Analysis Of Umts Handoffs For FTP And Http Applications Based On Simulation In Opnet™ 14.5

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ABSTRACT: This research paper is based on simulation and analysis of QOS parameters for hard and soft handoffs. Performance of UMTS scenario is evaluated for various multimedia applications like FTP and HTTP. To accomplish the task of simulation OPNET™ 14.5 modulator used. From results, soft handoff is better than hard handoff because soft handoff support connections during mobility and handoff.

Keywords : UMTS; QoS; FTP; HTTP; OPNET™ 14.5

1 Introduction

The Universal Mobile Telecommunication Service (UMTS) is cellular technology which is known as 3G mobile communication. Today mobile wireless communication is mostly used by human, in mobile communication GSM and internet revolutionary growth lead to provide integrated services over mobile using wireless network. But GSM is limited to maximum data rates of less than 50 kbps and not support Video Telephony. To enhance data rates enhanced data rates for global evaluation (EDGE) technology added to GSM to support up to 472 kbps data rates, still unsuccessful for voice applications. To offer high data rates to support different multimedia services over mobile, standard have been proposed by 3GPP leading to creation of UMTS. To support multimedia services as conversational video, voice messaging, streamed audio and voice, fax, telnet, interactive games, web browsing, file transfer, paging and e-mailing etc and offer high data rates for these multimedia services over mobile, standard have been projected by 3GPP leading to creation of UMTS [13]. UMTS is superior to second generation in terms of bandwidth efficiency, quality of service, speech quality, speed and capacity. In addition providing changes in the network infrastructure, the UMTS specifications identify the evolution path from GSM circuit switched networks towards packet switched technologies offering higher transmission rates. Based on the service demand the UMTS Terrestrial Radio Access Network (UTRAN) has been planned. Mobile terminals allow users to access services while on the move. This unique feature has driven the rapid growth in the mobile network industry. A key condition in the bearer capabilities in UMTS is the handoff to support mobility over geographical region. Handoff is the important function to deal with the mobility of the mobile users [24].

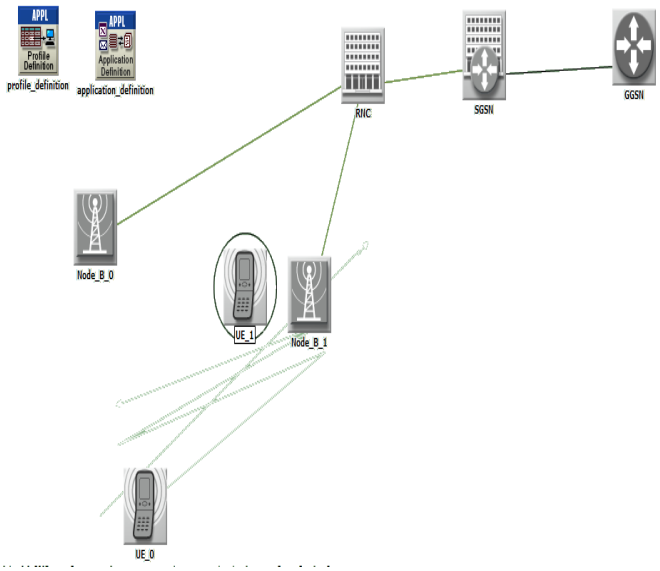

FIG. 1*. UMTS ARCHITECTURE*

2 UMTS ARCHITECTURE

UMTS architecture consists of three parts as shown in figure 1 called fixed infrastructure or core network of UMTS, UE (user equipment), and UMTS Terrestrial Radio Access Network (UTRAN) which is main part of UMTS architecture, it involves Radio Network Controller (RNC) and Node-B. Node-B performs radio resource management and RNC control air interface resource of UE and Node-B and handoff process. Core network consists packet switched and circuit switched connected to UTRAN. Where circuit switched elements of core network are visitor location register (VLR), mobile services switching center (MSC), and packet switched domain elements are serving GPRS support node (SGSN), gateway GPRS support node (GGSN). Core network interfaces to all other external cellular telecommunication networks including public phone network, and provide central processing for system.

3 HANDOFFS

Handoffs are used to gives ability of mobile services to a user roaming over geographical cell borders in a UMTS cellular infrastructure. During constant communication of user and passage of the cell boundary, so it is positive to use the radio resources in the next cell as the signal level received in the old

cell worsens as the user enters the target cell. The course of action of breaking the presented connection with the present cell and making a new connection with the suitable cell is called handoff [24]. In UMTS (3GPP) the handoff process consist two main functions that's are acquiring the resources, processing measurements and executing the handoff algorithm. In UMTS system different handoff types have been introduced to deal with necessities as throughput, delay for offering quality of services in UMTS cellular system. The ability of a cellular network to execute efficient handoffs is key to offer real-time applications or streaming media as intended in third generation networks. This chapter gives a brief introduction of UMTS architecture, handoff procedure and types of UMTS handoffs, QoS traffic classes and parameters.

