



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

CEDEX Rail interoperability Lab (RIL) Main activities and tests performed

September 2017

Ignacio Jorge Iglesias Ph.D. RIL Director



Summary

1. **CEDEX: A Public Research Centre for Civil Engineering**
2. **ERTMS creation**
3. **Rail Interoperability lab (RIL) presentation**
4. **ERTMS in Spain and main pending challenges worldwide**
5. **Train-Track integration Tests (Operational tests). Remote tests**
 - **How do we integrate the track and onboard subsystems at lab?**
6. **On-site tests vs. laboratory tests: lab validation**
7. **Eurobalise laboratory: Eurobalise and Antenna/BTM certification**
8. **Eurocab laboratory: EVC certification tests (Subset-076)**
9. **Spanish procedure of placing in service**
10. **Current international activities at RIL**
11. **Conclusions.**



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

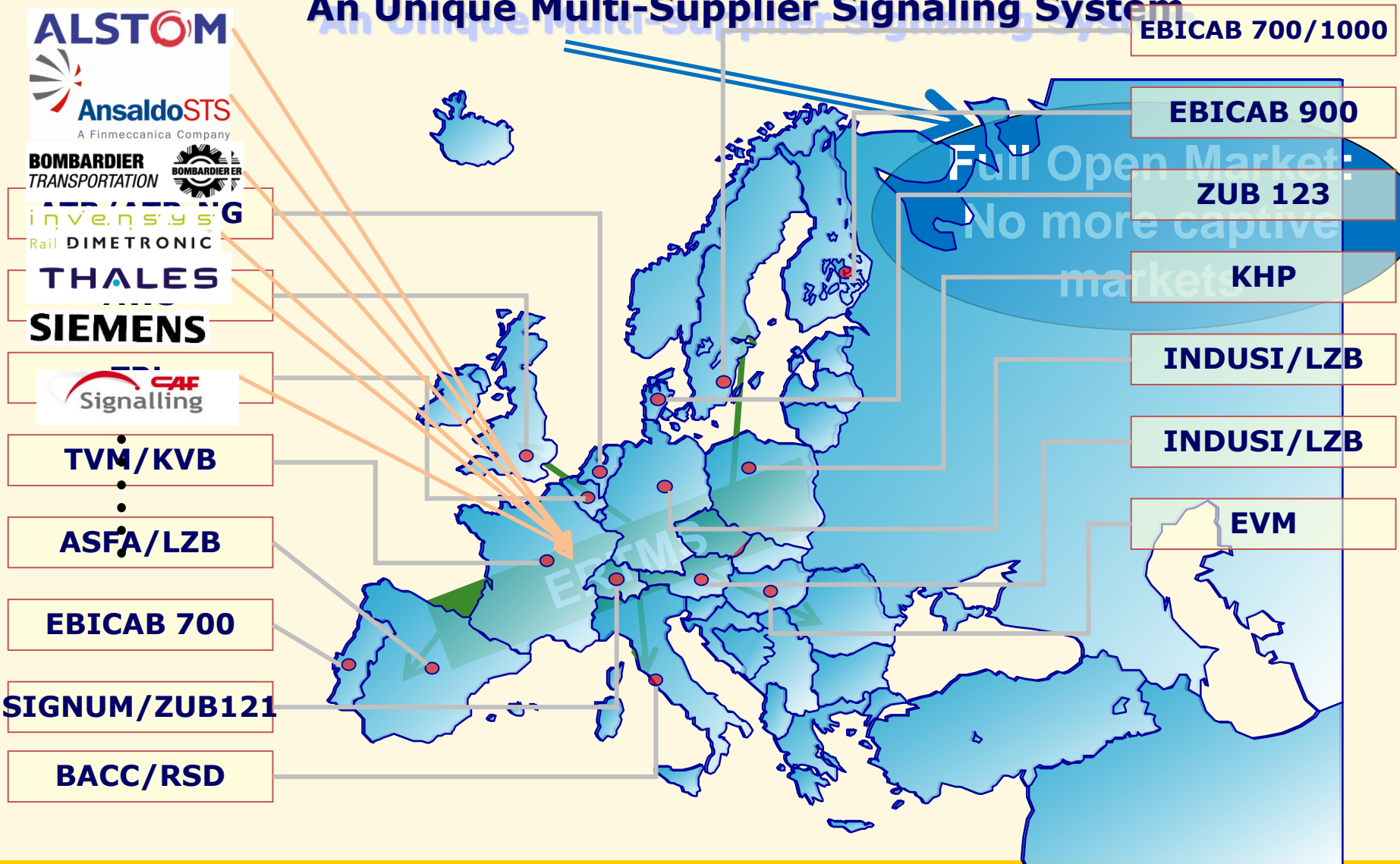
CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

2. ERTMS Creation



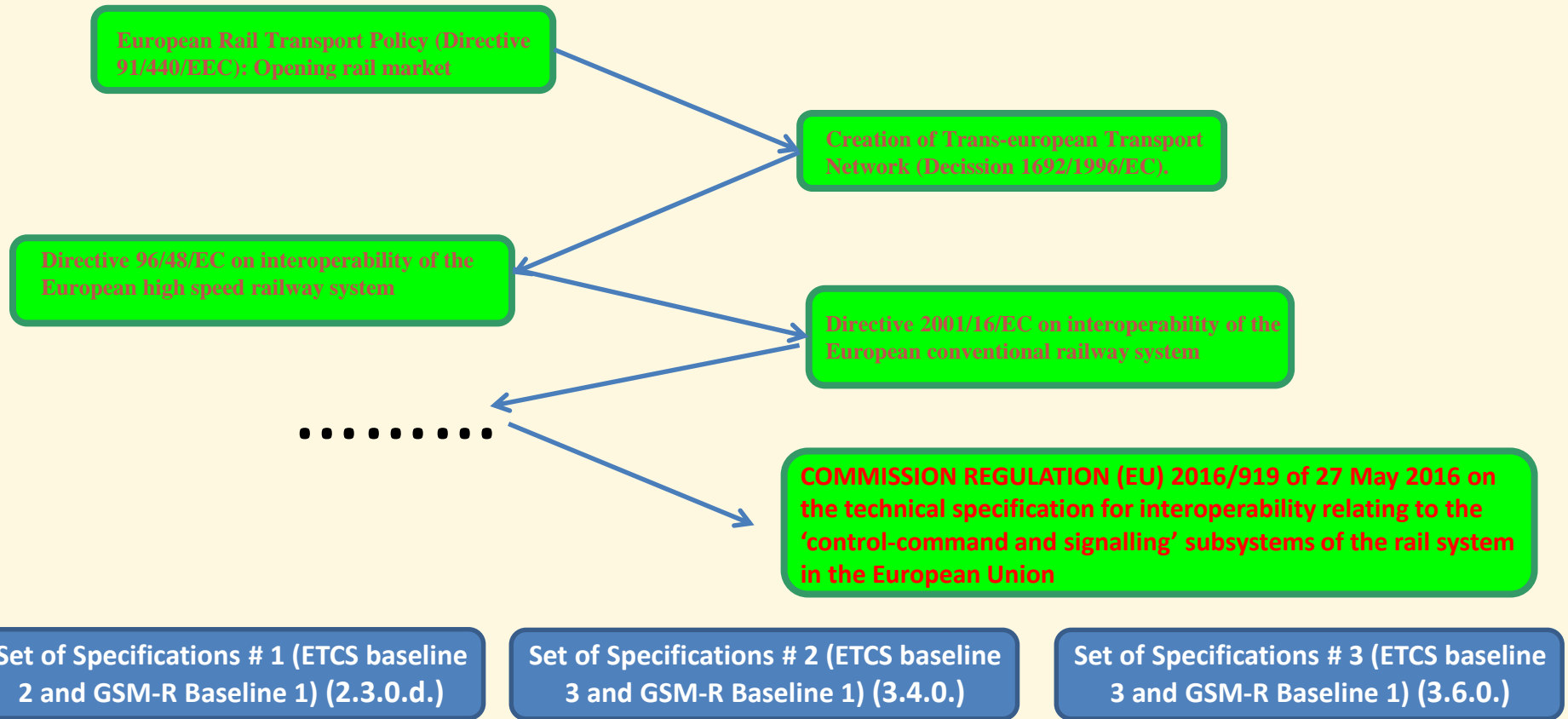
1. Signaling: A lot of systems in Europe

An Unique Multi-Supplier Signaling System





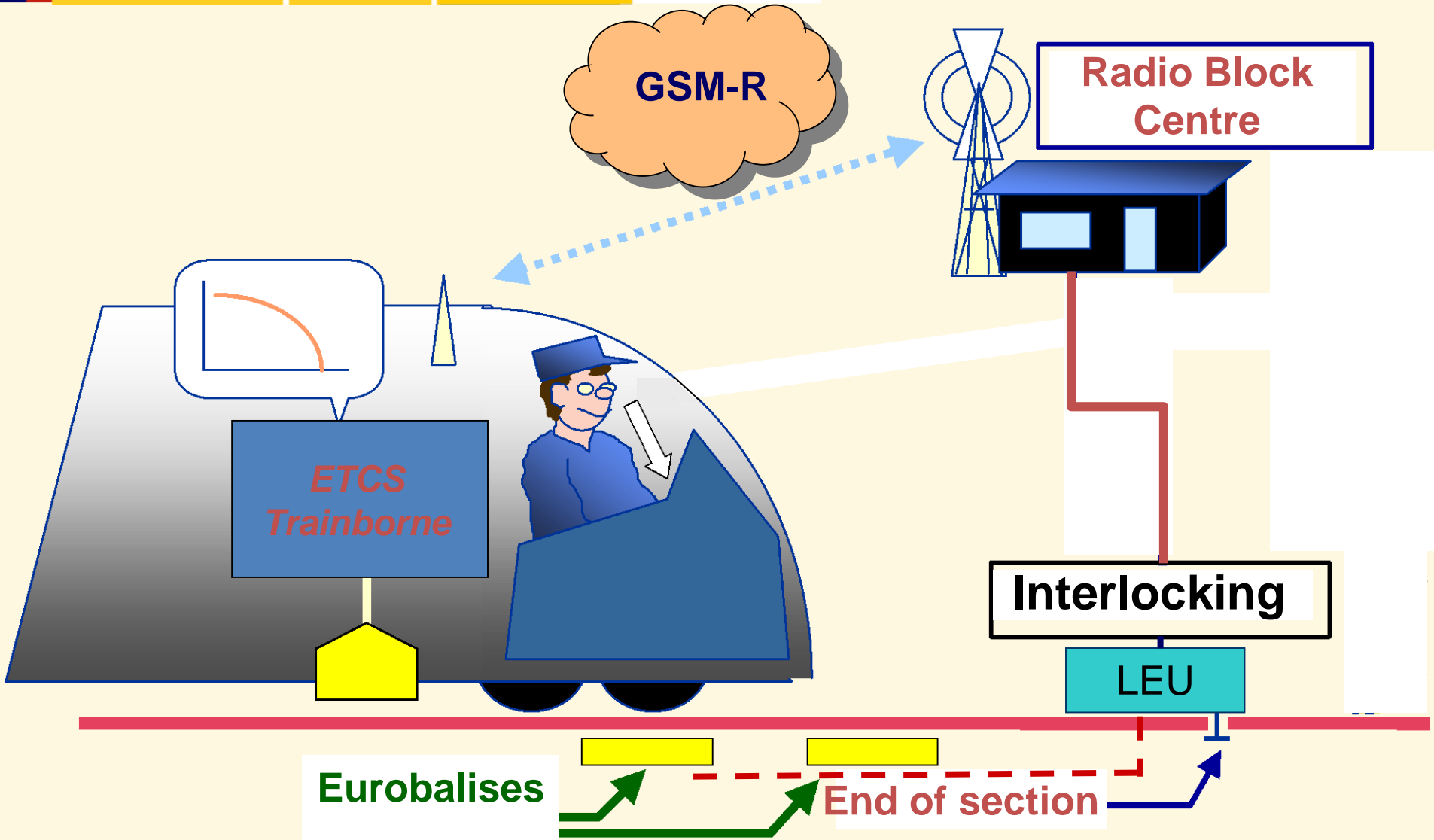
European Process. ERTMS creation. (European Rail Traffic Management System)



