

Table of Contents

Acknowledgements.....	
Table of Contents.....	I
List of Figures.....	V
List of tables.....	VIII
List of abbreviations	X

Chapter 1: Wireless Communication.

1.1 Introduction	1
1.2 Wireless Communication Growth.....	2
1.2.1 The first generation (1G cellular system)	3
1.2.2The second generation (digital cellular systems).....	4
1.2.3 2.5G Cellular Mobile Networks	5
1.2.3.1 General Packet Radio Service (GPRS)	5
1.2.3.2 Enhanced Data Rates for GSM Evolution (EDGE)...	6
1.2.4 The third generation	6
1.2.5The fourth generation	8
1.3 Different data rate for all generations of wireless communication.....	9
1.4Summary.....	10

Chapter 2: Performance Problems of Wireless Channel.

2.1 Introduction.....	11
2.2 Wireless Signal Attenuation	12
2.2.1 Path Loss	13
2.2.2 Shadowing and Multipath.....	14
2.2.2.1 Large Scale Fading.....	16
2.2.2.2 Small Scale Fading	16
2.3 How to Overcome Channel Problems	20
2.4 Quality of Service.....	20

2.5 Channel Characterization and Modeling.....	21
2.6 Channel Quality Estimation	22
2.7 Summary.....	23

Chapter 3: Channel Coding Techniques Overview

3.1 Introduction	24
3.2 Channel noise	25
3.3 Channel Coding	26
3.3.1 Block codes	28
3.3.1.1 Generating Matrices and Encoding.....	29
3.3.1.2 Hamming Distance and Error Correction.....	30
3.3.2 Convolutional coding	32
3.3.2.1 Convolutional encoder.....	34
3.3.2.2 State Diagram Representation of Convolutional codes.....	35
3.3.2.3 Decoding of convolutional codes	37
3.3.2.3.1 Maximum Likelihood (ML) Decoding	38
3.3.2.3.2 Viterbi Decoding	38
3.3.3 Turbo coding	39
3.4 Summary	40

Chapter 4: Turbo Coding and Low-power Design Techniques

4.1 Introduction	41
4.2 Turbo Encoder	42
4.2.1 Recursive Systematic Convolutional Codes.....	43
4.2.2 Puncturing Coding.....	45
4.2.3 Interleavers.....	46
4.2.3.1 Block Interleavers.....	48
4.2.3.2 Random (Pseudo-Random) Interleaver.....	48
4.3 Turbo Decoder.....	49

4.3.1 Principles of turbo decoding.....	49
4.3.2 Turbo Decoder Algorithm.....	51
4.3.2.1 Maximum A Posteriori algorithm	51
4.3.2.2 Max-Log-MAP and Log-MAP	57
4.4 Implementation of an Iterative Turbo Decoding Algorithm Based on the MAP Algorithm	59
4.5 Low-Power Design Techniques.	61
4. 5.1 Sliding window technique	61
4.5.2 Forward computation of backward recursion $\beta_k(s_k)$	63
4.5.3 Quantization	64
4.5.3.1 Performance considerations of Analog to digital converters (ADC)	65
4.5.3.1.1 signal-to-noise ratio (SNR)	65
4.5.3.1.2 Resolution and Accuracy	66
4.5.3.1.3 Power dissipation	67
4.5.4 Stopping Criteria.....	67
4.5.4.1 Cross Entropy (CE).....	68
4.5.4.2 Sign change ratio (SCR).....	68
4.5.4.3 Cyclic Redundancy Check (CRC).....	69
4.5.4.4 Sign difference ratio (SDR).....	69
4.6 Implementation of the MAP Algorithm Turbo Coding	69
4.7 summary	70

Chapter 5: Design of a Turbo decoder using SDR algorithm

5.1 problem definition	72
5.2 Implementation of the MAP Algorithm turbo decoder with fixed number of iterations.....	73
5.3 Implementation of the MAP Algorithm depend on SDR algorithm.....	93
5.4 Simulation Results.....	96
5.5 summary.....	112

<i>Chapter 6: Conclusion and Future Work</i>	
6.1 Conclusion.....	113
6.2 Future work.....	114
 <i>References and Appendixes</i>	
Appendixes	I
Appendix A: Some Useful Formula	I
Appendix B: Mat Lab code of full system of turbo coding	xiii
Appendix C: VHDL code for different blocks.....	xxiii
Appendix D: FPGA Hardware Design Reports for Design 'SDR' Algorithm	xxvIV
References	xxx