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Motion Aware Vertical Handoff of WLAN-WiMAX-LTE

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Abstract: In the last few years, rapid advancements in instant broadband networks happen to be driving the actual evolution regarding communication and network systems towards upcoming generation all-pervasive computing circumstances. To comprehend the all-pervasive environments, a seamless handover criteria between heterogeneous instant networks is one of the most critical techniques. The heterogeneous instant networks include wireless particular, local, and broadband systems. Among a number of candidate technologies to the numerous instant broadband systems, IEEE 802. 16-operated WiMAX indicates promising possibilities.

Keywords: WiMax, LTE, WLAN, Handoff.

I. INTRODUCTION

Within the last few decades, rapid advancements in wifi broadband networks have been driving this evolution of communication along with network technologies towards following generation common computing situations. To know the common environments, a seamless handover criteria between heterogeneous wifi networks is one of the most essential techniques. The actual heterogeneous wifi networks include things like wireless private, local, along with broadband networks. Among various candidate technologies with the numerous wifi broadband networks, IEEE 802. 16-operated WiMAX indicates promising possibilities. IEEE 802. 16 Set WiMAX continues to be developed from the IEEE 802. 04 standard routines. Because this cannot support the range of motion of terminals, IEEE802. 16 Set WiMAX just isn't suitable for mobile computing environments. Therefore, to support mobility on terminal gas stops, IEEE 802. 16e Mobile WiMAX common is recommended.

The handover treatment is identified as “horizontal handover” inside standard file. Due to the mobility within IEEE 802, 16e Mobile WiMAX, an interworking plan between heterogeneous networks, i. age., vertical handover, is basically required. Below this necessity, this cardstock addresses a new vertical handover criteria for interworking in between IEEE 802. 11 WLAN along with IEEE 802. 16e Mobile WiMAX. Currently, not very much attention continues to be paid to the handoffs in between IEEE 802. 11 WLAN along with IEEE 802. 16e WiMAX. From the literature, most study on vertical handover is perfect for interworking in between WLAN along with 3G networks. The almost all well-known study on vertical handover with regard to interworking in between WLAN along with 3G networks may be classified in radio indicate strength (RSS) structured approach along with policy-based approach. However, to take the mobile computing environment, for example Mobile WiMAX, we should consider motion pattern of mobile gas stops (MSs). From the early vertical handover study, homogeneous networks purchase the stereo signal power (RSS) since the main factor with the handover selection.

II. PREVIOUS WORK

However, the vertical handover decision needs to consider more factors because heterogeneous wireless networks have different characteristics. Therefore the policy-enabled handover decision algorithm using the utility function with various factors was proposed. It performs vertical handover to the best target BS determined by the utility functions. The factors used in vertical handover are service types, monetary cost, network conditions, system performance, mobile node conditions, etc. Such policy-based vertical handover decision algorithms can be used to provide QoS to BSs. In a homogeneous environment, the ping-pong effect is a phenomenon that rapidly repeats vertical handover between two BSs. In a heterogeneous environment, the ping-pong effect occurs if factors for the vertical handover decision are changing rapidly and an MS performs handover as soon as the MS detects the better BS. The dwell timer scheme has been used to avoid such ping-pong effects. It starts to work when the vertical handover condition is first satisfied. If the vertical handover condition persists during the dwell time, the MS performs vertical handover to the target BS after the dwell timer is expired. Otherwise, the MS resets the dwell timer.

Consequently, the MS does not execute premature vertical handover until the target BS becomes stable. Ping pong effect can also occur if the speed of an MS is high or the moving direction of the MS is irregular. Thus, the proposed scheme in this paper adjusts the length of the dwell time adaptively according to the ping-pong movement of MS. An MS selects a target BS with the least QoS level from neighbor BSs that can satisfy QoS requirement of the current application, i.e., an MS does not select the best BS as a target BS. Therefore, it remains with the serving BS as long as the BS satisfies the QoS requirement of the MS. When the type of the application used changes or an MS leaves the serving BS, the MS attempts to find another BS. The proposed vertical handover decision algorithm can avoid ping-pong effect since it is based on the need of the application, but not the RSS of the BS. On the other hand, we propose a vertical handover decision scheme that can avoid pin.

