ARC WHITE PAPER

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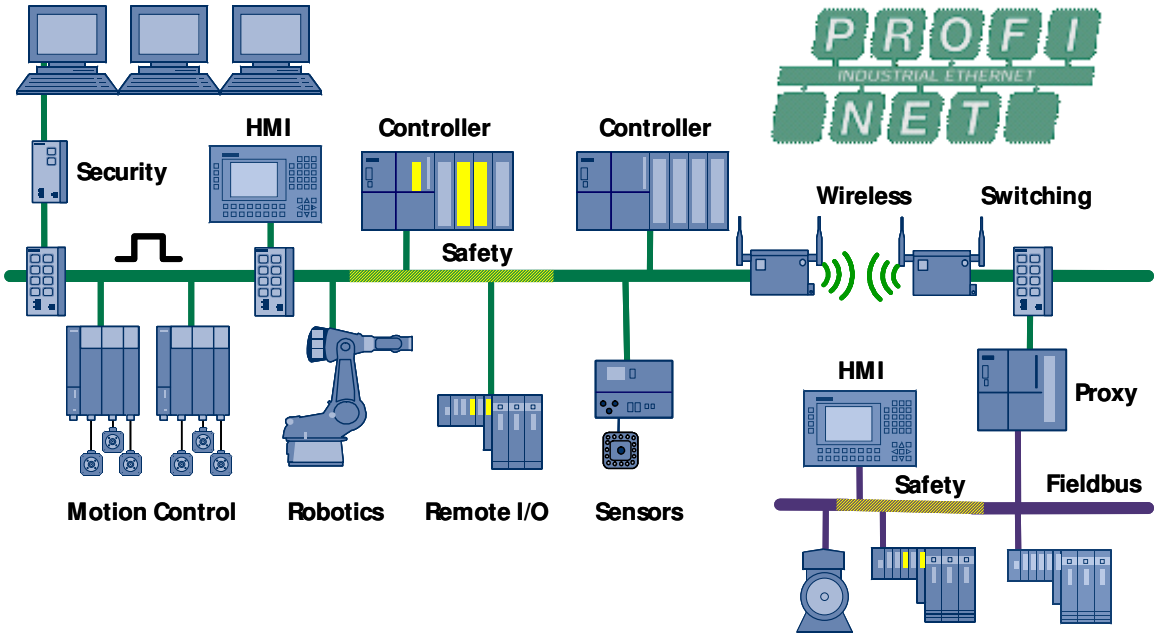
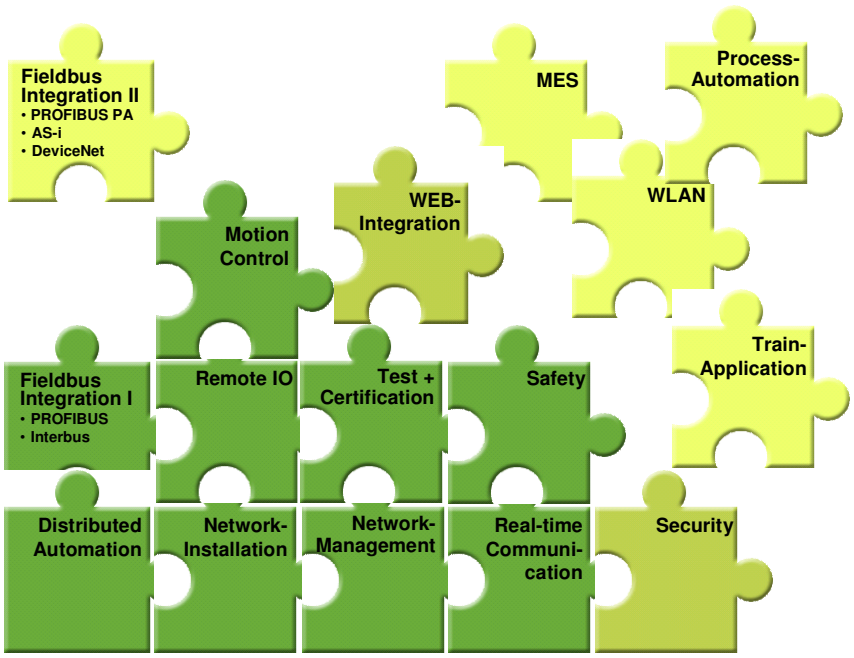
Profinet: An All-Encompassing Industrial Ethernet Solution



Profinet Networks the Whole Plant, From Automation Devices to Enterprise, With Support For Specific Tasks Such As Motion Control, Networked Safety And Wireless Connectivity



Profinet's Working Groups Develop Application Profiles To Address Particular Manufacturing Requirements

Executive Overview

No other technology in recent times has stimulated the world of industrial automation as much as Ethernet. Invented in the 1970s and widely deployed in office IT architectures ever since, Ethernet didn't make it into the factory until the 1980s. Not entirely suitable for deterministic logic control in its native form, Ethernet now has been fine-tuned by industrial consortia including Profibus International to deliver the performance demanded by manufacturers while addressing their specific needs. From harsh environments to high-speed performance requirements, these enhancements have opened up countless new application areas that were previously out of reach of the performance of conventional industrial networks.

With its universal acceptance in the IT world, solid grounding in international standards, and a wide base of future development directions, industrial Ethernet has revolutionized network communication in industrial automation.

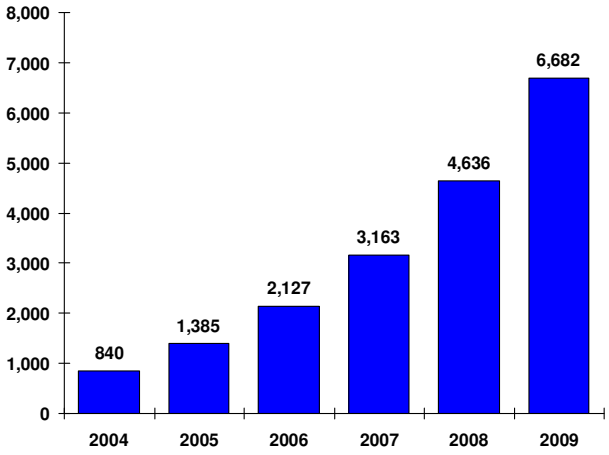
Ethernet's value proposition to manufacturers lies in its enabling of a single network architecture across all enterprise levels – from robot cells to transfer lines to business applications. Using Ethernet at the device level, for example, enables new generations of asset management solutions to extract data directly from networked sensors in the factory. This information is used in real-time by sophisticated maintenance or condition monitoring software to predict service problems before they happen, shortening machine down-time and lowering operational costs. Ethernet's ubiquitous IP addressing and routing capabilities enable a level of transparency never seen before in what was previously the domain of proprietary industrial networks.

