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Vertical Handoff In Cellular Netowrks using RSS and Velocity Measurement

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ABSTRACT: In recent years, Cellular wireless technologies like GPRS, UMTS, CDMA and Wireless Local Area Networks (WLAN) like IEEE 802.11 have seen a quantum leap in their growth. Cellular technologies can provide data services over a wide area, but with lower data rates. WLAN technologies offer higher data rates, but over smaller Hot Spot areas. The demand for ubiquitous data service can be fulfilled, if it is possible for the end-user to seamlessly roam between these heterogeneous technologies. The IP based next-generation wireless communication networks require mobility management for providing global information access to users on the move, particularly for domain independent applications. The main challenge for seamless mobility and service continuity is the availability of efficient handoff algorithms to enhance Quality of Service (QoS). This paper proposes algorithms for executing vertical handoff decision function on Received signal strength (RSS) and velocity of the mobile node criteria, to provide good quality of service. Simulation is performed to execute handoff between UMTS and HIPERLAN for a fast moving and a slow moving vehicle, along with the measured RSS. RSS with dynamic threshold values is considered to perform timely handoff decision between two heterogeneous networks.

Key Words: UMTS, 802.xx, mobility management, heterogeneous wireless networks, vertical handoff, seamless mobility, HIPERLAN.

1 INTRODUCTION

Technological developments, such as the Next Generation wireless systems [1] and their integration, offer rich services and applications at high data transfer rates and allow for global roaming and seamless mobility over a diverse range of heterogeneous wireless networks. To provide global information access to the users on the move through mobile computing, an efficient vertical handoff algorithm is required. Vertical handoff [2,3] is the process of transferring the connectivity between two access points or base stations in different wireless network technologies. A handoff algorithm with fixed parameters is not sufficient to achieve good performance in different system environments. In vertical handoffs, many characteristics have an effect in executing vertical handoff decision function. Considering received signal strength alone is not sufficient to perform good quality handoff as it results in ping-pong effect due to unnecessary number of handoffs, handoff decision delays, call dropping or call blocking probabilities. Handoff triggering time need to be adaptive[4] based on the mobility of the mobile node. For a fast moving node, the decision for handoff must be in a less time to avoid connection discontinuity or call drop. Minimizing number of handoffs or handoff rate decreases the power consumption of the mobile node and results in increased battery life. In the proposed simple vertical handoff algorithm, handoff decision time is decided based on the velocity of the mobile node along with the measured RSS.

2 Need for Integration of UMTS and HIPERLAN :

2.1 Universal Mobile Telephone Systems :

3GPP UMTS, the Universal Mobile Telecommunication Systems is the third generation (3G) successor to the second generation GSM based cellular technologies which also include GPRS, and EDGE. The need for high-speed internet access, live video communications, and simultaneous data transmission led to the development of 3G cellular networks. It provides high transmission rates over large coverage area and operates in the frequency band of (1710-2170)MHz.

2.2 HIPERLAN :

High Performance Radio LAN (HIPERLAN) is one of the wireless broadband access networks, which will provide high speed communication between mobile terminals and various broadband infrastructure networks such as UMTS and IP networks. HIPERLAN provide channel data rates up to 54 Mbps over short ranges and provides a better alternative connection in hot spot areas where cellular network coverage is poor.

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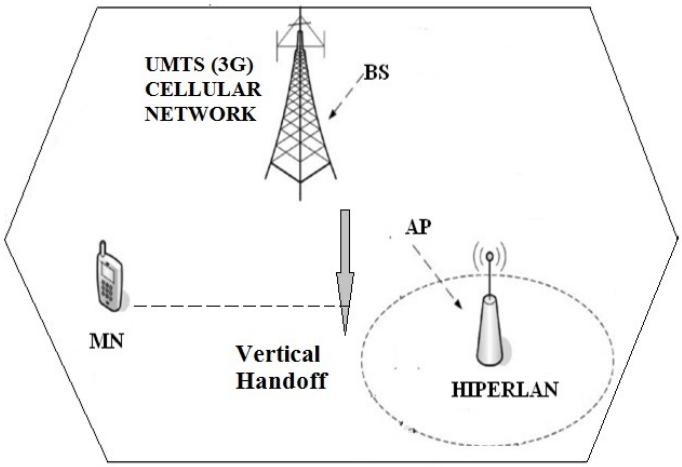