III. WLAN AND WIMAX

A. Macro-View of Interworking Architecture

As shown in Figure 1 below, the vertical handover adaptive mobile station (MS) has dual interfaces for both WLAN and Mobile WiMAX. If the WLAN network provides more efficient service for the MS, the MS uses the WLAN interface to use a WLAN connection link. Otherwise, the MS uses the Mobile WiMAX interface. The efficiency is determined by 'VHO module' in the MAC of the MS. To interconnect with WLAN or Mobile WiMAX, the MS connects an AP of WLAN with a RAS of Mobile WiMAX. The AP and RAS provide an interface to communicate with the MS. In the subsequent section, the AP and RAS are called as base stations (BSs).

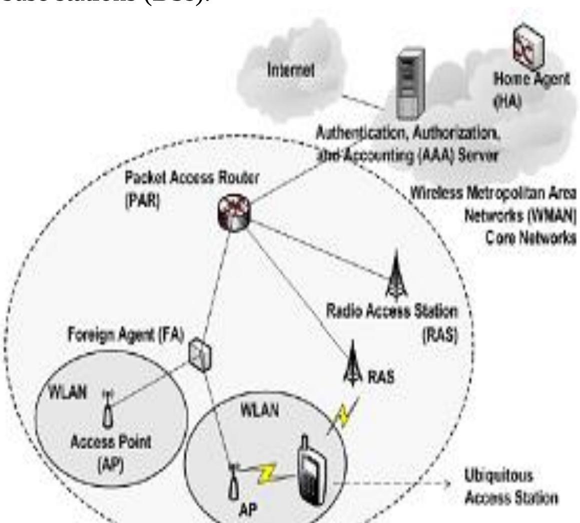

Fig 1: Internetworking Architecture.

B. Macro-View of Interworking Architecture

As shown in Figure 2 below, the vertical handover adaptive mobile station (MS) has dual interfaces for both WLAN and Mobile WiMAX. If the WLAN network provides more efficient service for the MS, the MS uses the WLAN interface to use a WLAN connection link. Otherwise, the MS uses the Mobile WiMAX interface. The efficiency is determined by 'VHO module' in the MAC of the MS. To interconnect with WLAN or Mobile WiMAX, the MS connects an AP of WLAN with a RAS of Mobile WiMAX. The AP and RAS provide an interface to communicate with the MS. In the subsequent section, the AP and RAS are called as base stations (BSs).

C. Micro-View of Interworking Architecture

First, the MS and BS have synchronization process to communicate for operating vertical handover. Next, the MS and BS exchanges parameters such as DL-MAP (Downlink MAP), UL-MAP (Uplink MAP), DCD (Downlink Channel Descriptor), UCD (Uplink Channel Descriptor), VHO_PARA_REQ (Vertical Handover Parameters Request), and VHO_PARA_RSP (Vertical Handover Parameters Response). The first four parameters are used for downlink/uplink synchronization and the next two parameters are used for VHO module. If a BS receives VHO_PARA_REQ, the BS sends VHO_PARA_RSP with its parameters to determine the efficiency of the serving networks. Upon the receipt of the received messages, the VHO module determines whether the MS needs vertical handover or not.

IV. MAV HANDOVER ALGORITHM

Our proposed movement-aware vertical handover algorithm (MAV) consists of three procedures as described in this section. The first procedure, location update procedure, detects the location of an MS periodically according to the velocity and movement pattern of the MS. Values used in the vertical handover decision are also updated periodically. The target BS selection process selects a BS providing the maximum utility and benefit among other candidates. Based on the information obtained from the above two procedure, the actual vertical handover is performed in the final handover execution procedure. In the MAV handover decision process, RSS-based vertical handover is triggered if the MS leaves the current serving BS, while utility-based vertical handover is triggered if the handover is beneficial based on predictive residence time in the target BS. The whole process of the proposed algorithm is described in Algorithm 1 as a pseudo code form. [1] Connection handoff is no longer limited to migration between two subnets in a wireless local area network (WLAN) or between two cells in a cellular network (generally known as "horizontal handoff"). In addition to roaming and horizontal handoff within homogeneous subnets (e.g., consisting of only IEEE 802.11 WLANs or only cellular networks), supporting service continuity and quality of service (QoS) requires seamless vertical handoffs (VHOs) between heterogeneous wireless access networks.

