Doesn't Store	Depends on Requirement
Routing Philosophy	Mostly flat	Flat	Hierarchical

1.5 Applications of MANET

Some of the applications of MANET are as follows:

1. Military battlefield
2. Collaborative work
3. Local level
4. Personal area network and Bluetooth
5. Commercial Sectors

II. REVIEW OF LITERATURE

Salman Bhimla et al. (2012)[1] described the Ad hoc On-Demand Distance Vector (AODV) routing protocol in 2012. This protocol is proposed to use by mobile nodes in an ad hoc network. The mobile nodes reply to any changes and link breakages in network topology in a timely manner. The AODV is loop-free and enables dynamic, multi-hop, self-starting routing for all participating mobile nodes. It is relevant for low power and low bandwidth networks due to low overhead.

Sujata V. Mallapur et al. (2012) [2] described the features of different network simulators that support the simulation of MANET's (NS-2, NS2, NCTUns, GloMoSim) with their advantages and disadvantages. According to the survey, simulators have the many its features, but none of them offer the good support for all features for MANET simulation. NS-2 and NS2 are the best choices for the MANETs. NS-2 profits from the large available models, Ns-2 supports broad range of protocols in all range of protocols in all layers for example, the Specific MANET routing protocols are provided by the NS-2. While the NS2 supports the powerful GUI, well defined simulation engine and supports hierarchical modeling, so it is better for development.

Surendra H. Rautet al. (2012) [3] proposed the study of MANET and its various routing protocols which are classified as proactive, reactive and hybrid protocol. In proactive routing scheme every node continuously maintains complete routing information of the network. This is achieved by flooding network periodically with network status information to find out any possible change in network topology. In reactive routing scheme every node in this routing protocol maintains information of only active paths to the destination nodes. Hybrid protocol is a combination of proactive and reactive routing and it is based upon distance vector protocol but contain many features and advantage of link state protocol. Reactive routing protocols are more popular set of routing algorithms for mobile computation because of their low bandwidth consumption.

NarendranSivakumar et al. (2012) [4] implemented DYMO Routing Protocol and compare with the other protocols (AODV,DSR,DSDV) and shows that DYMO performs better in comparison to other Protocols in a given network topology with respect to Quality of Service (QoS) parameters, i.e., throughput, jitter, delay, latency. From the simulation analysis, it is proved that DYMO and AODV are hybrid in nature i.e., of both reactive and proactive protocols, show more throughput and less delay time, lesser packet loss and jitter. It is also proved that DYMO is more efficient than AODV.

Salim EL KHEDIRI et al. (2014) [5] have worked on performance of three types of Mobile Ad-hoc network routing protocols using NS2 Simulator and Comparison of Ad-hoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR), Destination-Sequenced Distance Vector (DSDV) Protocols. They have the Throughput, Packet delivery Fraction (PDF), Average End-to-End delay and Energy Consumption per Delivered Packet by varying the number of nodes.

III.METHODOLOGY

Whenever RREQ messages are broadcast in the network for route discovery, then in most situations AODVv2 router might reply with redundant or duplicate information to some recently received RREQ message. An AODVv2 must delete these duplicate RREQ message before replying. In this the RREQ message must discard those requests coming from the routing table and the routing table updates time to time. The proposed protocol AODVv2-02 doesn't reply to such requests.

The block diagram (flowchart) summarizing the working of AODVv2-02 MANET routing

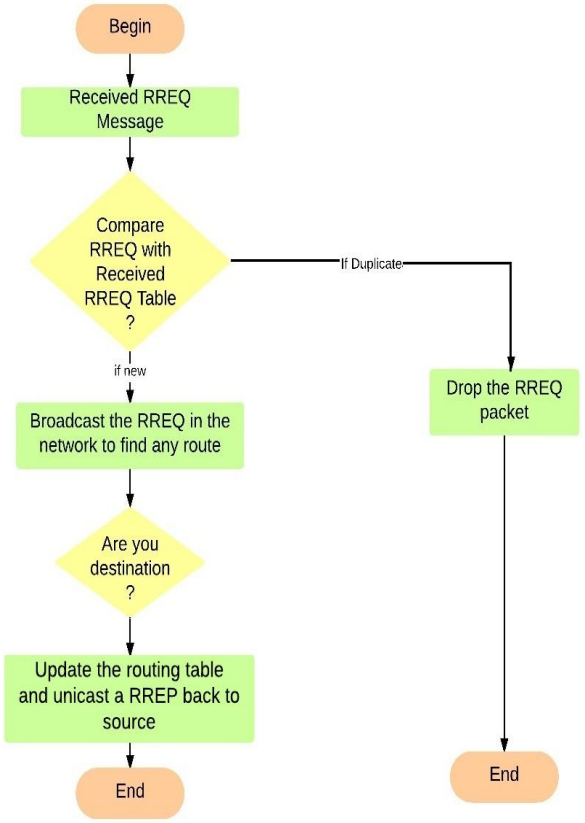

Figure 3.1: Flow of work

IV. RESULTS & DISCUSSION

Table 4.1: Simulation Setup Configuration

Constraint Area	900 * 800 m
No. Of Wireless Hosts	31
Mobility Model	Mobile Ad-hoc
Radio Transmitted Power	2.0Mw
Radio Tx Power	2.0Mw
Radio Bitrate	2 Mbps
Broadcast Delay	0s – 0.05s
Simulation Time	100 s
Network type	Network Animator
Routing Protocols	AODVv2-02 , DYMO ,AODV
Simulation Style	MANET

Throughput

In routing protocols, throughput is the number of successful messages delivered from one host to another host through a communication link per unit of time. Throughput is measured in bits per second. Whereas, good-put is the application level throughput, i.e. the number of useful information messages delivered by the network to a particular destination per unit of time. The amount of data messages considered excludes protocol overhead bits as well as retransmitted data packets.

