SUBSTATION AUTOMATION

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CHAPTER THREE	SUBSTAION AUTOMATION BASED ON IEC61850
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Problem Definition

- Intelligent Electronic Devices (IEDs) from different manufacturers, creates difficulties in integrated systems.
- hard wiring
- Difficulties in maintenance and expansion

Objectives

- Substation standardization.
- Implementation of Generic Object Oriented Substation Event (GOOSE) message.
- Using of Substation Configuration Language (SCL).

Methodology

- HELINKS (STS) Substation software Tool Set.
- Greater Nile Petroleum Operating Company (GNPOC) Local Area Network(LAN).

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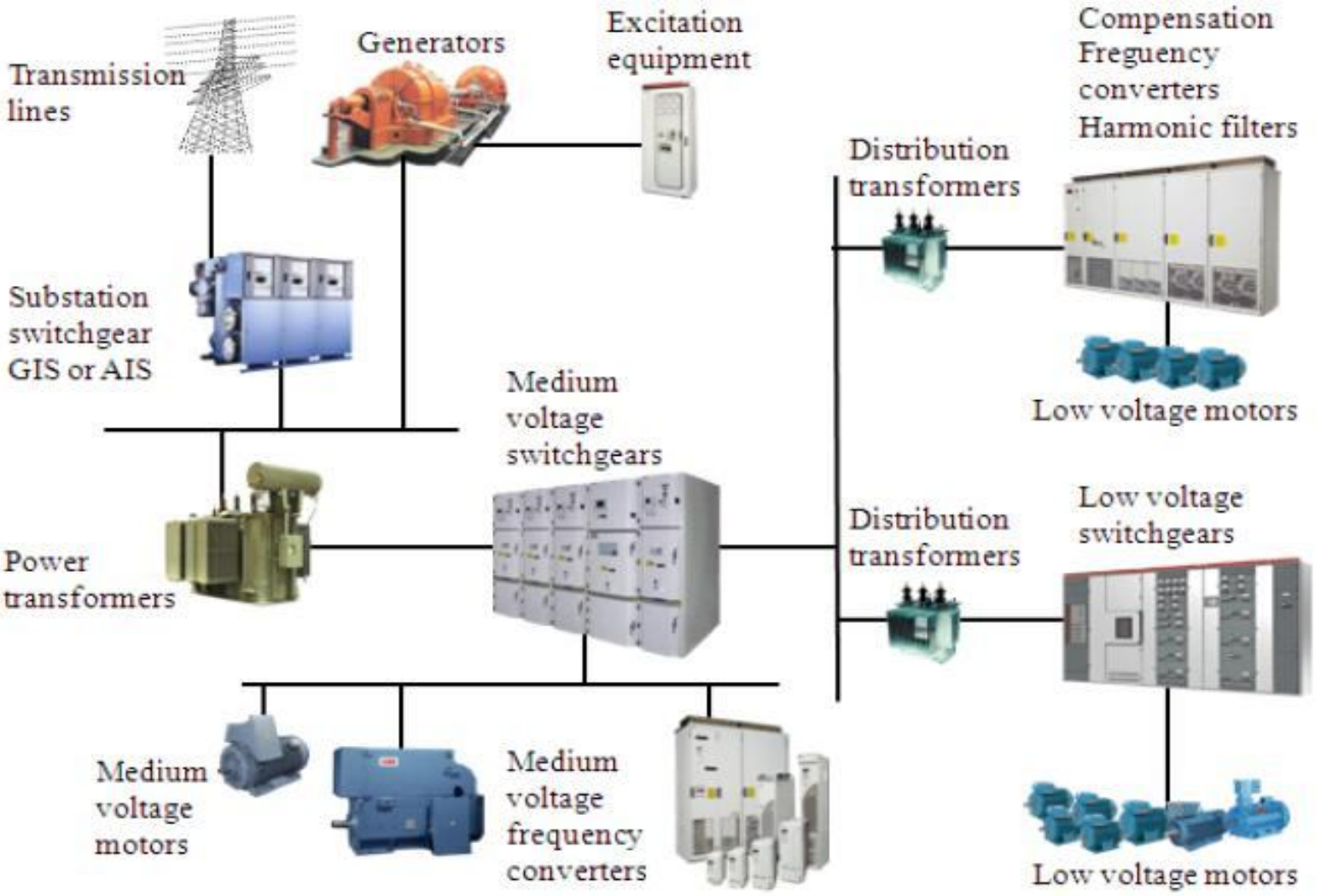
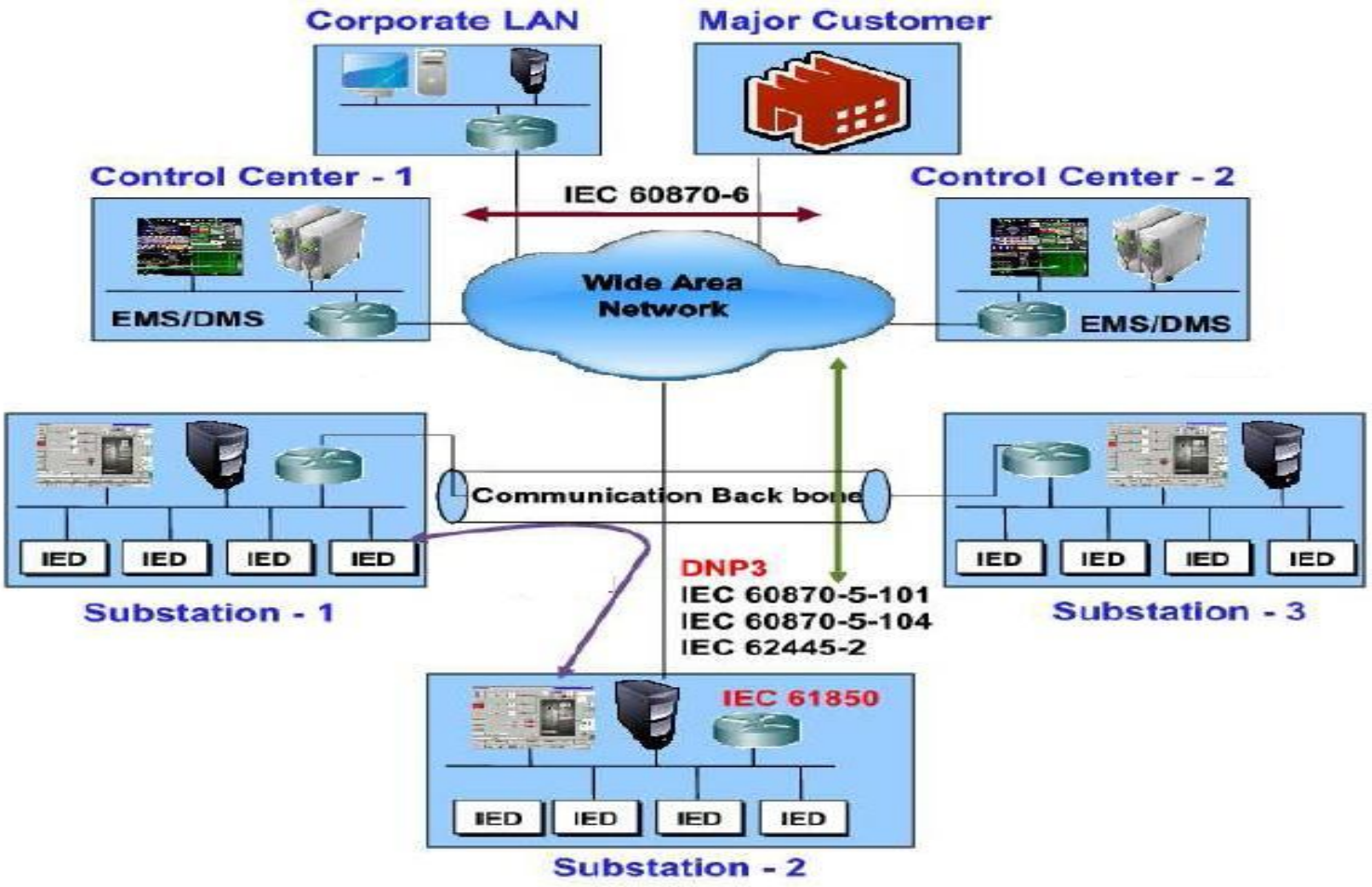
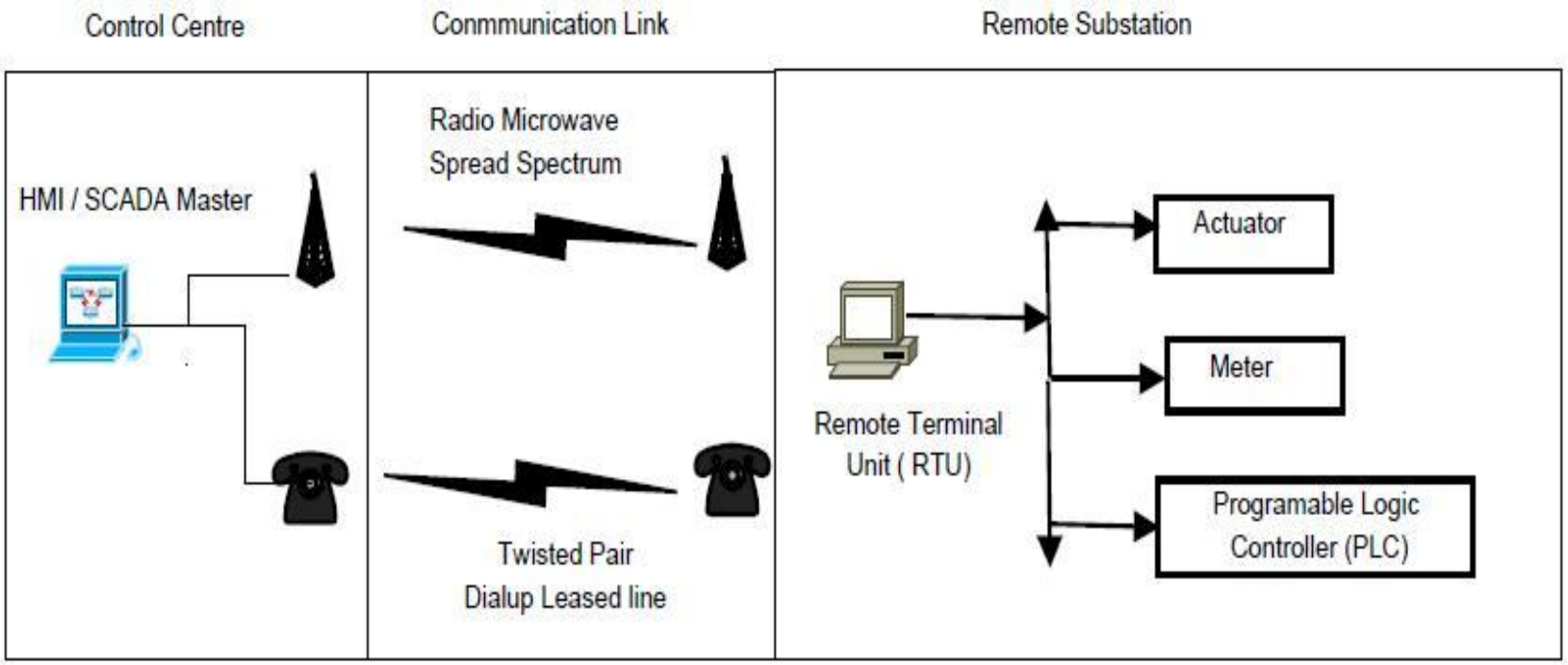
overview of electrical power system



