QoS and Energy Efficient Resource Allocation in Uplink SC-FDMA Systems-A Review

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***Abstract*—Long Term Evolution (LTE) is the popular technology so far for 4G mobile communication networks. The most important objective of LTE is to make high rate, low latency and high eminence sustaining flexible bandwidth deployments. The optimum resource allocation is formulated as a discrete connected cake cutting drawback, where completely different agents are allocated consecutive subsequences of a sequence of indivisible items. This drawback is NP-hard, thus a suboptimal algorithmic rule is introduced, that performs resource allocation using info on the estimated uplink packet delay, the standard delay and rate of past allotment, as well as the necessary uplink power per resource block. In this paper, we tend to present comparative study of various resource allocation algorithms to boost the quality of Service (QoS) provision and energy efficiency of uplink LTE.**

***Index Terms*— Delay, energy efficiency, Long Term Evolution (LTE), Quality of Service (QoS), Resource allocation, uplink**

I. INTRODUCTION

Resource Allocation (RA) in single carrier frequency division multiple access (SC-FDMA) technique is essentially tough suitable to exact control and quality of examine constraints. Energy efficient communication is a long-standing issue in modern wireless communication systems. The mobile device radio accounts for an outsized portion of a mobile device's battery life, and intrinsically, economical use of radio resources can dramatically improve mobile device energy consumption. In recent years, MA issues are well-studied for a general OFDMA transmission [1, 2]. However, additional modern systems, like 3GPP-LTE, utilize localized single carrier frequency division multiple access (SCFDMA) at the physical layer for uplink transmissions. This is often due to the improved peak to average power ratio (PAPR) when using SC-FDMA. Furthermore, the finite set of modulation and coding schemes (MCSs) dramatically increases the optimum allocation complexness. The contributions are given in 2 elements. In the first part, the dynamic scheduling policy framework originally presented in [3] is used to allocate user data in order to minimize the overall average power disbursement for intra-user distribution while get-together long-term QoS constraints. The problem of energy efficient RA in SC-FDMA uplink for improving QoS is the main focus of this paper. Here resource allocation is performed taking into consideration the estimated packet delays in the transmission direction, the typical delay and rate of allocation in past, uplink power per resource block. In this paper focuses in brief on various resource allocations algorithmic rules for LTE transmission system and describes the suboptimal uplink resource allocation algorithm rule [7] in element. Single carrier frequency division multiple access (SCFDMA) technique has been selected as uplink transmission scheme in long term evolution (LTE) system. Unlike orthogonal frequency division multiple access (OFDMA), it converts time domain transmit signal into frequency domain signal which can be used to improve system throughput. Also its low peak to average power ratio (PAPR) feature has the potential to benefit the mobile terminals in terms of transmit power energy [2]. In [6] the authors had performed the resource allocation in time and frequency domains considering energy efficiency as a prime factor. The authors in [7] proposed an uplink resource allocation algorithm based on optimal cake cutting problem for LTE system, which focuses on QoS provision in real-time applications at an equivalent time enhancing energy efficiency issue. On the opposite hand, quality-of-service (QoS) provisioning for various forms of delay sensitive services is a very important issue that has got to be considered in most resource allocation issues. standard resource allocation algorithms for H2H usually target throughput maximization which cannot hold for M2M scenarios as MTC mostly consists of low data rate applications. However, delay needs for MTC will be critical especially for applications where real time deciding is concerned like smart grids. Therefore, simultaneous consideration of delay and data rate requirements completely characterizes the M2M/H2H coexistence scenario. in this paper, we address the problem of energy-efficient resource allocation for the uplink of LTE networks (or SC-FDMA uplink systems) under statistical QoS guarantees. To the best of our knowledge, this problem has not been investigated before in general or in M2M/H2H co-existence scenarios..

II. LITERATURE SURVEY

First Klaus Moessner et. al. [1] "QoS and Energy Efficient Resource Allocation in Uplink SC-FDMA Systems" The proposed algorithm considers the main constraints in uplink LTE resource allocation, i.e., the allocation of contiguous sets of resource blocks of the localized Single Carrier Frequency Division Multiple Access (SC-FDMA) physical layer to each user, and the imperfect knowledge of the users' uplink buffer status and packet waiting time. In this paper we present and evaluate the performance of a resource allocation algorithm to enhance the Quality of Service (QoS) provision and energy efficiency of uplink Long Term Evolution (LTE) systems. In this paper we introduced an uplink resource allocation algorithm for LTE systems, which focuses on QoS provision

in real-time applications and energy efficiency. Therefore, we also proposed a suboptimal algorithm, which complies with the constraints of a practical uplink localized SC-FDMA LTE system.

Adnan Aijaz et. al. [2] "Energy Efficient Design of SC-FDMA Based Uplink under QoS Constraints" The resource allocation problem is formulated as a maximization of effective capacity based bits-per-joule capacity under statistical QoS provisioning, which is complicated due to specific constraints of SC-FDMA. The complicated RA problem is solved using CDT. Results show that the proposed energy efficient design significantly enhances the EE while simultaneously satisfying the QoS requirements.

