"Implementation and Analysis of Wimax Module for Reactive and Proactive Routing Protocols under ns2"

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Abstract

Today the world is moving towards wireless system. Wireless networks are gaining popularity to its peak today, as the users want wireless connectivity irrespective of their geographic positionWiMAX are considered to be the special application of infrastructure-less wireless Mobile ad-hoc network (MANET). In these networks, the speed of the data transmission is very rapid The paper is based on comparison between Ad hoc on demand Distance Vector routing protocol (AODV) and Destination sequenced distance vector routing (DSDV) in WiMAX Scenario on the basis of packet delivery ratio and average delay. Researchers are continuously publishing papers on performance work on WiMAX hence we worked on the issue. The tools which we used for the work of performance analysis are TRACEGRAPH and NETWORK SIMULATOR (NS2).

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I. Introduction

Wireless networks play an important role in modern era for transmitting data with minimal overhead and maximum possible speed. These networks have become more efficient with the introduction of mobility concept of nodes. Two variations of such networks exist. The first one called structured wireless networks, have fixed main nodes concerned with routing or switching of data (sometimes called gateways or base stations).The IEEE 802.16 standard forms the basis of Worldwide Interoperability for Microwave Access (WiMAX). It was developed by the WiMAX Forum with the objective of provide high speed data transfers over the air. The WiMAX Forum is an industry-led, not-for-profit organization that certifies and promotes the compatibility and interoperability of broadband wireless products based upon IEEE Standard 802.16 [1]. WiMAX has its origin in the computer industry and is an alternative to Third Generation Partnership Project (3GPP) and technologies like High Speed Packet Access (HSPA) and Long Term Evolution (LTE).

The most popular network simulator used by the academia and industry is the network simulator 2 (ns-2) [11], which has become the *de facto* standards for the simulation of packet-switched networks. Specifically, more and more published wireless network studies and investigations use ns-2 to evaluate and verify their work. Although there still another force investigates the IEEE 802.16-based simulator [8], this simulator is not public. The ns-2 is roughly composed of various traffic models, transport-layer protocols, network-layer protocols, and medium access control (MAC) layer protocols, etc. These components enable ns-2 to simulate different types of networks and their topologies. Researchers can benefit from these preliminary tests on their investigation and find out the drawbacks of their new design in efficient way.

Until today, as the best knowledge of the authors, no WiMAX/IEEE 802.16 module has been contributed to ns-2. Due to these reasons, we design and implement the WiMAX module for ns-2. The developed WiMAX module is focused on MAC protocol development and inherited from the original MAC class in ns-2. This module is based on IEEE 802.16 point-to-multipoint (PMP) mode, which means that one BS can serve multiple subscriber stations (SSs) concurrently. We choose the orthogonal frequency-division multiple access (OFDMA) scheme for the physical (PHY) layer. Based on the OFDMA PHY specifications, it has been of major interest for both wireless applications due to its high date rate transmission capability and its robustness to multipath delay spread [9].

The IEEE 802.16 standard defines the specifications related to the service-specific convergence sublayer (CS), the MAC common part sublayer (CPS), the security sublayer, and the PHY layer. The MAC management messages, such as downlink/ uplink map (DL-MAP/UL-MAP), downlink/uplink channel descriptor (DCD/UCD), ranging request/response (RNGREQ/ RNG-RSP), and so forth are implemented following the 802.16 standard to operate the WiMAX networks. All operations between the base station (BS) and subscriber stations (SSs) over a *superframe* interval follow the compulsory procedures of the 802.16 standard.

II. An Overview of IEEE 802.16 Standards

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The section briefly summarizes the operations of MAC and PHY layers in the IEEE 802.16 standard. Fig. 1 illustrates the architecture of IEEE 802.16. The CS provides any transformation or mapping of external network data that is received through the CS service access point (SAP) and converts them into MAC service data units (MSDUs) received by the MAC layer through the MAC SAP. This sublayer includes classifying external network SDUs and associating them to the proper MAC service flow identifier (SFID) and connection ID (CID). In addition, it may also include the payload header suppression (PHS) function.

