Safety and Open, Real-time Industrial Ethernet Achievable With SafetyNET p

Today, Ethernet is the worldwide standard in office communication. Not only is it used to network PCs and peripheral devices within the office, but also for communications between distributed servers or for the Internet and intranets. Annual growth for the use of Ethernet-compatible devices has been in double figures for years, and this trend is forecast to continue for years to come.

Ethernet has proven itself to be an economical, flexible medium suitable for universal use. The widest range of utilities (e-mail, Internet, data transfer, audio and video communications), device types (PCs, printers, digital cameras, servers, telephones) and transport media (copper or fiber-optic cable, radio or laser) can all be used as required.

In everyday language, Ethernet is understood to represent all properties and utilities in their entirety. On closer technical examination, however, it forms only basic communication, comprising the communications medium (the Physical Layer on OSI Layer 1) and the Data Link Layer (OSI Layer 2). All other utilities such as TCP, SMTP, or FTP for example, use Ethernet and build upon it.

Ethernet for industrial communications

Unlike office communications, industrial and process automation are based on a multitude of different fieldbus systems (e.g. ASI, CAN, DeviceNet, Interbus, LON, PROFIBUS). Particular versions with additional performance features have established themselves in parallel for specific applications such as drive technology or safety technology. Generally, these fieldbuses are not compatible with one another.

If one considers Ethernet as a network in which all devices and utilities can communicate with each other via the same medium, the idea of an industrial Ethernet seems completely natural. Due to technical restrictions in its current standard form, Ethernet requires some fundamental additions to make it suitable for industrial purposes. These are necessary to enable it for use both in new industrial applications as well as existing applications. Existing demands of the office world for robustness and reliability do not come close to satisfying the rugged environmental conditions of a body shell line at a car production plant or power station.

Industrial Ethernet is based on the actual performance features, cabling structures and available devices of office communication. Standard features of fieldbus cabling are then added. These include the ability to form linear structures without the use of switches or hubs, or the definition of robust industrial connection technology in higher protection types (IP65/67). Naturally it is intended that components employed in office communication, such as switches, routers, printers, laptops, etc. are still usable.

For universal usability, support of real-time communication is absolutely essential. Deterministically guaranteed scan times of 100 s and less are required in order to implement highly dynamic drive applications. Direct integration of a security protocol for machinery safety purposes is equally essential. This security protocol is necessary for communicating information used to protect man, machine, and the environment from hazards.

Add to this the demand for dynamic networks, in which subscribers can log in and log out, or that allow subscribers to change to other power supplies. This was scarcely a possibility using conventional fieldbus systems.

For the purposes of modular systems, stand-alone units, set-up mode, or diagnostics, users also wish for data traffic from subscriber to subscriber without a centralized controller.

Above all these requirements, the ultimate wish is for an integrated, economical, and flexible solution able to be applied universally for office and industry. To meet this requirement, it is absolutely imperative that the corresponding drivers are available and an open standard enabled, so that each manufacturer can apply this technology. SafetyNET p takes all these requirements into account.

Based on the above requirements, SafetyNET p was specified and developed by Germany's Pilz GmbH & Co. KG as an open network with optimum frame data. To ensure this system is open and widely propagated, integration is being supported by Safety Network International e. V., a fast-growing organization of SafetyNET users. The organization offers its affiliated member companies product-neutral integration utilities and development support.

What is SafetyNET p?

SafetyNET p was developed as a deterministic real-time Ethernet for the industrial environment. Established technology from the SafetyBUS p safe bus system was also considered and refined. So SafetyNET p is an Ethernet-based network for industry that can be used for real-time and safe communication functions.

In order to meet the various requirements, SafetyNET p supports two types of communications. The SafetyNET p RTFL format is optimized for extremely fast communication in highly dynamic applications. The RTFN format also provides the ability to communicate via any Ethernet network. Both versions are compatible with each other and may be used separately or in combination.

In SafetyNET p, individual devices are connected in a linear cable structure. If a branch is required, this can be created using a normal switch. So not only is it possible to have a standard industrial linear topology, but also a much more flexible tree or star topology. Standard Ethernet devices can either be connected to the last subscriber on a SafetyNET p line or at any point via a switch. Standard devices such as laptops, printers, or video cameras, for example, may use any type of Ethernet Frame. These include all the familiar PC utilities such as E-Mail, FTP, Internet, video, as well as other Industrial Ethernet versions, provided these use Ethernet Frames.

