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Automated Call Transfer Technique for Heterogeneous MANET

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Abstract: Call Transferring is the essential functionality for dealing with the mobility of the mobile users in mixed or heterogeneous network. Compared with the conventional handover employed in the mobile networks, the complete call transfer is being proposed for 3G/4G for better performance on both link and system level. Previous work on handover technique has led to several algorithms being proposed and extensive research has been conducted on the performance analysis and parameters optimization of these algorithms. Most of the previous analysis focused on the uplink direction. However, in future mobile networks, the downlink is more likely to be the bottleneck of the system capacity because of the asymmetric nature of new services, such as Internet traffic.

Keywords: Handoff, Opnet, UMTS

I. INTRODUCTION

Today mobile wireless communications are commonly seen as one of the most advanced form of human communications ever. The last decade GSM technology has been a leading force in this revolution. Simultaneously with the phenomenal deployment of wireless networks and distribution of user terminals, also the Internet has seen a similar revolutionary growth[1]. The success of both technologies offers a great opportunity to provide integrated services using a wireless network. In order to support multimedia, web, email and other data services in a broadband wireless network, standards have been proposed by the 3GPP leading to the creation of the Universal Mobile Telecommunications System (UMTS). Besides providing changes in the network infrastructure – the UMTS specifications point out the evolution path from GSM circuit switched networks towards packet switched technologies offering higher transmission rates. Based on the service requirements the UMTS Terrestrial Radio Access Network (UTRAN) has been designed. A key requirement in the bearer capabilities is the handover. Principally handover is necessary to support mobility of users and to enable the interoperability of different network technologies (e.g. Between UMTS and 2nd generation systems as GSM).

II. CELLULAR NETWORK

The aim of network and service providers to offer a wide variety of – often bandwidth extensive – services to a broad market of users via wireless networks, made the scarcity of the radio frequency spectrum a hot political issue in the telecommunications market[2]. To use the spectrum more efficiently cellular systems were designed. In opposite to "old" communication systems – using one transmitter transmitting at high power levels in a limited channel – a cellular architecture uses many transmitters at low power what makes it able to reuse frequencies. Traditional cellular systems are designed so that adjacent cells use different frequencies. As long as the cells are separated and the signal strength calibrated, there will not be harmful inter-cell interference. The picture on the next page shows the typical layout of a seven-way frequency reuse system often used in GSM networks. Cell 1 makes use of frequency f1, in cell 2 frequency f2 is transmitted.

$$D/R=\sqrt{3N}$$

During the spectrum assignment process a service provider is usually given a portion of the total spectrum band allocated to one technology. This spectrum band is further divided into smaller slices dedicated to the different base stations in the cells.
On top of this frequency division architecture a suitable multiple access scheme is deployed. In GSM networks Time Division Multiple Access (TDMA) is used to efficiently distribute the bandwidth inside a cell to the users. The UMTS system uses CDMA as multiple access scheme to utilize the bandwidth as efficient as possible. CDMA also enables different data rates for different services in a more flexible way. The next chapter deals with CDMA and the UMTS access part in more detail.

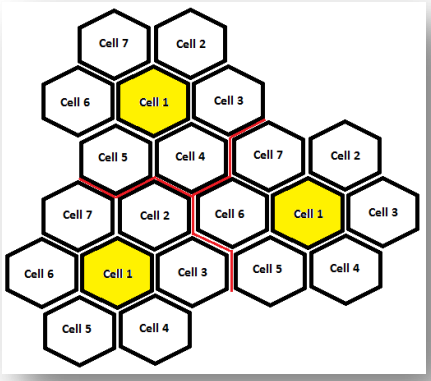


Fig. 1 Seven-way frequencies reuse cellular system

A.The handover concept-

The freedom to be able to make and receive calls anywhere, at any time, creating a totally new dimension in human communications has frequently been advertised as the main advantage of new wireless systems[3]. Handovers are a key concept in providing this mobility. It makes it possible for a user to travel from one cell to another while having a seamless connection.

