



White Paper

Transparent Network Infrastructure between CC-Link IE and PROFINET

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1 Introduction

General information about CLPA and PI

The CLPA (CC-Link Partner Association) and PI (PROFIBUS & PROFINET International) are announcing a close partnership. The objective of the partnership is to promote and broaden the use of open industrial Ethernet based networks.

The CLPA is an international organization with over 2,400 member companies worldwide. The common goal is dissemination and development of the open CC-Link technologies. CC-Link IE (industrial Ethernet) and CC Link (fieldbus) are the largest open networks in Asia and are becoming increasingly important in Europe and America as well. The CLPA has multiple offices and conformance test centers throughout the world. These locations are working with many vendor partners to promote widespread use of CLPA technology. Together, they offer a wide range of services for support of CLPA members in the individual regions, such as promotion and product development. About 300 manufacturers now offer more than 1,400 certified products and the installed base has grown to almost 15 million devices globally.

The key network technology offered by CLPA is CC-Link IE, the world's first and only open gigabit Ethernet for automation. This is seen as being a key technology to address the need of the new "Industry 4.0" or "The IIoT" applications which demand maximum bandwidth for the real time sharing of large amounts of process data between machines, throughout factories and beyond.

PI (PROFIBUS & PROFINET International) is a worldwide operating automation community and responsible for PROFIBUS and PROFINET, the two leading industrial communications technologies in automation today. The common interest of the PI's global network of vendors, developers, system integrators and end users is technical development and international promotion of these open fieldbus technologies. Currently, around 50 million PROFIBUS devices and 10 million PROFINET devices are installed worldwide. PI is supported by 26 regional associations (RPA). This global network shares a common interest in a larger installed base, further development, and application of PROFIBUS and PROFINET. Under the PI umbrella there are over 50 active working groups responsible for the development, standardization, and increased market presence of PROFIBUS and PROFINET. In addition, there is a global PI network of accredited Test Labs as well as Training and Competence Centers, which meet international quality standards.

PROFINET, the globally leading Industrial Ethernet standard, is the only Industrial Ethernet standard that offers full openness for TCP/IP traffic combined with deterministic real time behavior for motion control application. Especially with the

broad range of profiles, such as PROFIsafe, PROFIenergy and PROFIdrive, it is well prepared to serve as a backbone for Industrie 4.0 and Industrial IoT.

Shared values

CLPA and PI follow similar principles. For example, both organizations have relied on the openness and unconditional reliability of their systems since their founding. As a result, users can always trust that compatible devices will reliably communicate with one another independent of the manufacturer. In the case of CLPA, a worldwide network of conformance test centers guarantee that devices offer the performance required for interoperability. PI guarantees this with its global network of accredited test labs as well as Training and Competence Centers, which apply the same quality standards worldwide. Both organizations provide specifications free of charge to members, in which all required network parameters and device profiles are defined, in order to ensure interoperability at the application level.

2 Technologies

Both organizations have very powerful technologies. CC-Link IE, as the only open gigabit Ethernet solution, offers high performance. The performance is fully deterministic and is maintained across the network regardless of device type. It also offers safety and motion control capabilities as well as I/O control, all on the same network cable.

The total bandwidth is divided between deterministic “cyclic” (synchronous) communication and “transient” (asynchronous) message communication. The cyclic communication band, intended for I/O control, is fixed and will not suffer from degraded performance even when large volumes of traceability and diagnostic data are transferred via transient communication.

CC-Link IE is complemented by the SLMP (Seamless Message Protocol) technology. The SLMP is a common protocol which allows devices to communicate seamlessly regardless of different types of networks or network layers.

CC-Link IE has built a strong following in high performance industries such as automotive and electronics industries. It is also regarded as being the fastest growing industrial Ethernet protocol by independent market research.

For PROFINET, shorter I/O data cycle times are achieved just by upgrading fieldbus systems to PROFINET, due to the 100 Mbit and full duplex transmission. And

thanks to dynamic frame packing and automatic fragmentation of TCP/IP data in PROFINET, update rates of 31.25 µs are possible with open TCP/IP communication. PROFINET scores across industries in all markets with large networks in automotive production, real-time communication in different machine types up to and including high-performance printing machines, and extremely high availability in process automation.

In spite of the high performance of their systems, both organizations are convinced that this alone will no longer be decisive in the future. To offer an effective solution in terms of productivity, quality, and availability, the total package must be right. In other words, additional criteria, in particular, must be met. Important in this regard is the integration of products and systems in plants that are being expanded or when solving an automation task. For this, devices and machines with other integrated interface standards are often necessary. Currently, this task can only be fulfilled by vendor-specific converters. Standardized gateways will simplify this for users.

