



# Harmonization Issues of IEC 61850 and CIM

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# Topics

- IEC 61850 in a “Nutshell”
- IEC 61850 UML Model
- IEC 61850 mapping to SEP 2.0
- “Bottom-Up” Approach to CIM/61850 interactions
- IEC WG17 DER, Storage, and PEV Activities
- WG14 RBAC Response to WG15 Questionnaire



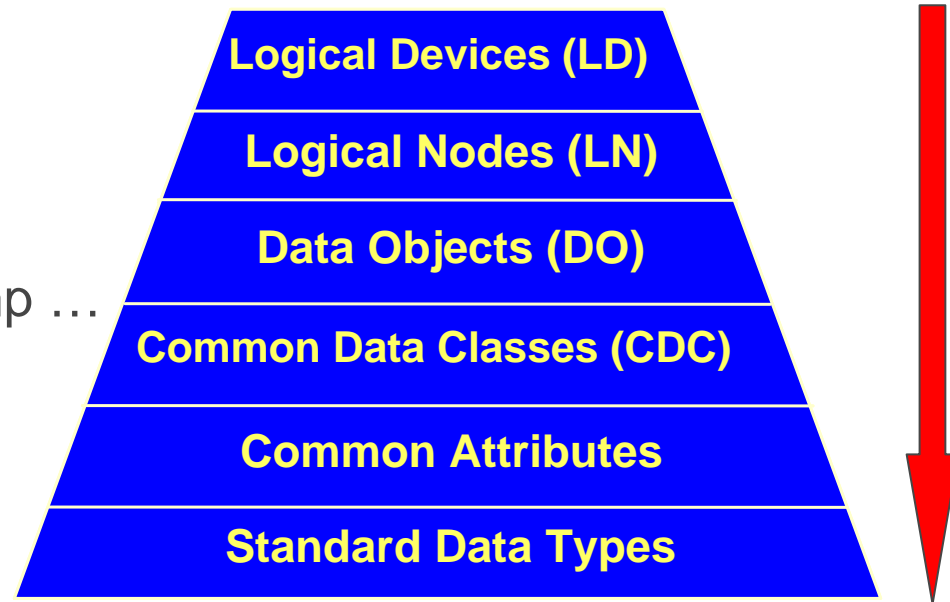
**IEC 61850 in a “Nutshell”**

**IEC 61850 UML Model**

**IEC 61850 mapping to SEP 2.0**

# “Nutshell” Description of IEC 61850 - Nouns

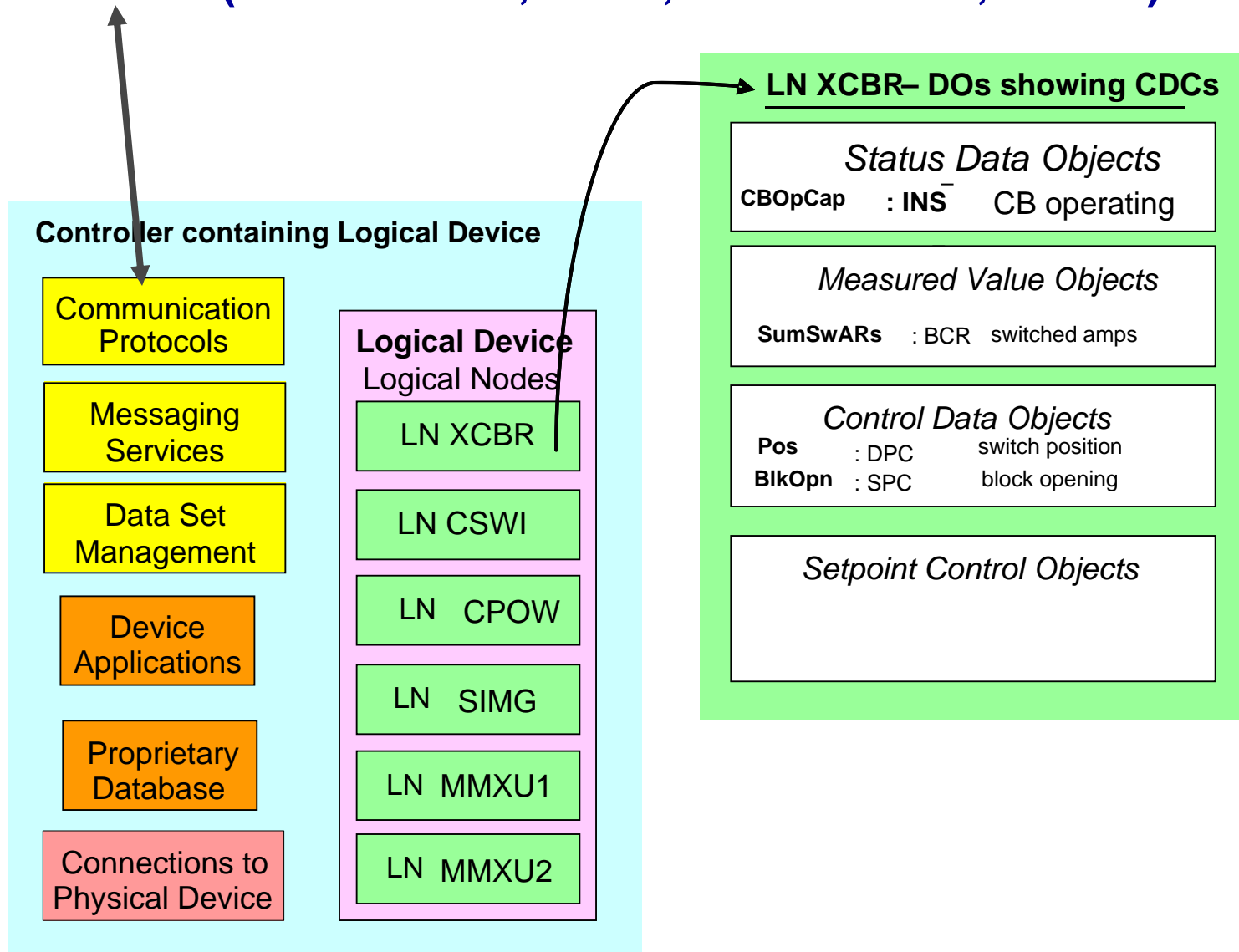
- Logical Devices (LDs):
  - Informative only, and consist of groups of LNs
  - Implemented using System Configuration Language (SCL)
- Logical Nodes (LNs):
  - Normative, consisting of Data Objects
  - Used for organizational and naming purposes
- Data Objects:
  - Data elements within LNs
- Common Data Classes:
  - Format of Data Objects
  - Value, quality code, timestamp ...
- Common Attributes
  - Quality codes, enumerations
  - Hi-Lo range limits
- Standard Data Types
  - Floating point, binary, integers



