



Harmonization Issues of IEC 61850 and CIM

Frances Cleveland
Xanthus Consulting International

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



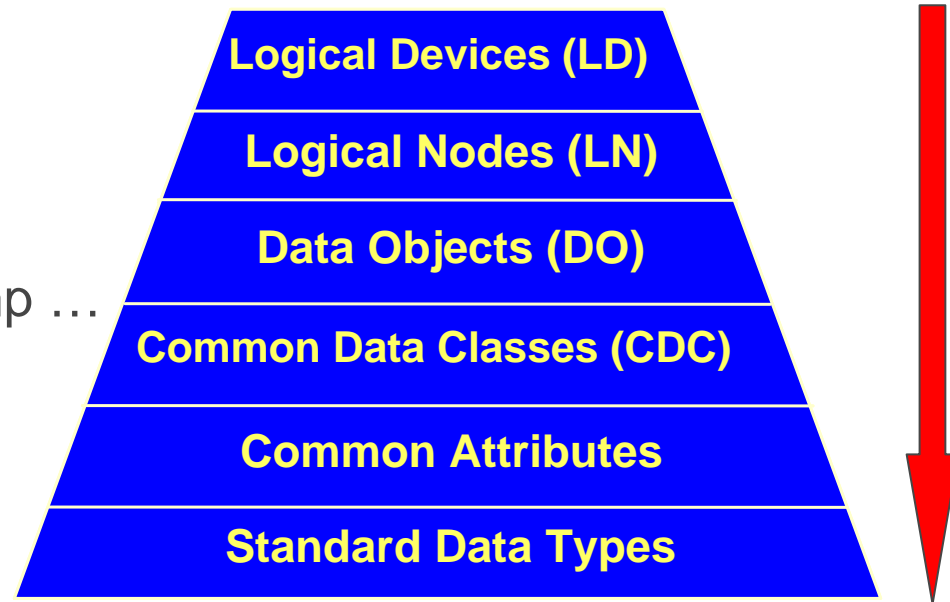
IEC 61850 in a “Nutshell”

IEC 61850 UML Model

IEC 61850 mapping to SEP 2.0

“Nutshell” Description of IEC 61850 - Nouns

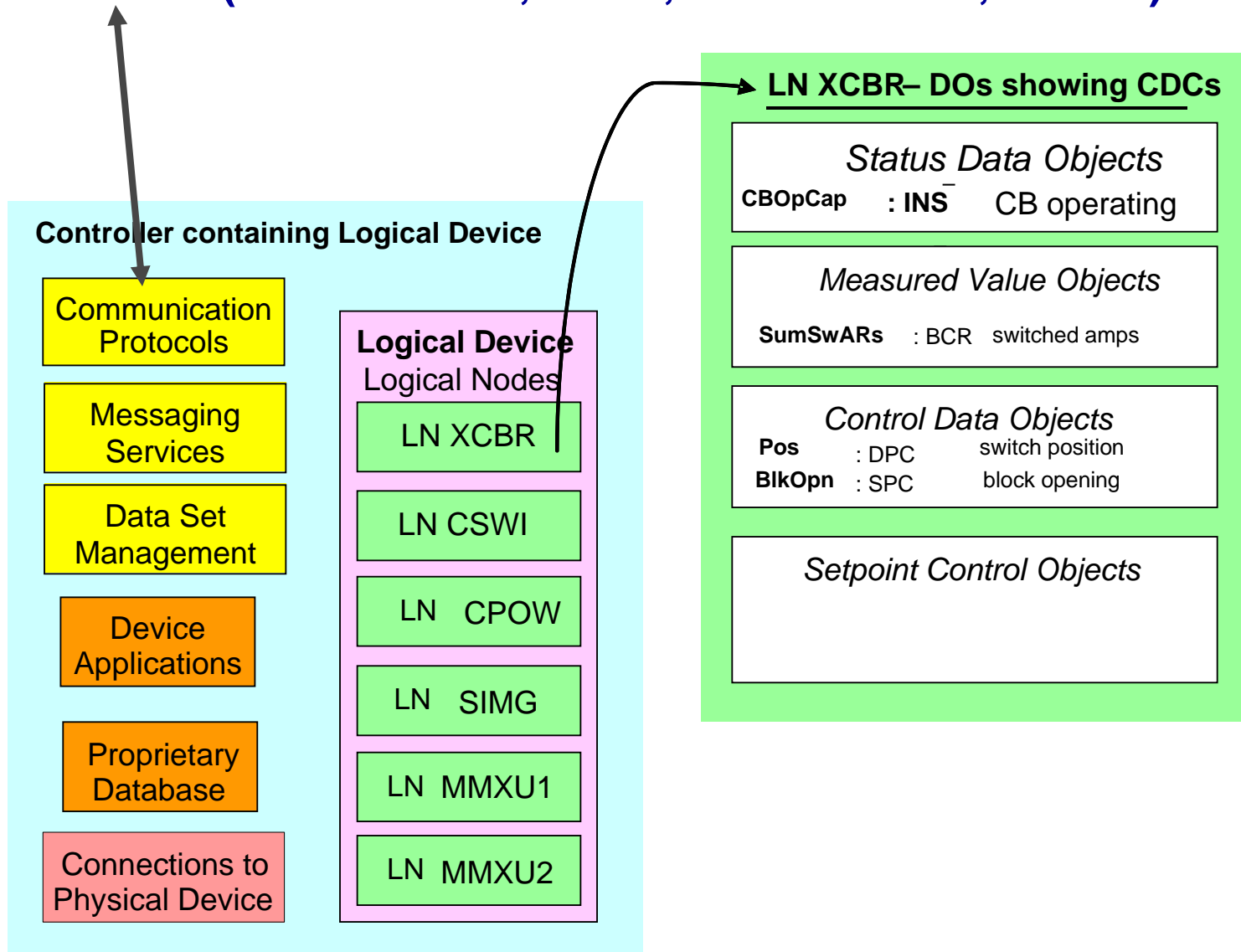
- Logical Devices (LDs):
 - Informative only, and consist of groups of LNs
 - Implemented using System Configuration Language (SCL)
- Logical Nodes (LNs):
 - Normative, consisting of Data Objects
 - Used for organizational and naming purposes
- Data Objects:
 - Data elements within LNs
- Common Data 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

