International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-1 Issue-2, July 2012

Improvement of call level loss performance using speed-sensitive CAC in hierarchical heterogeneous wireless networks

D.C.Vinod Rathna Kumar, K.Ramudu

Abstract*: Call Admission Control (CAC) prevents oversubscription of VoIP networks. It is used in the call set-up phase and applies to real-time media traffic as opposed to data traffic. The basic idea is the blocked calls from fast-speed users are redirected to high-tier large Cells, and the slow speed users are redirected to low-tier cells. A hierarchical overlay structure is an alternative solution that integrates existing and future heterogeneous wireless networks to provide subscribers with better mobile broadband services. Traffic loss performance in such integrated heterogeneous networks is necessary for an operator's network dimensioning and planning. This paper investigates the computationally efficient loss performance modeling for multiservice in hierarchical heterogeneous wireless networks. An approximation model with guaranteed accuracy and low computational complexity is presented for the loss performance of multiservice traffic.

***Index Terms:* Call Admission Control (CAC), Hierarchical overlay wireless network , Long Term Evaluation (LTE), performance evaluation, Quality of Service(QOS),**

I. INTRODUCTION

Now a days with the extensive development and usage of mobile broadband services there is an urgent need for high speed and continuous Internet access. This can be achieved by integration of various hierarchical heterogeneous wireless networks viz., WiFi, Worldwide Interoperability for microwave Access (WiMAX), Third-Generation (3G), and Long-Term Evaluation (LTE) popularly known as 4G. A solution that integrates various wireless networks into a hierarchical overlay system based on a hierarchical cell structure has been considered [1]. This solution has been used for the deployment of femtocell networks in 3G, WiMAX, and LTE networks [2]–[4]. The advantage of this solution is that mobile users in the systems can switch between various wireless networks for more efficient use of network resources overheads.

Additionally, frequent handoff can be incurred by mobile user's movement in those areas covered by small cells such as femtocells and leads to increased signaling overheads and operating costs. A solution to this problem is to take into account user mobility speed in call admission control (CAC) for mobility management as in cellular overlay networks In aWiMAX/femtocell overlay system presented in [2], mobile users can connect to the Internet via nearby femtocells, and the calls rejected by femtocell networks due to lack of radio access can overflow to overlaying WiMAX networks. Such kind of call overflow schemes has been used in cellular overlay networks for reducing call blocking probability and improving bandwidth utilization [5], [6]. However, allowing call overflow between the overlay networks results in forced handoff and extra signaling. Additionally, frequent handoff can be incurred by mobile user's movement in those areas covered by small cells such as femto cells and leads to increased signaling overheads and operating costs. A solution to this problem is to take into account user mobility speed in call admission control (CAC) for mobility management as in cellular overlay networks [7]–[8]. When calls are blocked due to cell capacity limits, blocked calls from fast-speed users are redirected to high-tier large cells, e.g., macro cells; blocked calls from slow speed users are redirected to low-tier cells, e.g., microcells or femto cells. This approach assigns mobile users to appropriate cells so that frequent call handoff from fast-speed users in small cells can be avoided and signaling overheads reduced.

In our current work, we consider heterogeneous overlay networks, where the overflow traffic from different networks has different statistical moments (e.g., mean and variance), which are related to the service time distributions in these networks. In addition, the statistical moments of the overflow traffic offered to a new network are redefined according to the service time distribution in this new network. The latter can be further elaborated by the following example: Consider a two tier overlay system with the single overflow traffic from tier-1 to tier-2. Service times t_s for a call are determined by a distribution function $F_1(t_s)$ in tier-1 and another distribution function $F_2(t_s)$ in tier-2. From the loss analysis in tier-1, we obtain mean m_1 and variance v_1 of the overflow traffic from tier-1 in terms of the service time distribution $F_1(t_s)$. For the loss analysis of this overflow traffic in tier-2, we need to recalculate mean m'_1 and variance v'_1 in terms of the service time distribution $F_2(t_s)$. As $F_1(t_s) = F_2(t_s)$,here, $m'_1 = m_1$, and $v'_1 = v_1$.

II. HIERARCHICAL HETEROGENEOUS OVERLAY SYSTEM

Consider a two-tier overlay system with heterogeneous wireless networks distinguished from each other in capacity, signal coverage range, statistical characteristics of service time distribution, user mobility, volume, and traffic behavior. The high tier networks are assumed to have greater signal coverage than those at the low tier; each high-tier network overlays several adjacent low-tier networks.

