Industrial Communication Network in Food and Beverage Industry

As things are, there is still substantial room for improvement in the food & beverage industries. This includes increasing operational efficiency and effectiveness of existing and planned new production facilities, among other issues.

An essential contribution to this will be provided by the integrated linking of production lines and machines from the inbound of raw material to production, packaging up to the outgoing goods, as well as the consistent recording of production parameters like quantities, machine time, etc. It will be possible to collet data across all areas of the production facility and have it analyzed by IT or even cloud-based systems, to enable the derivation of sustainable improvement measures.

Today this can be very time-consuming, because machines and components of different manufacturers must be linked and the collected data must be synchronized. Therefore, a plant-wide network concept from Siemens AG includes the horizontal integration from incoming goods across food processing and food packaging areas to outgoing goods and storage and vertical integration from machine level, supervisory systems, MES (Manufacturing Execution System) up to office IT. This concept describes different layers such as industrial backbone and aggregation, and cell/machine level. The dimensioning of the layers can vary according to the size of the plant.

Brief description of the architecture

The following figure shows an overview of a possible campus network in which both the classic IT infrastructure, including intranet, Internet, and the datacenter are illustrated schematically, as well as the connection to the industrial infrastructure. When looking at the picture, it is noticeable that some network components are shown on a gray background (core layer). These components are not the focus of the industrial network components but are part of the standard IT infrastructure of a location.
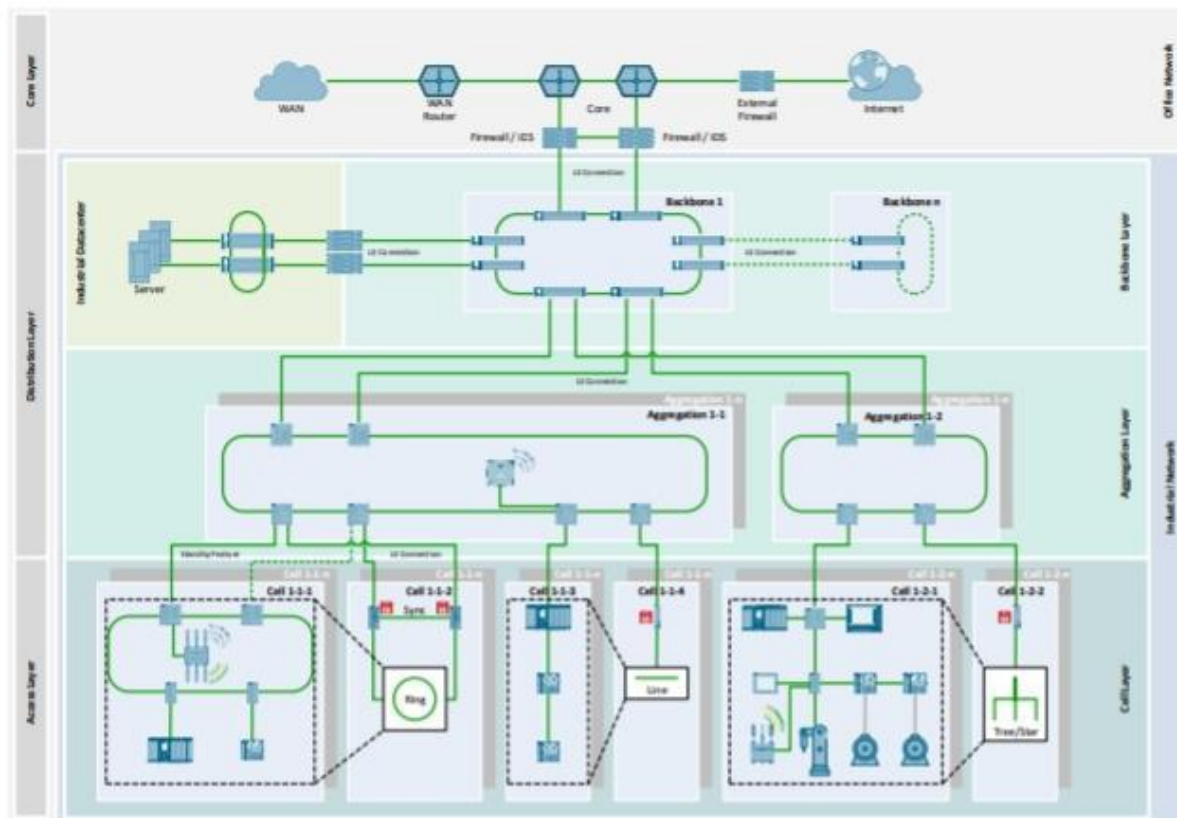
Having been a trusted partner by electrifying and automating several industrial plants worldwide, Siemens is now a trusted partner for Digitialization, striving to be the pioneer within this new age of production, whether in the discrete or process industries. Digitalization is already changing every aspect of our customers' business in the near future and the right communication networks are the basis for this. Enterprise and production networks look completely different, but are still connected with a defined interface. We want to connect these two "worlds" while making sure that the requirements of each are met.Looking at the picture above, the suggested way is to establish a production network to create a structured and reliable platform to support different communication needs. The production cell level is already responsible for production. The industrial backbone level is also an integral part of the production network and in collaboration and alignment with IT, as an interface to interconnect production with the enterprise network.

