Annual report

The Internet Research Center

i2cat

21

Member of

Institució CERCA
Centres de Recerca de Catalunya

Letter from the President

Jordi Puigneró i Ferrer

Vice president of the Government of Catalonia

President of i2CAT Foundation

Innovation is the springboard for making the big leap into digital transformation.

Eric Hoffer, the American writer and philosopher, said: "In times of change, those who are open to learning will take hold of the future, while those who think they know it all will be well equipped for a world that no longer exists".

Catalonia has already started its digital transformation, and i2CAT wants to lead the challenge of designing the digital society of the future, based on research and innovation in advanced digital technologies, to face the world of tomorrow successfully.

Digital and research policies are priorities on the agenda of the Government of Catalonia because they are one of the key drivers for implementing the plan for the social and economic reconstruction of the country. They are also priorities in Europe. The leading European research and innovation funding programme, *Horizon Europe*, and the European recovery plan, *Next Generation EU*, identify the digital sphere as one principal axe.

In recent years, i2CAT has positioned itself as a benchmark entity at the **European and local levels** in research and innovation in advanced digital technologies, and this fact has allowed the centre to experience sustained growth. In 2021, activity volume grew by 25%, and talent increased by 42 new positions.

In 2021, i2CAT obtained six projects from the new ***Horizon Europe*** funding programme, one of them as a technical leader, with total funding of 2.4 million euros, within the calls of the clusters:

1. Digital Industry and Space

2. Climate, Energy and Mobility and Food, Bioeconomy

3. Natural Resources, Agriculture and Environment

The centre's research and knowledge generation activities in 2021 have focused on two strategic axes: **5G/ 6G and space communications.**

6G must be a disruptive and enabling technology that helps achieve the European Commission's growth and the United Nations' sustainable development goals. In 2021, i2CAT, a benchmark centre in the 5G field, started to work on its vision of 6G to continue leading activities in the future 6G system. The centre has won 6 coordinated projects in the *UNICO-5G R&D* programme framework for recovery and resilience, financed by the *Next Generation EU* fund, for an aggregate value of around €17 million.

2021 also allowed the consolidation of research in space communications with the growth of the research team, which leads the research and ecosystem dynamisation activities. i2CAT has participated in developing and deploying sensors that communicate with the first nanosatellite of the Government of Catalonia, the *Enxaneta*, which allows data collection to improve the cultivation of vines in areas where there is no terrestrial coverage. i2CAT is also developing technologies that will allow the subsequent launches of nanosatellites to incorporate new IoT/ 5G communication capabilities.

i2CAT's talent has also worked locally to support and contribute to the definition and implementation of digital public policies throughout the territory by contributing to Catalonia's 5G, Blockchain, NewSpace, and Artificial Intelligence strategies and promoting initiatives and strategic projects.

In 2021, the *Digital Catalonia Alliance* (DCA) was formed as a disruptive and collaborative alliance of emerging technology communities. Designed to become a promoter of Catalonia's digital economic sectors, 386 companies and organisations are already members of the DCA.

As part of the *Àrees 5G* initiative, which aims to improve existing technology services throughout Catalonia, i2CAT boosted the deployment and commercial use of the 5G network by promoting use cases and proofs of concept in natural environments. These initiatives aim to foster a digital economy beyond urban areas. In 2021, deployment was accelerated by creating three new 5G areas.

The generation of impact and digital technological sovereignty are also priorities for i2CAT. The centre is working to establish strategic alliances with private companies in the digital sector, which enable the promotion of the talent and R&D activities developed at i2CAT, and co-innovate to jointly solve social and business challenges and needs. In this sense, during 2021, i2CAT has signed 35 new collaboration agreements with companies.

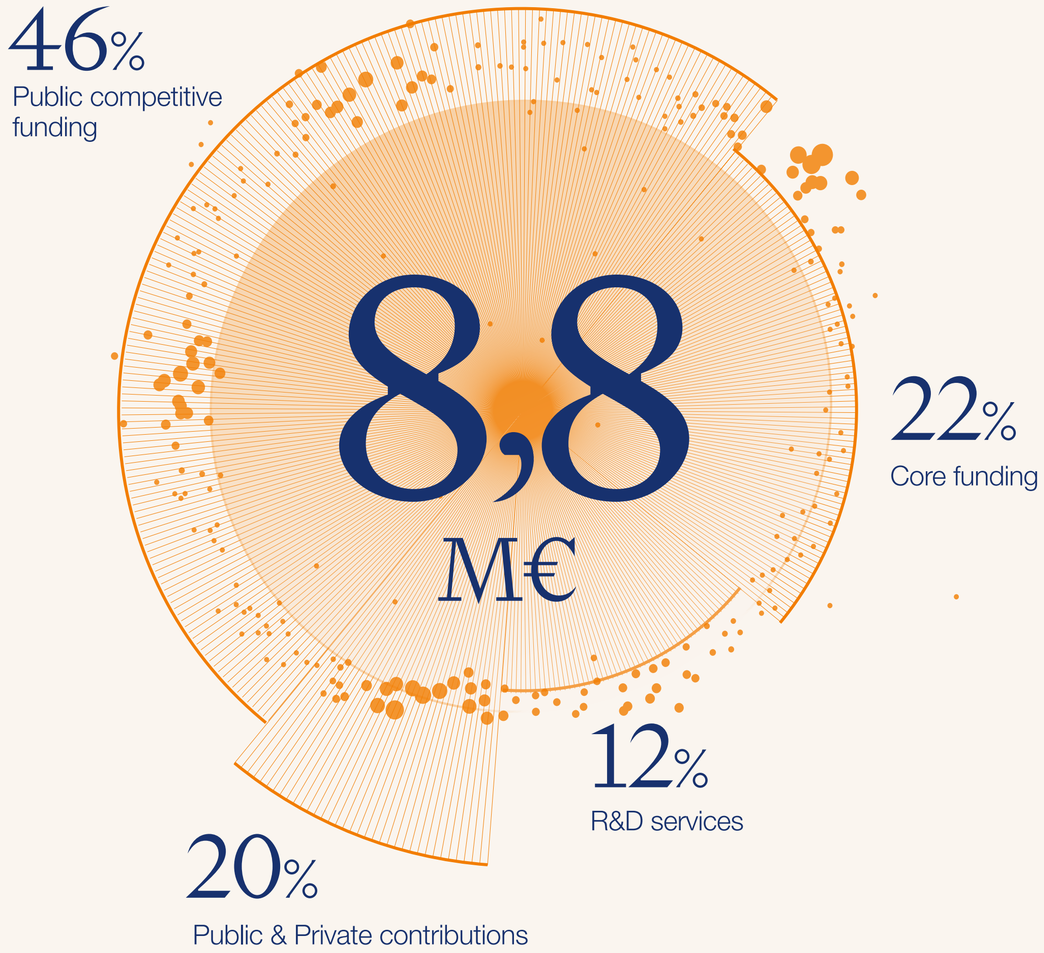
Another of i2CAT's strategic objectives, in which the centre is a pioneer, is to open research and digital social innovation to citizens and territories. Through *Col·laboratori Catalunya*, the centre has deployed digital innovation activities in three *col·laboratoris* (CatSud, Anoia and CatNord) to connect citizens and local agents with research and knowledge entities.

The main objective is to solve the territory's challenges with its people based on the application and training in digital technologies.

These milestones allow i2CAT to be the springboard to enable the country to make the great leap towards its digital transformation. I want to congratulate the entire team for their commitment and successes and encourage them to continue contributing to designing and building the digital society of the future.

Facts & Figures

Funding



111

Project proposals submitted

35

New contracts with companies /entities

33

New competitive projects

Results in the new European Commission Research and Innovation programme Horizon Europe

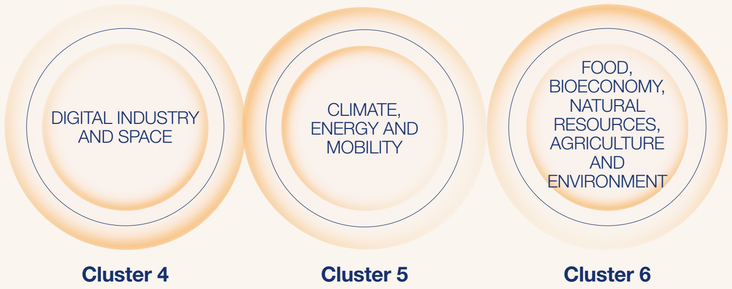
Success rate

+28,6%

Funding

2,4 M€

6 new projects granted under the Horizon Europe funding programme



Previous EU research funding programs

i2CAT's success rate in ICT calls under Horizon 2020 framework programme (2014-2020)

18,7%

Average European entities

9%

Funding granted

H2020 (2014-2020) 17 M€

FP7 (2007-2013) 7,2M€

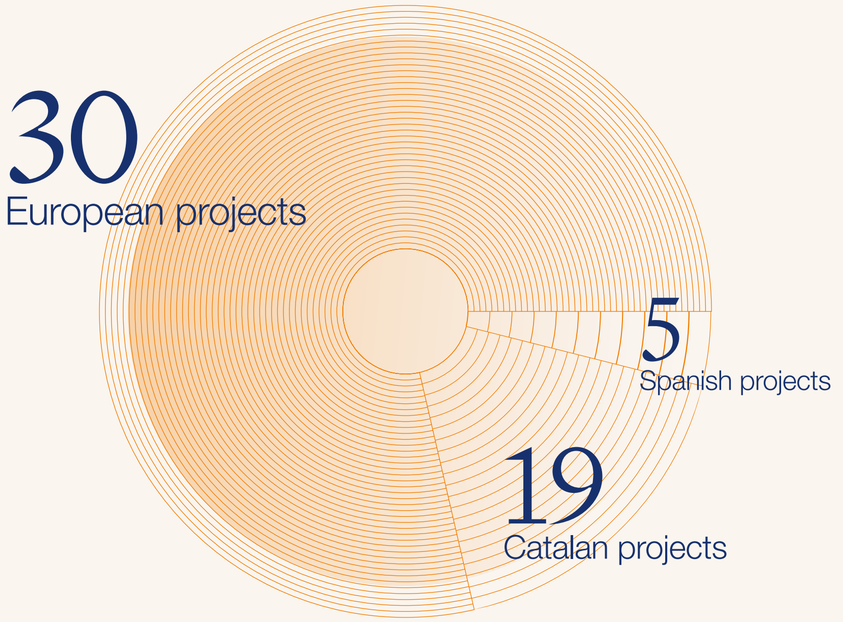
Growth rate from 7th Framework Programme to Horizon 2020