# “Nutshell” Description of IEC 61850 - Verbs

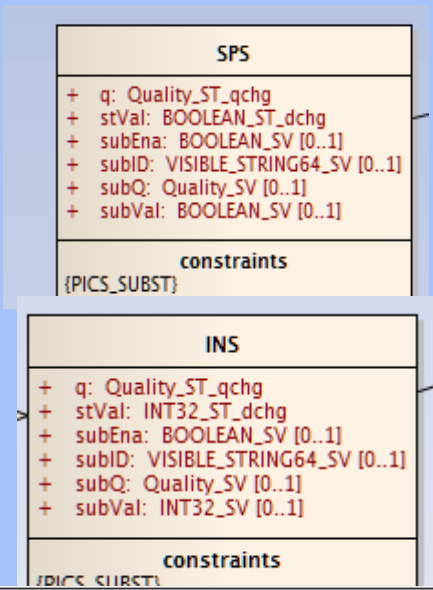
- Get data object
  - Value, quality, timestamp, ... as defined in CDC
- Put data object
  - Controls, settings, etc.
- Get metadata (self-discovery)
  - Logical nodes and data objects
- Establish datasets
  - Sets of data with criteria for reporting on data changes
- Get dataset (all data objects in a dataset in order)
- Put dataset (all data objects in a dataset in order)
- Report-by-exception of datasets
  - Reported when one or more values change beyond a deadband
  - Periodic “integrity scan”
- Logging of events with timestamps
- System Configuration Language (SCL) tools are used to configure implementations

# Logical Devices “Contain” Logical Nodes, “Constructed” of Data Objects, “Structured” by CDCs, and “Mapped” to Protocols (such as MMS, DNP3, Web Services, or SEP)

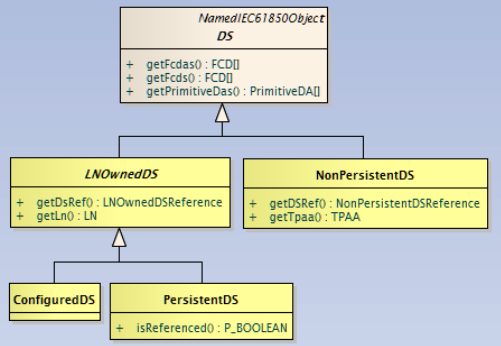


# WG10 Effort: UML Diagrams of IEC 61850 – CDCs, Data Sets, and Logical Nodes – Being Developed by Tanja Kostic

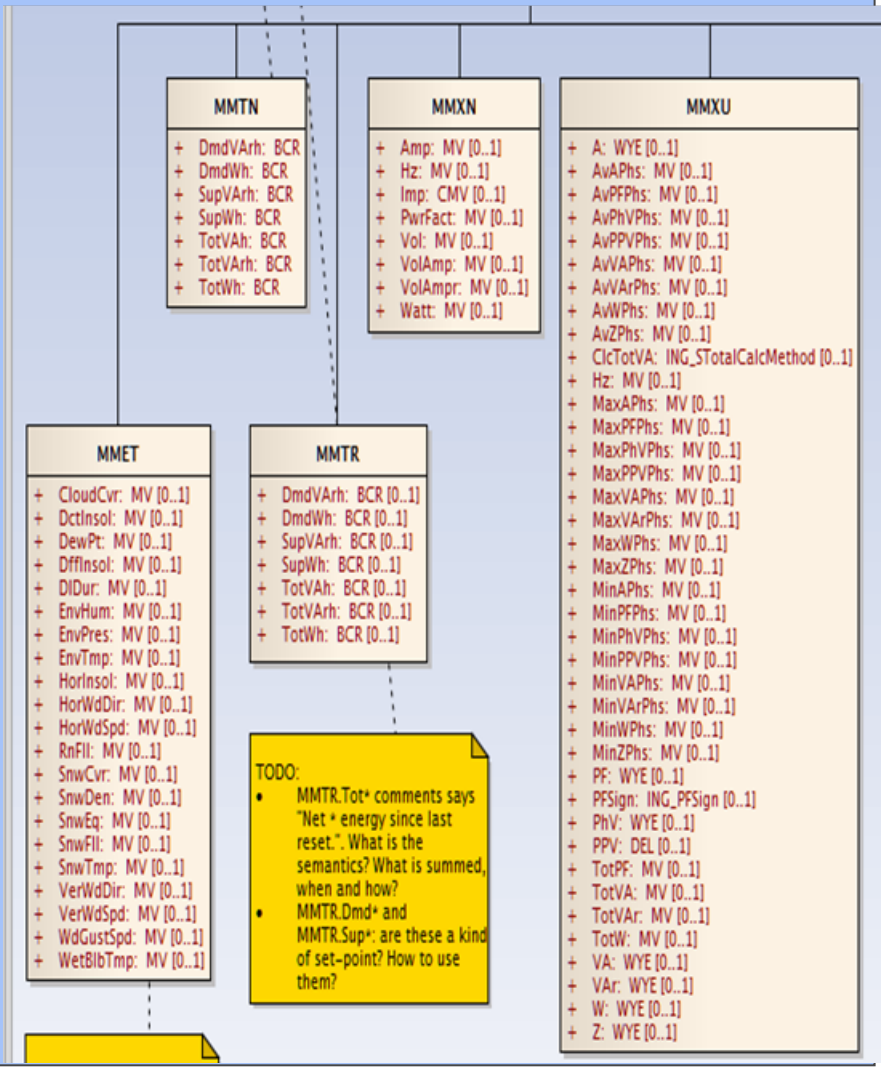
## Common Data Classes



Datasets are list of signal references, used for logging and eventing on data and/or quality change. They allow the application to "read" that list of references once, and then receive value updates as ordered lists of values. In the meta-model, datasets contain thus only information on contained references, as well as the naming-related services. Communication services are defined in CoreAcSi API.



