Key of Success in Europe & Worldwide

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Agenda

- GSM-R History
- Key of Success:
  - Fit the needs
  - Solid Foundation
  - Validated Standard
  - Mature Standard
  - ERTMS Communication Bearer
  - GSM-R IG contribution
  - World Railway Standard
- Latest development
- Future Railway Mobile Communication System
- Alstom Contribution

GSM-R History

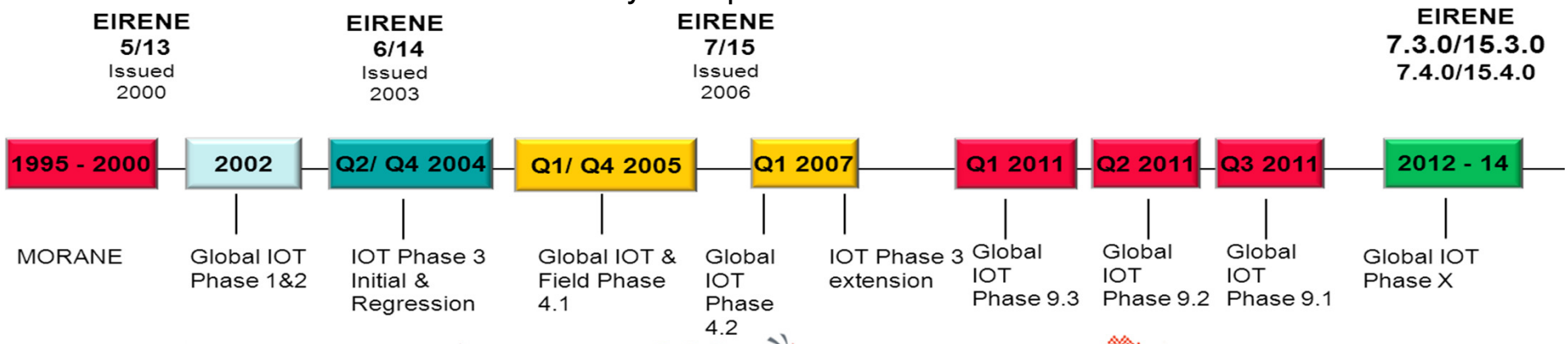
European Union as sponsor of a Pan-European Rail Traffic Network

- Railway business competitiveness
- Interoperability

Railways identified their common operational requirements and various technologies were evaluated.

GSM was selected as the technology for railway communication:

- 1995 - frequency bands 876-880 and 921-925 MHz were allocated
- 1995 – 2000 – specifications were defined EIRENE and validated Morane
- 1997 - MoU to GSM-R commitment was signed in 1997 by 32 railways
- 1997 - GSM-R was mandated by European Directive



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Fit the needs

- Interoperability: Railway communication without system borders
  - Increase average travel speeds through optimizing braking points
  - Increase maximum speeds through replacing line-of-sight signals with radio
  - Increase track capacity through minimizing train separation
  - Guaranteed high speed (500 km/h) and conventional lines operation
  - Seamless border crossing

- Efficiency: Railway communication at reduced cost
  - Reduce infrastructure cost by using widely-adopted GSM technology
  - Only one Radio system for all applications, including ETCS
  - Reduce infrastructure cost through competition
  - Standard products available off the shelf

GSM-R, standardized by railways and industry in EIRENE, validated in MORANE and in commercial operation for over 13 years, provides operational and commercial advantages to railways and makes them more competitive in a changing environment.

Solid Foundation

- Based on a solid platform: GSM
  - Standardized by 3GPP/ETSI
  - In commercial operation since 1992 with more than 3 billion users
  - Expected to grow even further
  - Significant development towards IP almost finished

Validated Standard

Extensive standardization and validation

Study
UIC decided for GSM – (R) against TETRA

Specification phase - EIRENE

ASCI features are specified by EIRENE & ETSI
Specification of railway operational features

Trial phase - Morane

Test tracks are deployed to validate the standard
GSM-R End-to-End system validated & approved
First products available

As result of MORANE railways approved GSM-R as future voice and data bearer in 2000

Network implementation phase
Deployment and operation in all European railways at high speed and conventional lines
Deployment and operation abroad Europe