R&D Projects in execution

Total 143

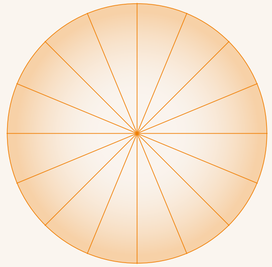
Competitive projects in execution 2021

Total 54

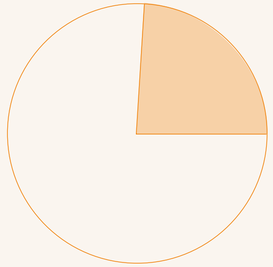


Staff

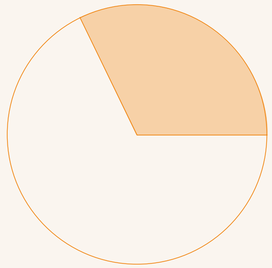
Total 145



16
Nationalities

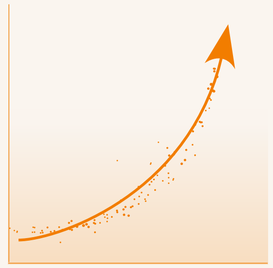


24%
PhD



29%
Women

Women area managers
6



33%
Staff growth rate

Impact-oriented research and innovation activities

Intelligent Communications 5G/ IoT/ Space Comms

Knowledge Excellence

Technological research

TERMINET

AFFORDABLE5G

5GaaS

OPEN VERSO
5G and Beyond Technology Enablers

DAEMON

IoT-NGIN

Applied innovation

Smart Environment	Industry 4.0	Autonomous and Connected Mobility	Creative Industries
Onofre	5GCLARITY	5GMED	PRINGO
	SMARTY Interreg Europe	5GCroCo	
	5GSMARTFACT		
	5GVICTORI		

Digital Innovation Strategies and Policies

Àrees 5G

Estratègia 5G de Catalunya

New Space Strategy for Catalonia

TDA 5G RURAL

TDA Bus Autònom

Digital Transformation

Private-Public Partnerships (PPP)

DCA Digital Catalonia Alliance

5GBarcelona

FEM-IoT

Tech Transfer & Private collaborations

neutroon

NEC

SATELIOT

TRANSCELESTIAL

Open Cosmos

simon

Cybersecurity

Technological research

QUANTUMCAT

Applied innovation

eHealth	Industry 4.0	Autonomous and Connected Mobility
SECANT	PALANTIR	CARAMEL
		integra

Digital Innovation Strategies and Policies

TDACiberseguretat

AGÈNCIA DE CIBERSEGURETAT DE CATALUNYA

Digital Transformation

Private-Public Partnerships (PPP)

DCA Digital Catalonia Alliance

Tech Transfer & Private collaborations

Unblur

Immersive and Media Technologies

Technological research

HoloMIT

Applied innovation

Smart Environment	eHealth	Creative Industries
RESPOND-A	**ACADOM** **HL 4.0**	MED GAIMS ViVIM Visió per computador per Vídeo Immersiu Multi-plataforma

Artificial Intelligence

Technological research

5GZORRO

AI@EDGE

Applied innovation

Smart Environment	Industry 4.0	Autonomous and Connected Mobility
FEM-IoT	Looming Factory	CARAMEL integra 5GMED

Knowledge & Excellence

Digital Innovation Strategies and Policies

Catalonia.ai

gaia-x

TDACiberseguretat

Digital Transformation

Private-Public Partnerships (PPP)

CREA &PLAY

Tech Transfer & Private collaborations

CISCO

NTT DATA

Private-Public Partnerships (PPP)

CIDAI Centre of Innovation for Data tech and Artificial Intelligence

DCA Digital Catalonia Alliance

Tech Transfer & Private collaborations

ALSTOM

Corporate highlights

Research activities

Horizon Europe EU funding program

The center has a solid track record in research and innovation activities that has been repeatedly recognised by the European Commission and by the Spanish and Catalan Government.

In 2021, the new EU funding program for research and innovation, **Horizon Europe**, and the European recovery plan, **Next Generation EU** identified the digital field as a priority.

i2CAT addressed this opportunity and focused its research and excellent knowledge generation activities on two main lines: Space communications and 5G/ 6G.

2021 is marked by the centre's success in the new EU's key funding programme for research and innovation (2021-2027), Horizon Europe. The i2CAT's results prove the leading role of i2CAT in the European R&D arena. i2CAT was granted **6 projects** under the new Horizon Europe program (FORGING, PODIUM, X-GAIN, XRECO, Zero-SWARM, TEADAL) and obtained funding of more than **2,4 M€**.

The projects belong to the calls of Clusters 4, 5 and 6: i) Digital Industry and Space, ii) Climate, Energy and Mobility and Food, Bioeconomy, iii) Natural Resources, Agriculture and Environment. It is worth highlighting the role of Technical Managers in the XRECO project. This project is aimed at creating a new data-driven ecosystem for the audiovisual industry.

HoloMIT

Additionally, i2CAT established Crea&Play Laboratory with Neapolis, where the center deploys its **immersive technology.**

One of the assets resulting of its activity in immersive technologies research is **HoloMIT**. It proposes an advance for a visual interaction between people in the metaverse. HoloMIT consists of an affordable volumetric capture system (in 3D) that allows captured users to be transferred to a metaverse and interact with each other with natural movements in real-time. The center also implemented some processing and network efficiency features.

In 2021 the center showcased a variety of use cases using this technology and involving real users in fairs and congresses such as Interihotel, MWC, and SCEWC.

5G outcomes

NEC-i2CAT Joint Research Unit

NEC and i2CAT have established a stable, long-term collaboration to carry out jointly R&D activities in the field of information and communications, especially on 5G/6G technologies.

Both entities aim to bring together their research teams to pool their complementary skills and expertise to promote research excellence in the research area of 5G/6G networks.

In this context, the ICREA professor Xavier Costa-Pérez hosted by i2CAT, is focused on the digital transformation of society (DX) driven by the interplay of mobile networks and AI. He leads fundamental research in **Artificial Intelligence-driven Systems** and **6G technologies**.

New Spin-off

In 2021, i2CAT officially joined the start-up Neutroon Technologies as a **shareholder**. A team of i2CAT researchers, with the support of the Knowledge and Technology Marketing unit, created a disruptive technology-based startup that tackles the challenges for companies interested in deploying private 5G Networks.

NewSpace activities

The NewSpace ecosystem in Catalonia is an emerging and innovative digital sector with great potential for technological transformation in industries such as telecommunications and audiovisual, agriculture, Smart Cities, and emergency security.

In 2021, i2CAT has created the SpaceComms research Area with a team of 9 researchers and engineers to lead research and innovation activities and to foster the NewSpace ecosystem. i2CAT, as one of its key stakeholders, contributed to initiatives of the NewSpace strategy of Catalonia. It collaborated in the launch and commissioning of the mission of the Enxaneta nanosatellite that enables direct communications between IoT and the spacecraft.

Estratègia New Space de Catalunya

18 anniversary of i2CAT

Eighteen years designing the digital future of the society

i2CAT came of age in September 2021. All staff members celebrated this anniversary with an informal face-to-face meeting. It was a special event to get back together and get to know each other after a year and a half of virtual encounters due to the pandemic. A period that is also defined by the growth of the center and an increase in the team. Many of the staff members had never met physically before. The occasion allowed them to meet with colleagues with whom they had been collaborating to achieve all those outstanding milestones thanks to a joint effort.

6G Research Strategy

UNICO5G/6G

Research and development (R&D) initiatives on 6G technologies are already paving their way worldwide

i2CAT Foundation is one of the research centers selected to promote the development of 5G and 6G R&D ecosystems under the Recovery, Transformation and Resilience Plan of the Spanish Government, funded by the **Next Generation EU program**.

Under this program, i2CAT obtained **16,5 M€** in 2021 to start fundamental research activities on 6G technologies in collaboration with companies that have experience in 5G. i2CAT will lead 6 coordinated projects on various research topics that are expected to generate game-changing use cases.

Topics

- Artificial Intelligence
- Open RAN
- Disruptive Wireless
- Cybersecurity
- Distributed Ledger Technologies
- NTN
- Mobility
- Testing and Trials

Use cases

- Digital Twins
- CCAM
- IoT
- Holograms
- Industry 4.0.

UNICO I+D 6G

Financiado por la Unión Europea
NextGenerationEU

Shaping the 6G vision

6G is expected to be a game-changing and enabling technology that will help realise the United Nations Sustainable Development Goals (UN SDGs) and the twin green and digital transition envisioned by the European Commission.

As a research and innovation technology center focused on digital technologies and with a leading position in 5G technology, i2CAT is determined to contribute to building 6G.

In 2021 it worked to design its research perspective, which must drive i2CAT activity in the future 6G system.

Find out more about the i2CAT's research perspective on 6G.

Download the White Paper ↗

Cervera Excellence Programme

Cervera Excellence center in 5G

i2CAT holds the CDTI's reward as a CERVERA Excellence Center in 5G under the "Tecnologías Cervera" program.

The center applies its excellent knowledge and collaborates with private companies to develop innovation projects like OpenVerso and Integra.

Open-VERSO, the National Network of Excellence in 5G and future technologies, addresses the design of a comprehensive 5G network architecture evolvable to 6G technologies and aims to create a federated ecosystem that enables knowledge transfer to the industrial sector.

gradiant

vicomtech
MEMBER OF BASQUE RESEARCH

Strategic cooperation for research in high security connected and autonomous mobility technologies in complex environments

The main objective of the **Integra** project is to strengthen the expertise of the technological centers involved for autonomous and connected high-security mobility in complex environments.

i2CAT is developing digital instrumentation applicable to assisted driving to increase safety through anti-collision sensory systems and intelligent networks (VANET).

Cidaut

CTAG

INSTITUTO TECNOLÓGICO DEL EMBALAJE, TRANSPORTE Y LOGÍSTICA
ITENE

Support to the digital policies and strategies

As part of the operation "Impuls de la transformació digital i mobile" co-financed with ERDF funds, i2CAT launched new activities and continued to work on successfully established initiatives that support and contribute to the definition and implementation of digital policies throughout the territory, impacting the whole region by addressing real challenges.

Unió Europea
Fons Europeu
de Desenvolupament Regional

DCA Digital Catalonia Alliance

Together with the Government of Catalonia, the center launched the **Digital Catalonia Alliance (DCA)**, ↗ a disruptive and collaborative alliance of emerging technological communities conceived to become the promoter of the digital economic sectors of Catalonia.

- 5 communities: IoT, Drones, AI, NewSpace, Cybersecurity
- + 260 companies and entities joined the alliance in 2021
- Added-value proposal:
  - Sectoral revitalization
  - Visibility and events
  - Synergies and multi-technology
  - Access to knowledge, technology and infrastructure
  - Access to funding
- Strategic stakeholders

IEEC Institut d'Estudis Espacials de Catalunya
CIDAI Centre of Innovation for Data tech and Artificial Intelligence
EIAC
Cambra Barcelona 'doing business'
Kim bcn Knowledge innovation marketbcn
Generalitat de Catalunya Agència de Ciberseguretat de Catalunya
AIRA Artificial Intelligence Research Alliance
ICGC Institut Cartogràfic i Geològic de Catalunya

Generalitat de Catalunya
Departament de la Vicepresidència i de Polítiques Digitals i Territori

Col·laboratori Catalunya

The col·laboratoris are networks of collaboration among Administrations, universities, companies, citizens, and research centers. Networks linked to a territory that take advantage of its stakeholders' added-value initiatives and knowledge to boost innovation and solve the arisen challenges. The **Col·laboratoris Catalunya** ↗ initiative aims to deploy an interconnection model of social and digital innovation throughout Catalonia.

2021 was a fruitful year for this project. It promoted: workshops, training sessions, collaborative projects, and labs.

+53 events

+400 people engaged

+200 actively involved entities

+700 participants in the sessions

SmartCatalonia Challenge

This competition aims to promote the creation and development of innovative solutions connecting companies, developers, organisations, and experts with municipal and infrastructural needs.

