GRANT **AGREEMENT NO.: 732174**

Call: H2020-ICT-2016-2017
Topic: ICT-13-2016
Type of action: RIA

Orchestration and Reconfiguration Control Architecture

2nd OPEN CALL FOR EXPERIMENTS

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1. General Open Call information

The ORCA project hereby announces its second Open Call for Experiments.

This call solicits for **Experiments** for rapid validation of innovative software defined radio (SDR) solutions using the facilities, SDR hardware platforms and software toolsets supported by the ORCA Consortium.

More information on the scope of this second Open Call can be found in Section 4 of this document.

2. Call information

Project full name:	ORCA - Orchestration and Reconfiguration Control Architecture
Project grant agreement number:	732174
Call identifier:	ORCA-OC2-EXP
Call title:	First ORCA Open Call for Experiments
Submission deadline:	9th of December 2018
Feasibility and Relevance check deadline:	2th of December 2018

Financial information:

Category and call identifier	Call budget	Max. budget per experiment	Expected No. of experiments to be funded	Guaranteed support[1]
Scientific Excellence ORCA-OC2-EXP-EXC	€ 350 000	€ 50 000	3	€ 28 000
Innovation by Industry ORCA-OC2-EXP-IND		€ 50 000	4	
Expected number of experiments to be funded			7	

Requirements related to the proposer:

- Proposers must be eligible for funding in H2020 projects
- Proposals will only be accepted from a **single party**.
- A proposer can only be selected for funding for one proposal, even if the proposer submitted multiple proposals that are ranked high enough to be selected for funding. In the latter case, the proposer may be given the opportunity to choose the one to be retained for funding.
- Parties having been selected for funding in previous ORCA Open Calls are not eligible to participate again.
- For the Experiments in the category 'Innovation by Industry', only proposals from small, medium and large size enterprises, including unipersonal companies and individuals, will be accepted. The ORCA project encourages in particular the participation of small and medium size enterprises (SMEs) and unipersonal companies. Proposals submitted by SMEs or unipersonal companies will receive a bonus in their score.

Other conditions:

- Language in which the proposal must be submitted: English
- Proposals must follow the provided template (see Appendix A)
- Proposals (draft as well as final proposals) must be submitted through the online submission portal (accessible from http://www.orca-project.eu/open-calls)[2]

Contact: opencalls@orca-project.eu

[1] An extra budget of typically € 4 000 per Experiment will be allocated to the ORCA consortium partner acting as Patron for guaranteed support.

[2] Please note that the submission portal for ORCA Open Call proposals is NOT the H2020 portal.

3. Project background

End-to-end network functionality is best conceptualized using the 5 layer OSI model, that naturally splits the complete functionality into well-defined layers, where each layer is responsible for a well-defined set of tasks. SDR functionality typically focuses on the lowest layer of the OSI, model, emulating a full or partial physical layer on a reconfigurable platform. The advantage of SDR over **"off-the-shelf" technology** is that it enables a full and open implementation of all low layer functions, enabling innovation everywhere. The disadvantage is however that implementing a full PHY layer is quite complicated, and for a very long time the real-time execution of the PHY layer functionality was only possible for the slowest and simplest technologies, such as IEEE 802.15.4.

Recently, SDR technology is improving, and more and more HW-accelerated SDR functionality is becoming available. As a result, SDRs can even be used for some very high throughput and advanced 5G technology, such as Massive MIMO or mmWave. In parallel, open, reconfigurable and real-time MAC protocols are emerging. As a result, SDR PHY and MAC layer technology is becoming mature enough to start considering the concept of networked SDRs.

The ultimate goal of the ORCA project is to enable wireless experimenters to unlock the potential of reconfigurable radio technology, by setting up complex experiments involving end-to-end applications that require control of multiple novel technologies or cooperation between multiple networked SDR platforms within 5G (or beyond 5G) performance constraints on latency, reliability or throughput, well before new radio technologies become available on the market in commercial off-the-shelf products.

3.1. The ORCA Project

The ORCA project is a Research and Innovation Action under the European Horizon 2020 Programme addressing the work programme topic Future Connectivity Systems. The project started in January 2017 and runs for 36 months, until the end of 2019.

The ORCA ambition is to enable end-to-end SDR networking by building SDR networks consisting of multiple SDRs, in various configurations, running multiple functionalities.

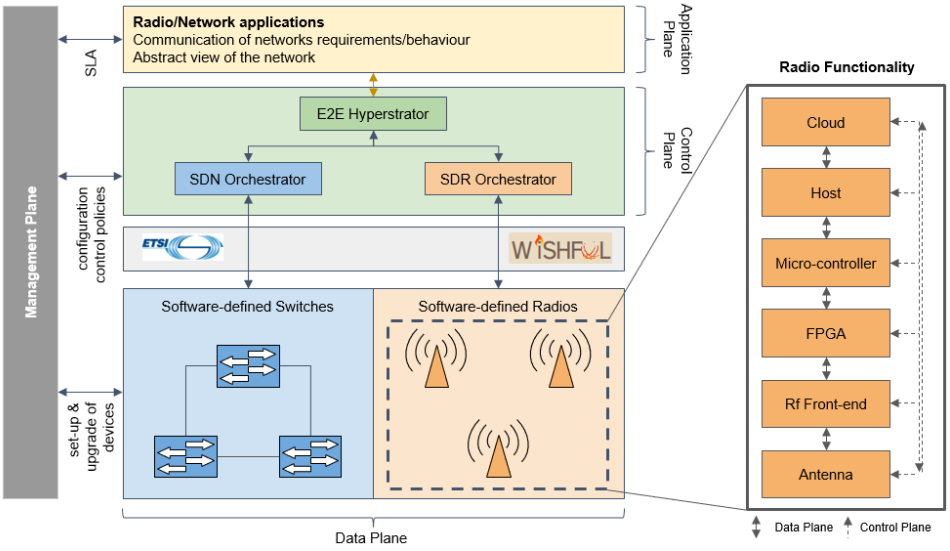

Figure 1 The ORCA architecture will focus on novel PHY and MAC functionality that can be controlled and reconfigured in real-time.

Referring to the ORCA Architecture which is shown in Figure 1, the ORCA project aim is to:

- identify novel wireless ***data plane functionality*** from PHY to network layer and implement it in SW or HW so that real-time end-to-end 5G experiments are enabled;
- identify novel control and monitoring functionality, together referred to as ***control plane functionality***, to enable smooth orchestration of the functional blocks. This means controlling functional blocks that are pre-loaded on the SDR, and can be controlled at runtime by updating parameter settings through an appropriate interface;
- identify ***novel reconfiguration and orchestration methods*** to upgrade or modify the ORCA SDR functionalities at runtime or design time.
    - Concerning design time, the project focuses on composition, by selecting appropriate PHY and MAC functional blocks and perform fundamental changes on the transceiver chain at system level.
    - Related to runtime, the project focuses on (1) parametric configuration, (2) on the fly composition of PHY and MAC chains in the radio stack, and (3) live (partial) hardware and software reprogramming by on the fly loading novel PHY and MAC functional blocks or updating existing PHY and MAC functional blocks

For more technical information about the ORCA project please visit the ORCA website (https://www.orca-project.eu/), and refer to overview video tutorial of the ORCA project (https://www.orca-project.eu/resources/video/) the already published deliverables (https://www.orca-project.eu/resources/deliverables/)

3.2. The ORCA consortium

The consortium is composed by seven partners with complementary competences and demonstrated capability to provide a solid contribution to the project:

- **imec (**IMEC, ORCA Project Coordinator).
  Inter-university Microelectronics Center (IMEC) is a world-leading independent research center in nano-electronics and digital technology. IMEC's uniqueness relies in the combination of a widely acclaimed leadership in microchip technology and a profound software and ICT expertise. In ORCA, the IDLab research group of IMEC in Flanders in involved. IDLab focuses its research on internet technologies and data science. IDLab develops technologies outperforming current solutions for communication subsystems, high speed and low power networking, distributed computing and multimedia processing, machine learning, artificial intelligence and web semantics. IDLab has established many open lab and real-life test environments and offers access to the hardware, measurement equipment, user-friendly software tools and professional technical expertise needed to efficiently prototype, develop, and test innovative ICT innovations. In ORCA imec brings open platforms offering advanced runtime PHY and MAC reconfigurability and live reprogramming capabilities for software-defined radios.

- **Trinity College Dublin (TCD)**
  TCD was founded in 1592 and is among the oldest universities in western Europe. It is recognized as the premier university in Ireland. CONNECT is Ireland's leading research centre in Future Networks and Communications, jointly funded by the Science Foundation Ireland and by industry. CONNECT is headquarted at Trinity College Dublin. The research efforts at CONNECT can be broadly described in four themes, namely the Internet of Things, the Service-Aware Networks, the Network-Aware Services, and the Integration and Testbeds. TCD brings extensive experience in intelligent reconfigurable radios and networks, and this expertise is used in ORCA on end-to-end network operation, and to contribute in the development of low-latency operation and reconfiguration solutions.

