IEC 61850 Drivers and Landscape

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IEC 61850 Drivers and Landscape

Establishing the progress being made in implementing IEC 61850 to make the smart grid concept a practical reality

- Impact and spread of IEC 61850
- Challenges for multivendor systems
- Key developments in the standard an products

Global Situation

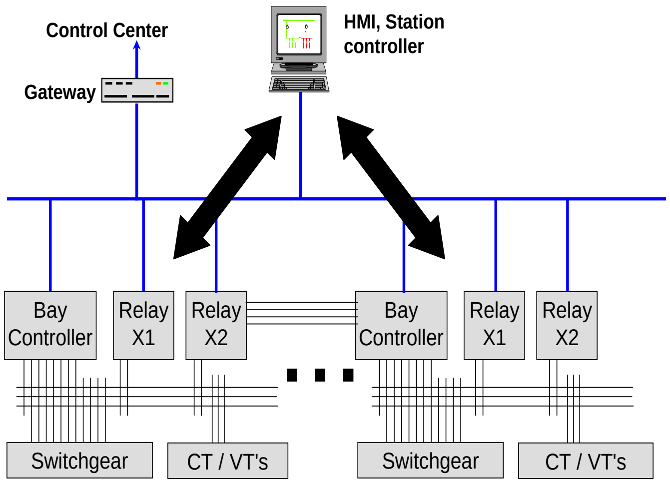
- IEC 61850 is used in several thousand substation projects worldwide
  - Widely used in Europe, Asia, South America
  - Usage in Australia started a few years ago
  - Usage in US is starting

This is related to different approaches

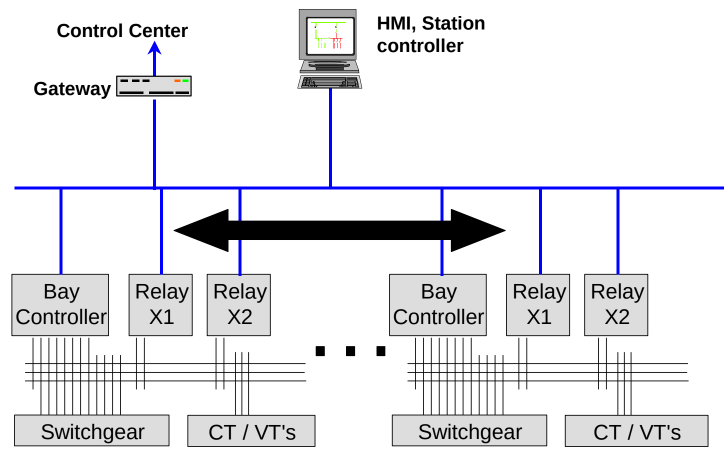
- Concepts of IEC 61850 are being applied to other domains
  - Windpower
  - Hydro and other bulk power plants
  - Distributed generation, energy storage and controllable loads

IEC 61850 has multiple aspects

… not all of them are always used in these projects

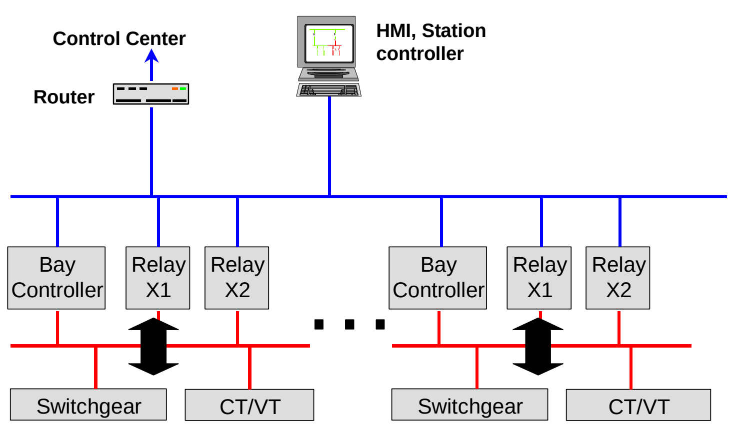


Client / Server



Peer to Peer (GOOSE)

Process bus and Sampled Values



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Several ways to approach IEC 61850

- Turn key approach – vendor delivers configured system
- Mixed approach – utility only configures HMI and gateway including communication
- Use third party system integrator
- Utility acts as system integrator

Turn key approach

- Scope of supply for the vendor
  - complete configured substation automation system
- Knowledge of utility
  - Basic IEC 61850 knowledge
  - Functional specification recommended; optionally a formal specification using .ssd file according to IEC 61850-6

This approach is used in most of the projects today

Utility as system integrator

- Utility buys IEDs, gateways and HMI as products
- Knowledge of utility
  - Data model
  - Communication services
  - Communication technologies
  - Engineering process according to part 6

This is the approach traditionally done in US and Australia and requires appropriate tools and engineering interoperability

Multivendor Systems

What are the issues?

