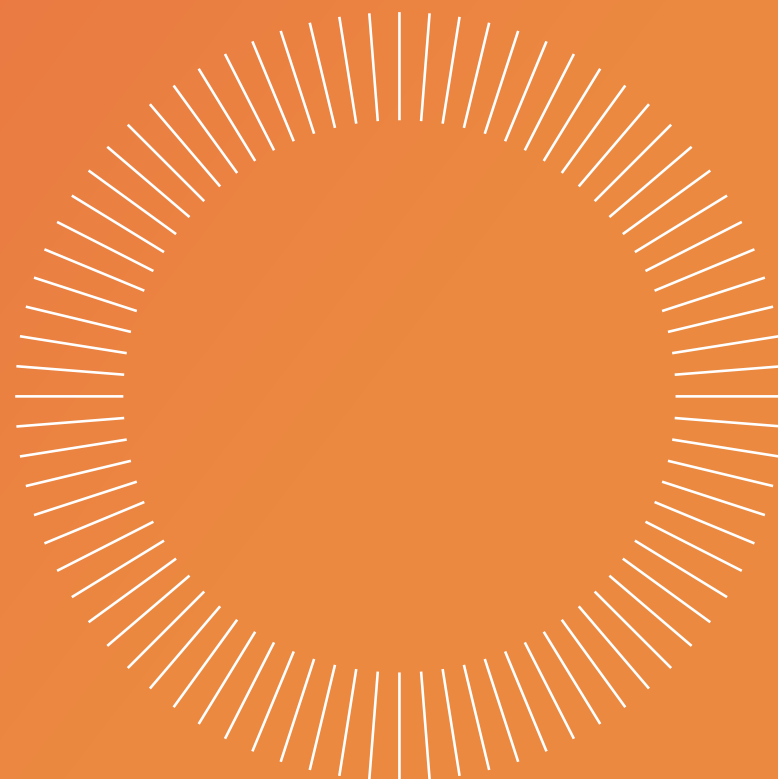




The Internet Research Center

# ANNUAL REPORT 2022



# ANNUAL REPORT 2022

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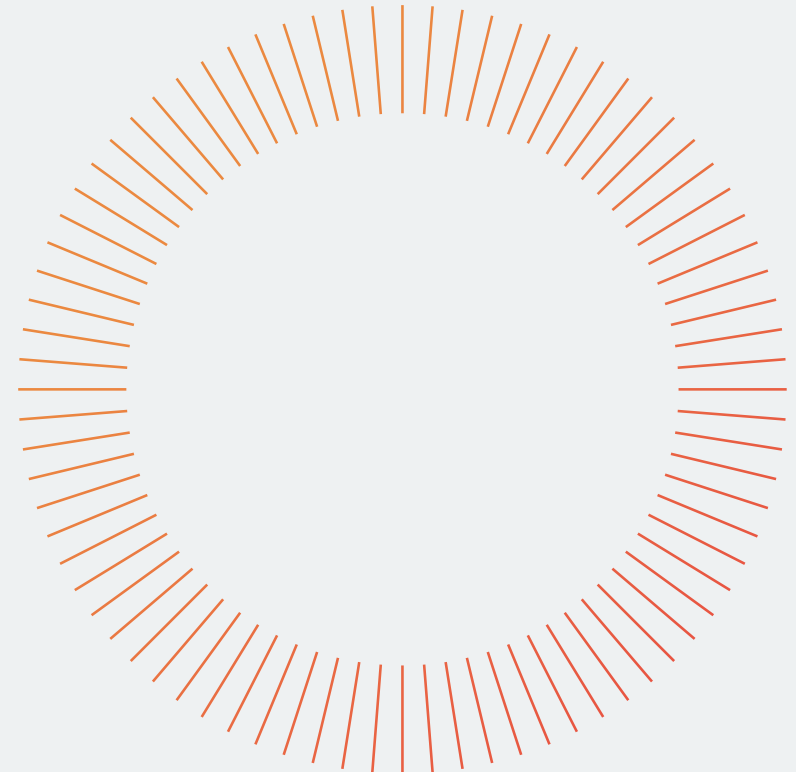
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# LETTER FROM THE PRESIDENT

Innovation and digital transformation have an enormous challenge: to leave no one behind



**Laura Vilagrà Pons,**  
President, Minister  
of Presidency of  
the Government of Catalonia

2022 was a year of changes, challenges and discoveries. In January 2023, I was named the president of the i2CAT Foundation. Becoming the first-ever female president of the centre's Board of Trustees is an honour and a reminder that technology is here to help our society become more inclusive. It needs to cover and work for everyone, whichever their gender, origin, income or residence.

i2CAT has been at the forefront of innovation in Catalonia for almost 20 years. Led by a team that continually strives to reach new heights, the centre has underpinned a reference position in the European research and innovation arena in recent years. This leadership was reinforced by the latest Horizon Europe results: 17 projects and nearly €7M in less than two years. The organisation remains the third institution in Catalonia that has obtained more European funds within the Information and Communication Technologies branch.

Generating knowledge, advancing new technologies, and exploring what is still inconceivable to most is what i2CAT does. Its internationally recognised position in 5G/6G was given another boost in 2022 through the UNICO R&D programme, by which i2CAT has started to develop 19 research projects in advanced 5G and 6G for an aggregate value of nearly €17M. These projects, lasting until the end of 2024, will

facilitate access to ultra-fast broadband in Spain and accelerate the deployment of 5G. The centre's research capacity was also recognised in Artificial Intelligence and Space Communications, which, together with 5G/6G, have obtained SGR grants from AGAUR.

The i2CAT Foundation not only holds a leading position in international research but also contributes inestimably to the digital strategies and policies of the Catalan administration. In recent years, it has played a crucial role in promoting initiatives aligned with the 5G, Artificial Intelligence and NewSpace strategies of the Government of Catalonia. The centre's participation in digital and innovation activities is paramount to empower the administration's digital transformation and solve social challenges in the territory. In the European 2030 Digital Compass strategy framework, i2CAT must play a key role in fostering new initiatives with the Government of Catalonia aligned with the vision of a successful digital transformation based on the empowerment of citizens and technological leadership, resulting in a more resilient and prosperous society.

Collaborating with the private sector is also a priority in establishing a genuinely digital society that leverages the power of advanced digital technologies to sustain economic growth. To this end, i2CAT establishes agreements with private

companies to co-create and co-develop innovative digital solutions that generate economic and social impact. Last year, 20 private organisations partnered with i2CAT and started their road to innovation.

All these milestones were only possible thanks to the commitment of the talented professionals that make i2CAT. The team has been growing exponentially since 2015, reaching 200 staff in 2022 and almost tripling the number of people who were part of the team in 2019.

The digital society of the future is already here, but we still need to work towards making innovation work for everyone and leaving no one behind. For this reason, the value offered by i2CAT and its contribution to advancing the digital transformation of Catalonia is invaluable.

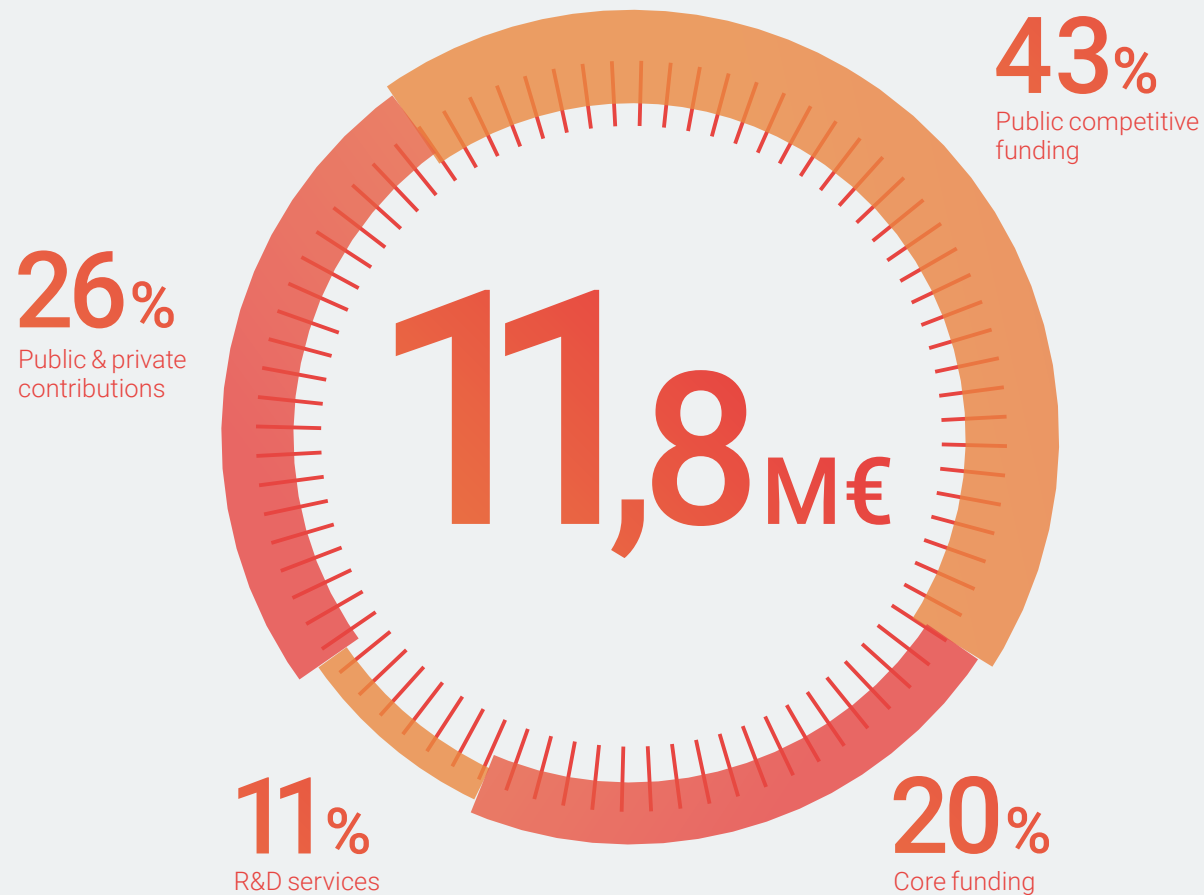
I would like to congratulate the i2CAT team on the excellent results of 2022 and invite them to continue fortifying our research and innovation ecosystem.

# FACTS & FIGURES

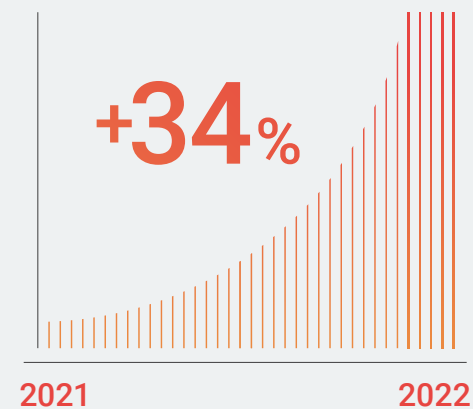


# FACTS & FIGURES

## Funding



Growth rate



New projects  
and contracts

**158** Project  
proposals  
submitted

**38** New  
competitive  
projects

**20** New contracts  
with companies  
/ organisations

# Horizon Europe results



Total success rate:



2022 funding:

# 6,8M€

**17** new projects  
granted under the Horizon  
Europe funding programme

COORDINATOR:



TECHNICAL LEADER:



**10** projects:  
Pillar II - Global challenges & European  
Industrial Competitiveness.

**1** project:  
Pillar III - Innovative Europe

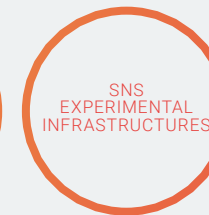
**6** projects:  
**6G SNS** (Smart Networks and Services Joint Undertaking)



**Stream A**  
(2 PROJECTS)



**Stream B**  
(1 PROJECT)



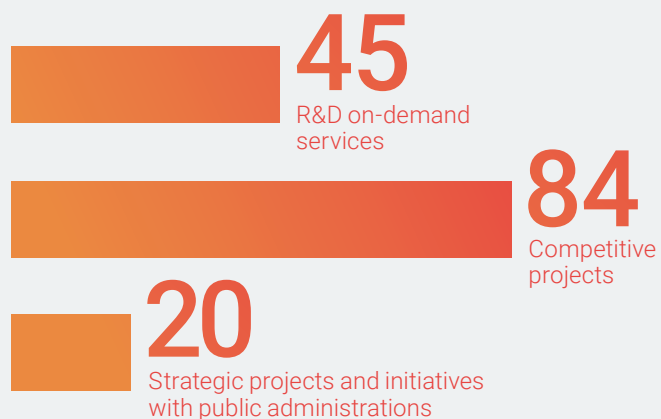
**Stream C**  
(2 PROJECTS)



**Stream D**  
(1 PROJECT)

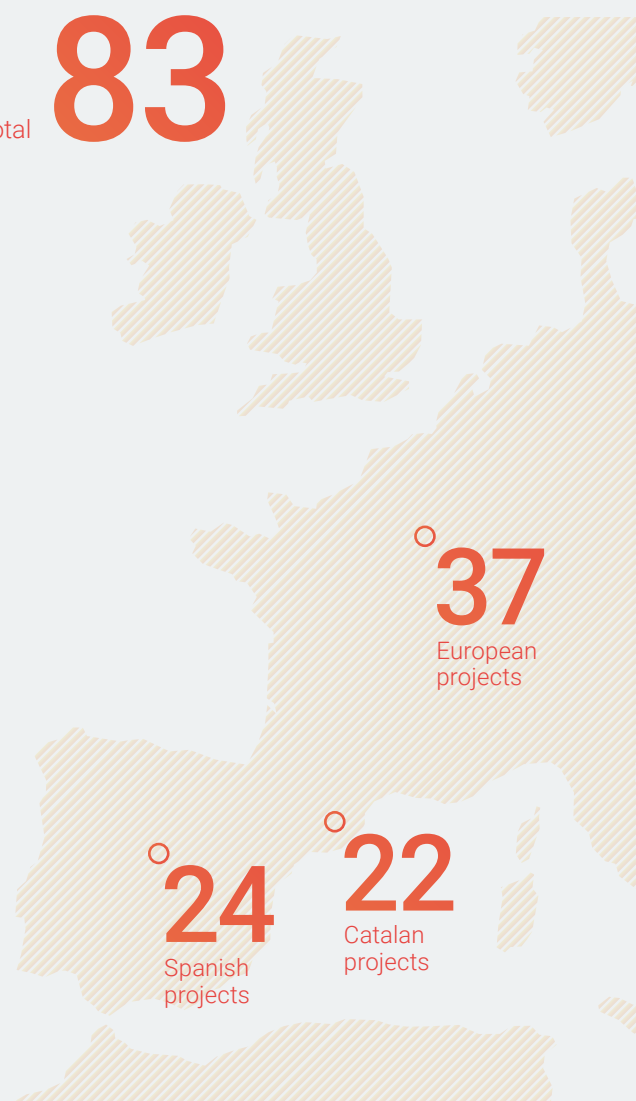
## R&D projects in execution

Total **149**



## Competitive projects in execution

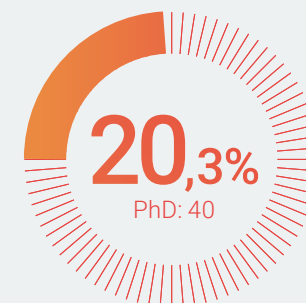
Total **83**



## Staff

Total **200**

**23**  
Nationalities




**39,86%**  
Staff growth rate





# IMPACT-ORIENTED RESEARCH AND INNOVATION ACTIVITIES

The background of the page is a stylized, top-down illustration of a city street intersection. The entire image is overlaid with a semi-transparent orange/red filter. In the center of the intersection, a car is positioned, with several concentric circles radiating outwards from it, suggesting a signal or a field of influence. The street is marked with white lines, and there are several other cars parked or moving along the roads. Pedestrians are also visible on the sidewalks. The overall aesthetic is modern and technological, fitting the theme of research and innovation.



