AROUND THE WORLD OF IOT

In this column we plan to take a tour around different physical locations in the world with the objective of highlighting the peculiarities of the trendiest IoT-related applications in selected regions. Thus, the "IoT World" will certainly be physical, but traveling around it shall also expose to the readers how different application domains have been addressed, with particular attention to business sustainability.

INTRODUCTION

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Column Editor

This edition of Around the World of IoT presents a summary of the IEEE World Forum on Internet of Things (WF-IoT 2019) that was held in April in Limerick, Ireland. Arriving at its fifth edition, the WF-IoT is the flagship event organized by the IEEE IoT Initiative, a multi-society activity gathering 20 IEEE member societies/councils. Due to its wide range and outreach, the conference is a means for virtual travel to feel the pulse of IoT growth in the industry, academia and government domains, from many different world regions. WF-IoT 2019 brought together researchers and practitioners who participated and contributed to a program that included both vertical (IoT applications) and topical (IoT technologies) tracks. Participants were able to learn about technology advances and research results, as well as discuss lessons learned from real-world deployments. This column shares highlights and useful links that will help the reader get a feel of where we are and what we can expect from the IoT in the next years. The journey does not end here, however. The World Forum of IoT will be stopping in April 2020 for its next edition in New Orleans, USA.

IEEE 5TH WORLD FORUM ON INTERNET OF THINGS BRINGS TOGETHER 500 EXPERTS TO DISCUSS THE FUTURE OF IOT

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The 5th IEEE World Forum on the Internet of Things 2019 (WF-IoT 2019) was held at the University of Limerick, Ireland on 15–18 April, 2019. The IEEE WF-IoT is the premier IEEE event on IoT organized by the multi society IEEE IoT Initiative. It brings together distinguished participants from industry, the public sector, and the research community. The theme of this year's event was "IoT and the Digital Revolution" in recognition of the strides and leadership that the host location of Limerick and the nation of Ireland have made in developing operating principles and policies for the deployment of "Smart" technologies. The theme also underscores the importance of IoT technologies in enabling the "Digital Revolution" and making it a reality. The papers, presentations, and events at the conference focused on contributions that nurture, cultivate, enhance and accelerate the adoption of IoT technologies and applications for the benefit of society. In the past year, IoT has experienced significant growth in the number of deployments, in the resource investments from both industry and governments, and in the attention from technologists and researchers in almost every discipline. The term IoT captures the vision of a connected world where things, people, and their institutions can interact purposefully to create better lives and sustainable stewardship of the planet.

Over 500 participants gathered in Limerick to exchange experiences from IoT deployments, obtain updates on technology advances, share visions and ideas, present the latest research results, and expand professional and social networking. These activities are a key part of the IEEE IoT Initiative's mission and program.

The four-day event featured:

- Twelve keynote speeches delivered by distinguished speakers from industry, academia and the public sector. Details are available at http://wfiot2019.iot.ieee.org/program/plenaries/.
- A program of technical sessions in the form of oral and poster presentations reporting on novel results from the research community, technical workshops focusing on the latest trends in various technologies, and tutorials targeting in-depth understanding of various aspects of IoT.
- A program of dedicated tracks for practitioners, policy makers, and executives built around applications of IoT to vertical markets and exploring cross-cutting topical areas important to IoT.
- And finally, an entrepreneurial track dedicated to innovation around IoT and early stage IoT companies.

As a key component of the WF-IoT 2019, the Technical Program addressed exciting developments from the research and academic communities. It hosted a record number of contributions to form a broad program of papers and presentations on technology developments and innovations in the many fields and disciplines that drive the utility and vitality of IoT solutions and applications. After extensive peer review, the highest rated papers and proposals were selected for the conference program. The Technical Program included technical papers, tutorials, workshops, a doctoral symposium, special sessions, and industry sessions. The topics addressed were specifically designed to advance technologies, end-to-end solutions, systems and infrastructure, processes and operating methods and experiences from demonstrations and field experiments that are contributing to how IoT can reshape the world and overcome the challenges we face, so that all individuals can participate in and enjoy life on the planet to the fullest. The program and track co-chairs, along with the organizing committee, did an outstanding job of creating exciting sessions on issues of regional and global importance and brought in prominent and knowledgeable speakers and panelists for the program. We want to specifically acknowledge their contribution and the intensive effort behind the scenes that made the conference a success. The peer-reviewed papers from the conference are available through publication in IEEE Xplore at: https://ieeexplore.ieee.org/xpl/conhome/8764305/proceeding

The Technical Program was also augmented by specific events for Young Professionals and for Women in Engineering. The popular BBC World Service radio technology-oriented program 'Click' highlighted the latter. It focused on many of

FIGURE 1. Kate Forbes, Scottish Minister for Public Finance and Digital Economy speaking to the attendees of IoT WF 2019 on efforts made by the Scottish government to foster the acceleration of the deployment of digital and IoT technologies at one of the Plenary Sessions.

