Annual report 2020

The Internet Research Center

Annual Report 2020

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Letter from the President

Thanks to its excellence, in 2020 i2CAT has consolidated its leading position in the research & innovation ecosystem. It achieved a 23% activities' growth rate. The center's vision of designing and building the digital society of the future is a priority to accelerate social and economic recovery. My acknowledgments to the entire team that, during this exceptionality period, maintained their activity in a professional and committed manner.

Jordi Puigneró i Ferrer
Vice president of the Government of Catalonia
President of i2CAT Foundation

The year 2020 will be remembered as the year of the COVID-19 pandemic causing great personal and economic effects on our society. For this reason, I would like to give a message of remembrance to all the people who have suffered during the pandemic, and a message of thanks to the i2CAT Foundation staff. The team has maintained the teleworking activity in a professional and committed way, and participating in initiatives designed to help overcome the situation of COVID.

In this context, it is remarkable that there has been room for positive learning and new opportunities have been identified. In our field, from the point of view of the digital sector, it has become clear that digital technologies are key to social and economic reactivation, and from the point of view of research and innovation, it has been shown that the collaboration and work aimed at solving shared needs and challenges is a guarantee of success of any initiative. For this reason, the i2CAT Foundation's vision of designing and building the digital society of the future based on research and innovation in advanced digital technologies, now more than ever, must be a priority to accelerate recovery.

5G technology is a present and future engine to improve society's connectivity and develop new disruptive and transformative services. In this area, i2CAT has continued to generate excellent knowledge. For example, he has technically coordinated the European project of the Mediterranean 5G corridor, 5GMED, and has received recognition as a member of the national network of excellence Cervera in 5G technologies. He has also carried out sectoral and territorial training and driving activities for the deployment of the first 5G Areas in Catalonia (Terres de l'Ebre, Terres de Ponent, Camp de Tarragona, and Penedès), and has participated in the deployment of use case pilots of 5G within the 5GBarcelona initiative.

In the field of immersive and interactive technologies, in which i2CAT is an international benchmark, it has coordinated two European projects (VRTogether and ImAc), and, in the Crea & Play i2CAT's laboratory located in Vilanova i la Geltrú, it has deployed the first prototype of a holoconferencing solution. This solution allows people to interact immersively and in 3D with multiple remote users. This prototype offers new future applications in fields such as health or education.

Establishing synergies with other local ecosystem stakeholders is a priority for co-developing solutions and launching strategic initiatives that address real challenges. During 2020 i2CAT has been one of the founding members of the public-private initiative CIDAI, Center of Innovation for Data Tech and Artificial Intelligence, within the framework of the Artificial Intelligence strategy, CataloniaAI, of the Government of the Generalitat. It aims to promote the adoption and use of AI solutions within the business sectors and has deployed multiple initiatives for sectoral revitalization and digital transformation, in collaboration with the Generalitat de Catalunya, to promote new sectors of advanced digital technologies such as IoT, Drones, and Blockchain, as part of an operation co-financed with ERDF funds.

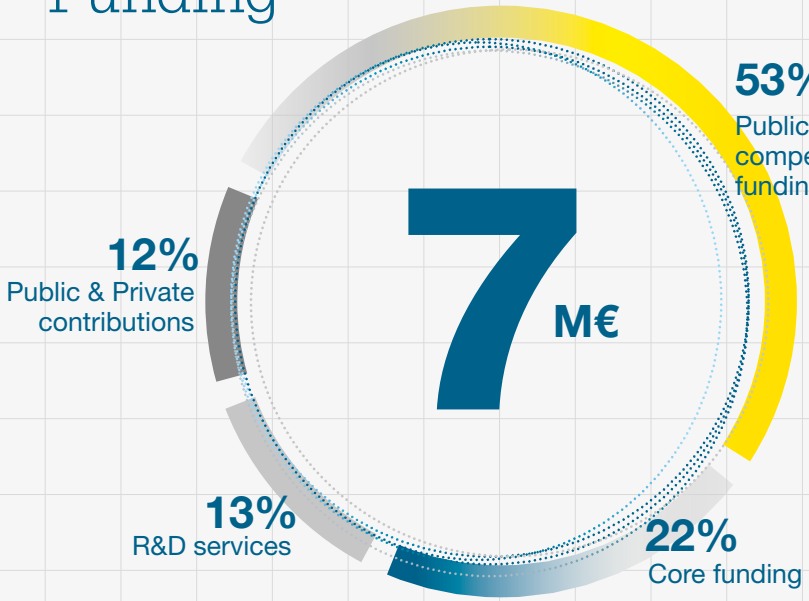
Opening research and digital social innovation to citizens and territories is another of the strategic objectives promoted by i2CAT during 2020. Through the Col·laboratori Catalunya initiative, it has deployed digital innovation activities in two first Col·laboratories, CatSud and Anoia, to connect citizens and local agents with research and knowledge organizations with the objective of addressing challenges in the territory and with the people through the digital technologies application and training.

With the talent of the i2CAT team, made up of more than 100 professionals, a 23% growth in the volume of activities carried out compared to the previous year has been achieved, reaching a turnover of more than € 7M. The center, which has also incorporated an ICREA Research Professor to increase fundamental research activity in emerging areas such as Artificial Intelligence-driven Systems and 6G technologies, has become the second entity in Catalonia with the most European funding obtained in ICT calls 2014-2020 within of the European Horizon 2020 program.

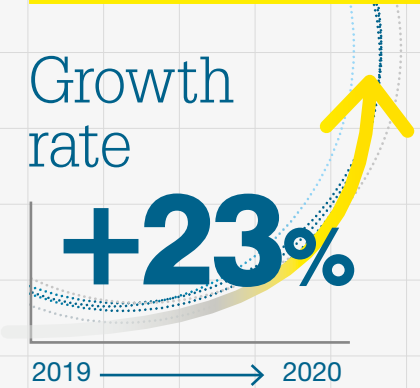
The new European research framework program, Horizon Europe, the European Commission's program, Digital Europe, and especially the European recovery plan, Next Generation EU, are great opportunities that i2CAT must seize to continue to make an impact on society promoting and participating in initiatives to turn Catalonia into a creative, empowered, and innovative society, where knowledge and digital technology are at the service of people.

