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Classification: GJCST Classification: C.2.2, C.2.1

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Adaptive Routing Based on Delay Trusted Routing in Adhoc Network

T.K.Shaik Shavali[1], Dr T. Bhaskara Reddy[2]

Abstract-Existing network hardware is constantly being improved and new communication technology continues to be developed. Together with the trend that computing hardware becomes smaller and portable, this network technology progress has led to dynamic networks. Next generation wireless networks are characterized as heterogeneous networks, particularly in terms of its underlying technology. One of the challenges of these heterogeneous networks is to manage handoff. Mobile IP is chosen for managing the handoff to accommodate the all-IP vision of the future interconnected networks. However, the handoff management of the mobile IP is mainly for data services where delay is not of a major concern. Therefore, it would be considerable challenge to achieve low latency handoff for real-time services. In this paper, we propose a multicasting scheme for delay-sensitive applications.

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I. Introduction

In the near future, a large number of Mobile Stations (MSs) will be equipped with multiple radio interfaces for wireless access to the Internet. A multi-mode MS with multiple air interfaces (cellular interface, Bluetooth, IEEE 802.11 and IEEE 802.16 etc) and different data rates will be able to access cellular Base Stations (BSs), WLAN or WMAN Access Points (APs). In this scenario, the integration of multi-hop ad hoc communications with infrastructure based (or single-hop) wireless networks, such as wireless WANs (e.g., 2.5G, 3G, and 4G), wireless LAN (e.g., IEEE 802.11 a/b/e/g and HiperLAn/2) and wireless MANs (e.g., IEEE 802.16), is fundamental to improving the coverage and performance of the integrated network [3]. In addition, multi-hop communications can be used to increase the utilization and capacity of a BS by decreasing the co-channel interference via lowering the transmission power either of the BS or of the MSs [5] [9].Also, the integration can be useful in achieving load-balancing by forwarding part of the traffic from an overloaded cell to a free neighboring cell [6] [7]. From the protocol stack perspective, the network layer is the lowest possible layer where the convergence of heterogeneous wireless systems can be developed. Furthermore, the desire to extend the great success of the Internet Protocol (IP) from the wired world to wireless leads to an all-IP vision [3]. So far, the IP is the best integration technology for heterogeneous networks and there is currently no foreseeable alternative to the IP [4]. To allow for seamless handoff to take place in IP-based heterogeneous networks, the IP must support users' mobility. In an effort to do that, the Internet Engineering Task Force (IETF) has developed the mobile IP standard to support mobility in IP-based networks [5]. In recent years, there has been a considerable amount of works that address the mobile IP-based handoff problem in heterogeneous networks [2],[3], [6]-[9]. Since data packets could be lost during the latency period, mobile IP-based handoff may not meet the quality-of-service (QoS) requirements for real time voice applications. Even though, mobile IP describes a scheme to recover the lost packets from the old foreign agent to the new one, this process takes some time as the signal experiences a random delay when it travels through the network. This makes the latency even longer. For non-real time services, this additional delay will not create a major problem. However, for real time services, this will dramatically degrade the QoS requirements. This problem can be solved if multicasting is employed. In this case, data packets are sent to the neighboring foreign agents as soon as the Received Signal Strength (RSS) of the mobile host goes below a certain threshold level. When this occurs, the data packets are stored in the buffer at the new foreign agent, and in the process, the latency can be reduced.

In this paper, we consider a multicasting scheme to solve the handoff latency problem in heterogeneous networks. The proposed handoff technique offers two main advantages:

a. It reduces the handoff latency in hybrid networks,
b. Recovers lost packets during the handoff process, which increases the system throughput.

II. Mobile IP and Handoffs

First, second- and third-generation mobile systems depended on the employment of the radio spectrum that was either unlicensed (available for public use) or licensed for use by a very small number of service providers and network operators in each region.

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Differences in bandwidth and coverage areas have led to the necessity of developing multi-network interface devices (terminals) that are capable of using the variety of different network services provided.

1) *Mobile IP*

Mobile IP is an Internet protocol, defined by the Internet Engineering Task Force (IETF) that allows users keep the same IP address, and stay connected to the Internet while roaming between networks. The key feature of Mobile IP design is that all required functionalities for processing and managing mobility information are embedded in well-defined entities, the Home Agent (HA), Foreign Agent (FA), and Mobile Nodes (MNs) [1, 2]. When a MN moves from its Home Network (HN) to a Foreign Network (FN), the correct delivery of packets to its current point of attachment depends on the MN's IP address, which changes at every new point of attachment. Therefore, in order to guarantee packets delivery to the MN, Mobile IP allows the MN to use two IP addresses: The Home address, which is static and assigned to the MN at the home network; and the Care-of-Address (CoA), which represents the current location of the MN [2]. One of the main problems that face the implementation of the original Mobile IP is the Triangle Routing Problem. When a CN sends traffic to the MN, the traffic gets first to the HA, which encapsulates this traffic and tunnels it to the FA. The FA de-tunnels the traffic and delivers it to the MN. The route taken by this traffic is triangular in nature, and the most extreme case of routing can be observed when the CN and the MN are in the same subnet [4, 5].

