Velkommen til Siemens Webinar: SIMATIC S7-1500 Redundant Systems

- Velkommen vi begynner ca : 10.05

- Vi tar opptak av presentasjonen (kun selve presentasjonen). Blir delt senere

- Full-skjerm:

- Vi tar gjerne spørsmål i chatten og vi går gjennom disse til slutt.
SIMATIC S7-1500
Redundant System
SIMATIC S7-1500 Redundant Systems

- Motivation and Product Strategy
- System Overview
- Network Configuration
- Failure Scenarios
- Communication
- Installation Recommendations
- New Features with TIA Portal V16
- Remaining Restrictions
- Demo from TIA Portal
**Simatic S7-1500 Redundant Systems**

**Motivation**

**Preventing plant downtime**
High availability during operation, Avoidance of loss of production

**Prevention of damages**
Avoidance of unplanned production stops where the product to be processed would be permanently damaged

**Save on maintenance**
Application solutions are mostly complicated and difficult to maintain

**Prevention of data losses**
The data remain intact and long restart times after a failure are eliminated.

**Operation without persons locally**
Maintenance trips can be better planned

**Redundant systems reduce costs**
SIMATIC S7-1500 Redundant Systems
Product Strategy S7-1500R/H

Based on Standard S7-1500 CPUs and PROFINET
• Basis Hardware Standard-CPUs/Fail-safe CPUs

Transparent Programming
• Standard Engineering Tool TIA Portal
  • Redundancy functions fully integrated in TIA Portal
  • General handling like standard
  • No deep Redundancy Know-How needed

Extensive Scalability
• Scalability of switch-over time
• Scalability of the Redundancy Architecture
• Scalability of the CPU Performance (1513 → 1517)

Step by Step Product Launch Strategy
• Step by Step increasing of feature set in future versions
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SIMATIC S7-1500 Redundant Systems
System overview

Consistent concept – **Identical** synchronization process

**Scaling** of the switching performance over the **available bandwidth** of the sync connection

<table>
<thead>
<tr>
<th>CPU type</th>
<th>Synchronization</th>
<th>Switchover time</th>
<th>I/O systems</th>
<th>Type of connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU 1513R / CPU 1515R</td>
<td>via PROFINET Ring (MRP)</td>
<td>300 ms</td>
<td>ET 200SP and ET 200MP</td>
<td>Single connection (PN redundancy S2) and switched S1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU 1517H</td>
<td>via Sync-Module</td>
<td>50 ms</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SIMATIC S7-1500 Redundant Systems
### PLC Hardware

<table>
<thead>
<tr>
<th>Program / memory</th>
<th>CPU 1513R-1 PN 6ES7513-1RL00-0AB0</th>
<th>CPU 1515R-2 PN 6ES7515-2RM00-0AB0</th>
<th>CPU 1517H-3 PN 6ES7517-3HP00-0AB0</th>
<th>Short Distance &lt;= 10m</th>
<th>Long Distance &lt;= 10km</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 kB code</td>
<td>500 kB code</td>
<td>2 MB code</td>
<td>2 MB code</td>
<td>Fiber Optic Cable</td>
<td>Fiber Optic Cable</td>
</tr>
<tr>
<td>1.5 MB data</td>
<td>3 MB data</td>
<td>8 MB data</td>
<td></td>
<td>Plastic</td>
<td>Glass fiber</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sync module SFP</td>
<td>SFP</td>
</tr>
</tbody>
</table>
### Interfaces

<table>
<thead>
<tr>
<th>Interfaces</th>
<th>X1</th>
<th>X2</th>
<th>X1</th>
<th>X2</th>
<th>X1</th>
<th>X3</th>
<th>X4</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X2: PROFINET IO Controller, Supports RT, MRP, Transport Protocol TCP/IP, Open User Communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Firmware