- **Katholieke Universiteit Leuven (KUL)**
  KU Leuven (KUL) boasts a rich tradition of education and research that dates back six centuries. KU Leuven is currently by far the largest university in Belgium in terms of research funding and expenditure (EUR 365 million in 2012), and is a charter member of the League of European Research Universities (LERU). The Electrical Engineering department at KU Leuven (ESAT) conducts research at a high international level. The division TELEMIC concentrates on telecommunications and microwave research, combining both strong theoretical, implementation and measurement expertise from electromagnetic propagation, antenna and RF circuit design, to telecommunication networks. In ORCA, the KUL testbed, consisting of networked real-time SDRs is made available. In addition, ESAT-TELEMIC exploits their mmWave expertise and test

equipment, towards designing and realizing extensions of the Massive MIMO testbed towards mmWave.

- **Technische Universität Dresden (TUD)**
  Founded in 1828, Technische Universität Dresden (TUD) is a full-scale university with 14 faculties, covering a wide range of fields in science and engineering, humanities, social sciences and medicine. TUD prides itself for its international flavour and has partnerships with more than 70 universities worldwide. Furthermore TUD is the only university in East Germany which has been granted a graduate school and a cluster of excellence in Germany's excellence initiative. In ORCE TUD will further evolve its current testbed into a Fed4Fire compliant indoor and outdoor testbed. Main focus of the experimentation platform is on macro and small cell scenarios for low latency and tactile internet applications.

- **National Instruments Dresden GmbH (NI)**
  NI is an industry partner in the ORCA project with a long history of designing and prototyping innovative test and measurement systems, e.g. in the RF space. Customers in nearly every industry—from healthcare and automotive to consumer electronics and particle physics—use NI's integrated hardware and software platform. NI is also collaborating with several top researchers focused on wireless research—specifically 5G wireless communications and is also actively engaged in the 3GPP standardization. The strong expertise in RF and wireless communications will help to provide ORCA feedback on the latest technology trends and products that will lead to a better practical relevance of the results.

- **Rutgers, The State University of New Jersey (RUTGERS)**
  Rutgers, The State University of New Jersey, is the largest and most comprehensive higher education institution in New Jersey founded in 1766. Wireless Information Laboratory (WINLAB) was founded in 1989 as an industry-university cooperative research centre at Rutgers University focusing on wireless technology. In ORCA the WINLAB develops functionalities for massive MIMO and cloud RAN and improves support for various radio platforms that are available in ORBIT.

- **Martel GmbH (MARTEL)**
  Martel is an innovative SME specialized in the management, dissemination, communication and promotion of international collaborative EC projects, with focus on ICT, Smart Cities and Future Internet. Martel leads the Communication, Dissemination and Exploitation work package playing a key role in the perspective of promoting the project outcomes and engaging a high number of experimenters in adoption of the ORCA's concepts and technologies. Martel also assists IMEC in the management and coordination of the various project's administrative activities.

3.3. The ORCA facility

One of the ORCA ambitions is to introduce advanced SDR functionalities in a number of Fed4FIRE compliant test facilities. The ORCA facility is the collection of wireless testbeds supported by ORCA hosting advanced SDR platforms, together with the code repositories and toolsets needed to generate ORCA SDR functionalities. The ORCA SDR functionalities and testbed are described in the next sections.

The ORCA SDR Functionalities

An overview of the main SDR functionalities supported in the ORCA project is given below. For more detailed technical information, we refer to Deliverable 2.2 (https://www.orca-project.eu/resources/deliverables/) the leaflets on the ORCA website (https://www.orca-project.eu/orca-functionalities/).

The ORCA functionalities that are offered in this open call are listed in the tables below. The first table focuses on a high-level description, while the second table focuses on the hardware and software components, supporting partner and licensing condition of a particular offer.

Table I Overview of ORCA functionalities

ORCA functionality	Acronym	Description	Link
Bidirectional, closed loop mmWave link (V-Band)	mmWaveLink	The bidirectional 60 GHz high throughput mmWave link provides an end-to-end communication PHY, using steerable antennas and beam steering algorithms that can be configured at run time. In addition, mobility can be emulated with a device capable of moving the antenna position.	http://owl.ifn.et.tu-dresden.de/
Radio slicing: resource allocation and instantiation, runtime parametric control of PHY and lower MAC through flexible GFDM PHY	GFDM	The Generalized Frequency Division Multiplexing (GFDM) framework is an open source flexible PHY implementation using NI's SDRs platforms, allowing runtime waveform parametrization.	http://owl.ifn.et.tu-dresden.de/
Sense and abort MAC	CSMA\CD	Employing a signal collision detector, the CSMA/CD MAC scheme aborts transmission in the case of probable signal interferences	https://www.esat.kuleuven.be/telemic/research/NetworkedSystems/infrastructure/full-duplex-testbed
Concurrent multi-channel sensing of	CONSENSE	A single preamble detector is used to simultaneously detect Wi-Fi and Zigbee packets over different channels.	https://orca-project.github.io/IMEC-CONSENSE/

multi-RAT on a single SDR			
Cellular Access Multi-Tenancy through Small-Cell Virtualization and Common RF Front-End	IQ switch	IQ samples are multiplexed and de-multiplexed through an IQ switch, for different base stations running on different channels channels, to access a common RF frontend.	https://orca-project.github.io/IMEC-IQ-switch/
Integration of PHY and upper layer protocols and runtime parametric control of PHY and lower MAC	TAISC	TAISC is a framework that offers the tight integration of PHY with upper layer and allows runtime configuration with a single MAC or dynamically loading different MAC protocols.	https://wirelesstestbedsacademy.github.io/TAISC/
Radio slicing: resource allocation and instantiation	Radio-slicing	Two transmitters are instantiated on two different channels, based on one physical transmitter. The air time of each transmitter is allocated through a control backbone network.	https://orca-project.github.io/RS-IMEC/
RF Front-end Virtualization + Spectrum Virtualization	MySVL	The Many-to-many Spectrum Virtualization Layer (MySVL) can virtualize both RF front-ends and wireless spectrum, meaning that multiple independent RATs can simultaneously use an RF front-end. In addition, spectrum can be sliced or aggregated into virtual spectrum chunks.	https://orca-project.github.io/gr-mysvl/
Coordination strategies between multiple RATs	MultiRat-Coord	A prototyping setup using NI's SDR platform (802.11 and LTE PHY) attached to the NS-3 network simulator (upper layers). Functionality of NS-3 can be used to test data split and aggregation as well as interworking concepts.	http://owl.ifn.et.tu-dresden.de/
Generation of RF Waveform Datasets	gr-specmonitor	Framework for generation and reuse of RF signal + metadata datasets and machine learning models for waveform classification	https://orca-project.github.io/gr-specmonitor/
Distributed Massive MIMO	DiMa-MIMO	This 62-antennas testbed is distributed in two arrays and it is able to handle up to 12 users simultaneously. Running in Labview Massive MIMO framework, this testbed stores all the channels from each user, their throughput and EVM.	To be released by end of 2018
Listen Before Talk functionality on FPGA as an IP core	LBT	The IP core is capable of wideband, concurrent spectrum sensing on multi-channels, and trigger transmission on the vacant channels. We offer support of this IP core on Zynq SDR in this call.	https://orca-project.github.io/opencall1-ext-lbt/
End-to-End slicing support	SDR-SDN	Provisions end-to-end network slices using a combination of radio slices, implemented	https://orca-project.github.io/sdr-sdn/

for SDR and SDN		through SDRs, and core slices, implemented through SDN.	
RAT interworking on NS-3 based SDR prototyping platform	MultiRat-LWx	Using the prototyping platform *MultiRatCoord*, the RAT interworking techniques LWA and LWIP can be incorporated into experiments.	http://owl.ifn.et.tu-dresden.de/ https://static.martel-innovate.com/wp-content/uploads/sites/4/2017/08/UP-ORCA_ORCA_OC1_EXT3_Summary.pdf
Digital self-interference cancellation for in-Band Full Duplex	Fullduplex	The full duplex capability allows in-band simultaneous send and receive.	https://www.esat.kuleuven.be/telemic/research/NetworkedSystems/infrastructure/full-duplex-testbed

Table II SW, HW and access condition for using ORCA functionalities

ORCA functionality (Acronym)	Hardware platform [supporting partner]	Software access	Licensing terms
mmWaveLink	NI PXI mmWave baseband + Sibeam V band transceivers [TUD + NI]	Pre-configured hard disk image at TUD server (or SVN repository)	The source code will be accessible through a technical license agreement (TLA)
GFDM	TUD: GFDM Flexible PHY + USRP RIO [TUD]	Open Source LabVIEW Project [TUD]	TUD: GPL
CSMA\CD	USRP 2952 + Analog SIC module [KUL + NI]	Via git repository: -LabVIEW host interface -FPGA bitstream	Free usage for non-commercial academic usage, for other purposes contact KUL.
CONSENSE	Xilinx ZC706 Evaluation Kit - Zynq® 7000 SoC + AD FMCOMM radio frontend [IMEC]	Via git repository: -firmware open source -API available for host development -FPGA bitstream	Free usage for non-commercial academic usage, for other purposes contact IMEC
IQ Switch	USRP X310/ USRP B200 / USRP B210	Via git repository: Completely open source	Free usage for non-commercial academic usage, for other purposes contact IMEC
TAISC	ZedBoard Xilinx Zynq®-7000 SoC + AD FMCOMM radio [IMEC]	Via git repository: -firmware open source -API available for host development -FPGA bitstream	Free usage for non-commercial academic usage, for other purposes contact IMEC
Radio-slicing	Xilinx ZC706 Evaluation Kit - Zynq® 7000 SoC + AD FMCOMM radio frontend [IMEC]	Via git repository: -firmware open source -API available for host development -FPGA bitstream	Free usage for non-commercial academic usage, for other purposes contact IMEC
MySVL	USRP N210 [TCD]	Via git repository: Completely open source	TCD: GPL

