

ANNUAL REPORT

2016



 **Generalitat de Catalunya**
Government of Catalonia

 **UNIVERSITAT POLITÈCNICA DE CATALUNYA**
BARCELONATECH

 **Ajuntament de Barcelona**

JUNIPER
NETWORKS

cellnex
enjoy. share. connectivity.

 **vodafone**

EPSON

 **MEDIAPRO**

 **orange**

 **upf.** **Universitat Pompeu Fabra Barcelona**

 **Universitat Ramon Llull**

 **CISCO**

 **FUJITSU**

 **interoute**
from the ground to the cloud

INDEX

2016 Annual Report

4

PRESENTATION

Letter of the President 4

6

HIGHLIGHTS

Facts & Figures 8
International R&D Activities..... 10
Projects with the Public
Administration12
Technology Transfer &
Social Impact 14
Outreach Activities 16

18

RESEARCH AREAS

5G/IoT 20
· Software Networks
· Mobile Wireless Internet
· RINA
Open Big Data 26
Media Internet 28

30

INNOVATION BUSINESS UNITS

Smart Cities & Regions 32
Industry 4.0 34
Health & Social Care 36
Living Labs & Digital Social
Innovation 38

40

AT A GLANCE

Board of Trustees 42
Scientific Advisory Board 42
Executive Committee 43
Staff 44
Associations, Standardization
Organizations & Platforms 46
Fairs & Congresses
Exhibitions 46

LETTER OF THE PRESIDENT



Jordi Puigneró i Ferrer
President of i2CAT Foundation

In 2016, the Government of Catalonia has invested in boosting ICT and advanced digital technologies as a strategic driver for the digital transformation. The inclusion of the *Secretary's Office for Telecommunications, Cybersecurity and Digital Society* in the Presidential Department of the Government of Catalonia and the creation of the National Pact for the Digital Society emphasise the relevance of ICT when facing new challenges, both inside the administration and in most of economic sectors.

Under these new circumstances, i2CAT Foundation has consolidated in 2016 as an essential institution to drive and develop strategic projects and initiatives which fully suit the Catalan Government's ICT policies and strategies. The cooperation with the Presidential Department for the **SmartCAT** strategy, the promotion of **Plataforma Industrial 4.0** with the Department of Business and Knowledge, or the creation of the **CatLabs Network** with the Vice-Presidency Department of Economy and Finance are some examples.

The achievement of these milestones is reflected in the 22% growth in revenue which the Foundation has experienced in 2016

From a research point of view, in 2016 i2CAT has increased its international relevance thanks to new R&D projects funded by the European Commission under the H2020 programme. It is worth mentioning the 5G projects, a field in which i2CAT is a European benchmark institution due to its participation in 20% of the total EC-funded 5G projects. The Foundation's exceptional knowledge of 5G will be the seed for the creation of an experimental 5G/IoT platform that will become a strategic infrastructure to position Catalonia as an international 5G hub.

Technology and knowledge transfer to market have also been very positive in 2016. It has seen the expansion in number and volume of R&D projects executed in cooperation with private companies and the incorporation as a new shareholder of a USA technological **start-up** which i2CAT has a strategic collaboration agreement with.

The achievement of these milestones is reflected in the **22% growth** in revenue which the Foundation has experienced in 2016.

I congratulate the i2CAT team for the landmarks of 2016 and encourage them to keep working at the same level of excellence and commitment to not only help the Foundation enhance its technological knowledge, but also generate the economic and social impact needed to address the new challenges of Catalonia.

2016 HIGHLIGHTS

The main efforts in 2016 have been focused on:

- ✔ Generating international relevant research knowledge in the field of Advanced Digital Technologies by leading and participating in R+D European projects.
- ✔ Fostering flagship initiatives to support ICT and innovation strategies of the Government of Catalonia.
- ✔ Collaborating with companies in the development of innovative added-value services and products.
- ✔ Participating in the main ICT fairs and events to identify new opportunities of collaboration



Some of the most relevant 2016 milestones have been:

- Achieving a 22% growth in turnover, reaching 4,45 M€
- Enhancing the leading position in the research and development of 5G technologies, achieving 4 new H2020 projects funded by the European Commission
- Increasing the involvement with companies and citizens, developing 34 R+D+i projects with companies
- Executing strategic projects with the Government of Catalonia, such as SmartCat, Industrial Platform 4.0 and Catlabs Network.

FACTS & FIGURES

FUNDING

Incomes Breakdown



11%

Core Funding. Government of Catalonia

43%

European Grants

3%

National Grants

20%

R+D Services to Companies

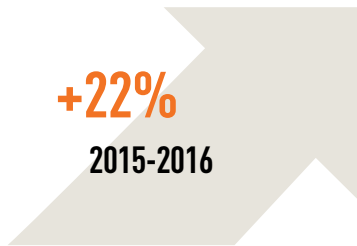
13%

R+D Projects Government of Catalonia

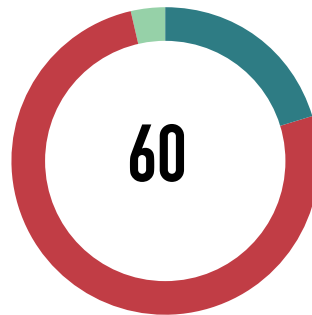
10%

Business Project Contributions

GROWTH TURNOVER



STAFF



20%

PhD

77%

Engineers and Graduates

3%

Others

PROJECTS

Number of R+D+I Projects



36

Competitive Funds

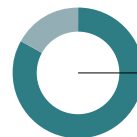
34

R+D Services to companies

9

R+D Projects Government of Catalonia

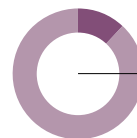
Competitive Funding R+D+I Projects



83% International

17% National

R+D+I Services to Companies



12% International

88% National

FAIRS & CONGRESSES

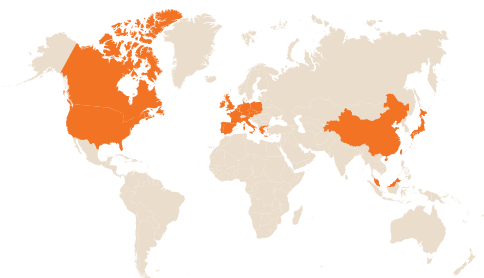
+30 Participations in scientific & commercial events

R&D COMPETITIVE PROJECTS PROPOSALS SUBMITTED

+150 Competitive projects proposals

INTERNATIONAL NETWORKING

+215 Travels across the world



MEDIA IMPACTS

+ 50 TV, radio, press

PUBLICATIONS

+ 40 Publications

Some of the publications of 2016:

1. M.S. Siddiqui, et al., "Hierarchical, Virtualized, and Distributed Intelligence 5G Architecture for Low-Latency and Secure Applications", Journal, Journal: Transactions on Emerging Telecommunications Technologies 5G issue.
2. S. Vrijders, V. Maffione, D. Staessens, F. Salvestrini, M. Biancani, E. Grasa, D. Colle, M. Pickavet, J. Day, L. Chitkushev; "Reducing complexity of Virtual Machine Networking", Journal IEEE Communications Magazine.
3. J.O. Fajardo, F. Liberal, I. Giannoulakis, E. Kafetzakis, V. Pii, I. Trajkovska, T.M. Bohnert, L. Goratti, R. Riggio, J. Garcia-Lloreda, P. S. Khodashenas, et al., "Introducing mobile edge computing capabilities through distributed 5G Cloud Enabled Small Cells". Springer Journal ACM/Springer Mobile Networks and Applications (MONET), Special Issue on Mobile Networks and Management.
4. A. Betzler, C. Gomez, I. Demirkol, J. Paradells, Congestion Control for the Internet of Things Journal Publications, IEEE Communications Magazine.
5. M. Aguilar, D. Cassany, S. Fernández, "Analysis of User Behavior with a Multicamera HbbTV App in a Live Sports Event", Conference Publications, ACM TVX 2016, International Conference on Interactive Experiences for Television and Online Video.
6. J. Gutiérrez, M. Nebojsa, D. Camps-Mur, E. García, I. Berberana, M. Anastasopoulos, A. Tzanakaki et al., "5G-XHaul: a converged optical and wireless solution for 5G transport networks", Journal, Transactions on Emerging Telecommunications Technologies.

