



POWERLINK

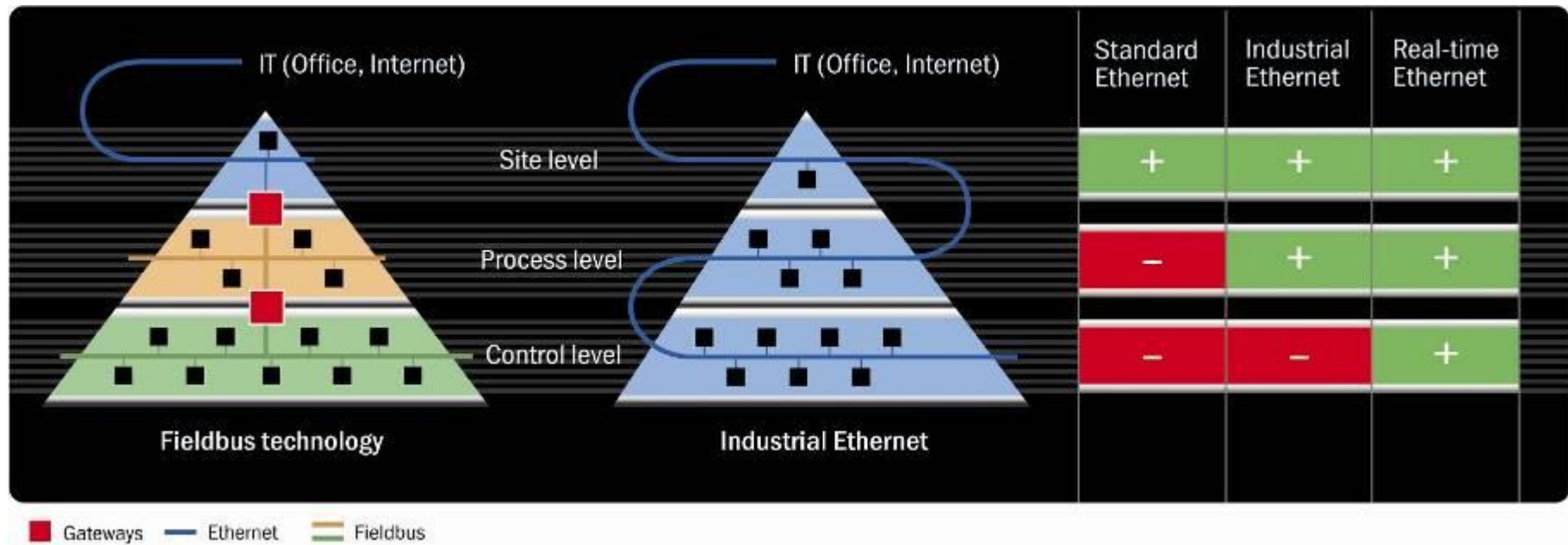
The standard for
Industrial Ethernet

- Old fieldbus technologies are limiting new demanding applications
 - Low bandwidth
 - Limited topologies
- Ethernet is a safe investment
 - High performance, higher productivity
 - Manufacturer independent
 - Proven technology



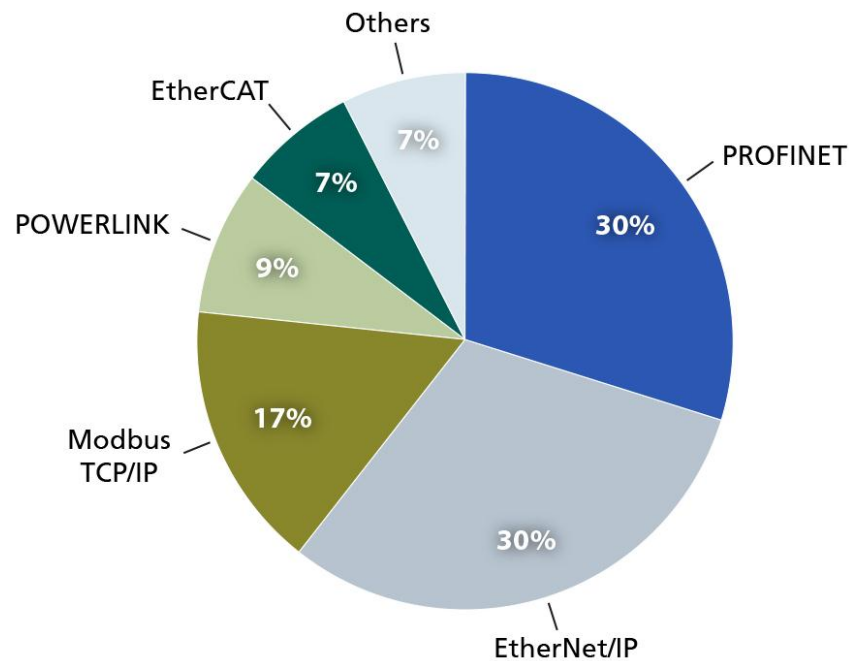
Why real-time Industrial Ethernet

- Standard Ethernet is not deterministic
 - Designed for office application
 - Not for time critical information
- Real-time Industrial Ethernet is required for
 - Critical processes, control level and sensor systems



- Maximum performance
- Absolute openness
- Based on Standard Ethernet
- Designed for Integrated Automation
- Lowest Total Cost of Ownership

- Worldwide leader for real-time Ethernet solutions
- 3,200 OEMs trust in POWERLINK
- More than 1,1 million POWERLINK systems installed