Ethernet build bridges between factory and corporate information systems by reducing networks requirements down to a single architecture and eliminating the wall that for years has separated the plant from the business world. While this strategy lowers maintenance costs and increases network serviceability, it also supports the proliferation of "open systems" in the factory. Open systems refers to the breed of PC-based control systems that combine the application-specific functionality of an industrial controller with the advanced storage, data handling and networking capabilities of a personal computer. With its universal acceptance in the IT world, solid grounding in international standards, and a wide base of future development directions, industrial Ethernet has revolutionized network communication in industrial automation.

Ethernet in its standard form is not suitable for many industrial applications due its lack of deterministic performance and ruggedized hardware for harsh environments. For this reason, automation suppliers have formed industrial consortia to enhance the technology, creating what is commonly known as "industrial Ethernet". With these challenges in mind, Profibus International (PI), a leading organization known for its popular Profibus network, set out to develop Profinet, a comprehensive standard for Ethernet on the factory floor. PI's goal was to base the solution on standard Ethernet while addressing the specific challenges of the manufacturing environment.

Industrial Ethernet: Business Perspectives

Today's manufacturers demand simpler and more modular automation solutions that use fewer dedicated and proprietary networks and interfaces. They want to seamlessly integrate production data to business systems to make more use of data generated and stored on the factory floor. Using Ethernet, production key performance indicators (KPI) and other productivity measures can be more easily and cost effectively gathered on the plant floor than with conventional industrial networks.

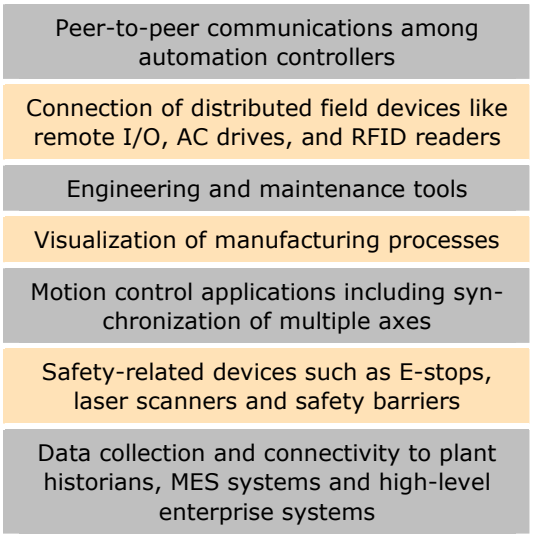


Total Shipments Of Ethernet Devices (Thousands Of Units) Source: ARC Advisory Group

Using Ethernet in the factory allows automation users to apply the latest IT components and tools such as SNMP and DHCP in the production environment, resulting in reduced engineering and maintenance effort. Standardized network services such as remote access and advanced network diagnostics can help increase productivity and plant availability by simplifying troubleshooting and shortening downtime. Ethernet provides these enhancements without sacrificing any of the capabilities found in existing automation architectures.

Existing industrial networks were often special purpose networks designed to address specific requirements. Distributed motion control was handled

with dedicated networks such as SERCOS. PLC suppliers offered both proprietary and "open" remote I/O networks such as Profibus and DeviceNet, while safety systems were typically hard-wired. The bottom line was that the factory floor had many communications solutions, but none was all-encompassing. Ethernet, with its large bandwidth, high throughput and support of multiple protocols, addresses each of these points with just one "cable". However, for Ethernet to establish itself as the basis for factory floor communication, it has to satisfy all aspects of automation. In a typical application in an industrial environment, these aspects include peer-to-peer PLC communication, connection of field devices, support for engineering, maintenance and visualization tools, motion control applications, safety-related devices, as well as connectivity to plant historians, MES systems and high-level enterprise systems.



Industrial Ethernet Supports All Aspects of Industrial Applications

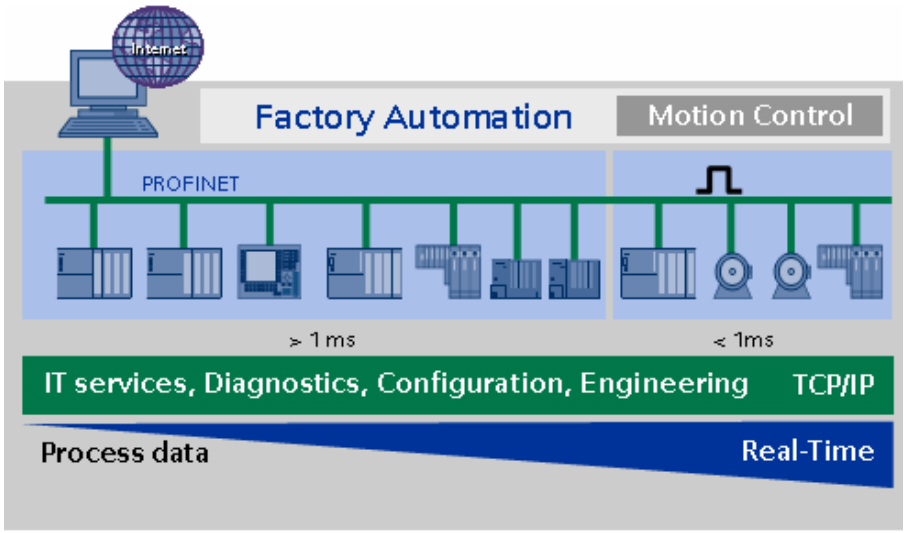
ARC believes that Ethernet is the logical choice for meeting the challenges of the next generation of factory communications. Ethernet accomplishes this by providing users with familiar IT tools while enabling seamless connectivity to enterprise-level applications. Most importantly, Ethernet is sufficiently "tweakable" for industrial organizations like Profibus International to adapt and enhance its performance while supporting all the functionality of standard Ethernet, resulting in single, open industrial networking solution for the whole enterprise. The net effect is a lower Total Cost of Ownership (TCO) for plant assets thanks to an all-encompassing approach to industrial networking.

Profinet is an All-Encompassing Solution for Industrial Ethernet

Profibus International (PI), with a global community of more than 1200 member companies, began addressing these previously discussed network challenges over 5 years ago. The organization quickly concluded that making Ethernet suitable for the factory would require more than simply adding several protocols to Ethernet. PI formed a number of working

groups to define the range of services and functions that would be required for Profinet to become a success. Each group set out to solve a particular industrial application need, ranging from safety to motion control to wireless communication.

To appreciate the motivation behind PI's developmental efforts for Profinet, it is important to understand that simply using Ethernet and TCP/IP does not mean that industrial devices can automatically communicate with each other. Application protocols such as HTTP and SMTP (for email) are not suitable for transferring control data between automation devices in time critical industrial applications. PI recognized this shortcoming early in the game and developed an industrial protocol tailored to the specific needs of industrial applications.