MultiRat-Coord + MultiRat-LWx	NI LTE and 802.11 application + NI L1-L2 API + NS-3 running on PXIe 8135/8880 controller and USRP RIO [NI] (GFDM Flexible PHY + USRP RIO [TUD])	Pre-configured hard disk image at TUD server (or SVN repository), NS-3 is also available under https://www.nsnam.org [NI] Open Source LabVIEW Project [TUD]	NI: The NI physical layer source code will be accessible through a technical license agreement (TLA). NI L1-L2 API and NS-3 is open source (GPLv2) TUD: GPL
gr-specmonitor	USRP N210 [TCD]	Open source GNURadio project [TCD]	TCD: GPL
DiMa-MIMO	NI USRP testbed with with 2 times 32 antenna elements and Labview Comms Massive MIMO Application Framework v1.1 [KUL]	Via git repository: logged channel measurements Further: online use of the testbed	Channel repository is public. NI License agreement applies to the Massive MIMO application framework.
LBT	Xilinx ZC706 Evaluation Kit - Zynq® 7000 SoC + AD FMCOMM radio frontend [IMEC]	Via git repository: open source.	Free usage for non-commercial academic usage
SDR-SDN	USRP N210 [TCD], Dell S4048T-ON [TCD]	Via git repository: Completely open source	Free usage for non-commercial academic usage
FullDuplex	USRP 2952 + Analog SIC module [KUL + NI]	Via git repository: -LabVIEW host interface -FPGA bitstream	Free usage for non-commercial academic usage

The ORCA Testbeds

Within the ORCA project diverse testbed facilities with complementary capabilities to enable innovative communications research are offered. In total 5 testbeds are available for experimentation by ORCA partners or by Third Parties selected via the Open Calls. In the following subsections all testbeds are briefly described focusing on major experimentation use cases as well as the general system features. For more detailed technical information on the testbeds, please refer to https://www.orca-project.eu/open-calls/.

IMEC w-iLab.t testbed for heterogeneous environments

- Testbed allows for indoor fixed, as well as mobile scenarios with up to 16 mobile robots.
- Support of heterogeneous scenarios involving multiple wireless technologies (WiFi-ZigBee coexistence, LTE-WiFi coexistence and load balancing, coexistence between LWPAN technologies).
- Testbed provides facilities for runtime parametric reconfiguration of transceiver chains, and mechanisms for updating of MAC and networking protocols.
- Testbed includes various SDR platforms like Ettus/NI USRP, Xilinx Zynq, as well as tools for MAC design and runtime MAC control (TAISC) and control and management

SW architectures for IoT devices (GITAR).

RUTGERS ORBIT heterogeneous multi-node testbed

- Testbed provides facilities for heterogeneous indoor and outdoor experimentations with up to 400 nodes (9 sandboxes and outdoor deployment) that can be interconnected into specified topologies.
- Testbed includes various SDR platforms like Ettus USRP incl RF NoC, Nutaq Zepto SDR as well as WARP v1.
- Network provides a configurable mix of off-the-shelf wireless technologies, e.g. high-speed cellular (WiMAX, LTE) and 802.11 wireless access in real-world settings.
- Testbed provides facilities for runtime reconfiguration of processing units of transceiver chain as well as mechanism for updates of MAC and networking protocols.

TCD IRIS radio and network virtualization testbed

- Testbed provides facilities for (static) indoor scenarios with up to 16 ceiling mounted USRP units, and approximately one dozen additional N- and X-series USRPs.
- Radio hardware is virtualized to support the experimental investigation of the interplay between radio capabilities and networks, e.g. allowing the combination of various physical layer approaches into coexisting or coherent networks.
- Platform is connected to a private computational cloud, allowing to deploy an array of computational environments.
- Testbed enables a wide range of dynamic spectrum access and cognitive radio experiments and provides a highly flexible architecture for real-time radio reconfigurability.
- Support of research on alternative waveforms (e.g. OFDM and FBMC), adaptive duplexing as well as adaptive network architecture demonstration (e.g. alternate between D2D and fixed infrastructure).

TUD macro scale testbed

- Real-time end to end outdoor and indoor experimentations representing macro and small cell scenarios with the focus on low latency and tactile internet applications
- Testbed includes multiple base stations (e.g. 2 at roof top) and several USRP based mobile user terminals (e.g. installed on bicycle rickshaw, mobile robots, measurement van)
- Testbed Includes sub-6 GHz links as well as mmWave links suitable for performance comparison and RAT interworking studies, e.g. LTE, New Waveforms / GFDM, new mmWave RAT
- mmWave link features small-form-factor integrated V-band RF with real-time configurable antennas typical for future mmWave enhanced small-cell network deployments
- Comparison of different backhaul technologies (wireless versus cable)
- Wide range of reconfigurable parameters like carrier frequency, transmit power and receive gain, modulation and coding scheme, resource blocks accessible from MAC layer, e.g. for scheduling experimentation.

KUL dense multi-node networks testbed

- Real-time indoor multi-node testbed with up to 45 USRP nodes jointly operating in distributed environments allowing for Massive MIMO and dense networks experiments.
- Testbed includes 3 rooms:
    - Anechoic room for measurements with 64 antennas, co-located or distributed around the room;
    - Lab experimentation room with 72 co-located and 8 distributed available in one additional room.
- Testbed includes sub-6 GHz links, 5 nodes are equipped with full duplex capabilities.
- Testbed supports 802.11a / WiFi based networks, Massive MIMO as well as the own developed IEEE 802.15.4 CLAWS platform.

All of the testbeds are installed in either office environments or other dedicated testbed environments. Because some research requires doing measurement campaigns or actual testing in heterogeneous environments, the ORCA project also offers a portable testbed to the community that can be deployed at any location, enabling experiments in real life environment involving real users in a big variety of scenarios.
The experimenter can use one user account to access all ORCA testbeds, including the portable testbed. The same user account can be used to access all Fed4FIRE testbeds.

Table III Overview of supported SDR platforms

Testbed	w-iLab.t (IMEC)	ORBIT (RUTGERS	IRIS (TCD)	OWL Testbed (TUD)	KUL Testbed
Nutaq ZeptoSDR		X			
Nutaq picoSDR		X			
PicoZed Xilinx Zynq®-7000 SoC		X			X
USRP B200-mini		X		X	
USRP E310		X			
USRP N210	X	X	X	X	
USRP X310	X	X	X		
USRP B210/B200	X				
USRP 2920				X	
USRP 2921					X
USRP RIO 2942R					X
USRP RIO 2943R	X				X
USRP RIO 2952R (+ GPS)					X
USRP RIO 2953R (+ GPS)				X	

Xilinx ZC706 Evaluation Kit - Zynq® 7000 SoC + AD FMCOMM radio frontend	X				
ZedBoard Xilinx Zynq®-7000 SoC		X			
ZedBoard Xilinx Zynq®-7000 SoC + AD FMCOMM radio frontend	X				
BB – NI PXI 7975R Module				X	
BB – NI PXI 7966 Module				X	
FE - NI PXI 5644				X	
FE – NI PXI 7976R					X

*Legend: BB (baseband motherboard), FE (Frontend, RF daughterboard)

The description of the testbeds offered by ORCA in terms of data and control plane functionality, including basic and advanced reconfiguration can be read in details on the ORCA website: https://www.orca-project.eu/orca-functionalities/

4. General purpose of RFP (Request for Proposals)

This call solicits for **Experiments** for validation of innovative software defined radio (SDR) solutions using the facilities, SDR hardware platforms and software toolsets supported by the ORCA Consortium.

This Open Call targets advanced end-to-end networking experiments involving real-time SDR dealing with very diverse QoS requirements (in terms of throughput, data volumes, latency, response time, reliability, availability, etc.) and sharing the same wireless technologies and/or spectral bands.

An ORCA experiment should encompass:
All of the following

- End-to-end communication between applications
- Runtime orchestration of the wireless network (e.g., reconfiguration, resource provisioning, adaption to dynamic context)
- Use at least one ORCA functionality (see Table I)

- Validate in ORCA test facility

And at least one of the following

- End-to-end integration of wireless and wired network segments
- Differentiated QoS support through virtualization/slicing
- strategies for coordination/cooperation between multiple RATs
- massive MIMO operation
- mmWave operation
- Full-duplex communication
- New waveforms

Experiments can build further on top of example showcases developed by ORCA, or proposers can also design their own showcases.

