Comparative Study and Performance Analysis of MANET Routing Protocol

Original Scientific Paper

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Abstract – *MANET (Mobile ad hoc networks) are famous in research due to their ad hoc nature and effectiveness during calamities across continents when no framework support is free. Wireless network interfaces have a limited transmission range; nodes may require multiple network hops to trade information across the organization. Each versatile node functions like a switch in such an organization, sending details to the other portable connected nodes. The nodes should not interrupt communication and associate themselves with the correct information transfer. Another significant issue was the development of expandable route discoveries capable of assessing rapid topography variations and numerous network detachments caused by high vehicle quality. This research article describes extensive technological changes, including the components and flaws of current progressive routing algorithms. Routing protocols designed for wired networks, such as the distance vector or connection state conventions, are inadequate for this application because they assume fixed geography and high overheads. This research article includes the MANET-supported routing protocols and their performance analysis across various performance parameters such as packet delivery ratio, average throughput, residual energy, and delay.*

Keywords: *AODV, AOMDV, DSR, DSDV, GSR, MANET, Network simulator*

1. INTRODUCTION

A private organization is a data communication network that uses wireless connections to connect devices for information exchange [1] [2]. Remote organization innovation eliminates the costly strategy of introducing links for information association between gadgets in various areas.

Cell networks are an illustration of this sort of organization. The last option is ordinarily alluded to as "impromptu organizations." Stations in such an organization are fit for making and trading data in a multi-jump organization. Because of the highly dynamic nature of a mobile ad hoc network, network topology changes frequently and unexpectedly, adding difficulty and complexity to routing among mobile nodes. The directing region is the most dynamic examination region inside the Mobile ad hoc networks space because of the problems and intricacies, as well as the fundamental significance of the steering convention in laying out correspondences among portable hubs [3].

Mobile ad hoc networks can work independently or as part of a more extensive network. A highly dynamic independent topology has one or more different transceivers between nodes. MANET's biggest challenge is equipping each device with the knowledge to route traffic correctly. Starting with environmental sensors can be used for road safety.

A mobile peer-to-peer network can exchange data between disparate compact machines after providing a central machine. In that regard, it is not an entry point into the versatile peer-to-peer network. This act is the miracle of the spontaneous cellular network with which the mobile node communicates. Since there is no central or fixed infrastructure, the MANET (Mobile ad hoc network) attribute is an entirely different alternative node. It is completely different from all alternative networks.

In measuring Mobile ad hoc networks moving nodes, such as unfix to occupy and enter into an effective net, each unique node becomes a part of the network any-time and anywhere, just as each node leaves the network. MANET offers numerous excellent options in terms of topology flexibility, reliability, rapid configuration, intrinsic quality assistance, superpower geography, adaptation to internal failure, self-mending, and free-gathering framework. It has led to many visions based on functions [4][5].

We provide a comprehensive overview of the Mobile ad hoc network routing protocol and discuss which routing protocol is most efficient for emergency transformation. The second section compares survey documents related to Mobile ad hoc network routing protocols. Section 3 will introduce the different mobile ad hoc networks, followed by a discussion of the protocol's operating environment as simulated by NS2. Sections 4 and 5 show the performance analysis of routing protocols using parameters such as packet transfer rate, residual performance, and average throughput. Finally, this concludes the paper.

2. LITERATURE SURVEY

Many authors have previously worked on deep performance analysis of standard models of AODV (Ad Hoc On-Demand Distance Vector) and DSDV routing protocols for various chain frameworks [6] [7]. Later, they conducted several experiments on AODV and DSDV routing protocols by sterilizing core attributes of the protocol parameters and comparing their performances with standard models to realize performance progression [8].

There was an In-depth simulation study of more and more network nodes in a specific cellular network and the performance of DSDV (Destination Sequenced Distance Vector). The network uses a CBR (constant bit rate) flow mode of very different quality. It calculates the scientific score and delay of the generated data packets, attempting to assess the exhibition of the DSDV steering convention [9].

Considering AODV, DSR (Dynamic Source Routing protocol), and other routing protocols, the joint node density, packet length, and quality in ad-hoc cellular networks are studied to compare performance. Based on the analysis, they mainly looked at some protocol parameters for the simulation. Mobility has a significant impact on basic routing protocols [10].

In [11] [12] author used NS3 reenactment to think about and dissect the exhibition of AODV (Ad Hoc On-Demand Distance Vector), DSDV (Destination Sequenced Distance Vector), DSR (Dynamic Source Routing protocol), and more directing conventions. The recreation utilizes the customary models of these steering conventions for various organization hub sets [13].

