



Modernizing the Cholfirst Tunnel control engineering system

Highlights

- Traffic signals are controlled dynamically along tunnel sections so that the traffic flows safely and without delays.
- Engineers need to ensure that the necessary data will be transmitted reliably between the traffic facilities and control engineering system.
- The Cholfirst Tunnel in Schaffhausen, Switzerland, uses easy-to-operate Managed Switches from Phoenix Contact to accomplish this goal.

Customer profile

Ticos Engineering & Software AG is based in Feuerthalen in the canton of Zürich. As a system integrator, Ticos realizes control, regulation, and management systems for structure and process automation. They employ their expertise to automate tunnels, buildings, and traffic control technology. Ticos's extensive portfolio of project experience has expanded over the years, all while keeping its regional focus in their home country of Switzerland.

Challenge

The Swiss A4 highway is a crucial transit route for north-south traffic. Every day, over 25,000 vehicles race through the northern section of the A4. This section also serves as the Schaffhausen expressway, which is considered to be a central part of the regional traffic system. The two-lane segment between

Schaffhausen-Nord and Flurlingen is composed of several tunnels and crosses the Rhine River between the individual tunnels. While driving through, travelers rarely see any of the technology that is installed within these structures that ensures the traffic flows smoothly. If, however, there were to be a power failure, fire, or accident, these technical systems could also save lives. The operating and safety equipment is divided into different utility systems, such as energy supply, lighting, ventilation, and traffic management. Each utility system functions off of its own, independent control technology.

The Schaffhausen section of the A4 opened in 1996, and, as a result, the technology installed at that time became outdated. In some parts, the technology no longer met current requirements, and because of this, the Swiss Federal Roads Office (FEDRO) initiated a refurbishment program to update tunnel systems. Ticos was commissioned to renovate and modernize the operating and safety systems in the Cholfirst, Fäsenstaub, and Schönenberg tunnels (Fig. 1).



Fig. 1 Ticos Engineering & Software AG specializes in tunnel and traffic control technology.

“We are particularly impressed with the easy handling of the components.”

Armin Spiess,
Division Manager at Ticos.

One of the challenges when working with tunnel applications is implementing upgrades without affecting the flow of traffic. Tunnel closures are considered to be the last resort and, if they are deemed necessary, must be planned long-term, and for periods of off-peak traffic flow.

Solution

The first traffic control system to be modernized was the 1,260-meter, three-lane Cholfirst Tunnel. To ensure that the work had as little impact on the traffic flow as possible, Ticos renovated the control engineering system at the same time as other ongoing operations. As a part of this project, Ticos replaced the original control system and several local controllers. The associated control cabinets were situated in the engineering rooms or in the two tunnel portals' sub-distribution stations. All new and existing traffic signals were connected to the traffic control engineering system. Ticos employees gradually transferred signals from the existing controller over to the new controller. Ethernet-based communication was also installed at the field level and the control level as part of the modernization.

Ticos installed a redundant Ethernet ring based on single-mode fiberglass technology to span long distances and ensure high availability. Ticos selected Managed Ethernet Switches of the FL Switch 2200 series from Phoenix Contact as the infrastructure components. A key factor in this decision was the easy handling of the devices. The switches can be set up in a redundant ring topology without any further configuration. Eliminating that time-consuming step was a key advantage for quick setup. The basic function of a plug-and-play switch already exists in the required ring topology, making this advantage possible. This simplifies startup, because the network is available again quickly after a rework operation or an extension (Fig. 2).



Fig. 2 The control technology installed in the substation is connected to the fiberglass ring via the FL Switch 2206-2FX-SM.

The 2206-2FX-SM switches have two single-mode, fiberglass interfaces with SC Duplex connectors, as well as six twisted pair copper interfaces with RJ45 connectors. The single-mode ports are connected to the fiberglass installation via FO patch fields. The fiberglass cables run parallel between the two tunnel portals below the carriageway service duct. Here, the signal and communication cables are routed on cable racks alongside the supply lines for water and energy. The switches are mounted in the transverse control boxes in the tunnel service duct, where they're coupled to the fiberglass ring. The main and local controllers installed in the substations were connected to the switches via RJ45 ports. The components were installed in the engineering rooms of the two tunnel portals. Switches with single-mode uplinks are supplemented in the substations with versions that have eight twisted pair ports so that more communication devices can be integrated into the network.

