ERTMS
the global standard for Train Control

Intercâmbio de conhecimento Ferroviário
Brazil – European Union

24 May 2016
Brasilia, Brazil

Agenda

- **Introduction: who we are**
- **PTC vs ETCS**
- **ERTMS levels**
- **ERTMS examples & system evolution**
- **Conclusion**

INTRODUCTION

Who we are

- **UNIFE represents the European Rail Supply Industry**
- **Based in Brussels since 1992**
- **The trusted partner of European and International Institutions in all matters related to rail and transport**
- **Full members:**
  Over 80 of the largest and small and medium-sized companies in the rail supply sector
- **Associated members:**
  17 including 15 National Associations, representing almost 1000 suppliers of railway equipment
- **UNIFE members have an 84% market share in Europe and supply more than 46% of the worldwide production of rail equipment and services.**

UNIFE Members/ETCS Suppliers

The ERTMS/ETCS suppliers are gathered in the UNISIG consortium

ALSTOM

AŽD PRAHA

AnsaldoSTS
A Finmeccanica Company

BOMBARDIER

CAF

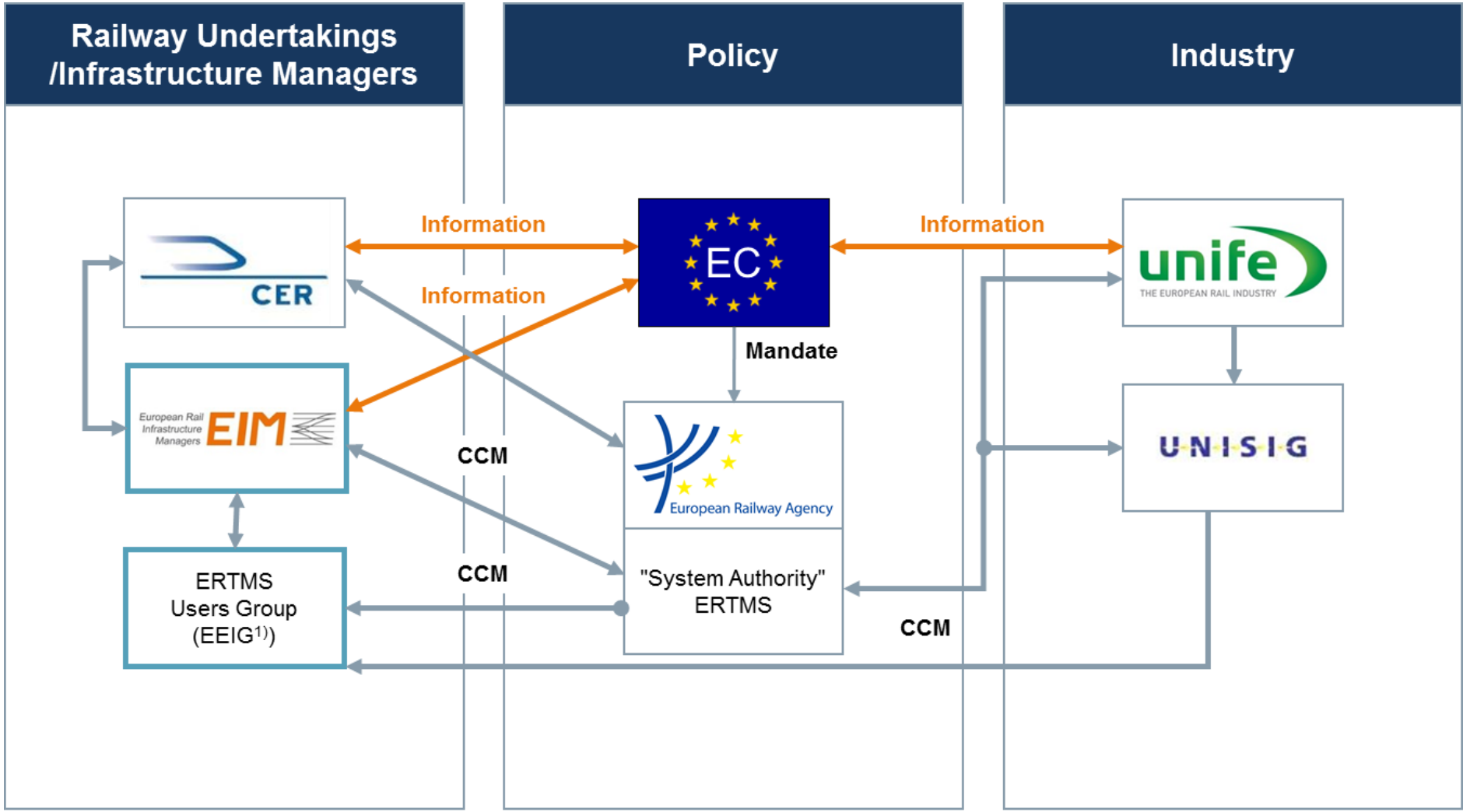
THALES

SIEMENS

mermec group

UNISIG

Stakeholders in the European context of ERTMS



CCM: Change Control Management for the ERTMS/ETCS specifications

PTC & ETCS

ERTMS & PTC
Overall description

European Railway Traffic Management System (ERTMS)	AAR Positive Train Control (PTC)

ERTMS

The ERTMS system is administered by an independent body, the European Railway Agency. It was created to meet different customer needs in an interoperable way and became the European standard. After that it has been adopted by other countries/customers worldwide. The different needs are met by different ERTMS Levels.

PTC

PTC is a set of safety requirements mandated by the US government after a series of accidents. The system for freight to meet the mandate that is administered and deployed by AAR is the I-ETMS system. The AAR PTC is an additional safety overlay system (as defined by AAR and FRA).

Introduction to Train control systems
Overlay or Integrated

- **Overlay train control systems :**
  - The safety system connects to the Signal and adds a protection layer
  - Transmission to the train can be either :
    - Via a transponder (balise) ERTMS Level 1.
    - By a radio system for PTC.
      - PTC is said to be “communications-based” as it has radio & GPS

- **Integrated train control systems :**
  - Are deployed
    - on new lines : require no signals and minimum trackside equipment
    - on existing lines : when the complete signaling needs to be replaced to be as a completely new system
  - Integrated systems minimize the need for signals and other trackside systems.

