



Annual report 2019

The Internet
Research Center





Annual Report 2019

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Letter from the President

The future is digital, exciting, full of challenges and opportunities, and i2CAT is committed to designing and building the digital society of the future based on research and innovation in advanced digital technologies.



Jordi Puigneró i Ferrer
President of i2CAT Foundation
Minister for Digital Policy
and Public Administration
of the Government of Catalonia

2019 was an outstanding year for the i2CAT Foundation, a staple of high-quality innovation in Catalonia after years of hard work and remarkable outcomes. The results achieved by the Foundation during the year are a reflection of its commitment to research and to the promotion of advanced digital technologies in both public and private ecosystems.

Catalonia is a recognized benchmark for digital technologies in Europe. As such, the Government of Catalonia counts on the support of the i2CAT Foundation to bring these advancements forward and to be an essential partner in designing the digital society of the future. In December 2019, the Government of Catalonia approved a Program Contract with i2CAT for the first time in the 16 years of activity of the Foundation. This program will provide economic stability thanks to an allocation of 9.4 million euros over the next four years. With this agreement, the Government, through the Ministry for Digital Policy and Public Administration, which I lead, reinforces the confidence in i2CAT as a key player in building the digital society of the future based on research and innovation in advanced digital technologies.

The Government of Catalonia considers that research into advanced digital technologies must aim at its transfer to the market to contribute to the creation of a digital economy made in Catalonia. The agreement between the Government of Catalonia and i2CAT focuses on mission-driven research and considers the importance of the center as a strategic government brand for digital innovation, acting as an engine of the new economy to consolidate Catalonia as an international hub for digital innovation.

The Ministry for Digital Policy and Public Administration of the Government of Catalonia has also involved i2CAT as a key stakeholder in the definition of 3 Digital Strategies of Catalonia in fields that will be essential in the near future: 5G, Blockchain, and Artificial Intelligence.

With research and innovation at the core of i2CAT's activities, 2019 has been another successful year for the organization with regard to R&D. The center has submitted 97 project proposals and has raised 6.6 million euros in competitive funding from European, Catalan, and Spanish calls, achieving an impressive success rate of 27.7% in H2020 calls.

i2CAT continues to host a leading position in Europe in the field of 5G, a reputation strengthened by the attainment of 4 new projects funded by the European Commission under 5GPPP, reaching 20% of all projects funded in the 2014-2019 period. At the Spanish level, the Foundation has been recognized as a "CERVERA Excellence Center in 5G" by the Centro para el Desarrollo Tecnológico Industrial (CDTI), which depends on the Spanish Ministry of Science and Innovation.

At the Catalan level, the i2CAT Foundation is a key player in the Regional Innovation Strategy for Smart Specialization of Catalonia (RIS3CAT), participating in 7 projects and having a leading role in the 5G/IoT Emerging Technology communities.

This level of excellence in activities and impacts during the 2015-2018 period in terms of scientific production and productivity, knowledge, and technology transfer activities and management were recognized with the award of an "A" qualification in the CERCA Institute evaluation that took place in 2019. i2CAT continues to foster public and private initiatives to progress new technologies in collaborative ways. As CTO and founding partner of the 5G Barcelona initiative, i2CAT is

responsible for its technical direction and that of the pioneering IoT Lab 'The Thinx 5G Barcelona'. The Foundation has been also essential to two of the main pilots carried out this year: the 5G Connected Car and the 5G Ambulance, which were demonstrated at MWC Barcelona 2019.

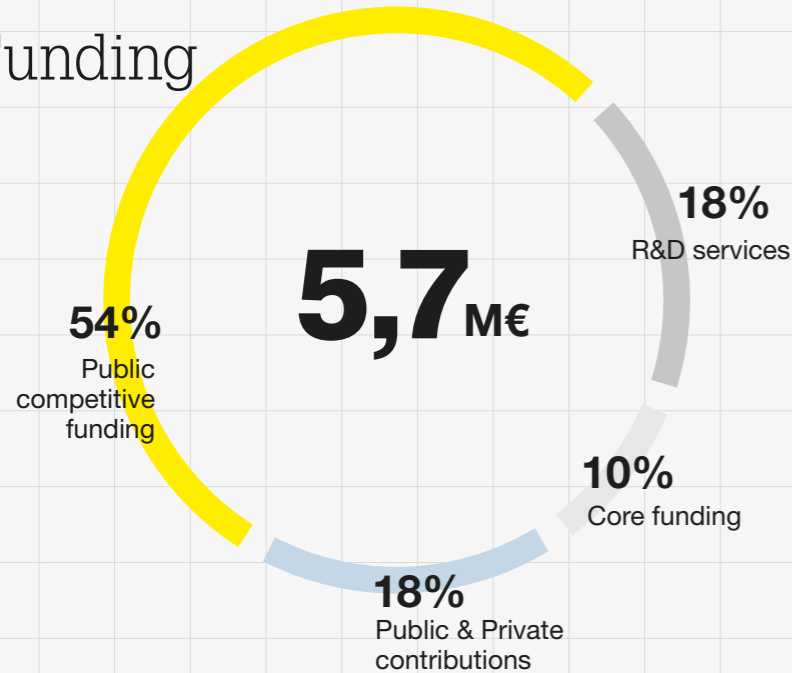
Additionally, in 2019 the center has carried out a participatory process to define the Strategic Plan that should regulate the future of the institution in the next 4 years. Guided by values such as excellence, inspiration, commitment, and collaboration, the i2CAT Foundation will continue contributing to the definition and structuring of a universal digital innovation system under this new plan. This ambitious strategy will highlight the center's talent and excellence in research and innovation in advanced digital technologies, as well as the expertise of i2CAT's wider ecosystem. In the end, the main objective of the Strategic Plan is to contribute to the digital transformation of the country, a milestone that is essential to guarantee a thriving, leading, state-of-the-art, fair, and democratic society.

An impressive growth rate of 56% in the last 4 years only corroborates the strategic role of the i2CAT Foundation as a pillar of digital innovation in Catalonia.

From the Ministry for Digital Policy and Public Administration and the whole Government, we will work side by side with i2CAT to promote its talent and knowledge and leverage it to further the digital transformation of the country.

Facts & Figures

Funding

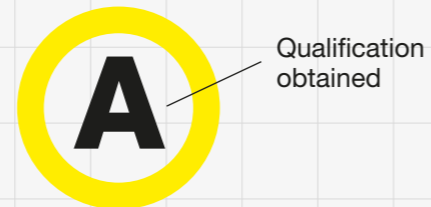


Growth rate

+56%

2015 → 2019

CERCA
evaluation



Project proposals submitted

97

H2020
success rate

27,7%

Competitive Funding

6,6 M€

Awarded in 2019

Projects

12
European
projects

9
Catalan
projects

1
Spanish
project

5GPPP
EC projects
granted
in 2019

4

Out of the
total funded
by the EC
+20%

12 5GPPP
projects in 2014-2019

Facts & Figures

R&D projects in execution

71



Key role in the definition of **3 digital strategies** by the Government of Catalonia

RIS3CAT projects

9

Leading the 5G/IoT Emerging Technology communities

Publications

34

International Congresses & Fairs

+25

Staff

74

10

Grants to incorporate talent

1

Beatriu de Pinós

1

TECNIOspring

+15,6%

Growth

25,7%
Women

28,5%
Women Area Managers

Team members

Nationalities

Median age

36,4
years

27%

PhD

2019 Competitive Funded Projects in execution

Technological Research



5G&IoT



FED4FIRE
 S&T 5G
 5G ESSENCE
 5G VICTORI
 5GZORRO
 PLEDGER
 SRG 217-2019 GRPRE GN4-3

DAI



SHIELD
 RETHSON-5G

Media



VRTogether
 ImAc

Cybersecurity



QuantumCAT

Applied Innovation



Smart Cities

5G&IoT



5GCity
 5G-PICTURE
 AERIAL UPTAKE
 PERSOSER SMARTSPACE

DAI



FEM-IoT

eHealth & Social

Media



VINCL5BCN
 ACADOM HL4.0

Industry 4.0

5G&IoT



5G CLARITY
 SMARTY
 DeepTech 4Good
 SENIX Fundition 4.0

DAI



Boost 4.0
 Looming Factory-FOF

Mobility

5G&IoT



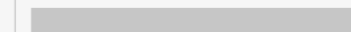
GrowSmarter
 5G CroCo

DAI



MUV

Cybersecurity



CARMEL

Creative Industries

5G&IoT



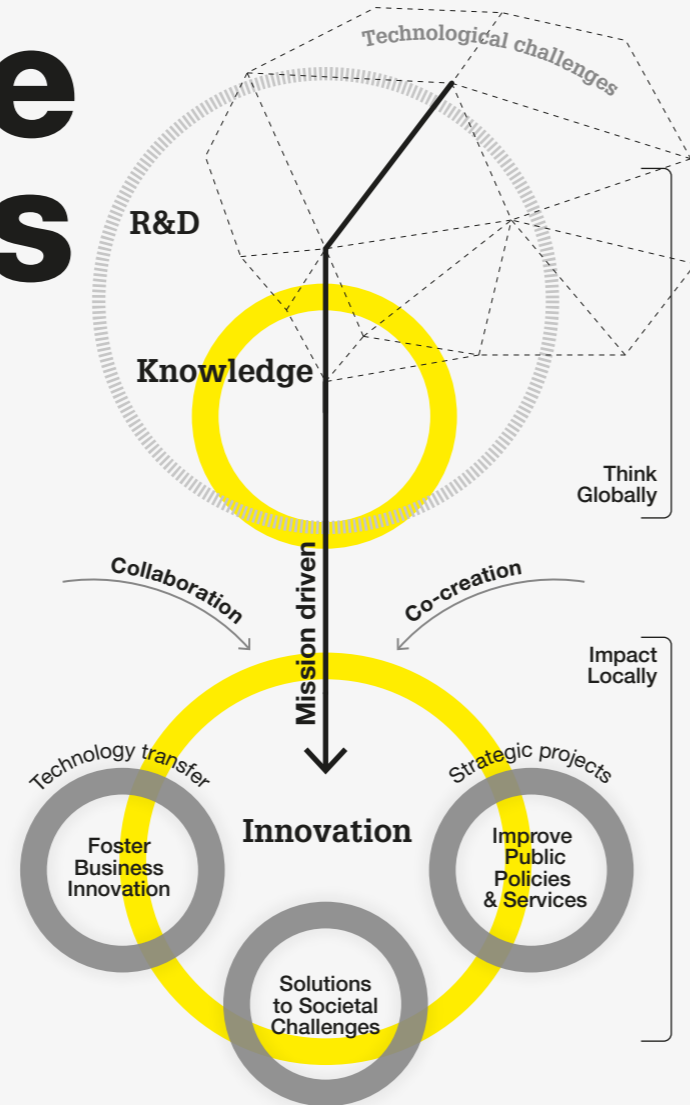
FLAME

Media



MED GAIMS
 ViVIM

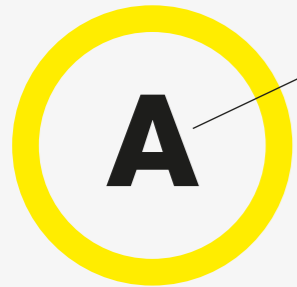
Corporate Highlights



Thanks to a **solid basis of European projects** that continue growing, new **core funding** that grants stability, a deeply-rooted **reputation for excellence** in the Catalan and European innovation ecosystems, and an ambitious **internal transformation**, i2CAT will never stop designing the digital future.

