Internet-of-Things (IoT)


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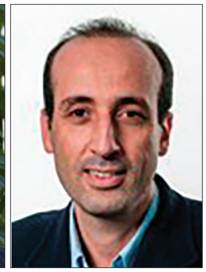
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The Internet of Things (IoT) is simply about connecting devices and creating related applications to suit a business and economic need. One of its value propositions is automation.

While the term IoT became popular in recent years, the basic concepts have been around for several decades. This time, however, it is commonly agreed that IoT is not only here to stay but will also grow steadily. The technology is finally ready to make IoT accessible for a very large number of market segments and use cases where the total cost of ownership had been prohibitive.

Industry initiatives, including standards and open source, and academia are heavily aligned on the vision and are backing the growth of IoT by addressing remaining gaps to help massive market uptake. When it comes to connectivity networks, recent advances in Low Power Wide Area (LPWA) networks are making IoT accessible for battery operated devices that need to occasionally exchange small amounts of data. Equally, 5G is providing a market driven answer for use cases that need very low latency or require the exchange massive amounts of data.

In parallel, semantic interoperability is now emerging as a major trend that allows data exchange between applications, an increased level of interoperability, analytics and reasoning. With ontologies engineering, the industry will soon overcome the limitations of static data models and bridge the gap between the currently deployed vertical silos.

Finally, Edge Computing, a paradigm that makes it possible to move processing closer to where the data is generated, is emerging as a market imperative to help address strict latency requirements and optimize network resources.

All those concepts have been considered in four selected papers of this series topic.

The first article by Kazmi *et al.*, "VITAL-OS: An Open Source IoT Operating System for Smart Cities," proposes an open source IoT operating system referred to as VITAL-OS. VITAL-OS facilitates access to and control of a city infrastructure, including resources and sensor networks. An abstraction layer and a set of tools are offered to developers to create new applications. VITAL-OS has been designed to be citizen-centric, which is an important pillar of future-proof IoT enabled smart cities. In addition, the paper introduces mechanisms for semantic interoperability of multiple IoT systems to enable integrated management of IoT resources as well as exploiting all the underlying data and services. VITAL-OS adopts various IoT related standards such as IoT-A, oneM2M and W3C SSN.

The second article by Zaidi *et al.*, "OFDM Numerology Design for 5G New Radio to Support IoT, eMBB, and MBSFN," presents a comprehensive discussion of the design of NR OFDM numerology to support eMBB, and IoT in particular. Further, the paper analyzes the main factors that impact NR design, such as the type of deployments, service requirements, hardware impairments, mobility, performance and implementation complexity. The papers shows that 1) low latency can also be achieved e.g. using transmissions via a mini-slot, and 2) asynchronous access in the case of mMTC applications can be supported by using windowing techniques.

The third article by Höglund *et al.*, "Overview of 3GPP Release-14 Further Enhanced MTC," describes and explains major features improvement to support the massive Machine Type Communication (MTC) service. It shows that the range of possible use cases that can be addressed by LTE-M devices is greatly improved through the introduction of the new device category known as M2. This category increases data rates and provides device positioning with significantly improved accuracy and support for multicast.

The fourth article by Höglund *et al.*, "3GPP Release 15 Early Data Transmission," presents the mechanism of Early Data Transmission (EDT) included by 3GPP in Release 15 specifications. In order to optimize support for infrequent small data packet transmissions, EDT allows IoT devices to transmit during the random access procedure. This technique improves device battery life and reduces message latency. Further, the paper provides updates on the status of specifications and simulation results on the benefit this technique may bring to the operation of IoT sensors. Results show that, for a device in extreme coverage, EDT can improve battery life by three years and reduce message latency by more than three seconds as compared to Release 13 performance.

We hope the readers will enjoy this issue and find the articles useful. We also wish to express our thanks to the Communications Society staff for their continuous support in the preparation of this issue.

Biographies

Afif Osseiran [SM] (afif.osseiran@ericsson.com) is Director of Industry Engagements and Research at the Ericsson headquarter in Stockholm. His main responsibility is to bridge insights, tactics and strategies between technology, research/standardization and industries such as manufacturing. He holds a doctorate degree from the Royal Institute of Technology (KTH), Sweden, and a master's degree from École Polytechnique de Montreal. Since 1999 he has held several positions at Ericsson in various units (such as the product, research and strategy units). He co-authored the first comprehensive book on 5G with Cambridge and two books on IMT-Advanced with Wiley.

Omar Elloumi [M] (omar.elloumi@alcatel-lucent.com) leads the oneM2M technical plenary, a partnership project chartered to advance interoperability standards for consumer, enterprise and industrial IoT. He is currently with Nokia Bell-Labs and CTO group as Distinguished Member of Technical Staff, where he is responsible for standards and system architectures for IoT. He has co-edited several books on M2M communications and Internet of Things published by Wiley and ETSI.

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Jose F. Monserrat [SM] (jomondel@iteam.upv.es) is an associate professor at the Universitat Politècnica de València. His research focuses on the design of future 5G wireless systems and their performance assessment. He has been involved in several European Projects, like METIS/METIS-II, leading the simulation activities. Currently he is a member of the 5G-XCAST H2020 consortium. He co-edited the Wiley book *Mobile and Wireless Communications for IMT-Advanced and Beyond* and the Cambridge book *5G Mobile and Wireless Communications Technology*. Jose has published more than 50 journal papers.