

Contents

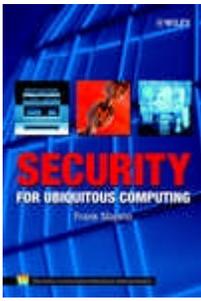
About the author	xi
Foreword	xii
Preface	xiv
Acknowledgements	xvii
Contact information	xx
1 Introduction	1
1.1 Scenario	1
1.2 Essential terminology	2
1.3 Problems	4
1.4 Notation	6
2 Ubiquitous computing	8
2.1 Xerox PARC	9
2.1.1 Disappearing computing	9
2.1.2 Tabs, pads and boards	10
2.1.3 Calm technology	12
2.2 Norman's Invisible Computer	13
2.3 MIT	15
2.3.1 Tangible bits	15
2.3.2 The WearComp	16
2.3.3 Auto-ID	21
2.3.4 Oxygen	25
2.4 HP's Cooltown	26
2.5 ORL/AT&T Labs Cambridge	27
2.5.1 The Active Badge	28
2.5.2 The Active Floor	35
2.5.3 The Active Bat	37
2.5.4 TRIP	40
2.5.5 PEN	43
2.6 Security issues	48

2.6.1	The disappearing computer	49
2.6.2	The voting button	50
2.6.3	The input recognition server	50
2.6.4	The Home Medical Advisor	51
2.6.5	The Weather and Traffic Display	52
2.6.6	The Home Financial Center	52
2.6.7	Security versus usability	52
2.6.8	The WearCam	54
2.6.9	Networked cameras and microphones	55
2.6.10	Auto-ID	56
2.6.11	The Active Badge and other location systems	56
2.6.12	Recording gadgets and other devices that Hollywood dislikes	59
3	Computer security	60
3.1	Confidentiality	60
3.1.1	Encryption and decryption	61
3.1.2	Security by obscurity (don't)	61
3.1.3	Brute force attacks	62
3.1.4	The confidentiality amplifier	64
3.1.5	Stream and block ciphers	65
3.1.6	Public key cryptography	66
3.1.7	Hybrid systems	67
3.1.8	Other vulnerabilities	68
3.2	Integrity	69
3.2.1	Independence from confidentiality	69
3.2.2	Error-detecting codes	70
3.2.3	Hash	70
3.2.4	MAC	71
3.2.5	Digital signature	72
3.2.6	Integrity primitives compared	73
3.3	Availability	75
3.4	Authentication	75
3.4.1	Passwords	76
3.4.2	One time passwords	77
3.4.3	Challenge-response and man-in-the-middle attacks	78
3.5	Security policies	82
3.5.1	Setting the goals	82
3.5.2	The Bell-LaPadula security policy model	83
3.5.3	Beyond multilevel security	84

4	Authentication	85
4.1	New preconditions	85
4.1.1	The absence of online servers	85
4.1.2	Secure Transient Association	87
4.2	The Resurrecting Duckling security policy model	88
4.2.1	Imprinting and reverse metempsychosis	88
4.2.2	Recovery of the imprinting key	89
4.2.3	Multilevel souls	90
4.2.4	Bootstrapping	91
4.2.5	The policy’s principles	91
4.2.6	Anonymous authentication	93
4.2.7	Other uses for the Duckling model	94
4.2.8	The computer as a duckling	95
4.3	The many ways of being a master	98
4.3.1	Human or machine?	99
4.3.2	Smart dust	99
4.3.3	<i>Mater semper certa</i>	100
4.3.4	Further indirection issues	102
5	Confidentiality	106
5.1	Cryptographic primitives for peanut processors	107
5.1.1	Asymmetric asymmetric cryptosystems	107
5.1.2	Maximum rate vs. maximum number of cycles	110
5.2	Personal privacy	111
5.2.1	The “only dishonest people have things to hide” fallacy	111
5.2.2	Leaving traces on shared devices	114
5.2.3	Secure disposal vs. encrypted storage	118
6	Integrity	123
6.1	Message integrity	123
6.1.1	Integrity for point-to-multipoint	124
6.1.2	Guy Fawkes	125
6.1.3	TESLA	126
6.2	Device integrity	127
6.2.1	The relationship between integrity and authenticity	127
6.2.2	Tamper resistance	128
6.2.3	Trusted path	131

7	Availability	133
7.1	Threats to the communications channel	134
7.1.1	Redefining “denial of service”	134
7.1.2	Covert communication techniques	135
7.1.3	Speaking to unknowns	135
7.1.4	Plutocratic access control	136
7.1.5	Cryptographic puzzles	137
7.2	Threats to the battery energy	138
7.2.1	Peanut devices have limited energy	138
7.2.2	Resource reservation	140
7.3	Threats from mobile code	145
7.3.1	The watchdog timer	146
7.3.2	The grenade timer	148
7.3.3	Limiting the addressable range	150
8	Anonymity	152
8.1	The Cocaine Auction Protocol	153
8.1.1	Why a cocaine auction?	153
8.1.2	The protocol	155
8.1.3	Attacks	156
8.2	The anonymity layer	160
8.2.1	The dining cryptographers	160
8.2.2	Anonymously broadcast based on physics	161
8.2.3	A fundamental protocol building block	162
8.2.4	The strength (or weakness) of broadcast anonymity	164
9	Conclusions	166
A	A short primer on functions	169
A.1	Sets	169
A.2	Relations	170
A.3	Functions	171
A.4	Functions of many arguments	173
B	Existing network security solutions	175
B.1	Needham-Schroeder	176
B.1.1	The original protocol	176
B.1.2	Denning-Sacco	177
B.2	Kerberos	179
B.3	Public key infrastructures	181
B.4	IPSEC	184

B.5	SSL/TLS	188
B.6	GSM	190
B.7	Bluetooth	193
B.7.1	System overview	193
B.7.2	Security services	194
B.7.3	Link keys	196
B.8	802.11	200
	Annotated bibliography	204
	Index	244



The book, and this freely available extract, are
copyright © 2002 by Frank Stajano.
All rights reserved.

Frank Stajano (University of Cambridge)
Security for Ubiquitous Computing
John Wiley and Sons, Ltd
Wiley Series in Communications Networking & Distributed Systems
ISBN: 0-470-84493-0
Hardcover; pp. 267 (xx + 247)
Publication date: 2002-02-12
RRP: 34.95 GBP (UK); 59 EUR (rest of Europe); 60 USD (USA)

<http://www-lce.eng.cam.ac.uk/~fms27/secubicomp/>