



# NextGen Railway Architecture

for a Safe & Secure Operation



**Europe's No 1  
in Real-Time Operating Systems**



## **SYSGO at a Glance**

SYSGO is an independent entity from the THALES group and Europe's No 1 in safe & secure operating systems. Since 1991, SYSGO has expertise in embedded devices and is one of the pioneers in embedded Linux. The main markets are Aerospace & Defense, Railway, Automotive, and Industrial Automation, where we are active with professional services mainly in customer systems that are following various certification standards.

Our RTOS & Hypervisor PikeOS is well-known in the market as a reliable and certifiable operating system including virtualization and multi-core support.

Our solutions significantly reduce cost, space, weight, time-to-market for our customers. We guarantee a reliable, long-term supported operating system as basis for their innovative products.

SYSGO offers long-term support for devices that need to run more than 20 years. As an European company, our products have no export restrictions and are ITAR free.

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## **Highest Safety Requirements meet Time-to-Market Demands**

The globalization of the economy requires fast and efficient transportation of goods and people from A to B without compromising on system Safety. This can be achieved by using Communication-Based Train Control Systems (CBTC) and by making a more efficient use of the available infrastructure. The European Train Control System (ETCS) was designed in order to harmonize the different, sometimes incompatible train control systems used within Europe.

This innovation for the European rail infrastructure ideally uses the concept of modularity, which gives rail operators the flexibility to combine the required software/hardware infrastructure from several vendors.

Usage of pre-certified COTS software and hardware components will speed up time-to-market and lower development and certification costs. Furthermore, a holistic architecture shall respect Safety and Security requirements for the future rail infrastructure.

These aspects require a robust real-time operating system (RTOS) platform to allow applications to run in a safe and secure manner, meeting standards like EN 50128 / EN 50657 (Safety) and IEC 62443 (Industrial Cyber Security). With PikeOS, developers have access to a hard real-time hypervisor-based on a separation kernel, which can be certified according to the EN 50128 / EN 50657 standard up to SIL 4.

→ [www.sysgo.com/certkits](http://www.sysgo.com/certkits)



## **The Future of the Railway Industry – an Outlook**

Future train control systems will take advantage of the available infrastructure, but at the same time it is desirable to reduce the number of devices required for the train control (on-board, on-rail and wayside) in order to save costs.

New regulations are reducing difficulties of mixing vendor proprietary systems, in order to deploy flexible Commercial-off-the-Shelf (COTS) and open standard solutions. Today, it is possible to use compatible software and hardware allowing the Railway operator to mix and/or exchange components from different vendors at any time.

The Railway Safety standards EN 50126, EN 50128 and EN 50129 mandate a complex development process to achieve functional Safety. The overall number of incidents has already decreased in the last two decades. In order to further increase Safety, the Railway industry faces huge investments. In order to save immense development and certification cost, equipment manufacturers have to focus on using pre-certified COTS SW and HW components. This will speed up the development cycle, mitigate the risk for Safety devices and lower certification cost.

Current processor architectures combine a huge set of functionalities on SOC (System on Chip) or even include multiple processors mixed on one silicon die (Multi Processor SOC, MPSOC). This complexity requires a new approach for Safety evaluation because a component-based evaluation of the used hardware is more or less impossible.

Multi-core systems even face the challenge, that their real-time behaviour is not fully predictable due to interference caused by shared CPU resources.



## Railway Market Challenges – Interoperability in Europe

Trains and Railway systems have to face many challenges, such as managing coming requirements for autonomy, optimizing overall system performance, bridging modern to legacy equipment, managing interoperability to remove virtual borders and the need to handle multiple standards, and ensuring functional Safety and Security.

When we look at the European Railway landscape today, interoperability is a big challenge. The various train system controls are quite fragmented across Europe where every country has its own standard. For example, when travelling from Germany to France, the train has to be equipped with two different control systems. Before reaching the border, the train needs to stop and switch to the other train control system – each and every time.

This is why a united standard is needed for Europe to ensure a smooth and automated transition between the countries which has been defined by the European Train Control System (ETCS). In the long term, ETCS will replace more than 20 different train control systems in Europe and will be mandated for all trans-European trains and high-speed trains driving over 160 km/h.

For that, the train control system will have to perform consistent speed and distance monitoring while considering other trains using the same infrastructure. That control system also defines the right braking behaviour in order to have a safe distance to other trains making the system highly Safety-relevant. Mistakes will put passenger lives at risk and that is why this kind of control is ranked as „highly critical“ – also represented by the level of SIL 4.

