An Overview ForWiMAX NetworksCovering Some Handover Algorithms

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Article History: Received: 25 June 2021; Revised: 15 July 2021; Accepted: 7 August 2021; Published online: 25 August 2021

ABSTRACT- As a consequence of Needs to continue in terms of data rates, speed and quality of service, various aspects of wireless networks are evolving. In the same network or across different technology and service provider networks, those aspects must be adaptable. Worldwide interoperability for microwave Access (WiMAX) is also one of the networks of the future century (4G) That requires additional research. However, the handoff structure that concerns the transition of mobile stations within the scope of network from one base station to another similar homogeneous network (horizontal handover) or various heterogeneous network (vertical handover) is a major consideration for WiMAX to achieve mobility. In the current context, this article discusses the characteristics of WiMAX, Concentrate on possible handoff-related study problems, generally addressing the two forms of handover. this essay concentratemore On homogeneous performance of handover . In WiMAX, mobility aspects are defined as an individual layer of the Mobility Agent (MA), above its MAC layer, and some indication of a network layer.

1. INTRODUCTION

The tremendous development made researchers compete in a great way in various fields, and all these fields were based on the new technologies used in order to implement whether artificial intelligence or other technologies [1]-[9].The ever-increasing demand for high data rate wireless networks gives rise to the improvement of broadband wireless communication technologies for anytime and anywhere [10]. Since WLANs suffer from poor scalability and short range. 3G networks, on the other hand have such drawbacks as limited capacity and high infrastructure costs, but this void between LAN and WAN technologies has been filled by the next-generation WMAN, which will integrate and introduce WiMAX as an option for the software platform use IEEE 802.16. Wimax (4G) technology is advancing as a new era dawns.. In the IEEE 802.16e standard, with the new introduction of mobility management systems, WiMAX is now competing to offer ubiquitous computing solutions to current and future generations of wireless technologies[11] . The remainder of the article is structured as follows: The WiMAX System, a summary of the comparative analysis between Mobile WiMAX and various networks(3G and WiFi), is briefly outlined in section II. we refer to handover procedures in MWiMAX (mobile WiMAX) in section III and give a comparative analysis Of the benefits of this various handover procedures. In section IV we discuss the various suggested solutions for two forms of handover process (horizontal and vertical) . The article ends in section V with Conclusion.

2. WIMAX SYSTEM

Based on an RF technology called orthogonal frequency division multiplexing (OFDM) and designed for broadband wireless access (BWA) and operating above 2 GHz, WiMAX is an efficient means of transmitting high-speed data, mainly when the bandwidth used is 5 MHz or greater. A WiMAX base station (BS) and customer premise equipment (CPE) for indoor service, and a mobile unit or modem for outdoor service are included in WiMAX wireless connectivity. A range of up to 30 miles is technically covered by WiMAX BS, but it is only limited to a more realistic range of 6 miles. Ranges of up to 70 Mbps were supported by data rates. A line-of-sight (LOS) service is WiMAX backhaul, interconnecting BSs, whereas a subscriber station (SS) and BS may just be a LOS or a nonline-of-sight (NLOS) service. The SS (subscriber station) may also be in motion in mobile WiMAX [12].
The fundamental applications and services provided by WiMAX are as shown in Figure 1 :