Exhibition investigation of the all-inclusive DSDV (Destination Sequenced Distance Vector) convention for effective steering in arbitrary remote organizations, and the multicast parameters, mainly based on the DSDV routing protocol, are introduced to increase energy savings in random networks [14].

Mobile ad hoc Network routing protocols studied for a real-world simulation scenario. In this scenario, they provide a Gauss-Markov movement model with a constant rate; that is, they send data packets at the same rate, change the three different outlines and measure the exhibition of various Mobile ad hoc Network routing protocols [15].

In [16], the authors showed a comparative study of passive and active routing protocols with different parameters (such as Packet Delivery Ratio and end-to-end delay); the author also mentions various attributes of routing protocols.

In [17], authors demonstrated research on proactive reagents combined with geographic routing protocols that are very suitable for sensor networks in which information aggregation effectively minimizes redundancy by eliminating the redundancy between data packets from multiple sources downstream transmission.

This article analyzes the updated MANET (Mobile ad hoc Network) standard routing protocol attribute model in mobile ad hoc networks. It provides a comparative analysis of geographic routing protocols, on-demand routing protocols, and table-based routing, as well as performance indicators, packet delivery ratio, residual energy, and throughput.

3. MANET ROUTING PROTOCOL

The routing protocol in mobile ad hoc networks can divide into a flat, hybrid, and hierarchical routing protocol. For example, active, reactive, and geographic routing protocols come under flat routing[18].ZRP under hybrid and zone-based, and cluster-based under hierarchical routing protocol.

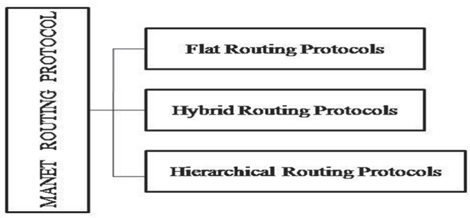

Fig.1. MANET Routing Protocol

3.1 FLAT ROUTING PROTOCOL

The geographic rules of hybrid management depend on the current geographic environment of the organization and correspond to the powerful ideas of mobile ad hoc networks. When we use contrast and geographic location-based control protocols (location-based control protocols), geographic-based control protocols have limited enforcement power. When interaction is required, these protocols use other data to determine geographic-based routing plans. Discretion of the hub address on the hub geographical control can be further subdivided into active (table) protocols, operational (on-demand) control protocols, and hybrid control protocols [19][20].

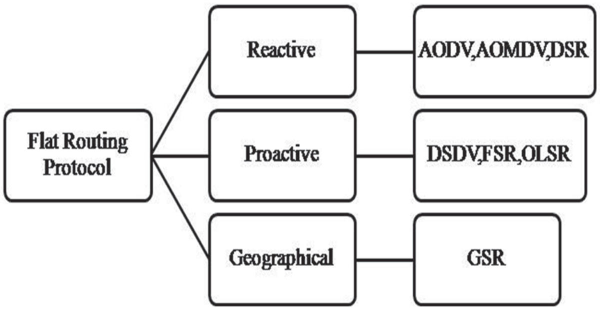

Fig. 2. Classification of Flat Routing Protocol

3.1.1 Proactive Routing Protocol

Another term for the present convention is table-based addressing. The current routine uses at least one address table to put existing address knowledge. Each center can generate data on changes in geography. This convention supports all legal procedures. It is time to move the package. Due to the update of the address table, all other centers' courses are always available when they are suitable. It uses a unique technique to update the address table. Examples of this convention include DSDV (Distance Sequencing Distance-Vector), OLSR (Optimized Link State Routing Protocol), and FSR (Fisheye State Routing).

3.1.1.1 Distance Sequenced Distance-Vector (DSDV)

The agreement builds on the "Bellman-Ford Act" with a few innovations, like the general aviation course on display, which offers a wise and trustworthy method to receive the most recent information. The first is referred to as a "full dump" and contains all the data required to update the table, whereas the second is a "fixed package" that only contains the most recent changes made to the data in the last complete dump. As a result, an incremental bulk transfer is quicker than dumping everything at once [21].

3.1.1.2 Fisheye State Routing (FSR)

FSR (Fisheye State routing) is a table-based strategy based on "calculating link state." It reduces the organization's total movement and also manages topography adjustment data. In FSR, a unique hub has modified data for maintaining tables. It is also very versatile for organizing large areas, but adaptability will reduce accuracy. The main problem with this strategy is the constant sending of interface updates, which can overwhelm organizations and air traffic [22].

