International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

# Admission Control in Heterogeneous Network: Overview

**Rajeshwari C. Choukimath[1], Vasudha V. Ayyannavar[2]**

[1, 2]Dept of Computer Science and Engineering, Basaveshwara Engineering College, Bagalkot, Karnataka, India

**Abstract:** ***The heterogeneous networks should support a broad range of multimedia services with guaranteed quality of service. In order to support the requirements, a new call admission control is needed to support the integrated architecture. Because rejecting a handoff session would lead to the result much worse than rejecting a new session, service class differentiation is adopted to define the service priority according to service type and handoff type. A new admission algorithm is used for service utility functions to maximize the utility function and balance load of heterogeneous networks, Hence admission control mechanism is effective to the extent. Network operators have been reluctant to deploy IP multicast services mainly due to the lack of native control over multicast groups. This lack of control does not only prevent operators from generating revenue from multicast based services but also hinders regular network management. Hence in this paper we provide a overview that enunciate architecture, that uses the existing Authentication Authorising Accounting (AAA) functionality to perform user identification and multicast session admission control.***

**Keywords:** Heterogeneous network, admission control, admission algorithm, AAA

## 1. Introduction

Advancements in mobile communications are being driven by the emergence of Multiple Radio Access Technologies (MRAT)[1]. Technologies like Bluetooth, WLAN and evolving UMTS networks, offer different capacity characteristics, coverage and costs. Two variations of heterogeneity are currently used and they are, HotSpot extensions to 3G Networks and a fully heterogeneous access network incorporating a wide variety of radio technologies.

Evolution to complete heterogeneity must be focused on the user, rather than on network operators. This promotes integration with and interoperability across existing systems, leading to a totally transparent public-private wireless broadband communication system that will extend the public network with ubiquitous coverage using multiple overlapping private systems. A fully heterogeneous access network will have the ability to integrate all systems, offering all services, all of the time, allowing users to be provided with seamless transparent mobile access to the most efficient, preferred network type depending on the required data-rate, user profile or traffic load.

The existing admission control strategies can handle the resource management in homogeneous wireless networks but are unable to handle the issue in heterogeneous wireless environment. The mobility of the terminals in the mobile communication environment makes the resource allocation a challenging task when the resources are always in scarce. The efficient call admission control policies should be in place which can take care of this contradicting environment to optimize the resource utilization. The design of call admission control algorithm must take into consideration the packet level QoS parameters like minimum delay, jitter as well as session level QoS parameters like call blocking probability (CBP) and call dropping probability (CDP),[2]. The CBP is the probability of denial of accepting the new call and CDP the likelihood of dropping the call by a new access network due to decline of the network resources to an unacceptable level in other words the networks is exhausted with the available resources at which it drops the handover calls.

## 2. Call Admission Control in Heterogeneous Networks

Further the discussion is on the common architecture for the admission control scheme, now we are discussing on a novel based 4G wireless networks, admission control architecture. CAC architecture for 4G wireless networks. The CAC module is divided into two submodules (i.e., two-tier CAC): one for the wireless part and the other for the wired part (Figure. 1).

In the wireless part the CAC needs to handle multiple classes of calls as well as calls due to vertical handoff from other types of networks. If the call is used for data transfer, ABA can be applied to increase resource utilization. Moreover, CAC in the wireless part must consider the nature of capacity of the systems (i.e., soft or hard) so that resource reservation and admission control can be performed optimally. Since the wireless resources are the scarcest resources in the system, the CAC submodule in the wired part must ensure that the wired network can maintain the QoS of traffic from wireless users (already transmitted across the wireless links) at the desired level. Both the call- and packet-level performance requirements need to be satisfied in the wireless part [3]. Packet-level QoS performance in the wireless part can be maintained through ABA and proper scheduling mechanisms. Call-level performance depends on the resource reservation and admission control strategy in the wireless part. However, in the wired part, only packet-level QoS requirements need to be satisfied.

