

Number 4, August 2017

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Contents

1 - Editor's address	p. 1
2 - Chairman's address	p. 2
3 - Workshop on IoT - testimonial	p. 2
4 - Interview with Laurent Clavier	p. 3
5 - Interview with ECI Sławomir J. Ambroziak.....	p. 4
6 - Selected scientific topics	p. 5
7 - Highlights from last meeting	p. 7
8 - Upcoming event	p. 8
9 - Facts & figures	p. 8

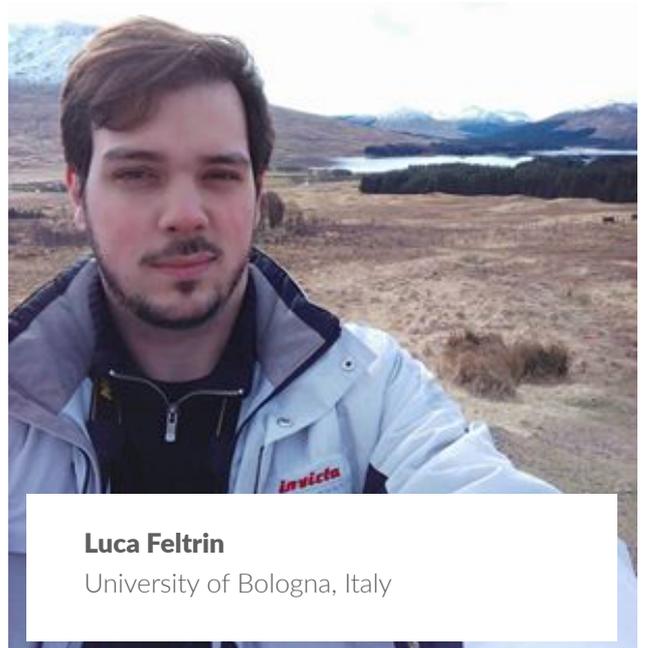
About COST IRACON

This COST Action IRACON (Inclusive Radio Communications) aims at scientific breakthroughs by introducing novel design and analysis methods for the 5th-generation (5G) and beyond-5G radio communication networks. Challenges include i) modelling the variety of radio channels that can be envisioned for future inclusive radio, ii) capacity, energy, mobility, latency, scalability at the physical layer and iii) network automation, moving nodes, cloud and virtualisation architectures at the network layer, as well as iv) experimental research addressing Over-the-Air testing, Internet of Things, localisation and tracking and new radio access technologies. This COST Action started on March 2016 and will end in March 2020.

<http://www.iracon.org>



Editor's Address

**Luca Feltrin**

University of Bologna, Italy

Dear reader,

I am happy to present you the fourth issue of this newsletter, focusing on our last meeting in Lund, Sweden.

During this last meeting, the elections for the new ECI representative took place and I am happy to say that I obtained the role. Starting from now I will do my best to continue Margot Deruyck's work, not an easy task for me as the gratitude manifested by everybody during the meeting can only confirm the excellence of her contribution to the action.

We hope that this newsletter will inspire you and can encourage you to join us (further) in the Action!

Enjoy the reading!

Chairman's Address

Dear IRACON colleagues,

Welcome to the fourth issue of our Newsletter! I hope you had the opportunity to enjoy some well deserved summer break before we roll into a new academic year!

Since my last address, we held our fourth Management Committee meeting, which took place in Lund (Sweden) in the last days of May. It gathered again more than 120 participants, with 80 technical documents being presented. As Action Chair, I really had the impression from my participation in various Working Group meetings that discussions have started to build up around well defined goals in most groups. I cannot help noticing that what differentiates COST meetings from conferences is precisely the quality of the discussions and the focus of entire groups towards common goals.

A second event took place under the Belgian sun of Louvain-la-Neuve, where we held our second Training School, jointly organised with the European School of Antennas (ESoA). During one entire (and really sunny, I am not joking) week, some 20 participants actively attended a comprehensive set of courses on Large-Scale Radio Propagation Modeling, from theory to applications in cellular (including 5G) and vehicular communications. Among these students, 8 were granted an IRACON grant to partially cover their expenses.