The MAC CPS provides the core MAC functionality of system access, bandwidth allocation, scheduling, contention mechanism, connection establishment, and connection maintenance. It receives data from various CSs through the MAC SAP, which is classified to particular MAC connections. The IEEE 802.16-2004 standard supports four quality-of-service scheduling types: unsolicited grant service (UGS) for the constant bit rate (CBR) service, real-time polling service (rtPS) for the variable bit rate (VBR) service, non-real-time polling service (nrtPS) for non-real-time VBR, and best effort service (BE) for service with no rate or delay requirements. In 802.16e standard, there is an additional service type called extended real-time polling service (ertPS) for voice over IP (VoIP) service with silence suppression.

These quality-of-service (QoS) classes are associated with certain predefined sets of QoS-related service flow parameters, and the MAC scheduler supports the appropriate data handling mechanisms for data transport according to each QoS classes. The upper-layer protocol data units (PDUs) are inserted into different levels of queues with an assigned CID in the MAC layer after the SFID-CID mapping. These data packets in these queues are treated as MSDUs and then will be fragmented or packed into various sizes according to the MAC scheduling operations. They will be processed by a selective repeat automatic repeat request (ARQ) block mechanism if the ARQ-enabled function is on.

For the UL traffic, each SS should range to the BS before entering the system. During the initial ranging period, the SS will request to be served in the DL via the particular burst profile by transmitting its choice of DL interval usage code (DIUC) to the BS. Afterwards, the BS will command the SS to use a particular uplink burst profile with the allocated UL interval usage code (UIUC) with the grant of SS in UL-MAP messages. The DL-MAP and UL-MAP contain the channel ID and the MAP information elements (IEs) which describes the PHY specification mapping in the UL and DL respectively. They are based on the different PHY specifications, such as single carrier (SC), single carrier access (SCa), OFDM, and OFDMA. The burst profile includes the DIUC, UIUC, and the type-length-value (TLV) encoded information. The TLV encoded information will notify the PHY layer of the modulation type, FEC code type, and encoding parameters. The MAC data payload is packed by these encoding type.

The PHY layer requires equal radio link control (RLC), which is the capability of the PHY layer to transit from one burst profile to another. The RLC begins with the periodic BS broadcasting of the burst profiles which have been chosen for the downlink or the uplink connections. After the initial determination of downlink and uplink burst profiles between the BS and a particular SS, RLC continues to monitor and control the burst profiles. The SS can range with the RNGREQ message to request a change in the downlink burst profile. The channel measurements report request (REPREQ) message will be used by a BS to request signal-to-noise ratio (SNR) channel measurements reports. The channel measurement report response (REP-RSP) message is used by the SS to respond the channel measurements listed in the received REP-REQ.

The IEEE 802.16 uses the frame-based transmission architecture where the frame length is variable. Each frame is called a superframe and is divided into two subframes: the DL subframe and the UL subframe. In this paper, we are focusing the frame structure of the OFDMA-PHY in time division duplex (TDD) mode. A DL subframe consists of DL subframe prefix to specify the modulation and coding (in PHY mode), the length of the first DL burst, and the broadcasted MAC control messages, e.g., the downlink channel descriptor (DCD) and the uplink channel descriptor (UCD). Both of them define the characteristics of the physical channels by comprising the detail information of the DL burst profile and the UL burst profile.

Although IEEE 802.16 defines the connection signaling (connection requests and responses) between SS and BS, itdoes not define the admission control process. All packets from the application layer are classified by the connection classifier based on the CID and are forwarded to the appropriate queue. At the SS, the scheduler will retrieve the packets from the queues and transmit them to the network in the appropriate time slots as defined by the UL-MAP sent by the BS. The UL-MAP is determined by the scheduler module based on the BW-request messages. These messages report the current queue size of each connection in SS.

