SIEMENS
Ingenuity for life

Sitras SCS, -RCI, -FFP, -TTU

Station control system for traction power supply
Remote control interface
Frame fault protection
Transfer trip unit

siemens.com/rail-electrification

The Sitras® SCS station control system performs all the control functions as well as protection and communication tasks in the AC and DC traction power supply.

Thus it provides the operating staff with a quick and reliable overview of the operating state of the system.

Features

- Programmable controllers and protection devices from the SIMATIC®, Siprotec® and Sitras families of products used the world over
- Standardized communication interfaces
- Detailed fault messages that facilitate restoration of functions of the substation in a very short time in the event of a fault
- Modular design, peripheral structure and scalable computer performance that simplify adaptation to system requirements
- Easy integration of customized functions

Overview

Philosophy

Sitras SCS enables operator control and visualization of the switchgear and protection relays from different locations. These different levels of operator control are implemented independently of each other and are noninteracting.

This is achieved by the use of matching components and thus ensures a high level of availability. Optional a redundant design can be realized.

Basic components

Sitras SCS employs programmable controllers from the SIMATIC S7, SIMATIC NET and SIMATIC HMI families of products. They have a modular design and feature an individually configurable, comprehensive range of modules. Their simple structure makes them flexible and very easy to maintain.

This hardware in combination with a modular component library enables an easy adaption to the project requirements.

Sitras SCS focuses on the combined protection and control unit Sitras PRO and the Siprotec protection devices – the standard for numerical protection technology and established in all areas of use. The proven standard solution is parameterized in advance.

Communication

• Station

Communication in the station is performed by means of a station communication system. Due to the realization in form of a fiber-optic cable ring, a high level of availability is ensured and EMC interference is prevented.

Sitras SCS uses preferred the protocols PROFINET, PROFIBUS and IEC 61850 and has also been prepared for future extensions.

• Remote link-up to central control room

Thanks to the modular design, all the standard media such as WAN, ISDN or modem can be used for remote link-up to the central control room with different protocols.

Sitras SCS can handle the PROFINET, PROFIBUS, Sinaut ST7 and IEC 60870-5-101/104 protocols and has also been prepared for future extensions.

With the program library Sitras SCS-RCI (remote control interface) according to IEC 60870-5-104 it is possible to realize a remote link-up without additional hardware.

Additional protocols can be implemented on request.

Functions

Station control system
• Remote link-up to central control room
• Open-loop and closed-loop control of the transformer tap changer
• Coordination of automated switching operations and interlocks (e.g. automatic testing and reclosing) throughout substations
• Monitoring of auxiliary power requirement distribution
• Central time management
• Operator control and visualization of the current status of switching devices, transformers, rectifiers and connections
• Display and archiving of fault and status events
• Transfer tripping of the circuit-breaker in the adjacent substation (optional)
• Parameterization and diagnosis of fault records of the numerical protection units (optional)
• Remote diagnosis (optional)

Decentralized bay control system
• Control and monitoring of the electrical equipment (operator control and visualization)
• Protection functions
• Automatic testing and reclosing
• Interlocks referring to bays
• Measured-value acquisition
• Transfer trip signals from and to adjacent substations

Hierarchy of operator control levels

Central control room (remote control) — e. g. Sitras RSC

Station control system (station control) — Sitras SCS

Decentralized bay control system (local control) — Sitras PRO Siprotec 4/5

Operator control levels

## Central control room
(remote control)

Normally, all substations, sectioning points, autotransformer stations, etc. are controlled and monitored from a central control room.

Due to the open and standardized interfaces, Sitras SCS may be connected to all established SCADA systems.

The SCADA system Sitras RSC is used preferentially and runs on powerful standard personal computers.

Central control room
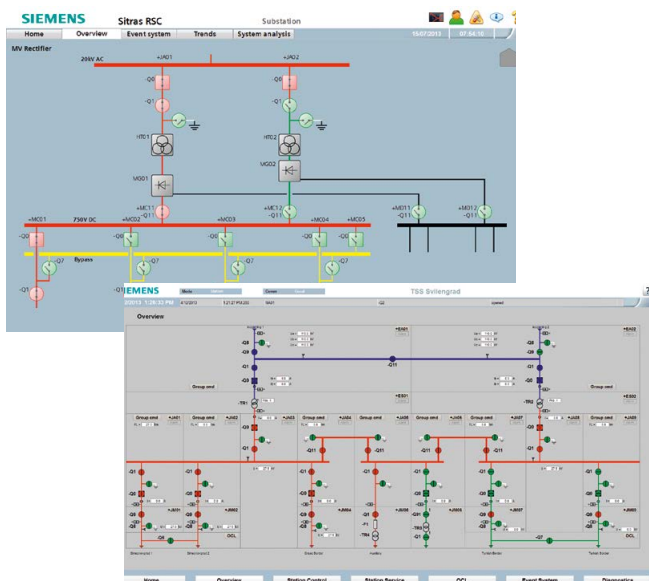
General diagram of Sitras SCS station control

