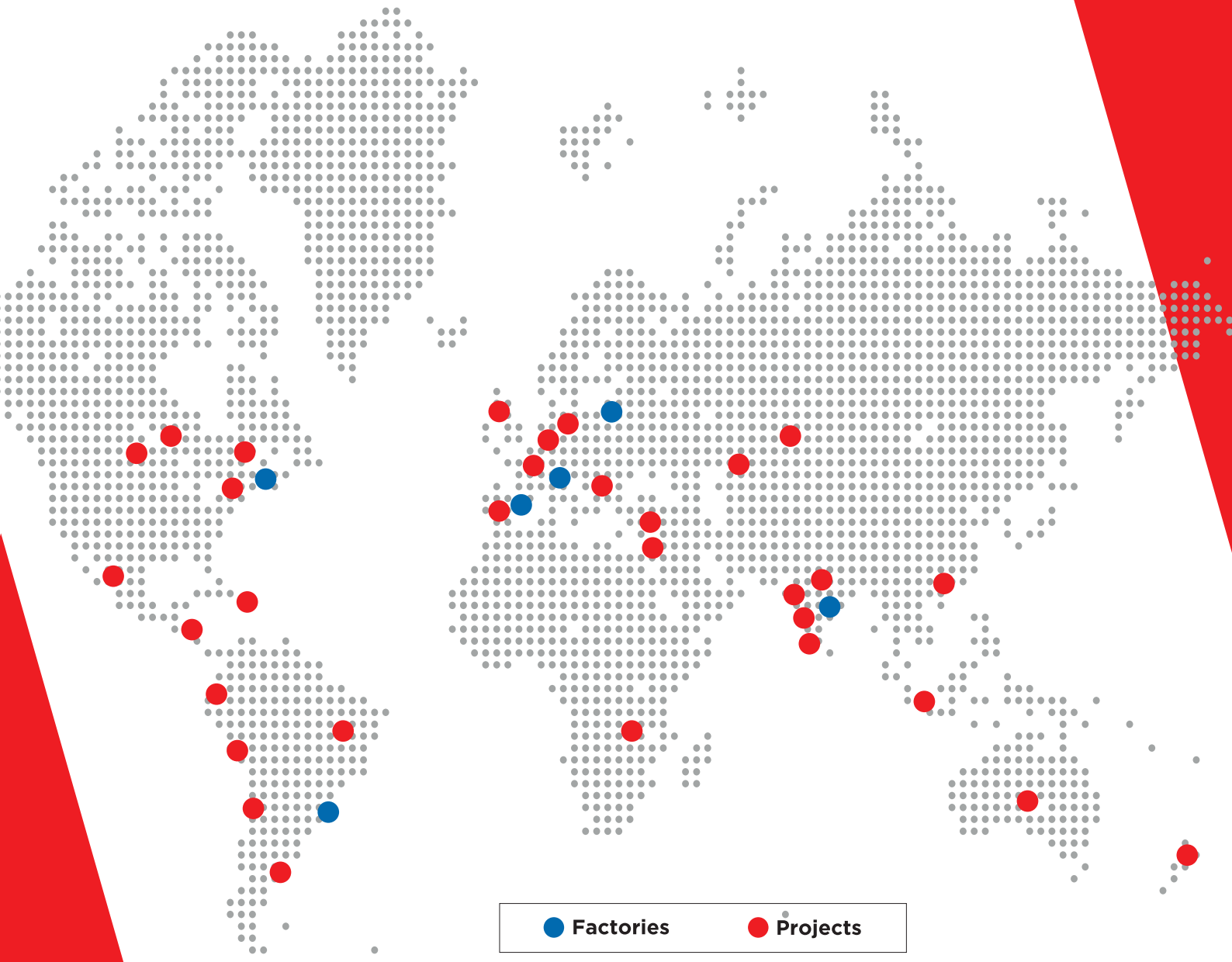
MEDHA®

- Network and Train to Ground Communication
- Public Address, Voice Communications and Passenger Information Systems (PACIS)
- CCTV System for Security
- Event Recorder and ASFA for safety

