iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** IV **Month of publication:** April 2021

DOI: https://doi.org/10.22214/ijraset.2021.33772

Proactive, Reactive, and Hybrid Routing Protocol Simulation-Based Results for MANET

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Abstract: An ad hoc network is called a set of autonomous mobile nodes. A dynamic and decentralized existence of an ad-hoc wireless network varies continuously in the network's topology. I researched the routing problem, which is more complex and challenging, in an ad-hoc network. The constructive, diplomatic, and hybrid routing protocol can be categorizing into an ad-hoc network. AODV, DSDV, ZRP, and DSR are amongst the most popular routing protocols. We observe the above protocol for varying traffic load in mobile ad hoc networks based on their efficiency and mobility comparison. Using the NS2 simulator, we carried out detailed simulations.
Keywords: AODV, DSDV, DSR, ZRP, MANET Routing, NS-2.

I. INTRODUCTION

Mobile ad-hoc networks [MANET] are dynamic wireless networks that do not need infrastructure support for data packets shared between two nodes. Nodes in this environment communicate through the wireless link, and these nodes work like a router in a network medium. These routers also route a packet from one node to other nodes, which is independent of each other, so nodes are free to move, i.e., nodes do not have any restriction to move. In the wireless environment, the Mobile ad-hoc network is dynamic that consists of constant change in network topology; thus, routing makes it much difficult. We may also conclude that routing is one of the most common ad hoc mobile network areas. Compared to the standard routing protocol, which works well in the static network context, the same efficiency does not occur in ad-hoc mobile networks. No infrastructure is necessary for a mobile ad hoc network to transmit data packets between two nodes; that is, infrastructure is not available on an ad hoc mobile network, and wireless networks are mobile ad hoc networks. The ad hoc mobile network does not know its network's topology because it is a dynamic topology. There is no time to occur a static infrastructure that it is fixed infrastructure. In an ad-hoc network, nodes also provide the packet path, and they work like a router. Packages move independently on this network; nodes can move freely on this network. An ad-hoc mobile network is dynamic in the environment; thus, it makes routing more complicated, making constant network topology. As an ad-hoc mobile network is active, not a static network environment, an ad-hoc mobile network does not show the same efficiency as a traditional routing protocol that works well on a fixed network. It reacts to topological changes quickly. Routing is also the region of most significant importance in the ad-hoc mobile network [4-5]. Ad-hoc wireless network routing protocols divide into three groups based on the routing information update mechanism: proactive routing, reactive routing, and hybrid routing. Often known as a table-driven routing protocol, the aggressive routing algorithm is every node maintains a separate routing table. Every node supports a different routing table. Each node contains the route information for the routes to all possible mobile destination nodes, so we can assume that all node information store in this information table. As the network topology changes, the routing information table is up to date between any pair of nodes. Before a request arrives for forwarding, the pro-active routing protocols learn the network topology. A constructive routing algorithm maintains a routing table; a path identifies as soon as it is needed [1] [10]. The destination sequenced distance vector is an example of a proactive routing protocol (DSDV). Often known as an on-demand routing protocol, the reactive routing algorithm is, i.e., the route discovered when the path requires in this routing algorithm. Once away in establishing, the node is maintained until the destination is no longer available or the way expires. Only when a node can forward a request does the reactive routing protocol become operational. Dynamic source routing protocol (DSR), Ad-hoc on-demand distance vector routing protocol (AODV), etc., are examples of a reactive routing protocol. A mixture of both the pro-active routing protocol and the reactive routing protocol is the hybrid routing protocol. In the environment, this protocol is adaptive as it adapts according to the source's zone and location and the destination of mobile nodes. An instance of a hybrid routing protocol is the zone routing protocol (ZRP) [1-11]. In the following paragraph, this paper is structure. We briefly define the routing protocols we test in this section 2. We address the most relevant previous research on the subject in section 3 and describe our work—the simulation environment used for testing the said protocols presented in Section 4. We give our simulation outcomes and findings in Section 5. Eventually, the conclusion is describing in section 6.

