How to access and use the CREW open federated test platform for wireless experimentation of advanced cognitive radio / cognitive networking solutions?

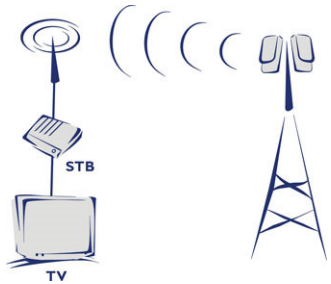
Ingrid Moerman - IBBT

Future Network & Mobile Summit, Berlin, July 4th, 2012

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).

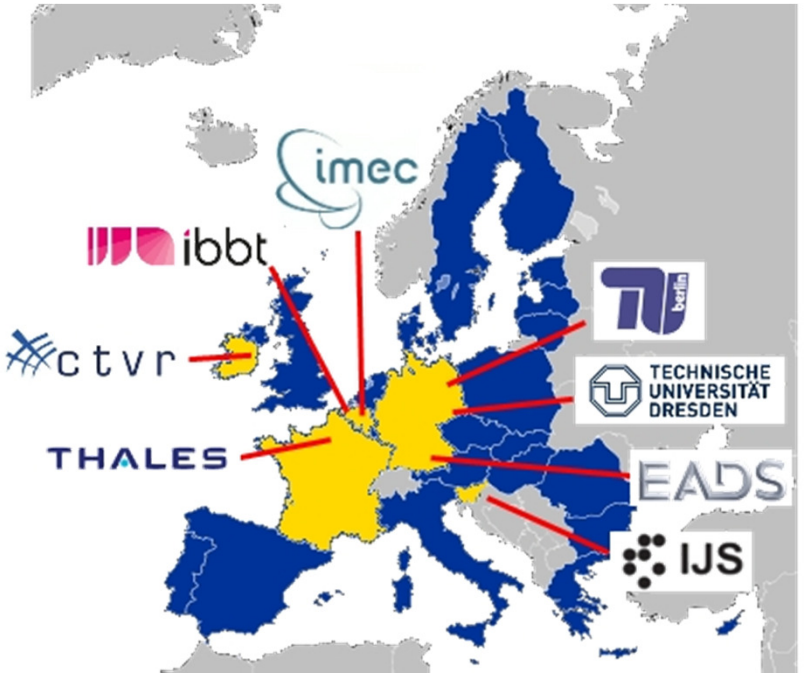
Wireless developer's questions

- **How to evaluate cognitive radio / cognitive networking solutions?**
  - … in a configurable environment
  - … in a repeatable way
  - … allowing fair comparison of results
- **Should/can I build my own testing environment?**



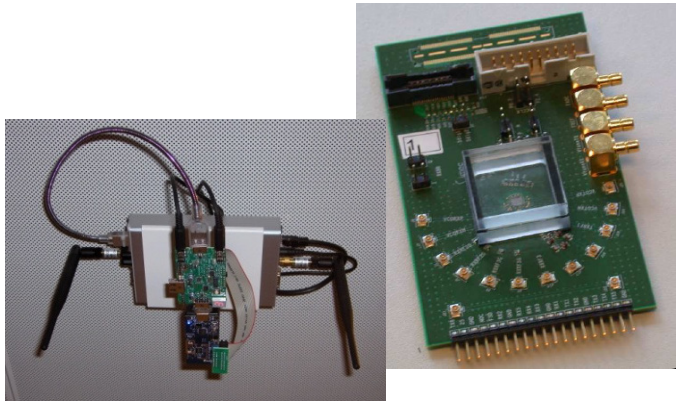
Answer = CREW

- **Cognitive Radio Experimentation World**
  - FP7 call 5
  - Project started October 2010
  - 8 core partners
  - 3 experimentation partners
  - www.crew-project.eu



Target: to establish an **open federated test platform**, facilitating experimentally-driven research on

- advanced spectrum sensing
- cognitive radio
- cognitive networking
- spectrum sharing
  in licensed and unlicensed bands



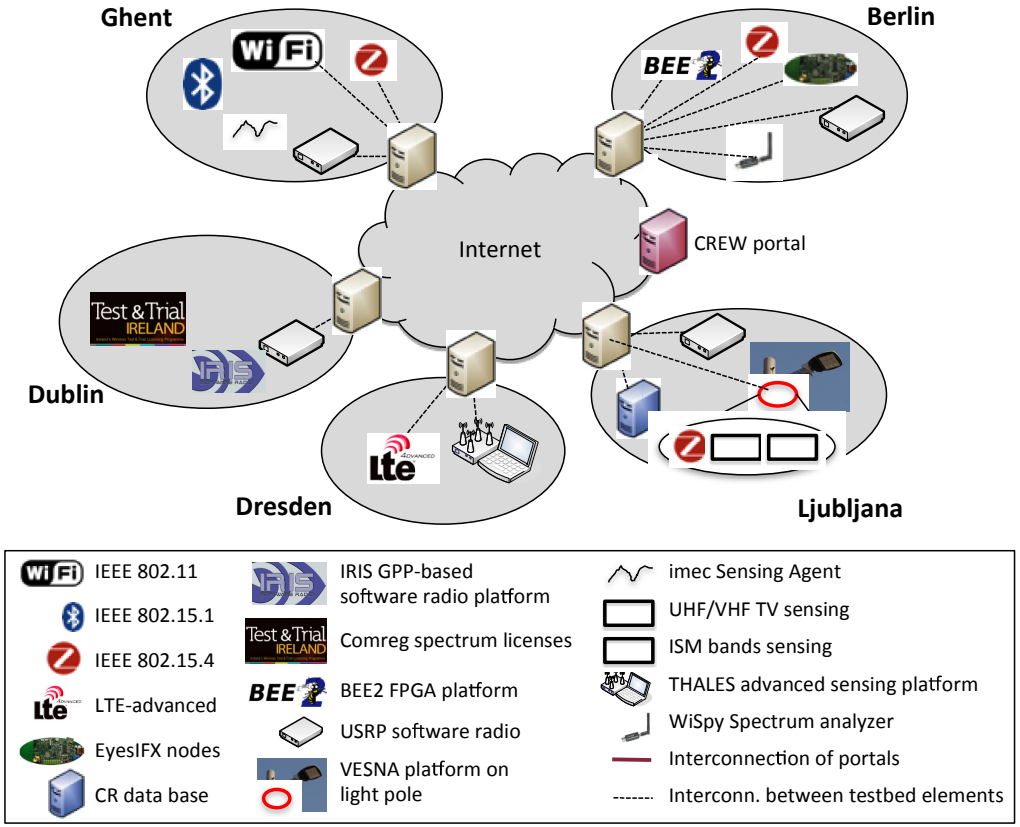
IP CREW: Target

- **CREW is NOT …**
  - doing research on spectrum sensing, cognitive radio & cognitive networking
  - design new algorithms

- **CREW is …**
  - bringing together test facilities for supporting research on spectrum, cognitive radio & cognitive networking
  - augment facilities with novel cognitive components
  - bringing together expertise on experimentation
  - facilitating access to heterogeneous test facilities
  - offering better methodologies for experimentation (repeatability, reproducibility, comparability)

CREW platform

- Starting from **5** operational **wireless testbeds**
  - heterogeneous ISM @ IBBT (Gent)
  - wireless sensor @ TUB (Berlin)
  - heterogeneous licensed @ TCD (Dublin)
  - LTE-advanced cellular @ TUD (Dresden)
  - heterogeneous outdoor ISM/TVWS @ JSI (Ljubljana)
- augmented with State-of-the-Art **cognitive sensing platforms**