General industrial network standards.

The top priority in automation is to guarantee the monitoring and operability of the Production. Even measures that are intended to prevent the spreading of security Threats are not allowed to restrict this. To achieve this, the F&B Network Guideline recommends employing the latest Security mechanisms available. This means that all solutions and configurations Have been selected as if the plant operator were to employ all currently available Security mechanisms and technologies and Siemens and third-party products in Order to achieve the best possible plant security. Depending on the protection Requirements of the plant operator, the existing

responsibilities, or already Implemented security mechanisms, configurations shown here can also be Implemented and scaled in modified forms. However, this should be planned Carefully in individual cases by all the technicians, specialists, administrators, and Managers involved. In order to achieve the best possible security, modified Configurations must not conflict with the fundamental principles of the security Concept.

Avoid isolated automation and Information technology solutions by assuring:

• Continuous flow of information from the actuator/sensor level through to the Corporate management level

• Availability of information at any location

• Accessibility of all devices from sensor up to IT infrastructure.

• High-speed data exchange between the different plant sections and machines

• Easy, plant-wide configuration and efficient diagnostics

• Integrated security functions that block unauthorized access

• Fail-safe and standard communication via the same connection

Our range

Communication networks are of utmost importance for automation solutions. Networking for Industry stands for a diverse range of modular blocks – designed for Different industries – which contribute to efficiently solving communications tasks:

• In the different production areas

• Across the entire workflow

• For the complete plant life cycle

• For your industry

Industrial Networking offers solutions which both maximize the benefits of Ethernet And simplifies integration into fieldbus systems. Noticeable examples are:

• The development of the field level for the use of Industrial Ethernet

• Complete integration from the field level to the corporate management level

• The implementation of new solutions by means of mobile communication

• The integration of IT technologies

Worldwide trends

Communication type	International Standard
Industrial Ethernet	IEEE 802.3
Industrial Wireless LAN	IEEE 802.11
PROFINET	IEC 61158 / IEC 61784
PROFIBUS [2]	IEC 61158 / IEC 61784

Industrial Networking offers all the components needed for an integrated overall

solution and supports the following communication systems:

• **Industrial Ethernet and Industrial Wireless LAN** (based on the Ethernet standard IEEE 802.3 and 802.11 a/b/g/h/n/ac wireless LAN standards). The international standard for robust networks is the number one in industrial LAN environments. Industrial Ethernet enables powerful communication networks to be constructed over widely distributed areas.

• **PROFINET (IEC 61158/61784):**The international standard uses Industrial Ethernet and allows real-time communication all the way to the field level, but also integrates the enterprise level. With the full utilization of existing IT standards, PROFINET allows isochronous motion control applications, efficient cross-manufacturer engineering and high availability of machines and systems on the Industrial Ethernet. PROFINET supports distributed automation (and controller-controller communication) it allows fail-safe and safety applications.

• **PROFIBUS (IEC 61158/61784):**The international standard for the field level is the global market leader among fieldbus systems. It is the only fieldbus to allow communication both in manufacturing applications and in process-oriented applications.

Industrial Ethernet

Industrial Ethernet provides the industrial area with a powerful network that Complies with the IEEE 802.3 (Ethernet). The diverse options of Ethernet and the Internet that are already available today in the office sector can also be used in Factory and process automation by means of Industrial Ethernet. Ethernet technology, which has been used successfully for decades, allows users To precisely match network performance to requirements. The user can choose the Data throughput rate to suit particular needs, as integrated compatibility makes it Possible to introduce this technology in stages. Ethernet is currently the protocol Number 1 in the network environment and offers significant advantages such as:

• Fast commissioning thanks to the simplest connection method

• High availability since existing networks can be extended without any adverse Effects

• Virtually unlimited communication capabilities, since scalable performance Using switching/routing technology and high data rates are available

• Networking of the most varied application areas such as the office and Production areas

• Company-wide communication thanks to the Internet connection option, with Security components providing for data integrity

• Investment protection through continuous compatible further development

• Precise time-based assignment of events in the overall plant by means of Plant-wide clock control and distribution.

The following communication functions and services are offered by Industrial Ethernet.

• **PG/OP communication**:Comprises integrated communication functions which allow data communication via SIMATIC, SIMOTION automation systems with every HMI device and SIMATIC PG (STEP 7). PG/OP communication is supported by PROFINET/Industrial Ethernet and PROFIBUS.

