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Relion. Thinking beyond the box.

Designed to seamlessly consolidate functions, Relion relays are smarter, more flexible and more adaptable. Easy to integrate and with an extensive function library, the Relion family of protection and control delivers advanced functionality and improved performance.

ABB Protective Relay School Webinar Series

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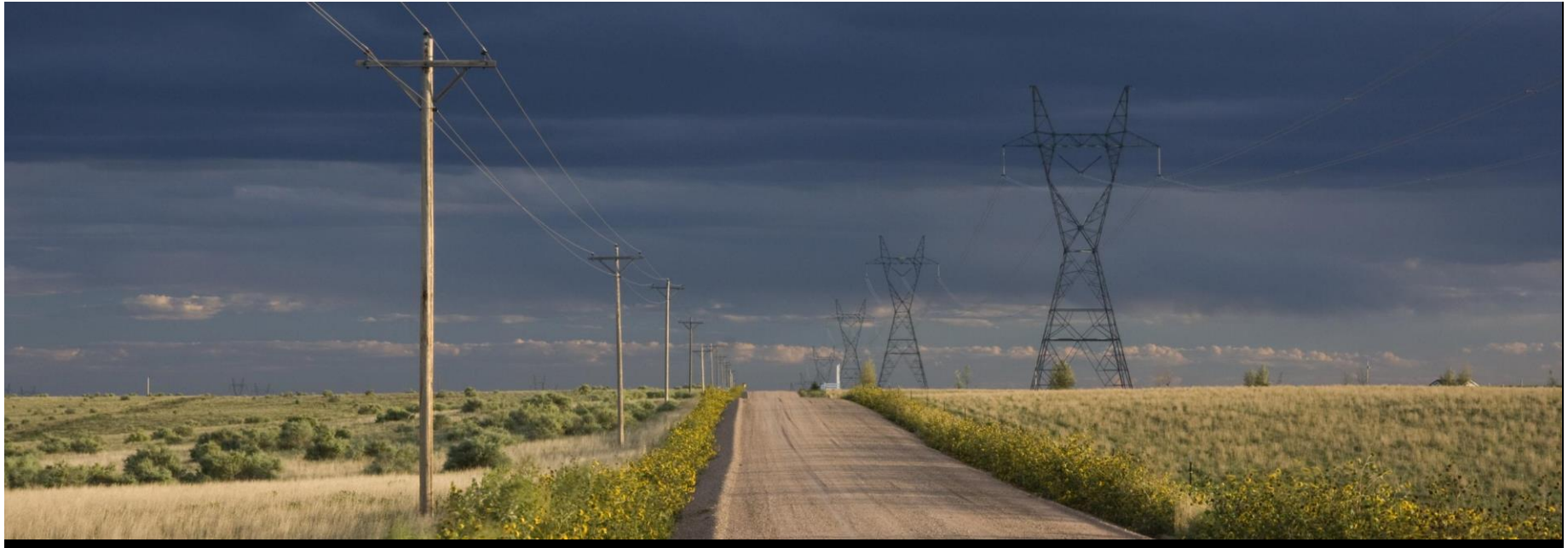


ABB Protective Relay School Webinar Series

Benefits of Digital Substation

Mahesh Sathe

December 03, 2013

Presenter

Mahesh Sathe

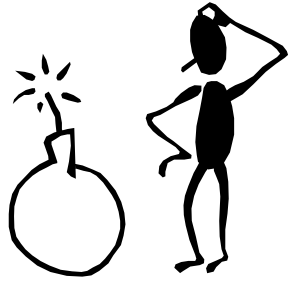
- Mahesh Sathe graduated from Pune University, India with a Bachelors degree in Electrical Engineering.
- In 2002 Mahesh moved to Canada and worked for Thomson Technology in Vancouver in the field of Generator Protection and Automation Systems
- He worked at GE Digital Energy and Siemens as a Protection and Control Engineer and has executed several IEC 61850 projects in India, Russia, Canada and United States
- Mahesh is currently leading the “Technical Pre-Sales” team for “Substation Automation Systems” in ABB for the North America Region

Learning objectives

- Background information
- Digital Substations
- IEC 61850 in details
- Sample Architecture

Today’s situation

- Aging infrastructure
- Aging / reduced workforce – less electrical engineers available – new technologies available
- Cost constraints (real estate, engineering, installation and operation phases)
- Requirements on more information for operations and asset management
- Higher reliability requirements
- Requirements on lower environmental impact



What to do

- Retrofitting P&C systems in existing substations
- Building new substations
- Using new technologies, making the system “smarter”
- Reduce space, engineering and installation cost.
- Use the P&C system for more than just protection and control purposes.
- Green decisions