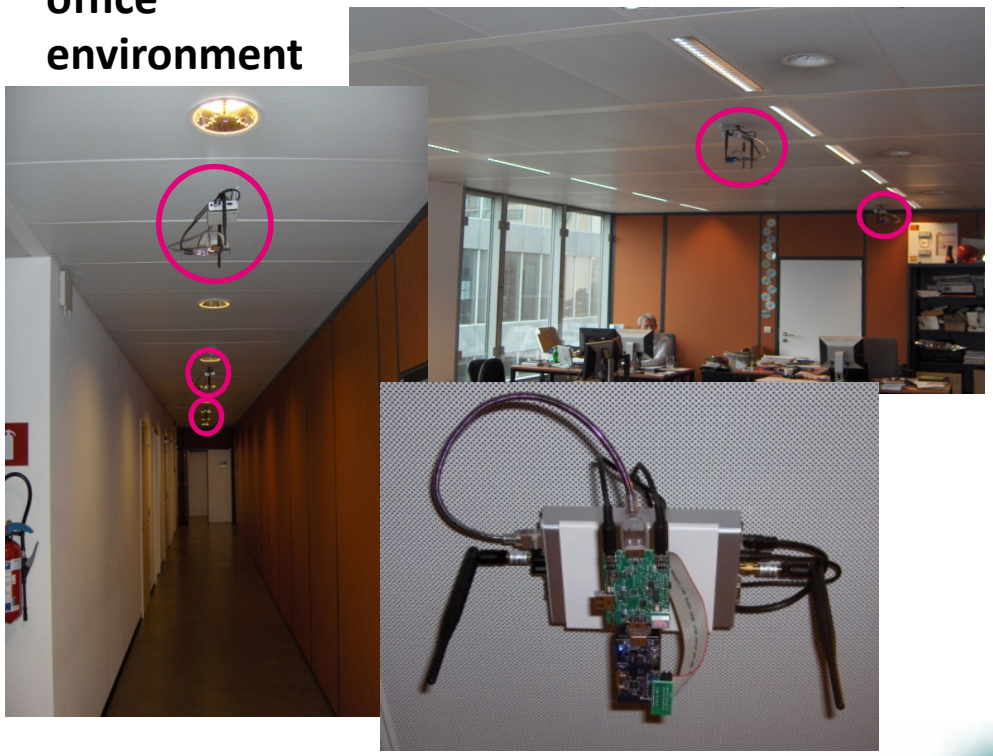


Ghent testbed - IBBT w-iLab.t

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

cognitive components: USRP, AirMagnet, imec sensing agent

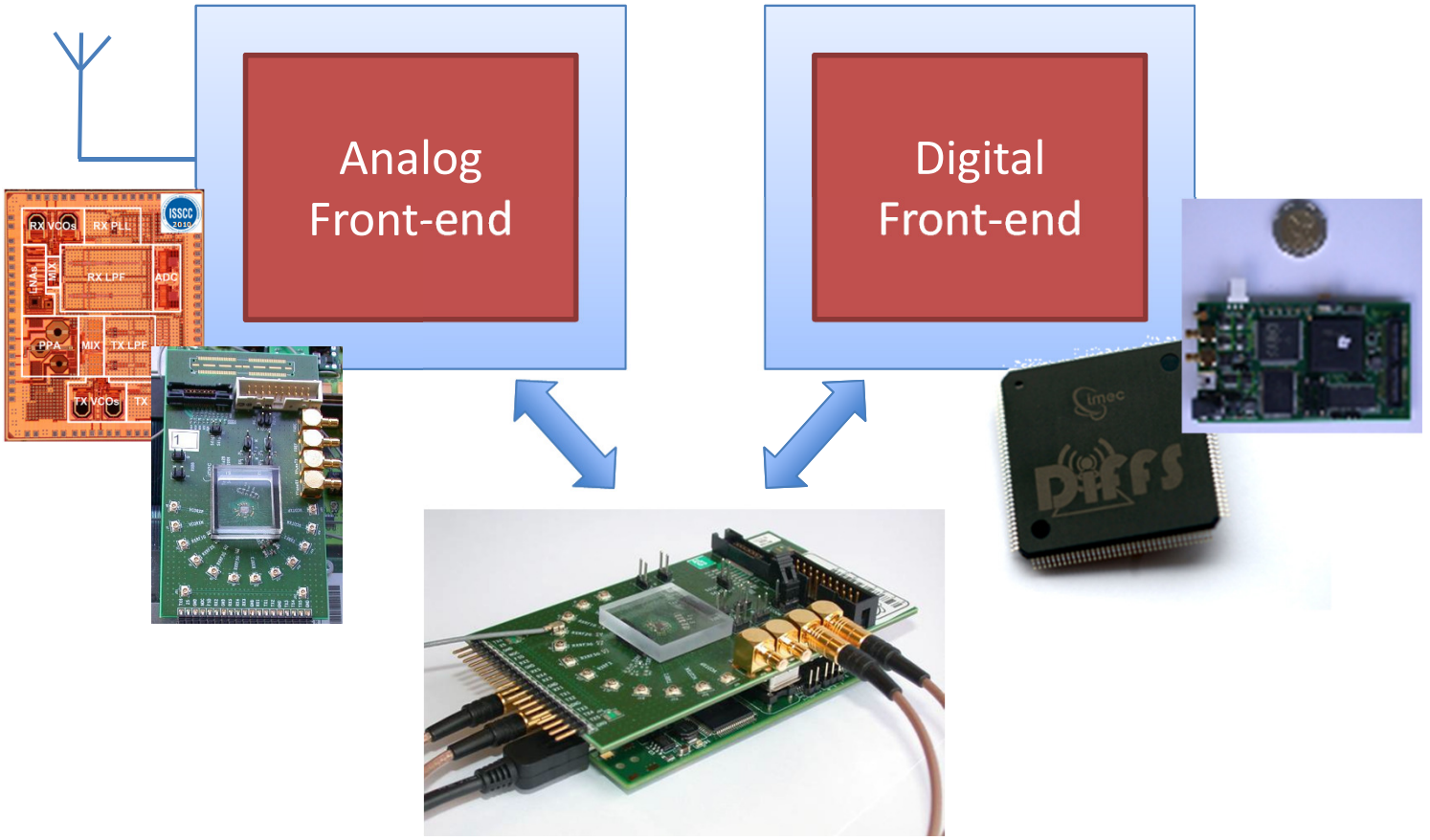
office environment



Pseudo-shielded environment

imec sensing agent

imec advanced spectrum sensing



Advanced spectrum sensing

Combination of analog & digital FE in compact device

Berlin testbed - TWIST

204 +16 wireless sensor nodes (Tmote Sky/EyesIFXv2/Shimmer2)
cognitive components: Wi-Spy, BEE 2 FPGA platform

