5G in Catalonia

July 2020

Technology Snapshot

Generalitat de Catalunya
Government of Catalonia

5G in Catalonia: Technological report

ACCIÓ
Regional Government of Catalonia (Generalitat de Catalunya)

Execution
Strategy and Competitive Intelligence Unit of ACCIÓ and
Secretariat of Digital Policies, Regional Government of Catalonia (Generalitat de Catalunya)

Collaboration
I2Cat
5G Barcelona

Barcelona, July 2020

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Technology trends target

This study is part of a collection of reports on the different disruptive technologies detected in the ACCIÓ Technology Trends Target (2018), which are expected to have a great impact on Catalan society and its productive fabric in the years to come.

DIGITAL
- Virtual reality and augmented reality
- Artificial intelligence
- Internet of Things
- DLT and blockchain

PHYSICAL
- 3D printing
- Nanotechnology and new materials
- Robotics
- Quantum science and photonics

BIOLOGICAL
- Neuroscience
- Advanced drug design
- Omics
- Biotechnology and synthetic biology

TRANSVERSAL
- Big Data
- Connectivity – 5G
- Cybersecurity

TECHNOLOGY HYBRIDISATION
- Drones
- Connected vehicle
- *New space*
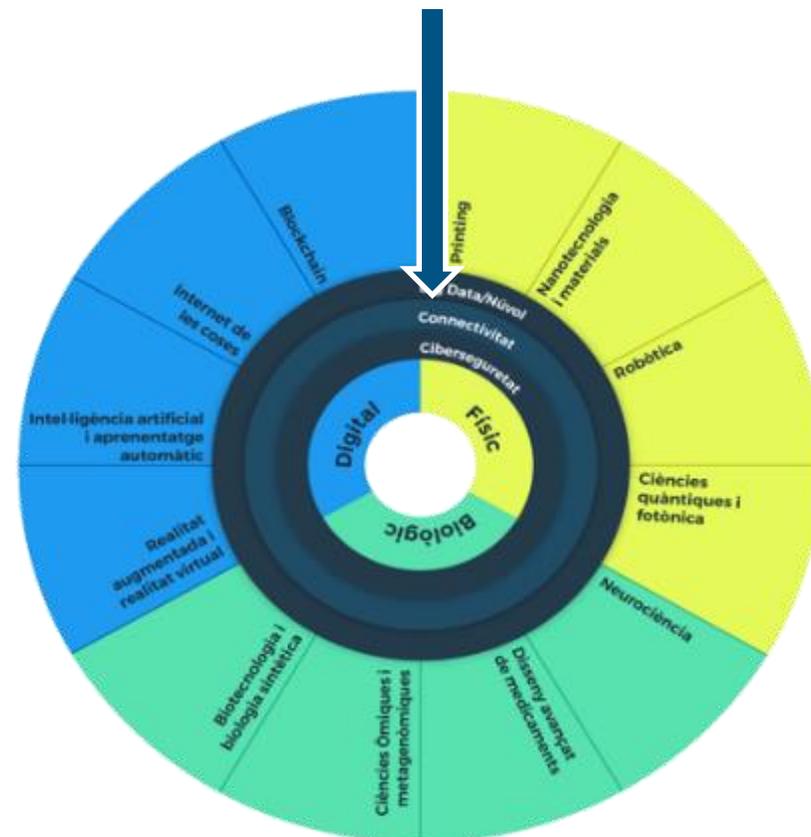
The reports published as of 1 July 2020 appear in blue. Those pending publication appear in red.

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1. 5G: definition and global and industry relevance

5G definition: a leap in terms of connectivity (I)

5G is the fifth generation of wireless communication technologies and standards.
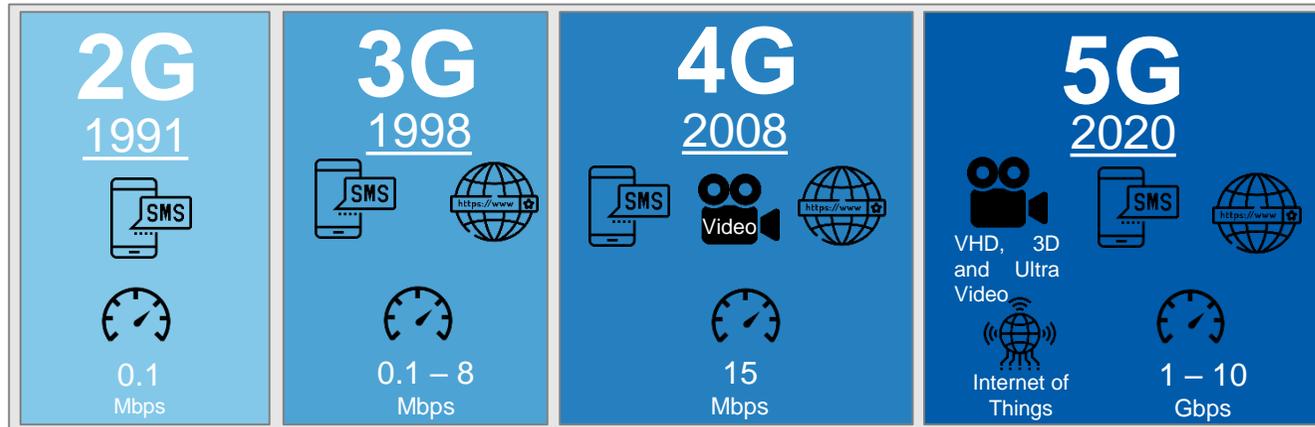
The main features of this development are a higher speed than the current one, more capacity that will allow us to respond to the increase in connected devices and a decrease in latency. This means that interactions could be almost instantaneous.

