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Performance Comparison of AODV, OLSR and ZRP Protocol in MANET using Grid Topology through QualNet Simulator

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Abstract

In MANET mobile nodes are communicating through wireless medium and do not require any pre-existent infrastructure. In MANET all mobile nodes behaves as router and when required they takes part in discovery and maintenance of the route to the other node. Without the fixed base station the mobile nodes dynamically exchange data among themselves. Popularity of MANET has been increased because of the availability of license-free wireless communication devices. MANET can be used for disaster-management, business meetings, military operations, rescue operations, or in a situation, where temporary communication network among some nodes is demanded. ZRP is a well known hybrid routing protocol. To understand its suitability we must understand its behavior under various real time conditions. This paper presents performance analysis of AODV routing protocol over OLSR and ZRP routing protocols using QualNet version 6.1. This experiment uses different network conditions, close to real time condition, for the performance analysis of AODV using OLSR and ZRP as a reference protocol. Simulations are carried out to analyze the different network parameters such as throughput, average jitter, average end-to-end delay and packet delivery ratio.

Keywords: MANET, AODV, OLSR, ZRP and QualNet version 6.1.

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1. NTRODUCTION

Mobile Ad-hoc Network (MANET) is a temporary network that is designed for communication among mobile nodes, without any need for fixed or pre-specified infrastructure. Each node here itself works like a router. Applications area of MANET are very large viz. military operations, disaster managements, rescue operations, meetings and conferences, educational purposes and many more. MANET can be used for disaster-management, business meetings, military operations, rescue operations, or in a situation, where temporary communication network among some nodes is demanded. In an ad-hoc network nodes are not familiar with the topology of the network, since all nodes are mobile, also topology of the network changes continuously. This change can be random with random velocity, or it can be uniform, depending upon the situation where network is operating. Nodes have to identify the topology of the network. A new node can introduce itself into a network by using the process of broadcast. For optimizing the route between source and destination, a variety of routing protocols for varying network conditions have been analyzed. To handle this MANET needs different types of routing protocols, some of them are: AODV [1, 2], OLSR, ZRP [1, 2, 8, 13] etc.The goal is to carry out a symmetric performance study of AODV, OLSR, ZRP routing protocol for ad-hoc networks. The rest of the paper is organized as follows: Section–2 gives a brief description about Related Works which help in performance evaluation of the ZRP, Section-3 introduces Overview of Routing Protocols; Section-4 gives the Simulation Environment, Section-5 presents Simulation Results and Discussion and performance comparison graphs. Finally, Conclusion is presented in Section-6.

2. RELATED WORK

D.W. Kum et al [1] compared AODV and DYMO using ns-2 simulator. Simulations are run to analyze the total throughput, routing overhead, and average packet size of the routing control packets. Their work shows that the path accumulation of DYMO reduced the routing overhead; the size of the routing packet was increased. At moving speeds between 1m/s and 9m/s, throughput of DYMO could outperform that of AODV. However, at moving speeds between 11m/s and 15m/s, AODV could achieve a higher throughput than DYMO. Their work did not include DYMO and ZRP protocols and did not include propagation models, Pathloss models.

Suresh and K. Jogendra [2] proposed the performance analysis of ZRP, AODV and DSR, they used QualNet simulator for simulation and taken First Packet sent, Last Packet sent, Total Bytes sent, Total Packet sent, Throughput client, First Packet Received, Last Packet Received, Total Bytes Received, Throughput server as performance metrics. battery models, energy models and varying pause time.

S. R. Raju, et al [5] used QualNet 4.5.1 Network simulator to study the behavior of ZRP versus AODV and DSR and find out that ZRP performed poorly throughout all the simulation sequences, hence putting itself out of competition. ZRP has low packet delivery ratio when compared to DSR and AODV. Their work did not include DYMO protocol, uses constant mobility speed and pause time but they use different network sizes with different nodes.

