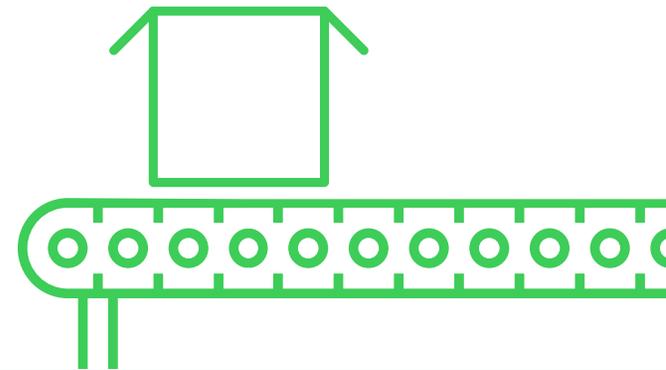


Life Is On

Schneider
Electric

Automation innovations in material handling

Smart solutions to meet
logistics challenges



Urbanization, connectivity everywhere, e-commerce, and mass personalization are reshaping the landscape in manufacturing and logistics material handling equipment and systems.

The supply chain for manufacturers and distributors is facing challenges around increased analytics, multichannel fulfillment, talent shortages, and the use of new technologies such as wireless, augmented reality, robotics and machine-to-machine (M2M). At the same time, there is continued focus on cost reduction and sustainability.

The Industrial Internet of Things is driving a huge transformation as it increases the interconnection between connected devices and analytics. The smart manufacturing enterprise can seize opportunities to maximize efficiency and safety through networking and intuitive collaboration with its users.

By taking some practical steps following a smart material handling approach, you can reduce downtime, supercharge productivity and boost accuracy. Processes across the entire supply chain – including material handling systems – must evolve to accommodate more predictive planning and more flexible business needs.

Ultimately, supply chain managers want to:

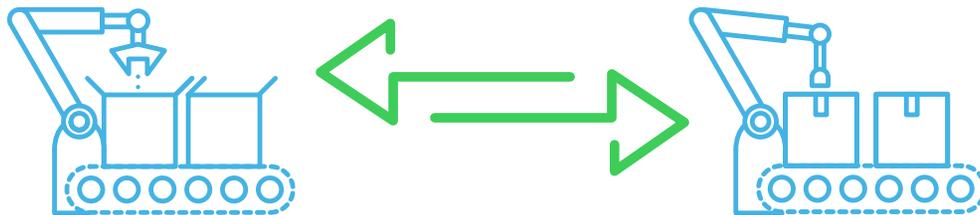
- » **Build logistics and material handling facilities faster and at lower overall cost using smart, integrated automation architectures.**
- » **Achieve greater flexibility in response to the evolving needs of their market dynamics and customers.**
- » **Face lower overall risk with an integrated solution that is easier and more flexible for OEMs and system integrators to incorporate in their designs.**

Features of the smart distribution facility

Smart enterprise control	Innovative technologies enable the tight integration of smart machines and smart manufacturing assets with the wider enterprise – leading to more flexibility, efficiency and profitability
Asset performance management	Deployment of cost-effective wireless sensors, easy cloud connectivity and data analytics will improve asset performance by giving decision makers actionable information in real time
Augmented operators	Plants will evolve to be more user-centric and less machine-centric – future employees will use mobile devices, data analytics, augmented reality and transparent connectivity to increase productivity
Wireless remote control systems	Wireless remote control systems keep operators safe , provide better diagnostics – and reduce installation and commissioning time

When machines talk to each other, the result is:

- » Increased *efficiency*
- » Increased *cybersecurity*
- » Increased *flexibility*
- » Increased *connectivity*



For further information, see [“Smart Machines Create New Possibilities for Logistics,” ARC strategies, Sept. 2017](#)

Solutions for material handling systems

For any material handling focus area – storage and retrieval systems, conveyor systems, picking and sorting, or fully automated warehouses – smart technology solutions allow you to quickly build safer, more connected, and more efficient systems.