- 2 editions
- More than 80 innovative solutions
- 40K in awards

SmartCatalonia Challenge ↗

agents rurals

Generalitat de Catalunya
Departament de Territori i Sostenibilitat
Direcció General de Transports i Mobilitat

Generalitat de Catalunya
Departament de la Vicepresidència i de Polítiques Digitals i Territori

Àrees 5G

It aims to create an infrastructure and an ecosystem stable throughout the territory. This project is working to define a model of broadband connectivity to the country areas away from urban areas. **5G Areas** ↗ is analysing how 5G technology impacts the strategic interest areas to accelerate the deployment of 5G communications and avoid a new digital divide.

MOBILE WORLD CAPITAL BARCELONA

Generalitat de Catalunya
Departament de la Vicepresidència i de Polítiques Digitals i Territori

Operational updates

Board of Trustees

In 2021 Telefónica entered the Board of Trustees of i2CAT. 5G and 6G communications are at the heart of this new strategic collaboration. It aims to connect the i2CAT's excellent knowledge and innovative talent with Telefonica's ability to generate advanced products and solutions to contribute to the growth of the digital sector and accelerate the country's digital transformation.

Formerly Telefónica and i2CAT collaborated extensively in 5G pilots, 5G European R&D projects, labs and other strategic initiatives fostered by the Government of Catalonia.

Telefónica is the most recent board member of a group of trustees that include the Government of Catalonia, the Barcelona City Council, Universitat Politècnica de Catalunya, Universitat Ramon Llull, Universitat Pompeu Fabra, Universitat Rovira i Virgili, Orange, Cellnex, Juniper Networks, CISCO, Vodafone, Fujitsu, Parlem Telecom, and Mediapro.

Telefónica

i2CAT headquarters: Co-creation premises

i2CAT is a **constantly growing center**. It increased its staff a **35%** in 2021. In response, the centre created new ways of working and reinvented the old ones. The headquarters were reformed and expanded to suit this new scenario better. i2CAT's spaces are conceived to make it easy to work collaboratively and according to the new routines.

Organization chart

*Organization chart as of May 2022

Board of Trustees


Jordi Puigneró

Executive Committee


Lluís Rovira

International Scientific Advisory Board


Professor PhD
Dimitra Simeonidou


Professor Dr.
Carsten Bormann


Professor Dr.
Jos Baeten


Inder Monga

Management Team


Josep Paradells


Artur Serra


Joan Manel Martín


Sergi Figuerola

EC R&I

Strategy & Policies
6G Program


Jesús Alonso-Zarate

Research

5G & IoT

Smart Networks & Services

AI Driven Systems


Xavier Costa

Mobile Wireless Internet


Daniel Camps

Software Networks


Shuaib Sidiqqi

Distributed Artificial Intelligence


Josep Escrig

Media Internet


Sergi Fernández

Digital Social Technologies


Artur Serra

Innovation

Cybersecurity


Shuaib Sidiqqi


Jordi Guijarro

Space Communications


J.A. Ruiz


Pol Guixé

Knowledge & Technology Marketing


Miguel Ángel Pérez

Innovation Business Development

Public Sector


Rosa Paradell

Private Sector


Ana Moliner

Operations and Digital Infrastructure & Services


Eduard Grasa

Digital Innovation Management Office


Carlos López

Software Development


Alejandra Guarnaccia

Support Areas

Project Management Office


Jose Miguel Sanjuan

ERDF & Procurement Office


Flaminio Minerva

Admin & Finance


Rocío Segura

Corporate Development


Susana Otero

People & Talent


Roger Onnen

Events, fairs and congresses

2021, a year to reconnect, exhibit ground-breaking technologies and reimagine use cases for future connectivity

In 2021 i2CAT did not miss the relevant ecosystem events, unique opportunities for **international exposure, networking interactions** and **increasing visibility.**

Across **fairs, congresses, workshops, keynotes** and **demonstrations**, the centre's talented team shared its knowledge and continued to showcase how emerging technologies can generate competitive advantage. i2CAT continued to explore innovative use cases, thanks to technologies such as 5G, AI, Immersive technologies, Space Comms, Blockchain and IoT.

i2CAT led and organised **evangelisation and training sessions** to show how these technologies create **new opportunities for companies to enhance their services, gain business insights, improve processes**, and **expand their offerings.**

And, not to mention the digital innovation activities deployed throughout the year conceived to **open research and digital social innovation to citizens** and **territories.**

Some KPIs of this activity are:

MOBILE WORLD CAPITAL BARCELONA · SMART CITY EXPO WORLD CONGRESS · BXCAT GIRONA 17 DE SETEMBRE DE 2021 · VAG VIDEO ART GAME · fira agrària de santmiquel SALÓ NACIONAL DE LA MAQUINÀRIA AGRÍCOLA

interihotel · BIG DATA & AI CONGRESS BARCELONA · LA FIRA DE NOVEMBRE · EUCNC 2021 June 8-11 European Conference on Networks and Communications | Porto, Portugal

MWC 2021

The center returned to the world's most influential event for the connectivity industry.
i2CAT showcased its emerging technologies and innovative use cases.

3
DEMOS

5.191K
MEDIA IMPACTS

1.7K
SOCIAL MEDIA REACTIONS

Real-time holoportation platform

i2CAT proposed to the most innovative companies to rethink digital products and services based on the capture, transmission and representation of volumetric video using Point Cloud. Visitors to i2CAT's stand were able to get to know HoloMIT and **experience a real holoconference demonstration** with a person located in our Crea & Play Laboratory in Vilanova i la Geltrú, and a real-time overview of the architecture and performance indicators

Real-time remote driving for safer mobility

This demonstration showed how **5G could enhance roadside assistance** by enabling real-time remote driving of a vehicle in a risky situation. i2CAT partnered with the Government of Catalonia, CCMA, Cellnex, MIR, and Vodafone to showcase real-time delivery of audiovisual information to the vehicle and the infrastructure thanks to 5G connectivity.

Demo Contact Tracing

The center showcased an **indoor real-time location solution with cm-level accuracy** allowing to monitor the people's safety distances at trade fairs. The solution was designed and developed by i2CAT, partnering with La Fira de Barcelona, TIC Salut, and MWCapital.

Knowledge & excellence

R&D roadmap

i2CAT stands for **technological sovereignty** and wants to contribute to strengthening European scientific and technological bases and the European Research Area.

In 2021 the center continued to focus on the topics where it can make a difference with its specific know-how, expertise, team skills, research and innovation.

It continued the R&D activities that cover fields such as **5G/ 6G, Artificial Intelligence, Cybersecurity, and Virtual and Immersive Media Technologies.**

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/ 6G & Internet of Things

- ORAN architecture for beyond 5G networks
- Core network extensions for NTN
- Internet of No Things
- Zero energy devices
- Vehicular digital twins
- “AI-readiness” of Software & Network management systems
- Elastic Slice modelling 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

- Predictive models for risk detection from data logs
- Optimization models to work on digital twins
- Virtual sensors calibration with ML models
- Audio classification with Deep Learning methods from cloud to Tiny ML
- Multi detection and multi tracking of objects with Computer Vision
- Deep Learning for calibration, compression and recognition of volumetric content
- Data Spaces components based on IDSA and Gaia-X architectures
- Cognitive clouds functions based on AI
- Stretched, distributed and federated Data Lakes

Cybersecurity

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

Media Technologies

- Real-time Holoportation & Holoconferencing
- Volumetric video optimization service
- Point Cloud Compression
- AI driven volumetric image and video reconstruction
- Novel media delivery paradigms
- Multi-source and multi-device synchronization
- Quality of Service and Quality of Experience evaluation
- Multi-modal Interaction

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 to the Internet of Satellites paradigm

Some of our partners

Universitat Autònoma de Barcelona · 8 Bells · rbb Rundfunk Berlin-Brandenburg · Alleleran · University of Bristol · Atos · Blu Wireless · avanti · Universidad de Murcia · Boston University · i2cat Innovations for high performance microelectronics · CTTC Centre Tecnològic de Telecomunicacions de Catalunya · CERTH Centre for Research & Technology Hellas · CWI · Ericsson · Altran · IMI Institut Municipal d'Informàtica · Nextworks Engineering Forward · NEC · Panasonic Automotive · TNO innovation for life · ubiwhere Suiting the Future · Corporació Catalana de Mitjans Audiovisuals, SA · cellnex · Telefónica · Nokia · neutroon · Huawei · Universitat Politècnica de Catalunya BarcelonaTech · Agència de Ciberseguretat de Catalunya · CRM Centre de Recerca Matemàtica · opencloud factory · Mediapro · Cisco · Politècnica · Sound · Joanneum Research · Huawei · raytrix · Deutsche Welle · Visyon

European and International 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 has a leading position both on a **European and Spanish scale. The European Commission has recognised i2CAT's research quality over the years**, especially in topics related to the 5G, Cybersecurity, AI and Media technological ecosystem. the CDTI also rewarded i2CAT through the "Tecnologías Cervera" programme identifying i2CAT as a **"CERVERA Excellence Center in 5G".**

EU funding programme for research and innovation Horizon 2020 (H2020)

i2CAT worked to increase and enhance the knowledge resulting from its R&D activities in 5G and beyond, Internet of Things, cybersecurity, AI, and Virtual and Immersive Media Technologies with a focus on innovation.

This funding programme has funded **39 projects** to i2CAT in the 2014-2020 period, rising to **17 M€.**

EU funding from H2020 ICT thematic priority

2nd
INSTITUTION IN CATALONIA

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

H2020 Coordinated projects

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

i2CAT leads 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 in the cyberthreat detection and response techniques for cooperative automated vehicles and PKI-enabled vehicle identity management against identity theft. CARAMEL's primary goal is to proactively address modern vehicle cybersecurity challenges by 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.

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.

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 project aimed 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 led the project and led the development of the VR player, as well as a PC-MCU (Point-Cloud-Multipoint Control Unit) that minimises the communication costs of this new format (Point Clouds).

In 2021 this project was finalized with the outstanding outcome: VR-Together has delivered an end-to-end holoconferencing platform for VR.

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

i2CAT is the technical lead of 5G-CLARITY that puts forward a beyond 5G architecture for private networks, which features a novel access network integrating 5G, WiFi, and LiFi, compute and transport resources, and novel management components to enable AI driven network automation. Based on this architecture, 5G-CLARITY defines communication services that deliver measurable enhancements with respect to the eMBB and URLLC services defined by 3GPP in Release 16, in terms of low latency, area capacity, reliability, and accurate positioning and synchronization capabilities.

European and International projects

Horizon Europe

In 2021, the new European Union's flagship Research and Innovation programme was launched. It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth.

The center continued to strive for excellence and obtained optimum results in this programme's first call for funding. i2CAT was granted 6 new projects in the following clusters:

1. Digital Industry and Space
2. Climate, Energy and Mobility and Food, Bioeconomy
3. Natural Resources, Agriculture and Environment

ZERO-SWARM is expected to provide technical solutions for open swarm framework, non-public 5G network, active information continuum and digital twin. At the core, it establishes a unique forum where separately maturing technologies of 5G and cloud-edge continuum, data technologies and analysis (including data spaces and GAIA-X) and operational technology (automation and agility) break their siloes to co-design and co-create through 10 trials.