Dublin testbed - IRIS reconfigurable radio

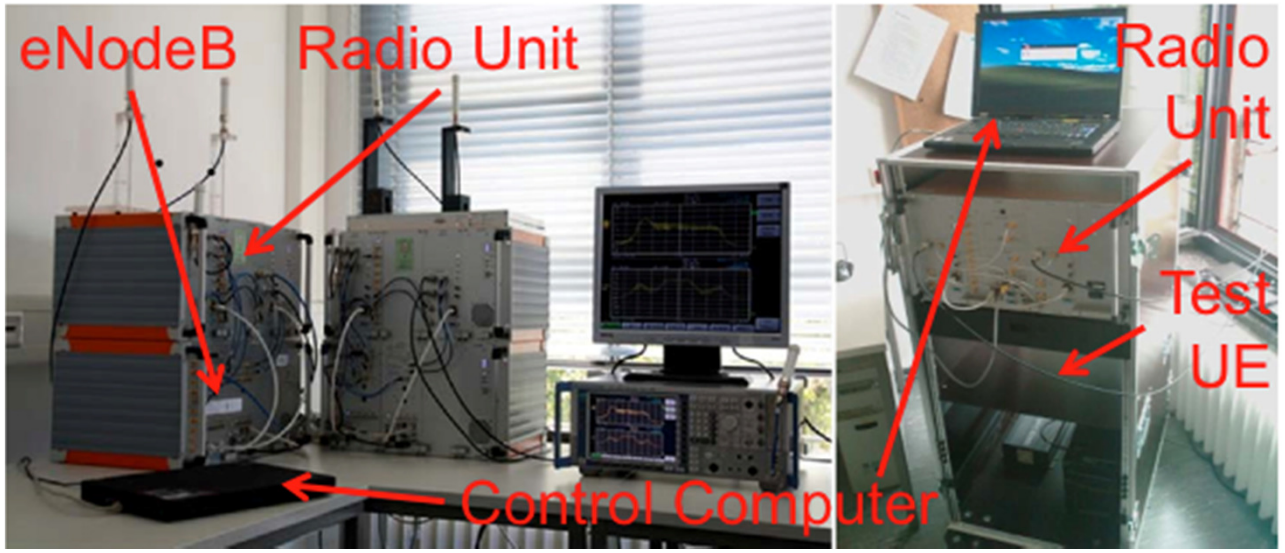
ctvr

17 IRIS reconfigurable cognitive radio platforms + 17 USRP

TV-bands license

Dresden testbed - LTE advanced testbed

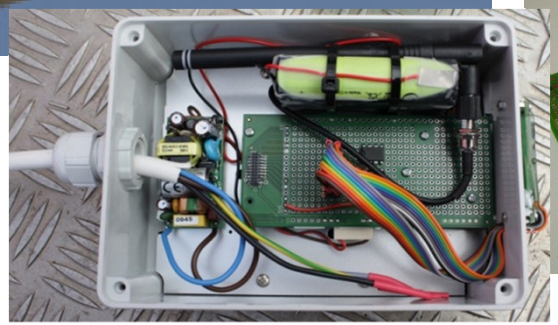
TECHNISCHE UNIVERSITÄT DRESDEN

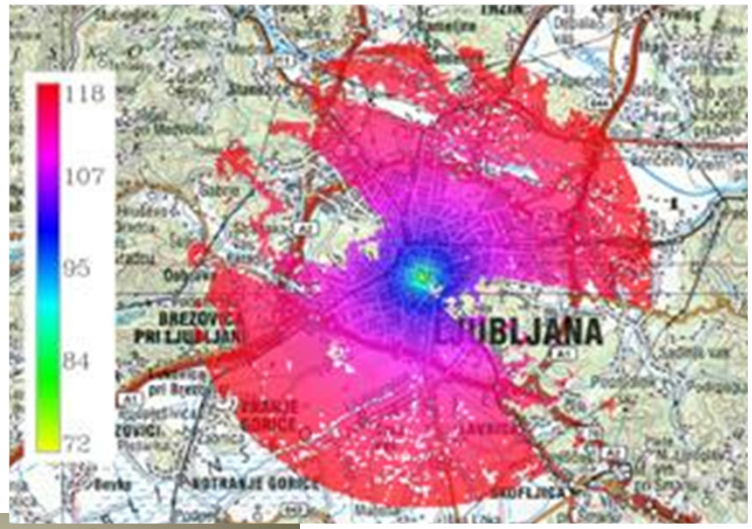


Signalion SORBAS (3 eNodeB + 3 UE)
Signalion HALO 430 SDR equipment
Indoor & outdoor
LTE license

Ljubljana testbed- outdoor VESNA testbed

IJS



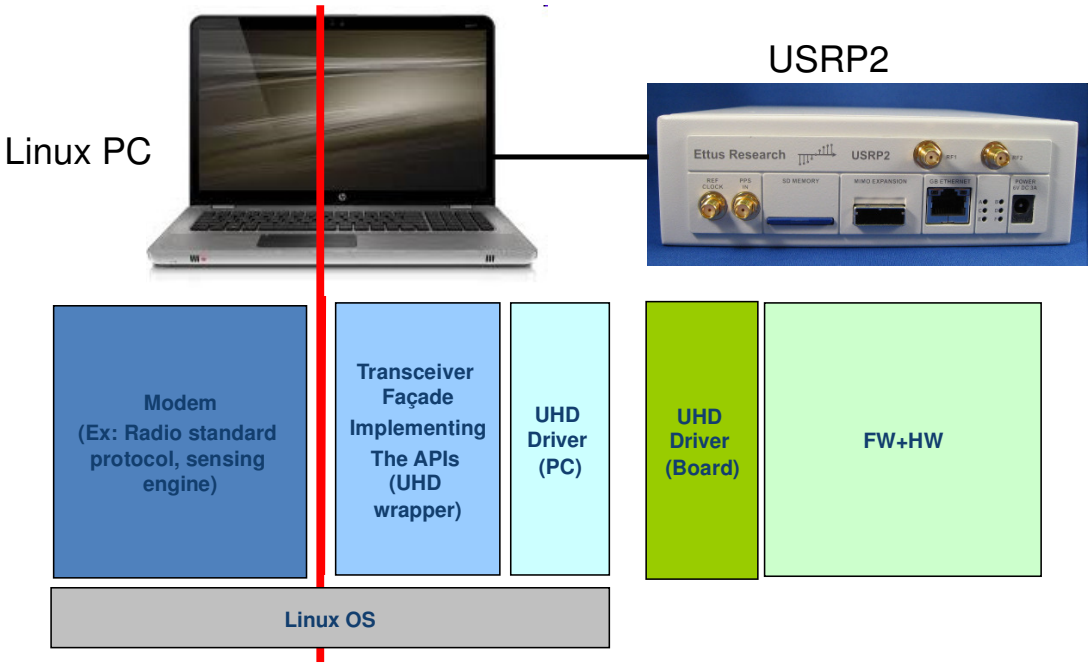


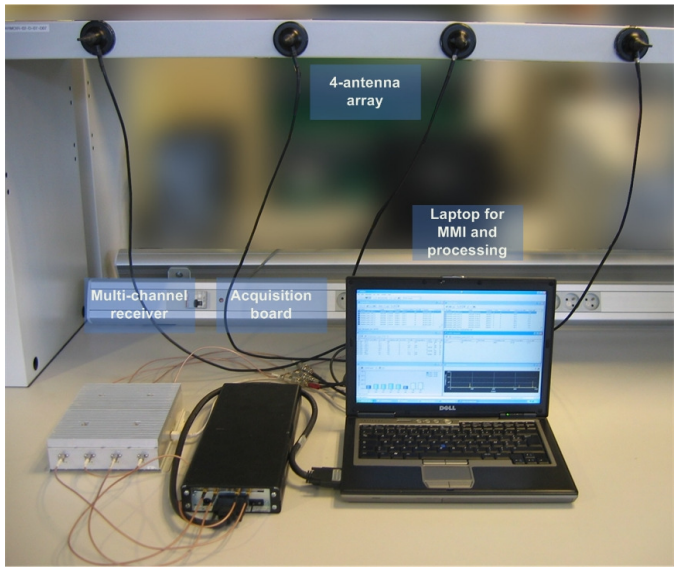
25 outdoor versatile sensor nodes

GRASS RaPlaT open source radio-planning tool

THALES advanced cognitive components

THALES





Transceiver API for SDR architecture (compliant to WINNF)

