MOBILE HANDOVER PROTOCOL FOR UMTS NETWORKS: A NEW APPROACH

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Abstract

This paper deals with the mobile handover protocol in the Universal Mobile Telecommunication System (UMTS) in context of 3rd generation mobile communication system. A handover protocol for mobility management in between Satellite UMTS (S-UMTS) and Terrestrial UMTS (T-UMTS) networks has been proposed. The UMTS system architecture and some functional requirements are discussed, first. Then the proposed protocol has been introduced and explained with information flow diagrams for certain cases of internetwork handover. Further key functions required to perform efficient handover is discussed. The proposed protocol decreases the handover blocking probability by allowing T-UMTS Mobile Terminals (MT) to use S-UMTS network as a backup and thereby ensures smooth handover.

I. Introduction

Universal Mobile Telecommunication System (UMTS), is the European vision of a 3rd–generation communication system, which is currently under development. It is to be designed to continue the global success of the European 2nd generation mobile communication system, GSM (Global System for Mobile Communication). UMTS seeks to unify existing cellular, cordless and paging networks, and with the migration of mobile and fixed networks into one global universal communication system. UMTS will deliver low-cost, high-capacity mobile communications offering data rates up to 2Mbps with global roaming and other advanced capabilities [1][2]. To satisfy the predicted traffic demands with efficient use of radio resources and to support the concept of global coverage, mixed cell architecture has been defined in the UMTS standards [3] as shown in figure 1. The cells namely, pico, micro and macro, overlap and mobile satellites overlapping the terrestrial cells. Mobile Satellites provides the most effective coverage method to sparsely populated rural areas and they are planned to act as umbrella cells. In fact, umbrella cells will act as backup cells to macro cells that cover suburban areas.

The maximum data rate and the maximum speed of the user are different in each hierarchical layer. In the macro layer a data rate of 144kbps with maximum speed of 500 km/h

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is possible. In the micro layer 384kbps data rate with maximum speed of 120km/h is supported. The pico layer offers up to 2Mbps with a maximum speed of 10km/h [3].

UMTS will support future multimedia services, which requires continuous connectivity throughout the entire length of the call, including roaming between different types of networks such as T-UMTS and S-UMTS. This leads to the necessity of an improved handover technique to support seamless handover between macro cells and mobile satellite cells, with reduced handover blocking probability.

