Relion® 615 series

Communication solutions overview - 5.0 FP1

2NGA000072

ABB

Relion® 615 series communication solutions
Content

Relion® 615 series

Introduction

- The 615 series protection and control relays (intelligent electronic devices) are members of ABB's Relion® product family

- 615 series products: REF615, RET615, REM615, RED615, REU615, REV615, REG615

- The 615 series protection relays are characterized by their native IEC 61850 implementation and Ethernet communication features

- IEC 61850 is the main protocol but other communication protocols are supported as well

Relion® 615 series
Ethernet communication features

- **Ethernet** is the communication media for IEC 61850 and other protocols such as Modbus® and DNP3

- IED tool PCM600 and WebHMI are used over Ethernet link

- Media types: 10/100TX galvanic Ethernet cable with RJ-45 connectors or optical multimode 100FX with LC connectors

- Galvanic Ethernet cables must always be shielded (STP), minimum CAT5e

- Network topology - either star or ring

- 3 Ethernet ports available for Ethernet redundancy (3xRJ-45 or LC+2xRJ-45 or 2xLC+RJ-45). [Note! RED615: 2xLC Ethernet ports]

- IEC 61850 can be used in parallel with Modbus® TCP or DNP3 TCP over the same Ethernet-based station bus

- Supports simultaneous event reporting to 5 different clients on the station bus

ABB

Relion® 615 series
Serial communication features

- **Serial communication** is used by various protocols; Modbus®, IEC 103 and DNP3

- Galvanic RS-485 or optical with ST connector

- HW variants: RS-232, RS-485, RS-485+ST, RS-485+Eth, RS-485+ST+Eth, ST+3*Eth. Port. [Note! RED615: RS-232 and ST+3*Eth. Port options excluded]

- RS-485 port includes always IRIG-B interface

- Optical serial communication: star or loop topology

- Galvanic RS-485 is a bus type topology supporting two parallel 2-wire station bus connections to two different IEC 103 or Modbus masters

- Galvanic serial cable must always be of shielded twisted pair type with proper grounding from all nodes on the bus

- Ethernet and serial based communication can be used in parallel: IEC 61850 + Modbus serial **or** IEC 61850 + IEC 103 **or** IEC 61850 + DNP3 serial **or** Serial protocol + Ethernet service bus

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Relion® 615 series

IEC 61850

- Settings and parameterization are done fully according to the IEC 61850 standard

- Standard versions Edition 1 and Edition 2 are supported

- COMTRADE disturbance rec. over PCM600, Web HMI, IEC 61850 or FTP

- Fault records can be read using the IEC 61850-8-1 communication protocol

- Supports Process Bus using IEC 61850-9-2LE protocol for sending of sampled values of analog currents and voltages and the receiving of sampled values of voltages

- Microsecond level accuracy with IEEE 1588 based time synchronization

- Supports HSR and PRP Ethernet redundancy protocols

- 615 series relays can simultaneously report events to five different clients

Relion® 615 series
IEC 61850 performance

- Meets the GOOSE performance requirements for protection tripping applications in distribution substations, as defined by the IEC 61850 standard (<3 ms)
- Enables faster than hardwired applications, e.g. arc and busbar protection
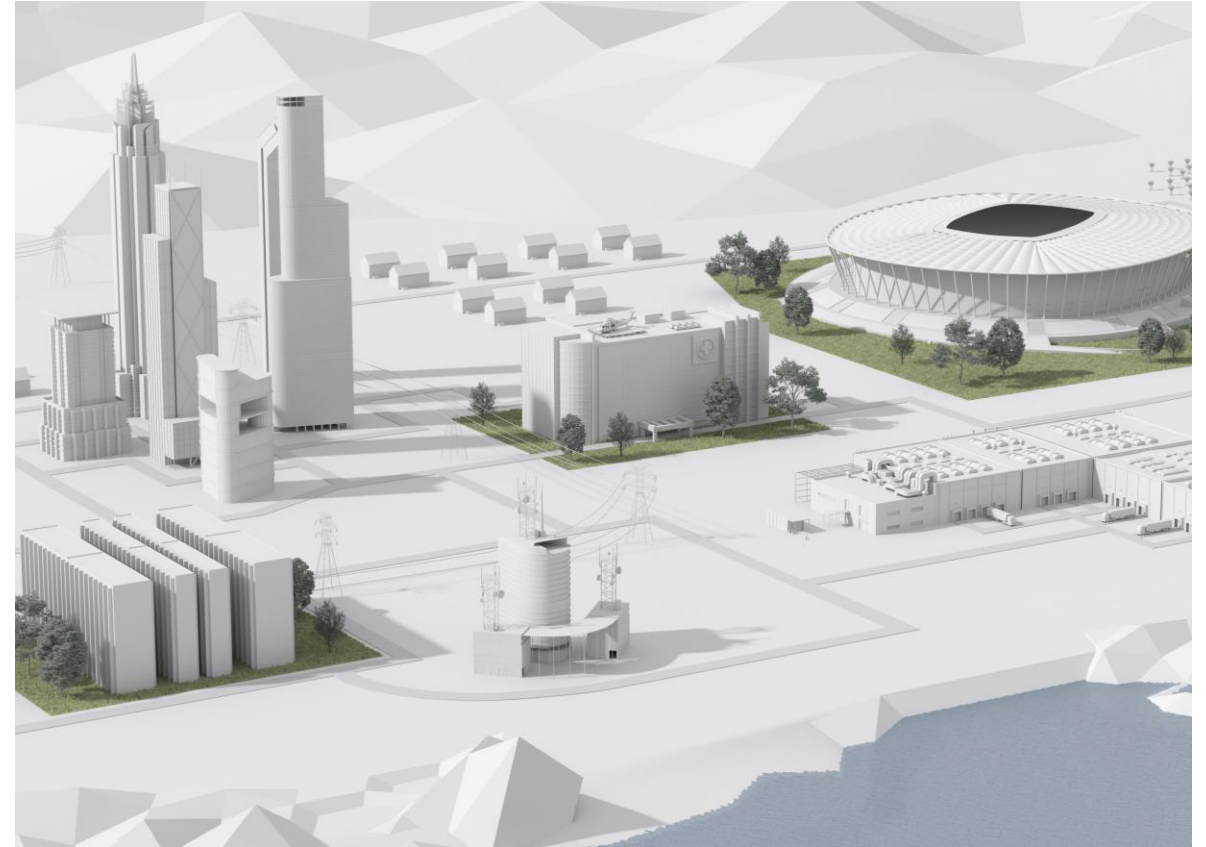
Relion® 615 series
Modbus®

- Used in industrial and utility power distribution applications

- Control, measurements and time synch

- Time stamped events

- Retrieval of fault records and changing of setting group

- Settings and parameterization using PCM600 or the Web HMI (front/rear Ethernet port)

- COMTRADE disturbance recordings over Web HMI, PCM600 or FTP

- Accurate IEEE 1588 or SNTP based time synchronization can be utilized with Ethernet option

- Modbus serial and TCP/IP type of communication can be used in parallel

- Support of five parallel Modbus masters

- Can be used in parallel with IEC 61850

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Relion® 615 series

IEC 60870-5-103

- Protocol for power distribution applications

- Control, events, measurements and time synchronization

- Changing of setting group according to the IEC 103 standard

- Disturbance recordings available in IEC 103 format for SCADA or in COMTRADE format for PCM600 and Web HMI

- Settings and parameterization using PCM600 or the Web HMI (front/rear Ethernet port)

- Fault records and disturbance recordings can be read using PCM600 or IEC 103

- Accurate IEEE 1588 or SNTP based time synchronization can be utilized together with communication card with Ethernet

- Support of two parallel IEC 103 masters using different RS-485 ports in 2-wire mode

- Can be used in parallel with IEC 61850

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Relion® 615 series

DNP3

- Used in industrial and utility power distribution applications

- Control, measurements and time synch

- Time stamped events

- Retrieval of fault records and changing of setting group

- Settings and parameterization using PCM600 or the Web HMI (front/rear Ethernet port)

- COMTRADE disturbance recordings over Web HMI, PCM600 or FTP

- Accurate IEEE 1588 or SNTP based time synchronization can be utilized with Ethernet option

- DNP serial and TCP/IP type of communication can be used in parallel

- Support of five parallel DNP masters

- Can be used in parallel with IEC 61850

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Relion® 615 series
Profibus

SPA-ZC 302 adapter

PLC

ProfibusDP

SPA-ZC 302

RS485/Modbus

615 relay
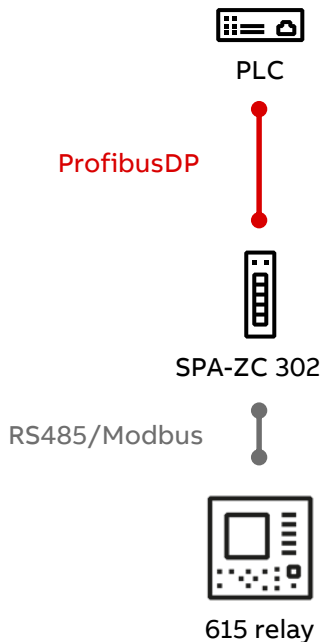
- Protocol for industrial applications

- Profibus DPV1 protocol available using SPA-ZC 302 communication adapter

- The relay must have Modbus® serial (RS 485) protocol option available

- Modbus® serial option includes functionality to emulate SPA protocol for SPA-ZC 302

- Control, events, measurements and time synchronization

- Changing of setting group

- Settings and parameterization using PCM600 or the Web HMI (front/rear Ethernet port)

- SNTP based time synchronization can be utilized if an Ethernet port is available

- Can be used in parallel with IEC 61850 and both Modbus TCP
  and serial

Relion® 615 series

Communication comparison table

| Functionality	IEC 61850	IEC 103	Modbus®	DNP3	Profibus
Time synchronization	SNTP, IRIG-B, IEEE 1588	IEC 103, SNTP, IRIG-B, IEEE 1588	Modbus®, SNTP, IRIG-B, IEEE 1588	DNP, SNTP, IRIG-B, IEEE 1588	SNTP, IRIG-B,
Disturbance record upload	IEC 61850, FTP, Web HMI or PCM600	IEC 103, FTP, Web HMI or PCM600	FTP, Web HMI or PCM600	FTP, Web HMI or PCM600	FTP, Web HMI or PCM600
GOOSE messaging	Supported	Supported in combination with IEC 61850	Supported in combination with IEC 61850	Supported in combination with IEC 61850	Supported in combination with IEC 61850
IEC 61850-9-2LE	Supported with Redundant Ethernet option	Parallel with Redundant Ethernet option	Supported with Redundant Ethernet option	Supported with Redundant Ethernet option	Not supported
Number of clients	5 parallel clients	2 parallel clients	5 parallel clients	5 parallel clients	1 Profibus master
Setting and parameterization	According to IEC 61850	Using PCM600 or the Web HMI	Using PCM600 or the Web HMI	Using PCM600 or the Web HMI	Using PCM600 or the Web HMI
Change of setting group	According to IEC 61850	According to IEC 103	Supported	Supported	Supported
Variants	Ethernet	Serial	Serial / Ethernet	Serial / Ethernet	Serial
Fault records	PCM600 or IEC 61850	PCM600 or IEC 103	Modbus® or PCM600	PCM600 or DNP3	PCM600