3.1.1.3 Optimized Link State Routing Protocol (OLSR)

Proactive is the optimized link state routing protocol. The contact status protocol, which alerts the other network centers of any geographic changes, is the foundation of this protocol. A multipoint repeater lessens the administrative load of employing a multipoint repeater by reducing duplicate message retransmission when messages are transmitted. Various junctions designate nearby hubs to receive information in an MPR (multipoint repeater). The number of retransmissions can be reduced by using any additional MPR-compatible hub to decrypt, measure, and send data packets but not retransmit them [23].

3.1.2 Reactive Routing Protocol

Another term for the present convention is the request address protocol. Adaptive conventions are the way to find courses. The focus of the agreement goes on reducing the organization's movement weight. This convention cannot keep the console aligned. According to geographic location, if the user needs to send information to the center, he can complete it as required. First, send a message to understand the purpose of this course. Till it processes, the found route will be the target center. The agreement also specifies the booking rate. It will reduce the company's traffic compared to the old routing protocol. The most common on-demand control protocols are DSR, AODV, and AOMDV [24] [25].

3.1.2.1 Dynamic Source Routing(DSR)

The dynamic source address uses the source address to send the message. Dynamic source routing allows a sender to specify the broad characteristics of a hub from which data send to the destination. This hub also connects the data of this process to the header of the forwarded data packet. Start at one center, then go on to the following center. Maintenance and exposure to the course are the two main components of this agreement. Looking for courses leading to the goal in the outreach process, of course, to provide support at every point of geographic change, he will see the setbacks that lead to the goal. Any time it is indicated that the original course is lost, the course will be resent. The main advantage of this method is that the center that finds the course will check it out after some time. When storing the rate and including the effective rate, the transmitter can search for it without searching, which is helpful for organizations with little versatility.

3.1.2.2 Ad-hoc On-Demand Distance Vector (AODV)

Any distance vector on-demand is a combo of dynamic source routing and distance sequencing distance vector, which can provide acyclic courses. The primary distinction between dynamic source routing and ad hoc on-demand distance vector is that a unique hub accepts complete network addressing instructions in dynamic source routing. The hub has only one target location in an ad hoc on-demand distance vector. It has been moving forward, so it will naturally react. Ad hoc on-demand distance vectors also added the direction of objective consistency to clarify this idea when geography changes during the broadcast.

3.1.2.3 An Optimized Ad-hoc On-demand Multipath Distance Vector (AOMDV)

An optimized ad hoc on-demand multipath distance vector stretches out the unmistakable ad hoc on-demand distance vector to find different connections in disjointed ways between the source and the objective in each course revelation. It extensively uses the directing input effectively accessible in the ad hoc on-demand distance vector convention. In addition, it utilizes AODV control bundles and a couple of additional fields in the parcel header, for example, publicized jump check, what is more, course list, which contains numerous ways. The primary issue, designated "course cutoff" in AOMDV, is that when there is at least one typical moderate center in a couple of disjointed ways, it cannot find both opposite ways. Therefore, it is vital to discover the current connection in disjointed ways [26].

3.1.3 Geographical Routing Protocols

Geological steering uses data from an area to plan and advance the looking course toward the objective [27] [28]. There is additionally a higher opportunity for enormous multi-jump remote organizations' geography to change as often as possible. Topographical steering needs the proliferation of single-jump geography data as the ideal neighbor to choose precisely on sending. The way it restricts its methodology diminishes the necessity of keeping up the directing tables, diminishes the control center, and dispenses with affecting requirement overloading [29]. The hub continues to send information parcels inside the stamped sending area. The source or moderate hubs can characterize this checked locale to avoid hubs that may hasten a diversion for sending the information bundle. The following property related to geological steering is position-based directing. A hub has to experience the location where its neighbor is present. The part related to this case is the exciting instrument whereby every center advances a group to an adjoining center. Since flooding for center disclosure and state expansion limit within a single leap, position-based control methods prepare to reduce overhead and energy. The organization thickness, the precise confinement of hubs, and the sending rule are the central considerations for the proficiency of the plan [30].

3.1.3.1 Geography Source Routing (GSR)

In GSR, the source hub registers the briefest path to the objective, utilizing Dijkstra's calculation dependent on distance measurements. It registers the separation from the source to moderated hubs through which information is to be sent [31]. The source hub questions the area and floods the parcel to the hubs, which squanders data transfer capacity.