Revised Manuscript Received on 30 July 2012
***Correspondence Author(s)**
D.C. Vinod Rathna Kumar*, Department of ECE, AITS, Rajampet, A.P., India.
K. Ramudu, Assistant Prof. of Department of ECE, AITS Rajampet, A.P., India.

The aforementioned speed-sensitive CAC scheme is used to manage the overflow traffic between the heterogeneous overlay networks. Initially, if the new calls of fast-speed users in a lowtier network are blocked due to capacity limits, the blocked new calls are overflowed to a high-tier network for possible service. If the blocked new calls are from slow-speed users in a high tier network, they are overflowed to a low-tier network. Similar control schemes are used to handle the handoff calls between the neighboring networks at the same tier. If fast-speed users in a low-tier network cannot be handed off to a neighboring network, their handoff calls are overflowed to the networks at the high tier. The failed handoff calls of slow-speed users in the high-tier networks are overflowed to the networks at the low tier. With this scheme, a call is finally dropped when there is no bandwidth available for it in the hierarchical system; call blocking and dropping probabilities can thus be improved. Additionally, we use the bandwidth reservation scheme [10] to protect handoff calls. A portion of capacity in each tier network is reserved for handoff calls only; the remaining bandwidth is shared by all arriving calls. For simplicity, the bandwidth required by a class-*k* call, which is denoted d_k, is measured by the number of BUs.

III. PROPOSED LOSS PERFORMANCE MODEL

A. VoIP over WLAN: Voice capacity, admission control, QoS, and MAC:

Voice over internet protocol (VoIP) is one of the fastest growing Internet applications. It is a viable alternative to the traditional telephony systems due to its high resource utilization and cost efficiency. Meanwhile, Wireless Local Area Networks (WLANs) have become a ubiquitous networking technology that has been deployed around the world. Driven by these two popular technologies, Voice over WLAN (VoWLAN) has been emerging as an infrastructure to provide low-cost wireless voice services. However, VoWLAN poses significant challenges since the performance characteristics of wireless networks are much worse than that of their wire line counterparts, and the IEEE 802.11-based WLAN was not originally designed to support delay-sensitive voice traffic. In this paper, we provide a survey of recent advances in VoWLAN voice capacity analysis, call admission schemes, and medium access control (MAC) layer quality of service (QoS) enhancement mechanisms.

B. WiMAX femtocells: a perspective on network architecture, capacity, and coverage

Femtocells are viewed as a promising option for mobile operators to improve coverage and provide high-data-rate services in a cost-effective manner. The idea is to overlay low-power and low-cost base station devices, Femto-APs, on the existing cellular network, where each Femto-AP provides high-speed wireless connection to subscribers within a small range. In particular, Femto-APs can be used to serve indoor users, resulting in a powerful solution for ubiquitous indoor and outdoor coverage, using a single access technology such as WiMAX. In this article we consider a WiMAX network deploying both macro BSs and Femto-APs, where it is assumed that Femto-APs have wired backhaul such as cable or DSL and operate on the same frequency band as macro BSs. Simulation results show that significant areal capacity (throughput per unit area) gain can be achieved via intense spatial reuse of the wireless spectrum. In addition, Femto-APs improve indoor coverage, where the macro BS signal may be weak. Motivated by the gains in capacity and coverage offered by femtocells, we review the state of the art of this "infant" technology, including use cases and network deployment scenarios, technical challenges that need to be addressed, and current standardization and industry activity.

C. On femto deployment architectures and macrocell offloading benefits in joint macro-femto deployments:

Macro and femtocells provides insights on possible deployment architectures for femtocells along with an analysis framework for quantifying macro offloading benefits in realistic network deployment scenarios by means of advanced performance analysis techniques. Such benefits include potential enhancement in quality of radio signals for users served by the macro network in joint macro-femto deployments. This in turn translates into potentially better data rates (throughput) for macrocell users and may offer the possibility of adding more users to the macro network while preserving the network configuration -- resulting in direct capital expenditure savings. The approach taken in this article consists of creating a framework for quantifying macro offloading benefits in joint macro-femto deployments. A baseline configuration where all users (indoor and outdoor) are served by a traditional macro network (state-of-the-art macro only network) is considered first. The analysis is followed through joint macro-femto deployments, where femtocells serve indoor users. Through comparison of the baseline configuration and the joint macro-femto analysis, we quantify the benefits of the joint macro-femto deployment.