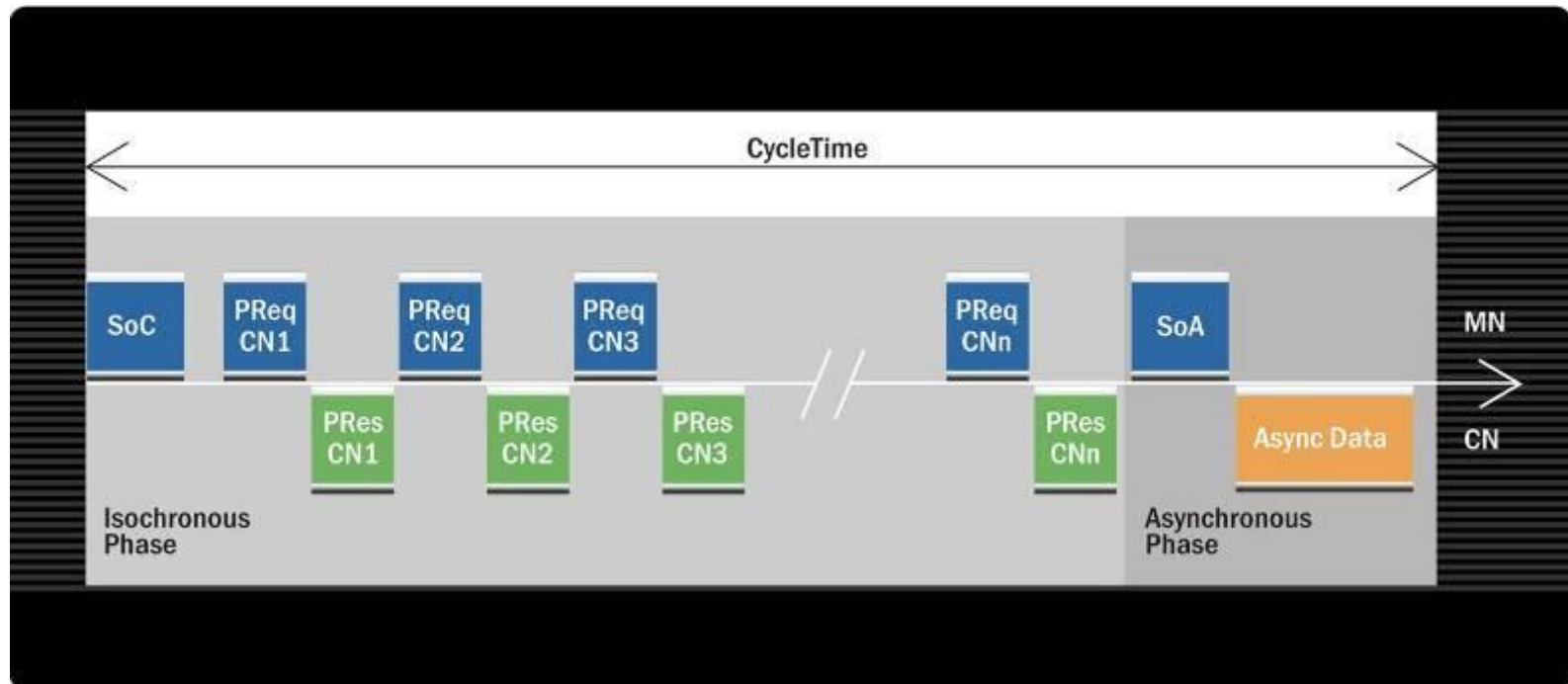


Source IMS Research 2013

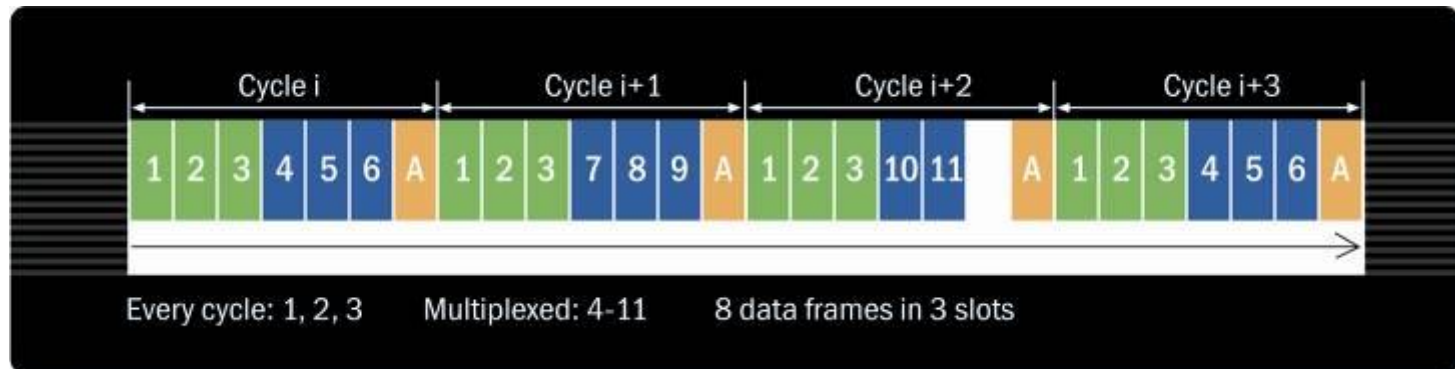
- Industrial Ethernet National Standard GB/T-27960



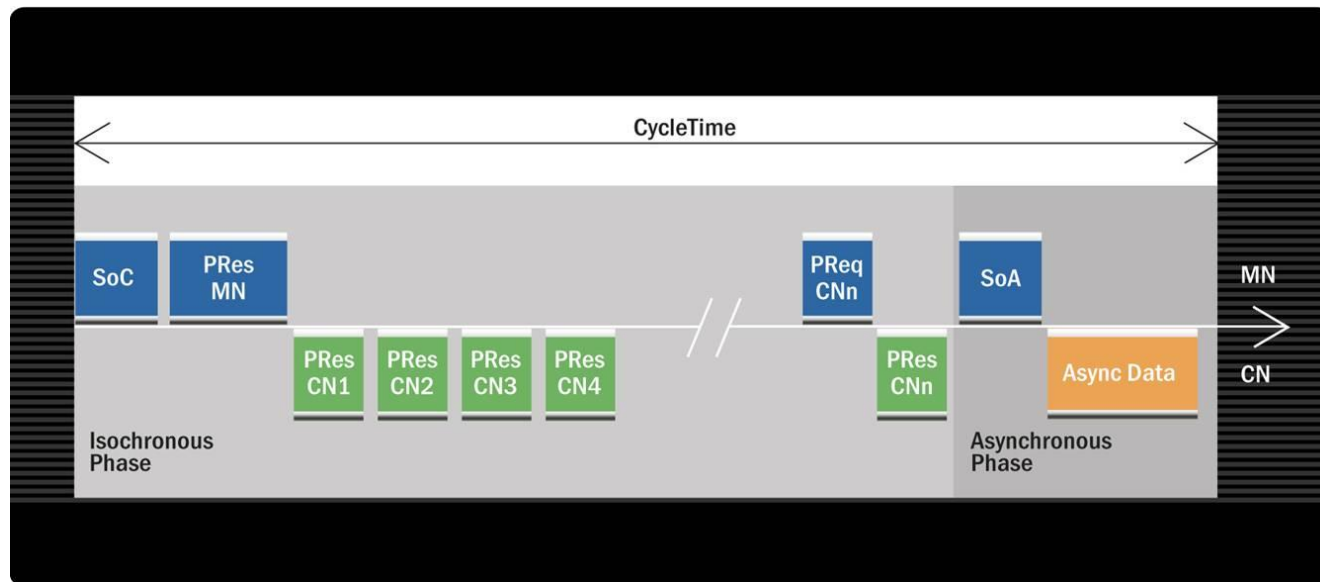
- Simplicity
 - Basic and robust mechanism
 - No complex time synchronization
 - Adequate to industrial automation



