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Implementation and Performance Evaluation of a Modified AODV Routing Protocol for Wireless Ad-hoc Network

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***Abstract*— In Wireless Ad-hoc Network mobile nodes communicate with each other using wireless channels without any existing infrastructure. Routing protocols play a vital role to facilitate communication within network and are also used to discover proper route among nodes. DSDV, DSR and AODV are the most popular routing protocol for Wireless Ad-hoc network. In this paper a modification of AODV routing protocol has been proposed by combining some of the features of DSDV and AODV routing protocol. In the proposed scheme each node maintains a routing table that contains the information about neighbor nodes only. Communication between source node and destination node happens using the same principle as AODV routing protocol. In this work, at first the basic network using DSDV and AODV protocols are implemented using Matlab simulation environment and then the performance of the proposed protocol has been analyzed against the performance metrics such as bandwidth consumption, packet delivery fraction and transmission delay with respect to number of nodes. It is observed that the proposed method has similar bandwith consumption as AODV. Packet processing delay and packet delivery fraction fall in between that for AODV and DSDV protocols.**

Keywords—MANET; AODV; DSDV; RREQ; RREP; ROUTING PROTOCOL; PERFORMANCE ANALYSIS

I. INTRODUCTION

Mobile ad hoc networks (MANETs) are infrastructure less networks which dynamically exchange data among themselves because its consist of wireless mobile nodes. In MANET nodes changes position frequently [1]. It is always difficult to design appropriate routing protocol for this dynamic network [2],[8]. Different routing protocols with different techniques have been proposed for the better performance of ad-hoc networks [3]. In MANETs the nodes do not depend on any fixed infrastructure for their operation. Wireless links plays the main role of communication with the help of their antenna [4].Closer nodes communicate directly with each other and the nodes at a far distance communicate via the intermediate nodes [5]. Nodes can communicate directly are known as neighboring nodes [6] and the nodes between two source and destination acts as router. So, when the nodes move then the network topology changes instantly [7]. Thats why, for better communication between the nodes an efficient routing protocol is needed [8].

Routing protocols in ad-hoc networks are classified into two types: Proactive (Table driven) routing protocols and reactive (On Demand) routing protocols [3]. In proactive routing protocol all the nodes transmits a broadcast message to the total network [7]. For this reason higher bandwidth is requiired due to maintaining up-to-date information and as a result: throughput of the network may be affected but it provides the actual information to the availability of the routes. Destination Sequenced Distance Vector (DSDV) protocol [7] is an example of this type. On the other hand in the reactive routing protocol a route to a destination is stablished only on demand [2]. AODV is an example of such routing algorithm. AODV eliminates the infinity counting problem of other distance-vector protocols by using sequence numbers on route updates [9].

II. RELATED WORKS

To improve the AODV routing performance many studies are undertaken. An extension of AODV routing protocol for ad-hoc network was done by Rakesh et al. [10] to resolve some realistic model problems. A route request (RREQ) message forwording scheme was introduced by Venetis et al. [11] for AODV routing protocol intended to reduce the routing overheads. The method was named as AODV_EXT. A reverse AODV protocol was proposed by Chonggun et al.[12] . This scheme was named as R-AODV and it was an

interesting improvement for AODV scheme to improve reliability of ad-hoc communication. A modified method called route enhanced AODV (RE-AODV) was implemented by Usha et al [13]. In this study the authors were able to reduce overhead and end to end delay by 25% and 11% respectively than that can be obtained in normal AODV. Saini and Dembla proposed a modified AODV protocol called enhanced AODV (E-AODV) [14]. In this method the E-AODV routing protocol discover out routes using a procedure called turn-around route request (TA-RREQ) message. In this scheme multiple routes from receiver to sender are selected. Reliability of transmission can be improved by using alternate route immediately if the previous selected route fails. A modified AODV scheme [15] was implemented for securing packet delivery in the wireless environment. The method was named as SCAN (self-organized network layer security in mobile ad-hoc networks). In this scehme there will be a network with sufficient node density that can overhear packets being sent by the neighbor.

Another technique was described in [16] using a different types of acknowledgement packet termed as 2ACK. In this technique a fixed route of two hops is assigned with the new packet in the opposite direction of the data traffic route.

