Automation and Power World, April 2011

Substation automation migration strategies to IEC 61850 using Relion protection and control

Power and productivity
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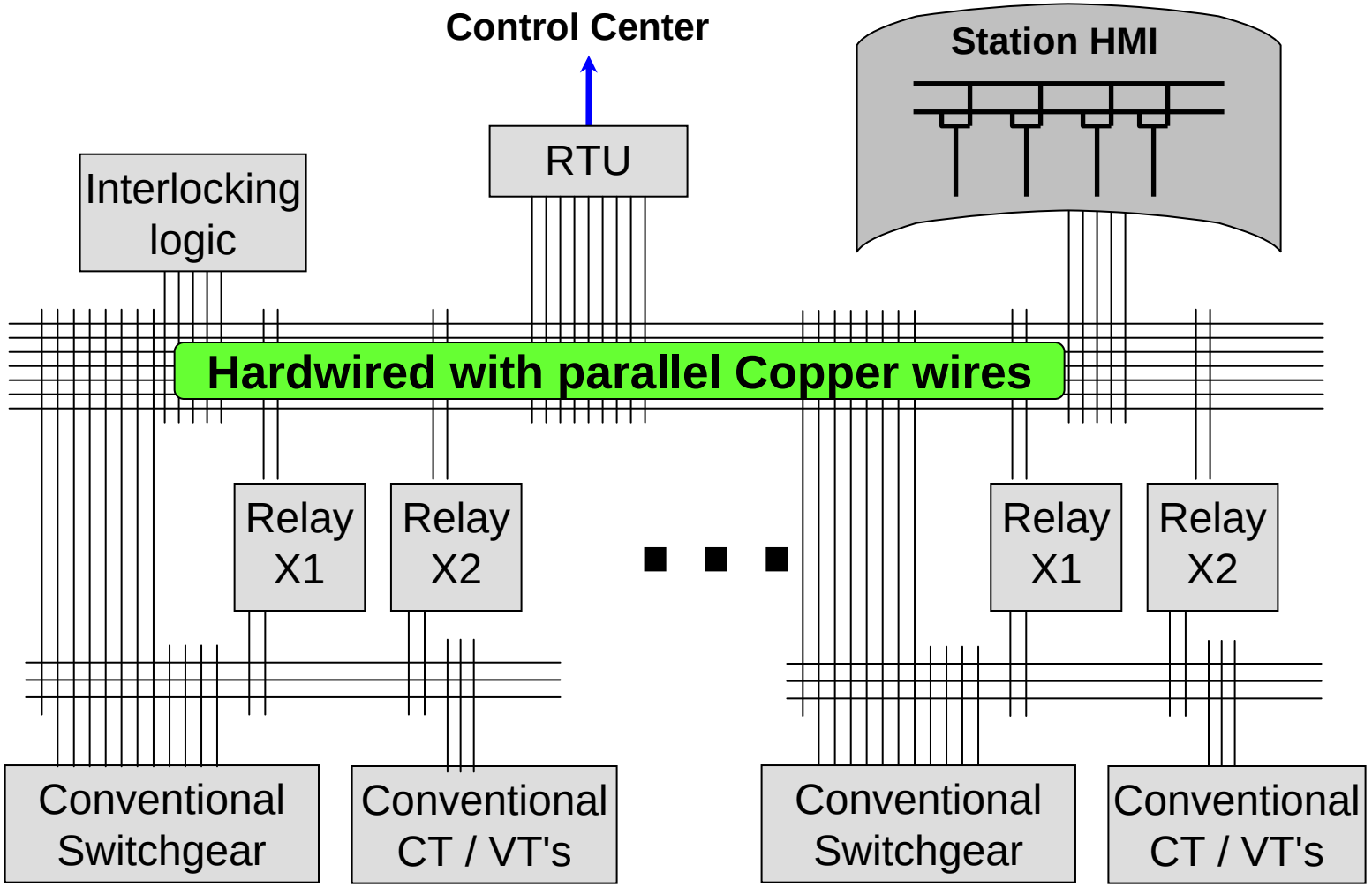
From PAC WORLD , December 2010

- The fact that The US National Institute of Standards and Technology (NIST) has advised the Federal Energy Regulatory Commission that if has identified IEC 61850 as one of five “foundational” sets of standards for Smart Grid interoperability and cyber security clearly shows that IEC 61850 is foreseeable in the future of all protection, automation, and control specialists around the world.

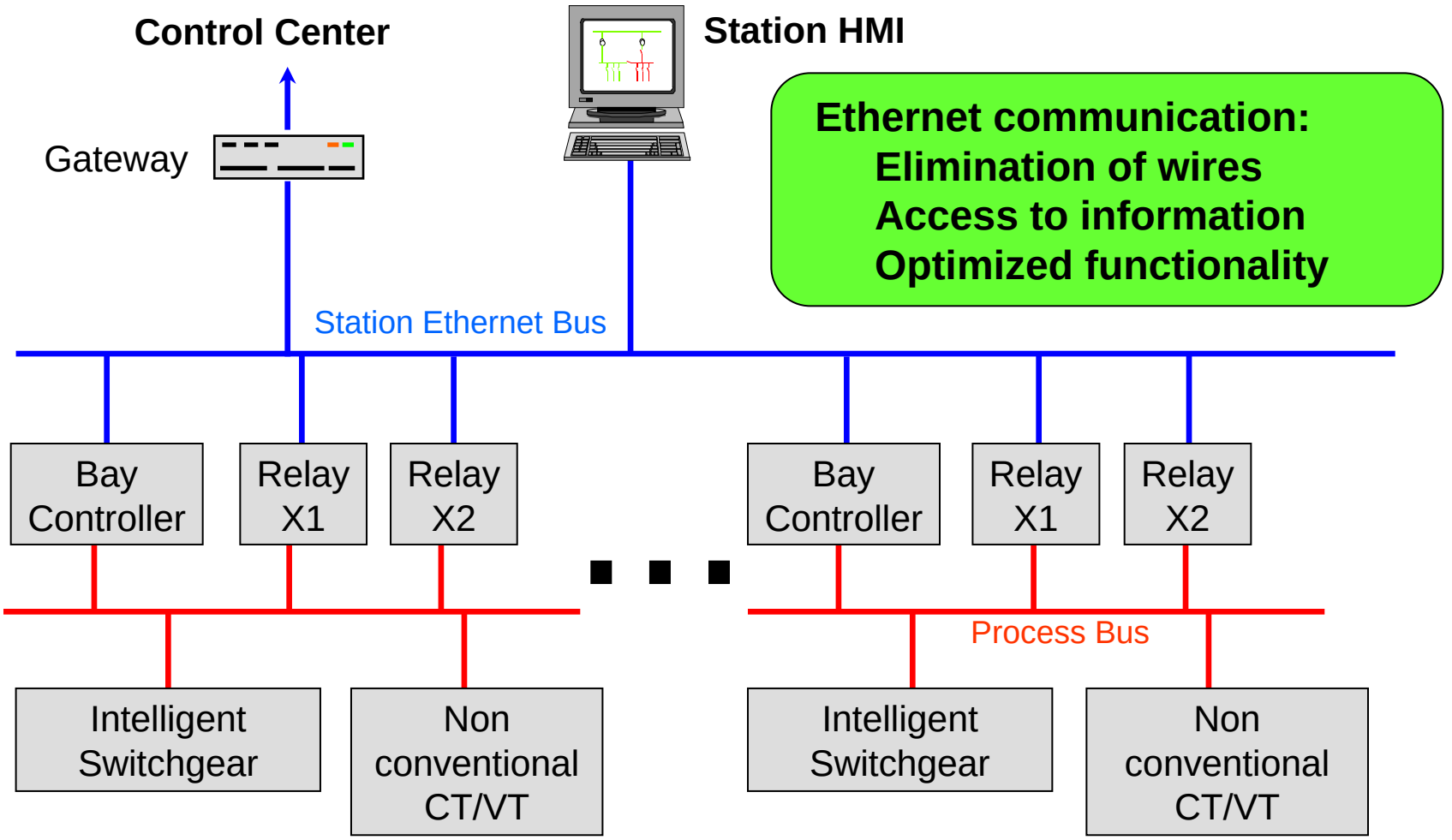
How to you get from ?