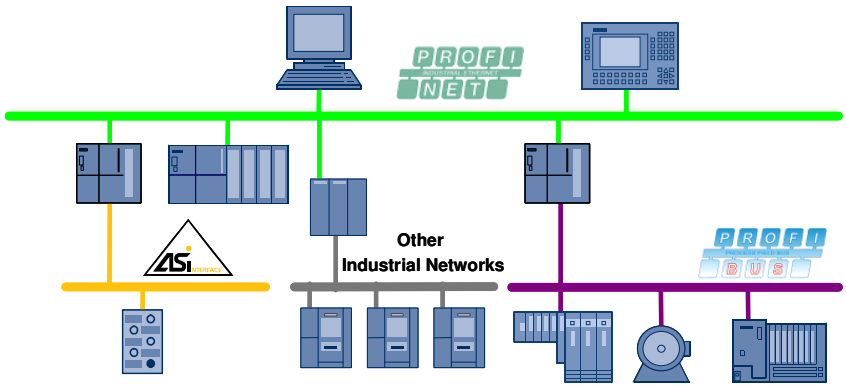


Profinet Extends the Performance Envelope of Industrial Ethernet To Demanding Applications Such as Motion Control

TCP/IP is the familiar network and transport-layer protocol of the internet and provides a set of services that two devices use to share data. Many users do not realize that using TCP/IP does not guarantee that these devices can communicate effectively. The closest real-world parallel comes from telecommunications. For example, it is possible to pick up a phone, dial a number in another country and be connected. However, just because the phone rings on the opposite end and someone answers does not mean that both parties can communicate. A common language is needed for a conversation, just as automation devices require a common application protocol to understand their process data. In this analogy, Profinet is the

application protocol that guarantees interoperability between automation devices connected to Ethernet.

Profinet uses the TCP/IP protocol suite without limitations or modifications. Automation-specific tasks such as device parameterization, configuration, network diagnostics (SNMP) and other IT applications are handled via the TCP/IP channel in the way. However, for applications such as remote I/O and motion control that place high demands on speed and determinism, TCP/IP, with its large overhead and long stack throughput times, is insufficient. To address these issues, PI's experts added an additional channel for real-time (RT) transfer of time-critical data. This method uses standard Ethernet hardware and network components (switches), but performs a prioritization of the datagrams in the switches via IEEE-based priority tagging. This enables deterministic response times in the range of 1 to 10 ms and opens up Ethernet to a whole new world of industrial applications.



Profinet Can Easily Integrate Other Networks To Serve As A Factory Backbone Network

Real-time communication with remote I/O and other field devices is called Profinet IO and uses the RT channel. Since Ethernet and wireless LAN are both based on the IEEE 802.xx standards set, Profinet can be easily extended to wireless communication via access points.

Profinet Protects Existing Fieldbus Investments

Industrial Ethernet may be a compelling new technology, but what about users' investments in existing networks? Few users are willing to tear out a working system and replace it with Ethernet just for technology's sake. Profinet helps users protect their investments by supporting the integration of existing Profibus networks and other fieldbus systems into a Profinet network via proxy. A proxy is a gateway that provides transparent communication between two dissimilar networks. Using a proxy allows users to set up mixed systems consisting of both fieldbus-based and Ethernet-based subsystems, while making possible a gradual migration to Profinet.

Another advantage of the proxy solution is that Profinet can be installed as a factory "backbone" network that integrates existing fieldbuses into one large network. Individual fieldbuses maintain their functional independence, but are connected to the rest of the factory network - giving plant-level applications such as asset management visibility to field devices.

German Carmakers Commit to Profinet

A consortium of Germany's top carmakers including Audi, BMW, Daimler-Chrysler (for the Mercedes Car Group) and Volkswagen, announced at the end of 2004 their commitment to use Profinet as their preferred industrial networking solution in the future. This commitment has helped to boost Profinet's visibility – not only the automobile industry but across the wider automation market – just as the first Profinet IO-compatible devices are appearing on the market.

AIDA members expect a positive return on their commitment in terms of business benefits. These include a unified networking concept based on Profinet to reduce short-term engineering, development and integration costs as well as long-term maintenance costs in ongoing operations.

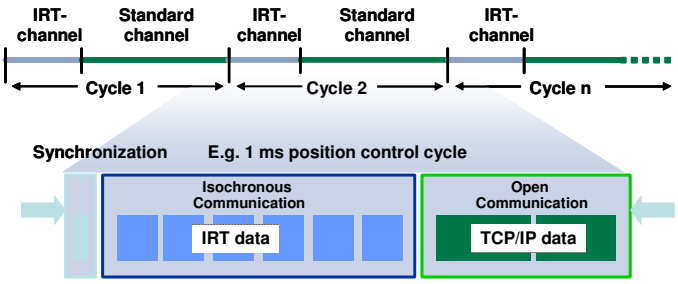
According to a position paper published by AIDA (in German "Automation Initiative of Domestic German Automobile Manufacturers"), the commitment applies to applications in which the use of the Profinet promises technical advantages as well as business benefits. The implication is that Profinet will be preferred over other conventional and Ethernet-based industrial networks at both the controller and the device levels, which should help reduce the cost of maintaining multiple, incompatible industrial networks.

The integration of safety-related information in Profinet was the most compelling argument for the commitment, according to AIDA members. German car manufacturers often use a 2-bus strategy – either Profibus or Interbus for discrete control and SafetyBus p to network safety components. To provide a migration path from legacy Profibus and Interbus networks, proxies will be available from several suppliers.

The 4-company consortium was founded with the goal of eliminating the coexistence of multiple, dissimilar industrial networks in factories after hard lessons learned during the fieldbus wars of the 1990s. AIDA recognizes that the full value proposition of industrial networks is not being achieved by the current situation of multiple hierarchies, master/slave architectures and low bandwidth networks. The use of multiple solutions leads to compatibility problems that result in higher integration, training

and operational costs, which ultimately adversely affect a manufacturer's bottom line. AIDA further recognizes that the time is ripe for a technological paradigm shift – the chance to migrate to a proven, ubiquitous medium that is flexible enough to support the various legacy communications protocols and "tweakable" enough to adapt to some specific application needs. Despite initial skepticism, Ethernet, together with its industrialized variants, has turned out to be the only network medium on which every automation supplier can agree.

For their commitment, AIDA members expect a positive return in terms of business benefits. These include a unified networking concept based on Profinet to reduce short-term engineering, development and integration costs as well as long-term maintenance costs in ongoing operations. ARC believes the biggest savings will result from standardized, ubiquitous communications tools that allow everything from development applications to field devices to communicate seamlessly with one another, thus eliminating a major cost built into current automation architectures.