INTERNATIONAL R&D ACTIVITIES

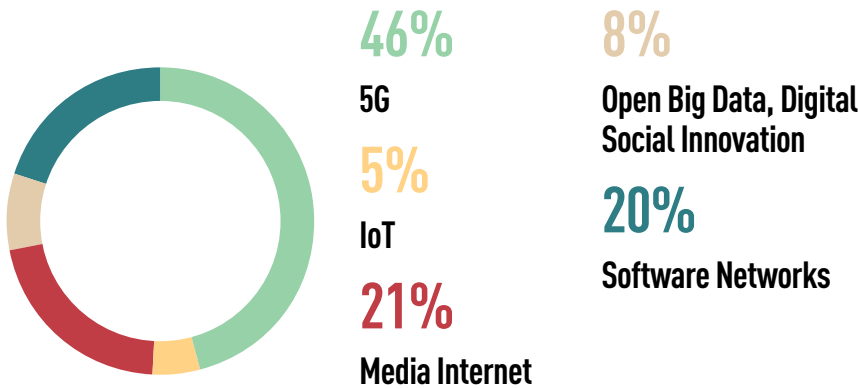
The success in the Horizon 2020 calls for funding during 2016 is a remarkable achievement. Thanks to the effort and quality research developed by the different areas and departments, i2CAT has obtained 9 new H2020 projects in several ICT fields.

9* H2020 projects granted

3,8 M€ H2020 funding granted

* 3 coordinated

H2020 FUNDING BREAKDOWN R&D FIELDS



PARTICIPATION IN THE EU H2020 WORK PROGRAMME SINCE 2014



21 projects granted
5 coordinated by i2CAT

11% of the overall EU H2020 Funds in the ICT LEIT field granted to Catalonia (*)

4,4% of the overall EU H2020 projects granted to CERCA research centers in Catalonia (*)

8,6 M€ funding granted

(*) period 2014-2015

5G LEADERSHIP

The European Commission (EC) has launched a plan to boost EU efforts for the deployment of 5G infrastructures and services across the Digital Single Market by 2020. These technologies are considered a key asset. The action plan has set out a clear roadmap for public and private investment on 5G infrastructure in all EU member states to meet the challenge of making 5G a reality for citizens and businesses by the end of this decade.

During 2016, i2CAT has strengthened its leading position in the research and development of 5G technologies, both in **Catalonia** and **Europe**.

EUROPE



8

5G H2020 on-going projects

2

coordinated by i2CAT

4 granted during 2014

4 granted during 2016



20%

participation share in the overall 5G projects funded by EC

5G ESSENCE

5GCity

5G-PICTURE

SAT 5G

LOCAL

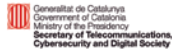
1. Supporting the creation of a 4G/ 5G Open Experimental Platform in Barcelona. A strategic field trial infrastructure aimed at strengthening the digital society in the territory.
2. In collaboration with other centers, institutions and companies and taking advantage of the knowledge generated by the 5GPPP H2020 projects, Catalonia has the potential to become an international 5G/ IoT digital hub.

PROJECTS WITH THE PUBLIC ADMINISTRATION

SMARTCAT, IoT CATALAN ALLIANCE

The IoT Catalan Alliance is an initiative that brings together all the players in the Catalan Smart ecosystem to raise awareness of the potential we have, as a country, to foster collaboration and the generation of projects in the Internet of Things area.

This project is included in the SmartCAT strategy of the Government of Catalonia and is managed and promoted from i2CAT. During 2016, the community has consolidated and worked to identify all the players in the IoT value chain. Currently, the members of the IoT Catalan Alliance include more than 60 companies and 10 universities and research centres.



MORE INFORMATION: www.cataloniaiot.com

INDUSTRIAL PLATFORM 4.0

The Industrial Platform 4.0 (PI4.0) stands for the Catalonian Smart Industry. It is a strategic initiative supported by the Government of Catalonia which aims at becoming an experimental environment for the creation, validation and testing of high added-value industrial digital services.

In 2016, the cloud platform and marketplace that compose the PI4.0 have been created, and the integration of digital services with different pilots has been validated. The integrated and tested services include two different cloud services that are available to be consumed by “pay per use” in the marketplace, a monitoring and predictive maintenance service based on machine learning in the cloud, and a IoT starter kit based on Node-red that can be used by IoT Master students.

The PI4.0, as a marketplace of digital services, provides companies with access to new technologies at a very competitive cost and minimizes the difficulties for new players in the ecosystem.



MORE INFORMATION: www.plataformai40.com

8

Open dissemination events

3

Events for the alliance members

4

Work-group sessions

XARXA CATLABS

The Xarxa CatLabs (CatLabs network) project is an ambitious collaboration between i2CAT Foundation and the Government of Catalonia to create a Digital Social Innovation Network in Catalonia. It aims at promoting new mechanisms for digital, social and collaborative innovation in order to provide better responses to the challenges faced by the economy and society, and to enable and promote the participation of the Quadruple Helix in the research and innovation system, RIS3CAT, and new European models of innovation.

A remarkable achievement in 2016 was the successful presentation and kickoff of the Catlabs network project within the BarcelonaSmart City Expo in November, providing the foundation with a proof of concept of this novel approach to citizen-driven, social impact-oriented open innovation during 2017.



MORE INFORMATION: www.catlabs.cat

VINCLES

A social innovation project designed to strengthen the social ties of elderly people who feel isolated and to improve their well-being with the aid of new technologies. The project creates personalized and connected trust circles that consist of a group of individuals who come together to provide intentional support for someone who is facing a challenging personal situation.

The Barcelona municipality has already initiated the pilot test of the programme and expects to reach 400 users. The participants in the initiative have been selected through the telecare service of the City Council.



TECHNOLOGY TRANSFER & SOCIAL IMPACT

During 2016, i2CAT has provided R&D services to more than 30 companies and institutions and has organized several initiatives to include citizens in the digital innovation ecosystem.

These are some of the outstanding projects, workshops and hackathons executed.

NEXT GENERATION INTERNET



Routing control plane to the cloud



Software defined WAN Services

eHEALTH



Patient monitoring and tracking platform



Platform for remote diagnosis

SMART:

Leisure



Collaborative live video platform



Video codec for cloud gaming platforms

Retail and Logistics



Visible Light Communications for automated guided vehicles



OPTO solution for contactless payment terminals

Buildings



Smart plugs based on the Internet of Things



Energy efficiency platform

Mobility



Vehicle to everything (v2X) communications

| Workshops | DATE | PROJECT | PROFILE OF USERS | NUMBER OF USERS |
|---|----------|---------------------|--|-----------------|
| The Ultraorbism experience: Living Labs and open experimentation with cultural heritage (Amsterdam, Recalibrating Relationships Conference) | April | RICHES | Cultural heritage specialists | 20 |
| The Open Data Lab model and pilots (Krems am Donau, CEDEM Conference) | May | Open4Citizens | Researchers on open governance and open data | 30 |
| Open data and citizen laboratories (Barcelona, Festa de la Ciència 2016) | June | Open4Citizens | Citizens | 80 |
| Open Innovation and Open Science (Istanbul, ENOLL OpenLivingLab Days) | August | ENOLL | Researchers on open innovation | 30 |
| The Catlabs model (Barcelona, The Med as Living Lab Conference) | November | Catlabs | Researchers on open innovation | 40 |
| Open Innovation Seminar (Zaragoza, Rutas de Innovación) | December | Rutas de Innovación | Health specialists | 30 |

| Hackathons | DATE | PROJECT | PROFILE OF USERS | NUMBER OF USERS |
|------------------------------------|-----------|---------------|---|-----------------|
| Open Data Citizen Hackathon | September | Open4Citizens | Citizens, open data enthusiasts and activists | 60 |

OUTREACH ACTIVITIES

FEBRUARY

| | |
|---|------------------------------|
| “i2CAT and 5G Industry” | TV3 |
| “A new kind of network: RINA progress Update” | <i>Geddes Fresh Thinking</i> |
| “The solution that helps blind people to get oriented in unfamiliar environments” | <i>ComputerWold</i> |
| Els Matins | TV3 |

MARCH

| | |
|--|------------------------------|
| “A technology that allows blind people to know where things are” | <i>TVE, A punto con La 2</i> |
| “To communicate through the light” | TV3 |

MAY

| | |
|---|----------------------|
| “i2CAT develops a payment method based on the mobile screen light and Bluetooth technology” | <i>Ecodiario</i> |
| “Europe lags US on productivity - so can living labs help bridge the innovation gap?” | ZDNet |
| “i2CAT frees contactless mobile payments” | <i>La Vanguardia</i> |

JUNE

| | |
|---|----------------------|
| “The rainbow as a contactless payment solution” | <i>El Mundo</i> |
| “TV3, i2CAT and Cellnex Telecom finish the TV-RING project they have been collaborating in” | <i>Video Popular</i> |

JULY

| | |
|---------------------------------------|----------------------|
| “Augmented reality, more than a game” | <i>Nació Digital</i> |
|---------------------------------------|----------------------|