In general, heterogeneous networks can be combinations of many different kinds of networks, e.g., vehicular ad hoc networks (VANETs), WLANs, Universal Mobile Telecommunications Systems (UMTSs), CDMA2000 (code-division multiple access), and mobile ad hoc networks

(MANETs). Many new architectures or schemes have recently been proposed for seamless integration of various wireless networks. However, the integration of WLANs and cellular networks has attracted the most attention, because, currently, WLANs and cellular networks coexist and many cellular devices have dual radio-frequency (RF) interfaces for WLANs and cellular access. With regard to VHO performance, there is a critical need for developing algorithms for connection management and optimal resource allocation for seamless mobility. Several interworking mechanisms for combining WLANs and cellular data networks into integrated wireless data environments have been proposed. Two main architectures for interworking between IEEE 802.11 WLAN and 3G cellular systems have been proposed: 1) tight coupling and 2) loose coupling. When the loose coupling scheme is used, the WLAN is deployed as an access network complementary to the 3G cellular network. In this approach, the WLAN bypasses the core cellular networks, and data traffic is more efficiently routed to and from the Internet, without having to go over the cellular networks, which could be a potential bottleneck. However, this approach mandates the provisioning of special authentication, authorization, and accounting (AAA) servers on the cellular operator for interworking with WLANs' AAA services.

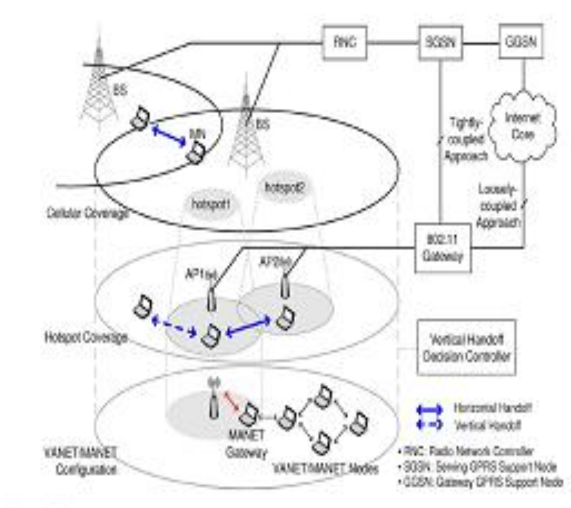

Fig 2: Architectureintegrated heterogeneous networks.

On the other hand, when the tight coupling scheme is used, the WLAN is connected to the cellular core network in the same manner as any other 3G radio access network so that the mechanisms for the mobility, QoS, and security of the 3G core network such as UMTS can be reused. As a result, a more seamless handoff between cellular and WLAN networks can be expected in the tightly coupled case, compared to that in the loosely coupled case. There have also been some research efforts to connect a mobile device equipped with multiple RF interfaces to the most optimal network among a set of available heterogeneous access networks. Vertical mobility is achieved by switching the interface of the mobile device to connect to an alternative target network. McNair and Zhu introduced important performance criteria to evaluate seamless vertical mobility, e.g., network latency, congestion, battery power, service type, etc. In Guo et al. proposed an end-to-end mobility management system that reduces unnecessary handoff and ping-pong effects by using measurements on the conditions of different networks.

In various network-layer-based internetwork handover techniques have been addressed, and their performances are evaluated in a realistic heterogeneous network test bed. Nasser et al. proposed a VHO decision (VHD) method that simply estimates the service quality for available networks and selects the network with the best quality. However, there still lie ahead many challenges in integrating cellular networks and WLANs (or any combination of heterogeneous networks in general). VHO algorithms are not adequate in coordinating the QoS of many individual mobile users or adapting to newly emerging performance requirements for handoff and changing network status. Furthermore, under the current WLAN technology, each mobile device selects an access point (AP) for which the received signal strength (RSS) is maximum, irrespective of the neighboring network status. Although the attachment to the closest AP is known to consume the least power for the individual mobile device at a given instant, in a situation where many mobile devices try to hand off to the same AP, there would be, in effect, significantly more power consumption at the mobile devices collectively due to increased congestion delays at the AP.

