PROFINET Conformance Class A Cabling

Guideline

for PROFINET

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may: indicates flexibility of choice with no implied preference.

should: indicates flexibility of choice with a strongly preferred implementation.

shall: indicates a mandatory requirement. Designers **shall** implement such mandatory requirements to ensure interoperability and to claim conformance with this specification.

Publisher:
PROFIBUS Nutzerorganisation e.V.
Haid-und-Neu-Str. 7
76131 Karlsruhe
Germany
Phone: +49 (0) 721 / 96 58 590
Fax: +49 (0) 721 / 96 58 589
E-mail: info@profibus.com
Web site: www.profibus.com

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0.1	TC2WG6	06-Jan-2008	First draft
0.2	Huhmann	26-Feb-2008	Normative references
0.3	Huhmann	09-May-2008	Review
1.0	Huhmann	02-July-2008	Change Request (Informative addition)

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1 Management Summary – Purpose and Scope of the Document

PROFINET-specific cabling is based on the IEC 61918 standard. PROFINET communication works best with a dedicated PROFINET installation.
This type of cabling is universally compatible with Fast Ethernet.

However, if the user is already using a network that meets the requirements of ISO/IEC 11801 or ISO/IEC 24702, this network may also be used for PROFINET as long as the relevant conditions are met. The standard governs the design of networks within industrial premises. ISO/IEC 24702 networks are conform to the ISO/IEC 11801 requirements.
This guide aims to outline the conditions under which the ISO/IEC 24702 standard may be applied for the purpose of cabling a PROFINET network.

Given the openness of PROFINET, Conformance Class A can also be achieved without actually using PROFINET-specific cabling.

Conformance Class **A**	Conformance Class **B**	Conformance Class **C**
61784-5-3 PROFINET Cabling **recommended**	61784-5-3 PROFINET Cabling **mandatory**	61784-5-3 PROFINET Cabling **mandatory**

However, PROFINET-specific cabling is absolutely indispensable for any Conformance Class B and C automation applications, as only this form of cabling offers the necessary properties for meeting the performance and availability requirements.

This guide is aimed at:

- Network designers
- Network operators

Its contents apply to:

- Conformance Class A
- Cabling

The guide is based on the following standards: ISO/IEC 24702 (2006-10) and IEC 61918/IEC 61784-5-3 (2007-12).

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2 List of Affected Patents / Certification

2.1 List of Affected Patents

Attention is drawn to the possibility that some of the elements of this guideline may be the subject of patent rights as listed below.
The PROFIBUS Nutzerorganisation e.V. (PNO) shall not be held responsible for identifying any or all such patent rights.

Relevant patents are only those which have an impact on mating compatibility.

This Guideline refers completely to the following documents. No elemets of this guideline are the subject of patent rights.

2.2 Certification

PI does not certify passive network components yet.

2.3 Related Documents and References

ISO/IEC 11801 (2002-09): *Information technology –Generic cabling for customer premises*

ISO/IEC 24702 (2006-10) *Information technology - Generic cabling- Industrial premises*

IEC 61784-1 (2007-12): *Industrial communication networks - Profiles - Part 1: Fieldbus profiles*

IEC 61784-2 (2007-12): *Industrial communication networks - Profiles - Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3*

IEC 61784-3 (2007-12): *Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions*

IEC 61784-3-3 (2007-12)
Industrial communication networks - Profiles - Part 3-3: Functional safety fieldbuses - Additional specifications for CPF 3

IEC 61784-4 (actual 65C/399/CD): *Industrial Communications - Fieldbus Profile - Part 4: Profiles for secure communications in industrial networks*

IEC 61784-5-3 (2007-12): *Industrial communication networks - Profiles - Part 5-3: Installation of fieldbuses - Installation profiles for CPF 3*

IEC 61918 (2007-12) *Industrial communication networks - Installation of communication networks in industrial premises*

2.4 Definitions and Abbreviations

See actual Glossary of the PNO / PI at www.profibus.com

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3 Current PROFINET position in terms of standards

The Conformance Classes are defined in IEC 61784-2.

Source
IEC 61784-2 **Table 13 — Conformance class behaviors**

General classes	Conformance Classes			
	A	A	B	C
CP	CP 3/4	CP 3/4	CP 3/5	CP 3/6
Node classes [a] (see 8.1.2)	IO device, IO controller	IO device, IO controller	IO device, IO controller	IO device, IO controller
Media classes (see 8.1.6)	Wireless	Selection of wired or fiber optic	Selection of wired or fiber optic	Selection of wired or fiber optic
Application classes (see 8.1.3)	Non-isochronous	Non-isochronous	Non-isochronous	Non-isochronous and/or isochronous
Communication classes [b] (see 8.1.4)	RT_CLASS_UDP (optional), RT_CLASS_1	RT_CLASS_UDP (optional), RT_CLASS_1	RT_CLASS_UDP (optional), RT_CLASS_1	RT_CLASS_UDP (optional), RT_CLASS_1, RT_CLASS_2[c], and RT_CLASS_3[d]
Redundancy classes	—	see 8.1.5	see 8.1.5	see 8.1.5
Installation guidelines	—	IEC 61784-5-3 recommended	IEC 61784-5-3	IEC 61784-5-3

Figure 1: Conformance classes behavior in accordance with IEC 61784-2/Ed.1.0, table 23

Automation island cabling is defined in IEC 61918, while dedicated PROFINET cabling is defined as a profile in IEC 61784-5-3. On the level of the automation island, ISO/IEC 24702 (Figure 2) applies.

