IP CREW

Cognitive Radio Experimentation World

1st open call - information session

Ingrid Moerman
Brussels, September 14, 2011

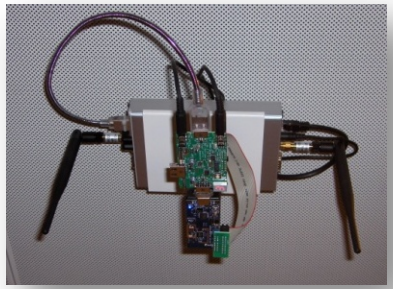
The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement n°258301 (CREW project).

Outline

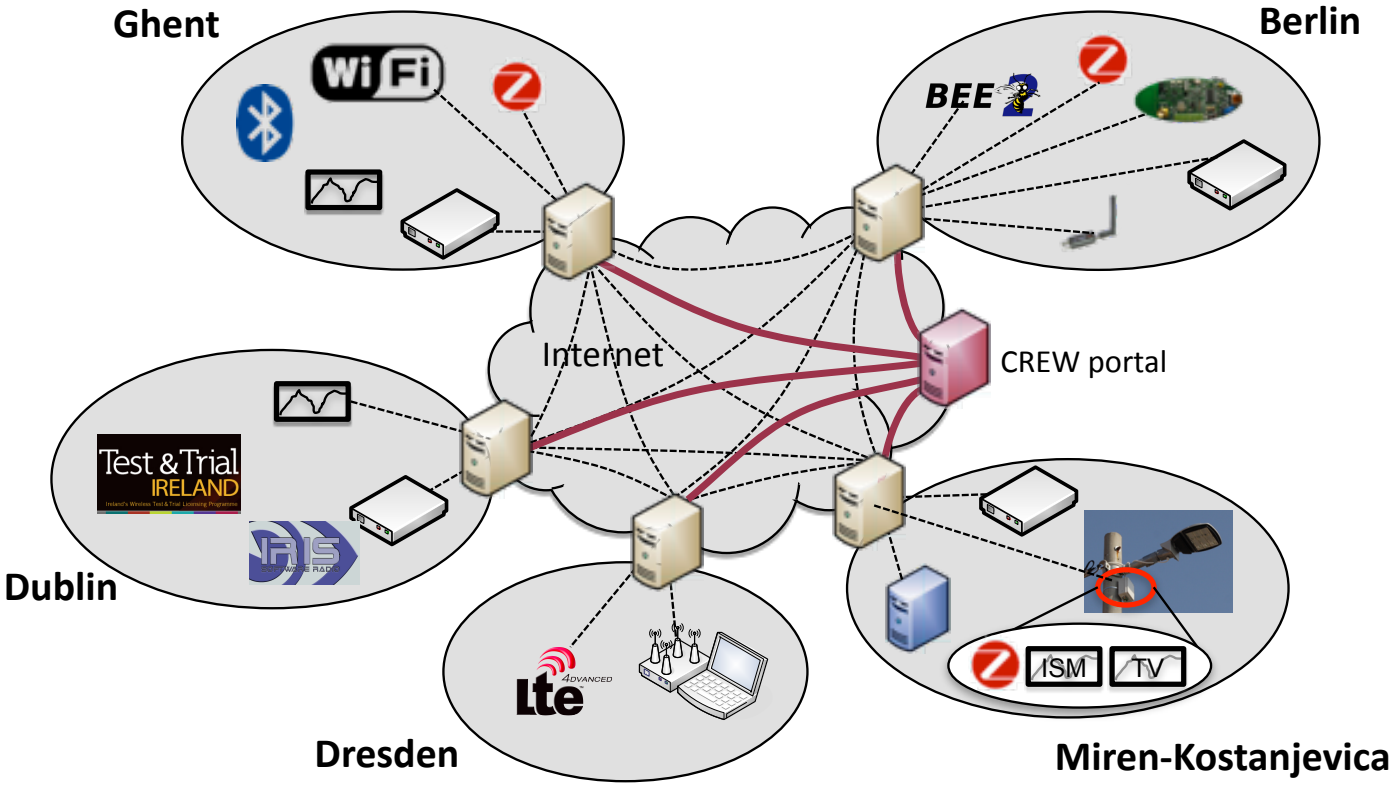
- **The CREW project**
  - Target
  - CREW platform: testbeds & hardware
  - Key functionalities of the federated platform
  - Usage scenarios
- **Open call information**
  - General information
  - CREW open call documents
  - Timing
  - More info

IP CREW: Target

- **to establish an open federated test platform, facilitating experimentally-driven research on**
  - advanced spectrum sensing
  - cognitive radio
  - spectrum sharing
    in licensed and unlicensed bands
  - cognitive networking



CREW platform

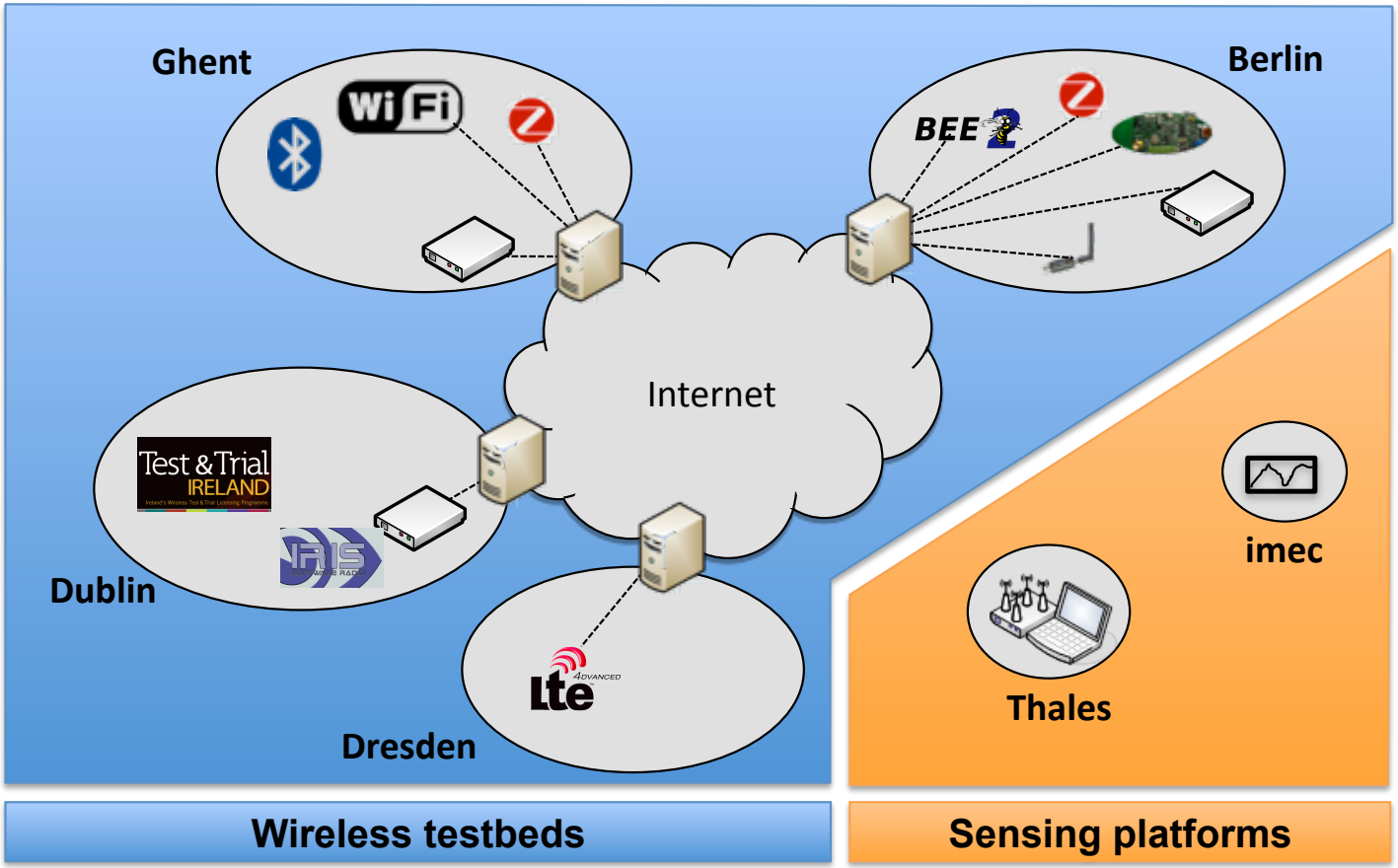


IEEE 802.11	IRIS GPP-based software radio platform	imec Sensing Agent
IEEE 802.15.1	Comreg spectrum licenses	UHF/VHF TV sensing
IEEE 802.15.4	BEE2 FPGA platform	ISM bands sensing
LTE-advanced	USRP software radio	THALES advanced sensing platform
EyesIFX nodes	Versatile Sensor Node on Light pole	WiSpy Spectrum analyzer
CR data base		Interconnection of portals
		Interconn. between testbed elements