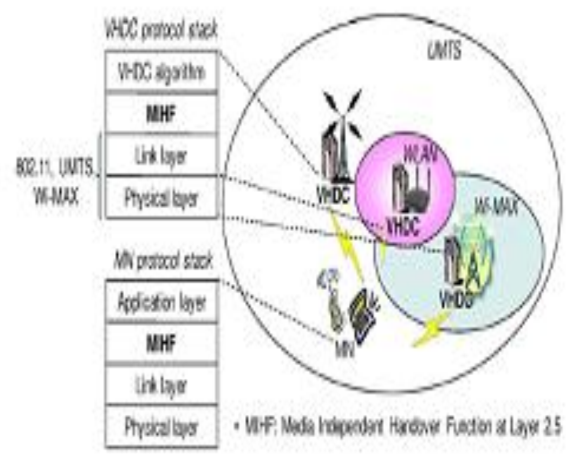

Fig 3: VHDC implementation.

V. VHD SYSTEM DESCRIPTION

As shown in Figure above, an MN can be existing at a given time in the coverage area of an UMTS alone. However, due to mobility, it can move into the regions covered by more than one access network, i.e., simultaneously within the coverage areas of, for example, an UMTS BS and an IEEE 802.11 AP. Multiple IEEE 802.11 WLAN coverage areas are usually contained within an UMTS coverage area. A Worldwide Interoperability for Microwave Access (WiMAX) coverage area can overlap with WLAN and/or UMTS coverage areas. In dense urban areas, even the coverage areas of multiple UMTS BSs can overlap. Thus, at any given time, the choice of an appropriate attachment point (BS or AP) for each MN needs to be made, and with VHO capability, the service continuity and QoS experience of the MN can significantly be enhanced. A single operator or multiple operators may operate the BSs and APs within a coverage area. Thus, multiple access technologies and multiple operators are typically involved in VHDs. Hence, there is a need for a common language in which the link-layer information and the MNs' battery power information can be exchanged between different networks and/or operators. As described here, this common language is provided by the MIHF of IEEE 802.21. We also show in Figure above how we envision the VHD to be implemented. We suggest that our proposed VHD algorithm be implemented in multiple VHDCs. These VHDCs are located in the access networks, as shown in Figure 3 above, and can provide the VHD function for a region covering one or multiple APs and/or BSs.

We envision that the decision inputs for the VHDCs will be obtainable via the MIHF, which is being defined in IEEE 802.21. The VHDC is, conceptually, a network-controlled mobility management entity utilizing the IEEE 802.21 MIHF, and some experimental implementations of this nature are in progress. The MIHF facilitates standards-based message exchanges between the various access networks (or attachment points) to share information about the current link-layer conditions, traffic load, network capacities, etc. The MIHF at an AP also maintains the battery life information of the MNs, which are currently serviced by it. [2]. When a common interworking platform for 3G cellular networks is considered many challenges lie ahead. Choosing the appropriate IP version and defining a mobility management platform, which is common for both 3GPP and 3GPP2 are some such challenges. As defined by 3GPP2, if MIPv4 is deployed, the Packet Data Switching Node (PDSN) of the CDMA2000 home network may act as the MIP Home Agent (HA) or Foreign Agent (FA) as the Mobile Node (MN) moves. In the event when MIPv6 is implemented, direct peer to peer communications may be established through its route optimization operation. Since 3GPP2's IMS does not fully support inter-PDSN mobility for IPv6, the proposed design will be primarily based on MIPv4. Other reasons for using MIPv4 are as follows: it eliminates the complexity of managing two IP addresses and enables IP mobility management transparently to the layers above.

