

## Increased Quality of Service through Vertical Handover in Heterogeneous Network of Umts and Wlan

<sup>1</sup>Candidus O. Okwor. <sup>2</sup>Nnamdi Okomba S. <sup>3</sup>Ezea Ugo Hilary

Computer Engineering Department

<sup>1,2</sup>Federal University Oye-Ekiti, Ekiti State, Nigeria

<sup>3</sup>Department of Electrical Electronic Engineering

**Abstract:** This paper is a part of an ongoing research on handover performance when a user seamlessly moves between different access technologies is called Vertical heterogeneous handover. It discussed some of the advances that have been made to reduce vertical handover (VHO) latency for successful handover especially in heterogeneous network environments. Video streaming and voice conversation across different network environment could pose serious challenges to the quality of service during handover. This is the reason why it is imperative that mechanism for maintaining quality of service during handover is considered seriously. This investigation is aimed at adopting a VHO Mobile IP scheme to further reduce handover latency in heterogeneous wireless networks composed of WLAN and GPRS or 3G networks for increased QoS for video and voice streaming. An enhanced hybrid scheme of Bi-mSCTP method with Mobile IP implementation, internetworking handover issue can be resolved and the handover Latency is reduced drastically to an accepted level for quality voice and video streaming. This approach reduces packet loss during handover and as a result the end user can get services continuously with minimal packet loss. The objective of this paper is to analyze the approach of hybrid scheme of Bi-mSCTP for real time traffics such as voice and video.

**Keywords:** Vertical Handover, Heterogeneous Networks, WLAN, 3G or GPRS, Bi-mSCTP

### I. Introduction

In these days of greater concern about next-generation wireless networks mitigation, and the use of an Internet Protocol (IP) based infrastructure with the integration of various wireless access networks such as IEEE 802.11 wireless local area networks (WLANs), IEEE 802.16 wireless metropolitan area networks (WMANs), General Packet Radio Service (GPRS), and Universal Mobile Telecommunications System (UMTS) (Abd-Elhamid T et al, 2008). The need to proffer solutions on how to provide users with seamless mobility and required quality of service (QoS) in heterogeneous networks is of critical imperative and to do so heterogeneous wireless networks need to cooperate so that mobile nodes (MNs) can automatically switch the connectivity between different types of networks (A. M. Vegni, 2007). It is very important to point out that Vertical handover (VHO) latency needs to be minimized for successful handover especially in heterogeneous network environments. Next generation wireless networks need to provide higher data rate and support mobility in a seamless manner. A greater advantage of cellular networks, which requires the implementation of cellular networks over wired access is the mobility and the wide coverage offered. An important segment of the Telecommunication market consist of corporate networks, which require the implementation of the advanced data and voice services in a secure environment (Banerjee N. et al, 2003). This scenario is shown in the Figure 1..below.

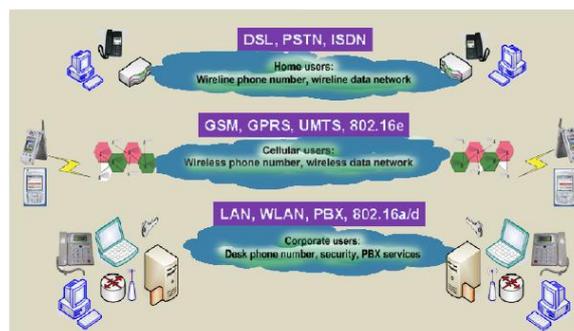


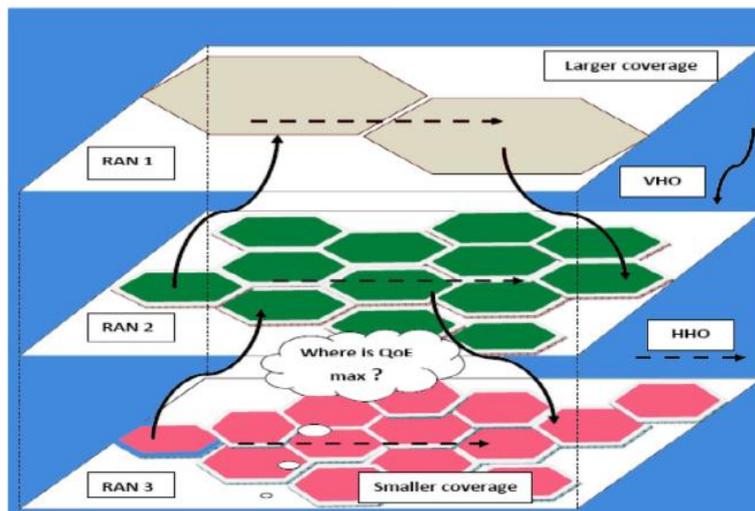
Figure1: Current Heterogeneous Network Topology