Multi-antenna LTE detection

EADS aeronautics wireless environment

EADS

Mock up of airplane

CREW Federated platform: key aspects

- **common portal**
  - comprehensive **description** of the individual testbeds
  - **guidelines** on how to access and use the federated testbed
- **novel cognitive components**
  - **relocation** of components
  - **linking together** software and hardware **entities** from the different partners
  - **standardized API** for SDR architectures (developed within WINNF)
- **creation of open data sets**
  - a **common data structure** enabling
    - emulation of CREW components in other experimental environments or in a simulator
    - spectrum sensing using heterogeneous sensing hardware
- **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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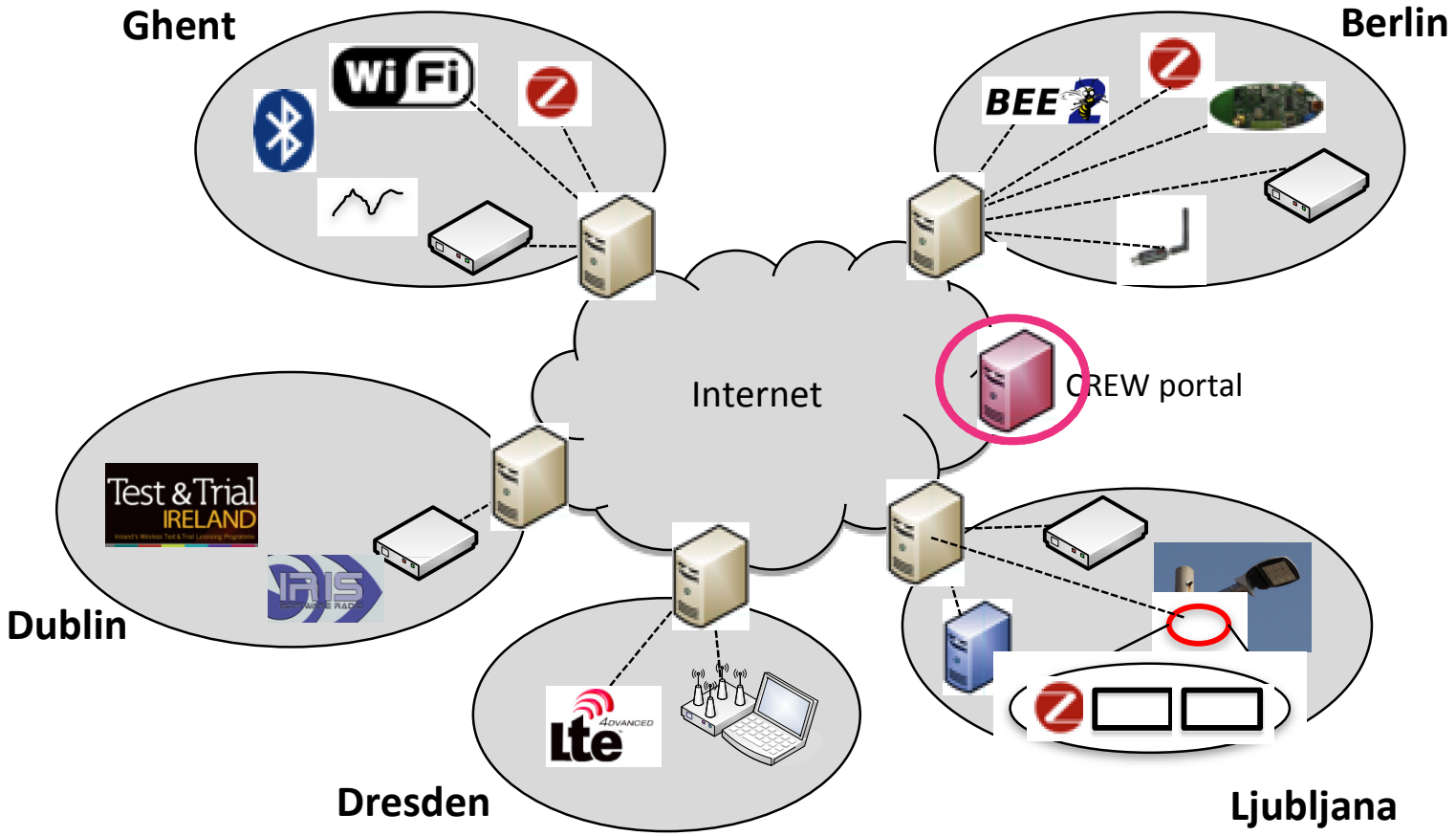


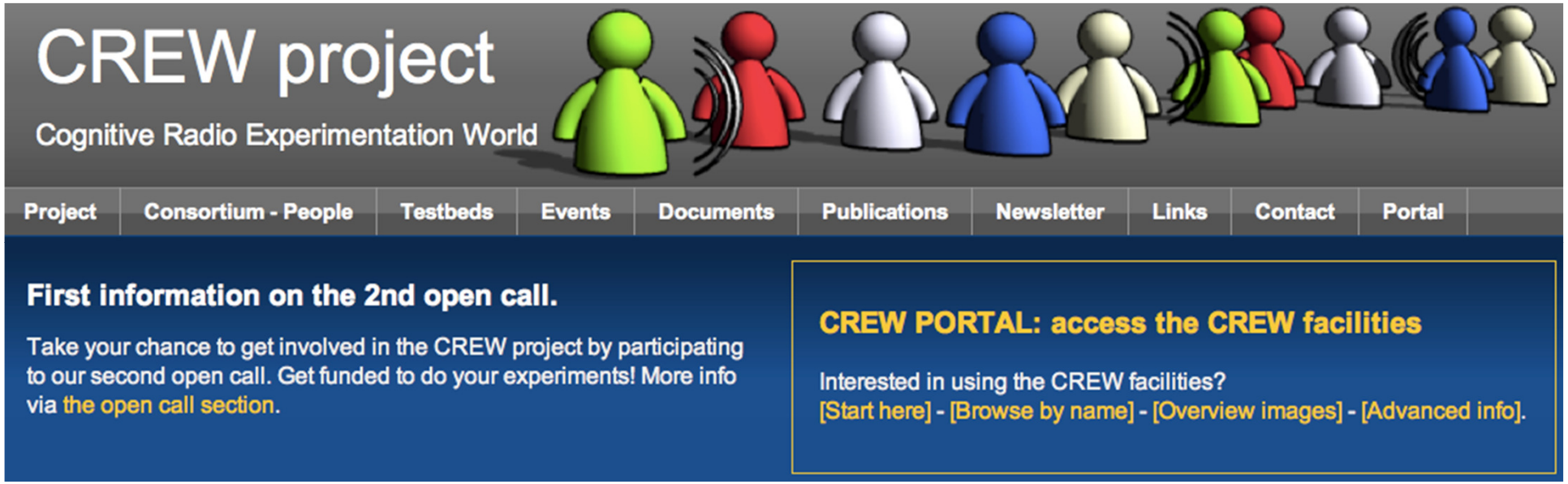
CREW federated platform: key aspects

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

- **content**
  - description of the facilities
  - description of cognitive components (e.g. sensing engine)
  - usage policies
  - requesting accounts
  - getting started: tutorials

CREW federated platform: key aspects

- **common portal**
  - Publicly accessible: www.crew-project.eu/portal

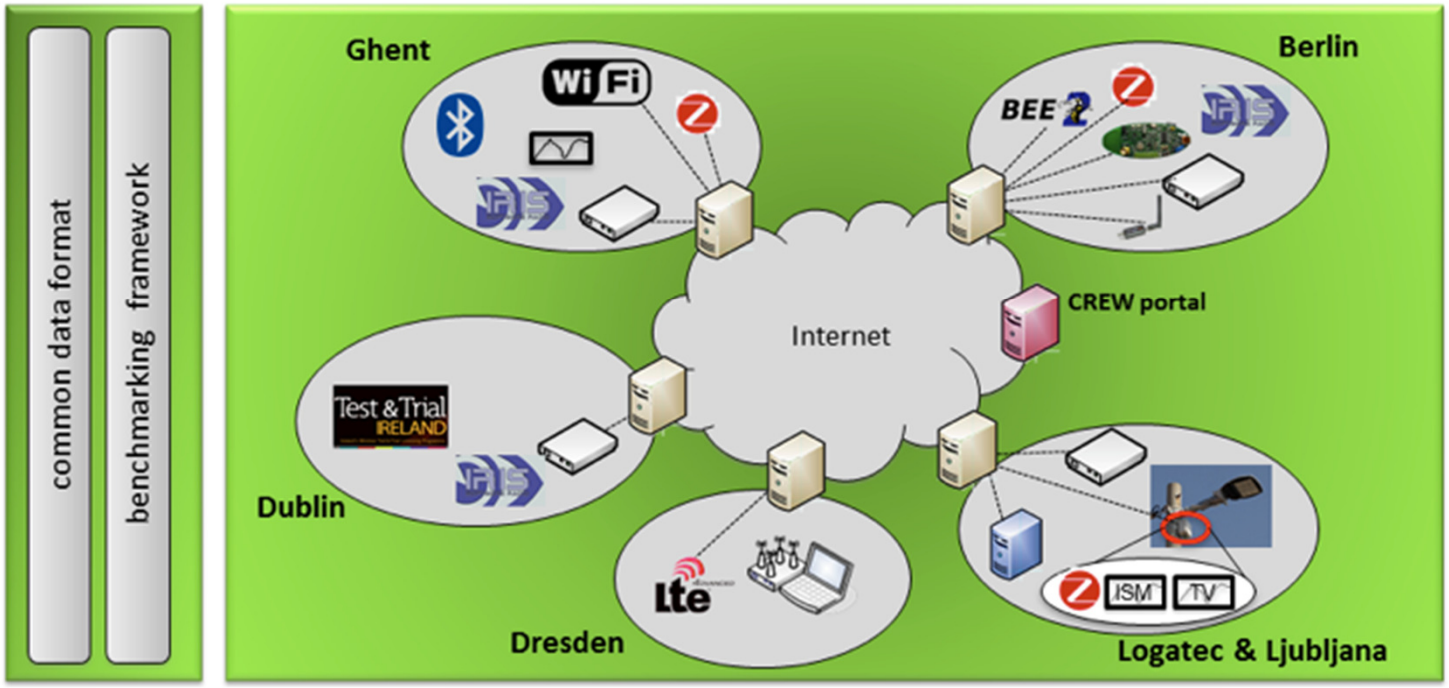


CREW federated platform: key aspects

- **common portal**

Portal: getting started

Not sure which facility to use? Start by accessing the graphical overview of the CREW facilities, or consult the list of testbeds and cognitive components for a concise description of the different components. This list can be filtered based on technology, application, and frequency range, to find the component that is most suitable to you. Once you know which testbed(s) or component(s) to use and for detailed information, consult the advanced information section. For **information on the benchmarking platform**, please consult the section of the w-iLab.t testbed on benchmarking. For **information on the CREW common data format**, please consult the page on the common data format.You can use the menu on the left of this website to navigate through the portal.



