A team of researchers from IT in Coimbra, University of Coimbra and the Department of Electrical and Computer Engineering of the University of Colorado Colorado Springs, USA, coordinated by Marco Gomes (IT) and João Vilela (CISUC), has developed an innovative security technology for wireless networks. After 5 years of studying and researching, with its roots in the IT internal project WINCE – Wireless Interference and Coding for secrecy, the new SWING - securing wireless networks with coding and jamming technology prevents a possible attacker from decoding the message, without compromising legitimate communications. According to Marco Gomes, “the aim has been to develop codes capable of ensuring both security against an attacker (eq. Eve) and message transmission reliability, while until very recently most of the proposed codes ensured only security”. By combining error correcting codes and random interleaving techniques (that make forward error correction more robust) a different key is generated for each message sent to Bob. The jamming (interference) effect allows Bob to receive it with advance over Eve. This way, “we have shown to be possible to achieve both reliability and security objectives”. The new technology has an international patent pending and is now in a real environment testing phase, in hardware boards with programmable software, in order to ensure the robustness of the code and to optimize the system.
Better, cheaper and greener OPV cells
Polymer photovoltaics (OPVs) hold a huge interest for enabling the use of low cost materials and fabrication processes of attractive solar energy conversion items, as curved and lightweight roofs or windows, and wearable personal electronics. However, OPVs are less efficient, less stable and less strong than its inorganic counterpart, the silicon cells. Another issue related to OPVs acceptance into the market is the cost of the organic/active materials that needs to be low enough to represent a small fraction of the device’s cost. In the recent project GreenSol a team led by IT researcher Ana Charas, aims to demonstrate OPVs exhibiting efficiency levels sufficient for commercial applications while involving reduced fabrication costs, and eliminating toxic solvents from the cells fabrication process.

PROJECT SNAPSHOT
Project Snapshot: S-DiaSelMan - Smart Diabetes Self-Management Care
It is estimated that by 2030 about 439 million people will be affected by Diabetes, with treatment costs of USD 490 billion. Portugal had, in 2011, 11.7% of the population between 20 and 79 with the disease. Diabetics may have uncontrolled glycaemic values, which in turn can seriously decrease their quality of life, leading to amputations, blindness or heart problems in the worst scenarios. However, if glycaemia is correctly controlled the patient can lead a normal life without complications. To achieve this, type 1 diabetics (insulin dependent) require a very strict control of their disease. This implies registering glucose levels, carbohydrate intake, insulin, exercise, stress, illness and other factors that influence glycaemic values. This allows patients to review their decisions, evaluate their results and discuss the treatment with their doctors. Data registration needs to be accompanied by correlation, so to know how to (re)act giving the context (e.g.: going to do an exercise; made an exercise 2h ago). Usually, patients keep their records on paper, making it difficult for patient and doctor to review, interpret and correlate the data. Patient and physician usually discuss the cause-effect of some of the events. This guidance by the doctor follows medical protocols, which are sometimes well defined but mostly arise from experience. The diversity of factors that influence glycaemic control makes it especially difficult managing the disease. The ultimate goal of this work is to provide a mobile application assistant that embeds medical knowledge and pattern analysis to provide feedback and suggestions to improve the disease management. The recommendations take into account the records entered by the patient or read from external medical devices. The project started addressing the above goal by developing an Android application that allows diabetic patients to register the factors mentioned. A Windows application for better visualization was also developed, which led to a web-based solution. Wireless interconnection with a glucometer was also developed. This development effort and testing with patients aimed at maximizing patient commitment and data

The next steps will improve patient engagement and enable in-application counselling

(continues on page 3)
Seeing through your ears!

João Pereira, from IT in Leiria and Nuno Almeida, from ESTG/IP Leiria, are developing a device that will allow blind people seeing through three-dimensional sounds. The device allows estimating the shape of real objects or the depth of scenarios, intended for the visually impaired or people lacking three-dimensional perception in unlit spaces.

While resembling headphones, the device actually includes a pair of 3D ultrasound scanners, a pair of visible light and infrared 3D scanners, and three pairs of speakers. The system calculates the distance from every point in the scenario to the user and generates a sound with proportional audible frequency. The farther is the point, the lower is its audible frequency and vice-versa. The layout of the speakers near the ears and the appropriate signal processing allows to provide the user with a spacial representation of the scenario through audible sounds of different frequencies.

Built with the help of a 3D printer, the device was already tested with a few different 3D objects, with different dimensions and in different positions. “I can say that the form of the first objects we’ve used is easily noticeable (through sounds). Obviously, the user must train up to recognize each of the shapes, distances and locations of objects 3D”, revealed João Pereira.

A provisional patent application was already submitted for the prototype of the device "Conversion of 3D objects and three-dimensional scenarios in 3D sound sources”. João Pereira intends to incorporate this device in the autonomous wheel chair he also developed, so as to allow blind people driving it.