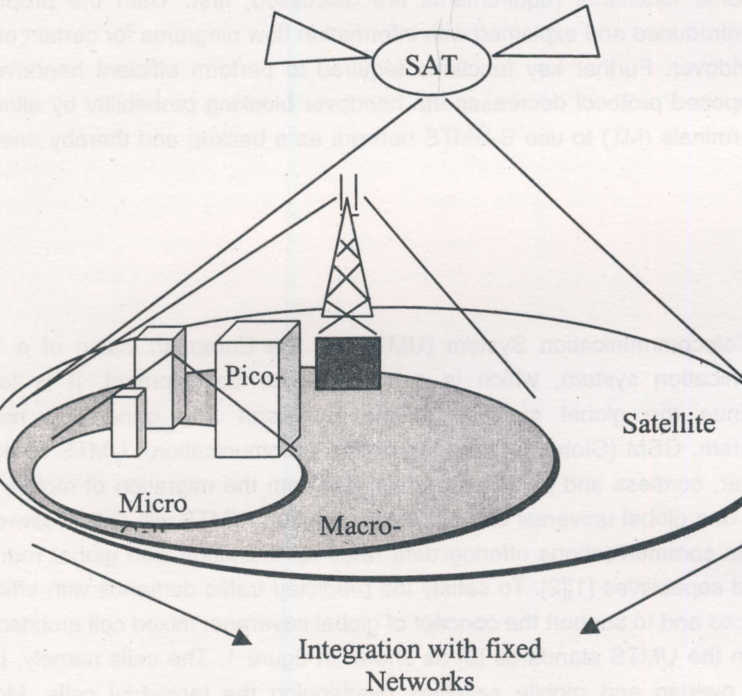


Figure 1. Hierarchical cell structure of UMTS to offer global radio coverage

2. SYSTEM ARCHITECTURE

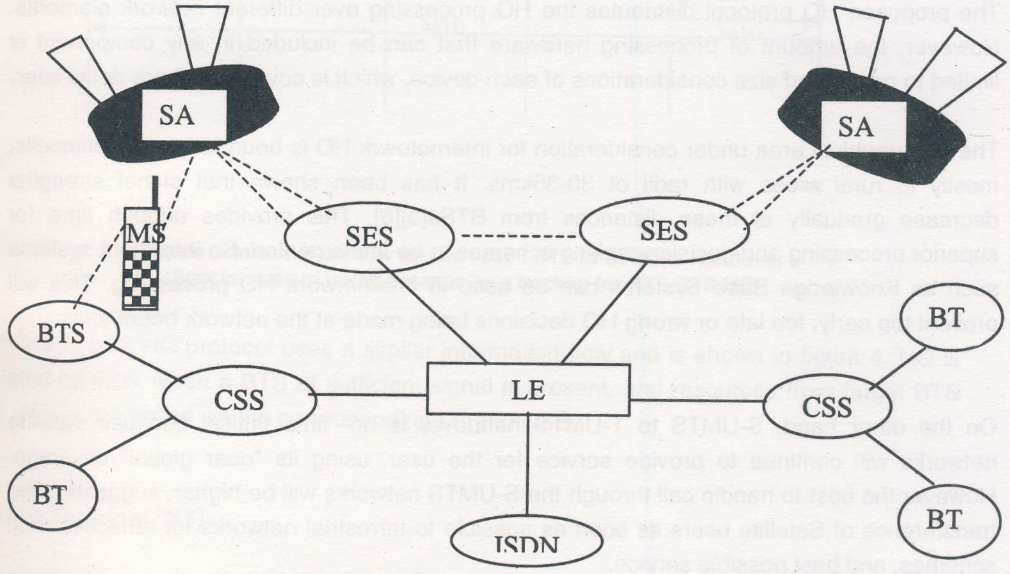
UMTS architecture is designed to integrate different wire and wireless networks together at network level and at system level. Figure 2 highlights different elements of the proposed UMTS networks [2][3].

2.1 Functional Requirements

A user's requirements and service profile is recorded in both networks. The following functional requirements can be listed as a basis of location updating process and the internetwork handover protocols [4].

1. Users can connect with either Terrestrial or Satellite networks, with the priority given to Terrestrial cells due to the cost factor.
2. Users in both types of networks can be addressed, by referring to the location registration databases at the LEs.
3. Avoid call dropping due to lack of coverage or traffic congestion in terrestrial network, by using satellite network resources.
4. Avoid usage of satellite networks whenever terrestrial networks with sufficient resources are available.

Execute the handover procedure at the best possible time, not only to decrease the probability of unnecexsary handovers, but also to decrease the probability of call dropping and at the same time with minimal costs to the user.



Legend
BTS – Base Transceiver System
MT – Mobile Terminal
SES – Satellite Earth Station
LE – Local Exchange
CSS – Cell Site Switch
SAT – Satellite

Figure 2. Integrated UMTS System Architecture

2.2 Location Updating

MTs will listen to the broadcast messages in the area and appropriate location updating will be done at the LE. The mobile will only be located with an SES, provided no BTS is available with the required signal level [5].

3. INTERNETWORK HANDOVER

Special Handover Protocols are to be used in UMTS network elements. They must be capable of handover between intra-network as well as inter-network components. The Quality of Service (QoS) desired in different networks may be different due to their different networks transmission environments, power levels and allowed bit rates. So these Handover (HO) protocols must also take into the consideration. The fact that, different network components are designed to perform with different QoSs and if the service profile permits, graceful degradation/upgradation of QoS is allowed over such network boundaries.

4. PROPOSED HANDOVER PROTOCOL

The proposed HO protocol distributes the HO processing over different network elements. However, the amount of processing hardware that can be included in any component is limited to power and size considerations of each device, which is covered in more detail later.

The geographical area under consideration for internetowrk HO is boundaries of macrocells, mostly in rural areas with radii of 30-35kms. It has been shown that signal strengths decrease gradually at these distances from BTSs[3][6]. This provides enough time for superior processing and decision-making schemes to be implemented. So intelligent systems such as Knowledge Base Systems can be used in internetwork HO processing. This will prevent too early, too late or wrong HO decisions being made at the network boundaries.

On the other hand, S-UMTS to T-UMTS handover is not time critical because satellite networks will continue to provide service for the user, using its "near global" coverage. However the cost to handle call through the S-UMTS networks will be higher, suggesting the transference of Satellite users as soon as possible to terrestrial networks for attractive tariff schemes, and best possible service.

Figure 3 and 4 describe the proposed HO protocol for special scenarios. If the BTS signal measurement (M1) is low, BTS sends a HO_REQUEST (M2) to the CSS requesting resources from the target BTS. If no resources have been found during a certain time CSS requests a SAT measurement from MT via old BTS (M3,M4). From this measurement (M5) appropriate target SES is identified and a HO_REQUEST (M6) is sent to the SES via LE. If SES has resources available, a HO_INFO (M7) packet is sent to the MT with all timing advance information and frequency information. Upon receiving this packet MT sends a HO_ACCEPT (M8) packet to the system through the old BTS and starts transmitting via Satellite (M9) according to the timing information supplied by the system. After receiving this SES will provide the synchronisation information (M10) for further transmission from MT.

