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Categorization of Vertical handover and Modeling of Overhead Involved

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***Abstract*— The evolution of new networks with their different technologies has enabled the existence of multiple standards to serve the basic necessities of communication. Each network with its own architecture stands different from the others and thus there exists simultaneously, a heterogeneous association of multiple networks. With all the diversities in the world, the end user wants and needs vary and that forms the basis of various technologies to facilitate the same end users even for a specific purpose. The power of choice is one factor that has compelled the technologists and the students like us, to explore the various ideas and come out with solutions to provide efficient systems to co-exist, having multiple technologies, serving the same purpose. In short search for homogeneity in the heterogeneous environment. In such scenarios the issue to provide mobility management between these heterogeneous networks becomes more and more critical. Since all the architectures have different attributes, mobility management requires much more attention in order to achieve uniformity. Mobility comes with handovers, which is a technical term for a procedure to pass on the attributes of a call/facility as the user roams between wireless cells.**

***Index Terms*— Vertical Handover, Wireless Local Area Network (WLAN), Universal Mobile Telecommunications System (UMTS), Wi-Fi, IP (Internet Protocol), Mobile Stream control transmission protocol (mSCTP), CoA (Care-Of-Address)**

INTRODUCTION

In this era communication requires universal wireless accession and seamless mobility and low cost. One of the major challenges for seamless mobility is vertical handover, which is the process of maintaining a mobile user's active connections as it moves between different types of network. Vertical handover between WLAN, UMTS (CDMA2000) and new generation technologies. In order to achieve seamless vertical handover in heterogeneous network environments, it is necessary to guarantee service continuity and quality-of service (QoS), which means low latency, low packet loss and jitter during handover.

IP was primarily introduced to hide the details of diverse underlying hardware and access technologies and bring them all to a common platform. It works at network layer of OSI Model.

Fig.1: IP's of different Devices

Mobile IP protocol allows location-independent routing of IP datagram on the Internet. Each mobile node is identified by its home address disregarding its current location in the Internet. While away from its home network, a mobile node is associated with a care-of address which identifies its current location and its home address is associated with the local endpoint of a tunnel to its home agent. Mobile IP specifies how a mobile node registers with its home agent and how the home agent routes datagram to the mobile node through the tunnel.

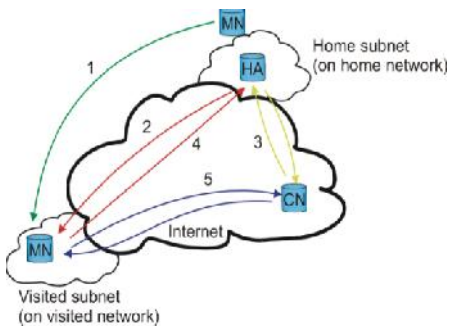

Fig.2: Routing of Mobile node, Home Address, Correspondent Node

IPv6 was essentially designed with the goal to solve the address space problem as faced in IPv4 and therefore, does not provide any special facilitation for seamless mobility. Like IPv4 the IPv6 also does not separate the location identifier and node identifier thus forbidding dynamic internetworking. Choosing IPv6 as a new internetworking layer is therefore, not a solution for seamless mobility. Even the Mobile IPv6 (MIPv6) does not provide seamless mobility. In handover delays reported for MIPv4 and MIPv6 are 0.26 sec and 1 sec respectively; not appropriate enough to support voice over IP.

Mobile IP version-6 eliminates the need for foreign agent (FA), thus reducing the required network modification. The remainder of the procedure remains exactly the same. MN acquires CoA in the foreign network and directly sends a binding update to HA in a secure fashion by using IP sec and ESP. In the home network the MN is represented by proxy neighbor discovery. Any packet sent to the MN is encapsulated in a IPv6 header, forming a tunnel, and sent to the CoA of the MN. Packets from the MN use the reverse tunnel, resulting in inefficient routing. Only Home Agent and Mobile Node will know of any change of network, but would be transparent for Correspondent Node. MN sends packets directly to CN, i.e. triangular routing.

