

Kai Rannenberg • Denis Royer
Andre Deuker
Editors

The Future of Identity in the Information Society

Challenges and Opportunities

VLI Springer

Table of Contents

| | | |
|----------|---|-----------|
| 1 | Introduction | 1 |
| | <i>Kai Rannenberg, Denis Royer, and Andre Deuker</i> | |
| 1.1 | Identity in a Changing World | 2 |
| 1.1.1 | One Identity or Many? Identity Unification vs. Identity Differentiation | 2 |
| 1.1.2 | Identity in Different Areas of the Information Society | 3 |
| 1.2 | The Role of FIDIS | 5 |
| 1.3 | On This Book | 6 |
| 1.3.1 | Basic Concepts | 6 |
| 1.3.2 | Identity and Advanced Technologies | 7 |
| 1.3.3 | Identity and Society | 9 |
| 1.3.4 | The Vignettes | 10 |
| 1.3.5 | The Annexes | 11 |
| | VIGNETTE 1: PUTTING THE MACHINES IN CONTROL | 13 |
| 2 | Identity of Identity | 19 |
| | <i>Thierry Nabeth</i> | |
| 2.1 | Defining the Identity Concept | 19 |
| 2.1.1 | The Multidisciplinary Challenge | 20 |
| 2.1.2 | Identity: A Concept Subject to Major Evolutions | 21 |
| 2.1.3 | Addressing the Challenges | 23 |
| 2.1.4 | Structure of This Chapter | 24 |
| 2.2 | Conceptualisation | 24 |
| 2.2.1 | Formal <i>versus</i> Informal Conceptualisation | 25 |
| 2.2.2 | Formal (or Explicit) Conceptualisation | 26 |
| 2.2.3 | Informal Conceptualisation with Narratives | 29 |
| 2.2.4 | Web 2.0 & Conceptualisation with Wikis, Blogs, Social Bookmarking and Other Tools | 31 |
| 2.3 | Identity of Identity Defined (Formal Conceptualisation) | 35 |
| 2.3.1 | The Concepts of Identity and Identification | 36 |
| 2.3.2 | (Self-)Identity Concepts. Some Models | 39 |
| 2.3.3 | Terminology of Identity | 42 |
| 2.3.4 | Profiles of the Person, and Overview | 44 |

Table of Contents

| | | |
|----------|--|-----------|
| 2.4 | Identity Use Cases and Scenarios | 48 |
| 2.4.1 | Virtual Online Social Environments, Real Identities Issues | 49 |
| 2.4.2 | Real Life in Virtual Worlds - Anthropological Analysis of MMO Games | 52 |
| 2.4.3 | Enjoy a Bar in 2012 | 53 |
| 2.4.4 | Tracing the Identity of a Money Launderer | 56 |
| 2.5 | Making Use of the New (Web 2.0) Participatory Tools | 59 |
| 2.5.1 | Web 2.0 Initiatives | 60 |
| 2.5.2 | Discussion | 60 |
| 2.6 | Conclusion and Outlooks | 61 |
| | References | 62 |
| | Appendix: Table of FIDIS Web 2.0 Initiatives | 66 |
| | VIGNETTE 2: VIRTUALLY LIVING IN VIRTUAL REALITIES | 71 |
| 3 | Virtual Persons and Identities | 75 |
| | <i>David-Olivier Jaquel-Chiffelle, Emmanuel Benoist, Rolf Haenni, Florent Wenger, and Harald Zwingelberg</i> | |
| 3.1 | Modelling New Forms of Identities | 76 |
| 3.1.1 | Partial Identities and Virtual Identities | 77 |
| 3.1.2 | The Case of Legal Persons | 78 |
| 3.1.3 | Identity and Privacy Issues | 79 |
| 3.1.4 | Unifying Model Based on Virtual Persons | 80 |
| 3.1.5 | Illustration of Our Model | 83 |
| 3.1.6 | Conclusion | 84 |
| 3.2 | Pseudonyms in the Light of Virtual Persons | 85 |
| 3.2.1 | Johnny Hallyday | 88 |
| 3.2.2 | Conclusion | 91 |
| 3.3 | Virtual Persons and the Law | 92 |
| 3.3.1 | Unborn Human Entities | 92 |
| 3.3.2 | New Challenges to Technology and Law | 95 |
| 3.3.3 | Conclusion | 97 |
| 3.4 | Trust in the Light of Virtual Persons | 97 |
| 3.4.1 | Research on Trust | 98 |
| 3.4.2 | Defining Trust | 100 |
| 3.4.3 | Trust Metrics and Trust Management Systems | 111 |
| 3.4.4 | Trust in the Light of Virtual Persons | 115 |
| 3.4.5 | Conclusion | 116 |
| | References | 117 |

