



POWERLINK

Basics

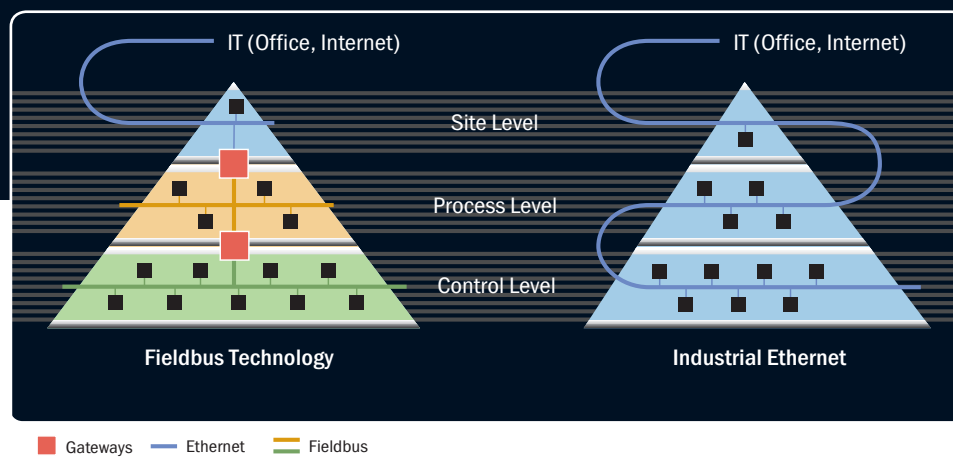


ETHERNET 
POWERLINK

Why Industrial Ethernet ?

Over the course of the last two decades, it has become hard to keep track of the numerous field-bus systems that have been developed in the automation industry specifically for purposes of process and factory production control. Yet there remain various restraints that are impeding their performance. Demand has therefore become more pressing for a reliable communication system that would offer high flexibility and across-the-board compatibility. A new solution in this vein was also expected to allow for ongoing improvements and future upgrades. Ethernet first rose to that challenge: it was a tried and tested technology that was free of patents and was widely standardized. Moreover, it had great potential to serve as a consistent, integrated communication solution, i.e. allow for an interconnection of the control, process, and field levels. However, standard Ethernet in

combination with an Internet protocol like TCP/IP is unsuitable for data transmission in hard real-time. Data traffic can be delayed in unforeseeable ways due to the CSMA/CD mechanism (Carrier Sense Multiple Access/Collision Detection). An integral part of the Ethernet standard IEEE 802.3, that mechanism helps prevent data collisions on the bus that can occur in Ethernet environments due to the particular nature of Ethernet transmissions. In order to develop Ethernet-based, but real-time capable fieldbuses, manufacturers have pursued various approaches in their efforts to eliminate such delays. These solutions are commonly referred to as “Industrial Ethernet” technologies. This booklet will introduce you to POWERLINK, which has become one of the most successful Industrial Ethernet systems in the world today.





Contents

INTRODUCTION

4
5

Application Areas

One Network for All Systems
Architectures, Performance Classes, Industry Sectors

TECHNOLOGY

6
7

How POWERLINK Works

The Mechanism
Performance

FEATURES

8
9
9
10
10
11
12
13
14
15
16

Benefits in POWERLINK Networks

Topology
Unique Addressing
Hot Plugging
Direct Cross-Traffic
Multiplexing
Asynchronous Data
Redundancy
Diagnostics
Safety
Security
CANopen

USER ORGANIZATION

18
18
19
19

Ethernet POWERLINK Standardization Group

The User Organization EPSG
Standards
Certification
POWERLINK Starter Kits

IMPLEMENTATION

20
21

How to POWERLINK-Enable Your Device

Master (Managing Node)
Slave (Controlled Node)

LONG-TERM VIABILITY

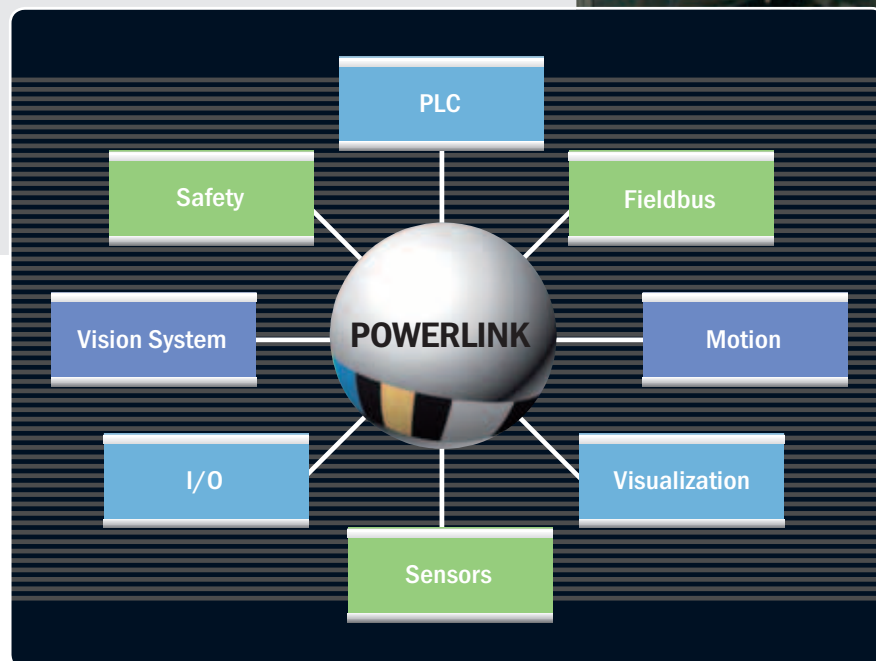
22
23

Open Source Technology
Gigabit POWERLINK: Thinking about Tomorrow Today

INTRODUCTION | APPLICATION AREAS

One Network for All Systems

What does “one network for all systems” mean? POWERLINK is an Industrial Ethernet solution devised to give users a single, consistent and integrated means for handling all communication tasks in modern automation. It is generally suitable for all conceivable applications in machine and plant engineering as well as for process industry applications. A POWERLINK network integrates all components in industrial automation, such as PLCs, sensors, I/O modules, motion controllers, safety controls, safety sensors and actuators, and HMI systems. A POWERLINK cycle does not only accommodate transmissions of actual payload data for applications, but, in its asynchronous phase (see section on “Asynchronous Data”), also provides a fixed timeslot reserved for transfers of miscellaneous user data. Hence, data that is not time-critical can also be transmitted, e.g. service data to enable the remote maintenance and configuration of a device. Likewise, devices that do not belong to the immediate automation level can be included in the network environment as well, e.g. in the case of video cameras for site surveillance and access control. Moreover, a proper gateway will also allow for the transmission of other, non-POWERLINK fieldbus data within the asynchronous portion of a cycle, i.e. the protocol enables an integration of various different networks.





