OVERVIEW OF UNICAST AND MULTICAST ROUTING PROTOCOLS

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ABSTRACT: Vehicular Ad-Hoc Network (VANET) is a technology that uses moving vehicles as nodes in a network to create a mobile network. VANET turns every participating vehicle into a wireless router or node, allowing vehicles connect to each other and in turn create a wireless network with a wide range. As vehicles fall out of the signal range and drop out of the network, other vehicle can join in, connecting vehicles to one another so that a mobile internet is created. It is estimated that the first systems that will integrate this technology are police department and fire vehicles to communicate with each other for safety purposes. The topology of the network may change frequently and unpredictably. Multicast routing has been widely applied in vehicular ad hoc networks, to support different applications like vehicular cloud and image processing. This paper presents the comparative analysis of two routing protocols PUMA and AOMDV. The comparison was done using four parameters like packet delivery ratio, average end-to-end delay, Energy and Throughput. The simulation was done on Network simulator NS 2.35.

Keywords: PUMA, AOMDV, VANET, Multicasting.

I. INTRODUCTION

Ad hoc Mobile Ad-hoc Network (MANET) is an autonomous mous system of mobile hosts, connected by wireless links that dynamically create a temporary network and establish an infrastructure less network [1].The topology of the network may change frequently and unpredictably. Each and every node in the MANET should be aware of its neighbor and act as a router to forward datagram's to the specified destination. If two mobile nodes are located within the forwarding range, they communicate with each other directly over the wireless radio frequencies. Otherwise, they need intermediate node(s) to forward their datagram's using a multi-point hopping method. MANETs are characterized by non-restricted mobility and easy deployment, which makes them very popular. Mobile wireless nodes will typically have limited transmission range, which means that packets might have to be forwarded by several nodes in order to ensure communication between one node in the network to another. Fig 1 below illustrates how node A uses a route through node B to send data to node C, as C is out of A‟s transmission range[2][3].

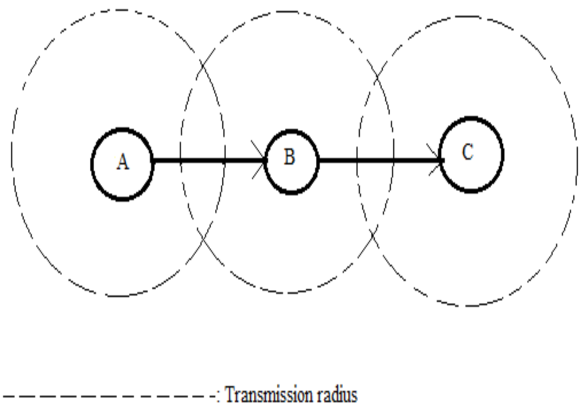


Fig.1: Routing in MANET

As a technology for dynamic wireless networks, ad hoc networking has been deployed in military since 1970s. Commercial interest in such networks has recently grown due to the advances in wireless communications. A new working group for MANET has been formed within the Internet Engineering Task Force (IETF), aiming to investigate and develop a framework for running IP

based protocols in ad hoc networks. In recent years, many group oriented applications have gained a lot of importance. Multicast routing has been widely applied in mobile ad hoc networks (MANETs), to support different group oriented applications efficiently. Some of them are:

- Military applications used in the battlefield

- Search and rescue operations
- Temporary networks within meeting rooms and airports Personal Area Networks connecting mobile devices like mobile phones, laptops, smart watches, and other wearable computers
- Disaster recovery
- Video conferencing and multimedia streaming

