# Voice-Based Communication Management Techniques for Developing Networks

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***Abstract:*** **Compared to its predecessors, LTE focuses on accelerating both upload and download rates. Mobile technology has made it possible for developers of applications to provide additional choices that will improve the user experience. Streaming, banking, and gaming, to name a few, will all function flawlessly on your smartphone. Call admission control (CAC) directly affects both the overall system efficiency and the quality of service (QoS) for individual connections in 4G cellular networks. For cellular networks, reservation-based CAC methods have been suggested in the past. These schemes provide a certain portion of the system bandwidth to high-priority calls, such as hand-off calls and real-time new calls. For 4G vehicle networks, traditional reservation-based systems are ineffective since the allotted bandwidth may not be used efficiently at low hand-off rates. We provide a method for channel borrowing that allows fresh best effort (BE) calls to use the bandwidth that has been set aside for high-priority calls. The servicing of a borrower BE call, if any, will be preempted if a hand-off call comes in later and all the channels are busy. In this study, we concentrate on the system modeling and performance assessment of the suggested plan. We provide two system models that roughly reflect how the suggested approach might function.**

***Keywords:*** **Voice-Based, High-Speed Wireless Communication, Network, Management Techniques.**

## 1. INTRODUCTION

Long Term Evolution, or LTE for short, is seen as the next big thing in mobile technology. The fourth generation of mobile technology, LTE, is an advancement above 3G, 2G, and 1G. Global mobile carriers have updated or are in the process of updating their networks to the newest technologies. The simplest way to describe LTE networks is as the mobile equivalent of broadband for dial-up access. Mobile phones can now access everything on the Internet as if they were linked to a fixed broadband connection thanks to LTE. Compared to its predecessors, LTE focuses on accelerating both upload and download rates. Mobile technology has made it possible for developers of applications to provide additional choices that will enhance the user experience. Streaming, banking, and gaming, to name a few, will all function flawlessly on your smartphone.

LTE is an all-IP technology that converts phone conversations into digital information and transmits it over networks. This technological change will improve your phone calls and discussions by reducing network traffic. LTE has the ability to reallocate bandwidth across several callers in real time when capacity is limited. We are approaching a day when more people will use their phones to access the Internet more quickly than fixed lines thanks to mobile technologies. When automobiles are able to interact with one another, such as vehicle-to-vehicle or vehicle-to-roadside communications, safety applications often call for quick message exchanges that don't use a lot of bandwidth [1–9]. However, non-safety multimedia applications that need fast Internet for mobile users are the focus of the development of vehicle networks. Thankfully, the cellular network landscape in the telecommunications sector is expanding quickly from 2G to 4G to handle consumers' increased mobility and the rising use of multimedia apps.

Two new broadband wireless technologies in 4G, Worldwide Interoperability for Microwave Access (WiMAX) and Long-Term Evolution (LTE), are designed to provide 100 Mbps high-speed Internet speeds up to 350 km/h [1, 2]. Researchers in the area of automotive networking have recently focused on studying the performance assessment and enhancement of 4G/5G vehicle networks [10–15]. Call admission control (CAC) is regarded as one of the radio resource managements (RRM) features of 4G vehicle networks, and it directly affects the efficiency of the system as a whole as well as the quality of service (QoS) for individual connections.

Controlling the quality of existing connections without any call dropouts while regulating the admission of new users is the aim of the CAC mechanism. CAC methods were created to manage voice traffic in conventional mobile networks, such as cellular and vehicle networks. However, the development of workable and effective CAC methods for 4G vehicle networks [16–21]. difficult work because of user mobility, multimedia traffic's heterogeneity, etc. However, 4G wireless network protocols like WiMAX and LTE allow for creativity in CAC design. The most often used QoS metrics for performance assessment in CAC scheme design are call blocking probability (CBP) and call dropping probability (CDP). Call blocking is the practice of rejecting new calls because of network capacity limitations or QoS requirements. Call dropping is the practice of ending an ongoing call during a hand-off procedure because of a user's mobility (pedestrian or vehicle). It is more annoying to have a call abruptly ended than to have a fresh call blocked.

In cellular/vehicular networks, hand-off calls are thus handled differently and are prioritized above new calls. Specifically, depending on the time-varying condition of vehicle traffic, we may either dynamically assign channels for a single cell or reserve a certain number of channels from the total number of accessible channels in a cell for hand-off calls.