Architectures, Performance Classes, Industry Sectors

Architectures

Due to its performance characteristics regarding bandwidth, brief cycle times, and the protocol's flexibility, POWERLINK is suitable for both centralized and decentral-style automation concepts. Machine and plant designs featuring decentralized structures give users increased flexibility for adaptations and extensions, but do require a communication system that lends itself well to such structures. POWERLINK technology is particularly well suited to these requirements due to its close adherence to the Ethernet standard, which yields two key features for its use in decentralized environments: cross-traffic and a free choice of network topology.

Cross-traffic enables direct cross-communications between components that bypass the Master. All devices can send their data in broadcast mode directly into the network, where all other nodes can receive these transmissions.

A free choice of topology is almost indispensable for modular system extensions. Machine upgrades, plant expansions and ongoing additions of new machinery to an installation are hardly possible at all, or only at a great expense, in systems with fixed topologies. Not least due to its excellent scalability, POWERLINK places no limits on system extensions with no negative effects on the network's real-time capability.

Performance Classes

POWERLINK covers all performance classes – as a software solution with no hardware acceleration for soft real-time performance, or as a high-end system featuring co-processor support for cycle times in the area of only a few hundred microseconds. Since POWERLINK is patent-free and solely based on standard hardware, various manufacturers provide cost-optimized solutions for hard real-time applications.

Industry Sectors

Given its scalability and its capability to integrate all systems, POWERLINK is used in machine and plant engineering, in process automation, and for measuring technology.

- | | |
|----------------------|------------------|
| ■ Automotive | ■ Plastics |
| ■ Mining | ■ Logistics |
| ■ Chemical | ■ Maritime |
| ■ Printing and paper | ■ Metals |
| ■ Energy | ■ Pharmaceutical |
| ■ Food and beverage | ■ Process |
| ■ Semiconductor | ■ Textile |
| ■ Timber | ■ Transport |
| | ■ Packaging |

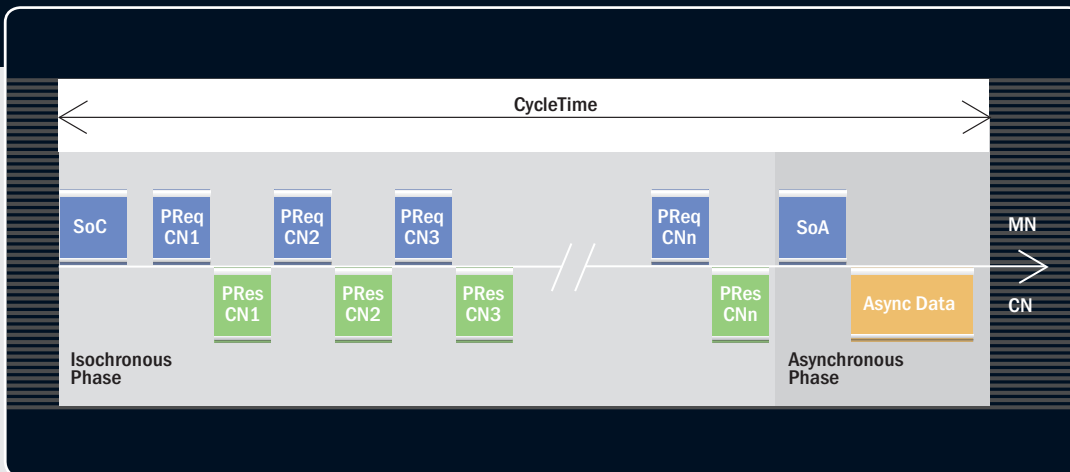
TECHNOLOGY | HOW POWERLINK WORKS

The Mechanism

Unlike other Industrial Ethernet systems, POWERLINK is a purely software-based solution that is 100% in line with the IEEE 802.3 Ethernet standard. Providing close compliance to the standard and doing without any proprietary hardware, POWERLINK ensures that all benefits and the flexibility of Ethernet technology carry over to the real-time protocol. Users are therefore able to draw on the same standardized hardware components and use the same tools for diagnostics. In order to achieve real-time capability, POWERLINK resorts to a mixed polling and timeslot procedure that only allows one node at a time to send data. Generally speaking, communication proceeds as it does in an organized roundtable conversation, where a moderator prompts participants to make their statements. In this scenario, the moderator sees to it that everyone gets a turn to get a word in by explicitly inviting one participant after the other to speak at a specific time. In contrast to standard Ethernet, this procedure ensures that nodes cannot “speak” at the same time. Hence, no arbitration is required either. POWERLINK networks use the following communication structure: one node, e.g. a PLC, motion controller, or industrial PC, is arbitrarily designated to function as the so-called Managing Node (MN), i.e. serve as the “moderator of the conversation.” All other devices operate as Controlled Nodes (CN). The MN defines the

clock pulse for the synchronization of all devices and manages the data communication cycle. In the course of one clock cycle within which all nodes are addressed, the MN sends its so-called Poll Requests to all CNs one after the other. They reply immediately to these prompts with Poll Responses. A POWERLINK cycle consists of three periods. During the “Start Period,” the MN sends a “Start of Cycle Frame” (SoC) to all CNs to synchronize the devices. Payload data exchange then proceeds in the second period, the isochronous phase. The third period of a cycle marks the beginning of the asynchronous phase, which allows for the transfer of larger, not time-critical data packets, e.g. parameterization data.





