Product portfolio
and ERTMS/RTCS projects of
Ansaldo Segnalamento Ferroviario
Ansaldo STS group

Pilsen, 27th May 2008
• Ansaldo STS Italy – products
• Ansaldo ERTMS/ETCS projects
• Czech Pilot Project
  – Technical description
  – Main functionalities
  – Progress of work
• Conclusions
PRODUCTS
Audio Frequency Track Circuit (ATIS)
ATIS – Basic requirements and architecture

- Max length: 2000 m
- Tx/Rx cables max length: 7000 m
- Power traction: 25 KV / 50 Hz
- Max conductance: 0.25 S/Km
- Max Shunt: 0.25 Ohm
Frequencies utilised are divided into two different types of track circuit.

Both of them transmit an FSK message with information customised for each track circuit.

Type “H” (9500÷16500 Hz)
- 10500 Hz, 12500 Hz, 14500 Hz, used for first main track
- 11500 Hz, 13500 Hz, 15500 Hz, used for second track
- 9500 Hz and 16500 Hz, used if necessary for auxiliary tracks

Type “L” (3750÷7250 Hz)
- 4250 Hz, 5250 Hz, 6250 Hz, used for first main track
- 4750 Hz, 5750 Hz, 6750 Hz, used for second track
- 3750 Hz and 7250 Hz, used if necessary for auxiliary tracks
Computer Based Interlocking (traditional e multistation)
Computer Based Interlocking (CBI) – Main features

- 2003 technology
- Interface with trackside subsystems (adjacent IXLs, RBCs)
  - 2 x E1 ports (G.703 / G.704 @ 2Mbit/s, 30 channel at 64 kbit/s)
  - Redundant interface and redundant communication (use of normal and redundant transmission channel)
- Integration with
  - Centralized traffic control and management systems
  - Automatic Train Protection systems
- Interface with Peripheral Posts
CBI - Architecture

Field Devices

- Central Interlocking Unit
- Alarm Record Telecontrol
- Functional Vital Keyboard
- Man Machine Interface

- CTC Control Room
- RBC Control Room

PERIPHERAL POST

FIELD

CENTRAL POST

Peripheral Post
Peripheral Post
Peripheral Post
Peripheral Post
Peripheral Post

Connecting Lines
MultiStation CBI – Main features

The architecture is based on the concentration of signalling controls, interlocking and supervision functions in the Control Centre Computers, which send controls to all Peripheral Posts and Field Equipment, distributed within the stations along the line, by means of the devoted geographical communication network.

Peripheral Posts do not realise route interlocking functions, but executes controls to and get detection and status from the field equipment (points, signals, track sections etc.). All information are sent to the Control Centre Interlocking.
The ETCS products are divided in:

- products for ERTMS L1 system
- products for ERTMS L2 system
ERTMS Level 1

Track data and authority are transmitted by balises from track to train.
EUROBALISE
• ERTMS EUROSIG EUROBALISE Compliance
• FSK transmission, 565.4 KHz
• 1023 and 341 - bit telegrams
• Fixed or variable data balises
• Programmable through C Interface
• Suitable for SIL 4 systems
• Class A Balise

• Length 523 mm
• Width 403 mm
• Height 40 mm
• Weight < 10kg
• Temperature Range - 40 °C / +70 °C
ENCODER and LEU
The ENCODER acquires the field and interlocking conditions and is capable of selecting a telegram on the basis of the acquired information to be sent Onboard the train.

The ENCODER also performs:

- Checks to verify the correct behaviour of the device
- Clock synchronisation through GPS
- Diagnostics and data retrieval
ENCODER - Technical Characteristics

• Modular Architecture
  • Each LEU can drive 4 balise
  • Each trackside cabinet can accommodate 8 LEU
  • Max. number of 4 cabinets (design constraint)

• Fail-Safe architecture based on “2oo2” architecture

• Supported Balise Types:
  • ASK, 32 bit telegram
  • ASK, 255 bit telegram
  • FSK, 341 bit telegram
  • FSK, 1023 bit telegram

• Compliant with CENELEC EN 50129, 50128, ...

