

System & Data Modelling with IEC 61850
Modelling of Distributed Energy
Resources (DER) with IEC 61850-7-420

Anders Johnsson, medlem i TC57 WG17

IEC 61850 nätverksträff, 26 oktober 2019



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**Urval av bilder från TC57 WG17.
Stort antal dolda i visningsläge.**

Distributed Energy Resources (DER): DER Definitions, Configurations, and Information Modeling



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Frances Cleveland

2019-09-25

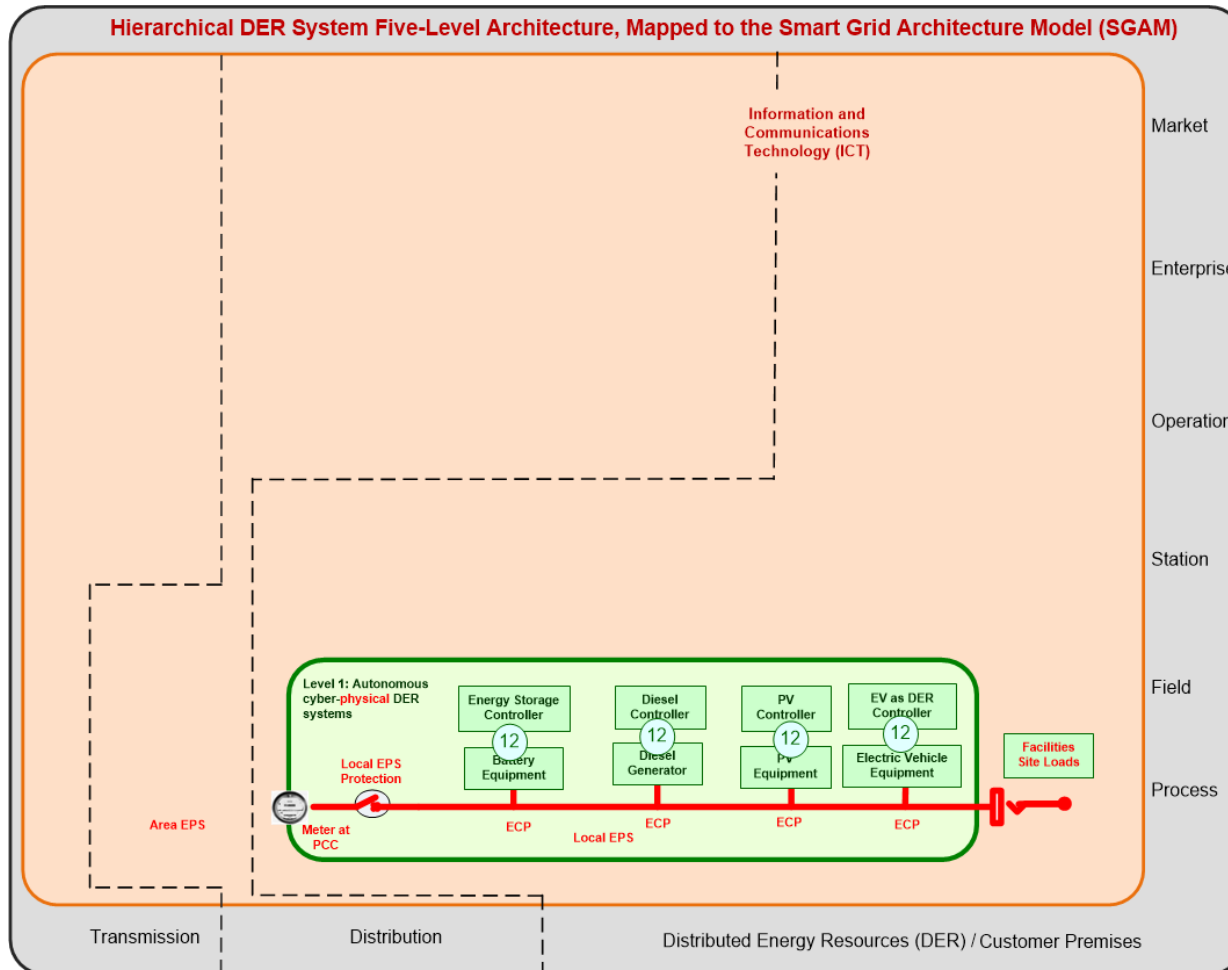


Definition of Distributed Energy Resources (DER)

- Distributed Energy Resources (DER) are generally defined as “**generation, storage, and controllable load** interconnected at the low or medium voltage distribution level”
 - *Note 1: DER may include associated protection, control, and monitoring capabilities, and may consist of aggregated DER units.*
 - *Note 2: DER may interact with the area and/or local electric power systems (EPS) by providing energy through the EPSs, by adapting their behaviour based on EPS conditions, and/or by providing other EPS-related services for regulatory, contractual, or market reasons.*
- DER may have prime movers (sources of energy) that are:
 - Purely renewable (solar, wind, hydro, geothermal) that rely directly on natural resources
 - Indirectly renewable (fuel cells, biomass such as methane, vegetable oil)
 - Energy storage (batteries, capacitors, flywheels, air compressors, electric vehicles)
 - Fossil fuel (diesel generators, gas turbines, microturbines)
 - Controllable load (air conditioners, water heaters, pumps, thermostats, energy storage when “charging”, etc.)

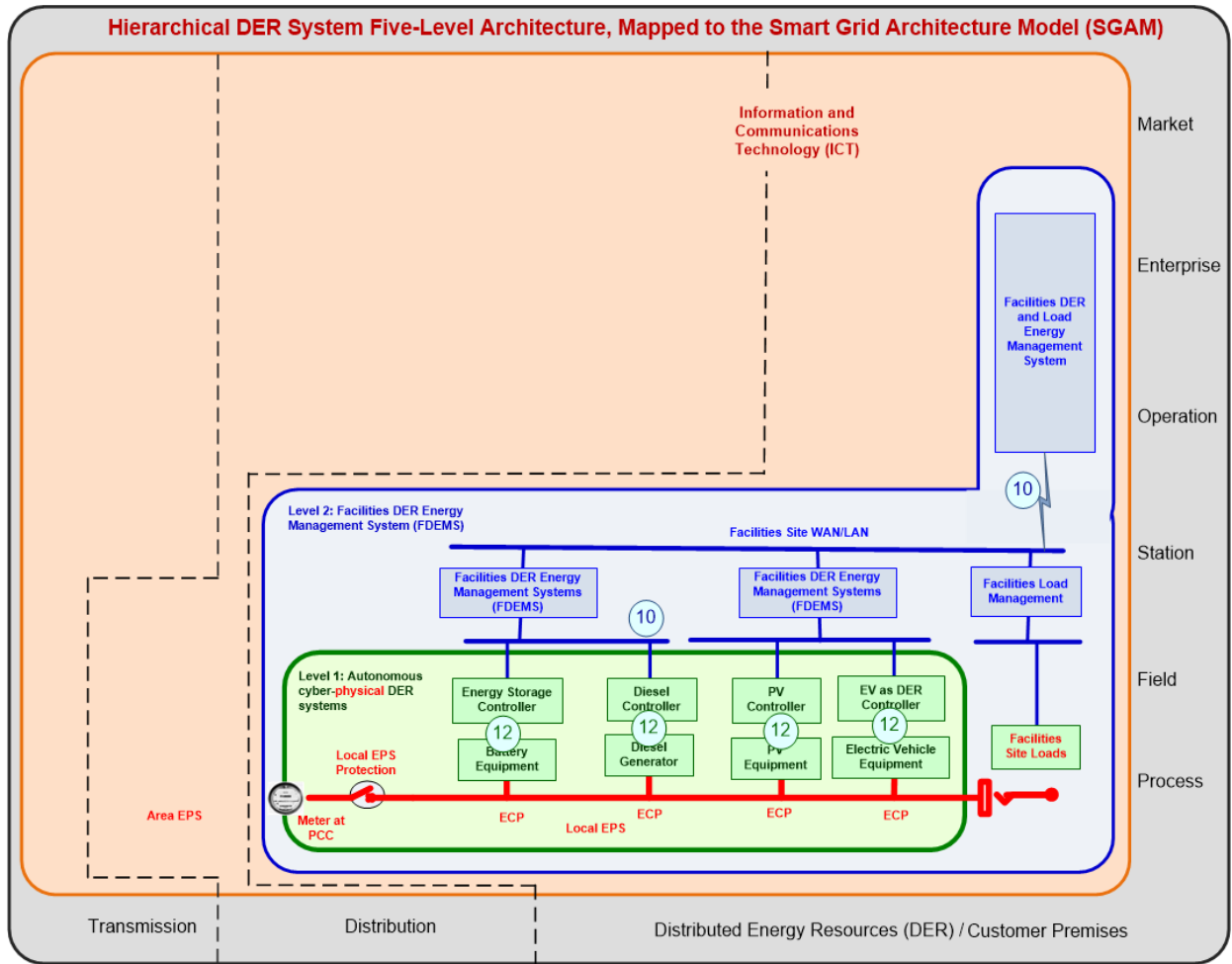


Hierarchical DER System 5-level Architecture, Level 1: DERs connected to local Electric Power System (EPS) – including “controllable” load!



