Why is TSN crucial for the future of industrial communications?

As the needs of manufacturing businesses have evolved over the years, so have the network infrastructures that support industrial communications. Now that Industry 4.0 is a reality, what should businesses look for in industrial networks, and how can they prepare for the future of manufacturing?

John Browett, General Manager of CLPA Europe, gives an overview on how industrial communication networks have changed and what the future looks like

From the fieldbus war to TSN: a brief history of industrial networks

Originally, no networks were used in automation at all, and cumbersome discrete wiring connected everything. This was replaced by various open fieldbuses in the 1980s. Although they were open, the wide variety of incompatible choices available caused a fierce battle for market control to be waged, known as the “fieldbus war”. Forward-looking network developers and vendors soon realised that fieldbuses with their open, but not interoperable nature, were doomed to have limited success, while open, interoperable solutions would triumph.

With this consideration in mind, the network technologies that followed offered an open, standardised physical layer in the form of Ethernet. Hence industrial Ethernet became a standard in industrial communications and factory automation. As a result, this generally allowed one type of infrastructure to be used. This solution also improved transparency, making it is easier for businesses to integrate the operational technology (OT) layer of the factory floor with information technology (IT), as well as combining safety, motion and normal control into one network. However, while the physical layer could now be standardised, in order to achieve deterministic operation, it was necessary to run various protocols on top of it. These were still not interoperable. So while openness was supported, this only worked if all devices on the network were using the same protocol. Hence the interoperability issues still remained.

What features do future industrial networks need to exhibit?

While industrial Ethernet has addressed many communications issues that businesses were experiencing in the past, its evolution is not yet complete. There are still a number of challenges left to address and the advent of Industry 4.0 is making these more acute.

As we already saw, the first problem is that there are multiple types of industrial Ethernet protocols. While they are open, thus giving freedom of choice to businesses, they are generally not interoperable.

Industry 4.0 applications generate larger volumes of information, which need to be shared among many different areas within a factory. This means that maintaining the information flow between “islands” of automation has become extremely important. It’s clear that multiple, incompatible industrial Ethernet protocols don’t support this. In

addition, Connected Industries require a greater convergence of OT and higher-level IT. Therefore, futureproof industrial networks need to support data sharing between these two layers.

The “holy grail” of industrial networks should offer a single, unified network architecture, which will allow businesses to connect anything together, independently of how many devices need to be linked, what they are and where they are located. In addition, the ideal system must be easy to maintain, secure and safe, as well as offering deterministic performance and high productivity.

While this “holy grail” isn’t currently available, knowing what is required helps define what technologies are needed to pave the way to future industrial communications. More importantly, with long automation lifecycles, businesses cannot wait for this future “holy grail” to upgrade their systems. Many projects require immediate action, so they have to start now on implementing network solutions that help them get closer to the future.

Increased network bandwidth will also be fundamental, as it allows businesses to share larger volumes of data more easily, addressing the requirements of Industry 4.0 and Connected Industries. Looking at the technologies that have already been introduced, such as CC-Link IE, it is possible to discern that gigabit bandwidth is becoming a requirement for moving forward with industrial Ethernet.

The importance of TSN for industrial automation

While bandwidth will certainly play a key role, another crucial gateway to Industry 4.0 will be Time-Sensitive Networking (TSN). This technology will further improve the possibility to merge different types of data traffic onto one network. For example, TSN supports the combination of control and standard TCP/IP traffic, such as video from machine vision systems used in inspection tasks.

Amongst other things, TSN allows traffic to be prioritised depending on its importance. Thus it is possible to use one network for different kinds of data without slowing down the transfer of information or negatively impacting the performance. As a result, businesses can put more traffic on the network and utilise it better, thus improving the overall performance of the system, while lowering the total cost of ownership (TCO).

Since TSN also makes “standard” Ethernet deterministic by itself, some have even argued that there will no longer be any need for industrial Ethernet protocols. However, we shouldn’t get too carried away yet. TSN is effectively just a “pipe” and has no ability to address common industrial needs, such as motion control, safety, device profiles and so on. Technologies such as OPC UA’s Field Level Communications (FLC) are addressing this, but it’s not clear when they will reach the necessary level of maturity.

CC-Link IE TSN to guide the quest for the “holy grail”

So we are currently left in an interim phase. While TSN offers great promise for the future, we still need to address the needs of today. A network technology that helps businesses get closer to the future “holy grail” of industrial communications is CC-Link IE TSN. This is the first open industrial Ethernet available on the market to combine gigabit bandwidth with Time-Sensitive Networking (TSN).

This latest solution was developed by the CLPA, the first open network association to use open gigabit Ethernet for automation. Over the years, the organisation has delivered key technologies aimed at supporting data sharing among controllers, 1Gbit and 100 Mbit field devices, as well as motion and safety control on one network.

CC-Link IE TSN builds on this legacy by offering a path to the future while also addressing today’s needs. It handles all current control needs as outlined above, while also providing a way to the converged networks of the future by incorporating TSN. Moreover, it was designed to handle high-performance motion control and offers the possibility to implement devices using software or hardware solutions, as well as supporting 100 Mbit and Gigabit Ethernet physical layers. Thanks to these future proof features, this innovative open gigabit Ethernet technology is able to handle all the challenges of Industry 4.0 and Connected Industries.

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Captions:

Image 1: As the needs of manufacturing businesses have evolved over the years, so have the network infrastructures that support industrial communications. (Copyright: iStock.com/ipopba)

Image 2: A network technology that helps businesses get closer to the future “holy grail” of industrial communications is CC-Link IE TSN. This is the first open industrial Ethernet available on the market to combine gigabit bandwidth with Time-Sensitive Networking (TSN).

Keywords: CLPA, CC-Link Partner Association, Time-Sensitive Networking, TSN, Gigabit Ethernet, Industry 4.0, Ethernet technology, Connected Industries

About The CC-Link Partner Association (CLPA)

The CLPA is an international organisation founded in 2000 dedicated to the technical development and promotion of the CC-Link family of open automation networks. The CLPA's key technology is CC-Link IE TSN, the world's first open industrial Ethernet to combine gigabit bandwidth with Time Sensitive Networking (TSN), making it the leading solution for Industry 4.0 applications. Currently the CLPA has over 3,600 member companies worldwide, and more than 1,900 compatible products available from over 300 manufacturers. Over 26 million devices using CLPA technology are in use worldwide.

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