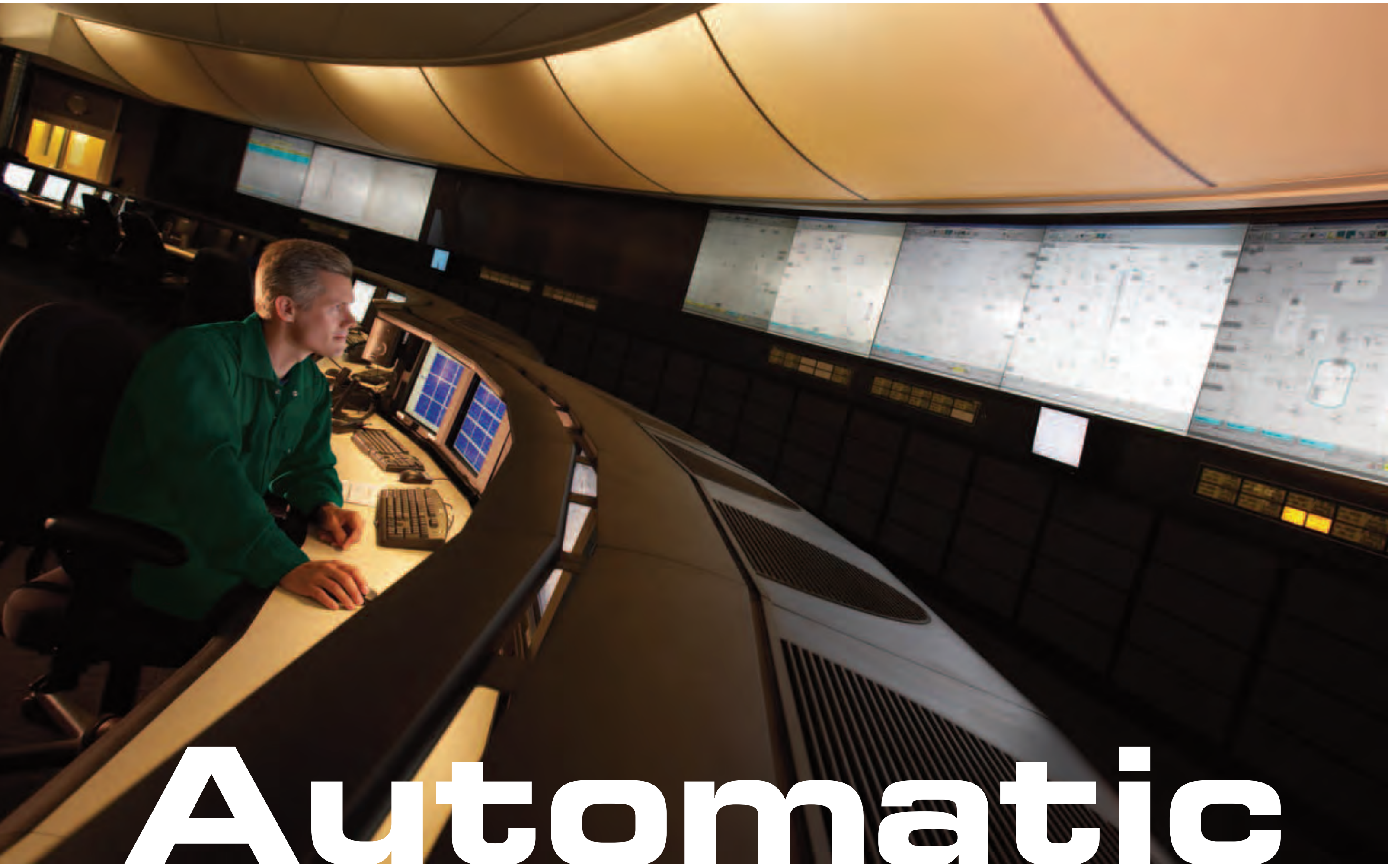


Automatic for the people

REM probably didn't have plant automation on their minds when they released that album in 1992, but computing for the masses is reinvigorating control, writes Brian Tinham

Almost a quarter of a century ago, Foxboro – then a lion in the process control systems world – launched the first ever so-called distributed control system (DCS) to be based on mainstream computing technologies. It was called I/A (for 'intelligent automation') and the so-called 'open' technologies concerned were the UNIX business computers' operating system and Ethernet interconnection network.