Prashant Kr.Maurya, et al [9] used QualNet 5.2 Network simulator to study the Behavior of ZRP versus AODV, DSR and DYMO and out that ZRP performed poorly throughout all the simulation sequences, hence putting itself out of competition. Observed that ZRP has lowest packet delivery ratio, performs worst, but DSR performs well among all. Their work did also include DYMO protocol.

3. OVERVIEW OF ROUTING PROTOCOLS

3.1 Ad-hoc On Demand distance Vector routing protocol (AODV)

Ad-hoc on-demand Distance Vector Routing protocol [1] is designed for wireless mobile ad-hoc networks. The Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV comes in the category of Reactive routing protocols. In reactive protocols routes are discovered and created on demand. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner. The operation of AODV is loop-free. In AODV, nodes never participate in periodic global routing-table exchange. When a node wants to communicate to another node, then only it finds and maintains a route to that node. AODV is the most famous protocol of MANET among all routing protocols but AODV has a heavy routing overhead and complexity problem as regards implementation.

3.2 Optimized Link State Routing Protocol (OLSR)

Optimized Link State Protocol (OLSR) is a proactive routing protocol, so the routes are always immediately available when needed. OLSR is an optimization version of a pure link state protocol. So the topological changes cause the flooding of the topological information to all available hosts in the network. To reduce the possible overhead in the network protocol uses Multipoint Relays (MPR). The idea of MPR is to reduce flooding of broadcasts by reducing the same broadcast in some regions in the network, more details about MPR can be found later in this chapter. Another reduce is to provide the shortest path. The reducing the time interval for the control messages transmission can bring more reactivity to the topological changes.

OLSR [8] uses two kinds of the control messages: Hello and Topology Control (TC). Hello messages are used for finding the information about the link status and the host's neighbours. With the Hello message the Multipoint Relay (MPR) Selector set is constructed which describes which neighbours has chosen this host to act as MPR and from this information the host can calculate its own set of the MPRs. the Hello messages are sent only one hop away but the TC messages are broadcasted throughout the entire network. TC messages are used for broadcasting information about own advertised neighbours which includes at least the MPR Selector list. The TC messages are broadcasted periodically and only the MPR hosts can forward the TC messages. OLSR is also a flat routing protocol; it does not need central administrative system to handle its routing process. The proactive characteristic of the protocol provides that the protocol has all the routing information to all participated hosts in the network. However, as a drawback OLSR protocol needs that each host periodic sends the updated topology information throughout the entire network, this increase the protocols bandwidth usage. But the flooding is minimized by the MPRs, which are only allowed to forward the topological messages.

OLSR protocols performs hop by hop routing i.e. each node uses its most recent information to route a packet. Therefore, when a node is moving, its packet is successfully delivered to it, if its speed is such that its movement could be followed in its neighborhoods, at least. The protocol thus supports a nodal mobility that can be traced through its control messages, which depends upon the frequency of these messages.

3.3 Zone Routing Protocol or ZRP

Zone Routing Protocol or ZRP [2] was the first hybrid routing protocol with both a proactive and a reactive routing component. ZRP is proposed to reduce the control overhead of proactive routing protocols and decrease the latency caused by routing discover in reactive routing protocols. ZRP defines a zone around each node consisting of its k neighborhood (e. g. k=3). ZRP can be categorized as a flat protocol because the zones overlap. Hence, optimal routes can be detected and network congestion can be reduced. 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. The behavior of ZRP is adaptive. The behavior depends on the current configuration of the network and the behavior of the users.

4. Simulation Environment

Simulations had carried out on QualNet version 6.1 [3] platforms and defined the parameters for the performance evaluation of AODV, OLSR and ZRP. Many authors [2, 4, 7, 9] have been worked with AODV, OLSR, ZRP and other routing protocols with different network conditions for evaluating performance. We had done simulations with network conditions. We have taken different routing protocols, path-loss models, shadowing models, energy models, battery models, varying mobility speed and varying pause time. We have taken same 1500X1500 m2 network size for both the network conditions and placed 90 nodes and apply four CBR applications. Simulation parameters are shown in table 1 and simulation results are shown in figures from 1 to 4. With the help of simulation results we had analyzed Average Jitter, Packet delivery ratio, Throughput, and End-to-End delay for the given protocol.