ETCS L1

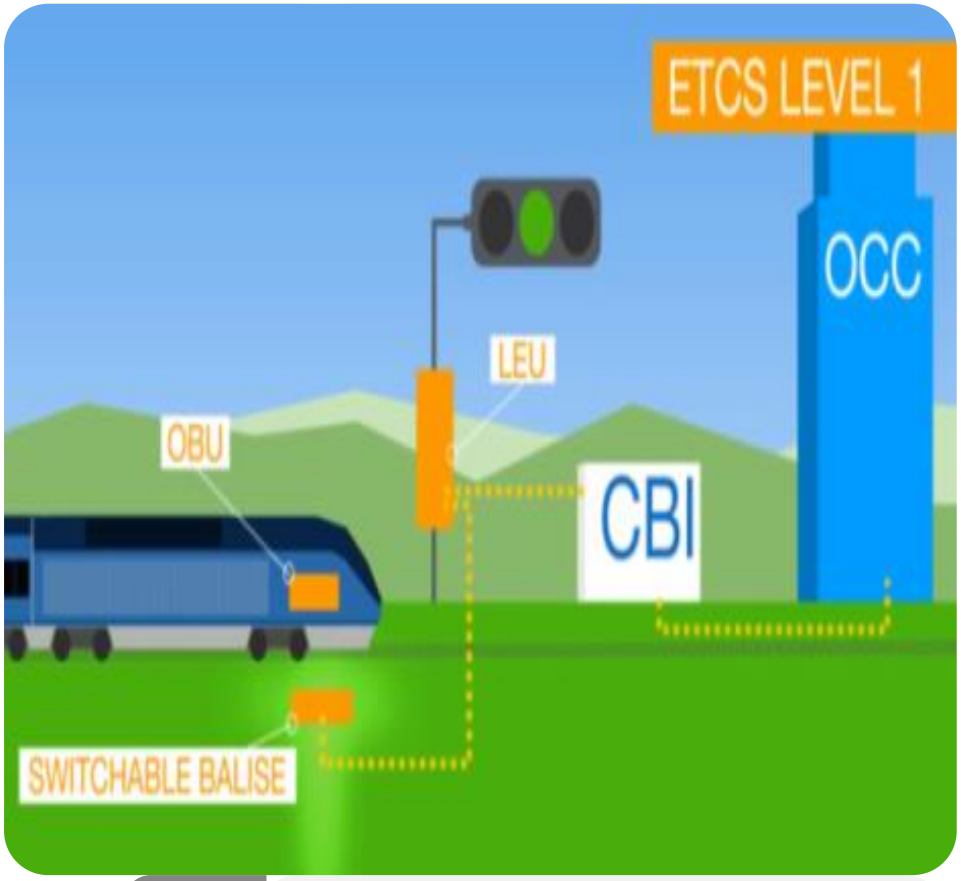
ETCS Level 1

Overlay train control

- Information sent from the Signal to the train
- Transmission via a Lineside unit (LEU) then a track Balise
- Onboard Unit (OBU) receives information via a balise reading antenna and ensures safety of train movements

Key features

- No requirement for a radio network
- Overlays on all types of signalling systems



Legend

- On-Board Unit (OBU)
- Computer-Based Interlocking (CBI)
- Operation Control Center (OCC)
- Lineside Electronic Unit (LEU)

ETCS L2/L3

ETCS Level 2/Level 3

An integrated system

- The trackside ETCS computer (RBC) is connected to :
  - the Operation Control Center (OCC)
  - the Interlocking system controlling the Points/Switches

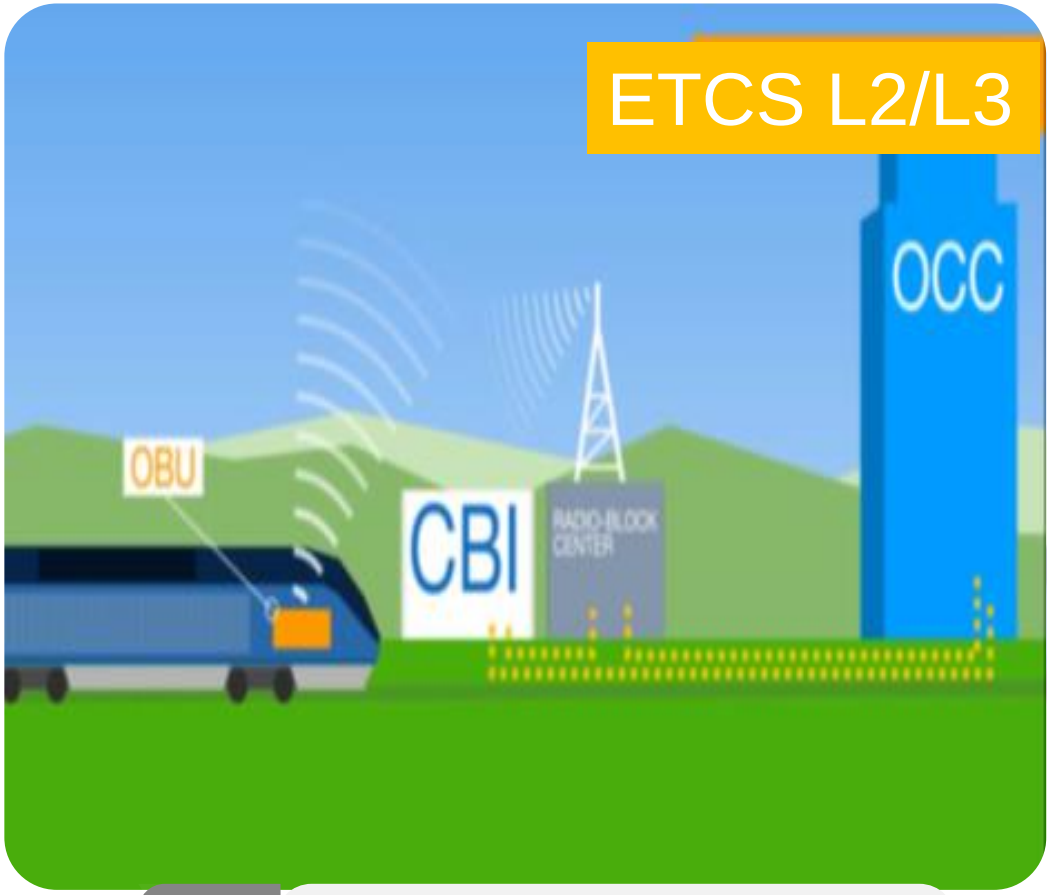
- The RBC sends the movement information to the Onboard Unit (OBU) on the train. It also receives the train position.

