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Handover evaluation of UMTS-WiMAX networks

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ABSTRACT

Recently, data traffic movement through a wireless channel is assisted by suggesting and implementing many mechanisms, to achieve the speedy increasing importunity and popularity of the wireless networks. Various wireless technologies can be copulated to develop a heterogeneous network, which is a candidate towards (4G) networks. OPNET modeler (14.5) is used to design simulation modules of the heterogeneous network. During device connection between the worldwide interoperability for microwave access (WiMAX) and universal mobile telecommunication system (UMTS) networks, Performance metrics such as; Jitter end-to-end delay (E-2-E) Throughput is used. The results of the simulation are measured to determine the efficiency of the transfer using WiMAX-UMTS according to the selected metrics. The WiMAX-UMTS has shown valuable improvement in Process Durability, reduction of E-2-E delay, and Jitter. The maximum amount of data transfer and the least amount of delay and Jitter is at 250 sec. Because of the handover operations and data transfer momentum, the worst-case passes in the network when 618 sec is the minimum amount. The efficiency of throughput for WiMAX equal to 0.092666% as for the efficiency of throughput for UMTS equal to $4.633333*10^{-6}$ % whereas the E-2-E efficiency a delay equal to 0.5466%.

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1. INTRODUCTION

In recent decades there has been a rapid growth in Internet technology, leading to a significant shift in communication between users. Where it has become one of the best methods to send data using the Internet instead of the public switched telephone network (PSTN) as a result of the tremendous development of wireless packet development networks in terms of reducing costs for users and providers of service. As a result of the rapid development of Internet services, especially in voice applications and the presence of modern communication devices such as the iPhone, voice has become one of the important standards in voice applications in Internet networks. It is now available to use the Internet service to make voice and video communications and high quality of communication at a lower cost than PSTN at any time and from anywhere using the mobile phone available frequently [1]. Which led to the possibility of making calls with high quality, despite being a long distance as a result of the development of communications from one generation to another more efficient to improve the quality of service for voice over Internet protocol (VoIP) Institutions such as call centers and businesses as well as ordinary users by a very large. The fact that the VoIP and the video have become widespread around the world to work for the common worldwide interoperability for microwave

access (WiMAX), and using the standard IEEE802.16, to equip contact spaces far and high-quality working methods and a variety of mobile cellular access. The WiMAX features are high-speed, up to 40 Mbps [2], moreover, a wide coverage area ranging from 30 to 50 km the low cost of WiMAX network deployment Thus, WiMAX is a great technology that works with real-time, non-real-time and is equipped with integrated audio and video. WiMAX plans to give remote broadband Internet in a range of a few kilometers and is planned basically for metropolitan systems [3]. Universal mobile telecommunication system (UMTS) is one of the parts of the third generation that was later developed as an integrated network system that is characterized by high coverage to include the rural speaker as well as urban areas and offices and institutions as well as being highly dynamic to meet the wishes of users in different regions. As it supports multimedia applications for video or audio over the VoIP and of the maximum link limit downlink 14.4 Mbps in real-time so it became very important to know the amount of the difference between each of WiMAX and UMTS to assess the quality of service and possible ways between the two models [3], [4].

We consider the categorization of quality of service (QoS) prerequisites are diverse for real-time As well as multimedia execution assist in selecting the superior the network is offered without reduce from quality of service applications [5]. Those sorting be able to utilize for realization the resource preparation system respecting UMTS as well as WiMAX as soon as they are joined together. For instance, depending on the network overcrowding Additionally resources can be obtained, a call able to be conveyed as of UMTS for WiMAX or conversely, and to get superior QoS to the user [6], [7]. Further, giving QoS to versatile access turns out to be more testing with disabilities like time fluctuation and flightiness of the channel, multipath blurring, shadowing, inactivity, and bundle misfortune by continuous handovers and restricted data transmission [8].

The goal of the research is to evaluate the ratio of the two networks UMTS and WiMAX Relative to quality of service (QoS) such as Jitter, end-to-end delay, throughput, and dropped traffic. Using OPNET modeler 14.5. The sections of the research are organized as follows. Section 2 briefly gives a literature review. Section 3 explains concisely about UMTS, WiMAX, and VoIP. Section 4 describes the heterogeneous network and handover 3 criteria shows the quality of service (QoS) section 6 deals with the simulation setup used in OPNET for both UMTS and WiMAX, and discussion of simulation results for VoIP application running on UMTS and WiMAX. Section 7 presents the conclusion and future work.