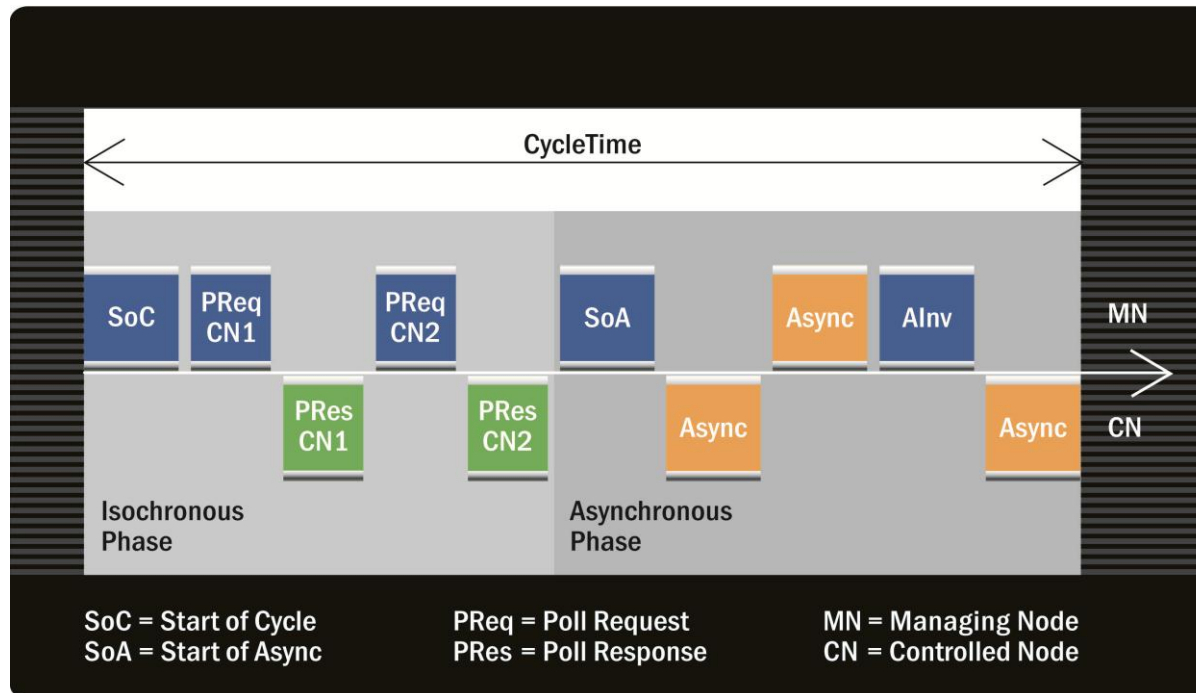
- Direct slave to slave communication
 - Fastest drive to drive reaction time
 - Centralized or decentralized architecture
- Multiplexed slot assignment
 - No need to exchange all data at fastest cycle time
 - Ideal for Integrated Automation



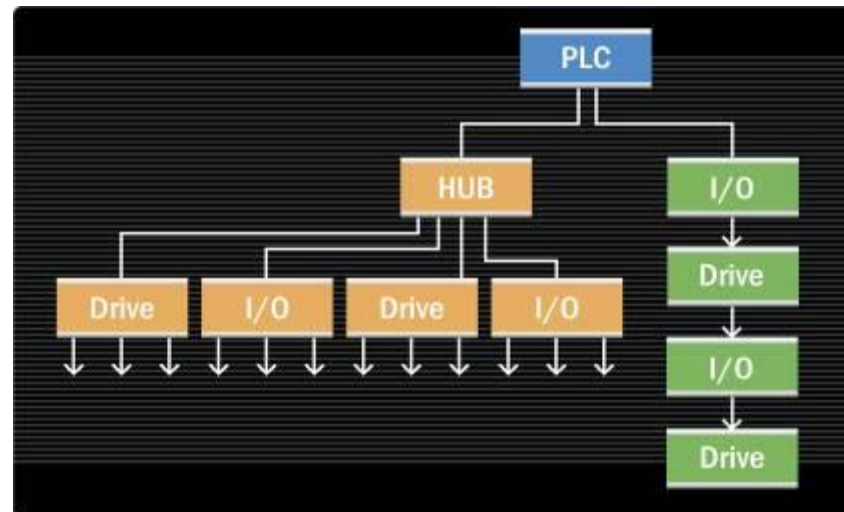
- Poll Response Chaining
 - Position Control Loop
 - Current Control Loop