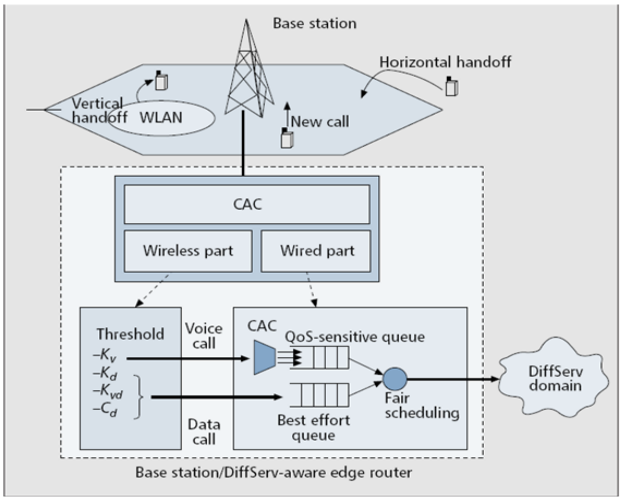



**Figure 1:** The system model for the proposed CAC scheme

CAC is a network process that receives as an input, a connection request that specifies the traffic descriptor and QoS (quality of service) requirements of the connection and returns a response granting or denying the admission request. The objective of the CAC is to ensure that the network meets its end-to-end QoS guarantees to connections that are admitted into the network. The CAC process is responsible for deciding whether a new connection request can be accepted, and if so, then how much resource should be allocated to it.

The main responsibility of CAC is not only to minimize the blocking of new call requests and the dropping of handover connections, but also to reduce the unnecessary handovers as far as possible. As we have know that , Admission control is a research field that has been receiving a considerable amount of interest since the introduction of IP network architectures designed to support QoS for traffic flows.

Call Admission Control (CAC) is used in the call set-up phase and applies to real-time media traffic as opposed to data traffic. CAC mechanisms complement and are distinct from the capabilities of Quality of Service tools to protect voice traffic from the negative effects of other voice traffic and to keep excess voice traffic off the network. Since it averts voice traffic congestion, it is a *preventive* Congestion Control Procedure. It ensures that there is enough bandwidth for authorized flows. Connection Admission Control can be used to prevent congestion in connection-oriented protocols such as ATM.

### A. Joint Call Admission Control in heterogeneous cellular networks

JCAC algorithm is one of the JRRM algorithms, which is referred from[4]. which decides whether an incoming call can be accepted or not. It also decides which of the available radio access networks is most suitable to accommodate the incoming call. Figure 2 shows call admission control procedure inheterogeneous cellular networks. A multi-mode mobile terminal wanting to make a call will send a service request to the JCAC algorithm. The JCAC scheme, which executes the JCAC algorithm, will then select the most suitable RAT for the incoming call.

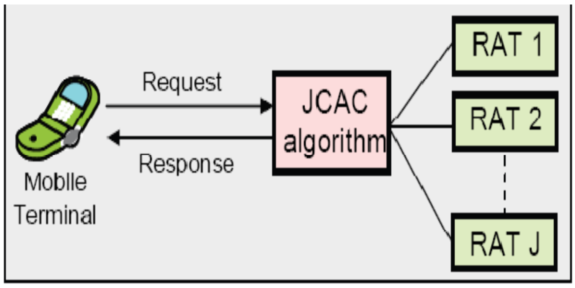



**Figure 2:** Call admission control procedure in heterogeneous cellular networks.

Bandwidth allocation strategies for wireless networks can be classified into four groups namely complete sharing, complete partitioning, handoff call prioritization, and service class prioritization.

- **Complete Sharing**: An incoming call is accepted, regardless of the class/ type, as long as there is enough radio resource to accommodate it.
- **Complete Partitioning:** Available bandwidth is partitioned into pools and each pool isdedicated to a particular type of calls. An incoming call can only be admitted into a particular pool.
- **Handoff Call Prioritization:** Handoff calls are given more access to radio resources than new calls. New calls may be blocked whereas handoff calls are still being admitted.

**Service-Class Prioritization:-**Certain classes of calls are given preferential treatment over some other classes of calls. For example, class-1 calls may be blocked whereas class-2 calls are still being admitted.

### B. Call admission control in integrated WLAN and 3G cellular networks

There have been some works on call admission control in integrated WLAN and 3G cellular networks,[5]. Most significant ones are WLAN-first approaches, mobility based algorithms and policy based CAC schemes.