- The OBU on the train shows the information to the driver and ensures the safety

Key features

- In Level 2 there are no Signals :
  - Train detection is by track circuits on the track as in classical signalling

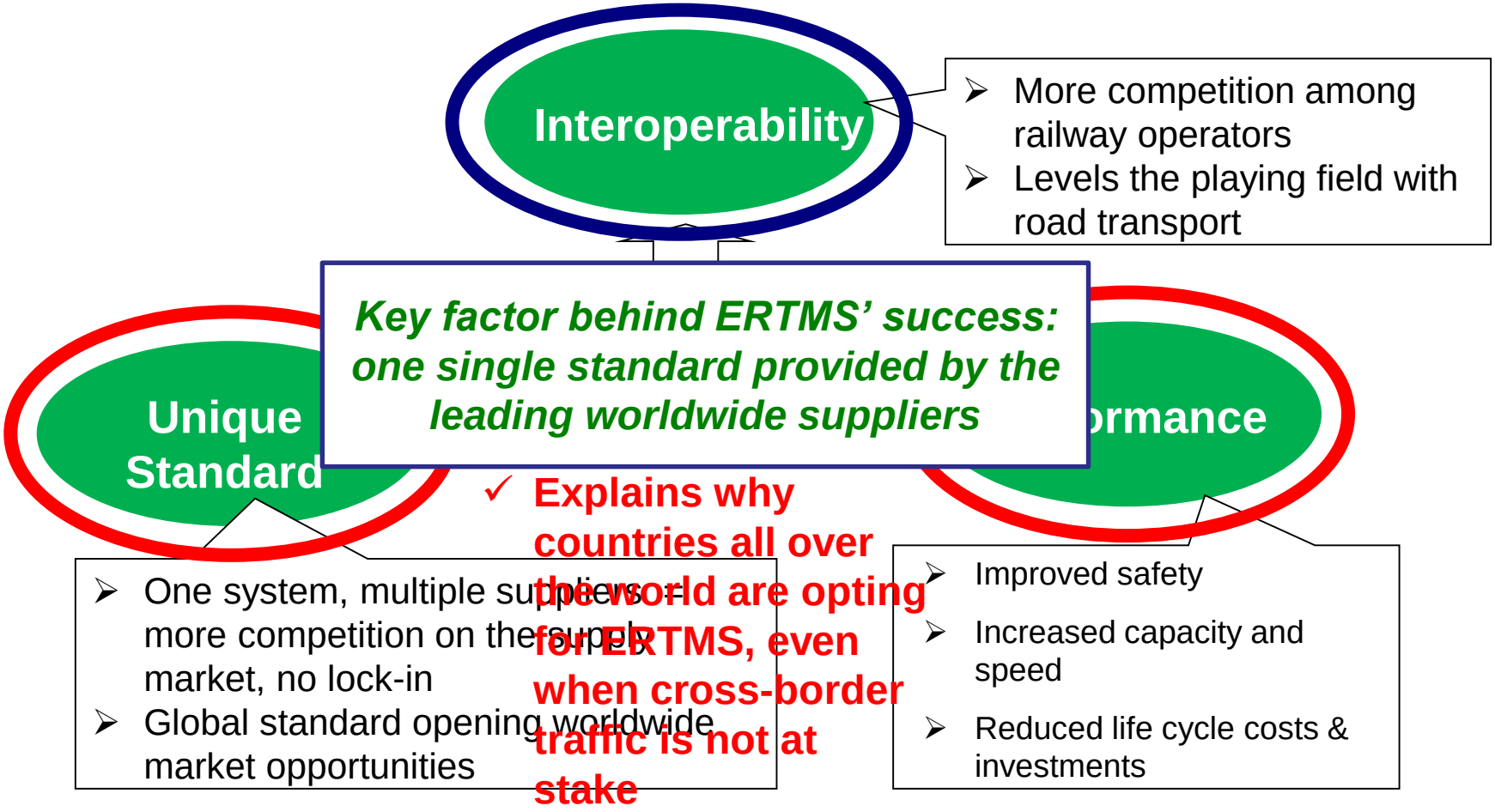
- In Level 3 : no Signals, no Track circuits :
  - Train detection is by train sending its position via radio



ERTMS compared to PTC

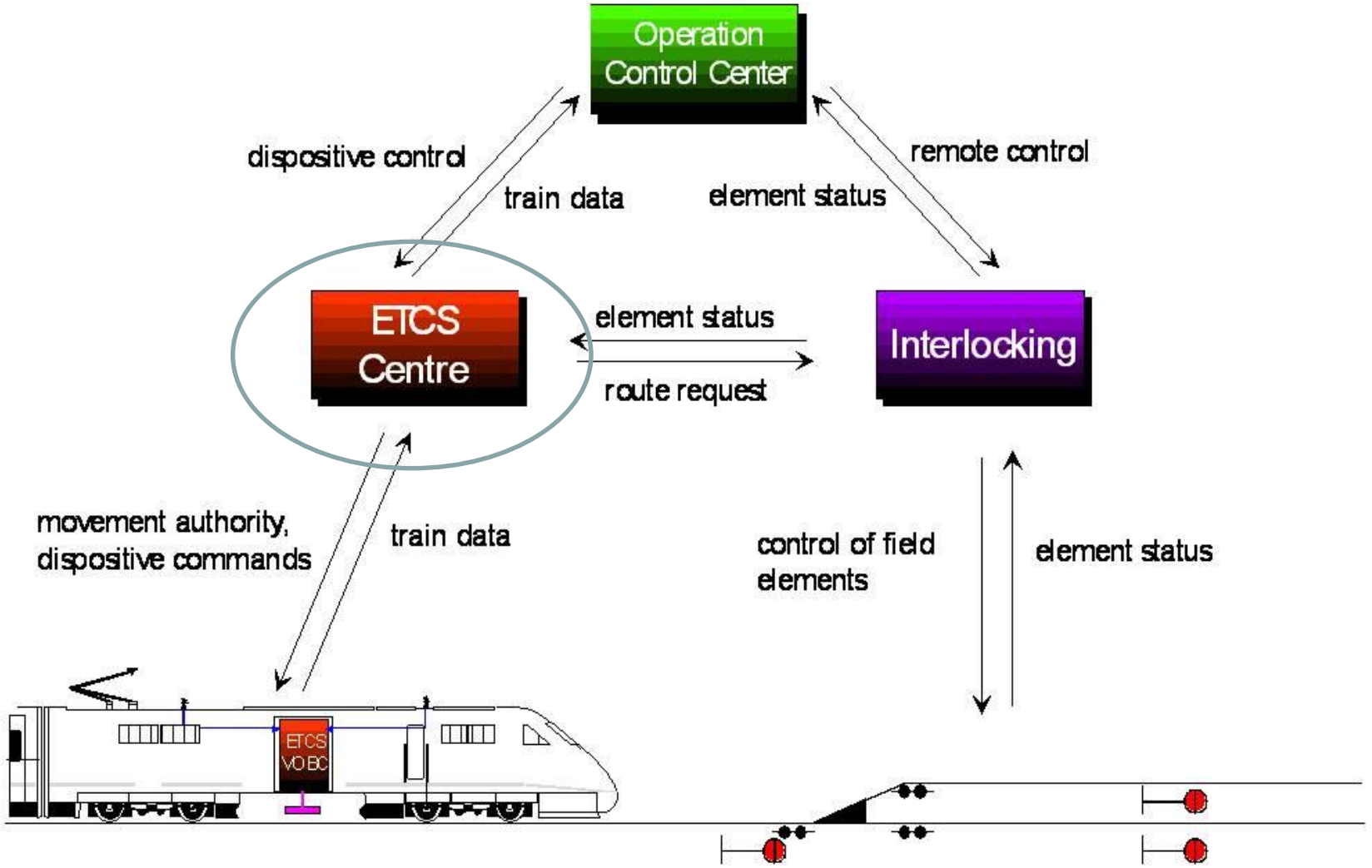
Attribute	ERTMS (Levels 1, 2 & 3)	PTC (I-ETMS)	Comments
Type of functionality	Overlay on signaling (Level 1) and integrated system (level 2 and 3)	Overlay on signaling.	PTC (as a usually used term by AAR and FRA) is a radio-based overlay on wayside signaling (one level). ERTMS has several levels from overlay (with signaling) up to integrated systems with no signals (Level 2) and no trackside systems (moving block or Level3)
Type of operations	Different types of lines	Mainly for Freight	ERTMS has been deployed on dedicated freight lines since 2007.
Technology Maturity	In service for more than 10 years. Being deployed in more than 40 countries	Recently in operation in USA and Brazil	ERTMS is a proven technology with proven examples of interoperability. New approved baseline (Baseline 3) is introducing ATO, alternative radios, GPS, etc.
Open /detailed standard with multi-supplier base	yes	no	ERTMS specifications are managed by an independent body. PTC (I-ETMS) does not have a complete set of Interface specifications to enable full interoperability.
Train Location	Balises . GPS being deployed on pilot lines	GPS	ERTMS suppliers have experience of GPS technology and are deploying GPS-based systems.
Data Communication	GSM-R, new Baseline 3 enables different radios.	256 Mhz (Brazil)	ERTMS customers can deploy their own radio standard when outside of Europe (Europe is studying what it will specify after GSM-R)..
Track infrastructure (Signals and Track circuits)	Only on level 1 . Level 2 needs no signals. Level 3 needs no Track Circuits either.	Signals generally needed. Track Circuits Always needed	PTC (as a usually used term) is an overlay system (one level) required by US government to add a safety level to a Signaling system. ERTMS has several levels of integration and automation levels. ERTMS Level 1 overlay does not require an additional radio system.

