

New SIL 4 PLC interlocking reduces lifecycle costs

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ProRail, the state-owned Dutch railway infrastructure enterprise, commissioned consulting and engineering firm Movares with implementing a PLC interlocking based on industrial COTS (commercial off-the-shelf) hardware. Based on a HIMax controller system, the new interlocking concept satisfies central ProRail requirements for supplier independence, safety, availability, easy operation and maintenance, and lower lifecycle costs – a minimum 30 % lower than other electronic interlocking solutions. A pilot project was successfully implemented at the Santpoort Noord railway station. Santpoort Noord is

the first PLC interlocking for main lines that satisfies the requirements of the highest safety level, SIL 4, in accordance with CENELEC.

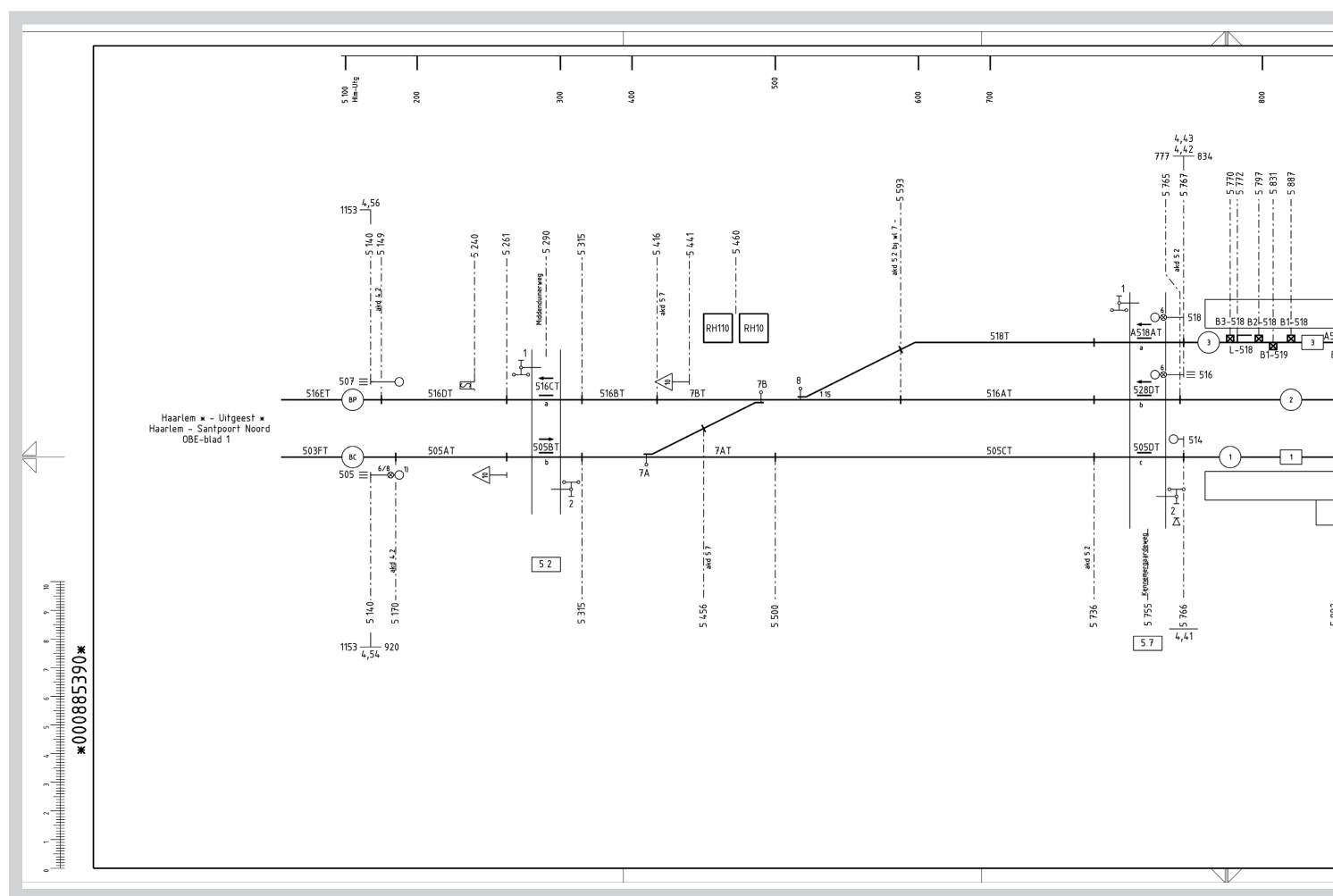
1 Initial situation

ProRail N.V. is the largest railway infrastructure company in the Netherlands and manages 7,000 kilometers of railway track. The state-owned enterprise provides services in three business segments: railway infrastructure, railway network, and rail traffic management. ProRail plans new routes and is responsible for the construction and maintenance of

the routes, as well as for the railway stations and everything else in the vicinity of the tracks. Administration and safety are additional tasks. Last but not least, the enterprise must ensure that the lines it manages have failure-free availability.

