INTEGRATING RADIO COMMUNICATIONS FOR ADVANCED CONTROL ON METROS

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TETRA Moving Forward in Poland

– Hyatt Regency Warsaw, July 8, 2010

Contents

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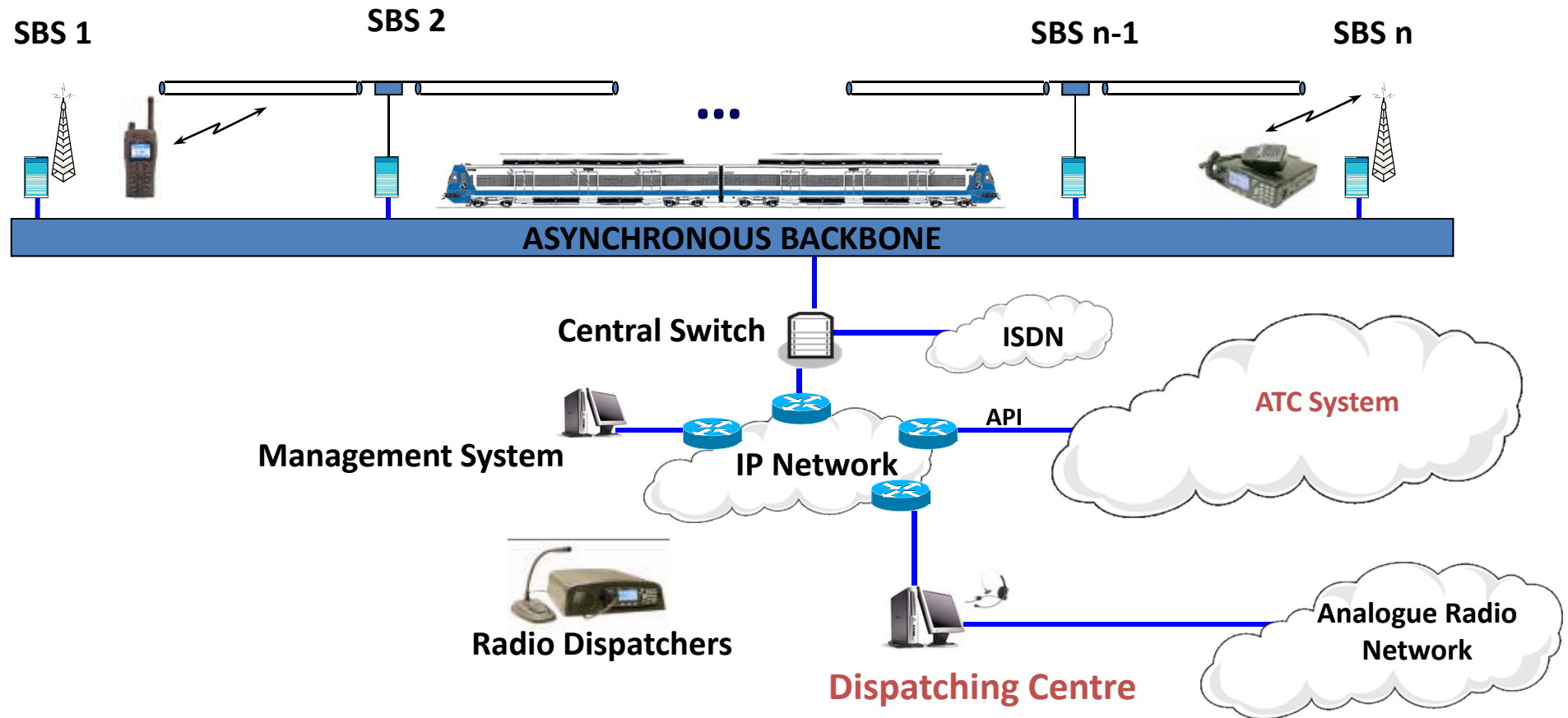# Mobile Digital Radio: Key factors

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- Improving voice quality
- Introducing security criteria:
    - Authentication / Remote disabling
    - Encryption
- Data transmission: ST, SDS, PD, CD
- Connectivity: Ethernet/IP, analogue networks, …
- Applications Platform (Ethernet based API's)
- Optimised Location (GPS, beacons)
- Low resolution video
- Data bases
- Dispatching centres
- Exploitation Support in Automated Metros
- Signaling and Control Applications

TETRA Network Model

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SBS 1   SBS 2   SBS n-1   SBS n

• • •

ASYNCHRONOUS BACKBONE

Central Switch   ISDN

Management System   ATC System

IP Network   API

Radio Dispatchers

Dispatching Centre   Analogue Radio Network
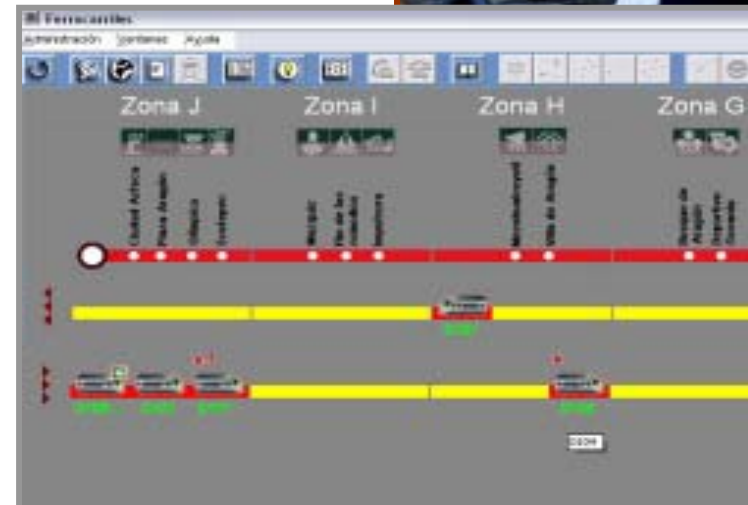
Typical requirements in Metro and Railway

• Full and half duplex calls (private and group)

• Built-in emergency button

• Status and short data services for specific control applications

• Operational console integrated into the driving dashboard

• Interaction with the Passenger Information System

• Interaction with the Train Control and Monitoring System.

