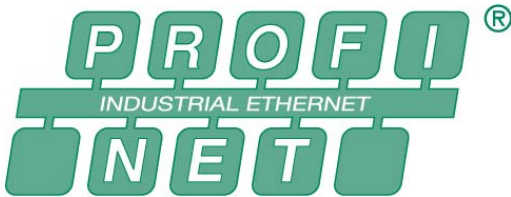




PROFIBUS and PROFINET • North America

A PTO White Paper MES and PROFINET



MES and PROFINET

Dr. Peter Wenzel,
PI (PROFIBUS & PROFINET International)
Karlsruhe, Germany

The PROFINET and MES Maintenance Operations guideline of PI (PROFIBUS & PROFINET International) defines an open integration path between MES and PROFINET based automation systems.

Proprietary technology has provided access to data stored on automation systems which is needed by Manufacturing Execution Systems (MES). Ethernet-based PROFINET offers an excellent mechanism for capturing process data as well as information which is relevant in the MES context. (See Figure 1.)

PROFINET is the open, manufacturer independent Industrial Ethernet standard for the manufacturing and process industries. PROFINET makes use of TCP/IP and IT standards to provide seamless communication from the corporate management level right down to field devices. It offers scalable real time communications up to synchronized motion control.

PROFINET can be used in safety applications to protect workers, machinery, and the environment. The PROFINET security strategy prevents unauthorized access and sabotage. The proxy feature provides seamless integration of any fieldbus system into PROFINET.

Automation of individual production cells, machines or entire production lines can be implemented using the scalable

communication features of PROFINET. Scalability means that a single communications system is sufficient to handle the full range of production applications. The key benefits are minimal hardware and software costs, efficient engineering and reduced system maintenance requirements.

Ethernet is the key to establishing seamless communication between the automation level and the office, and it takes the pain out of functional integration between the two levels. To support the functional vertical integration, a PROFINET interface to the MES level has been created and part of the specification is already in place.

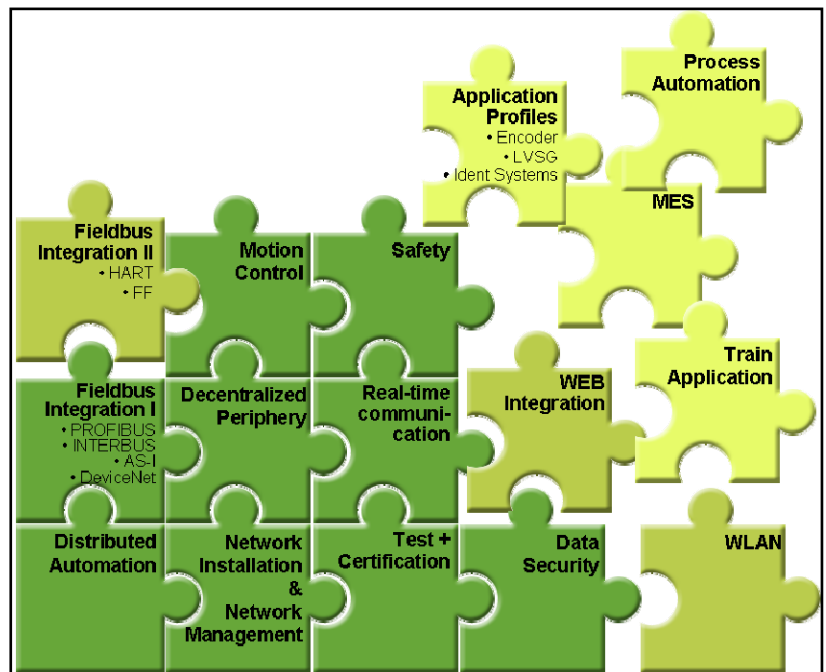


Figure 1: PROFINET, a modular technology

MES and ERP

Integration of automation systems into Manufacturing Execution Systems (MES) and Enterprise Resource Planning (ERP) is becoming an increasingly important feature of corporate-wide IT strategies. It enables companies to achieve maximum utilization of their production capacity. As companies strive to achieve greater flexibility, enhance delivery performance, and improve quality, they have continued to push the integration of their IT and production systems in recent years. They have also identified the need to eliminate gaps between their ERP and production automation systems.

MES systems were introduced to improve integration and provide additional functionality. These systems are positioned between ERP systems and production automation and control systems.