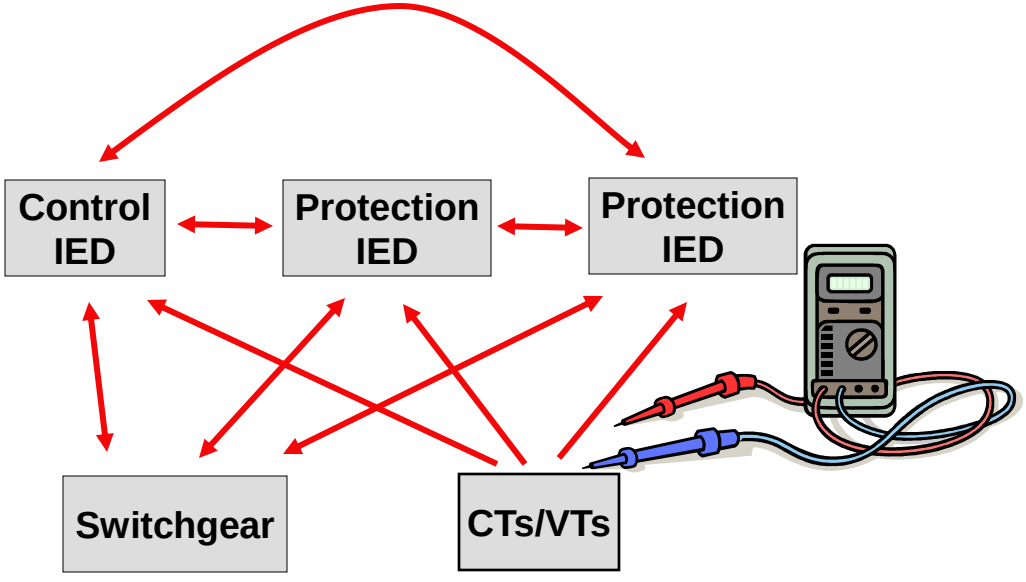
New Installations

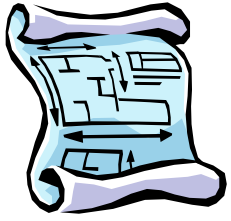
- Reduce footprint by utilizing communication technology
  - Less wiring
  - Smaller devices as a result of less wiring
  - Smaller / fewer panels
  - Smaller buildings

Asset Management

- Use the P&C system to provide asset management data
  - Breaker operations, sum of switched amps
  - Tap changer operations
  - Transformer monitoring (transformer models)
  - GIS SF6 density
  - Vibrations
  - …
- Use what is already installed, fewer systems needed, less complexity, do more with less
- Make your substation “smarter”

