ABSTRACT

The fifth generation of telecommunication technology (5G) has several criterions to meet the requirement of 5G networks, especially the required latency $t \leq 1$ ms, and ultra reliability. This Bachelor Thesis proposes Systematic Block (SB) on the Quasy-Cyclic Low Density Parity Check (QC-LDPC) codes, called SB QC-LDPC codes, to fulfill the Ultra Reliable and Low Latency Communications (URLLC). The proposed SB QC-LDPC codes are expected to reduce the complexity of the system by using matrix identity and a vector representing the whole matrix.

The parity check matrix of QC-LDPC consists of two matrices, $\mathbf{A}_1$ and $\mathbf{A}_2$, having quasy-cyclic property. This Bachelor Thesis proposes to change $\mathbf{A}_1$ to an identity matrix with the same size. This replacement is expected to reduce the complexity of QC-LDPC due to inverse of $\mathbf{A}_1$ matrix is unnecessary, the error protection capability of which is probably weaker causing degradation on bit-error-rate (BER) performances.

SB QC-LDPC codes are evaluated via computer simulations over Additive White Gaussian Noise (AWGN), slow Rayleigh fading, and fast Rayleigh fading channels to support various user mobilities, where with Binary Phase Shift Keying (BPSK) is considered. In addition, the complexity of SB QC-LDPC codes are also evaluated in terms of memory size, number of components and density of the matrices. The simulation results show that the complexity is reduced to 55%, with slightly performance degradation compared to the performances of QC-LDPC codes. This performance degradation is due to the change of QC-LDPC main matrix $\mathbf{A}_1$, which is replaced by an identity matrix, causing weaker error protection capability. This reduction is expected to be acceptable for applications having less sensitive to errors, such as temperature or smart parking sensors, where power efficiency is prioritized.

Keywords: *Channel coding*, LDPC *codes*, *Computational complexity*, *ultra reliable and low latency communications*, 5G.