Smart Adaptive-Efficient Packet Scheduler Used in Handoff in LTE-A Systems

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Abstract: ***For increased data transmission rate, larger bandwidth and hence increased capacity and increased cell edge performances paved the way to LTE-A systems. The implementation of network schedulers is inevitable in the wireless communication field. In the existing system the A-EPSA packet schedulers are used for improving the quality of service (QoS) of both GBR and NGBR traffic types while maintaining system throughput among all users. The consideration of realistic environments is not considered. So, the consideration of such environments such as handoff and mobility can be only done when the algorithm works in smarter environment. The creation of a smarter environment is done so that packet scheduling works effectively during handoff. The platform used is NS, the simulated results are compared with the algorithm in the existing form and the results are analyzed.***

Keywords: LTE-A, A-EPSA, smarter environment, S-EPSA.

1. Introduction

User demands is always the priority given in any field of technology. For faster data rates and improved cell coverage the technology has jumped onto better standards. LTE Advanced is a mobile communication standard and a major enhancement of the Long Term Evolution (LTE) standard. Formally submitted as a candidate 4G system to ITU-T in late 2009 as meeting the requirements of the IMT-Advanced standard, and was standardized by the 3rd Generation Partnership Project (3GPP) in March 2011 as 3GPP Release 10. LTE-A (Long Term Evolution-Advanced) having peak data rates of 1Gb/s these systems should meet the requirement of IMT-A systems. To get this achievement LTE-A has applied a number of new features such as support for large bandwidth (CA, Carrier Aggregation), MIMO and relaying.

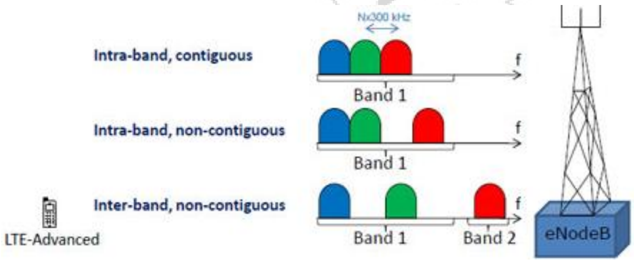

Figure 1: Carrier Aggregation; Intra-band and inter-band aggregation alternatives.

This paper proposes a smart environment built so that an existing packet scheduler A-EPSA (Adaptive-Efficient Packet Scheduling Algorithm) works more efficiently while maintaining system throughput among all users.

2. Related Works

Packet Scheduling or Network Scheduling is a very important mechanism essential in telecommunication field specifically. A scheduling discipline does two things: decides service order and manages queue of service requests. If the scheduling does not work properly then great network traffics occur. This traffic can create network congestions. So, a detailed literature survey is essential. We expect two types of future applications,best-effort (adaptive, non-real time) e.g. email, some types of file transfer guaranteed service (non-adaptive, real time) e.g. packet voice, interactive video.

Basically, many schedulers like Proportional Fair, Max-Min, Round Robin and Greedy algorithm are some schedulers that were used for packet scheduling until the ages. But as the user demands raised the requirements needed for schedulers also has to change.

In [1], Kais Mnif and *al*. proposed Adaptive Efficient Downlink Packet Scheduling Algorithm in LTE-Advanced System. It adds a new functionality of an adaptive Time Domain (TD) scheduler to adaptively allocate available resources to GBR (Guaranteed Bit Rate) and NGBR (Non GBR) traffic.

In [4], R. Kausar and *al*. proposed an Adaptive Time Domain Scheduling Algorithm for LTE-A downlink transmission. Classification of mixed traffic into different service classes and grants different scheduling priorities to them. This algorithm uses the Hebbian learning process to allocate radio resource adaptively to different types of traffic.

3. Existing System

The overall scheduling algorithm of the system model is shown in the figure below.

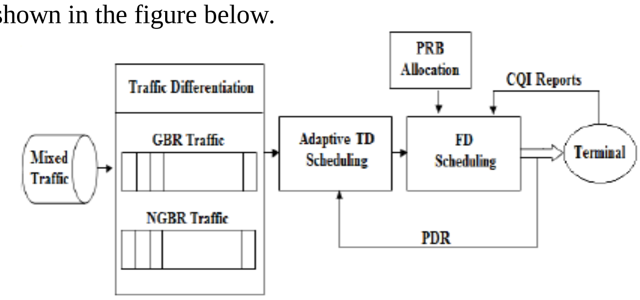

Figure 2: A-EPSA system model

It consists of various features such as traffic differentiation, an Adaptive Scheduler in the time domain (TD), a scheduler in the frequency domain (FD). The value of the PDR calculated of GBR traffic, after the transmission of each slot, will be subsequently used by the Adaptive TD Scheduler. The TD Scheduler uses this value to fix the number PRBs allocated to the GBR and NGBR traffic to each scheduling unit (each slot). The Channel Quality Information (CQI) is set by the user to the FD scheduler to make the right decision for attributing the PRB among the priority user according to the priority order chosen by the TD scheduler.