Conventional design

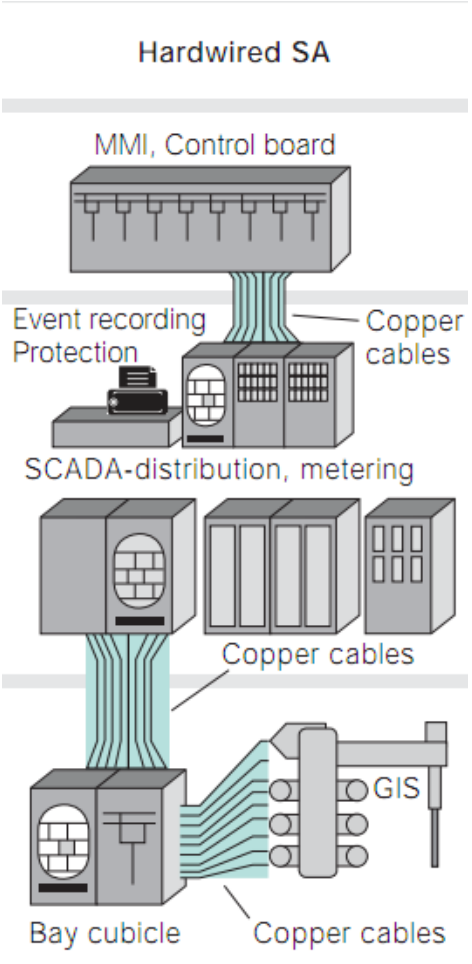




Circuit diagrams
Connection tables
Cable lists

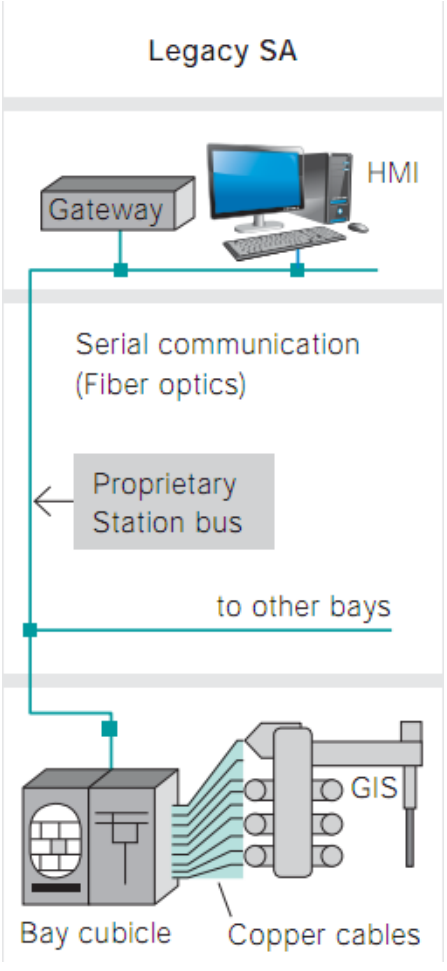
System Architecture
RTU / Hardwired

- IEDs do not have communication capability
- Status monitoring and control via RTU hardwired connections
- Significant amount of connections / documentation

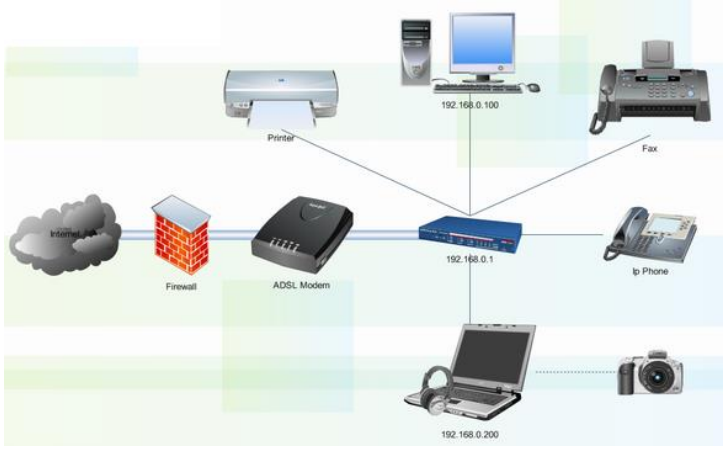


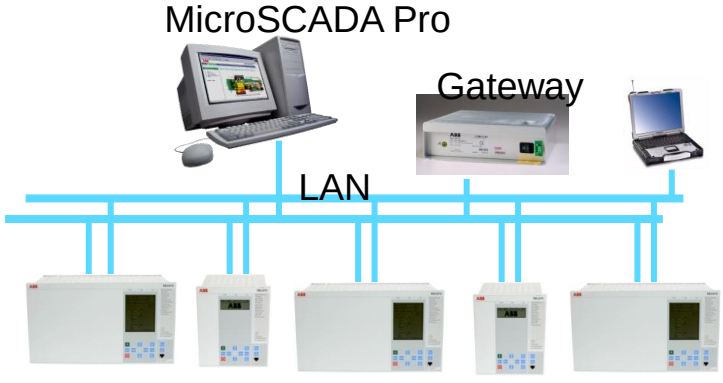
System Architecture
DNP / Modbus

- Integration of status monitoring into IEDs
- Reduction/elimination of RTU cabinet
- Defined protocol stack
- Non standard modeling of substation equipment and functions
- Non standard data format
- Integration requires intimate knowledge of each device
- Protocol conversion may be necessary



Communication
The new kind of communications





Home / Office Network

Plug and Play Technology –

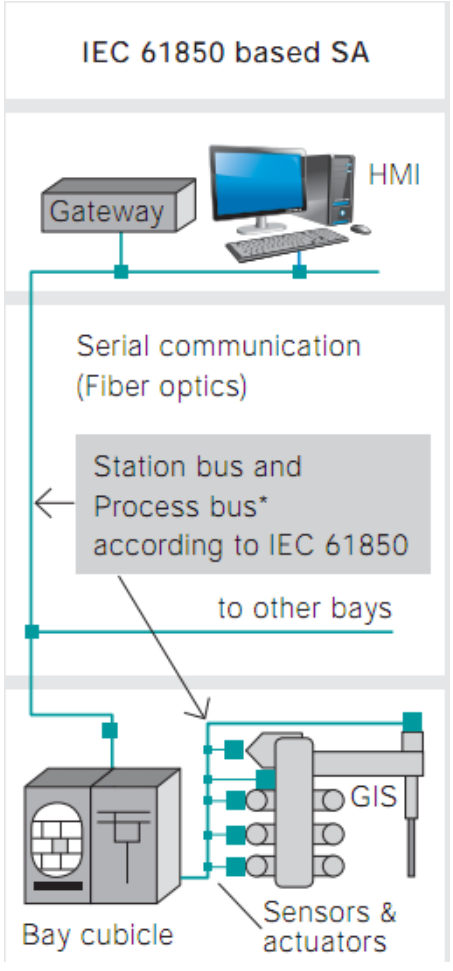
Phones, Printers, computers, mobile phones, network devices, Laptops, and many more devices

IEC 61850 brings the same networking technology to Substations

All the devices in the substation are connected in a Local area network that includes devices from multiple vendors.

