IC1301 -WiPE

Wireless Power Transmission for Sustainable Electronics

WG1: Far-field Wireless Power Transmission

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DEI University of Bologna, ITALY and CTTC, Barcelona, SPAIN

WIPE

COST IC1301

EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

Agenda

- WG1 chairs presentations
- Survey of the action MoU for WG1.
- Partners interested in WG1: knowledge and experience
- Points of interests with the other WGs.
- Short term research lines and potential collaborations among WG1 partners.
- Future projects and application of interest.

WG1 Chair and co-chair

Alessandra Costanzo.

Is Associate Professor of electromagnetic fields at the University of Bologna, Italy. She has authored more than 140 scientific publications, chapter books; she holds three international patents. She has developed innovative software platform for the nonlinear/electromagnetic co-simulation of RF systems. She is now involved in wearable energy-autonomous sensors and wireless power transfer systems. She is TPC member of MTT-S IMS, EUMW, WPTC, RFID-TA, ICUWB. She is executive editor of the Cambridge Journals "Wireless Power transmission" and "International Journal of Microwave and Wireless Technologies". She is IEEE senior member and EuMA member. She is vice chair of IEEE MTT-S TC-26 "Wireless Energy Transfer and Conversion " and member of IEEE MTT-S TC-24 RFID Technologies.

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Ana Collado

Received the M.Sc. and Ph.D. degrees in Telecommunications Engineering from the University of Cantabria, Spain, in 2002 and 2007 respectively. She is currently a Senior Research Associate and the R&D Management Coordinator at the Technological Telecommunications Center of Catalonia (CTTC), Barcelona, Spain. Her professional interests include active antennas, substrate integrated waveguide structures, nonlinear circuit design, and energy harvesting and wireless power transmission (WPT)solutions for self-sustainable and energy efficient systems. She has participated in several national and international research projects and has co-authored over 70 papers in journals and conferences. She has organized several international workshops in the European Union and also a Training School for PhD students. She is a Marie Curie Fellow of the FP7 project Symbiotic Wireless Autonomous Powered system (SWAP). She was the co-recipient of the EUCAP 2010 Best Student Paper Award and the ACES 2010 2nd Best Student Paper Award. She was finalist in the 2007 IEEE International Microwave Symposium. She serves in the Editorial Board of the Radioengineering Journal and of the Cambridge Wireless Power Transfer Journal. She is currently an Associate Editor of the IEEE Microwave Magazine and a member of the IEEE MTT-26 Wireless Energy Transfer and Conversion and IEEE MTT-24 RFID Technologies Technical Committees.