Automated storage and retrieval	Scalable control solutions for single carousel or various fully automated high-rise shelves
Pick and place robot systems	Solutions for high-performance machines up to 30 robots, with optional embedded safety
Automated conveying systems	Scalable conveying control solutions, from simple to high-performance applications
Automated guided vehicles	Scalable AGV solutions for designing flexible product flows to guarantee delivery of parts in a fully integrated solution
Automated robotic systems	Integrated robotics into a standard automation solution. Integration is simplified through a single, cohesive system free of complex interfaces. Robot types: Delta, Cartesian, Scara



[For more information on smart manufacturing, see our blog post, *“The future of material handling is ‘smart’”*](#)



Smart manufacturing offers benefits in 4 key areas:

1

**Stamping out
downtime**

2

**Supercharging
productivity**

3

**Boosting accuracy,
velocity, and quality**

4

**Increasing energy
efficiency**

Implement the right automation architecture and the associated automation components

Automation architectures are uniquely defined for any new material handling system. Depending on the size of the system, the architecture may have centralized or distributed controls.

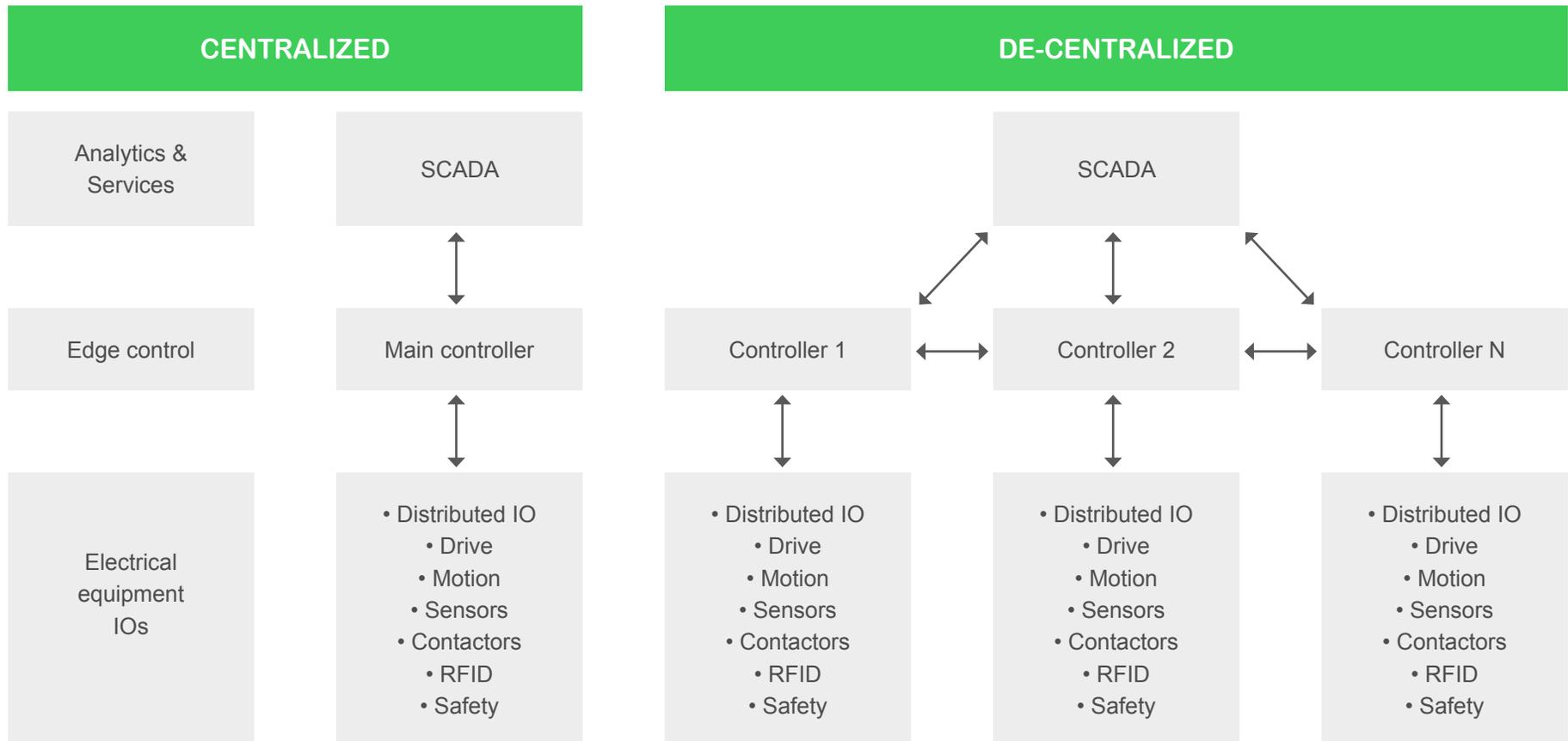
Centralized controls have been the standard for many years. All control devices such as motor starters, Variable Frequency Drive (VFDs), interface relays, and PLCs are mounted in one central panel. All devices such as motors, sensors, or stack lights must be wired back to the central panel.