System Arhchitecture
IEC 61850

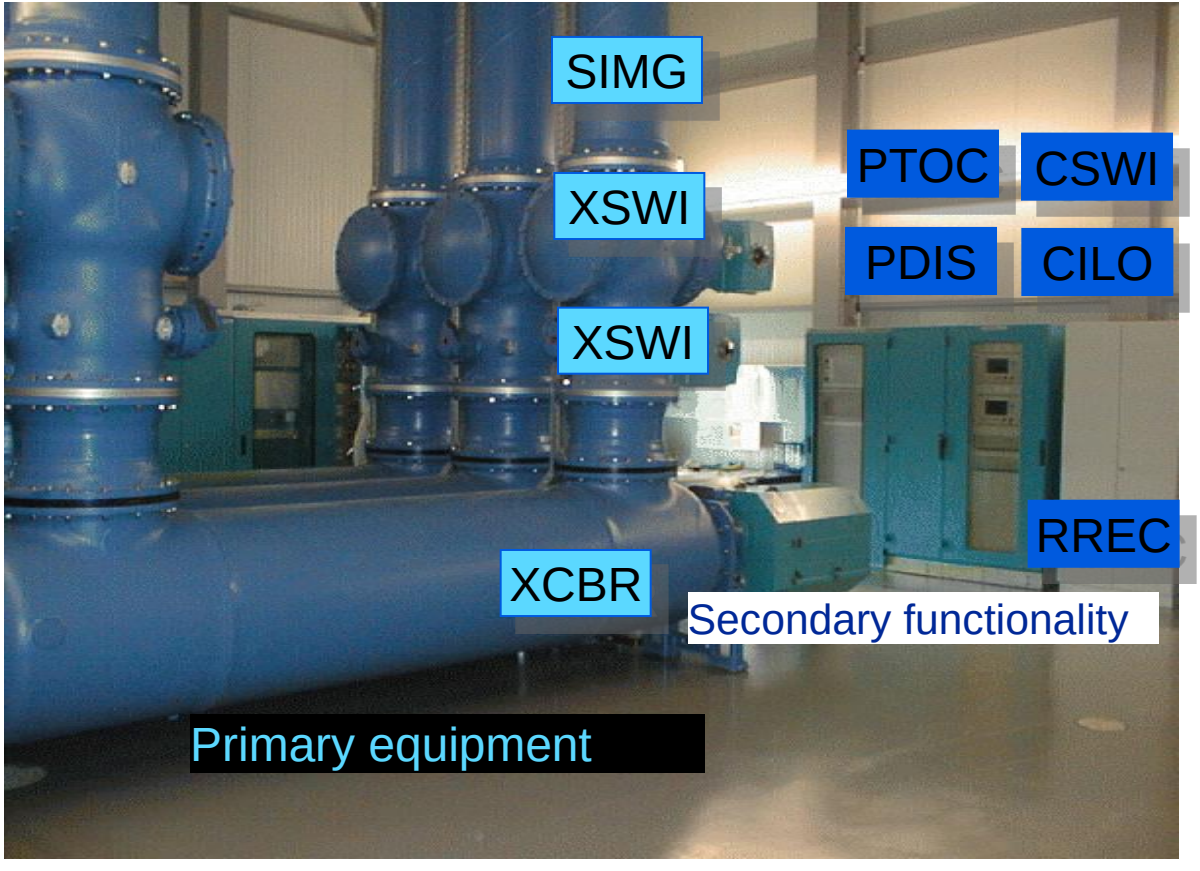
- Integration of status monitoring, protection, automation, and control into IEDs
- Digitization of copper wires
  - 61850-8-1
  - 61850-9-2
- Modeling of the substation, equipment and functions
- Protocol stack
- Interoperability by standardization and verification



A breakthrough for Substation Automation
Goal of the Standard

- **Interoperability**
  - Exchange information between IED's (Intelligent Electronic Device) from several manufacturers
  - IEDs use this information for their own function
- **Free Configuration**
  - Free allocation of functions to devices
  - Support any philosophy of customer – centralized or decentralized systems
- **Long Term Stability**
  - Future proof
  - Follow progress in mainstream communication technology
  - Follow evolving system requirements needed by customers

Data Model


SIMG
XSWI
XSWI
XCBR
PTOC
CSWI
PDIS
CILO
RREC
Secondary functionality
Primary equipment

Client – Server Relationship

- Reports have several configurable triggers
  - Data change
  - Quality change
  - Data update
  - Cyclic

Digitize Copper

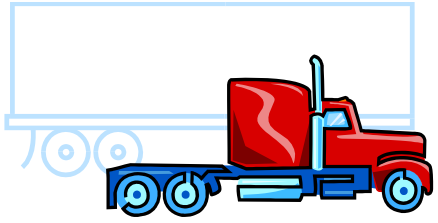
Digitize copper (GOOSE + SMV)

- Thanks to Ethernet technology and previously mentioned data model we are able to digitize copper:
  - Binary signals (GOOSE)
  - Analog signals (GOOSE)
  - Analog signals as input to protection and metering functions (SMV in the Process Bus)

What is GOOSE message ?