As you have probably noticed, we have a new Newsletter Editor: Luca Feltrin was indeed elected as Early Career Investigator (ECI) Representative for the second year of our Action.

I wish Luca all the best in his mission. That being said, welcoming Luca also means that Margot Deruyck ended her one-year term as ECI Representative and Newsletter Editor. Let me take this opportunity to warmly thank Margot for her work during this first year. Basically, Margot had to start everything from (almost) scratch, and she achieved this very efficiently! The Newsletter you are reading today is the living proof of her work!

Our next meeting will be held in Graz (Austria), on Sep 12-14, 2017, and will be preceded on Sep 12 by a workshop on Dependable Wireless Communications and Localization for the IoT. The workshop received a large number of submissions and will host two keynote speakers: Henk Wymeersch (Chalmers University, Sweden) and Jean-Marie Gorce (University of Lyon, France). After Graz, we will further meet for our 6th meeting in Nicosia (Cyprus) on Jan 29-31, 2018. Furthermore, I am also glad to announce that no less than three IRACON special sessions were accepted for the next edition of the European Conference on Antennas and Propagation (EuCAP 2018). Congratulations to all session conveners!

Enjoy the reading and looking forward to meeting you in Graz !



WIBEC Joint Training School on Antennas and Propagation Modeling for Body Environment Communications

First WIBEC Training School took place in Dresden, Germany

One of the challenges in body area networks is the communication between different devices or sensors in, on or outside the body. That's why a good knowledge about the underlying physical principles as well as component realizations and the regulatory framework is very interesting for WIBEC's interdisciplinary team. Collaborating with the COST Action "Inclusive Radio Communication Networks for 5G and beyond (IRACON)" helped to bring distinguished experts from more than five countries to Dresden. They covered design aspects like EM characteristics of human tissues, emulation of these properties and phantoms for measurement purposes, antenna concepts for on-body and in-body antennas, simulation tools and propagation channel modeling. Moreover, system aspects, international standards and regulation and SAR issues were covered.

During three days, over 40 participants from WIBEC and COST received a holistic view on antennas and propagation modeling for body environment communications and took home many new ideas from the stimulating talks and the inspiring discussions with their peers.



Interview with a senior researcher

Short biography

PhD in 1997, full Professor in Mines-Telecom institute (IMT Lille Douai) since 2011. He makes his research in IEMN and in IRCICA (CNRS and Univ. Lille). He is responsible of the research axis «Telecommunication Circuits and Systems» in IEMN. He is involved in the connected things theme in IRCICA and his research concerns physical layer for IoT with a special focus on non-Gaussian interference modelling.



LAURENT CLAVIER

University of Lille, France

What are your favourite areas of interest and research?

My research concerns the physical layer in wireless communications, but more related to low power, low cost contexts. This clearly modifies the traditional approaches that are used in digital communications and the massive number of connected devices that is expected raises numerous challenges involving mathematics and information theory. Besides, practical implementation is rarely exactly what theory predicts and reducing the gap between these two extremes is one important concern for me. However, very difficult to address, especially in the IoT context.

What is the “next big thing” in the wireless communication area?

One we probably do not really expect. I still think there is a huge challenge in the energy related things, from the small device that has to last for more than 10 years to the cloud and the artificial intelligence heavy machinery that produces so much heat. New electronics paradigms could be an incredible breakthrough to process the data from end to end, like neuro-inspired circuits.

What was your motivation to become a researcher?

To be honest, it is not a wish from as far as I remember. After an engineering school and a year abroad I did not feel ready for going into the industry so I continued for a PhD. And that's it. When you have this freedom for defining your research areas, the opportunity to share advanced topics with students and, above all, to travel and meet so many great persons, you just don't want to do something else. Of course, it is not always so much fun but at least the intellectual challenge is there every day and there are not so many jobs that gives you this opportunity.

What would you like COST IRACON to achieve?

Influence the 5G and the future of Telecommunication. That is already a significant challenge and it would be good if science has his word to say.

