A Downlink Scheduling Technique in LTE to Enhance QOS for Multimedia Services

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***Abstract*-Long Term Evolution (LTE) is a 4G technology which is having a high speed, low latency system and provides many multimedia services in mobile communication. Due to emerging multimedia services, power saving and resource allocation at the UEs is the new challenge in LTE. So a Downlink scheduling technique is proposed in LTE to improve the QoS for multimedia services. The proposed scheduling technique allocate the resources according to their priority matrix and optimize the power at the UE and ensures QoSparameters within QCI characteristics.**

Keyword-QoS, Scheduling, LTE, DRX, Multimedia.

I. INTRODUCTION

The Long Term Evolution (LTE) / System Architecture Evolution (SAE) in Release-8 which is standard by Third Generation Partnership Project (3GPP) to build 3G towards 4G.LTE supports many applications with better performance at reduced cost. LTE is designed to support high data rate of 100Mb/s in the downlink (DL) and 50 Mb/s in the uplink (UL), low latency up to10ms and improved coverage and system capacity. LTE supports radio access technology,Orthogonal Frequency Division Multiple Access (OFDMA) for downlink and Single Carrier Frequency Division Multiple Access (SC-FDMA) for uplink. The LTE operates in both Time Division Duplexing (TDD) and Frequency Division Duplexing (FDD) modes and can be deployed in a range of channel bandwidths up to 20MHz. However, the use of 4G multimedia services is limited because these services require more resources and also consumes more Power at the UEs.Hence, one of the main goalof LTE is to provide very efficient power saving mechanisms to achieve longer battery life and effectively allocate the Resource blocks [10]. One option to prolong the battery life is the use of discontinuous reception (DRX) [1]–[4] in LTE. The DRX was introduced by 3GPP [5], which allows an idle UE to save battery by turning off the radio receiver for a predefined period. There are two modes for DRX, light and deep sleep mode [1]-[4]. By considering the DRX status there is an improvement in resource blocks not to waste for particular applications.In this paper, we proposed a priority based downlink scheduling scheme for multimedia services. The proposed scheme calculates the priorities of UEs and assigns resources based on following conditions: Maximum signal to interference noise ratio (SINR) of UEs, average throughput history of UEs,Buffer space at the UEs, Real/Non-Real time services, DRX Status, oldest packet in the enodeB. The proposed scheme allocate the resource blocks to UEs and measure the performance in normal operation mode (without considering DRX status), power saving mode(considering the DRX status)and comparing proposed scheme with DRX light sleep mode and DRX deep sleep mode.

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II. RELATED WORK

The resource allocation and power saving are the two main QoS factor that directly affect the performance of network and UE. Because the 4G multimedia service require more radio resources and consume high power for providing better QoS.

A. Scheduling

In OFDM system the radio resource scheduling has been studied. Scheduling is the process of allocatingresources to the user to get better throughput, fair resource allocation while minimizing packet delay and packet losswithin Qosrequirement. There are various types of scheduling algorithm.In Round Robin (RR) the resources are allocated to each user without using channel condition [6] each user can use the resources in proper time interval. First user can use the resource for the given time interval after the completion of time then these resources is assigned to another user. The new user has placed at the end of waiting queue. The implementation of RR is easy and it result in poor throughput. This results in good fairness and it is the simplest algorithm. Best CQI scheduling algorithm chooses the highest value of CQI means that the channel quality is good.CQI is 5 bit information,a higher CQI value indicates that the channel has a better channel quality and lower value indicate low better channel quality. 5-bit CQI value ranges from 0-30.it provides excellent throughput but not fairness. In this resources are assigned to the user according to the link quality. During scheduling the terminals which are located far away from the base station are not scheduled and nearby terminals are scheduled by sending CQI to the base station.Proportional Fair (PF) scheduling algorithm is the most commonly used scheduling algorithm. PF results in high cell throughput and fairness. In PF channel condition is calculated and then resources are allocated to user which is having the highest priority and further the allocation is done to next priority user. Thisallocation is continuing until all the resources are allocate to the user. This PF scheduling algorithmdoes not take into account packet delay as a result packet loss ratio may increase.In [7] the time and frequency domain scheduling algorithm is proposed, which keep the fairness of radio resource and improve the throughput, butthis algorithm does not take into account power saving mechanism and GBR/non-GBR service, which is an important parameters of LTE networks.

B. DRX Mechanism

In LTEto save the power at UE's exploits the concepts of (Discontinuous Reception) DRXand Discontinuous Transmission (DTX) [8]. By using DRX,The terminal can turn the radio receiver into sleepmode for prolonged period to extend batterylife of the user.In LTE DRX mechanism, the sleep/wake scheduling of each UE is determined by the following four parameters: DRX Short Cycle (t_{DS}), DRX Long Cycle (t_{DL}), DRX Inactivity Timer (t_I) and DRX Short Cycle Timer (t_N). The t_{DS} andt_{DL}define duration of ON period, which is fixed value applied to both Long and Short Cycles. The UE monitors the physical downlink control channel (PDCCH) to determine if there is any transmission over the shared data channel allocated to the UE during the ON duration. In [9] the DRX-aware scheduling, which includes DRX status as scheduling decision parameter to reduce packet delay caused by DRX sleep duration. The scheduling priority is directly proportional to delay of a head of line packet delay in relation to the remaining active time before a UE enters into sleep mode.