• Integration of TETRA and analogue

Specific metro and railway functions:

- Voice calls to and from the Dispatching Centre
- Public announcements and ambience listening
- Functional and location dependant addressing
- Emergency braking activation
- Fire extinguishers activation
- Train switch on / switch off
- Update of the information panels
- Discreete location (beacons)
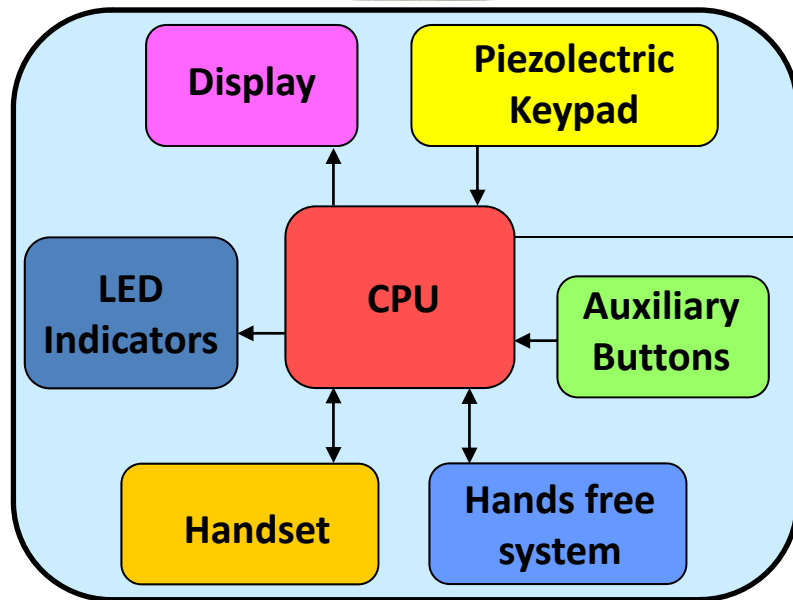- Alarm management
- Update of the TCMS parameters

On Board Subsystems:
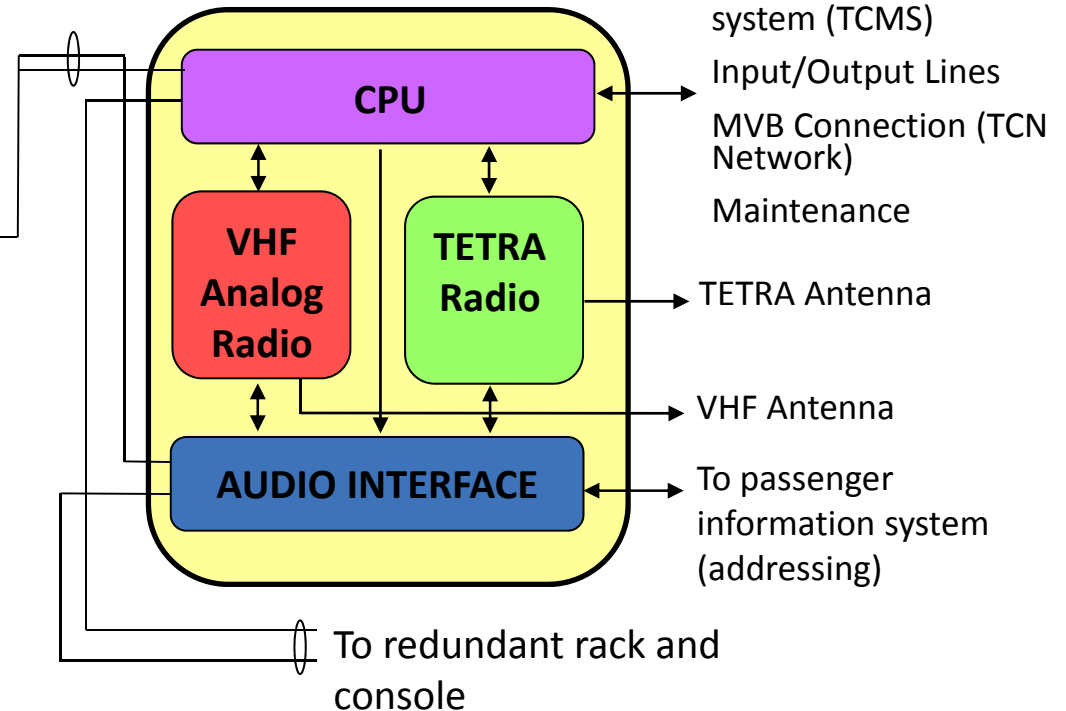
Basic configuration

(1 Rack & 2 consoles)

MVB bus

MMI
Console

Communications rack

(TETRA +VHF)