5G will not only change the way humans communicate, but also the way we communicate anything.
5G will connect the physical world (e.g. vehicles, ships, buildings, meters, machines, factories, medical devices and other items) through electronics, software, sensors and the cloud.

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5G definition: a leap in terms of connectivity (II)

Connectivity is growing at a very high rate:

42%
increase in data traffic
between 2014 and 2019

X2
The number of connections have doubled
between 2016 and 2020

IoT and *smart cities*
will increase device density and the need for more bandwidth

5G technology improvements

X10
Decreased **latency**
< 1ms

X10
Connection density
Provides a more efficient signal for IoT connectivity

X10
Performance

X3
Efficiency
Gets more bits per Hz
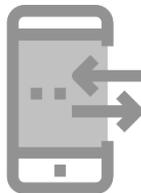
X100
Traffic capacity.
Manage network hyperdensification

X100
Network efficiency.
Network **optimisation** with more efficient processing.

Source: ACCIÓ based on Frost & Sullivan and GSMA

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The importance of 5G to companies

5G will **provide very stable and secure connections**, which are needed to operate critical devices and infrastructures remotely.

High reliability

Facilitation technology

5G **will allow the development and massive use of the Internet of Things (IoT), as well as smart and connected vehicles and** *smart cities,* thanks to the huge bandwidth and high connection density.

The importance of 5G to companies

The low latency of less than a millisecond will allow you to **monitor in real time devices that are many kilometres away**, such as vehicles or medical equipment.

Real time

Manage crowds

Crowds at sporting events and demonstrations have always collapsed the 4G network, rendering it unusable. 5G **will provide connection even in these situations of high connection density**.

Energy optimization

At present, the large number of 4G base stations needed to serve a region is very energy-intensive. 5G will optimise this energy consumption through **radio optimisations and virtualisation techniques** that will allow stations to be switched off when not active.

Source: own compilation

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2. Main global figures

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Global 5G market: forward-looking data by impact sector

In **2020, global wireless network infrastructure revenues** will reach **$4.2 billion,** an 89% increase from 2019 revenues of $2.2 billion, according to Gartner, Inc.

As for the sectors where 5G is expected to have the greatest economic impact, we find the following:

- **Energy:** The sector's paradigm shift towards the production of renewable energies, which feature more disaggregated production centres in the region, needs tools for monitoring the power grid and conveying information that IoT technology, based on 5G technology, can solve.

- **Manufacturing:** The increased competitiveness and flexibility experienced by the manufacturing industry requires 5G solutions that allow it to easily connect (without wiring) all the machinery and monitor robotics in real time.

- **Security:** The huge number of devices that will be connected to the network thanks to the advent of 5G will require specific security solutions. Moreover, in many cases these are critical infrastructures that require very high security.

Retail; 4%   Agriculture; 1%
Financial services; 6%
Automotive; 8%
Leisure and entertainment; 9%
Energy; 19%
Manufacture; 18%
Public transportation; 10%
Public security; 13%
Health; 12%
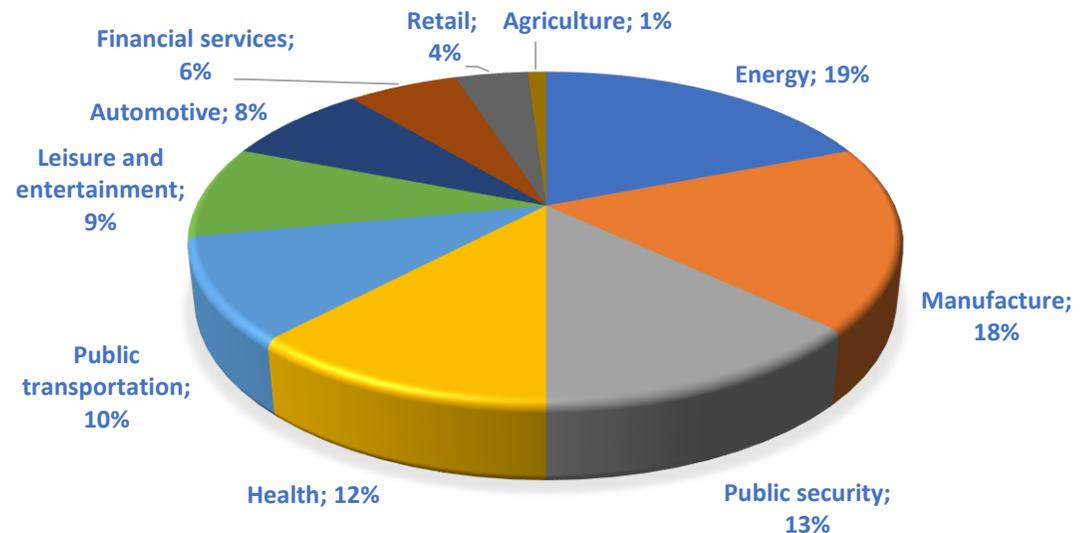
Source: ACCIÓ based on Ericsson

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Main regions and relevant hubs (I)

North America – Possible leader in 5G adoption

The United States is expected to be the world's leading market for 5G technology, just as it was for 4G technology. Companies like Verizon Wireless, AT&T, Cisco, Nokia, Ericsson, Samsung and Qualcomm feature many collaboration initiatives to develop 5G technologies and applications in the region. The leading company in the introduction of 5G in the US has been taken over by Verizon, which had already managed to bring this technology to more than twenty American cities by the end of 2019.