Conventional SA system



To This

IEC 61850 station and process communications

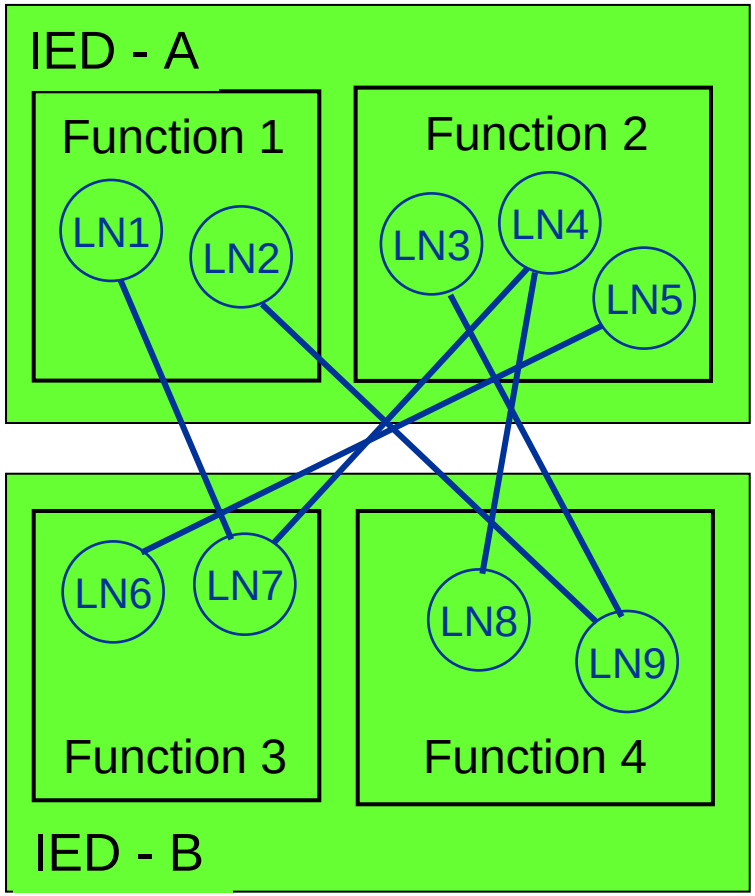


Let’s look at some 61850 concepts

- Logical node
- Physical Devices

Logical nodes

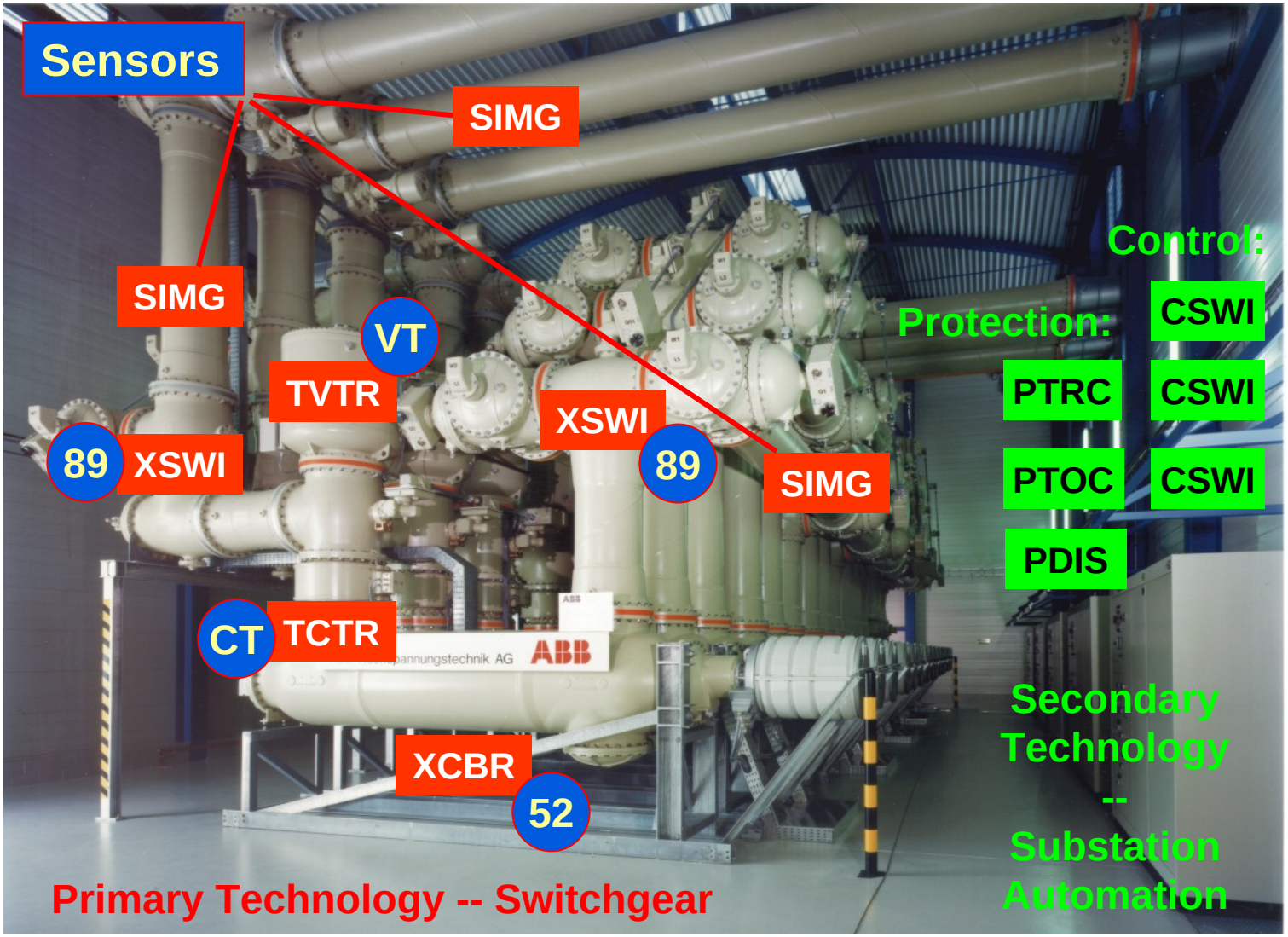
- IEC 61850 Definitions
  - A logical node is the smallest part of a function that exchanges data and represents a function within a physical device
  - A logical connection is the communication link between logical nodes
  - PICOM is a piece of information for communication describing an information transfer on a given logical connection with given communication attributes between two logical nodes
- The IEC 61850 logical node, and the communications of data between them, are at the core of interoperability



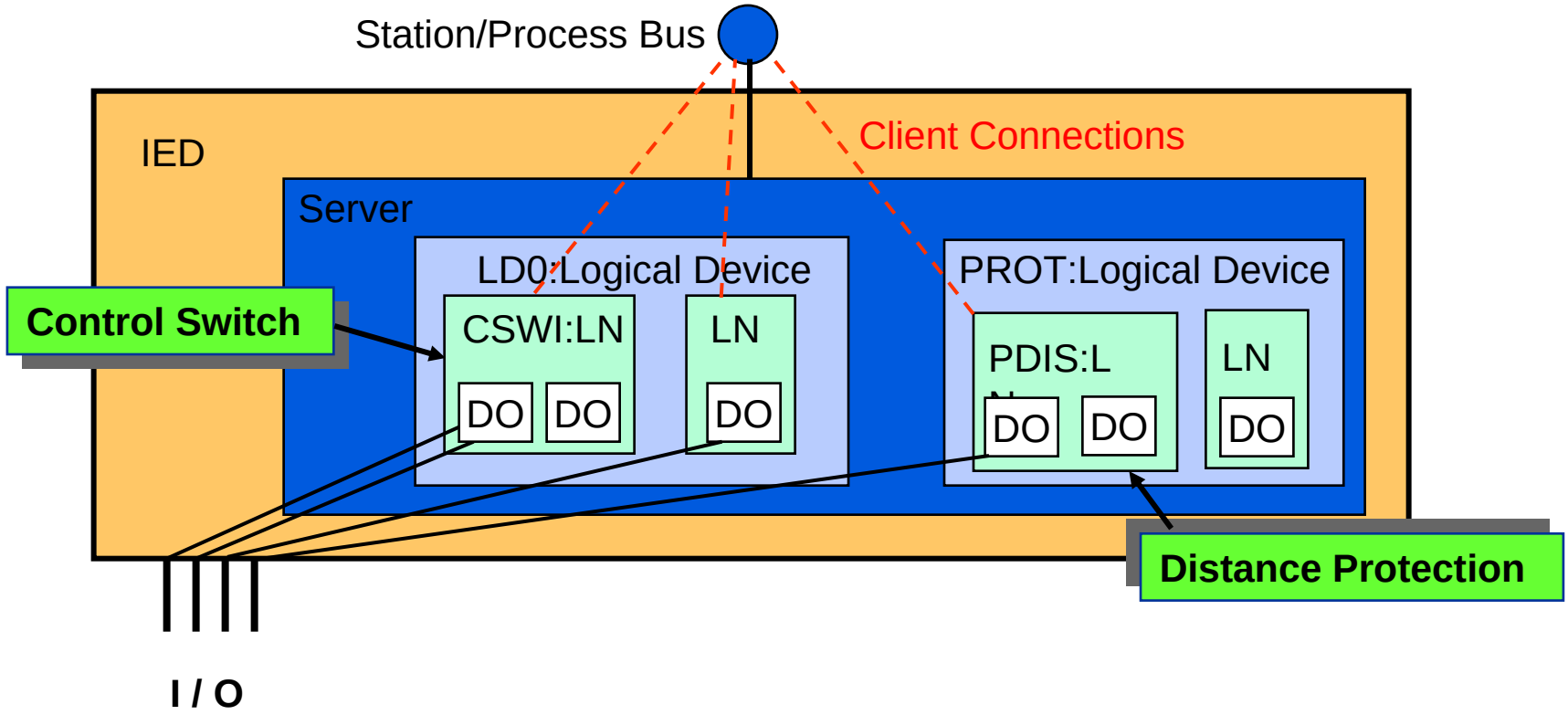
Physical Devices

- Primary System Devices
  - Circuit breakers
  - Disconnect and grounding switches
  - Power transformers
  - Instrument transformers
  - Generators
- Secondary System Devices
  - Protection
  - Reclosers
  - Annunciators
  - Meters, sensors
  - Fault recorders
  - Control switches and interfaces
  - Etc.