# IMPACT-ORIENTED RESEARCH AND INNOVATION ACTIVITIES

## Smart Services & Networks 6G/5G/IoT/Space Comms

### Technological research



### Applied innovation



## Cybersecurity & Blockchain

### Technological research



### Applied innovation



## Digital Innovation Strategies and Policies



## Private-Public Partnerships (PPP)



## Tech Transfer & Private collaborations



## Private-Public Partnerships (PPP)



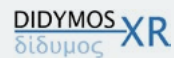
## Tech Transfer & Private collaborations



## Digital Transformation

## Immersive and Media Technologies

### Technological research



### Applied innovation

Smart Environment



Creative Industries



Holomit 2.0

## Artificial Intelligence

### Technological research



### Applied innovation

Smart Environment



Industry 4.0



Autonomous and Connected Mobility



## Digital Social Technologies

### Technological research



Knowledge & Excellence

Digital Innovation Strategies and Policies



Pla de Xoc Contra la Bretxa Digital

Generalitat de Catalunya  
Departament d'Empresa i Treball  
Secretaria de Polítiques Digitals



Digital Transformation

### Private-Public Partnerships (PPP)



### Tech Transfer & Private collaborations



### Private-Public Partnerships (PPP)



### Tech Transfer & Private collaborations



# CORPORATE HIGHLIGHTS

In 2022, the i2CAT team achieved impressive research results, continued supporting public digital innovation policies and strategies to bring about the digital society of the future, presented cutting-edge assets and participated in pilots that offer a glimpse into what technology will become in the following years.

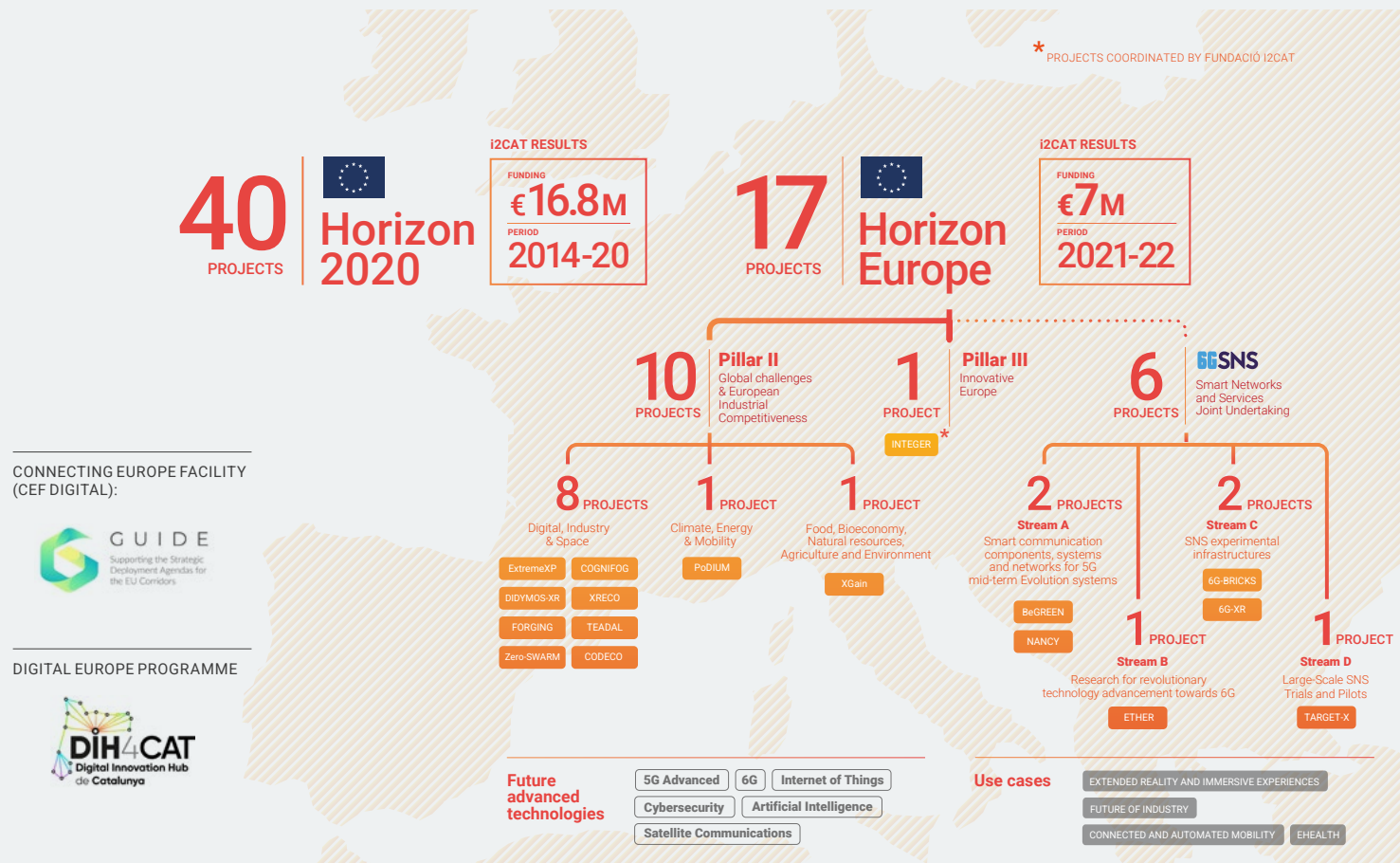
# CORPORATE HIGHLIGHTS

## Research activities

European research projects are at the core of i2CAT's activity. i2CAT has been the **third-top Catalan institution** in terms of funding return in Horizon 2020 (2014-2020), with 40 projects in total, and has already obtained 17 **Horizon Europe** (2021-2027) projects. Out of those 17 projects, six are part of the first call of the **6G Smart Networks and Services (SNS) Joint Undertaking**, the R&D European programme directed at designing and facilitating advanced 5G and 6G technologies for the next generation of mobile networks.

These numbers are a confirmation of the centre's strength in the EU research arena and a boost to continue contributing to the advance of emerging digital technologies.

### EU Research and innovation funding programmes [MORE](#)



## CARMEL project results

In 2022, the H2020 CARMEL project ended and presented its main results, opening a promising scenario in innovative anti-hacking solutions for the future of connected and automated cars. The project results were compiled in the book **"Artificial Intelligence-based Cybersecurity for Connected and Automated Vehicles"**, published by Now Publishers Inc. It can be [consulted online in an open format](#).



[MORE](#)

## 5G Clarity tested 5G private network architecture at Bosch production plant

In March 2022, researchers from the Mobile Wireless Internet (MWI) area of the i2CAT Foundation successfully deployed and tested a new type of 5G private network architecture at the Bosch company's production plant in Aranjuez (Madrid). The demonstration proved the advantages of combining **5G, WiFi6 and LiFi connectivity systems** in a real manufacturing environment.



[MORE](#)

[VIDEO](#)

## 5G/6G research and outcomes

### UNICO I+D 6G Programme

i2CAT's expertise in **5G**, **advanced 5G** and the **emerging 6G** was recognised by the Ministry of Economic Affairs and Digital Transformation of the Government of Spain and the European Union – NextGeneration EU through the granting of **19 research projects** for a total amount of more than **16M€** in the framework of the UNICO I+D 6G programme. UNICO aims at generating the knowledge needed to facilitate **access to ultra-fast broadband in Spain** and accelerate the deployment of 5G.

The 19 projects, which started in January 2022, are grouped into **six coordinated projects** plus an action to support the promotion of Telecommunications Engineering studies. i2CAT leads all projects, executing 30% of the budget and subcontracting the remaining 70% to large companies, SMEs and research organisations through public procurement procedures.

During 2022, the research centre has been focused on reaching important **collaboration agreements** in the **call for tenders** phase, and 2023 will mark the start of the execution of the different research projects.

**19** research projects

**1** promotion of Telecom studies plan

**+16M€**



[MORE](#) ↘

### ECO6G

i2CAT organised and hosted **ECO6G** in February 2022, an event that gathered key **5G and 6G** stakeholders to discuss 6G from a European perspective. As one of the main actors in the research and development of 5G networks, i2CAT is determined to shape the road to 6G and is already working on the future of connectivity through initiatives like the **6G White Paper**, which presents the centre's research perspective.



**+30** international speakers

**250** publications on social media

**600.000** people reach

**1K** interactions on social media

[MORE](#) ↘

## NewSpace activities

### Enxaneta: a year in orbit

The first Catalan nanosatellite, Enxaneta, provided its first results in 2022 after a year in orbit. It enabled a use case to offer **coverage assistance and sensor monitoring** for high-altitude vineyards in Tremp. The i2CAT Foundation designed the satellite device used to receive sensor data.

[MORE](#) ↘



## Institutional updates



**Mrs Laura Vilagrà Pons**, Minister of the Presidency at the Government of Catalonia, entered the i2CAT Foundation's Board of Trustees as its new president.

The Board also incorporated:



**Mrs Núria Cuenca León**  
Secretary General of the Presidency, Government of Catalonia.



**Mr Albert Castellanos Maduell**  
CEO, ACCIÓ.



**Mr Sergi Marcén López**  
Secretary for Telecommunications and Digital Transformation, Government of Catalonia.



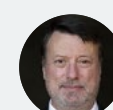
**Mrs Gina Tost i Faus**  
Secretary for Digital Policies, Government of Catalonia.



**Mr Tomàs Roy Català**  
general manager, Agència de Ciberseguretat de Catalunya.



**Mr Josep Pallarès Marzal**  
rector, Universitat Rovira i Virgili.



**Mr Jordi Teixidó Closa**  
vice rector, Universitat Ramon Llull.



# Digital Innovation Policies & Strategies

## 1st-anniversary Digital Catalonia Alliance

2022 marked one year of activity for the DCA, which exceeded **455 members** on its first anniversary. The initiative also incorporated the **DCA-Blockchain** in collaboration with the Centre Blockchain de Catalunya (CBCat). Other milestones include:

**36** business opportunities were identified in matchmaking events

**131** solutions presented

**42** challenges solved



[MORE](#)

## Àrees 5G covered the whole Catalan territory

The Àrees 5G project continues promoting 5G throughout the region through training and dissemination activities, workshops, concept trials, and laboratories. In 2022, it unveiled the new **5G Area of Aran**, thus covering the whole Catalan territory. It will boost sustainable mobility, improve services in the territory, and promote the local economy and technological training.

[MORE](#)

Àrees 5G

**9** 5G Areas covering the whole Catalan territory

**11** trainings and workshops

**5** pilot tests



## Partnership with Agència de Ciberseguretat de Catalunya: Cybersecurity Innovation Office (OIC)

In 2022, the i2CAT Foundation reinforced its partnership with the Agència de Ciberseguretat de Catalunya (ACC) to continue adopting innovative solutions and cybersecurity technologies, attracting funding, promoting the Catalan cybersecurity ecosystem and developing cutting-edge pilots.

[MORE](#)



## Creation of DIH4CAT

The DIH4CAT project kickstarted its activities in May 2022, becoming one of Europe's first European Digital Innovation Hubs (EDIH). It has established instruments to contribute to SMEs' and startups' digitalisation, such as public funding calls and +40 training and networking activities. i2CAT, in cooperation with Mobile World Capital Barcelona and UPC, is in charge of the **Smart Connectivity node**, allowing businesses to carry out viability studies, testing, validation, prototyping, and training on cybersecurity and technologies like 5G, IoT, and holopresence, as well as access to several tech laboratories in Catalonia.

[MORE](#)



# Digital transformation

## Innovative assets: ImmAcc Player v2 and Sync-X

i2CAT strives to make research outcomes contribute to the local and European ecosystems. In 2022, two of the most advanced assets generated from research projects were the **ImmAcc Player v2**, a web player enabling VR360 video and spatial audio consumption with an interactive and hyper-personalised presentation of access service content, and **Sync-X**, a set of software components and potentially cloud server resources that associates distributed media players and provides a group-based synchronised consumption experience.

The Media Internet team has developed both and they are prepared to integrate into third-party systems.

[MORE](#)

## 5G Catalunya: Augmented reality shopping at the Boqueria Market

The partners of the 5G Catalunya project demonstrated a novel experience of virtual shopping through augmented reality that enables clients who cannot shop in person to do so remotely preserving the experience. i2CAT designed and developed the **Augmented Reality Personal Shopper** application, which runs over a private 5G network based on edge computing servers.

The Media Internet team has developed both and they are prepared to integrate into third-party systems.

[VIDEO](#)

## CIDAI: Traffic risks and flows detection and improvement thanks to AI and Big Data

Within an initiative of the CIDAI, the i2CAT Foundation led the development of a system to detect traffic risks and flows on urban and interurban roads based on AI and big data to proactively prevent traffic accidents by identifying risk situations and analysing traffic flows to detect anomalous behaviour and reduce traffic jams. After live testing in the C31 road and urban intersections in Barcelona, the system demonstrated a **success rate of over 83%**.