Our proposed internetworking architecture is illustrated in Figure 4 below. Each network is connected to the all-IP CN via its corresponding gateway (i.e., WiMAX via the Connectivity Services Network (CSN) Gateway, UMTS via the GPRS Gateway Support Node (GGSN), CDMA2000 via the PDSN, and the WLAN via a GGSN emulator). Each network has a MIP-FA (or HA) at one of its gateways and a local PCSCF. The remaining elements of the IMS and the MIP-HA are located at the home network of the MN. Thus the IMS is used for centralized session mobility management and MIP for terminal mobility management. The data flow is routed from source to destination bypassing the home network. Only the SIP based session control signaling (call setup, call termination, and session management) gets routed via the home network. The session control signaling is forwarded by the P-CSCF of the visiting network to the S-CSCF (via the I-SCSF) of the home network. A session handoff scenario form UMTS to WiMAX can be described as follows. Following the UMTS system acquisition, setting up the data pipeline takes place. The IP address allocation for the MN is initiated by sending the MIPv4 registration request to its HA via the GGSN (i.e., the MIP-FA). Next the MN sends a SIP registration message to the S-CSCF via the PCSCF. Once authorized, a suitable S-CSCF gets assigned and its subscriber profile is sent to this designated S-CSCF. After the activation of the PDP context and service registration, the MN is now ready to establish a session.

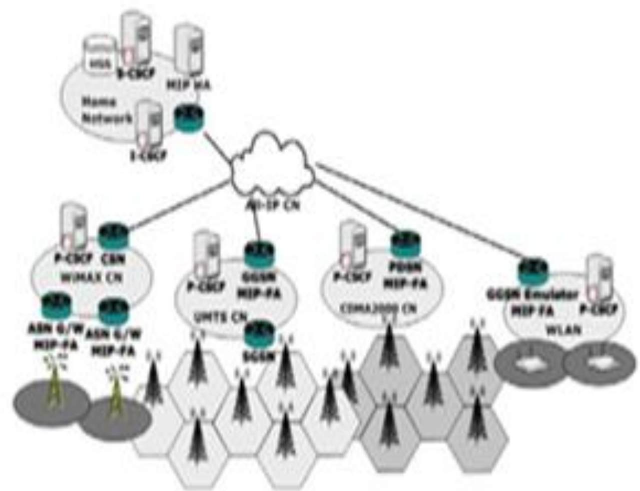

Fig 4: Proposed Interworking Architecture.

VI. LTE (LONG TERM EVOLUTION)

A. Tight Coupling

In tightly coupled interworking the WLAN network is connected to the WiMAX network directly and also with LTE networks and appears to be one of the core networks. All the WLAN traffic is injected into the core network directly. This type of connection tends to be quicker in data transfer hence the delay will be less. The simulated architecture of WiMAX-WLAN-LTE tight coupled interworking.

B. Loose Coupling

The simulated architecture of WiMAX-WLAN loose coupled interworking. In loose coupled interworking the WLAN network connected to the WiMAX and LTE network indirectly and appears to bypass through intermediate. All the WLAN traffic is injected into the intermediate network directly and from the intermediate network the traffic is sent to the core network. This approach gives independent deployment of WLAN, WiMAX and LTE networks.

C. Neighbor Reservation

In tightly coupled interworking the WLAN and LTE networks are connected to the WiMAX network directly. In this network the bandwidth of all the network resource are reserved about 20 % for the handover users so the time taken to allocate bandwidth for the mobile node will reduce.

D. Gateway Relocation

The heterogeneous wireless radio access technology consists of different gateway and corresponding base stations. Each gateway is connected to Session Initiation Protocol Gateway (SIP GW) which provides connectivity services. The different gateways are tunneled through Multi Protocol Label Switching. MPLS can encapsulate packets of various network protocols.

VII. RESULTS AND DISCUSSION

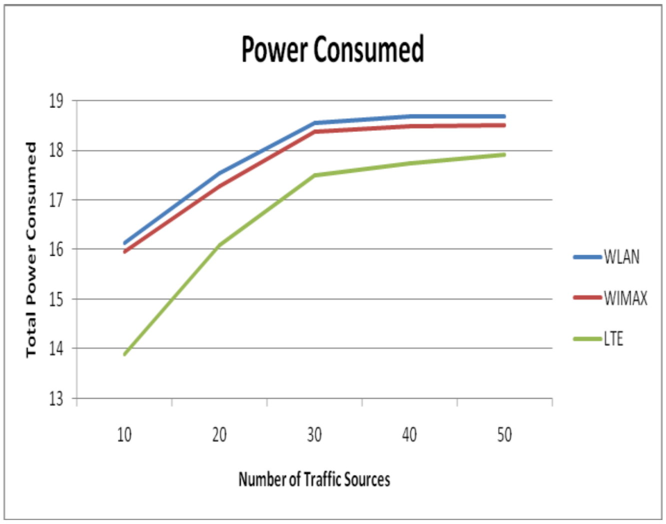

Fig5: Power Consumption Vs Number of Traffic Sources.

