

Universal network promises Open motion control

MOTION CONTROL SYSTEMS ARE USUALLY IMPLEMENTED ON SPECIALIST HIGH SPEED NETWORKS, BUT NOW AN ETHERNET-BASED SOLUTION CREATES THE POSSIBILITY OF A SINGLE NETWORK PROVIDING ALL DISTRIBUTED CONTROL REQUIREMENTS AROUND A MACHINE OR PLANT. AND BEING 'OPEN' MEANS IT IS NOT RESTRICTED TO ONE MAKE OF EQUIPMENT.

Most engineers are only too familiar with the proliferation of different specialist networks associated with automated production. But for some years Ethernet has been seen as having the potential to be a universal network – one which could be installed in one hit, would rationalise training and maintenance requirements and, significantly, reduce costs on every front.

The capabilities of Ethernet have been expanding towards this goal steadily for some years and now, following the launch of Ethernet/IP with CIP Motion, one of the last pieces of the puzzle is in place.

CIP (common industrial protocol) Motion provides an open, high bandwidth, high performance solution for distributed multi-axis motion control over an Ethernet/IP network. It encompasses a set of application profiles designed to allow position, speed and torque loops to be set within a drive or servo amplifier and combines with ODVA's (Open Device Vendors' Association) CIP precision synchronisation technology.

From the machine builder's point of view, rather than the motion specialist's, multi-axis motion control is usually based on event-driven synchronisation. For instance a packaging machine may have an operating sequence of: product placement into a blister pack; closure of the lid; sealing; labelling.

Each of these steps would involve a number of sub-steps related to a motion axis, and the correct order of operation has to be maintained throughout the

operation. The speed of sequencing, or the 'determinism', is also critical for successful motion control.

For such a sequence to be enacted requires scheduled, absolute hard delivery of time-critical cyclic data across a distributed network of axes. Precision sequencing of data delivery is necessary, typically to a resolution finer than 1 millisecond. But, as many practising engineers will be aware, Ethernet's data layer is not capable of this speed of response, so would not seem to be able to achieve the level of determinism required.

Multi-company development

Members of the ODVA have worked together to address this issue and, with CIP Motion, have changed the strategy for determinism. They

have removed the need for strict determinism from the network infrastructure and instead entrust the end devices with their own time-management functions. So, while each field device is acting autonomously, collectively they are handling the real-time control needs of the application.

Highly accurate clocks

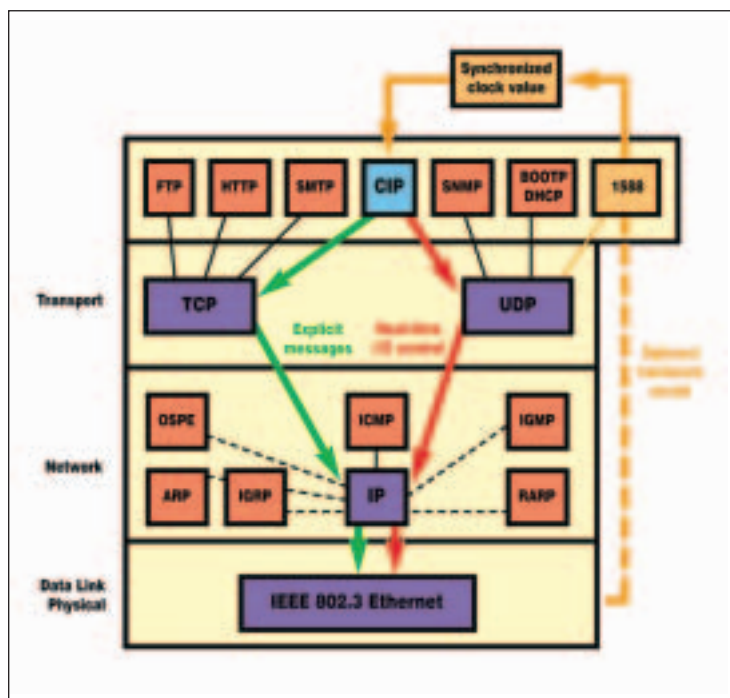
While this may seem to be a recipe for rapid desynchronisation and thus effective collapse of the operation, in fact the clocks in the end devices are highly accurate and can be synchronised across the whole network so that an overall resolution of better than 200 nanoseconds – five times better than is actually required – can be readily achieved.

Any time-jitter in the system is easily accom-

modated and, says the ODVA, perfect synchronisation of all axes of even the largest system can be guaranteed.

Using this approach, Ethernet's standard CSMA/CD data link layer can be used. Other strategies would almost all require its replacement with a proprietary driver or ASIC, which would compromise IEEE 802.3 compliance for open (multi-vendor) architecture and possibly also IEEE 1588, the standard for clock synchronisation across networked systems.