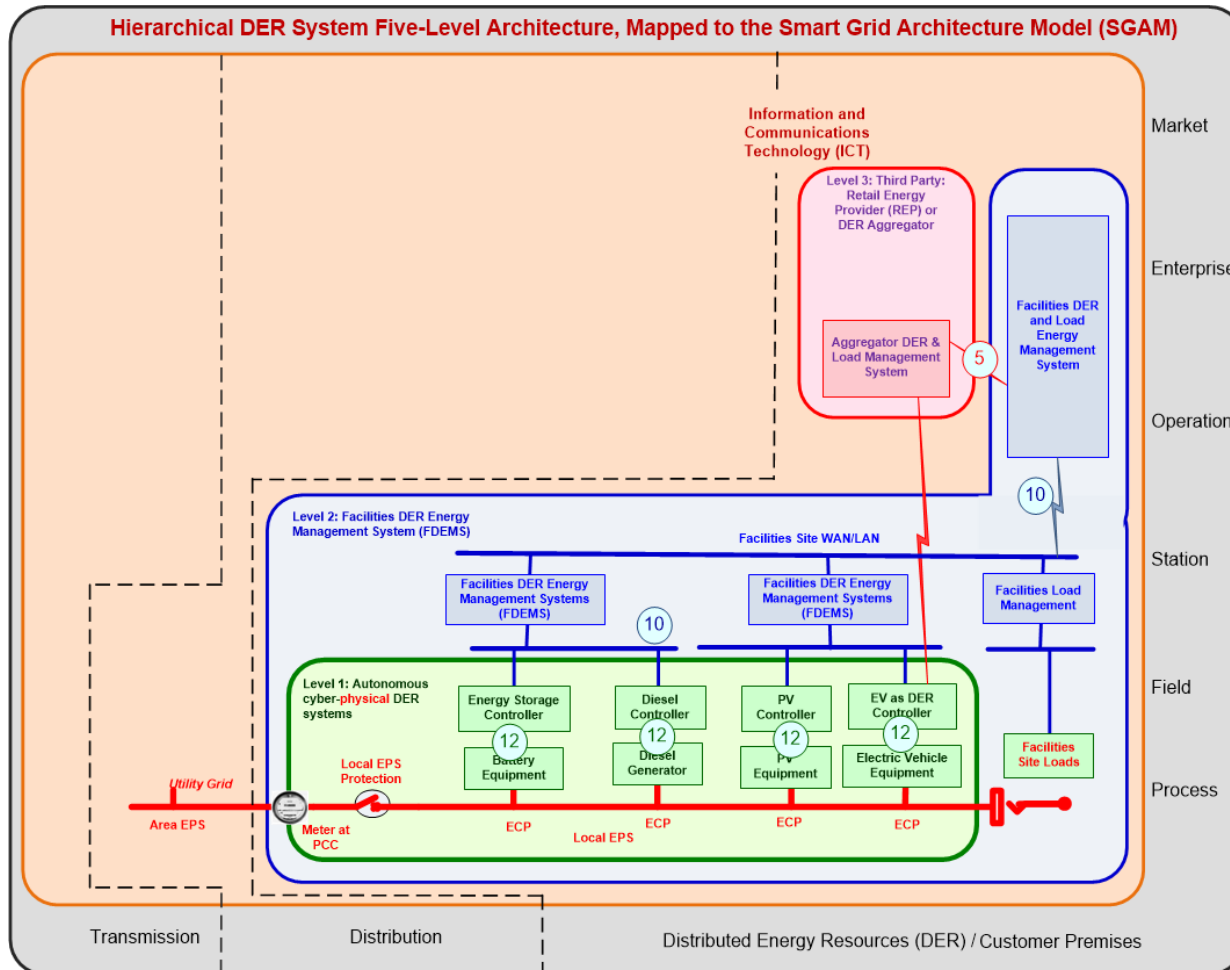


Hierarchical DER System 5-level Architecture, Level 2: Facility or Power Plant, with Energy Management System (FDEMS)



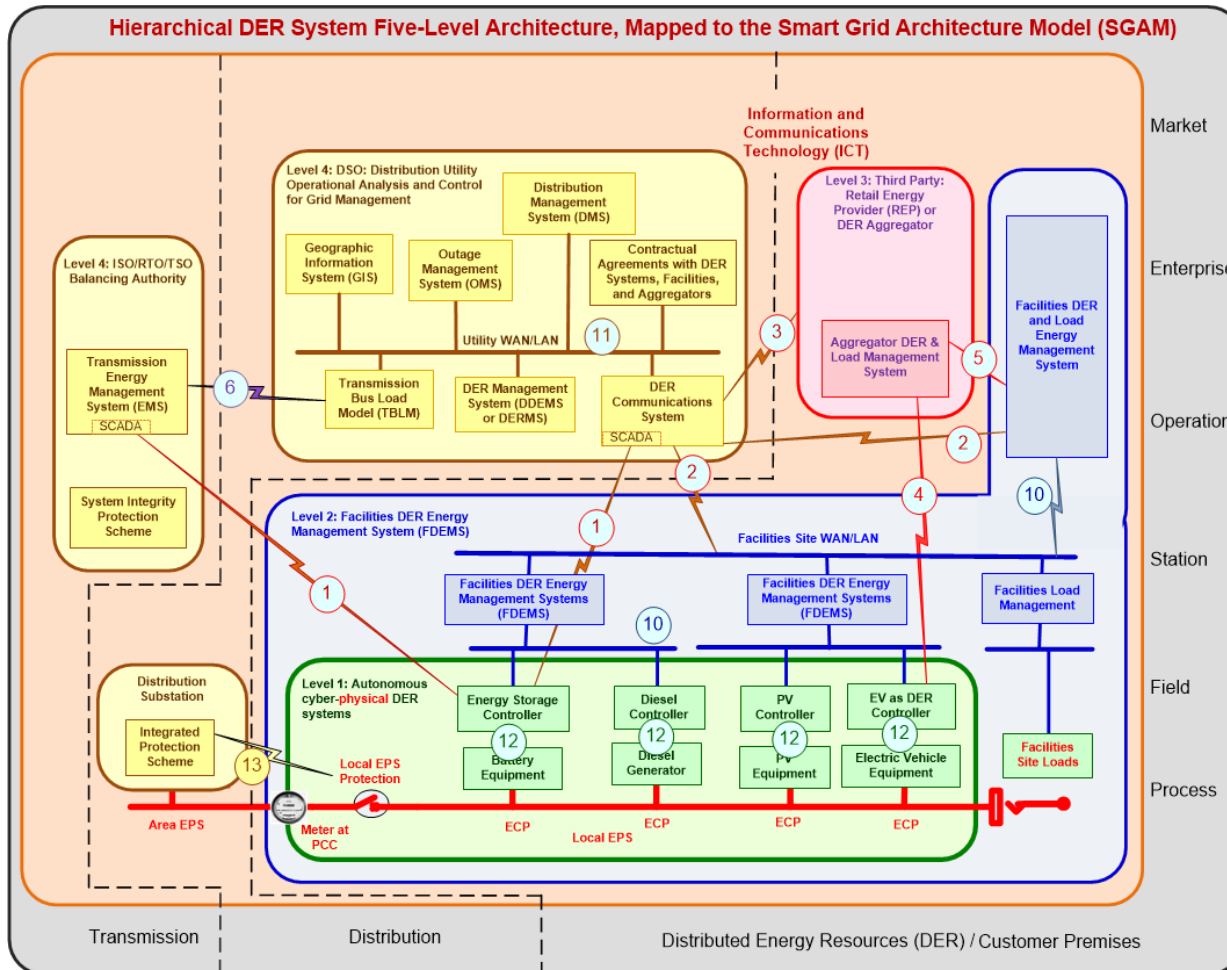


Hierarchical DER System 5-level Architecture, Level 3: Aggregators Communicating with their DERs and Facilities



