



## Cognitive Radio Experimentation World



June 2014

### Continuous open call to select experiments for the CREW project

The project “CREW – Cognitive Radio Experimentation World” is currently active in the Seventh Framework programme of the European Community. The primary target of the project is to establish an open federated test platform, which facilitates experimentally-driven research on advanced spectrum sensing, cognitive radio and cognitive networking strategies in view of horizontal and vertical spectrum sharing in licensed and unlicensed bands. Within this continuous open call the project solicits proposals to use the available CREW facilities for experimental validation or experimental performance analysis in the field of cognitive radio and cognitive networking.

**Project Coordinator:** iMinds

**Core project partners:** iMinds, imec (IMEC), Trinity College Dublin (TCD), Technische Universität Berlin (TUB), Technische Universität Dresden (TUD), THALES Communications & Security (TCS), EADS Deutschland GMBH (EADS), Institut Jozef Stefan (JSI)

**Project website:** [www.crew-project.eu](http://www.crew-project.eu)

### 1 Background information on the CREW project

The ability to move cognitive radio research from a theoretical or simulation phase to an experimental phase is crucial to make further advances in the field: cognitive experiments will help the international research community, industry, and regulatory bodies to understand the possibilities and limitations of spectrum sensing, spectrum sharing, coexistence and cooperation between wireless networks. The CREW project has established a federation of cognitive radio testbeds in Europe that aims to facilitate experimental research. The CREW project builds further on the hardware (wireless testbeds and cognitive components such as dedicated sensing hardware), tools and extensive expertise of eight European partners. The consortium holds expertise from the physical to the application layer, and has years of experience building and operating its heterogeneous wireless testbeds and cognitive components.

Diverse existing wireless testbeds were complemented with state-of-the-art cognitive sensing platforms (see Figure 1):

- heterogeneous ISM wireless testbed at iMinds (Ghent)
- software defined radio testbed at TCD (Dublin)
- cognitive sensor network testbed at TUB (Berlin)
- LTE-advanced cellular testbed at TUD (Dresden)
- Heterogeneous outdoor testbed LOG-a-TEC at JSI (Ljubljana)
- spectrum sensing platform developed at IMEC

Figure 1 depicts the CREW federation as it exists today: five different ‘islands’ are (most of them remotely) accessible by external experimenters. The CREW portal website ([www.crew-project.eu/portal](http://www.crew-project.eu/portal)), provides both uniform high-level descriptions of the available hardware and

software components, and in-depth information on how to get access to and how to use the federation components.