CERCA Evaluation

Following a mandate from the Catalan Parliament and, subsequently, from the Government of Catalonia, the **CERCA Institute** coordinates an **assessment of CERCA research centres** every 4 years with the aim of analysing the **fulfilment of their missions**.



CERCA Evaluation

Qualification obtained



In 2019, an independent panel of renowned international experts evaluated the activities and impacts achieved by i2CAT in the period 2015-2018 in terms of scientific production and productivity, knowledge and technology transfer activities and management.

In the overall qualification of the Evaluation Report, the **members of the committee** stated that they were **impressed by the performance and the evolution of i2CAT during the evaluated period**. The committee believes that the Institute has shown great progress in the last years and points to a promising future in the next period.



The reviewers **awarded i2CAT with an A**, the highest possible rating according to the scale A, B, C, D defined by the evaluation process.

The evaluation committee also provided added-value recommendations that i2CAT will consider to improve performance before the next assessment.

Program Contract signed with the Government of Catalonia



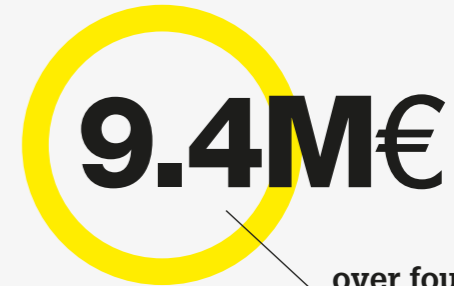
In December 2019, the Government of Catalonia approved a Program Contract with i2CAT for the 2020-2023 period with the aim of consolidating the research center as a **benchmark for Internet and advanced digital technologies in the research and innovation ecosystem of Catalonia**, and a **key partner to consolidate and improve the positioning of Catalonia as an international digital innovation hub**.



With this Program Contract, the Government of Catalonia is committed to **allocating 9.4 million euros over four years** to provide i2CAT with the funding needed to achieve **five strategic objectives**:

- **Increase excellence** in digital knowledge generation and improve research positioning at an international scale
- **Promote and generate alliances** within the digital research and innovation ecosystem of Catalonia
- **Improve the impact** of technology and knowledge transfer activities on the private sector
- **Consolidate the viability** and economic sustainability of the center
- Attract and promote **digital talent**

According to this contract, the Ministry for Digital Policy and Public Administration of the Government of Catalonia will contribute 2 million euros in 2020, 2.4 million euros in 2021 and 2022 each, and 2.6 million euros in 2023 to fund operational activities focused on achieving these objectives and on obtaining additional competitive resources to increase R&D activities and impacts.



over four years

i2CAT Strategic Plan 2020-2023



In 2019, the center has carried out a **participatory process** to obtain the vision and contributions of both the governing bodies of the Foundation and its staff. Their inputs are represented in the **Strategic Plan** that should guide the **future of the institution** for the next 4 years.



Make Things Happen

i2CAT's vision is to design and build the digital society of the future from research and innovation in advanced digital technologies. Generating talent and collaborating with agents of the local and international ecosystem, i2CAT, with the commitment of its members, wants to **transform Catalonia into a creative, empowered and innovative society, where knowledge and digital technologies are at the service of people.**

Applying the values of excellence, inspiration, commitment, and collaboration, the mission of the i2CAT Foundation is to contribute to the definition and structuring of a universal digital innovation system by promoting:

- The generation of excellence-based knowledge aimed at solving the challenges of companies, citizens, and public administrations (mission-driven research), highlighting the talent of local and international researchers.

- The establishment of collaborations and synergies with other agents of the local digital research and innovation ecosystem to co-develop solutions and products that generate a transformative impact.
- The digital empowerment of citizens through an open and participatory digital social innovation with territorial capillarity.
- The promotion of pioneering initiatives that enhance the projection and international visibility of Catalonia as a digital and innovative country.

i2CAT's Strategic Plan for the 2020-2023 period consists of 4 Strategic Objectives, 15 Specific Objectives, 42 actions, and 128 strategic sub-actions and aims to generate impact in knowledge fields, companies, public administrations, citizens, and the territory under the motto **"Make Things Happen"**.

Excellence in EU Projects

2019 has been a very successful year in terms of new European R&D projects granted to i2CAT from H2020, INTERREG and ENI CBCMED calls.



The center has received European Commission funding for **10 H2020** projects from different work programs:



- 6 projects in Industrial Leadership - Information and Communication Technologies
- Roles: 1 Coordinator and 2 Technical Leaders
- 2 projects in Societal Challenges - Secure Societies
- 1 project in Excellent Science - Research Infrastructures
- 1 project from the European Institute of Innovation and Technology (EIT – Urban Mobility KIC)

The complete list of 12 European projects granted in 2019 is the following:

CPSoSaware (GA N° 871738)	H2020-ICT-01-2019-2020
PLEDGER (GA N° 871536)	H2020-ICT-15-2019-2020
5G-CLARITY (GA N° 871428)	H2020-ICT-20-2019-2020
5GZORRO (GA N° 871533)	H2020-ICT-20-2019-2020
GN4-3 (GA N° 856726)	H2020-IBA-SGA-I
AERIAL UPTAKE (PGI05906)	INTERREG EUROPE
SMARTY (PGI05839)	INTERREG EUROPE
MEDGAIMS (A_A.1.3_0209_MED GAIMS)	ENI CBC MED
RESPOND-A (GA N° 883371)	H2020-SU-DRS02-2018-2019-2020
PALANTIR (GA N° 883335)	H2020-SU-DS03-2018-2019
5GMED (GA N° 951947)	H2020-ICT-53-2020: 5G for Connected and Automated Mobility
MOBY	EIT URBAN MOBILITY KIC

32 projects have been granted to i2CAT so far within the H2020 Framework Programme in the 2014-2019 period, rising to an amount of **14,2 million euros**.

**EU funding
from H2020
ICT thematic
priority**

**2nd institution
in Catalonia**

Organizational Update

The organizational structure of i2CAT has evolved in 2019.

According to the activities and priorities identified in the Strategic Plan approved in December 2019, **i2CAT has created new areas, profiles, and responsibilities within the organization chart.**



Continuous evolution to face new challenges and opportunities

Evolution of the organizational structure

Two new **Research Areas** will start generating digital knowledge in fields and topics that will be strategic to future challenges and Horizon Europe priorities:

- **Cybersecurity**
- **Distributed Artificial Intelligence**

With the aim to increase the strategic positioning in European research programs, the **EC Research & Innovation Strategy and Policies Area** has been established.

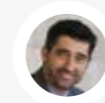
The former Innovation Business Development Area has split to focus on target markets and foster the innovation and collaboration with private companies and public administrations:

- **Innovation Business Development – Public Administration**
- **Innovation Business Development – Private Sector**

3 new areas will improve quality and efficiency in project execution and delivery:

- **Digital Innovation Management Office:** focused on the technical project management of innovation projects executed in collaboration with Public Administration and private companies.
- **Operations Area:** in charge of the supervision of all projects and initiatives developed at i2CAT, to improve coordination, efficiency, and knowledge management.
- **ERDF and Procurement Office:** responsible for the administrative management of strategic projects funded through European Regional Development Funds.

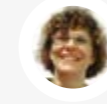
Board of Trustees



Executive Committee



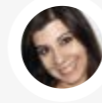
International Scientific Advisory Board



Management Team

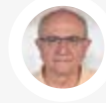
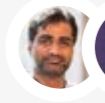
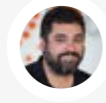


EC R&I Strategy and Policies

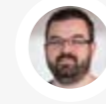


Research

5G & IoT Smart Networks & Services



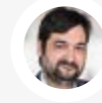
SEG Software Engineering Group



KTM Knowledge & Technology Marketing



Operations and Digital Infrastructure & Service



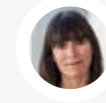
Project Management Office



ERDF & Procurement Office



Admin & Finance



Corporate Development



People & Talent

**Research
& Innovation
are at our core**

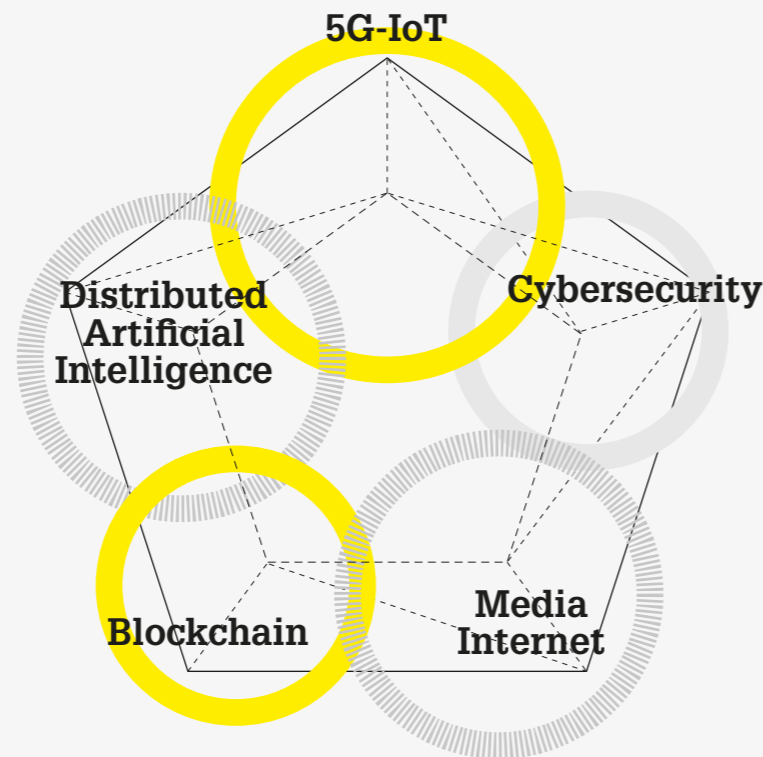
14,2 M€

Granted by the European Commission in the 2014-2019 period within the Horizon 2020 Framework Programme, rewarding i2CAT's quality research and remarkable achievements.