2 Old railway relay interlockings will be replaced

In 2004, ProRail decided that old relay-based railway control centers built from 1953 to 1969 should be replaced. The existing interlockings are not very flexible and have high lifecycle costs. Another disadvantage is the so-called ven-



dor lock-in – the costly dependence on individual providers for component purchase, engineering, maintenance, and for modifications.

The long-term goal of the program is complete replacement of the technical signaling infrastructure of these aging interlockings. Moreover, as part of this measure, the current ATB system will be extensively replaced through ERTMS (European Rail Traffic Management System), the future European traffic management system for lines of the trans-European railway network. The new interlocking systems must satisfy the following requirements: Better RAMS (Reliability, Available, Maintainability, Safety) performance, lower lifecycle costs per train kilometer, implementation of new functionalities, and a safer work environment for maintenance personnel on the line.

3 Lower lifecycle costs through standardized interfaces

ProRail pursues the principle of an open technology approach instead of proprietary solutions, to achieve low lifecycle costs for its interlockings on the main lines.

To avoid a vendor lock-in the enterprise relies on supplier-independence in all phases of the lifecycle. An open control system that can implement any established protocol meets ProRail's requirements.

Movares, the independent Dutch consulting and engineering firm, offered ProRail a suitable solution. In 2004, Movares had started an ambitious R&D project – the development of a new type of PLC railway interlocking solution that satisfies safety standards and fulfills the following requirements:

- COTS (commercial off-the-shelf) hardware, proven in safety-related applications in other industries.
- A SIL 4 certifiable solution in accordance with CENELEC, and based on open industry standards with interfaces for external devices.
- High availability and easy plug-and-play.
- Numerous I/O and communication interfaces.

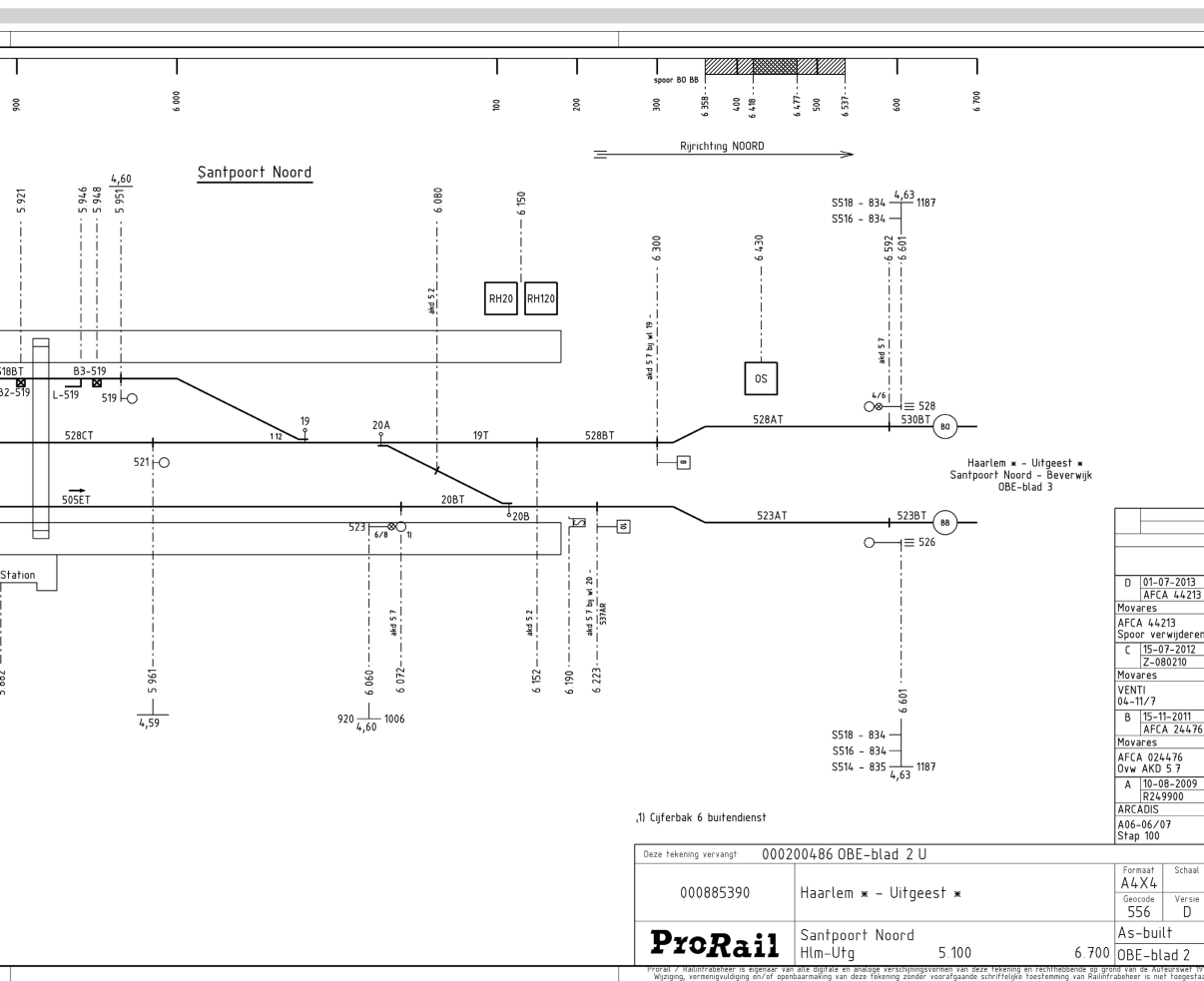
With this approach Movares envisioned crucial advantages: no vendor lock-in, supplier independence through the use of COTS components, and reduction of lifecycle costs by 30 % or more.

