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INFORMATION ABOUT SIMULATION SOFTWARE FOR TESTING OF WIRELESS NETWORK

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ABSTRACT

Actual network testing is time consuming and costly for researcher so Solution for this problem is that to test wireless network using open source and free software is available for that .The paper reflects the number of software availability to network model design and its performance . Many authors have worked on various QoS parameters using different service classes in WiMAX. WiMAX is wireless technology for fixed and mobile access and also known by IEEE802.16 standard .Now a day's WiMAX is fast and suitable wireless technology for urban and rural area which can cover maximum area with minimum infrastructure. IEEE 802.16e-2005 has been developed for mobile wireless communication which is based on OFDM technology and this enables going towards the 4G mobile in the future. In this paper, simulation model based on 802.16e OFDM-PHY baseband (WIMAX) and demonstrated in simulation scenarios with QPSK to find out the best performance of physical layer for WiMAX Mobile. All the necessary conditions were implemented in the simulation according to the 802.16e OFDMA-PHY specification. The study is conducted on various quality parameters impacting the WiMAX service performance of a WiMAX network and also introduces NS3 simulation software to test WiMAX network.

Keywords: Wireless N/W, Network simulation, Testing of N/W, Qos, Wimax., 4G Technology.

Contribution/ Originality

This paper contributes the literature study on network simulators availability and network model design and performance analysis using NS3 software. The contribution in the paper is based on number of nodes and their parameter which are (Design and simulation parameter, QOS) taken in to the consideration.

1. INTRODUCTION

The worldwide mobile subscribers and internet users are increasing day by day so to provide high data rate and advanced applications has become challenge in front of researchers and

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developers In high speed mobility communication 4G offers 100 Mbit/s (Such as trains or cars) and low mobility communication or fixed accessing would results 1 Gbit/s. This is a major revolution in wireless access technology. It's very much equivalent to getting a LAN or Gigabit Ethernet connection to a mobile device.4G provides all IP communication with high speed access to smart phones, tablets, laptops and any mobile smart devices. The number of application based on video , audio, text etc can be utilize with speed 54Mbits/s In many countries WiMAX testing is going on .The paper introduce different simulation software's to test wireless network such as WiMAX network and also one sample model simulation results using NS3 are explained . **Fig** 1 shows Fixed and Mobile WiMAX with different application scenario. For telemedicine purpose Hospitals connectivity, office access, home connection ,TV monitor , computer , laptop ,mobiles , vehicles like car , ambulance can be connected through WiMAX base stations . The WiMAX technology is selected as wireless technology for the research work due to following features .Different simulation softwares introduced and suitable network simulation software such as NS3 performance is included in the paper. The performance of WiMAX network for the purpose of to suggest the WiMAX technology for number of applications which could be useful as backbone for number of projects .The objective of thepaper are given below:

- To study the simulation soft wares
- To test the WiMAX N/W performance using NS3
- To suggest WiMAX technology as backbone for number of applicatons

The Challenges in case of WiMAX simulation:

- To decide Simulation Parameters
- To decide base station location
- To validate the results

2. METHODOLOGY

The network model based on WiMAX is simulated using NS3 and simulation results are taken into consideration for the number of applications. The number of design parameters and simulations parameters are taken in to the consideration during design and testing the N/W.

3. FEATURES OF WIMAX

3.1 Interoperability

The IEEE 802.16 standard is internationally accepted and the standard is maintained and certified by WiMAX forum which covers fixed, portable and mobile deployments and giving the user the freedom to choose their product from different certified vendors and use it in different fixed, portable or mobile networks.

3.2. Long Range

Another main feature of WiMAX is long range of coverage. It covers theoretically 50km from BS for LOS (Line of sight) and 10Km from BS for NLOS(non line of sight)

3.3. Mobility

WiMAX offers immense mobility especially IEEE 802.16e-2005 as it adopted SOFDMA (Scalable Orthogonal Frequency Division Multiple Access) as a modulation technique and MIMO (Multiple Input Multiple Output) in its physical layer. There are two challenges in wireless connectivity, one of them is for session initiation, which provides a mean to reach to inactive users and continue the connection service by extending it even the home location of that user has been changed and the other one provides an ongoing session without interruption while on moving.