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III. PROPOSED ALGORITHM

In this section, we proposed a priority based scheduling technique which allocate the resource blocks to UEs and quarantines the QoS for multimedia services. The priority matrix is calculated based on the following condition:

- **Maximum signal to interference noise ratio (SINR) of UEs:**which is the channel condition so the scheduler estimates CQI reports which is sent by every UEs to the corresponding eNodeB, which includes the information of SINR.
- **Average throughput history of UEs:**The scheduler will give more resources to those UEs which were lacking to fulfill their requirements by tracking the UE throughput history. So that fairness can increases among the UEs.
- **Buffer space at the UEs:** To avoid packet loss the scheduler will give priority to those UEs who have more buffer space.
- **Real/Non-Real time services:**The scheduler give high priority to RT service because GBR which is an important parameter for RT service UEs.
- **DRX Deep/light sleep status:** DRX is a power saving mechanism to save the battery life of the UE. More power saving results in packet loss and delays. So the scheduling considers the DRX deep/light sleep status to bind the delays according to QCI characteristics of LTE.
- **Oldest packet in the enodeB:** The scheduler to increase the priority of the UE, gives more resources which has the oldest packet in the enodeB buffer.

A. Proposed Priority Scheduler Architecture

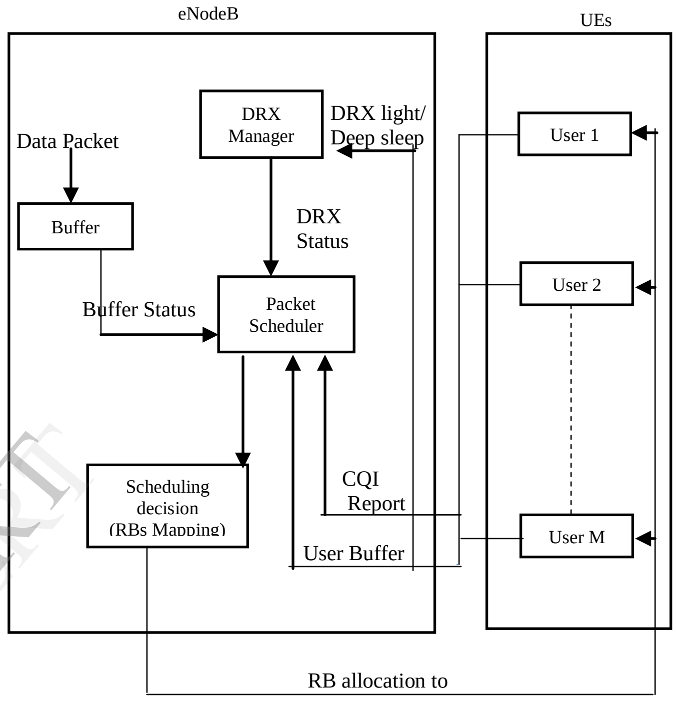

Fig.1.proposed architecture

B. Proposed scheduling Algorithm

The proposed algorithm calculates the priority matrix by considering the scheduling dependencies and allocate the available resources blocks. The algorithm is as follows

- Estimates the maximum achievable throughput for every RB if assigned to UEs based on channel condition.
- To provide fairness the scheduler calculates fairness factor

$$Fair\_factor_i = \frac{achievable\_throughput_{ij}}{average\_throughput_{ij}}$$

Achievable_throughput$_{ij}$represents the achievable throughput of RB$_j$ if assigned to UE$_i$.

- To increase the priority the scheduler calculates the buffer status of UEs.

$$Buff_i = \frac{Lbuff_i - Ncurr_i}{Lbuff_i}$$

$L_{buff}$is the length of receiver buffer length and $N_{curr}$is the length of the used space at the buffer.

- The scheduler gives more priority for RT service and then for NRT service. The priority function $P_{ij}$for RT and NRT service is calculated as

$P_{ij} = {}^{\delta}i\ (fair\_factor_i + buff\ i)$, i is NRT UE.

$P_{ij} = delay\_factor_i . {}^{\delta}i (fair\_factor_i \left(\frac{GBR}{average\ throughput_{ij}}\right)^{\wedge}\phi + buff\ i\ ))$, i is RT UE.

${}^{\delta}i$is the DRX status, if ${}^{\delta}i$=1 it is on and if ${}^{\delta}i$=0 it is in sleep condition so that can avoid resource blocks wastage.

IV.SIMULATION AND RESULT ANALYSIS

Fig 2 depicts throughput curves for Proposed Scheme. Results are taken by changing the lengths of DRX Sleep duration. The Proposed Scheme performs better system throughput to provide better fairness as DRX sleep duration increases.

