

# Theme 3: Connected development

## Abstract:

According to the United Nations, 54% of the world population live in cities today, a number that is expected to reach 66% by 2050. Yet today overcrowded urban areas, especially in developing countries, must already face problems in resource access and provision that obstruct their growth and development. This evolution is unstoppable: cities provide multiple economical advantages and as a result are a very efficient form of social organization. The concentration of job opportunities and skilled citizens on a relatively small geographical area enables scale economies on infrastructure and service provision, reducing costs in transportation, power, communications and social interactions.

In this session, we aim to discuss the role of engineering and technology on enabling cities to support exponential growths of population while keeping the economical advantages that make them an efficient social organization. We will particularly discuss how technology can be used for the benefit of citizens, enabling efficiency without sacrificing basic human rights.

## Session Co-Chairs:



**Dr Tung Duong** received his Ph.D. degree in Telecommunications Systems from Blekinge Institute of Technology (BTH), Sweden in 2012. In 2013 he joined Queen's University Belfast as an Assistant Professor. His current research interests include Internet of Things (IoT), smart-grid, physical layer security, energy-harvesting communications, and cognitive relay networks. He currently serves in the editorial board for the IEEE Transactions on Communications, IEEE Communications Letters, IET Communications as well as serving as the Guest Editor on special issues of some major journals. He was awarded the Best Paper Award at the IEEE Vehicular Technology Conference (VTC-Spring) in 2013, IEEE International Conference on Communications (ICC) 2014, and is a recipient of the prestigious Royal Academy of Engineering Research Fellowship (2015-2020)

**Robert Speicys Cardoso** is the founder of Scipopulis, a start-up that develops collaborative software for smart cities that provides real time transport data in developing cities. Developing cities very rarely have a public transportation monitoring infrastructure, and data collected and shared by passengers can effectively improve the quality of transportation data in those cities. He participated in the 2015 RAEng Leaders in Innovation Fellowship.

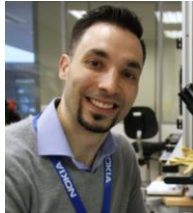


## Speakers:



**Marco Di Renzo, University Paris-Sud:** Educated in Italy, Marco Di Renzo is now a faculty member in the Laboratory of Signals & Systems of Paris-Saclay University, France and a co-founder of the startup WEST, Italy. He is a Distinguished Visiting Fellow of RAEng and a Distinguished Lecturer of IEEE-VTS. He is the project coordinator of the ETNs 5Gwireless and 5Gaura.

**Deniz Gunduz, Imperial College London:** Deniz is a Reader in Information Theory and Communications at Imperial College London. His research focuses on wireless communications, energy networks, and privacy. He is the recipient of an ERC Starting Grant, 2014 IEEE Communications Society Best Young Researcher Award, and Best Paper Awards at 2016 IEEE WCNC and 2007 IEEE ISIT.



**David Lopez-Perez, BellLabs:** David is Senior Research Scientist at Nokia Bell Labs, where he has made significant contributions to the development of small cell technology and pioneered cellular/Wi-Fi interworking techniques. His research resulted in product development as well as 1 book, 30 journal papers, 60 conference papers and 30 filed patent applications.

**Roberto Gallo, KYRPTOS Security:** Roberto has worked with security for 17 years, both in research and industry. At Kryptus, Roberto designed dozens of critical security systems. His research interests include cyber-physical systems, IoT, cryptography, and architectural-centric security. Roberto is a laureate of "Casimiro Montenegro Filho" award, by the Brazilian Presidency of Republic.



## Presentation Abstracts:

### **CONNECTED COMMUNICATION, David Lopez-Perez**

We are at the dawn of an era in networking that has the potential to define a new phase of human existence. This era will be shaped by the digitization and connection of everything and everyone with the goal of automating much of life, effectively creating time by maximizing the efficiency of everything we do.

Today's networks, however, are not up to the challenge, and at least a 100x network capacity increase will be required to meet the traffic demands by 2020. As a result, vendors and operators are now looking at using every tool at hand to enhance network capacity and in turn the user experience. In this epic campaign to create time, three paradigms are noteworthy at the radio access level, i.e., network densification, the use of higher frequency bands and spectral efficiency enhancement techniques. This talk analyses the potential gains and limitations of these three paradigms, and indicates that it is possible to achieve a 100x capacity increase using low spectrum bands, but further gains will have to be found in higher spectrum bands, not widely used for communications yet.

### **CONNECTED HEALTH, Marco Di Renzo**

Though advancements in medicine have now prolonged human lifetime, this in turn has put more pressure on the already overloaded healthcare system in developing countries. The elderly usually suffer from long-term conditions such as chronic diseases or dementia, and require constant monitoring/diagnosis/treatment, resulting in extra staff workload and other healthcare related costs. For this reason, tele-health is emerging as a promising solution, one domain of which is to wirelessly monitor patients' vital signs anytime, anywhere, as opposed to being measured manually in a costly hospital ward/infrastructure. More specifically, wireless body sensor networks are considered as one of the key research areas in computer sciences and application industries for healthcare provisioning.

On the other hand, molecular communications, i.e., the development of techniques for the manipulation of matter at extremely small scales, is revolutionizing fields from medicine to environmental protection and is becoming more important in many daily aspects of life. As techniques in synthetic biology and chemistry have matured, it is possible to reliably manipulate matter at these nano and micro scales. These developments have led to the emergence of applications such as nanomedicine, which is anticipated to play a fundamental role in improving people's quality of life.

### ***CONNECTED ENERGY, Deniz Gunduz***

There is strong evidence suggesting that climate changes are largely caused by human activities. Of most concern is the increase in CO<sub>2</sub> levels associated with global energy consumption. By 2017, more than 10 billion mobile-connected devices and 5 million base stations will consume 5 GW of power, resulting in 30 Megatons of carbon emission annually.

While energy consumption is a primary concern around the world, energy harvesting has emerged as a promising approach to enable self-sufficient and self-sustaining operation for devices in energy-constrained networks by scavenging energy from the ambient environment to power up devices.

The present power grid, though having been the major technology for power supply of electricity, is currently faced with new challenges, such as the depletion of primary energy resources, the diversification of energy generation and climate changes. In addition, it has the inherent weakness of being unable to provide optimal energy generation, distribution and usage. As an alternative approach, smart grid is emerging as a more efficient and intelligent technology.

### ***CONNECTED INDIVIDUALS, Roberto Gallo***

As technology permeates every aspect of the life of individuals in future cities, generating data on every interaction with other citizens, public services or the city infrastructure, citizens are exposed to a larger number of risks to their security and privacy. Identity theft, state surveillance, public shaming and aggressive marketing are some of the threats faced by citizens when they lose control of their personal data.

Technologies created to improve efficiency in future cities must be developed with focus on the individual. They must natively integrate mechanisms to protect communication from eavesdropping and to keep the citizen in control of their data. They must also balance those requirements with the benefits of large scale data gathering on the planning and operation of city wide infrastructure and services enabling gains in efficiency without sacrificing human rights.