RFI: national railway infrastructure

Network	16.742	km	
Double track	7.536	km	
Single track	9.206	km	
Power supplied lines	11.932	km	(71%)
Tunnels and bridges	1.980	km	
Stations	1500		

Signalling technologies

SSC – SCMT	16.742	km
ERTMS	758	km
Digital Interlocking	300	
GSM-R	12.000	km

~ 1.000 km	High Speed
~ 950 km	City network
~ 2.900 km	Basic performance
~ 3.900 km	Medium performance
~ 7.950 km	Low traffic line

RFI
RETE FERROVIARIA ITALIANA
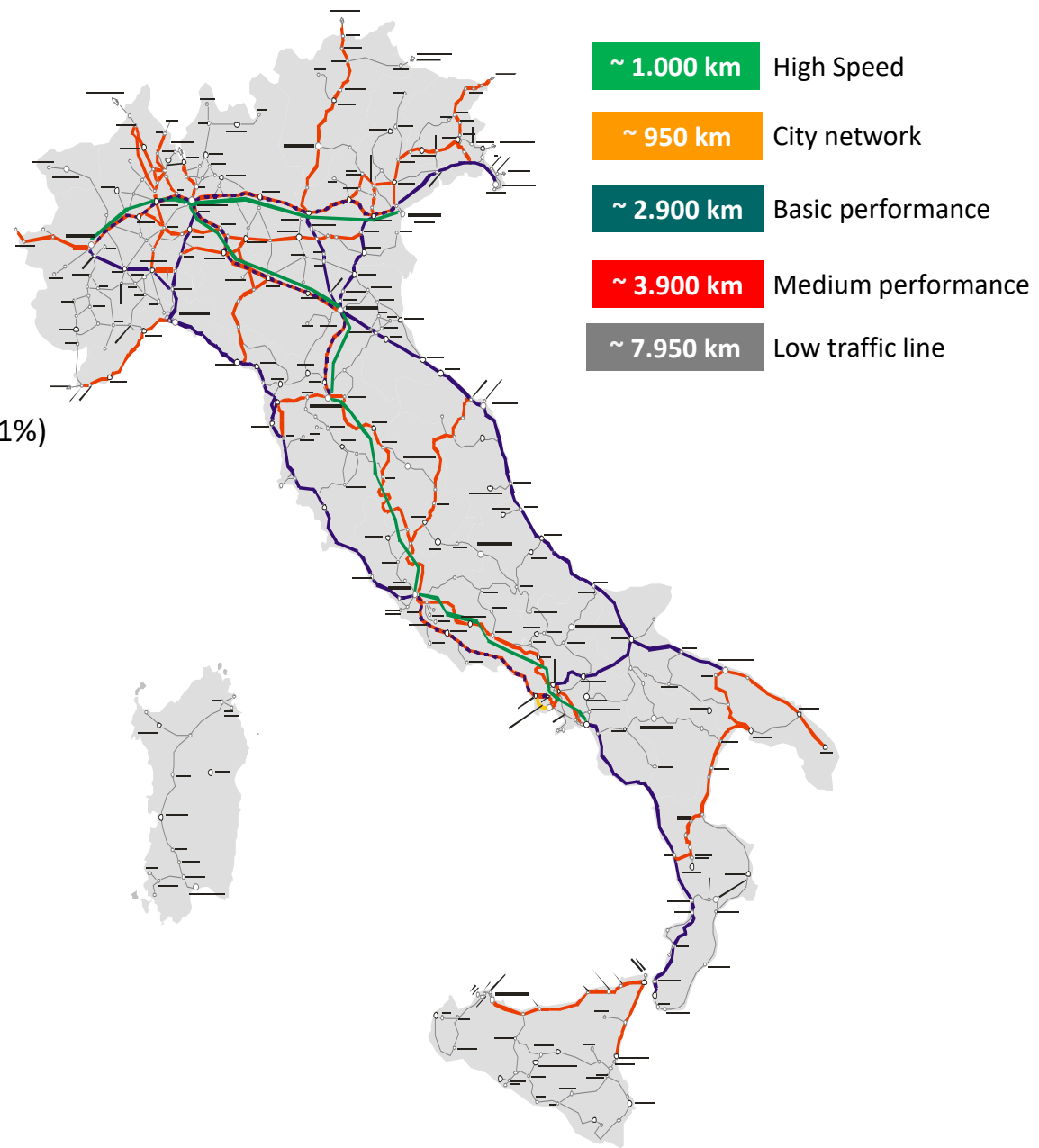
ERTMS IN ITALY: line in operation and ongoing projects

