QUANTITATE QOS APPROACH FOR ZRP UNDER VARYING ZONE RADIUS AND MOBILITY CONDITION OVER MANETS

Vikrant Manocha* , Shanu Malhotra #

* Asst. Professor, Dept. of Computer Science and Engg.
MMU, Mullana(Ambala), India.
Asst. Professor, Dept. of Computer Science and Engg.
ISTK, Yamuna Nagar, India

ABSTRACT

Traditionally, first-generation wireless networks were targeted primarily at voice and data communications occurring at low data rates. A mobile Ad hoc network is an autonomous system of mobile hosts which are free to move around randomly and organize themselves arbitrarily. *Ad hoc networks need to possess self-organizing characteristics, and they must perform routing and packet-forwarding functions. This paper* is *focused on designing scenario for Hybrid routing protocol - ZRP, basically to discuss by taking what parameters ZRP will give its best and to show how much effective this protocol is.* In this paper, the performance of ZRP *by varying mobility rate along with zone radius on QoS based performance metrics has been analyzed and simulated by NS-2 simulator.*

Keyword : - MANET, QoS, ZRP.

I. INTRODUCTION

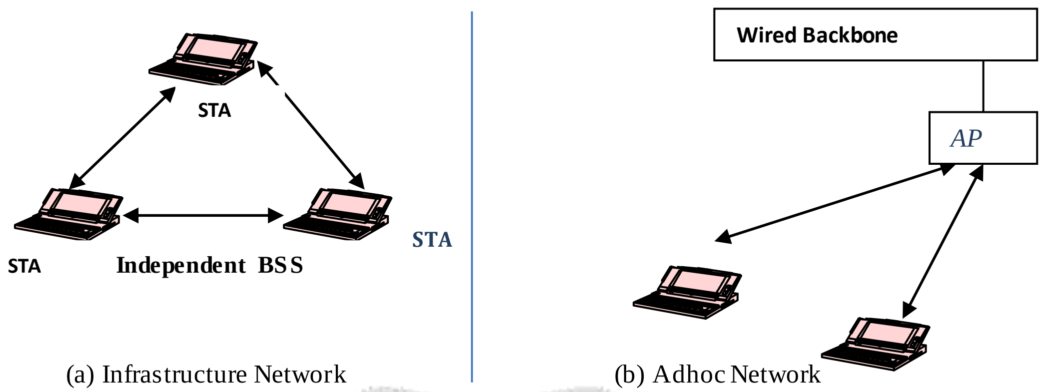
Multiple access techniques are used to provide access to a large number of users within same bandwidth. Of all Wireless communications have become very pervasive. The number of mobile phones and wireless Internet users has increased significantly in recent years. The topology of an ad hoc wireless network is dynamically changing since devices are not tied down to specific locations over time. The fact that nodes are not static implies that centralized media access is not entirely applicable. Routing protocols in ad hoc networks need to deal with the mobility of nodes and constraints in power and bandwidth. Ad hoc devices rely on batteries to operate; hence, any inefficiency in communication protocols can drastically shorten the uptime of these devices.

A wireless network connects computers without the need of physical wire connections. In wireless networks, users are able to roam or work wherever they wish and still have access to the computer network. There are three main types of wireless network:

- Wide Area Networks (WAN)
- Local Area Networks (LAN)
- Personal Area Networks (PAN)

Wireless networks can be classified in two types: - infrastructured network and infrastructure less (ad hoc) networks.

- **An infrastructure-network** consists of a group of mobile nodes with some bridges. These bridges called base stations connect the wireless network to the wired network. Communication takes place between two or more nodes by first searching for the nearest base station and information flow takes place between the nodes with the base stations as a bridge between them.
- **In ad-hoc networks**, there are no centralized base stations, fixed routers and central administration. All nodes move randomly and are capable of discovering and maintaining the routes between them. Each node acts as a router and communicates to other for a short interval of time like: emergency searches, quickly sharable information like meetings etc [3].