SEPTEMBER

| | |
|--|-----------------------------|
| “ImmersiaTV picked as number 1 interesting product” SandboxTV Product hunt on IBC” | <i>youtu.be/ZQJzp-Orzdl</i> |
| “Open data should be accessible to everyone” | <i>El Periódico</i> |
| “Open data citizen hackathon” | <i>El Digital</i> |

OCTOBER

“i2CAT Foundation creates a technology that allows for indoor autonomous guidance”

La Vanguardia
EcoDiario

“The Internet of Things lands and targets the industry instead of the consumer”

Diari Ara

NOVEMBER

“Smart Traffic Lights that notifies when the light colour is going to change”

Solomoto.es

“Catalan researchers are targeting the healthcare sector with a tiny new sensor that’s so precise it can detect the flutter of a butterfly”

DZNet

“To allocate functions to the connectivity”

El Punt Avu

“Smart Cities become a reality”

El Periòdico

“Urban Mobility solutions play a leading role in the Smart City Expo World Congress”

Telemadrid
Inversión y finanzas
Canarias 7

“i2CAT creates a smart traffic light that makes traffic easier and helps blind people to cross the street”

Gente digital
La Vanguardia

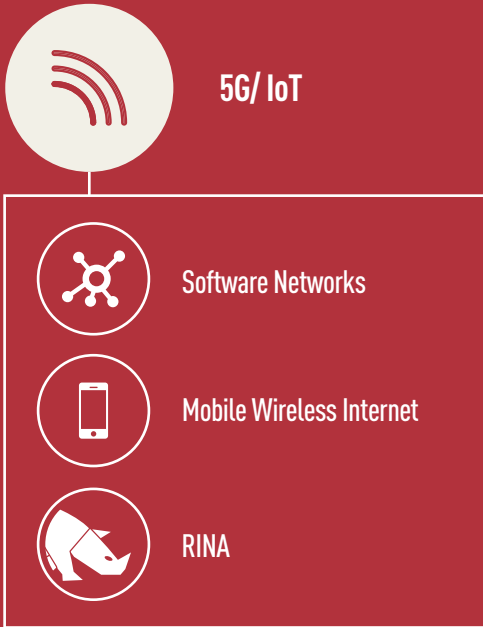
DECEMBER

“i2CAT in the Virtual Reality Landscape”

Real o virtual

RESEARCH AREAS

With the aim to continue increasing the excellence and international relevance of the research carried out to address new challenges of the next generation Internet, during 2016 i2CAT has introduced some changes in its research structure:



- Coordination of the research areas of Software Networks (SN), Mobile Wireless Internet (MWI) and Recursive Internetwork Architecture (RINA) under the “5G/IoT” Group, in order to boost the impact among all the 5G projects and IoT initiatives that i2CAT is leading and developing.

- Creation of the research area of Open and Big Data, in order to deploy scalable architectures and data preparation technologies to enhance the data-driven philosophy of the society.



Open Big Data

- Definition of a Cybersecurity roadmap in order to explore the main future challenges in fields like IoT, digital identity trust and network security, and to analyze the opportunities to create a new Cybersecurity research area in i2CAT during 2017.



Media Internet

FOCUS

H2020 on-going research projects during 2016

i2CAT gathers a wide experience in national and European R&D projects, leading research lines in new fixed & mobile network architectures, wireless sensor networks, and content-based multimedia technologies. This know-how is applied to the verticals of Smart Cities & Regions, Industry 4.0, Health & Social Care, and Digital Social Innovation.

Granted on:

| | 2014 | 2015 | 2016 |
|--|--|---|---|
| Software Networks | CYCLONE (GA N° 644925) GN4 (GA N° 38875) | GN4-2 (GA N° 731122) SHIELD (GA N° 700199) ARCFIRE (GA N° 687871) | Fed4FIREplus (GA N°732638) |
| RINA | PRISTINE (GA 619305) | | |
| 5G | CHARISMA** (GA N° 671704) SONATA (GA N° 671517) 5G-XHaul (GA N° 671551) SESAME-H2020 (GA N° 677596) | | 5GCITY** (GA N° 761508) 5G-PICTURE (GA N° 762057) SaT5G 5G-ESSENCE (GA N° 761592) |
| IoT | GrowSmarter (GA N° 646456) | | FLAME (GA N° 731677) |
| Immersive Technologies | | ImmersiaTV** (GA N° 688619) | ImAc** (GA N° 761974) VRTogether** (GA N° 762111) |
| Open Big Data & Digital Social Innovation | | O4C (GA N° 687818) | MUV (GA N° 723521) |

** coordinated by i2CAT



5G/IoT



SOFTWARE NETWORKS MOBILE WIRELESS INTERNET RINA

The digitalisation era requires an intelligent Internet based on new architectures and services, able to interconnect people, objects and environments in more efficient and dynamic ways. New systems and protocols are also needed to transform information into new knowledge by creating intelligent environments. Users shall be empowered to design, reconfigure and manage the networks based on their own interests and needs.

The **Software Networks (SN)** research area of i2CAT focuses on exploring and defining new ways to provision and manage Future Internet networks, enabling new functionalities and business models by means of integrating technologies such as networked Clouds, Software Defined Networking (SDN) and Network Function Virtualization.

RESEARCH CHALLENGES

5G Network Architectures

5G technologies represent the next generation of communication standards able to provide ultra-high connection speeds, increased coverage, spectral efficiency and very low latency, allowing connectivity among billions of devices. This line aims at investigating novel SDN/NFV based networking solutions for providing 5G services in a versatile, fast and efficient way.

TECHNOLOGIES

Software Defined Networking (SDN)

Network as a Service (NaaS)

Network Function Virtualisation (NFV)

Recursive Internet Architectures

APPLICATIONS

Multi-tenancy in Open Access Networks

Virtual network security

Dynamic network overlays

Mobility and multi-homing

Cloud Technologies

Cloud technologies are one of the main drivers of the digital transformation, enabling distributed computing and storage with secure and robust connectivity. SN is actively innovating in cloud technologies bringing automation to cloud and network services, while lowering the transformation barrier for SMEs and more traditional industries.

TECHNOLOGIES

Cloud computing

Fog/Edge computing

Infrastructure as a Service (IaaS)

OpenStack, Docker and Micro-services

APPLICATIONS

Cloud networking

Hybrid clouds

Deployment of complex cloud applications

Data integration and slicing

OUTSTANDING PROJECTS EXECUTED DURING 2016

- CHARISMA** Proposes an intelligent hierarchical routing and virtualised architecture for future converged wireless/wireline networking offering virtualized E2E security service.
- SONATA** Is a NFV-focused project targeting flexible programmability of software networks and the optimization of their deployments via network function chaining and dynamic customizable orchestration.
- SESAME** Targets innovations around three central elements in 5G: placement of network intelligence, evolution of Small Cell, and multi-tenancy in communication infrastructures.
- SHIELD** Aims at designing and developing a complete and integrated cybersecurity framework, leveraging the huge momentum and potential of NFV and Big Data.
- FLAME** Addresses management of OTT media applications and deliver insight into platform operations for every experiment that is executed, in actual smart city scenarios.
- CYCLONE** Is a Horizon 2020 innovation action which aims at integrating existing cloud management software to allow a unified management of federated clouds.

RELEVANT ACHIEVEMENTS

- ✓ Successful first year project reviews of three on-going 5G projects: CHARISMA, SONATA and SESAME.
- ✓ Kick-off of the SHIELD project and securing another new project, titled, FLAME, in which i2CAT will prepare an experimentation testbed in the city of Barcelona with a deployment of SDN enabled wired and wireless devices.
- ✓ Delivery of the final version TeNOR, an orchestration platform based on ETSI NFV specifications that allows OpenStack based VNF deployment and ODL based service chaining. TeNOR is also being used in other H2020 projects such as CHARISMA and SESAME.

MAIN PARTNERS





5G/loT



SOFTWARE NETWORKS MOBILE WIRELESS INTERNET RINA

The **Mobile Wireless Internet (MWI)** research area has developed more than 50 projects in the area of wireless communications in collaboration with the UPC Barcelona Tech since 2003. Its main areas of expertise are Wireless Sensor Networks (WSN) and high capacity wireless access technologies that are key enablers for the future Internet of Things and future 5G systems.

MWI's expertise spans from the physical design of embedded systems, application of wireless technologies to indoor location, driver level optimizations of broadband wireless technologies based on IEEE 802.11, software defined networking, and vehicular communications. Among the main market sectors impacted by the technology of the Mobile Wireless Internet Area we find: Smart Cities, Smart Building, Smart factories and Mobile networks.

