International Journal of Advanced Engineering Technology E-ISSN 0976-3945

Research Article

PACKET SWITCH TRAFFIC ANALYSIS IN 3G (W-CDMA) SYSTEM

Parvesh Rani [1], Kiran Ahuja[2]

Address for Correspondence

[1]M.Tech student Punjab Technical University Regional Campus DAVIET, Jalandhar

[2] Lecturer ECE Dept, DAVIET, Jalandhar

ABSTRACT

Third Generation (3G) mobile devices and services will transform wireless communications into on-line, real-time connectivity. 3G wireless technology will allow an individual to have immediate access to location-specific services that offer information on demand. 3G wireless systems such as 3G-1X, 1xEV-DO and 1xEV-DV provide support for a variety of high-speed data applications. The success of these services critically relies on the capability to ensure an adequate QoS experience to users at an affordable price. The traffic being transferred within 3G mobile networks will be composed by different information flows with various constraints on the required QoS (bit rate, delays, etc.). In this paper, we give an evaluation of the performance of 3G networks when providing access to voice and data services. In particular, we analyze through simulations a typical scenario where voice and data services affect the packet traffic in 3G system approach.

KEYWORDS- QoS, WCDMA, UMTS, Packet Traffic.

I. INTRODUCTION

The Universal Mobile Telecommunication System (UMTS) standardization bodies have designed a radio interface highly flexible able to provide different bearer services with different bit rates and different transfer modes for example, circuit switched and packet switched transfer modes are available. Within each transfer mode different quality of service can be achieved by suitably setting physical layer parameters such as the spreading factors (SF) of the physical channels, the rate of the FEC (Forward Error Correction) code used to protect information bits, and the ARQ (Automatic Repeat request) scheme. The W-CDMA (Wide Band Code Division Multiple Access) scheme of UMTS adopts a chip rate of 3, 84 MChip/s. The traffic being transferred within 3G mobile networks will be composed by different information flows with various constraints on the required QoS (bit rate, delays, etc.) [1].

Traffic monitoring and analysis is now an important topic of research. The ability to identify what to measure and how to interpret the results, i.e., to "read the traffic", particularly within the perspective of network validation and troubleshooting, must rely on extensive and deep knowledge of the traffic environment in the real network [2]. Traffic estimation or modeling is based on theoretical estimates or assumptions, and on studies of existing networks (i.e. experience). Traffic in the network is dependent on the user communication rate and user movement in the network. With the deployment of 3G, a novel packet-switched (PS) domain has been added to the legacy circuit-switched (CS) domain, and some legacy circuit-switched monitoring systems were extended to cope with the packet-switched domain. Furthermore, the packet-switched section supports a completely different usage environment (user populations, terminal types, applications, services, etc.) that is infinitely more heterogeneous and complex than the CS telephony. [3]. The radio network optimization process distributes the network resources in a way that allows maximizing their usage. These resources are the physical location of the base stations, their traffic capacity, assigned frequencies and, particularly in 3G, some physical parameters like their bearing, tilt or pilot power level etc. The process of the radio network optimization can be improved if the optimization engineer is fully aware of the spatial distribution of the traffic demand in the service area [4]. Many cellular network providers offer wireless Internet data services to their subscribers. These services include electronic mail, Web browsing, text messaging, camera phones, gaming, and more. Emerging services include low bandwidth wireless video streaming, home security monitoring, and peer-to-peer file sharing. The network traces record low-level information about the packet data call events occurring between the mobile stations (i.e., cell phones), the base station (i.e., cell site), and the base station controller. The events indicate mobile station identifiers, as well as the start time, end time, cell site, sector id, and carrier frequency used for each packet data call. Within each packet data call, the trace also records information about fundamental channel and supplementary channel usage, including the data rate and duration for each supplementary channel data burst in the forward and reverse directions [5]. The traffic being transferred within 3G mobile networks depends upon the different constrains that to be discussed in this paper. The rest of this paper is organized as follows. Review of related works in traffic analysis, especially in 3G (WCDMA) system presented in Section II. In section III system under consideration described and results are discussed in Section IV. Finally, we conclude our paper in the last section.