## Logical Nodes

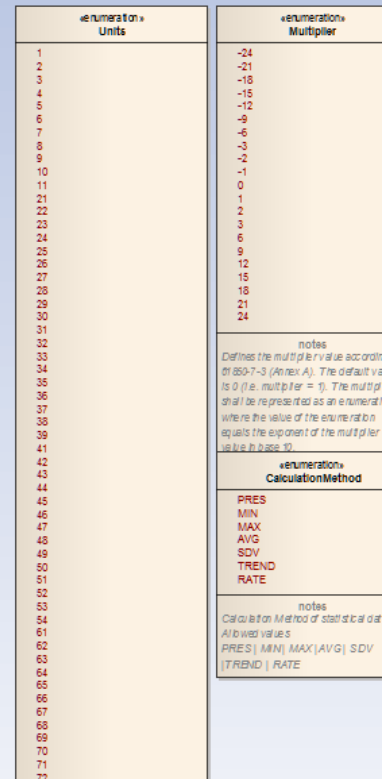
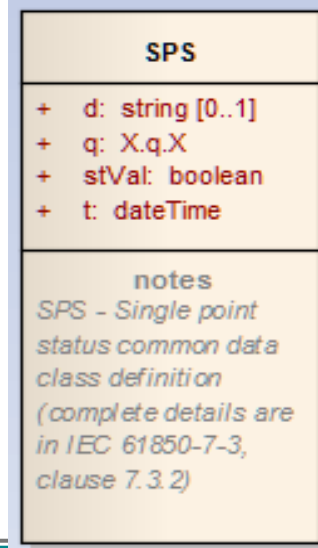
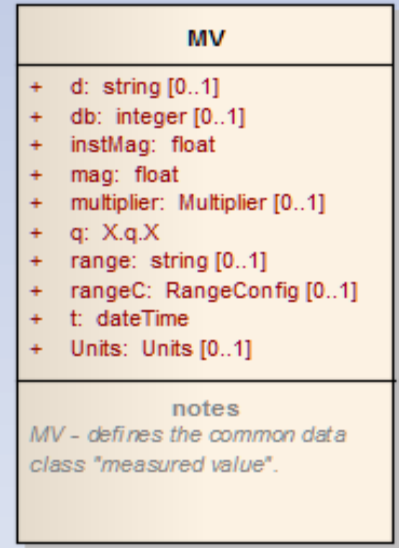
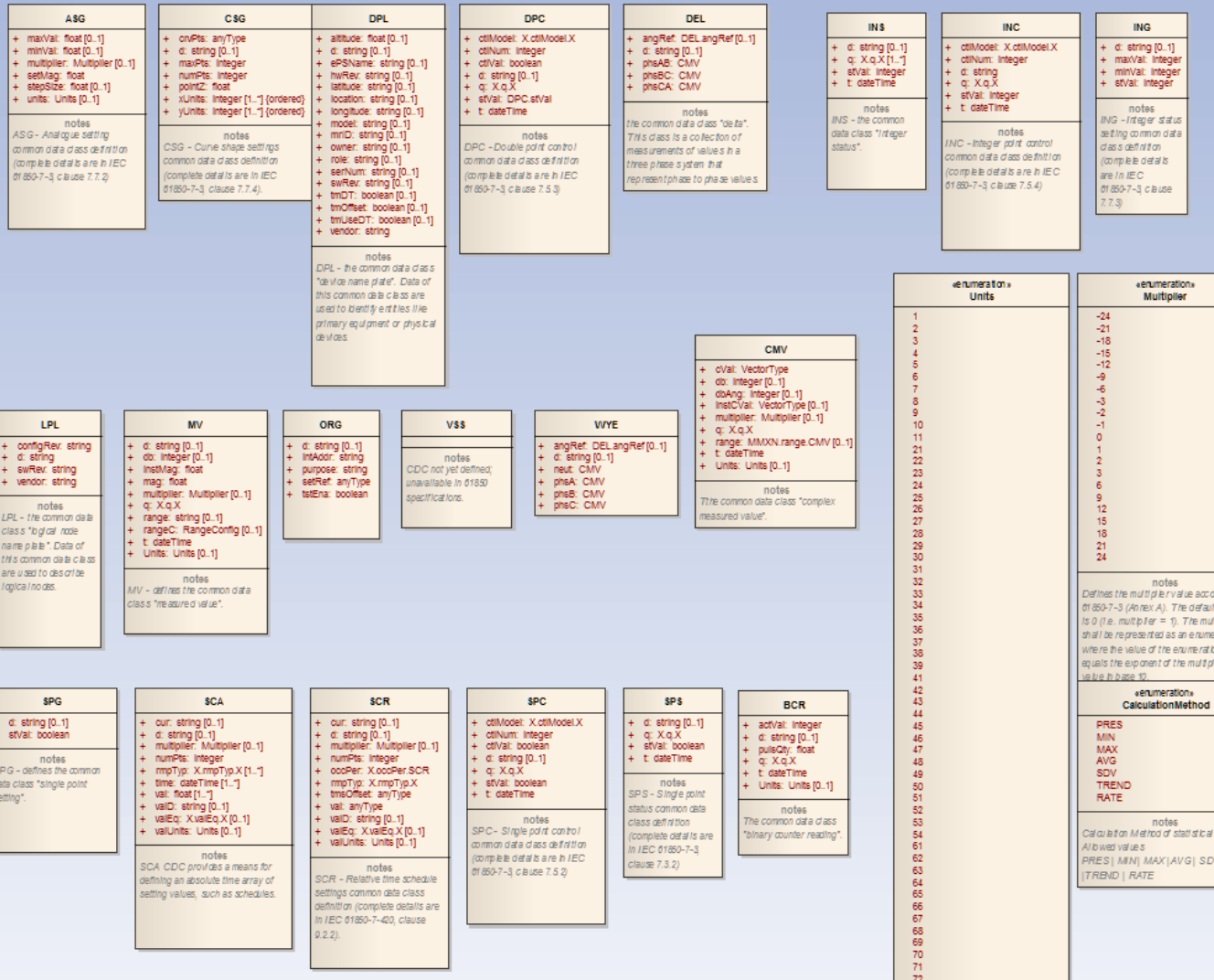