- The main drivers for IEC 61850:
  - … to reduce costs of implementation
  - … to achieve interoperability using standards-based products and technologies
  - … to enable seamless integration

… What does "interoperability" mean?

… What is the impact of a multivendor system on cost reduction for implementation and seamless integration?

Interoperability

From IEC 61850-2

"ability of two or more **IEDs** from the same vendor, or different vendors, to **exchange information** and **use that information** for correct execution of specified functions"

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Interoperability and IEC 61850

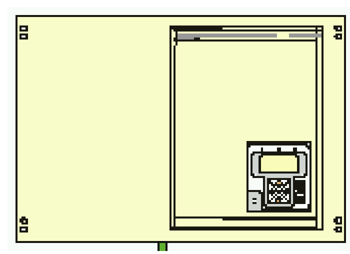
- IEC 61850 has three core components
  - Information exchange – ACSI and mappings on communication protocols
  - Application modeling – Logical nodes
  - Engineering – Configuration Language
- Interoperability has the same levels
  - Ability to exchange information is provided by ACSI – **this is mostly achieved today**
  - Ability to use the information is supported by the application models – **improvements are possible**
  - Engineering interoperability today is **limited**

IED properties and configuration

Functionality based data model (LNs, optional data)

Communication capability

IED Tool



Preconfigured functional parameters, CF attributes

Communication behavior (controls, data sets)

Tool or Online

Engineering flexibility of devices

- IED properties can be
  - Fix: defined by IED implementation
  - Conf: defined through configuration file (SCL); initialized at startup
  - Dyn: dynamically changed through client / server services or on front panel

This needs to be evaluated before selecting a IED, since it has an impact on how you can engineer your system. The information is found in the service section of the ICD file.

Data Models in reality

- Many real devices use a lot of LN GGIO
- User configurable signals typically can only be assigned to LNs GGIO
- Semantic of the model is not always obvious

How many LNs for a 3 zone distance protection?
How to identify earth fault and phase fault element?

Improving Interoperability

- Several users organizations are starting to collect issues
  - ENTSO-E
  - EPRI in collaboration with North American utilities
- A new task force in WG 10 has been created to address these issues

Key developments in standard

- Several new features available now in Edition 2 of IEC 61850 will help to improve interoperability on engineering and data modeling levels
  - New testing features
  - SCL implementation conformance statements and improved capability definition
  - SCL function modeling with enhanced features
- And ongoing development for DER Grid integration will support smart grid concepts

Testing

- Specification of LN Modes "**test**" and "**test/blocked**" improved
- **Simulation** flag for GOOSE and Sampled value messages allows for sending of regular messages and messages from test equipment at the same time
- **Mirroring of control** information allows performance testing with blocked outputs in mode "test/blocked"

