J. Basic. Appl. Sci. Res., 2(2)1888-1895, 2012
© 2012, TextRoad Publication

ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Novel QoS Providing Solution for Non-real and Real Time Services in Wireless Networks

Seyed Hossein Hosseini Nazhad ghazani, Jalil Jabari Lotf

Department of Computer Engineering, Ahar Branch, Islamic Azad University, Ahar, Iran.

ABSTRACT

Future wireless networks are expected to provide quality of service (QoS). The effective capacity (EC) and powerful tool for the design of QoS provisioning mechanisms since the effective capacity approach provides a simple and accurate method for predicting link-layer QoS performance measures such as data rate, delay, and delay bound violation probabilityFuture wired-wireless multimedia networks require diverse quality-of-service (QoS) support. To this end, it is essential to rely on QoS metrics pertinent to wireless links. In this paper, we develop a cross-layer model for adaptive wireless links, which enables derivation of the desired QoS metrics analytically from the typical wireless parameters across the hardware-radio layer, the physical layer and the data link layer. The Quality of Service (QoS) provisioning for wireless and mobile Next Generation Networks is becoming increasingly important objective.

KEY WORDS: Wireless, UMTS, WLAN, Delay, Jitter.

1- INTRODUCTION

The Quality of Service provisioning in the next generation wireless mobile networks is becoming increasingly important objective, because, considering the comfortably establishing wireless networks, the use of this type of network is increasing day to day. On the other side, it is predicted that using multimedia applications will be more public in these network. As it is known, in contrary to best-effort flows, the transmission of multimedia flows in any network need support from QoS. The implementation of all those advance NGN capabilities, such as: ubiquitous mobility, enormous processing power of the mobile equipment and adaptive high-level QoS support, require great thoughtfulness, scalability and thorough full analysis. Since radio bandwidth is one of the most precious resources in wireless heterogeneous systems, an efficient adaptive QoS framework is very important to guarantee QoS for any given services and to maximize radio resource utilization simultaneously.

Moreover, the most significant QoS parameters in the existing wireless and mobile heterogeneous networks are the throughput, packet delivery ratio, delivery ratio, packet error ratio, call blocking probability, delay and jitter. In the next generation mobile and wireless network, which is seen as user-centric concept instead of operator-centric as in 3G or service-centric concept as seen for 4G, the mobile user is on the top of all [1]. Next-generation wired-wireless networks are evolving to accommodate a variety of services, including voice, data and real-time or streaming video/audio. Different applications come with diverse QoS requirements, in terms of data loss, delay and throughput. The "bottleneck" in such networks is the wireless link, not only because wireless resources (bandwidth and power)are more scarce wired counterparts, but also because the overall system performance degrades markedly due to multipath fading, Doppler, and time-dispersive effects introduced by the wireless air interface. Unlike wired networks, even if large bandwidth/power is allocated to a certain wireless connection, the loss and delay requirements may not be satisfied when the channel experiences deep fades. Therefore, judicious schemes should be developed to support prioritization and resource reservation in wireless networks, in order to enable guaranteed QoS with efficient resource utilization. To this end, it is essential to construct wireless link models that can provide the desired QoS metrics under diverse wireless conditions. Many models have been established at separate layers, including energy-consumption models for hardware and path-loss models for radio propagation at the hardware-radio layer 1 [7]; the Rayleigh, Rician, Nakagami fading models at the physical layer and queuing models at the data link layer [5].

2. Related Works

The major aim in present days and in the future wireless and mobile multimedia networks will give high level of QoS support for any preferred service. The interest for adaptive QoS provisioning is raising jointly with the marvelous development in adaptive multimedia services in mobile and wireless communication networks, we can increase or decrease the bandwidth of the individual where it is possible to increase or decrease the bandwidth of individual constant flows. First one is adaptive QoS framework for Wireless Ad-hoc

***Corresponding Author:** Seyed Hossein Hosseini Nazhad Ghazani, Department of Computer Engineering, Ahar Branch, Islamic Azad University, Ahar, Iran. E-mail: S.HosseiniNejad@iau-ahar.ac.ir

Networks, which is enthusiastically adapts flows in reaction to observe the changes based on user-supplied alteration policy, is introduced in [3].