**TODO:**

- MMTR.Tot+ comments says "Net + energy since last reset.". What is the semantics? What is summed, when and how?
- MMTR.Dmd+ and MMTR.Sup+ are these a kind of set-point? How to use them?

# Proposed SEP UML for IEC 61850 CDCs – Does not include all optional data elements

(Readable example of MV & SPS)



# Possible SEP “Verbs” for IEC 61850

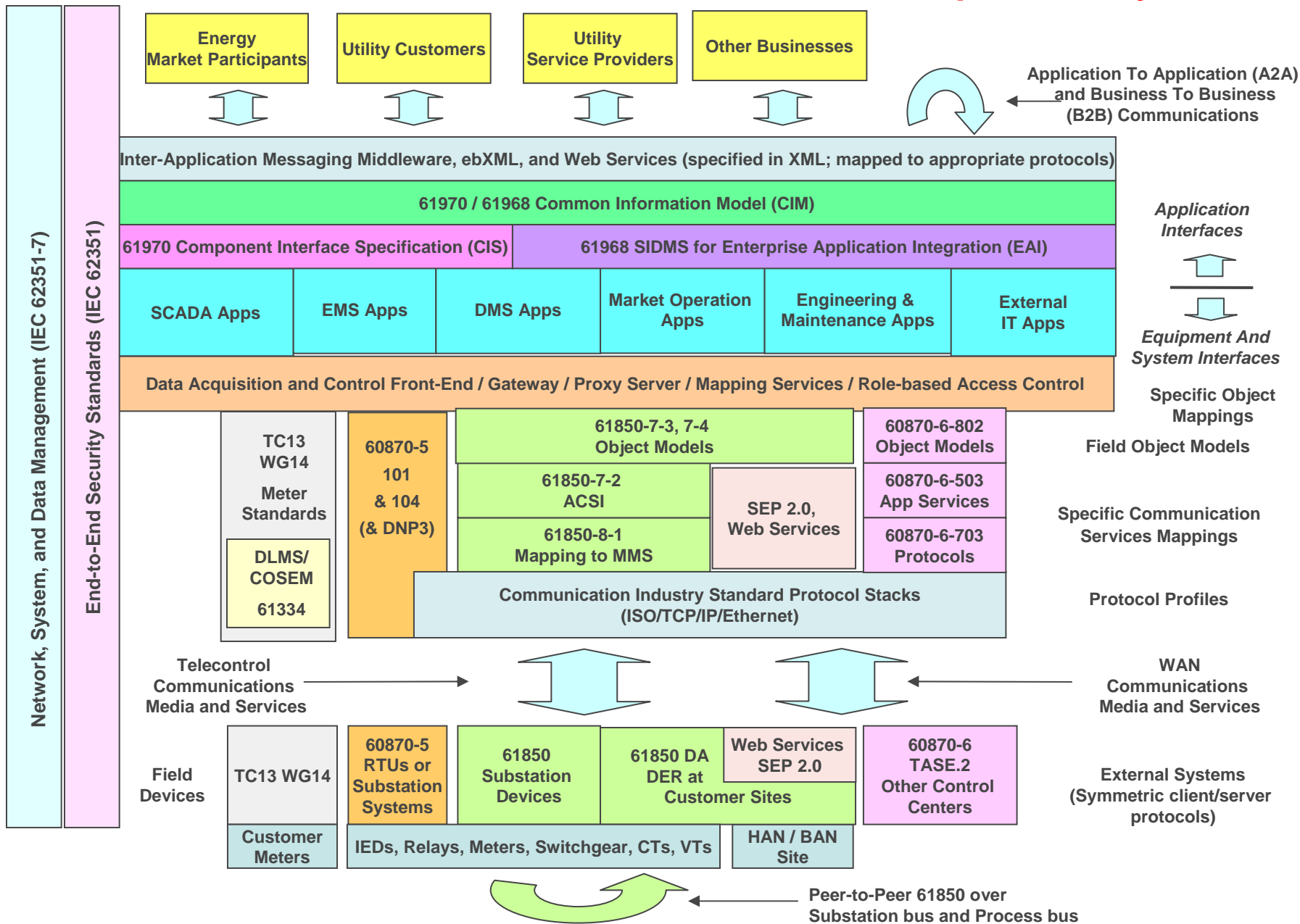
- **Get/Put Data Objects** provides monitoring, controlling, and setting values of individual data elements
- **Get/Put Datasets** provides monitoring, controlling, and setting values of groups of data objects that were established at implementation time or later. Data set values are reported automatically when values change or on a periodic basis.
- **Logging**: Not quite sure on collecting and transmitting logs (Robby??)
- **Report-by-Exception**: Still working on the exact mechanism to provide “report-by-exception” (Robby may be able to explain more).