II. IN MANETS, ROUTING PROTOCOLS

A. Protocols on Proactive Routing

A table-driven protocol is often called the aggressive routing protocol. Proactive routing protocols manage and build the routing data of all nodes. The route is independent of whether the path is required or not. The control messages are regularly transmitted. Bandwidth is not adequate with constructive routing protocols, and this is due to the control messages that are sent even though there is no data flow. There are benefits and drawbacks to this type of routing protocol. One of its key advantages is that routing information can be accessed easily by nodes, and creating a session is easy. The drawbacks include too much data retained for route maintenance by the nodes, and when there is a failure in a specific connection, it is slow to restructure. There is a count-to-infinity problem. An example of a constructive routing protocol is DSDV.

B. DSDV Protocol

The DSDV defined it as a table-driven proactive protocol based on the classical mechanism of Bellman-Ford routing. The fundamental changes made include independence from loops, more complex and less convergence time in routing tables. Each MANET node also maintains a routing table containing a list of all known network destination nodes and many hops needed to reach an individual node. The destination node mark allocates the sequence number for each entry to search for a path. The sequence number is used, thus preventing the creation of loops. The routing table retains continuity. Topology frequently takes the information, updates the routing table regularly to neighbors or when significant new information is available. The time difference is also stored between the first best destination arrivals for the route, so ways advertised. Ways that are likely to improve soon can postpone; this prohibits the advertising of courses that are not yet stabilizing to prevent rebroadcasting of route entries arriving with the node. It is vital to keep track of settling time for each way so that fluctuations can dampen by delaying advertising of a new path to a destination that is already known and available, reducing traffic. Fluctuating courses happen because two tracks to a destination with the same sequence number and a better metric can be obtained by a node later. But new forms that lead to a previously unreachable node must soon be marketed. Mobiles also track the settling time of paths, or the weighted average time that routes to a destination can fluctuate until the best metric way obtain. By delaying the transmission of a routing update by the settling period's duration, mobiles may decrease network traffic [1] [4-5].

C. Reactive Routing Protocols

The reactive routing protocol also recognizes as a protocol for routing on-demand. Reactive protocols for routing are effective for bandwidth routes forms as and when they are needed. The method achieve by sending route requests through the network. This routing protocol has drawbacks. When finding directions, one of them is high latency. AODV, DSDV, ZRP, and DSR were what we considered.

D. Ad hoc On-demand Distance Vector (AODV)

The routing protocol used in ad hoc networks is on-demand AODV. Like any other on-demand routing protocol, this algorithm enables quick adaptation to changes in the connection situation. In this case, alerts are sent only to the affected nodes when a connection fails. This data allows all the routes through the failed relationship to be invalidated by the affected nodes. It has a low overhead memory level. It also generates unicast routes and limited network use from source to destination. The network has little routing traffic as courses are on-demand. Nodes are not allowed to manage paths, and nodes are not in operation. AODV can create multi-hop routes between the mobile nodes involved when two nodes are in an ad hoc network to link them. Aodv is a loop-free device. They are using Destination Sequence Numbers to prevent counting to infinity (DSN). In this protocol, the DSN is a different function. Send DSNs together to request nodes in a network, including all routing information from the source to the destination node [1].

The optimal route from the sender to the destination is also selected based on the sequence number. Three messages are specifying by AODV: Route Requests (RREQs), Route Errors (RERRs), and Route Answers (RRSPs). Using UDP packets, these messages are using to discover and maintain routes through the network from source to destination. It uses its IP address as the source address in the message IP header and 255.255.255.255 for broadcast when a node requests a path. The Time-To-Live (TTL) in the IP header specifies the number of hops in the ad hoc network that a particular routing message propagates. The requesting node broadcasts an RREQ whenever there is a need to construct a new route to the destination. A path is deciding when the next-hop node (intermediate node with destination routing information) or the target itself reaches this message. The RREP got a request from the neighbor. Routes from the RREQ neighbor to all nodes that receive this message are cached nodes.

A RERR message is creating whenever there is a connection failure. Information about the nodes includes in this message. Because of this failure, the data is not available. The IP addresses of all nodes to their next node at the destination address are also including. AODV is a table-driven routing protocol; data on routing for network routes are store in table form. The following route entries contain these routing tables: destination IP address, next hop, DSN, flag, state, network interface, hop count, precursor list, and lifetime [4].