Station communication solutions

Connection schemes and examples

Relion® 615 series

Station communication solutions, examples

- The following slides illustrate examples of different communication solution use cases with 615 series relays
- There is a vast number of possible solutions, especially considering different client types, SCADA systems, gateways, RTUs, station HMIs and process controllers
- A maximum of 5 event clients can be connected at the same time to a relay
- PCM600 is considered as one of the IEC 61850 clients
- The 615 series Technical Manual and Communication Protocol Manuals offer more detailed information regarding the relays' communication ports and communication options
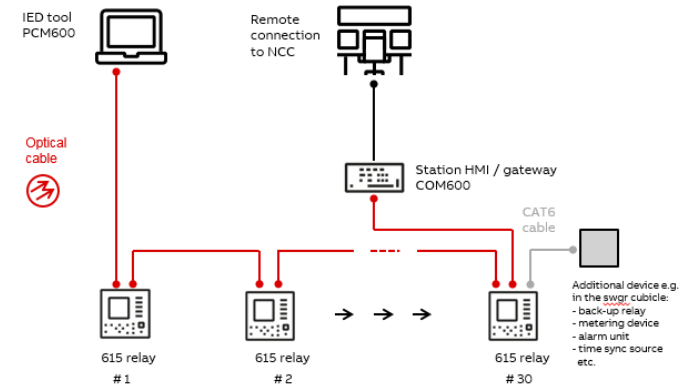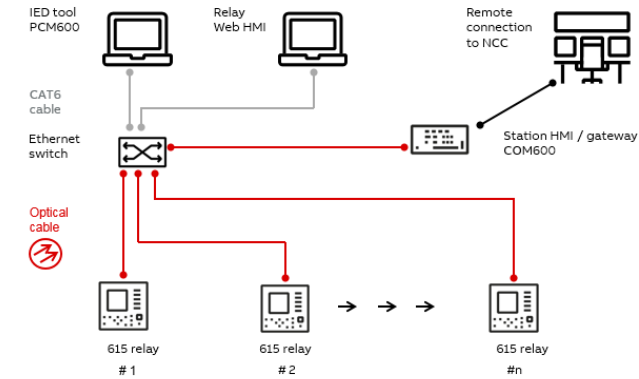
Station communication solutions

Connection schemes and examples for simple Ethernet communication

Relion® 615 series

Ethernet star topology, galvanic connection (RJ-45)

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
- Fault records (IEC 61850, Modbus, DNP)

IED tool
PCM600

Relay
Web HMI

Remote
connection
to NCC

Ethernet
switch

Station HMI / gateway
COM600

CAT6
cable

615 relay
1

615 relay
2

615 relay
n

ABB
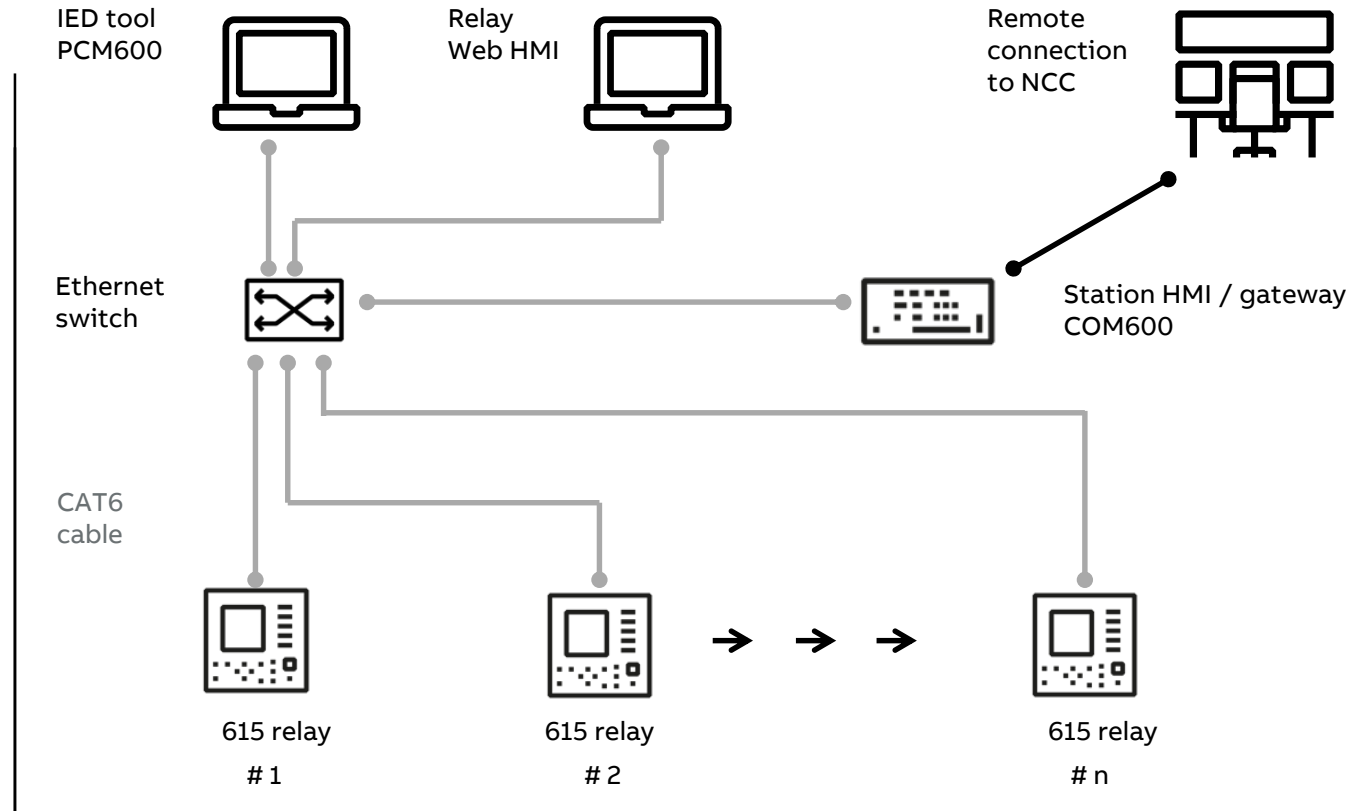
Relion® 615 series

Ethernet star topology, optical connection (LC)

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
- Fault records (IEC 61850, Modbus, DNP)

IED tool PCM600

Relay Web HMI

Remote connection to NCC

CAT6 cable

Ethernet switch

Station HMI / gateway COM600

Optical cable

615 relay # 1

615 relay # 2

615 relay #n

ABB

Relion® 615 series

Ethernet daisy chain, galvanic (RJ-45)

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
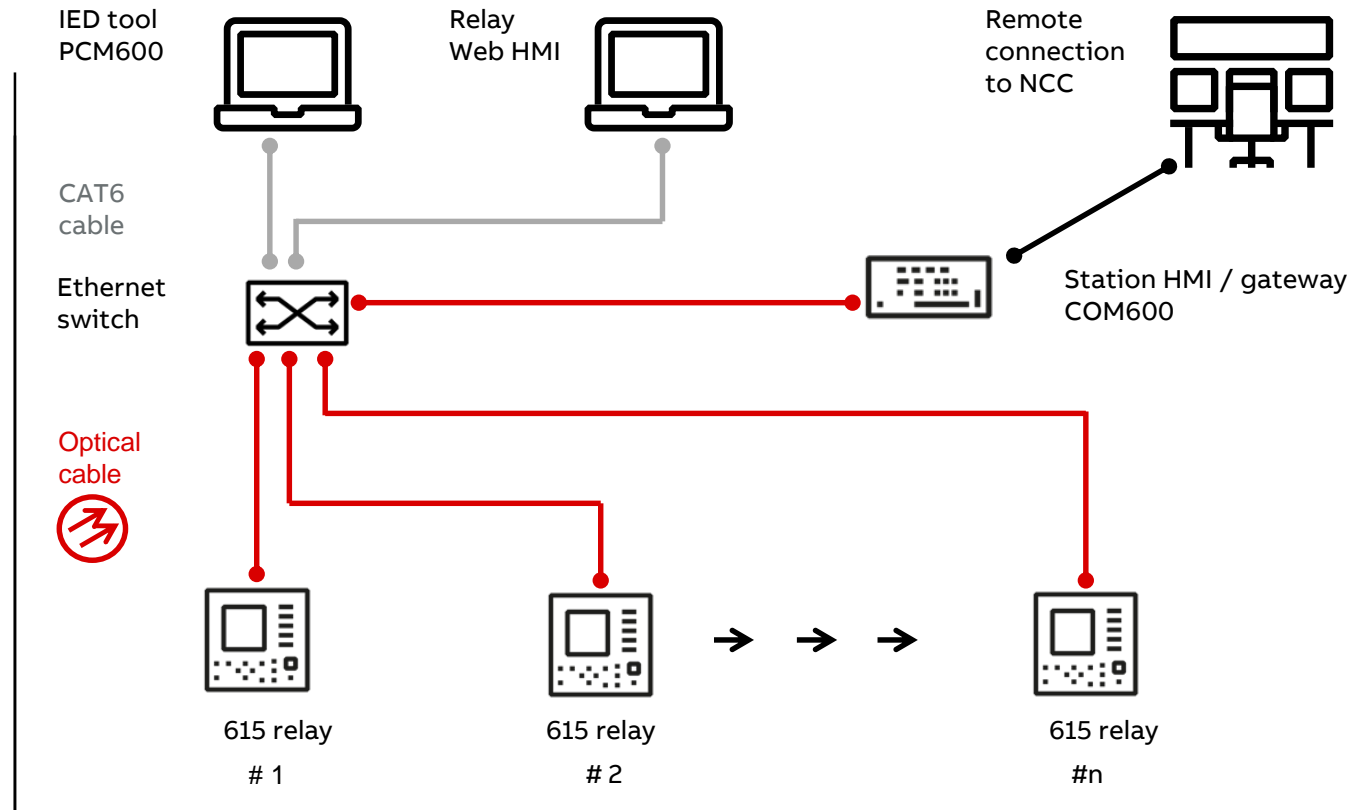- Fault records (IEC 61850, Modbus, DNP)

Note!

- The topology can be built totally without switches as the relays have multiple Ethernet ports

IED tool PCM600

Remote connection to NCC

Station HMI / gateway COM600

CAT6 cable

615 relay #1

615 relay #2

615 relay #30

Additional device e.g. in the swgr cubicle:
- back-up relay
- metering device
- alarm unit
- time sync source etc.

ABB

Relion® 615 series

Ethernet daisy chain, optical (LC)

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Control and events

- Measurements

- Settings and parameterization (IEC 61850)

- Disturbance record upload (IEC 61850 FTP)

- Fault records (IEC 61850, Modbus, DNP)

Note!