Europe – Horizon 2020 Initiatives

With the Horizon 2020 initiative, Europe is making significant progress in 5G; but the lack of technology infrastructure developers in the region may delay its initial adoption. Moreover, European operators have access to a frequency of 32 GHz, which many *hardware* developers may not support in the initial phase of this technology until standardisation occurs.

Asia Pacific – *Early adopters*

Asia Pacific is moving rapidly towards the implementation of the first 5G network. In fact, the world's first 5G tests were carried out in South Korea during the 2018 winter games. Asian companies such as Huawei and KT Corporation are investing heavily in the development of this technology in the region.

Source: ACCIÓ based on Frost & Sullivan

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World leading 5G companies

The leading companies in the field of **5G telecom operators** worldwide are:

The leading companies in the field of **5G mobile handset manufacturers** worldwide are:

The top 7 companies in the field of **5G network and component providers** worldwide are:

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Deployment of the 5G commercial network internationally

The first 5G commercial network launch came from the Finnish telecom company Elisa in June 2018. This first deployment was followed by the American companies Verizon and AT&T in 2018. It was not until 2019 that 5G started to be marketed in some states of the European Union. The target set by the European Union's 5G Action Plan is, by the end of 2020, to achieve 5G's commercial deployment in all member states.
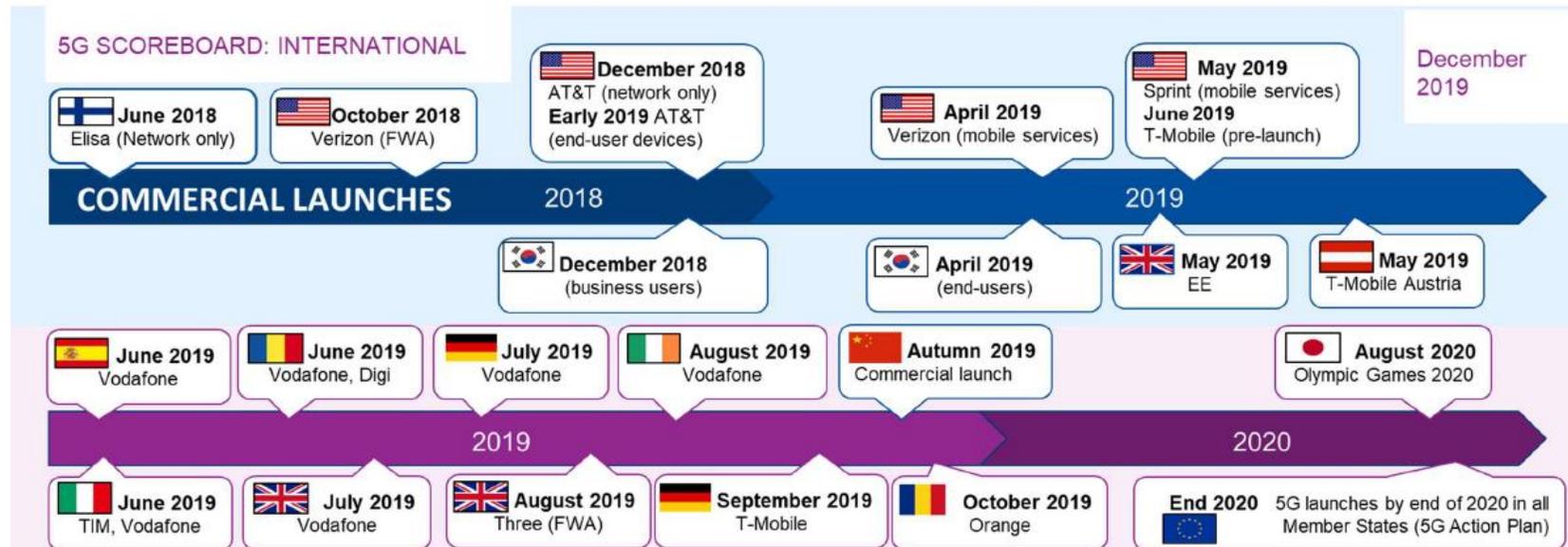
At present, there are only 5G commercial networks in Non-standalone mode (NSA: still requires 4G technology), although there are countries that are deploying pre-commercial test networks in Stand-alone mode (SA: can now operate independently).

Source: European 5G Observatory

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5G in Europe (I)

Spain, France, Italy and Germany are the European countries leading 5G tests in Europe. In fact, 25% of 5G tests in Europe have been carried out in Spain.

On the other hand, the most used frequency range for testing in Europe is, by far, with 69% of the total, 3.4 – 3.8 GHz, followed by 28 and 26 GHz.