E. Dynamic Source Routing

A simple and efficient routing protocol designed explicitly for multi-hop wireless ad hoc networks may be the DSR. DSR allows the network to be fully self-organized and self-configured, without any existing network infrastructure is necessary. The two main "Route Maintenance" and "Route Discovery" schemes include the routing protocol. Both operate together to allow nodes in the ad hoc network to maintain and discover routes to arbitrary destinations. The protocol operates entirely on the DSR protocol, including easily guaranteed free routing of the loop, operation in unidirectional linked networks. Routing and rapid recovery utilize only a "soft state" when routes change within the network. Unlike other protocols, DSR requires no periodic packages of any kind on any layer within the network. In DSR, Route Discovery and Route Maintenance both operate entirely on-demand. DSR does not use any regular routing ads, link status sensing, or neighbor detection packets, for instance, and does not believe these features from any network's underlying protocols. The number of overhead packages caused by DSR to scale down to zero is made possible by this completely on-demand behavior and lack of routine activity when all nodes are stationary to each other and have already discovered all the routes required for current communication.

A package's sender selects and controls the path used for its packages, which provides features such as load balancing that could define alongside multi-route support. As the sender can avoid duplicate hops in the selected paths, all methods used are easily bound to be loop-free. The DSR operation of both Route Discovery and Route Maintenance had designed to enable unidirectional routes of asymmetric and linking [3-4].

F. Hybrid Routing Protocol

Hybrid routing is referred to primarily as balanced-hybrid routing. It is a combination of distance-vector routing algorithms, which works by sharing with its neighbors and link-state routing their knowledge of the entire network. It works by having the routers tell their closest neighbors about every router on the web.

G. The Zone Routing Protocol

Excess bandwidth was using by Proactive Routing to preserve routing knowledge. Reactive routing entails lengthy delays in path queries, and Reactive Routing often inefficiently floods the entire route determination network. The Zone Routing Protocol (ZRP) addresses the problems by combining both approaches' best properties. ZRP could define as a reactive/proactive hybrid routing protocol. It could presume in an ad hoc network that much of the traffic had directed to neighboring nodes. ZRP, therefore, reduces the proactive range to a zone centered on each node. Maintenance of routing information is more manageable in a small area furthermore, the sum of routing data that never used to reduce it [7].

Hence, the reactive Routing protocol can be reached by nodes further apart. Thus, all nodes store local routing information proactively; they can execute route requests efficiently without querying all the network nodes in the environment. Despite the use of zones, the network had a flat view of ZRP. The organizational overhead linked to hierarchical protocols can avoid in this way. Hierarchical protocols for routing rely on the strategic allocation of gateways. All levels, primarily the top level, can be reached by any node. Nodes belonging to various subnets may send a common subnet to all nodes to send their communication. Nodes can contain sections of the network. ZRP, since the zones overlap, can be classified as a flat protocol. Optimal routes can then detect, and network congestion can minimize. Additionally, ZRP's behavior is adaptive. The action relies on the current network configuration and the movement of users [9].

H. Architecture

Based on the notion of zones in the routing protocol, the Zone Routing Protocol. Separately, a routing zone is identified for each node. The zones of adjacent nodes will overlap. A radius r specified in hops is available for the routing region. Thus, the region contains the nodes at most r hops whose distance from the node in question is. The Figure shows an example of the routing zone, where the routing zone consists of nodes B-E, but not H. The radius has been defined as a circle around the node in question in the diagrams. It should be noted, however, that the zone is specified by hops, not by physical distance.

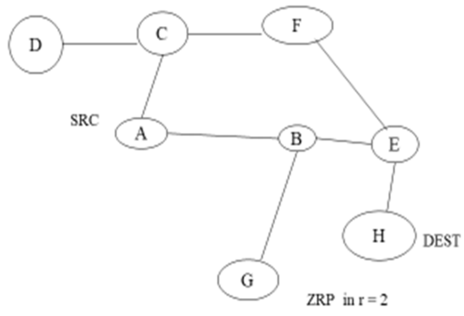

Fig-2.1 ZRP

The nodes of a region have divided into inner nodes and peripheral nodes in two parts. Peripheral nodes have a minimum size, precisely equal to the zone radius r, to the central node. Interior nodes are the nodes whose minimum space is less than radius r. In the figure, the A-E nodes are internal nodes, the H nodes are peripheral nodes, and in this network, the H node is outside the routing region. Two paths may reach node H: length three and one with four hops. The node is beyond the field, as the shortest route is less than or equal to the region's radius. The number of nodes in the routing zone could manage by changing the transmission energy of the nodes. To provide adequate accessibility and redundancy, the number of neighboring nodes may be appropriate. Lowering power decreases the number and vice versa of nodes within direct scope.

