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Enhancing the Performance of AODV by Exchanging Neighboring Node Information with Hello Packets in VANET

Shubham Mittal, Swati Singh, Kamlesh C. Purohit

P.G. Scholar,
Graphic Era Hill University, Dehradun, Uttarakhand-India
shubhamittal121@gmail.com
P.G. Scholar,
Graphic Era Hill University, Dehradun, Uttarakhand-India
ssswatisinghss@gmail.com
Assistant Professor,
Graphic Era University, Dehradun, Uttarakhand-India
kamleshpurohit80@gmail.com

***Abstract*— Today's developing innovation of wireless communication is a Vehicular Ad-hoc Network (VANET). VANET is an instance of MANET in which the foundation of wireless scenario is done between vehicles-vehicles and vehicles-roadside Unit (RSU) [12]. Mobile nodes in VANET are considered as quick moving vehicles because of which the topology turns out to be very dynamic in nature, which makes it exceedingly supportable for analyzing the security measures for drivers and travelers if there should be an occurrence of any perilous circumstance. AODV is a reactive routing protocol, which has critical influence in the route discovery from source to destination. In this paper, we have acquainted an enhanced strategy with lessening the overhead of control messages from the network by sharing the information through HELLO messages, and expansion the execution of AODV in VANET environment.**

Keywords: AODV, VANET, Hello Message, performance.

I. Introduction

Today, streets are turning into the greatest enemy of individuals around the globe. The fundamental explanation behind the addition in street mishaps is requirement of principles. With a specific end goal to enhance the way of life of a movement framework, another innovation is developed, named as Vehicular Ad-hoc Network (VANET).

With a specific end goal to give facilities in security applications, different new methods are adopting and one of them incorporates VANET. Another and extraordinary sort of Mobile Ad-hoc Network (MANET) is Vehicular Ad-hoc Network (VANET). In VANET, nodes are considered as fast moving vehicles which prompt dynamic network formation. It is a self-designed, autonomous and infrastructure-less remote system in which every one of the vehicles are following the traffic rules and keeping up the correspondence between Vehicle-to-Vehicle (V2V) and Vehicle-to-Road Side Infrastructural Unit (V2I). VANET works for the advancement and change of Intelligent Transportation System (ITS) by breaking down the security measures for drivers and travelers if there should arise an occurrence of any perilous circumstance. Compelled portability, large network size and profoundly dynamic topology nature render traditional MANET protocols unsuitable for VANET environment.

In this paper, we will analyze the working of AODV and spotlights on enhancing its execution by improving the network performance through HELLO packets. Section II incorporates the detailed study of AODV. In section III we analyzed the related work done in the execution development field of AODV. In section IV, we examine about the proposed work. The following section V covers the experiment and analyzes work. At last, we end this paper with a conclusion and future work recommendations.

II. AODV Routing Protocol

One of the reactive type protocols is Ad-hoc on demand Distance Vector (AODV) or an On-Demand Routing Protocol. Reactive protocols are those which build the route amongst the nodes when required by the source node [9]. In these types of protocols, when any information is needed to be sent to the destination node, a route is created by the source node. In AODV, the upkeep of the routing table is done by every node that set up the route to the destination node by adopting a backward technique [10]. Backward learning procedure helps in order to keep record for the route and previous hops. AODV permits versatile nodes not to keep up route to the destination nodes those are in-dynamic correspondence and make a node responding to link breakage and change in network topology periodically.

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Here, HELLO Message plays an imperative role in order to stay up with the up-to-date about the association between the mobile nodes. Every node gathers connectivity information by broadcasting the local HELLO Message to its neighboring nodes. These HELLO messages are shared to confirm for the active connection between them periodically. On the off chance that any nodes fail to send the answer to the got HELLO message inside permitted time, the sender node except that the connection in its neighboring node is lost[8].

