Analysis of Various Routing Protocols using Omni Directional Antenna in Qual-Net 6.1

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Abstract— Mobile Ad Hoc Networks are formed by devices that are able to communicate with each other using a wireless physical medium without having a route to a preexisting network infrastructure. Omni directional antenna plays a vital role. Omni directional antenna has many advantages such as increased transmission range, higher gain and reduced interference. Omni directional antenna uses a set of elements which has fixed beam nature and radiate the frequency in all directions and also at a specific angle. In this paper we analyse the performance of different Omni directional antennas for different routing protocols such as AODV, OLSR and ZRP. We evaluate analysis based performance comparison of different pause time duration in second The performance analysis is based on different metrics of the application layer such as average jitter, average end to end delay and the basis of physical layer metrics such as power consumed in transmit, receive and idle mode using Qual-Net 6.1.

Key words: Qual-Net6.1, MANET, AODV, OLSR, ZRP, Omni Directional Antenna, Pause Time

I. INTRODUCTION

Omni directional antenna [6] is a class of antenna which radiates area of coverage wave power uniformly in all directions in one plane with these features Omni directional antenna has been used in mobile ad hoc network. MANET is a network without infrastructure. Mobile ad hoc network has a new structure in the field of communication network. They do not require any fixed infrastructure for instance a base station to work. The nodes change address topology themselves due to the mobility, the entrance or exit of nodes. These nodes use a radio medium [5] [11]. In the infrastructure less networks the nodes can freely move within the range but in an infrastructure mode all the nodes are stationary. Due to the mobility of nodes and increasing number of nodes/users, the transformation of information will consume most of the bandwidth. To transmit the data [5] from one node to another node we use different types of protocols such as reactive, proactive and hybrid.

This paper is organized as follows: part II presents the related work done so far. Part III presents the description of routing protocols. Part IV represents the classification of omnidirectional antenna. Part V represents the method which is used. Part VI shows the Result and Discussion.

II. RELATED WORK

The Omni directional antenna offers the many benefit such as increases the spatial reuse, coverage range and network capacity. But it also increases the hidden terminal problems and the deafness problems. In this paper, author propose a MAC protocol with directional antenna in which proposed algorithm is based in a circular directional RTS (ready to send) and scans the area around the transmitter and informing the neighbours for the communication. Through the use of this technique, the hidden terminal problem is strongly decreases [10].The author propose the use of directional antenna for improving the efficiency of on-demand protocols and introduce the technique for saving the wireless bandwidth in the on demand routing and shows how the directional antenna can be effectively used to estimate the direction of a destination node from the source node and restrict the search for a new route with in the vicinity of the estimated direction [1]

Higher throughput gain and prolonged life time can be achieved for MANET with nodes equipped with directional antenna. The author represent the power control scheme for directional MAC protocols and derived the temporal transmission power correlation between the MAC protocols packets (RTS/CTS/DATA/ACK) for successful communication and avoid the hidden terminal problems, deafness and side lobe interference. The simulation results show that the power control scheme is sufficient and efficient in terms of throughput and energy consumption. [8]

III. ROUTING PROTOCOLS

A. Ad Hoc On Demand Distance Vector Routing Protocol (AODV):

This protocol is specially used for mobile ad hoc networks and provides a quick adaptation to dynamic link condition, link fault, low processing and memory usage overhead [12]. 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. It supports both IPv4 and IPv6. When a node i.e. source node is ready for communication and does not have a valid route to the destination then it performs two operations namely, route discovery and route maintenance [7].

1) Route Discovery:

As the name suggest, to transmit the data a new route is discovered. To find a new route, AODV proceeds by broadcasting the route request (RREQ) packet. If the neighbouring nodes which receives the RREQ has no route information regarding the destination, it will continue to broadcast RREQ packet in the network. Once the destination is found, it will send an answer key by the route reply (RREP) packet to the sender from which RREQ is received. When the RREP is received at the source node, the path is established. RREQ contains source address, source sequence number, broadcast id, destination address, destination sequence number and hop count [7].