III. EXPERIMENTAL

The proposed modified AODV routing protocol is a combination of DSDV and AODV routing protocols. In this protocol, every node receives the signal from surrounding node then it collect the information about surrounding node but do not pass information from one node to another node via middle node i.e it only pass information to it's neighbor node. So, it does not contain full routing table, only every node contain information about surrounding node to send packet directly. When it is required to send information from one node to another node then sender node will transmit request to destination node through the neighbor node since sender node knows the IP address of destination node. This protocol can send request to destination node at a faster speed compared to the conventional AODV protocol. Similarly the sender node will receive the reply from destination node with short time which led to reduce delay under sensitive case of data transmission. It is expected that this protocol will consume low bandwidth compared to DSDV protocol because every node does not contain full routing table but also contains the essential information about neighbor nodes. In this regard, the modified AODV protocol will experience a moderated performance regarding packet delivery fraction. Experimental detail of the current study has been described step by step in the following subsections.

A. Implementation of DSDV protocol

Let us consider a network as shown in fig.1. It consist of seven nodes and are connected as shown in the structure. For DSDV routing protocol every node will contain full routing table including destination sequence number, destination, next hope and metric as well as installation time about all node in the network. The green colored double arrowheads among the nodes are showing the bidirectional connectivity between the nodes.

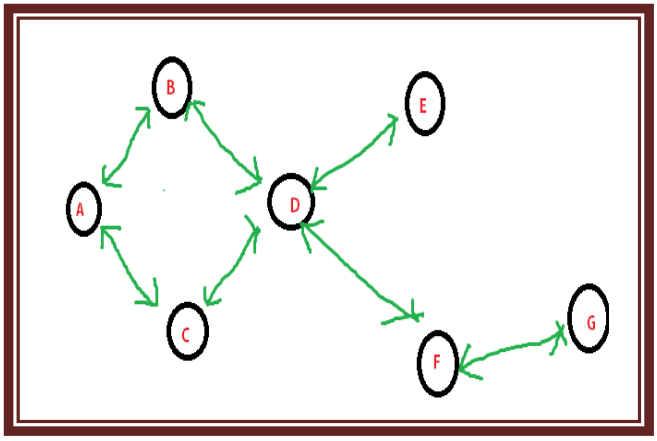

Fig. 1: Wireless Mobile Ad-hoc Network (Wireless MANET).

Node A in fig.1 will contain all the routing informations of the connected nodes as shown in table-1. Similarly,node B will contain all routing informations like node A as shown in table- 2.

Table 1: Routing Table for Node A

Destination	Next hop	Metric	Destination sequence number	Installation time
A	A	0	AA70010010	AA00000010
B	B	1	BB70020020	BB00000020
C	C	1	CC70030030	CC00000030
D	C	2	DD70040040	DD00000040
E	C	3	EE70050050	EE00000050
F	C	3	FF70050060	FF00000060
G	C	4	GG70050070	GG00000070

Table 2: Routing Table for Node B

Destination	Next hop	Metric	Destination sequence number	Installation time
B	B	0	BB70020020	BB00000020
A	A	1	AA70010010	AA00000010
C	A	2	CC70030030	CC00000030
D	D	1	DD70040040	DD00000040
E	D	2	EE70050050	EE00000050
F	D	2	FF70050060	FF00000060
G	D	3	GG70050070	GG00000070

Similarly routing table for node C, D, E, F and G will be created. Thus, in the DSDV protocol every node contains routing information of all the nodes in the network.

B. Implementation of AODV protocol

In AODV routing protocol**,** every node does not contain routing table as proactive form. When it is required to send the data then sender node sends request to a destination node with all possible routes and get reply and select the shortest path. For example node A is a sender and G is a destination as shown in fig.2 and *fig.3.*

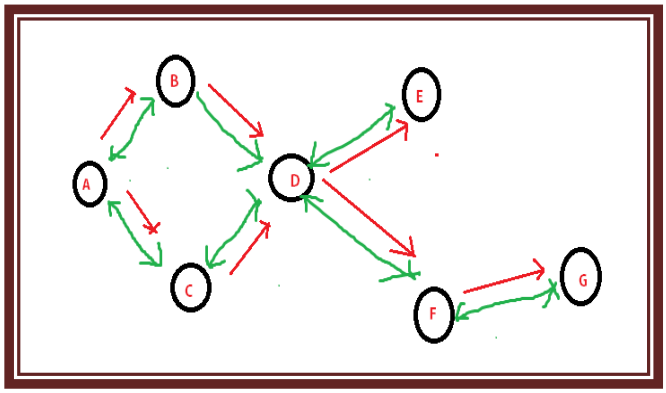

Fig 2: Node A sends route request (RREQ) to destination node G (request signal – red color).