(a) Infrastructure Network (b) Adhoc Network

Figure 1.1 Wireless Networks

A Mobile Ad Hoc Network (MANET) is an autonomous system of mobile nodes with routing capabilities connected by wireless links, the union of which forms a communication network [2]. Therefore, it can be considered as a temporary infrastructure less network formed by a set of wireless mobile hosts that dynamically establish their own network on the fly without relying on any central administration [1]. All participants at these networks act as both hosts and routers forming an autonomous network heavily depended on the belief that all participants give and take resources in a fairly manner. The nodes are usually devices with limited CPU, storage and energy resources such as laptops, PDAs and other mobile devices. The features can be broadly classified in terms of connectivity, bandwidth and battery lifetime etc. Moreover, we can easily understand the serious challenges that exist in the implementation of MANETs.

A. Routing

Routing is the process of selecting paths in a network through which data is to be send. Routing is performed by many kinds of networks, including telephone network, internet and transport networks. Each Routing directs forwarding the passing of logically addressed packets from their source toward their destination through intermediate nodes which are hardware devices called routers, bridges, firewalls. Routing process directs forwarding on the basis of routing tables which maintain a record of the routes to various network destinations. The routing process usually directs forwarding on the basis of routing tables which maintain a record of the routes to various network destinations. Thus constructing routing tables which are held in routers memory becomes very important for efficient routing. A routing metric is a value used by a routing algo*rithm to determine whether one route should perform better than other. Metrics can cover information like bandwidth, delay, hop count, path cost, reliability etc.

Ad hoc routing has following goals:

- Route computation must be distributed because centralized routing in a dynamic network is impossible even for small network.
- Each node must care only about the routes to its destination and must not be involved in frequent topology updates for the portions of the network that have no traffic.
- Stale route must be avoided or detected and eliminated quickly.
- If the topology stabilizes then routes must converge to the optimal routes.
- As few nodes as possible must be involved in route computation and state propagation as this involve monitoring and updating at least some states in the network.
- Give the nodes the best response time and throughput.
- Provide the maximum possible reliability by selecting alternative routes if nodes connectivity fails due to mobility of the node.
- The no packet collisions must be kept minimal by limiting the no of broadcasts made by each other.
- It must use scarce resources such as bandwidth, computing power, memory and battery power.

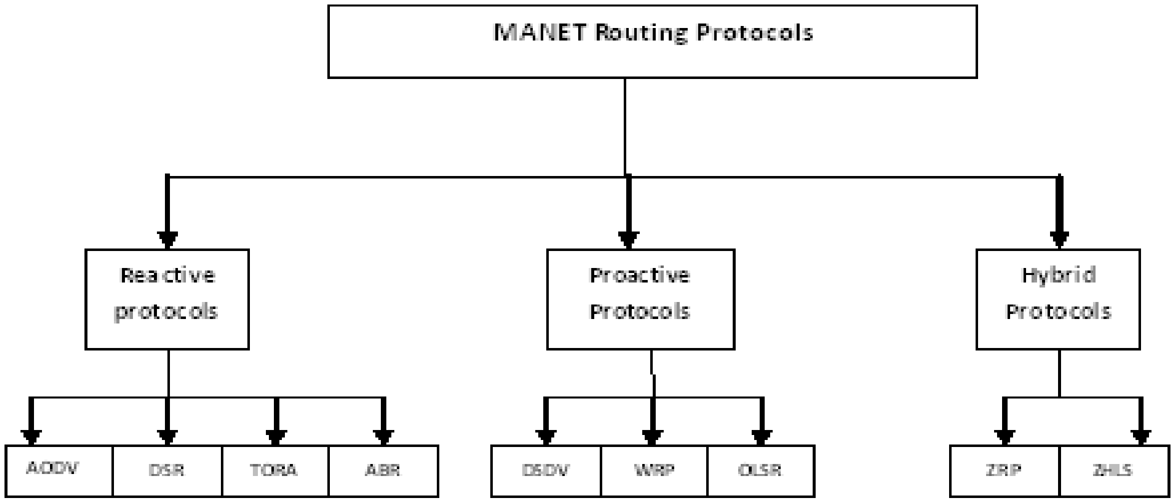


Figure 2. Classification of Ad hoc Network Routing Protocols

B. **Zone Routing Protocol**

ZRP is an example of a hybrid reactive/proactive routing protocol based on parameter called routing Zone [8]. ZRP is proposed to reduce the control overhead of proactive routing protocols and decrease the latency caused by routing discover in reactive routing protocols [9]. ZRP was introduced by Haas in 1997. In ZRP a node proactively maintains routes to destinations within a local neighborhood which is referred to as routing zone.