MMI
Console

TCMS

(Train Control
Management System)
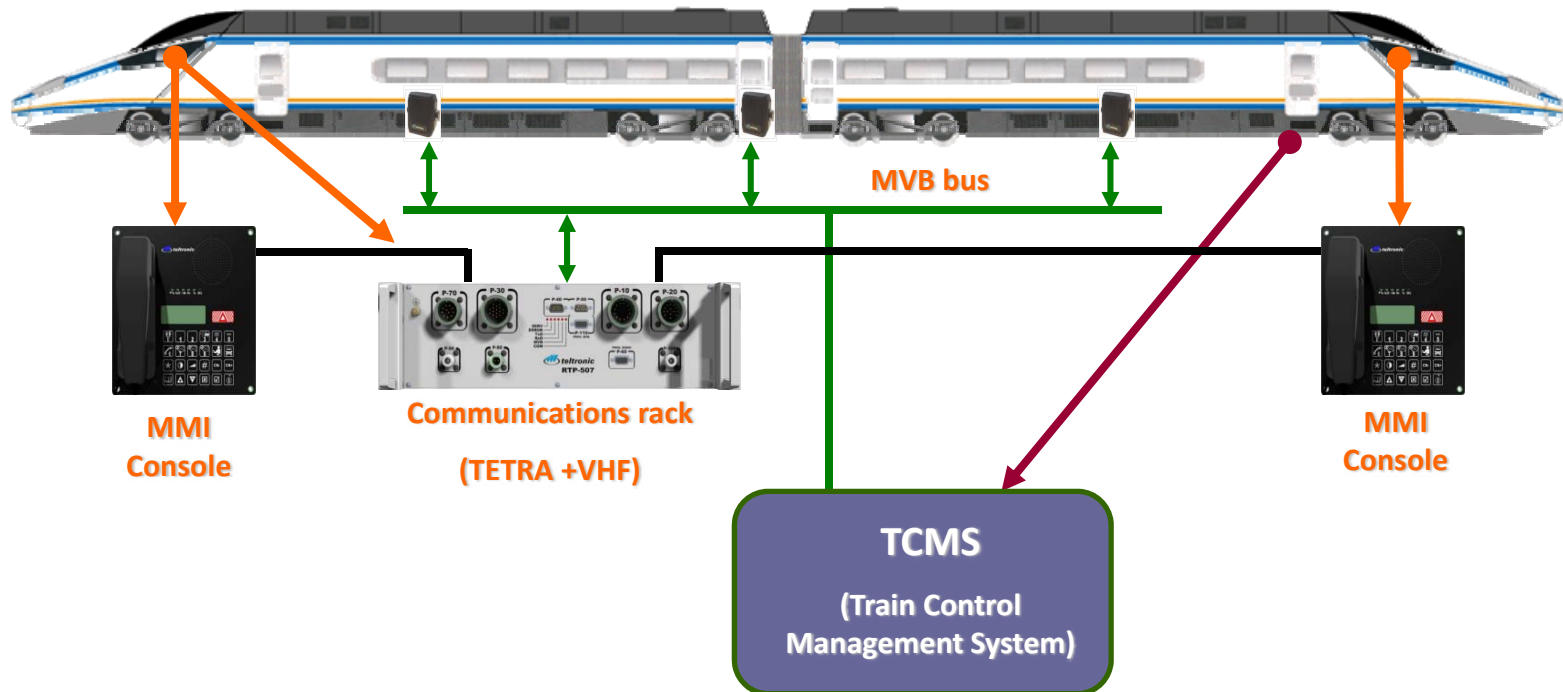
Redundant configuration

(2 Racks & 2 consoles, joined for redundancy functions)

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MVB bus

MMI Console

Communications rack

Communications rack

MMI Console

TCMS

(Train Control Management System)
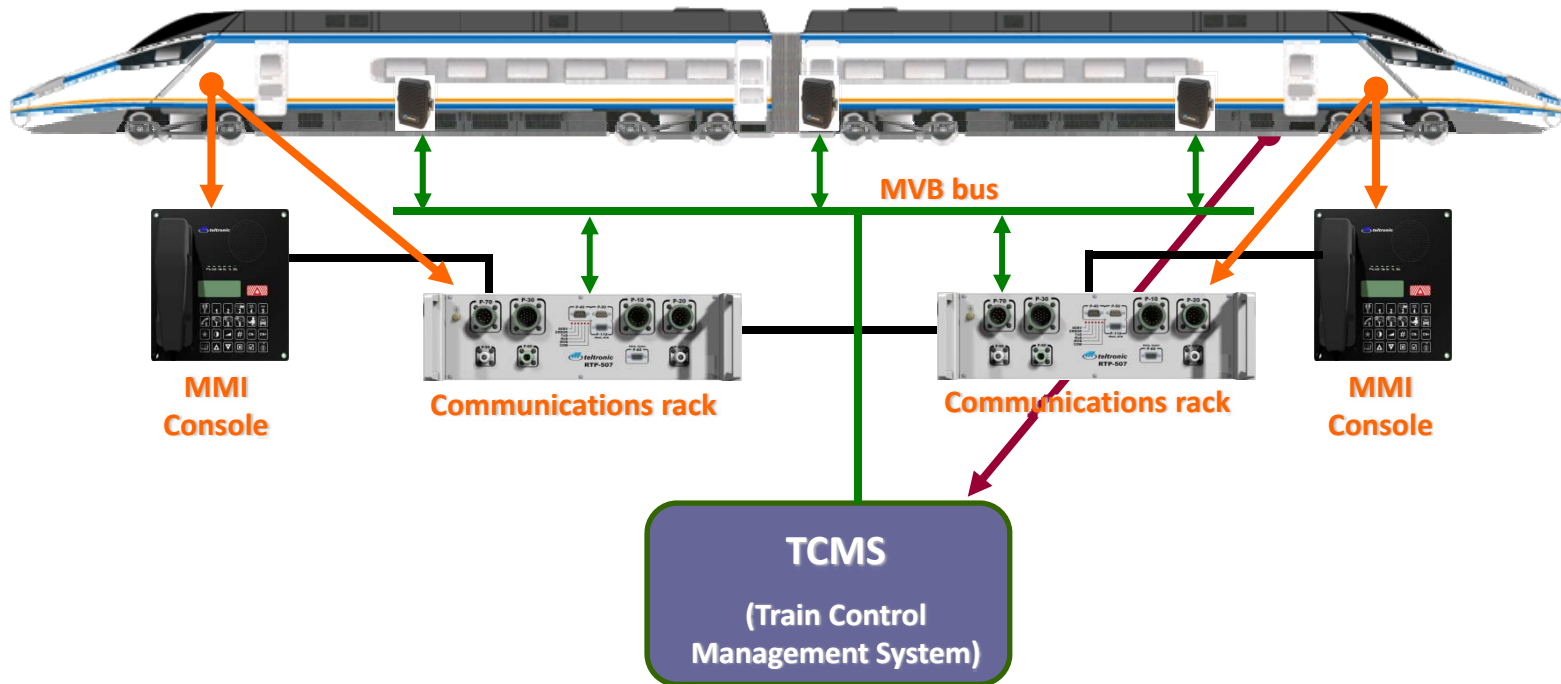
On Board Subsystems: Summary