Typically, protocol overhead is included in the throughput, but is excluded from the good-put. Retransmission of lost or corrupt packets caused by packet errors is excluded in the good-put but not in the throughput.

Figure 4.1 shows the throughput of all three protocols in the network. AODV2-02 has the highest through-put, while AODV have less than DYMO. AODVv2-02 has recorded the highest.

Figure 4.1: Throughput

Packet Delivery Ratio: Packet delivery ratio is defined as the ratio of data packets received by the destinations to those generated by the sources. Mathematically, it can be defined as:

$$PDR = S1 \div S2$$

Where, S1 is the sum of data packets received by the each destination and S2 is the sum of data packets generated by the each source.

Figure 4.2 shows statistics related to the packet delivery ratio in the network on all three protocols. AODVv2-02 has the highest packet delivery ratio compared with AODV and DYMO Routing Protocols.

Figure 4.2: Packet Delivery Ratio

Delay: The delay of a network specifies how long it takes for a bit of data to travel across the network from one node or end point to another.
Figure 4.3 shows the delay in the network of all three protocols. AODV has the highest delay, while DYMO have less delay than AODV and AODVv2-02 has recorded the least delay.

Figure 4.3: Delay

Jitter: Jitter is defined as a variation in the delay of received packets. The sending side transmits packets in a continuous stream and spaces them evenly apart.
Figure 4.4 shows the delay in the network of all three protocols. AODV has the highest delay, while DYMO have less delay than AODV and AODVv2-02 has recorded the least delay.

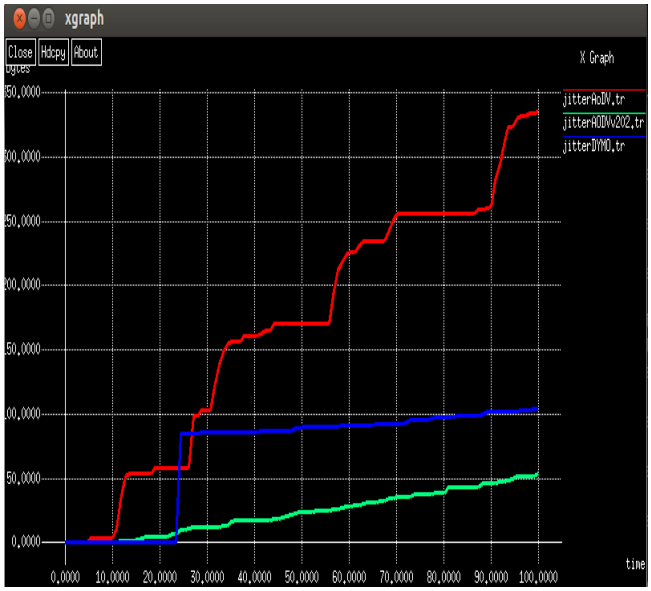

Figure 4.4: Jitter

Performance Comparison

Table 4.2 shows the overall performance comparison of all the three protocols simulated in NS2 network simulator. It has been observed that AODVv2-02 has a high Throughput and very low Delay. On the other hand its processor AODVv2-02 has shown a low performance compare to DYMO in case of Jitter. AODV and DYMO show less difference in Throughput and Packet Delivery Ratio, but AODVv2-02 as a revised version of DYMO performs better in all the metrics whereas AODV incurs large Delay and Jitter.

Table 4.2: Performance Comparison

Performance Metrics / **Protocols**	Through put	Packet Delivery Ratio(PDR)	Delay	Jitter
AODV v2-02	900	750	0.05	20
DYMO	710	600	0.43	110
AODV	700	590	1.5	340

V. CONCLUSION

Experiment analysis presented in this work is an implementation of the AODVv2-02 MANET routing protocol by changing the existing code of DYMO protocol. AODVv2-02 routing protocol has been successfully simulated and other MANET routing protocols of same category in NS2 Network Simulator and analyzed its performance based on various simulation metrics. The simulation has been performed with varying simulation time and number of nodes. It has been observed that AODVv2-02 has proved as a better MANET routing protocol. From the overall study and different analysis of graphs and simulations, it can be concluded that AODVv2-02 is a better protocol when it comes to networks with high mobility and changing topology. It has been observed that AODVv2-02 being the successor of DYMO performs better in all the terms.

Future work

In the area of MANET research, there is always scope for future work. In future the proposed work can simulate and analyze the performance of AODVv2-02 with other routing protocols on different simulation metrics with varying simulation time and number of nodes. Our implementation of the AODVv2-02 specification can be further extended to eighth version of IETF for future implementations. Future work can be done by implementation of the modified AODVv2-02 on the test bed scenario or in industrial application.

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