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DESIGN AND PERFORMANCE ANALYSIS OF ROUTING PROTOCOLS OVER WIMAX

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ABSTRACT

Mobile WiMAX is a technology which bridges the gap among fixed and mobile access and show the similar subscriber experience for fixed and mobile user, also fast-growing broadband access mechanism which supports low-cost mobile applications. Mobile WiMAX is a technology based on IEEE 802.16 standard advanced as an achievable and attractive key to these problems. It provides integration Orthogonal Frequency-Division Multiple Access (OFDMA) and Multiple-Input and Multiple-Output (MIMO) structures with fast connection. The chosen of a suitable routing protocol is key issue scheming a scalable and effective wireless networks. Nevertheless, the problemshappen in message delivering for dynamic WiMAX. In this paper, the performance of the Mobile WIMAX has been studied in different situations using QualNet simulator on two routing protocol namely Dynamic Manet on Demand (DYMO) routing Protocol and Optimized Link State (OLSR) Routing Protocol. The results show that DYMO protocols in performs better than OLSR in different quality of service (QoS).

Keywords: WiMAX, DYMO, OLSR, QualNet.

1. INTRODUCTION

WiMAX (Worldwide Interoperability for Microwave Access) is a wireless communications standard schemed to supply up to 1 Gbit/s for fixed stations.The name WiMAX was generated via the WiMAX Forum that was formed in June 2001 to promote conformity and interoperability of the standard. The forum defines WiMAX as a standards-based mechanism supporting the delivery of last mile wireless broadband access as a substitute to cable and DSL [1]. WiMAX indicate to interoperable operations of the IEEE 802.16 family of wireless-networks standards ratified via WiMAX Forum. WiMAX is named the next creation broadband wireless mechanism that suggestions high fast, secure, advanced and last mile broadband services. In addition, it has supplied wide details for the Physical (PHY) and MAC layers. WiMAX is designed to work in both licensed frequency band of 10-66 GHZ and unlicensed frequency band of 2-11GHZ. Mobile WiMAX is one of the greatest concepts for scheme designed in constant wireless access to supply better performance and cost effective solution. WiMAX faces different defies of meeting the further demands for enabling mobility in WiMAX, if line of sight (LOS) process is designed, then frequencies better than 10 GHZ will be used. The main concept regarding Mobile WiMAX is mobility in broadband wireless communication networks. Mobile WiMAX consists of high speed Internet access that supplies various data and multimedia information with bit rate of 73 Mbps. Some of the wireless routing protocols were designed to supply communication in wireless environment. In this paper the implementation of a given scenario has covered the performance of the routing protocols OLSR and DYMO over Mobile Worldwide Interoperability for Microwave Access (WiMAX) also answered the question of which is the best routing protocol the performance metrics which are the End-To-End delay, throughput, jitter and packet delivery ratio using the software QualNet version 7.0.

1.1 Routing protocols over WIMAX

The routing protocols that used in this paper over WiMAX environment are:

1.2 Dynamic MANET on-demand routing protocol (DYMO)

DYMO routing protocol has been proposed via Perkins &Chakeres[2] where route discovery is very similar to which of Ad-Hoc On-Demand Distance Vector (AODV) routing protocol except for the track cumulative advantage. Figure-1 illustrations the DYMO path detection procedure. Each intermediate node which distributes the RREQ message creates a reminder of the retrograderoute. With esteem to Figure-1, source node 1 requirements to connect with target node 10. It makes a RREQ package that consists its own address, number of sequence, hop count and target address.

Every intermediate node having a useful route to the target retains on collect its address and number of sequence to the RREQ packages as presented with number of nodes two and six, until target is arrived. The source node pauses for a RREP message. The target responses for this message which belong to RREP. A comparable route accumulation procedure takes area over the backward route. This creates positive which the send route is built and each intermediate node defines a path to each other node over the route. If source does not receive message based on RREP within an indicated the time-to-live (TTL) value, RREQ may be resend [3].

