# IEC 61850 制訂及應用實務

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# What is IEC 61850?

- A standard **structure** headed by IEC TC 57
- A standard that defines **functionalities of devices**
- A standard for a **common** communication system **architecture** inside a substation
  - Process level, cubical level, and station level
- A standardized **device description language**
- A standardized method to **access data**

# IEC61850 使用之目的

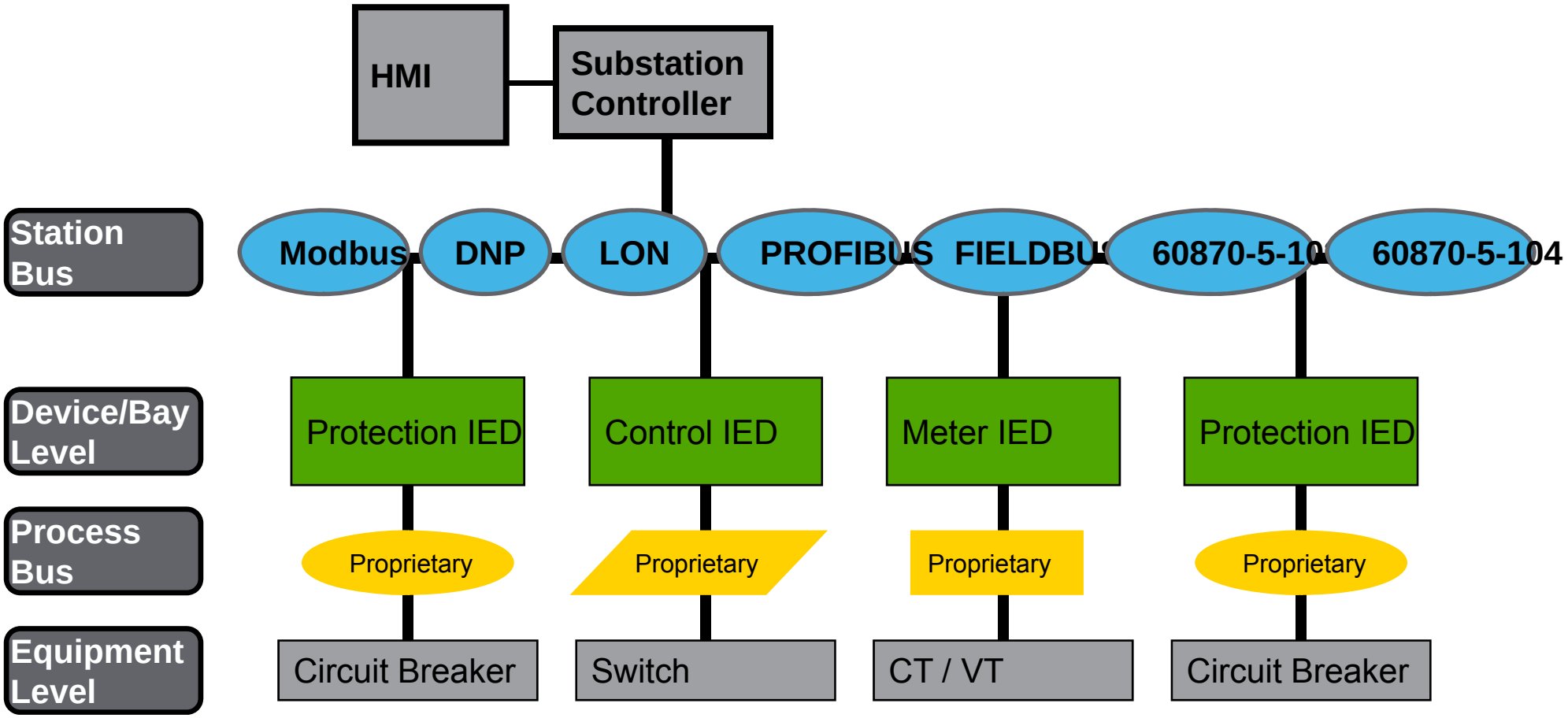
IEC61850 (Communication Networks and Systems in Substations)

- 成為一個標準之通訊語言

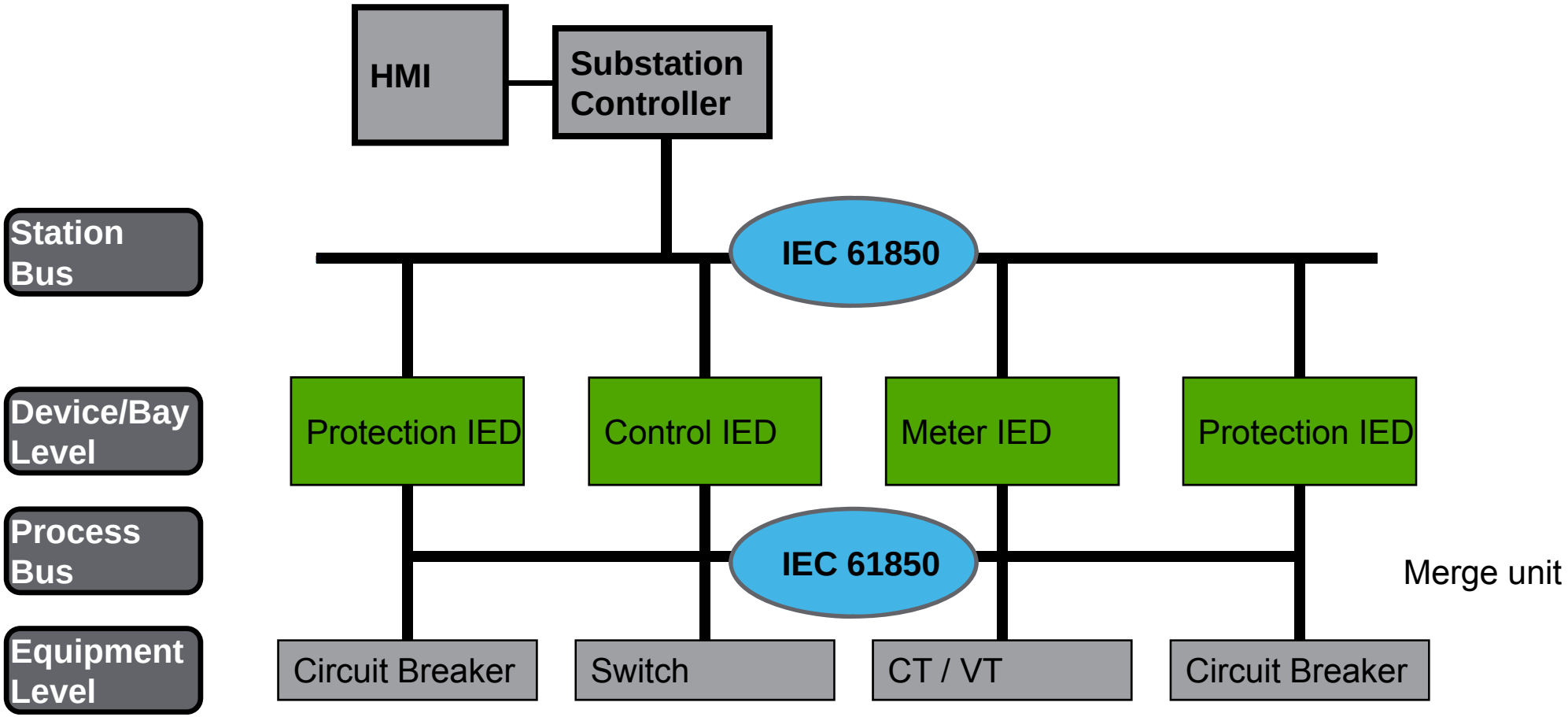
**IEC 61850**

**One world**
**One technology**
**One standard**

# Existing Protocols



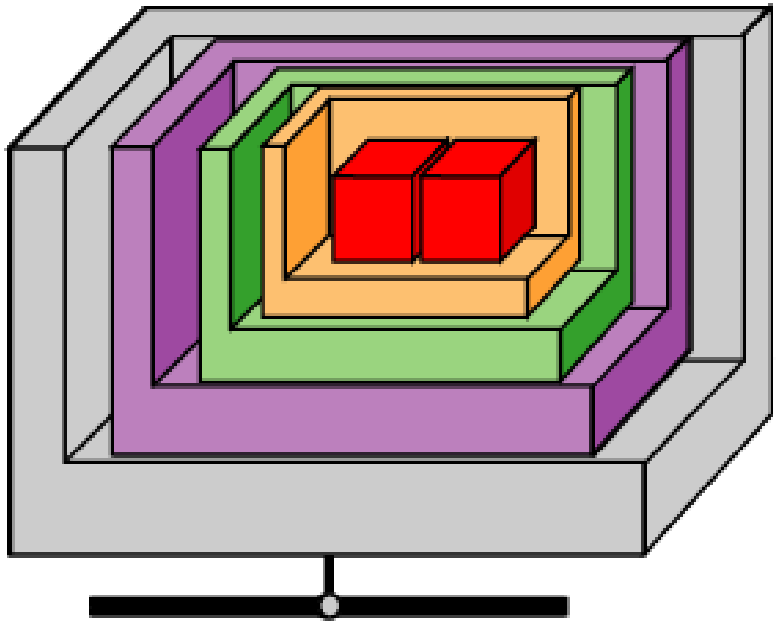
# With IEC 61850



# IEC 61850 之特點

- IEC 61850 有以下特性點: **(For IED Relays and Meters )**
  - 設備之資料格式(Device and data models, not registers and points)
  - 基於Ethernet LAN 架構下可實現快速之連所及跳脫之動作
  - 規劃語言
    - Substation Configuration Language (SCL)
  - 基於網路架構之時間同步
  - 即時之波形傳輸

# IEC61850 資料格式



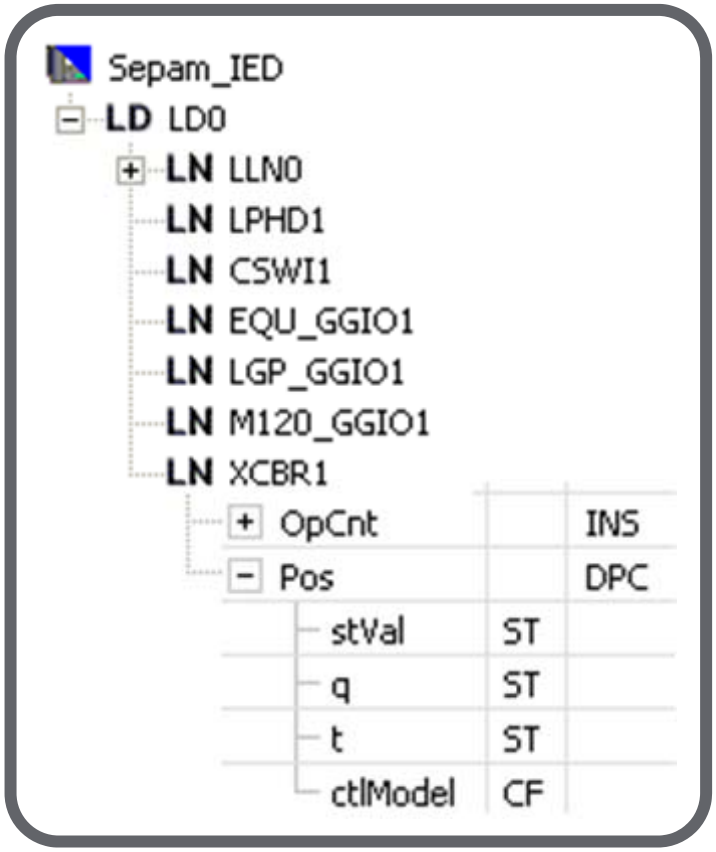
Physical Device

Logical Device

Logical Node

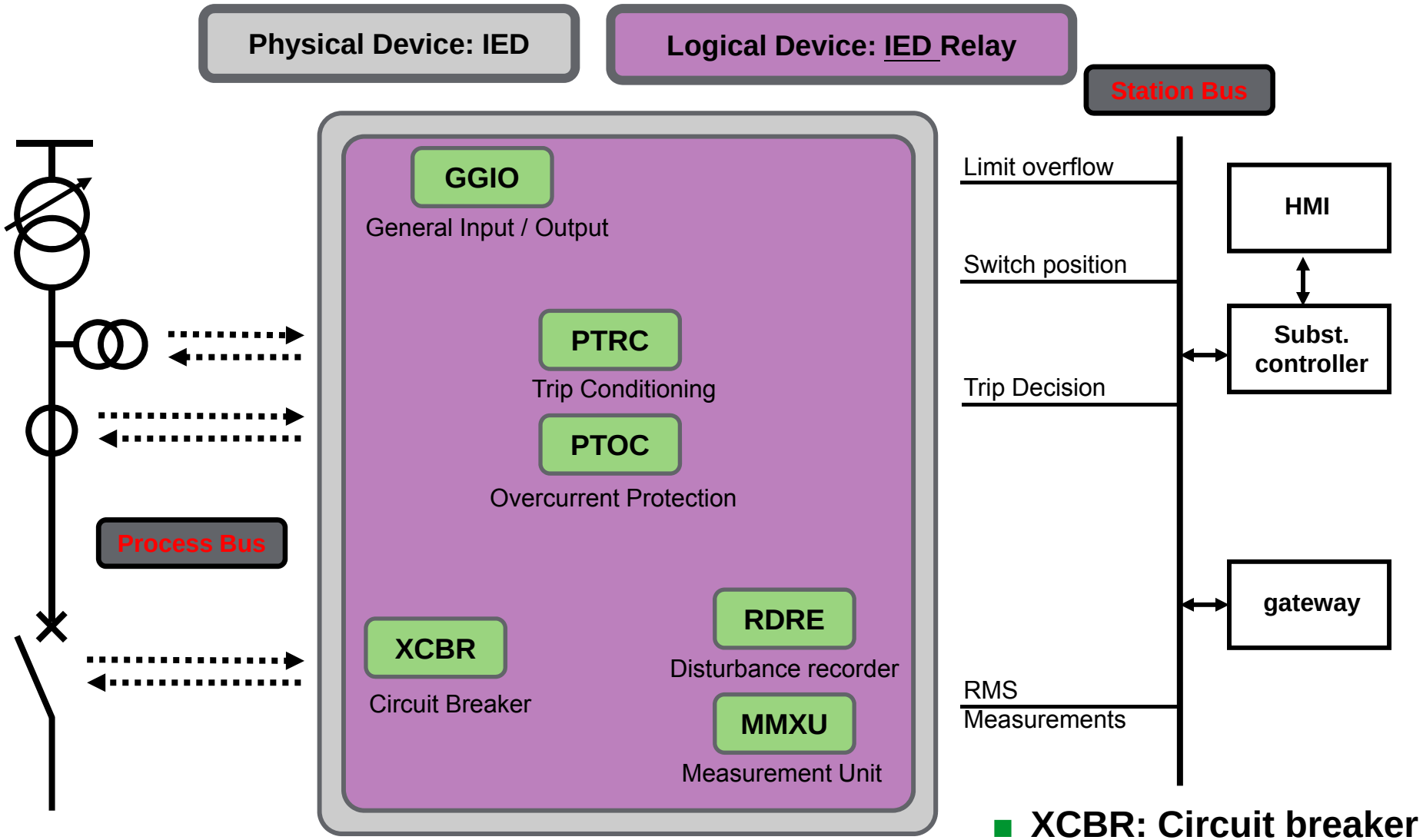
Data Object

Data Attribute




Physical Device：自我敘述描述此IED

# IEC61850 Device Model

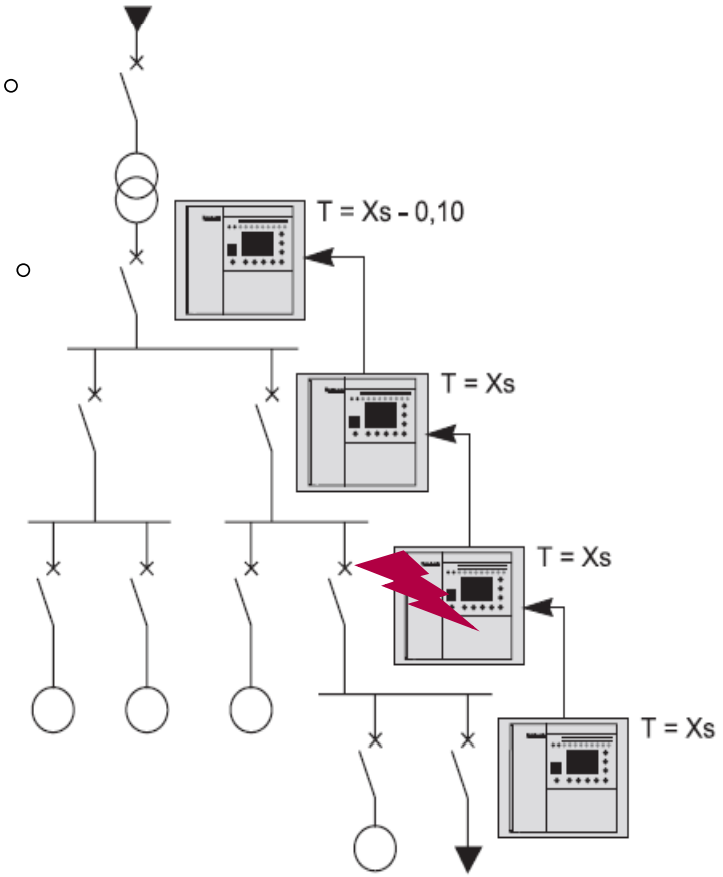



- **XCBR: Circuit breaker**

# IEC 61850 之特點 for IED Relays

## GOOSE (Generic Object Oriented Substation Event)

- GOOSE 功能為 (Peer-to-Peer) 點對點訊號傳輸。
- GOOSE 功能應用:
  - 下游故障點跳脫時，瞬間閉鎖上游保護功能。
    (GOOSE Timer is Faster )
  - 斷路器失靈保護
  - 直接傳輸跳脫
  - 連鎖用途
  - 卸載用途



# IEC61850 規劃語言(程式語言)

標準化之設備敘述語言 (A standardized device description language )

**S**ubstation **C**onfiguration Description **L**anguage (**SCL**)

Based on **XML** (Extensible Mark up Language)

- XML based language that allows a formal description of:
  - Substation automation system, the devices and the relation between them
  - IED configuration

- SCL file types
  - **ICD**: IED Capability Description
    - XML description of items and capabilities supported by an IED
  - **CID**: Configured IED Description
    - XML configuration for a specific IED
    - Resides on the device
  - **SCD**: Substation Configuration Description
    - XML description of the single substation
    - Can be imported or exported from the client software

# Substation Configuration Language (SCL )

```
<xml version="1.0" encoding="UTF-8" >
<SCL xmlns="http://www.iec.ch/61850/2003/SCL"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://www.iec.ch/61850/2003/SCL SCL.xsd">
<Header id="“IED definition file" version="1" revision="0" nameStructure="IEDName" />
<IED name="TEMPLATE" type="“IED Type" manufacturer="“IED Factory"      configVersion="1.0"
  desc="modèle générique ">
    <Services>
      <DynAssociation />
        <SettingGroups />
        <GetDirectory />
      ....
      </Services>
    <AccessPoint name="AP1">
        <Server>
          <Authentication none="true" />
          <LDevice inst="x8x" desc="xxxxxxx">
              <LN0 inst="" desc="General" lnClass="LLN0" lnType="LLNO_IED" />
              <LN inst="1" prefix="" desc="Device" lnClass="LPHD" lnType="LPHD" />
              ..................
```

ICD file

# IEC 61850 制訂準則

The standard covers general requirements relating to :
**substations, engineering, data models, communications solutions and conformity testing.**

- **1. Introduction and Overview of all the parts of IEC 61850**
- **2. Glossary**
- **3. General Requirements**
- **4. System and Project Management**
- **5. Communication Requirements for Functions and Device Models**
- **6. Substation Automation System Configuration Description Language**
- **7 Basic Communication Structure for Substation and Feeder Equipment**
  - **7-1 Principles and Models**
  - **7-2 Abstract Communication Service Interface (ACSI)**
  - **7-3 Common Data Classes**
  - **7-4 Compatible Logical Node Classes and Data Classes**
- **Specific Communication Service Mapping (SCSM)**
  - **8-1 Mapping to MMS (ISO/IEC 9506 Part 1 and 2)**
  - **9-1 Serial Unidirection Multidrop point to point link**
  - **9-2 Mapping on a IEEE 802.3 based process bus**
- **10 Conformance Testing**

# IEC 61850 制訂準則

There are 14 parts in the standard ( 10 of which are major sections)

Parts 1 to 4 : contain the introduction of all the general requirements

Part 5 :describes the basic requirements for substation automation functions

Part 6 :define the substation configuration language

Part 7 -1, 7-2, 7-4 :contain communication definitions for a variety of functions (data models and communications services )

Part 8 and 9: define mappings of the definitions contained in part 7 to real networks

Part 10 :define conformance testing methods

# Abstract Communication Service Interface ACSI

- Why have an Abstract Service?
  - Isolates actual data from the communication interface
  - Allows for mapping to other protocols
- What does it define?
  - How to organize Data objects in Logical Nodes
  - How to build a Logical Device from Logical Nodes

# ACSI – Models

- Client / Server model
  - Allows for browsing of the device data
  - Examples of services
    - GetDataValues – Read
    - SetDataValues – Write
    - GetDataDirectory – Read list of object names
  - Reporting of events

- Generic substation event model
  - Allows for peer to peer, real time communication (publisher / subscribers)
    - GOOSE (Generic object oriented substation event)

# Communication Models

- DataSet Model
- Reporting Model
- Control Model
- Substitution Model
- Setting Group Control Model
- Logging Model
- File Transfer Model

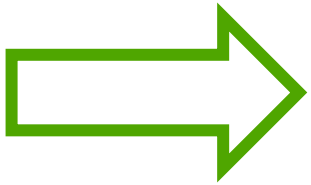
# DataSet Model

- A grouping of references to data objects and data attributes
- Used to access a specific set of data for reporting and logging purposes as defined by the client
- Stored on both the client and server; only data values need to be transmitted
- Data Objects in a dataset may be accessed by other datasets
- Resides within a Logical Node, but may reference data and attributes from any LN within the Logical Device

- Abstract Services
  - GetDataSetValues
  - SetDataSetValues
  - CreateDataSet
  - DeleteDataSet

# Data Objects

- Represents the data within a Logical Node
  - Voltage, current, breaker position, protection settings…
- Defined by groupings of specific data attribute types
  - Description, status, measurements, control…
- Uses standardized names instead of registers
  - PhV – Phase to neutral voltage (ie: not 41001)
- Abstract Services functions
  - GetDataValues
  - GetAllDataValues
  - SetDataValues



# Common Data Classes (CDC)

- **Status Information**
- **Measured Information**
- **Controllable Status**
- **Controllable Analogue**
- **Status Settings**
- **Analogue Settings**
- **Description Information**

# Reporting Model

- Reports the data listed in a **dataset** on events
- Each report is owned exclusively by a single client
- Buffered and Unbuffered models
- Can send all data, or just the data that has updated

- Trigger Conditions
  - **dchg** A change in the value of a data attribute by more than the deadband value
  - **qchg** A change in the value of the quality attribute
  - **dupd** A data attribute value is updated (refreshed), or a freezable attribute is frozen
  - **periodic** A report is generated periodically
  - **GI** A general interrogation request by the client

# Buffered vs. Unbuffered Reports

- Buffered Report Control Blocks (BRCB)
  - On event, the report is either sent immediately or buffered
  - Events are buffered so that data is not lost due to flow control of bad connections
  - Supports Sequence-of-Events (SOE)

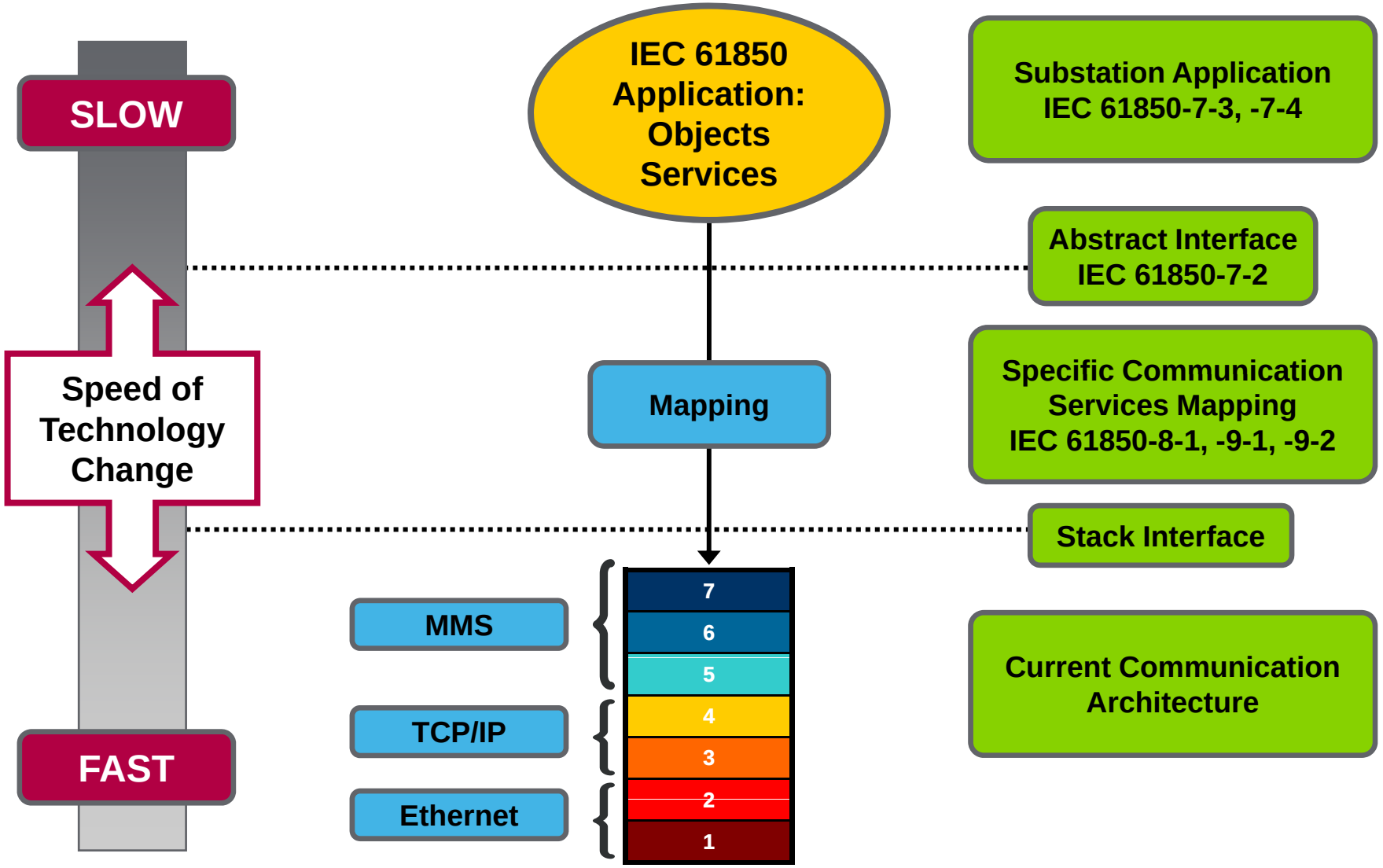
- Unbuffered Report Control Blocks (URCB)
  - On event, the report is sent immediately
  - Events can be lost if the transport flow control is not fast enough or the connection is poor

# Specific Communication Service Mapping SCSM

- Defines how to map objects and services from ACSI to an existing communication medium

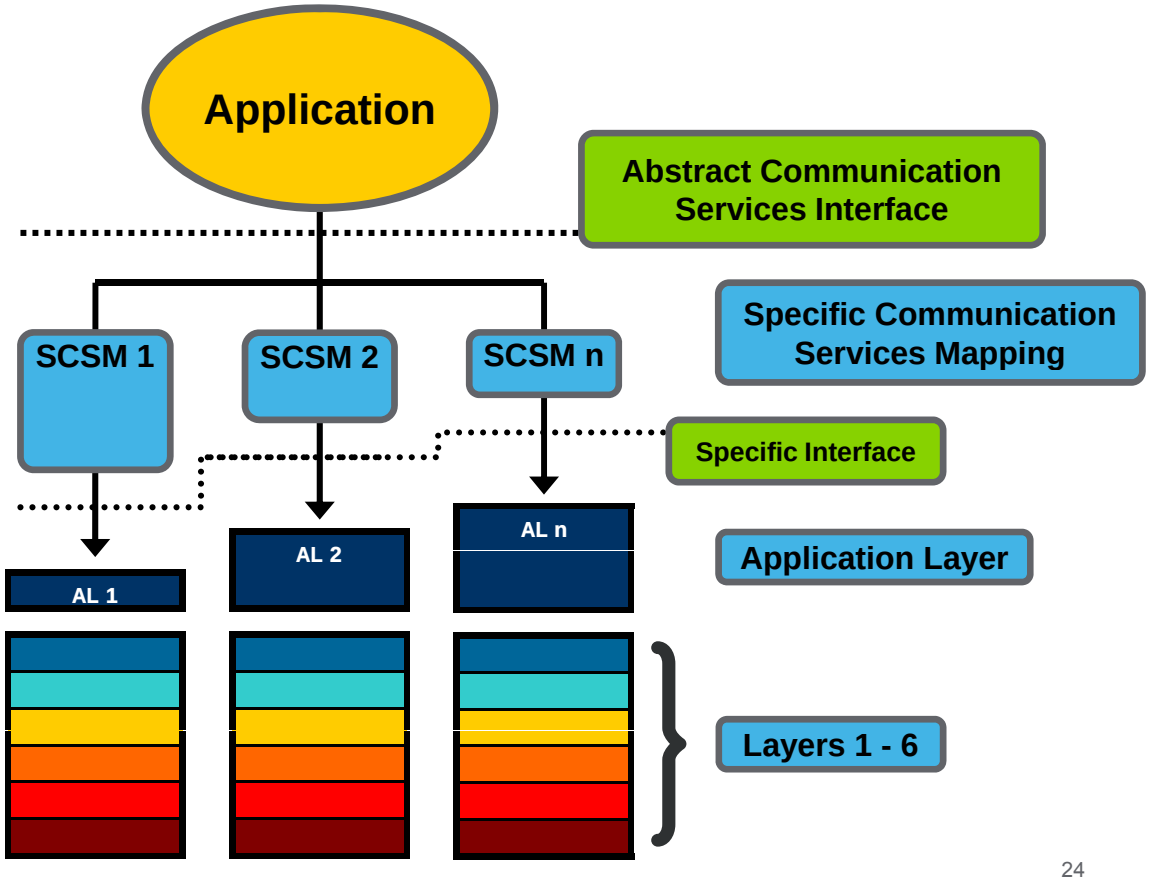
| | |
|---|---|
| Part 8-1 | Mapping ACSI to MMS |
| Part 9-1 | Mapping ACSI to Sampled Values over Serial |
| Part 9-2 | Mapping ACSI to Sampled Values over Ethernet |

# From Application to Communication



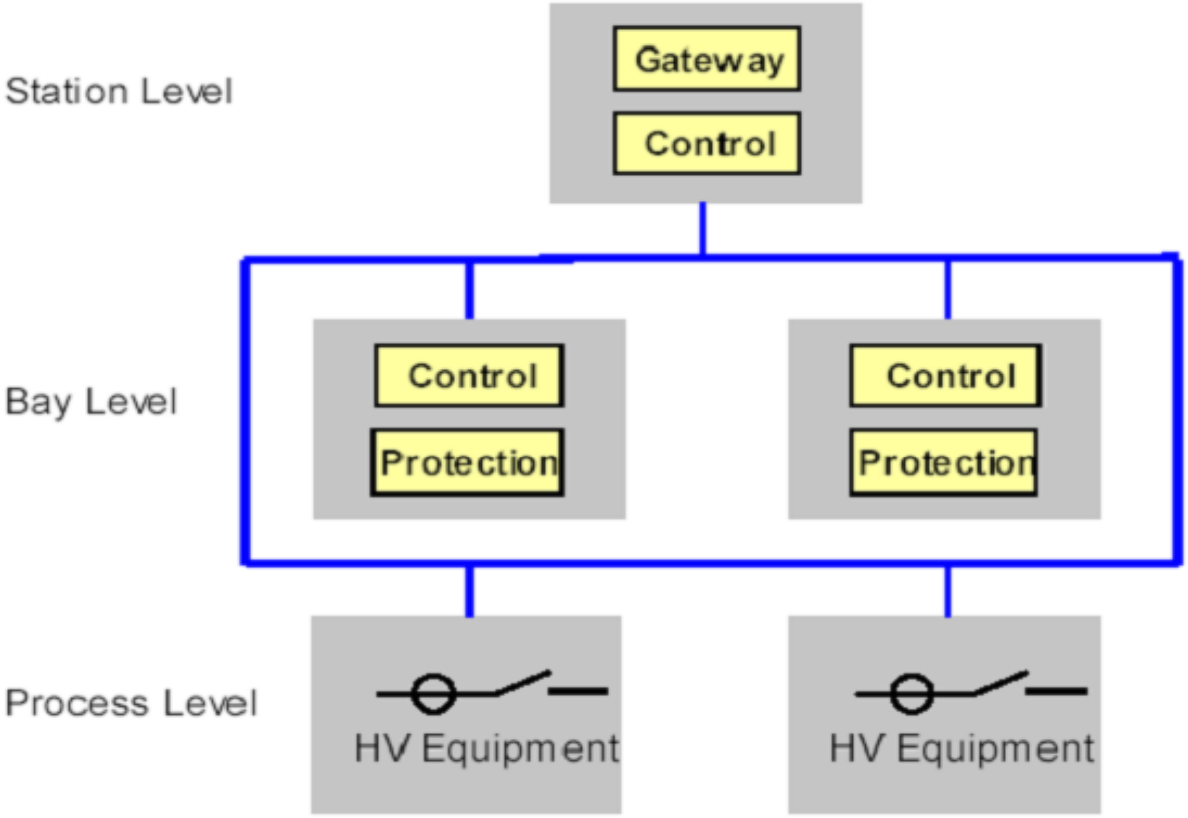
# Mapping to Different Buses

- Station bus
  - Part 8-1: Mapping to MMS and Ethernet
- Process bus
  - Part 9-1: Mapping over Serial
  - Part 9-2: Mapping over Ethernet



# IEC61850變電站屬性規劃

- Single substation bus network

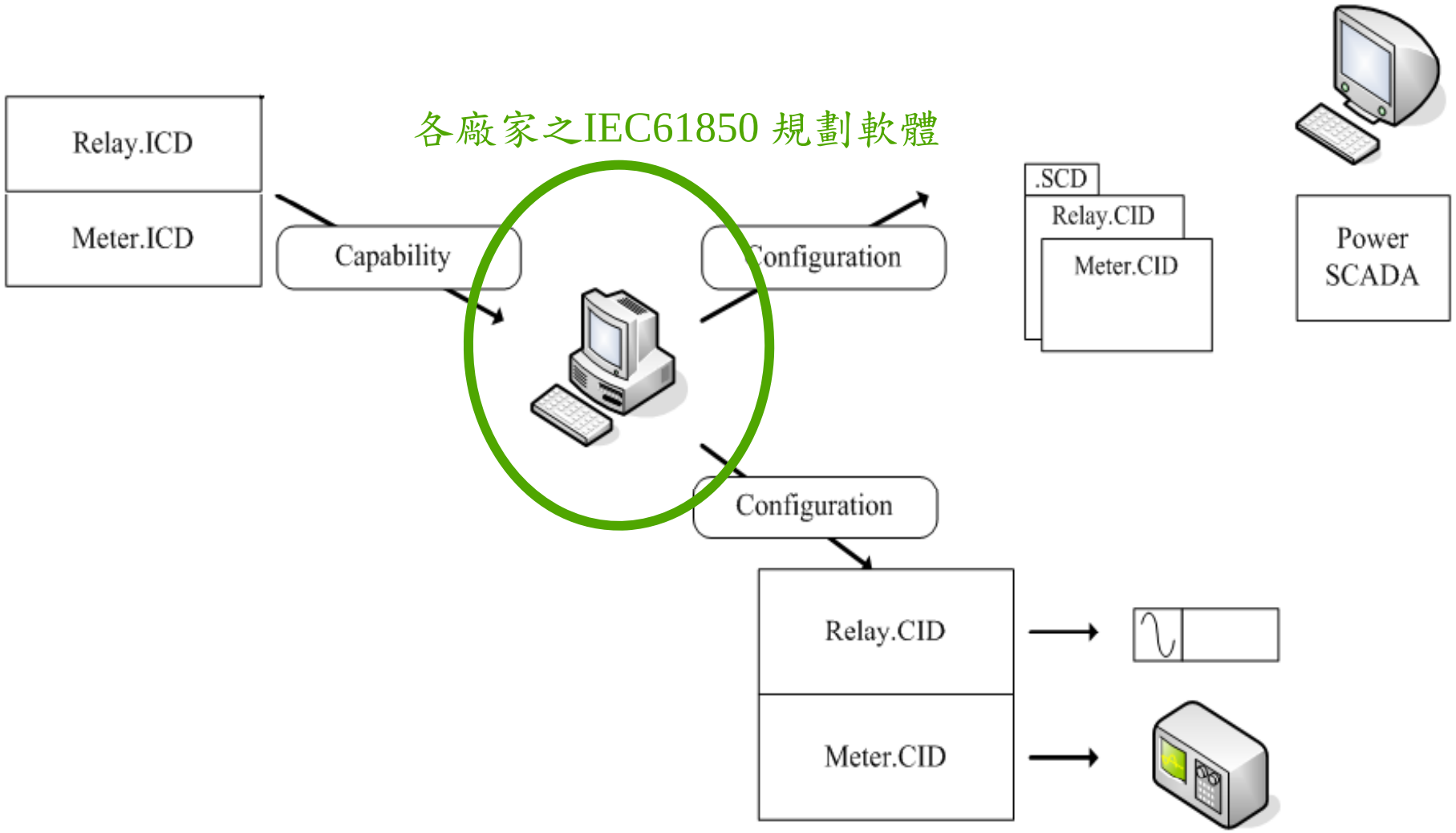


# Conformance Testing

- Part 10 defines interoperability tests
  - Only protocol, not application
  - **Official certification by Kema and other labs**

- Device conformances are described by a set of 4 documents:
  - **ACSI** (Abstract Communication Services Interface)
    - Describes the abstract services interface
    - These services are mapped to specific communication services (SCSM) described in the PICS
  - **MICS** (Model Implementation Conformance Statement)
    - Describes how the information model is implemented
  - **PICS** (Protocol Implementation Conformance Statement)
    - Describes choices made in the protocol implementation.
    - Many of these choices are implied in the ACSI conformance statement
  - **PIXIT** (Protocol Implementation eXtra Information for Testing)
    - Describes any extra implementation information not found in the above documents
    - Are useful for device operation, despite being called “extra”

# IEC61850 規劃作法流程圖



# Relay IEC61850 規劃流程

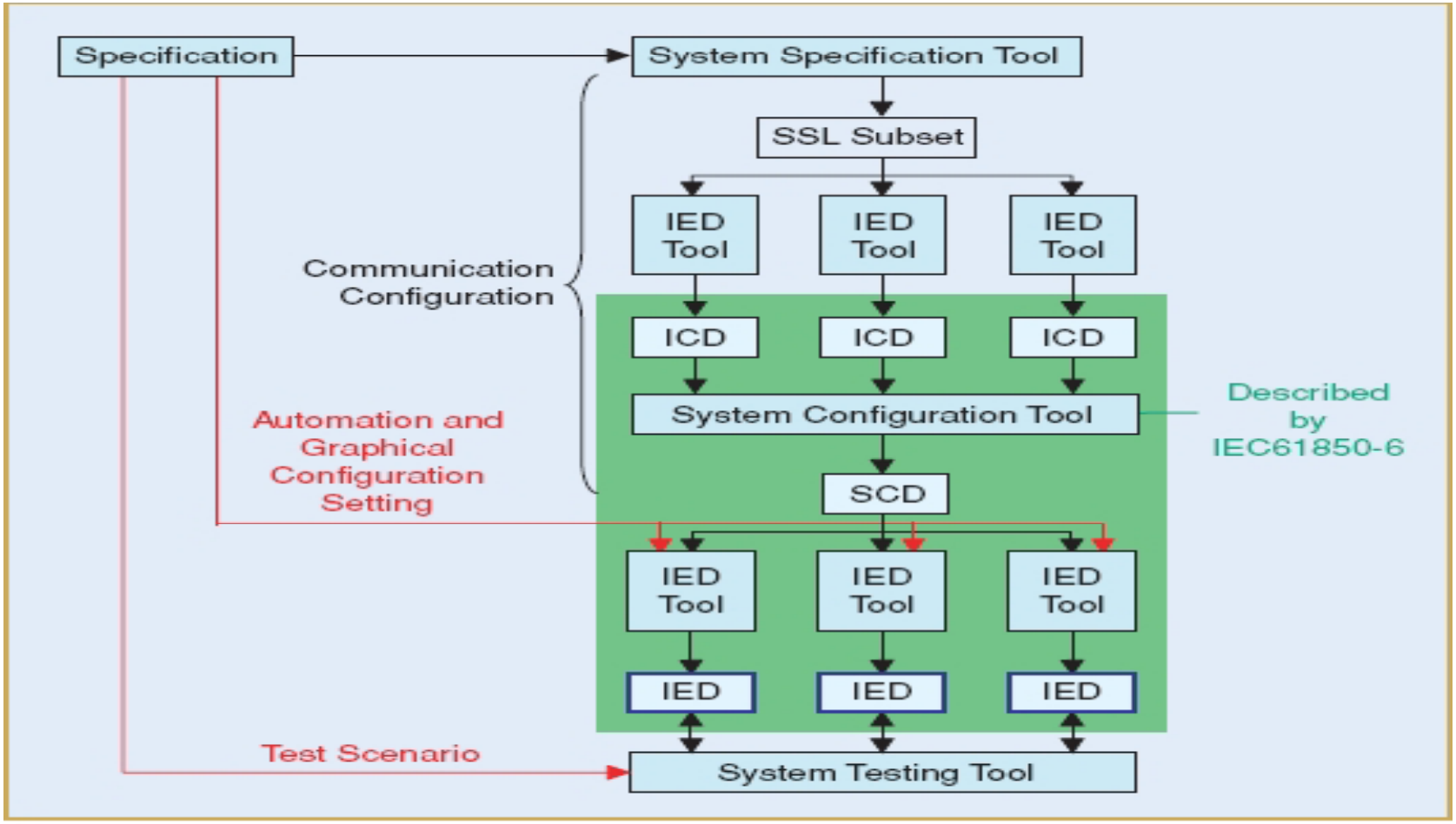
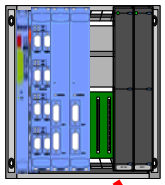



figure 4. Full engineering process versus IEC 61850-6 description.

# IEC 61850 系統主要整合解決方案 ( 整合IEDs )

Control Center



PLC/RTU

Supervision computer

Ethernet switch

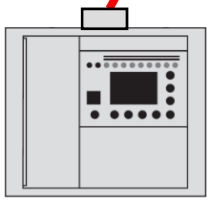
Ethernet switch

Ethernet switch

100 Mbit/s Ethernet
Fiber Optical

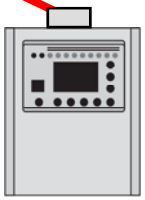
IEC61850 protocol

Relay

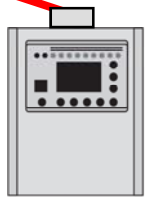


Relay

Meter



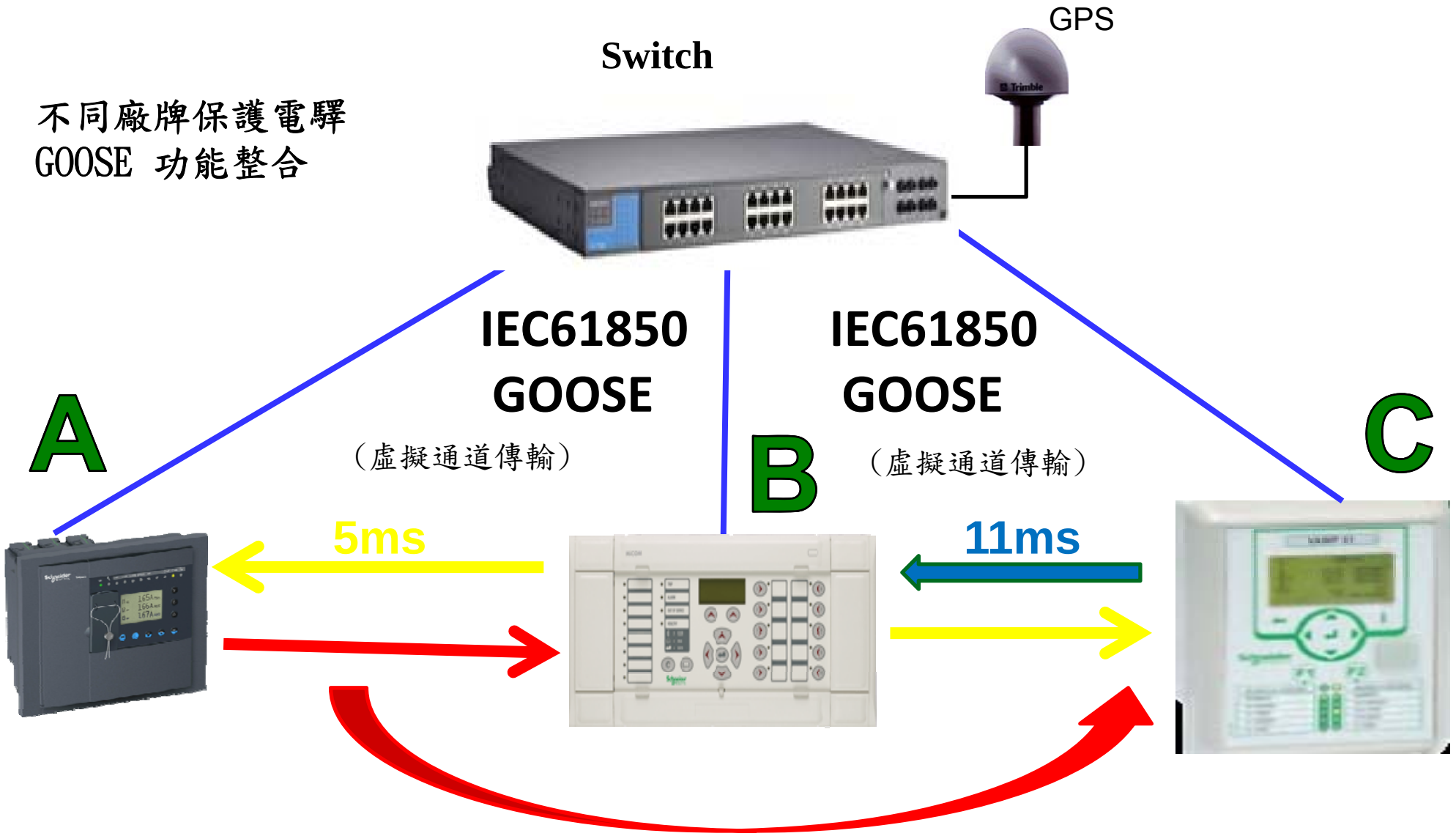
Relay



Relay

# IEC61850 GOOSE Presentation

不同廠牌保護電驛
GOOSE 功能整合




**IED-A** Relay send GOOSE signal

**IED-B** Relay send GOOSE signal

**IED-C** Relay receives the GOOSE signal

# 敬請指教!