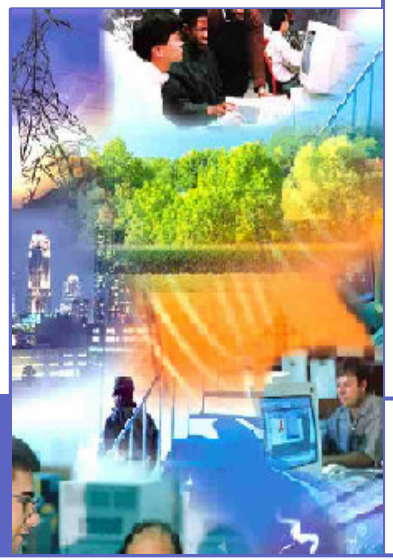
Klaus-Peter Brand

April 2006



Introduction to the Standard IEC 61850

Content

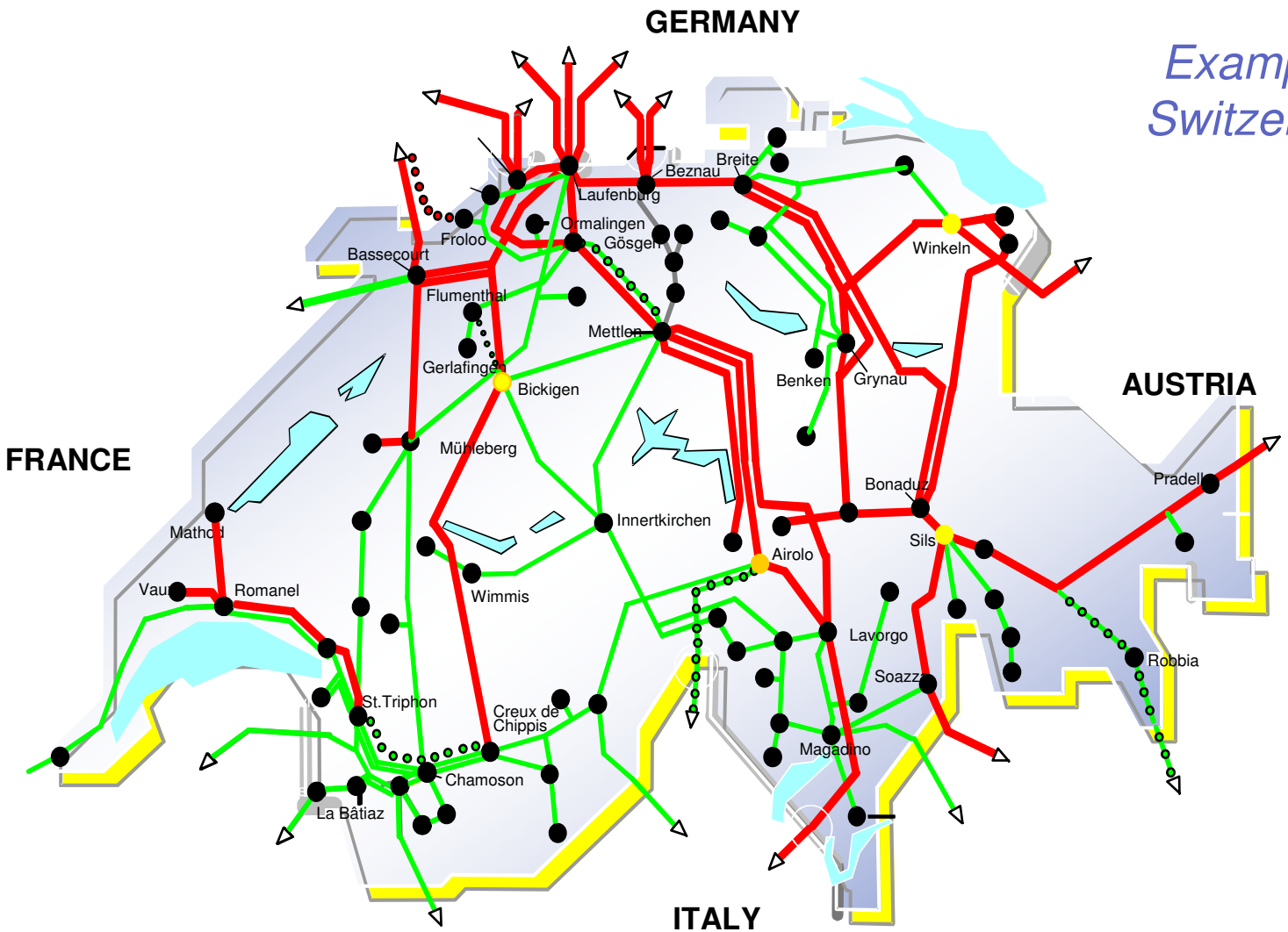
IEC 61850
Communication Networks and Systems in Substations

14 parts: IEC 61850-x-y © IEC : 2002-2005

- **Scope**: Substation Automation
- **Market Needs**: Interoperability
- **Approach**: Data Model and Stack