A routing zone is defined for each node separately [10]. A node routing zone is defined as a collection of nodes whose minimum distance i-n hops from the node in question is no longer greater than a parameter called zone radius. Each node maintains zone radius and routing zones of neighboring nodes overlap. The construction of a routing zone requires a node first to know who its neighbors are. A neighbor is a node that can communicate directly with a node in question. Neighbor discovery is implemented through a Mac level neighbor discovery protocol (NDP).

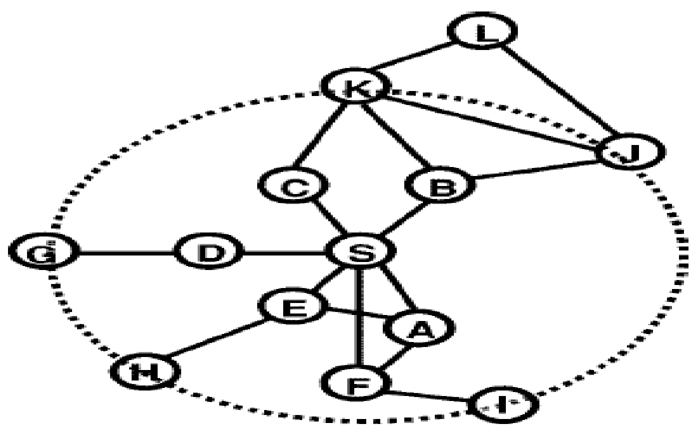


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Figure 3. Routing zone of radius 2

An example of routing zone of radius 2 is shown in figure 3 Nodes A through K are members of nodes S's routing zone whereas node L lies outside. Peripheral nodes are the nodes whose minimum distance to the node in question is equal to zone radius. Nodes G through K are peripheral whereas nodes A through F are interior. Each node maintains its own routing Zone [8,9].

The number of nodes in the routing zone can be regulated by adjusting the transmission power of the nodes. Lowering the power reduces the number of the nodes within direct reach and vice versa. The number of neighboring nodes should be sufficient to provide adequate reliability and redundancy.

C. **ZRP Architecture**

The relationship between components is illustrated in figure 4. The proactive maintenance of routing zone topology is performed by IARP through exchange of route packets. Route updates are triggered by the MAC level (NDP) which notifies IARP when a link to a neighbor is established or broken.