Performance

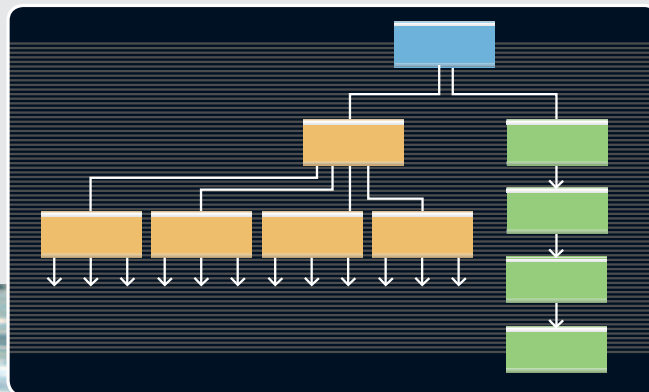
- 0.1 μ s system synchronization
- 100 μ s cycle time
- 100 Mbit/s bandwidth
- high data throughput even for brief cycles
- 240 nodes $\cong$ e.g. 480 synchronized axes/460,000 digital channels
- 100 m/2 km line length between nodes

FEATURES | BENEFITS IN POWERLINK NETWORKS

Topology

One of Ethernet's – and therefore, also POWERLINK's – most important characteristics is that users are one hundred percent free to choose any type of network topology. Networks may have a star, tree, daisy chain, or ring structure, or any combination of these topologies, and need no

configuration. There is also no binding interdependence between logical links in the application and the physical layout. Changes to the network, including live modifications, can be made at any time and in any way without compromising the application.



Unique Addressing

Unique addresses can be set using a built-in, manually operated node switch at every individual device, ensuring a transparent assignment of IP addresses to the devices. This addressing method allows for simple software configuration when setting up a network, and is indispensable for reliable service. Unique addressing is a key prerequisite particularly for machines featuring a modular design devised to enable quick and easy extensions.

Hot Plugging

Hot plugging means plugging nodes in or disconnecting them from a network line without

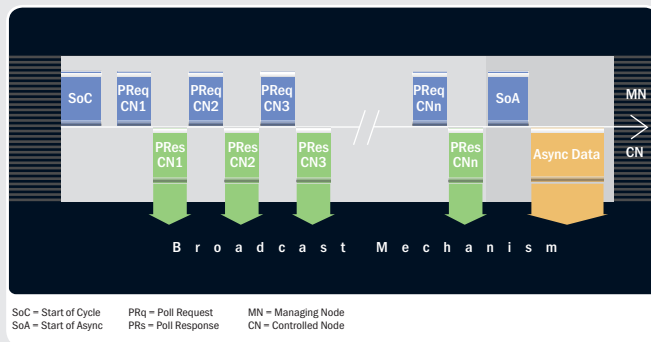
- compromising network functionality,
 - having to reboot for added or replaced nodes to become operational.
- POWERLINK provides unrestricted support for hot plugging. Extensions or local replacements of devices do not impair real-time performance, and no reboot of the system is required. Operators may therefore e.g. exchange sensors or add mechatronic units without having to shut down the network first – a basic precondition for using the protocol in the process industry or in modular machines and plants.



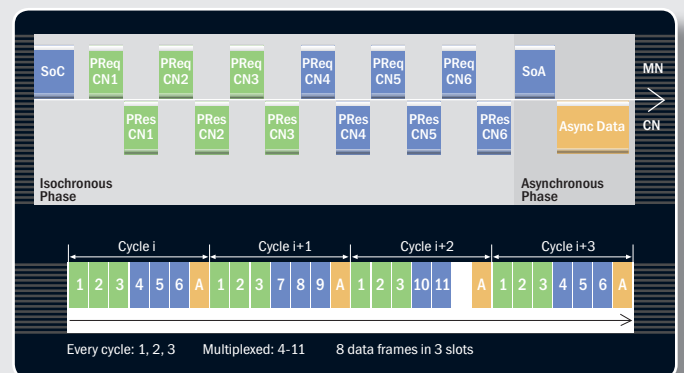
FEATURES | BENEFITS IN POWERLINK NETWORKS

Direct Cross-Traffic

Ethernet communication – hence, of course, also POWERLINK communication – works according to the broadcast scheme. This means that every node is free to broadcast its own data into the network, and every other node is generally able to receive these broadcasts. Nodes can tell by the target addresses on data packets whether any such data is intended for them. This send principle enables direct cross-traffic among controllers, i.e. communication does not have to go through a dedicated Master, or Managing Node. In synchronized production segments, for instance, this feature enables a synchronization of the rotary encoders on all drives with a master encoder. For decentralized safety architectures, direct cross-traffic among safety components is a basic prerequisite. Benefits lie in the time saved, the simplification of the system, and the reduction of control tasks, which permits the use of more economical controllers in many areas.



Multiplexing



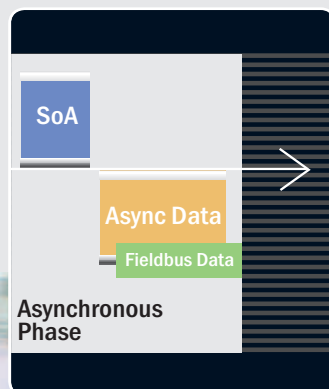
Multiplexing optimizes bandwidth use in the isochronous phase. Since requirements regarding data sampling intervals vary from application to application, not all Controlled Nodes have to be polled in every cycle. While it is necessary e.g. for many motion control applications to constantly provide drives with information, and to poll their feedback data in every cycle, polling sensor data only once every three cycles is sufficient for temperature measurement.

For multiplexing, Controlled Nodes with low priority data share a timeslot within the isochronous phase, taking turns in such a way that one device utilizes only the first, the second device only the second, and the third device only the third cycle in every sequence of three cycles to transfer their respective data. The MN assigns and manages shared timeslots for such groups of nodes.