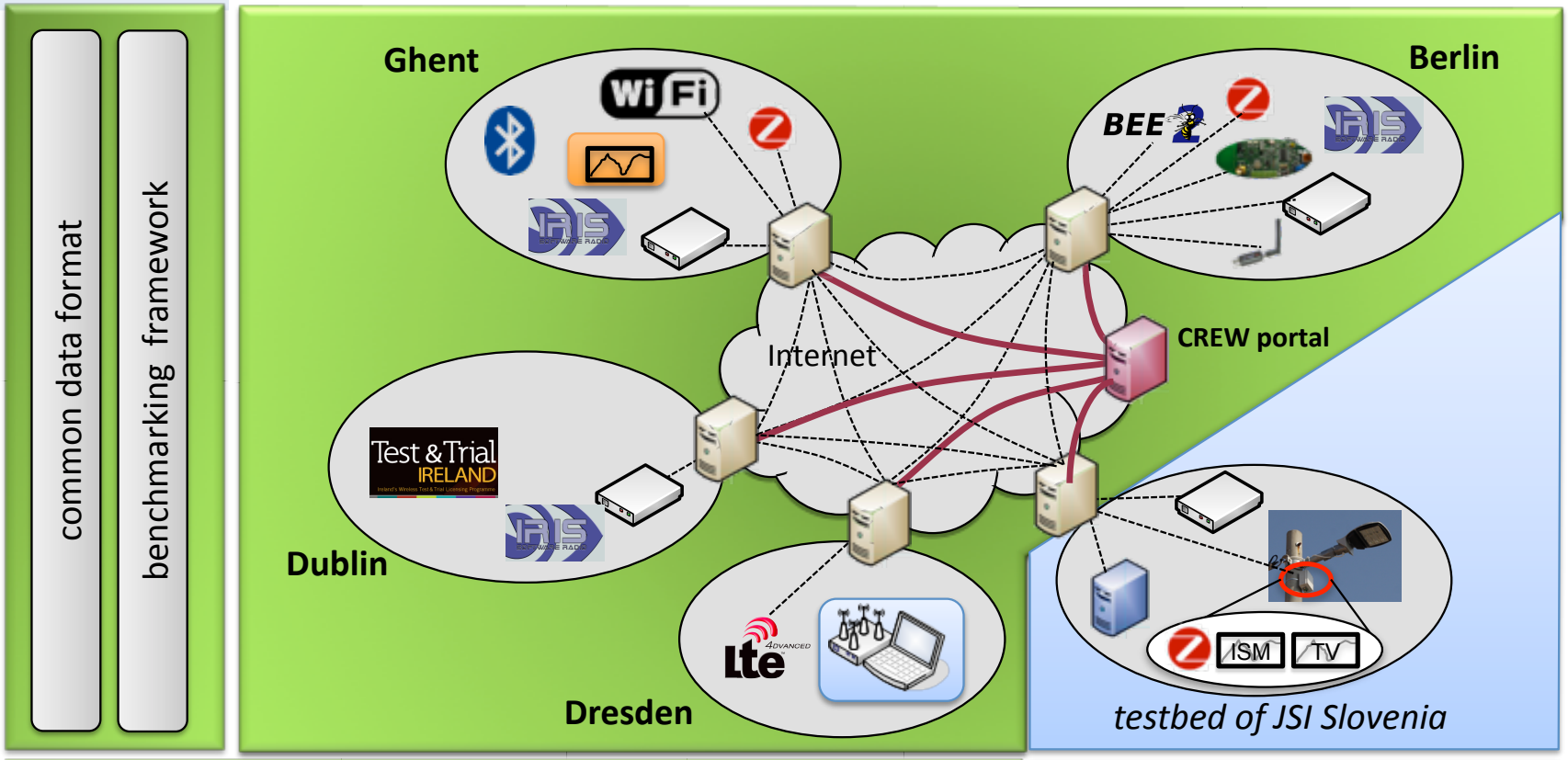
CREW platform for open call 1

- **Offer**
  - we deliver the facilities & hardware for your cognitive radio, cognitive networking, sensing experiments
    - mature testbeds, years of development and testing
  - we deliver all tools needed for you to effectively execute your experiments
  - consortium holds expertise from PHY to application layer
- **We are looking for**
  - people that want to make use of the CREW facilities
  - your feedback: what do you like or dislike, which feature(s) would you like to be implemented?
- **Our ambition**
  - to become the reference test platform for cognitive radio and cognitive networking

CREW platform for Open Call 1



CREW platform for Open Call 1



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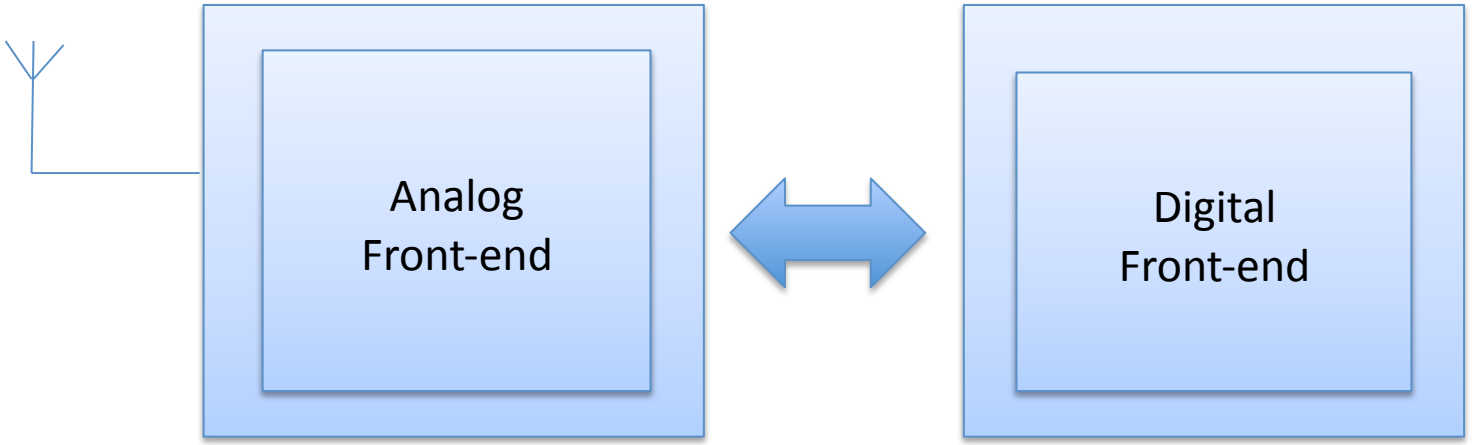
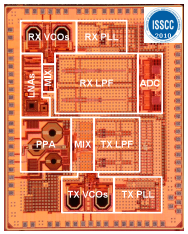
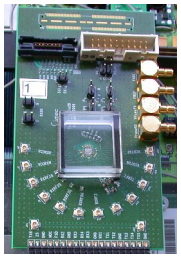
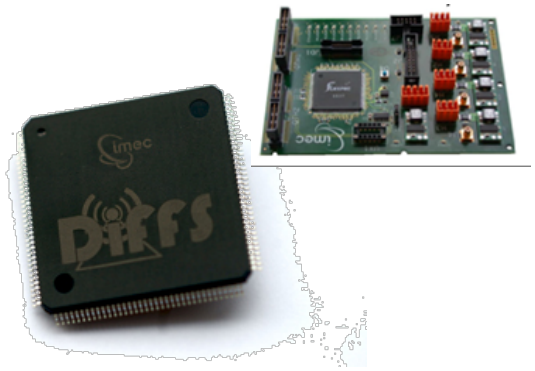
imec advanced spectrum sensing