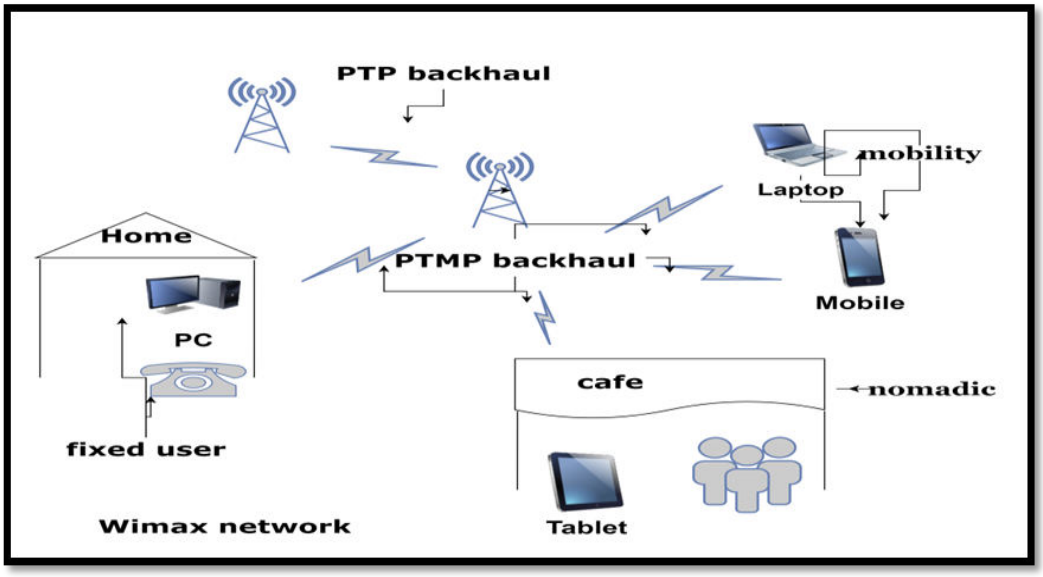

Figure 1. The fundamental applications and services provided by WiMAX

1.Fixed : in lieu of or supplement to cable or DSL, for the home Internet customer.
2. Phone: Voice-over-Internet Protocol (VoIP) for home telephone service, including video calls.
3. Nomadic: For Internet users of laptops in different locations where service may be accessible, such as in cafés or libraries.
4. Mobility: For Internet data connectivity for laptop and a VoIP service for handset users. (Pedestrian or vehicular use is indicated by mobility) .

2.1. WiMAX AND COMMON STANDARDS [12]

The WiMAX standard(wireless area metropolitan networks) was developed by the IEEE 802.16 working group (WMANs). The WiMAX-based IEEE 802.16 protocol also addresses an integrated high-performance radio and/or cellular telephone network (HiperMAN) standard of the European Telecommunications Standards Institute (ETSI), making it a globally compatible standard-network.
* The original standard 802.16 stipulated transmissions in the 10-66 GHz range.
* Lower frequencies in the 2–11 GHz range were included in 802.16d.
* the used Frequencies are 3.5 and 5.8 GHz for 802.16d.
* Depending on the region, the frequencies typically used for 802.16e are 2.3, 2.5, and 3.5 GHz.
In 802.16-2004 and 802.16e, the physical layer uses OFDM (Orthogonal Frequency Division Multiplexing) and SOFDMA (Scalable Orthogonal Frequency Division Multiple Access) respectively [13] In addition, communication is specified in the 2-11 GHz frequency range for NLOS (Non-Line Of Sight) and the 10-66 GHz frequency range for LOS(line of sight). WiMAX enables connectivity over a distance of approximately 8 km on a physical layer with a bit rate of up to 70 Mbps for LOS transmission[14]. The coverage distance is approximately 50 km in the case of NLOS conditions [15] Three modes, an obligatory hard handover , macro diversity handover (MDHO) and a fast BS switching (FBSS) , are included in IEEE 802.16e's link layer handover, alternatively called a layer 2 handover. The last two are selectable soft handovers in which a mobile station (MS) can simultaneously register with different base stations (BSs) in order to achieve minimal handover latency. anyhow, under these two modes there are quite a few constraints on the BS, such as synchronization in a shared timing source, the same frequency of the carrier, and sharing of all data. Therefore, the IEEE 802.16e essentially utilizes the hard handover. Cell reselection, handover decisions and initiation, synchronization to destination BS, ranging and network re-entry, and cancellation of relation with previous BS are part of the IEEE 802.16e connection layer handover process. The efficiency of a network depends on how secure handovers are performed regardless of the type of architecture installed [11].