**“Bottom-Up” Approach:**

**IEC 61850 CDCs Mapped to  
CIM Complex Datatypes**

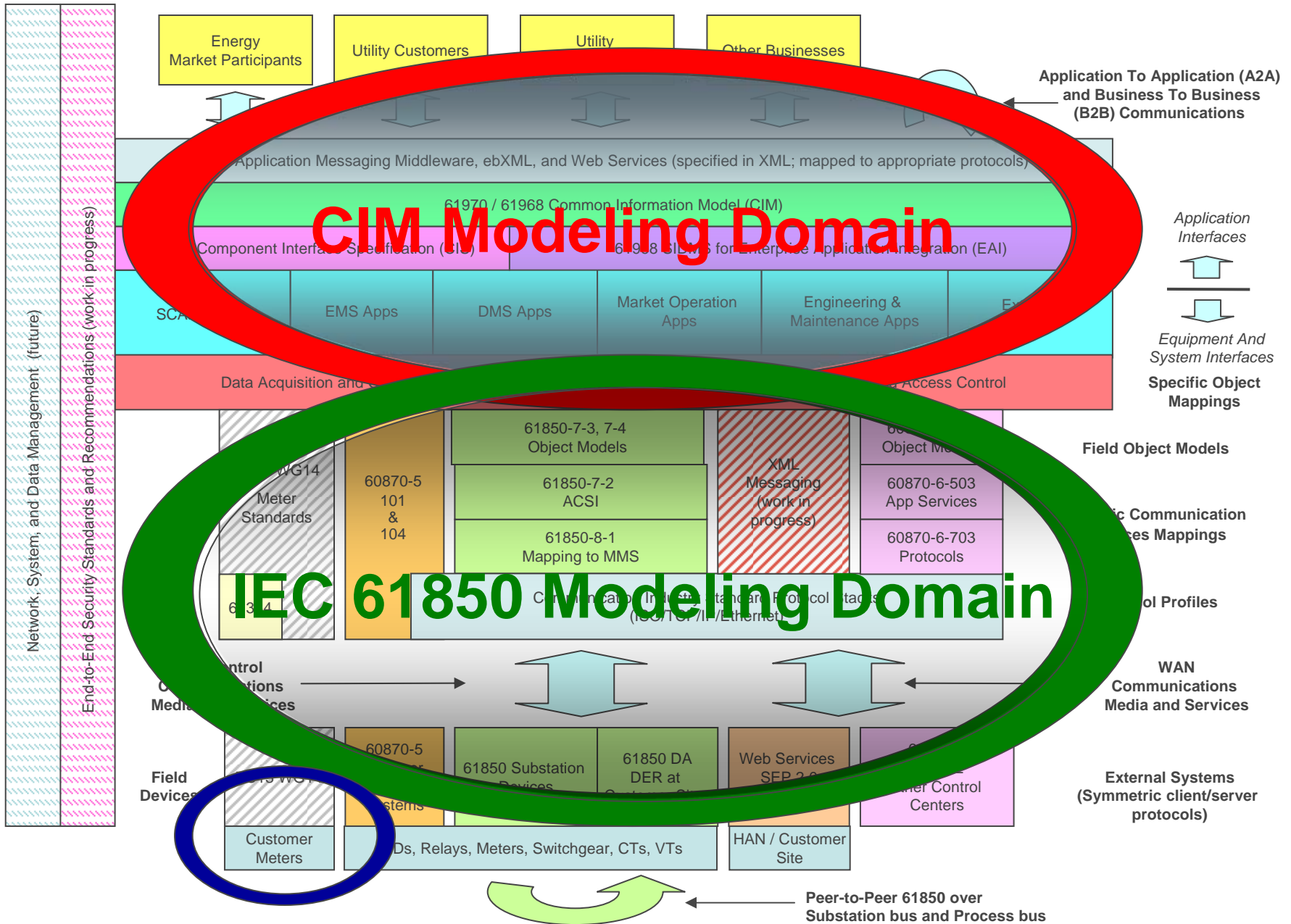
# Current IEC TC57 Reference Architecture – Scope and Layers



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\*Notes: 1) Solid colors correlate different parts of protocols within the architecture.  
 2) Non-solid patterns represent areas that are future work, or work in progress, or related work provided by another IEC TC.

# Current TC57 Reference Architecture – Scope and Layers



1) Solid patterns represent areas that are complete or in progress, while non-solid patterns represent areas that are future work, or work in progress, or related work provided by another IEC TC.  
 2) Non-solid patterns represent areas that are future work, or work in progress, or related work provided by another IEC TC.

# Bottom-Up Approach

- IEC 61850 has about 39 CDCs that define format or structure of the Data Objects
  - Some elements of CDCs are mandatory while others are optional
  - Some elements of CDCs are very commonly used, while others are not
  - Some CDCs are very commonly used, while others are not
- For the cross-over between measurements coming from field devices using 61850 to MeasurementValue in the CIM:
  - Select key CDCs
  - Select mandatory elements in those CDCs
  - Develop complex datatypes for each key CDC in CIM
  - Accept (don't model in CIM) all 61850 Data Objects, using the appropriate CDC complex datatypes