| | |
|---|-----|
| VIGNETTE 3: USE AND ABUSE OF BIOMETRIC DATA AND SOCIAL NETWORKS | 123 |
|---|-----|

4 High-Tech ID and Emerging Technologies 129

Martin Meints and Mark Gasson

| | |
|---|-----|
| 4.1 Identity Management and Identity Management Systems | 130 |
| 4.2 Technologies and Technical Components | 133 |
| 4.2.1 Public Key Infrastructure | 133 |
| 4.2.2 Electronic Signatures | 136 |
| 4.2.3 Biometrics | 138 |
| 4.2.4 RFID | 149 |
| 4.2.5 Credential Systems | 154 |
| 4.3 Supporting Technologies | 158 |
| 4.3.1 Trusted Computing, , | 158 |
| 4.3.2 Protocols with Respect to Identity and Identification | 162 |
| 4.3.3 Identity Management in Service Oriented Architectures | 167 |
| 4.3.4 Digital Rights Management | 171 |
| 4.4 Emerging Technologies | 172 |
| 4.4.1 Ambient Intelligence | 173 |
| 4.4.2 Human ICT Implants | 175 |
| 4.5 Use Cases | 176 |
| 4.5.1 ID Documents | 176 |
| 4.5.2 CardSpace | 181 |
| 4.6 Summary and Conclusions | 183 |
| References | 185 |

| | |
|---|-----|
| VIGNETTE 4: POWERING THE PROFILE: PLUGGING INTO THE MOBILE GRID | 191 |
|---|-----|

5 Mobility and Identity 195

Denis Rover, Andre Deuker, and Kai Rannenber

| | |
|---|-----|
| 5.1 GSM - How Mobile Communication Achieved Its Special Role in Identity Management | 196 |
| 5.2 Mobile Identities-Context Added | 198 |
| 5.2.1 Context Extension via LBS and User Control | 198 |
| 5.2.2 Mobile Identities in Action - A Scenario on Emergency Response | 200 |
| 5.3 The FIDIS Perspectives on Mobility and Identity | 202 |

| | | |
|----------|--|------------|
| 5.4 | Technological Aspects | 202 |
| 5.4.1 | Management of Mobile Identities vs. Mobile Identity Management | 203 |
| 5.4.2 | Positioning Technologies and Methods | 204 |
| 5.4.3 | Accuracy of Positioning Technologies and Methods | 211 |
| 5.4.4 | Security and Privacy in Mobile Identity Management | 211 |
| 5.5 | Legal Aspects | 215 |
| 5.5.1 | Two European Directives on Data Protection | 216 |
| 5.5.2 | Location Data, Traffic Data, and Their Relation to Personal Data | 217 |
| 5.5.3 | Which Directives Apply to Which Types of Data? | 219 |
| 5.5.4 | Conclusion | 220 |
| 5.6 | Sociological Aspects | 221 |
| 5.6.1 | A Socio-technical View on Mobility and Identity | 221 |
| 5.6.2 | Price of Convenience (PoC) | 223 |
| 5.7 | Economic Aspects | 225 |
| 5.7.1 | Market Players | 226 |
| 5.7.2 | Building User Trust | 227 |
| 5.7.3 | Related Economic Theories | 230 |
| 5.7.4 | A Framework for Analysing the Economic Impacts of MIdM in Mobile Services and Applications | 233 |
| 5.8 | Requirements for Mobile Identity Management Systems | 237 |
| 5.9 | Outlook and Further Challenges and Questions | 238 |
| | References | 240 |
| | VIGNETTE 5: HUMAN ENHANCEMENT, ROBOTS, AND THE FIGHT FOR HUMAN RIGHTS | 243 |
| 6 | Approaching Interoperability for Identity Management Systems | 245 |
| | <i>James Backhouse and Ruth Halperin</i> | |
| 6.1 | Introduction | 245 |
| 6.1.1 | Why Interoperability in iDMS: Relevance and Strategic Motivation | 245 |
| 6.1.2 | Interoperable Delivery of European eGovernment Services IDABC | 246 |
| 6.1.3 | Organization of This Chapter | 247 |
| 6.2 | Interoperable Identity Management Systems: Definitions and Framework | 247 |