2.2. WiMAX Vursus 3G and Wi-Fi

How does WiMAX compare with the current 3G and Wi-Fi and emerging capabilities? the throughput capabilities of WiMax relies on the channel bandwidth that is usedWiMAX specifies a channel bandwidth selectable between 1.25MHz and 20MHz. which enables a very versatile rollout differs from 3G networks, which have a specific channel bandwidth. It is more likely to use 10MHz TDD(time division duplexing) channel when deployed, suggesting 3:1(DL to UL) downlink-to-uplink divide and 2×2 multi input multi output, WiMAX present 46Mbps downlink top and 7Mbps uplink[16].

The dependence of Wi-Fi and WiMAX on modulation type OFDM as compared to CDMA in 3G enables them to assist excellent high rates. requirement for distribution causes extremely data rates most complicated for CDMA systems. The average throughput and the capacity of overall system when deployed in a multi - cellular environment are more important than the peak data rate offered over a single link. From a power perspective, spectral efficiency is the most important things in measurment of device output. The fact that WiMAX was more commonly used with multiple antennas from its inception gave it an advantage in spectral efficiency. On the other hand, in 3G networks, multiple-antenna aid is now being added in the form of amendments. In addition, the point of view of the necessary complexity for comparable benefit, the OFDM physical layer used by the WiMAX is more open to MIMO implementations than CDMA systems. In order to increase capacity, OFDM also makes it easier to leverage frequency diversity and multi-user diversity. Therefore, WiMAX has higher throughputin data transmission, network throughput is the amount of data moved successfully from one place to another in a given time period [17]greater versatility , greater overall throughput and device capability compared to 3G. Another benefit of WiMAX is its capacity to effectively accommodate more symmetrical links and the provision for versatile and dynamic adjustment of the DL (Down link)-to-UL (Up link) data rates. Typically, asymmetric data rates exist between UL and DL in 3G systems. How to support advanced IP applications like video, voice and multimedia? how can the technologies compareIn view of prioritization of traffic and regulation of quality? the WiMAX media access control layer is designedFrom the ground up to accommodate a variety of traffic mixes, including traffic priority data with fixed bit rate and different bit rate in real time and non-real time and best-effort data. Perhaps the most significant benefit for WiMAX due to its lightweight IP architecture could be the possibility of cost savings.A core network is simplified by using an IP architecture- 3G has a comprehensive and independent voice and data core network and cuts capital and expenses of operation .IP also positions WiMAX on an achievement curve that is more compatible with particular integrate with third-party developers of software and enables integration with many other networks and applications.

WiMAX features are rather unproven compared to those of 3G in relation to enabling Vehicle movement at high speeds and roaming. Mobility was a critical component of 3G design, and WiMAX was designed as a static device with mobility capabilities as an extra benefit.

In short ,WiMAX can a country very middle ground between Wi-Fi and 3G technologies when contrasted with the main dimensions of data rate, coverage, mobility, QoS (quality of service) and price.

3. HANDOVER

Handover is a process which helps in maintaining a link between the mobile station and the base station while it is moving from one base station to another[18]. While the BS that provides connection to MS is called serving base station, that is modified when the Mobile Station is moving from base station to another .The new BS will supply facilities to MS after the handover is done and the base station that's being replaced is called the target base station. Depending on the underlying technologyhandover can be roughly divided into two separate forms : horizontal handover and vertical handover.

Horizontal handovers are inter-cellular homogeneous intra-network while the vertical ones are inter-cellular heterogeneous inter-network. For instance, handovers are horizontal between multiple WiMAX networks while those are vertical between WiMAX and 3G or WLAN networks[19,20]. Figure (2) illustrates this form of handover.

There are another classification to handoff process in WiMAX networks depending onwhether there are disconnect during it or not they are HHO(hard handover) , MDHO (macro diversity handover) and FBSS (fast base station switching)[21].