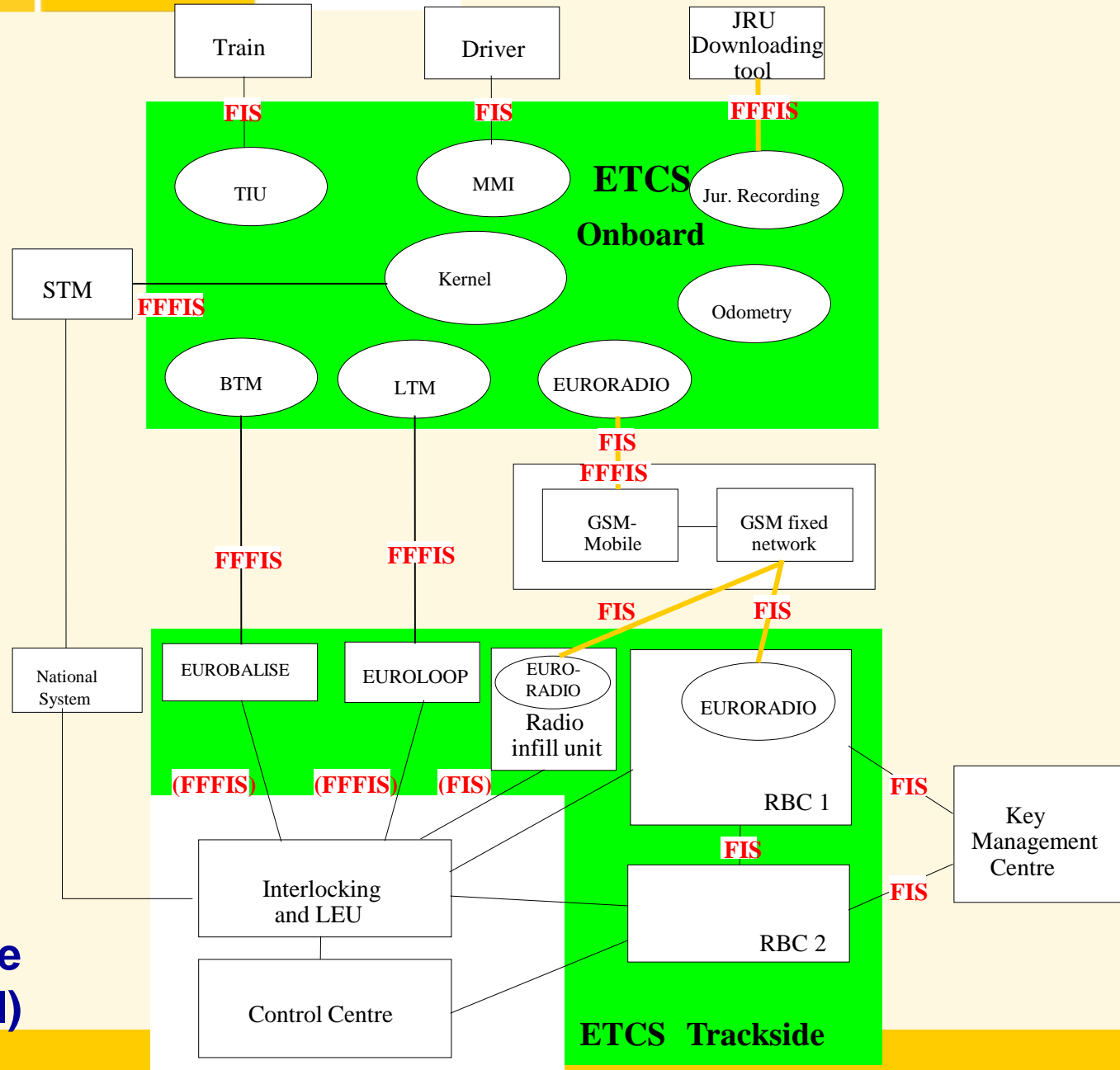
Interoperability means the ability of the Trans-european rail system to allow the safe and uninterrupted movement of trains which accomplish the specified levels of performance



Title	Identification	Version
System Requirement Specification	UNISIG Subset-026	Version 2.3.0 d
FFFIS Juridical Recorder-Downloading Tool	UNISIG Subset-027	Version 2.3.0
FIS for Man-Machine Interface	UNISIG Subset-033	Version 2.0.0
FIS for the Train Interface	UNISIG Subset-034	Version 2.0.0
Specific Transmission Module FFFIS	UNISIG Subset-035	Version 2.1.1
FFFIS for Eurobalise	UNISIG Subset-036	Version 2.4.1
Euroradio FIS	UNISIG Subset-037	Version 2.3.0
Offline Key management FIS	UNISIG Subset-038	Version 2.3.0
FIS for the RBC/RBC Handover	UNISIG Subset-039	Version 2.3.0
Dimensioning and Engineering rules	UNISIG Subset-040	Version 2.3.0
Performance Requirements for Interoperability	UNISIG Subset-041	Version 2.1.0
FFFIS for Euroloop sub-system	UNISIG Subset-044	Version 2.3.0
UNISIG Functional Requirements for an On-Board reference Test Facility	UNISIG Subset-094	Version 2.0.2
Test cases related to features	UNISIG Subset-0076-5-2	Version 2.3.3
Test sequences	UNISIG Subset-0076-6-3	Version 2.3.3
ERTMS EuroRadio Conformance Requirements	UNISIG Subset-094	Version 2.3.0
Test Specification for Eurobalise FFFIS	UNISIG Subset-085	Version 2.2.2
Test specification for EUROLOOP	UNISIG Subset-108	Version 1.0.0
Methodology of testing	UNISIG SUBSET-076-3	Version 2.3.1
ERTMS/ETCS Driver Machine Interface	ERA-ERTMS-015560	Version 2.3
Test Sequences Evaluation and Validation	UNISIG SUBSET-076-6-7	Version 1.0.2
RBC-RBC Safe Communication Interface Test Specifications	UNISIG SUBSET-099	Version 1.0.0



ERTMS = ETCS + GSM-R



ERTMS Reference Architecture (TSI)



- **CEDEX Rail Interoperability Lab is the first laboratory in the world accredited for certifying ERTMS components and for testing ERTMS lines.**
- **The laboratory was created in 2000. It is has been the pioneer on testing ETCS components and subsystems and it has tested equipments from almost all ERTMS worldwide suppliers.**
- **The laboratory has actively participated in the process of placing in service ERTMS in the Spanish High Speed and Conventional Lines (Madrid commuter lines).**
- **The laboratory has designed, together with Adif, Renfe and the Ministry of Fomento, the set of INT tests (around 200 tests) which really guarantee full interoperability.**



GOBIERNO
DE ESPAÑA

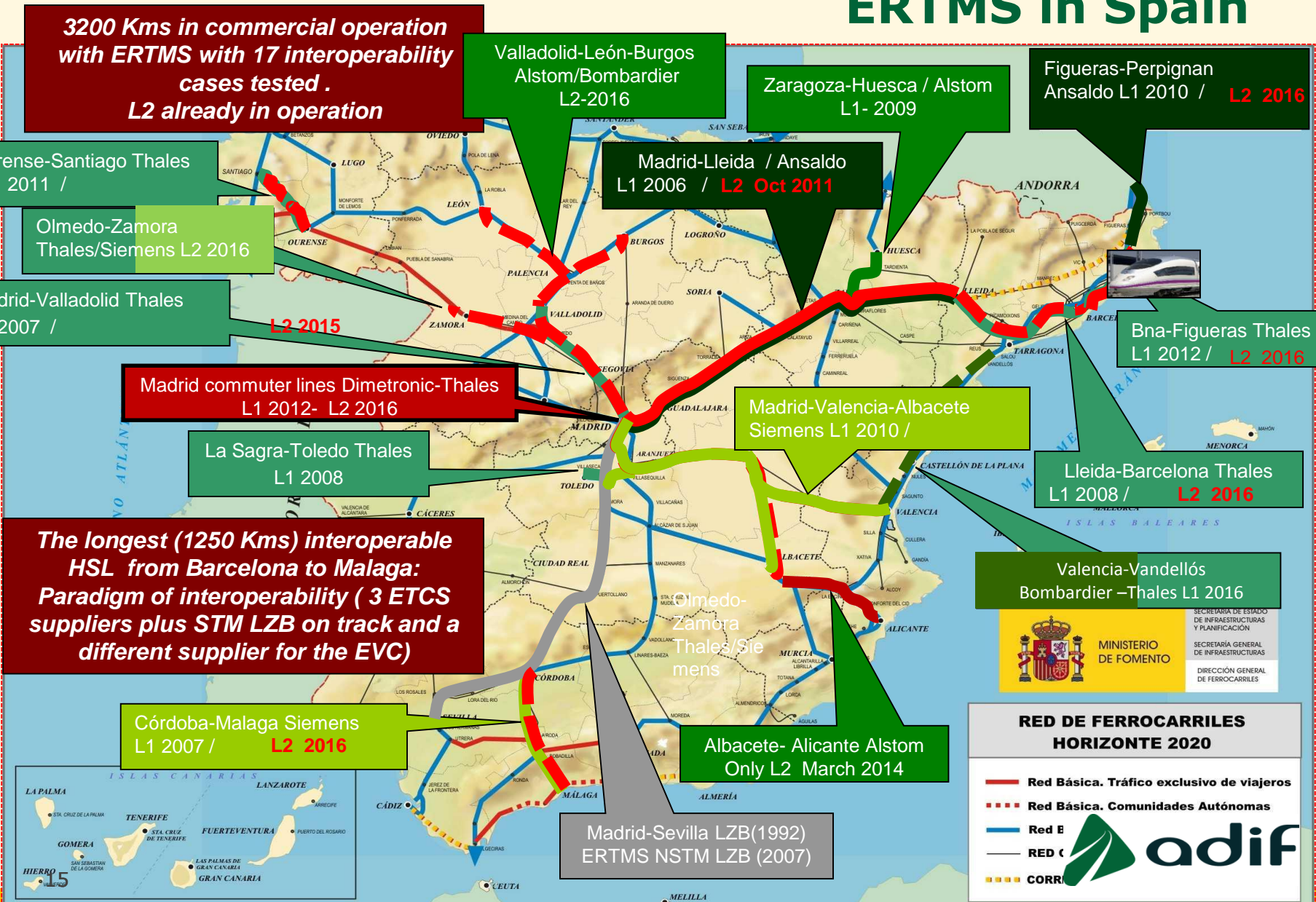
MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

4. ERTMS in Spain and main pending challenges worldwide

ERTMS in Spain



RED DE FERROCARRILES HORIZONTE 2020

- Red Básica. Tráfico exclusivo de viajeros
- Red Básica. Comunidades Autónomas
- Red E
- RED C
- CORR



HIGH SPEED/ LONG DISTANCE/ MEDIUM DISTANCES TRAINS

Train supplier	Alstom	Talgo	Siemens	Alstom		CAF (Variable Gauge)		Talgo (Variable Gauge)	
renfe trainset									
Class	100 + 101	102 + 112	103	104	114	120 + 120.050	121	130	730
Fleet	24	46	26	20	13	28	29	30	15
Signalling	ETCS N1/N2 LZB ASFA	ETCS N1/N2 STM LZB ASFA	ETCS N1/N2 STM LZB ASFA	ETCS N1/N2 LZB ASFA	ETCS N1/N2 LZB ASFA	ETCS N1/N2 ASFA	ETCS N1/N2 LZB ASFA	ETCS N1/N2 STM LZB STM EBICAB ASFA	ETCS N1/N2 STM LZB STM EBICAB ASFA
ERTMS Supplier	Alstom	Siemens	Siemens	Alstom	Alstom	Ansaldo - CSEE Transport	Ansaldo - CSEE Transport	Bombardier	Bombardier
ETCS SRS VERSION	2.3.0.d compatible	2.2.2 + CR	2.2.2 + CR	2.2.2 + CR	2.3.0.d compatible	2.2.2 + CR	2.2.2 + CR	2.3.0.d compatible	2.3.0.d compatible

More than 400 train sets equipped with ETCS





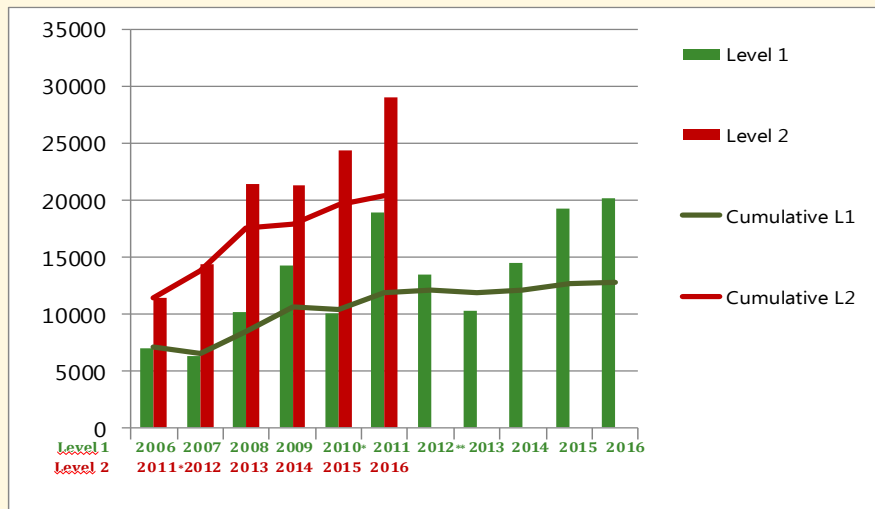
Interoperability cases: Cross ERTMS Interoperability table

CROSS INTEROPERABILITY IN SPAIN		TRACK EQUIPMENT					
		Alstom	Ansaldo	Bombardier	Dimetronic	Thales	STM-LZB
ON BOARD EQUIPMENT	Alstom S-100/104/114- 465	15	7		9	8	10
	Ansaldo S-120/121		5			6	
	Bombardier S-130/730	18	11		13	12	10
	Dimetronic 450/446/447			16 Pilot line	17 Mad. Comm.		
	Siemens S-102/103- 252	14	1		3	2	4
	Thales	No On Board Unit from Thales in Spain					





Kms between incidences

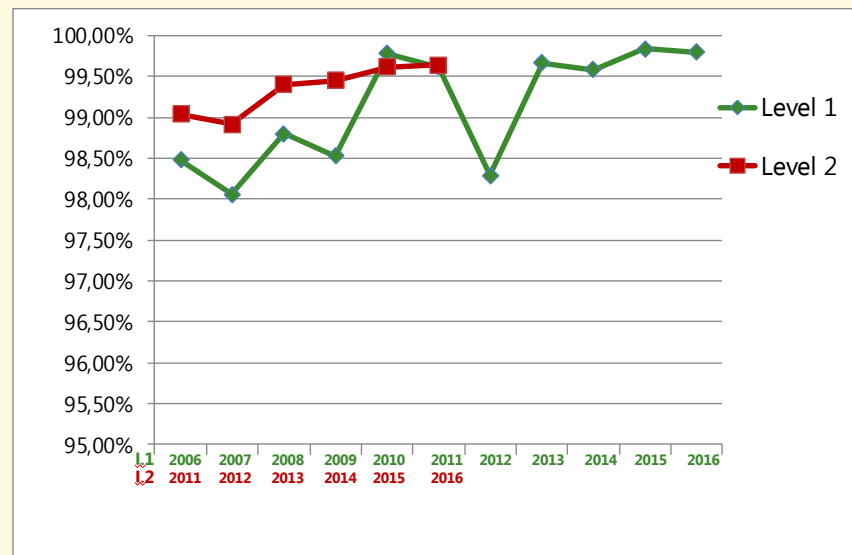


- * L2 started in October 2011
- * Line was extended in L1 up to Barcelona
- ** Line was extended in L1 up to French border

ERTMS works!!!

