Safety Network International e.V.

SafetyNET p

for complete automation

Real-time Ethernet

SafetyBUS p® The Safe Standard!

SafetyNET p®

Contents

Why SafetyNET p?

Alongside the ever growing demands on productivity and the requirement to reduce engineering and maintenance work, progressive product individualisation means that flexible automation systems are now increasing in importance. Globalisation and the march of the Internet also present new challenges for these systems' networkability.

SafetyNET p is an industrial communications solution that meets these complex requirements. Universal application of the Ethernet standard enables direct networking between the office and automation level. SafetyNET p enables universal networking of control, drive, safety and visualisation systems. Real-time capability at microsecond level and integrated safety-related communication make this possible. As a result, all the networking can be reduced to one uniform communication standard.

SafetyNET p implicitly supports the mechatronic approach to the modularisation and standardisation of plant and machinery by supporting a distributed control structure.

SafetyNET p represents a highly efficient and easily configured solution for operating multiple control systems within the same network.

SafetyNET p is one system for the entire automation technology

The individual levels of industrial communication place different demands on the communication systems. That's why two protocols are available: RTFN (Real-time Frame Network) and RTFL (Real-time Frame Line).

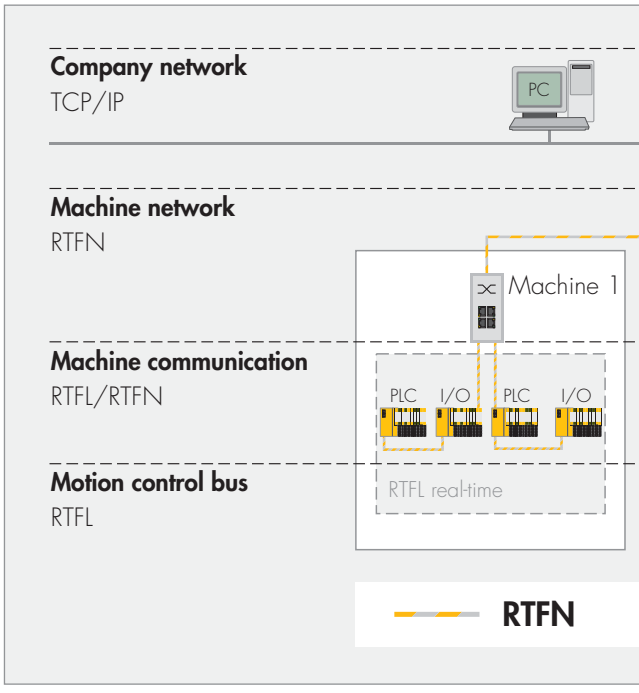
RTFN: RTFN is used in applications with less stringent real-time requirements and where standard Ethernet hardware and other Ethernet protocols are used. This is the case on PCs, operating and monitoring devices or where there is communication between different control systems. RTFN uses UDP/IP so it is also routable beyond the network limits. Coexistent operation of RTFN with other IP-based Industrial Ethernet versions is also possible.

RTFL: RTFL communication is used in applications with more stringent real-time requirements, such as the synchronisation of multiple axes in motion control applications or fast control loops in control systems, for example. With a cycle time of 62.5 microseconds, RTFL provides the necessary performance for these applications.

With a calculable time characteristic and simple daisy chain wiring, RTFL can be designed and installed just as easily as users would expect from fieldbus systems. What's more, the linear topology that occurs within plants can be implemented without any speed limitations.

Safety: Whichever of the two protocols is used, SafetyNET p provides safe communication. It doesn't matter whether a safe subscriber is in RTFN or RTFL; it will have constant access to the safety-related data on all the other subscribers.

Advantage / benefit:
- Reduces the number of bus systems
- Fewer breaks in the system
- All automation devices, both safety and non-safety-related, in one universal network