Generally a handover is performed when the quality of the link between the base station and the mobile terminal on the move is decreasing. The term "handover" refers to the whole process of tearing down an existing connection and replacing it by a new connection in the cell into which the user is handed over – the so called target cell [4].

B. Network modeling-

In order to carefully plan and dimension future telecommunications networks, modeling is of prime importance. Three modeling methods are commonly used: building analytical models, simulating with network modelers and performing measurements on real systems. Each method has some advantages and drawbacks. Seen the facts that operational UMTS test networks were not available at the time this research was performed and that it is almost impossible to develop a mathematical system model and get some reliable results in a reasonable time, the choice has been made to mainly model and simulate the UMTS network using OPNET® to obtain the results[5]. OPNET® is a modular network management software packet designed for optimizing network performance. It includes a specialized model for UMTS networks, based on the 3GPP specifications.

III. NETWORK ARCHITECTURE

The UMTS network architecture has been specified according to requirements that will offer higher flexibility to users than second-generation networks ever could support. As has been mentioned in the introductory chapter[6], two requirements are of prime importance.

A. Firstly an efficient resource management scheme is crucial. This contains making an efficient use of the available spectrum bandwidth and using advanced multiple access techniques.

B. The second requirement is the possibility to accommodate for different traffic types.

Networks supporting multimedia services such as voice and video conversations and high speed Internet require different methods to handle applications with diverse characteristics.

IV. HANDOFF TECHNIQUES IN CELLULAR NETWORKS

Continuation of an active call is one of the most important quality measurements in the cellular systems. Handoff process enables a cellular system to provide such a facility by transferring an active call from one cell to another. Different approaches are proposed and applied in order to achieve better handoff service. The principal parameters used to evaluate handoff techniques are: forced termination probability and call blocking probability[7]. The mechanisms such as guard channels and queuing handoff calls decrease the forced termination probability while increasing the call blocking probability. In this paper we present an overview about the issues related to handoff initiation and decision and discuss about different types of handoff techniques available in the literature.

A. Hard vs. Soft Handoff

The hard handoff term is used when the communication n channel is released first and the new channel is acquired later from the neighboring cell. Thus, there is a service interruption when the handoff occurs reducing the quality of service. Hard

handoff is used by the systems which use time division multiple access (TDMA) and frequency division multiple access (FDMA) such as GSM and General Packet Radio Service (GPRS) [9]**.**

B.Microcellular vs. Multilayer Handoff

In this section we will first look at the handoff issues in microcellular environments. Later, we will investigate some systems that use microcells overlaid by macro cells in order to minimize number of handoffs[8].The microcells are cells with small radii and employed in highly populated areas such as city buildings and streets to meet high system capacity by frequency reuse. In Fig. 2 we have two streets intersecting with three BSs employed on streets. BS1 and BS3 have line-of-sight (LOS) with each other. The handoff between BS1 and BS3 is called LOS handoff while the handoff between BS1 and BS2 is a non

C.Horizontal vs. Vertical Handoff

Handoff between homogenous networks where one type of network is considered is called horizontal handoff. On the other hand, handoff between different types of networks is also possible.

V.OPNET MODELER

OPNET Modeler provides a comprehensive development environment supporting the modeling of communication networks and distributed systems. Both behavior and performance of modeled systems can be analyzed by performing discrete event simulations. The **OPNET Modeler** environment incorporates tools for all phases of a study, including model design, simulation, data collection, and data analysis.

A.. User Equipment (UE's)

The advanced workstation and server model includes an application layer. It also includes the MAC layer, a radio transmitter and receiver, one antenna and the full TCP(UDP)/IP protocol stack in the application layer. It includes priority handling of data flows, the three types of RLC modes, and segmentation and reassembly of higher-layer packets[9].

B..The Node B

The Node-B manages the networks air interface for UEs in the same sector as the Node-B. There are both ATM and IP-enabled Node-Bs. The model suite includes a single-sector Node-B, a three-sector Node-B, and a six-sector Node-B[9]. An RNC connects to one or more Node-Bs to communicate with the UEs of the network and to manage multiple calls.