D. Microcellular communication systems with hierarchical macrocell overlays: traffic performance models and analysis:

A hierarchical overlaid scheme suitable for high-capacity microcellular communications systems is considered as a strategy to achieve high system performance and broad coverage. High-teletraffic areas are covered by microcells while overlaying macrocells cover low-teletraffic areas and provide overflow groups of channels for clusters of microcells. New calls and handoff calls enter at both the microcell and macrocell levels. Handoff calls are given priority access to channels at each level. The layout has inherent load-balancing capability, so spatial teletraffic variations are accommodated without the need for elaborate coordination of base stations (wireless gateways). An analytical model for teletraffic performance (including handoff) is developed. Theoretical performance characteristics that show carried traffic as well as blocking, handoff failure, and forced termination probabilities are derived. Effects of nonuniform teletraffic demand and channel allocation strategies on system performance are discussed.

E. On the design of mobility management scheme for 802.16-based network environment:

The characteristics of IEEE 802.16 and conclude that it is better to equip BS (base station) and SS (subscriber station) with Layer 3 functionality.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Therefore, an 802.16 network can act as the backbone network of different subnets for better deployment. Based on the two IEEE Specifications, 802.16-2004 and 802.16e, we propose two kinds of paradigms of the 802.16 network technology for mobile networking. In the first paradigm, a novel concept called middle-domain mobility management in between macro- and micro-domain for 802.16-2004 is proposed. The management scheme of middle-domain is designed to accommodate different micro-mobility protocols in an 802.16-2004 network environment. Moreover, a mathematical analysis and simulation study are presented for performance evaluation. In the second paradigm, by comparing with traditional overlay networks (e.g. GPRS/WLAN), we have found that the characteristics for the 802.16e/802.11 overlay network are actually different from traditional overlay networks. To provide more efficient vertical handoff, a novel protocol called speed-based vertical handoff scheme (SVH) is proposed. A Simulation study has demonstrated that SVH can achieve a better performance than its WLAN-first counterpart in terms of less signaling and fewer packet losses.

IV. MODULE DESCRIPTION

A. Deign of Heterogeneous wireless networks

We consider heterogeneous overlay networks, where the overflow traffic from different networks has different statistical moments (e.g., mean and variance), which are related to the service time distributions in these networks. In addition, the statistical moments of the overflow traffic offered to a new network are redefined according to the service time distribution in this new network.

B. Call admission control (CAC) scheme

With the speed-sensitive CAC scheme [9], bidirectional call overflows, both upward and downward, are supported in the hierarchical heterogeneous overlay systems. Blocked calls from fast-speed users are overflowed to the higher tier networks with larger coverage; blocked calls from slow-speed users are overflowed to the lower tier networks with smaller coverage. For conciseness, we elaborate our model by assuming that only upward overflow traffic from fast-speed users exists. The same analysis method can be used for downward overflow traffic from slow-speed users.

C. Data traffic management

IEEE 802.21 module uses the make-before-break (MBB) algorithm for the seamless handover. In this algorithm mobile node connect with new network before terminating its previous network. By using the MBB algorithm mobile node will use both interfaces at the same time in order to perform a seamless handover. IEEE 802.21 add-on modules uses only signal strength and the interface type for the interface selection. The proposed and implemented algorithm uses the available bandwidth, coverage radius, user mobility and power of the battery along with RSS for the interface selection. Access of different networks causes the different level of the battery power consumption, due to difference in energy required for transmitting and receiving the packets.

The battery power consumption for the WiFi interface is more than the power that of WiBro (mobile WiMAX) interface. MN can be in normal mode or power saving mode. If the MN is in power saving mode there is no handover from WiMAX to WiFi because of battery power consumption for WiFi is more than WiMAX interface and to avoid power loss during handover.

V. PERFORMANCE EVALUATION

A. Handovers

A system or network performance is evaluated based on some parameters, here we consider handover, generally a handover or handoff refers to the process of transferring an ongoing call or data session from one channel connected to the core network to another. Performance is measured under the successful handovers a system can make without the termination of the call.

B. Packet drop

Generally a packet contains group of messages or information. An efficient network is one which gives the minimum packet drop, the less the packet drop the more will be the network performance. Here we make a minimum packet drop service.

C. Time delay

The time gap between the sent message and received message is known as the time taken for message transmission. Delay must be always minimum or zero for an ideal case. Network performance is also evaluated through time delay.

VI. SIMULATION ENVIRONMENT

It is assumed that 24 nodes move over a square area of 300 × 1500*m*2. Each simulation has been run for 900 seconds of simulation time.

VII. SIMULATION RESULTS

In this section, we show and analyze the simulation results of overall Packet delivery ratio, overall throughput, delay comparison, overall communication comparison, performance under different packet loss rates, call dropping probability.