Critical Data For Motion Applications Are Transmitted On Profinet Via The IRT Channel, Ensuring A Precise And Deterministic Response

For legacy Interbus-S, a popular network in many German car plants, Profinet already has a solution ready. Interbus' main backer, Phoenix Contact, rejoined the Profibus club last year after a long hiatus and promptly announced the first proxy module to connect legacy Interbus-S networks to backbone Profinet networks, thus preserving generations of its installed base.

Profinet Opens the Door to High-Performance Motion Control

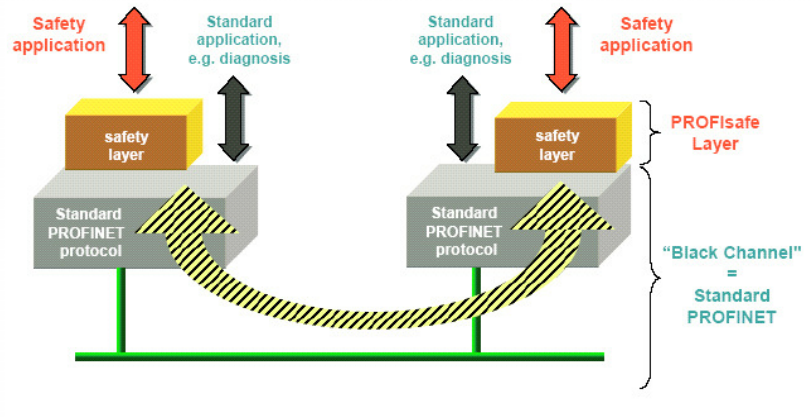
For high performance motion control applications such as the precise coordination of hundreds of axes with microsecond precision, Profinet includes an isochronous real-time channel (IRT). Profinet with IRT adds hardware support by means of a standard Profinet ASIC to achieve a high level of synchronization. A reserved time window is used to transfer datagrams in a reliable, cyclic sequence, while the remaining cycle time is used for standard TCP/IP communication.

Profinet with IRT is opening up new technological frontiers by allowing hundreds of machine axes to be synchronized electronically rather than

mechanically. In fact, the potential benefits of using industrial Ethernet as a motion network are leading machine builders to design future generation machines around a modular, network-enabled architecture. In machines with a large number of axes, movements by multiple axes are often coordinated or "geared" by mechanical linkages. In the past decade, these mechanical linkages have been widely replaced by electronic gearing, enabling rapid reconfiguration of axis movements. This greatly increases a machine's flexibility, making product changeovers possible within minutes rather than hours or days, and allowing manufacturers to run a greater larger variety of products on a single machine.

Profisafe Brings Safety to Profinet

Profibus International introduced Profisafe, a TÜV-certified safety application profile for Profibus, in 1999, and obtained additional certification for use with Profinet in 2005. The introduction of Profisafe heralded a new era of industrial networking in which a single bus can now handle both standard and safety-related messages, eliminating the need for a separate safety bus.



Profisafe Checks Data Integrity of Fail-Safe Devices Alongside Standard Profinet Communication

Communication technology using standard industrial networking protocols is not adequate to achieve the required levels of reliability to satisfy safety standards. Datagrams can get lost, become corrupted or get delivered out of sequence. To ensure data integrity to meet safety requirements, Profisafe adds additional safety data checks at the application layer that monitor watchdog timers, check datagram numbering, verify sequencing and signa-

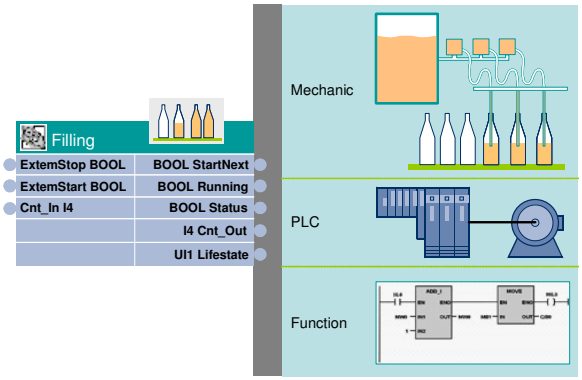
tures and perform additional data consistency checks. These extra steps take place within normal datagrams and co-exist on the same network.

Profisafe is designed to work seamlessly with all possible Profibus and Profinet architectures. This means a complete SIL 3-certified system in single architecture with the option of using Profisafe in a redundant architecture for higher availability. Since both Ethernet and wireless communication are based on the same set of IEEE 802.xx standards, Profisafe can also be extended seamlessly to wireless devices. These possibilities offer a high level of flexibility of which Siemens takes full advantage in its safety systems.

Graphical Communications with Profinet CBA

Profinet CBA (Component-Based Automation) helps users create modular, distributed applications in control architectures with multiple PLCs. With Profinet CBA, Profinet has taken a whole new approach to the issue of interoperability at the peer and supervisory communications level. Profinet CBA eliminates the complex task of programming controller to controller messages by allowing the programmer to graphically design communication paths between controllers.

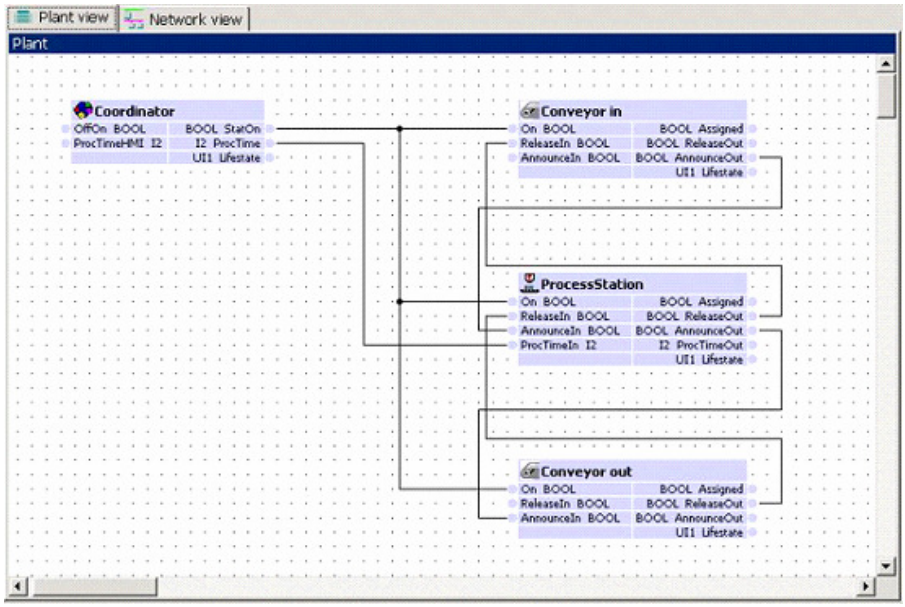
To exchange data with other controllers, the machine builder first defines so-called "Profinet components" that correspond to specific machine functions using a standard programming or configuration tool. These components encapsulate the machine's functionality as a communications object with defined inputs and outputs that are "exposed" to other Profinet components on the network. Later, during the start-up phase, the system integrator uses a graphical editor to interconnect the components without the need to understand PLC communication functions or modify PLC code. Since the component model uses a standardized XML representation, the handling, definition and functionality is not supplier specific. Profinet components from multiple vendors can be added to the library of any interconnection editor, and thanks to Profinet certification, provide the required interoperability.



