



Protocol API
PROFINET IO-Device
Supplement
V4

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DOC140103API04EN | Revision 4 | English | 2015-12 | Released | Public

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1 Introduction

1.1 About this document

This document describes the differences between the PROFINET IO RT/IRT Device stack V3.5 and the PROFINET IO RT Device stack V4. Thus all definitions made in document Protocol API PROFINET IO-Device V3.5 are valid for PROFINET IO RT Device stack V4 unless otherwise described within this document.

1.2 List of revisions

Rev	Date	Name	Chapter	Revision
1	2014-01-27	AM	all	Created
2	2014-10-30	AM / BM	1.6.2 1.7 2.3	Features / limitations updated. Section added. Adapt Packet API to current implementation.
3	2015-02-03	HH	all 1.7	Moved to version 4. Section Limitations: List reduced (Get Parameter Service is not supported, Flag PNS_IF_SYSTEM_NAME_IP_HANDLING_BY_STACK_ENABLED in Set Configuration Request is not supported, Loadable firmware does not support Flash Device Label removed)
4	2015-12-09	BM AM	1.6 2.3.1	Technical data updated to match version 4.2: IRT supported, no longer support for IO Supervisor, only 32 submodules supported (not 64) Section about Set Configuration Service added.

Table 1: List of revisions

1.3 Functional overview

The PROFINET IO RT Device stack V4 has been written to meet the IEC 61158 Type 10 Specification. The software package implements the following components of this specification:

- PROFINET IO Device Context Management
- PROFINET IO Device Cyclic Data Exchange
- PROFINET IO Device Acyclic Services
- PROFINET IO DCP Protocol

1.4 System requirements

This software package has the following system requirements:

- netX 52 Chip as CPU hardware platform
- Operating System rcX V2.1
- Quad SPI Flash accessible via XIP

1.5 Intended audience

This manual is suitable for software developers with the following background:

- Knowledge of the programming language C
- Knowledge of the IEC 61158 Type 10 specification

1.6 Specifications

The data below applies to the PROFINET IO RT Device stack V4.2.

1.6.1 Supported protocols

Protocol	Description
RTC	Real time Cyclic Protocol: RT_CLASS_1, RT_CLASS_3
RTA	Real time Acyclic Protocol
DCP	Discovery and Configuration Protocol
DCE/RPC	Distributed Computing Environment / Remote Procedure Calls: Connectionless RPC
LLDP	Link Layer Discovery Protocol
PTCP	Precision Transparent Clock Protocol
SNMP	Simple Network Management Protocol

Table 2: Supported protocols

1.6.2 Technical data

Parameter	Value
Maximum number of total cyclic input data	1440 Bytes
Maximum number of total cyclic output data	1440 Bytes
Maximum number submodules	32 configured (plugged) submodules
Multiple Application Relations	The stack can handle up to 4 IO-ARs and one Supervisor-DA AR
Record Objects	Up to 1024 bytes application record data
Alarm Types	Process Alarm and Return Of Submodule Alarm. Implicit Alarms: Plug Alarm, Pull Alarm and Diagnostic Alarms
Diagnosis Entries	The stack supports up to 256 application diagnosis records of type Channel or Extended Channel Diagnosis
Identification & Maintenance	I&M0 Read: Either built in for Slot 0/Subslot 1 or pass through to application for any submodule. I&M1-4 Read/Write: Either built in for Slot 0/Subslot 1 or pass through to application for any submodule. I&M5 Read: Only available when build in handling is used for Slot 0/Subslot 1
Topology	Via LLDP, SNMP V1 and Physical Device Record Objects
Minimum Cycle Time	RT_CLASS_1: 1ms RT_CLASS_3: 250 µs
IRT support	yes, RT_CLASS_3 is supported
Media Redundancy	MRP Client supported
Additional supported features	VLAN Priority Tagging Shared Device Fast Startup
PROFINET IO specification	V2.3, legacy startup of specification V2.2 is supported
Application IP stack API	The lwIP IP stack can be used by the application via Socket API Packets. Up to 8 sockets are available to the Application
Application Raw Ethernet API	Sending and Receiving Raw Ethernet Frames as Application is not supported.

Table 3: PROFINET IO-Device V4 features

The software package is available for the following devices:

Device	Supported
netX 50	No
netX 51	No
netX 52	Yes
netX 100, netX 500	No

Table 4: PROFINET IO Device V4 supported devices

Configuration is done either by packets or by SYCON.net configuration database. The software package does not support swapping the byte order of cyclic process data. Cyclic process is provided in network byte order (big endian) always.

