

ERTMS Deployment - Italian Experience

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ERTMS Project in Italy in realization



Portfolio of investments



**ERTMS ON
CONVENTIONAL
LINES (with
decommissioning of
CLASS B system)**
3.400km in
realization (PNRR)



**ERTMS ON
PRIORITY LINES OF
CORE CORRIDORS
(Overposed on
Signalling National
System)**
About 1.200km in
progress



**HD ERTMS FOR
HIGH DENSITY ON
NODES (Hybrid)**
In realization on
Roma, Firenze and
Milano



**ERTMS ON HS/HC
LINES and UPGRADE
BASELINE**
In realization
upgrade to Baseline
3 of Roma-Napoli
HS/HC line



**NEW
INFRASTRUCTURE
AND MAJOR WORK**
In realization
Milano Genova
«Terzo Valico dei
Giovi», Brescia –
Padova Vicenza HS
Line, etc.

RFI: State of ERTMS in operation and in construction up 2026

Up 2026: 4.103 Km

| | | |
|--------------|---------------|---------|
| IN OPERATION | Core | 1133 KM |
| | Comprehensive | 89 KM |
| | Off-TEN | 34 KM |

| | | |
|----------------|---------------|---------|
| IN COSTRUZIONE | Core | 994 KM |
| | Comprehensive | 777 KM |
| | Off-TEN | 1076 KM |



ERTMS TREE



Off-TEN Network

TEN-T Network

Breakthrough Program

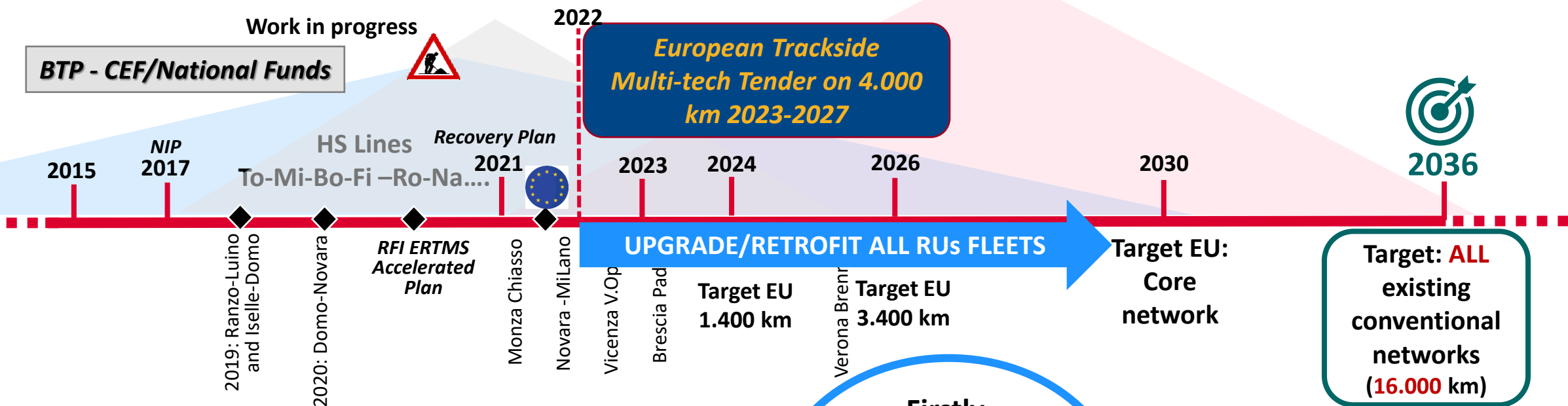


Strategies for ERTMS in RFI

Dual OnBord for HS Lines (2005....)
and Dual on Track Conventional
Lines (*Breakthrough Programme*)



ERTMS for the whole network
Dual OnBoard and Decommissioning Class B
also in conventional lines and technological renewal



Best Scenario

| | Until 2026 | 2027-2030 | 2031-2036 |
|---------------|------------|-----------|-----------|
| Core network | 40% | 60% | |
| Comprehensive | 26% | 22% | 52% |
| Off TEN | 30% | 8% | 62% |