<table>
<thead>
<tr>
<th>Firmware</th>
<th>V2.8</th>
<th>V2.8</th>
<th>V2.8</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Short Distance &lt;= 10m</th>
<th>Fiber Optic Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sync module SFP</td>
<td>SFP = Small Form-factor Pluggable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Long Distance &lt;= 10km</th>
<th>Plastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass fiber</td>
<td>SFP</td>
</tr>
</tbody>
</table>

X1: PROFINET IO Controller, Supports RT, MRP, Transport Protocol TCP/IP, Open User Communication
X2: PROFINET Basic Services, Transport Protocol TCP/IP, Open User Communication
SIMATIC S7-1500 Redundant Systems

Highlights

- Same Engineering like a single CPU
- Multi-Task program structure possible
- Automatic data exchange (all data)
- Automatic program update
  Primary -> Back-Up (Consistency)
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Network Configuration with S7-1500R/H

Requirements for the PROFINET network configuration

- MRP Ring (default setting in the configuration)
- PN IO only at X1 interface
- PLC’s need to be part of the ring
- S7-1500R → no devices in the connection between the two PLC’s
- PN Devices need to support PN System redundancy NAP S2 (V1.11)

Redundant – S7-1500R

High Available – S7-1500H

Max. 16 devices in ring

Max. 50 devices in ring

*) Recommendation
# PROFINET System Redundancy

## Siemens PN IO-Devices with PN S2 Support

## I/O-Systems

<table>
<thead>
<tr>
<th>Device Description</th>
<th>PN Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 200SP - IM155-6PN HF (FW&gt;=4.2)</td>
<td>6ES7155-6AU01-0CN0</td>
</tr>
<tr>
<td></td>
<td>6ES7155-6AU30-0CN0</td>
</tr>
<tr>
<td>ET 200MP - IM155-5PN HF (FW&gt;=4.2)</td>
<td>6ES7155-5AA00-0AC0</td>
</tr>
<tr>
<td>PN/PN-Koppler</td>
<td>6ES7158-3AD10-0XA0</td>
</tr>
<tr>
<td>ET 200eco PN M12-L(^1)</td>
<td>6ES7 14*-6**00-0BB0</td>
</tr>
</tbody>
</table>

\(^1\) In Vorbereitung
# PROFINET System Redundancy

Siemens PN IO-Devices with PN S2 Support

## Drives

<table>
<thead>
<tr>
<th>Device</th>
<th>SKU</th>
</tr>
</thead>
<tbody>
<tr>
<td>S120, CU310-2PN (FW &gt;=5.2)</td>
<td>6SL3040-1LA01-0AA0</td>
</tr>
<tr>
<td>(with gsdml)</td>
<td></td>
</tr>
<tr>
<td>S120, CU320-2PN (FW&gt;=5.2)</td>
<td>6SL3040-1MA01-0AA0</td>
</tr>
<tr>
<td>(with gsdml)</td>
<td></td>
</tr>
</tbody>
</table>

## Switches

<table>
<thead>
<tr>
<th>Device</th>
<th>SKU</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCALANCE XC-200 Serie</td>
<td>6GK5 2...-00 - 2.C2</td>
</tr>
<tr>
<td>SCALANCE XP-200 Serie</td>
<td>6GK5 2...-0.A00-...S6</td>
</tr>
<tr>
<td>SCALANCE XF204-2BA</td>
<td>6GK5 204-2AA00-2GF2</td>
</tr>
</tbody>
</table>
Network Configuration with S7-1500R

Length of the synchronization connection

- **Direct link up to 100 m**
- **Fiber optic link (media converter) up to 3 km**

CPU 1513R
CPU 1515R
Network Configuration with S7-1500H
Length of the synchronization connection

CPU 1517H

Short distance Sync modules up to 10 Meter (LED)

Long distance Sync modules up to 10 km

The sync cables are redundant. The loss of one fiber optic cable has no impact on the runtime behavior.
Network Configuration with S7-1500R/H
Connection of PROFINET Devices