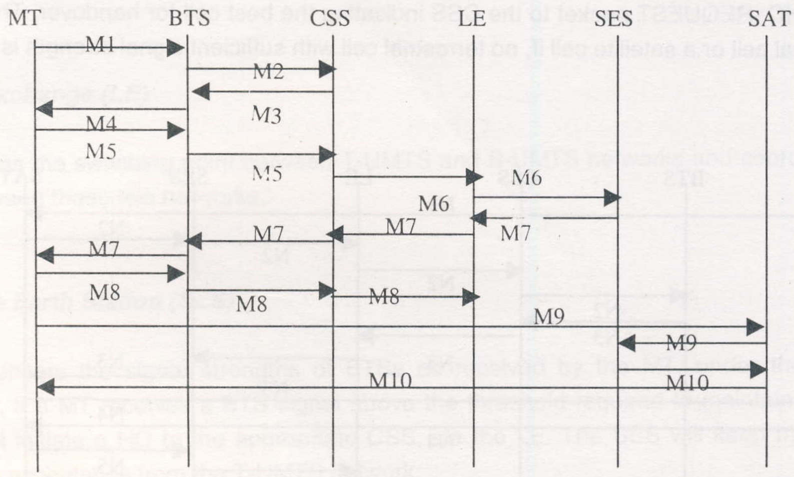


Figure 3. Information flow for the case : BTS to Satellite Handover (Special case of using Satellite as a backup for BTS-BTS HO)

Satellite to BTS HO protocol uses a similar information flow and is shown in figure 4. HO is initiated by SES, when a BTS of sufficient signal is present, and resources from target BTS (N2, N3) is requested via the corresponding LE and CSS.

Mobile Terminal (MT)

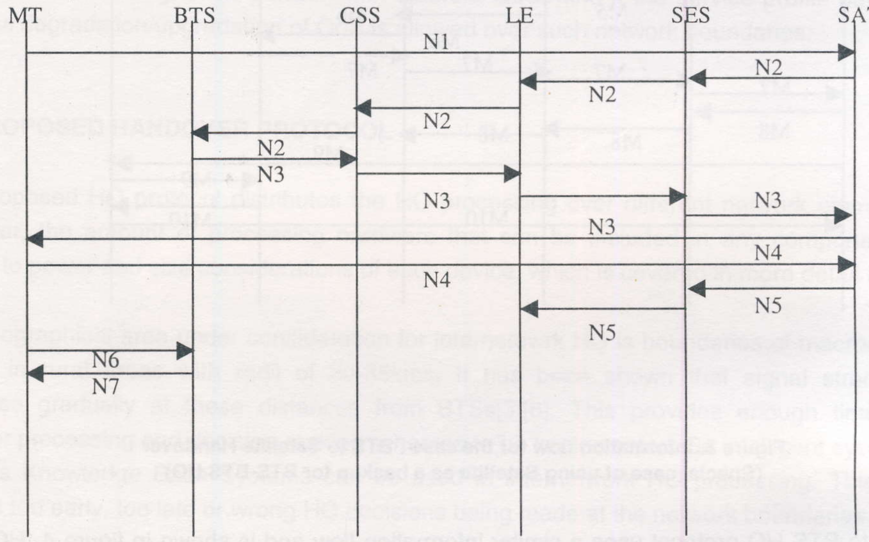
As transmit and processing power is constrained in the MT, minimal processing is available to perform a seamless handover. They must be provided with functionality to perform in both types of networks via a common protocol. Also they are capable of responding to the HO commands, issued by network components in the higher layers, to perform different HOs like BTS to BTS, BTS to SAT, inter SAT, intra SAT.

Low Earth Orbit (LEO) Satellites

Payload of LEO satellites intended to be used in the S-UMTS networks that is also power critical and they will only act as retransmission points as far as internetwork traffic and HO are concerned.

Base Transceiver System (BTS)

BTS initiates all the handovers triggered by insufficient signal strengths to maintain a call. It sends a HO_REQUEST packet to the CSS indicating the best cell for handover. This can be a terrestrial cell or a satellite cell if, no terrestrial cell with sufficient signal strength is close by.