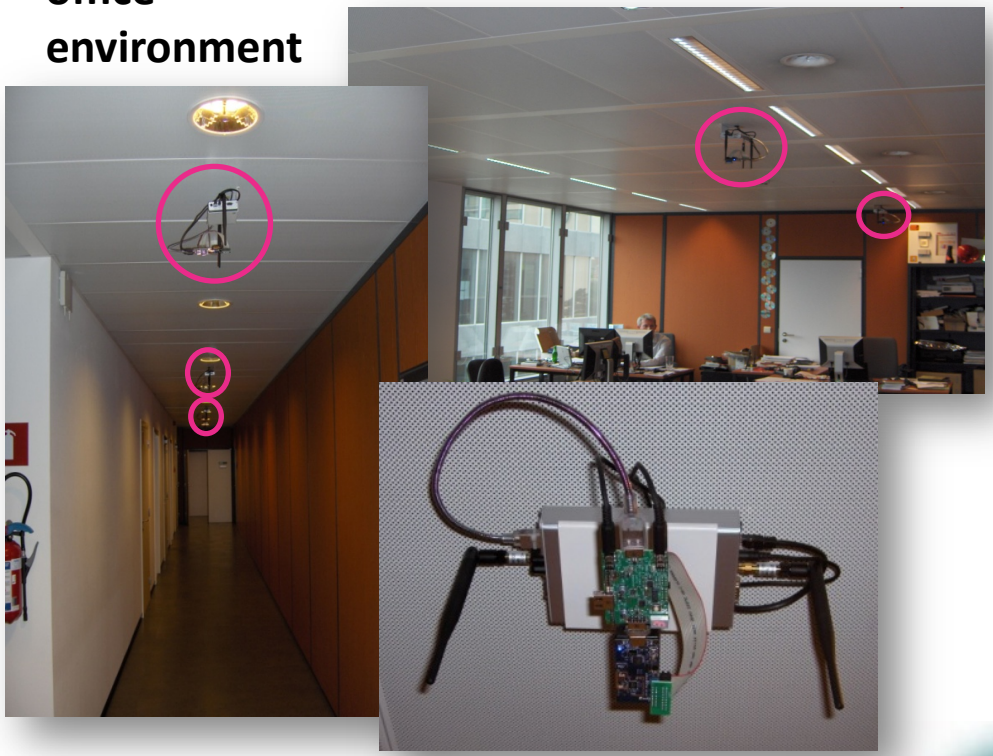
IBBT w-iLab.t

ibbt

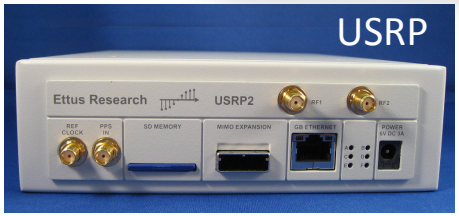
200 + 60 wireless nodes (WiFi/Zigbee/Bluetooth)

cognitive components: USRP, AirMagnet, imec sensing agent

office environment

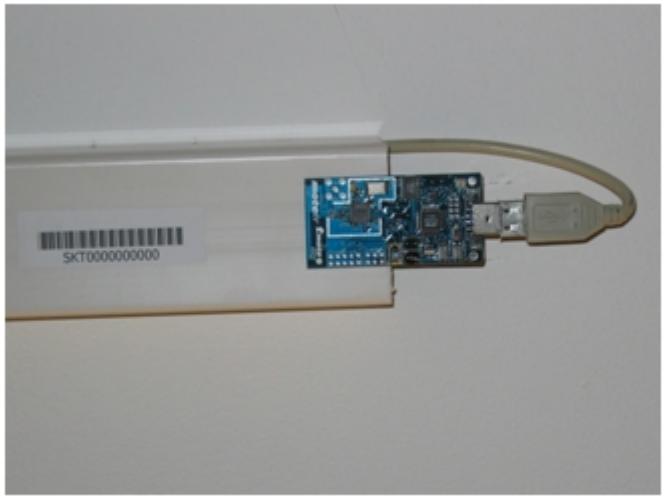


Pseudo-shielded environment



imec sensing agent

TU Berlin TWIST testbed



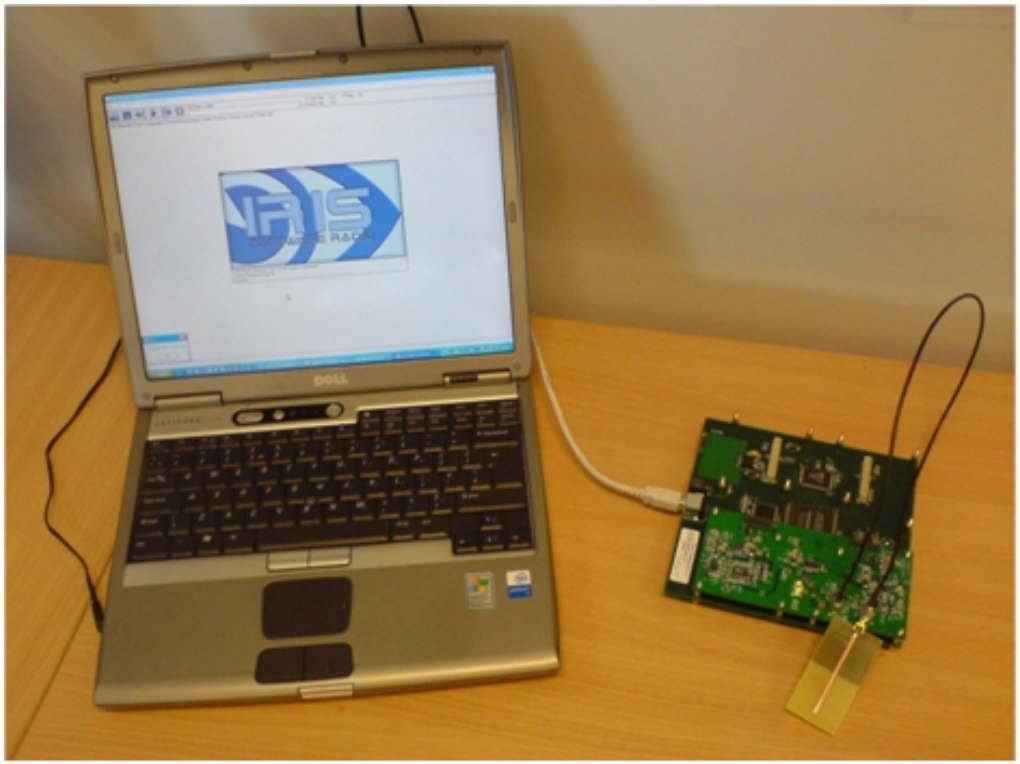
The TKN Wireless Indoor Sensor Network Testbed (TWIST) is a multiplatform, hierarchical testbed architecture.

LTE-Advanced testbed

TECHNISCHE UNIVERSITÄT DRESDEN

The LTE-Advanced testbed is a platform for research on coordinated multipoint transmission in cellular networks.