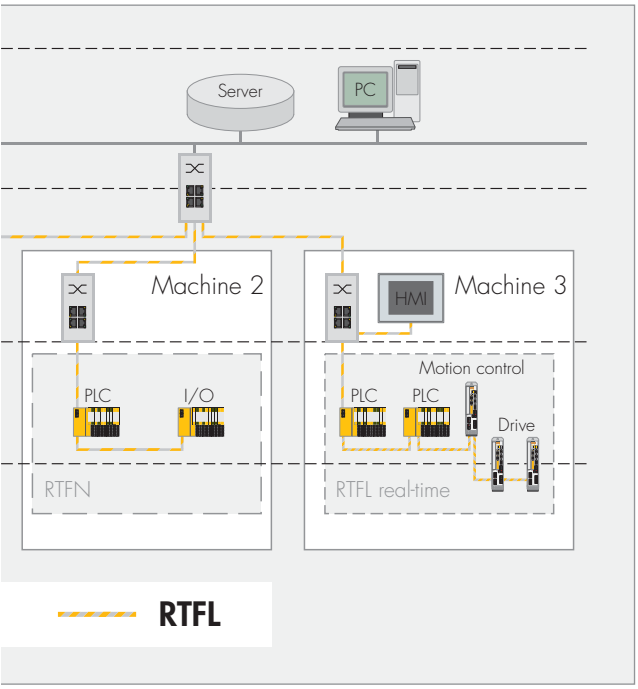
One solution for the entire automation technology

SafetyNET p – Modularisation through distributed control technology

Modern mechanical engineering often requires plant and machinery to be broken down into independently functional modules. One of the main objectives in modularisation is to standardise the mechatronic units. These can then be connected without any further adjustment. If this standardisation is also to be implemented in the software, each module needs its own software and intelligence to run the user program. A distributed control system of this type cannot be implemented using the Master/Slave fieldbus systems that are prevalent today, because these always require a centralised Master in a centralised control system. This control system must be known to all subscribers within the modules. Having various combinations of modules will inevitably require program changes in the centralised control system, so standardisation is impossible.

Communication principle

SafetyNET p uses the communication models Publish/Subscribe for RTFL and Producer/Consumer for RTFN. These models have no centralised Master to handle process signals and control communication. The publishers or producers publish data on the network, to which the subscribers or consumers can subscribe. This type of network is ideally suited for distributed control technology, as the intelligent subscribers can communicate directly with each other without having to communicate via a central instance, in other words a Master. The publisher of the data does not have to know the subscriber and the composition of the plant modules has no influence on the program in the module itself. Plants that are modularised using SafetyNET p can be developed, manufactured and commissioned independent of the subsequent configuration of the overall plant.



Advantage / benefit:

- Distributed, control architecture with multi-master capability
- Modular machine design
- Standardisation of plant and machinery

SafetyNET p is standard Ethernet

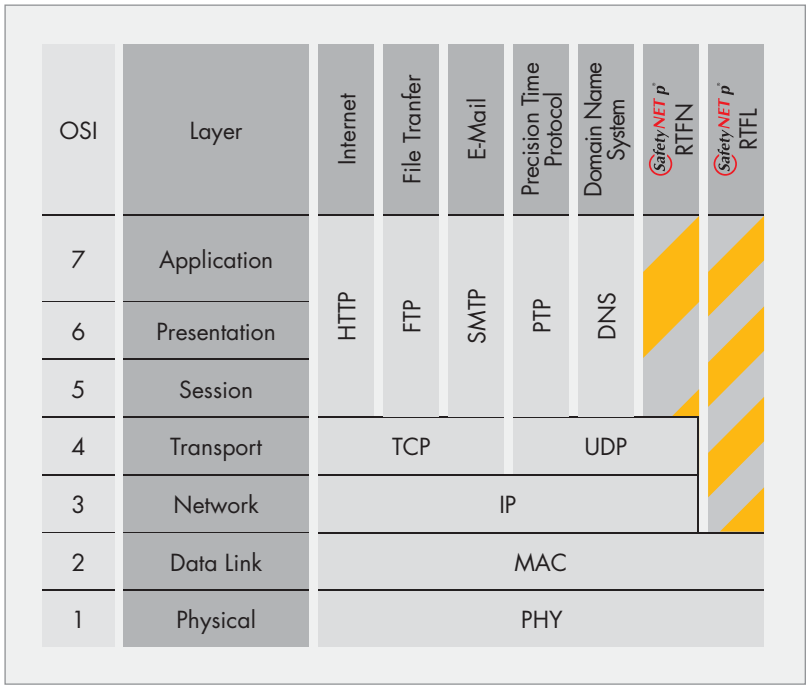
SafetyNET p is universally based on standard Ethernet in the whole network in accordance with IEEE 802.3. SafetyNET p uses a bandwidth of 100 Mbit/s, with 100BASE-TX for electrical transmission and 100BASE-FX for fibre-optic paths. This means that familiar Ethernet network components such as cables and connectors, as well as active devices such as switches, can be used without restriction. However, application of the Ethernet standard is not just restricted to the protocol layers below. Application layer protocols familiar from the IT world can also be used. Applications of particular importance in this context are those such as the Hypertext Transfer Protocol (http) for websites or the Simple Network Management Protocol (SNMP) for network diagnostics. This enables the use of widespread and familiar standard components and tools.