In its search for a suitable supplier for safe controller technology, Movares discovered HIMA Paul Hildebrandt GmbH. The Brühl-based safety expert offers safety systems for interlockings, railway crossings, rolling stock, and energy supply. Its systems for the railway industry use COTS components that are proven in the process industry and in factory automation.

Previously, across the railway industry, specialized and proprietary technology was the norm for safety solutions. Compared with this complex approach, COTS solutions are more flexible, more cost-effective and easier to upgrade. The safety systems based on proven HIMA safety controllers also feature intuitive programming and the capacity to easily be networked and integrated with cross-manufacturer communication interfaces. Consequently, HIMA solutions can be integrated in different technical environments, for retrofitting, as well as for new installations.

4 Pilot project Santpoort Noord

In 2009, ProRail commissioned Movares to implement a PLC interlocking, re-



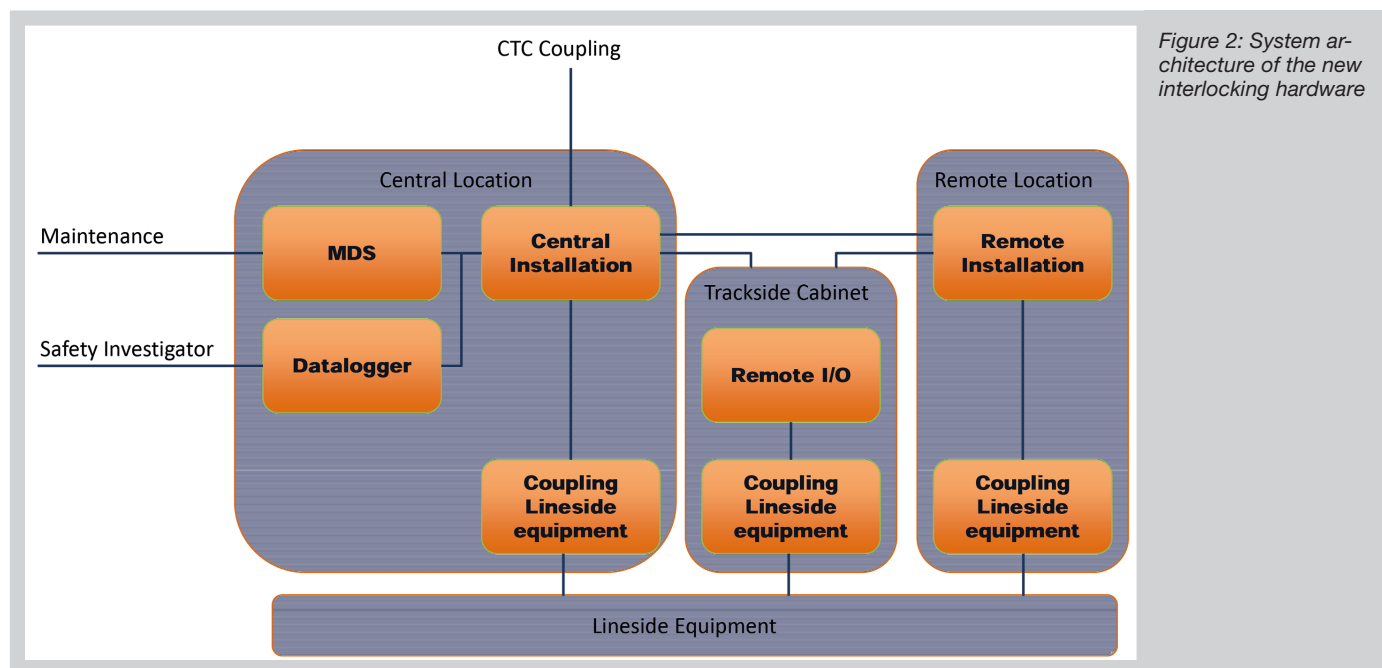


Figure 2: System architecture of the new interlocking hardware

placing the existing relay interlocking at the Santpoort Noord railway station. The station is on a main line with intercity traffic; ten to twelve trains stop there per hour, and there is freight train traffic.

The original plan from Movares called for HIMA HIMatrix controllers. These programmable logic safety controllers are certified for implementation to the highest safety level, SIL 4, in accordance with CENELEC, and at the same time have the robustness that railway applications require. After the more powerful and fully-redundant HIMax controller received SIL 4 certification in February 2011 – the first controller of this type to have received SIL 4 certification as stipulated by CENELEC, Movares transitioned to this new controller. HIMax is

suitable for high performance requirements and large safety applications, as well as for smaller and medium-size applications. Thanks to its scalable redundancy, the controller system is the right solution for railway stations and traffic hubs on main lines. As indicated by its Achilles Level 1 certification, HIMax offers the highest level of safety along with cyber security.

In the Santpoort Noord railway station the following components are controlled with the HIMax system (Fig. 1):

- 10 signals
- 6 points
- 20 track circuits
- 2 railway crossings.

Thanks to its high scalability and easy extensibility, the controller platform is

suitable for large and small interlocking tasks, and also for monitoring of railway crossings and rolling stock applications. Moreover, it is open for ERTMS.

