Standards for specification of microgrid controllers (IEEE Std 2030.7/8) and DERMS (IEEE P2030.11)

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Session 5 – Standards and grid codes

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Outline

- Distributed energy resources (DER) integration
  - Resource characteristics
  - Challenges – variability, dynamics
- Aggregation options
  - Microgrid – standards, IEEE Std 2030.7/8
  - DERMS – guide, IEEE P2030.11
- Observations – stakeholder perspective

DER features – types and features

- Energy resource – local power generation
  - Local resources – solar, wind, alternative fuels
  - Conventional fuels (diesel engines)
- Renewable resources – variable and intermittent
  - Non dispatchable (curtailment possible) – wind, solar
  - Operated at Maximum Power Point Tracking (MPPT)
- Storage – generator (discharging) / load (charging)
  - Firming production – balancing variability
  - Leveraging – storing/retrieving excess power
- Controlled/curtailable loads – demand response

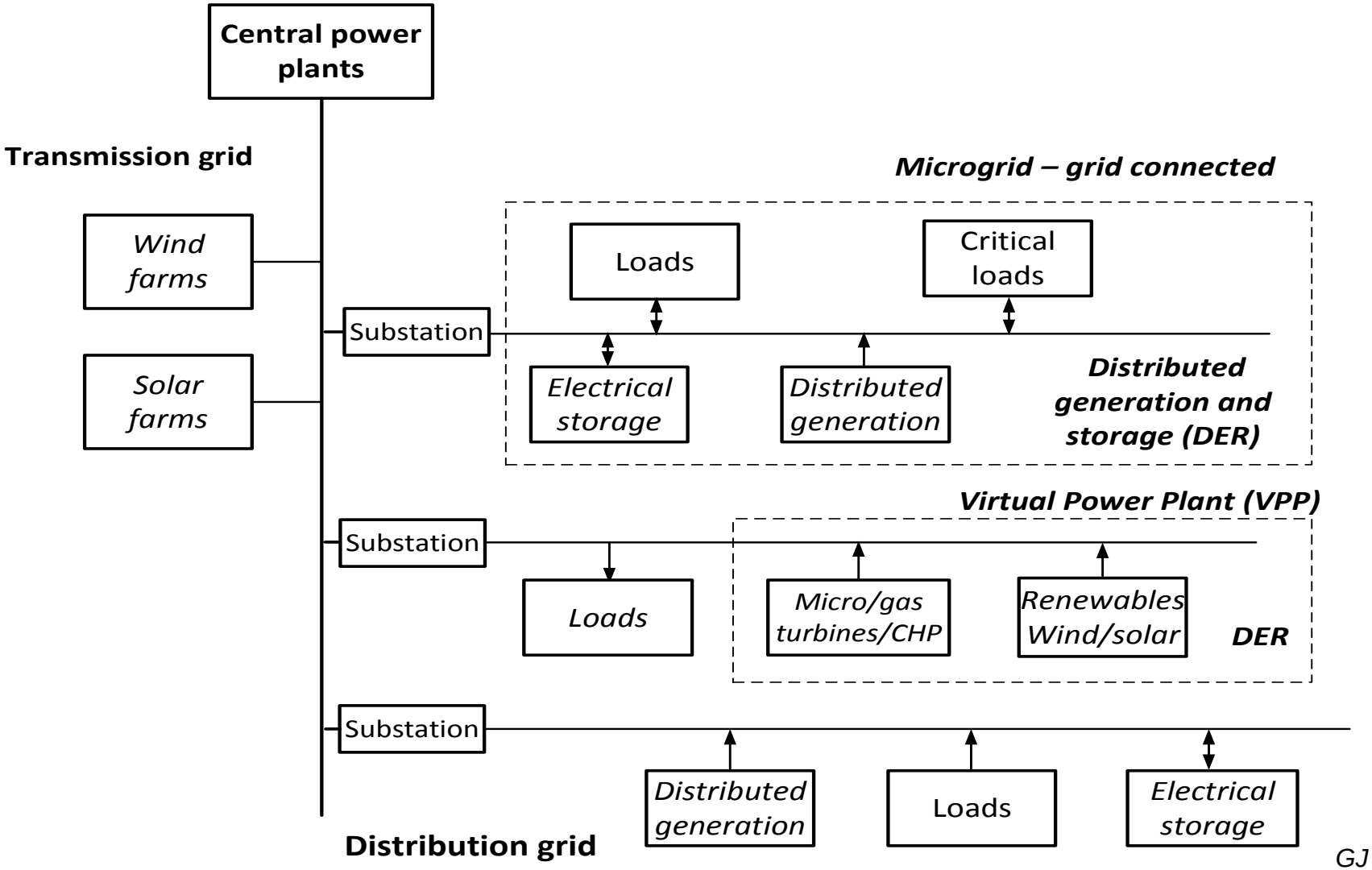
DER – grid interface – dynamics

- Generator/storage grid interface – types