Location and References



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MEDHA®

Network &
Mobile Gateways

PACIS

CCTV

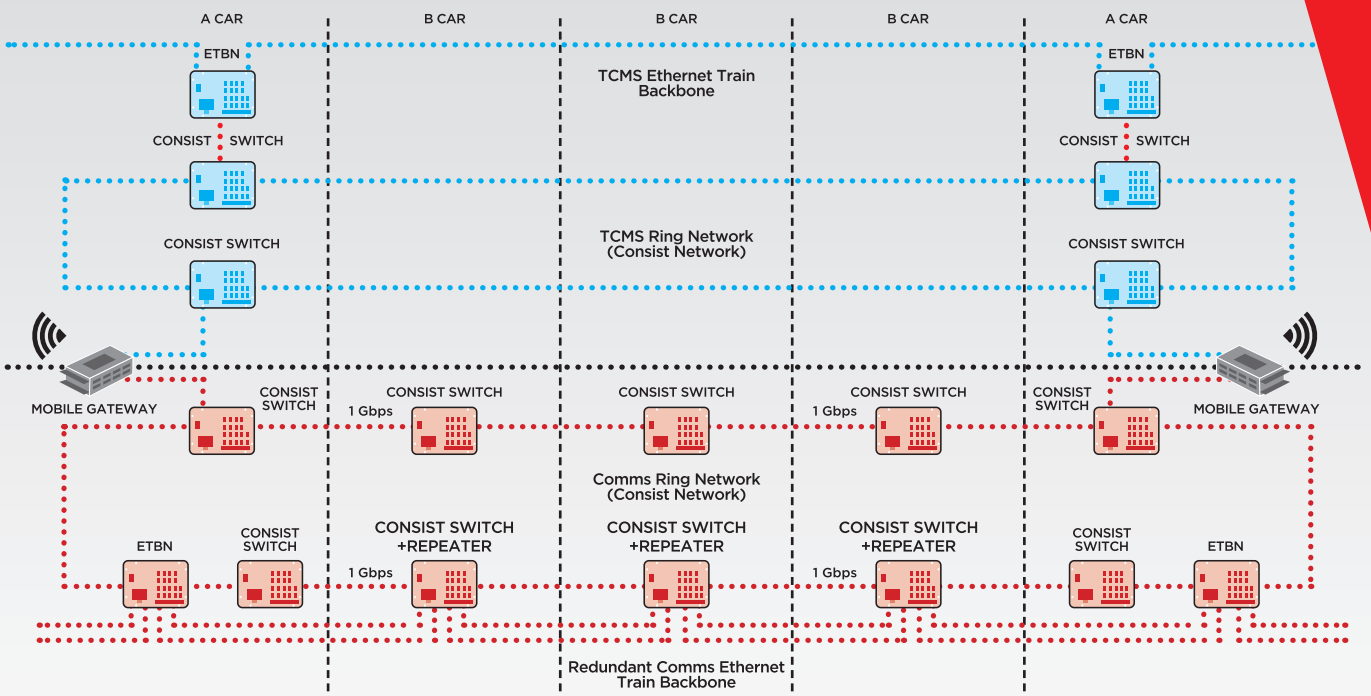
Multi-Service Driver
Display Unit (MS-DDU)