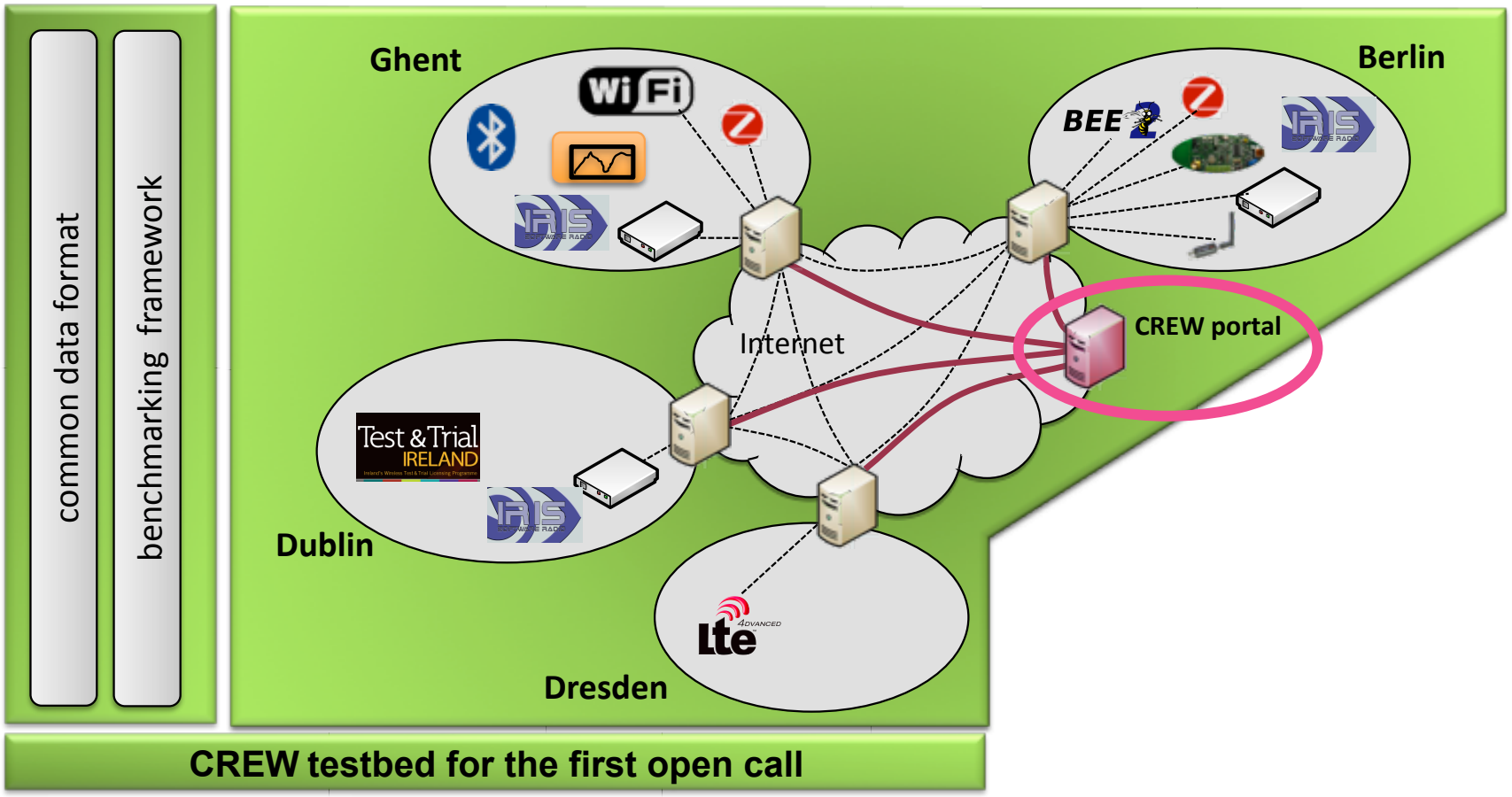
IRIS reconfigurable radio



IRIS can be used to create software radios that are reconfigurable in real-time.

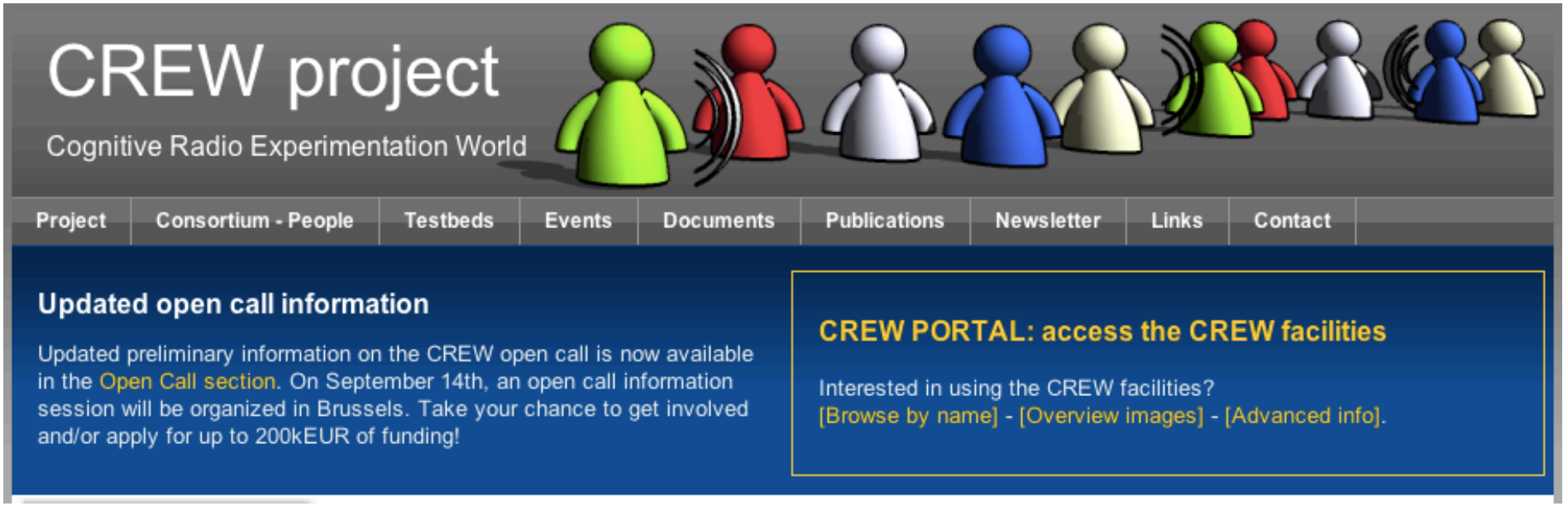
CREW federated platform: key aspects

- **common portal**
  - comprehensive **description** of the individual testbeds
  - **guidelines** on how to access and use the federated testbed



CREW common portal

- **CREW portal: www.crew-project.eu/portal**
  - Browse by name
  - Overview images
  - Advanced information

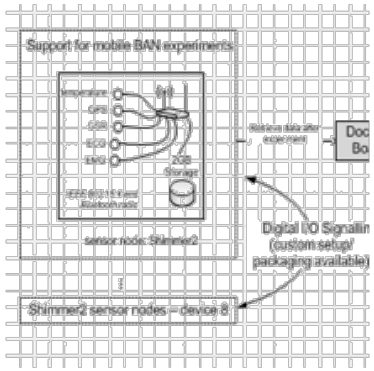
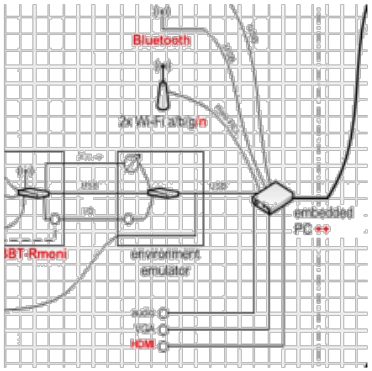
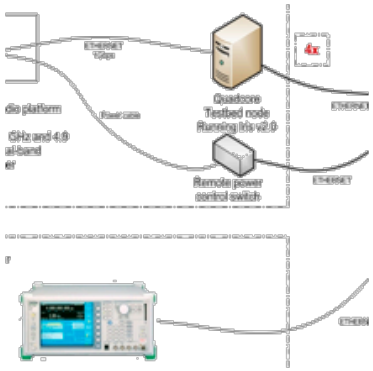
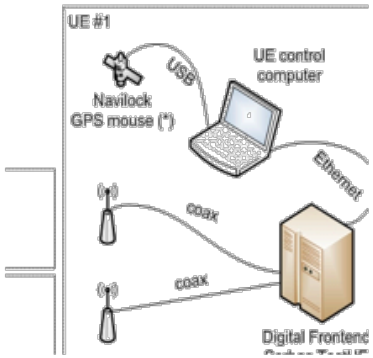
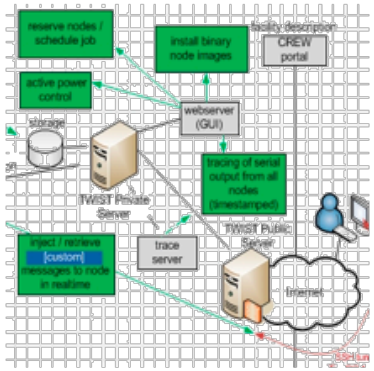
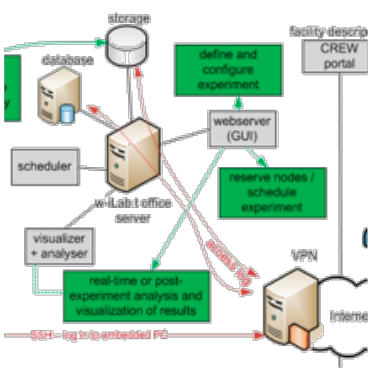
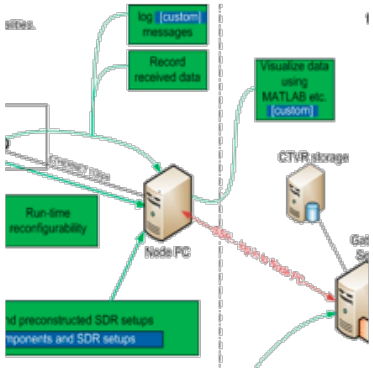
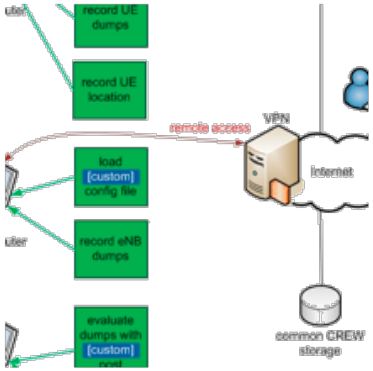