The amount of channel reserve for handoff calls is mostly determined by the mobility patterns of users, i.e., by combining factors like mean speed, traffic density, and so on in vehicle traffic modeling. The mobility model may be used to calculate the hand-off call arrival rate in a variety of mobile cellular network research projects. The assumptions utilized while estimating user movement and traffic patterns will determine the CAC designs based on these models. The wide variety of hand-off rates in vehicular networks is caused by the rapid movement of the vehicles.

For 4G vehicle networks, a suitable CAC design should be resilient enough to accommodate a wide variety of hand-off rates [22–24]. This encourages us to suggest a CAC system that is strong enough to accommodate a wide variety of hand-off rates. We will provide a CAC scheme that may significantly increase CBP throughout a wide range of hand-off rates without impacting CDP, regardless of the traffic model and mobility pattern. This encourages the use of the suggested plan for 4G automotive networks.

## 2. EXISTING METHODOLOGIES

The current research methods that have been published since 2010 are included in this section. Zulhasnine et al. have examined the interference difficulties caused by defective transmitter design and spoke about the spectrum sharing challenges on the 3GPP-LTE cellular network. Lai et al. have proposed an architecture that uses optimized proxy mobile IPv6 to carry out effective hand-off between IEEE 802.11 and EPS networks. In order to achieve IP flow mobility and normalize WLAN (Wireless Local Area Network) traffic, John and Ventura's work is also seen to use proxy mobile IPv6. Li et al.'s study demonstrated research on integrating security and access policy. To improve 3G network authentication, the authors have implemented common cryptographic concepts. Ahmed and Choukair's study effort for EPS-based services highlights the problem of mobile service. Despite the authors' claims that this method may significantly reduce traffic, no noteworthy results were found to support this claim. Wang et al. used statistical analysis to objectively examine the LTE network's transmission characteristics. Path-loss and coherence bandwidth were taken into account by the authors in order to assess the results of their investigation. Aiash et al. have put up a framework designed to accommodate the many features of LTE networks.

The research demonstrated how well the YComm framework works for analyzing LTE network components.

Guasch conducted important research on LTE networks from the perspective of cloud computing. The author has researched the LTE network's virtualization features. After researching scheduling issues in LTE networks while taking video traffic into account, Swetha et al. ultimately suggested a fair scheduling method that uses round robin to improve quality of experience (QoE). Sharma and Chopra [24–30] have conducted research in a similar vein while taking scheduling concerns into account. In cellular networks, guard channel-based call admission control techniques are a traditional area of in-depth study (Lunayach et al., 1982; Posner & Guerin, 1985; Hong & Rappaport, 1986).

Guard channel-based techniques have mostly been used to lower the handoff failure probability in mobile cellular networks. They reserve a certain amount of resources (bandwidth/number of channels/transmission power) for the exclusive use of a call type (i.e., new, handoff, etc.). The Conventional Guard Channel (CGC) scheme1 (Hong & Rappaport, 1986), Fractional Guard Channel (FGC) policies2 (Ramjee et al., 1997; Fang & Zhang, 2002; Vázquez-Ávila et al., 2006; Cruz-Pérez & Ortigoza-Guerrero, 2006), Limited Fractional Guard Channel scheme (LFGC) (Ramjee et al., 1997; Cruz-Pérez et al., 1999), and Uniform Fractional Guard Channel (UFGC) scheme3 (Beigy & Meybodi, 2002; Beigy & Meybodi, 2004) are examples of call admission control strategies based on guard channels. Due to their simplicity and efficacy as resource management methods, they have been generally accepted as prioritizing approaches in cellular networks for over 30 years (Lunayach et al., 1982; Posner & Guerin, 1985; Hong & Rappaport, 1986). The various approximated mathematical analysis techniques put forth in the literature for the performance evaluation of Guard Channel-based call admission control for handoff prioritization in mobile cellular networks are thoroughly reviewed and compared in this section.