S2 and S1 Devices can be connected

S2 Mode
➔ Bump less Switchover

Primary

Backup

H-Sync

Switched S1 Mode\(^1\)
(New in V16)
➔ Not bump less

Connection of S1 Devices via PN/PN Coupler
with subordinated controller.
➔ Bump less Switchover

Subordinated PLC

1) For S7-1500R, S1 devices should be connected via a switch to the MRP ring
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Possible Fault scenarios and Fault reaction

1. Primary CPU fails ➔ Backup CPU takes over control ✓
2. Connection Fault ➔ Connection still available via 2. Interface (MRP) ✓
3. Failure of Station (IM) ➔ Other devices not affected (MRP) ✓
**SIMATIC S7-1500 Redundant Systems**

**Communication**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>• One virtual IP Address always assigned to the primary CPU.</td>
<td>• Transparent communication between standard and H-systems</td>
</tr>
<tr>
<td></td>
<td>• No special add-on needed in the standard components</td>
</tr>
<tr>
<td></td>
<td>• Standard devices automatically communicate with primary</td>
</tr>
</tbody>
</table>

Diagram showing two CPUs with IP addresses 192.178.37.18 and 192.178.37.19, connected to standard components.
SIMATIC S7-1500 Redundant Systems
Communication

**Feature**
- One virtual IP Address always assigned to the primary CPU.

**Benefit**
- Transparent communication between standard and H-systems
- No special add-on needed in the standard components
- Standard devices automatically communicate with primary

192.178.37.18  192.178.37.19  192.178.37.20
Feature
• One virtual IP Address always assigned to the primary CPU.

Benefit
• Transparent communication between standard and H-systems
• No special add-on needed in the standard components
• Standard devices automatically communicate with primary
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Installation Recommendations for CPU 1513R-1 PN

- OK PN/PN Coupler
- OK Up to 14 Devices in MRP Ring
- Possible, but not recommended Communication to additional PLC via Open User Communication via X1
  Reason: Generates high load internally and on Sync-Line\(^1\) and increases PLC cycle time

1) Sync-Line runs with 100MBit/s on R-System
Installation Recommendations for CPU 1515R-2 PN

Conditionally recommended
Communication to additional PLC via Open User Communication via X2
Reason: Generates high load on Sync-Line\(^1\) and increases PLC cycle time

OK
PN/PN Coupler

OK
HMI Connection via X2

Basic/Comfort Panel

OK
Standard PLC

100MBit/s

Possible, but not recommended
Communication to additional PLC via Open User Communication via X1
Reason: Generates high load internally and on Sync-Line\(^1\) and increases PLC cycle time

1) Sync-Line runs with 100MBit/s on R-System
Installation Recommendations for CPU 1517H-3 PN

OK Communication to additional PLC via Open User Communication via X2

OK PN/PN Coupler

OK Up to 48 Devices in MRP Ring

WinCC

Basic/Comfort Panel

Industrial Ethernet

1 GBit/s

OK HMI Connection via X2

Subordinated PLCs

OK Communication to additional PLC via Open User Communication via X1
SIMATIC S7-1500 Redundant Systems

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### New Features and improvements

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection of standard (non redundant) PN devices: Switched S1</td>
</tr>
<tr>
<td>Program Download in Run-Redundant Mode</td>
</tr>
<tr>
<td>IP Forwarding</td>
</tr>
<tr>
<td>Significantly reduced communication breakdown time during Sync-Up</td>
</tr>
</tbody>
</table>

### Reduction of functional gaps compared with S7-1500

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support of Alarm SFC’s and Diagnosis SFC’s</td>
</tr>
<tr>
<td>Support of ProDiag and S7-Graph</td>
</tr>
<tr>
<td>Support of PNIO SFB’s</td>
</tr>
<tr>
<td>Support of Loop Control Blocks (PID)</td>
</tr>
<tr>
<td>S7-Routing</td>
</tr>
</tbody>
</table>
V16 – S1-Devices
S1-Devices can be connected directly to the PN-IO ring