III. The IEEE 802.16 NS-2 Modules

The developed 802.16-based WiMAX module named as the Mac802 16 class is in accordance with the specifications of the IEEE 802.16-2004 standard [1] and based on the ns-2 version 2.29 [11]. All modules are designed by using object oriented programming language C++ and modeled as several classes. The relationship between the WiMAX module and legacy ns-2 modules is based on the original network component stack of the ns-2 as shown in Fig 2. It illustrates the type of objects for the traffic generating agent (TGA), the link layer (LL), the interface queue (IFQ), the designed MAC layer (WiMAX module), and the PHY layer (Channel).

First, the TGA is considered simply as an application level traffic generator that generates VoIP, MPEG, FTP, HTTP traffic, and so on. These traffic are classified into five different types of service, the UGS, rtPS, ertPS, nrtPS, and BE, each with its own priority. All packets will be transferred to different types of priority queues according to their service types by using CS layer SFID-CID mapping mechanism. The data packets in these queues are treated as MSDUs and will be selected to pass into the WiMAX module in a round robin manner.

While the WiMAX module in the SS receives the MSDUs from the Queue object, the MAC management component will initiate the ranging process to enter the WiMAX system or to transmit the MSDUs according to the scheduled time obtained from UL-MAP. Once the process has been successfully finished in the MAC layer, the Network Interface will add a propagation delay and broadcast in the air interface.

IV. SIMULATION AND RESULT

Simulation Environment: In our scenario we take 30 nodes .The simulation is done using NS-2, to analyze the performance of the network by varying the nodes mobility. The protocols parameters used to evaluate the performance are given below:

i) Total No. of Drop Packets: It is the difference between sending and received packets.
ii) Throughput: Throughput is the average rate of successful message delivery over a communication channel.
iii) End to end Delay: It can be defined as the time a packet takes to travel from source to destination.

Simulation Parameter

Table 1: Simulation Parameters Considered

Parameters	Values
Simulator	NS-2.35
Mobility	Random Way Point

Model	
Antenna type	Omini
Area of Map	500X500
PHY/MAC	IEEE 802.16
Routing Protocol	AODV,DSDV
Network Traffic	TCP,UDP
Simulation Time	300sec
Antenna type	Omini

Simulation results of AODV

Sent received and dropped Packet: The graph shows the Simulation result between no. of sent, received and dropped packets with the simulation time in seconds.

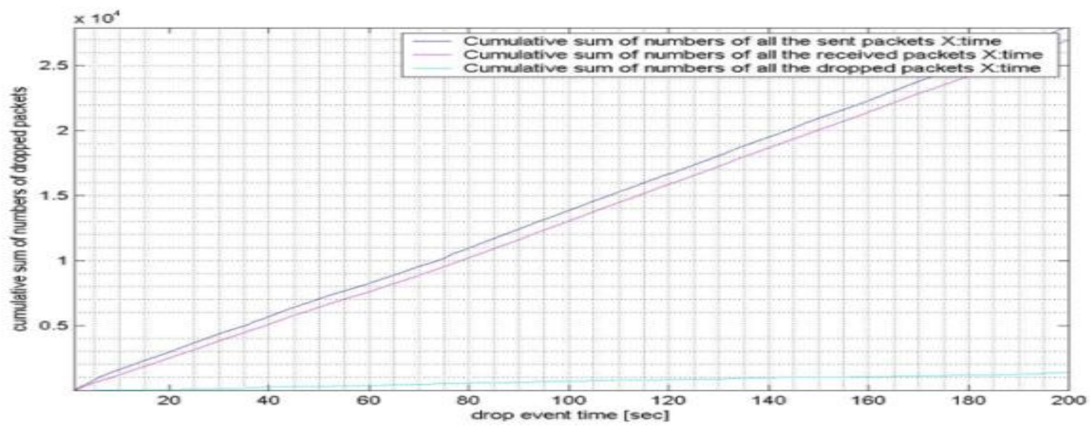

Fig.1 Simulation of sent, received and dropped packet in AODV

End to end delay: The graph shows the Simulation result between end to end delays with respect to packet sent time at source node