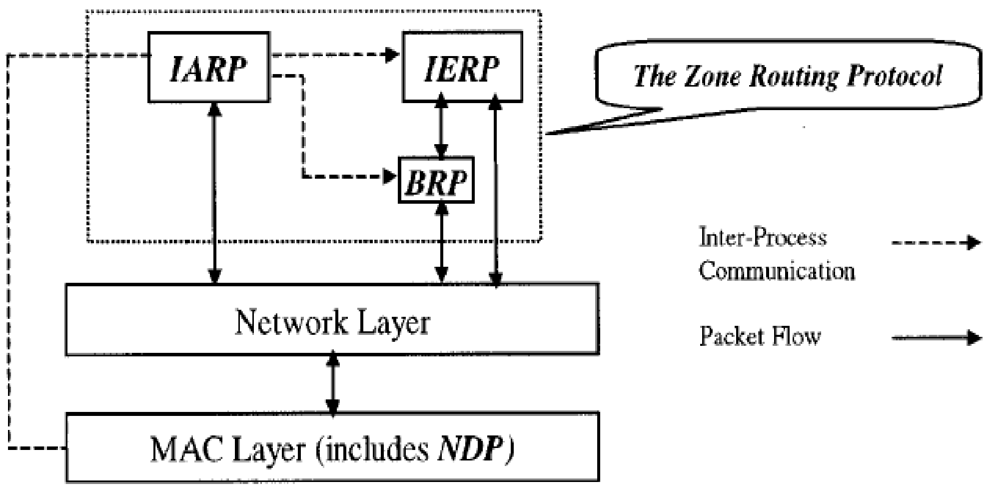

Figure 4. ZRP Architecture

IERP reactively requires routes to nodes beyond the routing zone using query reply mechanism. It forwards query to peripheral nodes from through the bordercast delivery service keeping track of peripheral nodes through update routing zone topology information provided by IARP [5]. IERP makes use of IARP routing zone information to determine whether a query for destination belongs to its routing Zone.

The Zone routing protocol consists of several components which only together provide the full routing benefit to ZRP.

II. LITERATURE REVIEW

A survey on MANET routing protocols has been done by H Zhou In [1], categorizing unicast, multicast and broadcast routing algorithms. Unicast algorithms are further categorized as reactive, proactive and hybrid routing algorithms. If two mobile nodes are within each other's transmission range, they can communicate with each other directly; otherwise, the nodes in between have to forward the packets for them. In such a case, every mobile node has to function as a router to forward the packets for others. Thus, routing is a basic operation for the MANET. Because traditional routing protocols cannot be directly applied in the MANET, a lot of routing protocols for unicast, multicast, and broadcast transmission have been proposed since the advent of the MANET. This survey gives a thorough study of routing protocols in the MANET.

To overcome the problems associated with the link-state and distance-vector algorithms a number of routing protocols have been proposed for MANETs. A broad classification of Ad hoc network routing protocols is given by M. Abolhasan et.al. in [2]. These protocols can be classified into three different groups: global/proactive, on demand/ reactive and hybrid. In proactive routing protocols, the routes to all the destination (or parts of the network) are determined at the start up, and maintained by using a periodic route update process. In reactive protocols, routes are determined when they are required by the source using a route discovery process. Hybrid routing protocols combine the basic properties of the first two classes of protocols into one. That is, they are both reactive and proactive in nature. Each group has a number of different routing strategies, which employ a flat or a hierarchical routing structure.

Prince Samar et.al. in [3] proposed independent zone routing algorithm framework which allowed adaptive and distributed configuration for the optimal size of each nodes routing zone on the per node basis. They demonstrated the performance of IZR is significantly improved by its ability to automatically and dynamically tune the network routing operation.

A routing protocol which utilizes the characteristics of Bluetooth technology for Bluetooth based MANET is proposed by Chenn-Jung Huang et.al. in [4]. They maintained routing tables in the master devices and adjusted routing zone radius for each table dynamically by using evolving fuzzy neural networks.

In [5], Performance evaluation and traffic analysis for routing protocols in a real MANET is conducted by H. Chen et.al. highlighting that CBR traffic does not reflect the complex nature of traffic in real applications and hence the relationship between traffic and routing is well worth investigation. It performed simulation studies for traffics based on different patterns and characteristics. The results show that the performance is sensitive to the routing protocol, path loss, and traffic characteristics. This provides rationale and insight for choosing the right protocols to provide quality of service in terms of different metrics in different environment.

Hao-Jun lie et.al. [6] analyzed the principle of cache mechanism on ZRP. In allusion to the problems of late-deletion and early deletion in ZRP they proposed optimized A-ZRP which associates routing information priority with latest access time.

