DOI: https://doi.org/10.24113/ijoscience.v3i10.16

Impact Analysis of Transmission Range on AODV, DYMO and ZRP Routing Protocol on QoS Issues in WiMax

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***Abstract* - WIMAX (World Wide Interoperability for Microwave Access) is used to provide a wireless solution in the metropolitan area networks. WIMAX network is capable of wide range coverage, high data rates, secured transmission and mobility supported at vehicular speed. Mobile WIMAX is one of the best concepts for system designed in fixed wireless access to provide good performance and cost effective solution. In this paper, performance of the WIMAX network is analyzed in terms of throughput, end to end delay, and jitter. Simulation is carried out using QUALNET simulator. In this paper AODV, DYMO and ZRP routing protocols are applied to the created mobility scenario with variable transmission range. AODV and DYMO shows low jitter and low end to end delay. It is concluded that AODV and DYMO gives optimized result below 40dbm transmission range with respect to throughput and ZRP shows high throughput above 40dbm transmission range.**

Keywords - WIMAX, AODV, DYMO, ZRP, Random Waypoint Mobility, QoS Metrics.

I. INTRODUCTION

The recent eVolution of ad hoc wireless techNologies has allowed to construct spontaneous connections among mobile devices without any infrastructure [1, 2]. Mobile Ad hoc Network consists of mobile Node which move around arbitrarily, Nodes may join and leave at any time, and the resulting topology is constantly changing. Moreover, with the emergence of sensor-enabled smart mobile devices, Mobile Ad hoc Network have become an essential component in the infrastructure of Smart City and Internet of Things (IoT) scenarios because people with smart devices can freely and dynamically form a self-configuring Mobile Ad hoc Network to send, receive and share data in a restricted zone [3].

802.16 is designed to provide a cost effective last mile broadband access. WIMAX is the newest example of broadband wireless networks that has been used lately to provide multimedia applications over large areas, but it is still in its fancy and requires more research on evaluating its performance while processing multimedia and other application. The development of wireless mobile techNologies and real time multimedia applications provide reason for the introduction of QoS in wireless ad hoc networks. QoS is concerned with guarantee of providing an assured grade of quality from the network. QoS parameters vary according to the applications. In case of real time traffic, delay is a key parameter and other parameters like average jitter, throughput are also important. The routing protocol must select the optimal route between pairs of source–destination Nodes in terms of QoS metrics such as available link bandwidth, average end-to-end delay and average jitter.

For high quality of service, network should show low jitter, low delay and high throughput and high packet reception at destination. Routing is the process of selecting a path for traffic. It is necessary to select optimized path in a network.

It will going to play major role in studying the performance of wireless networks. When coming to protocol No protocols perform well in all kind of scenario.

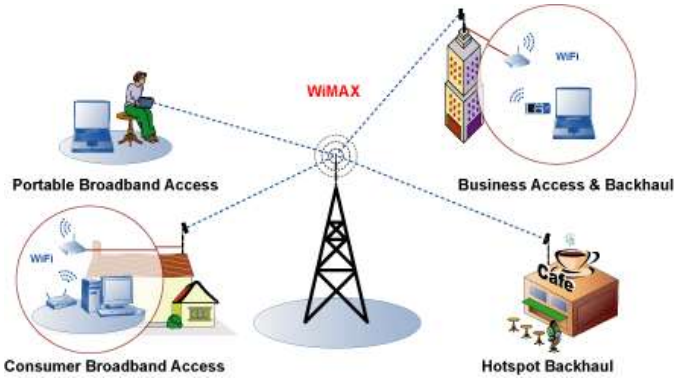

Figure 1:Wimax Environment

In this paper we have applied AODV, ZRP, and DYMO for the WIMAX network under varying transmission range to get the best performance of WIMAX. To represent the movement of a mobile Node, we use mobility models that indicate how mobile station's position and its velocity change over time. It will going to play major role in studying the performance of wireless networks.