Station control system
(station control)

The current status of all switches and protection devices can be observed in any operating mode on the operator panel or operator PC. Motor-operated switches can also be switched on and off from here.

According to the requirements, e. g. the SIMATIC S7 controller automation systems with a touch panel PC are used.

When using a PC-system, further features can be used, e.g. displaying operating instructions with a PDF-viewer and displaying websites of the field devices with an integrated browser.

Decentralized bay control system
(local control)

Local operator control makes it possible to open and close the switches directly at the panel. The decentralized bay control system detects all switching events independently of the operating mode, shows the current states of switches, etc. and reports these states to the overall station control system.

The combined protection and control unit Sitras PRO and devices from the Siprotec product family are used at this level.
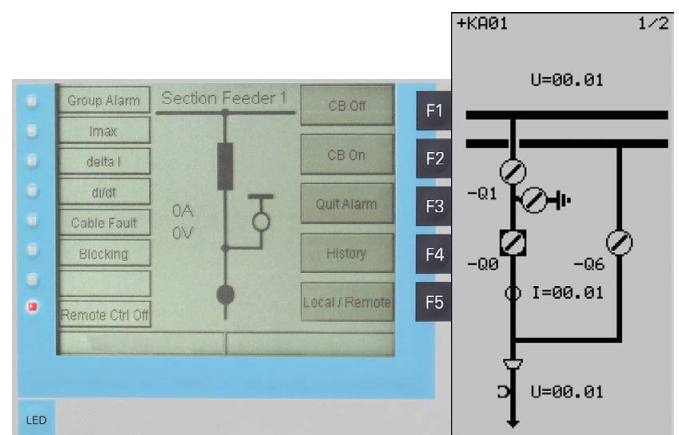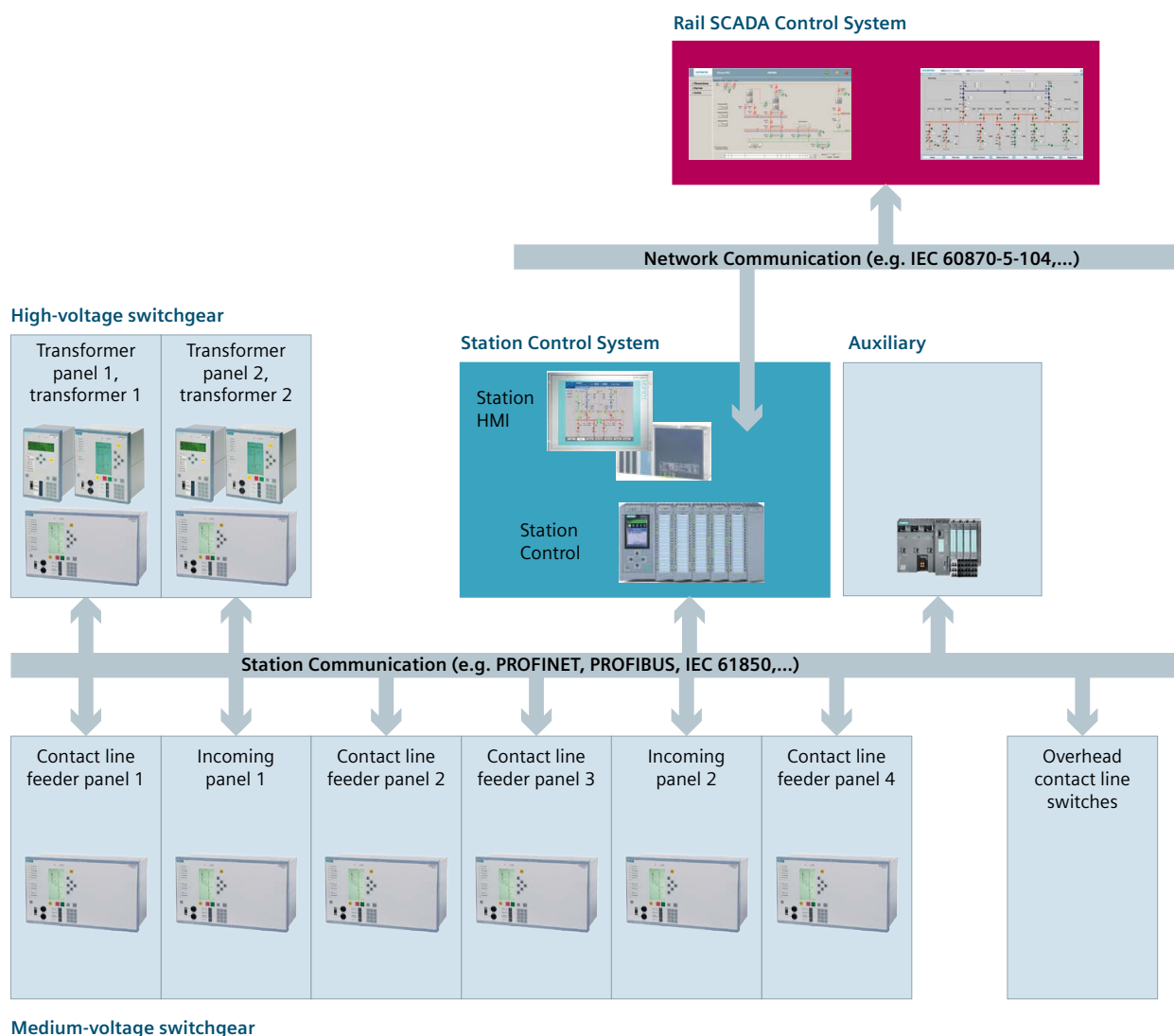