What was your motivation to be part of COST IRACON?

As said before, meet great people, share ideas, define challenging projects... and see Europe.

How did you become involved in COST IRACON (or any of the previous Actions)?

Quite a long time ago, I assisted to a COST 273 meeting I think. And it is just how I think research should be so I keep on taking part.

My favourite book, music(ian), movie, TV-series are ...

From Camus to Tolkien. Just to cite a few I really like Nancy Houston, Haruki Murakami and Bret Easton Ellis. And music is so important. I am a post-punk fan and the first trilogy from The Cure (seventeen seconds, faith, pornography) is probably my strongest encounter. More recently I listen to The Nationals, Arcade Fire, Asaf Avidan...

I'm most passionate about ...

I must admit my favourite hobby nowadays is reading a book with some music and nothing to hurry. But such free times are difficult to find...

My favourite holiday is...

With my family, close to the sea and if possible far from the crowd. Or in far countries, I really enjoyed South Africa for instance.

What is your country well known for?

Wine, food, landscape, sea are obvious so I would say its human values and freedom, which, however, are rather threatened in the current times.

My favourite or personal quote is ...

It depends on the day. Two from Haruki Murakami today: "If people aren't equal, where would you fit in?" (in Sputnik Sweetheart); "No matter what they wish for, no matter how far they go, people can never be anything but themselves. That's all." In Blind Willow, Sleeping Woman: 24 Stories)

Interview with an Early Career Investigator

Short biography

Sławomir J. Ambroziak was born in 1982. He received the M.Sc. and Ph.D. degrees in radio communication from Gdansk University of Technology (GUT), Poland, in 2008 and 2013, respectively. Since 2008 he is with the Department of Radio Communication Systems and Networks at GUT. He was a recipient of the Young Scientist Award of URSI in 2016 and 2011. He is a member of the Board of the Working Group on Propagation within European Association on Antennas and Propagation (EurAAP).



Sławomir J. Ambroziak,

Assistant Professor at Gdańsk University of Technology, Poland

What are your favourite areas of interest and research?

My favourite area is Body Area Networks - their countless potential applications are fascinating and inspirational. In addition, I am involved in research projects on special applications of wireless technologies, which also gives me a lot of satisfaction. I'm currently managing one such project.

What is the “next big thing” in the wireless communication area?

The biggest thing would be the teleportation. But now seriously, in my opinion, the next big thing (after 5G) is something difficult to imagine. Perhaps it will be the nano-communications, as a part of nanoscale in-body networks, providing an invaluable contribution to ICT in healthcare, i.e. a stepping stone that would change the medical treatments as we know it today.

Considering the innovations in the scientific world in the last 20 years, which was the most remarkable one, and which one finished with a “dead end”?

In my opinion, the most remarkable innovation was the mobile Internet, which totally changed our lives. One of the most amazing innovations that did not get enough attention was a mind-controlled prosthesis, which also allows the amputee to feel what he or she touches. Finally, I hope cloning will become the dead end of science.

What was your motivation to become a researcher?

At the time, I wanted to change my previous job in a telecom company, when I got a job offer at Gdańsk University of Technology. I accepted and I am sure now that it was the best decision in my professional life.

What would like COST IRACON to achieve?

The big achievement of IRACON - beside achieving its main goals, of course - would be if it inspired and initiated as many joint research between the project members as possible.

My favourite book, music(ian), movie, TV-series are ...

Since I am addicted to books, it is hard to point the favourite one, but books from Paweł Jasienica, Stanisław Lem and Norman Davies are at the top of my list. Regarding the movies, I like the ones with Al Pacino (in addition to some old Polish comedies), where "Scent of a Woman" and "The Devil's Advocate" are my favourites. My favourite TV series is "Friends". And music - I like to listen to Polish music, mainly alternative rock, and sometimes punk rock.

I'm most passionate about ...

Definitely books. I like historical books the most, as I find the history to be the best teacher which helps to understand the present and avoid the same mistakes in the future. But I like also crime novels, science-fiction, and popular science. Actually, I enjoy almost every kind of book. In addition, I like poems, both read and write - I have already published one book of poetry, and now I am working on the second one.