3 Motivation

Networks for the future

Digital communication using a fieldbus or Industrial Ethernet is already widely used in modern production plants and is an important building block for increasing productivity. The demand for intelligent communication will continue to increase due to megatrends such as Industry 4.0 and the IIoT (Industrial Internet of Things). The heterogeneous landscape of Industrial Ethernet standards that has existed for years, however, poses the above-outlined problem that devices and machines of different communication systems are in themselves unable to exchange data. Machine and plant manufacturers are therefore forced to equip their machines and plants with different networks. In addition, plant owners are limited in their selection of suitable machines. Manufacturer-specific transfer specifications and thus complicated converters are the consequence.

The success of Industry 4.0 and the IIoT depends largely on smooth information flow within the production process and on whether a homogeneous or heterogeneous network exists that accommodates different standards. Systems can only perform optimally; however, when there is unhindered data flow in real-time. Given the frequently used heterogeneous networks of today, the availability of a solution for easy integration of various networks, such as CC-Link IE and PROFINET, improves such applications.

This significantly expanded openness beyond a communication standard's boundaries is an essential requirement for solving the challenges of the future. The close networking between (autonomous) automation components, machines and plants, and IT systems, which is required for Industry 4.0 and the IIoT, can only function if standardization of cross-network communication becomes the focus of greater attention.

Goals of the cooperation

With their cooperation, CLPA and PI aim to make today's frequently required gateways between CC-Link IE and PROFINET networks possible in an easy transparent way through standardized interfaces. For users the benefits of the cooperation will be reflected in their day-to-day activities. When integrating machines and devices, users will no longer have to worry about how such gateways are to be arranged. Regardless of which network exists in an installation, in the future users can easily integrate both devices and components of CC-Link IE in PROFINET, and vice versa. Thanks to the partnership, device providers, machine manufacturers, and users can operate globally without having to worry about additional adaptations to their products, machines, and automation systems.

Users will additionally benefit from the fact that leading network organizations are undertaking harmonization between technologies and not individual companies. The sizable expertise of both organizations will benefit users. Difficulties arise, in particular, when advanced tasks such as diagnostics or integration of uncommon devices and components are involved. Because experts from both sides (CLPA and PI) are working on the standardization of this solution and various use cases, among other things, users will receive a solution from one source that covers all eventualities and even takes into consideration future requirements. At the same time, the solutions can be used for all machines and plants of a wide range of manufacturers.

4 Scenarios

To implement this cooperation from a technical point of view, there are two standardized technical gateway solutions: Coupler solution and link solution.

Coupler solution

The coupler solution covers communication between machines or systems. For example, an Asian machine builder would like to sell their machine, including the controller that is equipped with CC-Link IE, to a user in Europe that operates a PROFINET network. Conversely, a European machine builder may wish to sell their machine, which includes a PROFINET controller, to a user in Asia that operates a CC-Link IE network. Previously, developers had to devote considerable effort during engineering and installation as well as certification and commissioning in order to design the interfaces in such a way that seamless communication was possible.

In the future, these two controllers will communicate without impediments so that such a machine can be connected to European/Asian systems without much effort. For this, the machine with one network will be connected to another network as a quasi-black box via a coupler like a conventional network component. Cyclic data exchange will function as usual. Machine or system data aggregation will be done by acyclic/SLMP methods. The configuration of this coupler, the basic engineering, the handling of device profiles (CSP+/GSDML), and the network management will be carried out as usual. No complicated data transmission will be needed for this.

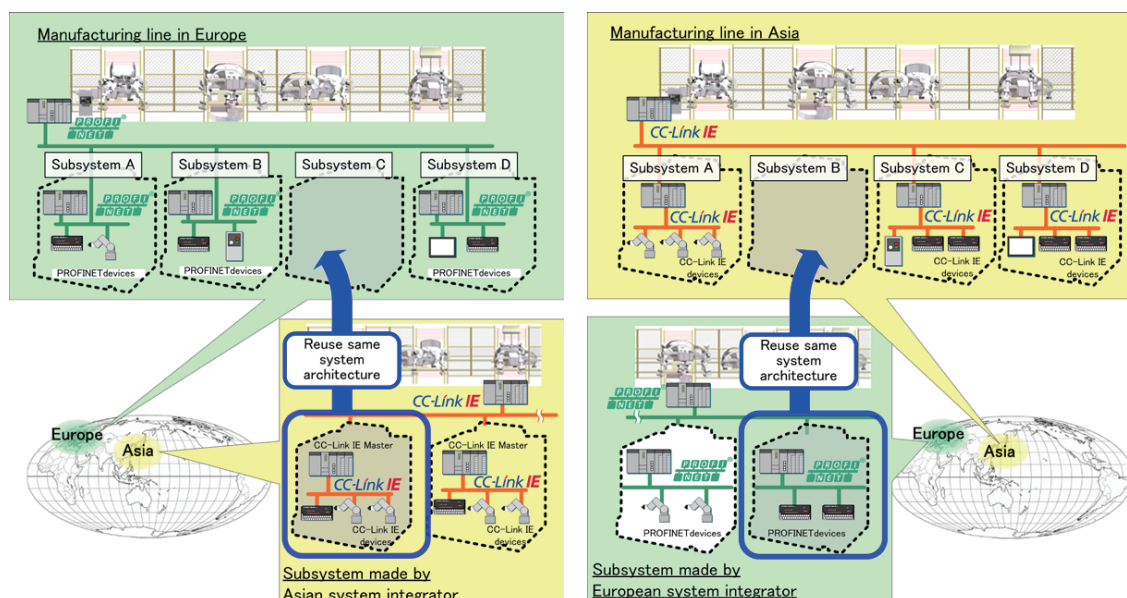


Figure 1: System integrator can reduce time for engineering and testing by integrating machines using couplers

