TECNOPORT2025

BUILDING THE IOT-CONNECTED FUTURE IN THE PORT OF SEVILLE

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The Port of Seville is the only inland seaport in Spain. It is a core port within the Trans-European Transport Networks (TEN-T), being part of the Mediterranean Corridor.

It is located on the 80 kilometre Guadalquivir EuroWay waterway that runs from Seville to the coast and forms part of the TEN-T.

But the Port of Seville is also an important logistics hub that serves a population of over one million people, maintaining a dominant position in certain logistic corridors, especially in the Madrid-Seville-Canary Islands corridor. Being an inland port facilitates cargo access to the city of Seville and the surrounding area, but it also introduces some major problems related to the navigability in the estuary, as the shallow depth of the waterway limits the size of vessls calling at the port.

The Port Authority of Seville is committed, as part of its long-term planning, to invest in technology. With this objective, in 2014, the Tecnoport2025 project was launched.

It was co-funded by the European Commission by means of European Region Development Funds (ERDFs), in an open tender under the pre-commercial public procurement model.

The University of Seville was the successful bidder and has led a team of five companies, namely Telefónica, Thales, Portel, Isotrol and Serviport, with the final goal of building the "Port of the Future".

Tecnoport2025 is conceived as an initiative to enhance existing physical infrastructure by means of an intensive use of information and communication technologies (ICTs).

Tecnoport2025 deployed innovative ICT infrastructure, including a heterogeneous communications network and an advanced platform for service integration, and carried out three subprojects called CUTS, FPS and eRIO. The various subprojects are described in the rest of this paper.

CUTS

The main objective of Container Unitized Tracking System (CUTS) is to develop a low-cost open platform for geo-location and for remote monitoring and control of containers and their cargo. CUTS provides monitoring of containers, integrating data coming from sensors located in the containers and actuation orders over them in an open platform accessible to the different actors in the logistic chain.

To this end, CUTS deploys wireless sensor networks in warehouses, container yards and vehicles, trains, trucks and vessels. Sensor nodes attached to containers detect the presence of such networks and periodically report its location, sending the information collected from sensors to the network coordinator, which, in turn, is connected in a global network using fixed, mobile or satellite communications, depending on the available technology. Moreover, the network coordinators collect the orders for the actuators from the platform for services integration by sending

them to the sensor nodes. Therefore CUTS transforms the container into an active element of the multimodal corridor, almost comparable to a store asset, increasing the capacity of management of supply chains. Sensor nodes have open interfaces, so that every technology provider can produce CUT compatible products. The use of open architectures and interfaces is a unique characteristic of CUTS.

FERROPORT SYSTEM (FPS)

The objective of FPS is the development of a support system for the operation of private railway facilities. These facilities exist in ports, large industries, maintenance yards of railway operators, large logistics nodes, etc. They have specific characteristics that differentiate them from public or general railways.

Trains run inside the confined facilities, while no passengers are transported, and they circulate at a walking pace. Systems developed for conventional or high-speed railways are not suitable for these particular facilities, where the requirements are quite different. Due to the cost of conventional regulation systems, at present, these facilities are exploited with a very limited use of technology. FPS is a complete low-cost solution for these particular facilities that includes the automation of the operation of the field elements, switchpoints, level crossings, protections, etc. and provides safety assistance to the operators of the railway installation as well as to those responsible for maneuvering containers, including train drivers. The main functions of the FPS are to:

- Monitor in real time the state of the railway installation, including switchpoints, level crossings, bridges, and the position and length of railway compositions.
- Define and launch routes according to the state of the rail network and the exploitation program.
- Automatically configure the railway elements to assign a route, mainly by making the switchpoint changes and protecting the level crossings involved.
- Offer recommendations and information to the operators of the railway installation and the train drivers.

FPS has developed some innovative solutions to decrease equipment and installation costs, such as specific low-cost control equipment, GPS train location assisted by magnetic detectors and virtual signaling.

WATERWAY MANAGEMENT

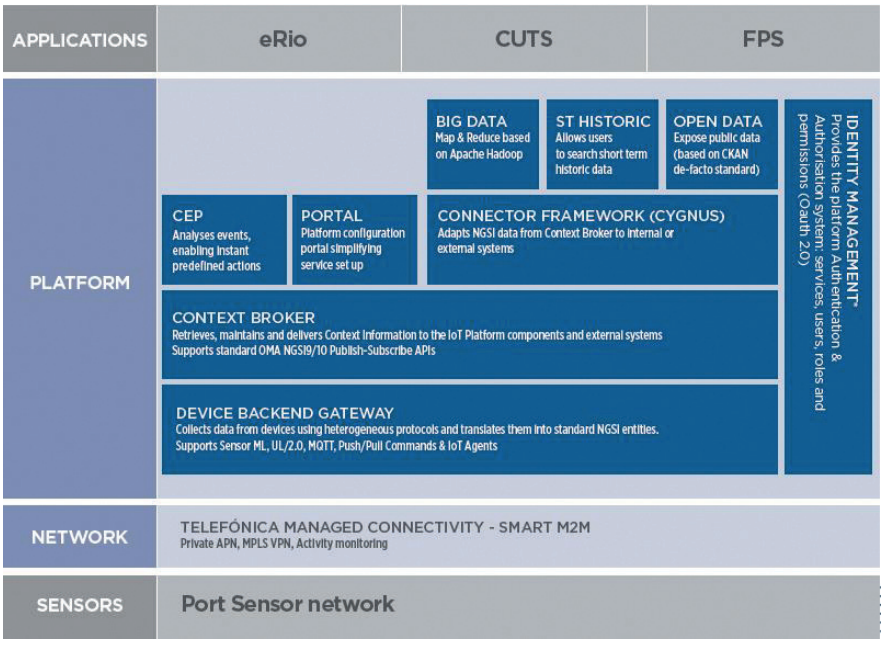
The eRIO project, which stands for river information and optimizaiton, countered the challenge of optimizing the management and operation of the Guadalquivir Euroway waterway by using resources better to achieve higher capacity, greater security and lower operating costs, while ensuring environmental sustainability. It also aims for the adoption of the River Information Services, which are services that enhance safety and efficiency of inland waterway transport through real time exchange of traffic information, which are are supported by EU policy. It comprises two sub-systems:

- The information sub-system, which is a platform that includes an unattended communications network for data monitoring and instrumentation deployed along the waterway and a database that facilitates the integration of data coming from internal and external sources. It also facilitates visualization and exploitation of data by other applications and systems.
- The traffic sub-system, which is an integrated system for traffic management in the waterway system under River Information Services. It includes support for the skippers, as well for traffic management operators and some capacity for action on maritime signalling.

INTEGRATION PLATFORM

Tecnoport2025 requires an integration platform that collects the information coming from the sensor network deployed in the different means of transport, trucks, trains and external services such as AIS systems, stores them in a distributed database, and serves them to the users by means of services and applications. FiWare, a de-facto standard shareware service pushed by the European Commission in its Future Internet initiative, has been chosen to implement this platform.

FiWare is an open cloud-based infrastructure for cost-effective creation and delivery of Future Internet applications and services based on the Internet of Things (IoT) paradigm. The API specification of FiWare is open and royalty-free, driven by the development of an open source reference implementation, which accelerates the availability of commercial products and services based on FiWare technologies.



SECURITY ASPECTS

Security is an important aspect for Tecnoport2025, which was designed to be secure from its concept to its final implementation. Telefónica, a Spanish communications provider, was in charge of the communication infrastructure, and employed the GSMA IoT Security Guideline to ensure that best practices in terms of security were followed. For example, Telefónica's connectivity platform is able to detect anomalies on connected devices and control their data usage, as recommended in the GSMA guidelines. Tecnoport2025 also maintains a clear separation of data between users, employs secure keys and requires users to authenticate themselves. As Tecnoport2025 solutions use a combination of intrinsically secure cellular networks and wireless networks operating in unlicensed spectrum, Telefónica employs a combination of private access point names (APNs) and virtual private networks (VPNs) to connect the remote sensors to the Integration Platform. Access to communications networks is also controlled by SIM cards and by other mobile authentication solutions.

NEW PRODUCTS DEVELOPED

Tecnoport2025 ended in December, 2015 with a full-scale demonstrator of the overall solution that verified both, its technical feasibility and the effective creation of value. Tecnoport2025 has developed a set of new products, which are being commercialized by the companies involved in the project under an exploitation agreement with both the Port of Seville and the University of Seville.

ABOUT THE AUTHORS

Antonio Torralba has a PhD in Electrical Engineering. He has been a Professor in the Electronic Engineering Department at the University of Seville since 1996. He has published more than 80 papers in international journals and transactions and has participated in more than 80 R&D projects with National and European-level funding. His interests are in electronic design, monitoring and control with application in Intelligent Transportation Systems.

Eduardo Hidalgo has a Telecommunications Engineering Degree and a master's in Electronic Communications from the University of Seville. Currently he is working in the Electronic Engineering Department towards his PhD. Since 2010 he has participated in more than 10 R&D National and International Projects. His interests are in sensor networks, data acquisition, data collection and data integration in large database or platforms.

María García-Castellano received a Telecommunication Engineering Degree in 2009 from the University of Seville. Since 2010, she has held a researcher position at the Electronic Engineering Department of the University of Seville. She currently manages different R&D projects based on Internet of Things, WSN, social computing and embedded systems. Her background is in low power low wireless sensor networks with new different technologies.

José Maria Peral-López received an Electronic Engineering Degree in 2015 from the University of Seville, where he has held a researcher position at the Electronic Engineering Department since 2008. She currently manages different R&D projects. His background is in RF design, low power low wireless sensor networks with new different technologies like IoT.

ABOUT THE ORGANIZATION

The Electronic Engineering Group (GIE, TIC-192) was born in 2003, in a call for research groups of the 3rd Andalusian Research Plan (III PAI), when its components split away from the Electronic Technology Group (GTE, TIC-109). Since then, the Electronic Engineering Group has received the 'excellence award' in successive editions of this call (2003 and 2004) with the maximum score. The GIE is based on the Department of Electronic Engineering in the School of Engineering at the University of Seville in Spain, and brings together more than 50 researchers, 21 of them with a PhD degree.

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