II. RELATED WORK

WiMAX Network performance for CBR traffic in three different Mobility models and four different Energy Models have been analyzed [1]. This [2] paper analyses Bit Error Rate for WIMAX based COFDM system with BPSK under various channel conditions like AWGN, Rayleigh, Rician and Nakagami. Further, Rayleigh and Rician channels are investigated in detail. It has been observed that performance of Nakagami fading channel is better than other fading channels. Mobile WiMAX [3] is based on orthogonal frequency division multiplexing/ orthogonal frequency division multiplexing Access (OFDM/OFDMA) techNology. It supports Adaptive Modulation and Coding in both downlink and uplink with variable packet size. This paper presents a new form of Adaptive Modulation (AM), which has the ability to improve the data rate of Mobile WiMAX OFDMA system especially at low SNR values, this new form of AM will combine together with the simplest Peak to Average Power ratio (PAPR) reduction technique, which is the clipping to produce a Novel algorithm called Modulation adaptation and Clipping algorithm (MC) has the ability to improve the performance of Mobile WiMAX system through reducing the PAPR, improving the SER performance, and increasing the data rate.

In [4] paper AODV, DYMO, ZRP routing protocols are applied to the created mobility scenario. DYMO shows best packet reception, highest throughput, low jitter and low end to end delay. We can say DYMO showed best performance out of AODV, ZRP. Later we have compared WIMAX scenario having mobility and having No mobility by applying DYMO Protocol which we have got under experimentation in terms of best performance. WIMAX scenario having No mobility shows the highest packet reception, high through put, low jitter and low end to end delay compared to the WIMAX scenario having mobility.

III. ROUTING PROTOCOLS IN MANET

According to the underlying network, three types: data-centric, hierarchical and location based as described below:

A. Routing protocols based on functions:

Proactive: A routing table is generated at each Node, so that routing information is kept for every Node in the network. Routing information is periodically updated [5, 6].
Reactive: No routing table is generated and route discovery is done as needed or on an on-demand basis. The route information is kept for future reference.
Hybrid: Combines the characteristics of proactive and reactive routing. Furthermore, hybrid routing protocol is powerful in reducing the cost of the network. It first computes all routes and then improves the routes at the time of routing [7].

B. Routing protocols based on participation style of Nodes

Direct: Allows Nodes to send information directly to base station/s[8-10].
Flat: If any Node needs to send data, primarily it will find a valid route to the base station and then forward it [8].
Clustering: The whole area is divided into a number of small clusters then each cluster will have a cluster head (CH) and only this cluster head will directly communicate with the base station [10].

On the basis of above three categories some important protocols are AODV, DYMO,ZRP each one of them have specific quality in different aspects of routing.
AODV: It is Ad-hoc on Demand Distance Vector Routing protocol [9-11] it comes under reactive protocol and based on distance vector algorithm. This algorithm uses different messages to discover and maintain links among Nodes, means whenever any Node want to communicate or send data packets to other specific Node then it first find out all possible routes, it send route request to all neighbor route and all Node will reply with specific message to source Node. When any Node send route request (RREQ) to all other Nodes, the sender Node will maintain all ackNowledged messages from other requested Nodes which helps to find route for the destination Node as well as it indicate that all Nodes are alive. If any other Node Not giving ackNowledgment to the sender's request (request response: RREP) then sender Node will remove that link as well as entry of that Node from routing table.
DYMO: DYMO is a purely reactive protocol within which routes are computed on demand i.e. as and once needed. Not like AODV, DYMO doesn't support unessential salutation messages and operation is solely supported sequence

varieties assigned to all or any the packets. It's a reactive routing protocol that computes unicast routes on demand or once needed. It employs sequence numbers to make sure loop freedom. It permits on demand, multi-hop unicast routing among the Nodes during a mobile ad hoc network [12]. The fundamental operations are route discovery and maintenance. Route discovery is performed at supply Node to a destination that it doesn't have a legitimate path. And route maintenance is performed to avoid the prevailing destroyed routes from the routing table and conjointly to reduce the packet dropping just in case of any route break or Node failure [13].