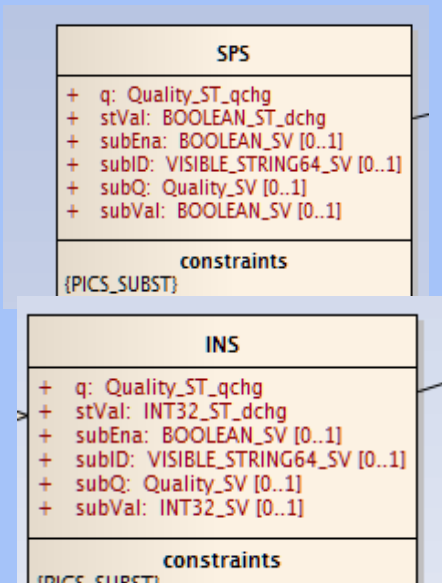
- Get data object
 - Value, quality, timestamp, ... as defined in CDC
- Put data object
 - Controls, settings, etc.
- Get metadata (self-discovery)
 - Logical nodes and data objects
- Establish datasets
 - Sets of data with criteria for reporting on data changes
- Get dataset (all data objects in a dataset 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)

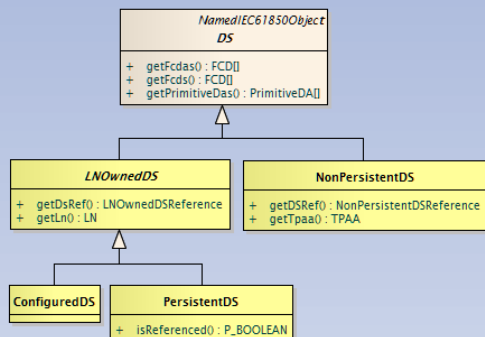


WG10 Effort: UML Diagrams of IEC 61850 – CDCs, Data Sets, and Logical Nodes – Being Developed by Tanja Kostic