Asynchronous Data

The isochronous phase of the POWERLINK cycle for time-critical payload data transfer is followed by the asynchronous phase that takes up the rest of the cycle. In this period, larger, not time-critical data packets can be transmitted in standard Ethernet frames. If a device has more such data to send than a single cycle's period has capacity for, the transfer is spread out over the asynchronous phases of several cycles. Routers or gateways can be used to separate asynchronous data from the real-time domains of the POWERLINK network. Moreover, such data may flow both ways and therefore also serve to access and configure devices within a real-time domain from the outside. Data of any kind can be transmitted in the asynchronous phase: Service Data Objects (SDO) for device configuration and diagnostics, application data such

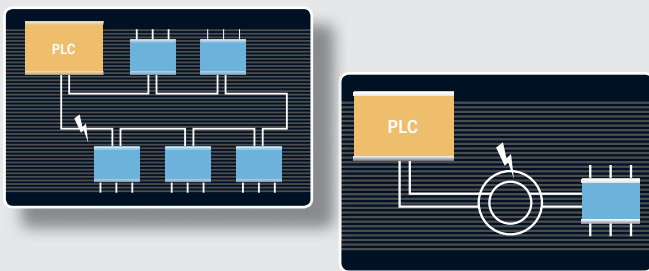
as surveillance camera feeds, and also protocols like TCP/IP for device configuration or maintenance from a web browser. This is also a way to connect nodes that are not real-time capable to the network, as well as a means to integrate components or plant segments equipped with other fieldbus interfaces. In the latter case, devices are hooked up to a POWERLINK node via a gateway for this purpose, and their non-POWERLINK fieldbus data is sent along in the asynchronous phase of the POWERLINK cycle. This mode of data transfer is a crucial prerequisite for hot plugging – newly added devices or replacements for others identify themselves by sending their device data to the Managing Node in the asynchronous phase.



FEATURES | BENEFITS IN POWERLINK NETWORKS

Redundancy

POWERLINK enables an implementation of two types of redundancy: ring or partial ring redundancy and Master redundancy.



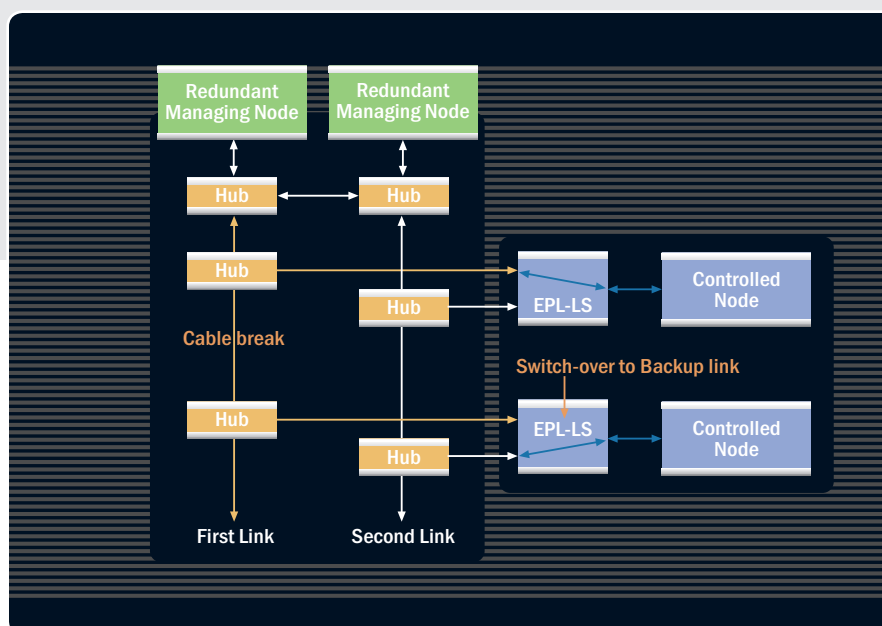
Ring Redundancy

Classic ring redundancy is a simple and very economic option in machine engineering. Applications are linked in the form of a ring; both outer ends of the data line running through the network are connected to the controller. (For this layout, one extra data cable suffices to turn a daisy chain of applications into a ring, provided that the controller

has two interface ports that support redundant operation.) When a line failure is detected, the system switches from the failed to the redundant data route within one cycle. This type of redundancy is typically used for solutions exposed to considerable mechanical stress.

Partial Ring Redundancy

Partial ring redundancy is a form of ring redundancy that is limited to a specific portion of the network. For instance, it may be sensible to use ring redundancy to safeguard rotating applications, i.e. to reserve a redundant channel on their slip ring connectors. Nodes that are placed behind the protected rotating application from the MN's perspective can then be connected via single lines again.





Diagnostics

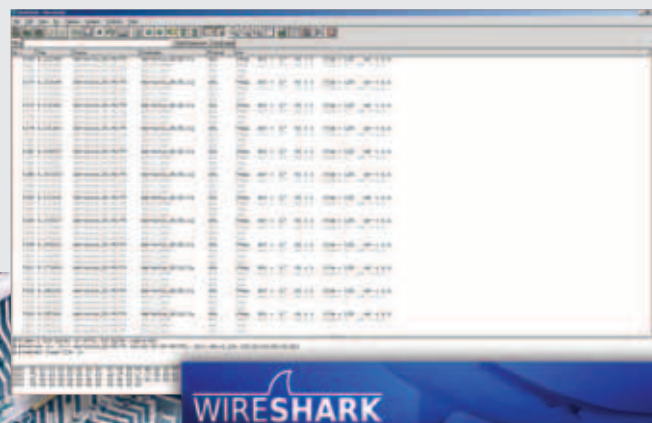
Master Redundancy

The second type of redundancy is full Master, or Managing Node, redundancy, which plays a key role for high-availability systems, and is used for energy systems in the process industry. Master redundancy is based on two or more redundant Managing Nodes at the top of the network hierarchy. Only one of them serves as an active Managing Node, the other(s) remain(s) on hot standby and act(s) as Controlled Nodes from the active Managing Node's point of view. The only difference between a standby MN and a CN is that a standby MN continuously monitors all network and CN functions, which ensures that it can assume the function of the active MN at any time without rebooting. In an emergency, the POWERLINK Node ID 240, which is reserved for the MN, is transferred on the fly to the closest redundant MN. This redundancy model allows for a wide range of topologies. In any case, all basic POWERLINK characteristics like minimal reaction times, real-time synchronization capability, high bandwidth, and simple diagnostics features continue to be fully available.

POWERLINK employs the single telegram procedure for data transfer, which gives users significant benefits for system diagnostics.

Unique node addressing and ready availability of all data throughout the entire network ensure unambiguous diagnostics in POWERLINK installations.

Any Ethernet-compatible diagnostics tool may be used. Moreover, POWERLINK provides bandwidth solely reserved for diagnostic purposes by design, ensuring full service capability even when the network is stressed to maximum performance.



