Sparse Vector Transmission for Ultra-Reliable and Low Latency Communications

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In the era of the fourth industrial revolution, our life is changing dramatically. We are witnessing the emergence of new services and applications such as autonomous vehicles, smart factories, remote medical surgery, and artificial intelligence (AI) based services. To support these new service categories, communication mechanism should be also changed significantly in terms of latency, energy efficiency, reliability, flexibility, and connection density. To address diversified services and applications, ITU has classified 5G services into three categories: enhanced mobile broadband (eMBB), massive machine-type communication (mMTC), ultra-reliable and low latency communication (URLLC) [1]. Since the data packet for the URLLC applications is in general small, a long packet designed to maximize the throughput is not so suitable to achieve the high reliability and low latency. In fact, since the current radio access mechanism in 4G LTE cannot support the URLLC communications, 3rd Generation Partnership Project (3GPP) sets up a new air interface named New Radio (NR). The primary goal of NR is to design an entirely new system which is not necessarily backward compatible with current 4G LTE systems.

In this presentation, we briefly discuss the current status of URLLC communications in 5G. Then, we present the sparse vector transmission for URLLC transmission. By the sparse vector, we mean the vector having a few non-zero elements. At the expense of the slight loss in the transmission rate, sparse vector transmission provides various benefits such as the reliability improvement, latency reduction, and design and operation cost reduction. In this presentation, we will go over fundamental principle of the sparse vector transmission, system implementation, and also future research direction.

1. H. Ji, S. Park, J. Yeo, Y. Kim, J. Lee, B. Shim, "Ultra-Reliable and Low-Latency Communications in 5G Downlink: Physical Layer Aspects," *IEEE Wireless Communications Magazine*, **25**, 3, July 2018, pp. 124-130, doi: 10.1109/MWC.2018.1700294