SafetyNET p connection technology

Easy handling and reliability of the connection technology are key factors in the acceptance of an industrial communication system. Twisted-pair cables that comply with Category 5e of ISO/IEC 11801 are used for the electrical wiring. Familiar RJ-45 connectors from the office environment are used in the IP20 area, but in a rugged industrial design with quick-connect technology.

Advantage / benefit:

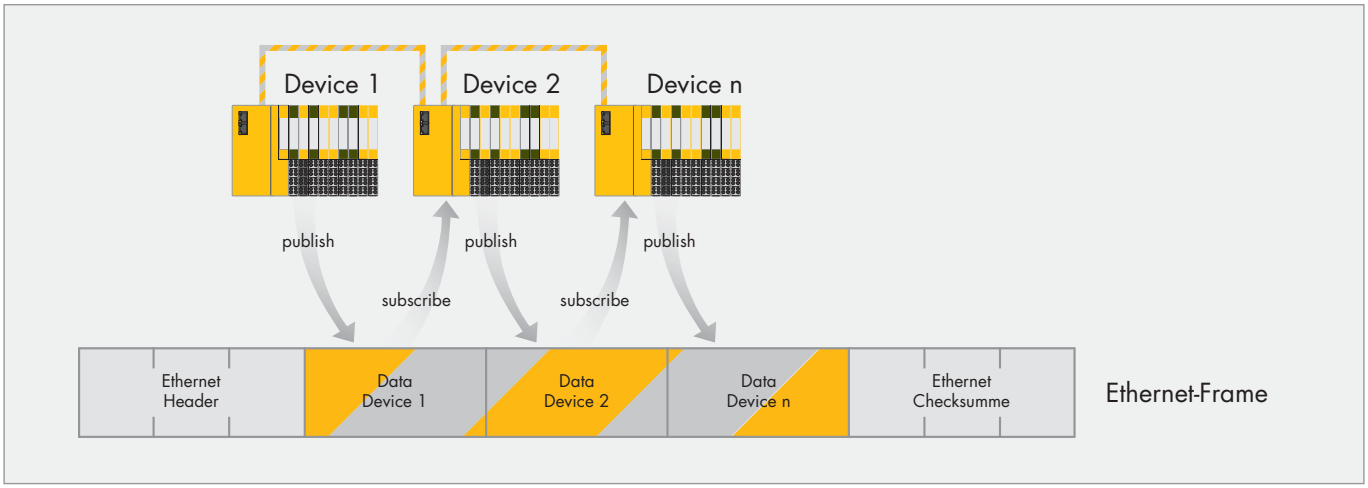
- Reliable installation
- Rapid commissioning
- Compatible with Ethernet connection technology
- Device diversity
- Cost reduction
- Use of known technology



SafetyNET p in the OSI reference model

SafetyNET p connector

SafetyNET p increases productivity



RTFL for fast linear topologies

In systems on which high speed is of the essence, the outstanding real-time properties of SafetyNET p enable productivity to be increased. Guaranteed scan times of up to 62.5 microseconds can be achieved with a jitter of 100 nanoseconds. This means that the real-time performance is sufficient to close the drive control loops via the network and to implement exactly synchronised multi-axis applications. With SafetyNET p it is possible to implement high-performance control applications that would not be conceivable with classic fieldbus systems.

High-performance control applications

With a fast network such as RTFL, I/O reaction times in control applications can be reduced. Short communication cycles mean that up-to-date measured values from the control system are available at shorter intervals, enabling faster reactions to control deviations. Higher precision control is the result. With RTFL it is possible to decentralise control applications that would previously only have been conceivable in a centralised format.