CREW federated platform: key aspects

- **common portal**

Filter on frequency range: ISM 2.4GHz | Filter on OSI layer: MAC | Filter on radio type: IEEE802.11 bg | Apply

Testbed or cognitive component	Short description
TWIST	The TKN Wireless Indoor Sensor Network Testbed (TWIST) is a multi-platform, hierarchical sensornetwork testbed architecture developed at the Technische Universität Berlin. One instance is currently deployed at TUB campus: a total of 204 sensor nodes (102 eyesIFX and 102 Tmote Sky nodes) are distributed in a 3D grid spanning 3 floors of an office building, resulting in more than 1500 m² of instrumented office space. Two nodes of each platform are deployed, while the larger ones (~28 m²) have four nodes. This setup results in a fairly regular grid deployment pattern with intra node distance of 3m. Within the rooms the sensor nodes are attached to the ceiling. The TWIST architecture introduces a layer of "super-nodes" (previous figure, right) between the sensor nodes and the testbed server, which manages sensor node reprogramming, configuration or accessing debug information over the serial connection. TWIST relies on COTS hardware and fully leverages the features of the USB 2.0 standard. The sensor nodes are connected to the super-nodes via USB hubs, which act as concentrators and also provide a power supply management capability. This enables active topology control and node fault injection modelling through selective powering on and off of nodes. TWIST is currently being extended by mobile robots which can be used for experiments that involve controlled mobility. At the end of CREW Year 1 (at the time of the first open call) one mobile robot can be used for local experiments.
w-iLab.t	The w-iLab.t allows flexible testing of the functionality and performance of wireless networking protocols and systems in a time-effective way, by providing hardware and the means to install and configure firmware and software on (a selection of) nodes, schedule automated experiments, and collect, visualize and process results. Thanks to an in-house designed hardware control device, unique features of the testbed include the triggering of repeatable digital or analog I/O events at the sensor nodes, real-time monitoring of the power consumption, and battery capacity emulation. At a first location, the "w-iLab.t Office" consists of a wireless Wi-Fi (IEEE 802.11a/b/g) and sensor network (IEEE 802.15.4) testbed infrastructure, deployed across three 90 m x 18 m floors of the IBBT office building in Ghent, Belgium. At 200 places throughout the office spaces, meeting rooms and corridors, wireless hardware is mounted to the ceiling.

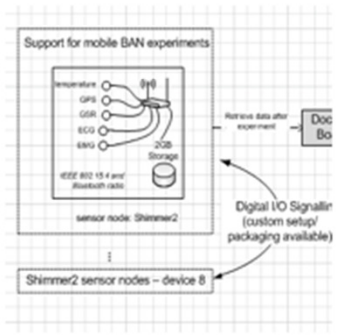
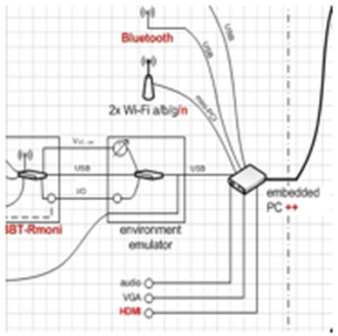
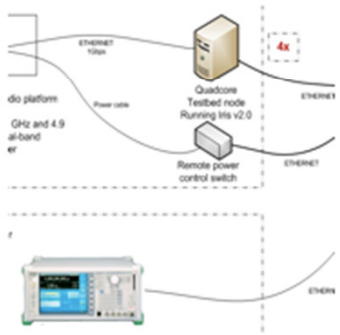
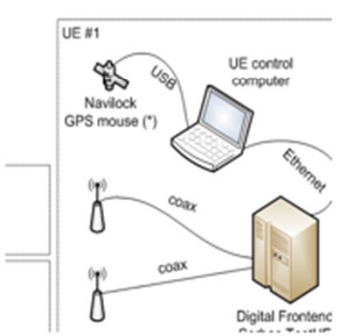
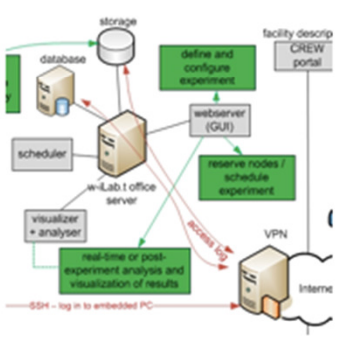
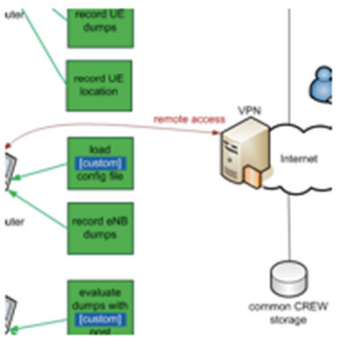
CREW federated platform: key aspects

