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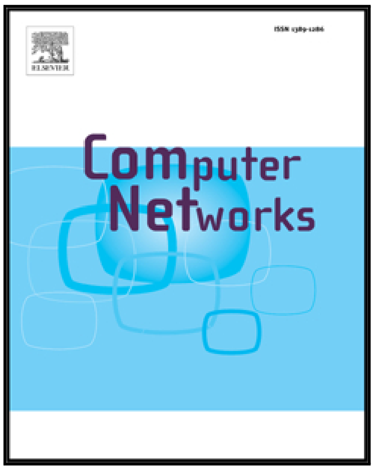

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A Novel QoS aware Medium Access Control Scheduler for LTE-Advanced Network

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***Abstract*—LTE-A specification mandates Medium Access Control (MAC) scheduler entity to ensure strict guaranteed quality of service (QoS) both in downlink and uplink direction. To the best of our knowledge the LTE-A MAC schedulers proposed so far constitute of an objective function dependent on single constraints like number of radio resources, user throughput, user channel conditions, user data buffer or user's downlink power requirement. In real world scenario if all the above constraints are not simultaneously taken into consideration, then it would be difficult to meet LTE-A QoS requirements. In this regard, to the best found knowledge, for first time in this paper, we propose a *Multi Objective QoS aware LTE-A Downlink-MAC Scheduler* (MOQDS) algorithm which adhere to two level QoS and fairness requirements of LTE-A specification. MOQDS algorithm does scheduling at two levels with each level has its *objective function* with its *multiple operational constraints*. Every transmission time interval, MOQDS uses multi-objective optimization to selects right user(s) and its corresponding application(s) to meet LTE-A QoS requirements. Simulation results are being compared with well referred LTE-A schedulers like modified largest weighted delay first, exponential rule proportional fairness and log rule under various ITU channel models. MOQDS achieves an average of 50% reduction in packet drop rate and minimum three times increased cell throughput as compared to above mentioned schedulers' types and also with respect to all the other MAC schedulers mentioned in the references.**

Keywords-component: LTE-A, MAC, Scheduler, QoS, Pareto Optimal, Min-Max, NSGAII

I. INTRODUCTION

3rd Generation Partnership Project (3GPP) body has come up with high-speed broadband wireless network specification (Release-10 and beyond), which is known as Long Term Evolution Advanced (LTE-A) architecture [1]. According to [1], the LTE-network deployment architecture is shown in Fig-1. It consist of multiple base-stations (referred as eNodeB) giving coverage to some designated geographical area. These eNodeBs are then connected to another LTE-A network element termed as Evolved Packet Core (EPC), via an IP based packet-switched network, sometime termed as IP backhaul network. Typical throughput of this IP backhaul network per eNodeB is 1Gbps. All the application servers like video streaming; audio streaming, etc. are connected to EPC via internet. The user equipment (UE) once establishes the session with eNodeB and EPC, will then be able to connect to the application servers.

To realize the application packet flow within the eNodeB system, in Fig-1 we also show the data plane protocol architecture as mandated by [1]. The data plane architecture consists of the protocol layers like physical (PHY), medium access control (MAC), radio link control (RLC), Packet Data Convergence Protocol (PDCP), and GPRS tunneling protocol user plane (GTPU). According to [1], if N number of users open M applications towards the internet, then there would be N x M numbers of logical channels created in RLC layer, with N x M queues (each application mapped to one queue) created at the MAC layer and N number of GTPU tunnels created at eNodeB system. These GTPU tunneled data is exchanged over the S1 user plane interface as shown in Fig-1.

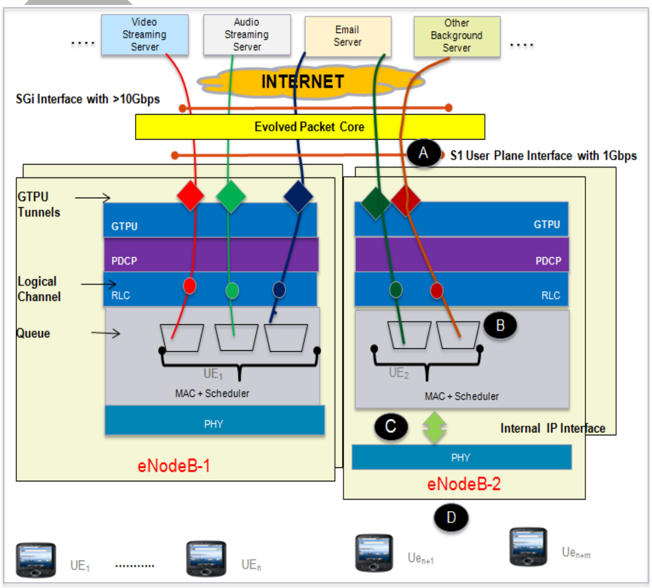

Figure 1: LTE-A Deployment and eNodeB Data Plane Architecture

In Fig-1, we also depict a two practical architecture showcasing how a PHY layer gets connected to the MAC protocol layer. In one of the architecture, there is a tight coupling between MAC protocol layer with the PHY layer (i.e. eNodeB-1) and in other architecture, there is a loose coupling between the layers using an internal IP interface (i.e. eNodeB-2).The above eNodeB-2 design of architecture is becoming popular due to cloud based radio access networks (RANs) for LTE-A. In this paper we will analyze the impact of eNodeB-2 design architecture.