On-board multichannel gateway

The onboard gateway provides extended services with the aim of further improving the user experience as well as optimizing operating costs.

The main services provided by the on-board gateway are:

- Automatic handover between satellite and terrestrial wireless technologies (e.g., GPRS, UMTS, Wi-fi, or WIMAX) in order to maximize service coverage to trains when entering into tunnels, urban areas, or covered rail stations.
- Performance enhancement functions (protocol accelerator) for optimizing the use of bandwidth capacity and improving the time of response of applications.
- Service management functions, for improving the overall quality of service by performing on-line monitoring and SLA enforcement of traffic.
- Access and security management functions, in order to allow: the use of a common authentication process (e.g., SLA profiling);
  - Authorization management of mobile terminals not only in the satellite network but in other networks (e.g., Wi-Fi hotspots, UMTS, GPRS, ...);
  - Traffic flow control quality;
  - Accounting management functions, to allow the collection of details of each IP session modeled (e.g., Telephony Call Detail Record (CDR)).
  - Support of payment methods such as smart cards, credit cards, and electronic checks (e.g., EFT, credit card, and domestic with the Access Control System from a business logic point of view.

SR40 IP modem
- IF frequency
  - 70 MHz +/- 20 MHz
- Clock reference
  - 10 MHz (internal or external)
- Roll-off factor
  - 0.22, 0.3, 0.4

DS-SCPC SPECIFICATION
- User data rates
  - 64 kbps – 2048 kbps
- Modulation
  - QPSK
- FEC (selectable)
  - Convolutional 1/2 or 3/4 Reed-Solomon
- Performance
  - Meets IESS308

FH-SCPC SPECIFICATION
- User data rates
  - 8 kbps – 256 kbps
- Spreading factor
  - 2, 4, 8, 16, 31, 63 and 127
- FEC (selectable)
  - Convolutional 1/2 or 3/4 Reed-Solomon
- BW
  - 20 kHz – 10 MHz
- SW jamming detector
  - Yes

CDMA SPECIFICATION
- User data rates
  - 8 kbps – 1522 kbps
- Spreading factor
  - 31, 63, 127
- Pilot FEC (fixed)
  - Convolutional 1/2 Reed-Solomon
- User FEC (selectable)
  - Convolutional 1/2 or 3/4 Reed-Solomon
- BW
  - 500 kHz – 5 MHz
BROADBAND TO TRAINS

BROADBAND TO TRAINS VIA SATELLITE

System overview

The system integrates the entire control centre and the fleet of railway mobile terminals (RMT). The railway network is a two-way communications system, which uses a very efficient DAMA access scheme in order to optimise the use of satellite bandwidth. Terminals are automatically allocated bandwidth, depending on their actual needs, on a real-time basis by the control centre.

The hub station handles the network in a fully automated mode and provides extended interfaces to the Internet backbone.

The system manages three types of satellite technologies:

- Industry standard DVB-S for the outbound link (hub to terminals), which allows easy communications with existing satellite operators and networks. However, standard open DVB-S solution is also available for the outbound link.
- Spread-spectrum CDMA for the inbound link (terminals to hub), since it is usually necessary when using small mobile antennae and broadband user data rates. Terminal antennae can be coexisting with other CDMA and/or DVB-S terminals to overcome off-axis radiation necessary when using small mobile antennae. The CDMA solution is also available for the outbound link.
- Single channel per carrier (SCPC) both for the inbound and outbound links, consisting of either CDMA or DVB-S terminals. It can be used in spread or nonspread spectrum mode.

A low profile elliptical antenna is used from the mobile terminals as a single-platform SR40 IP modem which provides a data communications channel.

Railway mobile terminal

Low profile elliptical antenna

Indoor low profile antenna solution is characterized by:

- Fully independent installed system two switched polarization adjustment
- Fully automatic acquisition and tracking, with no need for operator intervention
- Combination of microwave tracking and inertial stabilization
- Fast acquisition after RF signal blockage (e.g., stations, tunnels, ...)
- Easy international regulation compliance

The terminal has been designed using the software radio paradigm. Therefore, different configurations are available, ranging from a single unit (e.g., stations, tunnels) all the way up to a complete network (e.g., trains, coaches, stations, tunnels). Such flexibility provides:

- Minimum satellite bandwidth occupation
- Full integration into the railway network
- High system efficiency for complete real-time network management
- Compatibility with off-axis international regulations