Number of tests and trials by country

Number of tests by frequency

700 MHz ■ 3.6 GHz ■ 4.5 GHz ■ 15 GHz ■ 26 GHz ■ 28 GHz ■ 70 GHz

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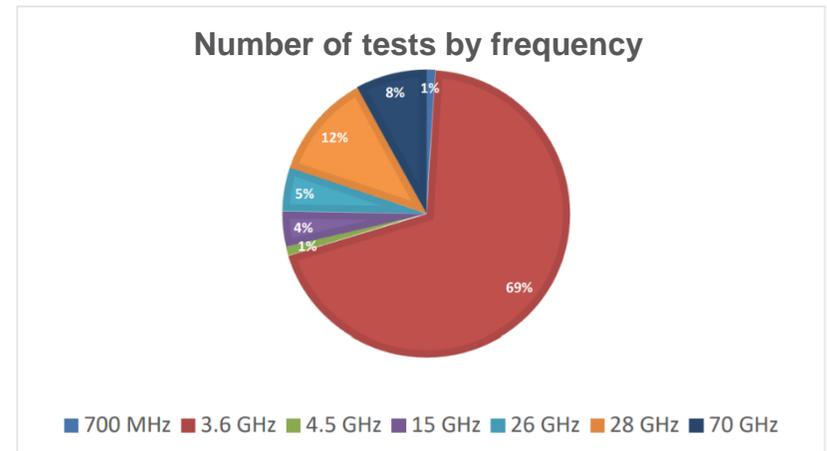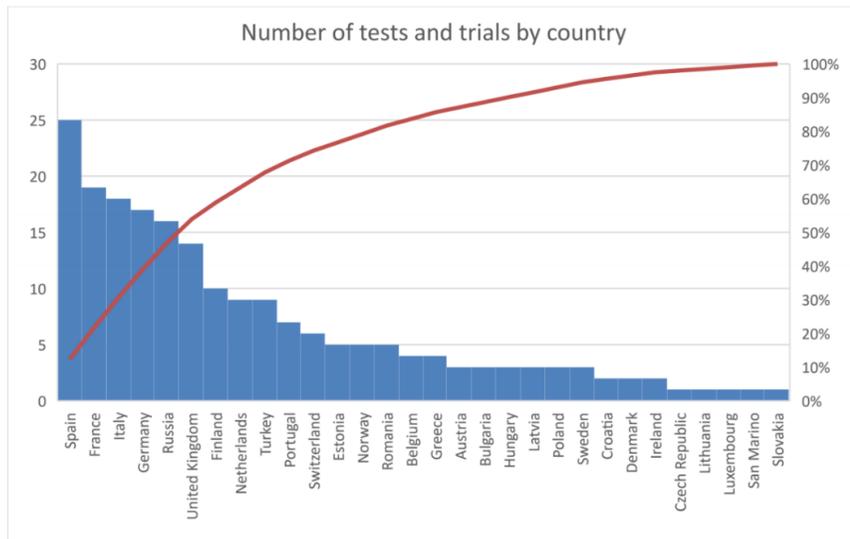
5G in Europe (II)

Audiovisual media and the car industry are the **main verticals** driving the tests.

As of December 2019, 10 European Union member states already enjoyed 5G commercial service: Germany, Austria, Estonia, Finland, Hungary, Ireland, Italy, the United Kingdom, Romania and Spain.

Number of tests by vertical

Vertical	Number of tests
Public safety	3
Virtual Reality	7
Energy	4
eHealth	12
Smart	2
Smart Cities	11
Media and	33
Industry 4.0	15
Transport	28
Automotive	20
Agriculture	3

States with 5G commercial service

States without 5G commercial service

Source: European 5G Observatory

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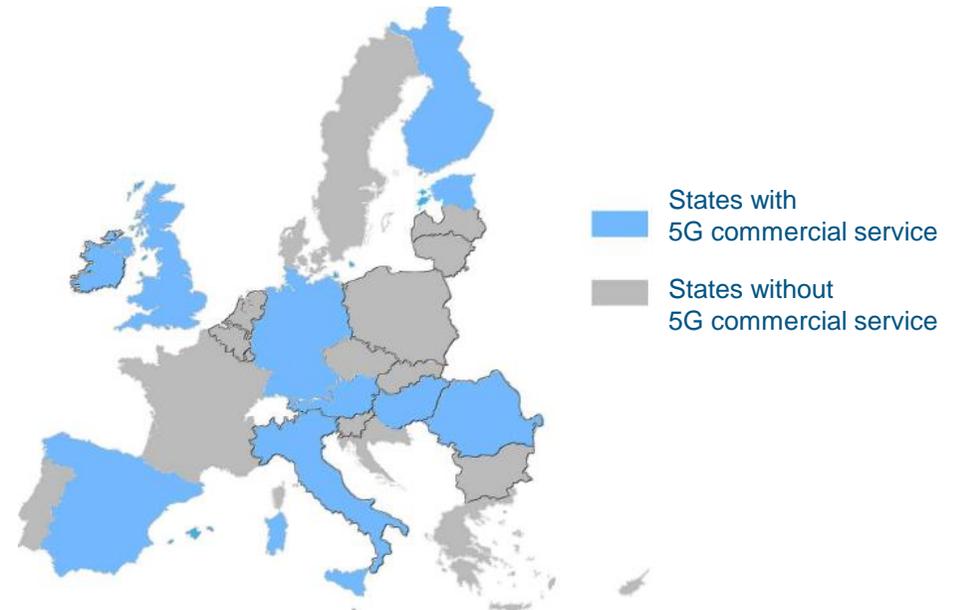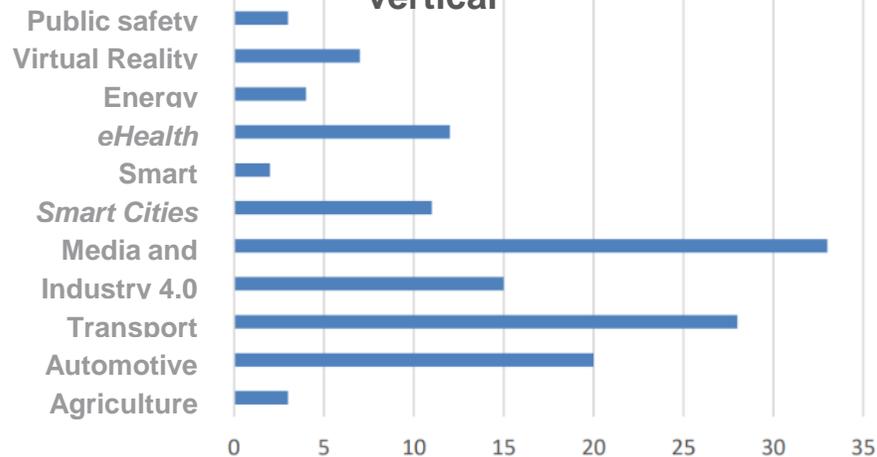
Main global investors