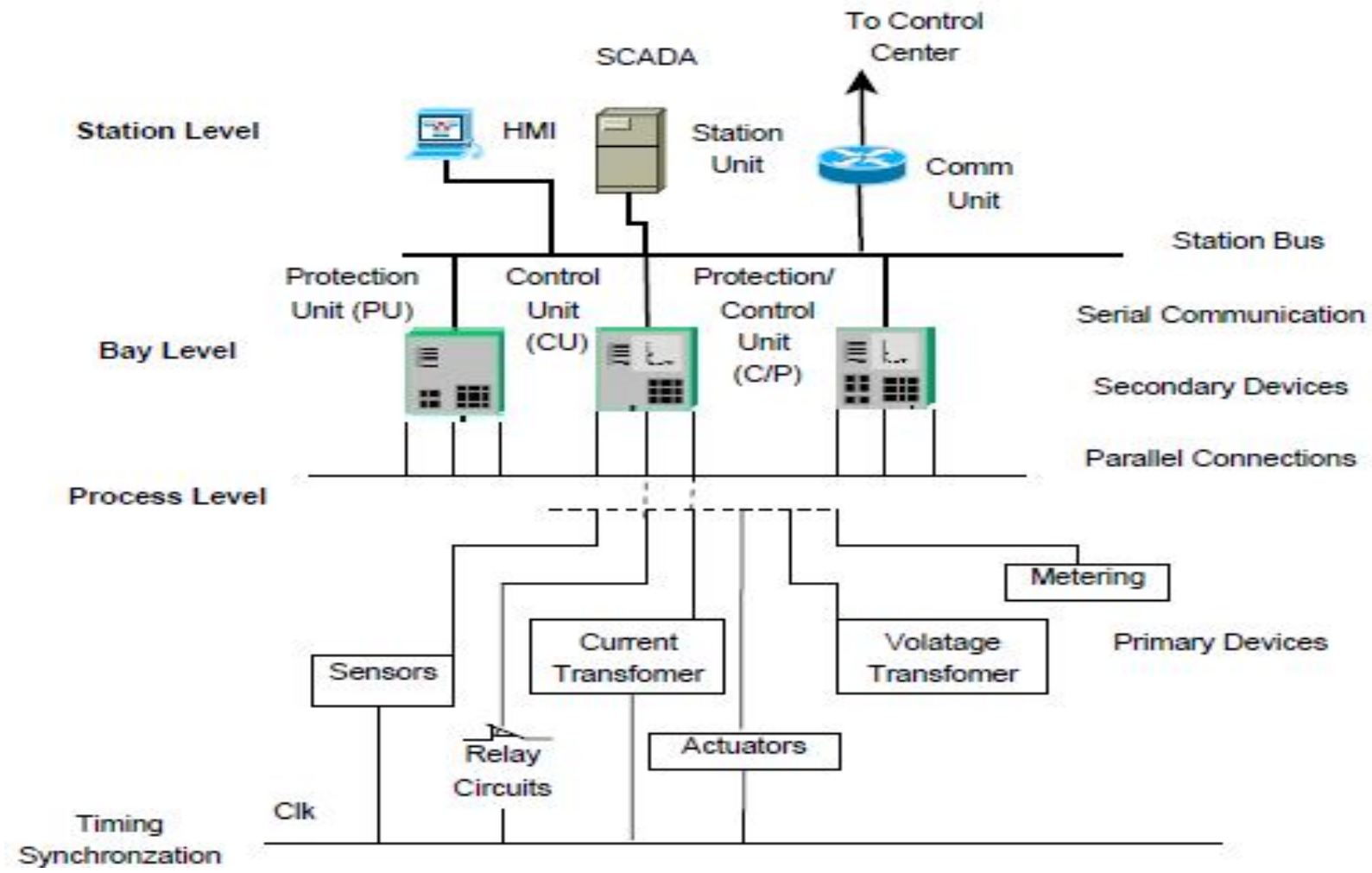
power system architecture and communication protocols



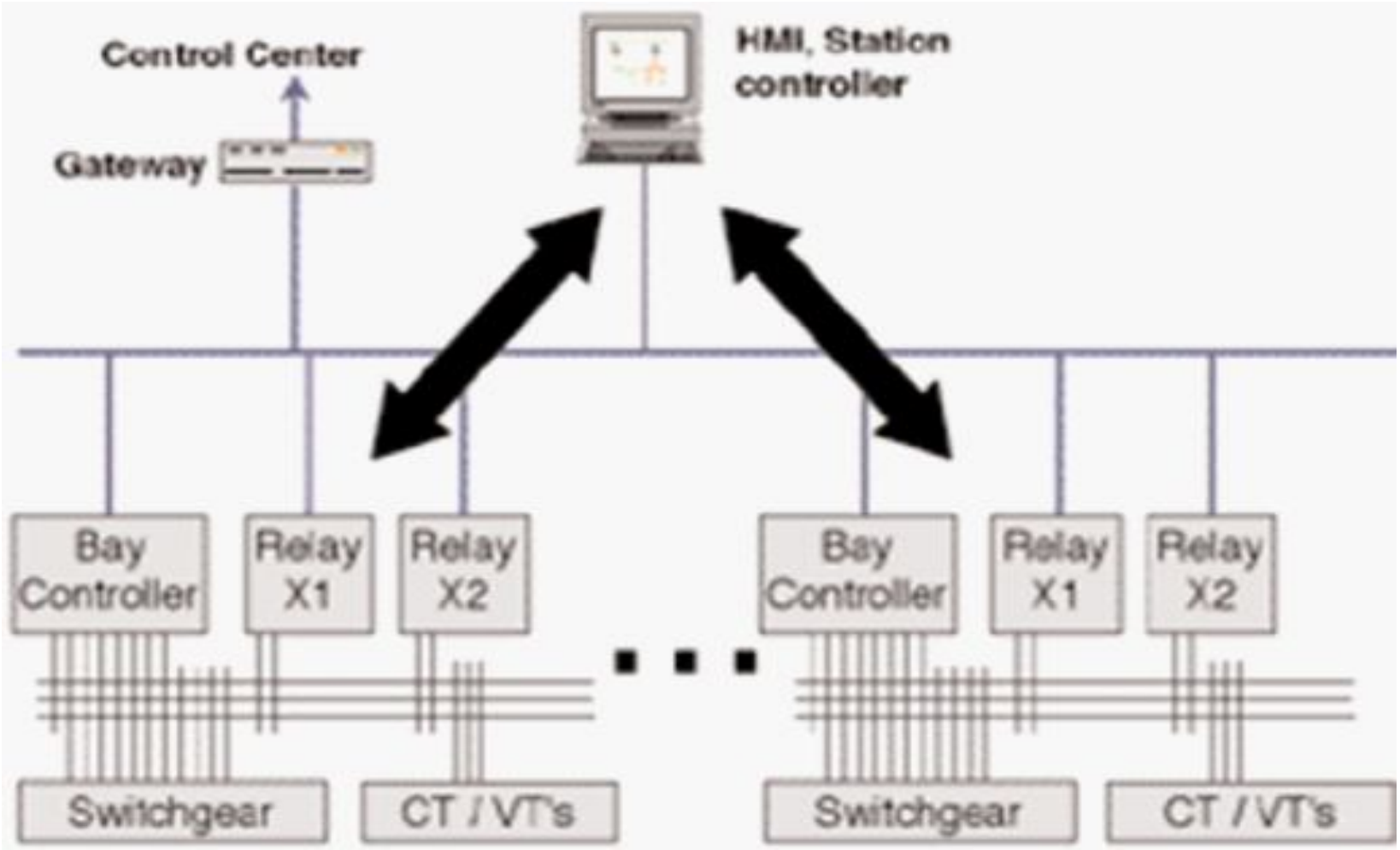
SuperviSory Control and data Acquisition (scADA) system