With Profinet CBA, The User Creates Functional Components That "Expose" Their Data To Other Network Components

With this object-oriented approach, the transfer of PLC data can be quickly and easily configured – either during the engineering phase, or later during

start-up at the customer site. The advantage of this approach is that connections between PLCs can be made quickly without having to view or modify any PLC code, which can help cut engineering costs and reduce programming errors.



During Start-up, Communication Between Profinet Objects Is Established Graphically, Allowing Quick Configuration of Controller-To-Controller Communication In The Field Without Modifying PLC Code

In addition to peer-to-peer communication between machines, Profinet CBA also enables simple and direct access to production data by business systems or HMI stations. For every machine, HMI tags can be created in a plant-wide Profinet engineering tool that automatically generates an OPC symbol list that can then be imported into any OPC server.

Profinet at Work: Five Case Studies

With more than 13 million installed nodes, Profibus is probably the most widely deployed fieldbus in the world. This success is due in part to the backing of the parent organization Profibus International with its broad technical resources, the marketing strength of its 1200+ members, and the wide range of Profibus application profiles that address specific manufacturing needs. The following section looks at fieldbus applications of five

end-users who have realized benefits from using Profinet in a variety of applications.

Profinet CBA Adds Flexibility to Cigar Making Process

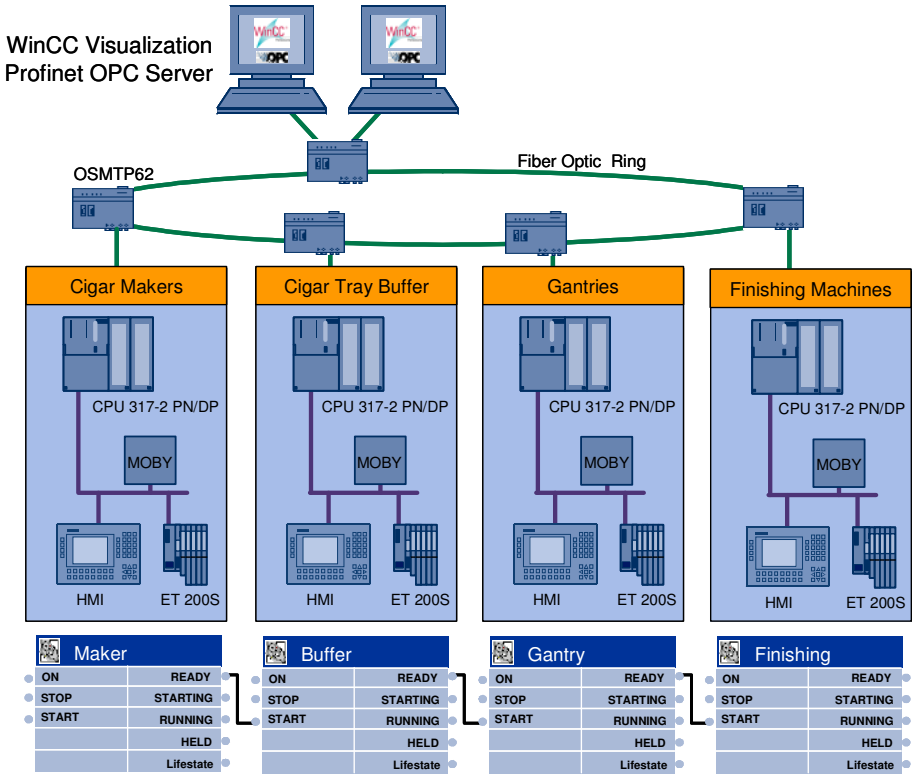
The finest cigars are still rolled by hand, but to satisfy demand in the high-volume mass market, one cigar maker employs specialized machines at one of its US plants. These machines include rod makers to roll cigars and finishing machines to apply a leaf overwrapper and seal the cigar's tip, and packaging machines to wrap the cigar in cellophane and apply the cigar band. While these machines use some automation, they mostly depend on highly complex, mechanical motion executed at high speed. This is particularly true of the finishing machines.

Facing cost pressures, the company set out to take costs out of the manufacturing process by eliminating the bottleneck caused by the manual handling of buffer zones between machines. In addition, market drivers dictated that the production process be made more flexible to support an ever increasing number of product varieties. Since the existing production machines could not be easily changed, the increased flexibility would have to result from the new materials handling solution.

The key to achieving flexibility was to ensure that work in progress (WIP) was tracked so that it could be intelligently routed to the right finishing machine at the right time. This approach would ensure that production capacity is maximized while the need to adjust machines on-the-fly for different products is kept to a minimum. The automation solution, engineered by Siemens Solution Provider Prism Systems, controls the routing and movement of over a thousand WIP trays through a complex system of conveyors and tray buffers. The system is controlled using over twenty Siemens 317-2 PN/DP controllers and monitored by panel PCs running WinCC visualization software. RFID tags are used to track work in progress by reading and writing lot information from and to tags on WIP trays. The compelling technology in this solution, however, is the use of Profinet Component-based Automation (CBA) to configure communication between PLCs networked via Ethernet.

Using Profinet CBA, Prism developed a flexible structure of communications relationships among reusable components that allowed development work to be divided among several engineers working independently. Profinet CBA allowed the integrator to encapsulate the functionality of entire

machines and conveyor modules and "expose" them as Profinet components with defined communication interfaces. At start-up, engineers were able to quickly connect objects to the system as they came online at the customer site. Prism also used Profinet CBA to transfer tracking and tracing data directly between the machines and the WinCC visualization stations.