High level of **customization** to adapt to:
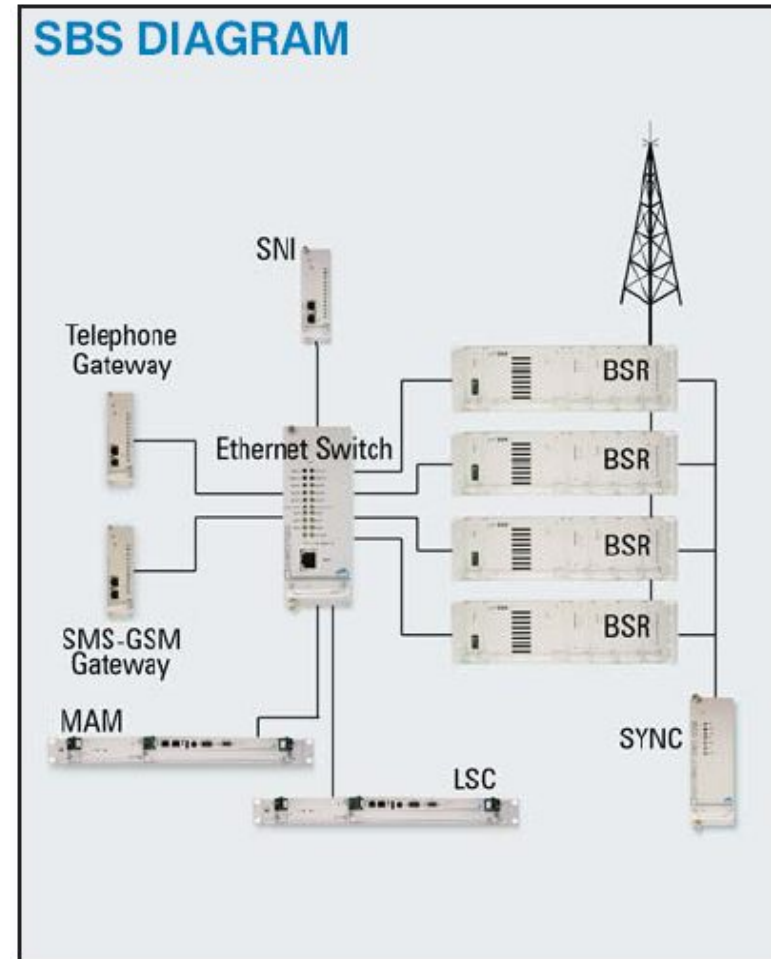
- Different train makers:

    (Alstom, Siemens, CAF, Ansaldobreda, Bombardier...).

- Different power supply levels and signaling:
    (+110v DC, +72v DC, +24v DC).

- Different operational requirements.

- Available mounting spaces.

- Custom consoles.

Example of TETRA Infrastructure

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SCN: Switching & Control Node   **SBS:** Base Station Site

NEBULA® Implementation

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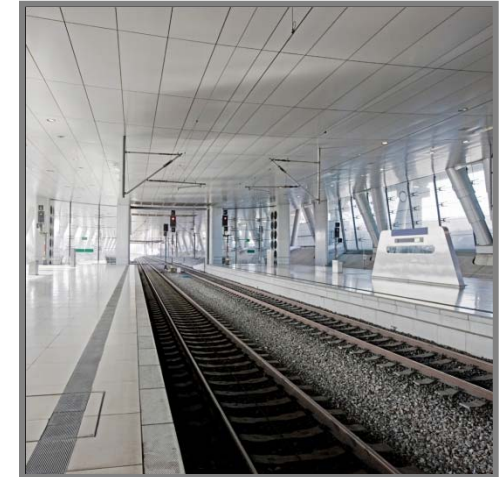| Main Base Station 1 | MCCH | SCCH | SCCH | SCCH |
| Base Station 2 | TCH | TCH | TCH | TCH |

- Supports up to 4 control channels per SBS → more capacity for SDS
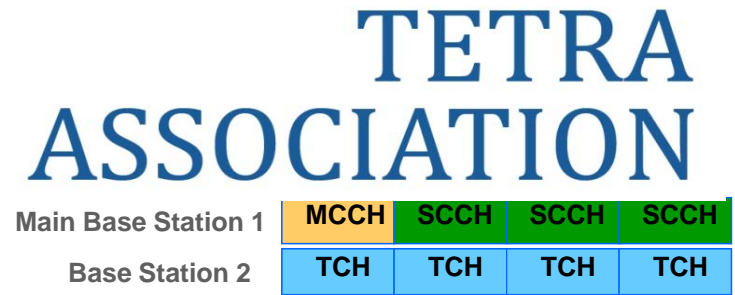
- Supports Circuit Data Service → more options of data services for control applications

- GPS-less at Base Stations → easier installation in tunnels

- Allows the use of Ethernet backbones (does not require E1 links)

TETRA in Automated Metros

Three sub-system to manage:

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Security

Exploitation

Maintenance

- Automatic Train Control systems (ATC) is based in CBTC signalling for driving operation and a set of additional control functions needed to provide realiability and security to the system.

