ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 5, May 2014

Performance Analysis of Reactive and Proactive Routing Protocols under Varying Mobility in WIMAX Environment

Gurpreet Kaur[1], Praveen Kumar[2]
Department of Electronics and communication Engineering, Institute of Science and Technology, Klawad, India

Abstract: Worldwide Interoperability for Microwave Access (WiMAX) is currently one of the hottest technologies in wireless, it's a standard-based on the IEEE 802.16 wireless technology that provides high throughput broadband connections over long distance, which supports Point to Multi-point (PMP) broadband wireless access. This paper presented an analysis on those routing protocols especially designed for wireless networks. A study and comparison on the performance of reactive protocol (AODV) and proactive protocols (OLSR , DSDV) for Mobile WiMAX environment is done under varying mobility conditions. The performance matrix includes Packet Delivery fraction (PDF), Throughput, End to End Delay, and routing load were identified. The study used NS2 simulator for the comparison on the performance analysis. Successfully results found that AODV protocol outperforms OLSR and DSDV routing protocols.

Keywords: AODV , DSDV, NS-2, OLSR, WiMAX

I. INTRODUCTION

Today's broadband Internet connections are restricted to wire line infrastructure using DSL, T1 or cable-modem based connection. However, these wire line infrastructures are considerably more expensive and time consuming to deploy than a wireless one. Moreover, in rural areas and developing countries, provide are unwilling to install the necessary equipment (optical fiber or copper-wire or other infrastructures) for broadband services expecting low profit. Broadband Wireless Access (BWA) has emerged as a promising solution for "last mile" access technology to provide high speed connections. IEEE 802.16 standard for BWA and its associated industry consortium, Worldwide Interoperability for Microwave Access (WiMAX) forum promise to offer high data rate over large areas to a large number of users where broadband is unavailable. This is the first industry wide standard that can be used for fixed wireless access with substantially higher bandwidth than most cellular networks [1]. Development of this standard facilitates low cost equipment, ensure interoperability, and reduce investment risk for operators. In the recent years, IEEE 802.16 working group has developed a number of standards for WiMAX. The first standard IEEE 802.16 was published in 2001 and focused on the frequency range between 10 and 66 GHz and required line-of-sight (LOS) propagation between the sender and the receiver. This reduces multipath distortion, thereby increases communication efficiency. Theoretically IEEE 802.16 can provide single channel data rates up to 75 Mbps on both the uplink and downlink. Providers could use multiple IEEE 802.16 channels for a single transmission to provide bandwidths of up to 350 Mbps [2]. However, because of LOS transmission, cost-effective deployment is not possible. Consequently, several versions came with new features and techniques. IEEE 802.16-2004, has been developed to expand the scope to licensed and license-exempt bands from 2 to 11 GHz. IEEE 802.16-2004 specifies the air interface, including the Media Access Control (MAC) of wireless access for fixed operation in metropolitan area networks. Support for portable/mobile devices is considered in IEEE 802.16e standard, which is published in December 2005. WiMAX networks consist of a central radio Base Station (BS) and a number of Subscriber Stations (SSs). In Mobile WiMAX network, BS (which is fixed) is connected to public network and can handle multiple sectors simultaneously and SSs are mobile. A number of wireless routing protocols are already designed to provide communication in wireless environment, such as AODV, OLSR, DSDV, ZRP, LAR, LANMAR, STAR, DYMO.

This paper presented an performance analysis of routing protocols(AODV) and proactive protocols (DSDV & OLSR) in WIMAX environment under the effect of varying mobility. The simulation is done by NS-2. To find the effect of mobility random way point mobility model is considered.

The rest of the paper is summarised as follows: Section 2 gives the related work. Section 3 and Section 4 gives the description about the protocols and simulation process used. Section 5 contains the performance matrices used to analyse the result. In section 6 the results and detailed analysis is carried out. Finally we conclude the paper.

II. RELATED WORK

Ruhani Ab Rahman et al. presented an analysis on those routing protocols especially designed for wireless networks. A study and comparison on the performance of three routing protocols (AODV, DSR, and DSDV) for Mobile WiMAX environment is done. The study used NS2 simulator for the comparison on the performance analysis. Successfully results found that AODV protocol outperform the DSR and DSDV.

