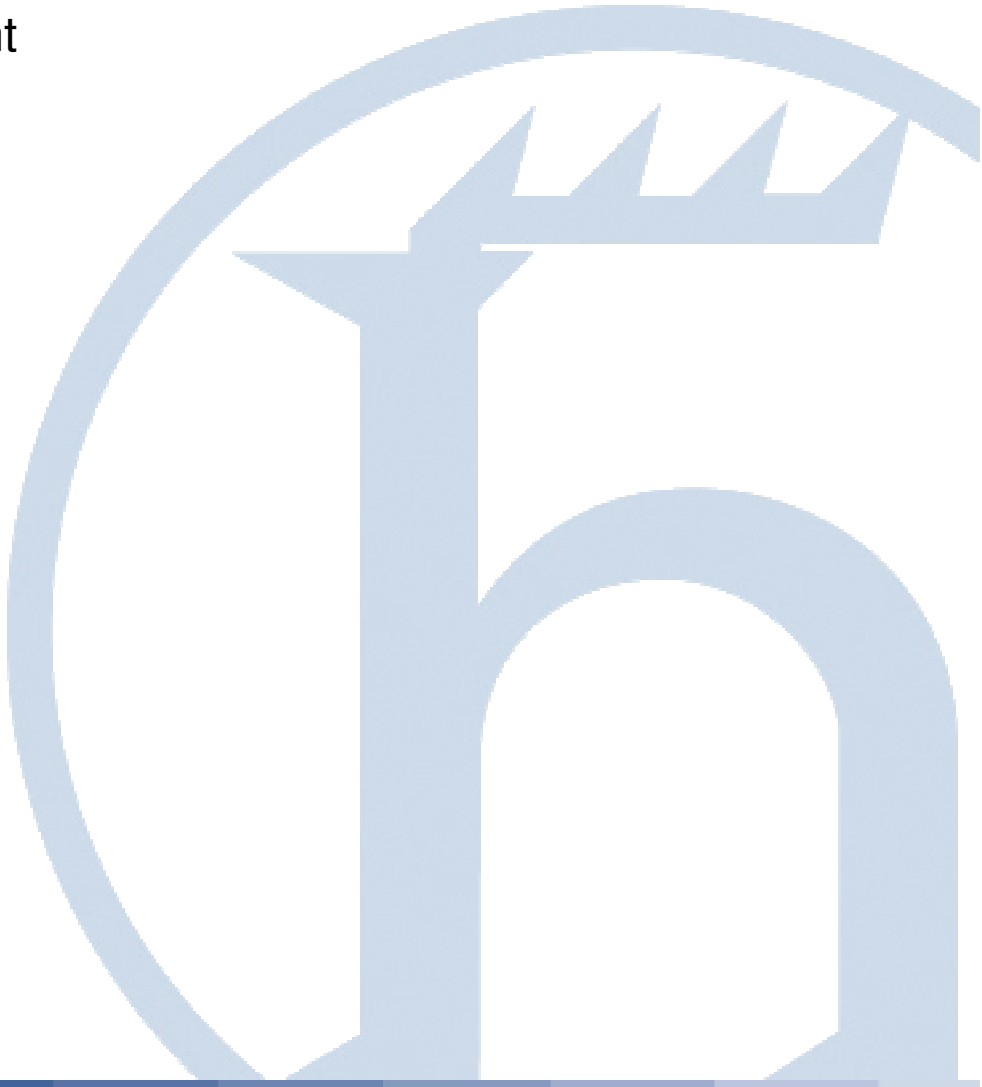
HIRSCHMANN

Automation and Network Solutions

Hirschmann Networking Interoperability in a

PROFInet

Environment



Hirschmann Interoperability

White Paper Rev. 1.1

Contents

Hirschmann Networking Interoperability in a Profinet Environment

Hirschmann Networking Interoperability in a PROFInet Environment

1 Introduction

PROFInet was invented in 2000 by Profibus International (PI) and developed with strong support by Siemens as a distributed automation architecture based on Industrial Ethernet. The architecture of PROFInet defines the engineering model and the communication between components.