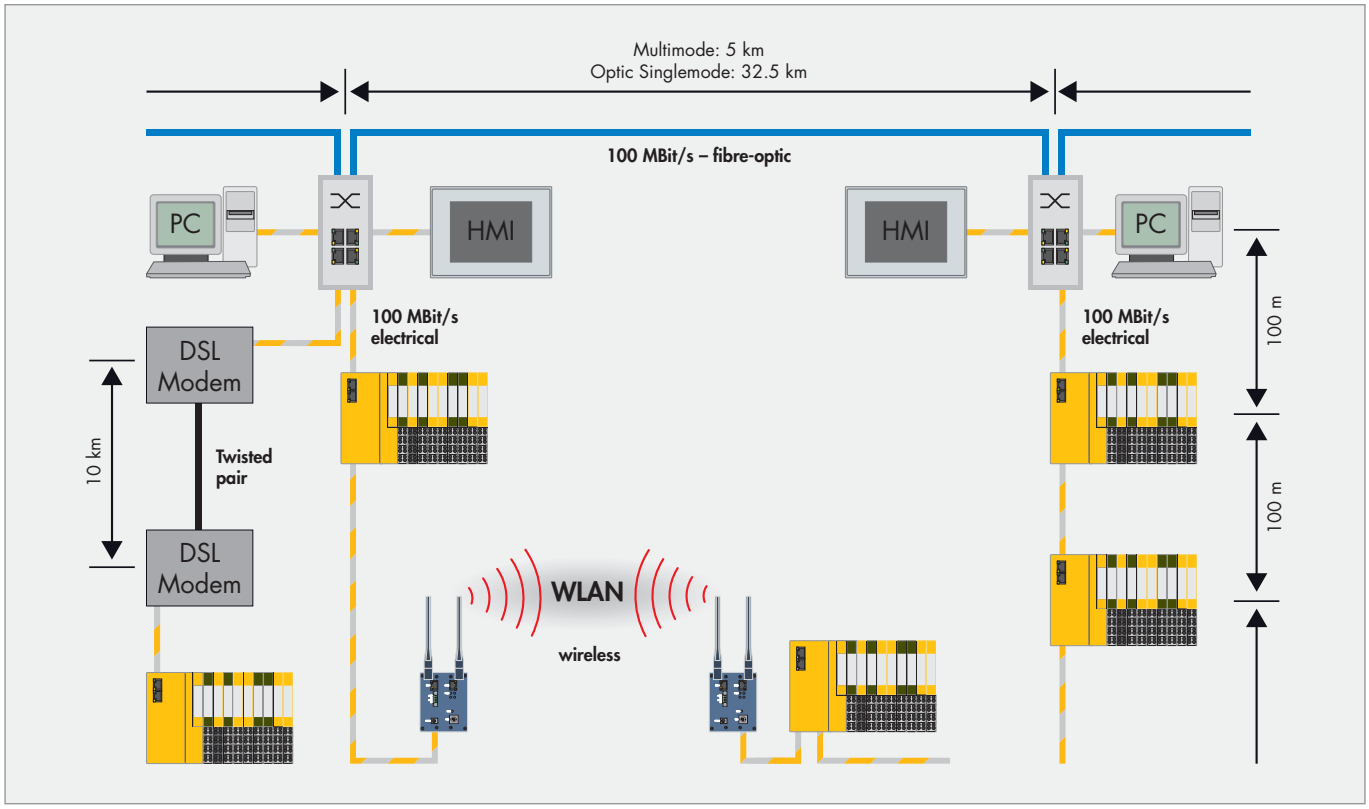
Motion control

On drive applications that are controlled and synchronised via the network, faster communication can speed up the production process and lead to higher product quality. For example, printing machines on which the axes are synchronised in shorter cycles via the network can accelerate production speed and thereby increase the volume produced, with no reduction of print quality.

Advantage / benefit:

- Increased productivity
- Real-time capability, short communication cycles of up to 62.5 ms
- Rapid synchronisation of motion applications via SafetyNET p
- Short cycle times on control applications

SafetyNET p has no limits



SafetyNET p is flexible and can be used with various infrastructure components

Large network extension

Thanks to the use of a standard Ethernet infrastructure, a wide range of options are available on SafetyNET p for the network's physical design. A variety of wired electrical and optical media can be used for data transfer, as well as wireless radio and optical media.

Electrical communication

Copper cables are the standard medium for wiring SafetyNET p components. With electrical wiring in compliance with Category 5e it is possible to span distances of up to 100 m between two subscribers. Infrastructure components, such as switches for example, are active components, so the cascading depth and therefore the overall length of the network is infinite. The transmission times are all that need to be considered in the network design.