DYMO is studied for the mobile nodes in multi-hop networks. DYMO mechanism is based on nodes gauge and permanently maintain the routing specifics only when it is requested [4]. It is able to be regulate to change the choosing unicast paths and also is used among nodes

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inside the network topology. The DYMO routing protocol has two main tasks, the first task involves managing the route process and also path discovery. In path discovery process, the node begins by sending the path demands to all the nodes in the network to discover the target node, after that the response of the target node sends in order to disclose suitable route. In addition, the nodes keep their paths and observe the connections by flows of the networks. Furthermore, the routing protocol is able to be work in a vast mobile network contain of a huge nodes number group connect with each other nodes;

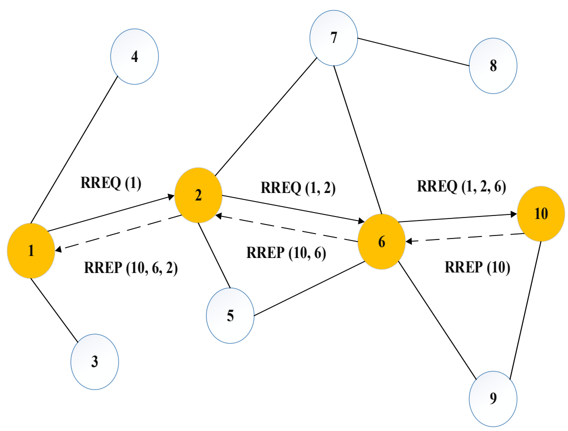

Figure-1. Discovery of DYMO path.

Each node retains up a special number of sequence with a specified end aim to keep a strategic distance from loops in the path also to get rid of the old packets.

Every period a RREQ is forwarded, the switch is improving its grouping number. On the off chance which the close to parcel has a similar or second rate organization number, the information is disposed of messages with prevalent numbers of arrangement are overhauled in the table of routing. The grouping number linked with the close to path is the similar as the hub number of sequence and also a loop is thinkable. Furthermore, the approaching package is got rid of one of the unique features of DYMO is which it is vitality productive. On the off chance which a hub is little on vitality, it has the select to not take an interest in the path revelation procedure. Furthermore, the hub won't send any of the close to RREQ messages. But, it will dissect the close to RREP messages and redesign its routing tables for future utilize.

On the other hand, through the routing processes every node has to unceasingly observe the case of contacts and keep the latest updates for the tables of routing. The path up keep procedure is essentially skilful with the support of route error RERR messages. For example, if node two has received a package and to be forwarded to node six, yet the router from node two to node six is discovered broken. For this situation, a RERR message is produced via node two and send towards the source node one. All the moderate nodes on the way in a split second overhaul their steering table sections with the new redesigned information in regards to connection disappointment and new router changes. Presently towards the packet will be sent from node two, node five and after that to node six and finally to node ten in order to arrive the target [3].

1.3 Optimized Link State Routing Protocol (OLSR)

Optimized Link State Protocol (OLSR) proposed via Jacquet *et al* [5-6] is one kind of proactive routing protocol typically utilized in ad-hoc networks. This type of protocol exchanges messages occasionally so as to keep the current network mechanism data at every node based on two steps.

First, the optimization is to decrease the control packages size, instead of flooding the control packages on every route. This routing protocol select a path with nodes of neighbouring. Second, this routing protocol reduces control packages flooding on the network via utilizing Multi Point Relay (MPR) to send the packets [7]. This method significantly decreases the number of retransfer which will occur overflow in the network with broadcast process. Usually, this routing protocol have five steps based on the work method:

- Connection Detecting is complete via forwarding frequent HELLO messages over the wireless interface which utilized in the node. The results of information operating which got from the messages which received via every node will create "local link set" that covers data around the link among the local interface with the interface of remote.
- Detecting of neighbors for every node broadcast messages within a confirmed time period. Package includes data around the nodes of neighboring and connection cases. In every node will store data about the nodes of neighboring for the "neighbor set".
- MPR Chosen: The main objective of the utilize this technology is to reduce the utilize of current overhead on the transmission of message in the network via decreasing re-transmitter in the similar area. Every node on the network will choice a number of hop neighbor node which is uniform to re-transmitter the message as illustrated in Figure-2. Every node of neighbor which does not selected based on this technology, will still receive and procedure transmission messages but will not send or forward back the messages.
- Topology Control (TC) every node must have at least data around the connection among himself and current nodes in its MPR group so as to get better routing data. This technology sends message to supply link-state data to every node in the network which able to be utilized to definition of paths which able to be utilized.
- Routing design via utilizing the connection case data got from exchange messages occasionally and the interface arrangement of every node, the routing table of every node can be calculated according to the data in the local connection database as well data on the topology group.