HELLO message is shared by every node after each periodic time interim, which helps the node to keep them updated with the neighboring node information. This updated information is used by the nodes in order to create an optimized route between the source node and destination node when required. AODV performs two critical stages: First is route discovery and the other one is route maintenance. On the first stage, source node set up the route to the destination node by exchanging RREQ (Route Request) and RREP (Route Reply) packets. Source node sent the RREQ packet to the destination node through intermediate nodes. This RREQ packet is sent until the maximum hop limit is reached. Once the destination node gets the RREQ packet, through the same path RREQ packet is transmitted back to the source node and communication link between these nodes gets open. Due to the dynamic nature of mobile nodes, the route is broken quite often which makes the implementation of route repair procedure necessary. At the point when a node gets down or moves out of transmission range, the upstream node propagates RERR (Route Error) packets in the network. This route failure notification is transmitted to the source node through intermediate nodes. Once the notification is reached to the source node, it carries out a route discovery procedure to set up another route to the destination node.

III. Related Work

Author *Ehsan Mostajerani et al.* [7] presents a new strategy of decreasing overhead of the neighbor discovery process. During a period when HELLO messages are broadcasted, then just neighboring nodes are recognized. To overcome to this load expanding method, HELLO message is sent by source node just to the destination node which results in the decrement of overhead in AODV..

Dharmendra Sutariya et al. [9] proposed new packet structure for RREQ packet. This method is proposed for both route discovery mechanism and route maintenance mechanism. They attach second node address in the RREQ packet with a specific end goal to bring down the routing load. To bring down the packet delay, a backup path is maintained if the active path is broken. The route discovery procedure is initiated if the backup path is also broken.

In the paper [1], author *Tanjida Kabir et al.* presented another hypothesis of the diminishing overhead of control messages. They bought an idea of scaling variable and probability. A scaling element figures the quantity of sharing neighbor nodes between two nodes (Let u and v) and registers the probability that the node (u or v) won't re-broadcast the message.

As energy utilization is additionally a noteworthy issue parallel to the network overhead in AODV, *Abhishek Nadda et al.* [4] accompanied another method. Hello interim of the node is made relative to the event interim that outcome in the decrement of control message overhead and lessening in energy utilization.

As indicated by the work [17], author D. Marina et al. thought of another procedure for neighbor discovery strategy. Lower limit and upper limit are set for Signal to Noise Ratio (SNR), if any node gets a control message from another node with no entry in the routing table, the SNR must be higher than upper limit and if any node gets a control message from its neighboring node, the SNR must be higher than the lower limit. These standards define the quality of nodes.

Author Zehua Chen et al. [13] presented a new strategy for stability between routes in AODV. Nodes which move in the same direction will have the communication range for a long period of time as compared to the nodes moving in different directions. Route in the middle of the source and destination is made of the nodes which have more steady connections, then different nodes and consequently diminish the network overhead.

In 2010, an author Yongjun Hu et al. [14] proposed a new technique by joining AODV and DSR strategies together. In IMAODV, location of second node is appended with the RREQ which results in a decrement of routing load and packet delay.

IV. Proposed Protocol

Our proposed Enhanced-AODV (E-AODV) routing protocol consolidates the component of OLSR into the fundamental working mechanism of AODV. Being a reactive protocol, AODV don't keep up a dynamic route between the nodes constantly, in fact, a route is built up on-demand only. HELLO message is shared by every node after each periodic time interim, so as to validate the presence of its neighboring node [6]. In case, any node doesn’t replies or its reply is lost, the sender node updates the table information as a broken connection between those two nodes. This sharing of HELLO messages guarantees the presence of the dynamic nodes adjacent so as to make an active route in future to transmit the information to its destination through them. Since this procedure is carried out only to validate the presence of the neighboring nodes, hence, we came up with an idea of upgrading each node in the network with the information of the two hop nodes and this information is shared amongst the nodes through HELLO messages. As we also know that in AODV, every node keeps up a table of its active neighboring node, which is upgraded time to time and non-active nodes are expelled from the table. So, according to our method, when a node sends the HELLO message to its neighboring node, it will likewise send the list of his active neighboring nodes to the receiving nodes. This list will be redesigned by the receiving nodes in two distinct segments, such as, 1-hop and 2-hop active neighboring nodes in its own table. This activity will result in the re-usability of the bandwidth and energy efficient network.