Facts & Figures

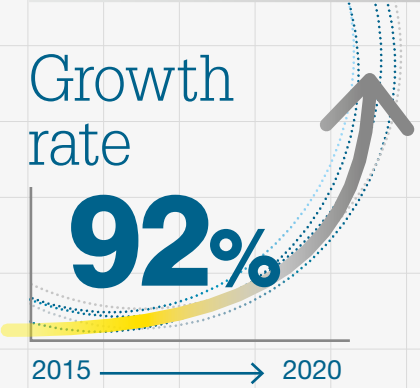
Funding



Growth rate



Growth rate



Project proposals submitted

143

Competitive projects in execution

53

New contracts with companies /entities

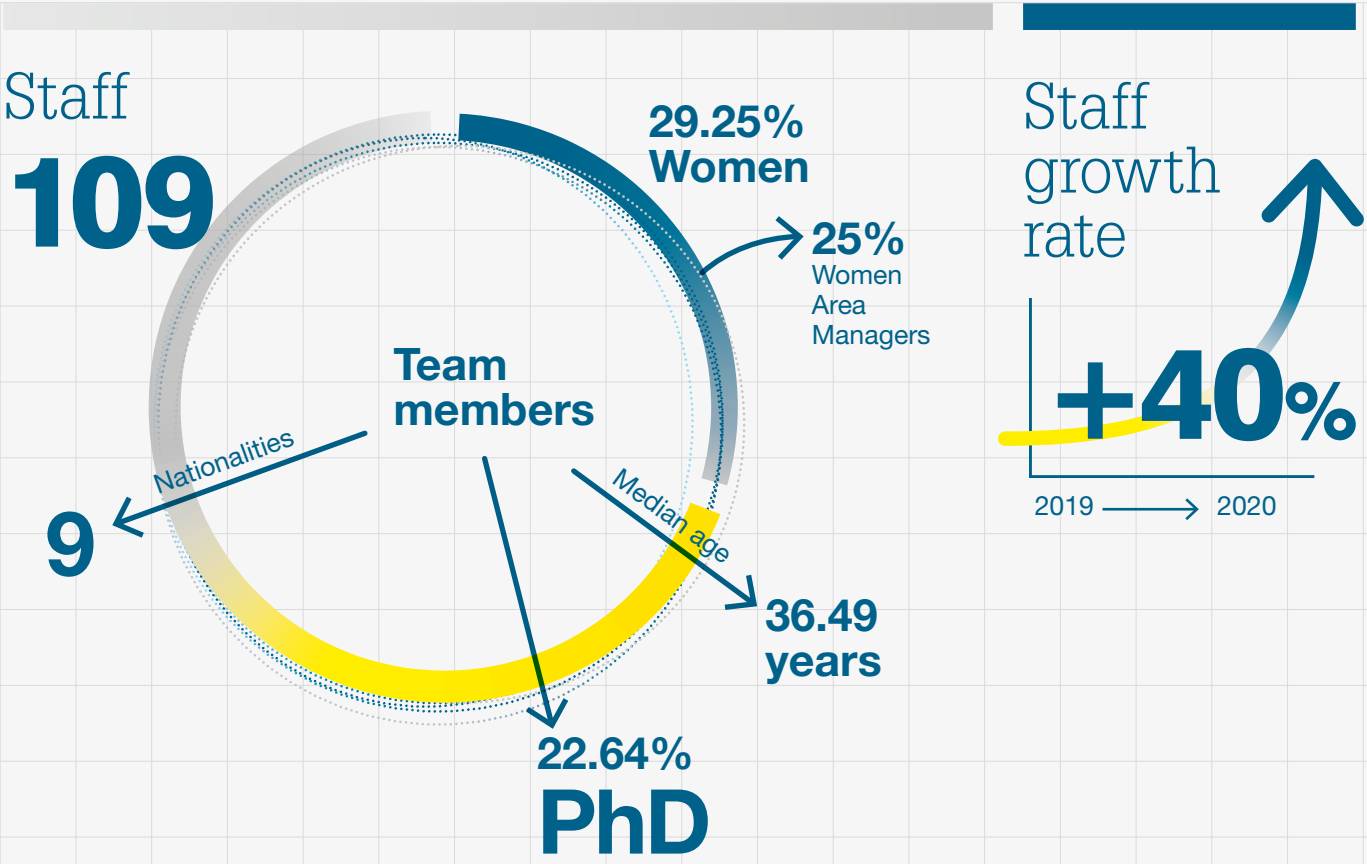
30

Funding granted by **ICT calls within the European Horizon 2020 program**

2nd entity

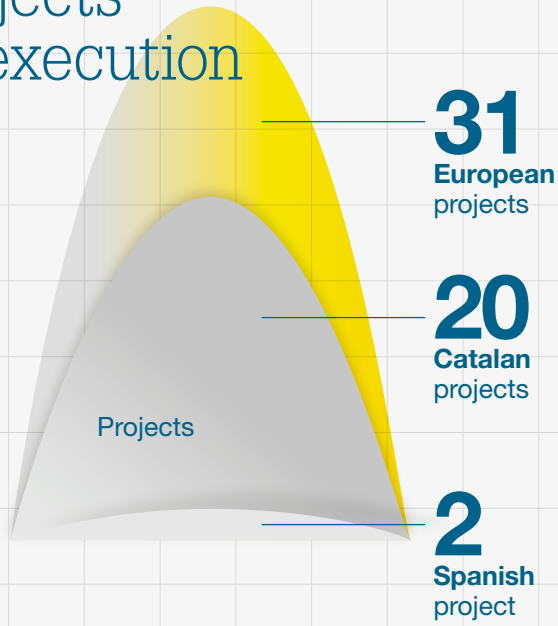
in Catalonia

Facts & Figures



R&D Projects in execution

Competitive projects in execution



Impact-oriented research and innovation activities

5G/IoT

Focus

Knowledge & Excellence

Technological research

TERMINET

5GaaS

IoT-NGIN

AFFORDABLE 5G

Applied innovation

Smart Environment

5GCity

5G-PICTURE

eHealth

Industry 4.0

5G CLARITY

SMARTY Interreg Europe

Autonomous and Connected Mobility

GrowSmarter

5GCroCo

5GMed

Creative Industries

FLAME

Digital Innovation Strategies and Policies

- **Àrees 5G**
- **TDA 5G Rural**

Digital Transformation

Private-Public Partnerships (PPP)

FEM-IoT

IoT CATALAN ALLIANCE

5G Barcelona

Tech Transfer & Private collaborations

- **Paytec**

ALSTOM

SIMON

neutroon

NEC

Port de Barcelona

Cybersecurity

Focus

	Technological research	Applied innovation				
		Smart Environment	eHealth	Industry 4.0	Autonomous and Connected Mobility	Creative Industries
Knowledge & Excellence				• **PALANTIR**	CARAMEL	
Digital Innovation Strategies and Policies	TDACiberseguretat					
Digital Transformation	**Private-Public Partnerships (PPP)** • **RIS3CAT QuantumCat**				**Tech Transfer & Private collaborations** AGÈNCIA DE CIBERSEGURETAT DE CATALUNYA	

Impact-oriented research and innovation activities

Immersive and Media Technologies

Focus

	Technological research	Applied innovation				
		Smart Environment	eHealth	Industry 4.0	Autonomous and Connected Mobility	Creative Industries
Knowledge & Excellence	ImAc VRTogether	• **Respond-A**	• **ACADOM** • **HL 4.0** VINCLESBCN			MED GAIMS ViVIM
Digital Innovation Strategies and Policies						
Digital Transformation	**Private-Public Partnerships (PPP)** • **Crea & Play Laboratory**					**Tech Transfer & Private collaborations** CISCO

Artificial Intelligence

Focus

Technological research

Applied innovation

Smart Environment

eHealth

Industry 4.0

Autonomous and Connected Mobility

Creative Industries

Knowledge & Excellence

5GZORRO

FEM-IoT

MUV

Persoser

Boost 4.0 BIG DATA FOR FACTORIES

5GMed

CARAMEL

Digital Innovation Strategies and Policies

Catalonia.ai

Private-Public Partnerships (PPP)

Tech Transfer & Private collaborations

Digital Transformation

TDACiberseguretat

CIDAI

Looming Factory

ALSTOM

Corporate Highlights

The centre has strengthened its excellence and key position both at a European and local scale through **R&D projects**, **strategic initiatives**, and **technological valorization** to **design the digital future** of the society.

Founding members of the CIDAI

In 2020 i2CAT has been one of the founders of the public-private initiative CIDAI (Center of Innovation for Data Tech and Artificial Intelligence), framed within the strategy of Artificial Intelligence (CataloniaAI) of the Government of Catalonia, which aims to promote the adoption and use of AI solutions within the business sectors.

The CIDAI promotes the transfer of knowledge and the implementation of joint projects between knowledge-generating entities (universities, research and innovation centers), technology and service providers, and user companies and institutions demanding innovative solutions in applied artificial intelligence.

The CIDAI is modelled on the Digital Innovation Hubs set up by the European Commission and will be structured as a networked service centre working for businesses and institutions.CIDAI is promoted by i2CAT, Government of Catalonia, Municipality of Barcelona, BSC Research Center, CVC, Eurecat, Everis, Microsoft, SDG Group, and UPC.

CIDAI

First ICREA Research Professor

In September 2020 i2CAT welcomed to its team the first ICREA Research Professor hosted by the centre.

Xavier Costa-Pérez research focuses on the digital transformation of society (DX) driven by the interplay of mobile networks and AI. As a i2CAT's Scientific Director he addresses the need to expand the mobile ecosystem to incorporate industry verticals like automotive, manufacturing, smart-grids, and health. The centre expects to boost the fundamental research in fields as Artificial Intelligence driven Systems and 6G technologies.

ICREA

Space Communications

i2CAT is in continuous evolution to face new challenges and opportunities. According to this mind-set, in 2020 i2CAT created a new research area to focus on Space Communications.

Space Communications (SpaceComms) research area aims at contributing to the development of enabler technologies that integrate new communications capabilities in Earth Observation (EO) missions. These technologies are mainly oriented on satellite-to-ground and inter-satellite interactions. In particular, the area contributes to integrate Internet of Things (IoT) technologies with satellite platforms, conceive novel protocols for Delay Tolerant Networks (DTN) and Federated Satellite Systems, participate in the development of Inter-Satellite Link devices, and promote the deployment of Software Defined Network (SDN) techniques over satellite systems.

Among the main market sectors impacted by SpaceComms research activity, Low Earth Orbit (LEO) satellite constellations, CubeSat platforms, and ground segment for satellite networks.

