



POWER GRIDS GRID INTEGRATION, APRIL 2017

ABB Digital Substation

The state of art substation

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Agenda

Introduction - ABB Ability™

What is Digital Substation

ABB Digital Substation offering

- Grid management, automation and control
- Primary equipment's technology (GIS and AIS)
- Digital MV switchgears

Digital Substation benefits

ABB reference cases

ABB Ability™: industry-leading digital solutions

Our expertise

Information

Technology

Know-how



Customers

ü Uptime

ü Speed

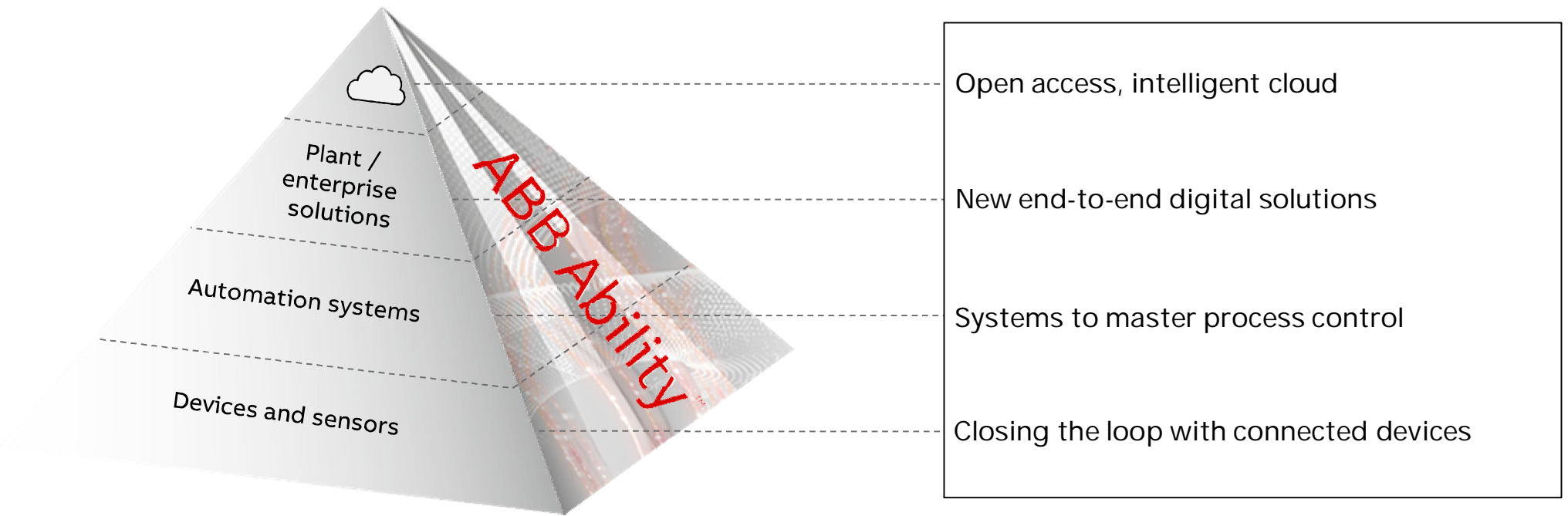
ü Yield

ü Safety

ü Security

Unlocking the ABB potential in digital

ABB Ability™: industry-leading digital solutions built on a common set of standard technologies



Utilities

SELECTION

Reduced installation time (<40%), maintenance costs (<50%) and outage time (<50%)