There are many advantages that come from maintaining compliance with IEEE 802.3 and 1588, which mostly boil down to reduced costs of ownership as the result of simple installation, reliability and ease



Universal network: Ethernet/IP's implementation for motion uses "time synchronised distributed control", in which time-stamped data packets relax the strict requirement for less than 1 microsecond jitter for cyclic data delivery

of maintenance and systems development.

The pertinent issues include free use of Ethernet hardware, efficient data transfer and clear upgrade paths for later systems development.

CIP Motion extends the capabilities of CIP by defining motion control functions, including:

- Torque, velocity and position control of both servo amplifiers and variable speed drives.
- Drive/amplifier configuration, status and diagnostics.
- Unicast control-to-drive/amp and drive-to-control communications.
- Multicast peer-to-peer communications.
- Both centralised and distributed motion support.

Significantly, CIP Motion uses a common approach to both drives and servo amps, making them interchangeable at the application level. This allows a migration from one technology to the other, which may become very significant if open loop induction motor control can, as predicted by some researchers, approach the performance of closed loop servo control.

Motion control technology moves forward in new products

THIS YEAR'S HANOVER FAIR HAD FEWER NEW MOTION TECHNOLOGY PRODUCT LAUNCHES THAN PREVIOUS YEARS, BUT INNOVATION AND DEVELOPMENT WERE VERY MUCH IN EVIDENCE WITH THOSE THAT MADE THEIR DEBUT.

The MR-J3 is Mitsubishi Electric's latest generation of servo amplifiers and motors for industrial automation applications. Functions include vibration suppression, improved real-time autotuning and fully-automatic controller configuration.

The amplifiers are available in two versions: MR-J3-A is for drives with conventional control systems and for speed, torque and closed-loop position control; the MR-J3-B suits complex multi-axis movement sequences. They are currently available with ratings from 50W to 7kW, but will be expanded up to 110kW.

All the amps in the series use the latest control systems to ensure fast installation and set-up and for stable systems with minimum rise times, irrespective of the application. As soon as the connection with the absolute position encoder is established, the amplifier reads the data of the connected servo motor from the electronic ratings plate. The control parameters are also set automatically by the real-time autotuning to ensure dynamic and vibration-free operation in all applications.

Another new feature is the advanced vibration suppression system, which suppress vibration at the end of a tool arm as well as those in the drive train. Further, a new filter suppresses mechanical resonances.

The MR-J3 brushless servo motors are 20 per cent shorter than their predecessors, which were already extremely compact. The range includes 200V and 400V versions with outputs of 0.5-7kW. An 18-bit absolute position encoder is integrated as standard in all the motors and provides more than 260,000 absolute values per rotation.

Baldor has launched a new family of all-stainless-steel servo motors, for use in both



clean and hostile environments. The SSBSM Series is protected to IP67 standards and will withstand cleaning using caustic materials at pressures up to 103bar.

Vibration suppression: This is said to allow Mitsubishi's new servo motors to redefine positional accuracy in motion systems

Other protection features include an FDA

shaft seal to comply with food industry standards, a potted stator for environmental and high voltage protection, an internal thermal switch to safeguard against overheating, advanced Exxon Polyrex EX Polyurea grease lubrication for extended life, and a laser etched nameplate to ensure there are no areas for dirt and bacteria to adhere.

The new servo motors are available in five frame sizes with continuous torques from 0.45 to 32Nm and peak torques ranging from three to four times the continuous duty ratings. The motors may also be specified with standard or low inertias to help OEMs optimise machine performance for specific applications and loads. In all, the new family offers a choice of 25 servo motors.

Trajexia is Omron's new motion platform. At its heart lies the new TJ multi-tasking motion co-ordinator. Powered by a 32-bit DSP it is specifically designed to meet the most demanding motion tasks such as interpolation and e-cam, e-gearbox and registration control – all via simple motion commands. Controlling up to 16 axes, it reduces wiring and space and offers full transparency down to motor level. The platform is not confined to servo motor systems, but can also be used with linear motors and inverter-induction motors.

As with other suppliers, Omron has worked to make its motion programming easy and intuitive and has adopted an open or multi-vendor standard with Ethernet, Profibus-DP and DeviceNET as options.

Similar technology has been developed by ABB. MPS Open Motion Control is a digital, state-of-the-art drive controller that can be used with any drive that has a Sercos interface, but this does not restrict users to servo motors. When used with ABB's ACS800 series of drives, standard motors can be used.

MPS Open Motion Control provides position or speed control, or a combination when running with multiple drives. Over 30 MPS Open Motion Control units can be connected with each other and each can control up to about 30 drives on the Sercos ring. MPS Open Motion Control can therefore be used for the synchronised control of several hundred drives. ■

For further information:

ABB
T: 01925 741111
E: info@gb.abb.com

Mitsubishi Electric
T: 01707 276100
E: automation@meeuk.mee.com

Baldor
T: 01454 850000
E: sales.uk@baldor.com

Omron
T: 01908 258258
E: paul_downey@eu.omron.com