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Research Papers

UMTS (ANALYSIS OF HANDOVERS IN 3G UMTS CONVERSATIONAL & INTERACTIVE TRAFFIC CLASSES)

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Abstract

The thesis work is about the investigation of different handovers in the 3G UMTS network which is the vital issue to the network to maintain the user's connection during in the ongoing session with the user's movement. The investigation is based on the UMTS QoS traffic classes. For this purpose the soft and the hard handovers techniques are analyzed in different scenarios implemented in the OPNET Modeler. To know and understand about the handover process between the Node B and the user equipment different statistics are calculated.

KEYWORDS:

component;UMTS,OPNET,SHO,HHO.

I.INTRODUCTION

For the implementation of our different scenarios we have used the OPNET Modeler 14.5. Users can easily use this tool by simply selecting the different technologies from start up wizard and dragging of different devices like RNC, Node B, etc, interconnecting them with the desired links.

Handover with the UMTS Different Traffic class

The general architecture of UMTS is implemented in OPNET by using different nodes from the object palette as shown in Figure 1. IP cloud was used between the servers and the core network to show that a network is involved. IP links were used to connect IP cloud to both the servers and the core network or GGSN node. These nodes were placed in a fashion so that the architecture can be clearly understood. All these nodes were connected using different connection links from the object Palette.

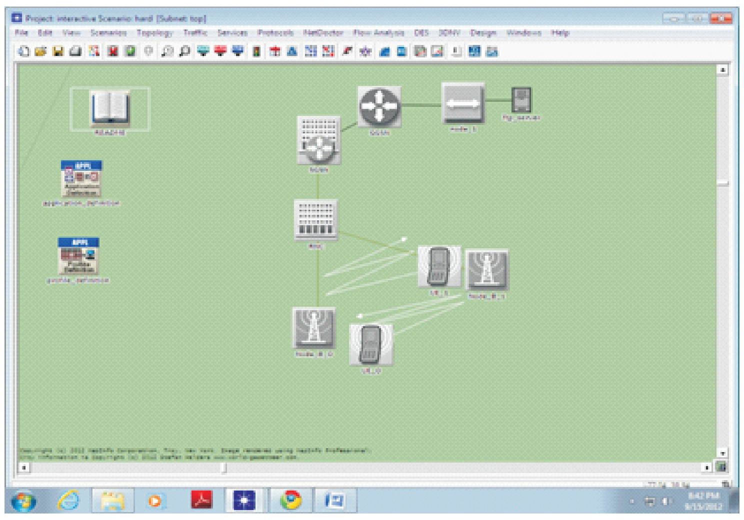

Figure 1 General UMTS architecture

After the architecture was completed, the required attributes were set for each node. Applications were defined in the application definition node and were assigned to the respective QoS of UMTS. The profiles were created in the profile configuration node to be used by the users. By using the Cell Creator utility, a grid of cells can be drawn in the Project Editor. The Cell Creator utility takes an existing map and superimposes on it a grid structure with the parameters specified. It then creates a new map that can be used in network topology. Figure 1 shows the cells created on the map.

Trajectory for the user equipment was defined based on simulation time. A trajectory is a path specification for a mobile site's motion during a simulation. In Modeler, a trajectory can be defined as either segment based or vector- based. The trajectory used is segment-based as shown in Figure 1.In order to analyze different results, global and node statistics were selected. A single scenario completed in all aspects was than duplicated and attributes were set for both the scenarios. Now there were two scenarios one for HARD HANDOVER and other for SOFT HANDOVER. Then the Simulation was completed for different seed values and results were examined.

SIMULATION RESULTS

A number of different statistics are simulated for both soft and hard handover and resulting graphs of this simulation are analyzed on the basis of QoS classes that which handover provides better services for these QoS classes. The results concluded can be very much helpful for the network operators to provide better QoS to the end users. These analyzed results and conclusions will improve the quality of services in the next generations of mobile networks

ANALYSIS OF HANDOVER

Three different statistics are observed to check whether the handover is being performed by the network or not.

Active Cell Count

This statistic reports the number of the cells in the Active Set of the surrounding user equipment (UE), which varies during soft handovers.

Initially UE is attached only to a single Node-B. Therefore the statistic starts with an initial value of 1 for the upper and lower part of the Figure 2. As during hard handover a cell replacement operation happens, the UE is attached to only a single Node-B at a time, it breaks the connection from one cell and then establishes with the other, which does not actually change the count of the cells in the set, the statistic is recorded. The repeating statistic values i.e.1, in Figure1 indicates Active Set cell replacement events, which shows that hard handover is performed.