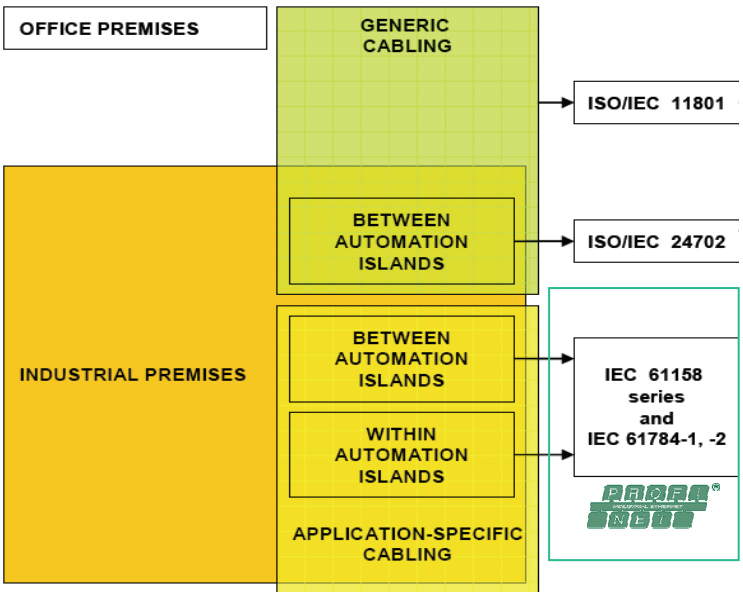

Figure 2: Relationships between standards; corresponds to Figure 2 for IEC 61918

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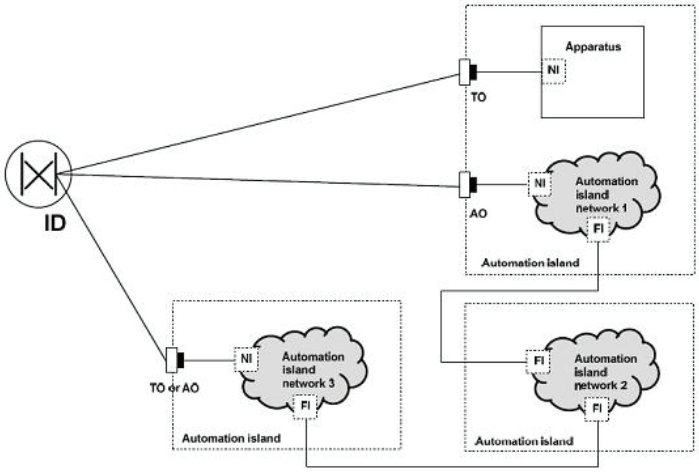

Figure 3: Description of the cabling topologies and the various automation island connections; corresponds to IEC 61918 – Figure 5 – Automation islands

PROFINET uses standard Ethernet technology. This provides openness and vertical integration as far as communication is concerned. From a technical data perspective, the performance of IEC 24702 cabling is the same as with ISO/IEC 11801. PROFINET-specific cabling is also based on ISO/IEC 11801, which means that from a technical point of view IEC 24702 communication can be used.

4 Implementing networks based on ISO/IEC 24702

PROFINET cabling takes place both within the automation island and between FIs (fieldbus interfaces). Where networking is based on Conformance Class A, standard network components such as the ID are expressly permitted. As a result, the ID (Intermediate Distributor) can be used for PROFINET communication, which is often required for applications that differ from typical automation scenarios.

The following applications illustrate when it may be necessary to use the cabling in industrial premises for the purpose of implementing a PROFINET network.

- Connecting automation systems to MES or ERP systems
- Downloading parameters and software
- Bridging large distances between manufacturing units
- Connecting IT equipment such as RFID Reader or Access Points

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Again, the automation island is connected to the ISO/IEC 2470 cabling via the "converter" (figure 2).

> If the two interconnected interfaces (NI and FI) have matching specifications, then the converter/adapter function may not be necessary. If the interconnection between the automation islands is through the ID, it is the responsibility of the planner to check the suitability of the generic cabling to support the requirements for the installation of the communication networks as defined by this standard. In this case the channel performance shall be met from the ID up to the NI (excluding the connector interface at the NI). (Source IEC 61918)

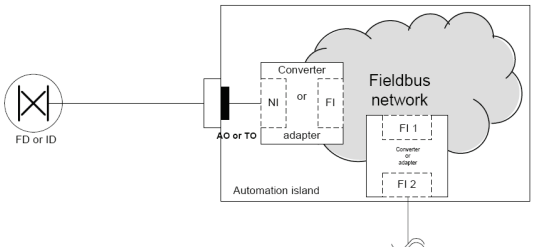

Figure 4: Connection of generic cabling to the fieldbus network via a converter; corresponds to IEC 61918 - Figure 6 - Automation island network external connections

Where there is no need for a “converter”, the channel extends as far as the NI of the device (network components can be used as a device). As PROFINET works on a standard Ethernet basis, “converters” shall not be used.