3.1 Hard Handoff

This handoff called "break before make". During user movement from one cell to other first connection to existing Node-B is break and then new connection formed to new Node-B.

3.2 Hard Handoff

Soft handoff called "make before break". When user moves to other region UE first make connection to new Node-B and then break old connections to old Node-B. Here UE connected to both Node-B's (old and new) for a while in whole process. UMTS network uses mostly soft handoff for mobility management in network.

4 Quality Of Service In UMTS

UMTS is cellular telecommunication network which provide end-to-end service and guaranteed QOS to different UMTS QOS classes. QOS in UMTS is capability of UMTS network to provide satisfactory services which includes voice quality, high data rates for multimedia applications, etc. Third generation cellular network UMTS supports mobility of users which ranges from one cell to several. UMTS supports traffic with different bandwidth and QoS requirements. QoS refers to resource reservation control mechanisms rather than the achieved service quality. Different priorities are assigned to various applications, users, to assured a specified level of performance to a data flow in QoS. To support QoS, each network have to reserve capacity and agree with the application software in the network on traffic deal. Network services are end-to-end that is from one terminal equipment to other. QoS support in UMTS is based on the hierarchical structure, defined in 3GPP specification TS 23.107. End to end QoS is supported by three bearer services UMTS bearer service, Local bearer service and External bearer service detail explanation by authors [11]. A bearer service includes all aspects to enable the terms of QoS. Each bearer service on a specific layer offers various services using services provided by the layers [30].

5 UMTS QoS Classes

QoS classes in UMTS network are divided in four classes that are conversational, streaming, interactive, and background which are divided on the basis of delay. Conversational class includes real time conversations. This is very delay sensitive and includes telephony speech, VOIP, and video conferencing. Here transfer time must be low that is delay should be less as possible, streaming class includes the listening of real time video and audio. This is end-to-end delay sensitive, interactive class includes web browsing, server access[27][30]. It depends upon how much load sent and received at end user. Examples of interactive class are FTP, HTTP. And background class is very less delay sensitive, as it active only when email comes and not required fixed data rates for processing. Examples are SMS, EMAIL programs.

6 QoS Parameters

- Throughput- It is the rate at which packet go through network or average rate to deliver message over communication channel. It is measured in bits/sec or bytes/sec. For better QOS maximum rate preferred.
- Delay- It depends upon time takes by packet to travel from one node to other node. Due to queuing and different routing paths, packet may take a longer time to reach destination. It measured as average end-to-end delay. Delay should be low for good QOS.
- Jitter- When packets reached at destination with different delays it cause jitter in message. Packet delay's varies with their positions in queues of routers along the path from source to destination.
- Reliability- Availability of connections support good QOS in UMTS network. Uplink transmission power- Power used by UE to transmit packets over physical channels during handoffs.
- Uplink reception power- Reception power (gain) of packets sends by UE.
- Object response time- Specifies response time for each inlined object from Hyper Text Markup Language (HTML) page.
- Page response time- Specifies time required to retrieve the entire page with all inline objects.
- Average End-to-End Delay- Time taken for a packet to be transmitted across network from source to destination. It includes transmission delay, propagation delay and processing delay.
- Mean opinion score (MOS)- It measures the quality of voice.

7 Related Work

For the implementation of scenarios of UMTS network, OPNET^{TM} 14.5 modeller used. Different entities that are used in scenarios taken from object palette of modeller. After configuring the network according to requirements and setting attributes, results can be simulated easily. Figure 2 shows the scenario of UMTS network with FTP traffic, to evaluate QoS metrics as traffic received, FTP upload time, uplink transmission power etc for hard handoff and soft handoff separately. Attributes are set for FTP having high load for both hard and soft handoffs. Scenario of FTP application comprises FTP server for generating FTP traffic and supporting respective application with specification of high load. User UE_0 is mobile node with FTP user request as client for application traffic. During covering trajectory path user UE_0 which initially connected to BS Node_B_0 request handoff with BS Node_B_1. QOS parameters of FTP are analyzed during handoff procedure for both soft and hand handoffs.

