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Enhanced Adaptive Call Admission Control Scheme With Bandwidth Reservation for LTE Networks

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ABSTRACT

Call admission control (CAC) is one of the radio resource management techniques that regulates and provide resources for new or ongoing calls in the network. The existing CAC schemes wastes bandwidth due to its failure to check before degrading admitted real-time calls and it also increases the call dropping probability (CBP) and calling blocking probability (CBP) of real-time calls due to the delay incurred when bandwidth is degraded from them. This paper proposed an enhanced adaptive call admission control (EA-CAC) scheme with bandwidth reservation. The scheme employs a prior-check mechanism that ensured bandwidth to be degraded will be enough to admit the new call request. It further incorporates an adaptive degradation mechanism that degrades non-real time calls before degrading the RT calls. The performance of the EA-CAC scheme was evaluated against two existing schemes using Vienna LTE system level simulator. The EA-CAC scheme exhibits better performance compared to the two schemes in terms of throughput, CBP, and CDP of RT calls without sacrificing the performance of NRT calls.

KEYWORDS

Bandwidth, Call Admission Control (CAC), Call Blocking Probability (CBP), Call Dropping Probability (CDP), Degradation, Long-Term Evolution (LTE), Non-Real Time, Radio Resource Management, Real Time

INTRODUCTION

Today, wireless broadband technologies (WiBB) are fast evolving to satisfy the present and future demand of users for efficient transmission of multimedia applications. Long Term Evolution (LTE) is one such WiBB technologies designed by the Third Generation Partnership Project (3GPP) for efficient transmission of multimedia applications by delivering high data rates, improving flexibility, and spectral efficiency. These features make LTE an attractive solution for both users and mobile operators (Angelos, Elli, Luis, and Christos, 2011).

LTE employs different radio resource management (RRM) techniques to improve the utilization of available network resources and minimize network congestion for different types of users (Mamman, Zurina, Azizol, and Abdullah, 2018). An efficient RRM technique that will handle the network resources efficiently is required due to the fact that network resources are in most cases scarce

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(Daniel, Edem and Enoch, 2014). Specifically, an efficient call admission control (CAC) scheme which regulates resources for new call requests or ongoing calls is needed. Call admission control is the process of accepting a new call or a handoff call request into the network while maintaining the quality of service (QoS) of admitted or ongoing calls (Vaishali and Uttam, 2019). Call requests are classified into two: new call and handoff call request. A new call is a call request that is requesting for a new connection into the network while a handoff call is an ongoing or already connected call that needs to be transferred from one cell to another without compromising the quality of service (QoS) of existing calls (Solomon, Abdulhakeem, Aminu, Maniru and Zaharadeen, 2019).

Several CAC schemes have been proposed in LTE with the aim of reducing call blocking and call dropping probability, guaranteeing the QoS of calls and utilizing the available network resources. The schemes proposed in (Ali *et al*, 2010, Senkapa and Franklin, 2012, and Ramraj *et al*, 2014) focused on reducing call blocking and call dropping probabilities for both new and handoff calls. However, the schemes starve lower priority call requests thereby increasing their call blocking and dropping probabilities. The schemes also fail to utilize network resources efficiently in some situations where bandwidth are reserved in advance for handoff call requests. While the scheme in (Chadchan & Akki, 2011, Khabazian *et al* 2012, Belghith *et al*, 2016a; AlQahtani, 2017) were more concerned about guaranteeing QoS of different users. However, the schemes increase call blocking and call dropping probabilities of lower priority calls. On the other hand, the schemes proposed in (Lei *et al*, 2008 and Belghith *et al*, 2016b) focused on improving resource utilization for different traffic types. The schemes ensure that resources and bandwidth are utilized effectively among all traffic types.

An Adaptive Call Admission Control with Bandwidth Reservation scheme was proposed by Maharazu, Zurina, Azizol & Abdullah (2017) to provide efficient resource utilization and prevent BE traffic starvation. The scheme increases the throughput of BE traffic and reduces both Call Blocking Probability (CBP) and Call Dropping Probability (CDP) for BE traffic. However, the QoS of RT calls is not guaranteed as a result of the degradation mechanism that is applied to all admitted RT calls when there are insufficient resources to admit a new call. Recently, a QoS-aware call admission control (QA-CAC) was presented by Maniru, Aminu, Abubakar, Ahmed & Abdulhakeem (2019). The scheme guaranteed the QoS of RT calls thereby increasing the throughput RT calls and reduces their dropping rate. However, it wastes bandwidth in a situation whereby the degraded bandwidth is less than the requested bandwidth. It also reduces the throughput of NRT calls as a result of the degradation approach applied to NRT calls

In this paper, an enhanced adaptive call admission control (EA-CAC) scheme is proposed to address the shortcomings of the scheme proposed by Maharazu *et al.* (2017) and the QA-CAC scheme presented by Maniru *et al* (2019). For the purpose of this paper, the scheme presented by Maharazu *et al.* (2017) will be given the acronym of ACAC i.e. adaptive call admission control scheme. The EA-CAC scheme introduced a prior-check mechanism that will ensure bandwidth to be degraded will be enough to admit the requested call. It further employs an adaptive degradation mechanism that will degrade all admitted calls one (class) after the other, i.e. by degrading NRT first and then degrading RT calls.

The major contributions of this paper are: implementation of a prior-checking mechanism which leads to an improved CAC scheme that guaranteed QoS of calls, better network throughput, low blocking and dropping rates of RT calls without sacrificing the performance of NRT calls in terms of throughput, CBP and CDP. The rest of the paper is organized as follows. The next section presents the review of related works and then followed by the description of the proposed enhanced adaptive call admission control (EA-CAC) scheme with bandwidth reservation for LTE networks. The performance evaluation of the proposed EA-CAC scheme against the ACAC and QA-CAC is also presented. Lastly, the paper concludes by summarizing the results obtained after several simulation experiments.