XGAIN fosters a sustainable, balanced and inclusive development of rural, coastal and urban areas by facilitating access to relevant stakeholders, such as municipalities, policymakers, farmers, foresters and their associations, to a comprehensive inventory of smart XG, last-mile connectivity and edge computing solutions, and of related assessment methods.

TEADAL aims to provide key cornerstone technologies to create stretched data lakes spanning the cloud-edge continuum and multi-cloud, providing privacy, confidentiality, and energy-efficient data management. The TEADAL data lake technologies will enable trusted, verifiable and energy-efficient data flows, both in a stretched data lake and across a trustworthy mediatorless federation, based on a shared approach for defining, enforcing, and tracking privacy/confidentiality requirements balanced with the need for energy reduction.

PODIUM proposes PDI connectivity and cooperation enablers building trust and sustainability for continuous and connected autonomous Mobility (CCAM). By using and enhancing the facilities of three well-equipped Living Labs (LLs) in Germany, Italy and Spain, we define a rich set of demanding CCAM UCs to identify and assess all the connectivity and cooperation enablers and needs to allow the proposed higher levels of automation.

XRECO will create a new data-driven ecosystem for the media industry, focusing on facilitating data sharing, search and discovery, and supporting the creation of news and entertainment content, particularly the creation and (re-) use of location-related 2D and 3D assets and the creation of XR experiences.

FORGING proposes a new methodology based on a value-sensitive innovation journey that breaks linear innovation trajectories to stimulate new technological visions and pathways attentive to the environment and society and human-centred in alignment with Industry 5.0. technological frameworks. It will develop 6 Technological Pathways to transfer ideas and help the industry navigate through issues related to the absorption and deployment of the use cases.

5G Cervera Center of Excellence

OPEN VERSO
5G and Beyond Technology Enablers

i2CAT holds the CDTI's reward as a CERVERA Excellence Center in 5G under the "Tecnologías Cervera" program

i2CAT's 5G expertise has also been recognised at the Spanish level by the CDTI through the "Tecnologías Cervera" program.
The complete virtualisation of network infrastructures, Artificial Intelligence, new vertical sectors, and a horizon of continuous standardisation of 5G and 6G networks can allow consortia such as OPEN-VERSO (VICOMTECH, GRADIANT, i2CAT) to position themselves 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 the volumetric video to the virtualised environment offered by OPEN-VERSO.

The focus in 2021 was on the definition of the architecture and the layout of the verticals to deliver by the platform. i2CAT delivered the implementation of the RINA L2 router based on netmap. The center also implemented the support for multiple domains by the SOE asset (with multiple MANO and VIMs).

integra

Strategic cooperation for research in high security connected and autonomous mobility technologies in complex environments

The main objective of the Integra project is to strengthen the expertise of the technological centers involved in autonomous and connected high-security mobility in complex environments.
i2CAT is developing digital instrumentation applicable to assisted driving to increase safety through anti-collision sensory systems and intelligent networks (VANET).

CISCO Research Grant

The center's research work in immersive and virtual technologies gained recognition also from the business sector. i2CAT developed a research project funded by CISCO to optimise the multi-user transmission and processing of volumetric video in the cloud to enable holoconferencing.

Talent

i2CAT is always striving for excellence to increase the center's scientific competitiveness. In 2021 it continued to invest in research and innovation talent to maintain its scientific and technological leadership.

ICREA, Catalan Institution for Research and Advanced Studies

i2CAT is one of the CERCA centers that have an ICREA Research Professor in their team to give a push to their research results.

ICREA is the Catalan Institution that aims to recruit **top scientists for the Catalan R & R&D ecosystem, scientists capable of leading new research groups, strengthening existing groups, and setting up new lines of research targeting foreign researchers most of the time.**

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

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 2021 NEC and i2CAT collaborated in the Beyond 5G technologies area through an industrial research project by jointly developing AI-driven O-RAN automation solutions maximising system performance and cooperative edge systems for specific areas 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 standardisation bodies such as 3GPP, ETSI NFV, ETSI MEC and IETF.

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

ICREA

Innovative Training Networks (ITN)

Future Wireless Connected and Automated Industry Enabled by 5G

5GSmartFact is an MSCA-ITN project funded by the EU to study, develop, optimise and assess the deployment of 5G networks. It targets the IIoT requirements in terms of availability, ultra-low latency, reliability, amount of supported devices, localisation accuracy and energy efficiency in factory environments and exploits them to integrate factory applications. These applications, especially those related to robot control and robot navigation, might lead to a complete redesign of networked robot architectures and a leap forward in industry automation.

The mission of 5GSmartFact is **to create an exciting EU-based cohesive training and research environment for young European and international researchers.** They are expected to work at the crossroads of factory automation and 5G evolutions to completely redesign robot architectures.

In 2021 the selection process of researchers was completed, and the training courses to develop in 2022 were prepared.

MARIE CURIE ACTIONS

Research outcomes: assets & valorisation

The work of i2CAT's research team produced notable research outcomes that will contribute to advancing research and innovation in the local and European ecosystems. This are some of the technology assets that have been developed by means of research projects.

Multi-tenant management framework for future 5G neutral and private infrastructures

It is a novel framework developed by i2CAT to **manage private and neutral 5G infrastructures** composed of Compute, Transport and RAN segments in a holistic manner. Neutroon aims at effectively lowering the entry barrier for vertical sectors to operate private 5G infrastructures, and to empower neutral host operators to enhance the flexibility of current RAN sharing agreements towards the **vision of providing 5G networks "as a Service".**

This framework provides the following **key benefits:**

- Pure open software which triggers a faster Time-to-Market (TTM) for new 5G service introduction in public networks and private venues.
- Significant Total Cost of Ownership (TCO) reduction for Network Infrastructure owners.
- Vendor Agnostic open software.
- Optimized flexibility, automation, virtualization and resources allocation.
- Reduces skills required by the network infrastructure owner to operate the network.

Contact Tracing Solution

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, which was showcased at International 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. The 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 less than 30 cm accuracy and low consumption.

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

DOWI

One of the most popular and bandwidth-demanding in nowadays networks is Dynamic Adaptive Streaming over HTTP (DASH) video streaming.

DOWI is a **novel solution to obtain a proportional allocation of resources among DASH clients in dense wireless networks** according to the properties of the video streams and the characteristics of the wireless channel. Using its novel algorithm, which jointly optimises fair airtime allocation and video-rate recommendations, maximises the QoE of the DASH clients and improves the efficiency of the access network.

i2CAT implemented DOWI in a realistic ultra-dense deployment based on a simulated In-Flight Entertainment Connectivity (IFEC) scenario.

HoloMIT

One of the assets resulting from the research area activity in immersive technologies research, is **HoloMIT**. It proposes an advance for a visual interaction between people in the metaverse. HoloMIT consists of an affordable volumetric capture system (in 3D) that allows captured users to be transferred to a metaverse and interact with each other with natural movements in real-time. The center also implemented some processing and network efficiency features.

In 2021 i2CAT developed significant volumetric video resolution and 360 video improvements. The **interactive video player** was used in several **interactive video pilots of the Catalan television corporation (CCMA)**, such as the CARNET event. In this context, **BroadcastTM awarded** the CCMA solution.

The center showcased a variety of use cases using this technology and involving **real users** in fairs and congresses such as Interihotel, MWC, and SCEWC, among others.

Other innovation initiatives

Crea&Play LAB

i2CAT established Crea&Play Laboratory with Neàpolis. Neàpolis is a **Public Innovation Agency for ICT, the multimedia sector, creativity, and entrepreneurship**. It offers a space for experimentation, incubation, and growth for the city's entrepreneurial community, promoting innovation and collaboration.

In this framework, i2CAT deployed and tested its immersive technology. The i2CAT's Media research area team co-developed a **gamification strategy for the Vilanova city** (the 10 games of the Agency of Secrets). As a result, they developed **two escape room games for VR set in the city's cultural heritage**. Additionally, the interactive video player was used in municipal public events and parades.

CREA &PLAY

neàpolis
TECHNOLOGICALLY MEDITERRANEAN

HH5G Barcelona

In 2021 was born the Health Hub 5G Design Barcelona (HH5GBarcelona).

i2CAT, MWCapital, Grupo MASMOVIL, and Barcelona Health Hub reached an agreement to promote **5G technology in the health sector** within the framework of the 5G Barcelona initiative. The laboratory, located in the **Hospital de Sant Pau**, was set to host the development of **pilots and proofs of concept** to respond to new challenges and needs arising in this sector.

Barcelona Health Hub 5G Design

i2cat

BARCELONA HEALTH HUB

MOBILE WORLD CAPITAL BARCELONA

MÁSMÓVIL

5GBarcelona

TDA Cibersecurity

The TDA Cybersecurity project aims to tackle a challenge proposed by the Catalan Cybersecurity Agency. i2CAT, as a research and technological center, is the manager of the challenge coordination, developing an open reference framework with modular nature to build a platform with predictive capacity in the field of operational cybersecurity. This platform is **OpenUEBA**, **Open User and Entity Behaviour Analytics**, which develops an AI engine that allows the automatic ingest of heterogeneous logs of entities and users to define patterns of behaviour in the network and calculate the exposition to specific security threats.

AGÈNCIA DE CIBERSEGURETAT DE CATALUNYA | CENTRE D'INNOVACIÓ I COMPETÈNCIA EN CIBERSEGURETAT

Publications

Excellence, cooperation, openness, inspiration, and commitment are i2CAT's hallmarks. In 2021, 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 making its scientific outcomes available to everyone and also giving further visibility to the results achieved by its researchers.

In 2021 the research areas produced 44 scientific contributions. These publications included:

Journals / Conferences/ Workshops

- A. Betzler, D. Camps-Mur and M. Catalan, "G-ADRR: Network-wide slicing of Wi-Fi networks with variable loads in space and time," in IEEE Transactions on Mobile Computing, doi: 10.1109/TMC.2021.3066875.
- E. Coronado, S. Bayhan, A. Thomas and R. Riggio, "AI-Empowered Software-Defined WLANs," in IEEE Communications Magazine, vol. 59, no. 3, pp. 54-60, March 2021
- C. Delgado and J. Famaey, "Optimal energy-aware task scheduling for batteryless IoT devices," in IEEE Transactions on Emerging Topics in Computing, doi: 10.1109/TETC.2021.3086144.
- Maurizio Rea, Domenico Giustiniano, Pablo Jiménez Mateo, Yago Lizarribar, Joerg Widmer, Beam searching for mmWave networks with sub-6GHz WiFi and inertial sensors inputs: An experimental study, Computer Networks, Volume 198, 2021
- S. Fernández, M. Montagud, G. Cernigliaro and D. Rincón, "Toward Hyper-Realistic and Interactive Social VR Experiences in Live TV Scenarios," in IEEE Transactions on Broadcasting, Early Access, 2021
- E. Coronado et al., "ONIX: Open Radio Network Information eXchange," in IEEE Communications Magazine, vol. 59, no. 10, pp. 14-20, October 2021
- Fernández-Fernández, A.; Colman-Meixner, C.; Ochoa-Aday, L.; Betzler, A.; Khalili, H.; Siddiqui, M.S.; Carrozzo, G.; Figuerola, S.; Nejabati, R.; Simeonidou, D. Validating a 5G-Enabled Neutral Host Framework in City-Wide Deployments. Sensors 2021, 21, 8103
- E. C. Cejudo, H. Zhu and J. Wang, "Resource Allocation in Multicarrier NOMA Systems Based on Optimal Channel Gain Ratios," in IEEE Transactions on Wireless Communications, vol. 21, no. 1, pp. 635-650, July. 2021
- M. Montagud, C. Hurtado, J.A. De Rus, S. Fernandez, "Subtitling 3D VR Content with limited 6DoF: Presentation Modes and Guiding Methods", Applied Sciences, 11, 7472, 2021
- L. Zanzi, V. Sciancalepore, A. Garcia-Saavedra, X. Costa-Pérez, G. Agapiou and H. D. Schotten, "ARENA: A Data-Driven Radio Access Networks Analysis of Football Events," in IEEE Transactions on Network and Service Management, vol. 17, no. 4, pp. 2634-2647, Dec. 2020

Research and innovation for the society and the territory

Annual report 21

i2CAT is committed to improving the quality of citizenship life. It pioneers the quest to design and build the digital society of the future. The center puts the technology to the service of society. It works to be **an instrument to meet the needs of citizenship's digital transformation, enhance inclusion and prevent the digital divide.**

Col·laboratori Catalunya

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

The Col·laboratoris Catalunya initiative aims to deploy an interconnection model of social and digital innovation throughout Catalonia. The collaboratories are the cornerstone for creating the Digital Social Innovation ecosystem. It is driven by the notion of becoming a lab of labs, which implies interconnecting innovation agents from the four helices: **Administrations, universities, companies, citizens, and research centers**. This approach enables networks connected to the territory, leveraging the stakeholders' knowledge, resources and capacities. The collaboration process may cover from identifying shared challenges to co-create solutions.