2. LITERATURE REVIEW

Jung *et al.* [9] suggested a power economy algorithm that minimizes the after that be sleeping window period into indicating involving sleep intervals minimum period and maximum period accordingly. The purpose is to make time decreased on the other hand, the overall energy used to maximize. Kim *et al.* [10] offered suggested a power reduction technique that Which are taken into account the demand interval of every beginning experience. This technique modifies process safety management (PSM) parameters, for illustration minimum period and maximum period that decreases the energy exhaustion and denotes conveyance time.

Another bundle exchanged organization that offered in [11] supported for clients to serve the requirement for information and voice traffic from the Internet protocol (IP) based parcel changed organization to PSTN based circuit-exchanged organization is proposed with new QoS. Chakraborty [12] proposed an approach that is appropriate to determine explicit issue of Internetworking among PSTN and IP organizations. The flagging messages from PSTN for example ISUP (ISDN user part) is changed over into session initiation protocol (SIP) text-based messages and the other way around. Kim *et al.* [13] a little bit changed their power sparing mechanism as of now suggested in [10]. The suggested calculation is invited to enhanced PSM. Kim *et al.* [10] change PSM elements considering the Battery status of portable terminals. Liu *et al.* [14] suggested a hidden markov model which expects the "time interval for packets" to reduce the energy spent. They carry out not regard as other elements also wasted package and package size for the reason that these elements own have a slight effect over the energy wastages. emulation outcome demonstrates for the technique suggested be able to decrease the energy wastage by five percent contrasted with PSM. Liu *et al.* [15] suggested a system to chooses clients to select the reasonable QoS prerequisites. these QoS prerequisites are chosen just the once most favorable double-threshold (respecting energy as well delay) is specified employing double Markov dimensional series model. As well as the quality of service prerequisites choice, Neeraja and Abhishiktha [16] suggested constructing modification for traffic. The modification adopts a decision over the access rate. Emulation outcome demonstrates capable accomplishment comparison with poisson arriving suppositions. The mathematical model proposed by Neeraja and Abhishiktha [17] is achievement with very less risk with wrong decision. For example, transfers at traffic load are 8, the probability of wrong handing over of decisions is 1.112x10-08. when traffic load raises the chances of misdecision in handing over raises even less. So, bandwidth-based transmission algorithm for five wireless heterogeneous networks gives the bet. Schepper *et al.* [18] concluded that the planned heterogeneous LTE/ Wi-Fi/WiMAX network has a high

performance and less E-E delay and Jitter that is useful for the deployment of heterogeneous 4G networks. Kansal *et al.* [19] suggested a creative arrangement that consolidates WiMAX framework with multiple input multiple output (MIMO) innovation to meet the essential raised information rates as wanted by the developing application needs of 5G. Besides, the suggested framework is artful presence strated joining with discrete wavelet transform (DWT), and fractional fourier transforms (FrFTs) in the actual layer of the WiMAX system. The assessed outcomes embody a significant improvement in bit error rate (BER). In [20], discrete wavelet changes (DWTs) and fractional fourier transforms (FrFTs) were charity to enlarge the unwavering quality and effectiveness of a versatile WiMAX framework. The outcomes showed substantial enhancements in both bit error rate (BER) decrease and ghostly proficiency upgrade at an offered signal-to-noise ratio (SNR). What's more, a huge peak to average power ratio (PAPR) decrease is achieved when the DWTs and FrFTs are utilized instead of quick fourier transforms. Xue *et al.* [21] introduced a novel issue of optimization of the structure that can be solved to design the network optimally. This provides a detailed review of designs through models and execution. We show that our software allows real-life, transparent, and real-time inter-technology transactions and that coordinated load balancing will then double the variable throughput through the network. Previous studies have completed work compared with adding other elements for assessment between the WiMAX-UMTS.

3. VOIP OVER UMTS AND WIMAX NETWORKS

3.1. UMTS network

UMTS represents the acronym for universal mobile telecommunication system (UMTS) is likewise more for the most part the new standard of portable communication, called communication of the third generation. As an overall network system, it gives more extensive coverage and high versatility to satisfy the client requests anywhere and workplace, home, cities, and country regions. UMTS backup packet-based on enforcements, including multimedia enforcements such as real-time VoIP with the peak of the link down from 14.4 MB data rate in the second [22].