Highlights

- Innovative and easy-to-deploy system that provides passengers an Internet access and multimedia broadcast services
- Can be used by railway operators for operations-related applications
- Can be used in the railway environment with its intensive vibrations, shocks and temperature fluctuations
- The CDMA technology allows secure small antennae and broadband user data services
- Rail-on-hoof radio-telecommunications technology currently used within the high demanding military environment
- Multiple modality of public access platforms (BPMS, GSM and multimedia platform) for international regulations and multimedia services
- Fully compatible with off-axis international regulations
- Fully compliant with IESS-308/309 SCPC and spread SCPC in a single platform
- Option for controlling the entire network from a remote computer
- SR40 Modem (CDMA, DVB-S in a single platform)
- Virtual private network (VPN) over IESS-308/309

Train acceleration: 5.5 m/s²
Train speed: 300 km/h
Yaw: 1 deg/s

Satellite system

GEO

Antenna type
Low profile elliptical antenna

Operation
Interim

Optimum

Peak

SNR

Minimum

EIRP max.
44.2 dBW, ITU-R S.728-1

Minimum G/T
14 dB/ºK

Antenna polarization
Linear

Cross-polar –1dB

EIRP max.
44.2 dBW, ITU-R S.728-1

Minimum G/T
14 dB/ºK

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EIRP max.
BROADBAND TO TRAINS VIA SATELLITE

Introduction

Nowadays train passengers deserve Internet access and multimedia broadcast services.

System overview

The system is composed of the central control centre and the fleet of railway mobile terminals (RMT). The satellite network is a two-way two-hop system, which ensures an easy deployment and uses a very efficient COMSAT access scheme in order to optimise the use of satellite bandwidth. Terminals are automatically allocated, reconfigured, depending on their traffic levels, on a real-time basis by the control centre.

The railway mobile terminals (RMT) offer a fully automatic mode and provides Internet access to the train passengers.

The system manages three types of satellite technologies:

- **Inmarsat Standard DSMR-S**: for the inbound link (hub to terminals), which allows for voice communications, data services and multimedia broadcast services.
- **Inmarsat standard DSMR**: is also available for the outbound link.
- **Spread-spectrum CDMA**: for the inbound and outbound links, since it is usually necessary when using small mobile terminals to overcome off-axis radiation necessary when using small mobile terminals.

Terminals are automatically configured when passing through a gateway, in a centralised way at the hub station.

The railway terminal offers all capabilities and functional capabilities of the core network. The railway terminal offers all capabilities for complete real time network management and is embedded as an integral part of the hub station.

The core of the terminal is the high-performance SR40 IP modem which provides a data communications channel. The modem has been designed using the software radio paradigm. Therefore, different configurations are available depending on the specific application. Different modulators are available: COMSAT standard IESS-308/309 QPSK, and spread spectrum. Such flexibility provides:

- Minimum satellite bandwidth required
- Easy international regulation compliance
- Broadband capabilities

Railway mobile terminal

**Low-profile antenna architecture**

Ideal low-profile antenna solution is characterized by:

- Fully independent installed system, two separate frequency bands, with no need for special link (terminals to hub), since it is usually necessary when using small mobile terminals to overcome off-axis radiation necessary when using small mobile terminals. The satellite network is composed of the control centre and the fleet of railway mobile terminals (RMT). The satellite network is a two-way two-hop system, which ensures an easy deployment and uses a very efficient COMSAT access scheme in order to optimise the use of satellite bandwidth. Terminals are automatically allocated, reconfigured, depending on their traffic levels, on a real-time basis by the control centre.

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**Railway mobile terminal**

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- Minimum satellite bandwidth required
- Easy international regulation compliance
- Broadband capabilities

![Equipment Specifications](image-url)
BROADBAND TO TRAINS

BROADBAND TO TRAINS VIA SATELLITE

Introduction

Nowadays train passengers deserve Internet access and multimedia broadcast services.

System overview

The system comprises:
- Train aboard central control and power unit: the system is a single虽说unit that covers the needs of the train. It uses a very efficient DAMA access scheme in order to optimise the use of satellite bandwidth. Terminals are automatically allocated and controlled depending on their actual needs, on a real-time basis by the central control.
- Each train car is equipped with a full multimedia module and provides Internet access for its passengers.

The system manages three types of satellite technologies:
- Industry-standard DVB-S for the outbound link (hub to terminals), which allows to reuse communications satellites.
- Broadband capabilities for the outbound link (hub to terminals) and provides Internet access for its passengers.
- Spinal spectrum DAMA for the inbound link (terminals to hub), since it is usually necessary when using mobile technology to optimise the use of bandwidth and communication international regulations.
- Single channel per carrier (SCPC) both for the inbound and outbound links, consisting of two DAMA depending on the specific application. Different configurations are available for complete real time network management.