RESEARCH CHALLENGES

Internet of Things (IoT)

The goal of the IoT research line is to Integrate Internet capabilities into devices constrained in terms of energy, compute, storage, and communications, in order to provide connectivity for the next billion devices.

TECHNOLOGIES

Radio wake-up System

6LowPAN, CoAP, ZigBee, Z-Wave, BLE, RFID, Ultra Wide Band (UWB)

LP-WAN (LoRa, NB-IoT, SIGFOX)

Visible Light Communications, Visible Light Positioning

V2X communications (ETSI-G5, 802.11p, LTE)

APPLICATIONS

Smart Cities (smart lighting, smart mobility, smart energy)

Industry 4.0

Automation and domotics for smart building

Mobile Payment systems

High precision indoor location

Software Defined Wireless Networks (SDWN)

The goal of this research line is to design algorithms and protocols that will lay the foundation of future 5G networks, allowing to provide the wireless capacity required to cope with the forecasted increase of demand on mobile connectivity. The group focuses on experimental improvements of systems based on IEEE 802.11 radios

TECHNOLOGIES

IEEE 802.11 technologies (803.11n, 802.11ac)

LTE (based on OpenAirInterface)

Software Defined Networking (openswitch, OpenDayLight)

Wireless backhauling (Sub6 and mmWave)

High Density Wi-Fi networks

APPLICATIONS

Wireless backhauling to support e.g. Small Cells, surveillance

Neutral Small Cell operators

Wireless access in high density venue (e.g. stadium, concert)

Bare Metal Wi-Fi

High precision indoor location

OUTSTANDING PROJECTS EXECUTED DURING 2016

5G-XHAUL

This (www.5g-xhaul-project.eu/) is a European H2020 project within the framework of the 5G-PPP initiative that is defining the future 5G technology. In particular, 5G-XHaul is developing a new software controlled transport network that will unify the current backhaul and fronthaul network segments over a single network infrastructure. In 2016 the MWI group demonstrated a custom SDN agent that allows to have an SDN controller controlling a mesh composed of 802.11 radio devices.

SIMON-AURA

SIMON, leading manufacturer of small electrical material on the Spanish market, has designed a new line of home automation products based on the Z-Wave technology that commemorates the centenary of the company. As part of this project, the MWI group developed the Hub IO product, a smart-plug that acts as the central controller of the Z-Wave network and allows user interaction through its Wi-Fi interface. The Hub IO also permits to orchestrate different devices in order to create automated scenes. SIMON has started its commercialization in 2017.

V2X-ARCH

The MWI group started in 2016 the project V2X-Arch, together with Cellnex, which investigates the future communication technologies that will be embedded in vehicles in the near future. These technologies should support use cases where vehicles directly communicate with one another in order to prevent accidents, or to spread information about traffic events (e.g. Emergency Vehicle Warning). For this project, the MWI group will build a systems level simulator that will allow the evaluation of the two main candidates V2X radio technologies, namely 802.11p and LTE evolutions.

RELEVANT ACHIEVEMENTS

- ✓ MWI demonstrated at MWC'16 how Visible Light Positioning (VLP) can be used to provide high precision localization in indoor environments. i2CAT is discussing licensing of this technology with several interested industrial partners. <https://youtu.be/aIVp8sVuiv>
- ✓ The area secured its participation in the FLAME project within the FIRE program. It will make a pre-deployment in Barcelona, a set of Wi-Fi devices equipped with custom SDN wireless extensions.
- ✓ MWI concluded its research and development efforts on a novel mobile payment technology for DINUBE. This has been transferred to PAYTEC, an Italian manufacturer of payment systems for vending machines, and will be productized as OPTO.

MAIN PARTNERS





5G/IoT



SOFTWARE NETWORKS MOBILE WIRELESS INTERNET RINA

Recursive Internetwork Architecture (RINA) is an effort to simplify the network protocol stack, minimizing the network complexity and solving the fundamental issues of the “TCP/IP protocol suite”. The RINA area is exploring the potential of RINA-based technologies, documenting the benefits of its adoption in different networking environments: data-centre (DC), multi-access service providers, core networks or overlays. i2CAT is also educating potential stakeholders and engaging key players in RINA research and development activities to mature the technology and its associated specifications so that RINA can be deployed in production networks.

RESEARCH CHALLENGES

RINA implementations

To develop programmable RINA implementations for experimentation and realisation of Proofs of Concept. Such implementations not only allow the practical verification of RINA's theoretical benefits, but can also be the basis of future RINA-based products.

TECHNOLOGIES

Linux

C

C++ (SDN)

APPLICATIONS

RINA overlays

RINA in the core

RINA for DMM

OMECE

RINA specifications and network design

- To maintain and evolve core RINA specifications, maturing them to the level of enabling interoperable, production-grade implementations.
- To design policies for a variety of network environments, to proof the flexibility of RINA and demonstrate that its architectural principles can be applied to any type of network.

TECHNOLOGIES

IRATI RINA implementation

APPLICATIONS

DCs

Service provider nets

App-specific overlays

OUTSTANDING PROJECTS EXECUTED DURING 2016

ARCFIRE

The project will bring RINA from labs into the real world. RINA addresses the challenges that drive the communications industry in moving from dedicated hardware to almost completely virtualised infrastructure. Now is the right time for ARCFIRE to provide experimental evidence of RINA's benefits, at large scale, leveraging the FIRE+ infrastructure, thus motivating RINA adoption.

PRISTINE

It intends to design, develop and implement programmable functions that can be plugged into RINA-enabled networks for: security of content and application processes; supporting QoS and congestion control in aggregated levels; topological addressing and routing; multi-layer management for handling configuration, and performance and security.

RELEVANT ACHIEVEMENTS

- ✔ **Demonstrations of RINA Proofs of Concepts at public events, using the IRATI open source RINA implementation.** RINA demos illustrating benefits for slicing, mobility management, renumbering or security have been presented at the SDN World Congress, IEEE OMEC workshop and TNC. i2CAT is the lead developer of the IRATI RINA implementation.
- ✔ **Contributing to standard bodies such as ETSI and the ISO.** i2CAT is an active participant at the ISO SC6 WG7 and at the ETSI ISG NGP, where the RINA specifications and RINA principles (respectively) are an important part of both groups work.
- ✔ **FP7 PRISTINE project successfully completed.** PRISTINE has demonstrated network programmability enabled by RINA in practice. The project managed to integrate research and developments on security, resource allocation, routing and network management from 15 partners. The IRATI open source RINA implementation has been made programmable via a Software Development Kit, and a number of policies have been developed and published as open source.
- ✔ **Publications at IEEE flagship conferences.** i2CAT researchers have contributed to 3 articles accepted for publication at IEEE ICC and one article published at IEEE Globecom 2016.

MAIN PARTNERS





OPEN BIG DATA

The **Open Big Data** technologies area is focused on fostering the adoption of the data-driven philosophy by the society through leveraging the potential of big data technologies. Some of the most important aspects that the unit tackles are: scalable architectures for Big Data processing, Open Big Data, and Big Data preparation (curate, clean, enrich, integrate). The main R&I line of the area is data virtualization, a concept that allows tailored access to shared Big Data environments where several users access the same data sources but they are so large that it is difficult to process them using traditional database and software techniques and, moreover, they cannot be moved or replicated.

RESEARCH CHALLENGES

Data slicing

- To develop the data slicing concept for a multi-tenant Big Data architecture for central data repositories.
- To study and adapt current Big Data technologies so that they permit tailored and isolated access to shared data resources through data slicing.
- To use machine learning techniques in order to help the user define schemas (data slices) on top of shared big data lakes.
- To mature the data slicing as a scalable option that can replace traditional ETL processes.

TECHNOLOGIES

SPARK

HADOOP

ElasticSearch

APPLICATIONS

Heterogeneous data integration

ETL processes

Central open data repository

Tailored and secure access to shared data resources

Data preparation

OUTSTANDING PROJECTS EXECUTED DURING 2016

SHIELD The project is an Innovation Action that introduces an Intrusion Detection and Protection system (IDPS) to replace specific hardware for generic software in order to perform monitoring and reacting functions in a network. To this end, SHIELD mixes three trending sectors: virtual network functions, hardware attestation, and a central decision engine. This project is concerned about the ETL problem in a Big Data environment.

MUV Mobility Urban Values levers behaviour change in local communities in an entirely novel approach to reducing urban traffic. The project raises citizen awareness on the quality of the urban environment to promote a shift towards more sustainable and healthy mobility choices.