Firstly, investments on regional lines (smaller fleets) as requested by RUs

Core TEN-T: ≈5.800km
Comprehensive TEN-T: ≈4.600km
Off-TEN: ≈6.400km

ERTMS STAND ALONE TRACKSIDE: More than 4.000 km contracted

About 3 Mrd€ PNRR- Recovery Fund Next Generation EU

Multitechnological Framework Agreement Phase 1 ERTMS Plan lines: Sicilia and Roccasecca - Avezzano

Roccasecca-Avezzano (pilot line)
≈ 80 km

Sicilia (first implementation)
≈ 583 km
Canicatti-Siracusa + lines of 2024

ERTMS Plan Multitechnological Framework Agreement Phase 2

LOT 1 CENTRAL-NORTH Italy
≈ 1.887 km
DOIT: Firenze, Milano, Torino, Venezia, Verona, Bologna, Genova, Trieste

LOT 2 CENTRAL-SOUTH Italy
≈ 1.396 km
DOIT: Roma, Napoli, Bari, Cagliari

LOT 3 CENTRAL of Italy
≈ 534 km
DOIT: Ancona

LOT 4 SOUTH of Italy
≈ 407 km
DOIT: Reggio Calabria

≈ 663 km up to 2024 (PNRR ERTMS)

≈ 777 km up to 2024 and ≈ 1840 km up to 2026 (PNRR ERTMS)
≈ 175 km for ERTMS Plan lines at 2025 and 2026 (not financed by PNRR ERTMS)
971 km for lines at 2027 + additional 460 km as backup at 2027

A division of Industrial Effort by suppliers and operators

THE ERTMS ACCELERATED MULTI-TECHNOLOGICAL PLAN

A great challenge for the whole country and a new governance of investments

»»» The ERTMS Accelerated Plan consists of:

ERTMS over the *whole railway infrastructure* (IT: 16.800 km TEN and Off-TEN)

↔ *Synchronized and harmonized ERTMS (trackside/on-board) deployment*



Simultaneous decommissioning of the national Class B system, with incentives for the RUs



Technological renewal of Control Command and Signaling (CCS) (Digital Interlocking, Traffic Management System (TMS), TLC (GSM-R/FRMCS based), and ERTMS/ETCS), coordinated and driven by ERTMS system