Asset performance management



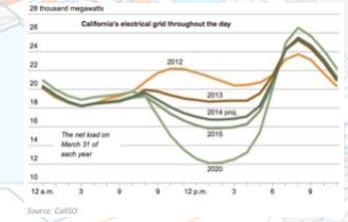
Distributed energy resource management



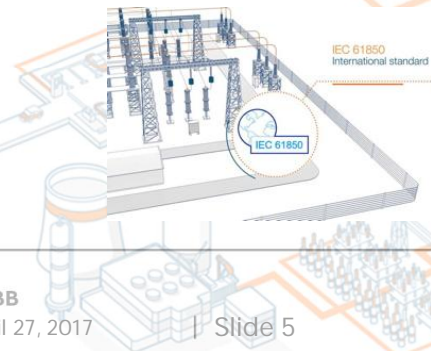
Maintenance workflow management



Energy market trading system



Automated digital substation



Standard IP communications



Microgrids



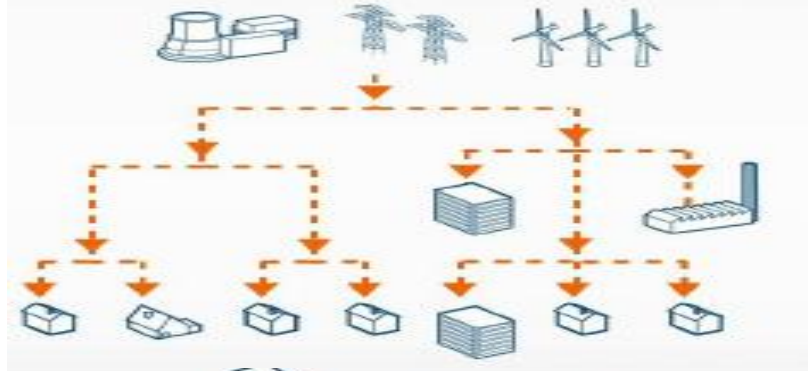
Electric power system of the future

Core themes defined by Cigré

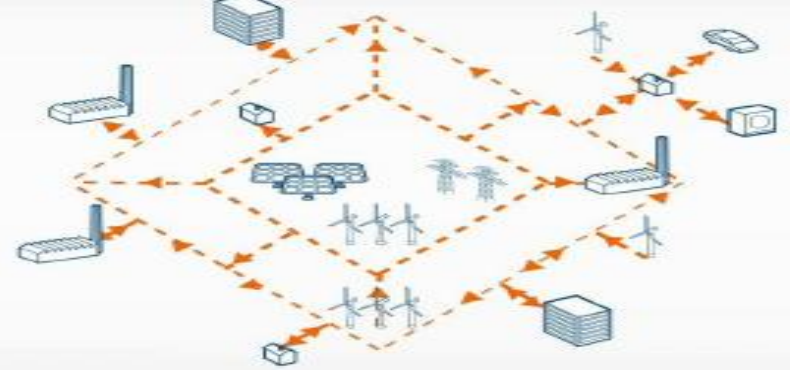
Characteristics

- § Bi-directional energy flow
- § Application of „Smart Metering“ and major need for information exchange.
- § More power electronics for AC and DC.
- § Storage for grid stability. .
- § New market design and market rules & regulations.
- § New grid protection concepts in order to cope with characteristics of renewable generation.
- § New environmental and energy efficiency regulations.
- § Increase capacity and efficiency of assets.
- § Involvement of stakeholders in the development of adequate grid infrastructure to cope with future requirements.

Today



Tomorrow



Agenda

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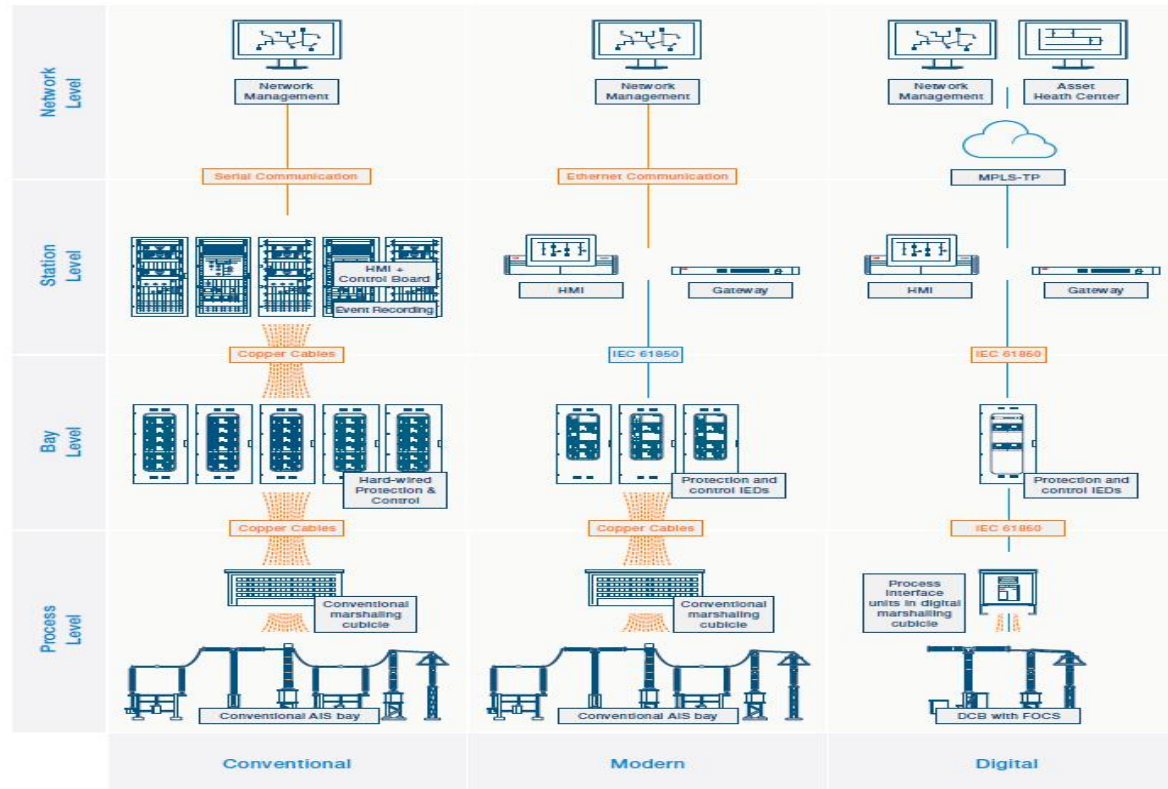
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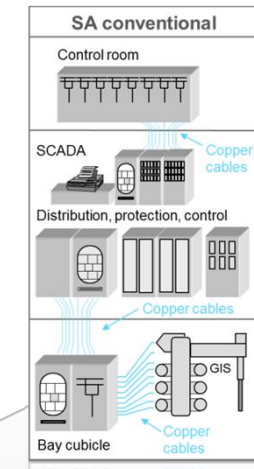
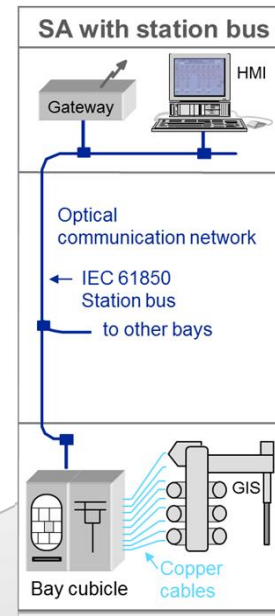
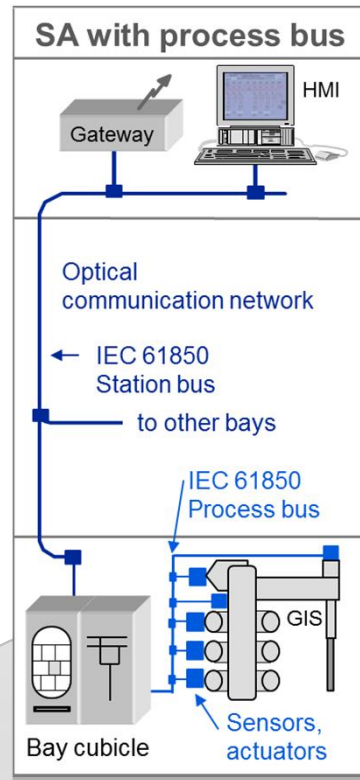
Substation evolution



