Mobility Management for Seamless Information flow in Heterogeneous Networks Using Hybrid Handover

Adiline Macriga. T, Dr. P. Anandha Kumar
Research Scholar, Department of Information & Communication, MIT Campus, Anna University Chennai, Chennai – 600025

Asst. Professor, Department of Information Technology, MIT Campus, Anna University Chennai, Chennai – 600025

Abstract
Today communication industry concentrates more on the live information transfer without altering the existing infrastructure. Since the existing architecture of multiple access technologies deployed by different operators is fundamental for future generation mobile networks the seamless inter-operator/ intersystem mobility is a mandatory requirement in the heterogeneous networks. Due to the existence of heterogeneous networks a seamless mobility management approach that does not require changes to existing network infrastructure is being proposed which mainly concentrates on the handover technique. The novelty of the proposed approach, heterogeneous handover is that mobility management is fully controlled by the terminal, and network selection is user-centric, power-saving, cost-aware, and performance-aware. Total mobility management, including interface management, handover decision, and execution, is also detailed. Advances in wireless communication technologies are driving the evolution toward ubiquitous and seamless service delivery across multiple wireless access systems. Next generation communication device users will be always best connected anywhere and anytime via diverse access technologies and possibly in a multi-operator environment stating the key "Anything Anywhere". End users will access services via several existing access technologies such as Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunications Systems (UMTS), wireless local area network (WLAN), and Worldwide Interoperability for Microwave Access (WiMAX). The definition of Next Generation Networks (NGN) includes the ability to make use of multiple broadband transport technologies and to support generalized mobility. Next generation networks must integrate several IP-based access technologies in a seamless way.

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Key words
All path shortest path, Mobility Management, Location tracking, Handover.

I. INTRODUCTION

The trend towards communication engineering especially in data exchange had made a revolution in the 2K decade. Due to the enormous growth of the industry and also the change in the life style of the people even the general communication had become paperless. From the trend of voice communication, later incorporated with data communication, then voice + data and now it had become a mobile video transmission. As this trend is considered, the amount of data and information that is being transmitted is voluminous. As we consider the transfer technique it is an understanding between the bandwidth and the frequency of the network. As we consider the traffic and flow rate of the network, it is very important to take care of the parameters which are closely related with the transmission of the information such as signal strength; traffic density of the network, flow rate, bandwidth, and the list grows. In this paper mainly the mobility management is considered and under this the nature of the network is studied in advance and based on the report generated and also the availability the data transmission is carried out. For the cause of mobility management, the technical factor that is considered is the handover. A handover called heterogeneous handover is proposed for the seamless flow of information. Heterogeneous handover is based on the nature of network and also it mainly deals with the operational performance and also the signal coverage and the strength of the network. Here the mobility architecture is framed dynamically based on the mobility pattern of the devices that are prone in for the transfer of information or in general based on the communicating media. Here the network considered are also a multilayered network that is any type of network such as backhaul network, WiMax,

3G, WLAN etc., The Heterogeneous handover works on the concept of request-response-information exchange between the networks.
The ultimate goal of this paper is to provide the services based on the saying “Anything any Where”. We follow this approach by proposing a location tracking based solution that supports vertical handovers without disruption of real time multimedia communication services. The solution is called mobility management using Location based tracking and management extension. The focus of this paper is on the requirements of a mobility management scheme for multimedia real-time communication services - Mobile Video Conferencing. Today, the more advanced mobile terminals are capable of having more than one interface active at the same time. In addition, the heterogeneity of access technologies likely will increase in the future, making the seamless integration of the access network a key challenge for next generation networks. Services must be provided to the user regardless of the particular access technology used; IP will be the common language for this integration at the network level.
The rest of the paper is organized as follows: Section II reviews related work on location estimation and vertical handover. Section III provides the requirements and solution for mobility management. Section IV presents the proposed method. Section V deals with the performance evaluation. Section VI presents the results and related discussion. Section VII discusses directions for future work and concludes this paper.

