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Performance Analysis of Bellman, DSR and ZRP Routing Protocols in MANET

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Abstract: This paper investigates and undertakes simulation based study of Adhoc routing protocols in wireless sensor networks. In this paper we have compared the performance of two routing protocol Bellman, DSR, and ZRP using random waypoint mobility model and changing the node density with varying number of source node. We have analyzed the performance of protocols for varying network load and mobility. Simulation with random waypoint mobility model has been carried out by using Qualnet 5.0.2 Simulator. The metrics used for performance evaluation are End-to-End delay(s), Average Jitter(s), Total packet received and Throughput.

Keywords: BELLMAN, DSR, ZRP, MANET, QUALNET.

I. INTRODUCTION

Wireless ad hoc networks are paradigms for mobile communication in which mobile nodes are with dynamism and randomly located in such a manner that communication between nodes does not depend on any underlying static network infrastructure. The communication medium is broadcast and the nodes in a mobile ad hoc network are typically portable mobile devices with inhibited resources, Such as power, computation aptitude and storage capacity. Since no fixed infrastructure or centralized administration is Available, these networks are self organized and end-to-end communication may require routing information via several intermediate nodes. The routing protocols are vital role and it has to adapt quickly to the repeated changes in the ad-hoc network topology. Ad-hoc routing protocols Fig.1.are categorized into following three types. Proactive or Table driven routing protocols: This kind of routing protocols are retains the network topology information in routing tables contains a updated list of destinations and their routes by time to time swapping their routing information with nearby nodes. Routing information is usually flooded in the entire network. At any time a node wants a route to the destination it runs a suitable path finding algorithm on the topology information it retains. E.g. DSDV, CGSR, WRP. Reactive or on demand routing protocols: These kinds of protocols are not maintaining topology information of the network, with the help of connection establishment process nodes can obtain necessary route when it is required. And therefore this type of protocols is not exchanging the routing information time to time. E.g. DSR, AODV, TORA. Hybrid routing protocols: In this protocols both proactive and reactive routing advantages are combined. The routing is in the beginning established with certain proactively prospected routes then it serves the demand from additionally activated nodes through reactive flooding. E.g. HRPLS, ZRP, HWMP.

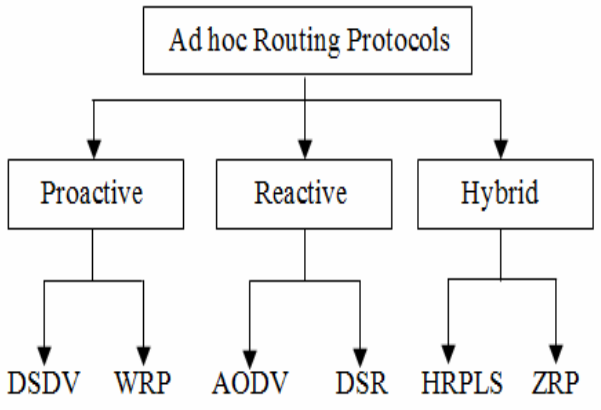


Fig.1: Ad-hoc routing protocols

II. AD-HOC ROUTING PROTOCOLS

2.1 ROUTING PROTOCOLS

Routing protocols are classified into three major categories: Proactive, Reactive and Hybrid. Proactive also called table driven forwards the packet to already known route by continuously evaluating the routes within the network. Each node maintains the routing information and updates it consistently. A reactive protocol also known as on demand performs the routing process only when required. A route discovery has to be initiated by the node when no route is found. Hybrid protocols have the benefits of proactive and reactive protocols.

2.2 The protocols studied here are :

2.2.1 BELLMAN

The algorithm known as Bellman-Ford was originally developed by Bellman [Bel58] and by Ford and Fulkerson [FF62]. It is typically described in pseudo code. [6] Bellman-Ford is used for single source shortest path along with Dijkstra Algorithm. It is a Dynamic Programming based algorithm and it work for negative weight edges. Also distributed variant of the Bellman–Ford algorithm is used in distance-vector routing protocols. The Bellman-Ford distance-vector routing algorithm is used by routers on inter networks to exchange routing information about the current status of the network and how to route packets to their destinations. The algorithm basically merges routing information provided by different routers into lookup tables. It is well defined and used on a number of popular networks. It also provides reasonable performance on small-to medium sized networks, but on larger networks the algorithm is slow at calculating updates to the network topology. In some cases, looping occurs, in which a packet goes through the same node more than once. In general, most DVR (distance-vector routing) algorithms are not suitable for larger networks that have thousands of nodes, or if the network configuration changes often. In the latter case, the routing algorithm must be able to dynamically update the routing tables quickly to accommodate changes [7]. It is used as an algorithm by distance vector routing protocols such as RIP, BGP, ISO, IDRP, NOVELL IPX. Routers that use this algorithm will maintain the distance tables, which tell the distances and shortest path to sending packets to each node in the network[8]. This protocols and algorithms currently use in the IPv4 Internet. If that protocol is used in those system of networks which have several hundreds of networks and if there is any loop formed then Bellman-ford take much time to resolve that loop so this protocol is not suitable for larger networks.