The substation as node in the power network

Example: Switzerland

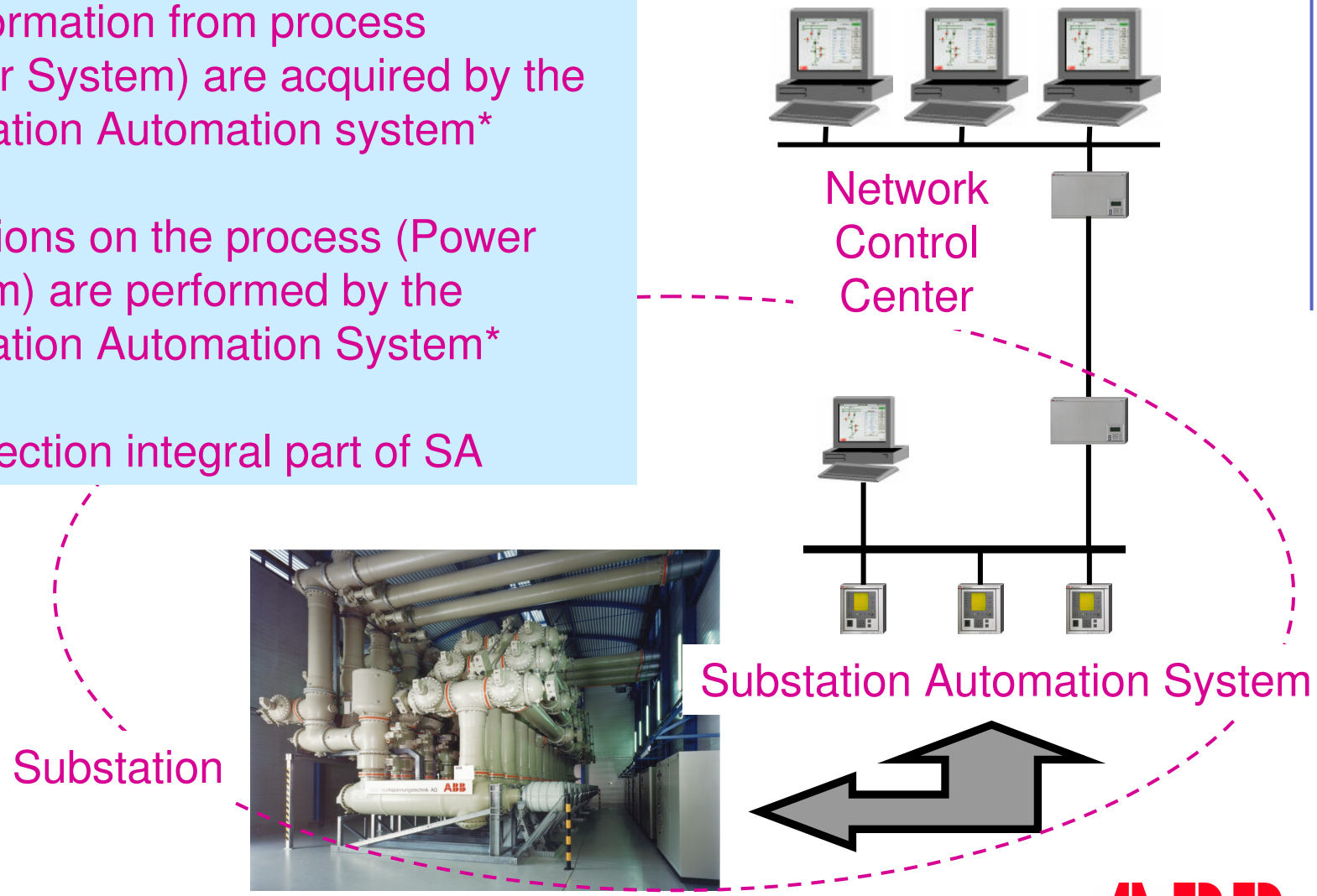


SA as process interface for network control

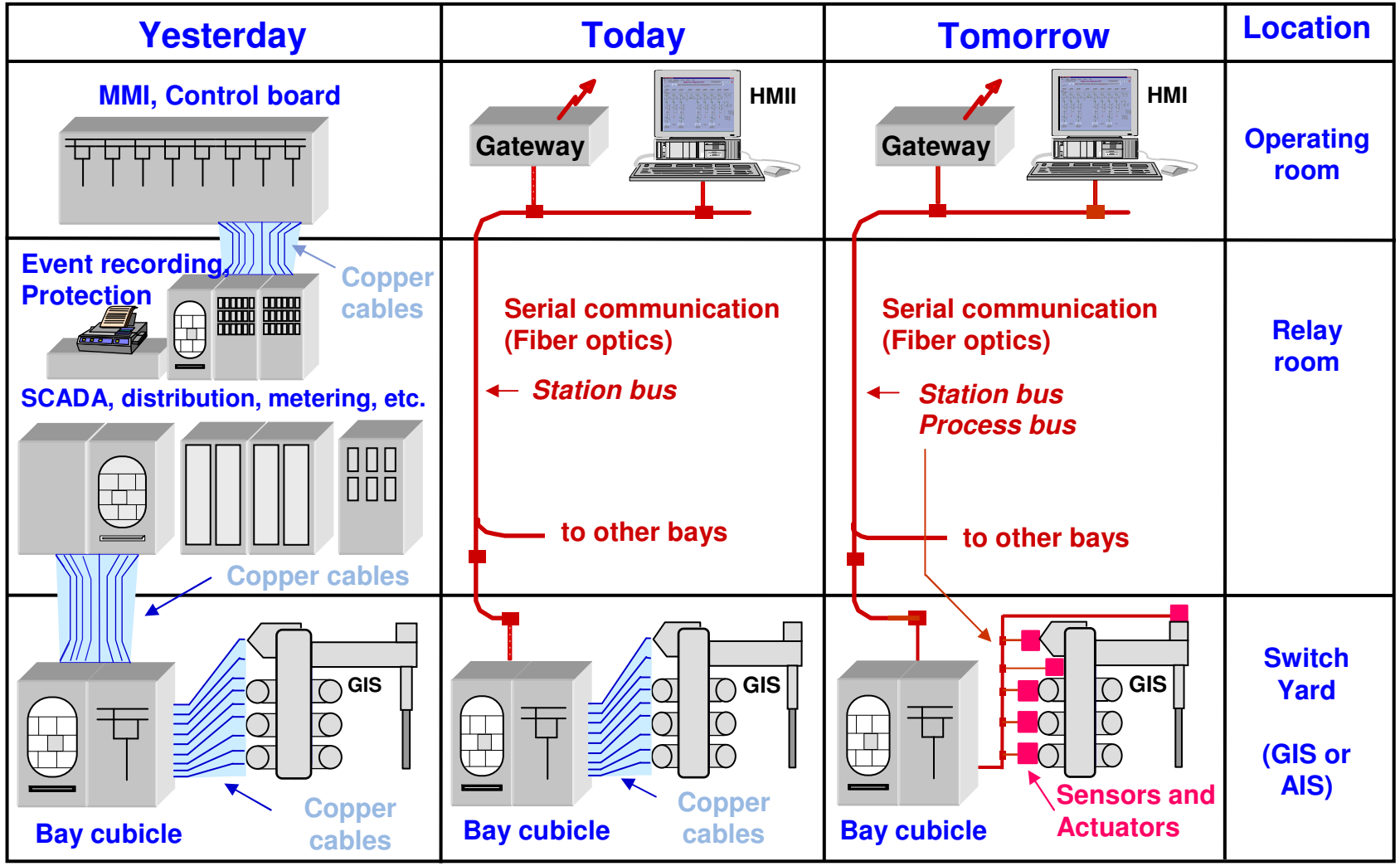
All information from process (Power System) are acquired