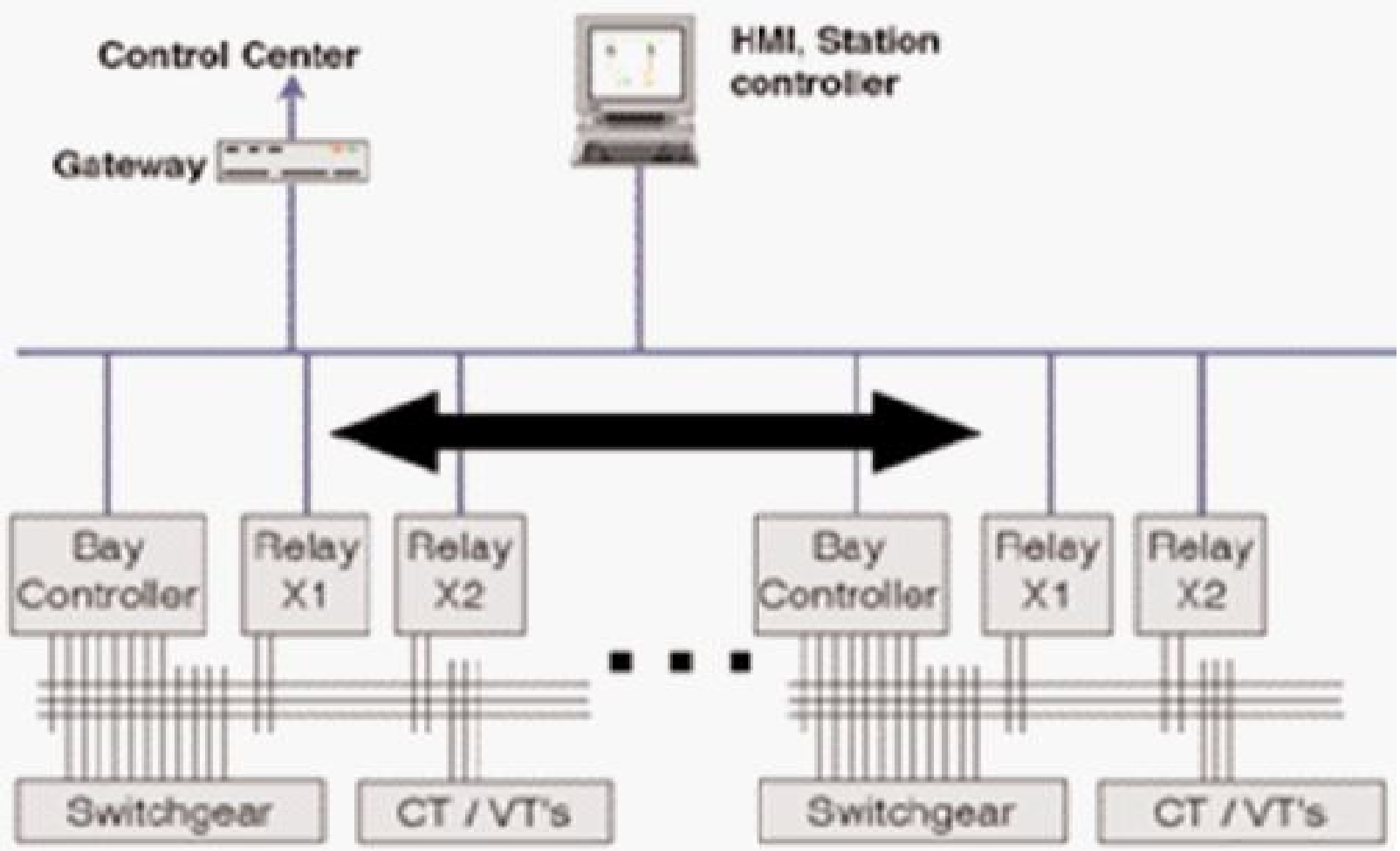
three levels of substation automation



Vertical communication



Horizontal communication



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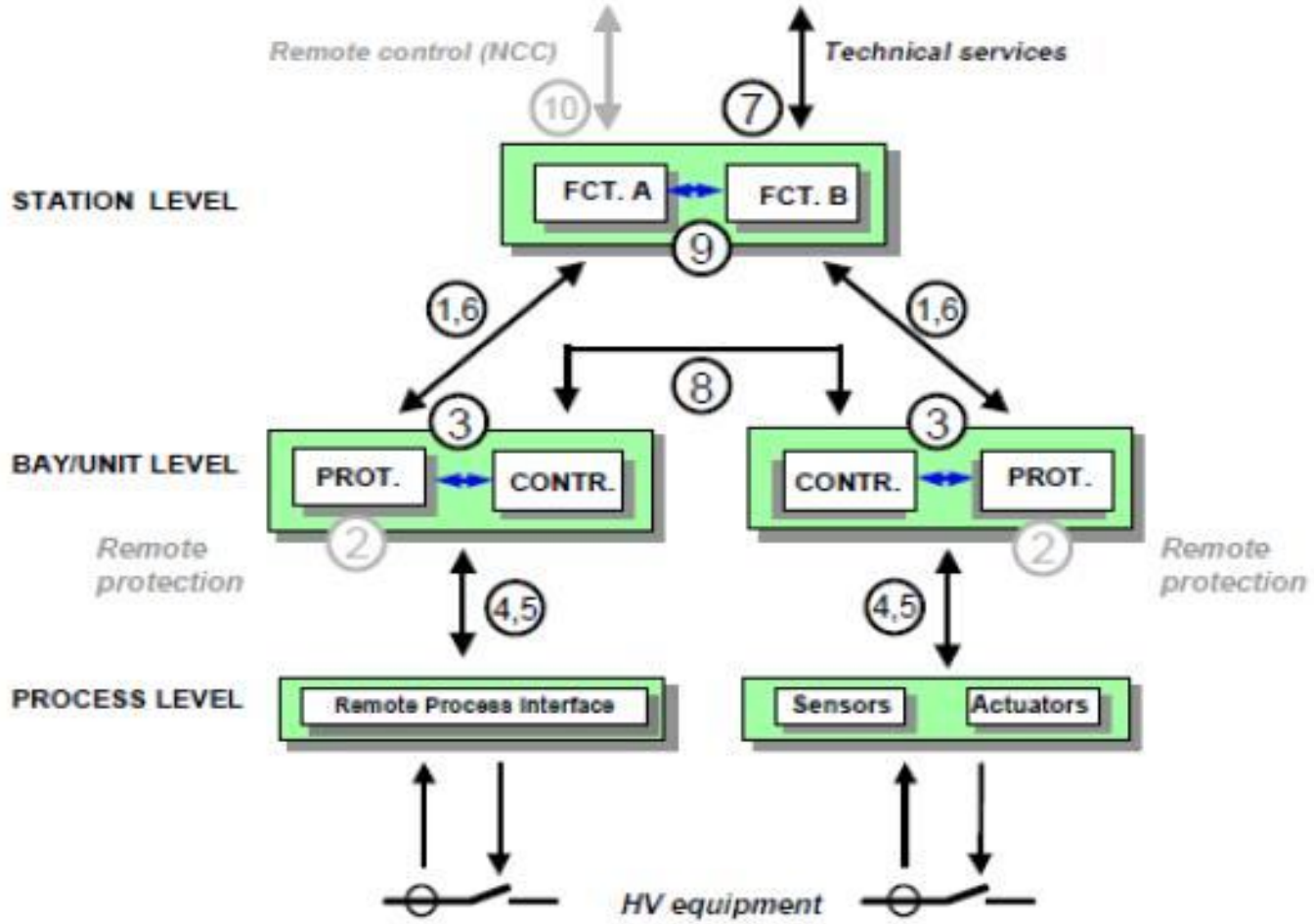
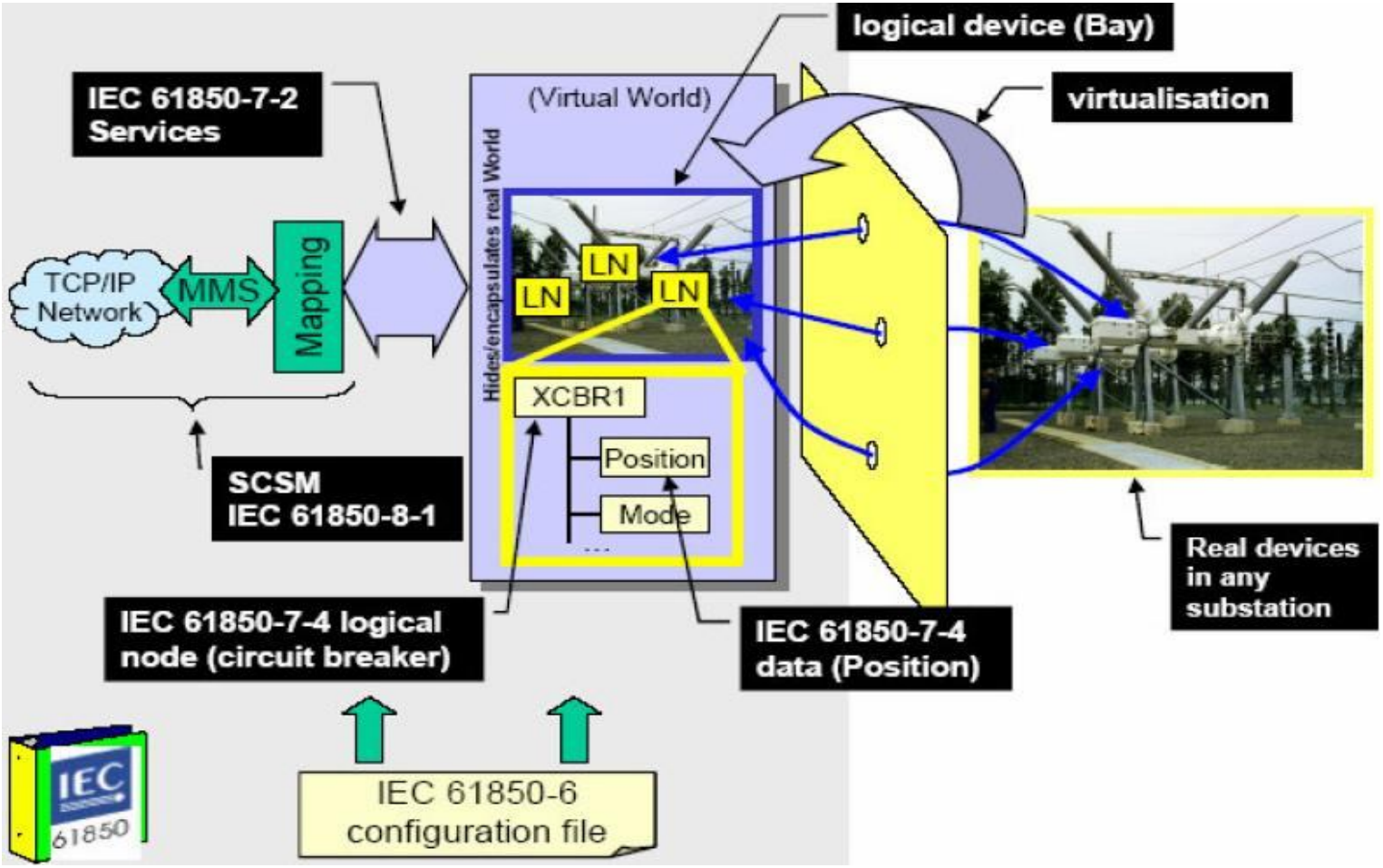
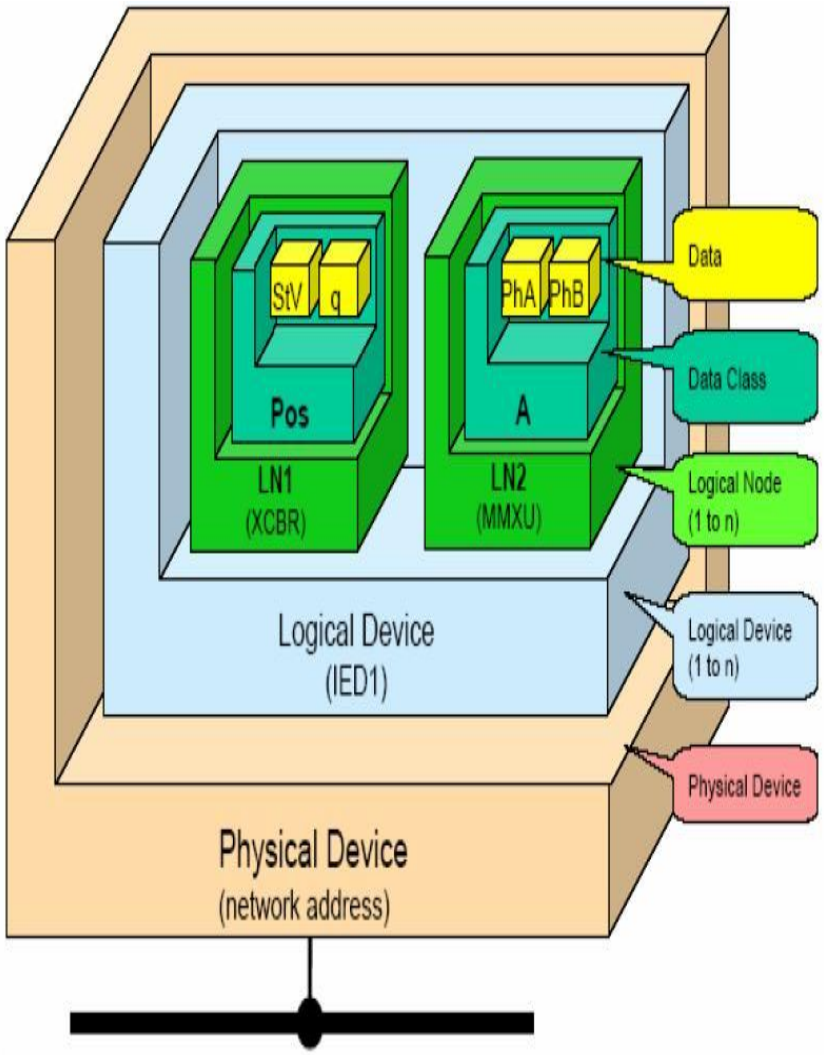
Information Structure In IEC61850