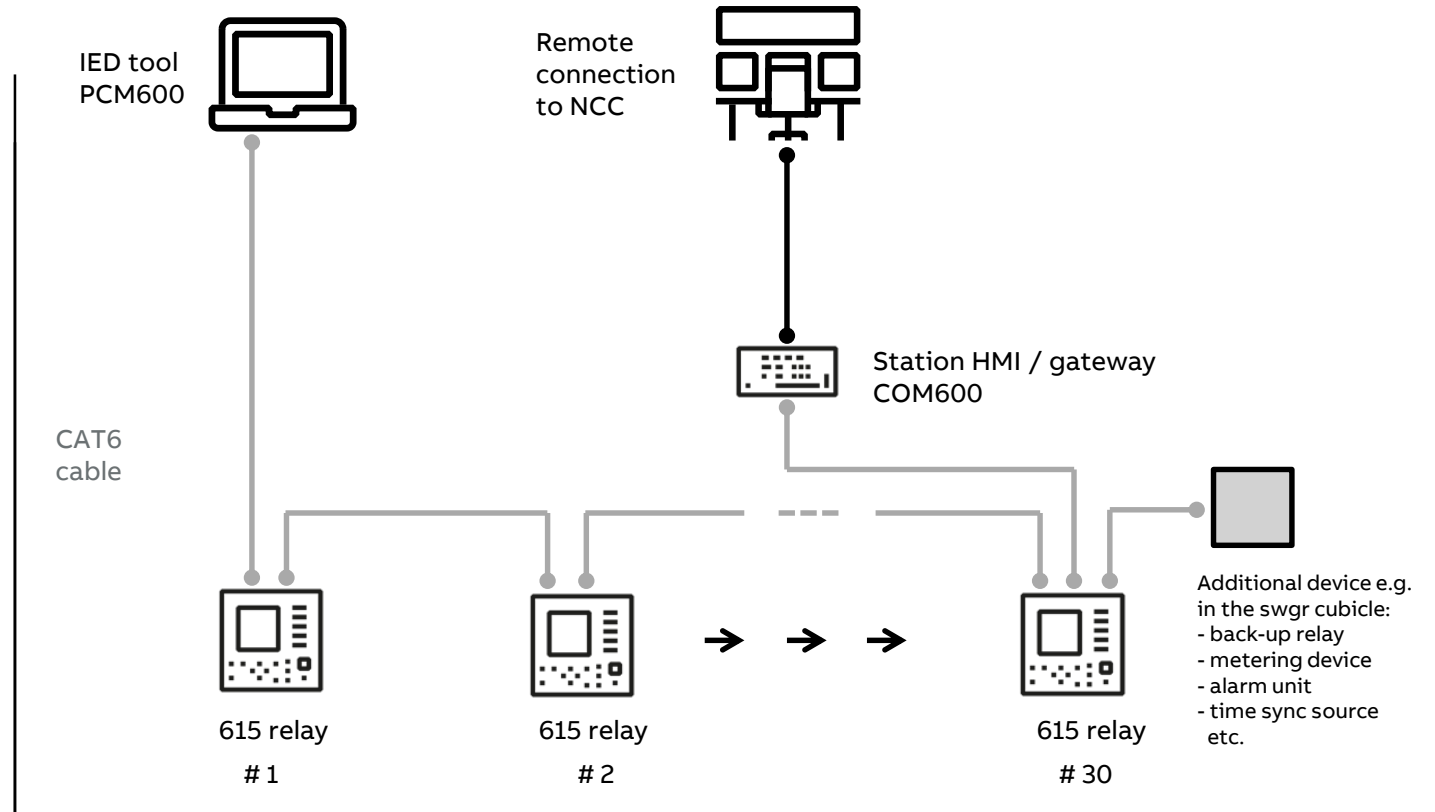- The topology can be built totally without switches as the relays have multiple Ethernet ports

IED tool
PCM600

Remote
connection
to NCC

Optical
cable

Station HMI / gateway
COM600

CAT6
cable

615 relay
1

615 relay
2

615 relay
30

Additional device e.g.
in the swgr cubicle:
- back-up relay
- metering device
- alarm unit
- time sync source
  etc.

ABB

Station communication solutions

Connection schemes and examples for redundant Ethernet communication

Relion® 615 series

PRP and HSR redundancy protocols

- Three Ethernet ports available on the optional communication card

- Parallel redundancy protocol (PRP) is based on parallel redundant networks without any interlinks

- High availability seamless redundancy (HSR) protocol is based on ring topology

- Protection relay works as HSR or PRP node

- Overcomes the failure of a link or switch with zero-switchover time

- Secures critical communication between devices

- Especially recommended for applications utilizing GOOSE and 9-2LE

- Third port (interlink port) can be used to connect additional device in cubicle or for connection to outside of switchgear

- Ethernet redundancy mode is configurable parameter in the relay
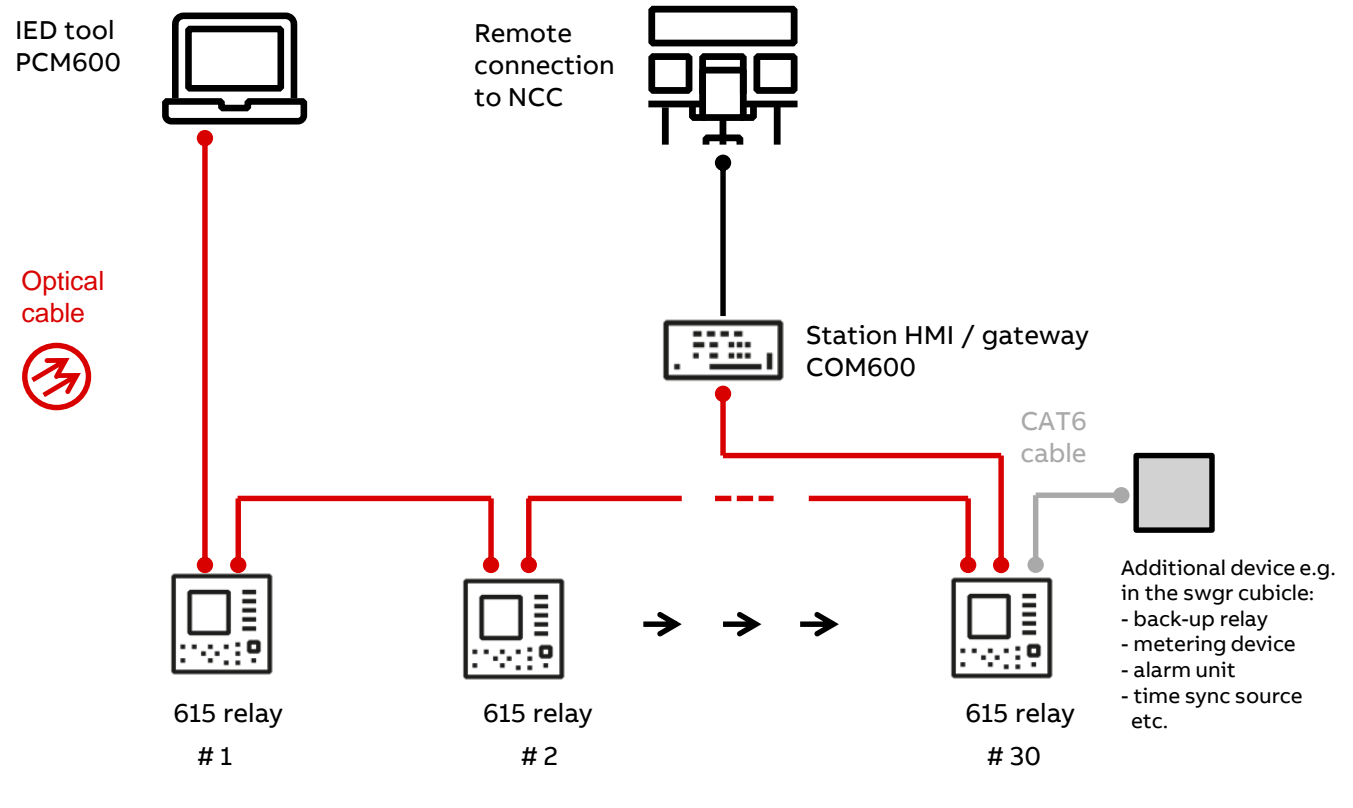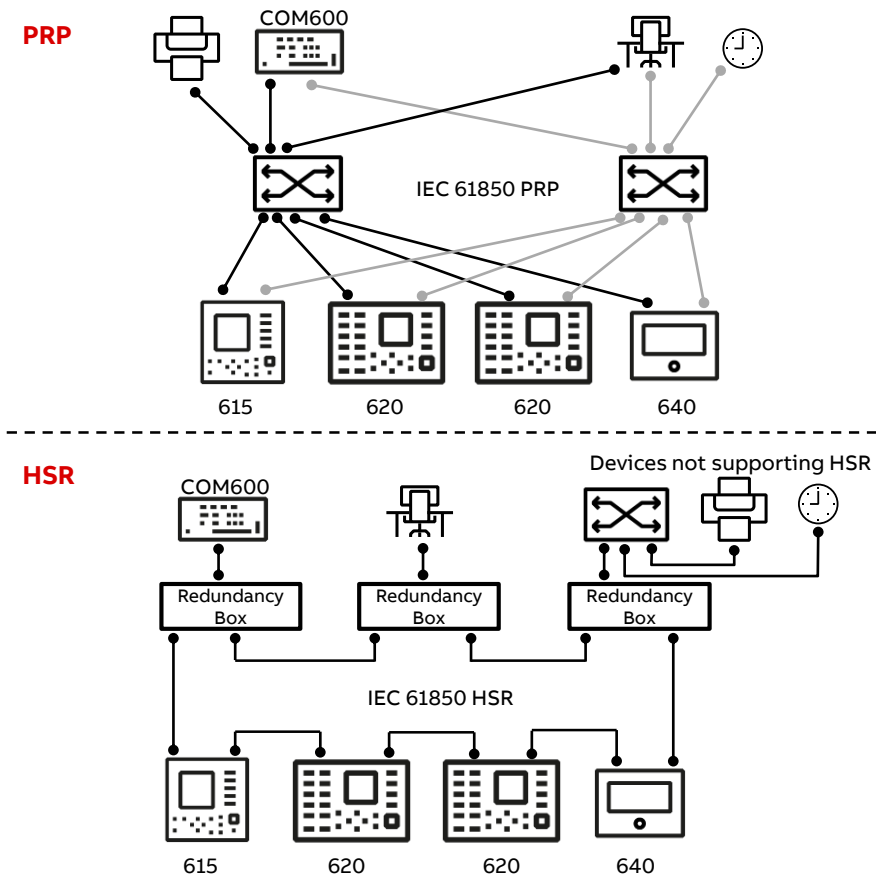
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Relion® 615 series

Ethernet PRP topology, galvanic

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
- Fault records (IEC 61850, Modbus, DNP)

Note!

- COM600 supports PRP
- 615 series relay works as RedBox via its interlink port

IED tool PCM600

Relay Web HMI

Remote connection to NCC

Redundancy Box

Red Box

Ethernet switch

Station HMI / gateway COM600

LAN A

LAN B

CAT6 cable

CAT6 cable

615 relay # 1

615 relay # 2

615 relay # n

Additional device e.g. in the swgr cubicle:
- back-up relay
- remote I/O
- metering device
- alarm unit
- time sync source
  etc.

ABB

Relion® 615 series

Ethernet PRP topology, optical

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
- Fault records (IEC 61850, Modbus, DNP)

Note!

