



Integrated factory automation networks will be key to Industry 4.0

As interest grows in the concepts of Industry 4.0, it has become clear that the plant communications network will be the key enabler. Industry 4.0 relies upon the integration and optimisation of communications between field devices, production control systems, enterprise level IT systems and beyond. The key challenge is to ensure seamless communications between these disparate worlds.

John Browett, General Manager of CLPA Europe, examines how the gigabit Ethernet CC-Link IE open network technology resolves these issues.

Across the spread of industries, competition is becoming ever more intense, and increasingly global. At the same time, the different needs of regional markets, and the increasing need for higher levels of customisation to meet modern user expectations, means companies must be able to produce smaller batch sizes cost-effectively. Where once mass production was a given, today 'mass customisation' is becoming the new norm.

This shift in the nature of production places a new onus on the communications infrastructure within manufacturing businesses and has seen key trends developing in recent years. In a traditional structure, businesses didn't have to worry about taking a global approach to manufacturing. A single facility would have had its own plant floor control network, an enterprise level production control network and a layer of management at the top of the pyramid. As the company opened more sites within a region, perhaps the management functions would have become centralised at headquarters.

Already challenges would have been forming within the business with regard to communications, but globalisation has exacerbated the problem, with plants located not just within a single region but potentially spread all over the world. The custom IT systems written to support these new structures are expensive to develop and costly to support, and all-too-frequently obsolete even before implementation has been completed.

It is easy to see, then, the attraction of the cloud-based services that have emerged in recent years, enabling business operations to be matched to services that improve management efficiency and agility. Standards such as OPC UA have made it easy to link management systems through the cloud to the production control systems of plants anywhere in the world, combining the simplicity of vertical integration with inherent system security.

Plant floor networks also need to be addressed to ensure ease of integration with these new vertical structures. They need to take into account a variety of factors such as real-time operation, consistent productivity, guaranteed machine safety, and enhanced levels of cyber security. These are challenges made more difficult by the different layers of communications between simple sensors and actuators at one end of the spectrum and the advanced machine control and peer-to-peer control networks at the other, with seamless connectivity required to straddle these various layers of networks.



Further, the increased data being generated throughout the plant floor also need to be accessible within higher-level enterprise systems, placing a new emphasis on seamless vertical network integration. Only by turning this data into meaningful information at the enterprise level can relevant production and business decisions be taken. Increasingly, these business decisions must also take into account the wider supply chain, effectively linking production capability to raw materials availability on the one hand with the demands of the customer on the other.

Addressing key business demands

Effective solution strategies to all of these business and technological challenges, with an eye on the requirements of Industry 4.0, can only come from network architectures that integrate seamlessly at all of the different enterprise levels. Many network protocols have strengths in one or perhaps two of these different levels, but users must then rely on gateways and protocol converters to move data higher up or lower down. This introduces cost and complexity and is certainly not conducive to effective Industry 4.0 operations.

An improved solution is a single protocol that spans all levels of the business enterprise. The CC-Link IE open gigabit industrial Ethernet is just such a solution, embracing field networks, control networks and higher level connectivity. CC-Link IE enabled products and systems can move data seamlessly from sensors at the edge of the network, through controllers around the plant floor and on to the higher level manufacturing execution systems and beyond.

On the plant floor, CC-Link IE Field embraces all of the requirements of general machine control, motion control and safety with a single, robust gigabit Ethernet infrastructure linking field devices to controllers. It is a future-proofed technology as well, with the gigabit bandwidth offering ample scope for increasingly data intensive operations without sacrificing performance. Finally, since it is an open standard, multiple well known vendors offer products that support the technology.

For higher level communication, such as between controllers in different production cells, CC-Link IE Control provides a higher capacity optical fibre backbone that is also based on standard gigabit Ethernet technology. While real time performance is characterised by high speed cyclic or synchronous communications, other manufacturing data, such as recipe control or alarms are usually delivered in a transient or asynchronous manner. In conventional network architectures there is the potential for one to disturb the other, compromising overall network response and hence manufacturing integrity or product quality. CC-Link IE's gigabit bandwidth means that even a sudden flood of alarm messages will have no impact on the routine execution of the process.

Addressing the requirements of machinery safety, CC-Link IE's SIL3 certified safety protocol has been developed to realise safety communications between safety field devices and a safety controller, as well as the transmission and reception of safety data between safety controllers. Further, the seamless integration within CC-Link IE of the safety communications with the standard control data means a single network can handle safety, process (and motion) control, thus reducing installation costs, simplifying maintenance and improving visibility.



For vertical integration with higher level networks, the CLPA offers the Seamless Message Protocol (SLMP). This allows point to point transient (asynchronous) data links to be formed from 100Mbit devices by simply implementing software on a given device. Hence almost any existing Ethernet device can be integrated into a CC-Link IE system in this way.

Already, these combined developments within CC-Link IE address current thinking behind implementations of Industry 4.0, but there is more to come. For example, within Industry 4.0 concepts there is talk of production lines that will reconfigure themselves according to the product being made or to enable productivity to be optimised by making best use of available capacity at any given station at any given time.

However, none of this will happen without a comprehensive range of devices and vendors with which to build such systems. The CLPA is constantly developing the catalogue of CC-Link IE products in partnership with its many members (currently over 300 companies offer CC-Link IE and/or CC-Link fieldbus products). To further enable the spread of the technology, CLPA also recently introduced CC-Link IE Field Basic, a new version of CC-Link IE intended for existing 100Mbit devices. This means that the number of devices capable of supporting the technology is now virtually unlimited.

We can see, then, that as Industry 4.0 gains traction and more businesses look to reap the benefits that an Industry 4.0 implementation can bring, network integration will be a key driver. CC-Link IE offers not only the highest performing technology for today, but is also future-proofed to meet the requirements of tomorrow.

Image Captions:

Image 1: Manufacturing IT system and batch management via cloud computing

Image 2: CC-Link protocol family

Image 3: Link Scan Time

Image 4: SLMP (Seamless Message Protocol)

Image 5: Dynamic network configuration



About the CC-Link Partner Association (CLPA)

The CLPA is an international organization 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, the world's first and only open gigabit Ethernet for automation and an ideal solution for Industry 4.0 applications due to its unmatched bandwidth. Currently the CLPA has over 2,800 member companies worldwide, with more than 1,500 certified products available from over 300 manufacturers. CC-Link is the leading open industrial automation network technology in Asia and is becoming increasingly popular in Europe and the Americas.

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