

SMART CITIES



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It is through information and communications technologies (ICT) that smart cities are truly turning “smart.” This is facilitated by means of services that use, among others, networked sensors and actuators deployed in the city, allowing the monitoring of the urban environment in real time, to react just in time if needed and to establish automated control processes with less or even without human intervention.

Given the importance of ICT, we are currently witnessing a shift of industries in the urban space: an arena formerly dominated by heavy infrastructure providers is now increasingly occupied by operators and service providers. This is being facilitated by an important transition within the ICT sector from simply providing data pipes toward designs that exploit the actual content of the gathered data. So-called big data, collected from the crowd or sensors, provides unprecedented opportunities to optimize operations in a city and thus improve urban living.

This Feature Topic, the first of its kind, focuses on ICT technologies allowing for smart city rollouts, deployments, and growth. Some of the gamut of technologies have been researched and developed for years already; others are new. However, their composition and application in the area of smart cities are unparalleled and account for the tremendous upsurge of work in this area, which is mainly attributed to the unique timing between the undeniable need to make cities more efficient, and an enormous set of ICT technologies having become available and affordable.

From the large number of submissions, we have assembled nine articles that yield a fairly complementary and complete picture of the technology landscape in smart city developments:

- Smart city business models
- Architectural implications due to business models
- Wireless access of smart city traffic through M2M
- Wired backbone offload of aggregated smart city traffic
- Management of these heterogeneous technologies
- Crowd-sourced data from/for smarter cities
- Big data mining approaches

- Big data exploitation through API stores
- Privacy issues

In more detail, the first article, by Walravens *et al.*, offers a theoretical framework for the analysis of platform business models that involve smart city stakeholders. It guides the first steps any city has to take to gauge the applicability and return on investment of deployed smart city technologies, and thus paves way for the subsequent articles in this Feature Topic.

The second article, by Mulligan *et al.*, follows up on the above article and discusses the architectural implication of smart city business models. It dwells on the evolution required to ensure that the rollout and deployment of smart city technologies is smooth through integrating the strengths of all system architectures proposed.

The third article, by Hasan *et al.*, focuses on wireless access technologies, notably machine-to-machine (M2M) technologies, which will be central in smart city deployments. The authors provide a review of M2M communication techniques in Long Term Evolution-Advanced (LTE-A) cellular networks and outline major research issues related, for example, to the random access channel and packet transmission in a self-organizing manner.

The fourth article, by Zhu *et al.*, focuses on wired backbone and data offloading technologies, notably the emerging wideband cable access. While mainly used for multimedia transmission today, the recently introduced channel bonding technique in DOCSIS3.0 allows for bidirectional data transfer and is thus of increasing interest to smart city deployments offering services to people and machines.

The fifth article, by Vlacheas *et al.*, focuses on management solutions for the above outlined technologies and the data they create. The authors recognize the heterogeneous nature of the smart city technology landscape, and thus call for cognitive and virtualization mechanisms to facilitate a scalable and sustainable uptake of these technologies.

The sixth article, by Cardone *et al.*, focuses on crowd-sourcing and investigates how and to what extent the

power of collective intelligence can be employed in smart cities. The authors introduce an innovative geo-social model to profile users and a real-world Android-based platform to collect sensing data from smartphones.

The seventh article, by Pan *et al.*, focuses on trace analysis and data mining of the big data accumulated through above-outlined M2M or crowdsourced means. The authors outline six precise research issues related to trace analysis and mining, then survey the state of the art in this field, and finally discuss promising application domains in smart cities.

The eighth article, by Vilajosana *et al.*, recognizes that business around smart cities has difficulties in taking off and proposes a procedure to bootstrap the market through an innovative big data API store concept. The article scrutinizes the smart city stakeholders, and outlines why and how big data flows can be channelized to create long-term value for cities.

The ninth and final article, by Martinez-Balleste *et al.*, identifies a number of privacy breaches that can appear within the context of smart cities and offered services. The authors define the concept of citizens' privacy as a model along five KPIs. They also show how existing privacy enhancing technologies can be used to preserve citizens' privacy.

As Guest Editors, we would like thank all the authors for their submissions to this Feature Topic; even though we were not able to accept all papers, the large number of submissions proved that the area of ICT in smart cities is of growing interest. We would also like to express our appreciation to all reviewers who have provided quality and timely reviews in this emerging field. Furthermore,

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We hope that this Feature Topic appeals to both the academic and industrial readership, and inspires future work in the emerging area of smart cities.

BIOGRAPHIES

MISCHA DOHLER [SM] (mischa.dohler@cttc.es) is Chair Professor in Wireless Communications at King's College London, United Kingdom. He is a Distinguished Lecturer of IEEE ComSoc and Editor-in-Chief of *ETT*. He is frequently featured as a keynote speaker, and has had press coverage by the BBC and *Wall Street Journal*. He is a tech company investor and entrepreneur of a smart city company. He has co-authored more than 160 papers, books, and standards. He is fluent in six languages.

CARLO RATTI teaches at the Massachusetts Institute of Technology, where he directs the Senseable City Lab. He has co-authored over 250 publications. He has written for the BBC and *New York Times*, and was listed by Forbes as one of the "Names You Need To Know." He was a presenter at TED 2011. The Italian Minister of Culture named him a member of the Italian Design Council. He serves on the World Economic Forum Global Agenda Council for Urban Management.

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GORDON FALCONER is director of Cisco's IBSG Urban Innovation practice, and has more than 20 years of experience in city strategies. He is a recognized thought leader on smart cities, and advises cities, governments, and NGOs (e.g., World Bank). He is a frequent speaker around the world on urban innovation and at smart cities conferences. He was formerly with Masdar City in Abu Dhabi, United Arab Emirates, one of the world's most innovative sustainable city projects.