

Contents

Abstract	i
Resumen	v
Resum	vii
Papers included in the thesis	ix
Acknowledgements	xiii
1 Introduction	1
1.1 Why photonics?	3
1.2 Photonics for Gb/s wireless: State of the art	5
1.2.1 Intensity modulated/direct detection (IM/DD) based wireless links	7
1.2.2 Optical heterodyne techniques	9
1.3 Outline of the thesis	10
2 Introduction to Radio-Over-Fibre Techniques	11
2.1 Optical Devices	11
2.1.1 Directly modulated laser	12
2.1.2 Mach-Zehnder Modulator	13
2.1.3 Electroabsorption modulator	16
2.1.4 Optical Fibre	17
2.1.5 Noise Sources	18
2.2 RF Up-conversion Techniques	19

2.2.1	Up-conversion using Mach-Zehnder modulator	19
2.2.2	Up-conversion Using Electroabsorption Modulator	24
2.3	Radio Over Fibre Uplinks	26
2.3.1	Photonic Downconversion	27
2.3.2	Harmonic Distortion	27
2.3.3	Envelope Detector [Paper A]	30
2.4	Conclusions	31
3	Photonic Vector Modulation and Demodulation Techniques	35
3.1	Photonic vector modulation: Working principle	36
3.1.1	System Architectures [Paper B]	37
3.1.2	LO Peak Suppression [Paper D]	42
3.1.3	Performance Evaluation [Paper C]	42
3.2	60 GHz Wireless Links	46
3.2.1	Link Availability and Link Budget Calculations	47
3.2.2	Photonic Vector Modulated 10 Gb/s 60 GHz QPSK Wireless Link	47
3.3	M-ary Quadrature Amplitude Modulation	50
3.3.1	16-QAM Wireless Signal Generation [Paper E, F, G]	51
3.4	Distribution of Wireless Signals in a Radio-Over-Fibre Access Network	53
3.4.1	Dynamic Reconfigurable Optical WDM Network	54
3.4.2	Multi service Co-existence [Paper H]	56
3.5	Photonic Vector Demodulation: Working Principle	57
3.5.1	Performance Optimization	59
3.5.2	Architectures for PvDM [Paper I]	60
3.6	Conclusion	62
4	Optical Baseband Modulation for Millimetre Wave Wireless	65
4.1	Introduction	65
4.2	Optical Baseband Modulation Formats	66
4.2.1	DPSK Demodulation	68
4.2.2	Optical (D)QPSK	69
4.3	Integrated Millimetre Wave Modulator Concept	71
4.3.1	Device Parameter Requirements	73
4.3.2	Differential Phase Modulated Wireless Links [Paper J]	75
4.4	Optical Digital Coherent Detection	77

4.4.1	Digital Demodulation	79
4.4.2	Radio over Fibre Demodulating Downlink [Paper K]	81
4.5	Optical Heterodyne Generation of Millimetre Wireless Signals [Paper L]	84
4.5.1	Experimental Validation	86
4.5.2	Optical OFDM based 40 Gb/s Wireless Signal Generation [Paper M]	87
4.6	Conclusions	90
5	Conclusions and Future Outlook	93
A	Expressions of Photonic Vector Demodulator	99