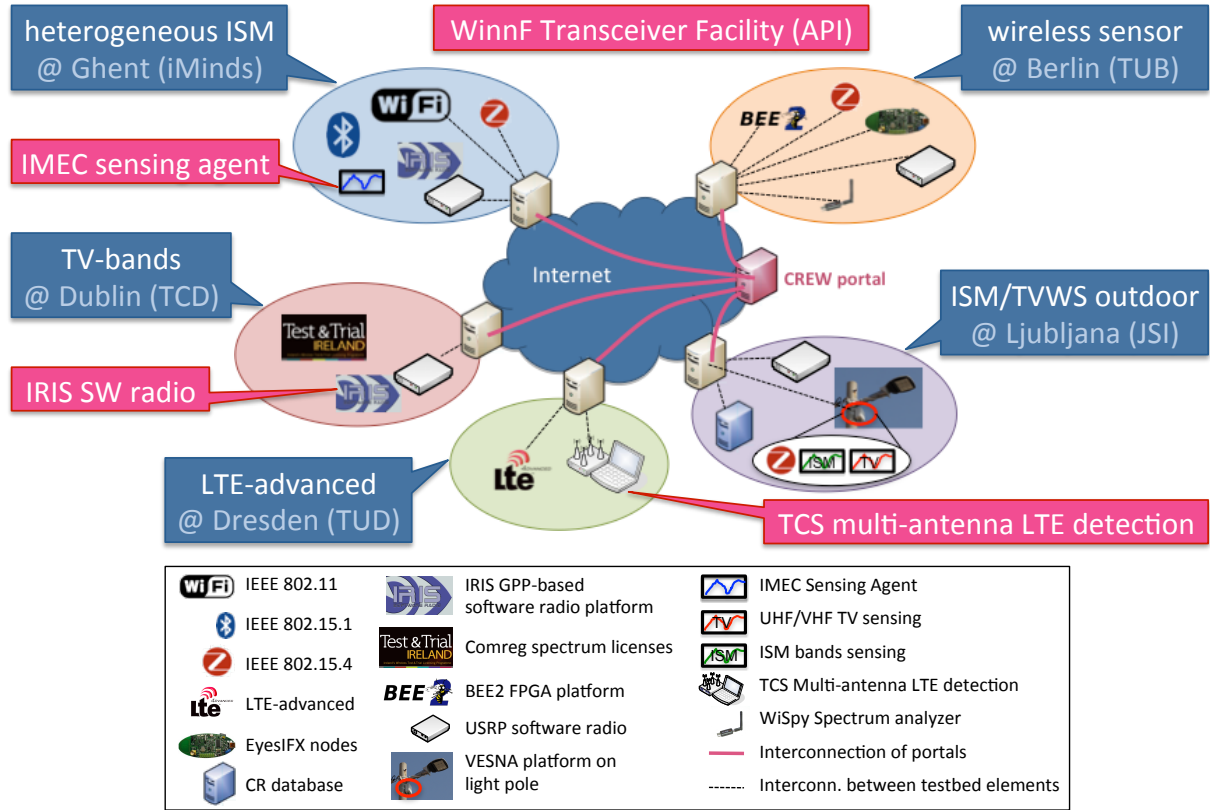


Figure 1: The CREW federation of cognitive radio testbeds

In addition to the common portal, CREW offers three other **federation functionalities**:

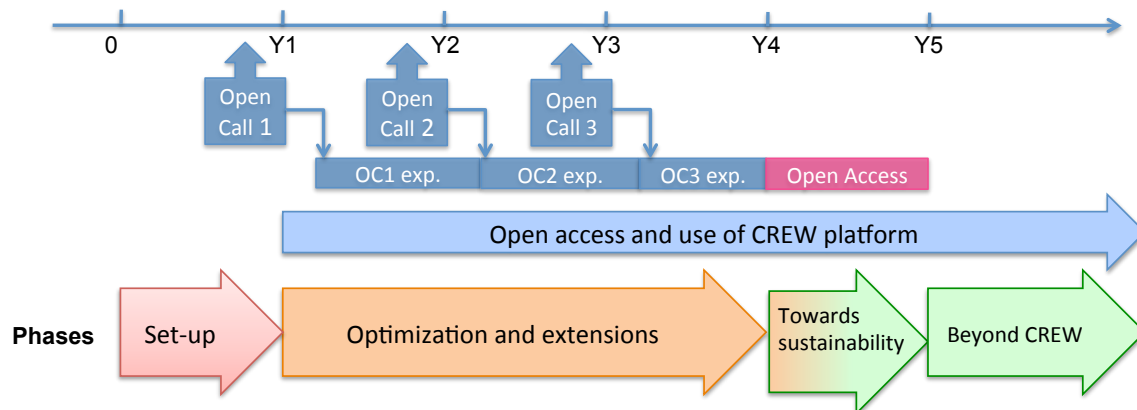
- *advanced cognitive components* such as spectrum sensing agents and configurable radio platforms, by linking together software and hardware solutions from multiple partners;
- *open data sets* for spectrum sensing data, primary user activity, background traffic, packet traces, etc. created under benchmarked conditions and using a common sensing data structure;
- a *benchmarking methodology and framework* for cognitive radio and network experiments, offering credible and rigorous methods and automated procedures for experiments and performance evaluation, enabling objective comparison between subsequent developments or competing cognitive solutions.

Possible **usage scenarios** for experiments using the CREW federation include, but are not limited to:

- *Context awareness for cognitive networking*: new techniques for context awareness in unlicensed (ISM) and licensed bands (TV white spaces, cellular systems);
- *Robust cognitive networks*: applications that require robust communications though avoiding harmful interference and using frequency agility to improve communication quality;
- *Horizontal resource sharing in the ISM bands*: algorithms, protocols and networking architectures for coexistence of and cooperation between independent heterogeneous network technologies;

- *Cooperation in heterogeneous networks in TV bands*: new ideas for opportunistic spectrum access to underutilized licensed TV bands;
- *Cognitive systems and cellular networks*: the impact of dynamic spectrum access by secondary users on LTE cellular primary systems.

CREW is a five-year project, which started in October 2010 (see CREW roadmap in Figure 2). Its first year was dedicated to the formation of the federation and experiments by the project partners. In the following three years, the consortium is expanded through three open calls for proposals. During this time, the testbeds in the federation are enhanced with demand-driven extensions. The final year of the project will allow the transition to a sustainable usage model for the federation, which is expected to evolve into a self-sustaining platform for cognitive radio experimentation.



**Figure 2: CREW roadmap**

For more information on the CREW usage scenarios and federation functionality we refer to the following project deliverables, publicly available at the CREW website:

- D2.1 - Definition of Internal Usage Scenarios ([http://www.crew-project.eu/sites/default/files/CREW\\_D2.1\\_TUD\\_R\\_PU\\_2011-01-31\\_final\\_v1.0.pdf](http://www.crew-project.eu/sites/default/files/CREW_D2.1_TUD_R_PU_2011-01-31_final_v1.0.pdf))
- D2.2 - Definition of Federation Functionality ([http://www.crew-project.eu/sites/default/files/deliverables/CREW\\_D2.2\\_TCD\\_R\\_PU\\_2011-03-31\\_final\\_PRC.pdf](http://www.crew-project.eu/sites/default/files/deliverables/CREW_D2.2_TCD_R_PU_2011-03-31_final_PRC.pdf))
- D2.3 - Definition of use of the Federation ([http://www.crew-project.eu/sites/default/files/CREW\\_D2.3\\_IMEC\\_R\\_PU\\_2011-09-30\\_final.pdf](http://www.crew-project.eu/sites/default/files/CREW_D2.3_IMEC_R_PU_2011-09-30_final.pdf))
- D2.4 - Definition of internal usage scenarios, federation functionality and the use of federation as applicable to the VESNA-based testbed ([http://www.crew-project.eu/sites/default/files/deliverables/CREW\\_D2.4\\_JSI\\_R\\_PU\\_2011-12-30\\_v1.pdf](http://www.crew-project.eu/sites/default/files/deliverables/CREW_D2.4_JSI_R_PU_2011-12-30_v1.pdf))
- D3.1 - Basic Operational Platform ([http://www.crew-project.eu/sites/default/files/CREW\\_D3.1\\_TCF\\_R\\_P\\_2011-09-30\\_final.pdf](http://www.crew-project.eu/sites/default/files/CREW_D3.1_TCF_R_P_2011-09-30_final.pdf))
- D3.2 - Optimized operational federated platform ([http://www.crew-project.eu/sites/default/files/CREW\\_D3.2\\_TCD\\_R\\_P\\_2012-09-30\\_final\\_v1.0\\_0.pdf](http://www.crew-project.eu/sites/default/files/CREW_D3.2_TCD_R_P_2012-09-30_final_v1.0_0.pdf))
- D4.1 - Definition of Test Configurations and Benchmarks ([http://www.crew-project.eu/sites/default/files/CREW\\_D4%201\\_TCD\\_R\\_PU\\_2011-09-30\\_final.pdf](http://www.crew-project.eu/sites/default/files/CREW_D4%201_TCD_R_PU_2011-09-30_final.pdf))
- D4.2 - Methodology for performance evaluation ([http://www.crew-project.eu/sites/default/files/CREW\\_D4.2\\_IBBT\\_R\\_PU\\_2012-09-30\\_final.pdf](http://www.crew-project.eu/sites/default/files/CREW_D4.2_IBBT_R_PU_2012-09-30_final.pdf))
- D4.3 - Definition of Test Scenarios and Benchmarks for VESNA Testbed ([http://www.crew-project.eu/sites/default/files/CREW\\_D4.3\\_JSI\\_R\\_PU\\_2012-03-01\\_v1.0\\_0.pdf](http://www.crew-project.eu/sites/default/files/CREW_D4.3_JSI_R_PU_2012-03-01_v1.0_0.pdf))
- D5.3 - Final report on demand-driven extensions and FIRE support actions ([http://www.crew-project.eu/sites/default/files/CREW\\_D5.3\\_iMinds\\_R\\_PU\\_2013-09-30.pdf](http://www.crew-project.eu/sites/default/files/CREW_D5.3_iMinds_R_PU_2013-09-30.pdf))



## 2 Call information

**Number of partners per experiment:** The target number of partners per proposal is 1 or 2.

**Type of participants:** The profile of participants is academics, individuals and small/medium/large enterprises active in the domain cognitive radio or cognitive networking, that need to run experiments to further test, evaluate and optimize their cognitive solutions.

**Duration of the experiment:** The maximum duration of an experiment is 4 months.

**Latest end date of experiment:** 30 September 2015

**Address for proposal submission:** [info@crew-project.eu](mailto:info@crew-project.eu)

**Call identifier** (used as subject in email for proposal submission): CREW2014-OA

**Language of the proposal:** English

**Contact for information on this call:** Ingrid Moerman (iMinds),  
email: [Ingrid.moerman@intec.ugent.be](mailto:Ingrid.moerman@intec.ugent.be),  
phone: +32 9 33 14 925

### Terms and conditions

Each experiment must make use of the CREW facilities: implementation and validation of the proposed experiment must happen on the CREW facilities. Please be aware that CREW hardware cannot be moved outside the CREW test facilities. The proposed experiment must lead to a public demonstration on the CREW platform and/or a scientific publication.

We strongly encourage potential proposers to discuss their ideas for experimentation with the CREW consortium prior to submission of their proposal, so as to ensure the feasibility of the proposed experiment with the CREW facilities and functionalities.

Details on the objectives of the present call including some examples for possible experiments can be found in Section 3 of this document. Information on the available CREW facilities, hardware components and software can be found in Annex I of this document. A detailed description of the characteristics of the individual testbeds is available on the CREW portal (<http://www.crew-project.eu/portal/>).

The template for proposal writing can be found in Annex II of this document. Proposals can be submitted at any time and will be evaluated on a monthly basis. Proposals will be selected by the CREW steering committee and approved by the EC taking into account (1) the quality of the experiment in terms of technical novelty and/or industrial relevance, (2) the feasibility of the experiment, and (3) the availability of resources (both infrastructure and manpower resources) within the CREW federated platform.

Experimenters from successful proposals in this call will receive no EC funding and will not become official partners in the CREW project. However, this call offers free access to the CREW facilities and guaranteed training & support by CREW partners covering guided training, technical assistance, and necessary extensions to experimentation tools. This call will implement a fast evaluation process based on a simple proposal template (see Annex II). The administrative burden will be kept minimally for the experimenters (more info: see Annex III).

