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PERFORMANCE ANALYSIS AND ENERGY CONSUMPTION OF ROUTING PROTOCOL IN MANET USING GRID TOPOLOGY

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Abstract—- **An ad hoc wireless network consists of mobile networks which creates an underlying architecture for communication without the help of traditional fixed-position routers. Ad-hoc On-demand Distance Vector (AODV) is a routing protocol used for Mobile Ad hoc Network (MANET). Nevertheless, the architecture must maintain communication routes although the hosts are mobile and they have limited transmission range. There are different protocols for handling the routing in the mobile environment. Routing protocols used in fixed infrastructure networks cannot be efficiently used for mobile ad-hoc networks, so that MANET requires different protocols. This paper presents the performance analysis of the routing protocols used various parameter-patterns with Two-ray model.**

Key Words: AODV, Packet Transmission rate, Pause time, ZRP, QualNet 6.1*Index Terms*— Withania somnifera, Chemotypes, medicinal plant, seed germination; regenerative potentiality *(key words)*

I. INTRODUCTION

MANET is a decentralized, peer-to-peer wireless ad hoc network, capable of configuring itself. A MANET network uses Wi-Fi or satellite transmission to connect to other networks or devices. Each device in a MANET is capable to move independently in any direction and thus can change its links to other devices frequently. Each node must forward traffic unrelated to its own use, thus functioning as a router. While configuring a MANET the primary challenge is enabling each device, to continuously maintain the information required for proper routing of the traffic. These networks may operate on their own or may be connected to larger Internet. Previously Ad-hoc networks were mainly used for military applications. Now they have become increasingly more popular within the computing industry. Its applications include virtual classrooms, meetings, casual conferences, emergency search-and-rescue operations, and disaster relief operations, automated battlefield operation in hostile environments where construction of infrastructure is difficult or expensive.

In MANET there are mainly three types of unicast routing protocols: proactive routing protocols, reactive routing protocols and hybrid routing protocols. There are several proactive routing protocols available for Ad-hoc networks such as DSDV, OLSR, FSR, GSR, CGSR and IARP etc. There are also a variety of reactive routing protocols such as AODV, DSR, LAR, DYMO and IERP etc. ZRP and TORA are categorised as hybrid routing protocols. The goal is to carry out a symmetric performance study of AODV (1), OLSR, ZRP routing protocol for ad-hoc networks. The rest of the paper is organized as follows: Section-2 introduces Overview of Routing Protocols; Section-3 gives the Simulation Environment, Section-4 presents Simulation Results and Discussion and performance comparison graphs. Finally, Conclusion is presented in Section-5.

II. OVERVIEW OF ROUTING PROTOCOL

A MANET is a collection of mobile nodes that are dynamically and arbitrarily located. The interconnections between nodes are capable of changing on a continuous basis. In order to commence communication within the network a routing protocol needs to discover routes between the nodes. Correct and efficient route establishment between a pair of nodes is the primary goal of such an ad hoc network routing protocol for timely delivery of the massages. Also route establishment must be done with a minimum overhead and bandwidth consumption. There are various types of unicast routing protocols designed for ad hoc networks. Proactive routing or 'table driven' routing protocol 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. Reactive protocol or ‘on demand' routing protocol performs the routing process only when it is required. A route discovery is initiated by the node when no route is found. A Hybrid protocols has the benefits of proactive and reactive protocols both.

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

Ad-hoc on-demand Distance Vector Routing protocol [1,3] 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.

2.2 OLSR

OLSR is a proactive routing protocol (16), 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, The reducing the time interval for the control messages transmission can bring more reactivity to the topological changes.OLSR uses two kinds of the control messages: Hello and Topology Control. Hello messages are used for finding the information about the link status and the host's neighbors. With the Hello message the MPR Selector set is constructed which describes which neighbors has chosen this host to act as MPR and from this information the host can calculate its own set of 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 neighbors. 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 periodically 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 protocol is well suited for the application which does not allow the long DELAYs in the transmission of the data packets. The best working environment for OLSR protocol is a dense network, where the most communication is concentrated between a large number of nodes.OLSR has also extensions to allow for hosts to have multiple OLSR interface addresses and provide the external routing information giving the possibility for routing to the external addresses. Based on this information there is possibility to have hosts in the ad hoc network which can act as gateways to another possible network.