3.2 WiMAX network

Nowadays, energy expenses, for diverse service providers, be a considerable and important part of operating costs in the state of portable networks. Users necessitate the backing of portable for every service, besides, this is network connectivity for job-providers. Worldwide microwave communication interoperability is a wireless broadband technology, provided that it has a high capacity and strong coverage. WiMAX is the current abbreviation for the mainstream IEEE 802.16. IEEE 802.16e, known as mobile WiMAX, was proposed to merge mobility and wired-wireless networking with network backup capabilities based on the integration concept of users [23]. WiMAX seeks to offer wireless broadband Internet for many kilometers and is mainly designed for metropolitan networks. Figure 1. shows an example of the WiMAX network.

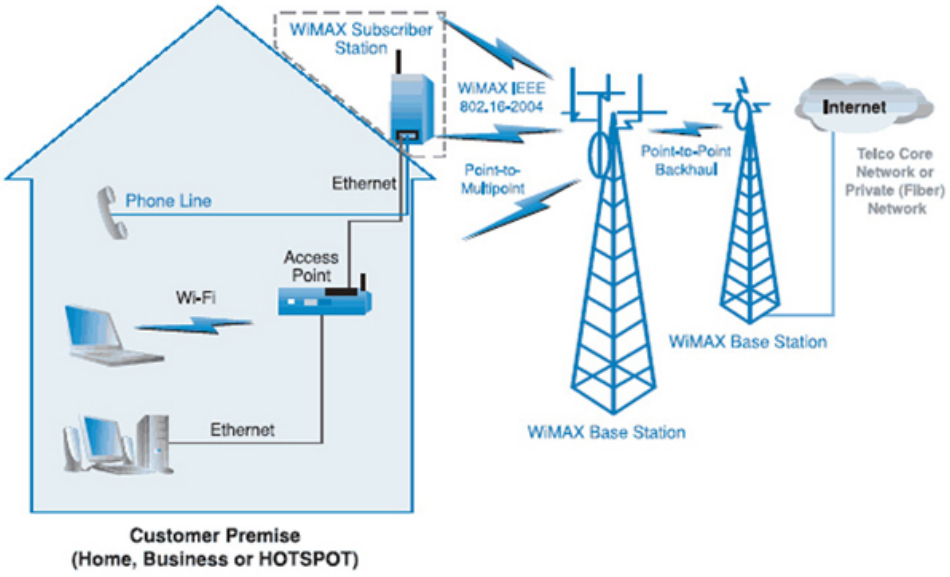

Figure 1. Example of WiMAX network

The primary organizations in WiMAX are required to permit remote regions, underserved by digital subscriber line (DSL) or link or wishing to exploit a remote association, to have a broadband Internet get to. WiMAX advancement could in this way assume a critical part in the territorial computerized improvement. With adaptation 802.16e, WiMAX will be accessible for the organization in tablets with migrant and portable utilization. A few producers consider along these lines that the 802.16e standard constitutes a vital issue for the dispatch of 4G mobile [3]. Versatile WiMAX opens the path for portable communication over IP, or all the more extensively to portable broadband. The hypothetical most extreme throughput is 30 Mbps for a scope of 2 to 4 kilometers without hindrances.

3.3. Comparison between UMTS and WiMAX

Both WiMAX and UMTS have focal points and weaknesses contrasted with everyone. WiMAX is the first of its kind open portable criterion (IEEE802.16e) administered through the IEEE's reasonable permitting practice and unlock to investment. In this truth progressive from the time of 3GPP as well 3GPP2 are grouping and don't permit open investment. This unlocks procedure should prompt more prominent advancement and thus a superior execution while pushing ahead and can conceivably decrease protected innovation authorizing charges since it accommodates a faster change of the innovation contrasted with existing portable advances. WiMAX is additionally the primary real portable criterion to present each-IP arrange. UMTS will arrive in ensuing discharges yet despite everything it utilizes a muddled and at last costly center system [24].

3.4. VoIP

The VoIP group utilizes the protocol to session initiation (SIP) specification for signaling purposes. SIP is the Internet technology task force (IETF) request for comment (RFC) standard accountable for maintaining and designing protocols characterizing the Internet. SIP translates username to the actual address of the network, handles the entry of calls, declines or changes of protocols, makes it easy to change the session settings. Additional popular voice/video communication protocol over an IP network is H.323. VoIP is among the most common and cost-effective short and long-distance networking systems. Most VoIP networks often provide connectivity free of charge, irrespective of the cost. The voice analog data is digitized and transmitted above an IP network as packets. Such packets are decoded and returned to an analog voice signal [22].