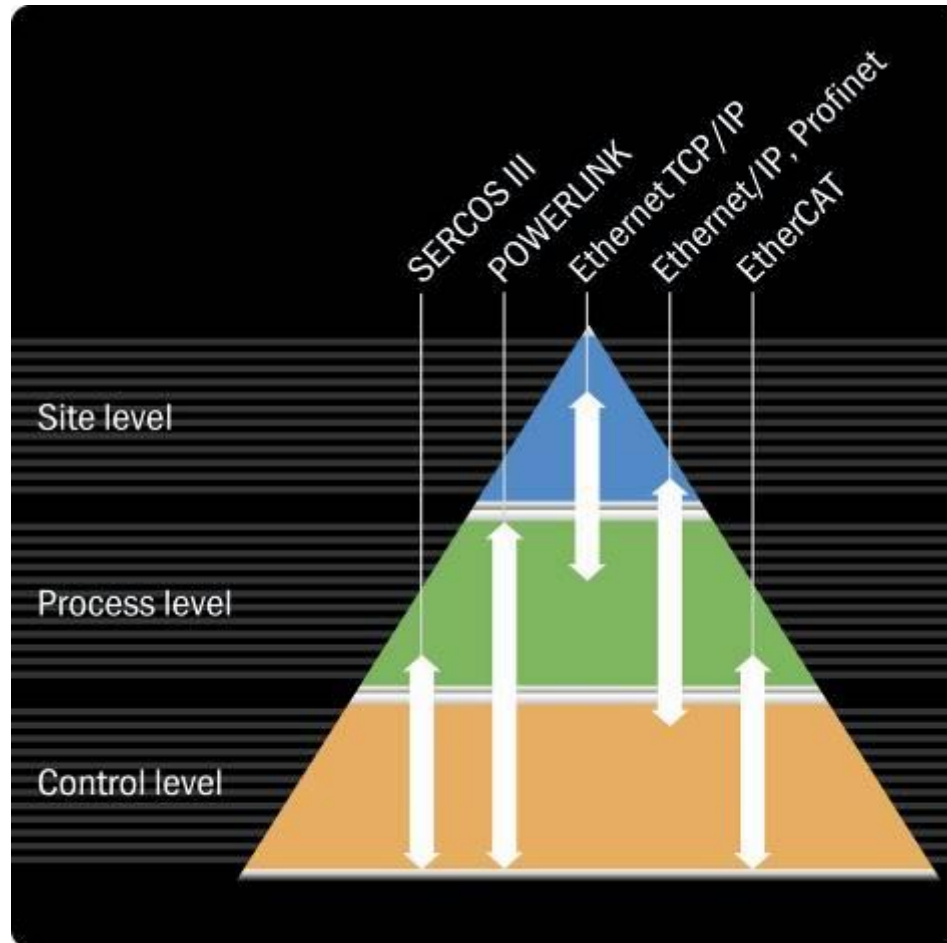
- Multiple Asynchronous Send
 - Increased asynchronous bandwidth
 - Ideal for standard Ethernet traffic



- Hot Plug
 - Higher productivity, modular system concepts
 - No violation of real-time behaviour
- Topology flexibility
 - 100% free choice of star, tree, ring, or daisy chain
 - No limits on system extensions

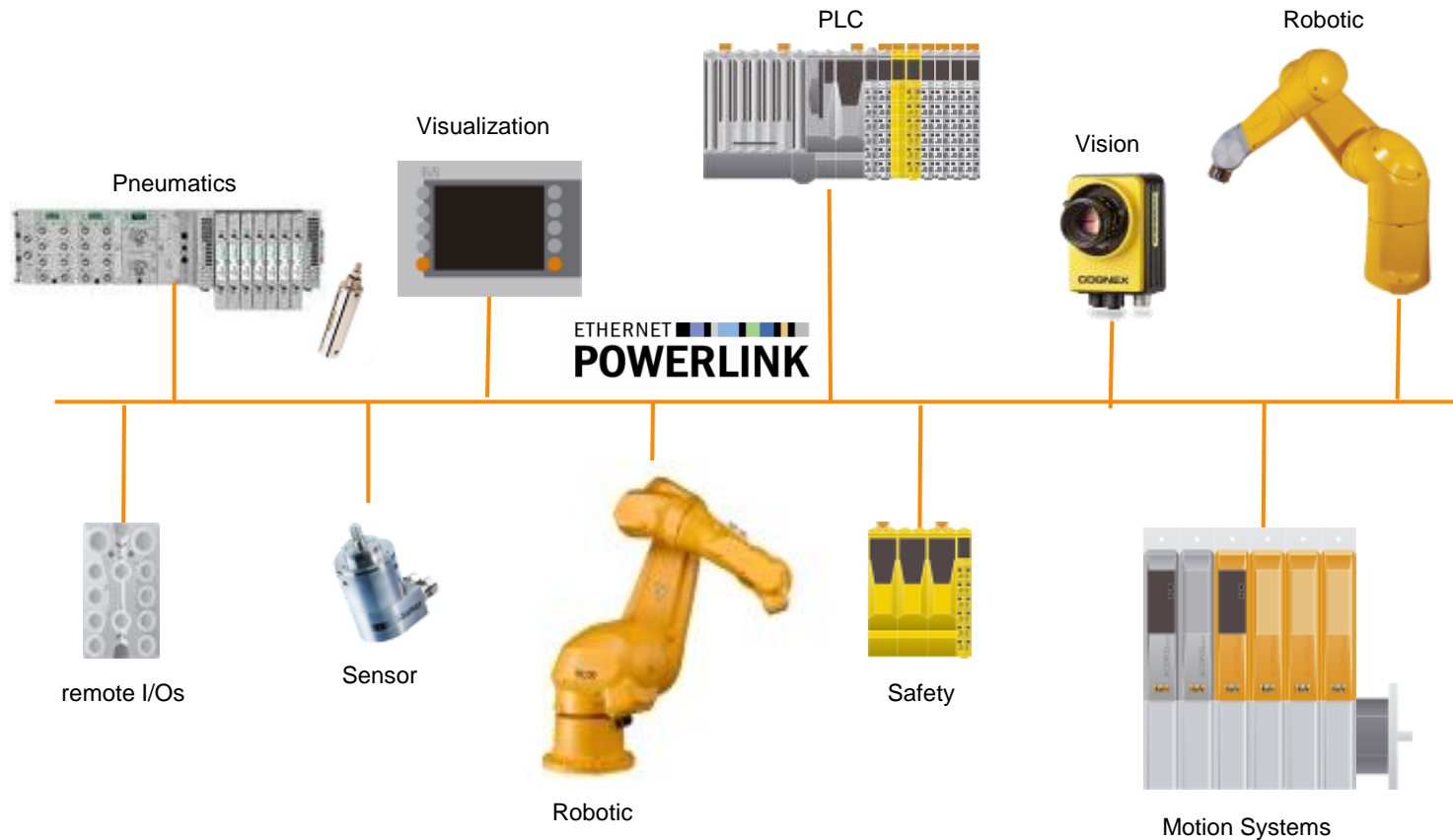


- POWERLINK fulfills all network requirements
 - One technology from motion to process