Dynamic detection and network structure management is provided explicitly in SafetyNET p. This enables service devices to be connected if required, but is also an absolute essential for mobile applications or for tool change, for example.

The SafetyNET p communications structure does not use a centralized PLC. “Peer-to-peer“ data transfer enables decentralized data processing. Complex plants, therefore, can have a modular structure and flexible individual modules in terms of dimensioning, planning, and commissioning. A pleasant side effect of decentralized processing can be seen in reaction to local events, which in most cases is considerably quicker.

For optimum protection of investment, existing fieldbus installations can communicate with other plant sections via SafetyNET p using proxies. That way SafetyNET p can have access to data from the relevant fieldbus.

Both safety functions and real-time functions use the real-time capability of SafetyNET p. When using SafetyNET p RTFL and the SafetyNET p protocol chip, a real-time scan time of 62.5 s is supported. Devices without these high real-time requirements can use generic Ethernet interfaces in SafetyNET p RTFN. Used in combination with the software driver for implementing the security protocol, this represents a flexible, cost-effective procedure.

Application options

To use SafetyNET p for all automation communication utilities offers the simplest integration method. All automation devices communicate via a common network. Whereas scan times of up to 62.5 s can be achieved in individual sectors, slower speeds may also be used at the same time. This can be adjusted to suit individual requirements of the devices and the application. Extremely fast scan times, combined with the possibility of synchronized distributed clocks, allow for synchronization of drives and even for communication within their internal sensor-actuator closed-loop control system.

The topology, in other words, the device layout, can be adapted to suit the requirements of respective production cells. Even devices only temporarily connected to the network may be used. Varying subscriber structures can also be used. While the former is primarily required for servicing or installation, the latter occurs in applications with mobile devices or on tool-changing equipment.

The combination of real-time capability and production control is rounded off on SafetyNET p by the facility for safe communication. Both real-time communication and safe communication can take place beyond the boundaries of a production cell, via a standard Ethernet TCP/IP network. By using switches, communication between devices such as laptops, printers, or cameras can take place as cross traffic.

SafetyNET p mechanisms guarantee these utilities can coexist on the same line, without adversely affecting real-time capability or safety. Users of SafetyBUS p can intelligently combine the system’s known capabilities with the real-time or TCP/IP capabilities of SafetyNET p. This means existing investments can be protected. In practical terms, SafetyBUS p is connected either via a special device (proxy) or via a safety PLC with interfaces to both networks.

This feature means that, even in the future, all existing SafetyBUS p devices can be used within SafetyNET p networks. Where a specific industrial Ethernet system such as PROFINET® or EtherNet/IP® has already been defined for the standard section, it is absolutely vital for SafetyNET p to have a high coexistence capability. In such a case, the specific industrial Ethernet can communicate within one and the same network. In this way the

user's individual preference for a specific industrial Ethernet can be guaranteed. At the same time, the user can employ SafetyNET p and benefit from its advantages. In particular these include performance features such as speed, security, openness, and extremely flexible topologies.

Users, system integrators, and engineers can therefore meet requirements arising from non-technical or organizational reasons. At the same time, they can benefit from the unique performance of SafetyNET p.

Applications

In the factory automation sector, it is important to be able to connect manufacturing cells, mostly built in a linear structure, to fast sensor-actuator loops in the motion control area. SafetyNET p in its RTFL structure is extremely suitable in this case, as it offers an extremely high real-time capability within linear structures. If mobile devices such as trucks or tool-changeover equipment are to be connected, this can easily be done in SafetyNET p via switches. The same applies for service laptops and commissioning tools.

On SafetyNET p, safety signals that one encounters everywhere in factory automation are transmitted on the same medium. Interconnection of the individual production cells or manufacturing units is absolutely essential for the overall process. On SafetyNET p, the cells are connected via RTFN. This way, as in RTFL, each subscriber has access to data from all the other subscribers, even those on other manufacturing cells. At the same time, TCP/IP traffic is also possible for real-time and security data.

For plant design, therefore, SafetyNET p offers a universal platform on which all utilities can communicate, from sensor to control level. The ability to segment SafetyNET p also means that feedback from individual sections is eliminated and the availability of the overall plant is maintained.