Nicklas Beijar in [7] discussed the problem of routing in Ad hoc network and also described the working of protocol with eg. Niclklas discussed the architecture and route maintenance but didn't show the practical results for mobility Routing protocols for mobile Ad hoc networks have to face the challenge of frequently changing topology, low transmission power and asymmetric links. Both proactive and reactive routing protocols prove to be inefficient under these circumstances. The Zone Routing Protocol (ZRP) combines the advantages of the proactive and reactive approaches by maintaining an up-to-date topological map of a zone centered on each node. Within the zone, routes are immediately available. For destinations outside the zone, ZRP employs a route discovery procedure, which can benefit from the local routing information of the zones. Proactive routing uses excess bandwidth to maintain routing information, while reactive routing involves long route request delays. Reactive routing also inefficiently floods the entire network for rout-e determination. The Zone Routing Protocol (ZRP) aims to address the problems by combining the best properties of both approaches. ZRP can be classed as a hybrid reactive/proactive routing protocol. He states that in an Ad hoc network, it can be assumed that the largest part of the traffic is directed to nearby nodes. Therefore, ZRP reduces the proactive scope to a zone centered on each node. In a limited zone, the maintenance of routing information is easier. Further, the amount of routing information that is never used is minimized. Still, nodes farther away can be reached with reactive routing. Since all nodes proactively store local routing information, route requests can be more efficiently performed without querying all the network nodes.ZRP refers to the locally proactive routing component as the IntrA-zone Routing Protocol (IARP). The globally reactive routing component is named IntEr-zone Routing Protocol (IERP). IARP maintains routing information for nodes that are within the routing zone of the node. IERP offers enhanced route discovery and route maintenance services based on local connectivity monitored by IARP. The bordercast packet delivery service is provided by the Bordercast Resolution Protocol (BRP). In order to detect new neighbor nodes and link failures, the ZRP relies on a Neighbor Discovery Protocol (NDP) provided by the Media Access Control (MAC) layer. Route updates are triggered by NDP, which notifies IARP when the neighbor table is updated. IERP uses the routing table of IARP to respond to route queries. IERP forwards queries with BRP. BRP uses the routing table of IARP to guide route queries away from the query source. He proposed ZRP reduces traffic amount compared to pure proactive or reactive routing.

P Satish kumar et.al. in [8] proposed new routing algorithm for MANET called genetic Zone routing protocol for finding shortest paths to the existing zone. He proposed how to load balance the network in case of congestion and route failure.

Yuanzhu Peter chen et.al. in [9] presented Zone routing algorithm for finding weakly connected dominating set and suggested clustering to simplify routing.

Fatma Outay et.al. in [10] discussed the fact of implementing service discovery at the routing layer in order to reduce service delivery overhead and developed integrated service delivery protocol called BF-SD-ZRP utilizing combination of different optimization techniques.

Anwar et.al. in [11] proposed extension to ZRP to support deployment when unidirectional links are present. In particular they proposed query enhancement mechanism that recursively builds partial routes to a destination.

III. RELATED WORK

From the literature survey it was found that lot of work has been done on ZRP, but no research work suggested us how well ZRP will adapt in MANET with respect to nodes mobility, zone size and transmission range. From the literature review, it was found that there are several problems in routing with Mobile. In asymmetric links most of the wired networks rely on the symmetric links which are always fixed. But this is not a case with ad-hoc networks as the nodes are mobile and constantly changing their position within network. But major problem is interference in which mobile ad-hoc networks as links come and go depending on the transmission characteristics, one transmission might interfere with another one and node might overhear transmissions of other nodes and can corrupt the total transmission. So objective is to analyze the impact of network density on ZRP under varying mobility rate and zone radius in MANETs. This simulation process considered a wireless network of five static nodes which are placed within a 900m x 900m area. CBR (constant bit rate) traffic is generated among the nodes. The simulation runs for 150 Seconds. Table II shows the important simulation parameters used in the simulation process.

TABLE 1.1: SALIENT SIMULATION PARAMETERS

Parameter	Value
Simulation time	150 Sec
Simulation area	900m x 900m
Antenna	Omni antenna
No. of nodes	20
Packet size	512 Bytes
Max queue length	50
Traffic	CBR (Constant bit rate)
Routing protocol	ZRP
Transport Layer	TCP
Mobility rate	50,100,200,300,400,500,600,700,800,900
Application	FTP, Telnet
Data Rate	2 Mbps