- GOOSE messages are based on change event
- GOOSE messages include diagnostic functions (a “heart beat” to all devices subscribed is sent periodically)
- GOOSE messages are managed by GCBs (GOOSE control block) inside IEDs
- GOOSE messages send “Data Sets” upon changes of state

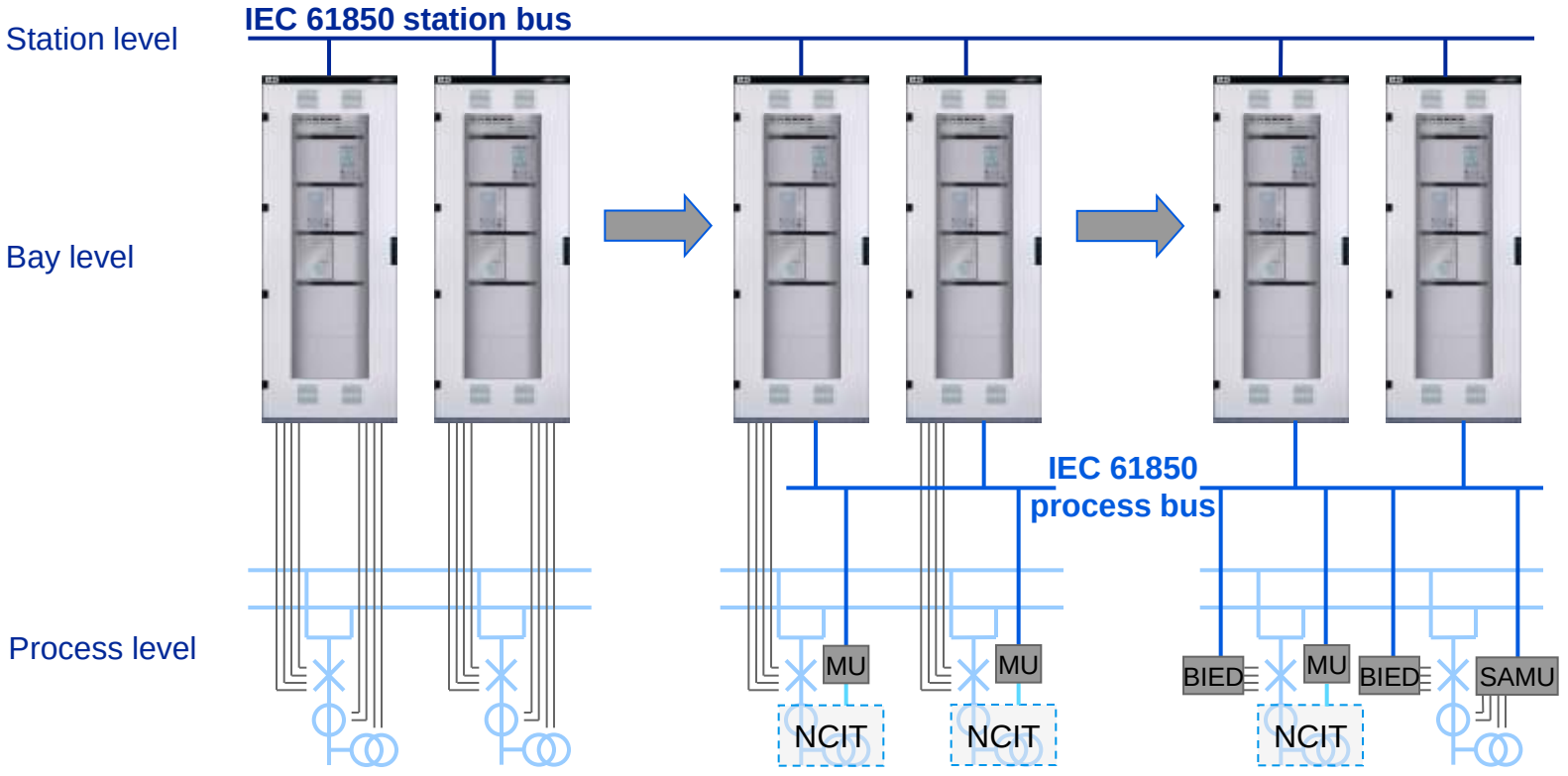
Data set (information)



