Techniques for Managing Voice-Based Communication in Network Expansion

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***Abstract* - Unlike its predecessors, LTE focuses on increasing upload and download speeds. Mobile technology allows developers of programs to provide more options that would enhance the user experience. Among a few, streaming, banking, and gaming will all run well on your smartphone. Directly affecting both the general system efficiency and the quality of service (QoS) for individual connections in 4G cellular networks is call admission control (CAC). Reservation-based CAC techniques have been proposed historically for cellular networks. These programs provide high-priority calls—such as hand-off calls and real-time new calls—a set amount of the system bandwidth. Conventional reserve-based solutions are useless for 4G car networks as the allocated bandwidth may not be utilized effectively at low hand-off rates. We provide a channel borrowing technique wherein fresh best effort (BE) calls may make use of the bandwidth allocated for high-priority calls. Should a hand-off call arrive later and all the channels are occupied, the servicing of a borrower BE call—if any—will be postponed. We focus in this work on the system modeling and performance evaluation of the proposed scheme. We provide two system models that essentially capture the possible performance of the proposed method.**

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

1. INTRODUCTION

In mobile technology, LTE—long term evolution—is seen as the next great thing. LTE, the fourth generation of mobile technology, rises above 3G, 2G, and 1G. Globally mobile providers have either upgraded their networks to the newest technology or are working on doing so. LTE networks are easiest understood as the mobile counterpart of broadband for dial-up access. Thanks to LTE, mobile phones can now access anything on the Internet as if they were connected to a fixed broadband connection. Unlike its predecessors, LTE focuses on increasing upload and download speeds. Thanks to mobile technology, developers of programs may now provide more options that would improve the usability. Among a few, streaming, banking, and gaming will all run well on your smartphone.

An all-IP technology, LTE turns phone talks into digital data and sends it over networks. This technical shift will lower network traffic, therefore enhancing your phone calls and conversations. When capacity is constrained, LTE may real-time reallocate bandwidth across numerous callers. Thanks to mobile technology, we are fast nearing a day when more people will use their phones to access the Internet than via fixed lines. Safety applications generally ask for rapid message exchanges that consume little bandwidth when vehicles may interact with one another, like vehicle-to--vehicle or vehicle-to--roadside interactions [1–9]. But the growth of car networks centers on non-safety multimedia applications requiring fast Internet for mobile users. Fortunately, the scene of cellular networks in the telecoms industry is rapidly changing from 2G to 4G to accommodate customers' growing mobility and increasing usage of multimedia applications.

Designed to provide 100 Mbps high-speed Internet rates up to 350 km/h [1, 2], two new broadband wireless technologies in 4G, Worldwide Interoperability for Microwave Access (WiMAX) and Long-Term Evolution (LTE) are intended Studies on the performance evaluation and upgrading of 4G/5G car networks have lately attracted the attention of local automotive networking researchers [10–15]. Considered as one of the radio resource management (RRM) characteristics of 4G vehicle networks, call admission control (CAC) directly influences both the general system efficiency as well as the quality of service (QoS) for individual connections.

The CAC system aims to control the quality of current connections without any call dropouts by means of new user admission. Conventional mobile networks like cellular and vehicle networks developed CAC techniques to control voice traffic. Still, the creation of sensible and successful CAC techniques for 4G car networks [16–21] challenging task resulting from user mobility, heterogeneous multimedia traffic, etc. But 4G wireless network technologies like WiMAX and LTE let CAC design be creatively flexible. In CAC scheme design, call blocking probability (CBP) and call dropping probability (CDP) are the most widely utilized QoS measures for performance evaluation. Rejecting new calls due to network capacity restrictions or QoS requirements is known as call blocking. Call dropping is the practice of stopping an ongoing call during a hand-off process due to user mobility—that of a pedestrian or a vehicle. Having a call cut off suddenly irritates more than having a new call blocked.

Hand-off calls in cellular/vehicular networks are therefore managed differently and given more priority than fresh ones. In particular, based on the time-varying status of vehicle traffic, we may either dynamically allocate channels for a single cell or reserve a fixed number of channels from the overall number of available channels in a cell for hand-off calls.

