Performance analysis of aodv, dsdv and aomdv using wimax in NS-2

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Abstract

WiMAX (IEEE 802.16) technology empowers ubiquitous delivery of wireless broadband facility for fixed and mobile users. WiMAX standard describes numerous physical and MAC layer characteristics. Here, an attempt is made to implement some of these physical and MAC layer structures including the mobility extension 802.16e. NS2 (Network Simulator-2) is chosen as the simulator to implement these features as NS2 provides suitable library to simulate network scenario. The performance of the simulated module is analyzed by running AODV, DSDV and AOMDV routing protocols on a wired-cum-wireless WiMAX scenario. The throughput for each routing protocol is calculated for varying number of mobile nodes or subscriber stations.

Keywords: *Worldwide Interoperability for Microwave Access (WiMAX), AODV, DSDV and AOMDV routing protocols*

1. Introduction

Worldwide Interoperability for Microwave Access (WiMAX), is wireless broadband standard that has promised high bandwidth over long-range transmission. The standard identifies the air interface, including the medium access control (MAC) and physical (PHY) layers, of Broadband Wireless Access.

WiMAX technology enables ubiquitous delivery of wireless broadband service for fixed and/or mobile users, and came into existence in 2006 by Korea Telecom, when it started the deployment of a 2.3 GHz type of mobile WiMAX service called WiBRO in the Seoul metropolitan area to provide great performance for data and video. WiMAX is a standard-based wireless technology that delivers high throughput broadband connections over lengthy distance. WiMAX can be deployed for a number of applications, comprising “last mile” broadband connections, hotspots and high-speed internet access for network users. It delivers wireless metropolitan area network (MAN) connectivity at speeds up to 70 Mbps and the WiMAX base station typically can cover 5 to 10 km.

The supple bandwidth allocation and multiple built-in types of Quality-of-Service (QoS) support in the WiMAX technology let the facility of high-speed Internet access Voice over IP (VoIP) and video calls, multimedia chats and mobile show business. Also, the WiMAX connection can be used to transport data to multimedia devices such as the iPod.

The significant growth in the Physical layer comprises orthogonal frequency- division multiplexing (OFDM), in which multiple access is accomplished by allocating a subset of subcarriers to each individual user. This looks like code-division multiple access (CDMA) spread spectrum in that it can offer diverse quality of service (QoS) for individual consumer; users attain different data rates by assigning different code spreading factors or different numbers of spreading codes [1].

NS2 is the simulator used here. It has two languages because simulator has two different kinds of things it needs to do. On one hand, a detailed simulation of protocols requires a systems programming language which can efficiently manipulate bytes, packet headers, and implement algorithms that run over large data sets. For these tasks run-time speed is important and turn-around time (run simulation, find bug, fix bug, recompile, re-run) is less important. On the other hand, a large part of network research involves slightly varying parameters or configurations, or quickly exploring a number of scenarios. In these cases, iteration time (change the model and re-run) is more important. Since configuration runs once (at the beginning of the simulation), run-time of this part of the task is less important. *NS* meets both of these needs with two languages, C++ and OTcl. C++ is fast to run but slower to change, making it suitable for detailed protocol implementation. OTcl runs much slower but

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can be changed very quickly (and interactively), making it ideal for simulation configuration. *NS* (via tclcl) provides glue to make objects and variables appear on both languages [2].

2. Literature Review

2.1. AODV (Ad hoc On-demand Distance Vector)

AODV is a distance vector routing algorithm which discovers route whenever it is needed via a route discovery process. It adopts a routing algorithm based on one entry per destination i.e., it records the address of the node which forwards the route request message. AODV possesses a significant feature that once the algorithm computes and establishes the route between source and destination, it does not require any overhead information with the data packets during routing. Moreover the route discovery process is initiated only when there is a free/available route to the destination. Route maintenance is also carried out to remove stale/unused routes. The algorithm has the ability to provide services to unicast, multicast and broadcast communication. AODV routing algorithm has two phases.

2.1.1. Route discovery phase

When a node wants to send some packets to the desired node or destination, it tries to look into the routing table for its next hop. Then the source sends RREQ message to the neighbors or next hop, which is then retransmitted by the intermediate node until the RREQ reaches the destination. To avoid the route request packets from congesting the network, the algorithm uses expanding-ring strategy. In this technique, the node which tries to send the packets sets the initial value of the TTL (time-to-live) to search the destination. If the RREQ reaches the next hop, TTL is decremented. If not reached/no reply is received, the value is incremented till it reaches the threshold value.

