The Internet of Things: Are we there yet?

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Introduction

It has been one year now since the first issue of the journal was launched in November 2015. Many interesting things have happened since then, and the concepts of the Internet of Things, Internet of Everything, Industry 4.0, autonomous driving, smart cities, eHealth, and relatives have become ubiquitous in specialized fora. Both the IoT Solutions World Congress in October and the Smart City Expo World Congress in November, were celebrated in Barcelona this year again. These events evidenced the facts that there is a non-stoppable growing interest from the industry and from the users, and that technology is getting mature enough to provide real and cost-effective solutions. However, the IoT is still not present in our daily lives. Why?

Arguably, the success of the IoT will come from at least three different fronts: 1) societal acceptance, 2) capability of getting value out of it, and 3) availability of technology to leverage its potential.

First, the IoT needs society to accept it; that's a fact. The 4th Industrial revolution brought by the Internet of Things will change our daily lives forever. This will imply destruction of jobs where involving a human being brings no added-value. At the same time, new jobs with remarkable added-value brought by the human factor will be created. These new jobs will require highly skilled people, which is good on one side; however, we will need to face the challenge of relocating non-skilled labor.

Otherwise, technology will not be accepted by society and may fail in achieving all expectations. In addition, the acceptance of the IoT by society must be driven by ease of use of technology and, above all, trusted security and privacy mechanisms. If we cannot put secure and private communications into place, people may be reluctant to connect their homes, cars, or health-monitoring devices to the Internet, thus failing to push this fourth wave of innovation. The IoT is about enabling transparency, and transparency is not always what we want.

Second, it is essential that we manage to find ways of monetizing the IoT and actually getting value of connecting things. Indeed, it is not just about connecting all things, but just connecting those things which can bring some value by being connected. We can see out in the press and professional social networks lots of news informing of new start-ups attracting funding from venture capitalists and business angels. Also, big tech companies are acquiring small-sized start-ups which are growing rapidly to provide IoT solutions. However, it is still not clear what the business models may be behind all this buzz. It is clear that the market is huge and the opportunity is unique; however, still ways of understanding the IoT ecosystem and value chain model creation are to be further understood. We have seen already in the past good technology hypes which have ended in nothing due to the lack of a clear value generation model. The IoT will not be the same, but still some efforts are required to ensure this. The best is yet to come.

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Last, but definitely not least, technology must be ready and put into order to make the IoT and the 4th Industrial Revolution a real thing. One of the key domains of technology relevant to the IoT is connectivity. Today, connectivity technologies are still not ready to provide efficient Machine-Type Communications (MTC). These are radically different from Human-Type Communications (HTC) and need a redesign of communication networks, sometimes, bringing into play new disruptive paradigms. Efforts are clearly being done, but still more work is necessary to enable applications where reliability and extreme low delay are necessary, or those where zero-power operation enabling perpetual operation of devices is sought, or those where tiny low-cost embedded sensors need to be able to transmit real-time video monitoring data.

The near-future will bring a new generation of communication networks (5G) which will coexist with a plethora of Low Power Wide Area (LPWA) technologies as well as short-range communication technologies (Zigbee, WiFi, Bluetooth, LiFi, RFID, etc.). However, still changes will be necessary after 5G is defined to cope with the rapidly evolving needs of new IoT applications being created and envisioned every day. Concepts like the tactile internet, where data can be transmitted with zero-latency and jitter from one end to another, are non-trivial to achieve. Therefore, further research, development and innovation actions are required. In all this process, it is necessary to ensure that standards come to a certain common agreement; otherwise, the current unspecified arena may lead to nothing good. As I heard recently in the LPWA event 2016, also in Barcelona: "noise does not help anyone".

From this perspective, this journal aims at putting together key papers which describe some of the main trends in the development of the IoT. In this issue, we have a compilation of 4 papers which touch upon 4 different topics related to the IoT.

The first paper deals with the need to handle heterogeneous Wireless Sensor Networks (WSN) in the context of smart cities. This tutorial article aims to be a first reference for any reader interested in management solutions for WSN in Smart Cities. It provides an insightful and comprehensible introduction to the scenarios, requirements, open challenges, problems, key technologies and desired features that will shape future developments on this field, as well as it surveys the most relevant and recent works from the literature.

The second paper describes a real implementation of an IoT solution to monitor frost events in peach orchards. The paper discusses about how the technology used for this particular approach was selected. It is based on a low-power wireless network composed entirely of commercial o-the-shelf devices. Authors develop a methodology for deploying the network and present the open-source tools to assist with the deployment and to monitor the network. The deployed low-power wireless mesh network is 100% reliable, with end-to-end latency below 2s, and offering over 3 years of battery lifetime.

The third paper describes a cross-layer approach for mobility support in the RPL protocol; the routing protocol for Low-power and Lossy Networks. In this article, the authors focus their analysis on mobility support. They first show that Neighbor Unreachability Detection (NUD) or Bidirectional Forwarding Detection (BFD) fail to mitigate node disconnection. Therefore, they propose a new cross-layer protocol operating between the Medium Access Control (MAC) and routing layers known as Mobility-Triggered RPL (MT-RPL). MT-RPL has been implemented in Contiki OS and is evaluated together with NUD and BFD through an extensive experimentation campaign. Results show that their solution significantly reduces the disconnection time, which increases the packet delivery ratio from the mobile node to the root and reduces control traffic in the network.

The fourth paper deals with a comparison between Bluetooh Low Energy (BLE) and IEEE 802.15.4, the technology used by Zigbee networks, to identify the most suitable technology for Smart Homes. Authors present a comparison of the physical layer of the two technologies and focus on two performance metrics: energy efficiency and wireless coverage. By combining the two metrics, the authors quantify the performance, and identify in which types of links it is preferable to use one technology or the other, thus providing practical guidelines to developers of short-range energy-constrained wireless networks and smart home applications.

I really hope that you enjoy the reading while we work towards the next issue of the journal. We welcome your submissions on topics related to the Internet of Things and the evolution of technology to make this dream become true.