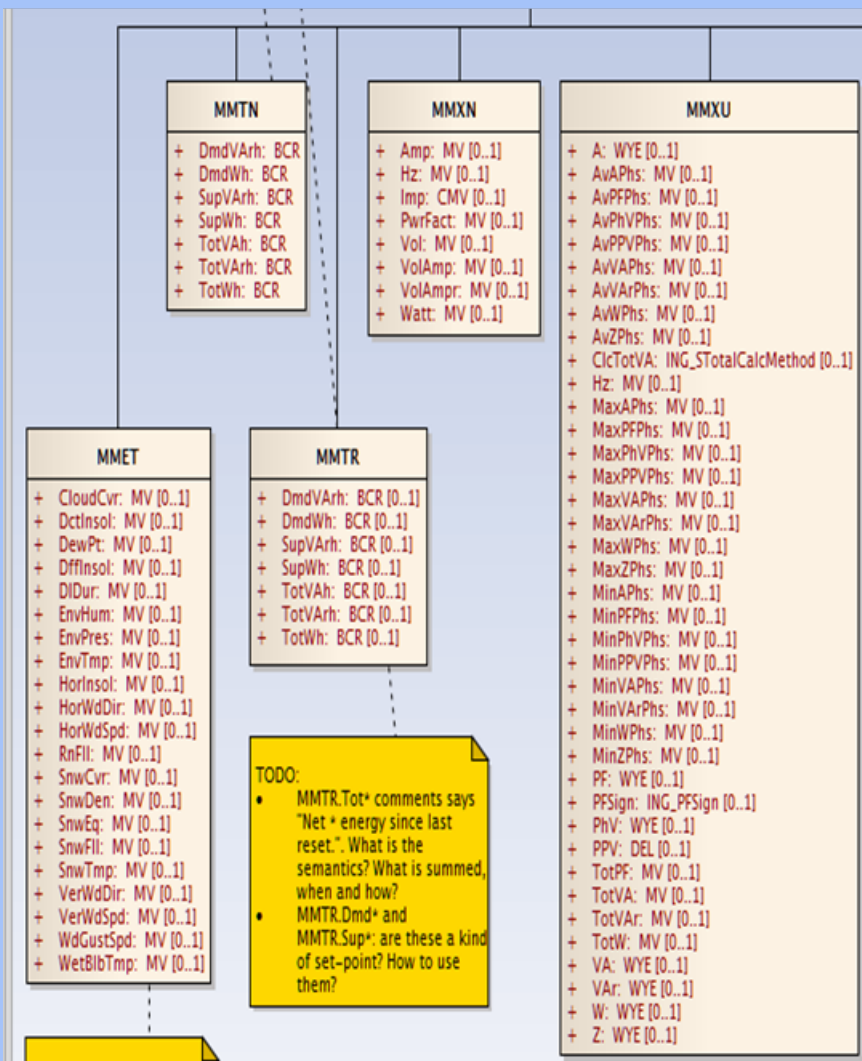
Common Data Classes



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