by the Substation Automation system*

All actions on the process (Power System) are performed by the Substation Automation System*

*) protection integral part of SA

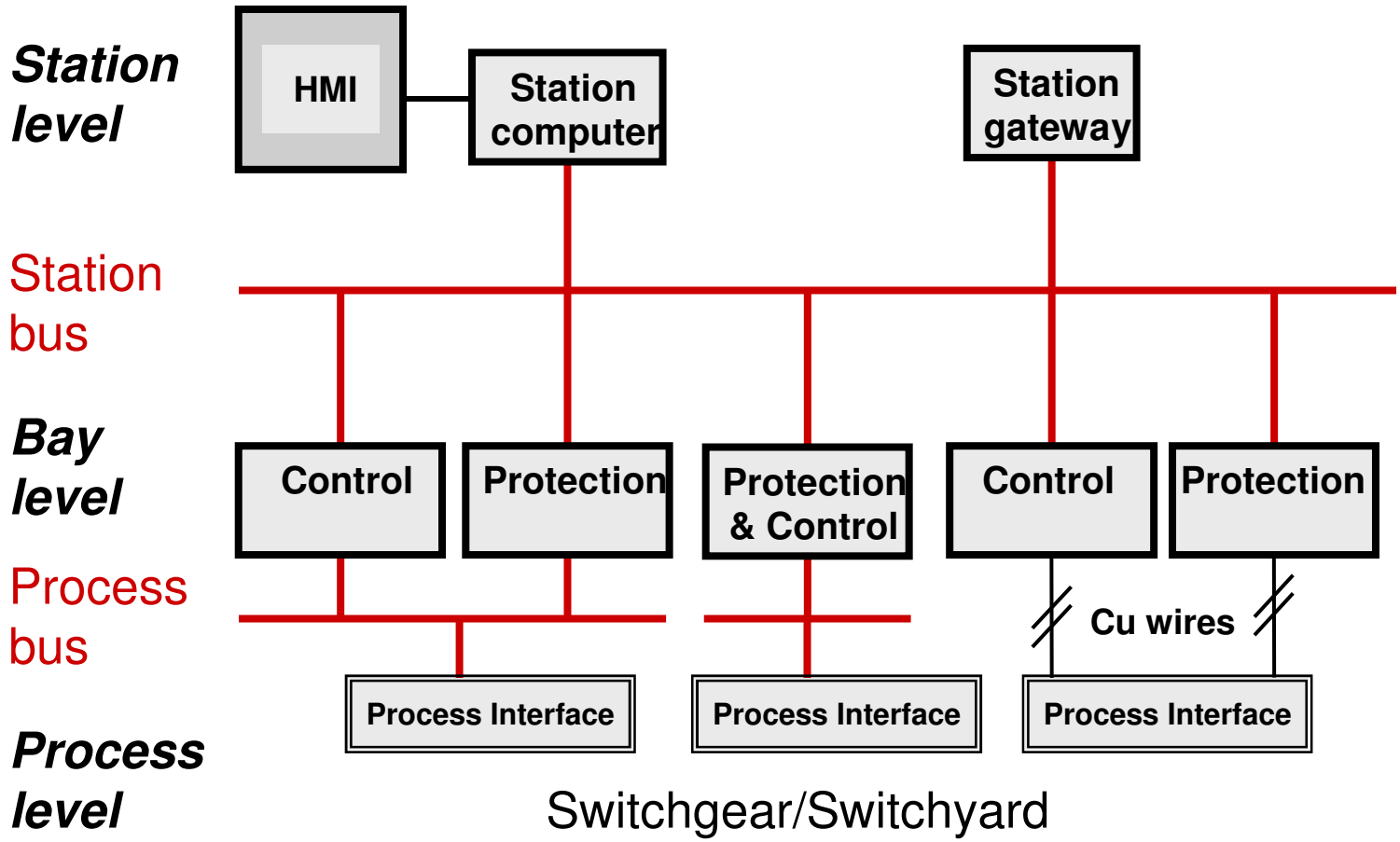


Trends in Substation Automation (SA)