3.4. Quality of Service

Quality of Service (QoS) refers to the collective effect of service perceived by the users. it is throughput, packet error rate, delay, and jitters etc. The WiMAX network supports a number of applications like voice, data, video, and multimedia. Each of these has different traffic pattern and requirements which is shown in the Table [1]

Table-1. Parameters for Broadband Wireless Application

Parameter	Interactive Gaming	Voice	Streaming Media	Data	Video
Data rate	50Kbps to 85Kbps	4Kbps-64Kbps	5Kbps-384Kbps	0.01Mbps-100Mbps	> 1Mbps
Applications	Interactive gaming	VoIP	Music, Speech, Video Clips	Web browsing, e-mail, instant messaging, telnet, file download	IPTV, movie download, p2p video sharing
Packet loss	Zero	<1%	<1% Audio <2% Video	Zero	<10-8
Delay Variation	Not Applicable	<20ms	<2sec	Not Applicable	<2sec
Delay	<50ms-150ms	<100ms	<250ms	Flexible	<100ms

3.5. Interfacing

Interface installation is one of the features of WiMAX. Each BS broadcast the radio signals to subscribers to maintain the connectivity. The one BS covers limited area so there is need to deploy numbers of BS at certain distance to broaden the network connectivity

3.6. Accessibility

To access the high speed network connectivity, there is need to become WiMAX subscriber

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After becoming authorized subscriber, service provider will install small hardware which you can connect through USB ports or Ethernet.

3.7. Scalability

802.16 standard supports flexible channel bandwidths for summarize cell planning in both licensed and unlicensed spectrum.

3.8. Portability

Portability is another feature as like mobility that is offered by WiMAX. It is not only offers mobility applications but also offers nomadic access applications.

3.9. Last Mile Connectivity

Wireless network accesses via DSL, T1-line or cable infrastructure are not available especially in rural areas. For such area the WiMAX is good solution .

3.10. Vigorous Security

WiMAX have a vigorous privacy and key management protocol as it uses Advanced Encryption Standard (AES) which provides vigorous encryption policy. It also supports flexible authentication architecture which is based on Extensible Authentication Protocol (EAP) which allows variety of subscriber credentials including subscriber's username and password, digital certificates and cards.
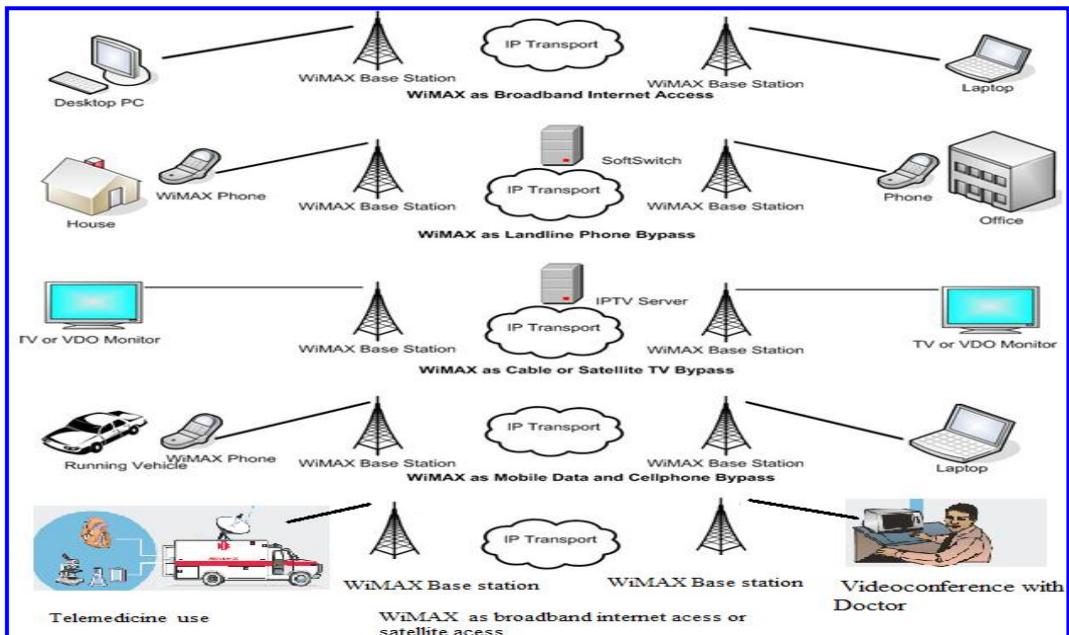