VHO is different from conventional horizontal handover where the mobile devices move from one base station to another within the same network Radio Access Network (RAN). In VHO, a session is seamlessly

handed over to a new RAN in an interoperable region based on a criterion dictating the signal quality (Ben-Jye Chang et al, 2008). The current network topology, where services are strongly dependent on the infrastructure is changing in the order to satisfy different customer requirements in a unified solution. This unified solution proposes a single platform for service provisioning in a promising concept known as Heterogeneous Network Convergence. Convergence was first applied for the internetworking between fixed and mobile operators providing voice services. The internetworking architecture allows telephone calls from fixed to mobile networks and voice services. In the past, the voice services were mainly associated with fixed and mobile Telecommunication networks. (Berezdivin R. et al, 2002)

Integrating conventional networks such as WLAN and GPRS and/or other 3G services heterogeneous networks is achieved. Moreover, the integration of WMNs with various existing wireless networks such as cellular, wireless-Fidelity (Wi-Fi), and worldwide inter-operability for microwave access (WiMAX) networks can be accomplished through the gateway/bridge functionalities in mesh routers. With the integration of multiple wireless access technologies, the wireless mesh backbone provides a viable solution for users to access the Internet anywhere, anytime. (Bo Li, et al, 2006)

Nowadays, a revolution has started and all the services and applications provided by internet are moving to wireless technologies. There is an increasing trend towards mobility, Convergence and connectivity anywhere anytime. (Budzisz L, et al, 2008). When a session is seamlessly handed over to a new Radio Access network (RAN), a criteria dictating the signal quality to form what is known as VHO Trigger.



**Figure2:** Vertical Handover in Future Heterogeneous Network

First step towards convergence emerged in 2004 following the approval of standardization of the IP Multimedia Subsystem (IMS) by Third Generation Partnership Project (3GPP). Due to the massive deployment of Wireless Local Area Network (WLAN) and VoIP, the initial effort in 3GPP is oriented to make possible the convergence between cellular Technologies and WLAN. However, the main targeted market is on corporate users. Owing to cost reasons and mobility benefits, these users have massively adopted WLAN technologies as part of their voice and data networks. These considerations, slightly changes the technology convergence concept into cellular technologies and WLAN-corporate convergence, which is the topic addressed in this paper. (Camarillo, et al 2005)

## **II. Heterogeneous Networks Problems**

In this convergence scenario, services are performed through two different wireless access networks. The mobile terminals must be capable of connecting to any of these access networks and to migrate existing sessions from one technology to another. (Ding S 2009). This process is known as Vertical Handover. In heterogeneous networks, a mobile station (MS) needs to switch its serving network to maintain connectivity or to improve service quality. Therefore, vertical handover (VHO) is one of the major issues to be prepared for the success of heterogeneous networks. When a MS performs VHO, it needs to exchange more information and takes more time to switch their connection than the case of the horizontal handover (HHO). However, long handover latency can make a MS to be disconnected from its serving network and failed in handover. Therefore we need to minimize VHO latency as much as possible. Due to the challenges imposed to the heterogeneous network by vertical handover Latency, there is the need to reduce the vertical handover latency to the level of Horizontal handover. (D. L. Oliva, et al 2008)(EngHweeOng, et al 2011)

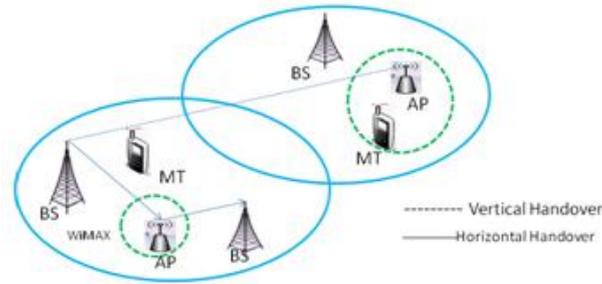


Fig3: Vertical and Horizontal Handover

### III. Vertical And Horizontal Handover

A handover performed when a user moves from one cell to another using the same access technology is called horizontal homogeneous handover; a typical example could be a user moving between two cells in a cellular system. A handover performed when a user moves between different access technologies is called Vertical heterogeneous handover. The study in this paper refers particularly to Vertical Handover implementation with assured quality of service for real-time traffic such as voice and video. To maintain QoS during vertical handover, the handover implementation has to be supported with a system that equally implements continuity in the network as handover occurs. (Fu S, et al, 2005)

### IV. Previous Works On Mip Mechanism For Vho

Different VHO latency reduction mechanism between WLAN and 3G networks have been proposed by different researchers. (EngHweeOng et al, 2011) illustrated three different designs namely centralized, distributed and trusted distributed for vertical handoff decision, by means of three parameters; Throughput, Decision Processing and End-End delay. The strength of his paper is that, it validates that among the each outcome of all the three designs the trusted distributed for vertical handoff decision having best performance among all. The limitation of the paper is that, a lot of delay time both in decision processing and End-End transmission. Secondly, there are many inappropriate judgments attempted by the mobile nodes to decide their target network due to data flooding which leads to network congestion. Hamza B. J. et al. (2010) presented a review of Minimizing a Vertical Handover in a heterogeneous wireless network architecture for a seamless VHO over WLAN and UMTS based on two existing mobility protocols, SIP and MIP. The authors perceived the VHO entity as a set of functions placed within the UMTS network which is responsible for VHO management. They proposed three solutions: MIP, SIP and hybrid based solutions. Although they analyzed the working principles of each solution with simulation results, they did not provide any simulation results of their work for real-time traffics.

