TETRA Advantages for Transportation

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One Platform, Multiple Technologies: TETRA, P25, Wireless Broadband
Sheraton Grand, Sacramento CA
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How does TETRA comply with basic requirements?

- Based on an international standard.
- Proven effectiveness in the performance of mobile communication networks currently in operation.
- Profitability and economic viability in construction and operation.
- Standard components of the communication system (open and multi-vendor market).
- Services especially adapted for railway needs and support for basic radio transmission systems currently in operation.
- Integration of railway services in a unique communication network.
- High level of reliability and availability, quality of communications for train speeds up to 500 Km/h (voice and data).
- Capability for easy integration of new future services.
Frequency band and spectrum efficiency

- TETRA operates in frequency bands from 300 MHz and higher. Other technologies, as for example, GSM-R, operate in the 900 MHz and 1800 MHz bands. It requires many more base station repeaters than TETRA to obtain the same coverage.
- **Savings not only in radio equipment, but also in civil engineering (buildings/shelters, towers, etc...)**
- TETRA is four times more efficient using the spectrum than GSM-R. It provides 4 channels in a bandwidth of 25 KHz, while GSM provides 8 channels in 200 KHz
- **The use of the spectrum, which is a very limited resource today, is clearly optimized with TETRA**

Technology usage profile

- GSM-R (based on GSM) was developed for mobile telephony. The infrastructure cost is supported by millions of subscribers.
- TETRA was initially created for low density user private systems, with a usage profile closer to the railway system requirements.
- **TETRA Technology is much more cost-efficient.**
100% Ethernet / IP architecture

<table>
<thead>
<tr>
<th>100% Ethernet / IP</th>
<th>Advantages</th>
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<tr>
<td>All modules can be duplicated to reach complete redundancy.</td>
<td>A system completely failure tolerant. Maximum reliability.</td>
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<td>All elements in the system can be freely distributed.</td>
<td>The transport network can use any kind of technology.</td>
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<td>The control nodes are not need to be geographically centralized.</td>
<td>Failure points are avoided.</td>
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<td>Optimized method for packet data transmission through the transport network.</td>
<td>Bandwidth requirements between SCNs and SBSs are reduced.</td>
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<td>Standard network equipment</td>
<td>Reduced obsolescence risk and reduced costs.</td>
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<td>Standard maintenance IP services</td>
<td>Standard tools: FTP, SNMP, TELNET, HTTP</td>
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TETRA: Additional features (III)

Standard TETRA functionalities applicable for use in railway networks:

- Fleet and Group management
- Group calls
- Broadcast calls
- Fast call set-up → always <1 sec (EIRENE requirement <8.5 sec)
- Priority management (up to 15 priority levels)
- Emergency calls
- Data services:
  - Packet Data service
  - Circuit Mode Data
  - Status messages
  - Short Data service
- Dialing and Addressing services
- Dynamic Group Number Assignment
- Ambience Listening call (driver cabin monitoring)
- Duplex calls (useful for hands-free mode)
- Direct Mode (useful for “shunting” operations)
Interoperability between networks

- TETRA is the most extended technology for public safety networks.
- Public Transport → Today, it is a high risk scenario.
- The usage of the same technology for railway communications will support an efficient and successful operation in crisis and emergency situations.
Highlighted aspects in our products

**NEBULA**
- Top-level features
  - Safety and Security
  - Availability
  - Redundancies
  - Connectivity, etc...
- Easy and low-cost installation and maintenance ➔ GPS is not required, internal SYNC board provides synchronization
- SDM functionality for advanced location services (optimization of TETRA resources: up to 1500 terminals per minute)
- MBS (Mast Base Station) to avoid Cell Enhancers
- Video monitoring applications within the trains (broadband need) ➔ Integration of TETRA and Broadband infrastructures

**RTP-Series + Console**
- On-board equipment with wide range of options to be adapted to different customer requirements.
- Railway specific applications:
  - Voice communications.
  - Interaction with TCMS (Train Control Management System) for remote control and alarms.
  - Interaction with Public Address systems.
  - Interaction with Intercom systems.
  - Interaction with Passenger Information System
  - Location services by beacons or GPS

**CeCoTRANS**
- CeCoCo licence specially adapted for a rail line operation management:
  - Line synoptic for train location
  - Voice and Data communication management