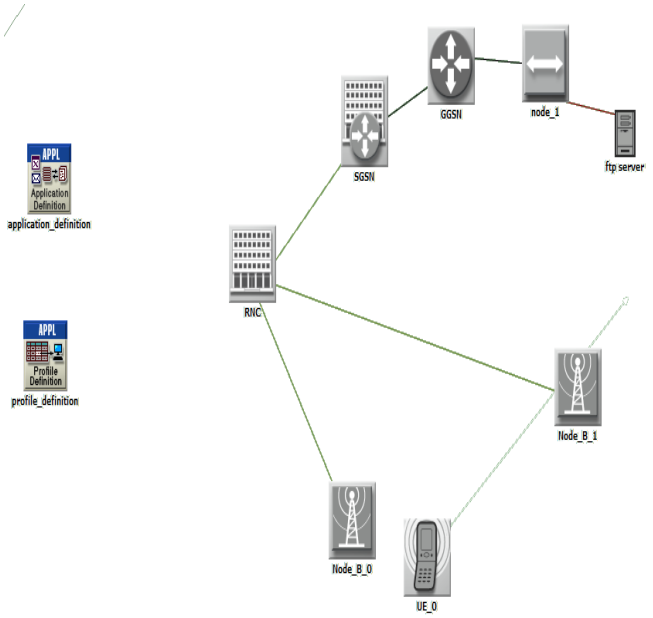

FIG. 2. *UMTS SCENARIO FOR FTP APPLICATION*

Scenario of figure 3 HTTP application scenario has two UEs, two node_b's (BS) connected to core network through RNC, and application server to generate HTTP traffic HTTP server connected to core network of UMTS system which support HTTP 1.1 heavy load traffic application. Both users UE1 and UE2 are HTTP users, request for application traffic. Initially user UE1 and user UE2 are connected to BS node_0 and BS node_B respectively. Trajectory defined for user UE1, to follow trajectory handoff request send by user UE1 to RNC through BS node_0, RNC support both hard and soft handoff which is carried out for this scenario to evaluate QOS metrics of HTTP application during soft handoff and hard handoff.

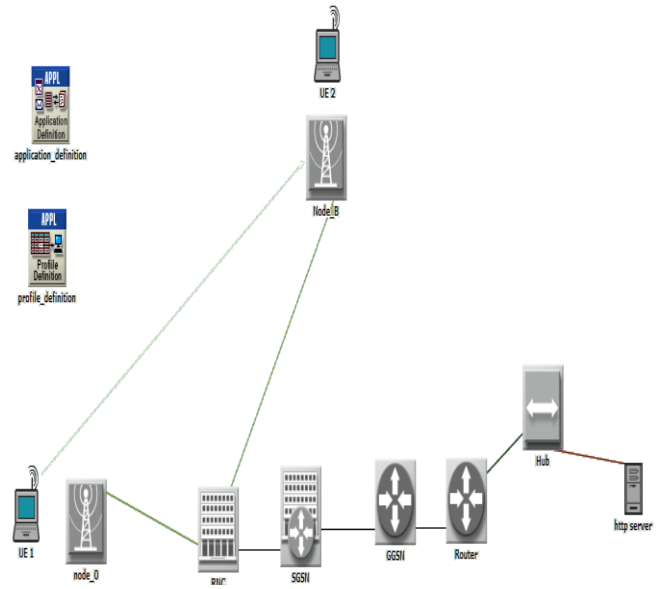

FIG. 3. UMTS SCENARIO FOR HTTP APPLICATION

8 SIMULATION RESULTS

The various results of analysis of FTP and HTTP applications are presented below.

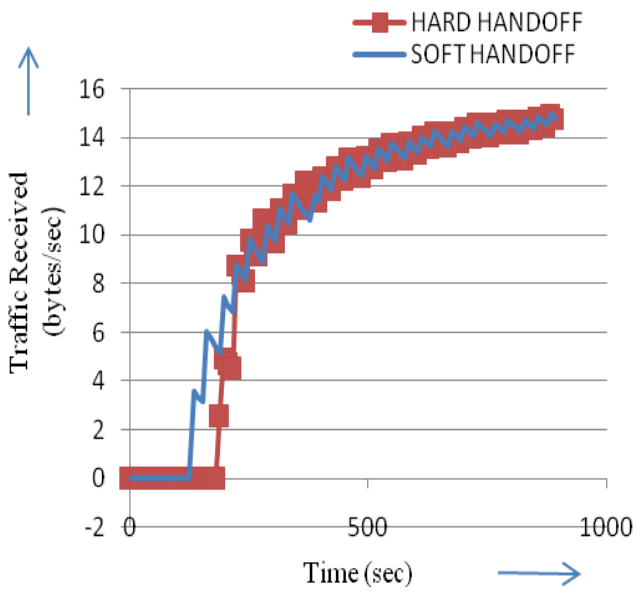

FIG. 4. *FTP TRAFFIC RECEIVED AT CLIENT (BYTES/SEC)*

Figure 4 shows FTP traffic received at client, this statistic shows the average bytes per second forwarded to the FTP application by the transport layer in this node. The simulated result shows traffic received at FTP client for both hard and soft handoffs. During hard handoff first bytes of traffic received at time 189 sec and during soft handoff it received at 135 sec. During soft handoff traffic received earlier than hard handoff.