RELEVANT ACHIEVEMENTS

- ✓ **Creation of the area.** The Open Big Data technologies area was part of the IAS area. Due to the growth in terms of knowledge, experience and funding, the group has emancipated from Internet Infrastructures and Services Area as an independent research area in the I2CAT R&I structure.
- ✓ **Creation of the first prototype of “Symphony: A secure data sharing platform”,** where data providers can share their datasets while developers, researchers and entrepreneurs can access easily and in a centralized manner an integrated slice of data tailored to their needs, and to the tools plus infrastructure needed to work with it.
- ✓ **Kick-off of the SHIELD project.** In September, the project SHIELD started and Open Big Data technologies is leading the developments holding also the technical leadership of the platform.
- ✓ **MUV project obtained.** MUV is a collaboration with the Living Labs unit and its achievement is a step forward to the adoption of the evidence based decision making to solve social and environmental challenges.
- ✓ **Collaboration with the Bioinformatics Barcelona.** Together with the Autonomous University of Barcelona (UAB) and the Hospital Sant Joan de Déu, the area is collaborating in the definition, creation, and development of a master in Big Data and Life Sciences. This is the first master in the sector that uses real data from a Hospital.

MAIN PARTNERS





MEDIA INTERNET

The **Media Internet Area** focuses its work on two main fields: Media Networks and Interactive and Immersive Media. The Media Networks division works on the development and application of new ways of distributing audiovisual content through the Internet. We have wide experience in design, creation of prototypes and development of distribution architectures and systems for streaming, videoconferencing, content delivery, synchronization and virtualization.

The Immersive and Interactive Media division works on the development and application of new ways of creating and consuming audiovisual content through the Internet. The area has extensive experience in virtual and augmented reality as well as in immersive video.

RESEARCH CHALLENGES

Networked Media

The main goal of this line of research is to study and develop efficient software systems to manipulate digital media over the network by using and aggregating industry standards. The Media Internet Area implements core services which are easy to orchestrate and appropriate for a cloud-based virtualized environment, where scalability and orchestration is a major requirement.

TECHNOLOGIES

Video & Audio coding

Real time network protocols (RTP, RTSP...)

Adaptive streaming (MPEG-DASH)

Hybrid Broadcast-Broadband TV (HbbTV)

APPLICATIONS

Connected TV Services

Ultra-HD media delivery

Low-latency video communication

Cloud operations (transcoding, mixing)

Content Delivery Networks

Immersive & Interactive Media

This line of research works towards the creation of new interactive services, in mobile devices and head mounted displays, with a major focus on location-based and personalized services. In particular, the area focuses mostly on augmented reality and second screen applications and target the cultural and the broadcast sectors. Our objective is to offer new and richer content experiences, immersive and interactive, and the tools to create them.

TECHNOLOGIES

Immersive virtual reality

Omnidirectional video

AI, machine learning, statistics

Mixed reality

HCI design

APPLICATIONS

Novel content formats

Multiplatform content (HMD, TV, tablet, mobile)

Cultural heritage

e-learning

EXECUTED DURING 2016

- IMMERSIATV** This project is creating a new content creation workflow and the associated tools to generate multi-device and synchronized immersive and interactive experiences.
- TV-RING** This project explores the great potential of next generation networks and mobile devices in the Connected TV market, which is a strong focus of interest for the media industry.
- CREATIFI** This project is an acceleration initiative from the European Commission which offers opportunities (e.g., funding, support services, cloud infrastructure and middleware) to SME's, web entrepreneurs and individuals working in the Creative Industry sector to shift innovative ideas into new applications and services.
- VINTAGE** This project aims at creating and testing a new encoding algorithm known as Logarithmical Hopping Encoding (LHE). i2CAT's role is to integrate, validate and compare this codec with current codecs widely used in the industry like H264 or MPEG-4.

RELEVANT ACHIEVEMENTS

- ✓ **Completion of the TV-Ring project.** The area concluded successfully TV-Ring, where we have deployed and validated 5 different HbbTV applications, with an overall user reach in the evaluation phase of +100.000 end users.
- ✓ **Execution of the first pilot of the project ImmersiaTV.** An end-to-end toolset for the production and distribution of multiscreen synchronized immersive TV experiences has been developed, tested and evaluated. The project demo was presented for the first time at IBC 2016, the main European venue for broadcast industry. Later on, the same demo, improved, obtained the best demo award at the NEM Summit 2016, and was also accepted in the highly prestigious TVx conference (2017)
- ✓ **Release of the GStreamer Unity Bridge.** This is a small module that allows combining GStreamer, a reference framework for video processing solutions and Unity3D, the most accessible game engine for VR and videogame content developers. This open-source module was published in the Unity3D asset store and had more than 2500 downloads. An active community of users employ it for their projects.

MAIN PARTNERS PARTNERS



INNOVATION BUSINESS UNITS

Innovation to drive ICT research towards market and society needs

The Innovation Business Units (IBUs) aim at boosting the collaborations with the innovation ecosystem and at increasing the social and business impact of the research capabilities and the knowledge generated by i2CAT.

Focused on verticals, the Innovation Business Units have a deep knowledge of the market (companies, needs, relevant players, users, etc.) in order to figure out innovative solutions based on the expertise and technologies of i2CAT research areas.

The i2CAT Innovation Business Units are focused on the following fields:



Smart Cities & Regions

Platforms: IoT, Big Data
Mobility, Smart Infrastructures for Connected Cars
Sustainability, Energy Efficiency, Intelligent Transport Systems
Public Services: Interoperability; Reliability; Resiliency



Industry 4.0

Industry digitization: industrial Internet; logistics4.0; Virtual Reality
Smart Manufacturing: Artificial Intelligence, Advanced Robotics
Industrial Platforms: IIoT, cloudservices; Big Data, HPC



Health & Social Care

Patient Empowerment
Social Inclusion
Active Ageing
Future Health Systems



Living Labs & Digital Social Innovation

Open Innovation
Systemic Innovation
Citizen Laboratories

The main activities of the Innovation Business Units, always in collaboration with the research, software engineering and support areas, are the following:

Co-development:

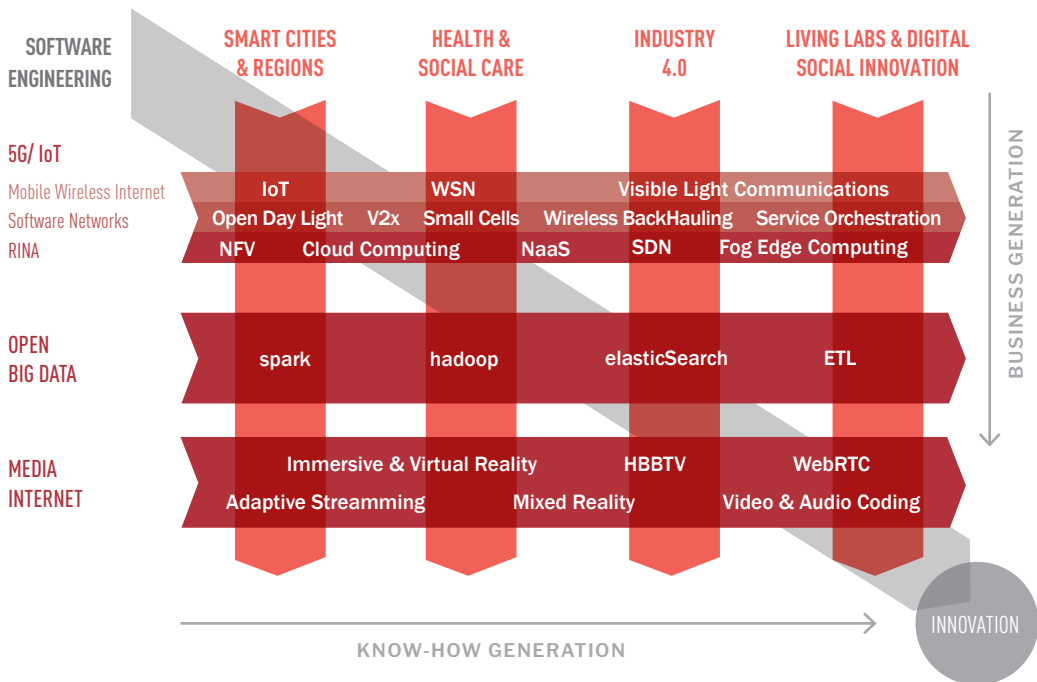
Fostering strategic alliances to create innovative market-oriented technologies and solutions addressed to societal challenges.

Technology roll-out and validation:

Coordinating the design and deployment of trials for technological and functional validation purposes with local partners, public administrations and users.

Technology and knowledge transfer:

Setting up IPR exploitation agreements, creating mixed R&D teams with companies, and boosting and supporting the creation of start-ups.