Detailed terms and conditions for access to the CREW facilities and collaboration between successful proposers and the CREW project partners will be formalized through a Memorandum of Understanding (MoU), of which a template can be found in Annex III.



### 3 Objectives of the present call

We are looking for exciting experiments and evaluations in the cognitive radio and cognitive networking research domain that make use of the CREW facilities and its federation functionality. The experiments should exploit the unique features of CREW facilities and address one or more (the quality is much more important than quantity) of the federation functionalities listed below:

- *Combination of* (at least) two *cognitive components* (from different testbeds)  
This can be either usage of cognitive components from different individual CREW testbeds or bringing own components into the federated testbed, e.g.:
  - Use of imec spectrum sensing agent in iMinds testbed.
  - Use of Iris software radio architecture for dynamic adaptations for coexistence (developed by TCD) in another testbed in the federation (e.g. at iMinds testbed of JSI testbed)
  - Comparing experimental results obtained in two different testbeds (e.g. iMinds and TUB experimental facilities)
- *CREW advanced spectrum sensing* functionality:
  - Combination of different sensing solutions (hardware and/or software) of the CREW federation.
  - Comparison of own sensing algorithms/hardware with sensing algorithms/hardware available in the CREW federation.
- *Benchmarking features*:
  - Run and compare novel cognitive solutions in a reproducible "reference" test environment offered by CREW (e.g. home/office reference scenario at iMinds)
  - Use and validation of available metrics and scores for performance evaluation of cognitive solutions. These metrics can be found in the repository on the CREW portal (see [http://www.crew-project.eu/repository/metrics\\_scores](http://www.crew-project.eu/repository/metrics_scores))
  - Definition of new or more advanced metrics and scores for performance evaluation of cognitive solutions
- Use the *CREW Common Data Collection and Storage Methodology*:
  - storing of measurement results in a common format
  - using the CREW facilities to make the traces publically available
- Using the *interfaces* proposed and promoted by CREW for linking together software and hardware solutions to build advanced cognitive components.
  - Taking full advantage of the Transceiver Facility API implementation for the USRP2 platform (available for Linux hosts)
  - Combining and integrating cognitive algorithms performing sensing, physical layer radio access, multi-channel medium access control, or any other cognitive radio feature with existing hardware platforms.
  - Analyzing and exploiting other available interfaces, such as the aforementioned for dealing with benchmarking configuration and data storage

Topics for experimentation proposals include (but are not limited to):

- Advanced spectrum sensing algorithms
- Coexistence of wireless networks in unlicensed bands: realization of the cognition loop
- Coexistence of wireless networks in licensed bands



## 1. Advanced spectrum sensing algorithms

The focus of this type of experiment is on validation of novel spectrum sensing algorithms in one (or more) of the CREW testbeds, e.g.

- Heterogeneous distributed sensing;
- Local versus distributed spectrum sensing techniques;
- Simple versus advanced spectrum sensing techniques, e.g. energy detection, matched filter detection, cyclostationary feature detection... ;
- Impact of the quality of the sensing hardware on spectrum sensing resolution and accuracy when using simple COTS (Commercial Off The Shelf) hardware versus advanced CREW spectrum sensing hardware;
- The effect of controlled mobility (via mobile robots) on spectrum sensing.

For this type of experiment, CREW offers the following tools:

- Access to different types of sensing hardware (see table 1 in Annex I);
  - API to IMEC sensing agent offering access to reconfigurable front-end (see [http://www.crew-project.eu/sites/default/files/SensingEngine\\_UserManual.pdf](http://www.crew-project.eu/sites/default/files/SensingEngine_UserManual.pdf));
  - Transceiver Facility API implementation for the USRP2 platform (more info, see [http://www.crew-project.eu/sites/default/files/CREW\\_D3.2\\_TCD\\_R\\_P\\_2012-09-30\\_final\\_v1.0\\_0.pdf](http://www.crew-project.eu/sites/default/files/CREW_D3.2_TCD_R_P_2012-09-30_final_v1.0_0.pdf))
- Repository containing traces (see <http://www.crew-project.eu/repository/traces>) that can be used to create reproducible wireless test environments (e.g. LTE primary user traces, ISM environments such as home/office/conference...);

## 2. Coexistence of wireless networks in unlicensed bands: realization of the cognition loop

The focus of this type of experiment is evaluating cognitive networking protocols (not only focusing on spectrum sensing, but also on layer 2 and higher layer aspects). In this category of experiments (possibly basic) spectrum sensing is a means, rather than the goal.