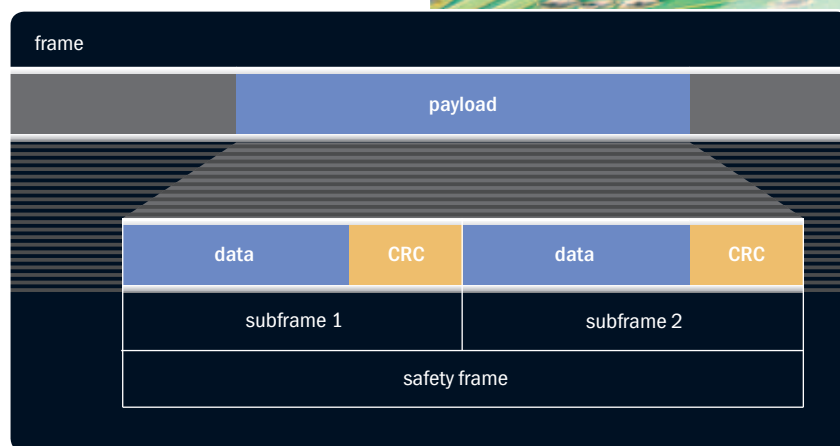
FEATURES | BENEFITS IN POWERLINK NETWORKS

POWERLINK Safety



POWERLINK Safety is a real-time capable, safety-oriented protocol for machine and factory automation that supports communication cycles in the microsecond range and can be implemented in systems required to provide SIL 3 protection. Reliably recognizing all data transmission errors, the open protocol achieves a high degree of safety, which means that a dedicated, separately wired safety bus is no longer required.

A safety protocol's job is not to prevent, but to recognize and "sort out" faulty data transmissions, which it accomplishes through mechanisms that immediately identify and filter out changed or corrupted data packets. POWERLINK Safety therefore even enables the use of unsafe networks for safety-relevant applications. POWERLINK Safety does not depend on a specific transport protocol. Hence, its use is not restricted to POWERLINK environments, but also extends to other protocols such as CAN. POWERLINK Safety's capability to provide full functionality regardless of the protocol that carries its safety frames is a feature known as the Black Channel principle. Besides "Safe Motion Control" applications, POWERLINK Safety is also suitable for easy integrations of emergency stop systems and safety installations such as light curtains.

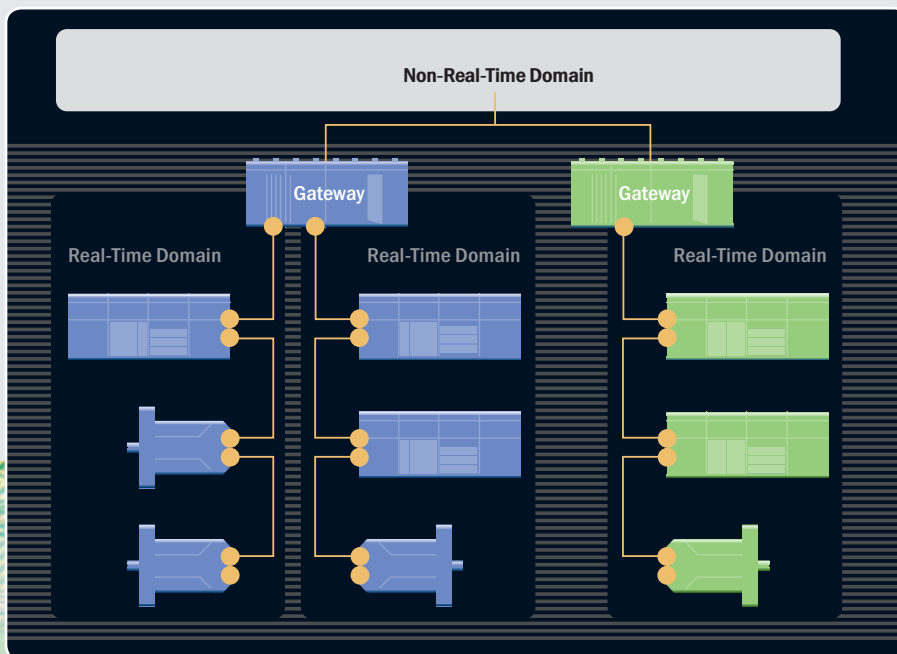


Security

POWERLINK real-time domains are strictly separated from non-real-time domains via gateways, which are often integrated into the controllers.

Every POWERLINK network constitutes its own network domain that is represented to the outside through one single IP address. The gateways operate like a firewall in this set-up, and internally resolve

the public IP address via Network Address Translation (NAT) to the invisible IP addresses of nodes in the real-time domain. Additional security measures and filter rules can be defined and implemented at the gateways as needed. Observing essential security aspects is a basic design requirement for any safety system to be deployed.



FEATURES | BENEFITS IN POWERLINK NETWORKS

POWERLINK and CANopen

■ Joint Task Force

- common, consistent use of the CANopen profile
- XML Device Description

■ CANopen over Ethernet

- long-term investment viability
- identical application access
- simple migration
- experienced service providers

■ Benefits compared to CAN's physical characteristics

- 100 times faster data transmission
- one medium for the entire machine
- line lengths up to 100 m

