asepa
ASOCIACIÓN ESPAÑOLA DE PROFESIONALES DE AUTOMOCIÓN

INSIA

Automatización de vehículos

(Aplicación y oportunidades en el Sector Transporte)
8ª edición

MÓDULO 3
Aplicaciones, experiencias y oportunidades

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MÓDULO 3
Aplicaciones, experiencias y oportunidades

Aplicaciones y Proyectos de I+D+i

Profesor:

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Dr. Ingeniero en Informática (Univ. de Deusto. Fac. de Informática, 1986). Trabaja en la División de Industria y Transporte de Tecnalia (miembro de BRTA: Basque Research & Technology Alliance) – Área de Movilidad – Plataforma CCAM (Cooperative, Connected and Automated Mobility). Master en Robótica y Automatización (Robotiker, 1987/88). Master en Ingeniería del Software (Deusto-ESIDE, 2000/01). Doctor por el programa "Ciencia de la computación" (2015). Más de 25 años de experiencia como director de proyectos de investigación y desarrollo en los ámbitos de Sistemas Inteligentes de Transporte (ITS) y conducción autónoma de vehículos. Ha publicado artículos, dado conferencias e impartido cursos y seminarios en estas temáticas a nivel nacional e internacional. Representante de Tecnalia en diversas plataformas, entre ellas las Task Force de Electronic & Communication Systems y de Urban Mobility en EARPA (European Automotive Research Partners Association). Defendió en diciembre del 2015 su tesis doctoral de título "Nuevo método basado en el HRV para la evaluación de HMIs y sistemas ITS para transporte por carretera integrando factores personales, temporales y ambientales". Es miembro del Colegio Oficial de Ingenieros en Informática del País Vasco.

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QUIÉNES SOMOS

TECNALIA es el **mayor centro de investigación aplicada y desarrollo tecnológico de España**, un referente en Europa y miembro de *Basque Research and Technology Alliance*.

Con **1.501** personas expertas de **30** nacionalidades, orientadas a transformar la investigación tecnológica en prosperidad, ejerciendo de agentes de transformación de las **empresas** y de la **sociedad** para su adaptación a los retos de un futuro en continua evolución.

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ÁMBITOS DE ACTUACIÓN

Nuestros ámbitos de actuación están alineados con los **Objetivos de Desarrollo Sostenible (ODS)**

Con una perspectiva **multisectorial** y **multitecnológica** escuchamos y trabajamos junto a las empresas e instituciones para dar respuesta a los **grandes desafíos globales**.

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ITS Projects: Validation & Impact Assessment

Project Name

AMITRAN: Assessment Methodologies for ICT in multimodal transport from User Behaviour to CO2 reduction

AMITRAN

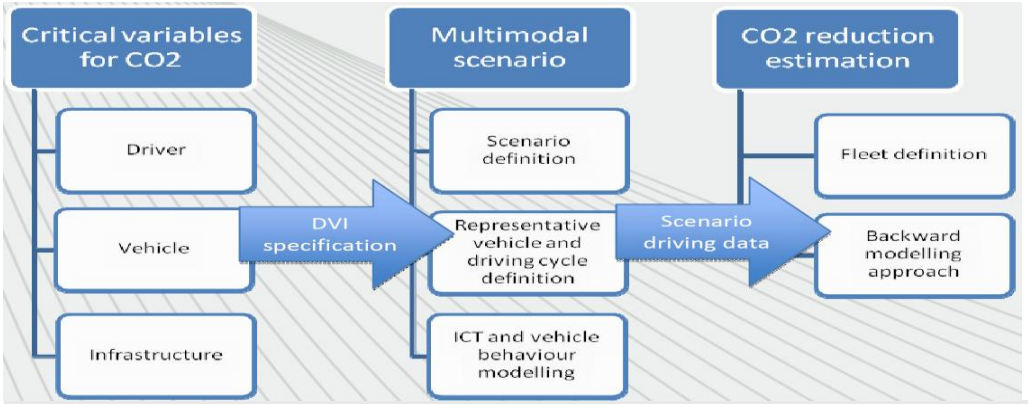
Roles

Validation and evaluation:

- Validation workpackage leadership.
- Impact analysis.
- Contribution to use cases and user needs analysis.
- Contribution to methodology framework and architecture.
- Contribution to the specification of AMITRAN models
- Verification methodology for models

AMITRAN Goal

"Development of a framework to assess the impact of ITS in passenger and freight transport on **energy efficiency** and **CO_2 reduction** in a systematic and consistent manner."



ITS Projects: Validation & Impact Assessment

Project Name

eCoMove: Cooperative Mobility Systems and Services for Energy Efficiency

eCoMove
Cooperative Mobility Systems and Services for Energy Efficiency

http://ecomoveproject.com/

Goal

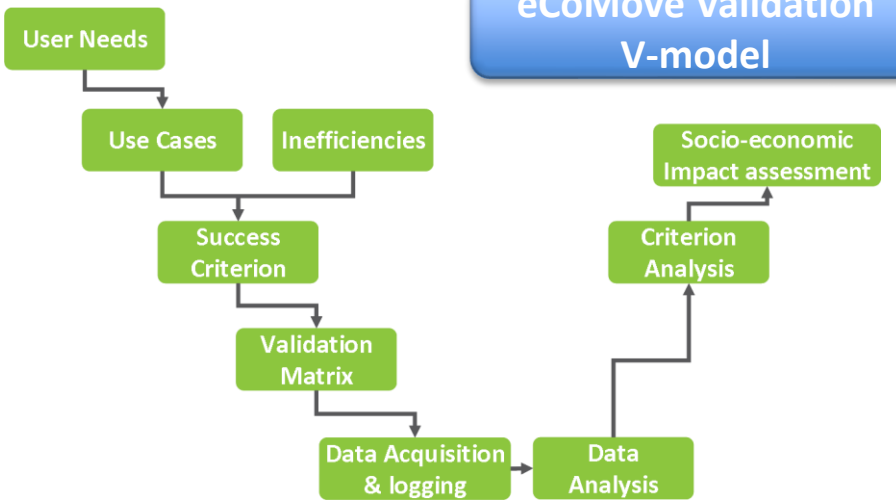
Develop ITS for drivers and traffic managers to reduce fuel consumption through combination of cooperative systems using vehicle-infrastructure communications

Roles

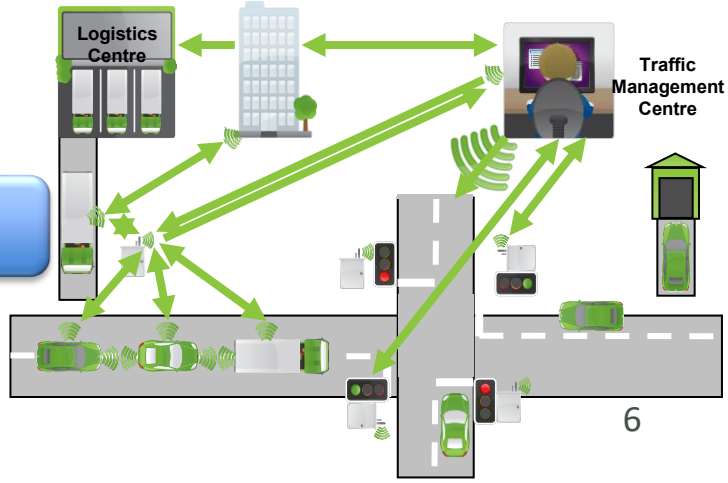
Validation and evaluation:

- Definition of the Validation fwk. and data collection systems
- Field trial planning and coordination
- Human behaviour for Impact assessment
- Coordination of the validation stage

eCoMove Validation V-model



eCoMove World



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ITS Projects: Validation & Impact Assessment

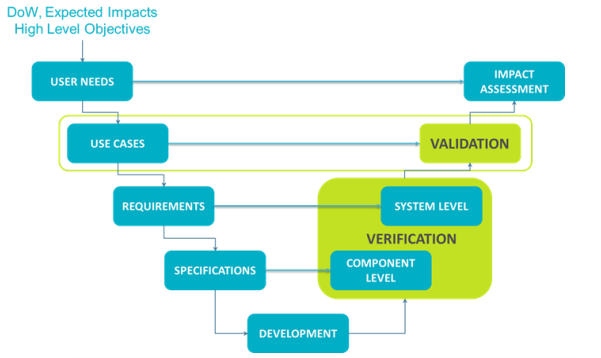
Project Name

MOBINET: Europe-Wide Platform for Cooperative Mobility Services

MOBiNET
Internet of mobility

Goal

To develop, deploy and operate the technical and organisational foundations of an open, platform for Europe-wide mobility services.
Tecnalia´s application to automated Personal Rapid Transit



