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A Standardized Approach to DER Group Management

A Look at IEC 61968-5

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OpenADR Alliance Member Meeting

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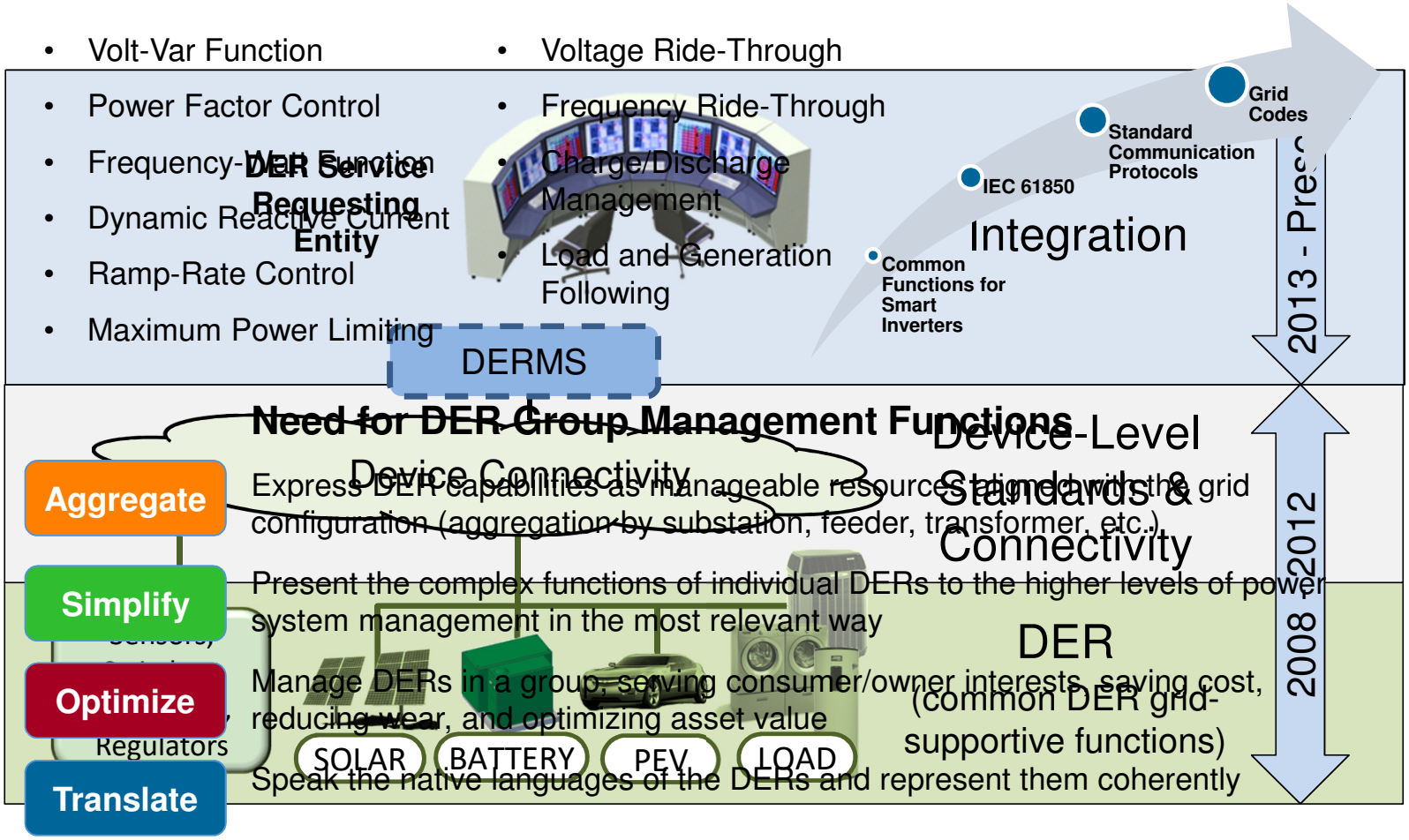
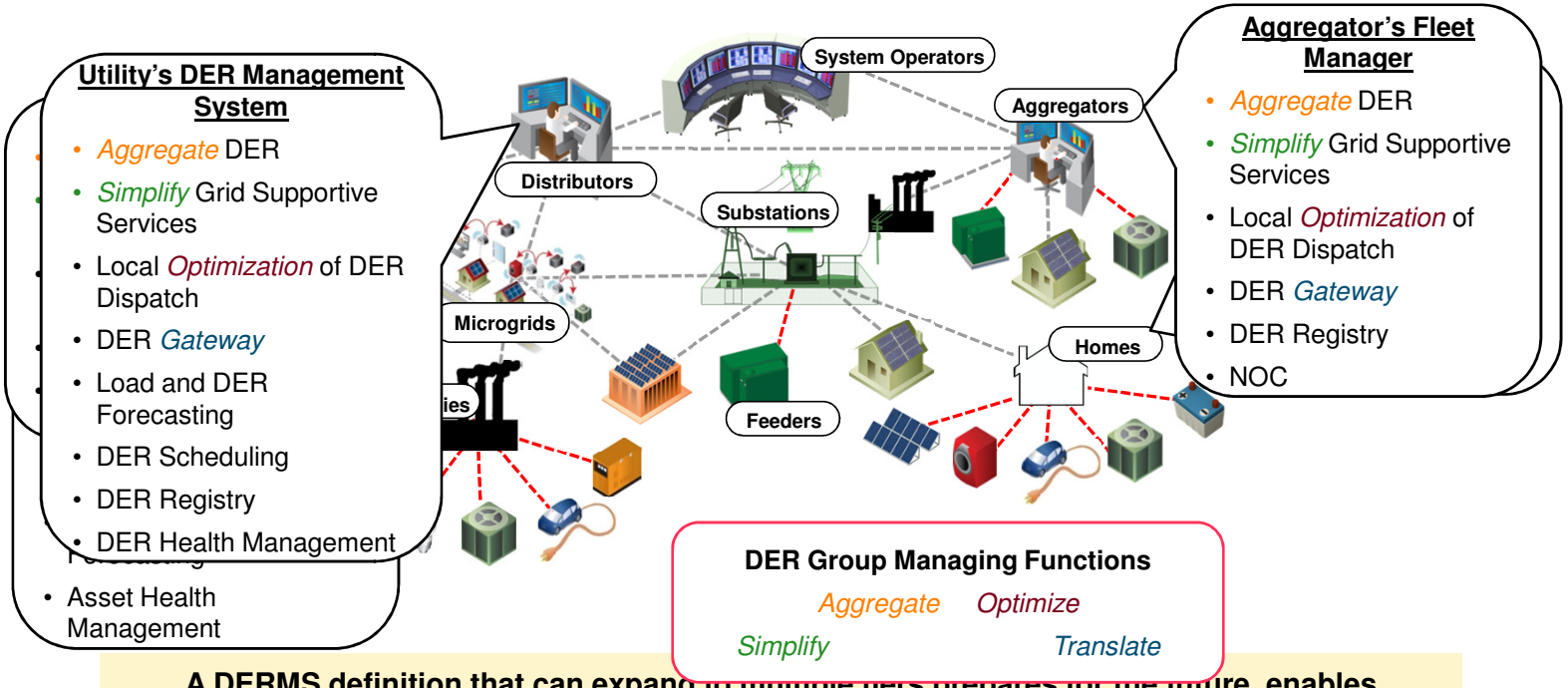
Recognizing the Need for Group Management