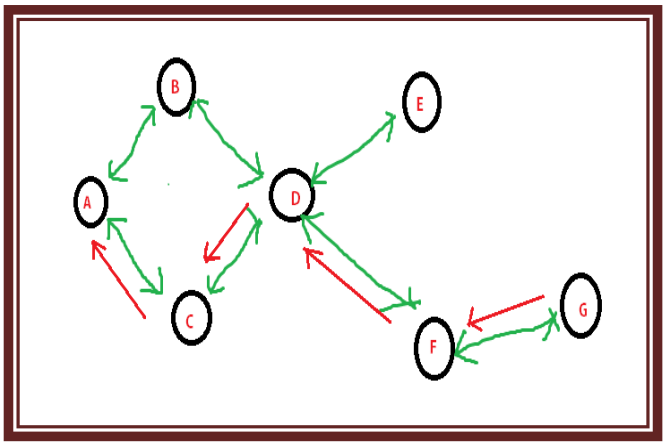

Fig 3: Node A receives the reply (RREP) from destination node G (reply– red color).

In fig.2 the red colored signal is transmitting as a RREQ towards the destination G and in fig.3 node G reply the route request as RREP in the directed way as shown in fig.3.

C. Implementation of modified AODV protocol

In proposed modified AODV protocol, every node contains routing table for only neighbors, not of all nodes in the network. When it is required to send information from one node to another node then sender node will transmit request to destination node through the neighbor node with shortest path because every node contains all essential information about neighbor node as shown in fig.4, fig.5 and in fig.6 where sender node is A and destination node is G.

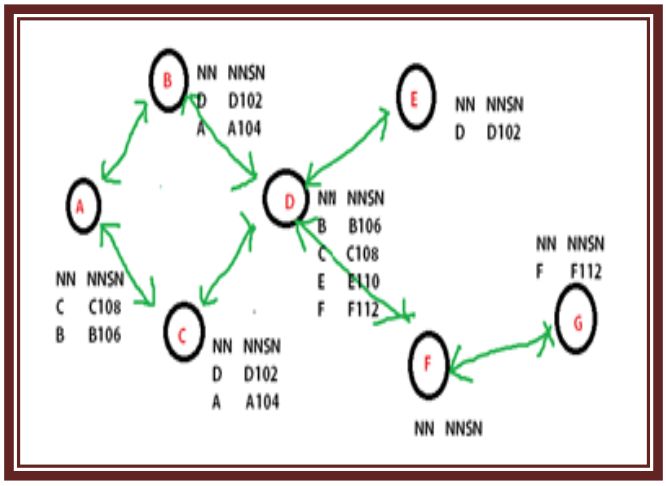

Fig. 4: Wireless Mobile Ad-hoc Network with the application of the modification of AODV routing protocol. Where NN means neighbor nodes and NNSN means neighbor node sequence numbers.

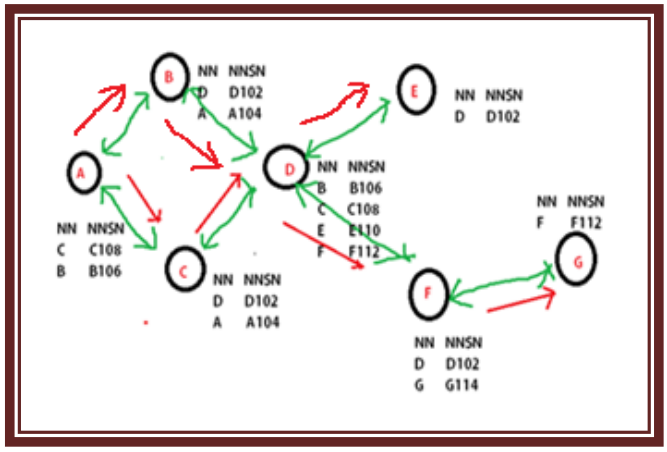

Fig. 5: Node A send request (RREQ) to destination node G (request signal – red color) with the application of modified AODV protocol.