II. Related Work

The data services in a third generation mobile telecommunication networks characterize the mix of several traffic types for capacity and quality of service (QoS) planning. The analysis of QoS parameters of a mobile network, such as channel occupation time, handoff, new call blocking probabilities and traffic in Erlangs were described in [6]. The WCDMA based 3G cellular standards have a great flexibility and a variety of logical and transport channels defined for different types of traffic classes, In [7] the performance of the dedicated channel for WWW traffic was investigated. Performance of the UMTS MAC on dedicated channel for web traffic had been studied through simulation models in terms of throughput, transfer delay, collision probability. In [8] the performance of three video traffic models in predicting the number of data packets that were scheduled at the next time slot was discussed. An access control protocol was proposed for an integrated voice, video and non real-time data traffic on the forward link (cell-site to mobile). The QoS of voice for mobile users in the mixed traffic environment was estimated in [9]. The results were compared with the performance obtained by deploying a scheduling scheme based on weight. The scheme was simulated with different number of users. The results showed that the scheme improved the system capacity while maintaining the acceptable end-to-end delay. In [10] the call admission control scheme for WCDMA wireless network was discussed. The capacity enhancement for WCDMA network with convolutional coding scheme was discussed and compared with block code and without coding scheme to achieve a better balance between resource utilization and quality of service provisioning.

III. System Description

In 3G network (W-CDMA) system design, the study area is divided into 6 sites (AAAA, AAAB, AAAC, AAAD, AAAE & AAAF). Each site has 3 sectors separated by an angle of 120 degree each. The RF channel spacing is 5000 kHz. The system describes the important functions for traffic loading. The study area is shown in figure 1. The link is created between the site AAAA and AAAB for analysis. For a given geographical hub base station layout, the assignment of channels to individual sectors will be determined by the desired the traffic requirements in each part of the service area.

The study radius is taken as 30 Km and cell radius is 10 Km. This study will only focus on packet switched traffic analysis of 3G network system. The channel loading for the CDMA sector can be automatically set by using traffic loading studies. The studies analyze the traffic requirements in the service area of each sector and calculate the required number of traffic (voice) channels for a given QoS. The core of any wireless RF communication system is the network of towers, transmitters, and antennas that convert information signals to radio signals that can be received and understood by the intended user. The parameters that describe this hardware for the 3G cellular system are shown in Table 1 for both transmitter and receiver.