Highlights

- Innovative and easily deployable system that provides Internet access and multimedia broadcast services.
- Can be used by railway operators for operational related applications.
- Terminal offers all capabilities demanding military environment.
- High performance SR40 IP modem which provides bandwidth interactive services and multimedia broadcast services to train passengers.
- The satellite network offers all capabilities demanding military environment.
- Fully automatic acquisition and tracking terminals, with high speed for tracking environments.
- Combination of microwave tracking and inertial stabilization.
- Fast re-acquisition after RF signal blockage.
- Combination of microwave tracking and inertial stabilization, with high speed for tracking environments.
- Broadband capabilities.
- Easy international regulation compliance.
- Broadband capabilities.

Railway mobile terminal

Low profile antenna solution

Indoor low profile antenna solution is characterized by:
- Fully independent installed system two antennas in parallel adjustment.
- Fully automatic acquisition and tracking terminals, with high speed for tracking environments.
- Combination of microwave tracking and inertial stabilization.
- Full access of RF signal blockage (e.g., stations, tunnels...)
- More to easy transparent interference due to the railway overhead wire.
- 

Railway mobile terminal

<table>
<thead>
<tr>
<th>Low profile antenna characteristics</th>
<th>10 dB EIRP at the rail end</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite type</td>
<td>Intelsat 30 (100 MHz)</td>
</tr>
<tr>
<td>Data rate</td>
<td>120 Mbps (SSPA)</td>
</tr>
<tr>
<td>Modulation</td>
<td>ITU-R S.728-1 standard</td>
</tr>
<tr>
<td>Antenna type</td>
<td>Double reflector Cassegrain</td>
</tr>
<tr>
<td>Cross-polar –1dB</td>
<td>30 dB</td>
</tr>
<tr>
<td>Gain</td>
<td>&gt;36.5 dBi (13.75 GHz)</td>
</tr>
<tr>
<td>Minimum G/T</td>
<td>&gt;35 dBi/ºK</td>
</tr>
<tr>
<td>EIRP max.</td>
<td>44.2 dBW, ITU-R S.728-1</td>
</tr>
<tr>
<td>Antenna pattern</td>
<td>Extended Ku band range</td>
</tr>
<tr>
<td>Polarisation</td>
<td>Linear</td>
</tr>
<tr>
<td>Tx: 13.75 to 14.5 GHz</td>
<td>Rx: 10.7 to 12.75 GHz</td>
</tr>
<tr>
<td>Neutral: 17º to 62º</td>
<td>Azimuth: ±25º</td>
</tr>
<tr>
<td>±360º</td>
<td>±90º</td>
</tr>
</tbody>
</table>

Railway mobile terminal

| Railways mobile terminal |
| --- | --- |
| Outdoor equipment weight | 1.2 kg |
| Power supply | 110/ 220 V (AC/DC) max. |
| Operative | Permanent IP: +2 to +85 ºC |
| Environmental conditions | −40 to +70 ºC |
| Data and voice link | 2.5 Mbps |
| Modelling & control | GPRS and/or UMTS |
SPACE

BROADBAND TO TRAINS VIA SATELLITE

Satellite communications, earth observation, navigation and positioning and control stations

Indra company.com

On-board multichannel gateway

The onboard gateway provides extended services with the aim of further improving the user experience as well as optimizing operating costs.

The main services provided by the on-board gateway are:

- Automatic handover between satellite and terrestrial wireless technologies (e.g., GPRS, UMTS, Wi-fi, or WiMAX) in order to maximize service coverage to trains when entering into tunnels, urban areas, or covered rail stations.
- Performance enhancement functions (protocol accelerator) for optimizing the use of bandwidth capacity and improving the time of response of applications.
- Service management functions, for improving the overall quality of service by performing on-line monitoring and SLA enforcement of traffic.
- Access control and security management functions, in order to provide access to authorized users based on their subscription and service agreement (e.g., SLA profiles).
- Authorization management functions, in order to allow the collection of details of each IP session monitored (e.g., temporary Call Detail Records (CDRs)).
- Accounting management functions, to allow the realization of revenues on each IP session monitored (e.g., temporary Call Detail Records (CDRs)).
- User data rates (64 kbps – 2048 kbps).
- Modulation (QPSK).
- FEC (selectable) Convolutional 1/2 or 3/4 Reed-Solomon.
- Performance Meets IESS308, DS-SCPC SPECIFICATION.

On-board multichannel gateway

- User data rates (12 kbps – 2048 kbps).
- Spreading factor (2, 4, 8, 16, 31, 63, and 127).
- FEC (selectable) Convolutional 1/2 or 3/4 Reed-Solomon.
- BW (20 kHz – 10 MHz).
- FH-SCPC SPECIFICATION.