Experiments should be of a short duration (maximum 6 months). Experiments can be inspired by, but not limited to, the **example showcases** implemented by the ORCA consortium. More information on ORCA showcases can be found at Deliverable 2.3 (https://www.orca-project.eu/resources/deliverables/)

This call is split in two categories of Experiments:

- **Scientific excellence** targeting Experiments validating novel wireless solutions that clearly advance the current state-of-the-art.
- **Innovation by Industry** targeting Experiments validating wireless solutions that have a large potential for commercial exploitation in existing or new products or services.

Independent evaluations of the submitted proposals will be performed, in order to select the Experiments that will be supported under the ORCA project. Different categories of Experiments will be evaluated against different criteria (see section 5.2). It is further required that the Experiments are performed by a single organization. In the category 'Innovation by Industry', only proposals from small and medium-size enterprises, as defined by H2020 guidelines, including unipersonal companies and individuals, and large size enterprises, will be accepted.

Benefits to participate in this Open Call are:

- Possibility to perform wireless Experiments starting from advanced and well-documented SDR platforms and software development toolsets; This allows the experimenter to focus on optimizing his wireless solutions, instead of setting up a complex SDR development environment.
- The simplified application process compared to the one from the standard H2020 calls together with a rapid review process by independent external evaluators;
- An extra benefit is the dedicated support from skilled ORCA consortium partners. Each proposer should seek a supporting ORCA consortium partner **(the Patron)** that will be in charge of dedicated (advanced) support of the Experiment.

Per proposal a budget can be made available up to a maximum of 50 k€. Next to this, an extra budget (on average 4 k€/Experiment) can be assigned to an ORCA consortium partner acting as the Patron in charge of dedicated (advanced) support of the Experiment.

5. RFP process

Each proposing party should seek contact with the ORCA consortium and identify an ORCA partner acting as “Patron”. The role of the Patron is to carry out an obligatory feasibility and relevance check and to provide support during the execution of the Experiment. This Patron will also be consulted for evaluation before payment by imec of the invoices. The role of the Patron is further described in Section 6.1.

5.1. Proposal Template

The use of a specific proposal format as described in this section is mandatory. The template is limited in size and is focusing on “what the proposer wants to do” and “what the expected result is”.
Following, a short description of all the proposal template sections:

Section A **Summary** (maximum 300 words).
The information in this section may be used in public documents and reports by the ORCA consortium.

Section B **Detailed description and expected results** (minimum 4 pages, and maximum 6 pages)
This section describes the details on the planned Experiment (what does the proposer hope to obtain?, how?, why is it relevant?). This section should also include all information with respect to the State-of-the-Art or a comparison to competing commercial wireless solutions in case of Experiments of category ‘Innovation by Industry’ to show the innovative character of the Experiment and the expected scientific or business impact.

Section C **Requested ORCA software tools, radio hardware platforms, testbeds** (target length 1 page)
The information in this section needs to be collected in collaboration with the ORCA partner acting as Patron on this Experiment. For this section, a specific format needs to be used, which is included in the proposal template.

Section D **Feasibility and relevance check** (max. 1 page)

This section contains the feedback from the ORCA partner acting as Patron on this Experiments. Each proposing party must contact the ORCA consortium regarding its submission to identify a possible Patron. This Patron can be the ORCA partner responsible for the testbed, SDR platforms or software toolset, the proposer will use or extend. The proposing party must submit its draft proposal to this Patron by the 25th of November 2019 (see Section 5.3). The feedback by the Patron is copied into this section of the proposal.

Section E **Background and qualifications** (maximum 2 pages)

This section describes the proposer and includes an overview of the activities, the proposer's qualifications, technical expertise and other information to allow the reviewers to judge the proposer's ability to carry out the Experiment.

Section F **Expected feedback to ORCA Consortium** (1 page)

This section contains valuable information for the ORCA consortium and should indicate the expected feedback the ORCA consortium can expect from the use of its SDR platforms, software toolsets and/or testbeds after carrying out the Experiment. This information is essential in view of the further improving the usability of the ORCA facility.

Section G **Requested funding** (1 page)

This section provides an overview of the budgeted costs and the requested funding. A split is made in personnel costs, other direct costs (travel, consumables, etc.) and indirect costs.

Section H **Use of proposal information**

In this section the proposing party is asked to include some statements related to sharing information of his proposal with the EC and the ORCA consortium.

Proposals are treated in a confidential way, meaning that only successful proposals must be disclosed to the ORCA consortium. Open calls previously organized by other projects were very successful and have revealed that many submitted non-granted proposals also contain very interesting and valuable information that could be used for setting up collaborations or to extract ideas for further improving the ORCA facility. Therefore, the ORCA project would like to have the opportunity to collect more detailed information and further use this information, also if the proposal is not selected for funding. In any case, the ORCA consortium will treat all information of a proposal

confidentially.

The full proposal template can be found in Annex A to this document.
Please note that **in the draft proposal** that will be submitted for feasibility and relevance check, **at least sections A, B and C should be fully completed**. Please be aware that the Patron will NOT review draft proposals or propose any changes to the proposal. The Patron will only give feedback on the feasibility and the relevance to ORCA of the proposed Experiment based on the completed sections A, B and C. The feasibility and relevance check does not provide a commitment that the proposal will be selected.

5.2. Evaluation criteria

Evaluation and ranking will be carried out by an external jury of experts.
Proposals submitted by Parties meeting the requirements (see page 4 of this document) will be further evaluated according to the following criteria:

General criteria (applicable to both categories of Experiments):

1. ***Clarity and methodology*** (Cf. Section B of the Proposal Template)

   The Experiments should be scientifically and/or technically sound. There should be a clear problem statement, a solid Experiments design, a good methodology, etc.

2. ***Relevance*** (Cf. Sections C and D of the Proposal Template)

   Experiments with low relevance for ORCA will get a lower score. Experiments have to meet the requirements as explained in section 4 of this call document.

3. ***Feasibility*** (Cf. Sections C and D of the Proposal Template)

   Experiments with low chances for success or requiring excessive support from the ORCA partners will get a lower score.

4. ***Qualifications of the proposer*** (Cf. Section E of the Proposal Template)

   The proposer should exhibit prior research/development experience and the necessary qualifications to perform the Experiment.

5. ***Value for money*** (Cf. Section G of the Proposal Template)

   The requested budget should be in line with the proposed work plan.

6. ***Potential for Feedback*** (Cf. Section F of the Proposal Template)

   The ORCA consortium is seeking feedback regarding the use of the ORCA facility. Proposals that can indicate a lot of information and feedback on the use of SDR hardware platforms, software tools and testbeds will get a higher score.

Specific criteria:

- Category 'Scientific Excellence':

7. ***Scientific innovation:*** the degree of scientific innovation of the solution for wireless control (cf. Section B of the proposal template).

   The score given here should reflect the degree of innovation: if an Experiment is pushing the boundaries of its domain, then it should get a higher score then Experiments testing trivial things. In order to demonstrate this criterion, the proposer is expected to clearly motivate his Experiment and indicate the State of the Art in the appropriate field.

8. ***Scientific relevance:*** potential for take-up of the results by the broader scientific community (cf. Section B of the proposal template).

   The proposed Experiment should be sufficiently relevant form a scientific point of view to be taken up by the broader scientific community. The score given here should reflect the extent to which the broader scientific community can benefit from the solution proposed in the Experiment.

9. ***Publication potential*** (cf. Section B of the proposal template)

   The expected results of the Experiment should have potential for publication in high-impact scientific journals and/or for presentation/demonstration of the results on major scientific conferences. The proposer is expected to identify publication/presentation/ demonstration opportunities.

- Category 'Innovation by Industry':

7. ***Industrial innovation: the degree of industrial innovation of the solution for wireless control (cf. Section B of the proposal template).***

   The score given here should reflect the degree of innovation: there should be an indication to which extent the proposed wireless solution is different and innovative compared to existing and/or competing commercial wireless solutions. In order to demonstrate this criterion, the proposer is expected to clearly motivate his Experiment and compare his proposed solution with existing solutions in the appropriate field.

8. ***Industrial and/or standardisation relevance:*** (cf. Section B of the proposal template).

Potential for exploiting the results of the Experiment in commercial wireless solutions and/or for providing a verifiable impact on the standardisation process. This score should reflect the industrial relevance including the expected and projected impact on the company through product development.

9. ***Demonstration potential*** (cf. Section B of the proposal template)

   The expected results of the Experiment should have potential for demonstration of the results on relevant events (exhibitions, congresses, technical seminars, networking events, user group events, etc.). The proposer is expected to identify relevant demonstration opportunities.

10. ***Type of industrial innovator***

    Unipersonal company, SME or large company.