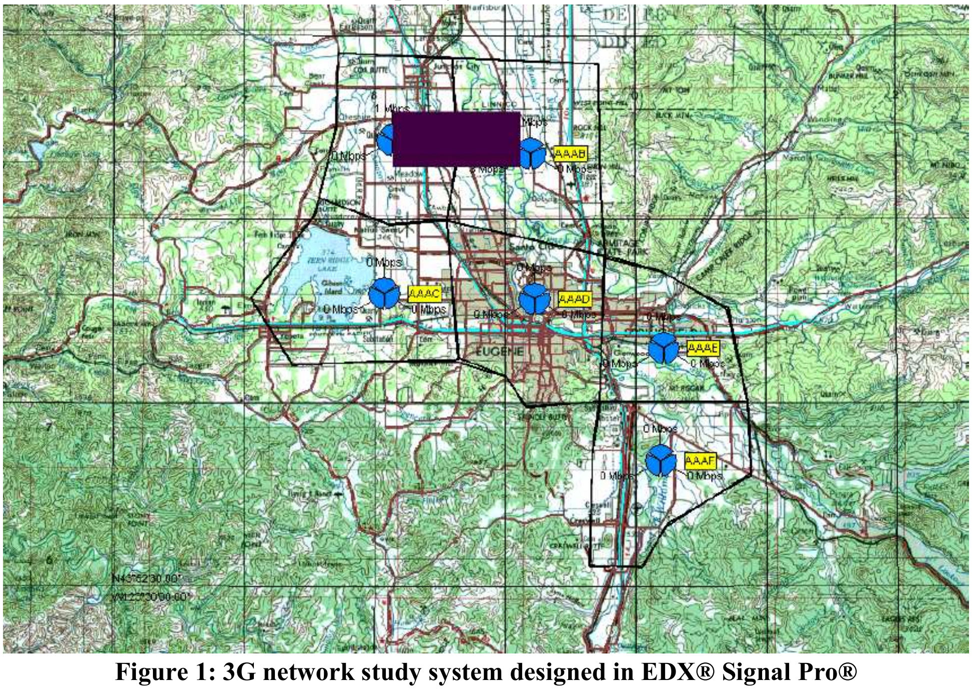

Figure 1: 3G network study system designed in EDX® Signal Pro®

Table 1: 3G system design parameters

Parameter	Value
System Type	WCDMA
System Type RF channel spacing (kHz)	5000
Traffic channels per RF channel	256
Forward link lower band edge (MHz)	1920
Forward link upper band edge (MHz)	1980
Chip Rate (mcps)	3.8400
Average call duration (Min)	1.76
Circuit Blocking Percentage (%)	2
Cell Radius (Km)	10
Study Radius (Km)	30
Approx. Sector Range (Km)	50
Total Channel Codes	64
Reverse link noise from adjacent cells or frequency reuse factor (%)	45
Neighbor minimum coverage (%)	10
Antenna Height(m)	30
Maximum ERP (dBWi)	20
Receiver Noise level (dBWm)	-103.6
Receive Noise Figure (dB)	5
Antenna Gain (dBi)	10

The performance of a 3G system depends not only on the quantity of mobiles using the system, but also on the type of switching (i.e. circuit- switched and packet-switched) service. Because each having the particular statistical parameters that describe the distribution and speed of packet transmissions on the uplink and the downlink. With the simulation analysis, we completely described all the particulars for such distributions and the results regarding these are described in the following section.

IV. RESULTS AND DISCUSSIONS

In order to accomplish the coverage requirement, the traffic is major factor. Simulation results are obtained in 3G system with packet traffic loading in terms of number of users and data rate as shown below.