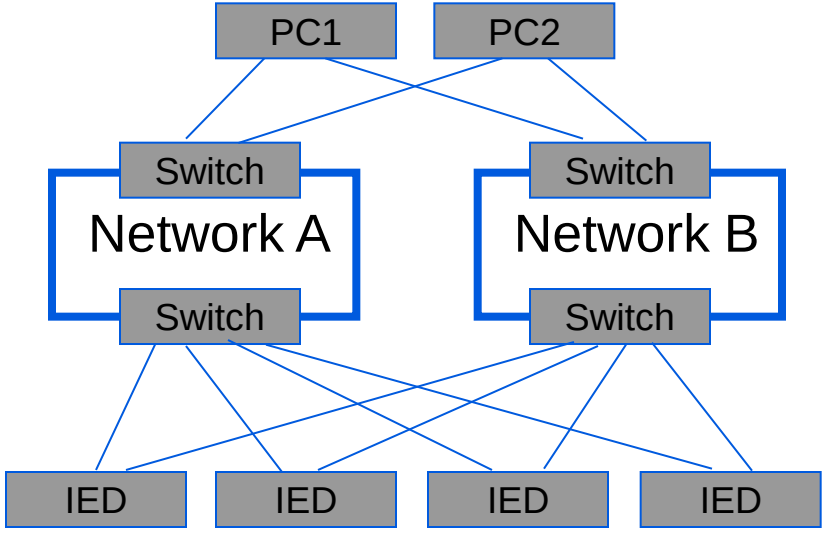
GCB

Network

Process Bus
What is Process Bus

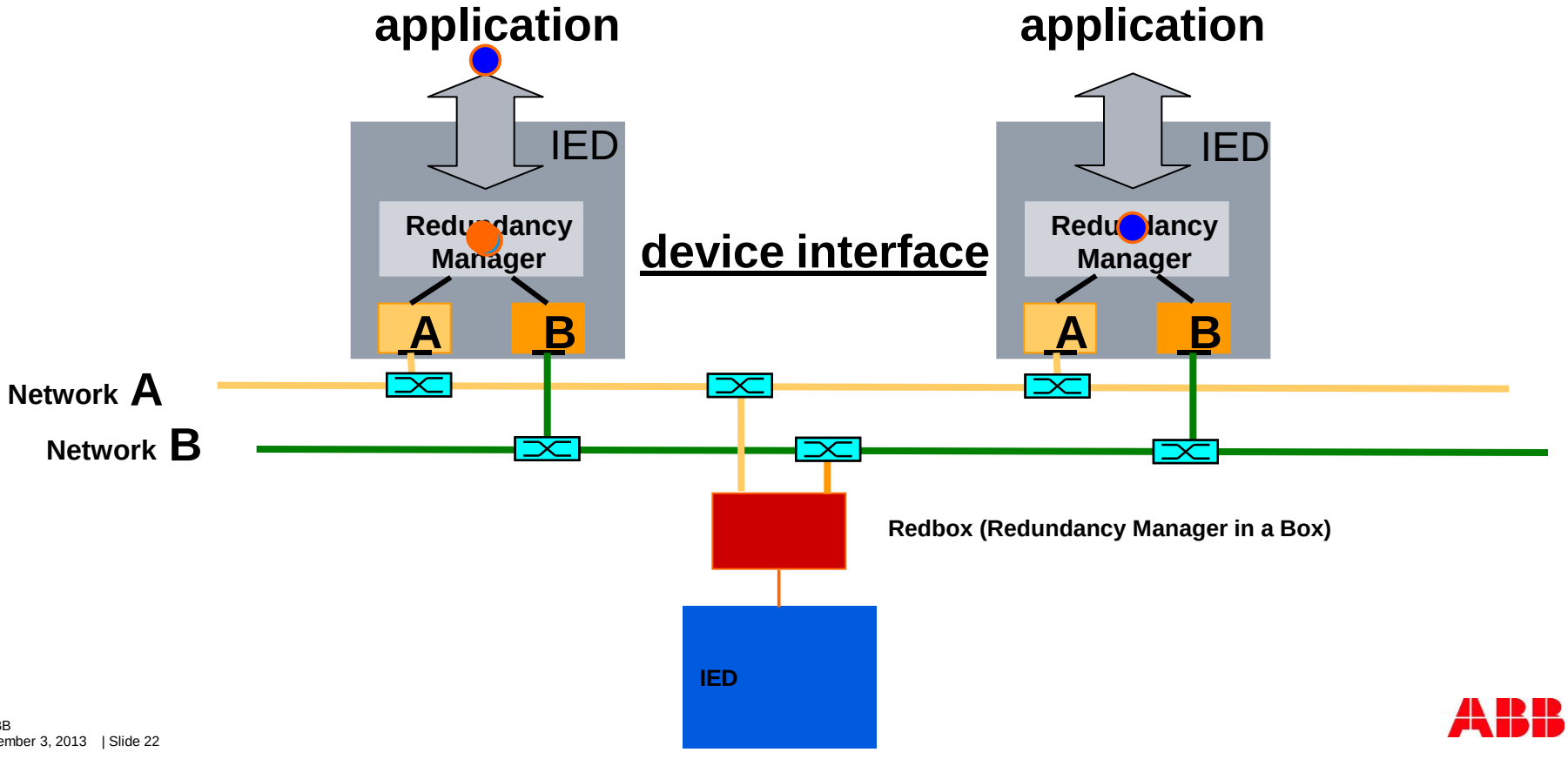


Parallel Redundancy Protocol (PRP)
Principle

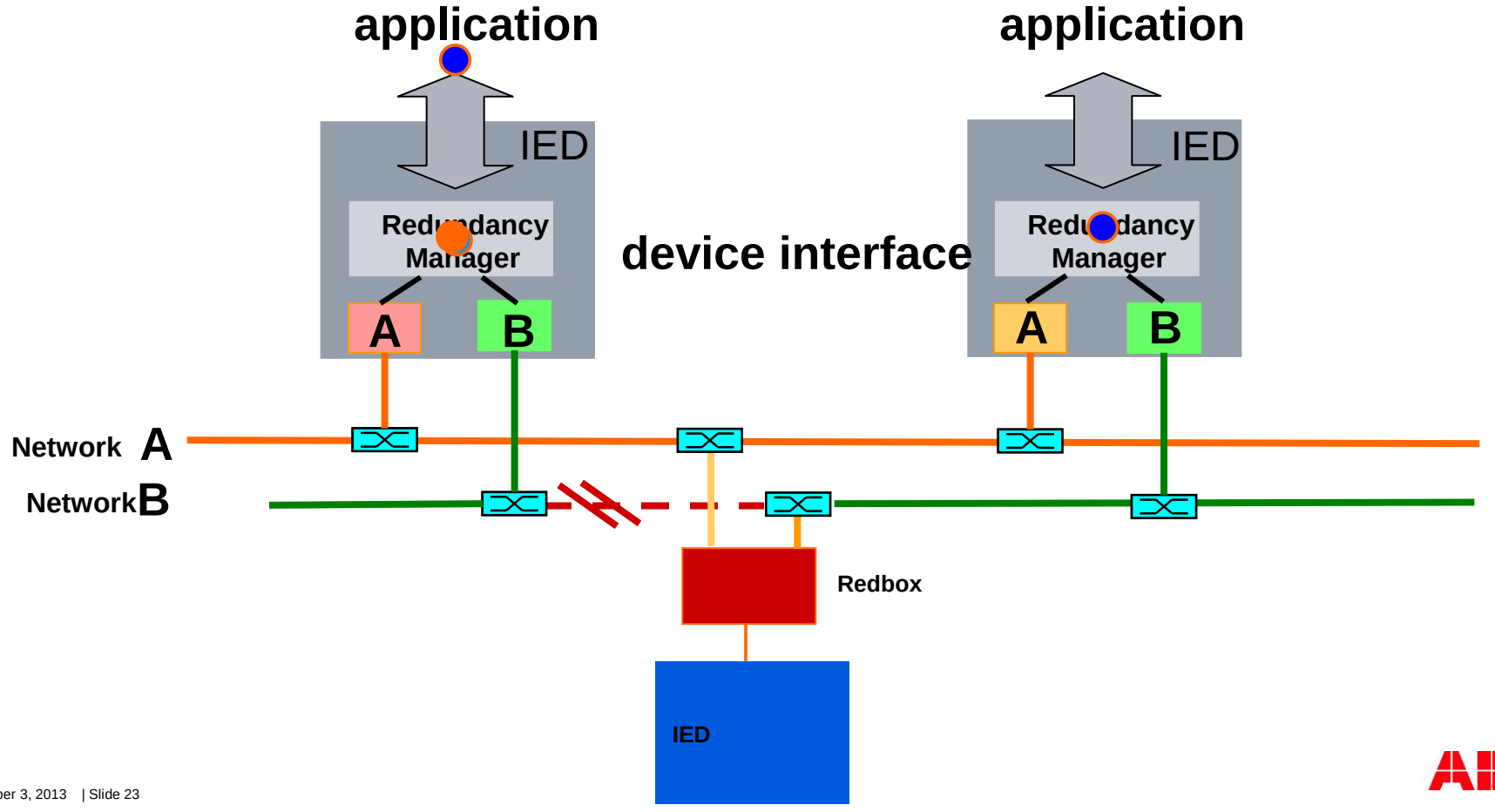


- Operation Mode
  - 2 Ports active
    - Messages are sent / received simultaneously on both ports
    - Switch over time 0ms
- Advantages
  - No recovery time
  - No messages are lost
  - Network redundancy (Network A and B)
  - IEDs are not active part of the network
  - Standard according IEC 61850-8-1/9-2 Edition 2

Demonstration
PRP Operation in normal condition



Demonstration
PRP Operation with “faulty” condition



Change
Maintenance

- Technicians and engineers need suitable tools
  - Conventional systems – multi meters
  - IEC 61850 systems – protocol analyzers?