• Compliant with EUROBALISE Specification
LEU - Main functions

- Interlocking status acquisition via dedicated input board or via a serial link with interlocking (respectively LEU-ID or LEU-IS)
- Selection of the telegram to be sent
- Transmission of the selected telegram to the train via the balise
- Diagnostic self tests at power-up and during normal operation
- Detection of LEU faults
ENCODER - Installation (example)

Reserve Cabinet

Main Cabinet
ENCODER – Trackside installation (example)
BALISE TRANSMISSION MODULE
and
ANTENNA
The BTM-ANTENNA consists of the BTM (Balise Transmission Module) and the ANTENNA, it is responsible for reading balises along the track.

The BTM-ANTENNA has been designed as stand alone fail safe equipment.
• Supported Balise Types
  • ASK, 32 bit telegram
  • ASK, 255 bit telegram
  • FSK, 341 bit telegram
  • FSK, 1023 bit telegram
• Weight: 12 kg
• Size: 320 X 280 X 249 mm
• Compliant with CENELEC EN 50155, 50129, 50128....
• Compliant with EUROBALISE Specification

• The BTM module is made up of the following sub-modules:
  • 27 MHz transmission unit
  • 4.2 MHz signal receiver and processing unit
  • Power supply unit
• Weight: 10 kg
• Size: 490 X 400 X 150 mm
• Twin function, reads ASK Balises and FSK EUROBALISE
ERTMS Level 2

Track data and authority are transmitted by radio, no lineside signals need
On-board Equipment
(Eurocab)
• ERTMS Kernel compliant with UNISIG SRS 2.3.0 (Level 2)
• BTM compliant with FFFIS for Eurobalise
• RIM module compliant with standard Euroradio protocol and MT Igsm interface
• Two RIM modules used either for availability or to ensure seamless RBC handover
• Integrated STM (Italian SCMT)
• Fail safe architecture
Eurocab Installation
Radio Block Center (RBC)
• 2003 technology
• Same technology used for Roma Termini IXL (reuse of hw, basic sw and design, configuration and test tools)
• Interface with trackside subsystems (IXLs, other RBCs)
  • 2 x E1 ports (G.703 / G.704 @ 2Mbit/s, 30 channel at 64 kbit/s)
  • Redundant interface and redundant communication (use of normal and redundant transmission channel)
• Interface with onboard subsystems (30 trains)
  • 2 port E1 2 Mb/s with 30 data channel (B) at 64 Kb/s and 1 signalling channel (D) a 64 Kb/s (ISDN PRI)
  • Redundant interface (use of normal and redundant transmission channel)
• **Vital Nucleus**
  - Safety functions for train separation
  - Safety functions for communication handling with IXLs, adjacent RBCs and trains
  - Safety functions for control of Vital Keyboard
  - Communication protocol for communication with trains (EURORADIO)
  - Communication protocol for communication with IXLs and adjacent RBCs (derived from EURORADIO)

• **IOART – Operator Interface Alarm Recording and Telecontrol**
  - Functions for Control System communication
  - Functions for diagnostic data logging
  - Functions for Human Machine Interface

• **HMI Interface**
  - Command from operator (speed restriction, emergency, …)
  - Graphic Display of RBC operations
  - Diagnostic Data Display
**RBC - Architecture**

- **GSM-R**
- **WAN**

**On Board**

- **Vital Section Communication**
- **ART1**
- **ART2**

- **Graphic Display & Functional Keyboard (vital)**
- **Functional Keyboard (not vital) & D&M Interface**

**RBC, IXL**
ASF ERTMS/ETCS projects

ERTMS/ETCS projects
Italian High Speed Line (L2 application)
### Italian High Speed Network

- **Design phase**
- **Building phase**
- **In revenue operation**

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<th>RBC</th>
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Italian High Speed Line (IHSL) – Main Features

- Lines of new construction
- ERTMS/ETCS Level 2
- No light signals - Fixed signals along the line and in the stations
- No other backup signalling systems (previous idea to have ERTMS/ETCS Level 1 was removed during the design phase)
- 300 km/h max speed
- Headway
  - 2.5 min theoretic
  - 5 min for operation
Italian High Speed Lines – Current Status