On the other hand, several zone members result in too comprehensive coverage, and the update traffic becomes excessive. Also, an extensive range of transmission adds to the possibility of local contention. In the Intra-zone Routing Protocol, ZRP identifies the locally proactive routing portion (IARP). The part of reactive routing is called Inter-zone Routing Protocol (IERP). IERP and IARP are not individual protocols for routing. In constructive link-state Routing, IARP is a member of limited-depth. IARP preserves routing information for nodes located within the node routing region. IERP is a family of reactive routing protocols that provide improved IARP-monitored local connectivity-based route discovery and route maintenance services.

When global route discovery is needed, each node's local zone's topology could minimize traffic. To build broadcast trees for query packets, BRP uses a map of an extended routing zone. Alternatively, based on the standard routing zone, it uses source routing Route requests could direct away from the network areas that the use of query control mechanisms has already protected. The ZRP relies on a Neighbor Discovery Protocol (NDP) provided by the Media Access Control (MAC) layer to detect new neighboring nodes and connection failures. "At regular intervals, NDP transmits "HELLO" beacons. The neighbor's table has changed upon receiving a beacon. Neighbors have been excluding from the table for whom no beacon had an issue within a stated period. If the MAC layer does not include an NDP, IARP might provide the functionality. NDP, which notifies IARP when the neighboring table is updated, triggers route changes. To react to route queries, IERP uses IARP's routing table. For BRP, IERP forwards questions. BRP uses IARP's routing table to steer route queries away from the source of the query [11].

III. SIMULATION ENVIRONMENT

For simulation, we used the NS-2 network simulator, the most commonly used network simulator. For a simulation time of 10 seconds and an area of 1500 m * 1500 m, we simulated the network. Packages nodes are 10, 20, and 50 within the network. With a maximum node speed of 10 m/s, the random waypoint model had used. By holding the pause time constant, different sources have varied traffic load (number of links). The simulation ran with 40 connections for a high traffic load.

1) *Area:* 1500x1500 m
2) *Number of Nodes:* 10, 20 and 50
3) *Simulation Period:* 100 sec
4) *Number of Iteration:* 10
5) *Physical/Mac Layer:* IEEE 802.11
6) *Range of Transmission:* 250 m
7) *Source of Traffic:* CBR

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue IV Apr 2021- Available at www.ijraset.com

IV. PERFORMANCE METRICS

Various performance metrics had used in the assessment of routing protocols. They reflect other features of the overall output of the network. In this article, four metrics used in our comparisons had analysed to study their overall performance impact on the web. Routing overhead, packet transmission ratio, end-to-end packet latency, and network throughput are these metrics.

A. *Packet Delivery Ratio*

The Packet Distribution Ratio (PDR) is the ratio of the number of packets transmitted by the traffic source to the number of packets received by the sink. As seen by transport protocols, PDR tests the failure rate, and it characterizes both the correctness and efficacy of mobile ad hoc routing protocols. It represents the maximum throughput that the network can reach. High distribution of packets.

B. *Packet End-to-End Delay*

The average time packets take to cross the network is the end-to-end packet delay. This end-to-end packet delay is the time from the sender's packet generation to its receipt at the destinations' application layer and expressed in seconds. It also involves all network delays, such as buffer queues, transmission time, and delays caused by routing operations and MAC power exchanges. Different applications require various packet delay levels. Delay-sensitive voice applications require a low average network delay, whereas other applications such as FTP may be tolerant of holding up to a certain amount. Due to low signal strengths between nodes, MANETs had characterized by node mobility, packet retransmissions, and connection tearing and making. These cause the network delay to increase. The end-to-end delay is thus a measure of how well a routing protocol adapts to the numerous constraints of the network and reflects the routing protocol's reliability.

C. *Residual Energy*

For each packet sent and every package received, a node loses a rare amount of energy. After receiving or sending routing packets, the current value of power in a node is the residual energy. Data transmission had developed between UDP agent nodes and CBR traffic. "The residual power of the node evaluated by accessing the built-in variable "power" in the process of seeking energy at a distinct time interval.