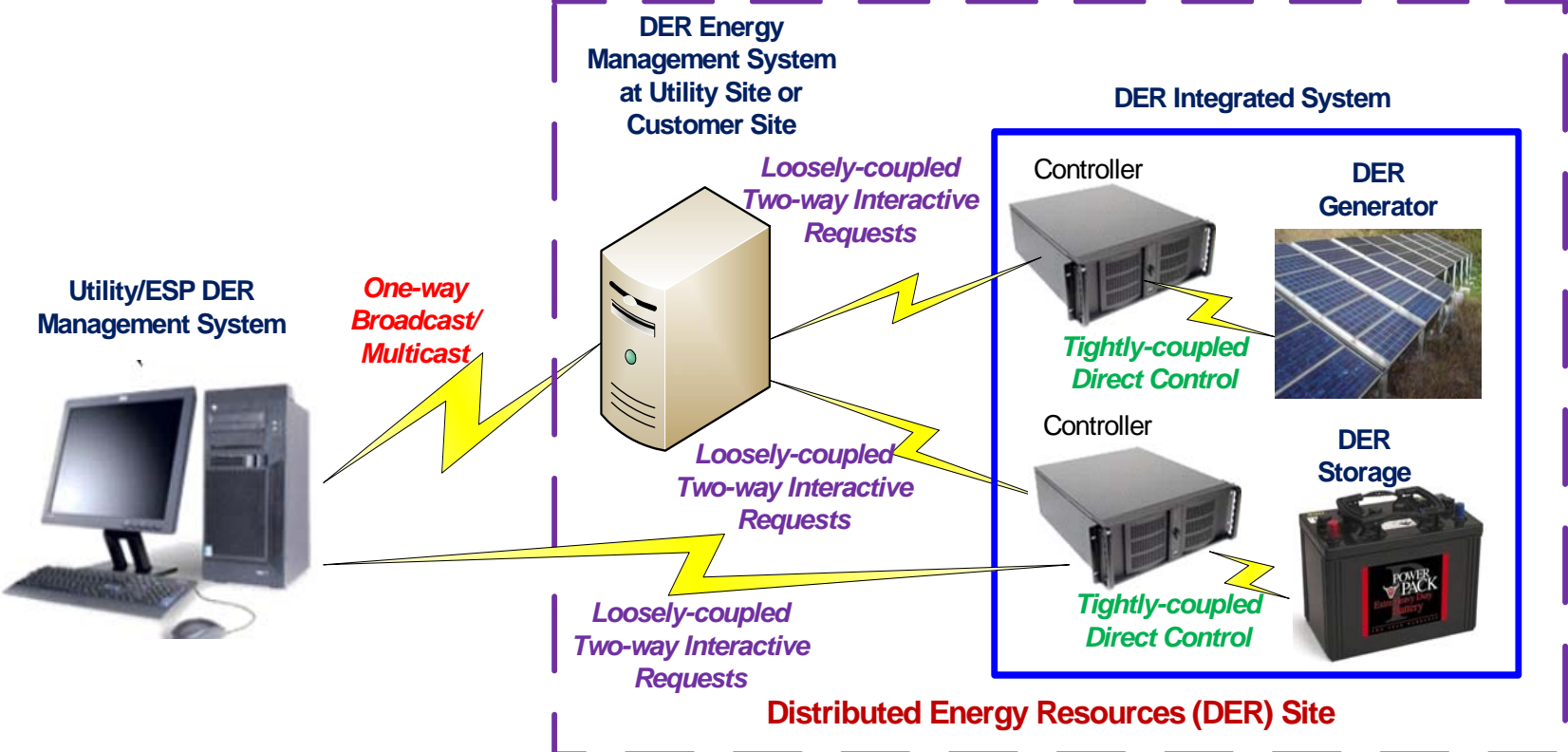


## **IEC WG17 DER, Storage, and PEV Activities**

# DER (Generation and Storage) Functions and Interactions

- DERs will provide:
  - Energy (real power) from generators and from storage units
  - Reactive power support (volt/var support) to both distribution and transmission efficiency and stability
  - Combined generation and storage can provide rapid response to mitigate intermittent renewable resources like wind and solar
  - Low voltage ride-through, emergency reserves, harmonic-damping
  - Rapid response to frequency deviations
- DER will be managed:
  - By customers for their own exclusive use
  - Through direct control by utilities or aggregators
  - Through market-driven bids, with direct control by utilities
  - Through market-driven, tariff-based demand response