HS/HS	ROMA – NAPOLI HS/HC	LEVEL 2 BASELINE 2	
	TORINO – MILANO HS/HC	LEVEL 2 BASELINE 2	
	MILANO - BOLOGNA HS/HC	LEVEL 2 BASELINE 2	738 km
	BOLOGNA – FIRENZE HS/HC	LEVEL 2 BASELINE 2	
	TREVIGLIO – BRESCIA HS/HC	LEVEL 2 BASELINE 2	
	DD FIRENZE – ROMA HS/HC	LEVEL 2 BASELINE 2 2021	
	BRESCIA – VERONA HS/HC	LEVEL 2 BASELINE 3 2024	363 km
	MILANO GENOVA HS/HC	LEVEL 2 BASELINE 3 2023	
CORE CORRIDORS	ISELLE – DOMODOSSOLA (DAL 25.10.2018)	LEVEL 1 LS BASELINE 3	20 km
	DOMODOSSOLA – NOVARA	LEVEL 1 RIU BASELINE 3 2019	
	RANZO – LUINO	LEVEL 1 LS BASELINE 3 2019	
	MILANO – CHIASSO	LEVEL 2 BASELINE 3 2021	
	BRENNERO – VERONA	LEVEL 2 BASELINE 3 2021	1200 km
	MILANO – GENOVA	LEVEL 2 BASELINE 3 2022	
	NOVARA – PADOVA – VENEZIA	LEVEL 2 BASELINE 3 2021	
	VICENZA – TRIESTE/VILLA OPICINA	LEVEL 1/2 BASELINE 3 2021	
REGIONAL	Urban Nodes HD ERTMS MILANO, ROMA, FIRENZE	LEVEL 2/3 BASELINE 3 2021	85 km
	ERSAT – PINEROLO SANGONE	LEVEL 2/3 BASELINE 3 2022	25 km
	REGIONAL – ROCCASECCA AVEZZANO	LEVEL 2/3 BASELINE 3 2022	25 km
		TOTAL 2456 km	
		(up to 16800km	

SST / SSB INTEGRATION IOP TEST FOR SAFE INTEGRATION

ERTMS IN OPERATION

ERTMS IN REALIZATION

ERTMS/ETCS RFI project facts & figures

❑ In commercial operation since 2005

❑ 738 km High speed Lines equipped by ERTMS/ETCS level 2 without fall back

❑ 300 km/h present operational speed

❑ Baseline 3 trackside system compatibility

❑ 300 trains per day

❑ 5' real headway (3' potential headway)

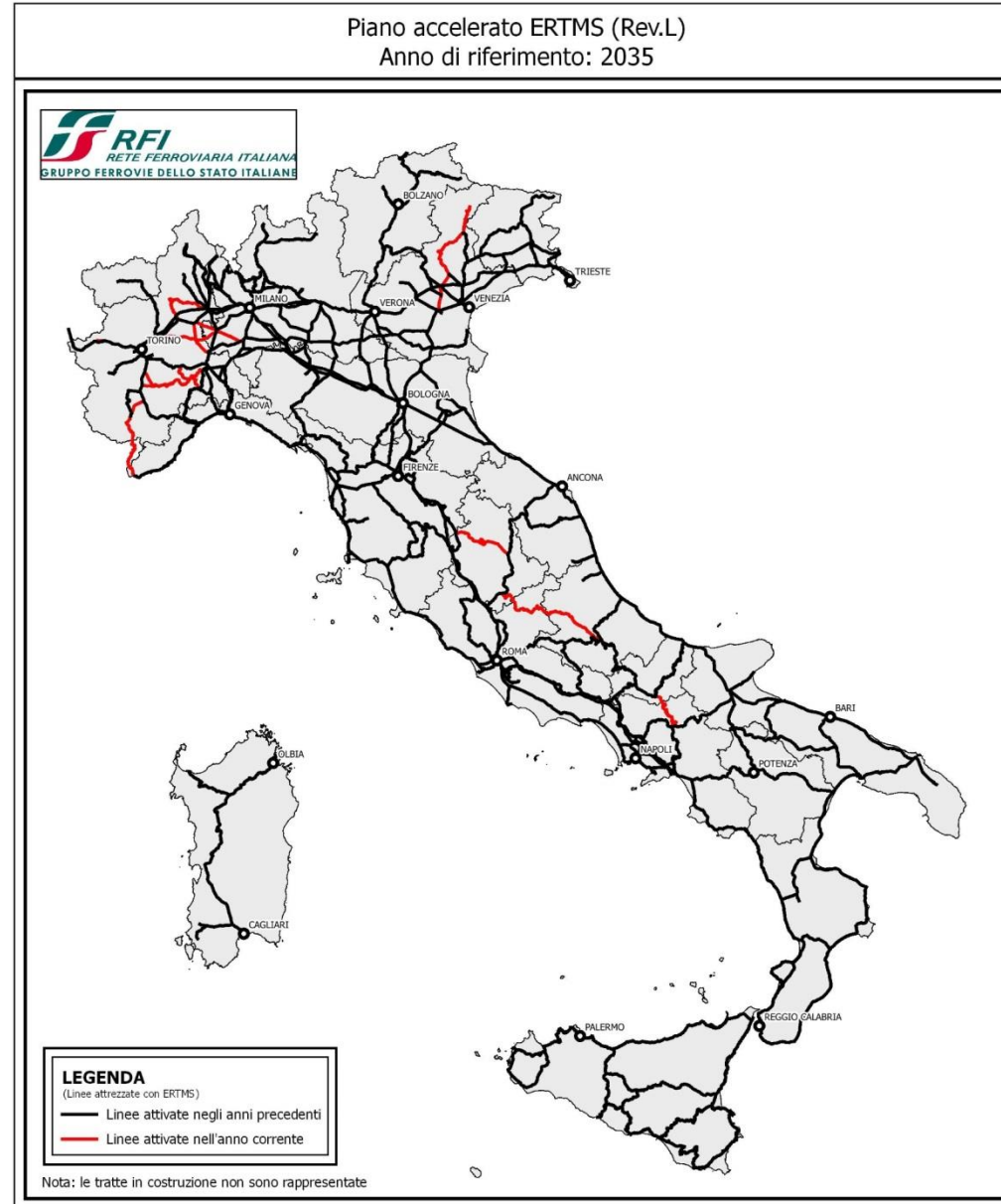## Future applications and on going trial site et forecst for operation

