PACKET SCHEDULING IN LTE

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Abstract

Today's data transmission networks face extreme challenges in providing high data rate and low latency. Known methods scheduling are commonly adopted in current LTE downlink scheduling algorithms, but they are far from optimal for satisfying latency requirements. In this thesis identify their main challenges of the art downlink scheduling algorithms in LTE. LTE downlink scheduling problem define as an optimization problem in order to meet the flow deadlines, then incorporate the formulation within the surveyed scheduling algorithms, to produce better performance

Dynamic resource allocation or Packet Scheduling (PS) takes care of QoS aspects on the access side by employing suitable algorithm for scheduling the data in both UL and DL. The main task of any scheduling algorithm is to maximize the network utilization and provide fairness among users. The PS is an entity of RRM in LTE which is present in the MAC layer of eNB. The MAC layer also provides most important procedures for the LTE radio interface like multiplexing/demultiplexing, random access procedures, scheduling requests etc [9].

In multiuser environment, a good PS scheme makes use of multiuser diversity and channel fading. When many users fade independently, at any time there is a high probability that one of the users will have a good channel. By allowing only that user to transmit, the shared channel resource is used in the most efficient way and the total system throughput is maximized. Thus with increasing number of users the multiuser diversity gain increases.

The difficulty lies in the fact that radio resource allocation should also satisfy fairness among UEs. Moreover, in slow fading, multiuser diversity hardly satisfies all QoS parameters at the same time, especially fairness. Ultimately, RRM should follow a combined form of multiuser diversity and fairness scheduling.

The two main entities of PS are Time Domain Packet Scheduling (TDPS) and Frequency Domain Packet Scheduling (FDPS). The TDPS selects a subset of schedulable UEs and FDPS determines the transport block size, MCS, Physical Resource Block (PRB) to UE mapping. Resource allocation for any UE is based on the scheduling decision of the algorithm. The factors that need to be considered before designing an algorithm are Qos provisioning, throughput maximization, fairness, complexity and scalability.

In LTE downlink, the QoS aspects depend on number of factors like channel conditions, resource allocation policies, available resources, delay sensitive/insensitive traffic etc. The resource allocation is realized in every TTI, that is exactly every two consecutive RBs. That is, resource allocation is done on a resource block pair basis. Fig. 3 shows the generalized model of a packet scheduler.

Resource allocation for each UE is usually based on the comparison of per-RB metric. This metric can be interpreted as the transmission priority of each UE on a specific RB. The detailed key issues in designing a scheduler are given in [11]. The scheduling strategies of any wireless network can be broadly classified following.

1) Channel independent scheduling.

2) Channel sensitive scheduling.

Here some algorithms satisfy the QoS requirements and some simply schedules. For both scheduling methods is used:

– QoS-aware downlink scheduling;

– QoS- unaware downlink scheduling.

Channel independent scheduling is based on the assumption that channel is time invariant and error-free. The channel independent scheduling is first introduced in wired networks With the help of CQI reports which are periodically sent by UEs to eNB, the scheduler can estimate the channel quality experienced by each UE. Such the scheduling is channel sensitive scheduling. In this type of scheduling the scheduler may try to maximize the QoS requirements of each UE (QoS aware scheduling) or it may try to provide fairness among UEs (QoS unaware scheduling).

A scheduler is a key element in the eNB which assigns the shared physical resources to different users. There are several downlink scheduling algorithms such as the Round Robin (RR) Scheduling, Best Channel Quality Indication (Best CQI) Scheduling, and Proportional Fair (PF) Scheduling.Es. Because the scheduler aims to maximize the system performance, the design of the scheduling algorithms has become a major issue. However, the sharp growth of QoS applications makes the aim much more challenging. It is well known that best-effort applications that require non-real time traffic do not call for strict requirements on packet delay, whereas real time services are delay sensitive and should be transmitted as soon as possible. The 3GPP specifications did not define scheduling algorithms that support real-time QoS applications [2]. Some work such as [8] proposes a variation to some state-of-the-art algorithms in order to increase QoS performance by taking into consideration the delay sensitivity. Alternatively, some proposes solutions that tackle the problem of scheduling by monitoring the buffer state of end users [11]. However, they didn't take into account the QoS of real time and non-real time applications.

Is proposed LTE downlink scheduling as an optimization problem where the objective is to optimize parameters such as the resource distribution, data rate, packet delay, and even buffer overflow. Our formulation is then incorporated in the existing state of the art LTE downlink scheduling algorithms leading to enhanced performance on all fronts. We mathematically formulate the scheduling problem in LTE using integer linear programming and incorporate the formulation in the surveyed algorithms. The optimization problem presented is a integer linear programming in which the variables are restricted to be integers, unknowns are binary. The problem is transformed to linear programming optimization which can be easily solved by the simplex algorithm.

Conclusion

In this thesis we have addressed the problem of down-link scheduling for QoS packet flow in LTE networks. The state-of-the-art scheduling algorithms have been formulated using integer linear programming. The formulation considers in addition to the regular QoS parameters, the UE buffer state parameter as an enhancement. The effects of the proposed approach have been studied and evaluated to demonstrate that it is suitable to provide better services for QoS and best-effort applications

References:

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