ERTMS, key success factors



ETCS LEVELS
GENERAL OVERVIEW

ETCS a part of the Signalling System



ETCS Level 1

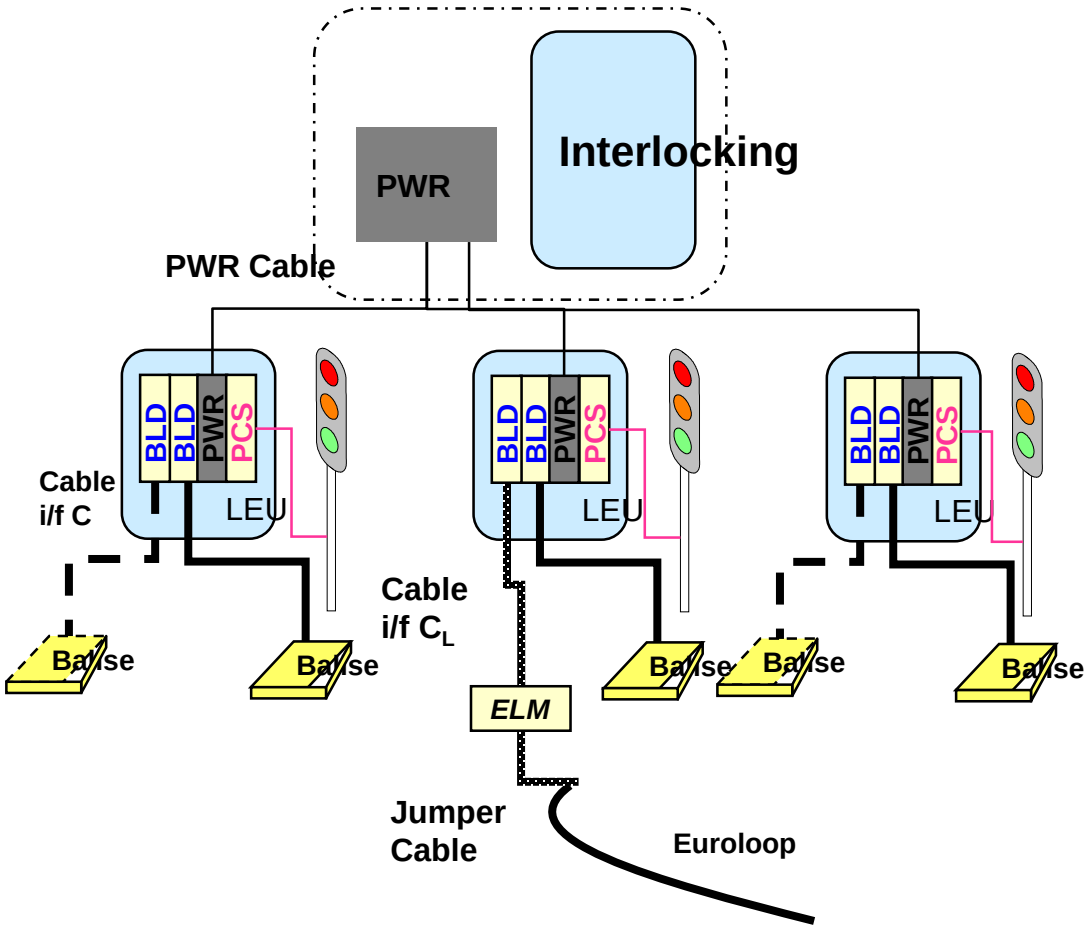
System Overview

ETCS L1 – System Components

- Balise (Tag) Drivers (BLD)
- PCS for signals up to 12 lamps
- Centralised ETCS controller
- Various LEU housing variants
- Standard Eurobalises

