SAE-R®

gmv INNOVATING SOLUTIONS

ITS

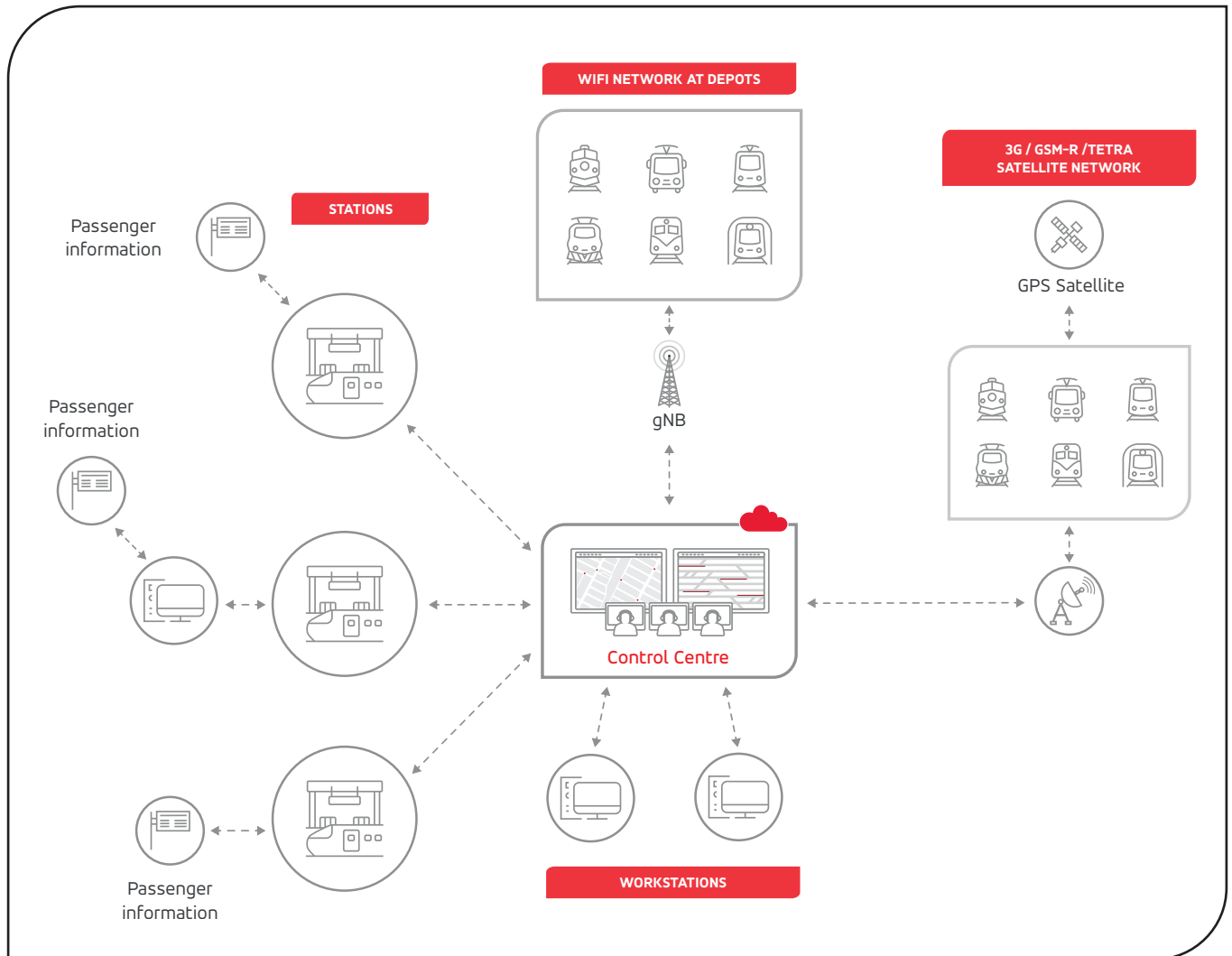# AVLS/PIS Advanced rail transportation platform

GMV's **SAE-R®** CAD/AVL system responds to the primary needs of rail transportation operators: service planning based on the available resources, continuous fleet monitoring, real-time management, passenger information (onboard and at stations), and use of recorded data for statistical purposes.

The **SAE-R®** CAD/AVL system has been designed for both passenger and freight train operations, and the list of GMV clients using **SAE-R®** includes national passenger and freight rail transportation operators, as well as urban rail networks, in countries such as Spain, Morocco, Poland, Taiwan, and Australia.

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WIFI NETWORK AT DEPOTS

STATIONS

Passenger information

Passenger information

Passenger information

gNB

3G / GSM-R /TETRA SATELLITE NETWORK

GPS Satellite

Control Centre

WORKSTATIONS

ARCHITECTURE (ON-BOARD)

- Modular architecture that gives the system a high level of scalability.

- Onboard elements: onboard unit (OBU), human-machine interface(s) (HMI) for train drivers, and multiband antenna. Other optional devices and systems can be added, such as RFID readers and tags and passenger information elements (LED panels, TFT displays, public address equipment).

- Various families of OBUs are available, ranging from devices based on microcontrollers to advanced platforms with high-performance CPUs.

- Multiple wireless communication interfaces: TETRA, Wi-Fi, mobile phone, and satellite, with built-in redundancy.