[MORE](#)

[VIDEO](#)



# Organisation chart

## Board of Trustees



Laura Vilagrà

## Executive Committee



Lluís Rovira

## International Scientific Advisory Board



Professor PhD Dimitra Simeonidou



Inder Monga

## Management Team



Josép Paradells



Artur Serra



Joan Manel Martín



Sergi Figuerola

## RISE

Research and Innovation Policy and Strategy in Europe

### 6G Program



Jesús Alonso Zarate

## 6G, 5G & IoT

Smart Networks & Services

### AI Driven Systems



Xavier Costa

### Mobile Wireless Internet



Daniel Camps

### Software Networks



Shuaib Sidiqqi

### Internet of Things



Marisa Catalán

### Distributed Artificial Intelligence



Josép Escrig

### Media Internet



Sergi Fernández

### Digital Social Technologies



Artur Serra

### Cybersecurity & DLT-Blockchain



Shuaib Sidiqqi



Jordi Guíjarro

### Space Communications



J.A. Ruiz



Pol Guixé

## Knowledge & Technology Marketing



Miguel Ángel Pérez

## Innovation Business Development



Rosa Paradell



Ana Moliner

## Operations and Digital Infrastructure & Service



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

2022 took i2CAT around the world to learn, connect, demonstrate and explore the future of technology. The team took part in more than 100 events, from technological fairs to territorial activities and co-innovation processes with citizens and private companies. All of them sparked innovation and ideas that will help build the future.



# EVENTS, FAIRS AND CONGRESSES

This year, i2CAT organised and participated in more than a hundred events. In-person interaction and networking opportunities returned in full during 2022, and i2CAT was there to share its knowledge and demonstrate the unique advantages of advanced and emerging technologies. Opening research and digital innovation to citizens and territories were also essential to the 2022 activities, generating innovative ideas through workshops and community sessions.

The centre also gained international recognition by hosting the first edition of **ECO6G**, an event born to become a global reference point for 6G discussions. i2CAT gathered distinguished and knowledgeable policymakers, program leaders, industry representatives, users, and critical academic players to explore what 6G will become.

**+100** Events

**15** International fairs & congresses

**25** Workshops & training sessions

**ECO6G**

**BNEW** 3-6  
THE BARCELONA NEW ECONOMY WEEK  
2022

**IOT SOLUTIONS**  
WORLD CONGRESS

**SMARTCITY**  
EXPO WORLD CONGRESS

**BIG DATA & AI**  
CONGRESS  
BARCELONA

**EUCNC** 2021  
European Conference on Networks and Communications  
10-11 June 2021

**GSMA MWC**  
Barcelona

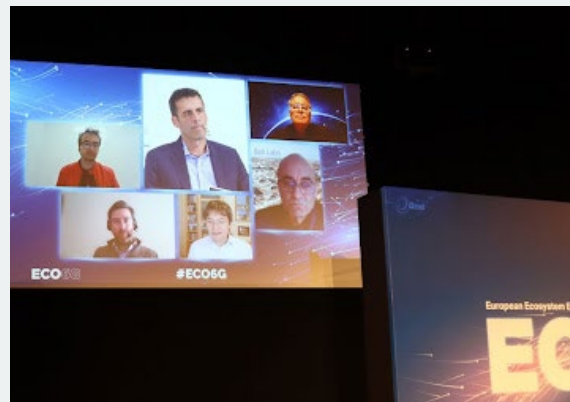
**MOBILE WORLD CAPITAL**  
BARCELONA

## ECO6G

The communications industry has set the ambitious goal to deliver 6G networks by 2030. 6G is expected to be a fundamental enabling technology that will help realise the **United Nations Sustainable Development Goals** and the twin green and digital transition envisioned by the European Commission. As a research and innovation technology centre focused on digital technologies, i2CAT is determined to contribute to **building 6G**. To further explore what 6G will become, the i2CAT Foundation organised the first edition of ECO6G, an event addressed to the European Ecosystem on 6G.

The event was divided into six sessions:

- European Vision, focusing on the European SNS Joint Undertaking
- European Initiatives
- 6G: What users need
- 6G Community: a researcher's perspective
- The operator's perspective on 6G
- The provider's perspective on 6G



▶ **22.676**  
reproductions  
on the online platform

👤 **600.000**  
people  
reach

📱 **250**  
publications  
on social media

💬 **+30**  
international  
speakers

❤️ **1k**  
interactions  
on social media



## MWC 2022

The 2022 edition of the Mobile World Congress meant returning to the presential version of this unmissable event. i2CAT presented a prototype of the nanosatellite **Enxaneta** and demonstrated **HoloMIT**, a Holoportation prototype for a real-time metaverse. It also announced the creation of a private 5G network at the technical centre of **Applus+ IDIADA** to test connected mobility.

i2CAT, together with the Institut d'Estudis Espacials de Catalunya (IEEC) and the Institut Cartogràfic i Geològic de Catalunya (ICGC), was part

of the Government of Catalonia's **New Space strategy** booth, demonstrating the growth of this emerging, innovative sector, its opportunities for competitiveness and novel use cases that were not feasible before.

During the congress, i2CAT achieved 18 digital and printed media impacts. More than 2.000 people visited the event landing page and social media posts.



## Demo CARMEL IoTSWC 2022

The H2020 project CARMEL, coordinated by i2CAT's Cybersecurity area, showcased artificial intelligence-based cybersecurity solutions for the European Cooperative, Connected, and Automated Mobility (CCAM) industry at the **Testbed Area of the IoTSWC22**. Visitors could better understand CARMEL solutions by participating in the daily guided tours.

The project developed cybersecurity solutions for the new generation of cars (autonomous cars,

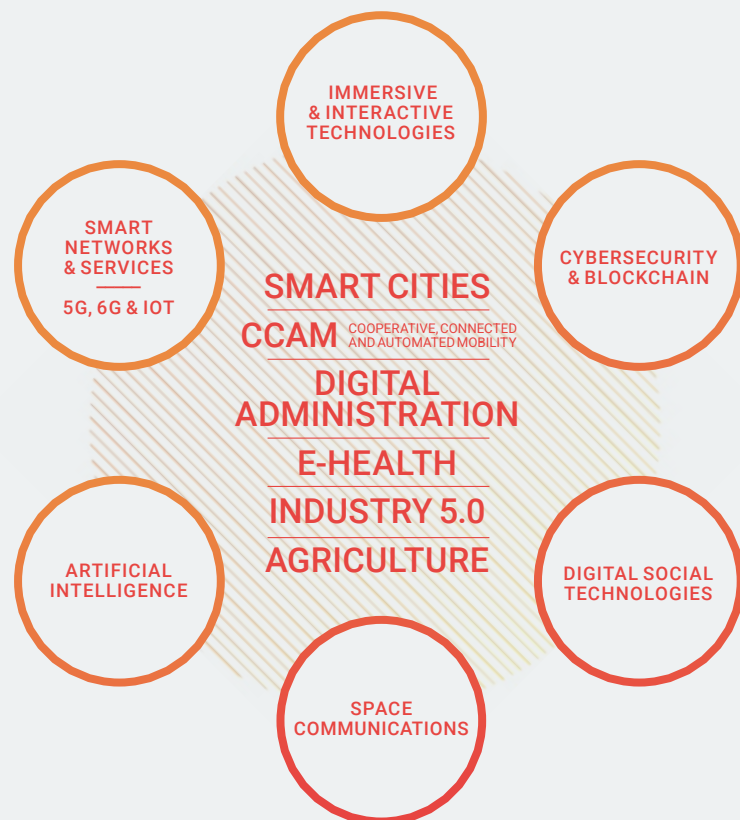
5G-connected vehicles, electromobility and remote-controlled vehicles). The project's results mitigated cybersecurity-originated road safety risks by applying a proactive method based on AI and machine learning techniques, introducing innovative anti-hacking intrusion detection/prevention systems for the European automotive industry.

# KNOWLEDGE AND EXCELLENCE

As a mission-driven research and innovation centre, i2CAT stands for technological sovereignty and wants to strengthen the European research arena. In 2022, the different centre's research areas reinforced their R&D activities. They carried out work that allowed fundamental advances and direct applications in crucial areas envisioned by the European Commission to complete the double green and digital transition, such as Smart Cities, Cooperative Connected and Automated Mobility (CCAM), Digital Administration, E-Health, Industry 4.0 and agriculture.



# KNOWLEDGE & EXCELLENCE



## SOME OF OUR PARTNERS:



## Research areas roadmap

As a mission-driven research and innovation centre, i2CAT stands for **technological sovereignty** and wants to strengthen the **European research arena**. To this end, during 2022, the different centre's research areas reinforced their R&D activities in 5G/6G, IoT, immersive and interactive technologies, cybersecurity, blockchain, artificial intelligence, space communications and digital social technologies.

### 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 & IoT

- 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
- Deep Reinforcement Learning for Swarm Systems
- Audio classification with Deep Learning methods from cloud to Tiny ML
- Multi-detection and multi-tracking of objects with multi-modal Computer Vision
- Deep Learning for calibration, compression, recognition and generation 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 & Blockchain

- Cyber Security as a Service
- Risk Assessment and management
- Privacy Enhancing Technologies (PET)
- Data Security and Privacy.
- Identity Management. Self-Sovereign Identity (SSI)
- Zero Knowledge Technologies & Verifiable Computation
- Web 3.0: Decentralized services, governance systems and new economic models
- Decentralised solutions and service automation for 5G and 6G network management and orchestration.
- Data availability & Decentralized storage
- Data sharing and monetisation while preserving privacy and control.

### Media Internet Technologies

- Real-time multi-user holoportation
- Immersive video
- Volumetric video
- Scalable communications
- Point Cloud Compression
- Stream Synchronization
- Multi-camera 3D reconstruction
- Supersampling and denoising
- Quality of Experience
- Adaptive and low-latency streaming

### Space Communications

- Sateliot-i2CAT development of Next-Generation Narrowband Internet of Things (NTN NB-IoT) to ensure strict adherence to 3GPP standards.
- Development software virtualisation in space.
- Creation of advanced constellation simulation, management, and orchestration tools.
- Transcelestial-i2CAT implementation of intersatellite communication protocols, which will enable the deployment of satellite networks.

### Digital Social Technologies

- Social technologies and regional development
- Regional and local innovation ecosystems design
- 4H Collaboratories, living labs & community building
- Social and digital innovation
- Co-creation, co-design and validation of socio-technical products and services (Usability, UXR)
- Adoption of new technologies, lifestyles & cultural values
- Impact of social and digital technologies & qualitative studies
- Technoanthropology
- Design, implementation and evaluation of innovation policies and strategies

# EU funding programmes for research and innovation

i2CAT has a leading role in numerous European research projects that set the way in cutting-edge technologies such as **5G** and **6G, VR, Internet of Things, Artificial Intelligence, Cybersecurity, Blockchain** and **Space Communications**. The centre has achieved great success within the Horizon 2020 and the Horizon Europe funding programmes and has become a benchmark at a European level in mission-oriented R&D activities in advanced digital technologies.

## Horizon Europe projects

i2CAT has obtained **19 projects** under the first call of the Horizon Europe programme, the EU's key funding programme for research and innovation, with total funding of more than **7M€**. The centre has gained ten projects linked to three of the six clusters into which Pillar II – Horizon Europe (Global Challenges & European Industrial Competitiveness) is divided:

- Digital, Industry & Space (8)
- Climate, Energy & Mobility (1)
- Food, Bioeconomy, Natural resources, Agriculture and Environment (1)

Another project is linked to Pillar III – Horizon Europe, “Innovative Europe”, to stimulate market-creating breakthroughs and ecosystems conducive to innovation.

The remaining six projects are part of the **Smart Network and Services (SNS) Partnership**, which aims to foster European technological leadership in digital and future enabling technologies based on **5G Advanced** and **6G**. i2CAT has active participation in the four streams of the SNS, ensuring contributions to the design of 5G Advanced (Stream A), the execution of large-scale demonstrations of 5G for verticals (Stream D), as well as the design of 6G (Stream B) and the future experimental platforms for the next generation (Stream C).

These excellent results will ensure that i2CAT keeps on contributing to the design, development, and testing of future digital technologies, including 5G, 6G, the Internet of Things, Cybersecurity, Satellite Communications, and Artificial Intelligence, all of them at the service of enabling **disruptive use cases**, such as those based on VR and immersive experiences, Connected and Automated Mobility, Industry 4.0, eHealth, and many more.



**BeGREEN** will take a holistic view to provide evolving radio networks that accommodate increasing traffic and service levels and consider power consumption as a factor. Determining the metrics by which power consumption should be included is a key feature of the project. An obvious first stage will be to consider the energy cost. Societal factors linked to the necessary reduction in global emissions will also be considered.



**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 mediator-less federation of them, based on a shared approach for defining, enforcing, and tracking privacy/confidentiality requirements balanced with the need for energy reduction.



i2CAT participates as the technical coordinator of XReco, a research project launched in September 2022 oriented at empowering the media sector in Europe and other members of the tourism and mobility industries through innovative solutions based on emerging technologies (AI, blockchain, Virtual Reality). XReco will create a new data-driven ecosystem for the media industry, facilitating data sharing, search, discovery, and supporting news and entertainment content creation. The focus will be on creating and (re-)use of location-related 2D and 3D assets and developing XR experiences.



**6G-XR** aims to strengthen European leadership in 6G technologies by enabling next-generation eXtended Reality (XR) services and infrastructures that will provide beyond state-of-the-art capabilities towards the 6G era. For that purpose, the project will develop an experimental multisite Research Infrastructure (RI) to provide a validation platform for various 6G use cases by developing enablers for networking and computing, radio access technologies beyond 5G, enablers for XR services with the in-build federation, trial management, abstraction tools as well as energy measurement frameworks.



**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. The overall project objective is to deliver a Knowledge Facilitation Tool, facilitating business model development and supporting decision-making in the selection of an ecosystem of technologies that consist of connectivity options and edge processing solutions. By following a multi-actor and practitioner oriented approach and by coherently assessing their socio-economic and techno-environmental effects, XGain aims at: increasing systemic resilience and energy efficiency; contributing to climate mitigation; and reducing the digital divides between different types of citizens, farms, sectors and regions.