Trends and news of global investment in 5G

Most 5G investment initiatives are in some way encouraged by public administrations, in most cases linked to subsidies or collaborations with public bodies. Investments in start-ups are expected to gain momentum with the commercialisation and standardisation of global 5G.

ZTE

The Chinese company ZTE plans to **invest approximately €144.5 million annually** in R&D linked to 5G. This company is one of the world's pioneers in 5G.

5G PPP

The 5G PPP programme, promoted by a public-private partnership within the framework of the H2020 programmes, **drives 5G projects in the EU** with M€1,500, with the aim of developing the network on the continent.

Major companies investing in 5G and destination of their investments

NOKIA → comptel   deepfield   Alcatel·Lucent   Eta Devices   GAINSPEED

AEM GROUP → AFORE   coriant → Coriant

Anritsu → Azimuth   qamcom → ReVibe ENERGY

Note: These marks are used for information purposes only. The brands mentioned in this document are registered trademarks of the companies they belong to and are not owned by ACCIÓ. This slide is a partial and illustrative representation of the companies that are part of the 5G ecosystem worldwide; there may be other companies that have not been included in the study

Source: ACCIÓ based on CB Insights and Frost and Sullivan

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Start-up investments in the 5G sector

The main funding rounds

The 10 most important funding rounds in 2019 for 5G technology were as follows:

BaiCells, December 2019
Round value: M€85

Ambeent, December 2019
Round value: M€1

Blu Wireless, May 2019
Round value: M£12.7

Ambeent, October 2019
Round value: M€1

BaiCells, January 2019
Round value: M$14.6

DoubleMe, September 2019
Round value: M$1

Isotropic Systems, January 2019
Round value: M$14

Cumucore, June 2019
Round value: €50,000

Rafay systems, September 2019
Round value: M$8

Metawave, February 2019

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Global 5G patent market

The top 10 companies for 5G patent ownership are as follows:

Huawei Technologies
3,325 patents

Ericsson
1,423 patents

Samsung Electronics
2,846 patents

Qualcomm
1,330 patents

LG Electronics
2,463 patents

Intel Corporation
934 patents

Nokia
2,308 patents

Sharp Corporation
808 patents

ZTE Corporation
2,204 patents

NTT Docomo
754 patents

Source: own compilation based on data by IPLytics

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3. Applications by 5G demand sector

Applications by demand sector

Media	Transport	Health	Industry 4.0	Smart City
Support interactive applications that require a lot of bandwidth, often devoted to entertainment. Effective connection management for streaming services.	5G is a necessary *driver* for autonomous cars and other high-performance multimedia services on the go, regardless of speed and location.	The development of telemedicine, especially with regard to remote surgery and remote monitoring of patients, requires fast connections with very low latency.	Productive robotics will require connections with very low latency to be controlled remotely and with very wide bandwidth to be mass automated.	The *smart cities'* policies and initiatives of the administrations are based on the IoT, which uses 5G as a facilitating technology.
High-definition video and video calls along with *fixed wireless*	Autonomous/connected car	Diagnosis and remote surgery	*Cloud computing* and *Mobile Cloud computing*	Advanced resource management
Virtual reality video games	Real-time vehicle and road diagnosis	Customised telemedicine, wearables and health monitoring	Automation and monitoring of production processes	Advanced traffic control and public safety
Immersive broadcasts in real time and *social networking*	Massive asset tracking	Precision robotic surgery	Preventative maintenance in real time	Tourism

Source: own compilation based on Frost&Sullivan

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5G and the SUSTAINABLE DEVELOPMENT GOALS (II)

11. Sustainable cities and communities
5G technology would enable the development of solutions that would improve traffic management, decongest cities and improve air quality. In addition, incorporating intelligent design and 5G in building construction would reduce their energy consumption by up to 70%.

Goals 3, 4, 8 and 10
5G will extend the broadband connection by increasing the number of users worldwide. This will improve social and economic inclusion and help meet the needs in education, health, e-governance and entrepreneurship.