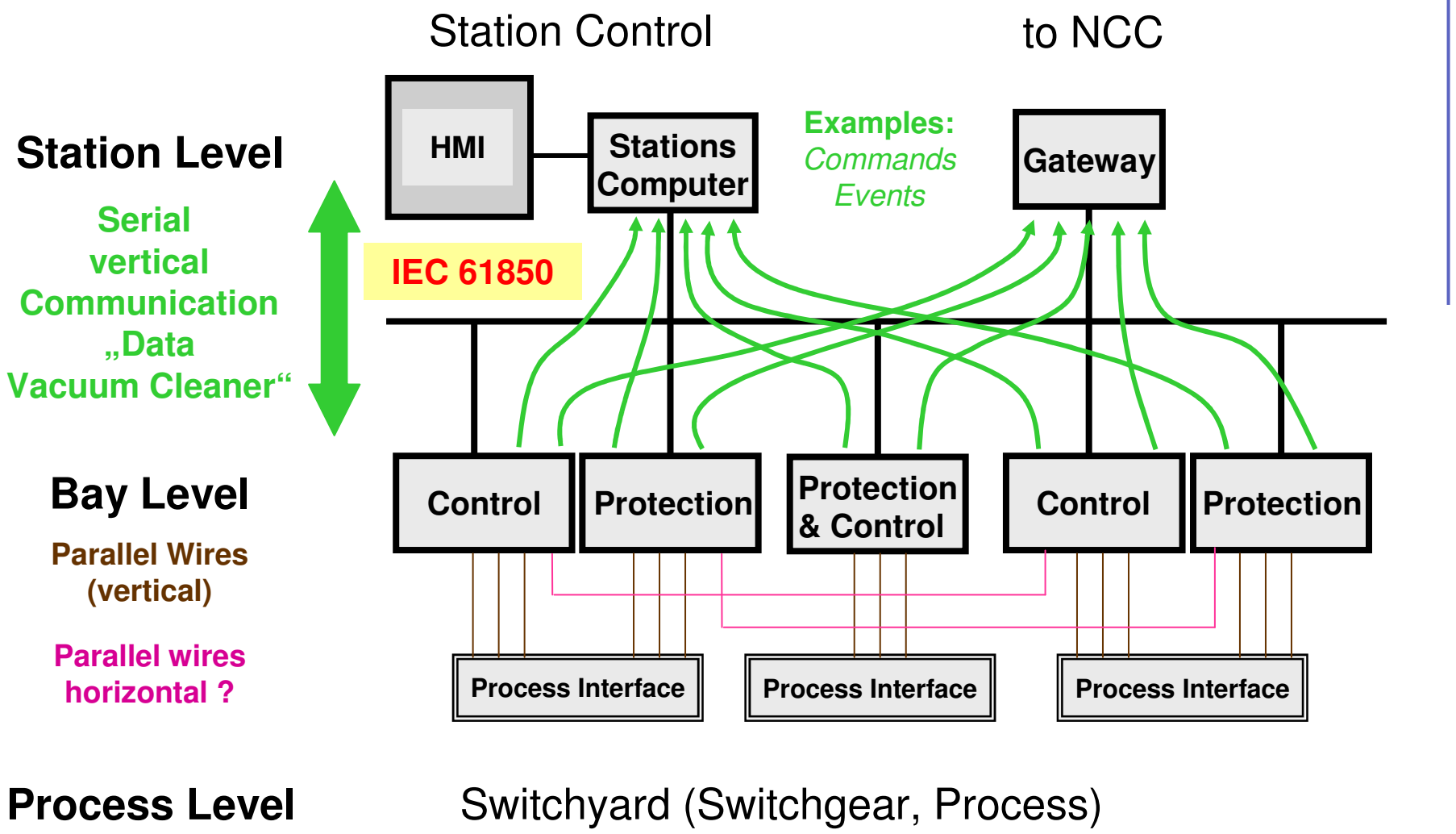


***Functionality:* SA to control,operate, monitor, and protect the substation**

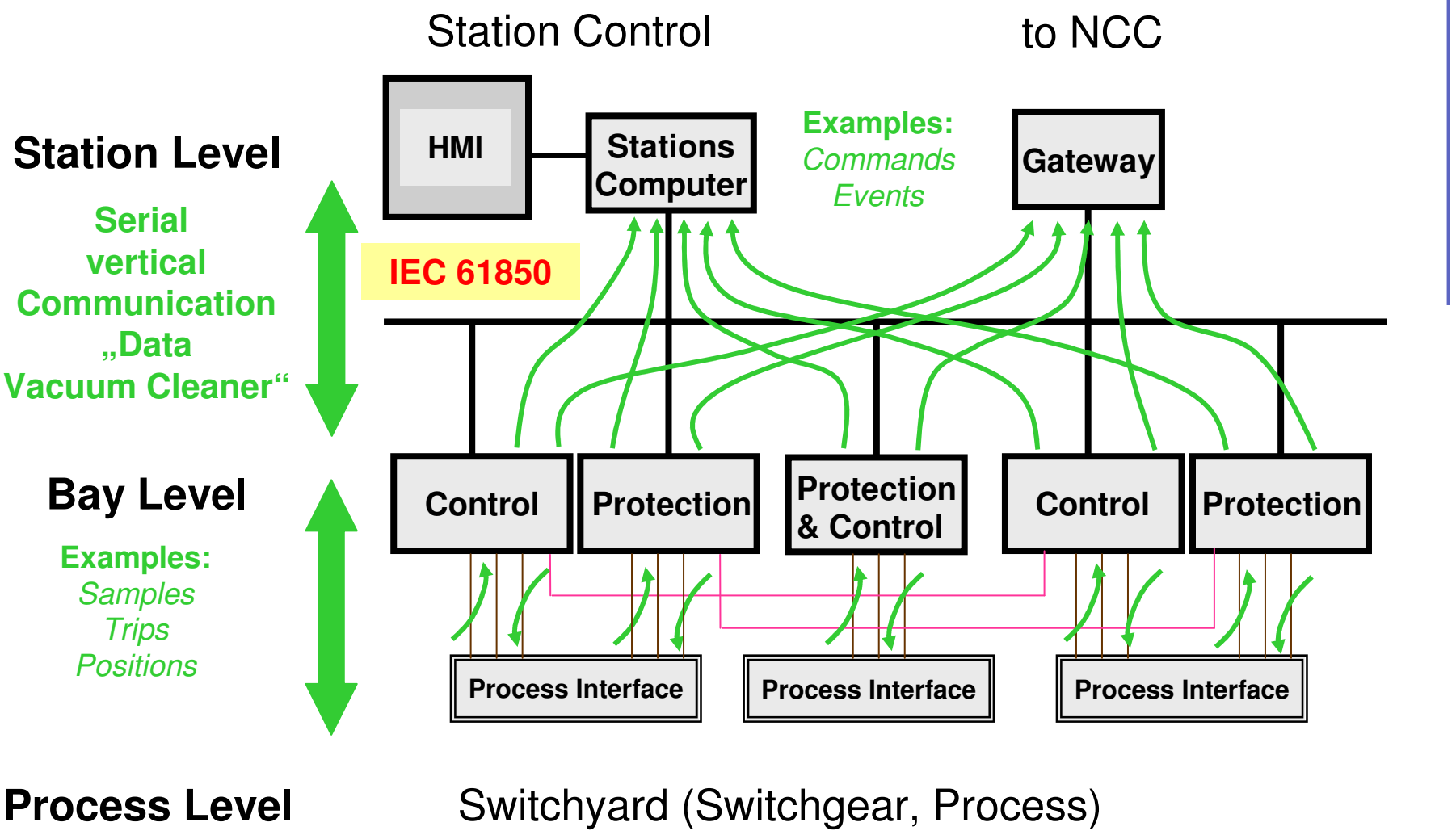
Serial communication in SA



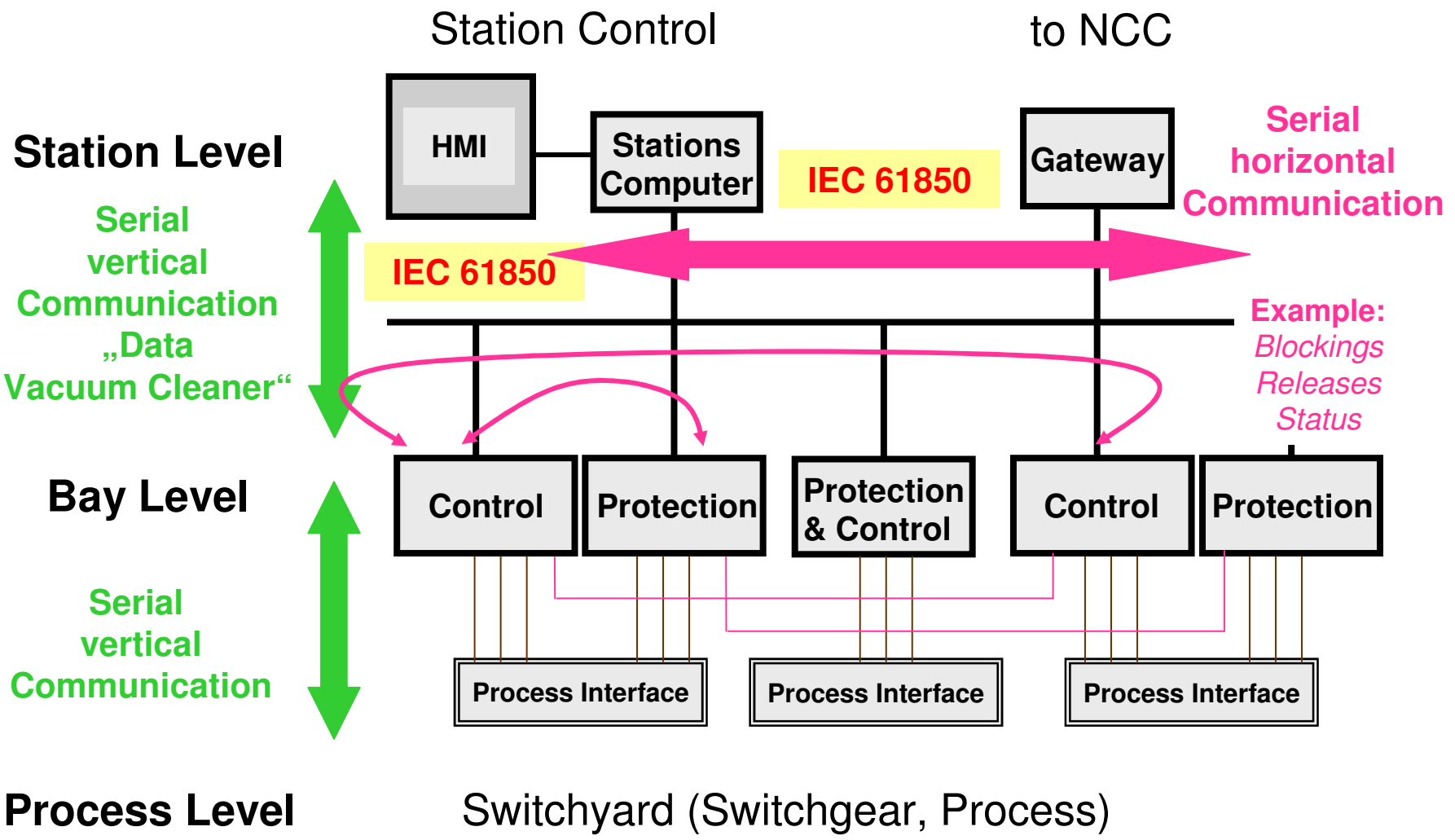
Vertical Communication



Vertical Communication



Vertical Communication



Function in SA (1) – *Headlines from IEC*

- **HMI and related station level functions**
  - Access control & access security management
  - Operators access to the system