2.3 ZRP

Zone Routing Protocol (ZRP) [4, 6], is an example of a hybrid reactive/proactive routing protocol. It was first proposed by Haas in 1997. It has the benefits of a proactive route discovery inside node's limited neighbourhood while a reactive protocol for interaction among neighbourhoods. The Broadcast Resolution Protocol (BRP) [18] forwards the route request. ZRP partitions the complete network into several zones. Due to overlapping of these zones ZRP is also considered as a flat protocol. Network congestion is reduced and optimal routes are detected with the use of these overlapping zones. Peripheral nodes are nodes with minimum distance, which is equal to the zone radius.

ZRP has two functional components IARP (Intrazone Routing Protocol) & IERP (Interzone Routing Protocol). IARP [17] is function as the proactive component and requires Neighbour Discovery Protocol while IERP works as the reactive component of ZRP. Hello messages identify the link failures and ensure that neighbours are present. IERP is triggered if IARP is unable to locate the destination, i.e., the destination is outside node's zone. With correct zone size control traffic can be reduced to a minimum. Thus ZRP achieves a better performance. On one hand, ZRP limits the scope of the proactive procedure only to the node's local neighbourhood while on the other, the search throughout the network is global in nature. That is done by efficiently querying selected nodes in the network, instead of querying all the network nodes.

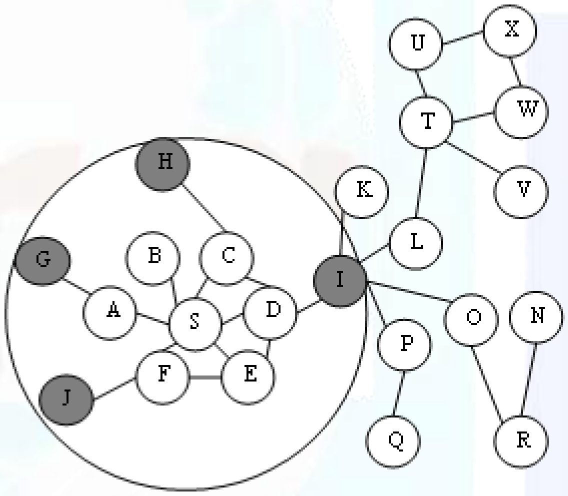

Figure 1: ZRP

The above example shows the source node S which sends packet to destination i.e. node X. This diagram has zone radius r=2. To check whether destination is within its zone, the node uses the routing table offered by IARP because if not found then route request is issued by IERP. Request is broadcasted to peripheral nodes represented gray in fig 1.

There is a significant reduction in communication overhead and delay in this routing protocol as compared to proactive approaches. ZRP appears to be disadvantageous when the zone radius is less. Normally it performs in a proactive manner but for reduced values it acts in a reactive manner; hence the complexity of ZRP is high.

III. SIMULATION ENVIRONMENT

A. RWP (Random Waypoint) Mobility Model

Mobility models represent the movement of mobile users, and how their location, velocity and acceleration change over time. Such models are frequently used for simulation purposes when new communication or navigation techniques are investigated.

The random waypoint model [9] is commonly used mobility model for the simulation of ad hoc networks. It is a random-based mobility model which describes the pattern of mobile users, and how their location, velocity and acceleration changes with time. In this model, the node selects an arbitrary position & moves towards it in a straight line with a constant speed that is randomly selected from a range, and pauses at that destination. The node continues this, throughout the simulation.

Simulations had carried out on QualNet version 6.1 [5] 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 nine CBR applications. Simulation parameters are shown in table 1 and simulation results are shown in figures from 2 to 5. With the help of simulation results we had analyzed Average Jitter, Packet delivery ratio, Throughput, and End-to-End delay for the given protocol.