D. *Throughput*

Throughput is the cumulative amount of information from a source that enters a receiver to the time it takes for the destination to get the last packet referred to as throughput. It's represented either in bits per second or in packets per second. In MANETs, frequent topology shifts, unreliable communication, small bandwidth, and little energy are factors that affect throughput. It is desirable to provide a high throughput network.

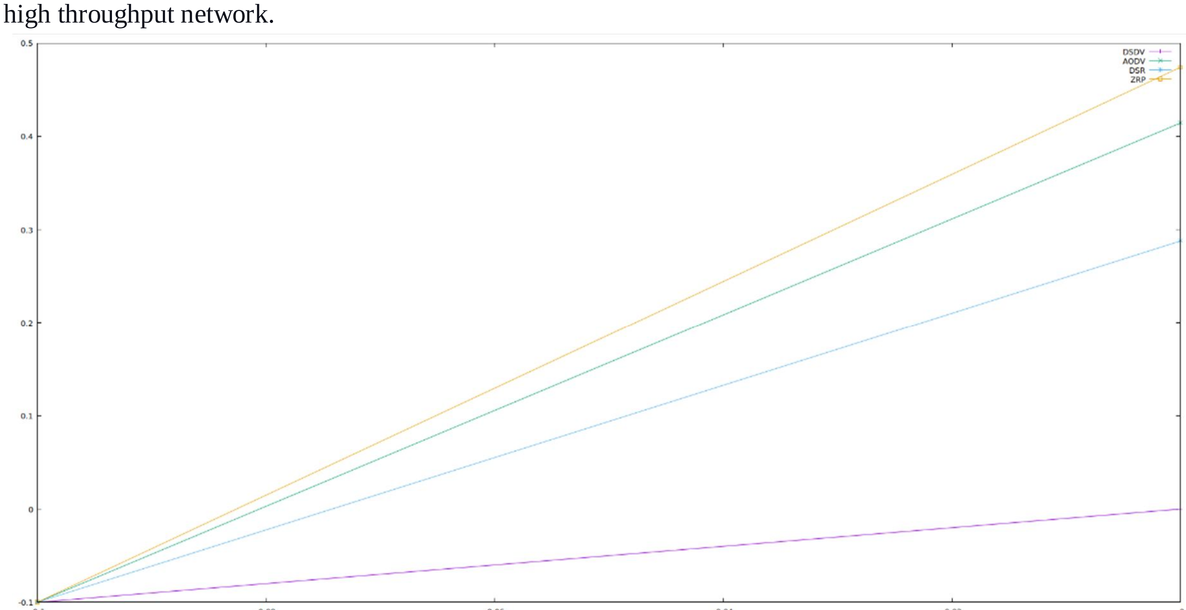

Fig-4.1: 10 nodes

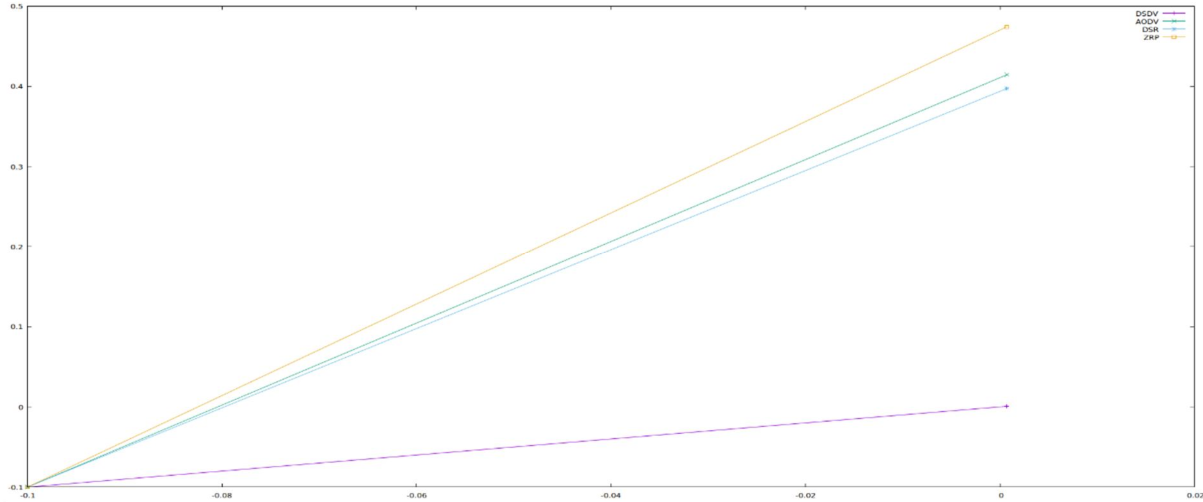

Fig-4.2: 20 nodes

E. Packet End-to-End Delay

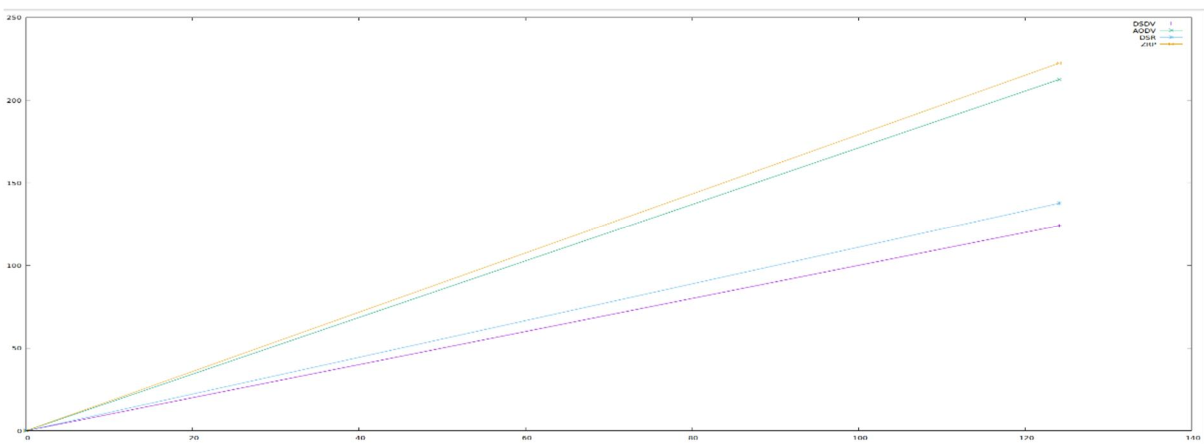

Fig-4.3: 10 nodes

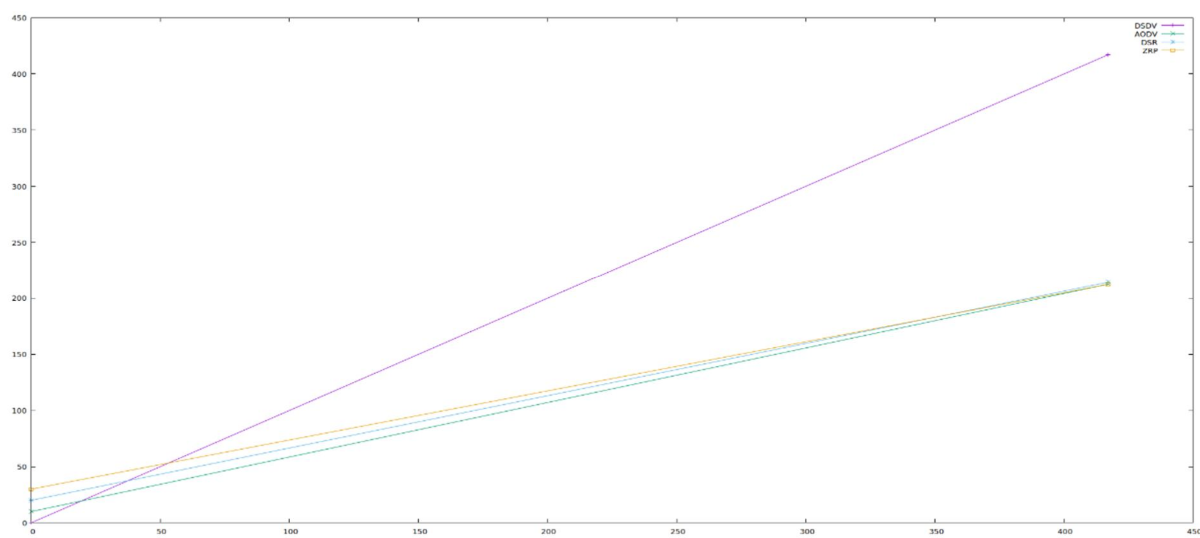

Fig-4.4: 20 nodes

F. Packet Delivery Ratio

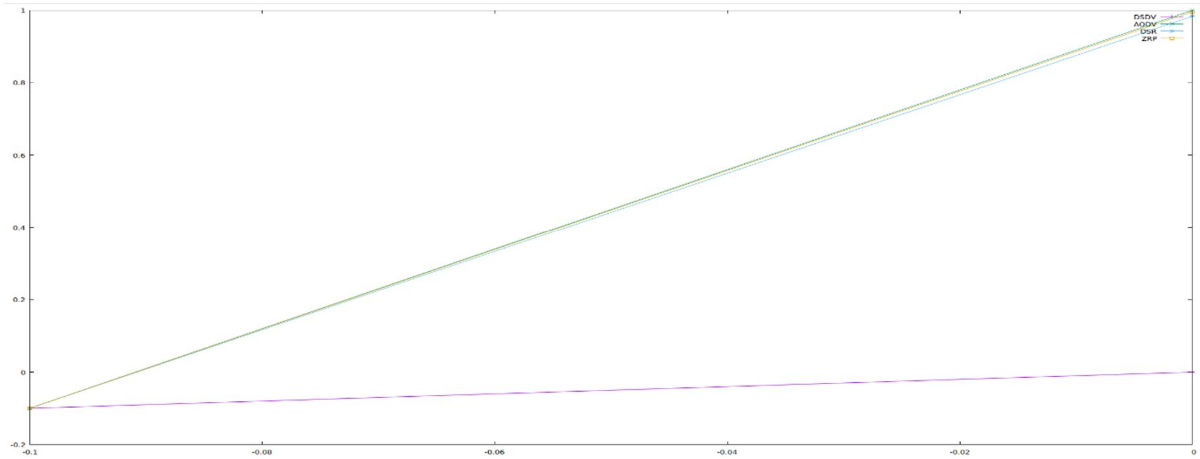

Fig-4.5: 10 nodes

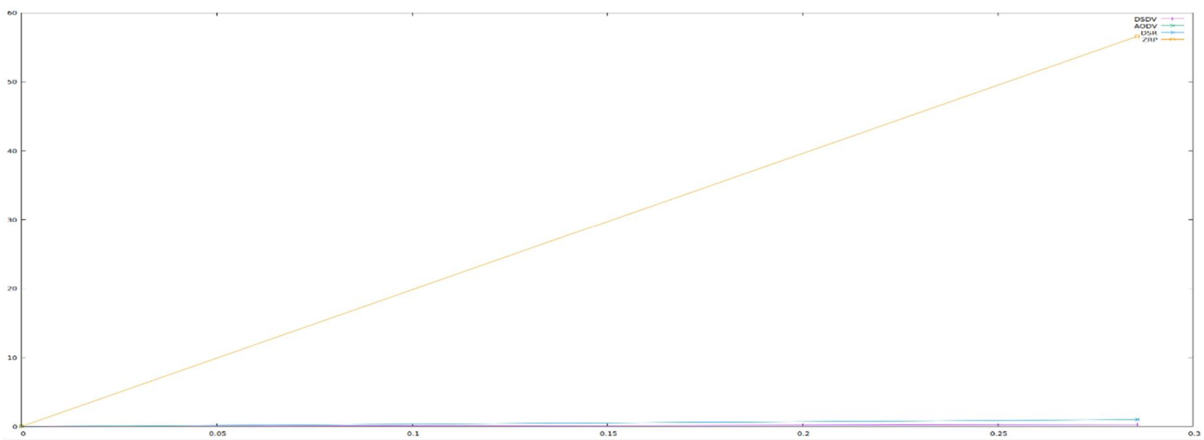