The motivation behind sending the details of 1-hop neighboring nodes consolidated with HELLO messages is to make the nodes aware with the presence of 1-hop as well as 2-hop neighboring nodes without sending any other additional message for the same. This results in the reduction of control messages in the network. In AODV, HELLO messages are sent intermittently, but table entry is done only when the route discovery mechanism is carried out. With our proposed approach, table entry is updated each time with the information shared with the HELLO Messages. For example, nodes which are having 2-hop distance from the destination node, will not broadcast the RREQ control message. On the off chance, i.e., if node is having more than one route to the destination node with 2-hop distance, it will choose the shortest path to send RREQ in place of broadcasting it. These outcomes, results in lessening the congestion from the network.

Figure 1 demonstrates the route discovery mechanism followed by the conventional AODV. At the point when a node (say A) need to send the information to some other node (say G), the route discovery mechanism is carried out by the source node. It sends a RREQ message to the majority of its neighboring nodes, which is further broadcasted by the intermediate nodes until it reaches to the destination node. Nodes which are the neighboring node of the destination node will not broadcast the received RREQ message, as they are already aware about the position of the destination node. Hence, it is straightforwardly sent to the destination node.

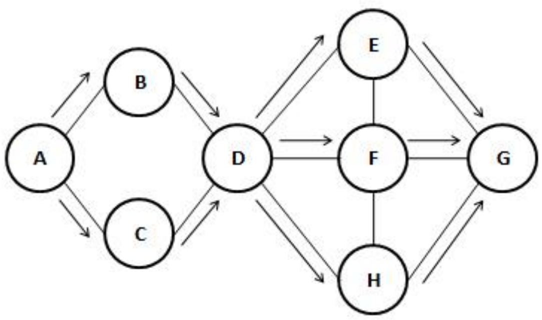

Fig 1: Flow of Control Message (RREQ) in AODV

Likewise, in our methodology, when nodes are having 2-hop node information, the unnecessary broadcasting of the control messages can be controlled and network overhead gets lessened. In figure 2, when a node (say A) necessities to send some data to another node (say G), so the route discovery mechanism is carried out and the node (say A), initiates the broadcast of RREQ message. At the point when the RREQ is received by a node (say D), it will check the location of the destination node (say G) in his 2-hop table and in place of broadcasting it, it will send the RREQ request directly to it through the shortest path (let us consider it to be D=>F=>G). In this way, node E and node H are not participating in route discovery mechanism. Node G receives a RREQ message just from one path, which don't requires any selection procedure to choose the shortest path as it is already decided by the node D.

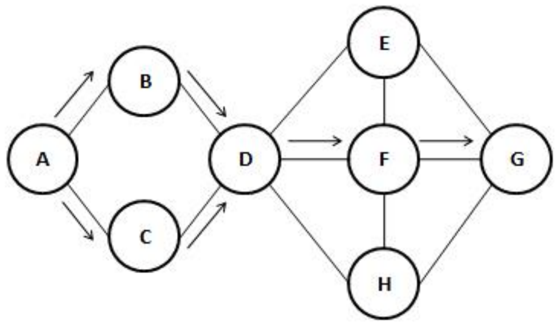

Fig 2: Flow of Control Message (RREQ) in E-AODV

Here, we found that, the quantity of control messages is diminished in numbers at the destination end. The advantage of best path selection by the intermediate node results in the reduction of network overhead, which also reduces the chance of the packet loss up to some extent. Energy conservation is likewise accomplished for the nodes which are not participating in unnecessary broadcasting by the packets.

Modification in the HELLO message system can be seen in the calculation and the flowchart structure as underneath:

Algorithm: HELLO Message Procedure

1. Node i switch ON in the network
2. Node i append its table information with HELLO message and broadcast to its neighbor nodes
3. Node j receives HELLO message and update its table information
4. **If** node j has already sent HELLO message, **then**
5. Wait until HELLO_TIMER gets over
6. **Else**
7. Append its table information with HELLO message and broadcast to its neighbor nodes
8. **End If**

Fig. 3: Algorithm for HELLO Message Procedure (Pseudo code)