The lower part of the Figure 1 shows the soft handover. Whenever an addition or removal takes place to/from the Active Set, the new count of the cells is recorded. The new count of the cells shows that a UE is attached to more than one Node-B at a time as it happens in the soft handover procedure. As the handover in this scenario is performed between the two cells of two different Node-B is as shown in Figure 6.1, so before handover UE gets connected with both the cells and the cell count value becomes 2 and after the good signal strength is received from the target cell the connection with previous cell is terminated which means UE is again connected to the one cell and the cell count value becomes 1 again as shown in the Figure 2

Figure 2 Active set Cell Count

Cells added to active set

This statistic reports the Cell IDs of the cells that are added to the Active Set of the surrounding UE throughout the simulation initially and during handovers. Each cell ID information is recorded at the simulation time when the addition takes place. This statistic is collected only for the UEs whose node type is mobile. As only two cells are involved in the handover procedures with the ID's 0 and 1 as shown in Figure1, Figure3 shows the ID's of the cells added to the active set (either 0 or 1) during the simulation time.

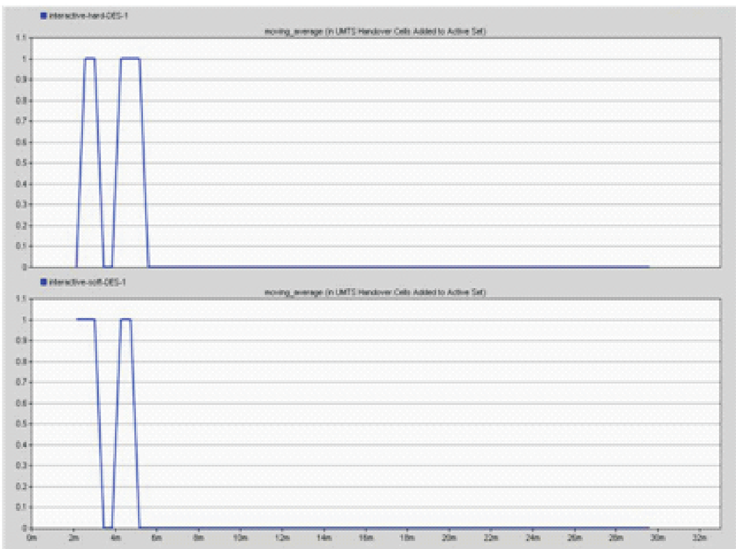

Figure 3 Cells added to active set

Analysis of Conversational Class (QoS 0)

The End to End Delay and voice traffic flow statistics for conversational class are simulated using both soft and hard handover schemes. Figure 4 shows that there is less end to end delay for QoS 0 in soft handover compared to the hard handover. This delay is due to a fact that in hard handover there is a loss of information because connection of UE is first terminated from the previous cell and then it gets connected with the new or target cell. While in soft handover the user first gets connected to the target cell and then terminates the previous connection.

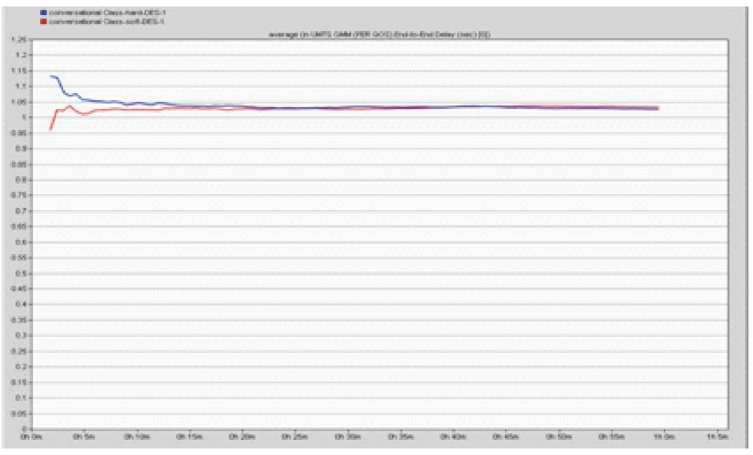

Figure 4 End to End Delay

Voice Application

A number of different statistics of voice application for QoS 0 are analyzed to make some conclusions.

Packet End-To-End Delay (sec)

The total voice packet network delay is the time at which the sender node gave the packet to real time transport protocol (RTP) to the time the receiver got it from RTP. Figure 5 shows that in hard handover there is more delay in packets as compared to soft handover. This is because in hard handover loss of session occurs while in soft handover the session is continued and not terminated.