  - Rotating machines – conventional synchronous generators
  - Power electronic converters (inverters)
- Power electronic converters (static generators)
  - Performance dictated by control loops acting on an (ideal) source (voltage for voltage source converters)
  - No inertial response, no loss of synchronization (if PLL used)
  - Control options – grid following (P-Q mode) or grid forming (synchronous generator)

DER grid integration challenges

- Dealing with power output variability – individual DER
  - Non dispatchable
  - Local balancing/firming – storage or provided by the grid
  - Power electronic interfaces can provide reactive power
- Dealing with dynamic characteristics – individual DER
  - Interaction between rotating and static generators
  - Faster response of the power electronic interfaces
- Issues related to a large penetration of DER – needs
  - Firming production – balancing variability
  - Providing grid support and ancillary services

DER integration – distribution grid



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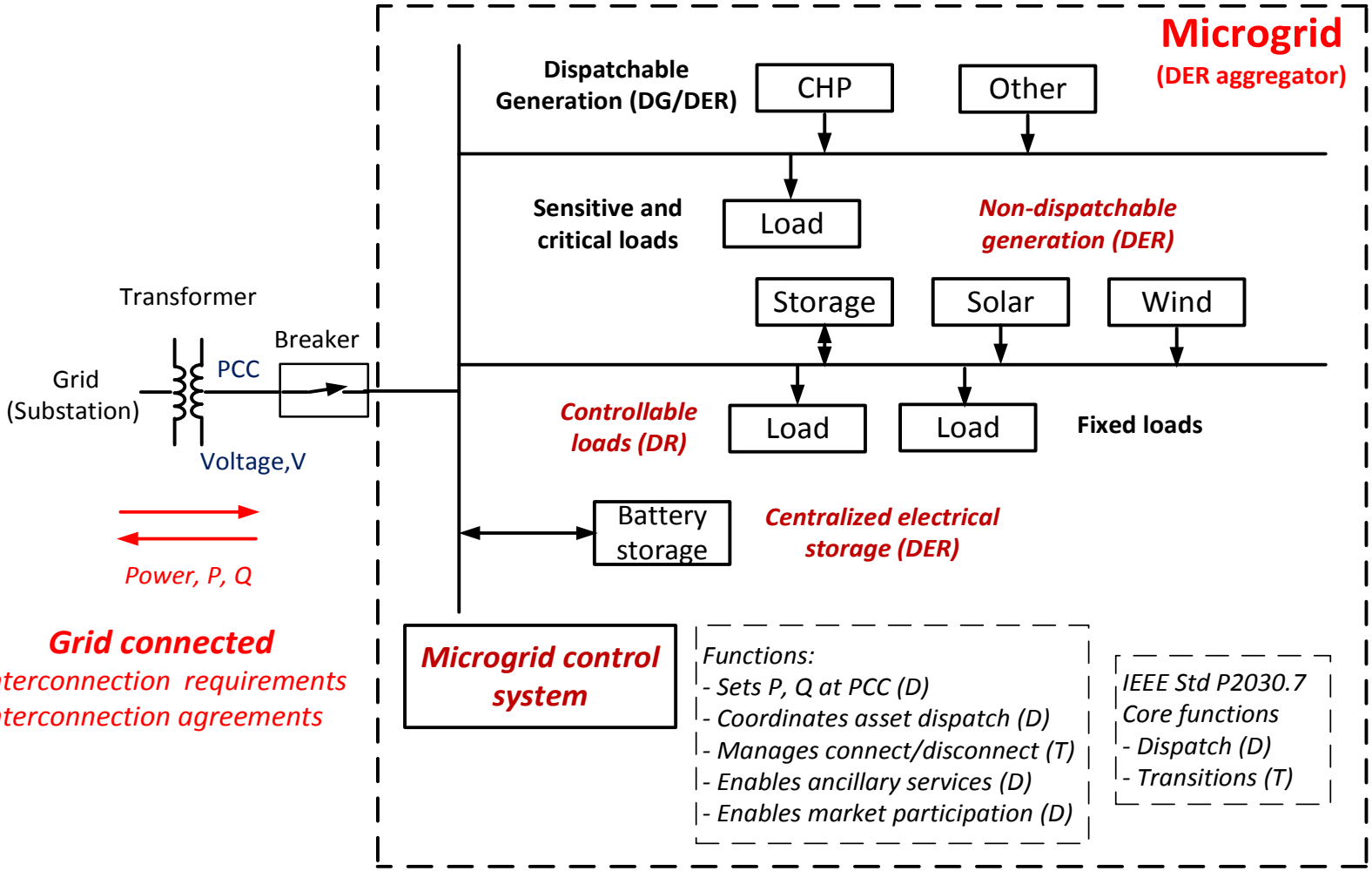
Dealing with a large DER penetration