SafetyNET p can be used to span a range of distances

Electrical	Fibre-optic		DSL
	Multimode	Singlemode	
100 m	5 km	32.5 km	10 km

Fibre-optic

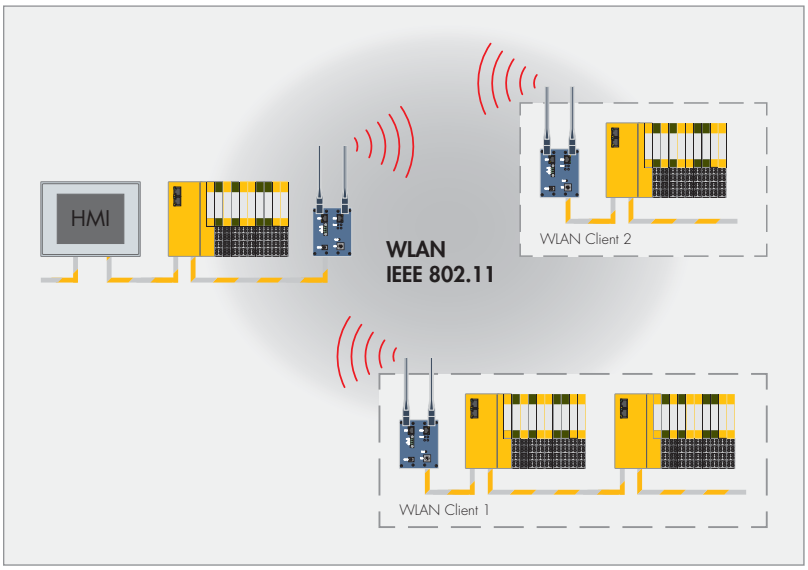
Fibre-optic communication can be used to span distances greater than 100 m between two subscribers. Cable lengths of 5 kilometres are possible with multimode technology; up to 32.5 kilometres are possible with singlemode. In applications that demand increased resistance against electromagnetic interference, fibre-optics provide the necessary immunity.

DSL (Digital Subscriber Line)

Cable lengths of up to 10 kilometres are possible with DSL technology. Economical twisted pair cables can be used as the medium. This makes DSL a particularly interesting option in applications using existing cables that do not comply with Category 5e.

Wireless

Wireless radio communication is used in applications in which cables cannot be used or where cables would be disruptive. This is the case on rotating or mobile systems, for example. Today, wireless technology is frequently used in these applications. WLAN from the IEEE 802.11 series of standards can be used to transmit SafetyNET p data wirelessly. The strengths of WLAN lie in its support for Ethernet and in the construction of large wireless networks.



Wireless radio communication with SafetyNET p

SafetyNET p offers flexible cabling

Flexible topologies

Support for a wide range of topologies is a significant factor in ensuring that cabling is carried out efficiently, based on the plant's physical layout. Cabling work is reduced as a result. What's more, the use of network redundancy mode can increase the network's failure safety and therefore the application's availability. Star, tree, linear and ring topologies can be implemented on SafetyNET p. The linear topology is implemented through two switch ports integrated into the subscribers. With RTFL, a fast line can be constructed with scan times of up to 62.5 microseconds. Star, tree and ring topologies are implemented through external switches.

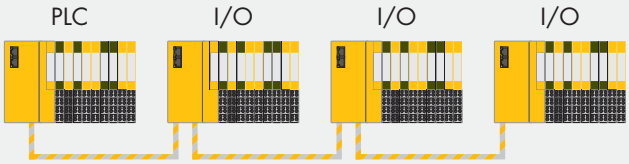
Switches with various ports and a range of media enable networks to be implemented with the upmost flexibility. It is possible to choose between simple unmanaged and managed switches. Extensive configuration and diagnostic options are available on managed switches. Managed switches also support redundancy functions such as ring redundancy.

Advantage / benefit:

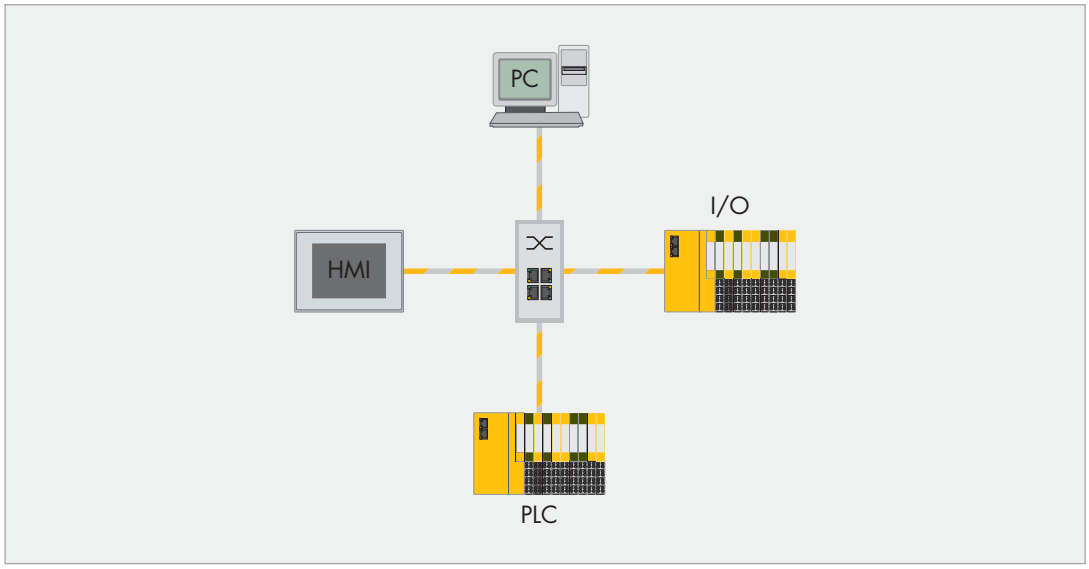
- Less cabling work
- Perfectly tailored to the plant layout
- Availability is increased
- Less work involved when extending the plant

Topology and property

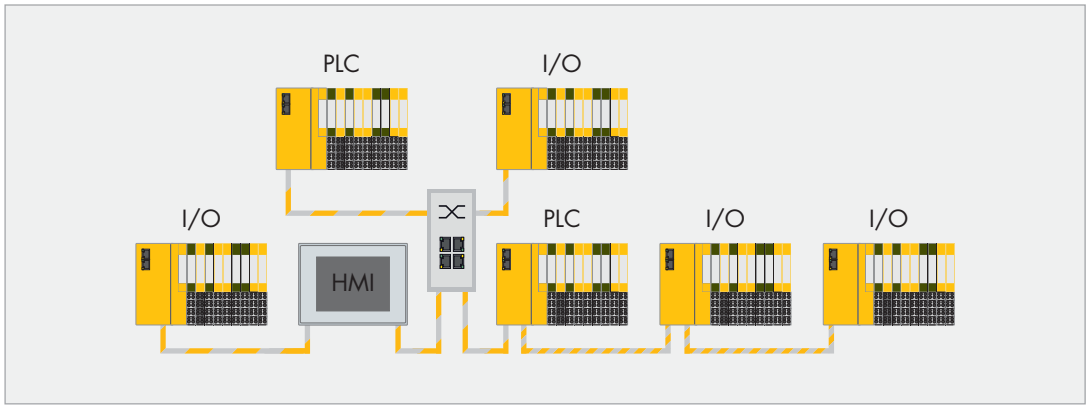
Linear	Star	Tree	Ring
- Less cabling work in heavily decentralised or linear applications - High speed with RTFL	- Mainly centralised applications - Easy to expand	- Combination of the properties of linear and star	- High failure safety and high availability