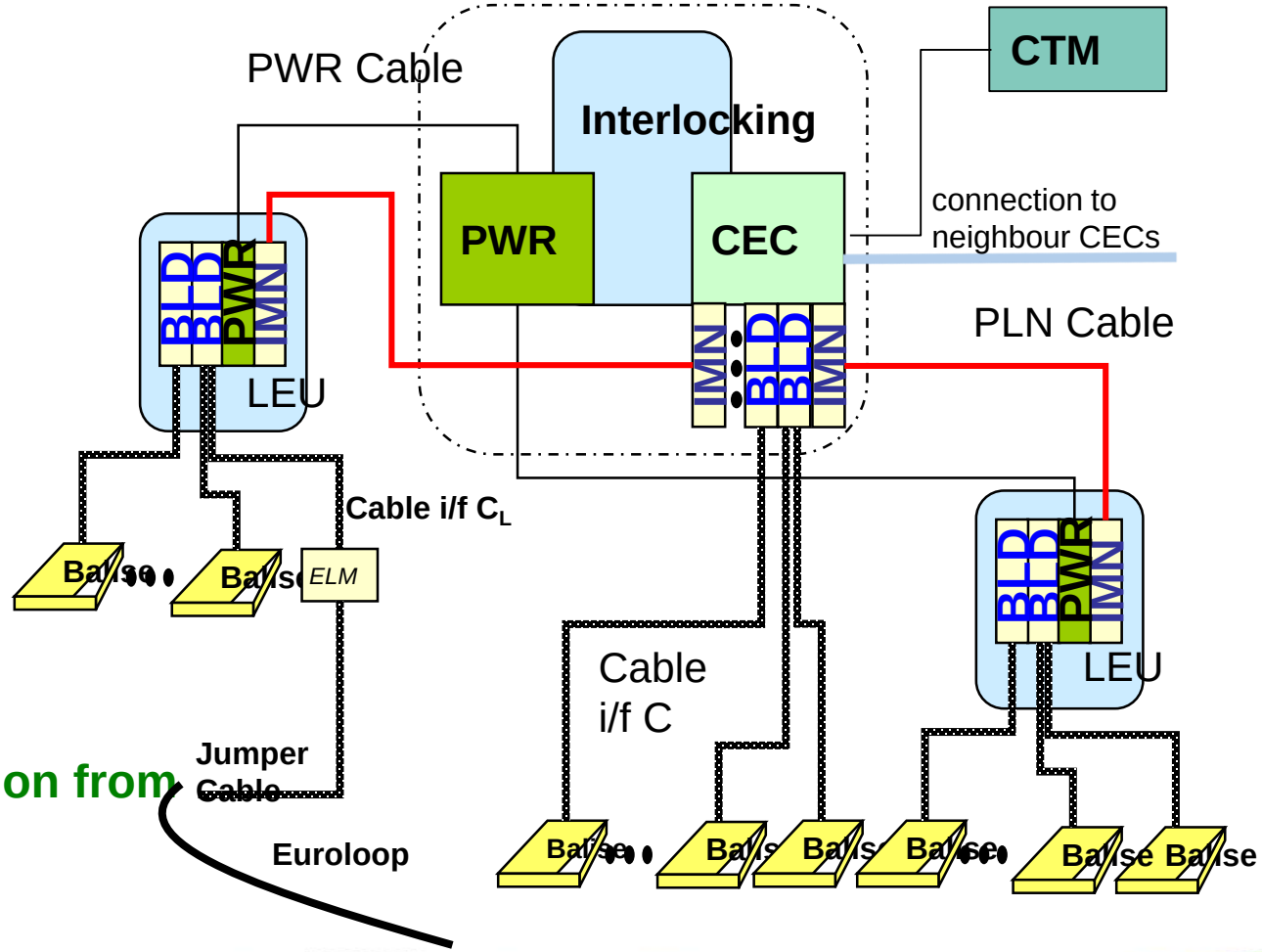
ETCS L1 – Decentralised solution

- Lineside Electronic Unit (LEU) installed at signal location
- Consisting of :
  - BLDs
  - PWR
  - PIO / current sensors PCS
  - Coupling to adjacent LEUs via parallel I/O
  - Balises (Tags)
- Interface between LEU and signal via lamp circuit or relay contact



ETCS L1 – Centralized solution

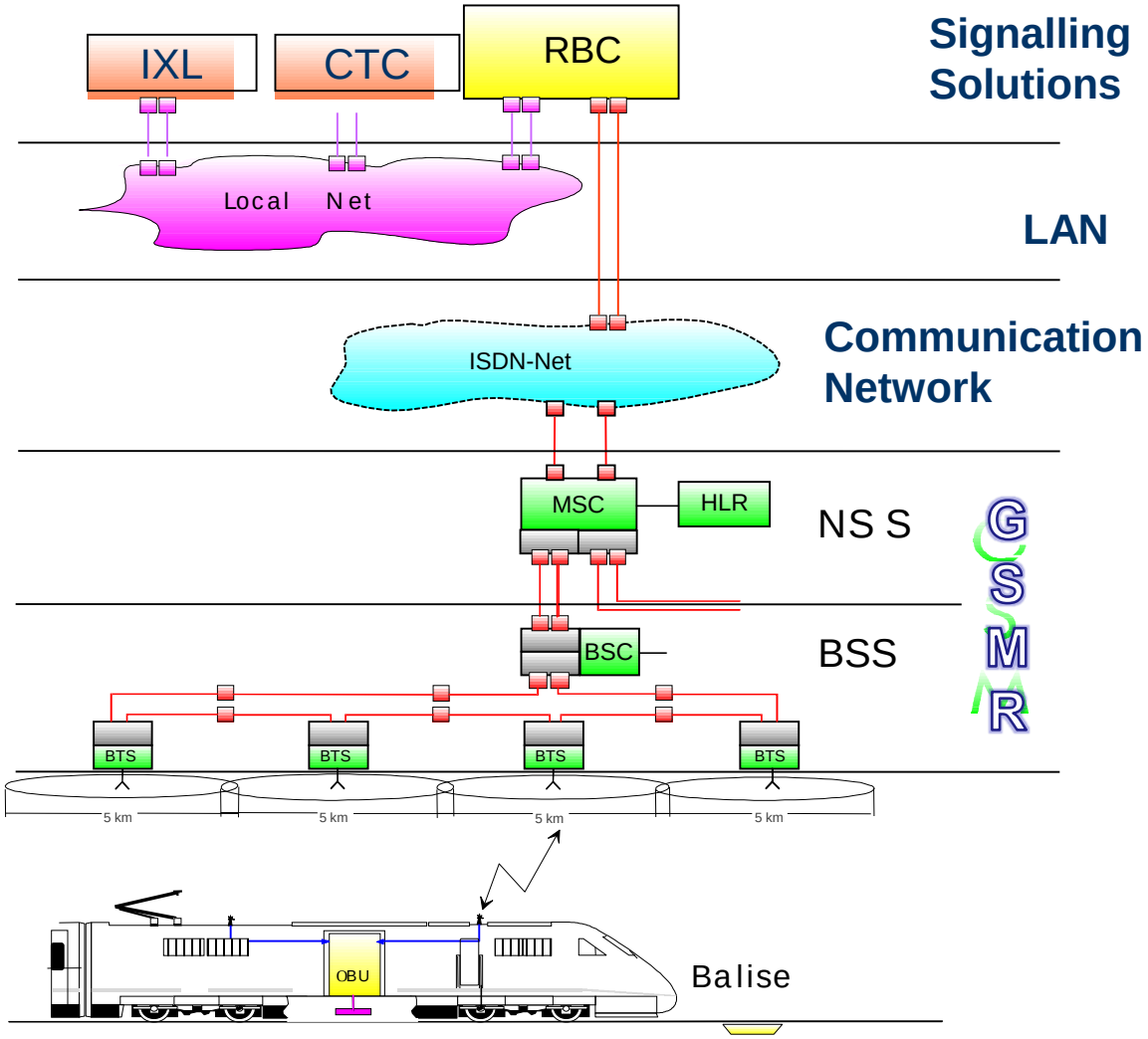
- **Direct connection CEC-Balises within station area or remote LEUs via PLN Cable**
- **Consisting of :**
  - **CEC**
  - **Remote LEU**
  - **BLDs**
  - **PWR**
  - **Connection to neighbour CECs**
  - **Balises, Euroloop**
- **Digital signal information from Interlocking via CEC**