Due to the openness of the system, supplier competition is ensured in all life-cycle phases, as there is no dependence on any single provider, neither for the engineering and commissioning, nor for changes and maintenance tasks. Modifications are easy to execute.

The plug-and-play system with hot-swap functionality enables fast, cost-effective replacement of components in running operation, ensuring a high level of system availability. If maintenance is required, the owner can handle it within normal work hours, while railway operation continues undisturbed.

Thanks to its compatibility with the existing interlocking system, HIMax was easily integrated in the existing infrastructure at Santpoort Noord railway station. SILworX, the fully integrated configuration, programming, and diagnostic tool from HIMA, provided support in the implementation of the project. The easy programmability of the tool was an advantage for this project.

Using SILworX, Movares programmers created approximately 20 standard function blocks that map interlocking functions and can be easily adapted to new requirements. Moreover, the interlocking function blocks improve the test and validation process for future applications. Programming errors are minimized through the tested, preprogrammed solutions. Test and commissioning costs are reduced. Figure 2 shows the system architecture.



Figure 3: New interlocking building RH110 in Santpoort Noord

5 30 % lower lifecycle costs

The lifecycle costs of the PLC interlocking are significantly lower than with other electronic interlockings. Movares calculated a minimum cost reduction of 30 %. The savings occur through the initial project costs, through significantly lower maintenance and repair costs, lower training costs of the development and maintenance teams, and the more reliable COTS hardware.

ProRail likes that the HIMA system has widespread use throughout a variety of industries and isn't designed exclusively for infrastructure enterprises. SIL 4 certification adds to the system's appeal and overall value.

For the Eurolocking pilot project at the Santpoort Noord site, an interlocking building was erected with the designation RH110 (Fig. 3). It stands directly adjacent to the old relay building. The control cabinets for the interlocking system are housed in the new building (Fig. 4). One of the cabinets contains a data logger and a maintenance and diagnostics system, while the other cabinet accommodates the hardware of the Movares interlocking solution. The central component of this cabinet is the HIMax system from HIMA. The installation consists of the CPU and communication modules and of the I/O modules that form the interface to the equipment on the route side.

