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## Substation networking best practices 8

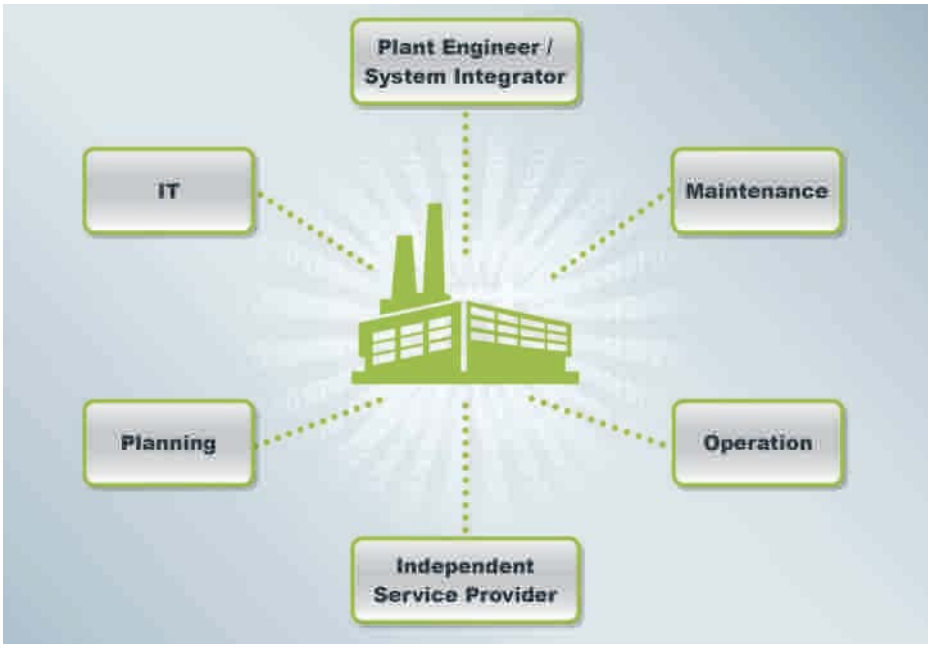
# PROFINET diagnostics: flying blind or efficient maintenance?

**Diagnosing problems with PROFINET networks and other TCP/IP-based Industrial Ethernet systems raises technological and organizational challenges. Issues span from routine checks of open networks through to complex technical troubleshooting of persistent faults, and require additional training within the enterprise.**

PROFINET IS AN ESTABLISHED COMMUNICATION standard in industrial automation, and the development and installation of PROFINET networks presents no problems in the majority of cases. If a diagnosis of the PROFINET network is needed, however, many users venture into new territory. A network acceptance test, for example, is often not included in the plant commissioning procedure, and plant operators and maintenance staff are looking for clear best practice guidance on how to monitor PROFINET networks during operation, how to reliably keep them up and running, and how to react quickly and efficiently if problems occur.

The reason for this situation lies in the profound changes brought about by the shift from traditional fieldbus systems to PROFINET, or to TCP/IP-based Industrial Ethernet systems, in general. One thing that becomes particularly apparent is that these changes not only raise technical but also organizational issues and their effects on plant organization.

Before delving into the subject, it is necessary to clarify what is meant by the terms "diagnosis" and "network diagnostics". In this context, Softing uses a comprehensive approach that not only covers fault localization and correction in the case of failure, but also includes general action and measures ensuring proper operation of a PROFINET network throughout the life cycle of a plant – from installation to commissioning and operation. The table below illustrates the individual diagnostic measures taken for each of the three life cycle phases of a plant or network. The transition to a plant's "network management" or even "system management" is seamless.




SOURCE: SOFTING

*Potential participants in PROFINET network diagnostics. Who does what tasks?*

## TCP/IP brings change

What changes does the use of PROFINET, as an example of TCP/IP-based Industrial Ethernet communication, actually bring to industrial automation? TCP/IP is an open, extremely widespread standard protocol. Users are looking to profit from this openness and the possibilities it offers. As a result, the conditions on PROFINET networks frequently change in the field. For example, users regularly modify the network configuration and exchange the nodes connected to the network. The use of a TCP/IP protocol therefore also means that the boundaries between industrial automation and enterprise IT are becoming more and more blurred and permeable.

