Reference

A Swiss rail network upgrades to a new control system

Redundant control system for traction power monitoring of the Matterhorn Gotthard Bahn

The Matterhorn Gotthard Bahn (MGBahn) is one of the largest transit companies in Switzerland. With more than eight million passengers per year, the company is an important infrastructure service provider for regional tourism.

The 144-kilometer rail network passes through the fascinating countryside of Disentis in the canton of Grisons over the Oberalppass at more than 2,000 meters altitude to Andermatt in the canton of Uri. From there, it continues via Realp through the Furka base tunnel to Oberwald in the canton of Valais, and via Brig and Visp on up to Zermatt below the Matterhorn.

In Disentis, it connects to the Rhaetian Railway (RhB) – a joint operation with MGBahn – running the Glacier-Express between Zermatt and the Grisons destinations of Chur, Davos, and St. Moritz. With the expansion of the partially single-track lines to double track, rail transport has become even more appealing to visitors in the region.

The Matterhorn Gotthard Bahn offices have a 24-7 connection to the central servers of the power control system in Brig and Glisergrund via redundant Ethernet switches. They use virtual coupling, which means that if a layer 3 switch fails, the other device takes over its function, thus securing both the control and monitoring of the traction power supply of all lines.

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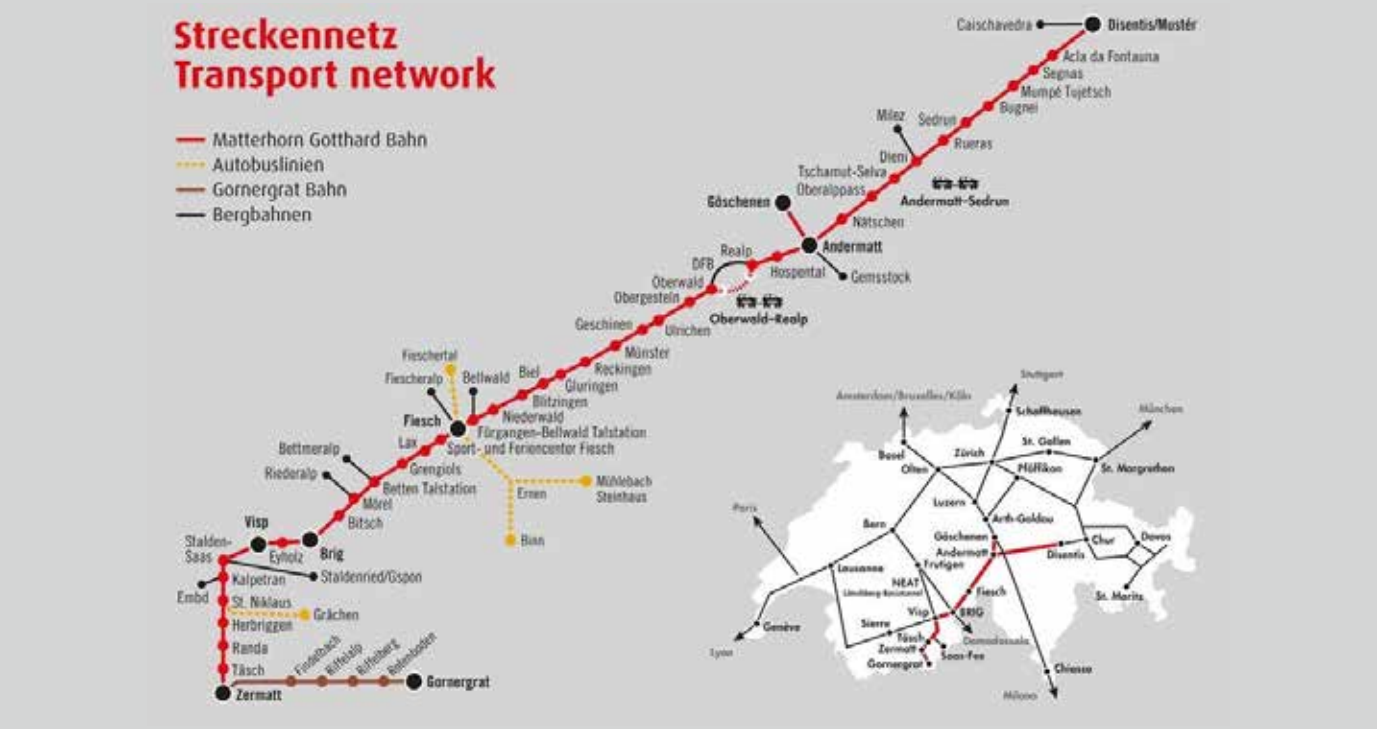

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Around three years ago, the engineering section of MGBahn asked Siemens to plan and implement an upgrade of the existing control system for the traction power supply, including the network infrastructure. Project manager Jean-Pierre Waldmann, responsible for technical infrastructures at MGBahn, describes it in these terms: „Efficient management of the rail network requires know-how and the right solutions. We want to know what is happening on the line at all times. That applies equally to tracking trains on their routes, to fast location and elimination of faults along the line, and in the requirement-based traction power supply." The installed network infrastructure with older devices will be upgraded with components that are not only modern, but also easier to manage and maintain.