  - Display of data and information
  - Storage of data in the station computer
  - Log management
- **Operational or control functions**
  - Operational control (switching devices, …)
  - Indication handling
  - Event (SER) and alarm handling
  - Parameter setting and parameter set switching
  - Data retrieval
- **Monitoring and metering functions**
  - Metering
  - Power equipment and system monitoring
  - Disturbance recording

Function in SA (2) – *Headlines from IEC*

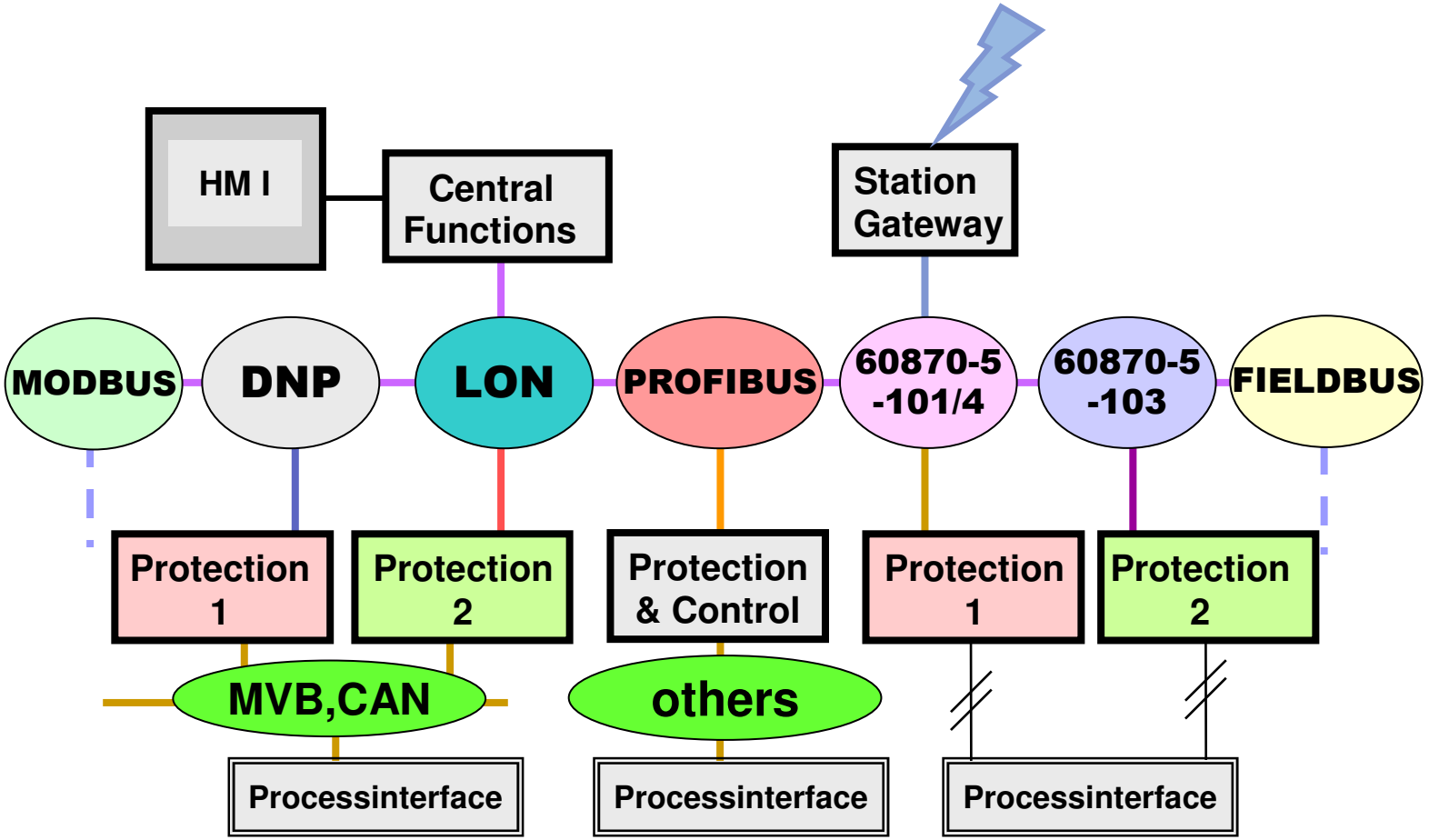
- **Local process automation functions**
  - Protection
  - Automatics
  - Bay interlocking
- **Distributed automatic support functions**
  - Station interlocking
  - Distributed synchrocheck
  - Synchronized switching
  - Automatic switching sequences
  - Load shedding and restoration
- **System support functions**
  - System supervision
  - Configuration management
  - Time synchronization (tagging of events 1 ms, phasors 1µs)
  - Communication

