SPACE

BROADBAND TO TRAINS VIA SATELLITE

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

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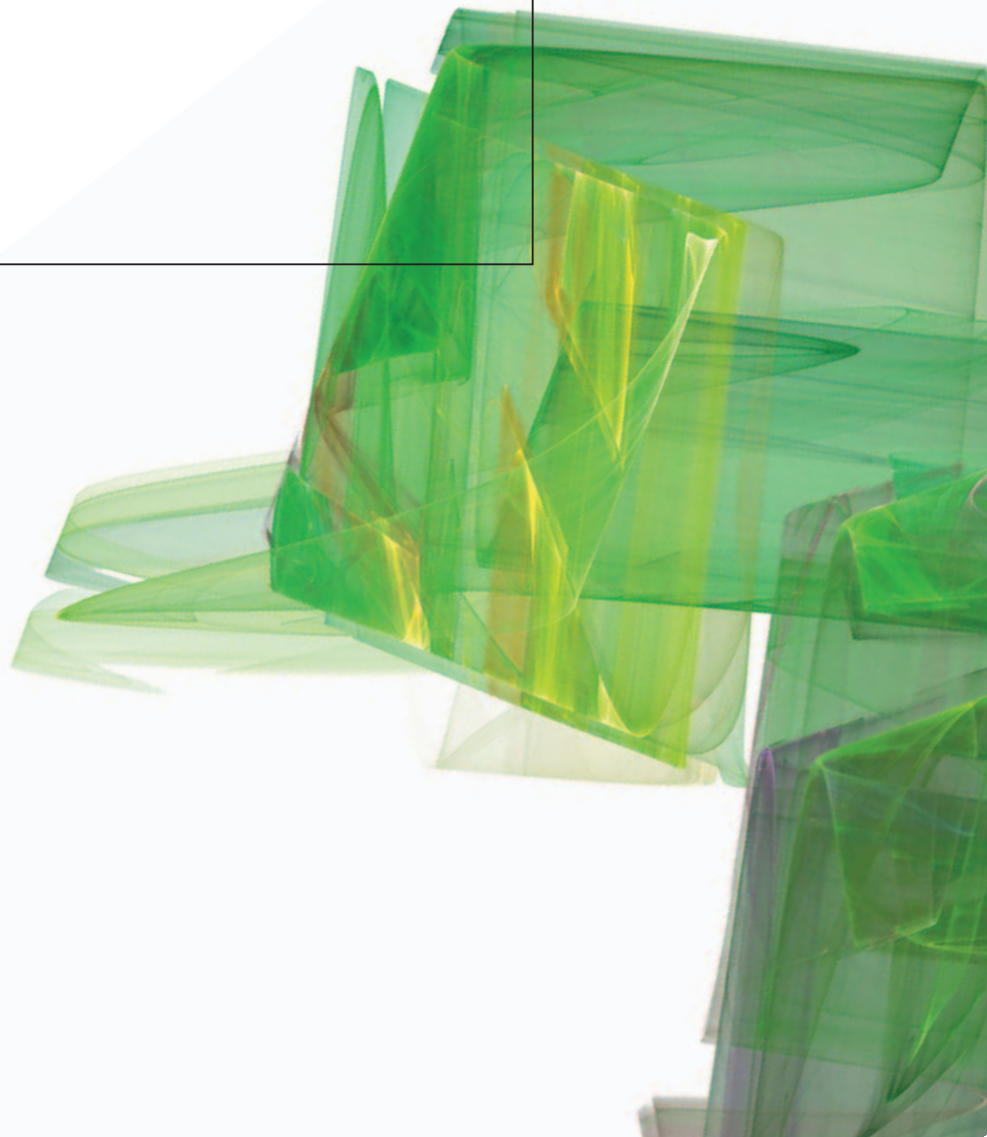


BROADBAND TO TRAINS VIA SATELLITE

Nowadays train passengers deserve Internet access and multimedia broadcast services

Introduction

Broadband to trains is an innovative and easily deployable solution based on satellite communications technology to provide broadband interactive services and multimedia broadcast services to train passengers.

Railway mobile terminal

Low profile elliptical antenna

Indra's low profile antenna solution is characterized by:

- Fully independent stabilized system: two axis plus polarization adjustment
- Fully automatic acquisition and tracking modes, with no need for operator intervention
- Combination of microwave tracking and inertial stabilization
- Fast re-acquisition after RF signal blockage (e.g., stations, tunnels,...)
- Immune to electromagnetic interferences due to the railway overhead wire
- Option for controlling the antenna system from a remote computer

SR40 IP Modem: CDMA Spread Spectrum and SCPC in a single platform

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 without any change of hardware, depending on the specific application. Different modulations are available: CDMA, standard IESS-308/309 SCPC and spread SCPC.