Many routing schemes and frameworks have been proposed to provide QoS support for ad hoc networks [10, 11, 12, 13, 14]. Among them, INSIGNIA [10] uses an in-band signaling protocol for distribution of QoS information. The term in-band signaling means that the control information is carried with data, and there is no separate control channel as opposed to another type of signaling called out-of-band signaling. INSIGNIA's architecture has several modules that are routing, in-band signaling, admission control, packet forwarding or scheduling, MAC protocol, etc. However, it is a stateful architecture because it uses soft state resource management scheme to utilize the resources. First method for giving QoS is built into the Asynchronous Transfer Mode (ATM) protocol.

Generally, the ATM is a standard switching technique designed to unify telecommunication and computer networks. It uses asynchronous time-division multiplexing, and it encodes data into small, fixed-sized *cells.* This differs from approaches such as the Internet Protocol or Ethernet that use variable sized *packets* or *frames.* ATM provides data link layer services that run over a wide range of OSI physical Layer links. ATM has functional similarity with both circuit switched networking and small packet switched networking. It was designed for a network that must handle both traditional high-throughput data traffic (e.g., file transfers), and real-time, low-latency content such as voice and video. ATM uses a connection-oriented model in which a virtual circuit must be established between two endpoints before the actual data exchange begins.ATM is a core protocol used over the SONET/SDH backbone of the public switched telephone network (PSTN) and Integrated Services Digital Network (ISDN), but its use is declining in favour of All IP.

The QoS scheme is integrated services. Here, the path can be reserved with the help of IntServ from the sender to receiver. IntServ operates on a heterogeneous network. This network may consist of mixture of IntServ and non-IntServ traffic which will flowing through each node. As a result, IntServ should take the measures the assurance, an upper bound on the queuing delays at each hop. Through the IntServ we can provide the controlled-load service and this will creates no hard service assurance. But, this can be used in real time audio and video applications. The subcarrier controller at the physical layer is already explained in previous algorithms. The CSI will distribute the resources between the users. The improvement is added to the future algorithm and also it is added with the information which is used in the distribution process. This algorithm is using subcarrier controller combines the information between CSI and QoS. This information can be transferred from the traffic controller in the MAC layer using defined weight (8) to distribute the resources between the system users. The main inspiration that led us to develop novel adaptive QoS module, is to provide intelligent high level of QoS in different type wireless and heterogeneous network [UMTS/WLAN] networks. This same technique and concepts is using to creating and implementing adaptive QoS management mechanisms. To emphasize that in comparison with other related works, our adaptive QoS module is implemented on IP level. In our previous works (with the first version of our adaptive QoS module) we have presented early simulation results and analysis for adaptive QoS VoIP provisioning (real-time services) in integrated WLAN/UMTS networks and also, adaptive QoS provisioning for non-real time services in heterogeneous wireless networks. QoS Module within the ME, we achieved even superior results then the previous one, and even better QoS provisioning in heterogeneous wireless and mobile networks. Furthermore, in the next section we elaborate the intelligence of our novel adaptive QoS module.

3. System Model

Novel NGN mobile equipment consist of dual mode i.e. UMTS/WLAN withAdaptive QoS module within the IP layer (figure 1). Based on [1] and [2] physical and OWA define the wireless technology. Subdivision of network layer is mandatory. The upper IP network layer has IP address within, and this will lead for routing as well as fabricate the sockets to upper application layer.

Telemedicine constitutes healthcare services implemented through network infrastructures such as LAN, WLAN, ATM, MPLS, 3G, and others, to provide health care service quality especially in rural, urban, isolated areas, or mobile areas (Ng et al., 2006). Furthermore, telemedicine involves interactions between medical specialists at one station and patients. video images, images, clinical equipment's, and radiographic images.

Heterogeneity of wireless networks enables the user terminal to perform a selection of access technologies depending on their preferences. This choice provides better conditions for user applications. The processes of achieving connectivity in new environments are strongly associated with the application process. Namely, the need of the user application to establish communication with the some application server usually ends by initiating a connection through the network level, i.e., network access to resources by the user terminal.