Link solution

A link solution will be available for easy integration of devices, such as a drive on one network that is to be connected to a controller on another network. In this case as well, users will be able to rely on seamless functioning of the cyclic data exchange. Device information will be collected by acyclic/SLMP methods. The configuration, the basic engineering, the handling of device profiles (CSP+/GSDML), and the network management will function as usual as will the addressing of devices. Subsequent device replacement will also be possible without problems. Network status and acyclic data will be displayed the same as previously. This solution will also function in the reverse case. While this solution is not yet suitable for motion control or safety applications, ideas for further development already exist here.

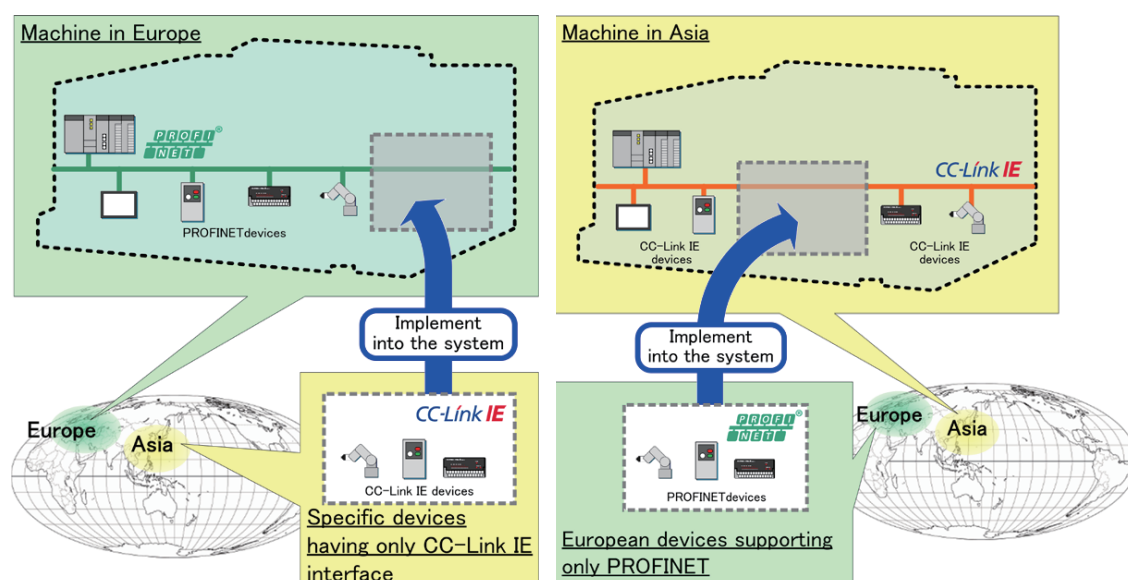


Figure 2: System integrator can select appropriate devices for their system by using a linking device

5 Benefits

Benefits for users, manufacturers, and system integrators

With these two solutions (coupler solution and link solution), it will become much easier to integrate machines of different systems into existing networks. In addition, users will have a greater selection. They can thus select from a large number of devices, systems and machines that are compatible with CC-Link IE and PROFINET. For users this means maximum freedom when designing their networks.

This simultaneously reduces expenses for engineering, development, commissioning, and subsequent maintenance of networks. This applies to users and manufacturers as well as to system integrators.

Through standardization of the interfaces and the fact that experts from both sides are working together to design these interfaces, future exchange of data between the systems, whether device or process information, will be even easier and better. This is of interest in particular if, in the context of networked production, detailed information about the plant must be made available faster and easier. The automation systems can easily exchange information about the machine status and product.

Users and manufacturers can thus expand their markets while still working with local standards. The partnership not only offers new prospects to controller manufacturers but also provides new opportunities for device manufacturers to generate new market shares. Entry into formerly 'foreign' markets will thus be significantly expanded. System integrators will also benefit from reduced costs in development, as well maintenance departments.

6 Outlook

Timeline

The collaboration was presented at SPS IPC Drives 2015 in Nuremberg. As a follow-up to that, a joint working group is working on the technical specifications of these solutions. When work on the specification is complete, it will be available to members of both organizations for implementation. Significant work on this specification is intended to be complete by SPC IPC Drives 2016, so that joint projects can be implemented starting from 2017.

Space for Notes



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