II. SURVEY OF EXISTING TECHNOLOGIES & METHODS

The session below provides the survey on the available technologies that supports the multimedia communication at the various stages and aspects.
In heterogeneous wireless networks, handoff can be separated into two parts: horizontal handoff (HHO) and vertical handoff (VHO). A horizontal handoff is made between different access points within the same link-layer technology such as when transferring a connection from one BS to another or from one AP to another. A vertical handoff is a handoff between access networks with different link-layer technologies, which will involve the transfer of a connection between a BS and an AP. Seamless and efficient VHO between different access technologies is an essential and challenging problem in the development toward the next-generation wireless networks[1][12].
In general, the VHO process can be divided into three main steps: system discovery, handoff decision, and handoff execution [24]. During the system discovery phase, mobile terminals equipped with multiple interfaces have to determine which networks can be used and the services available in each network. During the handoff decision phase, the mobile device determines which network it should connect to. During the handoff execution phase, connections need to be rerouted from the existing network to the new network in a seamless manner. During the VHO procedure, the handoff decision is the most important step that affects MH’s communication [9][11]. An incorrect handoff decision may degrade the QoS of traffic and even break off current communication. Handoff algorithms in heterogeneous wireless networks should support both HHO and VHO and can trigger HHO or VHO based on the network condition. What should be noted is that, because of the uncertainty of the network distribution and the randomness of MH’s mobility, it is impossible to forecast the type of the next handoff in advance[2][4][6]. Thus, handoff algorithms in heterogeneous wireless networks must make the appropriate handoff decision based on the network metrics in a related short time scale.
There are three strategies for handoff decision mechanisms: mobile-controlled handoff (MCHO), network-controlled handoff (NCHO), and mobile-assisted handoff (MAHO) [14]. MCHO is used in IEEE 802.11 WLAN networks, where an MH continuously monitors the signal of an AP and initiates the handoff procedure. NCHO is used in cellular voice networks where the decision mechanism of handoff control is located in a network entity. MAHO has been widely adopted in the current WWANs such as GPRS, where the MH measures the signal of surrounding BSs and the network then employs this information and decides whether or not to trigger handoff [3][13]. During VHO, only MHs have the knowledge about what kind of interfaces they are equipped with. Even if the network has this knowledge, there may be no way to control another network that the MH is about to hand off to. Therefore, MCHO and further assistance from the networks is more suitable for VHO [10].
Two main categories of handoff algorithms are proposed in the research literature [3] based on 1) the threshold comparison of one or more metrics and 2) dynamic programming (DP)/artificial intelligent techniques applied to improve the accuracy of the handoff procedure. The first category is the traditional algorithms widely used in radio cellular systems, which employs a threshold comparison of one or several specific metrics to make a handoff decision. The most common metrics are received signal strength (RSS), carrier-to-interference ratio (CIR), signal-to-interference ratio (SIR), and bit error rate (BER) [2]. In heterogeneous wireless networks, even though the functionalities of access networks are different, all the networks use a specific signal (beacon, BCCH, or reference channel) with a constant transmit power to enable RSS measurements. Thus, it is very natural and reasonable for VHO algorithms to use RSS as the basic criterion for handoff decisions [14] [16].
In order to avoid the ping-pong effect, additional

parameters such as hysteresis and dwelling timer can be used solely or jointly in the handoff decision process. In [4], in addition to the absolute RSS threshold, a relative RSS hysteresis between the new BS and the old BS is added as the handoff trigger condition to decrease unnecessary handoffs. Daniel et al. [5] proposes a handoff scheme based on RSS with the consideration of thresholds and hysteresis for mobile nodes to obtain better performance. However, in heterogeneous wireless networks, RSS from different networks can vary significantly due to different techniques used in the physical layers and cannot be easily compared with each other. Thus, the methods in [4] and [5] cannot be applied to VHO directly.

Anthony et al. [19] use the dwelling timer as a handoff initiation criterion to increase the WLAN utilization. It was shown in [21] that the optimal value for the dwelling timer varies along with the used data rate or, to be more precise, with the effective throughput ratio. In [8], Olama et al. extend the simulation framework in [14] by introducing a scenario for multiple radio network environments. Their main results show that the handoff delay caused by frequent handoff has a much bigger degrading effect for the throughput in the transition region. In addition, the benefit that can be achieved with the optimal value of the dwelling timer as in [7] may not be enough to compensate for the effect of handoff delay. In [27], claudio et al. propose an automatic Interface selection approach by performing the VHO if a specific number of continuous received beacons from the WLAN exceed or fall below a predefined threshold.

Additionally, in the real-time service, the number of continuous beacon signals should be lower than that of the non-real-time service in order to reduce the handoff delay [26][30]. More parameters may be employed to make more intelligent decisions. Li et al. [10] propose a bandwidth aware VHO technique which considers the residual bandwidth of a WLAN in addition to RSS as the criterion for handoff decisions. However, it relies on the QBSS load defined in the IEEE 802.11e Standard to estimate the residual bandwidth in the WLAN. In [29], Weishen et al. propose a method for defining the handoff cost as a function of the available bandwidth and monetary cost. In[16], actual RSS and bandwidth were chosen as two important parameters for the Waveform design.

Hossain et al. [15] propose a game theoretic frame work for radio resource management perform VHO in heterogeneous wireless networks. One main difficulty of the cost approach is its dependence on some parameters that are difficult to estimate, especially in large cellular networks. Mohanty and Akyildiz [14] developed a cross-layer (Layer 2 + 3) handoff management protocol CHMP, which calculates a dynamic value of the RSS threshold for handoff initiation by estimating MH's speed and predicting the handoff signaling delay of possible handoffs.

To sum up, the application scenario of current VHO algorithms is relatively simple. For example, most VHO algorithms only consider the pure VHO scenario, where the algorithm only needs to decide when to use a 3G network and when to use a WLAN [1], [10], [17], [18], [21], [25]. In fact, at any moment, there may be many available networks (homogeneous or heterogeneous), and the VHO algorithm has to select the optimal network for HHO or VHO from all the available candidates. For example, if the current access network of MH is a WLAN, the MH may sense many other WLANs and a 3G network at a particular moment, and it has to decide whether to trigger HHO or VHO. If the HHO trigger is selected, MH then needs to decide which WLAN is the optimal one [20] [22]. Consequently, an analytical framework to evaluate VHO algorithms is needed to provide guidelines for optimization of handoff in heterogeneous wireless networks. It is also necessary to build reasonable and typical simulation models to evaluate the performance of VHO algorithms.

