Contents

A	Acronyms										
F	Functions and Operators										
N	Notation										
1	Int	roduction	1								
	1.1	Motivation	1								
	1.2	Scope of this Work	2								
	1.3	Outline of this Contribution	3								
2	The	The MIMO-OFDM Transmission Technique									
	2.1	MIMO-OFDM System Model	4								
	2.2	MIMO-OFDM Signal Model	6								
	2.3	Stochastical Channel Model	13								
		2.3.1 The Propagation Model	13								
		2.3.2 Second-order Statistics of the MIMO Fading Channel	14								
	2.4	System Parameters	19								
3	Ada	Adaptive OFDM Systems									
	3.1	OFDM Systems for Uncoded Transmissions	23								
		3.1.1 System Model	23								
		3.1.2 Receiver Performance in AWGN and Frequency-flat Rayleigh Fading Channels	25								
	3.2	Adaptive Bit- and Power-Loading Algorithms	26								
		3.2.1 Classification of Known Algorithms	28								



			Frequency-selective Rayleigh Fading Channels	30
		3.2.3	Discussion	32
3.3 OFDM Systems for Coded Transmissions				33
		3.3.1	System Model	33
		3.3.2	Receiver Performance of BICM-OFDM in AWGN	33
		3.3.3	Average Performance of BICM-OFDM in Frequency-selective Rayleigh Fading Channels	40
		3.3.4	Discussion	41
	3.4 Data Rate Adaptation in BICM-OFDM Systems		Rate Adaptation in BICM-OFDM Systems	42
		3.4.1	Link Quality Estimation in Frequency-selective Channels	43
		3.4.2	Physical Mode Selection and Data Rate Adaptation	47
		3.4.3	Discussion	53
4	Ada	aptive	MIMO-OFDM Systems	55
4	Ada	_	MIMO-OFDM Systems ole Antenna Systems for Spatial Multiplexing and Spatial Diversity	55
4		Multip	•	
4	4.1	Multip Classi	ole Antenna Systems for Spatial Multiplexing and Spatial Diversity	55
4	4.1 4.2	Multip Classi	ole Antenna Systems for Spatial Multiplexing and Spatial Diversity	55 56
4	4.1 4.2	Multip Classi MIMO	ole Antenna Systems for Spatial Multiplexing and Spatial Diversity fication of MIMO algorithms	55 56 59
4	4.1 4.2	Multip Classi MIMO 4.3.1	ole Antenna Systems for Spatial Multiplexing and Spatial Diversity fication of MIMO algorithms	55 56 59 59
4	4.1 4.2	Multip Classi MIMC 4.3.1 4.3.2	cole Antenna Systems for Spatial Multiplexing and Spatial Diversity fication of MIMO algorithms O-OFDM System for Uncoded Transmissions System Model Diversity Schemes by Space-Frequency Coding with Constellation Rotations	55 56 59 59
4	4.1 4.2	Multip Classi MIMC 4.3.1 4.3.2 4.3.3	cole Antenna Systems for Spatial Multiplexing and Spatial Diversity fication of MIMO algorithms D-OFDM System for Uncoded Transmissions System Model Diversity Schemes by Space-Frequency Coding with Constellation Rotations Spatial Multiplexing Schemes	55 56 59 59 60 70
4	4.1 4.2 4.3	Multip Classi MIMC 4.3.1 4.3.2 4.3.3	ble Antenna Systems for Spatial Multiplexing and Spatial Diversity fication of MIMO algorithms D-OFDM System for Uncoded Transmissions System Model Diversity Schemes by Space-Frequency Coding with Constellation Rotations Spatial Multiplexing Schemes Discussion	55 56 59 59 60 70

3.2.2 Average Performance of Bit- and Power-loaded OFDM Systems in

		4.4.3	Adaptive MIMO Technique for BICM-OFDM by Physical Mode Selection and PARC	81			
		4.4.4	Average Bandwidth Efficiency of Adaptive BICM-MIMO-OFDM Systems	85			
		4.4.5	Discussion	90			
5	5 Closed-loop Real-time MIMO-OFDM System for Adaptive Transn						
	sioi	ıs		91			
	5.1	Testbe	ed System Model	92			
		5.1.1	Real-time Adaptive MIMO Transmitter Architecture	93			
		5.1.2	Real-time Adaptive MIMO Receiver Architecture	96			
	5.2	Applie	cation Examples and Measurement Results	101			
		5.2.1	The VBLAST Algorithm	101			
		5.2.2	Adaptive Subcarrier Modulation	103			
	5.3	Discus	ssion	105			
6	Cor	ıclusio	ns and Outlook	106			
	6.1	Concl	usions	106			
	6.2	Outlo	ok	109			
A	SFI	3C fro	m Orthogonal Designs	111			