Routing with Geographical Awareness It utilizes the GSR bundle-sending system to beat the issue of recuperation methodology in GPSR. It ascertains the most limited way by utilizing Dijkstra's calculation. A source sets a GSR, which comprises a rundown of intermediate hubs installed in the header of all information parcels by a source. Each sending hub maps the situation of its neighbors into diagram hubs and picks the following hub having the most limited way from the objective [32].

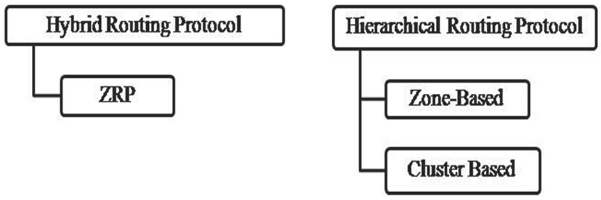

Fig. 3. Classification of hybrid and hierarchical protocol

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3.2 HYBRID ROUTING PROTOCOL

The advantages of reactive and proactive routing protocols are combined. Zone Routing Protocol is one of the maximum well-favored hybrid routing protocols (ZRP). Tracking occurs after segmenting the community into numerous zones, and the supply and vacation spot cellular nodes' arrangement happens. Proactive routing uses to transmit the facts packets among the supply and vacation spot cellular nodes if placed inside the identical zone. Additionally, reactive routing hires to transmit the facts packets among the supply and vacation spot cellular nodes if they locate in separate zones.

3.2.1 Zone directing convention (ZRP)

ZRP is a hybrid, including table-driven and adaptive contract management elements. With this method, the hop has a predefined address area that identifies the limits of each hub established upon the adequate opportunity of active organizations. Located in the downtown area, but for jumps outside these spaces, their paths have resolved, and these centers only use process leaders whose receptive consent is the ultimate source. Compared with the table convention, it reduces the corresponding channel. Compared with on-demand arrangements, it also limits the delay of package movement [33].

3.3 HIERARCHICAL ROUTING PROTOCOL

The idea of direct control is to divide self-organizing network hosts into different coverage areas or incompatible groups [34]. A hierarchical network uses when the network size within MANET increases significantly.

The direct control protocol classifies organizations into a cluster tree, where the tasks and elements of the hub are different at different levels of the direct system [35]. Heterogeneous forwarding protocols divide into two sub-categories: area-based and cluster-based. Multivalent Polish associations with management and leadership skills organize these agreements.

3.3.1 Zone–Based Hierarchical Routing Protocol

As correspondences pass across the covering extensions, each hub has a local scope and various directing techniques inside and outside the extension. With this adaptability, a more proficient general steering execution is possible. Moreover, by keeping up with steering data for all hubs in the organization, portable hubs in a similar zone realize how to arrive at one another with a more modest expense. In some zone-based directing conventions, explicit hubs are entryway hubs and complete between-zone correspondences. All along these lines, the organization will contain allotments or various zones. Examples: ZRP [36] is a MANET zone-based progressive directing protocol [37].

3.3.2 Cluster-Based Hierarchical Routing Protocol

The group control protocol is the most common method of sequence control. The division of organizations into interconnected sub-projects is called a "cluster," and the basis of interconnectedness is called a "cluster." The magnetic head acts as a non-permanent base station in its area or group. He also talked with other team leaders [38]. The group management agreement uses explicit group calculations for the political career of group leaders. The mobile center is standardized for new associations, and the association leader is responsible for effectively recruiting administrative staff and leadership skills. A universally voluntary agreement on organizational management, the device can support a multi-level group structure, such as hierarchical state routing (HSR) [39].

4. SIMULATION ENVIRONMENT

This paper's primary objective is to implement AODV in practice on a natural system and assess the protocol's effectiveness. The mobility model also plays a crucial part in performance comparison. Network Simulator 2.34 is employed to replicate the needed work. Discrete event simulator NS2 employs the C++ and OTcl programming languages. When sending data to the Internet domain, the MANET nodes use constant bit rate (CBR) traffic sources in the chosen simulation environment. The mobile nodes in the simulation environment move by our chosen random waypoint mobility model. Using the set dest software, we created the movement scenario files and the CBR gen tool used to create the traffic. Each simulation run lasts for a total of 300 seconds. Parameters in table 1 use To simulate a network.