Even if a network can be kept stable, the configuration of the network and nodes is still more complex. Regardless of whether faults in the network occur right at the beginning during commissioning or later on, e.g. after the replacement of a defective device during operation of the plant, they are often caused by configuration errors. Faults resulting from physical causes, in comparison, are far less frequent than in PROFIBUS networks, for example. (This is the current state of knowledge. The future will show how PROFINET networks will age in practice.) The lower protocol levels of PROFINET communication are complex. Depending on the cause of the fault and the necessary analysis to be performed by the user, it may take in-depth knowledge of communication technology or IT to identify and correct the fault.

All in all this means that, on the one hand, users of PROFINET technology are faced with the technological challenge of adapting network diagnostics to the new conditions brought about by TCP/IP-based communication. But on the other hand, users need to address organizational issues. These reach from routine checks of open networks that are basically running stably but are subject to changes, through to the complex technical troubleshooting of a persistent fault. The first question that needs to be answered here is how the wide range of diagnostic tasks can best be fulfilled and who is to take care of what tasks.

| | Installation | Commissioning | Operation |
|---|---|---|---|
| Cable test | X | | |
| Acceptance test | | X | |
| Continuous monitoring | | | X |
| Troubleshooting | | X | X |

SOURCE: SOFTING

*The individual phases of a plant's life cycle require different diagnostic functionalities for PROFINET networks.*

## Organizational matters

The following three example questions illustrate the organizational challenges facing

PROFINET technology users attempting to maintain plant networks.

1) Who does the maintenance staff call if they are unable to locate and correct a fault with their standard tools? A specialist from their own department? The in-house IT department? An external service provider? Are there in fact any clear criteria by which the maintenance staff can decide at which point external experts are to be called in?

2) How can users obtain a transparent, reliable acceptance test for a PROFINET network as part of plant commissioning? Is acceptance testing performed by the plant vendor? Is it performed by the in-house planning department? Or is an independent third party called in?

3) To what degree does the planning department take the responsibilities, processes and tool selection for network diagnostics into account at an early stage? If this is not the planning department's job, then whose is it?

It is striking how differently these organizational questions are currently answered by PROFINET technology users and how widely the assignment of responsibilities and tasks to different roles varies. Even within a single company, there are great differences between individual production sites.

It is largely undisputed that maintenance plays a key role. The maintenance department is responsible for first-level support for the entire plant, which is now based on complex PROFINET technology. Maintenance staff needs processes and suitable tools that enable them to efficiently work on PROFINET networks without having to "fly blind".

At the same time, it is neither necessary nor practical to have every member of the maintenance staff become an IT and communications expert able to detect and identify such difficult errors as an internal error in the device vendor's protocol stack.

## Consequences for diagnostic tools

Against this background there are a number of basic requirements that need to be met by network diagnostic tools. The fact is, there is no ultimate all-in-one tool that can automatically perform all conceivable diagnostic tasks for any conceivable user in the best possible way. What can be used instead is a set of individual tools which each fulfill a specific diagnostic task in reference to the assigned responsibility. The other way round, users should select their tools with a view to the precise role and tasks they have been assigned.

Back to the technological challenges, two working group initiatives in standards bodies (one current and one recently completed) are worth mentioning. The first initiative, a PROFIBUS+PROFINET International (PI) working group headed by Karl-Heinz Niemann, has revised and extended both the PROFINET Design Guideline and the PROFINET Commissioning Guideline (PROFINET Design Guideline Version 1.14, PROFINET Commissioning Guideline Version 1.36, both released in December 2014). In the second, the GMA Technical Division 6.15 (VDI/VDE) headed by Jürgen Jasperneite is currently preparing a guideline entitled "Reliable Operation of Ethernet-Based Bus Systems in Industrial Automation". These documents provide many detailed descriptions accompanied by concrete recommendations, in particular also for PROFINET network diagnostics.

Exactly what tasks are involved in the operation and diagnosis of PROFINET networks during the different phases of the plant life cycle? What functionality is needed during installation, commissioning or operation of the plant? And how can tools assist the different user groups in fulfilling these tasks? A second article on this topic will address these questions in detail in an upcoming issue.

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