



Ethernet/IP + Integrated CIP motion

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Adding integrated CIP Motion into Ethernet/IP's extensive list of capabilities reinforces the fact that this industry-proven communication protocol is gradually becoming the first point of call for many of the world's leading process companies, machine builders and end users.

Since its conception nearly 40 years ago, Ethernet has undergone a constant evolution - which has not lost any of its pace - becoming faster, more robust and eminently suitable for an even more extensive range of applications. It has also seen a number of tailored protocols developed to exploit its capabilities in a wider arena of operations. One such derivative, Ethernet/IP, is leading in the industrial arena, primarily due to its adherence to the main Ethernet standard. This is opposed to other industrial Ethernet solutions that bypass certain elements of the Ethernet model in order to achieve particular performance goals. However, this modified approach leads to the need for proprietary hardware, firmware and software to handle those portions of the application that require real-time control - none of which restrict the deployment of Ethernet/IP.

Seamless data exchange

Through its standard-based approach to Ethernet, Ethernet/IP has kept pace with the rapid development and enhancements experienced by the core protocol. It is now feasible to run an entire manufacturing or process operation on a single, scalable network, thanks to Ethernet/IP's adherence to the same Ethernet protocol used in the office environment. By offering seamless data exchange from the shop floor to the enterprise level, companies are capable of making significant savings in terms of engineering effort and deployment/commissioning costs.

Recent advancement

One of the most recent advances for Ethernet/IP is the addition of integrated CIP Motion, which means that companies can now handle automation, discrete, process, safety and motion on a single network. This is made even more attractive by the ability to programme all of these primary control disciplines with a single, scalable software environment - RSLogix 5000. By introducing these capabilities into its new midrange portfolio, Rockwell Automation is also bringing this control solution - normally seen in much bigger installations - down to single-machine or cell level.

Single-architecture approach

There are many reasons why the single-architecture approach to motion is attractive to the industrial market. From a holistic perspective, many machine builders and end users have to address multiple scenarios; such as integration, safety, information, diagnostics and sustainability. Often these will involve multiple protocols with equipment from many vendors; all of which ultimately have to 'talk' to each other to produce an outcome that, although feasible in terms of actual performance and end results, may not be in terms of cost and the applied engineering effort. The simplicity and functionality of the single-network approach makes Ethernet/IP so attractive. In addition, as it is based on an unmodified and established protocol, which has an extremely positive past, present and future, the investment in Ethernet/IP is very much a long-term commitment towards future proofing assets and effectively integrating them with the wider enterprise.

Flawed argument

The question is why certain competitors are slow to modifying Ethernet to handle motion? Speed is mentioned as being the defining reason for Ethernet/IP's perceived unsuitability for motion applications. However, this is a flawed argument and is disproven by the way Ethernet/IP handles motion commands.

What ODVA says

The ODVA sums it up nicely. Typically, multi-axis motion control uses event-based synchronisation, which requires scheduled, absolute hard delivery of time-critical cyclic data across the network. For precise speed and position control, jitter of less than 1 μ s for cyclic data is necessary, something which Ethernet's CSMA/CD data layer is not capable of delivering. This determinism problem might seem to rule out standard unmodified Ethernet for motion control, but ODVA has overcome this limitation with Ethernet/IP without resorting to changing any of the four lower layers of Ethernet, using standard, unmodified Ethernet and TCP/UDP/IP.

ODVA is the organisation that supports network technologies built on the Common Industrial Protocol (CIP) - DeviceNet, EtherNet/IP, CompoNet, and ControlNet.

Clock synchronisation

Ethernet/IP with CIP Motion solves the problem by changing the strategy for determinism. It removes the requirement for strict determinism from the network infrastructure and entrusts the end devices with the timing information necessary to handle the real-time control needs of the application. Thus, Ethernet/IP with CIP Motion can deliver the high performance, deterministic control required for closed-loop drive operation, using standard, unmodified Ethernet. Clock synchronisation of better than 200 ns can be readily achieved, meeting the needs of the most demanding motion control applications. Because the clocks in the end devices are tightly synchronised, a small amount of jitter in receipt time of the message is negligible, because information in the message is time-stamped. Ethernet/IP with CIP Motion allows 100 axes to be coordinated with a 1ms network update to all axes. Competitors may argue that 1 ms is still not as fast as what they can offer, but in real-world applications, the mechanical constraints/inertia imparted by what is being driven by the motion solution make this point debatable. Most likely, the end application is for packaging or label application. In these instances 1 ms is more than adequate and, indeed, will be for most motion applications.

Conclusion

There are many benefits to migrating to an Ethernet/IP-based solution for motion. These must be considered in parallel with the needs of the wider system and enterprise. Scalability, flexibility, seamless integration, a single operating environment and an Integrated Architecture

CIP – Common Industrial Protocol
CSMA/CD – Carrier Sense Multiple Access with Collision Detection
IP – Internet Protocol
TCP/UDP/IP – Transmission Control Protocol/ User Datagram Protocol/
Internet Protocol

Abbreviations

all work together to make it an extremely attractive proposition, not just for motion, but also for machine and process control in their broadest sense. Furthermore, future proofing plays a huge role, as later migration to Gigabit Ethernet is very easy for both users and device suppliers due to maximum leveraging of commercial off-the-shelf technology. Only Ethernet/IP with CIP Motion technology combines the requirements of deterministic, real-time, closed loop motion control with 'standard' Ethernet, offering full compliance with Ethernet standards, including IEEE 802.3 and TCP/IP.

Reference

- [1] IEEE 802.3: Working Group - develops standards for Ethernet based LANs.



With more than 20 years experience in automation, Lluís Martínez has spent the last six years on working with machine builders across EMEA to understand their needs and feed this into Rockwell Automation, to assist in the development of products, services and commercial programmes that meet requirements. Enquiries: 011 654 97 00 or email shoman@ra.rockwell.com.

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