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## Spain is ready for the future internet

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Spain is a country of contrasts: geographic extremes and economic diversity. You can travel from snowy mountain peaks to arid plains. You can pass from the cosmopolitan, vibrant cities of Barcelona and Madrid to the remoteness of Asturias. However, information and communications technologies (ICT) are a common thread. Spain takes a prominent role in the ICT research theme of the Seventh Framework Programme (FP7). A healthy mix of universities, research institutions, large and small private companies have participated, or are currently participating, in around 175 projects out of the more than 1500 FP7-ICT projects funded so far by FP7.

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Spain is a country of contrasts: geographic extremes and economic diversity. You can travel from snowy mountain peaks to arid plains. You can pass from the cosmopolitan, vibrant cities of Barcelona and Madrid to the remoteness of Asturias.

As you journey, you also experience strong cultural identities in Andalucia, the Basque country, Catalonia and Galicia, for example, and observe differences in wealth.

And although information and communications technologies (ICT) are a common thread - something that bridges the gap between these contrasts - even here the polarisation is apparent: Spain is below EU average for fixed broadband penetration, but well above average for mobile penetration and broadband availability.

A technology driver

Spain takes a prominent role in the ICT research theme of the Seventh Framework Programme (FP7). A healthy mix of universities, research institutions, large and small private companies have participated, or are currently participating, in around 175 projects out of the more than 1500 FP7-ICT

projects funded so far by FP7.

As the country's incumbent telecommunications company and a powerhouse for ICT research and infrastructure development, Telefónica has coordinated a total of 12 FP7-ICT projects to date (and participated in roughly 30 more).

Perhaps one of Telefónica's most important contributions, which could have an impact on everyone's future internet experience, is as coordinator of FI-WARE (1), funded through the [Future Internet Public-Private Partnership](#) [2] (FI-PPP) 'to advance the global competitiveness of the EU economy by introducing an innovative infrastructure for cost-effective creation and delivery of services.' The key deliverables of FI-WARE will be an open architecture and a reference implementation of a novel service infrastructure. Through Telefónica, Spain is leading the next internet revolution.

Telefónica is also coordinating the exciting SmartSantander project, a proof of concept/testbed project for many of the technologies and architectures being developed through the FI-PPP. SmartSantander proposes a unique experimental research facility: the entire city of Santander.

With the support of the city authorities, public transport and other municipal services the project is testing the deployment of numerous smart technologies. The city is being 'wired up' with around 20 000 sensors that will measure everything from atmospheric conditions, levels of carbon monoxide, noise and traffic flows - a veritable 'Internet of Things' (IoT) that will produce a continuous stream of data for real-time analysis and response systems.

The first 'service' will involve traffic sensors that detect cars in on-street parking spaces. This information could be used by the municipal authorities to improve traffic flows, regulate parking charges or provide citizens with smart mobile apps which could navigate them to available spaces.

The results of the Santander trials (and other IoT experiments taking place across Europe as part of the project) will greatly influence the definition and specification of future internet architecture design. SmartSantander's infrastructure builds on the results of two more major EU-funded projects, SENSEI (2) and WISEBED (3), which have demonstrated how heterogeneous technologies can be integrated securely into a single network.

Cloud nine

Another big Spanish player, Atos Origin, also takes a leading position in terms of Spanish involvement in FP7 ICT. This company's success is based on its long heritage of involvement in EU-funded projects; it has the prior experience and industry contacts that are necessary to the build strong, reliable and innovation-focused project consortia that receive good evaluations.

Atos has particular expertise in the development of service-oriented platforms and architectures. The Cloud4SOA (4) project is trying to find ways to stitch together multiple (and multiplying) 'cloud' infrastructures and services into one virtual, seamless resource. The project is taking a user-centric approach that will allow software developers to create cloud-based applications that are interoperable across all cloud services, irrespective of the underlying infrastructure or service provider. Cloud4SOA will combine three fundamental and complementary computing paradigms - cloud computing, 'service-oriented architectures' and lightweight semantics - to propose a reference architecture and deploy fully operational prototypes.

The related SOA4All (5) project is coordinated by Atos Research & Innovation. With tens of billions of devices networked together (a figure that is growing daily), the world is seeing a fundamental shift in

the way that data is produced, stored, used and shared. We are witnessing a new era where data is being linked in an open and altogether more usable way. And we are seeing a blurring of the boundaries between content providers and consumers, as social networking sites, blogs and other platforms proliferate on the internet, leading to a new generation of so-called 'prosumers'.