- **common portal**

Schematic overview

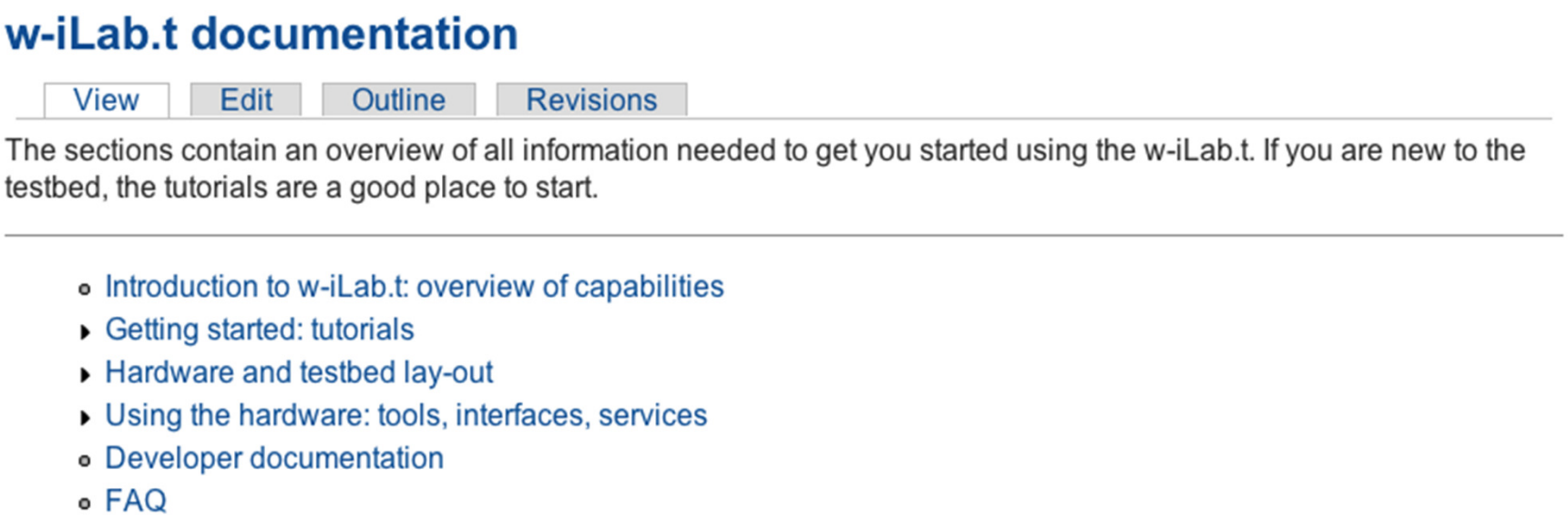
View | Edit | Outline | Revisions

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

- **common portal**



CREW Federated platform: key aspects

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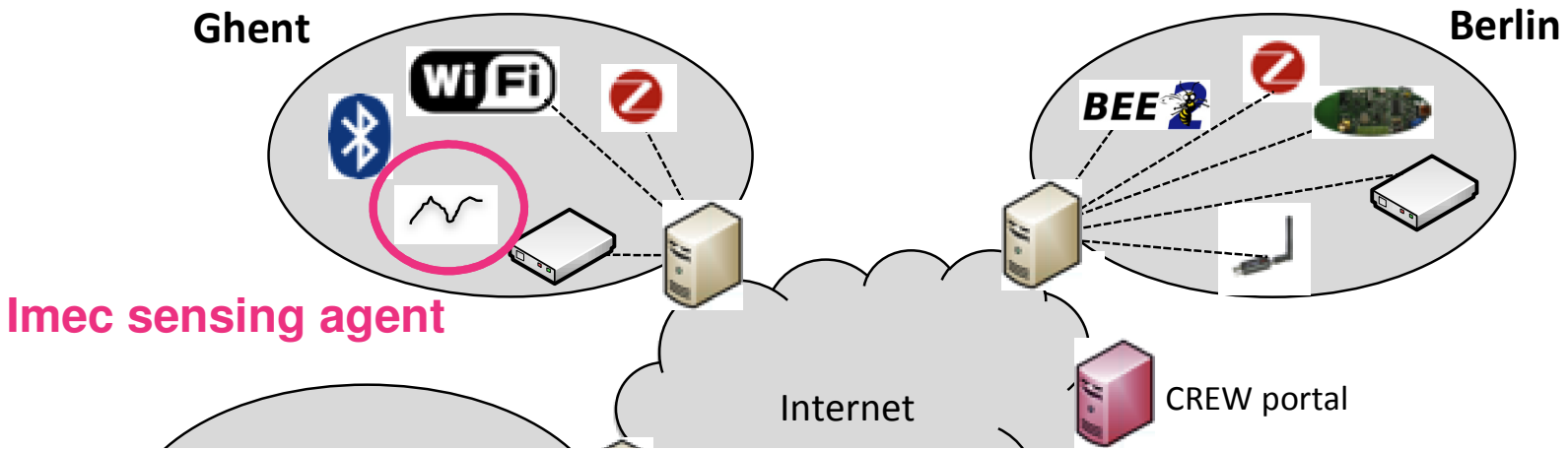
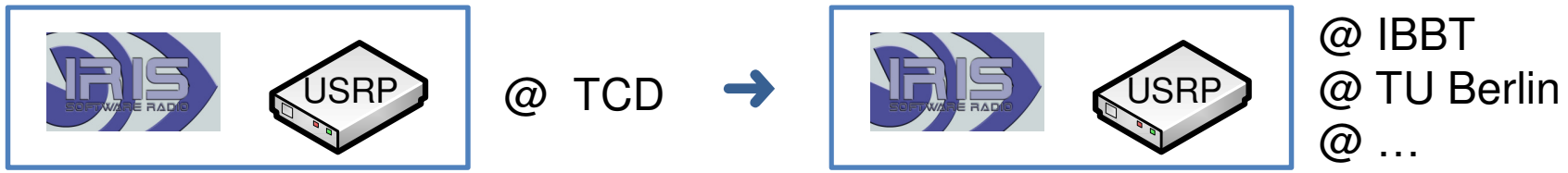
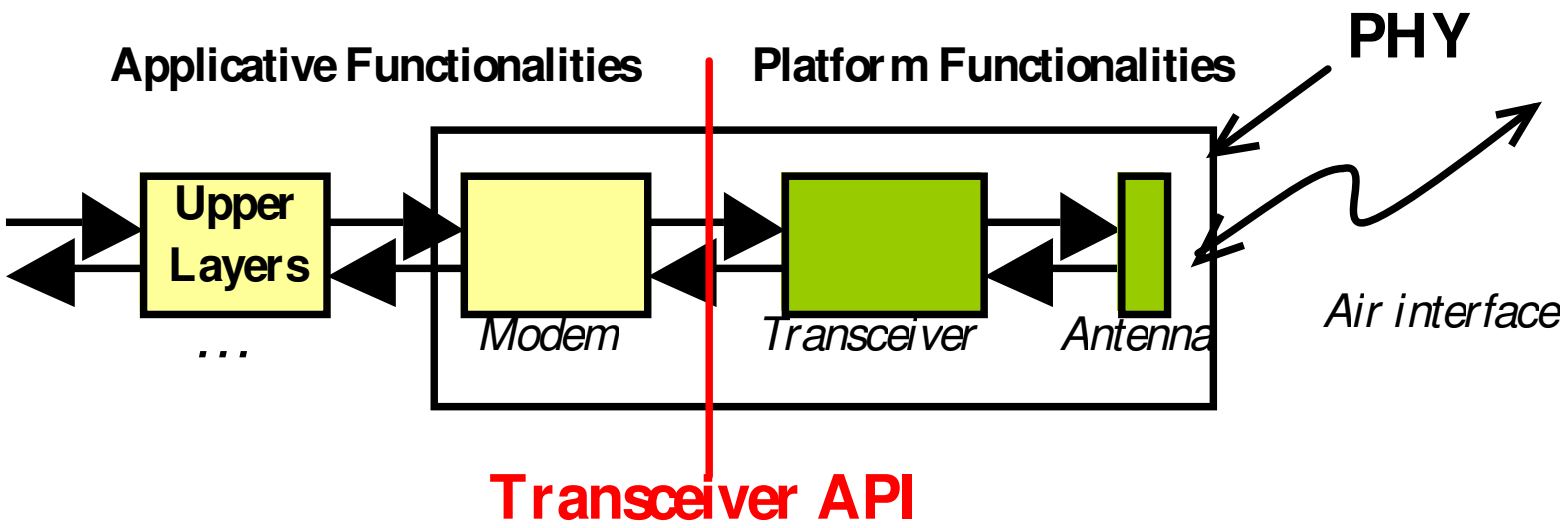




CREW Federated platform: key aspects

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



➜ See CREW deliverable D3.1

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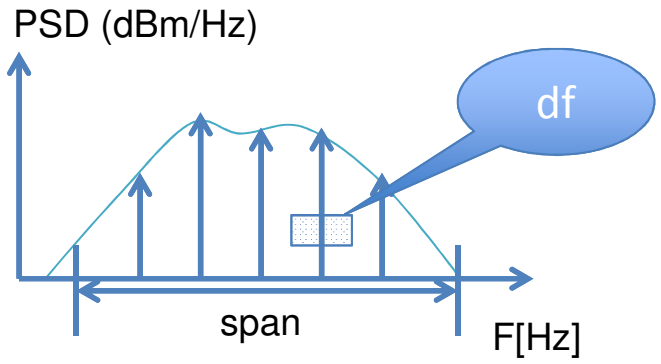
CREW Federated platform: key aspects

- **creation of open data sets**
  - a **common data structure** enables
    - the emulation of CREW components in other experimental environments or in a simulator
    - spectrum sensing using heterogeneous sensing hardware
  - Extension of IEEE 1900.6 standard
    - **experiment abstract**: structured description of experiment
    - **meta information**: info for describing, understanding, and evaluating information
      - devices, location, time, radio frequency, variable parameters, trace description, signal generation…
    - **experiment traces:** e.g. spectrum sensing data