In mobile IP, two network entities are defined to support users mobility namely; the home agent and the foreign agent. These two agents periodically send advertisement messages to their corresponding networks (i.e., home and foreign networks) to acknowledge the mobile of its present location. Based on these advertisement messages, and the present location of the mobile host, the mobile host decides whether it belongs to its home network or to a new foreign network. If the mobile host discovers that it has migrated to a new foreign network, it sends a registration request to the corresponding new foreign agent to obtain a care-of-address. Also the foreign agent registers the new address (i.e., new location) with the mobile host home agent. After this process, any data packets that are received at the mobile's home network will be encapsulated with a new IP address and tunneled to the new foreign agent to which the mobile host resides. The foreign agent (at the other end of the tunnel) takes care of the de-encapsulation of the arriving data packets, and then forwards them to the mobile host using the new IP address. In the same way, if the mobile host transmits data packets to its correspondent host, it uses the foreign agent for the tunneling process to forward these data packets to the home agent for subsequent transmission to the correspondent host.

2) *Classification of Handoffs*

In principle, each mobile terminal (node) is, at all times, within range of at least one network access point, also known as a base station. The area serviced by each base station is identified as its cell. The dimensions and profile of every cell depend on the network type, size of the base stations, and transmission and reception power of each base station. Usually, cells of the same network type are adjacent to each other and overlap in such a way that, for the majority of time, any mobile device is within the coverage area of more than one base station. Cells of heterogeneous networks, on the other hand, are overlaid within each other. Therefore, the key issue for a mobile host is to reach a decision from time to time as to which base station of which network will handle the signal transmissions to and from a specific host and handoff the signal transmission if necessary. We classify handoffs based on several factors as shown in Fig. 1. No longer is the network type the only handoff classification factor. Many more factors constitute categorization of handoffs including the administrative domains involved, number of connections and frequencies engaged. The following are categorization factors along with the handoff classifications that are based on them.

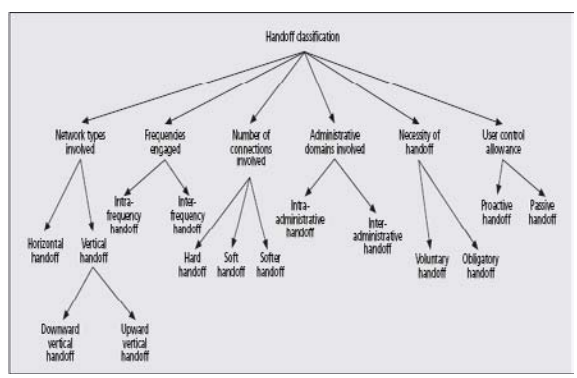

Figure1- Hierarichal Classification of Handoff

Handoffs can be classified as either horizontal or vertical. This depends on whether a handoff takes place between a single type of network interface or a variety of different network interfaces.

Horizontal Handoff: The handoff process of a mobile terminal between access points supporting the same network technology. For example, the changeover of signal transmission (as the mobile terminal moves around) from an IEEE 802.11b base station to a geographically neighboring IEEE 802.11b base station is considered as a horizontal handoff process.

Vertical Handoff: The handoff process of a mobile terminal among access points supporting different network technologies. For example, the changeover of signal transmission from an IEEE 802.11b base station to an overlaid cellular network is considered a vertical handoff process.

III. System Architecture

The proposed interconnection architecture using mobile IP is shown in Fig. 2. The following are the network parameters and assumptions used in our handoff technique:

1. The home agent (HA), the foreign agents (FAs) and the correspondent host (CH) are interconnected through Internet
2. FAs are connected to the Internet through a wireless or a wired medium with large bandwidth.
3. The CH can be a fixed or mobile host.

The time taken to switch from the home agent of the mobile user to the new foreign agent is known as the mobile IP handoff latency. In addition to this handoff latency if the mobile host enters into a new foreign agent (from another foreign agent) during the tunneling process between the home agent and the old foreign agent, and before registering with the new foreign agent, data packets destined to the mobile host will be lost. These packets will then be retransmitted leading to an increase in the overall system delay.

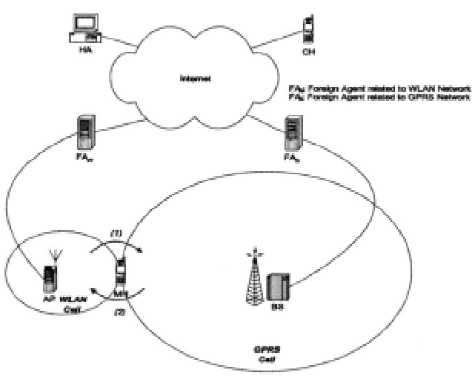

Figure2- Proposed IP-based handoff architecture.