Figure 1: Handoff between UMTS and HIPERLAN

Table 1: Mobile base station system assumptions

Specifications	Cellular Network BS	HiperLAN AP
Area of BS(sqm)	1200	200
Frequency of Operation(MHz)	910	500
Antenna Gain(dB)	17	5
Power at Maximum distance(W)	20	18

2.3 Need for Integration :

The integration of networks with different access technologies with seamless mobility and ubiquitous continuity is the main challenge in upcoming next generation wireless technologies. A ubiquitous system allows the user to continue working on an interrupted task anytime and anywhere. The growth in user demand and diversity of real time services has led to the integration of 3G and Wireless LAN technologies[5]. Figure 1. shows handoff scenario between UMTS and HIPERLAN. Service/call continuity is possible in cellular systems using microcells, where base stations are placed densely to provide high user capacity[6]. When a mobile node moves around a corner, the call must be handed off to a base station in the microcell. In the absence of cellular coverage through microcells environment in hot spot areas, available wireless LAN (HIPERLAN) access points[7] can be used for the uninterrupted services . Table.1 assumes typical mobile base station system specifications for consideration of Handoff:

3 PROPOSED ALGORITHM :

To perform vertical handoff between two networks, network characteristics need to be considered. availability of channel, link availability, network bandwidth, network performance, bit error rate, cost of service and many other parameters help in taking [1, 10] vertical handoff decision. The complete handoff process occurs in two phases: handoff initiation and handoff execution [4]. In the first phase, handoff decision is made regarding the selection of the new Base Station (BS), or Access Point (AP), to which the mobile node (MN) will be transferred. In the second phase, handoff is executed by transferring radio links between the base station or access point and MN,[8] and resources are allocated. Total handoff time includes handoff triggering time and handoff execution time (thandoff = ttrigger + texecute). The algorithm developed, mainly focus on the first phase of the handoff process. The vertical handoff decision function is defined considering the mobile node received signal strength and velocity assuming other parameters invariable. The velocity of the mobile node can be determined by using a GPS based system. Received signal strength of the cellular network and HIPERLAN are determined using propagation model[9].

RSS of the cellular network is determined by

$$P_{CN} = P_t + G_t + PL - A \tag{1}$$

where, PCN is received signal strength of CN in dBm, Pt is transmitted power in dBm, Gt is transmitted antenna gain in dB, PL is total path loss in dB and A is connector and cable loss in dB.

RSS of the HIPERLAN is determined by

$$P_{HLAN} = P_t - PL \tag{2}$$

where, PHLAN is received signal strength of HIPERLAN in dBm, Pt is transmitted power in dBm and PL is total path loss in dB.

$$V_{HDF}(t) = f(1/R_s, V_{mn}) \tag{3}$$

where Rs = Mobile node Received signal strength , Vmn = velocity of the mobile node.
V_H is threshold velocity.