4. HETEROGENEOUS NETWORK

As heterogeneous systems enhance range productivity, despite the covering scope of a few remote access advances, and hence their utilization has turned out to be typical. We take note that the heterogeneous system is attempting to give better administration through the mix of various advances and distinctive measures to accomplish every one of the necessities that clients require [1]. Figure 2 shows an example of the heterogeneous network.

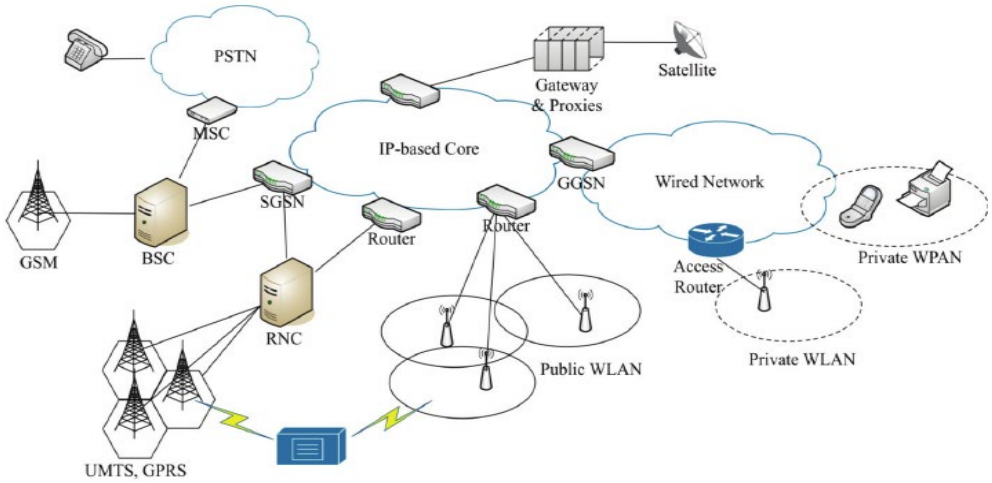

Figure 2. Heterogeneous network

4.1. Handover kinds

Handover is essential when a main station (MS) motion is starting with one base station (BS) region then onto the next BS zone or when the flag quality corrupts to a level where it isn't conceivable to keep up the

association. Some of the time handovers happen inside a similar BS territory among channels. This is named buried cell give up, whilst the counterpart is named inter cell handover [25]. They are likewise conceivable between various innovations; recognized as perpendicular handovers whilst the previous are recognized as level handovers. It was an advanced characterized designate conveyed inside one innovation while the first is the conveyance between various/numerous strategies [26]. There can be diverse purposes behind conveyances that happen, and here are a couple of reasons: at the edge of the screen, the quality of the flag is not enough to sustain the correspondence. A BS limit is filled in and there is no more movement in the area. The can channel of neighboring cells has resistance. A giving up occurs during vertical handover when faster and more modest innovation is available. MS performs divergence The 802.16e provides multiple technological transfer types: 1) hard handover, 2) micro variety handover, and 3) fast base station switching.

4.2. Hard handover (HHO)

HHO is disruption formerly more the association with the present BS is not working formerly making an association by another BS. The upside from HH is those the entrance flagging is abstained from amid the hand over yet it might require longer investment for the association with return to typical. The portable hub tunes in to interface layer messages while associated with BS, if a nearby BS promotion is gotten [26].

4.3. Handover in macro diversity

In versatile WiMAX, macro diversity handover (MDHO) is a voluntary conspired switch and run jointly by the base station and the main station. A rundown of BS including the ability of MDHO is kept up through MS; the gathering which is called a diversity group. A stay base station is characterized in a decent variety group in BS. There be able to situations as main station be able to achieve the base stations however the flag quality is too weakened for genuine movement. And while MS is drawing closer in the direction of a Base Station a point will achieve that the flag quality winds up sufficiently solid and the BS will in the end be included the decent variety set [26], [27]. The concepts of quick base station switching are just like MDHO; the MS and BS would be the same ability to support the quick base station switching. MS and BS also retain the diversity collection because, in the diversity system, the MS interacts only with one BS. The present/ active BS is known as an anchor for BS. For contact, priority in FBSS is for just one BS; it also involves signaling traffic. All BS's receive the data while in variety collection. In this MS, although very few of these data transmit on over air network, although others gradually lose the packages they get [26], [27].