Tarik Anouari et al.[4] investigate the performances of the most common VoIP codecs, which are G.711, G.723.1 and G.729 over a WiMAX network using various service classes and NOAH as a transport protocol. The objective is to compare different types of service classes with respect to the QoS parameters, such as, throughput, average jitter and average delay.

M. Rehan Rasheed et.al[5]. investigates different routing protocols and their performances on 802.16 WiMAX networks. Using simulation, different routing protocols have been tested with various network parameters. Results show that DSDV in general outperforms other routing protocols.

Jintana Nakasuwan [6] et. al., did comparative analysis of AODV and OLSR for average throughput as performance metric under varying network load and pause time in ns-2 simulator scenario. The result shows that the AODV perform better than OLSR for average throughput.

Fatima Furqan et. al. [7], propose a mechanism namely WiMAX Fair Intelligent Congestion Control (WFICC) to avoid congestion at the base station. The results have shown that the proposed WFICC algorithm enables the base station to avoid congestion and ensures the provision of QoS of different Class of Services (CoSs) in terms of throughput, fairness and packet delay.

P. Omprakash et. al. [8], focused on how TCP will beserviced by WiMAX, and what are the issues that are still open and can be used to increase the performance of the service.

III. ROUTING PROTOCOLS

The routing protocols are classified in mainly three categories:

Reactive Protocols:
Also known as on-demand routing protocols. These protocols start the routing process whenever a node requires otherwise the network is ideal. These are generally considered efficient, where the route discovery is required to be less frequent. This makes them more suitable to the network with light traffic and low mobility.

Proactive Protocols:
Also known as table driven routing protocols. In these protocols the routing information is stored in the form of tables maintained by each node. These tables need to be updated due to frequent change in the topology of the network. These protocols are used where the route requests are frequent.

Hybrid Routing Protocols:
These protocols combine the advantages of the two routing protocols in order to obtain higher efficiency. In these a network is divided in to the zones, if the routing is to be carried out within the zone than table driven routing is used otherwise on demand routing is preferable.

Here we are discussing those routing protocols used in the simulation process.

A . Reactive Routing Protocols

The reactive protocol used in the simulation process is:

1.Ad hoc On-demand Distance Vector Routing(AODV)
Ad-hoc On-demand distance vector (AODV) is another variant of classical distance vector routing algorithm, a confluence of both DSDV and DSR. It shares DSR's on demand characteristics hence discovers routes whenever it is needed via a similar route discovery process. However, AODV adopts traditional routing tables; one entry per destination which is in contrast to DSR that maintains multiple route cache entries for each destination. The initial design of AODV is undertaken after the experience with DSDV routing algorithm. Like DSDV, AODV provides loop free routes while repairing link breakages but unlike DSDV, it doesn't require global periodic routing advertisements. AODV also has other significant features. Whenever a route is available from source to destination, it does not add any overhead to the packets. However, route discovery process is only initiated when routes are not used and/or they expired and consequently discarded. This strategy reduces the effects of stale routes as well as the need for route maintenance for unused routes. Another distinguishing feature of AODV is the ability to provide unicast, multicast and broadcast communication. AODV uses a broadcast route discovery algorithm and then the unicast route reply massage.

B. Proactive Routing Protocols

Various proactive protocols used in the simulation process is:

1 . Optimized Link State Routing(OLSR):
It is a proactive non-uniform Link State routing approach. In OLSR, every node transmits its neighbor list using periodical beacons. So, all nodes can know their 2-hop neighbors. Like in CEDAR, OLSR uses an extraction algorithm for multipoint relay (MPR) selection. The multipoint relay set of a node N is the minimal (or near minimal) set of N's one-hop neighbors such that each of N's two-hop neighbors has at least one of N's multipoint relays as its one-hop neighbor. In OLSR, each node selects its MPR independently and only the knowledge of its two-hop neighbors is needed. When a node broadcasts a message, all of its neighbors will receive the message. Only the MPRs, which have not seen the message before, rebroadcast the message. Therefore, the overhead for message flooding can be greatly reduced.