ASFA

Event Recorder

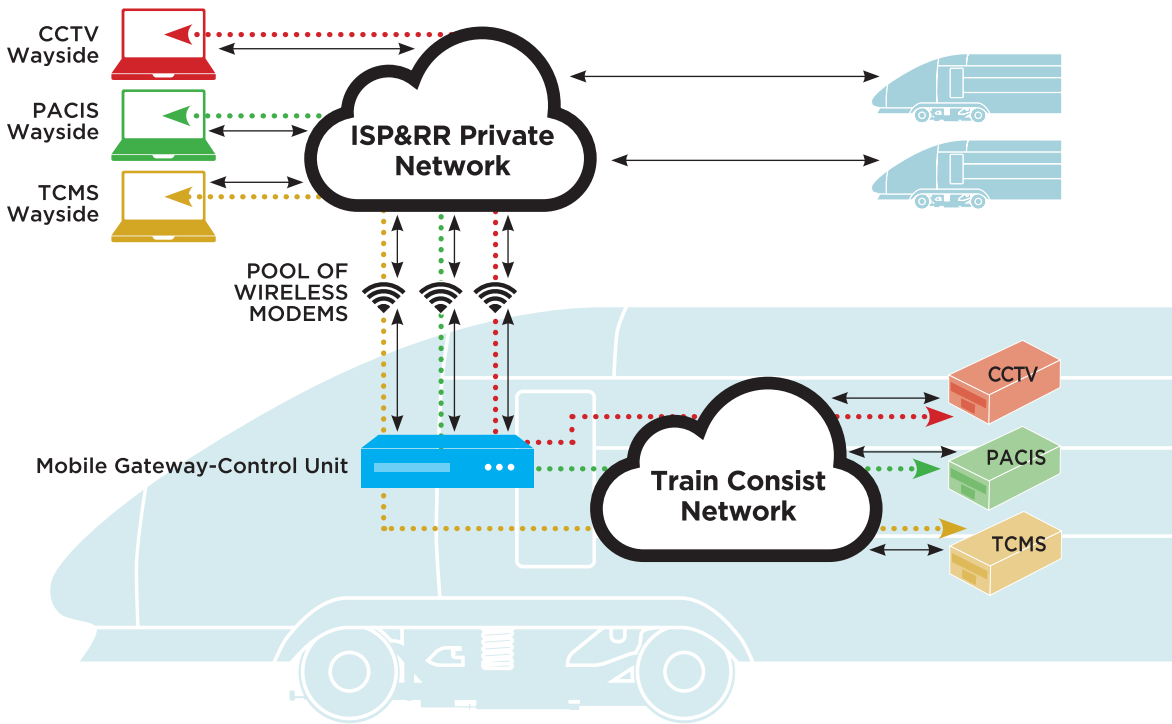
On-board Network and Train to Ground Communication

Multiservice onboard networks are essential infrastructure solution for all application systems of Digital Trains. These networks have to provide high bandwidth, but also different services to ease integration and allow smooth concurrent operation of the many possible onboard systems. **Mobile Gateways** are used to interconnect different onboard networks and these to ground-based systems via multimode broadband wireless communications links.



Main Features:

- Support of VLANs and QoS solutions.
- Network configuration support and network equipment firmware upgrades.
- Middleware for implementation of distributed application systems, using standard protocols (RTPS for implementation of DDO solution).
- Implementations for integration with third party systems (for example, with TCMS via interconnection of embedded networks, with Video Infotainment in direct connection to ECN network, other environments).



On-board Network and Train to Ground Communication

Mobile Gateways for interconnection of on-board networks, and routing of broadband train-ground communications.

