Mustang revisited

Ford's classic Mustang is being manufactured at the AutoAlliance car plant in Flat Rock, Michigan, USA. Brian Tinham looks at the automation now behind the all-American icon

Pointers

- Fieldbuses connect multiple devices digitally on a single wire, as opposed to conventional multicores
- They save thousands of metres of wiring, plus time and money in installation and fault-finding
- Not all fieldbuses are created equal, so, when automating plant, choose your technology carefully
- There are ongoing drives among many of the fieldbus committees to push derivatives on Ethernet – to get speed up and cost down
- Wireless fieldbuses are already in operation, but are still in development from a standards perspective

If you've been wondering what all this talk of digital fieldbus communications technology is about, read on. Equally, if you're specifying an automation project now, or currently installing or commissioning one – or even if you're already involved in maintaining reasonably serious plant, connected using one of the fieldbus types – your time will be well spent checking this out.

This is not only about the Flat Rock Michigan plant that produces everyone's dream Ford Mustang; nor is it just about a factory that's using one of the less well known fieldbus types – and with huge success. It's also about a plant that's done fieldbus-based automation work before and chose its new network very carefully, in light of bitter experience, to withstand the tough world of industrial plant. And, according to control engineers at the site, it paid off – resulting in a new level of simplicity, in terms of production line set-up and commissioning, as well as ongoing reliability, "in comparison to other networked systems used previously".

In fact, the AutoAlliance factory manufactures not just the mighty Mustang, but also the award-winning Mazda 6, producing more than 1,200 vehicles every day on one of the world's most highly automated lines. More than 400 robots are used to make 6,000-plus body welds on each vehicle, with a further 61 robots and 10 automatic paint machines applying seals, sound-deadening materials and any one of 24 paint colours in the plant's assembly and paint operations.

Digital challenge

Making all of that work smoothly and synchronously is a serious challenge, so engineers say they thought long and hard before selecting the CC-Link standard fieldbus – which originated in Japan, but is now finding its way into automation specialists' vocabulary way beyond the Far East and Asia. CC-Link, managed by CLPA (CC-Link Partner Association), is one of several high speed, high performance, open networking technologies – not dissimilar to Profibus, which still dominates the European market. But the AutoAlliance engineers say they chose it for its ability to network over distances up to 13.2km – important at Flat Rock, which is a 2.7 million square foot operation – and its proven performance, even in

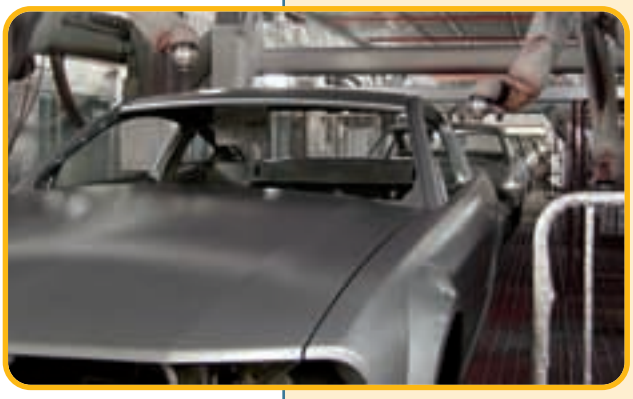
hostile manufacturing environments.

Each vehicle body travels 13 miles around the plant during production, through numerous automated welding, assembly and paint stations. So CC-Link forms the communications backbone, starting with the Mitsubishi inverter drives that provide speed control for the massive fleet of Power & Free conveyors – ensuring that each section of car body is always where it's needed, on time.

The same fieldbus also looks after all automation signalling throughout assembly and welding operations, with five CC-Link network masters in control. One links the control panels and PLCs within the body shop assembly cells, while the remaining four control materials handling equipment and the welding robots. And we're talking about some 125 control panels within the Mustang body shop, as well as a similar number for Mazda production.

Orchestrated manufacture

Also within the body shop, the same fieldbus handles controls for the jig bed that holds and folds large sections of the auto body – coordinating all the Kawasaki robots within this manufacturing cell. In effect, it's responsible for ensuring precise starts and stops for every robot movement, as each positions, welds and moves car body parts – also enabling the robots to communicate positional information, to avoid collisions.