1992 1995 2000 2013

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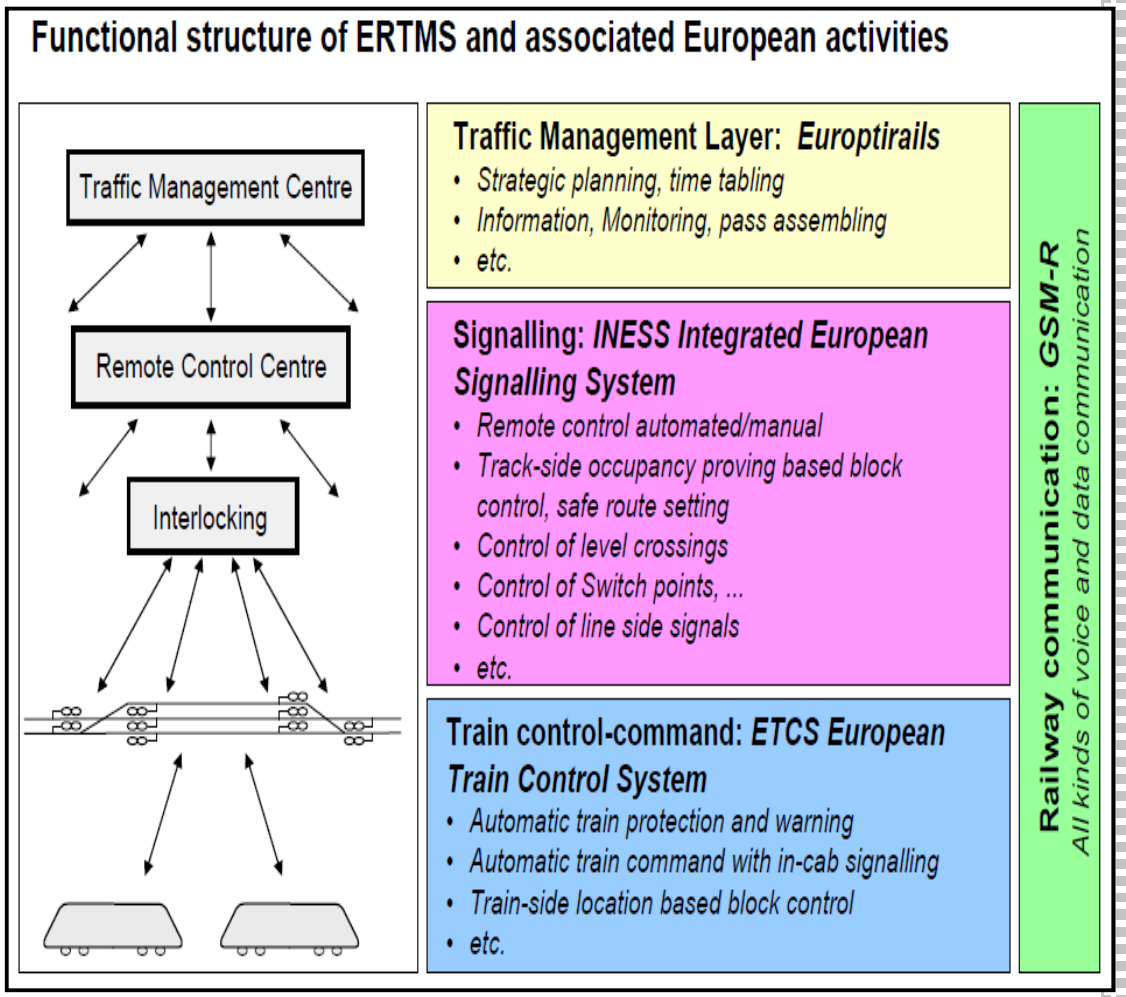
Mature Standard

- GSM-R : Mature communication platform for Railways
  - In daily commercial operation since 2000
  - Radio bearer for the European ERTMS standard
  - Continuously adaption of EIRENE considering new applications, services and railway operational rules
  - Future oriented technology (IP) based on ETSI/ TC-RT standardization for new functionalities and capabilities

The standard radio communication solution for Interoperable Railway System Ready for Today and Tomorrow application

ERTMS Communication Bearer

- Integration of independent subsystems into a single train control and command solution
  - ETCS and GSM-R (voice and data) are the building blocks of the European Railway Traffic Managements System (ERTMS)
  - ERTMS is designed for international communication and signaling
- International standardization and interoperability
  - Increase competition in the signalling market
  - Speeds up border crossing, reduces travel time and cost
  - Coexistence with existing ATP/ATC systems