The mobility patterns of users essentially define the level of channel reserve for handoff calls; so, in vehicle traffic modeling, mean speed, traffic density, and so on all help to define this level. Many mobile cellular network research projects might find the hand-off call arrival rate using the mobility model. The CAC designs depending on these models will be determined by the presumptions used when evaluating user mobility and traffic patterns. The fast mobility of the vehicles causes the great variation of hand-off rates in vehicular networks.

A good CAC design for 4G vehicle networks should be strong enough to allow a range of hand-off rates [22–24]. This motivates us to propose a CAC system powerful enough to allow a range of hand-off rates. Regardless of the traffic model and mobility pattern, we will provide a CAC technique that may greatly raise CBP throughout a broad spectrum of hand-off rates without affecting CDP. This is the recommended strategy for 4G automobile networks' application.

2. CURRENT APPROACHES

This part includes the present research techniques that have been published since 2010. Examining the interference problems resulting from poor transmitter design, Zulhasnine et al. have discussed the spectrum sharing issues on the 3GPP-LTE cellular network. Lai et al. have presented an architecture that effectively hand-off IEEE 802.11 and EPS networks using optimal proxy mobile IPv6. John and Ventura's work also uses proxy mobile IPv6 in order to enable IP flow mobility and normalize WLAN (Wireless Local Area Network) traffic. The paper by Li et al. on combining security and access regulation showed research on The authors have used standard cryptographic ideas in order to enhance 3G network authentication. The research effort of Ahmed and Choukair for EPS-based services draws attention on the issue of mobile services. Although the authors assert that this approach might drastically cut traffic, no notable data could find to support this assertion. Wang et al. investigated the transmission properties of the LTE network objectially using statistical analysis. The authors considered path-loss and coherence bandwidth in order to evaluate their study outcomes. Aiash et al. have presented a structure meant to support the many characteristics of LTE networks. The study showed the effectiveness of the YComm framework in component analysis of LTE networks. From the standpoint of cloud computing, Guasch conducted significant investigation on LTE networks. The author has looked at the virtualization tools of the LTE network. Following video traffic consideration and scheduling concerns in LTE networks, Swetha et al. finally proposed a fair scheduling technique using round robin to raise quality of experience (QoE). While considering scheduling issues, Sharma and Chopra [24–30] have done research in a similar line. Guard channel-based call admission control systems are a classic topic of in-depth research in cellular networks (Lunayach et al., 1982; Posner & Guerin, 1985; Hong & Rappaport, 1986).

Mostly used to reduce the handoff failure rate in mobile cellular networks, guard channel-based solutions have For the exclusive usage of a call type—that is, new, handoff, etc.—they set aside a certain amount of resources—bandwidth or number of channels/transmission power. Limited Fractional Guard Channel For more than thirty years, they have been largely acknowledged as prioritizing strategies in cellular networks based on their simplicity and efficiency as resource management techniques (Lunayach et al., 1982; Posner & Guerin, 1985; Hong & Rappaport, 1986). In this part we systematically analyze and evaluate the many approximated mathematical analytical approaches proposed in the literature for the performance assessment of Guard Channel-based call admission control for handoff prioritizing in mobile cellular networks.

Using the fundamental ideas of the model presented in most of the above books, the system under discussion is structured within the framework of birth and death processes. One takes into account a homogeneous multicellular system with S channels in every cell. Furthermore thought to have negative exponential probability density function (pdf) are the cell dwell times for both new and handed-off calls as well as the unlimited call duration. The channel's holding period is therefore equally negatively exponentially distributed. 1/μn shows the average channel holding time for new and handed-off calls accordingly. Finally, it is hypothesised that λn and λh, respectively, follow different Poisson processes for the mean arrival rates for new and handoff calls. Users of newly acquired and handed-off calls typically have different cell stay length means and probability distributions (Posner & Guerin, 1985; Hong & Rappaport, 1986; Ramjeeet al., 1997; Fang & Zhang, 2002). The channel occupancy distribution in a given cell directly depends on the channel holding time—that is, the duration of a call on a channel in that cell. The channel holding time is found by minimum of the cell dwell time and unobstructed service time. Conversely, the effective average channel holding time depends on the channel holding periods of both new and handed-off calls along with their respective admission rates. Whether fresh or passed off, a call's average duration consumes a channel in a cell.