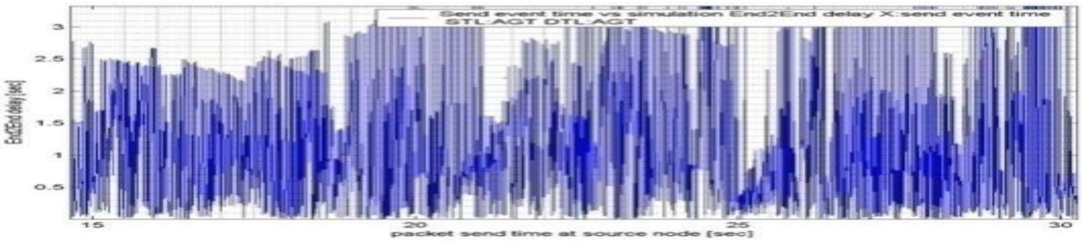

Fig .2 Simulation of End to End delay in AODV

Throughput of

Sending packets: The graph shows the Simulation result between of throughput of scending packets with respect to simulation time in seconds.

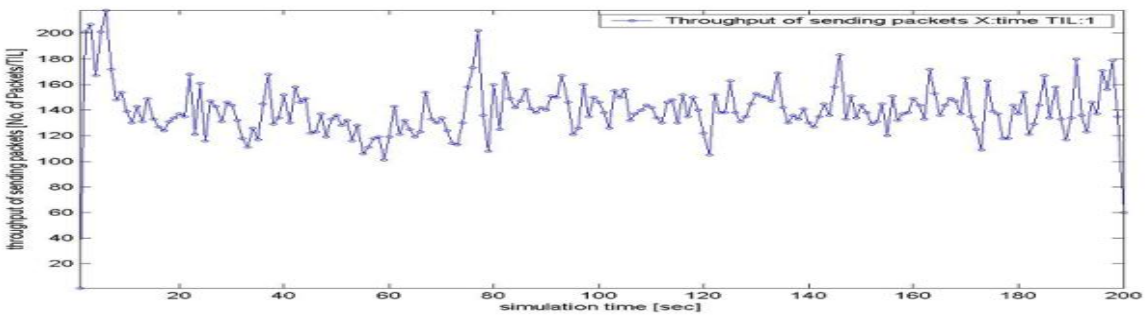

Fig .3 Throughput of Sent packet in AODV

Receiving packets: The graph shows the Simulation result between of throughput of receiving packets with respect to simulation time in seconds.

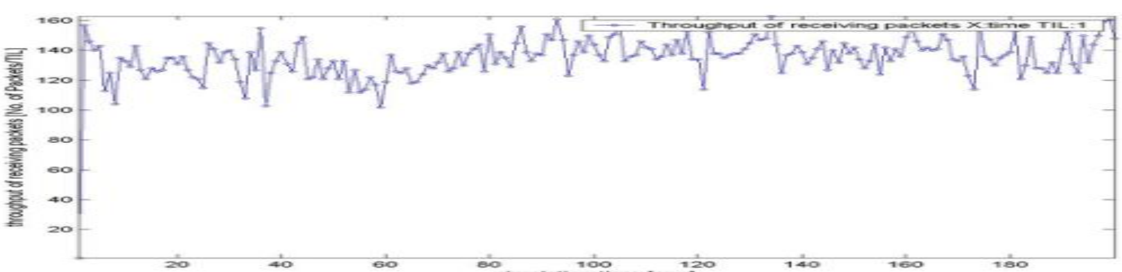

Fig .4 Throughput of Received packet in AODV

Simulation result of DSDV

Sent received and dropped Packet: The graph shows the Simulation result between no. of sent, received and dropped packets with the simulation time in seconds.