INTEGRATED MULTI-TECHNOLOGICAL PLAN AND REALIZATION OF INVESTMENTS



DRIVEN BY ERTMS – One CCS Safety Case

ERTMS L2

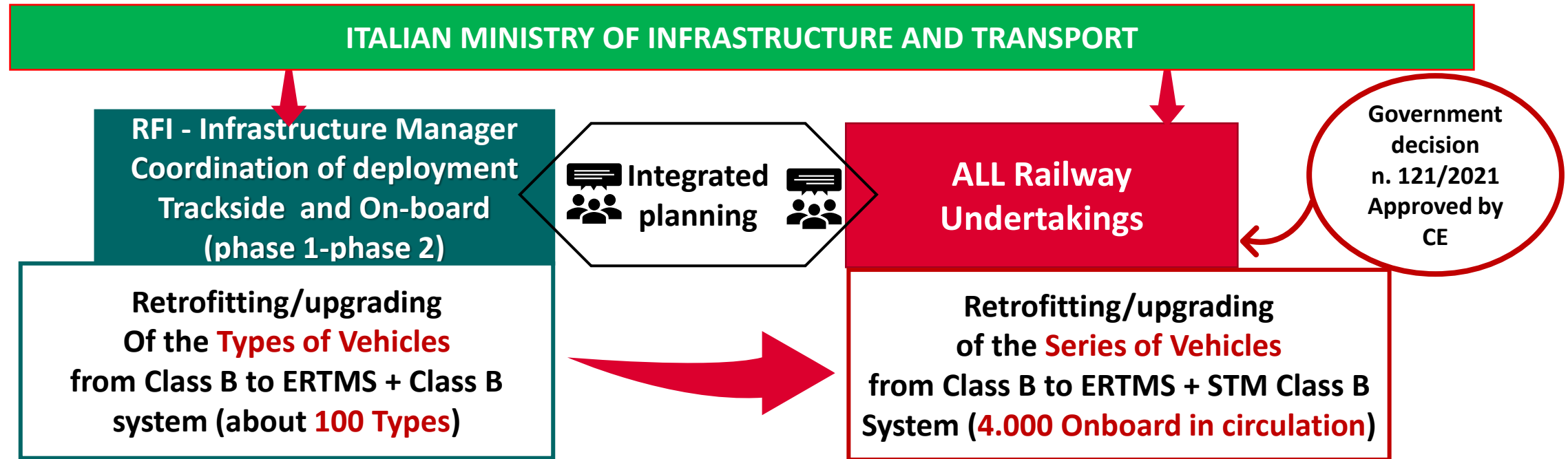
Interlockings

TLC

TMS

TRACK CIRCUITS AUDIO
FREQUENCY

ERTMS ON BOARD: IT retrofit/upgrade strategy for the Circulating Fleet



 This model *will be successful in EU* if:
Incentives on Series and Vehicles are granted **up to 100%** of the cost for ALL Rus
(at the moment cover only 30% of the cost) 


ERTMS deployment Plan depending on the financing available



Need of financing trackside and onboard to continue the ERTMS deployment Plan



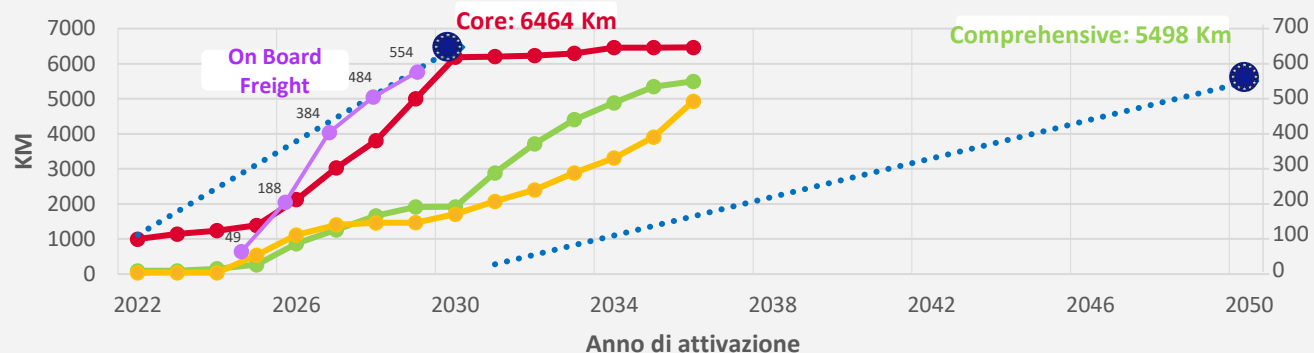
*The next phase of the ERTMS Plan in Italy is the ERTMS implementation on the core network. Financing has to be available for the **core network** and also for the update of on-board systems (**mostly freight**), because lack of financing for the RUs risk to slow down the ERTMS implementation plans.*

Analyses are in progress with the Member State to define the new NIP based on financing available for year for ERTMS system

Different Rate Scenarios for Network Installation ERTMS L2 Stand Alone



Three scenarios in function of kms/years based on available funds (1 M€/KM for IXL,ERTMS,GSMR)