We found a case in which mobile nodes are uniformly distributed across the plane attached to multiple base stations i.e. BS0 and BS1. The upload will be smooth enough for smartphone devices in such a manner that the continuing video or speech session is not disrupted or not heard by the client. Throughout the modern situation. If a mobile station is transiting by one base station to that other base station field, when sending signals intensity has diminished. For a point that contact cannot continue; a switch is performed in such a manner where there is negligible data loss and the established communications are not interrupted. Two forms of handovers are known to be intercell. Take the BS claim BS1. How to get their BS1 address is 1.1 transfer where the channels are handed over i.e. stations are exchanged, and some are transmitted within where the BS is modified. The Node mobility is marked with 0. The mobile node moves into the popular distribution region BS0 and BS1 during the simulation. BS1 must be addressed 2.1.1. Once the movable node recognizes (discovers BS1 signals) the BS1 service region and BS0 signal intensity is lower the mobile node switches Towards the BS1 then obtains fresh address treatment from BS1. The mobile node's current address (care-of-address) is 2.1.2, and all mobile node-related links are a new edition to the existing (care-of) statement. The region with the simultaneous scope is the location anywhere handover is taking place. Often identified employing media autonomous handover. That is not available under this article, is likely the transition of two technologies. The schematic for the layout is displayed in Figure 3. The applied in the proposed model is performed utilizing ns 2 as well as the various processing are performance, end to end waits, Jitters, declines in addition to handover latencies [17], [26]. Figure 3 displays the handover pattern for two technologies.

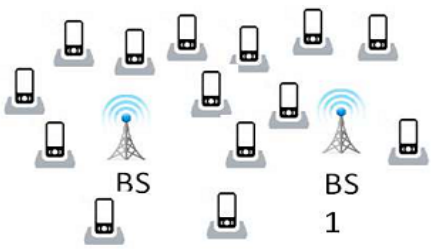

Figure 3. The two-technology application model

5. EVALUATION METRICS

Metrics can be used to calculate as well as analyze within WiMAX the transition processes homogeneously as well as heterogeneously [28]. First, average throughput: a ratio of the overall volume of data entering. The focus is on the transfer of data from source to destination. The packets of data collected at the physical layer shall be sent to the application layer if planned for this framework. Second, the typical end-to-end (E-2-E) delay is the interval occupied to send a packet from source to destination over a network. This statistic measures the arrival time for the packets because the inferior the E-2-E delay, the higher the efficiency of the program. The sum of the postponed E-2-E is summed by the number of packages [29], [30]. Lastly, the Jitter is the time difference between packets that arrive at a side of choice, induced by network interference, timing point, otherwise changing of the path. It indicates the Source Packets until they arrive at their destination with various delays. The delays of a package change according to its position in the routers trains along the destination address direction. This attitude isn't reliably provided the circumstances of the network. In OPNET, we developed simulation modules for WiMAX and UMTS, and performed comprehensive simulations to test and analyze several significant performance metrics such as end-to-end latency, Jitter, throughput, and dropped traffic.

5.1. Performance metrics

Performance indicators are used within the WiMAX setting to homogeneously and heterogeneously calculate and assess the handover processes. For the assessments, which are throughput, E-2-E, and Jitter, three parameters were chosen.

5.1.1. Throughput

The throughput average is defined by the ratio of the overall volume of data reaching its destination to the time taken to move the data from the source to the destination. If the data packets received by the physical layer are intended for this station, they are sent to the higher layers. Throughput is typically represented (Bps or bps) by bytes or bits per second.

$$Throughput = TBR * 8(bit) \div (ET - ST) \quad (1)$$

Where TBR is the total byte received, ET is End Time (sec), and ST is start time (sec).

5.1.2. End-to-end (E-2-E) delay

The typical end-to-end (E-2-E) Delay is the time taken to send a packet from source to destination over a network. This parameter determines the arrival time of the packet, while the lower the E-2-E delay, the higher the output of the application. The magnitude of the E-2-E delay is averaged by the number of data packets. The following equation mathematically describes it.

$$Average\ E-2-E\ delay = T\ E-2-E\ D \div N\ P\ R \quad (2)$$

Where T E-2-E D is total E-2-E delay, and NPR is no. of packets received.