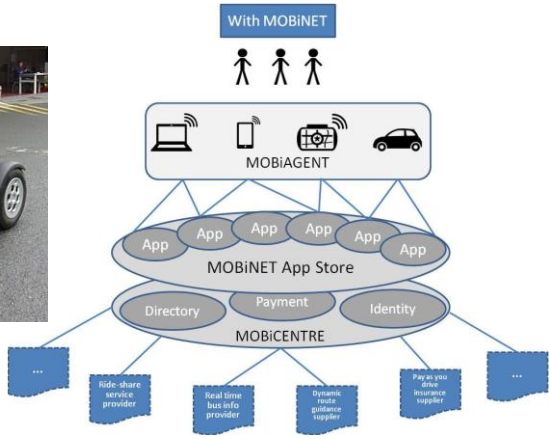
Mobinet Validation approach

Roles

Validation and evaluation:

- Leading activities related to the Validation Framework definition and contribution to validation plan of MOBINET platform and pilots.
- Implementation of Personal Rapid Transit in Vigo´s Pilot Site
- Contribution in business models and social aspects
- Leading Operational guidelines work package

TECNALIA´s vehicle for PRT



Mobinet open platform schema

ITS Projects: Human factors & HMI

Project Name

MARTA: Mobility and Automotive for advanced transport networks

www.cenitmarta.org

Goal

Research in communication V2V & V2I to develop technological solutions for traffic congestion and accidents reduction and, in case of accident, contact the Emergency Services.

Roles

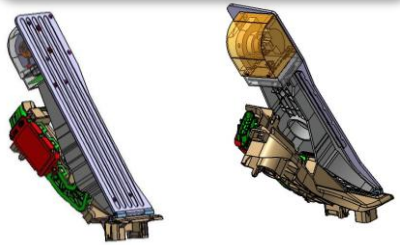
HMI design and development:

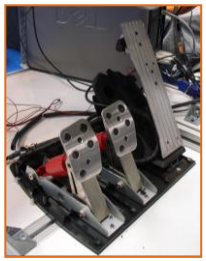
- Haptic throttle pedal (HTP)
- HMI HW & SW architecture
- Graphical User Interfaces (GUI)
- Vehicle implementation

HMI Architecture

GUIs

Haptic pedal develop. process





EXPERIENCE: PLATOONING

Project Name

SARTRE: Safe Road Trains for the Environment

Goal

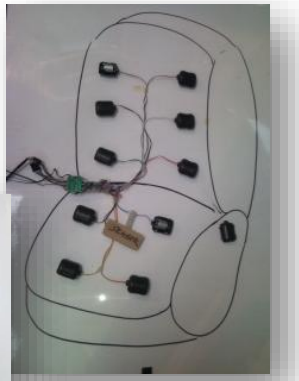
Develop strategies and technologies to allow vehicle platoons to operate on normal public highways with significant environmental, safety and comfort benefits.

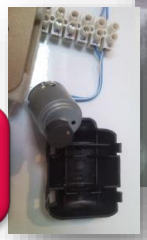
Roles

- HMI design and development: HMI grid, multi-modal HMI design (visual, acoustic and haptic technologies) haptic seat development.
- Behaviour analysis: driver behaviour, human reactions, safety analysis

HMI D&D

SARTRE
Safe Road Trains for the Environment





Haptic Seat Preliminary Design

Behaviour Analysis

EXPERIENCE: PRT

Project Name

PRT Miramon: PRT System in the Miramón (San Sebastian) technologic park

Partners

1. LOGICA
2. NOVADAYS
3. TECNALIA

SMART PRT

Total: 3 Companies

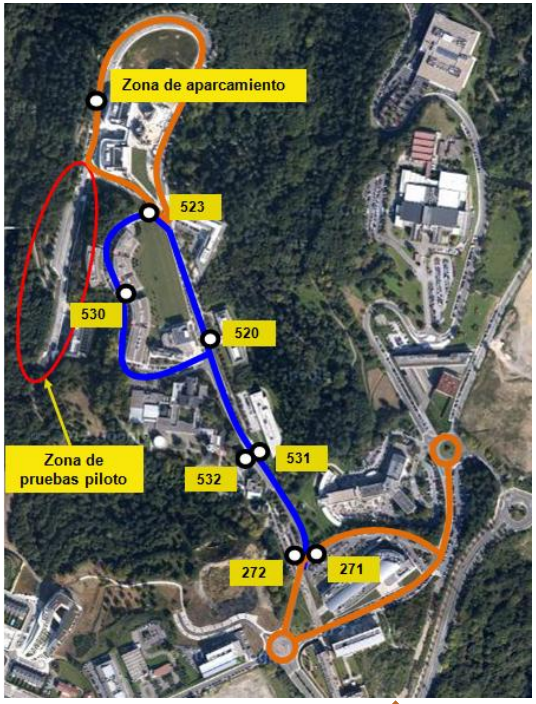
Project Budget

1,12 M€

Objectives

- Develop the first Spanish PRT (Personal Rapid Transit) solution based on existing vehicles oriented to cooperate within the overall public transport system.
- Improve the transport system in the Miramon campus (San Sebastian-Spain) taking advantage from new autonomous driving alternatives and technologies.

PARQUE TECNOLOGICO DE SAN SEBASTIAN
DONOSTIAKO TEKNOLOGI ELKARTEGIA



Heathrow/Masdar	Taxi 2000	Miramón
		

Time Schedule

2011 -> 2014

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GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

EXPERIENCE: PRT & PLATOONING

Project Name

ADAM: Automatization development for Autonomous Mobility

Partners

1. BOEING
2. MASER
3. AZKAR
4. FICOSA
5. ELECNOR
6. TECNALIA
7. INTA ….

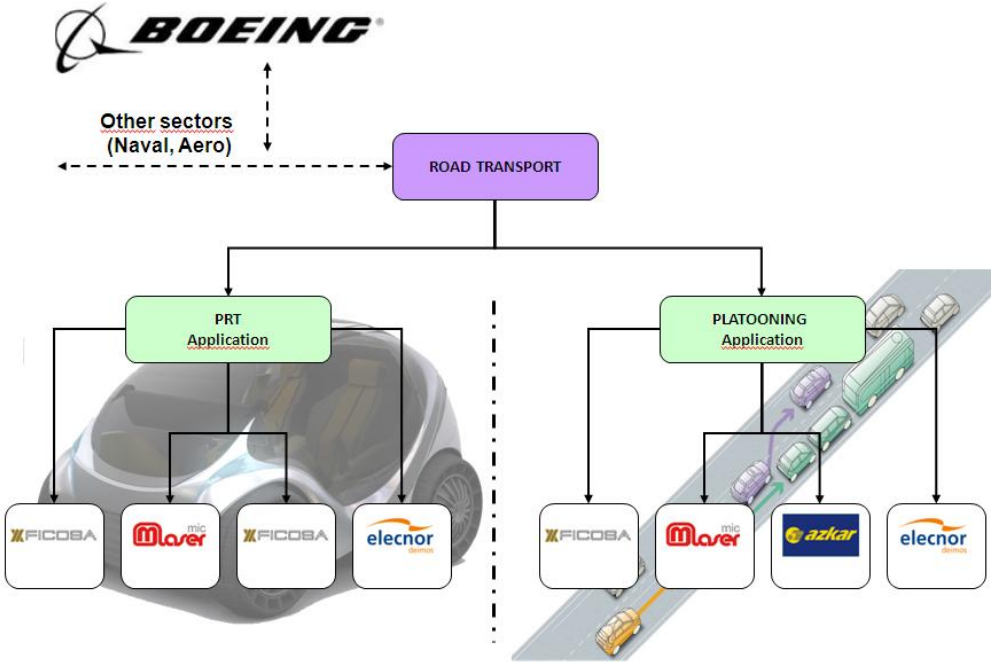
Total: 10 Companies

Project Budget

18,9 M€

Objectives

- Increase autonomous capabilities in transport systems through the development of advanced navigation, guidance, control, communications surveillance and automation based on architectures and technologies for autonomous mobile systems.