Basics of Market Requirements

- Substation Automation (SA) Systems with IEDs (intelligent electronic devices) with serial communication have been now very well accepted on the market (some 4000 systems worldwide)
- Numerical devices with serial communication from different suppliers cannot be combined in a system as in the old hardwired systems because of a missing standard (only with an uneconomic effort)
- The global, highly competitive market requests a standard for
  - competitive performance
  - cost reduction
- Both providers and utilities are global companies and request such an integration or have to perform such integrations

Market Requirements

One global standard instead of proprietary ones

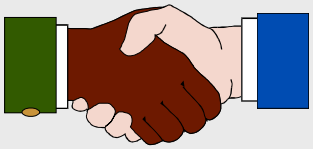


Details of Market Requirements

- **The global market**
  - needs a global standard
  - means a standard supporting all design & operation philosophies
- **Mixing of devices**
  - at least like with copper cables
- **Cost reduction**
  - by competition
  - by more intelligent functions
- **Cost reduction**
  - for investments
  - operation and maintenance
- **Open, future-proof standard**
  - for safe-guarding of investments
  - regarding suppliers and improving technology
  - for future extensions by bays or functions

Requirements for Standard in SA

Interoperability



The ability for IED's from one or several manufacturer to exchange information and use the information for the their own functions.