Roadmap R&D

In 2019, i2CAT has worked to formalize a **roadmap for its research and development activities**, re-orienting some of its research goals and topics to better align them towards the European Commission R&D strategic objectives for **H2020** and especially for **Horizon Europe**. Research topics are all structured around the "**Smart Networks and Services**" leitmotiv, including the following main areas: **5G networks and beyond, Internet of Things, Virtual and Immersive Media Technologies, Distributed Artificial Intelligence, Cybersecurity, and Blockchain**.



Research topics

5G & Internet of Things

- Multi-tenant wireless access control/management
- Machine Learning (ML) for Wireless Access Networks
- LPWAN (Low Power Wide Area Network) for LEO satellite constellations
- Evaluation of V2X technologies and virtualized V2X application functions
- "AI-readiness" of Software & Network management systems
- Elastic Slice modeling and management extensions
- Integration and harmonization of NFV, MEC, Cloud-Native VIMs/NFVOs
- Satellite-, and Security-related elements in the NFV lifecycle
- Network Virtualisation solutions based on RINA, the Recursive Internetwork Architecture

Distributed Artificial Intelligence

- AI for smart manufacturing
- AI for 5G and beyond networks
- AI for image and sound recognition
- AI for cybersecurity

Virtual and Immersive Media Technologies

- Network-based media services for XR-conferencing
- Streaming immersive content formats (360, 3D, PC, Lightfield)

Cybersecurity

- Cyber Security as a Service
- Risk Assessment and Management
- Privacy Enhancing Technologies (PET)
- Data Security and Privacy
- Identity Management

Blockchain

- Information and resource sharing between untrusted network operators, their partners and customers
- Data and content sharing preserving privacy
- Digital identity and traceability

Some of our partners



Coordinated H2020 projects in 2019

i2CAT has a leading role in a variety of European research projects that lead the way in cutting-edge technologies such as 5G, VR or Cybersecurity.

5 Project Coordinator

2 Technical Manager



A Distributed Cloud and Radio Platform for 5G Neutral Hosts

i2CAT is the project coordinator, as well as the leader of the 5GCity software platform development activities. 5GCity works to build and deploy a common, multi-tenant, open platform that extends the (centralized) cloud model to the extreme edge of the network by innovating with a distributed, 3-tier architecture providing network sharing, slicing and MEC capabilities.



Zero-touch security and trust for ubiquitous computing and connectivity in 5G networks

i2CAT coordinates 5GZORRO, which uses distributed Artificial Intelligence to implement cognitive network orchestration and management with minimal manual intervention. i2CAT leads the design

and development of spectrum sharing and Smart Contract based secure SLA monitoring, and contributes to the development of multi-domain slice orchestration & management and cross-domain security & trust modules of the project platform.



Beyond 5G multi-tenant private networks integrating Cellular, WiFi, and LiFi, Powered by Artificial Intelligence and Intent-Based Policy

i2CAT is the technical manager of 5G-CLARITY, which will develop and demonstrate a beyond 5G system for private networks integrating 5G, Wi-Fi, and LiFi technologies, and managed through AI-based autonomic networking. The center leads the work on the SDN/NFV management platform, the development of AI algorithms, and contributes coexistence solutions between WiFi and cellular and provide an OCC based positioning solution.



Sustainable 5G deployment model for future mobility in the Mediterranean Cross-Border Corridor

i2CAT is the technical manager of 5GMed, which brings together key stakeholders of the “Barcelona-Perpignan” cross-border section of the Mediterranean corridor including MNOs, road and rail operators and neutral hosts to demonstrate how a multistakeholder 5G infrastructure can be used to jointly deliver CCAM and FRMCS services. i2CAT is the technical coordinator and will provide a self-contained edge computing + radio node consisting of Edge computing server with OpenStack, distributed radio nodes with wireless backhaul capabilities, RSU (11p) capabilities, and multi-tenant Small Cell (LTE) and WiFi capabilities.



Artificial Intelligence-based Cybersecurity for Connected and Automated Vehicles

i2CAT coordinates CAMEL and participates on the cyberthreat detection and response techniques for cooperative automated vehicles and on PKI-enabled vehicle identity management against identity theft. CAMEL’s main goal is to proactively address modern vehicle cybersecurity challenges applying advanced Artificial Intelligence and Machine Learning techniques while seeking methods to mitigate associated safety risks.

Considering the entire supply chain of automotive operations, CAMEL targets to reach commercial anti-hacking IDS/IPS products for the European automotive cybersecurity and to demonstrate their value through extensive attack and penetration scenarios.



Immersive Accessibility

i2CAT is the coordinator of ImAc, a project aimed at exploring how accessibility tools and access services can be integrated into immersive media services, including 360-degree content spatial audio and Virtual Reality (VR). It specifically addresses the needs of deaf, hard of hearing, partially sighted and blind communities. The ImAc project aims to make the immersive and accessibility functionalities configurable according to the needs and/or preferences of the users while maintaining its compatibility with the technologies and formats used in the audiovisual sector.

i2CAT leads the development of the VR360 accessible player and coordinates the end-to-end system integration activities.



Photo-realistic Social Virtual Reality

VRTogether is developing and integrating new media formats that deliver high-quality photo-realistic content and create a strong feeling of co-presence in coherently integrated experiences. The aim of the project is to re-design the distribution chain so such an innovative content format can be orchestrated and delivered in a scalable manner, offering appropriate Quality of Experience (QoE) metrics and evaluation methods to impact content creators, producers, distributors, tooling companies, service providers and the general audience.

The i2CAT Foundation coordinates the project and leads the development of the VR player, as well as a PC-MCU (Point-Cloud - Multipoint Control Unit) that will minimize the communication costs of this new format (Point Clouds).

5G Projects

The **European Commission** has recognized i2CAT's research quality over the years, especially in topics related to the 5G technological ecosystem. Between 2014 and 2020, i2CAT has participated in **13 of the 65 projects** awarded under the three phases of the 5G-PPP, having raised **almost 7M € in funding**.

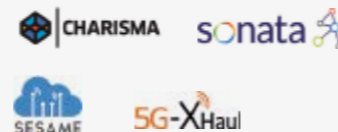
The market potential of the technological outcomes obtained in these projects has now been recognized through the award of an **EIT FTI project (5GaaS)**, which will provide funds for product development and commercialization activities targeting the markets of 5G private networks and neutral hosting.

Last but not least, i2CAT's 5G expertise has also been recognized at the Spanish level by the CDTI through the "**Tecnologías Cervera**" program, in which i2CAT participates in the only 5G project that has been granted: **OPEN-VERSO**. With this project, i2CAT has been recognized as a "**CERVERA Excellence Center in 5G**".



H2020

ICT 5G-PPP Phase 1 (2014-2018)



ICT 5G-PPP Phase 2 (2016-2020)



ICT 5G-PPP Phase 3 (2018-2022)



13 Projects

of 65 total 5GPPP



3 Project Coordinator

CHARISMA, 5G-CITY and 5G-ZORRO



3 Technical Manager

5G-XHAUL, 5G-CLARITY and 5GMED



EIT Fast Track to Innovation

(2020-2022)

5GaaS

5G as a Service

5GaaS intends to develop and launch a new product in the form of a decentralized marketplace for the telecom ecosystem under a new Joint Venture. This new platform is the culmination of three major components; two of them are already available in the market: a centralized marketplace for site leasing and tenant management, from Ubiwhere, and dRAX™, from Accelleran, an interoperable, standards-based and software-focused implementation of 5G networks. The other innovative component will come out of H2020 5Gcity project, to which 5GaaS partners have collaboratively contributed to by building an automated 5G network slicing engine for Neutral Hosts.

i2Cat will ensure 5Gcity's Automated 4G Network Slicing for Neutral Hosts will smoothly transit to 5GaaS architecture following the same design patterns once implemented and integrated with

ACC's dRAX™. The center will also lead the innovative actions on blockchain and smart contracts technology - the enabler for 5GaaS' decentralized marketplace with automatic programming of trusted contracts and automated transfer of value.



Redes Cervera

(topic: 5G) (2020-2022)

OPEN-VERSO

Open, Virtualized tEchnology demonstRators for Smart netwOrks

The complete virtualization of network infrastructures, Artificial Intelligence, new vertical sectors, and a horizon of continuous standardization of 5G and 6G networks can allow consortia such as OPEN-VERSO (VICOMTECH, GRADIENT, i2CAT) position itself as key players in the evolution of next-generation mobile networks. All this under the creation of an ecosystem for technology centers

by which the mutualization of their resources will be key to serve as a point of transfer to the Spanish academic and productive sectors in the context of the development and adoption of next-generation advanced mobile networks.

i2CAT will focus on the development, integration, and deployment of the following technologies: virtualized RAN controller; orchestration, monitoring and automation system for network resources and services; evolution of the 5G core network and the adaptation of a prototype of MCU for volumetric video to the virtualized environment offered by OPEN-VERSO.



Research Outcomes

The work of i2CAT's research areas in 2019 has produced **notable research outcomes** that will contribute to the **advancement of research and innovation** in the local and European ecosystems. Here is an example of three cutting-edge results that were developed this year by i2CAT's team of researchers.



Innovation in VR360 content

The Media Internet Area has led the development of end-to-end technological contributions to integrate accessibility within immersive media services, focusing on VR360 content. These contributions have been:

- Validated by more than **200 users** in controlled user tests and reached close to **1.000 users** in open pilots.
- Published in many **high-impact journals** (AI EDAM, MonTI, PUC, ITU Journal).

