Simulation Based Performance Analysis of AODV OLSR and ZRP Routing Protocols in MANET

Nidhi Singh, Ajay Kumar, Chandra Prakesh Sahu

Abstract— Mobile Adhoc Network (MANET) is the collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas others need the aid of intermediate nodes to route their packets. These networks are fully distributed and can work at any place without the help of any infrastructure. This property makes these networks highly exile and robust. There are many protocols which are proposed on the issues of MANET but they have not considered all possibility of routing in intra as well as inter zone. The main motto of the research is upgrading the existing ZRP Model with enhancement of namely MDVZRP, SBZRP, and QCS to achieve better performance. The design goals of ZRP enhancement are to enhance the performance in the area such as quick route reconfiguration, route acquisition delay, and low mobility scenarios considering the all possible way of routing in inter as well as intra zone.

KEY WORDS: - Routing, MANET, AODV, OLSR, ZRP, MID

I. INTRODUCTION

Mobile Ad Hoc Networks are the self-organizing and self-configuring wireless networks which do not rely on a fixed infrastructure and has the capability of rapid deployment in response to application needs. Nodes of these networks function as routers which discover and maintain routes to other nodes in the network. The AD-hoc network [1] applications include military applications, casual conferences, meeting, virtual classrooms, emergency search-and-rescue operations, disaster relief operation, automated battlefield and operations in environments where construction of infrastructure is difficult or expensive. In MANET, due to lack of centralized entity and mobile nature of nodes, network topology changes frequently and unpredictably. Hence the routing protocols for ad hoc wireless networks have to adapt quickly to the frequent and unpredictable changes of topology. There are many routing protocols available for Ad-hoc networks as AODV, CGSR, DSDV, DSR, DYMO, FSR, GSR, OLSR, STAR, TORA, WRP and ZRP etc. In this paper we have used three routing protocols: AODV [2], OLSF and ZRP and evaluated the performance of these three routing protocol as a function of pause time and number of nodes.

Manuscript Received on November 2014.

Nidhi Singh, M.Tech Student, Department of Computer Science & Engineering, Meerut Institute of Engineering and Technology; Meerut (U.P.), India

Ajay Kumar, Asst. Professor, IIMT Engineering College Meerut (U.P), India

Chandra Prakesh Sahu, Asst. Professor, MIET Engineering College Meerut (U.P), India

II. ROUTING IN MANET

The process of sending and receiving data from one node to another is done with the help of routing protocols. In MANET each node works as router. Sender and receiver be capable of communicate, if and only if they are inside the communicate range beside sender has sent the message through the nodes [5]. The chief goal in ad-hoc network is to create an accurate and capable route among couples of nodes and to make sure that the proper and timely release of packets [4]. The routing protocols for MANET can be categorized into three types according to procedure used for route discovery and route maintenance: reactive or on-demand, proactive or table driven and hybrid routing protocols combination of both reactive and proactive routing protocols [4].

A.REACTIVE ROUTING PROTOCOLS

Reactive Routing protocols are on demand routing protocols in which route is required, when its demand for the data packets [6]. At any time, if source wants to send message to receiver, then the protocol create a path as soon as when demand for the route. Ad hoc On-Demand Distance Vector Routing (AODV), Cluster based Routing Protocols (CBRP) and Dynamic Source Routing Protocol (DSRP) are On-Demand Routing protocols [2].

1. AODV

AODV have some combine properties of DSR and DSDV. It is based on Bellman-ford Distance Algorithm. AODV always discover a route source to destination only on-demand [7]. It used route finding procedure and routing tables for maintaining route information [8]. AODV used REEQ AND RREP for communication. A RREQ holds the senders' address, the address of the wanted node and the last sequence number inward starting that node, if there is present one. The receipt node checks if it has a route to the particular node, if there exists a route and the sequence-number to set up a fresh route. The node response to the requesting by transfer a route replies (RREP). But on the other hand supply a route does not stay alive the receipt node sends a RREQ itself to attempt to discover a route for the request node [9]. AODV perform both unicast and multicast routing and it preserve a path while needed for communication [4].