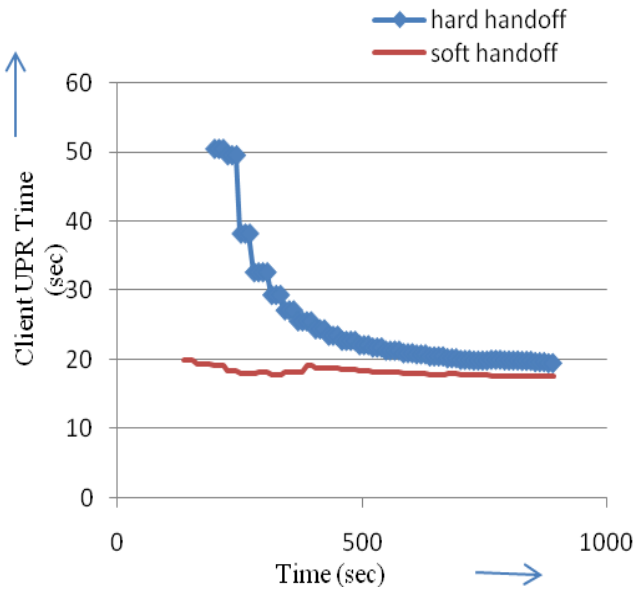

FIG. 5*. FTP UPLOAD RESPONSE TIME AT CLIENT (SEC)*

Figure 5 shows FTP upload response time at client, it is time elapsed between sending a file and receiving the response packet for the FTP application at client. It is measured from the

time a client sends a file to the server to the time it receives an acknowledgment. The upload response (UPR) time at FTP client, during hard handoff FTP URP time is initially 50 sec starts at time 216 sec. at time 225 sec URP time falls sharply to 38 sec and decreases gradually to 20 sec. For soft handoff starting UPR time is 20 sec at 135 sec which decreases up to 378 sec to 18 sec and with small increase it decreases frequently to 17 sec as shown in figure. So for soft handoff URP time to upload FTP is less than hard handoff.

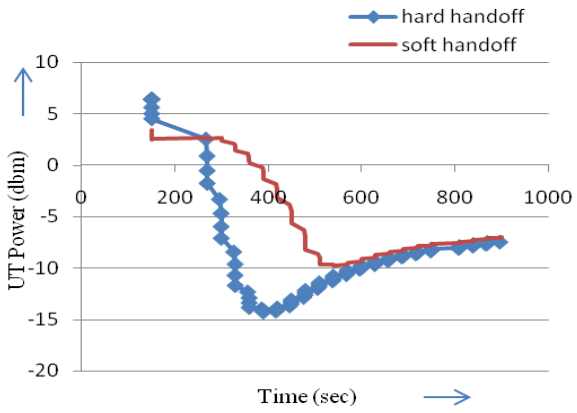

***FIG. 6**. FTP UPLINK TRANSMISSION POWER (DBM)*

Figure 6 shows FTP uplink transmission power represents the transmission power used by the UE while transmitting uplink packets over the physical channels. The uplink transmission (UT) power for hard handoff initially at 151 sec is 6.3dbm which falls sharply to 4.9dbm and steadily decreases to 2.7dbm at 267 sec from where it falls again to -1.7dbm and gradually decreases to lowest UT power value -13.9dbm at 386 sec then increase regularly to -7.0dbm. For soft handoff UE starts with 3.4dbm UT power which fall to 2.9dbm and stay constant up to 267 sec and falls step by step to lowest value -9.2dbm at 510 sec then increases steadily to -7.03dbm. FTP traffic user during soft handoff starts with less UT power then hard handoff but at time 267 sec there is huge difference occur for required transmission for UE to sent FTP packets to node_b for hard and soft handoff up to time 568 sec more UT power required by UE during soft handoff as compared to hard handoff. Required transmission power is zero for hard handoff user at 270 sec as for soft handoff user it become zero at 386 sec.