2) Route Maintenance:

It is the next step which is followed by the AODV protocol after route discovery. In this step it finds the error which comes during transmission like if the two nodes that were listed as neighbour on the route moved out of the range of each other and link is broken [7] and then source node is informed with a ROUTE ERROR packet and then again route discovery mechanism is used to find a route.

B. Optimized Link State Routing Protocol (OLSR):

The OLSR protocol is an optimization of classical link state routing protocols that lessen the number of control packet transmissions as well as the size of control packets required. OLSR uses the concept of Multipoint Relays (MPR) to reduce the control traffic overhead. A node's one-hop neighbour is known as an MPR is this has been chosen for forwarding packets. In OLSR the packets are forwarded by a node's MPRs, hence avoiding the use of pure flooding. For the purpose of routing OLSR selects bidirectional links, so that the process of packet transfer over single directional links can be avoided. Each node m selects, independently from the neighbour nodes, a minimal (or near minimal) set of MPR nodes, denoted as MPR (m), among its one-hop neighbours. The nodes in MPR (m) have some interesting property like: every node in symmetric two hops neigh bour hood of m must have a symmetric link towards MPR (m). In other words, the combination of the one-hop neighbour set of MPR (m) contains the entire two-hop neighbour. The MPR sets allowing flooding to be explained efficiently: when a node m wants to flood a message, it sends that message only to the nodes in MPR(i), which in turn send this message to their MPR nodes and so on.

The MPR selector set of a node n is consists of the set of neighbours which have selected the node n as MPR. Each node in the route regularly floods its MPR selector set, using the flooding technique and a special type of control message known as Topology Control (TC) message. With the help of TC message a node declare that it has approach to the nodes of its MPR selector set in other words it is its last hop node. A sequence number is also added with TC message this is incremented when any change occurs in the set of MPR selector.

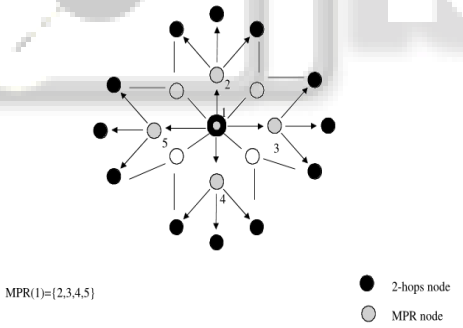

Fig. 1: Flooding using MPR nodes.

OLSR broadcast two types of control messages: Hello and Topology Control (TC) message. Using Hello messages the information about the link status and neighbour nodes have been found. While TC messages are used for broadcasting information about own advertised neighbours include at least the MPR selector list [2].

C. Zone Routing Protocol (ZRP):

Zone routing protocol (ZRP) combines the advantages of both reactive and pro-active protocols into a hybrid scheme, taking advantages of pro-active discovery within a node's local neighbourhood, and using a reactive protocol for communication between these neighbourhoods. In a wireless ad hoc network, it can safely be assumed that the most communication takes place between nodes close to each other [3]. The ZRP is not so much a distinct protocol as it provides a framework for other protocols. A source node transmits data packet using link state information if a destination is within its r-hop zone otherwise starts route discovery procedure for the destination in the network. After discovery of a path for the destination, the source node transmits data packets to the destination. Knowledge of the routing zone topology is leveraged by the ZRP to improve the efficiency of a globally reactive route query/reply mechanism. The proactive maintenance of routing zone also helps improve the quality of discovered routes, by making them more robust to changes in network topology. The ZRP can be configured for a particular network by proper selection of a single parameter, the routing zone radius [4].

IV. CLASSIFICATION OF ANTENNAS

A. Omni Directional:

An Omni directional antenna is used to avoid the co-channel interference. It is a device which radiates/receives the electromagnetic energy in all directions. Direction antenna is also known as smart antenna that consists of number of radiating elements as well as control unit which is implemented by the digital signal processor. When a network is closely packed with a large number of nodes then the transmission range of each node is collapsed with others. Due to this collapsing of range, nodes face the co-channel interference during transmission. The number of packet drops increases and hence the network performance decreases. Routing algorithms of Omni directional antennas and fixed transmission power have an upper bound to the number of intermediate hops between a pair of source and destination. To overcome this problem the Omni directional antenna focus the beam at narrow angles and radiate the energy in all direction [6] [5].