Possible experiments and evaluations are:

- New algorithms, protocols and networking architectures for solving the spectrum bottleneck in ISM bands enabling coexistence between wireless devices and (heterogeneous) technologies.
- Cognitive networking monitoring techniques (physical, link layer, network layer, transport layer, application layer) and understanding of the complex and dynamic wireless environment through intelligently combining the distributed local information.
- Local versus collective cognitive decision and control;
- Cross-layer, cross-node, cross-network, cross-technology optimization strategies;
- Analysis of same cognitive solution in different physical wireless environments (e.g. iMinds versus TUB test environment) or applied with different test scenarios (number of devices, type of devices, density of nodes, traffic load, external interferers...);
- The effect of controlled mobility (via mobile robots) on higher layer cognitive radio / cognitive networking protocols

For this type of experiment, CREW offers the following tools:

- Repository containing traces (see <http://www.crew-project.eu/repository/traces>) that can be used to create reproducible wireless test environments (e.g. LTE primary user traces, ISM environments such as home/office/conference...);
- Repository containing methodologies (see <http://www.crew-project.eu/portal/methodology>) and measurement tools for performance evaluation and comparison of cognitive networking solutions (see <http://www.crew-project.eu/portal/crew-benchmarking-tools>);



- API to access real-time (distributed) spectrum sensing information using available CREW hardware (see [http://www.crew-project.eu/sites/default/files/CREW\\_D5.2\\_TUB\\_R\\_PU\\_2012-09-30\\_final\\_v1.0.pdf](http://www.crew-project.eu/sites/default/files/CREW_D5.2_TUB_R_PU_2012-09-30_final_v1.0.pdf) and [http://www.crew-project.eu/sites/default/files/rabaey2010cbrokerage%20Connectivity%20Brokerage%20White%20Paper\\_v1.0.pdf](http://www.crew-project.eu/sites/default/files/rabaey2010cbrokerage%20Connectivity%20Brokerage%20White%20Paper_v1.0.pdf));
- Cognitive network protocol architecture, enabling focused experimentation on specific protocol components (MAC, routing...) (see for example IDRA architecture developed by iMinds <http://idraproject.net>);

### 3. Coexistence of wireless networks in licensed bands

In coexistence scenarios, interference between primary and secondary networks can usually not be avoided completely. Key questions that need to be answered in order to support the feasibility of cognitive radio solutions in licensed frequency bands revolve around the interference caused to an incumbent system by an overlay network and vice versa.

Possible experiments and evaluations are:

- Analysis of interference in a primary system (e.g. LTE, DVB-T), caused by a cognitive radio solution;
- Analysis of robustness of a secondary system towards interference from a primary system (e.g. LTE, DVB-T);
- Impact of erroneous and/or inaccurate sensing information;
- Techniques/protocols to deal with harmful interference from both primary and secondary side;
- Flexible PHY for cognitive radio
- Design of geo-location database architecture (communication between sensing nodes and decision node, data storage format, update frequency for sensing...)

For this type of experiment, CREW offers the following hardware and tools:

- Primary system hardware and spectrum licenses for experiments in the corresponding frequencies (see <http://www.crew-project.eu/portal/IRISdoc> and <http://www.crew-project.eu/portal/litedoc>);
- Access to different types of sensing hardware (cf. table 1 in Annex I);
- Repository containing traces (see <http://www.crew-project.eu/repository/traces>) that can be used to create reproducible wireless test environments;

## Annex I: Information on CREW facilities and components

Table 1 gives an overview of the main characteristics of the CREW individual testbeds and advanced components that will be available for experiments of the present call. ‘R’ refers to features that can be controlled remotely. For a detailed description of the characteristics we refer to the CREW portal (<http://www.crew-project.eu/portal/reference>).

Many of the experiments can be conducted remotely (as indicated by ‘R’ in table I). However, some of the experiments need to be conducted during on-site visits at the individual testbed locations. In the latter case, a careful planning for site visits needs to be included in the proposal. Discussion with the local testbed owner(s) is strongly recommended during proposal preparation.

Contact persons for local testbeds are:

- iMinds: Pieter Becue (Pieter.Becue@intec.ugent.be)
- IMEC: Hans Capelle (Hans.Cappelle@imec.be)
- TUB: Mikolaj Chwalisz (chwalisz@tkn.tu-berlin.de)
- TCD: Nicholas Kaminski (kaminsk@tcd.ie)
- TUD: Rohit Datta (rohit.datta@ifn.et.tu-dresden.de)
- JSI: Carolina Fortuna (carolina.fortuna@ijs.si)

Table 1: Characteristics and capabilities of CREW individual testbeds

Individual testbed locations →	iMinds	TUB	TCD	TUD	JSI
Features ↓					
<b>Wireless technologies/spectral bands</b>					
TV-bands					
OFDM			x		
License (ComReg)			x		
License free with limited tx power allowed in UHF (e.g. 50 mW e.r.p. for BW=200 kHz)					x
LTE-bands (1.98/2.00 GHz UL, 2.17/2.19 GHz DL)				x	
License (UMTS Band VII issued by BNetzA)				x	
License (EUTRAN Band I issued by BNetzA)				x	
ISM					
IEEE 802.11 a/b/g (2.40-2.48 GHz, 5.15-5.35, 5.725-5.825 GHz)	x		x		
IEEE 802.11 n (2.40-2.48 GHz, 5.15-5.35, 5.725-5.825 GHz)	x		x		
IEEE 802.15.1 (2.40-2.48 GHz)	x		x		
IEEE 802.15.4 (2.40-2.48 GHz)	x	x	x		x
IEEE 802.15.4 (868 MHz)		x	x		x
<b>COTS hardware (number of components)</b>					
Tmote Sky sensor node	200 R	102 R			
Eyes IFXv2		102 R			
Shimmer2		16			
iMinds/rmoni RM090 sensor node	80 R				
Alix Embedded Linux PC (incl. 2 x IEEE 802.11 a/b/g)	200 R				
Zotac Embedded Linux PC (incl. 2 x IEEE 802.11 a/b/g/n and 1 x IEEE 802.15.4)	80 R				
Tp-Link TL-WDR4300 Wireless Router		18			