Display image of combined protection and control unit

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System topology

Sitras SCS-AC – Station control system for AC traction power supply

The figure shows an example of a layout with communication between the different operator control levels. The decentralized bay control units are linked up to the station communication system. The central control functions of the entire substation are implemented in the station control system, which enables operator control and visualization via the HMI (human machine interface) and data transfer from and to the central control room.

Rail SCADA Control System

Network Communication (e.g. IEC 60870-5-104,...)

High-voltage switchgear

| Transformer panel 1, transformer 1 | Transformer panel 2, transformer 2 |

Station Control System

Station HMI

Station Control

Auxiliary

Station Communication (e.g. PROFINET, PROFIBUS, IEC 61850,...)

| Contact line feeder panel 1 | Incoming panel 1 | Contact line feeder panel 2 | Contact line feeder panel 3 | Incoming panel 2 | Contact line feeder panel 4 | Overhead contact line switches |

Medium-voltage switchgear
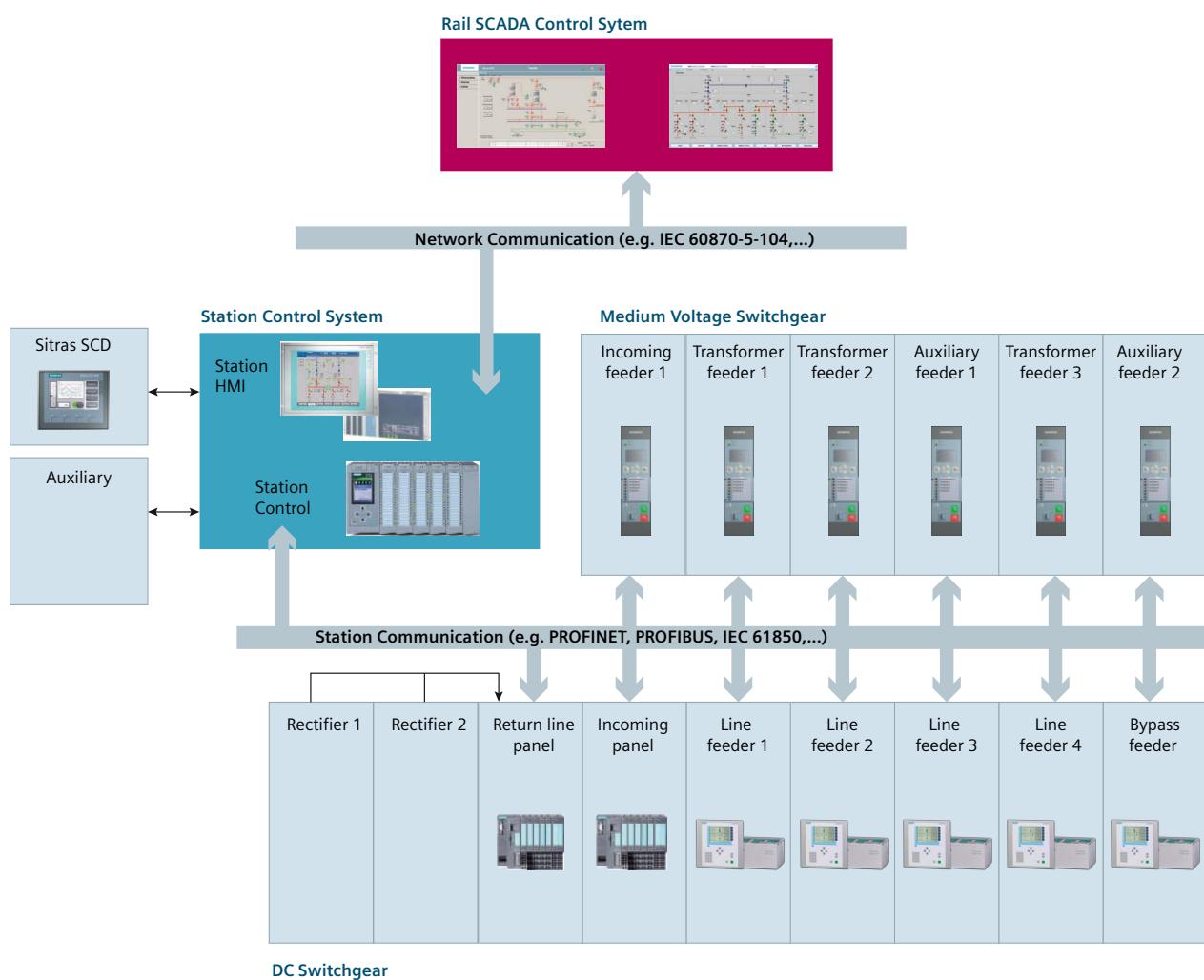
Typical topology of Sitras SCS

Sitras SCS-DC – Station control system for DC traction power supply

In principle, the station control system in the DC power supply is equally to the AC power supply.

The figure shows a user-friendly layout with the option of a separate message and operator control panel with PLC and HMI part. Additional the communication between the different operator control levels is illustrated.

Alternatively there is the possibility to integrate the station control system into a return line panel or into a combined incoming / return line panel. This solution allows displaying the operation and alarm message archive as well as a visualization and control of the switchgear at the HMI. The interface to SCADA is also directly integrated.

Rail SCADA Control Sytem

Network Communication (e.g. IEC 60870-5-104,...)