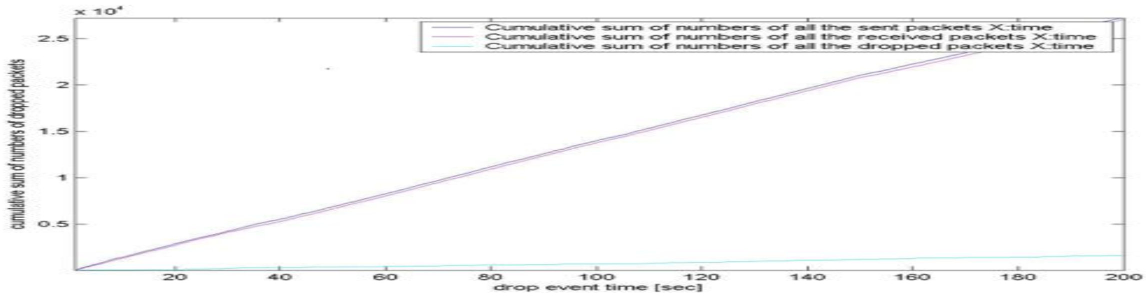

Fig.5 Simulation of sent, received and dropped packet in DSDV

End to end delay: The graph shows the Simulation result between end to end delays with respect to packet sent time at source node.

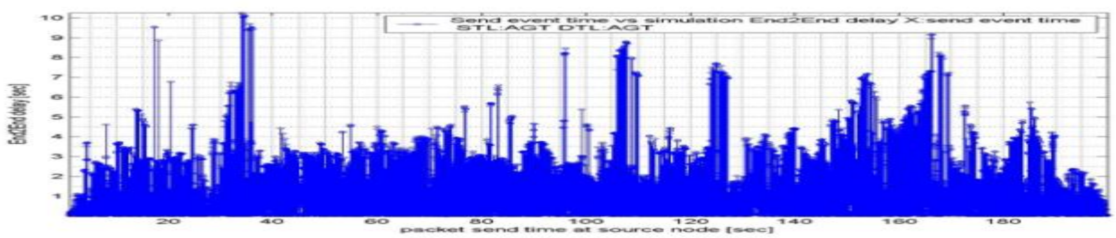

Fig .6 Simulation of End to End delay in DSSDV

Throughput of

Sending packets: The graph shows the Simulation result between throughputs of sending packets with respect to simulation time in seconds.

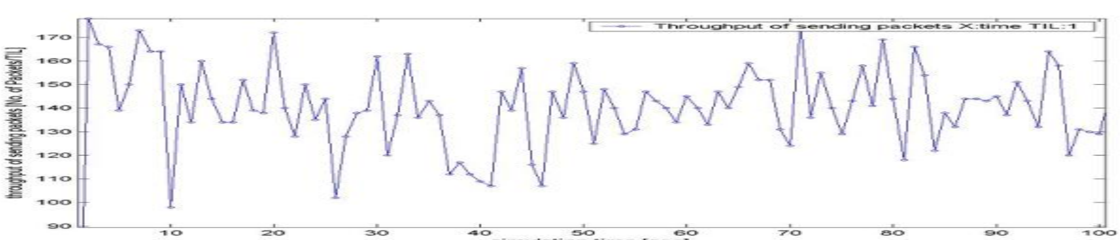

Fig. 7 Throughput of Sent packet in DSDV

Receiving packets: The graph shows the Simulation result between of throughput of receiving packets with respect to simulation time in seconds.