III. REQUIREMENTS AND SOLUTIONS FOR MOBILITY MANAGEMENT

Basically, the mobility management procedures allows users to be reached on whatever access network they are, allowing the handover of an active real-time communication session from one access network to another.

The following are the requirements of an optimal mobility management solution:

- The handover must be as fast as possible. When switching from one access network to another, the mobility management signaling should be sent over the new target network, because the old one could suddenly become unavailable; in such a case, it is necessary to perform the whole handover procedure on the new network (this is known as forward handover). On the contrary, if the old network is still available, the availability of both networks can be exploited to assist and speed up the whole procedure.
- The mobility management solution should be compatible with NAT(Network Address Translation) traversal. Users should be able to roam from one access network to another, even when one or both access networks use private IP addressing and reside behind a NAT. The mobility management solution should not require modifications to the Corresponding Hosts (CH). All existing terminals should be able to interoperate with roaming Mobile Hosts (MH).
- Existing user agents (UAs) in the MH should not be modified to be able to exploit the roaming capability provided by the mobility management solution. The

mobility management solution should not require additional support in the access networks. The access networks are required only to provide IP connectivity. The mobility management solution should interact properly with the user registration procedures and with existing solutions for handling personal mobility e.g., these solutions allow a user to use a set of mobile and fixed terminals in parallel or in sequence, as desired.

Mobile IP (MIP) [3] is a mobility solution working at the network layer. IPv4 assumes that every node has its own IP address that should remain unchanged during a communication session. MIP introduces the concepts of home address (the permanent address of the MH) and of care-of-address (CoA). The home agent acts as an anchor point, relaying the packets addressed to the home address towards the actual location of the MH, at the care-of-address. Using mobile IP for real-time communications has some drawbacks. A well-known problem is triangular routing, that is, the fact that the packets sent to the MH are captured by the home agent and tunneled, whereas the MH can send packets directly to the CH. This asymmetric routing adds delay to the traffic towards the MH , and delay is an important issue in voice over IP (VoIP). The fact that the packets are tunneled also means that an overhead of typically 20 bytes, due to the IP encapsulation, will be added to each packet. Still another drawback of using mobile IP is that each MH requires a permanent home IP address, which can be a problem because of the limited number of IP addresses in IPv4.

A number of works have built upon MIP to overcome its drawbacks. A notable one is cellular IP [4], which improves MIP, providing fast hand-off control and paging functionality comparable to those of cellular networks. Being a network level solution, cellular IP requires support from the access networks, and it is suitable for micro-mobility, namely, mobility within the environment of a single provider. The major work of this paper concentrates on seamless streaming in heterogeneous networks; one of the major challenges is the bit rate adaptation when the gap between two different networks is large. In the heterogeneous networks, an available channel bandwidth usually fluctuates in a wide range from bit rate below 64kbps to above 1mbps according to the type of network.

In the proposed paper the mobility management is done by generating a dynamic geographical map as and when the call/connection is initiated. Based on the nature of information transmission the networks in between are identified and analyzed upon the following parameters.

- Network type (GSM, CDMA)
- Traffic in the Network
- Bandwidth availability in the Network
- Information flow in the network
- Signal strength of the Network
- Coverage area of the network
- Power stability on the network
- Type of handover and the possible no. of handovers
- Also, the nature of usage of the network

By learning and framing a table dynamically on the node (Base Station) the apt possible path between the source and the destination is identified and since the type of the network and the type of handover is known in well advance and in the heavy flow of information the network manager can be requested in advance so that the transmission delay can be minimized and the seamless flow of information can be provided to the customers' while they are in roaming.

Mobility Management Using Location Based Tracking and Management Extension

- Generate a geographical map between the source and the destination based on the mode of transport (Fig. 1)
- Tabulate the list of service providers with their frequency and coverage
- Create an acyclic graph by pointing out the service providers and the geographical scenarios
- Form a topological graph from the acyclic graph by removing the obstacles and considering the signal strength
- Get the traffic status of each and every link from source to destination
- Now create a path from source to destination based on the network traffic and also by choosing the shortest path with minimum handovers

IV. PROPOSED SERVICE METHOD

For all the network in the specified path between the source and destination

- Get the bandwidth of the network
- Calculate the average traffic of the network
- Note down the obstacles on the way
- Note down the active service providers with their coverage area
- Note down the type of network services [3G, 3GPP]

- Calculate the traffic density in the in the network

  $NLc + \Delta E \leq NLth$ → take the same path

  NLc → Current Network Load

  ΔE → Estimated Increase in Load

  NLth → Network Threshold Load

- Generate a shortest path based on

- The maximum signal coverage
- Traffic density below the NLth

The algorithm used is **All Pairs Shortest Path**

$D_{k,i,j} = \min\{D_{k\_1,I,k} + D_{k-1,k,j}\}$

1. Compute all shortest paths
2. A[ ] contains the adjacency matrix
3. With A[i][i] presumed to be zero D[ ] contains the value of the shortest path
4. N is the number of vertices
5. A negative cycle exists iff D[i][i] is set to a negative value
6. Actual path can be computed using path [ ]
7. All arrays are indexed starting at 0
8. Not a vertex is -1