**Zero-SWARM** is a mission to achieve climate neutral and digitised production via a multidisciplinary, human centric, objective oriented innovative approach resulting in technical solutions for open swarm framework, non-public 5G network, active information continuum and digital twin. 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. It will showcase key achievements such as smart assembly, sustainable powertrains, 5G powered PLCs for real time distributed control systems, 5G enabled process aware AGVs, mobile intelligent agents for zero plastic waste, and remote quality control for zero defect resilient manufacturing, among others.

## Horizon 2020 projects

i2CAT has been the **third-top Catalan institution** regarding funding return in Horizon 2020. The programme has granted **40 projects** to i2CAT in the 2014-2020 period, rising to almost **17 M€**.



In October 2022, the 5G ZORRO consortium celebrated the project's Final Event to present the latest results and outcomes on the ambitious goal stated at the initial stage: to define solutions for the 5G evolution in longer terms, having Zero-touch automation, security, and trust among multiple parties through blockchains, network slicing across ubiquitous computing and connectivity as key aspects of the investigation. During the session, the researchers involved in the project also presented some demos and the 5G ZORRO platform, instantiated in each operator domain to share heterogeneous types of resources (i.e. spectrum, virtualised radio access, virtualised edge/core, software-defined WAN, etc.) across multiple operators and infrastructure/resource providers.



5G-CLARITY aims at developing and demonstrating a beyond 5G system for private networks integrating 5G, Wi-Fi, and LiFi technologies and managed through AI-based autonomic networking. The project brings forward a system design for beyond 5G private networks that addresses spectrum flexibility challenges, delivery of critical services, and autonomic network management. 5G-CLARITY aims to be instrumental in securing the leadership of Europe in the growing markets of private 5G networks and 5G for factory automation.



DAEMON develops and implements innovative and pragmatic approaches to Network Intelligence design that enable high-performance, sustainable and extremely reliable zero-touch network systems. To this end, DAEMON relies on end-to-end coordination of Network Intelligence-assisted functionalities deployed in both control and user planes.



In 2022, the H2020 CAMEL project ended by opening a promising scenario in innovative anti-hacking solutions for the future of connected and automated cars. At the end of August, the project's consortium, integrated by 15 organisations from 8 European countries and 3 Korean partners (ETRI, KATECH and MOBIGEN), presented their main results and some simulations to the experts of the European Commission. The final review meeting marked the end of the 33-month project, which applies a proactive approach based on Artificial Intelligence and Machine Learning techniques to detect and prevent potential cybersecurity threats to autonomous and connected vehicles. The project results were compiled in the book "Artificial Intelligence-based Cybersecurity for Connected and Automated Vehicles", launched in December 2022. The book has been published by now Publishers Inc and can be consulted online in an open format.



RESPOND-A project aims to develop technologies based on 5G wireless communications, augmented and virtual reality or autonomous robots to optimise first responders' work. RESPOND-A allows first responders to test these technologies and see how efficiently they can be applied within diverse disaster scenarios. With these technological advances, first responders can better predict and assess incidents and safeguard themselves before, during and after disasters.



The EU is gearing up to integrate European road and rail transport with 5G technologies that will function seamlessly across borders, enabling connected and automated mobility (CAM). The EU-funded 5GMED project is addressing this goal along the Mediterranean core network corridor, specifically the cross-border connection between Barcelona, Spain and Perpignan, France. Scientists plan to test new technologies to deliver both cooperative connected and automated mobility (CCAM) and future railway mobile communication system (FRMCS) services. The CCAM demonstration will include remote and autonomous driving enabled by extensive sensor deployment along the roads for AI-powered traffic management. FRMCS services will include real-time analysis of high-speed trains via camera data as well as high-speed internet service to passengers. Both will integrate media services for passengers to ensure the seamless migration of functionality across borders.

## Connecting Europe Facility (CEF Digital) projects

Supporting the Strategic Deployment Agendas for the EU Corridors (GUIDE).

The **GUIDE project** will coordinate the development of the **5G Strategic Deployment Agenda (SDA)** in the field of **Connected and Automated Mobility**. It will facilitate future CEF2 projects based on the evolution of SDA. This will include the development of deployment roadmaps, cooperation models and 'best practice' approaches to regulation combining input from CEF projects with stakeholder feedback. It will also collect and share best practices from the first round of CEF2 Study and Deployment projects to achieve common approaches across projects leading to a coherent deployment of 5G corridors across the EU.



## Digital Europe projects

The **Digital Innovation Hub of Catalonia (DIH4CAT)** was launched in May 2022 as a non-profit regional innovation ecosystem coordinated with the main digitization support agents in Catalonia, to meet **industry challenges** (especially SMEs) and **public administrations**. It is constituted following the Digital Innovation Hubs model established by the European Commission. The i2CAT Foundation, in cooperation with Mobile World Capital Barcelona and UPC, is in charge of the **Smart Connectivity node**. It allows businesses to carry out viability studies, testing, validation, prototyping, and training on cybersecurity and technologies like 5G, IoT, and holopresence, as well as access to several tech laboratories in Catalonia.





# UNICO I+D 6G Programme

i2CAT has obtained **19 research** projects for a total amount of more than **16 M€** within the UNICO I+D 6G, a research programme funded by the Ministry of Economic Affairs and Digital Transformation of the Government of Spain and the European Union - NextGeneration EU within the framework of the 'Recovery, Transformation and Resilience Plan'. The main objective of UNICO I+D 6G is to facilitate access to ultra-fast broadband in Spain and accelerate the deployment of 5G.

The 19 projects, which started in January 2022, are grouped into **six coordinated projects** plus an action to support the promotion of Telecommunications Engineering studies, particularly emphasising gender equality and the international arena. i2CAT leads all projects, executing 30% of the budget and subcontracting the remaining 70% to large companies, SMEs and research organisations through public procurement procedures.

**6G ENABLERS:** The project aims to design and prototype 6G enablers based on artificial intelligence, distributed ledger technologies and cybersecurity.

**6G SatNet:** Deployment of satellite non-terrestrial networks (NTN). The project leverages constructing a 5G core compatible with non-terrestrial networks and developing new routing and access medium protocols.

**6G TWINROAD:** This project proposes using 6G technologies to create digital twins for connected and autonomous mobility (CAM). State-of-the-art technologies, such as simulation platforms, advanced HD maps with volumetric information, and artificial vision algorithms, will be used to evaluate the characteristics of the mobile network in urban and interurban mobility environments.

**Open6G:** The Open RANs for Revolutionary 6G Systems project conducts applied research on open RANs currently underway to design and develop a 6G-based open test platform for the new network and sensing applications related to intelligent surfaces.

**6GSMART:** This project aims to use 6G technology to improve cyber-physical systems for smart production. These systems are based on 5G/6G private networks, time-sensitive networks, artificial intelligence techniques and Cloud Continuum environments.

**6G-OpenVerso:** It pursues the design, implementation, evaluation and demonstration of 5G/6G testbeds that will allow scientific experimentation of the next generation of the metaverse and future extended reality services in open 6G ecosystems.

The **Plan for the Promotion of Telecommunications Studies (PPET)** is a transversal activity to all the projects of the UNICO I+D 6G programme. Its main objective is to promote vocation in Telecommunications early to boost talent, particularly in advanced 5G and 6G. The Official College of Telecommunications Engineers (COIT) coordinates the initiative, and all the entities funded within UNICO I+D 6G, including the i2CAT Foundation, contribute to it. The project contemplates six areas of action:

- Area 1: Students up to 14 years old
- Area 2: Students from 14 to 18 years old
- Area 3: Undergraduate students
- Area 4: Master's students
- Area 5: International students
- Area 6: Women's vocations in Telecommunications



## Talent in research

i2CAT is always striving for excellence to increase the centre's scientific competitiveness. In 2022 it continued to invest in research and innovation talent to maintain its scientific and technological leadership.

### Marie Skłodowska-Curie Innovative Training Networks

In 2022, two researchers joined i2CAT under the programme within the project 5GSmartFact.



### Programa Investigo

In 2022, two researchers joined the Media Internet and Space Communications areas under the programme.

i2CAT is also committed to academic training initiatives that boost young researchers' personal and professional development. In 2022, the research centre hosted three visiting researchers actively involved in several projects led by different areas. A visiting researcher from the Universidad Carlos III of Madrid participated in a research stay in the AI-Driven Systems area within the **MSCA IF programme**. An **NTT Communications Science Laboratories** (Japan) researcher conducted another research stay in the Media Internet area. Finally, i2CAT welcomed a visiting researcher from **Yeungnam University** (South Korea), who joined the Mobile Wireless Internet area.



# Research outcomes: assets and valorisation

At i2CAT, research outcomes are a means to continually contribute to research and innovation in the local and European ecosystems. In 2022, the i2CAT team developed several technology assets due to work on various projects.

## 3DSAR

3DSAR is a **single-Drone 3D cellular Search and Rescue Solution** Leveraging 5G-NR developed by the AI-Driven Systems area. Its design comprises five main building blocks to improve the localisation accuracy of state-of-the-art systems. It shows an upgrade in positioning error results for single drone solutions compared to 2D and 3D fixed trajectory approaches instead of 3D dynamic prediction trajectory solutions. 3DSAR would interest First Responders (firefighters, law enforcement, military, etc.) for Search and Rescue operations.

## ImmAcc Player v2 & Sync-X

The ImmAcc Player v2 provides a new set of presentation methods for **accessibility content adapted to 360 video** scenarios. It consists of a web player that enables VR360 video and spatial audio consumption, augmented with an interactive and hyper-personalised presentation of access service content (subtitles, audio description and sign language) via accessible user interfaces.

Sync-X consists of a set of software components and potentially cloud server resources that can associate distributed media players and provide a **group-based synchronised consumption experience**, both in the context of multi-screen setups and social viewing setups with multiple remote users.

Both have been developed by the Media Internet team and tested as research outcomes from the **ImAc**, **Immersia TV**, **ViViM** and **Respond-A** projects. These two outcomes are prepared to integrate into third-party systems and are in search of licensees.

## MOTCAM: Mobile Object Tracking with CAmeras

MOTCAM is a product prototype to **analyse events in mobility**. It includes a set of tools and algorithms needed to deploy the complete system: from the camera calibration to the visualisation and analysis of the events. It can be updated and modified based on the client's preferences to automatically detect traffic risks and flows, allowing administrations to implement proactive prevention plans to substantially reduce traffic accidents and pollution. The technology has been validated in real roads through videos from the Servei Català de Transit. It is currently being considered for exploitation within a mobility data space.

MOTCAM is the main result of the **PAI-Mobility** project within **CIDAI** and is a development of the DAI area.

## SPECTOKEN: Spectrum Trading based on NFT

i2CAT is exploring a future in which spectrum will be a resource assigned dynamically, improving or complementing spectrum assignments made by regulators. SPECTOKEN represents the **right to use a spectrum resource**. It describes the spectrum resource as a unique combination of the frequency range(s), duration (start time to end time), geographic area, and beneficiary (the entity with the right to use the spectrum). Based on Non-Fungible Tokens (NFT), a spectoken is unique, non-interchangeable and non-fractionable. The resource that a spectoken represents may be traded, but the trade will result in a new spectoken that represents the new entitlement.

This prototype application has already raised interest from regulators to widen their concept of dynamic spectrum sharing.

## V2X Reference Kit

The Vehicle-To-Everything (V2X) Reference Kit is a **software library of parameterisable V2X applications and API**. It includes the transport, network, security, management and access layers of the ETSI C-ITS protocol stack integrated into a containerised (Docker) version of Vanetza. It also provides an easy-to-use interface between the ETSI C-ITS protocol stack and the external software applications (facilities layer).

It aims to facilitate and accelerate the development and integration of software applications on vehicles, vulnerable road users (VRU), and roadside infrastructure that requires the exchange of V2X messages (compliant with ETSI standards) with other actors of the V2X ecosystem.

The Kit, a development of the MWI area, was created within the framework of different public and private projects. It has been tested in real environments and for different use cases.

# Research publications

Excellence, cooperation, openness, inspiration, and commitment are i2CAT's hallmarks. In 2022, 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 2022 the research areas produced **42 scientific contributions**. These publications included Journals, Conferences, Workshops and Book Chapters.



**12**  
Journals



**25**  
Conferences



**3**  
Workshops

Books



**1**  
Book



**2**  
Book chapters

The main publications of 2022 are the following ones:

- Garcia-Aviles, G. and Garcia-Saavedra, A. and Gramaglia, M. and Costa-Perez, X. and Serrano, P. and Banchs, A., "Nuberu: Reliable RAN Virtualization in Shared Platforms." In: The 25th Annual International Conference on Mobile Computing and Networking. 2021, pp. 1–16.
- Montagud, M., Li, J., Cernigliaro, G. et al. Towards socialVR: evaluating a novel technology for watching videos together. *Virtual Reality* 26, 1593–1613 (2022)
- T. Kellermann, R. P. Centelles, D. Camps-Mur, R. Ferrús, M. Guadalupi and A. C. Augé, "Novel Architecture for Cellular IoT in Future Non-Terrestrial Networks: Store and Forward Adaptations for Enabling Discontinuous Feeder Link Operation," in *IEEE Access*, vol. 10, pp. 68922–68936, 2022
- E. Coronado et al., "Zero Touch Management: A Survey of Network Automation Solutions for 5G and 6G Networks," in *IEEE Communications Surveys & Tutorials*, vol. 24, no. 4, pp. 2535–2578, Fourthquarter 2022
- C. M. Stefanovic, A. G. Armada and X. Costa-Pérez, "Second Order Statistics of -Fisher-Snedecor Distribution and Their Application to Burst Error Rate Analysis of Multi-Hop Communications," in *IEEE Open Journal of the Communications Society*, vol. 3, pp. 2407–2424, 2022
- E. Carmona-Cejudo, F. Iadanza and M. S. Siddiqui, "Optimal Offloading of Kubernetes Pods in Three-Tier Networks," 2022 IEEE Wireless Communications and Networking Conference (WCNC), Austin, TX, USA, 2022, pp. 280–285, doi: 10.1109/WCNC51071.2022.9771724
- M. T. Ortiz, O. Sallent, D. Camps-Mur, J. E. Escrig and C. Herranz, "Analysis of Vehicular Scenarios and Mitigation of Cell Overload due to Traffic Congestions," 2022 IEEE 95th Vehicular Technology Conference: (VTC2022-Spring), Helsinki, Finland, 2022, pp. 1–6, doi: 10.1109/VTC2022-Spring54318.2022.9860570.
- J. S. Camargo, E. Coronado, B. Gómez, D. Rincón and S. Siddiqui, "Design of AI-based Resource Forecasting Methods for Network Slicing," 2022 International Wireless Communications and Mobile Computing (IWCMC), Dubrovnik, Croatia, 2022, pp. 1064–1069, doi: 10.1109/IWCMC55113.2022.9824551
- C. Delgado, L. Zanzi, X. Li and X. Costa-Pérez, "OROS: Orchestrating ROS-driven Collaborative Connected Robots in Mission-Critical Operations," in 2022 IEEE 23rd International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM), Belfast, United Kingdom, 2022 pp. 147–15
- T. Cogalan, D. Camps-Mur et al., "5G-CLARITY: 5G-Advanced Private Networks Integrating 5G NR, WiFi, and LiFi," in *IEEE Communications Magazine*, vol. 60, no. 2, pp. 73–79, February 2022.
- Edited by Jordi Guijarro Olivares, i2CAT, Spain; Peter Hofmann, Deutsche Telekom Security, Germany; Petros Kapsalas, Panasonic Automotive Systems Europe, Greece; Jordi Casademont, Universitat Politècnica de Catalunya, Spain; Saber Mhiri, i2CAT, Spain; Nikos Piperigkos, University of Patras, Greece; Rodrigo Diaz, ATOS, Spain; Bruno Cordero, i2CAT, Spain; Jordi Marias, i2CAT, Spain; Adrián Pino, i2CAT, Spain; Theodoris Saoulidis, SIDROCO, Cyprus; Josep Escrig, i2CAT, Spain; Choi You Jun, KATECH, South Korea; Taesang Choi, ETRI, South Korea. ["Artificial Intelligence-based Cybersecurity for Connected and Automated Vehicles"](#)

RESEARCH PORTAL OF CATALONIA (CORA.PRC)

# RESEARCH AND INNOVATION FOR THE SOCIETY AND THE TERRITORY

i2CAT is committed to improving our society. To do so, the centre works to empower citizens digitally, enhance inclusion and prevent the digital divide. From local projects to international initiatives, i2CAT puts technology at the service of people.