concept of virtualization

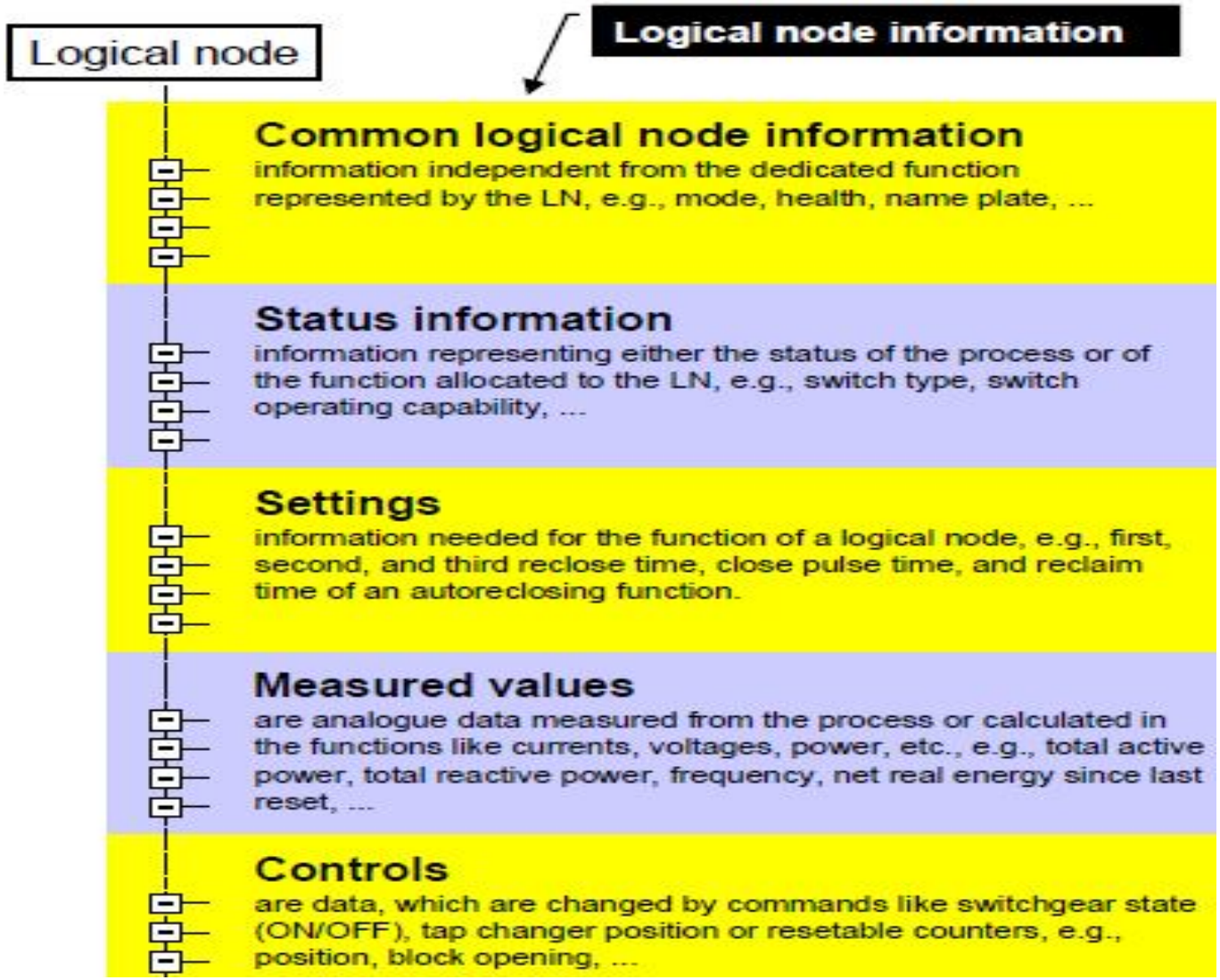


Data moDel

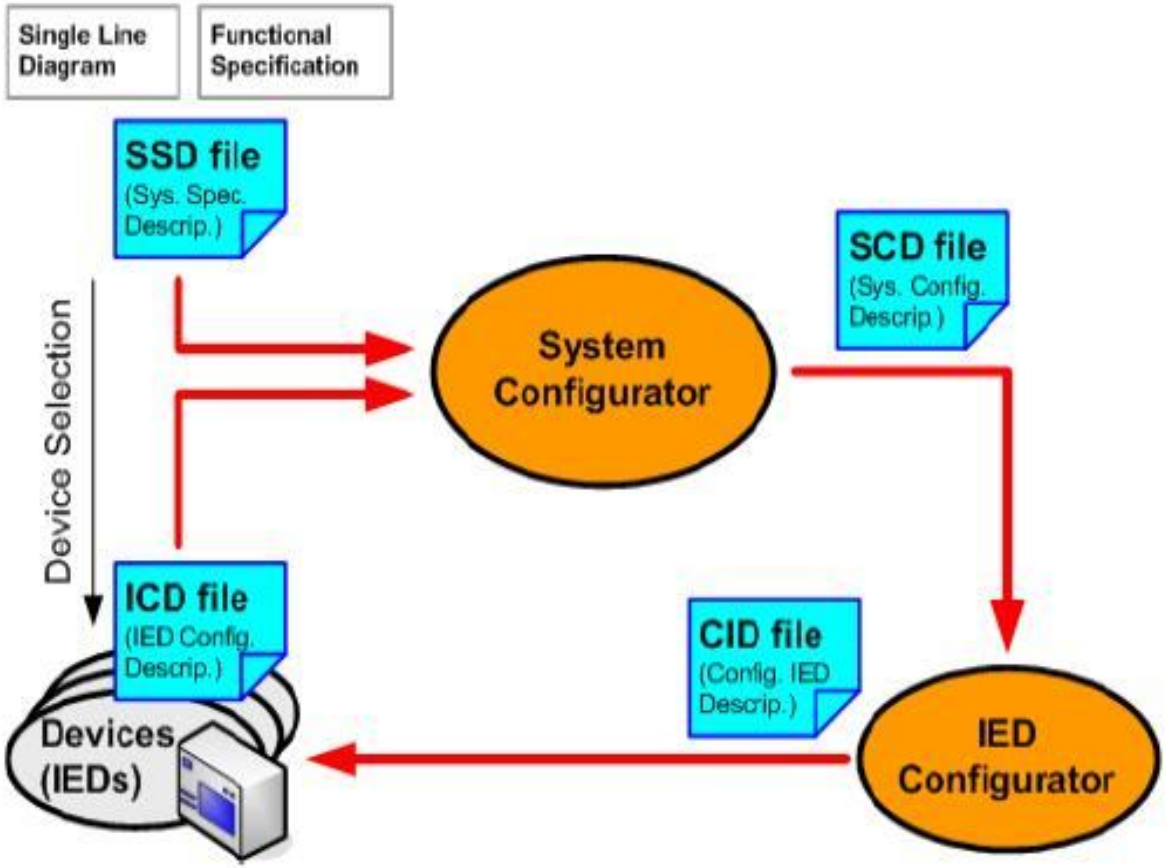


- Physical device: access by network address
- Logical device: collection of logical nodes, implemented in one IED
- Logical node:Function in the real device e.g. XEBR circuit breaker.
- Data & data attributes: properties of logical nodes e.g. position
- Several logical nodes builds a logical device(bay unit).
- Logical device builds in one IED.
- Logical devices are not distributed.

