

Contents

Acknowledgement	5
Abstract	7
Resumen.....	9
Resum.....	13
List of Acronyms	21
1 Introduction	25
1.1 Motivation.....	25
1.2 State-of-the-art	28
1.2.1 Impulse-radio UWB generation in the 3.1–10.6 GHz band.....	28
1.2.2 Millimetre-wave impulse-radio UWB generation.....	30
1.2.3 Detection and transmission performance of impulse-radio UWB signals	32
1.2.4 Multiband OFDM UWB radio-over-fibre.....	34
1.2.5 UWB optical and wireless coexistence.....	35
1.3 Improvement over the state-of-the-art.....	35
1.4 Outline of this work.....	37
2 Hybrid wireless-optical systems based on ultra-wideband (UWB) radio.....	39
2.1 Multigigabit wireless communications	39
2.1.1 Coexistence and interference with regulated narrowband services	40
2.1.2 Millimetre-wave radio technology.....	43
2.2 OFDM technology.....	43
2.3 UWB radio technology	46
2.3.1 Features and current standardization status	46
2.3.2 Worldwide regulatory status.....	47
2.3.3 Major implementations.....	50
2.4 60 GHz radio technology	53
2.4.1 Characteristics of the 60 GHz band	53
2.4.2 Worldwide regulatory status.....	54
2.4.3 Standardization status.....	54
2.5 Radio-over-fibre technology	56
2.5.1 Millimetre-wave systems	58
2.5.2 Optical fibre transmission	60
2.5.3 Optical access networks	62

2.5.4	UWB application scenarios.....	63
3	Optical generation of impulse-radio UWB signals	69
3.1	Introduction	69
3.2	Baseband with Gaussian-monocycle pulse shaping.....	70
3.2.1	Introduction.....	70
3.2.2	Optical delay and balanced photodetection technique.....	70
3.2.3	Differential photoreception and electrical delay technique.....	71
3.3	60 GHz radio-over-fibre for in-flight communications.....	72
3.3.1	Introduction.....	73
3.3.2	In-aircraft distributed antenna system	74
3.3.3	Simulation analysis.....	75
3.3.4	Experimental demonstration	82
3.3.5	Techno-economic analysis	85
3.4	Dual-band generation by frequency shifting in remote-connectivity fibre	90
3.4.1	Introduction.....	90
3.4.2	Integrating multiband operation in the optical access network.....	91
3.4.3	Principle of operation.....	92
3.4.4	Simulation analysis.....	94
3.4.5	Experimental demonstration	97
3.4.6	Practical considerations	102
3.5	Conclusion	102
4	Generation and optical-wireless transmission of UWB signals in the 60 GHz band.....	105
4.1	DCM OFDM and BPSK impulse radio employing VCSEL direct modulation	105
4.1.1	Introduction.....	106
4.1.2	Experimental setup	106
4.1.3	DCM-OFDM UWB performance	108
4.1.4	BPSK impulse-radio UWB performance	112
4.1.5	Simulation analysis.....	115
4.2	OOK impulse radio employing VCSEL and ECL up-conversion	116
4.2.1	Introduction.....	117
4.2.2	Experimental setup	117
4.2.3	Performance analysis	119
4.2.4	Simulation analysis.....	121
4.3	Conclusion	122

5	Reconfigurable multiwavelength source based on electrooptic phase modulation of a pulsed laser	123
5.1	Introduction	123
5.2	Principle of operation.....	124
5.3	Experimental setup	125
5.4	Functional demonstration.....	125
5.4.1	Reduction of the frequency spacing by a factor of 2	125
5.4.2	Reduction of the frequency spacing by a factor of 4	126
5.4.3	Wavelength shift by half frequency spacing	126
5.5	Chirp and noise impact analysis	127
5.6	Conclusion	129
6	Conclusion and further work.....	131
6.1	Conclusion	131
6.2	Ongoing and further work.....	133
A	Original contributions	135
Bibliography	141