ETCS L2 & L3

System Overview

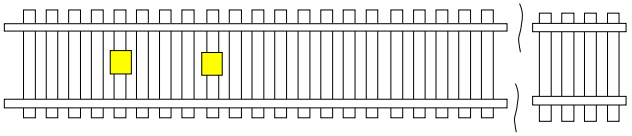
ERTMS L2/3 = ETCS + GSM-R

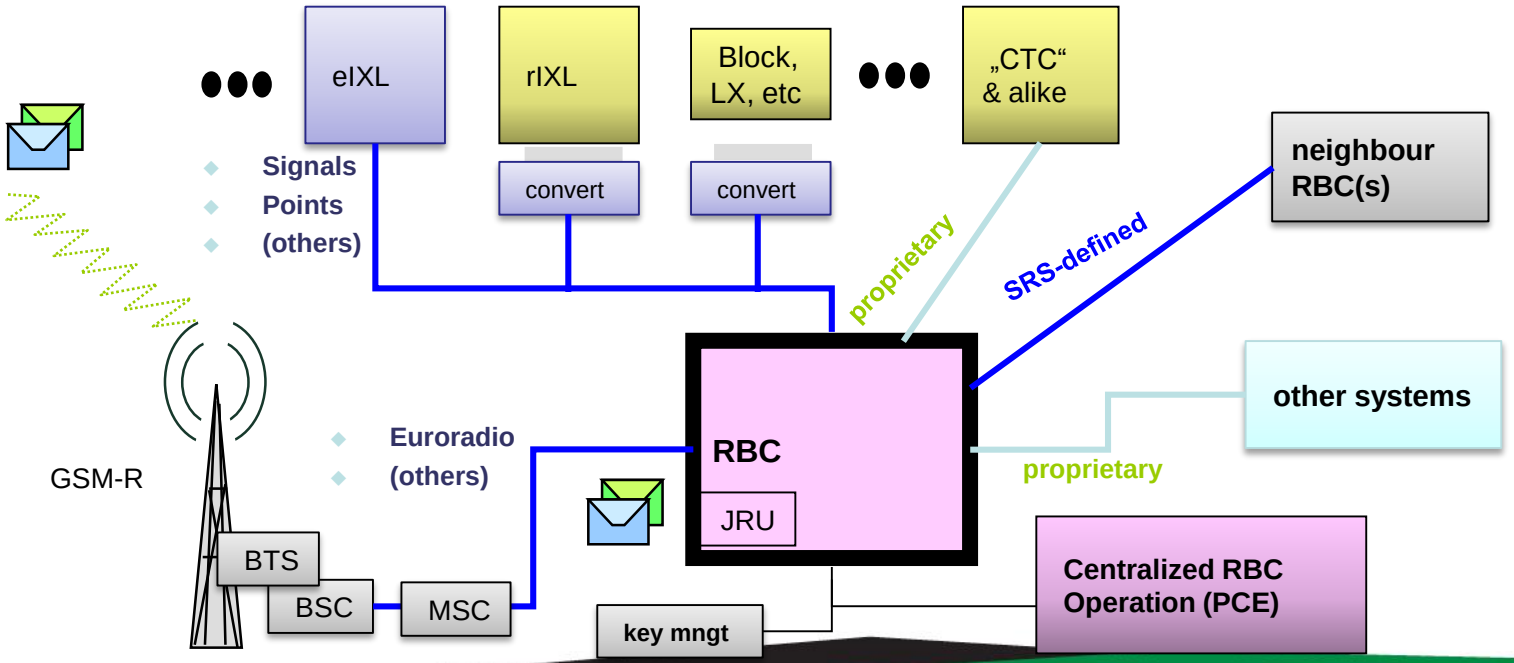


ETCS L2 Architecture Overview

- Track-Train Coms : 36 messages
  - 20 track → train
  - 16 train → track

Line topology

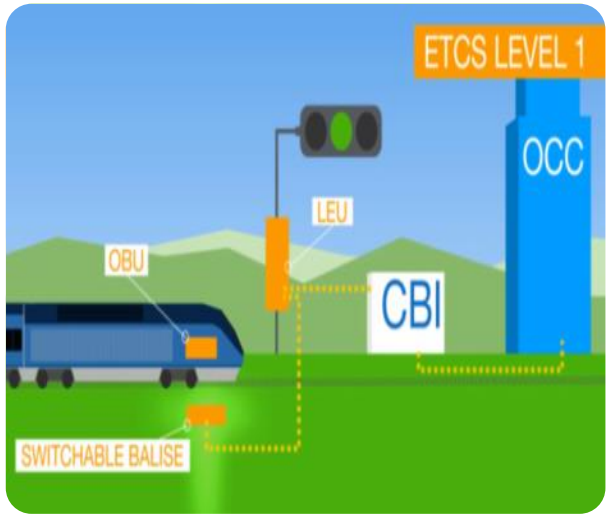




ETCS L1 & ETCS L2/L3

ETCS Level 1 overlay

Point-shaped train control system with spot transmission from trackside to train:
Communication between trains OBU and trackside equipment via balises.
One way communication from ground to train.



ETCS Level 2 & Level 3 integrated system

Continuous train control system with continuous, bi-directional transmission between trackside and train:
Communications between trains OBU and trackside via GSM-R link.

Legend

- On-Board Unit (OBU)
- Computer-Based Interlocking (CBI)
- Operation Control Center (OCC)
- Lineside Electronic Unit (LEU)
- Radio-Block Center (RBC)

Case study
North South Rail Link, Saudi Arabia

North South Rail link in Saudi Arabia

The world's longest ETCS line

ERTMS EXAMPLES & SYSTEM EVOLUTION

Case study
North South Rail Link, Saudi Arabia

Customer challenges

- Further develop the Kingdom by developing the non oil mineral capacities.
- Create:
  - A freight line linking phosphate and bauxite production plants in the northern part of the kingdom to industrial complex along the Arabian gulf.
  - Passenger services from Riyadh to the North of Saudi-Arabia.
- A turnkey solution based on advanced signalling and telecom technology.