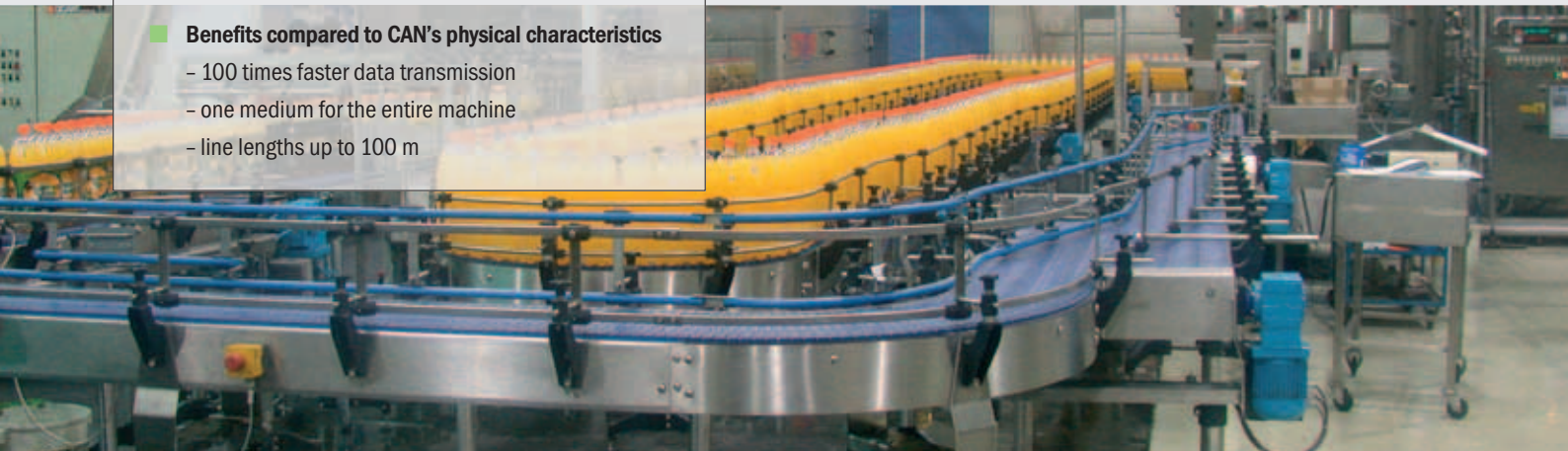
CANopen

Joint Task Force

One major decision made by the Ethernet POWERLINK Standardization Group (EPSG) was to define the protocol's application layer as a carrier of all CANopen mechanisms. CAN in Automation (CiA), the international association of CAN users and manufacturers, was significantly involved in this development.

CANopen – the Most Widely Used Application Protocol

CANopen is one of the most widely used application protocols today. Its key benefits include its standardized device description files, which make status information, parameterizations, device characteristics, and other relevant data transparently available on the network. Devices



CANopen



from different manufacturers that share the same description file can easily replace each other with no need for any reconfiguration.

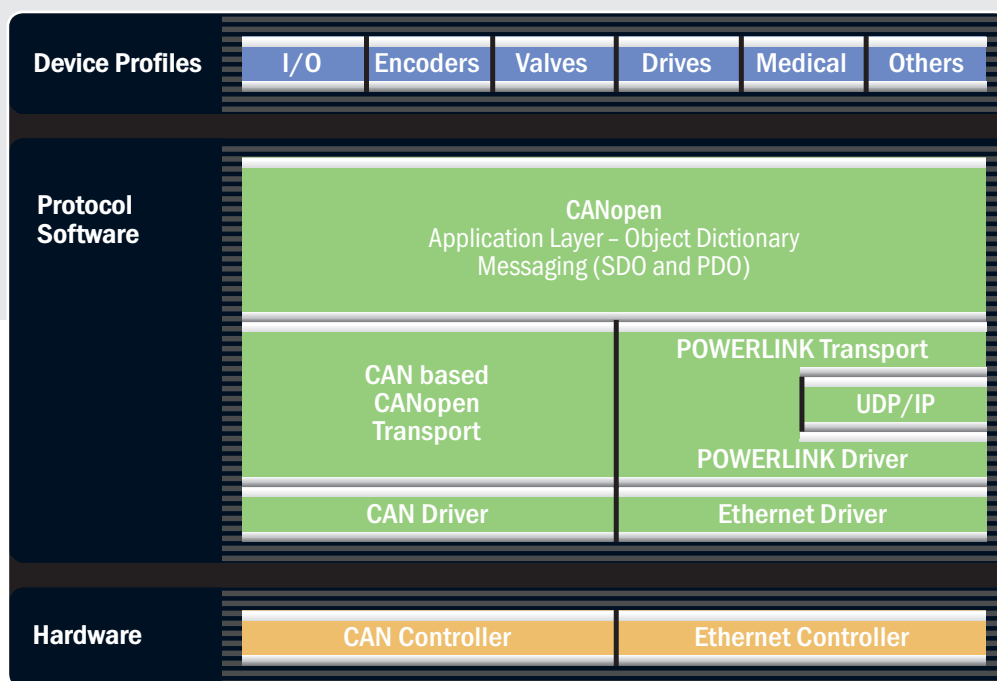
POWERLINK = CANopen over Ethernet

POWERLINK uses the same device description files as CANopen, the same Object Dictionaries, and the same communication mechanisms, such as Process Data Objects (PDO), Service Data Objects (SDO), and Network Management (NMT). As with CANopen, direct cross-traffic is also one of POWERLINK's essential features. All CANopen applications and device profiles can immediately be used in POWERLINK environments as well. Applications will not see a difference between the protocols. POWERLINK can therefore also be referred to as "CANopen

over Ethernet." Due to the CiA's and EPSG's close cooperation, many well-known CANopen service providers on the market also offer POWERLINK solutions and products today, which ensures that users have a wide range of qualified services to choose from.

High Performance With CANopen

Application complexity is generally increasing, which leads to a greater number of nodes, rising data load, and higher performance requirements. A simple migration to POWERLINK is an ideal alternative for users who wish to continue to enjoy CANopen's benefits in spite of more demanding requirements. Moreover, POWERLINK gives them one consistent medium throughout the entire application.



USER ORGANIZATION | ETHERNET POWERLINK STANDARDIZATION GROUP

The User Organization EPSG

Open Association

Based in Winterthur, Switzerland, the Ethernet POWERLINK Standardization Group is an independent registered association with a democratic charter. Founded by drive and automation industry leaders in 2003, the EPSG's members pursue their common goal of standardizing and enhancing POWERLINK technology. New members joining this organization have a say in it right away and become, in a manner of speaking, "co-owners" of this real-time Ethernet technology.

Open Protocol

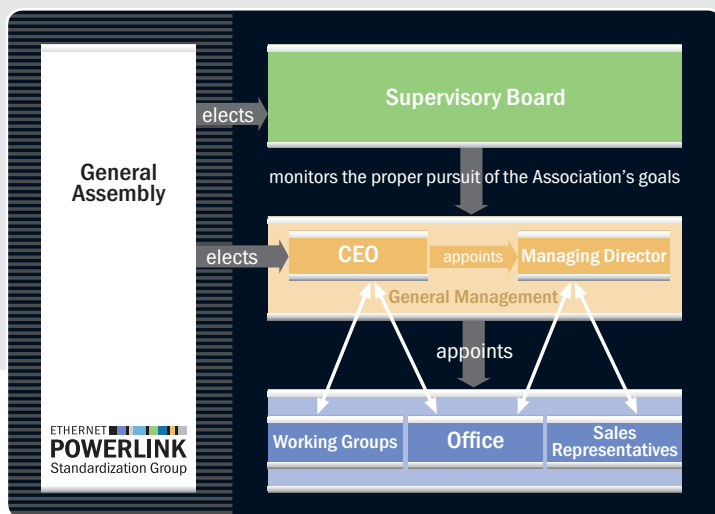
The protocol was introduced by B&R in 2001, followed by the open release of the specification in 2003. A testament to the protocol's openness, the technology is free of any patents. Released under the BSD license in 2008, the open source version openPOWERLINK is available free of charge.

