

Useful production data for the company level via intelligent Ethernet I/O modules

Process optimisation made easy

The function of the MES (Manufacturing Execution System) is to optimise production processes. To do so, measurement data from the production level is collected and analysed, often in real time. A quick data analysis makes it possible to introduce measures promptly. At least, in theory. In practice, it is a great challenge to forward the measurement data from the production level to the MES program, as there is a lack of standards for this. However, as the following article shows, this data linking can take place simply and cost-effectively over Ethernet and MSX-E modules from ADDI-DATA.

To improve the efficiency of a company, all available information must be optimally used. A prerequisite for this is that both levels of IT systems – the planning/management level and process and production level – can communicate with each other. For this, an enterprise resource planning (ERP) system supports a company's resource planning. As production and ERP levels primarily support completely different tasks, a manufacturing execution system (MES) is effectively required as a binding element. Process monitoring requires permanent access to current data and demands standardised interfaces between the MES and ERP systems so that data in both systems are on-hand.

Norms and standards simplify planning and control

The basis for efficient communication between ERP and MES levels is provided by the DIN EN 62264 norm series. This norm aims to enable the exchange of information in the company and to improve it independently of the degree of automation.

Significant benefits for the user are:

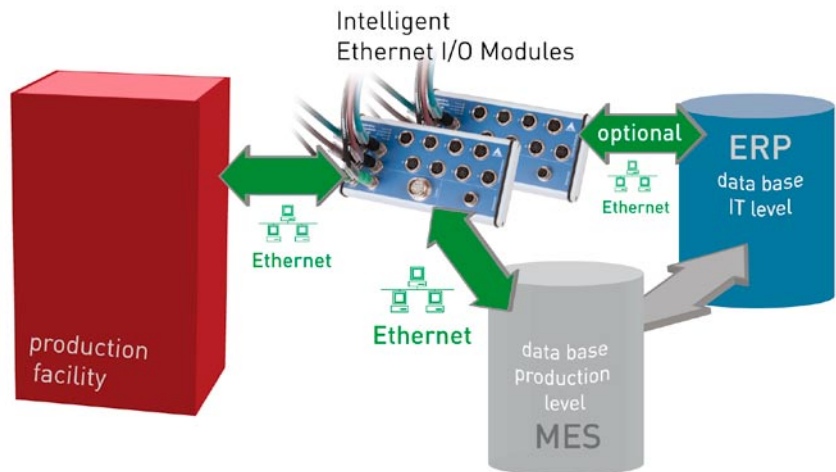
- Time savings when introducing new products
- Improved tools for integration
- Lower automation costs
- Better possibilities for defining user demands
- Optimising purchasing and logistics

The common standards for production, management and Internet communication also ensure an unlimited data flow between the management level and sensor/actuator level. Additionally, improvements are made in terms of data availability as well as communication and the quality of information in all company areas, ranging to convenient monitoring and remote maintenance.

Ethernet establishes efficient connection

For smooth communication between the various levels, it is useful to use standard interfaces such as standard Ethernet TCP/IP, web services (XML format) or the MODBUS protocol.

The Ethernet data transfer protocol is increasingly being used in industrial production. As it is also used in the IT level, it is obvious to use Ethernet for transferring production data into the company level. In addition, there is a wide availability of connection modules with industry standard plug-in/screw connections for connecting sensors and other hardware components, used for measurement and control tasks, to Ethernet.



The intelligent Ethernet I/O modules MSX-Exxxx acquire the data directly at the measuring point, convert the raw values into physical values and transfer them via the company network into the MES systems in the IT level.

Where and why intelligent Ethernet modules are useful

There are particular challenges when using Ethernet in automation when numerous measurement values are to be acquired accurately and synchronously. An example of this is provided by the automotive industry when measuring engine pistons and cylinders with numerous transducers. When manufacturing pistons and cylinders, small but not insignificant tolerances occur in the micrometre range.