Algorithm

```
Void    AllPairs (TwoDimArray A, TwoDimArray D, TwoDimArray path, int N)
{
        int i,j,k;
        /* Initialize D path */
        for (i=0;i<N;i++)
          for (j=0;j<N;j++)
             {
                  D[i][j] = A[i][j];
                  Path[i][j] = NotAVertex;
             }
        for  (k=0;k<N;k++)
         /* Consider each vertex as an intermediate */
        for (i=0;i<N;i++)
          for (j=0;j<N;j++)
             if (D[i][k] +  D[k][j] < D[i][j])
               {
                /* Update Shortest Path */
            D[i][j] = D[i][k] + D[k][j];
            path [i][k] = k;
             }
 }
```

- Continue the transmission in the specified path
- Continue the same procedure till the source reaches the destination or the source is stable or not in mobility

Assumptions made for the analysis

At least one type of service provider is available within the limit. There is at least one 3G or 2G wireless area network that provides location-based service [9]. In fact, CDMA2000, GSM, and UMTS all provide Location Based Services. All the RAN in the architecture is connected to the Internet. All the terminals are multi-interface supported. Therefore, they can switch from one access network to another successfully. Mobile IPv6 is supported in all of the RAN and the Internet.

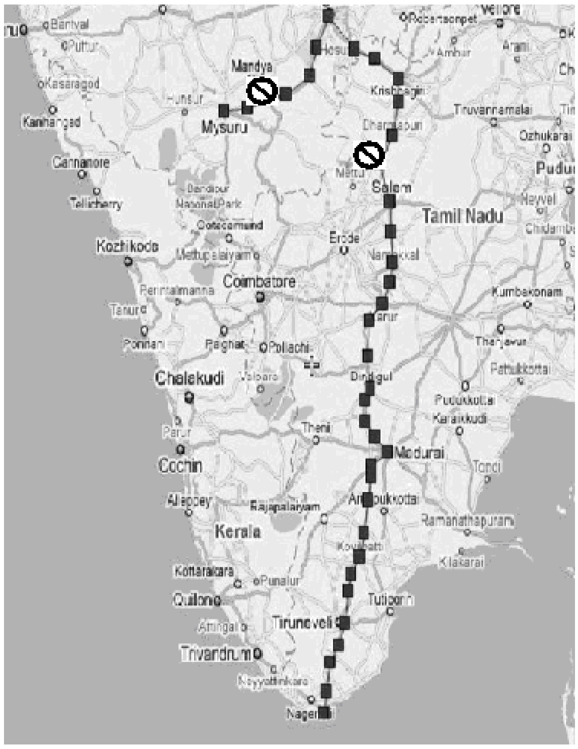

Fig. 1 Geographical Map between the Source and the Destination

Discoveries made are:

Type of Discovery	*Explanation*
Network Discovery	Survey of the networks from the source to destination
Path Discovery	Determining the shortest path for optimum transmission
Data Discovery	Perceiving the nature of the data for transmission
Handover Discovery	Checking the network characteristics facilitating handover
Mobility Discovery	Discovering the status of the user
Operation Discovery	Synchronizing the network parameter
Communication Discovery (Guidance Network)	Signaling and sequencing for connection establishment

Table 1 – Mobility Management discoveries

Network Selection

Most current network selection solutions [7, 8] are based on dynamic Quality-of-Service information such as physical throughput or access delay, which is challenging to obtain. Moreover, these solutions do not take into account the existence of different network administrative domains where the operators may not provide access network information to an unauthenticated terminal. Generally, to collect such information, either the terminal must set up an IP connection with the candidate access networks without initial authentication, or operators must enhance their networks to broadcast it. In this work a network selection solution using only available information collected through information gathering at the terminal is considered. The considered criteria are access network identity, cost, battery lifetime, handover frequency and Signal-to-noise-ratio. Network selection should also take into consideration the link quality, like the Signal-to-noise ratio, since this properly reflects the wireless transmission channel quality. Network selection is based on the following steps, For all the transmission nodes between the source and the destination, calculate the shortest path between the source and destination based on,

- Coverage area
- Signal Strength
- Power retention
- Link Quality
- Bandwidth Capacity
- QoS with the neighbor

As a measure of seamless flow of the information communication, the existing architecture is considered and no changes are recommended as the service providers has invested a huge amount to establish the existing infrastructure. So as a cost effective way, the existing architecture is considered as such and only the operational behavior of the network is being altered.

To summarize, the key entities in this network architecture fig. 2 are:

Network manager: This collects current QoS information in the Radio Access Network and updates it in the RADA. In fact, it is the SA in the SLP architecture that advertises the services on behalf of a service.

Guidance network: This is a WAN-supported LCS, for example, CDMA2000, WCDMA, and GSM. It provides the ABC agent with the location information of the UE, which is used to obtain available RAN information. It provides a signaling channel to enable all the UE to access the Internet.

LCS server: This is the gateway from where the LBS clients can obtain the location of users. It differs when guidance network varies. For example, it is a GMLC (gateway mobile location center) in UMTS, an MPC in CDMA2000, and an SMLC (serving mobile location center) in a GSM mobile system.

