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Design and Implementation of QoS in WiMAX Module using Two-ray ground and Shadowing Mobility Model under NS-2

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Abstract: WiMAX is the short form of the Worldwide Interoperability for Microwave Access. Typically, fixed WiMAX networks have a higher-gain directional antenna installed near the client results in greatly increased range and throughput. Mobile WiMAX networks are usually made of indoor Customer Premises Equipment (CPE) such as desktop modems, compared to directional antennas but they are more portable. The mobility model is designed to describe the movement pattern of mobile users, and how their location, velocity and acceleration change over time. Since mobility patterns play a significant role in determining the protocol performance, it is desirable for mobility models to emulate the movement pattern of real life applications in a reasonable way. We have provided a categorization for various mobility models onto several classes based on their specific mobility characteristics. For some mobility models, the movement of the WiMAX node is likely to be affected by its movement history. The authors are aware that this performance comparison of mobility scenarios has not attempted in WiMAX Environments or IEEE 802.16 module. We have taken scenario file as IEEE 802.16 Standard in which we have implemented reactive and proactive routing protocols, In our TCL scripts which consist of various routing protocols such as AODV (Ad-hoc On-Demand Distance Vector Routing) and DSDV (Dynamic Destination Sequenced Distance-Vector Routing) than a particular WiMAX scenario or topology with various node densities i.e. 20 nodes, 40 nodes and 60 nodes. The protocol result metrics are Packet Delivery Ratio (PDR), End to End Delay and Throughput, by using network simulator (NS-2).

Keyword: WiMAX, AODV, DSDV, NS-2.35, IEEE 802.16

I. INTRODUCTION

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 providing high speed data transfers over the air. The WiMAX Forum is an industry-led, non-profit organization that certifies and promotes the compatibility and interoperability of broadband wireless products based upon IEEE Standard 802.16 [9]. 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) [3], 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 [9], 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.The key functionality of MAC layer of IEEE 802.16 is to provide quality of service (QoS) constraint for MAC PDUs [6]. This means that the latency, jitter, data rate, packet error rate and system availability should be met for all service flow. Based to these QoS requirement, PDUs are scheduled and PHY resources are utilized efficiently. Due to the different data service presence, five distinct scheduling services are introduced as follows:

Unsolicited grant service (UGS): This scheduling service is defined for real-time service flows which generate fixed-size data packets on a periodic basis, like VoIP and T1/E1. UGS does not need SS to send bandwidth request. [11]

Real-time polling service (rtPS): This type is designed for real-time service flows which generate variable-size data packets on a periodic basis, like MPEG video. The BS provides unicast polling opportunities for the SS to request bandwidth. [11]

Non-real-time polling service (nrtPS): This is similar with rtPS, but BS provides contention-based polling in the uplink for SS to request bandwidth. FTP is a nice example of this service type. [11]

Best-effort service (BE): Best Effort services do not have QoS constraint which means no guarantee to deliver data.

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Data is sent when resource is available. The SS uses only the contention-based polling opportunity for bandwidth request. Web Browsing is BE service which is supported by WiMAX.[11]

Extended real-time polling service (ertPS): This scheduling service is a sort of combination of UGS and rtPS. It supports real-time applications, such as VoIP with silence suppression, that have variable data rates but require guaranteed data rate and delay. It is introduced in IEEE 802.16e.[11]

II. ANOVERVIEWOFIEEE802.16 STANDARDS

The standard defines the specifications related to the service-specific convergence sublayer (CS), the MAC common part sublayer (CPS), the security sublayer, and the physical layer. The MAC management messages are implemented to operate the WiMAX networks. All operations between the base station (BS) and subscriber station (SS) over a super frame interval follow the procedures of the 802.16 standard.

The section briefly summarizes the operations of MAC and PHY layers in the IEEE802. 16 standard, the architecture of IEEE802.16. The CS provides any transformation or mapping of external network data that is received through the CS service access point (SAP) and converts the minto MAC service data units (MSDUs) received by the MAC layer through the MACSAP. This sub layer includes classifying external network SDUs and associating the m 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 MACCPS 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 MACSAP, which is classified to particular MAC connections. The IEEE802.16-2004 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. In802.16e 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 appropriated at a 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 thet ype-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 pay load is packed by the seen coding 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 isused by the SS to respond the channel measurements listed in the received REP-REQ.