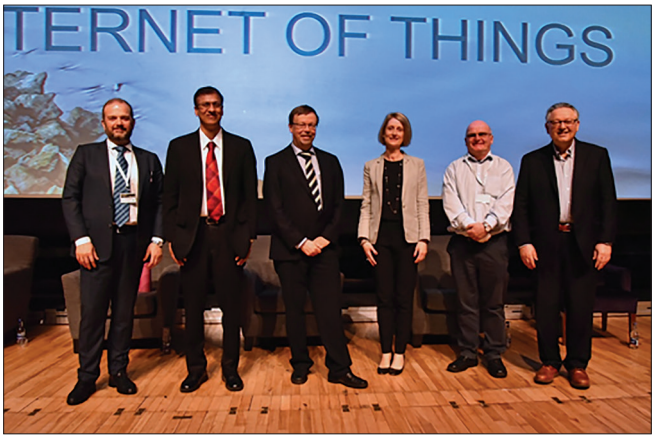

FIGURE 2. From left to right: Nikolaos Isaris (EU DG Connect), Thyaga Nandagopal (NSF USA), Heinrich Stüttgen (Co-Chair of IoT WF 2019), Aisling McEvoy (Science Foundation Ireland, Elfed Lewis (Co-Chair of IoT WF 2019) and Adam Dobot (Co-Chair of IoT WF 2019)

FIGURE 3. WF IoT 2019 co-chairs Adam Drobiot, Elfed Lewis, Heinrich Stüttgen with WF IoT 2020 General Chair Magdy Bayoumi

the topics of the event and included interviews with some of the contributors, which can be viewed here: https://www.bbc.co.uk/programmes/w3csy661.

The WF-IoT 2019 program contained strong involvement from the public sector and industry aimed at deepening understanding and fostering the necessary dialog and actions, such as: formation of working groups, development of roadmaps, creation of testbeds, and development of standards needed to accelerate the adoption and deployment of IoT.

Many of the attendees were highly interested in Thursday's plenary session in which representatives from four different research agencies from Ireland, the USA, Korea, and the EU presented their views on the next steps their government programs include to make IoT a technology and market success. They also provided the audience with a global view of their countries' strategies and approaches to IoT investments.

The IEEE WF-IoT is unique in its composition. The broad-ranging research and academic program is augmented by a focus on vertical and topical tracks, which are designed to stimulate participation by industry and government/public service organizations. This year's technology tracks addressed the following topical areas: Sensors and Sensor Systems for IoT; Advanced Communications and Connectivity for IoT; Data and Storage Platforms to master the explosion of IoT data; the use of Artificial Intelligence in the analysis and interpretation of IoT generated data and the progression of IoT toward automation and autonomy; Green Technologies to enable a sustainable IoT ecosystem; and last but not least, Data Security and Privacy aspects of IoT, including cyber-security technologies. The topical tracks were accompanied by tracks addressing IoT issues and solutions for vertical industries: IoT in Agriculture; IoT in Automotive and Transportation; IoT for Medical Devices and Healthcare; Industrial IoT; IoT Solutions for Maritime; and Smart Cities. These topics were specifically chosen because they are of general interest to IoT globally and to our host location in Ireland, drawing significant attendance and participation from local industry and government. Each vertical and topical area track was organized by co-chairs who carried much of the burden in selecting and attracting the speakers to the event and in moderating the discussions and round tables within the track. The presentations from the vertical and topical area tracks can be found on the IEEE IoT Initiative website at: https://iot.ieee.org/conferences-events.html

WF-IoT 2019 was generously sponsored by the member Societies and Councils of IEEE as well as its supporting patrons: Science Foundation Ireland, Analog Devices Inc., Intertrade

Ireland, Failte Ireland, Suga, and Sensors-MPDI. The event was co-chaired by Adam Drobot (OpenTechWorks, USA), Heinrich Stüttgen (NEC Laboratories Europe, Germany), and Elfed Lewis (University of Limerick, Ireland). Next year's event, IEEE WF-IoT 2020, will be held in New Orleans, USA, 5–9 April, 2020.