IT double-win at the SMACD 2016

IT had a double win at the 13th International Conference on Synthesis, Modeling, Analysis, and Simulation Methods and Applications to Circuit Design - SMACD 2016. IT researchers Ricardo Martins, António Canelas, Nuno Lourenço and Nuno Horta received the Best Paper Award for "On-the-fly Exploration of Placement Templates for Analog IC Layout-aware Sizing Methodologies”. Also from IT, Carlos Silva, Jorge Guilherme and Nuno Horta, won the EDA Competition of SMACD 2016 with the paper “SCALES: A High Speed Simulator Tool for Pipeline A/D Converters”.

Daniel Graça wins the ICALP 2016 Best Paper Award

The IT researcher, together with Olivier Bournez (LIX/École Polytechnique) and Amaury Pouly (University of Oxford), received the International Colloquium on Automata, Languages, and Programming - ICALP 2016 Best Paper Award for "Polynomial Time corresponds to Solutions of Polynomial Ordinary Differential Equations of Polynomial Length". For Daniel Graça “This prize was very important to us, since it acknowledges and recognizes the work we have been doing lately and validates our ideas”.

IT and Microsoft partnership wins Camões Prize 2016

Jorge Proença, Dirce Celorico, Carla Lopes and Fernando Perdigão, from IT in Coimbra, together with Miguel Dias, Michael Tjalve, Andreas Stolcke and Sara Candeias from Microsoft, were awarded the "Camões Prize 2016 for the Technologies for the Portuguese Language" for the best paper of PROPOR 2016 - International Conference on the Computational Processing of Portuguese. The paper is entitled "Design and Analysis of a Database to Evaluate Children’s Reading Aloud Performance".

Pedro Brandão
Latest concluded PhDs hosted by IT

Hoang Van Xiem

Combining Predictive and Distributed Video Coding
PhD in Electrical and Computer Engineering, IST, University of Lisbon, October 2015, supervised by Fernando Pereira and João Ascenso (both from IST, University of Lisbon). The thesis presented novel video coding solutions combining the predictive and distributed video coding paradigms which have rather complementary strengths and weaknesses. Hoang Van Xiem is currently a lecturer at Vietnam National University – University of Engineering and Technology, Hanoi, Vietnam.

Álvaro Caseiro de Almeida

Quantum Communications in Optical Fibers
PhD in Physical Engineering, University of Aveiro, February 2016, supervised by Armando Pinto and Paulo André. The thesis main topics were: experimental implementation of a probabilistic photon source based on four-wave mixing; development of an automatic method to compensate random rotations of polarization inside an optical fiber in real time and implementation of a quantum bit commitment protocol to be used between two untrusted entities. Álvaro works as a researcher at IT in Aveiro, in the field of next-generation optical networks.

Rui Meireles

Leveraging Diversity and Spatial Connectivity in Multi-hop Vehicular Networks
PhD in Computer Science, University of Porto and Carnegie Mellon University (CMU), August 2015, supervised by João Barros and Peter Steenkiste. The thesis focuses on forwarding and routing for multi-hop communication in vehicular wireless networks. It tackles the challenges of topology instability and spatial heterogeneity, by leveraging channel diversity across forwarders and spatial connectivity information, significantly increasing communication reliability. Rui works as a researcher at CMU, in the field of future Internet architectures.

Filipe Neves

Methods for Quality Enhancement of Voice Communications Over Erasure Channels
PhD in Computer Science at University of Trás-os-Montes e Alto Douro, July 2015, supervised by Pedro Assunção and Silviano Soares. The thesis proposes linear interpolation algorithms to reconstruct lost samples of voice signals transmitted through erasure channels, by solving constrained problems of maximum and minimum dimensionality. Filipe is an Associate Professor of the Department of Computer Engineering at IPL.

Where are you now?

Hamed Hasani

After finishing my Master studies in Tehran, Iran, I came to Portugal after that I was accepted for the joint doctoral program in Electrical Engineering, in the area of Antennas and EM Devices for Wireless Applications, between Instituto Superior Técnico and École polytechnique fédérale de Lausanne (EPFL), Switzerland. I started then my PhD in Instituto de Telecomunicações under the supervision of Prof. Peixeiro conducting independent research on cost-effective reflect array antennas for satellite communication systems. I spent one year and three months in IT during which I was working in a productive environment with many interesting people from whom I learned many things. The rest of my PhD (two years and nine months) was spent at EPFL Switzerland where I had the opportunity to extend my research in the exotic area of terahertz frequencies. After finishing my PhD I was offered a Post-Doc position in LEMA (Laboratory of Electromagnetism and Antennas) at EPFL. Currently, as a post-doctoral fellow, I conduct research on innovative solutions for reconfigurable antennas intended for space applications. Furthermore I have had the chance to apply my knowledge and experience gathered during my PhD in order to develop MicroNano structures for Infrared applications. I consider myself very lucky to have had the opportunity to be part of research labs both in IST and EPFL and I owe this of course to IT! Muito Obrigado!