Open Development

Various working groups within the EPSG engage in continual improvements to the technology in areas such as safety, technology design, certification, user requests, and marketing and sales.

Open Basis

POWERLINK technology is developed based on open standards like IEEE 802.3 (Standard Ethernet) and IEC 61784-2 (Real-time capable Ethernet-based fieldbuses).



- IEC 61784-2
- IEC 61784-3
- IEC 61158-300
- IEC 61158-400
- IEC 61158-500
- IEC 61158-600
- IEEE 802.3
- ISO 15745-1



Certification

The EPSG certifies POWERLINK devices. Besides providing certification services, the EPSG also regularly hosts plugfests, which are held e.g. at the Development & Support Center in Berlin.

POWERLINK Starter Kits

Various manufacturers and service providers in the EPSG supply evaluation boards (starter kits) that are ready to run right out of the box, which make hardware testing for POWERLINK networks much simpler for component and system manufacturers. Well-documented functions and interfaces enable users or testers to focus exclusively on the integration of their device into the network environment. Due to onboard integration of all key data communication functions, there is no need for time-consuming programming or protocol stack ports. The full performance and all capabilities of the target device continue to be available.

Well-Tried Technology

As soon as the evaluation of a device's functionality on a POWERLINK network using a test board is successfully concluded, the device and its interface are configured according to the specified requirements. The easiest way to reduce the time-to-market is to resort to a reference

design, which is achieved by transferring the blueprint of an evaluation board's circuitry to a target device and integrating it into it. Soft- and hardware suppliers in the EPSG provide various license models for this purpose, permitting manufacturers to choose a 1:1 implementation of a reference model as well as to use only portions of it. In either case, reference designs are an ideal starting point for a quick and successful POWERLINK implementation.

Broad Tool Support

A number of EPSG members offer designs and test tools for rapid POWERLINK application development. Programs for device database administration, for Object Dictionary, initialization code, and Electronic Data Sheet generation in XML format serve to optimize development processes and minimize the error rate. Tools for accurate network analysis and real-time performance analysis complement this range.

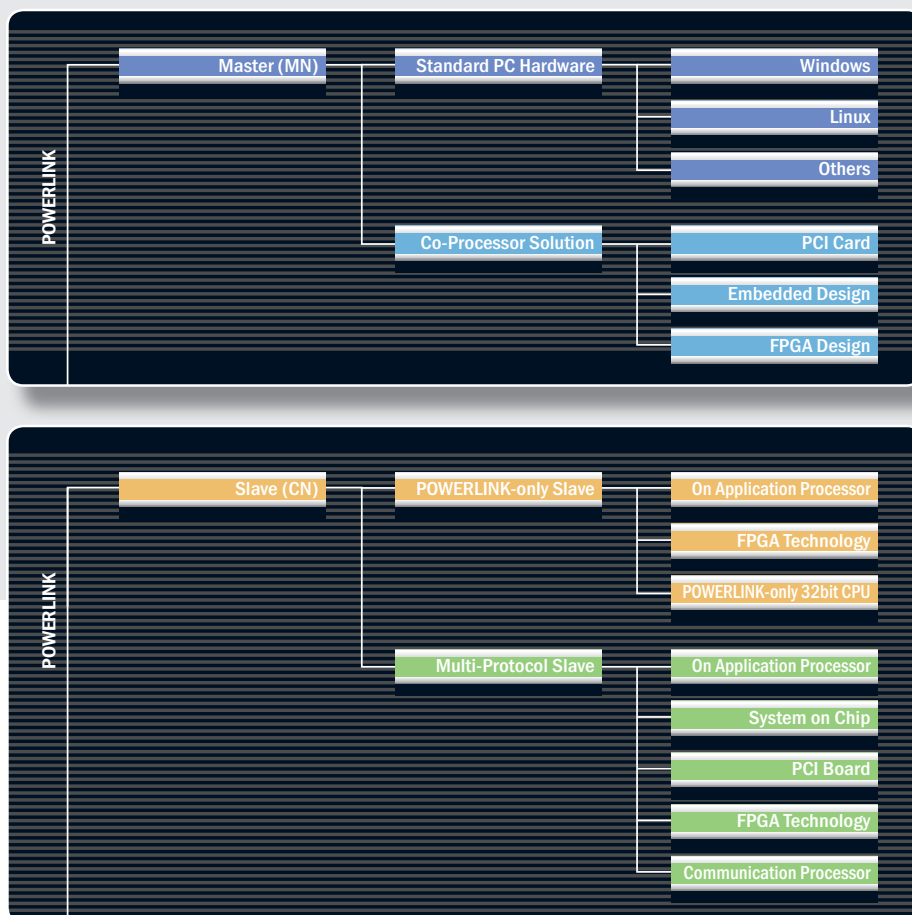
IMPLEMENTATION | HOW TO POWERLINK-ENABLE YOUR DEVICE

Technical Implementation for Master and Slave Devices

“How can I POWERLINK-enable my device?” is one of the questions most frequently asked by manufacturers. POWERLINK can generally be integrated into any standard embedded Ethernet design irrespective of the choice of processor architecture, either as a pure software solution or with hardware support. For pure software solutions, POWERLINK is directly integrated on the application processor, and uses a standard Ethernet controller as its bus connection. If very demanding requirements call for hardware acceleration, a number of manufacturers give users a broad variety of options permitting them to implement solutions tailored to their needs, all of which do not require any proprietary technology such as ASICs. The illustration below provides an overview of existing solutions.