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>Before Switchover</th>
<th>Switchover</th>
<th>After Switchover</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 200SP DQ S2-Device</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ET 200pro DQ S1-Device</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ET 200pro DQ HF S1-Device (with Feature: Keep last Value)</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
New in V16: Mode „Switched S1 Device“
Visualization of redundancy modes in TIA Portal

In the network view S1 and S2 devices are marked as „Multi-assigned“

Differences are shown in the column „Mode“ of the I/O communication table. Here: ET 200MP is connected as S2 device
New in V16: Support of additional blocks

<table>
<thead>
<tr>
<th>Program Block</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program_Alarm</td>
<td>Generate program alarm with associated values</td>
</tr>
<tr>
<td>Get_AlarmState</td>
<td>Output alarm state</td>
</tr>
<tr>
<td>Gen_UsrMsg</td>
<td>Generate user diagnostic messages</td>
</tr>
<tr>
<td>Get_Alarm</td>
<td>Read pending alarm</td>
</tr>
<tr>
<td>Ack_Alarms</td>
<td>Acknowledge alarms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PID_Compact</td>
<td>Universal PID controller with integrated optimization</td>
</tr>
<tr>
<td>PID_3Step</td>
<td>PID controller with integrated optimization for valves</td>
</tr>
<tr>
<td>PID_Temp</td>
<td>PID controller for temperature</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advances Instructions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GETIO / GETIO_PART</td>
<td>Read process image</td>
</tr>
<tr>
<td>SETIO / SETIO_PART</td>
<td>Transfer process image</td>
</tr>
<tr>
<td>GetStationInfo</td>
<td>Read information of an IO device</td>
</tr>
<tr>
<td>DeviceStates</td>
<td>Read module state information in an IO system</td>
</tr>
<tr>
<td>GEN_DIAG</td>
<td>Generate diagnostics information</td>
</tr>
</tbody>
</table>
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## Restrictions for S7-1500R/H

### Restrictions of the configuration for S7-1500R/H

<table>
<thead>
<tr>
<th>Feature</th>
<th>S7-1500R/H</th>
<th>S7-1500</th>
<th>S7-400H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single PLC projectable (H/R CPUs as redundant System only)</td>
<td>no</td>
<td>N/A</td>
<td>yes</td>
</tr>
<tr>
<td>Central periphery or central CPs / CMs projectable</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Configure System-PS</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Only MRP-Ring PN-Networks are supported</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Operation as Shared Device or I-Device</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>
## Functional restrictions for S7-1500R/H

<table>
<thead>
<tr>
<th>Feature</th>
<th>S7-1500R/H</th>
<th>S7-1500</th>
<th>S7-400H</th>
</tr>
</thead>
<tbody>
<tr>
<td>S7-Com, E-Mail, FDL, ISO, (OUC with dynamic connections is supported)</td>
<td>no¹⁾</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>OPC UA</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>System-supported H-communication (but the System IP-Address)</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Webserver</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>System-supported redundant I/Os</td>
<td>no²⁾</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>PROFIsafe</td>
<td>no</td>
<td>F-CPU</td>
<td>yes</td>
</tr>
<tr>
<td>Technology Objects</td>
<td>some³⁾</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Support for MRPD, clock synchrony and IRT</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>CiR and firmware update in run is supported</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Direct migration through hardware replacement (Import of user programs via Copy/Paste)</td>
<td>no</td>
<td>n.a.</td>
<td>no</td>
</tr>
<tr>
<td>PLCsim and PLCsim advanced are supported</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

¹⁾ S7-Communikation as server is supported
²⁾ Can be realized on application layer: See SIOS article [109767576](#)
³⁾ TO Count, Measuring, PID are supported
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Takk for oppmerksomheten

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