Engineering
With PROFInet machines, systems or plants can be broken up into technological modules. To configure and program the internal functionality of those individual technological modules vendor specific tools can be used. The functionality of those modules is encapsulated in related software components, the so-called PROFInet components (XML files).

Every PROFInet component is accessible via uniformly defined engineering interfaces containing the technological variables of the component. Because of the standardized vendor-independent interfaces any PROFInet component can be combined with one another in any way.
With a PROFInet Engineering Tool communication connections between those PROFInet components can be connected graphical. In this way the Engineering Tool merges the different applications throughout the entire system. By downloading the communication connections into the PROFInet devices each device knows all the communication partners, communication relationships and data to be exchanged.

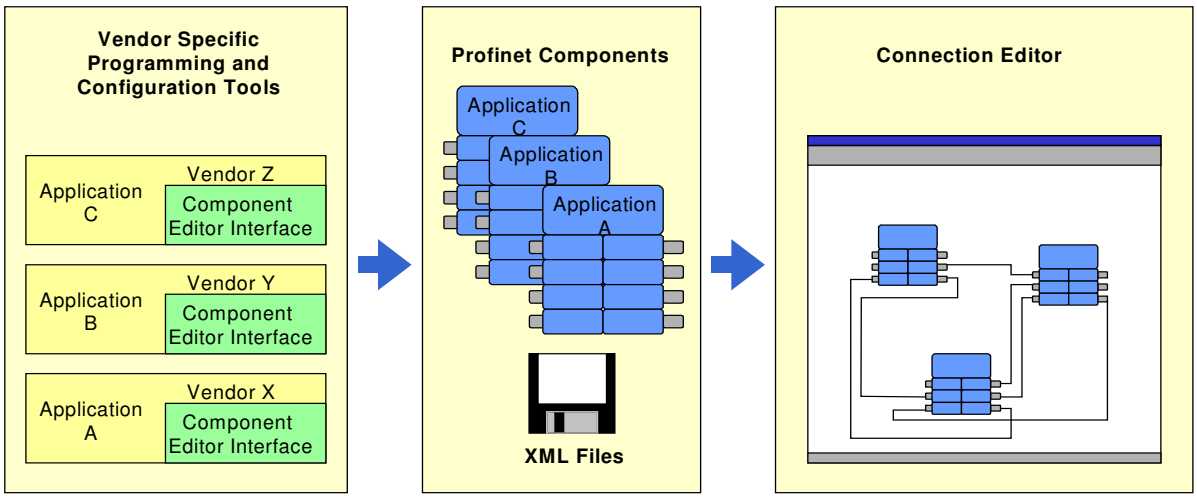


Figure PROFInet-1: Generation of PROFInet components and communication connections

Communication

PROFInet as an open Ethernet-based system offers the integration of fieldbus devices and entire fieldbus systems. To integrate those fieldbus devices proxies supporting PROFInet are used. They represents the functionality of the fieldbus devices on Ethernet.

With Ethernet switches network topologies in line, ring, tree or star structures can be realized.