The solution for measurement technology applications of this type is thorough localisation via intelligent Ethernet connection modules. A significant step is digitising the analog data as far as possible to the measuring point in order to achieve greater precision; giving it a time stamp and only then forwarding it via Ethernet. Thus when transmitting data to the parent controller, the assignment of the measurement values to the corresponding cylinder coordinates will no longer be lost. In the control or analysis unit, complete measurement sequences can be uniquely reproduced, regardless of the transmission time and sequence.

A further example: A microchip manufacturer would like to lower

wastage in production and optimise the production process. For this, it is necessary to acquire measurements such as temperature and pressure at different places in the production plant and forward the data to an MES system. The electronic measuring equipment must have a versatile data interface, with which it is possible to transfer measurement values to any MES system. Furthermore, the electronic measuring equipment must be housed with the machines themselves and not in switching cabinets for space reasons. The acquisition of many different signals is then done simultaneously to ensure the accuracy of the measurements. The existing Ethernet cables for production should be used for data transmission.

Cost-saving, practicable and future-proof

Traditional passive Ethernet connections cannot cope with such wide-ranging requirements. Intelligent Ethernet modules, in contrast, satisfy these demands if they meet a few criteria:

First, they must possess their own intelligence based on an economical and high-performance processor. This allows

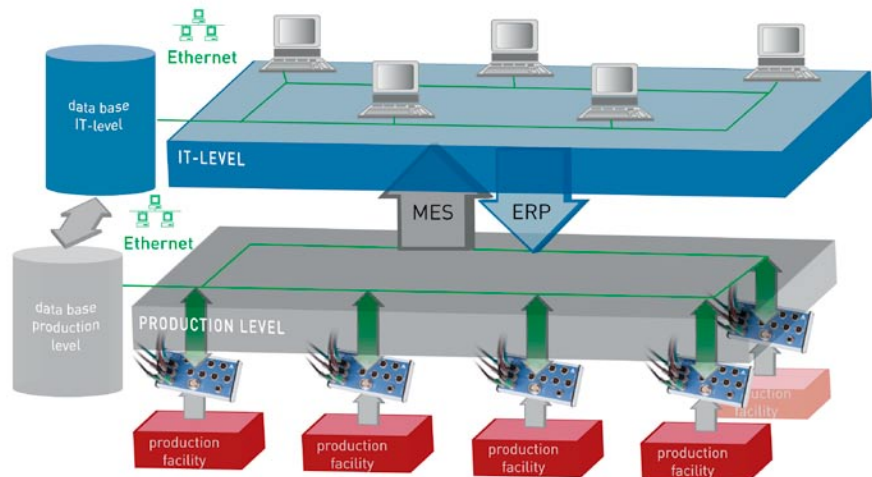
measurement data to be digitised on site and also pre-processed in almost any way. In this way, data can be compressed into packets with a time stamp and average values can be calculated, interpolated or simply buffered in the on-board RAM. It is essential to this that the MES is not provided with raw data, but that useful measurement data is filtered out from the huge data volumes. In other words, the intelligent Ethernet I/O module must be capable of independently converting raw measurement values into physical variables, such as temperature, pressure or length. Thus, changes can be recognised and evaluated more easily during the course of a process.

A second important criterion is the Ethernet module's suitability for industrial use: In order to improve the quality of the measurement values, they must be acquired directly at the machine or test item. This requires that the Ethernet I/O modules withstand vibrations, interfering signals, dust or jet water. Thus, a robust metal housing, screwed connections, and protection devices, such as numerous filters, optical isolation and the IP 65 degree of protection are requirements for the reliable acquisition of production data.

If the electronic measuring equipment is accessible over Ethernet, the third criterion is fulfilled, as the acquired data reaches the MES or ERP system directly and without detours.