Evolution of a substation

From wired to optical communication

Present



Past

Evolution of current and voltage transformer

From conventional CTs and VTs to NCITs*

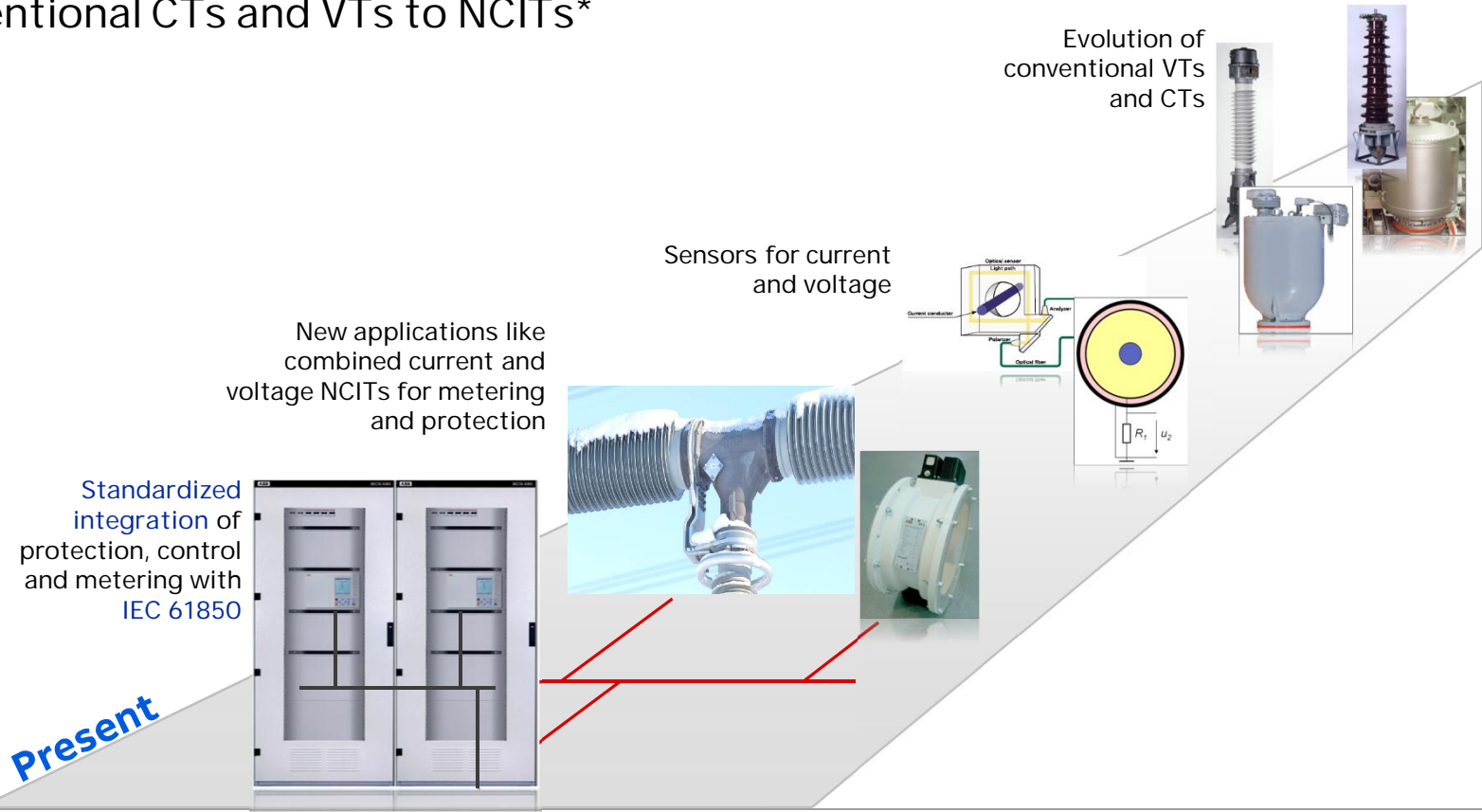
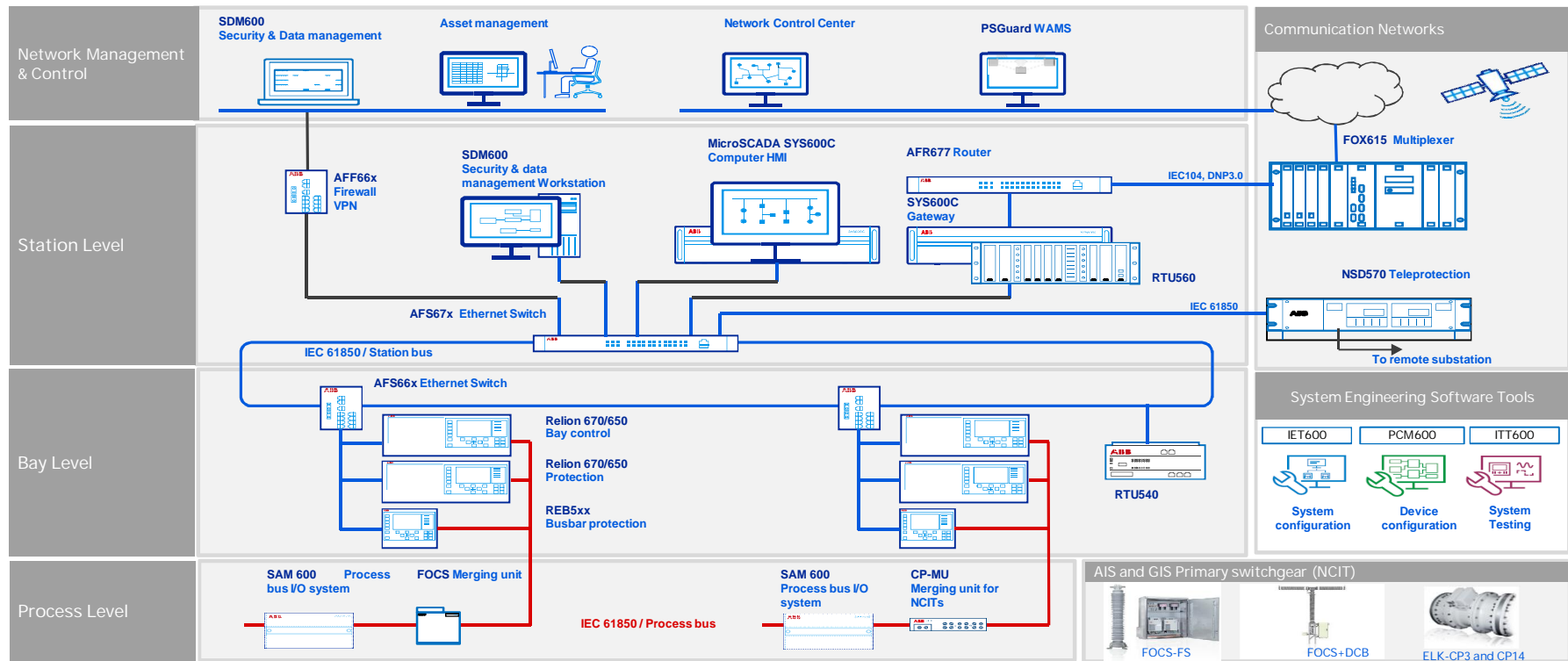