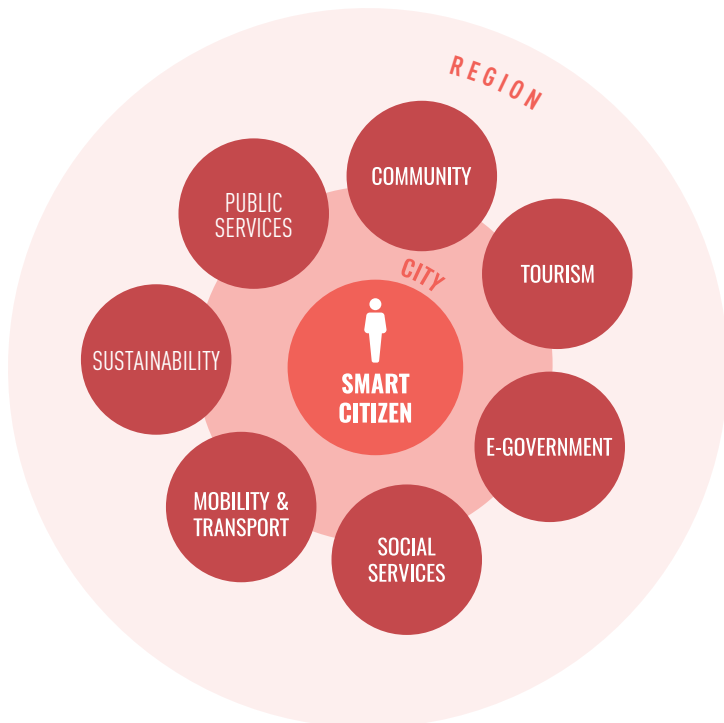


SMART CITIES & REGIONS

Cities are responsible for more than 70% of the GHG globally and at the same time are the main consumers of global power (about 70%). Governments of cities, as well as citizens, must commit to an efficient and responsible use of resources in order to guarantee a high quality of life for citizens and a sustainable future for the planet.

Smart cities and regions will be those that take advantage of all ICT resources available (IoT solutions, Big Data, Edge Computing, etcetera) to transform public services, social services and in general the whole relationship with citizens to guarantee sustainability.

From the Smart Cities & Regions Innovation Business Unit we help the authorities of local and regional governments to define and implement Smart strategies so that they achieve their objectives in a sustainable and efficient way. We also work with all the players of the Smart ecosystem, contributing our knowledge and technological baggage with the objective of offering a better quality of life to all living creatures of the planet.



OUTSTANDING PROJECTS

IoT Catalan Alliance
(IoT CAT)
cataloniaiot.com

The IoT Catalan Alliance is an initiative that brings together all the players in the Catalan Smart ecosystem to raise awareness of the potential we have, as a country, to foster collaboration and the generation of projects in this area. This project is included in the SmartCAT strategy of the Generalitat de Catalunya and is managed and promoted from i2CAT. During 2016, the community has consolidated and worked to identify all the players in the IoT value chain. Currently, the members of the IoT Catalan Alliance include more than 60 companies and 10 universities and research centres.

MORE RELEVANT INITIATIVES

SmartLab

Initiative that launches the pilot tests of innovative solutions to solve challenges defined by Catalan municipalities.

SmartCAT Challenge

Initiative that promotes entrepreneurship by providing solutions to challenges presented by cities or the non-profit sector to improve the quality of life of citizens.

LoRa BCN Project

Study in progress to deploy and implement a LoRa network in Barcelona in order to improve the management of urban services.

Smart Polígons

Study of the needs and Smart solutions necessary to improve security, mobility and the management of areas of economic activity through broadband connectivity.

MAIN PARTNERS





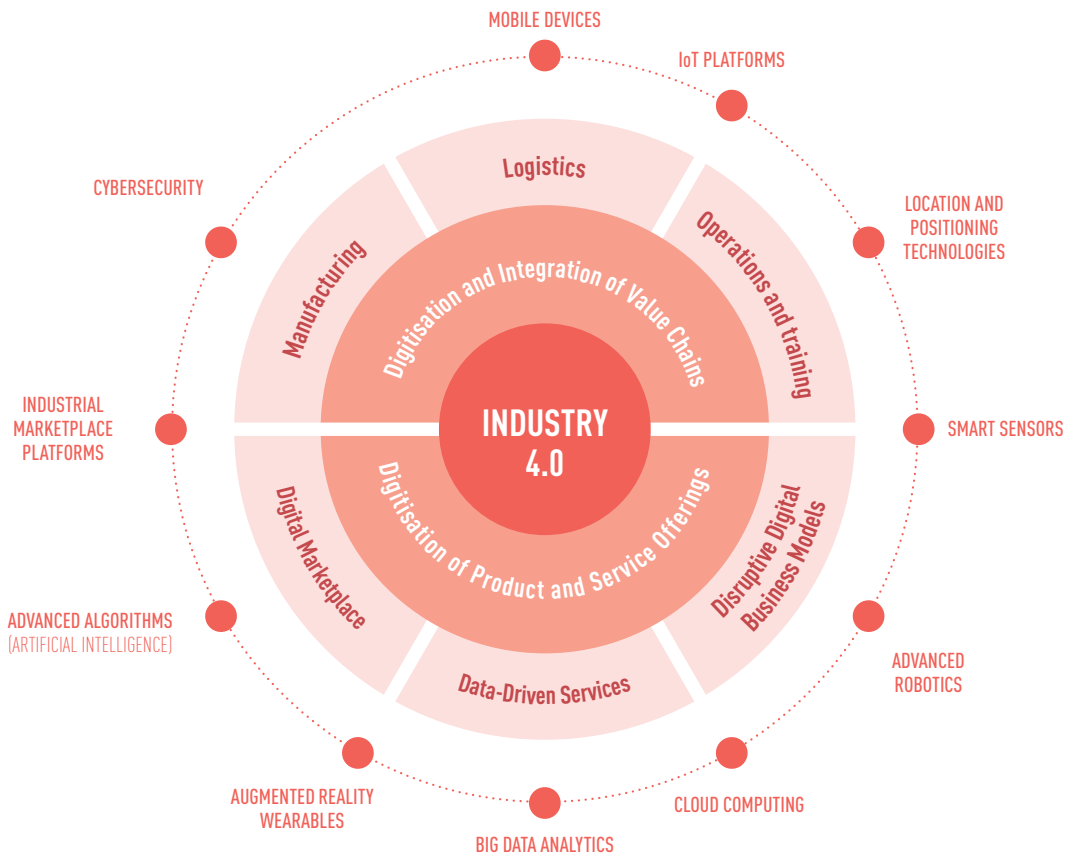
INDUSTRY 4.0

The industrial Internet, called Industry 4.0, is the digital transformation across the entire industrial ecosystem, from product development and purchasing, to manufacturing, logistics and service.

i2CAT's Industry 4.0 Innovation Business Unit aims at collaborating with companies in:

- the development and deployment of digital technologies that allow the collection, integration and analysis of all data about operation processes (efficiency, quality management and planning).
- the digitisation of products, by adding smart sensors, data analytics tools, as well as the creation of new digitised products able to generate data on product use and refine products to meet the increasing needs of end-customers.
- the expansion of the companies offering by providing disruptive digital solutions such as data-driven services and integrated platform solutions.

i2CAT is focused on the following Industry 4.0 framework:



OUTSTANDING PROJECTS

Innovation services

In order to move from the idea to the Proof of Concept, Industry 4.0 workshops aim at producing innovative ideas and industrial applications. Assessments to SMEs in defining customized PoC or designing their digital solution. Keynote speakers at top conferences and events.

Smart Manufacturing

Digital twin, system integration (sensors-gateway-cloud); connected machines and predictive maintenance.

Logistics 4.0

Cutting edge precise indoor location technologies. Visible Light Communication for AGVs, Ultra-Wide Band for forklifts and trucks. Smart industrial spaces.

Industrial Service Platform

Composed of a cloud platform, marketplace and high speed infrastructure for PoC, Digital Services development and testing and a Big Data platform for treatment and pre-processing solutions.

MORE RELEVANT INITIATIVES

Industrial Ring

Ecosystem of engineering and industrial companies, technology providers, associations, research centres, universities and the regional government with the objective of identifying, developing and promoting best practices in Industry4.0.

Industrial Platform 4.0

The Industrial Platform 4.0 (PI4.0) stands for the Catalonian Smart Industry. It is a strategic initiative supported by the Government of Catalonia to become an experimental environment based on the creation, validation and testing of high added-value industrial digital services.