A base plate with numbered slots accommodates the individual HIMA

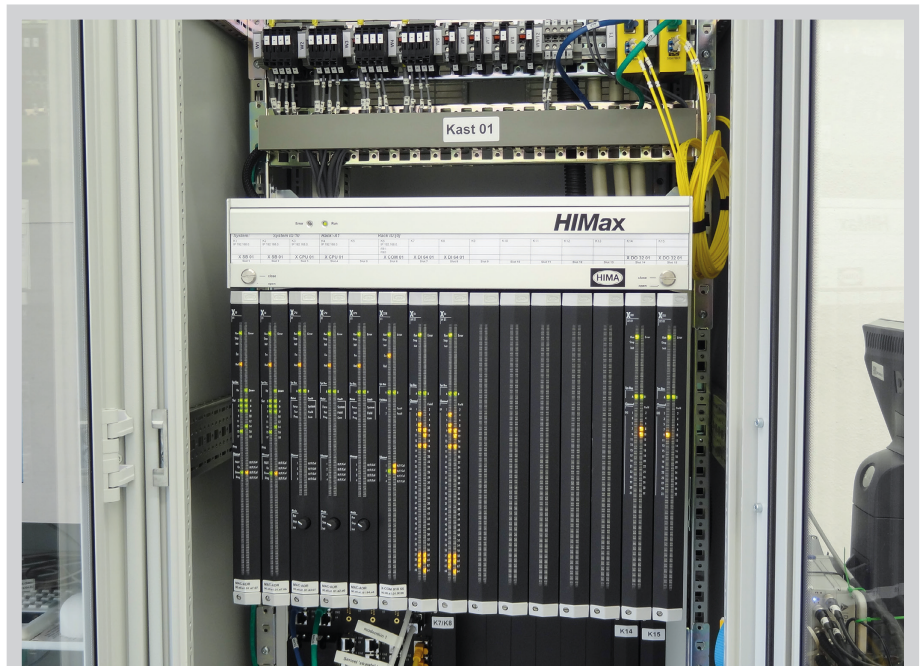


Figure 4: Control cabinet with PLC HIMax

modules and makes it simple to match the right slot with the suitable module.

For the pilot system a fallback scenario was created to ensure that a failure of the overall system could not occur during the test phase. The external system could be connected with the old, relay-based interlocking, or with the new HIMax-based solution from Movares. After several months of successful trial operation, the latter became the only interlocking solution for Santpoort Noord.

the same year, ProRail approved implementation of the PLC interlocking solution from Movares across the entire Dutch railway network. Movares views the ProRail approval as a breakthrough in the area of train control. The combination of proven industrial hardware with railway-specific applications will result in a cost-effective and flexible product.

Since its commissioning, the PLC interlocking has been working reliably and flexibly. ProRail is very satisfied with the solution and refers to it as one of its best systems. A second project is also commissioned: In 2014, Movares implemented a second PLC interlocking with COTS components from HIMA, this time at the Beverwijk railway station. This interlocking has been in operation since April 2015.

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6 Summary and future prospects

The first PLC interlocking has been in operation at the Santpoort Noord station since July 2012. In December of

■ ZUSAMMENFASSUNG

Neues SIL-4-SPS-Stellwerk senkt Lifecycle-Kosten

Seit Juli 2012 ist das erste SPS-Stellwerk am Bahnhof Santpoort Noord im Betrieb. Im Dezember desselben Jahres hat ProRail den Einsatz der SPS-Stellwerks-Lösung von Movares im gesamten niederländischen Bahnnetz genehmigt. Movares sieht in der Freigabe durch ProRail einen Durchbruch im Bereich der Zugsicherung. Die Kombination bewährter Industrie-Hardware mit bahnspezifischen Applikationen habe ein kostengünstiges und flexibles Produkt zur Folge. Das SPS-Stellwerk funktioniert seit seiner Inbetriebnahme zuverlässig und fehlerfrei. ProRail ist sehr zufrieden damit und bezeichnet es als eines seiner besten Systeme. Das nächste Projekt ist bereits angelaufen: 2014 hat Movares für ProRail am Bahnhof Beverwijk ein zweites SPS-Stellwerk mit COTS-Komponenten von HIMA realisiert. Dieses Stellwerk ist seit April 2015 in Betrieb.