Operation Discovery: The process of providing ABC services in this architecture has three steps: access discovery, access selection, and seamless handover. After network selection, the network manager in the selected RAN allocates radio resources to the UE. The UE changes its care-of-address (CoA) through the Mobile IPV6 mechanism. All of the operators can use the infrastructure in the guidance network and the Internet without a huge investment in the infrastructure. Also the equipment should be equipped with a multi-radio system which selects the best network according to the QoS information available from an ABC agent.

V. PERFORMANCE EVALUATION

Given the requirements for seamless mobility architectures listed above, the roles to be supported by a mobility management function exploiting the terminal capability to access several radio access networks are the following:

- Selection of the access network at application launch. This role is ensured by mobility management sub-functions here referred to as *service-to-radio mapping control*.
- Triggering of the handover during a session. The mobility management function aims at always providing the best access network to the terminal.

Finally, execution of the handover itself.

In general, three different approaches can be envisaged for radio access selection:

- A terminal-centric selection without network assistance or recommendation
- A network-controlled selection within network entities, based on both terminal and access network measurements, enforcing decisions on the terminal
- Network-assisted selection on the terminal side, the network providing operator policies, and access/core load information (joint terminal/network decisions)

The advantage of network-controlled and network-assisted solutions is in taking into account both terminal and network-related information. The architecture proposed in this article gives the operator the flexibility to apply one or the other according to mobility management policies. For instance, when only one access remains available, network-assisted selection is applied; when access selection is triggered by network load considerations, network control may be used for load balancing.

Finally, for access network selection, the mobility management function must retrieve the status of resource usage in each access network. This information is provided by an “access network resource management” function, which computes a technology-independent abstracted view of access resource availability.

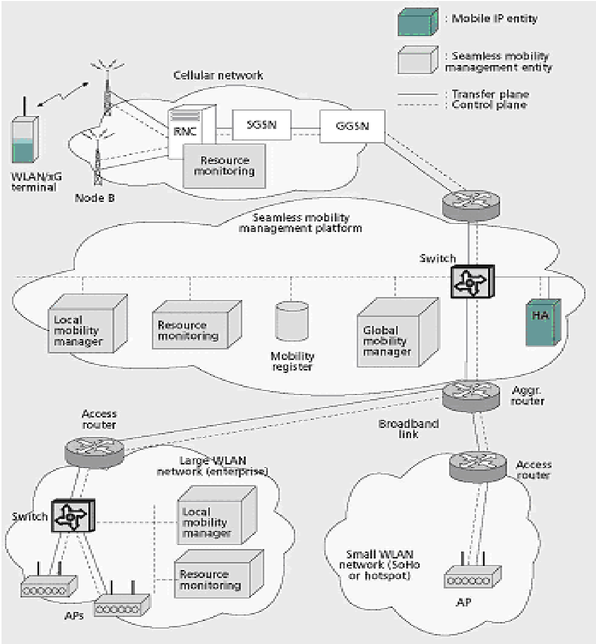

Fig 2 Cellular/ WLAN Seamless Mobile Architecture[17]

Functional Entities Involved in Mobility Management — The mobility management functions are supported by functional entities described in Fig. 5 (light green entities) that are responsible for selecting the best access network for each terminal. They may be triggered at application launch or during the application session by the terminal or local MM.

• The mobility register is a database that stores profiles and high-level characteristics of users, radio access networks, and operators. It also stores session information such as terminal location or application currently used. There is one database entity per operator.

• The global MM: –Registers users to the seamless mobility service. The global MM activates the user context in the mobility register and is the screen for the AAA process. –Interfaces with the mobility register. –Receives "global" information from the terminal on application needs, user preferences, and basic access network data (type, identity, availability). –Performs pre-selection of the access network. Using information from the terminal, the global MM provides the local MM with an ordered list of recommended access networks based on operator policies (e.g., prioritize WLAN access for streaming applications, manage access privileges according to user's profile), user and network profiles, application quality of service (QoS) constraints (e.g., minimum bandwidth, latency guaranty), and basic radio information (availability of access networks).

• The local MM: –Receives measurements of the environment in its coverage area from access network RM entities (access network load and quality information such as delay, packet loss ratio) and from the terminal on an event-triggered or a periodic basis. –Processes application requests from the terminal in order to map QoS application needs to radio parameters (e.g., bandwidth vs. load on the different networks) within the service-to-radio mapping control function. –Computes handover triggers such as radio coverage and quality on the current network being below an acceptable threshold, current access network load being above a threshold, and modification of the network classification provided by the global MM. –Processes the global MM recommendation before selecting an access network for a user. This recommendation arises on a global MM event trigger or a terminal event trigger. –Finally, makes the final handover decision based on the radio triggers, as well as on the global MM recommendation, and orders the terminal to execute the handover.

• The terminal implements a seamless mobility application programming interface (API) in charge of: –Computing handover triggers, related to coverage (radio signal strength) and signal quality in order to detect whether the radio bearer fulfills application needs in terms of link quality.