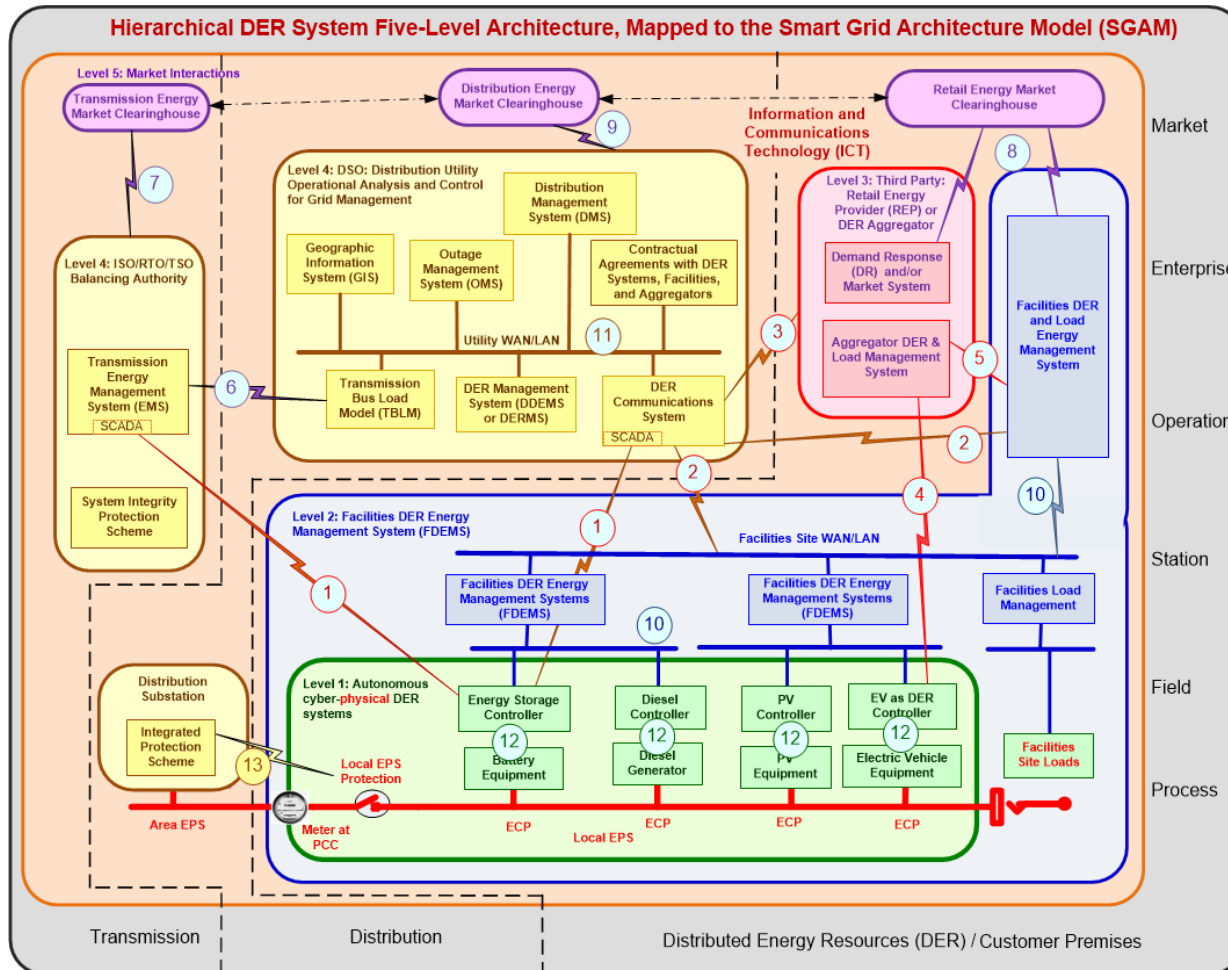


Hierarchical DER System 5-level Architecture, Level 4: Distribution and Transmission Utilities Interacting with DERs and Facilities



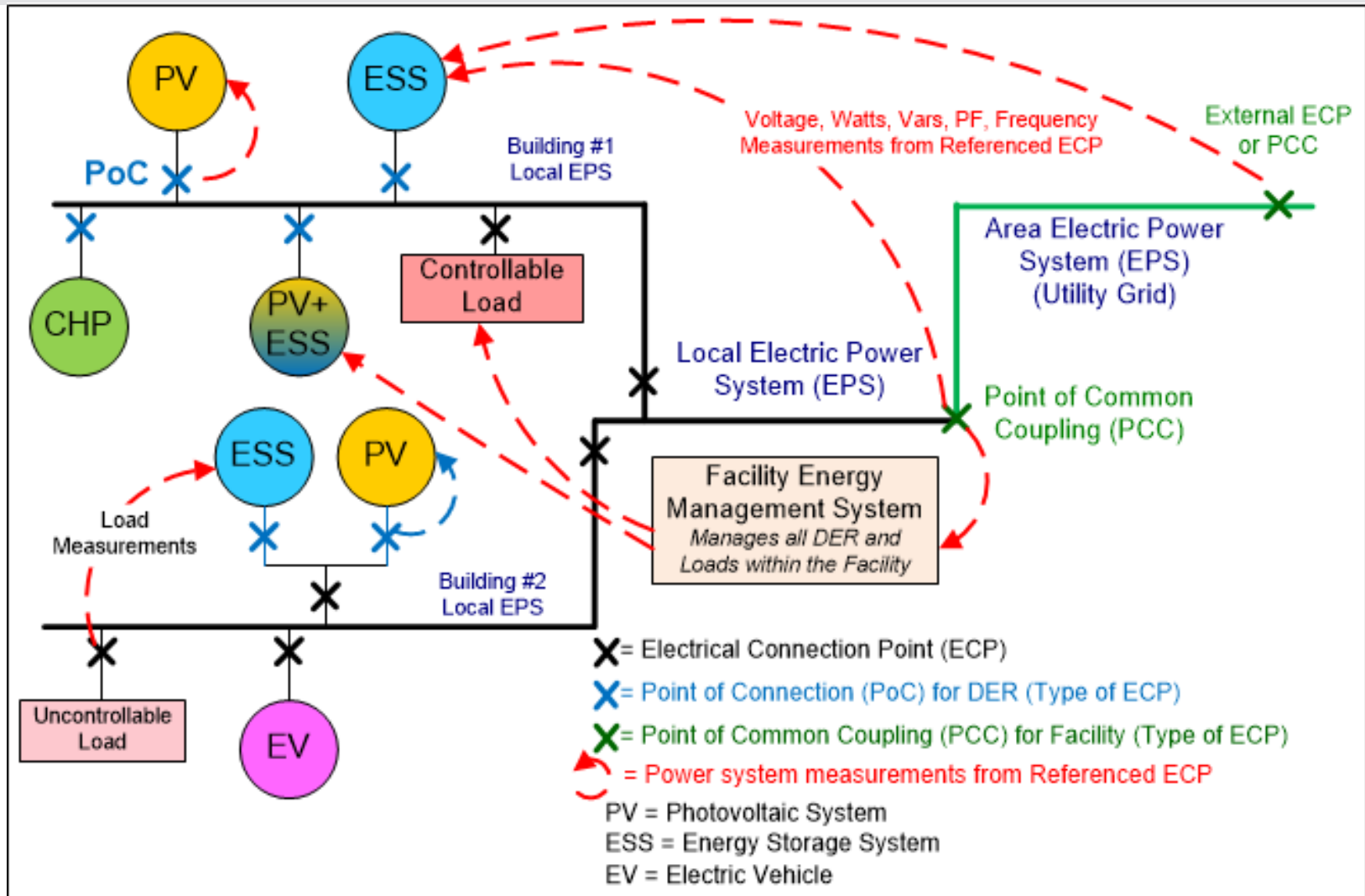


Hierarchical DER System 5-level Architecture, Level 5: Market Interactions: Energy Market, Ancillary Services, Demand Response



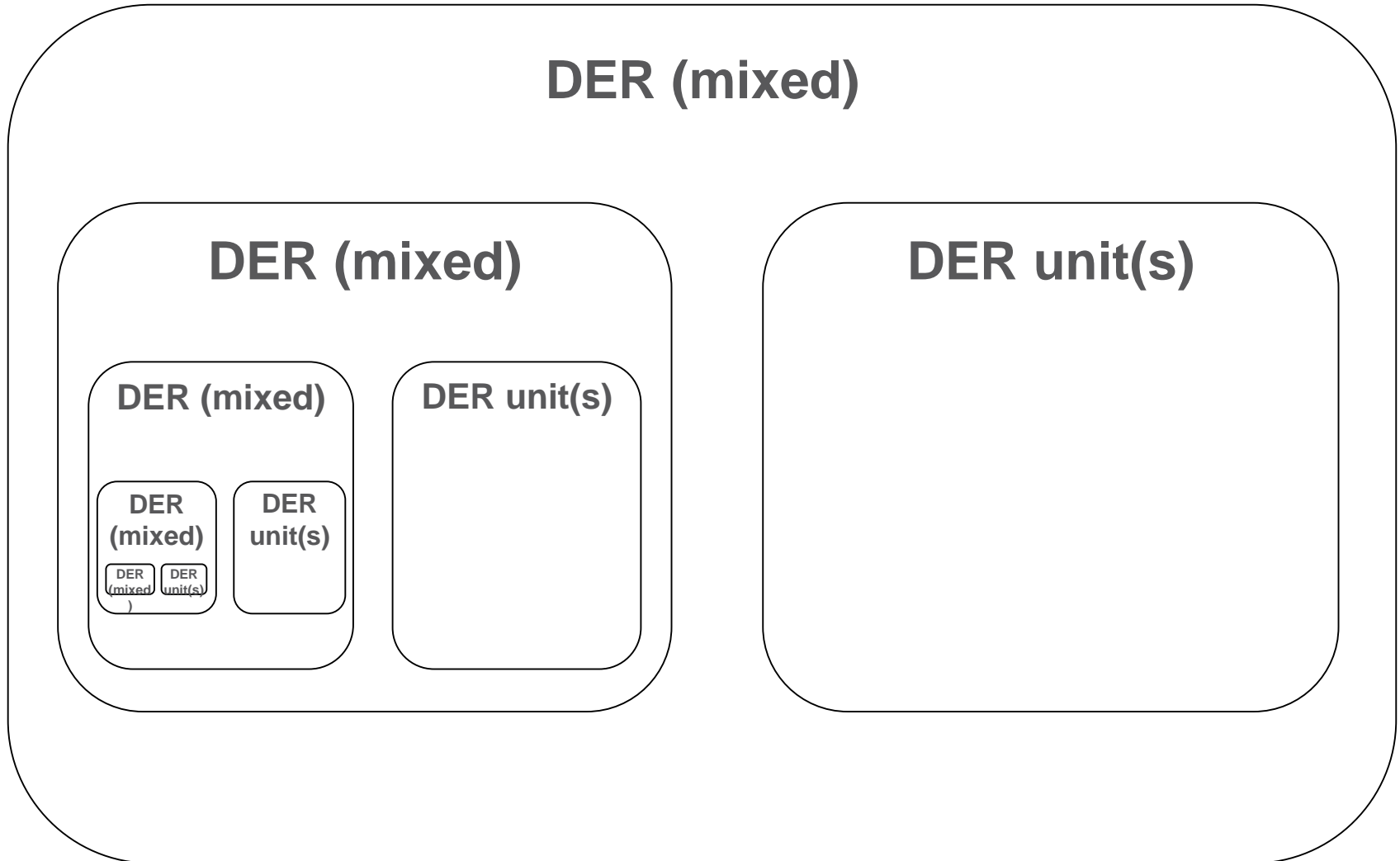


Concept of Electrical Connection Points (ECP) and the “Referenced ECP” for many Modes





