

LIST OF FIGURES

1.1 Deployment system of HAPS and UAV from MCRBS in area having obstacle.	1
2.1 General communications block from transmitter to receiver.	6
2.2 Polar codes construction with channel capacity.	8
2.3 Polar codes encoder with block-length of 4	9
2.4 The example of Polar codes encoding with block-length of 4.	9
2.5 Fundamental decoding block Polar codes.	10
2.6 The example of Polar codes decoding with block-length of 4	11
2.7 Differences between FDM and OFDM in frequency domain.	12
2.8 Cyclic Prefix for OFDM Symbols.	13
2.9 Constellation of multiple interconnected HAPS.	16
2.10 Encoder, channel and multistage decoder for Construction D	17
2.11 The performance of BER theory on AWGN and Rayleigh fading Channel in BPSK modulation.	20
2.12 Security methods in general communications.	21
2.13 Security communication concept.	22
2.14 USRP B200 and B210 hardware model.	23
2.15 Simulink interfacw with example block diagram.	24
3.1 Block system of Polar codes with OFDM in Multipath fading channel. 25	25
3.2 Equivalent encoder, channel and decoder for multilevel decoding of Construction D assuming each level is decoded successfully.	27
3.3 The function $\kappa(\sigma^2, P_e)$ is the maximum number of information bits k for a $(128, k)$ Polar codes to achieve decoder $P_e = 10^{-4}$ on a AMGN channel with noise σ^2 . The SCL decoder uses 10 CRC bits and decoder list size 8.	29
3.4 The representative PDP of Indonesia semi HAPS channel model under LOS propagation.	31
3.5 The representative PDP of Indonesia semi HAPS channel model under NLOS propagation.	32
3.6 Real-field scenario of Polar codes with security scheme.	34
3.7 Simulink block diagram for experiment transmitter.	35

3.8	Simulink block diagram for experiment receiver.	36
3.9	Real-Field experiment scenario at area 1	36
3.10	Real-Field experiment scenario at area 2	37
4.1	BER Performance of Secure Polar codes based on known frozen key values in AWGN Channel.	40
4.2	BER Performance of Secure Polar codes based on known frozen key values in Single-path Fading Channel.	41
4.3	BER Performance of Polar codes under proposed HAPS channel. . .	42
4.4	BER Performance of Secure Polar codes based on known frozen key values in proposed HAPS channel in LOS environment.	43
4.5	BER Performance of Secure Polar codes based on known frozen key values in proposed HAPS channel in NLOS environment.	44
4.6	FER Performance of Secure Polar codes based on known frozen value in Lattice AMGN Channel.	45
4.7	BER Performance of Secure Polar codes based on known frozen at Real-Field area 1.	47