- Torino-Novara-Milano Line – extension 120 km – **IN OPERATION** (Torino-Novara, 80 km) from February 2006 (after 3 months of pre-operation)
  - 2 RBC – 14 CBI (10 CBI Torino-Novara – 4 CBI Novara-Milano)
  - 900 balises (fixed and switchable)
  - about 40 LEU (HSL entrance handling / Hot Box Detection)
  - about 180 Audio frequency track circuits

- Roma-Napoli Line – extension 200 km - **IN OPERATION** from December 2005 (after 3 months of pre-operation)
  - 3 RBC - 18 CBI
  - about 1500 balises (fixed and switchable)
  - about 60 LEU (HSL entrance handling / Hot Box Detection)

- Milano-Bologna Line – extension 185 km – **IN PROGRESS** (expected 2008)
  - 3 RBC - 19 CBI (single MS CBI)
  - about 1500 balises (fixed and switchable)
  - about 60 LEU (HSL entrance handling / Hot Box Detection)

- Bologna-Firenze Line – extension 80 km – **IN PROGRESS** (expected 2009)
IHSL Torino-Novara – Detailed Architecture

**Control Centre**
- CTC
  - ANSALDO
- RBC
  - ANSALDO
- NSS
- BSC
- SIRTI

**Peripheral**
- Fiber optic WAN
- SIRTI

**Cabin**
- CBI CP/PP
  - ANSALDO
- BTS
  - SIRTI

**Trackside**
- Oleodyn. switch
  - Electromech. switch
  - ALSTOM
- (Hot Box Detector, …)
- Audiofrequency Track Circuit
  - ANSALDO
- EUROBALISE
  - ANSALDO
- OTHERS
IHSL Milano-Bologna – Detailed Architecture

Control Centre

- CTC
  - ANSALDO
- MS CBI CP
  - ANSALDO
- RBC
  - ANSALDO
  - SIRTI
  - NSS
  - BSC

Peripheral

- Fiber optic WAN
  - SIRTI

- Cabin
  - MS CBI PP
    - ANSALDO
  - BTS
  - SIRTI

Trackside

- Oleodyn. switch
  - Electromech. switch
  - ALSTOM
- Audiofrequency
  - Track Circuit
  - ALSTOM
  - (Hot Box Detector, …)
  - OTHERS
- EUROBALISE
  - ANSALDO
German POS Nord project
(L1 and L2 application)
POS Nord: Paris-Ostfrankreich-Südwestdeutschland

- **Scope of the Work**: to equip with ERTMS Level 1 and Level 2 the Saarbrücken–Ludwigshafen/Mannheim Line (about 125 km), located in the western-center part of Germany.

- **Customer**: Deutsche Bahn Aktiengesellschaft

- **Project Baseline**: ERTMS/ETCS v. 2.3.0 (with “Reclassification Package”) + Corridor 2007 + “Specific” “POS Nord” CR

- **Project Start Date**: 01 February 2008
- **Completion of Work Date (“HdF”)**: 12 months after Project start
- **Commercial Service Start**: 18 months after Project start
• **Radio Block Center:**
  – RBC 1: (Saarbrücken–Kaiserslautern, about 70 km), Unterzentrale Saarbrücken
  – RBC 2: (Neustadt–Ludwigshafen, about 22 km), Unterzentrale Neustadt

• **EuroBalise:**
  – Switchable (Lev. 1): about 500
  – Fixed (Lev. 1 & 2): about 1000

• **Remote IO–RBC (MMI):**
  – Betriebszentrale Karlsruhe

• **LEU:**
  – About 100

• **EuroLoop:**
  – Approx. 35000 m

• **RBC/Relay Interlocking Gateway:**
  – Unterzentrale Einsiedlerhof (Kaiserslautern acquisition)
Czech Pilot Project
Poříčany – Kolín
(L2 application)
The pilot project is part of the Trans European corridor IV.

It is the first installation of ETCS Level 2 in Czech Republic.