GSM-R IG contribution

The Industry Group, was and is a key contributor of GSM-R success

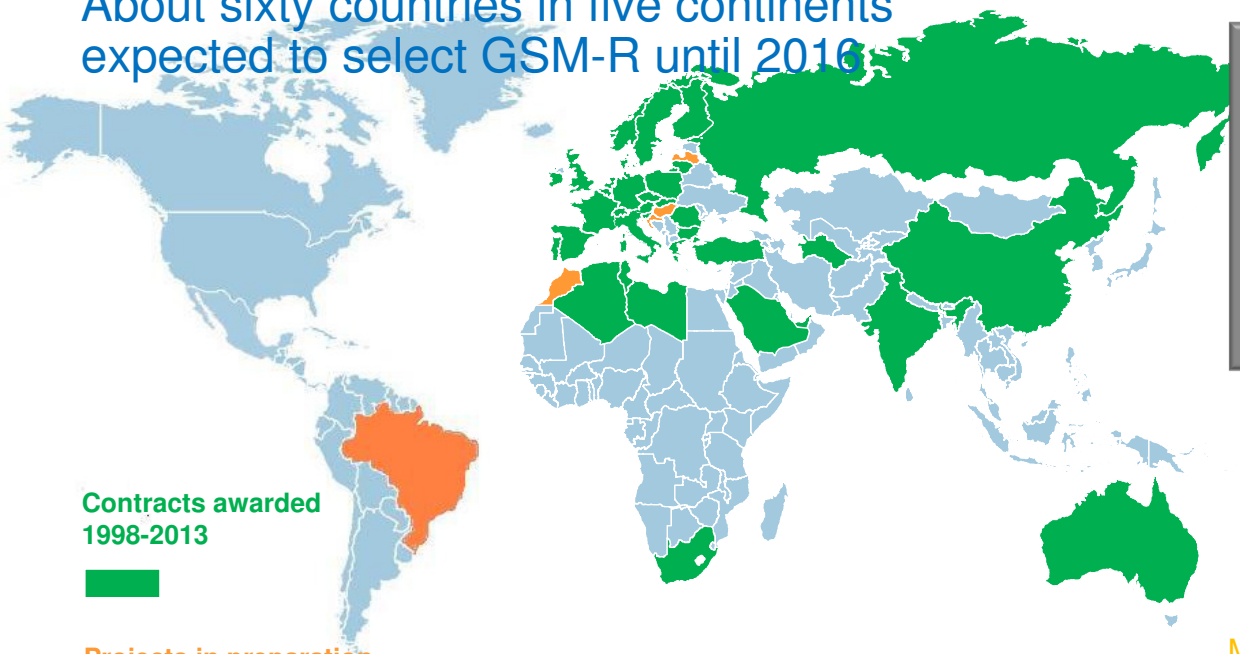
- Nine members dedicated to:
  - The supply of Interoperable End to End system
  - The minimization of integration efforts and Railway implementation and migration costs
  - The long term support of the GSM-R technology
  - The continued development of the EIRENE Standard and the smooth evolution and migration to a Future Railway Mobile Communication System (FRMCS)
  - Support, participate and contribute to the TEN-T call and activities
  - The global promotion of the technology

- It is a single interface for:

World Railway Standard

gsm-r INDUSTRY GROUP

About sixty countries in five continents expected to select GSM-R until 2016



Contracts awarded 1998-2013

Projects in preparation

GSM-R, in commercial operation for over 13 years, is the voice and data radio system for all European railways and abroad. IT IS THE OFF THE SHELF REFERENCE SOLUTION

1998	2000	2002	2004	2006	2008	2010	2012	2014	2016
Germany	Netherlands	Belgium	China	Algeria	Australia		Morocco	South Africa	Argentina
Italy		Finland	India	Turkey	Libya		Ireland	Brazil	Iran
Sweden		France	Saudi	Austria	Tunisia		Luxembourg	Venezuela	Iraq
UK		Norway	Arabia	Bulgaria	Denmark		Poland	Israel	Korea
		Slovakia	Czech	Greece	"Eurotunnel "		Romania	Turkmenistan	Ukraine
		Switzerland	Republic	Lithuania	Portugal		UAE	Kazakhstan	Uzbekistan
							Russia	Belarus	Bosnia-Herzegovina
							Hungary	Latvia	Macedonia
								Croatia	Moldavia
								Estonia	Hungary
								Slovenia	Serbia
									Taiwan
									Egypt

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Latest development

- IP Migration
  - IP: GPRS/EDGE, Rel. 4 Core, SIP interface, ETCS Over GPRS
- EC's TEN 3rd call project:
  - Development of ETCS over GPRS solution together with UIC, ERTMS Users Group, UNISIG and Railways
  - GSM-R certification/ assessment for CCS TSI
  - Support ERA for FRS/SRS baseline update (next one FRS/SRS 15.4/7.4)
- ER-GSM (extended GSM-R bandwidth), specification activity for 3GPP
  - UL [873 – 880 MHZ], DL [918 – 925 MHZ]
- GSM-R optimization concerning the public network interference issue
  - Three main axes: improved radio modules with enhanced RF stage, improved GSM-R coverage, filters. New products are already available on the market by different vendors

FRMCS

- Context
  - UIC & ERA are preparing the future launching complementary initiative for the **FRMCS** (Future Railway Mobile Communication System).
  - There will be a smooth migration around -2025…30- with a take-over from the existing infrastructure: Shelters, Tower, power supply, Optical transmission system, Trainborne cabling, etc.