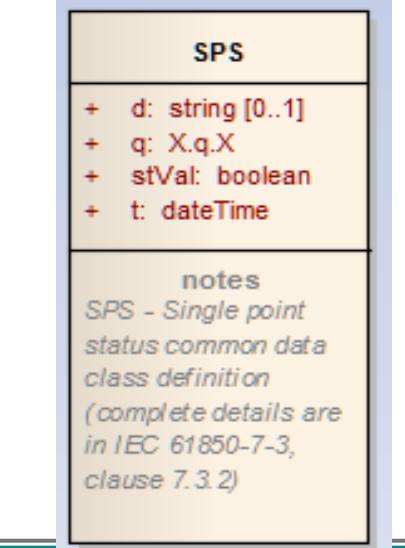
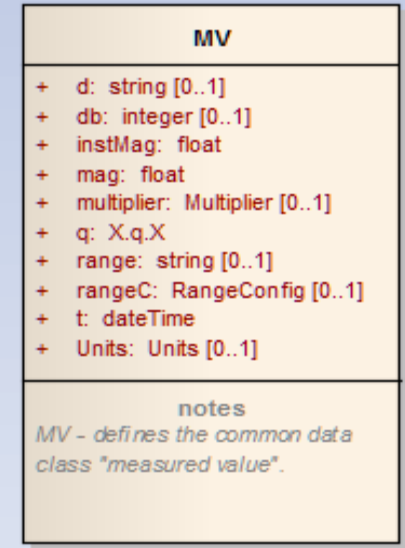
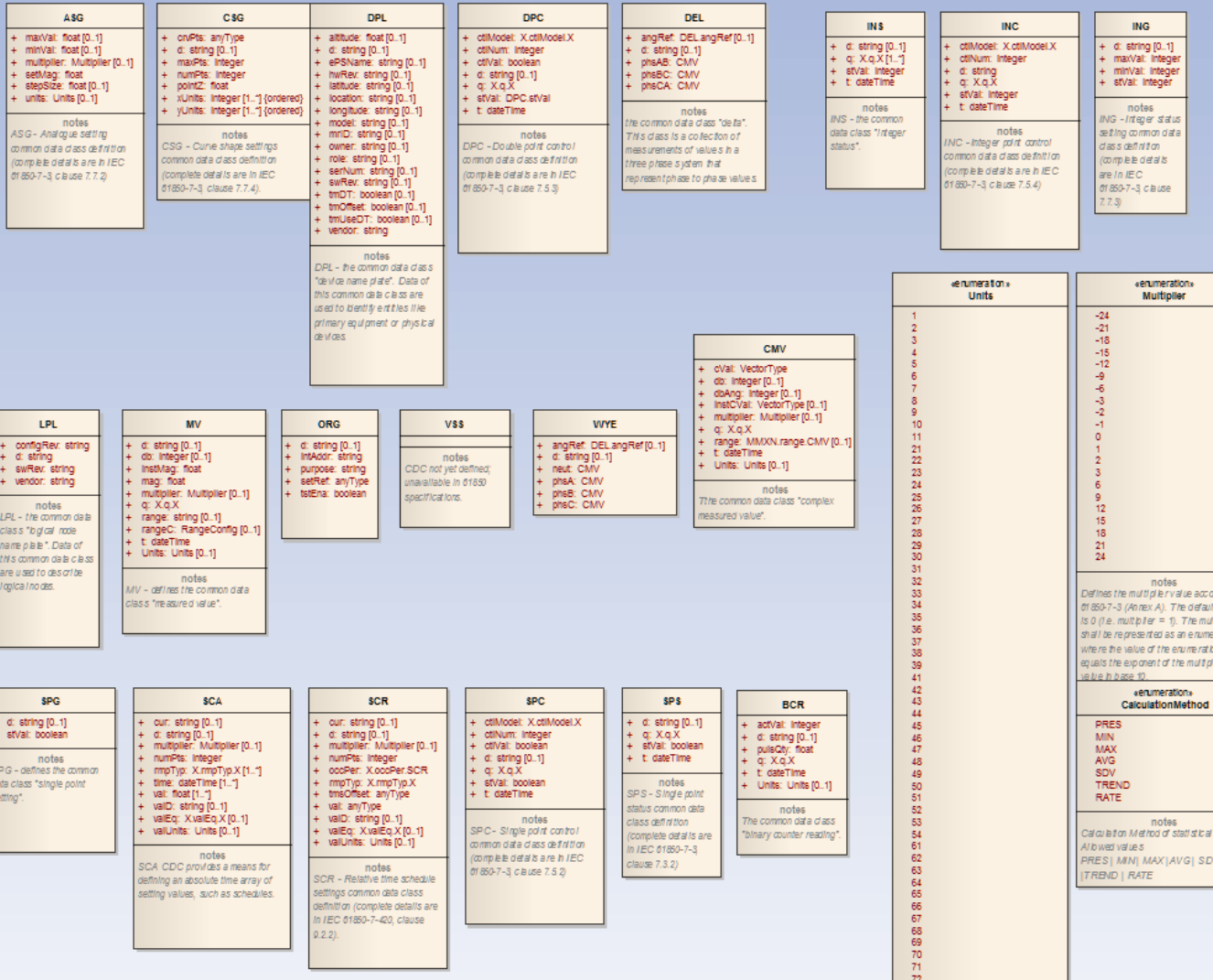


TODO:

- 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

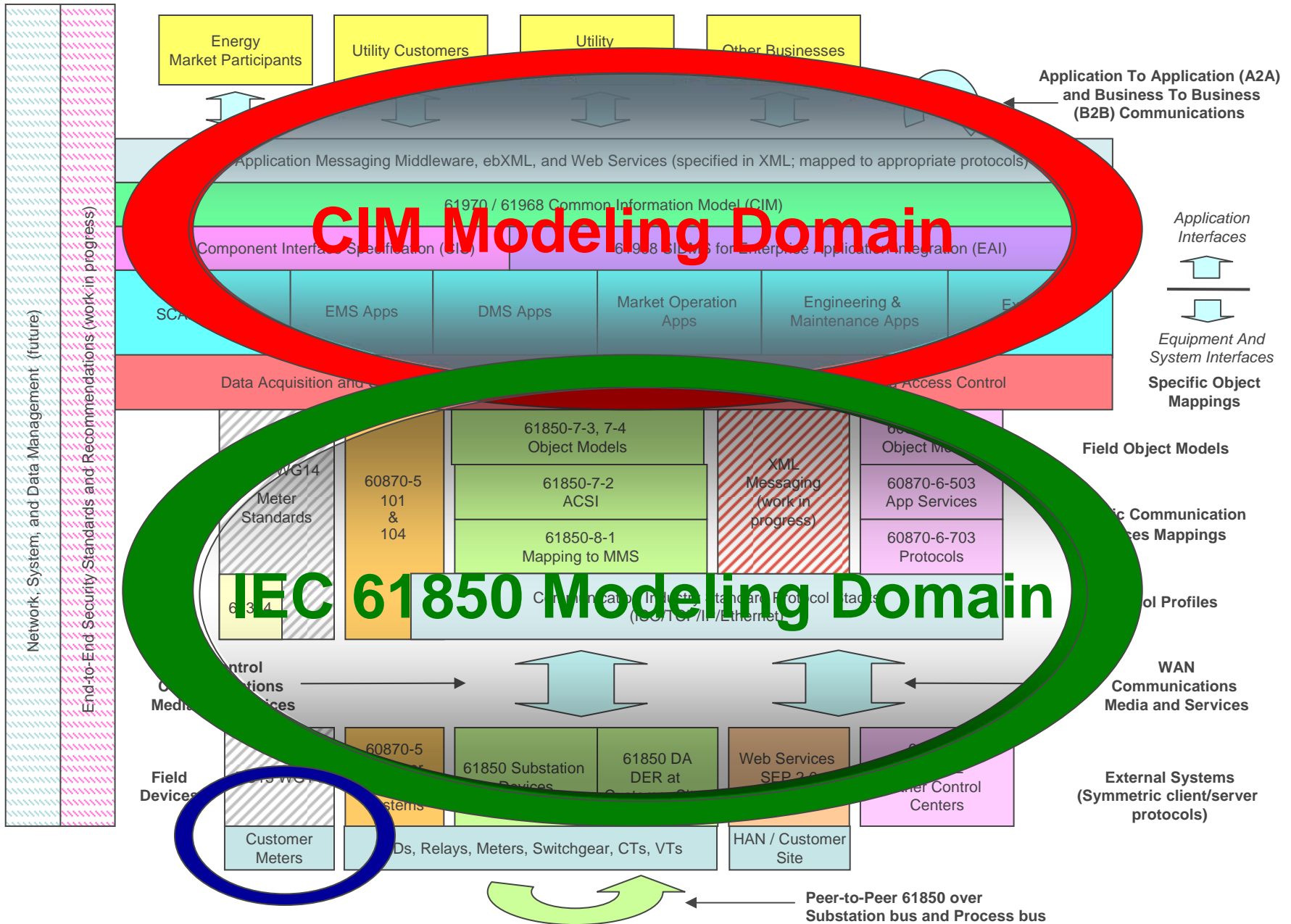
- **Get/Put Data Objects** provides monitoring, controlling, and setting values of individual data elements
- **Get/Put Datasets** provides monitoring, controlling, and setting values of groups of data objects that were established at implementation time or later. Data set values are reported automatically 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 TC57 Reference Architecture – Scope and Layers



1) Solid patterns represent areas that are complete or in progress 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.