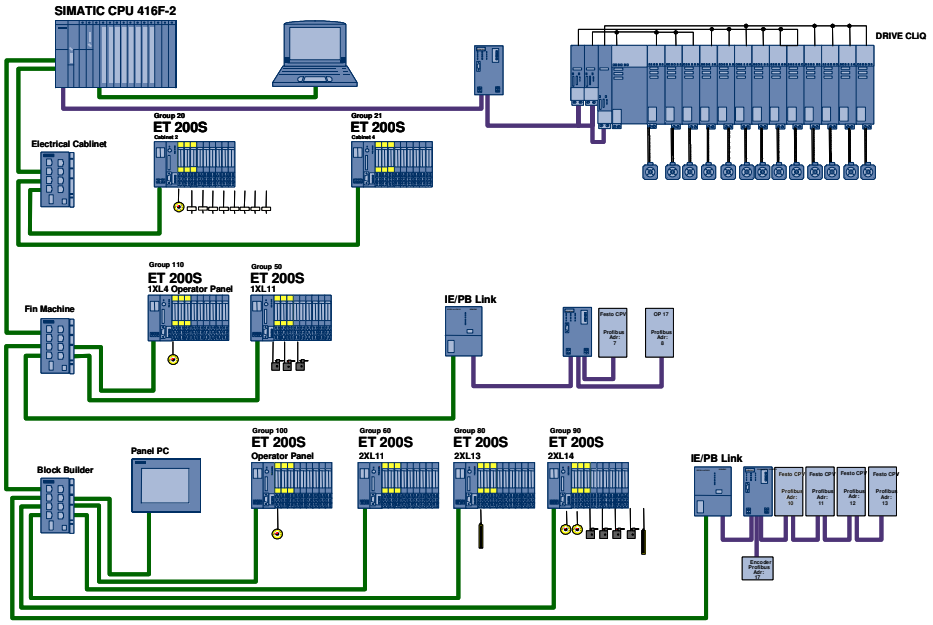
Profinet CBA Is The Key Technology At The Heart Of This Flexible Materials Handling Solution

The cigar maker has already identified numerous benefits from this solution, including a drop in production time. In addition, the company claims improvements in accuracy as well materials tracking and traceability - thanks to this "smart" approach to materials handling.

Volkswagen Employs Profisafe and Profinet IO in Radiator Production

As with office Ethernet, the real value of Profinet lies not in its cable and connectors, but rather in the portfolio of services and application profiles that use Ethernet as their medium. For example, "Profinet IO" is the application used by controllers and field devices to communicate data in real-time over Profinet. Additionally, the "Profisafe" application profile adds

an extra layer of data checks to bus datagrams to ensure the level of data integrity necessary to meet international safety standards.



Volkswagen's Radiator Production in Hanover Uses Profisafe Over Profinet To Network Safety Devices While Achieving Safety Category 4 (EN 954-1)

Volkswagen AG in Hanover, Germany decided to take advantage of these features by specifying Profinet in a production line for automobile radiators. The goal of the project was to achieve high production quality and a high level of process safety by using an industrial network rather than complex cabling. The production line had previously used an architecture based on a Pilz PNOZ controller with hard-wired safety devices.

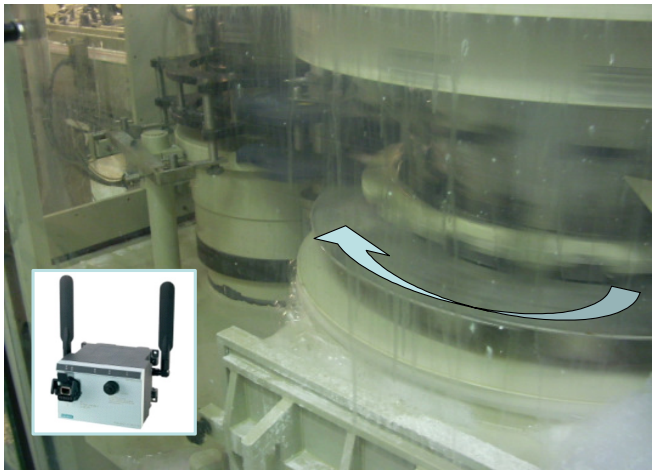
In the radiator manufacturing process, a sheet of steel rolls off a coil and into the first section of the machine at high speed where the cooling fins are formed and the sheet is cut to length. The finished fins are then transported to the second section of the plant, the so-called core builder, by compressed air, where they are pressed together into the finished raw radiator package. Motion control is provided by Siemens Sinamics S120 servo drives and Simotion D435 drive-based motion controllers networked via Profibus. Safety components such as E-stop switches and light curtains are wired to Simatic ET200S I/O blocks that, in turn, communicate via Profinet to a failsafe Simatic 416F-2 controller using Profinet IO and Profisafe. A Simatic Panel PC 670 for visualization is also linked in via Profinet.

According to Volkswagen, the solution is certified to Safety Category 4 according to EN 954-1, meeting the company's stringent safety level requirements. Using Profinet, a reaction time of 22 to 40 ms was achieved with 50 normal field devices and 11 safety devices connected to the bus. Typical process cycle times were measured at 11 ms, which is more than adequate for the application. VW pointed out several benefits using this architecture. Most importantly, the company was able to use a single controller for both normal and safety-related data, rather than separate PLCs for each function, as had been the practice. In addition, the new automation components were integrated easily into the old production line with existing HMI and pushbutton components. Using Safety Integrated components allowed engineers to take advantage of new diagnostic features such as recognition of short circuits and broken wires in I/O.

Based on the positive experience with the radiator line in Hanover, two press lines in plants in Hanover and Wolfsburg have been retrofitted in the meantime with the successful combination of Profinet, Profisafe and Safety Integrated components. Compared with the previous solution, Volkswagen also expects a significant cost savings in a new variation of the architecture that will use smaller 300-series PLCs.

HG International Replaces Slip Rings with Wireless Connection in Filling Machine

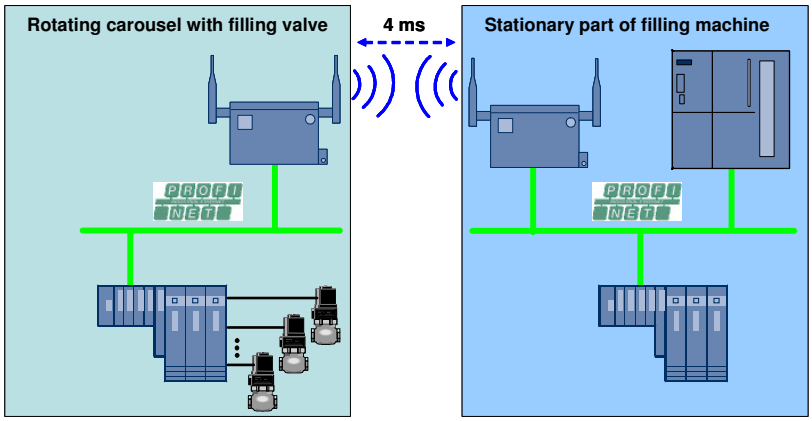
Wireless LAN has turned out to be one of the surprise benefactors of the proliferation of industrial Ethernet. Both wireless and Ethernet are based on related IEEE 802.xx standards, making wireless the natural extension of cabled Ethernet in both office and factory environments. Many users are discovering applications in which wireless technology can overcome physical barriers. One of these users is HG International (HGI).



