

Contents

- 1 Introduction 1**
 - 1.1 Principles and Challenges 1
 - 1.2 Standardization History and Open Issues 3
 - 1.2.1 Worldwide Standardization Process 3
 - 1.2.2 European Vision 4
 - 1.2.3 American Vision 7
 - 1.3 ITS Architecture 9
 - 1.3.1 A Global Standardization Effort 9
 - 1.3.2 ISO/ETSI ITS Station Architecture 9
 - 1.3.3 WAVE Station Architecture 12
 - 1.4 ITS Applications 13
 - 1.4.1 Traffic Information Services 15
 - 1.5 Chapter Outlines 16
 - References 17
- 2 Communication Paradigms and Literature Analysis 21**
 - 2.1 Vehicular Networks 21
 - 2.1.1 Terminology and Definition 21
 - 2.1.2 Key Challenges in Vehicular Networks 22
 - 2.1.3 Network Topology 24
 - 2.2 Vehicle-to-X Communications 26
 - 2.2.1 Key Features of a V2X Communication Protocol 26
 - 2.2.2 Vehicle-to-X Communication Paradigms 27
 - 2.3 Centralized Client/Server Technologies 29
 - 2.4 Decentralized and Peer-to-Peer Systems 32
 - 2.5 Enabling Technologies 40
 - 2.5.1 Cellular Networks 41
 - 2.5.2 WiFi and WiFi Direct 42
 - 2.5.3 IEEE 802.11p and WAVE 44
 - 2.5.4 ETSI ITS Protocol Stack 46
 - References 47

3	Wireless Communications for Vehicular Ad-Hoc Networks.	51
3.1	Information Dissemination in Loosely-Coupled VANETs.	51
3.2	Multihop Broadcast Protocols.	53
3.2.1	Reference Scenario	54
3.2.2	Performance Metrics of Interest	55
3.3	Average Distribution of Poisson Points in a Segment with Finite Length	56
3.4	A Quick Overview of the IEEE 802.11b Standard	58
3.4.1	The IEEE 802.11 Standard.	58
3.4.2	Physical Layer	58
3.4.3	MAC Layer	59
3.4.4	Main IEEE 802.11 Parameters	62
3.5	Probabilistic Broadcast Protocols with Silencing	62
3.5.1	Preliminaries Considerations.	62
3.5.2	Polynomial Broadcast Protocol	64
3.5.3	Silencing Irresponsible Forwarding	65
3.6	A Recursive Analytical Performance Evaluation Framework.	66
3.6.1	Local (Single Transmission Domain) Performance Analysis with a Given Number of Nodes.	66
3.6.2	Global Performance Analysis with Fixed Number of Nodes	69
3.6.3	Generalization to a PPP-Based Scenario.	71
3.7	Performance Analysis in Realistic Scenarios	73
3.7.1	Polynomial Protocol	73
3.7.2	Silencing Irresponsible Forwarding	76
3.7.3	Comparison with Benchmark Protocols	77
3.7.4	Highway-Style Scenarios	80
3.8	VANETs as Distributed Wireless Sensor Networks	82
3.8.1	System Model	82
3.8.2	Clustered VANET Creation and IVCs	83
	References.	87
4	Hierarchical Architecture for Cross Layer ITS Communications.	91
4.1	The Big Picture	91
4.2	Related Works	92
4.3	Cross-network Information Flow.	94
4.3.1	Information Dissemination Through Multihop Communications	94
4.3.2	A Push/Pull Dissemination Approach	95
4.3.3	Securing X-NETAD	96

4.4	Application Design and Implementation on Android Smartphones	98
4.4.1	System Overview and Challenges	99
4.4.2	Message Structure and Dissemination Protocol	100
4.4.3	System Architecture	103
4.5	Experimental Results	104
4.5.1	Metrics of Interest	105
4.5.2	Preliminary Results	105
4.5.3	Tests in Ideal Static Scenarios	108
4.5.4	Tests in a Mobile Scenario	114
4.5.5	Discussion	118
	References	119
5	Novel Distributed Algorithms for Intelligent Transportation Systems	121
5.1	Introduction	121
5.2	Distributed Geographic Table	122
5.3	Conceptual Framework	123
5.3.1	Routing Strategy	124
5.3.2	Data Structure	126
5.3.3	Network Join	126
5.3.4	Peer Lookup	127
5.3.5	Position Update	129
5.4	Analytical Model for Performance Evaluation	130
5.5	DGT and Mobility	135
5.5.1	Mobility Model with Vertical Handover	140
5.6	DGT Simulation	142
5.6.1	Packet Delay Model	144
5.6.2	DEUS Model	149
5.7	DGT for Vehicular Networks: The D4V Architecture	167
5.7.1	Traffic Information System and Vehicular Sensor Networks	168
5.7.2	D4V	170
5.8	D4V Simulation	172
5.9	D4V Prototype	179
5.9.1	Performance Evaluation of the D4V Prototype	182
5.10	Concluding Remarks	195
	References	196
	Appendix A: DEUS: A Simple Tool for Complex Simulations	201
	Appendix B: Mathematical Frameworks	215

Appendix C: Batch-Based Group Key Management 227

Index 237

Advanced Technologies for Intelligent Transportation
Systems

Picone, M.; Busanelli, S.; Amoretti, M.; Zanichelli, F.;
Ferrari, G.-L.

2015, XX, 238 p. 145 illus., 133 illus. in color.,

Hardcover

ISBN: 978-3-319-10667-0