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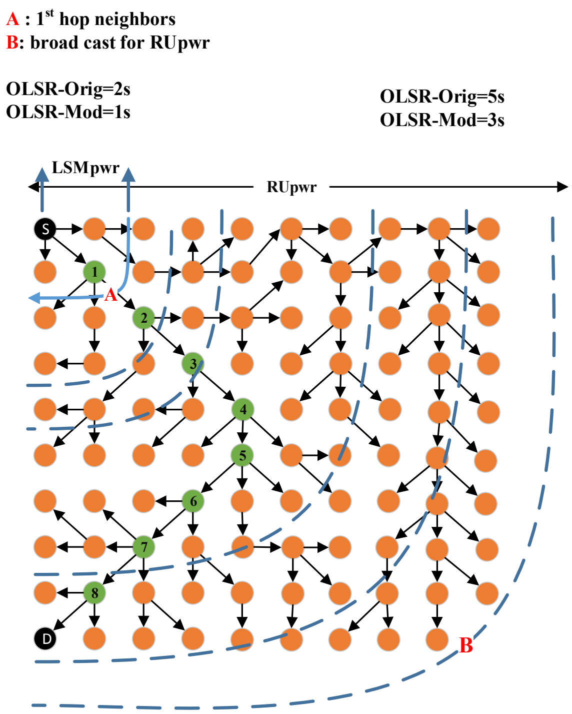

Figure-2. MPR behaviour in OLSR protocol.

2. RELATED WORK

In the recent years several researchers focus on developing efficient methods for wireless networks. Wireless networks have the promising areas of research because of their flexibility and the various applications. However, it is still facing many challenges which are under study and evaluation. This section presents an overview of the use of routing protocols for wireless networks.

It has investigated various routing protocols and estimates their performances on WiMAX networks. The two various routing protocols DSDV and OLSR have been examined based on delay, throughput and packet delivery ratio [8].Instead, it compares the performance two routing protocols AODV and DSR that doings on a gateway discovery methods and a geographical routing protocol GPSR that doings on a method continually depend on updates network topology data available to all nodes in VANETs for various scenarios [9].

On the other hand, performance investigation of routing protocols depend on two scenarios by WiMAX are made in which first scenario is without malicious node. In second scenario one malicious node is added. These scenarios are examined under VOICE and HTTP application utilizing various protocol DSR, OLSR and TORA [10]. Moreover, other work has examined various routing protocols and investigated their performances on WiMAX networks for example AODV, OLSR, ZRP and RIP according to throughput, jitter, and delay [11].In addition, performance analysis of AODV and AOMDV routing protocol for MANET considered a systematic comparative investigation of a multipath routing protocol and on demand routing protocol for MANETS. The protocol, called Ad-Hoc on demand Multipath Distance Vector (AONIDV), and Ad-Hoc On-demand Distance Vector (AODV). This effort evaluation metrics are packet delivery ratio and residual energy [12]. Furthermore, it has simulated and investigation two routing protocol DSR and DYMO over MANETs based on throughput, delay, collision ratio and packet dropping [13].

Moreover, it estimates the performance of PIM-DM and PIM-SM routing protocols depend on packet loss variable receivers via IPV6. The study contains of one main scenario that contains of network topology with a few numbers of receivers with three sources, seven receivers and seventeen intermediate nodes. The results show that, PIM-SM has better results in terms of packet loss. [14].