Distributed controls follow a different scheme. The motor starters and VFDs are mounted alongside the conveyor. Remote input/output (I/O) panels are positioned at various strategic locations throughout the system. The motor starters, sensors, and so on are wired back to the much closer remote I/O panels. Then all that is needed is a simple communication cable that goes back to the main panel where the PLC is located. This concept is less expensive to install from a wiring standpoint, but there are more devices for the electricians to mount.

In a conventional, centralized control system, the main panel houses all of the controls. The panel has to be sized to accommodate the PLC, motor starters, overloads and fuses. This can require expensive heat dissipating systems as the number of motors increase. A distributed control system eliminates the need for many of these components, thus shrinking the panel size and cost. With a centralized control, large conduit and/or cable trays are required to carry all of the wires from the panel to the conveyor drives. As the number of motors increases, so does the size and quantity of the conduit and wireway that are needed. On the other hand, a distributed control system requires minimal wiring due to the close proximity of the motor to its control devices. Reduced wire means cleaner signals in control wires and less interference, a potential source of system malfunction.

Between the two choices, centralized controls are preferred for small or compact systems. Distributed controls are the correct choice for larger systems that can cover many hundreds of feet.

Automation Architectures



Select the appropriate automation network

Many material handling applications have adopted the field bus. This backbone of automation system architecture is an extremely powerful means of exchange, visibility and flexibility in the devices connected to it.

The field bus has gradually led to an overhaul in architecture:

- » **Input/output wires eliminated**
- » **Input/output interfaces superseded or decentralized**
- » **Intelligence decentralized and distributed**
- » **Internet interconnection**

Before analyzing communication network technologies, there should be a breakdown of the main requirements for which these levels provide a relevant solution.

An initial approach is to adopt the two main focuses from the table of requirements (Table 1):

- » **Amount of information to transmit**
- » **Response time needed**



Table 1 - Communication requirements and constraints

Level	Requirement	Type and volume of data to transmit	Response time	Distance	Network topology	Number of addresses	Medium
Management	<ul style="list-style-type: none"> Data exchange Computer security Standards between software packages 	<ul style="list-style-type: none"> Files Mbits 	1 min	World	<ul style="list-style-type: none"> Bus Star 	Unlimited	<ul style="list-style-type: none"> Electrical Optic Radio
Shop floor	<ul style="list-style-type: none"> PLC synchronisation in the same data exchange automation cell in client/server mode with control tools (HMI, supervision) Real time performances 	<ul style="list-style-type: none"> Data Kbits 	50-500 ms	2-40 km (1.2-24.8 miles)	<ul style="list-style-type: none"> Bus Star 	10-100	<ul style="list-style-type: none"> Electrical Optic Radio
Machine	<ul style="list-style-type: none"> Distributed architecture Embedded functions and exchange Transparency Topology and connection costs 	<ul style="list-style-type: none"> Data Kbits 	5-100 ms (PLC cycle)	10 m to 1 km (33-3,281 ft)	<ul style="list-style-type: none"> Bus Star 	10-100	<ul style="list-style-type: none"> Electrical Optic Radio
Sensor	<ul style="list-style-type: none"> Simplification of distribution wiring for power supply to sensors and actuators Optimized wiring costs 	<ul style="list-style-type: none"> Data Bits 	–	1-100 m (3-328 ft)	No constraint	10-50	<ul style="list-style-type: none"> Electrical Radio

An industrial network is made up of PLCs, human-machine interfaces, motor drives and I/O devices linked together by communication links such as electric cables, optic fibers, radio links and interface elements such as network cards and gateways. The physical layout of a network is the hardware topology or network architecture.

There are three main types of LAN systems:

- » Star Topology
- » Ring Topology
- » Bus / Line Topology

A communication protocol specifies a set of rules for a given type of communication.

The use of networks for communication in industrial automation architectures increases their flexibility so they can fulfil the requirements for adapting to different machines or facilities. To do so involves making choices necessitating specific knowledge of the right solutions out of a wide range of communication networks.

Simple criteria should be used. This means that network products should be open, standardized and suitable:

- » An open network, as opposed to a proprietary one, leaves one free to choose suppliers of automation devices
- » An internationally standardized network guarantees durability and upgradeability
- » A suitable choice balanced between machine or plant requirements and network performance is the way to optimize the investment.

Depending on the desired application response time* required for your material handling system, several network protocols can be used.