On-board multichannel gateway

- User data rates (8 kbps – 256 kbps).
- FEC (fixed) (convolutional 1/2 + RS).
- SW jamming detector (Yes).
- CDMA SPECIFICATION.

On-board multichannel gateway

- User data rates (8 kbps – 1522 kbps).
- Spreading factor (31, 63, 127).
- Pilot FEC (fixed) Convolutional 1/2 Reed-Solomon.
- User FEC (selectable) Convolutional 1/2 or 3/4 Reed-Solomon.
- BW (500 kHz – 5 MHz).

On-board multichannel gateway

- Access control and security management functions, for enforcing the validity of sessions based on authorization rules (SLA profiles).
- Authentication management functions, based on standard payment platforms (e.g., Visa, MasterCard).

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- Performance enhancement functions (protocol accelerator) for optimizing the use of bandwidth capacity and improving the time of response of applications.
- Service management functions, for improving the overall quality of service by performing on-line monitoring and SLA enforcement of traffic.
- Access control and security management functions, in order to allow a safe and controlled use of the onboard gateway access rights (SLA profiles).
- Access control management of mobile terminals, not only in the satellite network but also in other networks (e.g.: Wi-Fi hotspots, UMTS, GPRS...).
- Security management functions: to secure the collection of details of each IP session modeled (e.g.: telephony’s Call Detail Record (CDR)).
- Accounting management functions that are connected with the Access Control System from a business-logic point of view.
- Billing functionality, based on standard payment platforms (e.g., VISA cards), and connected with the Access Control System from a business-logic point of view.

**SR40 IP modem**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
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<tbody>
<tr>
<td>IF frequency</td>
<td>70 MHz +/- 20 MHz</td>
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<tr>
<td>Clock reference</td>
<td>10 MHz (internal or external)</td>
</tr>
<tr>
<td>Roll-off factor</td>
<td>0.22, 0.3, 0.4</td>
</tr>
<tr>
<td><strong>SCPC SPECIFICATION</strong></td>
<td></td>
</tr>
<tr>
<td>User data rates</td>
<td>64 kbps – 2048 kbps</td>
</tr>
<tr>
<td>Modulation</td>
<td>QPSK</td>
</tr>
<tr>
<td>FEC (selectable)</td>
<td>Convolutional 1/2 or 3/4 Reed-Solomon</td>
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<td><strong>DS-SCPC SPECIFICATION</strong></td>
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<td>User data rates</td>
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<tr>
<td>Hopping rate</td>
<td>2000 hops/second</td>
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<tr>
<td>FEC</td>
<td>fixed (convolutional 1/2 + RS)</td>
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<td>SW jamming detector</td>
<td>yes</td>
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<td><strong>CDMA SPECIFICATION</strong></td>
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**BS SPECIFICATION**

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<tr>
<td>User data rates</td>
<td>12 kbps – 2048 kbps</td>
</tr>
<tr>
<td>Spreading factor</td>
<td>2, 4, 8, 16, 31, 63 and 127</td>
</tr>
<tr>
<td>FEC (selectable)</td>
<td>Convolutional 1/2 or 3/4 Reed-Solomon</td>
</tr>
<tr>
<td>BW</td>
<td>20 kHz – 10 MHz</td>
</tr>
<tr>
<td><strong>FH-SCPC SPECIFICATION</strong></td>
<td></td>
</tr>
<tr>
<td>User data rates</td>
<td>8 kbps – 256 kbps</td>
</tr>
<tr>
<td>Hopping rate</td>
<td>2000 hops/second</td>
</tr>
<tr>
<td>FEC</td>
<td>fixed (convolutional 1/2 + RS)</td>
</tr>
<tr>
<td>SW jamming detector</td>
<td>yes</td>
</tr>
<tr>
<td><strong>CDMA SPECIFICATION</strong></td>
<td></td>
</tr>
<tr>
<td>User data rates</td>
<td>8 kbps – 1522 kbps</td>
</tr>
<tr>
<td>Spreading factor</td>
<td>31, 63, 127</td>
</tr>
<tr>
<td>Pilot FEC (fixed)</td>
<td>Convolutional 1/2 Reed-Solomon</td>
</tr>
<tr>
<td>User FEC (selectable)</td>
<td>Convolutional 1/2 or 3/4 Reed-Solomon</td>
</tr>
<tr>
<td>BW</td>
<td>500 kHz – 5 MHz</td>
</tr>
</tbody>
</table>