• **Open communication:** The open communication allows controllers to communicate with other controllers, PC/IPC and third-party systems using libraries.

• **OPC (Object Linking and Embedding for Process Control):**This is a standardized, open and cross-vendor software interface. It permits interfacing of OPC-capable Windows applications to S7-communication, open communication and PROFINET.

• **OPC UA (Unified Architecture):**OPC UA is the successor of OPC. The new OPC standard provides an operating system independent platform for communication between e.g. Windows devices, mobile devices, PLCs etc. It also provides a cross-platform service-oriented architecture (SOA) for process control, while enhancing security and providing an information mode.

PROFINET

PROFINET – the Ethernet standard for automation.You need a seamless information flow for your strategic decisions within your company – from the first manufacturing step through operation up to the corporate management level. In order to achieve this, you already rely on efficiency and transparency during engineering.PROFINET, the open and innovative Industrial Ethernet standard, fulfills all the demands of industrial automation and ensures integrated, company-wide communication.PROFINET also supports the direct connection of distributed field devices to Industrial Ethernet and the implementation of isochronous motion control applications. PROFINET also allows distributed automation with the support of component technology, as well as vertical integration and the implementation of safety-oriented applications. PROFINET also supports controller-controller communication. PROFINET is the leading Industrial Ethernet standard with more than 21 million nodes worldwide.

More flexibility with PROFINET

• Industrial Wireless LAN (IWLAN) reduces maintenance costs, increases

Reliability, and convinces with high communication performance. Only PROFINET allows the use of IWLAN with safety.

• Safety-related communication by way of PROFIsafe reliably protects Personnel, the environment, and plants.

• Flexible topologies. PROFINET also enables the use of star, tree and ring Topologies in addition to the linear topology.

• Open standard

• Thanks to its openness, PROFINET creates the basis for a uniform Machine/plant automation network to which programmable controllers as well As standard Ethernet devices can be connected.

• Web tools

• PROFINET is 100 percent Ethernet and supports TCP/IP. Among other things, This enables the use of Web technologies, such as access to the integrated Web server of the field devices.

• Expandability

• With PROFINET, network infrastructures can be expanded as desired, even During operation.

More efficiency with PROFINET

• **One cable for all purposes:**PROFINET offers a host of functions on one cable: Machine data and standard IT data merge. This creates integration and saves costs by reducing the overhead for cabling and training overhead.

• **Device and network diagnostics:** Extensive diagnostic data can be read out from the devices to locate faults quickly. HTML standard Web sites are used for servicing PROFINET devices –locally and remotely.

• **Increased energy efficiency:**PROFIenergy switches off individual loads or entire production units during breaks – in a coordinated and centrally controlled way.

• **Easy cabling:** Fault-free establishment of industrial networks in a short time and without specialist knowledge: PROFINET makes this possible with the Fast Connect system.

• **Fast device replacement:** When replacing a PROFINET device, the Controller detects the new device and automatically assigns its name.

• **High degree of ruggedness:** The use of switches even in field devices prevents faults in one section of the network from influencing the entire plant network. PROFINET enables the use of fiber-optic cables especially for areas that are critically sensitive to EMI.

More performance with PROFINET

- Speed
- Precision
- Large quantity structure
- High transmission data
- Media redundancy
- Fast start-up

Field Device Bus Systems

PROFIBUS:PROFIBUS can be used to connect field devices, e.g. distributed I/O devices or Drives, to automation systems such as SIMATIC S7, SIMOTION, or PCs. PROFIBUS is standardized in accordance with IEC 61158/61784 and is a powerful, Open and rugged fieldbus system with short response times. PROFIBUS is Available in different forms for various applications.

PROFIBUS PA (Process Automation):PROFIBUS PA expands PROFIBUS DP with intrinsically safe transmission of data And power (e.g. transducers in the food processing industry) in accordance with the International standard IEC 61158-2 (same protocol, different physical properties). PROFIBUS PA is used predominantly in the hazardous areas of refineries (chemical, oil and gas).

AS-Interface:AS-Interface (Actuator Sensor Interface, AS-i) is an industrial networking solution (physical layer, data access method and protocol) used in PLC, DCS and PC-Based automation systems. It is designed for connecting simple field I/O devices (e.g. binary ON/OFF devices such as actuators, sensors, rotary encoders, analog Inputs and outputs, push buttons, and valve position sensors) in discrete Manufacturing and process applications using a single 2-conductor cable.

IO LINK:IO-Link is the first standardized IO technology worldwide (IEC 61131-9) for Communication with sensors and also actuators. The powerful point-to-point Communication is based on the long-established 3-wire sensor and actuator Connection without additional requirements regarding the cable material. So, IO-Link is not a fieldbus but the further development of the existing, tried-and-tested Connection technology for sensors and actuators.