Such flexibility provides:

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

Low profile elliptical antenna	
Extended Ku band range	Rx: 10.7 to 12.75 GHz • Tx: 13.75 to 14.5 GHz
Antenna type	Double reflector Cassegrain
EIRP max.	44.2 dBW, ITU-R S.728-1
Minimum G/T	14 dB/ºK
Gain	>35 dBi (10.7 GHz) • >36.5 dBi (13.75 GHz)
Polarization	Linear
Antenna patern	ITU-R 580-5
Cross-polar -1dB	30 dB
HPA power	Up to 8 W (SSPA)
Stabilizer system	Fully independent
Acquisition & tracking	Automatic
Positioner specifications	Elevation: 17° to 62° • Azimuth: ± 360°
Max. Train motions	Polarisation: ± 90° Roll: ± 10 deg/s Yaw: 1 deg/s Train speed: 300 km/h Train accel.: 5.5 m/s^2

Railway mobile terminal	
ENVIRONMENTAL CHARACTERISTICS	
Outdoor equipment weight	< 110 Kg
Power supply	110 – 220 Vac (800 W max.)
Operation	Remote M&C – via satellite Local M&C
Operational Temperature	-20 to 50 ºC
INTERFACES	
Data (hub and terminal)	IP, RJ45
Monitoring & control	SNMP and serial RS-232

System overview

The system is composed of the control centre and the fleet of railway mobile terminals (RMT). The satellite 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 interfaces to the Internet backbone.

The system manages three types of satellite technologies:

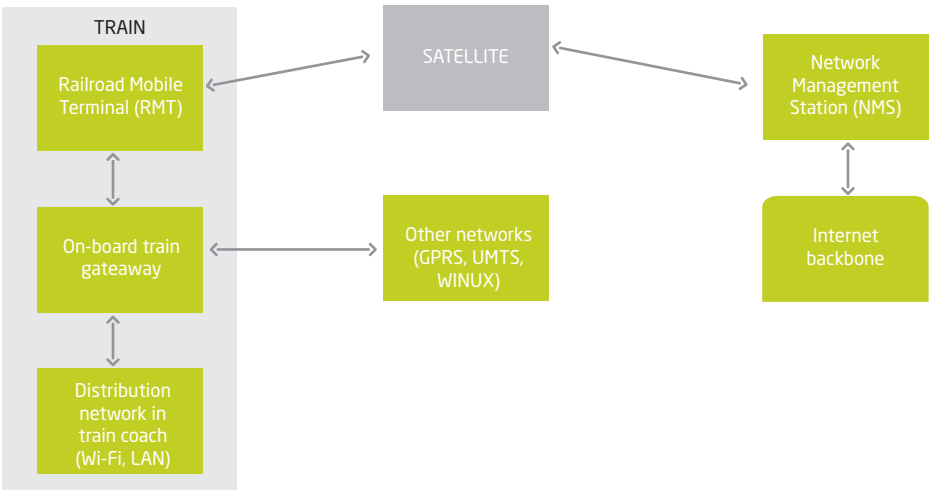
- **Industry-standard DVB-S** for the outbound link (hub to terminals), which allows to reuse communications infrastructure already available in most satellite operators and teleports. If needed, spread-spectrum CDMA solution is also available for the outbound link.
- **Spread-spectrum CDMA** for the inbound link (terminals to hub), since it is usually necessary when using small mobile terminals to overcome off-axis radiation international regulations.
- **Single channel per carrier (SCPC)** both for the inbound and outbound links, coexisting with other CDMA and/or DVB-S terminals. It can be used in spread or normal mode.

The railway terminal offers all capabilities for complete real time network management in a centralised way at the hub station.

An onboard Wi-Fi network, installed in every coach, provides wireless access to train passengers.

Highlights

- Innovative and easily deployable system that provides to passengers internet access and multimedia broadcast services
- Can be used by railway operators for operations-related applications
- The DVB-S technology allows to reuse existing infrastructure while still getting a flexible and high-performance outbound link
- The CDMA technology allows to use small antennae and broadband user data rates
- Built on top of rock-solid ground technology currently used within the high demanding military environment
- Multiple mode software radio platform: CDMA, plain QPSK and configurable spread-QPSK, for optimum spectrum efficiency in all scenarios
- Fully automated DAMA network
- Fully compliant with off-axis international regulations



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
SCPC SPECIFICATION	
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	
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	
User data rates	8 kbps – 256 kbps
Hopping rate	2000 hops/second
FEC	fixed (convolutional $^{1}/_{2}$ + RS)
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

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:
  - An access control system based on user's rights (SLA profiles)
  - Authentication management of mobile terminals, not only in the satellite network but in other networks (e.g.: Wi-Fi hotspots, UMTS, GPRS...)
  - IP traffic firewall capacity
- **Accounting management functions**, to allow the collection of details of each IP session modeled, e.g.: telephony's Call Detail Record (CDR)
- **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

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