Goals 9, 12 and 13
Digitisation and incorporating 5G technology from a wide range of services and industries can help reduce greenhouse gas emissions by 15% by 2030. 5G technology will help the industry be more flexible, secure and energy efficient.

6. Clean water and sanitation
5G technology could facilitate the development of systems to ensure safe water consumption. On the other hand, digitisation and 5G technology will make it possible to identify and manage leaks in water lines and, therefore, improve efficiency and water savings.

7. Affordable and clean energy
5G and digitisation enable the development of solutions that could reduce greenhouse gas emissions by up to 16.5%.

Source: EIC (DGI-ACCIÓ) based on West, Techonomy

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4. 5G in Catalonia

Catalonia's 5G strategy

Catalonia boasts a number of capabilities that make it a magnet for the development of 5G technology, such as the available telecom infrastructure, its position as a country that attracts investment and generates innovation, as well as being the world capital of mobile phones.

The implementation of 5G technology in Catalonia is a priority of the Regional Government of Catalonia, which wants to support the deployment of this technology through the 5G Strategy of Catalonia, which will deploy an action programme that is structured around five core ideas:
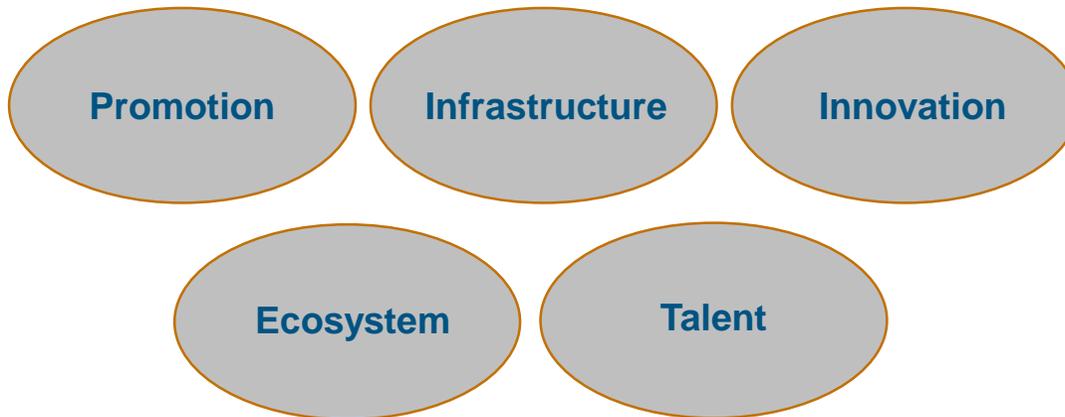
Promotion

Infrastructure

Innovation

Ecosystem

Talent

Source: Regional Government of Catalonia
(Generalitat de Catalunya)
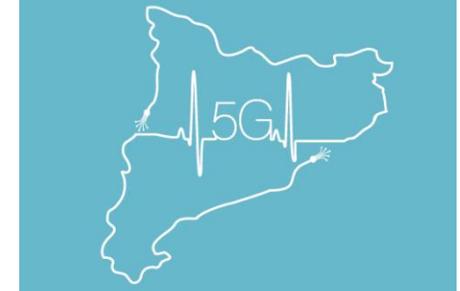
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5G in Catalonia: main mapping conclusions

38 companies

+72.7% companies

150 jobs

€87.6 million

55.26% of companies have a turnover of **more than one million euros**, whereas **44.74%** have a turnover of **more than ten million euros**

Average degree of internationalisation:

13.16% of companies have branches abroad.

28.95% of companies are exporters.

27.59% of the companies are less than ten years old

55.26% of them are SMEs

63.16% Solution developers

15.79% Equipment manufacturers

7.89% Integrators

13.16% Network or infrastructure providers

The ecosystem is made up of a combination of large mature companies and start-ups, which account for **15.79%** of the sector.

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Value chain segmentation in Catalonia

Within the **5G** market, the players can be classified in line with the following value chain:

Field of application

Network/infrastructure providers

A company that manages and offers network and infrastructure.

Catalonia is one of the pioneering areas, where use cases are being tested within research projects, whereas pilot tests are also conducted. The actual potential of 5G will reach the public when users of these technologies generate new high value-added services with the introduction of solutions developed by technology companies.

Equipment manufacturers

Manufacturers play a key role in designing new equipment to support the new network to fully exploit the capabilities of 5G.

Integrators

Engineering companies that design, build and install connectivity solutions.

Operators require players that are capable of managing the entire new ecosystem that is generated on the 5G horizon and package it for the very operator to be able to provide telecom services to customers. This is where integrators are key.

Solution developers

Services, engineering, consulting, component manufacturing, programming, facilitating technologies, etc.

Solution developers provide services related to the efficiency and flexibility of networks or implement applications that allow better decision-making and greater possibility of communication of citizens, organisations and administrations with their environment.

Industrial

Infrastructure

Transport

Mobility

Communication

Health

Tourism

Institutions

Public administrations.

Associations

Associations, clusters

Universities and research centres

Training in subjects related to robotics and automation.