At the time, it stunned the established automation and control community – both users and other control systems developers. Why? Because, ever since computers had been developed for automatic process control, back in the 1950s, engineers had understood that they needed proprietary control-orientated operating systems, networking and hardware. That was the only way computers could cope with the demands of physical plant – in terms of offering both guaranteed real-time response to events and reliability in what were invariably harsh environments.

Now, not only has that giant of process control long since disappeared, gobbled up by Invensys-owned Wonderware (which, 20 years ago, dared to challenge Foxboro and its ilk with its then upstart PC-based alternative to DCSs), but also there is general acceptance that more or less 'standard' business-based computer systems are just fine for control. Even more so when PCs (with specialist real-time operating systems) are 'embedded' in PLCs (programmable logic controllers) to provide the best of both worlds – the performance, flexibility and familiarity of PCs, wrapped in industry hardened, fault tolerant and fail safe PLCs – as championed by Siemens, among others.

And it's much the same with computer communications: even plant controllers' and PLCs' 'peer-to-peer' networks – which used to be proprietary, because of the criticality of 'deterministic' access – can now be based on regular TCPIP Ethernet, albeit with protocol variants. And word in the automation community is that Ethernet I/O could yet become the standard where the plethora of digital sensor-level fieldbuses (Profibus, Foundation fieldbus, CC Link, Modbus, ASi, CANbus etc) have reigned supreme.

Talk to any of the major automation system vendors and you'll hear a similar story. Chris Evans, marketing and operations group manager at Mitsubishi, for example, puts it thus: "The advent of

'I/O on-demand' for Emerson's Delta V enables pre-building of I/O racks using standard terminal blocks, with characterisation by Charm plug-ins

greater speed within Ethernet has made a massive difference. That's what is simplifying the process of getting data from plants to the business level. Mitsubishi will continue to bring more Ethernet connection technology down to the sensor level on an open protocol, like CC Link."

That said, PC-based SCADA (supervisory control and data acquisition) software, running alongside PLCs (initially aimed only at machine control, but long since augmented with continuous process controller functionality) at the sharp end, hit the big time well over a decade ago and has grown in stature ever since. In fact, the only surviving DCS (now process management system) developers left are those who jumped on the PC (or similar) bandwagon and 're-architected' their systems along PC/PLC lines. Form factors, and 'look and feel', may differ, but the concepts are all but identical. Under the covers, there's relatively little to choose between industrial systems and office systems.

Almost standard?

At least, that's the case up to a point. You won't, though, see many standard issue PCs or servers running serious petrochemical or chemical complexes. Nor many standard displays, for that matter, in such environments: plant operators need big wraparound screens, able to provide the 'visibility' (plant overviews progressively drilling down to detail) at multiple operational levels, to drive such enormous undertakings. You also won't see much office PC equipment running safety-related systems. But you will see some of it on all manner of plants that are not so far 'below' these, in terms of scale and risk – for example, wastewater plants, plant utilities, motor control centres, building management systems, and bottling and canning plants.

So what? So advances not just in business computing, but also in mobile phones, PDAs, batteries and even gaming (where development dollars are still plentiful) find themselves readily available for adoption by automation firms and system integrators. And this, in turn, means that what was impossible or too expensive yesterday could become run of the mill tomorrow – provided such developments pass sanity checks that prove they won't either cause or allow plant problems.

Look at wireless technology. Juergen Harwailk, Emerson's product manager for its DeltaV process management system, makes the obvious point that cutting out wiring between field transmitters and controllers makes for huge cost savings and is allowing plant mangers to consider hitherto infeasible plant monitoring strategies. And he says that's not just on green field plants. He cites projects aimed at improving existing pipeline monitoring schemes, and others in the oil and gas, and petrochemical industries, on terminals and tank farms – the latter involving wireless transmitters checking tank valve positions and providing automatic level signals to the control room, using what were previously manual level gauges.