2. *Destination-Sequenced Distance Vector routing (DSDV)*
Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. The improvement made to the Bellman-Ford algorithm includes freedom from loops in routing tables by using sequence numbers [2]. The DSDV protocol can be used in mobile ad hoc networking environments by assuming that each participating node acts as a router. Each mobile node in the system maintains a routing table in which all the possible destinations and the number of hops to them in

the network are recorded. A sequence number is also associated with each route or path to the destination. The route labelled with the highest sequence number is always used. This also helps in identifying the old routes from the new ones. This function would avoid the formation of loops. In order to minimize the traffic generated, there are two types of packets used that known as "full dump", which is a packet that carries all the information about a change. The second type of packet called "incremental" is used which carried just the changes of the loops. The second type benefits that increased the overall efficiency of the system. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle. Whenever the topology of the network changes, a new sequence number needed before the network re-converges. Thus, DSDV is not suitable for highly dynamic networks.

IV. SIMULATION PROCESS

The simulation process consists of:

A . Simulation Model:

A detail simulation model based on NS-2 has been used in the evaluation, and in order to perfectly evaluate the effect of out-of-order packet while multi-path routing protocol is used in different simulation scenarios have been used. The NS-2 simulator supports for simulating wireless networks consists of different network components including physical, data link, and medium access control (MAC) layer models. From channel type, a wireless channel model with a 1000m-transmission range has been chosen.

*IEEE 802.16*for wireless networks is used as the MAC layer protocol. All packets (both data and routing) sent by the routing layer are queued at the *interface queue* until the MAC layer can transmit them. The *interface queue* has a maximum size of 50 packets and is worked as a priority queue. The routing protocols that have been chosen at the network layer are AODV, DSDV and OLSR under multi-path route between base station and subscriber station.

B. Traffic Generator:

In our proposed work, for traffic source and application, *Constant bit rate (CBR)* is used above the agent UDP. The source-destination pairs are spread randomly over the network. The data generator is CBR. Mobility models were created for the simulations using 50 nodes, and this model was set in such a way that first all the 50 nodes were provided with initial location in the given rectangular topography field. The field configuration used is: 1000 m x 1000 m field. Then all the nodes move within their boundary by setting their final destination and the speed that each node move with.

The mean speed was chosen between 10 and 50 m/s. All the simulations are run for 200 simulated seconds. Different mobility and identical traffic scenarios are used across the protocol to collect fair results.

C. *Simulation Parameters:*

Table I shows the important simulation parameters used in the simulation process.

Table 1**:** Important Simulation Parameters

Parameter	**Value**
Simulation time	200 Sec
Simulation area	1500m x 1500m
Antenna	Omni antenna
No. of subscriber	50
Traffic	CBR
Routing protocol	AODV,DSDV,OLSR
Mobilty Model	Random Waypoint Model
Cyclic Prefix	¼
Modulation technique	BPSK ½
Transmission range	1000m

V. PERFORMANCE METRICES

Following performance metrics are used to evaluate and analyze the performance of various routing protocols:

A . Packet Delivery Ratio

PDF is the ratio of number of packets received over connections to destination to the total number of packets sent over the destinations through these connections. Mathematically it can be represented as:

$$P = 1/c \sum_{f=1}^{e} R_f / N_f$$

where c are total connections to destination, fth connection is index to connection to it. R_f is no. of received packets by fth connection.N_f is no. of packets sent over to the destination through fth connection. Higher PDF value means better performance of the protocol.

B. *Average End-to-End Delay*

Delay or latency represents the time taken by a bit of data to reach from source to destination across the network. The main sources of delay can be categorized into: propagation delay, source processing delay, Queuing delay, transmission delay and destination processing delay. When particular packet 'i' is sent at s_i time and received at r_i time delayed due to all these delays. Average for all the packets sent is given by:

$$D = \frac{1}{N} \sum_{i=1}^{s} r_i - s_i$$

Lessor delay means best performance for the protocol.