- COM600 supports PRP
- 615 series relay works as RedBox via its interlink port
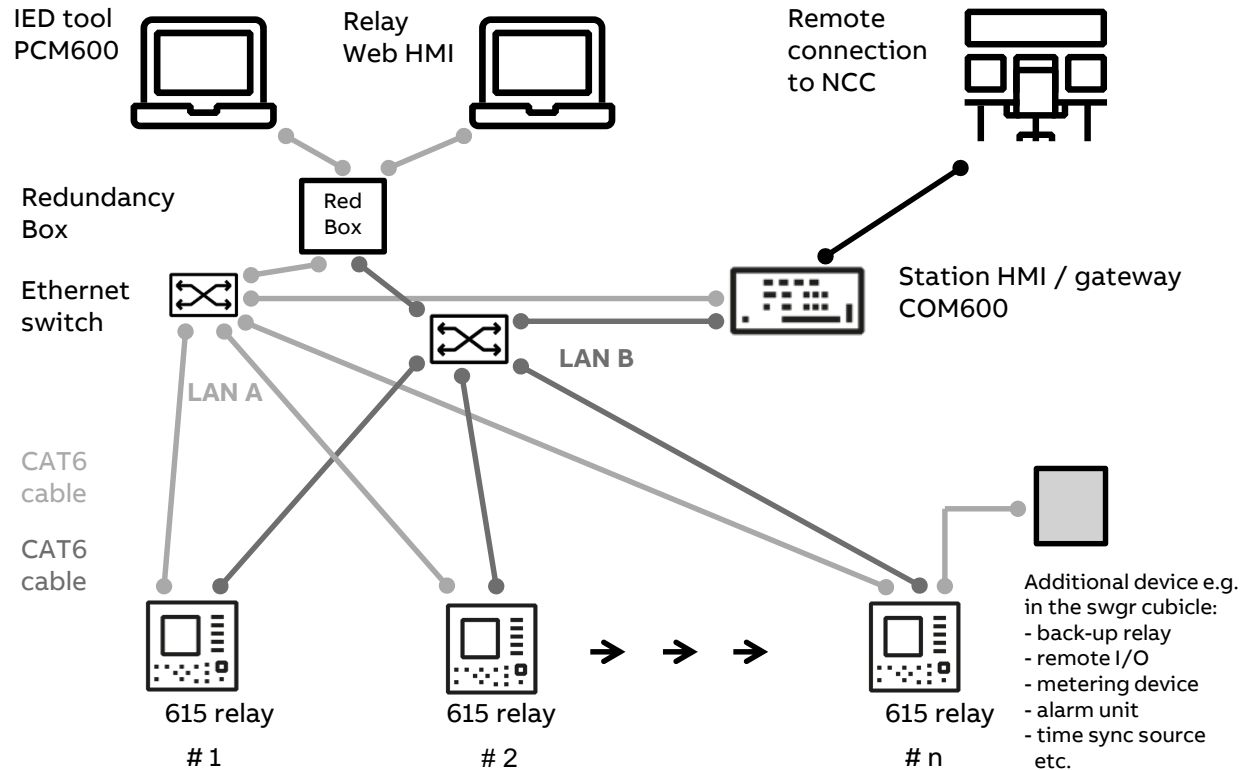
Relion® 615 series

Ethernet HSR topology, galvanic

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
- Fault records (IEC 61850, Modbus, DNP)

Note!

- COM600 and Local PC Station connected via RedBox to the HSR network
- 615 series relay works as RedBox via its interlink port

IED tool PCM600

relay Web HMI

Remote connection to NCC

Station HMI / gateway COM600

Redundancy Box / Switch — Red Box

Red Box

CAT6 cable

615 relay #1

615 relay #2

615 relay #30

Additional device e.g. in the swgr cubicle:
- back-up relay
- remote I/O
- metering device
- alarm unit
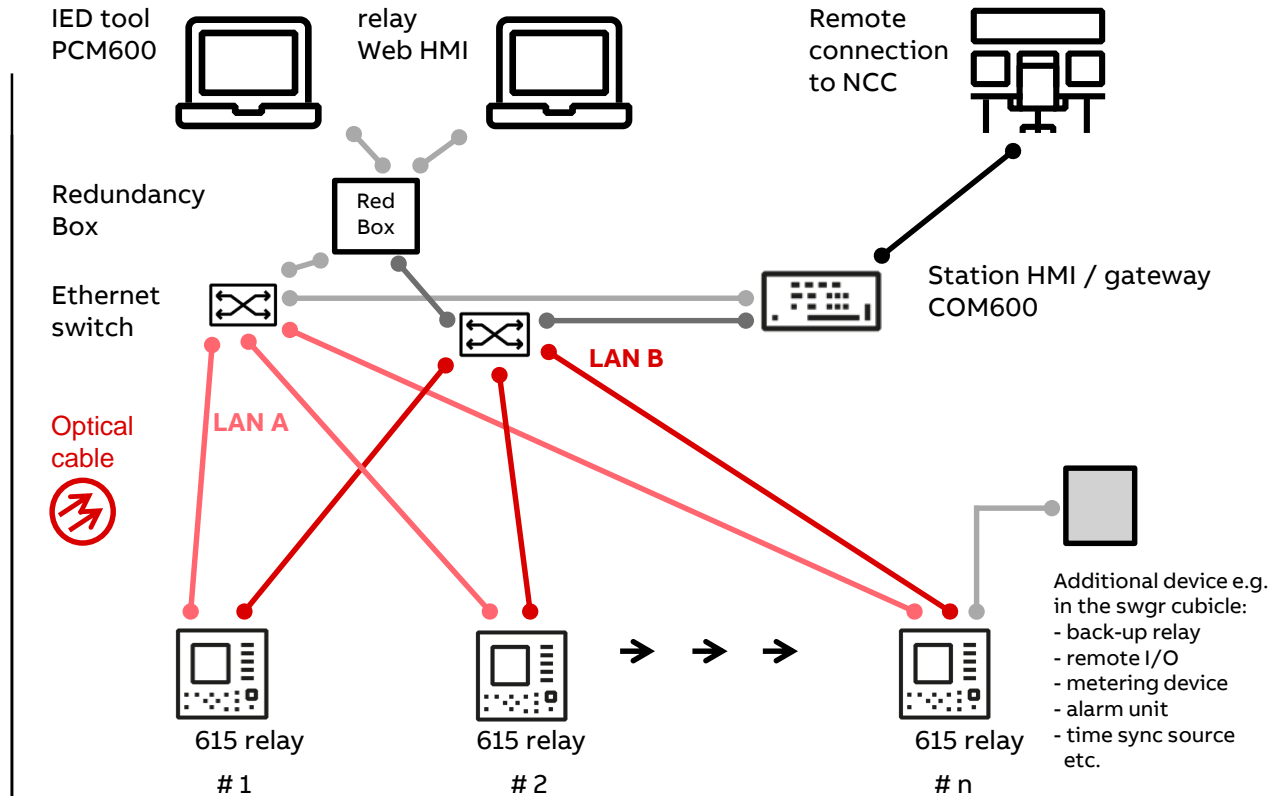- time sync source
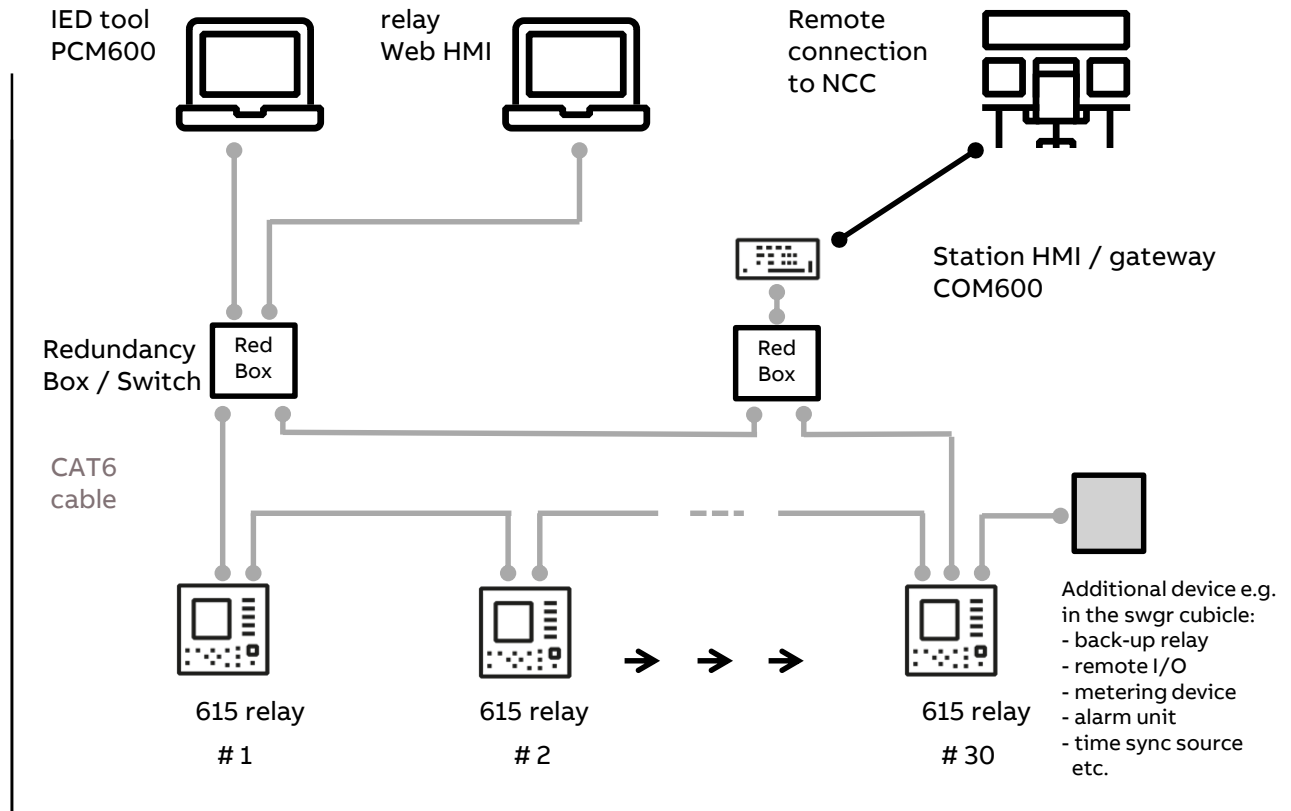 etc.

Relion® 615 series

Ethernet HSR topology, optical

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
- Fault records (IEC 61850, Modbus, DNP)

Note!

- COM600 and Local PC Station has to be connected via RedBox to the network
- 615 series relay works as RedBox via its interlink port

IED tool PCM600

relay Web HMI

Remote connection to NCC

Station HMI / gateway COM600

Redundancy Box / Switch — Red Box — Red Box

Optical cable

615 relay #1

615 relay #2

615 relay #30

Additional device e.g. in the swgr cubicle:
- back-up relay
- remote I/O
- metering device
- alarm unit
- time sync source
  etc.

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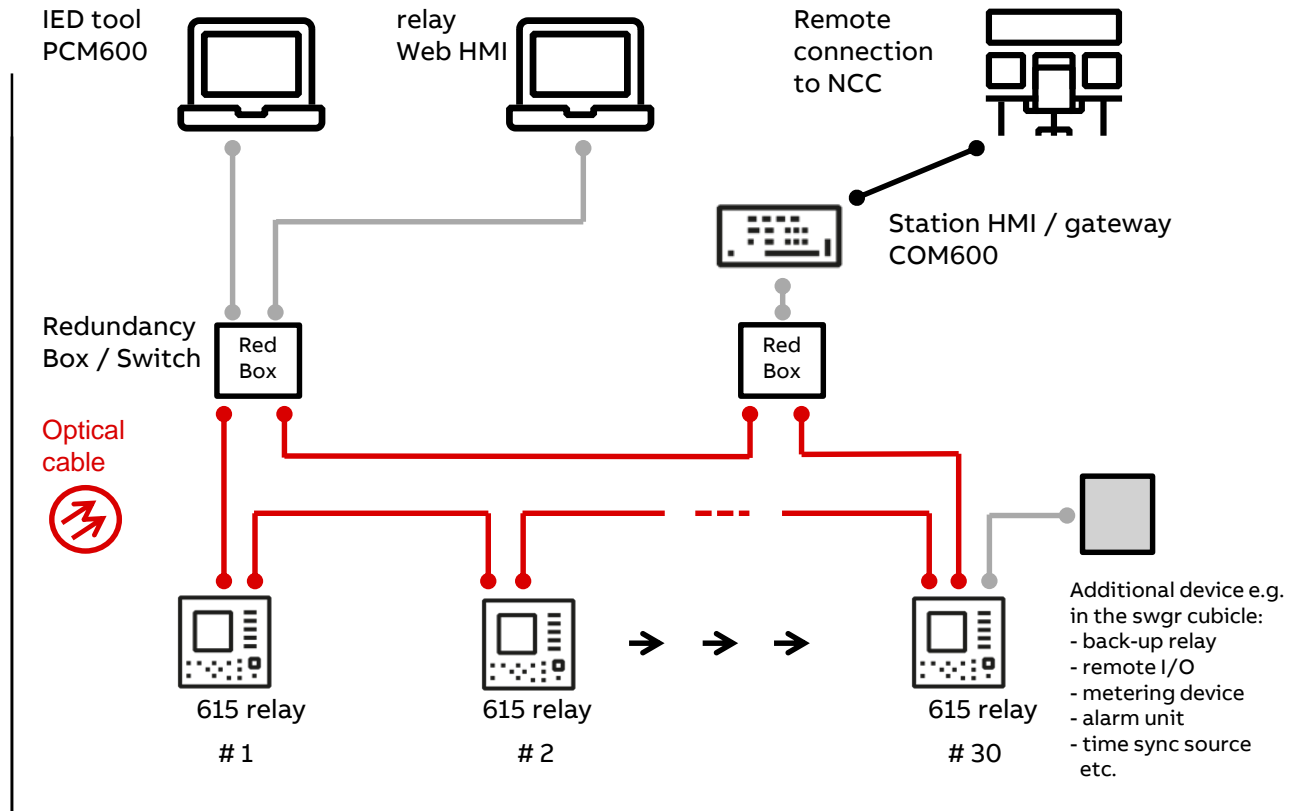
IEC 61850 communication redundancy

