Which PROFINET devices support media redundancy and which system redundancy?

SIMATIC / SIMOTION / SINAMICS

https://support.industry.siemens.com/cs/ww/en/view/67364686

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The functions and solutions described in this article confine themselves to the realization of the automation task predominantly. Please take into account furthermore that corresponding protective measures have to be taken up in the context of Industrial Security when connecting your equipment to other parts of the plant, the enterprise network or the Internet. Further information can be found under the Content-ID 50203404.

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1 Difference between media redundancy and system redundancy

1.1 Media redundancy

To prevent interruptions in an automation machine caused by a defect of a cable or a device, the functionalities

- MRP (Media Redundancy Protocol) for PROFINET RT and
- MRPD (Media Redundancy for Planned Duplication) for PROFINET IRT (high performance) are available.

It is possible to build up redundant networks via both protocols. The PROFINET devices, which are part of this redundant network, form a so called MRP domain.

MRP / MRPD is generally designed as a ring topology and therefore permits the connection of devices via two ways of communication. The changeover to the second way of communication is done automatically and with bumps / bumpless, if one way of communication is interrupted (e.g. cable break).

1.1.1 … with PROFINET RT (MRP)

With MRP the changeover in the ring is done by the so called media redundancy manager (MRM). All other devices of the MRP domain are called media redundancy clients (MRC).

The changeover times are depending on

- the concrete topology,
- the used devices and
- the network load in the considered network.

The typical changeover time (reconfiguration time) for PROFINET RT and standard Ethernet communication (e.g. TCP/IP) is round about 200 msec.

NOTE The RT communication will be interrupted (station failure), if the reconfiguration time of the ring is bigger than the chosen response monitoring time of the IO-devices. If necessary choose a sufficient big response monitoring time.

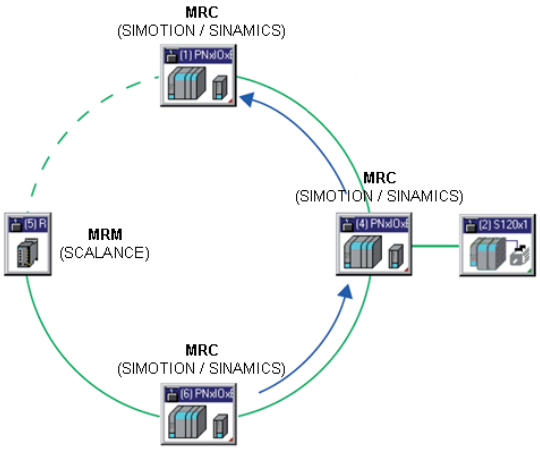
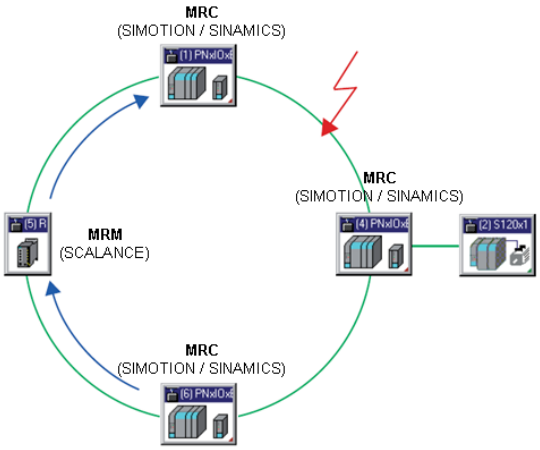
In case of failure the PROFINET connection will be automatically reassembled by the redundancy manager via the second way of communication. Therefore **one** failure in the network can be handled while the machine is continuing **with bumps**. Here you have to consider that fixing the error can lead to a PROFINET station failure, because there will be a changeover again.

Requirements

- “MRP” must be activated for all devices in the ring.
- All devices must be connected together via their ring ports (typically port 1 and 2).
- The ring may exist of maximum 50 devices.
- All devices in the ring belong to the same redundancy domain.
- At least one device in the ring is the media redundancy manager.
- All other devices in the ring are media redundancy clients.

NOTE Devices, that are not capable of MRP can be connected to the ring for example via a SCALANCE X switch or a PC with CP1616.

Table 1-1

MRP without failure in the ring	MRP with failure in the ring (e.g. cable break)
	
• The RT and NRT telegram will only be send via one way of communication. • The second way of communication will be blocked by the MRM (dashed line).	• The second way of communication will be opened by the MRM. • Reconfiguration time of the SAT (Source Address Table) is < 200 msec.