B. Performance metrics

(A) Jitter

Jitter is defined as the difference in end-to-end delay between selected packets in a flow with any lost packets being ignored. Lower figure of jitter shows better performance.

(B) Average end to end delay

The end-to-end delay is defined as time between the point in time the source want to send a packet and the moment the packet reaches it destination. It includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times.

Average end to end Delay =

Σ T (destination receives packet) – T (source wants to sent packet) / Number of Packets

(C) Packet Delivery Fraction (PDF)

The packet delivery ratio in this simulation is defined as the ratio between the number of packets sent by constant bit rate sources and the number of packets received by the CBR sink at destination.

(PDF) = CBR packets received by CBR sinks / CBR packets sent by CBR sources

(D) 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).

Table:1 Network Condition

Area	**1500x1500 m^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	**2.4 Ghz**
Mobility	**Random way point**
Mobility Speed	**Min =0mps, max =20mps**
Pause time	**(10,30,40,60,90sec), 20sec**
Packet rate	**5 packet/sec,(1, 2, 4, 10, 20)**
Data size	**512 byte**
MAC Protocol	**802.11**
Physical Layer	**802.11b**

IV. Simulation Results And Discussion

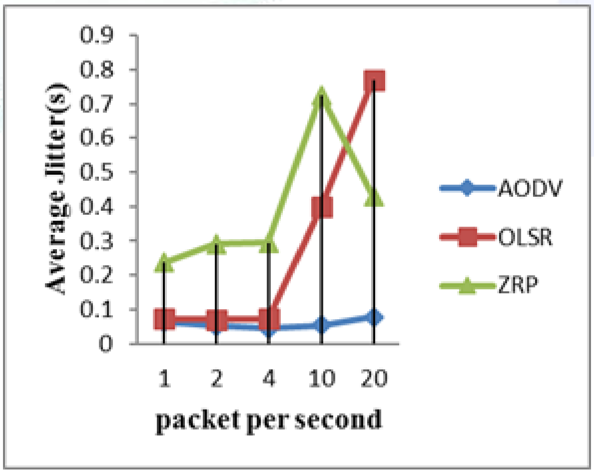

Figure 2: Average Jitter Vs Packet per Second

Fig 2 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

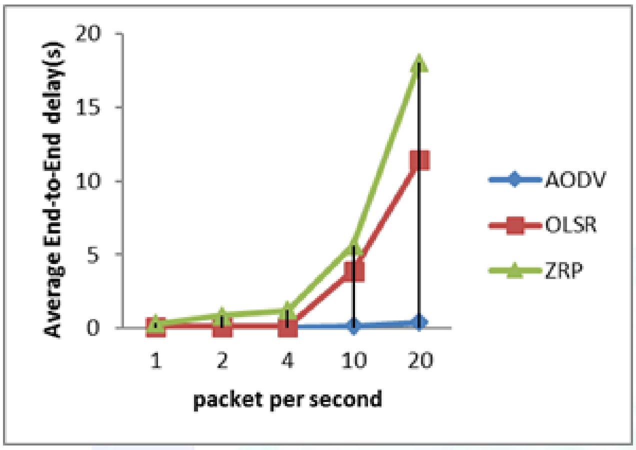

Figure 3: Average End-To-end Delay Vs Packet Per second

From Fig 3, 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.

Figure 4 Throughput Vs Packet per Second

From Fig 4, 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.

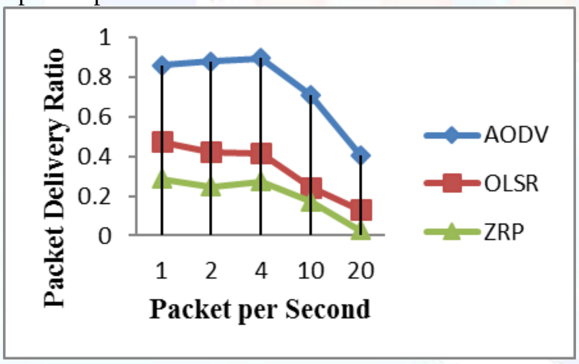

Figure 5: Packet Delivery ratio (PDR) Vs Packet per second

From Fig 5, 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.