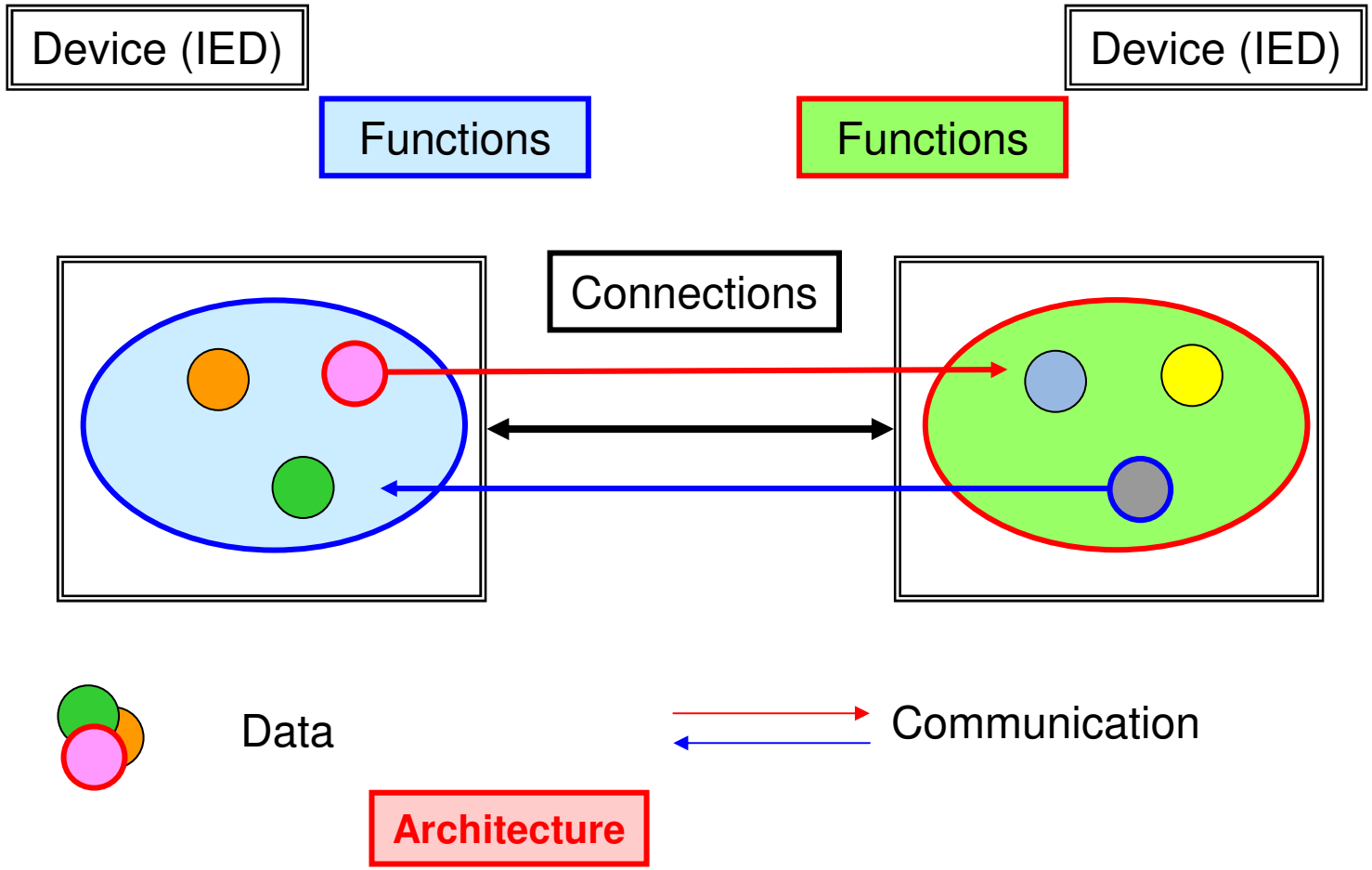
Free configuration

The standard shall support different philosophies and allow a free allocation of functions e.g. it must work equally well for centralized (RTU like) or decentralized (SCS like) systems.

Long term stability

The standard shall be future proof, i.e. it must be able to follow the progress in communication technology as well as evolving system requirements.

Elements of Substation Automation



What shall be standardized?

What shall be standardized?

- Physical Connections ?
- Physical Devices ?
- Functions ?
- Data ?
- Communication procedures ?

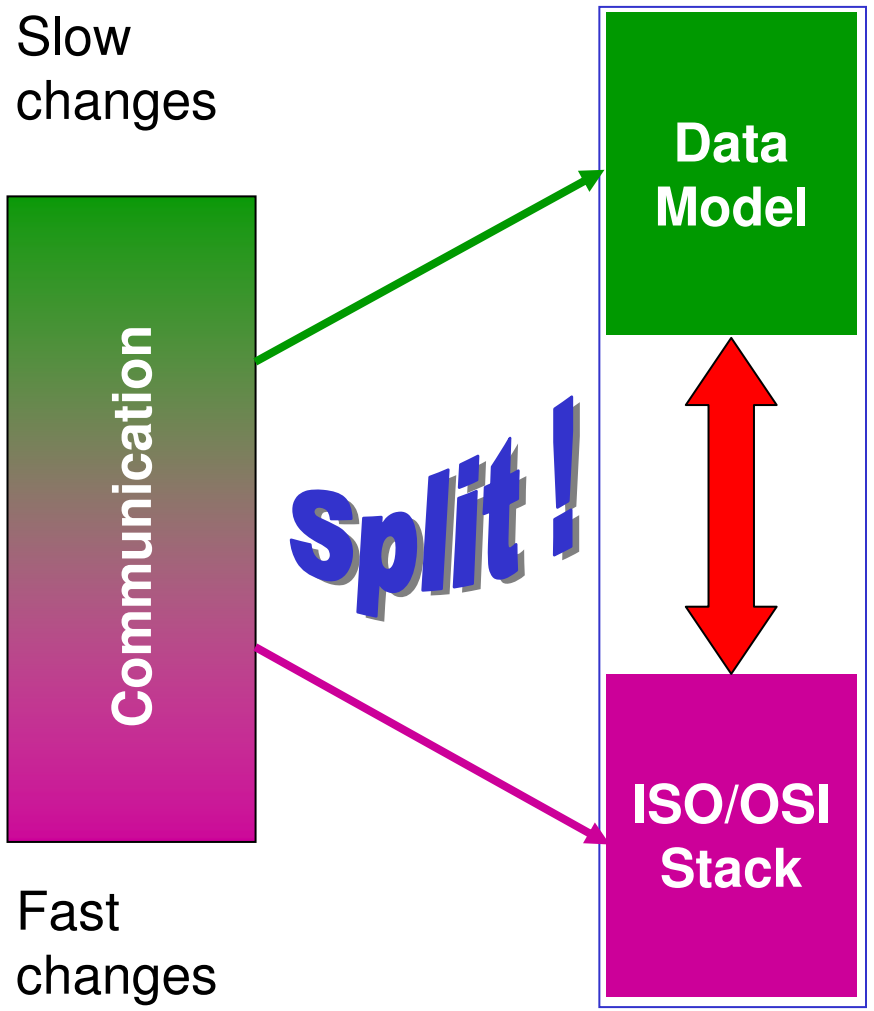
- Plugs !
- Development !
- Competition !
- Data exchange !
- Data exchange !

IEC 61850 Approach

Split in Data Model and Stack

Domain Substation :
What data have to be communicated ?

Communication Technology:
How are the data communicated ?



DEFINITION
Data and Services according to the Domain Substation

MAPPING
Data Model to the Communication Stack

SELECTION
ISO/OSI Stack from the Main Stream

IEC 61850

Communication Networks and Systems in Substations

14 parts: IEC 61850-x-y

IEC 61850
Result

Structure of IEC 61850 (14 parts)

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 description Language for Communication in electrical Substations related IEDs**
Testing	
Part 10:	**Conformance Testing**

Data Models	
Part 7-4:	**Compatible Logical Node Classes and Data Classes**
Part 7-3:	**Common Data Classes**
Abstract Communication Services	
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 to ISO/IEC 8802-3**
Part 9-1:	**Sampled Values over Serial Unidirectional Multidrop Point-to-Point link**
Part 9-2:	**Sampled values over ISO 8802-3**