B. PROACTIVE ROUTING PROTOCOLS

Proactive Routing protocols are table driven and there is require retaining regular up-to-date routing information about the every node inside the network and it stores the entire information within route table in the type of cache [6]. Destination Sequenced Distance Vector (DSDV)

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routing protocol, Global State Routing (GSR), Wireless Routing Protocol (WRP), Zone Based Hierarchical Link State Routing Protocol (ZHLS) and Clustered Gateway Switch Routing Protocol (CGSR) are table driven routing protocols [7].

1. OLSR

OLSR is a hop by hop proactive routing protocol. It is optimizations of clean connections state algorithm in ad hoc networks. The routes are always all the time at once presented when required suitable to its proactive nature [10]. OLSR used multipoint relay (MPR). MPR are responsible for generating and forwarding topology information. OLSR always need to maintain routing tables. OLSR has three types of control messages, Hello, Topology Control (TC), and Multiple Interface Declaration (MID) [11].

1. a. Hello: OLSR makes use of "Hello" messages to find it is one hop neighbors and it is two hop neighbours through their responses. This control message is transmitted for sense the neighbour and used for MPR calculation.

1. b. Topology Control: OLSR uses topology control (TC) messages along with MPR forwarding to disseminate neighbour information throughout the network.

1. c. Multiple Interface Declaration: MID message includes the record of every IP addresses use by every node in the network. Every single nodes running on OLSR broadcast messages on extra than single interface.

1. d. Multi Point Relaying: MPR are used nodes to transmit route message. The choice of MPR is base on HELLO communication send between the neighbor nodes.

C. HYBRID ROUTING PROTOCOLS

Hybrid routing protocol have both the combines feature of Reactive and Proactive Routing protocols [6]. It decreased the latency in reactive protocol and reduce the control overhead of proactive routing protocols. This protocol is based on hierarchical or layered system structure. Temporally ordered routing algorithm (TORA) and Zone routing protocol (ZRP) are Hybrid routing protocols [7].

1. ZRP

The Zone Routing protocols combine the feature of both reactive and proactive protocol into Hybrid Routing Protocol [13]. ZRP is adaptive in nature and it depends on the present organization of network. As the name infer ZRP is base on idea of the zone. A routing zone is distinct for all nodes, and the zones of adjacent nodes partially cover one by one [12]. ZRP can be considered like a flat protocol. Zone Routing Protocol consists of numerous components, which simply jointly offer the full routing advantage of ZRP, each's component work by itself. Components of ZRP are: IARP, IERP and BRP.

1. a. ARP: The first protocol of ZRP is the IARP (Intra zone Routing Protocol). This protocol is used to communicate through the inner nodes of its zone and is partial by the zones radius suitable to differ in topology, limited neighborhood of a node can modify rapidly. This node always desires to update the routing information [13]. IARP protocol is use indoor routing zones [14].

1. b. IERP: Inter zone Routing Protocol is global reactive routing component of the ZRP, the Inter zone Routing Protocol takes gain of the well-known local topology of a node's zone and using a reactive move towards enables communication using nodes in previous zones [13]. In Reactive routing protocol IERP is used among routing zones [14].

1. c. BRP: The Border casts Resolution Protocol is used in the ZRP to nonstop the route requests start with the global reactive IERP to the minor nodes and removing disused queries and maximize effectiveness [13]. It uses the Intra zone routing information provided by IARP to create a border cast tree.

III. RELATED WORK

This section reviews the some of literature pertaining to routing in wireless ad hoc networks. In [1], the work presents query controlled scheme to provide enhanced detection and prevention of overlapping queries. The work done in [2] presents a selective border casting zone routing protocol to reduce the network load by limiting the number of control packets when the protocol searches for new route. The work presented in [3], is a protocol called multipath distance vector zone routing protocol for mobile ad-hoc networks, which uses a topological map of the zone centered on a node to guarantee loop freedom and alternative paths in the case of route failure and disjoint paths. In [15] an algorithm is proposed to provide improved quality of service such as low end to end delay and high throughput via hybrid routing protocol ZRP. In paper [16] independent zone routing is proposed, which allows adaptive and distributed configuration for the optimal size of the each node's routing zone on the per node basis. In [6], it has given review about the current routing protocols in Ad-hoc networks.

In this paper [17], he has proposed the secure message transmission (SMT) protocol to safeguard the data transmission against arbitrary malicious behavior of network nodes. He suggest that SMT is a lightweight, yet very effective, protocol that can operate solely in an end-to-end manner. It exploits the redundancy of multi-path routing and adapts its operation to remain efficient and effective even in highly adverse environments. Overall, the ability of the protocols to mitigate both malicious and benign faults allows fast and reliable data transport even in highly adverse network environments is given in work [18].