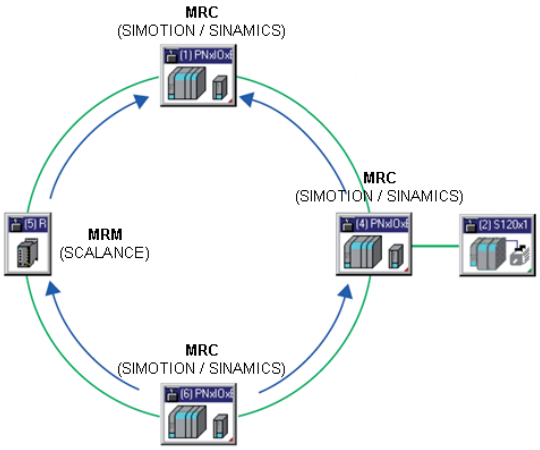
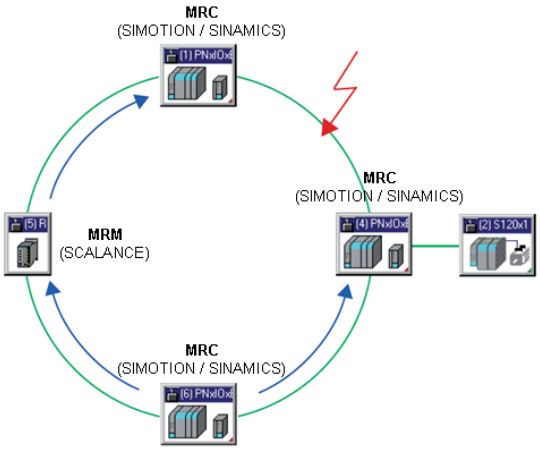
1.1.2 … with PROFINET IRT (MRPD)

MRPD (Media Redundancy for Planned Duplication) is a method for the bumpless changeover of the IRT telegrams (high performance). The bumpless changeover is ensured, as the cyclic IRT data is send via both ways of communication in the ring, i.e. the receiver gets two times the same IRT telegram, if there is no failure in the network. The first received IRT telegram will be used; the second one will be dropped.

Requirements

- see MRP
- IRT (high performance) must be activated for all participating devices.
- All participating devices must support MRPD, also devices in a pass, which exchange cyclic IRT data with a ring component.
- STEP7 as from V5.5 SP1
- SCALANCE X-200IRT as from firmware V5.0

Table 1-2

MRPD without failure in the ring	MRPD with failure in the ring (e.g. cable break)
	
• The IRT telegram will be send via both ways of communication. • The reservation of the bandwidth for the IRT communication will be calculated using the longer way of communication.	• No reconfiguration time • Bumpless media redundancy

NOTE A detailed description of the MRPD configuration you will find in the entry “SIMOTION & SINAMICS: Bumpless Media Redundancy with PROFINET IRT (MRPD)”:

http://support.automation.siemens.com/WW/view/en/60441190

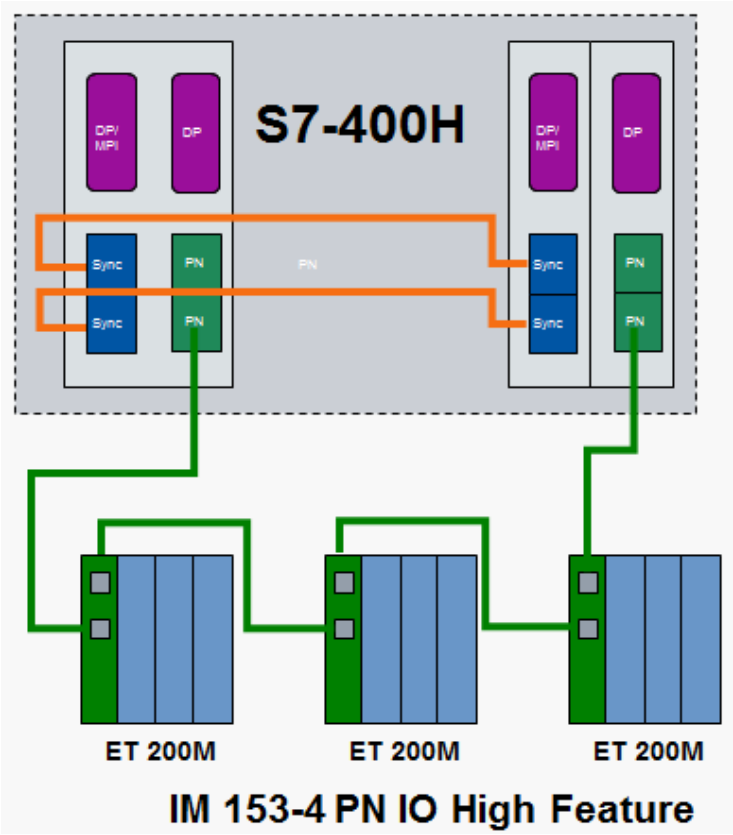
1.2 System redundancy

If further failure cases in a machine shall be covered and / or shorter changeover times are requested, the so called “system redundancy” can be used.