| | | |
|---|---|-----|
| 6.2.1 | Conceptualizing Interoperability | 247 |
| 6.2.2 | The TF1 Model | 250 |
| 6.3 | Stakeholders Perspectives on Interoperable iDMS | 254 |
| 6.3.1 | Expert Requirements for Interoperability | 254 |
| 6.3.2 | Citizens Perceptions on Interoperability | 258 |
| 6.4 | Conclusion | 265 |
| | References | 265 |
| | Appendix: Experts | 267 |
| VIGNETTE 6: MORE CONTROL FOR THE MACHINES | | 269 |
| 7 | Profiling and Ami | 273 |
| | <i>Mireille Hildebrandt</i> | |
| 7.1 | Profiling: Definitions, Applications and Risks | 275 |
| 7.1.1 | What Is Profiling? ¹ | 275 |
| 7.1.2 | Applications of Profiling | 278 |
| 7.1.3 | Profiling, Democracy and the Rule of Law | 283 |
| 7.2 | Profiling Technologies as the Enabling Technology for Ami | 286 |
| 7.2.1 | What about Ambient Intelligence? | 286 |
| 7.2.2 | Ami and Autonomic Profiling | 287 |
| 7.2.3 | Autonomic Profiling and Autonomous Action | 288 |
| 7.2.4 | Ami, Democracy and Rule of Law | 290 |
| 7.3 | When <i>Idem</i> Meets <i>Ipse</i> : The Identity of the European Citizen | 292 |
| 7.3.1 | Privacy and Identity | 292 |
| 7.3.2 | <i>Idem</i> (Sameness) and <i>Ipse</i> (Selfhood) | 293 |
| 7.3.3 | Freedom from and Freedom to | 294 |
| 7.4 | A Vision of Ambient Law | 295 |
| 7.4.1 | AmLaw as Law | 296 |
| 7.4.2 | Why Should Ami Require Another Type of Law? | 296 |
| 7.4.3 | From Written to Digital Law in Constitutional Democracy | 300 |
| 7.4.4 | Legal and Technological PETs and TETs | 302 |
| 7.5 | Conclusions | 305 |
| | References | 307 |

| | |
|--|------------|
| VIGNETTE 7: THE ROLE OF FORENSICS IN IDENTITY | 311 |
| 8 Identity-Related Crime and Forensics | 315 |
| <i>Bert-Jaap Koops and Zeno Geradts</i> | |
| 8.1 Introduction | 315 |
| 8.2 Identity-Related Crime | 316 |
| 8.2.1 The FIDIS Taxonomy of Identity-Related Crime | 316 |
| 8.2.2 Aspects of Identity-Related Crime | 322 |
| 8.3 Forensic Implications | 329 |
| 8.3.1 Forensic Aspects | 329 |
| 8.3.2 Example 1: Mobile Networks | 331 |
| 8.3.3 Example 2: Biometric Devices | 331 |
| 8.3.4 Conclusion | 332 |
| 8.4 Forensic Profiling | 333 |
| 8.4.1 Introduction | 333 |
| 8.4.2 Definition of Forensic Profiling | 334 |
| 8.4.3 Linkage Blindness and Limits of Profiling | 334 |
| 8.4.4 Data Available | 336 |
| 8.4.5 Structuring Evidence and Profiling | 337 |
| 8.4.6 Forensic Profiling in an Investigative Perspective | 337 |
| 8.4.7 Illicit Drug Profiling | 341 |
| 8.4.8 Legal Aspects | 342 |
| 8.5 Conclusion | 344 |
| Reference | 345 |
| VIGNETTE 8: DATING | 349 |
| 9 Privacy and Identity | 351 |
| <i>Maike Gilliot, Vashek Matyas, and Sven Wohlgemuth</i> | |
| 9.1 Introduction | 351 |
| 9.2 Privacy Aware Concepts for ID Numbers | 353 |
| 9.2.1 Legal Aspects | 354 |
| 9.2.2 Sociological Aspects | 357 |
| 9.2.3 Technical Aspects | 359 |
| 9.2.4 European Approaches | 359 |
| 9.2.5 Conclusions | 360 |
| 9.3 Privacy Primitives and Applications | 362 |
| 9.3.1 Privacy Primitives | 362 |
| 9.3.2 Application Privacy | 365 |
| 9.3.3 Summary | 372 |