Fig-1. Fixed and Mobile WiMAX with different applications scenario

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4. SIMULATION SOFTWARE'S

Simulation is one of the important tools for researchers. The simulation in desktop computer or Laptop can be design hypothetical and real-life objects on a desktop computer or laptop so that it can be analyzed . The network is also simulated on the computer which is also called as virtual network. A network simulator is a technique of implementing the network on the computer. Through this the behavior of the network is calculated either by network entities interconnection using mathematical formulas, or by capturing and playing back observations from a production network. Network simulator allows the researchers to test the scenarios that are difficult or expensive to simulate in real world. OPNET, NS2, NS3, NetSim, OMNeT++, REAL, J-Sim and QualNet are Some of the network simulators .The table 2 shows the network simulators and its language usage .

Table-2. Network simulators and its language usage.

Sr no	Name of Network	Simulator Language
1	NS2	C++, Otcl
2	NS3	C++, Python
3	OPNET :	C (C++):
4	NetSim	Java
5	OMNeT	C++
6	REAL	C
7	J-Sim	Java, Tcl
8	QualNet	C/C++

4.1. NETSIM (Network Based Environment for Modeling and Simulation)

It is an application that simulates Cisco Systems networking hardware and software and is designed to aid the user in learning the Cisco IOS command structure.

4.2. NS2 (Network Simulator Version2)

NS2 is a discrete event simulator targeted at networking research. It provides support for simulation of TCP, routing, and multicast protocols over all networks (wired and wireless) and it is
Free for R &D and academic use.

4.3. NS3 (Network Simulator Version3)

NS3 is also an open sourced discrete-event network simulator which targets primarily for research and educational use. NS3 is licensed under the GNU GPLv2 license, and is available for research and development.

4.4. OPNET (Optimized Network Engineering Tools)

It is extensive and powerful simulation software with wide variety of possibilities to simulate entire heterogeneous networks with various protocols but it is not free for users.

4.5. OMNET++ (Optical Micro-Networks plus Plus)

It is capable of being extended, modular, component-based C++ simulation library and framework, primarily for building network simulators. JSIM (Java-based simulation). For designing   quantitative numeric models and analyzing them with respect to experimental reference data Java-based simulation system used   .Component-based software architecture is having JSim application.

4.6. QUALNET

It is a commercial version of GloMoSim used by Scalable Network Technologies for their defense projects. It is originally used for studying the dynamic behavior of flow and congestion control schemes in packet-switched data networks. It shows the way to users how the specify network behavior and perform simulation.

4.7. JSIM (Java-Based Simulation)

It is a Java-based simulation   system for building quantitative numeric models and analyzing them with respect to experimental reference data. Component-based software architecture is having JSim application which is development environment .

4.8.REAL (REalistic and Large)

It is originally used for studying the dynamic behavior of flow and congestion control schemes in packet-switched data networks. It shows the way to users how the specify network behavior and perform simulation.

5. WIMAX SIMULATION MODEL USING NS3

The users of Ns-3 can construct simulations of computer networks using models of traffic generators, protocols such as TCP/IP, and devices and channels such as Wi-Fi, and analyze or visualize the results .The Ns-3 simulator is first choice because it is has live visualizer and it has multiple choice   , written entirely in C++. It has a simulation core engine, a set of models, example programs, and tests. The ns-3 testing environment provides design validation and testing tools and encourages the publication of validation results. It is free software for research and development purpose. The Ns-3 development effort has Strict implementation of IEEE specifications ,Broad international use and contribution, Continuous academic, corporate, and public scrutiny of the source code , Academic "validation" through published articles and

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conference presentations and Extensive testing. Fig 2 shows the WiMAX n/w model with two base station BS1 and BS2 and total 56 nodes , Across BS1 the total subscribers nodes (SN)and subscriber sub nodes (SSN) are 28 and all are configured as mobile nodes and across BS2 also total nodes are 28 but all are configured as fixed nodes the WiMAX N/W model physical layer is configured and two QOS , UGS and rtps are tested with N/W .Their throughput, delay and percentage delay rate is observed using NS3 simulation software.

5.1. Physical Layer scenario

Physical layer scenario consists of equally distributed frames with equal length which transmit through modulation and coding of RF signals. OFDM technology has been incorporated into WiMAX technology. Different user assigning different sub carries which are allowed in orthogonal frequency division multiplexing (OFDM) techniques. Basically physical layer handles error correction and signal connectivity, as well as registration, initial ranging, connectivity channels and bandwidth request for data and management.