In 2020 i2CAT pursued another strategic action in the field of Space Communications, the center contributed to the definition of the NewSpace Strategy of the Government of Catalonia.

i2CAT Strategic Plan 2020-2023

The Strategic Plan is the result of a participatory process involving both the **governing bodies and the staff members of i2CAT**. It **encompasses the contributions envisioned** by them and defines the **center's activity within the period 2020-2023**. Under the motto "Make things happen", the plan outlines an ambitious roadmap to guide i2CAT's activity for the coming years.

Specifically, the roadmap marks 4 Strategic Objectives, 15 specific objectives, 42 actions, and 128 strategic sub-actions and aims to generate impact in knowledge fields, business sector, public administrations, citizenship, and the territory.

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

IMX2020

i2CAT hosted and organised the 2020 edition of IMX ACM International Conference on Interactive Experiences for TV and Online Video. IMX (formerly TVX) is the leading international conference for presentation and discussion of research into interactive media experiences.

IMX 2020 brought together international researchers and practitioners from a wide range of disciplines, ranging from human-computer interaction, multimedia engineering and design to media studies, media psychology and sociology.

The event was initially planned as an onsite conference in Barcelona but turned into an online meeting due to the COVID-19 pandemic obtaining remarkable results and outcomes:

191 participants

3 workshops
1 creative challenge
2 industry talks

7 demos
13 papers
14 WiP papers

Operational Updates

COVID-19

The pandemic affected the entire society in 2020. The centre wants to have a virtual memorial for those we've lost and also a sincere recognition to the i2CAT team that, as the crisis stretched on, maintained the research and innovation activities' working remotely in a professional and committed way. Along the year the centre actively participated in different initiatives that aimed to help overcome the situation of COVID.

New work spaces

i2CAT Headquarters

Also the i2CAT workplaces have evolved during 2020.
The headquarters were reformed and expanded in order to better suit the new needs of the center and its staff members. It was rethought with the aim to enlarge its capacity and to offer spaces that make it easy to work in a collaborative way and according with the new routines.

Crea & Play Laboratory

In 2020 it was born a new space dedicated to the application of new media technologies. It is composed of a gamification center, led by the public innovation agency Neàpolis, and a Virtual Reality Lab managed by the Media Internet research area of the i2CAT Foundation.

Crea&Play aims to support initiatives at the municipal level through gamified methodologies and provide companies with professional technical training. Among the various initiatives, the European project MedGaims, destined to gamify touristic experiences of the city, is already being developed in this lab.

The facilities in which the project is located are an important part of guaranteeing its operation and enhancing Crea & Play's desire to become a hub for attracting companies and professionals.

New Board of Trustees

2020 was a year of changes also in the main governing body of the center. Two new entities, **Parlem Telecom** and **Universitat Rovira i Virgili**, joined a group of trustees that include the Government of Catalonia, the Barcelona City Council, Universitat Politècnica de Catalunya, Universitat Ramon Llull, Universitat Pompeu Fabra, Orange, Cellnex, Juniper Networks, CISCO, Vodafone, Fujitsu, and Mediapro.

These actions respond to the center's goal of cooperating with the Catalan ICT sector to foster innovation and launch strategic projects.

parlem telecom

UNIVERSITAT ROVIRA i VIRGILI

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Lluís Rovira

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Professor Dr. Carsten Bormann

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Sergi Figuerola

EC R&I

Strategy and Policies

Eunice Ribeiro

Research

5G & IoT

Smart Networks & Services

AI Driven Systems

Xavier Costa

MWI

Mobile Wireless Internet

Daniel Camps

SN

Software Networks

Shuaib Sidiqqi

DAI

Distributed Artificial Intelligence

Josep Escrig

Media internet

Sergi Fernández

DTS

Digital Social Technologies

Artur Serra

Innovation

Cybersecurity

Shuaib Sidiqqi

Jordi Guijarro

Space Communications

J.A. Ruiz

Pol Guixé

DIMO

Digital Innovation Management Office

Carlos López

IBD

Innovation Business Development

Public Sector

Rosa Paradell

Private Sector

Ana Moliner

Software Development

Julio C. Barrera

KTM

Knowledge & Technology Marketing

Miguel A. Perez

Operations and Digital Infrastructure & Service

Eduard Grasa

Project Management Office

Jose Miguel Sanjuan

ERDF & Procurement Office

Flaminio Minerva

Admin & Finance

Rocío Segura

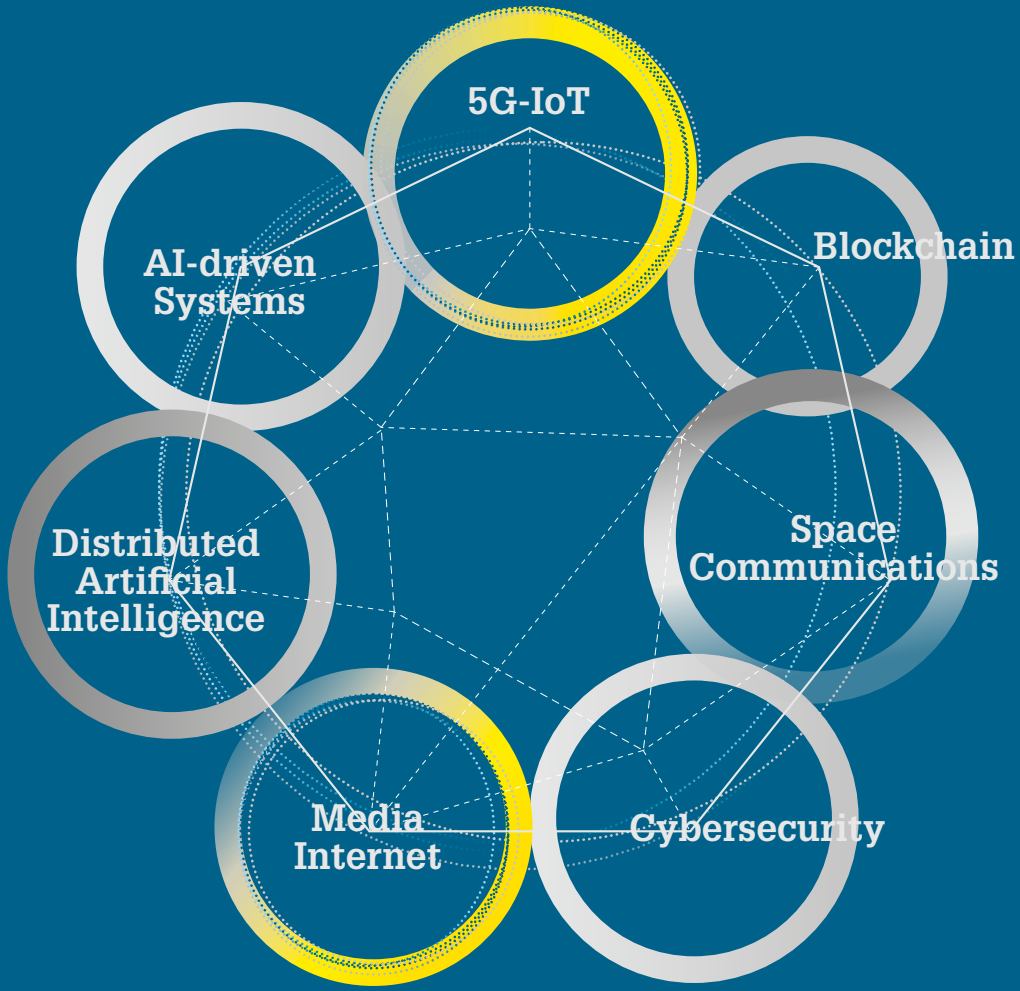
Corporate Development

Susana Otero

People & Talent

Roger Onnen

Knowledge & Excellence


5G-IoT
AI-driven Systems
Blockchain
Distributed Artificial Intelligence
Space Communications
Media Internet
Cybersecurity

R&D Roadmap

In 2020, i2CAT further advanced in the roadmap for its research and development activities around the "Smart Networks and Services" leitmotif. Fully aligned towards the European Commission R&D strategic objectives, it increased and enhanced the knowledge resulting from R&D activities in **5G and beyond**, **Internet of Things**, and **Virtual and Immersive Media Technologies**. The center also strengthened its position in **Artificial Intelligence**, **Cybersecurity**, and **Blockchain &DLT**. During 2020 the centre boosted the **Space Communications new research line**.