• Sending out radio signal strength and quality measurement for current and target access networks on an event-triggered basis (local MM request or triggers below thresholds), but also on a periodic basis if the radio metrics remain below the threshold. If the signal is good enough for the terminal, no periodic measurement will be sent to the local MM unless the local MM sends out a specific request to get information. –Detecting available networks in vicinity. –Managing user preferences. –Invoking services via service-to-radio mapping control: the API provides application needs and a preferred access network for this application. Then terminal pre-selection is confirmed (or not) by MMs according to access network condition. –Executing the handover upon local MM order depends on the link layer technology. There is no specific constraint on the mobility management protocol, which could be based on Internet Engineering Task Force (IETF) specifications, for instance. –Triggering the handover in case it does not receive local MM orders in time or when only one target access network remains available. –Optionally, managing operator policies and preferences so that it can efficiently make the handover decision by itself in the absence of a local MM recommendation.

The access network RM entities. This entity is access-technology-specific as it interfaces each access network with the local MM: RMs receive real-time radio load-related information from the access network access point (AP) and use it to provide load indicators to the local MM in a *standardized* abstracted format.

VI. RESULTS AND DISCUSSION

The purpose of this section is to revisit the seamless mobility functional architecture in a practical context that addresses the inter-working of cellular and WLAN access networks. In order to implement the different functions listed earlier, some initial technological choices need to be made.

First, only inter-technology handovers from (to) cellular to (from) WLAN are considered in the seamless mobility architecture. Intra-technology handovers are taken care of by technology-specific mechanisms.

Then Mobile IP (MIP) has been chosen as the L3 protocol for handover execution in the proof of concept, and is used on top of either IPv4 or IPv6 in order to provide session continuity during inter-technology handover. A clear separation of handover decision and execution processes allows any evolution of IP protocols to minimize new care-of address configuration and rerouting latencies, for instance, to replace baseline MIP without modifying the proposed architecture.

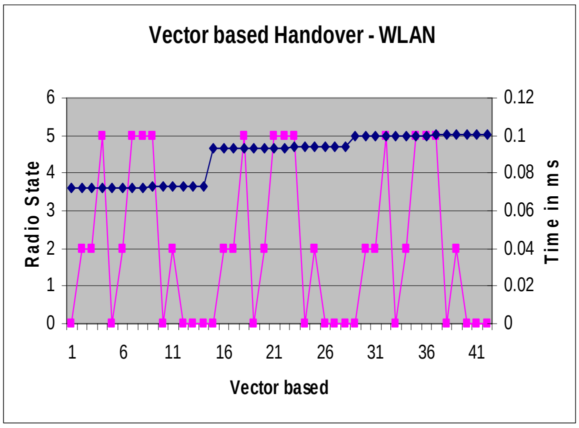

Fig. 3. Vector based Handover in the WLAN Environment

In order to monitor the WLAN environment, the terminal is set up to perform WLAN scanning every 0.02ms, during which no traffic can be transmitted or received (it corresponds to traffic interruptions on Fig. 3). Upon returning to normal operation, a peak of traffic is observed when the terminal or WLAN AP is transmitting a burst of packets that could not be transmitted during the scanning periods of 2–4 ms. In order to avoid perceivable interruption of voice transmission, an adaptive buffer has been set up on the receiver side, which enables the network to cope with "silences" but results in slightly increased latency. This configuration could further be improved by breaking the scanning period into shorter ones in order to avoid latency increase. However, this configuration may lead to lower measurement precision, so an acceptable compromise must be reached. In any case, this scenario is not considered for wider-scale deployment, since the latency on the EDGE network leads to unacceptable VoIP quality.

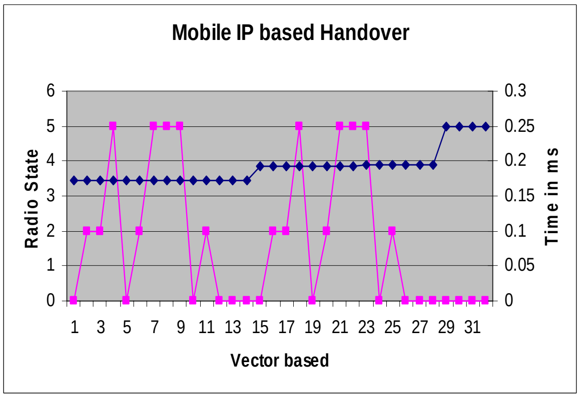

Fig. 4. Vector based Handover in the Mobile IP Environment

Another goal of the test bed was to assess performance of mobility management protocols. As an example, we considered handover delay for a 60 kb/s Real-Time Transmission Protocol (RTP) streaming service, with handover delay defined as the delay between the first RTP packet on the new interface and the last packet on the old interface. When network control is enabled, the decision to perform handover is taken on load criteria: the streaming starts on the WLAN interface where other terminals load the AP; when the network load reaches a given threshold, mobility management entities trigger the handover. In both cases handover delay was about 0.05 ms (Fig. 4), because of MIP and Generic Packet Radio Service (GPRS) network latencies.