Station Control System

Sitras SCD

Station HMI

Auxiliary

Station Control

Medium Voltage Switchgear

| Incoming feeder 1 | Transformer feeder 1 | Transformer feeder 2 | Auxiliary feeder 1 | Transformer feeder 3 | Auxiliary feeder 2 |

Station Communication (e.g. PROFINET, PROFIBUS, IEC 61850,...)

| Rectifier 1 | Rectifier 2 | Return line panel | Incoming panel | Line feeder 1 | Line feeder 2 | Line feeder 3 | Line feeder 4 | Bypass feeder |

DC Switchgear

Typical topology of Sitras SCS

Remote control interface with protocol according to IEC 60870-5-104 between SIMATIC S7 and remote control systems

The remote communication interface Sitras SCS-RCI is a program library fulfilling the requirement of the internationally standardized remote control protocol according to standard IEC 60870-5-104. The software supports IEC104-server- as well IEC104-client-function.

The blocks of the library have been programmed in Step 7 of TIA Portal. They can run on SIMATIC S7 CPUs of the 1500 family. The former versions are running on the SIMATIC S7 CPUs of the 300/400 family.

Thanks to this universal suitability for use in all the different SIMATIC product families, the remote communication function is adaptable to project requirements and scalable in a wide range.

Application

It can be used in a wide area of traction power supply and rail infrastructure, e.g. AC-, DC switchgear, LV-distribution, catenary systems, building infrastructure et cetera.

Features

- Use of standard components and software of the SIMATIC S7 product families
- Combinable and extendible with software for additional automation functions
- High availability because of redundant communication to central control
- Numbers of connections can be adjusted, e.g.: one connection to local HMI, one redundant connection to central control system and one redundant connection to back up central control system.

Hardware basis

Sitras SCS-RCI is runnable on the CPUs of the SIMATIC S7-family and preferred the integrated Ethernet interfaces.