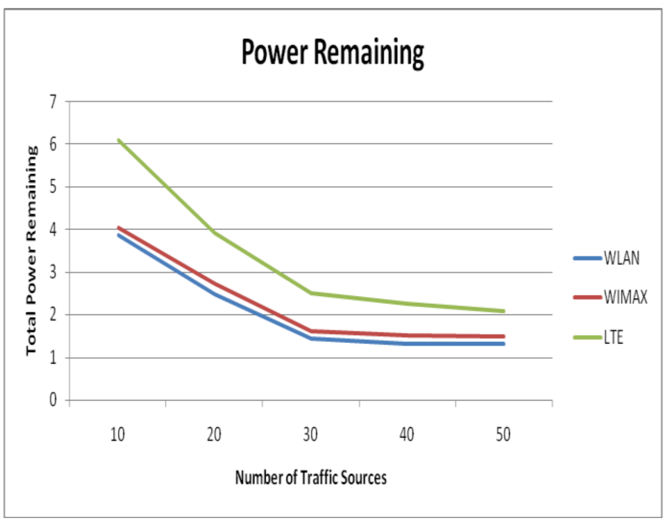

Fig 6: Power Remaining Vs Number of Traffic Sources.

The above graph (fig 5) represents the power consumption plotted for various numbers of traffic sources for WLAN, WIMAX, and LTE. The number of traffic sources varies from 10 to 50. We observe that whatever might be the case of number of traffic sources the Power consumption for LTE is always less than the other protocol. The above graph (fig 6) represents the power remaining plotted for various numbers of traffic sources for WLAN, WIMAX, and LTE. The number of traffic sources varies from 10 to 50. We observe that whatever might be the case of number of traffic sources the Power remaining for LTE is always more than the other protocol.

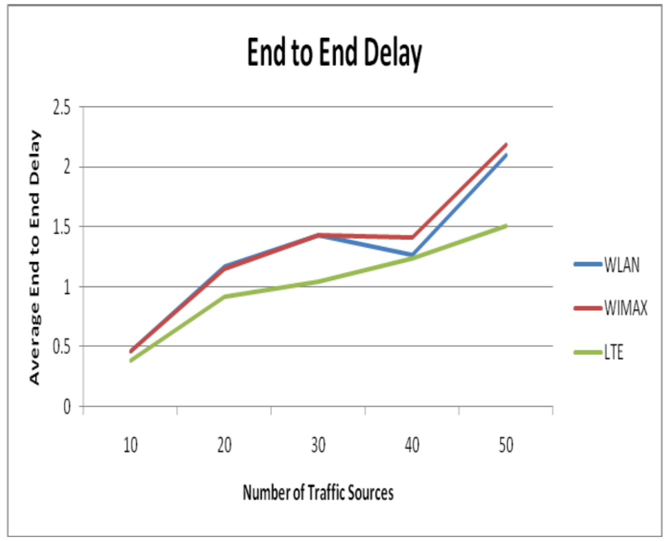

Fig 7: Average End to end Delay Vs Number of Traffic Sources.

The above graph (fig 7) represents the average end to end delay plotted for various numbers of traffic sources for WLAN, WIMAX, and LTE. The number of traffic sources varies from 10 to 50. We observe that whatever might be the case of number of traffic sources the average end to end delay for LTE is always less than the other protocol.