- TETRA may contribute to the system:
  - Communication with passengers from driver or control center
  - Telemetry of mobile equipments (emergency breaking, fire detection, air conditioning, lights, ambience music, etc...)
  - Back-up system for ATC system

Application Model

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TETRA Network

Commands

Commands

On Board TETRA
Subsystem
TCMS

Control Centre

SDS TL based Protocol

The communication needs identified in the application
model can be managed through this standard TETRA
Service: SDS-TL

TETRA

SDS TL Service

Application - Control
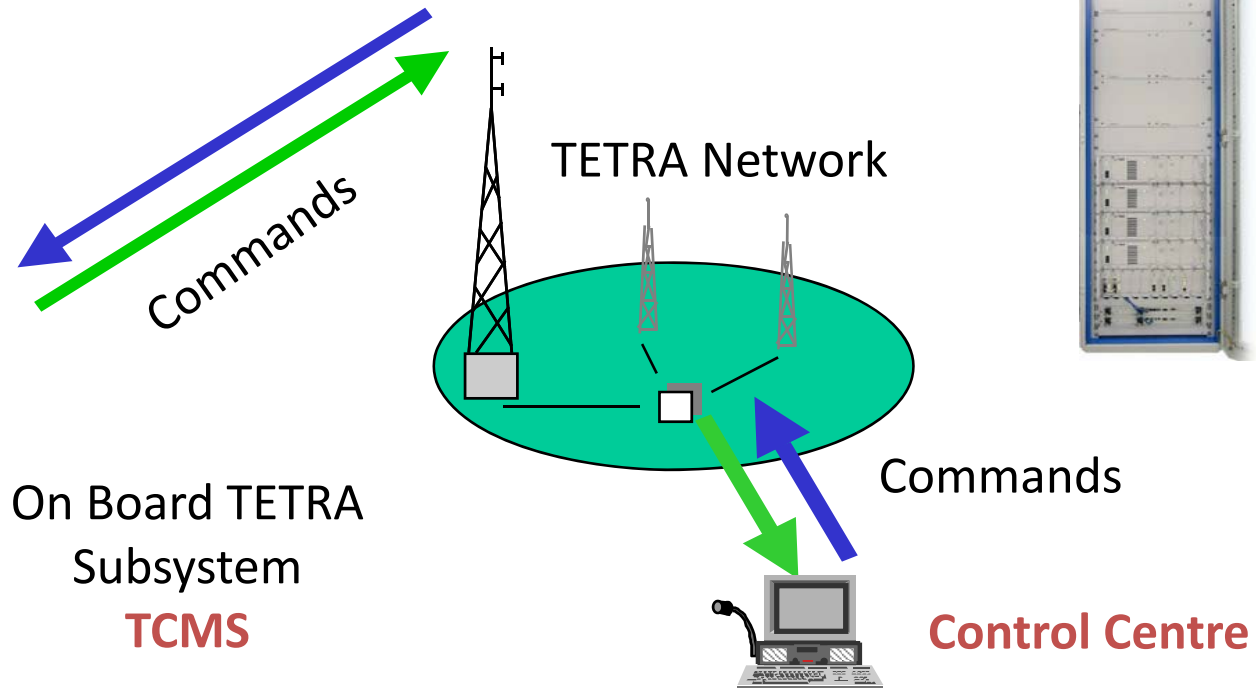
SDS TL based Protocol

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PROTOCOL ID = C0H (ETSI registered)			
TYPE OF MESSAGE	ACK	SS	ST
MESSAGE REFERENCE (counter)			
TEXT SCHEME = 01H (8-bit latin alphabet)			
PROPIETARY APPLICATION CODE			
COMMAND			
TRAIN NUMBER / TYPE OF TRAIN			
COMMAND PARAMETERS			