5.1.3. Jitter

Jitter is the time variation induced by network congestion, timing drift, or path changes between packets arriving at the destination side. It means the source packets before they reach their destination with distinct delays. The delays of a packet vary with its position in the path between source and destination in the queues of the routers. This position is not predictable because of network conditions. The Jitter calculation explains the (3).

$$Jitter = RTP(I) - RTP(I-1) \quad (3)$$

Where RTP(I) is reception time of packet (I), and RTP(I-1) is reception time of packet (I-1).

5.2. Network simulation

Through our study of the subject's handover, switch is a mobile process when switching from one network to another network without interrupting the touch. This research shows that the suggested form of interworking building between UMTS and WiMAX networks was planned as shown in Figure 4.

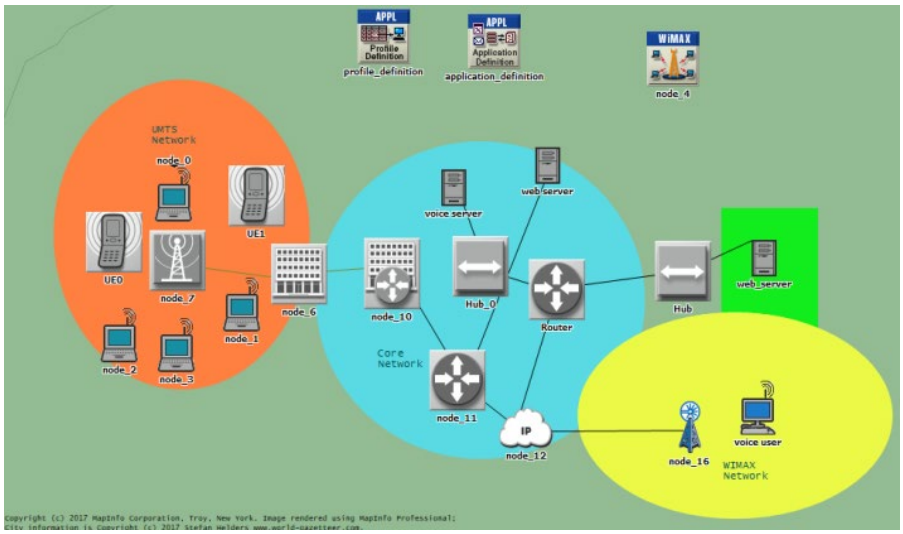

Figure 4. The simulation system of handover between UMTS and WiMAX service quality dependent QoS, like Jitter, E-2-E delay, throughput, and traffic dropped by using OPNET modeler 14.5

5.3. Discussion of results

This research highlights the use of different wireless technologies among heterogeneous networks such as WiMAX–UMTS While we note that the source [31] contains homogeneous networks between WiMAX-WiMAX and UMTS-UMTS. Figure 5 shows the handover Jitter for VoIP between UMTS and WiMAX networks. When the Jitter takes into account that the highest amount of Jitter is at the 250 sec due to increasing the amount of data transfer to the maximum extent and we note at the 618 sec an additional increase to the Jitter because of the momentum of data transfer as well as handover operations. At that point we discover another expansion in 730 seconds.