- IG View
  - IP native 4G/5G on ‘railway reserved’ band ; multiband retro-compatible terminals
  - Scalable solution
    - Low band high priority services: ETCS data , Emergency & operational voice call
    - High-band low priority services: Maintenance & Diagnostic data ; Infotainment & Internet On Board
  - Seamless handover between GSM-R line and FRMCS line
    - Trainborne capable of ‘NO-STOP’ vertical roaming between different GSM-R and FRMCS infrastructure
  - Fully transparent to the ETCS over IP application: change of radio beamer
    - Simplified safety case and TSI (interoperability) upgrade
  - Transition phase with Circuit Mode support(emulation)

Alstom Contribution

Alstom was one of the founding members of the ERTMS community, and our solution ATLAS has become the leader in bringing ERTMS into service for both trains and trackside equipment.

ATLAS™ – designing fluidity

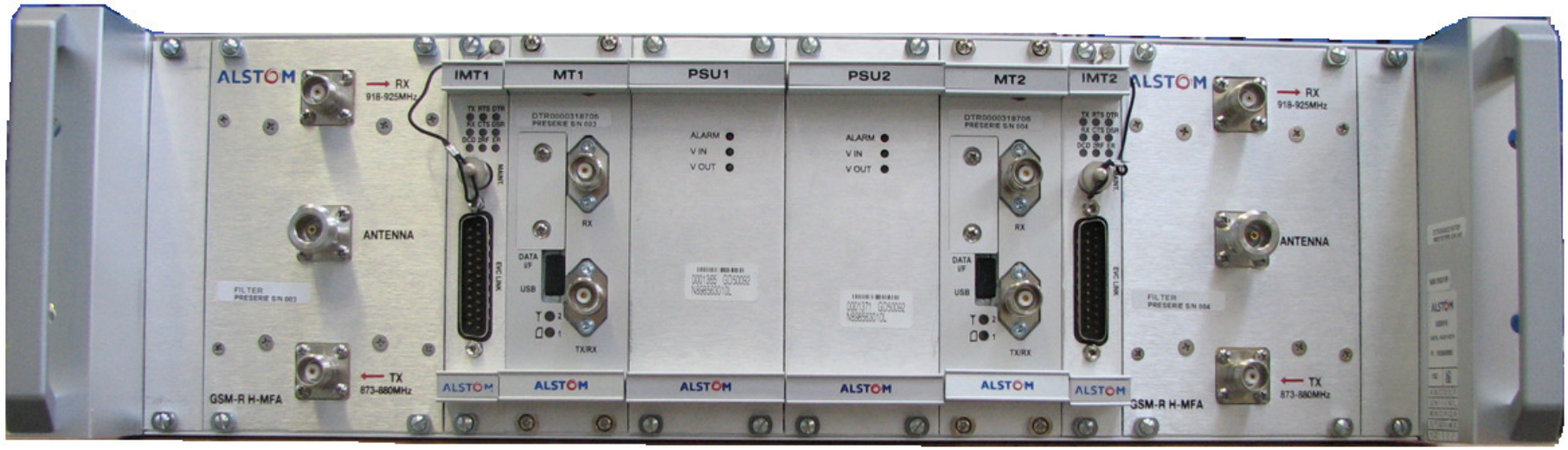
The ATLAS 200 ERTMS L2 system has been selected in more than ten countries and for over a hundred different types of trains, making it the foremost integrator of GSM-R equipment.
In 2013 our equipped trains will pass 250 million kilometres run, and our RBCs have over 750 000 hours of operation on all types of line and all types of train.

Alstom GPRS-EDOR

ARBE-C-3 is Alstom's third-generation ETCS data-only radio (EDOR) in the ATLAS signalling product range :

- Support for ETCS over GPRS(EDGE) applications
- Support for both the ER GSM-R band and the UIC band [873-880 ; 918-925 MHz]
- Integrated Enhanced Duplexer/filter & improved ETSI professional radio module for high immunity to interference from public GSM and UMTS

Delivered to TEN-T 3th Call for ETCS over GPRS Testing



Thank you

www.gsm-rail.com