Autonomous Road Transport

Time Schedule

2011 -> 2014

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CDTI

EXPERIENCE: PRT & PLATOONING

Project Name

PLATINO: Off-road platooning for ground vehicles

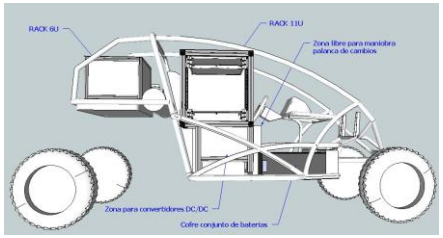
Partners

1. Militärtechnologie Diens und Überwachung (MDU)
2. Technologies of Telecommunications and Information (TTI)
3. ANAFOCUS
4. MESUREX

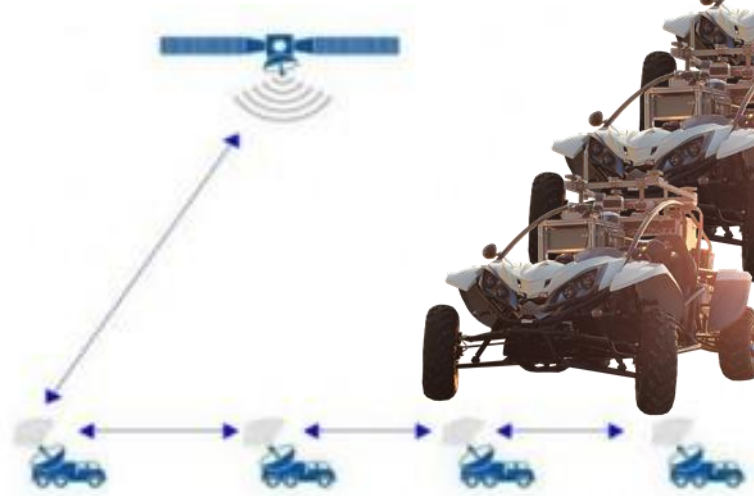
Total: 4 Companies

Objectives

- Research, analysis, design and validation of an automated platoon of unmanned off-road vehicles with capabilities of maneouvres in different type of soils and elusion of obstacles in movement. TECNALIA participates as a subcontractor of TTI



Automation of off-road vehicles



Time Schedule

2012 -> 2014

EXPERIENCE: HAD for RO/RO

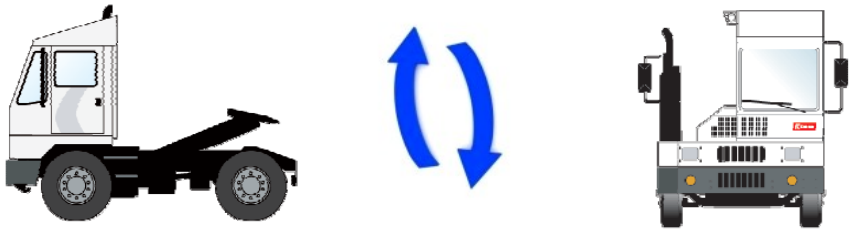
Project Name

AUTOPORT: Spanish Initiative for fully automated stowage on Ro/Ro operations

Partners

1. TERMICAR
2. IMATIA
3. GALMAN
4. U. VIGO
5. TECNALIA

Total: 5 Companies



Project Budget

- 1,7 M€

Objectives

- Develop and demonstrate innovative technologies in the field of Roll-on/Roll-off transport (Ro/Ro) based on highly automated driving solutions and oriented to the full automation of a terminal within the port of Vigo (Spain).

Time Schedule

- 2013 -> 2014

EXPERIENCE: GRT

Project Name

CITYMOBIL2: Cities demonstrating cybernetic mobility

Partners

1. LA SAPIENZA
2. DLR
3. YAMAHA
4. NOVADAYS
5. TECNALIA
6. …

Total: 45 Companies

Project Budget

17,96 M€

Objectives

- Remove existing barriers for the deployment of automated road vehicles and the transport systems, depending on the legal framework, the implementation framework, and the uncertainty of the wider economic impact.
- Implement large-scale pilot platforms for technical and socioeconomic validation of automated transport systems in urban environments around different cities for demonstration.

Time Schedule

2012 -> 2016

- 12 Cities
- 5 Demonstrations
- 5 Show cases

EXPERIENCE: HAD for AIRPORT

Project Name

AIRPORTS: Airport Improvement Research on Processes & Operations of Runway, TMA and Surface

Partners

1. BOEING
2. IKUSI
3. MASER
4. CRIDA
5. CARBURES
6. SKYLIFE
7. TECNALIA ….

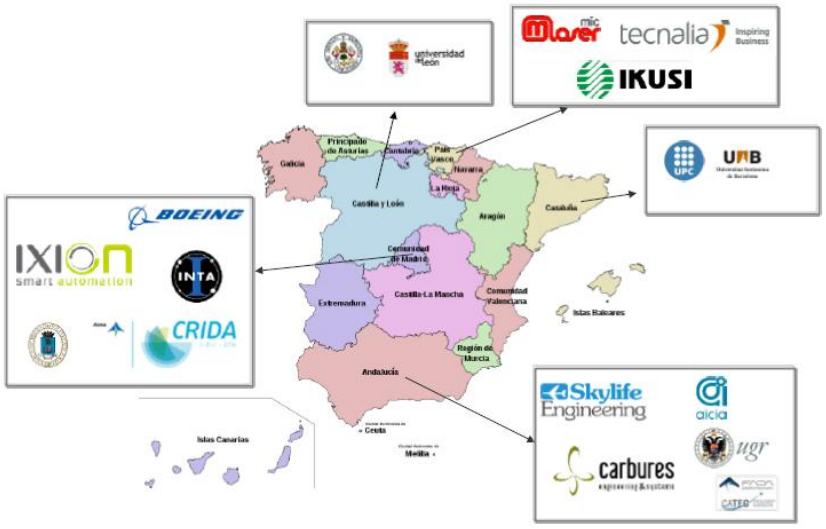
Total: 17 Companies

Project Budget

12,5 M€

Objectives

- Development of technologies to support TBO (Trajectory-Based Operations) and PBO (Performance-Based Operations) concepts within the airport environment



Highly Automated Driving (HAD) for Handling Operations

Time Schedule

2015 -> 2018

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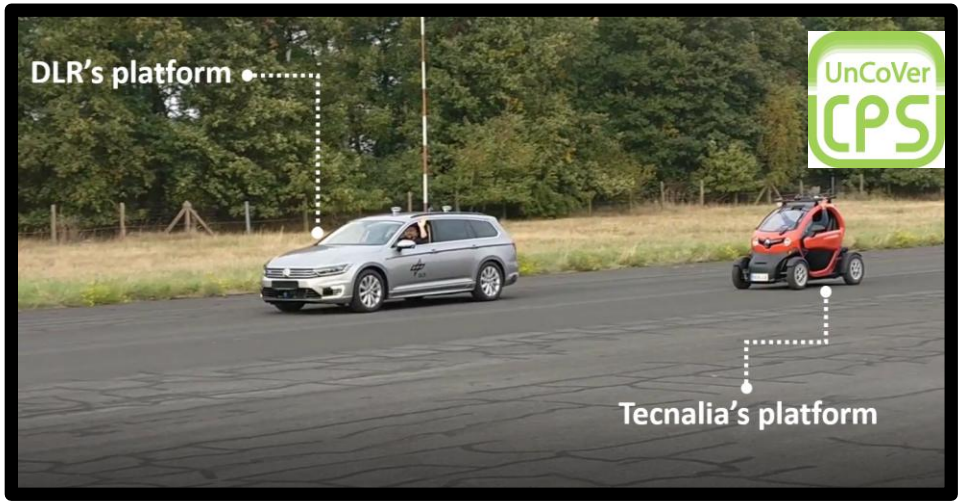
CDTI

EXPERIENCE: HAD under Cooperative Applications

Project Name

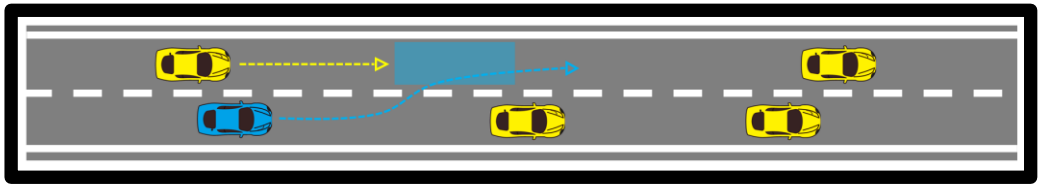
UnCoVerCPS: Unifying Control and Verification of Cyber-Physical Systems especially considering autonomous driving and mobile robot applications.



Partners

1. Bosch
2. DLR
3. TU Munich
4. Univeristy Grenoble
5. Politecnico Milano
6. RU Robotos
7. Esteral Technologies
8. Tecnalia
9. …..

Total: 11 partners



Project Budget

4,9 M€

Objectives

- The proposed research effort provides methods for a faster and more efficient development process of safety- or operation-critical cyber-physical systems in (partially) unknown environments
- Development of novel techniques for the cooperation of autonomous vehicles increasing safety.