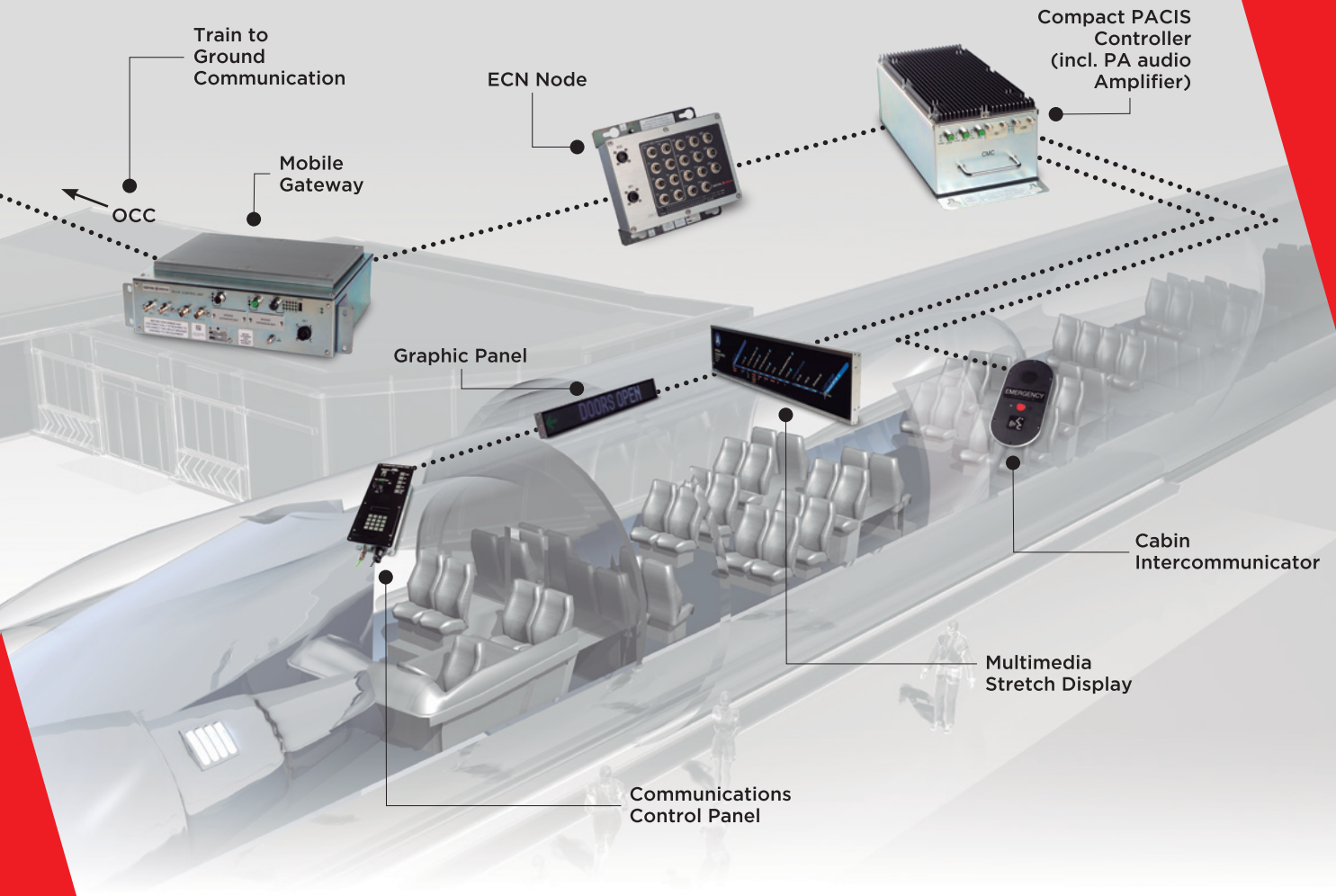
- Multimode communications:
  - WAN cellular 4G.
  - WLAN 802.11n/ac MIMO.
- Support operation in redundant configuration (management through VRRP), VLANs and QoS solutions with assignment of priority channels (modems) based on the type/class of traffic.
- Integrated Firewall solution.
- Allows software integration of specific application:
  Adaptation of proprietary protocols
  Information processing (structuring, combination of sources, elaboration of added value info).
- (Future development)
  Train-ground links aggregation support.
  WAN cellular 5G.

Switches for implementation of ECN and ETB in redundant networks, complying with TCN std.

- Redundancy in ECN & ETB managed by VRPP.
- Gigabit Ethernet ports for network backbone, also for End-Device in need of high bandwidth (i.e. Mobile Gateway, DVR).
- Fast Ethernet ports combined with/without PoE for end-devices.
- **ECS1: basic ECN node.**
- **ETBN: Combined ETB and ECN node.**
  Operates as standard ETB node, managing changes in train topology, providing key onboard network services (DHCP, DNS, train topology info).
- **ECS2: Combined ETB Repeater and ECN node**
  Applying TCN standard recommendation, supports ETB repeater function, with automatic bypass in case of failure.

Public Address, Voice Communications and Passenger Information Systems (PACIS)

The **Passeger Information system (PIS)** displays data and pre-recorded advertising media to the passengers in the vehicle, as well as video or warning messages sent from the OCC to the train. **Public Address (PA) system** performs the emergency and security warning announcements broadcasting as main target. The PA system also offers functions such as automatic audio broadcast of service information and special messages and is also able to broadcast the announcements from the Operation Control Center (OCC).



Graphic Panels (interior/exterior) RGB LED technology:

- Customizable formats, maximum resolution 256x48 pixel
- Image refresh by dedicated coprocessor (FPGA),
- User-configurable character fonts, icon/image loading, animated-GIF playback
- Support firmware upgrade by Ethernet interface.

Multimedia TFT 48” stretch (16:3) Full-HD Display:

- Embedded HTML server and client, support elaboration of visual service information in real time –line synoptics, station map, relevant stop information, others)
- Interface with PACIS Controller based on standard protocols (FTP, XML, RTPS)

Exterior Graphic LED Panel

TFT 48” Strech (16:3) FHD Display

Interior Graphic LED Panel

Public Address, Voice Communications and Passenger Information Systems (PACIS)

PACIS Controller

Main control unit of the PACIS implements all the control logic for management of voice/ audio services (PA, Cab-Cab, Passenger Intercoms) and information (PIS) connections, as well as reporting their status to the TCMS. As a space-saving measure, it also embeds an audio amplifier for PA.