If mobile terminals locate in a WLAN service area, both new voice and data calls first request admission to the WLAN. If rejected, the calls overflow to 3G cellular network. If mobile terminals with on-going voice and data calls move into the WLAN, the calls always try to handoff to WLAN. This unconditional preference to WLAN aims to take advantage of cheaper and higher bandwidth in WLAN, compared to 3G cellular network,[6]. However, these approaches may cause an over-crowded traffic situation in WLAN, without load balance in both networks.

Mobility based algorithms:The processing load and new call blocking probability can be reduced while maintaining reasonable throughput in the WLAN. Besides handoff management based on mobility information, more works are needed for considering service differentiations, QoS cost, and user preference, to provide global optimization for resource utilization in integrated networks.

### C. Policy Based CAC Schemes

As shown in Figure 3, a pairing of a policy decision point (PDP) and policy enforcement point (PEP) exist in both engines, along with policy repositories. PEP is responsible for the execution of a policy that is decided by PDP, and the policy repositories define the policies that must be followed for a proper handover decision. In the call admission control procedure, PEPs in the mobile terminals consult a PDP residing at the network for available resources. The PDP will make a decision on call admission, based on network capacities, QoS level, call types, user preferences as well as estimations on current network load and performances. This approach gives flexibility to the terminal and the network to make the best possible handover decision, and implements load balance. However, there are several drawbacks of this policy method, such as high latencies to fetch context information during the candidate access point classification procedure, and no optimization policy is defined for resource allocation in integrated networks.

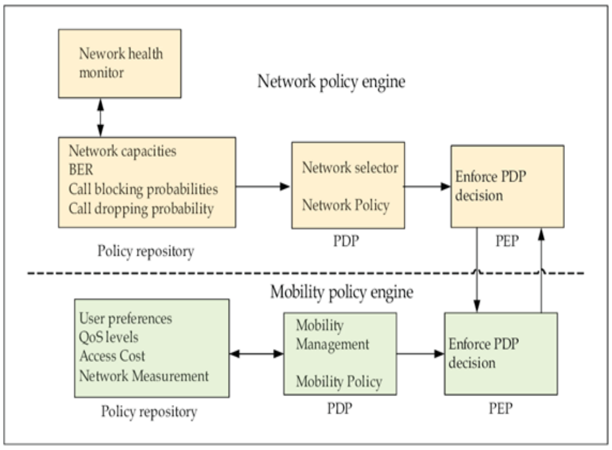
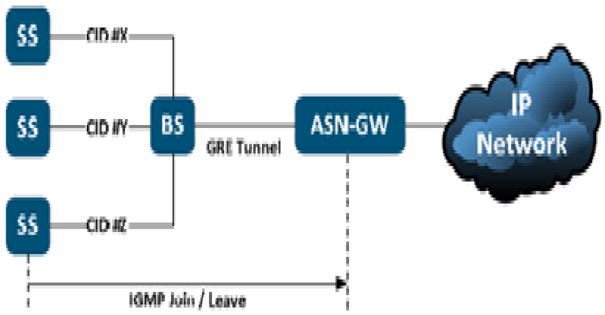



**Figure 3:** Policy based call admission control

### D. Admission Control in IP Multicast over Heterogeneous Access Networks



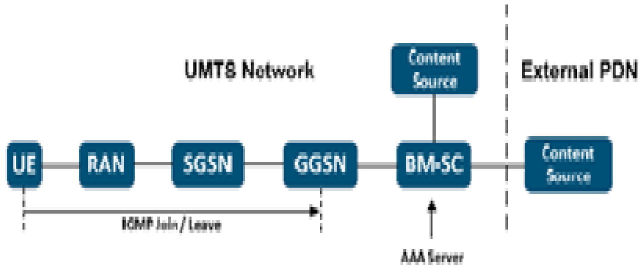




**Figure 4:** Wimax and UMTS architecture call admission control

The architecture uses the existing AAA functionality to perform user identification and multicast session admission control. This control is made at the network layer with no protocol modification.