ERTMS reliability and punctuality in Madrid-Barcelona HSL

Punctuality (delay <5')



CURRENT SITUATION: POSITIVE MESSAGES

1

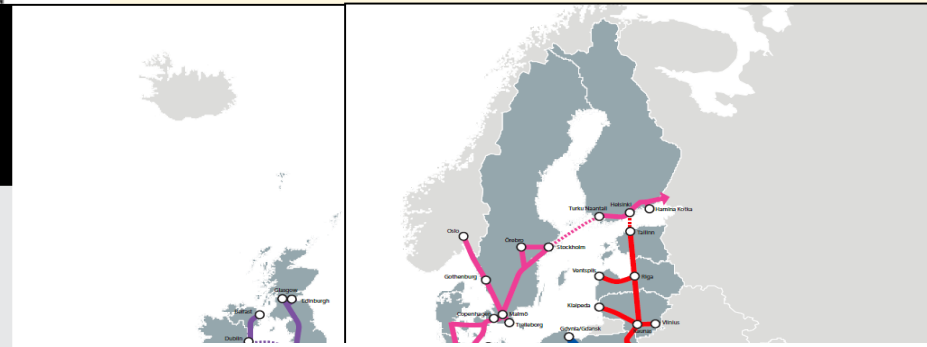
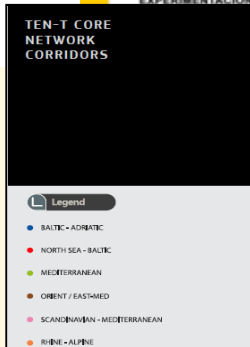
ERTMS will be the worldwide standard for rail signaling for the next decades

2

ERTMS will be deployed in European core and comprehensive corridors

3

ERTMS Specifications are stable enough and properly managed by ERA



- Baseline 2 (2.3.0.d) is an stable version in successful commercial operation in many European and non-European countries (Spain, Italy, Switzerland, The Netherlands, China....)
- Baseline 3 has been already published into the TSI (3.3.0) and it includes some added functionality (braking curves, crossing supervision...) as well as k



- Baseline 2 (2.3.0.d) is an stable version in successful commercial operation in many European and non-European countries (Spain, Italy, Switzerland, The Netherlands, China....)
- Baseline 3 has been already published into the TSI (3.3.0) and it includes some added functionality (braking curves, crossing level, limited supervision...) as well as bugs debugging.



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

5. Train-Track integration Tests (Operational tests): Remote tests

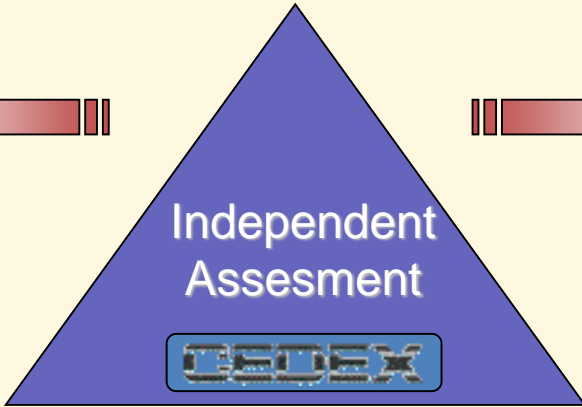


SYSTEM AUTHORITY AND INTEROPERABILITY (IOP) TESTS

- ❑ Within the new European frame where the operators and infrastructure managers are separated, it is essential the existence of a System Authority to manage interoperability problems.
- ❑ MFOM has played this role in the Spanish ERTMS project.
- ❑ The group led by MFOM (ADIF, RENFE, CEDEX and INECO) has created the validation procedure that allows the opening of railway lines with full warranties of interoperability.

OPERATIONAL TESTS

NATIONAL AUTHORITY:
Ministry of Fomento (Public Works)



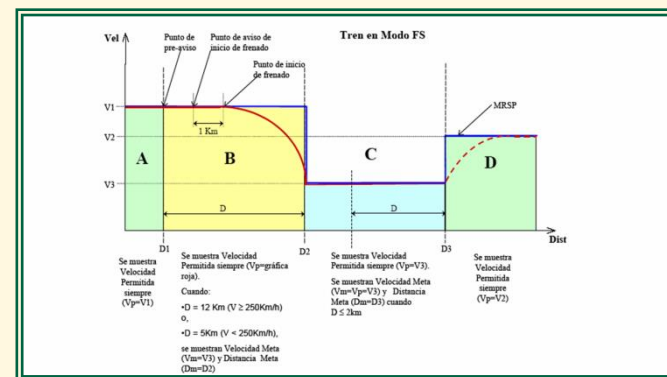
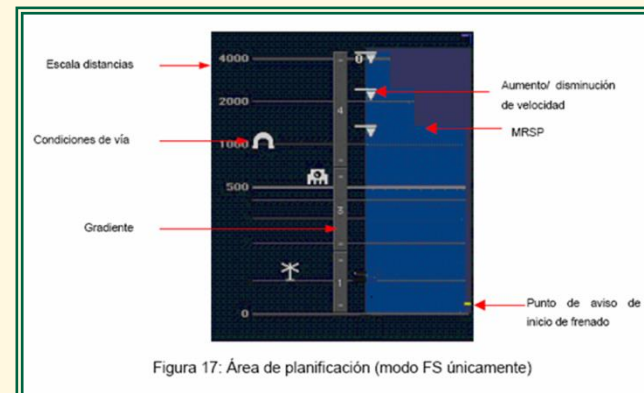
adif INFRASTRUCTURE MANAGER

renfe OPERATOR



Operational Tests. Main Tested Functionality

- Speed supervision and braking curves
- Level transitions
- Mode changes
- TSR Managing
- Managing of MA timers
- Odometry
- Track conditions
- Train Interface unit
- ATO and preset speed
- DMI
- National Functions
- Maximum Speed for exploitation with free route ahead
- Degraded situations (loss of communications, balise group lost, etc)
- EoA override
- RBC Handover

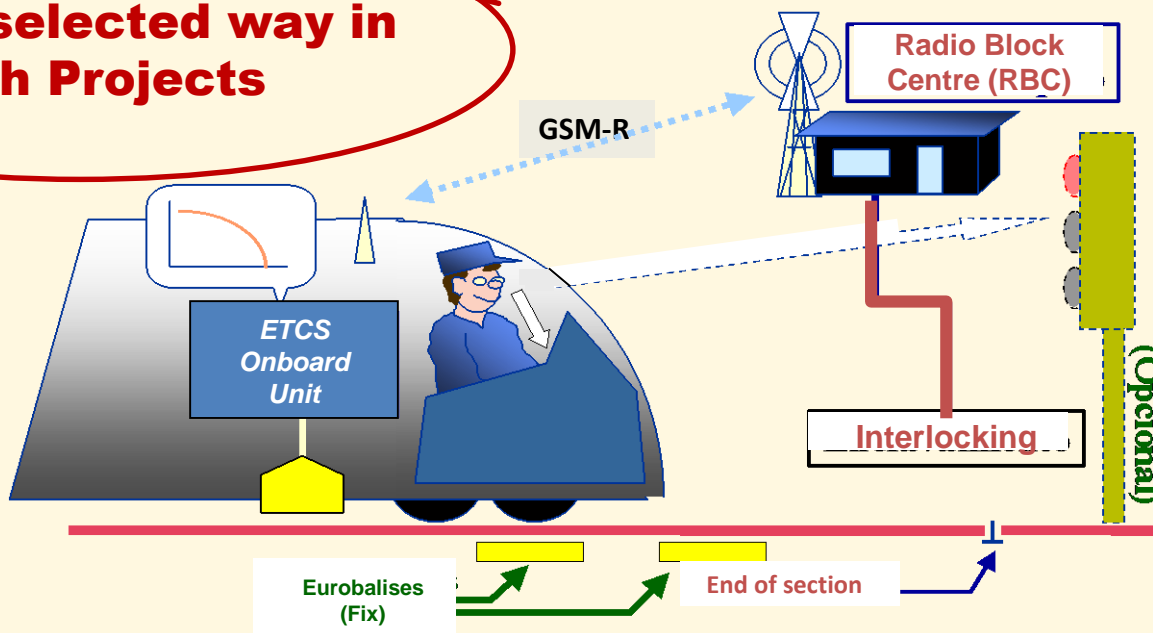




To achieve full interoperability two options are possible:

1. Performing OP tests once the whole system is installed on the track.
2. Advance interoperability issues by performing OP tests in a lab and after solving the problems appeared, running OP tests on track

This is the selected way in Spanish Projects





GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

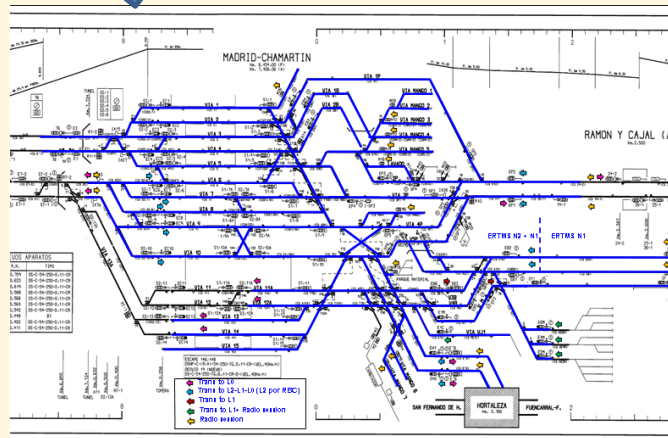
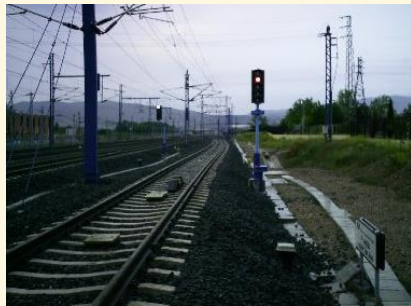
MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

- **How do we integrate the track and onboard subsystems at lab?**



The real track data and configuration is introduced into the real Radio Block Center (RBC).....



Track layout, switches, signals, track circuits...





And the real RBC is connected to the laboratory





GOBIERNO DE ESPAÑA

MINISTERIO DE FOMENTO

MINISTERIO DE AGRICULTURA ALIMENTACIÓN Y MEDIO AMBIENTE

CEDEX CENTRO DE ESTUDIOS Y EXPERIMENTACIÓN DE OBRAS PÚBLICAS

OP test at lab

The real train data are introduced into the real On Board Unit (EVC).....



Braking capacity, brakes activation, train interface unit (odometry, pantograph, main switch).....





GOBIERNO DE ESPAÑA

MINISTERIO DE FOMENTO

MINISTERIO DE AGRICULTURA ALIMENTACIÓN Y MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y EXPERIMENTACIÓN DE OBRAS PÚBLICAS