Combined PRP and HSR, optical

Station HMI / gateway
COM600

Remote
connection
to NCC

LAN A

LAN B

PRP

Ethernet
switch

Coupling from HSR ring
to one PRP LAN

Redundancy
Box

| Red Box | Red Box | Red Box | Red Box |

Port configuration
selection between LAN A
or LAN B

HSR ring 1

HSR ring 2

Optical
cable

615 IED
1

615 IED
30

615 IED
1

615 IED
30

Relion® 615 series

Ethernet self-healing ring topology

- Three Ethernet ports available on the optional communication module

- Enables the creation of a cost efficient self-healing Ethernet communication ring controlled by a managed switch with rapid spanning tree protocol (RSTP) configuration in switches

- Recommendation to use only in small installation with simple ring topology

- Avoids single point of failure concerns

- The relay works as unmanaged switch, no configuration required in relays

- Third port can be used to connect additional device in cubicle or for connection to outside of switchgear when third port is optical

- Ring supervision by SNMP functionality in managed switches

Client A

Client B

Managed Ethernet switch with RSTP support

Managed Ethernet switch with RSTP support

615 relay
1

615 relay
2

615 relay
30

ABB

Relion® 615 series

Self-healing ring topology, galvanic

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Suitable for small simple systems with ring topology
- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
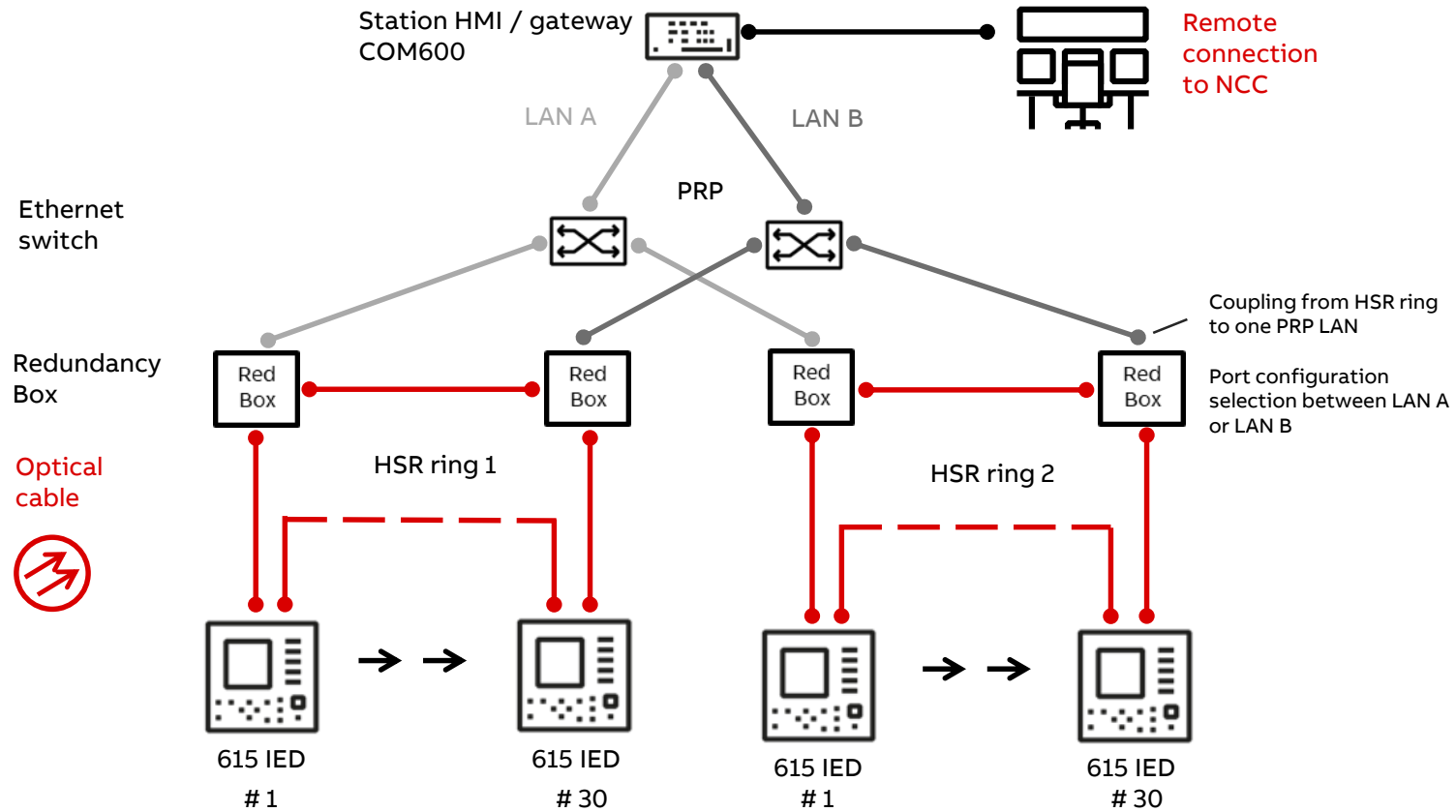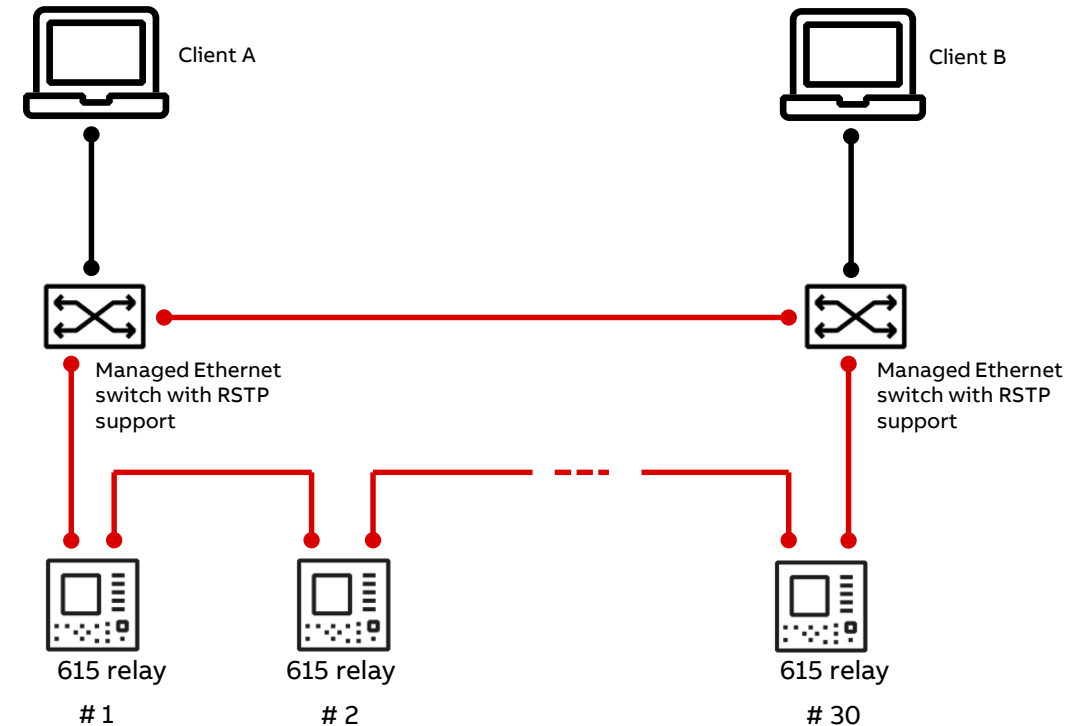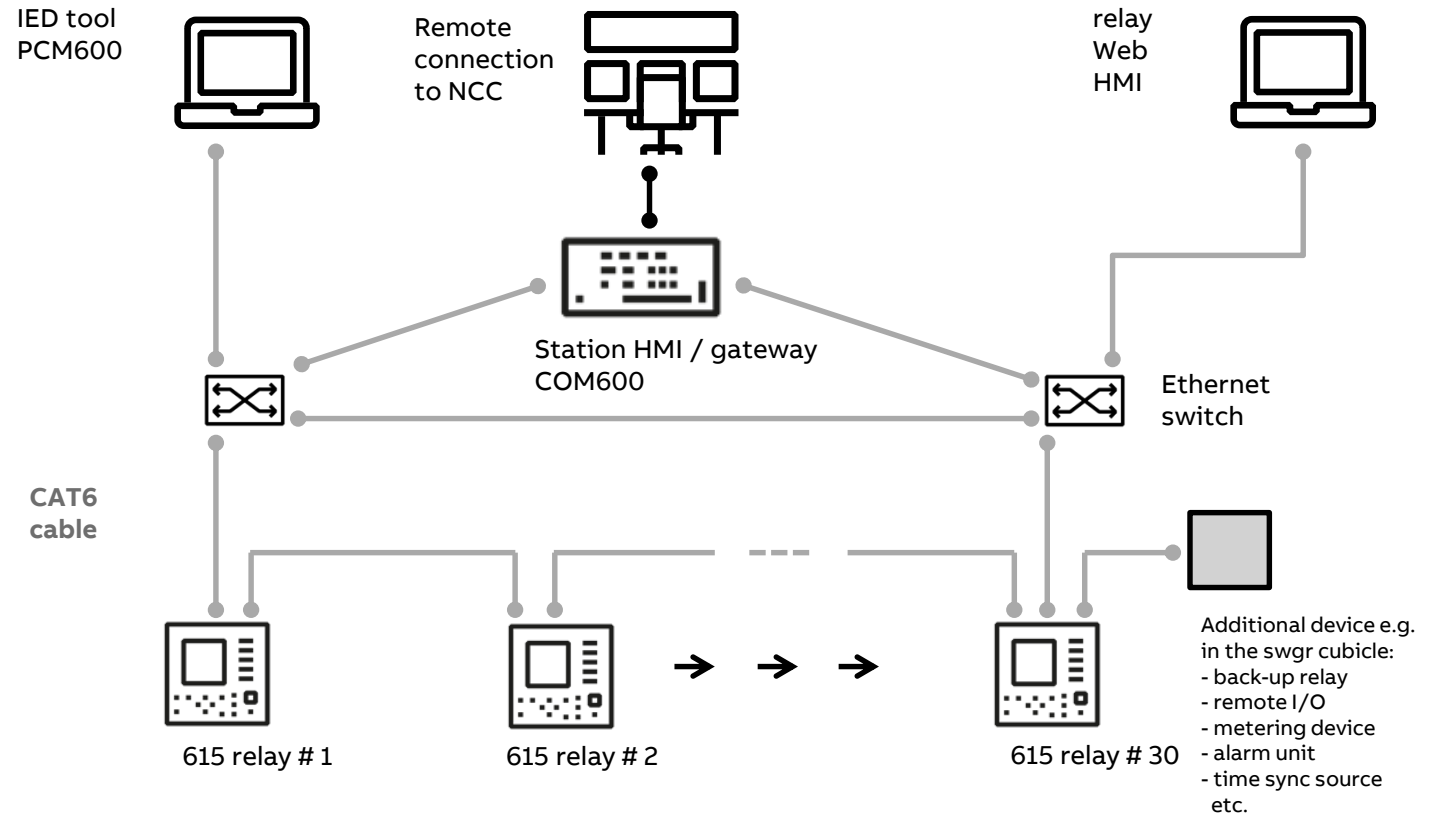- Fault records (IEC 61850, Modbus, DNP)

