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Implementation of Soft Handover in "3G" using OPNET

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Abstract:
Mobile applications for multimedia services such as video conferencing, file downloading and web browsing etc. over the network have high demands in terms of available network resources and Quality of Service (QoS) performances. The importance of QoS provisioning has become one of the central issues of 3G mobile network design and analysis. Now a day's, tere is a need to achieve mobility and continuous service is achieved by supporting handover from one cell to another. It is regularly initiate either by crossing a cell boundary or by deterioration in quality of the signal in the current channel. Handover is a key concept to achieving mobility. Handover stands for event which is start when user equipment moving to another base station and leave the previous base station. It makes possible for a user to travel from one cell to another, with no interrupt is known as seamless connection. In this paper, implementation of soft handover is made using OPNET MODELER.5 user equipment perform soft handover in logical network under soft limits of soft handover criteria. The performance of soft handover is test under characteristics of GPRS attach delay, CBR delay (sec), active cell size, cell added to the set and cell removed from the set.

Keywords: UMTS- Universal Mobile Telecommunication System, QOS – Quality of Service, RNC – Radio Network Controller, GGSN Gateway GPRS Support Node, SGSN- Serving GPRS Support Node

Introduction

Mobile communication allows transmission of multimedia data and voice using a computer or a mobile devices using wireless link. The wireless technology began in the early 1980s with the mobile phone, the initial technology makes use of analog interface and it only supported voice capacities. High demand of cell phone and increased demand for enhanced quality, the 2nd generation (2G) was introduced. 2G support voice service with higher bandwidth, better voice quality and limited data service which use packet data technology. Conservatory of the 2G system is introduced in 2.5G system as General Packet Radio Service (GPRS). Still, the continual success of mobile communication systems pushes the need for better quality of service (QoS), more efficiency systems and more services. It shortly leads to the development of the 3rd generation (3G) telecommunication system: Universal Mobile Telecommunication System (UMTS). UMTS is the standard version of 3G mobile systems in Europe. It promises a transmission rate up to 2Mbps, which makes it possible to provide a wide range of multimedia services such as TV broadcast, video calls, video clips – news, music, sports, enhanced gaming, and location services, and for business it provides high speed VPN access, sales force automation, real-time financial information and

video conferencing. 3G services use Code Division Multiple Access (CDMA) and Wideband Code Division Multiple Access (WCDMA). 3G Standard is formed by ITU-T and is called as IMT-2000[1].

In mobile communication, Handover is a process when a user switches to another channel without any interruption. It enables the users to receive their calls anywhere and at any time. In Handover process the existing link is replaced by another cell. The network controller decides from the measurement reports about the link quality that the hand over process is needed to another cell or not. The main aim of the handover process is to permit the mobile users to roam freely from one mobile network to another either the network are same or different.

Necessity of Handover process:

• When the movement of the user equipment/cell phone is very fast.

• The movement of the user's equipment from one cell to another during an ongoing session.

• The experience of interference phenomena by the user's equipment from the near cell.

1.1 UMTS

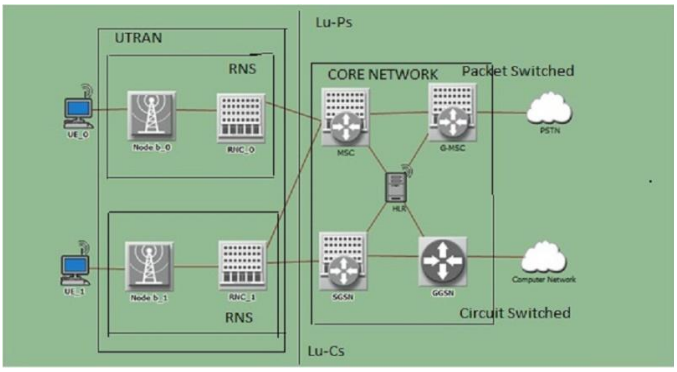

Fig. 1 UMTS Architecture

UMTS architecture is according to the 3GP necessities. Basically network consists of three interacting domains: User Equipment (UE), UMTS Terrestrial Radio Access Network (UTRAN) and Core Network (CN).