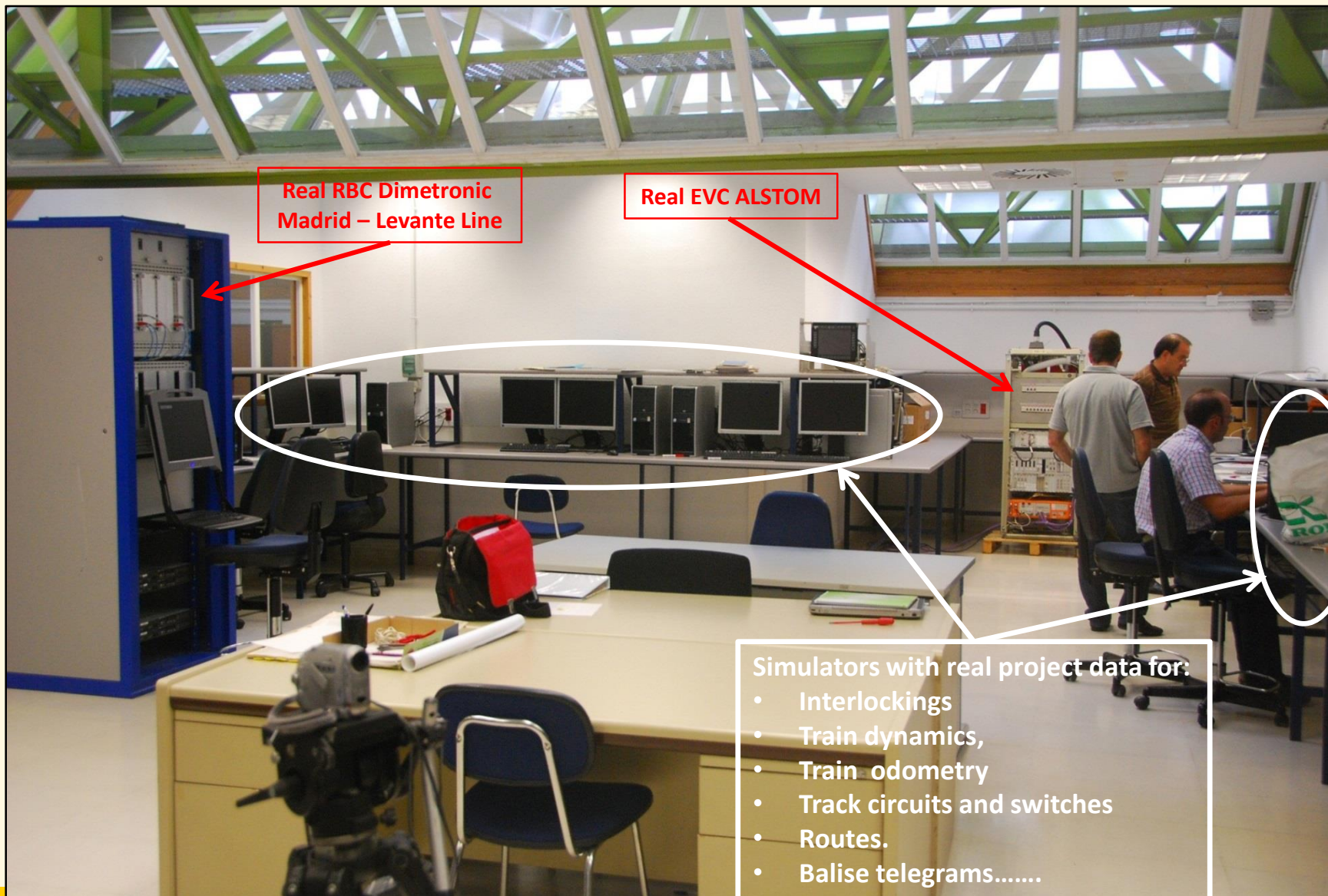
OP test at lab

And the real On Board Unit is connected to the laboratory





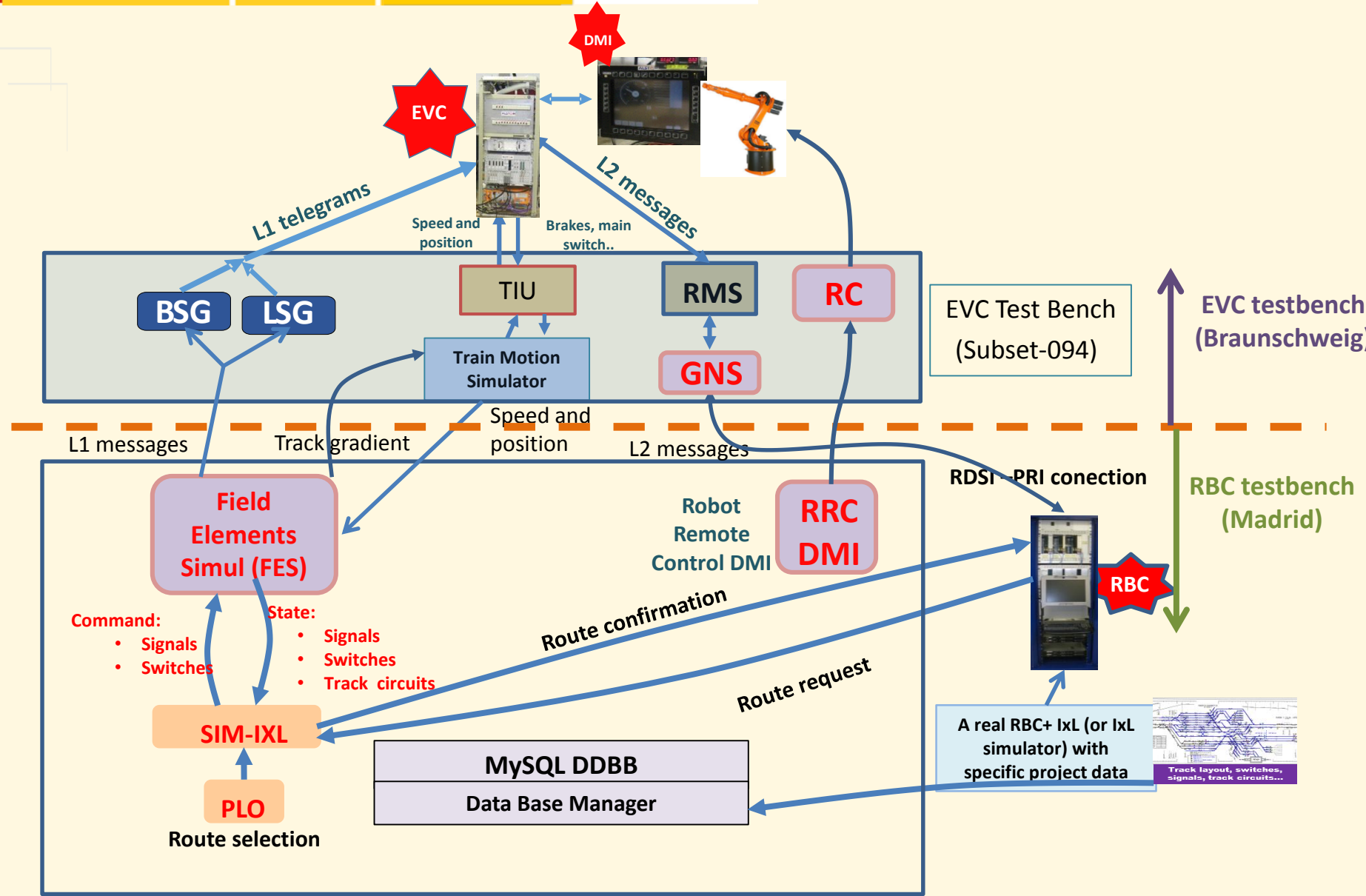
RBC and OBU are integrated and tested in the lab connected to all the simulators reproducing: a) the real train dynamics and b) track circuits occupancy, interlocking selected routes and balise telegrams.



Real RBC Dimetronic Madrid – Levante Line

Real EVC ALSTOM

- Simulators with real project data for:
- Interlockings
 - Train dynamics,
 - Train odometry
 - Track circuits and switches
 - Routes.
 - Balise telegrams.....





02/06/2015 09:32:08 11 32 11

Confirmation

ACK FOR ON SIGHT MODE

ACK FOR ON SIGHT MODE

DMInteractive

Numeric 1 Numeric 2 Numeric 3 Numeric 4 Numeric 5
 Numeric 6 Numeric 7 Numeric 8 Numeric 9 Numeric 0
 Cancel Arrow Left Arrow Right Arrow Up Arrow Down
 Enter Acknowledge Enter and Acknowledge

Time	Distance	Step number	Descrip
09:30:33	...154.36 m		Recei...
09:30:06	...965.16 m		Recei...
09:30:06	...961.98 m		Recei...
09:29:32	...523.00 m		Recei...
09:29:32	...515.93 m		Recei...
09:28:37	...105.50 m		Recei...
09:28:36	...092.69 m		Recei...
09:27:43	...543.16 m		Recei...
09:27:01	...024.68 m		Recei...
09:27:01	...016.45 m		Recei...
09:26:13	...481.70 m		Recei...

Position 58196.81 m

Train Behaviour Simulator 267

Inputs

- Cut Off Traction
- Apply Service Brake
- Apply Emergency Brake
- Open Main Circuit Breaker
- Lower Pantograph
- Inhibit Passenger E.B.
- Request Air Tightness
- Switch Off Balise Reader
- Allow Regenerative Brake
- Allow Eddy Current Brake
- Allow Magnetic Shoe Brake

TIU Outputs (Status)

- ETCS Main Switch (ON)
- Service Brake (Released)
- Emergency Brake (Released)
- Passenger E.B. (Released)
- Main Circuit Breaker (Closed)
- Pantograph (Up)
- Train Integrity (OK)
- Isolation (NO)
- Sleeping (NO)
- Doors (Closed)
- Deadman (OFF)

Desk

Cab Selection: Cab A, No Cab, Cab B

Power OFF

Open Main Circuit Breaker

Lower Pantograph

Inhibit Passenger EB

Activate Isolation

Activate Sleeping

Open Doors

Driver Safety Device

Dead Man OFF

Warning Emergency

Simulation Parameters

Drive Mode: Manual Automatic

Gradient: -20 0 20

Power Voltage: 0 750 1500 15000 25000

Power Frequency: 0 16,7 25 50 60

Force: 0.00 kN

Speed: 12.96 km/h

Position: 58196.05 m

Direction: FORWARD

Time: min 25 sec (x1.00)

Direction: Backward Neutral Forward

Traction Brake

Release Emergency Brake

Apply Emergency Brake

Apply Passenger E.B.

2015-02-06 Friday 09:30:44

railsite@railsiteCEDEX... TigerVNC: railsiteBS1:... gst-launch-0.10 DMInteractive

Robot Remote Control DMI



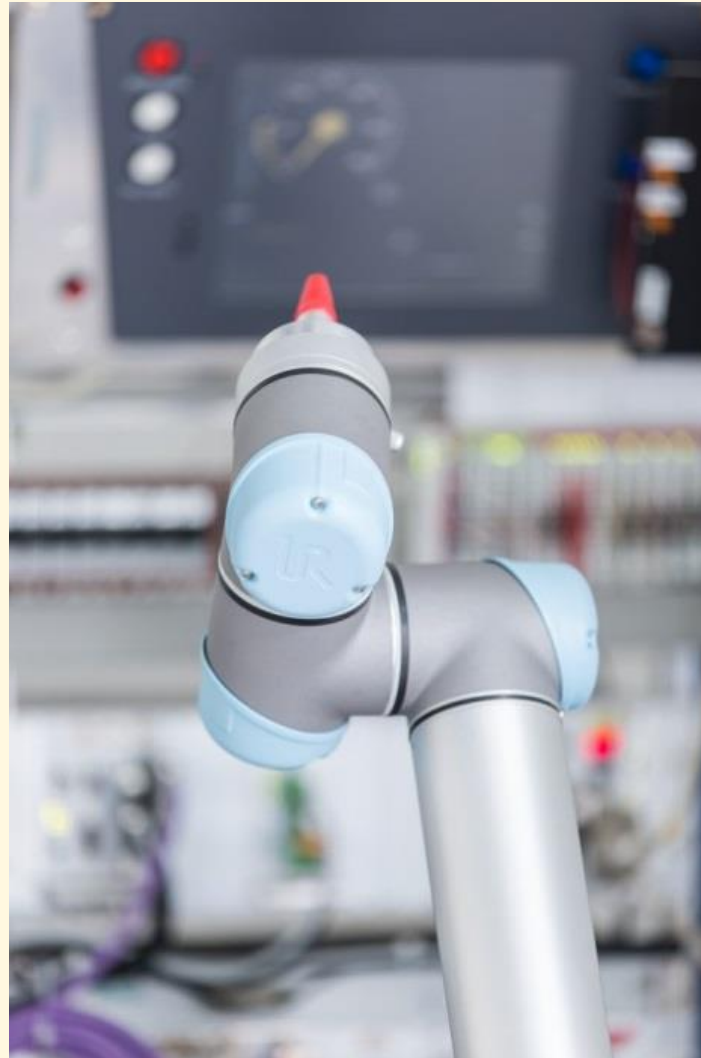
GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

OP test at lab



EVC test bench: DLR DMI Robot



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

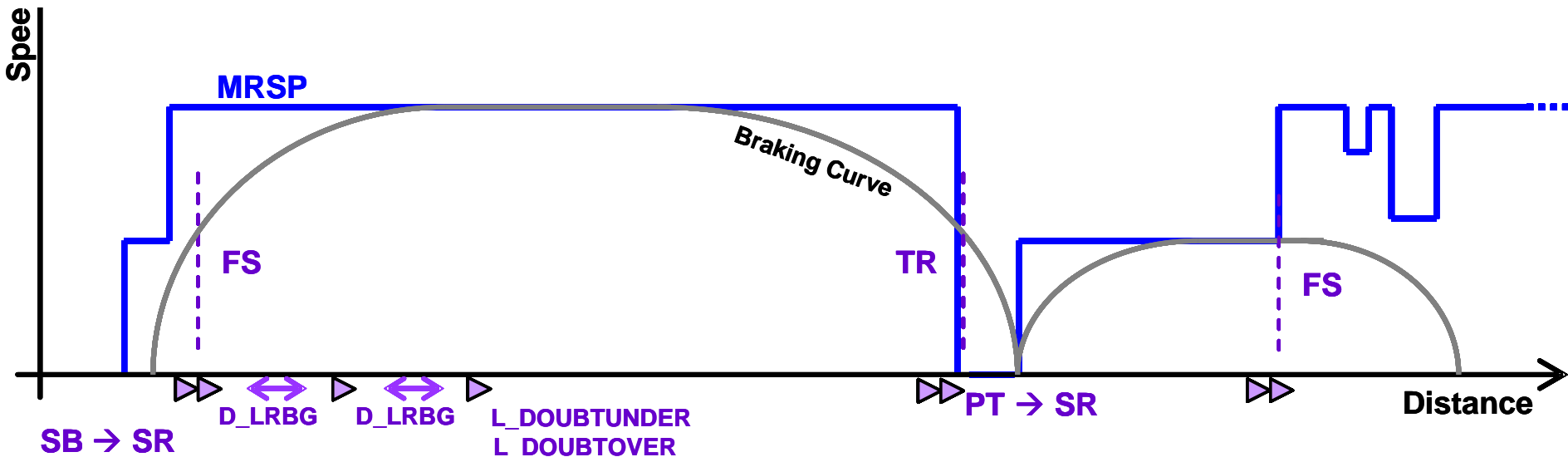
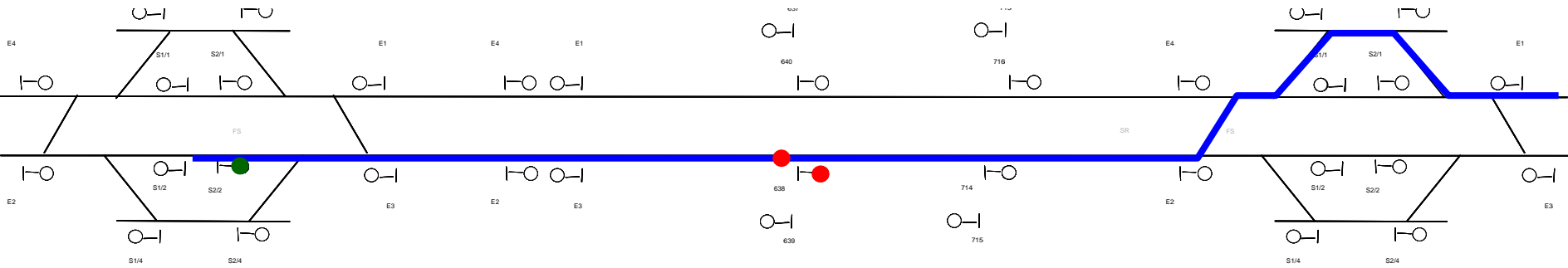
CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