Fu et al. (2005), proposed handover scheme called Seamless IP diversity based Generalized Mobility Architecture (SIGMA). In his scheme Fu et al's SIGMA scheme uses mSCTP to implement IP diversity by keeping the old path alive during the process of setting up the new path for seamless handover. When this happens, some handover drawbacks associated with IP mobility can be improved. Thus, in situations where the mobile host travels with a faster speed in which the host may move out of the overlapping region of the two adjacent access networks before finishing the steps of obtaining a new IP address and adding IP address into association with CN. This situation seriously makes handover performance of SIGMA difficult.

Tao et al., (2010) proposed a Smooth Handover Scheme based-on mSCTP (SHSBM) which attempts to address this issue imposed by Fu et al's mSCTP scheme. In this paper a Smooth Handover Scheme based-on mSCTP (SHSBM) adopts the advantages of SIGMA, and utilizes buffer and tunnel to better serve fast-moving users, with ensuring communication in ubiquitous environments as its main objective. The authors proved by simulation that the proposed SHSBM depict lower packet losses rate as well as higher throughput compared to SIGMA and MIPv6 in fast-moving scenarios.

Varma et al. (2003) presented a solutions for the integrated GPRS and WLAN using MIP or SIP for mobility management. In his research work only location management aspect was addressed seamless VHO using the loose coupling integration method.

Ma et al. (2004) presented an mSCTP scheme for UMTS/WLAN VHO via two types of SCTP configurations; single-homing and dual-homing. In the single-homing configuration, the fixed server (FS) has one IP address which communicates with a multihomed MN. In the dual-homing configuration, both the FS and the MN have more than one IP address each to support the VHO. The authors changed the VHO operations to reduce the VHO delay in the dual-home configuration.

Kwon et al. (2008) proposed a multipath approach to reduce the packet loss during soft handoff. After the new IP address is added into the association, both old and new addresses are considered as the primary

address of the association. Data from the corresponding host is duplicated and sent to both addresses. This avoids a long latency due to retransmission.

Koh and Hyun, (2008) presented an extension of SIP to support a soft handover named mobile SIP (mSIP). The mSIP handover is designed to support the 'bicasting' of media streams from CN to MN during handover. In this way, an mSIP handover with bicasting can reduce the handover loss and latency compared to the baseline SIP scheme.

#### **A. Mobile IP (MIP) mechanism for VHO**

The Universal Mobile Telecommunications System (UMTS) is a third generation (3G) cellular system which is expected to deliver low-cost, high-capacity mobile communications and offering data rates of up to 390 Kbps. The wireless radio access network for UMTS contains user equipment (UE) and UMTS terrestrial radio access network (UTRAN), which includes the node-B and radio network controller (RNC). The packet domain core network is comprised of the serving GPRS support node (SGSN) and the gateway GPRS support node (GGSN) (Kim K. R. et al., 2006).

The next generation heterogeneous wireless network (HWN) consists of various wireless technologies including UMTS and WLAN. Smooth mobility is expected to be the most significant feature for future HWNs. To achieve smooth mobility, especially for a seamless vertical handover (VHO) in wireless communication, it is necessary to install an association to a mobile node (MN) and keep the association while the MN is roaming (Kim et al., 2006). The management of VHO deals with a group of essential functions to vary the MN's point of attachment (POA) to the IP network, while keeping the connection with the corresponding node (CN) (Larry Taylor et al., 1999).

The location server for VHO is used to register the current IP address of an MN. Then, the location information of the MN is saved inside this server. The CN which is associating with the MN acquires the location information of the MN through the location server. The tracking of the current IP address of an MN is achieved by the location management. This IP address provides the gateway for any entity requiring to link with the CN (Liu J. et al., 2008). The MN can keep its present link without disconnection during new data session. However, the VHO faces several drawbacks such as high packet loss due to the disparity in bandwidth, a high handover delay from the high packet overhead and large congestion windows which will reduce the throughput of the network system. Currently, the seamless VHO problems are solved by different protocols in various ways such as Stream Control Transmission Protocol (SCTP), Mobile IP (MIP) and Session Initiation Protocol (SIP) to achieve a seamless VHO (Spatscheck et al., 2000); Berezdivin et al., 2002; Kozlovsky et al., 2006). SCTP is an order of data packet delivery between two endpoints (Kozlovsky et al., 2006). It has a highly reliable transport layer protocol which provides stability similar to TCP, and also preserves the boundaries of data messages similar to UDP. Nevertheless, unlike TCP and UDP, SCTP offers advantages such as capabilities of multihoming and multistreaming which enhance reliability and availability. A multihoming host uses more than one network layer address to communicate. Hence for an MN, it can use multiple network interfaces simultaneously. If the primary path fails, the protocol will send traffic over the alternate path. Multistreaming can be used to deliver multiple objects (webpage, audio, video and text) that belong to the same association independently. Each stream is given a stream number that is encoded inside SCTP packets flowing through the association (Leu, 2009).