ATO 2022	ETCS Level 3 HD Project 2021	Satellite positioning 2021	Next Gen. Communications 2025

RFI
RETE FERROVIARIA ITALIANA

The RFI Accelerated ERTMS Plan

Piano accelerato ERTMS (Rev.L)
Anno di riferimento: 2035

LEGENDA
(Linee attrezzate con ERTMS)
— Linee attivate negli anni precedenti
— Linee attivate nell'anno corrente

Nota: le tratte in costruzione non sono rappresentate

The ERTMS advantages as a stand alone CCS System

ERTMS is the system chosen by EC to realise interoperability in the railway network, but it is also the best system in order to:	
Improve safety for railway transport	• **Protection of shunting movements** • Increased **protection at level crossings** • Availability of the **function to protect axle weight** • On-board calculation of **release speed** • Gradual replacement of mechanical joints with **electric joints**
Increase capacity at nodes	With the implementation of **ERTMS HD (High Density)** in major urban nodes
Increase reliability, punctuality and speed	Also **on conventional lines** by improving performance in relation to the speed allowed by the infrastructure
Reduced maintenance costs	**Cost savings in signalling installation** (light signals and cables are no required with ERTMS level 2/3) **and maintenance** due to the higher performance of the electronic equipment.
Reduced costs for the implementation of digital Interlockings (IXLs) and increased efficiency in implementing changes to the station layout	**ERTMS-oriented IXLs cost 30% less** than non-ERTMS oriented IXLs and enable to optimize changes to stations' layout.

RFI
RETE FERROVIARIA ITALIANA

The ERTMS actual NIP 2017 program: criticalities

Main criticalitiese of a non coordinated technological Trackside – Trainborne strategy investement:

Dual CCS Trackside without a synchronous Class B decommissiong

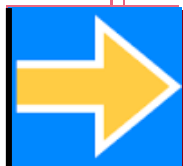|	
OVERLAPPING CLASS A over CLASS B	• **Different Protection and Operation Rules for SCMT and ETCS** • Increase **Capex** and **Opex** • Decrease **reliability, punctuality** • **Reduced performance benefit** for a potential **ERTMS** application

ELECTRONIC INTERLOCKING AND ERTMS INVESTEMENT NOT COORDINATED	• **Delay for ERTMS implementation (depending basically by Electronic Interlocking realization)**
	    • Problem for respect MIT/EU **time scheduling**
	    • Problem to maintain **Cofinanced EU Fund Action**
	• Extra cost for **double business operating interruption**
	• **Less efficiency** for station on **layout modification**
	• Use of an **ETCS Level 1** instead of Level 2/3 for EDP compliance

CCS DIGITALISATION NOT COORDINATED WITH ERTMS	• **Disomogeneus measurement and for infrastructure data digitalization** • Inefficient **Configuration Management** of the digital systems • **Difficult knowledge** transfer **for operator and Data Management (diagnostic, pubblic information)**

- **How to manage the migration from national system to ERTMS? Dual on board or dual track-side?**
- **How many kms of ERTMS to deploy? Only TEN-T network or WHOLE network?**

RFI
RETE FERROVIARIA ITALIANA

Simplify the infrastructure and increase performance

Trackside Subsystem   **OnBoard Subsystem**

The ERTMS implementation scenarios compared

	2022	2026	2035	2050	2060

ERTMS deployment on TEN-T network in compliance with Reg (EU) N. 1315/2013 and the National Implementation Plan (NIP 2017)

Scenario A – Legal obligations

10.755 km

5.000 cabins*

Equipment of the whole national network beyond 2050 (ERTMS on the regional network following the TEN-T network equipment).