ABB Digital Substations

Transmission portfolio and architecture



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Digital Substation benefits

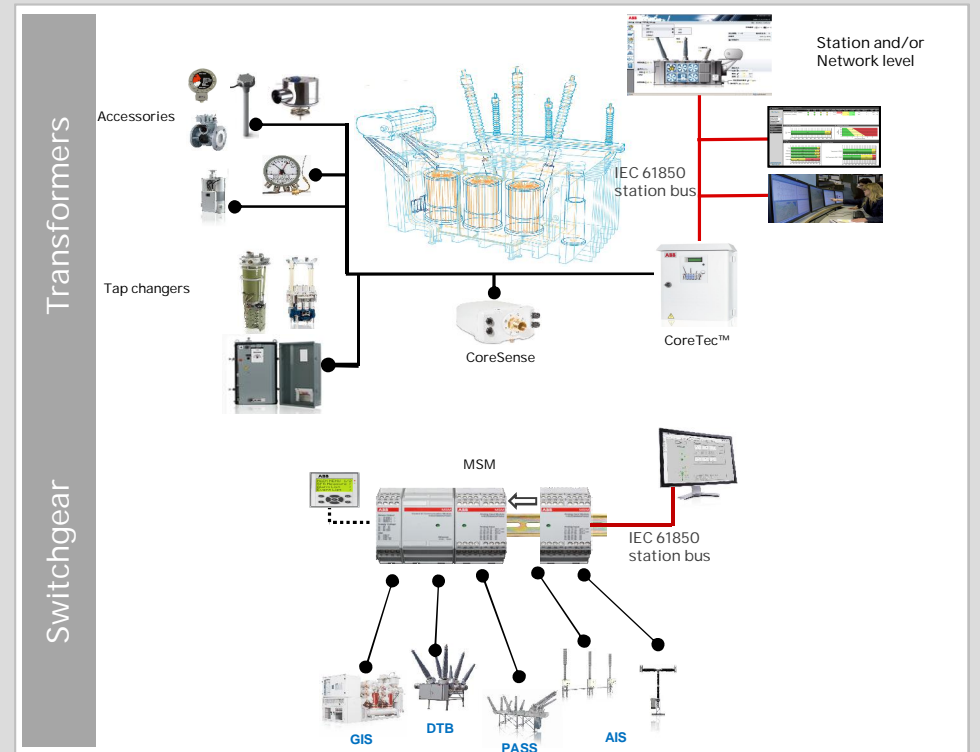
ABB reference cases

ABB solution for digital substations

Monitoring and Diagnostics for switchgear, transformers and IEDs

From time based to condition/risk maintenance

- § Integrated Monitoring and Diagnostics
- § Switchgear, transformers and IEDs
- § Communication via IEC 61850 and other standards
- § Connected to station monitoring and network level system