- Grid interconnection requirements – individual DER
  - Utility grid codes or standards – IEEE Std 1547
  - Requirements for ride-through (V/ f), grid support, communications
- DER aggregation – microgrids
  - Utility requirements or standards – IEEE Std 2030.7/8
  - Microgrid (entity) – manages local DER interconnection and aggregation, power and ancillary services provided to local grid
- DER aggregation – DER Management Systems (DERMS)
  - Functional specification of DERMS – IEEE P2030.11, guide
  - DERMS – aggregated power (P, Q), ancillary services – for other aspects, local DER codes apply

Microgrid operation – IEEE Std 2030.7



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IEEE Std 2030.7 – microgrid functions

Distribution grid

Microgrid control system

Level 3	Higher level functions	
	Operator interface	Communications/SCADA
	Grid/market	Optimal dispatch
Level 2	Core level functions	
	Transition	Dispatch
	(Connect/disconnect)	(including simple rules)
Level 1	Lower level functions	
	Voltage/frequency control	Device specific functions
	Real/reactive power control	

Microgrid assets, devices and components

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IEEE Std 2030.7 – Scope and approach

- Functional specification of a microgrid control system
- Functions of the control system
  - Allows the microgrid to manage itself, operate autonomously or grid connected, and connect to and disconnect from the distribution grid
  - Controls the exchange with the distribution grid of power and the supply of ancillary services
- Scope of standard – functions common to microgrids, regardless of topology and configuration – for interoperability
- Requirements – set by DSO/utility (interconnection) and microgrid operator (internal and grid interface)
- Test procedures – covered in companion IEEE P2030.8
- Approved in Dec 2017

IEEE Std 2030.7/8 – Metrics and conformance

- Components of conformance validation
  - Elements of the function to be tested
  - Function characterization
  - Testing approach (scenarios) and measured parameters
- Test procedures – covered in companion IEEE P2030.8
  - Scenarios
  - Instrumentation
- Metrics – covered in IEEE P2030.8
  - Based on interconnection requirements
  - Agreed upon between the microgrid and DSO
- Approved in June 2018