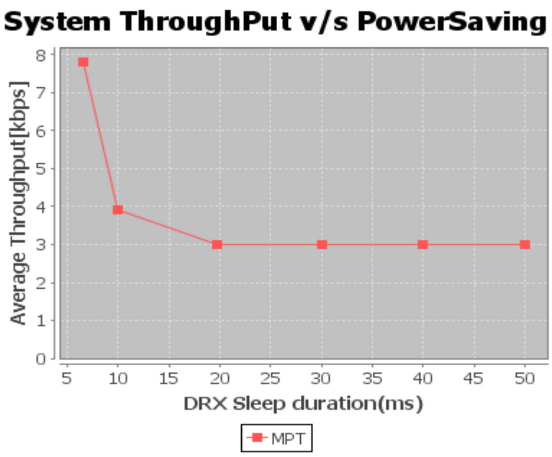

Fig.2. system throughput Vs power saving

Fig 3 depicts the fairness among the UEs. The proposed scheme performs fairness by giving more resources to the UE which packet is getting closer to delay threshold. Results are taken by increasing the sleep duration.

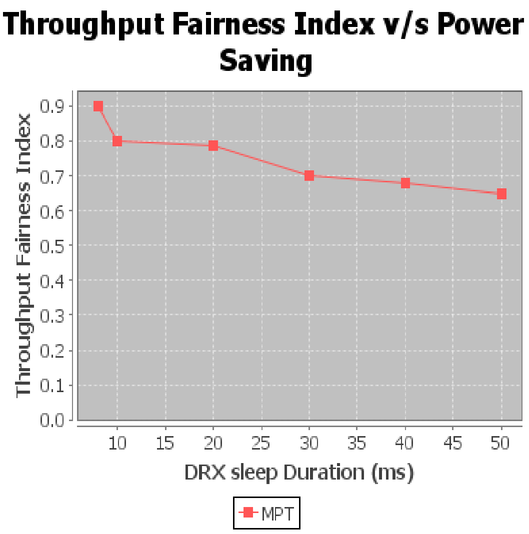

Fig. 3.Throughput fairness Vs Power Saving

Fig 4 depicts Packet delay for proposed scheme. When the DRX sleep duration increases, the most of the time UE switched off which results in packed delay. The proposed scheme results decreased packet delay as compared to other systems.

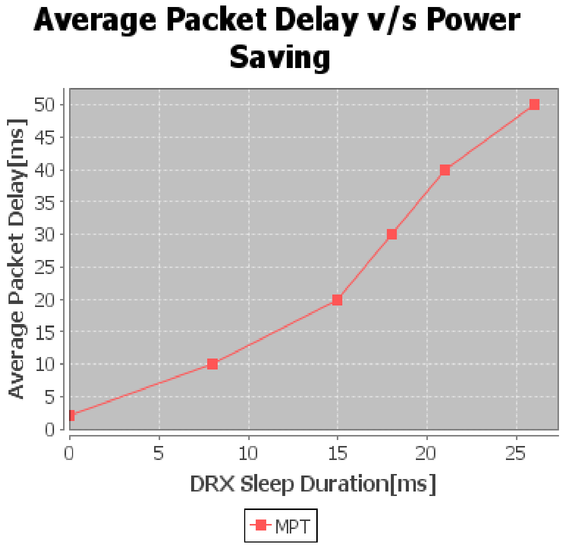

Fig.4. Average packet delay Vs power saving

Fig 5 depicts the Packet loss rate. Results are take by increasing the DRX Sleep duration. The Proposed scheme performs decreased PLR as compared to other systems.

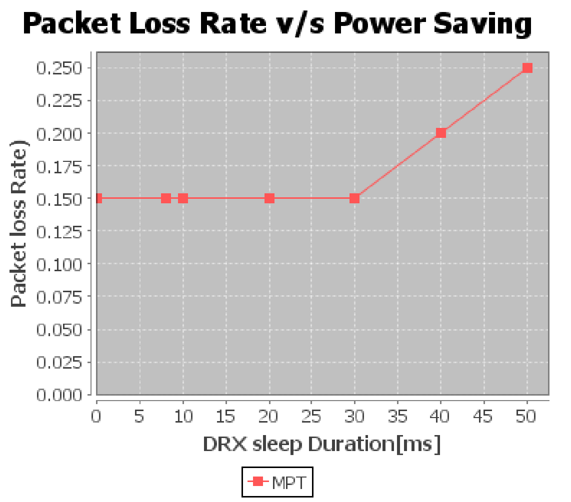

Fig .5. Packet Loss Rate Vs power saving

V. CONCLUSION

In this paper, we proposed a priority based downlink scheduling algorithm for multimedia services.The proposed scheme allocate the resource blocks to UEs based on the priority in order to increase QoS parameters for multimedia services such as system throughput, fairness and keep packet loss rate and packet delay within QCI Characterictics.And measure the proposed algorithm performance in normal operation mode (without considering DRX status), power saving mode (considering the DRX status) with the existing

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systems and comparing proposed scheme with DRX light sleep mode and DRX deep sleep mode.

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