Dan J. Dechene et. al. [3] "Energy efficient QoS constrained scheduler for SC-FDMA uplink" In this paper we propose a framework for an energy efficient scheduler for multiuser SCFDMA with queue state information (QSI) and quality of service (QoS) constraints. The scheduling policy is obtained in two stages for the intra- and inter-user allocations respectively. Resource allocation is formulated as a two-stage problem where resources are allocated in both time and frequency.

Md. Kalil et. al. [4] "The proposed schedulers are subject to rate, delay, contiguous allocation, and maximum transmission power constraints. We first consider an optimal scheduler that uses binary integer programming (BIP). Then, we propose an iterative scheduler that performs a low-complexity greedy algorithm which solves the BIP problem. We compare the performance of the proposed schedulers to the state-of-the-art schedulers such as the energy-aware resource allocation (EARA) [1] and the proportional fair (PF) [2] in terms of rate, delay, average transmission power and complexity. The continuous increase of mobile data traffic has created a substantial demand for high data rate transmission over mobile networks. In this paper, we developed a framework for power-efficient scheduling in LTE uplink systems. Both the QoS requirements and the channel fading parameters were considered.

Fatma Irem Sokmen et. al. [5] "Uplink Resource Allocation Algorithms for Single-Carrier FDMA Systems" We considered a binary integer programming-based solution recently proposed for weighted sum rate maximization and extended it to different problems. We considered problems such as rate constraint satisfaction with minimum number sub-channels and sum-power minimization subject to rate constraints. We considered three resource allocation problems such as: weighted sum-rate maximization, transmission with minimal number of subchannels and sum-power minimization subject to rate constraints.

III. METHOD

The discovery provides for association of data streams (and/or logical channels) with individual carriers (cells), and free buffer status reporting per carrier for terminals with more than one uplink carrier configured. In a "Small Cell" scenario for 3GPP LTE, a terminal may be simultaneously served by a macro cell and one or more small cells. These may operate at different frequencies, have different traffic loading and support different QoS (Quality of Service). The creation permit autonomous control of transfer on the uplinks to the macro cell and the small cells, which can be used to optimize the user experience in relation to the accessible possessions at any given time/location, and permit exacting information to be routed via particular cells. In this paper, we propose a quality of service (QoS) uplink scheduling algorithm for long term evolution (LTE) that collaborates with delay estimation. Unlike downlink scheduling, uplink scheduling cannot incorporate packet delay information due to specification constraints of LTE.

This study considers an LTE uplink multiuser system in a single cell, where K UEs communicate with an evolved Node B (eNB).

A. Long Term Evaluation (LTE)

A Long Term Evolution (LTE) describes the latest standardization work by 3G Partnership Project (3GPP) in the mobile network technology tree previously realized the GSM/EDGE and UMTS/HSxPA network technologies that now account for over 85% of all mobile subscribers. In preparation for further increasing user demands and tougher competition from new radio access technologies, LTE is enhanced with a new radio access technique called Evolved UMTS Terrestrial Radio Access Network (E-UTRAN) unlike other latest deployed technologies such as HSPA, LTE is accommodated within a new Packet Core architecture called Enhanced Packet Core (EPC) network architecture. Technically, 3GPP specifies the EPC to support the E-UTRAN. EPC is designed to deploy TCP/IP protocols thus enabling LTE to support all IP-based services including voice, video, rich media and messaging with end-to-end Quality of Service (QoS). LTE promises to delivery truly mobile broadband services through a combination of very high DL and UL transmission speeds and reduced packet latency. LTE also ensures efficient use of spectrum and spectral flexibility which means wider deployment options while adding exciting new value-added services possibilities.

B. LTE QoS and Buffer Status Reports (BSRs)

LTE systems are designed to support a wide range of applications and services. In general, the user might run multiple applications simultaneously, each application requires different QoS. The QoS class identifier (QCI) and the allocation and retention priority (ARP) are the bearer QoS parameters. The QCI is a scalar that specifies Internet Protocol (IP) level packet characteristics of the bearers. LTE uplink scheduling takes place in the eNB, where information about buffered data sizes is reported for all UEs who have data to be transmitted using the buffer status reporting (BSR) mechanism. If a user has only one bearer, the short format is used to conserve channel resources because the short format report requires fewer bits. Although UEs may have more than four non-empty buffers, the maximum number of reporting bearers is four. In this paper, we assume that each user has a maximum of four bearers, where each bearer is modeled as an infinite first-in first-out buffer in the radio link control (RLC) sub-layer.

IV. CONCLUSION

In this paper all study is around survey on the work of QoS and Energy Efficient Resource Allocation in Uplink SC-FDMA Systems. As per survey of the related work [4] this paper, author developed a framework for power-efficient scheduling in LTE uplink systems. Both the QoS requirements and the channel fading parameters were considered. The scheduling problem was formulated and presented as a multi-stage problem. Then, it was simplified into a single point binary integer programming problem. In [1] this paper we introduced an uplink resource allocation algorithm for LTE systems, which focuses on QoS provision in real-time applications and energy efficiency.

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