

# 4G WIMAX NETWORK BEHAVIOUR WITH TORA, DSR & AODV PROTOCOLS USING OPNET

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## ABSTRACT

In this modern day's mobile is not only a device used for talking but it's more or less a portable computer that can serve different purpose. 4G offers higher data rate with seamless roaming. The mobile user can communicate without any disturbance while switching his coverage area. MANET Routing protocols plays an important role in any generation working process because Network packets follow that path which is suggested by routing protocols to reach from source to destination in Network. This paper shows research work where three different Routing protocols AODV, TORA & DSR are taken. Three different 4G Networks are created for each protocol and some performance metrics are taken to check the performance of all different networks. 4G Networks created with the help of WIMAX Nodes. In this Research work TORA provides best results rather than others Protocols. OPNET Tool is used as simulator.

Keyword- 4G Networks, AODV, DSR, TORA, GRP, MANET, ROUTING PROTOCOLS, WIMAX

## 1 INTRODUCTION

Mobile communication is developing very rapidly and with passage of time, new technologies are being introduced to facilitate the mobile users more from the technology. The past technologies are replaced by new ones and needs are growing for the new technologies to be developed. One such development is 4G Networks. The introduction of 4G has widened the scope of mobile communication.

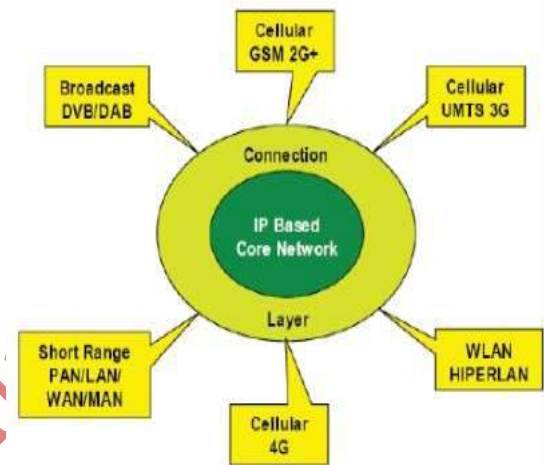


Figure 1.1 Samples of 4G Network

The better the technology, the more users friendly it becomes. This is what 4G brings to us than 3G. 4G provides us 3 times faster speed than 3G technology. 4G is the short name of fourth generation of wireless /mobile communication that will enable things like IP –based voice, data, gaming services & high quality streamed multimedia on portable devices with cable modem like transmission speed. The expectation for the 4G technology is basically the high quality audio/video streaming over end to end Internet Protocol.

## 2. WIMAX

WIMAX is one of the latest broadband wireless technologies all around today. WIMAX systems are expected to deliver broadband access services to residential and enterprise customers in an economical way. WIMAX is a standardized wireless version of Ethernet intended primarily as an alternative to wire technologies (such as Cable Modems, DSL and T1/E1 links) to provide broadband access to customer premises. More

strictly, WIMAX is an industry trade organization formed by leading communications, component, and equipment companies to promote and certify compatibility and interoperability of broadband wireless access equipment that conforms to the IEEE 802.16 and ETSI HIPERMAN standards. WIMAX would operate similar to Wi-Fi, but at higher speeds over greater distances and for a greater number of users. WIMAX has the ability to provide service even in areas that are difficult for wired infrastructure to reach and the ability to overcome the physical limitations of traditional wired infrastructure. WIMAX was formed in April 2001, in anticipation of the publication of the original 10-66 GHz IEEE 802.16 specifications. WIMAX is to 802.16 as the Wi-Fi Alliance is to 802.11. Bluetooth is also considered in wireless network. Bluetooth is defined as being a *short-range radio technology* (or wireless technology) aimed at simplifying communications among Internet devices and between devices and the Internet. It also aims to simplify data synchronization between Internet devices and other computers.

### 3. Routing Protocols

#### 3.1 Temporally-Ordered Routing Algorithm (TORA)

The Temporally-Ordered Routing Algorithm (TORA) is an adaptive routing protocol for multi-hop networks. TORA is a distributed algorithm so that routers only need to maintain knowledge about their neighbors. TORA uses the concept of height associated with a certain destination to describe the routing metric used by routers. Like water flows in pipes, routers with higher heights may forward packet flows to neighbors with lower heights. In TORA, it is necessary for each Node to collect the neighbor's routers information so that it can search out easily and transferred all the needed packets to destination in a sequence manner. All the communication of TORA is depended on following packets.