IED tool
PCM600

Remote connection to NCC

relay Web HMI

Station HMI / gateway
COM600

Ethernet switch

CAT6 cable

615 relay # 1

615 relay # 2

615 relay # 30

Additional device e.g. in the swgr cubicle:
- back-up relay
- remote I/O
- metering device
- alarm unit
- time sync source
  etc.

ABB

Relion® 615 series

Secured Ethernet self-healing ring topology, optical

Ethernet station bus (IEC 61850, Modbus, DNP3)

- Suitable for small simple systems with ring topology
- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
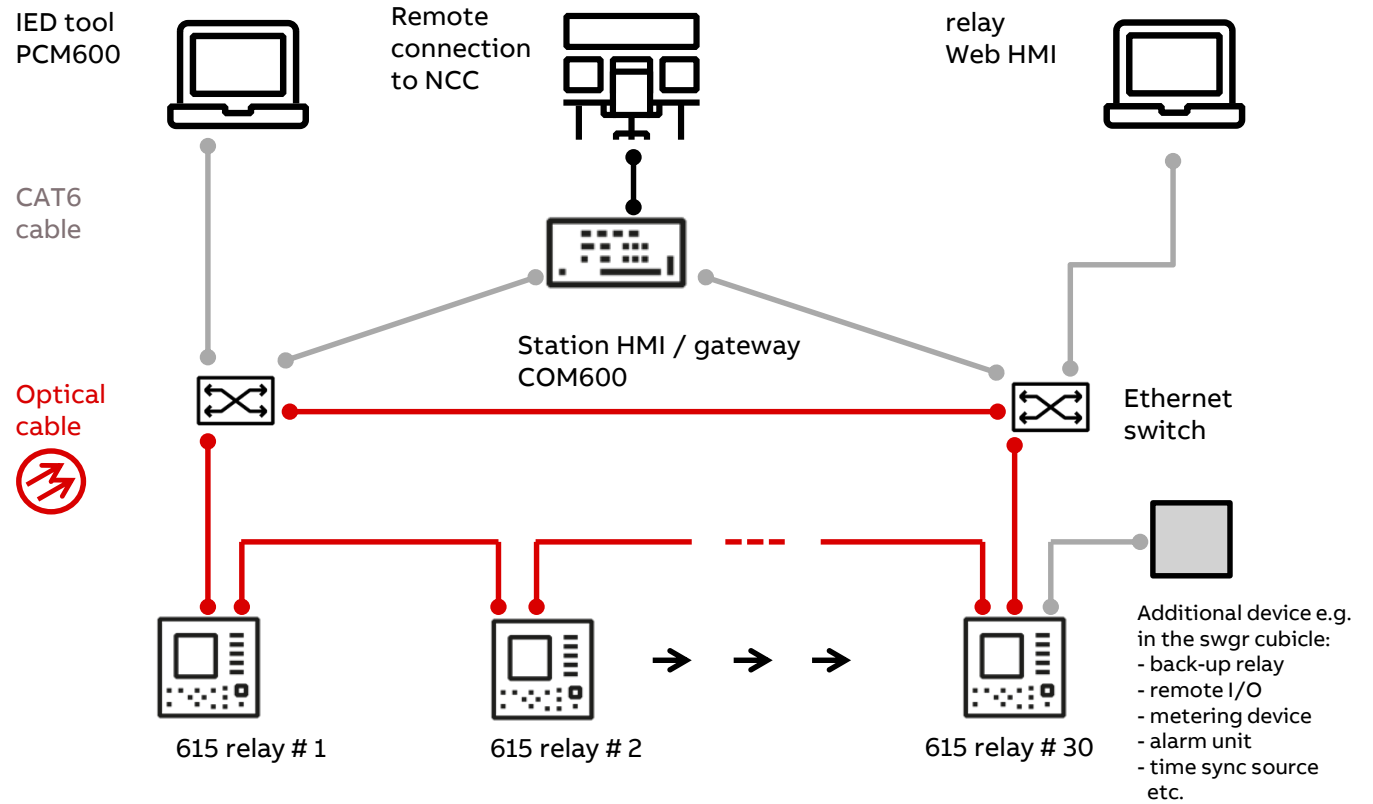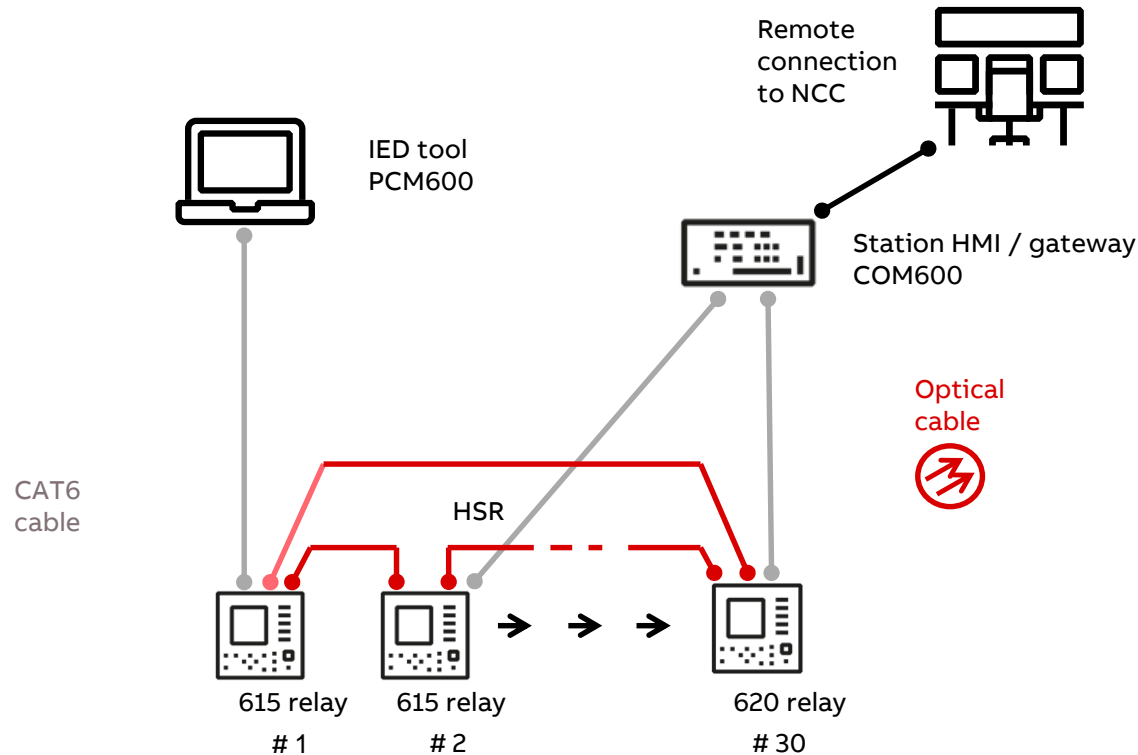- Fault records (IEC 61850, Modbus, DNP)

IED tool
PCM600

Remote connection to NCC

relay
Web HMI

CAT6 cable

Optical cable

Station HMI / gateway
COM600

Ethernet switch

615 relay # 1

615 relay # 2

615 relay # 30

Additional device e.g. in the swgr cubicle:
- back-up relay
- remote I/O
- metering device
- alarm unit
- time sync source
  etc.

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Relion® 615 and 620 series without Ethernet switches

COM600 with fault switch tolerance

Remote connection to NCC

IED tool PCM600

Station HMI / gateway COM600

Optical cable

CAT6 cable

HSR

615 relay #1

615 relay #2

620 relay #30

For what protocols this can be used:

- IEC 61850

- Modbus and DNP3 TCP

Description:

- This example shows how it is possible to utilize the relay's third port to connect HSR ring to rest if the network in a small substation

- COM600 has dual port Ethernet communication card for fault switch tolerance redundancy

- Connections from COM600 are connected to two different 615 or 620 series relay interlink ports to form redundancy towards COM600 as well

- HSR redundancy between relays

- Suitable for simple small systems

- Can be implemented even without Ethernet switches

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Relion® 615 and 620 series

Separate Ethernet IP networks

Description

- User requires two separated IP networks

- One for IEC 61850 based power system

- Another for Modbus TCP based automation system

- Second Modbus TCP/IP network can be build using Modbus serial to Modbus TCP converters
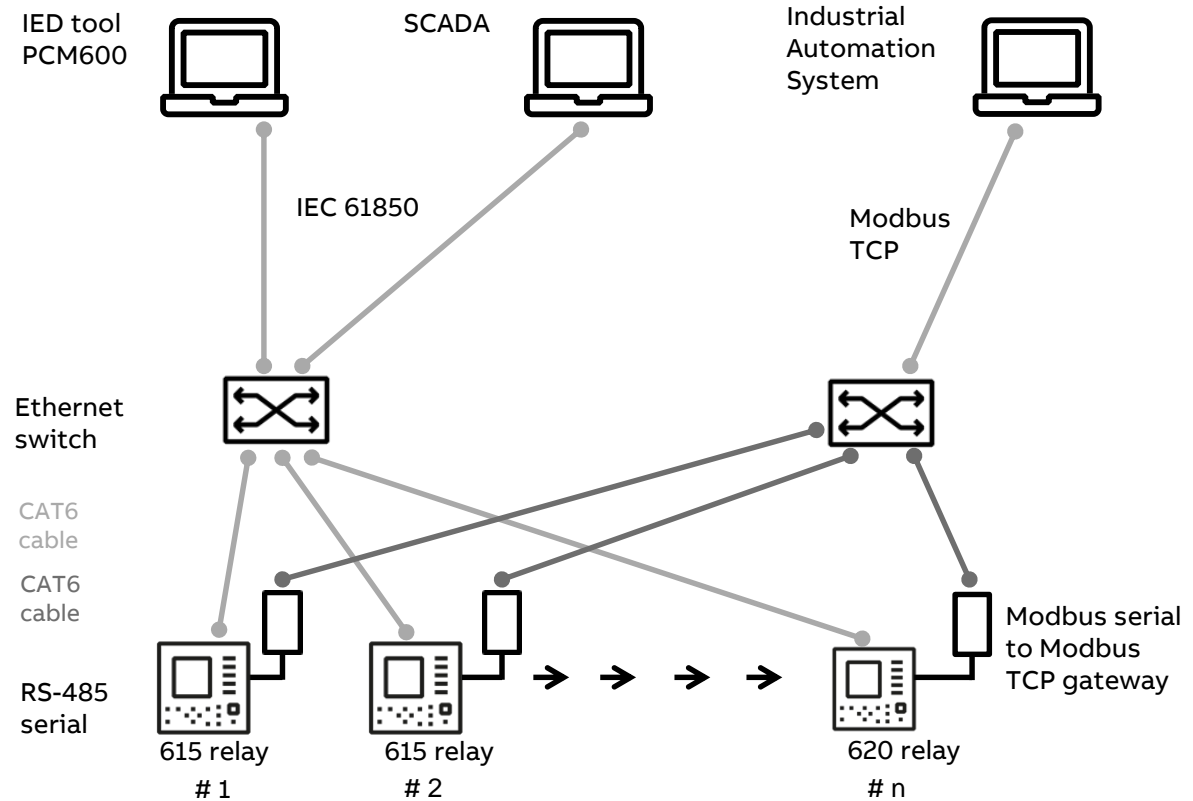
Station communication solutions