***Routing protocol*:** A routing protocol specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network. Routing algorithms determine the specific choice of route.

AODV: A node running Ad-hoc on demand distance vector (AODV) initiates a route discovery process only when it has data packets to send and it does not know any route to the destination node that is route discovery AODV is on-demand AODV uses a routing table to specify distances to destinations. It uses sequence numbers maintained at each destination to determine the freshness of routing information and to prevent routing loops. Ad hoc On-Demand Distance Vector (AODV) Routing is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad-hoc networks. It is jointly developed in Nokia Research Centre, University of California, Santa Barbara and University of Cincinnati by C. Perkins, E. Belding-Royer and S. Das. It is a reactive routing protocol,

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meaning that it establishes a route to a destination only on demand. In contrast, the most common routing protocols of the Internet are proactive, meaning that they find routing paths independently of the usage of the paths. AODV is, as the name indicates, an on demand distance-vector routing protocol. AODV avoids the counting-to-infinity problem of other distance-vector protocols by using sequence numbers on route updates, a technique pioneered by DSDV. AODV is capable of both unicast and multicast routing. [6]

Working of AODV: In AODV, the network is silent until a connection is needed at this time the network node that needs a connection broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node [17]. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time. When a link fails, a routing error is passed back to a transmitting node, and the process repeats with complexity of the protocol is to lower the number of messages to conserve the capacity of the network. For example, each request for a route has a sequence number. Nodes use this sequence number so that they do not repeat route requests that they have already passed on. Another such feature is that the route requests have a "time to live" number that limits how many times they can be retransmitted. Another such feature is that if a route request fails, another route request may not be sent until twice as much time has passed as the timeout of the previous route request.

DSDV: Destination-Sequence based Distance-Vector Routing (DSDV) protocol is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. It was developed by C. Perkins and P.Bhagwat in 1994. The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently. [7]

Working of DSDV: Packets are transmitted between the stations of the network by using routing tables which are stored at each station of the network. Each routing table, at each of the stations, lists all available destinations, and the number of hops to each. Each route table entry is tagged with a sequence number which is originated by the destination station. To maintain the consistency of routing tables in a dynamically varying topology, each station periodically transmits updates, and transmit updates immediately when significant new information is available, since we do not assume that the mobile hosts are maintaining any sort of time synchronization, we also make no assumption about the phase relationship of the update periods between the mobile hosts. These packets indicate which stations are accessible from each station and the number of hops necessary to reach these accessible stations, as is often done in distance-vector routing algorithms. Updating of routing table of a node is done when it received routing information from any node and when some criteria are satisfied. The node updates its routing information in its routing table entry for the corresponding destination describe in the incoming data with the incoming routing information if:

1. Sequence number of the incoming routing information >Sequence number of the routing table entry.
2. Sequence number of the incoming routing information > Sequence number of the routing table entry and value of metric that is the number of hop of the incoming routing information < Value of metric in the corresponding routing table entry. The node will discard the incoming message if: Sequence number of the incoming routing information = Sequence number of the routing table entry and Value of metric of the incoming routing information > Value of metric in the corresponding routing table entry. The node will then increment the value of metric by 1 only if the routing information is updated.

Propagation type: The propagation models implemented in ns are used to predict the received signal power of each packet. At the physical layer of each wireless node, there is a receiving threshold.When a packet is received, if its signal power is below the receiving threshold, it is marked as error and dropped by the MAC layer. Up to now there are three propagation models in ns, which are the free space model1, two-ray ground reflection model and the shadowing model.

Two-Ray Ground: The Two Ray Ground model is also a large scale model. It is assumed that the received energy is the sum of the direct line of sight path and the path including one reflection on the ground between the sender and the receiver. A limitation in ns-2 is that sender and receiver have to be on the same height. It is shown that this model gives more accurate prediction at a long distance than the free space modelTwo-ray ground radio propagation model is highly preferred in the research of MANET .Two Ray Ground radio propagation model is also used for protocols performance in VANET scenario. This is a more realistic than the Free-Space model when we consider a ground reflected propagation path between transmitter and receiver. The model is especially useful for predicting the received power at large distances from the transmitter. The received power at distance d is predicted by:

$$P_r = \frac{h_r^2 h_t^2 P_t G_r G_t}{d^4 L}$$

In the formula h_r and h_t are the heights of the transmitter and receiver antennas respectively and **L** is system

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loss.However, the two-ray model does not give a good result for a short distance due to the oscillation caused by the constructive and destructive combination of the two rays.