6. On-site tests vs. laboratory tests: lab validation.



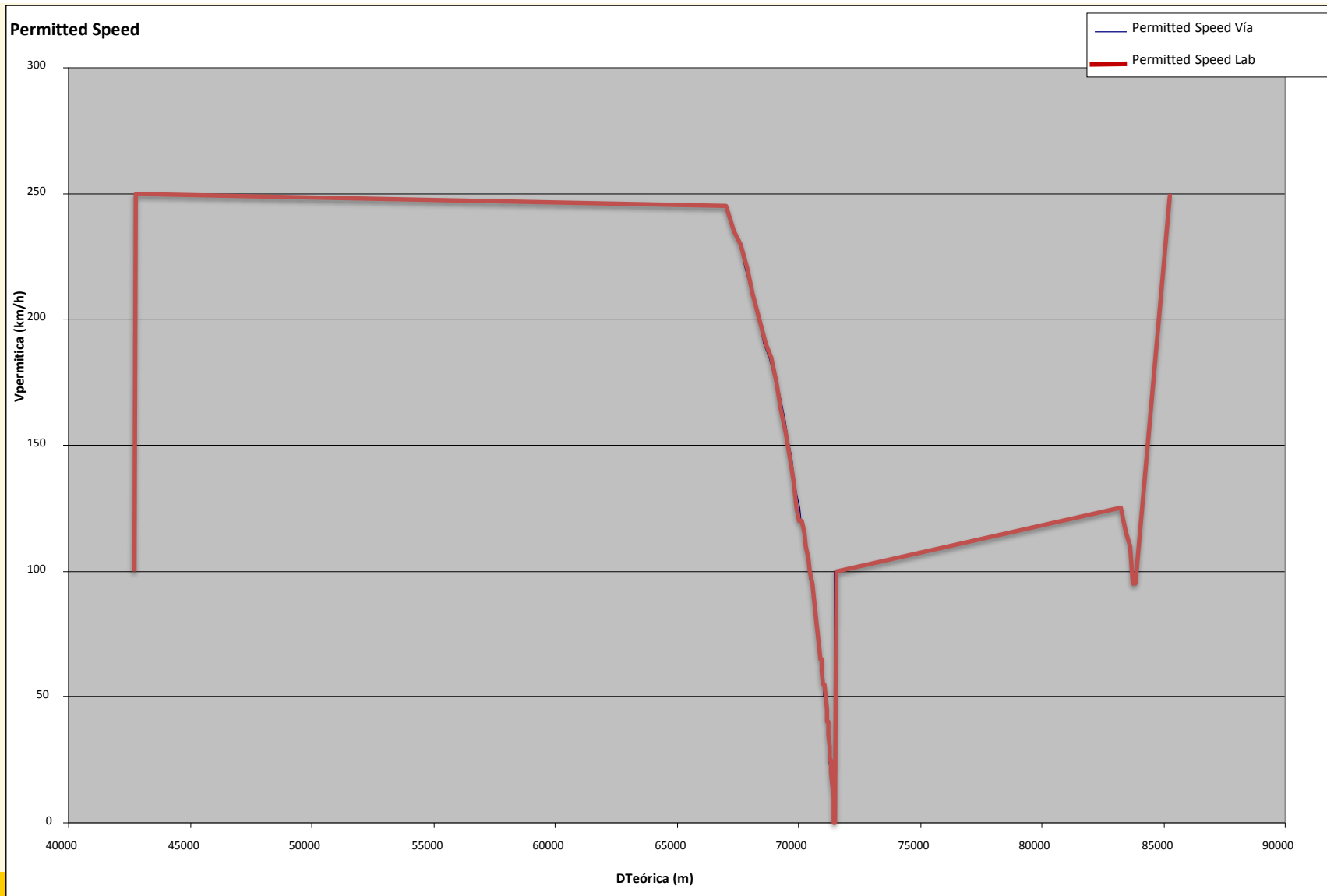
DEFINITION OF THE OPERATIONAL SCENARIO FOR LABORATORY VALIDATION

Trip between Valdemoro and Villarubia stations Trackside: Dimetronic / Onboard: Siemens





COMPARISON OF THE CALCULATION OF PERMITTED SPEEDS (L1)



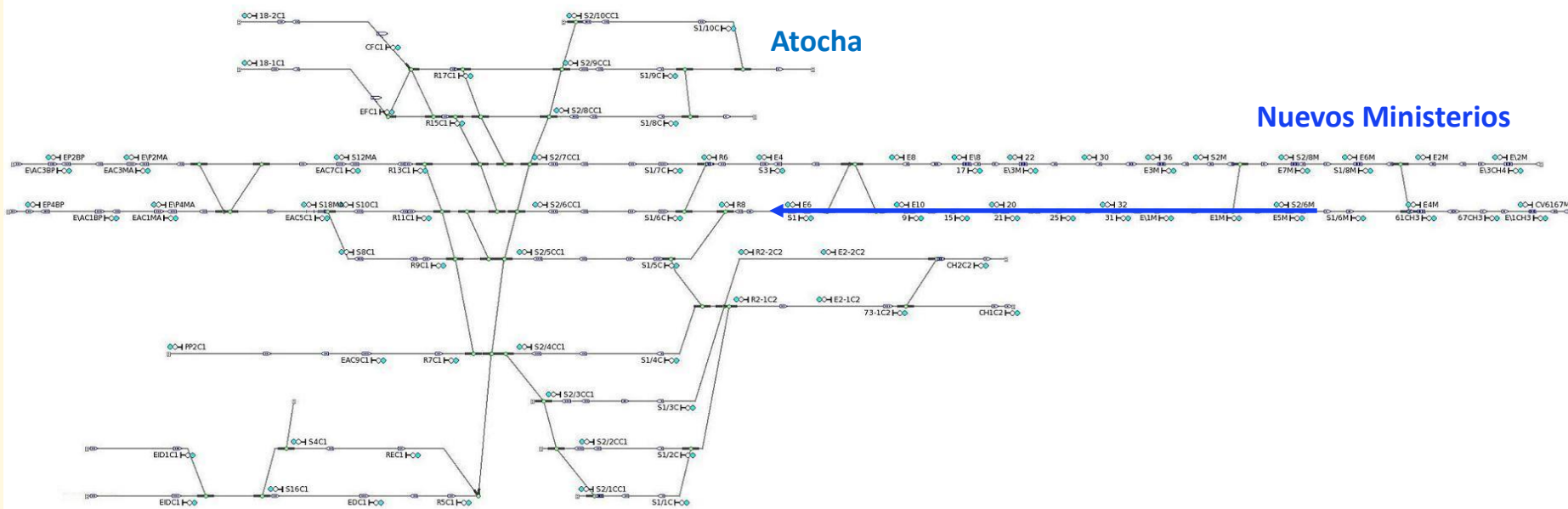


DEFINITION OF THE OPERATIONAL SCENARIO FOR LABORATORY VALIDATION

Validation trip in LEVEL 2

Trip between Nuevos Ministerios and Atocha commuter stations

Trackside: Thales / Onboard: Alstom



Level 2 Laboratory validation operational scenario for the commuter lines of Madrid:

- ❖ Train starting at the Balise Group 8102 (associated to signal S2/6M).
- ❖ Track free until signal S32 (Balise Group 8102) that will take free aspect when train approaches.
- ❖ Once S32 shows green aspect the signaling system will allocate track free until Atocha
- ❖ Atocha entry signal E6 shows non proceed aspect



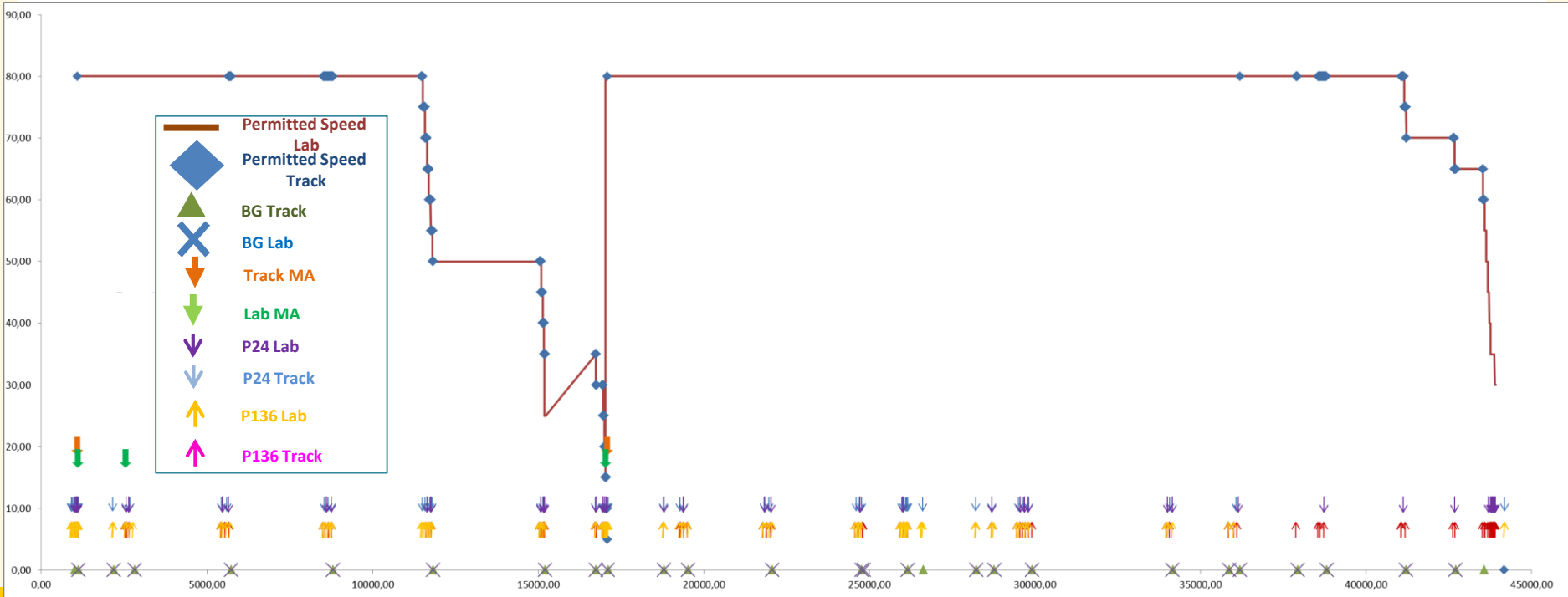
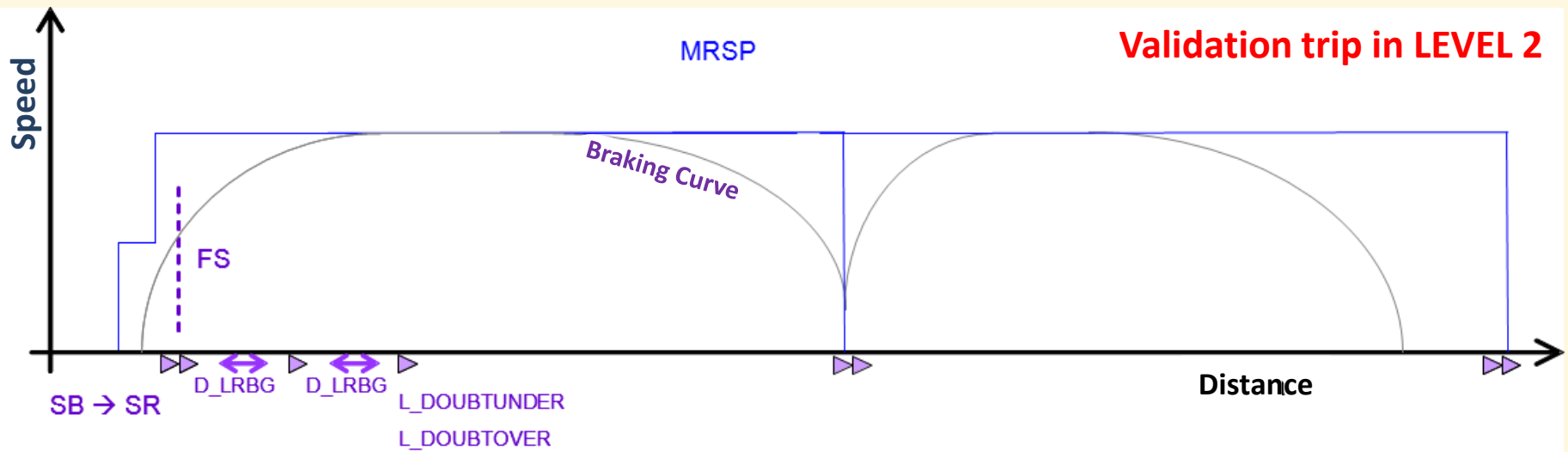
GOBIERNO DE ESPAÑA

MINISTERIO DE FOMENTO

MINISTERIO DE AGRICULTURA ALIMENTACIÓN Y MEDIO AMBIENTE



Testing the line in the laboratory. Laboratory validation





GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

7. Eurobalise laboratory



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

Eurobalise Laboratory



European Test Specifications (SS 085)
were debugged at CEDEX lab (2004)