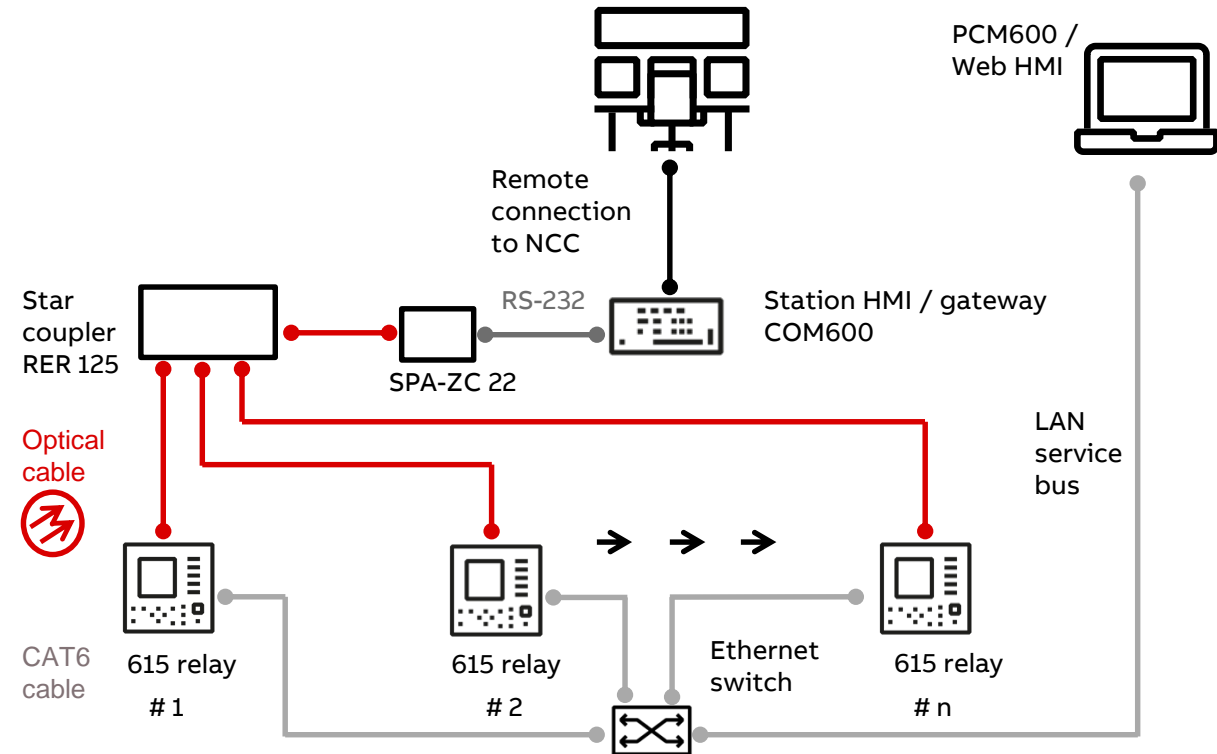Connection schemes and examples for serial communication

Relion® 615 series

Optical serial star-topology

Serial station bus (IEC103, Modbus, DNP3)

- Control and events
- Measurements
- Setting group selection
- Disturbance record upload (IEC 103)
- Fault records (Modbus)

Note!

- The optional service bus can also be optical

PCM600 / Web HMI

Remote connection to NCC

RS-232

Star coupler RER 125

SPA-ZC 22

Station HMI / gateway COM600

Optical cable

LAN service bus

CAT6 cable

615 relay # 1

615 relay # 2

Ethernet switch

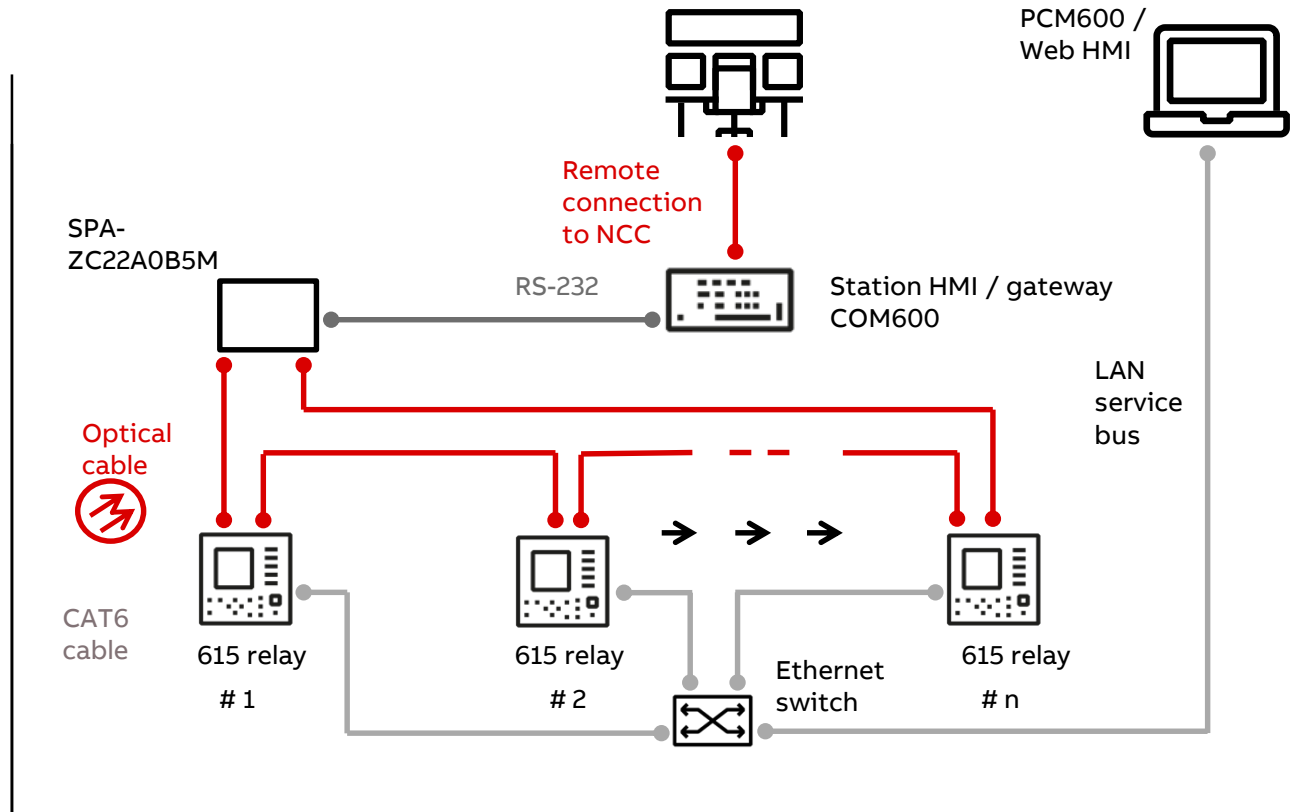615 relay # n

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Relion® 615 series

Optical serial loop-topology

Serial station bus (IEC103, Modbus, DNP3)

- Control and events

- Measurements

- Setting group selection

- Disturbance record upload (IEC 103)

- Fault records (Modbus)

Note!

- The optional service bus can also be optical

Relion® 615 series

Serial bus, galvanic connection

Serial station bus (IEC103, Modbus, DNP3)

- Control and events

- Measurements

- Setting group selection

- Disturbance record upload (IEC 103)

- Fault records (Modbus)

Note!