1. Query (QRY)
2. Update (UPD)
3. Clear (CLR)

#### 3.2 Dynamic Source Routing (DSR)

The Dynamic Source Routing (DSR) protocol is an on-demand routing protocol that is based on the concept of source routing. Mobile nodes are required to maintain route caches that contain the

source routes of which the mobile is aware. Entries in the route cache are continually updated as new routes are learned. The protocol consists of two major phases:

1. Route discovery :-
2. Route Maintenance

#### 3.3 The Ad hoc On Demand Distance Vector (AODV)

AODV is a routing protocol designed for ad hoc mobile networks. AODV build routes using a Route request & Route reply query cycle. A source node broadcasts a Route request (RREQ) packet across the network. Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables. In addition to the source node's IP address, current sequence number, and broadcast ID, A node receiving the RREQ may send a route reply (RREP) if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it. As the RREP propagates back to the source, nodes set up forward pointers to the destination. Once the source node receives the RREP, it may begin to forward data packets to the destination. If the source later receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hop count, it may update its routing information for that destination and begin using the better route. If Error accrued in RREQ & RREP then RERR Process is begin.

### 4 Simulation work

The protocols taken in this Research work are AODV, DSR and TORA routing protocols. The WIMAX network is a set of 4G computer laboratories in an engineering institute where each laboratory implemented 10 nodes. The proposed routing protocols are compared and evaluated based on some quantitative metrics such as Database query Response Time, Http Page Response Time, Remote Login Response Time, Video End to End Delay, Jitter, MOS value, Voice Packet Delay, Voice End to End Delay. In this work, motive is to evaluate the performance of AODV, TORA and DSR on the basis of different scenarios. OPNET provides output in a graphical manner in such a way that can easily analyze the

performance of network or any device which is being used as described earlier, in this research work have taken AODV, TORA and DSR protocols. Performance has been checked with various performance metrics. Then three different scenarios for AODV, TORA and DSR are created. The network topology composed of the following network devices and configuration utilities:

#### 4.1 TORA 4G NETWORK



Figure 4.1 TORA 4G Network

#### 4.2 DSR 4G NETWORK



Figure 4.2 DSR 4G Network

#### 4.3 AODV NETWORK



Figure 4.3 AODV 4G Network

#### 4.4 Database Query Response Time:

Time elapsed between sending a Request and Receiving the Response Packet Measured from the Time when the Database Query Application sends a Request to the Server to the time it receives a Response Packet Every Response Packet sent from a Server to Database Query application is included in the statistic

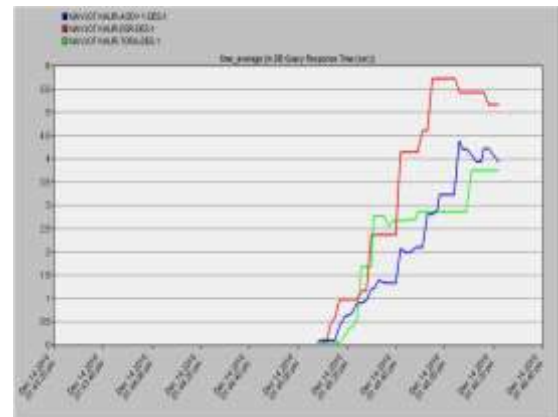


Figure 4.4: Progress of Database Query Response Time

According to simulation, from the Figure 4.4, it can be seen that the Database Query Response time for AODV, DSR & TORA are different. In the above figure, red, blue, and green curves are used to represent DSR, AODV, & TORA Routing protocols respectively. In Database Query Response time performance of TORA is providing best results.

#### 4.5 Http Page Response Time:

Http Object Response time is defined as specific Response time for each inlined objects from the HTML page.

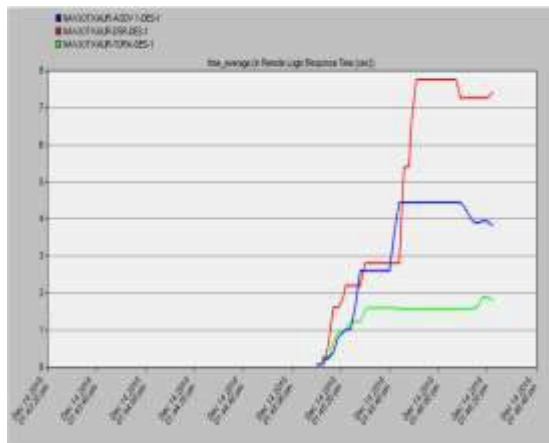


Figure 4.5: Progress of Http Page Response Time

According to simulation, from the Figure 4.5, it can be seen that the Http Page Response Time for AODV, DSR & TORA are different. In the above figure red, blue, and green curves are used to represent DSR AODV, & TORA Routing protocol respectively. In Http Page Response Time performance of DSR is providing best results.