ZRP: Zone Routing Protocol [12] is suitable for big range of MANETs, significantly for the networks with large coverage and numerous mobility patterns. Within this protocol, every Node pro-actively maintains routes with a neighborhood region, which is thought as routing zone. Route creation is performed by employing a query-reply mechanism. For creating completely different zones inside network, a Node first has got to recognize who its neighbours are. A neighbour suggests that a Node with whom direct communication is sometimes established, that is among one hop transmission array of a Node. Neighbour discovery facts are used as being a basis for Intra-zone Routing Protocol (IARP), which might be described in more detail in [12]. As an alternative to blind broadcasting, ZRP runs on the query control mechanism to cut back route query traffic by guiding query messages outward from your query source and far from covered routing zones. A covered Node is basically a Node that belongs to the routing zone of any Node that has received a route query. Throughout the forwarding with the query packet, a Node identifies be it via its neighbour or Not. If yes, then it marks most of its familiar neighbouring Nodes within the same zone as covered. Thus query is relayed until it reaches its final destination. The destination successively sends back a response message through the reverse path and helps to create the path.

IV. METHODOLOGY

The overall goal of this work was to measure and compare the QoS metrics of the three analyzed routing protocols i.e. AODV, DYMO and ZRP. Our basic methodology consists of first selecting the most representative parameters for a MANET, then defining and simulating a basic scenario and finally, by varying the selected parameters, simulate and evaluate more cases of varying time duration. The selected parameters were: (1) the routing protocols, (2) transmission Range. All the traffic sources used in our simulations generated CBR data traffic. The traffic structure was defined as the basic scenario with 30 mobile Nodes spread randomly over an area of 1500m^2. We evaluated the following performance indexes under Random Waypoint Mobility model: (a) Throughput, (b) Average End to End Delay, (c) Jitter.

V. SIMULATION SETUP & RESULT ANALYSIS

Aim of this study is to analyze the performance i.e. End to End Delay, Average Jitter and Throughput by the AODV, DYMO and ZRP routing protocols varying transmission range. The simulations have been performed by using QualNet 5.0.2 simulator [13]. The simulation has been carried out using following parameters as described in Table I.

Table I: Parameters Considered for Simulation

S. No.	Parameters	Values
1	Simulator	Qualnet 5.0.
2	Terrain	1500*1500m
3	No. of Nodes	11
4	Radio Type	802.16
5	Traffic Source	CBR
6	CBR Links	5
7	Mobility Model	Random Way Point
8	Traffic Source	CBR
9	CBR Links	13
10	Routing Protocols	AODV, DSR, DYMO
11	Transmission Range	15dbm
12	Node Speed	Min=1m/s, Max=10m/s
13	Performance Matrix in Application Layer	Throughput, Average Jitter, End to End Delay

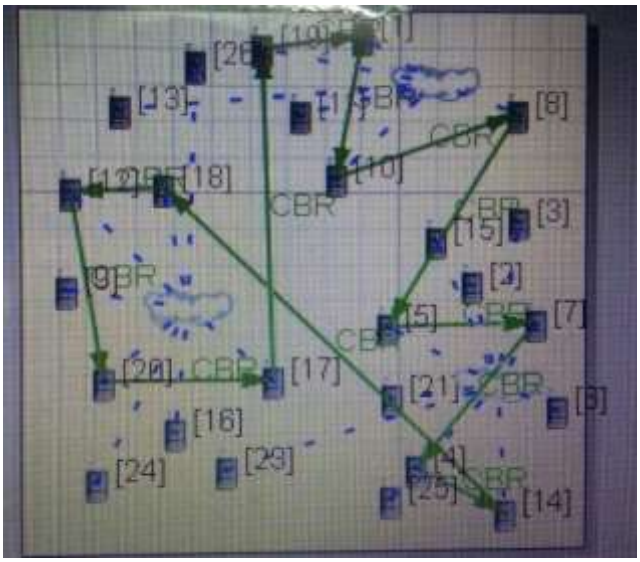

Figure 2: Simulation Scenario

A. End to End Delay

End to end delay stands for the holdup encountered between data packet transmission and reception. Buffering, queuing, propagation, transmission and re-transmission of packets are possible cause of end-to-end delay. Average end-to-end delay is obtained when total time duration for each

individual packet transmission is divided over the total number of packets received. The unit of average end-to-end delay is seconds(s).