- Adopted by **four European broadcasters** (CCMA, RBB, Aragón TV, A Punt) and by **two third-party EU H2020 projects** (TRACTION, SO-CLOSE).
- Proposed to **standardization** within MPEG, W3C and ISO, even providing reference implementations.

i2CAT's RAN Controller

The **Mobile Wireless Internet Area** has developed a **RAN Controller technology** within the framework of the H2020 5G-PICTURE and 5G-CITY projects. The i2CAT RAN Controller controls custom Wi-Fi devices that include wireless access and backhaul interfaces in a single device. It also enables an operator to **slice the wireless network** by dynamically instantiating virtualized Wi-Fi access points with a guaranteed portion of the wireless resources, while **routing traffic** from these access points through the **wireless multi-hop mesh network** until a fixed network attachment point. The i2CAT RAN Controller is also able to control **multi-tenant LTE Small Cells**, dynamically deploying PLMNIDs that connect to a virtual core network instantiated in a nearby MEC location, while also forwarding LTE traffic through the wireless mesh. i2CAT plans to continue developing this technology adding support for 5G NR access nodes and for 60 GHz wireless backhaul interfaces.

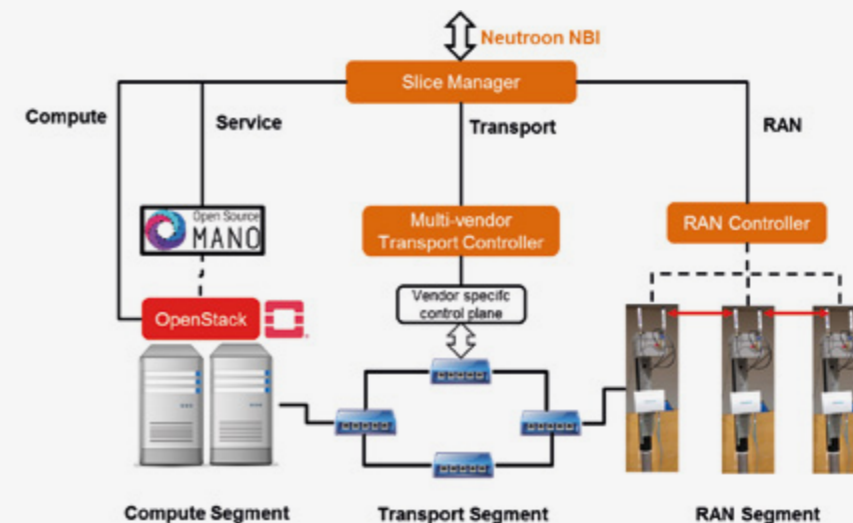
NEUTROON platform for private 5G networks

The **Software Networks and Mobile Wireless Internet Areas** have developed NEUTROON, a multi-tenant service & network management platform with SLA guarantees for 5G neutral host operators. It supports the **management of heterogeneous, multi-vendor 5G infrastructure**

and agile provisioning of services on top of such infrastructure. NEUTROON features **hard slicing** of 5G infrastructure in the RAN, transport, and compute domains while providing integrated management of 5G services: virtual base stations, VNFs of application functions, and transport network resources connecting them.

Among its benefits, NEUTROON **i)** is an open solution, avoiding vendor lock-in; **ii)** is extensible and

flexible, capable of adapting to the requirements of multiple private 5G networks; **iii)** reduces the skill set required to operate private 5G networks and **iv)** enables neutral host business models. NEUTROON has been selected as one of the 15 candidates of the **COLLIDER program**, a pioneering technology transfer program that encourages the development of highly disruptive technology-based startups for the 5G ecosystem.



Standardization & Publications

In 2019, the research areas of i2CAT worked to produce **relevant scientific results** to contribute to the general advancement of digital technologies and to **boost standard bodies** such as ETSI and ISO. The center also strived to set up i2CAT's **open access publications repository** and to make scientific outcomes available to everyone.



Standardization

The i2CAT Foundation contributes to standard bodies such as ETSI and the ISO and is an active participant at ISO SC6 WG7 and ETSI ISG NGP, where the RINA specifications and RINA principles (respectively) are an important part of both groups work. i2CAT works hard to offer key insights into the RINA projects and to promote the advances of the Network, Transport and Future Network working groups.

Milestones in 2019:

ISO SC6 Working Group 7 (Future Networks).

The following RINA specifications have reached the status of "Committee Draft", only one step towards becoming a Draft International Standard (DIS): Reference Model, Error and Flow Control Protocol (EFCP), Common Distributed Application Protocol (CDAP), Flow Allocator, Common Application Connection Establishment Phase (CACEP).



ETSI Next Generation Protocols (NGP) ISG.

Publication of the following Group Recommendation (GR): E. Grasa, J. Day, M. Tarzan, D. Lopez, K. Smith; **"Next Generation Protocols: A example of a non-IP network architecture based on RINA design principles"**. ETSI ISG on Next Generation Protocols (ISG NGP), ETSI GR NGP 009 v1.1.1, February 2019.



In 2019 the research areas produced 34 scientific contributions. These publications included:

D. Camps-Mur, J. Gutierrez, E. Grass, A. Tzanakaki, P. Flegkas, K. Choumas, D. Giatsios, J. Zou, P. Legg, J. Bartlett, J. K. Chaudhary, A. Betzler, J. J. Alexandri, D. Simeonidou, A. Beldachi, T. Diallo, R. Gonzalez; **"5G-XHaul: A Novel Wireless-Optical SDN Transport Network to Support Joint 5G Backhaul and Fronthaul Services"** in IEEE Communications Magazine, Volume 57, Issue 7, July 2019.

I. Demirkol, D. Camps-Mur, J. Paradells, M. Combalia, W. Popoola and H. Haas; **"Powering the Internet of Things Through Light Communication"** in IEEE Communications Magazine, Volume 57, Issue 6, June 2019.

C. C. Mexixner, H. Khalili, S. Siddiqui, A. Papageorgiou, A. Albanese, P. Cruschelli, G. Carrozzo, A. Ulisses, J. Colom, I. Neokosmidis, J. A. Garcia Peiro, S. Figuerola, R. Nejabati, D. Simeonidou; **"Deploying a Novel 5G-Enabled Architecture on City Infrastructure for Ultra-High Definition and Immersive Media Production and Broadcasting"**, In IEEE Transaction on Broadcasting, Vol. 65, pp. 392-403, 2019.

A. Betzler, D. Camps-Mur, E. Garcia-Villegas, I. Demirkol, J.J. Aleixandri; **"SODALITE: SDN Wireless Backhauling for Dense 4G/5G Small Cell Networks"**, in IEEE Transactions on Network and Service Management, Vol. 16 Issue 4, 2019.

Montagud, M., Orero, P. & Matamala; **"A. Culture 4 all: accessibility-enabled cultural experiences through immersive VR360 content"**, in Springer Personal and Ubiquitous Computing (2020).

Open Access Policy

During the first quarter of 2019, i2CAT has partnered with the **Consorci de Serveis Universitaris de Catalunya (CSUC)** to set up **i2CAT's open access publications repository**, which is available via the RECERCAT portal (Dipòsit de la Recerca de Catalunya), specifically via the area reserved to the CERCA research centers (<https://recercat.cat/handle/2072/4427>).

In order to give further visibility to the results achieved by its researchers, i2CAT has also joined the **Portal de la Recerca Catalana (PRC) initiative**, driven by CSUC. PRC's main goal is to display and disseminate the research activity carried out in Catalonia in regard to researchers, publications, groups, and research projects for the international scientific community, companies, financial organizations, and public in general, thus making **open access to scientific output** easy. In the long term, the project aims at simplifying management processes as well as to support their evaluation. PRC is available at <https://portalrecerca.csuc.cat/>.

i2CAT has been enrolled at the PRC program during Q2 2019, and information on its publications have been available through the portal since Q4 2019.



Public Administration

**we are
committed
with the digital
future society**

The i2CAT Foundation works **hand in hand with Public Administrations** to promote and facilitate the **digital transformation of society**. The center aims at becoming the **benchmark in digital innovation** for Public Administrations and to **contribute to the digital empowerment of citizens** through digital social innovation and open and participative access to technological advancements.

i2CAT will continue working to **strengthen its collaboration with Public Administrations** and to play a fundamental role in the definition and deployment of digital public policies throughout the country.

Participation in digital strategies of the Government of Catalonia

In 2019, the Government of Catalonia has granted the i2CAT Foundation a key role in the definition of 3 digital strategies that will be essential for the digital transformation of our society and industry in the near future: the 5G, Blockchain, and Artificial Intelligence Strategies of Catalonia.

The 5G Strategy of Catalonia

i2CAT has collaborated with the **Ministry for Digital Policy and Public Administration** in the definition of the document for the **5G Strategy of Catalonia**, which was approved on 25th February 2019 by the Government of Catalonia.

With this strategy, the Government is promoting a program of actions

to support the **deployment of 5G** in Catalonia around five central concepts: 5G Promotion, 5G Infrastructure, 5G Innovation, 5G Ecosystem, and 5G Talent.

The i2CAT Foundation will play an important role in the definition, promotion, execution, and leadership of research and innovation initiatives that align with this strategy.



The Blockchain Strategy of Catalonia

i2CAT has led the technical management of a working group to promote the **implementation of Blockchain technology** together with other experts, departments, and agencies of the Public Administration. The content, contributions, requests, and conclusions of this working group have served as the basis for the **Blockchain Strategy of Catalonia** which was approved on June 18th, 2019, by the Government of Catalonia.

The center will play a relevant role in initiatives aiming at the **promotion of research and innovation in Blockchain**, as well as developing **proof of concepts** to validate use cases, involving the agents of the

quadruple helix (administrations, companies, universities, and citizens).



The Artificial Intelligence Strategy of Catalonia

The i2CAT Foundation has taken part in the working group for the definition of the **Artificial Intelligence Strategy of Catalonia** by preparing a document that was the subject of a participatory process to allow all interested parties to contribute. The final document of the Artificial Intelligence Strategy of Catalonia, under the name of **CATALONIA.AI**, was finally approved by the Government of Catalonia on 18th February 2020.

i2CAT will lead and **Advanced Research and Innovation Programme** in the field of AI and will work to foster **mission-oriented research and innovation** initiatives with the objective of resolving social or business issues related to AI in collaboration with other universities, research groups, institutes and public centers that carry out AI projects in Catalonia.



Impulse of Digital and Mobile Transformation

The Impulse of Digital and Mobile Transformation initiative works to **boost and consolidate the ICT sector** in Catalonia, improve the **efficiency and competitiveness of productive sectors** through their digital transformation and increase the impact generated by research and innovation in the **quality of life of citizens**.



