


# Selection of PROFINET device classes and technology

Shorten your development time for PROFINET devices and precisely meet your customers' requirements. As a committed member of the PROFIBUS & PROFINET International (PI) Organization, Siemens has been actively driving the development of PROFINET right from the start. By choosing us, you benefit from end-to-end PROFINET expertise, advanced consulting skills, and proven technology components to help you develop your devices faster and more efficiently. You can count on our support during the entire development process, from technology consulting to certification.

To optimally develop PROFINET devices, we suggest that you take the following aspects into account:

- Where should the device to be developed be used in the plant?
- Which Conformance Class must be met and what type of communication is needed?
- Which PROFINET features are necessary, e.g. MRP, Shared Device, system redundancy, etc.?
- Which device design is the goal: PC-based or embedded device? In the case of an embedded device, is it a brand-new development to supplement a communication stack for an existing hardware solution or is it communication via a companion chip?

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# Device specification

PROFINET specifies two different device types:

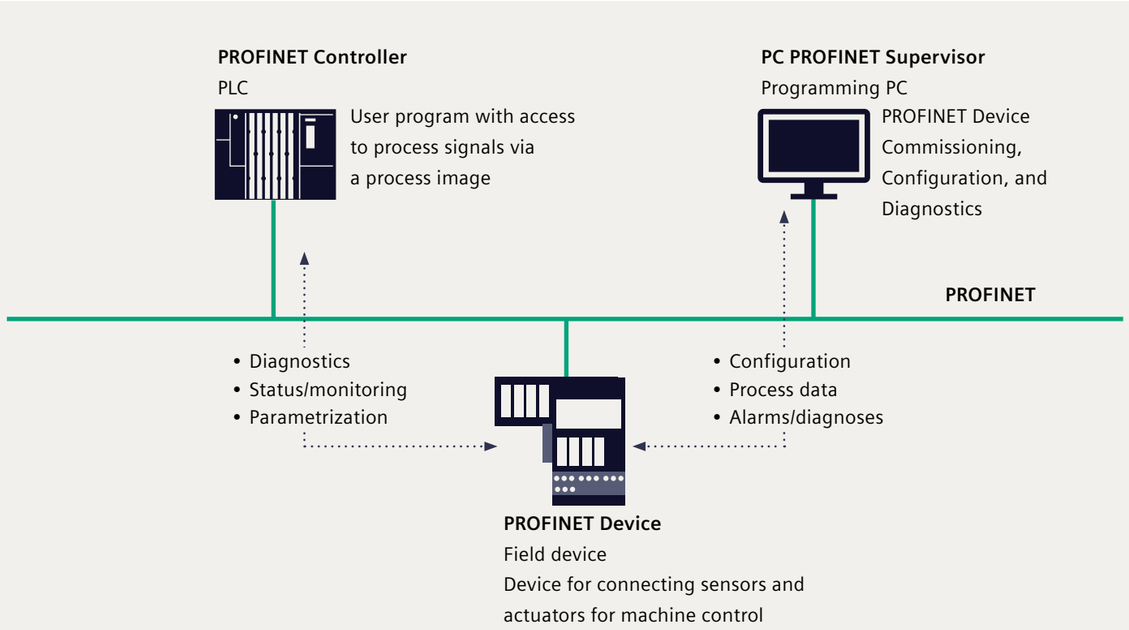
- **PROFINET controller** (usually the machine controller)
- **PROFINET device** (e.g. field device)

The decision as to whether the device should have a controller or device functionality is primarily based on its intended use.

The controller is in charge of control functions and is the active partner when establishing communication. The device, on the other hand, waits until it is addressed or parametrized by a controller.

The exchange of cyclic data is always bidirectional. From the controller's point of view, outputs are written and inputs are read. PROFINET also supports the exchange of large data blocks using data record service.

The definition of whether the device should have a controller or device functionality also affects the development process or the selection of a development kit.




## PROFINET Conformance Classes (CC)

| Ethernet interface: not synchronized | | Ethernet interface: synchronized | |
|---|---|---|---|
| **CC-A**<br>Standard Ethernet according to IEEE 802.3<br><br>Physical transmission:<br>wireless, copper, FO | **CC-B** = CC-A<br>Plus services to read device-related information, e.g. topology<br><br>Physical transmission:<br>copper, FO | **CC-A** = CC-B plus<br>Synchronized Ethernet interfaces and switches<br><br>Physical transmission:<br>copper, FO | **CC-D**<br>• TSN (Standard Ethernet of 2020 with IEC/IEEE 60802)<br>• RSI<br><br>Physical transmission:<br>wireless, copper, FO |
| 10/100/1,000 MBit | 10/100/1,000 MBit | 100 MBit | 10/100/1,000/.../10,000 MBit |

# Choice of technology

The PROFINET standard defines what are called Conformance Classes. The Conformance Class is independent of the decision as to whether a controller or device is developed. Functionality and performance are standardized. The most suitable type of PROFINET implementation must be selected for each area of application, depending on the functionality required.

Selecting the Conformance Class to be implemented depends on the application (e.g. coordinated axis control or measuring technology), but the Class may also be determined by the end customer's requirements.

The hardware to be used depends on the Conformance Class (CC) that must be met. PROFINET over RT (CC-A and CC-B) can be implemented using standard Ethernet hardware. PROFINET over IRT (CC-C) and PROFINET over TSN (CC-D) require specific hardware support.

Naturally, an IRT device that meets CC-C can also communicate over RT (= CC-B). The same also applies to a TSN device if the development kit supports both Conformance Classes.

**PROFINET over RT – Conformance Classes A (CC-A) and B (CC-B)**
Conformance Class A coves basic functions for PROFINET over RT (real-time communication). All IT services can be used without restriction. Conformance Class B expands PROFINET to include network diagnostics and topology information. PROFINET over RT can be implemented cost-effectively on standard Ethernet hardware. There are no special hardware requirements. Of course, industrial suitability should also be taken into account.

**PROFINET over IRT – Conformance Class C (CC-C)**
Conformance Class C defines functions for synchronization and bandwidth reservation. Hardware support is required – for example, using ASICs. Synchronized communication is also known as isochronous real-time (IRT) and is a precondition for isochronous applications.

Whether a field device must support IRT is a question for your own customers and their requirements – or the industry for which the field device is intended. For example, if the field device is used in the vicinity of high-performance machines (e.g. for rotary encoders, shift angular position, coordinated motion control, measuring technology), it must support isochronous communication and isochronous mode.

**PROFINET over TSN – Conformance Class D (CC-D)**
Conformance Class D* offers users the same services as CC-C except that these services are provided with the new mechanisms of Time-Sensitive Networking (TSN) defined by IEEE. This makes it possible to achieve transmission speeds from 10 Mbit to 10 Gbit as well as wireless communikation (5G).

TSN must be supported by suitable hardware, such as the Ethernet controller, and firmware. PROFINET over TSN is available as of Version V2.44 and, in addition to the familiar features from IRT like isochronous mode for motion control, it also offers new features like Plug&Produce, isochronous mode without typology planning, and wider bandwidths (Gbit).

*Siemens currently offers the right basic PROFINET technology for Conformance Classes CC-A to CC-C.

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