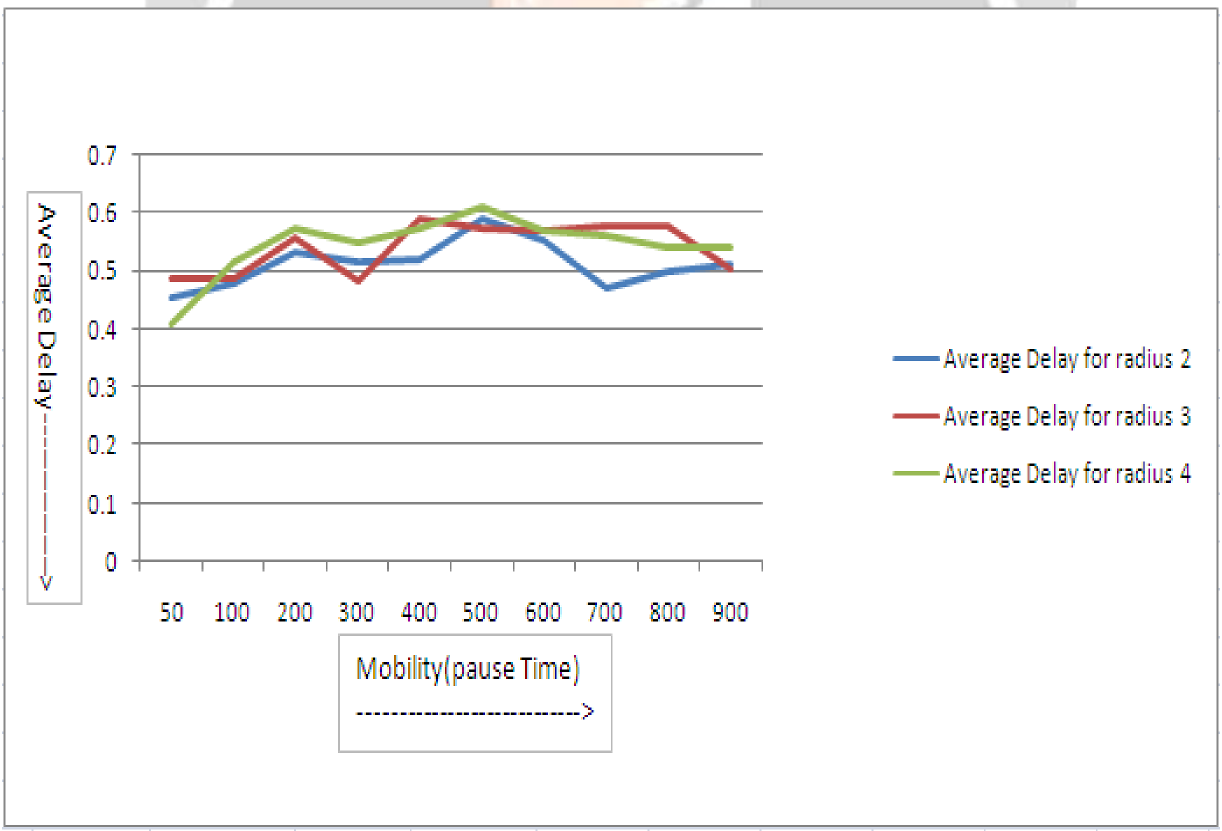

Figure 5. Varying Zone Radius and Mobility Rate on the Average Delay.

As shown in table 5 Average end-to-end delay is varied when the zone radius and mobility is varied. ZRP protocol makes use of route cache (proactive) within zone radius which many a times contains stale routes, as a result of which its average end-to-end delay is increase when the zone radius and mobility rate are increases.