Funded by:

Horizon 2020
European Union Funding
for Research & Innovation

Time Schedule

- 2015 -> 2019

EXPERIENCE: IoT Sensors for HAD

ProjectName

IoSENSE: Flexible FE/BE Sensor Pilot Line for the Internet of Everything

Partners

1. INFINEON
2. BOSCH
3. PHILIPS
4. TECNALIA

5. SIEMENS
6. THALES
7. FRAUNHOFER
8. AMS
9. INTEGRASYS
10. .....

Total: 34 Companies

Project Budget

70 M€

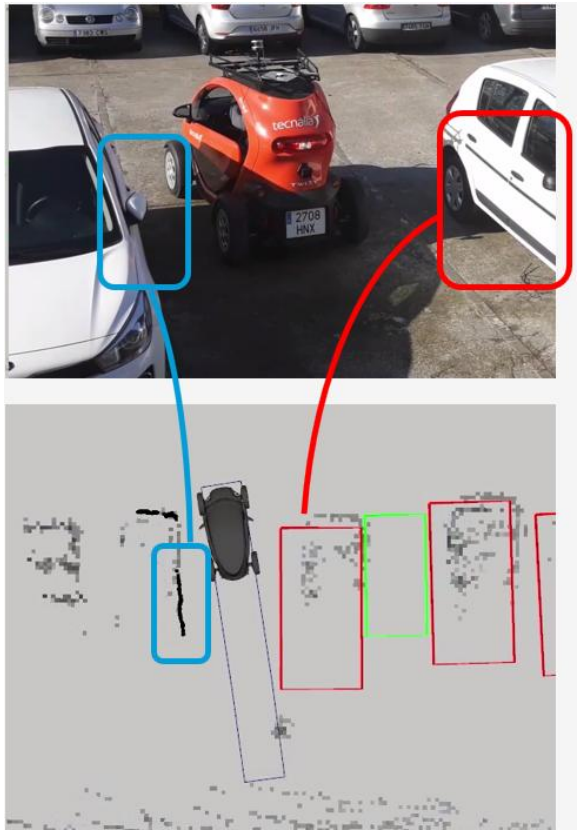
Objectives

- Boost the European competitiveness of Electronics Components and Systems industries. IoSense aims to:
  - Increase the manufacturing capacity of sensor/MEMS components by factor of 10.
  - Improve manufacturing cost by 30%.
  - Improve manufacturing time by flexible FE/BE processes and easy reuse by 30%.
  - Improve time for idea-to-market for new sensor systems down to less than one year.

Time Schedule

- 2016 -> 2019

Smart Mobility: Parking assistance based on Time-of-Flight camera



Funded by:

ECSEL Joint Undertaking
Electronic Components and Systems for European Leadership

EXPERIENCE: HAD for TURN AROUND

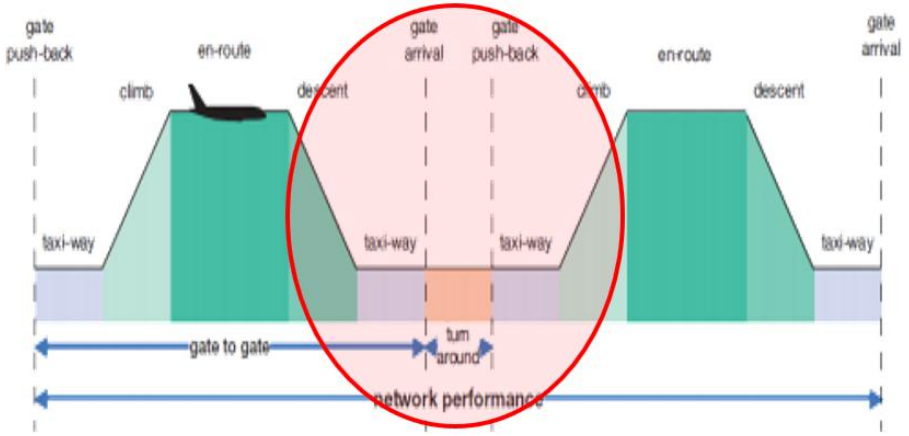
Project Name

ESKALA 4.0: Optimization of the "turn-around" in the airport environment according to the "Industry 4.0" paradigm

Partners

1. IKUSI - VELATIA
2. MASERMIC
3. DACHSER
4. GRUPO ACHA
5. ITS SECURITY
6. ITS SECURITY
7. INGENET
8. RETEVISION

Total: 8 Companies



Project Budget

5,2 M€

Objectives

- Develop technologies for the automation of handling vehicles in the airport environment, to minimize the scale time (turn-around) and increase the efficiency, safety and environmental sustainability, all according to the "Industry 4.0" concept.

"HAZITEK"
Regional Program

Time Schedule

2017 -> 2019

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GOBIERNO VASCO
EKONOMIAREN GARAPEN ETA AZPIEGITURA SAILA
DEPARTAMENTO DE DESARROLLO ECONÓMICO E INFRAESTRUCTURAS

GRUPO spri TALDEA

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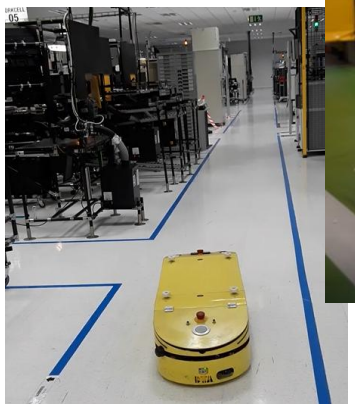
EXPERIENCE: HAD for LOGISTICS

Project Name

SMART FACTORY: Investigating and progressing on technologies enabling the deployment of smart systems for the so-called Factories of the Future

SMART FACTORY



Partners

1. DGH
2. IBERMÁTICA
3. FICOMIRRORS
4. CONTINENTAL
5. …

Total: 6 Companies

Project Budget

7,50 M€

Objectives

- Increase the flexibility of the plants and allow the optimization of the industrial processes, thus improving their productivity in a total quality environment. The efforts are directed to the development of smart robotic systems, thus taking advantage of all the information available on the environment and process to reduce and ease programming from operators.

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Ibermática
Tecnología y Conocimiento

FICOMIRRORS

Time Schedule

2016 -> 2020

Funded by: CDTI

EXPERIENCE: HAD enabled by System on Chip

Project Name

AUTODRIVE: Advancing fail-aware, fail-safe, and fail-operational electronic components for HAD to make future mobility safer, more efficient, affordable, and end-user acceptable.

Partners

1. INFINEON
2. IRIZAR
3. CRF
4. DAIMLER AG
5. BOSCH
6. TECNALIA
7. MASER
8. AYTO MÁLAGA
9. U. ALCALÁ
10. …..

Total: 59 Companies

Project Budget

6,5 M€

Objectives

- Increase reliability and robustness of automated driving systems through fail-aware, fail-safe, fail-operational semiconductor-based components and systems.
- Competitive advantage through sophisticated electronic components and systems tailored for safe automated driving.

Funded by:
the European Union within the ECSEL JU programme.
ECSEL JU

Time Schedule

2017 -> 2020

EXPERIENCE: CCAM for URBAN TRANSPORT

Project Name

AUTOMOST: Automated driving for Dual-Mode system transport

Partners

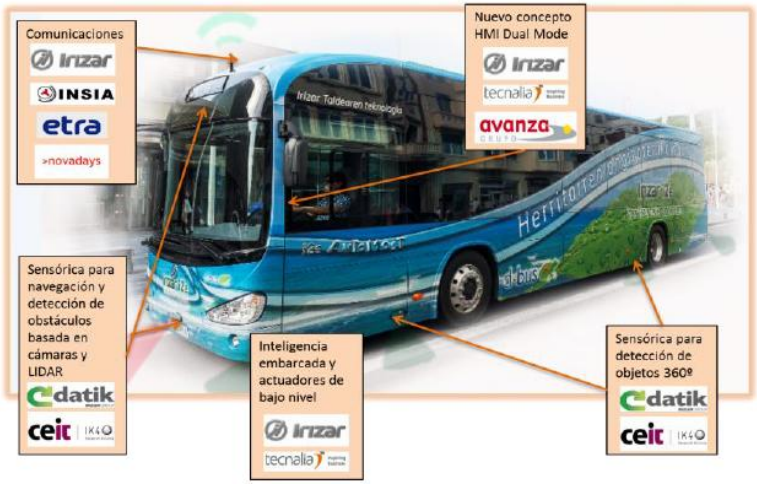
1. GRUPO AVANZA
2. IRIZAR
3. DATIK
4. ETRALUX
5. MASER
6. NOVADAYS
7. … Total: 8 Companies

Project Budget

9 M€

Objectives

- Develop technologies for the automation of vehicles in urban transport and industrial applications, to increase the efficiency, safety and environmental sustainability.
- Implementation of shared control systems (Dual-Mode) for future automated vehicles that allow the services operation more efficiently and flexibly, in a context of intelligent and connected infrastructures.