The SCTP with dynamic association reconfiguration (DAR) allows IP addresses to be added and removed from an SCTP association. The data packets can then be transmitted to the new destination. This enables an MN to move to a new network and implement a VHO at the transport layer. For prior forwarding of data packets from one node to the other, the data packet handshake between the two endpoints among the peer SCTP users must be established. On the other hand, being a network layer protocol, MIP ensures the smooth management of VHO during mobility. However, the MIP needs particular routers, such as a Foreign Agent (FA) and a Home Agent (HA). These routers are capable of intercepting and encoding/decoding data packets for the MN in the whole network (Stevens et al., 2010). Triangular routing of all arriving data packets to the MN via the home network can cause data session disruption in the MN during VHO which leads to further delays in receiving packets. Session Initiation Protocol (SIP) is an application layer protocol responsible for establishing, modifying and terminating multimedia sessions (Schulzrinne and Wedlund, 2000). Some logical entities such as proxy servers, redirect servers, user agents and registrars can be extended to support personal mobility (Banerjee et al., 2003). Personal mobility enables an MN to switch between IP subnets while still being connectable to incoming requests and saving data sessions across subnet changes. Although SIP based protocols can facilitate VHO over HWN networks, it increases system complexity and does not allow seamless data packet sessions due to the long latency time (Pangalos et al., 2001). In this paper, we propose a novel scheme to eliminate router overheads in the MN due to buffering, registration period and data session disruptions in the MIP during VHO. This new scheme is known as a hybrid scheme of mSCTP with bicasting or so-called Bi-mSCTP which uses an HA to continuously track the location of the MN during the course of bicasting in the MIP. It instructs the MN to transmit its own data packets to the CN by using either IP1 of the cellular UMTS or IP2 of the WLAN. In this

way, the CN can send the same data packet to the MN over both UMTS IP1 and WLAN IP2 networks. The simulation results showed that the hybrid scheme has a VHO delay of about 0.302 seconds when the MN moves from a WLAN to a UMTS, while the VHO delays for both mSCTP and MIP schemes are 1.124 and 2.538 seconds respectively. Similarly, the proposed hybrid scheme has registered about 36.4 and 48.1% improvement in packet loss reduction compared to the mSCTP and MIP respectively Hamza B. J. et al. (2010).

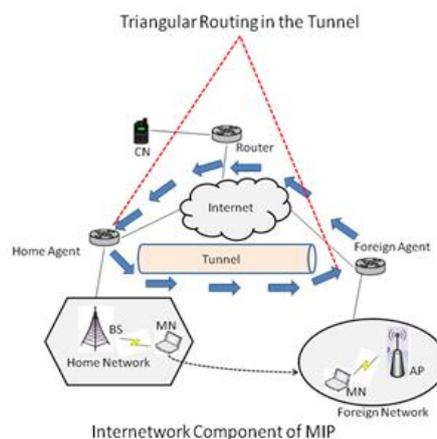
Many researchers have proposed different mechanisms of VHO to enable global roaming of HWN between different access networks such as UMTS and WLAN networks. Sattari et al. (2004) presents network architecture for a seamless VHO over WLAN and UMTS based on two existing mobility protocols, SIP and MIP.

The authors perceived the VHO entity as a set of functions placed within the UMTS network which is responsible for VHO management. They proposed three solutions: MIP, SIP and hybrid based solutions. Although they analyzed the working principles of each solution, they did not provide any simulation results. Varma et al. (2003) proposed solutions for the integrated GPRS and WLAN using MIP or SIP for mobility management. The study addressed only the location management aspect in place of a seamless VHO using the loose coupling integration approach. Ma et al. (2004) presented an mSCTP scheme for UMTS/WLAN VHO via two types of SCTP configurations; single-homing and dual-homing. In the single-homing configuration, the fixed server (FS) has one IP address which communicates with a multihomed MN. In the dual-homing configuration, both the FS and the MN have more than one IP address each to support the VHO. The authors changed the VHO operations to reduce the VHO delay in the dual-home configuration. Kwon et al. (2008) proposed a multipath approach to reduce the packet loss during soft handoff. After the new IP address is added into the association, both old and new addresses are considered as the primary address of the association. Data from the corresponding host is duplicated and sent to both addresses. This avoids a long latency due to retransmission. Koh and Hyun, (2008) presented an extension of SIP to support a soft handover named mobile SIP (mSIP). The mSIP handover is designed to support the ‘bicasting’ of media streams from CN to MN during handover. In this way, an mSIP handover with bicasting can reduce the handover loss and latency compared to the baseline SIP scheme.