Scenario B –Whole network Not accelerated

15.911 km

5.000 cabins*

Accelerated implementation on the whole network (TEN-T and regional network) by 2035 –

Scenario C – Whole network accelerated

15.911 km

5.000 cabins*

- ERTMS trackside equipment + Digital Interlocking
- ERTMS on board equipment
- Decommissioning of the Class B national system

The best scenario is "C" (DUAL ON BOARD AND WHOLE NETWORK) - (RFI proposal for a new NIP 2019)

Anticipates and maximizes the advantages of ERTMS also taking into account that the national system should be renewed in any case by 2030.

This is the result of an independent **Cost-Effectiveness Analysis** and we are preparing a <u>Cost-Benefit Analysis</u>

RFI RETE FERROVIARIA ITALIANA

* Cabins currently circulating on the national railway infrastructure. The new vehicles must be equipped with ERTMS / ETCS systems in accordance with the SRS Baseline 3 if put into service after 01/01/2019, with some exceptions, as reported in Reg. UE 919/2016, TSI CCS.

The pre-conditions to accelerate the ERTMS Plan

1   *Authorization* for the infrastructure manager *to decommission* the legacy system before 2026

2   *Making the programs* already in progress for the **Digital IXLs realization** *(250/1511 already realized)* and for the **GSM-R extension** *(13.000/16.800 already covered)* **harmonized with the ERTMS Implementation Plan** *(reinforcing GSM-R and realizing Digital IXL ERTMS-Oriented)*

3   *Definition of an ERTMS deployment plan on the rolling stock* coherent with the ERTMS lines equipment programs managed by Infrastructure Manager

4   *Appropriate production capacity* of the infrastructure manager, railway undertakings and suppliers *(1.000 km/year of ERTMS and 100 IXL ERTMS-oriented/year)*

5   *Definition of a scheme of financing* for the whole system (trackside and on-board system)

High Level ERTMS: Types of investment cost, and on board and track-side savings

CAPEX

INVESTMENT COSTS ERTMS

Costs related to the ERTMS realization, to the upgrading/extension of the GSM-R and for the audio-frequency track circuits

INVESTMENT COSTS of IXLs AND RELATED SYSTEMS

Costs related to the realization of Digital Interlockings (IXLs) and for the upgrading of the network with Supervisions Systems (CTCs)

OTHER COSTS: OVERLAPPING, RENEWAL AND DISMISSIONS

Costs due to the ERTMS overlap with existing systems, if the legacy system SCMT (discontinuous signaling system currently used in Italy) is not decommissioned contextually. In particular, this kind of costs are related to the renewal and reconfiguration of the SCMT, the interfacing with existing IXL-CTC systems and for the reconfiguration of the IXL following the decommissioning of the SCMT system

INVESTMENT COSTS FOR ROLLING STOCKS EQUIPMENT

Investment costs due to the rolling stock on-board equipment

OPEX

SAVINGS ON LINE MAINTENANCE, TSR AND PERSONNEL

Delta savings due to the reduction of ordinary maintenance costs, to the reduction of costs for manage the track speed reduction (TSR) given via radio and to the use optimized of personnel

ORDINARY MAINTANANCE COSTS

Delta costs due to ordinary maintenance

RFI RETE FERROVIARIA ITALIANA

Ground and on board costs and (savings)

G€ 2018 values

Infrastructure breakdown capex (G€)

Scenario A – Legal Framework 2022-2050*

CAPEX
- 🚆 **12,2 G€**
- 🚈 0,3 G€

OPEX
- 🚆 (1,7) G€
- 🚈 0,2 G€

ACC AND RELATED SYSTEMS	8,2
ERTMS COSTS	1,9
OTHER COSTS	2,7
INFRASTRUCTURE CAPEX	**12,2**

Medium annual obligation 0,42 G€ (29 years)
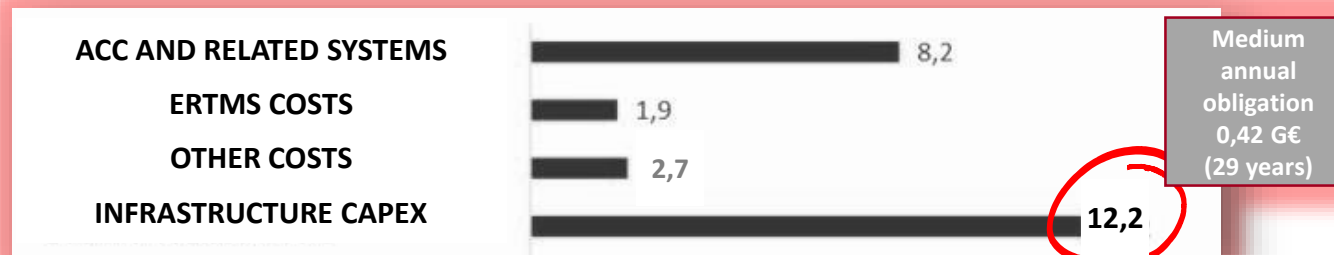
Scenario B – Whole national network not accelerated 2022 – 2060*