What do you like the most about your country?

I think Poland is well known for The Solidarity Movement, which gave the impulse for almost entirely peaceful anti-communist revolutions in Central and Eastern Europe. The thing I like the most about Poland is its rich history, whose drama has been perfectly described by the title of the book "God's Playground" by Norman Davies.

My favourite or personal quote is ...

"Choose a job you love, and you will never have to work a day in your life" - Confucius

Selected scientific topic:

"Channel Characteristics and User Body Effects in an Outdoor Urban Scenario at 15 and 28 GHz" by K. Zhao, C. Gustafson, Q. Liao, S. Zhang, T. Bolin, Z. Ying, S. He - TD(17)04068

Due to the increased demand on the data rate of mobile communications, the spectrum below 6 GHz is getting saturated. Therefore, people's attention has moved to spectrum above 6 GHz for the 5th generation (5G) mobile communication system, as the large contiguous frequency bands that these higher frequencies offer. However, a downside of using higher spectrum is that propagation conditions become less favorable. In particular, the shadowing effect of the user body on the user equipment (UE) will become more pronounced at higher frequencies, due to the increased size of a human body in terms of wavelengths. As a UE will always operate close to a user body, it is crucial to consider this effect for 5G communication systems, especially for the design and development of UE antennas and channel models. In this work, the user body effect on the UE antenna and the corresponding channel characteristics at 15 and 28 GHz in an urban environment are investigated.

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The user body effect on the UE antenna is carried out by 3D antenna far-field measurements with a real user, and the corresponding impacts on channel characteristics is further obtained through Ray-tracing simulations. It has been observed that the shadowing loss of the user body can be up to 25 to 30 dB at those frequencies, and it will introduce a large fluctuation of the received signal strength of UE when the orientation of the user changes.

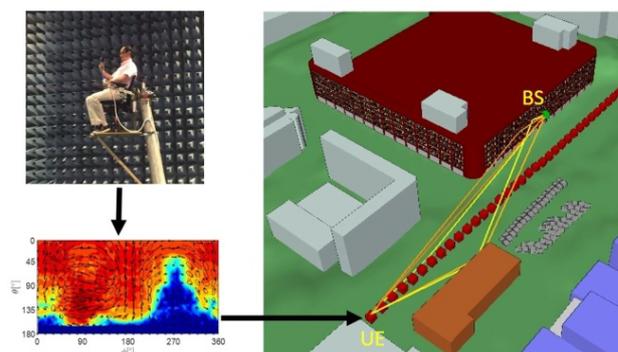


Figure: The 3D antenna measurements and Ray-tracing simulations.

Selected scientific topic:

"Internet-of-Animals: wireless communication and location tracking" by D. Plets, J. Trogh, S. Benaissa, W. Joseph, L. Martens - TD(17)04035

The increase of farmers' herd sizes makes it increasingly difficult to manually follow-up the health status of each individual animal. Lately, on-body animal sensors have been deployed to collect health data, such as temperature, movement,... An accurate knowledge of this information allows animal scientists to detect health anomalies such as lameness, even at an early stage. However, an accurate and reliable wireless communication on the body (from sensor to collar hub) and off the body (from collar hub to backend in barn) is indispensable for a successful operation. In this work, it was shown that udder to neck and ear to neck links presented the highest and the lowest on-body path loss values with an average of 81 dB and 65 dB, respectively. A log-normal path loss model for the whole cow's body was obtained, with a path loss at 10 cm of 44 dB and a path loss exponent of 3.1. The off-body wireless channel between an on-cow node and an access point inside three barns has been modeled at 2.4 GHz as a one-slope log-normal

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Figure: BLE node with housing case attached to collar

path loss model. The body of the cow wearing the sensor node caused an additional 3 dB path loss increase, while other cows had less influence.

Finally, a Bluetooth Low Energy (BLE) positioning system for tracking cow behavior yielded a median precision of 3.3 meter. This allows finding a cow in the herd but does not suffice to accurately calculate the traveled distance.

