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QOS Evaluation of Call Admission Control for a 4G Network

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Abstract: In the last years, the cellular communications system has evolved greatly, mainly moved by the increase of applications and user requirements. The growth of demand in this area is attributed to facilities and usability of services through cellular networks. Future wireless scenarios will be characterized by the coexistence of a variety of heterogeneous wireless access technologies. There will be complex protocol stacks, supporting a number of applications and services with different Quality of Service (QoS) demands and, in addition, requiring multi-mode terminal capabilities to access such networks. Call admission control (CAC) is a radio resource management technique aimed at providing fair quality of service (QoS) to mobile users in cellular networks. These techniques allow the operator to manage its networks resources, which provide better service to its users. This paper presents new algorithm for joint radio resource management using the UMTS and WLAN architecture, where these networks are connected to each other. This algorithm based on its decisions criteria related to mobility of user reducing the handoffs

Keywords: 3rd Generation Partnership Project (3GPP), Call Admission Control (CAC), Joint Radio Resource Management (JRRM), Quality of Service (QoS), User Mobility, UMTS, WLAN.

I. INTRODUCTION

There cent evolution sin telecommunications had been started by the need of user to use their subscribed various services in mobiles. This demand hast worse each objectives in the mobile communication area. One is heterogeneous network which is capable to access different wireless network technologies, such as Universal Mobile Telecommunication System (UMTS), Wireless Local Area Network (WLAN) or Bluetooth etc. The second is the interconnection of different wireless networks has been defined which can manage call transference from one network to another.

In 4G system where one telecommunication operator controls different network technologies in same location, but a joint management of those network resources is desired which will improve the services offered to the users. The3rd Generation Partnership Project (3GPP) defined anointer connection architecture in between 3G networks and WLAN, illustrated in Fig.1[10],[11].Reference using from 3GPP architecture, this paper proposes a new algorithm called DEC for a join tradio resource management (JRRM) in the reference scenario where a user is located in an area which is covered by different radio access networks. This algorithm based on its behavior in the criteria related with respect to user mobility. In the II section, Joint Radio Resource management is presented. Section III includes the new algorithm for joint management of multi-radio network resources based on user mobility; this sectional so describes the decision strategy used to define the network to which a new call can be allocated. Section IV presents the simulation scenario and results to validate the algorithm proposed in this paper. Finally, Section V presents the conclusions.

II. JOINT RADIO RA SOURCE MANAGEMENT

The joint multi-radio resource management provides solutions to support Quality of Service (QoS) while optimizing usage of resources. An algorithm is proposed in [2], where the authors have used two strategies: The first strategy aims to ensure the same QoS for real-time calls and non-real-time (BE (best effort)) calls. The strategy also limits the number of calls of these classes in the system, and minimizes the probability of blocking and the probability of loss by reserving resources for calls in mobility. The second strategy maintains the same QoS for real-time calls and introduces fair sharing of resources for non-real-time. Two quantities of resources are reserved, the first is for real-time calls in migration, and the other second is to reserve a minimum quantity of resources for non-real-time calls and to dynamically use resources not used by real-time calls.

In Release 7, 3GPP proposes to interconnect the WLAN with 3G technology as a way to minimize the visibility of the vertical handoff... Figure 1show the architecture of interconnection, where the network operator controls the two interfaces based on IP. In this scenario, an environment where the 3G networks and WLAN are located in the same area is assumed. Thus, the user can, through its equipment, compatible with the two network

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technologies, use the 3G network or WLAN transparently. A typical usage scenario is one where the user's equipment is connected to a 3G network and detects the Service Set Identifier (SSID) of an available WLAN network, and starts trying to connect to the network through the WLAN interface. If the operator identities the equipment as a user of its network, it will allow the transmission of information by the 3G network or by the WLAN.