4. Proposed Ideology

4.1 Handoff in Wireless Networks

The A-EPSA is a scheduler that aim at improving QoS requirements of GBR and NGBR users. But reality environments are not considered so far. So, I decided to implement the adaptive algorithm in a reality environment like handoff. During mobility conditions the algorithm's efficiency drops. Let's consider the handoff scenario.

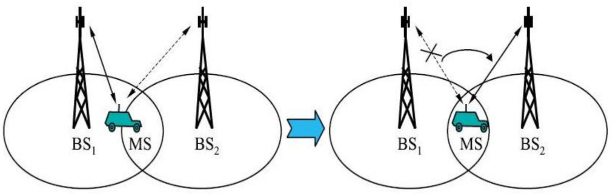

Figure 3: Scenarios depicting before and after handoff

4.2 Smart environment and S-EPSA

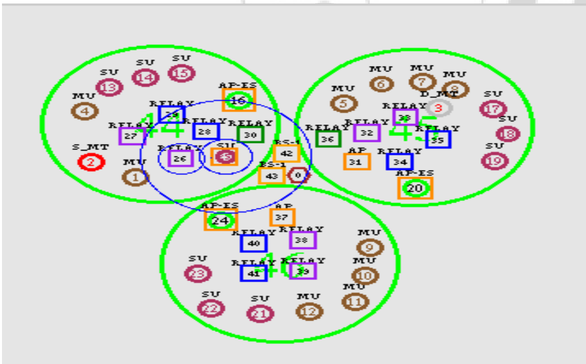

Figure 4: Smart Environment for effective working of A-EPSA

The figure 3 depicts an overall system model of the smart environment. During handover when a ongoing call attended by a mobile user it's seen that the channel switches to another channel. But if the number of users increases the network traffic rises. So, efficient scheduling of packets does not occur. In such case the rates of packet drops increases and congested situation stays. I included extra Access points energy savers (AP-ES) and two base stations instead of one, base station 1 and base station 2(BS 1 and BS 2s).

Access points (AP's) are devices used during handover. So, when the access points becomes busy or fails the access points-energy savers (AP-ES) are activated. The activated AP-ES connects to base station 2.Hence the base stations involves in handoff. The resources are allocated effectively by energy consumption to the users. Load over a base station is avoided. Handover mechanism is shared between BS 1 and BS 2. The packets are scheduled by A-EPSA and the resources are allocated effectively faster without much traffic Noises during handoff are reduced. So the algorithm works smartly by reducing the noises and faster data transfer with faster scheduling of the packets. Hence, on designing the network in this way the adaptive algorithm works efficiently. Cell edge performances are improves. So, due to multiple usages the algorithm running in such a smart environment turns into a S-EPSA (Smart-Adaptive Efficient Scheduling Algorithm) , which is termed so.

5. Simulation Results

The platform used here is Network Simulator (NS-2).It predicates the behavior of wireless networks without actually creating one.

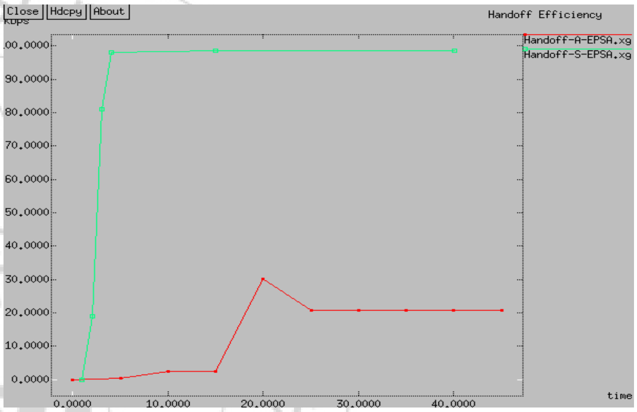

Figure 5: Comparison of Handoff Efficiency between S-EPSA and A-EPSA

In figure 4, the comparison between the schedulers in terms of handoff is done. The plotting is done between kbps and time. It can be seen that as time proceeds the switching from one channel to another with less interferences and less energy consumption is observed better when the scheduler runs in the smart environment. But the existing algorithm contains more noises , requires more energy and is subjected to more inter-cell interferences. This is what is termed as handoff efficiency. So, S-EPSA works more efficiently than A-EPSA during handoff.