It's a similar story on the paint line, with the system providing the automation network for the fleet of Fanuc P500 paint robots. And the fieldbus also links five inverter drives that control huge fans on the associated air treatment and exhaust plant, with its incineration units and catalytic oxidisers.

"The ease of assembly line start-up and excellent reliability of CC-Link has translated into a highly productive manufacturing facility," says a spokesperson. "The speed at which these new lines were installed and commissioned resulted in significant savings, in comparison to other networked systems used previously."

And he adds that control engineers have so far not reported a single network failure – in stark contrast to other areas of the AutoAlliance plant, where industrial Ethernet and two other commonly used fieldbuses have apparently experienced troublesome failures. PE

Horses for courses

In common with most digital plant networks, CC-Link is an 'open source' (free international standard specification) high-speed fieldbus, configured as a single wire control loop to which all switches and devices are connected – as opposed to conventional multi-core wiring, where each device has to be hard-wired back to its controller.

On big plant, fieldbus networks have been known to save thousands of metres of wiring per large machine. But there are other significant savings in time and money, in terms of installation, certainly, but also commissioning and subsequent fault-finding, because of the diagnostics facilitated by digital communications technology.

It's also the case that adding new I/O points is far quicker and easier than with conventional wiring: they are typically just connected to the network wherever is most convenient. Then, when it comes to maintenance, the old problems of broken, loose or shorting wires – which typically account for a fair proportion of machine breakdowns and downtimes – become things of the past.

But not all fieldbuses are created equal, so it's a case of horses for courses. Mostly, that's about assessing technical capabilities (distances covered, speed, functionality, industry bias), but engineers also need to consider the availability of support in their country and location, as well as the associated set-up and troubleshooting skills.

Briefly, Profibus DP and PA (for factory automation and the process industries respectively – and with ProfiSafe for safety-related controls) are dominant on European plants, with the exception of those in the refining, and oil and gas sectors, which tend to favour the US-centric Foundation fieldbus. Meanwhile, CC-Link is spreading from the Far East and gaining ground, particularly in factory automation, with some 200 device manufacturers (large and small) now on-board. But there are plenty of others – for example, BACnet, which is gaining ground in the HVAC (heating and ventilating) industry, CANbus (controller area network), particularly for cars, as well as DeviceNet, EtherNet/IP, CompoNet, ControlNet and derivations, such as CIP Safety and CIP Motion – all based on the so-called Common Industrial Protocol and represented by ODVA (formerly the Open DeviceNet Vendors Association).

Plant engineers need also to be aware of the ongoing drive from many of the fieldbus standards communities to push derivatives on Ethernet – to get speed up, costs down etc. Profinet is a good example, with its obvious origins in Profibus. They also need to know that wireless fieldbuses are already in operation – although development work (technical and among the standards bodies) is incomplete.

Profibus and Profinet, for example, have only relatively recently defined upcoming work for wireless coupling of sensors and actuators in factory automation – using radio technology compliant with IEEE 802.15.1 (WISA technology). That choice is important, because it recognises the different requirements in manufacturing, as opposed to process automation – not just around performance, but also optimisation for other widely used standards.

In the process industries and utilities, that means the widely adopted HART (early semi-fieldbus, which superimposes digital signals on analogue 4–20mA wiring for sensors and actuators). For manufacturing automation, Profibus' concern is IO-Link. Wireless HART already uses IEEE 802.15.4 radio technology and the work is largely done, but factory automation needs faster response times – and hence IEEE 802.15.1.

CLPA-Europe general manager Steve Jones comments: "Fieldbus technology, such as CC-Link, has proved itself time and again in the most hostile of network environments. In areas such as automotive manufacture, downtime is extremely expensive. But you also have to consider the safety aspects of network failures, too. The AutoAlliance facility, for example, employs more than 3,700 people and the consequences of a network failure could be fatal. CC-Link ticks all the boxes by offering standard, safety-specific and bit-bus level options for the industry's most robust and reliable fieldbus technology."