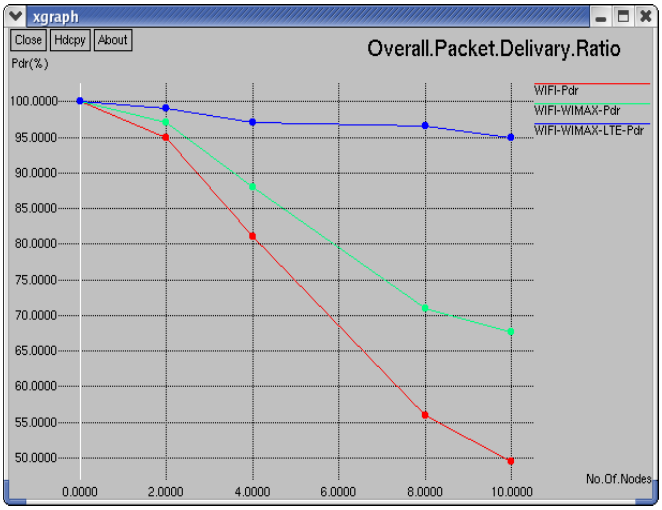

Fig 1: It gives overall packet delivery ratio in wifi, wifi-wimax. wifi-wimax-lte.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

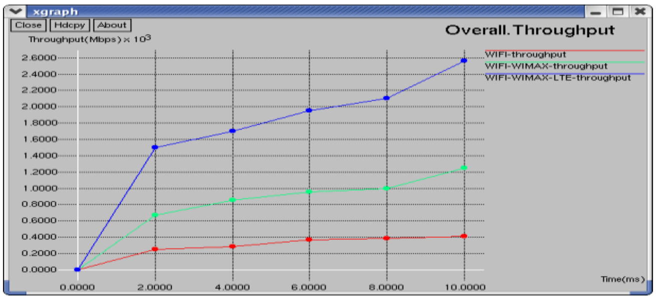

Fig 2: In these graph we are showing overall throughput for wifi, wifi-wimax, wifi-wimax-lte.

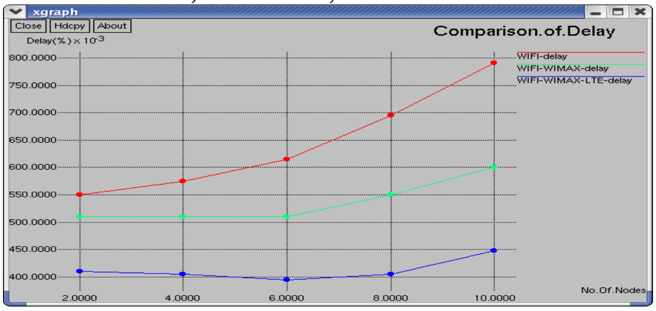

Fig 3: comparison of delay between wifi, wifi-wimax, wifi-wimax-lte.

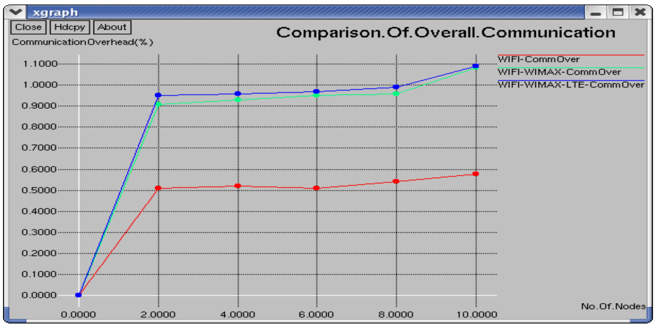

Fig 4:communication comparison between wifi, wifi-wimax, wifi-wimax-lte

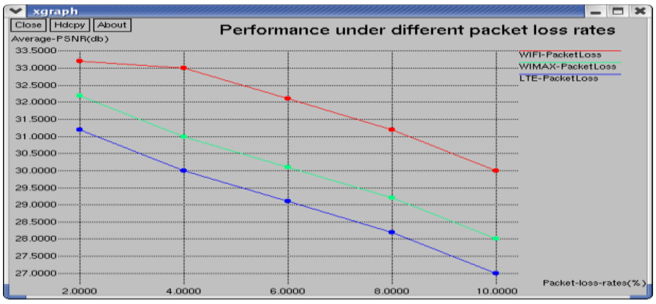

Fig 5: performance under different packet loss rates for wifi, wimax, lte.