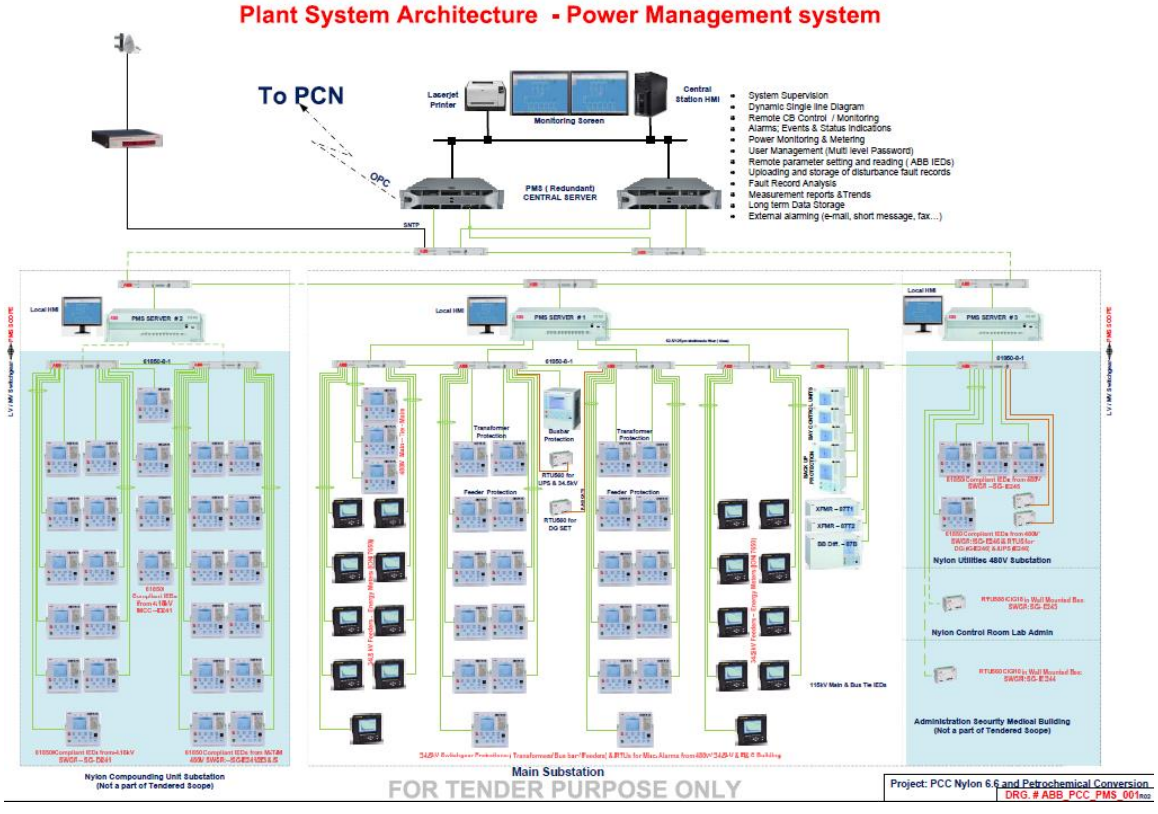
- Tools must be
  - user friendly
  - powerful
  - give benefits from using IEC 61850

And Yes, they do exist now

Justification
Keys to successful implementation

- Identify all the benefits (obvious)
- Identify ALL the costs :-
  - Equipment
  - Installation
  - Engineering
  - Commissioning
  - Utilization costs
  - Impact on External systems
  - Costs to Change/Migrate in the future
  - New potential savings

System Architecture
Example



Digital Substation – Panels
Example

Drop in Control House
Example

Digital Substation
Benefits

- Overall reduced time to engineer and install substations
- Up to 50% reduction in real estate requirements
- >30% reduction in copper wiring – installation, maintenance, and debug
- Reduced operational costs using tools to improve installation and troubleshooting needs
- Improved documentation
- Improved utilization of assets with increased flexibility for expansion
- Safeguards investment with a future-ready solution that provides migration to technology advancements in the digital substation

Thank you for your participation

Shortly, you will receive a link to an archive of this presentation.
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