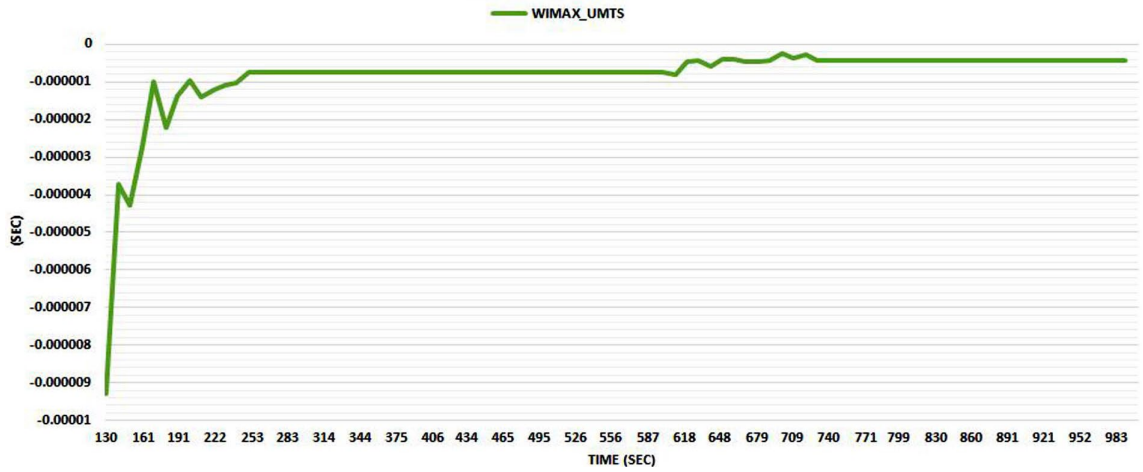

Figure 5. The Jitter of simulation results between UMTS-WiMAX networks

Figure 6 represents the stability of the end-to-end delay rate at the 250 sec at the lowest point of the delay because that period the data transfer rate is high and this stability is similar to the curves in [32]. We notice an increase in the delay at 618 sec for the reasons mentioned in the previous drawing of the Jitter. At that point we discover another expansion in 730 seconds. Figure 7 shows that there is an imbalance transfer data for each node where we note that 2 nodes are the highest amount of data transfer, while the rest of the node 3 is less than the rest data transfer rate. According to the module-based UGS service.

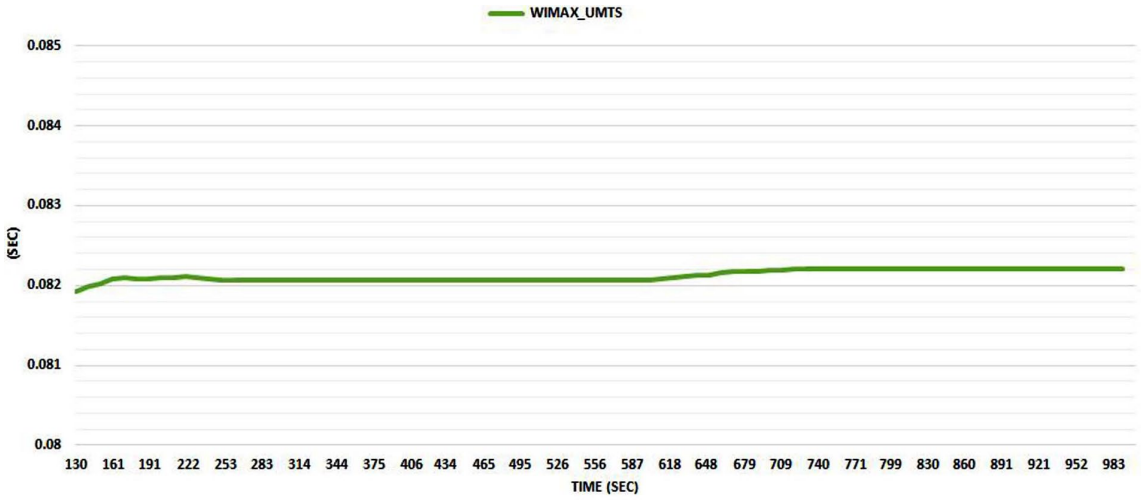

Figure 6. The E-2-E delay of UMTS-WiMAX networks

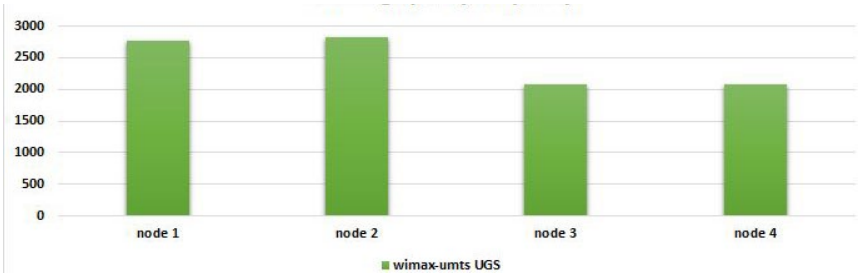

Figure 7. System throughput of UMTS-WiMAX networks for various number of nodes

Figure 8 represents that the highest amount of data transfer is 1390 at 250 sec. After the start of data transfer at the 120 sec. However, after some time there was congestion in the transfer of data as well as the occurrence of hand over, which led to a decrease in the rate of data transfer. But at 730 seconds, it increments and afterward diminishes once more. Also in Figure 9 shows there is a match in its results with the results of throughput, which shows that increasing data transfer leads to an increase in the rate of data wasted as seen at the 250 sec.