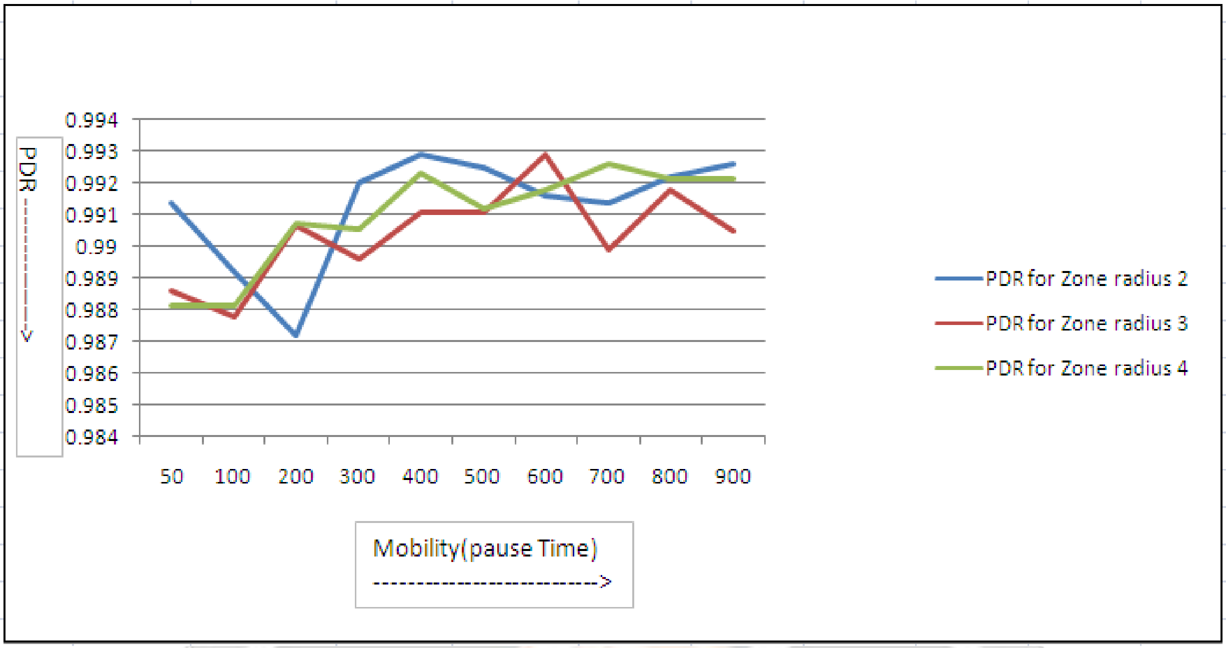

Figure 6. Varying Zone Radius and Mobility Rate on the Packet Delivery Ratio.

As analyzed from the Table 6 the Packet Delivery Ratio is at higher side when zone radius and Mobility is maximum. It has also been observed that packet delivery rate start increasing at higher zone radius and mobility environment. We can analyze that when mobility rate and zone size are minimum then packet delivery ratio is maximum.