Wide range of frequencies supported by IEEE 802.16 standard and physical layer contains several multiplexing and modulation forms. Modulation methods in the uplink (UL) and downlink (DL) are Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK) and Quadrature Amplitude Modulation (QAM). The Time division duplex (TDD) and frequency division duplex(FDD) are supported by WiMAX standard . TDD framing is adaptive (when input changes then output behavior automatically changes). It consists fixed duration which consists one downlink frame and uplink frame. Base station (BS) sends complete downlink Up and Down link share same frequency but they are separated in time. In FDD Downlink and uplink can be done in same time, but on different frequency. UL and DL channels grouped into some continuous blocks of some paired channel. FDD system provide full duplex where we can make some application like voice, where DL and UP traffic requirement need more or less symmetric. In Base station (BS) to base station interface kept in minimum, in this technique, network for radio communication planning is easier.
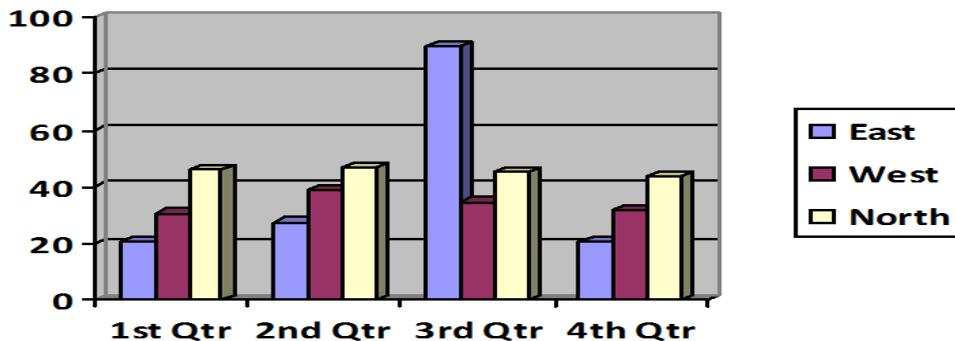
5.2. WiMAX Quality of Services(QOS)

5.2.1. UGS (Unsolicited Grant Service)

The best example of UGS is ATM which has Constant Bit Rate which generates a fixed size burst periodically. This service can be used to replace T1/E1 wired line or a constant rate service. During OFF period in case of UGC, there is wastage of BW then   also it supports real time applications such as VoIP or streaming applications.

5.2.2. The rtPS (Real-Time Polling Service)

It is for a variable bit rate real-time service such as VoIP. Every polling interval, BS polls a mobile and the polled mobile transmits band width request if it has data to transmit. The BS grants the data burst using UL-MAP-IE upon its reception.

5.2.3. The nrtPS(Non-Real-Time Polling Service)

It is very similar to the rtPS except that it allows contention based polling.

5.2.4. The BE (Best Effort)

E-mail or FTP are the applications of BE , in which there is no strict latency requirement. The allocation mechanism is contention based using the ranging channel.

5.2.5. ertPS (Extended rtPS)

ertPS (Extended rtPS) is another options was introduced to support variable rate real-time services such as VoIP and video streaming. It carries lower overhead than UGS and rtPS .