0	-101	-90	-82	-94	-91	-91	-89
T1	-98	-90	-90	-93	-95	-94	-92
T2	-76	-75	-92	-72	-92	-96	-92

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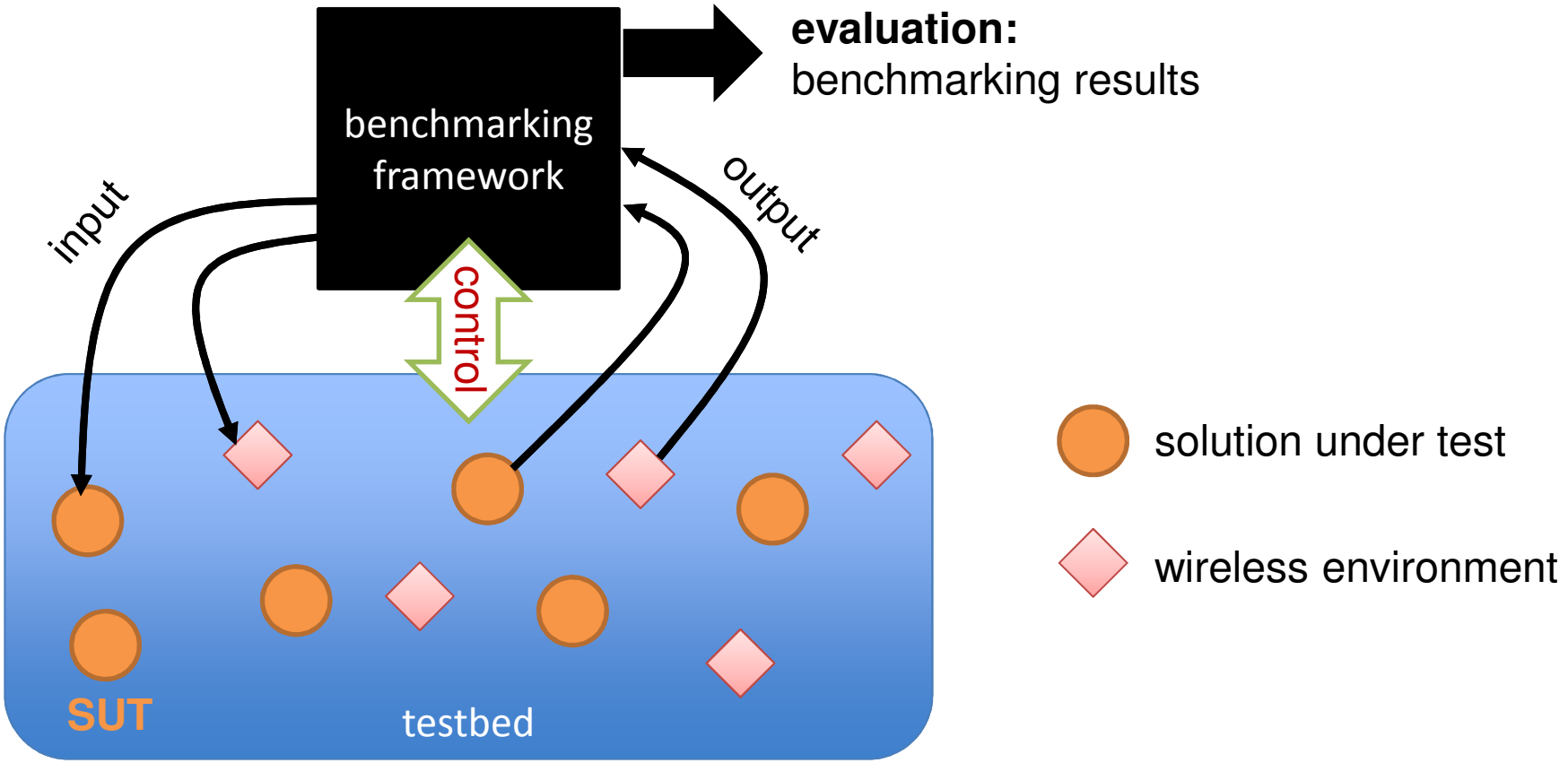
CREW Federated platform: key aspects

benchmarking framework

- diversity of testbeds vs. “generic” benchmarking



➜ See CREW deliverables D2.2 & D4.1 + white paper

CREW Federated platform: key aspects

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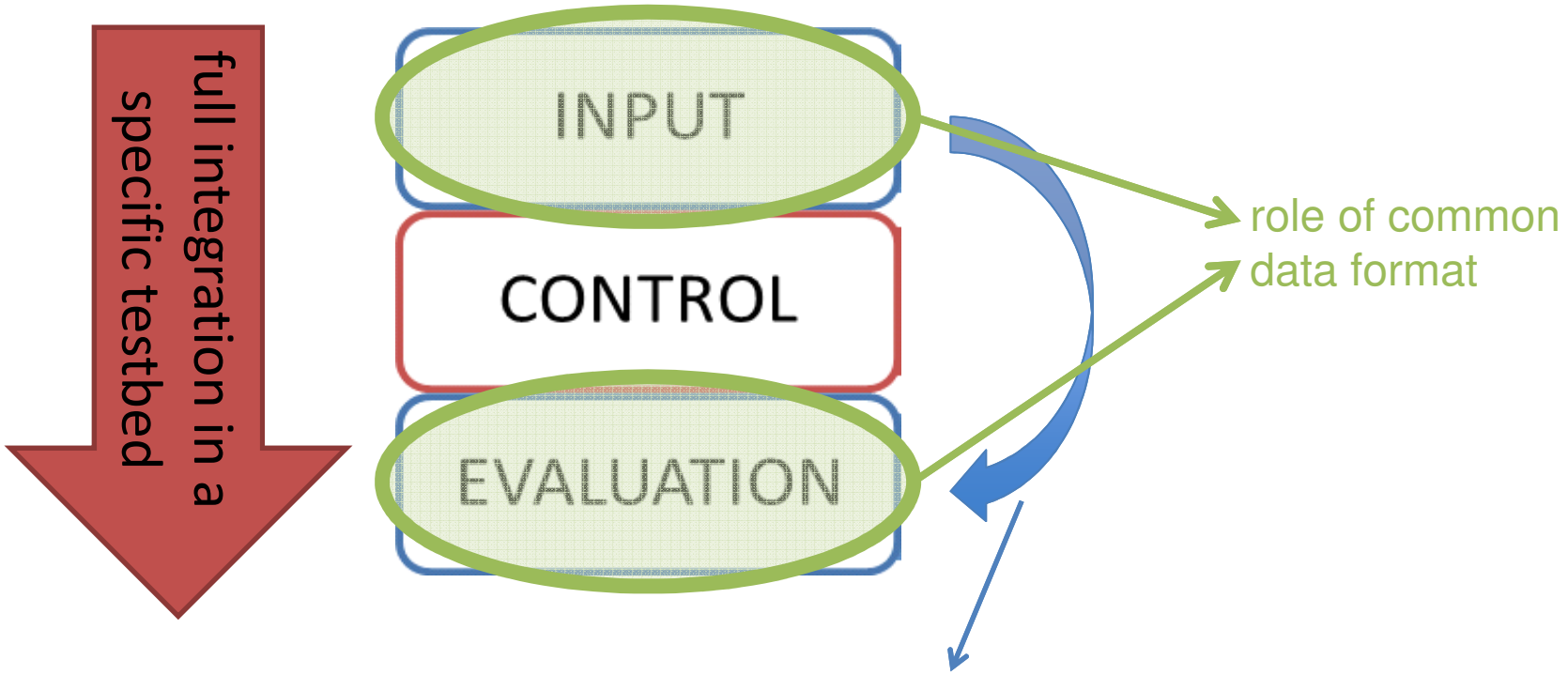
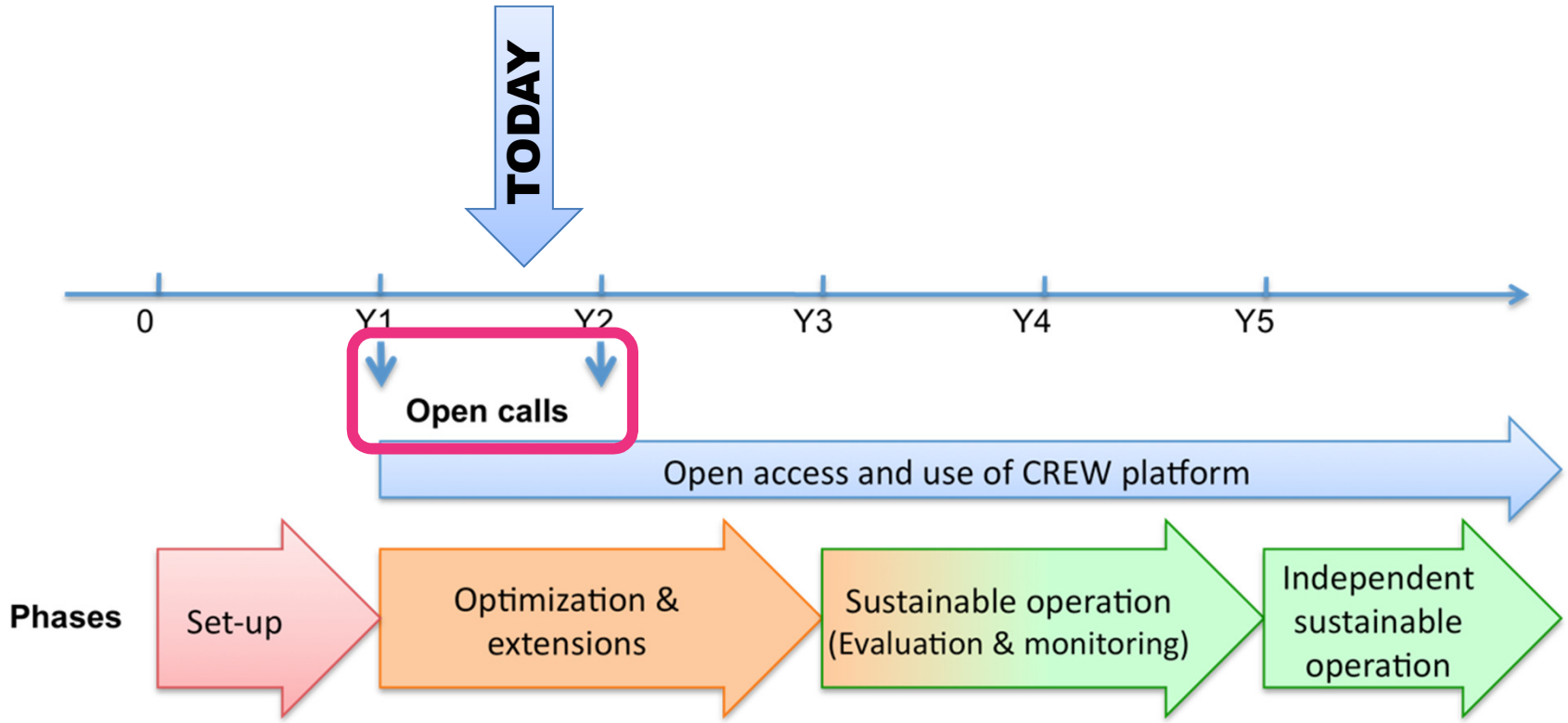