2.2.2 DSR

The Dynamic Source Routing protocol (DSR) is (Perkins, 2007), an on demand routing protocol. DSR is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. Using DSR, the network is completely self organizing and self-configuring, requiring no existing network infrastructure or administration. The DSR protocol is composed of two main mechanisms that work together to allow the discovery and maintenance of source routes in the ad hoc network [9]:

- Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D.

  Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D.

- Route Maintenance is the mechanism by which node S is able to detect, while using a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. When Route Maintenance indicates a source route is broken, S can attempt to use any other route it happens to know to D, or it can invoke Route Discovery again to find a new route for subsequent packets to D. Route Maintenance for this route is used only when S is actually sending packets to D. In DSR Route Discovery and Route Maintenance each operate entirely" on demand"[12].

2.2.3 ZRP

ZRP is the first hybrid category protocol which effectively combines best features of reactive and proactive routing protocols. It employs concept of proactive routing scheme within limited zone (within the r-hop neighborhood of each node), and uses reactive approach beyond that zone. The two routing schemes used by ZRP are: (i) Intra-zone routing

protocol (IARP) and (ii) Inter-zone routing protocol (IERP). In ZRP, the distance and a node, all nodes within -hop distance from node belongs to the routing zone of node. ZRP is formed by two sub-protocols, a proactive routing protocol: Intra-zone Routing Protocol (IARP) is used inside routing zones and a reactive routing protocol: Inter-zone Routing Protocol (IERP) is used between routing zones, respectively. A route to a destination within the local zone can be established from the proactively cached routing table of the source by IARP; Therefore, if the source and destination is in the same zone, the packet can be delivered immediately. Most of the existing proactive routing algorithms can be used as the IARP for ZRP.

III. SIMULATION ENVIRONMENTS

To evaluate and compare the effectiveness of these routing protocols in a Mobile Ad-Hoc network, we performed extensive simulations in QualNet5.0.2 each simulation is carried out under a constant mobility.

The simulation parameters are listed in Table 1.

Table 1: Simulation Parameters

PARAMETER	VALUE
Data Rate	1 Mbps
Buffer Size	150000
Antenna	Steerable
Terrain Range	1500mx1500m
Traffic Type	CBR
No. of nodes	50
Channel Type	Wireless channel
Protocol	Bellman, DSR, ZRP

3.1 PERFORMANCE METRICS

The following performance metrics are used to compare the performance of the routing protocols in the simulation:

3.1.1 Average Jitter
Average Jitter is the variation (difference) of the inter-arrival times between the two successive packets received.

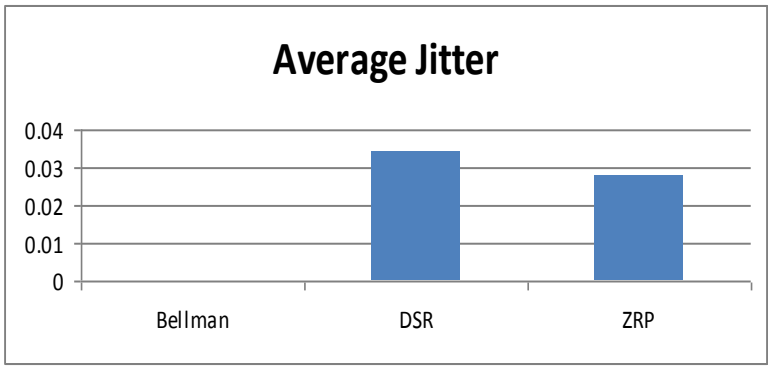
3.1.2 Average End-To-End Delay(s)
End-to-end delay refers to the time taken for a packet to be transmitted across a network from source to destination

3.1.3 Total Packet Received
It is the number of packets received by the server.

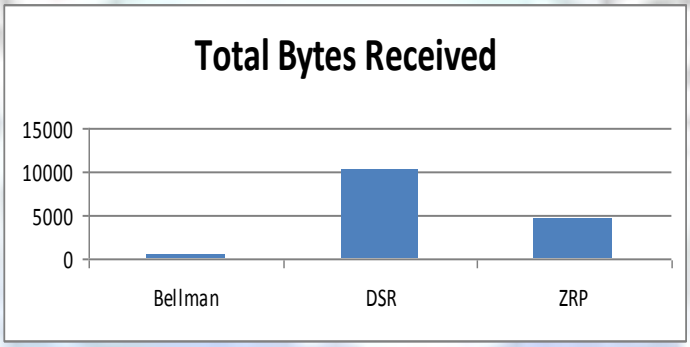
3.1.4 Throughput (bit/s)
Throughput is the average rate of successful message delivery over a communication channel