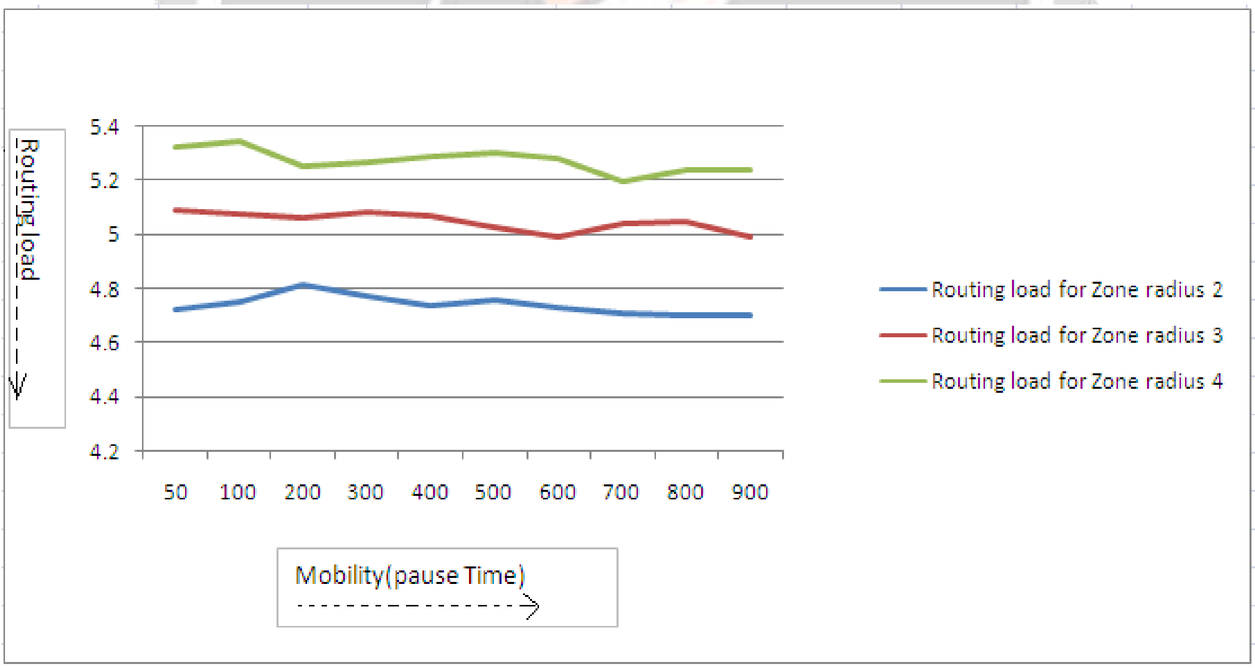

Figure 7. Varying Zone Radius and Mobility Rate on Routing Overhead.

Figure 7, shows the results for routing overhead. As observed from Table 5.3 and Figure 5.3, the routing overhead is increased when zone radius and mobility rate is higher due to the route cache entry is found to be enriched and this results the increased in routing overhead.

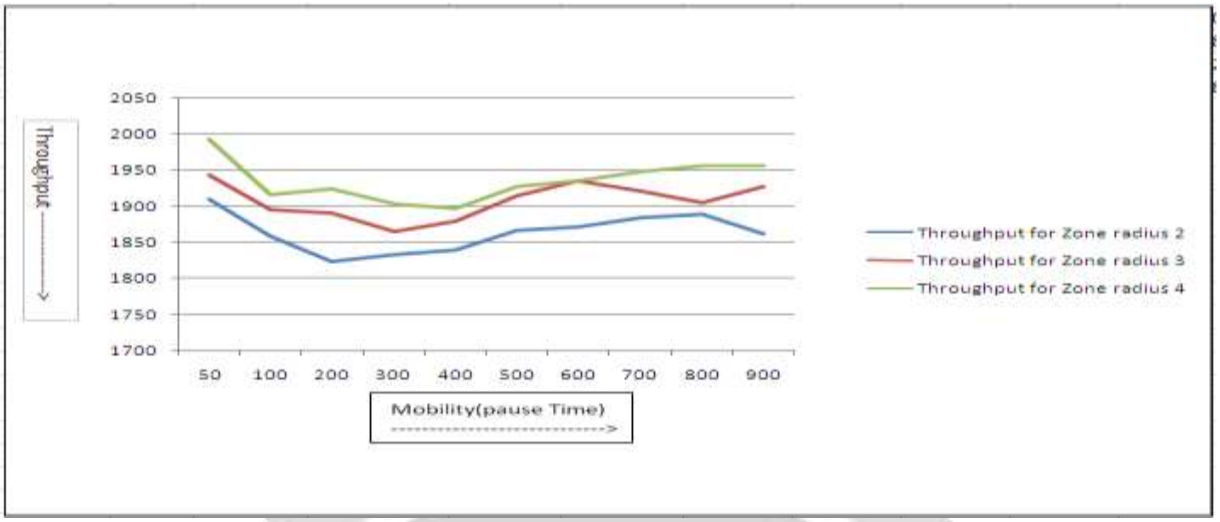

Figure 8.Impact of Varying Zone Radius and Mobility Rate on the Throughput

The results analyzed from Figure 8 indicates that the throughput is highest when the mobility rate is minimum and zone radius is maximum. It is also observed that throughput is directly proportional to number of packets are received by the receiver node.

IV. CONCLUSION

In MANETs, mobility management is a critical issue as the network performance is affected by the mobility of nodes. The effect of mobility and zone size is analyzed for the performance of ZRP protocol under the TCP agent using CBR traffic. In this paper, we have been proposed a hybrid protocol under varying zone size and it is observed that as the mobility increases, the QoS metrics such as packet delivery ratio and throughput in the case of ZRP protocol increases under higher zone sizes and minimum mobility rates. ZRP uses proactive routing within the zone as zone size gets increased then the average end-to-end delay keeps on increasing.

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