C. *Throughput*

Throughput is defined as the ratio of the total data reaches a receiver from the sender. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec). Some factors affect the throughput as; if there are many topology changes in the network, unreliable communication between nodes, limited bandwidth available and limited energy . A high throughput is absolute choice in every network. Throughput can be represented mathematically as in equation below:

*Throughput=number of packets delivered*packet size*8/total duration.*

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

D. Routing Overhead

It is calculated as total number of control packets transmitted. The increase in routing message overhead reduces the performance of the ad hoc network. Routing a packet to its destination is done by network layer. When any packet arrives and its destination route is available, it is sent forward. Otherwise, the packet is buffered. The buffered packet could be dropped due to 1) when the buffer is full 2) when time of packet expires. We expect least packet loss from the routing protocol.

VI. RESULT AND ANALYSIS

Simulations are performed for various proactive and reactive routing protocols. The impact of node's mean speed on the performance of above said AODV, DSDV and OLSR protocols is shown with the help of simulation graphs in terms of packet delivery ratio, throughput, average end to end delay and routing load.

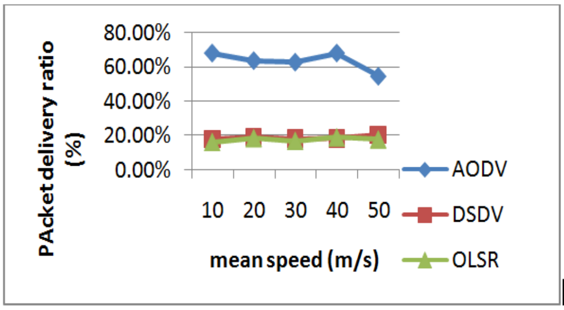

Figure 1: Impact of mobility on the packet delivery ratio of AODV, DSDV and OLSR protocols

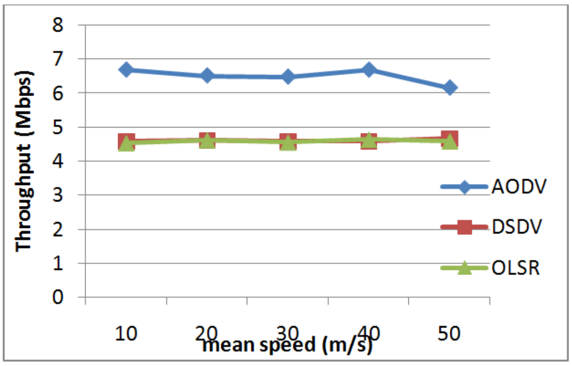

Figure 2: Impact of mobility on the throughput of AODV, DSDV and OLSR protocols

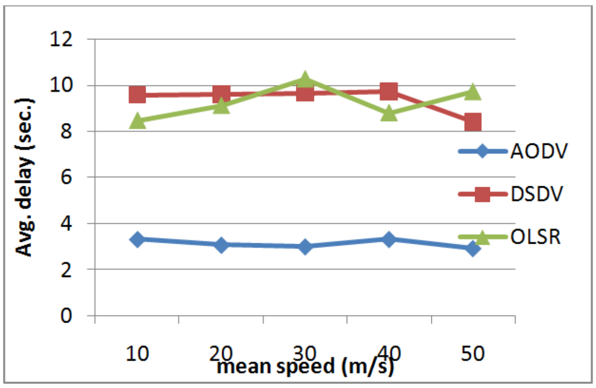

Figure 3: Impact of mean speed on the average end-to-end delay of AODV, DSDV and OLSR protocols

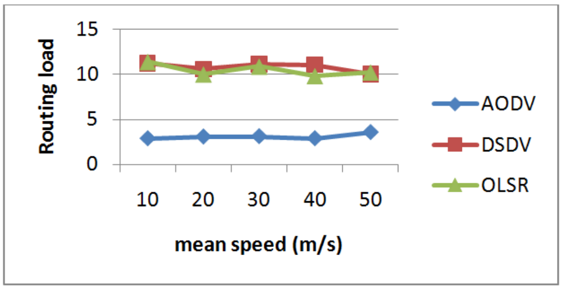

Figure 4: Impact of mean speed on the Routing Load of AODV, DSDV and OLSR protocols