CREW common portal

Schematic overview

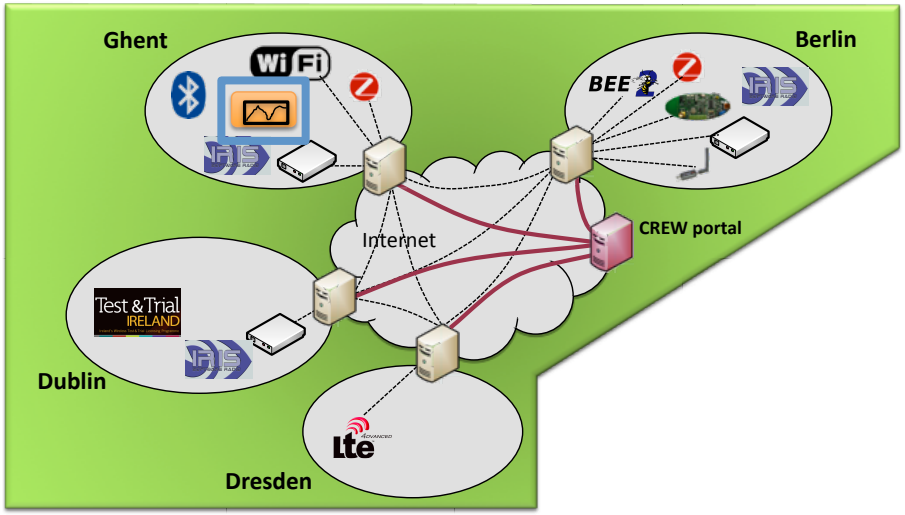
View | Edit | Outline | Revisions

Please click the thumbnail extracts below to get a full screen view of the different infrastructures. After clicking the thumbnails, click to zoom in. The images may also be downloaded on the bottom of this page.

TWIST - Berlin	w-iLab.t - Gent	Iris - Dublin	LTE-Advanced - Dresden
			
Hardware overview	Hardware overview	Hardware overview	Hardware overview
			
Usage overview	Usage overview	Usage overview	Usage overview
Access documentation	Access documentation	Access documentation	Access documentation

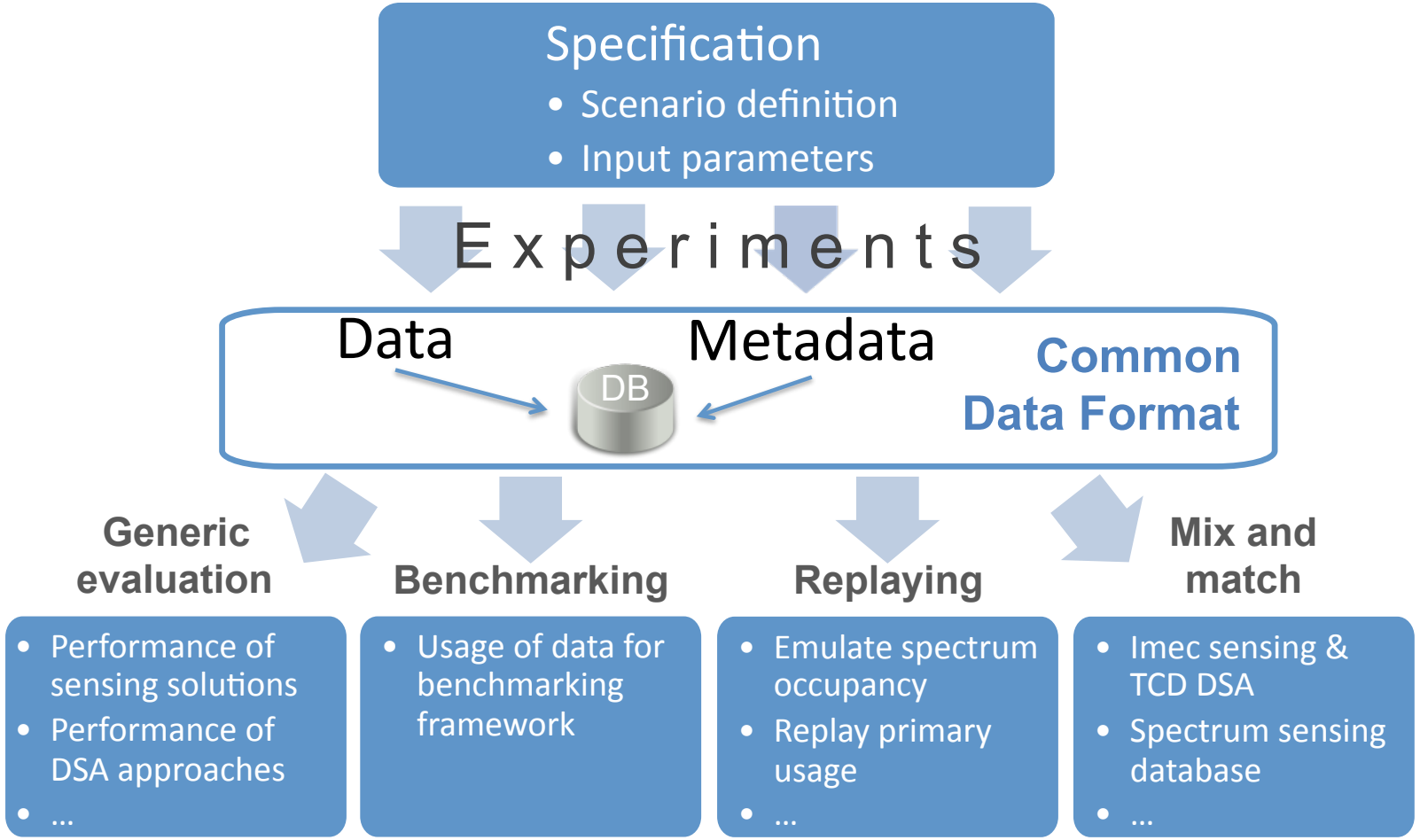
CREW federated platform: key aspects

- **novel cognitive components**
  - **relocation** of components
  - **linking together** software and hardware **entities** from the different partners