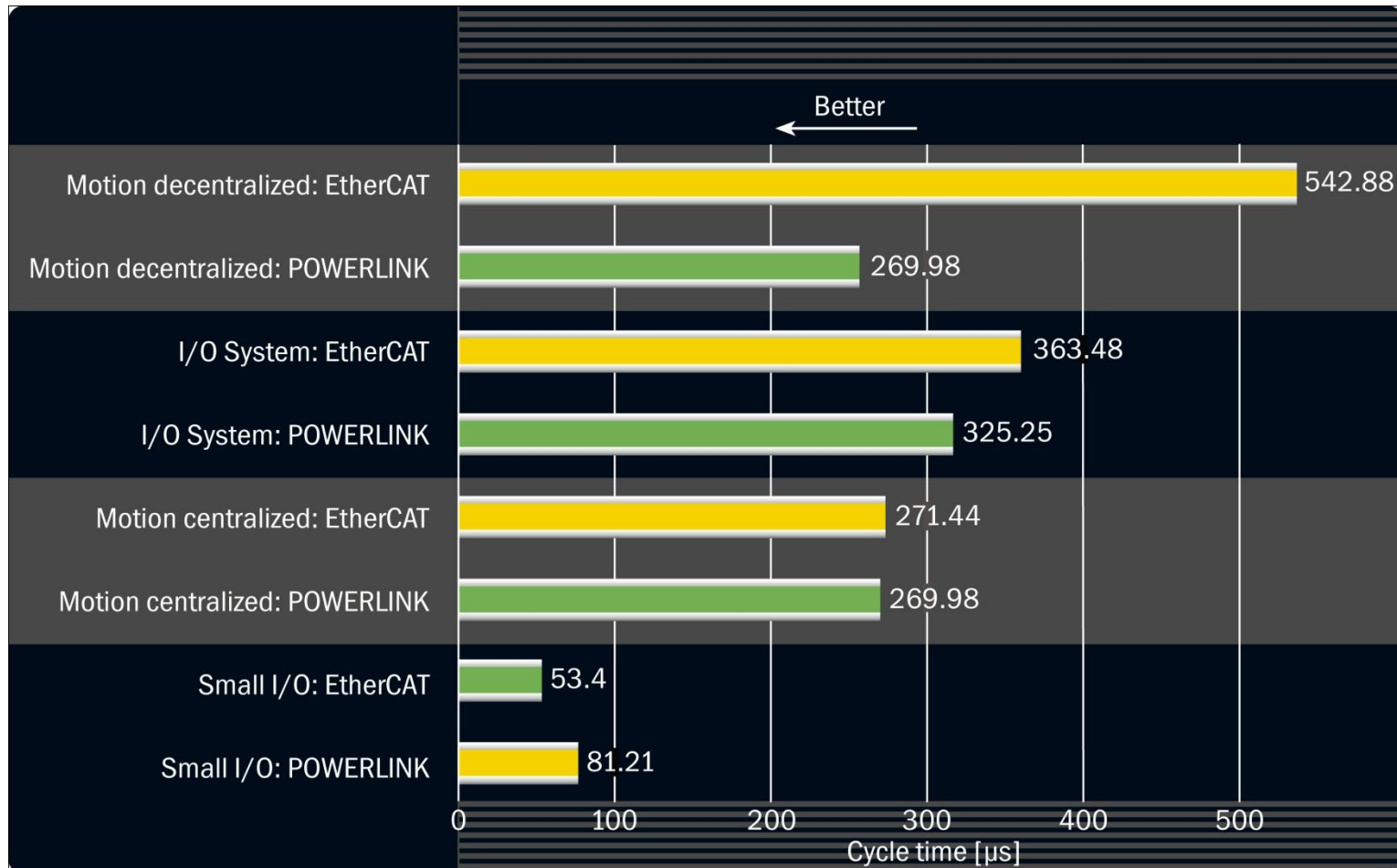


Everything connected to one network

- Perfect for Integrated Automation

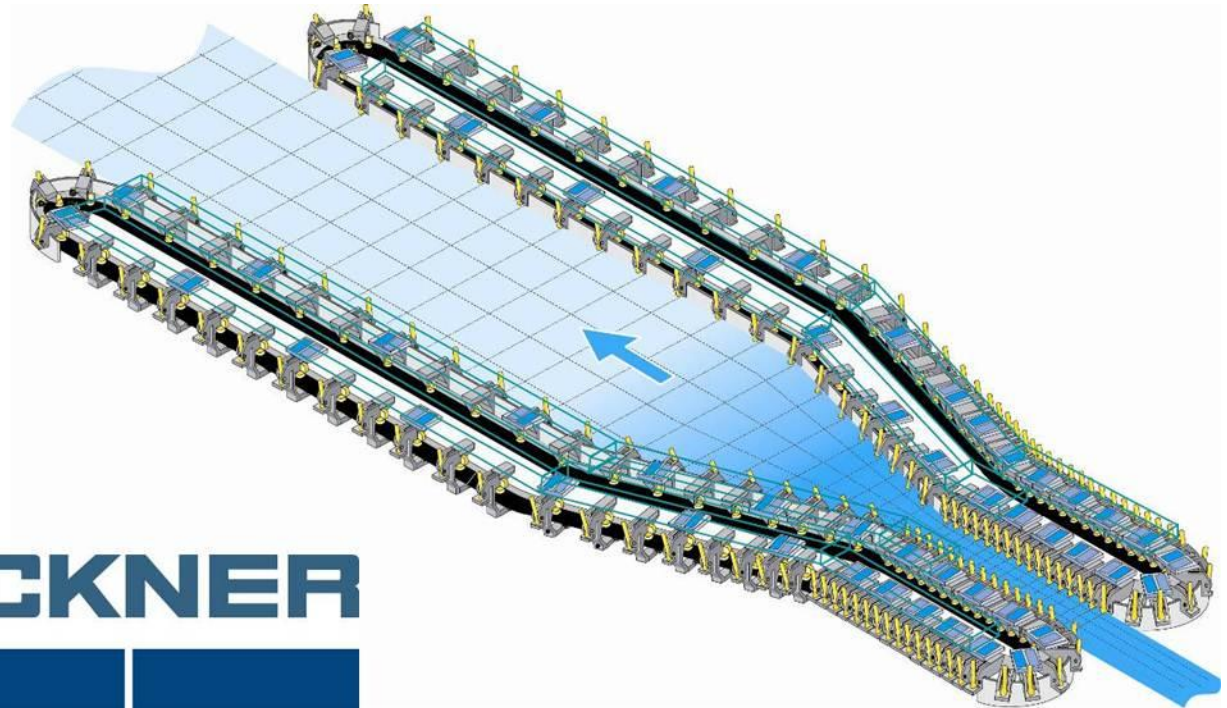


- POWERLINK is faster than EtherCAT in many applications!