**4.6 Remote Login Response Time:**

Time elapsed between sending a Request and Receiving the response packet Measured from the time a client application sends a request to the server to the time it receives a response packet. It is also the elapsed time between the end of an inquiry or demand on a computer system and the beginning of a response; for example, the length of the time between an indication of the end of an inquiry and the display of the first character of the response at a user terminal. Every response packet sent from a server to a remote login application is included in the statistic.



**Figure 4.6: Progress of Remote Login Response Time**

According to simulation, from the Figure 4.6, it can be seen that the Remote Login Response Time for AODV, DSR & TORA are different. In Remote Login Response Time performance of TORA is providing best results.

**4.7 Video End to End Delay:**

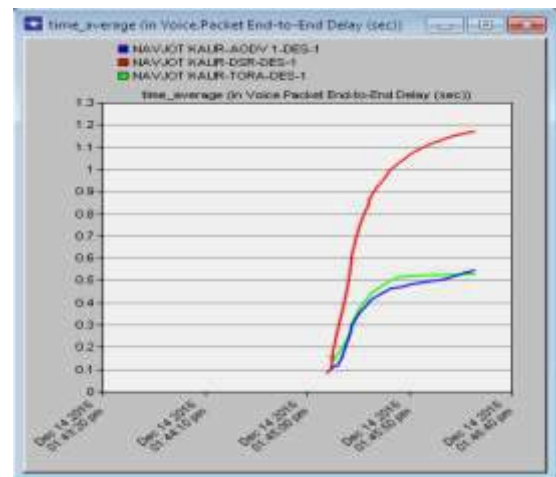
Variance among end to end delays for video packets .End to End Delay for video packets is measured from the time it is created to the time it is received.



**Figure 4.7: Progress of Video End to End Delay**  
According to simulation, from the Figure 4.7, it can be seen that the Video End to End Delay Performance value for AODV, DSR & TORA are different. In the above figure red, blue, and green curves are used to represent DSR, AODV & TORA Routing protocols respectively. In Video End to End Delay performance of TORA is providing best results.

**4.8 Voice End to End Delay**

It is Average number of Packets per second submitted to the transport layers by all voice application in the network



**Figure 4.8 Progress of Voice End to End Delay**

According to simulation, from the Figure 4.8, it can be seen that the Voice End to End Delay Performance time for AODV, DSR & TORA are different. In the above figure red, blue, and green curves are used to represent DSR, AODV & TORA Routing protocols respectively. In Voice

End to End Delay performance of TORA is providing best Results.

**4.9 Jitter:** Voice Jitter is define as if two consecutive packets leave the source node with time stamps  $t_1$  &  $t_2$  and are played back at the destination node at time  $t_3$  &  $t_4$ , then jitter =  $(t_4 - t_3) - (t_2 - t_1)$ . Negative Jitter indicates that the time difference between the packets at the destination node was less than that at source node. Jitter is defined as a variation in the delay of received packets. The sending side transmits packets in a continuous stream and spaces them evenly apart. Because of network congestion, improper queuing, or configuration errors, the delay between packets can vary instead of remaining constant, as shown in the figure. This variation causes problems for audio playback at e receiving end. Playback may experience gaps while waiting for the arrival of variable delayed packets

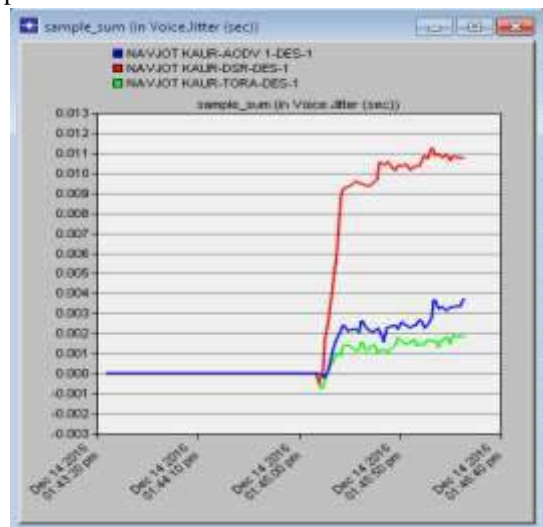


Figure 4.9: Progress of Jitter

According to simulation, from the Figure 4.9, it can be seen that the Jitter performance time for AODV, DSR & TORA are different. In the above figure red, blue, and green curves are used to represent DSR, AODV, & TORA Routing protocols respectively. In Jitter performance of TORA is providing best results.