Security Commands
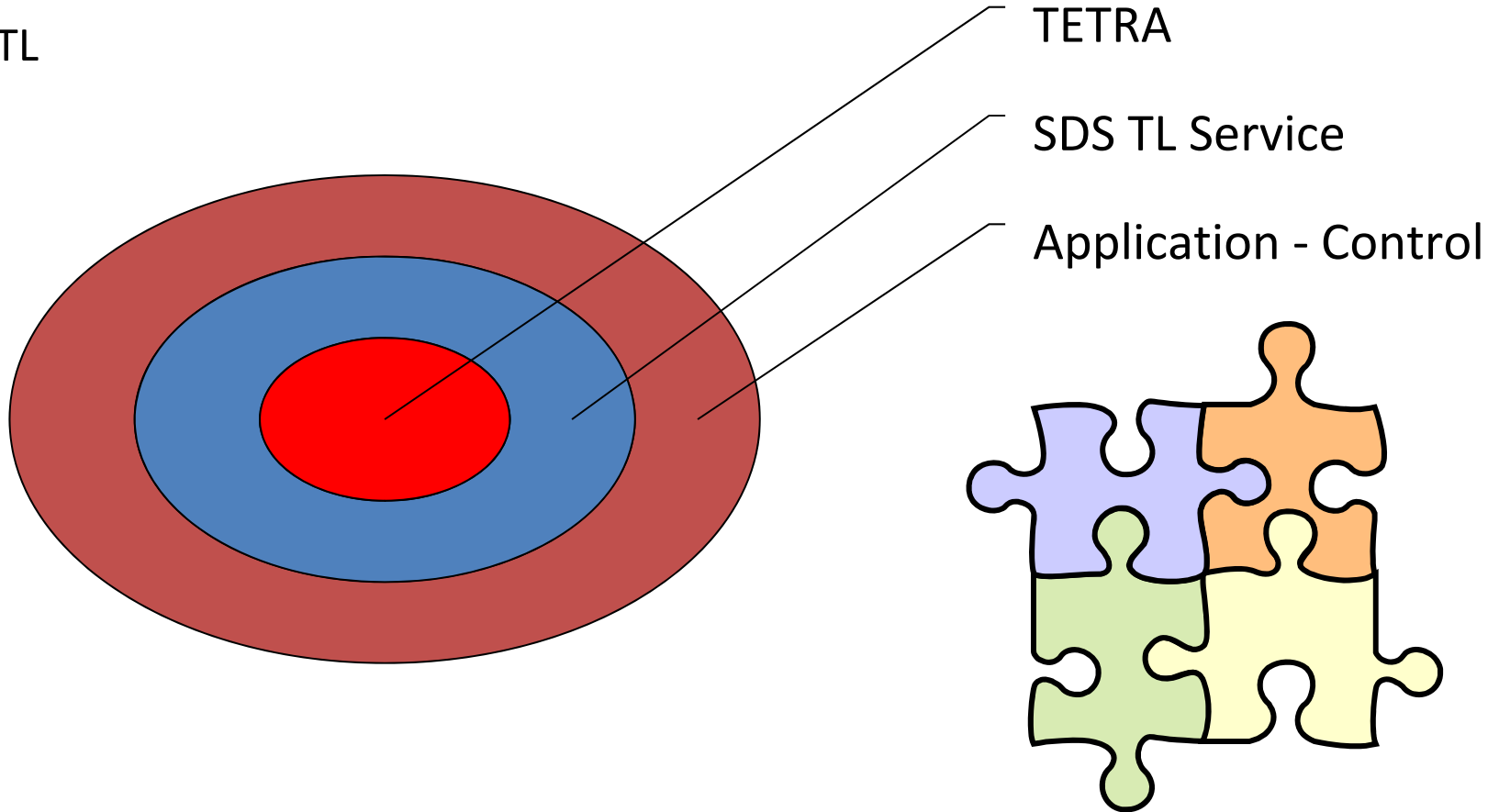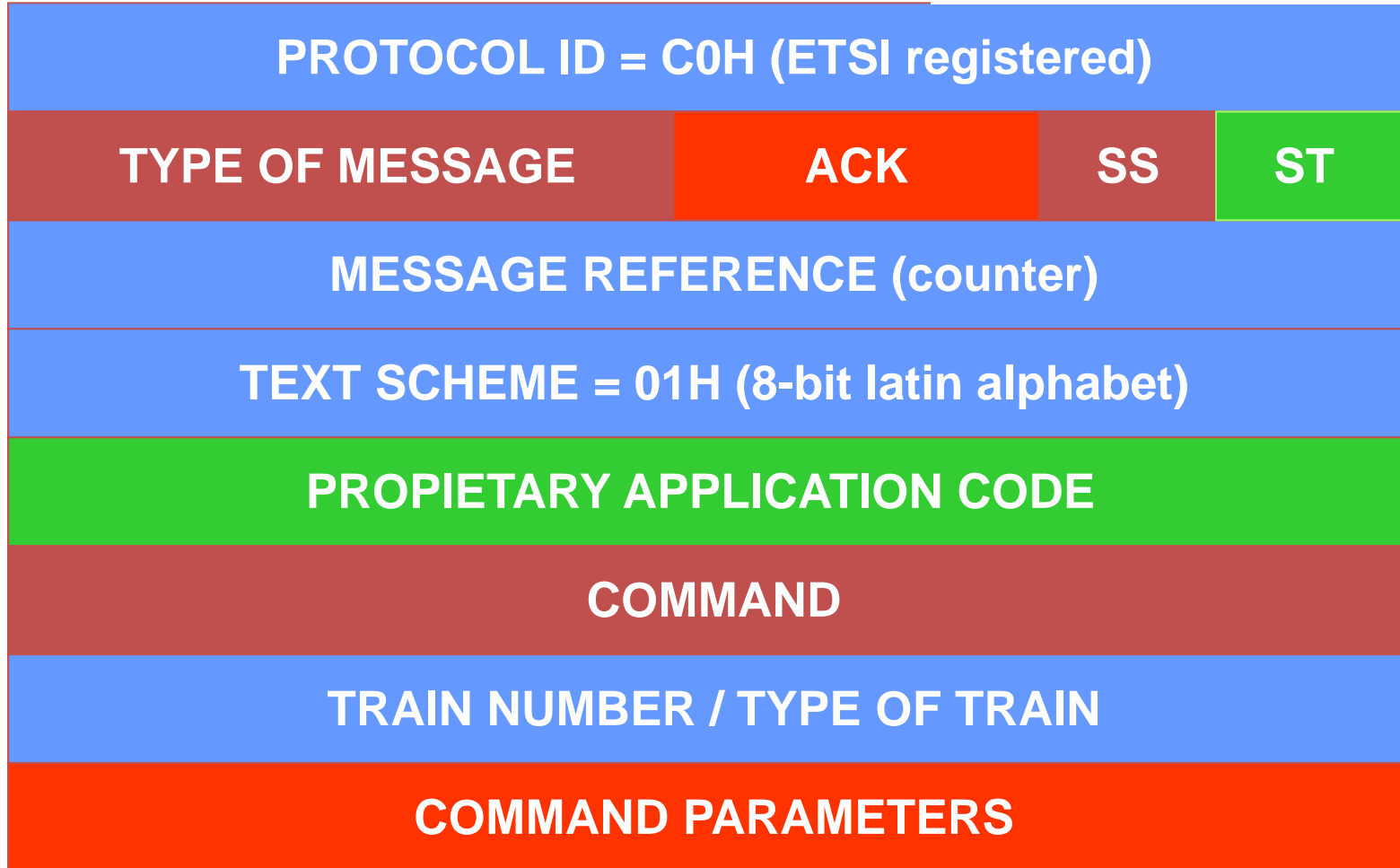
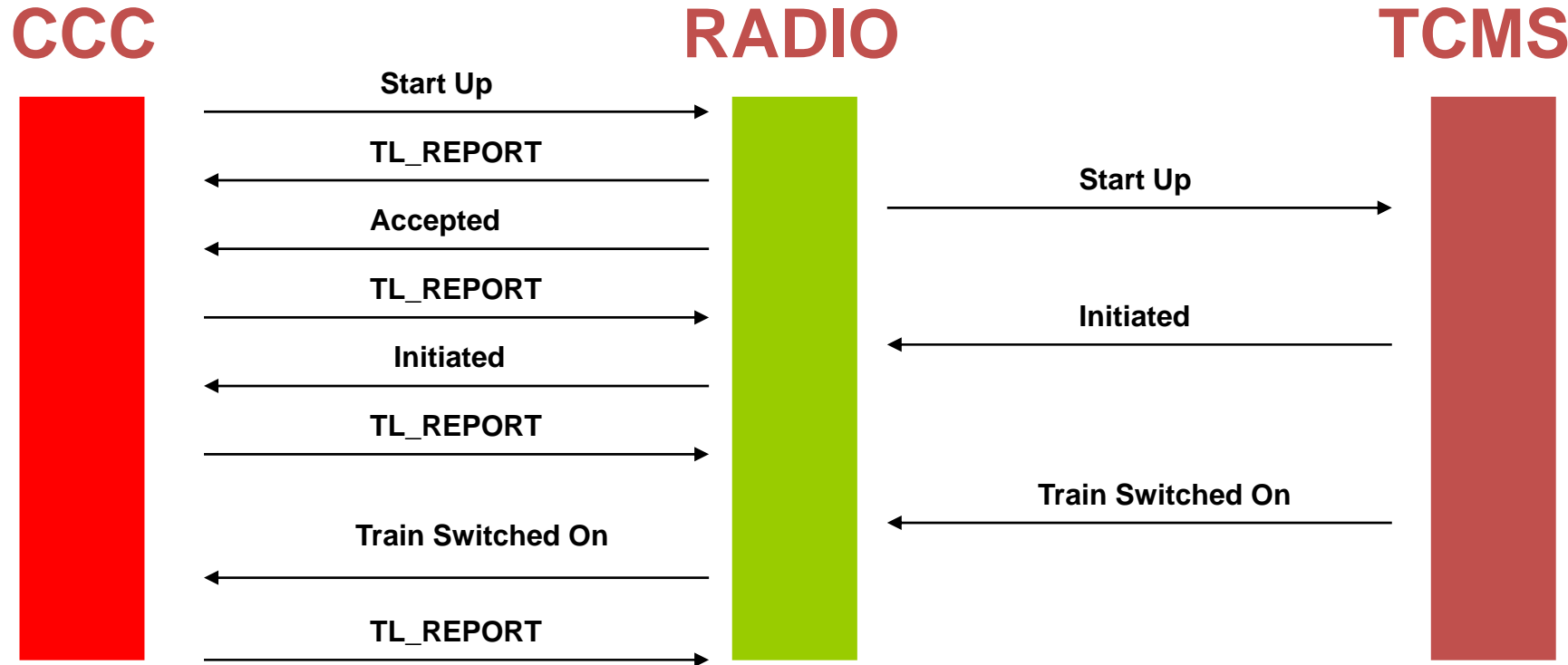| TYPES OF COMMANDS |
|---|
| EMERGENCY BRAKING |
| BYPASS OF BRAKE / TRACTION LOOP |
| PUBLIC ADDRESSING MESSAGE |
| DISABLE SERVICE BRAKE |
| FIRE DETECTION / FIRE EXTINGUISHERS ACTIVATION |
| DETECT ALARM HANDLE UNATTENDED |
| DOORS OPEN / CLOSE |