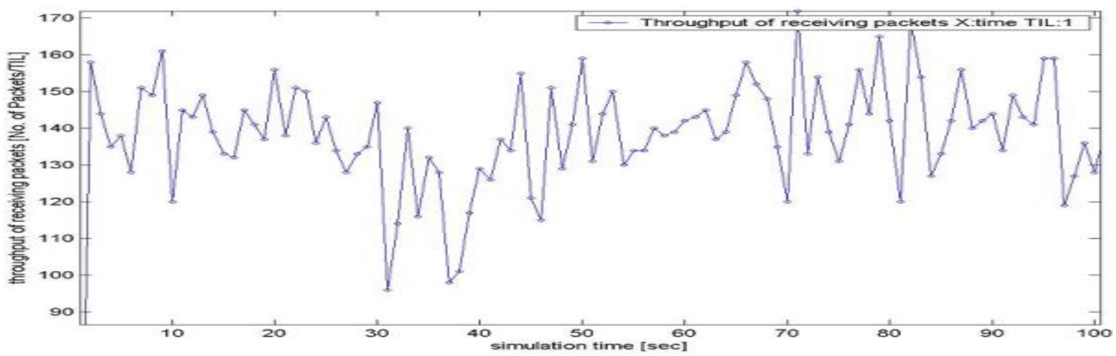

Fig. 8 Throughput of Received packet in DSDV

V. CONCLUSION

Comparison of Dropped Packets in AODV and DSDV

Table. No. of of all the Dropped Packets in AODV

Simulation time in sec	cumulative sum of all the sent packet	Cumulative sum of all the received packet	Dropped packet-(sent-received)
10	1610	1190	420
20	2947	2497	450
30	4350	3825	525
40	5695	5100	595
50	7400	6410	990
60	8200	7550	650
70	9545	8855	690
80	11000	10200	800
90	12404	11600	804
100	13855	13041	814
Total	-	-	6738

AVERAGE=TOTAL DROPED PACKET/10

6738/10 = 673.8

Table. 3 No. of all the Dropped Packets in DSDV

Simulation time in sec	cumulative sum of all the sent packet	Cumulative sum of all the received packet	Dropped packet-(sent-received)
10	1400	1234	116
20	2855	2705	150
30	4225	4100	125
40	5510	5270	240
50	6870	6640	230
60	8252	8020	232
70	9680	9490	190
80	11150	10930	220
90	12575	12350	225
100	13950	13740	210
Total	-	-	1938

AVERAGE=TOTAL DROPED PACKET/10

1938/10 = 193.8

Table 2 and 3 conclusion shows that the number of dropped packets is less in DSDV.

6.2 Comparison of Throughput of sent and received packets in AODV and DSDV

Table. 4 Throughput of sent and received packets in AODV

Simulation time in sec	Throughput of sent packet	Throughput of received packet
10	139	133
20	137	131
30	144	140
40	152	138
50	136	132
60	119	118
70	134	131
80	160	151
90	140	137
100	146	137
Total	1407	1355

AVERAGE=TOTAL/10

SENT = (1407/10)=140.7

RECEIVED=(1355/10)=135.5

Table.5 Throughput of sent and received packets in DSDV

Simulation time in sec	Throughput of sent packet	Throughput of received packet
10	98	120
20	172	156
30	162	147
40	109	129
50	147	159
60	145	142
70	124	120
80	144	142
90	145	144
100	129	128
Total	1519	1387

AVERAGE=TOTAL/10

SENT= (1519/10)=151.9

RECEIVED=(1387/10)=138.7

Table 4 and 5 conclusion shows that the throughput of DSDV is good.

6.3 Comparison of End to end delay in AODV and DSDV

Table. 6 Comparison End to end delays in AODV and DSDV

Simulation time in sec	End to End delay in AODV	End o End delay in DSDV
10	0.2	o.1
20	3.3	1.2
30	0.4	0.29
40	0.89	1.7
50	0.13	1.72
60	2.18	0.4
70	2.35	0.96
80	0.1	0.07
90	0.66	0.55
100	0.53	1.02
Total	10.74	8.01

AVERAGE=TOTAL/10

AODV= (10.74/10)=1.07

DSDV= (8.01/10)=0.8

Table 6 conclusion shows that the average of End to end delay in DSDV is lesser.

VI. Conclusion

We have first implementedWimax Module under Ns-2.35 Simulator and than analyzed its performance under various routing protocols in our case AODV & DSDV.From above results it is clear that when the wimax scenario is used with AODV protocol than it gives better performance as compare to that of DSDV.

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