**Design**
- Railway normative compliance
- Design internal procedure prepared to comply with RAMS
Felipe Calderón, president of Mexico, driving a TETRA-equipped train in Mexico City

Overview of Transportation references
Transport Cases

- **Rail systems**
  - Moscow - St. Petersburg Railway, **Russia**
  - FGV Generalitat de Valencia Railways, **Spain**
  - Santiago Chile Underground, **Chile**
  - L9 of Barcelona Underground, **Spain**
  - Palma de Mallorca Underground, **Spain**
  - Algiers Underground, **Algeria**
  - Oran and Constantine Trams, **Algeria**
  - Line B and Line 12 of Mexico City Underground, **Mexico**
  - Supervía, Rio de Janeiro Railways, **Brazil**

- **Buses**
  - TMB Metropolitan Transport of Barcelona, **Spain**
  - Transmilenio. Buses of Bogotá, **Colombia**
  - NJ Transit Pilot, **USA**
Moscow - St. Petersburg Railway, Russia

- 51 SBS with 4 carriers each.
- 2 SCN with several gateways.
- **Redundancy** in the management and control systems.
- **Recording of all communications.**
- Monitoring systems according to **SORM** specifications.
- **Phase 1**: 2 SCN and 19 SBS.
- **Phase 2**: additional 500 Km (total of 800 Km), with 32 SBS.
L9 of Barcelona Underground, Spain

46 Km., 51 stations and 90 million passengers/year
L9 of Barcelona Underground, Spain

- **Total coverage:** SCN and network infrastructure installation, **36 SBS**.
- **Compact solution** (RTP on-board equipment) able to connect to train management systems:
  - Public address / intercom / passenger information systems (PIS).
  - Voice communications control.
  - Monitoring and remote control of rolling stock.
- **Data capacity**, train commands management from a control center and vice versa (remote control, alarms, timetables information, station, incidents, etc...).
L9 of Barcelona Underground, Spain

TETRA Console in ALSTOM trains
L9 of Barcelona Underground, Spain

Dual TETRA-VHF rack integrated in ALSTOM trains
“We have worked together for a long time, and TELTRONIC has always known how to be an excellent radio communications systems supplier” says Lourdes Pérez Argemi, TMB radio-telephony projects manager.
Lines B & 12 of Mexico City Underground
Lines B & 12 of Mexico City Underground

- TETRA solution: 1 SCN, 6 SBS and 2 management systems
- Continuous and optimized coverage
- Network connectivity by dedicated optical fiber.
- **CeCo-TRANS** system: Communications module and train synoptic.
- **SDM** application for real-time train monitoring (balize, train ID, state of alarms, etc...)
- Excellent on-board equipment
- Guaranteed security: Immune to noise, inclusion and unauthorized listening.
“The radio-telephony solution of Line B of the Mexico DF Underground, consolidates Teltronic’s leadership in integral communications technologies for rail projects. The perfect integration among the different Teltronic products is the key to success for the implementation of a solution adapted to specific requirements in record time”, says Javier Ortega, Line B Project Manager.
Santiago de Chile Underground
The TELTRONIC solution proposed by SIEMENS is based on a network with:

- 1 SCN expandable for the rest of the lines and 7 SBS with 1 carrier each.
- 4 cell-enhancers for coverage outside the tunnels.
- 120 on-board terminals, 10 fixed terminals and 5 Line Dispatchers.

The keys to success of the solution are:

- **Different groups**: L4, L4A, workshops...
- **Voice communications**: From the OCC (Operation Control Center) to one (Selective), several or all mobiles.
- **Data communications**: Train numbering, security/safety alarm, power shut-off.
Algiers Underground

- Project lead by Siemens Transportation Systems France.