Research topics

AI-driven Systems

- AI-driven Systems Automation. Beyond 5G/6G
- Collaborative Smart Networked/Edge Systems. Drones, Robotics, …
- Advanced Localization Solutions. Industrial IoT, Public Safety, …
- AI-based Wireless Sensing. Privacy, Healthcare, …
- Smart/Intelligent Surfaces. Industry 4.0, Logistics, …

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 tecnologies 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 image and sound recognition**. CNNs and deploying applications for ambient intelligence
- **AI for Virtual Reality**. ML for calibration, compression and recognition of volumetric content in VR applications
- **AI for 5G networks**. ML to improve resource allocation and network optimisation, key to the deployment of efficient 5G networks
- **AI for smart manufacturing**:
  - Smart Factories – ML to optimise production and reduce energy consumption
  - Digital Twins – to enhance monitoring and simulate new operational models in factories

- **AI for cybersecurity**:
  - AI techniques to detect attacks and vulnerabilities in V2X communications
  - Profiling and identifying vulnerable users faced with cyber-attacks
- **AI for sensors**. ML on arrays of low-cost sensor readings to provide robust and precise measurements

Cibersecurity

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

Media Technologies

- Network-based media services for XR-conferencing
- Streaming immersive content formats (360, 3D, PC, Lighftield) Cybersecurity
- Cyber Security as a Service
- Risk Assessment and Management
- Privacy Enhancing Technologies (PET)
- Data Security and Privacy
- Identity Management

Blockchain & DLT

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

Space Communications

- IoT technologies for satellite-to-sensor direct connections and sporadic inter-satellite communications.
- Inter-satellite communications protocols to deploy temporal satellite networks in a variable and uncertain node density environment.
- Software Defined Networks (SDN) architectures for dynamic networks composed of terrestrial and non-terrestrial nodes.
- Federative collaborations among heterogeneous satellite systems to contribute on the Internet of Satellites paradigm

Some of our partners

European projects

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

The center's expertise was recognised both at a European and Spanish scale. The **European Commission** has recognized i2CAT's research quality over the years, especially in topics related to the 5G and Media technological ecosystem. i2CAT was also rewarded by the CDTI through the "Tecnologías Cervera" programe identifying i2CAT as a "**CERVERA Excellence Center in 5G**".

H2020 Coordinated projects

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 onitoring, and contributes to the development of multi-domain slice orchestration & management and cross-domain security & trust modules of the project platform.

Artificial Intelligence-based Cybersecurity for Connected and Automated Vehicles

i2CAT coordinates CARAMEL and participates on the cyberthreat detection and response techniques for cooperative automated vehicles and on PKI-enabled vehicle identity management against identity theft. CARAMEL'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, CARAMEL 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 was 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 addressed the needs of deaf, hard of hearing, partially sighted and blind communities. The ImAc project aimed 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 led the development of the VR360 accessible player and coordinated the end-to-end system integration platform.

Photo-realistic Social Virtual Reality

VRTogether developed and integrated 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 was 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 coordinated the project and led the development of the VR player, as well as a PC-MCU (Point-Cloud - Multipoint Control Unit) that minimizes the communication costs of this new format (Point Clouds). VR-Together has delivered an end-to-end holconferencing platform for VR.

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.

5G Cervera Center of Excellence

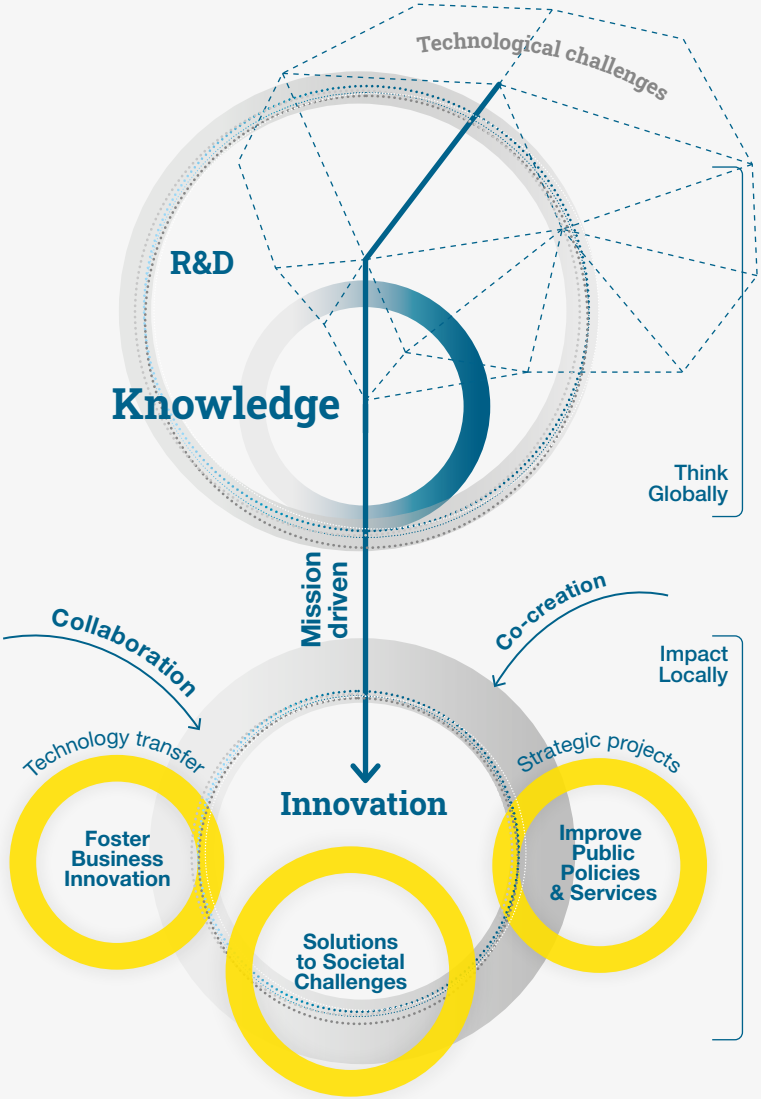
i2CAT’s 5G expertise has also been recognized at the Spanish level by the **CDTI** through the “**Tecnologías Cervera**” program.

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, GRADIANT, i2CAT) position itself as key players in the evolution of next-generation mobile networks. i2CAT is focused 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.

Talent

Talent is the cornerstone of i2CAT, which aims to be a leading research and innovation center that drives the digital transformation of society. The center is committed to recruiting international prestige researchers. Thus, it is focused on developing an active policy in attracting and retaining talent.

In 2020 i2CAT, among other actions, focused on hiring calls to recruit the most talented researchers at different stages of seniority.



Tecniospring

i2CAT also was granted by Tecniospring INDUSTRY fellowship programme to host experienced researchers at the postdoctoral level to develop i2CAT's applied research projects.

Innovative Training Networks (ITN)

During 2020 i2CAT also kicked-off 5GSmartFact, a project funded by Innovative Training Networks (ITNs) call. ITNs are European-level training networks for researchers who are within the first four years of their research careers. It is essentially aimed to recruit PhD students to develop research and innovation projects.

ICREA

In September of 2020 i2CAT joined the CERCA centers group that has an ICREA Research Professor in their team to give a push to their research results. ICREA is the **Catalan Institution for Research and Advanced Studies** which aim is to recruit top scientists for the Catalan R&D ecosystem, scientists capable of leading new research groups, strengthening existing groups, and setting up new lines of research targeting most of the time foreign researchers.

Xavier Costa-Pérez research focuses on the **digital transformation of society (DX) driven by the interplay of mobile networks and AI**. As a Scientific Director at i2CAT, he focuses on the need to expand the mobile ecosystem to incorporate industry verticals like automotive, manufacturing, smart-grids and health. Under the leadership of PhD. Costa-Pérez in 2020 NEC and i2CAT collaborated in the Beyond 5G technologies area through an industrial research project by jointly developing AI-driven O-RAN automation solutions maximizing system performance as well as cooperative edge systems for specific industry verticals.

PhD. Costa-Perez is also the Head of 5G Networks R&D at NEC Laboratories Europe. He regularly publishes at top scientific venues and produces innovations which have received **several awards** for successful technology transfers, while participating in major European Commission R&D collaborative projects and contributing to **standardization bodies** such as 3GPP, ETSI NFV, ETSI MEC and IETF.

Previous experience includes multiple leadership positions both in industry and research organizations such as Deputy General Manager, Chief Researcher, Technology Board member and Scientific Advisory Board Member. Xavier received both his **M.Sc. and Ph.D. degrees in Telecommunications from the Polytechnic University of Catalonia** (UPC) in Barcelona and was the recipient of a national award for his Ph.D. thesis.