II. Routing Protocols

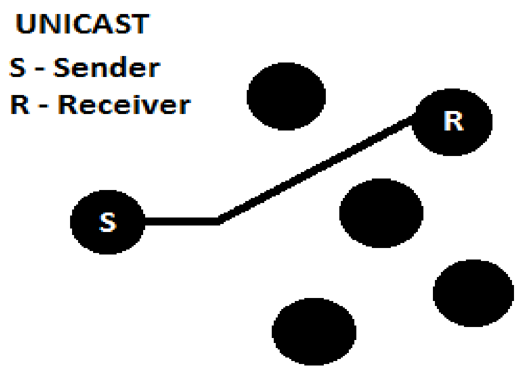


Fig.2: Unicasting Routing

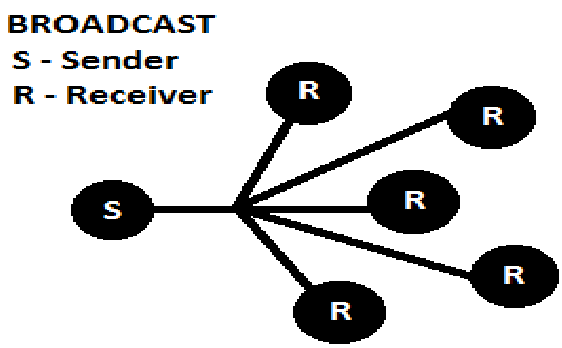


Fig.3: Broadcast Routing

Routing protocol is a set of rules used by router to determine the appropriate path on to which data should be forwarded. It also specifies how routers report changes and share information with the other routers in the network that they can reach. This decides whether the network should dynamically adjust to changing conditions, otherwise all routing decisions have to be predetermined and remain static. To achieve the preliminary objectives, several routing protocols in the area of mobile ad hoc networks should be examined. Routing Protocols can be classified based on message delivery semantics as unicast, multicast and broadcast showed in the Fig 2, Fig 3, and Fig 4

- Unicast – to single specified node by the host
- Broadcast – to all nodes in the network
- Multicast – to a group of nodes that have expressed interest in receiving messages

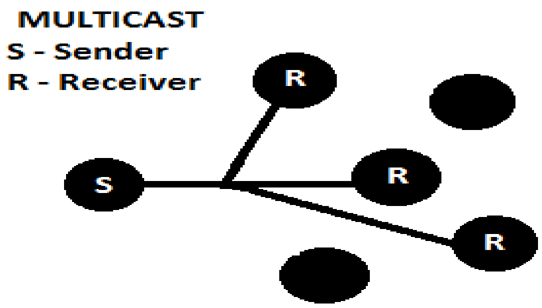


Fig.4: Multicast Routing

1. Unicast Routing:

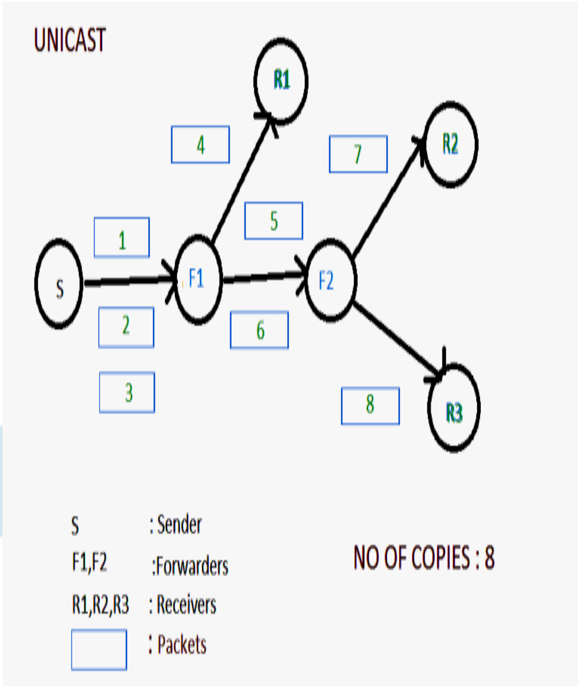


Fig.5: Packet Transmissions in Unicast

Unicast routing refers to finding a feasible path between a single source and a single receiver. Unicast term is used to describe communication where a piece of information is sent from one point to another point. Some of the unicast protocols are AODV, DSDV and DSR [4] [5] etc.