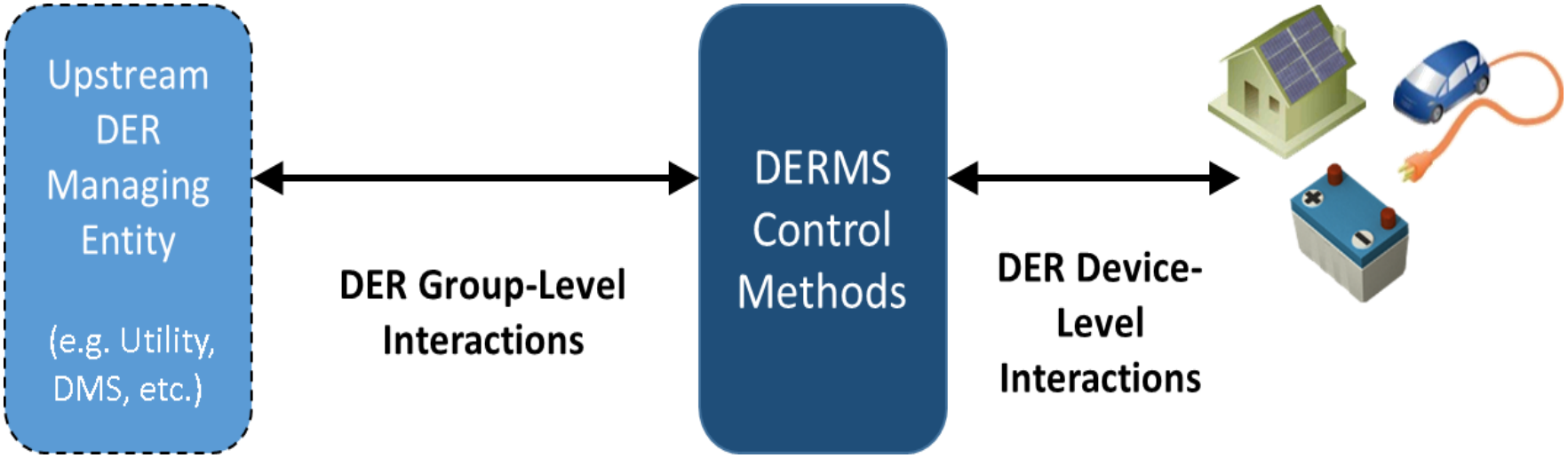
DERMS guide – IEEE P2030.11 WG

- Distributed Energy Resources Management Systems (DERMS) Functional Specification
- Purpose of DERMS
  - Aggregation of Distributed Energy Resources (DER)
  - A link between a large number of DER (mainly solar) and the Distribution Management System (DMS)
- Scope of Guide
  - Guiding principles for application and deployment
  - Basic functional requirements and core functions

DERMS guide – IEEE P2030.11 WG

- Stakeholders
  - Independent aggregators
  - Utilities integrating and interconnecting DER
  - Virtual Power Plant (VPP) control systems
  - Equipment suppliers, consultants, regulators
- An extension of the microgrid dispatch function, a core function defined in IEEE Std 2030.7
- IEEE PAR approved in March 2018, first meeting June 2018