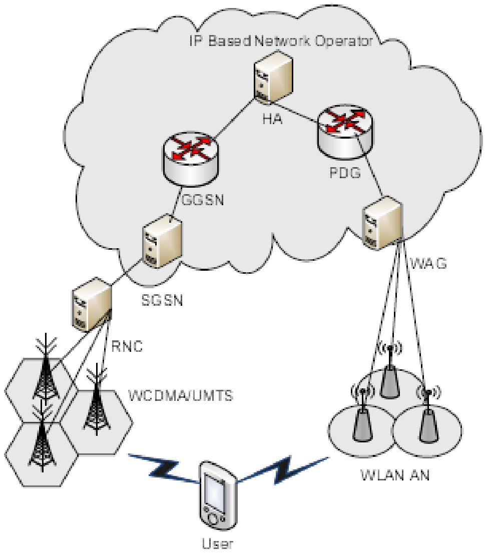

Fig.1. 3GPP architecture for interconnection of 3G and WLAN networks

III. JRRM BASED ON MOBILITY OF USER

The join tradio resource management algorithm DEC is proposed in paper which aims to increase the use of radio resources, while satisfying QoS requirements. Fig.2showsthestructureofdecisionalgorithmusedforjointmanagementofinter connected UMTS and WLAN radio resource networks under the control of common operator. When the new call request arrives, algorithm decides that which network it should be selected, based on the call characteristics and resources available. In the context where both networks have resources available, the algorithm is based on the Mobility decision of the users, classifying applications according to their decision for mobility just like voice calls are generally mobile, since the probability of user receiving or starting a call in mobility is relatively high. Thus, this algorithm gives priority to mobile applications in the UMTS network in order to avoid hand offs between different network technologies. Applications usually used in the static scenarios (e.g. video streaming) are accepted generally in WLAN networks.

The following equations show the decision algorithm formulae. The network selected to serve a new call is chosen according to Eq.(1),where DEC represents the mobility decision. The indicator function is 1if the even ty is true, else it is zero. PUMTS and PWLAN are the eligibility degrees given to the arriving calls, respectively to be transported over UMTS and WLAN networks, as show in Table1.

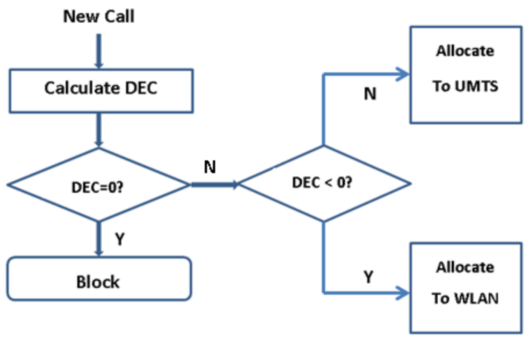

Fig.2. Join tradio resource management algorithm

$$DEC = P_{UMTS} * I_{\eta aUMTS \geq \Delta\eta r} - P_{WLAN} * I_{BwWLAN \geq r} \quad ....(1)$$

The ηaUMTS and BwWLAN are variables respectively indicating the available UMTS load factor and available bandwidth in the WLAN network. In UMTS, load factor estimates the amount of supported traffic per base station site; in [9], it is described the mechanism to obtain the available UMTS load factor. The available bandwidths in WLAN interface is obtained by monitoring the channel occupation ratio, as described in [8]. Δηr is the UMTS load factor associated to a new call and it is obtained also as described in [9]. r is the WLAN mean bit rate requested by the new call. The network selected for an arriving call is given by Eq. (2).

$$\text{Network Allocator} = \begin{cases} \text{WLAN}, & \text{if } DEC \\ \text{UMTS}, & \text{if } DEC > 0 \end{cases} \quad (2)$$

Application	Eligibility Degree	
	PUMTS	PWLAN
Voice	2	1
Video streaming	1	2
www	1	2

Table1. UMTS and WLAN eligibility degrees according to the user mobility criterion

IV. SIMULATION SCENARIO AND RESULT ANALYSIS

To demonstrate and evaluate the algorithm proposed in this paper, we considered simulation parameters where number of mobile nodes are 32, maximum packet in a queue are 50 and MAC type is 802.11 , 802.16. The number of users varies from 1000 to 9000 and, in the busy hour, each user is involved.