Fu et al. (2005) presented a handover scheme called Seamless IP diversity based Generalized Mobility Architecture (SIGMA). SIGMA used mSCTP to implement IP diversity by keeping the old path alive during the process of setting up the new path for seamless handover. In this way, the model improved some of the drawbacks associated with Mobile IP. However, in real life with the development of society and modern vehicles, people’s rhythms of life unceasingly speed up. As such, in scenarios where the mobile host has faster travelling speed, it may move out of the overlapping region of the two adjacent access networks before finishing the steps of obtaining a new IP address and adding IP address into association with CN, thereby seriously reducing the handover performance of SIGMA. In an attempt to address this problem, Tao et al., (2010) proposed a Smooth Handover Scheme based-on mSCTP (SHSBM). This scheme adopts the advantages of SIGMA, and utilizes buffer and tunnel to better serve fast-moving users, with ensuring communication in ubiquitous environments as its main objective. The authors proved by simulation that the proposed SHSBM depict lower packet losses rate as well as higher throughput compared to SIGMA and MIPv6 in fast-moving scenarios such as Vehicular Vertical Handover.

**B. Mobility management in MIP**

Mobile IP (MIP) is virtually accepted as the internet standard for MNs although, it is yet to be widely deployed. MIP seeks to solve mobility issues at the IP network layer.



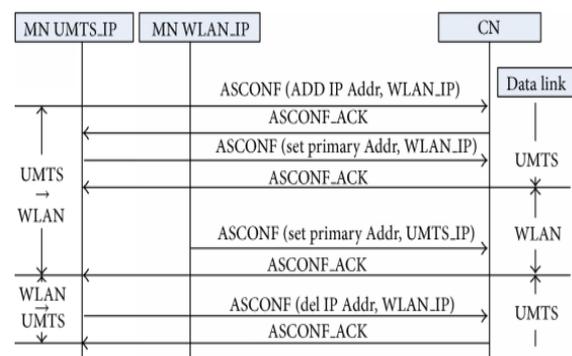
**Fig 4: Internetwork Component of MIP**

The HA is located in the home network as a router capable of intercepting and encoding (encapsulating) transmitted data packets for the MN. The FA on the other hand, is a router of an MN located in a foreign network providing routing services to the MN upon successful registration. The FA decodes (decapsulates) and sends data packets tunneled by the HA to the MN as shown in Figure 4 (Perkins, 1998; Ding et al., 2009). When an MN moves into a new network such as a foreign network, it must get a new IP address compatible with the new network. In MIP, an MN can have two ADD IP addresses; a permanent home address (a fixed IP address allocated by its home network) as well as a care of address (CoA). A CoA is a temporal address assigned to the MN when it operates in a foreign network. When the MN is in the HA, it employs its home address to transmit or receive data packets. Moreover, when the MN travels away from its home network and enters a foreign network, it is allocated a CoA by the FA through the exchange of agent solicitation and advertisement messages also known as CoA discovery. As soon as the MN discovers its CoA in the foreign agent, it transmits a registration request to its HA via its new network to inform the HA of the MN's new CoA (Ding et al., 2009). When the HA receives this request, it adds the necessary information to its routing table and sends a registration reply message back to the MN to approve the request (Sharma et al., 2004). This is referred to as the CoA registration. Once the registration process is successful, the HA intercepts any data packets transmitted with the MN's home address and tunnels them using its current CoA. The original packet can be decoded at the termination of the tunnel and forwarded to the MN.

**C. BI-MSCTP mechanism for VHO**

The standard mSCTP management scheme for VHO between UMTS and WLAN networks is illustrated in Figure 1. In the cellular UMTS-IP1 region, the MN connects to the CN by using an IP configuration such as the IP1 address. When the MN moves to a new network such as the WLAN-IP2, the data packets of the cellular UMTSIP1 address are discarded. The MN then begins movement detection and address configuration (Ma et al., 2007).

The MN will receive the IP2 address of the new location via the new access router of the WLAN by transmitting a change ASCONF data chunk. The MN then receives the ASCONF-ACK reply data chunk from the CN. It is vital to note that during the VHO session, the MN cannot receive data packets from the CN since this may lead to a high VHO delay. Once the MN moves away from the coverage of the WLAN network, the old IP address is deleted by transmitting an ASCONF data chunk. The MN then receives the replying ASCONF-ACK data chunk from the CN (Lee et al., 2006) (Figure 1). The procedure of the Bi-mSCTP for VHO (Koh and Hyun, 2008; Kwon et al., 2008) is depicted in Figure below.