The requirements of the process industry are determined partly by the structure of the plant, but also by signal quantity. Effective plant design demands flexible topologies, which can be represented in any type of tree structure using SafetyNET p. Branches can be made at any point using switches. If branches are not required, the linear structure can continue or end on any device. Thanks to automatic mechanisms to identify the current topology, both commissioning and servicing are extremely simple. The ability to manage each subscriber with its individual cycle length permits the use of high-performance devices as well as low-power and low-cost devices. As all devices communicate via SafetyNET p, access to each subscriber is guaranteed in the control room at all times.

Sub-networks available in other bus topologies can be incorporated via gateways. The openness of SafetyNET p guarantees that gateways such as these can be supplied for all systems. Redundant cabling and devices can be used to optimize the availability of individual sectors or whole networks. A wealth of cables and connectors can also be accessed for outdoor use (IP65). Fiber-optic connections or radio links can be implemented via the familiar Ethernet components from office communication.

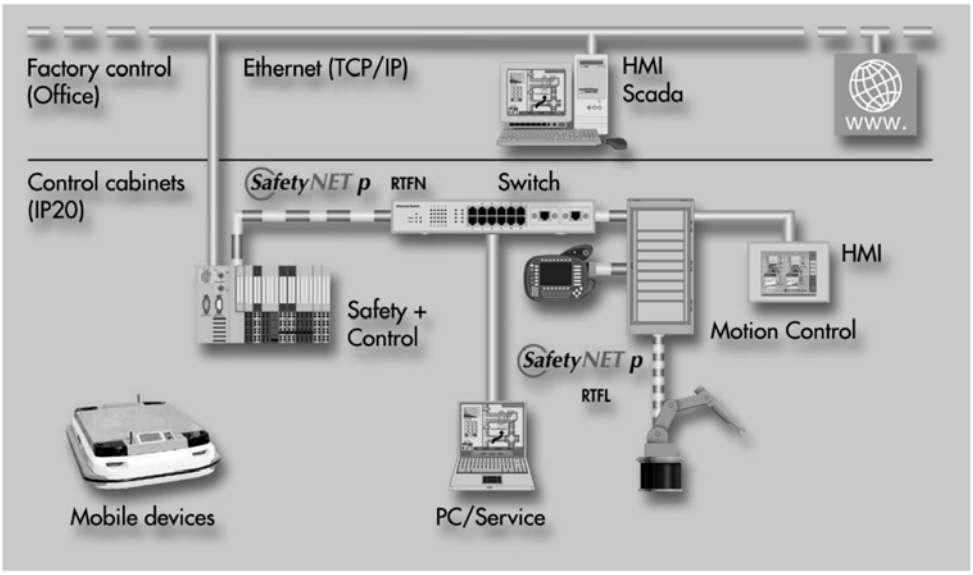
Recommendations

SafetyNET p demonstrates that it is possible to meet all the user requirements of an open, safe and deterministic real-time Ethernet. The real-time performance with scan times of up to 62.5 s is around 20 times faster than most other industrial Ethernet versions. With secure communication integrated from the start, SafetyNET p is the perfect transport medium for combined safety applications. SafetyNET p is open for any type of Ethernet traffic, even for data traffic from other industrial Ethernet versions, laptops or video. Extremely flexible connection technology enables a plant to have a linear, tree or star structure. The capability of structures and subscribers that can be changed during operation is unrivalled.

So SafetyNET p is the perfect industrial Ethernet. SafetyNET p can also be used in combination with other Ethernet versions, if the particular performance features of SafetyNET p are required. In particular this may be the case where there are special safety or realtime requirements or where existing plants need to be expanded.

Features of SafetyNET p

- Each Ethernet device, such as a PC, camera, or printer can be connected to a SafetyNET p network.
- All Ethernet utilities based on the IP protocol can be used, for example E-Mail, Internet, file transfer or streaming.
- The basic topology in RTFL is a linear structure. This means that existing evolved structures within industry can continue to be used.
- Branches can be created through the use of switches, enabling the formation of tree or star structures.
- Real-time communications with scan times of up to 62.5 s in RTFL and up to 1 ms in RTFN.
- The security protocol is integrated right from the start.
- The publisher/subscriber principle enables direct communication from subscriber to subscriber, without the need for a centralized PLC.
- The network structure is identified during operation. This enables:
    - Mobile devices to be connected,
    - Varying configurations, as required for tool change
    - Existing fieldbus installations can be incorporated by using proxies.
- SafetyBUS p networks can be incorporated by using proxies.
- Devices with real-time capability can be incorporated by using special SafetyNET p RTFL protocol chips.
- Applications with scan times > 1 ms can communicate with standard Ethernet interfaces via SafetyNET p RTFN.
- The security protocol is incorporated as a software driver.