3. PROPOSED METHODOLOGY

One of the traffic classes that have been established for the network is the one that a new call belongs to. Hand-off calls may be generated by a cell in addition to new call arrivals. This occurs when a user moves about inside the cell rather than leaving the cell. Remember that the traffic classification for the hand-off calls is the same as it is for the other calls.

Under the assumption of a wireless network with N traffic classes, the Markov modelling of the system would produce a Markov chain with a state space that is 2×N-dimensional, which would make mathematical analysis unfeasible.

As part of our efforts to illustrate the effectiveness of our proposed reservation-based CAC system and to give an analytical performance evaluation for it, we investigate a 4G wireless network that has two major priority traffic classes. Within the context of our model, we make the assumption that the high-priority class corresponds only to hand-off calls that originate from other cellular network cells. There is also the possibility of using this class in order to categorize the new calls that are made in the present cell in real time.

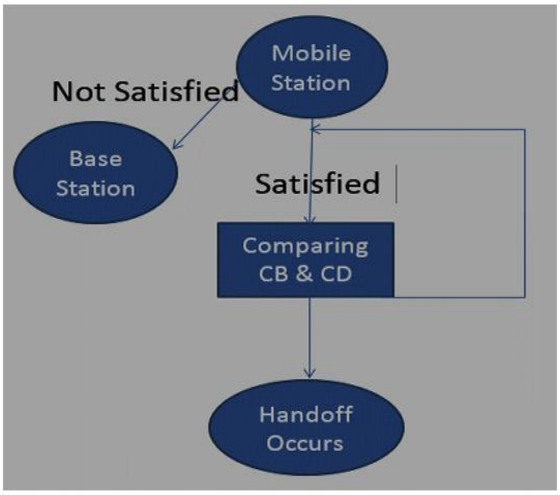

Figure 1: Diagram of the Suggested Procedure

The low-priority class was assigned to the newly formed calls that were made in the current cell. We are currently operating under the assumption that the new calls are classified as non-real-time (nRT) new calls. The calls, in addition to the new calls with the best effort (BE). Examples of BE and nRT calls include traffic on the web and traffic on non-real-time multimedia platforms, such as videos on YouTube. Providing an example of real-time traffic is the practice of live broadcasting. The assumption is made that the arrival processes of hand-off, nRT, and BE calls are Poisson distributed. This is based on the values λH, λnRT, and λBE, respectively. In addition, we make the assumption that the parameters μH, μnRT, and μBE pertain to the service processes of the hand-off, nRT, and BE calls, respectively. These parameters are assumed to have an exponential distribution.

The system is channelized since it has C channels, which are units of bandwidth. This indicates that the bandwidth is channelized. It is important to keep in mind that C does not indicate the capacity of the network in terms of the amount of data that is delivered; rather, this is dependent on the interference and wireless channel model of the users. In this paradigm, the letter C represents the quantity of physical network resources in a cell that need to be allocated to incoming calls. For instance, the number of physical resource blocks in an LTE network is an example of this. For the sake of our channel borrowing idea, which we will now refer to as the usual scheme (CAC), the new call boundary scheme that was offered serves as the basis. Following our discussion of the new call bounding scheme, we will now explain how we intend to implement our channel borrowing approach with regard to it.

4. CONCLUSION

Using the available spectrum effectively while still providing a quality of service that mobile users are satisfied with is the biggest challenge that LTE networks have. But Inter-cell Interference (ICI) becomes apparent, especially close to the cell edge, when adjacent cells share the same bandwidth. A borrower BE call may not be serviced in time if a hand-off arrival call is made before it. In order to resume service at a later time, the BE calls that were pre-empted will be kept in a queue.

Our modelling of the channel borrowing scheme included a mixed loss-queuing system, which further simplified the mathematical analysis. In addition, we proposed a borrowing method and created two system approximations to evaluate it. Numerical research and simulations allowed us to show that the two approximations provide CBP and CDP values that are close to the actual values. Furthermore, it was shown that channel borrowing significantly lowers CBP while just slightly increasing CDP concentration. The number of channels designated for high-priority calls (the letter T) remains consistent, according to our analysis. A possible next step in this area of research may be to optimize T according to the cell's user count and the arrival rate of high-priority calls.

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