Using A Wireless Connection In Place Of Slip Rings Helped Improve The Reliability Of The Network Connection In HGI's Filling Machines

Based in the Netherlands, HGI produces a portfolio of over 250 specialized cleaning, protection and polishing products for the consumer market. To quickly and accurately fill plastic bottles, the company uses rotating filling carousels similar to those used in the beverage industry. Control of the filling process is handled by valves located on the rotating part of the filler. Since the carousel is con-

stantly in motion, slip rings are used to transfer open and close control signals in real-time to the valve controllers. While slip rings are mostly reliable, performance can degrade in harsh environments due to wear and tear. HGI determined that the frequency of network errors resulting from disturbances to the communication over the slip rings was unsatisfactory, resulting in unacceptably low availability. The company also considered using infrared transmission, but this also proved to be unreliable.



HGI's Solution Uses Two Scalance W Access Points That Allow The Controller To "Talk" To The Rotating Devices Wirelessly Via Profinet IO

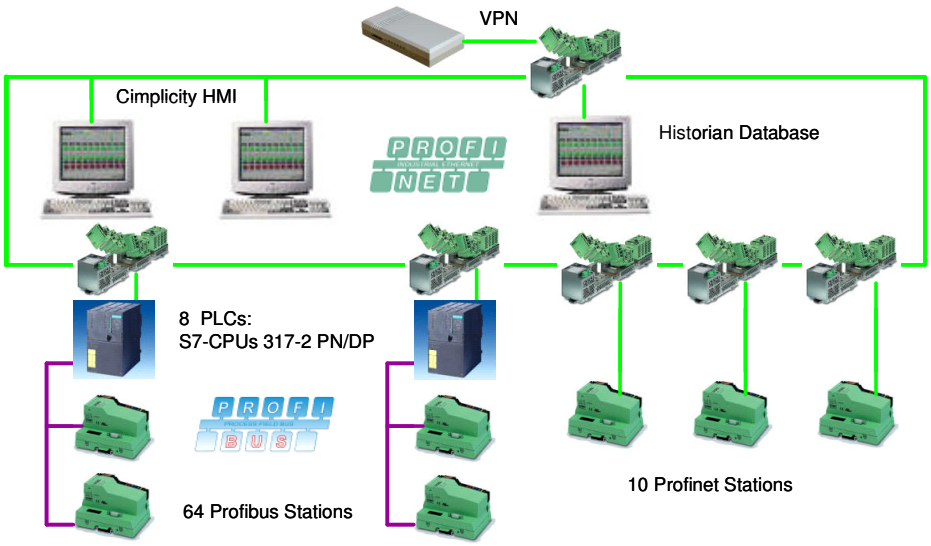
To solve the problem, HGI developed and tested a solution using a wireless LAN technology to transmit data between the Siemens S7-300 PLC and the rotating valves via Profinet. The solution uses a Scalance W wireless access point, also from Siemens, together with ET200S I/O blocks mounted on the rotating carousel to control the filling valves. All three devices use Profinet IO to support the transfer of real-time control data.

According to HGI, this solution meets their requirement of a 4 millisecond cycle time to activate the valves. As it turned out, the solution is cost competitive compared with the alternate methods considered. In addition to I/O control, the use of Profinet and wireless also supports programming and maintenance operations – functions that essentially remain transparent to the user despite the wireless connection.

Dutch Manufacturer Chooses Profinet for Multi-Vendor Environment

One of the Netherlands' best kept secrets is that it is the world's largest exporter of cultivated mushrooms. The country's 450 mushroom farms grow and harvest crops of the delicacy using semi-automated systems. To

maximize yield, mushrooms today are grown under carefully controlled climatic conditions in special spawning sheds. A key to successfully growing mushrooms is the use of specially conditioned soil. Known as „indoor verse compost“ (IVC), this soil is manufactured using a special process developed by *Coöperatieve Nederlandse Champignonkwekersvereniging* (CNC), a cooperative of Dutch mushroom growers. IVC is prepared by composting a combination of chicken and horse manure with water and other ingredients. The mixture is first aerated in batches for several in long climate-controlled tunnels, and then pasteurized to kill germs. Finally, the compost is conditioned at constant temperature with mycelium, the “seeds” from which mushrooms will later grow, in a final phase that lasts two weeks.



CNC Uses Both Profinet And Profibus To Bridge Long Distances In the Plant As Well As To Remotely Access Data For Quality and Maintenance Analysis

To regulate temperature, humidity and airflow in the conditioning tunnels, CNC previously had used proprietary, VME/DOS-based controls. However this system started showing its age as components broke down and replacements were no longer available. Also, the engineering tools were dated and required too many specialist skills to program and maintain. CNC decided to replace the control system with a modern, open system that allowed modular design and could be serviced remotely. Designed and built by Dutch systems integrator Alewijnse, the solution in one plant controls 100 tunnels using 3900 I/O points connected to remote I/O blocks from Phoenix Contact connected via Profibus and Profinet to 8 Siemens 317-2 PN/DP controllers. A Cimplicity SCADA server monitors 56,000 tags while a data historian logs 2500 data points via OPC.

The networks employ several kilometers of fiber optic cable segmented by 8 industrial Ethernet switches from Phoenix Contact using the spanning tree algorithm to ensure the connection between the PLCs and the SCADA system. One switch is used as a bridge for transferring production data between the plant network and the office network. This data is used by the quality department to optimize and control the compost flow. The maintenance department uses alarm information to analyze and schedule maintenance activities.

Alewijnse chose Profinet for its multi-vendor support and ability to bridge the long distances between tunnels using a fiber optic ring topology. Planning for the future, Profinet was also selected for its support of wireless devices that the company plans to install on free moving machinery. CNC and Alewijnse take advantage of Ethernet to remotely access the production networks in multiple plants via a Virtual Private Network (VPN).