This project is fostered by the i2CAT Foundation, with the support of the Department of Digital Policies of the Government of Catalonia.

In 2021, the **CatNord Col·laboratori** was created to prototype and validate a model for promoting, designing and executing social and digital structures in Girona counties to address the territory's challenges. This col·laboratori join two other already established territorial col·laboratories **CatSud** and **Anoia**.

It was a year of **retrospective actions** to analyse the consequences of the pandemia and identify the most affected sectors, such as health and education. To help to address these sectors' situations, Col·laboratories have started to work on designing thematic collaboration initiatives on these topics. As a result:

- The **Health and Wellbeing Col·laboratory** was born in October.

- The initiative starts designing the roadmap for **Educolab**. Under this framework, it executes some educational activities to put the Digital Advanced Technologies at the service of educational professionals to raise awareness of these enabling technologies' potential and help them cope with the new challenges. In this context, the initiative executed several **training** activities **for Vocational Training Degree teachers on Cybersecurity, IoT**, and **5G**.

Generalitat de Catalunya
Departament de la Vicepresidència i de Polítiques Digitals i Territori

TDA 5G RURAL

This project aims to define, develop, and demonstrate a deployment model that allows the provision of 5G service to less populated areas of the territory, validating that it is economically viable.

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

To make it possible, this project focuses on three fields:

• A laboratory deployment in an isolated rural environment also covers an industrial area.
In 2021 an **experimental 5G network infrastructure** was deployed covering an **industrial area** of the Ribera d'Ebre County Council, the Polígon del Molló in Mora la Nova. This infrastructure must enable the **validation of both a multi-operator model for rural environments and the business model** to be deployed in these environments.

• This laboratory is a **pioneering experience** in deploying a test environment offering a dedicated network of remote rural environments and a network of medium-sized cities. A private Cloud complements this network to host applications designed to be used on the edge, where there is a real need for the service. All this will allow validating the behaviour of two environments that are overlapping in the territory, and it will enable the deployment of use cases explicitly oriented to the rural environment. Thus, we will be able to validate what is needed and what works in rural environments.

• The deployment of an **experimental outdoor infrastructure** using the **experimental spectrum in the 5G** band to deploy use cases.
In 2021, two **pilots** were designed. They will be deployed in the territory during 2022:

Home hospitalization

TIC Salut Social · Masimo · Philips

Determination of fruit ripening point

CVC · IRTA

• The execution of experimental tests with telecom operators to reduce costs and speed up the implementation of 5G aiming at a multi-operator model.

Generalitat de Catalunya
Departament de la Vicepresidència i de Polítiques Digitals i Territori

Àrees 5G

The 5G Areas aim to enhance the Catalan 5G ecosystem and to turn Catalonia into an international benchmark for 5G technology.

The purpose of the 5G areas, which are to be established throughout Catalonia, is to promote this technology in the region through training and dissemination activities, workshops, concept trials, and laboratories. This project aims 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, analysing both technical parameters, costs of unfolding and studying the economic viability. The strategy is to create an infrastructure and an ecosystem stable in the territory.

This regional 5G project is promoted by the Ministry of the Vice Presidency and for Digital Policy and Territory of the Government of Catalonia in collaboration with i2CAT, the Mobile World Capital Barcelona, and other rural territory entities.

In 2021 the 5G Areas of **Alt Pirineu, Catalunya Central, Girona** were created.

As far as other running areas, it is remarkable the deployment of the ***Digital observant*** **pilot** within the **Ponent 5G Area**.

The 5G Digital Vigilant pilot located at the Official Chamber of Commerce and Industry of Lleida provides remote surveillance and real-time monitoring with cameras to prevent, detect, and act on unwanted situations. It uses Artificial Intelligence-based models trained to detect falls, personal protective equipment and counting people, and local video analytics, and sends events to the central system.

It is worth mentioning the training initiatives executed throughout the 5G Areas in order to raise awareness about the 5G potential and how this technologies can boost productive sectors. In 2021 the initiative executed **6 workshops** on **agriculture, smart cities, health, chemical industry, mobility** and **tourism.**

Generalitat de Catalunya
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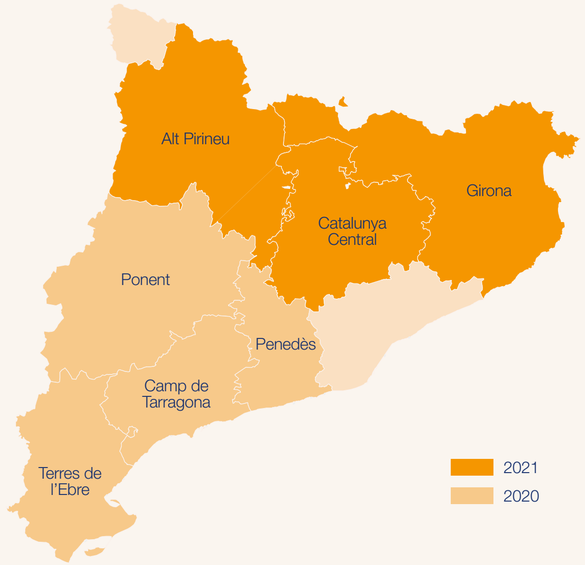
MOBILE WORLD CAPITAL BARCELONA



Digital innovation strategies and policies

Annual report 21

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 and the European Union.

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.

Unió Europea
Fons Europeu
de Desenvolupament Regional

5G Barcelona

5G Barcelona is a public-private initiative that works to position Barcelona as an innovative and open environment for the validation and adoption of 5G technologies and applications in a real-life environment. The initiative will create synergies within the 5G ecosystem and offer an experimental infrastructure to test, prototype, and implement new digital solutions. In 2021 5G Barcelona continued to work to transform Barcelona into a reference hub for 5G in Southern Europe, to stimulate the existing innovation in the city, attract foreign investment, and promote new technology businesses through 10 labs, 8 pilot projects and 13 workshop activities.

The i2CAT Foundation acts as CTO of the initiative and has been responsible for its technical direction since its foundation.

SmartCatalonia Challenge

SmartCatalonia Challenge is a competition that aims to promote the creation and development of innovative solutions connecting companies, developers, organizations, and experts with municipal and infrastructural needs to improve citizens' life quality.

The initiative gives prizes and the opportunity to conduct pilot tests in a real environment.

In 2021 two editions were organized in collaboration with the catalan public road transport department (DGTM) and the rural agent force.

SMEs, entrepreneurs and start-Ups presented a high number of solutions to address the challenges proposed by these entities, which were susceptible to be solved by innovative solutions based on ICT.

- 2 editions
- More than 80 innovative solutions
- 40K in awards

Àrees 5G

The Government of Catalonia, in collaboration with i2CAT and other territory entities, is working on this 5G project. It is analyzing 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, all together 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 2021 the 5G Areas of Alt Pirineu, Catalunya Central, Girona were created.

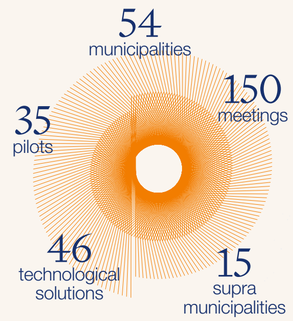
SmartCatalonia Laboratori

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.

This project was born in Barcelona as part of the Urban Lab project. Within the framework of the SmartCAT strategy, it has spread all over the country. The variety of venues available to companies range from tourist towns to rural areas, small to large settlements, and from the mountain to the coast.



DCA Digital Catalonia Alliance

This initiative promoted by the Government of Catalonia and i2CAT brings together the main emerging technology sectors in the territory to promote their growth and collaborate in their consolidation.

It is born to promote the creation of new business niches based on talent, entrepreneurship and digital innovation, focusing on advanced digital technologies such as IoT, Drones, Cybersecurity, Artificial Intelligence and NewSpace. It focuses on enhancing Catalonia as a technology and digital hub.

The alliance has a unique value proposition that tackles the following lines:

- Sectoral revitalisation
- Visibility and events
- Synergies and multi-technology
- Access to knowledge, technology and infrastructure
- Access to funding

In 2021, the alliance **engaged more than 260 companies and organisations**.

Col·laboratori Catalunya

The commitment of the *Col·laboratori Catalunya* is to get the key stakeholders in the territory to coordinate and add synergies to execute projects that generate positive impacts by solving social challenges.

The local and global challenges are organised into different projects that arise from a decision-making process led by the institutions which are part of the *col·laboratoris*.

Mission-oriented projects with public administration

TDA 5G RURAL

Minimizing the digital divide and so putting the necessary resources and tools to all areas of the territory is one of the main objectives of the Administration.

i2CAT leads the challenge to define, develop and demonstrate a deployment model to provide 5G communications to less populated areas of the territory, involving the Administration (Government of Catalonia, provincial councils, and municipalities) and private companies, at a national and local level (mobile operators, neutral operators, local operators).

TDA 5G Rural was born to help deploy this game-changing technology to rural areas, increase connection speed, minimise latency, and exponentially increase the number of connected devices. It is expected to enable innovative and added-value use cases for the productive sector.

Generalitat de Catalunya
Departament de la Vicepresidència i de Polítiques Digitals i Territori

TDACiberseguretat

The TDA Cybersecurity project was born to respond to a challenge posed by the Catalan Cybersecurity Agency.

i2CAT, as a technology and research center, is in charge of coordinating the challenge and developing a modular “open framework” of reference to build a platform with predictive capacity in operational cybersecurity. This platform is OpenUEBA, Open User and Entity Behavior Analytics, which develops an AI engine that allows the automatic ingestion of heterogeneous logs of entities and users to define patterns of behaviour on the network and calculate the exposure to specific threats.