When an intermediate node receives the RREQ, it stores the address of the adjacent node from which it receives the first packet of the route request message, so that the node will be capable of establishing a reverse path. When route request RREQ message reaches the destination node, a unicast route reply RREP message is sent along the reverse path. As the RREP traverse along the reverse path, forward path entries to the destination are recorded. Hence the route from source to destination is established when route reply message is received at the source.

2.1.2. Route maintenance phase

The route established between the source and destination is maintained as long as the route is needed by the source to transmit packets. Source can reinitiate route discovery phase to establish new route when it moves during routing of packets. In other case, if the destination/intermediate node breaks from the routing chain, route error RERR message is sent to the nodes in the route till it reaches the source. Upon receiving the route error message, the source stops the data transmission and reinitiates route discovery process [5]

AODV (Reactive type routing protocol) AODV is a modification version of destination sequence distance vector (DSDV) protocol used in wireless mobile networks. This property solves the disadvantages of DSDV by implementing a sequence number. Not like DSR [9] which carries the whole route from source to destination in the packet, the nodes in AODV carry out the next hop information corresponding to each data flow. Reactive protocol route is discovered as when needed and maintained as long as they required. Hybrid protocols have well combination form of both reactive and proactive routing protocols methods [3]

2.2. DSDV

DSDV is a pro-active, table-driven protocol based on the distributed version of the classical. Each mobile node stores a routing table that contains information about all the possible destinations in the network. Each entry in the routing table is marked with a sequence number assigned by the destination node and contains information like the number of hops required to reach the destination and the next hop on the path to the destination. The route labelled with the latest sequence number is always used to avoid stale routes. If two updates have the same sequence number, the route with the minimum number of hops to reach the destination is used. Routing table updates are propagated periodically across all nodes to maintain table consistency. Thus, in spite of the high communication overhead, a node always learns of the shortest hop route to the destination. DSDV fits under the minimum-weight path routing category.

Destination-Sequenced Distance Vector routing protocol (DSDV) is a typical routing protocol for MANETs, which is adapted from the conventional Routing Information Protocol (RIP) to ad hoc networks routing. One key advantage of DSDV over traditional vector protocols is that it guarantees loopfreedom. Each DSDV node maintains a routing table for the next hop to reach a destination node. DSDV tags each route with a sequence number which is originated by the destination, indicating how old the route is. Each node manages its own sequence number by assigning it two greater than the old one (call an even sequence number) every time. When a route update with a higher sequence number is received, the old route is replaced [4]

2.3. AOMDV

AOMDV is based on AODV and obtains multiple loop-free link-disjoint paths using the following property observable in flooding: Let *S* be a node that floods a packet m to the network. At any node *I* (_*S*), the set of copies of m received via different neighbours of *S* constitute a set of node disjoint paths (and hence the link-disjoint paths) from *I* to *S*.

Loop freedom is guaranteed using the notion of "advertised hop count" for a given destination sequence number (or RREQ packet) at each node in the network. The "advertised hop count" of a node *I* is basically the hop count incurred by t1he first RREQ packet for a given destination sequence number from the source *S* to node *I*. When a node has no route to the destination, it forwards only the first arriving RREQ packet. When a node has a valid route to the destination and receives a duplicate RREQ packet, it checks whether the RREQ packet arrived on a new node-disjoint path using the above flooding property. If so, the node checks whether the hop count incurred by this RREQ is less than that of the primary path. As the primary path is selected similar to the procedure used in AODV, it is most likely to be a minimum delay path, while the alternate paths have hop counts shorter or equal to the primary path. Thus, AOMDV could fit into the category of routing protocols based on minimum-weight path routing. Since, AOMDV selects only link-disjoint or node-disjoint paths, the multiple paths are likely to have infrequent route discoveries at low mobility compared to single-path AODV.

3. Implementation

The prototype implemented is based on the IEEE 802.16 standard (802.16-2004) and the mobility extension 80216e-2005. The wireless simulation supports multi-hop ad-hoc networks or wireless LANs. But there is a need to simulate a topology of multiple LANs connected over wired nodes, or in other words necessity is to create a wired-cum-wireless topology. The wired-cum-wireless network scenario of the WiMAX networks is being created using Tool Command Language (TCl). TCL is the front-end language in NS2.

3.1. Topology

For the mixed scenario, we are going to have 1 wired node called Sink, connected to our wireless domain consisting of 5 mobile nodes and 10 mobile nodes in the second scenario via a base-station node, BS. Base station nodes are similar to gateways between wired and wireless spheres and permit packets to be exchanged between the two kinds of nodes.