ICREA employs 266 researchers in all fields of knowledge, from philosophers to astrophysicists, that perform their research in 48 different host institutions in Catalonia.

Research Outcomes

The work of i2CAT's research team 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 result developed by i2CAT's team of researchers.

Neutroon
start up creation

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.

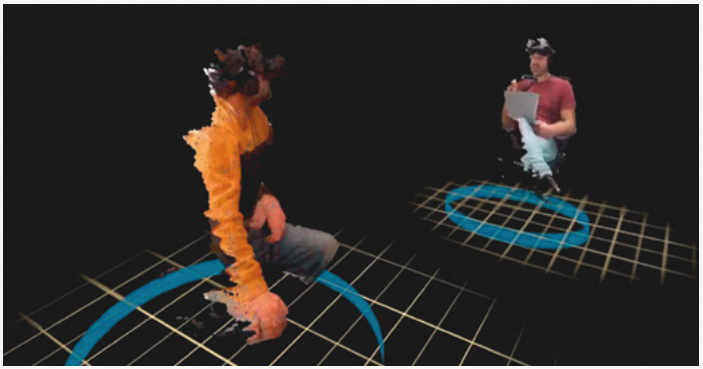
Other new initiatives

Licensing 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 interfases 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. The centre plans to continue developing this technology adding support for 5GNR access nodes and for 60 GHz wireless backhaul interfaces.

Contact Tracing Solution

During 2020 i2CAT designed and developed a contact tracing solution based on UWB for Fira de Barcelona. The location of people, equipment and objects, now more than ever, is a critical aspect in the efficient use of resources and in the management of congresses venues. This prototype, that was showcased at International real congresses held in Barcelona, offers an indoor real-time location solution with cm-level contact tracing accuracy. It monitors the maintenance of the safety distances of people at congresses and trade fairs.
Up to now, indoor location has been based on other technologies such as WiFi or Bluetooth, which are expensive, complex and inaccurate. Contract Tracing Solution proposes an indoor location solution based on Ultra Wide Band (UWB) technology that allows data to be transmitted at high speed over short distances, with an accuracy of less than 30 cm and low consumption.



Crea & Play Laboratory

During 2020 i2CAT launched the Crea & Play Laboratory in Vilanova i la Geltrú in collaboration with Neàpolis centre.
In the Crea Play laboratory it was deployed a first prototype of a holoconferencing solution, which allows to interact immersively and in 3D with multiple remote users. This opens new possibilities and applications of future in environments such as Health, Entertainment or Education. Within the laboratory it were developed 5 games for Vilanova i la Geltrú Municipality gamification strategy.

CISCO Research Grant

The center's research work in immersive and virtual tecnologies gained recognition also from the business sector. In 2020 i2CAT started a research project funded by CISCO aimed at optimising the multi-user transmission and processing of volumetric video in the cloud to enable holoconferencing.

Publications

Excellence, cooperation, openness, inspiration, and **committment** are i2CAT's **hallmarks**. In 2020, 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. i2CAT is committed to make its **scientific outcomes available to everyone** giving also further visibility to the results achieved by its researchers.

In 2020 the research areas produced 49 scientific contributions. These publications included:

- G. Cernigliaro, M. Martos, M. Montagud, A. Ansari, S. Fernández, **PC-MCU: Point Cloud Multipoint Control Unit for Multi-user Holoconferencing Systems**, ACM NOSSDAV 2020, Istanbul (Turkey), June 2020, COREA CONFERENCE, BEST PAPER AWARD, https://dl.acm.org/doi /10.1145/3386290.3396936.

- Catalan-Cid, Miguel and Camps-Mur, Daniel and Montagud, Mario and Betzler, August, FALCON: **Joint Fair Airtime Allocation and Rate Control for DASH Video Streaming in Software Defined Wireless Networks** in Proceedings of the 30th ACM Workshop on Network and Operating Systems Support for Digital Audio and Video, pages 14–20, June 2020, NOSSDAV '20.

- Leonardo Goratti Supreeth Herle Tobias Betz Elisenda Temprado Garriga Hamzeh Khalili Pouria Sayyad Khodashenas Alain-Pierre Brunel Duy-Kha Chau Srikant Ravuri Ramesh Vasudevamurthy Avi Gal Menachem Dodge Konstantinos Liolis, **Satellite Integration into 5G: Accent on Testbed Implementation and Demonstration Results for 5G Aero Platform Backhauling Use Case** in International Journal of Satellite Communications and Networking (SAT)", Wiley.

- Apostolos Papageorgiou, Adriana Fernández-Fernández, Shuaib Siddiqui, Gino Carrozzo, **On 5G network slice modelling: Service-, resource-, or deployment-driven?**, in Computer Communications, Volume 149, 2020, Pages 232-240, ISSN 0140-3664.

- M. Montagud, O. Soler, I. Fraile, S. Fernández. **VR360 Subtitling: Requirements, Technology and User Experience**, in IEEE ACCESS, 2020.

- D. Bega, M. Gramaglia, R. Perez, M. Fiore, A. Banchs and X. Costa-Perez, A**I-Based Autonomous Control, Management, and Orchestration in 5G: From Standards to Algorithms** in IEEE Network, vol. 34, no. 6, pp. 14-20, November/December 2020.

- Fernández, C.; Giménez, S.; Grasa, E.; Bunch, S, **A P4-Enabled RINA Interior Router for Software-Defined Data Centers** in Computers 2020, 9, 70.

- Leandro Miguel Lopez,1 Charmae Franchesca Mendoza,1 Jordi Casademont , 1,2 and Daniel Camps-Mur2, **Understanding the impact of the PC5 Resource Grid design on the capacity and efficiency of LTE-V2X in vehicular networks** in Wireless Communications and Mobile Computing, Hindawi, Volume 2020, Article ID 8156908, 13 pages.

- A. Banchs, G. de Veciana, V. Sciancalepore and X. Costa-Perez, **Resource Allocation for Network Slicing in Mobile Networks**, in IEEE Access, vol. 8, pp. 214696-214706, 2020.

Awards and recognitions

i2CAT's research excellent work was recognised and awarded at a variety of prestigious International research & technical events. Here is some exemples:

Best Workshop Paper Award at ACM NOSSDAV 2020

PC-MCU: Point Cloud Multipoint Control Unit for Multi-user Holoconferencing Systems

Best Demo and Industry Paper Award at MMSys 2020

The artificial intelligence in Catalonia: Technology report

One of the Catalan government's priorities is to boost Artificial Intelligence with the aim of supporting the deployment of AI technology and making Catalonia a hub for innovation and leadership to attract talent and companies in the field of this technology.

ACCIÓ's Strategy and Competitive Intelligence Unit together with Secretariat of Digital Policies of the Government of Catalonia released this technology report where i2CAT was identified as **one of the 9 technology** and research centres in the AI ecosystem companies and agents.

One of the 9 technology centers in the Catalonia AI ecosystem

Horizon 2020 Framework Programme

On December 2020 ended the European Comission H2020 Framework Programme. Under this funding programme, **39 projects** have been granted to i2CAT within the H2020 Framework Programme in the 2014-2020 period, rising to an amount of **16,7 million euros**.

EU funding from H2020 ICT thematic priority

16,7 M€

Granted by the European Comission to further contribute to the state of the art, boost talent, and generate excellent knowledge.

COST Actions

These actions are aimed to help connect research initiatives across Europe and beyond and enable researchers and innovators to grow their ideas in any science and technology field by sharing them with their peers.

Another achievement resulting from the activities performed during 2020 aimed to diversify the center's funding calls participation are the two following projects developed under COST **(European Cooperation in Science and Technology)** funding programme.

NewFocus

The COST Action NEWFOCUS will propose truly radical solutions with the potential to impact the design of future wireless networks. Particularly, NEWFOCUS aims to establish optical wireless communications (OWC) as an efficient technology that can satisfy the demanding requirements of backhaul and access network levels in beyond 5G networks. This also includes the use of hybrid links that associate OWC with radiofrequency or wired/fiber-based technologies.

MissionLabs

Today's technology-driven innovation ecosystems have difficulties to address the interconnected challenges of ecological integrity, human and social well-being. At the same time, the digital transformation removes traditional barriers and enables innovators to enter new disruptive markets and to contribute towards sustainability. The aim of this COST Action is to coordinate research and capacity building on mission-driven innovation ecosystems within Europe, Russia, Australia and Canada. A specific focus will be set on Living Lab activities including transformative research to enable innovations with social-ecological impact.