WiMAX and UMTS network architecture is depicted in Figure 4. Before packets can be transmitted, an IEEE 802.16 transport connection must be created between a Base Station (BS) and a Subscriber Station (SS). These connections are identified by a 16-bit Connection ID (CID) number, and by a layer 2 tunnel between the BS and Access Service Network Gateway (ASN-GW) [7]. In WiMAX the role of IGMP router falls upon the ASN-GW network element, which is also responsible for client AAA. Upstream connections (SS to ASN-GW) are exclusively point-to-point. Downstream connections can be used to transmit data to a group of SSs (under the same BS), using multicast CIDs (mCIDs). Multicast CIDs are therefore suited for IP Multicast data transmission. This solution requires the establishment and management of mCIDs and their associations with IP multicast-based services. These management mechanisms and related protocols are still under development by the WiMAX Forums Networking Group.

IP multicast packet transmission inside the UMTS network is performed over point-to-point tunnels (from the GGSN to the UE), thus no sharing gains are achieved. MBMS adds a new network element to the UMTS network. Its functions include MBMS multicast session announcements, user authentication and authorization, and signaling. In order to support MBMS services all UMTS network elements require additional functionality. MBMS multicast data distribution is designed only for downstream connections (from the BM-SC to the UE); any upstream multicast traffic must go to the GGSN and then forwarded to the intended recipients. Multicast group joining and leaving is carried out through IGMP messages and multicast groups are represented by IPv4 class D addresses. MBMS is designed for IP multicast interoperability. However, the interface that connects the BM-SC to external Packet Data Networks (PDNs) is not yet specified in the latest 3GPP release. Therefore, MBMS services are limited to a single UMTS network.

### E. Priority Based Admission Control Mechanism

The highest priority is audio traffic, the second is video streaming, and the lowest is data transmission. And the priorities of these services are given in Table 1. Because each service has special attributes and performance requirements, we set up the priority of networks for the services. For example, there are three networks considered like WLAN, WCDMA and WiMAX, [8]. The network priority of audio is WCDMA, WiMAX. And WLAN that of the video is WLAN, WiMAX and WCDMA, and the data is WLAN, WiMAX and WCDMA. Thus, it can make the system accommodate much more users and improve the system utilization.

**Table 1:** The priority of service class Differentiation

| ID | Service type | Call type | Priority |
|---|---|---|---|
| SC1 | Audio | Handoff | 1 |
| SC2 | Video | Handoff | 2 |
| SC3 | Audio | New | 3 |
| SC4 | Data | Handoff | 4 |
| SC5 | Video | New | 5 |
| SC6 | Data | New | 6 |

At first, the platform measures the status information of heterogeneous networks such as service type, session type, bandwidth requirement, delay sensitivity, user preference etc. When a session request arrives, the admission control module will look up the available network list and select the target network according to the session information.

When a unique network is available, the session is admitted directly. When several networks are available, the session is admitted after the optimal target network is selected to guarantee load balancing and maximizing utility according to utility function of heterogeneous networks. When no network is available, further measurement is taken into consideration such as session type, priority. If the session is the handoff call, the target network is selected on basis of the default network priority and the existing session with low priority is forced to handoff to another network. If the session is a new call, the session priority is considered to determine whether the priority of the session is high or low. The new session with highest priority for example audio session is admitted by forced handoff like as the handoff session and the other new sessions are rejected.

When the forced handoff occurs, those outward sessions at the marginal border are selected as the first choice. The sign will be marked up after the handoff is finished, which can avoid the frequent handoff. Thus these criteria can guarantee the success probability of all handoff sessions and new session with high priority.

**F. Throughput Based Admission Control.**

Now the discussion is on Throughput Based Admission Control algorithms protect the network from overloading by determining whether incoming requests will be rejected or accepted. If the acceptance of a user will increase the load η on the cell above a threshold level η threshold whereby the quality of the ongoing calls is reduced and the quality of the call itself cannot be guaranteed, the user will not be admitted to the system.