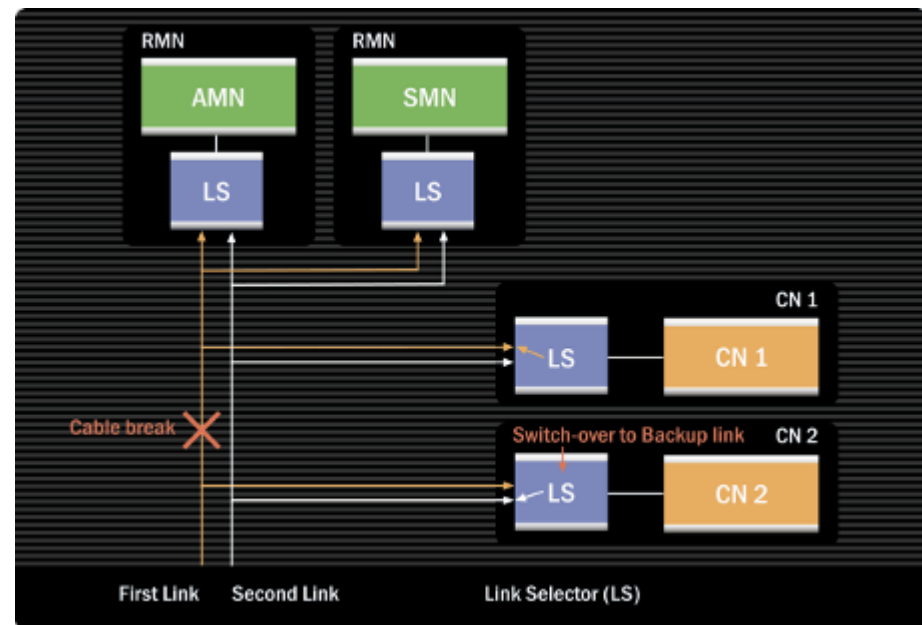
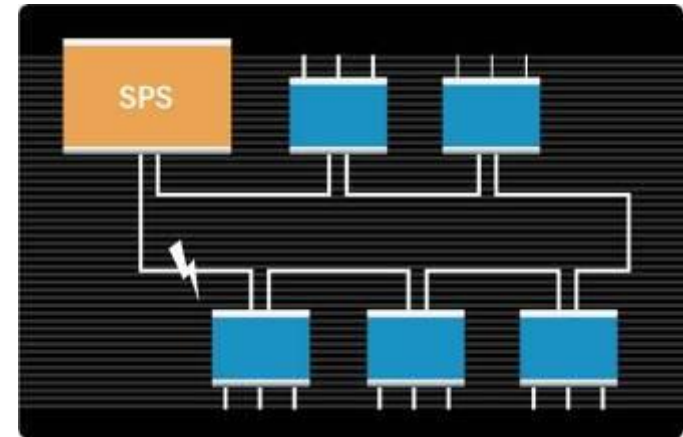
The fastest network in the world!

- **728 axes in 400 μ s**
- ... realized, not just theory!