Remote control				(x)	
Open VPN	x	x			
Web tools	x	x			x
SSH		x			
mysql	x				
Automated measurements	x				x
Runtime interaction	x	x			x



## Annex II: Proposal template for an experiment using the CREW platform

### Proposal application form for an open access experiment

Note: The application form has to be completed in Times pt. 11 and single line spacing. The lay-out, font type, spacing or titles should not be modified. An indication of expected page length is given for each section in the proposal template. It is allowed to deviate from this page length indication. Shorter or longer proposals are allowed. Longer proposals should not exceed the page length indication by more than a factor 2. The Word version of the application form can be downloaded from the CREW website (<http://www.crew-project.eu/opencall3>)

#### Proposer information

##### Contact information

Organization 1, name:

Organization 1, address:

Organization 2, name (optional):

Organization 2, address (optional):

Name of the contact person<sup>1</sup>:

Contact telephone number:

Contact email:

##### Profile & expertise of proposers (½ page for each organization)

##### Organization 1:

##### Organization 2:

<sup>1</sup> In case of two proposing organizations, the contact person should belong to the first organization



## General experiment information

Full title of experiment:

Acronym of experiment (optional):

Desired start date (DD/MM/YYYY):

Intended duration (maximum 4 months)<sup>2</sup>:

## Experiment description

### Concept & motivation (1 page):

*Which cognitive solution will be evaluated in your experiment? What does the experiment aims to test (e.g. the spectrum efficiency, primary user detection, coexistence between competing technologies, comparison of multiple solutions...)? What is the main technical innovation of the proposed solution?*

*Please note that a cognitive solution does not have to implement a full cognitive cycle, but could as well focus on a single aspect of the cognitive cycle.*

*Motivate the need for using the CREW facilities. How can the CREW facilities help you for the evaluation of your solution?*

### Specification of experiment (2 pages):

*How do you propose to set up the experiment? What are the test scenarios? Which measurements do you want to perform? Which performance metrics will be applied? What is the expected output from the experiment?*

### Use of the CREW federation (1 page):

*Which CREW infrastructures/components, federation functionality will be used? How much resources will be needed (e.g. number of nodes in an individual testbed). What is the estimated occupation of the CREW infrastructures/components...(e.g. 20 runs, each with a duration of 1 hour)?*

*Are there specific demands for essential extensions to improve/extend the CREW federation functionality? If yes, describe the extra functionality that is indispensable for the execution of your experiment. Such extensions must be discussed and agreed upon with the core CREW partners. Please indicate who is expected to implement the extensions: CREW core partner(s) and/or proposer(s)? The guaranteed support that will be given to a successful proposal (expressed in a fixed number of support days) will be based on the information given in this proposal. Please note that the guaranteed support is limited and is part of the feasibility criterion for selection of proposals.*

<sup>2</sup> Please take into account that the experiment must be finalized at latest by 30/09/2015.



### Impact of the experiment (½ page)

*How will the experiment create value to your organization or your community in general? What is your interest in the results?*

*Describe the measures you propose for the dissemination and/or exploitation of the results of your action?*

### Terms and conditions

Successful proposers in this continuous open call will gain access to the CREW testing facilities for a maximum duration of 4 months, free of charge and with guaranteed support. There are however some restrictions that need to be followed, as stipulated in the Memorandum of Understanding for using the CREW facilities for experimentation (see Annex III of the CREW Announcement document for Open Call 3).

- ☐ By ticking this box the proposers indicate that, in case this proposal is successful and when they execute their experiment using the CREW facilities, they agree with the conditions as stipulated in the “Memorandum for Understanding for using the CREW facilities for experimentation”.
- ☐ By ticking this box the proposers confirm that, in case this proposal is successful, they have the necessary manpower resources to execute the proposed experiment.



## Annex III: Memorandum of Understanding for using the CREW facilities for experimentation

This Memorandum of Understanding (MoU) is entered into between the FP7 project CREW, hereafter referred to as the Project and represented by its leader iMinds, and [*Organization 1*] and [*Organization 2*], hereafter referred to as the Experimenters.