1) User Equipment*:* The User Equipment or UE is the name given to what was previous termed the mobile. It describes the equipment used by the client to establish a radio connection to the UMTS network and access the services offered. Terminals work as an air interface counterpart for Node-B and have many different types of identities taken directly from GSM specifications such as International Mobile Subscriber Identity (IMSI) and Temporary Mobile Subscriber Identity (TMSI).

2) UTRAN*:* UTRAN stands for Universal Terrestrial Radio Access Network is a collective term for the Node B's and Radio Network Controllers (RNCs) which make up the UMTS radio access network. This communications network, frequently carry many traffic types from real-time Circuit Switched to IP based Packet Switched. The UTRAN provides connectivity between the UE (user equipment) and the core network.

The UTRAN may consists of more than one radio network subsystems (RNS) each containing a radio network controller
(RNC) and a group of node B's. There can be more than one RNS present in a UTRAN [7].

a) **Radio Network Subsystem (RNS):** The RNS provides same functionality as the previous BSS (Base Station Subsystem) in GSM. It provides and manages the air interface for the overall network. Each RNS controlled by RNC (Radio Network Controller) and comprises several components that are called node B.

b) **The Node B:** The node B is equivalent to BTS (Base transceiver station) in GSM. Node B provides the physical radio link between the UE and the network. Base Station is referred as Node-B and control equipment for Node-B's is called Radio Network Controller (RNC).Node B measure connection qualities and signal strengths.

3) The Core Network: The core network provides same functionality as the GSM NSS (Network Switching Subsystem). The function of the core network is to provide switching, routing and transit for user traffic. Network management and Database handling functions are controlled by core network. The basic Core Network architecture for UMTS is based on GSM network with GPRS.

The Core Network is divided in to two domains as:

- Circuit switched domain
- Packet switched domain.

Some of the circuit switched elements are Mobile services Switching Centre (MSC), Visitor location register (VLR) and Gateway MSC. Packet switched elements are Gateway GPRS Support Node (GGSN) and Serving GPRS Support Node (SGSN). Some network elements, like HLR, VLR and AUC are commonly shared by both domains.

1. Soft Handover

Soft handover, a mobile at the same time communicates with two or more cells belonging to different BSs of the identical RNC (intra-RNC) or different RNCs (inter-RNC). When a call is in a state of soft handover, the most excellent signal is used or all the signals can be collective to generate a clearer copy of the signal.

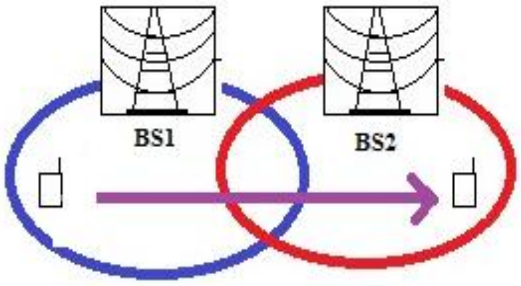

Fig 2. Soft Handover

Soft handover network consists of user equipment, node B, RNC, GGSN, SGSN and Server. The GGSN include all

GPRS functionality that is needed to support GSM and UMTS packet services. The SGSN monitors user location and performs security functions and access control. The GGSN contains routing information for packet-switched (PS) attached users. It provides interworking with external PS networks such as the packet data network (PDN). The model's CN nodes include both SGSN and GGSN functionality. The Circuit Switched Network consists of no. of server. HLR server is used to store the home location of user equipment. VLR server is used to store the random location of user equipment.

2.2 OPNET Simulator

The OPNET Modeler tool provides the power of the graphical program during which the users will model and simulate their networks. For developing completely different communication structures and implementing different eventualities, totally different tradable layers square measure gift within the atmosphere of the modeling. Users will build a detail model consistent with the need to try to do the analysis of the system. The systems square measure designed within the object destined method, on compilation of the model its produces a separate event simulation within the C language. When playacting the simulation, the results square measure analyzed with the various statistics associated with the performance provided by the OPNET.
In the first section introduction is explained, in the rest of the paper about the tool, design of the idea of the paper and the execution of soft handover in OPNET tool is explained with the simulation results.

Proposed Work

Using OPNET MODELER, create an UMTS network. This UMTS network consists of 25 UE and 6 BS's and 1 RNC and 1 UMTS Cn_east node. Cn_east is the combination of GGSN and SGSN.
Using this UMTS network, implementation of soft handover between 4 UE's is done. As well as see the 2D movement of mobile node. In Global statistics, ATM Throughput (bits/sec) parameter is checked. In Object statistics UMTS handover parameter for 4 mobile nodes are checked.