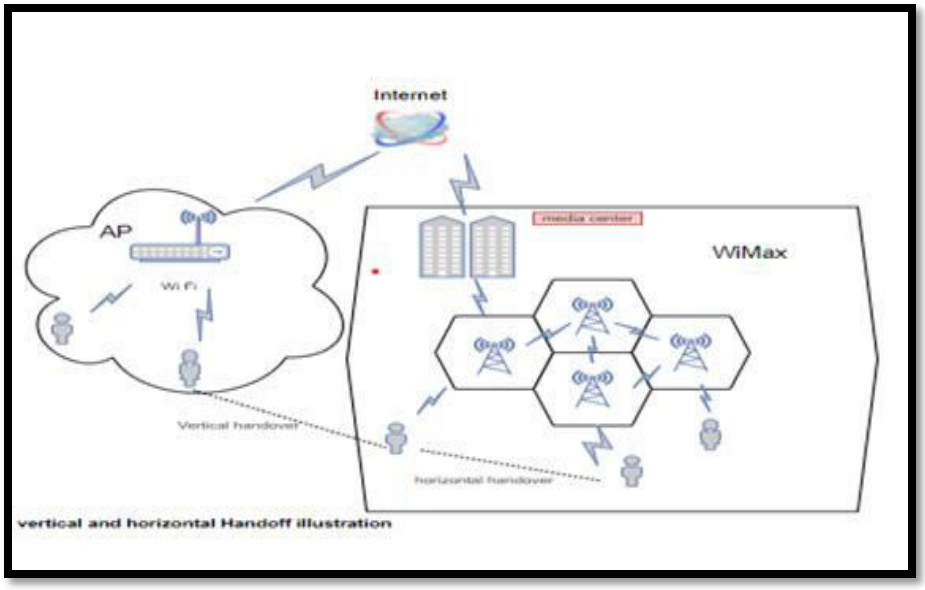

Figure 2. horizontal and vertical handover

Table (1):Brief comparison for handover in MWiMAX

Parameter	Hard Handover	Macro diversity	Fast Base Station Switching
Latency	High	Low	Medium
Complexity	Low	High	Medium
Reliability	Low	High	Medium
Packet loss	High	Low	Low
Cost	Low	High	Medium
Support for real-application	Low	High	High
Speed	Low	High	Medium
Link quality	Low	High	Medium

3.4. Mobile WiMAX Hard Handover Scenario.

The whole process of HHO method in IEEE 802.16e is generally split into the Acquisition Phase of Network Topology (NTAP) and the Actual Handover Phase (AHOP) [22].

Network Topology Acquisition Phase: The MS and Serving BS (SBS) collect information about the underlying network topology during the NTAP along with the assistance of the backhaul network before the final handover decision is taken. It's done to choose lists of possible target BSs for handover operation from which one unique TBS may be selected. Fig. 3 Describe this phase.

Actual Handover Phase (AHOP): during the AHOP MS switches to the chosen TBS location from the serving BS position. fig.4Describe this phase.

