

Slot based Radio Resource Management for Low Latency in LTE-Advanced System

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Abstract—This paper proposes Slot TTI(transmission time interval) based radio resource management of LTE(Long Term Evolution)-Advanced for low latency. The LTE-A system could not support the new features introduced in 5G system such as low latency. Thus, enhanced Physical Downlink Control Channel (ePDCCH) evolved in LTE-A to fulfill the new requirements for low latency. This paper shows latency reduction by using slotted TTI and ePDCCH in LTE-A system. It is backward compatibility for 5G so that it can reduce radio latency.

Keywords—Low latency, short TTI, ePDCCH and LTE-A

I. INTRODUCTION

First and second generation mobile communications networks were dominated by analog and then digital audio signals and text messaging. The third generation was more about scaling the number of users on the network for voice communications and text messaging, but was overwhelmed by an unpredictable tsunami of image and video content. This trend is sure to continue. Video, audio, and image formats are going to become richer and will require even more data, most probably beyond improvements in codec technologies. Therefore, the thirst for data communications is going to continue, and our transmission networks will most probably remain the bottleneck. Hence, we need to provide as much capacity as we can, and ensure that we build an efficient and smart architecture that can accommodate future demands for data communications [1].

Some of these applications can be supported by today's mobile broadband networks and their future evolution. However, some other applications will impose additional and very diverse requirements on mobile and wireless communication systems that 5G will have to support. Far more stringent latency and reliability requirements are expected to be necessary to support applications related to healthcare, security, logistics, automotive applications, or mission-critical control. A wide range of data rates has to be supported, up to multiple Gbps, and tens of Mbps need to be guaranteed with a very high availability and reliability. Network scalability and flexibility are required to support a large number of devices with very low complexity and requirements for very long battery lifetimes [2].

For these requirements, this paper proposes a radio resource management for low latency based LTE-A system. Proposed technology use 5G system to provide latency reduction.

II. EXISTING RESEARCH

The main physical channels present in LTE were the Physical Downlink Shared Channel (PDSCH) which carries the data of all users and the Physical Downlink Control Channel (PDCCH) which contains all the control information needed by the user equipment (UE) to receive and transmit data to the base station (eNB). The new supported features for LTE-Advanced required higher capacities from the PDCCH than it used to offer in LTE and highlighted some problems present in the PDCCH.

Because of all these problems in PDCCH a new control channel was introduced in LTE-A Rel.11 named the enhanced PDCCH (ePDCCH). This new channel is Frequency Division Multiplexed (FDM) with the PDSCH to offer some flexibility required by the newly introduced features [3].

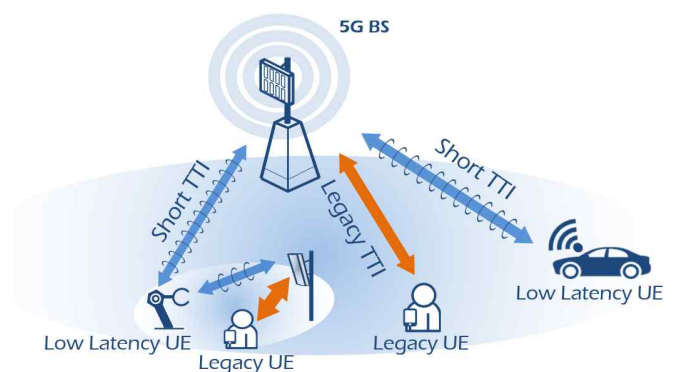


Fig.1. Architecture of low latency in 5G

III. PROPOSED MECHANISM FOR LOW LATENCY

In this section, we describe our proposed procedures and radio resource scheduling management for establishing the low latency service inside the LTE-A system. We design a low latency service procedure based on the proposed network architecture. Figure 1 illustrates an architecture to provide the low latency service for 5G system. Proposed mechanism is backward compatibility support in LTE-A and 5G system.

Access link of a conventional mobile communication system will be accompanied by a delay of a certain degree. For

LTE-A is 1 way latency undergoes a delay of about 5 msec. From which the components described in the present mobile communication 5G be described as a new generation of network access links may require more than the case of the conventional low-delay. The current technical requirements is not support for latency reduction in a frame structure away from the frame structure 1 msec to 1 TTI in LTE-A. For Slot based TTI is required in the conventional scheduling method that is different. In the paper, there is provided a method for scheduling in a slot based frame TTI based. It is called sTTI.

Assigning a symbol to the beginning of the control channel, and it is the basis for allocation of the PDSCH or the PUSCH for uplink downlink in sTTI units. In such a structure to maintain the HARQ RTT is 8 sTTI. In the sTTI based on the concept of slot for a low-delay HARQ RTT is 8 sTTI and maintain, while maintaining the traditional frame concept, the latency from 5ms slot in the existing LTE-based TTI can be reduced to 2.5ms.