| | | |
|--------------------|--|------------|
| 9.4 | Privacy with Delegation of Personal Data | 372 |
| 9.4.1 | The One-Sided Trust Model in CRM | 373 |
| 9.4.2 | Delegation of Rights in CRM | 374 |
| 9.4.3 | Security Systems and Delegation of Rights | 376 |
| 9.4.4 | DREISAM: Protocols for Delegation of Rights | 378 |
| 9.4.5 | Proof-of-Concept Implementation of DREISAM for CRM | 381 |
| 9.4.6 | Properties of DREISAM | 383 |
| 9.4.7 | Conclusion | 385 |
| 9.5 | Towards Transparency | 385 |
| | References | 386 |
| 10 | Open Challenges - Towards the (Not So Distant) Future of Identity | 391 |
| | <i>Kai Rannenberg and Denis Royen \</i> | |
| IOI | Identity Reference Architectures | 391 |
| IOI.1 | What Is to Be Done? | 392 |
| IOI.1.2 | How Can It Be Done? | 392 |
| IOI.1.3 | What Needs to Be Considered? | 393 |
| 10.2 | Identity Management and Privacy | 393 |
| 10.2.1 | What Is to Be Done? | 393 |
| 10.2.2 | How Can It Be Done? | 395 |
| 10.2.3 | What Needs to Be Considered? | 396 |
| 10.3 | Identity Management and Multilateral Security | 396 |
| 10.3.1 | What Is to Be Done? | 397 |
| 10.3.2 | How Can It Be Done? | 397 |
| 10.3.3 | What Needs to Be Considered? | 397 |
| 10.4 | Identity in the Internet of Things | 398 |
| 10.4.1 | What Needs to Be Done? | 398 |
| 10.4.2 | How Can It Be Done? | 398 |
| 10.4.3 | What Needs to Be Considered? | 398 |
| | | |
| Appendix A. | List of Deliverables | 401 |
| A.1 | Communication Infrastructure (WP1) | 401 |
| A.2 | Taxonomy: Identity of Identity (WP2) | 402 |
| A.3 | HighTechID: Technologies to Support Identity and Identification (WP3) | 404 |
| A.4 | Interoperability of Identity and Identification Concepts (WP4) | 409 |
| A.5 | ID-Theft, Privacy and Security (WP5) | 414 |

| | |
|---|------------|
| A.6 Forensic Implications (WP6) | 417 |
| A.7 Profiling (WP7) | 418, |
| A.8 Integration of the NoE (WP8) | 422 |
| A.9 Mobility and Identity (WP11) | 423 |
| A. 10 Emerging Technologies (WP12) | 425 |
| A. 11 Privacy Fundamentals (WP 13) | 427 |
| A. 12 Privacy in Business Processes (WPI4) | 430 |
| A.13 eGovernment(WP16) | 432 |
| A. 14 Abstract Persons (WP 17) | 432 |
| Appendix B. Contributors | 435 |
| Appendix C. FIDIS Consortium | 457 |
| Appendix D. Proposal for a Common Identity Framework: A User-Centric Identity Metasystem | 477 |
| <i>Kim Cameron, Reinhard Posch, and Kai Rannenberg</i> | |
| D.1 Introduction | 477 |
| D.2 Terminology | 477 |
| D.3 Scope | 480 |
| D.4 Metasystem Requirements in the Light of Multilateral Security | 480 |
| D.5 Abstract Model of the Identity Metasystem | 485 |
| D.6 Enabling Technologies | 495 |
| D.7 Administration | 498 |
| D.8 Standardisation | 499 |
| Glossary | 501 |