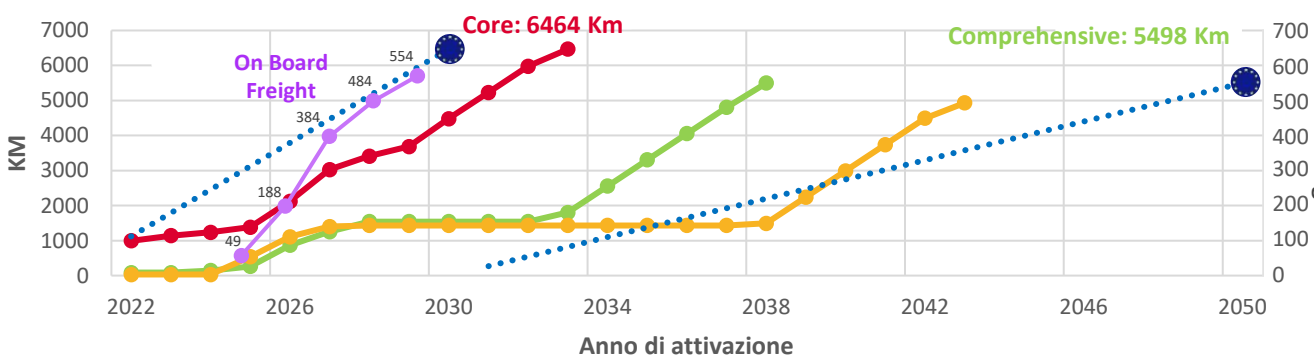


Scenario A : 1000 km/Year

2026: 4.103 Km
(Core 33%, Comprehensive 16%, Off-TEN 23%)

2030: 9.808 Km
(Core 96%, Comprehensive 35%, Off-TEN 35%)

2036: 16.894 Km
(Core 100%, Comprehensive 100%, Off-TEN 100%)



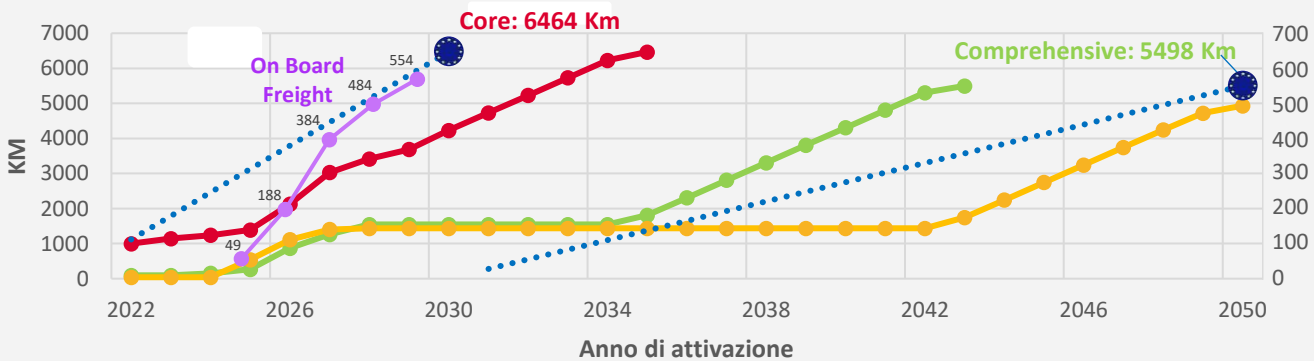
Scenario B: 750 km/Year

2026: 4.103 Km
(Core 33%, Comprehensive 16%, Off-TEN 23%)

2030: 7.454 Km
(Core 70%, Comprehensive 28%, Off-TEN 29%)

2036: 11.954 Km
(Core 100%, Comprehensive 74%, Off-TEN 29%)

2043: 16.894 Km
(Core 100%, Comprehensive 100%, Off-TEN 100%)



Scenario C: 500 km/Year

2026: 4.103 Km
(Core 33%, Comprehensive 16%, Off-TEN 23%)

2030: 7.204 Km
(Core 65%, Comprehensive 28%, Off-TEN 29%)

2036: 10.204 Km
(Core 100%, Comprehensive 42%, Off-TEN 29%)

2050: 16.894 Km
(Core 100%, Comprehensive 100%, Off-TEN 100%)

- Obligation UE
- Core and HS
- Comprehensive
- Off-TEN
- Freight On Board Train



ETCS on board: Trenitalia's Plan for installation

- The Plan for the installation of ETCS on board is made by Trenitalia strictly linked with RFI's installation Plan
 - The final objective is:

Put on board ETCS not too time before its use on a certain line, but have the trains equipped in coherence with the presence of ERTMS wayside



ETCS on board: Trenitalia's Plan for installation – More details

- All Trenitalia fleet for High Speed Service is already equipped with ETCS, together with the national class B system SCMT
- All Trenitalia trainsets or locomotives for Regional or other kind of use, put in service after the 2022 are already equipped with ETCS, together with the national class B system SCMT (FITMENT)
- The plan for installing ETCS on board on the rest of Trenitalia fleet already in service covers 1600 Driver Cabs, with almost 20 Types of rolling stock (RETROFITTING)