MAIN PARTNERS



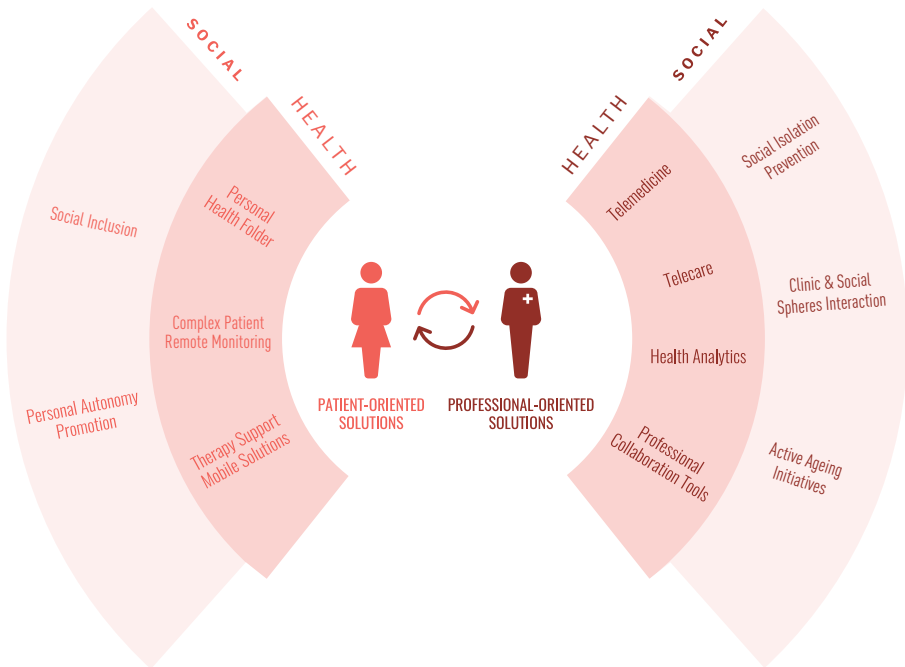


HEALTH & SOCIAL CARE

Internet is helping users to play a more active role in their own health and social processes. Is it possible to find a huge number of projects and success stories providing technology on the professional side. From i2CAT point of view, now is the time to empower the citizen by intensifying the use of technology on the citizen side.

The IBU focuses on social and health needs, and how ICT can support new assistance models.

On the citizen side by creating sustainable communication channels with professionals breaking with physical spaces. On the professional side by rethinking assistance towards proactivity through the capabilities that technology offers (BigData, IoT).



OUTSTANDING PROJECTS

ACADOM (RIS3CAT)

The main goal of the project is to ensure the continuum of care at the patient's home in logopedic rehabilitation therapies through telemedicine. Intelligent systems will be used, suggesting therapy pathways and adapting to the patient evolution through voice recognition systems. These functionalities are especially complicated in the case of children with pathologies such as Acquired Brain Damage.

HL4.0 (RIS3CAT)

This project aims at identifying and collecting all healthcare data generated both inside and outside of the hospital and thus take advantage of it using Big Data and analytic systems to establish a new way of providing services. It involves clinical data, genomic information, biomedical images and other hospital systems or information generated by patients themselves in online communities.

MORE RELEVANT INITIATIVES

Vincles

A social innovation project designed to strengthen the social ties of elderly people who feel isolated and to improve their well-being with the aid of new technologies. This is achieved through personalized and connected trust circles, which consists in a group of individuals who come together to provide intentional support for someone who is facing a challenging personal situation.

Remote Health Services Platform

Remote Health Services platform developed from the collaboration between everis and the i2cat Foundation to meet the needs for a system of remote health care that is reliable and accessible to everyone. RHS's main aim is to provide remote access to professional health services from any place and at any time.

MAIN PARTNERS





LIVING LABS & DIGITAL SOCIAL INNOVATION

The Living Labs-DSI Area is in charge of helping to define i2CAT's Quadruple Helix model and strategy, promoting the Living Labs approach across the R&I areas of the organization, as well as designing, testing and evaluating new living labs in Catalonia.

The area works according the digital social innovation (DSI) model that is conceived as a 'a type of social and collaborative innovation in which innovators, users and communities collaborate using digital technologies to co-create knowledge and solutions for a wide range of social needs and at a scale and speed that was unimaginable before the rise of the Internet'.



OUTSTANDING PROJECTS

Xarxa CatLabs

The Xarxa CatLabs (CatLabs network) project is an ambitious collaboration between i2CAT Foundation and the Generalitat de Catalunya to create a Digital Social Innovation Network in Catalonia. Its aims at promoting new mechanisms for digital, social and collaborative innovation in order to provide better responses to the challenges faced by the economy and society, and to enable and promote the participation of the Quadruple Helix in the research and innovation system, RIS3CAT, and new European models of innovation.

MORE RELEVANT INITIATIVES

Open4Citizens

Empowering everyone to make meaningful use of open data, designing a citizen laboratory model where different actors can co-create solutions based on open data that address a range of urban problems, stimulating local communities to find innovative solutions based on the reuse of open data.

InnovaT

Training course for unemployed youth to become local digital social innovation agents, in collaboration with the Catalan Employment Service (SOC). The alumni will receive a two-month crash course, and head out to a range of public administrations, municipalities and digital social innovation labs to carry out a practical project where they will address a local challenge with DSI solutions.

BCNLab

Joint project with the Barcelona Municipality to design and implement a model of a citizen laboratory for open cultural innovation. The project aims at building an open laboratory for culture, knowledge, creativity and innovation in the city of Barcelona. This lab wants to encourage innovation through public collaboration between the arts, science and technology.

MUV

Raising citizen awareness on the quality of the urban environments to promote a shift towards more sustainable and healthy mobility choices. The technological ecosystem of MUV, piloted in Barcelona and five other cities, is based on three main components: mobile and wearable apps, a distributed network of artistically-designed monitoring stations, and a scalable, open and interoperable cloud platform.

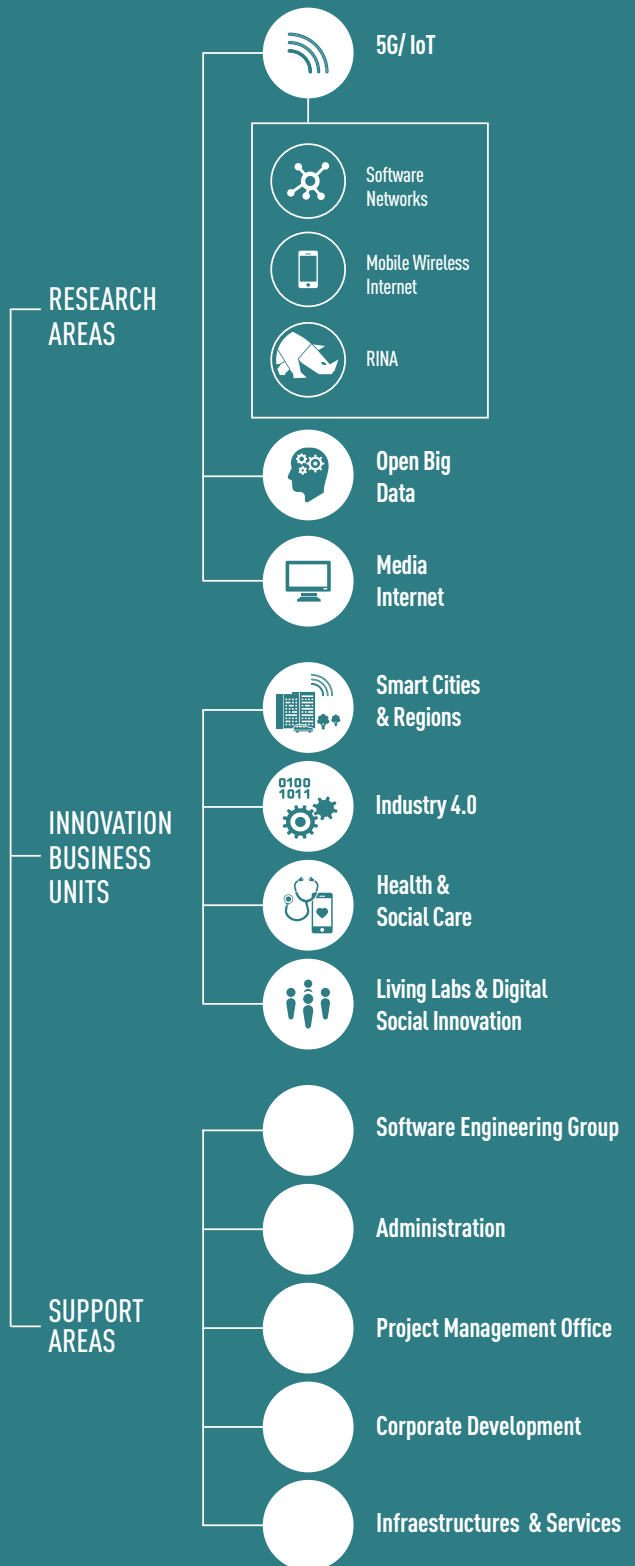
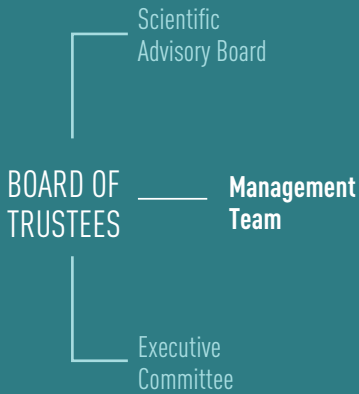
MAIN PARTNERS