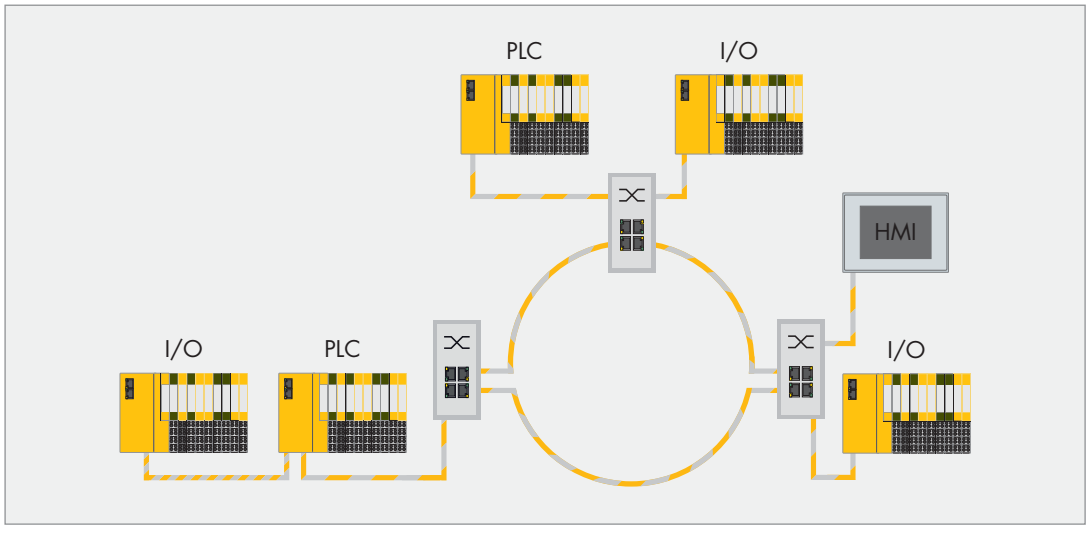
Linear topology



Star topology



Tree topology



Ring topology

SafetyNET p is safe

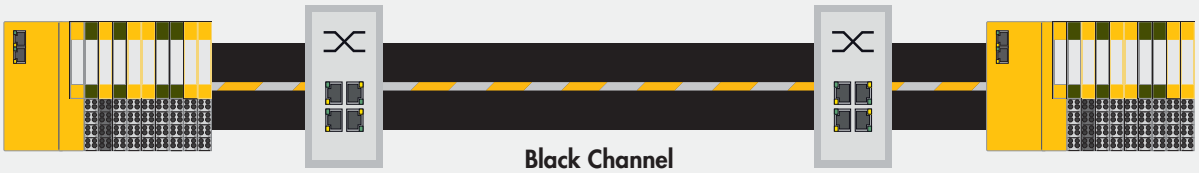
The SafetyNET p safe application layer enables safety-related data to be transmitted via the same network cable used to communicate non-safety-related data.

The SafetyNET p protocol is designed for communication of data up to SIL CL 3 of EN/IEC 61508. Independent test institutes such as TÜV and BG have confirmed the suitability of SafetyNET p in safety-related applications up to Performance Level e of EN ISO 13849 and SIL CL 3 of EN/IEC 62061. A SafetyNET p segment may contain up to 512 safe subscribers.

SafetyNET p operates in accordance with the black channel principle; this means that, with the exception of the safe bus subscribers, all other network components are regarded as non-safety-related.

Advantage / benefit:

- Number of bus systems is reduced
- Fewer breaks in the system
- Extensive range of safety applications can be implemented