- First underground line in Algiers:
  
  - 9 Km.
  - **10 stations** (the extension of this line and other additional lines are already planned). 9 indoor and 1 outdoor stations.
  - 1 SBS to cover each station, and another SBS covers the parking area (outdoor).
Oran and Constantine Trams (Algeria)

The solution consists of:

- 3 SBS/line with optimized SDM and 30 special terminals for trains.
- DT-410, HTT-500 and NMS client.
- **Redundancy**: CNC, NMS and power supply.
- **RAM** plan.
54 Km. from Mercado to Altea (Alicante - Denia line):

- **7 SBS** to cover outdoor zones
- 6 cell-enhancers to cover 8 tunnels
- On-board equipment integration
Palma de Mallorca Underground

- 7 SBS to cover outdoor and indoor zones.
- 2 system control nodes (SCN).
- Control Center.
- On-board terminals.
Supervía – Rio de Janeiro Railways, Brazil

- **7 SBS** and 1 SCN.
- On-board terminals.
- 1 Control Center with 6 operators.
Transmilenio. Bogotá Buses

1621 buses, 1.4 million passengers/day
Previous problem: billing, security, traffic jams and accidents.

Integrated Public Transport System

GPS positioning and fleet regulation of **1500** buses in 20 sec.

MDT-400 integration in each bus.

CeCoCo, 7 operators: fleet regulation, bus control, supervisors.

Ticket inspectors equipped with HTT-500.

Emergency network (police, fire brigade, ambulances).

356 information panels at bus stops.
“Thanks to the new communications system, the security perception index increased 17.89 points in November 2008, and 70.54% of the passengers assure that they feel safer due to the new infrastructure”.
Barcelona Metropolitan Transport

1300 buses, positions updated in 20-30 sec.
Barcelona Metropolitan Transport

- TETRA solution for the positioning and regulation of a fleet of 1300 buses.
- Complete coverage of Barcelona: 9 SBS.
- STATUS and SDS messages.
- Voice communications with the Control Center.
- MMI integrated with the driver equipment.
- Interaction to the Passenger Information System.
- GPS: Global Positioning System.
- Excellent ROI solution (Return on Investment).
- Passenger security.
Barcelona Metropolitan Transport

Number of daily calls

Traffic of Line 15:

- GPS information polling every 20-30 seconds
- 100,000 SDS per day
- 3 million SDS per month since 2002
- 100% availability
NJ Transit Pilot

The first TETRA LMR pilot network in the US
NJ Transit Pilot

- Two-site network in 800MHz band
- Mobile and portable terminals with GPS
- Integration with third party CAD system
- Integration with legacy VHF system.
- FCC type-acceptance obtained for all TETRA equipment.
On-board equipment

- SBS 1
- SBS 2
- SBS n-1
- SBS n

Coordination and Control Centers

Standard terminals

On-board equipment

TETRA infrastructure

ISDN

3rd party applications

IP NETWORK

N2A
Integration of ERTMS with TETRA
ERTMS Safety Levels

- **ERTMS Level 1**
  - Sporadic data transmission by using Eurobalises / Euroloop.
  - Radio system used for voice.

- **ERTMS Level 2**
  - Continuous data transmission by using the radio system (monitoring and control).
  - Radio system used for voice and data.

**TETRA integration:**

- Immediate
- Connection with signaling system
Radio system architecture

- Interfaces with signaling system:

  - Interface between the on-board radio equipment and DMI (Driver Machine Interface)
  - Interface between the on-board radio equipment and the on-board application $\rightarrow I_{GSM}$
  - Interface between the TETRA infrastructure and the wayside application (RBC) $\rightarrow I_{FIX}$

Since the ERTMS system is designed as a layered model, the integration of the radio equipment can be carried out very easily without affecting the rest of the system. The focus would be in the interfaces:
Basic approach for integration: ERTMS Level 1

- To integrate a TETRA modem in the ERTMS cab-radio
- To develop the interface with the DMI consoles (based on AT commands)
- To adapt the TETRA serial protocol AT commands to the commands required for communication with the ERTMS control module (similar to the protocol used today with the GSM-R radios - IGSM)

In this scenario, the actions to be performed with the radio are limited (mainly voice).

Therefore, the protocol to be implemented will be a subset of the full interface IGSM.
Basic approach for integration: ERTMS Level 2

- To integrate a TETRA modem in the ERTMS cab-radio.
- To develop the interface with the DMI consoles (based on AT commands)
- To adapt the TETRA serial protocol AT commands to the commands required for the communication with the ERTMS control module (similar to the protocol used today with the GSM-R radios - IGSM)
- To develop the IFIX protocol to interface with the infrastructure at wayside.

In this scenario, security and safety data are transmitted through the radio system.

Therefore, the complete AT commands protocol (IGSM) to interface with the Euroradio module will be implemented.
Questions..?