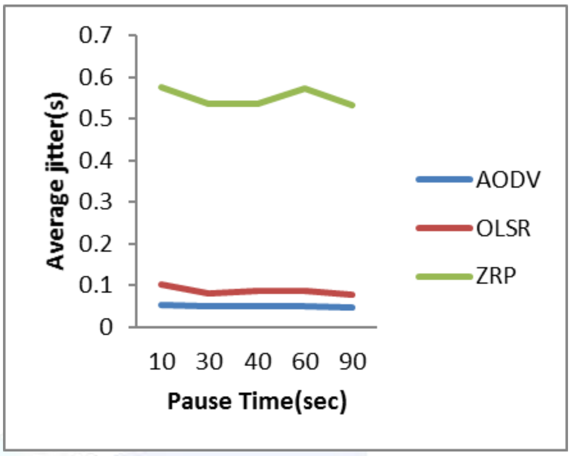

Figure 6: Average Jitter Vs Pause time

In Fig. 6, average jitter is shown against different pause times; jitter is not changing too frequently and in the two-ray model for the AODV has lower average jitter and have almost constant value than OLSR and ZRP.

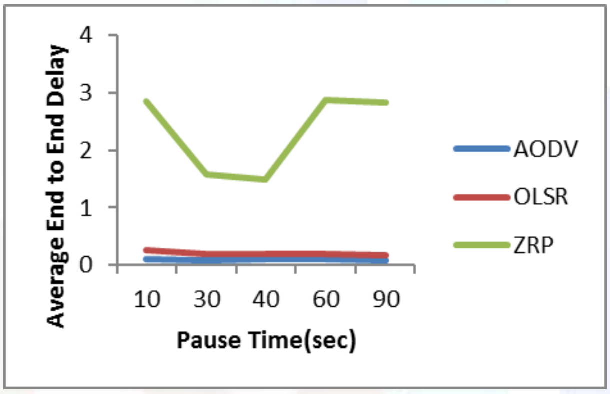

Figure 7: Average End-To-end Delay Vs Pause time

In fig 7, average end to end delay is shown against different pause times, in the two-ray model for the AODV has lower end to delay average delay and have almost constant value than OLSR and ZRP. When we increases the pause time above the 40 second, average end to end delay for ZRP increases and gives the lower performance than other Protocols.

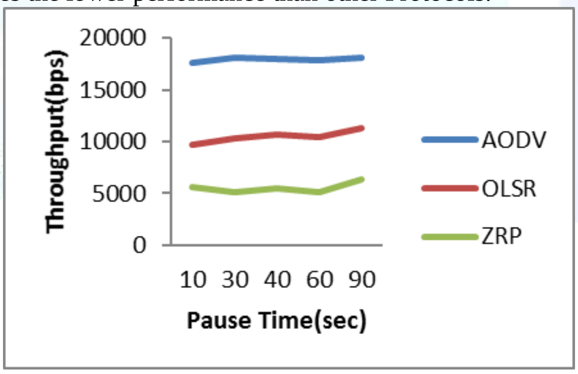

Figure 8: Throughput Vs Pause time

In fig 8, throughput is shown against different pause times; in the two-ray model for the AODV has higher throughput. When we increase the pause time at regular interval, AODV performs better than other OLSR and ZRP.

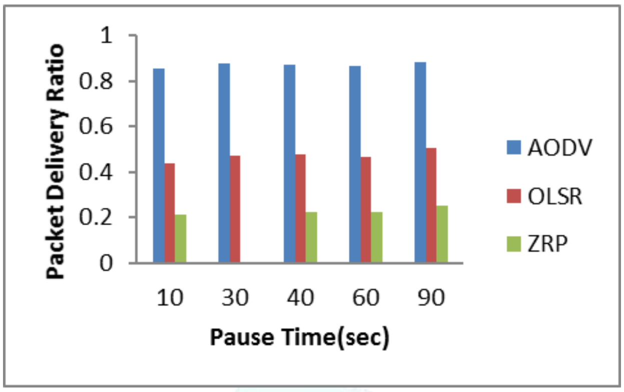

Figure 9: Packet Delivery ratio (PDR) Vs Pause time

In figure 9, packet delivery ratio versus pause time of AODV is maximum as compared to OLSR and ZRP.