"CIEN"
Spanish Program

Time Schedule

2016 -> 2021

CDTI

EXPERIENCE: CCAM for SMART PORT

Project Name

ESTIBA+ 2022: Development of i4.0 technologies for the digitalization of Spanish ports through highly automated logistics (Smart Digital Ports)

Partners

1. BERGÉ
2. CELSA
3. DACHSER SPAIN
4. EUROHELP
5. FICOSA
6. PRODEVELOP
7. RETEVISION

Total: 8 Companies

Project Budget

5,1 M€

Objectives

- Go forward in the provisioning of strategic technologies that will bring us closer to the port of the future (SmartPort) as the only way to meet the growing demands of efficiency, economy, safety and environmental compatibility according to the "Industry 4.0" concept and with the highest levels of automation.

Time Schedule

2018 -> 2022

Funded by: CDTI

EXPERIENCE: CCAM for LOGISTICS

Project Name

MELCART: Development of a new advanced interconnection system for internal and external logistics in steel processes.

Partners

1. ACERINOX
2. DTA

Total: 2 Companies

Project Budget

1,58 M€

Objectives

- Overcome the technical limitations for the carrying, handling and storage of the large dimensioned stainless steel coils through the experimental development of new Auto Guided Vehicles (AGV´s), integrated by a Basic Logistic System and a series of digital technologies for guiding them in the indoors and outdoors, with the capacity to make decisions over objects or situations not programmed.

Time Schedule

- 2019 -> 2022

Funded by: CDTI @CDTIoficial
FEDER European Commission

EXPERIENCE: CCAM for urban transport

Project Name

DIGIZITY-0: Industrial research of innovative solutions to decarbonize, digitize and automate urban transport of zero-emission buses

Partners

1. AVANZA
2. IRIZAR
3. JEMA
4. HISPACOLD
5. IDNEO
6. TELNET

Total: 6 Companies

Project Budget

11,6 M€

Objectives

- Comprehensive research, throughout the entire value chain, of the connectivity, robotization and electrification of buses, extending this research beyond the vehicles themselves, to create disruptive technologies in fleet management and usage-based smart-cities of artificial intelligence.

Smart, connected vehicles and physical infrastructure of the transport system

Technological infrastructure: communications, storage and processing of images and data.

Artificial intelligence: challenges and algorithms created by multiple actors in an open innovation environment.

Services and solutions: applications for users and integration of data and solutions with the smart city.

Time Schedule

2021 -> 2023

Funded by: MINISTERIO DE CIENCIA E INNOVACIÓN CDTI
@CDTIoficial

EXPERIENCE: CCAM for microMobility

Project Name

BIZI-BIKE: New generation of drive and assistance systems for e-Bikes and e-Trikes for emission-free micromobility.

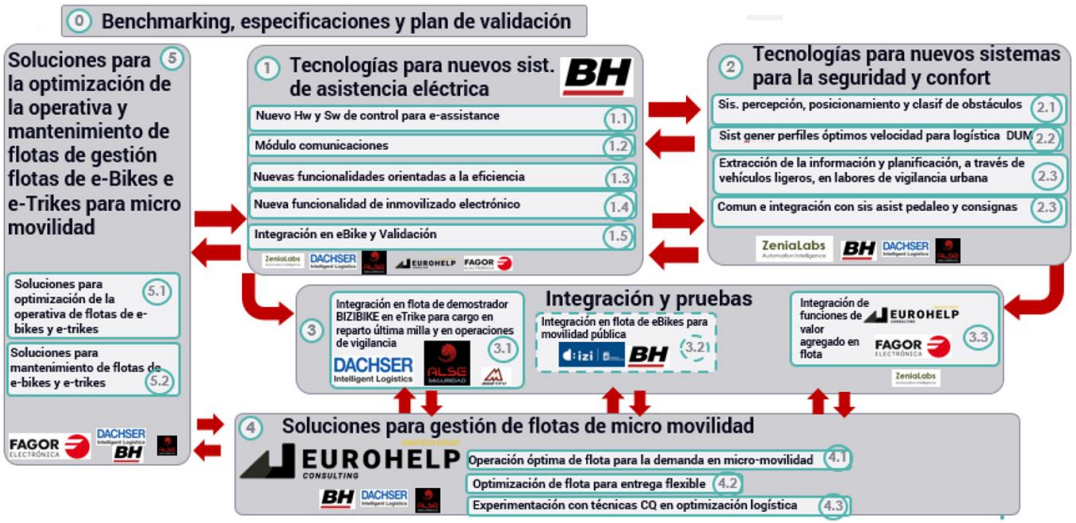
Partners

1. BH-BIKE
2. EUROHELP
3. FAGOR ELECTRÓNICA
4. ZENIALABS
5. DACHSER
6. ALSE TECNOLOGÍA

Total: 6 Companies

Project Budget

4,9 M€



Objectives

- Research and develop technologies for new comprehensive solutions for e-BIKEs and e-TRIKEs aimed at the private user, but above all at the new emerging business models around sustainable and CO2-neutral micro-mobility.

Time Schedule

2021 -> 2023

Funded by: "HAZITEK" Regional Program

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GRUPO spri TALDEA

EXPERIENCE: CCAM for R3

Project Name

R3CAV: Research of technologies and architectures for the development of a new autonomous, connected, robust, reliable and resistant vehicle.

Partners

1. RENAULT
2. GMV
3. ALSA
4. INDRA
5. MASERMIC
6. SIGMA
7. MASMOVIL

Total: 7 Companies

Project Budget

10 M€

Objectives

- Research and develop new connected technologies, as well as design and develop a new adaptable architecture, both hardware and software, of the future connected autonomous vehicle, capable of operating at different levels of autonomy, starting with advanced predictive driving assistance systems, up to completely autonomous without driver.

ALCOBENDAS

PALENCIA

Time Schedule

2021 -> 2023

Funded by: MINISTERIO DE CIENCIA E INNOVACIÓN CDTI
@CDTIoficial

EXPERIENCE: CCAM for Heavy Duty

Project Name

SHINE-FLEET: Hydrogen-based technological solutions for the intelligent and sustainable mobility of independent heavy-duty fleets.

Partners

1. TÉCNICAS REUNIDAS
2. AVIA
3. CARBOTAINER
4. CIKAUTXO
5. FM-LOGISTIC
6. FRACTALIA
7. IDNEO

Total: 7 Companies

Project Budget

9,4 M€

Objectives

- Promote and accelerate the transformation towards freight transport solutions that integrate decentralized hydrogen generation with a low carbon footprint, and the use of fleets of Zero emissions long-haul heavy duty trucks through research and fusion of technologies associated with multi-fuel generation, autonomous mobility, and electromobility and to the exploitation of data in integrated management systems.

Funded by: MINISTERIO DE CIENCIA E INNOVACIÓN · CDTI

@CDTIoficial

Time Schedule

2020 -> 2024

EXPERIENCE: CCAM for Ports

Project Name

CLEANPORTS 5.0: Investigación de soluciones navales inteligentes y sostenibles para automatización de procesos logísticos e intermodalidad avanzados desde puerto a última milla.

Partners

1. IGNIS
2. EIFFAGE
3. FM-LOGISTIC
4. TRANS-BASE SOLER
5. SCOOBIC
6. ASTANDER
7. AQUILES

Total: 7 Companies

Project Budget

4,5 M€

Objectives

- Improve logistics processes for the complete handling of goods at a multimodal level by incorporating Artificial Intelligence (AI) and collaborative robotics in process automation, optimization platforms, new, more sustainable vehicles, incorporation of renewable energies and energy vectors such as hydrogen.

Time Schedule

2022 -> 2025

Funded by: CDTI
@CDTIoficial

EXPERIENCE: CCAM for VEC

Project Name

DIVEC: Diseño inteligente del vehículo eléctrico y conectado.