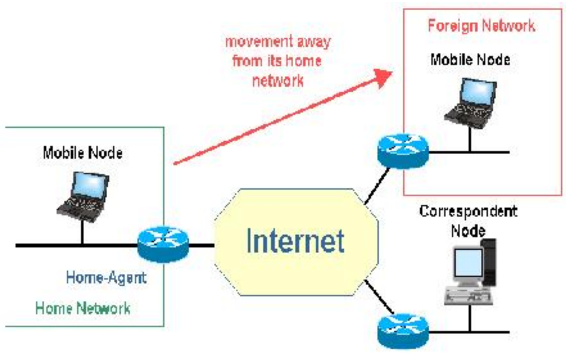

Fig.3: Triangular Routing

Fast Mobile IP is proposed by MIPSHOP to reduce the packet loss incurred due to the handover delay in MIP. It creates a tunnel between Previous CoA(PCoA) and New CoA (NCoA), thus expediting the handover process.

Hierarchical MIP is designed with the goal to reduce signaling overhead, which otherwise can be very high when MN and HA (or CN) are very far apart.

F-HMIP is the Combination of FMIP and HMIP produces not only favorable effect on handover delay but also the packet loss is minimized. However this is achieved at the cost of increased signaling overhead.

Cellular IP is a 'new way' combining the strengths of mobile IP and next generation cellular services without inheriting their weaknesses. Cellular IP combines the capability of cellular networks to provide smooth fast handoff and efficient location management of active and idle mobile users with the inherent flexibility, robustness and scalability found in IP networks. Cellular mobile telephony systems are based on a different concept from that of Mobile IP. Instead of aiming at global mobility support, cellular systems are optimized to provide fast and smooth handoff within restricted geographical areas. In the area of coverage, mobile users have wireless access to the mobility unaware global telephony network. A scalable forwarding protocol interconnects distinct cellular networks to support roaming between them.

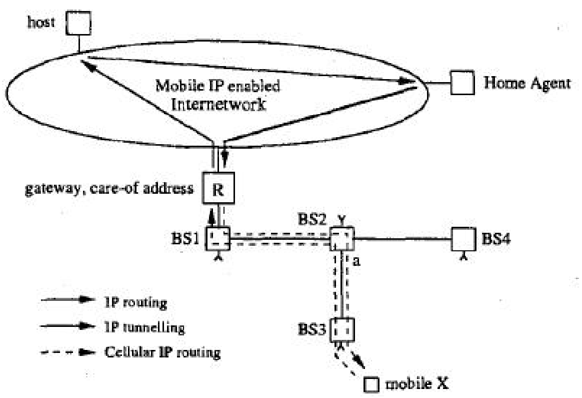

Fig.4: Handover Process from BS to BS

The handover process of CIP is automatic and transparent to the upper layers. When the strength of the beacon signals from the serving BS is lower than that of a neighboring BS, the MH initiates a handoff. The first packet that travels to the gateway through the new BS configures a new path through the new BS. These results in two parallel paths from the gateway to the MH: one through the old BS and one through the new BS. If the MH is capable of listening to both BSs at the same time, the handoff is soft; otherwise, the handoff is hard. The path through the old BS will be active for duration equal to the timeout of route caches. After timeout, the entries corresponding to the MH in the nodes that belong only to the old path are deleted. Thereafter, only the new path exists between the gateway and the MH. Mobile IP represents a simple and scalable global mobility solution but is not appropriate in support of fast and seamless handoff control. In contrast, third generation cellular systems offer smooth mobility but are built on complex networking infrastructure that lacks the flexibility offered by IP-based solutions. It works at network layer. Instead of global mobility it provides restricted mobility.

mSCTP is defined as SCTP with the capability of dynamic address reconfiguration. The mSCTP can be used to support the vertical handover of mobile terminals.