The i2CAT Foundation is working to boost the ICT sector while fostering the adoption of Advanced Digital Technologies along with the Catalan Government in different projects. Some of the most relevant are:

- **IoT Catalan Alliance:** In 2019, the project promoted the impact of the Internet of Things and related technologies in the health, utilities, agrifood, and logistics sectors.
- **SmartCatalonia Challenge:** The 2019 editions have focused on the impact of advanced digital technologies on the marine sector in collaboration with the Barcelona and Tarragona Port Authorities.
- **5G Areas:** This project, started in 2019, consists of a roadshow through Catalonia in the form of 4 dissemination events and 3 workshops oriented to define the impact of 5G on the tourism, agrifood, and chemical industry sectors, among others.
- **Laboratori SmartCatalonia:** In 2019, the project has promoted and coordinated the deployment of 10 pilot tests and PoC in Catalan towns, granting the reach of smart

solutions beyond cities and capitals and offering Catalan companies the opportunity to test their solutions in real environments.

i2CAT has also participated in the **main technological events** celebrated in Barcelona and has continued its work to foster the ICT sector by offering Catalan SMEs the opportunity to present their most advanced products and solutions at:

- **IoT Solutions World Congress 2019:** more than 25 Catalan SMEs showcased their most advanced solutions at the AI area, mainly focused on Industry 4.0, and at the Blockchain pavilion. i2CAT was also part of one of the official Industrial Internet Consortium testbed based on 5G technology.
- **Mobile World Congress Barcelona 2019:** The i2CAT Foundation sponsored the drone innovation area, where the Catalan ecosystem was represented together with the main stakeholders of the sector.

Innovation Offices

Supporting public administrations in their digital transformation processes.



Innovation Offices are **alliances among the i2CAT Foundation and public organizations** to promote innovation that impacts fields like digital administration, secure societies, digital culture, or climate action. i2CAT helps in the **creation of an innovative ecosystem** to generate and execute innovation projects within the **quadruple helix**.

This 2019, i2CAT has worked with **CTTI**, the public company that manages the digital services of the Government of Catalonia, and with **Catalonia's Cybersecurity Agency** (formerly CESICAT).

In the framework of the **CTTI Innovation Office**, i2CAT has:

- Organized 2 technological workshops (Artificial Intelligence & Big Data and Robotic Process Automation)
- Lead the dynamization of more than 40 people to administrate 22 challenges, 120 use-case ideas, and 18 proof of concepts in the fields of AI, Blockchain, 5G, Data Analytics, IoT, and Robotics

The **Cybersecurity Agency Innovation Office** was launched in 2019 to promote, revitalize, and execute transformative activities together with the **Catalan ecosystem of cybersecurity research and innovation**.

Among the first activities that have taken place we can highlight:

- Creation of a Strategic Plan for Innovation in Cybersecurity
- Proposal and acceptance of a cybersecurity challenge in the Advanced Digital Technologies program, promoted by the Ministry for Digital Policy, with an estimated budget of 1M €
- Support on the membership of the European Cyber Security Organization (ECISO)



5G Barcelona

Transforming the Barcelona metropolitan area into an open and neutral 5G urban laboratory.



5G Barcelona is a **public-private initiative** founded with the objective to transform Barcelona into a **reference hub for 5G in Southern Europe**. This hub is focused on the **validation and adoption of 5G technologies** and applications in real environments. To this end, 13 **pilot projects** were carried out in 2019, two of which will still be active throughout 2020.

The i2CAT Foundation acts as **CTO** of the initiative and has been responsible for its technical direction since its foundation, leading more than **10 workshops** in key verticals such as Industry, Healthcare, Mobility, and Energy.

In 2019, i2CAT's participation has also been crucial for two strategic 5G projects: the **5G Connected Car** and the **5G Ambulance**, which were demonstrated at MWC Barcelona 2019.

From a technical standpoint, in 2019 **5G Barcelona and Orange** signed an agreement which grants the initiative use of the company's **3.5 GHz radio spectrum band**, access points to its 5G network and other technical components necessary for research. The **'The Thinx 5G Barcelona'** lab, which i2CAT is in technical charge of, has also continued to facilitate state of the art IoT tests to companies.



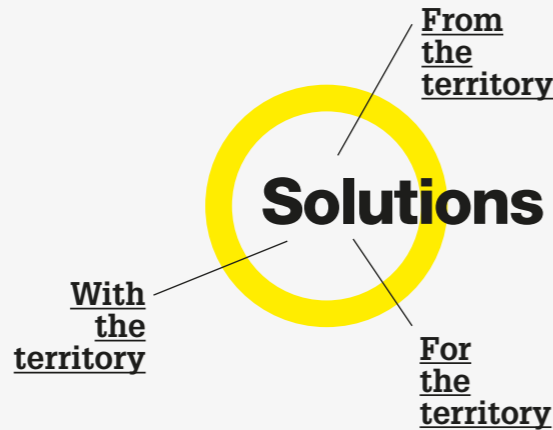
5G Barcelona

Digital Citizenship Lab (LCD)

Towards a universal digital social innovation system for Catalonia.



The Digital Citizenship Lab (Laboratori de Ciutadania Digital – LCD) is an initiative by i2CAT that aims at introducing the concept of **collaboratories in Catalonia** to promote innovation and suggest solutions:



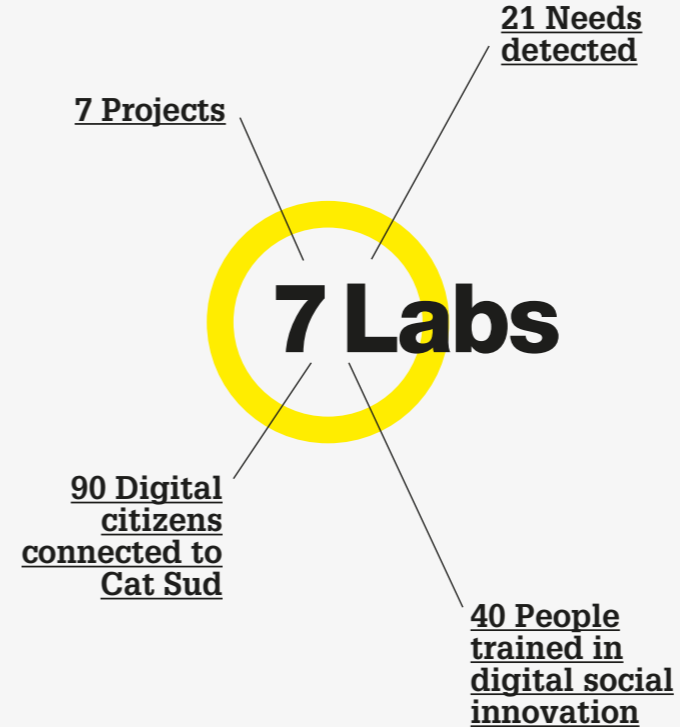
Collaboratories are labs and collaboration networks established between **public administrations, companies, citizens, research institutions**, and the territory (quintuple helix framework) to leverage assets and knowledge, scout for challenges, and innovate.

Labs are spaces to **share, design, and reflect**. Every lab will promote and carry out a diversity of activities in constant connection to the rest, supporting stakeholders in the territory to learn and immerse themselves in **digital social innovation to solve challenges**. The solutions to these challenges will be tackled **from the community**, through **sustainable models** that **impact positively** in the society, the economy, and the environment.

With this view in mind, i2CAT is leading the **Col-laboratori Cat Sud** pilot project to deploy the real operation of a territorial col-laboratory in the South of Catalonia. This collaboratory will be a **lab of labs**, an innovation structure that will work to prototype the **first universal digital innovation system** in Catalonia.

The Col-laboratory Cat Sud is working to promote this universe of labs with a territorial vision, **accelerating new initiatives** and **training citizens** to become empowered through **digital social innovation**. Research will also be a tool to promote this empowerment, opening the **results and outcomes** in this field to citizens and to the territory as a whole.

Currently, the Col-laboratory Cat Sud comprises **7 labs** and has reached the following milestones:



Promoters of Col-laboratori Catalunya



Promoters of Col-laboratori Cat Sud pilot



Col-laboratori Cat Sud Labs

- URV Labs
- Social Lab Tarragona
- Ciutat Sàvia CoLab
- Laboral Lab



Collaboration with private companies we foster your innovation

The i2CAT Foundation continues working to translate the outcomes and knowledge generated as a result of research activities into productive sectors of the local and international economy. Through **strategic alliances, cooperation, and joint efforts** with companies and organizations, i2CAT fosters their digital transformation.

Some of our partners



Collaboration with private companies

Empowering eHealth with Blockchain technology

Salus Coop and i2CAT offer citizens a tool to share medical data to aid in disease research.

The i2CAT application will allow **citizens** to collaborate with specialized **research institutes** by sharing their **health data** in order to improve disease research. The solution takes advantage of the characteristics of the **blockchain architecture**, such as security, transparency, data immutability, auditing or distributed computing. The application will connect the research institutes with the user's data, ensuring that the intermediary is not aware of the shared content, fully respecting **privacy** and access control at any time. **Zero Knowledge** technology will be the basis of future applications, when privacy becomes a design pillar and third parties access only the part of the necessary data.



5G and beyond infrastructure

Partnering with TRIA to deploy Recursive InterNetwork Architecture (RINA) Proof of Concept for distributed datacenters.

TRIA is a US company that aims to commercialize **RINA-based products**. i2CAT is leveraging 10 years of R&D experience on RINA to partner with TRIA and develop a smart networking fabric for **distributed data centers supporting 5G and beyond deployments**. i2CAT is prototyping the world's **first high-performance RINA router**, taking advantage of programmable switching silicon. Such routers will be deployed and tested within data centers belonging to the Canadian **ENCQOR 5G innovation program**, sponsored by **Ciena**.



Collaboration with private companies

AI & V2X for mobility

Alstom and i2CAT focus on enhancing mobility for citizens through innovation.

2019 has been the year of **consolidation** in the relationship between Alstom and i2CAT. The partnership has carried out **3 projects in the fields of AI and V2X**, two of which will still be active throughout 2020. These projects are clearly focused on **social benefits**, helping people with their daily mobility and the integration with public transport. From identifying an empty space for a wheelchair in the subway to prioritizing the circulation of special transport, the aim of these projects is to help Alstom be a reference in the **mobility sector**. i2CAT has achieved the role of strategic and technological partner for Alstom, a position that offers the opportunity to deploy **new projects and strategies** in the coming years.