AGÈNCIA DE CIBERSEGURETAT DE CATALUNYA

VINCLESBCN

i2CAT collaborates with the Social Rights Area of the Barcelona City Council to develop 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 improve 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).

In 2021 the Vincles project had a significant evolution, as the new back-end platform developed by i2CAT was put into production, replacing the previous back-end. Android and iOS mobile apps for end-users were also updated to work with the new platform. The whole procedure was carried out with minimal impact on users, as the data was migrated between platforms securely, maintaining their privacy.

Ajuntament de Barcelona

Participation in digital strategies of the Government of Catalonia

Catalonia.ai

i2CAT leads an Advanced Research and Innovation Programme in the field of Artificial Intelligence to foster mission-oriented research and innovation initiatives. With the objective of takling social or business issues related to AI the center collaborates with other universities, research groups, institutes and public centers that carry out AI projects in Catalonia.

New Space Strategy for Catalonia

The i2CAT Foundation, is one of the most outstanding entities in the Space Comms arena in Catalonia. NewSpace provides opportunities to use and exploit space platforms in Earth Observation, Telecommunications, and Global Navigation Satellite Systems (GNSS), allowing the development and qualification of space technology and the extension of spatial data services.

The collaboration and coordination between IEEC, i2CAT, ICGC, and the Government allowed identifying and generating synergies and promoting a joint strategy. The strategy will enable the development of innovative use cases that were not possible before.

Estratègia Blockchain de Catalunya

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 2021, among other activities, the center organized two workshops to review the opportunities offered by decentralized technologies (DLTs) through real and practical experiences that foster the adoption of blockchain in Catalonia. Also published:

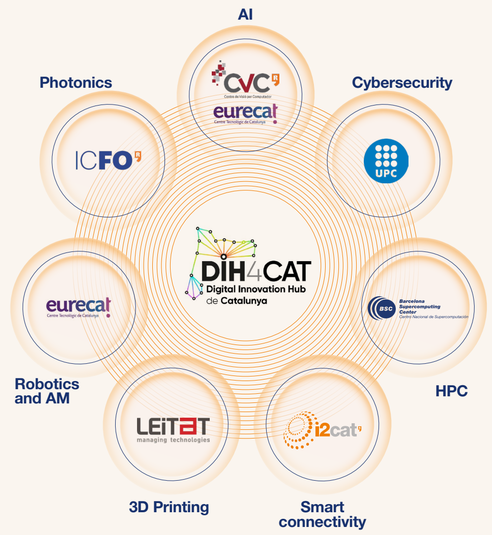
- 2 technical reports
- 4 success cases

DIH4CAT Digital Innovation Hub de Catalunya

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

The DIH4CAT is composed of 7 nodes of specialisation, 7 technological areas that reflect the reference capacities available in Catalonia and a representative critical mass.

The digital Innovation nodes are coordinated by leading research and technological centers and Universities in Catalonia and must bring together the main technological capacities in the field of reference. The technological areas that initially constitute the DIH4CAT scope of action are the following:

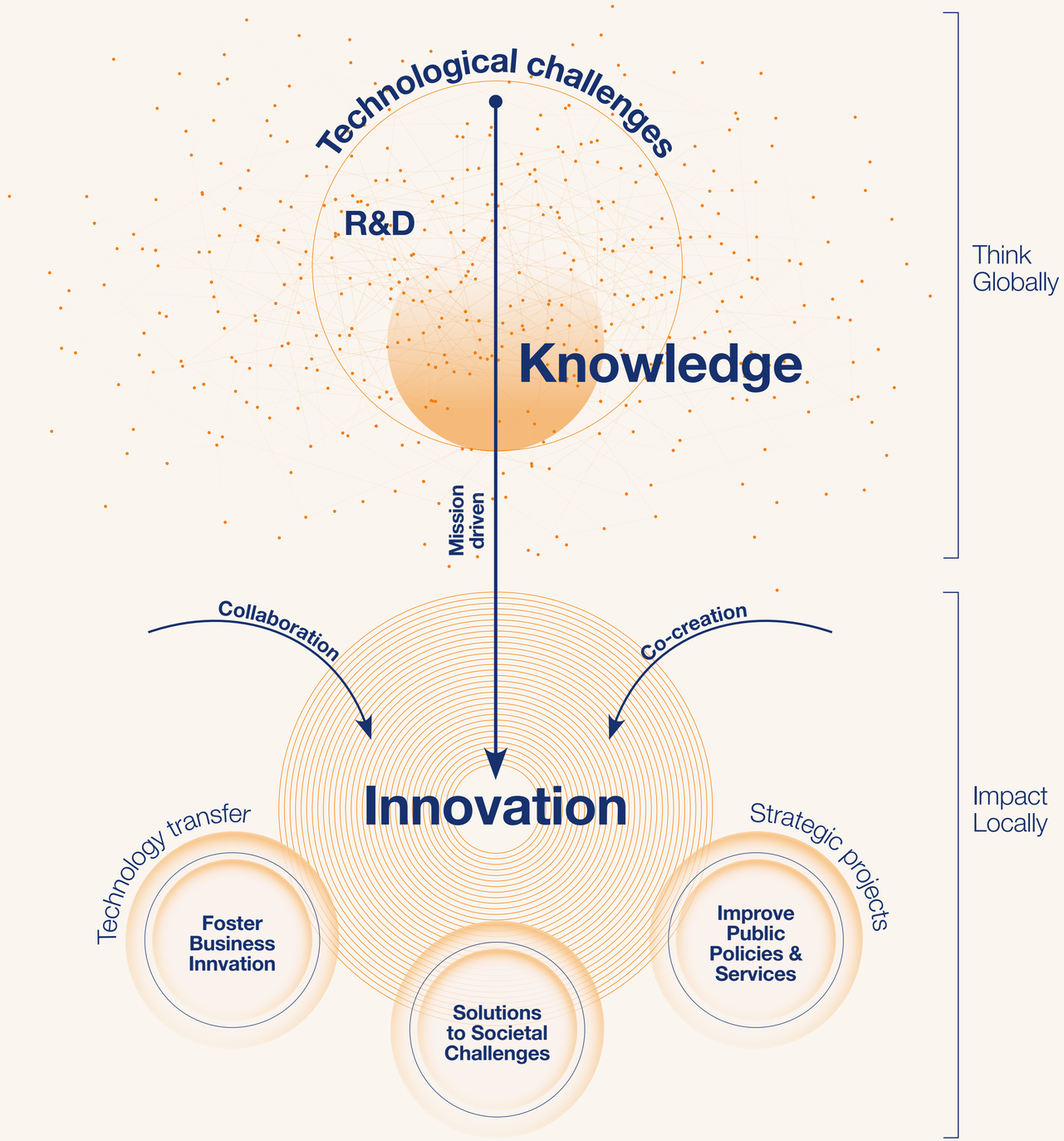


Digital transformation

Annual report 21

Digital transformation is at the heart of i2CAT's activity. It is a mission-driven center that aims to revitalise and boost the social and productive sectors through advanced digital technologies. The knowledge and expertise gained over 18 years from ICT R&D initiatives are the cornerstones to fulfilling this mission.

IoT, network management, cloud computing, robotics, virtual reality, and cybersecurity are relevant topics that i2CAT applies to propose and enable these innovative solutions.



The center sets strategic alliances with private companies and the innovation ecosystem players to jointly co-create in fields such as **Smart environment, eHealth, Industry 4.0, Autonomous and Connected Mobility, or Creative Industries.**

In 2021, it continued to identify opportunities and develop collaborations with private sector companies to provide innovative market-oriented technologies and solutions. The center focus on:

- Generating impact by applying i2CAT's excellent knowledge gained from R&D projects
- Contributing with added value to the Catalan ICT sector
- Promoting proofs of concept and valorisation activities

Some of our partners

Telefónica · SALTO Intelligent Technology · ALSTOM · SATELIOT · bequant
Continental · keonn · parlem telecom · NEC · urbiotica
Unblur · simon · PAYTEC smart payments for vending · Opticks · neutroon
MaxLinear · ELZABURU · indra · IDEAS FOR CHANGE · FACTUAL
CENFIM Home & Contract furnishings cluster and innovation hub · TRANSCELESTIAL · Open Cosmos

Technology transfer

i2CAT works to create innovative market-oriented technologies and solutions. It leads the **design and deployment of trials for technical 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 building startups, proofs of concept and valorisation activities.

i2CAT is committed to fostering entrepreneurship, tech transfer and spin-off creation.

In 2021, i2CAT started receiving **incomes by royalties**. Tech transfer deals are beginning to be a reality, and revenue streams are expected to increase significantly.

New spin-off: Neutroon

In 2021, i2CAT officially joined the start-up Neutroon Technologies as a shareholder. A team of i2CAT researchers, with the support of the Knowledge and Technology Marketing unit, created a disruptive technology-based start-up that tackles the challenges for companies interested in deploying private 5G networks.

In 2021 the i2CAT's spin-off grew significantly and raised a private funding round. Additionally, i2CAT set a licensing agreement with Neutroon Technologies SL to commercialise its technology. The collaboration between the center and the start-up also resulted in the Zero-SWARM project granted by the European Commission under the Twin Green And Digital Transition 2021 call of Horizon Europe. Zero-SWARM aims to achieve climate-neutral and digitised production via a multidisciplinary, human-centric, objective-oriented innovative approach.

Neutroon offers fully developed software that has been used in several European projects as the backbone to manage private 5G networks. It is an end-to-end management platform of shared and vendor-agnostic networks for different tenants (e.g. mobile network operators and private users).

neutroon

DOWI

One of the most popular and bandwidth-demanding in nowadays networks is Dynamic Adaptive Streaming over HTTP (DASH) video streaming.

DOWI is a **novel solution to obtain a proportional allocation of resources among DASH clients in dense wireless networks** according to the properties of the video streams and the characteristics of the wireless channel. Using its novel algorithm, which jointly optimises fair airtime allocation and video-rate recommendations, maximises the QoE of the DASH clients and improves the efficiency of the access network.

i2CAT implemented DOWI in a realistic ultra-dense deployment based on a simulated In-Flight Entertainment Connectivity (IFEC) scenario. The results showed that DOWI could avoid the main problems which impact the QoE of state-of-the-art rate adaptation algorithms, as is the case of instability and buffer underrunning, without decreasing the video rate of the clients.

DOWI is a patent-pending method that, integrated into WiFi access points, is expected to enable an outstanding performance for streaming in densely populated networks such as sports matches or music festivals, or even transportation, avoiding the oversizing of wireless networks. i2CAT is currently looking for licensees in WiFi equipment and Content Delivery Network vendors.

In 2021 Dowi was rewarded with funds under the CERCA Gínjol funding programme aimed to protect, exploit and market the research results.

Catalonia Valorization Networks

Catalonia Valorization Networks help valorise assets, contribute patent application funding, execute Proofs of Concept, and disseminate.

i2CAT is a member of 3 Valorization Networks that are conceived to bring project results to the market.

XAFIR

The **Fourth Industrial Revolution Network** 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.

In 2021 the center worked with XAFIR, conducting a market study for DOWI and a patentability analysis of XR-MCU multimedia technology.

XARTEC

The **R&D Network in Health Technologies** aim to enhance the quality and value of the health research group's results to increase patents and licenses and promote the creation of technological companies.

i4KIDS

The **Pediatrics Innovation Hub** i4Kids promotes the results of collaborative research in pediatrics, increases their value and facilitates their access to the market, contributing to the new knowledge industry.