V. SIMULATION SETUP

A. Simulation Scenario:

In this paper we used the Qual-Net 6.1 simulator [5] which is developed by the Scalable Network Technologies. In this paper we use the terrain size 1500X1500 m^2, number of nodes is 60, CBR of packet size is 1024, the simulation time is 300 sec, MAC protocol 802.11, mobility model is random way point. It analyses the performance of AODV, OLSR and ZRP protocols using Omni directional antenna

Simulator	Qual-Net 6.1
Number Of Nodes	60
Traffic Resources	Constant Bit Rate
Link	Wireless
Item To Send	1024bytes
Radio Type	802.11b
Antenna Model	Omni Directional
Routing Protocols	AODV, OLSR, ZRP
Simulation Time	300sec
Mobility	Random Way Point
Pause Time	10,20,30,40,50 seconds
Minimum speed	0
Maximum speed	3,6,9,12,15mps
Terrain Size	1500*1500m^2
Channel Frequency	2.4 GHz

Table 1: show the parameter table and fig 1 shows the snapshot scenario of wireless network

B. Simulation Scenario:

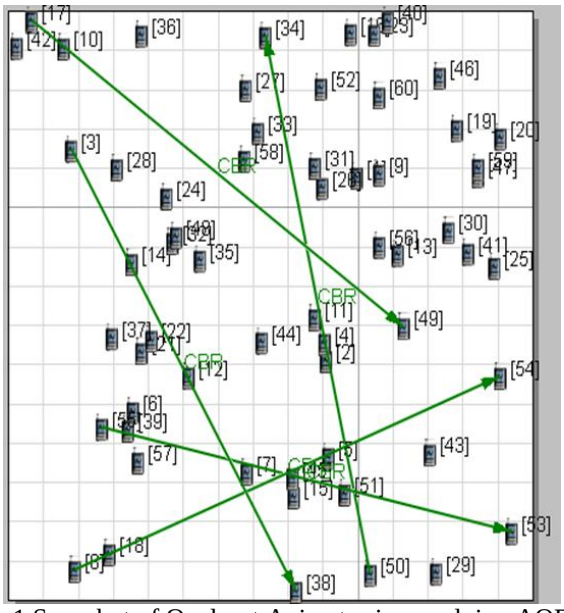

Fig.1 Snapshot of Qual-net Animator in applying AODV routing protocol using 60 nodes

VI. Result and Discussion

A. Jitter-

Jitter is defined as the difference between the ideal time on which the packet should receive and the actual time on which it is received.

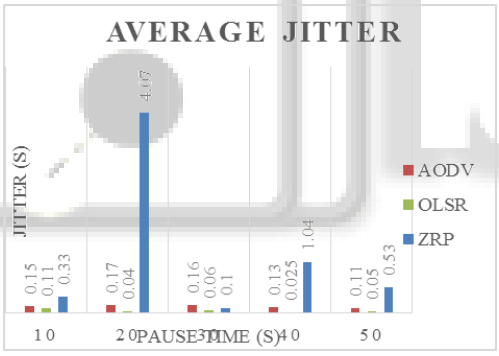

Fig. 2: Graph

In the simulation results if is evident that OLSR gives better jitter than that of AODV and ZRP.

B. End To End Delay

It is defined as the total time taken by a packet from sender to receiver.

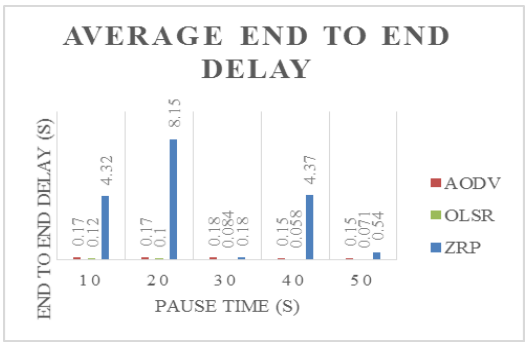

Fig. 3: Graph

In the case of end to end delay again OLSR out performs the ZRP but AODV and OLSR both have almost some end to end delay.