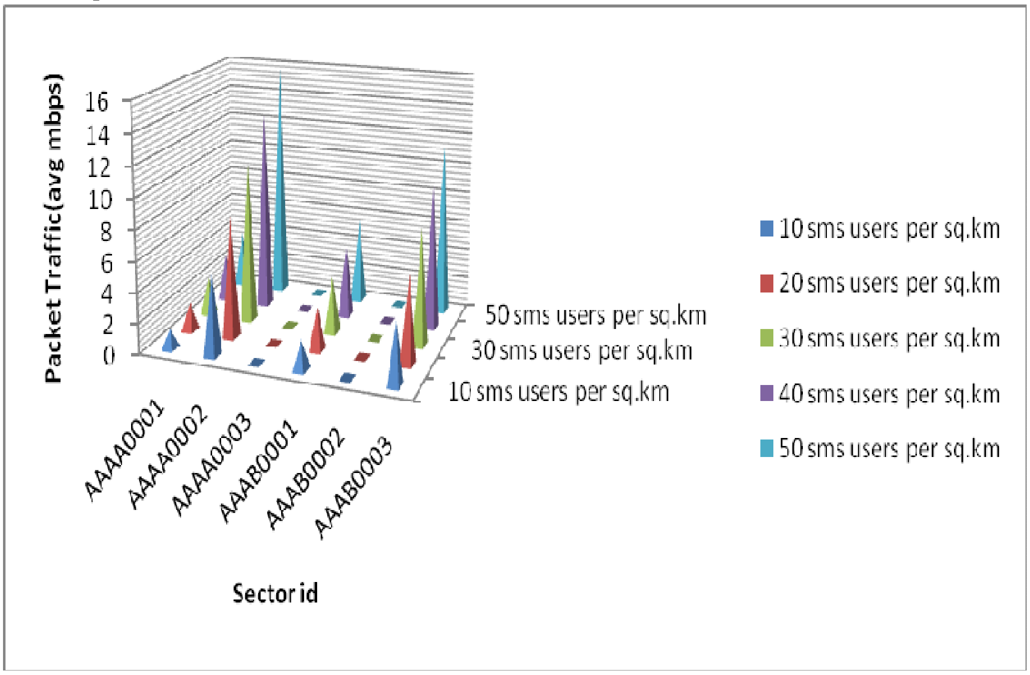

Figure 2(a). Packet traffic variation with number of data users in 3G system

We analyzed the effect of number of users and data rates on the packet traffic. Fig 2(a) shows the effect of number of SMS users per sq km on the packet traffic. The maximum value of packet traffic to be calculated is 15.72 mbps for 50 sms users. Packet traffic increases as we increase the number of users. The number of users in a cell depends upon the number of RF carrier in a cell. As the number of users or the amount of data sent by each user increases the latency or time delay inherent in the data transmission goes up. This effectively reduces the maximum data rate or throughput of each user. So, we can increase the number of users in a cell depending upon the RF carriers. Packet traffic increases with the number of voice users in a cell as shown in the fig 2(b). The active sites serving the number of users are two. So it only affects the sector AAAA0001, AAAA0002, AAAB0001 & AAAB0003 with the line of sight. The packet traffic increases with the number of voice users. The minimum value of packet traffic in this scenario is 1.27 mbps for 17 voice users and maximum up to 8.7 mbps for 37 voice users. This value of packet traffic can increase according to the number of users using the RF carriers.