Modular for efficient measurement technology

The MSX-E modules from ADDI-DATA are developed for direct use at the measuring point and meet the specified demands. They are designed for application with various signal types: digital I/O, analog I/O for acquiring pressure, temperature or length as well as counter signals. They are developed specially for use in harsh industrial environments and therefore correspond with the IP 65 degree of protection. In addition, they are also equipped with numerous other protection measures. To save on licence costs and bypass update obligations, the MSX-E module is equipped with the Embedded Linux operating system. An implemented embedded web server enables simple



If the measurement values are forwarded without detours by the electronic measuring equipment into MES or ERP systems, it is possible to adapt production processes promptly and in a targeted way.

configuration of the Ethernet modules. Various data retrieval options are useful here, e.g. an auto-refresh mode, which continually updates the memory with current measurement values, as well as a sequence mode, which supplies predefined data packets.

The Ethernet modules possess an ARM9 processor, which allows them to calculate acquired values, convert them into physical values and store them. The modules then provide for a smooth transfer of the measurement values to the MES or ERP system, "select" the useful data, or inform the higher-level system as soon as a measurement value changes. The measurement values are transferred by a program with which the user defines the parameters that should be transferred to the MES system (channel, acquisition time, etc.) and which provides a range of databases with different data formats such as MySQL, SQL Server, Access, XML, etc. The advantage is obvious: The user can select the parameters which he needs for process monitoring with a simple mouse click. The list of implemented databases can be further processed so that measurement data in other data formats can also be transferred. If several modules are used, e.g., because diverse signal types or a large

number of signals should be acquired, Ethernet, 24 V voltage supply and external hardware trigger signals are passed from one module to another. The modules can also communicate with any Ethernet hardware over the Ethernet switch. Ethernet and TCP/IP in conjunction with the Simple Object Access Protocol (SOAP) enable standardised access by remote computers and the simple use of .NET or processing programmes.

Self-sufficient and individually customisable

If special demands are made on the hardware, the MSX-E modules from ADDI-DATA can be adjusted as required. With the integrated Development Mode, self-developed applications can be easily implemented on one or divided across several MSX-E modules on site. For this, users have the possibility to adapt the software themselves or to commission the manufacturer to do so. Catherine Guinot, software developer at ADDI-DATA: "We write the software for our modules ourselves, possess the source code and, as such, can also carry out customer-specific adaptations ourselves. The advantage of this is that the customer does not require more

partners in order to be able to carry out software changes.”

If own intelligence and self-written applications are combined with each other, the Ethernet modules prove to be self-sufficient measurement systems, which are capable of starting and independently executing saved applications using the autostart function.

It also works without industrial PCs

Intelligent preprocessing is possible directly in production using an IPC, but not always necessary. The MSX-E modules from ADDI-DATA provide for a slim measurement system that, thanks to its own intelligence, is capable of

forwarding measurement values, i.e. “useful” data and no raw values, directly to the MES as a stand-alone operation (without additional computers). With expansion through the Development Mode, applications can be customised and can relieve the load on additional existing control computers. ■

Distinguishing features of the MSX-E modules:

- Compact system for use in close proximity to the measuring point. Robustness as a result of the extended temperature range from -40 °C to +85 °C and the IP 65 or IP 40 degree of protection.
- Can be cascaded and synchronised in the μ s range. The acquisition can take place over the synchronisation signal simultaneously when several signals are registered. Furthermore, thanks to cascading, Ethernet and the power supply can be looped.
- No (on-site) programming necessary. Measuring tasks can be parameterised over the web interface, where the autostart function ensures that measurement begins immediately after booting. The data server makes measurement values available to all users.
- Highly flexible due to the possibility to choose between different modules that can acquire various signal types.
- Highly flexible due to the embedded (Linux) operating system; many interfaces, such as TCP/IP, MODBUS, etc.
- Customisation through Development Mode, which allows any pre-preparation of the measurement data to be carried out directly at the measurement location. A plug-in is conceivable that can convert the voltage level into a “level in mm” quantity, for example.
- The MES does not receive any raw data, only “relevant” data, such as pressure, temperature, fill level and information when limit values have been exceeded.
- Safety through optical isolation.
- LED status display for quick error diagnosis.
- Direct use with MS Excel without programming knowledge for quick and clear documentation of measurement values.
- Easy to use, e.g. with .NET and LabVIEW™ via web services (WSDL files).



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