The term “DER” is recursive. It can consist of a single DER unit, an aggregation of DER units, and/or a DER plant of mixed DER types





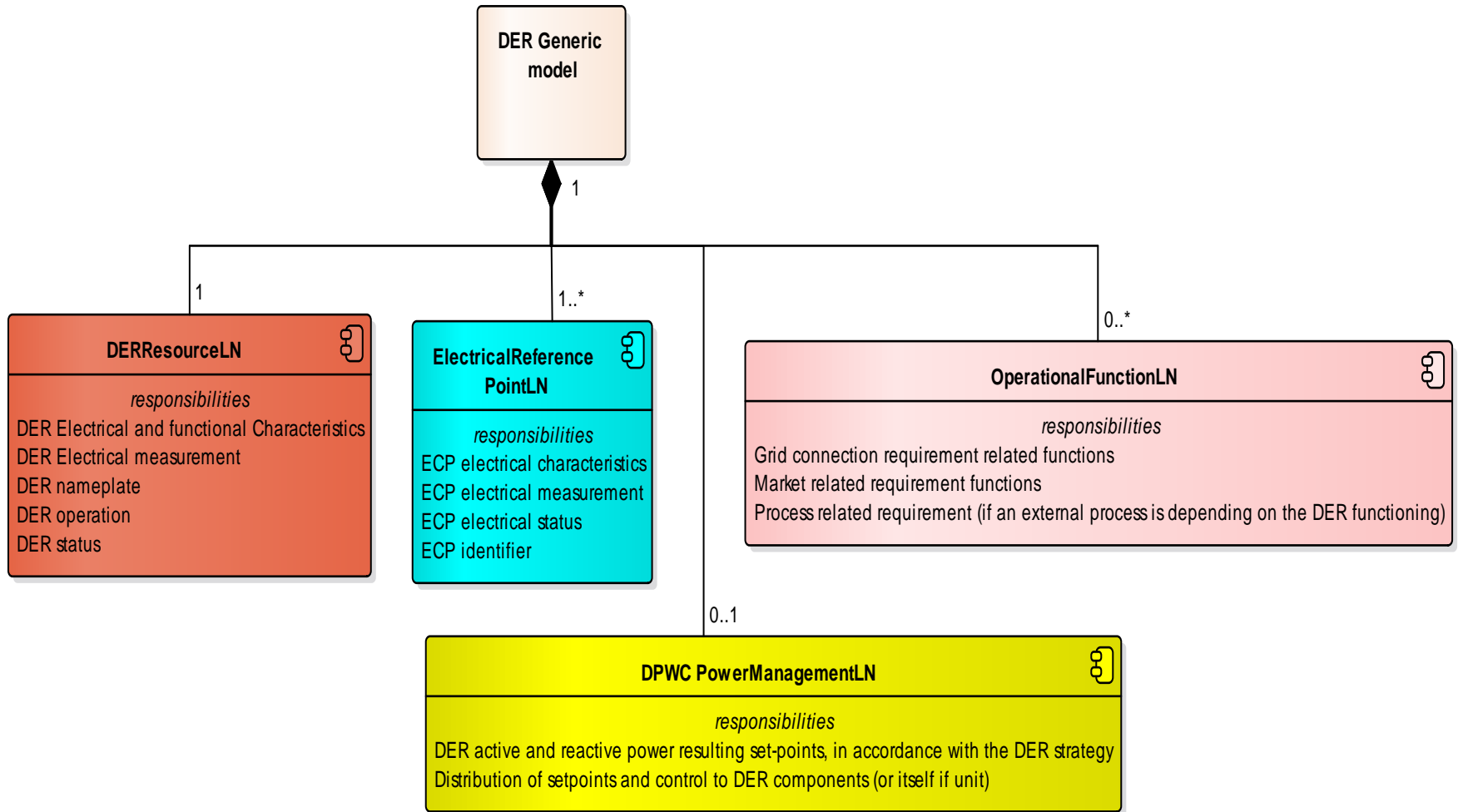
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IEC 61850-7-420 High Level Information Model