#### 4.10 MOS

In voice and video communication, quality usually dictates whether the experience is a good or bad one. Besides the qualitative description it hears, like 'quite good' or 'very bad', there is a numerical method of expressing voice and video quality. It is called Mean Opinion Score (MOS). MOS gives a numerical indication of the perceived

quality of the media received after being transmitted and eventually compressed MOS is expressed in one number, from 1 to 5, 1 being the worst and 5 the best. MOS is quite subjective, as it is based figures that result from what is perceived by people during tests. However, there are software applications that measure MOS on networks, as seen below.

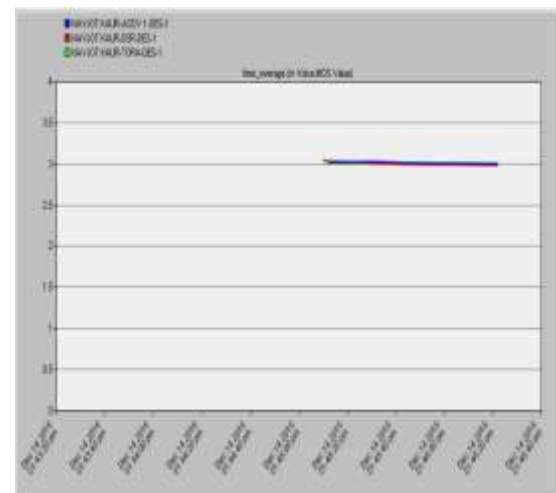


Figure 4.10: Progress of MOS

According to simulation, from the Figure 4.10, it can be seen that the MOS performance time for AODV, DSR & TORA are not varying much. In the above figure red, blue, and green curves are used to represent DSR, AODV, & TORA Routing protocols respectively. However, in MOS performance of TORA is still better.

**4.11 Voice Packets Delay:** Delay is caused when packets of data (voice) take more time than expected to reach their destination. This causes some disruption is the voice quality.

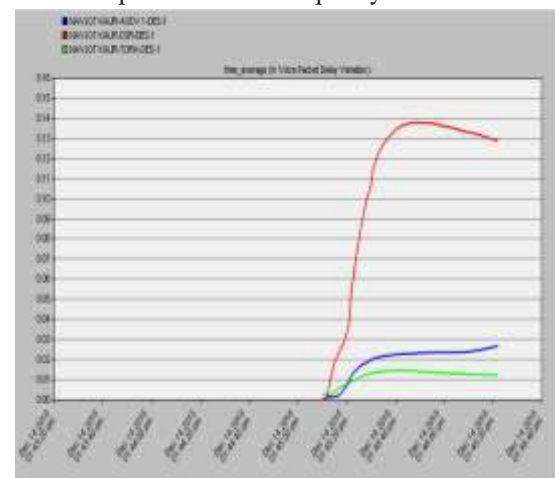


Figure 4.11: Progress of Voice Packets Delay

According to simulation, from the Figure 4.11, it can be seen that the Voice Packets Delay performance time for AODV, DSR & TORA are different. In the above figure red, blue, and green curves are used to represent DSR, AODV & TORA Routing protocols respectively. In Voice Packets Delay performance of TORA is providing best results.

## 5. CONCLUSION

In this Research work, it is presented a work creating three different 4G Networks which are based on different Routing Protocols such as AODV, DSR & TORA. To Obtain the Performance of different 4G Network different setup of some related devices has been configured. To fulfill the objectives of this thesis then it is created three different scenarios in which 50 WIMAX nodes has been taken each for different Network. The behavior of three different Networks has been configured. The comparative analysis has been done respectively with TORA, AODV & DSR for real time applications. Performance has been measured on the basis of some parameters that aimed to figure out the effects of routing protocols. Respective Performance Metrics are Database query Response Time, Http Page Response Time, Remote Login Response Time, Video End to End Delay, Jitter, MOS value, Voice Packet Delay, Voice End to End Delay. The simulation Run time processing Time is set to 180 seconds for each Network. To check the Performance each Network have taken different eight Performance metrics, In Seven of Eight performance metrics TORA is providing best Results These performances metrics are Database query Response Time, Remote Login Response Time, Video End to End Delay, Jitter, MOS value, Voice Packet Delay, Voice End to End Delay. Only in Http Page Response Time, DSR is best. So on behalf of this simulation study TORA is providing best results. AODV is much better than DSR. So in the last, it can be concluded that TORA routing protocol is best suitable for 4G WIMAX networks. In future, research work can be done on the hybrid protocols and some other performance metrics also can be taken.

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