Protocol functions

Sitras RCI supports most oft the telegram types of the IEC60870-5-104 standard with and whithout time stamp in server and client application.

Time stamp, local time or UTC

As time stamp value for each connection can be used local time or UTC. Also the command for time synchronization can be handled for local time and UTC.

Quality bits for information

In addition to the process value, quality bits can be stored for each information.
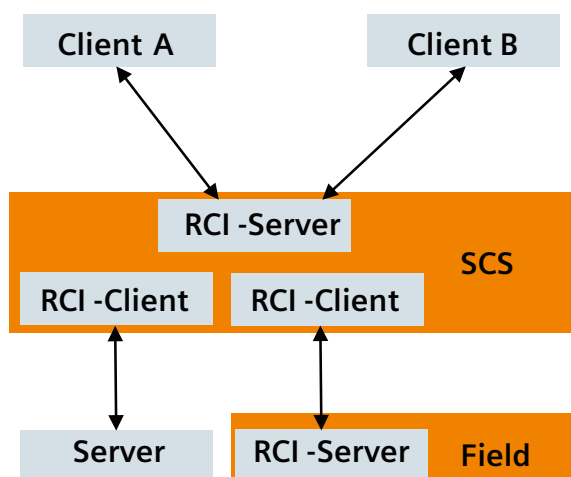
If a communication line fails, the quality bits for all information are set to invalid.

Interrogation group

Each information can be individual assigned to an interrogation group.

Configuration

Sitras SCS-RCI can be used for client as well for server function in one-channel and redundant configuration for SIMATIC S7-1500 CPUs.

Frame fault protection for DC traction power supply switchgears

Frame fault protection according to EN 50123-7-1 is used in DC traction power supply switchgears as a general protection to detect short circuits between conductor and switchgear frame.

Siemens delivers state of the art frame fault protection systems since years.

Sitras SCS-FFP is an innovated solution based on modern PLC technology.

The fundamental base for this solution is the simple and variable configurability in accordance with customer specific requirements. Another focus is also always the economical efficiency.

Not least because of the usage of the open technology of the market leader SIMATIC the solution of Siemens is well applicable for various customer requirements.

In addition to the offered solutions of Sitras SCS-FFP, other special technical requirements can be fullfilled.

Safe and reliable fault current detection

Main component of the standard configuration is a controller of the type SIMATIC S7 (PLC). The supply voltage is DC 24 V, but can be adapted by voltage converters or other power supplies.

A Hall sensor is used to detect fault currents fast and reliable. With this solution galvanic isolation is ensured. Therefore the only element limiting the current carrying capability is the brought in conductor.

The most important functions at a glance

- Due to the fast sampling and measurement of instantaneous values DC and AC currents can be detected and supervised
- Fast reaction time in case of current changes
- High measurement accuracy
- Adjustable trip thereshold
- Adjustable trip delay
- Trip circuits in open or closed circuit principle
- Trip by 24 V signal or by dry contacts
- Measuring element does not influence the current carrying capability

Optional measuring circuit monitoring

The optional measuring circuit monitoring allows supervision of components of the measuring circuit:
- Fast fault detection
- Measuring circuit monitoring by current injection (small currents due to multiple windings of the test circuit through the Hall sensor)
- Automatic function test of measuring circuit at predefined daytimes
- Manual function test of measuring circuit (e.g. by SCADA)
- Frame fault protection remains functional during measuring circuit test, no unintended trips during test
- Fault indications to remote in case of measuring circuit faults (e.g. to SCADA).
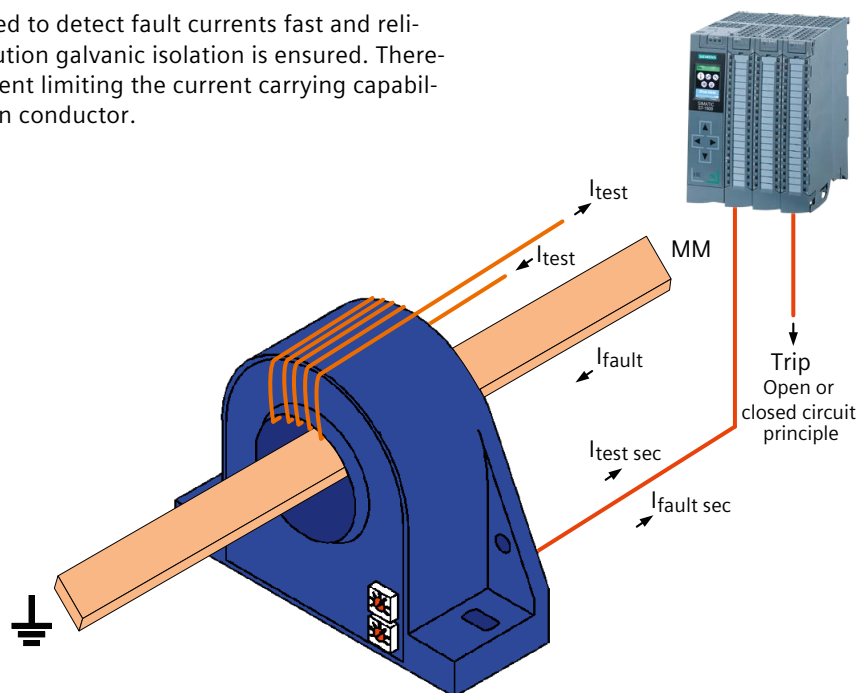
Sitras SCS-FFP