### 1 Definitions

Experiment	Experimentation activity proposed by the Experimenters in their application for the CREW continuous open call.
Experimenters	Organisations of successful proposals in the CREW continuous open call.
Platform	The CREW facilities as a whole. The Platform is described in detail at the CREW portal (see <a href="http://www.crew-project.eu/portal">http://www.crew-project.eu/portal</a> ).
Project	The FP7 CREW project (GA No. 258301).
Testbed	An individual island of test infrastructure in the Platform. The Testbeds are described in detail at the CREW portal (see <a href="http://www.crew-project.eu/portal">http://www.crew-project.eu/portal</a> ).

### 2 Objectives and scope

The scope of this agreement is to stipulate the terms and conditions under which Experimenters can make use of the CREW facilities for experimental validation of their cognitive wireless solution(s). The CREW facilities as a whole are further referred to as the Platform. An individual island of test infrastructure in the Platform is called Testbed. The Platform consists of five different Testbeds located at iMinds, TCD, TU Berlin, TU Dresden and JSI. The Platform and its Testbeds are described in detail at the CREW portal (see <http://www.crew-project.eu/portal>). The experimentation activity that is performed by the Experimenters is further referred to as the Experiment.

In addition to offering its experimental facilities, the Project also provides the basic training and support to the Experimenters in order to enable them to successfully execute their Experiment. The specific members of the CREW consortium and its personnel that provide the facilities and give support to the Experimenters for executing their Experiment are further referred to as Providers.

Details of the Experiment can be found in the application form submitted by the Experimenters for the third CREW Open Call. The Experiment has been selected for support by the Project as a result of an evaluation process that is approved by the EC.

This MoU is not intended to constrain the Experimenters unnecessarily, but to make them aware and protect them as far as is reasonable, along with all the participating institutions, from the consequences of any misuse or illegal activity.

### 3 Terms and conditions

#### 3.1 Applicability

These Terms and Conditions apply to every Experimenter using the Platform (this could be one or more of the individual Testbeds).





The Terms and Conditions apply to the use of all equipment connected to the Platform. This includes wireless components, servers, network(s) residing in the Platform and Experimenters' equipment or facilities (whether institutionally or privately owned) connected to the Platform.

These Terms and Conditions apply to use of all software and data within the Platform.

These Terms and Conditions apply to third parties using the Platform through services Experimenters have made available through the Platform as part of an experiment whereby the Experimenters remain liable for this use by third parties.

### **3.2 Liability**

The Providers involved assume no liability especially in regards to interruption, corruption, loss or disclosure of the services, processes and data hosted on the Testbed.

Experimenters shall be liable for actions performed on the involved Testbed(s) in the Platform, either by the Experimenters themselves or at the request of any other user invited or permitted by the Experimenters to use the Testbed(s). In case of misuse, Experimenters are responsible for making good all damages to the Testbed(s) and are responsible for any loss or damage incurred.

Experimenters are granted account(s) to the Testbed(s) for own and personal use. Experimenters should take appropriate measures to protect their credentials and prevent their use by third parties. The information Experimenters provide when requesting an account should be correct to the best of their knowledge. Experimenters shall be responsible for all and any loss or damages incurred by them and/or the Project as a result of any unauthorized transfer by them of their password.

Experimenters are granted Resources within the Testbed(s) so that they can use the Testbed(s) for the purposes described in the CREW application form for an open access experiment. These resources are not provided for any other purposes.

Experimenters must respect the regulations of the various Testbed resources they use in their Experiment.

Experimenters must not interfere with others' work or attempt to invade their privacy. Experimenters must not attempt to disrupt the working of the Testbed(s) or any other system.

It is important to understand that when Experimenters use the Testbed they are bound by three sets of regulations: (1) the ICT regulations of the Experimenters' institution; (2) those of the Testbed(s) itself (as provided at <http://www.crew-project.eu/portal/reference>, see 'Access information'), and; (3) all terms and conditions stipulated in this MoU. Thus Experimenters must have read and understood these before using Testbed resources. Once Experimenters have registered to use the Testbed(s), it is their responsibility to remain aware of all applicable regulations and of any changes made to them.

Providers aim to provide a stable, high-quality service. If there is evidence that the actions of Experimenters are adversely impacting this, Providers are empowered to take reasonable measures to terminate or reprioritize usage in order to protect the overall operation of their services. Implicated Experimenters will be contacted by the Providers as early as is reasonable.

Experimenters must respect and do not infringe any copyright, other intellectual property and data protection legislations apply to software and data. The terms of applicable software and data licenses must be respected.

Experimenters must not move proprietary data (other than data owned by the Experimenters) to, from, or via Testbed systems without the prior agreement of its owner.

In order to keep the Testbed(s) operating correctly both technically and legally, it may become necessary to investigate network traffic (for example, wireless traffic) as well as examine information



held on systems that are, or have been, connected to the Testbed(s). Experimenters are deemed to have agreed to this and to provide the required access.

Resources provided by the Project are under the jurisdiction of the Wassenaar Arrangement. Therefore certain nationalities will not be allowed to get access to the Platform and according Testbeds. According to the Wassenaar Arrangement, the following nationalities are restricted from accessing the Platform and according Testbeds: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.