Source: ACCIÓ based on SmartCatalonia

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Companies and players in the Catalan ecosystem (I)

Partially illustrative

Institutions

Associations

Universities and R&D centres

1. Equipment manufacturers

2. Integrators

4. Solution developers

Users

3. Network and/or infrastructure providers

Neutral operator

Source: I2Cat

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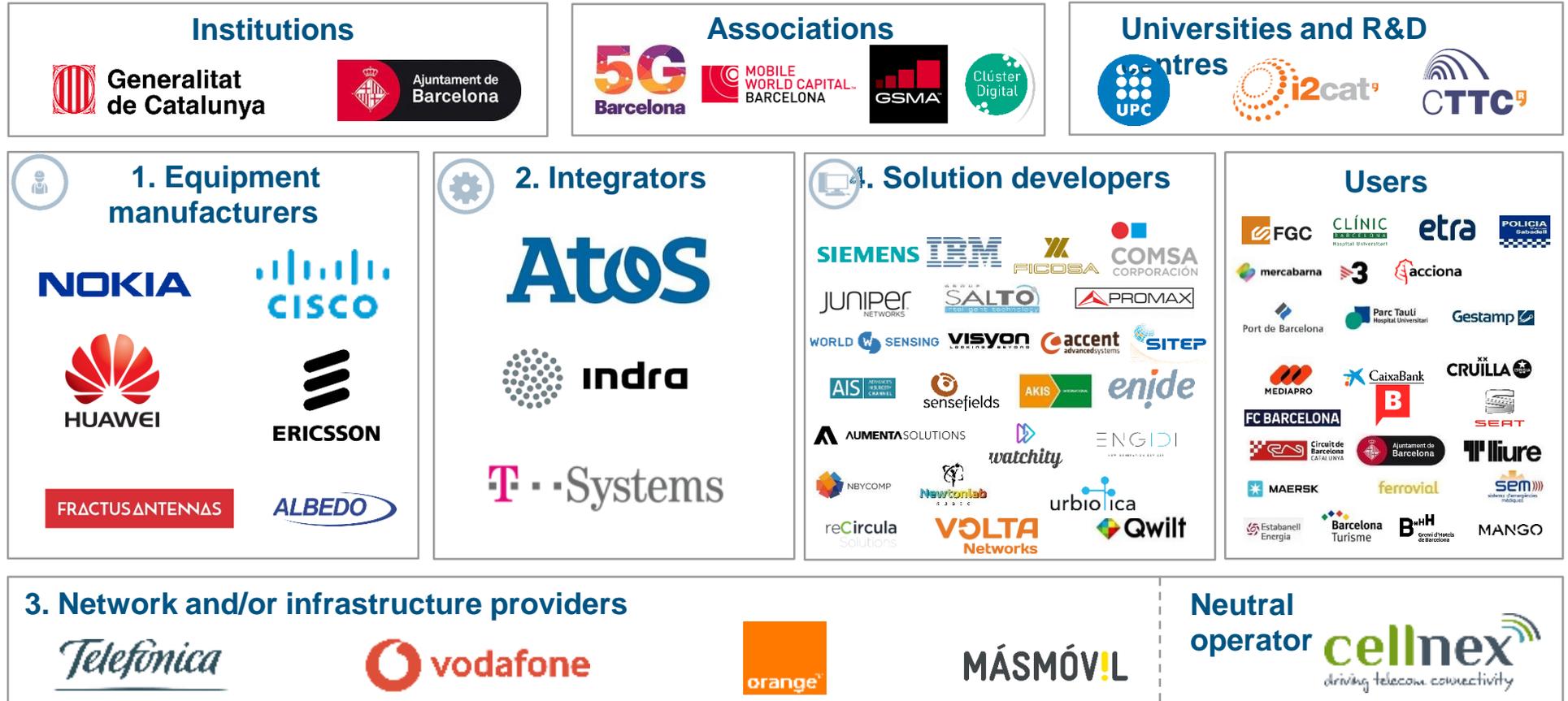
The 5G Barcelona initiative

5G represents a **technological revolution** in the context of wireless data transfer. In this context, the most innovative aspect is the participation of **new agents** and **the increase of new models of collaboration**, which inevitably leads to a **change in the value chain**, where there will be a repositioning of traditional agents and the incorporation of new ones, which will once again give a greater role to infrastructure operators and managers, and will give a **boost to new sectors, such as the IoT ecosystem** in the "smart cities" environment, Industry 4.0 or the transformation of audiovisual media.

The Regional Government of Catalonia, Barcelona City Council, the Mobile World Capital Barcelona Foundation, the i2CAT Foundation, the CTTC (Telecommunications Technology Centre of Catalonia), Atos and the UPC (Polytechnic University of Catalonia) have signed an **agreement to promote the 5G Barcelona initiative**. This association aims to **position Barcelona as a neutral laboratory**, where any agent can **design, develop and test services or applications that are implemented using 5G technologies**, thus placing the city as a European centre of digital innovation.

Create, attract and retain talent

Test, prototype and implement 5G solutions

Generate business through alliances in PPP models

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5G is key to future economic development

Catalonia will be one of the **ports of arrival** and **intercontinental connection** of the 2Africa route, one of the longest, most complete and important underwater fibre optic cable projects in the world, which will interconnect Europe, Asia, the Middle East and Africa by means of a 37,000-km long underwater cable. The 2Africa project is promoted by Facebook and major international telecom operators, such as China Mobile International, MTN GlobalConnect, Orange, STC, Telecom Egypt, Vodafone and WIOCC.