Eurobalise lab description

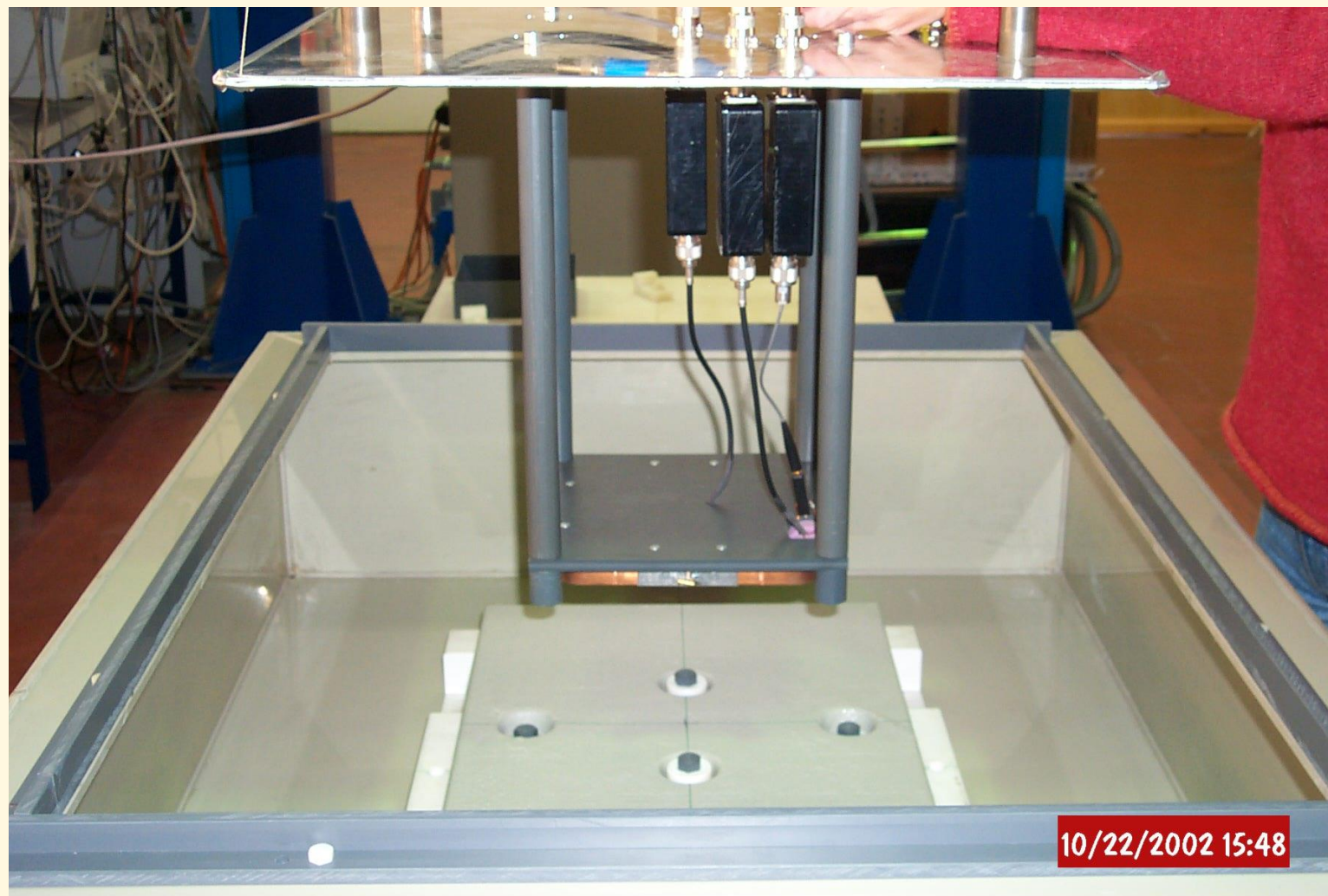
- European Eurobalise Test campaign, promoted by ERTMS-EEIG Users Group to debug the official Eurobalise test specifications (2003-2005): all the Eurobalise and antenna-BTM manufacturers from UNISIG at that moment were tested at the lab.
- Recognized as Reference Laboratory by the European Commission (ERA), UNISIG, Users Group
- Eurobalise Lab can perform in a neutral way the Certification tests required by the NOBO's.
- Eurobalise lab is reference laboratory for the component certification: First certification of an Eurobalise in an industry independent lab.
- The Lab is accredited by ENAC according to norm UNE-EN ISO/IEC 17025, accreditation number 465/LE1003



Eurobalise lab main activities

- Eurobalise tests (TSI-Subset-085)
- Antenna-BTM tests (TSI-Subset-085)
- Euroloop tests (TSI-Subset-103)
- Noise Immunity tests
- Several investigations and specific studies related to Eurobalise, working for ADIF, RENFE, Ministry of Fomento and private companies.
- Tests for different manufacturers since 2005: new manufacturers from Europe, China, Japan, Korea...

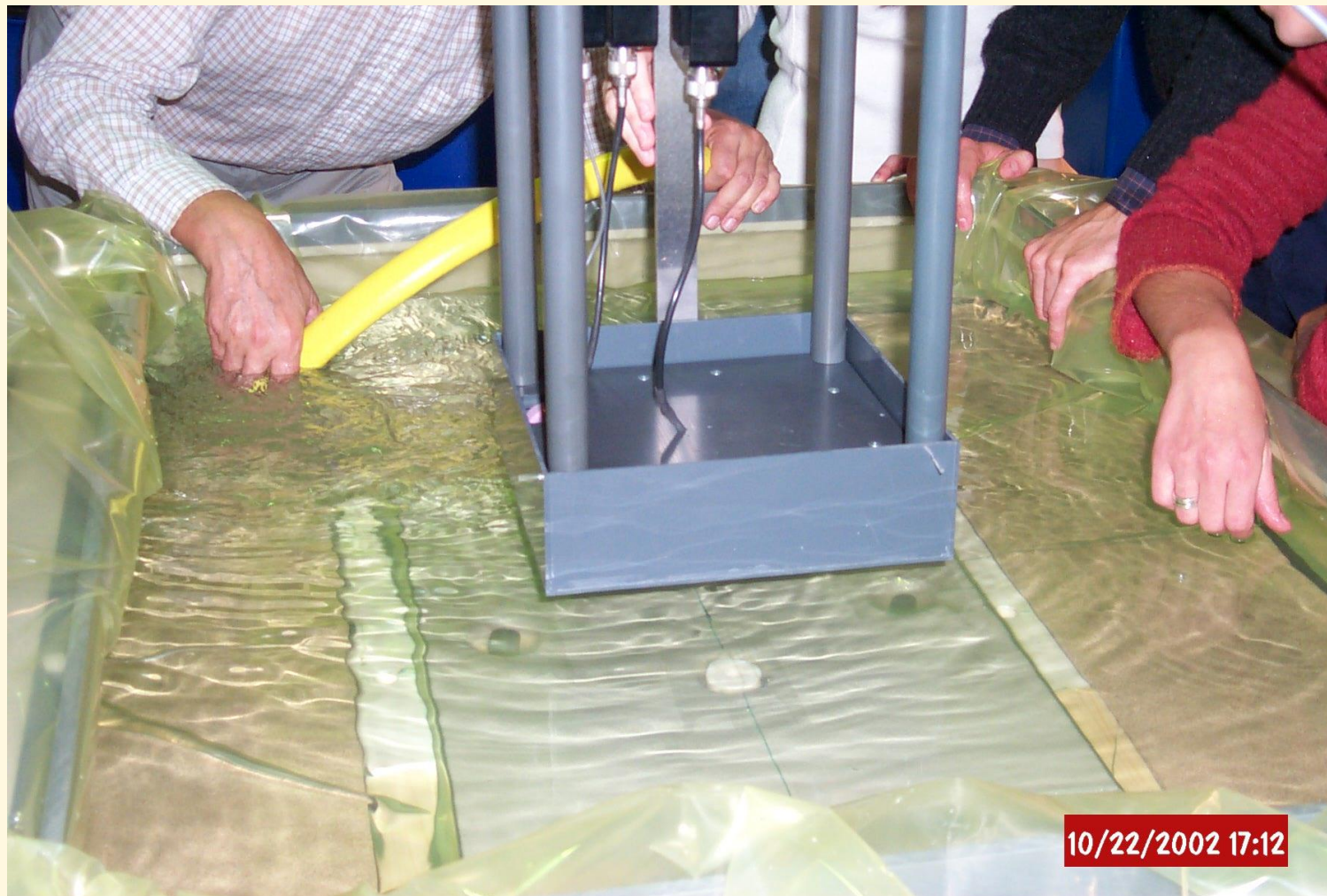




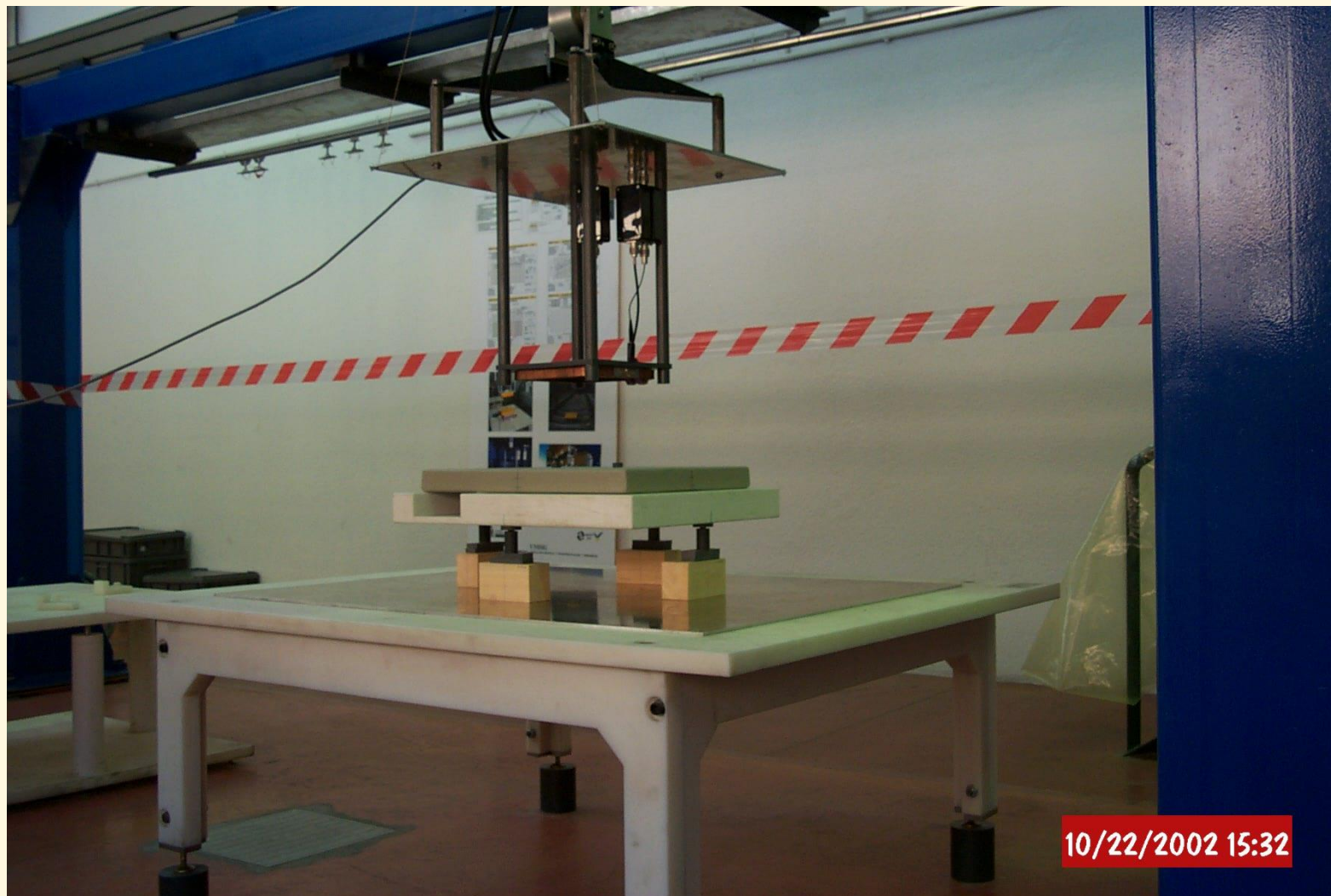
Free-air debris balise Test



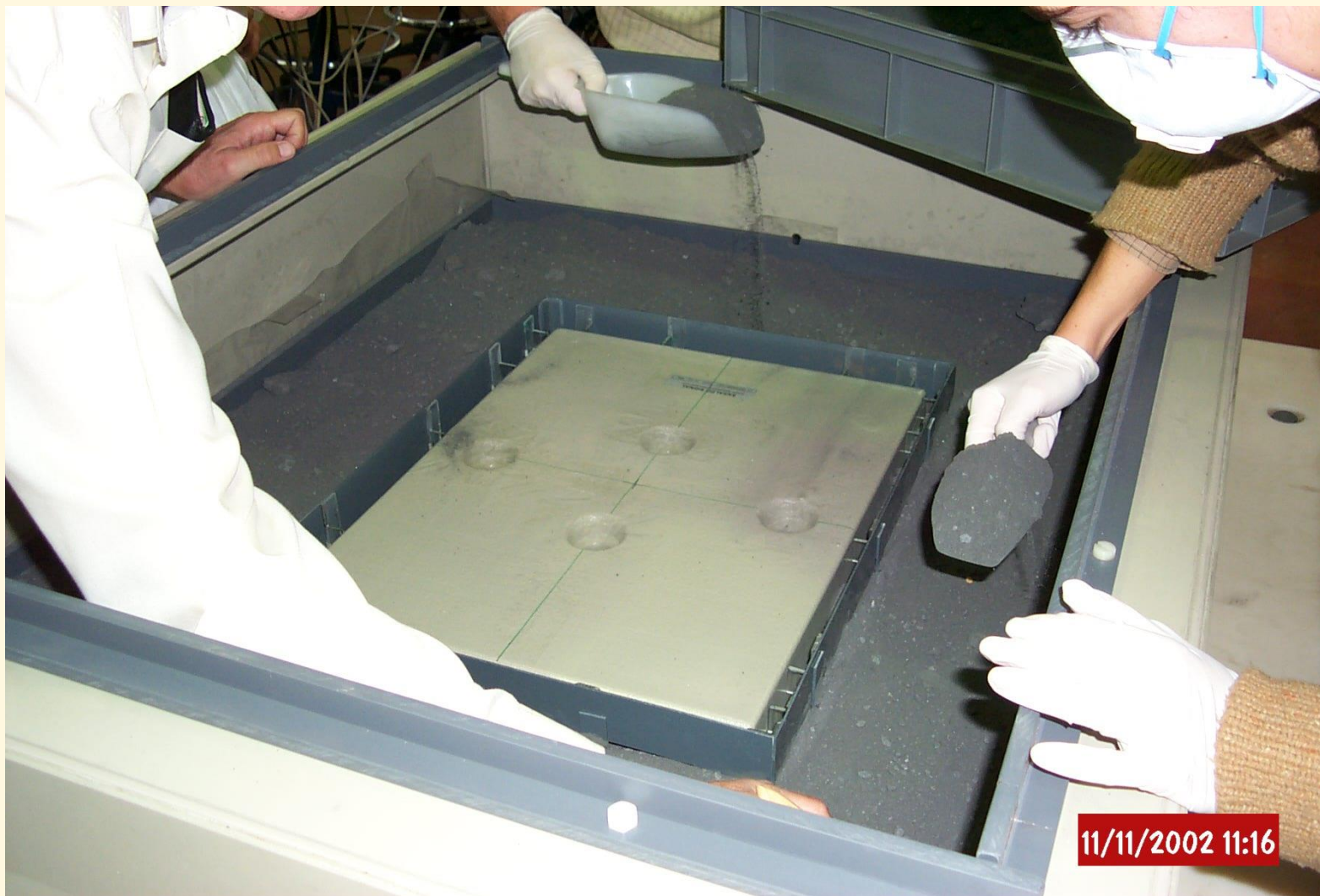
Preparation for the Reference Loop Calibration under clear water debris



