# Unleashing the Power of Ethernet/IP

**Curt Christensen**
Automotive Program Manager
FANUC America
Hoffman Estates, IL

Manufacturing automotive powertrain components and systems has evolved into a complex system. In fact, more than one industry leader has stated that the automotive industry is always on the bleeding edge of integrated manufacturing solutions. The increased complexity of CNC systems, programmable logic controllers (PLC) and manufacturing execution systems (MES), as well as more advanced supervisory control and data acquisition (SCADA) systems, has led the industry to new levels of integration between motion control, distributed I/O, and manufacturing information systems. Additionally, these systems need to be integrated across multiple suppliers' machines in continuously shorter project cycles.

To address the market challenges of the increasing complexity of machine systems, new safety and security requirements and the growing importance of information technologies, new standardized field bus architectures have been developed and are now being implemented across a wide spectrum of powertrain manufacturing applications. These solutions integrate CNCs and robots to cell controllers so manufacturers can more easily manage operations across equipment controlled by the two systems. This provides cost efficiencies, reduced setup, better part quality, safer work environments, usable manufacturing intelligence and overall increased productivity. Additionally these systems also integrate into the Industrial Automation Controls System (IACS) networks that are becoming more prevalent in the automotive manufacturing environment.

## Industrial Automation Controls Systems (IACS)

As the industry is continually faced with development of "better, stronger and faster" products, manufacturers are realizing the business benefits of converged manufacturing and enterprise networks. The IT integration with IACS enables plant-to-business network convergence, which in turn drives strategic business decisions that are backed by real-time data from IACS.

IACS, Process Automation Systems, Process Control Systems, Supervisory Control System and Data Acquisition Systems are all a part of the significant integration of data systems. All of these systems have benefited greatly from the transition to modern Ethernet and Ethernet/IP field bus networking technologies from the vendor-optimized networks typically used in the past.

> Data sharing isn't the world of the future, **it's the world of now**, and CNC must be integrated into it.

Information sharing and streamlined efficiency will be the result when the information contained within the IACS is available and shared throughout the larger enterprise. Manufacturers and industrial suppliers are discovering that standard communication architectures and uniform networking of an IACS is the key to optimized services, greater visibility and lower total cost of ownership (TCO). And as the industry develops to higher integration levels, manufacturers are moving to embrace standard information technology, particularly standard Ethernet and Ethernet/IP, for IACS networking environments.

## Converging Networks

The industrial manufacturing data collection environment has been, and continues to be, very similar to the IBM legacy mainframe environments that were in use in the late 1990s. Although the current legacy industrial systems are functional, they are costly to maintain, difficult to connect and slow to evolve. The current IACS systems in place are often a mixed bag of discrete, process, batch or hybrid systems. And while manufacturers need their systems to interact in real-time with the other enterprise applications, supply chain partners, and outside manufacturers, these systems are extremely difficult to integrate. To accomplish this integration, manufacturers are converging their IACS networks with their enterprise networks. However, this convergence leads to a number of issues:

- Maintainability and Reliability—As manufacturing operations become globally integrated, manufacturers are challenged to provide consistent access to data while making the manufacturing environment flexible. Security, availability and asset use are critically important to manufacturing companies because IACS equipment is mission-critical, and efficiency is critical in maintaining a competitive edge.
- Implementation Costs—Legacy IACS systems, although often fully depreciated in existing manufacturing environments,

can be difficult to integrate with the enterprise and can be costly to operate due to the multiple networks in use that require management, training, integration, gateways, spares, etc.

Information sharing and streamlined efficiency will be the result **when the information contained within the IACS is available and shared** throughout the larger enterprise.

- Product Design Integration—It is difficult to bring together the required technical experts on the various aspects of the manufacturing process. This often negatively impacts the ability to quickly respond to events, to collaborate with engineering on new products and forces up the cost of resolving problems.
- Product Information Integration—Development of systems to fully document manufacturing genealogy data regarding the products produced has been moving forward steadily; however, integration of this information from disparate sources is difficult and costly to implement.
- Data Sharing and Management—Incorporating real-time plant productivity and operational data into MES, customer relationship management (CRM) systems, supply chain management (SCM) systems and other enterprise resource planning (ERP) systems causes restrictions on design development and adds further costs to the implementation.

## Standardized Ethernet and Ethernet/IP Networks

The challenges of integrating manufacturing and information technology have pushed automotive manufacturers to adopt standardized Ethernet and Ethernet/IP field bus network technologies. The advantages of a standardized network are significant and varied, they include:

- Overall Cost Savings—Standard Ethernet and Ethernet/IP network technology has a broad base of IACS suppliers, resources and innovation. This provides manufacturers with a significantly lower TCO. Additionally, savings generated from better integration, easier data management and the ability to operate more applications on one network create significant cost savings to the business.
- Simplified Maintainability—Legacy IACS network technology has become more complex to maintain than standard Ethernet and Ethernet/IP networking technology. Technical resources are readily available for the standard Ethernet and Ethernet/IP networking technologies and therefore are more cost effective. Reliance on standardized Ethernet and Ethernet/IP networking technologies offers more options to allow skilled personnel to securely access the plant systems.
- Enhanced Flexibility & Expansion—By utilizing standard Ethernet and Ethernet/IP technology, manufacturers are able to take advantage of a larger base of vendors with connected products. Additionally, new functionality and evolving capabilities in the IACS are focused on standard networking technologies and development.
- Increased Efficiency—Standard Ethernet and Ethernet/IP technology improves visibility for business decisions and provides management with the ability to transform business processes due to integration of IACS and the business systems.