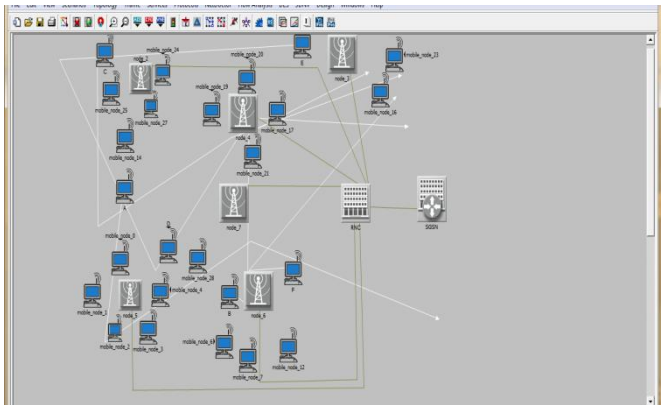

Fig. 3 UMTS network of Soft Handover

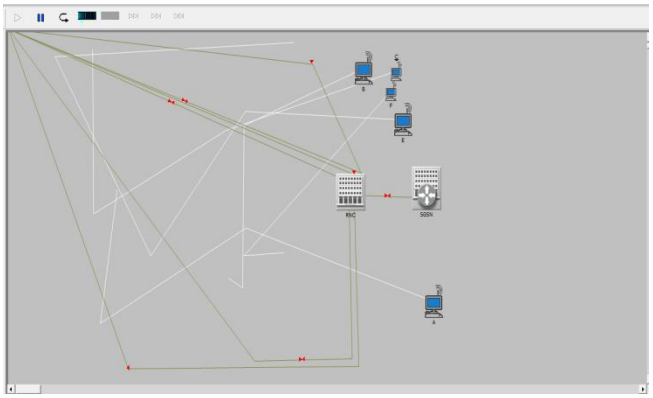

Fig. 4 Movements of UE

Total 4 UE's change their position after moving. In fig. 2 animated view is shown. After animation, 42354 total requests are processed.
UE E has the longest path to reach to destination. Due to longest path UE E is unable to maintain connection with Cn_east. To maintain a connection with cn_east, increase the time of "Timer 3350" After increasing timer value to 60 sec, Cn_east is able to maintain their connections with E UE.

The simulation parameters are shown in table below:

Parameter	*Value*
Transmission Range	10 km
Data Rate	11 mbps
Simulation Time	3 min 20 sec
Number of nodes	29
Node b	6
Traffic Type	Constant Bit Rate
Seed	128
Values Statistic	100
Update Interval	100
Simulation	500000 events Based on Kernel type preference
Trajectory Inf.	Random
Area of Movement	Within a logical network
Events	1,307,660
Speed	84,791(event/sec)
No. of runs	5
Host	Local Host
Port Offset	0
Timeout (sec)	3

- **Global Statistics:** Test out the UMTS parameter that includes GPRS attach delay and CBR delay(sec).

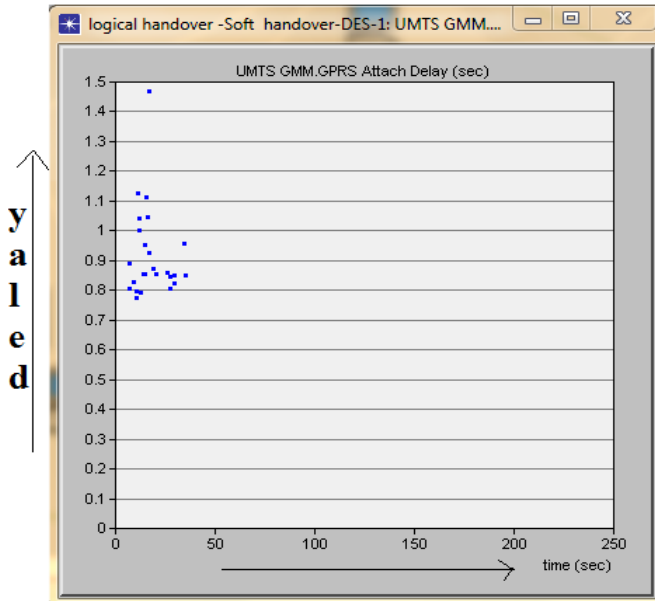

Fig. 5 UMTS GMM GPRS Attach Delay

Fig. 5 shows the global statistic for the delay experienced by the UEs and their SGSNs during UEs' GPRS attachment procedures. The delay is measured from the moment when the UE sends its first GPRS Attach Request message (it may be re-transmitted if needed) to the SGSN node until the moment when the SGSN receives the GRPS Attach Complete message from the UE, which indicates the end of the procedure. This statistics will have only a single value for each UE in the network if that UE could have completed its GPRS attachment during the simulation duration.