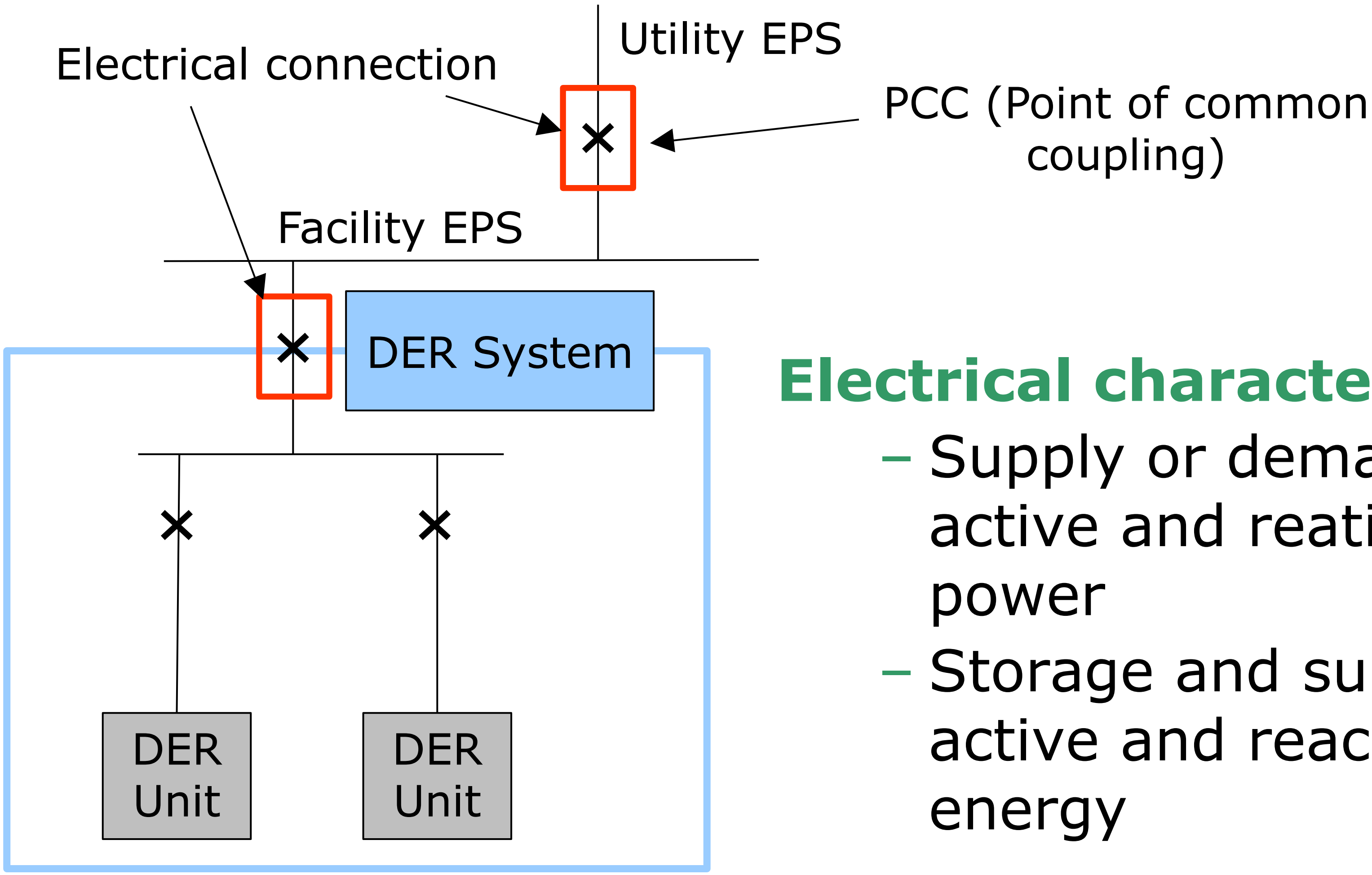
SCL improvements

- Task split between IED and system tool is better defined – including implementation conformance statements (SICS)
- Specification of IED capability (service and configuration support) improved
- Functional description in SCL ("Substation Section") is improved – supports grouping of LNs in Functions and Subfunctions

SCL functional description example

SCL Element							Name	Type	Explanation
	Substation						AA1		
		VoltageLevel					E1		
			Bay				Q3		
				Function			F51	*OCP*	Overcurrent Protection
					LNode			PTRC	
					ConductingEquipment		T1A	CTR	
					SubFunction		Ph	*PHS*	Phase Fault
						LNode		PIOC	
						LNode		PTOC1	
						LNode		PTOC2	
						LNode		PDIR	
					SubFunction		E	*GND*	Ground Fault
						LNode		PIOC	
						LNode		PTOC1	
						LNode		PTOC2	
						LNode		PDIR	
				Function			F79	*REC*	Reclosing
					LNode			RREC	
				ConductingEquipment			QA1	CBR	
				Function			MET	MEAS	Measurement
					ConductingEquipment		T1B	CTR	
						LNode		TCTR	
					ConductingEquipment		T2	VTR	
						LNode		TVTR	
					LNode			MMXU	

DER Integration



Electrical characteristics

– Supply or demand of active and reative power
– Storage and supply of active and reactive energy