1.7 Limitations

In addition to the limitations mentioned in [1] the following limitations apply:

- Set OEM Parameters Service is not fully supported
- FiberOptic hardware (including POF) is not supported

1.8 References to documents

This document refers to the following documents:

- [1] Hilscher Gesellschaft für Systemautomation mbH: Protocol API, PROFINET IO RT/IRT Device, V3.5, revision 10, english, 2014.
- [2] Hilscher Gesellschaft für Systemautomation mbH: Dual-Port Memory Interface Manual, netX based Products, revision 12, English, 2012.

Table 5: References to documents

1.9 Legal notes

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2 Deviating API and features between V3.5 to V4

2.1 Limitations

If the PROFINET IO RT Device V4 stack is running on the netX 52 chip several limitations apply. Especially to consider are:

Submodules configuration limit: Please see *Technical data* on page 5 for technical details. The limitation only affects the number of configured submodules and not the mapping to slots/subslots. Thus it is for example still possible to configure a module/submodule for slot 1000 subslot 1.

2.2 Structure of the PROFINET IO-Device stack

The drawing below shows the internal structure of the layers which together represent the PROFINET IO Device stack V4.

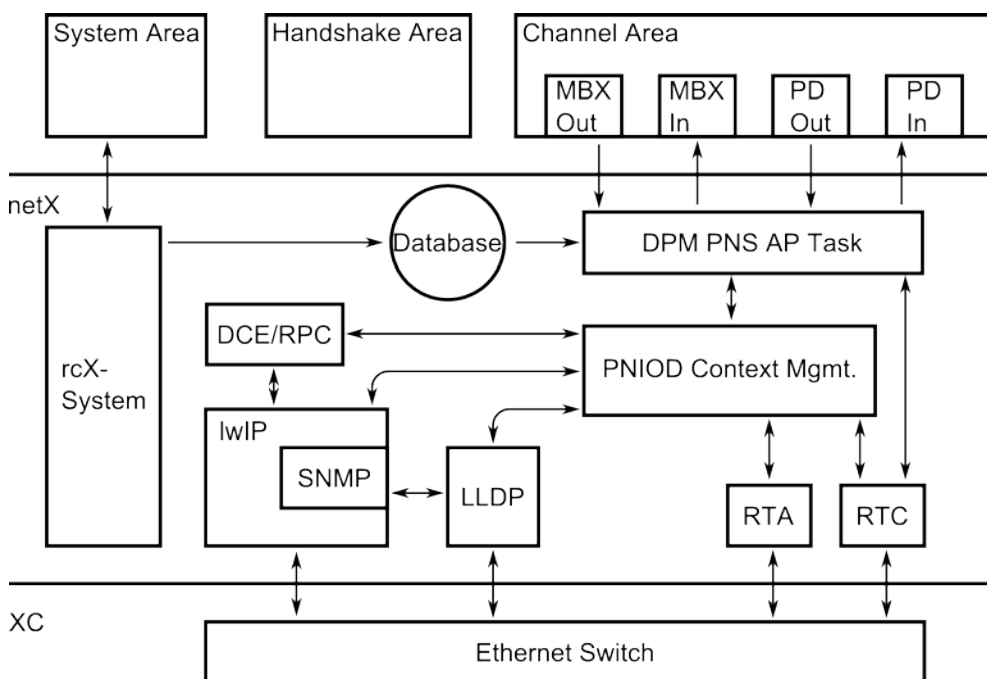


Figure 1: Layer structure of PROFINET IO-Device stack V4

2.3 Packet API

The packet API of the PROFINET IO RT Device stack V4 is identical to the packet API of PROFINET IO RT/IRT Device stack V3.5 except the differences described below. Nevertheless the behavior of the protocol stack was changed for some packets to fulfill resource requirements or to simplify usage. These changes are described in the following.

2.3.1 Configuring the IO-Device stack

Set Configuration Service

The field `ulTotalConfigPckLen` is not evaluated by the firmware. Nevertheless it is strongly recommended to set the value of this field to the total length of the data part of the packet. (including the field itself).

Configure Signal Service

This software package does not support byte order swapping of process data. Therefore this request is not supported. The stack confirms to application with the status "Unknown command".

Set Port Mac Address Service

This service is supported.

2.3.2 Connection establishment

Parameter End Service

Setting application ready for a specific AR is not possible anymore. If the `fSetApplReady` flag is set to True, all pending ARs will be set by the stack to application ready.

Application Ready Service

The device handle argument of set application ready service is ignored. There is no AR-specific application ready service anymore. All pending ARs will be set by the stack to application ready. (Relevant for Shared Device ARs) This does not affect future ARs, which must be set to Application Ready when they are established.