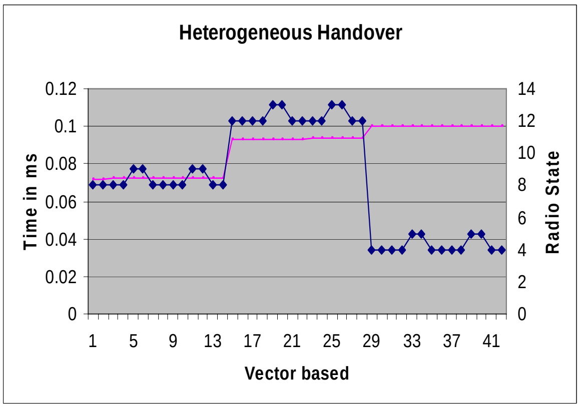

Fig.5. Vector based Handover in the Heterogeneous Environment

The higher transmission latency experienced in the cellular access network can be observed at handover. On the transmit side, handover is performed with no silence period. On the receive side, handing over to the cellular network, introducing more latency, results in a silence period the order of magnitude of which is equal to the latency difference between both networks. The use of an adaptive buffer at the receiver side makes it transparent to the user which is reflected as a smooth seamless flow in the heterogeneous Networks (Fig. 5).

VII. CONCLUSION AND FUTURE ENHANCEMENT

Today's communication technology becomes outdated for tomorrows requirement. The growth of the communication industry is tremendous and unimaginable. There are different modes like "wired, wireless, adhoc, mobile etc., supporting the growth of the communication industry but with all certain limits. Now, it is time to emerge into the world of mobility where the wireless communication plays a vital role, where it is necessary to satisfy the requirements of the modern world. A world without a mobile phone is unimaginable. It has taken people to a different world. Now it is the time for providing services in an uninterrupted way. In medical industry a millisecond delay in transfer of information may lead to a loss of life. So the technology has to be updated day by day to meet the needs of the various industries. As the communication industry is considered it is one of the challenging one for the researchers. Considering the infrastructure of the existing communication industry a huge amount has been deployed by different service providers to satisfy their customer needs. It is now a challenge to provide the flow of information seamlessly without re-modifying the existing infrastructure. There are many techniques followed for interlinking the different technologies and this paper also focuses on one such technology. This paper discusses the challenge involved in the mobility and handoff technique. With this implementation it will be possible to provide an uninterrupted flow of multimedia communication.

Results have confirmed the feasibility of the approach; its scalability to large geographical areas has to be confirmed with additional validation through simulations and trials. A possible stepwise approach to the deployment of the different functional elements of the presented architecture is defined. In this approach a vector based location tracking and management is only considered for the seamless flow. By combining the parameters such as signal strength and delay management in flow and also the formats of the information we can have a seamless flow. Also the QoS between the RAN's should be standardized in such a way that there is no mismatch of transmission from one type of environment to another type.

Finally, with the advent of research on moving networks (e.g., Network Mobility), in which the whole network is mobile, the integration of WLANs and WMANs can improve mobile network connectivity. It is expected that public transportation (trains, buses, airplanes, ships, etc.) will popularize Internet access through WiFi connectivity to passengers while in movement. To this end, it will be equipped with a bridge to communicate with external networks such as WiMAX. Moreover, seamless handover is still an issue as clients may be equipped with both interfaces, and the vehicle gateway may also give support to WiFi external connectivity through dual gateways/interfaces (WiFi/ WiMAX) in order to offer fault tolerance and load balance between networks as well as new connectivity opportunities to passengers. Apart from serving the movement network, the mobile gateway can also be used by external clients, such as those outside the WiFi AP and WiMAX BS coverage areas, but that have the opportunity to download data or attain Internet access through the dual gateway belonging to the vehicular area network (VAN).

REFERENCES

[1] Yu and Vikram Krishnamurthy, " Optimal Joint Session Admission Control in integrated WLAN and CDMA Cellular Networks with Vertical Handoff", IEEE Transaction on Mobile Computing, vol 6, No. 1, pp. 126 – 139, Jan' 2007.

[2] Jaroslav Holis and Pavel Pechac," Elevation Dependent Shadowing Model for Mobile Communications via High Altitude Platforms in Built-Up Areas" - IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 56, NO. 4, APRIL 2008

[3] Sándor Imre, "Dynamic Call Admission Control for Uplink in 3G/4G CDMA-Based Systems" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 56, NO. 5, SEPTEMBER 2007

[4] Yan Zhang, and Masayuki Fujise, "Location Management Congestion Problem in Wireless Networks" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 56, NO. 2, MARCH 2007

[5] Daniel Morris and A. Hamid Aghvami, "Location Management Strategies for Cellular Overlay Networks—A Signaling Cost Analysis" - IEEE TRANSACTIONS ON BROADCASTING, VOL. 53, NO. 2, JUNE 2007

[6] Haining Chen, Hongyi Wu, Sundara Kumar and Nian-Feng Tzeng, "Minimum-Cost Data Delivery in Heterogeneous Wireless Networks" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 56, NO. 6, NOVEMBER 2007

[7] Yuh-Shyan Chen, Ming-Chin Chuang, and Chung-Kai Chen, "DeuceScan: Deuce-Based Fast Handoff Scheme in IEEE 802.11 Wireless Networks" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 57, NO. 2, MARCH 2008

[8] Mohammed M. Olama, Seddik M. Djouadi, Ioannis G. Papageorgiou, and Charalambos D. Charalambous "Position

and Velocity Tracking in Mobile Networks Using Particle and Kalman Filtering With Comparison" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 57, NO. 2, MARCH 2008

