
Contents

Acknowledgments	v
Abstract	vii
Resumen	xi
Resum	xv
Contents	xix
List of Figures	xxiii
List of Tables	xxvii
I Background	1
1 Introduction	3

1.1	Motivation	4
1.2	Objectives	5
1.3	Structure of the thesis	6
2	Wireless Technologies and Vehicular Networks (VNs) Overview	7
2.1	Wireless technologies overview	9
2.1.1	Wireless Fidelity (Wi-Fi)	9
2.1.2	Worldwide interoperability for Microwave Access (WiMAX) . .	11
2.1.3	Universal Mobile Telecommunications System (UMTS)	15
2.2	Vehicular Networks (VNs) overview	18
2.3	Summary	20
3	Vertical Handover (VHO) Overview	21
3.1	Introduction	21
3.2	IEEE 802.21 Protocol: Media Independent Handover Services	25
3.2.1	Media Independent Handover Function (MIHF)	25
3.3	Vertical handover overview	30
3.3.1	Handover information gathering	31
3.3.2	Handover decision	32
3.3.3	Handover execution	33
3.4	Handover information gathering phase	33
3.5	Handover decision phase	35
3.5.1	Parameter selection algorithms	36
3.5.2	Parameter processing algorithms	38
3.5.3	Parameter aggregation algorithms	39
3.5.4	Comments on algorithm applicability to VNs	41
3.6	Handover execution phase	42
3.6.1	Handover management	42
3.6.2	Mobility management	42
3.7	VHO evaluation strategies	44
3.7.1	Evaluation methodology	44
3.7.2	Simulation tools	50
3.8	Open research issues	53
3.8.1	Quality of Service (QoS)	53
3.8.2	Quality of Experience (QoE)	53
3.8.3	Security	54
3.8.4	Industry standardization effort and alliances	54
3.8.5	Homogeneous VHO evaluation	54
3.9	Summary	54

II Contributions	57
4 Proposed IEEE 802.21-based Vertical Handover Decision Algorithms (VHDAs)	59
4.1 Introduction	59
4.2 Description of the Technology-Aware VHDA	60
4.2.1 Mobility support for Internet Protocol v.6 (MIPv6)	61
4.2.2 Mobile IP (MIP) within VN contexts	63
4.3 Description of the MACHU VHDA	63
4.3.1 Networking	65
4.3.2 Neighborhooding	66
4.3.3 Decision-making	68
4.4 Description of the Geo-MACHU VHDA	69
4.4.1 Underlying network considerations	69
4.4.2 Geo-MACHU main tasks	70
4.5 Description of the MCDM-MACHU VHDA	72
4.5.1 User preferences	73
4.5.2 Application requirements	73
4.5.3 Proposed SAW-based network assessment function	74
4.5.4 Calibration of the β_i values	74
4.5.5 MCDM decision process	75
4.6 Summary	76
III Experimentation and results	77
5 Simulation Frameworks and Experimentation	79
5.1 Content delivery approach in Vehicular <i>Ad-hoc</i> Networks (VANETs) . .	80
5.1.1 VANET-based delivery framework overview	80
5.1.2 Simulation set-up	81
5.1.3 Performance evaluation	82
5.2 Wireless technologies performance	87
5.2.1 Simulation framework and tools	88
5.2.2 Performance evaluation	90
5.3 Technology-aware VHDA evaluation	95
5.3.1 Evaluation framework	95
5.3.2 Performance evaluation under best-case conditions	96
5.3.3 Performance evaluation under stress conditions	99
5.4 MACHU VHDA evaluation	106
5.4.1 Simulation tools	106
5.4.2 Simulation scheme	107

5.4.3	Performance evaluation	108
5.5	Geo-MACHU VHDA evaluation	111
5.5.1	Simulation scheme	111
5.5.2	Performance evaluation	111
5.6	MCDM-MACHU VHDA evaluation	115
5.6.1	Simulation scheme	115
5.6.2	Performance evaluation	116
5.7	Summary	118
IV	Conclusions	123
6	Conclusions, Publications and Future work	125
6.1	Conclusions	125
6.2	Publications related to the thesis	127
6.3	Other publications obtained during the PhD research period	132
6.4	Future work	133
V	Appendices and References	135
Acronyms		137
Bibliography		143