The simulation was implemented in Network Simulator 2 (NS-2), being the UMTS network developed as a statistical module, based in [9]. NS-2 already implements the IEEE 802.11 multi-rate standard (i.e., 6 Mbps to 54 Mbps). We assumed that UMTS network supports applications with QoS requirements, while WLAN network does not integrate any mechanism for the QoS support.

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In UMTS network, the usual value for the maximum load factor, ηmax, is 0.75 [9]. Fig. 3 shows the ηmax distribution. We assumed that the user density inside the hotspot is average twice than the density in the remaining of the UMTS cell. In this case, the load factor inside the intersection area of both technologies was considered 0.50, being the remaining 0.25 applied to the outside of the intersection area. The simulations presented in this paper used voice and www or video traffic parameterized according to the Table I.

The graphs shown below indicate the result of the strategy among which first graph shown is of calls admitted in UMTS network with respect to number of users whereas second graph indicates calls admitted in WLAN network with respect to number of users, both graphs clearly indicates that the number of users and call admissions are continuously go on increasing thereby affecting the performance of system as both networks can't provide service to the simultaneously calls at the same time in busy hour but by using the adopted strategy the call blocking can be overcome by call handovering to either network depending of various criterion The third graph shows the call handover with respect to number of user in which it is clear that the maximum number of calls admitted in the network are handed over WLAN depending on the mobility of user, if the user is mobile, the call is handed over to UMTS in order to satisfy QoS but always priority is given to voice calls.

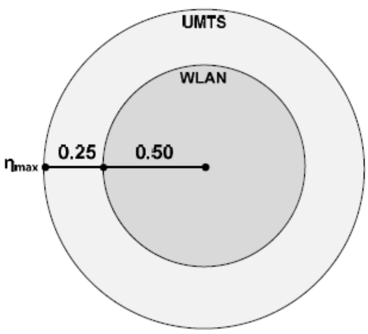
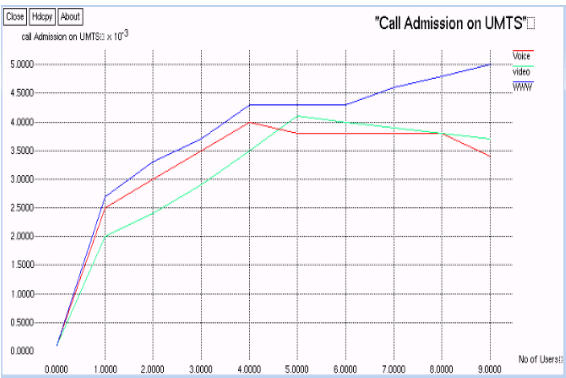
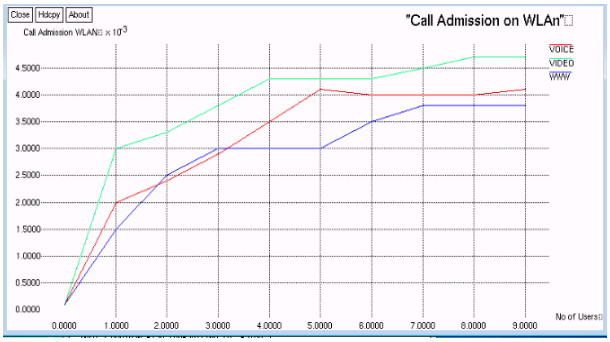


Fig.3.ηmax distribution according to users' location - inside/outside hotspot



Graph 1. Call Admission on UMTS



Graph 2. Call Admission on WLAN

Graph 3. Call Handover

V. CONCLUSION

This paper presents the strategy for joint radio resource management. If the user is supposed to be covered by both UMTS and WLAN networks then the algorithm efficiently manages the new call by using both network interfaces by considering the mobility of user and application thereby increasing WLAN efficiently while transporting large packets in video applications.

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