3.2. TCL Script

The Adhoc routing protocol used are DSDV, AODV and AOMDV. Also, TCP and CBR links are defined between the wired and wireless nodes in the script.

For mixed simulations it is required to use hierarchical routing in order to route packets between wireless and wired domains. In NS-2, the routing statistics for wired nodes are centered on connectivity of the topology that is how nodes are connected to one another using Links. This connectivity information is conditioned to populate the forwarding tables in every wired node. However wireless nodes have no perception of "links". Packets are routed in a wireless topology by means of their adhoc routing protocols which construct forwarding tables by trading routing queries among its neighbors. Consequently so as to exchange packets among these wired and wireless nodes, base-stations are used, which work as gateways between the two domains. Separation of wired and wireless nodes is done by employing them in different domains. Domains and sub-domains (or clusters) are defined using hierarchical topology structure

The throughput of the WiMAX network is analyzed by implementing three routing algorithms, DSDV, AODV and AOMDV. The comparison of the throughput of WiMAX network in scenarios for different number of nodes is shown in following sections.

4. Performance analysis

The graphs are plotted by considering number of packets and the throughput. The graphs show the behavior of routing protocols with varied number of nodes. The graphs change when different protocols of Transport layer are used. So the each routing algorithm is analysed with both TCP and UDP separately.

Figure 1 and Figure 2 show the performance of the network with DSDV as routing protocol. The throughput of the WiMAX network varies as the number of nodes is increased. It fails when the number of nodes increases to 35 with only one destination node.

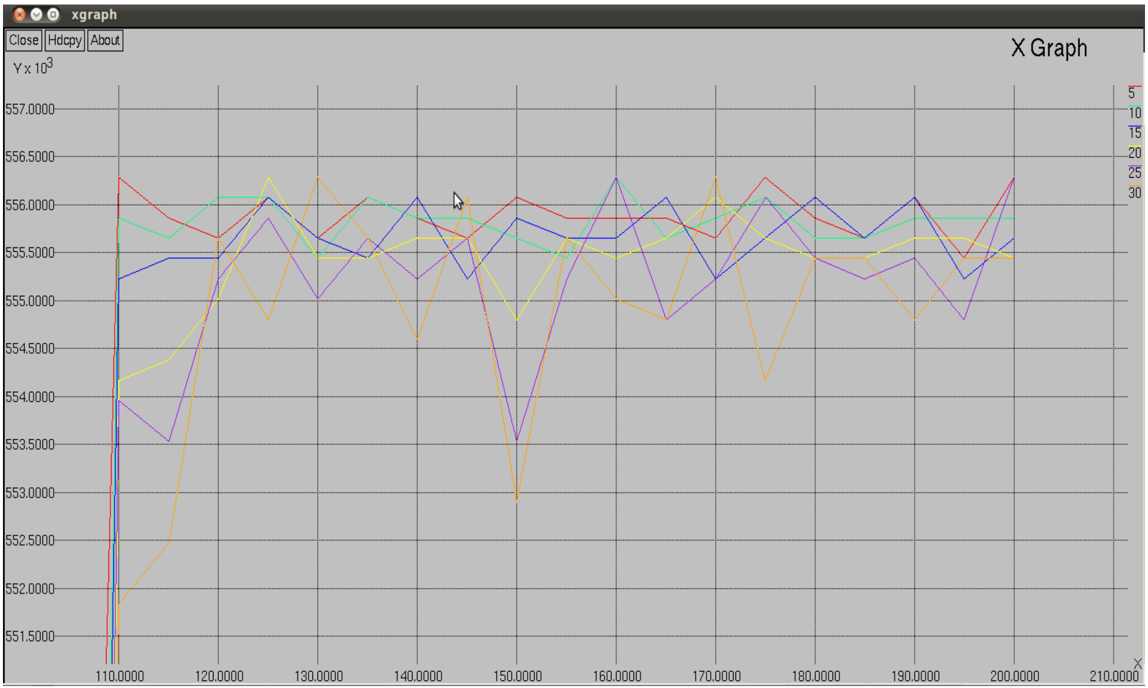

Figure1: DSDV performance analysis using TCP

Figure 3 and Figure 4 show the performance of the network with AODV with TCP and UDP. Figure 5 and Figure 6 show the performance of the network with AOMDV as routing protocol with TCP and UDP.