POWERLINK Master

POWERLINK can be used without hardware support on any operating system of choice, e.g. Windows, Linux, or VxWorks, with a standard onboard Ethernet controller. The jitter and cycle times that can be achieved are contingent on CPU performance and on an optimal adaptation of the operating system to the CPU. Cycle times around 500 μ s and jitter values of about 30 μ s are typical. Integrating a PCI card with a POWERLINK pre-implementation into the system is an alternative option for a POWERLINK Master. In this case, a co-processor handles the protocol stack and saves central processor resources, typically achieving cycle times of 100 μ s and an accuracy of .1 μ s.





POWERLINK Slave

Likewise, POWERLINK Slaves can be implemented as stacks on the application processor, or alternatively be based on dedicated communication hardware. POWERLINK Slave implementation types range from ready-to-run evaluation boards or piggyback-style single boards, which are suitable for prototyping or for series manufacturing of smaller lots, to optimized, FPGA-based chip solutions complete with the protocol as well as the application software. These various options differ in terms of flexibility as well as cost. Multi-protocol solutions allow component manufacturers to use a consistent hardware platform that is open for various Industrial Ethernet solutions, and only calls for a decision for a specific fieldbus when a product is customized to be shipped to an end user. This option is usually more expensive than dedicated POWERLINK-only solutions. Multi-protocol ASICs accommodate the entire system design in one chip. Benefits include the defined interface between the communication processor and application processor, but there are also drawbacks such as the fixed programming interface, and higher hardware costs, or costs that vary with production lots. Multi-protocol FPGA solutions provide flexibility for environments where different protocols are used. In contrast to ASIC solutions, users have an influence on the API. However, they should be aware that the hardware costs are contingent on the resource requirements of the most demanding protocol involved. POWERLINK-only FPGA solutions provide more economic alternatives, and are flexible regarding the interface. Conventional 32-bit CPUs equipped with internal RAM and internal flash memory constitute



the most cost-efficient option to connect a Slave, clearly undercutting even the price range of other, ASIC-based protocols, while still ensuring that users enjoy the flexibility and openness of a standard microprocessor. A common characteristic of all options is that they feature a flexible connection of the application and communication software, e.g. via dual port RAM or a serial interface.

LONG-TERM INVESTMENT VIABILITY

Open Source Technology

openPOWERLINK

openPOWERLINK is a complete protocol solution for Masters and Slaves. Programmed in ANSI-C, the implementation can be easily ported to any target system. Detailed instructions for setting up a system and putting it into operation are available at www.sourceforge.net/projects/openPOWERLINK.

License-free

The EPSG does not levy any license fees for the technology. POWERLINK is an open technology; customers can always choose among various POWERLINK manufacturers and service providers, which ensures an optimal price/performance ratio for every application. Whether time-to-market or price is what matters most: the open software solution featuring a consistent specification gives users greater freedom and more opportunities for technical optimizations than other comparable real-time Ethernet systems.

XML – the New Device Description Standard

Standardized device description files minimize the configuration effort needed for networks with devices from different manufacturers. These files enable consistent access from the Network Master to all relevant device information, e.g. status data, device parameterization, or key characteristics, regardless of device types and manufacturers. New devices are immediately available on the network. POWERLINK uses the new standard XML for its device description files. An XML-based description format gives manufacturers the major advantage that they can use a consistent, standardized description for different fieldbuses or real-time Ethernet systems for their devices. Moreover, XML provides a range of options for device descriptions that other languages have failed to implement to date, including e.g. multi-language capability, an option for textual descriptions, or parameter and value characterizations by physical units and scaling functions.



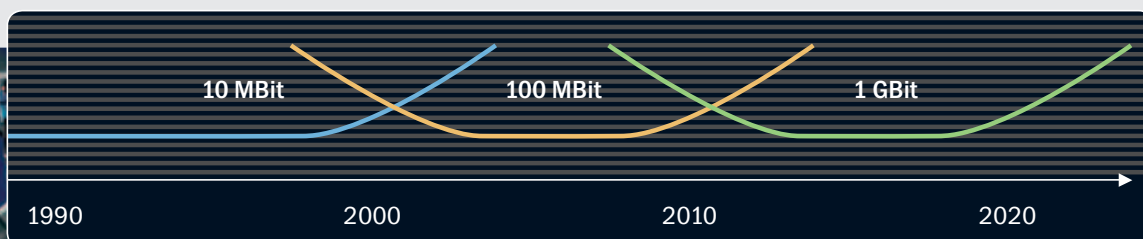
Gigabit POWERLINK: Thinking about Tomorrow Today

One glance at the world of automation reveals that bandwidth is not a bottleneck for current real-time Ethernet systems. As of yet, 100 Mbit/s do suffice completely. POWERLINK even provides enough capacity for the most demanding applications, like Safe Motion Control for machines with e.g. one hundred axes. However, a look back at the course of development in automation makes one thing clear: data load keeps rising, the number of drives per machine leaps up, and sensor and actuator performance and capabilities are increasing. As this trend continues, complexity and, by extension, data traffic are also mounting. This ongoing development has already pushed the non-Ethernet-based fieldbuses to their limits, and has eventually gave rise to Ethernet as a replacement for fieldbus systems.

The integration of essential technologies is set to generate more and more data load, e.g. for safety. Extensive functionality delivers more flexible solutions, while the amount of data surges at the same time. Therefore, in the medium term, Gigabit Ethernet will become the standard that replaces Fast Ethernet. With Gigabit POWERLINK development already underway, POWERLINK is fully prepared for the

future. POWERLINK's inventors were determined to create a real-time capable system based on standard Ethernet that draws on that medium's ongoing enhancement, and puts it to use in automation technology: that is the reason why POWERLINK keeps absolutely close to the standard and is solely software-based. In addition, the real-time protocol uses the CANopen application interface that is completely independent of the underlying transport protocol. A migration to Gigabit technology will therefore not change the application interface in any way, which will ensure full compatibility to the application – the key factor for the long-term viability of investments in this technology.

The advent of Gigabit technology in the consumer world currently results in a shift in hardware pricing for manufacturers: Gigabit equipment is becoming less expensive, while, in the medium term, Fast Ethernet hardware will become more expensive due to decreasing production lots. POWERLINK's standard compliance makes it ideally suited for Gigabit Ethernet. With up to a factor 20 speed increase, the migration to Gigabit POWERLINK opens up a new dimension of performance in Industrial Ethernet environments.





www.ethernet-powerlink.org

ETHERNET 
POWERLINK

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