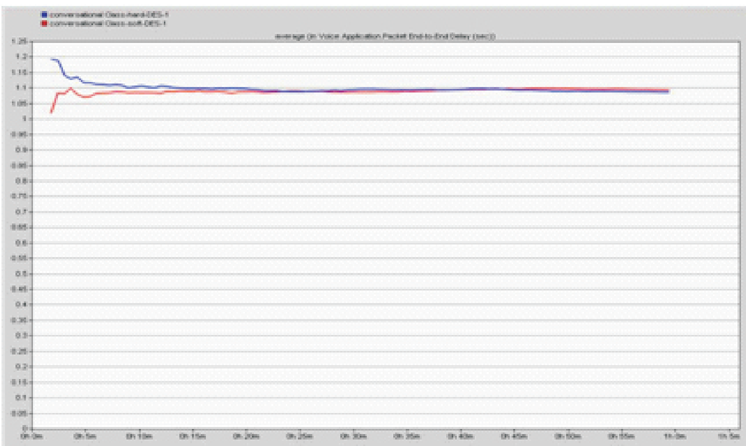

Figure 5 Packet End to End Delay

Traffic Sent (packets /sec)

This statistic reports Average number of packets per second submitted to the transport layer by the voice application. Figure 6 shows that there are same numbers of packets sent in both soft and hard handover because all the resources used and the environmental conditions are same for both the scenarios.

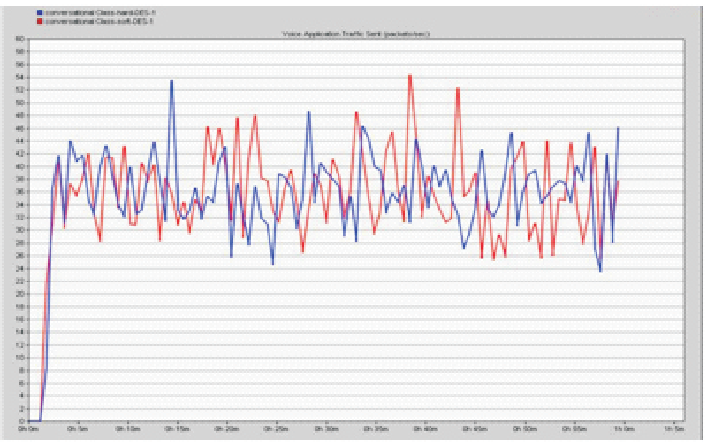

Figure 6 Traffic Sent (packet/sec)

Traffic Received (packets /sec)

This statistic report average number of packets per second forwarded to the voice application by the transport layer. Figure 7 shows that traffic received in soft handover is greater than in hard handover because there is no session loss in soft handover and there is no loss of information.

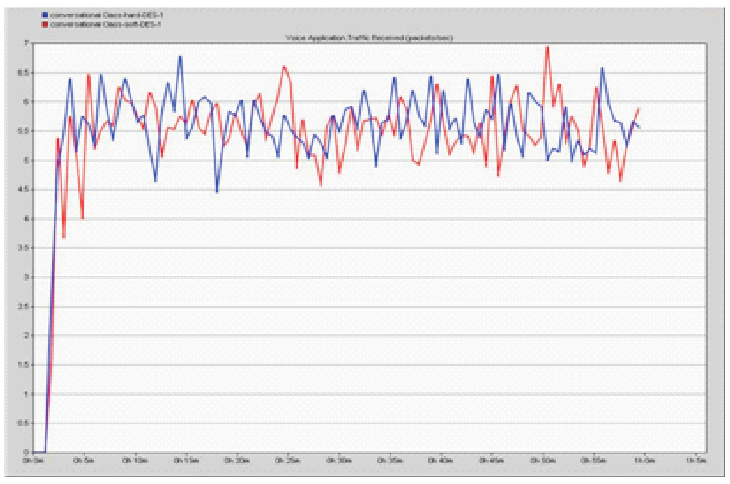

Figure7 Traffic Received (packet/sec)

Conclusion for QoS 0

The QoS 0 also called conversational class has the characteristic of tolerating less delay i.e. it is very much delay sensitive. From the above discussion it is clear that the end to end delay of QoS0 is more in hard handover as compared to the soft handover. Similarly the packet end to end delay is also more in hard handover. The traffic sent is almost the same in both hard and soft handover but more traffic is received in soft handover than in hard handover. So it is concluded that the soft handover which has less delay than hard handover, is suitable for the conversational class.