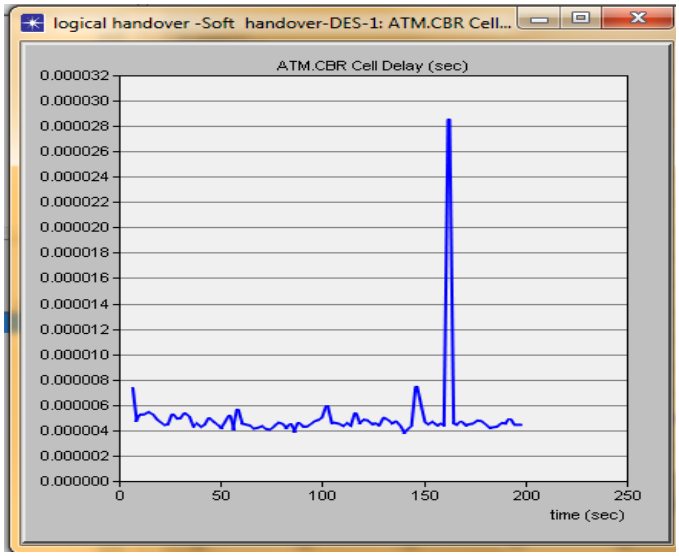

Fig. 6 CBR Call delay (sec)

Fig. 6 represents the Constant Bit Rate (CBR) cell delay (sec) in .It Represents the end to end delay for all the CBR category ATM cells in the network. Measured from the timean ATM cell is sent from the source ATM layer to the time it is received by the ATM layer in the destination node.

- **Object Statistics: -** In object statistics we check the comparison of UMTS handover parameters. In UMTS handover check the comparison of active cell set count, cell added to active set and cell removed from the active set.

- **Moving Average UMTS Parameter for comparison**

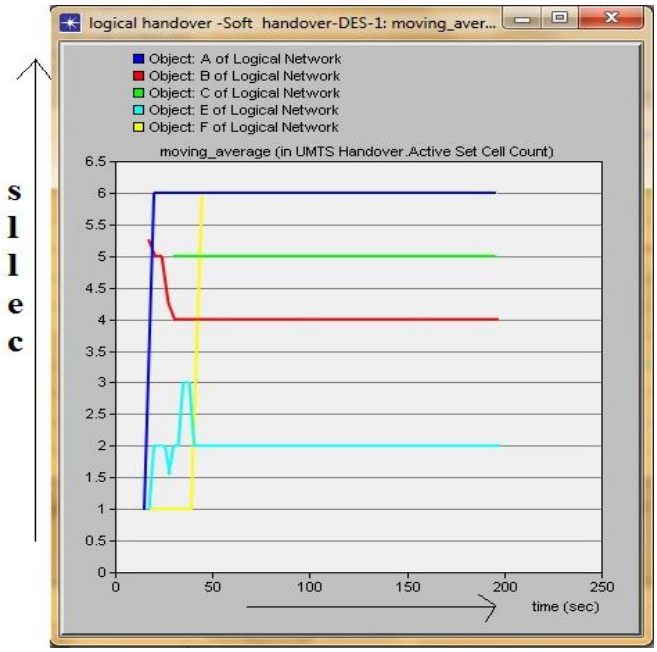

Fig 7 Comparison of UMTS Handover Active Set Cell Count between 5 UE

Fig. 7 shows number of the cells in the Active Set of the surrounding UE, which varies during soft handovers. The repeating statistic values indicate Active Set cell replacement events.

