

Contents

1	Introduction	1
1.1	Key results and publications	4
1.2	Scope and limitations	8
1.3	Structure of this work	8
2	Background	11
2.1	Vehicular communication	11
2.1.1	Motivation and use cases	11
2.1.2	Research, standardization and deployment	12
2.2	Privacy	14
2.2.1	Location privacy	16
2.2.2	Location privacy metrics	16
2.2.3	Verifiable privacy protection	18
2.3	Security and privacy in vehicular communication	19
2.3.1	Security and privacy requirements	20
2.3.2	Security research projects	21
2.3.3	Pseudonymous authentication	22
2.3.4	Tracking attacks	23
2.4	Notation	25
3	Evaluation of Pseudonym Strategies	27
3.1	Motivation	28
3.2	Related work	29
3.3	System model and scenario	31
3.3.1	Requirements	33
3.3.2	Requirements for pseudonym strategies	33
3.3.3	Attacker model	34
3.4	Building blocks	35
3.4.1	Mix-zones	35
3.4.2	Matching in bipartite graphs	36
3.5	Evaluation framework	36
3.6	Framework implementation	38
3.6.1	Model mobility	38
3.6.2	Apply pseudonym strategy	41

3.6.3	Observe vehicles	43
3.6.4	Learn & attack	44
3.7	Evaluation	47
3.8	Summary	53
4	A Pseudonym System with Strong Privacy Guarantees	55
4.1	Motivation	56
4.2	Related work	58
4.3	System model and scenario	60
4.3.1	Requirements	62
4.3.2	Attacker model	63
4.4	Building blocks	64
4.4.1	The basic pseudonym scheme	64
4.4.2	Zero-knowledge proofs of knowledge	65
4.4.3	Dynamic accumulators	65
4.4.4	Blind signatures	66
4.4.5	CL signatures	67
4.4.6	Periodic n-show credentials	68
4.4.7	Trusted components	69
4.5	PUCA – Pseudonyms with user-controlled anonymity	70
4.5.1	Protocols	71
4.5.2	Extensions and modifications	74
4.5.3	Alternative realization using Brands credentials	75
4.5.4	Alternative realization using Lian et al.’s credential scheme	76
4.5.5	Integration into existing systems	76
4.6	REWIRE – Revocation without resolution	76
4.6.1	R-Tokens for self-identification	78
4.6.2	Protocols and message formats	81
4.6.3	Trusted computing integration	83
4.6.4	Prevent blocking of OSR messages	84
4.7	Evaluation	85
4.7.1	Security and privacy analysis	86
4.7.2	Performance evaluation	88
4.8	Summary	90
5	Decentralized Enforcement of k-Anonymity	93
5.1	Motivation	94
5.2	Related work	95
5.3	System model and scenario	97
5.3.1	Requirements	97

5.3.2	Attacker model	98
5.4	Building blocks	99
5.4.1	K-anonymity	99
5.4.2	Shamir's secret sharing	99
5.5	Decentralized, non-interactive secret sharing	100
5.6	Privacy-friendly traffic analysis	100
5.6.1	Location obfuscation	102
5.6.2	Location- and time-specific keys	102
5.6.3	Key exchange modes	103
5.6.4	Protocols	103
5.7	Evaluation	113
5.7.1	Security and privacy analysis	113
5.7.2	Simulation setup	115
5.7.3	Availability of information	115
5.7.4	Scalability	117
5.8	Summary	120
6	Conclusion and Outlook	123
	Acronyms	129
	Publications	131
	References	133



<http://www.springer.com/978-3-658-18549-7>

Verifiable Privacy Protection for Vehicular
Communication Systems

Förster, D.

2017, XV, 150 p. 30 illus., 13 illus. in color., Softcover

ISBN: 978-3-658-18549-7