The basis for the buildup of the system redundancy is formed by two controller systems. Between both CPUs, I/O-stations and other redundant components are arranged in one line.

A logical ring topology is established via sync-modules, which are located beside every CPU. This solution requires a so called “H-system” (S7-400H) on the CPU side. On the communication side, however, standard components can still be used. Therefore this solution is a bit more complex than media redundancy; in this way, however, further applications with higher availability requirements can be covered. Beside the pure interruption of the communication way respectively the breakdown of a single I/O-station even the breakdown of **one** CPU doesn’t lead to a standstill of the machine when system redundancy is used. If one CPU should completely fail, the duties are assumed automatically and nearly bumpless by the other one. Therefore the continuous operation of the machine is ensured. With this solution changeover times of about 30 msec can be reached.
After repairing or changing the CPU both systems are synchronizing independently, i.e. for the user there is no further intervention or even programming necessary.

Figure 1-1: System redundancy with a S7-400H



Requirements to the system redundancy

- Automatically changeover in case of interruption (high availability)
- Process-controlled synchronization of both stations (CPUs) for a fast and bumpless changeover
- Processing at the location of interruption without loss of information and alarms by the redundant CPU
- Change of components during running operation (Hot Swapping)
- Automatic reloading of programs and data after change of the CPU

Requirements

- All participating components support the PROFINET functionality system redundancy.
- The I/O-systems of the H-system must be located in the same network.

NOTE **H-systems and separated subnets**

I/O-devices are only be integrated in a redundant way, if both PROFINET I/O-systems of the H-system are located in the same subnet. Alternatively every CPU can be networked with another subnet, too. In this case the I/O-devices are always tied onesided.

2 Which devices support media redundancy?

Table 2-1

Device		Media redundancy	
		MRP	MRPD
SIMOTION	D4x5-2 DP/PN (+ CBE30-2)	as from V4.3	as from V4.3
	D410-2 DP/PN	---	---
	C240 PN	as from V4.3	as from V4.3
	P320-3	as from V4.3	as from V4.3
	P350-3 + MCI-PN	---	---
SINAMICS S120	CU310-2 PN	as from V4.5	as from V4.5
	CU320-2 DP + CBE20	as from V4.5	as from V4.5
	CU320-2 PN	as from V4.5	as from V4.5
	CU320-2 PN + CBE20	as from V4.5	as from V4.5
SINAMICS G120	CU240E-2 PN (+ F)	as from V4.5	as from V4.5
	CU230P-2 PN	as from V4.5	as from V4.5
	CU250S-2 PN	as from V4.5	as from V4.5
	CU240D-2 PN (+ F)	as from V4.5	as from V4.5
	CU250D-2 PN-F	as from V4.5	as from V4.5
	G120C	as from V4.5	as from V4.5
SCALANCE	X-200	as from V4.0	---
	X-200 IRT	as from V4.0	as from V5.0
	X-300	as from V3.0	---
	X-400	as from V3.0	---
TMC (Terminal Module Compact)	1x80 PN	as from V1.1	as from V1.1
	2x40 PN	as from V1.1	as from V1.1

NOTE You will find an overview over all devices that support MRP using following link:

http://support.automation.siemens.com/WW/view/en/44383954

NOTE Mixing of devices, which are capable of MRP and MRPD, is not allowed in one ring! I.e. in one MRPD ring all devices must support the functionality MRPD.

3 Which devices support system redundancy?

Table 3-1

Device		Note
SIMATIC S7-400H		as from V6.0
SIMATIC ET200 M	IM153-4 PN High Feature	as from V4.0
SINAMICS S120, G130, G150 und S150	PROFINET Control Units	ab V4.8 HF 2

NOTE Further information regarding system redundancy you will find in following entry:

http://support.automation.siemens.com/WW/view/en/60179783

NOTE The application example describe the PROFINET-system redundancy with the SINAMICS drives:

https://support.industry.siemens.com/cs/ww/en/view/109744811

4 Related literature

4.1 Internet link specifications

This list does not claim to be complete and only provides a selection of suitable information.

Table 4-1

	Topic	Title
\1\	Reference to the entry	http://support.automation.siemens.com/WW/view/en/67364686
\2\	Siemens Industry Online Support	http://support.automation.siemens.com
\3\	SIMATIC Manual	SIMATIC PROFINET system description http://support.automation.siemens.com/WW/view/en/19292127
\4\	SIMATIC NET Manual	SIMATIC NET Industrial Ethernet Switches SCALANCE X-200 configuration manual http://support.automation.siemens.com/WW/view/en/63203259