3. QOS METRICS

Quality is constantly describing as the grade to that a set of ingrained characteristics achieve a particular requirement [15]. In other words, QoS is typically realized as a group of service requests which requirements to be met via the network while transferring a packet stream from a source to its target. The network is probable to guarantee a set of measurable specified service attributes to the user in terms of end-to-end delay, throughput, jitter and packet delivery ratio statistics. Four type of the performance metrics is used in this paper, average end-to-end delay, throughput, jitter and packet delivery ratio as followed: -

3.1. End-To-End delay

Lateness of data packet is time taken via the packet from source to target. In addition, the delay time contain all the lateness via router to seek the route in network consumption, spread delay and processing delay for packet that was forwarded over the node, as a source node and received successfully at target node is in delay.

$$End-To-End = StratTime_{np} - EndTime_{np}$$

Where $StratTime_{np}$ is the time when the packages forwarding *pat* node *n* starts, $EndTime_{np}$, is the time when packet *p* is forward over node *n* is received successfully at target node.

End-To-End delay is significant for the quality of service (QoS). The QoS denote to the probability of the telecommunication network meeting a given traffic contract. In networking, it could be termed as the probability of a packet successfully crossing between two points in the network. For instance, application or router to have some level of guarantee which its traffic and service requests will satisfy [16].

3.2 Packet delivery ratio

Packet delay ratio is utilized to gauge the number of information packet sent via the source node and number

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of information received via the target node. Furthermore, it is utilized to gauge the loss rate of information packets. In addition, it evaluates the loss rate and measures up both the accuracy and efficiency of routing protocols.

$$Packet\ \text{Delivery}Ratio = \frac{Packet\ \text{Re}ceive\ Number}{Packet\ Send\ Number}$$

3.3 Jitter

Jitter is the deviation of signals through a time period. In addition, the packet stream time represents S_i when packet i was forward from the sender and R_i represents the time is being received through the receiver.

$$Jitter = (R_i + 1 - R_i) - (S_i + 1 - S_i)$$

3.4 Throughput

Throughput is clear as the total amount of information that received from the sender.

$$Throughput = (recvdSize/(StopTime_{np} - StartTime_{np}))*(8/1000)$$

Where

$recvdSize = store$ received packets size

$\text{StopTime} = Simulation$ stop time

$\text{StartTime} = Simulation$ start time

4. MATERIALS AND METHODS

4.1. Simulation tools

In this paper, the simulation was used QualNet version 7.0 in order to investigate the performance of the two protocols, proactive OLSR and reactive DYMO routing protocols over WiMAX. The MAC protocol utilized in this paper is 802.16. The performance will estimate utilizing with mobility of certain node. The simulation is executed over node densities 9.

4.2. Simulation scenario

The primary step in the scheme of these networks is generating nodes. Simulation in this work consist of nine nodes with three cells served by Mobile WiMAX Wireless Network. Furthermore, nine nodes will be designated to build the scenario network topologies that arespread for three cells and every cell will be served visits own Mobile WiMAX Wireless Network as in Figure-3. In addition, Nodes 1, 2 & 3 are linked directly to each other via physical cables that are considered as base station linking among the rests of the nodes which are worked over Mobile WiMAX wireless network. Moreover, Node 2 transfers from the right to the top then to the left and stop when arrive a specific point within the scenario space which is specified through utilizing the red flag

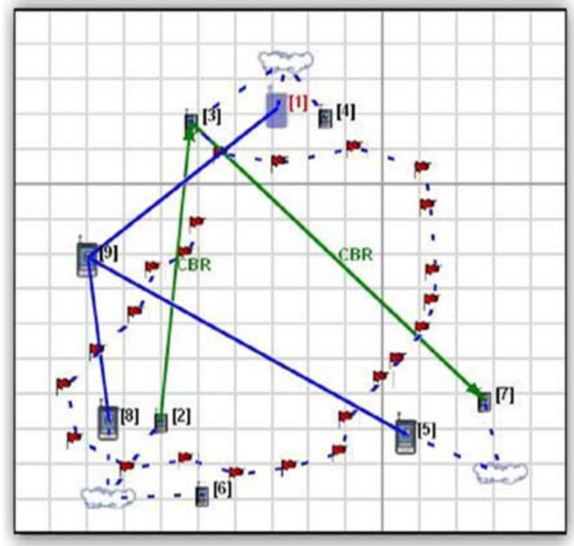

Figure-3. Snapshot for the simulation scenario.