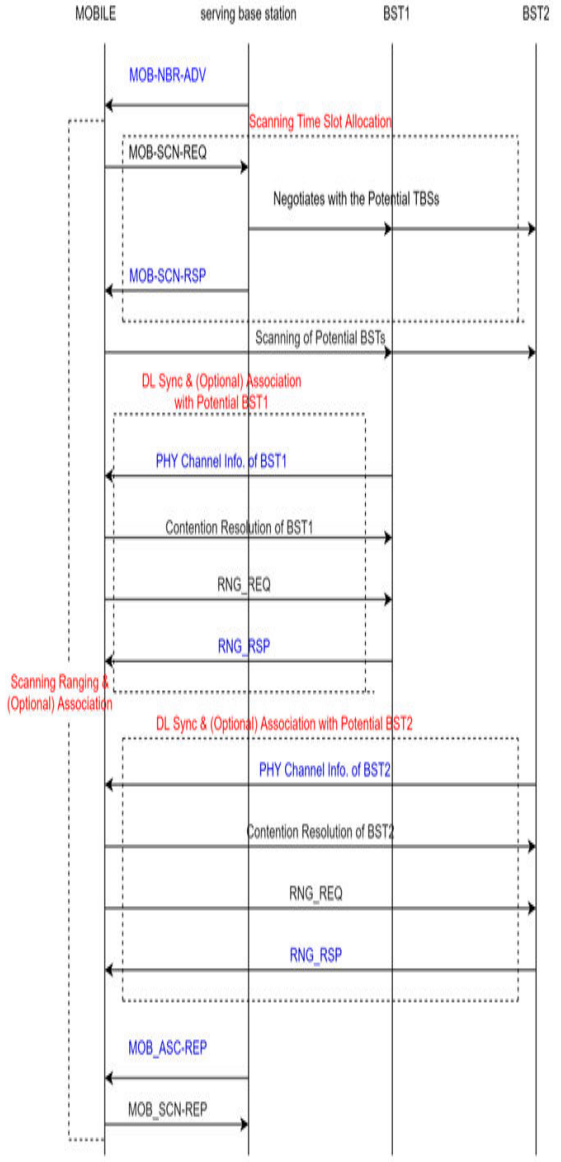

Figure 3. NTAP

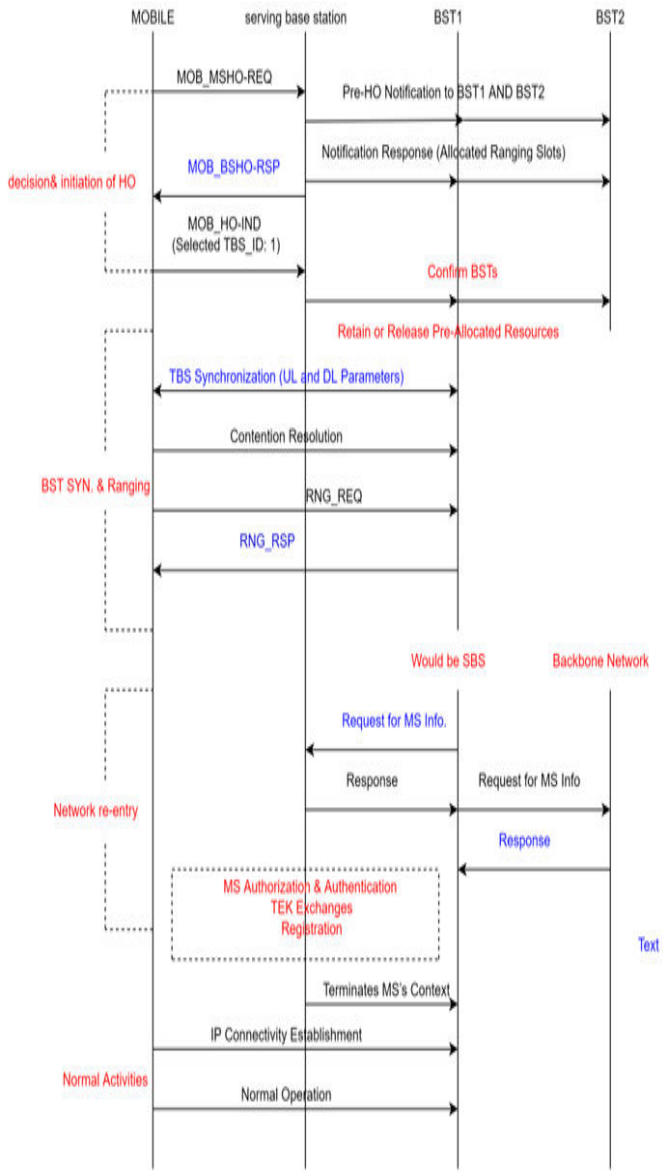

Figure 4. AHOP

4. SOME PROPOSED SOLUTION FOR HANDOVER PROCESS (HORIZONTAL AND VERTICAL)

The handover is an essential process for continuity and quality of service when a user travels from one area to another during communication. Handover affects QoS particularly in real time applications[23]. Therefore, researchers should focus on improving this procedure from various aspects. this sectionwill list some suggested solutions for both horizontal and vertical handover. Integrated networks composed of various wireless connectivity technologies such as WiFi, WiMAX, GSM and LTE can be used for next-generation mobile communications. With a range of access technologies, smartphone users want to take advantage of switching from one spot to another without any interruptions. Seamless transfer between homogeneous or heterogeneous wireless access networks is a key to providing the necessary QoS for mobile users[24]. The overall handover delay must be very short in order to achieve smooth handover in vehicle environments.