Criterion	Short description	Weight	Maximum score
1	Clarity and methodology	1	5
2	Feasibility	1	5
3	Relevance	2	10
4	Qualifications of the proposer	1	5
5	Value for money	1	5
6	Potential for Feedback	2	10
7	- Scientific innovation - Industrial innovation	2	10
8	- Scientific relevance - Industrial and/or standardization relevance	2	10
9	- Publication potential - Demonstration potential	1	5
10	Type of Industrial Innovation	n.a	+3
	Maximum Total score		**65**

We expect to select 7 proposals, of which minimum 3 proposals of category “Scientific Excellence” and minimum 4 proposal of category “Innovation by Industry”. Additional proposals will be

selected based on quality (highest ranked proposals not selected so far that still fit within the call budget disregarding the category).
The 4 highest ranked proposals (that exceeds all threshold criteria) in the category “Innovation by Industry” and the 3 highest ranked proposals (that exceeds all threshold criteria) in the category “Scientific Excellence” will be selected. If after that, there is still budget left, the highest ranked proposal(s) not selected so far will be selected, no matter which category. In this case, the proposers will be asked whether they are willing to implement the experiment using as funds the budget left (which might be lower than the budget initial requested in the proposal).

The proposals submitted by unipersonal companies or SMEs in the category ‘Innovation by Industry’ will receive an extra 3 points (for criterion 10) on top of their total score. This measure is introduced to encourage participation of smaller and unipersonal companies.
The maximum score is 65. This maximum score cannot be exceeded by criterion 10.

5.3. Submission information

The proposal must be:

- Submitted on-line through: https://www.orca-project.eu/2nd-open-call-for-experiments/
- Submitted in English

A **technical feasibility and relevance check** is required before submission. This feasibility and relevance check will be carried out by the ORCA members responsible for the facilities, radio hardware platforms, and software platforms involved. As a result of this, an additional concise section is added to the proposal (Section D of the Proposal Template) and is provided in collaboration with the ORCA project consortium members. This section also identifies the Patron of the Experiments, who is the lead contact person within the project who will be responsible for the follow up of this Experiments (see Section 6 of this document).

Once the deadline for submitting a proposal is reached, the call will be closed and the evaluation process will start. The duration of the evaluation of the proposals and approval by the EU will be kept within 1.5 month.
In case of this specific Call, the target date for acknowledgement of selection is set around middle of January 2019.
The outcome of the evaluation will be communicated to the proposers via email as soon as the process is completed. The notification will include a detailed report of the evaluation process where for each criterion the score and the motivation of the evaluators will be reported.

Selected experiments can start at the earliest on the 1st of February 2019, but no later than 1st of March 2019.

The deadline for the final report for an Experiments is expected 6 months after the start of the Experiments, and no later than the end of August 2019. Please note that a later start may imply a shorter (than 6 months) Experiments.
The final evaluation of the Experiments will happen at a review meeting with the EC. The review meeting for Experiments is currently scheduled for October-November 2019 at the imec premises in Ghent. The exact date will be fixed during the execution of the Experiments.

Submission deadline of draft proposal to the ORCA partner acting as Patron for Feasibility and Relevance check:	25th of November 2019, at 17:00 Brussels local time
Submission deadline:	30th of November 2019, at 17:00 Brussels local time
Notification of the result:	**Mid of January 2019**
Start of the Experiment:	At the earliest Friday the 1st of February 2019
End of the Experiment: **Maximum duration of the Experiment**	Not later than Friday the 30th of August 2019 6 months

6. Terms & conditions

Once a proposer is selected to perform the proposed Experiment, the proposer will become a third party receiving financial support using Cascade Funding, and to this end needs to sign an Agreement with IMEC. In the remainder of this document a 'third party using Cascade Funding' is referred to as 'Third Party'.
The administrative load for the Third Party will be minimal as only two invoices need to be submitted to IMEC upon completion of the Experiments together with a final report describing the tasks performed and the results achieved. This final report will be required before payment will be carried out. A payment of up to 75% of the costs incurred, amounting to maximum 75% of the approved funding, will be carried out by IMEC based on the evaluation of the final report and the declared costs and upon submission of a first invoice. The remaining 25% will be paid following a formal approval of the report and the work at a technical project review by the European

Commission (EC), and upon submission of the secon invoice. More details on the payment scheme are given in Section 7.
The template of the Agreement that the winning proposer will be asked to sign is attached to this document as Annex B. Upon submission
By submitting a proposal for Experiment, the proposer confirms that he is aware of the terms and conditions in the aforementioned agreement and that he/she implicitly agrees to them.

6.1. Support of Experiment and role of Patron

Successful proposers in this open call have access to basic and advanced support:

1. **Basic support**
   - Guaranteeing that the ORCA facility is up and running (e.g. answering/solving "Why can I not reach SDR node X?")
   - Providing pointers to documentation on how the ORCA facility, SDR platforms and software toolsets can be used (e.g. "how to use a specific SDR platform in one of the ORCA testbeds" => answer: check out our tutorial online at page x")
   - Providing pointers to technical questions as far as relevant (e.g. answering "do you know how I could access a certain functionality of a SDR device" => answer: yes, it is described on following page: y"; irrelevant questions are for example "how to copy a directory under Linux")
2. **Dedicated (advanced) support** includes all of the following supporting activities by the Patron:
   - Deeper study of the problem: invest effort to fully understand what the proposer's goals are, suggest (alternative) ways to reach the proposer's goals. To put it more concretely, proposers do not need to know all details of a specific testbed or how it should be used, they will be told what is relevant to them and can focus on their problem, not on how to solve a testbed problem.
   - Help with setting up the Experiments (e.g. "how to use a specific testbed " => answer: the tutorial is there, but let me show you what is relevant for you, let me sit together with you while going through this example and let us then also make (together) a description for the Experiment that matches what you are trying to do).
   - (Joint) solving of practical technical problems (e.g. "do you know how I could change a certain functionality on a specific SDR node " => yes, it is described on page y, in your case you could implement this as follows.., perhaps we should quickly make a script that helps you to do it more easily, ...)
   - Technical consultancy during or after the Experiment (e.g. "I do get result X, but would have expected Y, what could be the problem?")

It is essential that the proposer gets in contact with the main ORCA partner in charge of the testbed(s), SDR platforms and/or software toolset(s) that will be used for the Experiment to discuss the Experiment itself and the specific requirements. However, additional technical information may be required on specific SDR hardware platforms, software toolsets and testbeds, that cannot be provided by the Patron. A list of possible contact persons is therefore given below:

Partner	**Contact**	**Supported Testbeds, HW and SW**
IMEC	Wei Liu Wei.liu@imec.be	Testbeds: w.iLab.t
		SDR HW: USRP2-N210, USRP B200mini, ZedBoard Xilinx Zynq®-7000 SoC, Xilinx ZC706 Evaluation Kit - Zynq® SoC, USRP X310, NI USRP-2943R
		SW: Xilinx Vivado Design Suite v2016.2 and Analog Device AD9361 HDL Reference Design[3], Xilinx Vivado Design Suite v2015.4 for RFNoC related development, SrsLTE, TAISC[4], GITAR[5]
		Functionalities: (i) CONSENSE (ii) TAISC (iv) Radio-slicing: (iv) LBT
TCD	Joao Santos facocalj@tcd.ie	Testbed: IRIS
		SDR HW: USRP2-N210, USRP2-N210 w/ beamforming, USRP X310
		SW: GNU Radio, IRIS software radio, srsLTE
		Functionalities: (i) gr-specmonitor (ii) MySVL (iii) SDR-SDN
RUTGERS	Ivan Seskar seskar@winlab.rutgers.edu	Testbeds: ORBIT
		SDR HW: USRP2-N210, USRP X310, USRP B210, Nutaq PicoSDR2x2-E, Nutaq ZeptoSDR, RTL-SDR
		SW: GNU Radio, RFNoC, SrsLTE, OAI
		Functionalities: (i) Multiple SDR platforms with tools for control and sample collection (ii) Massive MIMO setup with 2 sets of 8 USRP X310s
KUL	Full Duplex:	Testbed: KU Leuven
		SDR HW:

[3] https://wiki.analog.com/resources/eval/user-guides/ad-fmcomms2-ebz/reference_hdl
[4] http://www.wishful-project.eu/taisc
[5] http://www.wishful-project.eu/gitar

	Seyed Ali Hassani seyedali.hassani@kuleuven.be Massive MIMO: Andrea Guevara andrea.guevara@esat.kuleuven.be	Full Duplex: NI USRP-2952R, NI USRP-2943R Massive MIMO: NI USRP-2942R (34), NI USRP-2943R (2), NI USRP-2952R (8), NI USRP-2921 (2)
		SW: Full Duplex: NI LabVIEW Massive MIMO: NI LabVIEW
		Functionalities: (I) Fullduplex; (ii) DiMa-MIMO
TUD	Roberto Bomfin roberto.bomfin@ifn.et.tu-dresden.de	Testbed: TUD OWL testbed
		SDR HW: NI PXI 5791, NI USRP 2920, NI USRP RIO 2953R, NI PXI 7975R , NI PXI 7966
		SW: NI LabVIEW Communications System Design Suite based GFDM flexible transmitter
		Functionalities: (i) mmWaveLink (ii) GFDM
NI	Walter Nitzold walter.nitzold@ni.com	SW: LabVIEW Communications LTE Application Framework, LabVIEW Communications 802.11 Application Framework, NI L1-L2 API, ns-3 network simulator (LTE + WiFi module)
		Functionalities (Acronym): (i) MultiRat-Coord, (ii) MultiRat-LWx

6.2. Reporting

As the selected proposers Third Party in the ORCA project, no input will be required for any of the regular project reports (ORCA deliverables), which the ORCA consortium needs to submit to the EC. The Third Party may be requested by his Patron for informal intermediate progress updates.