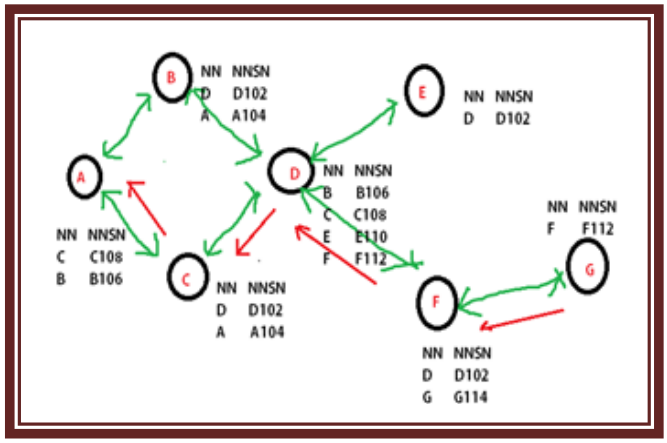

Fig. 6: Node A received the reply from destination node G (reply– red color) with the application of modified AODV protocol.

IV. Result and Discussion

In this section the performance of proposed modified AODV routing protocol has been compared with DSDV and AODV protocol with performance

metrics like bandwidth consumption ratio, packet processing delay and packet delivery fraction. In each case the node speedwas kept fixed at 7 km/h.Matlab 2009 is used for the simulation.

A. Bandwidth Consumption Ratio

In fig.7 the red coloured graph shows the bandwidth consumption of conventional DSDV protocol and the black coloured is for AODV.

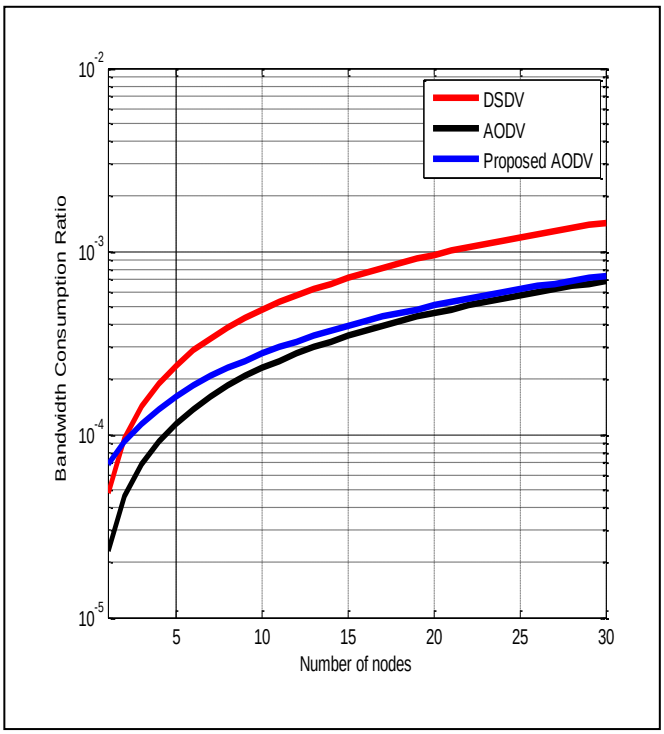

Fig 7: Performance analysis of bandwidth consumption ratio.

The blue coloured graph shows the bandwidth consumption of proposed modified AODV protocol. In this comparison it is observed that when the number of node is minimum then the effectiveness of the proposed protocol is the same as the existing protocol. But when the number of node is increased then the bandwidth consumption is much less than the DSDV protocol and it is as like the AODV protocol. We know that AODV protocol has the best bandwidth utilisation capability [15].

B. Packet processing delay

DSDV protocol is a proactive protocol and it has less time delay than AODV protocol. As the AODV is a reactive protocol it has greater time delay. In the proposed modified AODV protocol it is seen that this protocol has also time delay but it is less than the AODV protocol. With the increasing of number of nodes this will take effects and benifits are observed. In fig.8 it is seen that the time delay of modified AODV protocol is greater than DSDV and less than AODV. This may happen due to the fact that the proposed protocol need to process information of it's neighbor nodes only.