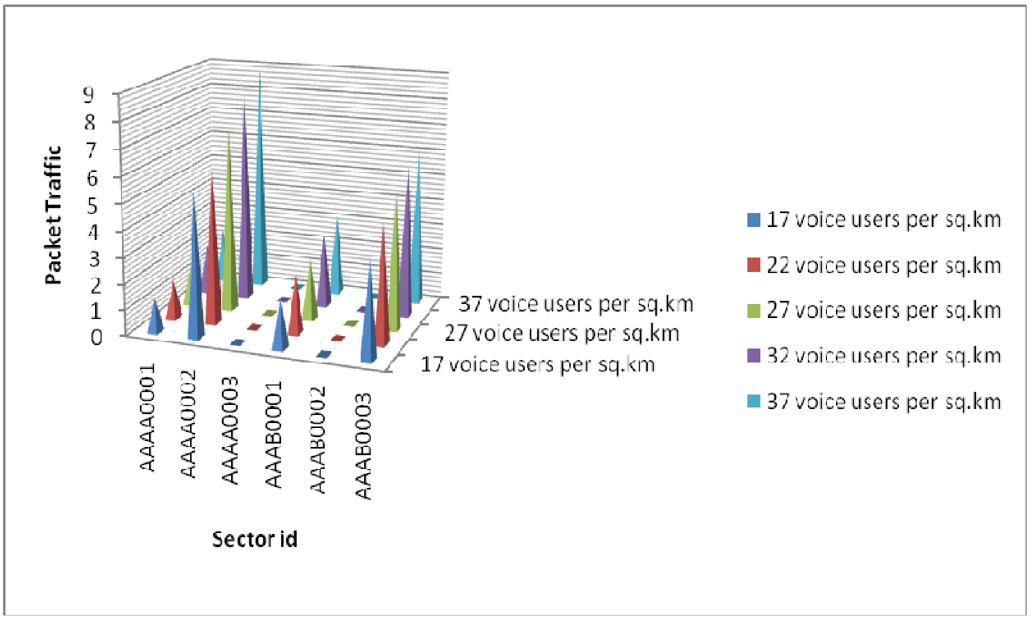

Figure 2(b). Packet traffic variation with number of voice users in 3G system

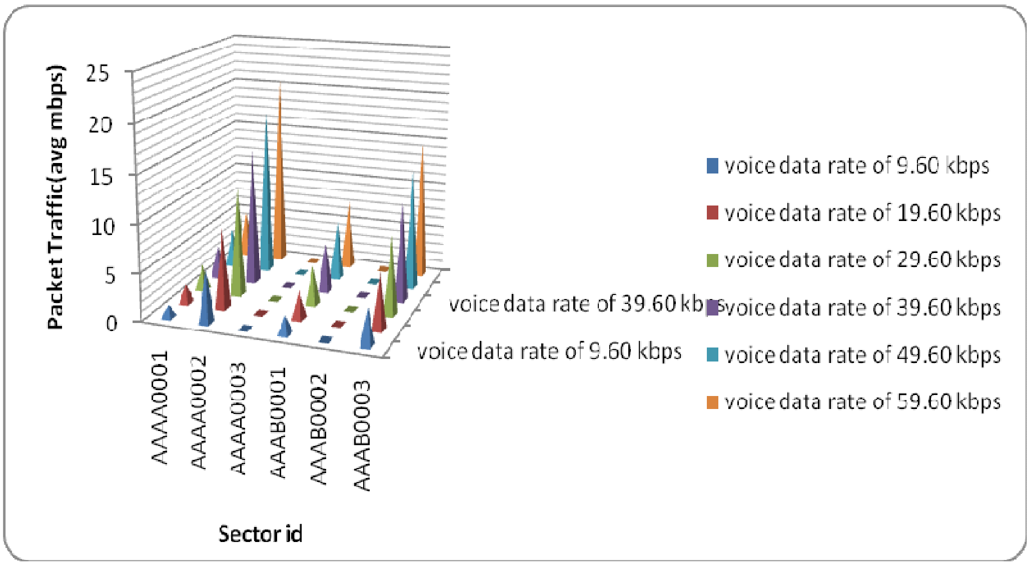

Figure 2(c). Packet traffic variation with voice data rate in 3G system

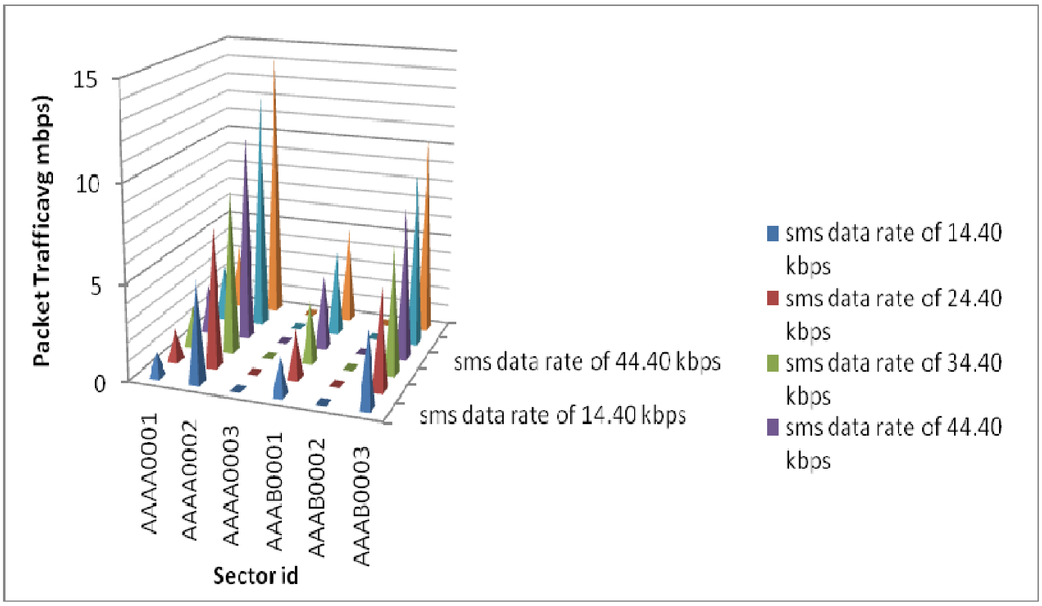

Figure 2(d). Packet traffic variation with sms data rate in 3G system

Fig 2(c) shows the graph between the packet traffic and voice data rates. We assign the minimum data rate of voice services to 9.6 kbps. We increase the voice data rate from the 9.6 kbps to maximum 59.60 kbps and the packet traffic varies maximum to 20.50 mbps. The voice calls limits the capacity of data service in terms of maximum throughput.