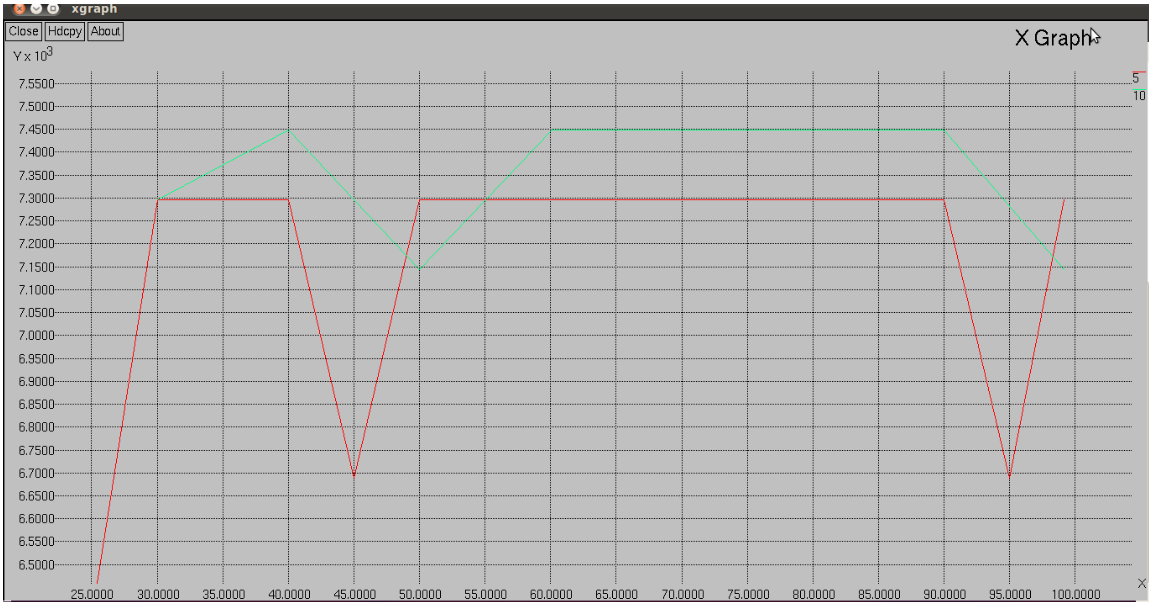

Figure2: DSDV performance analysis using UDP

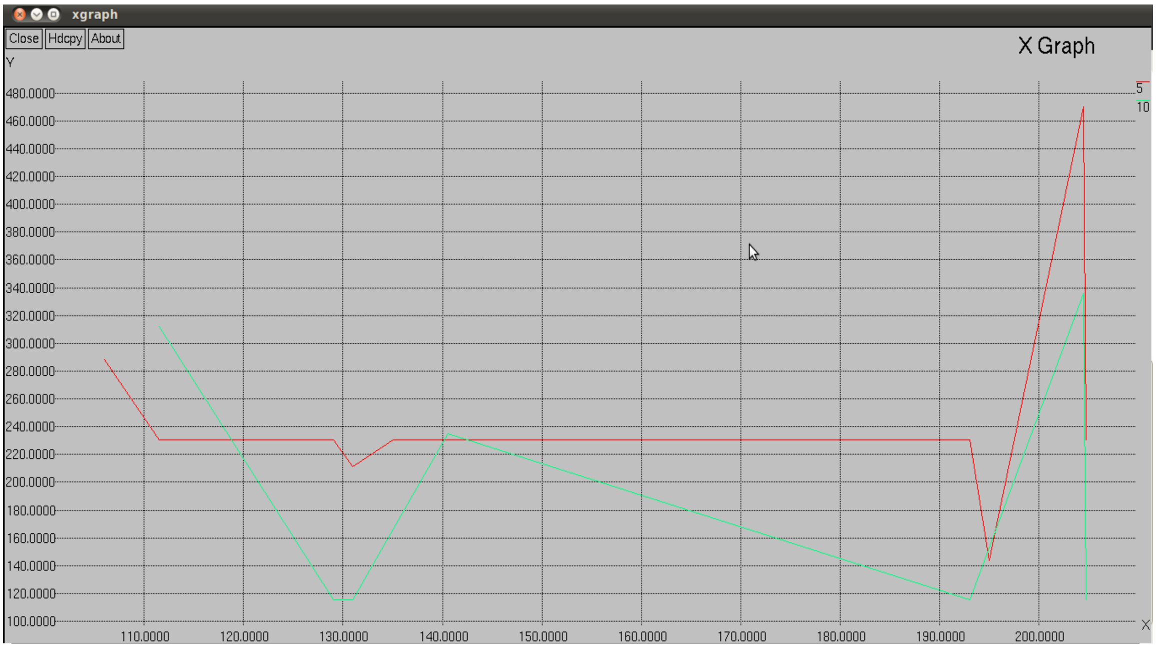

Figure 3: AODV performance analysis using TCP

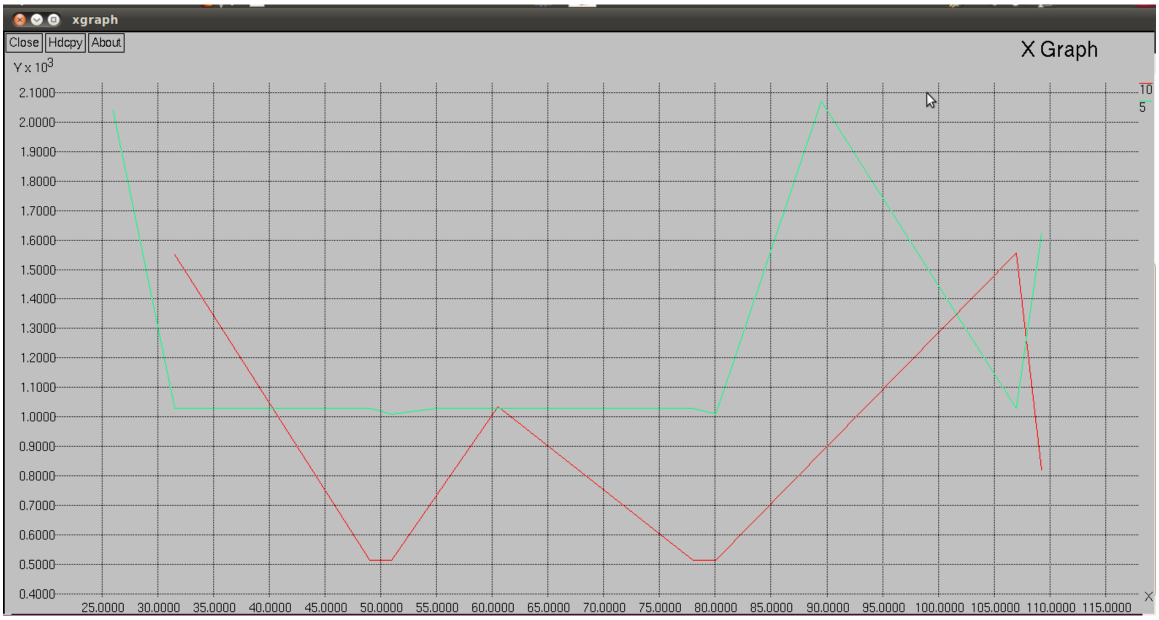

Figure 4: AODV performance analysis using UDP

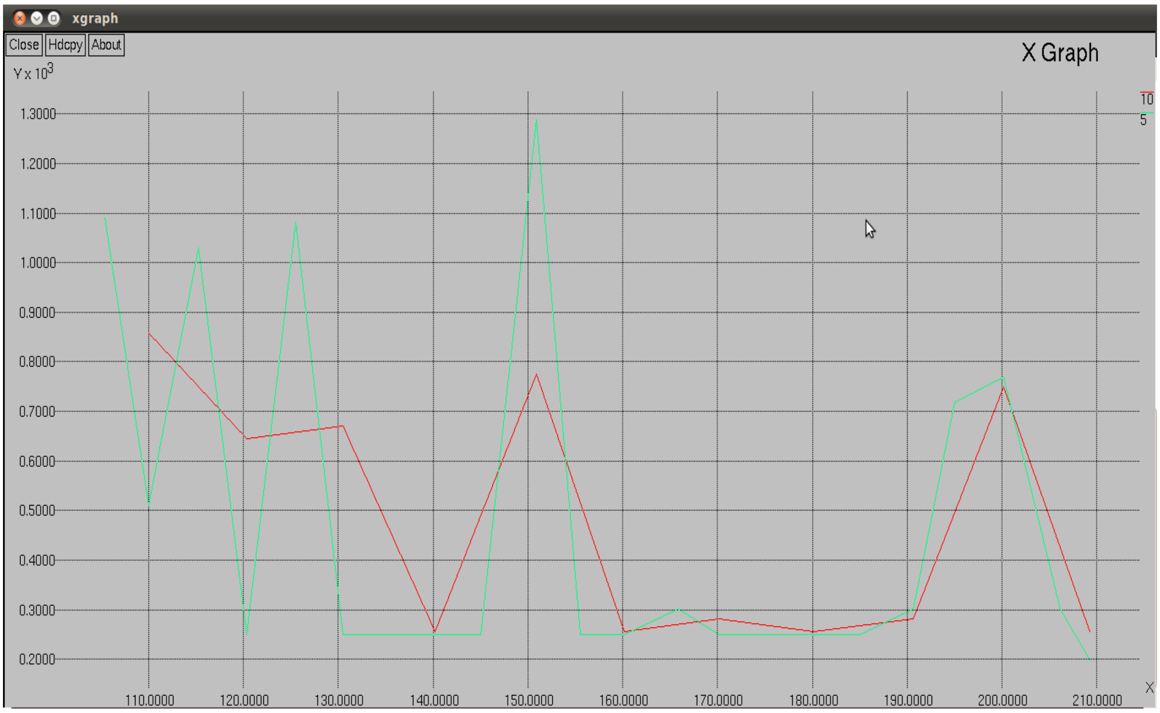

Figure 5: AOMDV performance analysis using TCP

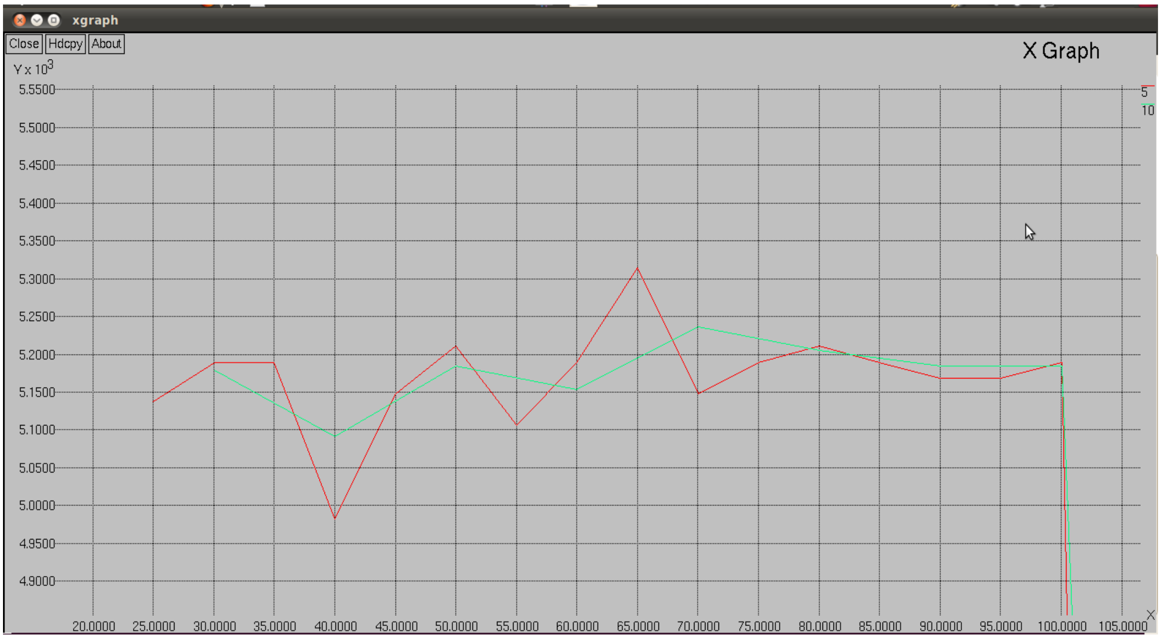

Figure 6: AOMDV performance analysis using UDP

5. Conclusion

Various modules for IEEE 802.16 WiMAX network were implemented using NS-2. To measure the performance of the implemented modules various routing algorithms like AODV, AOMDV and DSDV are run and graphs are plot for measuring throughput of these algorithms by varying the number of subscriber stations. It is being observed that the throughput increases initially and as the simulation is carried out the throughput varies over a range. It decreases as the number of subscriber stations communicating with the wired sink node via base station, increases. It is also noticed that, the throughput of the system is the highest for DSDV protocol and the lowest for AOMDV protocol. As most of the physical and MAC layer features are implemented, the WiMAX package can further be enhanced by implementing new wireless routing algorithms and measuring the performance of various parameters for those routing algorithms.

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