➜ **See CREW deliverables D2.2 & D4.1 + white paper**

CREW roadmap

Start

- October 2010
- Duration 5 years



CREW Open Call 2

- **Budget: 440 000 EUR**
  - min. funding/proposal: 50 kEUR
  - max budget/proposal: 120 kEUR
  - *[note: funding = EU contribution]*
- **Target number of proposals to be funded:** 4-8
- **Number of partners per proposal:** 1 or 2
- **Call deadline:** Wednesday, October 3, 2012

- **Expected start date:** February 2013
- **Maximum duration of experiment:** 12 months

- **Address for proposal submission:** info@crew-project.eu
- **Call identifier:** CREW2012-OC2
- **Language of the proposal: English**

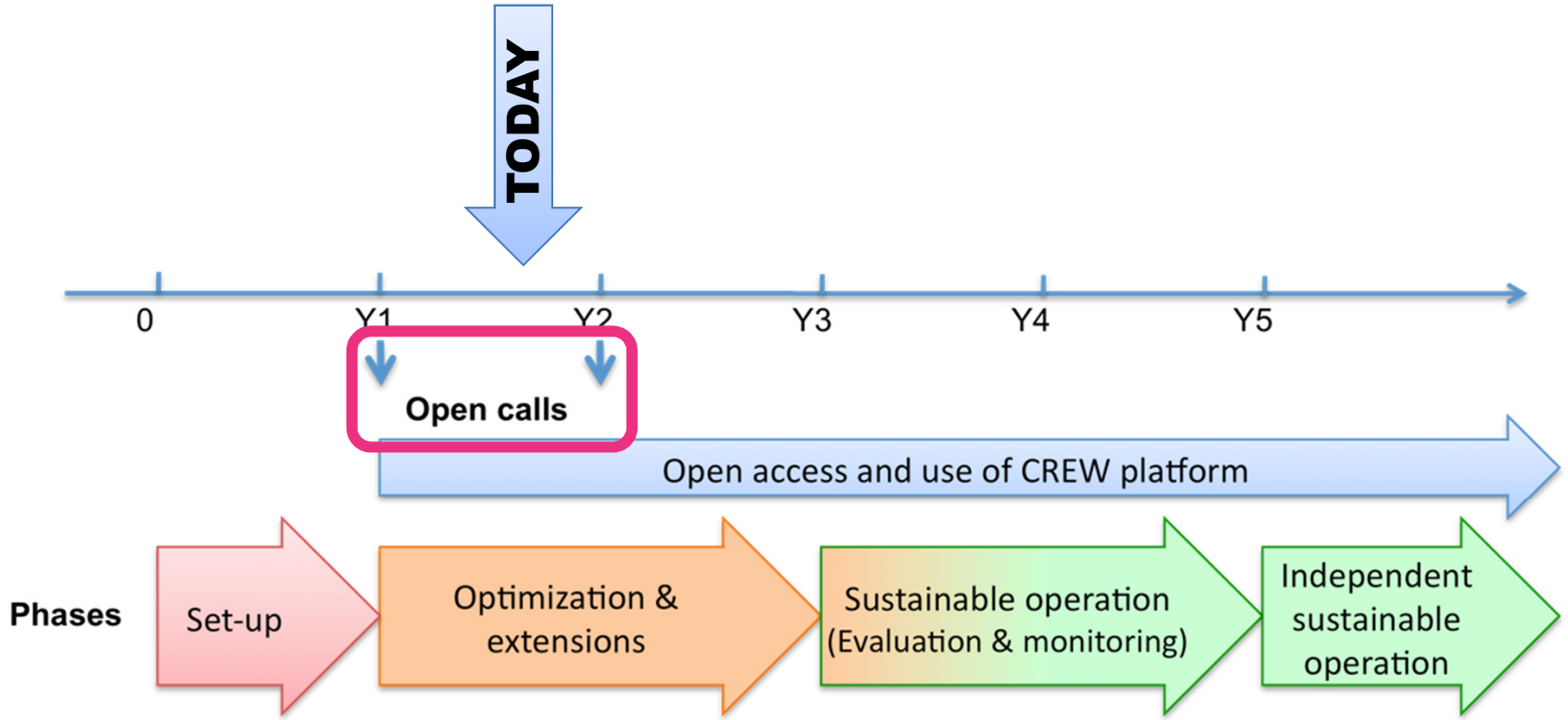
CREW Open Call 2

- **Type of experiments: 4 categories**
  1. Advanced spectrum sensing algorithms
  2. Layer 2 and higher layer cognitive radio / cognitive networking protocols
  3. Coexistence of wireless networks in licensed bands
  4. Strengthening CREW experimentation tools
- **Acceptance rules**
  - At least 1 proposal in each category will be funded
  - At least 1 proposal with industrial participant(s) will be funded
- **Requirements**
  - Each proposal **must make use** of the CREW facilities: implementation and validation of the experiment must happen on the CREW facilities and must lead to a demonstrator on the CREW platform
- **Restrictions**
  - CREW hardware cannot be moved outside the CREW testbeds.

CREW Open Call 2

Timing

- Official launch of open call: July 4th, 2012 @ Berlin
- Submission deadline: October 3th, 2012 @ 17:00h (CET)
- Evaluation results available: December 2012
- Start of new partners: February 2012 (tentative)



CREW open call 2

More information

- **http://www.crew-project.eu/opencallinfo**
  - Call documents
    - Open call announcement document
    - Guide for applicants
    - CREW consortium agreement
  - Open call presentation

- Come & visit us at **Future Network & Mobile Summit** - Berlin, 4-6 July 2012
  - **Call announcement** - Workshop 2b (Wednesday July 4th, 11:30-13:15)
  - **Paper**: 'Robust Distributed Sensing with Heterogeneous Devices', Peter Van Wesemael, imec, Belgium' (Friday, July 6th, Session 9a, 9:00-10-45)
  - **Booth** at exhibition

Q & A

Contact:

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www.crew-project.eu

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).

We want you

to apply for the CREW open call!

Cognitive Radio Experimentation World

Get up to 120kEUR funding for using the CREW facilities for doing your experiment in the area of cognitive radio and cognitive networking.

spectrum sensing ● OSI L2↗ cognitive radio and cognitive networking protocols ● wireless coexistence in licensed bands ● strengthening CREW experimentation tools

More info at www.crew-project.eu/opencallinfo

The FP7-CREW Open Call 2 closes
October 3, 2012 at 17:00 CET

CREW