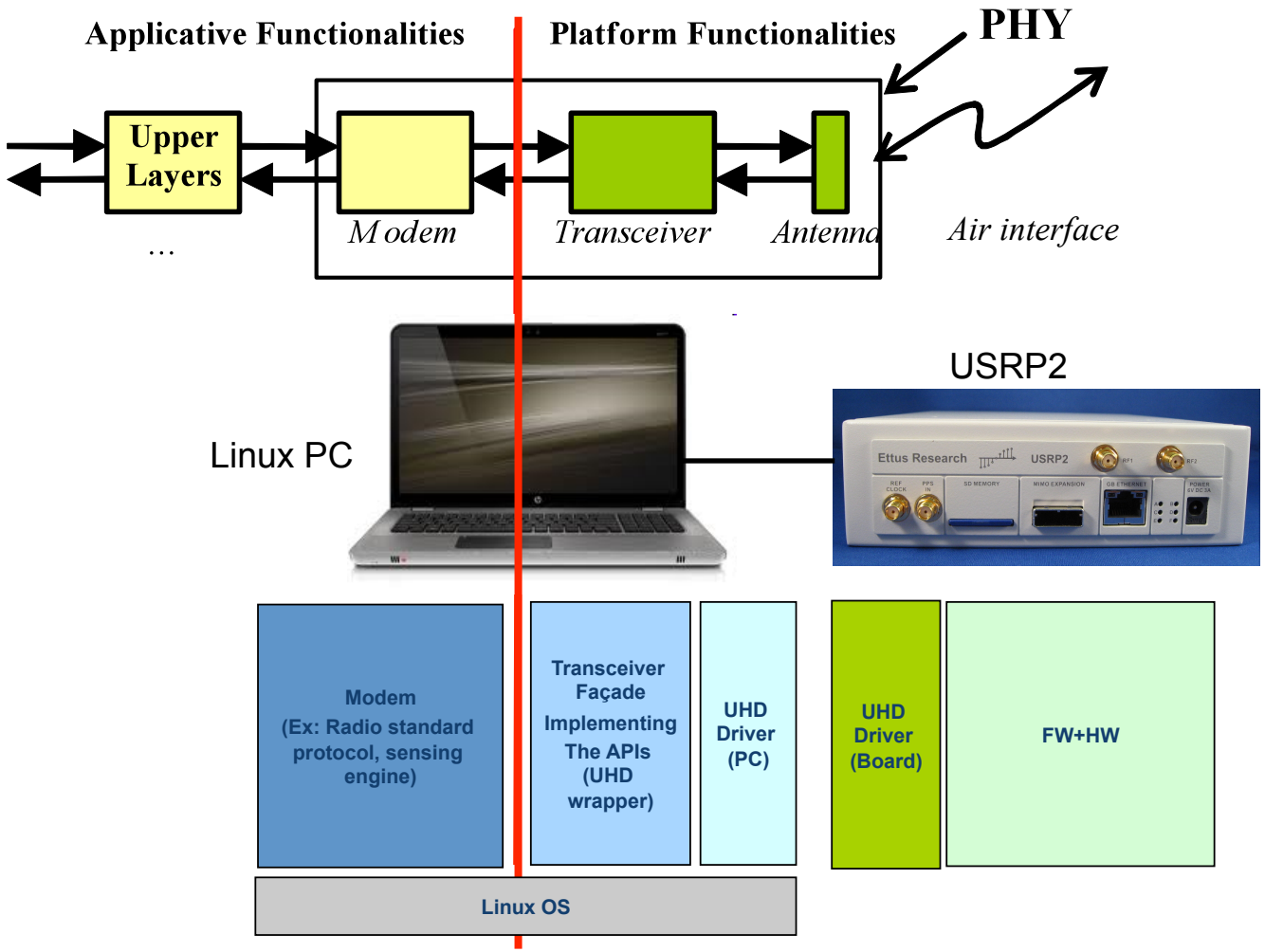
CREW federated platform: key aspects

- **creation of open data sets**
  - a **common data structure** enables the emulation of CREW components in other experimental environments or in a simulator
  - Compliance with + extension of IEEE 1900.6 standard



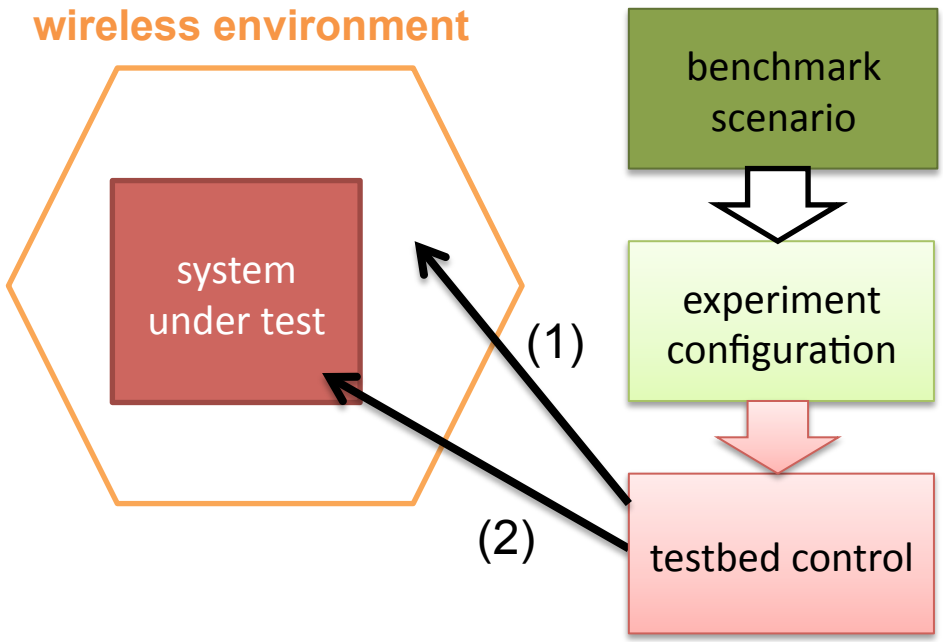
CREW federated platform: key aspects

- **transceiver API**
  - **standardized API** for SDR architectures (developed within WINNF)
  - functional specification for RF hardware platforms command and control



CREW federated platform: key aspects

- **benchmarking framework**
  - enabling experiments under controlled and **reproducible test conditions**
  - offering **automated procedures** for experiments and performance evaluation
  - allowing **fair comparison**



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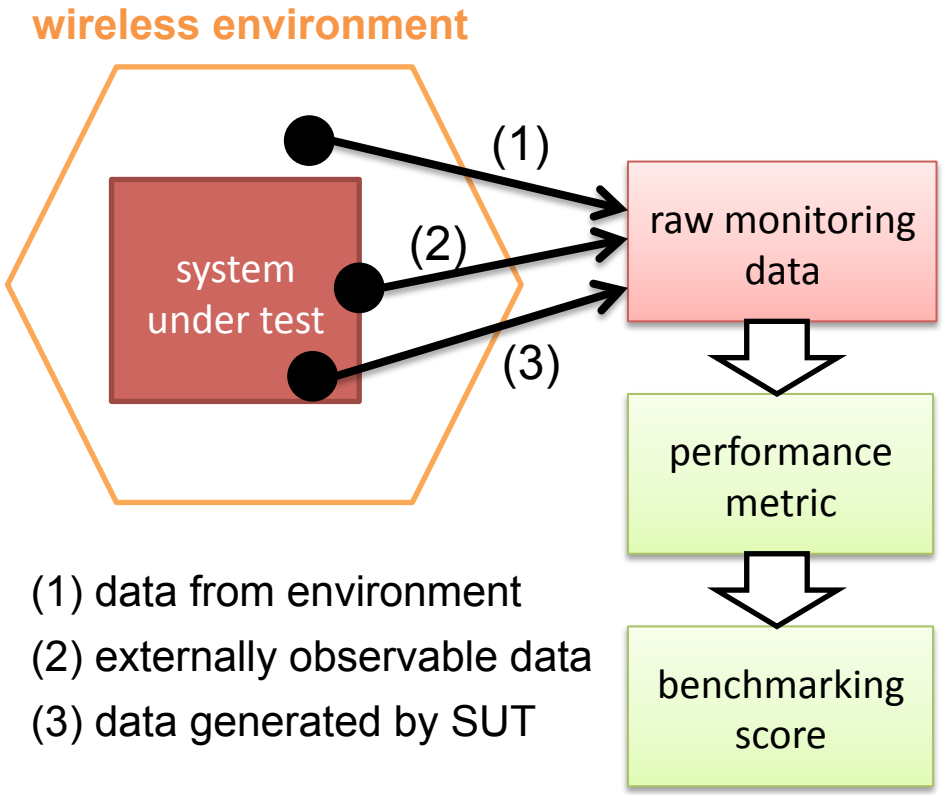
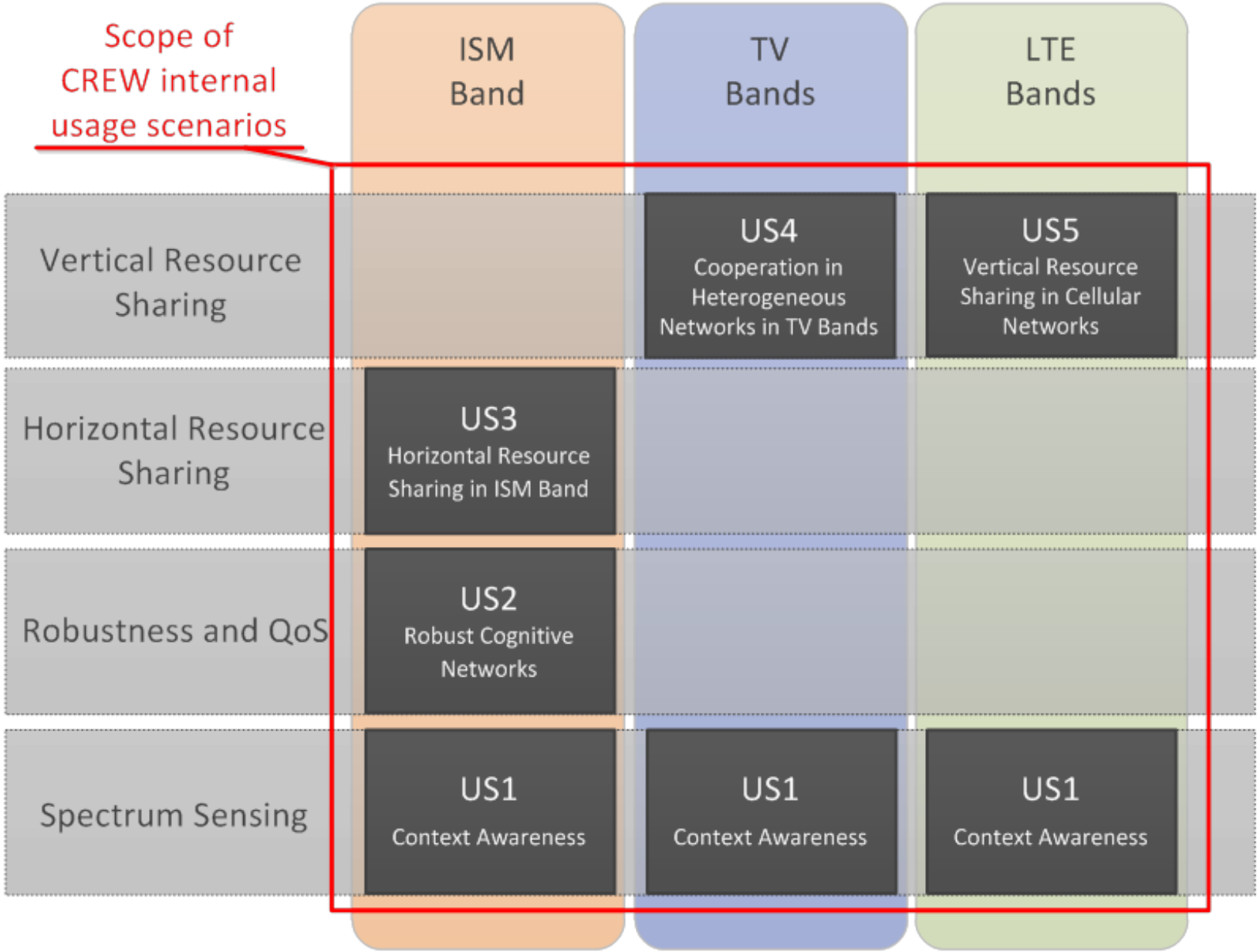