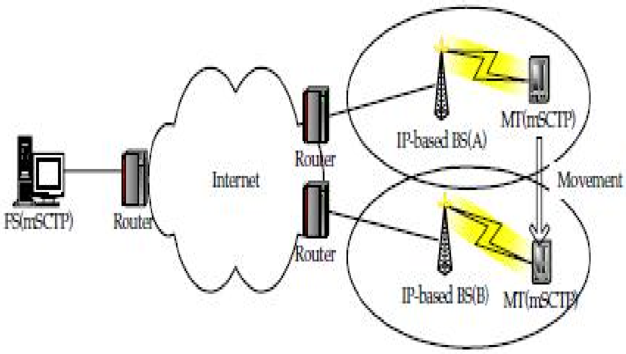

Fig.5: Vertical Handover of Mobile Terminals

In the initial stage, we assume that FS has 'IP address 1', whereas MT uses 'IP address 2'. Note in this phase that the MT is in the single-homing state, and it uses IP address 2 as its primary IP address in the SCTP association. Now, the MT is moving from A to B and it is now in the overlapping region. In this phase, the MT will obtain a new address 'IP address 3' from the BS B by using any scheme for address configuration such as Dynamic Host Configuration Protocol (DHCP). After obtaining a new IP address, the MT informs FS that it will use a new IP address. The MT is now in the dual homing state. The old IP address (IP address 2) is still used as the primary address, until the new IP address 3 will be set to be "Primary Address" for MT.
While the MT further continues to move toward BS B, it will set the primary address as the new IP address according to an appropriately configured rule. Once the primary address is changed, the FS will send the outgoing data to the new primary IP address of MT, whereas the old IP address may be used as a backup address to recover the lost data chunks. As the MT progresses to move toward BS B, if the old IP address gets inactive, the MT will delete it from the association. The steps for handover described above will be repeated each time the MT moves to a new BS, until the SCTP association will be terminated. It works at transport layer. mSCTP do not provide enough support for the upper layers.

HAWAII, A domain-based approach for supporting Mobility. HAWAII uses specialized path setup schemes which install host-based forwarding entries in specific routers to support Intra-Domain-Micro-Mobility. This path setup mobility delivers excellent performance by reducing mobility related disruption to User applications. Also, mobile hosts retain their network address while moving within the domain, simplifying quality-of-service.

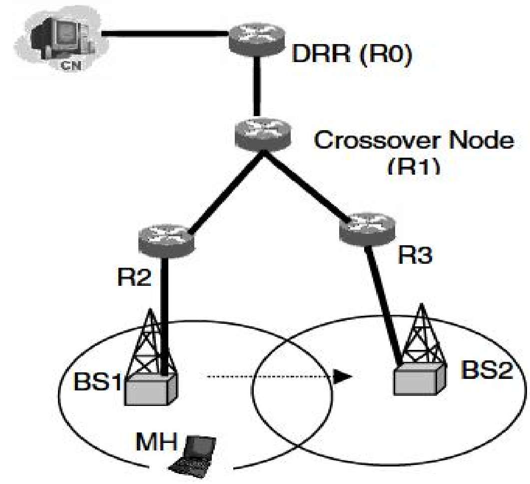

Fig.6: Path Setup Handover

It supports two approaches of path setup handover schemes:
i) Forwarding Path Setup.
ii) Non-Forwarding Path Setup.

In the forwarding schemes, the packets from the old base station are buffered and forwarded to the new base station to minimize packet loss. In the non-forwarding schemes, multicasting is used in situations where the MN (mobile node) can receive packets from both base stations simultaneously.
SIP is used for control of real-time multimedia sessions. It can also be used to support a variety of Internet mobility. This Letter will focus on the SIP based IP handover for terminal mobility. In the existing SIP handover, a mobile node (MN) performs IP handover by sending another INVITE (called re-INVITE) method to the correspondent node (CN) after getting a new IP address. This SIP handover tends to give a large handover latency associated with movement detection and IP address configuration .This is mainly because the SIP handover cannot effectively support the 'soft' handover [15,16].

HIP provides new tools and functions for future network needs, including the ability to securely identify previously unknown hosts and the ability to securely delegate signaling rights between hosts and from hosts to other nodes.