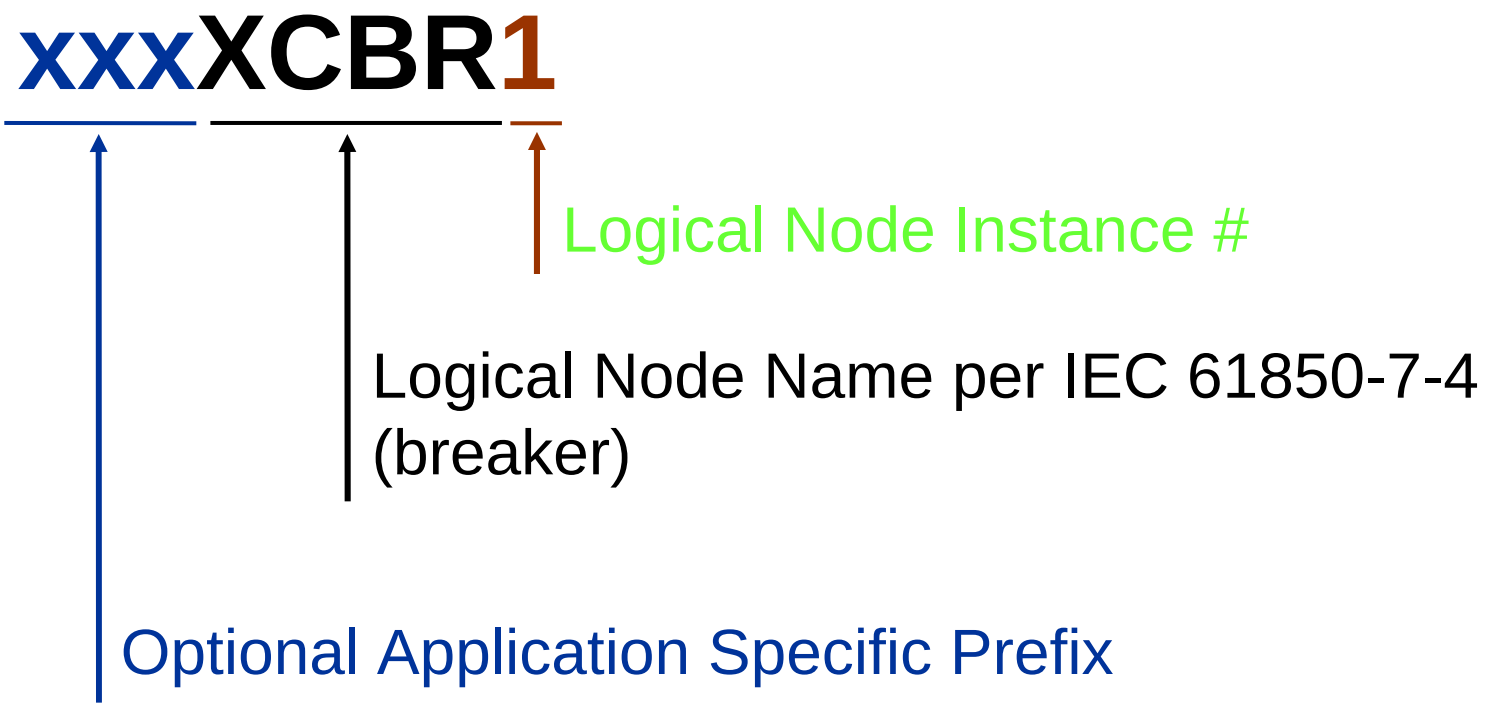
Logical Nodes and Physical Devices



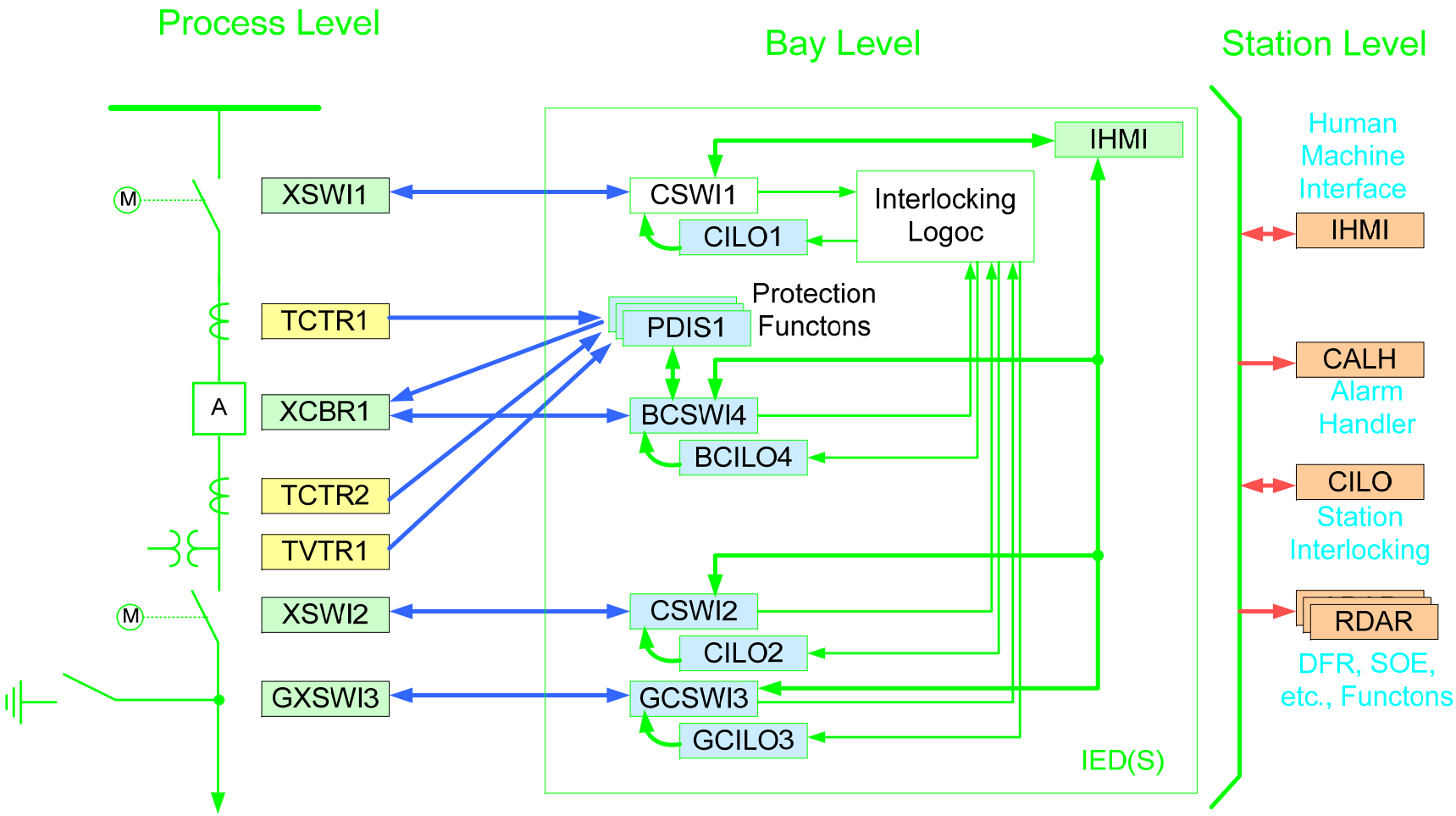
Logical Nodes and Physical Devices



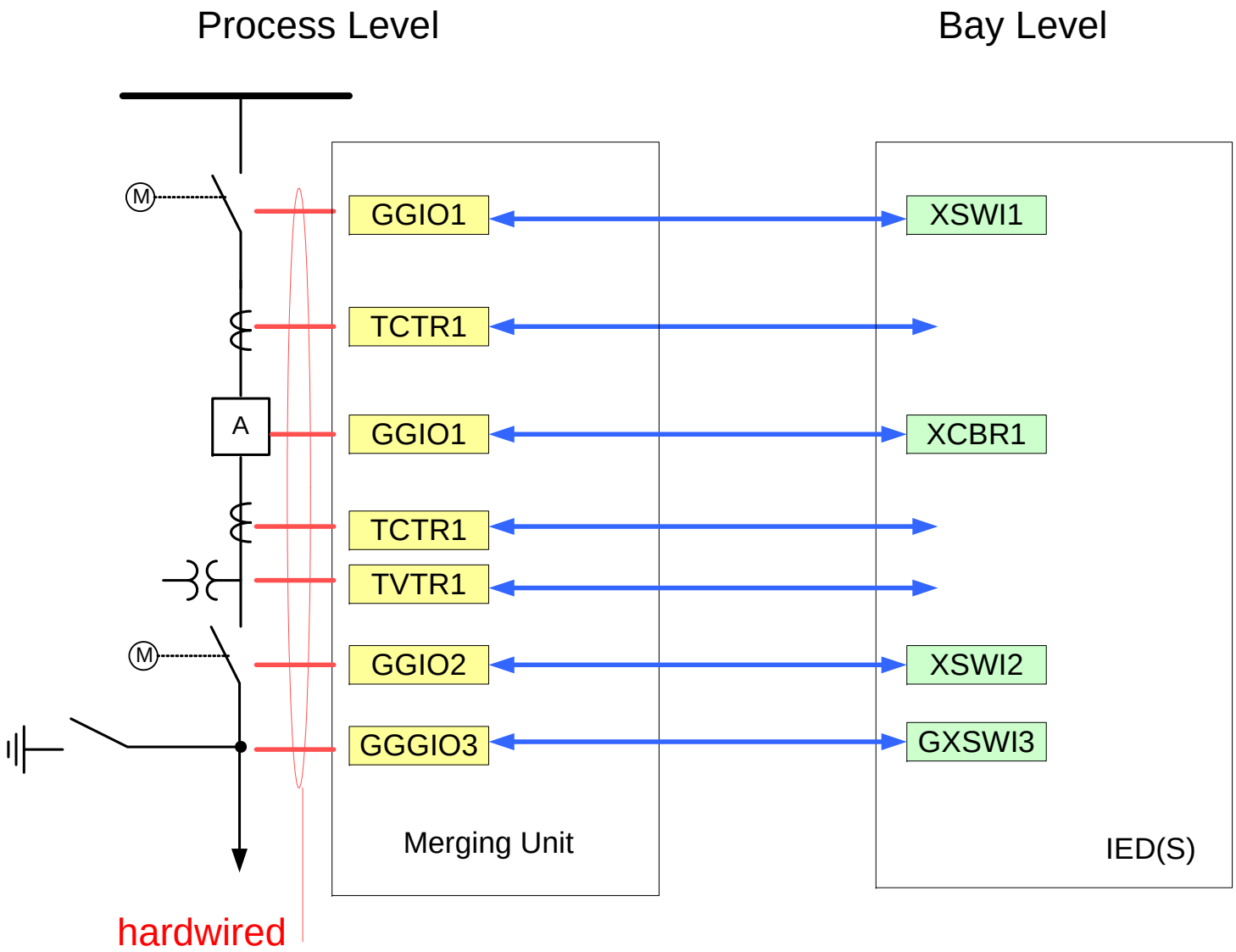
Logical Node Names



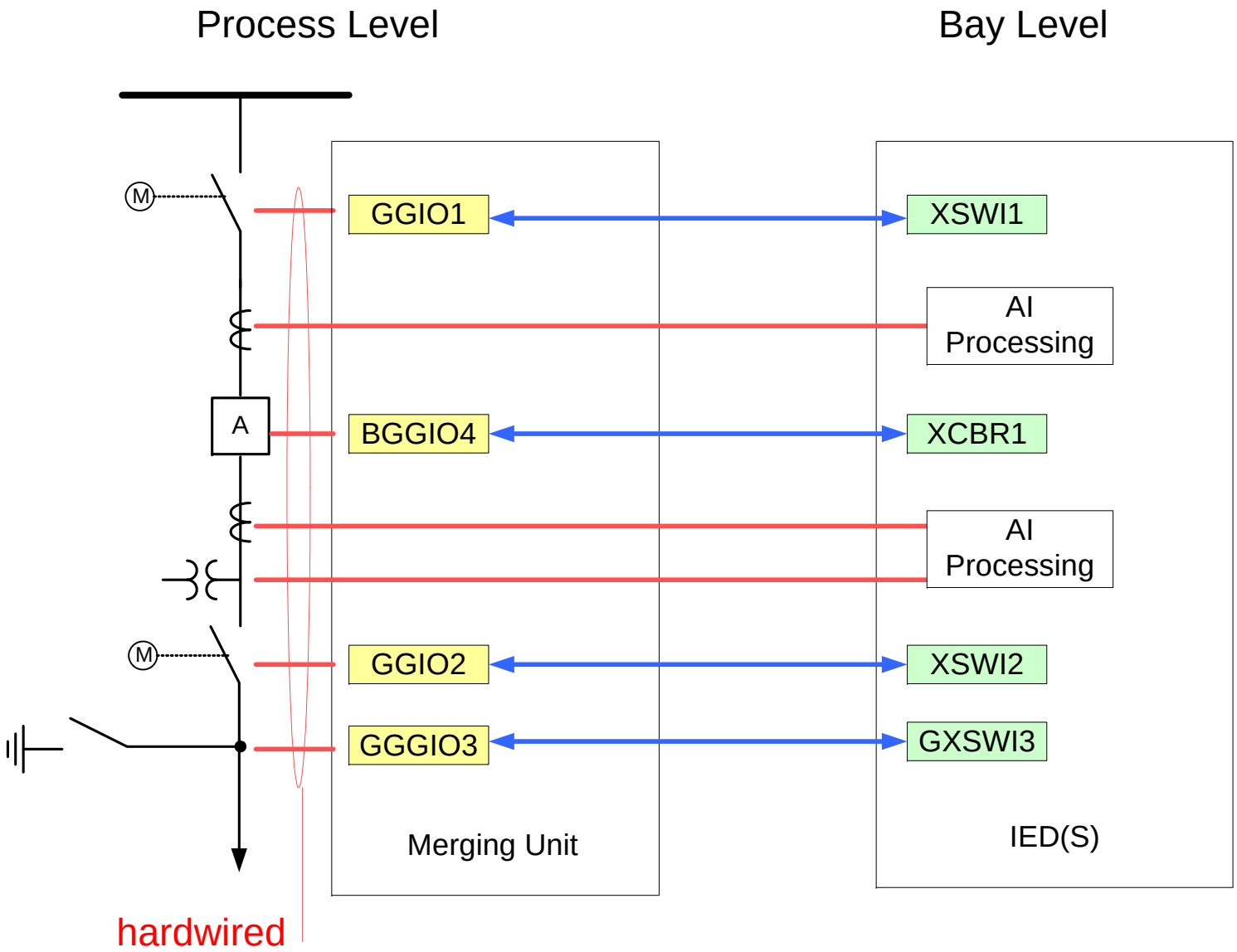
Basic Principle



Application Variances (retrofit)