* ART = scan time of processor + communication update time of the I/O over the network



Modbus TCP/IP



Modbus is a serial communications protocol originally published by Modicon (now Schneider Electric) in 1979 for use with its programmable logic controllers (PLCs).

Modbus has become a de facto standard communication protocol and is now a commonly available means of connecting industrial automation devices. MODBUS/TCP is a variant of the Modbus family of simple, vendor-neutral communication protocols intended for supervision and control of automation equipment. Specifically, it covers the use of Modbus messaging in an “Intranet” or “Internet” environment using the TCP/IP protocols. The most common use of the protocols at this time are for Ethernet attachment of PLCs, I/O modules, and “gateways” to other simple field buses or I/O networks.

EtherNet/IP



Initially released in 2000, EtherNet/IP is an open industrial standard developed by the ODVA (Open DeviceNet Vendors Association). The “Ethernet Industrial Protocol” is essentially

a port of the CIP application protocol (Common Industrial Protocol), to the Ethernet data transfer protocol.

EtherNet/IP is an application-layer protocol on top of TCP/IP. EtherNet/IP uses standard Ethernet physical, data link, network, and transport layers, while using Common Industrial Protocol (CIP) over TCP/IP. CIP provides a common set of messages and services for industrial automation control systems, and it can be used in multiple physical media.

EtherNet/IP establishes communication from one application node to another through CIP connections over a TCP connection, and multiple CIP connections can be established over one TCP connection. EtherNet/IP uses the standard Ethernet and switches, thus it can have an unlimited number of nodes in a system. This enables one network across many different end points in a factory floor. EtherNet/IP offers complete producer-consumer service and enables very efficient slave peer-to-peer communications. EtherNet/IP is compatible with many standard internet and Ethernet protocols but has limited real-time and deterministic capabilities. EtherNet/IP is the only one of the real-time methods described to be based entirely on Ethernet standards.



In contrast to the other protocols, EtherNet/IP is not cycle-based but time-based, meaning that it merely requires that control commands are received by the field stations in time. This means the performance of the overall system can be made independent of network performance. Real-time delivery is safeguarded by three mechanisms which are all standards-based: UDP, Quality of Service (prioritization), and IEEE1588. To achieve real-time capability, accessible bandwidth is limited in order to avoid contention and latency. In other words, because EtherNet/IP is an application-layer protocol, it has a limited performance range that can deliver in real time.

SERCOS III

sercos the automation bus

A freely available *real-time* communication standard for digital drive interfaces, SERCOS III not only specifies the hardware architecture of the physical connections, but also a protocol structure and an extensive range of profile definitions. For SERCOS III, effectively the third generation of the SERCOS Interface (SERCOS, Serial Realtime Communication System) that was originally introduced to the market in 1985, Standard Ethernet according to IEEE 802.3 serves as the data transfer protocol. This communication system was originally designed for motion control-based automation systems but has success in material handling due to its high performance and speed. A registered association, SERCOS International, supports the technology's ongoing development and ensures compliance with the standard.

SERCOS-III uses the Ethernet physics (100Mbps) and the Ethernet telegram while retaining the existing SERCOS mechanisms. SERCOS-III is likewise based on a time slot mechanism in which bandwidth is reserved for the isochronous (real-time channel) and asynchronous (IP channel) data traffic. SERCOSIII works without hubs or switches. Each station has a special integrated ASIC or FPGA with two communication ports, enabling it to be connected via line or ring topology. Eliminating the switches means shorter cycle times can be implemented, though at the cost of flexibility in the network topology.

In general, if the material handling application response time is $>10\text{ms}$, then Modbus TCP and/or Ethernet IP can be a good choice for the automation field bus. If the material handling application response time is $<10\text{ms}$, then SERCOS III becomes a good choice for the automation field bus.