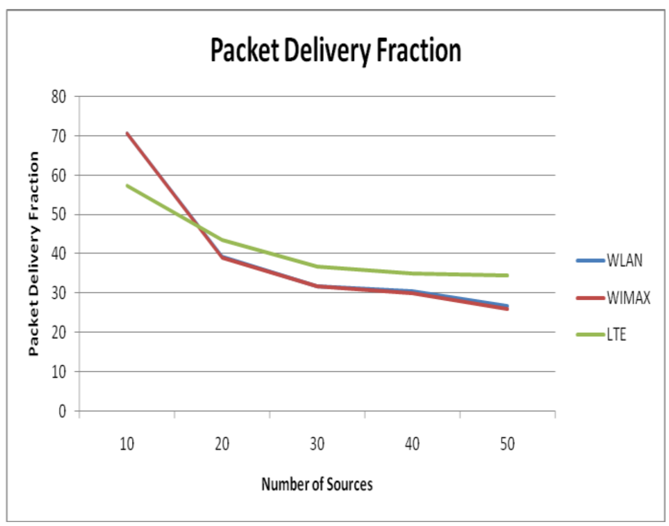

Fig 8: Packet Delivery Fraction Vs Number of Traffic Sources.

The above graph (fig 8) represents the packet delivery fraction plotted for various numbers of traffic sources for WLAN, WIMAX, and LTE. The number of traffic sources varies from 10 to 50. We observe that whatever might be the case of number of traffic sources the Packet delivery fraction for LTE is always more than the other protocol except in the case of traffic sources of 10 flows. The graph (fig 10) represents the routing overhead plotted for various numbers of traffic sources for WLAN, WIMAX, and LTE. The number of traffic sources varies from 10 to 50. We observe that the case of number of traffic sources the routing overhead for LTE and other protocol is almost same but we achieve more PDF and less delay in LTE.

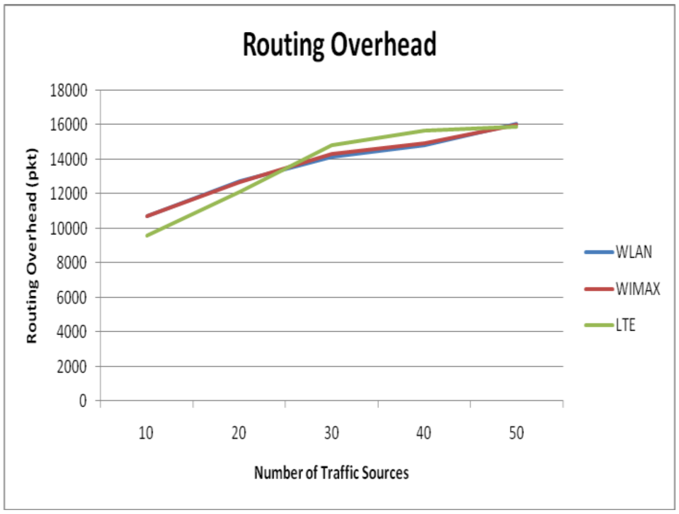

Fig 9: Routing Overhead Vs Number of Traffic Sources.

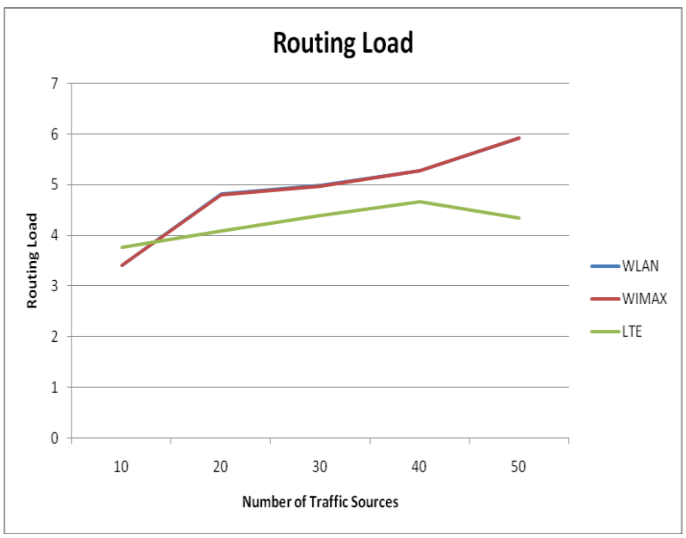

Fig 10: Routing Load Vs Number of Traffic Sources.