2. Multicast Routing:

Multicast [3] is a bandwidth-conserving technology that reduces traffic by simultaneously delivering a single stream of information to thousands of recipients. Multicast routing refers to finding a feasible tree covering a single source and a set of receivers. Multicast transmission is a more effective mechanism when compared to unicasting in supporting group communication applications and hence is an important aspect of future network development. Multicast is used in videoconferencing, corporate communications, distance learning, and distribution of software, stock quotes, and news in real time.

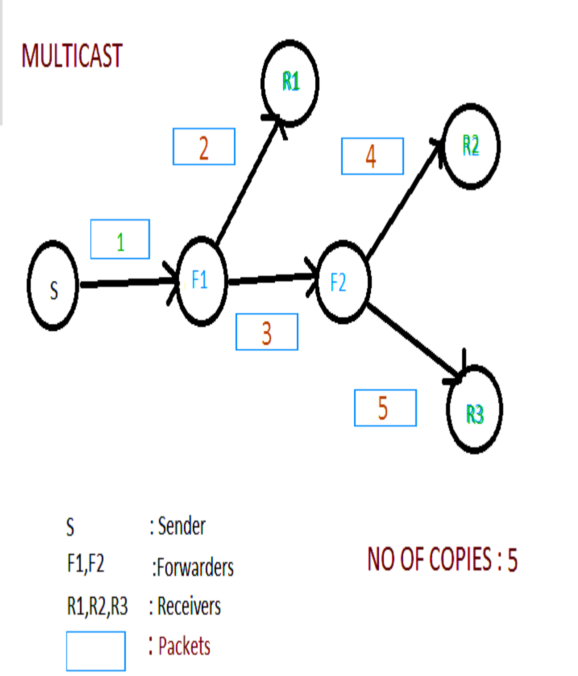


Fig.6: Packet Transmissions in Multicast

Two types of Routing Protocols are used to analyze the network performance of VANET. They are:

A. PUMA

Puma is a receiver initiated routing protocol in which receivers join a multicast group using special address (core in CAMP protocol or group leader in Multicast AODV protocol).The flooding of data or control packets is reduced using special address (core of the group) by all sources. Distributed algorithm is used to elect core among receivers of a multicast group. Election algorithm is same as the spanning tree algorithm to find loop-free shortest path between the core and group members. The elected core is connected to receivers in the network through all possible shortest paths. All intermediate nodes on shortest paths collectively form the mesh structure. Data packets are sent from sender to the group via core along any possible shortest path and flooded within the formed mesh whenever mesh member receives. All nodes in the network keep a packet ID cache to remove data packets that are duplicated [6]. Multicast announcement acts as a single control message to perform all tasks in PUMA.

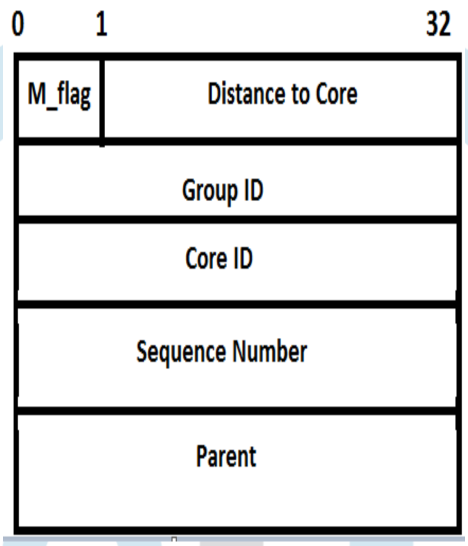


Fig.7: MAP Format

Each multicast announcement showed in Fig.8: specifies a sequence number, the address of the group (group ID), the address of the core (core ID), the distance to the core, a mesh member flag that is set when the sending node belongs to the mesh, and a parent that states the preferred neighbor to reach the core. With the information contained in such announcements, nodes elect cores, determine the routes for sources outside a multicast group to multicast data packets towards the group, notify others about joining or leaving the mesh of a group, and maintain the mesh of the group. Connectivity list is established using multicast announcements at every node in the network. It is used to establish a mesh and keep track of multicast announcement received from neighbor by nodes. It also stores the receiving time and neighborhood details.