Results: Fast migration and expansion of the field devices

The traffic control system included the lighting of static signals, indicators, traffic lights, and lane and switching signals. The scope of the traffic control engineering system included the tunnels, their entrance zones, and the associated open roadway sections (Fig. 3).



Fig. 3 The sign gantry at the entrance to the Cholfirst tunnel is equipped with a dynamic traffic control system.

A rerouting system was used in the project section of the A4. This meant that the traffic was diverted to the nearest possible connecting route in the event of a scheduled or short-notice tunnel closure. Two alternative routes were identified for this purpose, both of which were displayed via prism rerouting signs. Rerouting signals were previously connected in parallel to the control engineering system. With the new solution, it was possible to couple to the switches directly or via serial/Ethernet converters. The use of Ethernet technology, therefore, supported both the migration of existing field devices and their expansion (Fig. 4).



Fig. 4 The 2000 series switch is also used to couple the sign gantry with prism rerouting signs to the fiberglass network.

While the switches installed in the engineering rooms could be easily accessed by service personnel, the devices installed in the service ducts could only be reached by a walk of several kilometers. Accessing the switches installed on the masts and gantries in the entrance zones and in the open roadway sections also involved considerable effort (Fig. 5). Ticos employees used the central Network Manager startup tool from Phoenix Contact to



Fig. 5 The control boxes installed in the tunnel entrance zone are difficult to access.

assign each device an IP address, allowing the device settings to be configured via the software. As a result, employees could configure and perform diagnostics on all of the installed switches right from the engineering room.

Furthermore, the Network Manager could now be used to maintain and archive the configuration data of the switches used in the project.

Future expansion to other tunnel sections

To date, Ticos has only had positive experiences with the FL Switch 2200. “We are particularly impressed with the easy handling of the components,” says Armin Spiess, Division Manager at Ticos (Fig. 6). “Therefore, we are also going to expand this networking concept to other tunnel sections, as well as any potential follow-up projects once approved by the client.” Now, there is nothing standing in the way of free-flowing traffic around Schaffhausen and the German-Swiss border.



Fig. 6 Ticos employees were provided with comprehensive support from Phoenix Contact. From left to right: René Weber and Daniel Kübler (both Ticos Network Project Managers), Uwe Nolte, Toni Widmer, Erich Matzinger (Phoenix Contact), Armin Spiess (Division Manager at Ticos.)

Significant reduction in configuration effort

With the Network Manager, Phoenix Contact offers a new software solution for the quick and easy startup of Managed Switches, wireless components, and security appliances.

The use of Managed Switches and WLAN components always involves configuration effort for the user: IP parameters, redundancy, segmentation via VLANs, and the SSID (in the case of WLAN components) all need to be configured (Fig. 7).

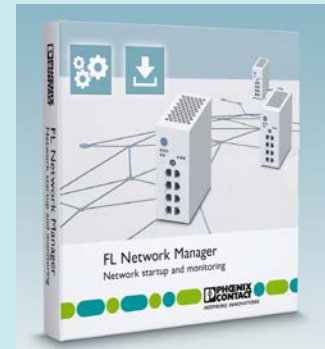


Fig. 7 All network components are monitored, configured, and kept up-to-date via the Network Manager.

To help users handle the growing number of managed devices in the network, the Network Manager minimizes configuration efforts. All network components are monitored, configured, and kept up-to-date via the Network Manager. Ensuring that the large number of devices are up-to-date is particularly time-consuming. This process can be simplified and sped up through a firmware rollout. Furthermore, IP assignment in EtherNet/IP and PROFINET networks via DHCP and DCP have been integrated. Therefore, the Network Manager can be used in all application areas, such as machine building, systems manufacturing, and process technology.