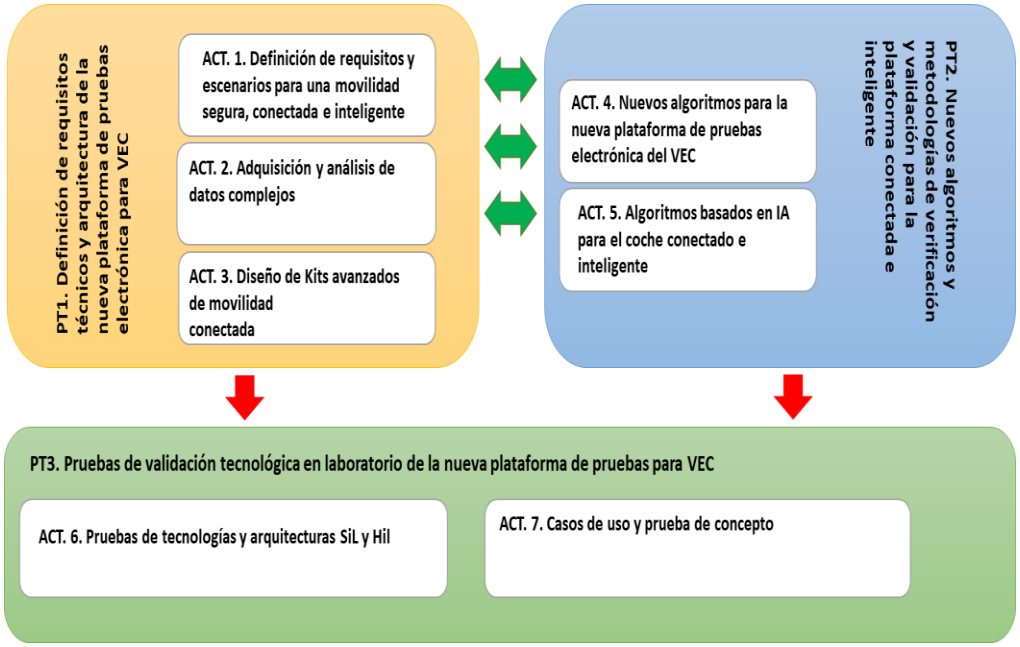
Partners

1. RENAULT
2. ASIMOB
3. ESTUDIOS GIS
4. GANTABI
5. ITELLIGENT
6. KOLOKIUM
7. MASERMIC
5. MULTIVERSE
6. NOMMON
7. PIPERLAB
8. SIGMA
9. UC3M
10. ZENIALABS

Total: 13 Companies

Project Budget

30,7 M€



Objectives

- Investigate methods for obtaining and processing mobility data obtained by expert drivers, generating new knowledge that will aid driving and future connected systems, based on AI-oriented business models. The result will be a prototype in a laboratory environment of an electronic test platform for the Electric and Connected Vehicle that will facilitate the development of solutions for the automotive sector.

Time Schedule

2022 -> 2025

Financiado por la Unión Europea NextGenerationEU

Funded by: MINISTERIO DE INDUSTRIA, COMERCIO Y TURISMO

Plan de Recuperación, Transformación y Resiliencia

EXPERIENCE: CCAM for security & surveillance

Project Name

ZAIMDU: Vigilancia móvil, autónoma y conectada.

Partners

1. ALSE
2. Estudios GIS

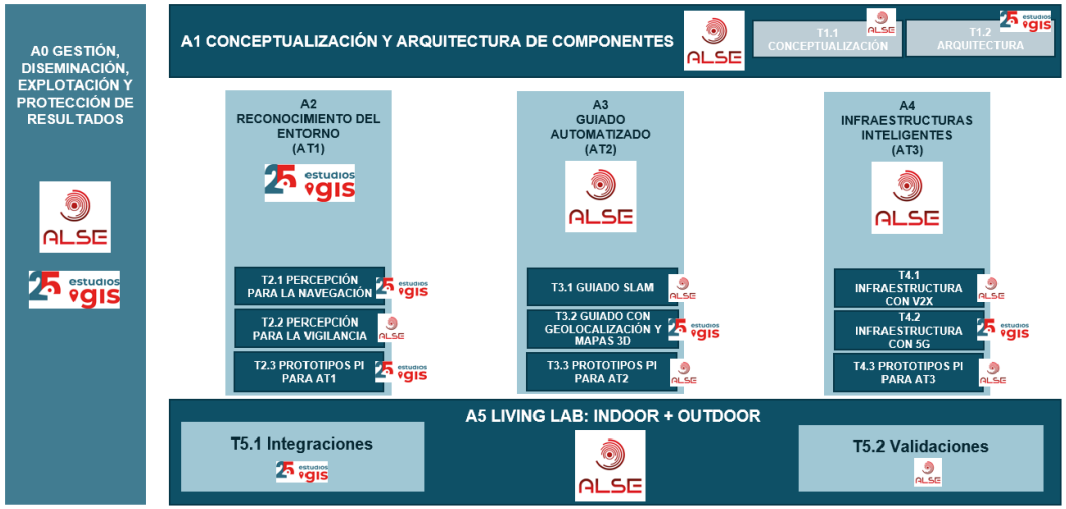
Total: 2 Companies

Project Budget

1,422 M€

Objectives

- Innovate in technologies that enable the creation of a new generation of vehicles for security and surveillance tasks, capable of remote and automated operation and integrable into indoor and outdoor settings, seamlessly resolving the transition from indoor to outdoor and vice versa.



Time Schedule

- 2024 -> 2026

Funded by: "HAZITEK" Regional Program

EUSKO JAURLARITZA GOBIERNO VASCO
EKONOMIAREN GARAPEN ETA AZPIEGITURA SAILA
DEPARTAMENTO DE DESARROLLO ECONÓMICO E INFRAESTRUCTURAS
GRUPO spri TALDEA

EXPERIENCE: CCAM for ECO & LIGHT mobility

Project Name

SIMCAR: Sistema avanzado de Inspección y Mantenimiento de CARreteras para el vehículo autónomo y conectado.

Partners

1. GESTIOMA
2. IRONTEC
3. IMMERSIA
4. URQUIZO
5. BELAKO LANAK
6. MASERMIC

Total: 6 Companies

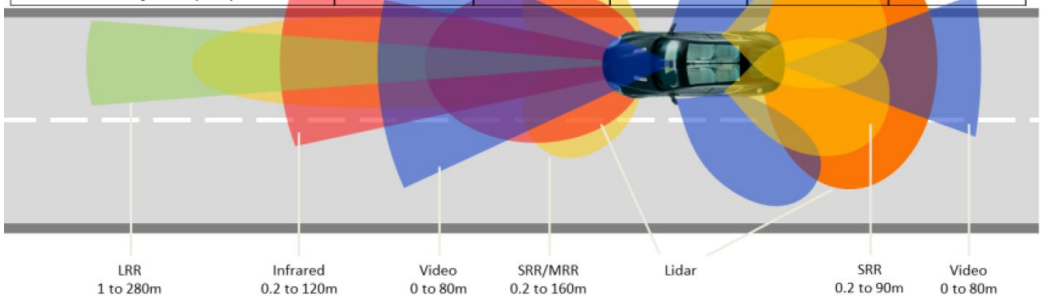
Project Budget

2,81 M€

Objectives

- Investigate & develop an autonomous vehicle platform equipped with advanced technologies such as multimodal capture and machine vision to enable the inspection, identification, and classification of roads according to their suitability for the circulation of Level 3 to Level 5 automated vehicles.

Application \ Sensor Type	Vision	Infrared / Thermal	Long Range Radar 76..81MHz	Short / Mid Range Radar 24..26 / 76..81 GHz	Lidar
Adaptive Front Lighting (AFL), Traffic Sign Recognition (TSR)	X				
Night vision (NV)	X	X			
Adaptive Cruise Control (ACC)	X		X	X	X
Lane Departure Warning (LDW)	X				
Low-Speed ACC, Emergency Brake Assist (EBA), Lane Keep Support (LKS)	X			X	X
Pedestrian detection	X	X		X	
Blind Spot Detection (BSD), Rear Collision Warning (RCW), Lane Change Assist (LCA)	X			X	X
Park Assist (PA)	X			X	X
Camera monitor systems (CMS)	X				



Time Schedule

- 2025 -> 2027

Funded by: "HAZITEK" Regional Program

EXPERIENCE: CCAM for ECO & LIGHT mobility

Project Name

ERLE-A: Investigación en tecnologías para un Vehículo Eléctrico comeRcial Ligero, Ecológico y Automatizable.