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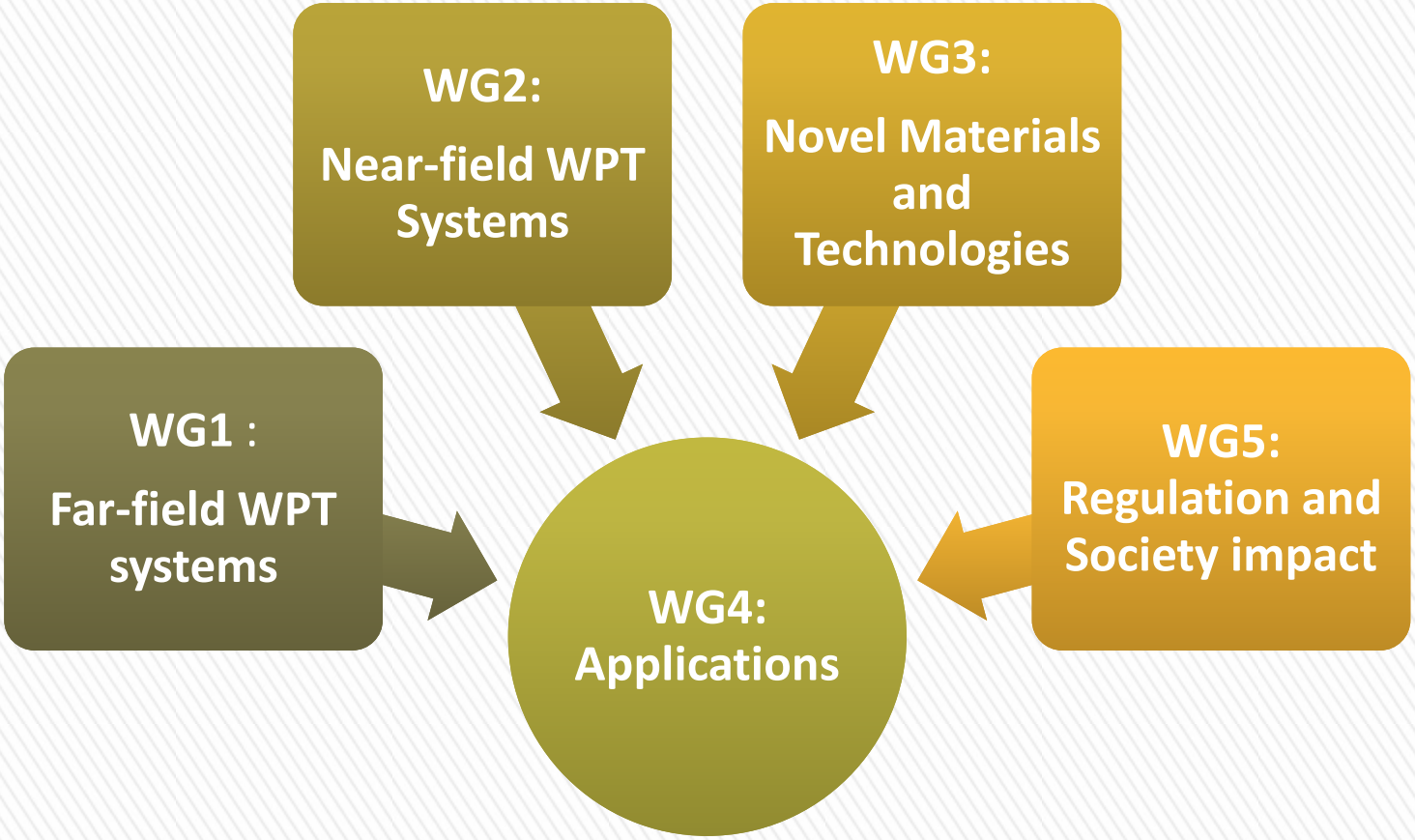
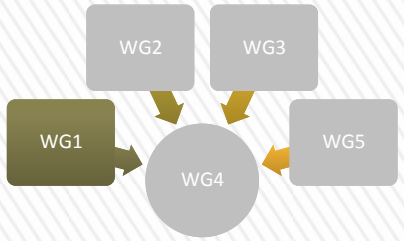
The WGs in WiPE



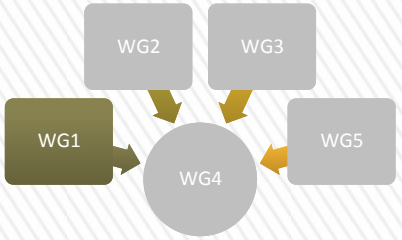


WG1: Far-field WPT Systems

SUBTASKS

- Design tools to maximize the **RF-to-DC** conversion efficiency;
- Joint techniques for **co-optimizing the WPT** building blocks;
- New architectures for rectenna elements that lead to improved performance;
- New **reduced-size antenna structures** that allow integration of rectenna based WPT systems in small devices;
- Design of optimum RF signals to maximize efficiency;
- System design for **intentional autonomous powering** ;
- Strategies to guarantee RF powering from a predicted source while preserving safety regulations,

WG1: Far-field WPT Systems

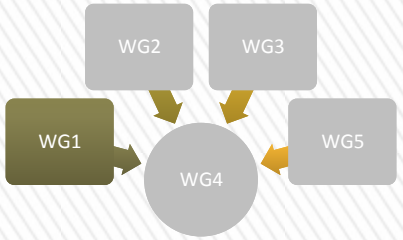


Relevance of Far- field wireless power transmission

» Solutions to deploy battery-less distributed electronics (such as embedded systems or WSN) that are difficult and/or are in such a large quantities that battery replacement is too costly or even unfeasible.

» Need for component-level optimization of the entire WPT system (***from the transmitter side to the receiver side***) to simultaneously minimize the requested RF power and to guarantee the needed energy.