LogicaL node information categories



SubStation configuration language (SCI)

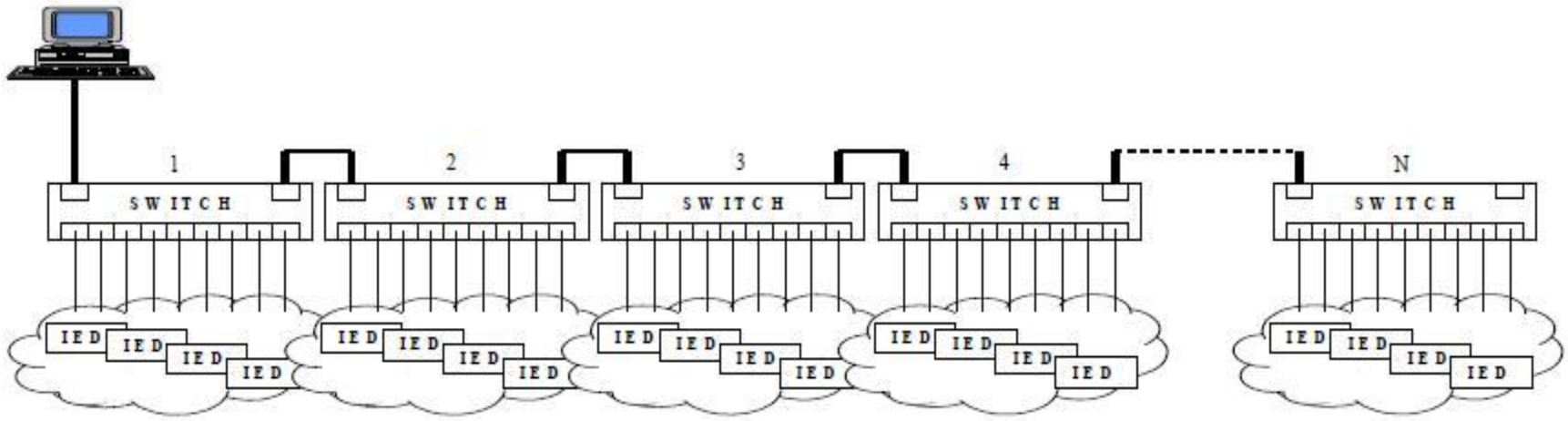


SubStation configuration language (SCl)

- **Four different file types:**
- ✓ Substation Specification Description(SSD).
- ✓ Substation Configuration Description(SCD).
- ✓ IED capability Description (ICD).
- ✓ Configured IED description(CID)
- **Five section per file**:
- ✓ Header.
- ✓ Substation.
- ✓ Communication.
- ✓ IED.
- ✓ Data type template:

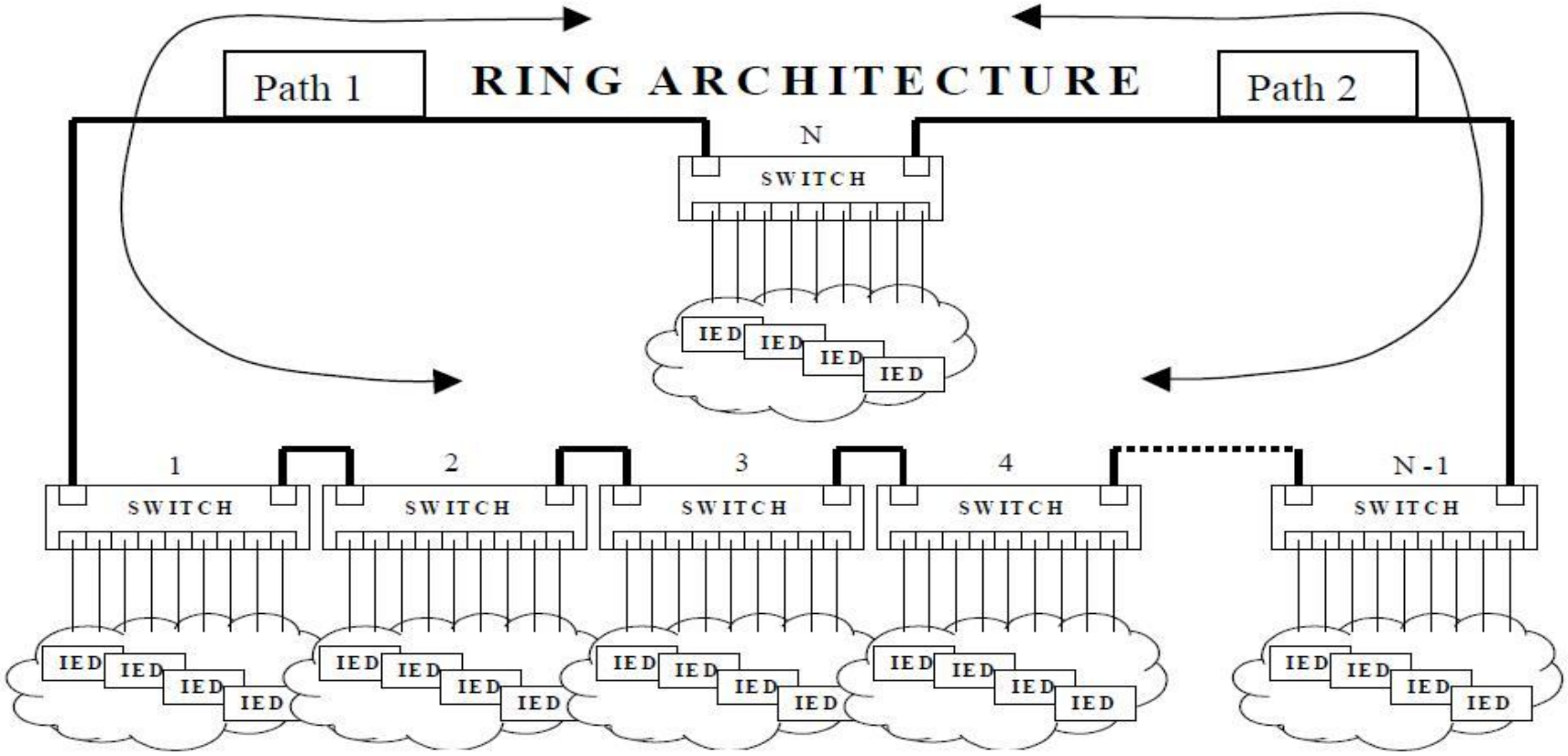
Network architecture

Bus or cascading architecture



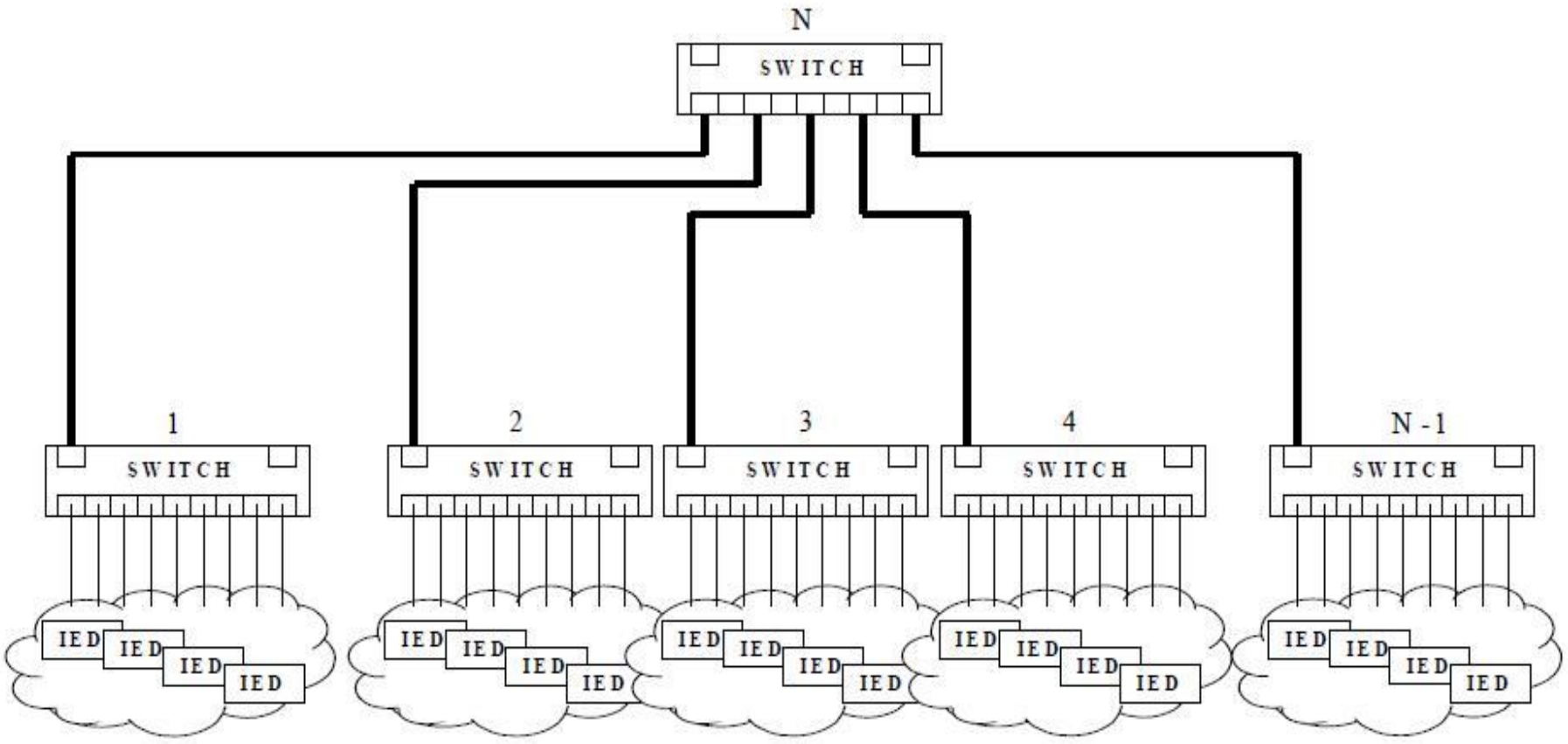
Network architecture

Ring network architecture



Network architecture

Star network architecture



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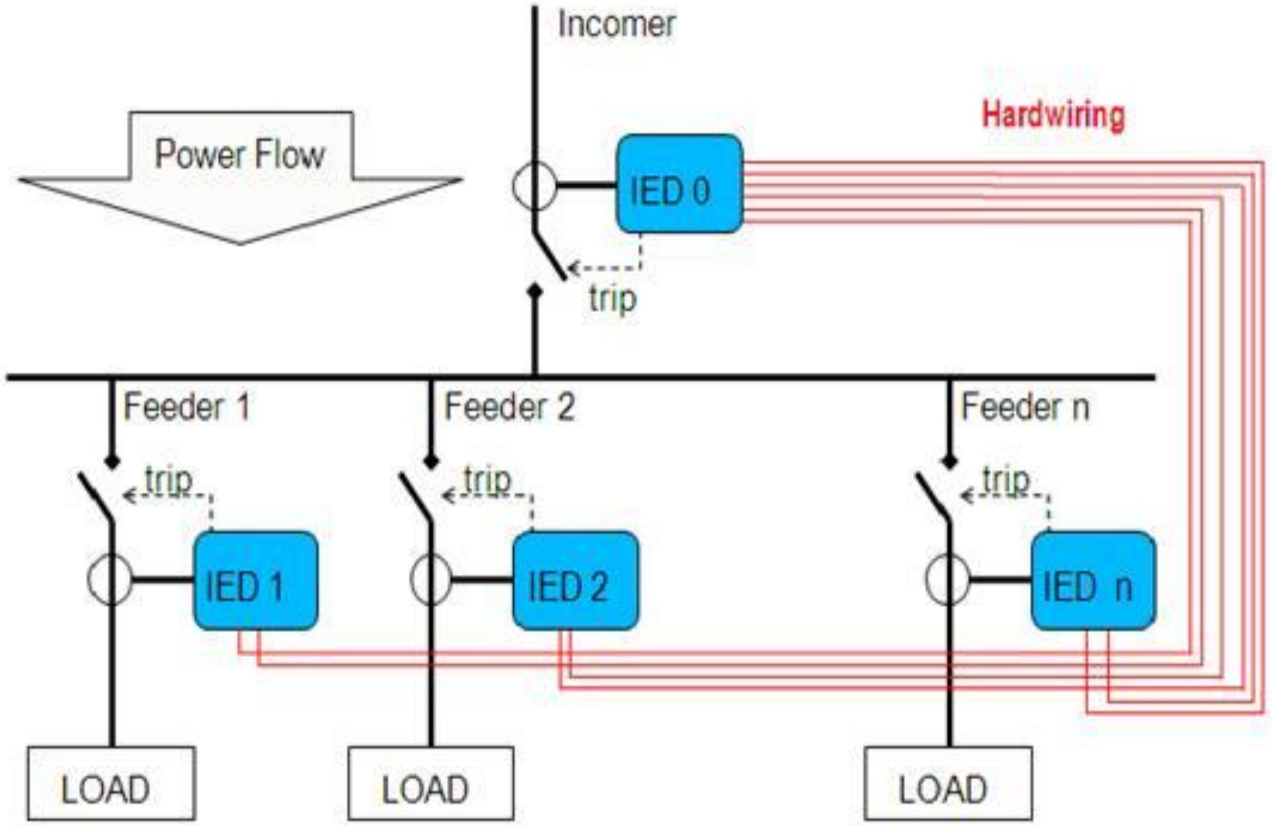
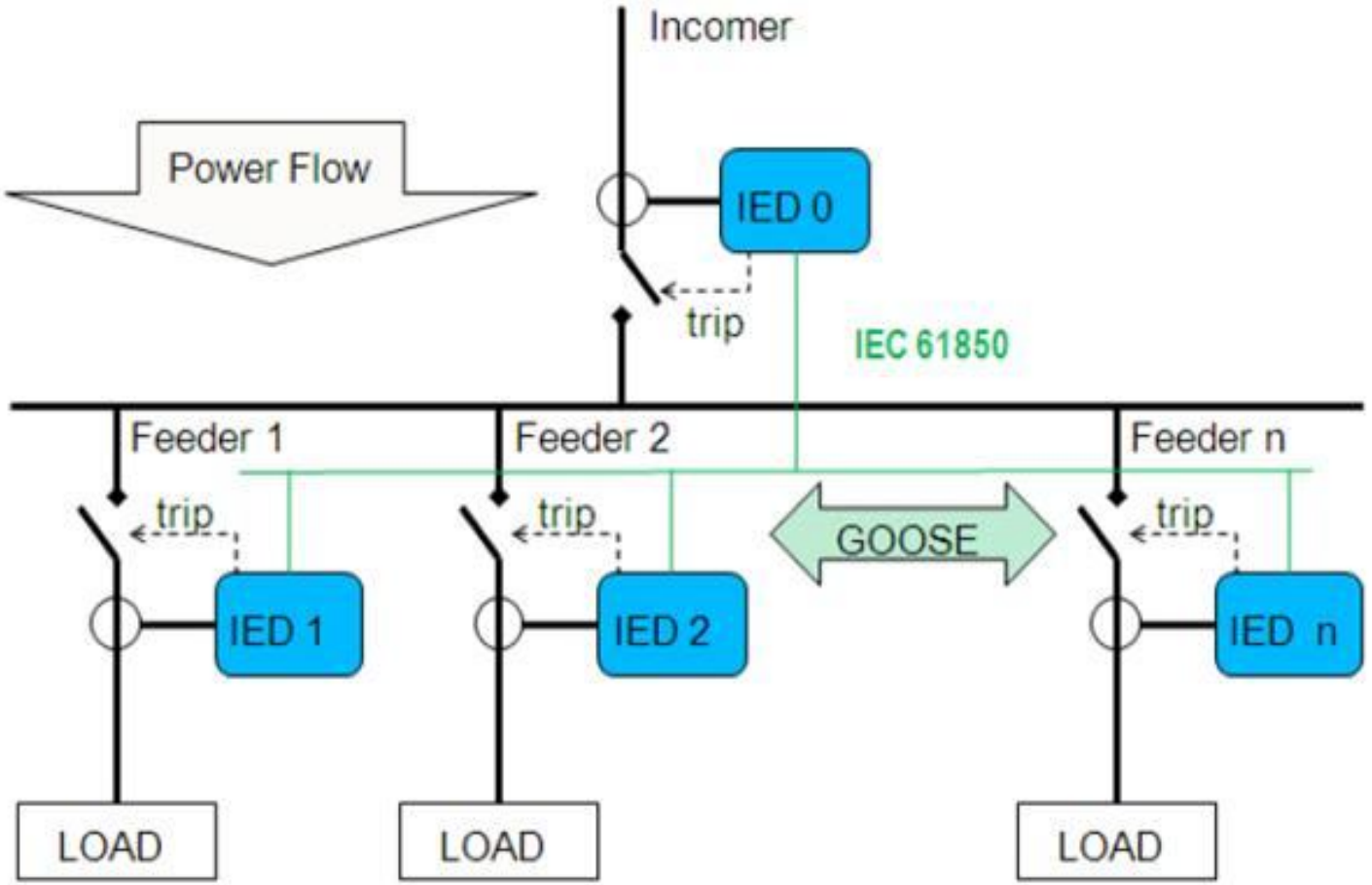
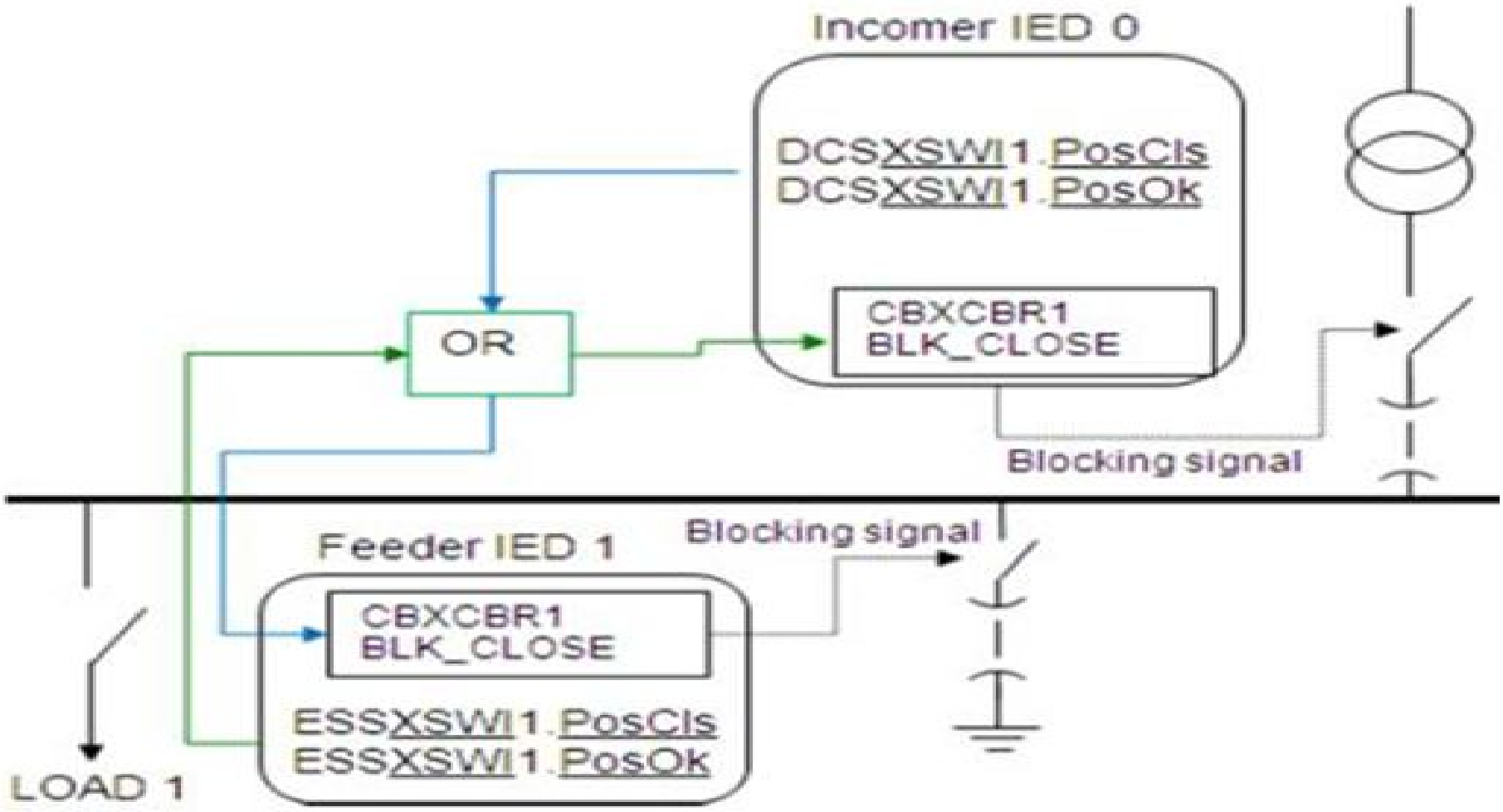
Conventional information ExchangE in SubStation