The contracting authority is SŽDC.
Technical features

- Poříčany - Kolín pilot section 22 km long
- ERTMS/ETCS Class 1, Level 2 system according to the UNISIG SRS version 2.3.0 (Commission Decision 2004/447/EC modified by CR classified IN in the UNISIG Subset-108 version 1.0.0)
- 3 IXL ETB type: Poříčany – Pečky – Velim
- New Interlocking-RBC interface
- Implementation of the Euroradio based safe protocol for the communication IRI (Interlocking-RBC interface) -RBC
- Development of STM National with the functionality of the national ATP LS90
- Installation of the mobile part of the equipment on locomotives of 3 different types.
Scope of supply (1/2)

GSM-R Network

RBC

Velim Control Center

OBU

STM LS 90

IRI

CTC

IXL Poříčany

Automatic Block Level Crossing

IXL Pečky

Automatic Block Level Crossing

IXL Velim

Automatic Block Level Crossing

ASF

ASTS F

AZD
Scope of supply (2/2)

• ASF
  – Radio Block Centre, Eurobalises
  – Testing and V&V
  – System Integration

• ASTS France
  – ETCS On-board
  – On-board relevant tests

• AZD
  – Modification to existing trackside
  – Interlocking-RBC Interface (IRI)
  – STM LS90
  – Construction and Installation
The main requirement of the pilot project is the management of mixed traffic on the same line: ETCS equipped trains running according to ETCS rules and ETCS-non equipped trains running according to optical signals and national ATP.

The Functional Requirements Specifications includes the functionalities of the pilot project.

The on-board and the RBC fulfil the pilot project FRS ensuring full ERTMS interoperability

(CD 2004/447/EC modified with CR “IN” of the Subset 108)
- Mar 2006: Approval of the FRS
- Jan 2007: End of system design
- Nov 2007: End of manufacturing
- Jan 2008: End of construction
- Jan 2008 – Oct 2008: Commissioning tests
- Jan 2009 – Feb 2009: System acceptance tests
- 31 Mar 2009: Taking over of the project
Progress of work – Test phase

Different steps of integration:

• **Tests via ISDN** Genoa-Paris (communication protocol RBC-EVC) and Genoa-Prague (configuration and management of data transmitted from IRI to RBC)

• **Genoa lab**: target RBC (ASF), target EVC (ASTS France), IXL simulators (AZD), IRI simulator (AZD), simulators for the movement of the train

• **Velim test ring**: RBC, EVC installed on a running train, IRI, simulated IXLs

• **Open line with “shadow IXLs”**: RBC, EVC installed on a running train, IRI, simulated IXLs (new SW version for PP) receiving the real information about the track circuit occupancies by CTC (old IXL version still installed on the station)

• **Open line with real equipments**: RBC, EVC installed on a running train, IRI, IXLs (new IXL SW installed in the stations)
Tests RBC-IRI via ISDN

Board-side RBC Stimulator

- RBC MMI
- Log file
- Operator Keyboard

IXLi-1 simulator

- Operator interface
- Log file

RBC

Line Status Simulator

IXLi+1 simulator

Operator Keyboard

ISDN line
Genoa lab integration tests

Environment simulator

Sync.

Odometry data (pulses)

EVC Gateway

IRI simulator

IXL simulator

RBC

EVC

GSM-R

TIU statuses

Track circuit occupancy information
Velim test ring integration tests

- A part of the Pilot Project line configuration has been reproduced on the Velim test ring (balise installed on the Velim test ring have the same content as the balises of a part of PP line)
- No track circuits on the Velim test ring
- Routes, level crossings, signals for the exit from L2 area referred to that part of Pilot Project line are simulated by the IXL simulator
Open line integration tests – “shadow IXLs”

RBC → IRI

TC, LX, routes, exit border signal,

“shadow IXL” simulators

TC occupancy information

GSM-R

Poříčany IXL → CTC → Pečky IXL

Velim IXL
This configuration allows the tests on real Pilot Project Line with trains equipped with ETCS on board without impact on the existing traffic on the three stations of the pilot project.

The train is supervised both by ERTMS system and by the traditional signalling.

The driver follows the most restrictive between the two.

The new IXL SW is installed in the stations only after a test phase that shows the correct management of the “traditional part” of the station signalling.
Open line integration tests – real equipments

- RBC
- IRI
- Poříčany
  - IXL
- Pečky
  - IXL
- Velim
  - IXL

GSM-R
Conclusions

At the end of the described test phases (some of them already completed), the acceptance tests will be performed, to reach the permission for putting in service the system.

The Pilot Project puts the basis for future enlargement of the ERTMS L2 system in Czech Republic
Thank you for your attention