WG1: Far-field WPT Systems: Transmitter side issues



Transmitter
"power on demand"

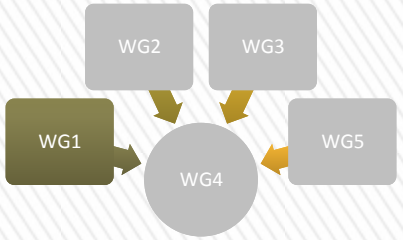
Antenna
- Shape
- Frequency band
- Polarization
- Material

Power genera-tor
- Efficient oscillator/ amplifier
- EM-nonlinear co-design
- Strategies to guarantee RF powering while preserving safety regulations

Signal design
- Multi-band/broadband
- Spectrum optimization for maximum efficiency

Other interests ?
- .....
- .....
- .....

WG1: Far-field WPT Systems: Transmitter side issues interested partners



Transmitter "power on demand"

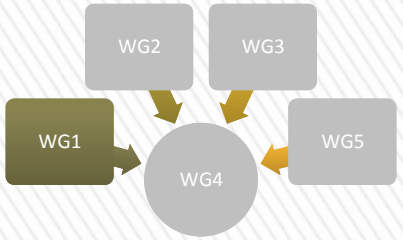
Antenna
- Ghent University
- CTTC

Power genera-tor
- IT/University of Aveiro
- TUKE
- Georgia Institute of Technology
- CTTC
- University of Bologna

Signal design
- CTTC
- IT/University of Aveiro
- TUKE

Other interests ?
- University of Nis
- University of Pavia
- ACORDE
- Imperial College London
- University of Nantes

WG1: Far-field WPT Systems: Receiver side



Receiver
- Intentional autonomous powering
- Energy harvesting

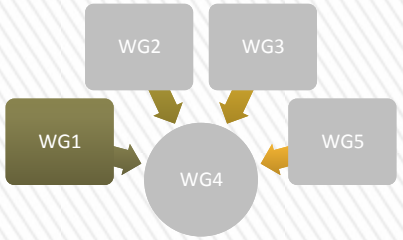
Antenna
- Shape/polarization /frequency
- reduced-size for integration in small devices
- Material

Rectifier
- CAD tools to maximize the RF-to-DC conversion
- switched-mode single-device high power rectifiers
- new improved architectures for rectennas

Power manage-ment
- architectures for highly efficient DC-DC converters
- optimum power and energy management strategies

Other interests ?
- Multi-band/broadband
- Spectrum optimization for maximum efficiency
- …

WG1: Far-field WPT Systems: receiver side partenrs' contributions



Receiver
- Intentional autonomous powering
- Energy harvesting

Antenna
- CTTC
- University of Bologna
- Holst Centre / IMEC
- Ghent University
- Georgia Institute of Technology

Rectifier
- University of Bologna
- CTTC
- IT/University of Aveiro
- TUKE
- Aristotle University of Thessaloniki
- Holst Centre / IMEC
- Georgia Institute of Technology
- Imperial College London

Power manage-ment
- TUKE
- Georgia Institute of Technology
- Imperial College London
- University of Bologna