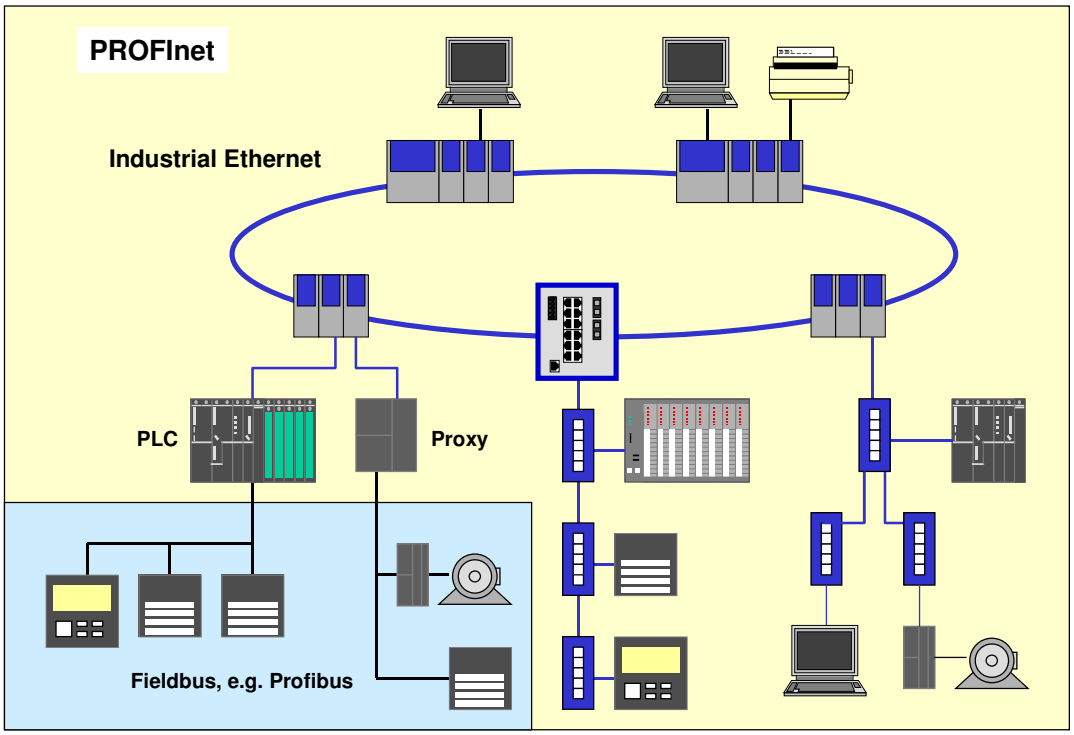


Figure PROFInet-2: PROFInet communication architecture

The run-time model of PROFInet offers three options for communication, PROFInet V1, V2 and V3. PROFInet International has announced that all three versions will be combinable and can be adapted to meet a wide range of requirements.

In the first version of PROFInet (PROFInet V1), fieldbus systems like Profibus-DP were applied for real-time domains and Ethernet networks for standard communication with TCP/IP for non real-time domains.

The first step of PROFInet for real time based on Ethernet is addressed in version two. The second release (PROFInet V2) specifies Ethernet with two communication channels. One channel is for non real-time communication and the second one is for Soft Real-time (SRT) communication. While the non real-time channel is based on a standard TCP/IP Stack the SRT channel is based on an optimized software stack, bypassing layer 3 and 4 of the OSI reference model.

Including further optimizations PROFInet SRT is able to achieve cycle times of 5 to 10 ms. This is comparable to popular fieldbus systems. PROFInet devices supporting SRT are available since 2002.

Typical network infrastructure components for PROFInet SRT are industrial grade Ethernet switches supporting 100 Mb/s full-duplex.

The third release of PROFInet (PROFInet V3) will replace the Soft Real-time solution by a so-called Isochronous Real-time solution (IRT). The target is to fulfil the requirements for motion control applications with cycle times of 1 ms for over 150 axes and a jitter accuracy of less than 1 µs in conjunction with unlimited IT openness.
To meet the IRT targets hardware support is needed. Therefore PROFInet IRT is based on a real-time ASIC. According to Profibus International the ASIC will support PROFInet V2 as well as V3 and will have two or four switched Ethernet ports on board.
Ethernet switches supporting IRT functionality will act like standard Ethernet switches according to IEEE802.