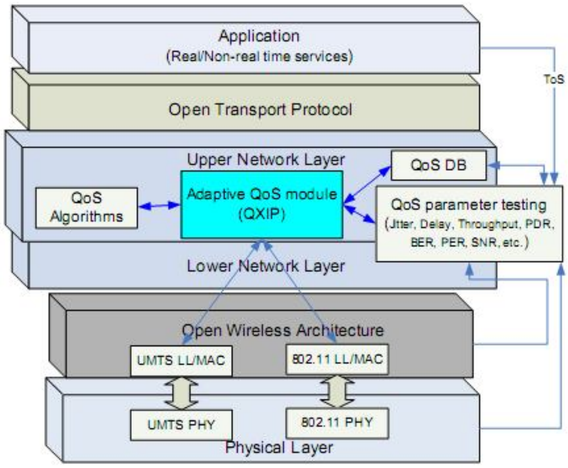

Figure 1 : Fig. 1. Dual-mode Node

The fourth functionality is associated with the management mechanisms for measuring the parameters that define the Quality of Service and Experience in terms of user applications. This functionality is accomplished by cooperative working between the QoS / QoE module on the client side and QoS / QoE module on the server side. The purpose of this module in the mobile terminal (the client side) is to continuously measure the basic qualitative parameters of radio access technologies. Thus, the measured parameters give a realistic picture of the Quality of Service that can be expected from the radio access technologies, which in fact are on the path between the client and Policy Router. Measurements are carried out individually by each access technology. The results of these measurements are a direct input to the ITHC module for handover decisions between tunnels. The other sub-layer, Lower IP Network Layer may include several different IPv4 (or IPv6 addresses), ne IP address for each of the radio interfaces, while each of these IP addresses will be mapped with unified IP address of the Upper IP Network Layer. In the middleware between the Upper and Lower IP Network layers will be address translation module, which shall maintain and translate IP addresses from Upper IP Network address (one IPv4 or IPv6) to different Lower IP Network layer IP addresses (IPv4 or IPv6), and vice versa. Moreover, for NGN mobile terminals will be suitable to have Open Transport Protocol - OTP (nowadays it is Transport Layer Protocol in the classical OSI model) that is possible to be downloaded and installed.

Such MEs shall have the possibility to download (e.g., TCP, modifications and adaptation of TCP for the mobile and wireless networks, RTP, some new transport protocol and etc.) version which is targeted to a specific wireless and mobile technology installed at the base stations. Application layer in Fig.1 is the same like that from classical OSI model. More detail description for the all OSI layers in the future 5G mobile terminal designs is given in [1]. Furthermore, we briefly present our adaptive QoS framework in ME. The core of our work is development of novel adaptive QoS Module; we will refer to it as QoS-Cross-IP Module (QXIP), which is defined separately from each wireless technology (e.g. UMTS, WLAN, WiMAX, 3G-LTE, 4G, etc.). It is implemented on Upper IP Network Layer, which will be able to provide intelligent QoS management and routing over variety of network technologies.

Moreover, the QXIP module is able to combine simultaneously several different traffic flows transmitted over the same or different wireless access channels, achieving higher throughput and optimally using the radio resources. All those functionalities and performances are programmed in C++ and Octal within the IP layer module class (and its subclasses) in ns-miracle 1.2.2 simulator. For the purpose of the QXIP, the ME must collect QoS parameters, such as delay, jitter, losses, bandwidth, reliability, Packer-Error-Ratio (PER), Signal-to-Noise-Ratio (SNR), Transmission Power (TP), etc., continuously, at given time intervals (all the time while simulation is going on), by collecting the measurements data via cross-layer messages (special Message C++ class developed in ns-miracle 1.2.2 for cross-layer communication) from OSI layer 1 up to Lower IP Network layer, and then storing the data into two-dimensional matrix variable within the QXIP module. This two-dimensional matrix is a small QoS DB (database), which can be easy extended, in a more complex multi-dimensional matrix (more complex DB, which will save all other relevant parameters for any used mobile wireless technology).

