Full control of communication and diagnostics at Audi

PROFINET standards for diagnostics and management are suited for acceptance testing and continuous monitoring of the network, along with functionality to carry out maintenance tasks. The premium car manufacturer Audi uses PROFINET for a wide range of communication control and maintenance diagnostics.

THE NECKARSULM SITE OF AUDI stands out by the variety of product variants produced there. These products are manufactured on an area of more than one million square meters including a press shop, a paint shop, a body shop and assembly lines. Depending on its tasks, each department has different requirements as to how to use PROFINET communication.

Communication requirements

The body manufacturing production planning department is responsible for the plant technology of new body manufacturing facilities. These cover all production steps from the manufacture of the component parts to the assembly of the complete body-in-white including doors and flaps.

For this purpose, PROFINET was introduced in 2006 and has been employed ever since in linear, star, and ring network topologies using Conformance Class C (PROFINET IRT) devices. The automation networks are integrated into the corporate network using SNMP services and a defined transfer interface. Besides PLCs, robots and, partly also process devices are equipped with PROFINET controller functionality. As the associated project engineering tools typically only support the diagnostics of PROFINET devices assigned to them, a central overview of the network state of the entire plant is lacking.

As a central requirement to the PROFINET diagnostics solution to be used, the body manufacturing production planning department requested its consistent use in the various project phases of the plant. During the installation phase, all components are built into the plant as defined in the specification. The subsequent commissioning procedure is completed by creating an acceptance report that includes communication characteristics serving as a reference for future target / actual comparisons.

In the maintenance phase, finally, the operation of the facility is continually monitored so that conditions such as device errors or an additional communication load on individual ports due to a change to a camera that requires a higher bandwidth, can be detected. In the event of a malfunction, it is necessary to locate its cause quickly so that a suitable maintenance action, e.g. test of a device, replacement during the next scheduled facility maintenance, or immediate installation of a spare device can be initiated.

SOURCE: SOFTING

Levels of interoperability within a connectivity architecture

The final assembly department performs all operations on the painted car body, from installing the interiors as well as the engine and the gear box, to the final inspection and factory acceptance test for the automobile. Here, primarily flat PROFINET structures with a central network connection of the PC to the switch are used. For the A4 and A6 series, final assembly at the site relies on approximately 60 PROFINET networks, separated from each other by firewalls.

A diagnostics and monitoring solution which specifically meets maintenance requirements, which can be integrated into the maintenance workflows, and which takes some load off the limited resources had to be built into the existing networks. Great importance is attached to the use of tools which are independent of the PROFINET components employed and lend themselves to integration into projects and existing networks while the facility is in operation. What is more, the integration must neither require additional components, such as database computers, nor installation work, and must make do with the limited space in the control cabinet.

Diagnostics and monitoring

Meeting the Audi requirements requires a diagnostics and monitoring solution which provides all diagnostics, system, and device information, permanently records monitored actual conditions and enables access to history data from the entire network. This way, all required information is available in case of need. Critical sub-functions of the solution employed are a topology view that allows a quick localization of failed devices, the display of detail information for the components in use, including inventory and stock details, as well as the detection of intermittent communication errors.

After gathering experience from corresponding test installations and a detailed comparison of the requirements with the supported functionality, the body manufacturing production planning and final assembly departments at the Neckarsulm site opted for the diagnostics and monitoring solution from Softing which is based on two components.

The TH LINK PROFINET product provides secure access to the individual PROFINET networks and monitors the communication and device status on the network based on a

SOURCE: SOFTING

Monitoring Tools	Description
Firmware Check	The Inventory screen shows all devices detected on the network. The entries in the FW Version column allow you to compare the firmware versions of similar devices.
Topology	The Topology screen visualizes the network structure so that the individual devices can be located quickly in case of an error.
Configuration Errors	From the Topology screen, it is possible to detect configuration errors such as the use of a wrong device name, by comparing the defined configuration to the actually determined network structure.
Detection of Connection Problems	The Error statistics screen provides an overview of the errors detected on the individual networked devices. If, for example, the negotiated bandwidth is low (e.g. 10 Mbit instead of 100 Mbit) or the number of lost packets is high, a problem with the cables or plugs can be excluded as a probable error cause.
Device or Connection Failure	After a failed device has been detected, the Network statistics screen helps you on by supplying further information to isolate the problem: • A short system up time of a device may indicate a restart after a device failure. • A long system up time, in contrast, rather signals a connection or cable problem.
Reference Measurement	The current network status at the time of acceptance testing is recorded via a reference measurement. This allows a comparison with the actual state at a later time so that alterations such as port errors, changed wiring, or the installation of other devices, become obvious.

A broad range of functionalities is available for permanent monitoring of PROFINET networks. Various screens provide different views on the current network status, and allow users to draw conclusions about errors that have occurred.

specific diagnostics algorithm. This algorithm not only performs passive monitoring of the data traffic, but also actively uses the diagnostics options provided by PROFINET and general Ethernet protocols.

This allows Audi to identify the devices on the network, supply device diagnostics information including network statistics, detect communication errors, and determine the network topology. The TH SCOPE monitoring software gathers all data at a central location and presents the consolidated data in a graphical user interface accessible from a web server. The presentation of results is geared to a consistent use across the various project phases and in particular supports the completion of maintenance measures.

In the meantime, Audio has included this solution as an integral part of all new body manufacturing projects managed by the Neckarsulm site. 25 PROFINET networks in new projects were equipped with this solution in 2014. In addition, the diagnostics and monitoring solution is gradually integrated into existing final assembly facilities.

This integration in the control cabinet requires minimum installation effort and can be accomplished without stopping normal operation. Up to now, about 60 PROFINET networks could be retrofitted. The introduction of the Softing solution is accompanied by a 1-day training course.

Operation benefits

The TH LINK PROFINET and TH SCOPE products support Audi by ensuring consistent high quality of PROFINET communication both for network acceptance testing and during normal operation.

Due to the straightforward and quick determination of error causes after the detection of erratic behavior, a constantly higher availability of the facilities is achieved. The possibility to connect an entire network including its subnetworks by means of a single TH LINK PROFINET device contributes to a positive cost-benefit ratio. Another decisive factor is the option to retrofit existing facilities without stopping normal operation.

"A major benefit for Audi is the consistent use of the diagnostics and monitoring solution, from installation to daily operation. This allows us for example to do reference measurements for a comparison of the acceptance test situation to the current network status and quickly spot any alterations," said Felix Niederbacher, technical manager for automation engineering standardization in the body manufacturing production planning department.

"As part of the cooperation with Softing, the tool was optimized to meet the specific Audi requirements. Besides network diagnostics, the solution also covers the use of the tool in the factory acceptance procedure and in the creation of suitable network documentation," Niederbacher said.

Dr. Christopher Anhalt, Senior Produkt Manager Diagnostics and Georg Suess, Operational Marketing work for ***Softing Industrial Automation.***