CAPEX
- 🚆 **13,9 G€**
- 🚈 0,3 G€

OPEX
- 🚆 (1,8) G€
- 🚈 0,2 G€

ACC AND RELATED SYSTEMS	8,4
ERTMS COSTS	2,6
OTHER COSTS	2,9
INFRASTRUCTURE CAPEX	**13,9**

Medium annual obligation 0,35 G€ (39 years)
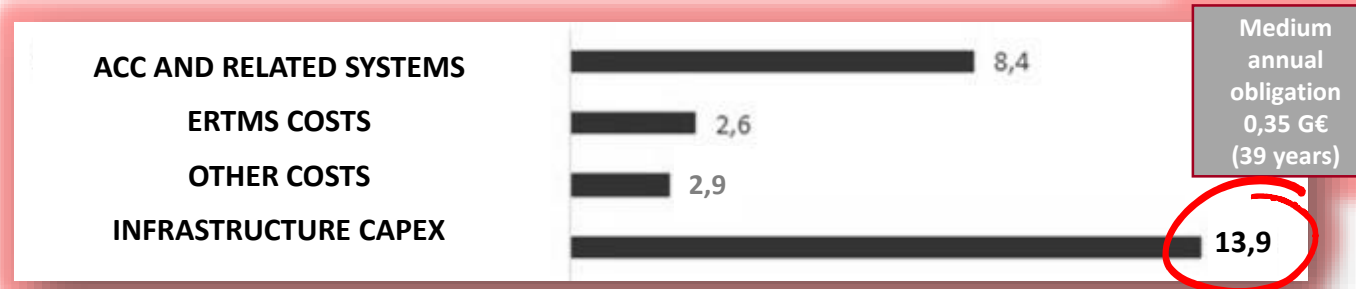
Scenario C – Whole national network accelerated 2022 – 2035*

CAPEX
- 🚆 **12 G€**
- 🚈 0,3 G€

OPEX
- 🚆 (2,9) G€
- 🚈 0,2 G€

ACC AND RELATED SYSTEMS	8,1
ERTMS COSTS	2,6
OTHER COSTS	1,3
INFRASTRUCTURE CAPEX	**12**

Medium annual obligation 0,8 G€ (14 years)

RFI RETE FERROVIARIA ITALIANA
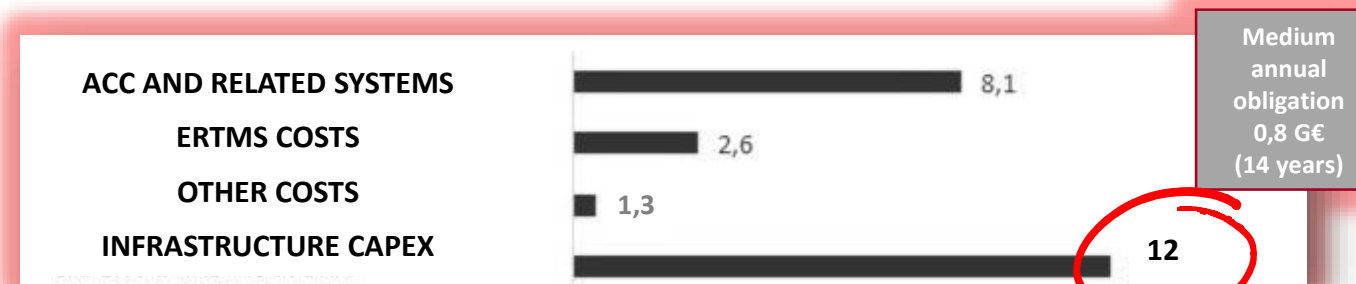
* Deadline of the investments hypothesized equally distributed during the period
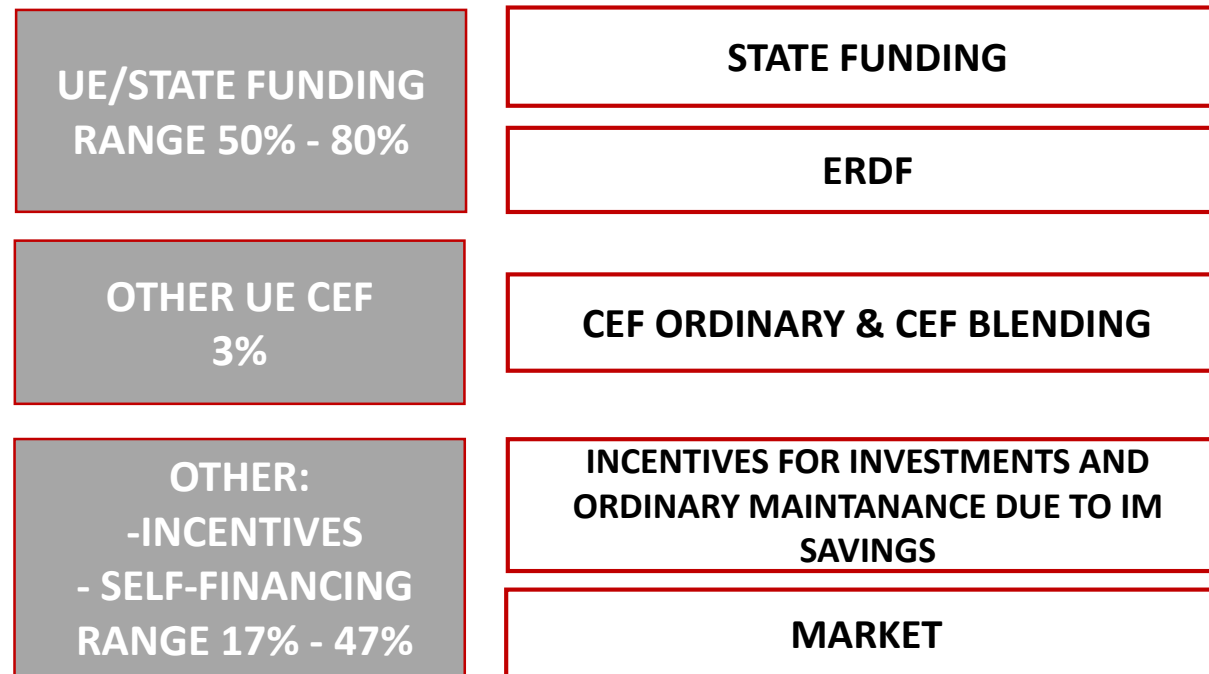
Prospective financial sources for the accelerated plan