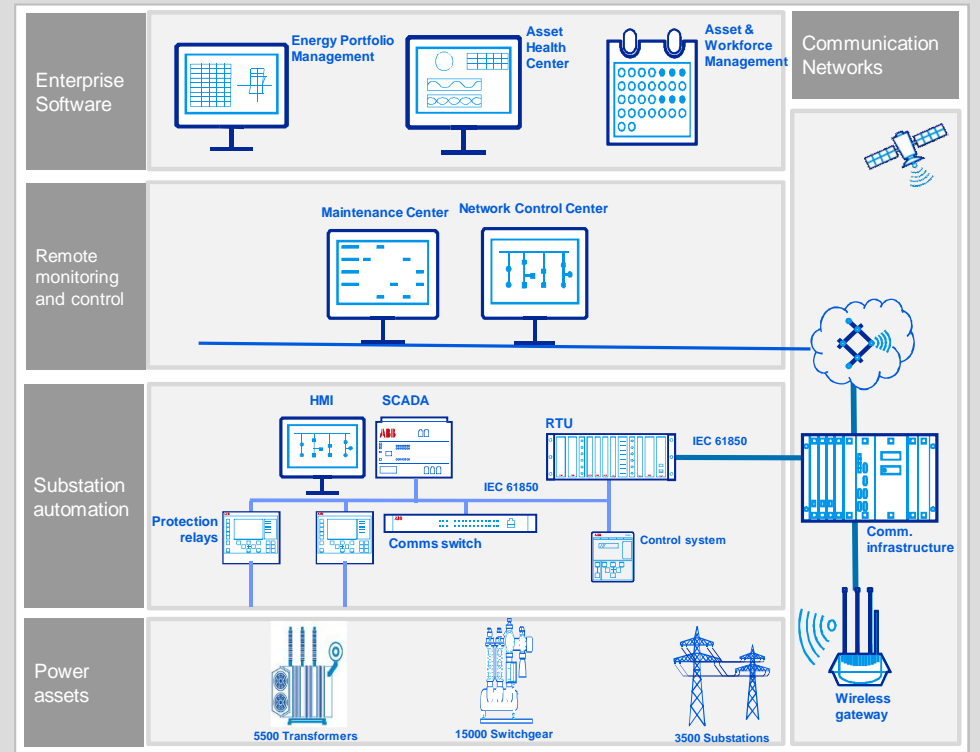


End-to-end integration for reduced OPEX

Asset Health with on line monitoring

Asset Health Center benefits

- § Prevent failures
- § Optimize maintenance
- § Support asset renewal prioritization
- § Provides situational awareness
- § Supports maintenance and capital replacement decisions
- § Indicates early warning signals of potential failures
- § Improves asset utilization
- § Improves workforce efficiency



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What is Digital Substation

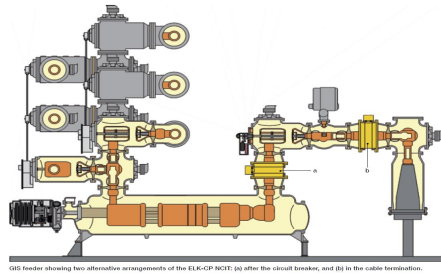
ABB Digital Substation offering

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Digital Substation benefits

ABB reference cases

ABB Digital substation offering Instrument transformers with NCIT (sensors)

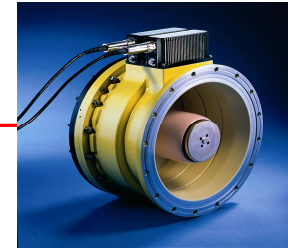


GIS feeder showing two alternative arrangements of the ELK-OP NCIT: (a) after the circuit breaker, and (b) in the cable termination.

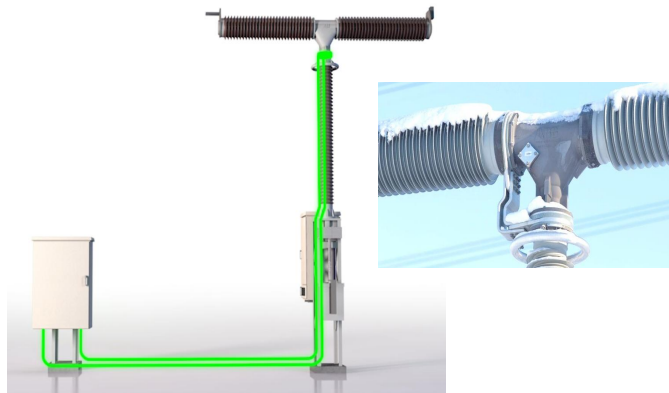
IEC 61850-9-2LE



Merging Unit



Combined Current & Voltage sensor



IEC 61850-9-2LE



FOCS sensor head and electronics

ABB Digital substation offering

Less space required, "One bay one footing" concept

1. Reduce needed space with DCB, Disconnecting Circuit Breaker
2. Minimize the footprint even further with integrated optical CT