The Instrumentation, Systems and Automation Society (ISA) has defined interaction models and uniform terminology in standard ISA S95. This is the major specification for MES solutions, and it has largely been incorporated into international standard ISO/IEC 62264. The specification divides MES into four categories:

- Production
- Quality
- Maintenance
- Inventory

(See Figure 2.)

These so called operations are included in the maintenance category. They describe actions within the MES and interaction between the MES and ERP systems. It has been difficult in

the past to transfer information from automation systems to the MES because there were no established standards. PI (PROFIBUS & PROFINET International) has published the PROFINET and MES Maintenance Operations guideline to address this problem. It describes PROFINET functionality which is not directly relevant at the automation level but which is very important for MES maintenance systems.

Condition monitoring at the control system level

The status of a production asset is an essential piece of information which can be used to assess system availability, and this makes it a key parameter in the production planning process. The MES Maintenance Operations activity model needs status information as an

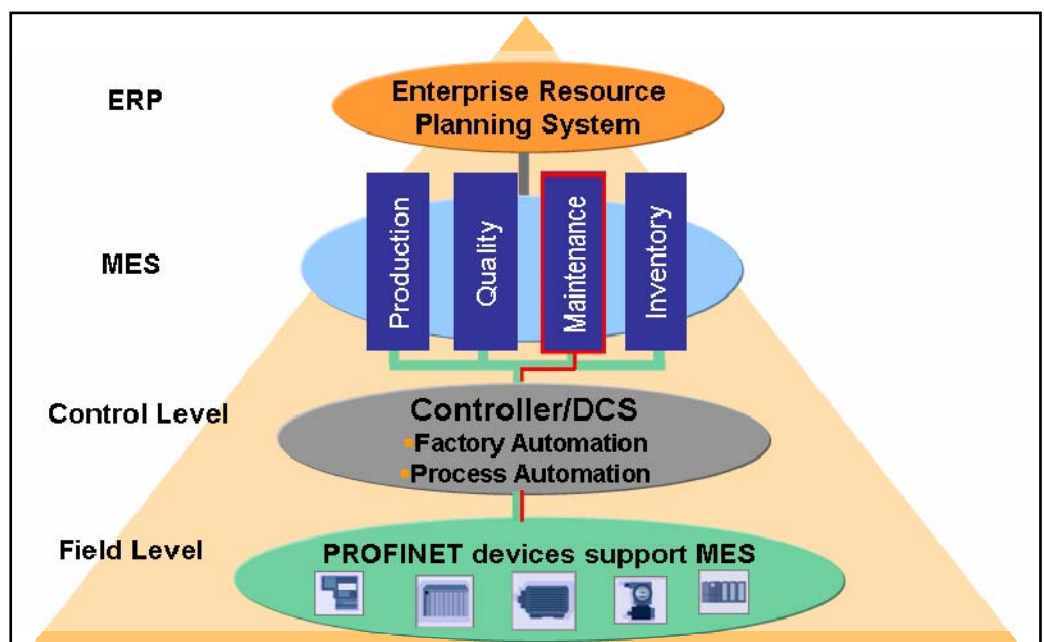


Figure 2: PROFINET defines the interface between the control system level and MES systems

input for planning and execution of maintenance activities.

Status information can normally only be provided by system components which have communications capability. These components can also act as proxies for components which do not have this capability. The availability of a standardized communications mechanism is extremely important to avoid extensive engineering work.

PROFINET uses an expanded “traffic light” model to represent device states. The warning levels maintenance request and maintenance demand have been added to supplement the device fault status. An additional 30 status conditions per device can be defined, and this ensures that maintenance state data (standardized device status information from the control system level) is adequate to handle future requirements.

The two warning levels can be used to distinguish between a condition that requires attention without delay and a condition that can be addressed during scheduled preventive maintenance. They support simple implementation of condition-based maintenance wherever wear, contamination, etc. can impair equipment operation. Manufacturers can define monitored entities which are associated with device channels and are used to track device status. A channel can have one or more monitored entities. A message is sent to the I/O controller whenever the state of a monitored entity changes using the diagnostic alarms which are defined in the PROFINET specification. This ensures that no information is lost and guarantees maximum transparency. Reporting the state change as an event avoids an increase in the communications load, and the status data can

be accessed in acyclic mode. (See Figure 3.)