Table 1. Simulation Parameter

Vehicle Density	**5,10,20,30,40,50,60 nodes**
Simulation Time	300 second
Mobility (Km/hr.)	40 km/hr.
MAC	802.11p
Propagation Model	Two-Ray Ground
Area	500 * 500
Mobility	Random Walk
Antenna	Omni Antenna
Traffic Model	CBR

This replay event uses NS-2, a discrete test system created at the University of California, Berkeley. The NS-2 organization simulator can plan new protocols, check various protocols, and estimate traffic [40]. The following created document saves on the board with *.tr and other script records. These scripts calculate the number of packages transported and the length of the path taken by each package. This information is also visible in the AWK script [41]. The number of hubs with the maximum length of each line is 50. Any waypoint model in a 500 m x 500 m rectangular field uses as the general model, and the station is also suitable for this rectangular field [42][43]. Each package tour departs from the incorrect location and travels to an unusual destination at a random speed.

5. PERFORMANCE RESULTS

Use the graph to display the results of the above recovery attempts. The metrics used to validate the results are output, packet transfer rate, residual energy, and average throughput output [44] [45].

5.1 PACKET DELIVERY RATIO

This ratio can derive from the entire sum of packets arriving at the target divided by the entire sum of packets directed by the origin, which is the packet transmission rate. Therefore, the delivery rate of packages is critical in evaluating the effectiveness of guidance arrangements in an organization.

The main constraints are the size of the location, the number of centers, the spread range, and the organizational structure [46]. The total amount of information determines the transportation part of the package. The data packet indicated in the objection decomposes into all information sources sent by the source [47]. In this manner, the bundle transmission rate is the proportion of the number of parcels received at the objective to the number of bundles sent by an origin. The presentation impact is better when the bundle transportation speed is high.

$$\mathrm{P} = \left(\frac{\mathrm{P_r}}{\mathrm{P_g}}\right) \times 100 \tag{1}$$

Where are the number of received packets and the number of generated packets?

5.2 AVERAGE THROUGHPUT

Compared with the imaginary package delivery, this is a reasonable proportion of the actual package delivery. The expected message bandwidth tells the client the number of packets displayed on its target. The performance will show the amount of information removed from the source at any time. Organizational efficiency includes how much data can be moved from source to target in a given time. During the protest, the number of packages would display successfully. As the power limits estimate in bits per second, similarly, the data rate per second is in data units.

$$T = \left(\frac{R}{T^2 - T^1}\right) \times \left(\frac{8}{1000}\right) \tag{2}$$

Where R is the complete received packets at all destination nodes, is the simulation stop time, and the simulation starts time.

5.3. RESIDUAL ENERGY

Adding up the energy consumed when the concentrator is in each state gives the remaining energy of the sensor concentrator. The hub loses a certain amount of energy for each data packet sent and received. Therefore, the value of the initial energy is in the concentrator. After receiving or sending address packets, the current energy value in the concentrator is constant energy. The energy model refers to the energy level of the organization's hub. The energy mode described in the hub has a primary meaning: the energy that the center has at the beginning of the stationary phase. This energy is called the "initial energy." In playback, the variable "energy" refers to the energy level in the middle of a predetermined point in time. Transmitters will transmit the initial energy value as a payload. The hub loses a certain amount of energy for each data packet sent and received. As a result, the initial energy value decreases in the middle. After receiving or sending address data packets, the current energy cost of the center is excess energy. Information transmission is established between centers using CBR traffic and UDP experts. The center is estimated multiple times by obtaining the variable "energy" included in the energy search method.

5.4. DELAY

This metric calculates the average time between the packet origination time at all sources and the packet reaching time at all destination nodes. It is measured by:

$$D = \frac{\sum_{i=1}^{N} d_t^i + d_p^i + d_{pc}^i + d_q^i}{N} \tag{3}$$

Where N is the number of total transmission links, is the link's transmission delay, is the link's propagation delay, is the link's processing delay, and is the transmission delay of the link.

6. RESULTS AND DISCUSSION

The presentation measurements utilized for MANET directing convention investigation incorporate packet delivery ratio, average throughput, and residual energy consumed [48]. The packet delivery ratio is the proportion of the number of information bundles conveyed to the objective. A higher worth of packet delivery ratio shows that the convention is performing better [49][50][51][52]. AODV and DSR convention gives the most noteworthy packet delivery ratio. However, because of successive course disappointments and its proactive nature, it has been found that DSDV gives a meager packet delivery ratio. Fig. 4 shows a graph of the packet delivery ratio over different nodes in a MANET with random mobility.

