

Table of contents

1	Introduction	13
1.1	Point-to-multipoint Services	13
1.1.1	Terrestrial Broadcast	15
1.1.2	Broadcast Spectrum	18
1.2	The 5G standard	20
1.2.1	5G Core	21
1.2.2	NG-RAN	24
1.3	Objectives	26
1.4	Structure and contributions	27
1.5	List of Publications	29
1.5.1	Publications and Activities Related to this Thesis	29
2	Pre-Release 17 Mobile Broadcasting	31
2.1	eMBMS in Release 14 to 16	31
2.1.1	eMBMS introduction	32
2.1.2	ENTV: eMBMS in Release 14	36
2.1.3	5G Broadcast: eMBMS in Release 15 and 16	38
2.1.4	Applications of eMBMS beyond multimedia delivery	39
2.2	eMBMS limitations	45
2.2.1	Static configuration of MBSFN	45
2.2.2	Lack of feedback on eMBMS session management	47
2.2.3	Lack of feedback from RAN to Core	48
2.2.4	Trigger eMBMS reception	49
2.2.5	Improvement proposal	50
2.3	5G-Xcast	51
2.3.1	5G-Xcast Core architecture	52
2.3.2	5G-Xcast RAN architecture	56
3	Convergence of Terrestrial and Mobile Networks	63

TABLE OF CONTENTS

3.1	Introduction to convergence	64
3.1.1	Fundamentals of Convergence	65
3.2	Convergence in 3GPP	69
3.3	ATSSS-enabled convergence between ATSC 3.0 and 5G	73
3.3.1	Limitations of ATSSS for ATSC 3.0-5G Convergence	74
3.3.2	ATSC 3.0-5G Trusted Convergence	76
3.3.3	ATSC 3.0-5G Untrusted Convergence	78
3.4	QUIC-enabled Convergence	80
3.4.1	Convergent Service Call-flows	81
4	Release 17 Mobile Broadcasting & Evaluation	85
4.1	Point-to-Multipoint Standardization in Rel-17	85
4.1.1	5G Multicast Broadcast Services	88
4.2	Laboratory Description	96
4.2.1	VLC 5G Campus	97
4.2.2	Open5GCore	99
4.2.3	Landslide	100
4.3	5MBS Prototype	102
4.3.1	Prototype Description	102
4.3.2	Prototype Implementation	104
4.4	Performance of the 5MBS prototype	107
4.4.1	System model and considered scenarios	107
4.4.2	Performance results and discussion	109
5	Conclusions and Future Work	113
5.1	Concluding Remarks	113
5.1.1	Pre-Release 17 Mobile Broadcasting	113
5.1.2	Convergence of Terrestrial and Mobile Networks	114
5.1.3	5MBS Mobile Broadcasting and prototype evaluation	114
5.2	Future work	115
5.2.1	5MBS in Release 18	115
5.2.2	5MBS Prototype development	115
5.2.3	Cloud deployment analysis for TV Broadcasting	116
5.2.4	6G Broadcast	116
Acronyms		117
References		127