ARCHITECTURE (CONTROL CENTER)

- The Operations Control Center (OCC) typically uses a redundant, hot-swappable cluster architecture. As an alternative, a virtualized platform system can be installed on an existing server.

- Two types of workstations are available: a client server desktop version, with higher performance and intensive daily fleet supervision, and a web-based version, with basic features that can be accessed via any web browser with authorized connectivity.

- Panels with information about the services for passengers at stations, primarily using LED and TFT screen technologies.

- Communications for the panels at stations: Ethernet (copper and fiber-optic cables), mobile phone signals (GPRS, 3G, HSPA, 4G/LTE), and TETRA.

PRODUCT CHARACTERISTICS

The **SAE-R®** CAD/AVL system's real-time precise location feature makes it possible to generate information about each journey, using an advanced multi-source algorithm that combines inputs from RFID tags, odometer readings, GPS, and open door and active cabin signals.

SAE-R® is compatible with communication interfaces such as TETRA, Wi-Fi, mobile phone (up to 4G/LTE), GSM-R, and satellite, with automated management and switching for redundancy. The protocols are also optimized to minimize bandwidth usage.

GMV's **SAE-R®** system provides interoperability on board the trains and at the Operations Control Center, and it can be integrated with the TCMSs of the main rolling stock manufacturers. It also communicates with corporate ERP systems, to share data on working hours for personnel and rolling stock availability and use.

SAE-R® incorporates advanced tools such as a depot management system (DMS) to optimize operations at train depots and yards. This system provides advanced tools for planning, monitoring, and controlling train locations and movements inside of these areas.

SERVICE ADJUSTMENTS

The service adjustment features allow correction of any deviations that occur during service, to ensure punctuality, maintain optimal quality levels, and minimize dead time. The **SAE-R®** system offers a wide range of adjustment actions (to adjust planning, exchange resources, and send orders to drivers) that can be used to manage typical operational situations, with adjustment modes based on time schedules or frequencies. Also, in any case where connections with the OCC are lost, the OBU can operate independently in time schedule adjustment mode.

REAL-TIME FLEET MONITORING

Each train's position is updated approximately every 5 seconds, and any asynchronous events are immediately recorded. The **SAE-R®** system's interfaces provide real-time viewing for trains and stations (GIS, traditional synoptic, vertical synoptic), each with specific graphic tools for their management. The synoptic view for train depots gives managers essential information about the organization and location of the trains stabled there, to facilitate decisions about their assignment.

ALARMS AND EVENTS

SAE-R® provides a wide range of alarms, such as alerts for hardware failures (for rolling stock, **SAE-R®** hardware, and other interconnected systems), adjustment alarms (early or late arrivals), and service alarms. The OBU can include connection of a panic button, which will send an audio feed from the driver's cabin to the OCC if activated.

OPERATIONS CONTROL CENTER

PLANNING AND ASSIGNMENT OF SERVICES

GMV's **SAE-R®** CAD/AVL system integrates various sources for managing time schedules and planning. Services can be scheduled in the system's planning tool, imported using standard file formats (Excel, CSV), or obtained from third-party systems. In addition, daily assignment of services to the available rolling stock can be adjusted in real time.

The speed warning system gives the driver alerts using visual and audio signals if the train exceeds the speed limit or deviates from the speed profile for its route.

REPORTS AND STATISTICS

The system provides a series of reports for rail transportation operators, covering aspects such as driving quality, passenger counts, communications, alarms, and punctuality, among others. The operating reports generated include data on speed profiles, early/late arrivals at key points, onboard monitoring, and passenger counts.

ONBOARD SYSTEM

TECHNICAL CHARACTERISTICS
All hardware is certified based on the EN50155, EN50121-3-2, and EN61373 standards, and it is compatible with nominal voltages of 24, 48, 72, and 110 VDC according to the EN50155 standard.

GMV's own design and development of the hardware makes it possible to offer various models of OBU, as well as audio options and control variations for the information panels, so these can be adapted to the needs of each client.

HUMAN-MACHINE INTERFACE
The human-machine interfaces (HMIs) located in both cabins give the driver:

- Two-way text messaging with the OCC
- Voice communication controls
- Service information and adjustment orders
- Control over the passenger information system
- Document viewing feature
- Monitoring and diagnostics
- Speed profiles and alerts

VOICE COMMUNICATIONS

The onboard features offered by the **SAE-R®** system allow for fluid communications by voice, in the following modes:

- Driver <--> OCC
- Driver --> OCC (panic button activated)
- OCC --> passengers (via public address system)
- Passengers <--> OCC (via emergency intercom system)

PASSENGER INFORMATION

GMV's **SAE-R®** system generates accurate, real-time information for passengers, with a combination of train locations, service information, and speed profiles. This information is presented visually on the trains via LED/TFT screens, as well as at stations and terminals and on personalized websites and smartphone apps. To improve accessibility, the system can also play prerecorded or automated messages via a public address system.

INTERACTION WITH OTHER SYSTEMS

SAE-R® can interact with a wide range of other systems, both at the OCC and on board the trains.

- At the OCC: integration with CTC systems, planning/assignment tools, communication systems, and SCADA, among others, using open XML or proprietary protocols.

- On the trains: connection with systems such as passenger information (PIS), public address, intercom, traffic priority, ticket issuance, passenger counting, diagnostics, energy metering, CCTV, and train event recording (JRU), via Ethernet, RS485, USB, MVB, IBIS, and CAN connections.

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