More info: benchmarking white paper (www.crew-project.eu/documents)

CREW internal usage scenarios



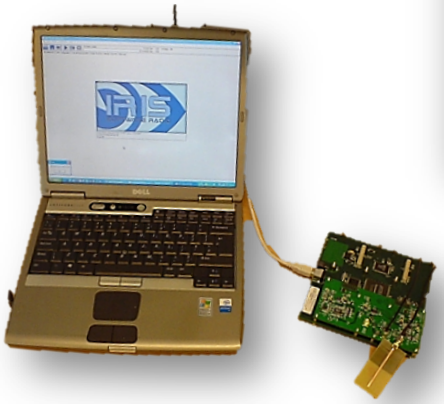
CREW internal usage scenarios

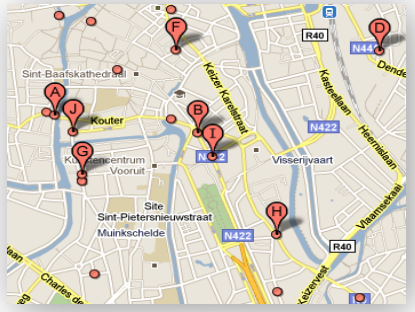
- **US1 - Context awareness for cognitive networking**
  - spectrum sensing in unlicensed (ISM) and licensed bands (TV white spaces, cellular systems)
- **US2 - Robust cognitive networks**
  - applications that require robust communications though avoiding harmful interference and using frequency agility to improve communication quality
- **US3 - Horizontal resource sharing in the ISM band**
  - algorithms, protocols and networking architectures for coexistence of and cooperation between independent heterogeneous network technologies
- **US4 - Cooperation in heterogeneous networks in TV bands**
  - new ideas for opportunistic spectrum access to underutilized licensed TV bands
- **US5 - Cognitive Systems and Cellular Networks**
  - the impact of dynamic spectrum access by secondary users on LTE cellular primary systems.

➜ **See CREW deliverable D2.1**

Example experiments (1)

- **Context awareness approaches**
  - Local sensing performance for various frequency bands and signals (ISM, TV, LTE)
  - Characterization of sensing performance of different hardware solutions
  - Comparison of local versus distributed sensing
  - Context awareness performance of database versus local or distributed sensing

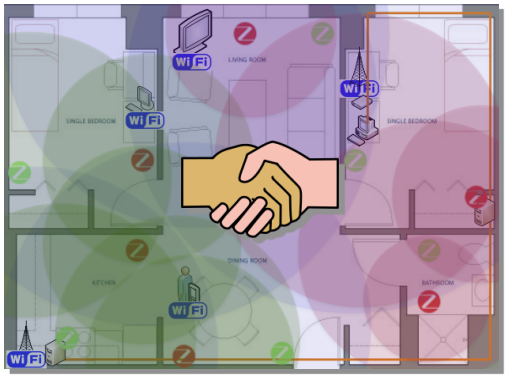




database approach

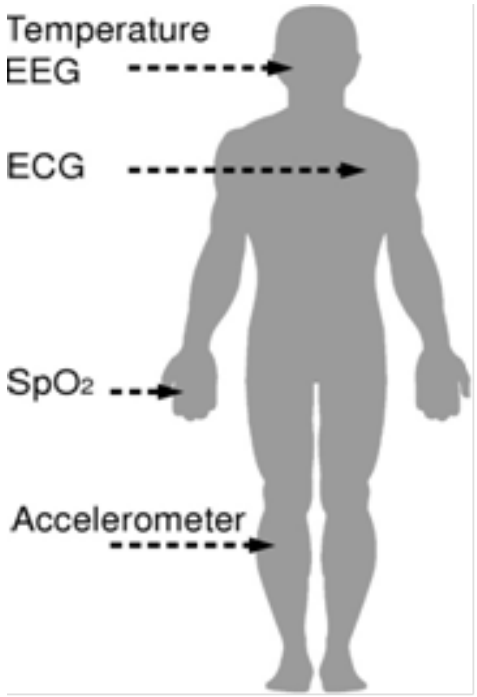
Example experiments (2)

- **Cognitive networking solutions for coexistence / horizontal spectrum sharing / interference avoidance in ISM bands**
  - Scenario: home/office/public environment
  - Simple versus advanced spectrum sensing techniques
    - Energy detection versus feature detection
    - COTS hardware versus CREW hardware
  - Cognitive networking monitoring techniques;
  - Local versus collective cognitive decision and control;
  - Cross-layer, cross-node, cross-network, cross-technology optimization strategies;
  - Different physical wireless environments, different test scenarios;



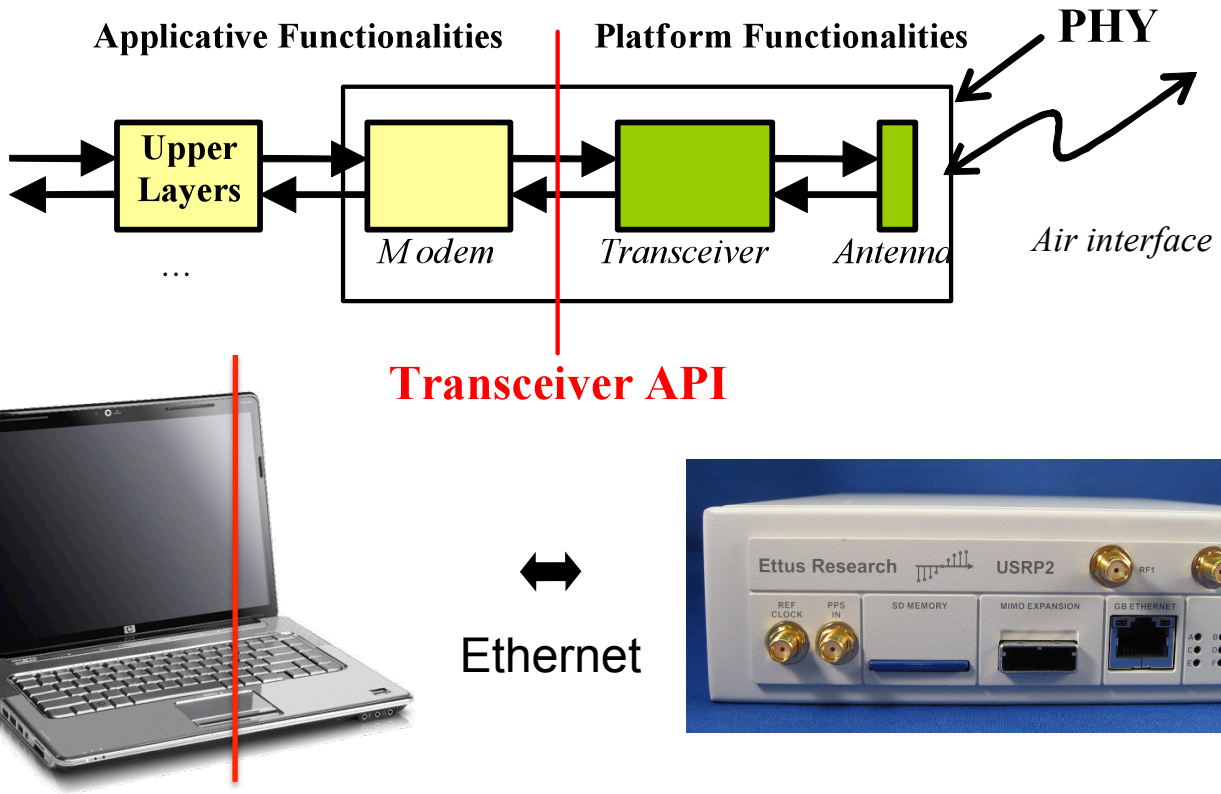
Example experiments (3)