**Fig 5:** The vertical handover procedure UMTS-WLAN

Initially, the MN in the cellular UMTS is tagged with an IP1 address. When it moves from cellular UMTS towards WLAN network, the access router of the WLAN is detected, thus provoking the MN to perform an IP address configuration such as in DHCP. Once the IP address configuration is completed, the MN directly communicates with the CN using the new address by transmitting an ASCONF data chunk which contains the VHO flag. This flag informs the CN to start bicasting to the MN. Thus, the CN can send a replica of the data packets to the MN via both UMTS-IP1 and WLAN-IP2 in the VHO region (Koh and Hyun, 2008). In response to the ASCONF, the CN sends an ASCONF-ACK data chunk to the MN to add the new IP address in the association between the MN and the CN, which ensures that the MN's IP in the new network is set as the primary address of the MN. The CN then starts bicasting, and the MN sends its individual data packets to the CN through either UMTS-IP1

or WLAN-IP2. Conversely, as the MN leaves the WLAN-IP2 region, it senses the link down event for the UMTS-IP1 to disconnect the WLAN network by transmitting an ASCONF data chunk which deletes the old IP address. Upon receiving the ASCONF-ACK data chunk reply from the CN, bicasting is stopped. Henceforth, MN and CN use only the IP1 address for all future communications.

#### **D. The limitations of Mobile IP (MIP)**

There are a number of drawbacks in MIP. Every packet in the standard MIP incurs additional routing and packet overheads. This problem is especially evident in applications used for transmitting relatively small and delay sensitive packets. A second issue in MIP is handover performance that is, the duration of the process. An unacceptable increase in the duration of the registration time can lead to more and more packets being lost or reordered. On the other hand, the MIP approach provides some level of VHO support between UMTS and WLAN networks. Experiments have shown that it is difficult to keep the seamless continuity of data sessions over VHO due to the long latency. The aforementioned problems lead to data session disruption or degradation in the user experience during VHOs if MIP is used (Perkins, 1998; Sharma et al., 2004).

#### **E. Hybrid scheme of Bi-mSCTP for MIP**

In this work, an integrated scheme employing mSCTP with multicasting or so-called Bi-mSCTP mechanism for MIP was proposed. It is proposed to overcome several MIP issues such as additional routing, time of registration, data session disruption and data packet overheads in the MN during VHO. The Bi-mSCTP mechanism relies on the generated signals to allocate a new CoA dynamically to the CN before the link layer handover. When the MN is in the region of VHO, it inserts a multicasting flag inside the ASCONF data chunk to inform the CN to start the transmission over both the WLAN and UMTS links. Similarly, when the MN of the cellular UMTS moves to a new network such as a WLAN, it senses the signal strength of the new link and transmits a registration request to the access router of the old cellular UMTS network as shown in Figure 6. The old network then sends a registration reply message from its access router to the MN. Once this message is correctly received, the new CoA, which is allocated to the MN from the old access router will be employed in the new network. Thereafter, the MN will transmit an ASCONF data chunk to the CN. The CN then knows the new allocated CoA and adds a new IP by using the ASCONF transmitted from the MN. At this juncture, the CN commences the multicasting of data packets via both UMTS-IP1 and WLAN-IP2. (B. J. Hamza et al 2010)

Henceforth, the MN transmits its individual data packets to the CN through either UMTS-IP1 or WLAN-IP2 depending on the quality of their links. In this way, the VHO delay is significantly minimized. The MN, upon receiving the ASCONF\_ACK data chunk from the CN, adds a new CoA in the current association and sets it as the primary-IP address. The CN and MN then exchange data packets by using the new CoA since the registered primary-IP address is currently associated with the new network. This situation continues to persist until the MN completely leaves the WLAN-IP2 region. When the MN senses the link down event for the UMTS-IP1, it seeks to move away from the coverage of the WLAN network. Thus, it transmits an ASCONF data chunk to the CN requesting to delete the old IP address in order to delete the old address of the WLAN. It then receives an ASCONF-ACK data chunk reply message from the CN to stop the multicasting procedure and delete the old CoA at the association address (that is, transmission over IP address of UMTS). Upon reception of this reply message, the CN and MN may only use the IP1 address for all future communication. Moreover, the hybrid scheme uses the HA to continuously track the location of the MN during the course of the multicasting under the MIP. In this way, the proposed scheme succeeds in discarding the use of a tunnel between the cellular UMTS and WLAN access routers. As a result, the delay due to the message exchanges in the tunnel is minimized. Similarly, it eliminates the routing-overheads due to buffering. (B. J. Hamza et al 2010).