The above graph (fig 10) represents the routing load plotted for various numbers of traffic sources for WLAN, WIMAX, and LTE. The number of traffic sources varies from 10 to 50. We observe that whatever might be the case of number of traffic sources the routing load for LTE is always less than the other protocol except in the case of traffic sources of 10 flows. The graph (fig 11) represents the packets received plotted for various numbers of traffic sources for WLAN, WIMAX, and LTE. The number of traffic sources varies from 10 to 50. We observe that whatever might be the case of number of traffic sources the packets received for LTE is always less than the other protocol except in the case of traffic sources of 10 flows.

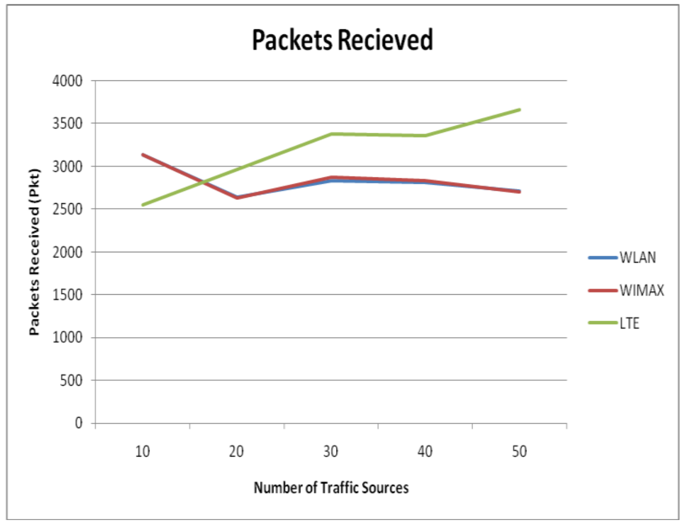

Fig 11: Packets Received Vs Number of Traffic Sources.

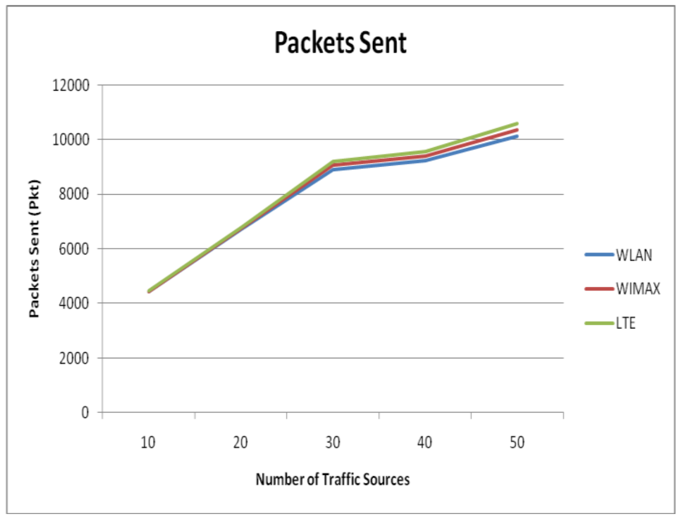

Fig 12: Packets Sent Vs Number of Traffic Sources.

The above graph (fig 12) represents the packets sent plotted for various numbers of traffic sources for WLAN, WIMAX, and LTE. The number of traffic sources varies from 10 to 50. We observe that whatever might be the case of number of traffic sources the packets sent for LTE and other protocol is almost same.

VII. CONCLUSIONS

Heterogeneous cell networks like WLAN, LTE and WiMAX need efficient handoff mechanisms to guarantee seamless on-line. In that work four a variety of interworking architectures have been designed concerning WLAN, LTE and WiMAX communities namely: snugly coupled integration, often coupled integration, tight coupling having neighbour reservation is actually gateway new house purchase. Consideration of vertical handover is done by seeking the mobile node in a region exactly where WLAN, LTE and WiMAX insurance coexist. It had been found that will tight coupling having neighbour reservation is actually gateway new house purchase provides far better handover overall performance. The system simulation also demonstrates interworking buildings with entry relocation outperforms the opposite coupling methodologies because of the reason a secondary path is established prior for you to handover plus it results inside less handover wait, lesser packets dropped and higher signal for you to noise relation. It was found that will handover wait is lesser compared to the voice a sedentary lifestyle time having neighbour reservation is actually gateway relocation thus we can assure that seamless connectivity may be accomplished.

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