## PikeOS - Proven Platform for a Safe & Secure Operation

Railway infrastructures are heavily relying on networking technology. As a replacement for Multifunction Vehicle Bus (MVB) and Wire Train Bus (WTB), (industrial) Ethernet solutions have found their way into trains and way-side appliances. As networking infrastructure is commonly subject to hacker attacks (e.g. STUXNET), Security for safe operation is a high demand for networked railway infrastructure.

PikeOS is a real-time operating system (RTOS) based on hypervisor technology. Its safe and secure virtualization features allow multiple operating system APIs (guest OS) to run side by side on one machine.

For Communications-based Train Control (CBTC), PikeOS Native and POSIX guest OSs are considered. The PikeOS microkernel architecture allows to be used in cost-sensitive, resource-constrained devices as well as large, complex systems. Typically, PikeOS can be used for onboard and ground parts of the same distributed system, as it is the case with CBTC.

The PikeOS Separation Kernel Version 5.1.3 is currently the only Separation Kernel worldwide that holds a Common Criteria EAL5+ certification for its separation performance.

→ [www.sysgo.com/cc](http://www.sysgo.com/cc)

### Use Cases

Brake & Traction Control Systems, Train Wayside Communication, Autonomous Trains, Train Screenboard / Driver Display, Train Control Systems

→ [www.sysgo.com/railway](http://www.sysgo.com/railway)



## PikeOS in Railway

PikeOS provides a modular system architecture allowing various applications to run simultaneously on a single hardware. A safe and efficient integration of electronics in Railway systems is reached via virtualization technology.

The basis of PikeOS is a small, certifiable microkernel upon which a hypervisor provides separate partitions for resource and function needs.

As Railway systems can include anything from non-critical graphic applications to time-critical measurement systems and Safety-critical control functions, PikeOS accordingly offers a broad variety of guest OSs: From PikeOS native for Safety and real-time applications to POSIX and embedded Linux, which is a perfect basis for UI and communication tasks.

Thanks to strong separation, applications with differing Security and varying criticality levels, real-time or non real-time can run in a mixed criticality environment on a single hardware platform.

## Customer Voice

*“We are very impressed by SYSGO’s innovative products, in particular their EN 50128 certified RTOS PikeOS and its EN 50128 Certification Kit, which provides a safe & secure embedded virtualization solution - perfectly suited to the new challenges of the railway industry.”*

**Erich Ruprecht**

CEO

RDCS Informations-technologie GmbH



### Railway Customers

- ALSTOM
- Deutsche Bahn
- Hitachi Rail STS
- Knorr-Bremse
- Kontron
- Matisa
- POSCO
- Samsung SDS
- SBB CFF FFS
- Selectron
- Wabtec

### SYSGO & Kontron: SAFe-VX – Turnkey-Ready Development Platform

Partitioning critical and non-critical application code in independent time and memory spaces:



SYSGO and Kontron present a turnkey-ready developing suite, providing fully representative hardware and a complete tool-chain for software development, which is integrated into the Eclipse-based IDE CODEO. The integrated development environment provides all the components that software engineers need for embedded applications and includes comprehensive tools to realize embedded projects in a time-saving and cost-efficient way.



### HASELNUSS – Security for Railway

The next generation Railway signalling infrastructure uses COTS hardware as the computing elements and open network for the communication. The main role of SYSGO in the HASELNUSS project is to provide the separation kernel, which will be part of the MILS core for integrating Safety-critical applications together with Security-enhancing applications on one hardware platform. Furthermore, SYSGO will provide support for the secure boot, measured boot, and secure update functionality.

→ [www.sysgo.com/haselnuSS](http://www.sysgo.com/haselnuSS)

### Samsung & PikeOS – Communication-Based Train Control (CBTC)

SYSGO's PikeOS has been chosen for the CBTC (Communications-Based Train Control) system by a South Korean consortium led by SAMSUNG SDS. The system complies with Safety standard EN 50128 SIL 4 and PikeOS serves as the certified real-time operating system platform for both ground and on-board components.

CBTC is a wireless-based train control system that accurately detects the location of a train by exchanging information, including exact position, speed, travel direction and braking distance, in real time via continuous two-way communication between ground and train (board).

In the modern CBTC systems this information enables the way-side equipment to define the points on the line that must never be passed by the other trains on the same track. These points are communicated to make the trains automatically and continuously adjust their speed while maintaining the Safety and comfort requirements.

→ [www.sysgo.com/samsung\\_cbtc](http://www.sysgo.com/samsung_cbtc)

### Whitepaper Download

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