The system under consideration is framed within the framework of birth and death processes using the basic principles of the model that is offered in the majority of the cited texts. Consideration is given to a homogenous multicellular system having S channels in each cell. Additionally, it is believed that the cell dwell time for both new and handed-off calls, as well as the unrestricted call length, have a negative exponential probability density function (pdf). As a result, the holding duration of the channel is likewise negatively exponentially distributed. The average channel holding time for new and handed-off calls is shown by $1/\mu n$ and $1/\mu h$, respectively. Lastly, it is assumed that the mean arrival rates for new and handoff calls, $\lambda n$ and $\lambda h$, respectively, follow separate Poisson processes. Users with new and handed-off calls often have distinct cell stay duration means and probability distributions (Posner & Guerin, 1985; Hong & Rappaport, 1986; Ramjeeet al., 1997; Fang & Zhang, 2002). The channel holding time, or how long a call takes up a channel in a certain cell, has a direct impact on the channel occupancy distribution in that cell. The minimum of the cell dwell time and the unobstructed service time determines the channel holding time. The effective average channel holding time, on the other hand, is determined by the channel holding times of both new and handed-off calls as well as their corresponding admission rates. It is the average amount of time that a call, whether new or handed off, occupies a channel in a cell.

## 3. PROPOSED METHODOLOGY

A new call is a member of one of the network's designated traffic classes. In addition to new call arrivals, a cell may also create hand-off calls as a result of user movement inside the cell. Keep in mind that the traffic categorization for the hand-off calls is the same.

The Markov modeling of the system, assuming a wireless network with N traffic classes, would result in a Markov chain with a 2×N-dimensional state space, rendering mathematical analysis impossible.

We examine a 4G wireless network with two primary priority traffic classes in order to demonstrate the efficacy of our suggested reservation-based CAC system and to provide an analytical performance assessment for it. We assume that the high-priority class in our model only includes hand-off calls originating from other cellular network cells. This class may also be used to group the new calls that are made in real time in the current cell.

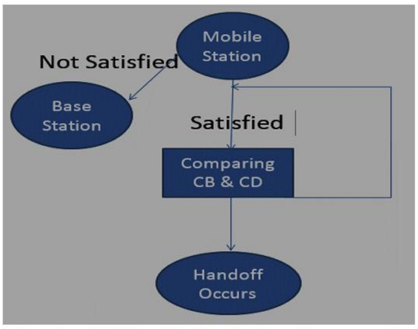


Figure 1: Flowchart of the Proposed Method

The new calls created in the present cell are in the low-priority class. We presume that the new calls fall under the non-real-time (nRT) new call category. Calls as well as new calls with best effort (BE). Web traffic and non-real-time multimedia traffic (such YouTube videos) are examples of BE and nRT calls, respectively. Live broadcasting is an illustration of real-time traffic. With parameters $\lambda H$, $\lambda nRT$, and $\lambda BE$, respectively, it is assumed that the arrival processes of hand-off, nRT, and BE calls are Poisson distributed. Furthermore, we assume that the parameters $\mu H$, $\mu nRT$, and $\mu BE$, respectively, for the service processes of the hand-off, nRT, and BE calls are exponentially distributed.

There are C channels (bandwidth units) in the system, which means that the bandwidth is channelized. Keep in mind that C does not represent the network capacity in terms of the volume of traffic delivered; rather, this depends on the interference and wireless channel model of the users. The amount of physical network resources in a cell that should be allotted to incoming calls is indicated by C in this model; for example, the number of physical resource blocks in an LTE network. The suggested new call boundary scheme serves as the foundation for our channel borrowing concept, which we will now refer to as the customary scheme (CAC). After going over the new call bounding scheme, we describe how we apply our channel borrowing strategy to it.

## 4. CONCLUSIONS

The most significant problem that LTE networks face is making effective use of the spectrum that is available while still delivering a level of service that is satisfactory to mobile consumers. The use of the same bandwidth among neighboring cells, on the other hand, results in the appearance of Inter-cell Interference (ICI), particularly near the cell edge. There is the possibility that a hand-off arrival call would pre-empt the service of a borrower BE call. The BE calls that have been pre-empted will be held in a queue so that they can continue their service at a later time.

Furthermore, in order to simplify the mathematical analysis, we modeled the channel borrowing scheme by using a mixed loss-queuing system. Additionally, we developed two system approximations for the suggested borrowing scheme. Through the use of simulations and numerical analysis, we were able to demonstrate that the two approximations provide CBP and CDP values that are very near to the real CBP and CDP values. Additionally, it was shown that channel borrowing results in a significant reduction in CBP, whereas it only results in a minor rise in CDP concentration. Our research makes the assumption that the number of channels that are earmarked for high-priority calls, denoted by the letter T, stays constant. The optimization of T with regard to the number of users in the cell and the arrival rate of high-priority calls is something that might be considered as a potential future effort in this field of study.

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