There is common definition of the maintenance state for PROFINET I/O nodes and Component Based Automation (CBA) components. The status information for CBA components is stored in the component interface for the monitored entities and as a summary status for all of the components using the same syntax and semantics. The component manufacturer supplies the information to the interface.

Electronic device identification

Other PROFINET functionality which is important in the MES context includes the ability to electronically and uniquely identify the devices that are installed on the system. PROFINET uses the functions that are defined in the Identification and Maintenance Functions (I&M) guideline.

The basic I&M functions include the electronic nameplate which the manufacturer stores in the device and which can be read by the user. The nameplate contains device-specific data relating to items such as spare part selection, procurement and inventory, and it can also be used to schedule device updates. Some of the information contained in the electronic

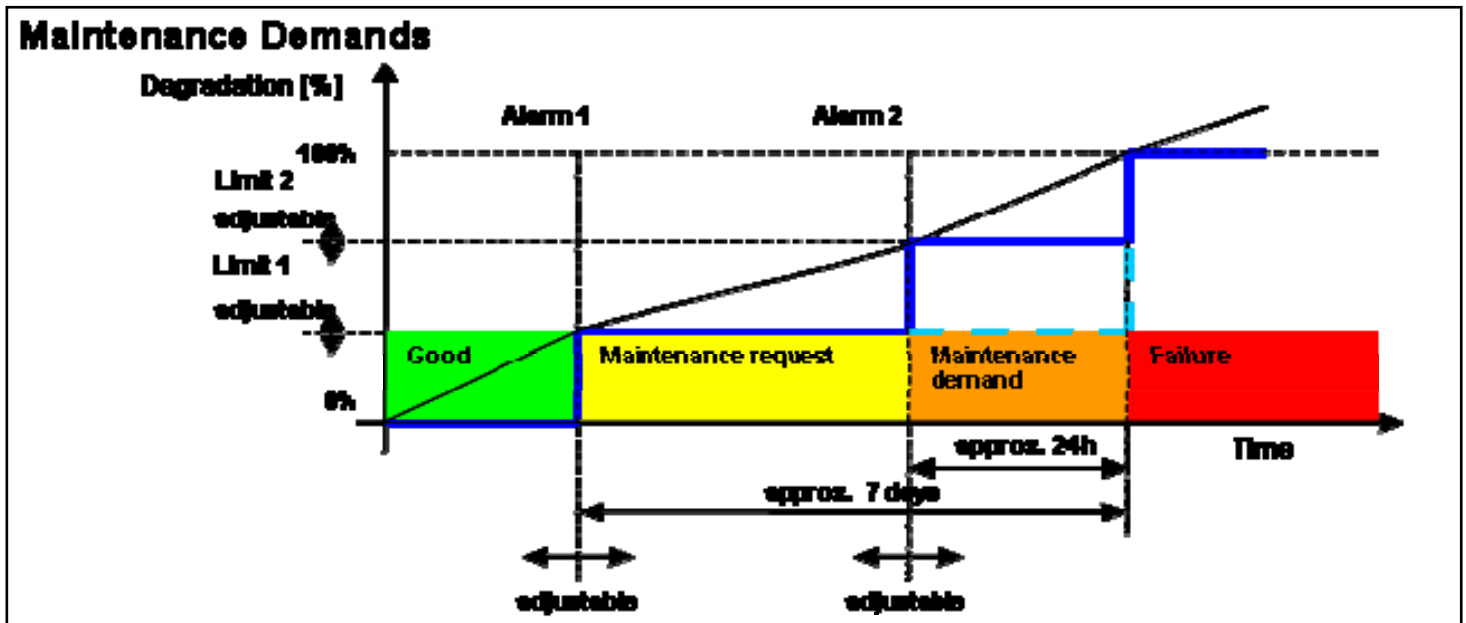


Figure 3: The PROFINET MES state model

nameplate is as follows:

- device manufacturer
- order number
- hardware revision
- firmware revision
- revision number

In addition to the electronic nameplate, other I&M data has been defined which users can store in the device when they are installing the system:

- system and location ID
- installation date & comments

I&M data in the device is stored in data records which can be read in acyclic mode.

Summary

PROFINET is a powerful communications technology which can provide access to process data and information which is needed by MES systems. It provides excellent support for MES and ERP systems. The PROFINET and MES Maintenance Operations guideline lays the foundation for future convergence of MES and automation systems.