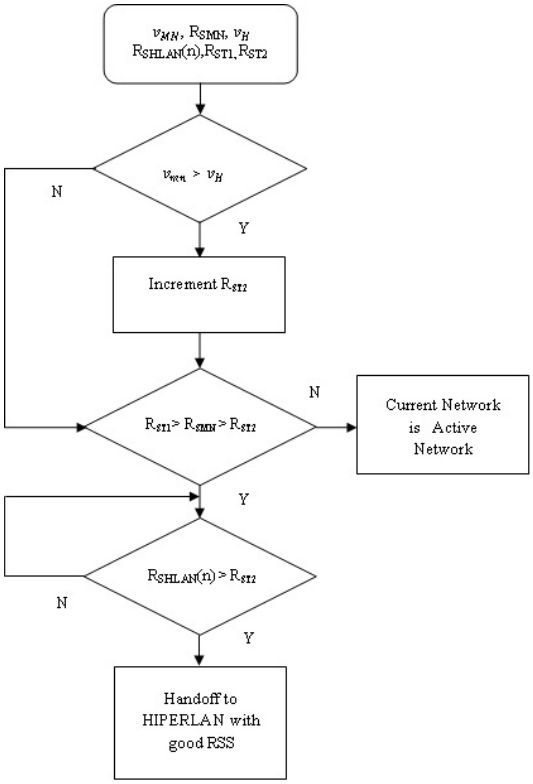

Figure 2: Flow of Vertical Handoff

The proposed algorithm is developed to perform handoff between UMTS-3G cellular system and HIPERLAN. Mobile node (MN) accessing UMTS cellular network on move, searches for other available wireless networks to perform handoff and achieves service continuity where there is no UMTS coverage. When a mobile node is moving with high velocity, fast handoff decision is required to perform handoff to maintain call connectivity. To achieve this, dynamic RSS threshold value is chosen to reduce handoff decision time.Handoff decision flow is depicted in Figure.2. Selection of threshold is very important criteria to decide handoff decision and execution time. Threshold should not be low so that handoff may be delayed or it should not be high so that call drops before the decision is taken. When the moving mobile node RSS is within the hysteresis either for a fast moving or slow moving vehicle, handoff occurs between UMTS and the available wireless network HIPERLAN with sufficient signal strength by hysteresis margin. The algorithm uses adaptive thresholds to decrease handoff decision time and increases the efficiency of handoff algorithm.

4 ANALYSIS AND RESULTS :

Figure.3 shows the received signal strength as a function of time for a slow moving and fast moving mobile node. Fast moving vehicle signal strength is decreasing at a faster rate compared to slow moving vehicle. For fast moving MN, handoff decision time is less. Hence handoff threshold is varied by increasing the RST2 threshold so that handoff is executed before MN reaches the minimum acceptable signal level, and continue the services.

NOTE: Power level measurements shown are real time measurements which are depending on the actual traffic scenario, which is not available quantitatively, in the channels and has considerable effect on the measured levels.

5 CONCLUSIONS

Todays communication network deployment is driven by the requirement to send, receive, handoff, and deliver voice, video, and data communications from one end-user to another. The two requirements of a Quality of Service handoff are : Handoff should be fast enough to avoid service degradation or interruption at the mobile node and: Handoff should be reliable such that the MN will be able to maintain the required QoS after handoff. Mobility of a mobile node at a high speed requires reliable handoff to be done promptly. This paper mainly focus to perform handoff between UMTS cellular

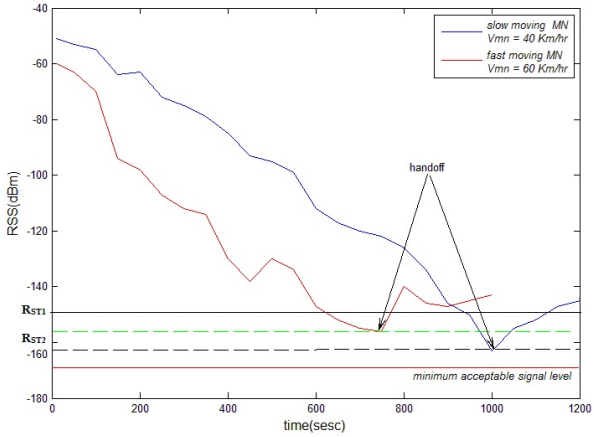

Figure 3: Measured RSS at Mobile Node moving with varying speeds

network and HIPERLAN in hot spot coverage areas where cellular network with good signal strength is not available. Vertical handoff decision time of a mobile node is determined based on the Received signal strength and velocity of the MN. Adaptive hysteresis of RSS thresholds considered based on fast moving or slow moving MN resulted in prompt and reliable vertical handoff.

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