The system presented is very tightly coupled UMTS/WLAN network. In this environment the RNC monitors and manages all service requests from the WLAN and UMTS access networks. The systems transport preferences are to initiate inelastic services, such as voice or video, and some low rate data on UMTS. Other higher rate data services, such as file transfers are initiated on WLAN. The purpose of CAC is to improve the stability and capacity of the combined systems. This is achieved by allowing a burdened system redirect new service request, or low priority service. For Example, A mobile initiated voice call request is generated via the RACH [9], which is forwarded through the Node B, to the RNC. The RNC calculates the load value $\eta_{new}$ of the new service. The RNC then evaluates load $\eta_{umts}$ on the Node B due to the ongoing UMTS services. If $\eta_{new} + \eta_{umts} \leq \eta_{threshold}$ the service is admitted, and a dedicated channel is set up for the service. Otherwise, the RNC evaluates load $\eta_{wlan}$ on Access Point due to ongoing WLAN services. If $\eta_{new} + \eta_{wlan} \leq \eta_{threshold}$ the service is admitted to WLAN. Failing that, the service is blocked, and backoff occurs.

## 3. Challenging Issues

- **Adaptive bandwidth allocation**
  With multimedia applications, system utilization and QoS performance can be improved by adjusting the bandwidth allocation depending on the state of the network and users QoS requirements[10].
- **Heterogeneous environment**
  4G systems will consist of several types of wireless access technologies, so CAC schemes must be able to handle vertical handoff and special modes of connection such as ad hoc network on cellular.The heterogeneous networks should support a broad range of multimedia services with guaranteed quality of service. In order to support the requirements, a new call admission control is needed to support the integrated architecture[11].
- **Cross-layer design**
  Both call and packet-level QoSs need to be considered to design CAC algorithms[12]. so that not only the call dropping and call blocking probabilities, but also the packet delay and packet dropping probabilities can be maintained at the target level. While the research on cross-layer AC policies focuses on single-antenna systems, which does not capitalize on the significant benefits provided by multiple antenna systems.
- **Support for Quality of service**
  Distribution of the available channel capacity among the set of multiple users; those are operating with different bandwidth requirements ensuring the QoS requirements of the traffic.In order to support multiple types of service with different QoS requirements in heterogeneous wireless networks [13], efficient resource management, call admission control strategies, and mobility management are important issues.
- **Fairness in resource assignment**
  The main drawback of CAC scheme basing their admission criterion on the call priority is that high priority calls often monopolize the new resources[14]. This results in a severe blocking of low priority call and consequently, in high CBP levels for the low priority

traffic flow. Specific CAC scheme exist which take into consideration fairness criteria based on various network parameter, such as the network throughput or the CBP achieved, to ensure that no SC or user class dominates the network resources.

- **Transmission Rate**
  CAC scheme are employed to guarantees the minimum bandwidth requirement for ongoing calls moreover, every SC call may also have a maximum bandwidth requirement. Based on the available resources, a CAC scheme aims at providing the highest possible bandwidth between the minimum and maximum requirement to every call and, at the same time, reducing CBP[15]. Certain CAC schemes incorporate Qos renegotiation, a mechanism which is activated when the cell resources of network of network cell are not sufficient, to reduce the transmission rate of ongoing calls, as much as required for the admission of a new call. The reduced transmission rate may be increased when resource are released due to the termination of the call.
- **User's mobility characteristics**
  Users mobility is a critical factor in wireless network as users travel across multiple cells; thus, the traffic in the cells is variable and it cannot be precisely predicted as an active terminal may move from one cell to a neighboring one, resulting in calls handoff. If a handoff call cannot be served by the BS of the new cell, it is, dropped increasing the call dropping rate. Since users are more sensitive to call dropping than to call blocking, CAC schemes[16] are employed to reduce the handoff failure probability.

## 4. Applications

- Internet protocol television (IPTV)[20],system through which television services are delivered using the Internet protocol suite over a packet-switched network such as the Internet, instead of being delivered through traditional terrestrial, satellite signal.
- Safety-critical applications such as remote surgery where availability issues can be hazardous. A doctor to perform surgery on a patient even though they are not physically in the same location. It is a form of tele presence [21]. A robot surgical system generally consists of one or more arms (controlled by the surgeon), a master controller (console), and a sensory system giving feedback to the user.
- Network operations support systems either for the network itself, or for customers' business critical needs, Operations support systems (also called operational support systems or OSS) are computer systems used by telecommunications service providers [22].supporting processes such as maintaining network inventory, provisioning services, configuring network components, and managing faults.
- VoIP [23] systems employ control and signaling protocols to control the signaling, setup, and tear down of calls. They transport audio streams over IP networks using special media delivery protocols that encode a voice, audio, video with audio codes and video codes as digital audio by streaming media. Some implementations rely on narrowband and compressed speech, while others support high fidelity stereo code.