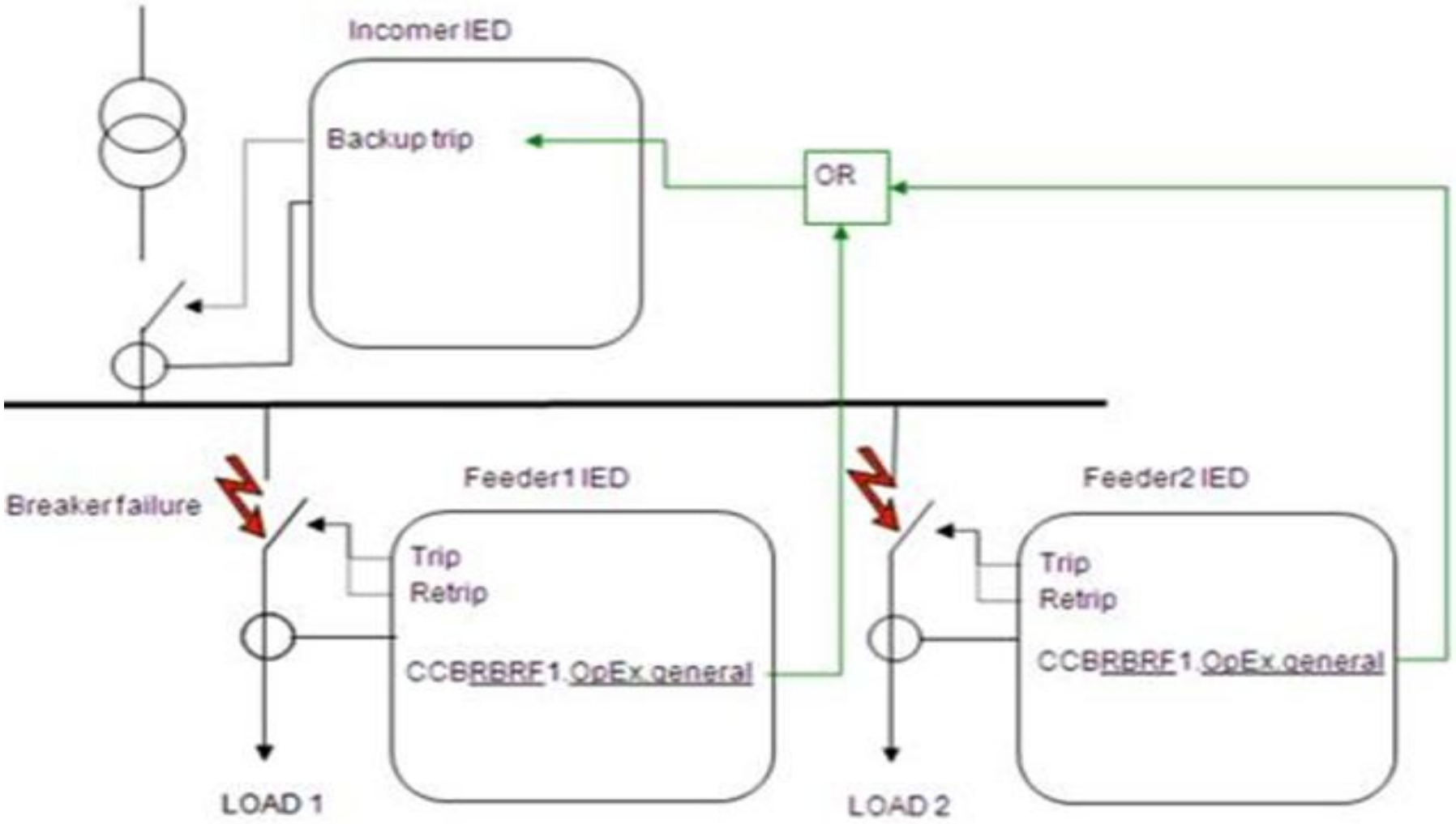
Generic Object Oriented SubStatiOn EvEnt (GOOSE)InfOrmatIOn ExchanGE



Bay interlocking



Breaker failure protection



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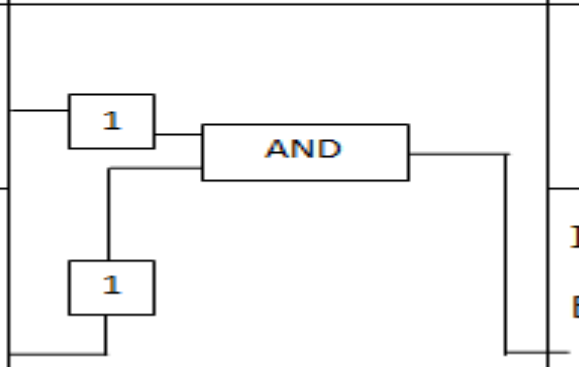
Documentation

- Substation automation system documentation:
  - ✓ Hardware documentation.
  - ✓ Parameter documentation.

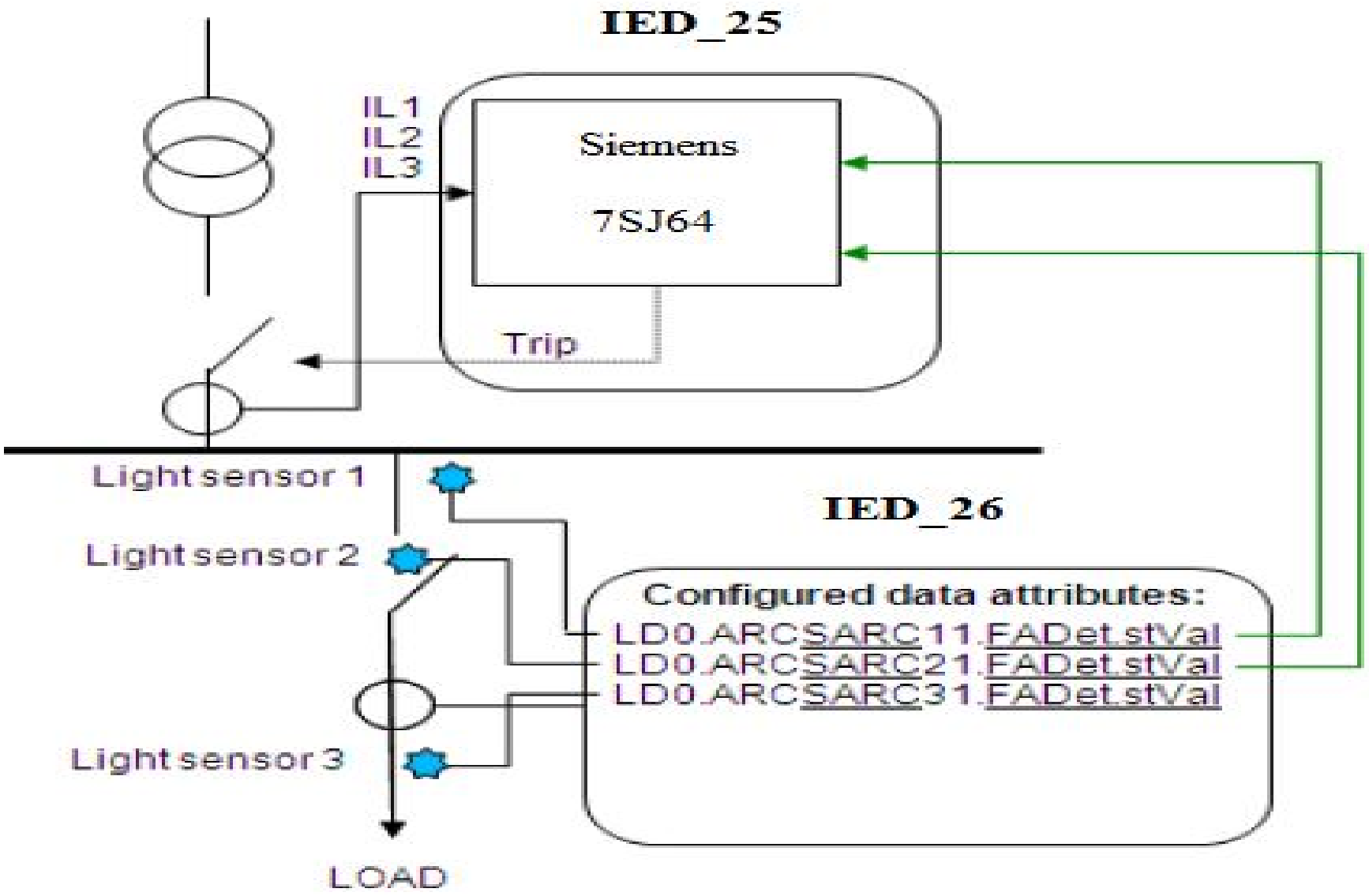
- Documentation concerning GOOSE
  - ✓ Signal list.
  - ✓ Logical diagram

example publisher	Example signal description	Example data attributes	Example GOOSE APPID	Example subscriber
IED ABB REF 615_26	ARC light detection signal,sensor1	LD0.ARCSARC11.FADet.stVal	0001	IED _25 Siemens 7SJ64

Example description	Example input signal	Example logical diagram	Example output signal	Example description
Arc light detected, sensor 1	IED_26; GOOSE 0001			
Over current protection start	IED_25 B16,B17		IED_25 B01,B02	Trip circuit breaker

Arc Flash Protection Application

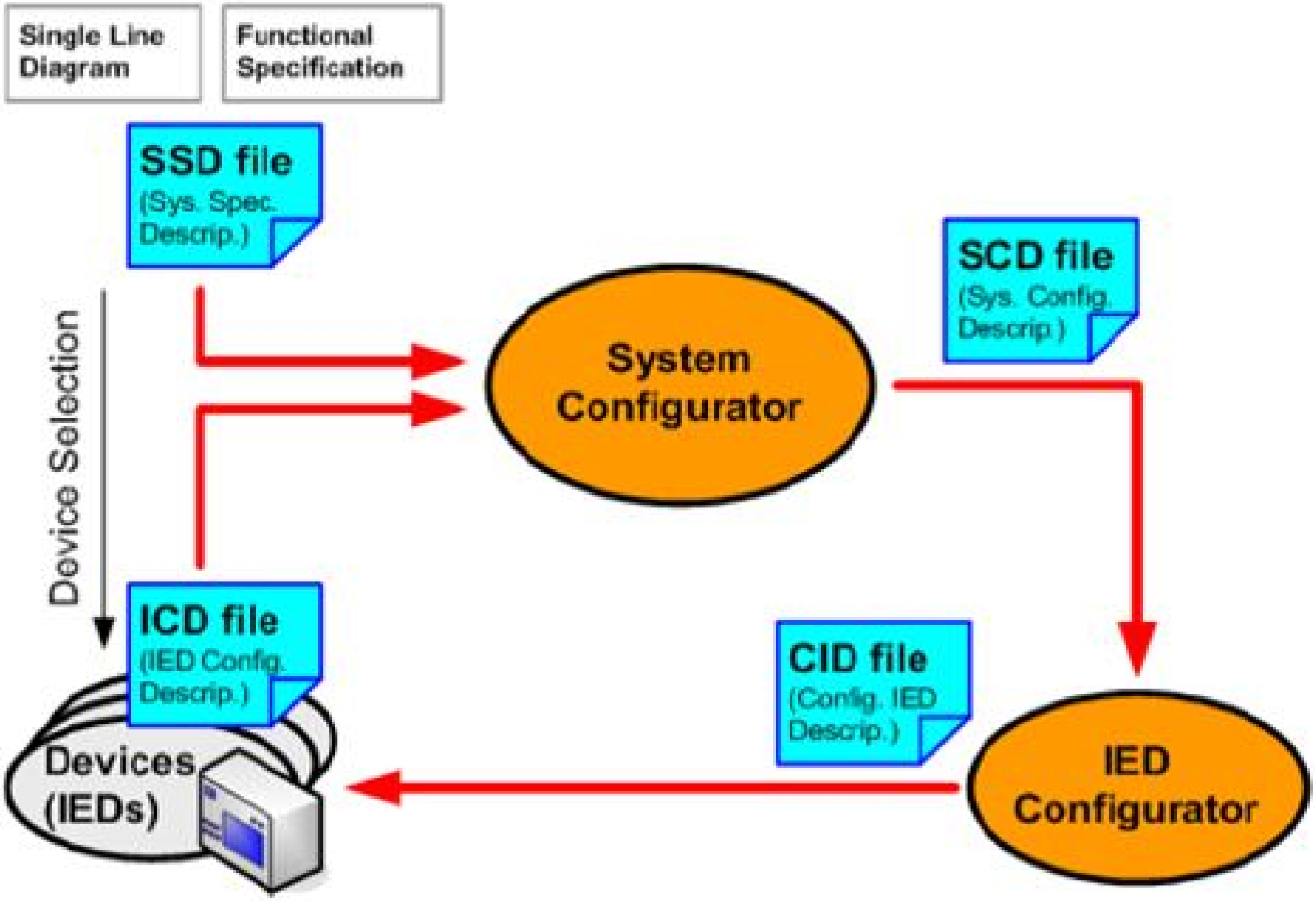
- the arc flash protection is detected by protection logical node called sensing arc (SARC).
- SARC logical node uses as a function to monitor phases and can detect light.
- SARC function sends trip signal to the related circuit breaker by using GOOSE message.


IED_25
IL1
IL2
IL3
Siemens
7SJ64
Trip
Light sensor 1
Light sensor 2
Light sensor 3
LOAD
IED_26
Configured data attributes:
LD0.ARCSARC11.FADet.stVal
LD0.ARCSARC21.FADet.stVal
LD0.ARCSARC31.FADet.stVal

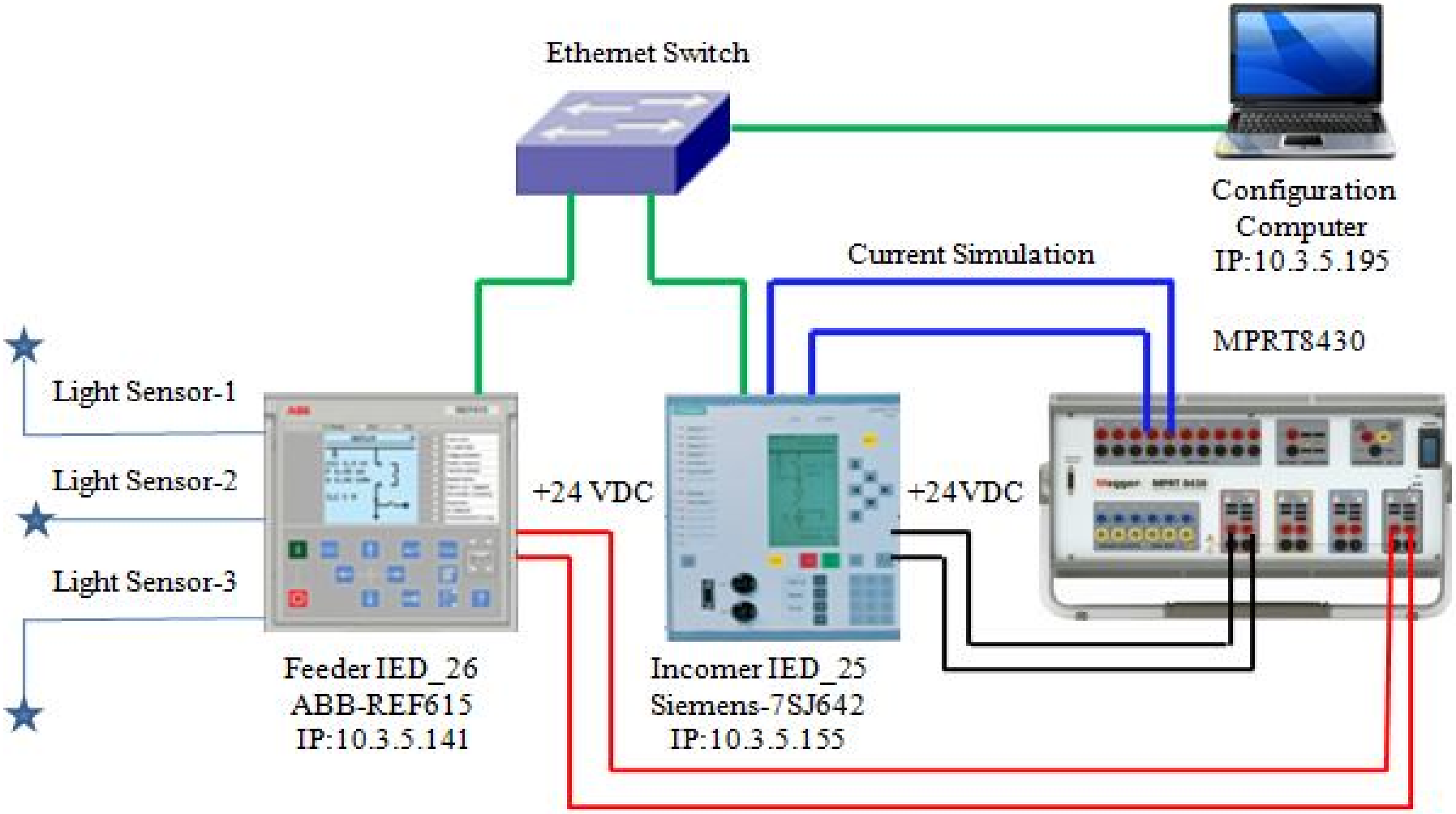
Intelligent electronic Devices (IED) Configuration

HELINKS (STS) software, used to configure IED Siemens- 7SJ64, by creating these files:

- System specification description (SSD).
- Loading the IED capability description (ICD).
- substation configuration description (SCD).
- Configured IED description (CID)


Single Line Diagram
Functional Specification
SSD file
(Sys. Spec. Descrip.)
SCD file
(Sys. Config. Descrip.)
System Configurator
Device Selection
ICD file
(IED Config. Descrip.)
CID file
(Config. IED Descrip.)
Devices (IEDs)
IED Configurator

TesTing equipmenTs



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CONCLUSIONS

- IEC 61850 Ethernet base provides interoperability.
- Investigation of GOOSE application between siemens7SJ64 and ABB REF615 has been confirmed.
- GOOSE can reduce the cost of the substation installation ,maintenance and expandability
- HELINKS(STS) is useful as substation configuration language(SCL) ,for engineers.

Recommendations

- The challenges of GOOSE based are related to security of the network, LAN is recommended to use.
- GOOSE should be used for less time critical applications, such as interlocking.
- GOOSE based application, require new type of training.
- Other tools for configuration of the IEDs based on IEC61850:

✓ ASE Visual SCL (VSCL)

✓ HELINKS Substation Tool Set (STS)

✓ H&S Substation Configuration Tool (SCT)

✓ KALKITECHSCL Manager (SCLM)

Thanks