Partners

1. ARESAR Manufacturing & Sales
2. FAGOR Electrónica
3. FEGEMU Automatismos

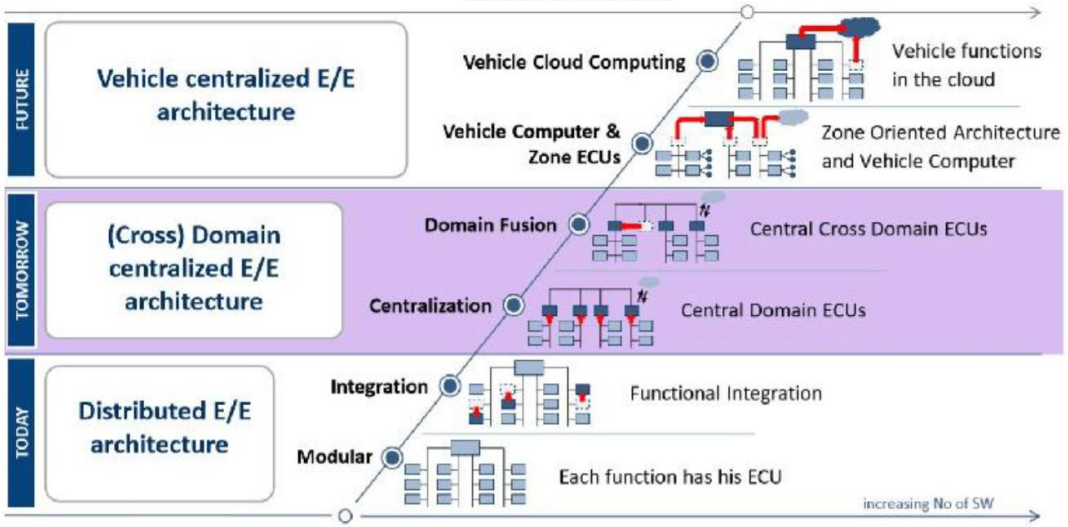
Total: 3 Companies

Project Budget

3,64 M€

Objectives

- Investigate new methods and solutions that overcome current barriers in the development of autonomous mobile platforms, focusing on the optimization of electronics, advanced sensor technology, autonomous navigation, and real-time interconnectivity.



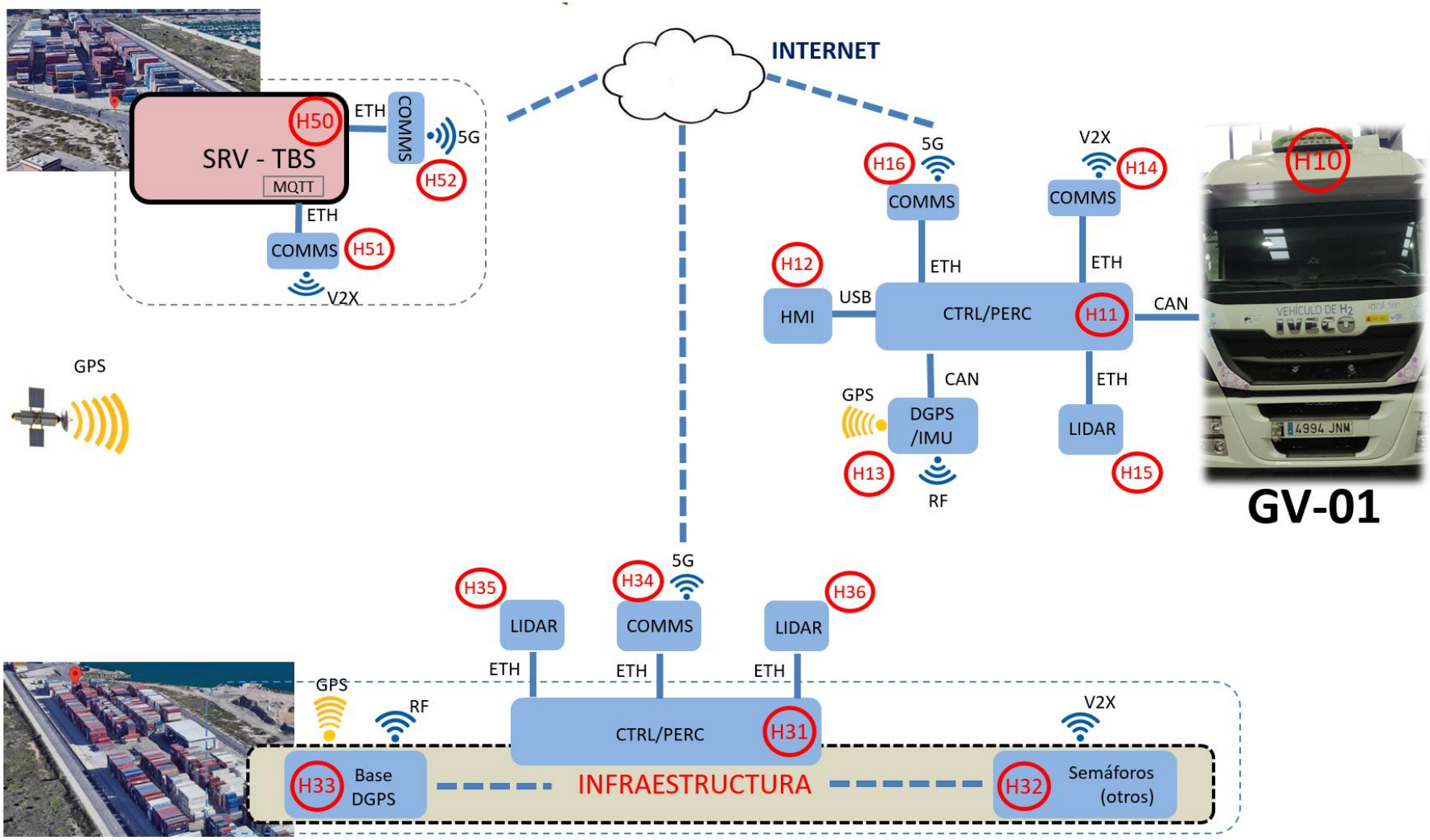
Time Schedule

- 2025 -> 2027

Funded by: "HAZITEK" Regional Program

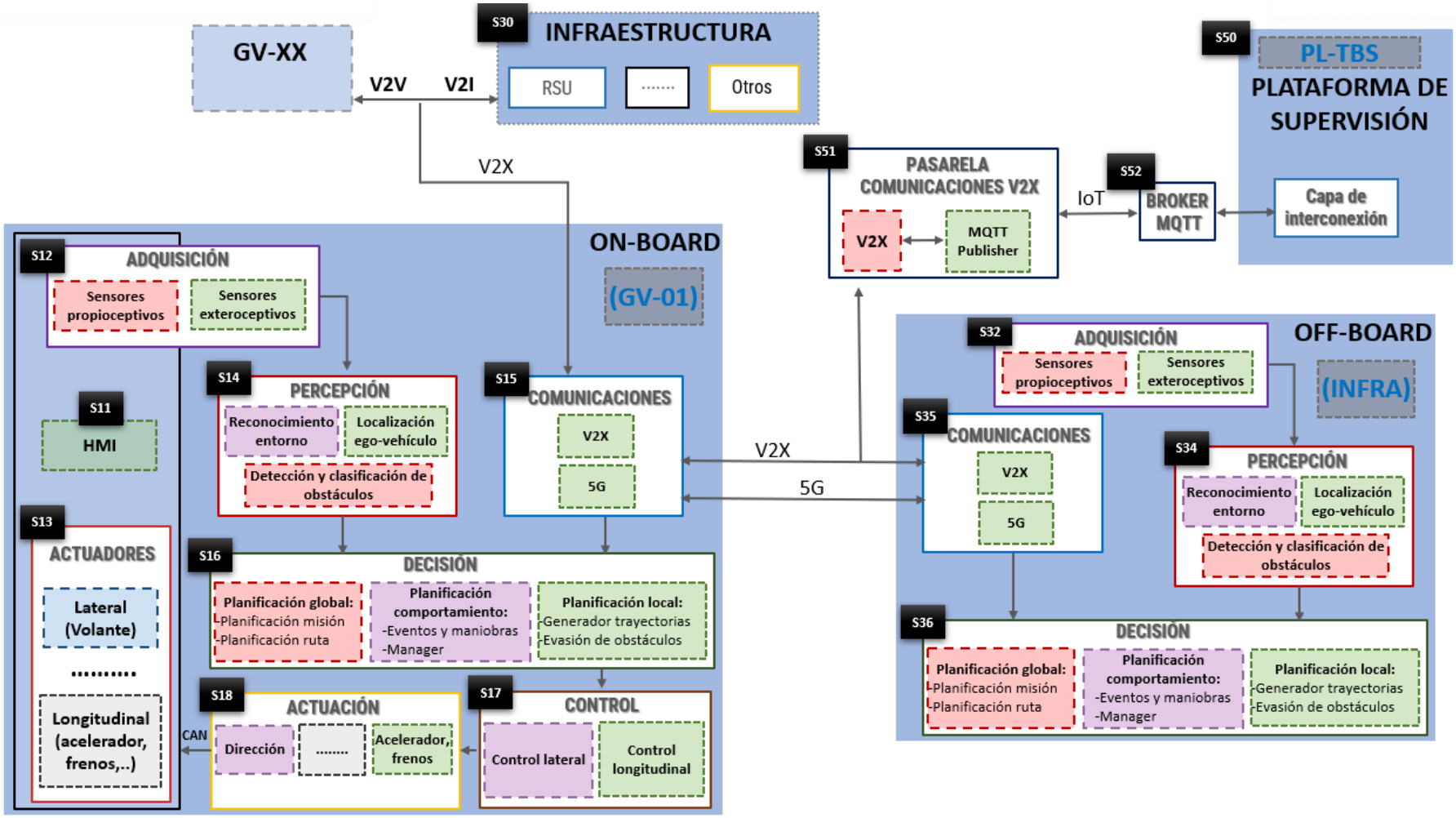
CCAM: COMPONENTES PRINCIPALES

VISTA "HARDWARE"