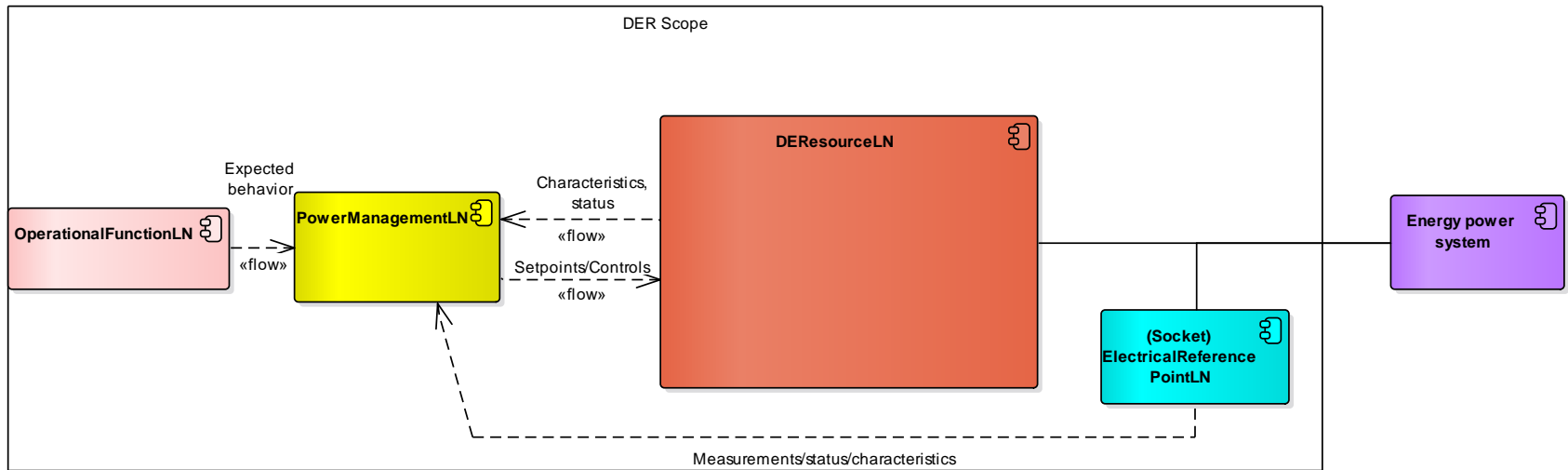
DER Generic model summary

class DER Generic model



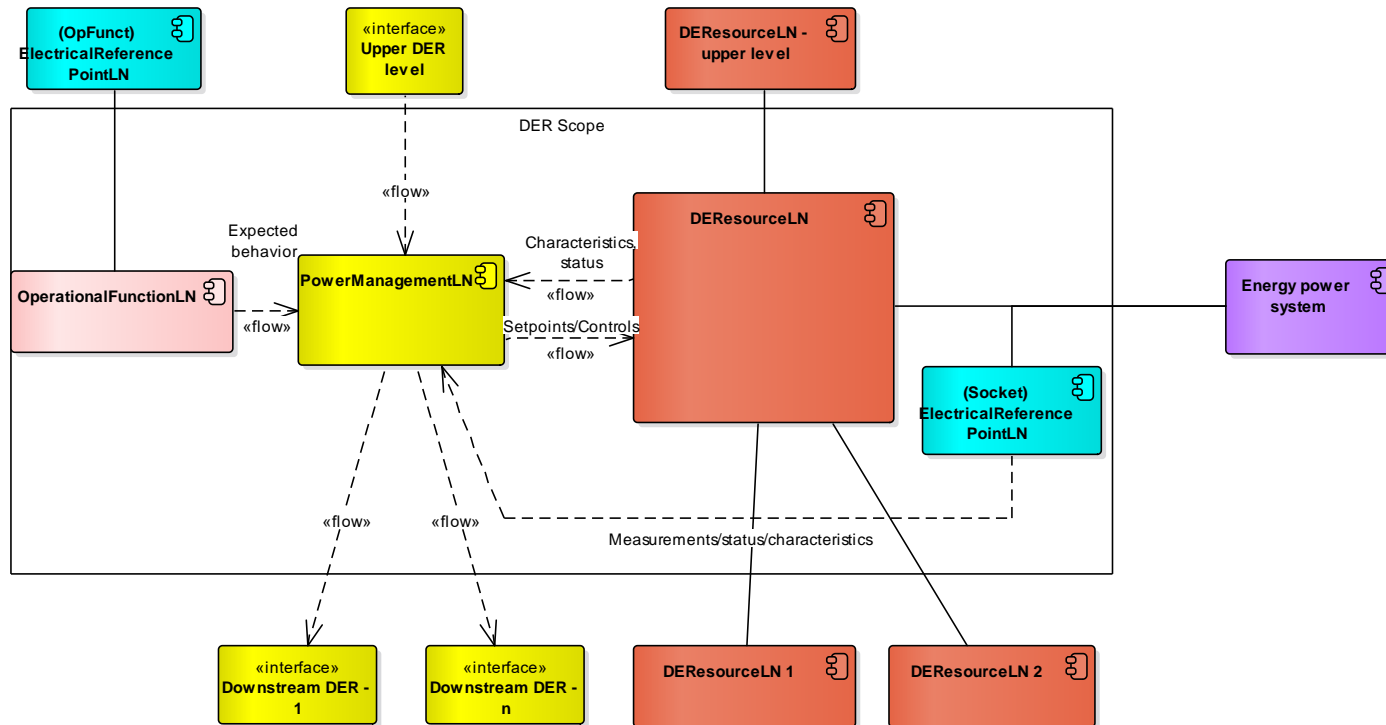


DER component typical interactions (single level)



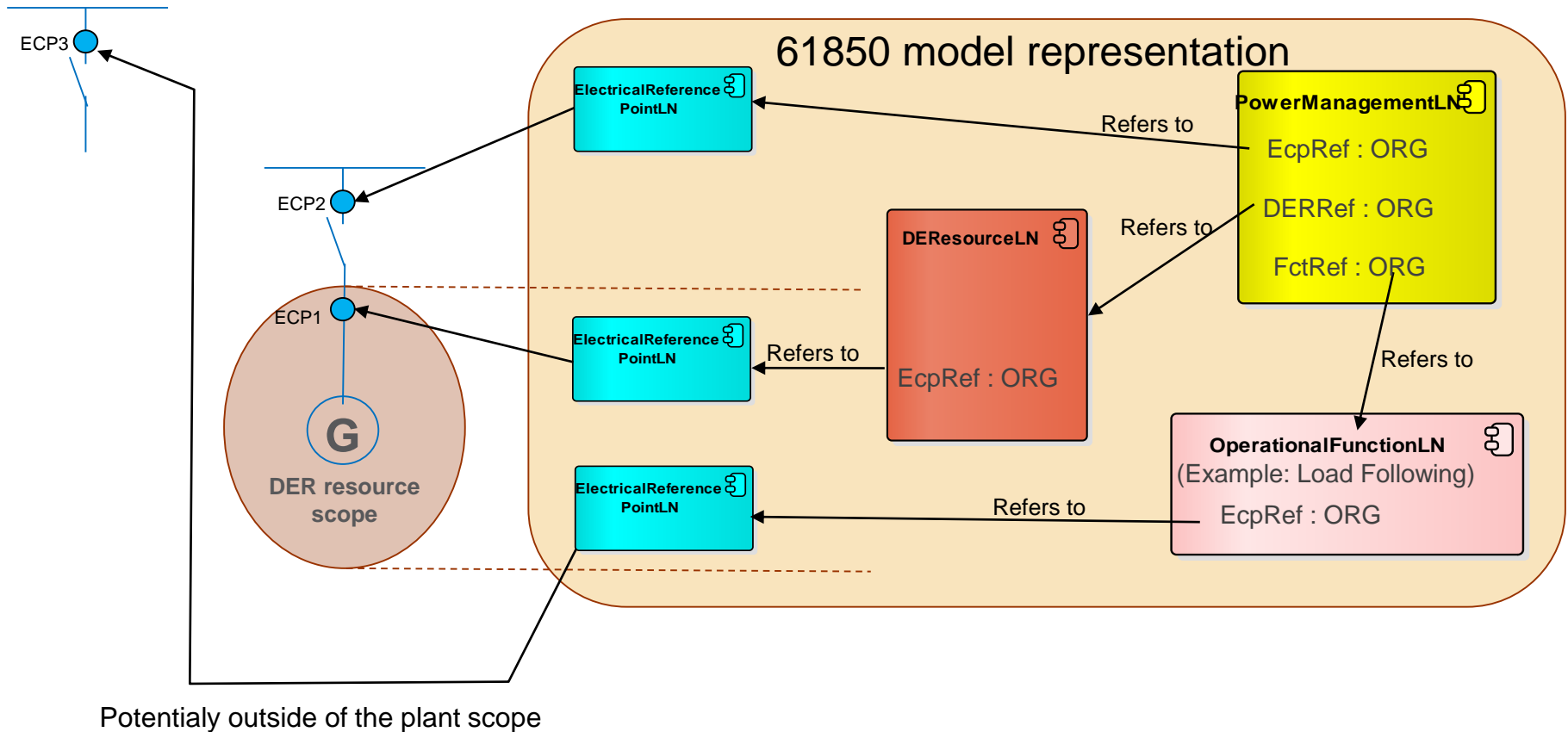


DER component typical interactions (multiple levels)