Establishment of Mesh Initially mesh member flag of all receivers set to TRUE by considering themselves as mesh members in the multicast announcements they send. Non-receivers consider themselves as a mesh member if they have at least one mesh child in their connectivity list. A neighbor in the connectivity list is a mesh child if : (a) its mesh member flag is set; (b) the distance to core of the neighbor is larger than the nodes own distance to core; and (c) the multicast announcement corresponding to this entry was received in within a time period equal to two multicast announcement intervals. Condition (c) is used to ensure that a neighbor is still in the neighborhood. If a node has a mesh child and is hence a mesh member, then it means that it lies on a shortest path from a receiver to the core.

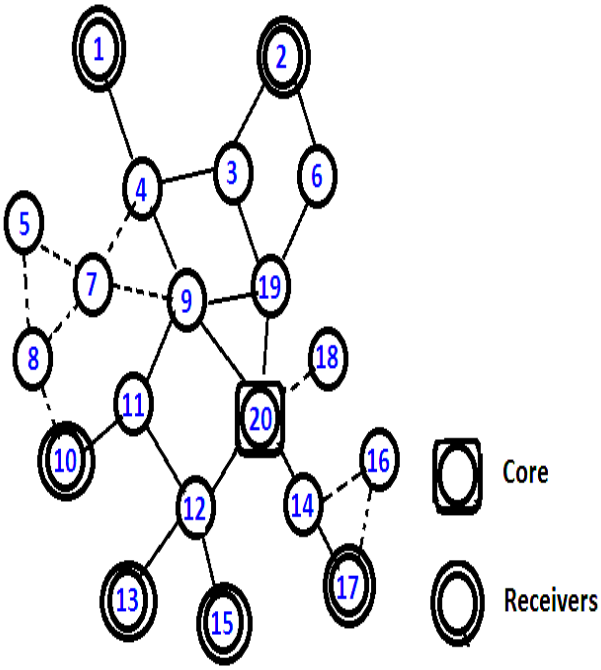


Fig.8: Mesh Establishment and Maintenance

As represented in Fig 8, node 20 is treated as core and other nodes in the group mark the connectivity list distance field by adding one to the finest entry. The receivers (nodes 1, 2, 10, 13, 15, 17 and 20) update the mesh member status to 1, node 3 and node 6 become mesh-members after receiving multicast announcement from qualified mesh child node 2 as the distance to core is same. Similarly, nodes 4, 9, 12, 19 and 14 become the mesh members as the overall distance to the core node from mesh members is small. The procedure continues until the shortest paths are detected to the core from the receivers in the mesh. In this example, the route between the node 2 and core 20 of distance 3 exist through 2-3-19-20 and 2-6-19-20 and both paths are part of the mesh.

Core Election: If a node does not receive any multicast announcement for particular group, it assumes itself the core of the multicast group and transmits multicast announcements to its neighbors and set self-distance to 0. Nodes update their connectivity list based on multicast announcements with higher core ID. The receiver which joins the group first becomes the core of the multicast group. If two or more receivers join simultaneously, then the one with largest IP address becomes core [7].

Propagation of Data Packets: The best multicast announcement from neighbor is considered in order to fill the parent field of connectivity list. A node fills parent field with a node entry from which it receives the best announcement. This field allows nodes that are non-members to forward multicast packets towards the mesh of a group. A node forwards a multicast data packet it receives from its neighbor if the parent for the neighbor is the node itself. Hence, multicast data packets move hop by hop, until they reach mesh members. The packets are then flooded within the mesh, and group members use a packet ID cache to detect and discard packet duplicates [8] [9].