Store Remanent Data Service

If configured the protocol stack will send remanent data to the application instead of storing it within the on-board flash. The service might occur at different places and must always be responded. RPC Parameter End Request, DCP Set Station Name, DCP Set IP Address and DCP Reset to Factory are not responded the requesting device until this service is responded by the application.

2.3.3 Acyclic Events indicated by the stack

Save Station Name Service

The DCP Set Station Name response is sent to the bus after the application responds to the Save Station Name Service. PROFINET IO Specification defines a timeout of 30 seconds. The application must respond within this timeframe.

Save IP Address Service

The DCP Set IP Address response is sent to the bus after the application responds to the Save IP Address Service. PROFINET IO Specification defines a timeout of 30 seconds. The application must respond within this timeframe.

Reset Factory Settings Service

The DCP Set Reset Factory response is sent to the bus after the application responds to the Reset Factory Settings Service. PROFINET IO Specification defines a timeout of 30 seconds. The application must respond within this timeframe.

Alarm Indication Service

This service is used to indicate incoming alarms to the application. The alarm acknowledge will be generated after the application responds to the Alarm Indication.

2.3.4 Acyclic Events requested by the application

Process Alarm Service

The application should not send more than one alarm request at a time to the protocol stack. After the protocol stacks confirms the process alarm then the next Process Alarm Service can be activated.

Please note that the protocol stack has only limited capability of queuing process alarms. If the application sends more than one alarm request at a time, the stack has to buffer the packet. Therefore, the stack uses the DPM Mailbox packet buffers. Each pending Process Alarm Service will occupy one packet buffer, but these buffers are used for other application initiated services as well. Thus it is strongly recommended to implement process alarm queuing at application level.

Diagnosis Alarm Service

This service is not used anymore. The PROFINET IO Specification defines that diagnosis alarms are to be sent when a diagnosis appears and when a diagnosis disappears. The protocol stack will automatically initiate the corresponding alarms if needed. If this packet is sent to the protocol stack it will not result in any action of the protocol stack. It will be responded with status code TLR_S_OK for backwards compatibility.

Plug Submodule/Extended Plug Submodule Service

In contrast to version V3.5 protocol stack, this service will be responded immediately to the application and then communicate with the IO-Controller. Any other requests associated with a Plug Submodule will occur afterwards.

Add Generic Channel Diagnosis Service

Generally, using this kind of diagnosis is strongly discouraged by the PI Diagnosis Guideline. They should be used in justified exceptions to this rule only.

Generic Diagnoses contain application specific amount of user data. Thus the memory must be allocated dynamically at runtime and can not be predicted. In turn the successful creation of a generic diagnosis entry depends on the following runtime properties:

- Available dynamic memory
- Memory Fragmentation due to runtime memory allocation

Therefore there can be no guarantee for the success of this service under all operating conditions. It is strongly recommended to not use this service. Applications requiring this service should be tested carefully regarding this scenario.

Return of Submodule Alarm Service

This service is not required anymore and it will not trigger any action of the stack. Since version V4 handling regarding this functionality will be performed by the stack automatically. The associated request packet will be returned to application with status TLR_S_OK always for backwards compatibility.

Get Xmac Diagnosis Service

This service is available since version V4, but uses a new format. The information is not intended to be used by the application. This packet is for support purposes only and is only used to help debugging Ethernet problems.

2.4 Connection establishment

The sequence of packets when a connection is established is identical to PROFINET IO RT/IRT Device V3.5 with the following behavior changes:

- Only one RPC request is processed by a stack at a time. That means that only one of the following services can be active at a time. The application must respond to the service before another service will be indicated.
 - AR Check Indication, Check Indication Service and Connect Request Done Service: As these requests are all related to RPC Connect, these services always occur as a whole for an AR, e.g. it can never happen that the application receives an AR Check Indication for another AR until the Connect Request Done Service has been responded
 - Read Record Service
 - Write Record Service
 - Parameter End Service
- The RPC Connect Response will be sent after Connect Request Done Service has been responded by application. Thus the application might collect all Check Indications Data and adapt the Module/Submodule Configuration on Connect Request Done Indication. This is different to V3.5 versions where the Connect Request Done Indication is sent after RPC Connect Response.

2.5 Linkable object

Accessing the protocol stack is only possible with access via DPM of loadable firmware.

Linkable Object is currently not support by PROFINET IO RT Device V4. Thus programming the AP Tasks Queue is not supported. Because of the internal stack structure it is not possible to identify an AP-Task Queue called "QUE_PNS_IF". As of now the application can not run on the netX device along with the protocol stack. In turn all sections of the PROFINET IO Device V3.5 Protocol API related to linkable objects usage do not apply to version 4.

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