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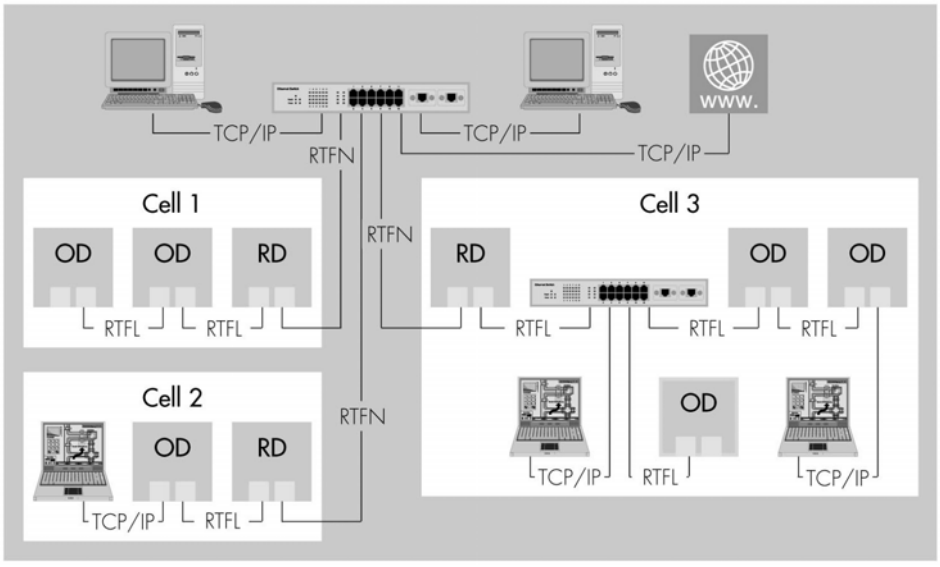

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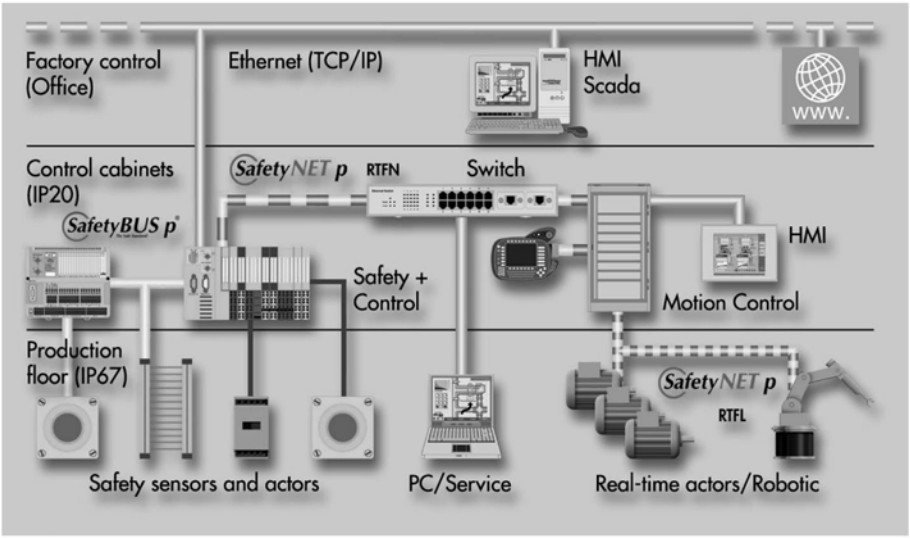

Users of SafetyBUS p can intelligently combine the system's known capabilities with the real-time or TCP/IP capabilities of SafetyNET p.

more than automation
safe automation

Pilz Automation Safety L.P.
7150 Commerce Blvd.
Phone: (734) 354-0272
Fax: (734) 354-3355
www.pilz.com