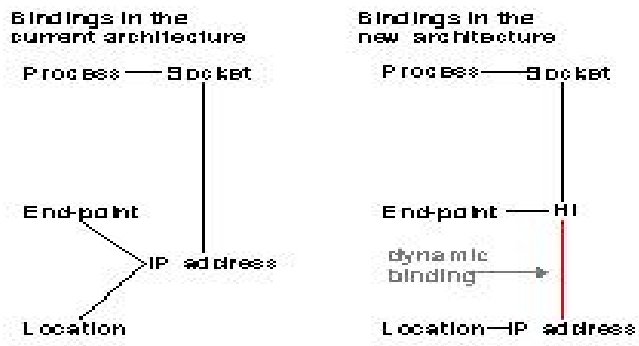

Fig.7: Binding in Current Architecture and New Architecture

From a technical point of view, the basic idea of HIP is to add a new name space to the TCP/IP stack. In this new name space, hosts (i.e., computers) are identified with new identifiers, *Host Identifiers*. The Host Identifiers (HI) is public cryptographic keys, allowing hosts to authenticate their peer hosts directly by their HI.

As a result of adding this new name space to the stack, when applications open connections and send packets, they no longer refer to IP addresses but to these public keys, i.e., Host Identifiers. Additionally, HIP has been designed in such a way that it is fully backwards compatible to applications and the deployed IP infrastructure.

UMA is a technology helping cellular operators to retain control over subscribers in the era of converging radio access technologies. By supporting handovers to and from Wi-Fi networks, UMA seems to be a perfect solution as new mobile services requires performance and seamless mobility. From the cellular operator point of view UMA does not require enormous investments and is a good choice for extending network coverage. This research paper discusses the technical implications of UMA based on measurement results for GSM to Wi-Fi handovers and packet data performance. The measurements show that UMA works well, and voice handover breaks are similar or lower than those experienced in traditional GSM systems. In addition, UMA provides a considerably higher throughput than GSM systems. The results showed that the average throughput is twice or more than in GSM. Therefore, the user experience for data services improves to 3G-kind of services. It works on the Network layer of OSI model and provides local mobility.

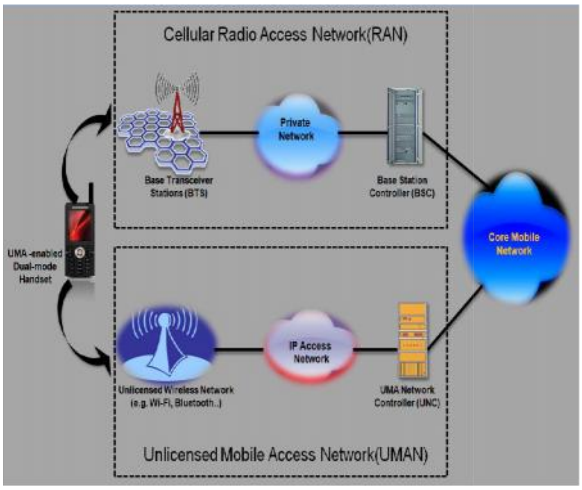

Fig.8: Unlicensed Mobile Access (UMAN) And Cellular Radio Access Network (RAN)

In traditional cellular network, MS (mobile station) talks with mobile core network via access network, which consists of BS (base station), BSC (base station controller) and antenna. Once cell phone detect cellular signal, it will trigger location update procedure which enable phone to log in cellular mobile network. If cell phone log in successfully, all traffic including voice, short message and so on will go through cellular access network via cellular signal.

In UMA solution, dual-mode handset will connects with mobile core network via UMA network, which consists of access point, UNC (UMA network controller). Once dual mode handset detect Wi-Fi network, it will connect with the UNC via ip connection. If the connection between dual mode handset and UNC is successful, dual mode handset will trigger location update procedure which is the same with the one of cellular network. When dual mode handset log in cellular network, all traffic will go through Wi-Fi network via ip connection.

Conclusion

We have developed good understanding of vertical handover process. In this project we have studied different techniques for vertical handover and categorized them on the basis of factors affecting the performance of vertical handover. It will help the people in choosing the vertical handover technique for a particular scenario. We have also implemented interface monitor part of our end to end solution i.e. HaMAT.

In future we will implement the decision engine of HaMAT architecture to provide complete vertical handover process between Wi-Fi and WCDMA.

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