Rolling Stock scheduled to remove from service for obsolescence up to 2026 is not present in the plan for Installation

ETCS on board: Trenitalia's Plan for installation – More details

All High Speed Trenitalia fleet and part of Trenitalia fleet where ETCS is already installed is equipped with ETCS Baseline 2 and so must be upgraded to Baseline 3 (UPGRADING)

In coherence with RFI plan, fleet that run on nodes will be equipped with ETCS High Density (**Hybrid level 3**): on board it's necessary a specific SW version and the hardware sure link between front and end of the train for assuring the integrity

ETCS on board: Trenitalia's Plan for installation – Contracts with the suppliers

According to the directive of Italian Ministry of Transport, the activities for the retrofit and the costs for the homologation of the GENERAL Applications and for the SPECIFIC Application is in charge RFI , the Italian Infrastructure Manager

Railway undertakings make available to RFI the rolling stock for the application/homologation of GENERAL APPLICATION and for the application/homologation for each SPECIFIC APPLICATION

The railway undertakings make the contracts with the suppliers for the series applications, starting from the specific applications already homologated by RFI

The General and Specific Application are available for all the railway undertaking

Trenitalia Plan: Overview on the type of rolling stock



| Business | Type | Supplier of ETCS | Type of intervent | Economic value | Number of vehicles | Number of cabins | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|------------|--------------------------|------------------|-------------------------|----------------|--------------------|------------------|------|------|------|------|------|------|
| Regional | Loco E464 series 1 | Alstom | Retrofitting | 13,1 Mln€ | 90 | 90 | 0 | 8 | 22 | 46 | 14 | 0 |
| | DMU Minuetto | Alstom | Retrofitting | 29,9 Mln€ | 103 | 206 | 0 | 0 | 34 | 69 | 0 | 0 |
| | EMU Rock | Hitachi | Retrofitting | 46,7 Mln€ | 119 | 238 | 0 | 0 | 39 | 80 | 0 | 0 |
| | DMU Swing | AngelStar | Retrofitting | 32 Mln€ | 57 | 114 | 0 | 0 | 9 | 32 | 16 | 0 |
| | Loco E464 series 0 | Alstom | Retrofitting | 51,1 Mln€ | 171 | 171 | 0 | 0 | 0 | 0 | 96 | 75 |
| | Loco E464 | Alstom | Upgrade to BL3 | 31,7 Mln€ | 164 | 164 | 0 | 0 | 0 | 0 | 96 | 68 |
| | EMU Jazz | Alstom | Retrofitting | 52,7 Mln€ | 86 | 172 | 0 | 0 | 9 | 34 | 43 | 0 |
| | EMU Minuetto | Alstom | Retrofitting | 55,2 Mln€ | 99 | 198 | 0 | 0 | 3 | 68 | 28 | 0 |
| | EMU Pop | Alstom | Retrofitting | 74,1 Mln€ | 132 | 264 | 0 | 0 | 9 | 68 | 55 | 0 |
| | DrivingCoach Vivalto I | Alstom | Retrofitting | 12,4 Mln€ | 41 | 41 | 0 | 0 | 8 | 33 | 0 | 0 |
| | EMU Flirt 170 | Stadler | Retrofitting | 18,3 Mln€ | 10 | 20 | 0 | 0 | 0 | 0 | 2 | 8 |
| | EMU TAF | Hitachi | Retrofitting | 26,9 Mln€ | 43 | 43 | 0 | 0 | 0 | 24 | 19 | 0 |
| | Driving Coach Vivalto II | Hitachi | Retrofitting | 32 Mln€ | 95 | 95 | 0 | 0 | 0 | 48 | 47 | 0 |
| | Driving Coach Vivalto II | Hitachi | Upgrade to BL3 | 6 Mln€ | 22 | 22 | 0 | 0 | 0 | 0 | 13 | 9 |
| | EMU Rock | Hitachi | Upgrade to High Density | 12,7 Mln€ | 119 | 238 | 0 | 0 | 0 | 0 | 59 | 60 |