Figure 3 applies directly to PROFINET. The NI (network interface) is a component of the first device in the automation island network (switch, PLC, industrial PC, etc.).

5 Conditions for using ISO/IEC 24702 cabling

Conditions for using ISO/IEC 24702:

- Limited to Conformance Class A
- The only type of cabling supported, other than PROFINET-specific cabling, is ISO/IEC 24702 cabling (this is inevitable, given the standards relevant to this situation).
- Only PROFINET-compliant cabling satisfying IEC 61784-5-3 is permitted for the automation island network.
- ISO/IEC 24702 cabling applies from the ID to the AO at all times.
- As regards connectionless channels as per ISO/IEC 24702, connection (as far as responsibility and competence are concerned) extends as far as the NI using generic cabling (PROFINET-specific cabling cannot be used for single channel ISO/IEC 24702 structures such as connectionless channels).
- ISO/IEC 24702 cabling is also used for the permanent link as far as the TO/AO.
    - ISO/IEC 24702 cabling can be used for PROFINET as far as the NI (device).

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Note: If the PROFINET-specific 2 pair cabling below the TO or AO is installed, the 2 unused of the 4 pairs shall be properly terminated in the TO or AO.

- For the purpose of connecting automation islands, cabling that meets the requirements of ISO/IEC 24702 can be used for Conformance Class A. In Conformance Class A applications, there is no technical necessity for direct cabling between FI and FI using PROFINET-specific cabling, as long as the user can guarantee performance via the ID through the use of suitable components and measuring technology (Figure 5).

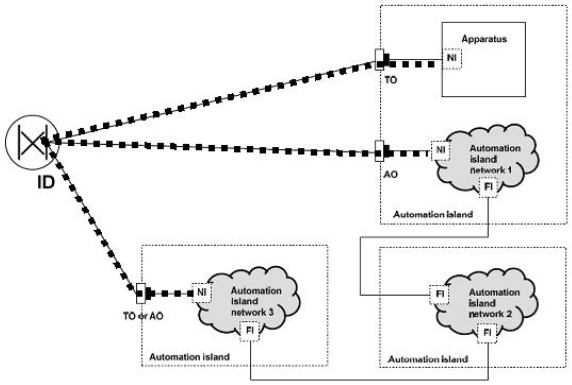

Figure 5: PROFINET CONFORMANCE CLASS A connection

- A PROFINET-compliant network can be configured on the basis of the ISO/IEC 24702 structure (Figure 6)

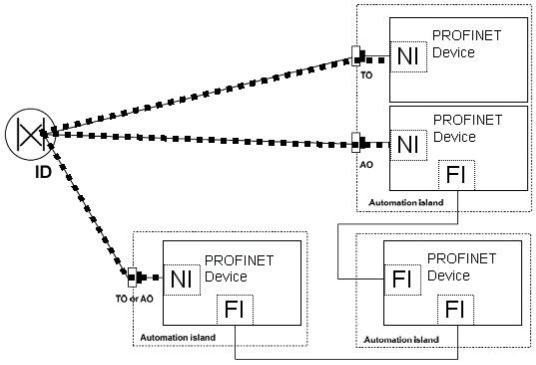

Figure 6: PROFINET CONFORMANCE CLASS A with reduced automation island

Note: Automation-specific topologies such as line topologies cannot be implemented on the basis of ISO/IEC 24702. Similarly, the PROFINET component model for cabling cannot be used with ISO/IEC 24702.
The connections shown in the figure 6 are all possible connections. They should be selected in a way that no physical loop arises.
If a network is build up in a way that a physical loop exists, then an appropriate devices shall be used to disconnect the loop.

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6 Summary

Permitted cabling standards for Conformance Class A:

A) PROFINET-specific cabling in accordance with IEC 61784-5-3

B) Generic cabling in accordance with ISO/IEC 24702

Permitted cabling standard for Conformance Class B/C:

PROFINET-specific cabling in accordance with IEC 61784-5-3

Note:

- *Within the automation island network only PROFINET-specific cabling shall be used for all Conformance Classes.*
- *Automation Islands may be interconnected using ISO/IEC 24702 topology and components within the context of Conformance Class A.*
- *Where an automation island features only one device, it is possible to configure a Conformance Class A network in this way in accordance with the requirements of ISO/IEC 24702. This means that only star topologies based on the ID are permitted. The line topologies required for automation are within the automation island and need PROFINET-specific cabling.*

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PROFIBUS Nutzerorganisation e.V.
Haid-und-Neu-Str. 7
76131 Karlsruhe
Germany
Phone: +49 (0) 721 / 96 58 590
Fax: +49 (0) 721 / 96 58 589
e-mail: info@profibus.com
http://www.profibus.com