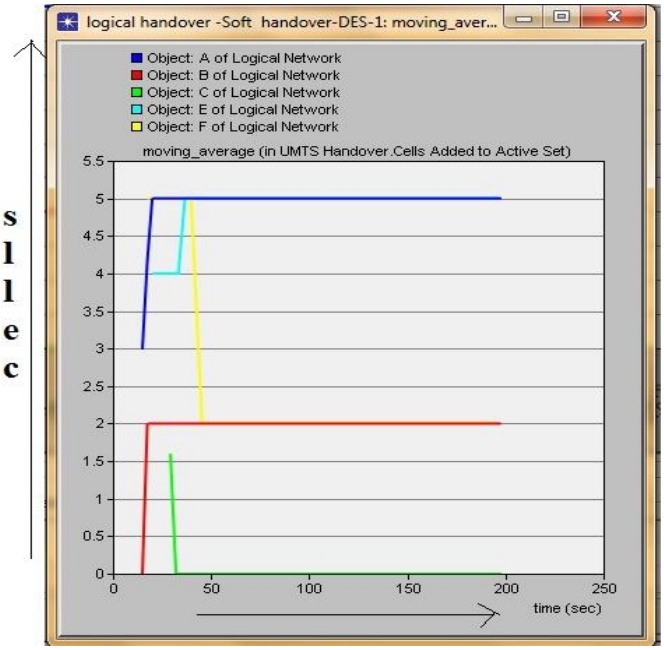

Fig 8 Comparison of Handover Cell Added To Active Set between 5 UE

Fig 8 shows the Cell IDs of the cells that are added to the Active Set of the surrounding UE throughout the simulation initially and during handovers

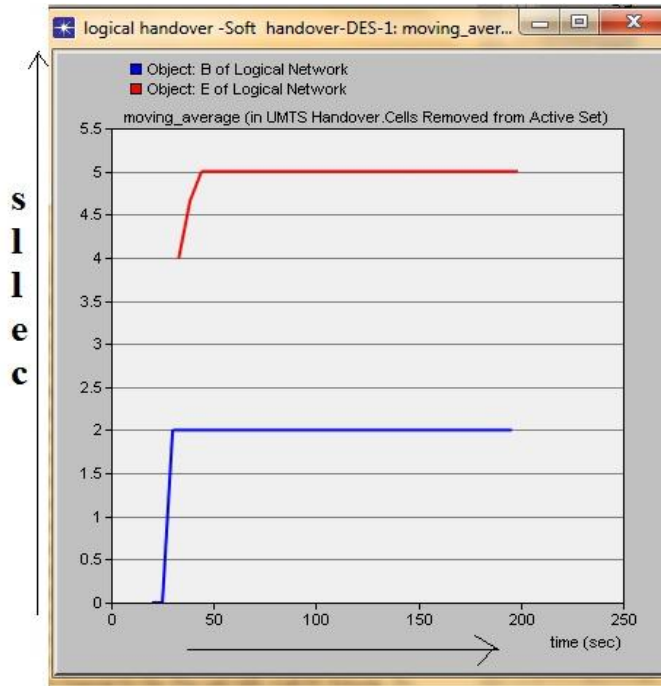

Fig 9 Comparison of UMTS Handover Cell Removed To Active Set between 5 UE

Fig. 9 shows the Cell IDs of the cells that are removed from the Active Set of the surrounding UE throughout the simulation during handovers. Due to very long path of UE "B" & "E", only cells are removed in it. There is no cells removed in other UE.

Global Statistics Packet Info:

- Module Centric Packet Information's

Table 2 Packet information

No. of Packets Created	*No. of Packets Copied*	*No. of Packets Destroyed*	*No. of hand-over*
21236	6363	345	F
19416	2345	567	E
34456	3456	456	C
36250	6545	234	B
13714	4567	345	A

Conclusion

The research paper is working to evaluate the performance of soft handover under predefined soft limits. The paper presented a few results for network. 5 user equipments are configured to perform handover task in network. The results show moving average of the UE during handover. After performing an animated view of network, 62354 total requests are processed by UMTS network. Zig-Zag movements of UE's are implemented using Fixed Interval. By increase the value of Timer 3350 UE's are enabling to maintain connection with Cn_East. Using this simulation tool virtually create a network and check the performance.

2. Future Work

Before implementing a large network, virtually check the performance of networks. By increasing the timer value we can achieve a better handover. By joining more than 2 cities build a network and check the performance as well as check the Qos. By increasing the density of the network QoS of the network can be increase !!

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