The completed three-year SOA4All project has produced web-based tools designed for both technical and non-technical users, allowing them to interact with services in different ways. Industrial partners have already demonstrated the benefits of SOA4All technology and the project has produced components that will promote greater take-up of SOA as a whole.

SOA4All thus provides the basis for a powerful impact among the internet research and developer communities and, according to its coordinator Elies Prunés Soler of ATOS Research & Innovation: 'SOA4All's work can also have a significant impact on the competitiveness of the European software and services industry in the future internet.'

### Money matters

These high level projects are complemented by more applied ones in different domains, for example financial services. PARSIFAL (6) brought together stakeholder representatives of critical infrastructure in financial services, from both the public and private sphere. Together they developed a communication platform that would alert everyone to any critical infrastructure issues so that action and cooperation would be swift, effective and avert escalation or potential disaster.

The FIRST (7) project, also coordinated by Atos Origin, is now underway to 'extract information from a wide range of data sources on a large scale and use it to support non-ICT-skilled end users who want financial information and market analyses; for example, individuals who make small trades in stocks and shares as personal investments.

The project has already produced several unique tools: information extraction from unreliable semi-structured sources on a massive scale and in near real time; automatic reuse of existing ontologies, large-scale ontology learning, and advanced decision models that make use of semantic attributes.

### Energy for research

Telefónica and Atos account for a quarter of FP7-ICT funding going to Spanish participants. The bulk of funds, however, goes to higher education and research organisations; indeed almost all of the technical universities across the country are involved in at least one FP7 project. Universities are particularly involved in applied research projects, especially in the areas of e-health, e-inclusion and energy efficiency where the Spanish share of FP7 funding is much higher than the EU average.

The ENERSIP project (8), for example, is coordinated by the Fundacion Tecnalia Research & Innovation. Its goal is to create an adaptive, customisable, and service-oriented energy monitoring and control system for energy grids. The idea is that every element of an energy grid - the communications, control, computing and construction of both consumption and generation facilities - requires proactive and coordinated control and management. The project is developing an open information platform where sensor data from every element in the grid can be used to match electricity generation to demand in residential and commercial buildings and entire neighbourhoods.

The FIEMSER (9) project is also developing real-time smart control systems which will help to match local consumption and generation. It will include methods to save energy too, so rather than increase generation the system may choose to close blinds or curtains in a property instead. An intuitive user

interface will allow the people to save energy while maintaining their desired level of comfort.

ICT holds significant promise in Europe's attempts to reduce its carbon footprint. The SEEDS (10) project is coordinated by engineering firm CEMOSA and will develop sense and control systems that will help to regulate the energy consumption of buildings and learn how to optimise heating, air conditioning and lighting according to various human criteria (and the weather). The system is geared to maintain user comfort whilst minimising energy consumption and CO2 emissions.

Smart systems like the SEEDS prototype could be used throughout Spain, whether the building is located in the chilly mountains or is subject to the intense summer heat of the southern Mediterranean. Indeed, wherever you go in Spain you could soon see the fruits of the country's research effort, as it starts to deploy and benefit from smart applications and solid ICT infrastructure. Spain is ready for the future internet.

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The projects featured in this article have been supported by the Competitive and Innovation Programme's (CIP) ICT-Policy Support scheme or the Seventh Framework Programme (FP7) for research.

- (1) FI-WARE: Future Internet Core Platform
- (2) SENSEI: Integrating the physical with the digital world of the network of the future
- (3) WISEBED: Wireless Sensor Network Testbeds
- (4) Cloud4SOA: A Cloud interoperability framework and platform for user-centric, semantically-enhanced service-oriented applications design, deployment and distributed execution
- (5) SOA4All: Service oriented architectures for all
- (6) PARSIFAL: Protection and trust in financial infrastructures
- (7) FIRST: Large scale information extraction and integration infrastructure for supporting financial decision making
- (8) ENERSIP: Energy Saving Information Platform for Generation and Consumption Networks
- (9) FIEMSER: Friendly Intelligent Energy Management System for Existing Residential Buildings
- (10) SEEDS: Self learning Energy Efficient builDings and open Spaces

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