Legend

N1 – BTS & Satellite signal measurement N2 – HO_REQUEST
N3 – HO_INFO (target cell) N4 – HO_INFO (target cell), timing info
N5 – HO_ACCEPT
N6 – Data transmission according to timing advance set by the system
N7 – Synchronization information from BTS

Figure 4. Information Flow for the case : Satellite to BTS Handover

Cell Site Switch (CSS)

CSS initiates traffic handovers to distribute the load through all the cells as much as possible when individual cell's traffic increase load beyond some threshold. The appropriate BTS then selects the MTs that can be handed over to neighbouring cells while maintaining an acceptable signal level in their target cell. CSS acts as the switching point for intra CSS HO and coordinates the HO procedure. If there are no radio resources available in the target BTS, the CSS requests a Satellite signal measurement from the MT, via the old BTS. If the MT receives the sufficient signal strength from a satellite, the CSS will initiate a HO to the S-UMTS network.

Local Exchange (LE)

LE acts as the switching point between T-UMTS and S-UMTS networks and coordinates the HO between these two networks.

Satellite Earth Station (SES)

SES monitors the signal strengths of BTSs as received by the MT, under the S-UMTS network. If a MT receives a BTS signal above the threshold required to maintain a link, the SES will initiate a HO to the appropriate CSS, via the LE. The SES will keep trying until it gets the acceptance from the T-UMTS network.

5. CONCLUSION

It can be concluded that the proposed HO protocol will decrease BTS to BTS HO blocking probability as the users are allowed to use S-UMTS network as a backup. This is as expected as this effectively increases the resources available for T-UMTS handover. This process also results in achieving high utilization in the T-UMTS network without excessive additional load in the S-UMTS network. This can be thought of as S-UMTS network acting as a buffer for handover users in T-UMTS networks, until resources in BTSs are available.

Many researchers and scientists of all over the world are working to make UMTS successful. This paper may be an affix to those efforts.

REFERENCES

[1] Nadege Faggion, Cegetel, Thierry Hua, *Personal Communication Services Through the Evolution of Fixed and Mobile Communications and the Intelligent Network Concept,* IEEE Network Magazine, July/Aug 1998

[2] Mikko Martikainen, Sven-Gustav Haggman, *Integration of UMTS with B-ISDN,* A master's thesis of Faculty of Electrical Engineering in the HELSINKI UNIVERSITY OF TECHNOLOGY, collected from the Internet

[3] Thomas Neubauer, *Universal Mobile Telecommunication System architecture, protocols and Services,* A research work collected from the Internet,
Email: Thomas.Neubauer@mobile.nt.tuwein.ac.at

[4] Buitenwerf, E., Colombo, G., Hakan, M., Wright, P. *UMTS: Fixed Network Issues and Design Options.* IEEE Personal Communications. Vol. 2, No. 1, February 1995, pp. 30-37

[5] Md. Abdur Razzaque, Prof. Dr. Lutfar Rahman, *A study on virtual circuit management in Wireless ATM Networks,* M. Sc. Thesis, Department of Computer Science, University of Dhaka, June1999

[6] Greorgy P. Pollini, *Trends in Handover Design,* IEEE Communications Magazine, pp.82-90, March 1996

DESIGN OF A COMPUTER AIDED PROCESS PLANNING TOOL (CAPP-S6) FOR SHAFT TYPE OBJECTS USING AUTO LISP AND C

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Abstract

This paper deals with the Computer Aided Process Planning system for shaft type of objects. The system is designed using C and Auto LISP for the process planning of six different types of shafts. It is a combination of variant and automatic process planning. The system takes input from the user, generates drawing of the work piece, simulates, and generates process plan for each part. The input data are the dimensions and the material specifications of the shaft. Different types of materials can also be selected using this programme. The process plans can be saved and retrieved again. The system also generates part code according to the shape and dimensions of the work piece.

Introduction

Process planning is that function within a manufacturing facility that establishes which machining process parameters are to be used to convert a work material (blank) from its initial form (raw material) to a final form, defined by an engineering drawing. The quality of the product and the cost of producing it are strongly influenced by the process plan. In the past, majority of the manufacturing systems were operated by human. Such system responds slowly, with incomplete or inaccurate information and an inflexible and slow process plan generation. Today, the production method is fast moving toward automation and computers are used to accelerate and improve the process planning systems. Computer aided process planning (CAPP) or automated process planning is an approach that uses computers to generate a process plan. CAPP can eliminate many of the manual decisions required during planning. It has the following advantages:

1. It reduces the demand of skilled planner
2. It reduces the process planning time.
3. It reduces the process planning and manufacturing cost.
4. It creates consistent and accurate plan and increases productivity.

There are three basic approaches to computer aided process planning: variant, generative and automatic.

The variant approach uses computer terminology to retrieve plans for similar components using table look up procedures. The process planner then edits the plan to create a variant to suite the specific requirement of the component being planned. Creation and modification of standard plans are the process planner responsibility.

The generative approach, however, is based on generating a plan for each component without referring to existing plans. Generative type systems are systems that perform many of the functions in a generative manner. The remaining functions are performed with the use

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