Selected scientific topic:

"Towards an ITU channel model for 5G" by S. Salous - TD(17)04021

The World Radiocommunications Conference in 2015 (WRC15) identified a number of frequency bands in the range 24-86 GHz for possible future allocation for 5G. To this end different research groups and administrations performed radio propagation measurements towards a site general path loss channel model. In the UK Durham University carried out radio measurements in a typical suburban environment (Figure 1) for both over the rooftop and below the rooftop for both line of sight and non-line of sight scenarios in three of the frequency bands identified by WRC15. These covered the bands 25.5-28.5 GHz, 51-57 GHz and 67-73 GHz. To generate a path loss model across the different frequency bands, some of these measurements were combined with measurements from other administrations including ETRI-Korea, NTT-Japan and Intel-USA to derive a site general path loss model for outdoor scenarios. The new models were submitted via Correspondence Group 3K-6 led by Samsung Korea to the ITU-Study Group 3 meeting in March 2017. The approved new model will be used to update ITU-R recommendation 1411-8.

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Other parameters such as r.m.s delay spread and cross polar discrimination were also submitted and approved in addition to results of indoor propagation to be added to ITU-R 1238-8. The estimation of path loss from directional measurements was also approved for updating ITU-R 1407-5. The TD gives an overview of the UK input into Study Group 3 and the relevant ITU-R recommendations.

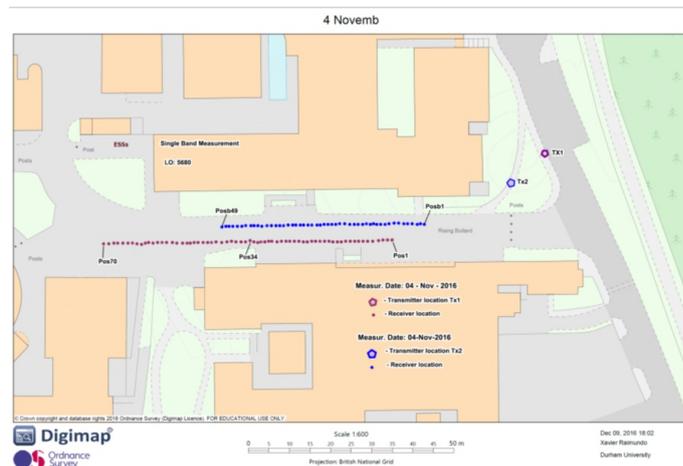


Figure: Textile antenna array deployed at user clothing (see left figure) and 3x5 textile prototype deployed at UC3M (see right figure).

Selected scientific topic:

"Performance Evaluation of the Dynamic Trajectory Design for an Unmanned Aerial Base Station in a Single Frequency Network" by M. Deruyck, A. Marri, S. Mignardi, L. Martens, W. Joseph, R. Verdone - TD(17)04018

An interesting approach to provide capacity to those users that are not being covered by the terrestrial network is the introduction of a UABS (Unmanned Aerial Base Station) in the considered area. A UABS is a base station mounted on a UAV (Unmanned Aerial Vehicle) or drone. Our TD proposes a novel dynamic trajectory design for the UABS, allowing to decide on the fly which cluster, made of nearby unsatisfied users, the UABS will visit next, instead of planning its whole trajectory at the beginning of its journey. Besides the trajectory design, the TD also proposes an interference avoidance strategy when both the UABS and the terrestrial network are operating in the same frequency band. To study the performance of the UABS, we considered an urban environment where users move around and request video downloads (with a predefined minimal throughput). Introducing the UABS with the novel trajectory design improves the sum throughput up to almost 1.6% compared to the terrestrial network only scenario.

This improvement can be further increased up to 4% by choosing a larger cluster cardinality and/or a higher fly speed. One might expect that the introduction of the interference avoidance strategy will deteriorate the sum throughput improvement obtained by the UABS. Fortunately, this effect is limited, since a decrease of only 0.3% is found. This still results in an improvement of up to 2% compared to the no UABS scenario.