Compact PACIS Controller

- Compact design.
- Amplifier class D with 4 speaker audio lines 25W each.
- 3 Ethernet Ports.
- Storage: 32GB.
- Operating Temperature: -20°C to 70°C.
- Active cooling: Fan-less.
- Level of protection of the enclosure: IP60.

Modular PACIS Controller

- Rack Size 19” 3U or 6U racks.
- Fully configurable by the end user.
- Amplifier class D 25W.
- Operating Temperature: -20°C to 70°C.
- Active cooling: Fan-less.
- Level of protection of the enclosure: IP60.

- Allows management of events,
  - by odometry.
  - by location through (ATC, ERTMS or GPS).
- Manages visual and acoustic events.
- Provides audio output to indoor / outdoor speakers.

Communication Panels, Intercoms

The new platform for voice services, allows a two-way communication between driver and passengers in case of emergency; among train cabs and driver-ground control center (OCC). This system also allows the integration with external standard FM/TETRA and other train-ground voice radio systems.

- Power Consumption: PoE device.
- 1 Ethernet port 10/100 BASE TX full-duplex M12.
- Speaker frequency response: 300 Hz to 3.2 kHz.
- Speaker output power: 5W.
- Microphone sensitivity: -40 dB @ 1 kHz 0 dB ref. 1V/PA (94 dB SPL).
- Operating Temperature Range: -20°C to 70°C.
- Active cooling: Fan-less.
- Level of protection of the enclosure: IP54.

Communications Control Panel with interface to Radio

Communications Control Panel

Passenger Intercommunicator

On Board Security - CCTV System

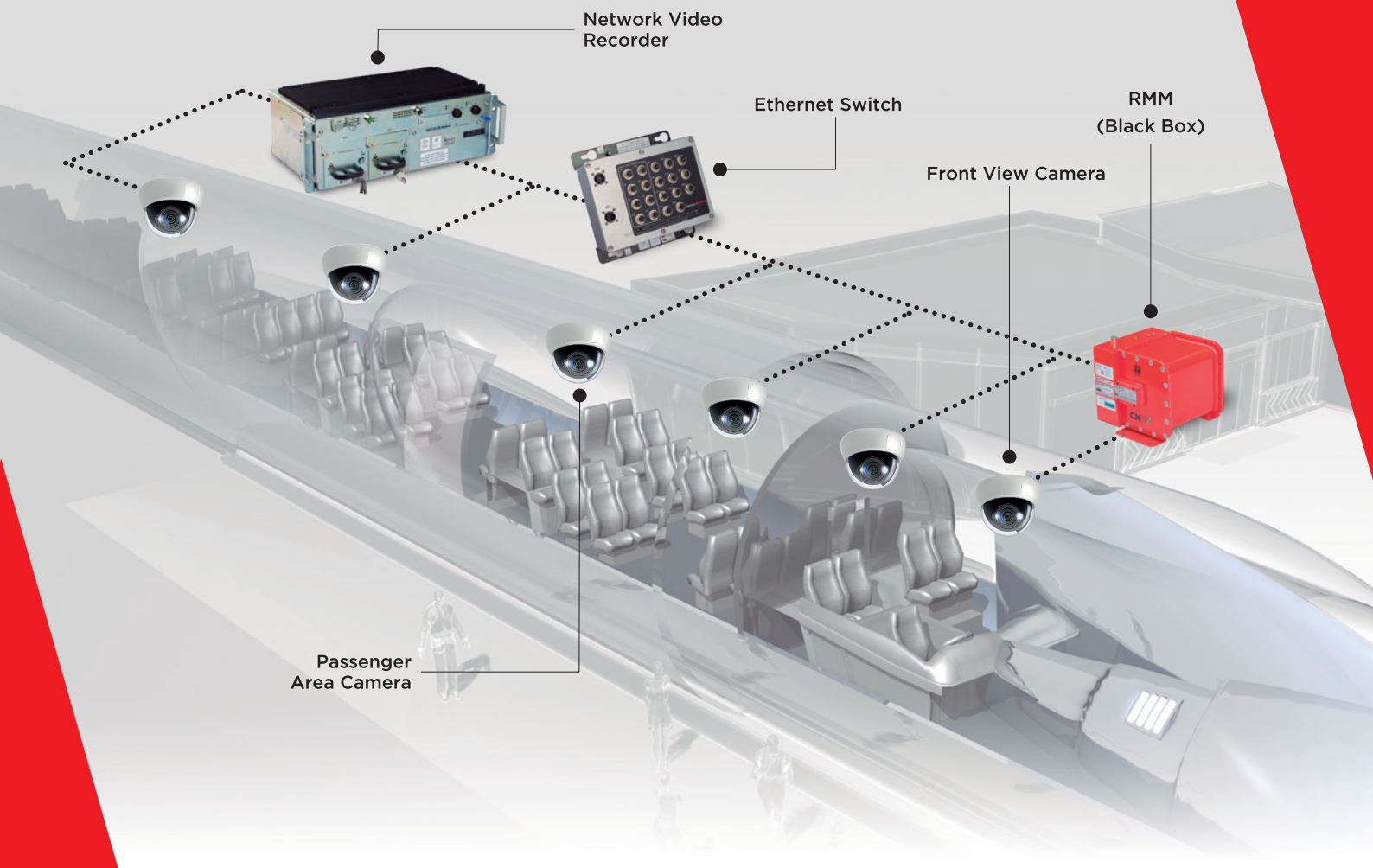
Closed circuit television (CCTV) is an essential tool for both passenger security and train safety. The main components that CCTV encompasses are Network Video Recording equipment (NVR), Video Monitors (Driver Display Unit, electronic mirrors), peripheral devices (video cameras, other sensors), video/audio crash-proof memory modules (black boxes) and of course the software that manages all these equipment.