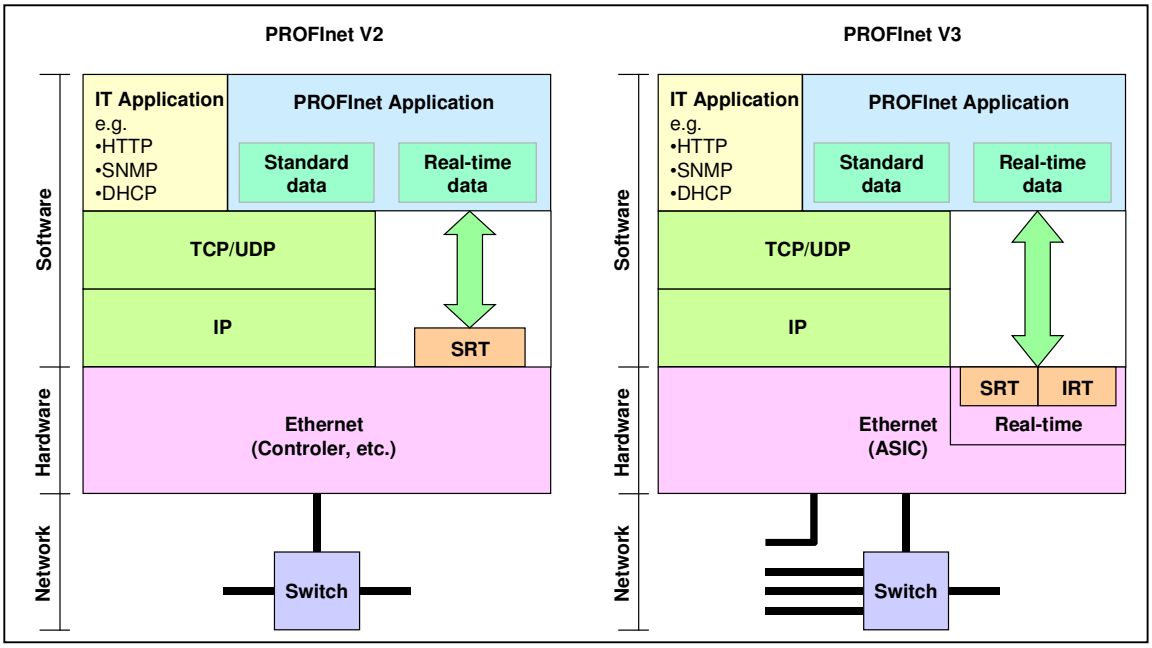


Figure PROFInet-3: Real-time communication channels of PROFInet V2 and V3

Pilot devices supporting PROFInet IRT are expected to be available by end of 2004 and finished products by mid of 2005.
Hirschmann plans to offer switches supporting IRT after the specific ASIC is available in 2005.

2 Vendor interoperability considerations

2.1 Switches vs. Hubs

PROFInet International recognizes that switches simplify the network configuration. A switch can work in full-duplex mode. This means switches are able to send and receive data simultaneously at the same port. Therefore checking of cable lengths within collision domains is much easier. Also switches improve the performance by physical segmentation between 10-Mb/s and 100-Mb/s sections.

Hirschmann concurs with Profibus International recommendations regarding the advantages of switches over hubs.

Within a PROFInet system it is usually not possible to use standard office switches because of the industrial environment. Switches are used in this environment needs to meet electrical demands (e.g. EMC, 24 Volt power supply, ...) and mechanical demands (e.g. DIN rail mounting, size, ...) of machines and systems in industrial environments.

With the Rail- and MICE Family Hirschmann offers a wide range of industrial grade switches and further network components in order to ensure safe operation and easy installation in industrial applications.

2.2 Switch performance

Switches suitable for PROFInet have to be designed for Fast-Ethernet (100 Mb/s) and should support 10 Mb/s to ensure compatibility to older systems or devices like hubs and terminals. Also those switches should support prioritized telegrams according to IEEE 802.1Q.

Hirschmann switches support Ethernet (10Mb/s), Fast Ethernet (100Mb/s) and prioritized telegrams according to IEEE 802.1Q.