A. ENERGY CONSUMPTION OF ROUTING PROTOCOLS

1) TRANSMIT MODE ENERGY CONSUMPTION VS PACKET RATE

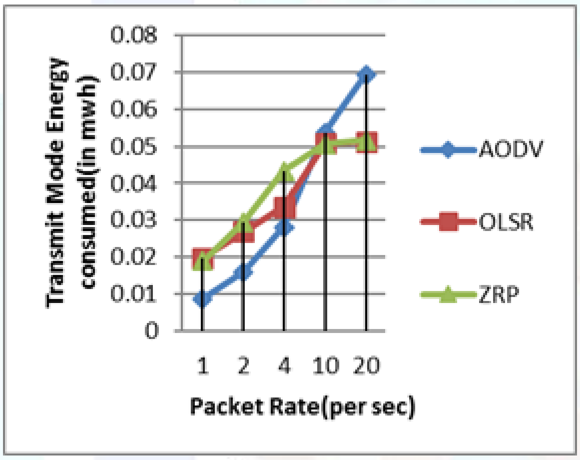

Figure 10: Transmit mode energy consumed Vs Packet rate

From Figure 10, in a Transmit mode it is observed that OLSR has consumed minimum energy, as packet rate increases AODV consumed more energy than other routing protocols. But at certain time interval when packet rate increases above upto 10 packets per second, OLSR and ZRP consumed slightly equal energy.

2) RECEIVED MODE ENERGY CONSUMPTION VS PACKET RATE

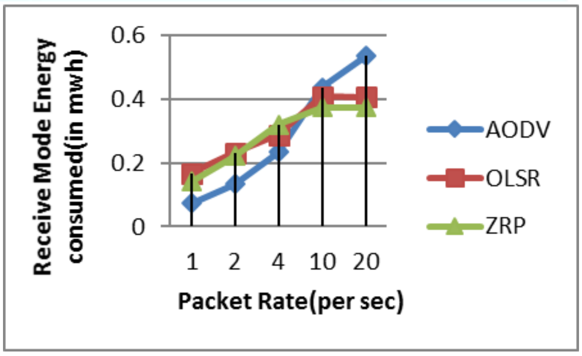

Figure 11: Receive mode energy consumed Vs Packet rate

From Fig 11, in a receive mode it has been seen that ZRP has consumed minimum energy than the other routing protocols. But at certain time interval when packet rate increases above upto 10 packets per second then energy consumption for OLSR is 0.4mwh and below this value for ZRP. Overall Energy consumption for AODV is greater than the other routing protocols.

3) IDLE MODE ENERGY CONSUMPTION VS PACKET RATE

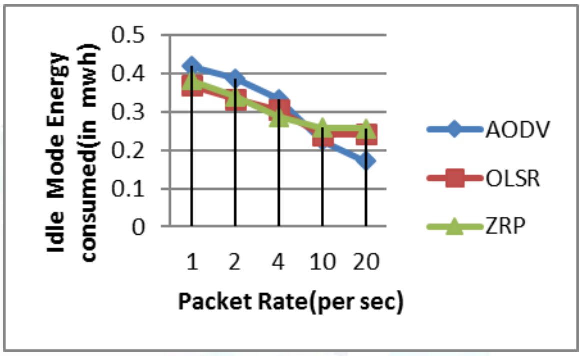

Figure 12: Idle mode energy consumed Vs Packet Rate

From Fig 12, in an idle mode it is observed that as the packet rate increases then the energy consumption of protocols decreases. In an idle mode AODV has consumed minimum energy. But at certain time interval when packet rate increases above 10 packets per second, OLSR and ZRP consumed slightly equal energy and it becomes linear.

V. 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 and pause time 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. Energy consumption of OLSR and ZRP in transmit and receive mode is slightly equal at certain packet rate

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