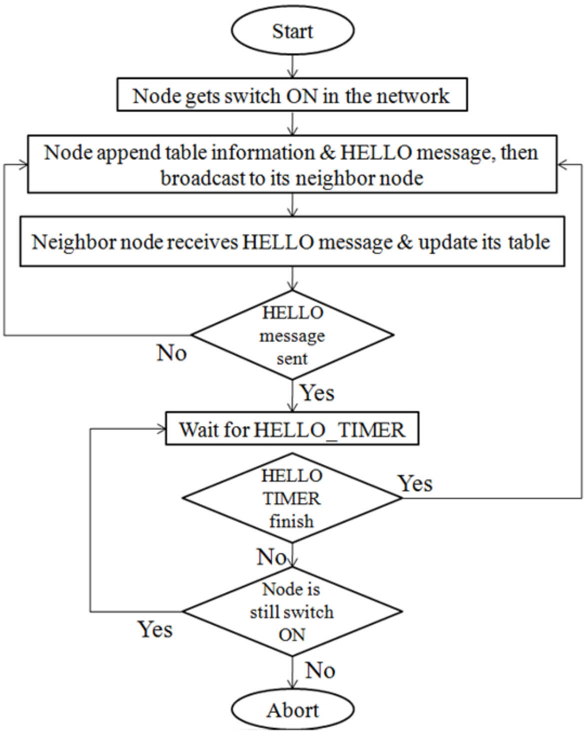

Fig. 4: HELLO Message Procedure (Flowchart)

V. SIMULATION & RESULT ANALYSIS

A. *Simulation Network and Parameters:* Simulation of the network is experimented in Network Simulator (NS2). A network size is compromised with the extent of 910m*800m region with 10 nodes and each are moving in an irregular direction to a specific spot. After reaching to the random point, it pauses for 2 seconds and return back to its beginning spot. Every node sends 1 packet during a period of size 210 bytes. We have simulated the network in various situations by varying the quantity of nodes. Simulation has kept going for 500 seconds in which we have set IEEE 802.11 MAC detail for remote channel took after by Two Ray Ground Propagation model, Omni Directional Antenna with CBR Type Traffic. The performance of our proposed algorithm is compared with the existing AODV and OLSR approach in terms of the packet delivery ratio, end-to-end delay, normalized routing overhead and throughput. Table 1 demonstrates the parameters which are set for the network in various scenarios.

Parameter	Value
Packet size	210 bytes
Pause time	2 sec
Simulator	NS-2 (Version 2.35)
Routing Protocol	AODV, EAODV
Channel Type	Channel/WirelessChannel
Simulation Time	500 sec
Network Interface Type	Phy/WirelessPhyExt
Radio Propagation Model	Propagation/Two Ray Ground
MAC Type	Mac/802_11
Interface Queue Type	Queue/DropTail/PriQueue
Antenna	Antenna/OmniAntenna
Traffic Type	CBR (Constant Bit Rate)
Maximum Packets queued	50
Topology Size (M*M)	910*800
Number of nodes (vehicles)	10, 20, 30, 40, 50

Table 1: Parameter of the network

B. *Packet delivery ratio:* With expanding the quantity of nodes, the numbers of control message in the network start decreasing, which increases the delivery ratio as well. In the chart, we can see that by increasing the quantity of nodes, the packet delivery ratio for E-AODV is performing superior to anything AODV and OLSR.

C. *Average End to end delay*: Lesser number of nodes in the network are highly affected with lower mobility of the nodes as 2-hop nodes tries to send the control messages directly to the destination in place of broadcasting them, as it results in the frequent path break as well as increment in end-to-end delay. By expanding the quantity of nodes, the numbers of control message in the network start decreasing and re-establishment of path takes lesser time, which decreases the end-to-end delay in the network.

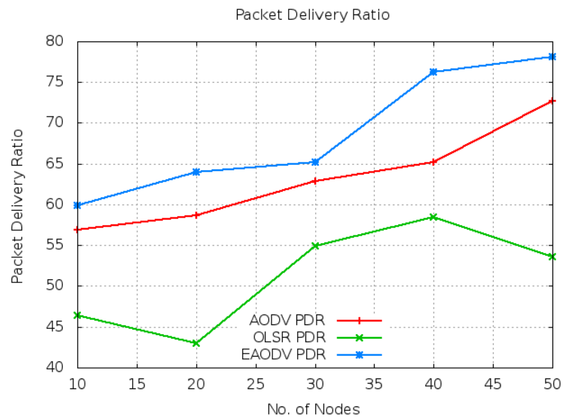

Fig. 5: Packet Delivery Ratio (Graph)