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

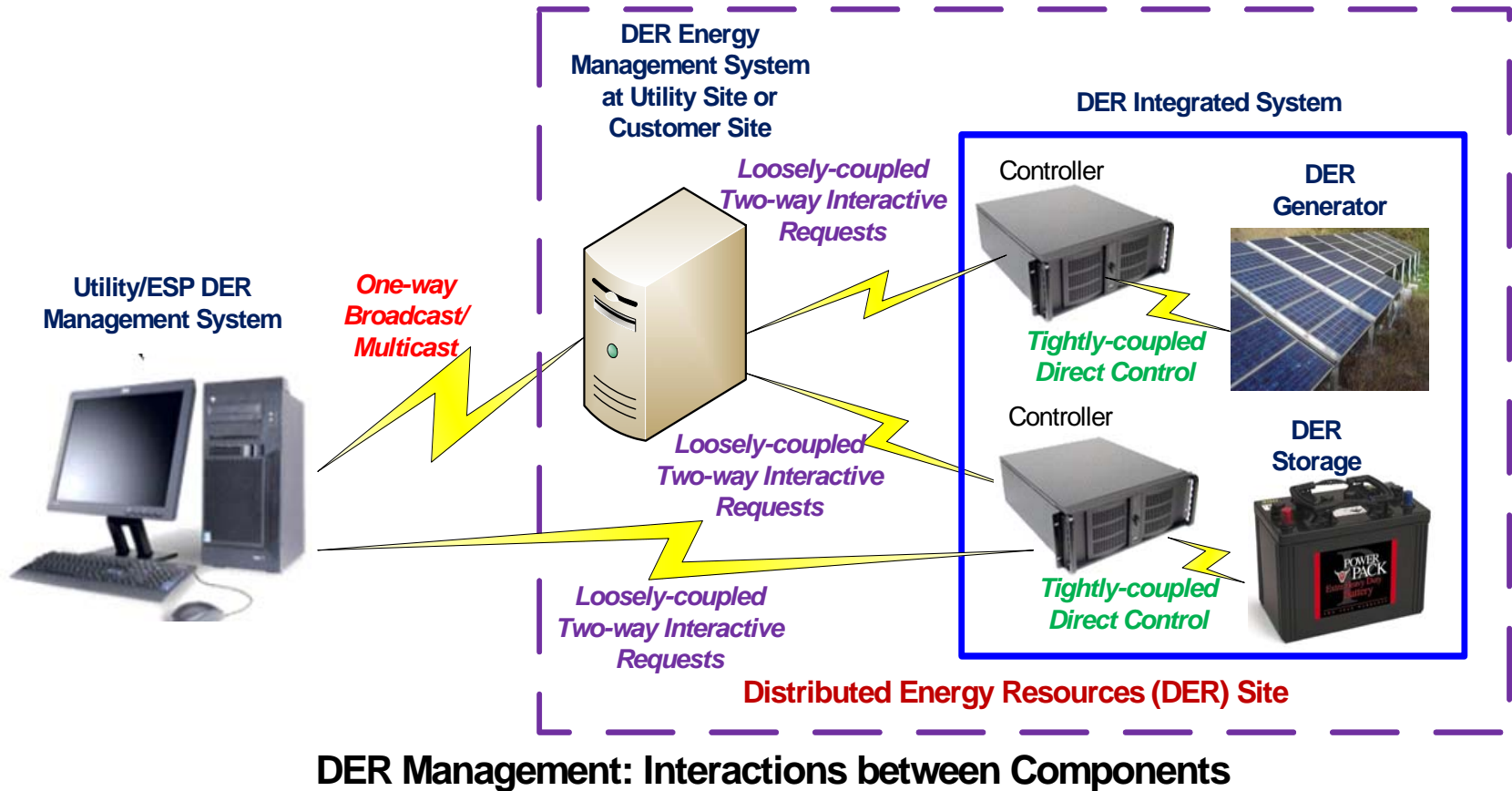


IEC WG17 DER, Storage, and PEV Activities

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

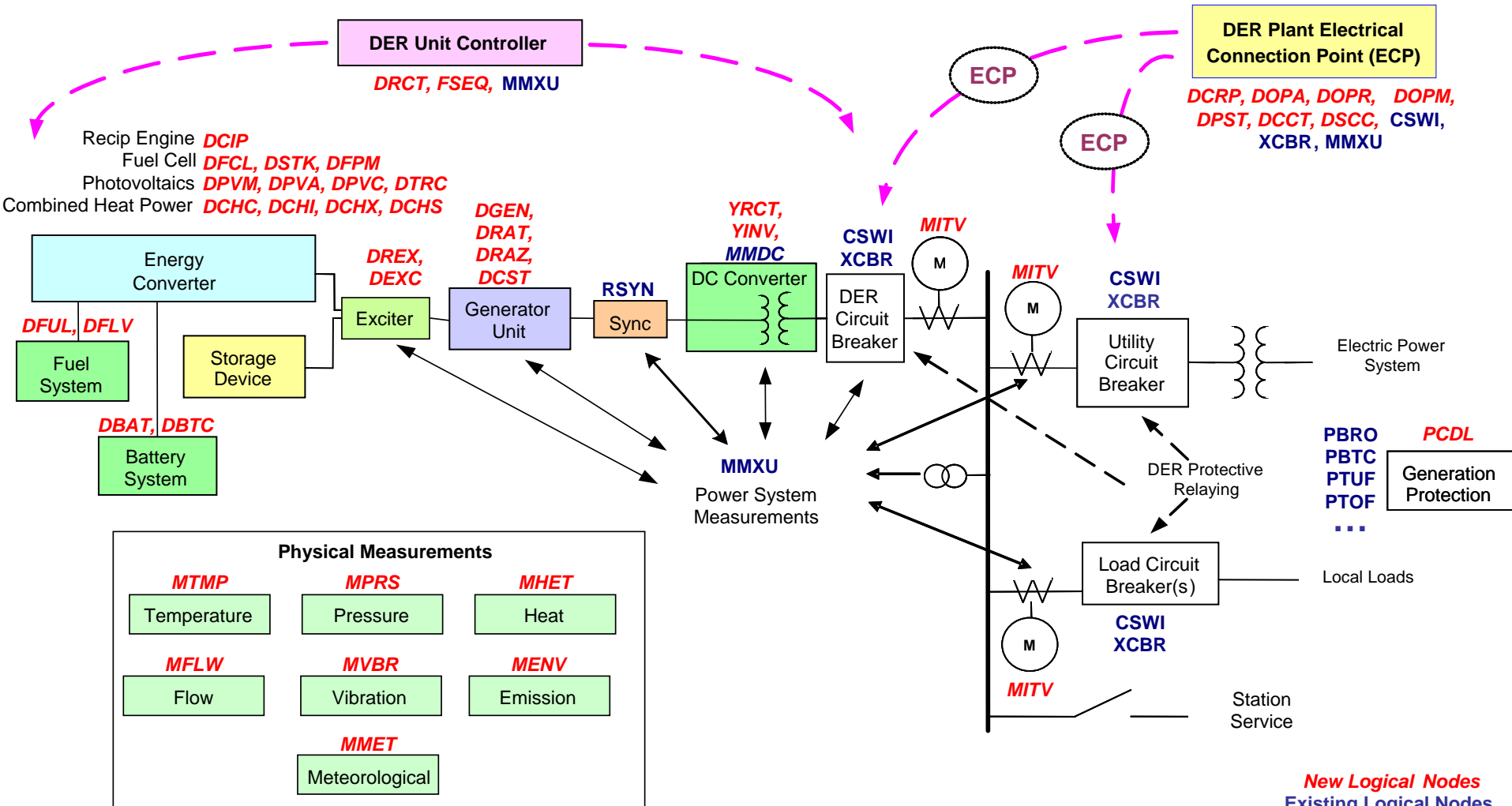
Different DER Interactions: Direct Control, Interactive Requests, Broadcast/Multicast