DERMS Functionality at Multiple Levels



A DERMS definition that can expand to multiple tiers prepares for the future, enables distributed intelligence, and enhances grid resilience

Scope of the Full IEC 61968 Standard

- Defines interfaces for the major elements of an **interface architecture** for a Distribution Management System (DMS):
  - Part 1: *Interface Architecture and General Recommendations*, identifies and establishes requirements for standard interfaces based on an *Interface Reference Model* (IRM)
  - Parts 3-9 define interfaces relevant to each of the major business functions described by the IRM
- As used in 61968, a DMS consists of various distributed application components used by the utility to manage electrical distribution networks, including:
  - Monitoring and control of equipment for power delivery
  - Management processes to ensure system reliability, voltage management, demand-side management, outage management, work management, automated mapping, and facilities management
- Limited to the definition of interfaces and **implementation independent**
  - Provides interoperability among different computer systems, platforms, and languages
  - Methods and technologies used to implement functionality conforming to the interfaces are out of scope: only the **interface itself** is specified in the 61968 standards

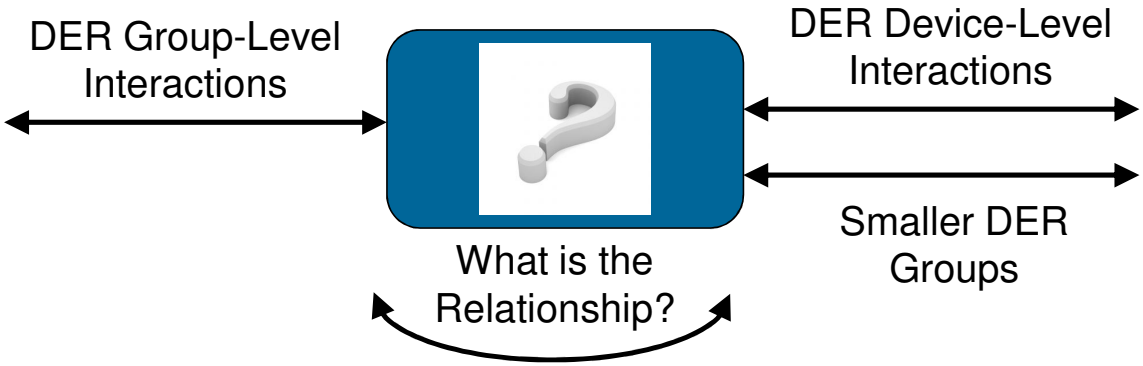
Scope of the IEC 61968-5 Standard

- Description of a set of functions that are needed for **enterprise integration of DERMS** functions
- These exchanges are most likely to occur between a DERMS and a DMS
  - There are no technical limitations on systems with which a DERMS might exchange information
  - A DERMS might communicate with individual DERs using a variety of standards and protocols, such as:
    - IEC 61850
    - IEEE 2030.5
    - Distribution Network Protocol (DNP), aka IEEE 1815
    - SunSpec Modbus
    - Open Field Message Bus (OpenFMB)
    - OpenADR (maybe)
  - One role of the DERMS is to manage this disparity and complexity of communications However, the communication to individual DERs is **out of scope** of this standard.

Use Case Categories in Scope for 61968-5

- **Group Management**
  - **DER Group Creation** – Management of DERs in aggregate
  - **DER Group Maintenance** – Addition, removal, or modification of the members and/or aggregated capabilities of a given group of DERs
  - **DER Group Deletion** – Removal of an entire group
- **Control of Grouped DER**
  - **DER Group Status Monitoring** – Quantifying or ascertaining the current capabilities and/or status of a group of DERs
  - **DER Group Forecast** – Predicting the capabilities and/or status of a group of DER for a given period in the future
  - **DER Group Dispatch** – Requesting that specified capabilities of a group of DERs be dispatched to the grid
  - **DER Group Voltage Ramp Rate Control** – Requesting that a DER group follow a ramp rate curve
  - **DER Group Connect/Disconnect** – Requesting that DERs either isolate themselves or reconnect to the grid, as needed

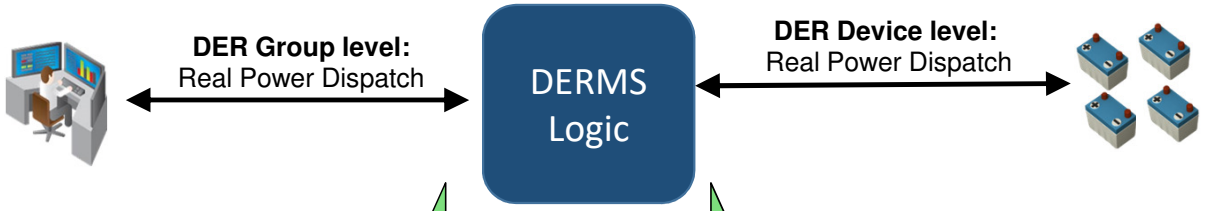
What Would a DERMS Do with Groups?



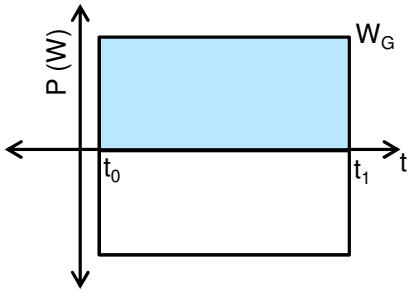
- How might a given DER group-level command be disseminated to the downstream members of the group?
- How is device-level status aggregated into the group-level status and resource availability indicators?

The aim is to identify and publicly document a reference set of methods for mapping DER group-level to device-level interactions.

Example: DER Group Real Power Dispatch

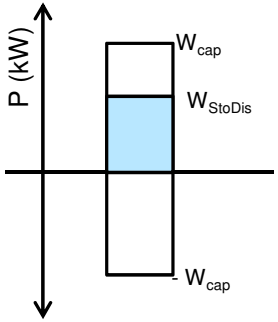


Group-level command:
Requested real power level, W_G



What is the mapping logic?