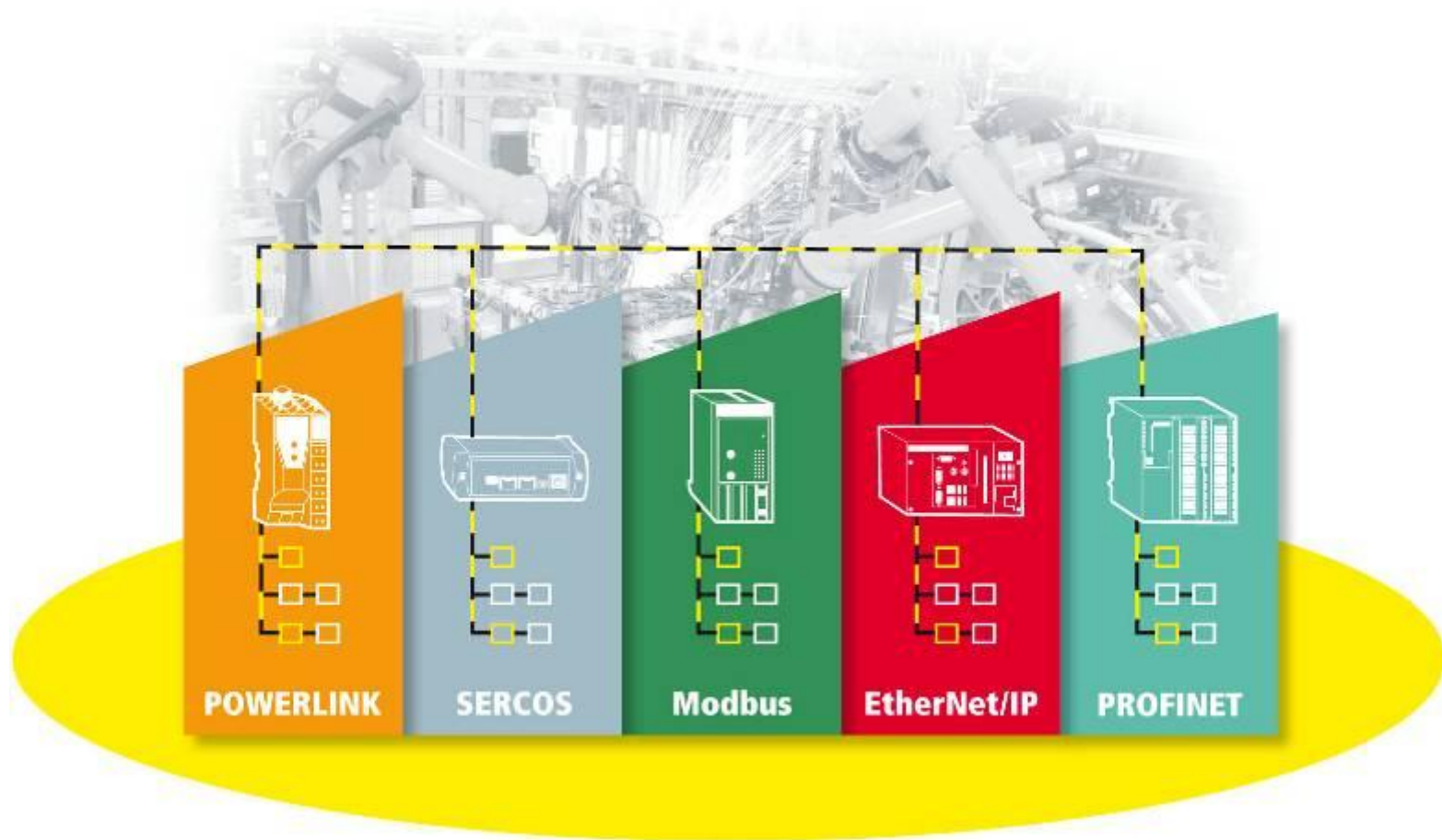


BRÜCKNER

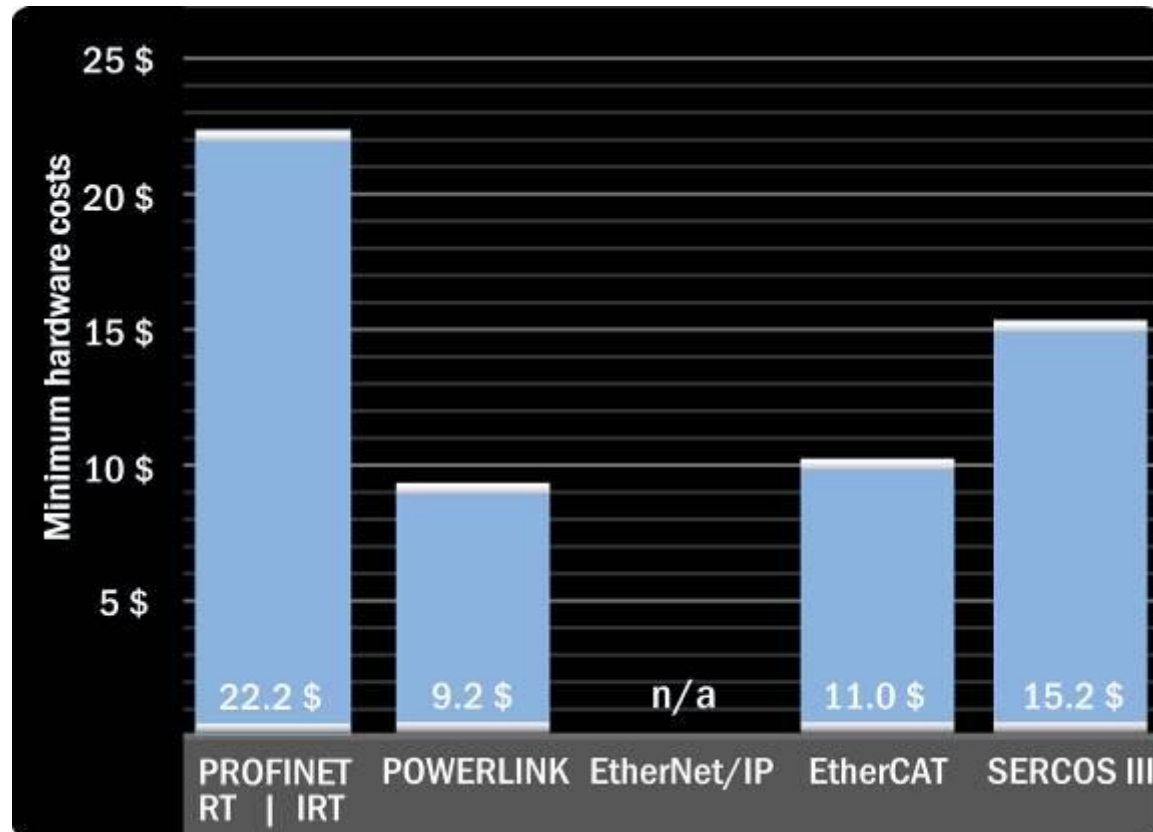

- Ring redundancy
- Full medium redundancy
- Redundant master
- No downtime



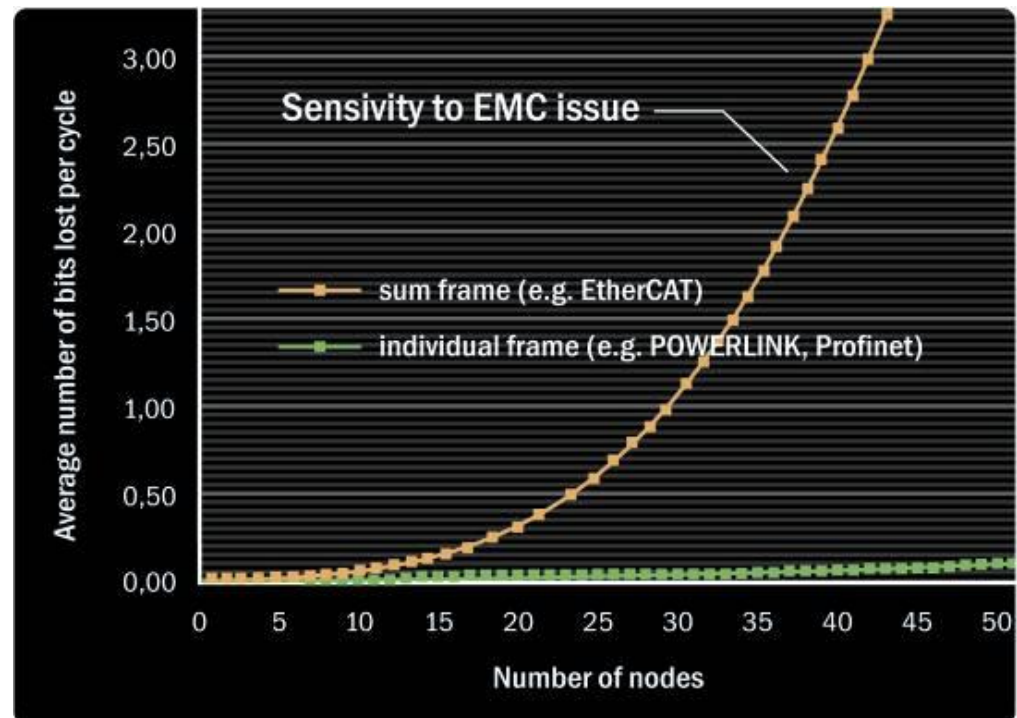
- One Safety standard for every bus system