The Third Party only has to submit a final report after completion of the Experiment. A specific template needs to be used and will include:

Part A. ***Summary***

Part B. ***Detailed description***

This section describes the details on the Experiment
It includes:

- B.1 Concept, Objectives, Set-up and Background
- B.2 Technical results and Functionality Validation
- B.3 Impact

Part C. ***Feedback to ORCA***

This section contains valuable information for the ORCA consortium and describes the Third Party's experiences while performing the Experiment starting from the available testbeds, SDR platforms and software toolsets. It includes:

- C.1 Testbeds/SDR Hardware/Software Toolsets used
- C.2 Feedback on getting acquainted/using/extending the testbeds, SDR platforms and software toolsets offered in ORCA
- C.3 Feedback on the administration process of your proposal, Patron communication, and support received from the consortium
- C.4 Why ORCA was useful?
- C.5 Other feedback
- C.6 Quote

Part D. ***Leaflet***

This section provides information that can be used to make a leaflet/poster of your Experiment for promotional purposes

This report will not only serve as an evaluation tool to judge payment of the Third Party, but will also serve as:

- input to the evaluation of the user-friendliness of the ORCA testbeds, SDR hardware platforms and toolsets, and
- identification of missing gaps in testbeds, SDR hardware and/or software toolsets.

Part of this report may be used by the ORCA consortium for inclusion in their reporting documents to the EC and in public presentations. Inclusion of confidential information should therefore be indicated and discussed with the ORCA consortium.

This report will also be used for the formal review by the European Commission. Each Third Party is expected to attend this formal review meeting with the EC. In exceptional cases (to be motivated by the Third Party), the Third Party can be represented by his Patron.
The template for the final report will be made available during the execution of the Experiment.

7. Financial information

For this first round of Open Calls for Experiment the available total budget is 350 k€ and per each proposal a budget can be made available up to a maximum of 50 k€ for an experiment of the category 'Scientific Excellence' and 50k€ for 'Innovation by Industry'.

7.1. Payment scheme

As the selected proposers will be linked to the ORCA consortium as Third party, specific arrangements exist with respect to financial costs and payment schemes.

As a Third Party, the proposing party needs to include an overview of the estimated costs in its proposal at the time of submission. Costs consist of personnel costs, direct costs (such as travel, consumables, etc.) and indirect costs. The costs of a Third Party have to comply with the rules and the principles mentioned in Section I, Article 6 (Eligible and ineligible costs) of the H2020 AGA — Annotated Model Grant Agreement (see http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf), in the same way as the beneficiaries, and must be recorded in the accounts of the Third Party. In other words, the rules relating to eligibility of costs, identification of direct and indirect costs and upper funding limits apply. Equally those concerning controls and audits of Section I, Article 22 of the H2020 AGA.

The maximum requested funding for an Experiments in this Call is set at 50 k€ and the funding for the ORCA partner acting as the Patron for an Experiment is 4 k€ euro on average. Costs in this case are related to the provision of dedicated (advanced) support by the Patron

As a Third Party, the selected parties for Experiments need to submit a report at the end of the Experiment (for this call this will be at the latest end of August 2019, under the assumption that the project starts on 1st of March 2019). This report (see Appendix A), must include an overview of the costs incurred and will be accompanied by an invoice to IMEC for 75% of the costs incurred. The report and the declared costs will be evaluated by the ORCA consortium including the partner acting as Patron.
Based on this evaluation, a payment of up to 75% costs incurred, amounting to maximum 75% of the approved funding, will be carried out by imec.

The remaining 25% will be paid following a formal approval of the report and the work at a technical project review by the European Commission (EC). To this end a second invoice needs to be submitted to the project coordinator (imec) for the remaining 25% of the costs incurred.

For Open Call 2 for experiments, review meetings with the EC are planned in October-November 2019. The exact date will be fixed during the execution of the Experiment. The review meeting will be held in Ghent at the imec premises. At the review meeting the results of the Experiment need to be presented, preferably through a real-life (remote) demo running in one the ORCA testbeds. Either the Third Party or the Patron has to present the final results. In the latter case, the Patron should be very well informed, as 25% of the payment depends on the formal approval of the work at the review meeting.

Annex A: Proposal Template

Orchestration and Reconfiguration Control Architecture

Open Call 2

Second ORCA Competitive Call for Experiments

Full Title of your proposal

Acronym of your proposal (optional)

Call[6] - Identifier[7]	ORCA-OC2-EXP-category
Date of preparation of your proposal:	xx/yy/2018
Version number (optional):	
Your organisation name:	name
Name of the coordinating person:	First name Last name
Coordinator telephone number:	number
Coordinator email: [This is the email address to which the Acknowledgment of receipt will be sent]	Email address

[6] This call: ORCA-OC2
[7] 'Experiments (EXP)'
[7] 'Scientific Excellence (EXC)' or 'Innovation by Industry (IND)'

Note: Grey highlighted areas need to be filled. Word template can be downloaded from ORCA project website (see http://www.orca-project.eu/open-calls)

Section A Project Summary

(Maximum 300 words – summary of the proposed work)

Remark: The information in this section may be used in public documents and reports by the ORCA consortium.

This section needs to be completed in the draft proposal and will be used for the feasibility check (cf. Section D)

Section B Detailed description and expected results

(minimum 4 pages, and maximum 6 pages)

This section describes the details on the planned Experiment (what does the proposer hope to obtain?, how?, why is it relevant?). This section should also include all information with respect to the State-of-the-Art, or a comparison to competing commercial wireless solutions in case of Experiments of category 'Innovation by Industry' to show the innovative character of the Experiment and the expected scientific or business impact.

This section needs to be completed in the draft proposal and will be used for the feasibility check (cf. Section D)

B.1. Concept and objectives

Describe the specific objectives of the proposed Experiment, which should be clear, measurable, realistic and achievable within the duration of the Experiment (not through subsequent development). Show how they relate to the topic(s) addressed by the competitive call and how and why ORCA is needed for realizing them.

Describe and explain the overall concept that forms the basis for your Experiment. Describe the main ideas, models or assumptions involved.

B.2. Impact

For Experiments of category ''Scientific Excellence": *Describe how this Experiment fits in your internal research roadmap, and to which extent the broader research community can benefit from the results of the Experiment.*

For Experiments of category ''Innovation by Industry": *Describe how this Experiment fits in your activities, and how this Experiment may strengthen the competitiveness of your business and the growth of your company. Having close contacts with possible end-users during this Experimental phase might be used to illustrate the business impact of the Experiment.*

For all Experiments: *Show that the proposed Experiment has sufficient sustainable benefits for the ORCA project, meaning that there should be an added value for the ORCA project, after the proposer has finished his Experiment.*

B.3. Description of State-of-the-Art

For Experiments of category ''Scientific Excellence": *Describe the advances the proposed Experiment would provide beyond the state-of-the-art, and the extent the Experiment is ambitious. Is this Experiment expected to lead to groundbreaking results or rather incremental results compared to existing work?*

For Experiments of category ''Innovation by Industry": *Describe in detail how the proposed solution compares with existing solutions in the field covered by the Experiment. Are there similar Experiments, products, services, etc. on the market? Is this Experiment incremental to existing work?*

B.4. Methodology and associated work plan

Provide a work plan. Provide clear goals and verifiable results, and also a clear timing.
The work plan involves at least the following phases:

1. *Design of Experiment*
2. *Executing the Experiment*
3. *Analysis & feedback*
    - *Analysis of the results of the Experiment*
    - *Feedback on user experience*
    - *Recommendations for improvements and/or future extensions of ORCA software platforms and testbeds*

4. *Showcase: Set up of a showcase (demonstration) to be used for the evaluation of the Experiment at the review meeting with the EC, and for further promotion of ORCA*
5. *Dissemination: Regular dissemination actions (journal publications, conferences, workshops, exhibitions, events, advertising of results at ORCA website, etc.)*
6. *Final report, code and documentation*

NOTE: there is NO need to define work packages or deliverables. All results need to be reported in the final report at the end of the Experiment. Of course, a good communication plan with the Patron is required to exchange progress within different phases.

Section C Requested ORCA software platforms, radio hardware platforms and testbeds

(Target length 1 page)

Please check the ORCA SDR hardware platforms, software tools and testbeds that will be required for your Experiment.
Please visit the ORCA website to get details on the specific:

- http://www.orca-project.eu/testbeds

This section needs to be completed in the draft proposal and will be used for the feasibility check (cf. Section D).