4.1. vertical Handover And Some Proposed Solutions

The vertical handoff occurs between the two cells with various technologies or when a node transfers between different wireless access networks[25]–[29] In this scenario, access technologies and IP addresses change because the infrastructure itself shifts as the node switches from one network to another. Network interface and IP address willchange .

4.1.1 SomeProposed Solution For Handover Between WiMAX and WiFiNetworks.

WiFi networks are one of the most relevant networks dealing with the implementation of different user services by WiMAX [30] ,table (2) include some proposals for some researchers .

Table (2): some proposed work for handover between wimax and wi fi networks

Authors	The proposed work	Result or effect
Vuchkovska, L., &Jakimoski, K. (2017, November)..[31]	The algorithm that has been proposed is based on WLAN overload, which is critical for delivering effective service to the mobile nodes.	This paper minimized needless vertical handover procedures in WLAN networks, thus enhancing QoS for all users in the scenario.
Guo, J., Tsuboi, T., & Zhang, J. (2010)[32]	The paper proposes a handover strategy that minimizes the target network latency, guarantees handover to the proper network and prevents any Ping-Pong effects.	This paper is on how Reducing the average latency of handovers latency, and it also provides suggestions for smooth handover between WiMAX and WiFi.
Rashid Abdelhaleem, S., Hafizal, M., Mazlan, A., &BorhanuddinMohd, A. (2011).[33]	A new industrial architecture is proposed for the adaptation layer of WiWi (WiMAX and WiFi).	Reduce the delay in the conversion protocol will result of reducing the delay in handovers.
Gehlot, A., &Rajavat, A. (2016, March).[34]	use AODV(Ad-hoc On –demand distance vector) protocol	Calculate the missing packet rate and determine the efficiency of intra-system transmission and inter-system transfer between WiFi and WiMAX.
Al Emam, F. A., Nasr, M. E., &Kishk, S. E. (2020).[35]	Manage signaling communication behavior based on feedback causes and different policies.	Reduce false handover signals, compensate for variations in the link-layer and reduce the mobility effect.

4.1.3 Some Proposed Solution For Vertical Handover Between WIMAX and LTE Networks.

Study [36] introduces a new Genetic Algorithm-based vertical handover algorithm (GAfVH). It seeks to decrease the amount of unnecessary handovers and maximize the efficiency of the system. GAfVH uses the best RSS values, which are collected as a threshold from the GA and compared with the calculated value. Even if a network's RSS becomes stronger than another one, there is no need to make a handover decision if it is not greater than the threshold value.In [37] a QoS architecture is proposed to provide effective and best traffic classification and end-to-end connectivity for a single WiMAX-LTE network. They simulated an integrated WiMAX and LTE Internet networking environment and tested the performance of the proposed architecture in isolated and mixed scenarios by transmitting real-time (RT) and non-RT traffic. Simulation results showed that end-to-end QoS support can be offered by the proposed architecture while satisfying the traffic requirements of the applications. In general, the vertical handover process is split into three phases: system exploration, handover decision and execution of handover [38]-[40].