Smart Home IoT Solutions

SIMON and i2CAT foster Smart Homes through wireless tech, software optimizations, and AI.

i2CAT collaborates with SIMON Tech in the development and evolution of their Smart Home IoT solution. The aim of this project is to combine wireless technologies, software optimizations, and artificial intelligence aiming at the implementation of an enhanced Smart Home gateway for domotic control (lights, sockets, etc.). This enhanced gateway supports different wireless interfaces (such as Zigbee and Z-Wave) to control the sensors/actuators and an array of technologies to interact with the user or with the Cloud (such as WiFi or BLE).



RIS3CAT

The 'Research and Innovation Strategy for the Smart Specialisation of Catalonia' (RIS3CAT) promotes the cooperation of companies and stakeholders of the research and innovation ecosystem in Catalonia to **boost R&D projects** in a variety of productive and technological fields. The i2CAT Foundation participates in **9 RIS3CAT projects** and leads the **5G/IoT Emerging Technology** communities



Emerging Technologies

FEM IOT

Fostering the Emerging Market of the Internet of Things

The FEM IOT community works to boost and strengthen the collaborations within the **Catalan Internet of Things ecosystem**. The work is as well focused on increasing the business **impact of research** and the social impact related to **Intelligent Mobility** and **IoT Data Valorization**. i2CAT's Innovation Business Developers leverage their knowledge of market companies, industry needs, and relevant players related to provide intelligence to the city's infrastructure with IoT solutions.



Looming Factory

Paving the way for the Catalan Factories of the Future

Looming Factory aims to facilitate and boost the **market introduction of emerging technologies in the industry ecosystem**. The i2CAT team works to strengthen the Catalan market needs of the **Factories of Future** related challenges through either the industrial Data Connector systems or a Marketplace platform. i2CAT's Innovation Business Developers leverage their knowledge of the market companies, needs, and relevant players to provide the business impact that the Catalan Industry 4.0 requires.



QUANTUMCAT

Quantum technologies for industrial ecosystems

Quantumcat aims to boost the **development of quantum technologies** to integrate them into the industry and consolidate the position of Catalonia as a **reference** in this sector.

RIS3CAT Communities

ViVIM

Computer Vision for Immersive Multi-platform Video

As a member of the recently established RIS3CAT Media Community, **i2CAT coordinates ViVIM**, a collaborative project aimed at implementing an **innovative media production and consumption system**. This system will focus on a novel form of audiovisual narrative based on **omnidirectional video**. Furthermore, the project will develop production tools for immersive screens, support for omnidirectional cameras, and coordinated access to content through head-mounted displays, tablet devices, and conventional TV. Finally, ViVIM will test the viability of this system by means of **two demonstrators** addressed at live and deferred broadcasting.

ViVIM

ACADOM

Ensuring continuity of home care

ACADOM, coordinated by the Sant Joan de Déu Barcelona Children's Hospital, develops services to patients and families through **digital platforms** to facilitate adherence to the continuous treatment for pediatric patients through the use of **telemedicine**.

PERSOSER

Customization of services to improve customer experience

PERSOSER uses sensor technologies, data analytics, and customer engagement activities so that utilities can offer tailor-made services to every customer. The **PERSOSER** team has created new **customer behavior analysis models** based on the processing of customer data and the development, design, and testing of advanced and personalized services.

HL 4.0

Expert digital system of comprehensive personalized pediatric patient care

The Hospital Liquid 4.0 project has worked to advance the organization and care changes implemented by the Sant Joan de Déu Barcelona Children's Hospital towards more **proactive, collaborative, and personalized medicine** using ICTs as a lever of change.

SENIX

Network Sensoring and Inspection

SENIX investigates and uses new technologies to digitize and automate inspection and network management tasks in **Utilities**. The project aims to transform the operation, maintenance, and planning of **distribution networks** by increasing the current level of sensorization and integrating new inspection systems in harsh field environments.

SMARTSPACE

IoT solution for the interior furnishing sector in Catalonia

SMARTSPACE develops an **IoT solution** composed of a series of new **smart products** connected to an IoT platform and specifically directed at the **interior furnishing sector**. The project expects brands and manufacturers to introduce this differential factor within their product catalog and promote this platform, or others, in the future.

Technology Transfer

**we care about
research impact**

i2CAT works to boost collaborations with the companies and the innovation ecosystem players through **strategic alliances** to create innovative **market-oriented technologies and solutions**. The center also coordinates the design and deployment of **trials for technological and functional validation purposes** with local partners, public administration, and users and sets up **IPR exploitation agreements**, creating mixed R&D teams with companies to cooperate in the creation of startups.

Producte – Llabor

Funding to bring research to market.



i2CAT has received funding from the **Industria del Coneixement Program**, promoted by the Government of Catalonia, which seeks to foster the creation and consolidation of a **new entrepreneurial ecosystem** of high added value and knowledge-rich, based on results produced by the different knowledge centers of the Catalan science and innovation ecosystem.

The i2CAT Foundation has reached a 100% success rate of the proposals submitted with the granting of **120k€** to boost **two novel technologies** in the telecommunications field: **Neutron**, a fully developed software to manage 5G networks, and **Dash Optimization Engine for Wireless Networks (DOW)**. The funds will be used to go forward within the TRL scale of both technologies thanks to the development, deployment and test of different pilots in real environments.

The success of this call evidences i2CAT's strategic steps towards a **greater relevance of research outcomes in society**, as well as the role of ICT as a high impact science such as Materials, Energy, or Health.



The Collider & Neutron

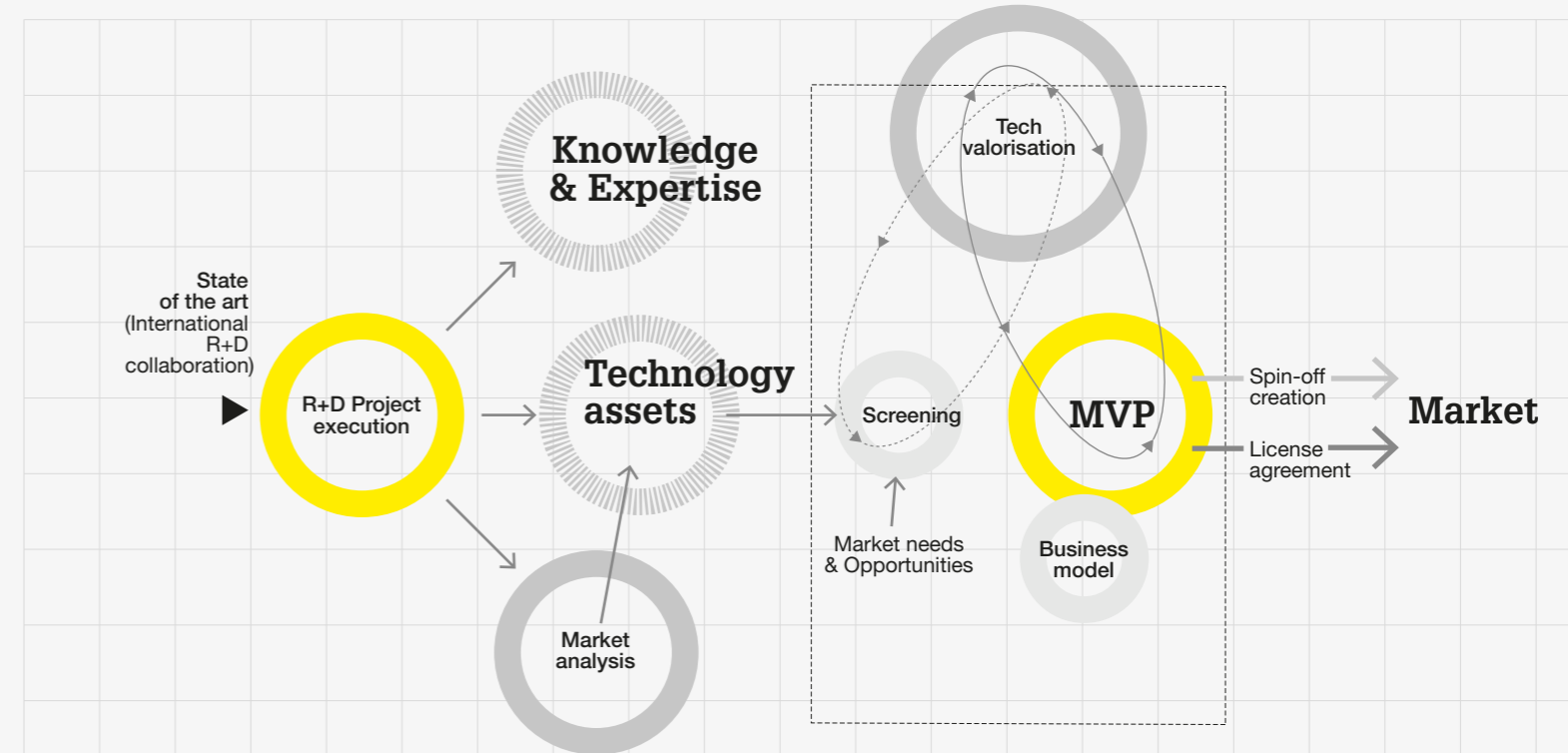
Innovation to drive ICT research towards market and society needs.



A team of i2CAT researchers, with the support of the Knowledge and Technology Marketing unit, has been enrolled in **The Collider program** to create a disruptive **technology-based startup** that addresses both society and industry challenges.

The Collider is an innovation program promoted by **Mobile World Capital Barcelona** that connects scientific and entrepreneurial talent. The Neutron project brought together i2CAT's research team with two entrepreneurs who have also been involved in the process of **translating research results into well-defined and profitable products**.

Neutron is a **fully developed software** that has been used in several EU projects as the backbone to **manage 5G networks** and will become an end-to-end management platform of shared and vendor-agnostic networks for different tenants (e.g. mobile network operators, private users) via APIs.



Events & Media

**bringing research
and innovation
activities closer
to the industry
and society**

Commercial and technological congresses and events are an exceptional opportunity to **showcase the milestones and outcomes** resulting from the center's work in research and innovation. i2CAT participates in a wide variety of **local and international events**, while also disseminating its knowledge through **workshops, roundtables, or technological demonstrations**. In 2019, not only has i2CAT participated in **more than 50 events**, but the center has also awakened the interest of local and international media, reaching a total of **+400 impacts** in the **press, TV, online media and radio**.

MWC Barcelona 2019: Betting on the potential of intelligent connectivity



The 5G connected ambulance of the future

The i2CAT Foundation was present at the **2019 MWC Barcelona** to showcase how advanced digital technologies can design a **smarter and more inclusive future**.