This [19] paper presents evidence that multipath routing can mask a substantial number of failures in the network compared to single path routing protocols and that the selection of paths according to DPSP can be beneficial for mobile ad hoc networks since it dramatically reduces the rate of route discoveries. In [20], it is proposed a solution to the managed-open scenario.

In this paper [21], it is presented a protocol called Trustworthiness-based Quality Of Service (TQOS) routing, which includes secure route discovery, secure route setup, and trustworthiness-based QoS routing metrics. The routing metrics are obtained by combing the requirements on the trustworthiness of the nodes in the network and the QoS of the links along a route.

In this paper[22], it is focused on the impact of rushing attack implemented by malicious nodes (MNs) on AODV

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routing protocol. The Simulation results shows that AODV protocol fails completely in presence of rushing attack Helpful Hints.

IV. SIMULATION

Simulation is the imitation of the operation of a real-world process over time. Various simulators are available like QualNet, OPNET, and NS2 etc. Here, simulation work is done on NS2. NS2 is an object oriented simulator and is extensively used by research community. It is event-driven and works in non-real-time fashion. NS2 uses Tcl and object Tcl shell as interface and consist of C++ core methods. This section will do analysis on AODV, OLSR and ZRP. Also performance evaluation is done on the basis of different parameters.

A. Simulation Parameters

Parameter	Value
Platform	Linux CentOS 5
NS Version	Ns-2.33
Traffic Type	CBR
Radio Propagation	TwoRayGround
Antenna Type	OmniAntenna
Packet Size	512 bytes
Pause Time	5, 10, 20, 40, 100
Number of nodes	10, 20, 30, 40, 50

Table 1. Setup parameters for simulation

B. Performance Parameters

The following metrics are used for different protocols evaluation:

- **Throughput:** Average rate of packets successfully transferred to their final destination per unit time.
- **End to End Delay:** It signifies the amount of time taken by packet from source to destination.
- **Packet Delivery Fraction:** Ratio of total data packets received to total ones sent by CBR source.

C. Results Analysis

Results are analyzed on the basis of different performance metrics. Graphs shown below shows simulation results are according to network and pause time model i.e. varying number of nodes and changing pause time respectively.

1. ***Packet Delivery Ratio:*** Fig 4 shows the Packet Delivery Ratio of AODV, OLSR and ZRP. In case of low traffic 5-30 no. Of source nodes and by placing 50 nodes AODV perform better, but Packet Delivery Ratio starts decreases as the number of source nodes increases. OLSR and ZRP perform less efficiently. Both OLSR and ZRP have similar values of Packet Delivery Ratio with small variation.

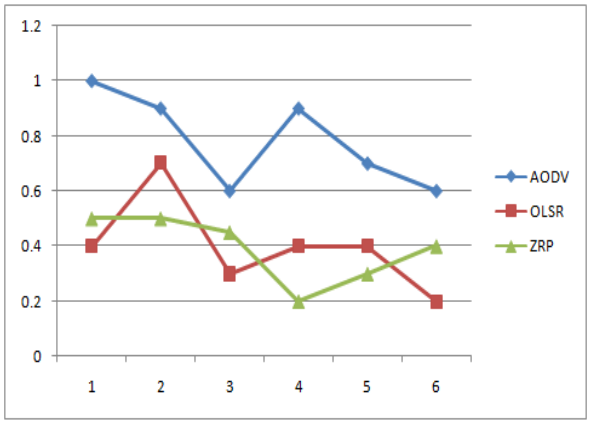

Figure 1.Packet Delivery Ratio

2. ***Average Throughput:*** - The throughput of AODV is greater than another routing protocol. OLSR and ZRP have almost similar throughput with small variations. AODV has less overhead comparison to OLSR and ZRP routing protocols. AODV performed better than OLSR and ZRP.