The first row of this matrix contains UMTS QoS parameters and second row contains the WLAN QoS parameters, appropriately. On the other hand, with one cross-layer message, for each send packet, the Type-Of-Service information from Application Layer is collected, in order to implement packet scheduling priority, i.e. higher priority for real-time service packets (VoIP, Video-conference and etc.), modules, the QXIP module is doing service quality analysis by using the data stored in the QoS DB in the Upper Network Layer of ME for given time period in the past (e.g., seconds, minutes) in order to choose the best wireless connection upon required QoS. Here, in our current implementation, We have tested only TOS, SNR, PER and transmission power which are collected from the application and OWA layer via cross – layer messages in c++ class we called x Message. This is used to save the SNR, PER and transmission power parameters in private variables. If the IP packet comes to the QXIP module it always try to get the admission to the WLAN whenever it is available (i.e. the tested parameters by WLAN parameter SNR. PER and TP, are above their appropriate WLAN thresholds and moreover.

The WLAN utility function in [10] given with the equation [8], is satisfied). Sometime the QXIP module doesn't get WLAN admission and it will try to get admission from the UMTS network (all tested UMTS parameters are above their appropriate UMTS thresholds and also the UMTS utility function given in (equation (7)) is satisfied). Finally the QXIP module will sends the packet which is coming from upper layer IP network layer down via the appropriate lower IP network layer. Suppose if there is no admission from anyone of the network, then the pocket goes to priority scheduling before it is passed to the above indicated downlink procedure.

On the other hand, in uplink, all packets which are coming from all LL/MAC modules are received in Upper Network Layer, and send without any losses up, from QXIP module to Transport Layer. With those procedures different flow combining is done within the QXIP module.

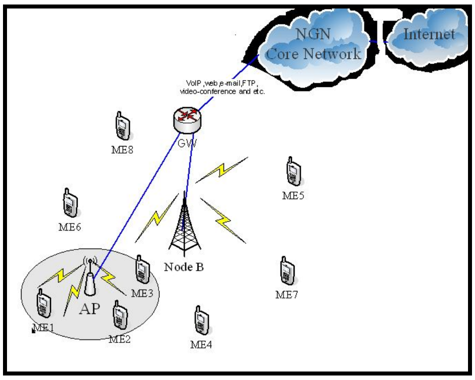

Figure 2. Simulation scenario for multimedia traffic

Table 1. Simulation parameters

Parameters	Values
CBR packet size	160 Bytes
WLAN Data rate	1 Mbps
Physical header	192 bits
MAC header	224 bits
SIFS	10 µs
DIFS	50 µs
CTS, ACK	112 bits + Phy header
WLAN_PER threshold	7x10-11 W
UMTS_PER threshold	10-6 W
NodeB spreading factor	32
ME spreading factor	16
TCP packet size	500 Bytes
Traffic frame interarrival time	4 seconds

4. SIMULATION RESULTS

From the fig 2 the simulation setup has given and we fabricate one UMTS Node B and one WLAN access point. At the starting of the simulation the ME's arbitrarily scattered within the area of $500X500m^{2.}$ To fine MEs physical mobility we had Gauss- Markov mobility model considering average speeds in the range of 2-18 m/s. The Node B coordinates are (500,500) this will provide coverage for the MEs placed within a distance of about 520m. In other hand WLAN AP is placed at (150,150) which providing coverage for the MEs placed within the prescribed distance of about 130m. This simulation result is providing total network coverage for all MEs.

At the starting to ending of the simulation time we will get constant bit ratio and variable bit ratio traffic through the gateway which is wired to UMTS Node B and 802.11 AP to all MEs such as video conference, email and other web session. The traffic flows between MEs such as sends some multimedia file like video, audio and data while we sending the data to another user or group of users.Mostly the MEs are often connected with WLAN AP using the higher throughput and time to time using of UMTS access if they are out from the WLAN area. Furthermore when two traffic flows are combined with each other. The WLAN traffic characteristics are leading in case of high throughput.