# RESEARCH AND INNOVATION FOR THE SOCIETY AND THE TERRITORY



One of i2CAT's undertakings is improving the quality of life of citizens. Making cutting-edge technology available and accessible to everyone will enable full-scale digital transformation and prevent the digital divide.

The Col·laboratori Catalunya initiative aims to deploy an interconnection model of social and digital innovation throughout Catalonia, with the collaboratories as the cornerstone of the **Digital Social Innovation ecosystem**.

The initiative fosters collaboration networks between the five main actors of the **Quadruple Helix** innovation model: citizens, public administrations, private companies and academia. These collaborative networks leverage their stakeholders' expertise, resources and ideas to promote innovation and address social and digital challenges in the territory. The resulting processes span from identifying shared challenges to co-creating solutions.

This project is fostered by the i2CAT Foundation, with the support of the **Secretariat for Digital Policy of the Government of Catalonia**.

In 2022, Col·laboratori Catalunya made significant strides by increasing the number of entities and participants involved in the initiative and its territorial reach. With more stakeholders on board, the initiative is well-positioned to create an interconnected social and digital innovation model throughout Catalonia.

**+600** people engaged

**+900** potentially identified entities to be part of the initiative

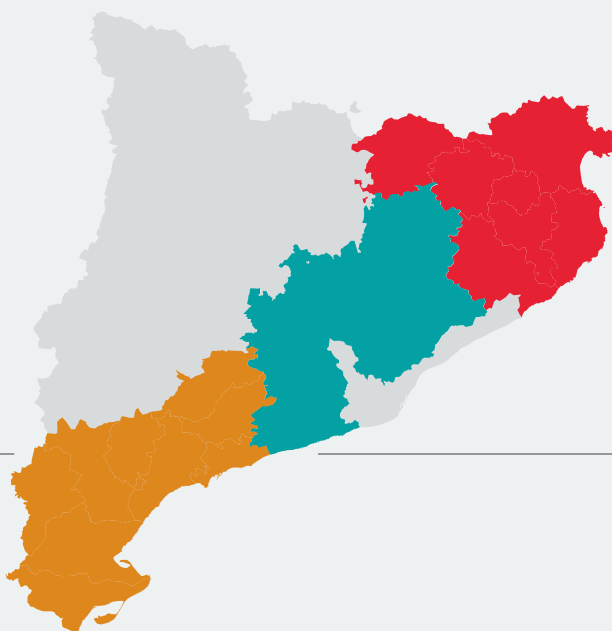
**14** divulgation and educational sessions

One of the main milestones of 2022 was the evolution of CatAnoia, which comprised only Anoia region, into **CatCentral**, adding Garraf, Alt and Baix Penedès, Bages, Osona, Vallès Oriental and Vallès Occidental, as a response to the growing interest from stakeholders to be part of the initiative. The restructuring of CatCentral has been undertaken while also working towards consolidating **CatNord**, created in 2021, and **CatSud**, the first col·laboratori to achieve management autonomy.

Col·laboratori Catalunya also worked and cooperated closely with participating entities. By providing expert resources, methodological guidance, digital tools, education and knowledge, the initiative has spurred the appearance of **new innovation projects throughout the territory**, such as the Makeathon 2022 Riu Anoia (CatCentral), the 5Gható to identify 5G opportunities (CoEbreLab, CatSud) and the 1st Drone Course for FP faculty in Catalonia.

It was a year of continued support for the thematic initiatives launched in 2021, specifically in the health and education sectors, two of the most heavily impacted sectors during the pandemic. **As a result:**

- The **Col·laboratori de Salut i Benestar** joined the European project **INTEGER**, coordinated by i2CAT, aimed at accelerating the integration of social actors into the European innovation ecosystem, which will specifically focus on Healthy Living Collaboratory.
- The **Educolab** partnered with five education centres in Catalonia to develop awareness and knowledge of advanced digital technologies (drones, cybersecurity, IoT, 5G) among professionals, preparing them to face new challenges.
- The initiative was presented to more than 400 high school students during the **Video Art Game Experience**, a cultural event related to the digital industry and video. VAG, an active member of CatSud, organised the event.





## TDA 5G RURAL

This project aims to define a deployment model for 5G technology with the maximum benefits and minimum investment to accelerate the development of **5G connectivity in rural areas** of Catalonia and thus improve competitiveness and services.

TDA 5G Rural is a research and innovation project promoted by the **Generalitat of Catalonia** within the framework of its Digital Catalonia strategy and led by the i2CAT Foundation. The main objective is to define the best technical-economic model for deploying 5G in rural areas with low population density under a Public Private Partnership (PPP) scheme involving operators, manufacturers and public administration.

The project focuses on three fields:

- Deployment of an **experimental 5G network infrastructure** in El Molló industrial area in Móra la Nova (Ribera d'Ebre). This laboratory must enable the validation of a multi-operator model, an **FWA-based** broadband connectivity approach, and a business model for rural environments. It is a **pioneering experience** deploying a test environment offering a dedicated network of remote rural settings and a network of medium-sized cities.
- Including a **distributed** OpenStack-based **private Cloud** to complement this pioneering network to host applications designed for the edge, with a real need for the service. This will validate the behaviour of two environments overlapping in the territory, enabling the deployment of use cases explicitly oriented to the rural environment.
- Deployment of an outdoor infrastructure using the experimental spectrum in the 5G band to implement a **use case on home hospitalization**, together with partners TIC Salut Social, Masimo and Philips.

### HOME HOSPITALIZATION USE CASE:



Implementing **X-Gain** will complement these use cases. This Horizon Europe project aims at creating a high-tech ecosystem to reduce the digital gap between urban and rural areas in Europe. Within the project, the i2CAT Foundation will lead a pilot based on applying 5G drones for services with high demand in rural areas. Those 5G drones will monitor plantations and forests in real time to prevent natural disasters, such as fires, and optimise resources (water, fertilisers or treatments for pest control).



## Àrees 5G

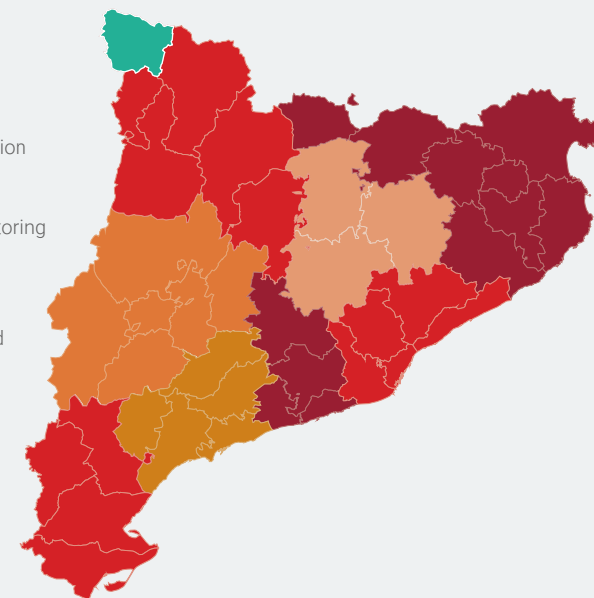
Àrees 5G is a project that works to boost the Catalan 5G ecosystem, avoid a digital divide in rural areas and transform Catalonia into an international benchmark for 5G

The Àrees 5G **promote 5G throughout the region** through training and dissemination activities, workshops, concept trials, and laboratories. They mainly aim to define a model of broadband connectivity away from urban areas through a high-capacity radio deployment that is tested in different meteorological conditions, analysing technical parameters, costs of unfolding and economic viability. The strategy is to create a permanent infrastructure and ecosystem in the territory.

The **Government of Catalonia** promotes the project in collaboration with **i2CAT, Mobile World Capital Barcelona**, and territorial institutions.

In 2022, the project achieved coverage of the whole Catalan territory with the new **5G Area of Aran**. Other highlights of the initiative include:

- 5 pilots
  - Banc PIRA (Ponent): a new model of 5G-connected urban furniture and scooter parking
  - Baixada de falles (Alt Pirineu): 5G connection for media broadcast in remote locations
  - Aigües de Catalunya (Terres de l'Ebre): 5G for real-time water consumption monitoring
  - UFEC- Esports Igualada (Penedès): live broadcast of sporting events through 5G connectivity for AI cameras
  - Vall d'Aran Artiga de Lin (Aran): broadband satellite connectivity for shelters in remote mountainous areas
- 8 trainings
- 3 workshops
- 4 congresses





FORGING intends to become a **participatory forum** aimed at catalysing multiple stakeholders from different sectors (academia, industry, society, policymakers, etc.) to contribute to **innovation journeys**. It will also promote the co-creation and absorption of disruptive enabling technologies expected to bring about major transformative shifts from a social and sustainable perspective.

In October 2022, the i2CAT Foundation joined **FORGING** (Forum for **Emerging Enabling Technologies in Support to the Digital and Green Transitions through Value Sensitive Innovations**), a Horizon Europe research and innovation project funded by the European Commission with almost 2.5 million euros. It involves 6 European partners, including research organisations and private companies.

The i2CAT Foundation has extensive experience cooperating with the innovation ecosystem to make social changes and reality and digitally empower citizens. The centre will work within the project to develop a pioneering methodology based on a value-sensitive innovation process that promotes new technological paths attentive to the environment and society. The project contemplates 3 different phases:

1. **Technological discovery** with the help of academia and industry to detect the first signs of emerging technologies.
2. **Social confluence** exploring social desirability and social impact.
3. The openness of **complete co-creation** to the broader community to develop concrete use cases

The project contemplates six major technology areas:

- Human-centric solutions & human-machine interaction
- Bio-inspired technologies and smart materials
- Real-time-based digital twins and simulation
- Cyber-safe data transmission, storage & analysis technologies
- Artificial Intelligence
- Technologies for energy efficiency and trustworthy autonomy

The project will provide three assets: The **FORGING Forum** (a European community of experts in enabling technologies), the **FORGING Playbook** and the **FORGING ToolBox** that will, respectively, bring methodology for guidance and facilitation materials for the exploration, reflection, co-creation and evaluation of emerging technologies.



Laboratori SmartCatalonia 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 innovative solutions in real environments to tackle the urban challenges of the local municipalities of Catalonia. It aims to promote the technology sector by providing access to infrastructure and equipment and enhancing open innovation in cities by participating in pilot tests.

Within the framework of the SmartCatalonia strategy, the project has spread all over the country by developing projects of impact, providing technical advice and public tenders and promoting the use of open data to help administrations make strategic decisions.

**56**  
municipalities

**+150**  
meetings

**15**  
supra  
municipalities

**+46**  
technological  
solutions

**38**  
current  
pilots

**55**  
technological  
consultations

**126**  
companies



SmartCatalonia Challenge is a **competition** that connects companies, entrepreneurs, developers, and organisations with municipal and infrastructural needs to improve citizens' life quality through innovative solutions. The initiative offers monetary incentives and the opportunity to conduct pilot tests in a real environment. In 2022, **three editions** were organised in collaboration with **Mossos d'Esquadra, Catalan Museums and the Institut Cartogràfic i Geològic de Catalunya**.

**+110** innovative  
solutions  
presented

**85k** in prizes



# DIGITAL INNOVATION STRATEGIES AND POLICIES

i2CAT works to transfer the knowledge gained in almost 20 years of innovative ICT R&D international initiatives to the digital strategies and policies of the Catalan administration, making every effort to boost the administration's digital transformation and solve social challenges in the territory.



# DIGITAL INNOVATION STRATEGIES AND POLICIES

## Mission-oriented projects with public administration



### TDA Ciberseguretat

Advanced Digital  
Technologies  
in Cybersecurity

In response to a challenge posed by the **Agència de Ciberseguretat de Catalunya (ACC)**, the TDA Cybersecurity aims to create a solution to help minimise the success rate of cybersecurity incidents. It will do so by analysing the user's behaviours on a network to calculate the risk and exposure associated with cybersecurity threats, allowing stakeholders to apply preventive measures to mitigate the risk before an incident occurs.

In the context of the TDA Cybersecurity, i2CAT developed **OpenUEBA**, an open-source framework for User and Entity Behaviour Analytics. OpenUEBA is the first data-driven, data-agnostic, open-source framework that provides out-of-the-box UEBA techniques, integrating threat intelligence information. OpenUEBA has developed an AI engine that allows the automatic ingestion of heterogeneous logs of entities and users to define behavioural patterns in the network to calculate exposure to specific threats.