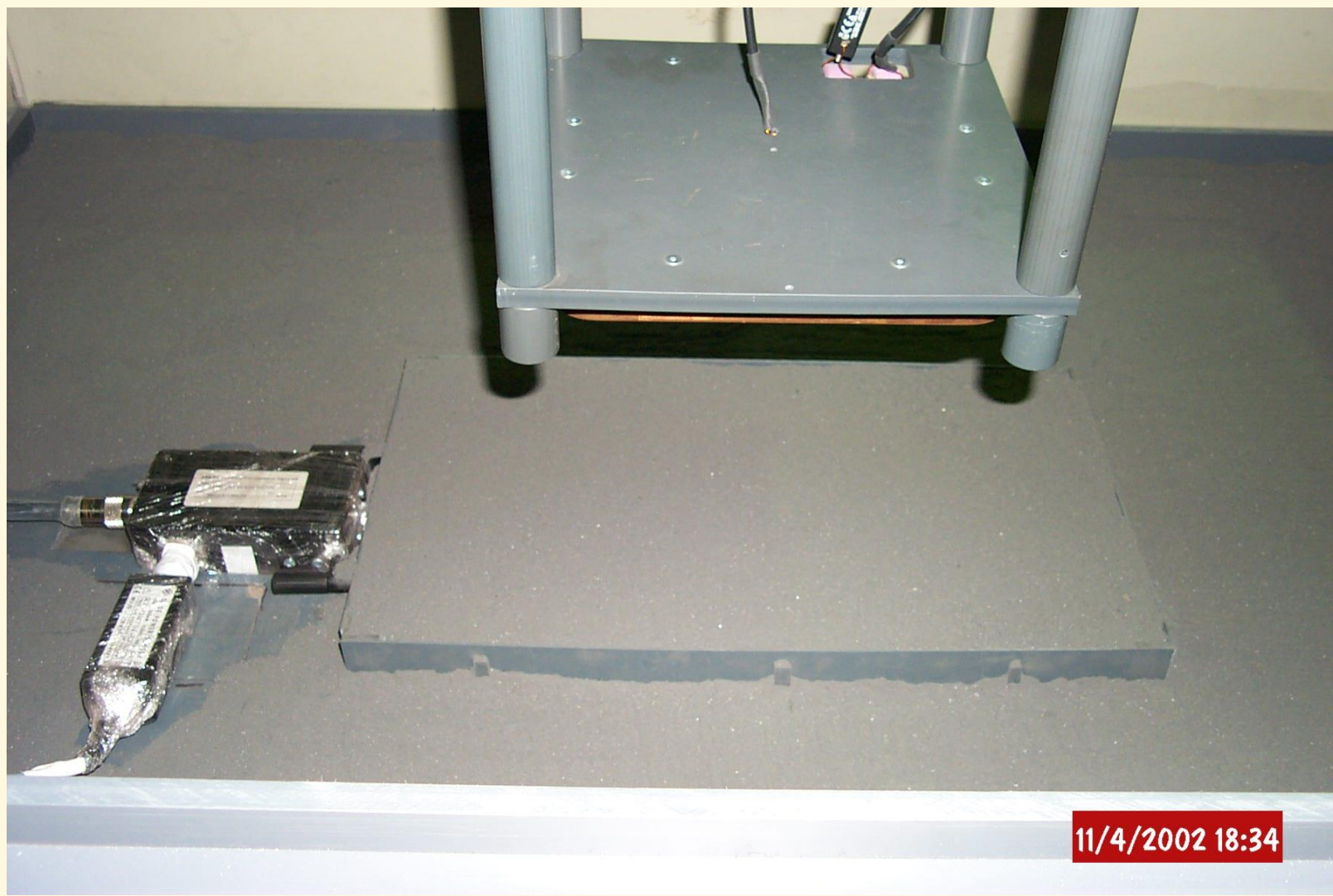
Debris Box filling-up for the Balise Clear-Water Tests



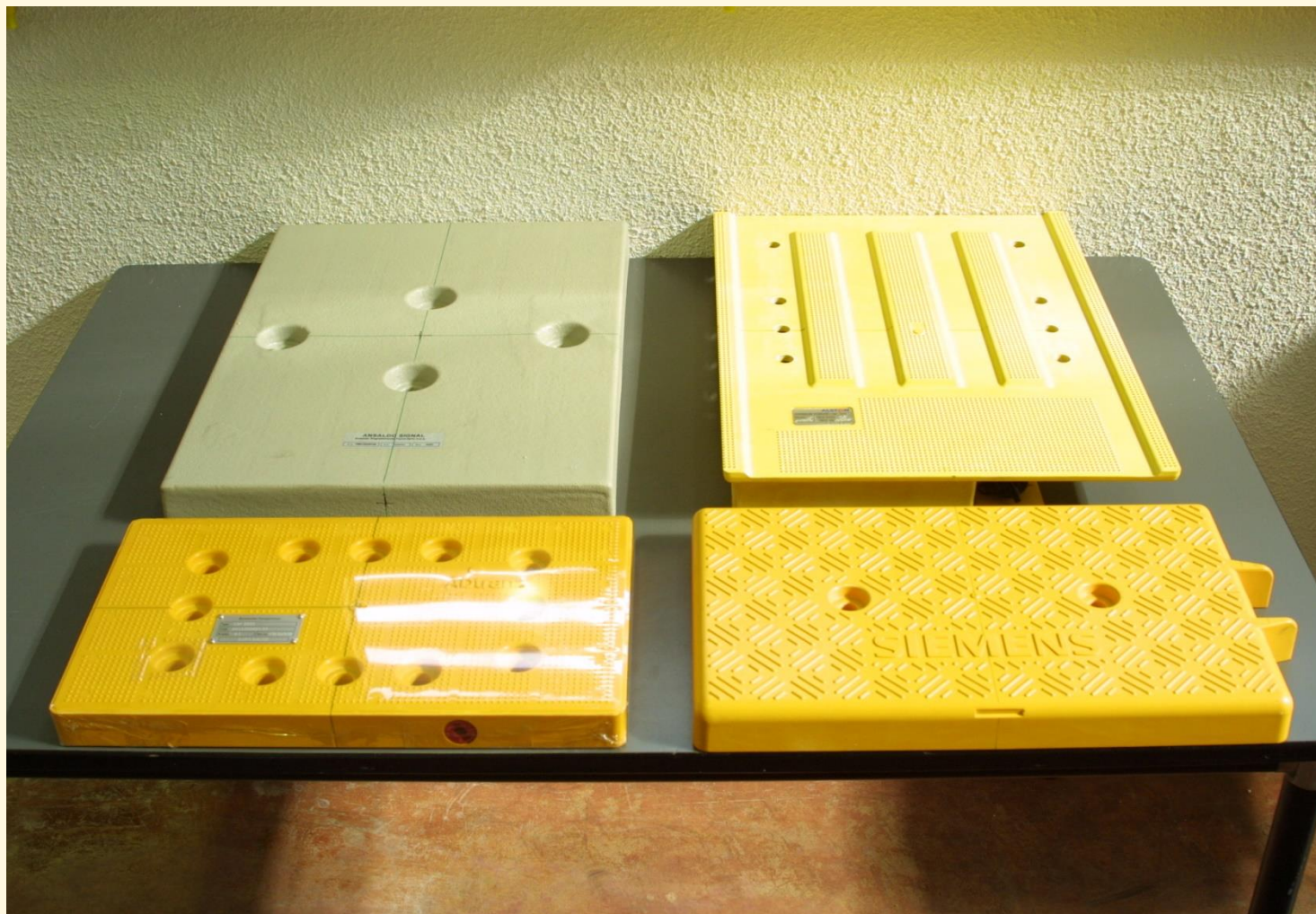
Balise Test under the Metallic-Plate Debris Condition



Preparation of Iron-Ore debris Balise Test



Test on the Balise under Iron-Ore Debris condition



Tested Balises from the four suppliers (ANS, BTS, ALS, SIE)



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

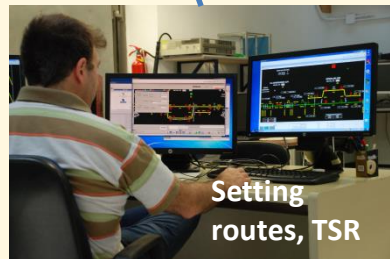
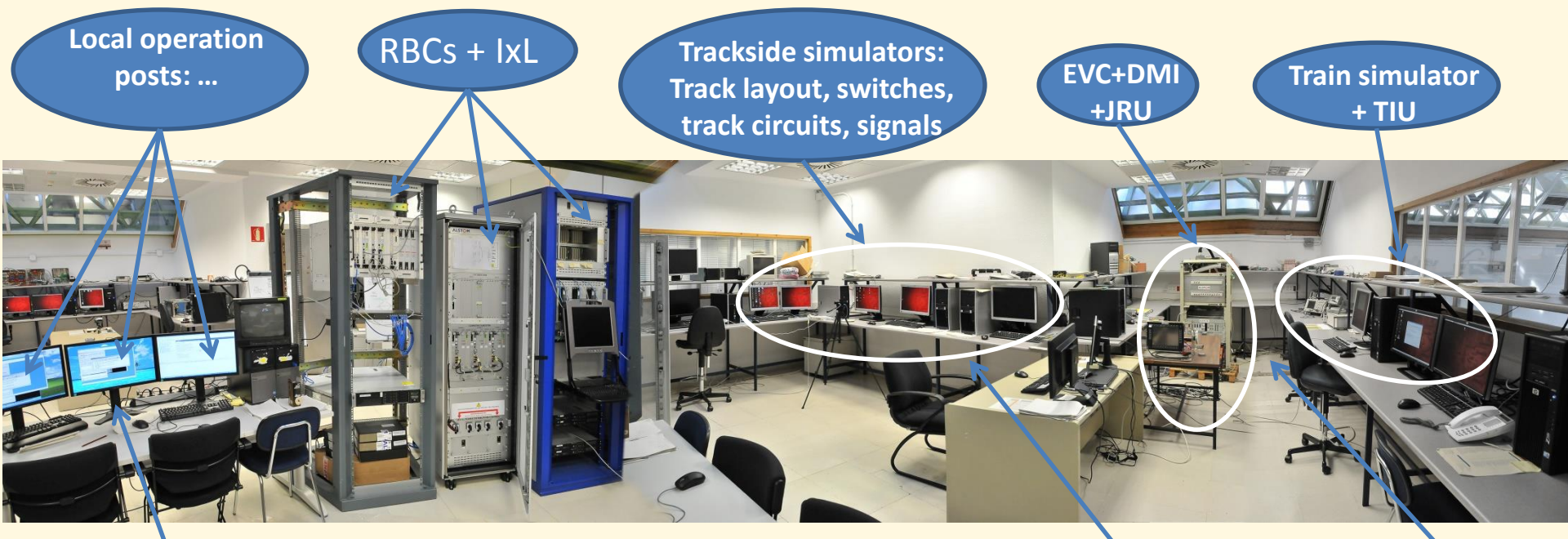
8. Eurocab laboratory:

- Tests for placing in service new lines and trains
 - EVC certification tests (Subset-076)

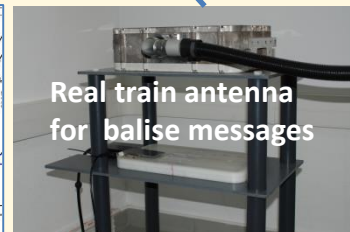
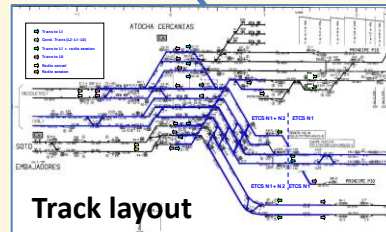


OPERATIONAL TESTS EXECUTED AT CEDEX RIL

- Operational Test Cases (OTCs) to test new lines and train-track integration are currently performed first at lab in Spanish ETCS lines.
- Every new ETCS line is tested against 3 different EVCs and every EVC is tested over 3 ETCS lines.
- HO between different RBC suppliers have been successfully tested
- Integration of both RBC and IxL (or IxL simulator) makes easier the interface between RBC (or IxL in this case) and the lab. (track circuits occupancy, aspect of the signals and status of the switches)



Panoramic view of the Railway Interoperability Laboratory of CEDEX during the test campaigns of the Alstom/Bombardier project Valladolid-Burgos-León