## 5. Summary

Thus Admission Control uses different mechanism like joint admission control, novel, policy and priority based, and admission control can be defined as the set of online actions that need to be taken during the flow establishment phase to determine whether the flow should be admitted or not and its primary role is to control the amount of traffic injected to the network. Then a novel joint CAC scheme which is used for resource reservation and admission control. The responsibility of CAC is not only to avoid blocking and dropping handover connection, but also to reduce unnecessary handover. Further, it decides which of the available radio access network is most suitable to accommodate the call. The CAC then uses the priority mechanism, which is used to accommodate the high priority call than the lower priority by determining whether priority of the session is high or low. Finally the discussion is on throughput based scheme, which is going to admit the call, which is less than the presser threshold value, otherwise it drops the call. Finally the discussion is on the challenging issues like, cross layer design, fairness in resource allocation & transmission rate etc. The network guarantee the minimum bandwidth request for the ongoing call and which is used to provide the Qos to the users. Based on the available resources, the scheme provides the highest possible bandwidth between the minimum and maximum requirement to every call. To provide requested Qos under any offered traffic conditions, thus performing authentication prior to establishing connections over networks.

Finally we conclude that the important issue to be addressed is to avoid the congestion free network, by providing the available bandwidth and resource to the users, in order to support multiple types of service with different QoS requirements in heterogeneous wireless networks.

## 6. Future Scope

Techniques adopted for admission control and location discovery may be improved by reliable one so that space and time complexity may be reduced. In some cases when more and more number of nodes increase then quality parameters need to be incorporated to get better quality of service while communication. Sometimes the network is wired and sometimes it is wireless so signaling overhead can be measured to achieve lower handoff latency. Overall throughput can be calculated under heavily loaded network conditions. Security aspect that could be integrated into the system in order to detect adversaries.

## References

[1] F. Ma, W.A. Zhou, J.D. Song, "Application of Spectrum Pooling Based on Cognitive Radio for Modern Service Industry", The IET 2nd international

conference on wireless, mobile& multimedia networks on 12-15 October,2008, pp. 102-105.

[2] Georgoulas, S.; Pavlou, G.; Borcoci, E.; Ho, K.H.; Vraka, E.; "Admission Control for End-to-End Multimedia Content Delivery with Quality of Service Guarantees", Image Analysis for Multimedia Interactive Services, 2008. WIAMIS '08. Ninth International Workshop on 7-9 May 2008 Page(s):105 – 108.

[3] Tragos, E.Z.; Tsiropoulos, G.; Karetsos, G.T.; Kyriazakos, S.A.; "Admission control for QoS support in heterogeneous 4G wireless networks Network", IEEE Volume 22, Issue 3, May-June 2008 Page(s):30 – 37

[4] Bejaoui, T.; Nasser, N.; "Handover and class-based Call Admission Control policy for 4G-heterogeneous mobile networks", Computer Systems and Applications, 2008. AICCSA 2008. IEEE/ACS International Conference on March 31 2008-April 4 2008 Page(s):373 – 380

[5] CHEN Ming-xin; LIU Gan; ZHU Guang-xi **,"**Utility Based Call Admission Control in WLAN**",**Acta Electronica Sinica, 2008, 07, Vol.36 , No.7 July 2008 pages 0341-4341. [7] LIU Yan hang; YUAN Sen miao; SUN Hui ping, "A Measurement- Based Admission Control Algorithm of General Packet Radio Service", Journal of Software, Vo l. 12, No. 10,2001, pages 1525- 1533

[6] W. Song, H. Jiang, W. Zhuang, and X. Shen, "Resource Management for QoS Support in Cellular/WLAN Interworking", IEEE Network, vol.19, no.5, pp.12-18, Sept-Oct 2005.