Exploitation Commands

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TYPES OF COMMANDS
TRAIN SWITCH ON / SWITCH OFF
TRAIN BIRTH (Number and Type of Train, Driver)
EXTERNAL / INTERNAL PANELS CONTENT
LIGHTS / MUSIC / VIDEO / CLIMATIZATION
TCMS CONFIGURATION/ DRIVING MODE
TRAIN LOCATION (SBS or BEACONS)
VOICE GROUP CHANGE (SBS or BEACONS)

Maintenance Commands

TYPES OF COMMANDS
DIAGNOSIS / REQUEST / SENDING ALARMS
TRAIN TIME SETUP
PANTOGRAPH UP / DOWN
NEUMATIC SUSPENSION DISABLE / ENABLE
VOLTAGE INTERRUPTOR
REMOTE SOFTWARE DOWNLOADING (circuit data)
ATP SYSTEM RESET

Example: Start-up Sequence
with TL_REPORT

CCC   **RADIO**   **TCMS**

Start Up →

← TL_REPORT

← Accepted

TL_REPORT →

← Initiated

TL_REPORT →

Train Switched On ←

TL_REPORT →

Start Up →

← Initiated

← Train Switched On

CCC = Command & Control Centre

TCMS = Train Control & Monitoring System

ERTMS: TETRA vs. GSM-R

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ERTMS (European Rail Traffic Management System) =

ETCS (European Train Control System) + GSM-R (radio communication system)

TETRA is a real alternative for the GSM-R sub-system

Customers can select between a more flexible range of alternatives to design the best solution (configuration, cost, etc...)