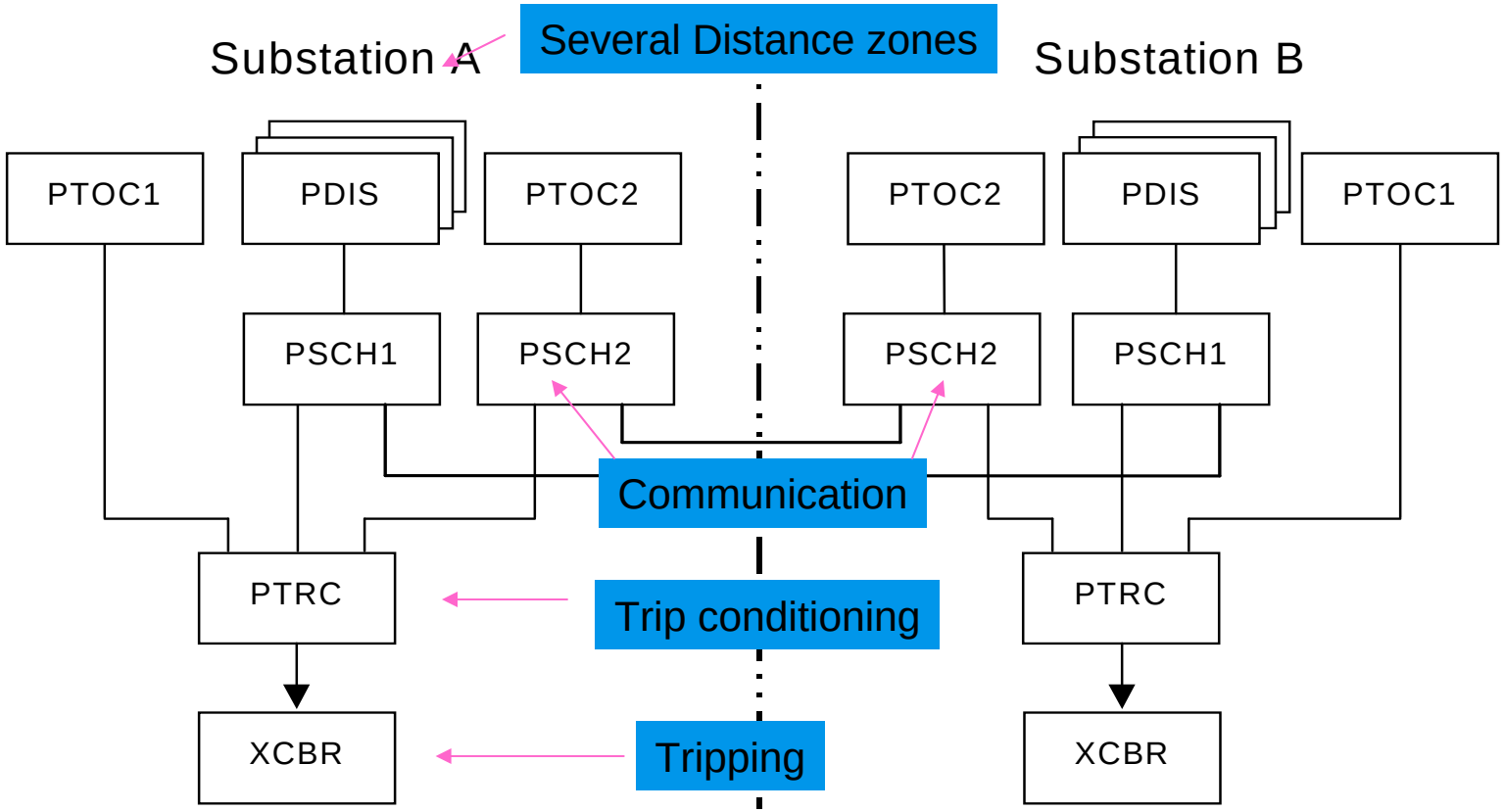
Application Variances (retrofit)



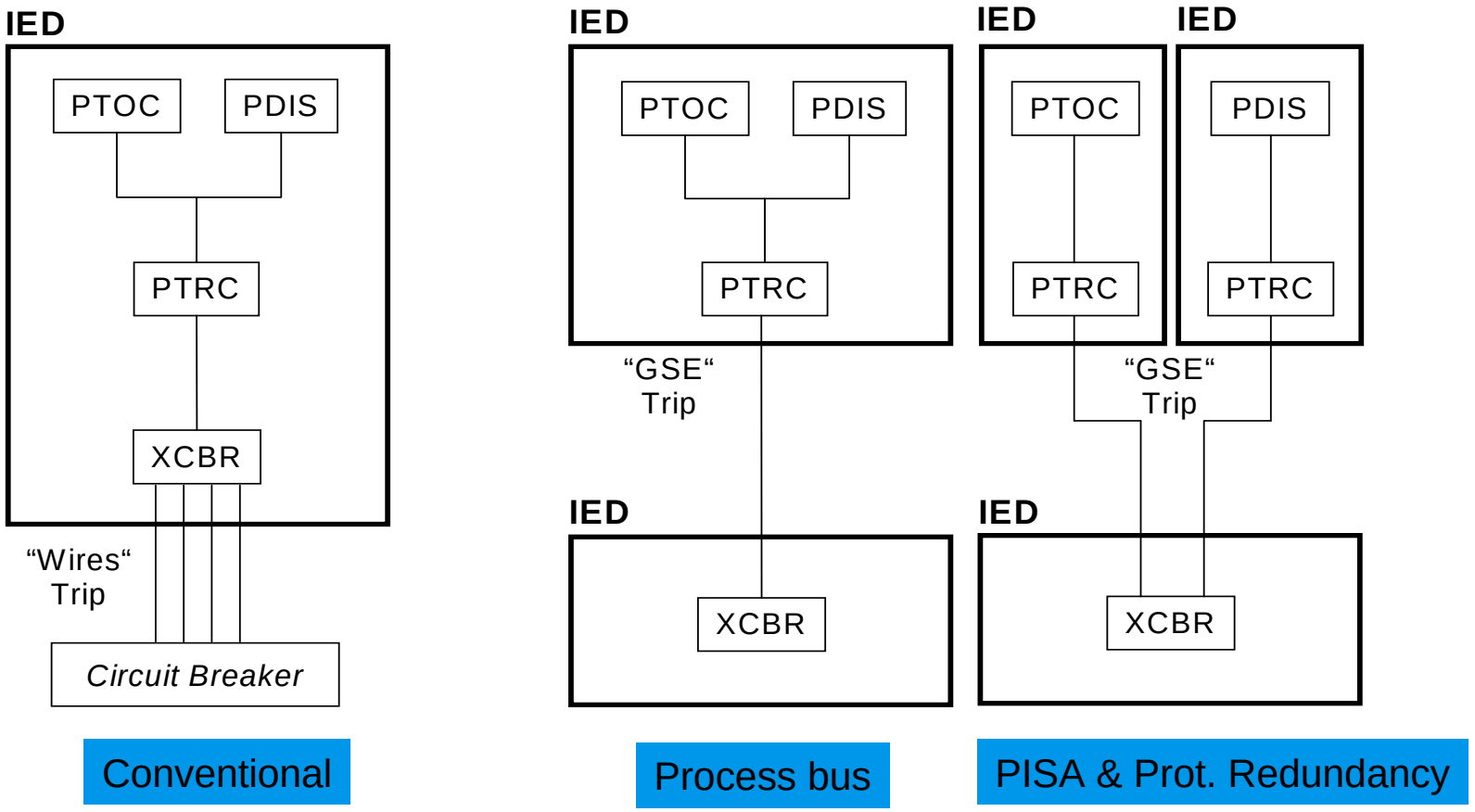
Basic line protection functions

- Distance protection
- Tripping in distributed systems
- Differential protection
- Autoreclosing
- Disturbance recording

Distance Protection



Physical distribution examples

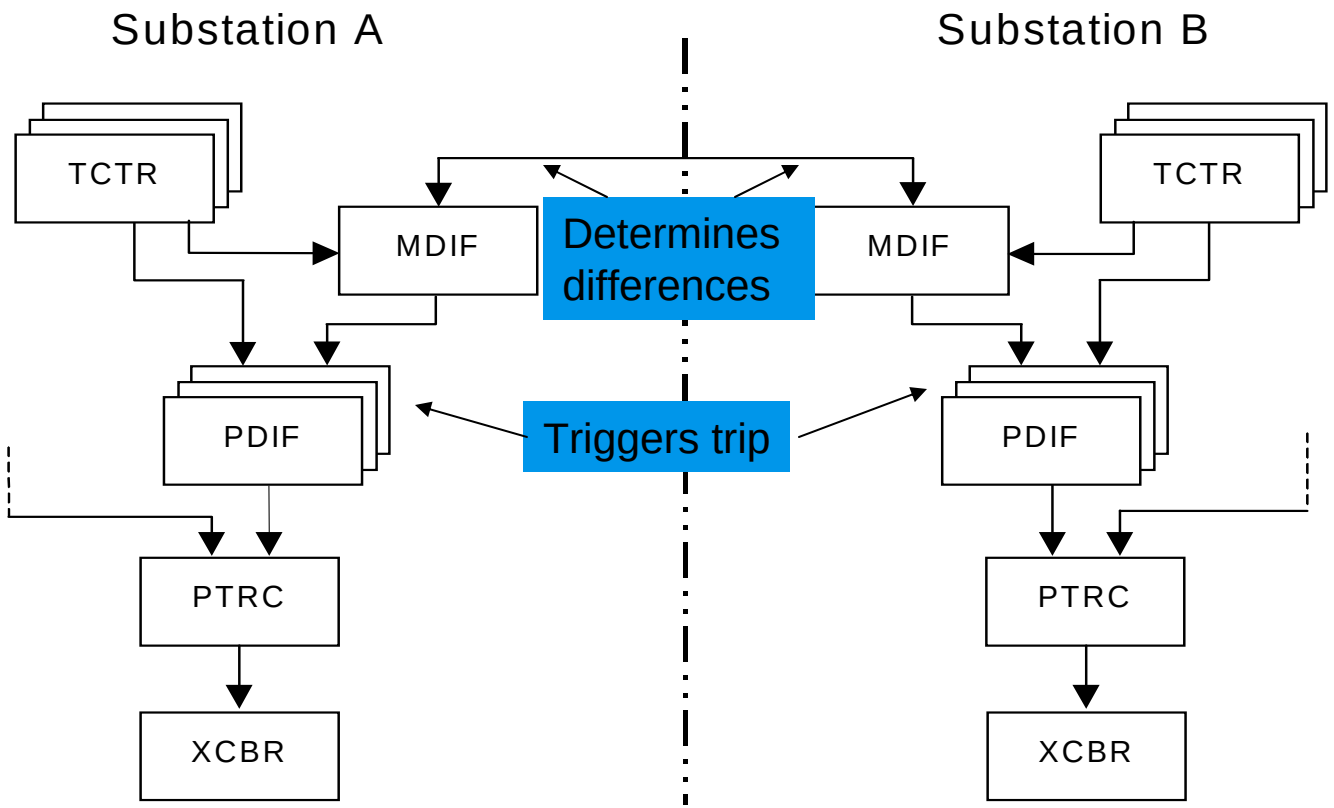


Conventional

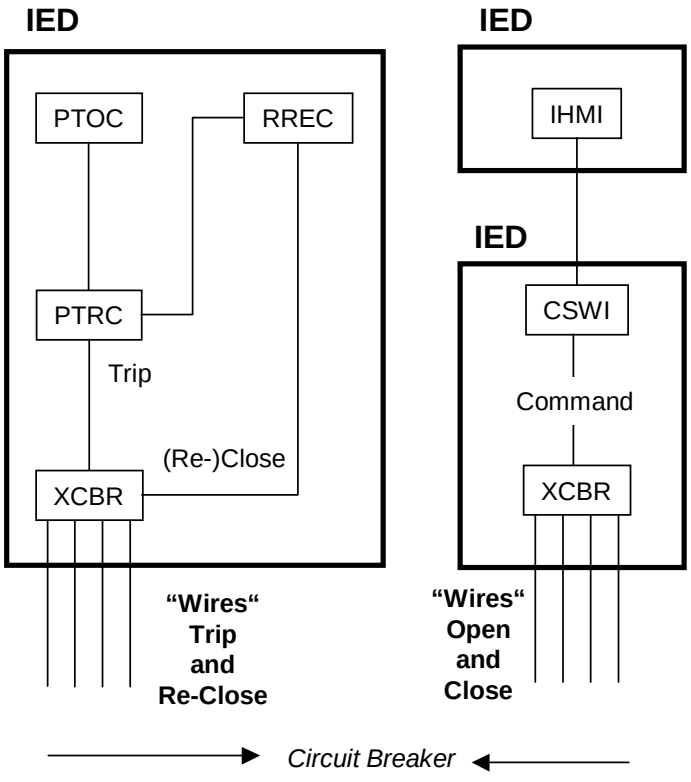
Process bus

PISA & Prot. Redundancy

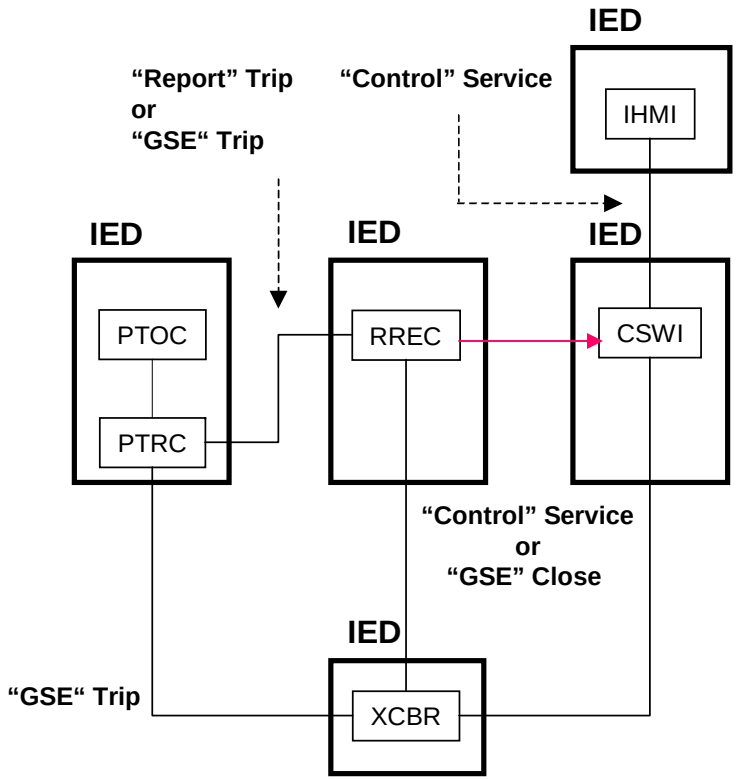
Differential Protection



Autoreclosure and Control

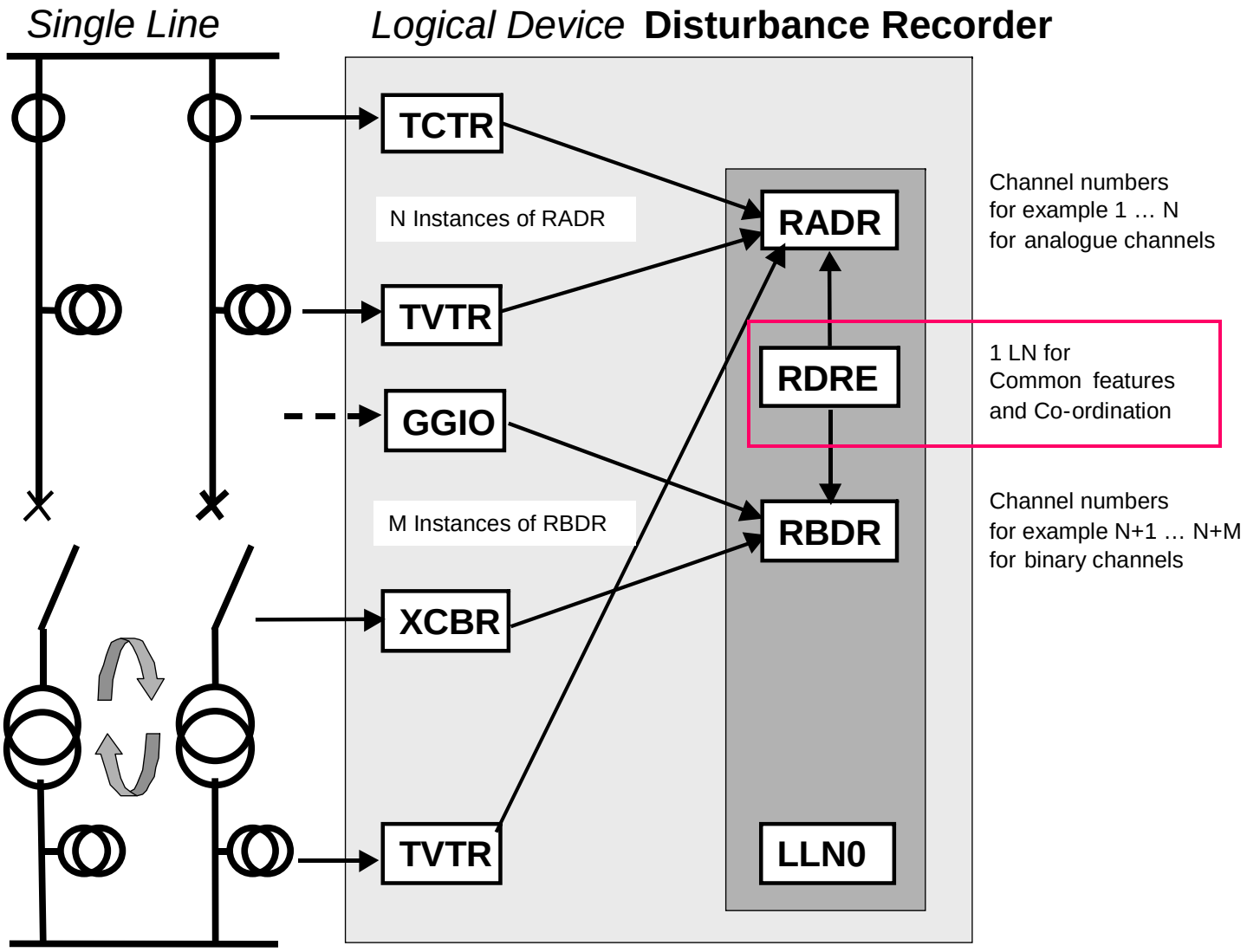


Conventional



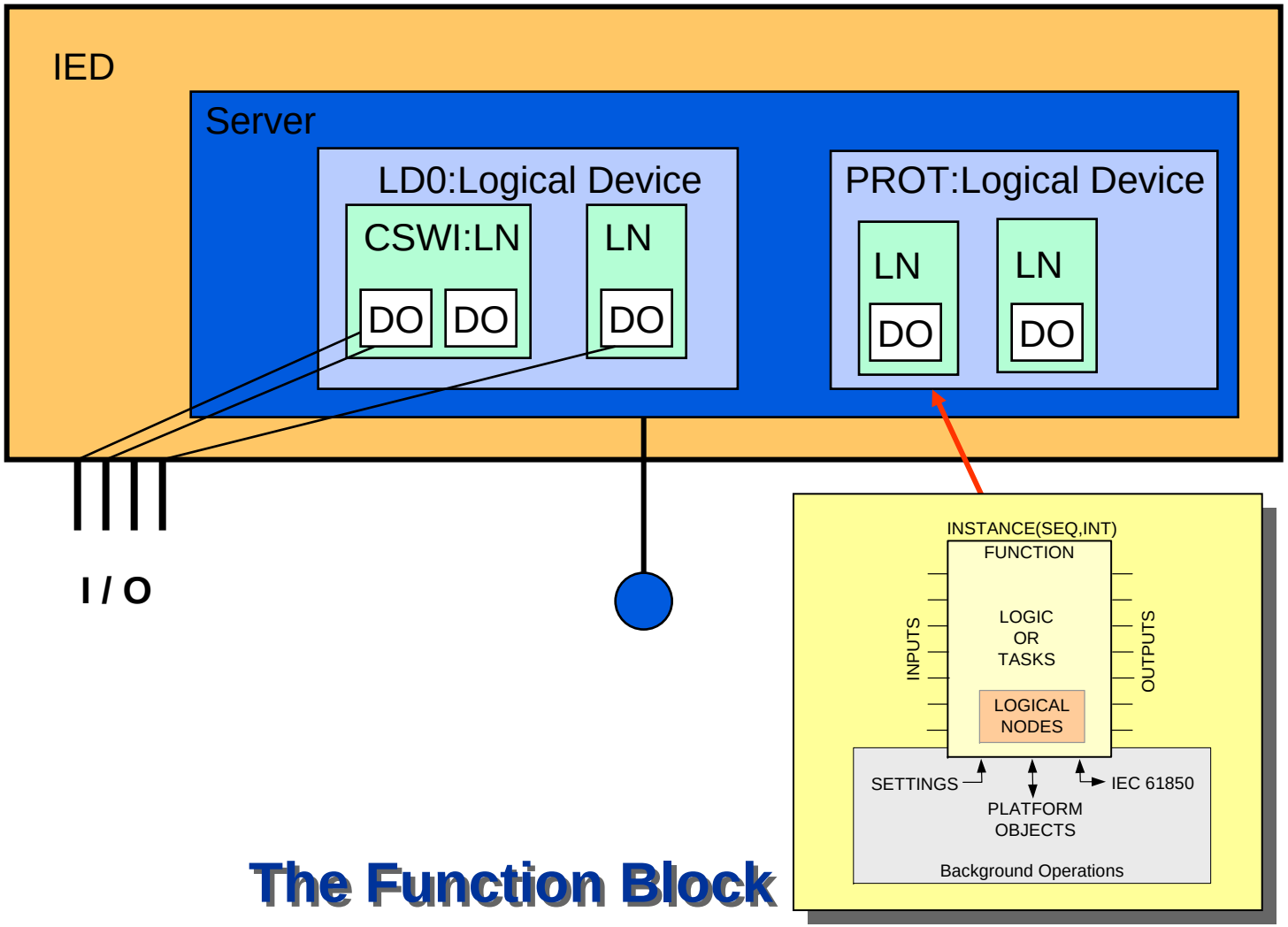
Distributed

Disturbance Recording



How do these concepts apply to our Relion series relays ?

Logical Nodes applied to Relay



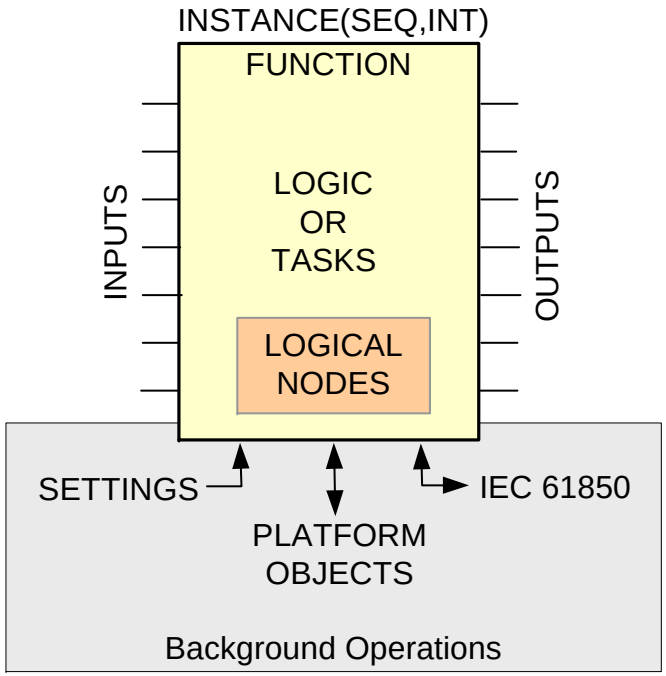
The Function Block

The Function Block

Discrete
Function Relay
(made smart)

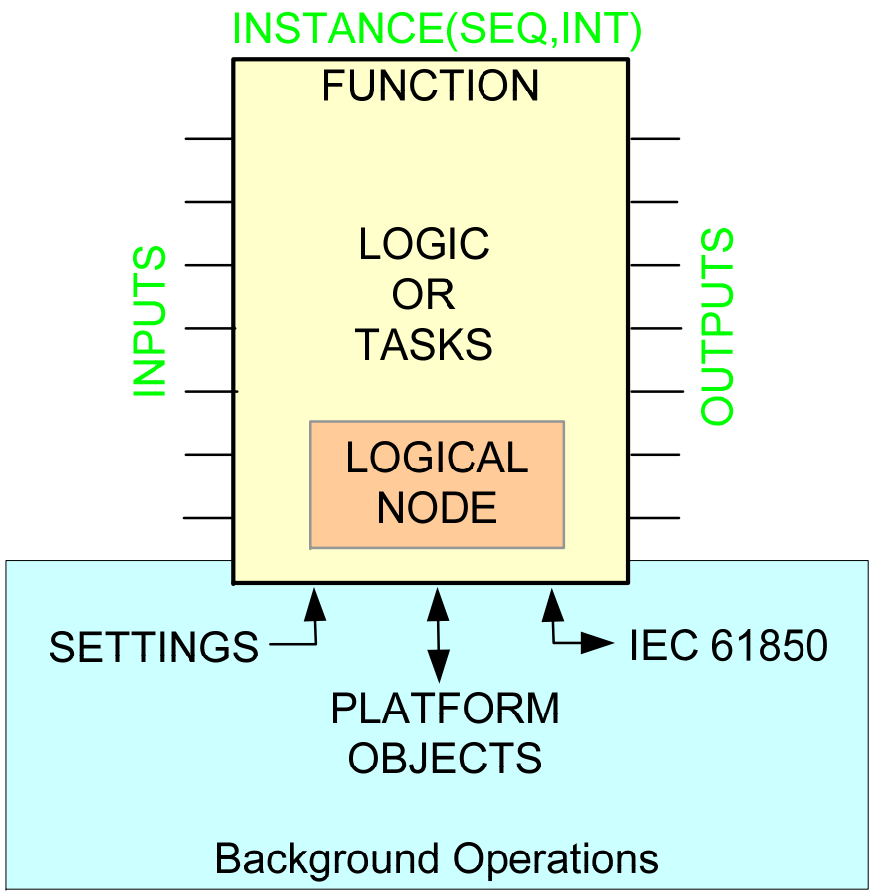
+ IEC 61850

=



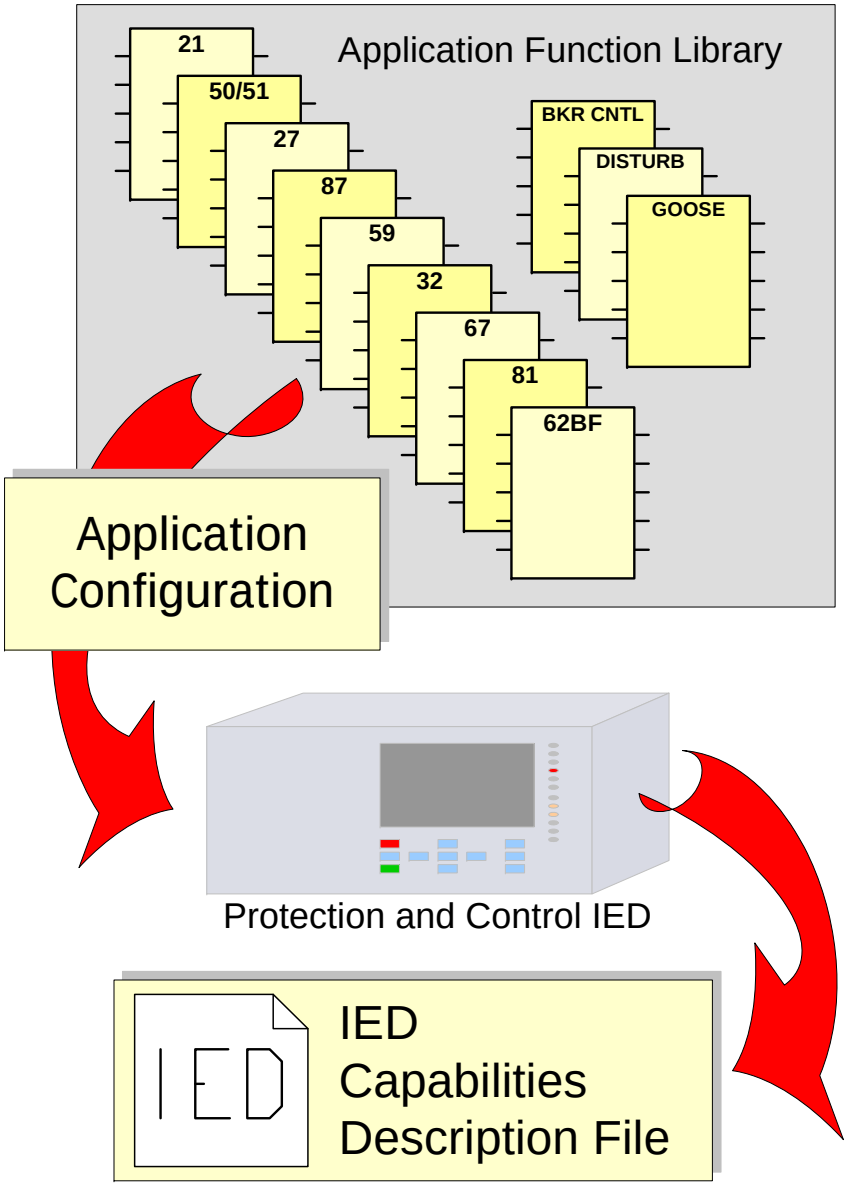
Function Block

Basic Function Block Description



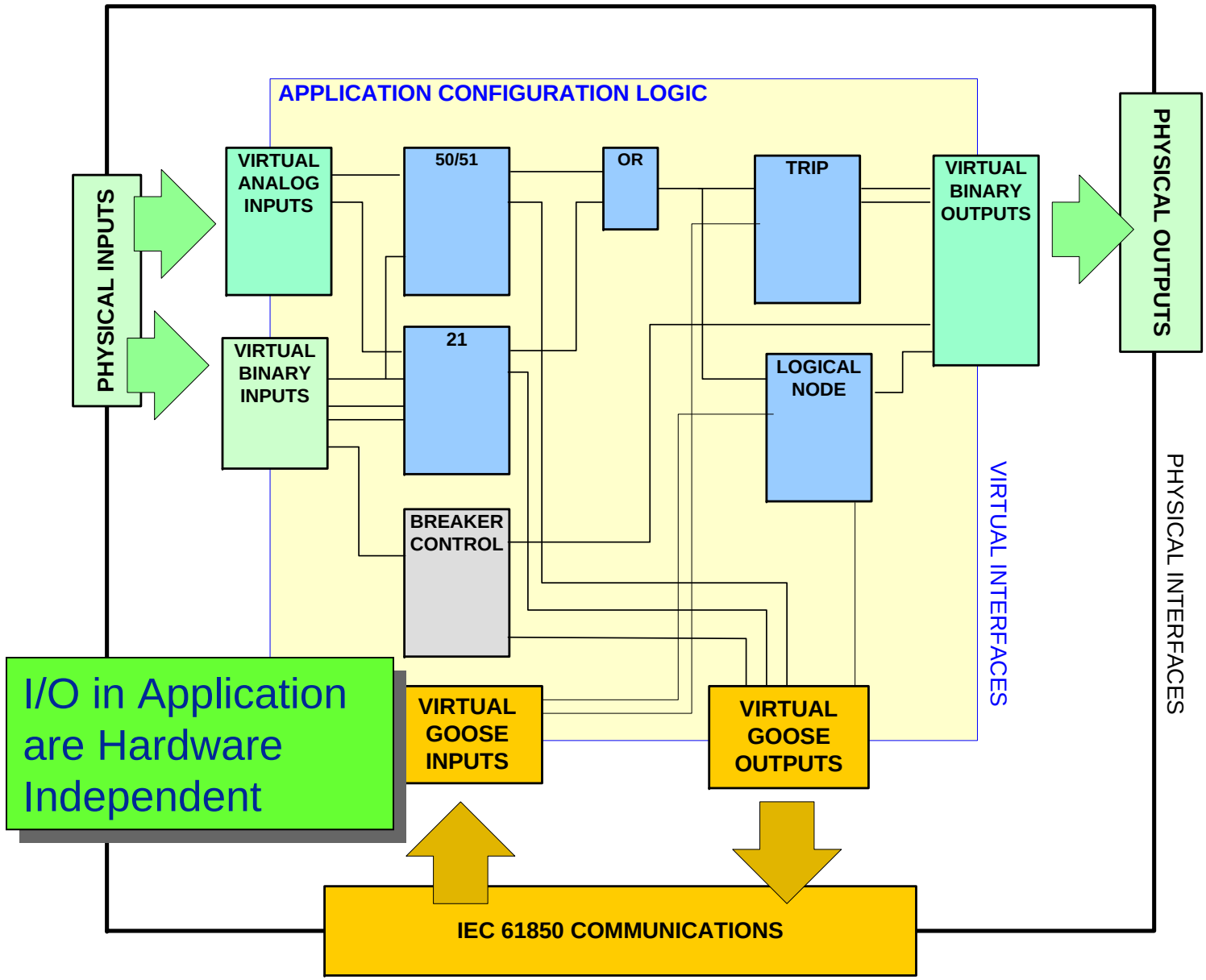
- Function
  - Tasks or logic performed
- I/O Connections to other FBs
  - Analog
  - Binary
  - Data
- Computation resources
  - Instance – N^{TH} time used
  - Sequence of execution
  - Computation Interval
- Background Operations
  - Settings

Basic Design Process for IED

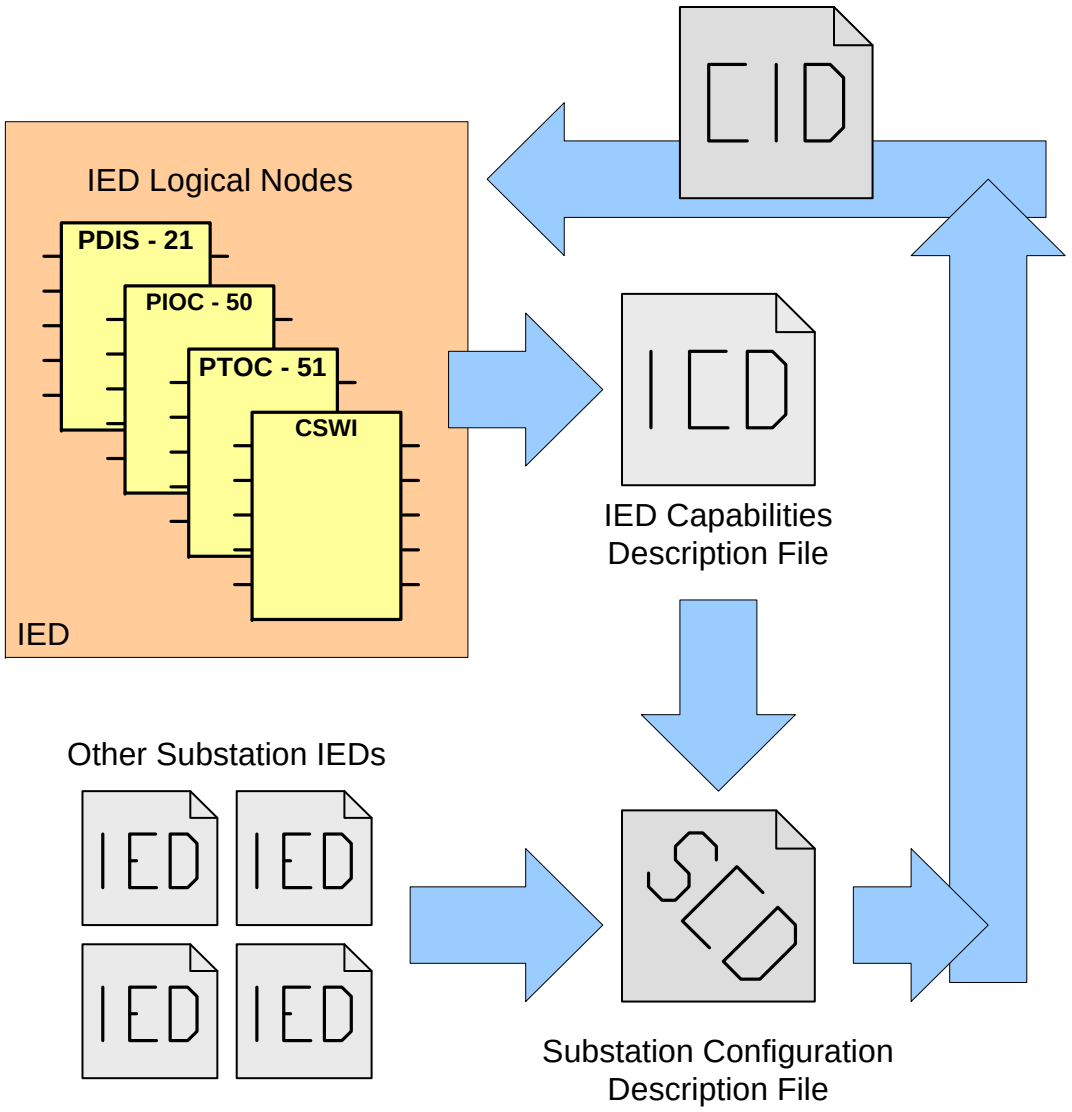


- Application Function Library
- Application Configuration
  - Combine discrete application functions to meet P&C requirements
- Down load IED
- Test configuration
- Create ICD
  - Defines the IED capabilities to the rest of the IEC 61850 substation
- Substation configuration process

Application Configuration

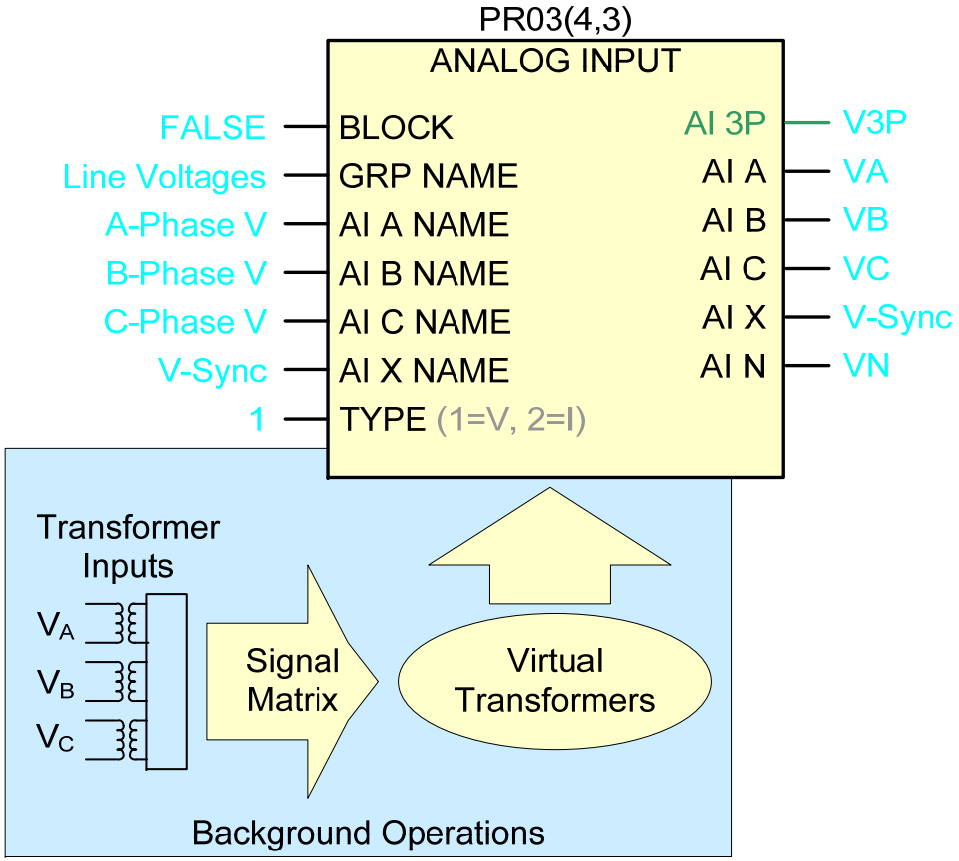


IED & SCD Configuration Descriptions



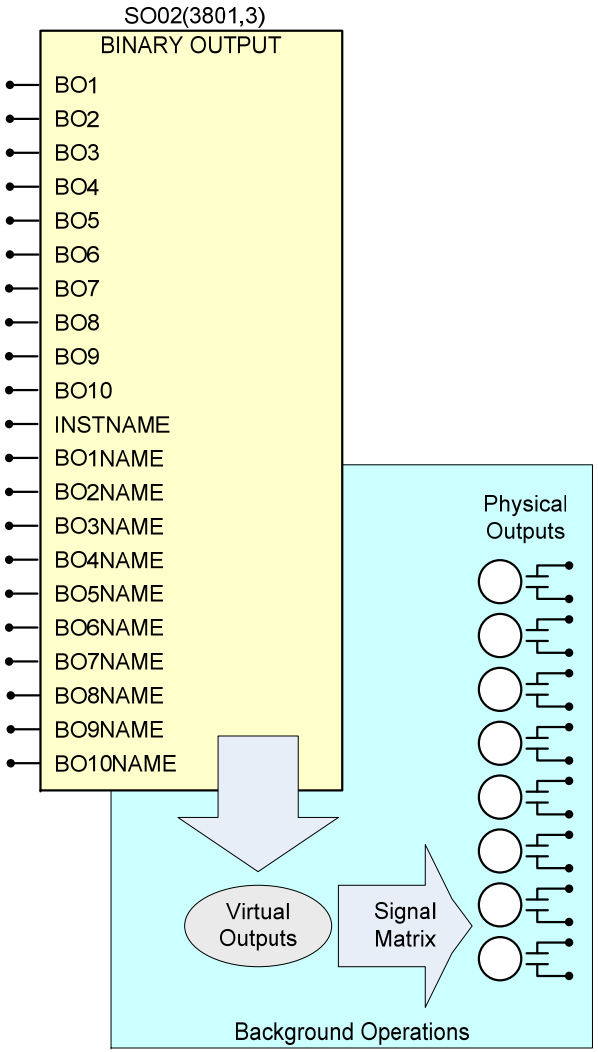
- Function blocks that are logical nodes provide data with ICD file that describes it to other substation IEDs
- SCD file defines the substation
- ICD and SCD are written with the defined Substation Configuration Language (SCL)
- The SCD file is used by all substation IEDs and station HMI with tools to make appropriate interfaces

Analog Input Function Block



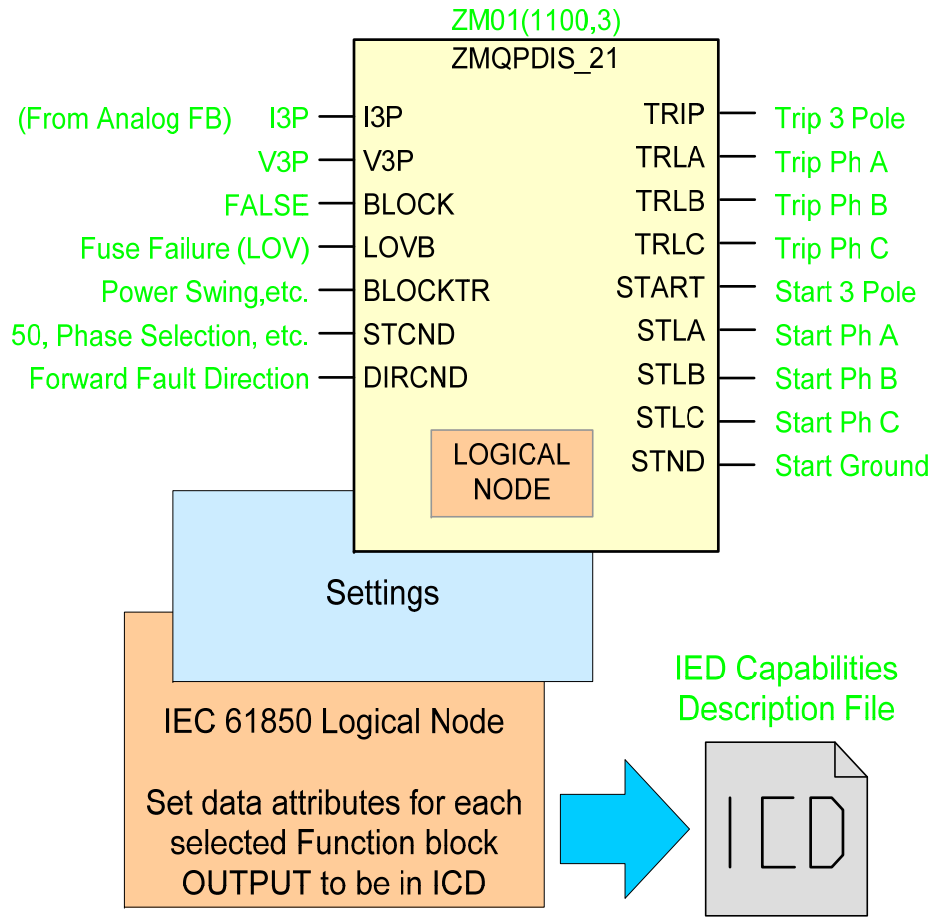
- Input
  - Block (True / False)
  - Group and signal names for signal matrix mapping
  - Type (Current / Voltage)
- Output
  - AI3P
    - Data for measurement and computations
  - AI A, …, N
    - Sampled data for DFR
  - Logic Names
    - V3P, …, VN

Binary Output Function Block



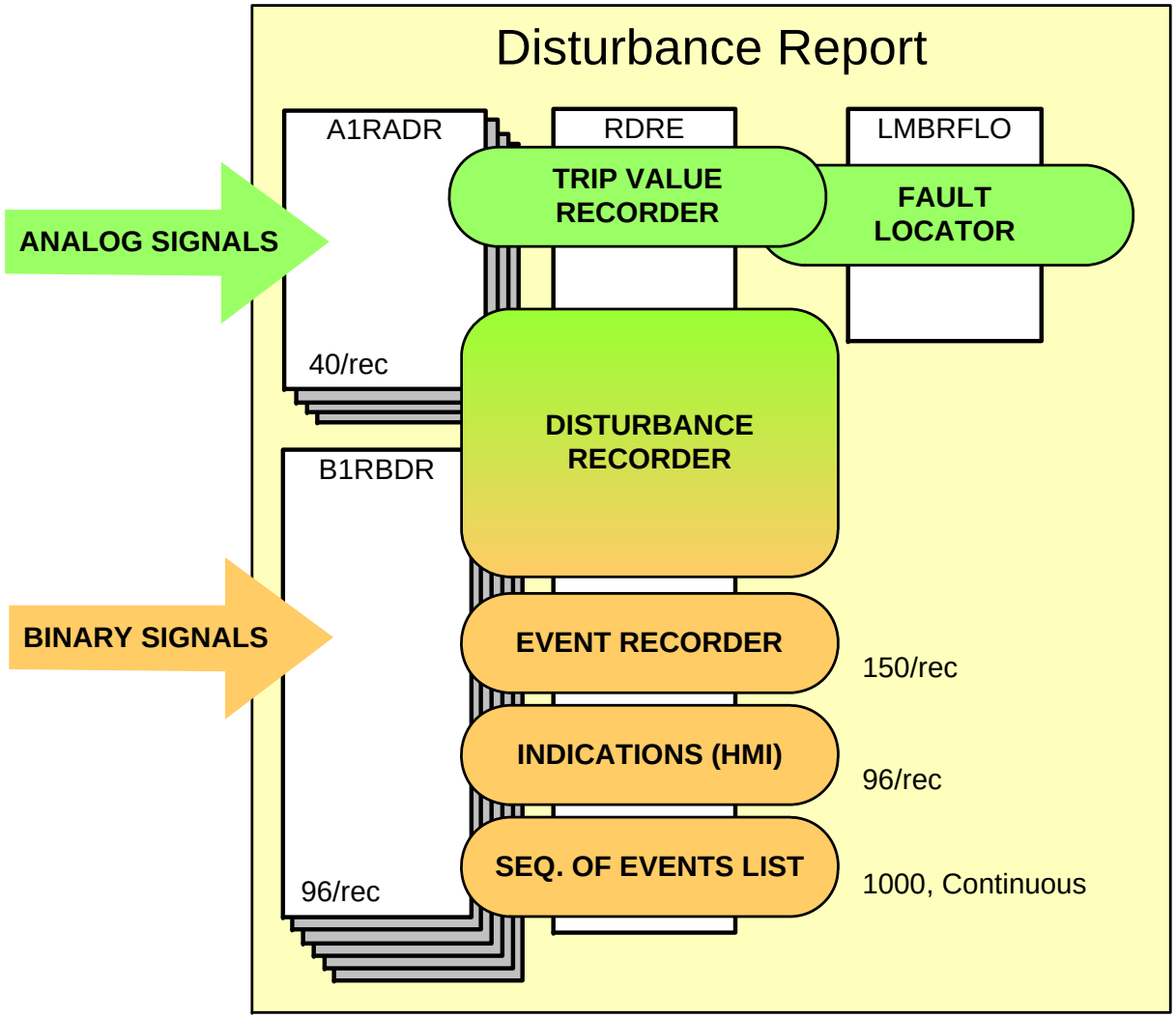
- Inputs:
  - Logic signals to be output to physical outputs
    - Contacts
    - LEDs
  - Group and signal names for signal matrix mapping

Impedance Function Block

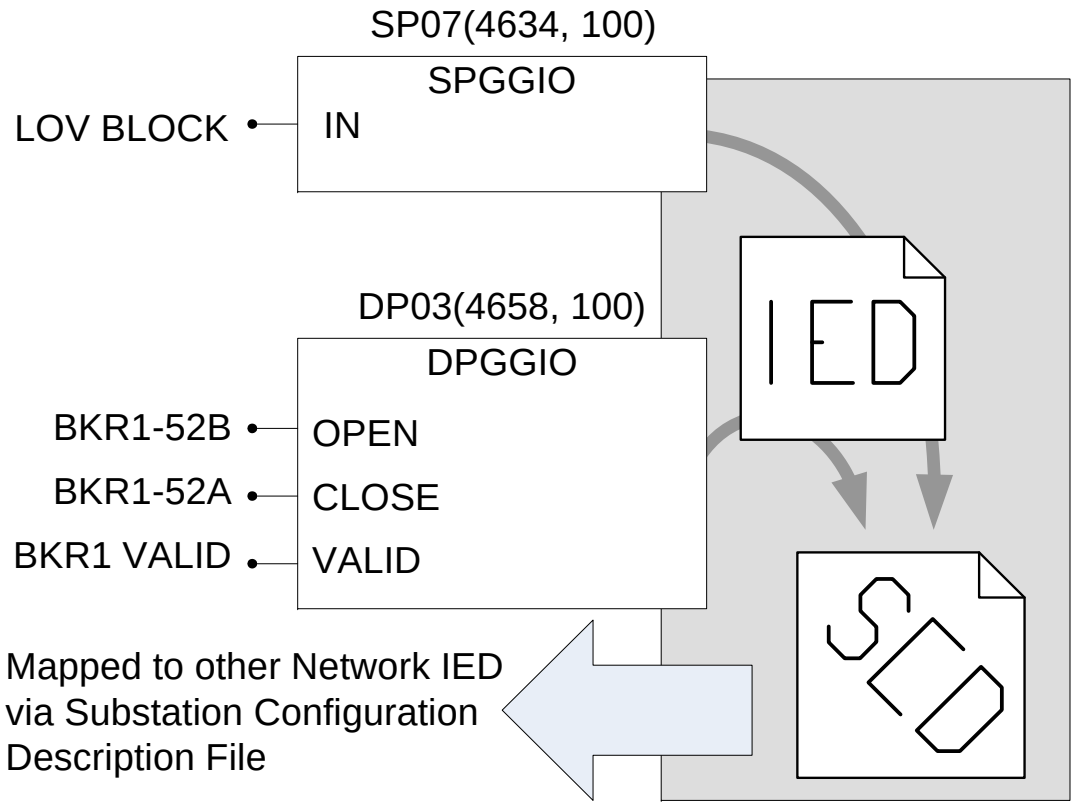


- Detect phase and ground faults on transmission lines
- Inputs
  - Supervision
  - Analog data
- Outputs
  - Single and three pole tripping
  - Single and three pole starting
- Logical node

Disturbance Reporting Function Blocks

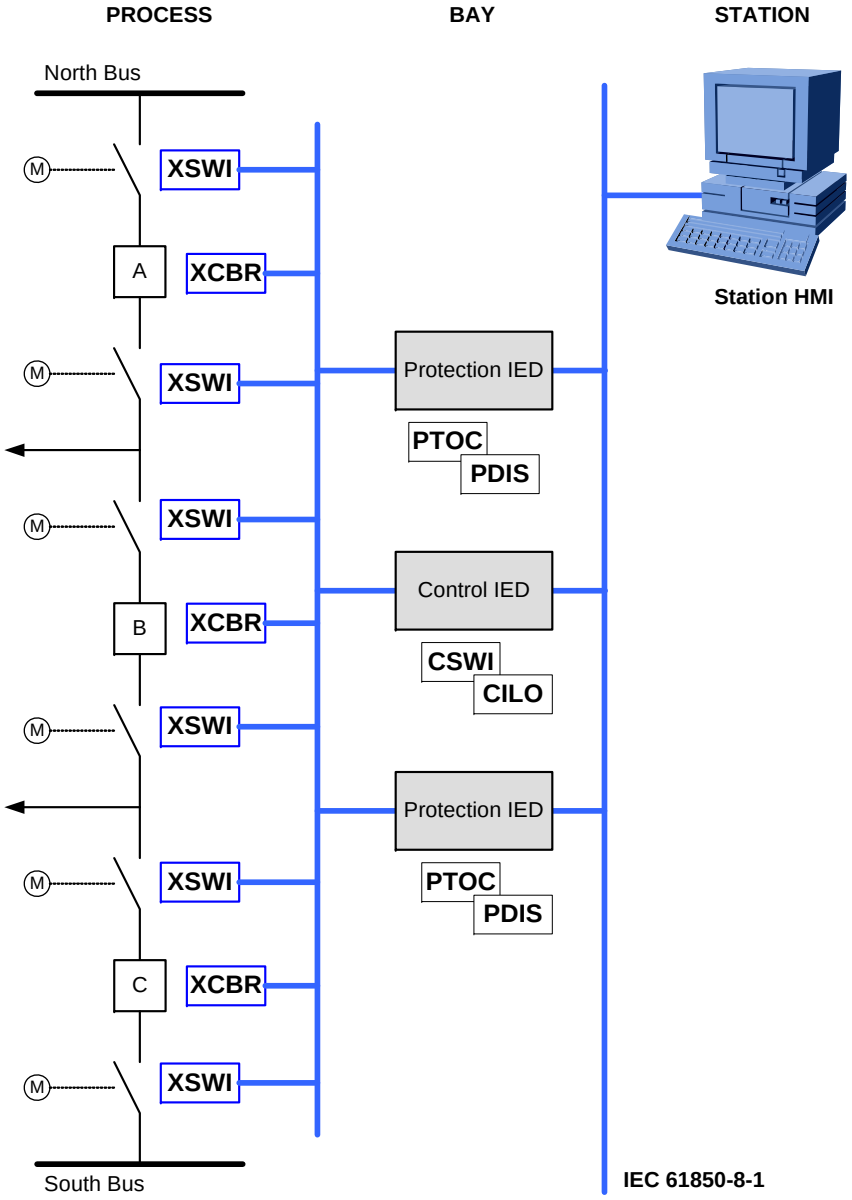


Generic GOOSE Output Function Blocks



- SPGGIO
  - Single point GOOSE
  - Binary
  - 1 / 0
- DPGGIO
  - Double point control GOOSE
  - Integer
  - 1/0, 0/1, 0/0, 1/1
  - Valid
- Inputs
  - Logic signals to sent to other station IEDs

Control Function Blocks



- Function blocks (IEC 61850 logical nodes) for IEDs at process level
  - XCBR – circuit breaker
  - XSWI – MOD
- Function blocks (IEC 61850 logical nodes) for IEDs at bay level
  - CSWI – switch controller
  - CILO – Interlocking
  - PDIS – distance protection
  - PTOC – TOC protection
  - Many more defined in IEC 61850 to provide secure substation control
- Operator places that provide control through function blocks (logical nodes)
  - Station HMI
  - IED (front panel)

Benefits to This Design Method

- Versatile Applications
- Simplify settings
- Design documentation
- Testing

Relion series relays for your current and future needs

- 61850 Logical Node concept used in Relion design
- Don’t see need to implement 61850 design at this time ??
- There for future use without having to modify relays
- Can implement in stages
- Future Proofing your substation protection and control design process

QUESTIONS ?