At the gala dinner in the Limerick Strand hotel, the traditional "Conference Globe" was passed on from this year's co-chairs to next year's General Chair, Magdy Bayoumi from the University of Lousiana at Lafayette. With the fresh experience of a truly outstanding IoT conference in Limerick, many of the attendees are sure to come to New Orleans to attend WF-IoT 2020. The deadline for contributions to the 6th IEEE World Forum on IoT are due 3 November 2019. Details can be found at: http://www.ieee-wfiot2020.org

Biographies

Adam Drobot is an experienced technologist. His activities are strategic consulting, start-ups, and industry associations. He is the Chairman of the Board of OpenTechWorks, Inc. He was the Managing Director and CTO of 2M Companies, the President of the Applied Research at Telcordia Technologies (Bellcore) and the company's CTO. Prior to that, he managed the Advanced Technology Group at Science Applications International (SAIC/Leidos) and was the Senior Vice President for Science and Technology as part of his service. He is a member of the FCC Technological Advisory Council. In the past he was on the Board of the Telecommunications Industry Association, the US DoT ITS Program Advisory Committee; and the University of Michigan Transportation Research Institute External Advisory Board. For the IEEE he has Chaired the Employee Benefits and Compensation Committee, the Awards Recognition Council, served as a member of the Awards Board. In 2017 and 2018 he chaired the IEEE IoT Activities Board. He is the 2007 recipient of IEEE's Managerial Excellence Award. He has published over 100 journal articles and holds 27 patents. His degrees include a BA in Engineering Physics from Cornell University and a Ph.D. in Plasma Physics from the University of Texas.

Elfed Lewis [M'01, SM'03] graduated with B.Eng. (Hons) in Electrical and Electronic Engineering from Liverpool University in 1978 and was awarded his Ph.D. from the same institution in 1987. He is Associate Professor and Director of the Optical Fibre Sensors Research Centre at University of Limerick, which he founded in 1996. He is Fellow of Institute of Physics and IET. He has authored and co-authored more than 150 journal papers and made in excess of 300 contributions to international conferences. He currently holds 9 patents on Optical Fibre Sensor Devices. In 2005 he was recipient of the University of Limerick Special Achievement in Research Award and was a Fulbright Scholar with CREOL (University of Central Florida) in 2008. He was Distinguished Lecturer for IEEE Sensors Council for the period July 2013-June 2015 and General Co-Chair of the recent IEEE 2019 World Forum on IoT held at University of Limerick, Ireland.

Heinrich Stüttgen studied computer science at the University of Dortmund in Germany and SUNY Buffalo. In 1985 he joined the IBM's R&D Laboratory in Germany, developing one of the first mainframe UNIX systems. In 1987 he moved to IBM's European Networking Center at Heidelberg, where he researched protocols for high-speed and multimedia communications. In 1997 he joined NEC Europe Ltd. as founding manager of NEC's Network Laboratories in Heidelberg. Since June 2007 he has been Vice President of NEC Laboratories Europe, responsible for NEC's ICT research in Europe, covering topics like SDN/NFV, security and IoT and smart cities. He is a Fellow of the IEEE and has held many leadership positions in the IEEE Communications Society. Most recently he has chaired ComSoc's Emerging technologies Committee and the Activities Board of the IEEE IoT Initiative.

Raffaele Giaffreda (rgiaffreda@fbk.eu) is a chief IoT scientist at FBK CREATE-NET, Italy. He has worked in the telecom R&D environment since the beginning of his career, focusing in the last decade on IoT and related technology transfer activities. In his role, he is now responsible for setting research and innovation directions, acquisition of funding, and the execution of a number of collaborative projects in the IoT domain. He has worked in Italy and the United Kingdom (10 years), acquiring experience in both corporate telco environments (R&D of BT and Telecom Italia) as well as in a small research organization (CREATE-NET before its merger with FBK), where the ability to acquire funding was key to ensuring continuity of operations. He is a recognized expert with a substantial record of IEEE publications and conference presentations, a patent, and various book chapters and tutorials on IoT. He is an experienced speaker and chair of IoT related events, serves as an EU reviewer, has served on the TPCs of a number of international conferences, and he is the Editor-in-Chief of the *IEEE IoT Newsletter*.