The main functions of the CCTV system:

1.- Recording of videos captured by the train cameras.

2.- Extraction and Reproduction of the videos outside the train.

3.- Configuration of the cameras so that they can be viewed in real time in the DDU or OCC.



Video Management Software

- Operates on Windows OS platform.
- Video and Audio functions:

  - Searching, playback and download of video from NVR, RMM and Dock Station (for workshop).
  - Replay of video/audio previously downloaded.
  - Export to open multimedia formats and snapshots.
  - Verification of video/audio digital signatures and video decryption (tampering / manipulation detection).

- Maintenance functions:

  - Configure the NVR settings.
  - Download and analysis of NVR logs.
  - Diagnostic and functions for checking the performance of the System.
  - Installing NVR and RMM software.

On Board Security - CCTV System

NVR Devices (Network Video Recording)

NVR Type I

- U5 19” module.
- Up to 54 video IP channels H.264 / H.265.
- Up to 4 audio channels.
- 2 Ethernet port for maintenance.
- 1 Gb Ethernet port for connection.
- 1 USB port for video download. + config through memory stick.
- SLC-flash disk for OS storage.
- 2 Extractable Storage Modules for redundant recording.
- 4 SSD slots per Storage Module (Total up to 32 TB per NVR).
- 2 Slots for Wireless Interfaces (Wi-Fi 802.11n and/or LTE Cell).
- 1 GPS built-in receiver.
- Supercapacitor power bank for graceful shutdown in the event of sudden power loss.
- VID memory for storage of NVR settings.
- IP degree: IP54.
- EN-50155 and EN-61373 tested.

NVR Type II

- U3 19” module.
- Up to 54 video IP channels H.264 / H.265.
- Up to 4 audio channels.
- 2 Ethernet port for maintenance
- 1 Gb Ethernet port for connection.
- 1 USB port for video download + config through memory stick.
- SLC-flash disk for OS storage.
- 2 Extractable Storage Modules for redundant recording.
- 3 SSD slots per Storage Module (Total up to 24 TB per NVR).
- 2 Slots for Wireless Interfaces (Wi-Fi 802.11n and/or LTE Cell).
- Integrated PoE Ethernet Switch.14 port M12 d-coded connectors.
- Supercapacitor power bank for graceful shutdown in the event of sudden power loss.
- VID memory for storage of NVR settings
- IP degree: IP40.
- EN-50155 and EN-61373 tested.