Fig 2(d) shows the graph between the packet traffic and sms data rates. We assign the minimum data rate of sms users to 14.40 kbps. The sms data rate varies from 14.4 kbps to 64.40 kbps and the maximum traffic to be handled by the system is 14.36 mbps as shown in fig 2(d). The maximum data rate can achieve in 3G network is 2 Mb with web browsing session. We have analyzed the packet traffic only with voice and sms. Packet traffic variation with sms users is more as compared to voice users. If additional data traffic is considered in each cell, the capacity of the voice service decreases. So, finally we analyzed that both the number of users and data rate are the factors more important for estimating the capacity and quality of service planning in 3G system (WCDMA).

V. CONCLUSION

In conclusion, we analyze that packet traffic is being affected, when providing access to speech and data users. The packet switched traffic analysis limits the performance of 3G network with the data rate and the number of users if additional data traffic is considered in each cell. The maximum values of packet traffic to be calculated above for sms users and voice users are 20.50 mbps and 8.6 mbps. Furthermore, the voice calls limits the capacity of data service in terms of maximum throughput. From the results shown above, we analyzed that as we increase the voice data rate from the 9.6 kbps to maximum 59.60 kbps then the packet traffic varies maximum to 20.50 mbps. Similarly sms data rate varies from 14.4 kbps to 64.40 kbps then the maximum traffic to be handled by the system is 14.36 mbps. These are the maximum values of packet traffic handled according to the system we designed with the specific parameters.

REFERENCES

1. Matteo Cesana, Antonio Capone, "Impact of Mixed voice and data traffic on the UMTS-FDD performance", VOL. 1 No. 1, pp. 758-761, 2002.
2. Fabio Ricciato et al, "Traffic Analysis at Short Time Scale: An Empirical Case Study from a 3g Cellular Network", IEEE Transaction on network and service management, Vol. 5 No. 1, March 2008
3. Fabio Ricciato, " Traffic Monitoring and analysis for the optimization of a 3G Network", IEEE Wireless Communications, Vol. 13 No. 16, pp. 42-49, December 2006.
4. Maciej Miernik Polkomtel S.A," Application of 2G Spatial Traffic Analysis in the Process of 2G and 3G radio network optimization:, ISSN: 1550-2252, pp. 909-913, April, 2007.
5. Carey Williamson et al, "Characterization of CDMA 2000 Cellular data Network Traffic", Department of Computer Science, University of Calgary, 8 August, 2008.
6. Aloizio P Silva, Geraldo R. Mateus, "Performance Analysis for Data Service in 3G Network", Vol. No 3 pp. 1-27, 2003.
7. Munju Sarvugyu, Ratnam V. Raju Kumar, "Performance Analysis of the UMTS system for web traffic over dedicated channels", Department of Electrical Communication Engineering, pp. 414-417, 2005.
8. Yat Hong Chan et.al, "Traffic Prediction Based Access Control Using Different Video Traffic

Models in 3G CDMA High Speed Data Networks, School of Engineering Science Simon Fraser University, ISBN:1-59593-306-9, 2006.

9. N. Sulaiman, R. Carrasco and G. Chester, “Estimating Quality of Service of Mixed Traffic in 3G Networks”, International Conference on Intelligent and Advanced Systems, Vol. No. 1, pp. 427-429, 2007.
10. K.Ayyappan and R. Kumar, “Oos Based Capacity Enhancement for WCDMA Network with Coding Scheme”, International Journals of VLSI Design & Communication System (VLSICS), Vol. 1, No. 2,pp. 1-10, March 2010.