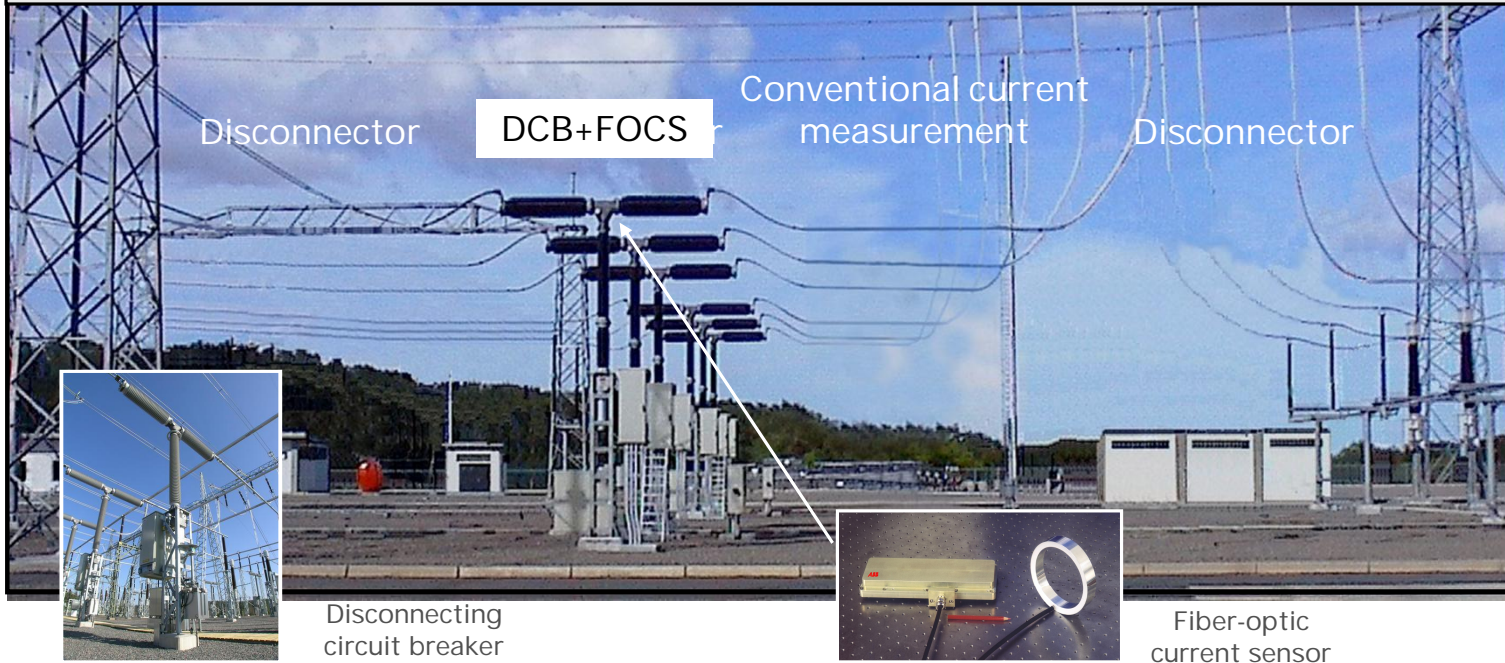


ABB Digital substation offering PASS with motor drive™ 1.4

PASS (Plug and Switch System) with
Motor Drive™ 1.4

- Digitally controlled motor drive for CB operation
- Drastically reduction of moving party enables highest reliability
- Local control of all switching objects in PASS
- IEC 61850 interface for integration in protection and control system



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- **Digital MV switchgears**