Device-level command:
Real power dispatch



Name	Description
Action Identifier	Requested real power level
Schedule	t_1-t_0
Requested power level	W_G

Parameter	Description
Real power dispatch enable	Enable Mode
Set Storage Charge/Discharge Rate, W_{StoCh} / W_{StoDis}	Rate at which the storage unit is charged/discharged in Watts
Storage capability, W_{cap}	Capability of the Energy Storage unit

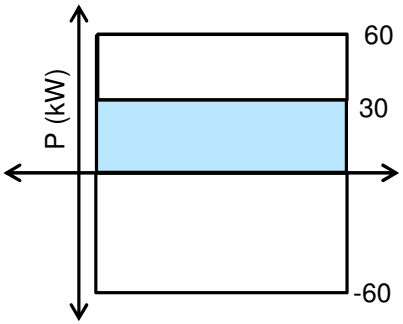
Example: DER Group Real Power Dispatch Strategy #1

"Strategy #1 - Uniform Distribution in Watts": Set/limit the active power level of each device in the DER group to the **same power level** in order to achieve the specified group power level.

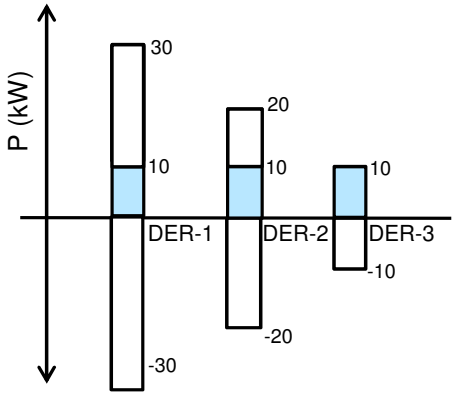
Group Capability (W_G) = +/- 60kW

3 DER Capability (W_{cap}) = +/- 30kW, +/- 20kW, +/- 10kW

Group command:
Requested real power level: +60kW



Device commands:



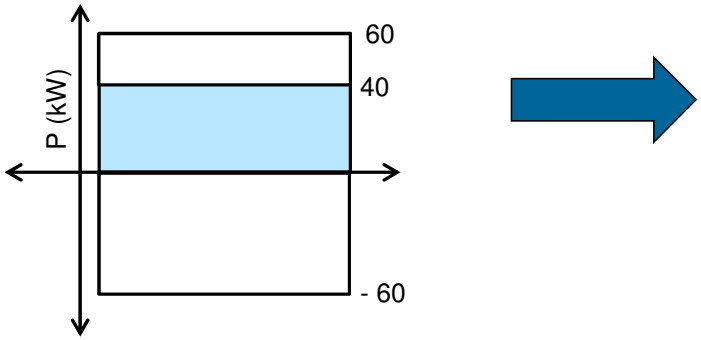
Example: DER Group Real Power Dispatch Strategy #1a

"Strategy #1 - Uniform Distribution in Watts": Set/limit the active power level of each device in the DER group to the **same power level** in order to achieve the specified group power level.

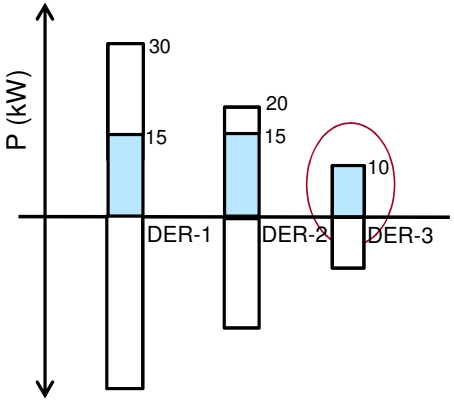
Group Capability (W_G) = +/- 60kW

3 DER Capability (W_{cap}) = +/- 30kW, +/- 20kW, +/- 10kW

Group command:
Requested real power level: +**40kW**



Device commands:



If individual devices in the group reach their physical limits in this process, others are set evenly to achieve the specified level.

Example: DER Group Real Power Dispatch Strategy #2

"Strategy #2 - Uniform Distribution as a % of Nameplate Rating": Set/limit the active power of each device in the DER group to the **same % of nameplate rating** in order to achieve the specified group power level.