In the past, the structure was highly complex. There was a duplicate network with separate switches and routers. The entire system frequently failed if malfunctions occurred. Raymond Püntener, the Siemens project manager responsible for the MGBahn project, planned a solution based on two layer 3 switches – for faster and more flexible modification of the network. According to Püntener: "The redundant design makes one virtual switch out of two devices. If one device fails, the other device automatically takes over its function."

Partitioning of the process LAN

Siemens decided to use the RUGGEDCOM RX1500 for this solution. The RX1500 is a multi-service network component that combines the Ethernet functions of a switch, router, and firewall with WAN connectivity. The robust Ethernet switch and TCP/IP router is designed for use in high-performance automation networks. The combined device ensures high reliability with hot-swappable media modules and power supplies. The primary additional benefit for the user is flexible expansion with media modules. Also critical in the decision for selecting the RX1500 was the product's robust design, capable of withstanding high levels of electromagnetic interference, shock, and vibration, along with flexibility in the input voltage range and the extended temperature range without cooling fans.

The network of the control system needed to be divided into several virtual LANs (VLANs) i.e. the process LAN for checking the booking or customer information systems. A layer 3 switch, like the RUGGEDCOM RX1500, is ideal for this task.

The network infrastructure was implemented using layer 3 switches and virtual routing. As a multiservice network component, the RUGGEDCOM RX1500 combines the Ethernet functions of a switch, router, and firewall. (© Raymond Püntener)

In addition, the Virtual Router Redundancy Protocol (VRRP) feature incorporated into the RX1500 provides a method that ensures the availability of the network.

At MGBahn, the two RX1500 switches at separate locations became one logical unit, a virtual router. The existing structure was initially broken down and the process LAN was subdivided into ten VLANs. The traction power supply is controlled via the Brig and Glisergrund stations. The two locations are around four kilometers apart and redundantly connected via glass fiber. If one of the RX1500 switches fails, the other takes over the gateway function immediately.

Employees at the Brig power system control center constantly monitor the quality of the electricity supply. Individual switching of the overhead lines is carried out by the control system. The instructions are routed through the network of the control system to the relevant substations. Along the line, the control center monitors and controls the 44 stations, with seven stations connected together to form a single VLAN. If a malfunction occurs on a line segment, the affected segment is disconnected without disturbing the remaining power system operation.

Employees at the control center of Brig station monitor and control the power supply of the entire line network. (© Raymond Püntener)

Since the messages are sent directly to the control system, an employee can send the service team straight to the affected line segment.

Commissioning of the systems

The approximately ten-year-old hardware of both locations has been replaced by new systems, as upgrading the installed equipment would have been technically and economically infeasible. Siemens first set up the hardware and software in a testing environment. The simulation demonstrated perfect interaction of all components and showed that the switching commands arrive at the destination as planned.

The project started by replacing the installed systems with a leaner hardware infrastructure. Püntener explains: "Because we had built a redundant system (A + B), we were able to convert system A of the power system control center to the new IP structure first and test it. Once we had a successful result, system B was also converted."

Substantial benefits from the new control system

The project manager at MGBahn is extremely satisfied with the new solution. Jean-Pierre Waldmann explains: "Without intelligent power supply networks, it is not possible to handle the stringent requirements of automated railroad operation. Siemens showed us how existing distribution networks can be made fit for the future with the new control system. Significant advantages in maintenance and operation and substantially simpler routing are the result."

According to Waldmann, having one point of contact for any service related inquiries is also a big advantage. A service technician is able to diagnose the control system at any time through secured remote maintenance via Internet. Personnel can set values and transfer program updates by remote access. This results in shorter response times. Service call-outs can often be avoided altogether.

MGBahn benefits from the innovative functions of the new control system. It integrates the existing infrastructures with the new hardware and software components into the Brig and Glisergrund stations. At the core of the new infrastructure are two layer 3 switches, whose routing functions enable communication between the various IP subnetworks and the high-performance automation network. The new infrastructure improves fault detection, accelerates power system recovery, and increases reliable power supply throughout the entire MGBahn rail network.

Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept. For more information about industrial security, please visit siemens.com/industrialsecurity

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