"Organisations are seeing them, testing them and, now that NAMUR [the independent process automation user group] says they're worth using, users are ramping up acceptance," says Harwailk. "We have more than 1,000 monitoring systems on wireless and about 10,000 devices. We can even do process control with wireless: we ran a test on a [fractionation] column in Houston, Texas, and got closed loop control, with responses every eight seconds. Wireless HART can scan every second, but battery life is then reduced. If sensor monitoring is every 30 seconds, it extends to between seven and 10 years – and that will grow as the phone market continues to develop better batteries."

Emerson is not alone here: the company may have been the first, but others, including Endress + Hauser, Siemens and ABB, are all out there with wireless process instruments. And with NAMUR reporting success in trials on wireless transmitters in the 2.4GHz broadcast region, and having certified interoperability on the now officially approved Wireless HART (the hybrid semi-fieldbus that sits on a 4—20mA instrument loop) standard, wireless for monitoring and control will only grow in popularity.

As it does so, more devices will follow. For example, acceptance is bound to get a boost when Emerson (among others) releases redundant wireless gateways this year, enabling plants – potentially with several hundred wireless devices – to keep 'talking', in the event of communications failures. Incidentally, that includes in hazardous areas, where gateways already provide coverage of Zone 2 and Zone 1 (albeit with a restriction of 200m between the wireless antenna and the I/O card).

By the way, modern fieldbus-based transmitters (wireless or conventional) are not just about Foxboro's early dream of intelligent automation (with, effectively, multiplexed instrument signalling), but also diagnostics – of the transmitter, its attached sensor/instrument or final element (process valve, whatever) and even the plant process itself.

"Today's equipment is capable of everything from integrated asset management to remote device configuration," agrees Harwailk. "Plant operators can get all the information from the field, diagnostics from the field and also configuration from the field devices. So there are a lot of cost savings. For example, when a transmitter needs to be swapped out, technicians can simply download the configuration from the control database and it works exactly as the previous device."

And the technology improvements don't stop there. Returning to the subject of I/O, even the humble input/output card is benefiting from new technology that looks set to overcome one of the single biggest problems for instrument and control

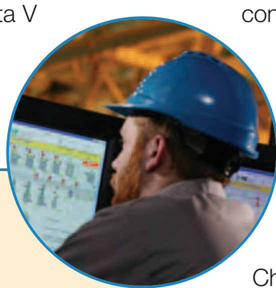
Squeezing more out of process plants is the task of today's advanced automation systems

Pointers

- Modern automation systems are benefiting from business computing, communications and even gaming technologies
- Wireless technology is making the hitherto impossible possible
- It's not just about operations: diagnostics are transforming maintenance engineering
- Even plant I/O and marshalling are changing, with configuration now carried out in software

engineers, who invariably find themselves right on the end of plant design. Traditionally, that has resulted in engineers having to react to late changes by redesigning schemes, in terms of I/O and controller numbers and types, with the inevitable knock-on impact on marshalling racks, cabinets etc.

Last September, however, Emerson introduced its 'I/O on-demand' for Delta V (at version 11, available around now), which enables pre-building of I/O racks using standard terminal blocks, followed by characterisation for type by Charm (characterisation module) plug-ins, when process design is signed off and loops are being commissioned. This could mark the end of swapping I/O cards and controllers in and out, and cross-wiring to the marshalling racks. Engineers will be able to specify the approximate numbers of racks and I/O they need, and then wire direct to the control room interface.



As Harwaik points out: "Everything is done in software, so it's flexible. It allows for late changes and assignments, right up to plant start-up. For example, suppose you've wired up for a level switch, but that now needs to be a level meter. You just change from a discrete input to an analogue input, using the Charm module. Also, I/O cards aren't dedicated to any particular controller, so control engineers can use spare capacity or just add controllers and bunches of I/O, as they need them."