**As automaking becomes increasingly streamlined it becomes increasingly complex, resulting in a system of systems.**

## Ethernet/IP Today

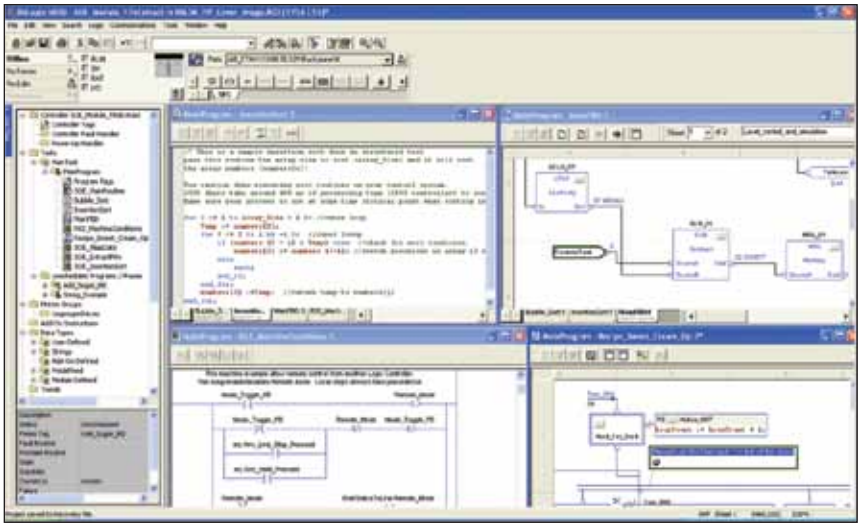
Today, CNC manufacturers such as FANUC and PLC manufacturers such as Rockwell Automation have teamed up to develop integrated automation powertrain solutions that provide engineering advantages and cost saving benefits for both end users and machine tool builders.

With standardized Ethernet/IP architectures, end users are able to control

and collect data from a wide variety of devices over a single industrial Ethernet/IP network. No single vendor makes every device necessary for complex machining, but more and more suppliers are offering Ethernet/IP connectivity for their machine tool devices that have predeveloped logic instructions and HMI faceplates designed to quickly and efficiently integrate them into a complex system. Even machine safety guarding and control can be handled on the same Ethernet/IP network as standard I/O and data collection traffic. By using a common network topology, valuable machine status and part production data is available anywhere in the machining cell, plant floor and enterprise without the complexity and expense of custom-engineered networking hardware and software. With pre-engineered integration between the CNCs, robots and the cell controller, end users minimize the time specifying these connections and then reviewing each machine builder's work for compliance, while machine tool builders are able to take advantage of the efficiency gained in the integration of the system. Ethernet/IP network integration benefits include:

The advantages of a standardized network are **significant and varied**.

- Reduced start-up time and cost to end user; simplified machining system architecture for end users to specify.
- Less system engineering required for a machine tool builder to integrate multiple CNCs and robots with a cell controller, saving cost and time during design and engineering.
- Integrated safety network provides simple diagnostics and coordinates machine tools, robots and cells for overall improvements including safety provisions for machining, material handling and guarding.



**Integrated communication is necessary in the drive to increase productivity, efficiency and quality and reduce cost.**

- Improved quality, quantity and usability of manufacturing intelligence; production and machine information is easily transferred to enterprise IT systems enabling better decision making and cost reductions.

An integrated solution is ideal for a machining cell controller architecture comprised of several CNC machines cutting parts and robots handling the loading and unloading. These architectures typically include coolant and chip removal systems, deburr and wash machines, test operations, part marking, identification and inspections stations and more. Common connectivity to Ethernet/IP makes engineering and managing all of this integration much more simple, especially with those devices that are already profiled in the programming software. This solution is scalable and can be changed and upgraded, allowing the user to choose the devices needed for the process. The advantage of the pre-developed tools and preferred integration can greatly reduce the engineering time required to integrate and test the complete system.

## Conclusion

Manufacturers are beginning to recognize the benefit of using standard Ethernet and Ethernet/IP networking technologies in IACS networks in the automotive manufacturing environment. While challenges remain, development of a strong integrated Ethernet-based network continues to move forward. Guidance from the manufacturing development engineers, controls engineers and IT professionals will need to be stronger than ever. Many vendors continue to promote legacy or application-specific IACS networking technologies because they are comfortable with them. The principle argument from these vendors has been that deterministic and time-sensitive manufacturing environments require more than what standard Ethernet and IP technologies can deliver. However, Ethernet and Ethernet/IP-based systems offer performance that meets or exceeds the needs of IACS applications while offering better benefits than the older field-bus networks they replace. In addition, these modern networks have mature and tested technologies to safely secure the network and the systems they interconnect beyond what are available for the older field-bus networks. And finally, these networks provide a platform for development and expansion of plant manufacturing technology systems—now and in the future.