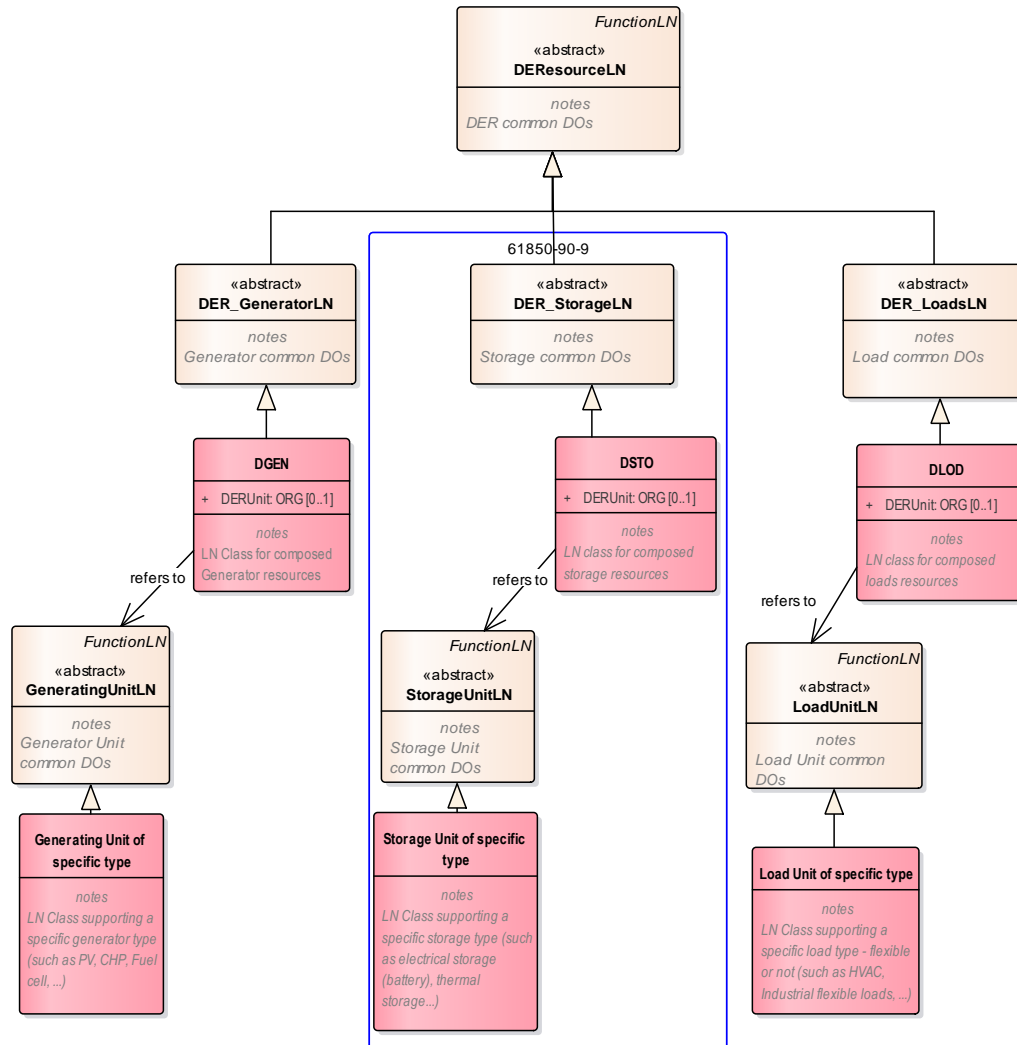


Typical DER resources relationships



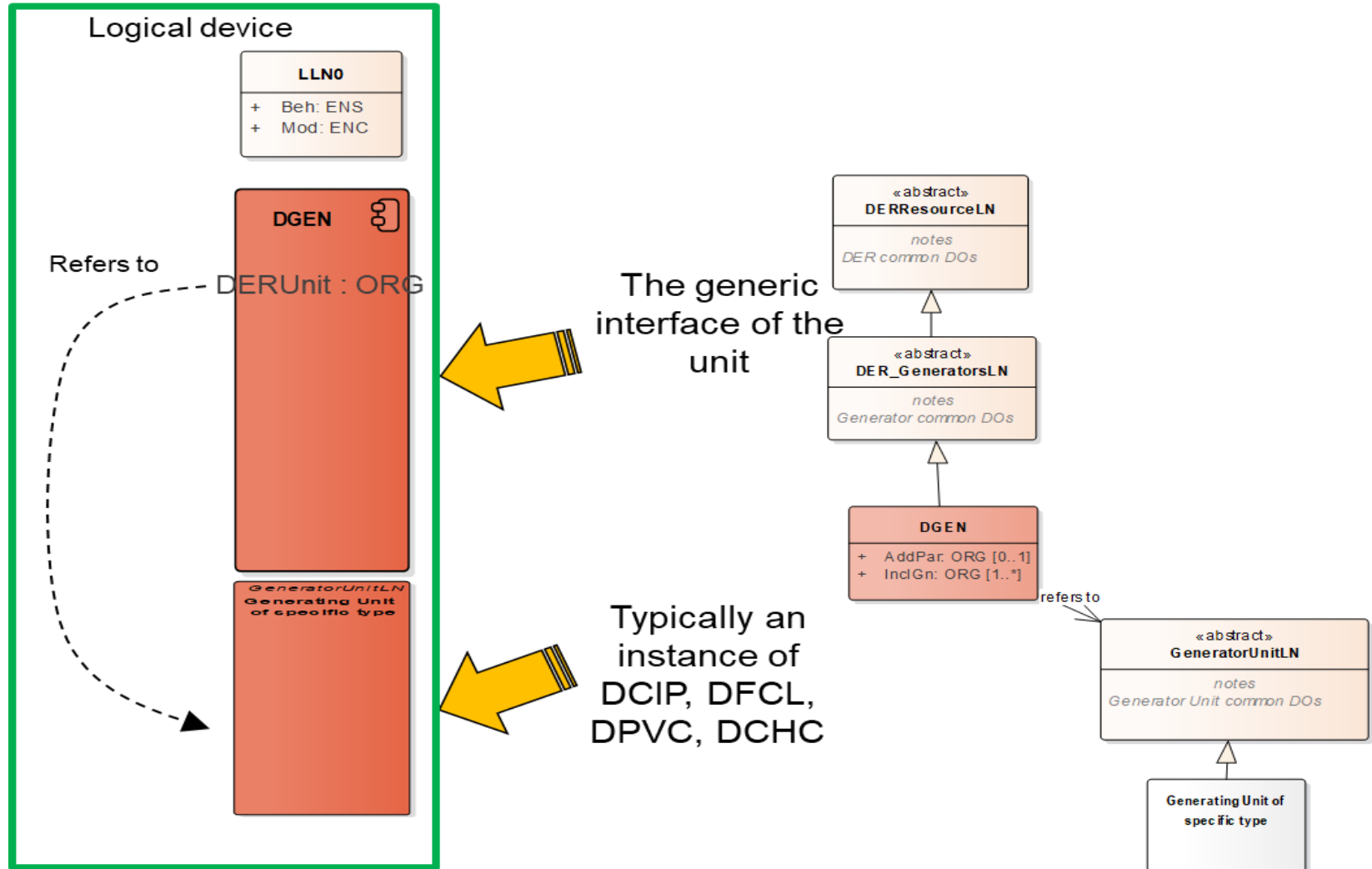


Supporting generation, storage and load

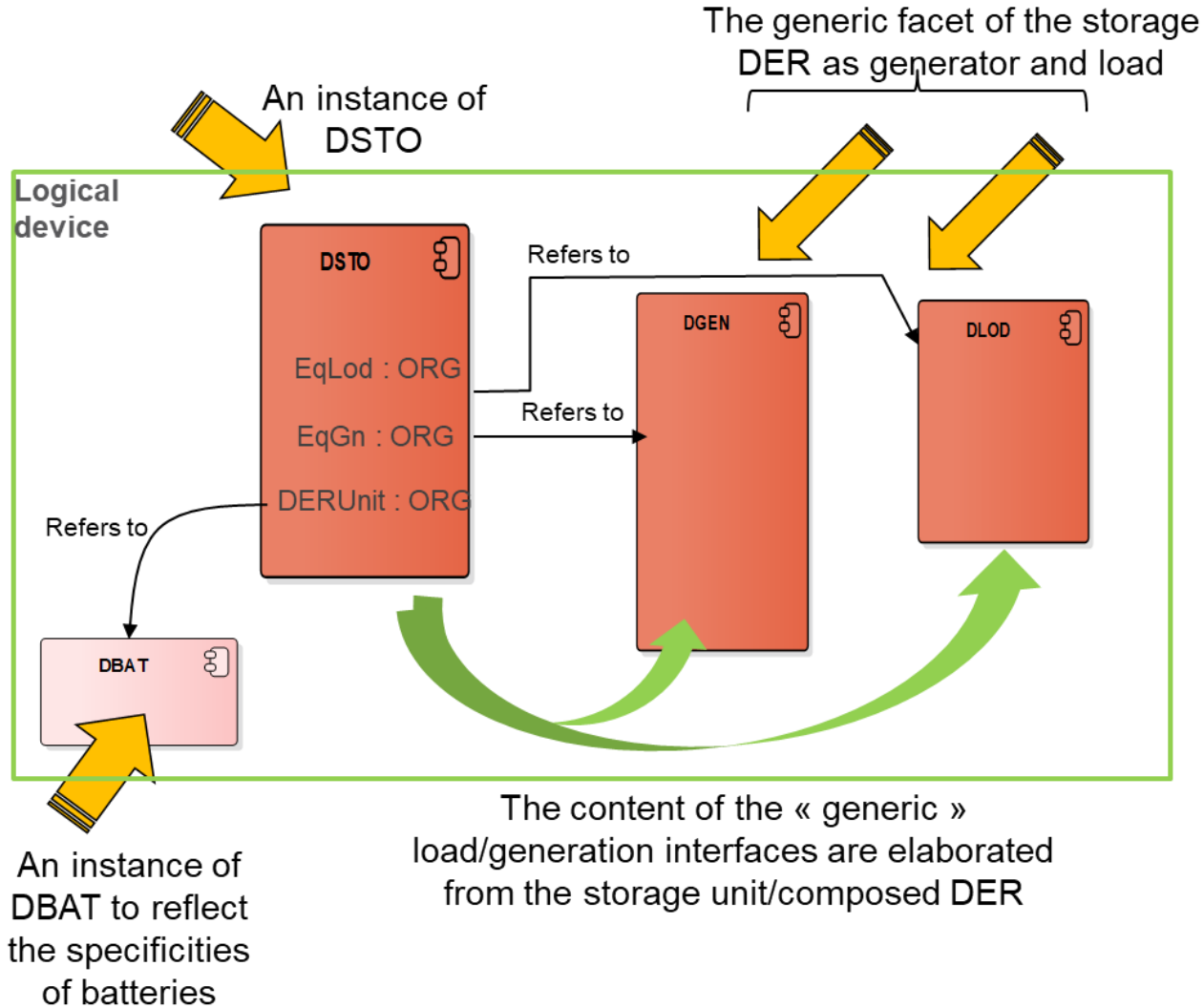




