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White Paper

RAR VEHICLE CONNECTIVITY HUB SIMPLIFIES VEHICLE COMMUNICATION

With this communication solution, operators gain complete control over digital communication in their vehicles – secure, structured and future-proof.

In modern bus and rail transport, the large number of digital subsystems is increasingly creating challenges in terms of data integration, communication security and operational monitoring. The Parametric RAR Solution is a highly integrated, secure, and flexible platform that consolidates the communication of existing subsystems, intelligently processes log data, and communicates with the cloud via a central cellular connection.

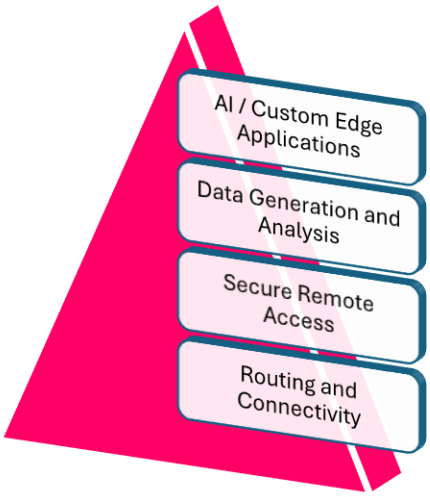
The underlying hardware was developed by Parametric specifically for the application purpose, and guarantees long availability. It is designed for the extended temperature range from -40 °C to +85 °C and meets all relevant standards for use in buses and trains. For installation in buses in series operation, the hardware has an E24 type approval. The devices are characterized by a very compact design, high mechanical stability and easy installation in narrow compartments. Since 2014, more than 5000 RAR units have been installed in buses and trains in various countries and operated for a long time.

Three expansion stages – tailor-made for every need

Basic equipment: communication platform & router functionality

Even in the basic version, the system offers a powerful router platform with flexible configuration. It supports LTE cellular, Wi-Fi, GPS, and optional communication redundancies. An integrated managed 5 Port Ethernet switch allows port-based separation of networks at the hardware level (VLAN). This also includes functions such as Packet Storm Protection as well as security-relevant features such as MAC address filtering for access control. The software architecture supports both online and offline updates, thus creating the basis for long-term maintainable operation.

Module 1: Certified Secure Remote Access to Subsystems



The optional remote access feature gives operators full control over who is allowed to access which subsystems in the vehicle. All access takes place via a central, outgoing network connection and is fully tracked. Access security meets certified industry standards. The solution supports role-based access control and audit logging. Access rights can be assigned temporarily and revoked centrally. Even in the absence of connectivity, control is maintained via prepared rules. The status of the connected systems can also be monitored centrally.

Module 2: Aggregation & Data Provision

This module enables the structured acquisition, aggregation and transmission of log and measurement data of all connected subsystems. Data is provided with accurate timestamps and transferred to Parametric cloud environment with full traceability. Clean data is made available via a uniform interface for further processing, alerting and connection to customer-side control systems. A special focus is on applications in the field of predictive maintenance, condition-based maintenance (CBM) and operational optimization. For example, acceleration or vibration data can be combined with in-vehicle control data – such as the driver's console – in order to detect anomalies or optimization potential at an early stage. This allows conclusions to be drawn about the condition of the vehicle infrastructure as well as the efficiency of subsystems such as the energy supply, and is an important prerequisite for digital twins and V2I (vehicle-to-infrastructure) scenarios.

Module 3: Local Intelligence, AI & Sandbox

Using the third module, partners and customers can execute their own evaluation and control algorithms directly on the device. The container architecture and integrated sandbox make it easy to develop, deploy, and execute custom software solutions. Thanks to the integrated AI accelerator (Neural Processing Unit, NPU), even computationally intensive AI models can be run locally – e.g. for image recognition, anomaly detection or predictive maintenance.

Customer added value

With the RAR solution, operators retain complete control over digital communication in their vehicles. They determine which subsystems are allowed to communicate with each other and through which channels data is transmitted to the outside. The hardware-side separation using VLANs allows communication streams to be controlled securely and traceably. At the same time, data traffic is bundled centrally via one or more modems, which both increases security and reduces operating costs.

The platform replaces selective individual connections with a structured, uniform infrastructure. Subsystems such as ticketing, passenger information, sensors or cameras are reliably connected without their communication to the outside world being uncontrolled.

A special feature of the solution is local data processing: log data from the subsystems can be analyzed directly in the vehicle and converted into structured measured values. In this way, relevant information can be transferred to the cloud without unnecessary data overload. If required, the system also stores large amounts of data locally as a digital black box – synchronized with time and position information.

Thanks to the integrated container architecture, customers can run their own algorithms directly on the gateway. They use local data sources – such as GPS, diagnostic data or camera feeds – without any additional hardware or cloud dependency. The open interface structure also allows seamless integration into existing IT and fleet management systems.

The RAR Unified Vehicle Connectivity Solution offers the right basis for numerous fields of application and thus creates a sustainable and future-proof digital infrastructure in the vehicle.

Feature Matrix – Overview by Equipment

Feature	Base	Module 1	Module 2	Module 3
LTE / 5G Connectivity (Up to 3 Modems)	X	X	X	X
GPS	X	X	X	X
Wi-Fi	X	X	X	X
Redundant cellular connection	X	X	X	X
Managed 5 Port Ethernet Switch with VLAN	X	X	X	X
Firewall & Routing Functions	X	X	X	X
Online and offline update	X	X	X	X
Centralized remote access control		X	X	X
Role-based access control		X	X	X
Audit logging of all remote access		X	X	X
Remote monitoring of subsystem states		X	X	X
Time-stamped data aggregation			X	X
Measurement Data Analysis & Infrastructure Health			X	X
Data provision for control systems			X	X
Local container runtime environment				X
Customer-specific algorithms				X
Support for ML/AI models				X
OTA update for containers				X

Examples

- ✓ Fleet management: Uniform vehicle data platform for entire bus or train fleets.
- ✓ Evaluation and transmission of log data from connected subsystems
- ✓ Condition Monitoring: Real-time analysis for preventive maintenance.
- ✓ Controlled, secure access to subsystems via remote maintenance
- ✓ Video surveillance: camera integration and transcoding directly in the vehicle.

- ✓ Video Transmission and Streaming for Digital Signage
- ✓ Smart Ticketing & Passenger Information: Consolidated database for all digital services.

A Future-Proof Unified Connectivity Solution

The RAR platform offers a systemic, modular and hardware-integrated approach for complete control, analysis and optimization of all communication and subsystem processes in the vehicle.

Key benefits:

- Hardware-side network sovereignty: port-based VLAN, firewall, MAC-controlled access
- Edge intelligence with integrated NPU: Local AI processing, anomaly detection, condition monitoring
- Modularly expandable: remote access, data aggregation, container platform
- Independence: Cloud-usable but not mandatory, full operator control
- Swiss Development & Production: Durability, E-Mark, Railway Suitability

This makes RAR suitable not only as a communication gateway, but also as a complete operating platform for intelligent vehicles – especially in public transport, rail transport, special vehicles or OEM-related series integrations.

The RAR Unified Vehicle Connectivity solution is therefore the ideal solution for bus and rail fleet operators who want to reconcile digitalization, efficiency and safety. With complete control over communication flows, subsystem access, and data processing, operators retain control over their infrastructure at all times. It offers a future-proof, open and scalable platform that not only integrates existing infrastructure, but also enables new services.

For detailed technical specifications, please refer to the separate data sheets.

Contact us to discuss your requirements!

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