Besides in the fig 4 is presented average throughput for different velocity i.e. from 2 up to 18m/s of the MEs, First of all it can be clearly obtain that the average throughputs of our case [when the dual mode QXIP MEs is used), from the simulation result we can understand average velocity and the values over compared with the average throughput values from the other two cases. To highlight higher velocity values the QXIP and WLAN throughput curves have ascending trend because at those speeds all MEs have possibility to access WLAN AP (there are more frequently UMTS-WLAN handovers). From the curve we know that UMTS throughput value almost constant because of UMTS coverage. From the fig 5 the average packet delivery ratio values are very balanced in case if we use ME PDR values [when the number of MEs is up to 5. After we use more than 10MEs in the simulation the PDR values are better in case if we use QXIP dual mode compare to WLAN PDR values. So the QXIP gives good balanced results in many useful environments. Just to emphasize that the lower QXIP PDR values are due to the packet losses during UMTS – WLAN transfers

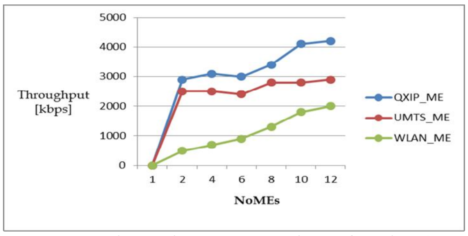

Figure 3. Average throughput vs. number of nodes (=2m/s). v

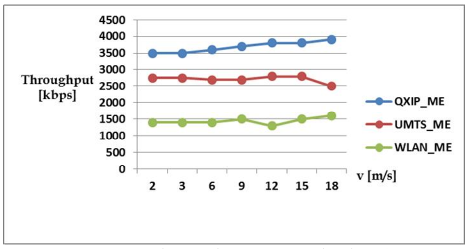

Figure 4. Average throughput vs. velocity (N0MEs=8).

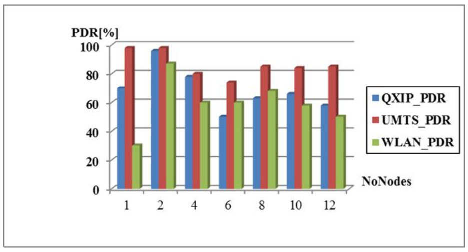

Figure 5. Average PDF vs number of nodes (*v*=2m/s).

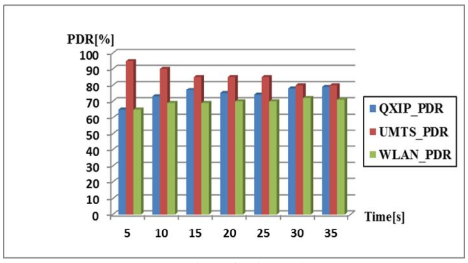

Figure 6. Average PDF vs. simulation time (N0MEs=8, *v* =2m/s).

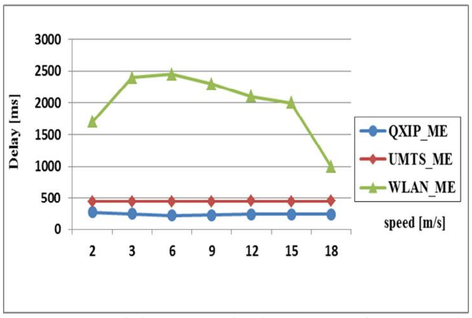

Figure 7. Average delay vs. velocity (N0Nodes=8, t_sim=15s).

Consequently, UMTS PDR values in any case are superior in comparison with our QXIP PDR and WLAN PDR values, due to the full network coverage in the given simulation scenario. In Fig. 6 similar results for PDR values versus simulation time, for all three cases are shown. In this case number of MEs is set to 8, and the average velocity of MEs is 2 m/s. This motivates us to develop a new cross-layer multichannel QoS-aware MAC protocol for clustered WMSNs that adaptively changes the intervals and use dynamic nature at channel and time slot assigning, therefore promoting the throughput of the network and exploit the high energy efficiency.