In delay-sensitive applications, handoff latency can cause serious degradation in the quality of the underlying application. As a result of the frequent handoffs, this handoff latency becomes a major problem if the coverage area of the sub-networks gets smaller. Recent works on the existing problems of the handoff latency of mobile IP based networks and possible solutions can be found in [12]-[14].

IV. Proposed Improvement in Latency

1) *Improvement in Registration Time*

The improvement in Registration Time is achieved by starting to forward data packets after a small fixed delay (termed as the 'Fixed Registration Delay') following the Registration Request from the MH to the new FA through the new AP/BS. That is, data packets will not wait for the registration process to be completed. Given the fact that the new FA has data packets stored in its buffer, it can start sending these packets to the MH immediately after receiving the Registration Request from the MH. This, in turn, will reduce the total handoff latency and the requirement of large buffer capacity at the FA. To improve the probability of packet loss during the handoff process, we propose a simple modification to the standard mobile IP. In that, the new FA can directly send the Binding Update to the CH instead of sending it to the HA. This of course requires the CH to be notified earlier about the new point of attachment of the MH. This modification is shown to assist in reducing the number of data packets forwarded to the old FA, which in turn reduces the probability of packet loss during the handoff process.

2) *Improvement in Packet Reception Time*

The main contributor to the Packet Reception Time is the time required for transmitting the data packets to the MH. This time is mainly dependent on the packet size and the transmission data rate. For low data rate applications, such as voice communications, the transmission takes a significant amount of time. In this case, the Packet Reception Time will have a significant effect on the overall handoff latency. In our scheme, the network will adjust the packet size according to the application data rate. Therefore, the packet size will be small (or large) depending on the transmission data rate of the underlying application.

Note that the use of smaller packet size has an impact on the amount of packet lost. A smaller packet size results in a short packet transmission time. Hence, the duration of which packet loss occurs also gets smaller [3]. Since our focus is on the handoff latency and not on the system throughput, we have not considered the effect of packet loss here. For more details on the system throughput and probability of packet loss, the reader is referred to [15]. Even though the proposed adaptive packet size technique may lead to a large reduction in the handoff latency, lowering the packet size will have an impact on the associated transmission are accompanied with a considerably large header size. However using header compression techniques, this problem can be greatly eliminated.

V. Result Observation

Results have been for the handoffs in a network model to observe the distribution of handoff latency using the standard mobile IP multicasting technique compared to our proposed multicasting technique.

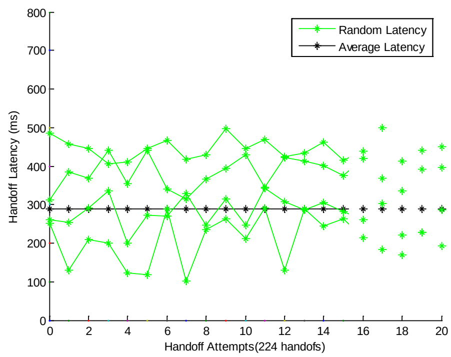

Figure 3. Handoff latency distribution using the standard multicasting mobile IP with 224 random handoffs.

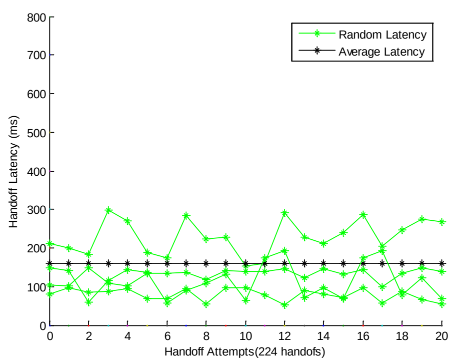

Figure 4. Handoff latency distribution using the proposed improvement.

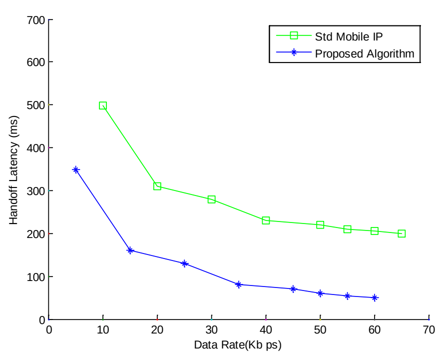

Figure 5. Comparison of handoff latency for different data rates. Standard mobile IP versus proposed algorithm.

VI. Conclusions

Mobility is the most important feature of a wireless cellular communication system. Usually, continuous service is achieved by supporting handoff (or handover) from one cell to another. Handoff is the process of changing the channel (frequency, time slot, spreading code, or combination of them) associated with the current connection while a call is in progress. Mobile IP signal flows to reduce the handoff latency in heterogeneous networks with frequent handoffs. In the first modification, we proposed a multicasting scheme where the new foreign agent can only wait for a fixed time for the registration time process to be completed, and after which it can send data packets to the mobile host. The second approach implements a variable packet size depending on the underlying application.

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