- Reduced Total Cost of Ownership
 - No license - no patents
 - Free software stack - minimum hardware cost



- New machines include numerous electronic power components
- POWERLINK has an excellent EMC immunity

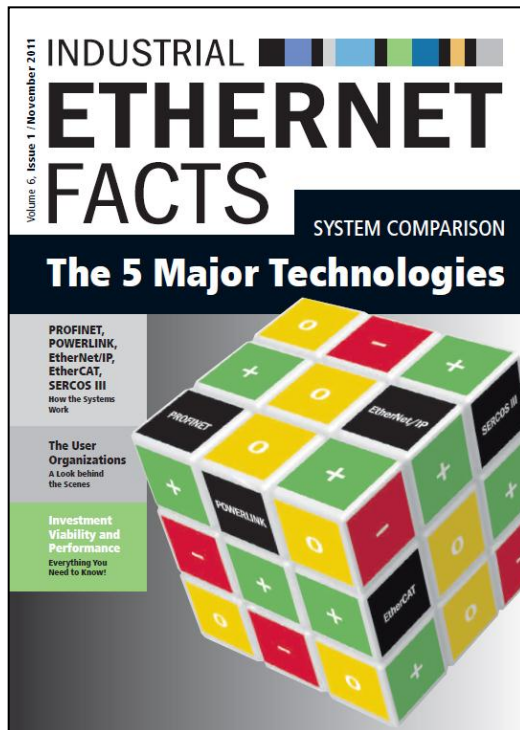


- OEM
 - High performance
 - Open technology
 - Easy integration and diagnostic

- Users
 - Cost reduction
 - Increased productivity
 - Reduced downtime

- Component manufacturer
 - Enter the largest established market
 - No specific hardware required
 - Training and worldwide support available

- Comparison of 5 major Industrial Ethernet technologies
- Available at <http://www.ethernet-powerlink.org/>



Systems Roundup:
The 5 Major Contenders

INDUSTRIAL
ETHERNET
FACTS

Hence, if a Master sends out a frame addressed to itself that does not pass through any other nodes, that time will be available to the Master again after 122 microseconds have elapsed (in the case of a single, maximum-length Ethernet frame).

In theory, it would be possible to process parts of a frame as soon as they come in. However, the CRC bytes that confirm the validity of the data received are lost to arrive at the end of a frame. This scenario does not factor in delays effected by PHYs, cables, and Ethernet ports, times for internal data transfer in the Master, etc. Moreover, once a signal leaves the Master, the time it takes to travel along network lines (5 ns/m) and the processing time inside a Slave have to be taken into account as well.

Prospective extensions of a system and possible future requirements need to be carefully considered for choosing either a centralized or a decentralized architecture. One advantage of the decentralized processing of various control loops is that it allows for adding nodes without any noticeable effect on the basic cycle time, i.e. no fundamental changes to the overall concept must be made. Moreover, additional functions such as condition monitoring or integrated safety technology will have less impact on the control concept than in central architectures, which very much depend on a low volume of data.

In order to select a solution that is viable for future use as well, preference should be given, whenever possible, to a decentralized handling of control loops for cycle times below 500 microseconds, especially in drive applications.

Communication architecture of the systems

Options	PROFINET RT / IRT	POWERLINK	EtherNet/IP	EtherCAT	SERCOS III
Supports master-slave	+	+	+	+	+
Supports peer-to-peer	+	+	+	+	+

Direct cross-traffic:
Direct cross-traffic provides crucial benefits particularly in case of very demanding real-time requirements: for fast drive controllers, axes can be synchronized easily and with extreme precision, since all position values can be distributed directly without having to go through a Master. That results in lower network load and also ensures that data (e.g. actual angle position of axes) is available to all relevant nodes within the current cycle. On the other hand, if data must pass through a Master first, it is not only delayed by one cycle, but overall data traffic on the network is increased as well.

Options	PROFINET RT / IRT	POWERLINK	EtherNet/IP	EtherCAT	SERCOS III
Direct cross-traffic	+	+	+	+	+

With POWERLINK and SERCOS III, direct cross-traffic is a feature even for modules with exclusive time functionality, while EtherNet/IP requires a module with summer functionality.

Heavy data to traffic:
In applications involving a large volume of process data, the time for passing through the nodes greatly impacts the overall cycle time. Data prioritization, on the other hand, enables lower cycle times. Systems that support prioritization mechanisms allow for reading high-priority data once per cycle, and putting low-priority data with a lower priority only every n-th cycle.

Options	PROFINET RT / IRT	POWERLINK	EtherNet/IP	EtherCAT	SERCOS III
Prioritization	+	+	+	+	+

For POWERLINK, EtherNet/IP and PROFINET, variable cycle times have been firmly established in the previous specifications. SERCOS III has only recently added this feature. For EtherCAT, solutions within a specific application are generally feasible as well.

Network load for Safety communication
Safety over Ethernet is based on a cyclic exchange of protected data between Safety nodes (emergency stop switches, drives with Safety controllers). The safeguard procedures in this process involve data duplication and wrapping data in sub-frames, which increases data rates on the network. Solutions using the summation frame method will see the frame count go up, whereas the single frame method will increase the volume of data in each of the frames that are due to be sent anyway. All in all, the theoretically superior performance of the summation frame method is canceled out.

Options	PROFINET RT / IRT	POWERLINK	EtherNet/IP	EtherCAT	SERCOS III
Sum	+	+	+	+	+

EtherCAT, POWERLINK, and SERCOS III give users a system with almost no jitter (<100 ns) at all times. On EtherNet/IP networks, jitter can be considerably reduced with special IEEE 1588 extensions in all components. Reduced jitter can also be achieved in PROFINET IRT applications.

ETHERNET 
POWERLINK
Standardization Group

www.ethernet-powerlink.org/



www.linkedin.com/groups?about=&gid=2331103



**Thank you for
your attention**