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LTE TECHNOLOGY FOR SMART GRID COMMUNICATION WITH QOS SUPPORT

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Технология LTE для Smart Grid Communication с поддержкой QoS

В этой статье рассматривается использование технологии LTE для Smart Grid Communication. Рассматриваются приоритеты пользователей в Smart Grid в соответствии с необходимыми для них параметрами QoS.

In this paper, the use of LTE technology for smart grid communication is presented. The priorities of users in the Smart Grid in accordance with the necessary QoS parameters for them are considered.

The Smart Grid (SG) purpose is to meet the needs of modern information grid by utilizing advanced communication technology into the power grid. How to use wireless communication technology to provide better guarantee for smart grid has become the center of the problem in mobile communication research. Proposed by the 3-rd Generation Partnership Project (3GPP), Long Term Evolution (LTE) is one of the most widely accepted technologies in smart grid wireless communication network. It is the long-term evolution of 3G network technology which provides high transmission rate and reduces system transmission delay. In order to make better use of LTE in the smart grid communication environment, some optimization must be implemented.

The LTE system is usually composed of an access network, a core network, an application layer and certain number of UEs. The UE establishes a wireless link with the eNodeB through the Uu interface to obtain an access to the Evolved Packet Core (EPC). In the smart grid communication environment, the application layer mainly refers to the power management station and UEs are considered to be AMI devices, e.g. smart meters and aggregators. These devices, which require LTE system, are very different from traditional LTE users. In the traditional LTE network, UE, with certain mobility, doesn’t have the burst flow and consider the fairness of the system. While in the SG communication environment, UE, e.g. smart meter, is always set in initialized locations, and in most cases its data transmission (including upload and download streams) is strictly periodic. On the other hand, the SG communication environment can be classified as a machine-to-machine (M2M) system. Figure 1 shows the structure of an SG-LTE network.

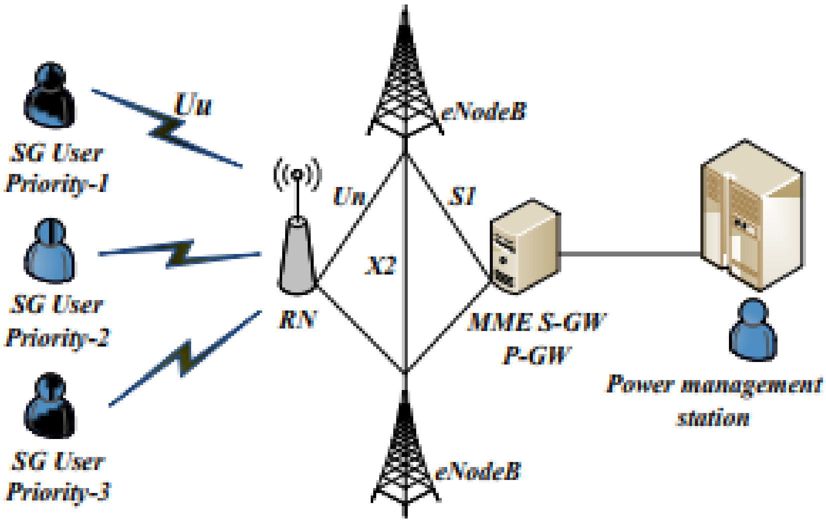

Figure 1: System structure of SG-LTE network

The architecture of scheduler in LTE system is shown in Figure 2. In the downlink LTE cell system, a single cell model is composed of a base station and a plurality of users. eNodeB transmits data through the downlink time-varying channel. In the Media Access Control (MAC) layer, the packets from the upper layer of eNodeB are buffered in the First In First Out (FIFO) queue, and then packets are transmitted to the different users through the resource allocation controller. The scheduler can make full use of channel status information, data buffer queue status, QoS requirements and other information to decide which user will be scheduled. The user measures the Signal to Interference plus Noise Ratio (SINR) of the downlink channel between the eNodeB and user as the basis for the quality of channel state at the next resource allocation. Resource Block (RB) is the scheduling unit in LTE system. Scheduling can be considered as a mapping between users and the resource blocks, as is shown in Figure 3.

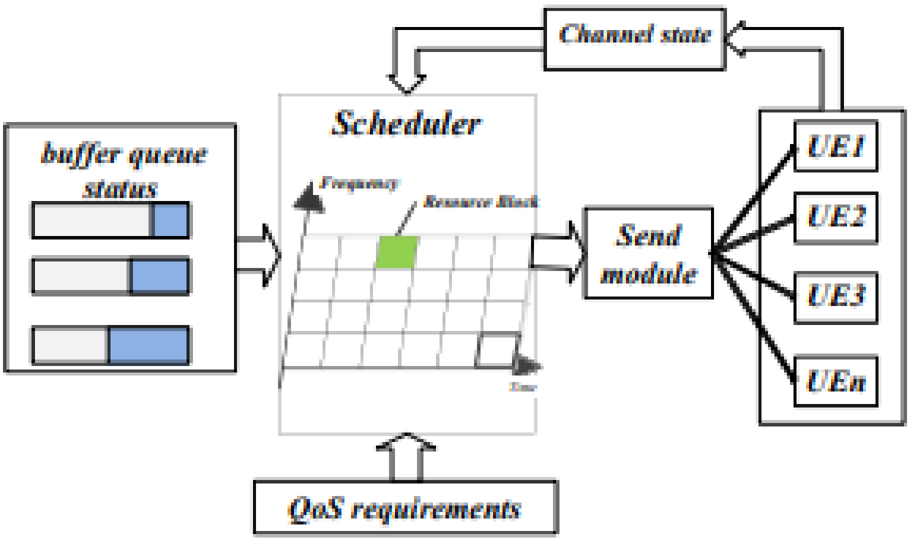

Figure 2: The architecture of scheduling system

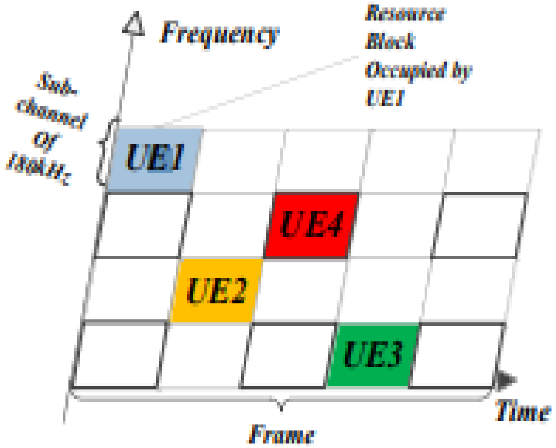

Figure 3: Resource scheduling for UE

In the SG communication environment, the main services of information contain automated smart meter reading, power distribution automation, emergency repair and others. There is a significant difference in the sensitivity of information among different users in SG. According to the user's QoS requirements, we can divide UEs into three priorities:

I) Priority-1: The user needs absolute prioritized transmission and has a high demand for transmission rate and delay, e.g. emergency repair and maintenance.

II) Priority-2: The characteristics of user's QoS requirements are low delay, high reliability, low probability of interruption, e.g. visualization management of mobile asset, distribution automation.

III) Priority-3: Delay requirements are very loose, e.g. automated smart meter reading.

The difference of average throughput, delay, packet loss rate and fairness index among different priority users, that verifies the effect of the proposed scheduler in the given scenario. This improvement is significant in smart grid communication based on LTE network.

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