Analysis Of Interactive Class (QoS 2)

The end to end delay and the application (Email) traffic flows for Interactive class are simulated using both soft and hard handover schemes. Figure 8 shows that there is less end to end delay for QoS 2 in hard handover than in soft handover because in hard handover there is a connectivity with one Node-B and there is more delay in soft handover because it takes time for the selection of Node-B.

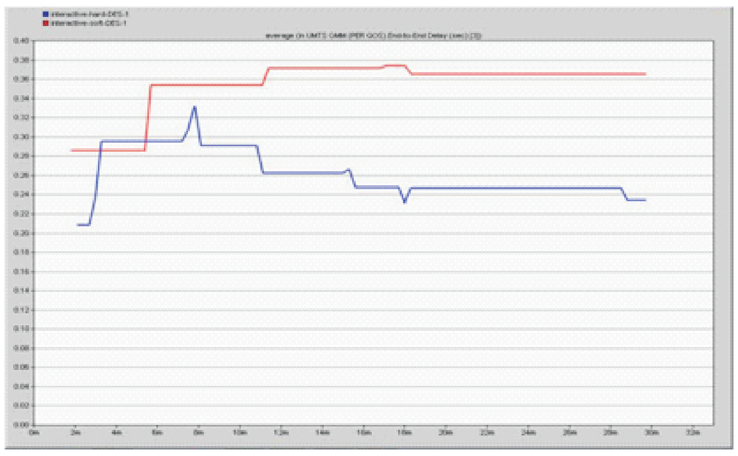

Figure 8 End to End Delay

Client Email

A number of different statistics of Client Email application for QoS 2 are analyzed to make some conclusions

Download Response Time (sec)

It is the time elapsed between sending request for emails and receiving emails from email server in this node. Figure 9 shows that the download response time is less in hard handover than in soft handover The download response time is more in soft handover because UE receives data simultaneously from two node-B and while making decision it takes time in downloading.

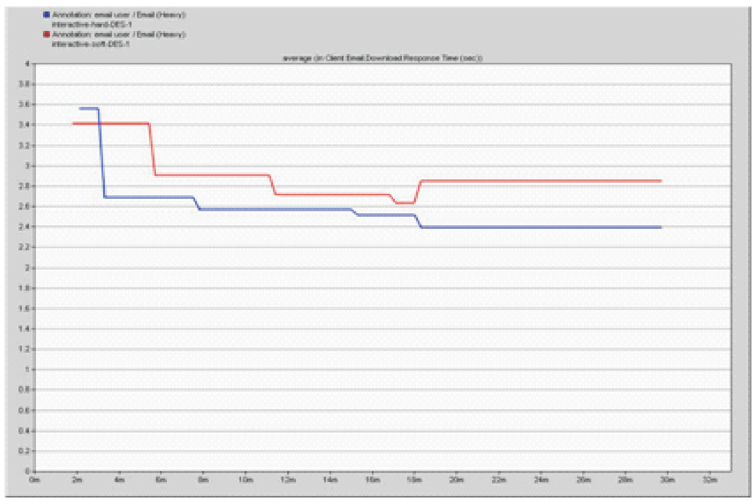

Figure 9 Client email download response time

Traffic Sent (packets/sec)

Figure10 shows that more traffic is sent in hard handover with less response time as compared to the soft handover. As this QoS is less sensitive to delay so the delay of hard handover does not affect the transmission and more data is sent with hard handover.

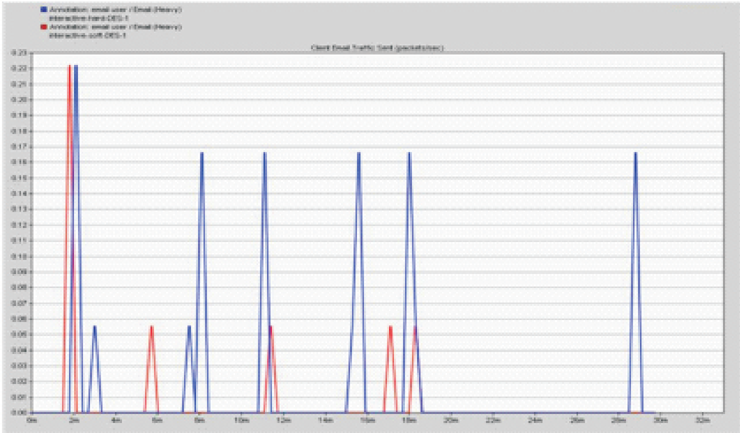

Figure 10 Traffic sent (packet/sec)

Traffic Received (packets/sec)

Figure 11 shows that more traffic is received in hard handover with less response time as compared to the soft handover. As this QoS is less sensitive to delay so the delay of hard handover does not affect the reception and more data is received with hard handover.