Digital transformation

The Catalan business fabric, made up mainly of small and medium-sized companies, requires to boost its digital transformation to guarantee its survival and success. i2CAT has the strategic objective to contribute to **structuring and promote the digital transformation of the private sector** in fields as **Smart environment, eHealth, Industry 4.0, Autonomous and Connected Mobility, or Creative Industries**.

Through the collaboration in R+D and strategic projects, the center helps the companies to **innovate in their products and services**. Additionally, the center's technological outputs enable i2CAT to develop **proofs of concept** and **valorization initiatives**.

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**.

won R&D services contracts

Some of our partners

R&D projects & strategic alliances

5G and Beyond

NEC and i2CAT collaborated in the Beyond 5G technologies area through an industrial research project by jointly developing AI-driven O-RAN automation solutions maximizing system performance as well as cooperative edge systems for specific industry verticals.

NEC

5G Catalunya

The first two initiatives to be carried out jointly by Parlem Telecom and i2CAT consist of a double pilot project linked to 5G technology to take place in the metropolitan area of Barcelona. The pilots are focused on autonomous and sustainable mobility and on the promotion of augmented reality in shopping environments. The two tests are part of the 5G Catalunya project, framed in the Red.es call for 5G pilots.

parlem telecom

5G and beyond infrastructure

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

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.

TRIA ENCQOR 5G

ciena

AI & V2X for mobility

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

i2CAT is partnering Alstom to carry out 2 projects in the fields of AI and V2X. 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.

ALSTOM

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).

SIMON

Sateliot (NS)

The i2CAT Foundation participates in the NewSpace Strategy of Catalonia, recently expanded financially by the Government.

The i2CAT Foundation, in collaboration with the IEEC, is working on various activities framed in this strategy. “Enxaneta” is a project tendered by IEEC and developed in partnership with Open Cosmos and Sateliot, aimed to deploy global IoT connectivity services with 5G network coverage, allowing communications and data collection of sensors located throughout the territory, allowing various implementations like monitoring rivers’ flows and water supplies to improve the efficiency of water management; monitoring and protecting wildlife; receiving weather data; monitoring soil movements to anticipate natural disasters, and monitoring livestock and crops.

SATELIOT

Public-private alliances

5GBarcelona

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 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, Transport and Energy.

An important field of activity is the creation of open spaces for companies and people to test their ideas: Test concepts and build initial prototypes that can reach the market.

9 5G labs

12 pilot projects developed

9 pilots presented

12 workshops

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.

In 2020, i2CAT, MWCapital, MASMOVIL Group, and Barcelona Health Hub have also worked to create the **Barcelona Health Hub 5G Design**, a 5G laboratory in the health sector located in the Hospital Sant Pau Innovation Hub.

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5G Barcelona

CIDAI

It is an integrative initiative open to the incorporation of new companies and organizations promoted by Government of Catalonia, Municipality of Barcelona, i2CAT, BSC Research Center, CVC, Eurecat, Everis, Microsoft, SDG Group, and UPC. It focuses on:

- Generate, validate and transfer of high-value-added AI technologies to foster innovation in the country's strategic sectors, including utilities and the third sector.
- To foster the IA Catalan ecosystem as an international reference point, creating a connected, active and dynamic community that involves most stakeholders.
- Accelerate the adoption of AI in the business world and in society through outreach activities coordinated with different agents and the promotion of projects that reduce existing barriers.
- To support in the construction of the strategic vision of the institutions and companies of the territory, and to promote the collaboration with the main national and international initiatives.

Emerging technologies

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.

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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.

FEM-IoT

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.

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.

Looming Factory

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

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

i2CAT works to create innovative **market-oriented technologies and solutions**. It leads the design and deployment of trials for technological and functional validation purposes with local partners, public administration, and users. The centre also sets up **IPR exploitation agreements**, creating mixed R&D teams with companies to cooperate in the creation of startups, proofs of concept and **valorisation activities**.

Techtransfer deals are starting to be a reality and revenue streams are expected to increase significantly.

Neutroon

i2CAT is shareholder of the Neutroon spin-off

Neutroon offers 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. i2CAT has a licensing agreement for the explotatin of the RAN Controller technology exploitation.

A team of i2CAT researchers, with the support of the Knowledge and Technology Marketing unit, created a disruptive technology-based startup that addresses both society and industry challenges. The Neutroon 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.

VOLTA Networks

i2CAT has been a shareholder of Volta Networks since 2016. It delivers the first cloud-native routing engine which reduces cost by an order of magnitude by using the cloud to optimize routing for low cost, white box switches.

Unlike legacy routers or routing appliances, Volta enables much lower cost by virtualizing and scaling the routing control plane while using automation to accelerate new network services.

In 2020 the company has continued to grow reaching a 39.9 M$ valuation estimate.

Watchity

i2CAT has been a shareholder of the start-up Watchity since 2017. In 2020 Wayra participated in the last funding round with 170k€ and a commercial agreement to boost sales.

Watchity proposes a B2B2C recording platform and application that, in a simple way and without ad-hoc audio-visual infrastructures deployments, allows a manual or automatic broadcasting of different video streams from different mobile devices in real time. The solution is also integrated with social networks to allow the distribution of audio-visual content 'mono-camera'. The centre developed a collaborative live streaming application and platform.

watchity

Catalonia Valorization Networks

XaFIR: Fourth Industrial Revolution Network

It proposes an action programme to promote and drive the knowledge valorisation and the technological transfer of research results in technologies related to Industry 4.0. It proposes products and services to companies, and especially to SMEs of the industry 4.0 sector. The objective is maximazing the impact of these transfers and making Catalonia a new reference for the digital transformation of the Industry.

XARTEC

Network R&D in Health Technologies

Identify the results of technology research in the health sector to enhance its promotion and enhancement The aim is to increase the quality and value of the research group's results to increase patents and licenses and promote the creation of technological companies. The aim of the network is also to raise the international impact of the research outputs results of the centers and to become a reference point for groups of investors, accelerators, and potential clients of medical technology at an international level.

HIP: Pediatrics Hub Innovation i4Kids

Promote the results of collaborative research in pediatrics, increase their value and facilitate their access to the market, contributing to the new knowledge industry.
Boost industry and the economy by providing new business opportunities and value generation in the pediatric field.

Innovation Strategies and Policies

The i2CAT Foundation works to support and contribute to the definition and implementation of digital public policies throughout the territory.

The center works to provide a technological and innovative vision to the Public Administrations that helps to promote and define digital policies and strategies with an impact on the whole territory: the 5G, Blockchain, and Artificial Intelligence Strategies of Catalonia.

Impulse of Digital and Mobile Transformation

The i2CAT Foundation participated in a wide variety of innovative initiatives aligned with the digital policies and strategies of the Government of Catalonia, aligned with the European Commission Europe 2020 strategy, such as the Catalonia SmartLab, the SmartCAT Challenge, the SmartCatalonia Observatory, the IoT Catalan Alliance, the Catalonia Smart Drone, the Blockchain sector revitalization, the BitBot Challenge initiative, and the 5G sector revitalization.

These initiatives have been developed within the Impulse of the digital and mobile transformation initiative, co-financed by the European Union in the framework of the operational program ERDF for Catalonia 2014-2020.

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5G Barcelona

5G Barcelona is a public-private initiative that works to position Barcelona and Catalonia as an innovative and open environment for the validation and adoption of 5G technologies and applications in a real-life environment. The initiative creates synergies within the 5G ecosystem and offer an experimental infrastructure to test, prototype and implement new digital solutions. In 2020 5G Barcelona worked to stimulate the existing innovation in Barcelona, attract foreign investment, promote new technology businesses, and generate an entire industry around 5G technology through:

- Labs
- **12** Pilot project
- **10** Dissemination activities

CATALONIA SMARTDRONES

Catalonia Smart Drones is the cluster of the drone industry, promoted by the Government of Catalonia, which includes the leading companies, technology centers, universities, and other institutions boosting the drone sector. In 2020 were carried out a variety of activities to boost the business sector and establish new synergies within the ecosystem.

- **113** stakeholders
- **9** events

Blockchain Strategy

i2CAT participates in this initiative promoted by the Government of Catalonia that carries out a program of actions that enhance the development of the Blockchain and DLT ecosystem in the country.

In 2020, among other actions, the center published:

- **2** technical reports
- **8** success cases

SmartCatalonia Challenge

SmartCatalonia Challenge is a competition that aim is to promote the creation and development of innovative solutions to the main needs of the Catalan territory, connecting companies, developers, organizations, and experts with municipal and infrastructural needs.
During 2020 several editions were organized partnering with entities such as **Tarragona Harbour, the Catalan Water Agency, and the Association of Rural Initiatives of Catalonia**.
A high number of **solutions** were presented by SMEs and Start-Ups to address the challenges proposed by these entities.