### VinclesBCN

i2CAT collaborates with the **Social Rights Area of the Barcelona City Council** to develop the Vincles BCN program, an initiative to help older people lead more active and sociable lives. The program aims to **bridge the digital divide** affecting older people and improve their quality of life by using new digital technologies to communicate (from both the public and personal spheres, such as family, friends, social workers, and volunteers).

In 2022, the Vincles project evolved significantly, with a complete redesign of the backend platform and the Android/iOS mobile applications and the renaming of the platform to **BCN+65**. Considerable changes were made to the image, navigability and content, as well as the incorporation of new features to improve usability and accessibility to all current information and the primary services and resources available to the elderly.



### Partnership with Agència de Ciberseguretat de Catalunya: Cybersecurity Innovation Office (IOC)

The i2CAT Foundation maintains a solid partnership with the **Agència de Ciberseguretat de Catalunya (ACC)** with a common goal: to boost the adoption of innovative solutions and cybersecurity technologies within the strategic sectors that the ACC focuses on. The partnership is also centred on reinforcing the Catalan cybersecurity ecosystem. i2CAT leverages its expertise in coordinating innovative communities to achieve this mission by coordinating the Digital Catalonia Alliance cybersecurity (DCA) community.

The activities conducted by the partnership are structured around three main pillars: **Funding, Cybersecurity Ecosystem and Innovation Office**. These activities generate a significant impact on the territory and productive sectors. Some milestones are:

- **Increment of cybersecurity funding:** support in the technical definition of the proposal for a Cybersecurity Dataspaces Demonstrator Center for the national RETECH Cyber call, leveraging i2CAT expertise in GAIA-X-related initiatives. The proposal has granted **2,8 M€** to the Government of Catalonia.
- **Innovative pilots** in cooperation with different agents of the ecosystem in the fields of operative excellence through automation, collaborative cybersecurity information sharing, attractive cybersecurity skills evaluation and training, and cybersecurity experimentation infrastructures for threat intel and for 5G.
- A fortified **Catalan cyber ecosystem:** DCA-Cyber growth and the celebration of DCA-Cyber activities in the Barcelona Cybersecurity Congress 2022.



# Participation in digital strategies of the Government of Catalonia



The DIH4CAT project kickstarted its activities in May 2022, becoming one of Europe's first **European Digital Innovation Hubs (EDIH)**. The project has set up mechanisms to contribute to SMEs' and startups' digitalisation in its first months. The i2CAT Foundation, in cooperation with **Mobile World Capital Barcelona** and **UPC**, is in charge of the **Smart Connectivity node**. It allows businesses to carry out viability studies, testing, validation, prototyping, and training on cybersecurity and technologies like 5G, IoT, and holopresence, as well as access to several tech laboratories in Catalonia.

Some of the activities that took place in 2022 are:

- Cupons tecnològics: first public funding supporting digitalisation services by DIH4CAT partners and associates (pilots, tests, and viability studies). Grants up to 10€ funding almost 100 companies.
- +18 networking activities to approach the ecosystem and find potential collaborations with stakeholders, including matchmaking, presentations, webinars and showcases.
- +30 training activities to boost knowledge and capacitate SMEs in advanced digital technologies.
- European Digital Innovation Forum by IESE: public presentation of DIH4CAT with 300 attendees.



i2CAT leads an **Advanced Research and Innovation Programme in Artificial Intelligence** to foster mission-oriented R&D initiatives. Intending to tackle social and business challenges related to AI, the centre collaborates with other universities, research groups, institutes and public organisations in Catalonia.

i2CAT collaborates with the **Government of Catalonia** to deploy its **CATALONIA.AI** strategy. This strategy is structured around the following topics: AI ecosystem, R&D, Talent, Infrastructure and Data, AI adoption, Ethics and Society. i2CAT leads or participates directly in several projects within the strategy, such as the **Digital Catalonia Alliance**, **CIDAI** or the **Tecnologies Digitals Avançades** programme.

i2CAT also specialises in “**data spaces**”, the European architectures and standards for a new generation of distributed data infrastructure that empower governments and busi-

nesses with data sovereignty. i2CAT supported the Government of Catalonia and the region through a strategic project to engage and contribute to national and European data space ecosystems, such as **Gaia-X** and the **International Data Space Association**, while helping the Catalan public and private sectors to understand these new technologies, identify new opportunities and contribute to their future standards. Some examples are the collaboration with **EIT Urban Mobility**, in which i2CAT worked with Catalonia's mobility ecosystem to identify how data spaces can advance sector goals such as multimodal transportation and sustainable mobility services, and the new public-private collaboration and association **Gaia-X Spanish Hub**, where i2CAT is helping Catalan organisations to become actively involved.



i2CAT is a key actor in the **New Space Strategy for Catalonia**. The initiative is a collaboration between the **Institut d'Estudis Espacials de Catalunya (IEEC)**, **i2CAT**, **Institut Cartogràfic i Geològic de Catalunya (ICGC)**, and the **Government of Catalonia**. It provides unique opportunities to use and exploit space platforms in Earth Observation, Telecommunications, and Global Navigation Satellite Systems (GNSS) and to explore and use the resulting data. Through research, use cases, missions and internationalisation, the strategy carries out activities to boost and promote the Catalan New Space ecosystem.

In 2022, the **first Catalan nano-satellite, Enxaneta**, provided its first results after a year in orbit. Its objective was to deploy global IoT coverage and services to obtain data from sensors located around Catalonia. The first use case enabled by it was the coverage assistance and sensor monitoring for high-altitude vineyards in Tremp. The i2CAT Foundation designed the **satellite device used to receive sensor data**.

In order to identify challenges within the Administration that can be solved with New Space technologies, i2CAT, together with IEEC and ICGC, organised 13 innovation sessions with several departments from the Government of Catalonia. These sessions resulted in several challenges and **3 use cases** leveraging the potential of satellite IoT or Earth Observation.

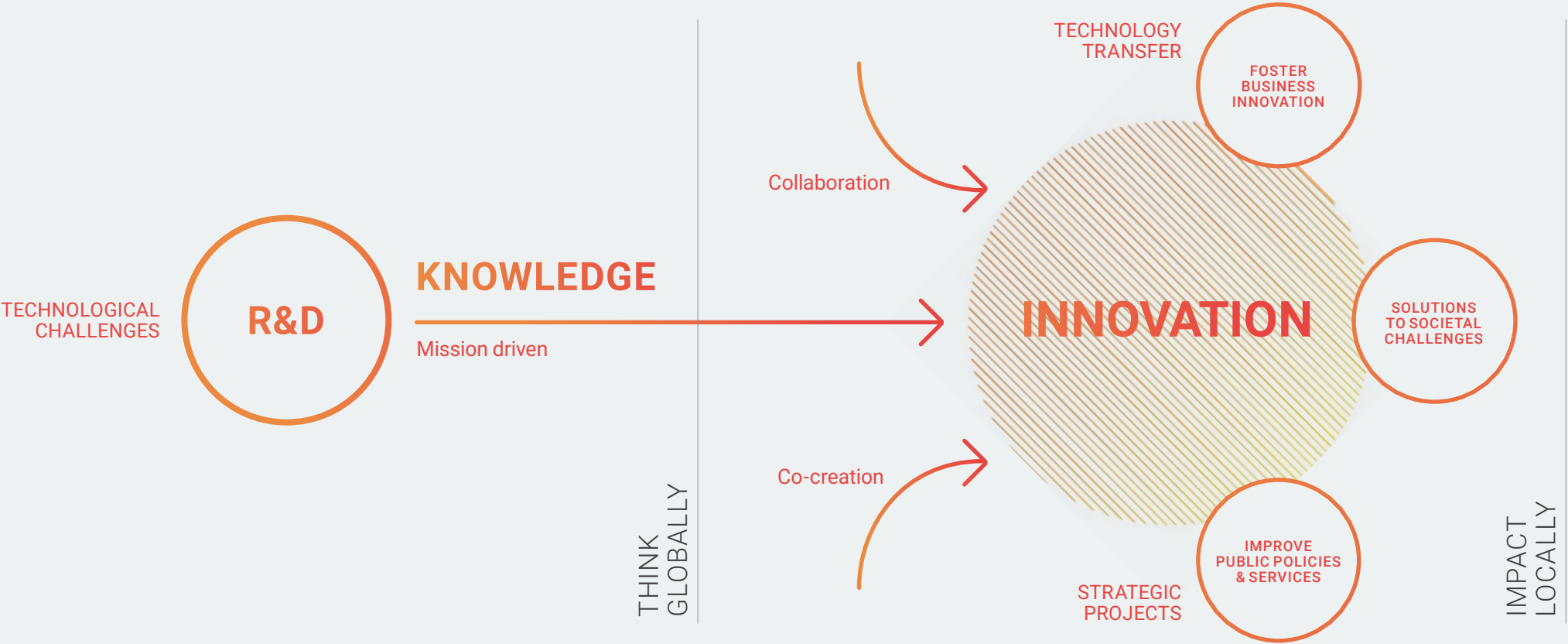
In September 2022, i2CAT was present at the **International Astronautical Congress (IAC)** in Paris, the world's most important global space event. The Catalonia booth hosted 11 companies of the Catalan space community and the four organisations that cooperate in the New Space Strategy. i2CAT was one of the leading partners of the **New Space Economy Congress**, celebrated in October in Barcelona, and attended by more than 400 people. Sergi Figuerola, i2CAT's CTIO, was one of the featured speakers and Pol Guixé, Innovation Director for Space Communications at the centre, moderated the sector opportunities roundtable.



# DIGITAL TRANSFORMATION

Digital transformation is at the heart of i2CAT's activity. With its expertise in international coordination and participation in ICT R&D initiatives, i2CAT wants to revitalise and uplift the social and productive sectors through advanced digital technologies.

# DIGITAL TRANSFORMATION



## Collaboration and co-creation with the private digital sector

The centre sets strategic alliances with private companies and the innovation ecosystem players to co-create jointly in fields such as **Smart Cities, CCAM, Digital Administration, e-health, and Industry 4.0.**

i2CAT aims to generate impact by transferring the knowledge gained from R&D projects. The centre offers added-value services to the Catalan ICT sector through proofs of concept and valorisation activities.

2022 was a fruitful year which saw the fulfilment of plenty of opportunities and collaborations with private companies to continue uncovering innovative market-oriented solutions based on advanced technologies.



**acisa**

**ambit**  
LIVING SPACES CLUSTER

**ALSTOM**

**FACTUAL**

**indra**

**keonn**

**SATEL IOT**

**MAXLINEAR**

**MITSUBISHI ELECTRIC**  
Changes for the Better

**mosaicfactor**

**NEC**

**Open Cosmos**

**Opticks**

**RDI network**

**TRANSCESTRAL**

**Unblur**

**VRi**

**watchity**

**GROUP SALTO**  
INTEGRATED TECHNOLOGY

**simon**



# Technology transfer

i2CAT strives to generate market-oriented technologies and solutions. The centre establishes agreements with private companies to create joint R&D teams to solve market-driven technical challenges, valorise technologies and exploit the intellectual property rights resulting from research. It also **leads the design and deployment of technical and functional proofs-of-concept, with ICT companies, public administration and end users** to validate technologies and disseminate their adoption.

In 2022, the centre consolidated its **income through royalties**, tech transfer deals, and its position in the market as an invaluable partner to support and advance entrepreneurship and spin-off creation.

## Neutroon

i2CAT's spin-off Neutroon has considerably expanded its activity in 2022. The start-up closed an agreement with **Fujitsu** to cover its flagship building for innovation in Barcelona, with the deployment of 32 small cells by 2023. It also launched its first product, the **Nomad 5G**, a Private 5G + Edge pre-integrated solution, assembled and tested in Barcelona and shippable worldwide in its flight case.

Neutron also raised more private funding and underpinned its position in a market that is slowly transitioning to multi-site, multi-vendor deployments. i2CAT continues to collaborate closely with Neutroon on several projects. In 2022, the two organisations participated in Tech Barcelona's TB Insights #2 to present the tech transfer success case that led to the creation of the spin-off.



## DOWI

One of the most popular bandwidth-demanding networks nowadays 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 wireless networks according to the properties of the video streams and the characteristics of the wireless channel.

DOWI is a patent-pending method that, integrated into WiFi access points, is expected to enable an outstanding performance and solve problems for streaming in densely populated wireless networks such as sports matches or music festivals, or even transportation, with a good cost-benefit for network owners, avoiding the oversizing of networks or the quality of experience degrading.

In 2022, DOWI obtained funding from the **Indústria del Coneixement Producte** programme (AGAUR), which will be devoted to an implementation demonstrating the performance and benefits of real-environment use cases. DOWI patent applications are published as **EP3923536A1** and **WO2021249925A1**.

## Catalonia Valorization Networks

Catalonia Valorization Networks help valorise assets, contribute to patent application funding, execute **Proofs of Concept**, and help disseminate. i2CAT is a member of 5 Valorization Networks that are conceived to bring project results to the market.

### RDI-IA

The RDI-IA network was created in 2022 and includes 28 research groups of 16 Catalan institutions focusing on Artificial Intelligence. It aims at underpinning the ecosystem and offers tech transfer and valorisation mechanisms.

### AccessCat

In 2022, i2CAT joined AccessCat, a network that gathers 175 researchers with experience in ICT for accessibility. It expects to become a referent in this field, particularly in culture, education and the media.

### XAFIR

The Fourth Industrial Revolution Network proposes an action programme to promote knowledge valorisation and technological transfer of research results related to Industry 4.0.

### XARTEC

R&D Network in Health Technologies that enhances the quality and value of health research groups' results to increase patents and licenses and promote company creation.

### i4KIDS

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

## Royalties

2022 has seen a **60% increase** in royalties income, which positions i2CAT in the European arena. Additionally, the centre continuously contributes to open-source projects like **Magma** or **Vanetza**.

## Catalan R&D ecosystem alliances

The i2CAT Foundation seeks to encourage and generate alliances within the Catalan R&D ecosystem by cooperating with other ICT centres, organisations, or research groups to establish joint strategies.

The 'Research and Innovation Strategy for the Smart Specialisation of Catalonia' (RIS3CAT) applies talent, excellent research knowledge and creativity to a diversified business fabric within a dynamic, enterprising, and inclusive society. RIS3CAT boosts R&D projects in various productive and technological fields by promoting cooperation.