The nodes in Figure-3 represent each user device that requests to attach to a wireless network. They likewise work as access points for other devices, due to the multi-hop functionality.

4.3 Simulation parameters

The simulation is performed using the network simulator QualNet 7.0. These are simulation parameter used in this scenario to develop the network as illustrated in Table-1.

Performance metrics are determined earlier in order to identify which protocols gives better output when compare to each other [17].

Table-1. Simulation parameters.

Component	Type
Routing Protocols	OLSR, DYMO
Radio Type	802.16
No. of Channel	Two
Channel Frequency	2.4 GHz
Simulation Time	300s
Simulation Area	1500 m * 1500 m
N0. Of Nodes	9
Simulation Name	QualNet 7.0

4.4 Constant bit rate

Constant bit rate (CBR) is a term utilized in telecommunication and is an encoding technique that retains bit rate the same. It hasa high speed duo to its fixed bit rate value. The downside to a fixed bit rate is that the files processis not as optimized for QoS. In addition, it is suitable for flowing multimedia applications on limited ability networks. In this paper, it used nodes two, three and

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three, seven are source and target at the same time in new scenario. In addition, the packets have been sent 1P, 2P, 4P, 8P, 10P positions for every scenario with different protocol.

4.5 Duration

Each of the scenarios run for 300 simulated seconds through which the test application sending packets from source to target among the nodes. Simulator usages a created random number to generate a more realistic simulation. A seed value of 1.0 mc was utilized to every of these examinations.

5. RESULTS

In this paper, the simulation results for these experiments were collected from output files generated via QualNet. It is the time taken for a packet to be transmitted across a network from source to destination. The performance of DYMO and OLSR routing protocols based on new scenario to create our parameter aims. The quality of service is measured and analyzed of DYMO and OLSR routing protocols.

5.1. End-T0-End delay

Figure-4 shows the performance of both the routing protocols DEMO and OLSR for End-To-End delay. The DYMO has fewerdelay than OLSR in different experiment. In addition, In Figure-4 is shown the simulation results of positions vs delay. In the 1P we can see a superiority percentage among DEMO and OLSR is 71%. On the other hand, in the 10P was superiority percentage is 83% due the mechanism of processing to establish and maintain the routing from the source to the destination and the DYMO was faster thanOLSR to send and receive the packet with less time consuming for routing initiation.

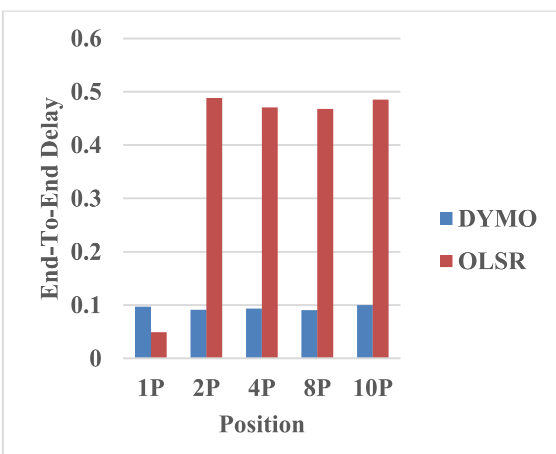

Figure-4. End-To-End delay.

5.2. Jitter

In Figure-5 are shown the simulation results of positions vs jitter. In the 1P we can see a superiority percentage among DEMO and OLSR is 38%. On the other hand, in the 10P was superiority percentage is 46%. The jitteris decrease with reducing the distance among the source and the destination due the mobility the node number (2) moved toward the target with respect to the two routing protocol with their routing procedure behaviour forDYMO and OLSR.