# Different DER Interactions: Direct Control, Interactive Requests, Broadcast/Multicast

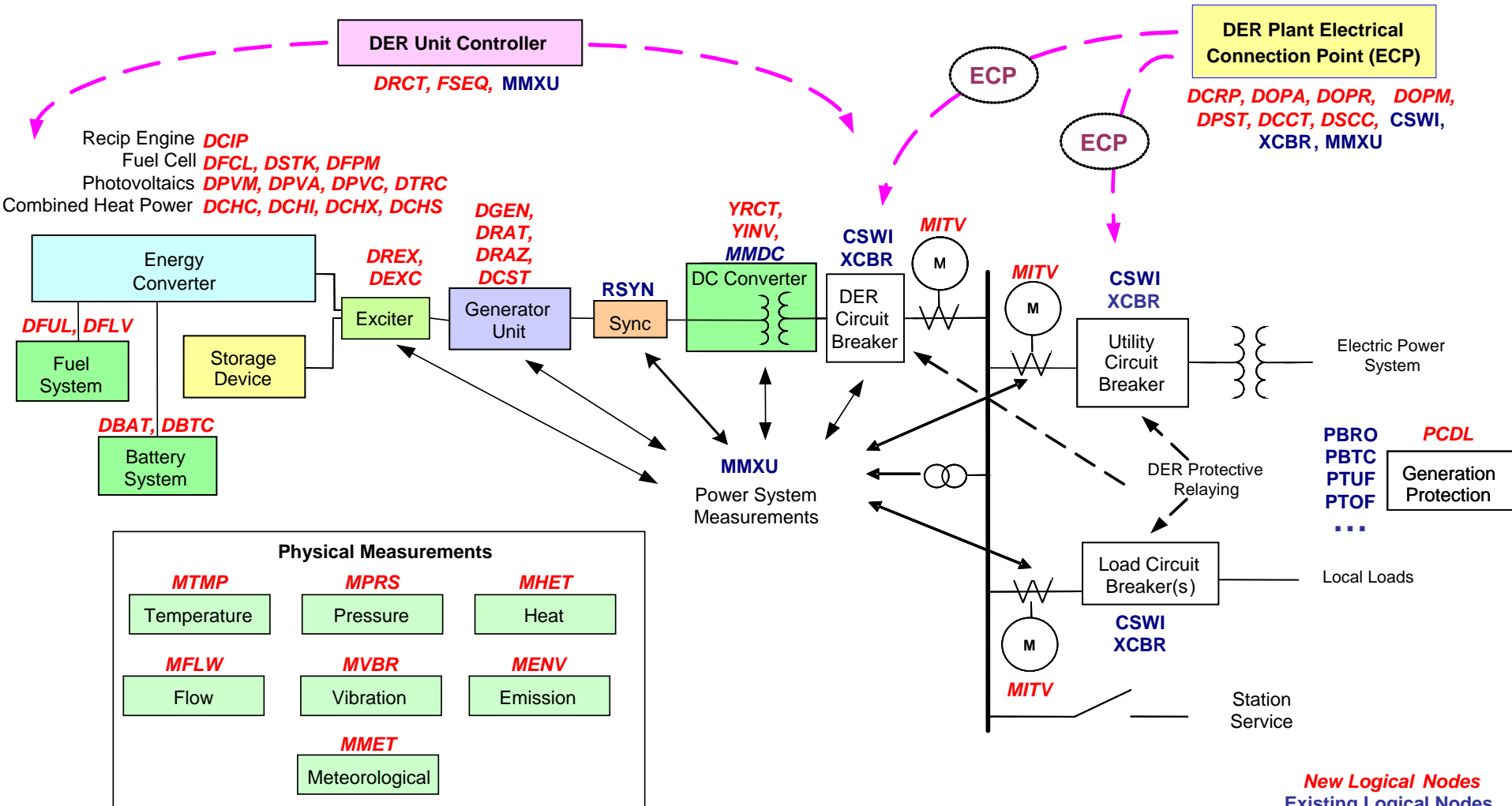


DER Management: Interactions between Components

# DER Key Use Cases Must Cope with Many Different Configurations

- Direct, tightly-coupled control
  - Between inverter controller and ES-DER device
  - Between Customer EMS and multiple ES-DER devices in a building, subdivision, or campus
- Interactive two-way monitoring and control
  - Between ISO/RTO and ES-DER system whose bid has been accepted
  - Between Customer EMS and multiple ES-DER systems with their own (sophisticated) controllers
- Broadcast/multicast one-way “pricing” or “request” signals
  - Between utility and Customer EMS
  - Between aggregator and ES-DER systems

# Logical Devices and Logical Nodes for Distributed Energy Resource (DER) Systems



**New Logical Nodes**  
**Existing Logical Nodes**

Logical Device

Energy Converter = Microturbines, Fuel Cell, Photovoltaic System, Wind turbines, Diesel Generators, Combustion Turbines

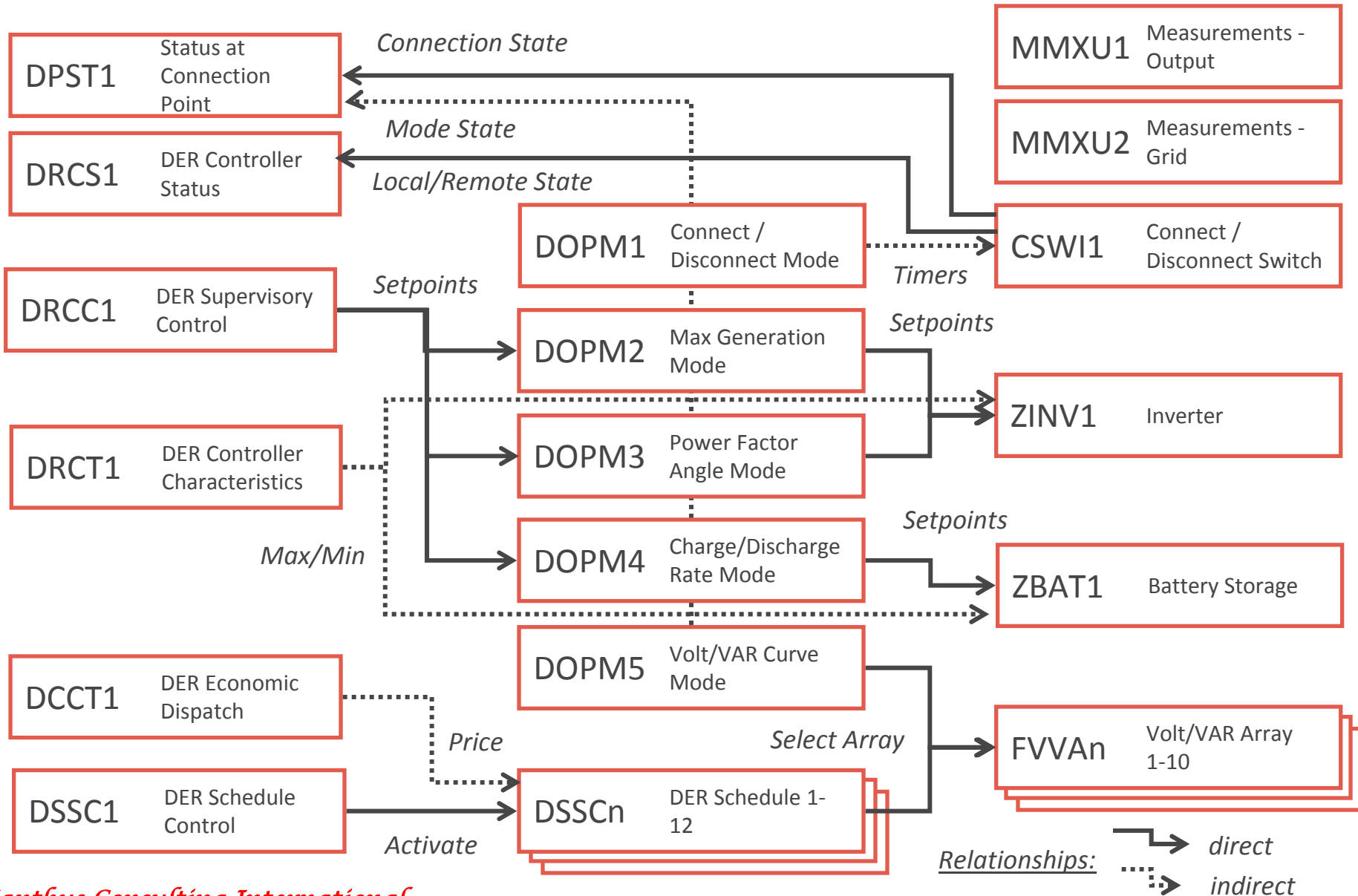
Storage Device = Battery, Pumped Hydro, Superconducting Magnetic Energy Storage, Flywheels, Micro-flywheels