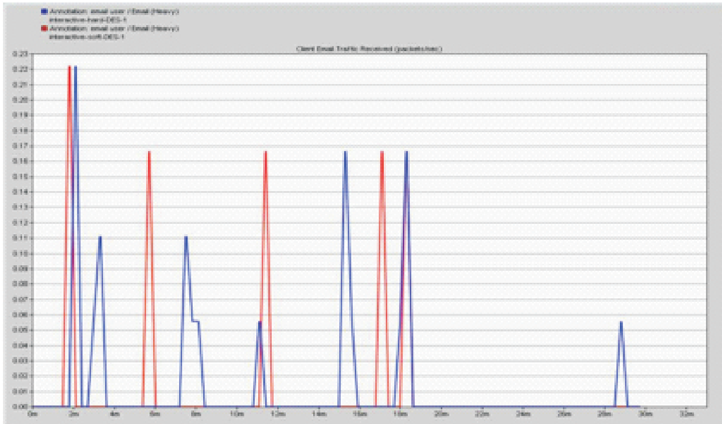

Figure 11 Traffic Received (packets/sec)

Upload Response Time (sec)

Time elapsed between sending emails to the email server and receiving acknowledgements from the email server. Figure 12 shows that upload response time is less for hard handover than in soft handover The upload response time is more in soft due the reason that UE sends data simultaneously to the two node-B's and while doing this it takes time in uploading.

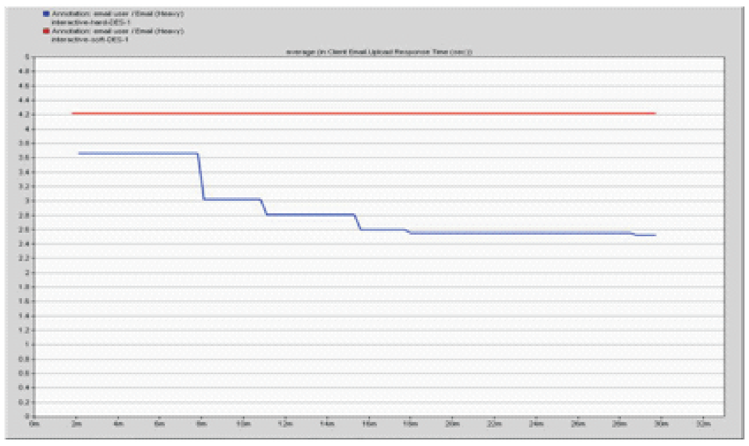

Figure 12 Upload Response Time (sec)

Conclusion for QoS 2

The QoS 2 also called interactive class has the characteristic that it is delay in sensitive. The data integrity is important in this class so UE using the QoS 2 applications cannot afford data loss in the transmission and reception. From the above results it is clear that the end to end delay of QoS 2 is more in soft handover as compared to the hard handover. Similarly the download and upload responses in the hard handover are also less than in soft handover. From the traffic sent and received Figures it becomes clear that while performing hard handover the UE receives more traffic than in soft handover. In soft handover the user equipment while taking the decision of connectivity with either of the two Node-B's loses packets and the response time also increases due to the refreshing of the page. So it can be concluded that the hard handover which has less delay and less uploading and downloading response time for more data transfer is suitable for the interactive class.

Performance Analysis of Soft & Hard Handover

Two different scenarios were implemented for the two types of the UMTS handovers i.e. soft handover and hard handover.

Performance of Soft Handover

In the scenario of Soft Handover, the user equipment communicates in parallel with different Node-B's. So the cell is added and removed in such a way that the UE and the UTRAN always remain connected. This handover is also called as [3]make before break. It is because the connection is made first to the other Node-B and releases the older connection after making the connection to the target Node-B. This type of handover provides better services for the real time and the downloading services. As it is clear from the analysis that the two QoS classes i.e. the conversational class provide better services during soft handover as compared to hard handover.