| IC | ETR610 | Alstom | Upgrade to BL3 | 4,3 Mln€ | 7 | 14 | 0 | 7 | 0 | 0 | 0 | 0 |
| | Loco E414 | Hitachi | Retrofitting | 14,7 Mln€ | 57 | 57 | 0 | 0 | 34 | 23 | 0 | 0 |
| | Loco E464 series 0 | Alstom | Retrofitting | 13,6 Mln€ | 92 | 92 | 2 | 40 | 50 | 0 | 0 | 0 |
| | Loco E401 | Hitachi | Upgrade to BL3 | 11 Mln€ | 39 | 39 | 0 | 0 | 0 | 39 | 0 | 0 |
| | Loco E402B | Hitachi | Upgrade to BL3 | 10,6 Mln€ | 33 | 33 | 0 | 0 | 8 | 25 | 0 | 0 |
| | Loco E403 | Hitachi | Upgrade to BL3 | 6,8 Mln€ | 22 | 22 | 0 | 0 | 13 | 9 | 0 | 0 |
| | Loco E464 series 0 | Alstom | Upgrade to BL3 | 7,3 Mln€ | 69 | 69 | 0 | 0 | 15 | 54 | 0 | 0 |
| | Driving Coach Z1 | Alstom | Upgrade to BL3 | 5,5 Mln€ | 52 | 52 | 0 | 0 | 19 | 33 | 0 | 0 |
| | ETR610 | Alstom | Upgrade for Ifill | 2,2 Mln€ | 7 | 14 | 0 | 0 | 7 | 0 | 0 | 0 |
| High Speed | ETR700 | Hitachi | Upgrade to BL3 | 7,9 Mln€ | 16 | 32 | 3 | 6 | 7 | 0 | 0 | 0 |
| | ETR1000 | Hitachi | Upgrade to BL3 | 25,6 Mln€ | 48 | 96 | 0 | 6 | 21 | 21 | 0 | 0 |
| | ETR500 series 600 | Hitachi | Upgrade to BL3 | 15,7 Mln€ | 57 | 57 | 0 | 0 | 12 | 45 | 0 | 0 |
| | ETR600 | Alstom | Upgrade to BL3 | 10 Mln€ | 11 | 22 | 0 | 0 | 2 | 9 | 0 | 0 |
| | ETR500 series 500 | Alstom | Upgrade to BL3 | 22,8 Mln€ | 56 | 56 | 0 | 0 | 0 | 56 | 0 | 0 |
| | ETR700 | Hitachi | Upgrade da BL3 | 3,3 Mln€ | 16 | 32 | 0 | 0 | 0 | 0 | 16 | 0 |
| | ETR1000 | Hitachi | Upgrade da BL3 | 9,9 Mln€ | 48 | 96 | 0 | 0 | 0 | 0 | 48 | 0 |
| Total | | | | 665,9 Mln€ | 1981 | 2859 | 5 | 67 | 321 | 816 | 552 | 220 |

ETCS on board: Some issues linked to the plan

The effort linked to the plan is **very strong** for the following aspects:

- activities of the suppliers, of the NoBos and DeBos and of the deputed Agencies for the process of homologation

It's fundamental to standardize the documents and not repeat tests or activities already done in other applications

- Activities of the railway undertaking for tests in line, to do in strict coordination with the Infrastructure Manager

ETCS on board: Some issues linked to the plan

- Making the activities for retrofitting or upgrading means removing the rolling stock from commercial service

So it's very important to reduce the time for installing ETCS and reducing the waiting time for the new series authorization; How?

a) Avoiding new series authorization, starting from the type authorization and working according the principle of quality assurance

- Necessity of a stability of configuration and of the specifications/requirements

- ETCS and the new communication system FRCMS: actually the technical requirements for FRCMS provide for compatibility with ETCS Baseline 4

it's necessary to give the possibility for the compatibility also with Baseline 3, in order not to force a new upgrade in the medium term

ETCS on board: Some issues linked to the plan

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it's necessary to give the possibility for the compatibility also with Baseline 3, in order not to force a new upgrade in the medium term

- Large number of Type Test, linked to different suppliers for earth and board

It's fundamental to standardize the documents and not repeat tests or activities already done in other applications

Thank you.