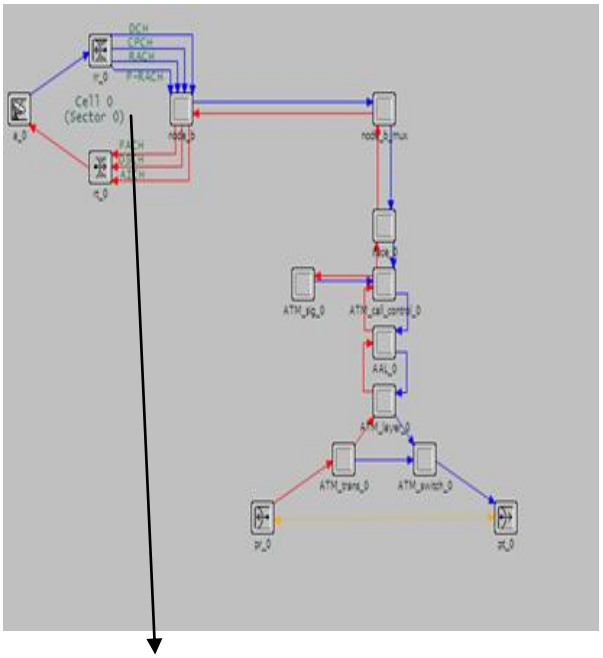


Fig. 2Single Node Model

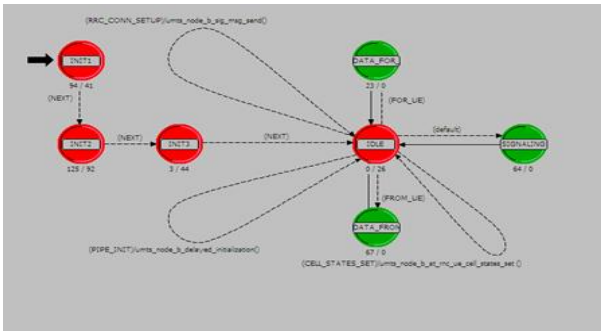
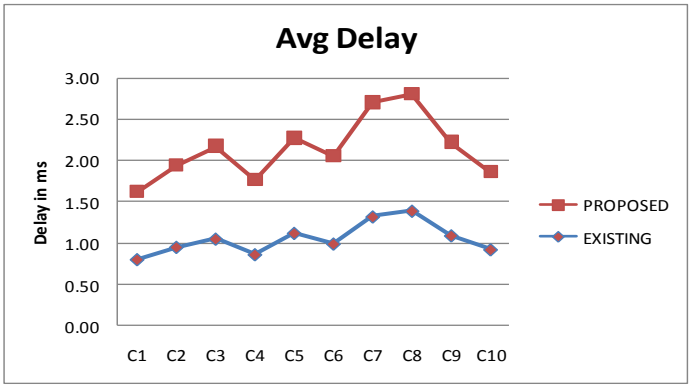


Fig. 3Process Model

VI. RESULTS

We have created several network scenarios to have a thorough analytical view of proposed algorithm with respect to existing soft handsoff methods. To introduce the variations, we have randomly changed the number of Base Stations and User Equipments. We have made several scenarios for thorough testing but only the significant scenarios and their results are shown. The scenarios were tested on existing protocol and then after recording the results, they were tested with the proposed algorithm. Finally the following results were achieved.

Scenario 1



In this scenario1 , we can see that the average delay of receiving packets has increased drastically in the case C7 and C8. While the C1 and C10 cases were comparatively low. The respective delay caused by the proposed algorithm is slightly more than the existing algorithm in almost all the cases of scenario

.

VII. CONCLUSION

This research presents beside a thorough dissertation of the UMTS technology, issues around network modeling and the main findings of the simulations carried out. The probability a user is in soft handover has been analyzed using six different simulation series. To study capacity and coverage in a system and the correlation between those two network parameters, three cases have been carried out. As in every cellular system, in UMTS handovers have been implemented to allow roaming between cells.

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