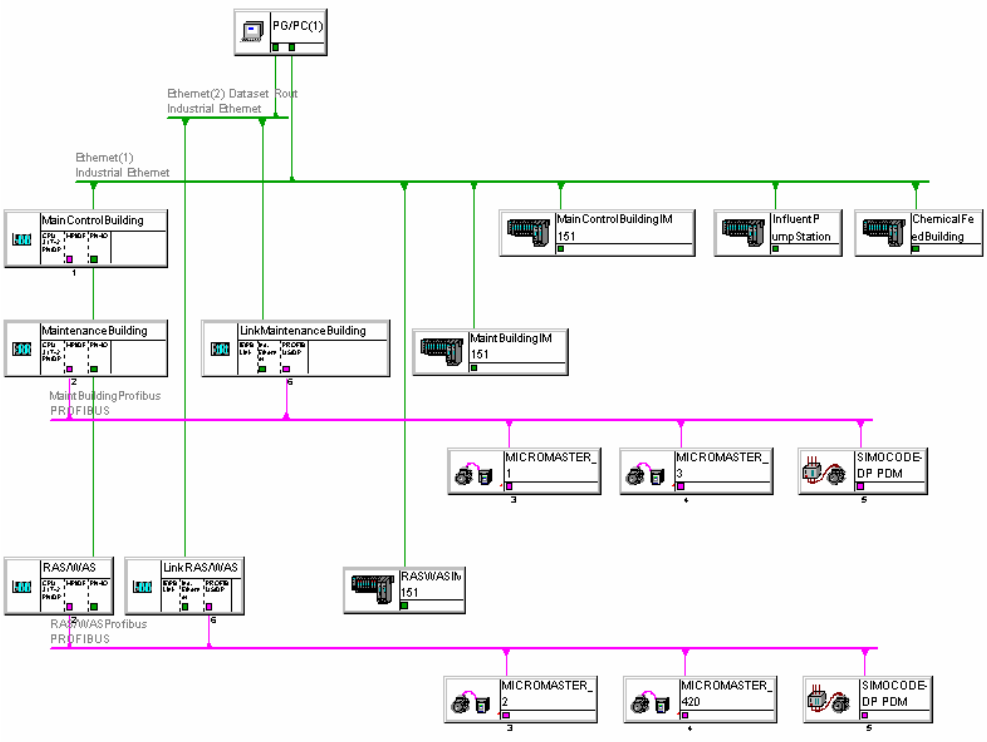
Profinet CBA Facilitates Communication in a Wastewater Treatment Plant

A good municipal infrastructure is of critical importance for communities that want to attract more job-creating industries. Such was the case in a municipality in Alabama that decided it needed to increase the capacity of its water treatment plant to attract more businesses. The expansion targeted a 30 percent average increase in the capacity of the plant to treat wastewater, along with a higher peak value to handle the aftermath of occasional heavy rains. To automate this solution, system integrator Hi-Tech Systems in conjunction with Smith Engineering Consultants and Ladd Engineering Associates, chose Profinet as the backbone network.

This Water Treatment Plant Uses Profinet Over A Fiber Optic Ring Topology To Network Controllers And Drives Separated By Long Distances

Spread out over 4 acres, the treatment plant clearly needed a solution that could span longer distances than in a typical factory. Industrial Ethernet over a redundant fiber optic ring was selected as the solution, while Profinet was chosen as the network protocol. The ring network has a total length of 6000 feet with as much as 1200 feet between stations. Traffic on the network is managed by Scalance X industrial Ethernet switches that support both copper and fiber optic media as well as the ring

redundancy. Physically, the site consists of several buildings housing motor control centers (MCC) responsible for pumping and screening influent and effluent water through various stages of treatment, ranging from preliminary treatment to oxidation, clarification and disinfection. Additional stations for chemical feed and other pumping tasks use Simatic ET200S I/O blocks connected directly to the Profinet trunkline.



The Profibus Topology Used In This Water Treatment Plant Was Laid Out Graphically Using The iMap Configuration Tool

The controls architecture consists of Simatic 317-2 PN/DP controllers with both Profibus and Profinet interfaces distributed throughout the treatment plant. This combination of networks serves to support both legacy installations of drives networked via Profibus as well as customer wishes to program and configure controllers and field devices over Profinet. To simplify the transfer of drive data to the main control building, Profinet CBA was used to set up intra-PLC communication, saving the need to program data transfers individually since each PLC is responsible for monitoring an MCC on Profibus.

One particular advantage of using Profinet in this application is its ability to seamlessly route information from devices on Profibus to devices on Pro-

finet via IE/PB links. This feature was necessary to support the Simatic PDM asset management tool used to monitor the performance of drives. Another benefit is that technicians can access devices located anywhere in the system via any PC – on Profinet or Profibus – for programming or maintenance purposes.

In addition to the communication between automation devices, this application also demonstrates the advantage of using standard IT services available with enabled remote diagnostics. For example, the water treatment plant also installed a DSL/VPN connection to the control room, giving technicians access from remote locations to any device connected to the network via the internet.

Conclusions and Recommendations

Ethernet's penetration of the control and device levels in the factory amounts to no less than a minor revolution in the manufacturing industries. With its wide appeal, common services and simultaneous support of multiple protocols, industrial Ethernet has effectively re-defined the role that networks play in industrial applications.

Thanks to industrial Ethernet, manufacturers now have access to data previously hidden by technical barriers that can be used effectively by both production and enterprise applications to measure and better understand what is happening in manufacturing processes, helping to cut costs and increase productivity. While Ethernet can greatly enhance data gathering from the plant floor, this is especially useful if the data are effectively evaluated using applications such as asset management.

Under the Profinet name, industrial consortium Profibus International offers an all-encompassing suite of solutions for Ethernet in the factory. Built around standard Ethernet, Profinet's application profiles provide Ethernet-based solutions for specific application areas such as safety and motion control. Thanks to the common IEEE 802.xx standard, Profinet also supports cable-less networking of devices using standard wireless LAN.

Profinet with IRT opens up the door to high-end application performance by enabling levels of speed, capacity and determinism unthinkable just a few years ago. Performance improvements on this order of magnitude are already leading some machine builders to designs next generations machines around the new capabilities offered by industrial Ethernet.

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Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/Community/terms/terms.htm

API	Application Program Interface
APS	Advanced Planning & Scheduling
B2B	Business-to-Business
BPM	Business Process Management
CAGR	Compound Annual Growth Rate
CAS	Collaborative Automation System
CMM	Collaborative Manufacturing Management
CNC	Computer Numeric Control
CPG	Consumer Packaged Goods
CPAS	Collaborative Process Automation System
CPM	Collaborative Production Mgmt
CRM	Customer Relationship Mgmt
DCS	Distributed Control System
EAM	Enterprise Asset Management
ERP	Enterprise Resource Planning
HMI	Human Machine Interface
IT	Information Technology
KPI	Key Performance Indicator
MRP	Materials Resource Planning
OpX	Operational Excellence
OEE	Operational Equipment Effectiveness
OPC	OLE for Process Control
PAS	Process Automation System
PI	Profibus International
PLC	Programmable Logic Controller
PLM	Product Lifecycle Management
RFID	Radio Frequency Identification
ROA	Return on Assets
SCE	Supply Chain Execution

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