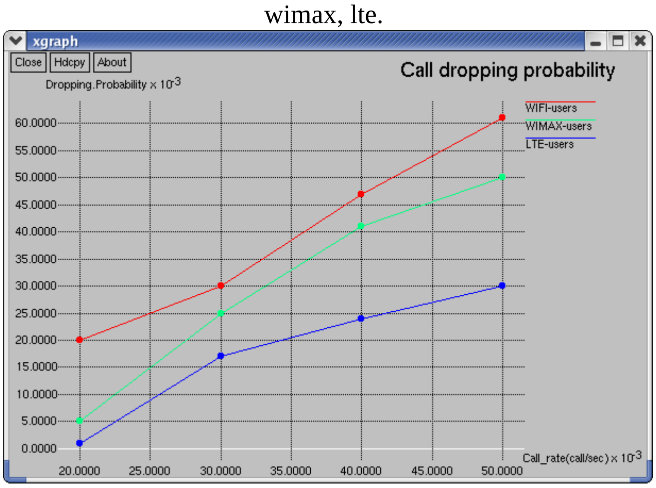

Fig 6: call dropping probability in wifi, wimax, lte.

VIII. CONCLUSION

In this paper we have explained graphically the overlay networks performance by calculating the overall throughput of the hierarchical networks (Wifi-Wimax-LTE) and compared individually.

By taking the effects of user mobility, bandwidth reservation,
cell coverage, and varying service time distributions for cells at the same or different tiers into consideration, we have proposed a comprehensive loss model to obtain the numerical solution of multiservice loss performance in hierarchical heterogeneous overlay networks. We have also demonstrated that the use of a speed-sensitive CAC scheme in hierarchical heterogeneous overlay networks helps improve the call-level loss performance.

REFERENCES

1. WU, B. MUKHERJEE, AND D. GHOSAL, "HIERARCHICAL ARCHITECTURES IN THE THIRD-GENERATION CELLULAR NETWORK," *IEEE WIRELESS COMMUN.*, VOL. 11, NO. 3, PP. 62–71, JUN. 2004.
2. S.-P. Yeh, S. Talwar, S.-C. Lee, and H. Kim, "WiMAX femtocells: A B perspective on network architecture, capacity, and coverage," *IEEE Commun. Mag.*, vol. 46, no. 10, pp. 58–65, Oct. 2008.
3. D. Calin, H. Claussen, and H. Uzunalioglu, "On femto employment architectures and macrocell offloading benefits in joint macro-femto deployments," *IEEE Commun. Mag.*, vol. 48, no. 1, pp. 26–32, Jan. 2010.
4. R. Y. Kim, J. S. Kwak, and K. Etemad, "WiMAX femtocells: Requirements, challenges, and solutions," *IEEE Commun. Mag.*, vol. 47, no. 9, pp. 84–91, Sep. 2009.
5. S. S. Rappaport and L.-R. Hu, "Microcellular communication systems with hierarchical macrocell overlays: Traffic performance models and analysis," *Proc. IEEE*, vol. 82, no. 9, pp. 1383–1397, Sep. 1994.
6. L.-R. Hu and S. S. Rappaport, "Personal communication systems using multiple hierarchical cellular overlays," *IEEE J. Sel. Areas Commun.*, vol. 13, no. 2, pp. 406–415, Feb. 1995.
7. C. Yang, C. Tsai, J. Hu, and T. Chung, "On the design of mobility management scheme for 802.16-based network environment," *Comput. Netw.*, vol. 51, no. 8, pp. 2049–2066, Jun. 2007.
8. D. J. Lee, B. C. Shin, and D. H. Cho, "Speed estimation of mobile station in additive noise and Rayleigh fading environments," *Wireless Netw.*, vol. 8, no. 6, pp. 541–548, Nov. 2002.
9. Y.-R. Haung and J.-M. Ho, "Distributed call admission control for a heterogeneous PCS network," *IEEE Trans. Comput.*, vol. 51, no. 12, pp. 1400–1409, Dec. 2002.
10. P. V. Orlik and S. S. Rappaport, "On the handoff arrival process in cellular communications," *Wireless Netw.*, vol. 7, no. 2, pp. 147–157, Mar./Apr. 2001.

AUTHOR PROFILE

D.C. Vinod Rathna Kumar received B.Tech Degree in Electronics& Communication Engg. From JNT University, Anantapur, India. Presently he is with Annamacharya Institute of Technology & Sciences, Rajampet, A.P., India in Dept. of ECE and pursuing his M.Tech. His research interests include Wireless communication Networks.

K. Ramudu B.Tech & M.Tech Degree in Electronics & Communication Engg. From JNT University, Hyderabad, India.Presently he is with Annamacharya Institute of Technology & Sciences, Rajampet, A.P, India. He is working as Assistant Professor in Dept. of ECE. He presented many research papers in National & International Conferences & journals.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)