2.3 Auto-negotiation

Switches suitable for PROFInet should support auto-crossing, auto-negotiation and auto-polarity.

Switches from Hirschmann like RS2, MICE and MACH support auto-crossing, auto-negotiation and auto-polarity.

2.4 Multicast filtering

Profibus International does not require multicast filtering methods for PROFInet.

Hirschmann offers switches supporting multicast filtering methods like IGMP or GMRP. The default setting for this functions is Off.

2.5 VLAN implementation

Profibus International does not require the use of VLANs for PROFInet.

Hirschmann switches for example RS2, MICE and MACH support 802.1q VLANs, which are disabled by default.

2.6 Port mirroring

Port mirroring for diagnostic purposes is for switches suitable for PROFInet optionally.

Hirschmann recommends the use of port mirroring as a means of connecting a traffic analyzer to a switch based network. This permits system diagnosis without affecting the data flow in the run-time system.

2.7 Network management

Profibus International has identified the Simple Network Management Protocol (SNMP) as the de-facto standard for maintaining and monitoring network components and that SNMP is ideal for monitoring devices supporting PROFInet.

Hirschmann recommends the use of switches supporting SNMP. In addition to switches supporting SNMP Hirschmann offers HiVision as a well established management tool for those switches. The support of SNMP in conjunction applying HiOPC, a gateway software from Hirschmann, all network based information can be viewed by SCADA devices.

2.8 Redundancy

PROFInet redundancy is based on ring topologies respectively Rapid Spanning Tree. The support of this methods is optional and not required by PROFInet International.

Hirschmann RS2, MICE and MACH switches support ring topologies, Rapid Spanning Tree and further protocols to increase network reliability.

2.9 Summary

Capabilities:	**Switch suitable for PROFInet**	**Hirschmann RS2 and MICE**	**Hirschmann MACH 300**	**Hirschmann GES/LION**
Ethernet (10 Mb/s)	R	S	S	S
Fast Ethernet (100 Mb/s)	R	S	S	S
Gigabit Ethernet (1000 Mb/s)	-		S	S
Auto-negotiation	R	S	S	S
Auto-crossing	R	S	S	S
Auto-polarity	R	S	S	S
Services:				
IEEE 802.1Q (Prioritization)	R	S	S	S
Port mirroring	O	S	S	S
SNMP	O	S	S	S
RMON	O	S	S	S
VLAN	-	S	S	S
Multicast filtering	-	S	S	S
Ring topology	O	S	S	S
Rapid Spanning Tree	O	S	S	S

R – required, O – optional, S - supported

Figure PROFInet : Summary of switch features required for PROFInet and supported by Hirschmann products

3 Field interoperability testing

3.1 Hirschmann switches in a PROFInet network

To validate the interoperability of Hirschmann switches and PROFInet equipment extensive testing was performed at Volkswagen test center for instance.
Tested equipment included control systems from Siemens, Kuka, Faser, Trumpf-Laser as well as various field devices connected via Profibus and Interbus.

The conclusion was Hirschmann switches inter-operate in a PROFInet environment best possible.
This is one reason why Hirschmann switches were chosen for PROFInet networks at Volkswagen, for example:

Volkswagen Hanover T5 body shop
More than 500 RS2 switches, 10 MACH switches and thereabout 2500 connected nodes.

Volkswagen Wolfsburg Golf A5 metal forming, paint shop and final assembly
Approx. 170 MICE switches, 4 MACH switches and more than 5000 connected nodes.

Volkswagen Wolfsburg Golf A5 body shop
More than 500 MICE switches, 7 MACH switches and roughly 7000 connected nodes.

And there are much more PROFInet installations around the world communicating via Industrial Ethernet networks build up with Hirschmann switches.

Harald Wessels
Hirschmann Electronics GmbH & Co. KG
Neckartenzlingen, Germany