IV. RESULT

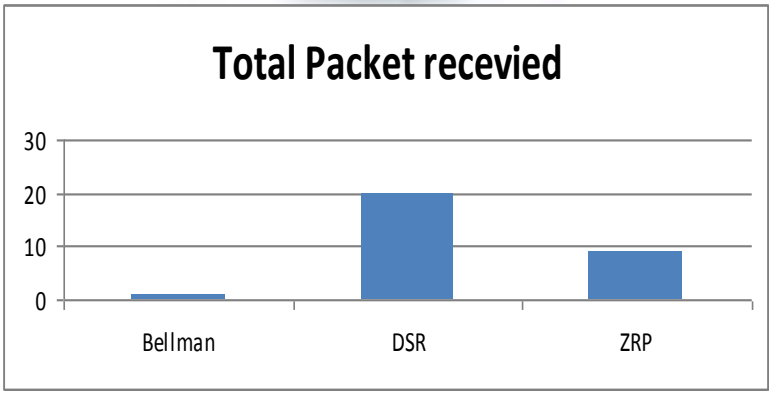
Average Jitter	
Protocol	**Value**
Bellman	0
DSR	0.034343
ZRP	0.027862



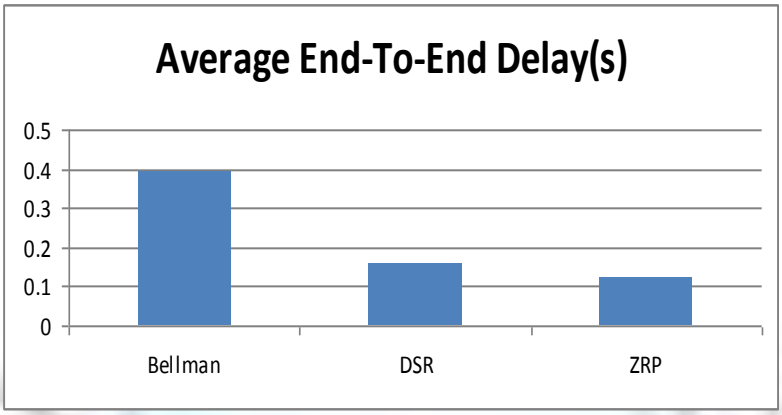
Total Bytes Received	
Protocol	**Value**
Bellman	514
DSR	10240
ZRP	4608



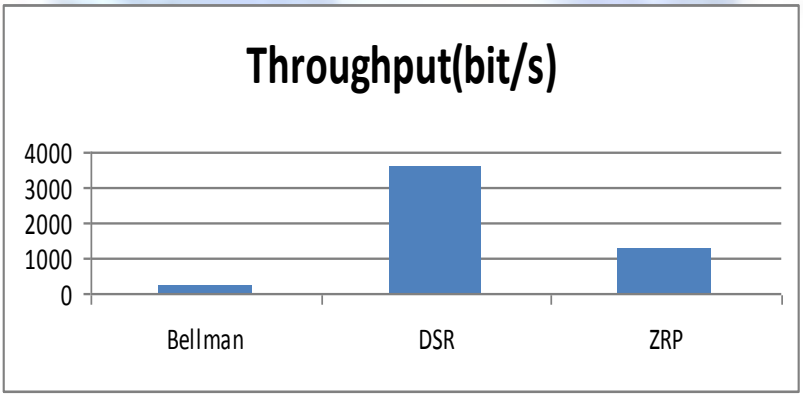
Total Packet received	
Protocol	**Value**
Bellman	1
DSR	20
ZRP	9



Average End-To-End Delay(s)	
Protocol	**Value**
Bellman	0.392595
DSR	0.158806
ZRP	0.122934



Throughput(bit/s)	
Protocol	**Value**
Bellman	208
DSR	3621
ZRP	1298



CONCLUSIONS

In this paper we have compared the performances of routing protocols at a data rate of 1mbps using steerable antennas. Through comparison of performance, the DSR protocol exhibits higher rates of successfully routing data packets & larger number of packets/bytes delivered to their destinations while ZRP incurs the lowest end-to-end delay per data packet and the average jitter among the three routing protocols for all the simulation conditions tested. As far as the average jitter is concerned bellman outing protocol suits better as it has lowest average jitter among three but while talking about the throughput DSR protocol gives better performance and it also have higher number of total bytes/packets received as it is on demand routing protocol.

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