4.1 Performance metrics

A. Throughput: Throughput is defined as the total amount of data received by destination node from the source node divided by the total time it takes from the destination to get the last packet and it measures is bits per second (bit/s or bps).

B. Average Jitter: Jitter is the time variation between subsequent packet arrivals; it is caused by network congestion, timing drift, or route changes. It must be as low as possible for an efficient protocol.

C. Average End-to-End delay: Average end-to-end delay is the time interval when a data packet generated from source node is completely received to the destination node.

D. Packet delivery ratio: Packet delivery ratio is the ratio of total packets sent by the source node to the successfully received packets by the destination node.

Table 1: Network Condition

Area	1500x1500m^2
No. of Nodes	90
Node placement	Grid
Simulation time	110sec
Path Loss	Two ray
Shadowing Model	Constant
Routing Protocol	AODV,OLSR, ZRP
Channel Frequency	2.4Ghz
Mobility	Random way point
Mobility Speed	Min =0 mps, max =20 mps
Packet rate	1,2,4,10,20
Data size	512 byte

5. SIMULATION RESULTS AND DISSCUSSION

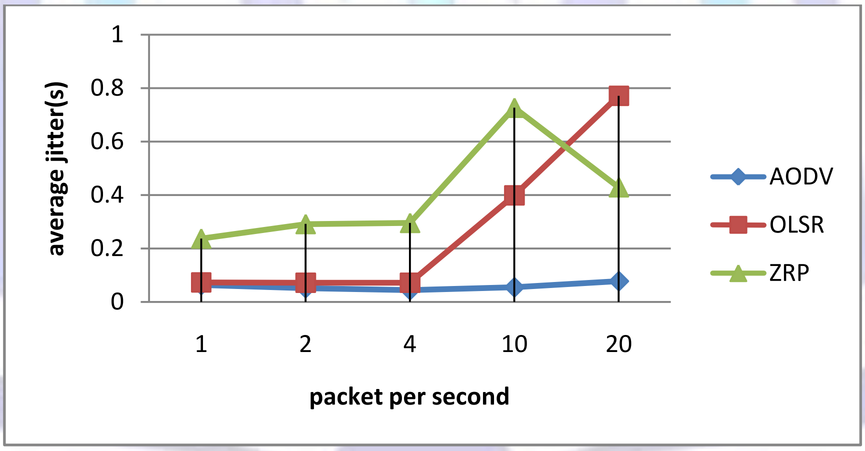

Fig 1: Average jitter Vs Packet per Second

Fig 1 shows Average jitter against Packet per second, it can be observed that for AODV jitter variation is very small but AODV performs well than OLSR and ZRP. Among all AODV performs very well but when Packet per second increases above 10 seconds the value of jitter for AODV increases.