- **Cognitive body area networks**
  - Scenario: impact of interference on QoS in CBANs
  - Static versus mobile CBAN
    - Sensors on test persons or robots
  - Comparison of different sensing solutions
  - Experimentation with link / multi-channel MAC protocols for CBANs
  - Real-time / delay sensitive protocol support



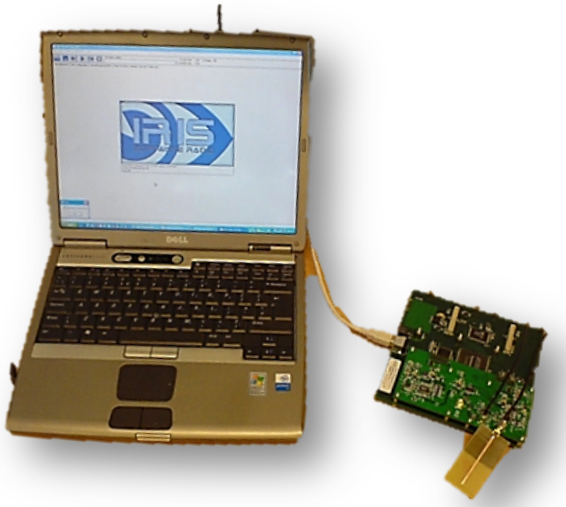
Example experiments (4)

- **Cognitive algorithms integration through Transceiver API**
  - Implementation of cognitive solution on USRP2 platform (access to USRP radio through API from host PC)
  - System integration of the new device (= cognitive algorithm + USRP2 radio-subsystem) in any of the CREW testbeds



Example experiments (5)

- **Reconfigurable radios and adaptation mechanisms in a cognitive network**
  - Iris SW radio platform: dynamic adaptations at multiple layers in the protocol stack, including the physical layer
  - spectrum sculpting for better coexistence with co-located and/or adjacent systems
  - the implementation of a cognitive medium access control (MAC) protocol
  - use of TV white spaces through sensing and geolocation database methods



Example experiments (6)

- **Impact of cognitive radio on a primary cellular system**
  - Scenario: opportunistic use of white spaces in licensed bands and impact on the primary system's performance
  - enhance coexistence by minimizing interference (by secondary system) to the primary system
  - algorithms for the reliable detection of the targeted white spaces via energy or feature detection
  - algorithms for avoidance of the licensed signals

Call information

- **Budget:** € 400,000
  - Minimum funding per experiment: € 50,000
  - Maximum funding per experiment: € 200,000
- **Number of experiments to be funded:** 3 to 5
- **Number of partners per experiment**: 1 or 2
- **Type of participants:** academics and companies
- **Duration of the experiment:** maximum 12 months.
- **Language of the proposal:** English
- **Call deadline:** Wednesday, October 19th, 2011 at 17:00h CET
- **Address for proposal submission**: ict@ec.europa.eu
- **Call identifier:** CREW2011-OC1
- **Contact for information:**

Ingrid Moerman (IBBT)
email: Ingrid.moerman@intec.ugent.be
phone: +32 9 33 14 925 (office)

CREW open call documents

- **CREW open call announcement**
  - Background information on the CREW project
  - Call information
  - Objectives of CREW open call 1
    - How to use the CREW federation
    - Example experiments
  - Information on CREW facilities and components
  - Experiment work plan and timing
- **Guide for applicants**
  - How to prepare and submit a proposal
  - Proposal evaluation and selection
  - Support to proposers
  - Proposal format (+ CREW specific information!)
  - Evaluation form
- **CREW Consortium Agreement**
- **Slides of this presentation**

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Call objectives

- **Experiments and evaluations in the cognitive radio and cognitive networking research domain that make use of the CREW facilities and its federation functionality**
- **Maximally exploit the unique features of the CREW facilities (at least 2 functionalities!)**
  - Combination of cognitive components from different testbeds
    - E.g. use of imec sensing agent or IRIS SW radio in another testbed
    - Comparing experimental results obtained in two different testbeds
  - CREW advanced spectrum functionality
    - Combination of CREW different sensing solutions (HW, SW)
    - Comparison of own sensing hardware with CREW sensing hardware
  - Benchmarking features
    - Use of reference test environment
    - Use of existing metrics and scores
    - Definition of new metrics and scores
  - Common Data Collection and Storage Methodology
    - Creation of public data traces according to common data format
    - Record behavior in one testbed & replay in another testbed
  - Transceiver API

Experiment work plan

1. **Experiment design**
   - Description of cognitive solution
   - Use of CREW federation
   - Description of experiments
   - Specific demand for extensions
2. **Experiment set-up**
   - Deployment of cognitive solution(s) on CREW infrastructure
   - Implementation of extensions to the CREW federated platform
3. **Experiment execution**
4. **Feedback**
   - Experiments results & analysis
   - User experience
   - Recommendations
5. **Dissemination**
   - Regular dissemination actions
   - Demonstration (showcase)

Timing of experiment

- **Timing**
  - Maximum duration: 12 months
  - Major milestones:
    - Experiment design: no later than M2
    - Experiment set-up: no later than M4
    - Experiment execution: first successful experiment no later than M6
  - Experiment feedback: final report no later than M12
  - Dissemination:
    - first dissemination of results no later than M9
    - showcase available no later than M12
- **Remarks**
  - Design & development of cognitive solutions is NOT part of the proposal (only experiments!)
  - Make clear planning for on-site visits, if no remote experiments are possible

Some more guidelines

- **Discuss your proposal idea with CREW consortium!**
- **Ask information** about capabilities of facilities
- Available **budget** in the open call is primarily meant for experimentation and not for buying hardware
- Experiments should lead to **sustainable** solutions for CREW
  - Experiment should have sufficient added value for the CREW federated platform (during & after the CREW project)
  - Foreground knowledge created during experiment can be further used by CREW partners and future experimenters (also after the CREW project)
- New partners must **adhere to the CREW IPR regulations**, as stipulated in the CREW consortium agreement
  - All foreground developed in CREW before the accession of the new experimenter is considered to be background
  - A specific written agreement is needed in order to fix the terms and conditions of the ownership of the foreground concerned
  - ➔ identify if any foreground will be created and under which conditions access rights for using foreground will be granted during and after the CREW project (see section 3.2 of proposal)
- **Use of proposal information** by CREW consortium is desired (also when proposal is not selected for funding)
- Recommended total **proposal size**: 20 - 25 pages

Timing of open call

- **Preliminary announcement:** June 16th, 2011 @ FNMS
- **Official launch of open call:** September 14th, 2011 @ Brussels
- **Submission deadline:** October 19th, 2011 @ 17:00h (CET)
- **Evaluation results available:** December 2011 (tentative)
- **Start of new partners:** January 2012 (tentative)

Information on CREW facilities

- **Individual testbeds**
  - **IBBT**
    - Stefan Bouckaert (Stefan.bouckaert@intec.ugent.be)
  - **TU Berlin**
    - Jan Hauer (hauer@tkn.tu-berlin.de)
  - **TCD**
    - Luiz DaSilva (dasilval@tcd.ie)
  - **TU Dresden**
    - Nicola Michailow (nicola.michailow@ifn.et.tu-dresden.de)
- **Sensing agent**
  - **imec**
    - Peter Van Wesemael (wesemael@imec.be)
- **Transceiver API**
  - **THALES**
    - Alejandro Sanchez (Alejandro.SANCHEZ@fr.thalesgroup.com)

More info

- **CREW website**
  - www.crew-project.eu/opencallinfo
  - Open call announcement document
  - Guide for proposers
  - CREW consortium agreement
  - CREW portal: www.crew-project.eu/portal

- **CREW parallel session**
  - Av. Beaulieu, 25 - BU25, room 0/S5
  - Start at 13:30h