As it is shown, the average PDR values for our QXIP dual-mode MEs have tendency to reach UMTS PDR values, and as the simulation time increases this two PDR values are becoming almost equal (e.g., at 30 and 35 seconds, in Figure 6). Moreover, the QXIP PDR values are all the time higher then WLAN PDR values. Again we have balanced and very stabilized PDR values for our QXIP case in any time during the simulation. Moreover, in Fig. 7 the average delays for all three cases are presented. In this scenario, the number of Mes is fixed on 8, simulation duration is 15s and we change the Mes mean velocity from 2 m/s up to 18 m/s.As we can see, the delay values of our dual-stack QXIP ME case is between the delay curves for UMTS and WLAN cases, with similar statistic with the values of WLAN curve, and lower than the values of UMTS curve. Interesting fact is that with rise of the mean speeds of the dual-stack QXIP Mes their delay values are almost constant (400 ms), because in these cases with higher mean speed, more frequently the Mes are entering in the WLAN area, and due to the lower latency of WLAN network, all QXIP Mes are achieving similar statistic of lower latency.

The lower latency of WLAN network is because of the above mentioned fact that we carefully managed the traffic load of the WLAN network (we set it to be maximum 60 %) in order to achieve satisfying level of QoS provisioning with this wireless technology. On the other side, the UMTS delays are higher for a low speeds, but as the mean speed is increasing; its values are converging to stabile values (closer to those from our QXIP and WLAN Mes) due to the increased present of Mes outside of WLAN area (inside the UMTS network coverage area). Protocols, like SPEED cluster-QoS and delay constrained least cost routing discuss the QoS-routing issues in wireless sensor networks. Unfortunately all these works attempt to optimize QoS in the sensor-routing from higher layers only.

However, end-to-end QoS in WMSNs cannot be satisfied without designing an efficient QoS-awareMAC protocol. Unfortunately only a handful of works exist for QoS-MAC in wireless sensor networks. The Other results for the delay, as a function of number of Mes, in this all three cases are shown in Fig. 8.In this scenario, average velocity of the Mes is fixed on 2 m/s, simulation duration is 15 seconds and we change the number of Mes from 1 up to 12. As we can see, our dual-stack QXIP ME delay curve is between the curves for UMTS and WLAN cases, with lower values than the values of UMTS curve, and higher values compared with the values of the WLAN curve. By increasing the number of Mes the dual-stack QXIP Mes delay curve becomes very balanced, oscillating around its average value (in this case 1 second for every multimedia service).

At the beginning, for a small number of Mes, we have superior results for the delay of our QXIP ME, but as the number of Mes is increasing the delay values are increasing too (showing the worst delay for 4 Mes) and are converging between two other curves. This delay characteristic of our QXIP ME is due to the procedure of different traffic flow combining (real-time and non-real-time traffic from both networks) within the QXIP module.

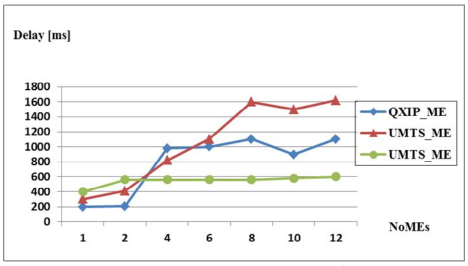

Figure 8. Average delay vs. number of MEs (*v* =2m/s).

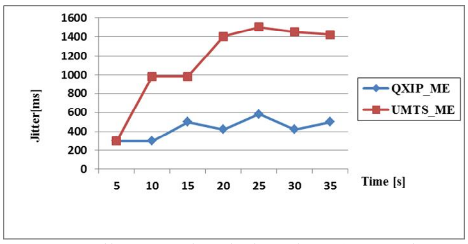

Figure 9. Average jitter vs simulation time (N0Nodes=8,*v*=2m/s).

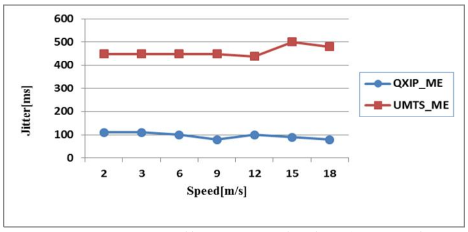

Figure 10. Average jitter vs velocity (N0Nodes=8).