The i2CAT Foundation participates in 8 RIS3CAT projects and leads the 5G/IoT Emerging Technology communities.



### FEM-IoT

#### Fostering the Emerging Market of the Internet of Things

The FEM-IoT community promotes and strengthens collaborations within the **Catalan Internet of Things ecosystem**, focusing on increasing the business impact of research and the social impact of Intelligent Mobility and IoT Data Valorization. i2CAT leads this project from its IoT research and innovation expertise, coordinating the twelve partners involved for two years on a **4M€** budget.

In 2022, the project resulted in the **V2X Reference Kit** and contributed to advancing the TRL of V2X simulation tools. The positioning use case developed within the project also achieved contracts with the private sector. Several technological innovations from FEM-IoT were used in projects such as **Looming Factory** or **5GCroCo**, a project which deployed a small-scale trial site in Barcelona using FEM-IoT developments to validate 5G technologies enabling Cooperative Connected and Automatized Mobility services.

The achievements of this community were also presented at the **Smart City Expo World Congress** and **IoT Solutions World Congress**.



### Looming Factory

#### Paving the way for the Catalan Factories of the Future

The Looming Factory project, financed partly by ERDF funds, brought forth **Industry 4.0** research from principal R+D+i centres of Catalonia to demonstrate such technology to the local industry.

In 2022, i2CAT developed a distributed data infrastructure (a "data space") and a marketplace platform for project demonstrators in the area of smart and connected factories. Based on the **International Data Space (IDS)** reference architecture and standards, i2CAT established a secure data flow between factory machinery and externally hosted predictive algorithms developed by partners to optimise the machine's operations and maintenance. These algorithms were added-value services that were hosted in an IDS-compatible AppStore implemented by i2CAT: essentially an on-ramp for data services to be deployed and used in trusted data space environments.

The scenario demonstrated the data sovereignty sought by industry actors, providing them with secure data sharing, traceability and usage control between factories and third-party service providers. Such scenarios are envisioned by EU flagship initiatives like Gaia-X.



## RIS3CAT Communities

The RIS3CAT communities are voluntary groups of companies and stakeholders of the Catalan research and innovation system that promote R&D in several areas. Through competitive calls, the Government of Catalonia has accredited them to co-finance their action plan with the Operational Program of the ERDF of Catalonia 2014-2020. i2CAT partners in several communities:

### ViVIM

The centre's Media Internet area (MIA) coordinates **ViVIM (Computer Vision for Immersive Multi-platform Video)**, a collaborative project to implement an innovative media production and consumption system. This system focuses on a novel form of audiovisual narrative based on omnidirectional video. The project has developed production tools for immersive screens, support for omnidirectional cameras and coordinated access to content through head-mounted displays, tablet devices and conventional TV. ViVIM tested this system's viability through two demonstrators addressed to live and deferred broadcasting, such as the virtual elevator for Catalan broadcaster **TV3** at the Carnival in **Vilanova i la Geltrú**.



### SMARTSPACE

The project SMARTSPACE aims to develop an IoT solution for Catalonia's home furnishing and accessories sector. Its aim is to expand the sector's offer and include connected products and devices, as well as help manufacturers and brands introduce this key aspect in their catalogue and speech. The project aims to ease their connection to this platform or others that may appear in the future.

In 2022, the Media Internet team was at interihotel's **Interiors Living Lab initiative** with a demonstration of **HoloMIT** that was adapted to interior design and the hospitality sector, a presentation framed on SMARTSPACE.



# Public-private alliances

## 5G Barcelona

5G Barcelona is a public-private initiative that positions Barcelona as an innovative and open environment for **validating and adopting 5G technologies** and applications in a real-life setting. Through workshops with private companies, promotion of prototypes and test concepts and dissemination activities, 5G Barcelona aims to bring the technology closer to all interested parties and become one of the leading 5G hubs in Southern Europe. The i2CAT Foundation acts as the CTO of the initiative.

In 2022, 5G Barcelona re-inaugurated its **The Thinx lab**, lead technically by i2CAT, incorporating **Fira de Barcelona** as a partner and relocating to the **Telefonica** building to grow in Blockchain and 5G NSA. The initiative also presented the '5G Connected Vehicle Hub' pilot together with **Applus+ IDIADA**, consisting of the creation of a private 5G network at the company's technical centre in Tarragona, thus transforming the location in the most relevant space in Europe for the development and trial of connected and autonomous vehicles.

## 5GBarcelona



## CIDAI

The **Centre of Innovation for Data Tech and Artificial Intelligence (CIDAI)** proposes networked services for businesses and institutions promoting technology transfer and cooperation among knowledge-generating organisations (universities, research and innovation centres), companies providing technology and services, and user companies and institutions demanding innovative solutions in applied Artificial Intelligence. Its current partners 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, Huawei 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**.

2022 was a year filled with initiatives and achievements. Some of them are:

- 9 AI-based PoCs in sustainability, farm monitoring, Digital Twins for industrial environments, Catalan language processing, cancer detection, autonomous mobility, gas networks maintenance and stroke detection
- Development of high-impact projects on micro-mobility and agro-food
- Agro-food Whitepaper
- AI & Big Data Congress, with +1300 registered
- 8 masterclasses and workshops 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 promoted by the **Government of Catalonia** and **i2CAT** that brings together the ecosystem of emerging technologies in Catalonia into an alliance that supports its growth, stimulates innovation and the development of new solutions and digital applications through the exchange of ideas between members. It is the meeting point and trust of the sector and it ensures its members the best market opportunities to increase their competitiveness.


In 2022, along with the reinforcement of IoT, Drones, AI, NewSpace and Cybersecurity communities, the initiative incorporated the **DCA-Blockchain** in collaboration with the **Centre Blockchain de Catalunya (CBCat)**.


2022 marked one year of activity for the DCA, which exceeded **455 members** on its first anniversary. Other relevant milestones include:

- 179 companies and entities joined the alliance in 2022
- Sectoral revitalisation with 96 networking requests managed
- 36 business opportunities identified in matchmaking events, with 131 solutions presented to solve 42 challenges
- +100K € of potential business value generated through the DCA activity.

**151**   
COMPANIES  
/ ENTITIES

**76**   
COMPANIES  
/ ENTITIES

**36**   
COMPANIES  
/ ENTITIES

**121**   
COMPANIES  
/ ENTITIES

**58**   
COMPANIES  
/ ENTITIES

**13**   
COMPANIES  
/ ENTITIES

PARTNERS:

**AIRA** Artificial  
Intelligence  
Research  
Alliance

**CIDAI** Centre of Innovation  
for Data tech  
and Artificial Intelligence

 AGÈNCIA DE  
CIBERSEGURETAT  
DE CATALUNYA

 **ICGC**  
Institut  
Cartogràfic i Geològic  
de Catalunya

 **CBCat**  
Centre  
Blockchain  
de Catalunya

 Generalitat de Catalunya  
Departament d'Empresa  
i Treball

 **Cambra**  
de Comerç de Barcelona

 **IEEC**<sup>R</sup>

 **OEIAC**  
Observatori d'Innovació i Emprenes de Catalunya

# R&D projects & strategic alliances

## Beyond 5G

### NEC and i2CAT bring the full potential of 5G to the industrial sector

The continued collaboration between NEC and i2CAT in the Beyond 5G technologies area through an industrial research project has produced OROS. This novel orchestration approach minimises mission-critical task completion times of 5G-connected robots by jointly optimising robotic navigation and sensing together with infrastructure resources, thus reducing overall energy consumption.



## Mobile Wireless Internet

### i2CAT supports MaxLinear in the development of a network simulator that will help to bring the new generation of WiFi7 chipsets

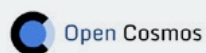
In 2022, i2CAT closed a project that aimed to design and develop a realistic traffic generator for network simulator NS-3. The work focused on the synthetic generation of application layer traffic that would enable MaxLinear to test the performance of their new WiFi7 chipsets in a scenario as close as possible to reality. The team experimented with two approaches to the traffic models: one based on machine learning and the other based on statistical models.



## Space Communications

### Open Cosmos, i2CAT and ICGC team up in the Earth Observation Smart Monitoring System (EOSMS) project

Co-funded under the innovation call Innotec by the Catalan Agency for Business Competitiveness (ACCIÓ), the EOSMS project aims at demonstrating the technical and commercial feasibility of an intelligent monitoring system integrating satellite imagery with on-ground measurements, with a particular focus on agriculture and emergency services. i2CAT contributed its extensive knowledge in Machine Learning to develop two models: one capable of defining soil moisture from satellite data and another capable of analysing the value of soil moisture over time and predicting any anomalies that could help agricultural or emergency service users.



### Further design and development of the first LEO satellite communications network operating 5G NB-IoT NTN standard

Sateliot, the Catalan satellite operator for the first 5G NB-IoT NTN constellation, joined efforts with i2CAT's research teams to develop the first Core Network with Store and Forward capabilities. In 2022, they worked together on designing and implementing additional features, gradually allowing Sateliot to build their system to full operational capabilities. The team also worked on preparing and coordinating the end-to-end testing activities conducted on the ground, which will be tested in-space after launching their first LEO Satellite in early 2023.



## V2X for Mobility

### ACISA and i2CAT develop SAVE: Safe, Accurate & Virtualised Edge solutions for V2X services

Co-funded under the innovation call Nuclis by ACCIÓ, the SAVE-V2X project aims to offer cities the infrastructure needed to deploy connected mobility services, including vehicular communications infrastructure, which enables exchanging information with any vehicle. The project will develop, integrate, and deploy various services on top of ACISA's Mobility Hub platform to demonstrate the benefits of connected infrastructure in urban mobility management. Thanks to the combination of C-V2X technologies, edge computing, virtualisation and precise positioning techniques, the project will showcase traffic control and road safety applications that require high precision in the positioning and location of vulnerable vehicles and users.



## Immersive Media Technologies

### i2CAT supports Watchity in developing an immersive live e-commerce platform

In 2022, i2CAT's Media Internet research area started its involvement in designing and developing an innovative e-commerce platform based on holographic communications, augmented reality, and artificial intelligence. The research team is leading the development of the immersive component of the platform, which will enable shoppers to have a more authentic experience thanks to virtual/augmented reality, 3D interactive models and 360° live video combined with traditional 2D video images.



## AI for Industry 4.0

### i2CAT helps Mitsubishi Electric in co-creating product evolutions and new use cases for their robotic arms

Thanks to the regional innovation ecosystem, Digital Innovation Hub Catalonia, i2CAT supports Mitsubishi Electric with its knowledge in artificial intelligence applied to advanced manufacturing. i2CAT is producing a twofold analysis: on the one hand, it studies the robotic products and proposes an evolution roadmap based on the use of AI technologies, and on the other hand, it assesses the current use cases for robotic products and proposes new disruptive business models.



### i2CAT supports the evolution of Group Saltó's nursing care robot with the addition of "speech" capabilities

In 2022, Group Saltó was awarded funding by the Spanish Centre for the Development of Industrial Technology to further research and develop their assistive care robot. The project aims to explore the technical feasibility of adding and testing another type of conversational technology on their robots. Currently, the team is in the process of building a proof of concept for one technology that will allow the company to assess its potential while weighing the added complexity to the operation and maintenance of the system.



### SIMON and i2CAT continue their fruitful cooperation in the field of Smart Homes

In 2022, SIMON and i2CAT strengthened their collaboration in developing and evolving SIMON's Smart Home IoT solution. The research teams at i2CAT are contributing their knowledge and experience in wireless technologies and artificial intelligence to further develop SIMON's solution's home automation control mechanisms.





# ABOUT US

i2CAT has been at the forefront of innovation for almost 20 years. With the main objective of designing the digital society of the future, the centre strives to excel in advanced digital technologies research and innovation. Talent and cooperation will be the pillars of this future society. Transferring knowledge to the community will be essential to guarantee this vision and achieve technological sovereignty.

# ABOUT US

## Strategic goals

- Generate excellent and significant knowledge in advanced digital technologies
- Become a benchmark organisation in digital innovation for public administrations
- Foster 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 the territory

Driving technological sovereignty from cooperation with a potent research and innovation ecosystem



# Local Partners

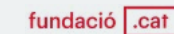
## Research and universities



## Civil society



## Public administration and organisations



## Catalan companies



## Mission and vision

To design this digital society of the future, the i2CAT Foundation will boost excellent research, **mission-driven** knowledge addressed at solving business challenges, **cocreate 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





# Board of trustees

As of April 30th 2023, the members' representatives were:

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## Mrs. Laura Vilagrà Pons

President, Minister of Presidency,  
Government of Catalonia

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## Mr. Daniel Crespo

Vice-President I, Rector, Universitat  
Politécnica de Catalunya (UPC)

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## Mr. Carles Salvadó Usach

Secretary of the  
Telecommunications and Digital  
Transformation Department,  
Government of Catalonia

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## Mr. Sergi Marcén

Secretary of Telecommunications  
and Digital Transformation,  
Government of Catalonia

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## Mrs. Gina Tost

Secretary of Digital Policies,  
Government of Catalonia

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## Mrs. Núria Cuenca

Secretary General of Presidency,  
Government of Catalonia

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## Mr. Víctor Vera Vinardell

Key Account Territorial  
Director, Orange

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## Mr. Albert Castellanos

Chief Executive Officer, ACCIÓ

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## Mr. Joan Gómez Pallarès

Director General of Research,  
Government of Catalonia

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## Mr. Climent Molins

Vice-rector for Transfer, Innovation  
and Entrepreneurship, Universitat  
Politécnica de Catalunya (UPC)

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## Mr. Jordi Llorca

Vice-rector for Research, Universitat  
Politécnica de Catalunya (UPC)

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## Mr. Josep Lluís Larriba-Pey

Deputy Rector Representative  
for the Transfer, Innovation and  
Entrepreneurship Vice-Rector, UPC

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## Mr. Xavier Milà Vidal

Managing Director for the  
Centre of Telecommunication  
and Information Technologies,  
Government of Catalonia

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## Mr. Lluís Rovira Pato

Director, CERCA Institution

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## Mr. Alejandro Carballo

Director Public Administrations  
Catalunya and Aragón, Vodafone

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## Mr. Albert Armengol López

Director for the Public Sector,  
Fujitsu Technology Solutions

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## Mr. Francesc Bert i Josa

General Manager, Cisco  
Systems in Catalonia

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## Mr. Gemma Ribas

Member of the Governing  
Council, CCMA

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## Mrs. Carme Torras

Research Professor, Spanish  
Scientific Research Council (CSIC)  
and Head of research line Perception  
and Manipulation, Institut de  
Robotica i Informatica Industrial (IRI)