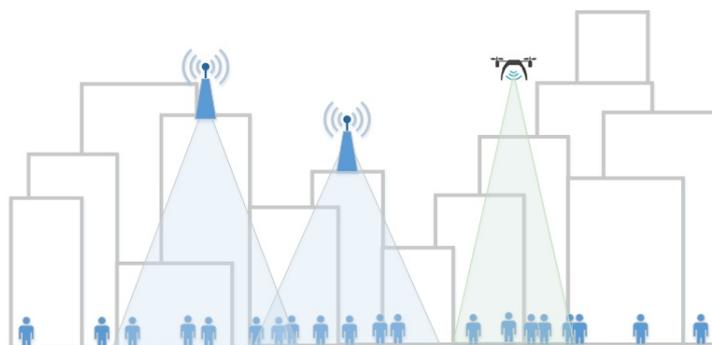


Figure: Representation of the reference scenario

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Highlights from the last meeting

DWG1 - Radio channels: DWG1 covered 29 TDs including those presented in a joint session with EWG-RA. The sessions covered novel radio channel sounding campaigns in various scenarios, including urban and suburban microcellular scenarios, indoor small-cells, high-speed train, long-range backhaul links and inside cars, covering frequencies between 3 and 94 GHz. Novel channel sounding techniques were also reported, including multi-frequency measurements comparing below- and above 6 GHz channels. There was a TD reporting a completed short-term scientific mission, and 11 TDs were authored jointly by multiple institution members of the IRACON action.

DWG2 - PHY (Physical) Layer: We had 3 sessions attended by 26 attendees and 11 TDs were presented.

There were three major focus areas - signal processing for communications, coding, and MIMO related processing. The signal processing session covered topic of KLT transform based CSI compression in M-MIMO, analog HW based ultra low power equaliser, capacity bounds in dynamic interference non-Gaussian environments, and full-duplex HW compensated analog front-end. The coding session focused on improved LDPC decoding with list erasure post-processing, and distributed M-MIMO processing with optimised quantisation of relay-to-destination signals. The MIMO session covered a range of topic from channel reciprocity implications on the PHY processing to low complexity scheduling and beamforming in M-MIMO Systems with cluster-based COST2100 channel model.

DWG3 - NET (Network) Layer: WG3 in Lund meeting had two sessions and 9 TDs were presented. The presented TDs covered topics of virtualization, vehicular networks, small cells, system and link level simulation, and providing service using UAVs. The TD on UAV-based communications was the result of an STSM between university of Bologna and University of Gent. In one of WG3 session the General chair of IEEE ISWCS'17, Prof. Verdone, introduced the conference.

EWG-OTA - Over-The-Air testing: During the meeting of the EWG Over-the-Air testing, it became clear that these are demanding times for research into OTA. On one hand, with system specification barely ready, channel models for new frequency bands still incomplete, and with equipment that have no accessible RF interface terminals any longer, developing tests is largely a green field situation. On the other hand, the 5G time schedule requires such tests to be available preferably by tomorrow. In this meeting, new test principles were explored for 5G, flanked by research into making testing present mobile comms generations more realistic by incorporating user influence.

EWG-IoT - Internet-of-Things: Within the EWG-IoT first two works on novel technologies for IoT, that are LoRa and NB-IoT. Both papers focused on the evaluation of the network capacity, when considering different use cases and system parameters. Results of an experimental campaign conducted with LoRa devices, aiming at characterizing the transmission range and capture threshold, have been also presented. Finally, outcomes of the STSM done by EBI at UNIBL were reported; the activity is dealing with experimental characterization of different routing protocols over 6TiSCH in OpenWSN.

SEWG-IoT - Internet-of-Things for Health: The Sub-EWG on IoT-Health had three sessions including a joint session with OTA. During these sessions nine TDs were presented. Several TDs considered various topics in Body Area Networks (BAN). These topics included data streams allocation in heterogeneous BANs, adaptive energy detection threshold in IEEE802.15.6, motion model for wearable antennas in BANs, radio channel measurements in a ferry environment and SAR evaluation. Other topics related to the general IoT-Health were also presented. The subject of those TDs were Internet-of-Animals for tracking and monitoring, health applications in crowd sensing environment, connected healthcare using TV White Spaces, and nano-communication.