DER 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



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

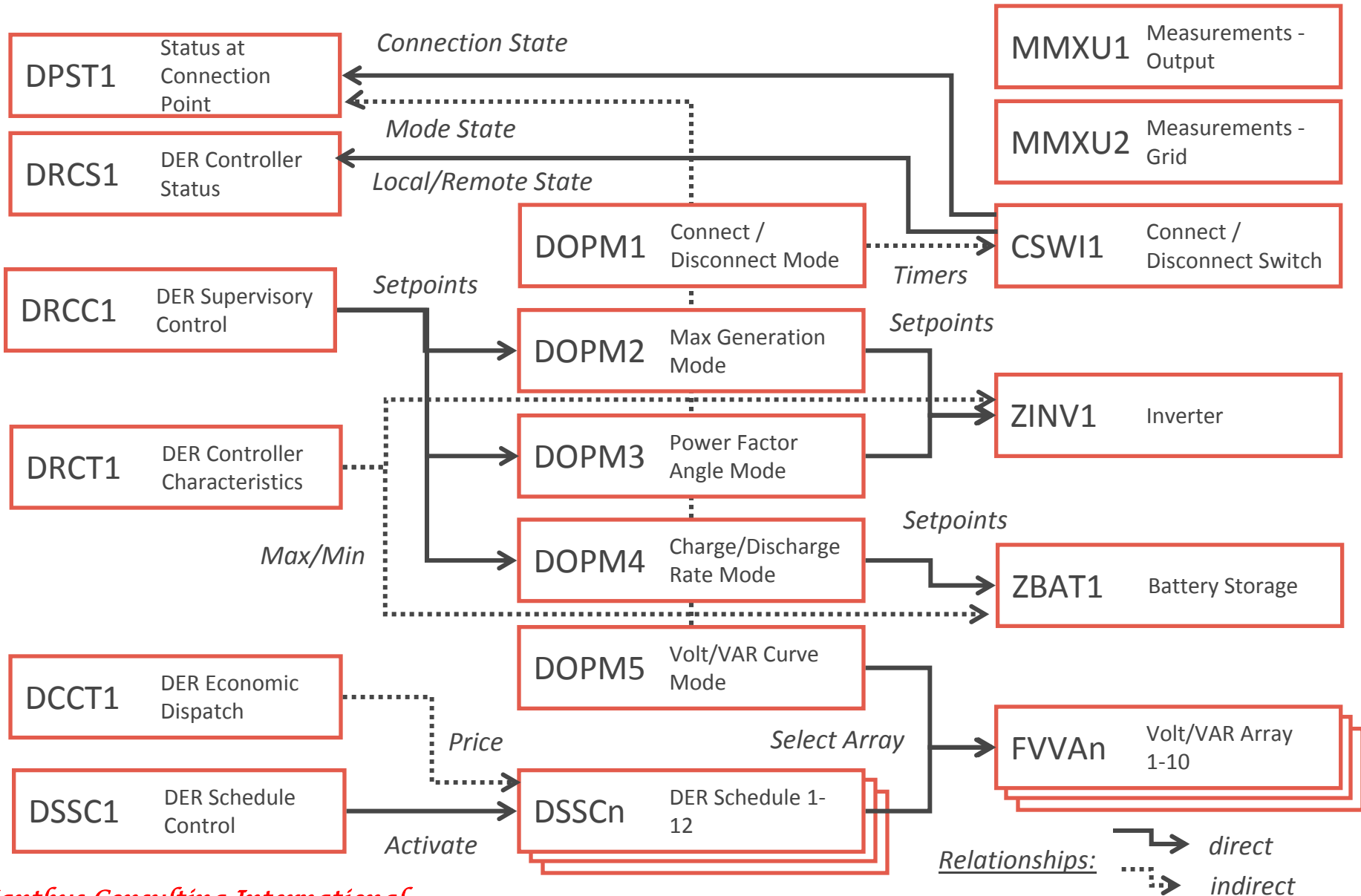
Storage Device = Battery, Pumped Hydro, Superconducting Magnetic Energy Storage, Flywheels, Micro-flywheels