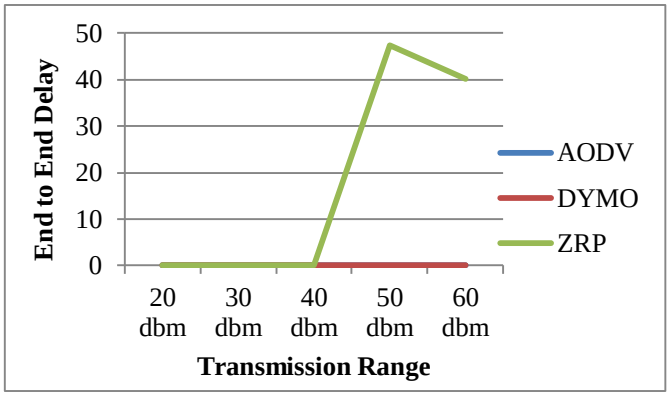

Figure 1: Average End-to-End Delay

End to End delay of AODV and DYMO shows less compare to ZRP. So it is concluded that as the transmission range increases in WiMax environment after 40dbm End to End delay increases in ZRP routing protocol.

B. Throughput

Throughput is one of the dimensional constraint of the system which gives the ratio of the channel capacity utilized for useful transmission. It represents the number of packets received within a given time interval. Hence, it is the average rate of successful information delivery over a communication channel. Throughput is expressed as bytes or bits per second (byte/s or bit/s).

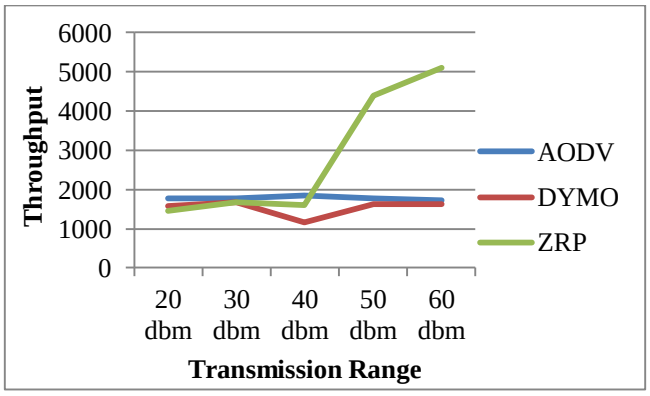

Figure 2: Throughput

Throughput of ZRP shows more as compared to AODV AND DYMO. So it is concluded that as the transmission range increases in WiMax environment after 40dbm Throughput increases.

C. Average Jitter

Jitter signifies any unwanted variation in one or more signals generated during packet transfer due to network congestion, improper queuing or configuration errors. The unit for jitter is seconds.

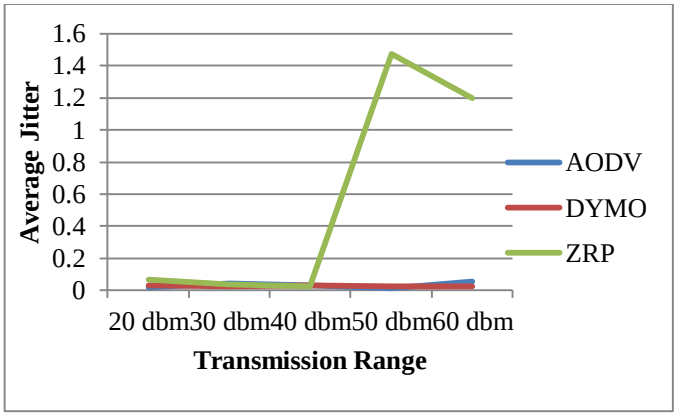

Figure 3: Average Jitter

Jitter of DYMO and AODV shows less compare to ZRP. So we can say DYMO gives the best performance over ZRP and AODV protocol. As the transmission range increases ZRP jitter increases. So, it is concluded that in WiMax scenario AODV and DYMO gives optimized result.

VI. CONCLUSION

This work presents a comparative analysis of three MANET routing protocols i.e. AODV (Ad Hoc On Demand Distance Vector), DYMO (Dynamic MANET On-demand Protocol) and ZRP (Zone Routing Protocol) under mobility model with varying transmission range for significant performance metrics. From the observations and results obtained, it is concluded that AODV and DYMO performs well with respect to End to End Delay and Average Jitter for MANET Nodes but ZRP gives high throughput in varying transmission range scenario. This means that AODV and DYMO Protocol is the ideal choice for communication under 40dbm transmission range. The future scope is the extensive comparisons between the other routing protocols. It would be significant to consider other metrics like bandwidth, fault tolerance, congestion control of packets, energy, etc.

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