- **4** editions
- **136** innovative solutions

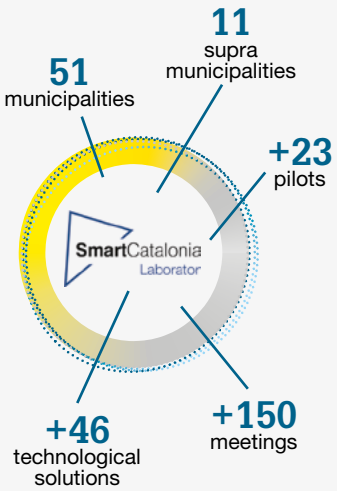
IoT CATALAN ALLIANCE

In 2020, the project promoted the impact of the Internet of Things and related technologies in the health, utilities, industry, agrifood, and agricultural.

- **17** sectorial and technological training events
- **151** stakeholders

SmartCatalonia Laborator

Catalonia SmartLab is a community of municipalities that offer their public space so that small and medium-sized companies can try their ICT solutions.
It structures a network of urban laboratories testing and validating smart solutions in real environments.
Its aim is twofold - to promote the technology sector by providing access to infrastructure and equipment, and enhancing open innovation in cities by participation in pilot tests.



Hackovid

In 2020 i2CAT continued to put its digital technologies skills at the service of the citizenship.

It launched **virtual hackathons** in order to boost citizenship and ICT ecosystem participation in open events aimed at addressing the social needs arisen by the COVID-19 situation.

They responded massively to the call: more than **100 teams** participated in the Hakcovid, a hackathon organized by the Catalan Government and the i2CAT Foundation. These teams developed solutions based on web services or mobile apps to respond to the 176 social needs received under main challenges voted by the citizens.

5G Areas

The Government of Catalonia, in collaboration with i2CAT and other rural territory entities, is working on this 5G project. It is analysing how 5G technology impacts the areas of strategic interest to be able to accelerate the deployment of 5G communications and avoid a new digital divide.

The objective of this project is to define a model of broadband connectivity to the country areas away from urban areas through a high-capacity radio deployment that is tested in different meteorological conditions, analyzing both technical parameters, costs of unfolding and also studying the economic viability.

In these 5G areas, several activities are pursued aimed at satisfying the needs of different business verticals, altogether with the organization of workshops with area stakeholders and formative actions facilitating the development of 5G infrastructure. The strategy is to create an infrastructure and an ecosystem that stay in the territory.

In 2020 the 5G Areas of T*erres de l'Ebre*, *Ponent*, *Penedès*, and *Camp de Tarragona* were created.

TDA rural 5G

The i2CAT Foundation began the implementation of this project to define, develop, and demonstrating a deployment model that allows the provision of 5G service to less populated areas of the territory, validating that it is economically viable.

This model contemplates public collaboration (Generalitat de Catalunya, provincial councils, and municipalities) and private collaboration (mobile operators, neutral operators, local operators) to evaluate the strategies and policies to promote the deployment of 5G technology. The aim is to avoid new technological loopholes in sparsely populated areas.

The Generalitat wants to guarantee the development of 5G connectivity throughout the territory, even if demand is low. Therefore, the project will analyze how to minimize the investments that a 5G operator has to face to ensure that there is service everywhere.

TDA cybersecurity

The i2CAT Foundation led the start of an innovation project within the Advanced Digital Technologies program that aims to develop and deploy a proof of concept in the field of cybersecurity to measure the degree of exposure of users to a cyber threat, a challenge that was defined by the Cybersecurity Agency of Catalonia.

The project aims to implement a technological solution to anticipate the impacts that a cyber threat may have, determine the groups of users who may be most vulnerable, and take automatic protection actions.

Digital strategies

Catalonia.ai

i2CAT leads an 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.

The i2CAT Foundation participates in the NewSpace Strategy of Catalonia. It is focused on promoting the NewSpace Strategy of Catalonia and the NewSpace sector to contribute to the deployment of activities in development framed in this Strategy.

The i2CAT Foundation, in collaboration with the IEEC, worked on various activities:

- The creation of a ground station in the Montsec Observatory to track and download data received by the "Enxaneta" and future nanosatellites in orbit.
- The production of a Catalonia NewSpaceLab to map and enhance laboratories and experimental test infrastructures for the NewSpace economy.
- The launching of the Catalonia NewSpace Alliance, the international positioning of the NewSpace Strategy, and a startup acceleration program for the NewSpace economy.

DIH4CAT

The Digital Innovation Hub of Catalonia (DIH4CAT) is a structuring of the ecosystem that promotes the digital and technological transformation of industry and public administrations with a clear technological focus. DIH4CAT is set up to be a benchmark in certain digital tecnologies. This is thanks to the high level of expertise and knowledge brought together by the digital innovation nodes that constitute it, as well as the wide ecosystem related to each of its technological areas.

The technological areas that initially constitute the DIH4CAT scope of action are the following:

a) Artificial Intelligence
b) Supercomputing
c) Intelligent communications
d) Additive Manufacturing / 3D Printing
e) Robotics and Advanced Manufacturing
f) Cybersecurity
g) Photonics

In 2020 i2CAT Foundation has lead the activities in the field of intelligent communications.

VINCLESBCN

i2CAT collaborated with the Social Rights Area of the Barcelona City Council in the development of the Vincles BCN program, an initiative to help the elderly lead more active and sociable lives. The program aims to bridge the digital divide, which particularly affects the elderly, as well as improving the quality of life by using new digital technologies as a means of communication with people's local environment (from both the public and personal environment such as family, friends, social workers, and volunteers.

Research and innovation for the society and the territory

i2CAT works to **improve the quality of life of all citizens**. It pioners the quest to design and build the digital society of the future. Thus, i2CAT puts the technology **to the service of society** and works to be an instrument to meet the needs of citizenship's digital transformation through the development of an advanced network of Digital Citizenship Laboratories, **opening digital social research and innovation to the world. citizenship and territories**.

Col·laboratori Catalunya

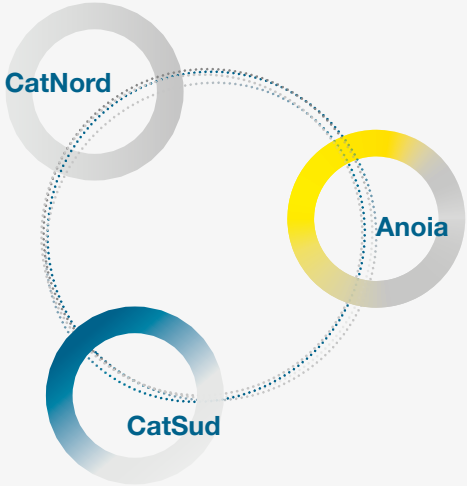
The col·laboratoris are networks of collaboration between Administrations, universities, companies, citizens, and research centers. A network that is linked to a territory and taking advantage of the actions and knowledge of the various actors to innovate together and solve the challenges that arise. It is a laboratory of laboratories because it starts from the existing laboratories or experimental spaces, from which a whole network of key institutions and territory stakeholders is connected.

The *Col·laboratoris* Catalunya initiative aims to deploy an interconnection model of social and digital innovation col·laboratoris throughout Catalonia.

In June of 2020, the CatSud *Col·laboratori* was presented, which aims to prototype and validate a model for the promotion, design and execution of social and digital structures in the Penedès, the Tarragona counties and the Terres de l'Ebre in order to promote the deployment of the digital society and knowledge to turn Southern Catalonia into a region of knowledge.

In December 2020, the *Anoia Col·laboratori* was launched to address the challenges of the territory and to innovate together around the Anoia innovation plan. It focuses on projects working on activities in the around the 5G *Area Penedès Anoia*, women's empowerment in the ICT field, the activities of Fablab / Design Lab, the Social and Health Lab and the Mobility Lab.

Col·laboratori
Catalunya



Master's Degree in Lab Design and Management

In 2020, the **Didilabs Master** was also defined, jointly by the i2CAT Foundation, the University of Barcelona, and Citilab. It aims to train and equip professionals with a new generation of social and digital innovation laboratories that are currently being deployed in a variety of areas. The Master is part of the process of social and digital transformation, the creation of a state of innovation as a counterpoint to the welfare state, and as an instrument for creating and articulating a Universal System of Innovation.