Fig. 4 shows that the exhibition of AODV is superior to the four protocols in the corresponding PDR. As the count of nodes rises, the data packet delivery rate of AODV decreases on all nodes.

DSDV remains unchanged as the count of nodes rises, but DSR and GSR rise and decrease as the count of nodes rises. The count of mobile nodes 5 for AODV, GSR, AOMDV, and DSDV are almost the same, but they have changed a lot afterward. The exhibition of DSDV is consistent with the count of nodes.

All nodes remain unchanged except for five for AODV, DSR, DSDV, AOMDV, and GSR. The remaining energy of DSR is the largest for all nodes, and all other remaining power is the same for different nodes. DSDV remains unchanged as the count of nodes rises.

Fig. 7 shows the delay for all routing protocols. From Fig. 7, the AODV delay is the lowest compared to other protocols.

7. CONCLUSION

This paper analyses the presentation of existing routing protocols like AODV, DSR, AOMDV, DSDV, and GSR. Packet transfer rate, residual energy, and average are execution measurements. The result is obtained after the dissection some proactive and on-request steering conventions. For low loads and low portability, dynamic DSDV conventions produce improved results.

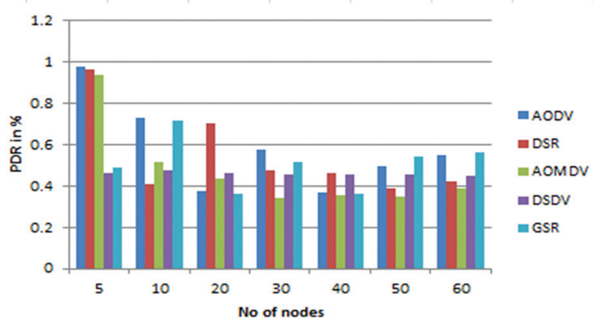

Fig. 4. Packet Delivery Ratio versus the number of nodes

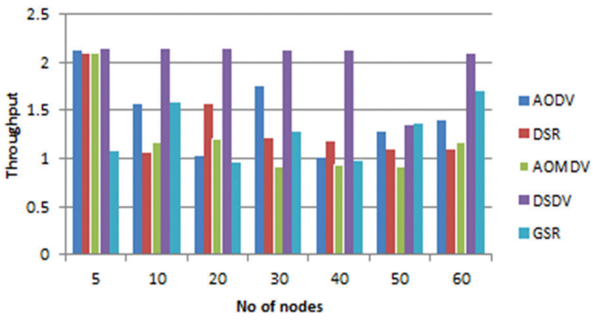

Fig. 5. Average Throughput versus the number of nodes

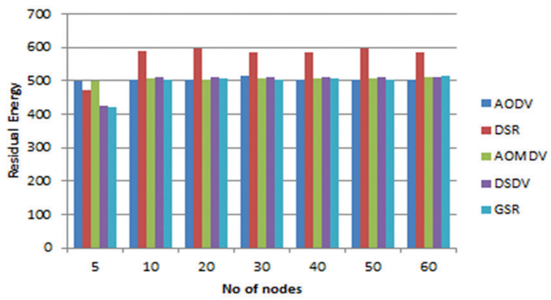

Fig. 6. Residual Energy versus the number of nodes

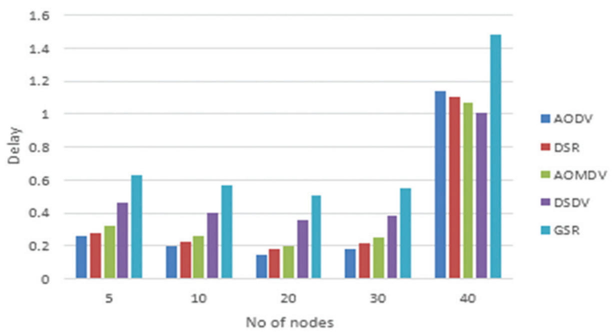

Fig. 7. Delay versus number of nodes

Most noteworthy packet delivery ratios are obtained by operating AODV and DSR conventions. AODV and DSR conventions are more suitable for high traffic because of their responsive nature, which creates less upward control. The DSDV convention gives a typical high throughput, paying little heed to organized traffic. For all hubs, the DSR convention has a below-the-norm throughput. In contrast with AODV and DSR, DSDV conventions consume less energy overall. Accordingly, the DSDV convention decreases energy utilization while expanding network lifetime.

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