PROSPECTIVE ON TRACK INSTALLATION FINANCIAL SOURCES FOR THE IM

STATE FUNDING 95%
- STATE FUNDING
- SPECIFIC LAW

UE FUNDING 5%
- ERDF
- CEF ORDINARY & CEF BLENDING
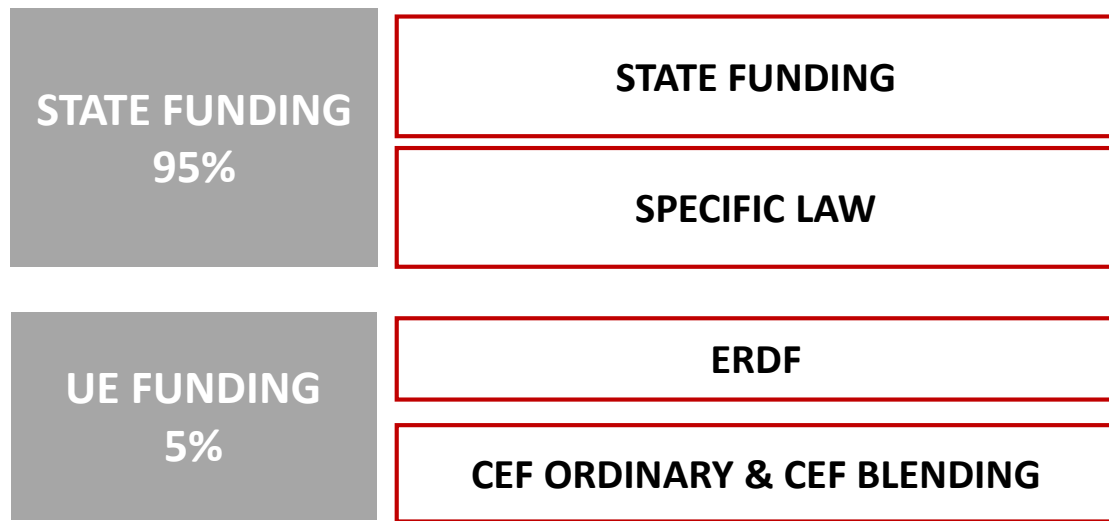
REQUIRED FUNDING

	BUDGET LAW (B€)	LAST CEF CALL (B€)
ERTMS	0,4	0,009
ACC	2,2	-
TOTAL	2,6	0,009

PROSPECTIVE ON BOARD EQUIPMENT FINANCIAL SOURCES FOR RUS

UE/STATE FUNDING RANGE 50% - 80%
- STATE FUNDING
- ERDF

OTHER UE CEF 3%
- CEF ORDINARY & CEF BLENDING

**OTHER:
-INCENTIVES
- SELF-FINANCING
RANGE 17% - 47%**
- INCENTIVES FOR INVESTMENTS AND ORDINARY MAINTANANCE DUE TO IM SAVINGS
- MARKET

OPEX SAVINGS IM 2022 – 2035 (*)

0,7 G€

(*) 2,9 G€ at 2060

ERTMS Investement: possible alternative scenarios

- ERTMS Onboard Upgrade became **INPUT** for deployment of trackside **ERTMS**.