5.2.6. Performance of WiMAX N/W Model

Fig 3 Shows the overall response is given by 56 nodes in 7 sec during transmission .The 224 packets are transmitted and received packets are 203   , overall delay is 0.0384147 sec and packet delivery ratio is 90%   , throughput is 263 Kbps . The response given by the N/W   is shown in graphical format in Fig 4, Fig 5, Fig 6 .The Fig 4 has simulation maximum period 7 sec on X axis and Y axis has the throughput ,the response is 263 Kbps .Fig 5 has simulation period   maximum 7 sec and   overall delay of 56 nodes transmission is 0.0384137 sec .Fig 6 shows the packet delivery ratio is 90% within 7 sec.
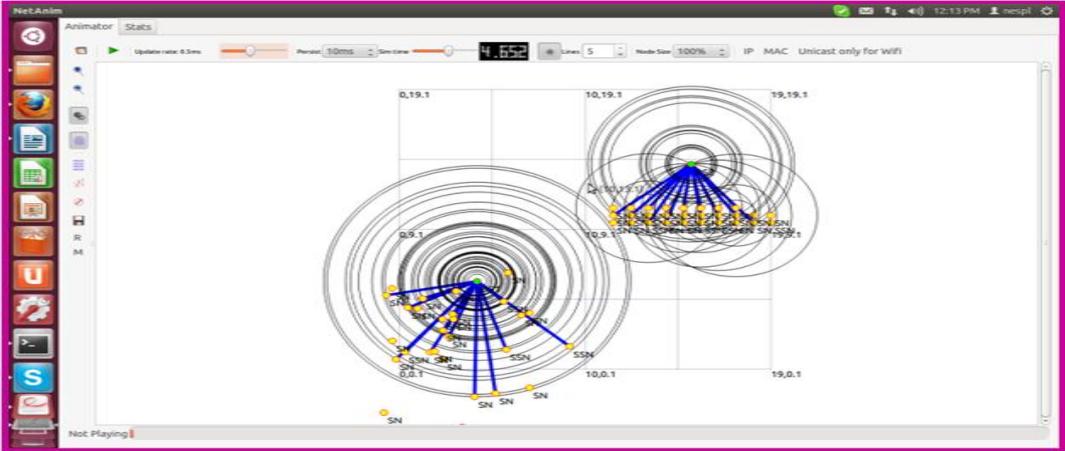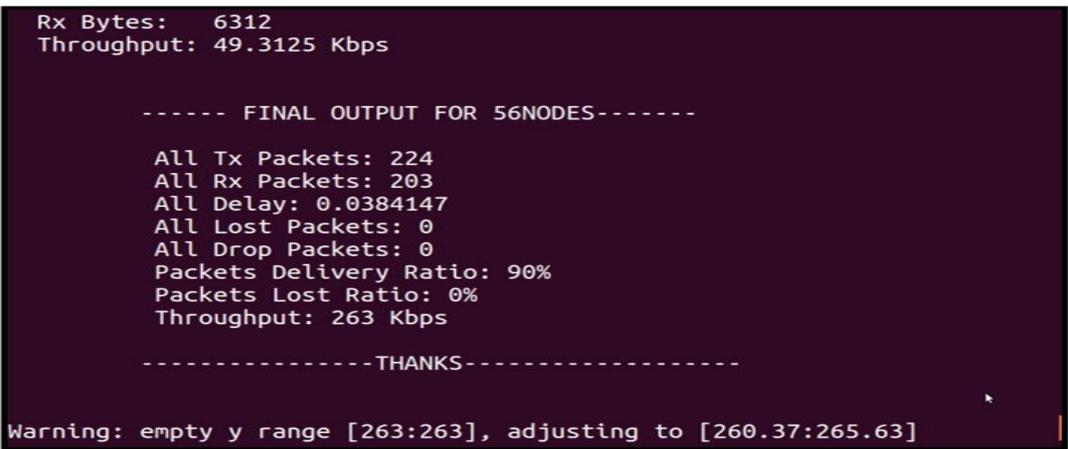
Fig-2. WiMAX N/W model
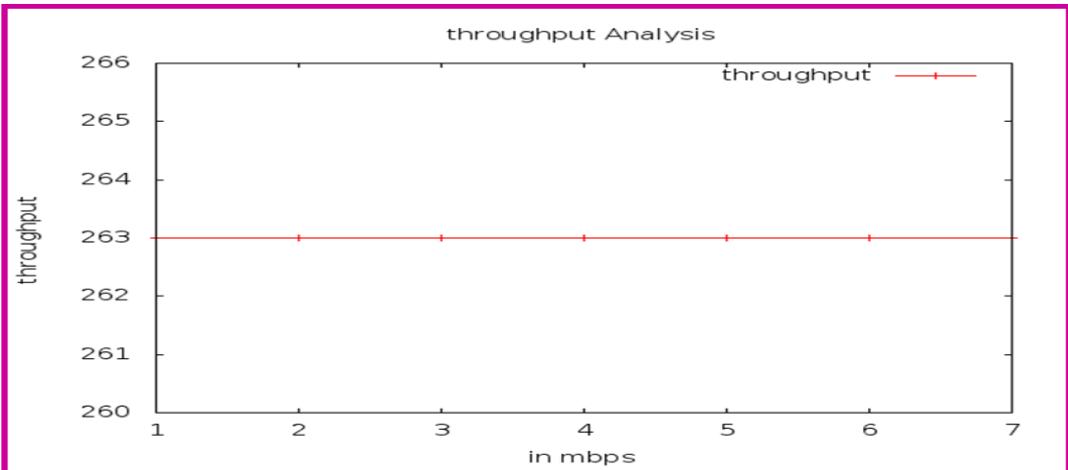