B. AOMDV

Ad-hoc On-demand Multipath Distance Vector is a multipath and a reactive routing protocol. It is extension to the AODV protocol for computing multiple loop free paths. Multipath routing is a technique gives the multiple alternate routes between source and destination. It discovers the multiple paths from source to destination in a single route discovery process. It consists of two components: Route update rule and a distributed protocol. Route update rule is used to establish and maintained the nodes and Distributed protocol is used to find the link-disjoint paths. It is used in highly dynamic network where link breakage occurs due to the high load on the network. After every link breakage or failure a route discovery process is needed in AODV routing protocol. When route discovery process is done after every link breakage then it gives the high overhead and latency. Thus having multiple paths may solve this problem. Route discovery process is used when all the routes from source to destination fail. The AOMDV attempts to use routing information. The advantage of using AOMDV is it allows the intermediate nodes to respond to RREQ, while it still choosing the disjoint paths [12]. In AOMDV when node S sends a RREQ (Route Request) message in the network, every RREQ reached at node I through the different neighbors of the S, or S itself, it defines a node disjoint path from path I to S. This is used at the intermediate nodes by AOMDV. During this process replicate copies of Route Request are formed and they are not instantly rejected. Every message is examined separately whether source is provided with the node-disjoint path or not. For node disjoint paths all route requests (RREQs) must be reached through the different neighbors of the source. The RREQs only need to arrive via unique neighbors [13] [14].

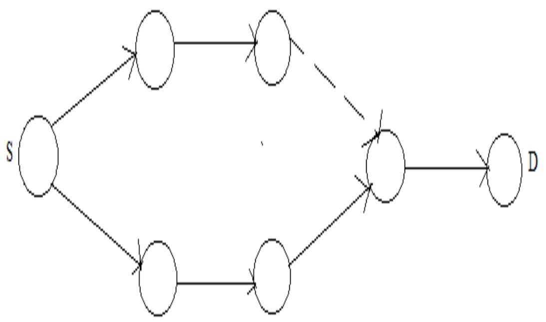


Fig.9: AOMDV

III. PERFORMANCE EVALUATION

1. Performance metrics

Performance of Manet routing protocols can be evaluated using a number of quantitative metrics those are mentioned as Packet Delivery Ratio, Throughput, End-to-End Delay and Energy for evaluating the performance of Unicast and Multicast routing protocols PUMA & AOMDV.

1. Packet delivery ratio: It is the ratio of total no. of packets received at node to total no. of packets sent

by all nodes.

Packet delivery ratio = Σ Number of received packets / Σ Number of Send packets

2. Average end-to-end delay: The difference between end time and start time to send packet.

Delay = Σ (Arrive time - Send time) / Σ Number of send messages

3. Throughput: It represents number of bits received successfully per second. This implies the quality of routing protocol.

Throughput = (No. of Packets ∗ Packet Size) / Total Time

4. Energy consumed: The total energy utilized by the vehicles on roads which is measured in terms of Mega Joules.

Total energy=initial energy- final energy

Average energy=Total energy/n, Where n is number of nodes

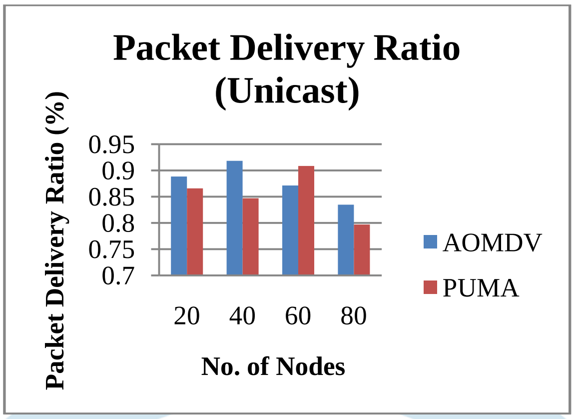
IV. Network Simulator

It is a simulation tool (NS-2) which is used to simulate network performance by performance parameters using AOMDV and PUMA routing protocol. In this paper we worked on Unicasting and Multicasting environment and taken different no. of nodes like 20, 40, 60 & 80. Simulation parameters are given below:

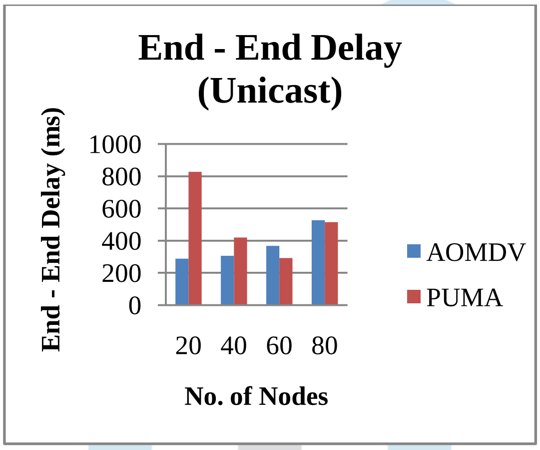
Table 4.1. Simulation Parameters

Simulation Tool	NS-2.35
IEEE Standard	802.11p
Mobility Model	Two Ray Ground
Antenna Model	Omni Directional
No. of Nodes	20 Nodes , 40 Nodes, 60 Nodes, 80 Nodes
Routing Protocols	AOMDV , PUMA
Simulation Area	4100 * 4100
Simulation Time	100 Secs. 101

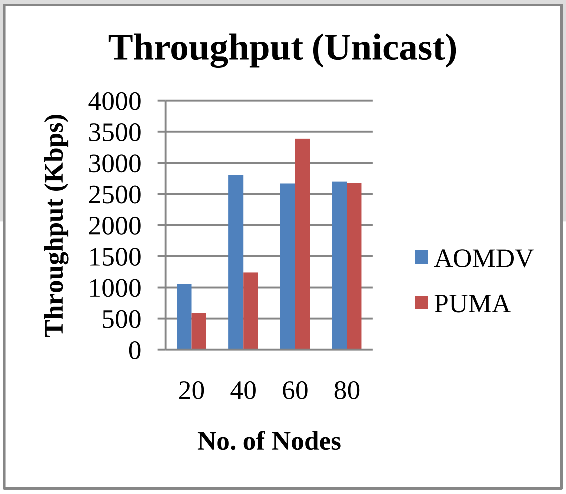
V. RESULT



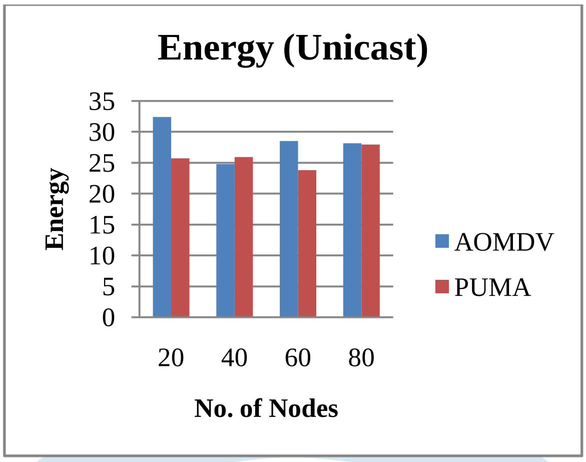
Graph 1: Packet Delivery Ratio in unicasting