Fig-4.6: 20 nodes

G. Residual Energy

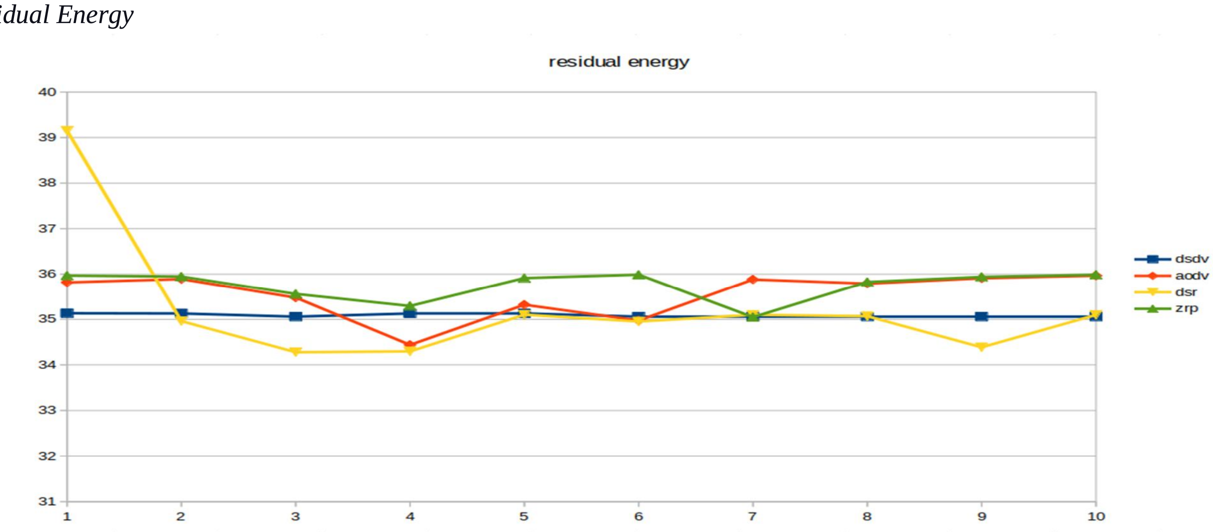

Fig-4.7: 10 nodes

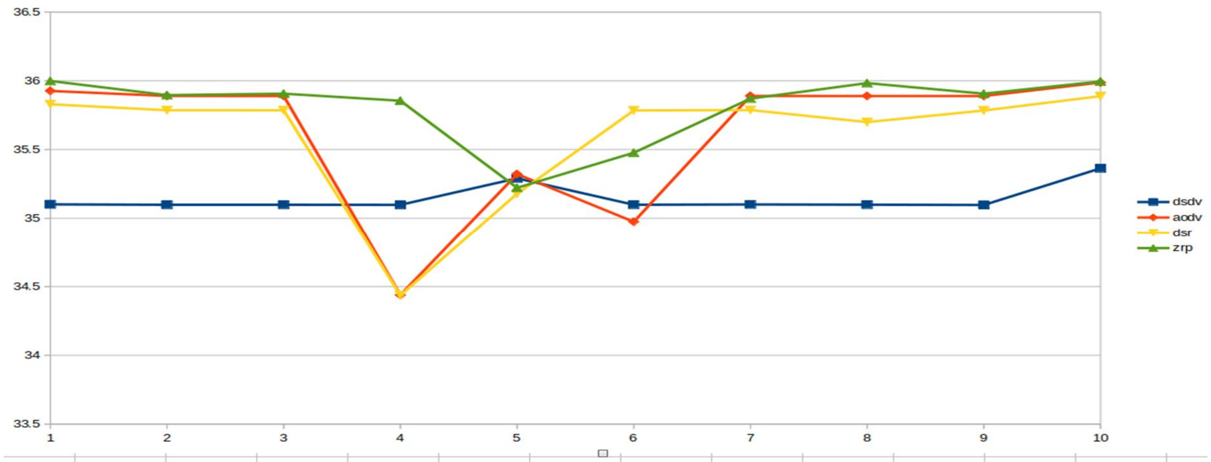

Fig-4.8: 20 nodes

V. CONCLUSION

For their routing overhead, packet delivery ratio, throughput, and end-to-end packet delay, we have assessed four distinct ad hoc routing protocols. Two dimensions of success in a network reflect these performance measures used in our assessment. The protocols' reliability has been discussing by throughput, end-to-end packet delay, and packet delivery ratio. We are currently working on a protocol to compare the ZRP routing protocol's performance with the DSDV, DSR, and AODV standard protocols. DSDV is a constructive protocol, and AODV is a protocol for reactive routing through DSR.

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