Emerging technologies

The 'Research and Innovation Strategy for the Smart Specialisation of Catalonia' (RIS3CAT) promotes the vision of Catalonia as **an industrial-based country with an open, competitive and sustainable economy**. It applies talent, excellent research knowledge and creativity to a diversified business fabric within a dynamic, enterprising and inclusive society.

RIS3CAT promotes the **cooperation of companies, both local and international, and stakeholders of Catalonia's research and innovation ecosystem** to boost R&D projects in various productive and technological fields.

The i2CAT Foundation participates in **9 RIS3CAT projects** and **leads the 5G/IoT Emerging Technology communities**.

Unió Europea
Fons Europeu
de Desenvolupament Regional

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 activity is as well focused on increasing the business impact of research and the social impact related to Intelligent Mobility and

IoT Data Valorization. i2CAT leads this project that aims at boosting IoT-based research and innovation.

In 2021 FEM-IoT permitted the development of algorithms, mechanisms, and optimised solutions for the hybridisation of localisation technologies (concretely, UWB, and inertial systems) to improve positioning for Cooperative Connected and Automatized Mobility (CCAM) services.

FEM-IoT

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 Catalan Industry 4.0 requires.

Looming Factory

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.

QUANTUMCAT

RIS3CAT Communities

The RIS3CAT communities are voluntary groups of companies and stakeholders of the Catalan research and innovation system, which promote R & D actions in the leading sectorial areas.

Through competitive calls, the Government of Catalonia accredits them to obtain a grant from the Operational Program of the ERDF of Catalonia 2014-2020 to co-finance the action plan.

i2CAT is a partner in several communities:

ViVIM

Computer Vision for Immersive Multi-platform Video

PERSOSER

Customisation of services to improve customer experience

HL 4.0

Expert digital system of comprehensive, personalised pediatric patient care

SENIX

Network Sensoring and Inspection

SMARTSPACE

IoT solution for the interior furnishing sector in Catalonia

Public-private alliances

5G Barcelona

5G Barcelona is a public-private initiative that works to position Barcelona as an innovative and open environment for validating and adopting 5G technologies and applications in a real-life setting. Also, the initiative seeks to become the leading 5G hub for Southern Europe.

To this end, in 2021, it carried out 8 pilot projects in key sectors such as Mobility, Healthcare, Security, Industry, Media and Entertainment, Rural, Security, and Transport. The i2CAT Foundation acts as CTO of the initiative. Since its foundation, it has been responsible for its technical direction leading 13 workshops with companies to foster new use cases and promote initial prototypes and test concepts. In 2021, the 5G Barcelona initiative also participated in more than 95 dissemination sessions at conferences, congresses, and round tables to bring the technology closer to all audiences.

Since its foundation, 5G Barcelona opened 10 5G laboratories around the city, open spaces for companies and people to test their ideas in different IoT networks.

In 2021, the Barcelona Health Hub 5G Design and The Thinx 5G Barcelona lab, which i2CAT is in technical charge of, have also continued to facilitate state of the art and tests for companies.

5GBarcelona

CIDAI

The AI Digital Innovation Hub in Catalonia (CIDAI) proposes networked services for businesses and institutions. It promotes the transfer of knowledge and the joint projects among knowledge-generating entities (universities, research and innovation centers), companies providing technology and services, and user companies and institutions demanding innovative solutions in applied Artificial Intelligence. Its founding members are the Government of Catalonia, Barcelona City Council, the Barcelona Supercomputing Center, the Computer Vision Center, NTT DATA, the i2CAT Foundation, IDEAI-UPC, Microsoft, SDG Group, SAP and Eurecat, who is the coordinator.

The CIDAI is modelled on the Digital Innovation Hubs set up by the European Commission and is conceived as a networked service centre working for businesses and institutions. It is a crucial instrument for the AI Catalonia Strategy of the Government of Catalonia.

2021 was a year with plenty of initiatives and achievements. Some of them are listed below:

- 9 AI-based PoCs in mobility, culture, and food industries
- Development of high-impact projects on mobility, tourism, and health
- 5 White papers on mobility, health, food, creative and cultural industries
- Ai & Bid Data Congress, with near 2000 registered people
- Workshops and 16 masterclasses in AI techniques and algorithms, AI implementation & development, AI-Driven companies, Data Tech & Ai Trends

CIDAI Centre of Innovation for Data tech and Artificial Intelligence

Digital Catalonia Alliance

The Digital Catalonia Alliance (DCA) is an initiative that gathers the main emerging technological sectors of Catalonia into an innovative, visionary, disruptive and collaborative alliance of technological communities.

The DCA wants to become the promoter of the digital economic sectors of Catalonia, and, for that reason, it works to:

- Solve the common challenges of the sector's SMEs
- Offer support to the adoption of technological changes for companies and the society
- Group digital innovation benchmark companies in order to provide a dynamic ecosystem that contributes to the digital economy
- Align with the Sustainable Development Goals (SDGs) and with the strategic challenges of the territory

Currently, the DCA focuses on five communities: Internet of Things (IoT), Drones, Artificial Intelligence (AI), NewSpace, and Cybersecurity. However, the initiative's roadmap envisages the formation of new communities within the field of innovative digital technologies.

DCA IoT	DCA Ciberseguretat	DCA Drons	DCA IA	DCA NewSpace
215 companies/ entities	85 companies/ entities	145 companies/ entities	110 companies/ entities	65 companies/ entities

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 maximising system performance as well as cooperative edge systems for **specific industry verticals**.

In 2021, the most outstanding output was **Nuberu**, an architecture that allows **80% Resource Savings in Future Virtualized Radio Access Networks (5G and Beyond)**.

Radio access networks virtualisation (vRAN) will become a key technology for the last mile of next-generation mobile networks (5G and beyond) driven by initiatives such as the Open Radio Access Network Alliance (O-RAN). However, due to the computing fluctuations inherent to wireless dynamics and resource contention in shared computing infrastructure, the price to migrate from dedicated to shared platforms may be too high. Indeed, we show that the baseline architecture of a base station's distributed unit (DU) collapses upon moments of deficit in computing capacity. Recent solutions to accelerate some signal processing tasks certainly help but do not tackle the core problem: a DU pipeline that requires predictable computing to provide carrier-grade reliability.

Nuberu is a novel pipeline architecture for 4G/5G DUs specifically engineered for non-deterministic computing platforms. Our design has one key objective to attain reliability: to guarantee a minimum set of signals that preserve synchronisation between the DU and its users during computing capacity shortages and, provided this, maximise network throughput. To this end, we use techniques such as tight deadline control, jitter-absorbing buffers, predictive HARQ, and congestion control. Using an experimental prototype, **we show that Nuberu attains more than 95% of the theoretical spectrum efficiency in hostile environments (where state-of-art approaches lose connectivity) and at least 80% resource savings**.

NEC

5G Catalunya

i2CAT collaborates with Parlem Telecom in the 5G Catalunya project; one of the grantees by the Red.es call for 5G pilots.

Red.es is the 5G program that depends on the Ministry of Economic Affairs and Digital Transformation. This initiative is co-funded by the European Fund for Economic and Regional Development (ERFD).

The consortium involves 8 companies, among them the Catalan operator Parlem Telecom, Aumenta Solutions, a company specialised in augmented reality for the industry, Atos engineering, Nae consultants, Lenovo technology and the Nearby Computing start-up, a spin-off of the Barcelona Supercomputing Center.

The project has an overall budget of €5.4 million — 40% of which will be financed by Red.es — and is performed in collaboration with Barcelona City Council, Mobile World Capital Barcelona through the 5G Barcelona initiative, Fira Barcelona, i2CAT, Intel, and the IESE business school. In 2021 i2CAT actively contributed to the following pilots:

parlem telecom

• Pilot on autonomous and sustainable mobility

The pilot was deployed in Fira's private venue on Barcelona's Gran Via to validate a possible shuttle service bus running during the different fairs and congresses held in their spaces.

Visitor mobility can be difficult at major events and fairs due to the extensive area and number of halls. It causes attendees to stop visiting specific pavilions for the long distances to cover. One possible solution to facilitate mobility is creating and enabling a flexible and dynamic 5G shuttle bus service depending on the event.

The purpose of the use case at the technical level is to validate how the combination of Mobility Autonomous and state-of-the-art mobile networks can offer value-added services to users of the service during a bus ride and service managers at the level of security.

In 2021 i2CAT worked on deploying a multi-tenant 5G private network in Fira de Barcelona to validate advanced V2X services with an autonomous bus used for transport.

• 5G and immersive technolgies-based pilot in shopping environments

This pilot aims to test a 5G technology use case to make it easier for customers in remote locations to buy immersively. They are also advised by a market expert who gives them visibility of the products shop through the glasses and suggests and comments on products.

A personal shopper located in the Mercat de la Boqueria wears augmented reality glasses, which allow recording images and sounds of everything that happens to a remote buyer. The remote buyer can view the video that the personal shopper is transmitting in real-time. They can communicate with each other by voice. Additionally, the buyer can indicate the product they are interested in on the screen. This information is reflected in real-time in the glasses of the personal shopper as an overlay.

AI & V2X for mobility

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

i2CAT is partnering with Alstom to carry out projects in AI and V2X. These projects are oriented to social benefits, helping people with their daily mobility and integrating public transport. From identifying a space for a wheelchair in the subway to prioritising the circulation of special vehicles, these projects aim to help Alstom be a reference in the mobility sector. i2CAT is a technological partner for Alstom, which offers the opportunity to deploy new projects and strategies in the coming years.

ALSTOM

i2CAT is working with CVC in the remote roads of Catalonia's Pyrenees mountains to demonstrate the navigation of an isolated, autonomous vehicle "off the grid" from conventional networks.

i2CAT has developed a hybrid infrastructure that integrates various positioning methods to support CVC's autonomous driving system further. This infrastructure brings together data from GPS-RTK stations, UWB deployments, ferromagnetic tags and distance sensors to provide ultra-precise positioning accuracy to less than 10 cm, designed for the most extreme driving conditions.

The project began in 2021, and in 2022 the results will be demonstrated in an autonomous vehicle on a remote, winding mountain road in Alós d'Isil. The demo will show the technical feasibility of this hybrid approach to inspire development for a variety of scenarios, such as supporting autonomous buses in rural, remote areas with little or no network coverage.

CVC Centre de Visió per Computador

Smart Home IoT Solutions

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

i2CAT collaborates with SIMON Tech to develop and evolve their Smart Home IoT solution. This project aims to combine wireless technologies, software optimisations, and artificial intelligence to implement an enhanced Smart Home gateway for domotic control (lights, sockets, etc.).

simon

Space Communications

The i2CAT Foundation is a key stakeholder in the NewSpace Strategy of Catalonia.

In 2021 took place the launch and commissioning of a mission, the Enxaneta nanosatellite, that enabled direct communications between IoT and the spacecraft. i2CAT has participated in the development and deployment of sensors that communicate with the first nanosatellite of the Government of Catalonia, the Enxaneta, which allow data obtention to improve the cultivation of vines in areas where there is no terrestrial coverage.

The center is also developing technologies that will allow the subsequent launches of nanosatellites to incorporate new IoT/5G communication capabilities.