Massive savings

He estimates the savings on what he calls "electronic marshalling" to be 32%, in terms of Delta V controller footprint, with a 90% reduction in intra-cabinet wiring, based on a typical oil and gas installation. "So there are no more wiring diagrams; the cabinets can go, because the I/O moves into the marshalling cabinets; and jumpers are gone, because all that is done in Charm. All you need is power and grounding design: no more fuse design in the marshalling, because Charm has current limiters and works as a fuse."

So much for the detail. But there's another point. As Phil Gillard, general manager of Solutions PT, which distributes Wonderware SCADA technology in the UK, says: "People are now making strategic decisions in the 'automation layer'. If, for example, [a user] chooses to standardise on a plant technology, they can develop standard [software] 'objects' to optimise their engineering efficiency."

It's the same with automation system integrators, which are now able to use such objects (complete function blocks that configure and manage, say, pumps, fans etc) as a mechanism for installing and commissioning controls faster and cheaper. Indeed, Gillard estimates engineering savings of circa 40%, "because objects can be defined upfront and type tested, so that software coding is reduced, along with testing in deployment".

That matters a lot, particularly when plants aren't flush with cash and most can only afford to get site and/or production improvements by proving that they can cut opex (operational expenditure). If the job of installing and commissioning systems – usually the lion's share of any system price tag – is significantly reduced, then projects geared, for example, to improving OEE (overall equipment effectiveness) become much more affordable. PE

Farmers profit by controlling biogas

Farmers wanting to extract biogas from slurry to fuel cogeneration plants – and thus establish additional revenue and a future in the emerging low carbon economy – require automation and control systems that are not only reliable, but also easy to operate.

German power plant specialist Dreyer & Bosse has built up something of a reputation here, using CC-Link open fieldbus network technology for plant monitoring, control and safety. Why? Because, in Germany, farmers running cogeneration plants are paid guaranteed rates for the power they feed into the grid and they can also feed energy into local district heating.

Essentially, Dreyer & Bosse builds containerised cogeneration plants, based on standard components, with generators usually driven by biogas, but running dual-fuel diesel/biogas engines for back-up, and harnessing frequency inverters to power and regulate the engine cooling system and gas compressor. A typical scenario might involve a 500kW cogeneration unit installed on a farm with, say, 70 hectares of arable land and five of pasture. Slurry, then, is a mix of straw and manure.

Such a system would be controlled by a compact PLC from Mitsubishi (Melsec FX3U PLC), supported by two smaller controllers, communicating with the system's automation components via a CC-Link master module and serial ports. Other devices include: a graphical control panel and an industrial modem for remote access, so that service engineers can interrogate the plant remotely.

Several safety and monitoring functions will be performed by air circuit breakers, also with CC-Link interfaces. These switchgear components protect the generators against peak overloads, short circuits and power failures, but also handle automatic network synchronisation with the power grid – while also supporting remote control with an under-voltage tripping device, combined with an integrated motor drive. The fast-switching circuit breakers of Mitsubishi's Super AE series effectively act as the link between the gas engine, the generator set and the grid.

The circuit breakers' electronic trip relay will then be connected to the central controller via CC-Link, so that, for example, the system can check the voltage, current and power levels in the low-voltage network – and send them to the controller and the control panel. The circuit breaker can also be switched on and off remotely via CC-Link and a peripheral I/O module, with its digital inputs configured as relay contacts and dimensioned to handle the currents of the circuit breaker's closing coil, shunt trip device and drive motor.

All good stuff, but one of the key points here is that the CC-Link fieldbus impacts several aspects – starting by significantly reducing both material costs and wiring overheads. Then its 10Mbps data transfer rate and its deterministic performance ensure a continuous update cycle speed of just 3.9ms for all data. Beyond that, it can be configured using menus in the PLC programming package, which conforms to the IEC 61131-3 standard.

Finally, in operation, all the electrical parameters of the low-voltage network can be displayed on the system's graphical panel. When a circuit breaker trips, a message is then triggered and the operator gets detailed information from the trip relay, via CC-Link. Remote maintenance and monitoring via modem are also supported, further adding to the safety, reliability and service-friendliness of the system.