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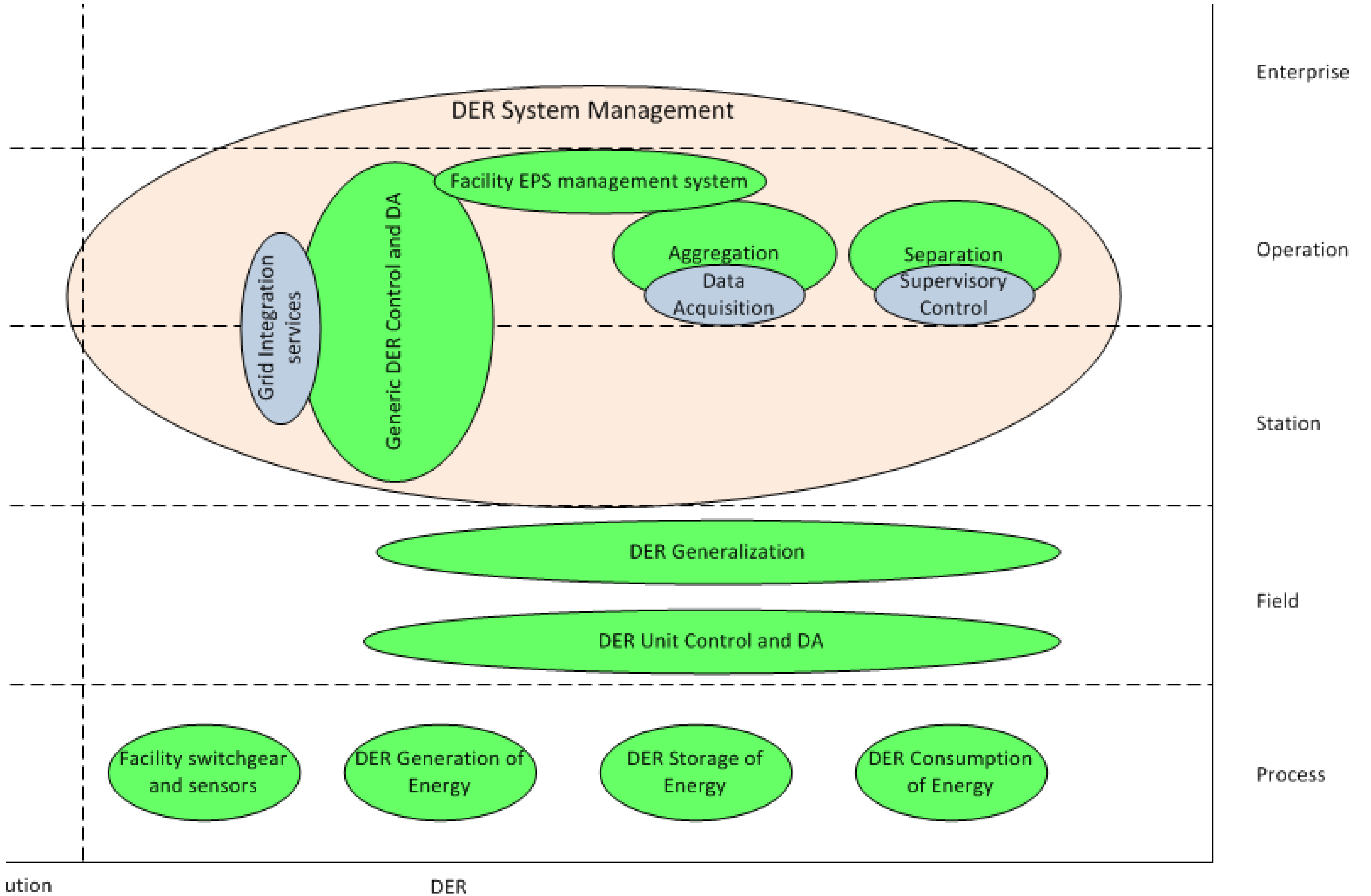
Functions for DER Grid integration



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Product status

- Third party system integration tools available with increasing capabilities
- More functionality in vendor tools
  - e.g. renaming of generic I/O from LN GGIO to a semantic name
- Interoperability Tests planned for November
  - Expect to create guidelines / agreements to improve engineering interoperability

Conclusion

Two major directions of standardization work

- Extend interoperability from **communication** interoperability to **engineering** interoperability
- Support **grid integration** of renewable power and distributed energy resources