Generalitat de Catalunya
Departament de la Vicepresidència i de Polítiques Digitals i Territori

IEEC Institut d'Estudis Espacials de Catalunya

ICGC Institut Cartogràfic i Geològic de Catalunya

Development and deployment of a satellite communication network.

i2CAT is designing and validating a customized NB-IoT Release 13 core network in a laboratory environment. The solution will allow Sateliot to connect NB-IoT devices that operate with SIMs provided by terrestrial mobile network operators.

SATELIOT

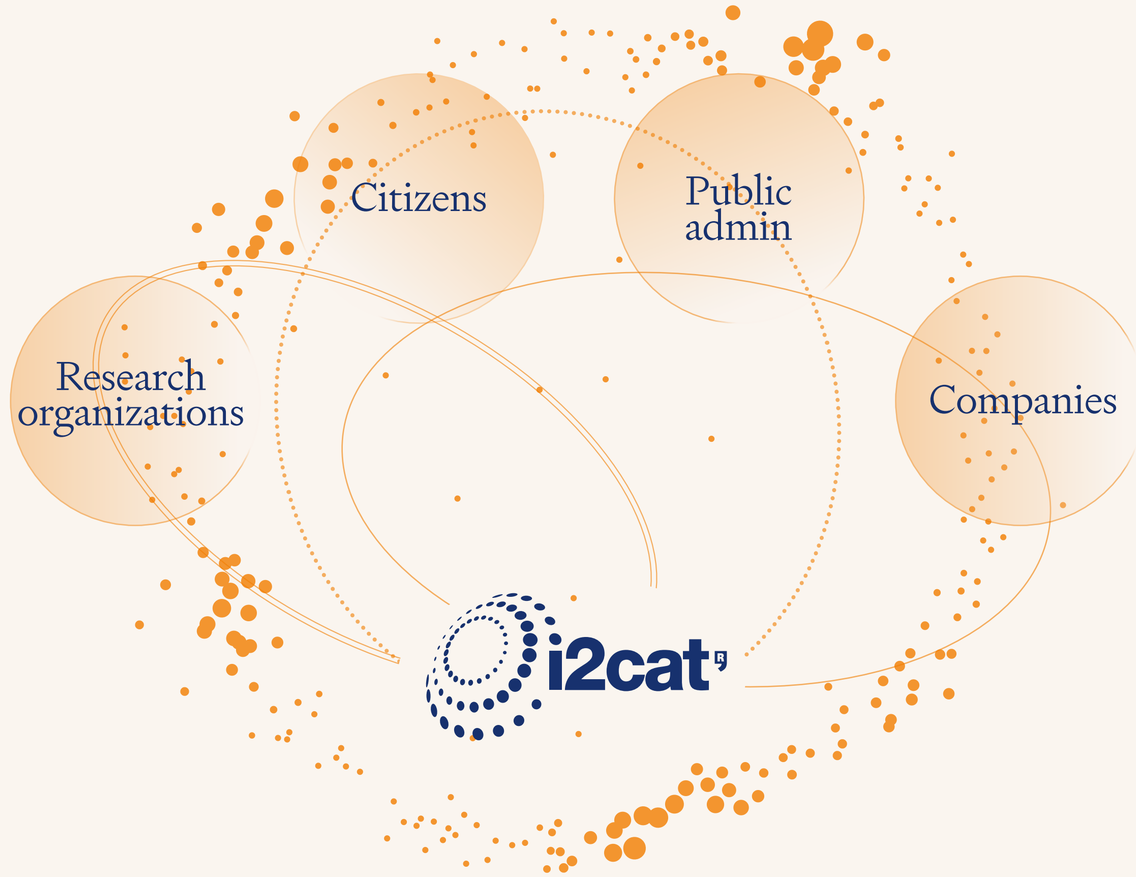
About us

Strategic goals

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.

- Generate excellent and significant knowledge in advanced digital technologies
- Become a benchmark organization in digital innovation for public administrations
- Foster the collaboration with companies to co-create and co-develop innovative digital solutions to meet market and society needs
- 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



Local partners

Research and universities

- UAB Universitat Autònoma de Barcelona
- ICREA
- UOC Universitat Oberta de Catalunya
- IEEC Institut d'Estudis Espacials de Catalunya
- Universitat Rovira i Virgili
- Universitat Ramon Llull
- CIMNE International Centre for Numerical Methods in Engineering
- ICFO
- Universitat de Girona
- upf. Universitat Pompeu Fabra Barcelona
- eurecat Centre Tecnològic de Catalunya
- CVC Centre de Visió per Computador
- UPC Universitat Politècnica de Catalunya BarcelonaTech
- CTTC
- BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación

Citizenship

- Espai Maker
- Enginy era
- CENFIM Furnishings Cluster
- punt Tic
- VallsGenera Institut Municipal de Desenvolupament Local
- neàpolis Technologically Mediterranean
- ticanoia
- AENTEG Associació d'Empreses de Noves Tecnologies de Girona
- COEbreLAB espai d'innovació social, digital i col·laborativa
- disseny=igualada

Administration and public organizations

- Ajuntament de Barcelona
- Diputació Barcelona
- Generalitat de Catalunya Agència de Ciberseguretat de Catalunya
- Ajuntament de Girona
- Generalitat de Catalunya Centre de Telecomunicacions i Tecnologies de la Informació
- Ajuntament d'Igualada
- Ajuntament de Tarragona
- Generalitat de Catalunya Departament de la Vicepresidència i de Polítiques Digitals i Territori
- Port de Barcelona
- Generalitat de Catalunya Departament de Recerca i Universitats
- AMB
- Generalitat de Catalunya Departament d'Interior
- ZF Consorci barcelona Zona Franca
- Generalitat de Catalunya Departament d'Educació
- Mobile World Capital Barcelona
- Ajuntament de Vilanova i la Geltrú
- fundació .cat

Catalan companies

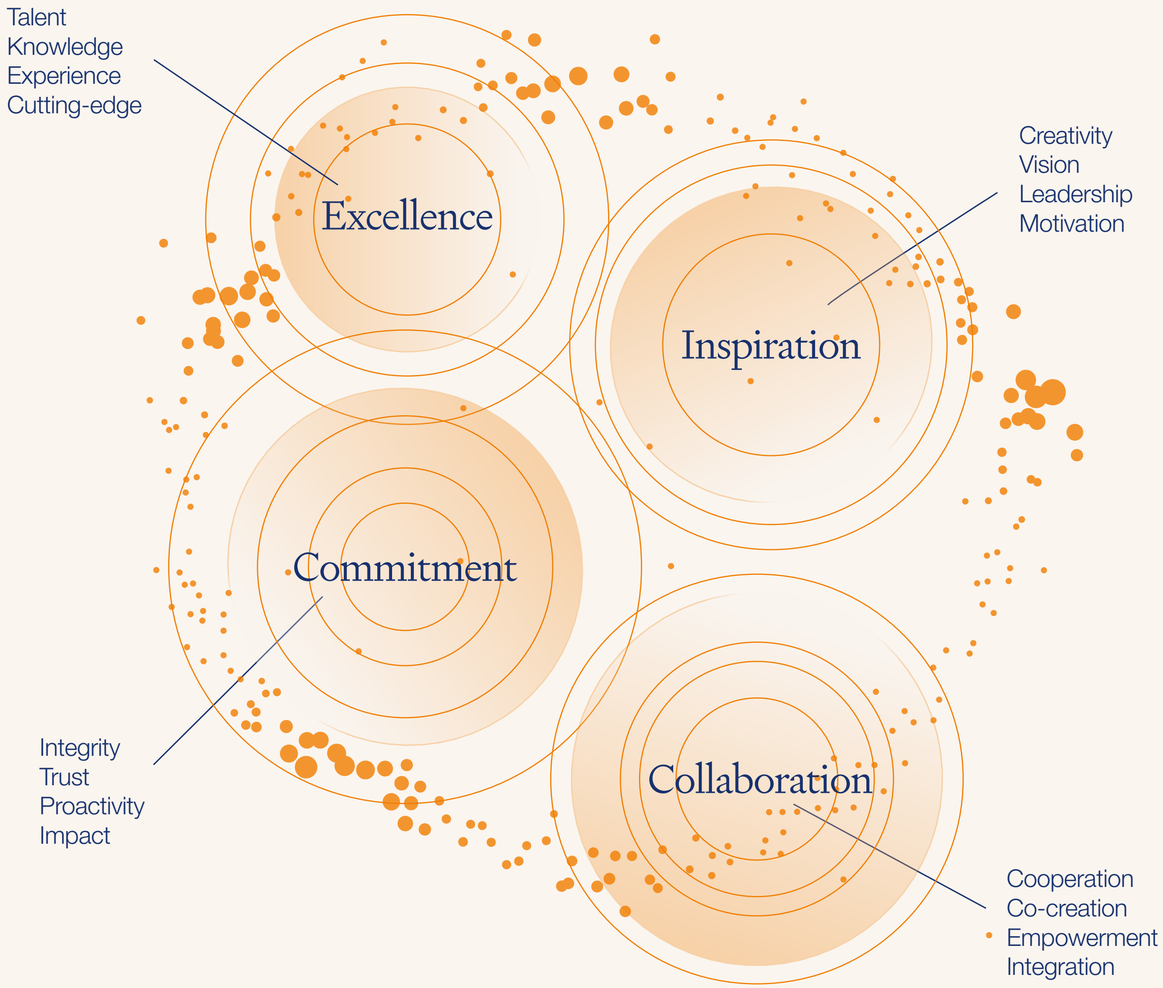
- ALSTOM
- NEC
- SALTO Group intelligent technology
- neutroon
- bequant
- parlem telecom
- keonn
- simon
- SATELIOT
- Unblur

Vision and mission

To design this digital society of the future, the i2CAT Foundation will boost excellent research, **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. The center's activity aims to:

- 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 **research excellence and mission-driven projects** 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



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Vice-President I Rector of the Universitat Politècnica de Catalunya (UPC)

Mr. David Ferrer i Canosa
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Mr. Daniel Marco Pàrraga
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Mr. Joan Gómez Pallarès
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Mr. Lluís Rovira Pato
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Regional Director for Catalunya, Comunitat Valenciana, Illes Balears, Aragón and Región de Murcia at Telefónica

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Founder, President and Chief Executive Officer, Parlem Telecomunicacions, S.A

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Innovation Manager at Media Pro

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

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General Manager at Cisco Systems in Catalonia

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Technical Manager at CCMA

Mr. Óscar Pallarols Brossa
Director of Strategy for Product and Innovation at Cellnex Telecom

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Regional Manager at Juniper Networks

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

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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

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Innovation Manager at Media Pro

Mrs. María José Figueras
Rector at Universitat Rovira i Virgili

Mr. Julián Vinué Biarnés
Digital Innovation Manager and Institutional Relations at Telefónica

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High Performance Networks Faculty of Engineering, University of Bristol

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

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

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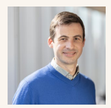

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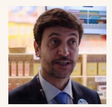

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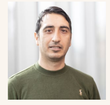

Hossein Rouzegar, PhD

Elena Fernández

Arnau Singla

i2CAT Staff as of May 31st 2022

Member of

Institució CERCA
Centres de Recerca de Catalunya

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CDTI

Associations, Standardization Organizations & Platforms

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ESSI European School of Social Innovation

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i2cat

www.i2CAT.net

fundacio@i2cat.net

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