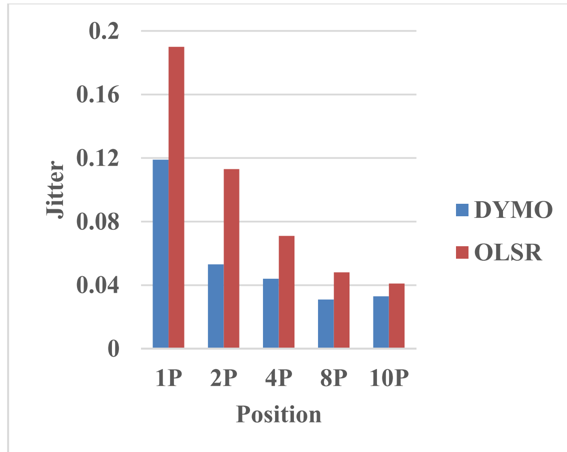

Figure-5. Jitter.

5.3. Packet delivery ratio

As shown Figure-6 the value of the packet delivery ratio based on two routing protocols x_ axis showing the number of packet that sent for every protocol and Y axis represents percentage at which packet are delivered for every routing protocol. The packet delivery ratio in DYMO routing protocols is better than OLSR routing protocol with different positions. Furthermore, the DYMO routing protocol gets superiority percentage 51% in 1P and 10P compared to OLSR routing protocol.

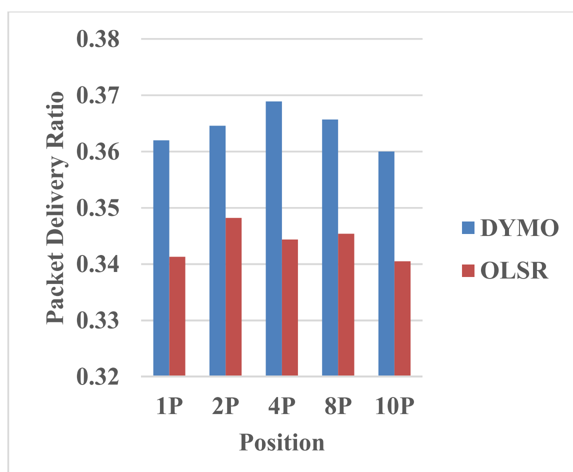

Figure-6. Packet delivery ratio.

5.4. Throughput

Figure-4 shows the performance of both the routing protocols DEMO and OLSR for throughput. The DYMO has better throughput than OLSR in different experiment. In the 1P DYMO routing protocol has a superiority percentage 63% compared to OLSR routing protocol. On the other hand, in the 10P was superiority percentage is 64% this because more routing packets are generated and delivered by DYMO routing protocol with different positions.

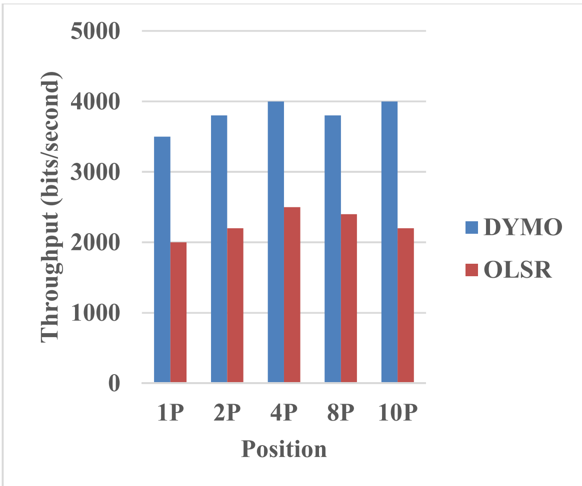

Figure-7. Throughput.

6. CONCLUSIONS

In this paper, the performance of two routing protocol DYMO and OLSR have been evaluated in different positions of packet sent in different experiments using QualNet simulator. The results show that the performance of reactive protocol DYMO is better than proactive protocol OLSR in different QoS metrics over WiMAX. The DYMO is suited for the WiMAX networks and QoS will be faster in the mobile Internet applications.

FUTURE WORK

The future work suggested is the development of modified version of the selected routing protocols which should consider different aspects of routing protocols and more complex scenario such as handover establishment to discover the behaviour of the two routing protocols and the weakness of the protocol mentioned should be improvised.

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