Shadowing: Shadowing is an important effect in wireless networks. It causes the received SINR to vary dramatically over long time scales. The Walfish-Ikegami (W-I) model applies to smaller cells it is recommended by WiMAX forum for modelling microcellular environments. The model assumes an urban environment with a series of buildings. The shadowing radio propagation model have many possible scenario that can affect radio signal power the research study by Ibrahim khider. The sender-receiver distance is the only variable parameter during simulations. This forms a circular coverage around a sending node and a sharp range limit. Beyond this range, no further reception is possible. To introduce random events, the shadowing model utilizes a random variable X. The shadowing model requires a reference distance **d0** to calculate the average received FS signal strength **Pr,fs(d0)**. The path loss exponent **β** depends on the simulated environment and is constant throughout simulations. Values vary between two (free space) and six (indoor, non-line-of-sight). X is normal distributed with an average of zero and a standard deviation σ (called shadow deviation). Again it is non-variable and reasonable values vary between three (factory, LOS) and twelve (outside of buildings). Values for **β**was empirically determined. The shadowing model consists of two parts. The first one is known as path loss model, which also predicts the mean received power at distance d denoted by$\boldsymbol{P_r(d)}$.It uses a close-in distance $\boldsymbol{P_0}$ as a reference. $\boldsymbol{P_r}$**(d)** Is computed relative to $\boldsymbol{P_r(d_0)}$ as follows.

$$\frac{\boldsymbol{P_r(d_0)}}{\boldsymbol{P_r(d)}} = \{\boldsymbol{d/d0}\}^{\beta}$$

III. 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:

1. Total no. of Drop Packets: It is the difference between sending and received packets.
2. Throughput: Throughput is the average rate of successful message delivery over a communication channel.
3. End to end Delay: It can be defined as the time a packet takes to travel from source to destination. We have implemented our work i.e. Creation of WiMAX Scenario for NS-2 and then to create Different routing protocols with the use of Various performance matrices like Packet Delivery Ratio, End to End delay, Residual Energy and Overall Throughput. In our case first we have created scenario file for IEEE 802.16e standard which is TCL script consist of various routing protocols in our case these are AODV, DSDV and MAODV than a particular WiMAX scenario or topology with low to high node densities.

We have reached to the results with the help of various performance matrices the following performance matrices are:-

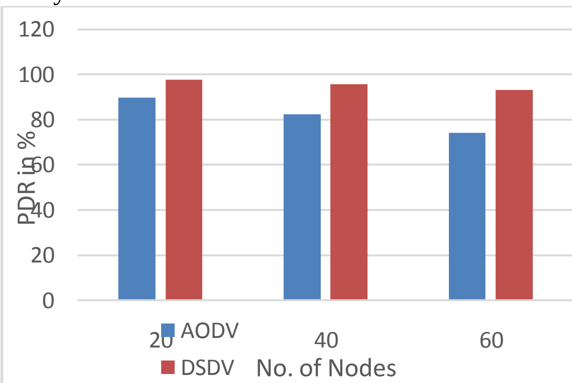
- Packet Delivery Ratio
- End to End Delay
- Throughput

Table 1: Simulation Parameters Considered

Parameters	PDR,E2Edelay, Throughput
Simulator	NS-2.35
Antenna type	Omni Directional
IEEE Standard	IEEE 802.16
Routing Protocol	AODV,DSDV
Simulation Time	30sec

Packet Delivery Ratio*:*
Packet delivery ratio is defined as the ratio of data packets received by the destinations to thosegenerated by the sources.

Figure 1 Comparison of AODV & DSDV with Packet Delivery Ratio



Parameters	AODV			DSDV		
Number of Nodes	20	40	60	20	40	60
Packet Delivery Ratio (In %)	89.68	82.42	74.16	97.58	95.66	93.23
End to End Delay (in ms)	429.44	490.67	344.88	468.47	462.55	311.99
Throughput (in Kbps)	614.50	567.18	597.82	604.06	603.95	634.33

Table 2: Shadowing mobility model for AODV & DSDV

Analysis of Packet Delivery Ratio: **-** In terms of packet delivery ratio the WiMAX module withlow to high node density from Figure 1 shows that the AODV gives better performance for low to high node density.