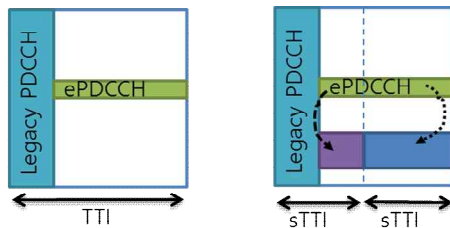


Fig.2. Low latency radio resource used ePDCCH

Figure 2 shows radio resource management. Existing settings are set to the same on the left in Fig 3, as proposed in this paper is the right figure in Fig 3. ePDCCH was defined in Rel-11 to the cross carrier MIMO and scheduling. The ePDCCH is set through UE-specific RRC message. Therefore, it is possible to UE-specific settings to start a low-delay services. ePDCCH position are also possible a different position of low latency data region. That delay set in the resource location ePDCCH also may be assigned to UEs in PDSCH area shown below is in Fig 3, it supports other resources.

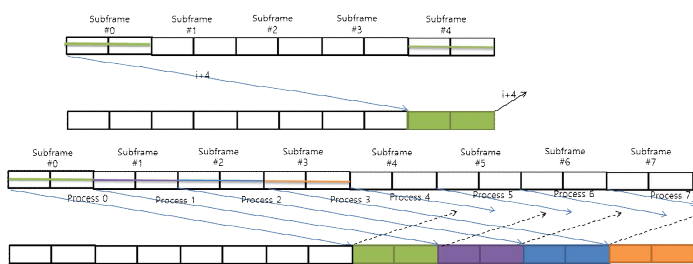


Fig.3. HARQ timing in 4G

Subframe slot of the $i+4$ be the individual, and can follow the existing structure of LTE. Assignment information for each slot that it is possible according to the example ePDCCH.

Subframe # 0 in slot # 0 of ePDCCH DCI (DL assignment) is slot # 0 of the TB, Subframe # 0 in slot # 1 of ePDCCH DCI (DL assignment) slot # 1 of the TB indicates. Ack/Nack for the Slot0_TB slot1_TB are made respectively in slot # 0 and slot #

1 of subframe # 2. The base station receiving the Slot0_Ack/Nack for the Slot0_TB slot1_TB are made respectively in slot # 0 and is assigned to DCI in subframe # 4. The base station receiving the slot1_Ack/Nack is to be assigned to each DCI ePDCCH the slot # 0 of the subframe # $i+4$ and 4 corresponding to slot # 1. Assigned ePDCCH DCI may indicate the retransmission of the TB transmitted on subframe # 0. Using a slot based frame structure for a low-delay and, using an ePDCCH to set it and, in the scheduling method is characterized in this patent to use the structure of the existing LTE. In the DL scheduling HARQ has a multi-structure process as follows. A number of DL HARQ process is allocated from 0-7.

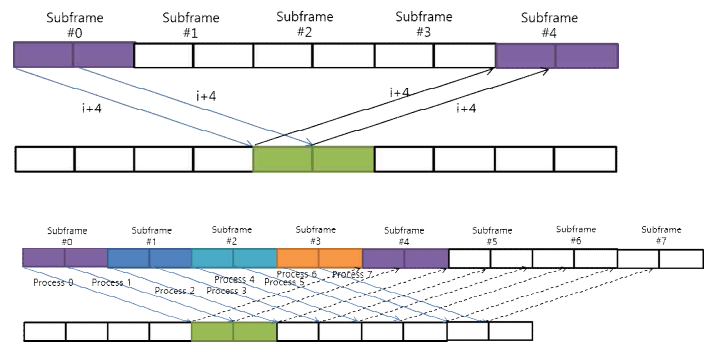


Fig.4. HARQ timing in Low-Latency system used Slotted TTI

Figure 5 illustrates a call flow to provide the low latency service call flow in detail.

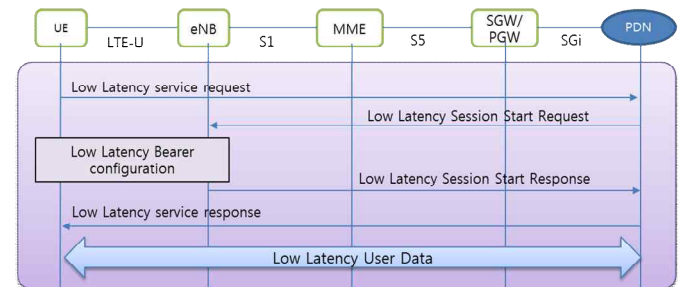


Fig.5. Low latency service configuration procedure

1. A UE requests to start for low latency service to PDN. A UE sends the Low latency service request message.
2. The PDN sends the Low latency Session start request message to an eNB.
3. The eNB could configure to the low latency radio resources of the UE. The eNB manages the UE to start for the low latency service
4. The eNB sends the Low latency Session start response message to the PDN.
5. The PDN sends the Low latency service message to the UE for the Low latency service
6. The UE and PDN start Low latency service.

IV. CONCLUSION

This paper presents a radio resource management scheme for latency reduction in LTE-Advanced system. We propose the architecture for low latency in 5G system. This architecture can reduce the burden of network structure and procedures by solving an extension of LTE-A. It is possible to be backward compatibility in LTE-A to latency reduction. The latency reduction standardization is currently underway, because of the sufficient study on 5G. In this paper we presented the low latency management in LTE-Advanced system for 5G.

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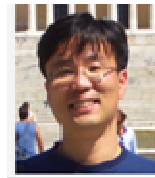
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