The inclusion of Catalonia as one of the landing points and sea-land connection with Europe of this infrastructure is the result of a long work carried out by the **Department of Digital Policies**, within the framework of its strategy to provide Catalonia with first-class **digital infrastructures** in order to position the country as the **main digital hub of southern Europe** and a magnet for international investment.

Currently, underwater fibre optic cables are **the basis of the global telecom network**: 99% of intercontinental Internet traffic is carried out on submarine fibre optic cables, which are already an essential infrastructure for the development of the present and future digital society.

This arrival of an important digital infrastructure has been possible thanks to the sum of different projects promoted by the Government in recent years under the premise of providing Catalonia with the necessary infrastructures in the digital field and thus prepare it to lead digital economic development in Europe.

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The 5G Mediterranean Corridor

The European Commission has announced the approval of **the 5G Mediterranean Corridor** project, promoted by a consortium of 21 entities, companies and technology centres from six countries to develop a **cross-border corridor, where autonomous and connected vehicles can be tested**.

It will provide connected and automated mobility and mobile communication services on the motorway and railway between Figueres and Perpinyà on a 5G mobile network infrastructure offering connectivity services along this corridor.

The project relies on a global investment of **16 million euros**, of which 75% is funded by the European Commission. The project will be launched in **September 2020 and will run until November 2022.**

The infrastructure will support four use cases:

CATALONIA, 5G WORLD CAPITAL

Benvingut Corredor 5G del Mediterrani

#5GMed
#DigitalCatalonia

Generalitat de Catalunya   7,5 Milions de futurs

Automated remote driving

Advanced traffic management

Continuity of commercial services on the railway during the cross-border change

Augmented reality entertainment for autonomous cars and railways.

Source: Gencat and the European Commission

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Business cases in Catalonia (I)

Cirurgià Remot (Remote Surgeon)

The "Remote Surgeon" project combines the features of telestration applied to surgical telecare through the adaptation of an operating room with 5G technology, so that a specialist surgeon can guide the surgeon working in the operating room without being physically present and in real time.

TV3

On 11 September, TV3 became the first channel to make a live broadcast through the 5G commercial network in a real, public, open and massive environment throughout the country.

FC Barcelona and Telefonica: football match broadcasts

In February 2019, FC Barcelona and Telefonica announced that the Camp Nou will be the first stadium in Europe with 5G coverage to broadcast Barça matches. Thus, spectators will be able to follow the match from home with virtual reality glasses

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Business cases in Catalonia (II)

Remote-controlled Robotic Platform with 5G

The pilot project "Remote-controlled Robotic Platform with 5G" combines the innovative technology of autonomous robotics with remote control of vehicles and has enabled complex operation tasks in an industrial environment based on an integrated system of cameras and remote controls.

Connected vehicle

Telefonica and Seat will use 5G technologies to implement projects related to the connected car.

5G City

Three use cases related to audiovisual media (real-time mobile transmission, UHD video distribution as well as real-time video acquisition and production via Edge & Cloud Computing) will be deployed and evaluated.

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Business cases in Catalonia (III)

Ambulància Connectada (Connected Ambulance)

The "Connected Ambulance" pilot project provides specialised remote support to EMS professionals in the event of a complicated medical emergency or when a certain level of specialisation is required (for example, an ongoing delivery, a complex, critically ill patient, a suspected heart attack or stroke) with high-definition, real-time video during ambulance care.

5G Firefighting Drone

The "5G Firefighting Drone" pilot project aims to improve firefighting management through the transmission of images in real time, geo-positioning and ground temperature. This data is sent to a base station, where it is further processed, combined and shared with emergency teams.

5G Cruïlla

Thanks to the "5G Cruïlla" initiative, those attending the tenth edition experienced a concert from the stage, alongside their favourite artists, through a 360° virtual and immersive reality experience and 5G connectivity, making El Cruilla the first 5G festival in Europe.

Business cases in Catalonia (IV)

5G Rural

The "5G Rural" project transformed nectarine field in Albatàrrec into the first connected 5G field throughout Spain. 5G was used to optimise the pruning process, a key operation to improve agricultural production.

5G Interactive City

The "5G Interactive City" project combines mixed reality and 5G technology to create an immersive tourist experience that allows visitors to discover interior spaces of monuments, access enriched content and even shop virtually.

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Ferrocarrils de la Generalitat de Catalunya (Catalonian Railways)

The 5G railway laboratory connects the Ferrocarrils de la Generalitat de Catalunya section between Plaça Espanya and Europa Fira with 15 5G antennas to test new digital services aimed at both the railway sector and citizens using this transport.

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Business cases in Catalonia (V)

Misty It: Improving the quality of life of the elderly

One of the winners of the social challenge "How to improve the quality of life of the elderly with technology", Misty II, is a robot programmed to remind its companions of their daily medication or food needs, ask about their health or even communicate with medical services by holding videoconference via the 5G network.

5G First responders

The "5G First responders" pilot has allowed a police officer to receive real-time instructions from medical staff located in the hospital's ICU. During simulation, the medical staff has given directions to perform first aid and stabilise the patient. 5G technology allows you to respond immediately in the first moments of a medical emergency, a few key minutes in order to avoid serious injuries or even to save lives.

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Read the full report here:

http://catalonia.com/.content/documents/5G-in-catalonia.pdf

More information on the industry, related news and opportunities:

http://catalonia.com/trade-with-catalonia/ict-mobile.jsp

For the full technological report, please send an e-mail to
irodriguez@catalonia.com

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