- At the moment we identify 3 possible migration scenarios towards ERTMS :

This means: Acceleration of implementing Elettronic Interlocking

	Implementation of ERTMS on existing network (brownfield)	Investement Cost	Complexity of trackside implementation	Contract management	Immediate benefit performance/ safety
1	ERTMS + Digital IXL and decomissioning Classe B	🙂	🙂	🙂	🙂
2	ERTMS + Renewal (IXL + Class B)	😐	🙁	🙂	🙁
3	ERTMS + Pre-existent (IXL + Class B)	🙁	🙁	🙁	🙁

Best Case (Roma - Florence) project

All trains pre- equipped with ERTMS

Average Case (Mi-Chiasso Project)

Worst Case (Breakthroug Program)

(*) Classe B: SCMT, Light signal, Automatic Block with coded current , infill, meccanical joint

Technological Semplification of Stations and Lines

Layout Semplification and Flexibility by using only ERTMS Level 2 : - 30% on time and costs and less operating disruption

Semplification and less Opex/Capex, by eliminating:

- Signal
- Signal cable
- Cable for Encoder to Eurobalise
- Release Speed fixed
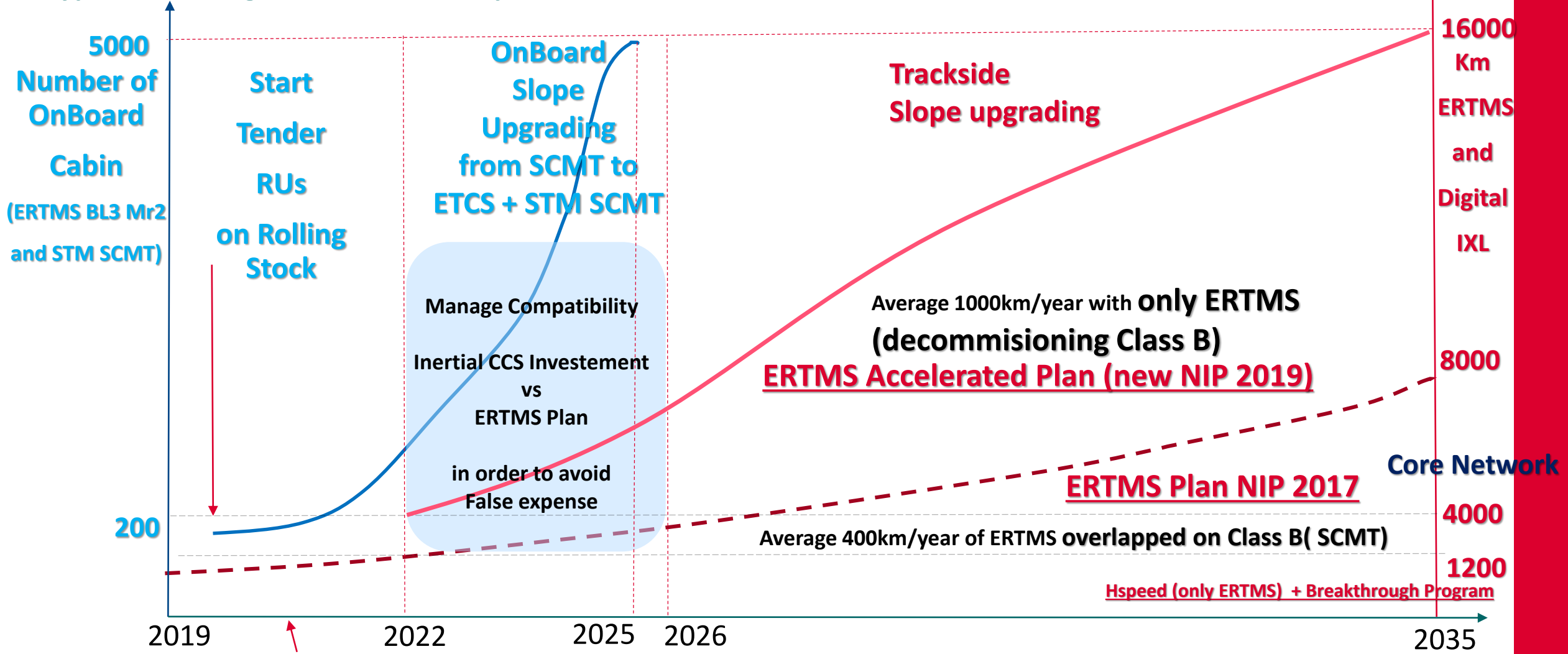- Infill device
- Inductive device
- Mechanical Joint

Flexibility

- No constraints for new sections
- No constraints for signal visibility
- Different types of Operating Management
- Shunting Zones
- Release speed calculated on board
- Centralized Management of Temporary Speed restriction
- Centralized Level Crossing alarm
- Optimization path and increase simultaneous routes
- Higher capacity on the line and in station, optimized breaking curve by ERTMS BL3