VII. CONCLUSION AND FUTURE SCOPE

In this paper the effect of mobility and offered load is examined on to compare the performance of three protocols DSDV, OLSR (proactive) and AODV (reactive) under the CBR traffic over WiMAX environment. From the simulation results it is observed that reactive protocol AODV has best all-round performance under different scenarios considered. OLSR in terms of average end to end delay performs almost similar to DSDV but for packet delivery ratio and throughput DSDV performs better than OLSR while AODV is better than both DSDV and OLSR
The results show that when varying mean speed is considered as one of the network scenario with different performance metrics the results are as follows:

Table 2 **:** Results showing the impact of varying mean speed on protocols

Matrices Used	**Conclusion**	
	Best Performance	**Worst Performance**
Packet Delivery Ratio	AODV	OLSR
Average End-to-End Delay	AODV	OLSR, DSDV
Throughput	AODV	OLSR
Routing Load	AODV	DSDV

REFERENCES

[1] M. Azizul Hasan, "Performance Analysis of WiMAX/IEEE 802.16 OFDM Physical Layer" Masters Thesis, Department of electrical and communication engineering, comnmunication laboratory,Helsinki University of Technology, Finland 2007.
[2] C.E.Perkins and P.Bhagwat, "Highly Dynamic Destination Sequence Distance Vactor Routing (DSDV) for mobile computers," IGCOMM London, UK, August 1994.
[3] Ruhani Ab Rahman ," Performance Analysis of Routing Protocol in WiMAX Network", IEEE International Conference on System Engineering and Technology,2011.
[4] Tarik Anouari ,"Performance Analysis of VoIP Traffic in WiMAX using various Service Classes ",International Journal of Computer Applications ,Volume 52– No.20, August 2012
[5] M. Rehan Rasheed ," Performance of Routing Protocols in WiMAX Networks", International Journal of Engineering and Technology, Vol.2, No.5, October 2010.
[6] Jintana Nakasuwan and Paitoon Rakluе , "Performance Comparison of AODV and OLSR for MANET "International Conference on Control, Automation and Systems, 2010.
[7] Fatima Furqan, Doan B. Hoang," WFICC: A New Mechanism for Provision of QoSand Congestion Control in WiMAX" Consumer

Communications and Networking Conference (CCNC), IEEE, 2013.
[8] P.Omprakash and R. Sabitha ," PERFORMANCE ANALYSIS OF TCP OVER WiMAX" IEEE, 2011.
[9] Vikram Mehta ,"Performance Analysis of QoS Parameters for WiMAX Networks", International Journal of Engineering and Innovative Technology, Volume 1, Issue 5, May 2012.
[10] Ipsita Panda ," A Survey on Routing Protocols of MANETs by Using QoS Metrics", International Journal of Advanced Research in Computer Science and Software Engineering,Volume 2, Issue 10, 2012.
[11] Chenn-Jung Huang et al "A Bluetooth routing protocol using evolving fuzzy neural network" international journal of wireless information network vol. 11 ,no3 ,july 2004
[12] .H. Chen, J. Jou, D. Dharamaraju, G. Papageorgiou, J. S. Baras, "Performance Evaluation and Traffic Analysis for Routing in a Real MANET," Collaborative Technology Alliance for Communications and Networks, supported by DARPA through SPAWAR, 2007.
[13] Lucas Guardalben, Joao B.M. Sobral,"A Performance Evaluation of OLSR and AODV Routing Protocols Using a Self-Configuration Mechanism for Heterogeneous Wireless Mesh Networks" guardalben,bosco@inf.ufsc.br 978-1-4244-2413-9/08/©2008 IEEE.
[14] WiMAX Forum. WiMAX end-to-end network systems architecture. Stage 2: Architecture tenets, reference model and reference points. Release 1.0, V&V Draft, August 8, 2006. www.WiMaxforum.org/technology/documents.
[15] Z. M. Elkwash, N. M. Shebani, A. Mjahed ,"Effect of Cyclic Prefix on Data Rates in WiMAX System with Variation in Delay Vector, Gain Vector, Signal to Noise Ratio and Coding Rates for Different Modulation", International Conference on Technological Advances in Electrical, Electronics and Computer Engineering (TAEECE), IEEE, 2013.