DERMS – placement and function



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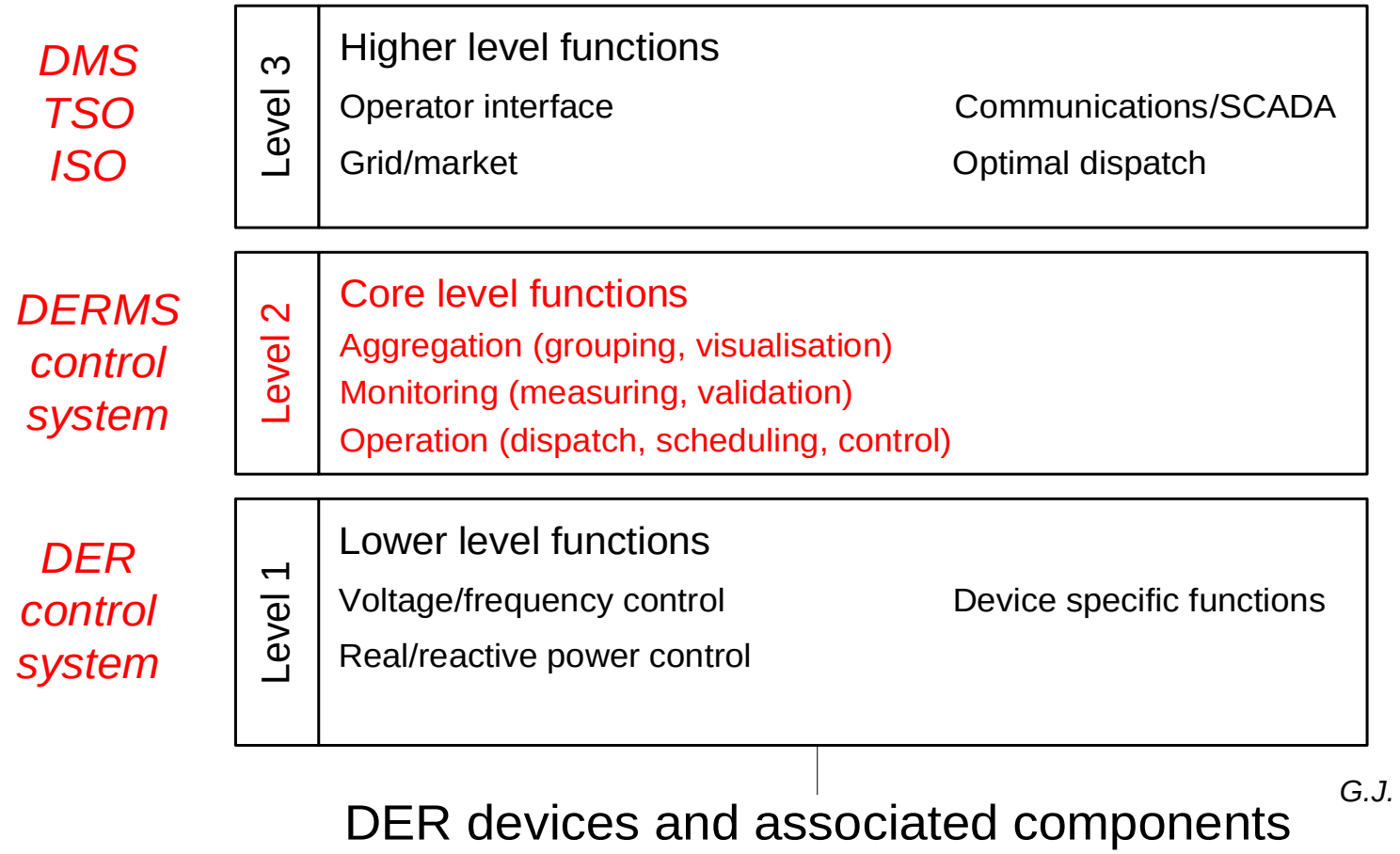
DERMS – core functions

Electric grid – distribution / transmission



Observations – stakeholder perspective

- DER, embedded, can provide services to the electric grid/wholesale market – P, E, Q, ancillary services
- DER interconnection/integration
  - Done on an individual DER basis by the DSO, TSO, other
  - Aggregated by independent operators or utilities using microgrids or DERMS
- Utilities/regulators need to be involved in defining
  - DER interconnection/integration requirements
  - DERMS – designed to provide customers/buyers bulk services products – aggregated P, E, Q, ancillary