Congress attendees had the opportunity to witness a live pilot test of the **first 5G connected ambulance** in the territory. To make this innovation possible, i2CAT cooperated with the **Government of Catalonia and the Emergency Medical System of Catalonia (SEM)**. The pilot's presentation was hosted by the president of the Government of Catalonia, Quim Torra, the Minister for Digital Policy and Public Administration, Jordi Puigneró, and the Minister of Health, Alba Vergés.

The ambulance, developed under the umbrella of **5G Barcelona**, included advanced communication tools thanks to which it received remote medical support via HD video over a 5G network. The live pilot had a significant impact on local and international media and was covered by the USA TV channel **CNBC** as well as by the two main daily newspapers in Spain, **El País** and **El Mundo**.

A project by:



5G Barcelona



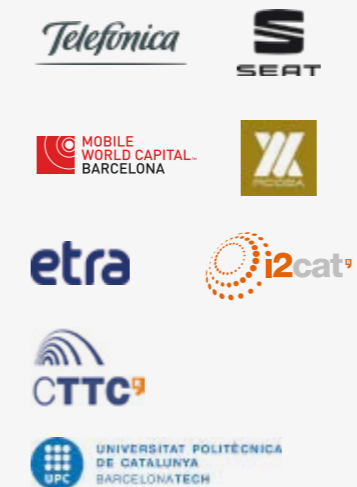
5G connected car

From February 24th to the 26th, the streets of L'Hospitalet de Llobregat were the scenario of the **connected car and assisted driving via 5G** use case pilot thanks to the joint work of Telefónica, SEAT, Mobile World Capital Barcelona, Ficosa, ETRA and i2CAT (with the support of CTTC and UPC).

Journalists and citizens were able to test and watch this 5G assisted driving test, which was supported by **Cellular Vehicle to Everything C-V2X** and **Edge Computing** technologies. The use of these technologies maximizes road security through minimal latency, offering driving assistance and communication with the car's immediate surroundings.

The car was connected in real-time to different elements, from other vehicles to traffic lights and signs, pedestrians or cyclists. The i2CAT Foundation developed and provided an **ultra-precise edge-location solution based on UWB for bicycles** in order to geolocate them.

A project by:



5G Barcelona



IoT Solutions World Congress 2019

Showing the potential of technology to improve both industry and society.

The i2CAT Foundation was present in another edition of **IoT Solutions World Congress** to showcase how advanced digital technologies will be paramount in designing a better and smarter future for all. More than **16,000 visitors** from 120 countries came to the congress from October 29th to 31st and had the opportunity to get in touch with advanced digital technologies like **UWB, IoT, AI, 5G** or **Blockchain** at i2CAT's booths.

Bringing healthcare to the home thanks to AI, IoT & 5G

The i2CAT Foundation, together with Suara Cooperativa, ConneCThink and Group Saltó, presented a **testbed** that demonstrated how **healthcare providers can bring care into the home** and rapidly respond to emergencies originated at the patient's house. The demonstration was an integration of **AI, IoT, and 5G** to provide a platform to monitor the patient at home.

A project by:



UWB and RFID to improve Smart Factory operations

During IoTSWC, visitors had the opportunity to see a **real-time test** that showcased how advanced technologies can **help factories** in their stock inventory, geopositioning of goods, and smart picking processes. The **Smart Factory** demonstrator integrated **UWB, RFID, SMAC100 iBeacon,** and **BLE beacons** powered by **LoraWAN** and **Sigfox + WIFI**.

A project by:



Blockchain Solutions World within IoTSWC

To be at the forefront of innovation, i2CAT was present at the **Blockchain Solutions World**, the area devoted exclusively to this novel technology. Through the project **Coldchain Solution**, i2CAT showed the potential of the technology both for industries and citizens. Coldchain is a **battery-less, encrypted, and 100% reliable tracking system** that combines the **potential of IoT** with the **highest levels of security offered by Blockchain** to attain the standard of quality and transparency that both manufacturers and end-users demand for their products.



Smart City Expo World Congress 2019

Exploring the Inclusive Supermarket of the Future.



The i2CAT Foundation was present in another edition of Smart City Expo World Congress to showcase how **Visible Light Communications (VLC)** can be applied to retail in order to facilitate the **shopping experience of visually impaired citizens** thanks to a highly precise location system. The demonstration was part of the 'City of the Future', an impressive display by the Government of Catalonia exploring **16 innovative and cutting-edge experiences** that will define the years to come.

The **VLC-based system** included only commercial LED lights, a switch, and a smartphone equipped with a camera and an app. After capturing the position of only 3 lights, the smartphone is able to **locate** the shelved

products in real-time, as well as **offer information** about them, with an error margin of less than 5 cm in position and in orientation. This remarkable new application of VLC **sparked the interest of a great deal of media**, including TVE, TV3, Catalunya Ràdio, or La Vanguardia.



Other industry and scientific events

i2CAT strengthens its presence in trade fairs, industry shows and research conferences worldwide.



During 2019, several successful demonstrations of the center's capacities were presented at various events, including a **supply chain solution based on Blockchain** which was presented at **SIL Barcelona**, the leading logistics, transport and supply chain trade show in Southern Europe. The **battery-less, encrypted, and 100% reliable** tracking system showcased at SIL combines the potential of IoT with the highest levels of security offered by Blockchain.

The research work carried out at i2CAT also had a strong presence at multiple scientific conferences. The H2020 project **VRTogether**, led by

i2CAT, received the **Best Exhibition Award at New European Media (NEM) Summit 2019**, and the **Best Demo Award at the 10th ACM Multimedia Systems Conference (MMSys 2019)**. i2CAT also contributed to several **sessions, workshops, and booths** by H2020 projects 5GCITY, 5GCroCo, 5G ESSENCE, 5G-PICTURE, and SaT5G at the 2019 **European Conference on Networks and Communications (EuCNC)**.



Participation at International Fairs & Congresses

13 Demos
7 Booths



ISWCS 2019
16th International Symposium on
Wireless Communications Systems



DeepTech4Good

Keynotes, Workshops & Roundtables

47

Organization of Commercial & Technological Events

22

i2CAT in The Media

Our projects and initiatives made headlines in 2019. Here is a selection of remarkable pieces featuring the i2CAT Foundation.



+472 Media impacts



Diari Ara – The 5G car parks at MWC

https://www.ara.cat/tecnologia/cotxe-del-aparc-a-al-Mobile_0_2186181407.html

El País – The ambulance that saves lives connected to the hospital through 5G

https://cat.elpais.com/cat/2019/02/25/tecnologia/1551096771_723173.html

El Punt Avui – Cars talk to bikes and traffic lights through 5G

<http://www.elpuntavui.cat/societat/5-societat/1560038-els-cotxes-ja-parlen-per-5g-amb-bicis-i-semafors.html>

Betevé – An interview to test the 5G network of Barcelona

<https://betvev.com/ciencia-i-tecnologia/entrevista-a-5g-televi-si-portuguesa/>

El Periódico – Catalunya, a testbed for 5G

<https://www.elperiodico.com/es/economia/20190723/catalunya-banco-de-pruebas-del-5g-7565849>

Betevé – Barcelona will have a new laboratory to test 5G

<https://betvev.com/ciencia-i-tecnologia/barcelona-a-nou-laboratori-proves-5g/>

TV3 – i2CAT's inclusive supermarket featured at TN Vespres

<https://www.ccma.cat/tv3/alacarta/teletotals/telenoticies-vespre-20112019/video/5963826/>

RTVE – i2CAT's inclusive supermarket featured at L'Informatiu TVE

<https://www.rtve.es/alacarta/videos/informatiu/les-noticies-del-dimarts-19-novembre-del-2019-informatiu/5448585/>

El Mundo – A city with functional connectivity

<https://www.elmundo.es/cataluna/2019/11/09/5dc5c08c21efa00c1d8b45be.html>

Diario del Puerto – i2cat unites IoT and Blockchain to monitor temperature in cold chain processes with total reliability

<https://www.diariodelpuerto.com/i2cat-fusiona-el-iot-y-blockchain-para-el-control-de-la-temperatura-en-la-cadena-de-frigo-con-total-fiabilidad>

Cadena SER – The technology that will change our lives

https://cadenaser.com/programa/2019/06/23/a-vivir_que_son_dos_dias/1561288092_350033.html

VilaWeb – Mollerussa demonstrates the benefits of IoT and drones for the agri-food business

<https://mollerussa.vilaweb.cat/noticies/mollerussa-mostra-els-beneficis-en-el-sector-agroalimernari-de-les-technologies-iot-i-dron/>

ara

MOBILE WORLD CONGRESS

El cotxe del 5G aparca al Mobile

Els fabricants d'automòbils abracen la tecnologia per oferir vehicles connectats i més segurs



PIELLA MORGANAS BARCELONA

El cotxe del 5G és el cotxe de color taronja i el cotxe de color verd, però el cotxe de color vermell és el cotxe de color verd, però el cotxe de color vermell és el cotxe de color verd, però el cotxe de color vermell és el cotxe de color verd...

Motivació
Les operacions es bolquen en el 5G perquè el negoci actual "ho s'agafa"

5G "Si veiem col·lidir els cotxes, els cotxes han de poder parlar entre ells per evitar accidents, és a dir, que el cotxe que està al semàfor..."

La tecnologia 5G fa servir la infraestructura de fibra òptica i les antenes 5G per oferir un servei més ràpid i estable...
Aquesta primera passa permetrà controlar els processos de fabricació i els processos de distribució...
El cotxe del 5G aparca al Mobile World Congress...
Els fabricants d'automòbils abracen la tecnologia per oferir vehicles connectats i més segurs...
Aquesta primera passa permetrà controlar els processos de fabricació i els processos de distribució...
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Els fabricants d'automòbils abracen la tecnologia per oferir vehicles connectats i més segurs...

el Periódico

NUEVA TECNOLOGÍA Banco de pruebas del 5G

El consorcio Barcelona 5G y Orange convierten Catalunya en un 'laboratorio abierto' de telecomunicaciones. El objetivo es desarrollar nuevas aplicaciones



GILLES TARRA, FOLGARIT

para que empresas internacionales lleguen a Barcelona para hacer pruebas con la tecnología 5G...
El consorcio de Barcelona 5G y Orange convierten Catalunya en un laboratorio abierto de telecomunicaciones...
El objetivo es desarrollar nuevas aplicaciones...
El consorcio de Barcelona 5G y Orange convierten Catalunya en un laboratorio abierto de telecomunicaciones...
El objetivo es desarrollar nuevas aplicaciones...

