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EDITORIAL

Editorial of ETT Feature Issue: Smart Cities – Trends & Technologies

Today (2014), more than 1 in 2 is living in cities; the related efforts to facilitate viable living conditions are tremendous. And, to make matters worse, the effect of urbanization on global climate has come into limelight. Solutions are urgently needed, and quickly advancing technologies may just be the answer.

This has triggered major global ICT players to launch their respective smart city initiatives. For a good reason: the smart city market is estimated to be of three-digit billion dollars by 2020, with an annual spending reaching nearly $16bn.

Pike Research defines a smart city as “the integration of technology into a strategic approach to sustainability, citizen well-being, and economic development”. Viable smart city models thus ought to be “multi-dimensional, encompassing different aspects of smartness and stressing the importance of integration and interaction across multiple domains”. A city, in the end, is a system of systems, and “any models that attempt to define its dynamic nature must also be able to represent the diversity of those elements”.

Designing smartness into cities thus requires some major infrastructure upgrade. Some similar connectivity exercise had been conducted before: we have built highways, the Internet, the Smart Grid. These have two things in common: i) they have meshed and connected entities (computers, cities, etc) to the point that connectivity is secondary whilst the ability to provide services (FaceBook, supply chains, etc) has become the prime point of interest; and ii) they were built without a specific nor proven return-of-investment (ROI) model in mind, with all of them having returned their investment by orders of magnitude.

Above confirms that connectivity and the ability to add “smartness” on top are key features of smart cities. This feature issue on Smart Cities thus assembles latest developments on these issues. Notably, the first two papers deal with the provisioning of data through low-rate M2M as well as high-capacity small-cell data links. The third to sixth papers introduce different smart city platforms, stretching from infrastructure-sensing-only to crowdsourced-only data gathering platforms. The seventh paper introduces an innovative smart city service approach, i.e. sensing as a service, and the eighth paper dwells on the important issue of privacy. The remaining three papers then deal with general or specific smart city applications. A more detailed discussion follows.

The first paper, “M2M Access Performance in LTE-A System” by Bo Yang et al., discusses the challenges related to cellular machine-to-machine (M2M) LTE-A access mechanism. The authors model the access on the air interface as a queuing system, and the access performance is evaluated by means of system level simulations. Said simulations confirm that congestion on the air interface is very serious for some applications, for which a novel bundling transmission scheme is introduced.

The second paper, “The Role of Small Cell Technology in Future Smart City Applications” by Antonio Cimmino et al., examines in great depth the challenges, requirements and latest solutions in facilitating data-rich smart city services and applications. The authors examine the role of the latest developments of LTE-A smallcell broadband technologies. They show that this emerging 4G technology family fully meets the emerging communication and networking requirements of future smart cities.

The third paper, “Stem-Net: An Evolutionary Network Architecture for Smart and Sustainable Cities” by Gianluca Aloi et al., recognizes the lack of ubiquitous connectivity and the fragmentation of networks that are usually deployed by different operators and without any centralized control by the city authorities. The authors advocate the heterogeneity of devices and network technologies as a potential to increase the connectivity in a smart city, and introduce a self-configuring and self-managing “stem” node. Interestingly, the proposed architecture is deployed on real-world prototyping devices using an Alix-based router, a laptop, and a smartphone.

The fourth paper, “User-Centric Smart Buildings for Energy Sustainable Smart Cities” by Marra Moreno et al., analyzes the role that buildings play in terms of their energy performance at city level. The authors introduce an energy-efficient management system integrated in a building automation platform based on IoT technologies but also a citizen-centric approach. The building management platform has been deployed in a real building, and savings up to 20% were reported.

The fifth paper, “Electromagnetic Energy Harvesting - Global Information Database” by Ludimar Guenda et al., recognizes that sensing and other smart city infrastructure can only be meaningfully powered through energy scavenging. With focus on electromagnetic energy harvesting, this article presents a georeferenced database that can be used to gather information about electromagnetic energy availability around the world. The paper describes the information system architecture that is behind the database structure and two methods that can be used to gather the electromagnetic information; one based on typical RF
The sixth paper, “CityWatch: Exploiting Sensor Data to Manage Cities Better” by Atif Manzoor et al., proposes and prototypes a crowdsourced data sensing and dissemination platform, CityWatch, which has been successfully deployed in Dublin, Ireland. The authors argue that the scale and complexity of future cities mean that having a fixed sensing infrastructure will become unsustainable at some point, thereby hindering the scalability of smart city deployments. The authors discuss the innovative architecture, the prototype and some very interesting outcomes on the user participation.

The seventh paper, “Sensing as a Service Model for Smart Cities Supported by Internet of Things” by Charith Perera et al., focuses on the emerging field of Internet of Things (IoT), which is supported by infrastructures, platforms, and software applications allowing to offer cloud technologies as a services. The authors thus examine in details the concept of sensing as a service and how it relates to the IoT. The authors introduce the fairly innovative, but commercially very appealing issue, of smart city sensing as a service. They discuss findings from technological, economical, and social perspectives, and identify the major open challenges.

The eighth paper, “Reconciling Privacy and Efficient Utility Management in Smart Cities” by David Rebollo-Monedero et al., examines a very pertinent issue arising in smart cities where a lot of data is being gathered, including from or pertaining to citizens. With application to smart metering, an integral part of smart buildings in future cities, the authors provide a general perspective on the contrasting issues of privacy and efficient utility management. They also survey the most important requirements and tools for addressing this challenge.

The ninth paper, “Escaping From Ancient Rome! Applications and Challenges for Designing Smart Cities” by Taewook Heo et al., is a fairly complete overview of representative smart city applications, along with their respective challenges and application requirements. The authors also share practical experiences obtained from designing and deploying examples of such smart systems in multiple application domains. The authors then dwell on future challenges which remain to be addressed to make smart cities a reality.

The tenth paper, “A Control and Decision System for Smart Buildings using Wireless Sensor and Actuator Networks” by Claudio de Farias et al., proposes innovative control and decision mechanisms in devices of the building in order to automate and improve operations of Smart Buildings. The authors propose a distributed system for decision and control for Smart Building applications that makes use of wireless sensor and actuator networks. The experimental framework proved that, since data is not transmitted to a centralizing location, there is a gain in response time.

And finally, the eleventh paper, “On-street smart parking networks at a fraction of their cost: performance analysis of a sampling approach” by S. Evenepoel et al., deals with a specific smart city application, i.e. smart parking. It is likely the most prolific smart city application to date (2014) since clearly being of great interest to citizens (guidance to vacant parking spots), cities (reduction of pollution and increase of income), and law enforcement operators (increase in operational efficiency). The currently used infrastructure to support said application is typically composed of sensors in each parking spot, which is very expensive. The authors thus propose a truly innovative approach in deploying only a fraction of sensors together with some statistical insides to yield approximately the same degree of detection reliability.

As guest editors, we would like to thank all the authors for their submissions to this feature topic. We would also like to express our appreciation to all reviewers who have provided quality and timely reviews in this emerging field. Furthermore, this special issue would not have happened without the constant support of the publishing staff of the journal.

We hope that this feature issue appeals to both the academic and industrial readership, and inspires future work in the emerging area of machine Smart Cities. Interestingly, most of above papers had experiments to support the claims and findings, showing that the field is quickly growing from a purely academic field into applied sciences.

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