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## Mr. Óscar Pallarols Brossa

Director of Strategy for Product  
and Innovation, Cellnex Telecom

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## Mr. Pol Pérez

Director of the Information Systems  
Area, Servei Català de la Salut

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## Mr. Jordi Teixidó

Vice-Rector for Research and  
Innovation, Universitat Ramon Llull

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## Mr. Michael Donaldson Carbón

Commissioner for Digital Innovation,  
Electronic Administration and Good  
Governance, Barcelona City Council

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## Mr. David Noguer i Bau

Regional Manager, Juniper Networks

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## Mr. Ernest Pérez-Mas

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

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## Mr. Josep Pallarès

Rector, Universitat Rovira i Virgili

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## Mr. José Manuel Casas Aljama

Regional Director for Catalunya,  
Comunitat Valenciana, Illes  
Balears, Aragón and Región  
de Murcia, Telefónica

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## Mr. Tomàs Roy

Director of the Cybersecurity  
Agency of Catalonia,  
Government of Catalonia

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## Mr. Boris Bellalta Jiménez

Teacher of the ICT Department,  
Universitat Pompeu Fabra

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## Mrs. M<sup>a</sup> Carmen Fernández

Innovation Manager, Media Pro

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## Executive Committee

As of April 30th 2023,  
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### Mr. Lluís Rovira i Pato

President, Director,  
CERCA Institution

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Government of Catalonia

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### Mrs. Gina Tost

Secretary of Digital Policies,  
Government of Catalonia

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### Mrs. Montserrat Cereza Carril

Territorial Manager of  
Institutional Relations, Orange

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### Mr. Lluís Anaya Torres

Executive Director for Digital  
Innovation and Social Areas,  
Centre de Telecomunicacions  
i Tecnologies de la Informació,  
Government of Catalonia

---

### Mr. Jordi Aguasca

Technology Transformation  
and Disruption  
Manager, ACCIÓ

---

### Mrs. Rosa Maria Alsina

Engineering Professor,  
Universitat Ramon Llull

---

### Mrs. Cristina Villà

Research and Innovation  
Director, CCMA

---

### Mr. José Antonio Aranda

Product Strategy and  
Innovation Director,  
Cellnex Telecom

---

### Joan Guanyabens

Director, TIC Salut  
Social Foundation

---

### Mr. Fernando García

Key Account Manager  
Public Sector, Vodafone.

---

### Mr. Albert Armengol López

Director for the Public Sector,  
Fujitsu Technology Solutions

---

### Mr. Xavier Azemar Mallard

Head of Barcelona Innovation  
Center, Cisco Systems

---

### Mr. Francisco Rodríguez

Managing Director, IMI  
(Barcelona City Council)

---

### Mr. David Noguer i Bau

Regional Director,  
Juniper Networks

---

### Mr. Jordi Llorca

Vice-rector for Research,  
Universitat Politècnica  
de Catalunya (UPC)

---

### Mr. Josep Lluís Larriba-Pey

Deputy Rector Representative  
for the Transfer, Innovation  
and Entrepreneurship  
Vice-Rector, UPC

---

### Mr. Boris Bellalta Jiménez

Teacher of the ICT  
Department, Universitat  
Pompeu Fabra

---

### Mrs. M<sup>a</sup> Carmen Fernández

Innovation Manager,  
Media Pro

---

### Mr. Manolo Ginart

Head of Telco  
Operations, Parlem  
Telecomunicacions, SA

---

### Mr. Jordi Castellà

Vice-rector for Research,  
Universitat Rovira i Virgili

---

### Mr. Julián Vinué Biarnés

Digital Innovation  
Manager and Institutional  
Relations, Telefónica

---

### Mr. Tomàs Roy

Director of the Cybersecurity  
Agency of Catalonia,  
Government of Catalonia

## Scientific Advisory Board

As of April 30th 2023,  
the members' representatives were:

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### Professor PhD Dimitra Simeonidou

High Performance Networks,  
Faculty of Engineering,  
University of Bristol

---

### Inder Monga

Executive Director ESnet,  
Division Director Scientific  
Networking

# Staff

## Management Team



**Josep Paradells, PhD**  
Director



**Artur Serra, PhD**  
Deputy Director



**Joan Manel Martín**  
Executive Director



**Sergi Figuerola, PhD**  
Chief Technology & Innovation Officer

## Admin & Finance



**Rocío Segura**  
Director



**Eva Carrascosa**



**Rosa Santamaria**



**Sònia Beltran**

## AI Driven Systems



**Xavier Costa, PhD**  
Director



**Arnau Romero**



**Carmen Delgado, PhD**



**Federico Campolo**



**Óscar Lasiera**



**Andra Blaga**



**Esteban Municio, PhD**



**Filip Lémic**



**Ginés García, PhD**

## Corporate Development



**Susana Otero**  
Director



**Anna Civit**



**Elena Samblás**



**Eulàlia Ferreres**



**Ivan Rodríguez**



**Marcos Doespiritusanto**



**Míriam Castillo**



**Núria Prieto**

## Cybersecurity and DLT-Blockchain



**Jordi Guíjarro**  
Innovation Director



**Shuaib Siddiqui, PhD**  
Research Director



**Alfonso Egio**



**David Company**



**Ignasi Oliva**



**Nil Ortiz**



**Pablo Cosio**



**Sonu Preetam**



**Xavier Marrugat**



**Saber Mhiri, PhD**



**Abel Pozo**



**Daniel Rodríguez**



**Maxime Compasté, PhD**



**Muhammad Asad**

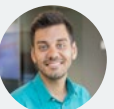
## Digital Innovation Management Office



**Carlos López**  
Director



**Antoni Camp**



**Arnau Sala**



**Carles Guillamon**



**Cristina Ramos**



**Jara Forcadell**



**Jordi Daura**



**Leticia Gómez**



**Manel Medina**



**Marina Prats**



**Martín Ferrer**



**Miquel Bergadà**



**Oscar Alavedra**



**Pau Pamplona**



**Rosa Maria Meseguer**



**Xavier Galceran**



**Angela Lalatta**



**Christian Moscardi**



**Ramon Moliner**



**Xavier Salip**

## Digital Social Technologies



**Artur Serra, PhD**  
Director



**Antonia Caro, PhD**



**Carla Brito**



**Eva Gómez**



**Jordi Colobrans, PhD**



**Rafael Nualart**



**Iñaki Martín, PhD**

## Distributed Artificial Intelligence



**Josep Escrig, PhD**  
Director



**Albert Calvo**



**Angel Martín**



**Daniel Alzueta**



**Estel Ferrer**



**Miguel Tarzán**



**Jim Ahtes**



**Rizk Allah Touma, PhD**



**Sergi Mercadé**



**Sergi Sánchez**



**Ivan Huerta, PhD**



**Alex Sanchez**



**Iker Gonzalez**



**Josep Brugués**



**Santi Escuder**



**Sergio Montoya**

## ERDF & Procurement Office



**Flaminio Minerva**  
Director



**Begonya Domene**



**Joan Sales**



**Yolanda Marín**

## Innovation Business Development for the Private Sector



**Ana Moliner**  
Director



**Àlex Romaguera**



**Claudia Mateo**

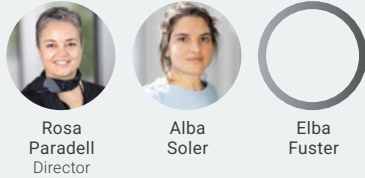


**Marc Guerrero**

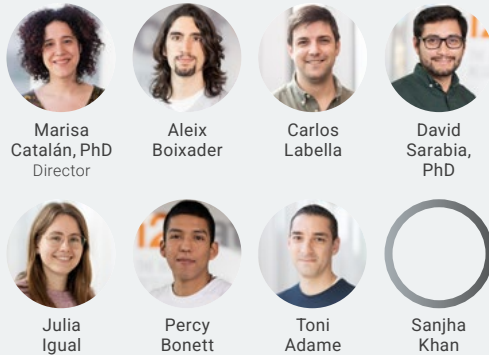


**Aina Bernal**

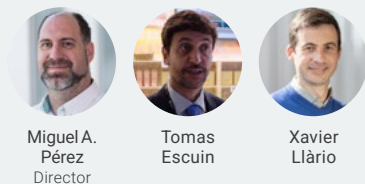
## Innovation Business Development for the Public Sector



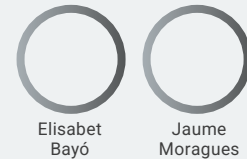
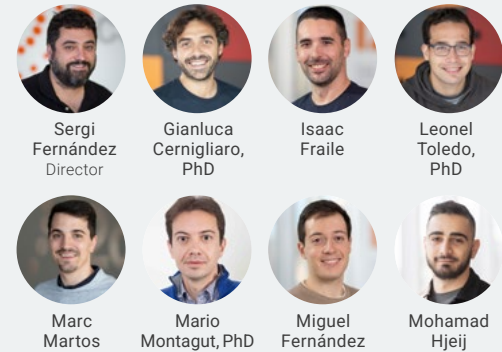
## Internet of Things



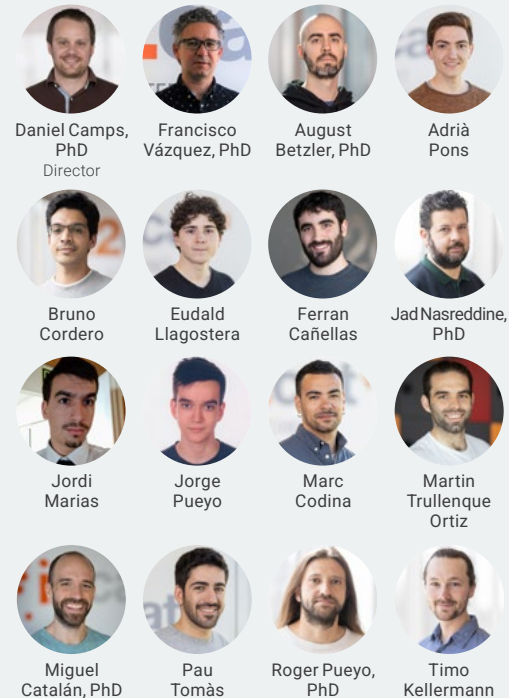
## Knowledge and Technology Marketing



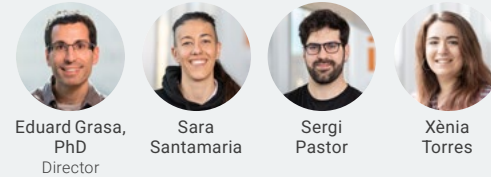
## Media Internet



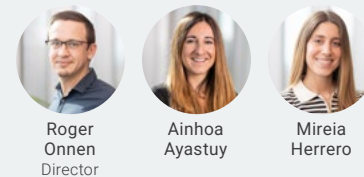
## Mobile Wireless Internet



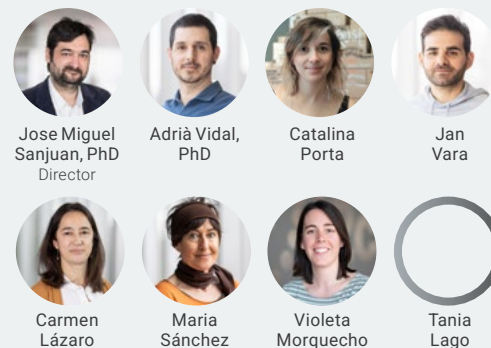
## Operations and Digital Infrastructure & Service



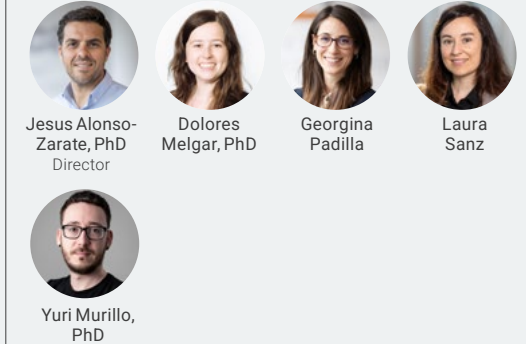
## People & Talent



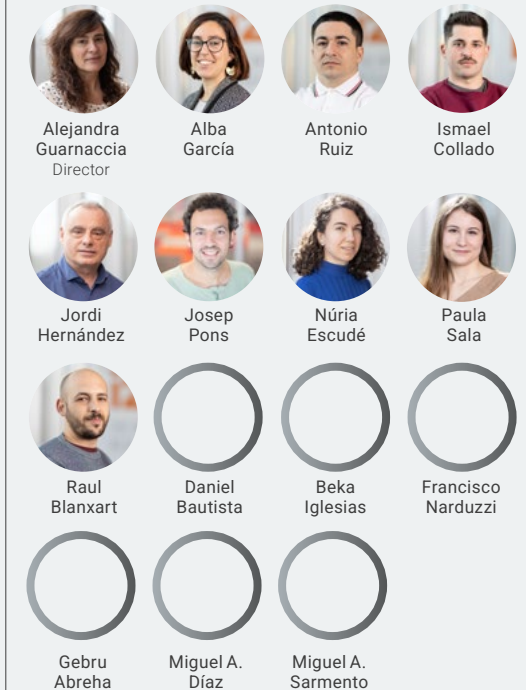
## Project Management Office



## Research and Innovation Policy and Strategy in Europe




## Software Development







Software Networks



Shuaib Siddiqui, PhD  
Director



Adrian Pino



Adriana Fernández, PhD




César Cajas




Daniel Ullied




Estefanía Coronado, PhD



Estela Carmona, PhD




Javier Fernández




Javier Palomares




Juan Camargo



Kurdman Rasol, PhD




Reza Mosahebfard




Sergio Giménez




Andrés Cárdenas, PhD



Carolina Fernández




Claudia Torres




Hatim Chergui, PhD


Space Communications




Joan Adrià Ruiz de Azúa, PhD  
Research Director




Pol Guixé  
Innovation Director




Arnau Singla




Hossein Rouzegar, PhD




Joan Pagès




Jose Avila




Marcel Marín




Oriol Fusté




Oscar Baselga




Victor Montilla




Xavier Jordan




Xavier Tort



Elena Fernández



Alessandro Villegas



Cesc Betorz

## Official certifications



## Associations, Standardization Organizations & Platforms





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The Internet Research Center

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Let's solve it together!