TDA rural 5G

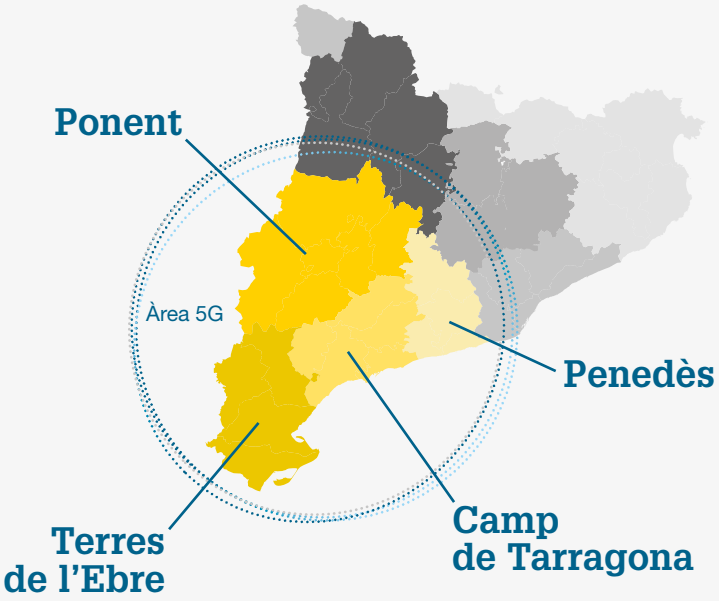
i2CAT kicked off this project to define, develop, and demonstrating a deployment model that allows the provision of 5G service to less populated areas of the territory, thus, validating that it is economically viable.

The project is carried out in public collaboration (Government of Catalonia, provincial councils and municipalities) and private (mobile operators, neutral operators, and local operators), to evaluate the strategies and policies to promote the deployment of 5G technology to avoid new technological gaps in areas with low population density and ensure the development of 5G connectivity throughout the territory.

5G Areas

This project consists of a roadshow through Catalonia in the form of dissemination events and workshops oriented to define the impact of 5G on the tourism, agrifood, and chemical industry sectors, among others.

In 2020, the 5G Areas of Terres de l'Ebre, Ponent, Penedès, and Camp de Tarragona were created. They are spaces that join a variety of initiatives conceived to promote 5G technology as a facilitating technology, and where activities are developed aimed at meeting the needs of different business verticals. These actions are workshops involving the area stakeholders, training actions facilitating the development of 5G infrastructure, to create an infrastructure and an ecosystem that remain in the territory.



About us

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

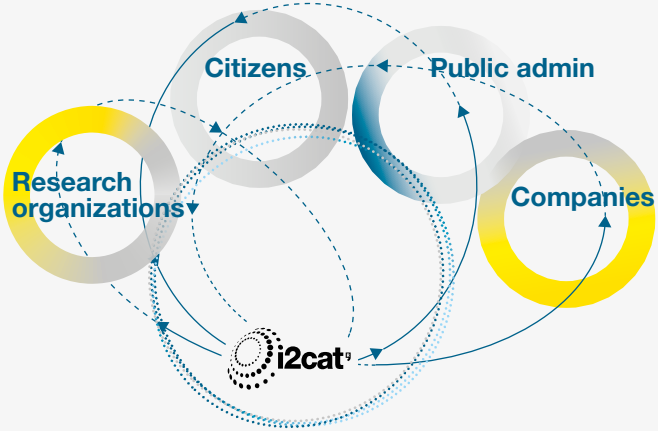
To design this digital society of the future, the i2CAT Foundation will **boost excellence-based, mission-driven knowledge** addressed at solving business challenges, **co-create solutions** with a transformative impact, **empower citizens** through open and participative digital social innovation with 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.

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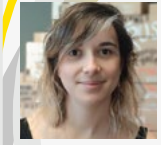

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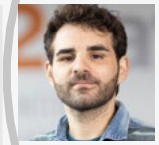

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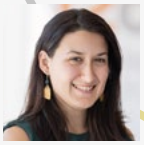

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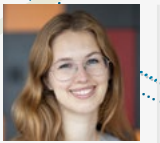

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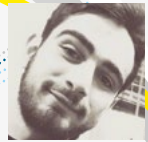

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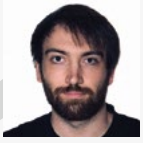

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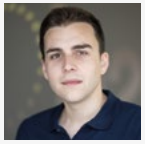

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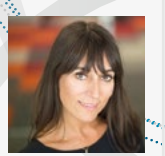

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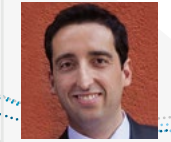

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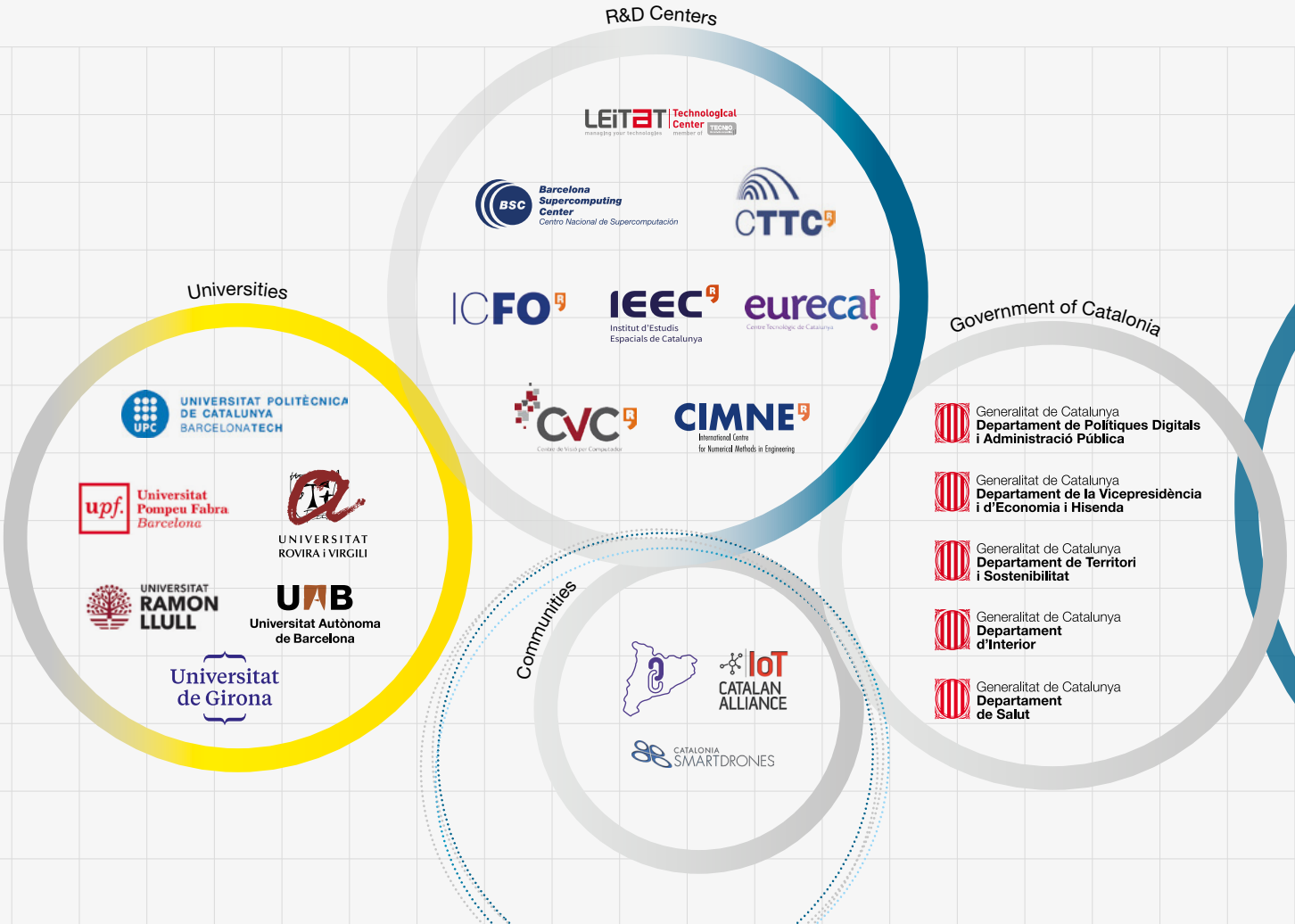

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