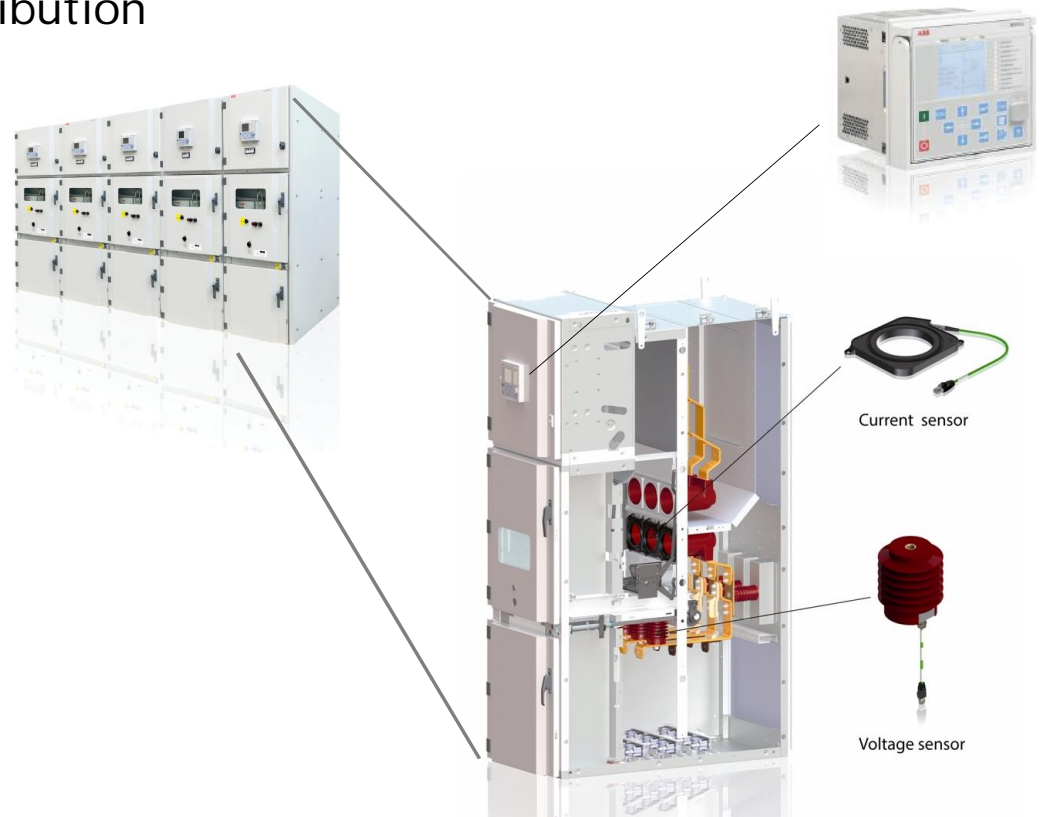
Digital Substation benefits

ABB reference cases

ABB Digital substation offering

UniGear Digital: The smart solution for Distribution

- UniGear Digital switchgears for up to 24kV
- Non-conventional current and voltage sensors
- 615 series IEDs exchange GOOSE and IEC 61850-9-2 sampled voltage values on station bus within the switchgear
- IEDs can act as publisher and receiver of sampled values
- Only voltage values are exchanged



Sensors for UniGear Digital

...are smaller, lighter, have much lower losses and are easy to handle

Current transformer



1 piece = 18kg

Voltage transformer



1 piece = 27kg

vs.

Current sensor



1 piece = 0.5kg

Voltage sensor



1 piece = 2kg

3x18 + 3x27 = 135kg

3x0.5 + 3x2 = 7.5kg

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Digital Substation benefits

ABB reference cases

Digital substation

Main benefits

*Based on a typical conventional 400kV double bus bar AIS substation compared to a modern variant using SAM600 process bus IO system and FOCS integrated in disconnecting circuit breakers.

“Potentially eligible for “iper-ammortamento” under the “industria 4.0” law for fiscal incentives, once duly interconnected and in accordance with the law. “



Digital substation

Main benefits: increased personal safety

Reduced risk of electrical shock

- Handling of current transformer circuits and signaling voltage poses a threat to life and equipment
- Process bus eliminates the galvanic connection between protection and control panels and the switchyard.
- Eliminates CT and VT circuits in the protection & control panels
- Replaces conventional 110/220VDC indications with fiber optics
- No risk of fire or explosion

Eliminates the electrical connection between primary and secondary



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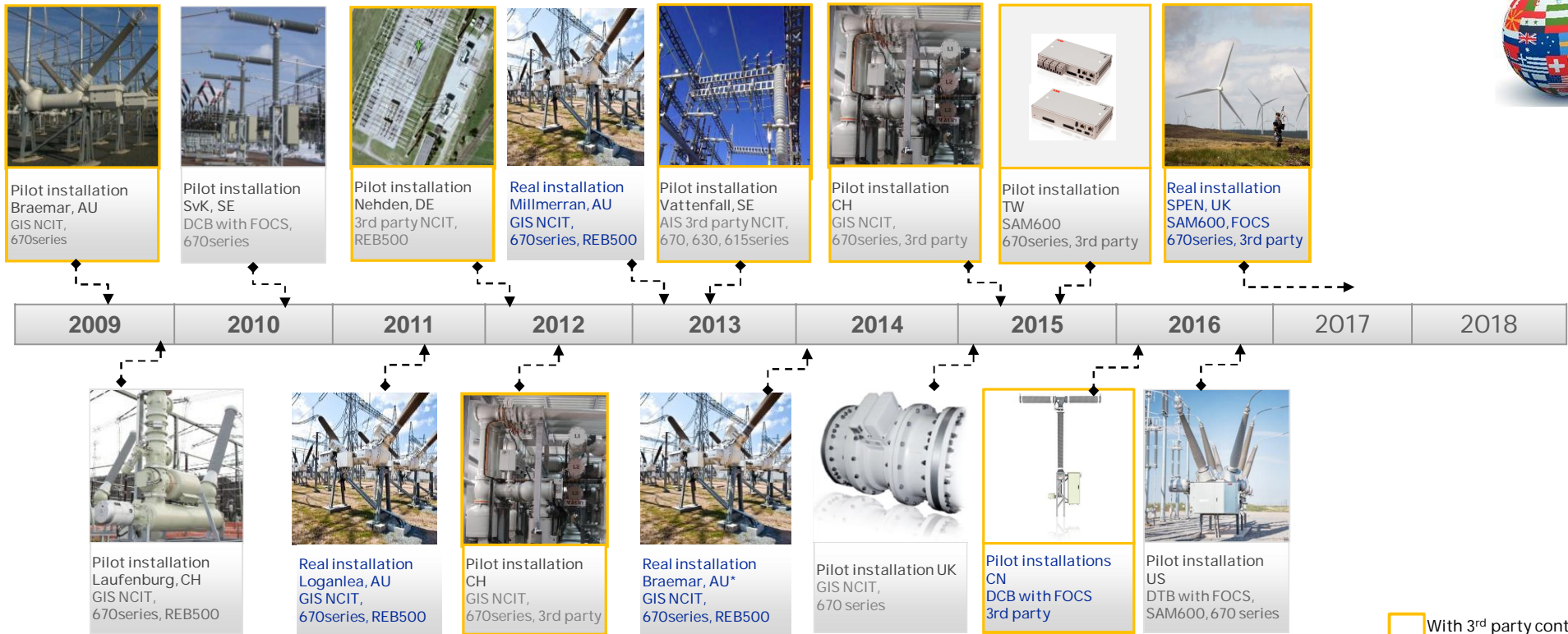
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Digital Substation benefits