Exposing the generic interface of a DER unit –case for generator

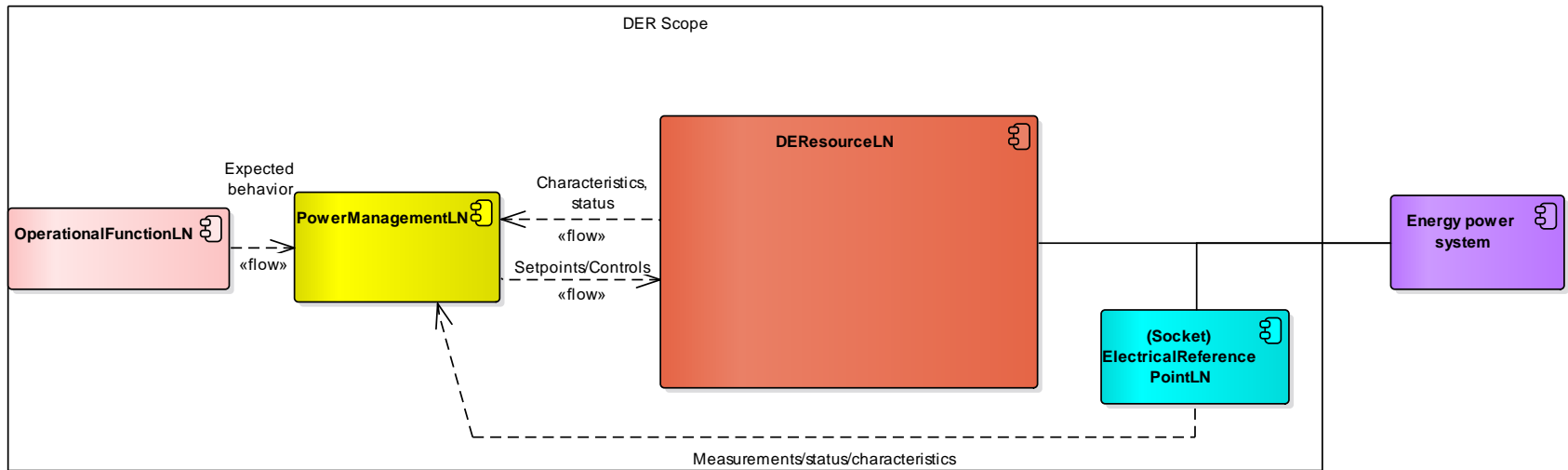


Exposing the load/generation generic interface of a storage DER



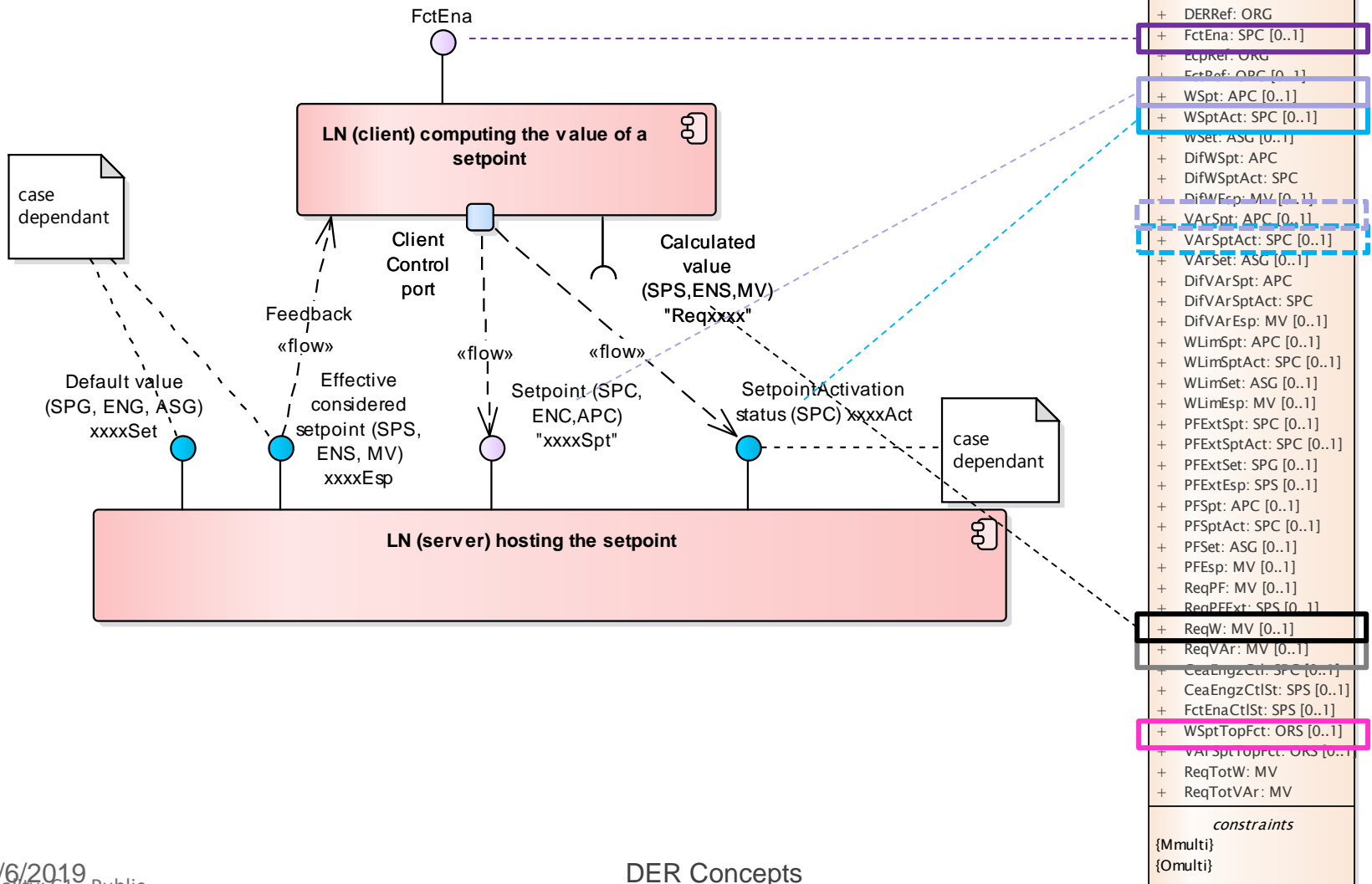


DER component typical interactions (single level)