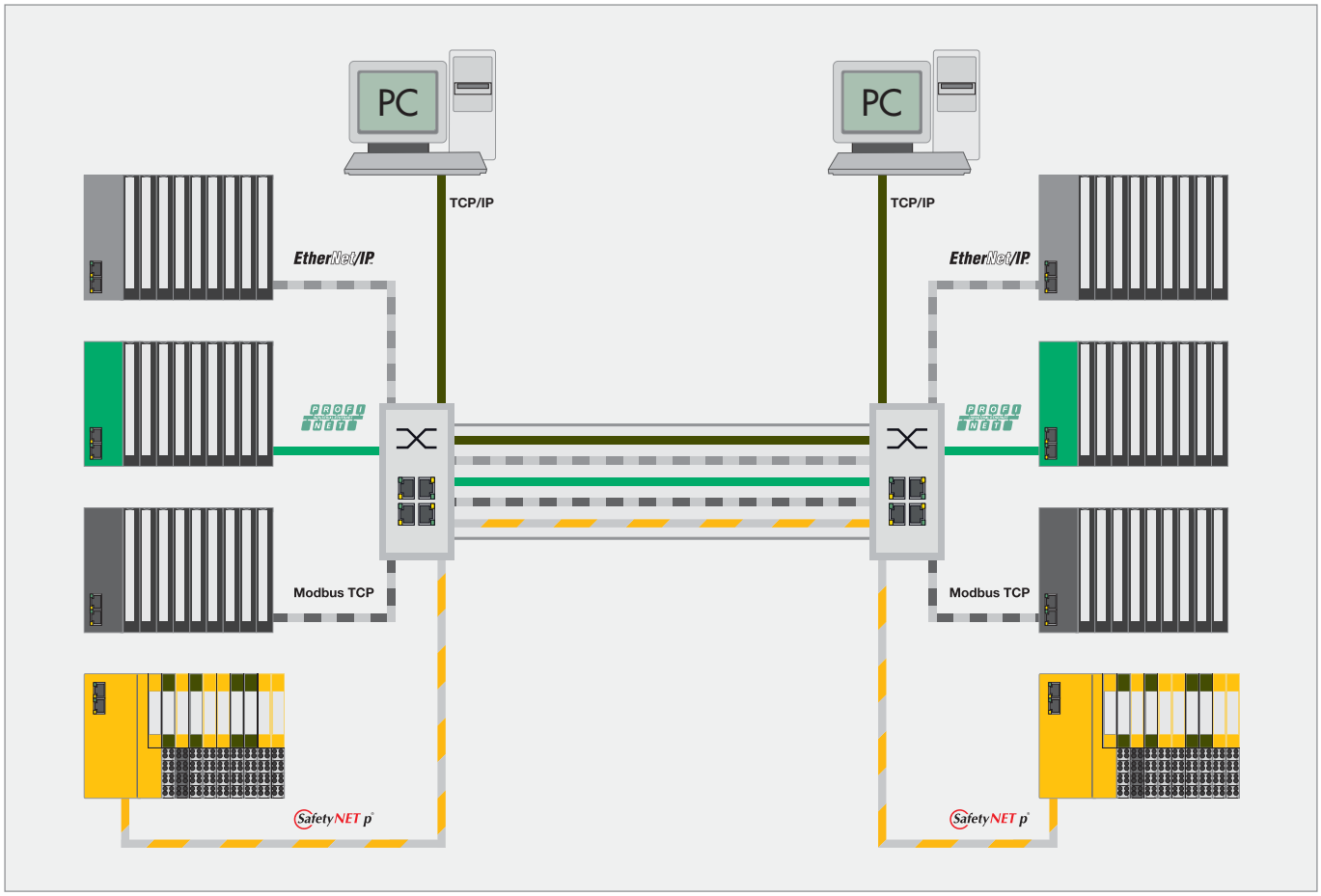
Black channel principle

SafetyNET p has coexistence capability

The UDP/IP-based RTFN protocol on SafetyNET p enables different Ethernet protocols to be operated at the same time in the same network. As a result, the usual IT protocols such as http or SNMP can be communicated via the same cable and infrastructure components. Standard PC technology can be used. Even third-party IP-based Industrial Ethernet protocols can coexist alongside SafetyNET p in the transmission. One will not affect the other. This enables systems to be mixed, without separating the networks. SafetyNET p devices can also be integrated into existing Ethernet infrastructures.

Advantage / benefit:

- Coexistence with other Ethernet protocols
- Ability to use different systems in one network



SafetyNET p has coexistence capability

SafetyNET p implementation

Simple, flexible and economical implementation options are the key to gaining acceptance of an industrial communication system among automation device manufacturers. These requirements have been considered on SafetyNET p, in that various options are available for the implementation of SafetyNET p devices. The manufacturer can therefore reduce the effort required for interface implementation to a minimum.

Implementation support

SafetyNET p is an open technology. All documents required for the implementation of SafetyNET p, such as specifications and the hardware and software protocol stacks, can be procured through Safety Network International e. V. The organisation supports manufacturers of SafetyNET p devices during the entire integration process.

Primarily, Safety Network International e. V. is there to support manufacturers as a partner in the implementation of SafetyNET p devices. In other words, to accompany the manufacturer from the initial product idea right through to product conformity testing.

Certified for SafetyNET p®

Safety Network International e. V. enables systems to be open

A system's openness can only be guaranteed if an independent organisation acts as the platform for manufacturers, users and organisations. Membership of the organisation is open to all companies, associations and institutes interested in widening the use of the systems. Membership enables them to influence the continued development or new development of the technologies. Safety Network International e. V. is the independent and open user organisation that emerged from the SafetyBUS p Club, founded in 1999. Since its foundation it has promoted the propagation and continued development of both industrial communication systems, SafetyBUS p and SafetyNET p.

Organisation members

Members include companies, institutes and associations from the various sectors of automation technology. The benefits of membership arise from networking among the individual companies with various interests in industrial communication systems. This produces synergy effects, which are key in promoting the development of both systems.

Technological support

Technological support is the basis on which the work of Safety Network International e. V. is founded. From support in implementing the system into new devices through to conformity testing, Safety Network International e. V. is there to support individual development projects. Another important element here is the technical documentation that is associated with a project of this kind. Particular importance is also placed on certification. Safety Network International e. V. has been included in the list of test laboratories accredited by the TÜV Product Service Group (TÜV) since 2006. This means that Safety Network International e. V. can certify SafetyBUS p-based products itself, making the approval process for manufacturers even simpler.

Committee work

Safety Network International e. V. is a Liaison-D member within the IEC and is committed to its work in standards' committees and industry associations. The goal is to suitably represent the members' interests and to influence future developments.

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Safety Network International e.V.

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10-42-0-005, 2011-03 Printed in Germany