Performance of Hard Handover

In the scenario of Hard Handover, the user equipment communicates with different Node-B's but not simultaneously. So the cell is added and removed in such away that the UE and the UTRAN do not always remain connected. Thus the source connection is broken first and then the target connection is made, so this type of handover is also called as break before make. This type of handover provides better services for the interactive online remote access services and the streaming services. As it is clear from the analysis that the two QoS classes i.e the interactive class provide better services during hard handover as compared to soft handover

CONCLUSIONS

This thesis work gives the concept of handovers in 3G universal mobile telecommunications systems. Different scenarios were implemented in OPNET and the results were discussed in detail. This research work gives an impression of the main factors which are being affected by the soft and the hard handovers techniques in terms of the UMTS QoS classes. To understand about the handover process between the Node B and the user equipment, different statistics were calculated. On these measurements it was observed that how different types of the traffic are affected. This was analyzed in terms of the upload and download responses, end-to-end delay and the packet delay variations, by different types of handover. The results were concluded on the basis of QoS classes that for which class which handover is suitable. These conclusions can be implemented in the real networks for the provision of better services. The conclusions will be helpful in future to implement the handovers according to the applications or the quality of services the user is using.

REFERENCES

1.Vijaya Chandran Ramasami "Advanced Mobile Phone Service – An Overview" http://www.ittc.ukans.edu/~rvc/documents/865/865_amps.pdf

2.Aruna Uppendra Jayasuriya "Improved Handover Performance Through Mobility Predictions", University of South Australia, 31 August 2001

3. Juan Ventura Agustina, Peng Zhang, Raimo Kantola "Performance evaluation of GSM handover trafficGPRS/GSM network" http://keskus.hut.fi/tutkimus/ironet/3g/handover.doc

4. 3rd Generation Partnership Project, Technical Specification Group RAN, Working Group 2 (TSG RAN WG2), "General UMTS Architecture", 3G 23.101 v3.0.1, April 1999

5. Jussi Laukkanen "UMTS Quality of servive concept and Architecture", University of Helsinki, 4-5-2000

6. http://www.iec.org/ IEC online tutorials, UMTS

7. Riku Jäntti "Lecture material WCDMA course", University of Vaasa, Finland, spring 2003. http://www.uwasa.fi/~riku/opetus/wcdma.htm

8. Peter Chong "WCDMA physical layer" – lecture slides Wideband CDMA systems, Helsinki University of Technology

9. 3rd Generation Partnership Project, Technical Specification Group RAN, Working Group 2 (TSG RAN WG2), "Radio Resource Management Strategies", 3G TR 25.922, V2.0.0, December 1999

10. Harri Holma, "Physical Layer Performance" – lecture slides Wideband CDMA systems, Helsinki University of Technology 47

11. 3rd Generation Partnership Project, Technical Specification Group RAN, Working Group 2 (TSG RAN WG2), "Radio Resource Control (RRC) protocol specification", 3G TR 25.331, V3.14.0, Release 99, March 2003
http://www.umtsworld.com/technology/RCC_states.htm

12.M C Chauh, Q Zhang, Design and performance of 3G wireless Networks and Wireless Lans , Chapter 6, Springer, 2006.

13.JP Castro, The UMTS Network and radio Access Technology, chapter 6, John Wiley andSons, 2001.

14. B Walke, P Seidenberg, MP Althoff, UMTS the fundamentals, John Wiley and Sons, 2003.

15. P. Nicopolitidis, M. S. Obaidat, G. I. Papadimitriou and A. S. Pomportsis, Wireless Networks, Chapter 5, John Wiley and Sons, 2003.

16. Holma, H., Toskala, A, WCDMA for UMTS: Radio Access for Third Generation Mobile Communications. John Wiley and Sons, 2004.

17. B Walke, P Seidenberg, MP Althoff, UMTS the fundamentals, John Wiley and Sons, 2003

18. Sumit Kasera & Nishit Narang, "3G Networks Architecture, Protocols and Procedures (Based on 3GPP Specifications for UMTS WCDMA Network)",

19. J. Laukkanen "UMTS Quality of service concept and Architecture", University of Helsinki, 4-5-2000

20.4th Generation [Online]. Available: http://burgami.com /4g

21.M C Chauh, Q Zhang, Design and performance of 3G wireless Networks and Wireless Lans , Chapter 6, Springer, 2006.

22. JP Castro, The UMTS Network and radio Access Technology, chapter 6, John Wiley and Sons, 2001.

23.Yi-Bing Lin and Imrich Chlamtac," Wireless and mobile Network Architectures", Wiley and Sons,
http://www.opnet.com/support/des_model_library/umts.html