Case study
North South Rail Link, Saudi Arabia

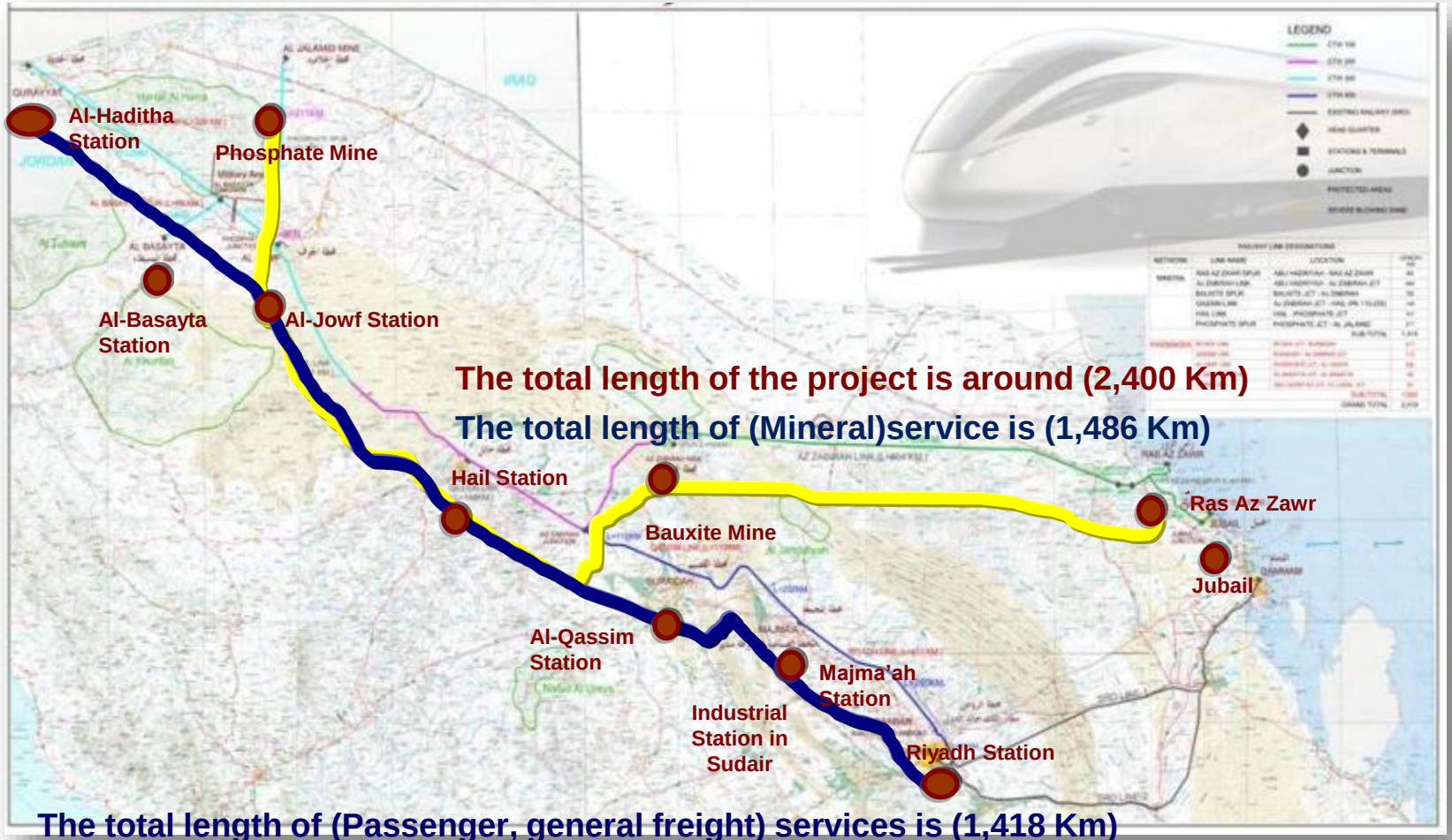
North-South Rail link ID card

Largest ETCS line in the world

- Total length 2,400 kilometres
- Phase 1: Mineral line
  - 1,400km whereof 400 km for passenger and freight traffic
  - 7 Mine and yards
  - 22 sidings and junctions
- Phase 2: Passenger line
  - 1,000km
  - 6 passenger stations
  - 14 yards, sidings and junctions
- An example of an interoperability
  - Thales trackiside and integartion
  - Alstom Onboard equipment
  - Nokia – radio system

Case study
North South Rail Link, Saudi Arabia

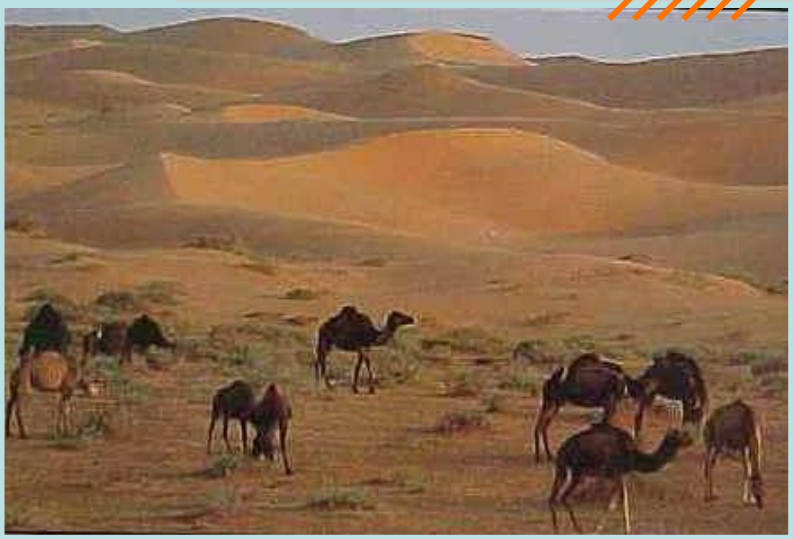
North South Rail link map



Case study
North South Rail Link, Saudi Arabia

Local challenges : environment / climate

- Harsh, dry desert with great temperature extremes.
- Dirt, dust, high humidity & temperatures that affects the performance.

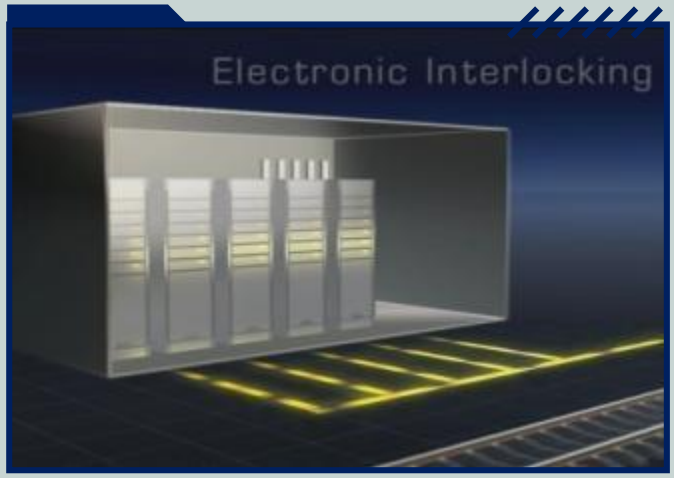


Case study
North South Rail Link, Saudi Arabia

Thales answer

Turnkey solution : Signalling, Supervision and Communications, Security, Fare Management systems and associated services