TETRA vs. GSM-R (main issues)

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	GSM-R	
Security normatives: -EN50155, EN60950, EN50124, EN50153, EN50125, EN50121-3-2	OK	Ok Note: these are the usual requirements for metro systems
EIRENE functional requirements: -Voice / Data / Railway specific services	OK	Ok
Coverage and performance	900 MHz Up-to 8W Terminals (according to Eirene)	•TETRA works in 400 MHz, requiring less than half of the base stations than needed with GSM-R •TETRA spectrum efficiency is double that of GSM-R •Up-to 10W terminals
Seamless handover: Eirene estimation to be confirmed through user trials, 300 mseg	Ok	Ok
-Network registration delay **-Connection Establishment delay**	- 95% <30sg - Emerg < 2s Others < 10s	- Always < 1s - Always average of 300ms

Conclusions

- Mobile Digital Radio is dominant in Transport today

- TETRA is the most implemented technology

- TETRA is suitable to support exploitation in Metros (Manual or Automated)

- TETRA may be a real alternative for the GSM-R sub-system in a railway network based on ERTMS

Some Teltronic references

Teltronic has real experience in working with different train manufacturers, integrators and signalling providers:

ETRA – Valencia Railways, Alicante Tramway, Spain
SAMPOL – Mallorca Metro, Spain
ALSTOM, CAF, ABERTIS – Barcelona Metro Line 9, Spain
METRO MADRID, CAF, ANSALDOBREDA – Madrid Metro, Spain
COBRA, ETRA – Madrid Light Trains, Spain
ALSTOM – Parla Tramway, Spain
ALSTOM – Mexico D.F. Metro Line 12, Mexico
CYS GROUP – Mexico D.F. Metro Lines 2 and B, Mexico
SUPERVIA – Rio de Janeiro Railway, Brazil
EFACEC – Constantine and Oran Tramways, Algeria
EFACEC-IKUSI – Tenerife Light Rail, Spain
RUSSIAN RAILWAY – Moscow-St.Petersburg line, Russia
SIEMENS – Santiago Metro, Lines 4 and 4A, Chile
SIEMENS – Algiers Metro, Algeria
THALES - Buenavista-Cuautitlán, México D.F., Mexico
T-SYSTEMS – Nuremberg Metro, Germany
T-SYSTEMS - KÖR Tramways, Germany

Some pictures of real projects

Barcelona Metro (CAF-ALSTOM)

Barcelona Metro (CAF-ALSTOM)

Mallorca Metro (CAF)

Madrid Metro (CAF)

Madrid Metro (CAF)

Nuremberg Metro (Siemens)
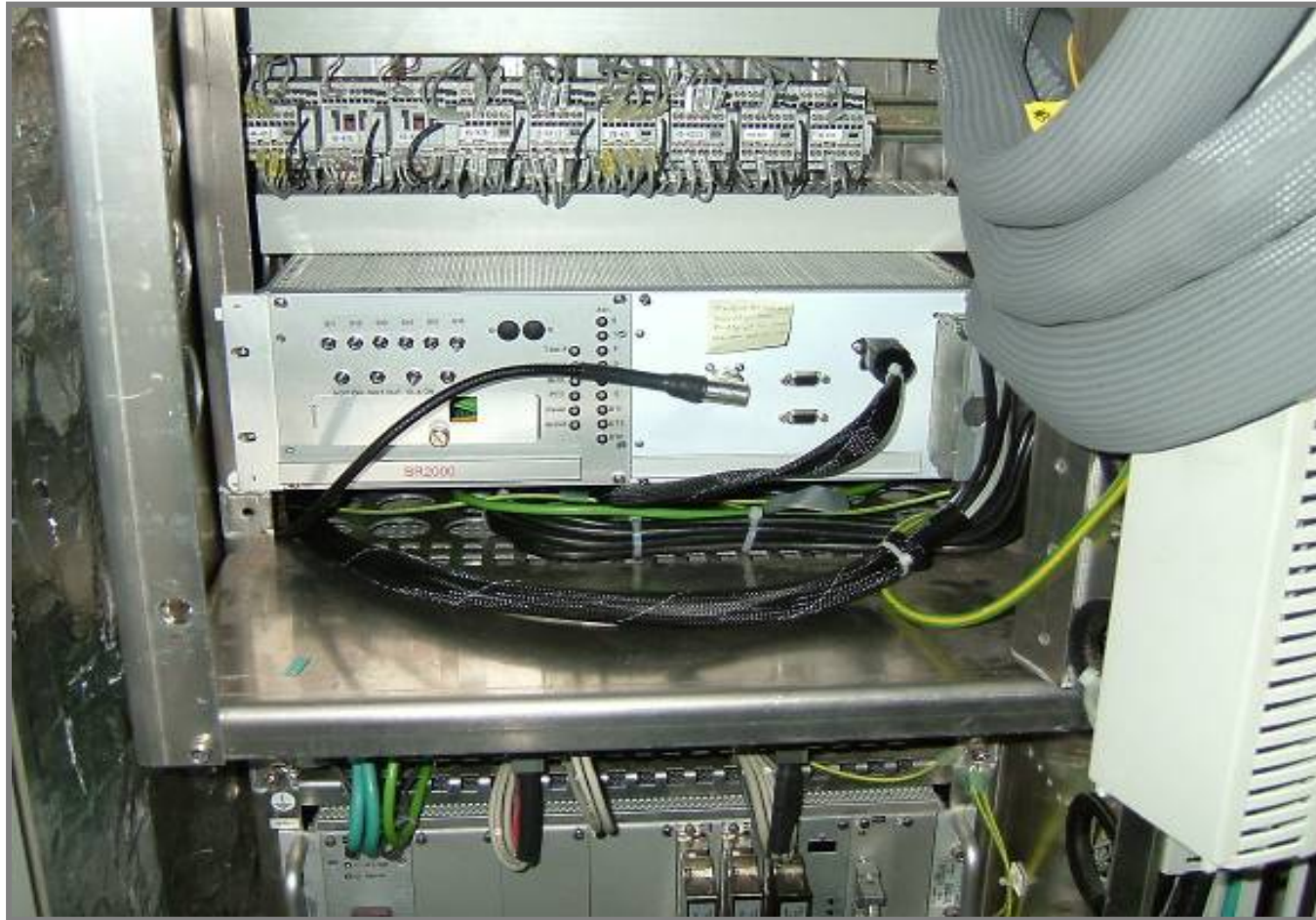
Santiago Chile Metro (Siemens)

Tenerife Light Train (Alstom)

Mexico D.F. Metro (CAF)

Felipe Calderón, President of Mexico, driving a train. TETRA console on the left

Thank you for your attention!

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