Station

Line
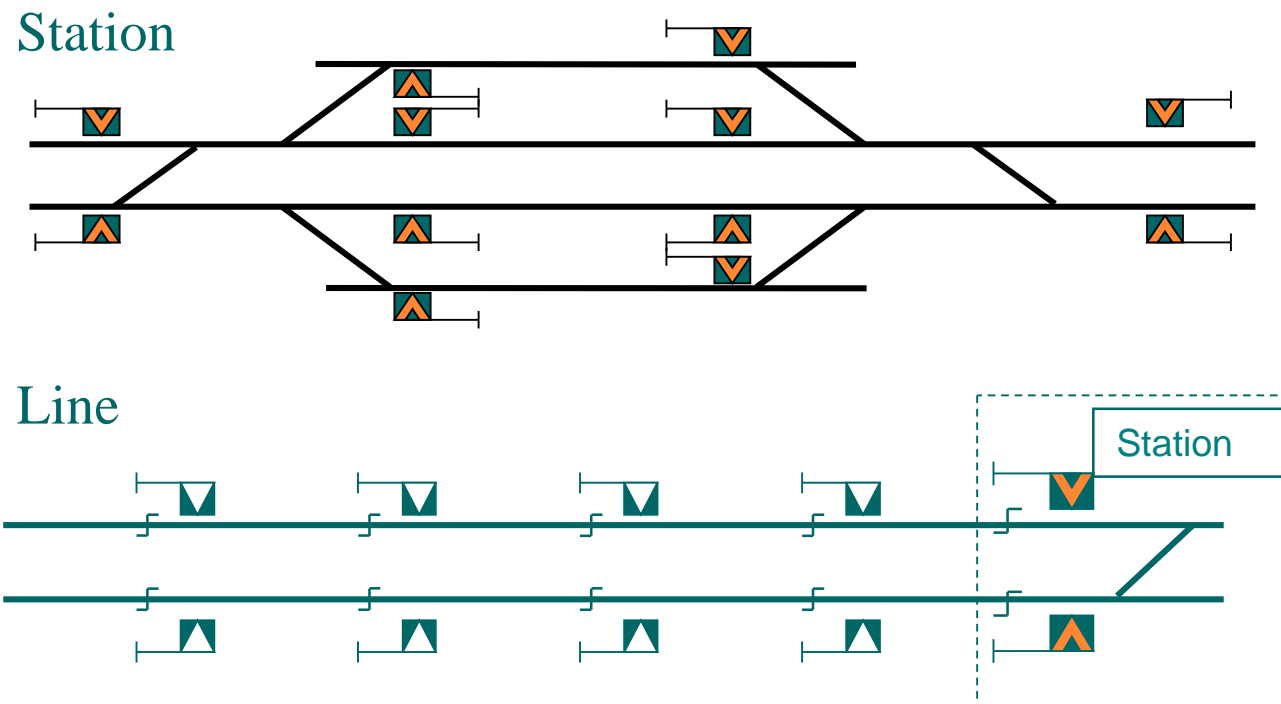
Station

Forecast of growth of Onboard and Trackside ERTMS/Electronic IXL

Hypotheses of growth rate for implementation Trackside / Onboard ERTMS

RFI Network

5000
Number of OnBoard Cabin
(ERTMS BL3 Mr2 and STM SCMT)

Start Tender RUs on Rolling Stock

OnBoard Slope Upgrading from SCMT to ETCS + STM SCMT

Trackside Slope upgrading

16000
Km ERTMS and Digital IXL

Manage Compatibility

Inertial CCS Investement vs ERTMS Plan

in order to avoid False expense

Average 1000km/year with **only ERTMS** **(decommisioning Class B)** <u>**ERTMS Accelerated Plan (new NIP 2019)**</u>

8000

Core Network

<u>**ERTMS Plan NIP 2017**</u>

4000

200

Average 400km/year of ERTMS **overlapped on Class B(SCMT)**

1200

<u>Hspeed (only ERTMS) + Breakthrough Program</u>

2019   2022   2025   2026   2035

New ERTMS + IXL (Ertms Oriented) Tender

16

ERTMS IN EU - A real Challenge: Cross Acceptance GA IOP TEST

A proposal for a MoU

"In order to simplify the Ertms ESC activities, the Unsig company provide the evidence of compatibility test results between their respective Generic Application EVC and RBC. The ESC test in Specific Application Project between Trackside and Trainborne across Europe, will be limited at specific test for evidence of compatibilty of engineering rules and reuse the evidence of Generic Application ESC test."

RBC Generic Application Supplier # 1

EVC Generic Application Supplier # 2

Cross Acceptance GA ESC

RBC Specific Application Supplier # 1

EVC Specific Application Supplier # 2