EWG-LT - Localisation and Tracking: Six TDs were presented in the EWG-LT, plus one in a joint session with the EWG-IoT-B. The contributions were all very well focused on the main research challenges identified for this EWG, in particular, how the features of 5G communications technologies can be exploited for accurate positioning. Individual contributions have been focusing on the use of massive-MIMO radios and on algorithms for multipath-assisted tracking. The working group is currently preparing a workshop on dependable communications and positioning for the IoT, which is a joint event with the EWG-IoT to be held in Graz, Austria, on Sept. 12, 2017.

EWG-RA - Radio Access: The Experimental WG Radio Access had one session with 5 TDs in total and two joint sessions with WG1 and the OTA WG. The contributions covered test-beds and various aspects of Sub-6GHz massive MIMO, mm-wave, and hardware in the loop as well as 2 presentations reporting on STSMs. Approximately 25 delegates attended the focussed EW-RA session. In addition to the TD presentations and Q&A, discussions were also held regarding the 2nd IRACON deliverable. This included the reference scenarios, addressing sub-6GHz and mmWAVE test beds separately and potential use of this deliverable within an IRACON book chapter.



Newcomers to the Action.

Dependable Wireless Communications and Localization for the IoT: 12th September 2017, Graz, Austria

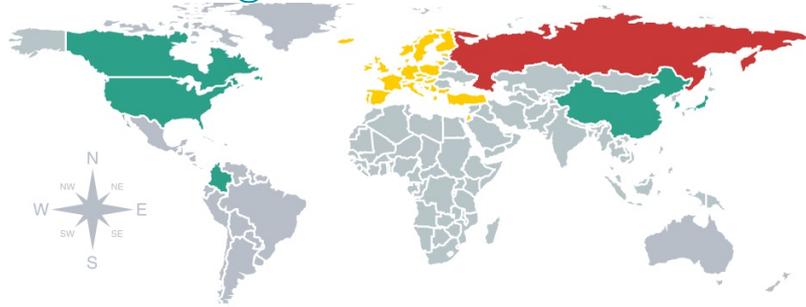
Organisers: Klaus Witrals (TU Graz, Austria), Chiara Buratti (Univ. of Bologna, Italy), Carles Antón-Haro (CTTC, Spain), Carlo Alberto Boano (TU Graz, Austria)

Abstract: The Internet of Things (IoT) will represent the backbone of modern society and the next-generation Internet. By integrating heterogeneous service models and devices into a cohesive system, the IoT exhibits tremendous potential to meet the information-processing demands of smart environments, such as Industry 4.0, Smart Cities and Connected Cars. The integration, however, also aggravates the complexity of design and deployment, and brings new challenges with respect to the dependability of IoT systems. This workshop will place its focus on wireless technologies that play a key role in connecting IoT-devices to the Internet. Wireless technologies can also be used for localization, a critical capability to provide the context between physical devices and the virtual world. Physical and man-made impairments (e.g., multipath propagation and radio interference) have a strong influence on the dependability of these wireless services. We specifically welcome contributions that aim at making wireless communications and localization more reliable, predictable, safe, and secure to enable safety-critical applications that require guaranteed performance. Both research and practical aspects of dependability considerations in the IoT are of interest.

Workshop on
Dependable Wireless Communications and Localization for the IoT
Sept. 12, 2017
Graz University of Technology, Austria

TU Graz Graz University of Technology
DEPENDABLE THINGS Dependable Internet of Things in Adverse Environments
IRACON
COST EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY
COST is supported by the EU Framework Programme Horizon 2020

Facts & Figures



Signatory countries: 34

Austria, Belgium, Bosnia and Herzegovina, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, FYR Macedonia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom

COST international partner countries: 6

Canada, China, Columbia, Japan, South Korea, USA

COST Near Neighbour Countries: 1

Russian federation