- **Signalling : ETCS L 2, Interlocking, Axle Counters, Point Machines. Operation Control Centre, Rolling Stock Management,**
- **CheckPoint: CheckPoint Master Node, 65 CheckPoints including Dynamic Scales, Hot Box/Hot Wheel Detectors, Tag Readers, Derailment & Dragging equipment Detectors**
- **Communications : SDH transmission network, GSM-R, Passenger Information System, Video surveillance, Access control.**
- **Additionally : Supervisory Control and Data Acquisition (SCADA), uninterrupted power supply, Diesel generators.**



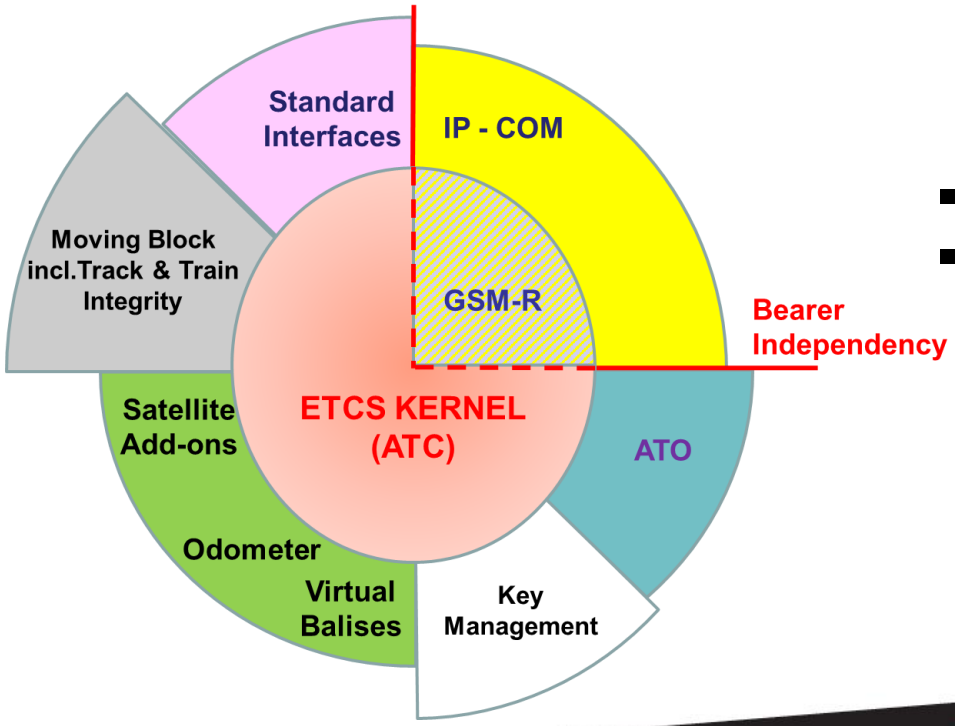
Case study
North South Rail Link, Saudi Arabia

Customer benefits

- Customer specific integrated solution : everything from a single source.
- State-of-the-art rail control systems : signalling, communications, supervision, security and fare collection systems.
- Products adapted to the specific local conditions : temperature, sand, etc.
- Full automatic rolling stock condition supervision

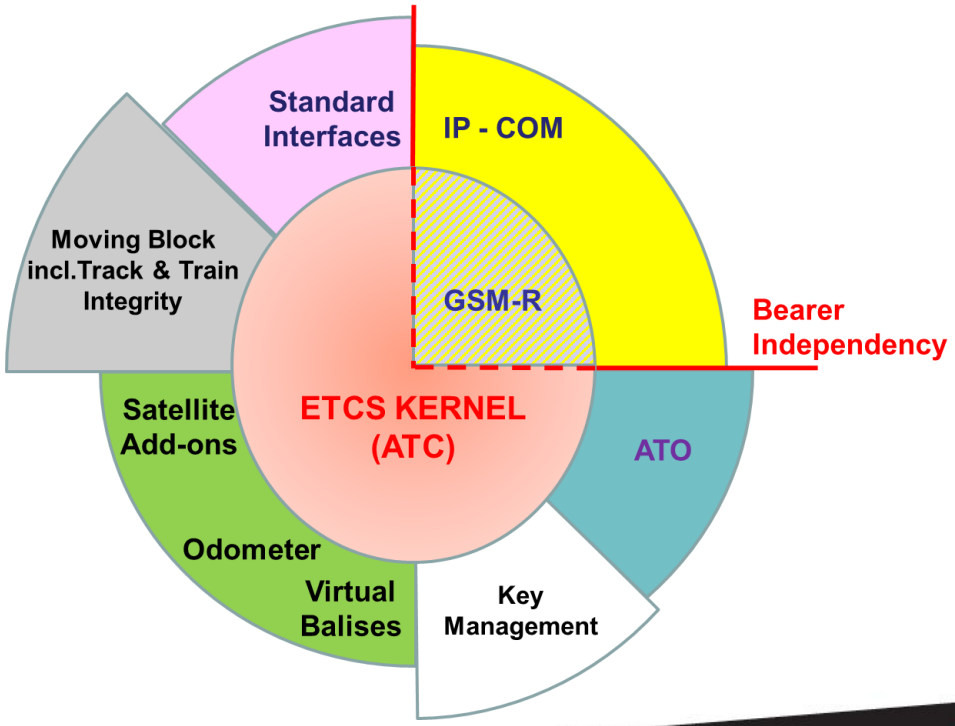
Foreseen evolution in telecommunications

- **In Europe, GSM-R obsolescence expected in 2025**
  - Roadmap for future European standard to be prepared
  - Backward compatibility is key to preserve investments made by Railways and Suppliers
- **Outside Europe**
  - Some customers cannot use GSM-R to deploy ETCS Level 2
  - Projects are already developed with ETCS and other communication standard, like Tetra (e.g. Kazakhstan) or 1800MHz GSM (Australia)
  - A "**bearer independent**" ETCS is a priority
  - Modern telecom standards are all "IP-based". In the future, ERTMS shall be based on **IP communication principles**, while offering **"backwards" compatibility**



Foreseen evolution of functionalities

- **Functional enhancements**



- Functions proven in other systems
- Need to be integrated into new Baseline for Interoperability
- Moving Block - Level 3
- ATO (Automatic Train Operation)
- GPS and satellite based positioning

CONCLUSION

Key takeaways (1/2)

- **ERTMS was designed for highest availability and safety:**
  - High-end safety (SIL 4)
  - Safe operator terminal
  - CENELEC standards
- **ERTMS protects investments by:**
  - Easy integration in new or existing environments
  - High scalability from small to large topologies
  - Integration of leading edge technologies (Packet Switched Radio)
  - Lower maintenance costs (standard equipment)
  - Constant evolution (L3)

Key takeaways (2/2)

- **ERTMS increases capacity through ETCS L1 or L2**
- **Supports the seamless integration to all kinds of interlocking systems:**
  - existing or new infrastructure
  - other NRBC providers
- **Seamless integration and interoperability with other suppliers**
- **Compact RBC for all kinds of traffic:**
  - High Speed
  - Mainline
  - Urban
  - Freight

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