NVR Type III

- U3 19” module.
- Up to 54 video IP channels H.264 / H.265.
- Up to 4 audio channels.
- 1 Ethernet port for maintenance.
- 1 Gb Ethernet port for connection.
- SLC-flash disk for OS storage.
- 1 Extractable Storage Module.
- 4 SSD slots per Storage Module (Total up to 16 TB per NVR).
- Supercapacitor power bank for graceful shutdown in the event of sudden power loss.
- IP degree: IP40.
- EN-50155 and EN-61373 tested.

Black Box (RMM)

The Black Box device, or Ruggedized Memory Module (RMM), is a recording module designed to withstand extreme stress (by heat, mechanical impact/ crush/ penetration, other) thus preserving integrity of stored video and audio information in case of an accident.

- RAM: 4 GB DDR3.
- Connectors: 10/100 Mbps & M12D-Coded.
- Storage Capacity: 4 memory slots – 64 GB per memory / Total 256 GB.
- Crashworthiness Criteria: IEEE 1482.1-2013.
- Vibration Shock: IEC601173 1999-01
- EN 50155
- IP 40 – CPU / IP68 – Crashworty memory storage box.
- Dimensions: 236 x 182 x 206 (WxHxD).
- Weight: 10 Kg.

Multi-Service Driver Display Unit (MS-DDU)

Multi-Service Driver Displays are onboard computers integrating a high-resolution graphics and touch-sensor based human machine interface, supporting direct user interactions with onboard systems as needed for train operation and maintenance purposes. The design of MS-DDU allows for an integration of HMI facilities belonging to different train-borne systems (TCMS, PA-PIS, CCTV, other) combined with an operation as communications gateway among different onboard train buses (RS485, Ethernet) and/or as main controller for specific subsystems (for example, as controller of Automatic Announcement.)

- High resolution display and PCAP touch-sensors, different sizes / formats available.
- Computer-on-Module based architecture, ARM processors, with scalable computing power and memory resources. Embedded Linux OS platform.
- Optionally integrates dedicated embedded processor, acting as communications gateway, to ease integration to legacy onboard communications buses.
- Ethernet (1 or 2 Gigabit ports), RS-485 (1 or 2 ports) and optional wireless 802.11 (WiFi) interface.
- Fully-customized look & feel of graphical human interface.

Multi-Service Driver Display Unit (MS-DDU)

Technical Specifications

	SCREEN	TFT	10.4”
		Resolution	1024 x 768 WGA (Lower resolutions supported)
		Format	4:3
		Maximum Brightness	1300 cd/m²
	Processor	CPU	NXP iMX.6 Quad Core ARM Cortex A9
	Supply voltage	Power supply	24-110Vdc.
		Power	35W
		Natural cooling	Yes
	Environment	IP Code	IP65 on the front *“EN 60529”*
		Operating temperature	-25ºC to 70ºC “Class T3 EN 50155”
		Storing temperature	-40ºC˜+85ºC
		Shock & vibrations	Category 1 class B “EN 61373”
		Dimensions (W x H x D)	335x235x55,46 (mm)
		Weight	3.4 Kg
	Reliability	MTBF (hrs)	100.000

Applicable Standards

Electrical	Insulations	EN 50155 12.2.9.
EMC	Surges inmmunity	EN 50121-3-2:2015
	Electrostatic discharge (ESD) susceptibility.	EN 50121-3-2:2015
	Transient burst susceptibility	EN 50121-3-2:2015
	Radio frequency interference susceptibility (conducted)	EN 50121-3-2:2015
	Radio frequency interference susceptibility (radiated)	EN 50121-3-2:2015
	Radio frequency interference emission from housings and conductors	EN 50121-3-2:2015
Temperature	Cooling.	EN 60068-2-1, Test Ad
	Dry heat	EN 60068-2-1, Test Bd
Vibrations and Shock	Fatigue random test	EN 61373
	Shock test	EN 61373
	Functionality test	EN 61373
Materials	Fire resistance & Smoke emission	NF F 16-101 & NF F 16-102 grade A1 NFPA130

ASFA

ASFA DIGITAL is a semi-continuous ATP. It provides a continuous speed supervision by transmitting information when the train passes over beacons located on the track.