When a MN moves from the UMTS coverage area into the WLAN, the VHO procedure occurs. Specifically, the MN of the UMTS network first scans to ensure that a WLAN network access within the vicinity is available. The cellular UMTS/BS periodically transmits a CoA advertisement for the outgoing MNs to WLAN networks to track the availability of the UMTS network. When the MN detects the advertisement, it begins examining the received signal strength (RSS) to make the VHO decision. The MN first estimates the RSS from the WLAN access router and compares it with the UMTS network (A. M. Vegni et al 2007). If the RSS of the WLAN is found to be greater than the UMTS, then the VHO procedure is initiated. Otherwise, the MN maintains its connectivity with the UMTS network. The RSS of the UMTS will continue to get weaker as the MN moves away from the UMTS/BS towards the WLAN/AP. As the MN approaches the overlapping area of two networks, it informs the CN to start the multicasting of data packets via both UMTS-IP1 and WLAN-IP2. As the movement towards the WLAN network intensifies, the MN senses the high RSS of the new link and transmits a registration request to the access router of the cellular UMTS. It then assigns a new CoA from the old access router to the new WLAN-IP2 network. The WLAN HA then begins to track the location of the MN during the course of the Bi-mSCTP in MIP. Similarly, when the MN moves into the coverage area of the cellular UMTS, it begins a reverse VHO procedure. Figure 9 illustrates the whole VHO delay of the MNs when it roams between UMTS and the WLAN.

Since VHO delay consists of the following; Detection Delay, IP address Registration delay, Signal exchange delay.

Therefore, if detection delay is the time spent when MN moves in close range to an AP (region of VHO) and detects a better network strength  $T_d$ , IP address registration delay is spent by the MN to

configure a new IP address  $T_{ar}$  and the Signal exchange delay is the time spent by the MN to insert a bicasting flag inside an ASCONF data chunk to inform the CN to start transmitting over both WLAN and UMTS link  $T_s$ . Thus, according to (Koh and Hyun, 2008) VHO delay  $T_{VHO} = T_d + T_{ar} + T_s$

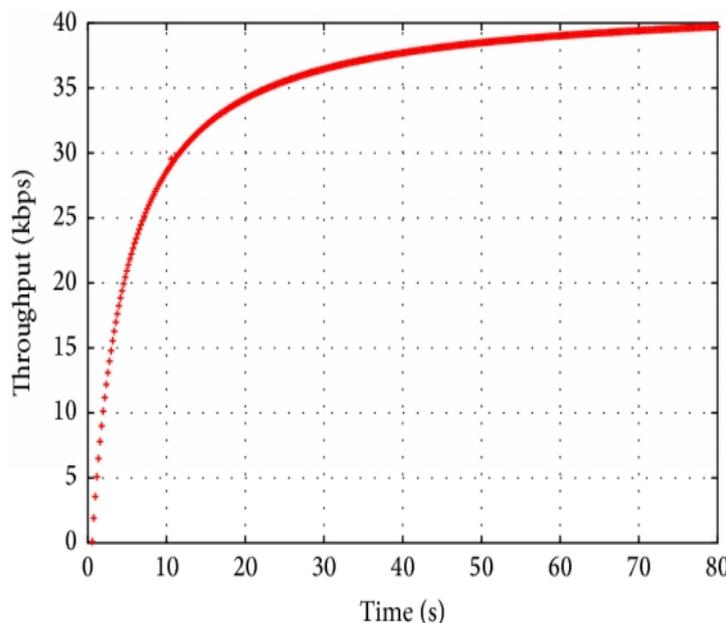
**V. The Behaviour Of Hybride Scheme Of Bi-Msc upon Real Time Traffic**

To understand the behavior of real-time traffic during vertical handover, we simulated voice and video traffic. A VoIP flow requires low packet loss to maintain a conversation at good quality levels. Loss rate up to 10% may be tolerated but can be very significant in some cases and depends on the packet concealment techniques adopted by the decoder at the receiving end. To maintain good communication for VoIP traffic, the total end-to-end delay must remain below 150ms. Delay in the range of 150 – 400ms is considered acceptable, although the annoyance becomes perceptible; delays greater than 400 ms are considered intolerable and thus unacceptable for effective communication. When an MN moves from one access network to another. The aim of the simulations is to research the performance metrics during vertical handovers in heterogeneous networks with real-time video traffic, to analyze the impact of the mobile terminal speed on the performance metrics for real time traffic and to find a solution to improve the results of the performance metrics during vertical handovers between UMTS and WLAN networks especially when the increase of mobile terminal speed degrades the QoS of real time applications. Simulations are done with the MATLAB. VoIP is simulated as a two-state voice traffic model. Both states are distributed exponentially with mean for the ON-period  $\_on = 1000$  ms and OFF-period  $\_off = 1350$  ms. During the ON-period the voice IP flow carried a payload of 24 bytes transmitted at 30 ms intervals. Such data rate specification is compliant with G.723.1 codec at 6.3 Kbps data rate.