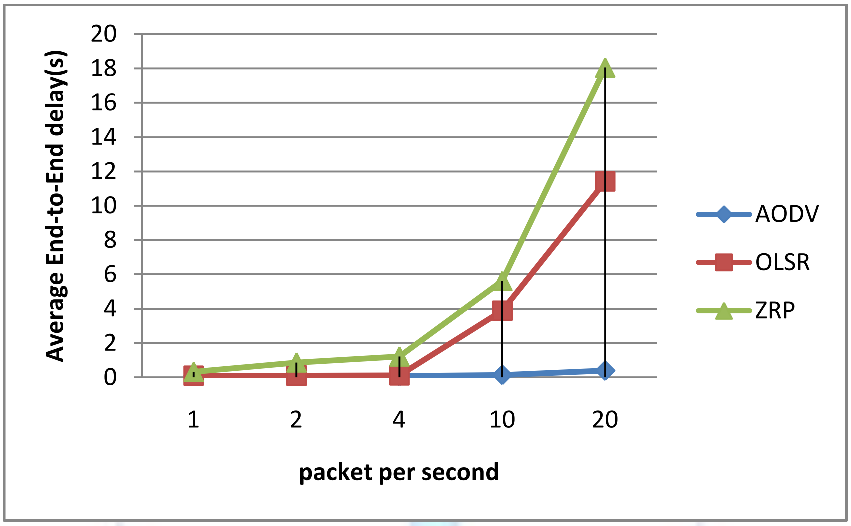

Fig 2: Average End-To-end Delay Vs Packet Per second

From Fig 2, shows the average end-to-end delay of AODV, OLSR and ZRP. For the propagation model AODV has lower average delay and have almost constant value than OLSR and ZRP. Average Delay under Two Ray model increases with increasing packet rate and performs worst.

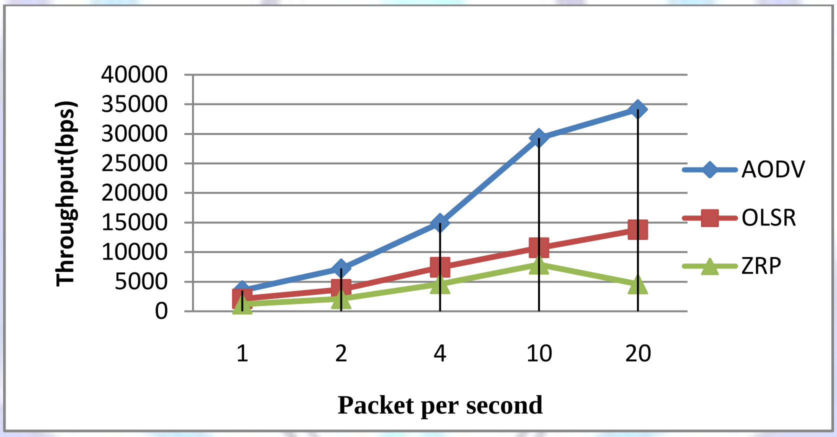

Fig 3: Throughput Vs Packet per Second

From Fig 3, it can be observed that ZRP has lowest throughput with increasing packet per second. AODV and OLSR have during the experiment increasing the throughput with packet per second.

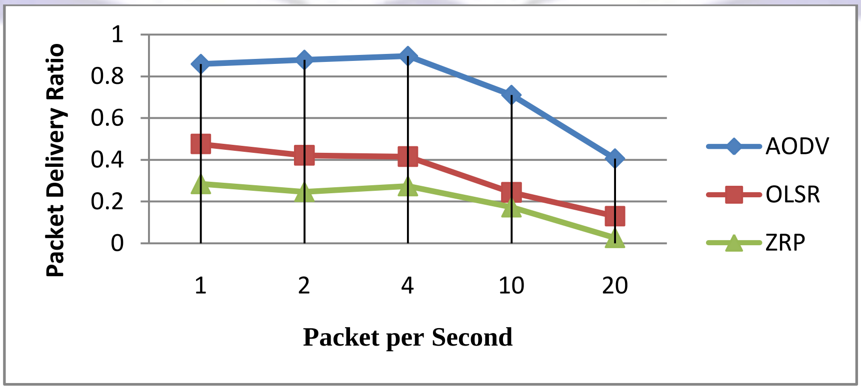

Fig 4: Packet Delivery ratio (PDR) Vs Packet per second

From Fig 4, it is observed that ZRP has lowest packet delivery ratio, performs worst, but AODV performs well among all. OLSR have PDR value between AODV and ZRP. OLSR shows decrease in PDR with increase in pause time.

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6. CONCLUSION

In this paper the performance of AODV, OLSR ZRP protocol is evaluated. With the help of simulation results we compared and varying data rate protocol with three important standard routing protocols AODV, OLSR and ZRP, under different network conditions. We measure the average jitter, average end-to-end delay, packet delivery ratio and throughput as performance metrics. Our simulation results show that ZRP has lower throughput, lower PDR than AODV and OLSR and makes himself out of the race. On the other hand the performance of AODV is better than others in the network condition. OLSR shows average performance in given network condition (better than ZRP). Over all we can say that AODV performs better under different network conditions.

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