Other interests ?
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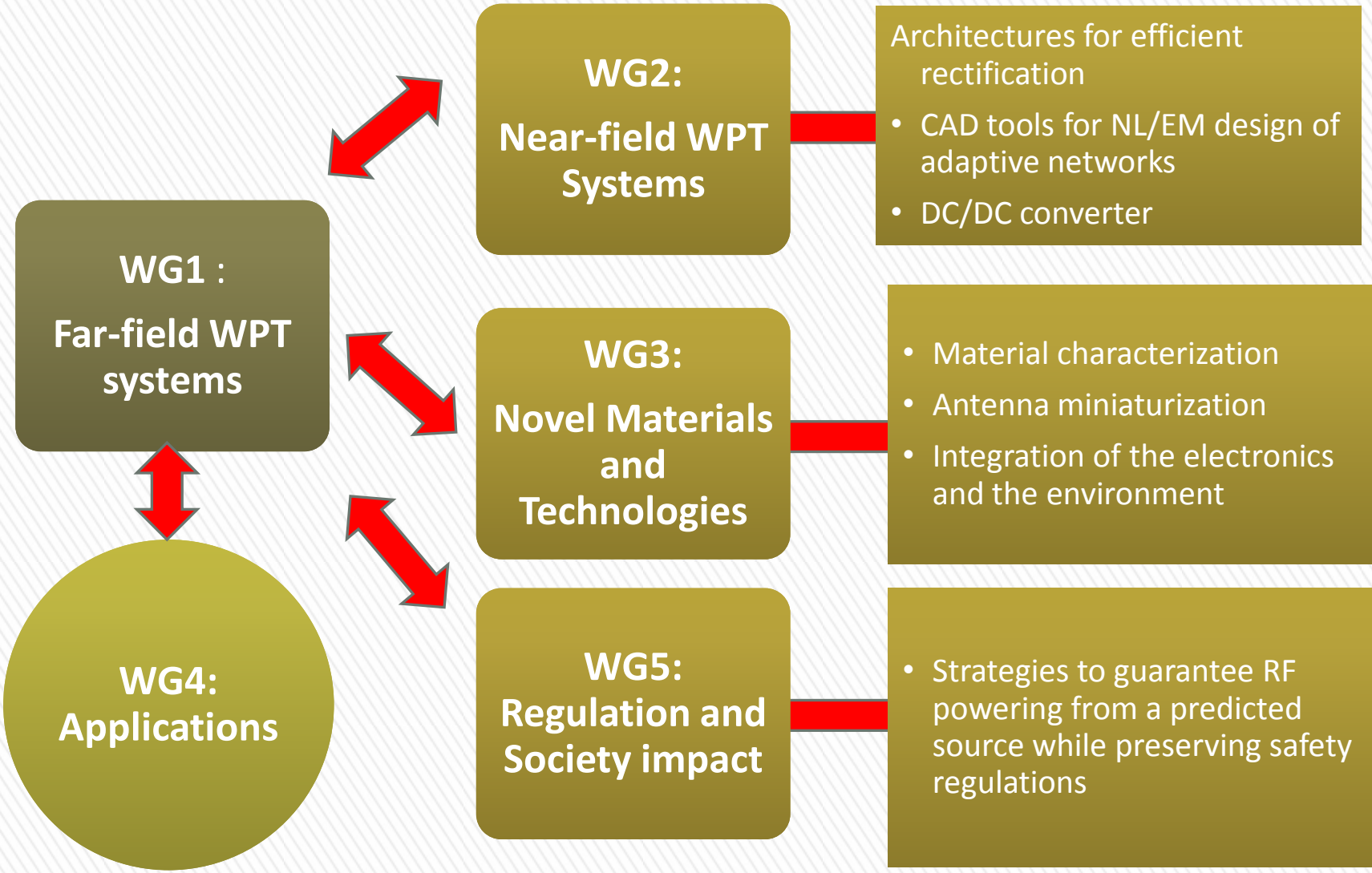
Foreseen Interaction of WG1 and the other WGs



Proposed next future actions: *share already achieved research results*

- Gather design methods from interested partners
  - Define a common optimum procedure for rectennas harvesting from ambient RF energy
    - Theory-based and simulation-based procedure
    - Experimental procedures
- Gather rectifier/antenna topologies and system combinations
  - Broadband/multiband antennas
  - Rectifier topologies
  - Sensor powering implementation
  - Power ranges
  - Load ranges
- Define a reference scenario for the ambient source and the sensor application
- (exploiting Imperial College/ Georgia Tech /IMEC surveys)
  - Feasibility test
- Exploitation of one or two STSM
- demonstration of an autonomous sensor powering and readout

Proposed future actions: dissemination

strongly encouraging a balanced Industry and Academia participation

- Joint Scientific publications: expected new advanced common solutions
- COST training school on: “Antenna and RF systems for low-power energy harvesting”. (Summer 2015)
- Possible topics
  - antenna design with eco-friendly materials
  - Survey of energy available from ambient
  - Topologies for the nonlinear subsystems
  - Design tools and characterization
  - Prototypes demonstrations

Thank you!

Alessandra Costanzo

WG1 :

Far-field WPT systems