AT A GLANCE

Infrastructures and Services

Cutting-edge Internet technologies to foster business innovation and generate a new digital society and economy



MISSION AND VISION

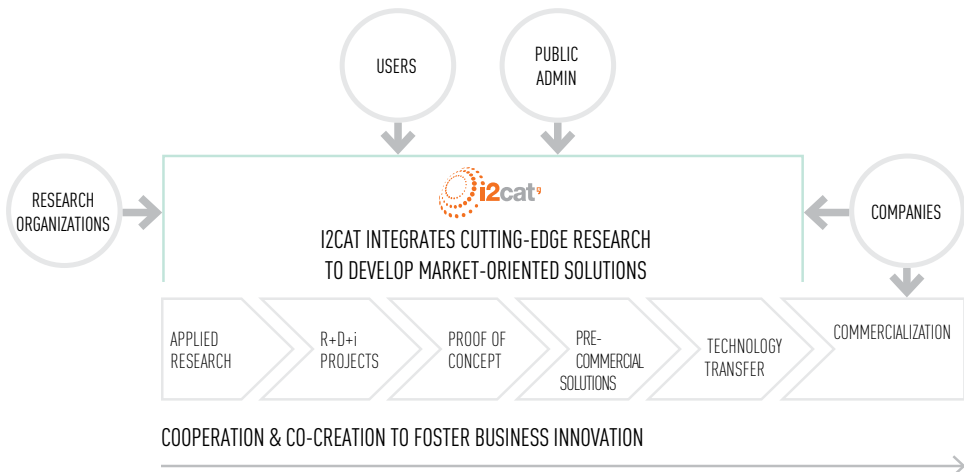
i2CAT Foundation is a non-profit research and innovation centre which promotes mission oriented R+D+i activities on advanced Internet architectures, applications and services. The centre stands up for a new open innovation framework, fostering the collaboration between companies, public administration, the academic environment and end-users.

Internet has produced a superabundance of data, information and networks. The next step is to advance in the research and innovation of an Internet based on intelligent systems and smart technologies. The Internet of knowledge and creativity is the new challenge to face. The i2CAT vision for the next 10 years is a networked smart world, a co-laboratory based in a new generation of networked intelligent technologies and systems, a co-creating platform between machines, people and the environment for a sustainable and smart future.

VALUE CHAIN

i2CAT's activities span the following three areas:

- **Research:** Both at international and local level. i2CAT plays a key role in the EU Framework programme for Research & Innovation.
- **Strategic projects:** Leading local initiatives to deploy digital strategies and policies of the Government of Catalonia.
- **Technology Transfer:** Fostering R&D collaboration with companies to develop innovative market-oriented solutions.



BOARD OF TRUSTEES

As of 31st December 2016, the members representatives were:

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Secretary for Telecommunications, Cybersecurity and Digital Society, Government of Catalonia

Mr. Enric Fossas Colet | VICE-PRESIDENT I

Rector of the Universitat Politècnica de Catalunya (UPC)

Mrs. Núria Betriu | VICE-PRESIDENT II

Managing Director at ACCIÓ

Mr. Carles Salvadó Usach | SECRETARY OF THE BOARD

Head of Telecommunications Service at Secretary's Office of Telecommunications, Cybersecurity and Digital Society, Government of Catalonia

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General Director of Research, Government of Catalonia

Mr. Víctor Vera Vinardell

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Director at CERCA Institution

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Regional Director at Juniper Networks

Mr. Mateo Valero

Director at Barcelona Supercomputing Center (BSC)

Mr. Felip Fenollosa

General Manager at Fundació CIM

Mr. Ernest Quingles

Vice-President Business Sales Europe at Epson

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The Board, created in 2012, is composed by the following members:

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UNIVERSITY OF BRISTOL, UNITED KINGDOM

Head of the University of Bristol's High Performance Networks Group. BSc and MSc in Physics from the Aristotle University of Thessaloniki (Greece), PhD from the University of Essex.

Prof. Dae-Young Kim

CHUNGMAN NATIONAL UNIVERSITY, SOUTH KOREA

Professor of the Department of Information Communications Engineering at Chungnam National University.

Bill St Arnaud

INDEPENDENT R&E NETWORK AND GREEN IT CONSULTANT,

CANADA

Independent Consultant specialising in advanced networks and Green IT.

Prof. Carsten Bormann

UNIVERSITÄT BREMEN (UNIVERSITY OF BREMEN), GERMANY

Professor of Internet Technology at the University of Bremen and member of the board of directors of the Centre for Computing and Communications Technology (TZI).

EXECUTIVE COMMITTEE

As of 31st of December 2016, the member representatives were:



Mr. Lluís Rovira i Pato | PRESIDENT
Director at CERCA institution

Mr. Carles Salvadó Usach | SECRETARY
Head of Telecommunications Service at Secretary's Office of Telecommunications, Cybersecurity and Digital Society, Government of Catalonia

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Innovation Manager at ACCIÓ

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Mr. Diego Matas Morillo
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Mr. David Noguer i Bau
Regional Director at Juniper Networks

Mr. Josep Maria Martorell i Rodon
Associate Director at Barcelona Supercomputing Center (BSC)

Mr. Felip Fenollosa, Director at Fundació CIM

Mrs. Maria Zaragoza
Marketing Services Manager at Epson Ibérica S.A.U.

Mr. Daniel Marco
Director of SmartCat Strategy at the Government of Catalonia

STAFF*

* As of 31st of December 2016

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Josep Paradells
Director



Artur Serra
Deputy Director



Joan Manel Martín
Managing Director



Sergi Figuerola
Chief Technology and Innovation Officer

RESEARCH AREAS



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5G/IoT: MWI



Daniel Camps
5G/IoT: MWI



Jacint Castells
5G/IoT: MWI



Laura Herrera
5G/IoT: MWI



Marc Combalia
5G/IoT: MWI



Marisa Catalán
5G/IoT: MWI



Joan Josep Aleixendri
5G/IoT: MWI



Miquel Catalán
5G/IoT: MWI



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Albert Viñes
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Jordi Ferrer
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José Ignacio Aznar
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Carolina Fernández
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Shuaib Siddiqui
5G/IoT: Software Networks



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5G/IoT: Software Networks



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5G/IoT: RINA



Miquel Tarzán
5G/IoT: RINA



Bernat Gastón
Open Big Data



Cristian Dávila
Open Big Data



Ibai Jurado
Media Internet



Isaac Fraile
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David Gómez
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Vanessa Llobet
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Sandrine Schwartz
PMO



Mónica Fernández
PMO



Jan Vara
PMO



Rocío Segura
Administration
Finance &
Accounting



Sonia Beltran
Administration
Finance &
Accounting



Dani Lirio
ASIS



Susana Otero
Corporate
Development



Julio Carlos Barrera
Software
Engineering



Lino Valdivia
Software
Engineering



Josep Pons
Software
Engineering



Adrián Roselló
Software
Engineering



Athanasios Chalas
Software
Engineering



Enric Almiñana
Software
Engineering



Ricardo González
Software
Engineering



Ferran Quer
Software
Engineering

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Andrea Cervera
Health &
Social Care



Yolanda Lupiáñez
Health &
Social Care



Marc Vicente
Industry 4.0



Silvia Castellví
Industry 4.0



Isart Canyameres
Smart Cities
& Regions



Rosa Paradell
Smart Cities
& Regions



Miquel de la Mano
Smart Cities
& Regions



Marc Aguilar
Living Labs &
Digital Social
Innovation



Pau Adelantado
Living Labs &
Digital Social
Innovation



Víctor Jiménez
Living Labs &
Digital Social
Innovation

ASSOCIATIONS, STANDARDIZATION ORGANIZATIONS & PLATFORMS



EXHIBITIONS AT FAIRS & CONGRESSES



2016 YEAR IN REVIEW



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