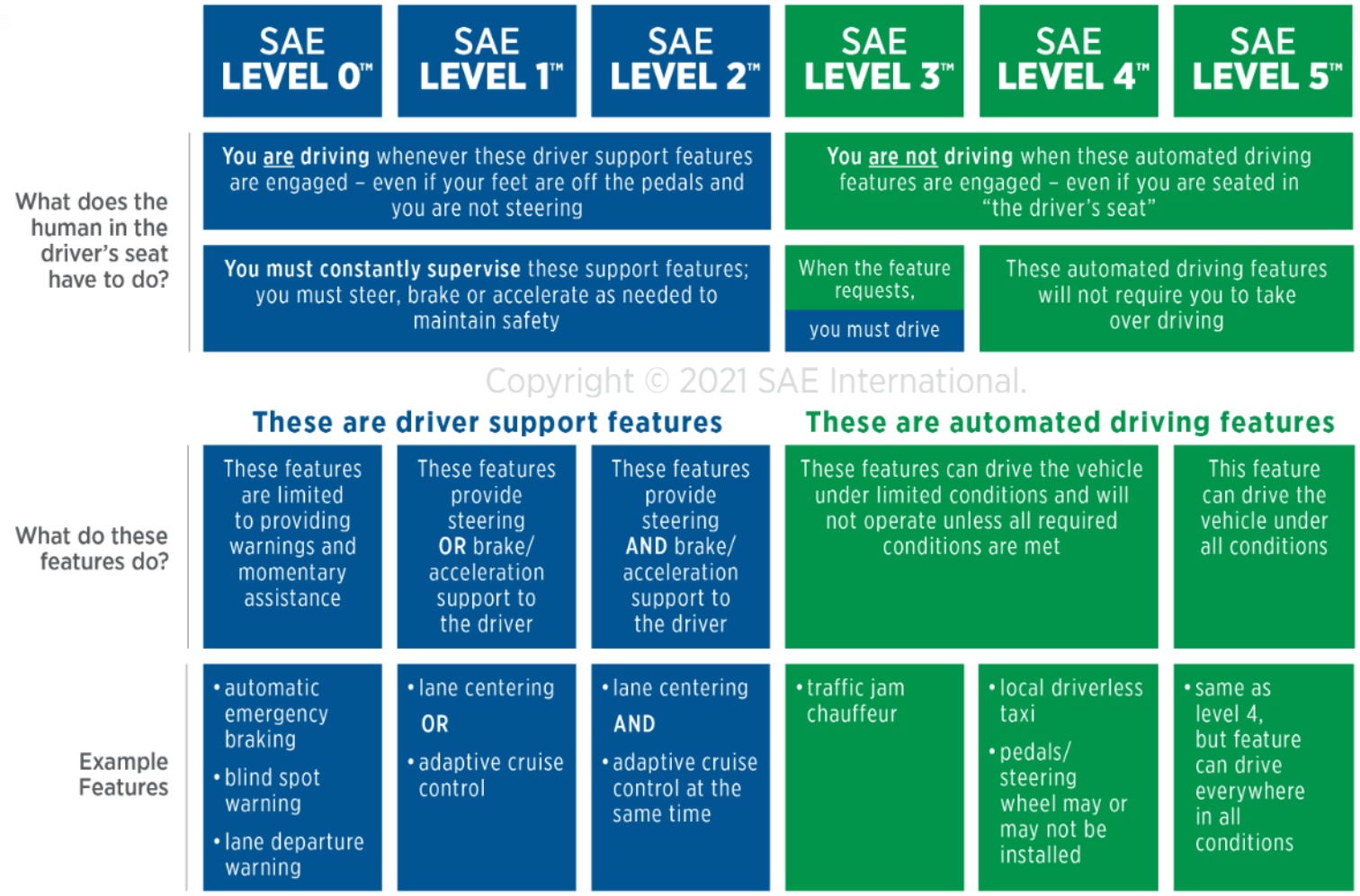
CCAM: COMPONENTES PRINCIPALES

VISTA "SOFTWARE"



CCAM: REFERENCIAS ÚTILES

NIVELES SAE de "CONDUCCIÓN AUTOMATIZADA"



CCAM: REFERENCIAS ÚTILES

NIVELES "TRL"

		Componentes / subsistemas / sistemas	Entorno de verificación y validación
TRL 9 — El sistema real es probado satisfactoriamente en operaciones reales	Aplicación real de la tecnología en su sistema final y bajo las condiciones de las misiones operativas.	Sistemas de serie	Entorno operativo
TRL 8 — El sistema real es probado mediante test y demostraciones	El sistema que contiene la tecnología se encuentra completamente desarrollado e integrado con los sistemas existentes, y se llevan a cabo las pruebas de calificación del mismos en los escenarios operativos simulados para los que se requiere.	Primeros sistemas de serie	
TRL 7 — Se realiza una demostración de un prototipo de sistema en un entorno operativo	El prototipo está cerca o al nivel del sistema operativo planeado, y las funcionalidades críticas y de riesgo de la tecnología se demuestran y prueban en un entorno operativo (ejemplo: en una aeronave, vehículo o en el espacio).	Prototipo industrializado	
TRL 6 — Se hace una demostración de un modelo o prototipo de sistema/ subsistema en un entorno relevante	El modelo representativo o prototipo del sistema, que está cerca de la configuración deseada en términos de rendimiento, aspectos físicos y/o interfaces, se prueba en un entorno relevante. Representa un avance considerable en la madurez de la tecnología que se demuestra en un entorno de laboratorio de alta fidelidad o en un entorno operativo simulado.	Modelo o prototipo de demostración del sistema (demostrador)	Entorno relevante
TRL 5 — Los componentes de la tecnología son validados en un entorno relevante	Los componentes básicos de la tecnología se integran con elementos de soporte razonablemente realistas de manera que puedan ser probados en un entorno simulado. Representa una réplica de "alta fidelidad" que integra componentes de laboratorio con sistemas existentes.	Componentes / subsistemas críticos integrados con elementos de soporte (alta fidelidad)	
TRL 4 — Los componentes de la tecnología son validados en un entorno de laboratorio	Los componentes básicos de la tecnología se integran para determinar que trabajarán de forma conjunta en laboratorio. Representa una réplica de "baja fidelidad" comparado con el sistema final, en cuanto a la eficiencia y robustez.	Componentes / subsistemas críticos integrados en breadboard (baja fidelidad)	Laboratorio
TRL 3 — Existe una analítica y experimentación de la funcionalidad crítica y/o una prueba del concepto	Comienza el I+D activo. Se obtienen resultados de estudios analíticos y pruebas de laboratorio de los componentes o subsistemas críticos, que no están todavía integrados o no son todavía representativos, llevadas a cabo para medir parámetros de interés y validar las hipótesis.	Componentes / subsistemas críticos de la tecnología separados	
TRL 2 — Se ha formulado el concepto y/o la aplicación de la tecnología	Inicio de la invención práctica. Actividades de investigación aplicada, estudios analíticos, publicaciones u otras referencias que resumen la aplicación bajo consideración, proporcionan el análisis que respalda el concepto y comparan las tecnologías competidoras.		Publicaciones
TRL 1 — Están identificados y se han observado los principios básicos de la tecnología	Nivel de desarrollo tecnológico más bajo posible. Actividades de investigación básica y publicaciones científicas que identifican los principios básicos de la tecnología.		