5. **Conclusion**

In this paper we explained about the novel simulation results for the quality of the parameters such as throughput and delay and packet delivery ration in one of the heterogeneous wireless and mobile network using the proposed novel adaptive quality of service module within the forth coming generation dual mode UMTS/WLAN mobile terminals. With reference to the simulation results our proposed next generation dual – stack UMTS/WLAN ME with quality of service unit performs very well under different network conditions. The results showed the performance gain with QXP module in the dual network situation, at the same time as it can be easily generalized in multi wireless network situation including any wireless NGN access network. In future we will work towards on development of advanced QXIP module, by using additional network conditions as inputs for intelligent wirelessaccess decisions. More than this we plan add WiMAX, Bluetooth and LTE interfaces in OWA layer, and also we ready to use more complex algorithmic QXIP module, together with more complex database. We can choose the best wireless network by using this technology with QoS requirements and time intervals for the best satisfaction in QoS. And it can combine a Varity of traffic flows from or two different wireless and mobile networks, with aim to obtain superior QoS provisioning (Maximal throughput, Minimum delay and jitter, Maximal PDR, Minimal packet error). All the novel adaptive QoS framework combine together with fundamental parts of the next generation mobile and wireless network paradigm.

REFERENCES

[1] Toni Janevski, “5G Mobile Phone Concept” – CCNC conference in Las Vegas, 2009.

[2] Willie W. Lu, “An Open Baseband Processing Architecture for Future Mobile Terminals Design”, IEEE Wireless Communications, April 2008.

[3] Seoung-Bum Lee, "Adaptive Quality of Service for Wireless Ad hoc Networks", Ph.D. Thesis, Columbia University, 2006.

[4] AntonisDimakis, Linhai He, John Musacchio, Hoi-Sheung Wilson So, Teresa Tung, Jean Walrand, "Adaptive Quality of Service for a Mobile Ad Hoc Network", Fifth IFIP-TC6 International Conference, pp.90-93, 2003.

[5] T. Kwon, Y. Choi, C. Bisdikianand M. Naghshineh, “QoS provisioning in wireless/mobile multimedia networks using an adaptive framework”, Wireless Networks 9, pp. 51–59, 2003.

[6] Yu Fei, Vincent W.S. Wong, Victor C.M. Leung, “Efficient QoS Provisioning for Adaptive Multimedia in Mobile Communication Networks by Reinforcement Learning”, Mobile Networks and Applications 11, pp. 101–110, 2006.

[7] Xin Gang Wang, Geyong Min, John E. Mellor, Khalid Al-begain, "An Adaptive QoS Management Scheme For Interworking Cellular and WLAN Networks", Computer Networks

[8] M. Buddhikot, G. Chandranmenon, S. Han, Y. W. Lee, S. Miller and L. Salgarelli, Integration of 802.11 and Third-Generation Wireless Data Networks, Proc. IEEE INFOCOM, Apr. 2003.

[9] 3GPP, Group Services and System Aspects; 3GPP Systems to Wireless Local Area Network (WLAN) Interworking; System Description (Release 6), TS 23.234, v. 6.2.0, Sept. 2004.

S. Lee, G.-S.Ahn, X. Zhang, and A. T. Campbell.

[10] “INSIGNIA: An IP-Based Quality of Service Framework for Mobile Ad Hoc Networks”. *Journal of Parallel and Distributed Computing, Special issue on Wireless and Mobile Computing and Communications*, 60:374–406, 2000.

[11] G.-S. Ahn, A. Campbell, A. Veres, and L.-H.Sun. "Supporting Service Differentiation for Real-Time and Best-Effort Traffic in Stateless Wireless Ad Hoc Networks (SWAN)".*IEEE Transactions on Mobile Computing*, vol 1, pp.192–207, July- Septemeber 2002.

[12] S. Chen and K. Nahrstedt."Distributed Quality-of-Service Routing in Ad-Hoc Networks".*IEEE Journal of Selected Areas in Communications*, vol 17, pp 1454-1465, August 1999.

[13] T. Chen, M. Gerla, and J. Tsai. "QoS Routing Performance in a Multi-hop, Wireless Network". In *Proceedings of the IEEE ICUPC'97*,vol 2, pp 557—61 , San Diego, CA, October 1997.

[14] P. Sinha, R. Sivakumar, and V. Bharghavan. CEDAR: "A Core-Extraction Distributed Ad Hoc Routing Algorithm". In *Proceedings of the IEEE Conference on Computer Communications (INFOCOM)*, pages 202–209, New York, NY, 1999.