Table 2 – Automation network options

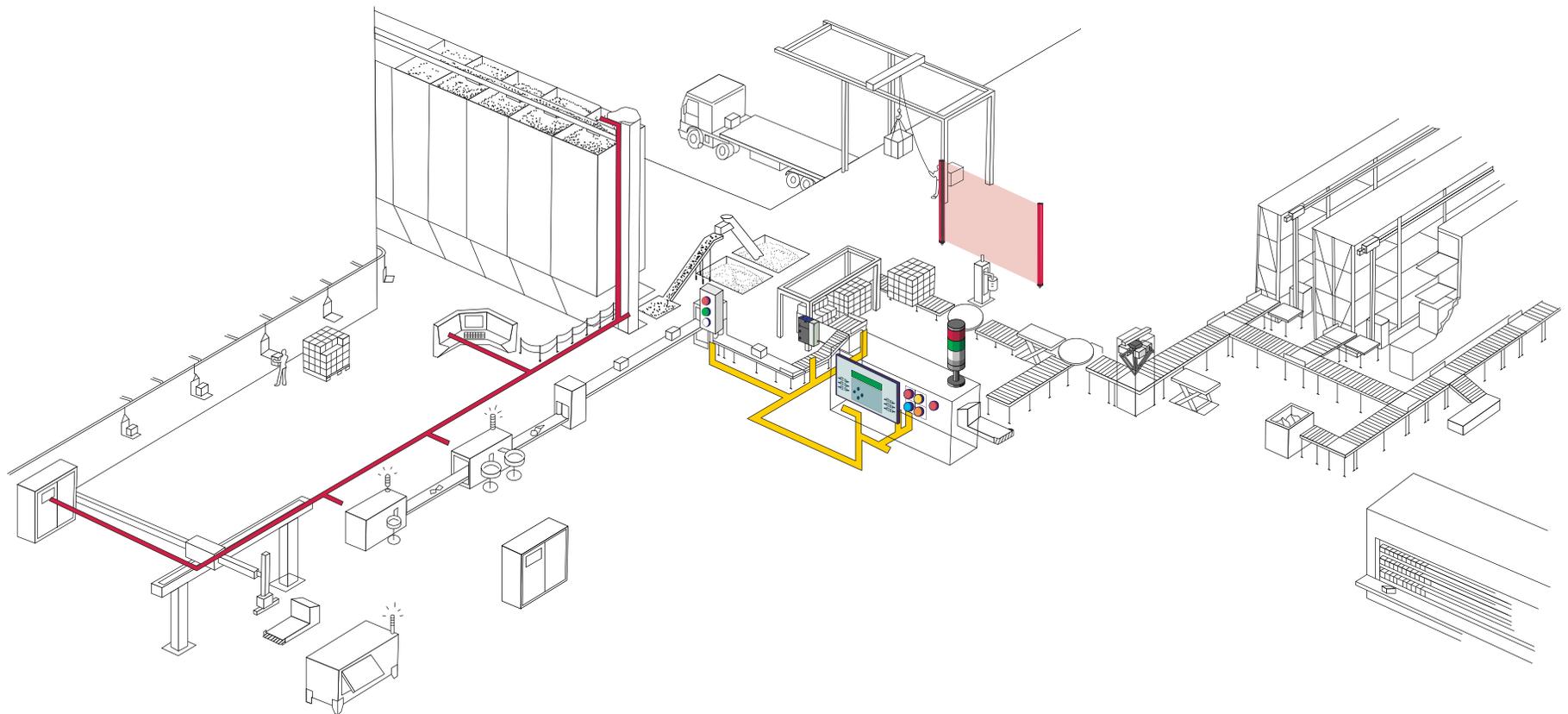
	Control network	Standard I/O	Safety I/O	Drives	Servos
De-centralized architecture Performance requirement > 10 ms	Modbus TCP/ IP	EtherNet/IP	Hardwire	EtherNet/IP	EtherNet/IP CANOpen
De-centralized architecture Performance requirement < 10 ms	SERCOS III	SERCOS III	SERCOS III	SERCOS III or EtherNet/IP	SERCOS III

Using a controller master such as PacDrive 3 (from Schneider Electric) allows synchronous deterministic communication between controllers by using SERCOS III protocol over Ethernet field bus. We are able to reach high performance to exchange data collection with complete synchronization between the controller which manages the data flow and the controller which manages the material handling equipment.

SERCOS III is a field bus designed to manage fast acting inputs and outputs (synchronous deterministic communication). PacDrive 3 and SERCOS III offers the capabilities to manage safe inputs and outputs, and standard I/O as well.

Products that provide complete material handling control technology, up and down the line.

Mouse over each of the following product categories to see details. For additional information, click on a category to visit the website.



Life Is On



For more information

Refer to Schneider Electric whitepapers on the following related topics:

- » **Smart Manufacturing – Enabling Three Key Areas of Excellence**
- » **Wireless Technology – Changing the Face of Safety Applications**
- » **On the road to smart machines – How OEMs can Improve the energy efficiency of machines**
- » **The Future-Proof Plant: Impact of Evolving Operations, Technology, and Workforce Changes**