End to End Delay:
The average time it takes a data packet to reach the destination. This includes all possible delays caused by

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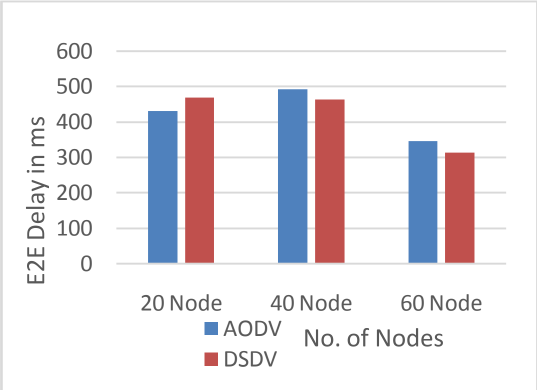
buffering during route discovery latency, queuing at the interface queue. This metric is calculated by subtracting time at which first packet was transmitted by source from time at which first data packet arrived to destination.

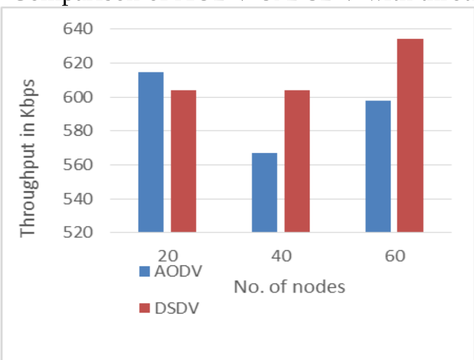
Figure 2 Comparison of AODV & DSDV with End to End Delay



Analysis of End to End Delay:-From above Graph it is clear that AODV have low end to end delay as compare to DSDV and AODV for low to high node density.

Throughput:
It is defined as the total number of packets delivered over the total simulation time. The throughput comparison shows that the three algorithms performance margins are very close under traffic load of 50 and 100 nodes in MANET scenario and have large margins when number of nodes increases to 200.

Figure3 Comparison of AODV & DSDV with throughput



Analysis of Throughput: -In terms of throughput it is clear from the Figure that the AODV gives good throughput as compare to the DSDV

Table 3: Two ray ground mobility model for AODV & DSDV

Parameters	AODV			DSDV		
Number of Nodes	20	40	60	20	40	60
Packet Delivery Ratio (in %)	94.88	89.34	92.52	96.34	87.94	91.77
End to End Delay (in ms)	625.293	548.844	166.945	320.094	494.423	106.299
Throughput (in Kbps)	380.72	436.29	904.88	446.79	324.88	859.56

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Two ray ground mobility model

1. Packet Delivery Ratio:

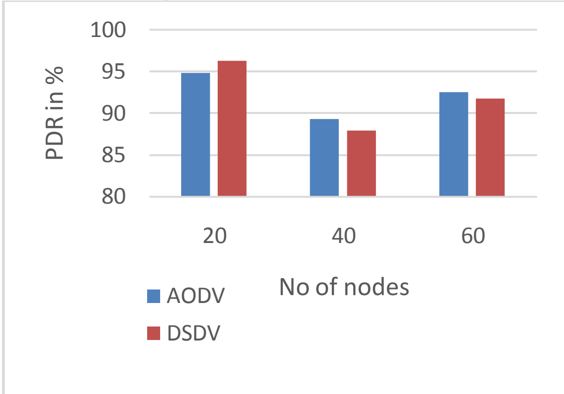

Figure 4 Comparison of AODV & DSDV with Packet Delivery Ratio

Figure 4 shows that the performance of AODV is better while increasing the number of nodes in the network then DSDV. This is occur due to AODV always use activated pre-used routes.

2. End to End Delay:

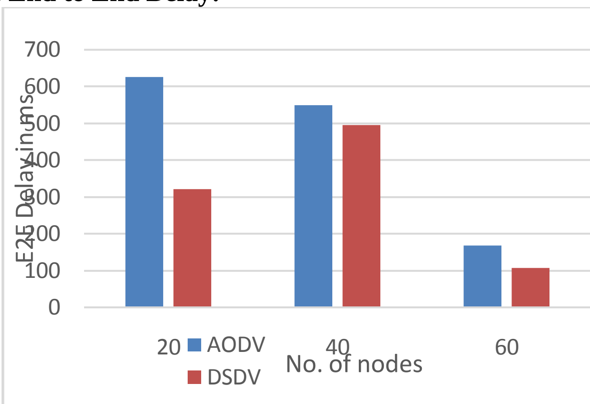

Figure 5 Comparison of AODV & DSDV with End to End Delay

Figure 5 shows that the performance of DSDV is better than AODV due to less conjunction**.**