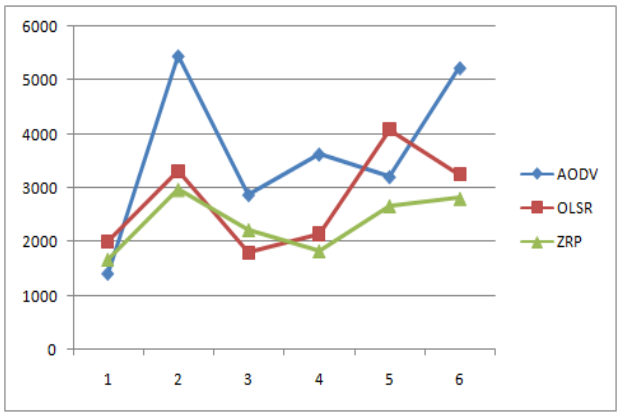

Figure 2. Average Throughput

3. ***Average End to End Delay:*** - *The* nature of AODV, it has less connection setup delay than both OLSR and ZRP. As the number of source nodes increases end to end delay is also increases in AODV, OLSR and ZRP routing protocols. But AODV has less end to end delay than OLSR and ZRP.

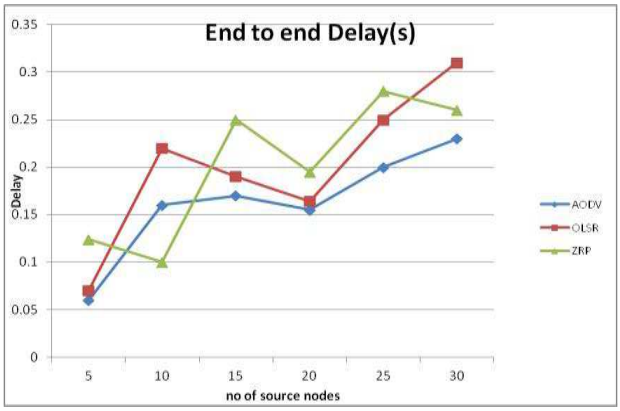

FIGURE 3. AVERAGE END TO END DELAY

V CONCLUSION AND FUTURE WORK

In the comparative analysis of Reactive protocol AODV, Proactive protocol OLSR and Hybrid routing protocol ZRP performance metrics packet delivery ratio, Average throughput, Average End to End Delay. The results show that ZRP demonstrated a really low packet delivery ratio

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and throughput where the mobility is high. As the number of nodes increases, the routing load also increases with the Zone Radius. The Zone radius in order to achieve higher throughput should be kept low in range of 2-4 as the figures depicted above shows the best performance of ZRP at these zone radius. On the other hand, average end to end delay is least at high Zone Radius. But this parameter alone can't be taken as a whole criterion for good performance. Therefore, ZRP is termed as suitable only for a very large network so the benefits of both proactive and reactive protocols are enjoyed. For future work, the analytical study for Optimum Zone Radius will be done to achieve high throughput. In this literature, the simulations are done at constant pause times and through CBR traffic. For our future work, simulations will be done by varying pause time and through TCP traffic.

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AUTHOR'S BIOGRAPHY

Nidhi Singh is a student of M.Tech in Department of Computer Science & Engineering in Meerut Institute of Engineering and Technology; Meerut affiliated to Uttar Pradesh Technical University, Lucknow, Uttar Pradesh & B.Tech degree in Computer Science & Engineering from ABSS Engineering and Technology, Meerut, affiliated to Uttar Pradesh Technical University, Lucknow, Uttar Pradesh.

Ajay Kumar received his M.Tech degree in Computer Science & Engineering from IIMT Engineering College, Meerut affiliated to Uttar Pradesh Technical University, Lucknow, Uttar Pradesh & B.Tech degree in Computer Science & Engineering from Meerut Institute of Engineering and Technology, Meerut, affiliated to Uttar Pradesh Technical University, Lucknow, Uttar Pradesh. He has 5 years of teaching experience in Technical education. He is presently working in IIMT Engineering College Meerut (U.P) as Assistant Professor & His research area is Ad hod Networks, protocol design for MANETs, Internet access solutions for MANETs etc.

Chandra Prakesh Sahu received his M.Tech degree in Computer Science & Engineering Netaji Subhas Institute of Technology (NSIT), Delhi/ Delhi University, Delhi & B.Tech degree in Computer Science & Engineering from Sri Ram Swaroop Memorial College of Engg. and Mgt. UPTU, Lucknow. He has 8 years of teaching experience in Technical education. He is presently working in MIET Engineering College Meerut (U.P) as Assistant Professor & His research area is Ad hod Networks, protocol design for MANETs, He has no of research in magnet.

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