Sitras SCS-TTU

Transfer trip unit

Occasionally concepts for the so called transfer tripping of switching elements are more and more requested for rail systems. Based on EN 50123-7-1 a transfer tripping system is necessary when it cannot be ensured that a fault on a track can be detected from all infeed points independently.

Easy to use and flexible concepts ensure a huge field of applications inside railway electrification systems with consideration of customer specific requirements. Another focus is to provide a cost optimized solution with Sitras SCS-TTU.

Because of using open technologies of market leader SIMATIC this solution is ready for specified requirements.

Hardware basis

Main component for all standard applications is the controller SIMATIC S7-1200. Power supply of the unit is DC 24 V and can be adapted by using voltage converters if needed.
The Sitras SCS-TTU unit can handle more than one connection at the same time and can communicate in line- and / or multicast-mode.

Basically the communication between substations is realized by using of Ethernet technology with the following communications:
• Backbone networks
• Fiber optic connections such as multi mode cables with transfer rates of 10, 100 or 1000 MBit/s
• Fiber optic connections such as single mode cables with transfer rates of 10, 100 or 1000 MBit/s
• Modem technology or dedicated lines (e.g. GSM, ADSL).

Additionally to the flexibility of communication networks even the data transfer between the field devices (e.g. control and protection device Sitras PRO) is variable:
• Serial communication to the field devices in the outgoing feeders and vice versa
• Data transfer to the field devices by using of hardwired connection (digital I/Os).

Configuration

The standard configuration contains signal transfer of information like protection trips of the single outgoing feeders and frame fault protection units. These kinds of signals are a basis that needs to be transferred to a neighbored substation.
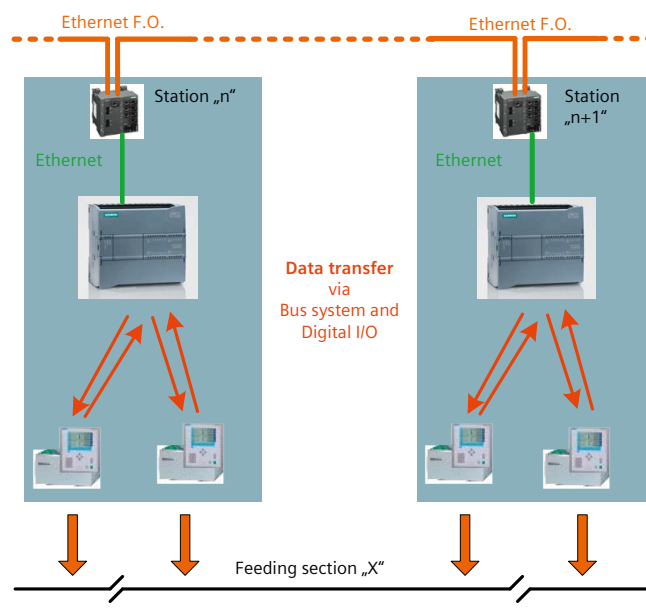
Additionally user-defined logic can be implemented as well, e.g. different transfer of trip signals based on the status of bypass switch of the over-head contact line system.

The general functionality will be preconfigured by Siemens according your requirements. The IP addressing will be done on site by using the integrated web interface of the PLC.

Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

For more information about industrial security, please visit:
http://www.siemens.com/industrialsecurity.

Ethernet F.O. Ethernet F.O. Station „n" Station „n+1" Ethernet Ethernet Data transfer via Bus system and Digital I/O Feeding section „X"

Overview Data transfer