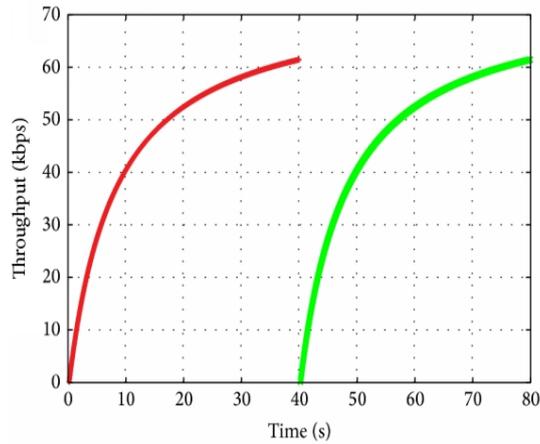
Video traffic is simulated with constant bit rate so that the packet size is 1500 bytes and a packet is sent with 10 ms interval. The selected rate is nearly sufficient to provide a MPEG-1 video stream, which needs a data rate up to 1.5 Mbit/s. Since the goal was not to test the capacity, the low data rate was reasonable. Simulation parameters used in the simulations for this paper are recommended and optimized parameter values for link triggers and router configuration based on the previous work in this field. An assumption that the MN is multihomed was made. (Mandeep K. et al, 2011)

Traffic	Delay Interval	Packet Size	Data Rate
H.261	≈26 ms	≈600 bytes	150 kb/s
MPEG-4	2 ms	700 bytes	150 kb/s
HDTV	2 ms	1024 bytes	5 Mb/s

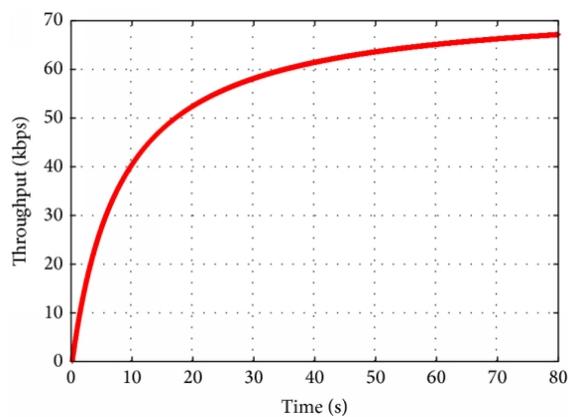
**Table 1:** Simulation parameter



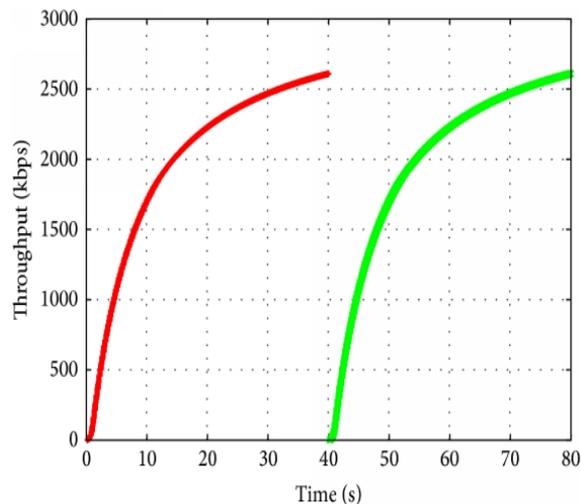
**Fig 6:** Delay performance when MN transmits Video data traffic in 3G without handover



**Fig 7:** Delay performance when MN transmits Video data traffic during handover



**Fig 8:** Delay performance when MN transmits VoIP traffic in WLAN without handover.



**Fig 9:** Delay performance when MN transmits VoIP traffic in WLAN during handover

Figure 6 illustrates the delay when an MN in 3G network transmits video traffic in nationwide UMTS network. From the figure it can be seen that the x-axis represents the time of transmission of data chunks in seconds while the y-axis represents the transmission throughput of data chunks. The delay is the time interval between the reception of the first packet of data chunk and the time the data chunk was transmitted. The throughput of the data chunk transmitted increased until the first 20s at which the throughput remain slightly constant with time at 38.5kbps. Figure 7 illustrates the VHO delay when an MN moves from cellular UMTS to WLAN under hybrid scheme of Bi-mSCTP. The VHO delay, when MN moves away from cellular UMTS, is the period between the moment when MN receives the last packet using cellular UMTS and the moment when it

receives the first packet using WLAN. Fig 8 illustrates the delay when MN transmits VoIP traffic in WLAN without handover under hybrid scheme of Bi-mSCTP. As shown in Figure 9, the MN initially receives data chunks from the CN via the old path of WLAN, When the MN moves away from the cellular WLAN network coverage area into the UMTS network, the VHO occurs at 40 s under hybrid scheme of Bi-mSCTP. As can be seen from the fig, the VHO delay up to 40s is still much for VoIP traffics. This is the basics of our research.

## VI. Conclusion

In this paper, the most significant contribution published in the recent years pertaining to VHO scheme and radio resource management in heterogeneous network has been analyzed. However, it is clearly noticed that though the contributions are highly valuable and effective, more still need to be done to further reduce the VHO latency to the bearest minimum for voice and video traffics. The current handoff and radio resource management schemes fail to enable seamless handoff and effective service continuity for real time data traffics. Evidence from our simulations indicates that the seamless communication for real-time data traffics is not good enough in the heterogeneous network even with the hybrid scheme of Bi-mSCTP for mobile IP implementation and the above form the foundation for the work presented here.

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