EL PUNT AVUI Els cotxes ja 'parlen' per 5G amb bicis i semàfors



EL PUNT AVUI

A l'entrada de la Fira Industrial de Barcelona, el cotxe del 5G parla amb el semàfor i la bicicleta...
Els cotxes ja 'parlen' per 5G amb bicis i semàfors...
A l'entrada de la Fira Industrial de Barcelona, el cotxe del 5G parla amb el semàfor i la bicicleta...
Els cotxes ja 'parlen' per 5G amb bicis i semàfors...
A l'entrada de la Fira Industrial de Barcelona, el cotxe del 5G parla amb el semàfor i la bicicleta...
Els cotxes ja 'parlen' per 5G amb bicis i semàfors...

At a Glance

i2CAT wants to lead the challenge of **designing the digital society of the future based on research and innovation in advanced digital technologies**. Through talent generation and cooperation with the stakeholders of the local and international digital research and innovation ecosystem, i2CAT, with the commitment of its members, envisions **Catalonia as a creative, empowered, and innovative society**, where knowledge and digital technology are at the service of people.

Mission and Vision

To design this digital society of the future, the i2CAT Foundation will **boost excellence-based, mission-driven knowledge** addressed at solving business challenges, **co-create solutions** with a transformative impact, **empower citizens** through open and participative digital social innovation with territorial capillarity and **promote pioneering and strategic initiatives** to increase the international projection of Catalonia as an innovative digital country.

- Generate **excellent and significant knowledge** in advanced digital technologies
- **Become a benchmark** organization in digital innovation for public administrations
- **Support the innovation and digital transformation** of the corporate sector in the country

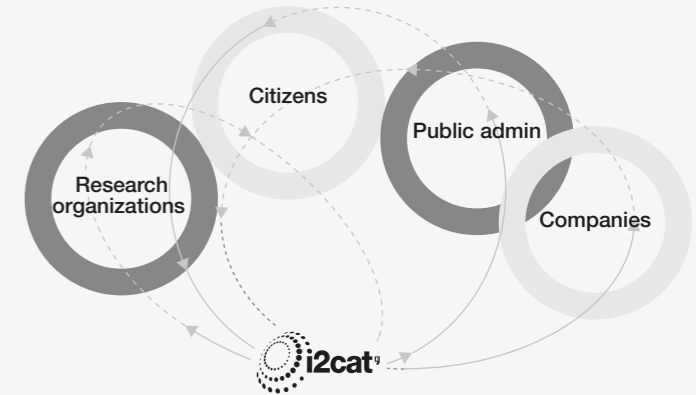
- **Open research** and digital social innovation to citizens and to the whole territory
- Generation of **excellence-based, mission-driven knowledge** addressed at solving the challenges of businesses, citizens and public administrations, highlighting the value of talented local and international researchers
- **Cooperation** and joint efforts with local research and innovation stakeholders to **co-create solutions and products** with a transformative impact
- **Citizen digital empowerment** through open and participative digital social innovation with territorial capillarity
- **Promotion of pioneering and strategic initiatives** to increase the international projection of Catalonia as an innovative digital country.

Core values



Value chain

- Generate excellent and significant knowledge in advanced digital technologies
- Become a benchmark organization in digital innovation for public administrations
- Support the innovation and digital transformation of the corporate sector in the country
- Open research and digital social innovation to citizens and to the whole territory



Cooperation and joint efforts to build a research and innovation ecosystem that helps Catalonia become an advanced digital society.

At a Glance

Board of Trustees

As of the 31st May 2020, the members' representatives were:

Mr. Jordi Puigneró i Ferrer, President, Minister for Digital Policy and Public Administration, Government of Catalonia

Mr. Francesc Torres Torres, Vice-President I, Rector, Universitat Politècnica de Catalunya (UPC)

Mr. Carles Salvadó Usach, Secretary of the Board non-member, Head of Telecommunications Service for the Telecommunications, Cybersecurity and Digital Society Department, Government of Catalonia

Mr. David Ferrer i Canosa, Secretary for Digital Policy, Government of Catalonia

Mr. Daniel Marco Pàrraga, Director General of Innovation and Digital Economy, Government of Catalonia

Mr. Víctor Vera Vinardell, Key Account Territorial Director, Orange

Mr. Joan Romero Circuns, CEO, ACCIÓ

Mr. Joan Gómez Pallarès, General Manager of Research, Government of Catalonia

Mr. Jordi Berenguer Sau, Vice-Rector for Knowledge and Innovation Transfer, Universitat Politècnica de Catalunya (UPC)

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Mr. David Noguera i Bau, Service Provider Marketing, Juniper Networks

Mr. Felip Fenollosa, Director, Fundació CIM

Mr. Oriol Torruella, Director, Cybersecurity Agency of Catalonia, Government of Catalonia

Mr. Joan Bennassar, R&D Director, Media Pro

Mr. Boris Bellalta Jiménez, Teacher ICT Department, Universitat Pompeu Fabra

Mr. Diego Matas Morillo, General Manager, Interoute Iberia

At a Glance

Executive Committee

As of the 31st May 2020, the members' representatives were:

Mr. Lluís Rovira i Pato, President, Director at CERCA Institution

Mr. Carles Salvadó Usach, Vice-President of Delegate Committee, Head of Telecommunications Service at Secretary of Telecommunications, Cybersecurity and Digital Society

Mr. Daniel Marco Pàrraga, Director General of Innovation and Digital Economy, Government of Catalonia

Mrs. Montserrat Cereza Carril, Territorial Manager of Institutional Relations, Orange

Mr. Lluís Anaya Torres, Data and Innovation Manager for the Centre of Telecommunication and Information Technologies, Government of Catalonia

Mr. Joan Romero Circuns, CEO, ACCIÓ

Mr. Lluís Comellas i Riera, Vice-Rector for Research and Innovation, Universitat Ramon Llull

Mr. Xavier Ferrándiz, Vocal, Engineering and Infrastructures Manager at CCMA

Mr. Javier Marcos Álvarez, Head of Innovation Unit, Cellnex Telecom

Mr. Josuè Sallent Ribes, Director, TICSalut Foundation

Mr. Álex Carballo Romero, Sales Manager of Government and Public Services, Vodafone

Mr. Albert Armengol López, Director for the Public Sector, Fujitsu Technology Solutions

Mr. Xavier Azemar Mallard, Head of Barcelona Co-Innovation Center, Cisco Systems

Mr. Francisco Rodríguez, Managing Director, IMI (Barcelona City Council)

Mr. David Noguera i Bau, Service Provider Marketing, Juniper Networks

Mr. Jordi Berenguer Sau, Vice-Rector for Knowledge and Innovation Transfer, Universitat Politècnica de Catalunya (UPC)

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Mr. Tomàs Roy Català, Chief Innovation and Strategy Officer, Cybersecurity Agency of Catalonia, Government of Catalonia

Mr. Boris Bellalta Jiménez, Teacher ICT Department, Universitat Pompeu Fabra

Mr. Joan Bennassar, R&D Director, Media Pro

Mr. Diego Matas Morillo, General Manager, Interoute Iberia, S.A.U

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As of the 31st May 2020, the members' representatives were:

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Professor Dr. Carsten Bormann, Computer Science, Center for Computing Technology (TZI), Universität Bremen

Professor Dr. Jos Baeten, Centrum Wiskunde & Informatica (CWI), Universiteit van Amsterdam

Inder Monga, Executive Director ESnet, Division Director Scientific Networking

At a glance

Staff

Management Team



Josep Paradells, PhD
Director

Artur Serra, PhD
Deputy director

Joan Manel Martín
Managing director

Sergi Figuerola, PhD
Chief technology & Innovation officer

Software Development



Julio Carlos Barrera
Director Software Development

Alfonso Egio
Software Development

Josep Pons
Software Development

Ricardo González
Software Development

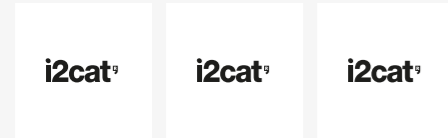
Belén Pousa
Software Development

Adrià Sanchez
Software Development

Santiago López
Software Development

Mateo Hermosilla
Software Development

Lucio Fernandez
Software Development



Dolores García
Software Development

Beka Iglesias
Software Development

Sergi Solvez
Software Development

i2CAT Staff as of April 30th 2020.

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Eduard Grasa, PhD
Director Operations

EC R&I Strategy and Policies



Eunice Ribeiro, PhD
Director EC R&I Strategy and Policies

Pouria Khodashenas, PhD
EC R&I Strategy and Policies

Knowledge & Technology Marketing



Miguel Angel Perez
Director KTM

Alba Garcia
KTM

Tomás Escuin
KTM

Staff

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Daniel Camps, PhD
Director 5G/IoT; MWI

María Luisa Catalán, PhD
5G/IoT; MWI

August Betzler, PhD
5G/IoT; MWI

Miguel Catalan, PhD
5G/IoT; MWI

Pol Delgado
5G/IoT; MWI

Bruno Cordero
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5G/IoT; MWI



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Adriana Fernández, PhD
5G/IoT; Software Networks

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Miquel Tarzán
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Sergi Sánchez
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Sergi Fernández
Director Media Internet



Isaac Fraile
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Gianluca Cernigliaro
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Marc Martos
Media Internet

Amir Ansari, PhD
Media Internet

Mohammad Heijh
Media Internet

Quim Colobrants
Media Internet

Jordi Guijarro
Director Cybersecurity

At a glance

Staff

Support Areas



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Rosa Santamaría Admin & Finance; Sonia Beltrán Admin & Finance; Roger Onnen Director People & Talent; Mireia Herrero People & Talent; Susana Otero Director Corporate Development; Miriam Castillo Corporate Development; Ivan Rodríguez Corporate Development; Anna Civit Corporate Development

IBD Public Sector



Rosa Paradell Director Innovation Business Development

IBD Private Sector



Ana Moliner Director Innovation Business Development

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Cristian Crespo DIMO; Arnau Fatjó DIMO; Patricia González DIMO; Xavier Jordán DIMO; Eduard Balbuena PhD DIMO

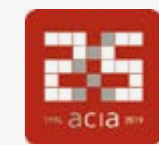
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Associations, Standardization Organizations & Platforms



2019 YEAR IN REVIEW



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Download the Annual Report 2019 here:
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