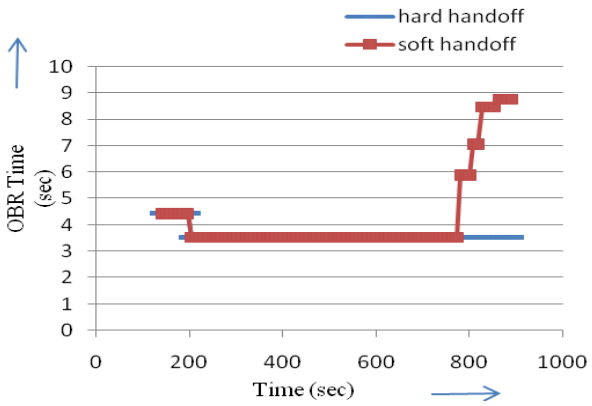

***FIG. 7.** HTTP OBJECT RESPONSE TIME (SEC)*

Figure 7 shows HTTP object response time, it is statistic which specifies response time for each in lined object from the HTML page. Figure specifies the response time for each inline objects from HTML pages. As shown in fig during both soft and hard handoff objects start responding at time 144 sec with OBR time 4.4 sec which stay constant up to time 200 sec and decreases to OBR time 3.2 sec and constant for hard handoff. But for soft handoff at time 783 sec there is instant increase in OBR time to 6 sec which increases step by step to 8.74 sec. there is 5 sec improvement in soft handoff as more inline object response than hard handoff. Figure 8 shows page response time, it Specifies time required to retrieve the entire page with all the contained inline objects. Figure 4.16 reveals that more number of pages response during soft handoff than hard handoff. From figure at time 216

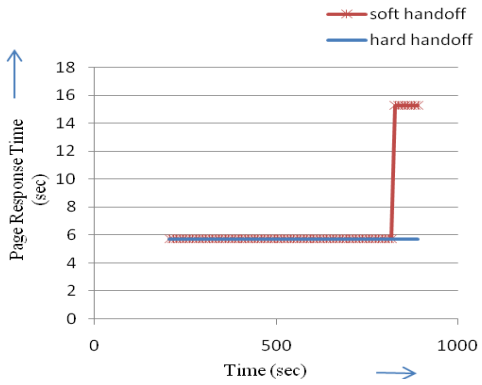

***FIG. 8.**HTTP PAGE RESPONSE TIME (SEC)*

sec approximately 6 pages respond for both hard and soft handoffs and constant respond up to time 855 sec for hard handoff but during soft handoff from time 783 sec sharply increase in number of responded pages from 6 to 15, which shows 9 pages improvement with soft handoff as compared to hard handoff.

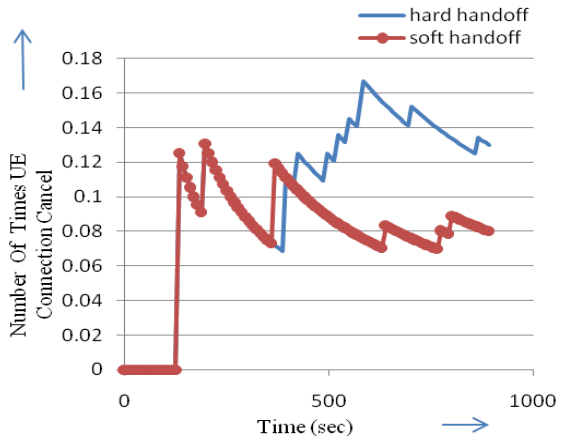

***FIG. 9.**NUMBER OF TIMES UE CONNECTION CANCELLATION FOR HTTP*

Figure 9 shows number of times HTTP user UE tries or request to set up connection during hard handoff and soft handoff. As figure 4.18 shows at time 135 sec HTTP UE tries to set up connection with 0.12 times during both handoffs and that fall step by step to 0.07 times at 360 sec during soft handoff and 0.06 times for hard handoff at 369 sec. For hard han-

doff it increases to highest 0.16 times and fall step by step to 0.13 sec. during soft handoff it decreases throughout the process to 0.08 times. It is observed that less no. of times client have to try 0.03 times less for connection during soft handoff than hard handoff.

9 Conclusion

UMTS hard handoff support less uplink transmission power for transmitting FTP packets by UE to node_b. During soft handoff files responding in less time than hard handoff. Improvement of approximate 19 sec during soft handoff for FTP files to respond. For HTTP application large no. of pages are downloaded with more inline object response and also user connection cancellation times are less in case of soft handoff. Overall improvement of approximate 9 more downloaded pages of HTTP during soft handoff and 0.03 times less tries for connection by user during soft handoff.

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