Considering the information obtained from the beacons located on the track, the system executes requests for the acknowledgement of signals, represents the icons corresponding to such signals and the final control speed applicable in the Display, and sets the applicable speed curve for the driver to follow.

If such speed curve is not followed or acknowledgements are not done when applicable, the system applies the emergency brake

SYSTEM ARCHITECTURE

- CONTROL AND PROCESS EQUIPMENT

The ECP is the system in charge of processing the information received from the track and carrying out the corresponding odometry calculations, which includes the electronic modules responsible for the execution of the different protection and indication functions of the on-board system. Allows operation with one or two driving cabins.

ASFA

• VISUALIZATION SCREEN / DISPLAY

Displays information to the driver combined with audio warnings, about final control speed, efficacy, last ASFA information, overspeed, etc.

• REPEATER PANEL

Contains optical devices which provide information coming from the track and push buttons for the driver to press when required.

When ASFA operates in Basic Mode (no indications in Display), this equipment provides visual indications to the driver.

• GENERAL COMBINER

Module responsible for power-up/down and bypass of ASFA, selecting the type of train and wheel diameter for speed calculation.

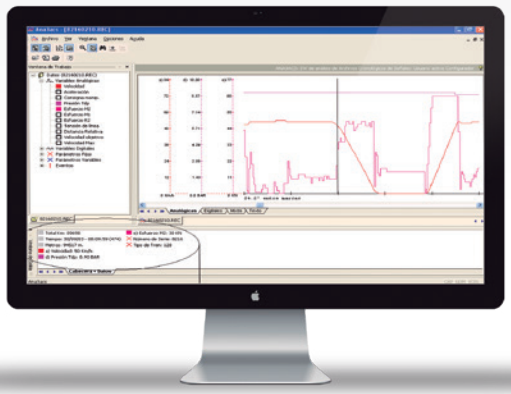
On Board Security - Event Recorder

The **Event Recorder (ER)** is an on-board device that records events data about the train operation and performance with the aim to use them for judicial and legal purposes.

Event Recorder (ER)

Accessible SD memory: PRM register

PRM (Black Box)



Maintenance and remote configuration SW.

Main Functions:

- Speed and distance measurement (odometry).
- Chronological register of events and signals (configurable recording policies for digital & analogue inputs).
- Allows for integration of deadman-lock subsystem.
- Configuration of functional parameters, self-check of operation.
- Easy extraction, graphic display and analysis of recordings.

On Board Security - Event Recorder

GENERATIONS

FEATURES	3G	4G	5G
Digitals Direct Inputs	48	24	24/48
Digitals Outputs	8	10	10
Analog Direct Inputs	4	4	6
Analog Outputs	✗	2	Optional
Communications	RS-485 (x2) MVB Class 2 Ethernet (10 Mbps)	RS-485 (x4) MVB Class 2 Ethernet (10/100 Mbps)	RS-485 MVB Class 2 Ethernet (10/100 Mbps)
Vehicle Identification Device	✗	✓	✓
Storage Capacity	16 MB	32 MB / 64 MB	64 MB
Backup Chronological Logging & Failure Logging Operation Enviroment	✗	1 GB	1 GB
Download via encrypted USB	✗	✓	✓
Remote Configuration Utility	✗	✗	✓
Double Effect Dead Man	Optional	Optional	Optional
GPS / GSM	Optional GPS / GSM	Optional GPS / GSM	GPS
Wi-Fi	✗	Optional	✗
Audio Recording	✗	Optional	✗
Size	Rack 19” 3U	Rack 19” 3U	Rack 19” 4U

References:

- Metro Madrid
- FGV
- FGC
- Metro Barcelona
- RENFE
- Metro Bilbao
- FEVE
- FESUR
- FFCC Mallorca
- FFCC País Vasco
- Metro Málaga
- Metro Sevilla
- Tram Alicante
- Metro Valencia
- Tren de la Costa (ARG)
- CPTM, Metro Recife, Supervia, Portoalegre (BRA)
- EFE Chile (CHL)
- Metro Santo Domingo (DOM)
- Metro Lima (PER)
- Metro Panamá (PAN)
- Metro Washington – WMATA (USA)
- Irish Railways (IRL)
- Metro Roma (ITA)
- TCDD Turkish Railways, Tram Antalya (TUR)
- Metro Argel (DZA)
- NYCT
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