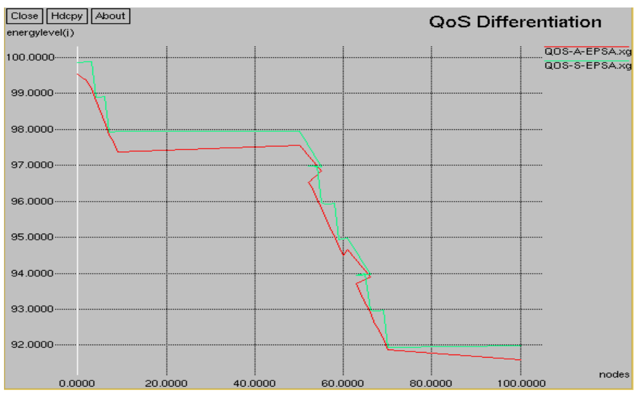

Figure 6: Comparison of QoS Differentiation between the two schedulers

While comparing between the two schedulers the cell edge performance of S-EPSA is better than A-EPSA.

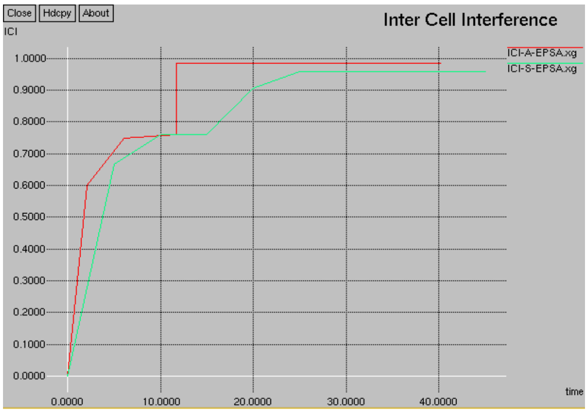

Figure 7: Comparison of Inter-cell interference between the two schedulers

Inter-cell interferences are great impediments affecting the handoff process .The cell interferences are calculated to be more for the existing algorithm than the proposed.

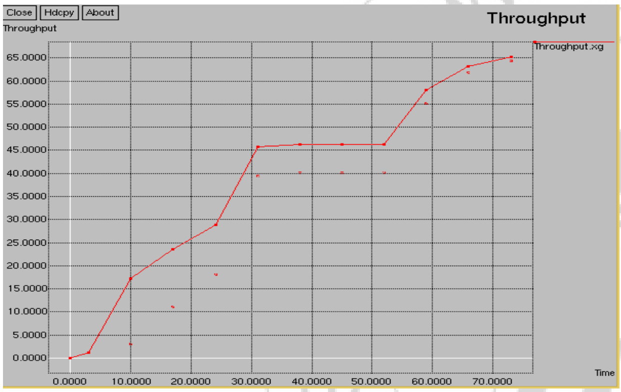

Figure 8: System Throughput of the S-EPSA

Figure 8 presents the system throughput, defined as the number of kilobits transmitted per second.

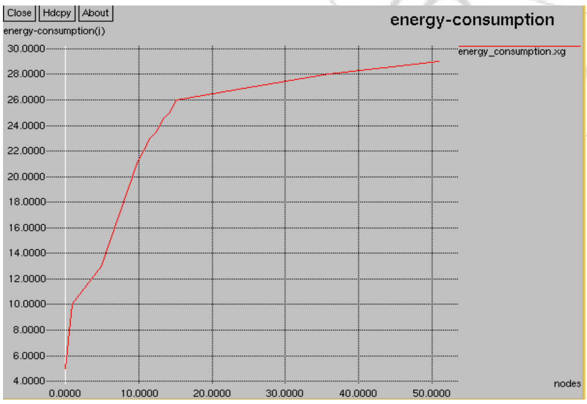

Figure 9: Energy Consumption in the smart environment

6. Conclusion

The advancement to better communication standards is a never ending process. LTE-A systems do guarantee better and faster data rate. Quality of Service is improved hence the Experience of Service. It has been observed from the simulations that the existing scheduler works better when the environment is made smarter. The A-EPSA hence is termed as S-EPSA. Simulation done using a network simulator the handoff efficiency, QoS differentiation and the inter-cell interference are simulated, and analyzed.

7. Future Works

As, future works the smart environment created can be structured in another way instead of the present one, hence infrastructure costs can be reduced.

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