CLEVER network management tools help maintenance personnel in detecting network problems at an early stage. Profinet is based on Industrial Ethernet. In some cases this network structure can be complex due to the flexibility of Profinet.

Profinet Technology offers additional Diagnostic mechanisms which are related to Ethernet standards such as Simple Network Management Protocol (SNMP) or Link Layer Discovery Protocol (LLDP). These mechanisms are standards which are built-in in a lot of Profinet Devices available on the market.

Sometimes it is not easy to keep an eye on the often complex and flexible network architecture of a production plant. But a clever industrial network management tool or engineering software which automatically creates pictures of the current network topology helps maintenance personnel with error analysis.

Navigation devices, bus line maps and street maps are crucial when you want to explore a new city by car or public transportation. The same is true for management of industrial networks, such as those found in production plants. Pictures of the network topology can be used to perform diagnostics and implement measures even before plant automation is affected. However, it is important to select the right network management tool; one that is able to automatically create pictures of the network topology and keep them up-to-date without major effort even if there have been changes to the plant.

**Topology Knowledge Is The Key To Success**

Such pictures graphically depict the structure of the network with the physical connections between the devices as well as their arrangement. Errors can be easily localised with the help of these pictures, for example, in plants that are networked with Profinet or Industrial Ethernet. The importance of knowing the topology increases with the number and variety of devices managed in the network.

Unlike a Fieldbus, such as Profinet, Ethernet does not connect all devices with the same cable and the number of devices from different manufacturers is significantly larger. Special components, such as switches and Wireless LAN access points, are used to connect communication partners in Ethernet; these can be used to physically expand the network as much as necessary.

In addition to automation terminal devices (SCADA, Panels), such as controllers, drives and IO devices, standard Ethernet devices (eg: printers) found in a typical office environment are occasionally connected.

Topology graphics help you to keep an overview, and they are crucial for a number of critical network management tasks, including correlation and analysis of events. Not only do they trace problems all the way to their source, topology graphics can also be used to analyse utilisation and weak spots of individual network paths under very different load conditions.
Standards And Manageable Switches For Topology Detection

It is not an easy job to identify all devices in the Ethernet and combine them into a global and cohesive network topology. Automatic detection function also requires information on switches and WLANs in the network in addition to information on the terminal devices. These are transparent for the actual communication between the terminal devices, however. They merely forward the data packets without participating in the communication.

Fortunately, protocols such as Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP) and Simple Network Management Protocol (SNMP) are available to determine topology data from the network, such as the ‘learned’ MAC addresses per port.

However, this data can be incomplete or outdated when a port is not used for communication for some time or if the switch does not constantly update this data.

A reliable method was introduced with the LLDP standard (Link Layer Discovery Protocol; IEEE 802.1AB) — also for Profinet — to find out more about the neighbourhood. LLDP helps devices discover information about their immediate neighbours in the network at regular intervals and saves this information for each device in the special Management Information Base (MIB) — RFC 2922; Physical Topology MIB. Mutual recognition using LLDP requires this function to be used throughout the system.

However, a large network can always include devices that do not support this standard. What is more, there are also manufacturer-specific and model-specific differences in the data offered by SNMP. This means topology tools must use a variety of sources and be able to compensate any gaps in the data by employing special algorithms. If these gaps are too large or the results too inconclusive, the user can still correct them.

Automatic topology recognition always works when standardised network components with SNMP and Profinet support are used.

Benefits Of Industrial Network Management Tools

The range of available SNMP tools starts with simple freeware tools available on the Internet and goes all the way to company network management tools for €100,000 (US$135,520). These tools are no longer limited to merely managing networks. In addition to their high price, they also require the expertise of an IT administrator, who can monitor the database or e-mail applications of the numerous PCs and servers in a company.

Monitoring of the ‘switch topology’, which means monitoring the port interconnection between devices, usually plays a minor role in traditional IT. The IP addresses of the network are often only grouped into subnets in IT tools and the connection of the subnets is displayed by routers or Layer 3 switches.

However, such ‘router or Layer 3 topologies’ only represent a small fraction of industrial networks because all physical connections on the port level are lacking within these subnets. In addition, the networks in automation plants are not only configured in star or tree shape configurations, they are often adapted to the machine designs from the days of Fieldbus technology. This means Industrial Ethernet switches are often distributed throughout the entire plant with only a few ports, and they are often networked in line structures and redundant ring structures, such as Media Redundancy Protocol (MRP). Many Profinet devices have the switch on board integrated.

Industrial network management tools or engineering tools can detect and display these special network architectures. They are using the Profinet protocols Discovery Configuration Protocol (DCP) and LLDP in addition to SNMP to monitor devices and topology at regular intervals. The collected diagnostic data can be displayed by a web browser in the form of various tables and topological diagrams, and they can also be integrated into the plant’s Human Machine Interface (HMI) or Operating Panels.

With today’s technology and standards, Profinet offers powerful tools to document and monitor the healthiness of a complete automation network.