Handbook of Mobile Data Privacy

Aris Gkoulalas-Divanis • Claudio Bettini
Editors

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Dedicated to my parents, Aspa and Dimitris, and to my lovely wife Elena for all their support.

–Aris Gkoulalas-Divanis

Dedicated to my parents, Anna Maria and Giovanni, and to my son Matteo.

–Claudio Bettini

Preface

The advances in mobile devices and positioning technologies, together with the progress in spatiotemporal database research, have made possible the tracking of mobile devices (and their human companions) at a very high accuracy while supporting the efficient storage of mobility data in data warehouses. This has provided the means to collect, store, and process mobility data of an unprecedented quantity, quality, and timeliness. As ubiquitous computing pervades our society, user mobility data represents a very useful, but also extremely sensitive, source of information. On the one hand, the movement traces that are left behind by the mobile devices of the users can be very useful in a wide spectrum of applications such as urban planning, traffic engineering, and environmental pollution management. On the other hand, the disclosure of mobility data to third parties may severely jeopardize the privacy of the users whose movement is recorded, leading to abuse scenarios such as user tailing and profiling.

A significant body of research work has been conducted in the last 15 years in the area of mobility data privacy, along a number of important research directions such as privacy-preserving mobility data management, privacy in location sensing technologies and location-based services, privacy in vehicular communication networks, privacy in location-based social networks, and privacy in participatory sensing systems. This work has identified important privacy gaps in the use of human mobility data and has resulted to the adoption of international laws for location privacy protection (e.g., in EU, the USA, Canada, Australia, New Zealand, Japan, Singapore), as well as to a large number of interesting technologies for privacy-protecting mobility data, some of which have been made available through open-source systems and featured in real-world applications.

The overarching aim of this book is to survey the field of mobility data privacy and to present the fundamental principles and theory, as well as the state-of-the-art research, systems, and applications, to a wide audience including non-experts. Emphasis in the book is given toward coverage of the most recent directions in mobility data privacy. The structure of the book closely follows the main categories of research works that have been recently undertaken to protect user privacy in the context of mobility data and applications. After the first introductory chapters,

which cover the fundamentals around the offering of privacy in mobility data, each subsequent chapter of the book surveys an important research problem related to mobility data privacy and discusses the corresponding privacy threats that have been identified and the solutions that have been proposed. The last part of the book is devoted to state-of-the-art systems for mobility data privacy, as well as to real-world applications where privacy-protection techniques have been applied.

We would like to note that this book is primarily addressed to computer science and statistics researchers and educators, who are interested in topics related to mobility privacy. We expect that the book will be also valuable to industry developers, as it covers the state-of-the-art algorithms for offering privacy. To ease understanding by nonexperts, the chapters contain a lot of background material, as well as many examples and citations to related literature. By discussing a wide range of privacy techniques, providing in-depth coverage of the most important ones, and highlighting promising avenues for future research, this book also aims at attracting computer science and statistics students to this fascinating field of research.

Boston, MA, USA — Aris Gkoulalas-Divanis
Milan, Italy — Claudio Bettini
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We would like to thank all authors who contributed chapters to this handbook, for their valuable contributions. This work would not have been possible without their efforts. A total of 31 authors who hold positions in leading academic institutions and industry, in Italy, Hungary, Austria, Switzerland, Greece, France, Germany, the USA, and the UK, have contributed 15 chapters to this book. We sincerely thank them for their hard work and the time they devoted to this effort.

In addition, we would like to express our deep gratitude to all the expert reviewers of the chapters for their constructive comments, which significantly helped toward improving the organization, readability, and overall quality of the book.

Last but not least, we are indebted to Susan Lagerstrom-Fife and Caroline Flanagan from Springer, for their great guidance and advice in the preparation and completion of this handbook, as well as to the typesetting and publication team at Springer for their valuable assistance in the editing process.

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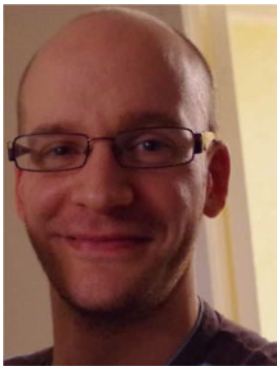

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In 2009, he co-edited the Springer book *Privacy in Location-Based Applications*, offering a first overview of the main research results in the field. Among his many organizational activities, he acted as General Chair of IEEE PerCom 2017 and IEEE MDM 2013 and as TPC Chair of IEEE PerCom 2013. He is a member of the steering committee of IEEE PerCom and Associate Editor of the *Pervasive and Mobile Computing* journal and previously Editor of *The VLDB Journal* and of the *IEEE Transactions on Knowledge and Data Engineering*. In 2011, he founded EveryWare Technologies, a startup developing innovative mobile apps and services for privacy and assistive technologies. He is a senior member of the IEEE Computer Society.

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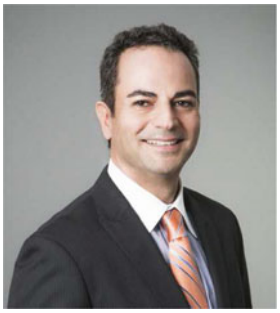

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