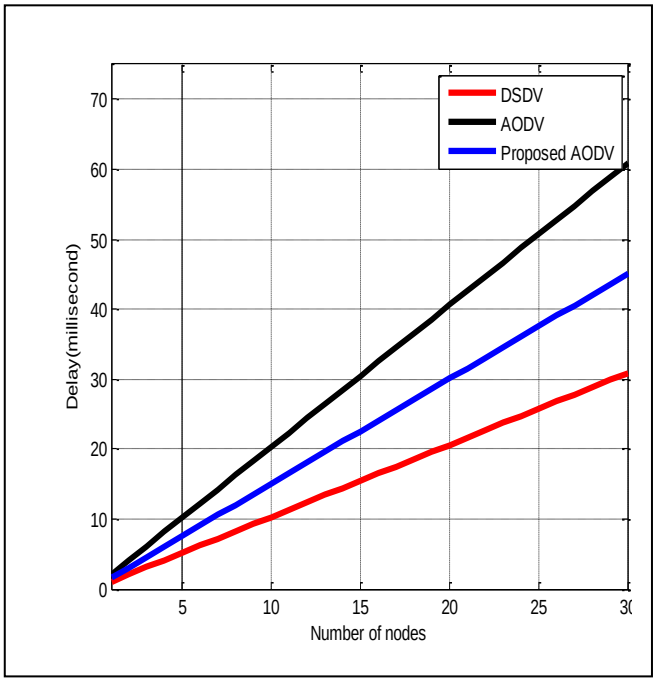

Fig. 8: Performance analysis of packet processing delay.

C. Packet delivery fraction

After identifying the proper path while delivering the information as a packet then the success of receiving the amount of data is known as packet delivery fraction. The packet delivery fraction will be at best 1. In AODV protocol it is seen that the packet delivery fraction is near about 1 and it is the best performance regarding packet delivery fraction among all the protocols.

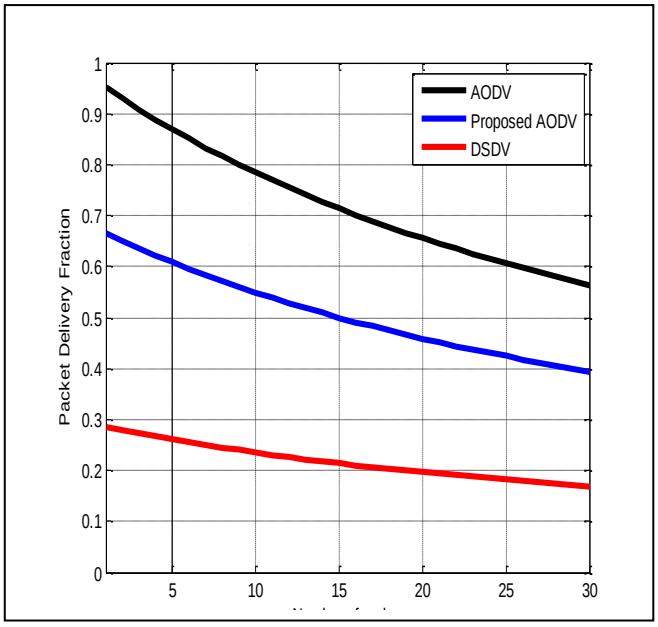

Fig.9: Performance analysis of packet delivery fraction.

In the modified AODV protocol it is seen that the packet delivery fraction is less than AODV protocol but it is greater than DSDV protocol.

V. CONCLUSION

In this paper the modified AODV protocol has been implemented and it's performce was compared with DSDV and AODV protocol against the performance metrics such as bandwidth consumption ratio, packet processing delay and packet delivery fraction. It is observed that the proposed method performs better than AODV for bandwidth utilization and it's performance falls in between DSDV and AODV in case of processing delay and packet delivery fraction.

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Biography

Md. Khalid Hossain Jewel received his Bachelor's and Master's degree from the dept. of Applied Physics, Electronics & Communication Engineering of Islamic University, Kushtia-7003, Bangladesh in 2004 and 2005 respectively. Now he is currently an assistant professor in the same department .His research interest includes Ad-hoc wireless communication, cellular mobile communication and optical fiber communication.

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