TETRA, The best communication platform for the railway transport

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http://www.tetramou.com/uploadedFiles/Files/Presentations/INDIA06_8_ALBlasco_Railways.ppt
TETRA vs. GSM-R
## TETRA vs. GSM-R

<table>
<thead>
<tr>
<th>Item</th>
<th>TETRA</th>
<th>GSM-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETSI Standard availability</td>
<td>Full ETSI status December 1995</td>
<td>Early 1997</td>
</tr>
<tr>
<td>Modulation</td>
<td>Pi/4 DQPSK</td>
<td>GMSK</td>
</tr>
<tr>
<td>Channel bandwidth</td>
<td>25 kHz &gt;&gt; 4 channels.</td>
<td>200 kHz &gt;&gt; 8 channels.</td>
</tr>
<tr>
<td>Frequency Bands (MHz)</td>
<td>380-400, 410-430, 450-470, 806-821/851-866</td>
<td>876-880/921-925</td>
</tr>
<tr>
<td>Guard band for –60dBc (kHz)</td>
<td>25</td>
<td>300</td>
</tr>
<tr>
<td>Net data per timeslot (kbit/s)</td>
<td>7.2</td>
<td>22</td>
</tr>
<tr>
<td>Typical Cell size in rural</td>
<td>10 to 25 km</td>
<td>5 to 10 km</td>
</tr>
<tr>
<td>Scalability</td>
<td>No small network capability</td>
<td>from single site to nation-wide network.</td>
</tr>
</tbody>
</table>

Significantly less Base Stations are required with TETRA
In terms of frequency usage, it can be seen that TETRA is 4 times more efficient than GSM-R.
# TETRA vs. GSM-R

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<tr>
<td>Backbone bandwidth per Base Station</td>
<td>&lt;64 kbps per carrier</td>
<td>At least E1 circuit (30 channels)</td>
</tr>
<tr>
<td>BS Fall Back</td>
<td>Y</td>
<td>-</td>
</tr>
<tr>
<td>SUPPLEMENTARY SERVICES:</td>
<td>Y</td>
<td>-</td>
</tr>
<tr>
<td>Dynamic Group Number Assignment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Call authorized by dispatcher</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambience and Discrete listening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SECURITY: Authentication of the Infrastructure, OTAR, Disabling of stolen radios, End to End Encryption</td>
<td>Y</td>
<td>-</td>
</tr>
<tr>
<td>DIRECT MODE: Voice &amp; Data, Air Interface Encryption, E2EE, DMO Gateway &amp; Repeater</td>
<td>Y</td>
<td>-</td>
</tr>
<tr>
<td>CALL SETUP TIMES:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency calls</td>
<td>&lt; 1 s</td>
<td>&lt; 300 ms</td>
</tr>
<tr>
<td>All low priority calls</td>
<td>&lt; 10 s</td>
<td>&lt; 500 ms</td>
</tr>
</tbody>
</table>

A lot of important features only available in TETRA
TETRA Railways Solution
In railway the use of a fiber link, with Ethernet/IP connectivity is a new trend

⇒ Asynchronous links - Layer 2: Railway application

- Ethernet rings over optical fiber
  - Direct Ethernet connection to optical fiber
  - Up to 100 switches
  - Up to 85 Km between two consecutive switches
  - 300 ms to change loop sense in a fail situation

Physical Connections:
- Optical fiber
- Ethernet, 100Mbps
Link options between SCN and SBS

- **Synchronous links with SNI (Site node interface)**
  - SNI G.703/G.704 (E1) 32 channels of 64 kbps
  - SNI V.35 Up to 2 Mbps
  - SNI S/T (ISDN BRI) 2B+D 128kbps
  - SNI G.703 Co-directional 64 kbps used in radio links

- **Asynchronous Links Layer 2**
  - VLAN Switches.
  - VLAN Service provider (VPN/MPLS)
  - WLAN , WIMAX

- **Asynchronous Links Layer 3**
  - IRB Integrated Routing & Bridging
  - L2TP/UTI Level 2 Tunnelling Protocol

It is possible to use standard low level routers. For example from CISCO
Railways train equipment

**USUAL REQUIREMENTS**
- Half-duplex and duplex **voice calls (individual, group)**
- **Emergency Key**.
- Status and short **data transmission**.
- **MMI console integrated** on driver’s dashboards.
- **Interaction** with passenger information system.
- **Interaction with on-board train computer**.
- **Integration** of multiple communication subsystems.
Integrated solution

**MMI console**

- Display
- Antivandalic Keypad
- LED indicators
- Auxiliary buttons
- Handset
- Hands free audio system

**Communications rack**

- CONTROL MODULE
  - VHF analog radio
  - TETRA radio unit
- AUDIO INTERFACE
- To TETRA antenna
- To VHF antenna
- To passenger audio system
- To MMI console #n

**Terrestrial Trunked Radio - The global standard for professional mobile radio communications**
Railway train equipment

Example: **BASIC CONFIGURATION (1 Rack & 2 consoles)**

- MMI console
- Communications rack (TETRA + analog VHF)
- Train’s main control system
- MMI console
Railway train equipment

Example: REDUNDANT CONFIGURATION (2 Rack & 2 consoles, more than 200 meters between them)
SOFT MIGRATION

To enable a soft migration, a dual terminal rack is a recommended approach:
- Migration of lines are step by step, and trains can be used on old & new lines.
- In the migration phase the analogue system is used as a redundant system.

Different technologies:
- TETRA - Conventional
- TETRA - MPT-1327
- ...
High level of customisation required to adapt to:

- Different train manufacturers (CAF, Alstom, AnsaldoBreda, Siemens, …)
- Different power supplies (+110v DC, +72v DC, +24v DC)
- The operational procedures of each customer.
- The documentation required in each project.
- The place & size available for the products.
- Different MMI requirements.
Case Study

Moscow – St Petersburg Railway line
Case study

- TETRA and GSM-R systems was tested at Sverdlovsk Railway testing zone in 2002-2003
- TETRA was approved as a standard for digital RC development by Scientific and Technical Council of Ministry of Railways on June 24, 2003
- Department of communications of Russian Railway made decision to deploy TETRA system in 2004.

The Russian Railway is the first one in the world to take a national decision to adopt TETRA instead of GSM-R. Starting with the Moscow-St. Petersburg 800 km line
TETRA vs. GSM-R evaluation and decision

Russian Railway requirements:

- Highest possible level of fault tolerance.
- Internal network management. No interconnection with PSTN.
- Assured connection for less than 0.5s.
- Number of specific railway requirements.
- Trains that allow the communication through TETRA & VHF conventional
Infrastructure

- S-300 was selected as the TETRA system to be deployed.
- S-300 is a local infrastructure, in technological partnership between TELTRONIC (NEBULA) and MICROTEST.
- The complet project consists in the installation of 51 Base Stations (SBS) with redundant configuration plus 2 SCN (System Controller Node).
- Locally developed, line dispatching facilities.
- SORM specifications to allow a comprehensive call monitoring capability.
- Teltronic’s russian partners Globalsvyaz, main contractor, and Microtest, engineering, will build, assemble and commission the system in the field.
Future Trends

Improve data applications.
(The right information at the right time)
• Train monitoring and control
• Information display systems
  – Text messaging
  – AVLS
• Video / image transmission
• Use of TETRA as a redundant Railway Security System
TETRA, The best communication platform for the railway transport

Thank you

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