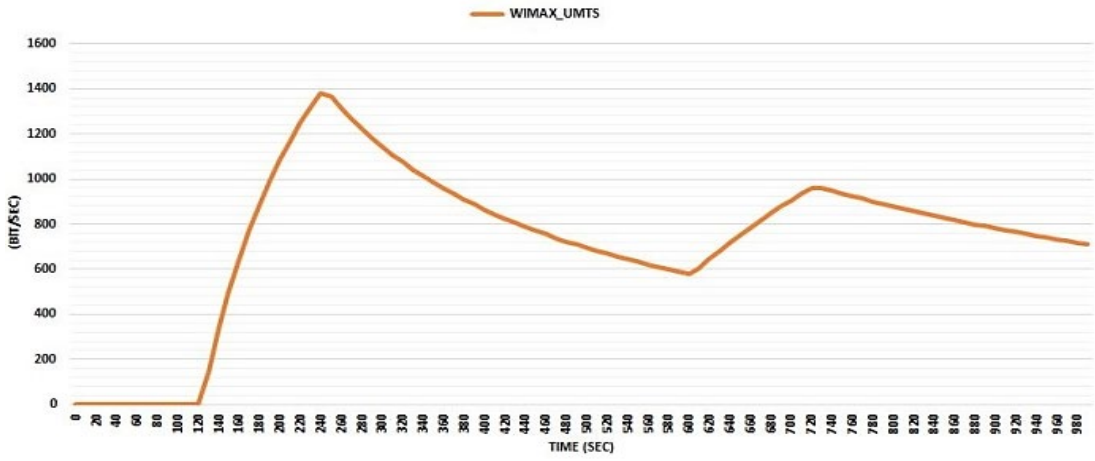

Figure 8. System throughput of UMTS-WiMAX network

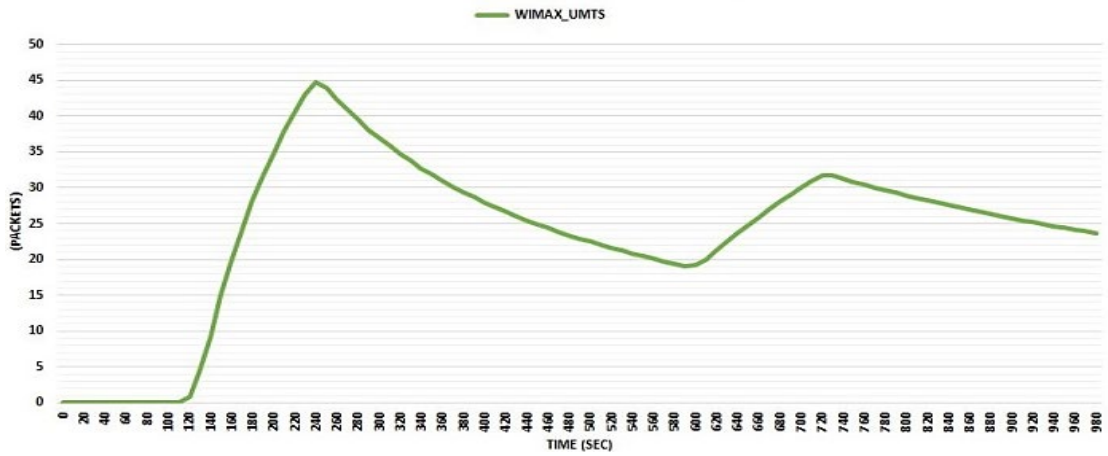

Figure 9. System traffic dropped of UMTS-WiMAX networks

6. CONCLUSIONS

This research highlights that, the results obtained above show the following: at 250 sec is the highest amount of data transfer as well as the least amount of delay and Jitter. When 618 sec is the least amount, the worst-case passes in the network because of the handover operations and data transfer momentum. The efficiency of throughput for WiMAX equal to 0.092666% as for the efficiency of throughput for UMTS equal to $4.633333*10^{-6}$% whereas the E-2-E efficiency a Delay equal to 0.5466%. So that the simulation results show that WiMAX outscores the UMTS with an adequate border the presence of the proposed UMTS-WiMAX heterogeneous organization and proposed a vertical handover, and is the better innovation to help VoIP applications, contrasted and UMTS. Where it will be applied in the fields of future communication. As future work, further execution, examination, and approval will be led to assess and affirm convention.

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