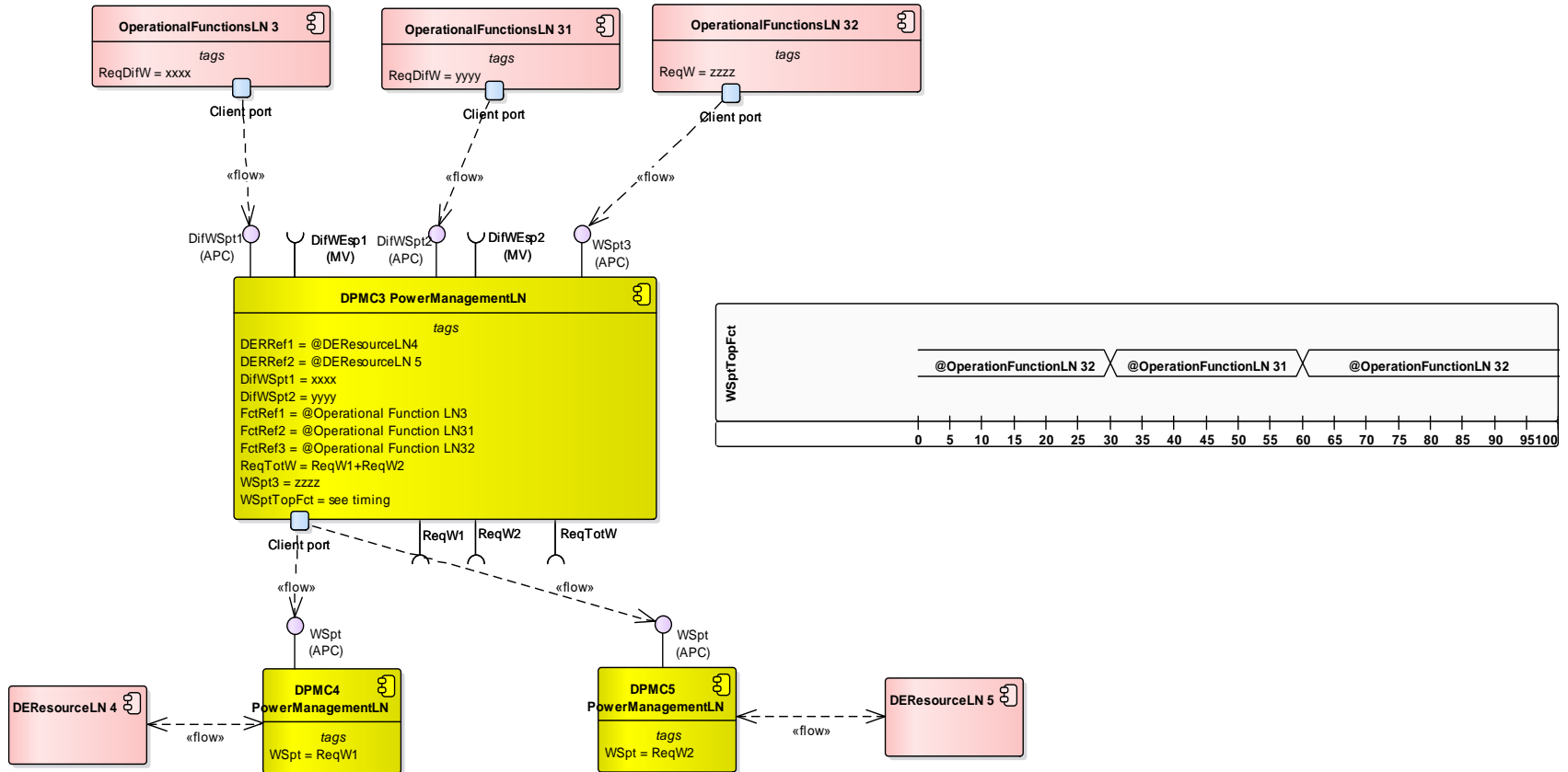


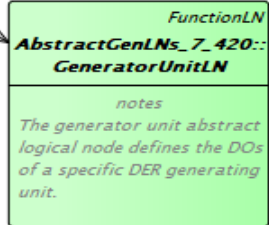
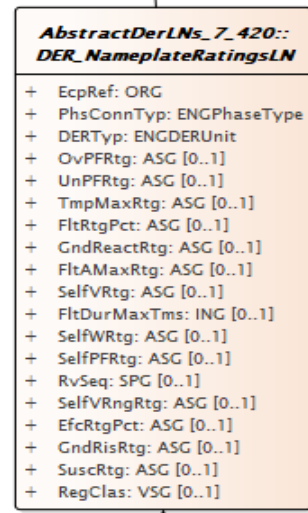
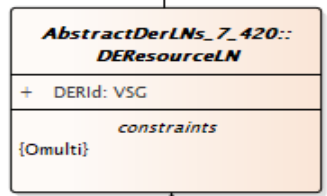
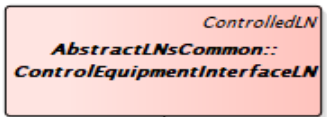
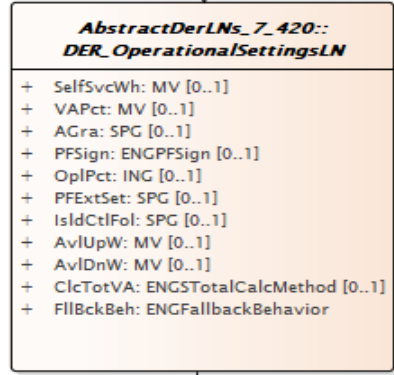
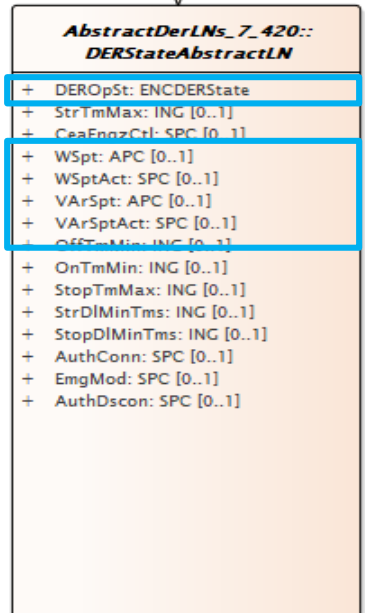
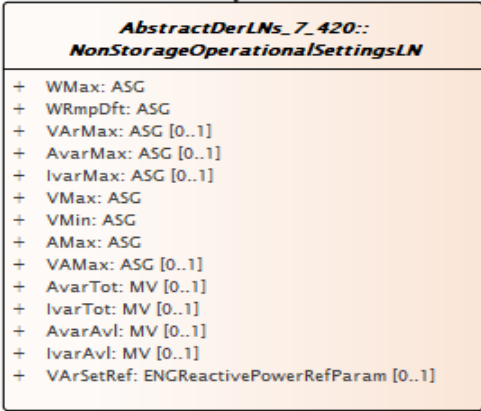
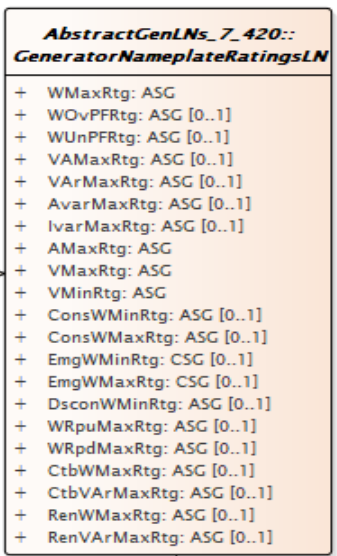
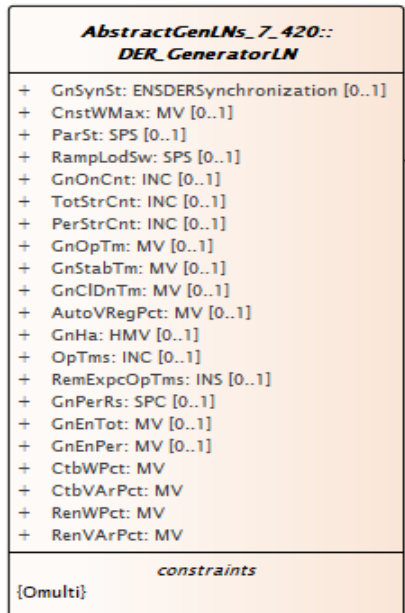
Power management modelling concepts



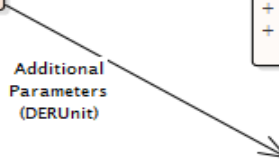


Power management observability





Additional Parameters (DERUnit)





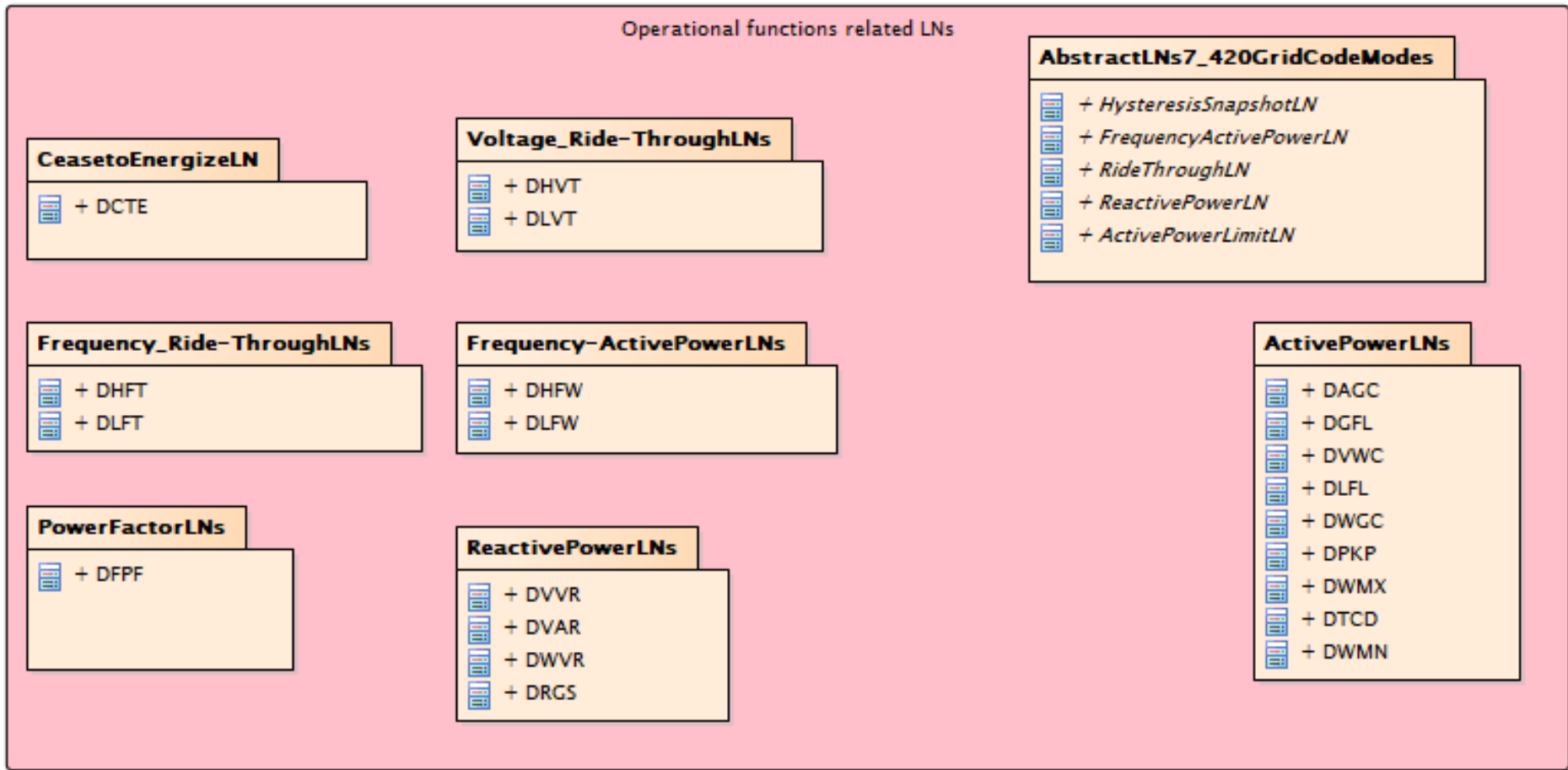
List of Mandatory Grid Code Functions from IEEE 1547 and European Codes (RfG/DCC one)

1. Disconnect / Connect Function
2. Cease to Energize / Return to Service Function
3. High/Low Voltage Ride-Through (Fault Ride-Through) Mode
4. High/Low Frequency Ride-Through Mode
5. Dynamic Reactive Current Support Mode
6. Frequency Watt Mode (Frequency Sensitivity Mode)
7. Volt-Watt Mode
8. Fixed (Constant) Power Factor Mode
9. Fixed (Constant) Reactive Power Mode
10. Volt-Var Mode
11. Watt-Var Mode
12. Watt-PF Mode
13. Active Power Limiting Mode
14. Active Power Setting Mode
15. Low Frequency-Watt Emergency Mode for Demand Side Management (fast load shedding)
16. Low Voltage-Watt Emergency Mode for Demand Side Management
17. Monitoring key status, alarm, and measurement values
18. Scheduling of Power Settings and Modes

Operational functions



Operational functions related LNs





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Questions?



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