TESTBEDS	**Required (Yes/No)**
w.iLab.t (Heterogeneous wireless testbed @ imec, Ghent, Belgium)	
IRIS (Software Defined Radio testbed @ TCD, Dublin, Ireland)	
ORBIT (20 x 20 radio grid testbed @ Rutgers University, New Jersey, US)	
TUD macro scale testbed (Macro scale testbed @ TUD, Desden , Germany	
KU Leuven testbed (KU Leuven @Leuven, Belgium)	

SDR HARDWARE PLATFORMS	**Number of nodes required**
Nutaq ZeptoSDR	
Nutaq picoSDR	
PicoZed Xilinx Zynq®-7000 SoC	
USRP B200-mini	
USRP E310	
USRP N210	
USRP X310	
USRP B210/B200	
USRP 2920	
USRP 2921	
USRP RIO 2942R	
USRP RIO 2943R	

USRP RIO 2952R (+ GPS)	
USRP RIO 2953R (+ GPS)	
Xilinx ZC706 Evaluation Kit - Zynq® 7000 SoC + AD FMCOMM radio frontend	
ZedBoard Xilinx Zynq®-7000 SoC	
ZedBoard Xilinx Zynq®-7000 SoC + AD FMCOMM radio frontend	
BB – NI PXI 7975 Module	
BB – NI PXI 7965 Module	
FE – NI PXI 5644	
FE – NI PXI 7976R	

ORCA functionalities	**Required (Yes/No)**
mmWaveLink	
GFDM	
CSMA\CD	
CONSENSE	
IQ Switch	
TAISC	
Radio-slicing	
MySVL	
MultiRat-Coord	
MultiRat-LWx	
gr-specmonitor	
DiMa-MIMO	
LBT	
SDR-SDN	
FullDuplex	

Please provide a short motivation on why specific testbeds, hardware platforms and orca functionalities will be required for the proposed Experiment. (maximum ½ page), for more

details regarding specific ORCA functionalities, please refer to Table I and Table II in the call document.

Section D Feasibility and Relevance check

(maximum 1 page)

This section contains the feedback from the ORCA partner acting as Patron on this Experiment. Each proposing party must contact the ORCA consortium regarding its submission to identify a possible Patron. This Patron can be the ORCA partner responsible for the testbed, hardware or software platform the proposer will use during her/his Experiment. The proposing party must submit its draft proposal to this Patron by Sunday the 25th of November 2018, at 17:00 Brussels local time. The feedback by the Patron is copied into this section of the proposal.

Section E Background and qualifications

(maximum 2 pages)

This section describes the proposer and includes an overview of the activities, the proposer's qualifications, technical expertise and other information to allow the reviewers to judge the proposer's ability to carry out the Experiment.

Section F Expected feedback to the ORCA Consortium

(maximum 1 page)

This section contains valuable information for the ORCA consortium and should indicate the expected feedback the ORCA consortium can expect from the use of its software tools, hardware platforms and/or testbeds after carrying out the Experiment. This information is essential in view of the further improving the usability of the ORCA facility.

Section G Requested funding

(maximum 1 page)

This section provides an overview of the budgeted costs and the requested funding. A split is made in personnel costs, other direct costs (travel, consumables, etc.) and indirect costs.
Besides the table below, extra information can be provided to support the requested funding and which may help to judge the cost to the ORCA project.
Please show your figures in euros (not thousands of euros).

	Total PM	**Cost (€)**
(1) Direct personnel costs		
(2) Other direct costs, of which:		
Travel		
Equipment		
Other goods and services		
(3) Indirect costs		
(4) Total costs (Sum of 1, 2 and 3)		

In row (1), insert your direct personnel costs for the work involved.
In row (2), insert any other costs, for example travel or equipment costs. Please allocate sufficient budget for participation at the final review meeting, and visit(s) to ORCA partners, in case this is required in view of advanced support by the Patron.
In row (3), calculate the indirect costs (for personnel and other direct costs)
In row (4), calculate the sum of your personnel, other direct costs and indirect costs.
The maximum funding which is allowed in this call is set at 50 000 € for Experiment.
In view of the review of your proposal it is best to list the costs related to the proposed Experiment as would be done for any European Project.

Section H Use of proposal information

In this section the proposing party is asked to include some statements related to sharing information of his proposal within the ORCA consortium.
Proposals are treated in a confidential way, meaning that only successful proposals must be disclosed to the ORCA consortium. Open calls previously organized by other projects were very

successful and have revealed that many submitted non-granted proposals also contain very interesting and valuable information that could be used for setting up collaborations or to extract ideas for further improving the federated test infrastructures. Therefore the ORCA project would like to have the opportunity to collect more detailed information and further use this information, also if the proposal is not selected for funding. In any case, the ORCA consortium will treat all information of a proposal confidentially.

Two types of information usage are envisaged:

- *Information which is part of the Sections A, C, D and F will be used within the ORCA project as input for tasks related to testbed and software tools optimizations, sustainability studies, etc. The same information can also be used in an anonymous way to create statistics and reports about this first open call. All proposals submitted to this competitive open call are obliged to allow this form of information access and usage.*
- *Other information belonging to this proposal might also be accessed by the EC and the ORCA consortium, if allowed by the corresponding proposer. Any use of such information will be discussed and agreed upon with the proposers. Proposers have the freedom to select if they wish to support this kind of information usage.*

I allow that the material provided in Sections A, C, D and F of this proposal may be accessed by the EC and the ORCA consortium, also if the proposal is not selected for funding. In any case, the ORCA consortium will treat all this information confidentially. It will be used within the ORCA project as input for tasks related to testbed and software platform optimizations, sustainability studies, etc. The same information can also be used in an anonymous way to create statistics and reports about this first open call.	Yes ☐	
Furthermore, I allow that the other parts of this proposal may be accessed by the EC and the ORCA consortium, also if the proposal is not selected for funding. In any case, the ORCA consortium will treat all information of this proposal confidentially. Any use of this information will be discussed and agreed upon with the proposers.	Yes ☐	No ☐

Annex B: Agreement for the Use of the ORCA Test Facility for Experimentation

Agreement for the Use of the ORCA Test Facility for Experimentation

This Agreement for the Use of the ORCA Test Facility for Experimentation (hereinafter referred to as the "Agreement") is executed by and between:

1. Experimenter:

[FULL NAME + LEGAL FORM], with its registered office situated at [ADRESS] and hereby duly represented by [NAME+TITLE]

2. Coordinator:

Interuniversitair Micro-Electronica Centrum vzw (IMEC), a non-profit organisation duly organized under the laws of Belgium, Register of Legal Entities Leuven VAT BE 0425.260.668, with its registered office situated at Kapeldreef 75, 3001 Leuven, Belgium and hereby duly represented by Ludo Deferm, Executive Vice-President, acting on behalf of and as authorized by the ORCA Partners

relating to the research project under the Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020), Call: H2020-ICT-2016-2017, Topic: ICT-13-2016 for the implementation of the project entitled "Orchestration and Reconfiguration Control Architecture" (hereinafter referred to as "ORCA" or "the Project)

Hereinafter individually referred to as the "Party" and jointly as the "Parties"

- WHEREAS as from January 1st, 2017, the Coordinator participates in the Project together with The Provost, fellows, Foundation Scholars & The other Members of Board of the College of the Holy & Undivided Trinity of Queen Elizabeth near Dublin ("TCD"), Katholieke Universiteit Leuven ("KUL"), Technische Universitaet Dresden ("TUD"), National Instruments Dresden GmbH ("NI"), Rutgers, The State University of New Jersey ("Rutgers"), Martel GmbH ("MARTEL") (hereinafter collectively referred to as the "ORCA Partners" or "Beneficiaries";

- WHEREAS the ORCA Partners have amongst themselves entered into a written agreement detailing their respective rights and obligations under the Project;

- WHEREAS the purpose of ORCA **is** to accelerate flexible end-to-end network experimentation by making open and modular software and hardware architectures available that smartly use novel versatile radio technology, more-specifically real-time Software Defined Radio (SDR) platforms meeting the requirements in terms of runtime latencies, throughput, and fast reconfiguration and reprogramming;

- WHEREAS the ORCA platform consists of individual testbeds and tools put at the disposal by different resource providers;

- WHEREAS the Experimenter through the execution of the submitted proposal (hereinafter referred to as the "Proposal") under an open call (in accordance with the rules detailed in the open call documents) has applied to use the **Test Facility** to be provided by the ORCA Partner(s) identified in the Proposal;

- WHEREAS on the basis hereof the Experimenter will be entitled to use the Test Facility subject to the terms and conditions described hereunder;

NOW, THEREFORE, the Parties agree as follows:

Article 1 - Definitions

When used herein, unless the context requires otherwise, the following words and expressions shall have the meaning as stated hereunder:

1.1. "Experiment(s)" means the experimentation activity(ies) undertaken by the Experimenter, alone or (if applicable) with the patron, for testing new ideas and technologies in the area of computer networking. Details of the Experiment can be found in the Proposal submitted by the Experimenter.

1.2. "Experiment Results" means any tangible and intangible outputs of the Experiments that are generated by or on behalf of the Experimenter (e.g. involvement of patron) as well as any rights attached to them.

1.3. "Maximum Budget" means the maximum amount of funding to be made available by the Coordinator to the Experimenter by way of financial support as further detailed in Appendix 1 hereto.

1.4. "Platform" means the ORCA resources and tools in the ORCA **Facility**. The Platform has 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, provided that this activity is legal.