- The optional service bus can also be optical

PCM600 / Web HMI
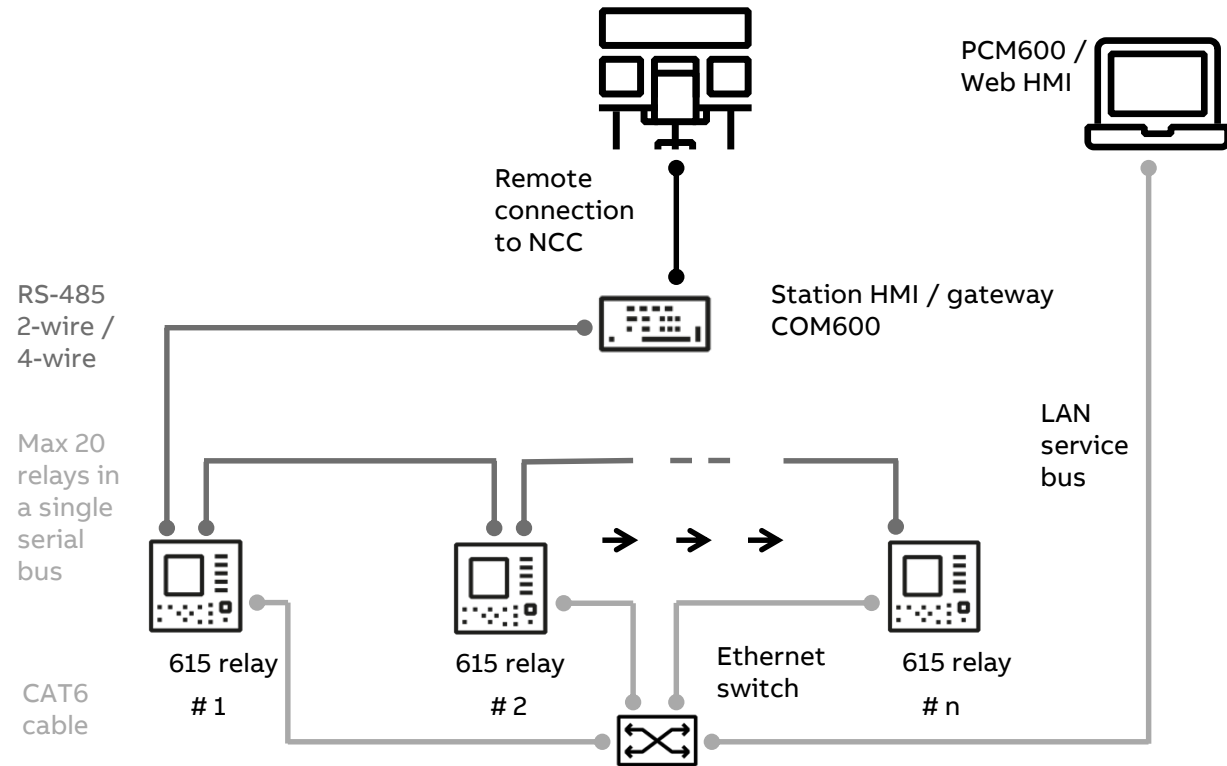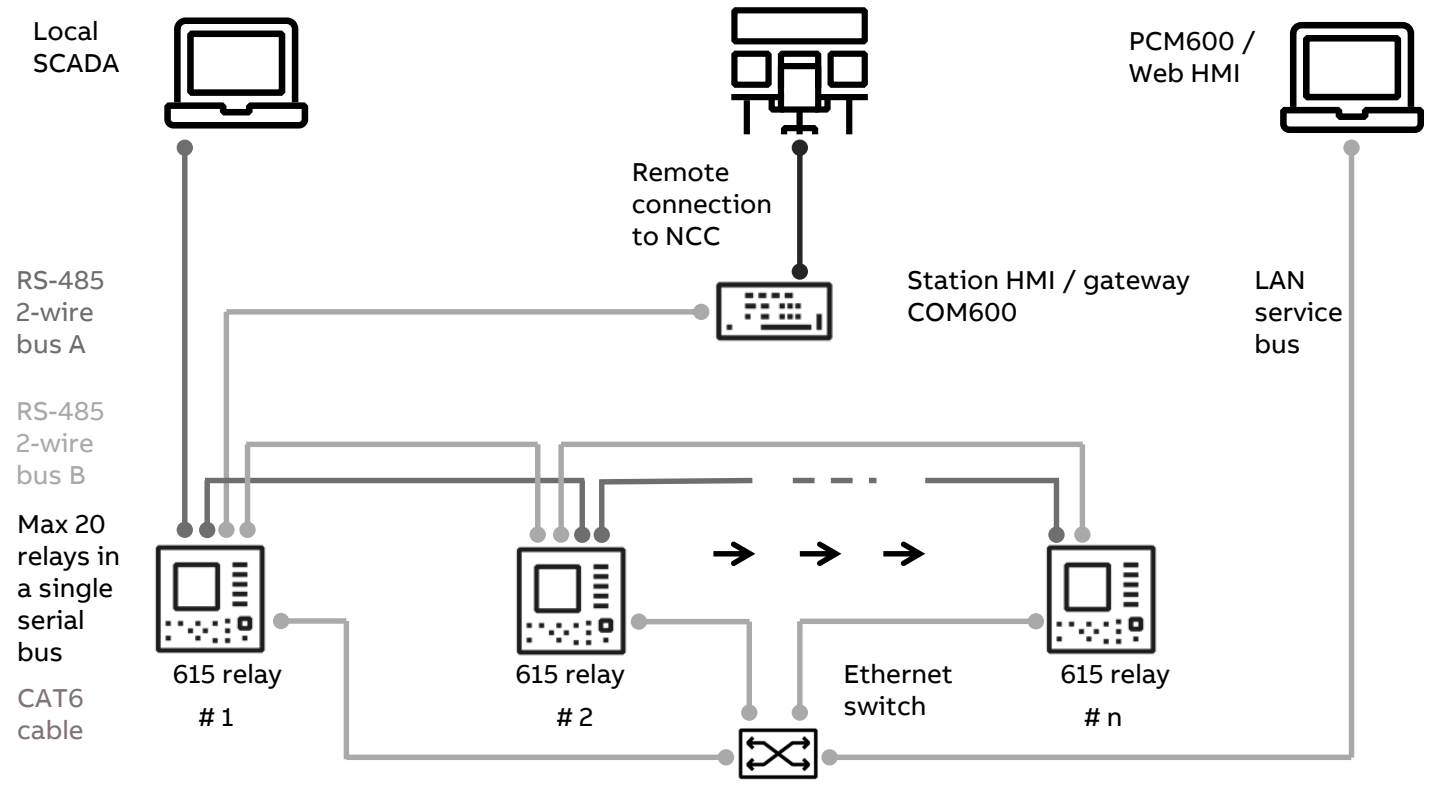
Remote connection to NCC

RS-485 2-wire / 4-wire

Station HMI / gateway COM600

Max 20 relays in a single serial bus

LAN service bus

CAT6 cable

615 relay # 1

615 relay # 2

Ethernet switch

615 relay # n

ABB

Relion® 615 series

Serial bus, galvanic connection, dual master support

Serial station bus (IEC103, Modbus, DNP3)

- Control and events
- Measurements
- Setting group selection
- Disturbance record upload (IEC 103)
- Fault records (Modbus)

Local SCADA

Remote connection to NCC

PCM600 / Web HMI

RS-485 2-wire bus A

Station HMI / gateway COM600

LAN service bus

RS-485 2-wire bus B

Max 20 relays in a single serial bus

CAT6 cable

615 relay # 1

615 relay # 2

Ethernet switch

615 relay # n

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Relion® 615 series

Ethernet and serial station buses in parallel

PCM600

Local
SCADA

Web HMI

Remote
connection
to NCC

Ethernet
switch

Station HMI /
gateway
COM600

RS-485
2-wire or
4-wire
bus

CAT6
cable

Max 20
relays in
a single
serial
bus

615 relay

1

615 relay

2

615 relay

n

Ethernet station bus (IEC61850 or Modbus or DNP3)

- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
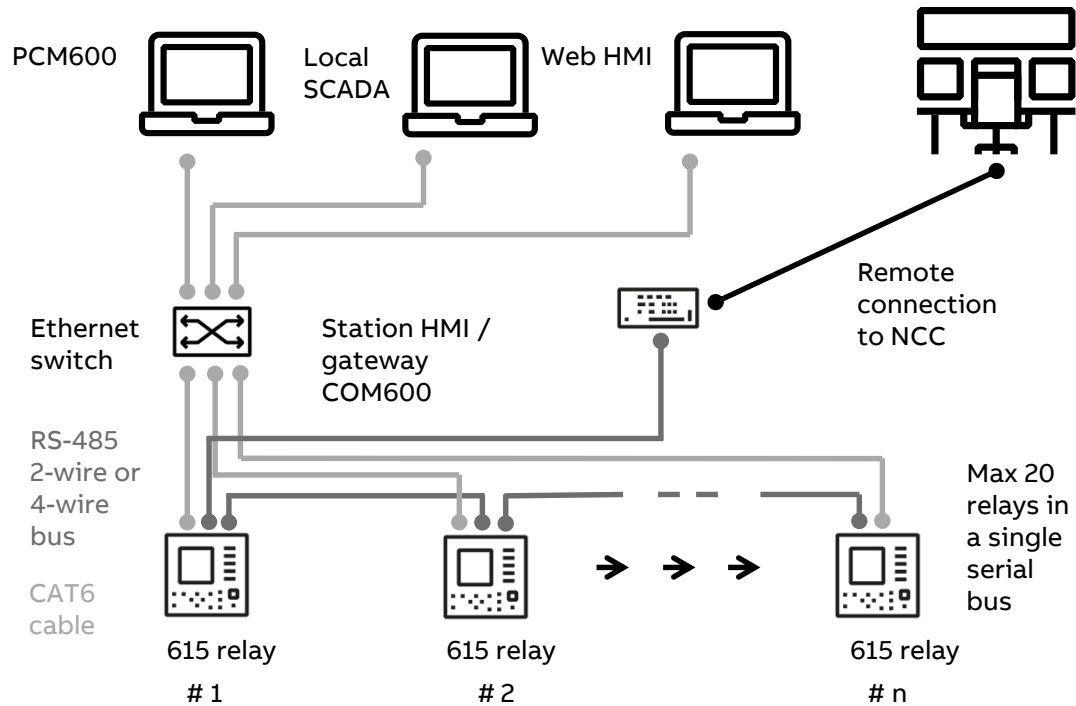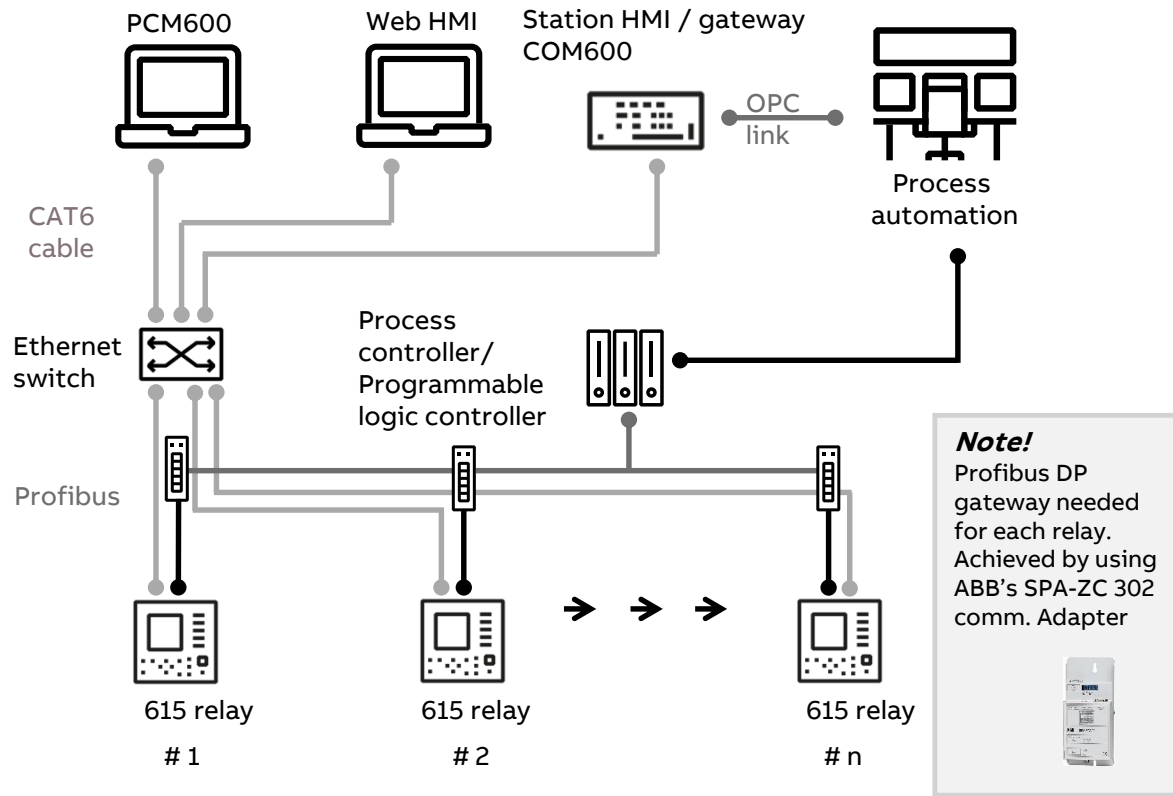- Disturbance record upload (IEC 61850, FTP)
- Fault records

Serial station bus (Modbus, DNP3, IEC 103)

- Control and events
- Measurements
- Setting group selection
- Disturbance record upload (IEC 103)
- Fault records (Modbus)

Note! Both types of station buses can be either galvanic or optical using star or loop topologies, see previous pages for examples

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Relion® 615 series

IEC 61850 and Profibus DPV1 in parallel

PCM600

Web HMI

Station HMI / gateway
COM600

OPC link

Process automation

CAT6 cable

Ethernet switch

Process controller/ Programmable logic controller

Profibus

615 relay
1

615 relay
2

615 relay
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Note!
Profibus DP gateway needed for each relay. Achieved by using ABB's SPA-ZC 302 comm. Adapter

Ethernet station bus (IEC61850 or Modbus):

Control and events

Measurements

Settings and parameterization (IEC 61850)

Disturbance record upload (IEC 61850, FTP)

Fault records

Serial station bus (Profibus DPV1)

Control and events

Measurements

Setting group selection

Note! The Ethernet station bus can be either galvanic or optical

ABB