Should Experimenters' usage imply giving access to the Testbed(s) to third parties, Experimenters understand they will need to gather explicit consent from the Providers of the local Testbed(s) they will use, and they agree to enforce any restrictions imposed by a local Testbed provider and accept to fulfill their legal obligations as a service provider regarding data protection and retention laws. This implies also respecting the Wassenaar Arrangement.

The following Experiments are explicitly forbidden on the Platform and according Testbeds:

- The development and production of weapons of mass destruction or any military usage. This includes but is not limited to:
  - Nuclear weapons
  - Biological weapons
  - Chemical weapons
  - Missiles
  - Conventional weapons
- Any activity resulting in compromising the security or integrity of any sites or networks connected to the Platform or individual Testbeds.
- Distribution of documents or materials containing:
  - Insults or defamation
  - Racial hatred or revisionism
  - Advertising for commercial products
  - Distribution of material in a way that infringes the copyright of another person

Further, additional national regulations from the government of the Providers of the local Testbeds must be observed.

### **3.3 Enforcement**

Whenever Experimenters use the Testbed(s), they are bound by all the above regulations and the legislation in force at the time.

The regulations and legislation that applies to Experimenters will be enforced by iMinds, as leader of the CREW consortium, or/and by the affected Testbed Providers, even if a breach of either has been evidenced from elsewhere.

Note that for breaches of some legislation, the police can be involved. Ignorance of regulations or legislation is not a defense.

Penalties, as defined in the applicable specific Testbed regulations, will be levied for confirmed breaches of regulations.

Disciplinary and investigative processes may also involve any Project partners, Testbed Providers and other Testbed users, involved in or affected by Experimenters' actions.

Note that all Testbed Providers have agreed to co-operate in investigating disciplinary cases.

Experimenters agree that the Testbed Providers involved may monitor the systems and traffic for vulnerabilities and conformance to the acceptable uses, and Experimenters will collaborate with the Project and any third party involved should any violations or breaches be noticed. The Providers involved may suspend or stop systems without notice if such violations are found or suspected, or



suspend network connectivity. To fulfill legal and contractual requirements, they may communicate to authorized third parties the owner and user of any resource provisioned and connected to the Internet.

### 3.4 Non-research use of Testbed resources

The CREW Platform and involved Testbeds have been constructed for experiment-driven research activities, where experiment-driven research is defined as any activity that furthers the Experimenters' knowledge and/or understanding of concepts, algorithms, protocols of wireless solutions (more specifically related to cognitive radio and cognitive networking), provided that this activity is legal.

If Experimenters wish to use the Platform or any of the Testbeds for any other purpose, this must be authorized in a documentary form in advance by the Providers of the CREW Testbed(s) they will use. Experimenters will be expected to provide detailed information in support of their requirement.

Experiments must obtain prior agreement from the Providers of all resources (e.g. computers, wireless devices, software, data, networks, and any other facilities) before these are used for any purposes other than experiment-driven research activities.

The use of the CREW platform or any individual Testbed to host commercial activities is explicitly forbidden.

### 3.5 Dissemination of Experiment results

Experimenters are encouraged to promote the results of their Experiments via publication in International Journals and at International Conference proceedings or through public demonstrations.

In case the Experiment does not lead to any publication or demonstration, the Experimenters have to deliver a 2 page final report that can be made public for further promotion of the CREW Platform.

Publications/demonstrations that are made based on the results of the Experiment should clearly mention the usage of the CREW Platform and the involved Testbed(s), also if the publication/demonstration occurs after the end date of the Experiment.

## 4 CREW support policy

All support to Experiments is provided on a reasonable-effort basis. Support should first be sought in the user documentation, which is a living online resource (see <http://www.crew-project.eu/portal>) that has a 'getting started' guide and a FAQ section to deal with common questions and problems. It is expected that Experimenters will go through this to master the basics of managing resources for experimentation on the Testbed(s).

The forum (organized in different forums for each specific Testbed) is a good support channel for discussing how to best do something that the online documentation does not cover. Experimenters may find that their questions have already been addressed in existing threads, so they are encouraged to do a search for their question before creating a new thread. Experimenters are further encouraged to support fellow community members if they know the answers.

If email support is used, the problem should be specified in as much detail as possible. Emails will be redirected to the responsible Testbed Provider.

Experimenters have to respect general business hours when seeking support, which are between 09:00 – 17:00 CET / CEST.

## 5 Period for this collaboration

The start date of the Experiment is [*start date*] and the end date is [*end date*].



## 6 Financial provisions

By signing this agreement, the Project commits to provide the necessary facility resources, the technical documentation and manpower resources to the Experimenters, free of charge at best & reasonable efforts.

By signing this agreement, and considering the fact that the Experimenters will not receive any EU funding through the CREW Open Call 3, the Experimenters confirm that they have the necessary manpower resources whatever to execute the proposed Experiment and according resources for travel expenses for training activities and site visits.

## 7 Signatures

### iMinds, on behalf of the FP7 CREW project

By:

Name:

Title:

Phone:

Email:

### Organization 1

By:

Name:

Title:

Phone:

Email:

### Organization 2

By:

Name:

Title:

Phone:

Email: