Applications and Industry Activities

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The Contents of IEC 61850, Edition 1

System Aspects

Part 1: Introduction and Overview

Part 2: Glossary

Part 3: General Requirements

Part 4: System and Project Management

Part 5: Comm Requirements for Functions and Device Models

Configuration

Part 6: Configuration Language for electrical Substation IED's

Testing

Part 10: Conform. Testing

Data Models

Basic Communication Structure for Substations and Feeder Equipment

Part 7-4: Compatible Logical Node Classes and Data Classes

Part 7-3: Common Data Classes

Abstract Comm. Services

Basic Communication Structure for Substations and Feeder Equipment

Part 7-2: Abstract Communication Services (ACSI)

Part 7-1: Principles and Models

Mapping to real Comm. Networks (SCSM)

Part 8-1: Mapping to MMS and ISO/IEC 8802-3

Part 9-1: Sampled Values over Serial Unidirectional Multidrop Point-to-Point link

Part 9-2: Sampled Values over ISO/IEC 8802-3

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Who should know what from IEC61850?

	Part 1 Introduction	Part 5 Requirements	Part 7-1 Principles	Part 7-2 ACSI	Part 7-3 CDC	Part 7-4 LN	Part 6 SCL	Part 8-1, 9-x mapping to MMS
UTILITY								
Manager	important		partly important					
Engineer	important	important	important	partly important	important	important	partly important	
VENDOR								
Application E.	important	important	important	partly important	important	important	important	partly important
Communication E.	important	important	important	important			partly important	important
Product Manager	important	important	partly important	partly important	partly important	important	partly important	
Marketing	important	important	partly important	partly important	partly important	partly important	partly important	
CONSULTANT								
Application E.	important	important	important		important	important	partly important	
Communication E.	important		important	important			partly important	important
others	important	important	important					

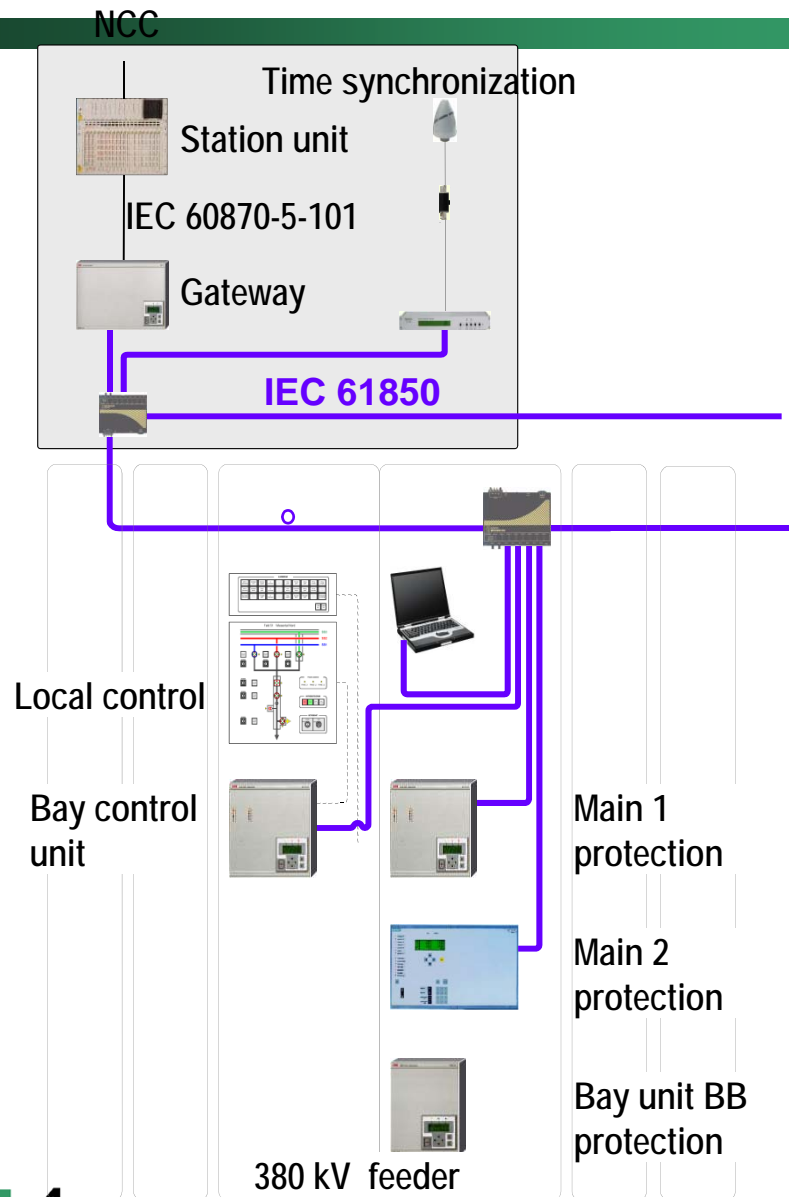|	
important	(red)
partly important	(yellow)
minor importance	(white)

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Content

- Project Examples
- Application Examples
- Industry Activities

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Winznauschachen (Switzerland)

- In operation since 11/2004
- 16 kV Distribution
- 9 Bays
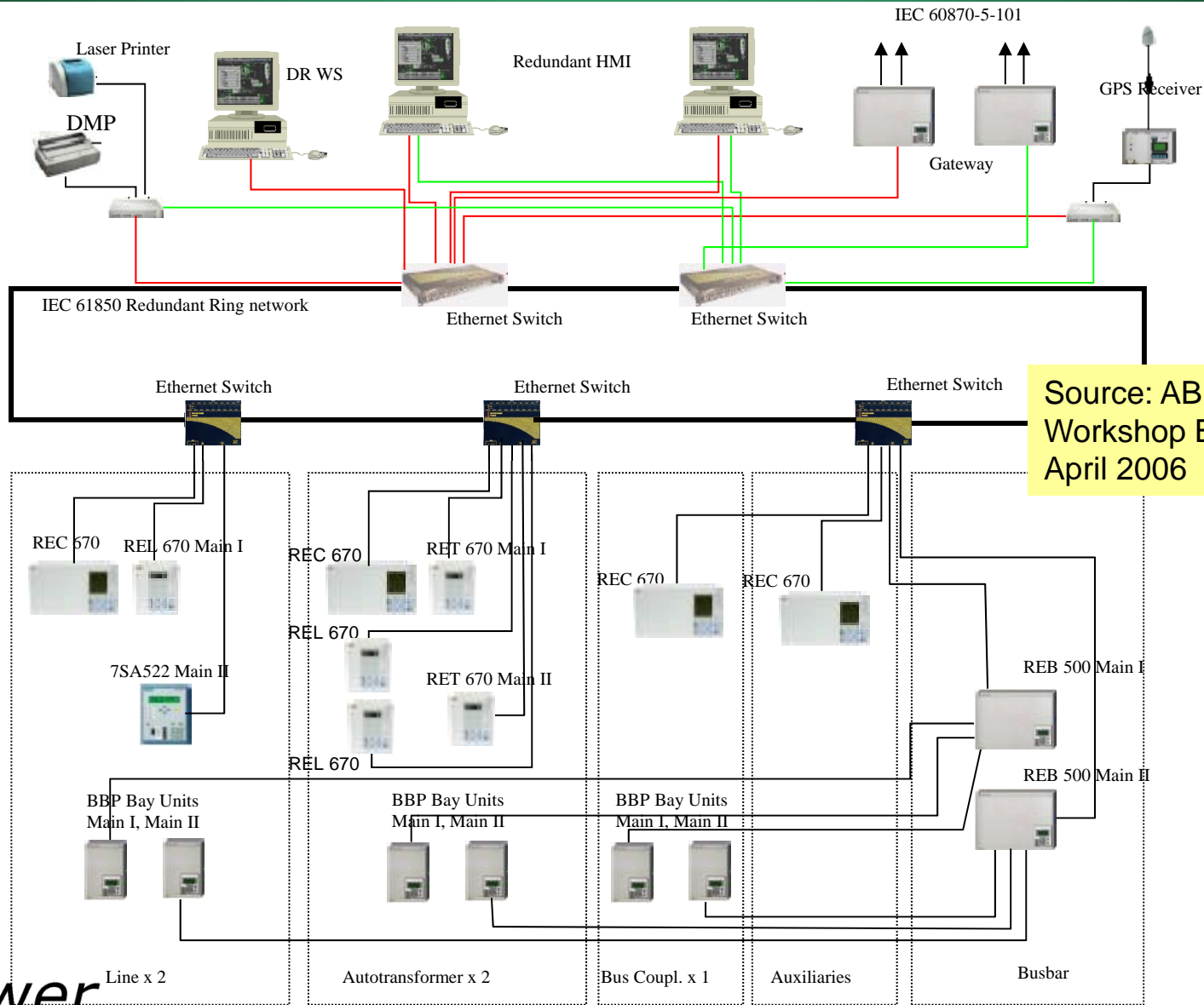- Comprising Substation Controller, Relays, Engineering according to part 6

Laufenburg (Switzerland)

NCC

Time synchronization

Station unit

IEC 60870-5-101

Gateway

IEC 61850

Local control

Bay control unit

Main 1 protection

Main 2 protection

Bay unit BB protection

380 kV feeder

- **First bay in operation since 12/2004**
- **380 kV transmission substation**
- **Main 2 protection from different supplier**
- **Retrofit**
  - Stepwise retrofit of 7 bays
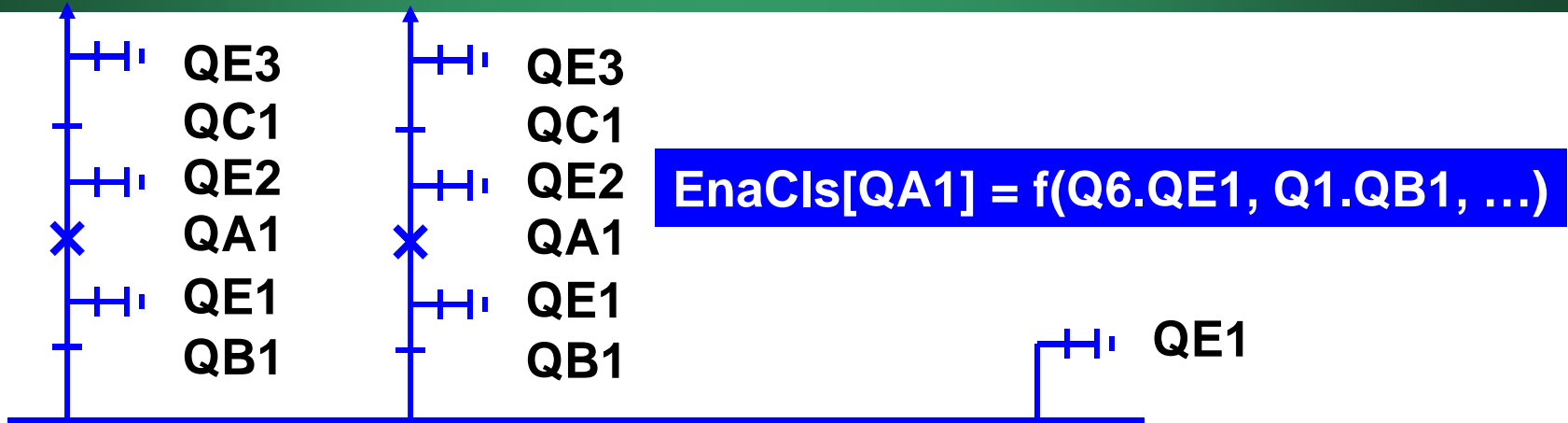 - Integration of the existing station control system

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PGCIL Maharanibagh 400 kV S/S

Laser Printer

DMP

DR WS

Redundant HMI

IEC 60870-5-101

GPS Receiver

Gateway

IEC 61850 Redundant Ring network

Ethernet Switch

Ethernet Switch

Ethernet Switch

Ethernet Switch

Ethernet Switch

Source: ABB at CPRI Workshop Bangalore, April 2006

REC 670 REL 670 Main I

REC 670 RET 670 Main I

REC 670 REC 670

REL 670

7SA522 Main II

RET 670 Main II

REB 500 Main I

REL 670

REB 500 Main II

BBP Bay Units
Main I, Main II

BBP Bay Units
Main I, Main II

BBP Bay Units
Main I, Main II

Line x 2

Autotransformer x 2

Bus Coupl. x 1

Auxiliaries

Busbar

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Case study: Integral Energy (Australia)

- Issued Functional Specification for IEC 61850 based SAS
- Fully duplicated main 1 / main 2 protection scheme
- No physical wires between IEDs in different bays

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Integral Energy - Architecture

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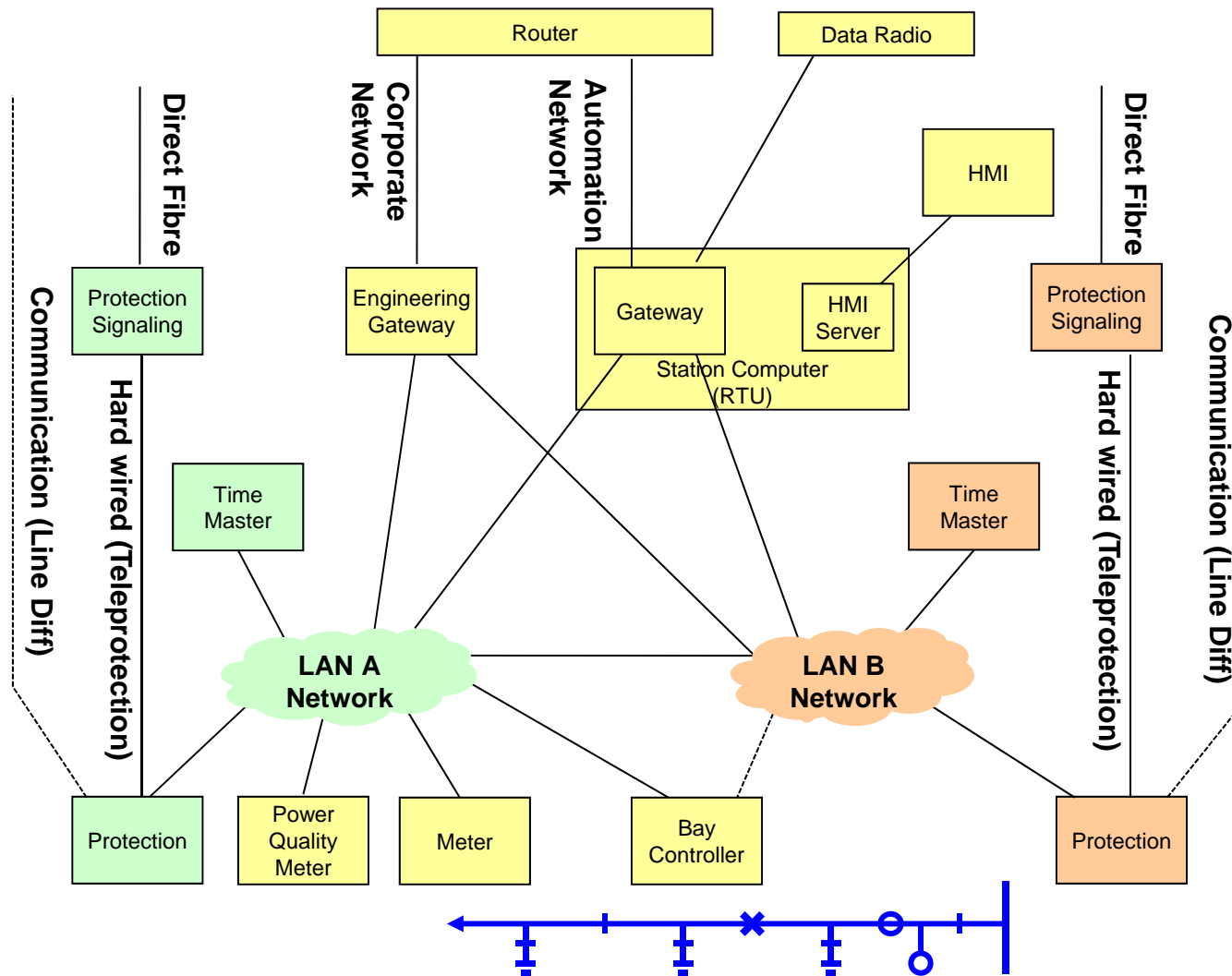
Integral Energy – Extract specification
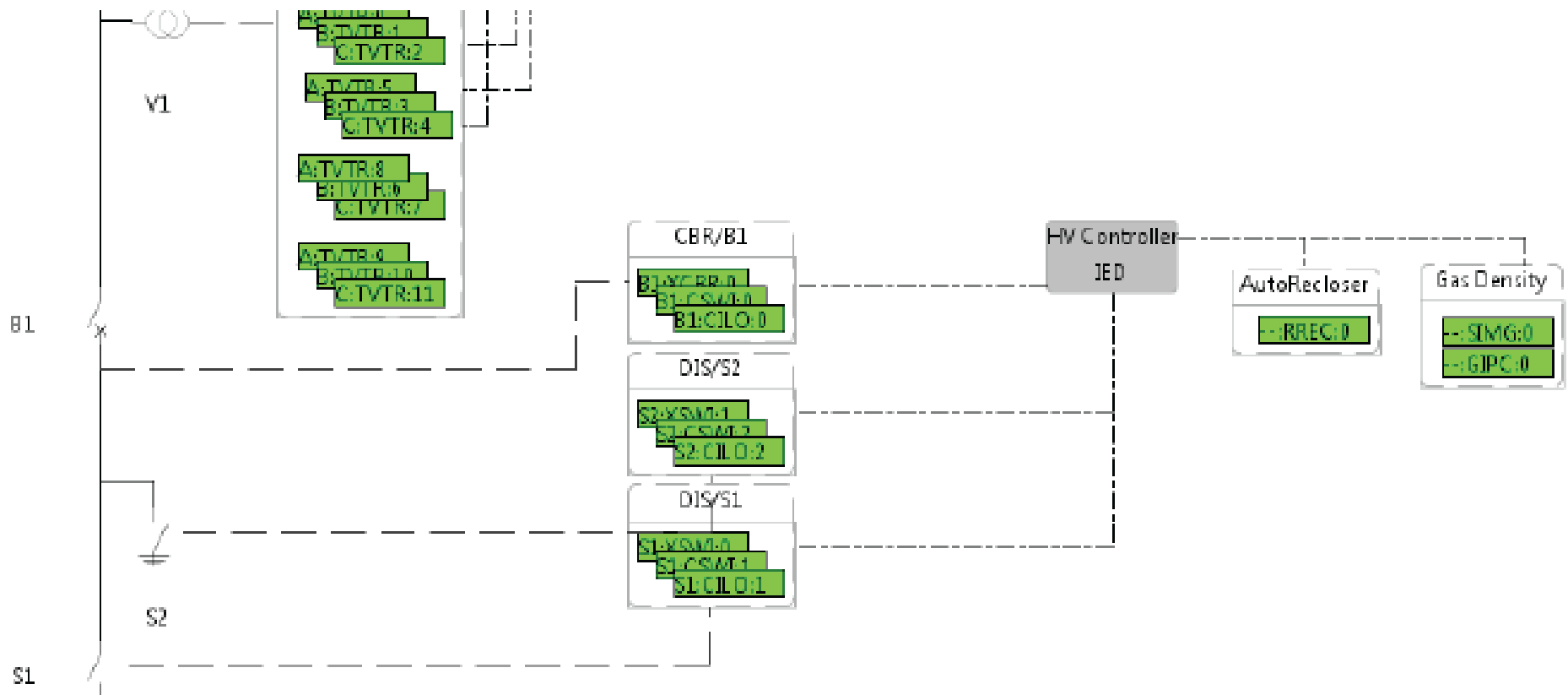
Content

- Project Examples
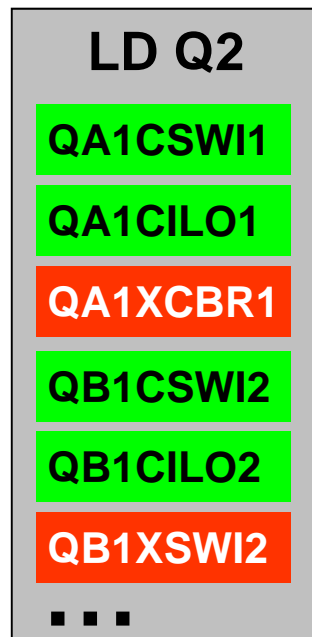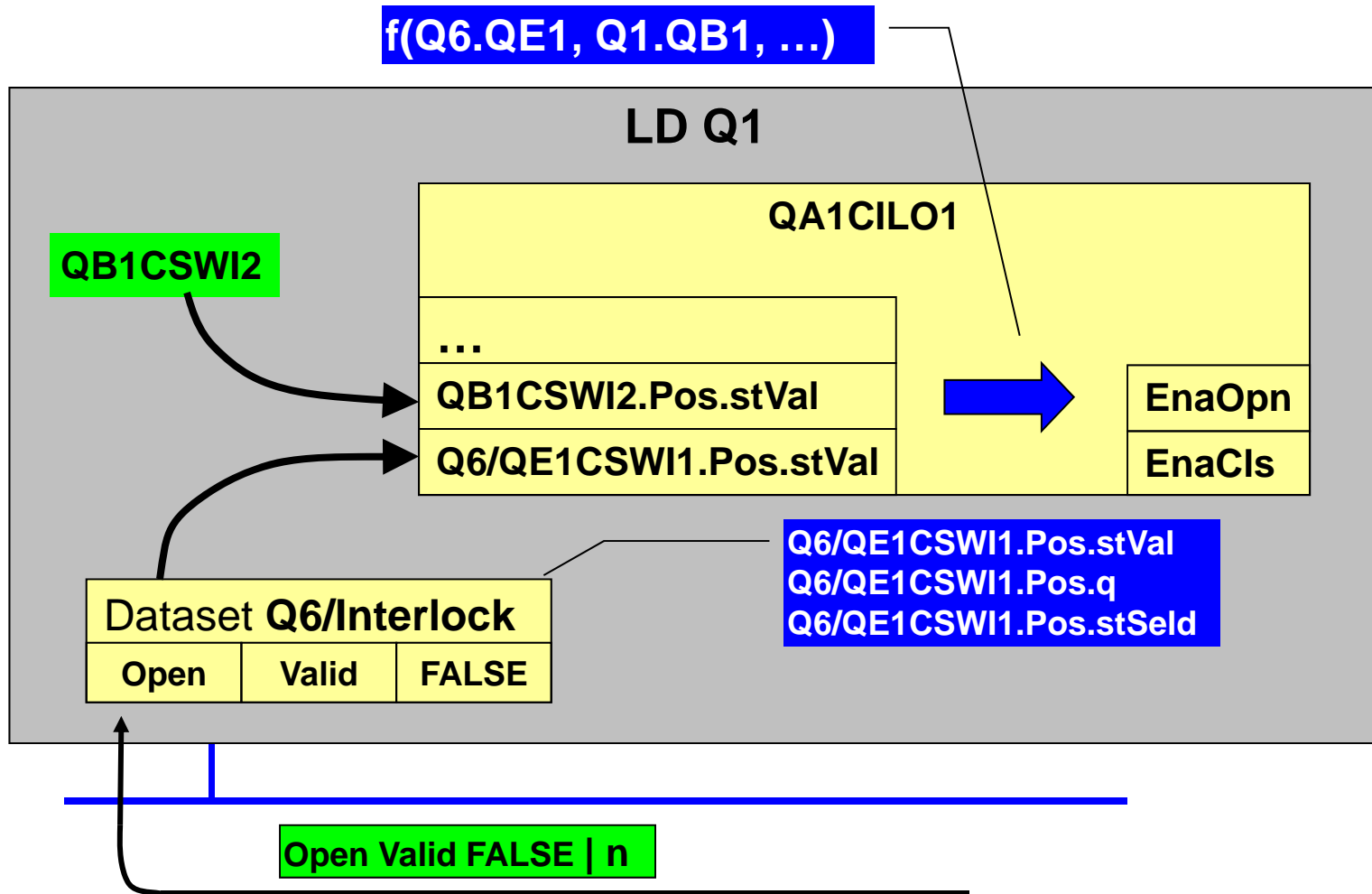- **Application Examples**
- Industry Activities

Interlocking (1)

QE3
QC1
QE2
QA1
QE1
QB1

QE3
QC1
QE2
QA1
QE1
QB1

QE1

$$EnaCIs[QA1] = f(Q6.QE1, Q1.QB1, …)$$

Q1

Q2

Q6

LD Q1

QA1CSWI1

QA1CILO1

QA1XCBR1

QB1CSWI2

QB1CILO2

QB1XSWI2

. . .

LD Q2

QA1CSWI1

QA1CILO1

QA1XCBR1

QB1CSWI2

QB1CILO2

QB1XSWI2

. . .

LD Q6

QE1CSWI1

QE1CILO1

QE1XSWI1

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Interlocking (2)

LD Q1
- QA1CSWI1
- QA1CILO1
- QA1XCBR1
- QB1CSWI2
- QB1CILO2
- QB1XSWI2
- . . .

LD Q2
- QA1CSWI1
- QA1CILO1
- QA1XCBR1
- QB1CSWI2
- QB1CILO2
- QB1XSWI2
- . . .

LD Q6
- QE1CSWI1
- QE1CILO1
- QE1XSWI1

Dataset **Q6/Interlock**
Q6/QE1CSWI1.Pos.stVal
Q6/QE1CSWI1.Pos.q
Q6/QE1CSWI1.Pos.stSeld

Open Valid FALSE | n

EnaCls[QA1] = f(Q6.QE1, Q1.QB1, …)

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Interlocking (3)

f(Q6.QE1, Q1.QB1, …)

LD Q1

QB1CSWI2

QA1CILO1

…

QB1CSWI2.Pos.stVal

Q6/QE1CSWI1.Pos.stVal

EnaOpn

EnaCls

Q6/QE1CSWI1.Pos.stVal
Q6/QE1CSWI1.Pos.q
Q6/QE1CSWI1.Pos.stSeld

Dataset **Q6/Interlock**

Open	Valid	FALSE

Open Valid FALSE | n

Underfrequency Load Shedding

PTUF1

PTUF2

PTUF2.Op

PTUF1.Op

PTRC

PTRC

Feeder to trip on stage 2

Feeder to trip on stage 1
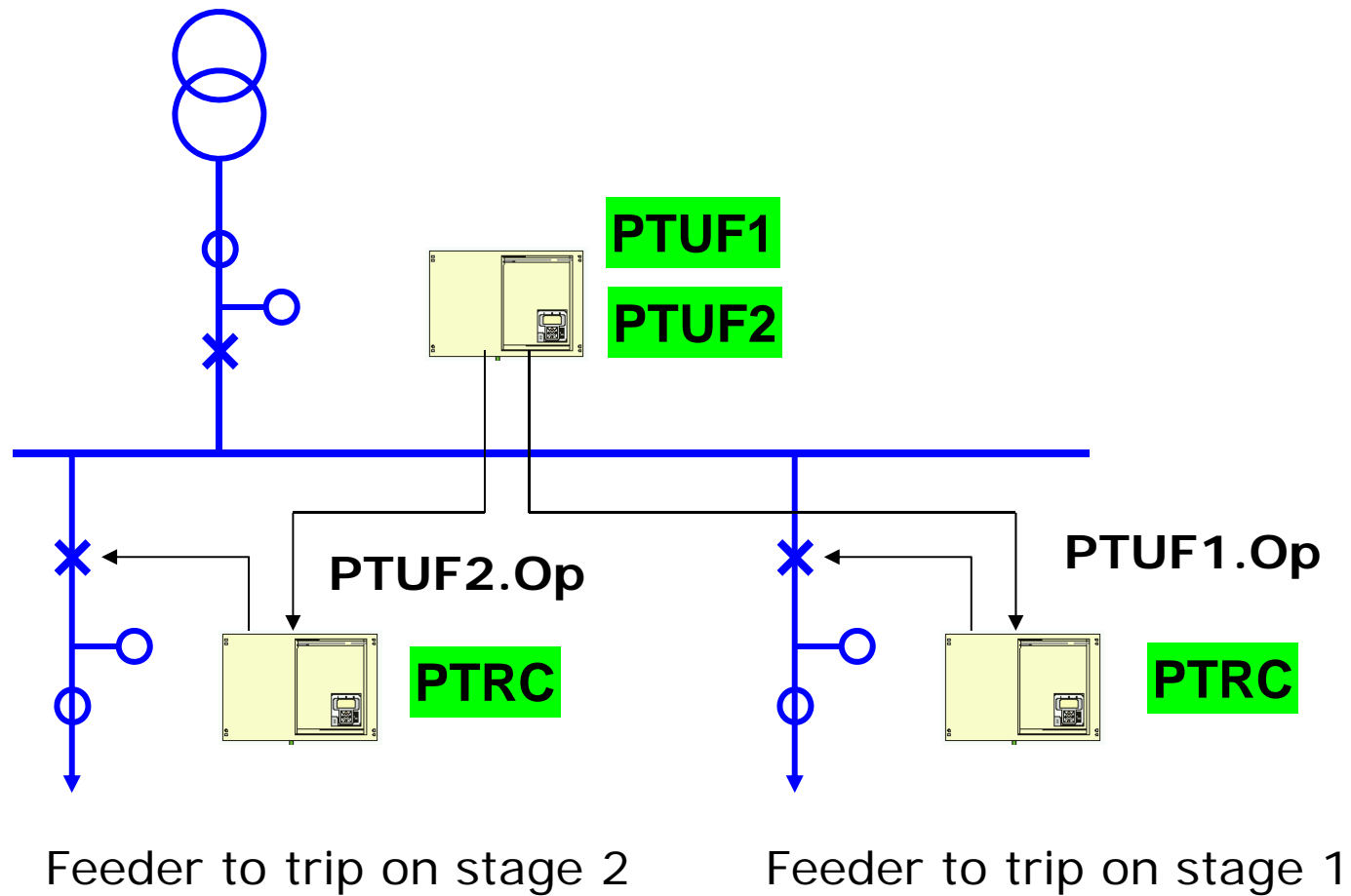
Reverse blocking

GOOSE Message
- PDIS.Str
- PTRC.Op

Trigger Breaker Failure

Control HV
Transformer Protection Main 2

Trigger Breaker Failure

PDIF

PDIS

PTRC

Control LV
Transformer Protection Main 1
Busbar Protection 16 kV BB

Trigger Breaker Failure
Reverse blocking

PDIS

PTRC

Feeder Control
Feeder Protection

Feeder Control
Feeder Protection

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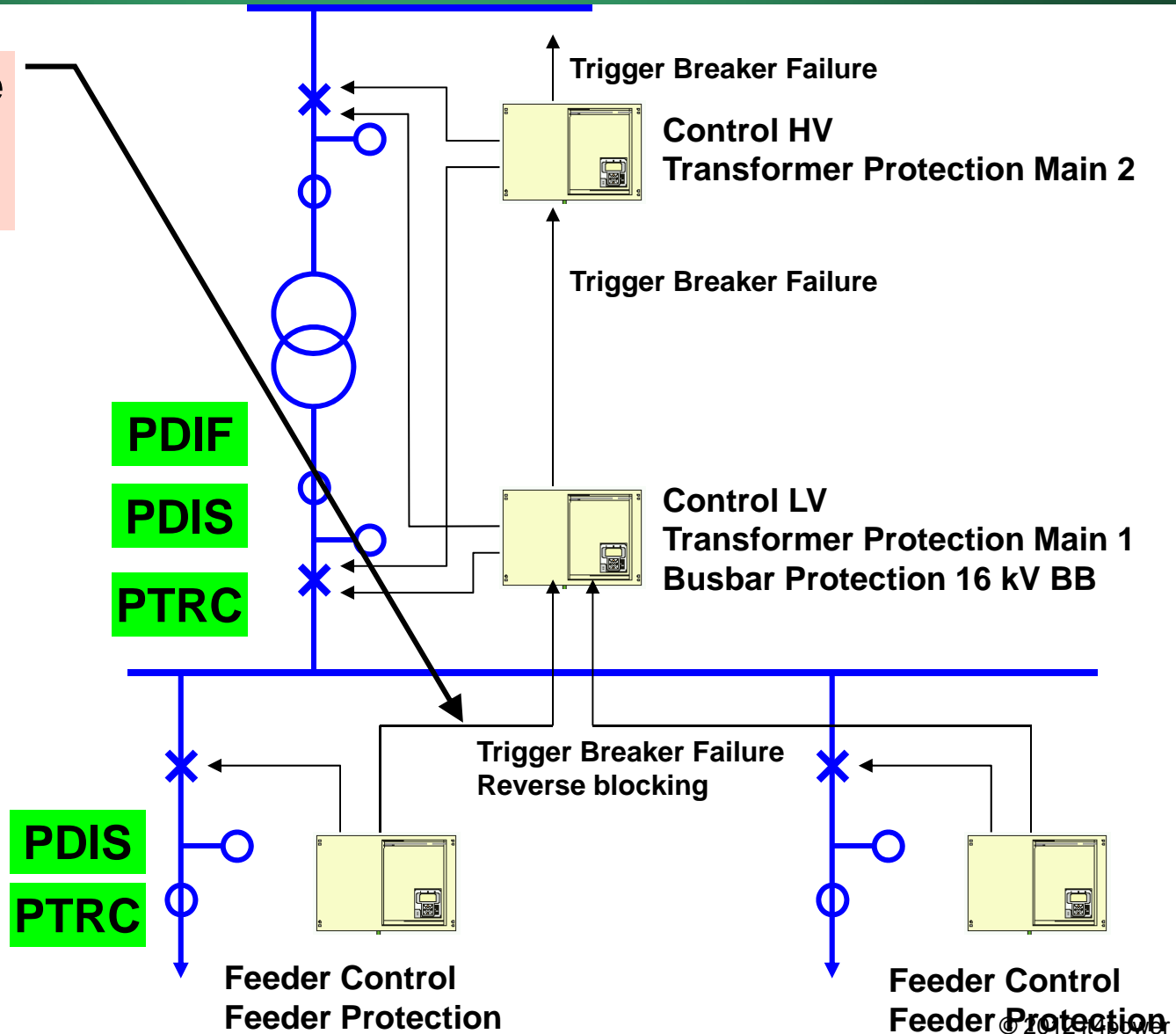
PUTT scheme – Gateway approach
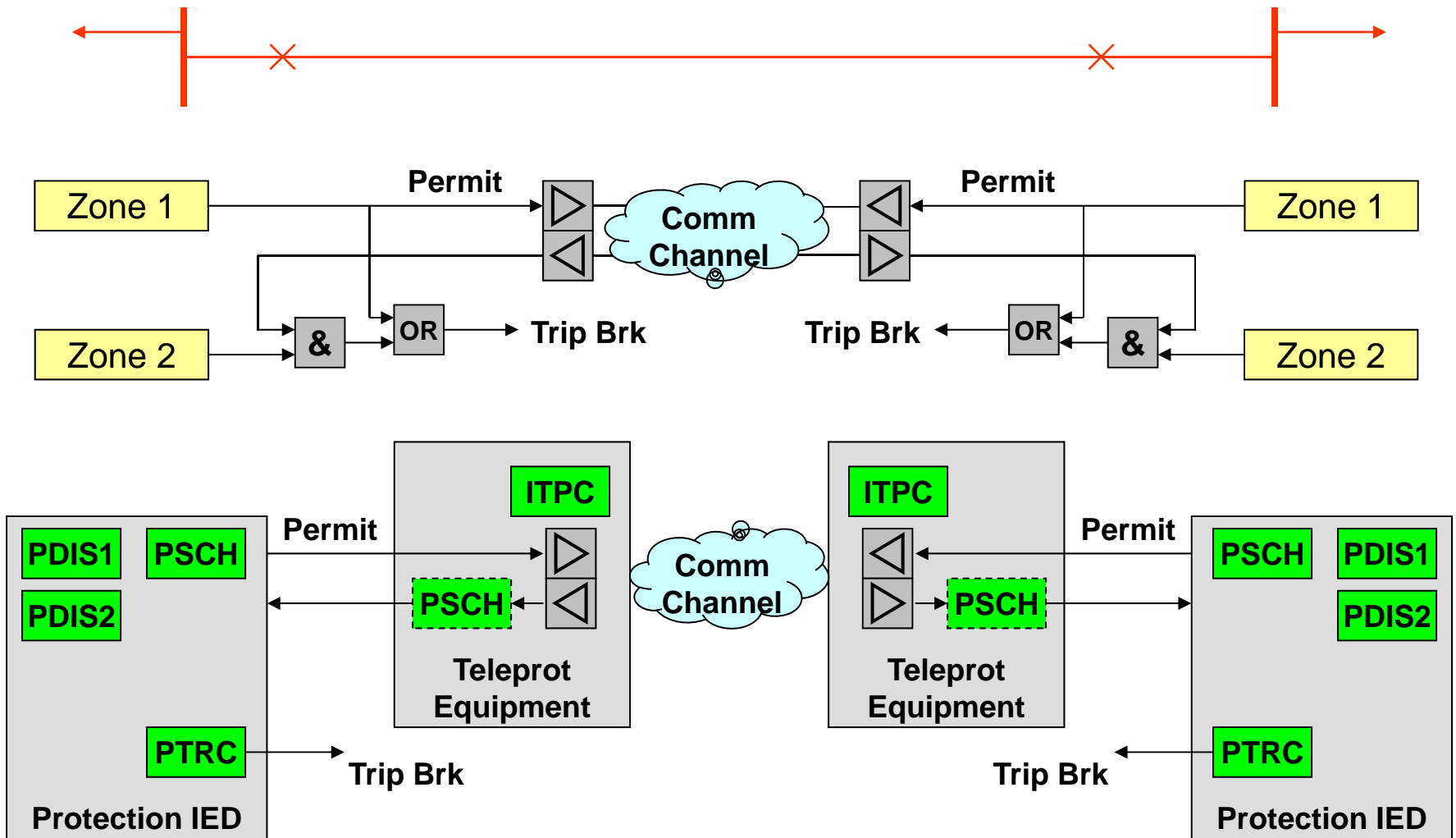
Gateway approach

PUTT scheme – Tunneling approach
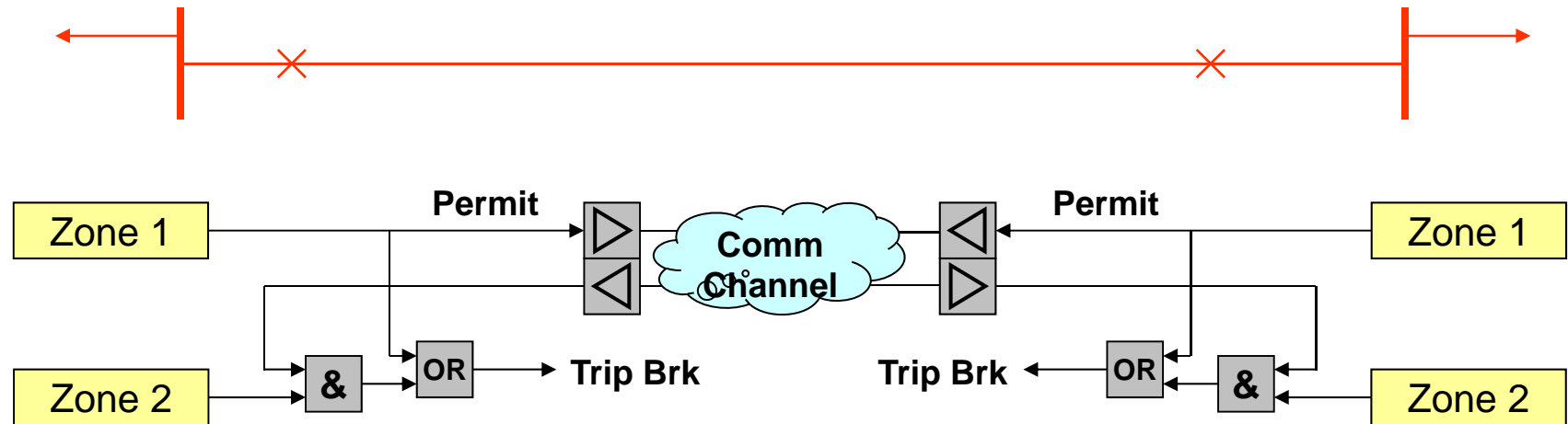
Tunneling approach

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- Project Examples
- Application Examples
- **Industry Activities**

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Published documents beyond Ed 1

- IEC 61850-7-410 – Hydroelectric power plants – Communication for monitoring and control
- IEC 61850-7-420 – Communications Systems for Distributed Energy Resources (DER)
- IEC 61850-80-1 – Guideline to exchange information from a CDC based data model using IEC 60870-5-101 / -104

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New technical reports published

- IEC 61850-90-1: Using IEC 61850 for communication between substations (published)
- IEC 61850-90-5: Using IEC 61850 to transmit synchrophasor information according to IEEE C37.118

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WG10 ongoing work (1)

- IEC 61850-90-2: Using IEC 61850 for communication between substations and control center
- IEC 61850-90-3: Using IEC 61850 for condition monitoring
- IEC 61850-90-4: Network engineering guidelines (LAN in substations)
- IEC 61850-90-11: Methodologies for modeling of logics for IEC 61850 based applications
- IEC 61850-90-12: Network engineering guidelines for WAN
- IEC 61850-90-14: Using IEC 61850 for FACTS data modeling

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WG10 ongoing work (2)

- IEC 61850-7-5: Use of logical nodes to model applications – generic principles
- IEC 61850-7-500: Use of logical nodes to model applications in substations
  - Explain, how to use the concepts of IEC 61850 to model the applications of a substation automation system
- IEC 61850-100-1: Methodologies for testing of functions in IEC 61850 based systems
- System management
- Alarm handling
- Preparation of UML model for IEC 61850

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WG17 ongoing work

- IEC 61850-90-6: Using IEC 61850 for distribution automation
- IEC 61850-90-7: IEC 61850 object models for photovoltaic, storage and other DER inverters
- IEC 61850-90-8: IEC 61850 object models for electrical vehicles
- IEC 61850-90-9: IEC 61850 object models for electrical energy storage systems
- IEC 61850-90-10: Modeling of schedules in IEC 61850
- IEC 61850-90-15: Hierarchical DER system model
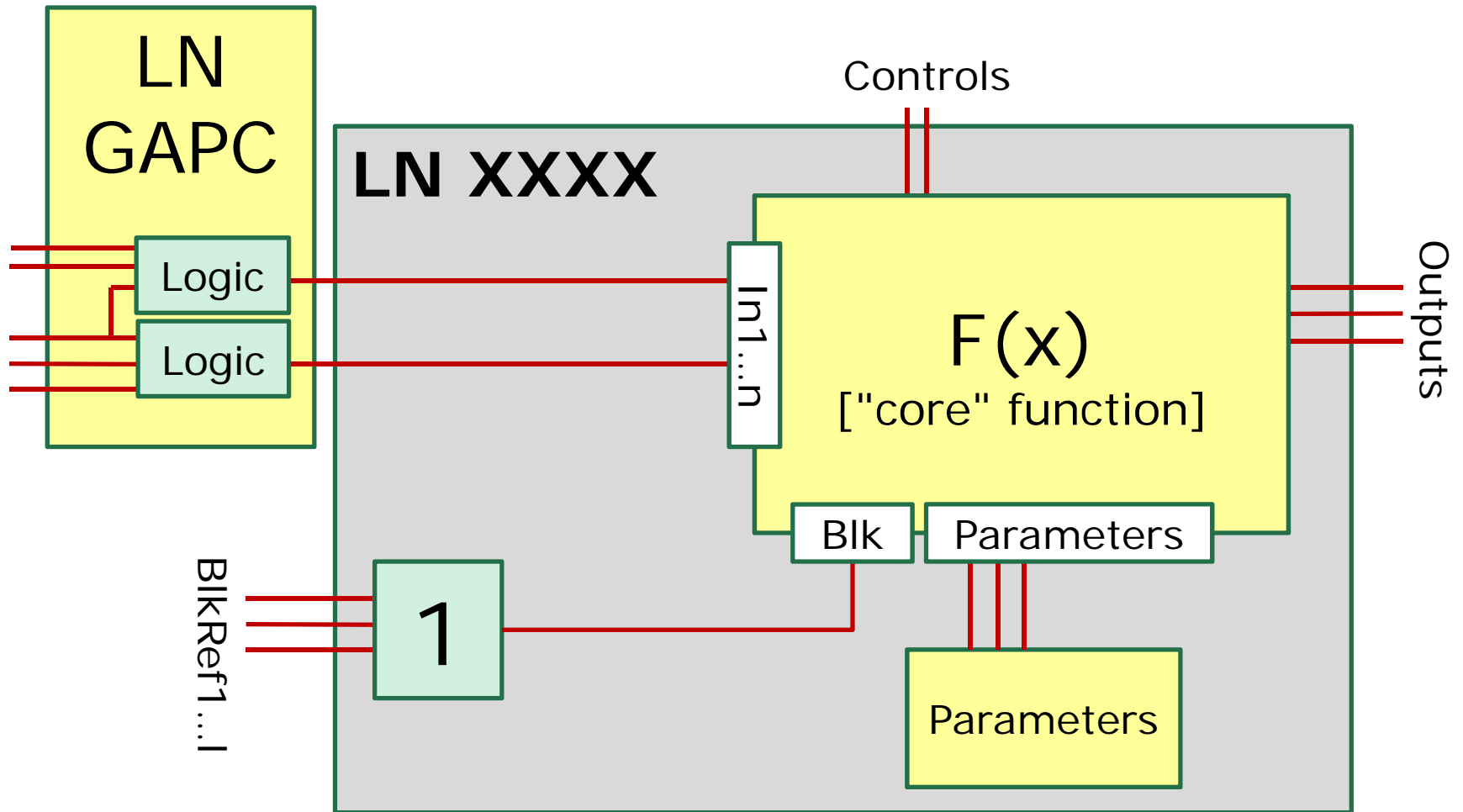- IEC 61850-8-2: Mapping on Web Services

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WG18 ongoing work

- IEC 61850-7-510: Hydro Power plants – Modeling concepts and guidelines
- Communication network structure in hydro power plants
- IEC 61850-90-13: Extensions to include models for steam and gas turbines
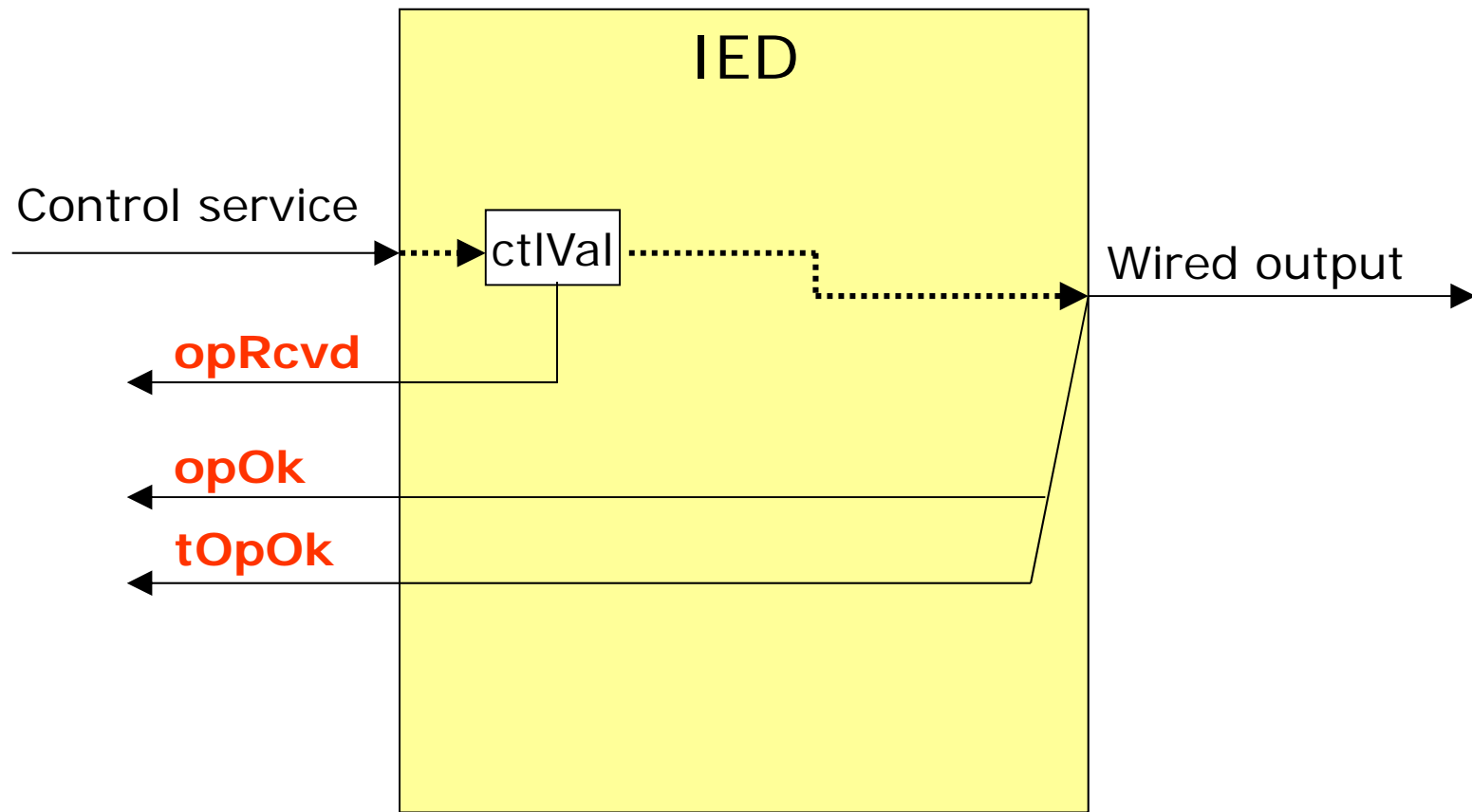- Interoperability test for hydro equipment based on IEC 61850

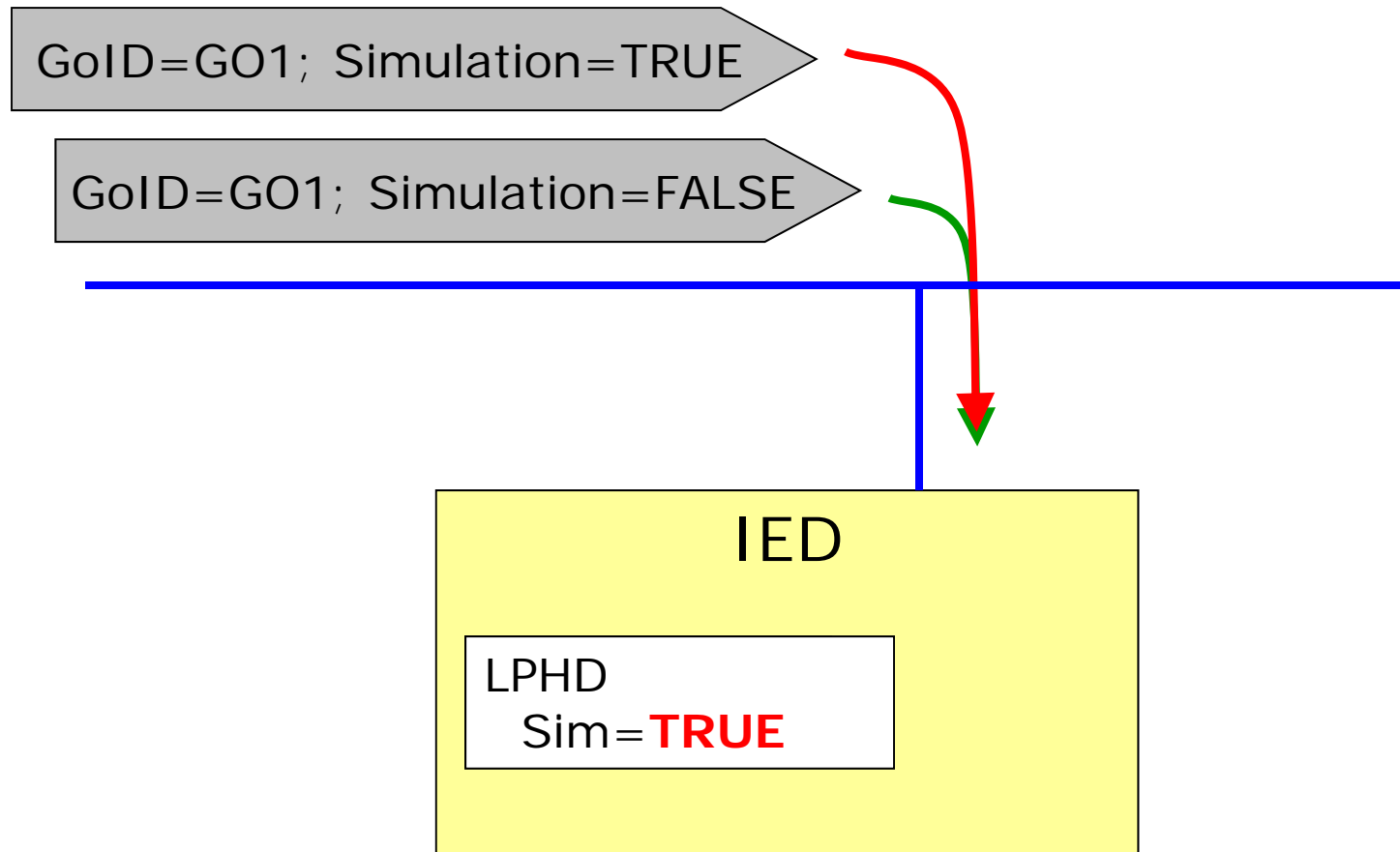it4power

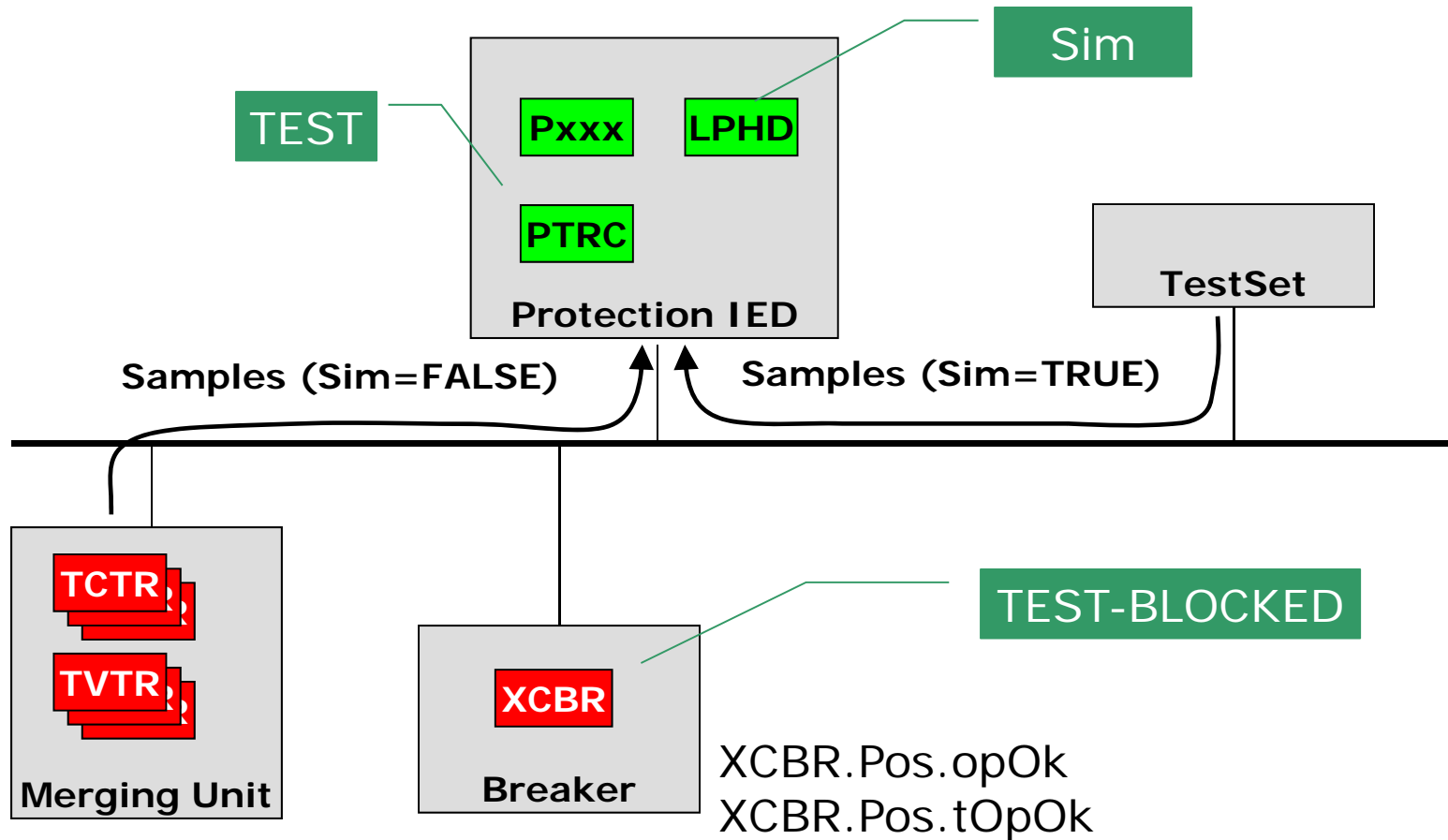# Logic modeling - Functional view of a LN
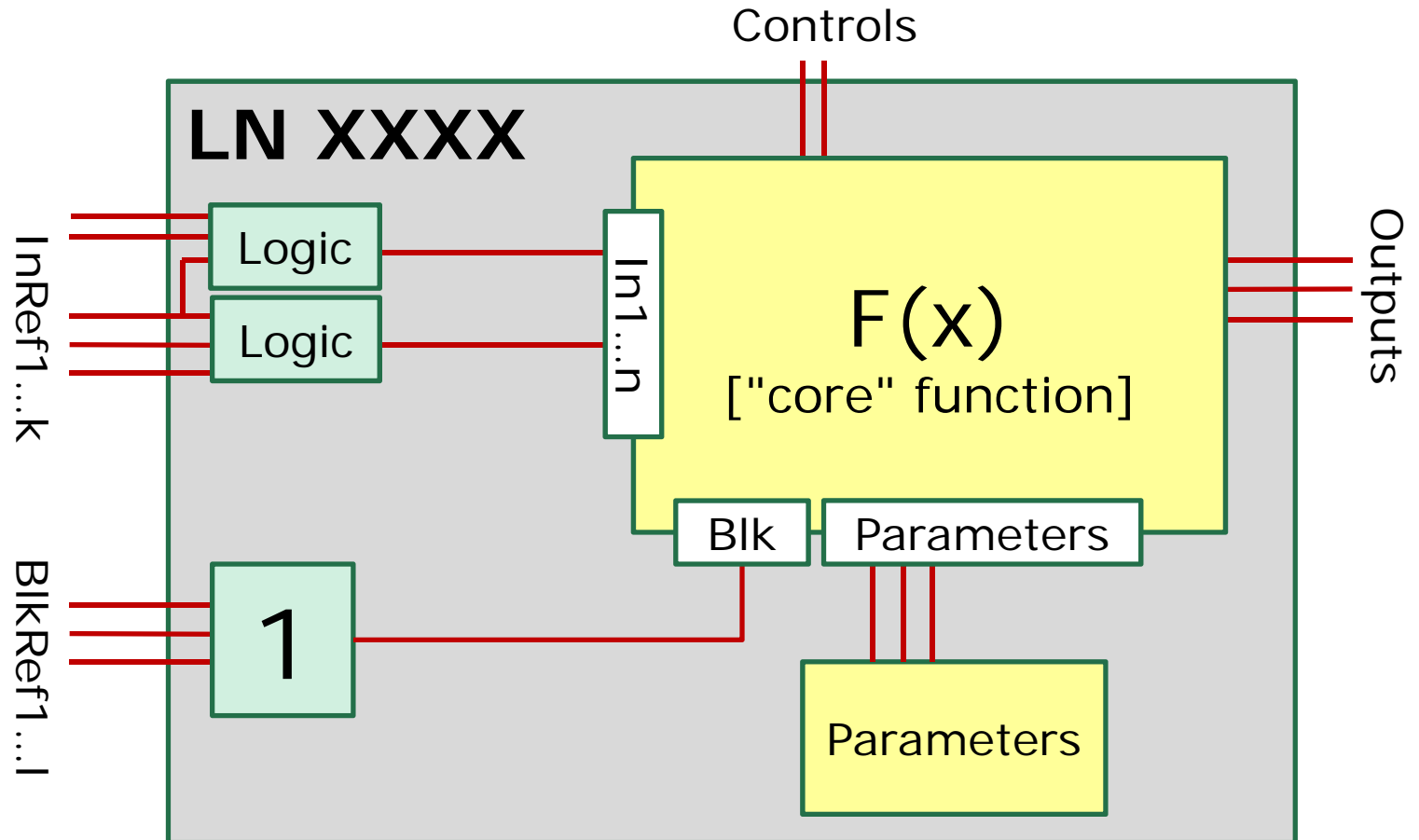
Logic modeling - Functional view of a LN

Testing - Mirroring control information
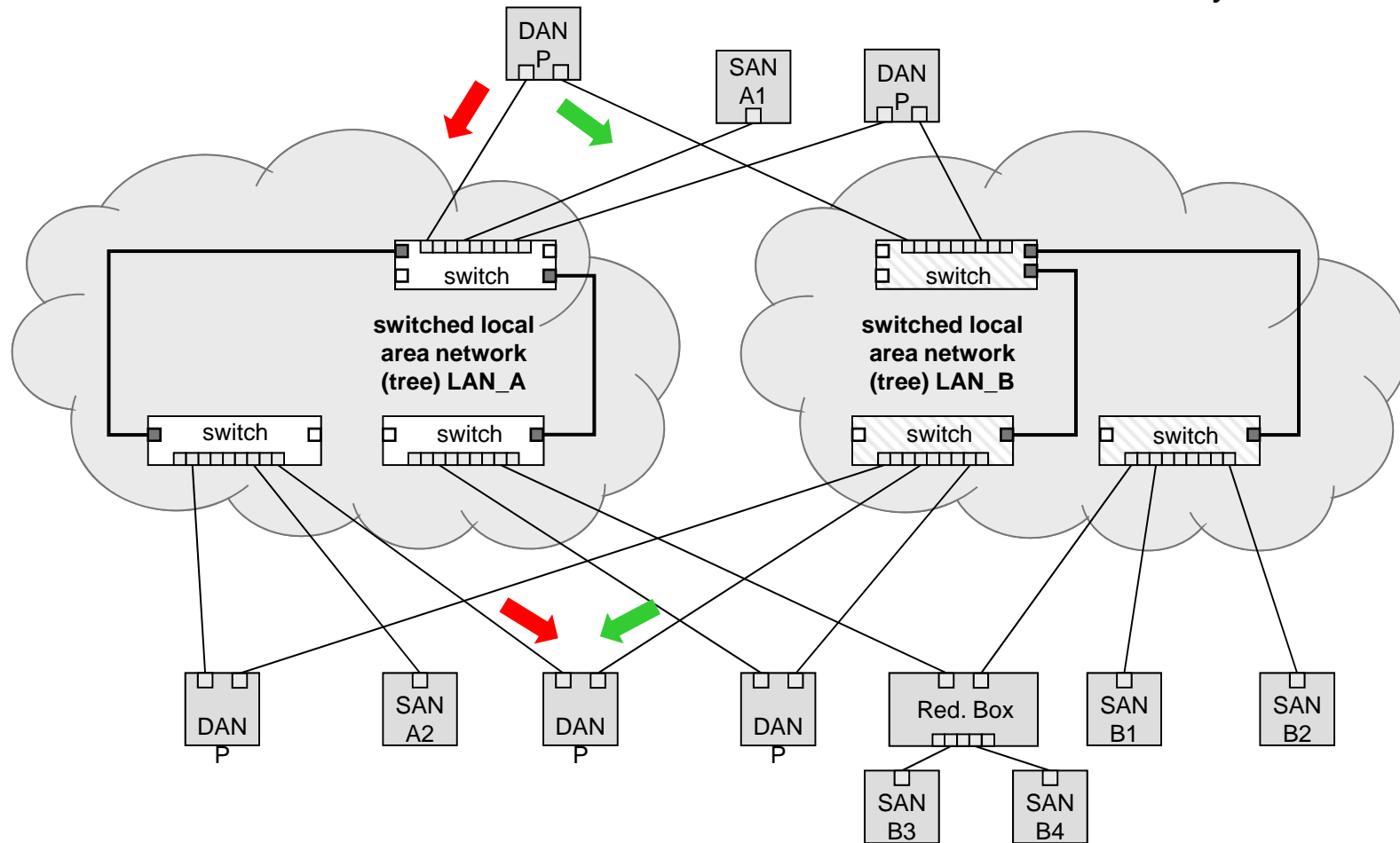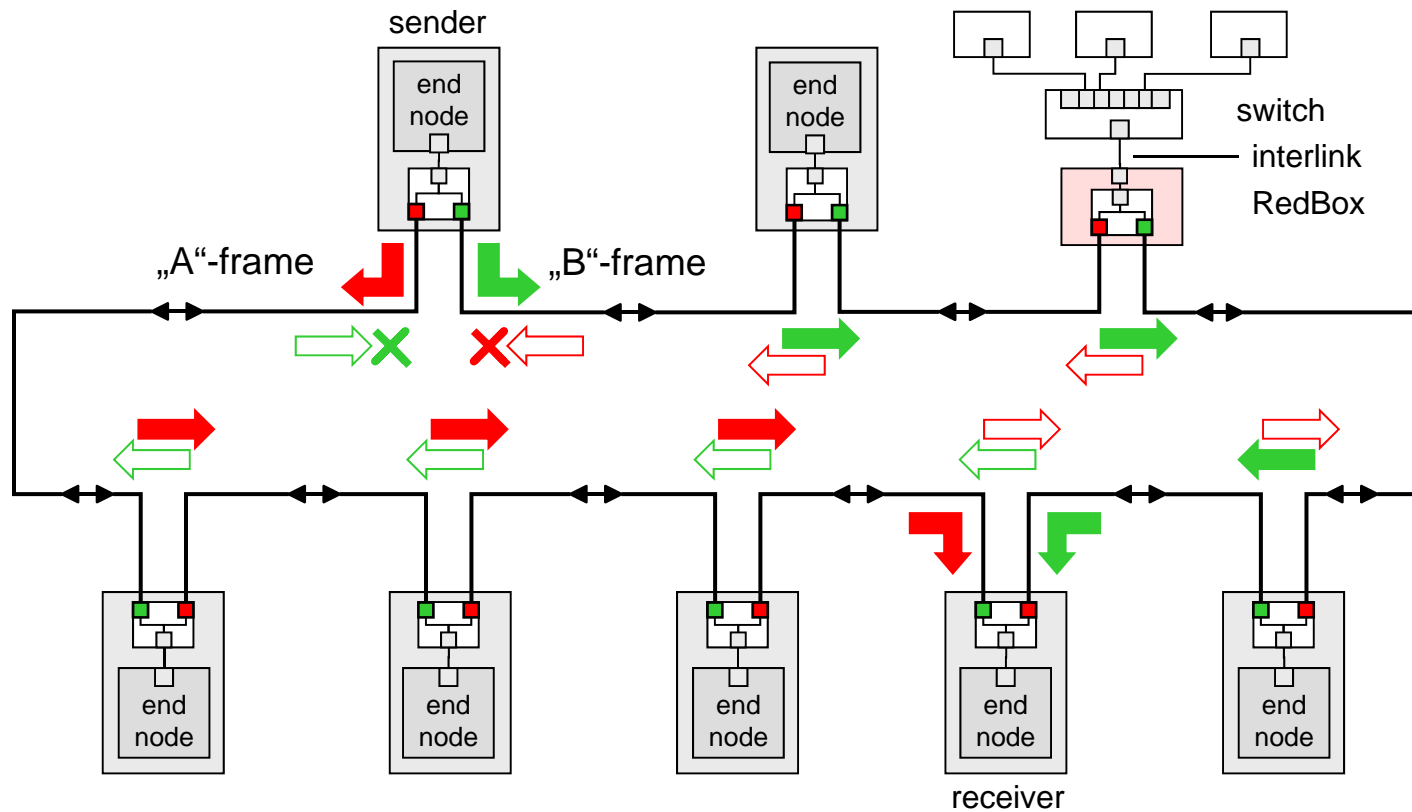
Testing - Simulation of messages

GoID=GO1; Simulation=TRUE

GoID=GO1; Simulation=FALSE

IED

LPHD
Sim=**TRUE**

Isolation and test

Sim

TEST

Pxxx LPHD

PTRC

Protection IED

TestSet

Samples (Sim=FALSE) **Samples (Sim=TRUE)**

TCTR

TVTR

Merging Unit

XCBR

Breaker

TEST-BLOCKED

XCBR.Pos.opOk
XCBR.Pos.tOpOk

Parallel Redundancy Protocol (PRP)

SAN = singly attached nodes
DAN = doubly attached nodes

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High Availability Seamless Ring (HSR)

sender

end node

end node

switch

interlink

RedBox

„A"-frame

„B"-frame

end node

end node

end node

end node

end node

receiver

Communication network redundancy

Fig 2. Network Topology of PRP/HSR Interoperability Demonstration and Generic IEC 61850 Demonstration at UCAIug CIGRÉ 2012 Booth

Demo CIGRE 2012

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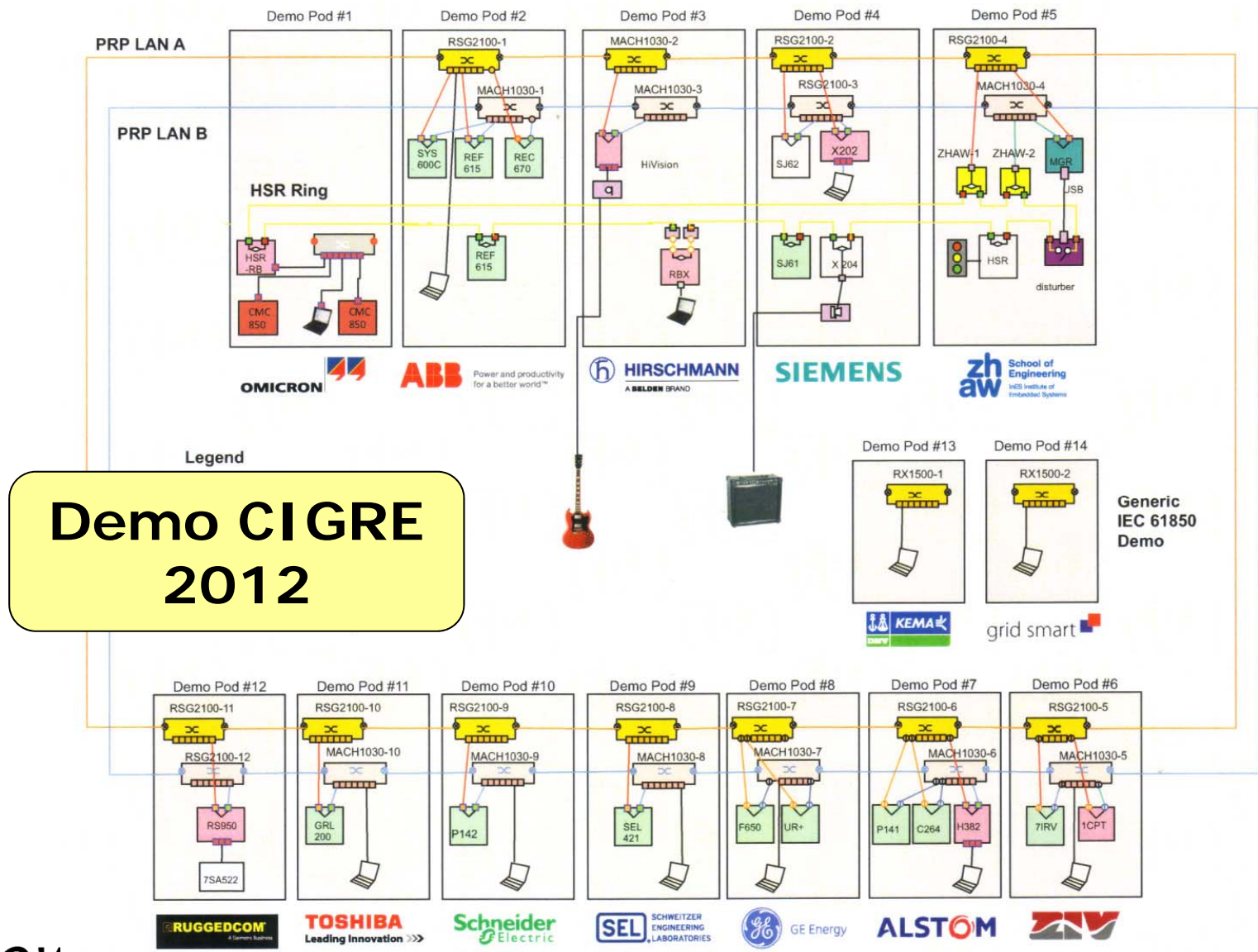
Conclusions

- **IEC 61850 today**
  - Interoperability for communication of information in several domains of the power utility automation
  - Framework to facilitate engineering
- **IEC 61850 tomorrow**
  - Improved engineering interoperability to design distributed automation function like protection and control schemes
  - New features supporting the challenges of a Smart Grid communication backbone

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