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ABB's Digital Substation

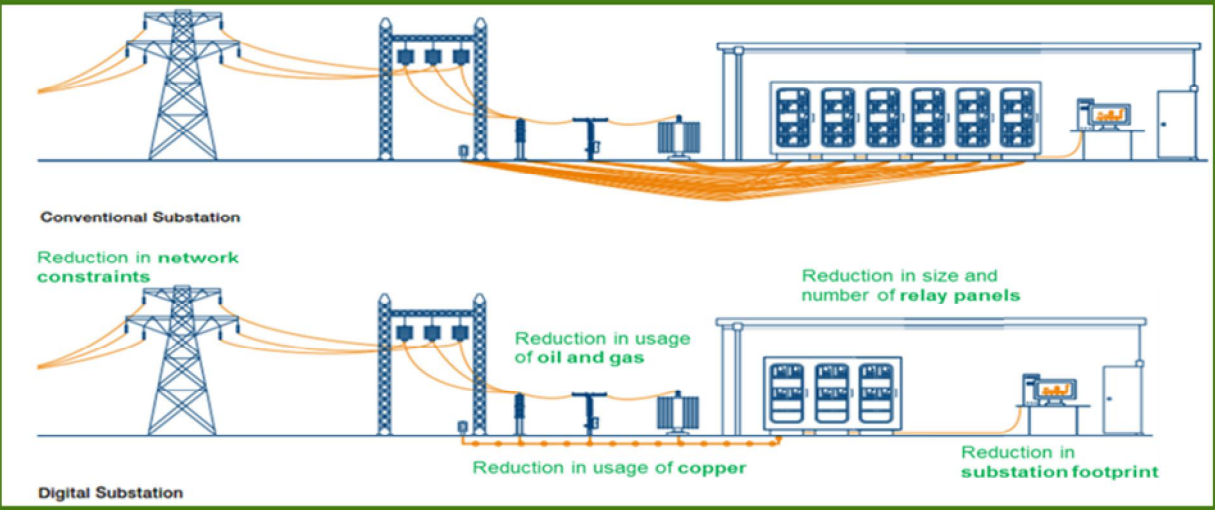
References: installations with process bus IEC61850-9-2



With 3rd party content

Engineering Optimisation

Reducing physical footprint and materials and improving safety



Targeted areas of improvement and optimisation in conventional design

<p>Steelwork Foundations DIT weigh 5 - 10% of conventional: tonnes become kg</p>	<p>Building Foundations</p>	<p>Cubicles Half size relays and BCU – half the number of panels</p>	<p>Copper replaced with fibre</p>	<p>Relay Room</p>
15%	10%	10-30%	80%	10%

Asset Health Center

Asset management solution

Case study

Situation and challenge:

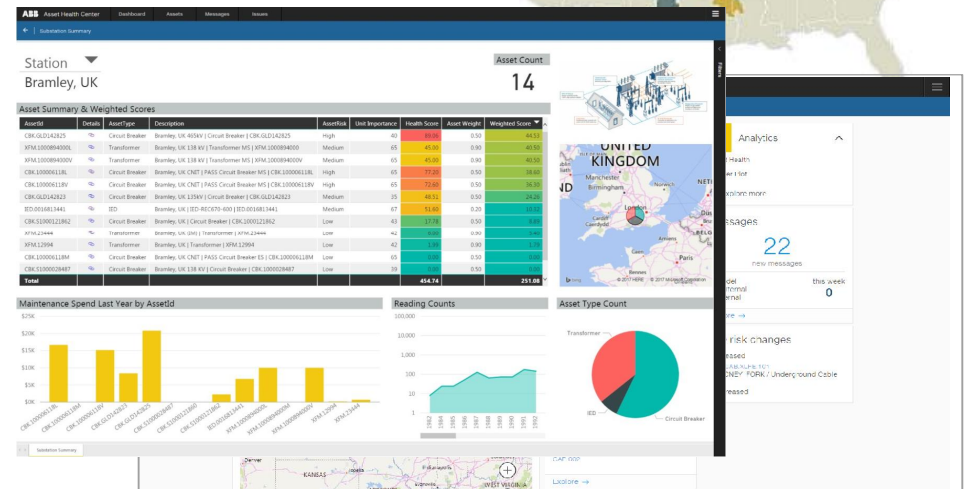
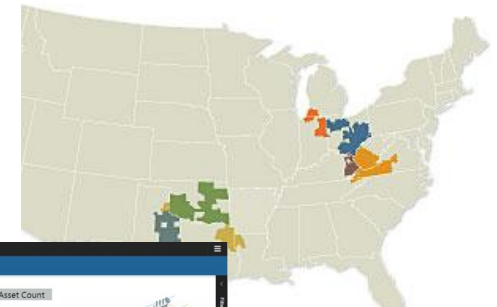
- Critical assets to be analyzed: 3,500 substations, 8,667 transformers, 10,737 breakers, 274 batteries; 33% transformers over 50yrs old; 18% over 60yrs
- How can AEP prevent failures, optimize maintenance and prioritize renewals?

Solution:

- ABB Asset Health Center
- Consolidated SCADA, sensor & maintenance data analyzed via industry-leading asset performance models

Benefits:

- Target 15% savings on O&M
- Automatic alerts, action recommendations & priorities
 - Prevented at least three transformer failures
- Consistent prioritization of asset replacements





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