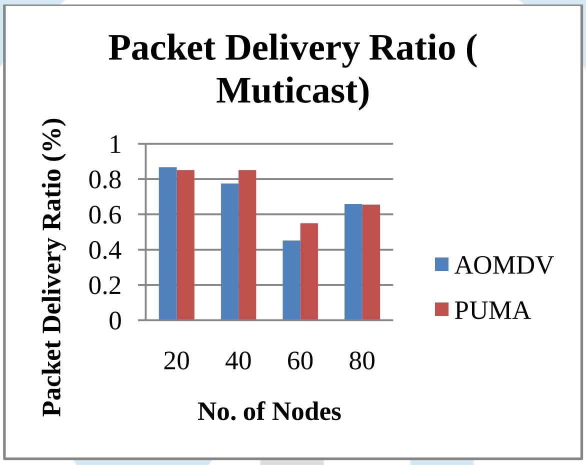
Graph.2: End- End Delay in unicasting



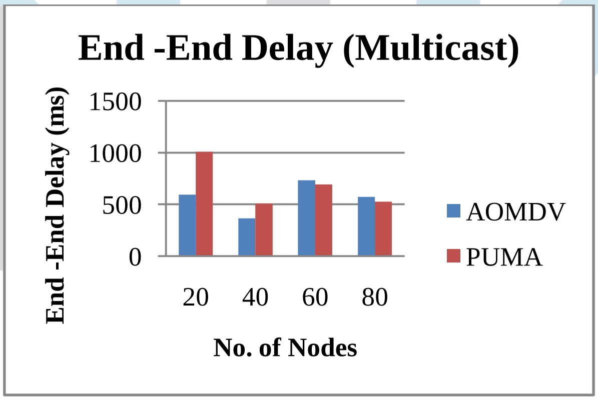
Graph 3: Throughput in unicasting



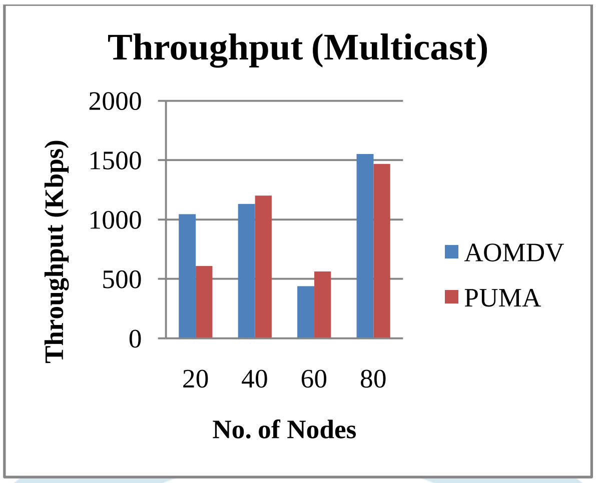
Graph.4: Energy in unicasting



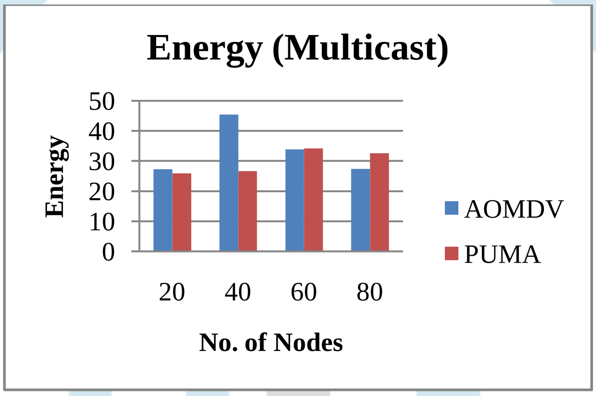
Graph 5: Packet Delivery Ratio in multicasting



Graph 6: End – End Delay in multicasting



Graph 7: Throughput in multicasting



Graph 8: Energy in multicasting

VI. CONCLUSION

Vanet is a network where nodes continuously change its location so the performance is calculated in unicast and multicast modes using AOMDV and PUMA. In unicast, the performance of AOMDV is better in Throughput, PDR and energy and PUMA gives better results in end–end delay while in multicasting, the performance of AOMDV is better for Throughput, end–end delay, energy and PUMA performs better for PDR.

VII. FUTURE ENHANCEMENTS

To reduce accidents on road if no. of nodes increases and to find a solution of traffic problems and also if we take no. of nodes more than 80 than the condition of accidents on road should not occur and also reduces traffic problems.

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