3. Throughput:

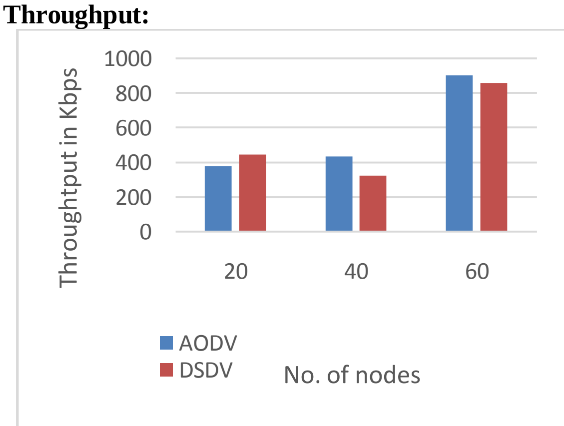

Figure 6 Comparison of AODV & DSDV with Throughput

Figure 6 shows AODV has better throughput then DSDV with increasing number of nodes.

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IV. CONCLUSION

We have first implemented WiMAX Module under Ns-2 Simulator and then 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.

REFERENCES

[1]. VivekThaper, Bindyia Jain, and VarshaSahni, "Performance analysis of adhoc routing protocols using random waypoint mobility model in wireless sensor networks", International Journal on Computer Science and Engineering (IJCSE), August 2011.

[2]. SreeramaMurty, M.,andVenkatDas,M., "Performance Evalution of MANET Routing Protocols using Reference Point Group Mobility and Random WayPointModels",International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC) vol.2, no.1, March 2011

[3]. Nadesh, R. K., Sumathy, D., and BenjulaAnbu Malar, M.B. "Performance Analysis of MANET (WLAN) Using Different Routing Protocols in Multi service Environments-An Quantitative Study", Advanced Networking and Applications vol. 03, no.02, pp: 10761079, 2011.

[4]. SuchismitaChinara and Santanu Kumar Rath, "Topology Control by Transmission Range Adjustment Protocol for Clustered Mobile Ad Hoc Networks",ISRN Communications and Networking,2011

[5]. Harminder S. Bindra, Sunil K. Maakar and Sangal, A.L., " Performance Evaluation of Two Reactive Routing Protocols of MANET using Group Mobility Model",IJCSI International Journal of Computer Science Issues, vol. 7, no. 10, May 2010.

[6]. Usop, N., Abdullah, A., and Abidin, A., "Performance Evaluation of AODV, DSDV and DSR routing Protocol in Grid Environment", International Journal of Computer and Network Security, vol. 9, no. 7, 2009.

[7]. Rahman, A., and Zukarnain, Z., "Performance Comparison of AODV, DSDV and I-DSDV Routing Protocols in Mobile Ad-hoc Networks", European Journal of Scientific Research, vol. 31, no. 4, pp. 566– 576, 2009.

[8]. Boomarani Malany,A.,SarmaDhulipala, V.R., and Chandrasekaran, RM , "Throughput and Delay Comparison of MANET Routing Protocols" ,Int. J. Open Problems Compt. Math.,vol. 2, no. 3, September 2009.

[9]. Anwar, F., Azad, M., Rahman,M., and Uddin,M., "Performance Analysis of Ad-hoc Routing Protocols in Mobile WiMAX Environment,"IAENG International Journal of Computer Science, vol. 35, no. 3, pp. 353– 359,2008. .

[10]. Siva Ram Murthy, C., and Manoj, B.S. Second Edition, Low price Edition, Pearson Education, 2007.Ad-hoc Wireless Networks, Architectures and Protocols.

[11]. J. Sun, Y. Yao, and H. Zhu, "Quality of service scheduling for 802.16 broadband wireless access systems," Vehicular Technology Conference, 2006. VTC 2006-Spring.IEEE 63rd, vol. 3, pp. 1221–1225, 7-10 May 2006

[12]. Feeney, L.M., and Nilsson, M.,"Investigating the energy consumption of a wireless network interface in an Ad-hoc networking environment", In Proceedings of the IEEE INFOCOM, pp.1548 - 1557, 2001.