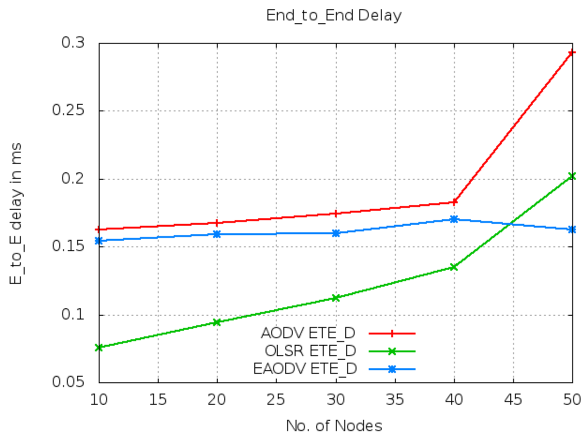

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Fig. 6: Average End-to-End Delay (Graph)

D. *Normalized routing overhead:* With expanding the quantity of the nodes, chances of broadcast of control messages in the network increases. As per our technique, broadcast of control messages is controlled at the destination end, which helps in controlling the network overhead. So, the decrement in the control messages results in the decrement in the routing overhead.

E. *Throughput:* Decrement in the system overhead results in the efficient flow of data packets. The ratio of packet drop is reduced because of which the execution of the protocol is moved forward. As appeared in the chart underneath, the enhanced system of E-AODV diminishes the system overhead and expansions the execution with the augmentation in the quantity of nodes.

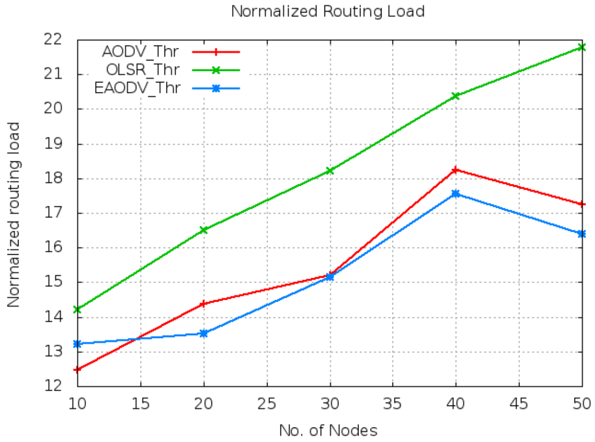

Fig. 7: Normalized Routing Overhead (Graph)

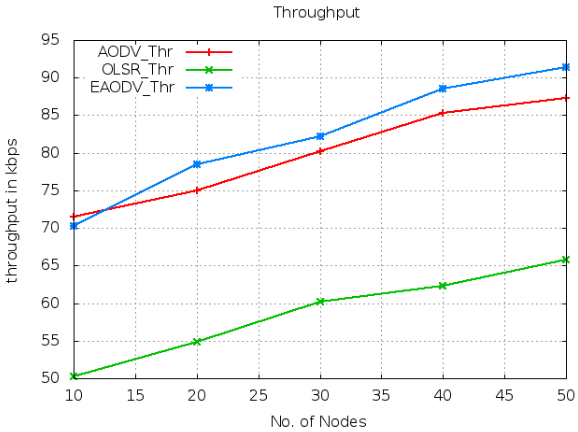

Fig. 8: Throughput (Graph)

VI. Conclusion and Future Work

In this paper, we present improved procedure so as to take care of the network overhead issue. HELLO messages are one of the important control message sent by every single node after each occasional time interim. In our proposed approach, we are sending the node data clubbed with HELLO messages in order to utilize the bandwidth completely. Each node maintains a table of its active neighboring node, but updates the table information only when it needs to establish a path between two nodes. This shows that nodes keep the out-dated information in their table for long. As per our proposed technique, frequent table data updating scheme results in lessening the system overhead as well as reducing packet loss rate and makes energy efficient network.

This research can be done further by looking at the proposed approach over the huge scale network and compute the received packet rate by the nodes. Likewise, we plan to develop our work through a substantial scale network so as to advance the estimation of HELLO interims utilizing different enhancement procedures.

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