Fig-3. Simulation results for WiMAX N/W model
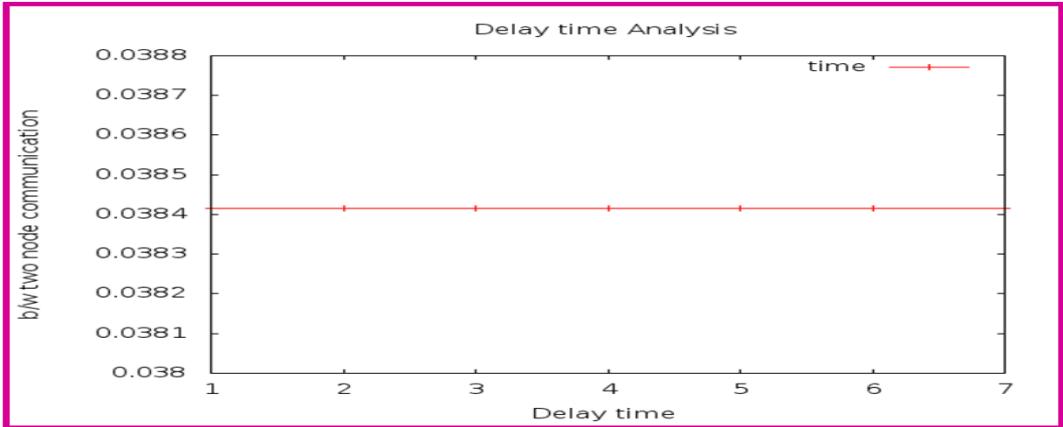

Fig-4. Throughput analysis
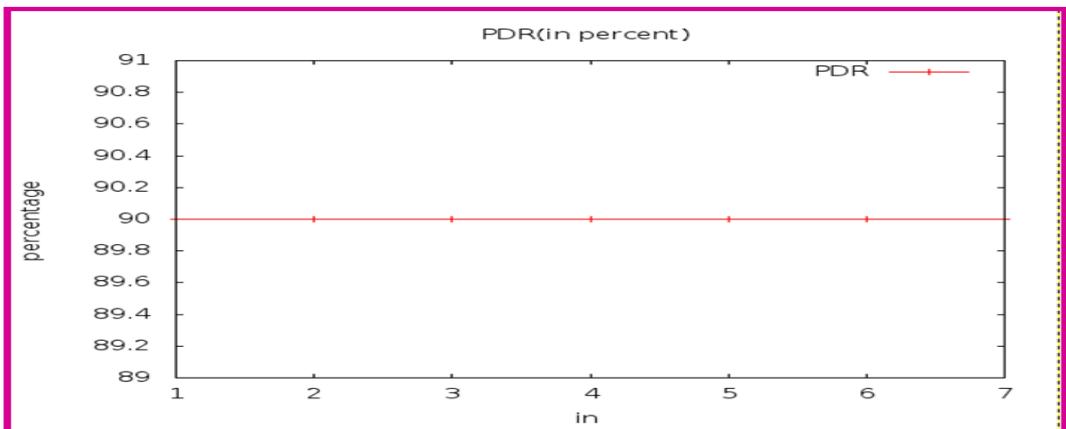
Fig-5. Delay time analysis

Fig-6. packet delivery ratio (PDR)

6. CONCLUSIONS

In above results it has been shown that performance WIMAX network is satisfied there is negligible packet delivery loss. Above results has been analyzed using NS3 simulator and to measure the performance we took three parameters Network Throughput, Network Delay and PDR Value, and after examining the simulation in mobile environment and fixed environment , it shows that the performance of WIMAX network depends on speed of the mobile nodes. For testing the WiMAX network the NS3 software found suitable and maximum 90 % response in case of transmission and reception is found . Without spending any cost thWiMAX n/w testing is done successfully . This could help to transform India's mobile N/W into WiMAX at root level . The new design of the physical layer has improved the simulation time by several magnitude orders while still providing a realistic implementation of the standard. Furthermore, the IP classifier has enabled the simulation of an unlimited number of service flows per subscriber station, while the proposed schedulers improve the management of the QoS requirements for the different service flows.

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