[9] Archan Misra, Abhishek Roy and Sajal K. Das, "Information-Theory Based Optimal Location Management Schemes for Integrated Multi-System Wireless Networks" - IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 16, NO. 3, JUNE 2008

[10] Yang Xiao, Yi Pan and Jie Li, "Design and Analysis of Location Management for 3G Cellular Networks" - IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, VOL. 15, NO. 4, APRIL 2004

[11] Di-Wei Huang, Phone Lin and Chai-Hien Gan, "Design and Performance Study for a Mobility Management Mechanism (WMM) Using Location Cache for Wireless Mesh Networks" -IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 7, NO. 5, MAY 2008

[12] Yi-hua Zhu and Victor C. M. Leung, "Optimization of Sequential Paging in Movement-Based Location Management Based on Movement Statistics" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 56, NO. 2, MARCH 2007

[13] Ramón M. Rodríguez-Dagnino, and Hideaki Takagi, "Movement-Based Location Management for General Cell Residence Times in Wireless Networks" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 56, NO. 5, SEPTEMBER 2007

[14] Wenchao Ma, Yuguang Fang and Phone Lin, "Mobility Management Strategy Based on User Mobility Patterns in Wireless Networks" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 56, NO. 1, JANUARY 2007

[15] Dusit Niyato and Ekram Hossain, "A Non-cooperative Game-Theoretic Framework for Radio Resource Management in 4G Heterogeneous Wireless Access Networks" - IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 7, NO. 3, MARCH 2008

[16] Marcus L. Roberts, Michael A. Temple, Richard A. Raines, Robert F. Mills, and Mark E. Oxley, "Communication Waveform Design Using an Adaptive Spectrally Modulated, Spectrally Encoded (SMSE) Framework" - IEEE JOURNAL OF SELECTED TOPICS IN SIGNAL PROCESSING, VOL. 1, NO. 1, JUNE 2007

[17] Christian Makaya and Samuel Pierre, "An Architecture for Seamless Mobility Support in IP-Based Next-Generation Wireless Networks" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 57, NO. 2, MARCH 2008

[18] Haiyun Luo, Xiaqiao Meng, Ram Ramjee, Prasun Sinha, and Li (Erran) Li, "The Design and Evaluation of Unified Cellular and Ad Hoc Networks" - IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 6, NO. 9, SEPTEMBER 2007\

[19] Anthony Almudevar, "Approximate Calibration-Free Trajectory Reconstruction in a Wireless Network" - IEEE TRANSACTIONS ON SIGNAL PROCESSING, VOL. 56, NO. 7, JULY 2008

[20] Yi Yuan-Wu and Ye Li, "Iterative and Diversity Techniques for Uplink MC-CDMA Mobile Systems With Full Load" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 57, NO. 2, MARCH 2008

[21] Abhishek Roy, Archan Misra, and Sajal K. Das, "Location Update versus Paging Trade-Off in Cellular Networks: An Approach Based on Vector Quantization" - IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 6, NO. 12, DECEMBER 2007

[22] Enrique Stevens-Navarro, Yuxia Lin, and Vincent W. S. Wong, "An MDP-Based Vertical Handoff Decision Algorithm for Heterogeneous Wireless Networks" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 57, NO. 2, MARCH 2008

[23] Sai Shankar N and Mihaela van der Schaar, "Performance Analysis of Video Transmission Over IEEE 802.11a/e WLANs"- IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 56, NO. 4, JULY 2007

[24] Abhishek Roy, Archan Misra and Sajal K. Das, "Location Update versus Paging Trade-Off in Cellular Networks: An Approach Based on Vector Quantization" - IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 6, NO. 12, DECEMBER 2007

[25] Dusit Niyato, and Ekram Hossain, "A Noncooperative Game-Theoretic Framework for Radio Resource Management in 4GHeterogeneous Wireless Access Networks" - IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 7, NO. 3, MARCH 2008

[26] Tansu Alpcan, Jatinder Pal Singh, and Tamer Basar, "Robust Rate Control for Heterogeneous Network Access in Multihomed Environments", IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 8, NO. 1, JANUARY 2009

[27] Claudio Casetti, Carla-Fabiana Chiasserini, Roberta Fracchia, and Michela Meo, "Autonomic Interface Selection for Mobile Wireless Users" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 57, NO. 6, NOVEMBER 2008

[28] Z Xun Yang, and Gang Feng, "Bandwidth Reallocation for Bandwidth Asymmetry Wireless Networks Based on Distributed Multiservice Admission Control" - IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 7, NO. 11, NOVEMBER 2008

[29] Wei Shen, and Qing-An Zeng, "Cost-Function-Based Network Selection Strategy in Integrated

[30] Wireless and Mobile Networks" - IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 57, NO. 6, NOVEMBER 2008

[31] Jingnan Yao, Jiani Guo, and Laxmi Narayan Bhuyan, "Ordered Round-Robin: An Efficient Sequence Preserving Packet Scheduler" – IEEE TRANSACTIONS ON COMPUTERS, VOL. 57, NO. 12, DECEMBER 2008