C. Throughput

Throughput is the rate of successful message deliver over a communication channel.

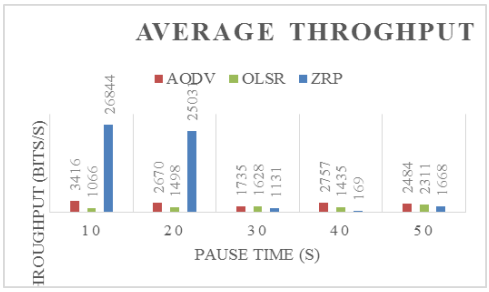

Fig. 4: Graph

In throughput ZRP have maximum throughput than OLSR, AODV when pause time is 10 and 20s.But as pause time increases (10, 20, 30, 40, 50 seconds) it drastically reduces which is evident from the graph.

VII. Conclusion

In this paper for routing protocols (AODV, OLSR, ZRP) are compared using Omni directional antenna from the graphs it is clearly evident that OLSR is better in case of end to end delay and jitter but in case of throughput ZRP is best it gives very high throughput values in pause time 10 and 20s but it is significantly less on 30, 40, 50 seconds as compared to other two protocol the graphical representation of comparison between different protocol (AODV, OLSR,ZRP) During simulation we analyse different parameters such as Throughput, Average jitter, and End to End delay for physical layer and Energy consumed in Transmit, receive and Idle mod for application layer.

References

[1] AsisNasipurietal; "On-Demand Routing Using Directional Antennas in Mobile Ad Hoc Networks", IEEE, pp-535-541, 2000.

[2] Jatin Gupta, Amandeep Verma,"Exhaustive Study on the Infulence of Hello Packets in OLSR Routing Protocol", International Journal of Information

[3] SubramanyaBhat.M, Shwetha.D, Devaraju.J.T, "A performance study of proactive, reactive and hybrid routing protocols using qualnet simulator", International Journal of Computer Applications (0975 – 8887) volume 28– No.5, august 2011.

[4] Mukesh Kumar Garg, DharamVir, Dr. S.K. Agarwal, "Simulation analysis of AODV, DSR and ZRP routing protocols in manet using qualnet 5.0 simulator",International journal of scientific and research publications, ISSN 2250-3153,volume 3, issue 3, March 2013

[5] Royer, E., and Chai-Keong, "A review of current routing protocols for ad hoc mobile wireless networks", IEEE Personal Communications 6, 2 (Apr 1999), 46-55.

[6] Hongning Dai and Kam-Wing Ng, Min-You Wu "An Overview of MAC Protocols with Directional Antennas in Wireless ad hoc Networks", IEEE, 2006.

[7] Elizabethm, Royer, Chai-keongToh "A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks" IEEE Personal Communications, pp. 46-55, April 1999.
[8] BasselAlawieh, Chadi Assi, WessamAjib "A Power Control Scheme for Directional MAC Protocols in MANET" IEEE, pp. 258-263, 2007.
[9] "QualNet simulator version 6.1" scalable network technology, www.scalable- network.com.
[10] ThanasisKorakis, Gentian Jakllari, LeandrosTassiulas "A MAC protocol for full exploitation of Directional Antennas in Ad-hoc Wireless Networks", Proc. of the 4th ACM international symposium on Mobile ad hoc networking & computing, pp.98-107, june 2003.
[11] Dharamvir, Dr S.K. Agarwal, Dr.S.A.Imam, "Simulation of energy consumption analysis of multi-hop 802.11 wireless ad-hoc networks on reactive routing protocols", IJERA, ISSN: 2248-9622, Vol. 3, Issue 1, pp.1213-1218, January -February 2013.
[12] "QualNet simulator model library" scalable network technology, www.scalable-network.com
[13] Charles E. Perkins, Elizabeth M. Royer "Ad-hoc On-Demand Distance Vector Routing", Proceedings of the 2nd IEEE Workshop on Mobile Computing Systems and Applications, New Orleans, LA, February 1999, pp. 90-100.