4.2. Horizontal Handover And Some Proposed Solutions.

Horizontal handover-this process takes place between the two cells with the same access technologies or between the homogeneous base stations [41-43]. There is no link split between the two cells in this process.Generally, the scanning process is the key part of the handover delay[44] so many researchers try to study and propose a way to minimize it for example[45] proposing an effective network-assisted handover scheme that decrease the scanning latency suffered by vehicles while the handover procedure by offering a network-assisted handover in such a way that the service RSU (road side unit) selects the required target RSU. Additionally , the MS will obtain correct channel/frequency information from the target RSU and the estimated time to start the dedicated scanning phase based on its speed.Data contact between the MS and the RSU service will also not be interrupted during the transfer process and the MS will also be approved with the upcoming RSU before its arrival. Research [46] suggest a hybrid clustering strategy using the k-mean and genetic algorithm Cluster. The purpose of clustering is minimizing the

scanning process of the mobile node by reducing number of access points which require to be scanned for handoff.The clustering technique increases the classification model's accuracy [47].

In [45] suggests a method of mobility patterns used to decrease HO delays. Skipping needless scans in HO is the basic principle of this scheme.The estimation of the target base station also contributed to a reduction in the scanning process as part of the transfer reduction. In [49] suggested a prediction approach focused on monitoring the signal strength between the mobile station and all neighboring base stations. This procedure uses two thresholds for selecting the most likely base station. also the research was provided on the potential of the approaches originally proposed for reducing handover redundancies.

In [50] suggest a system where the intersection between the Serving Base Station (SBS) Coverage Area and the Neighboring Base Station (NBS) Coverage Area is considered to be one set of NBSs (Set A). Another group of NBSS shapes the NBS in the direction in which MS travels (Set B). MS will then search the NBS that exists in Set A as well as Set B to find a suitable TBS. research [51] developed a triangular method of predicting the next likely base station. This approach eliminates hexa-directional uncertainty and predicts the following one completely in advance, greatly enhancing efficiency .This study assumes that the network is completely divided into hexagons which is not the case in fact. Additionally calls are prone to failure if the user is traveling at a fast speed and abruptly changes direction.

Another researcher relies on reducing the transmission delay in order to enhance the handoff , As In [52] the base station transition management solution is suggested to provide quality service for the transfer of nodes. In addition, a delay reduction approach is suggested to decrease the delay in transmission of the packets during the HO. To treat calls from various service groups equally, according to their preferences, a Call Admission Control (CAC) algorithm is suggested. It was proposed to minimize handoff errors by minimizing the various service classes' probabilities while not wasting the continuing calls of lesser priority service kind.In [53]A relay node is allowed to transmit to an end-user wireless system , any data packets remaining in the end-user wireless device buffer prior to the end-user wireless device switch. Upon beginning the switch, the relay node changes the scheduling operation to use the lowest possible modulating coding scheme (MCS) in order to transmit the remaining buffered data to the end-user wireless computer. In addition, the scheduling operation is modified to disregard any subsequent channel quality indicator (CRI) reports from the end-user wireless system, thus ensuring that the end-user wireless device has a higher chance of receiving the data. The handover is executed when the buffer is zero.

The effectiveness of handovers mainly depends on the criteria used to make the decision and no secret that the Signal intensity is one of the most important criteria. There are studies that have adopted additional criteria to further enhance the efficiency like in [54] introduces a novel algorithm that not only supports horizontal hand-off in the same network but can also distinguish RSS and optimize speed and data rate under various channel conditions in order to select an appropriate network to hand-off.For low computational complexity, RSS is utilized to provide handoff among cells and the fuzzy logic decision algorithm is utilized to provide handoff between floors

5. CONCLUSION

Effective handover support is an essential demands of communication techniques which are expected to be widely adopted in next-generation communication systems. The WiMAX-WiMAX handover scenario has shown significant enhancement through increased through rate, reduced delay and reduced jitter. This is mostly due to the similarity in the BS form that saves any extra management signals while vertical handovers take longer time because they add extra management signals. This paper examined the efficiency of the different handoff mechanisms. Both of these mechanisms was able to reduce the latency of handovers relative to traditional HO. While WiMAX has a range of charming features, its handoff mechanism is not without restrictions and has attracted considerable research attention. Researchers have looked at different aspects when seeking to enhance handoff efficiency However, there is still space for study on these aspects.

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