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

New Logical Nodes
Existing Logical Nodes

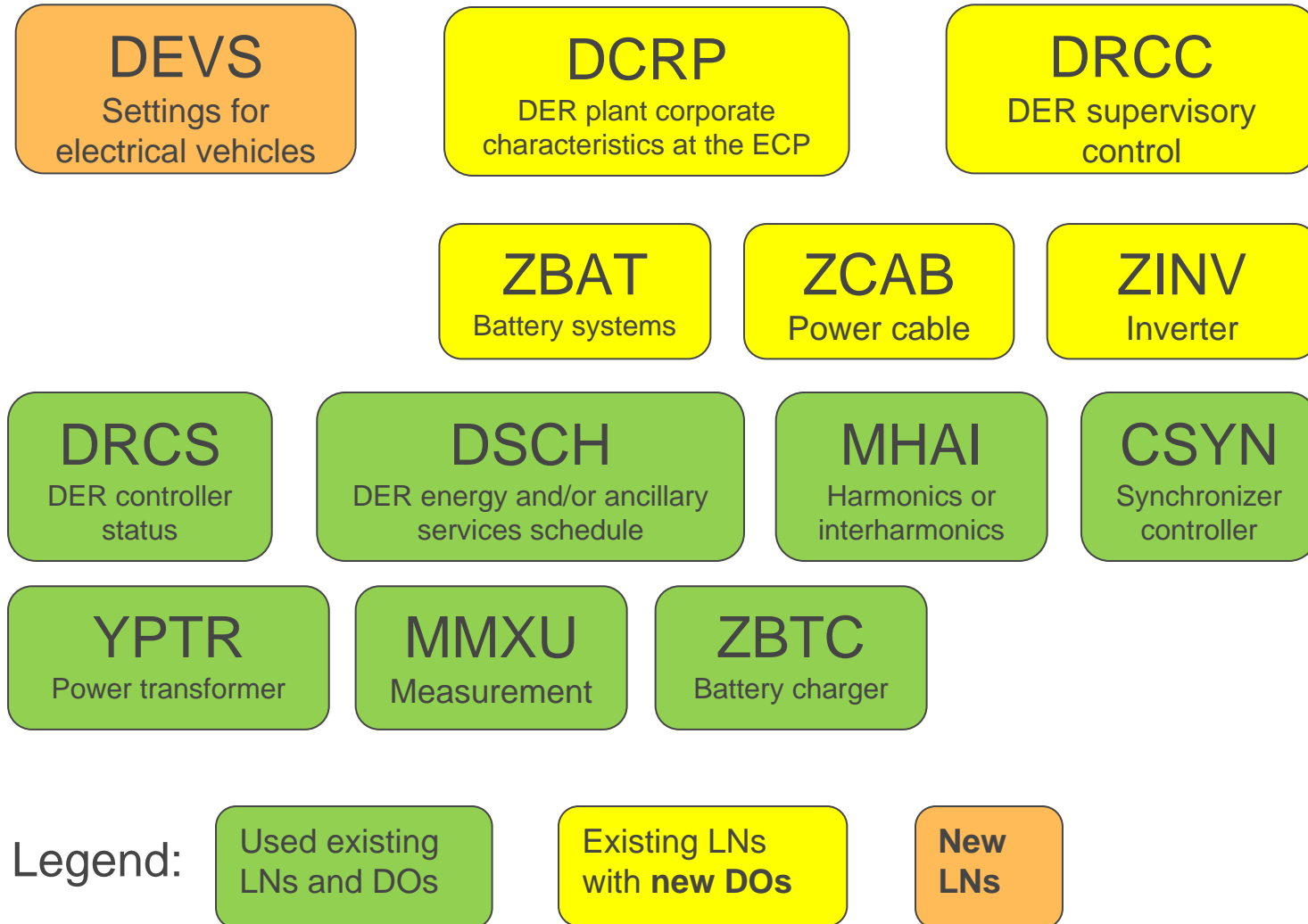
Logical Device

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

Name of Resource:		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??? !!!