Group Capability (W_G) = +/- 60kW

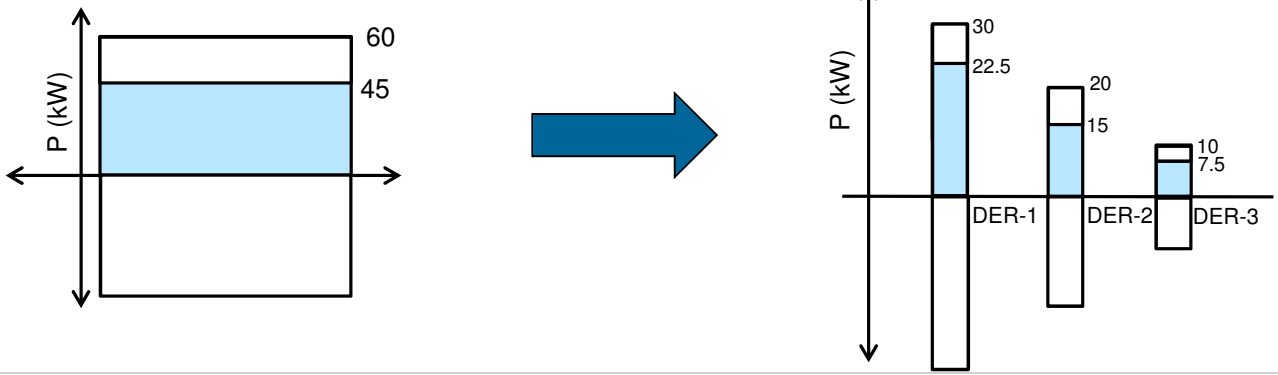
3 DER Capability (W_{cap}) = +/- 30kW, +/- 20kW, +/- 10kW

Group command:

Requested real power level: **45kW**

Device-level commands:

$$\%\ of\ W_{\max} = W_G \,/\, \sum_{i=0}^{n} W_i$$



High Priority DERMS Functions for Groups

- **Status Monitoring** – Reading/reporting the present status of a DER group
- **Capabilities Discovery** – Reading/reporting the capabilities of DER groups
- **Dispatch (Real Power)** – Requesting/dispatching real power from a DER group. This function has two forms:
  - A request that the real power for the group be set to a specified level
  - A request that the real power for the group be raised/lowered by a specified amount
- **Dispatch (Reactive Power)** – Requesting/dispatching reactive power from a DER group. This function is a request that the reactive power for the group be set to a specified level.
- **Forecast** – Exchanging forecasts of DER group availability

61968-5 Information Model (IEC TC57 WG14 CIM for DER)

1 INTRODUCTION
2 FRAMING THE DISCUSSION: WHAT IS DER GROUP MANAGEMENT?
3 SUPPORTING DER AGGREGATION AT MULTIPLE LEVELS
4 ACTIVITIES OF THIS INITIATIVE
5 SCOPE OF THIS INITIATIVE: LIMITATIONS AND DEPENDENCIES
6 PRIORITIZATION AND PRECEDENCE OF DER GROUP MANAGEMENT FUNCTIONS
7 RESPONSE SUCCESS & FAILURE INDICATORS
8 DER GROUP CREATION
9 DER GROUP VERSION AND MEMBER QUERY
10 DER GROUP DELETION
11 DER GROUP MAINTENANCE (ADDING, UPDATING, AND DELETING MEMBERS)
12 DER GROUP CAPABILITY DISCOVERY
13 DER GROUP STATUS MONITORING
14 DER GROUP FORECASTING
15 DER GROUP HISTORICAL AGGREGATE METER DATA
16 DER GROUP MAXIMUM REAL POWER LIMITING
17 DER GROUP RAMP RATE LIMIT CONTROL
18 DER GROUP PHASE BALANCE LIMITING
19 DER GROUP REAL POWER DISPATCH
20 DER GROUP REACTIVE POWER DISPATCH
21 DER GROUP VOLTAGE REGULATION FUNCTION
22 SET DER GROUP CURVE FUNCTIONS
23 PROVIDE PRICES TO DER GROUP
24 REQUEST COST OF SERVICE FROM DER GROUP
25 MANAGE POWER AT A POINT OF REFERENCE
26 CONNECT/DISCONNECT DER GROUP
27 SPECIFY BELLWETHER METERS
28 NEXT STEPS

Free EPRI Report that describes this body of work: 3002008215

Four Function Categories:

- Group Setup
- Monitoring, Capabilities, and Status
- Operational Boundaries/Limits
- Control Functions

Intended to serve as the information model basis for protocol encodings: IEEE 2030.5, OpenADR, OpenFMB, etc.

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