GOBIERNO DE ESPAÑA

MINISTERIO DE FOMENTO

MINISTERIO DE AGRICULTURA ALIMENTACIÓN Y MEDIO AMBIENTE

CEDEX CENTRO DE ESTUDIOS Y EXPERIMENTACIÓN DE OBRAS PÚBLICAS

TRAFFIC SIMULATION LABORATORY

THALES RBC

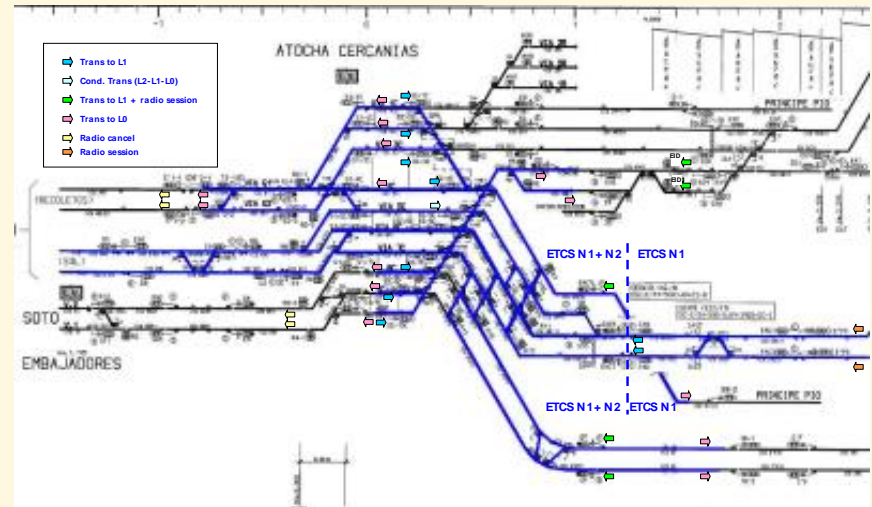
DIMETRONIC / SIEMENS RBC

ALSTOM EVC

European Cross Tests are being run at CEDEX lab



TEST LAY-OUT TO TEST THE LEVEL 2 ON THE COMMUTER LINES OF MADRID (MINISTRY OF FOMENTO)

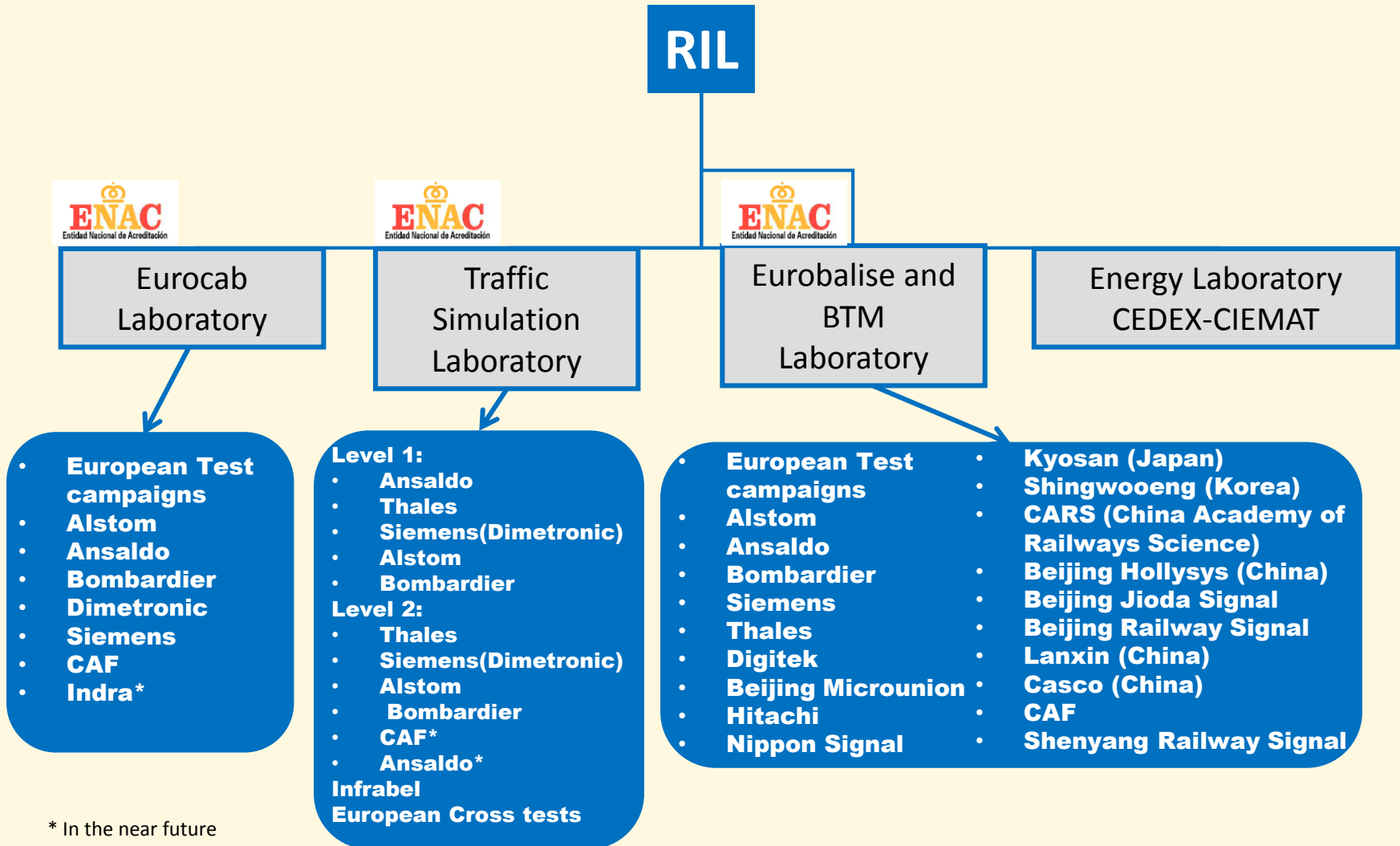




Different labs at Rail Interoperability lab -CEDEX



Spanish Entity for labs accreditation



* In the near future



EVCs

ALSTOM

Line	RBC supplier
Madrid commuter lines	Thales – Dimetronic (Siemens)
Madrid_Valencia HSL	Dimetronic (Siemens)
Valladolid-León-Burgos	Alstom and Bombardier
Olmedo-Zamora	Thales

BOMBARDIER

Subset 076 (2.3.0.d) tests

Line	RBC supplier
Madrid_Valencia HSL	Dimetronic (Siemens)
Valladolid-León-Burgos	Alstom and Bombardier
Olmedo-Zamora	Thales

CAF

Subset 07(2.3.0.d)6 tests (in progress)

Olmedo-Zamora	Thales
Valladolid-León-Burgos (in progress)	Bombardier and Alstom

SIEMENS

Subset 076 (2.3.0.) tests (Dimetronic)

Valladolid-León-Burgos (in progress)	Alstom and Bombardier
--------------------------------------	-----------------------

ANSALDO

Subset 076 (3.4.0) (near future)

EVCs and RBCs tested or being tested at RIL

RBCs

ALSTOM

Line	EVCs suppliers
Valladolid-León	Bombardier, Alstom, CAF And Siemens (in progress)

BOMBARDIER

Line	EVCs suppliers
Valladolid-Burgos	CAF, Alstom, Bombardier, and Siemens (in progress)

THALES

Madrid Commuter Lines	Alstom
Olmedo- Zamora	Alstom, Bombardier and CAF. Siemens (in progress)

SIEMENS

Madrid Commuter lines	Alstom
Madrid-Valencia	Alstom and Bombardier
Meca-Medina HSL (in progress)	Alstom



Cost and duration reduction by performing Operational Tests on lab

Scenario . Test campaign with 3 OBU's	Cost (k€)	Duration (months)	Duration after construction end
1.- Test campaign only on track	1,328	10,5	10,5
2.-Test campaign only at lab	180 (13%)	3	0
3.- Test campaign first in the lab (debugging) and later on track	824 (62%)	5	2



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

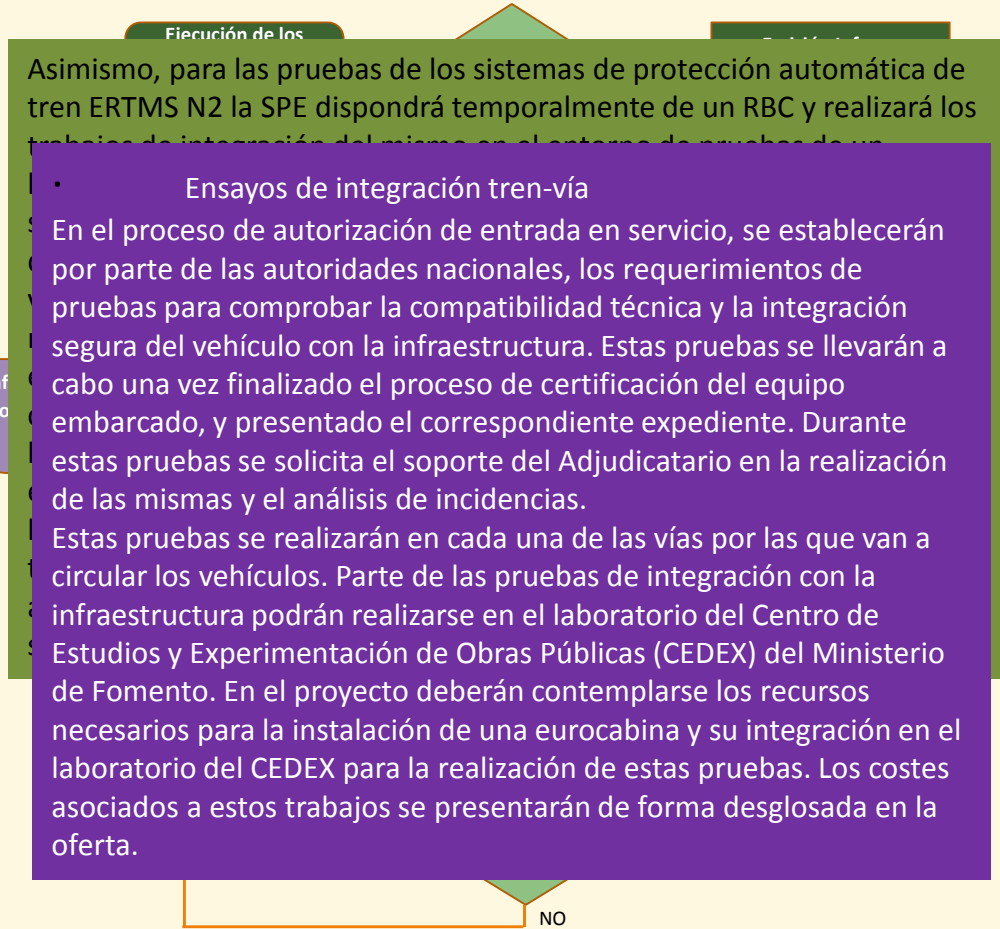
CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

9. Spanish procedure of placing in service.



ERTMS PLACE IN SERVICE PROCEDURE

1. It is needed to harmonize the procedure of placing in service ERTMS, including the role of the neutral (proposal sent from CEDEX to the AESF Dic 2015)
2. ADIF has included a clause in the tender documents regulating the tests to be run by the RBCs in a neutral lab with at least 3 EVCs.
3. Renfe Operadora has also recently included a clause requesting the EVCs to run test in a neutral lab to assure route compatibility.
4. RIL proposal: Integration in the lab of all RBCs installed in Spanish lines, as well as all the EVCs to be run over the Spanish lines.





GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

10. Current international activities at RIL



CURRENT INTERNATIONAL ACTIVITY AT RIL

- 1. Leader of European working group writing ETCS Test Specifications (SS-076).**
- 2. ETCS tests for Haramain project (HSL in Saudi Arabia) (Alstom EVC/ Siemens RBC)**
- 3. ETCS tests for for ISR (Israel Railways).**
- 4. Tendering for the creation of a similar ETCS lab for Network Rail ERTMS program.**
- 5. Definition and execution of operational tests for Danish ERTMS program.**
- 6. Participation in the European Project : “Support to the implementation of ERTMS” (2014-EU-TM-0279-S) financed by the European Commission.**
- 7. Participation in the Project VITE (Virtual Test of ERTMS), financed by the European Commission through the initiative Shift to Rail.**
- 8. Participation in the Project ERSAT, Galileo satellite application for ERTMS, financed by the European Commission**
- 9. Testing ERTMS L2 in Senegal (Dakar commuter lines) in the near future.**



GOBIERNO DE ESPAÑA

MINISTERIO DE FOMENTO

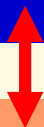
MINISTERIO DE AGRICULTURA ALIMENTACIÓN Y MEDIO AMBIENTE



ALIANCES AND NETWORKING



Deployment of European Freight corridors



Tools development



Laboratories network: Consolidation



ineco

National Projects: Putting in service





GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

11. Conclusions



CONCLUSIONS: USING THE LAB TO HELP ERTMS DEPLOYMENT

- **Conforms with CCS TSI requirements (efficient assessment/certification)**
 - CEDEX lab is accredited for certifying Eurobalises, Antennas-BTM (SS-85), Euroloop (SS-103) and EVCs (SS-076).
 - Operational lab test can be used as a powerful tool, not only for Placing in Service new lines but also for certifying the ETCS line (IOP successful tests of a certified OBU over a line, would be enough to certify the line).
 - CEDEX IOP tests are based on real data and are supported by a technical staff with the highest experience in ETCS lines testing and deployment
- **Maximising Lab based testing (reduced time/cost)**
 - CEDEX experience demonstrates that IOP tests at lab achieve a strong reduction of test onsite (from 10,5 to 3 months for 3 EVCs and around 8 times less cost), as well as avoid “last minute problems”.
 - CEDEX lab has been pioneer in executing IOP tests in Europe. Comparison between onsite tests and lab tests have been USED TO VALIDATE THE LAB.
 - A similar strategy can be used in Europe and mainly for the European corridors
- **International presence**
 - CEDEX is the WP leader of SS-76 ETCS Test Specifications
 - CEDEX-RIL is proposing this strategy to many foreign countries as England, Denmark, as well as offering his installations to test ERTMS projects in Saudi Arabia, India, China, Senegal etc....



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA
ALIMENTACIÓN Y
MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS Y
EXPERIMENTACIÓN
DE OBRAS PÚBLICAS

**Thank you very
much for your
kind attention**

Ignacio Jorge Iglesias Ph.D.
RIL Director
jorge.iglesias@cedex.es