1.5. "Test Facility" means the specific Platform components that are to be made available to the Experimenter for the performance of Experiment(s) in accordance with the terms and conditions of the Agreement.

Article 2 – Scope of the Agreement - Responsibilities

2.1. Subject to the terms and conditions set forth in the Agreement, the Experimenter is hereby granted the non-exclusive, non-sub licensable, non-transferable right to use the Test Facility for the performance of Experiments. Any other use of the Test Facility by the Experimenter than the use expressly described in the Experiments is not permitted.

2.2. Responsibilities of the Experimenter

2.2.1. The Experimenter shall perform its tasks in accordance with the conditions of the Agreement and the Proposal towards the implementation of the Experiment to the best of its ability and in accordance with any guidelines issued by the Coordinator.

2.2.2. The Experimenter shall not, directly or indirectly:

- rent, lease, transfer or sub-license the Test Facility, nor permit any third party to do so;
- use the Test Facility to host commercial activities or in a way that limits the rights of others to use the Test Facility;
- remove, alter, cover or obscure any copyright notices or other proprietary rights notices placed or embedded on or in Test Facility;
- reverse engineer, decompile, disassemble, re-engineer, translate, integrate, adapt, create derivate works or updates of the Test Facility or any part thereof nor permit, allow, or assist any third party to do so.

2.2.3. The Experimenter acknowledges and agrees that besides the terms and conditions detailed in the Agreement, specific regulations of the party providing the Test Facility (the "Provider") may apply. It is the Experimenter's responsibility to remain aware of all applicable regulations and of any changes made to them.

If there is evidence that the actions of the Experimenter are adversely impacting the quality offered by the Platform, the Coordinator is empowered to take reasonable measures to terminate or reprioritize usage in order to protect the overall operation of the Platform.

2.2.4. The Experimenter is responsible and liable for any and all actions performed by using the Test Facility. The Experimenter undertake that it shall:

- comply with all instructions and regulations relating to the use of the Test Facility;
- not use the Test Facility in a manner which is or is likely to adversely affect the Test Facility or which may disturb the working of, interfere or damage the Test Facility or any other system. In case of misuse, the Experimenter is responsible for restoring all damages to the Test Facility and is responsible for any loss and damages incurred;
- not interfere with others' work or attempt to invade their privacy;

- not use the Test Facility in a manner that may damage the ORCA Partner'(s) t's good name and reputation or may infringe the intellectual or industrial property rights of a Party or any other third party. Copyright, other intellectual property right and data protection legislation must be observed by the Experimenter.

2.2.5. The Experimenter shall, in a timely manner, provide all information reasonably required by the Coordinator such as but not limited to the information required for the Coordinator to comply with its obligations under the Agreement, the Grant Agreement with the European Commission and the Consortium Agreement.

2.2.6. The Experimenter shall ensure that neither the Experimenter nor anyone of its behalf or with its consent causes any damage to the Test Facility.

2.2.7. The use of the Test Facility is at Experimenter's own risk and responsibility. The Coordinator does not assume any liability in regards to interruption, corruption, loss or disclosure of services, processes and data hosted on the Platform. The Experimenter acknowledges and agrees that the uninterrupted availability and use of the Test Facility cannot be ensured ("reasonable efforts"). The Experimenter shall take appropriate measures to protect its credentials and prevent their use by third parties. The information the Experimenter provides when requesting an account should be correct. The Experimenter is responsible for all and any loss or damages incurred by the Coordinator, the Provider and/or the Beneficiaries as a result of any unauthorized transfer by them of their password.

2.3. The Test Facility will be put at the disposal of the Experimenter free of charge for the Experiments detailed in the Proposal and on a reasonable effort basis.

2.4. The Coordinator shall give the Financial Support for the Experiment in accordance with the conditions detailed in article 3 of the Agreement.

Article 3 – Financial support

3.1. For the performance of the Experiment in accordance with the terms and conditions of the Agreement, the Coordinator agrees to provide within the Maximum Budget financial support to the Experimenter. Details can be found in Appendix 1.

3.2. Invoicing of the financial support will effectuated by the Coordinator for the Experimenter as detailed in the Open Call document. Payment is subject to receipt of the funding from the European Commission, acceptance by the Beneficiaries of the reports and the attendance of the meetings as detailed in the Open Call documents.

3.3. The Experimenter hereby agrees to be bound by the obligations as set forth in the articles 22, 23, 35, 36, 38 and 46 of the Grant Agreement. These articles can be found http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf

Article 4 – Intellectual property – Consent to use data

The Results achieved by the Experimenter using the Test Facility will be owned by the Experimenter.

The Experimenter will deliver a final report describing the Results of the Experiment and the experience gained in using the Test Facility. This final report can be made public to the European Commission and all Beneficiaries including their Affiliated Entities.

Publications and demonstrations made based on the Results of the Experiment should clearly mention the usage of the Test Facility and the provider and refer to the Project even if the publication or demonstration takes place after the end of the Experiment.

The Experimenter agrees the Coordinator and the other relevant ORCA Partner(s) may monitor the Test Facility and traffic for vulnerabilities and conformance to authorized use and may collect and use data and information, including but not limited to the information about Experimenter's use of the Test Facility. This information, provided it is anonymized, can be used by to improve the Test Facility.

Article 5 - Liability – Warranty

5.1. The Experimenter shall fully and exclusively bear the risks in connection with the Experiment, including without limitation to any risk arising from the use of the Test Facility. The Experimenter shall hold harmless and indemnify the Coordinator and/or the ORCA Partners harmless against all losses, repayments, liabilities, claims or damages which the ORCA Partners and/or the Coordinator as a result thereof would incur or suffer or have to pay to the European Commission or any third parties. In addition, should the European Commission have a right of recovery against the Coordinator or any other Beneficiary regarding any or all of the Financial Support granted under the Agreement, the Experimenter shall repay the sums in question in the terms and on the dates stipulated by the Coordinator.

5.2. No warranty whatsoever is given with respect to the Test Facility, support and all information provided hereunder including, but not limited to, any express or implied warranty for use,

availability, reliability, quality, fitness for a particular purpose or non-infringement of third party intellectual property rights. They are provided “AS IS”.

5.3. To the extent authorized under mandatory law, in no event shall the Coordinator or any of the other Beneficiaries be liable to the Experimenter or any person or entity connection with any of them for costs of procurement of substitute goods, property damage, personal injury, profit loss, business interruption, or for any other special, indirect, consequential or incidental damages, however caused, whether for breach of warranty, contract, tort or negligence, strict liability or otherwise.

The Coordinator’s liability in aggregate, arising out of or in connection with the Experiment and/or the Agreement, however caused, whether for breach of warranty, contract, tort or negligence, strict liability or otherwise, shall not exceed the Maximum Grant.

5.4. The Coordinator is not liable for any failure due to the direct or indirect use, loss of use, or delay in delivery of the Test Facility or the services provided herein, unless the Experimenter can show wilful misconduct, fraud or deceit by the Coordinator.

Article 6 – Term and termination of the Agreement

The Agreement enters into force on the date detailed in Appendix 1 for the period provided in Appendix 1, unless sooner terminated in accordance with article 6. The Experimenter acknowledges and agrees that its authorized use of the Test Facility is only effective during the term of the Agreement.

The Experimenter’s right to use the Test Facility and the Agreement are automatically and without notice from the Coordinator terminated if the Experimenter fails to comply with any of the obligations detailed in the Agreement.
Upon termination of the Agreement, the Experimenter shall immediately discontinue all use of the Test Facility.

Article 7 - Applicable law

The Agreement is governed by the laws of Belgium without reference to its conflict of law principles. Any dispute arising out of the Agreement shall be settled by the competent courts located in Brussels (Belgium).

Article 8 - Miscellaneous

8.1. The Experimenter represent and warrant that the Test Facility shall not be evaluated or employed for the purpose of use in the design, development, production, stockpiling or use of weapons of mass destruction, such as nuclear, chemical or biological weapons or in any manner for a military end use or with a military end-user. The Experimenter shall comply with applicable laws and regulations controlling the export of technical data, computer software and all other export controlled commodities and ensures that it will not include the participation of persons on any restricted party listing in accordance with applicable national and international regulations. The Experimenter agree to indemnify, defend and hold harmless the Coordinator and the other ORCA Partners from any and all claims, damages and other liabilities resulting from the Experimenter's violation of any applicable export regulations.

8.2. The Parties may sign and deliver this Agreement by electronic transmission. Each Party agrees that the delivery of this Agreement by electronic transmission shall have the same force and effect as delivery of original signatures and that each Party may use such electronic or facsimile signatures as evidence of the execution and delivery of this Agreement by the Parties to the same extent that an original signature could be used.

AS WITNESS, the Parties have caused the Agreement to be duly signed by the undersigned authorised representatives in separate signature pages.

For Experimenter,

Name:
Title:
Date:

For IMEC,

Ludo Deferm
Executive Vice-President
Date:

Appendix 1:

Experiment – financial information

Duration of the Experiment:

Start date: xxx

End date: xxx

Maximum Budget: xxx k€

Payment conditions (subject to payment conditions detailed in article 3.3): (timing of the payment, unless this is included in the open call document)