Converter = DC to AC, frequency conversion, voltage level conversion  
Auxiliaries = Battery, Fuel Cell

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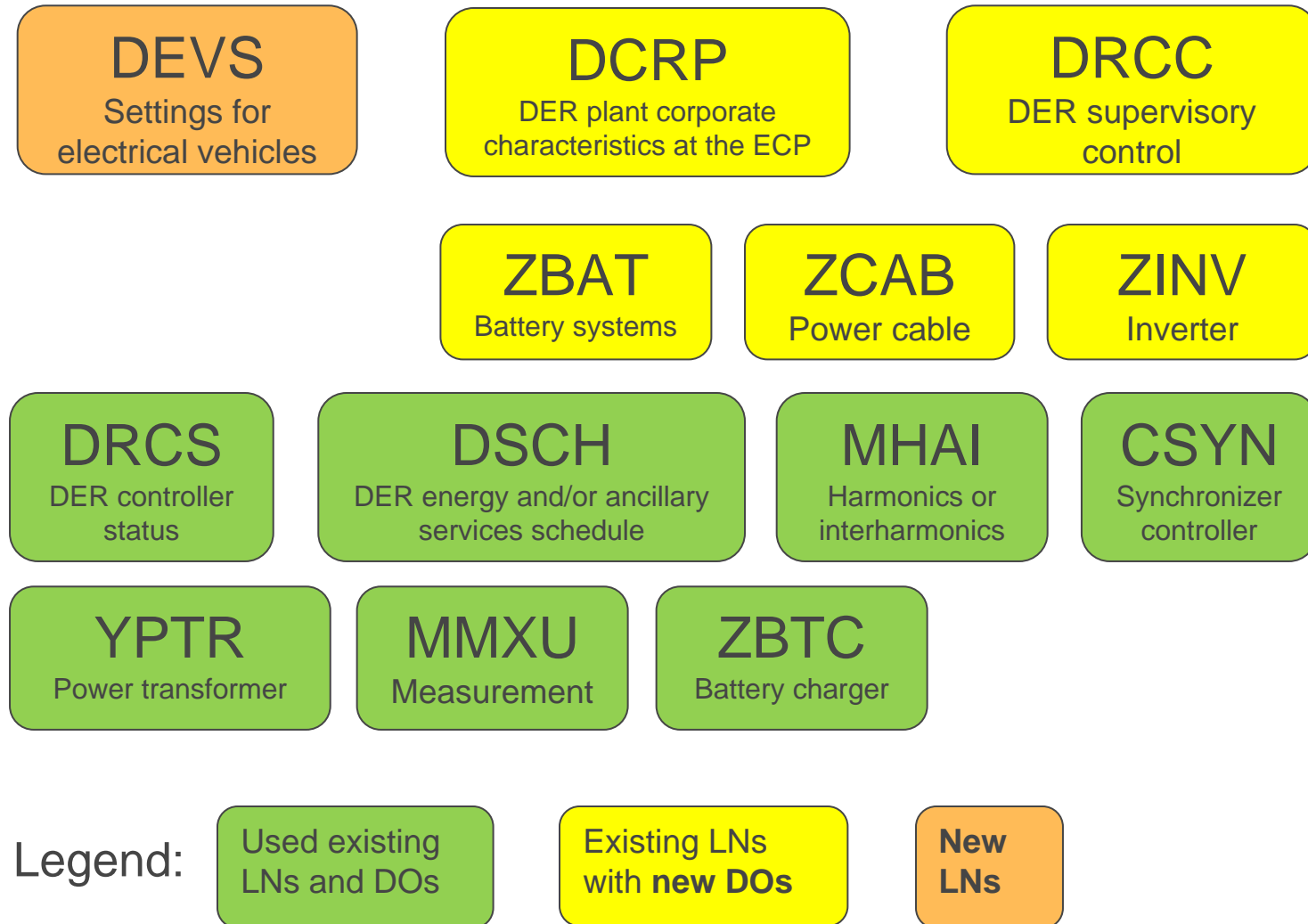
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# Possible Inverter Logical Device



# Extension for IEC 61850-7-420 for EVs

## Overview of extensions for EVs





# **WG14 RBAC Response to WG15 Questionnaire**

# WG15 Request for WG14: Role-Based Access Control

(Extensive Spreadsheet --- Thanks David Haynes!!)

Name of Resource:		Data collection							
Role		Permissions							
		View	Read	Write	Execute	Configure	Create	Delete	Assign Permission
1	Metering System (MS)	X	X	X	X	-	X	X	-
12	Metering System (MS) user	X	X	-	-	X	X	-	-
13	Metering System (MS) admin	X	-	-	-	-	-	-	X
2	Meter Data Management System (MDMS)	X	X	-	-	-	X	-	-
3	Load Management System (LM)	X	X	-	-	-	X	-	-
4	Meter Asset Management (MAM)	X	X	-	-	-	-	-	-
5	Meter Maintenance (MM)	X	X	-	-	X	X	-	X
6	Work Management (WM)	X	-	-	-	-	-	-	-
7	Network Operations (NO)	X	-	-	-	-	-	-	-
8	Point of Sale (POS)	X	X	-	-	-	-	-	-
9	Outage Management (OMS)	X	X	-	-	-	X	-	-
10	Planning and Scheduling (PAS)	X	-	-	-	-	-	-	-
11	Customer Information and Billing (CIS)	X	X	-	-	-	X	-	-

Notes:

The meter itself is the source of collected data, and the meter is part of the MS

Data will be deleted after a period of time per the utility's archival policy

# WG15 Response

- WG15 is having a meeting Oct 26-27 in Knoxville
- We will review the WG14 submission
- Already have some questions:
  - Can you identify which roles might be Mandatory and which Optional – or are they all Optional?



**Discussions???** !!!