[7] D. Niyato, and E. Hossain, "call Admission Control for QoSProvisionning in 4G Wireless Networks: Issues and Approaches," IEEE Network, vol. 19, no.5, pp-11, Sept-Oct 2005.

[8] C. Goulding, B. Holland, E. Kiely and R. Skehill; "WLAN/UMTS Integration Techniques"; to appear in Proceedings of Irish Signals & Systems Conference, Belfast 2004

[9] S.L. Tsao and C.C. Lin; "Design and evaluation of UMTS-WLAN interworking strategies"; in Proceedings of Vehicular Technology Conference 2002; IEEE VTC 56th, Fall 2002

[10] M. Jaseemuddin; "An Architecture for Integrating UMTS and 802.11 WLAN Networks"; in Proceedings of Eight IEEE International Symposium on Computers and Communication ISCC03; 2003

[11] K. Ahmavaara, H. Haverinen and R. Pichna; "Interworking Architecture Between 3GPP and WLAN Systems"; IEEE Communications Magazine; Vol. 41; November 2003

[12] 3GPP TS 25.922; "Radio Resource Management Strategies"; V5.0.0 (2002-03)

[13] O.Sallent, J. Perez-Romero, R. Agusti, F. Casadevall; **"**Provisioning multimedia wireless networks for better QoS: RRM strategies for 3G W-CDMA"; IEEE Communications Magazine; Vol. 41; Feb. 2003

[14] H. Holma, A. Toscala; "WCDMA for UMTS"; John Wiley & Sons, England; 2000.

[15] H. Holma, J. Laakso; "Uplink Admission Control and Soft Capacity with MUD in CDMA"; in Proceedings of Vehicular Technology Conference 1999; Vol. 1; VTC 1999 Fall, IEEE VTS 50th

[16] Y. Fang, Y. Zhang; "Call Admission Control Schemes and Performance Analysis in Wireless Mobile Networks"; IEEE Transactions on Vehicular Technology; Volume 51, No.2 March 2002

[17] F. Yong Li, N. Stol; "A priority-orientated call admission control paradigm with QoS renegotiation for multimedia services in UMTS"; in Proceedings of Vehicular Technology Conference 2001; Vol. 3; VTC 2001 Spring, IEEE VTS 53rd

[18] L. Vignali; "Adaptive Admission Control for Granted Speech User QoS in a WCDMA mixed service scenario"; in Proceedings of IEE 3G Mobile Communication Technologies 2002; Conference Publication no. 489

[19] V. Phan-Van, D.D. Luong; "Capacity Enhancement with Simple and Robust Soft-Decision Call Admission Control for WCDMA Mobile Cellular PCN's"; in Proceedings of Vehicular Technology Conference 2001; Vol.3; VTC 2001 Fall, IEEE VTS 54th

[20] R. Ramjee, R. Nagarajan, and D. Towsley, "On Optimal Call Admission Control in Cellular Networks," Proc. IEEE INFOCOM '96, vol. 1, Mar. 1996, pp. 43–50.

[21] B. Epstein and M. Schwartz, "Predictive QoS-based Admission Control for Multiclass Traffic in Cellular Wireless Networks," IEEE JSAC, vol. 18, Mar. 2000, pp. 523–34.

[22] D. A. Levine, I. F. Akyildiz, and M. Naghshineh, "A Resource Estimation and Call Admission Algorithm for Wireless Multimedia Networks Using the Shadow Cluster Concept," IEEE/ACM Trans. Net., vol. 5, Feb. 1997, pp. 1–12.

[23] J. Hou, J. Yang, and S. Papavassiliou, "Integration of Pricing with Call Admission Control to Meet QoS Requirements in Cellular Networks," IEEETrans. Parallel and Distrib. Sys., vol. 19, no. 9, Sept. 2002, pp. 898–910.

## Author Profile

**Miss. Rajeshwari C. Choukimath,** currently perceiving PG degree in Computer Science and Engineering College Bagalkot-587102, Karnataka, India.

**Mrs. V. V. Ayyannavar** has perceived her M.Tech from VTU University and currently working as Asst. Professor in Computer Science and Engineering College Bagalkot-587102, Karnataka, India.