

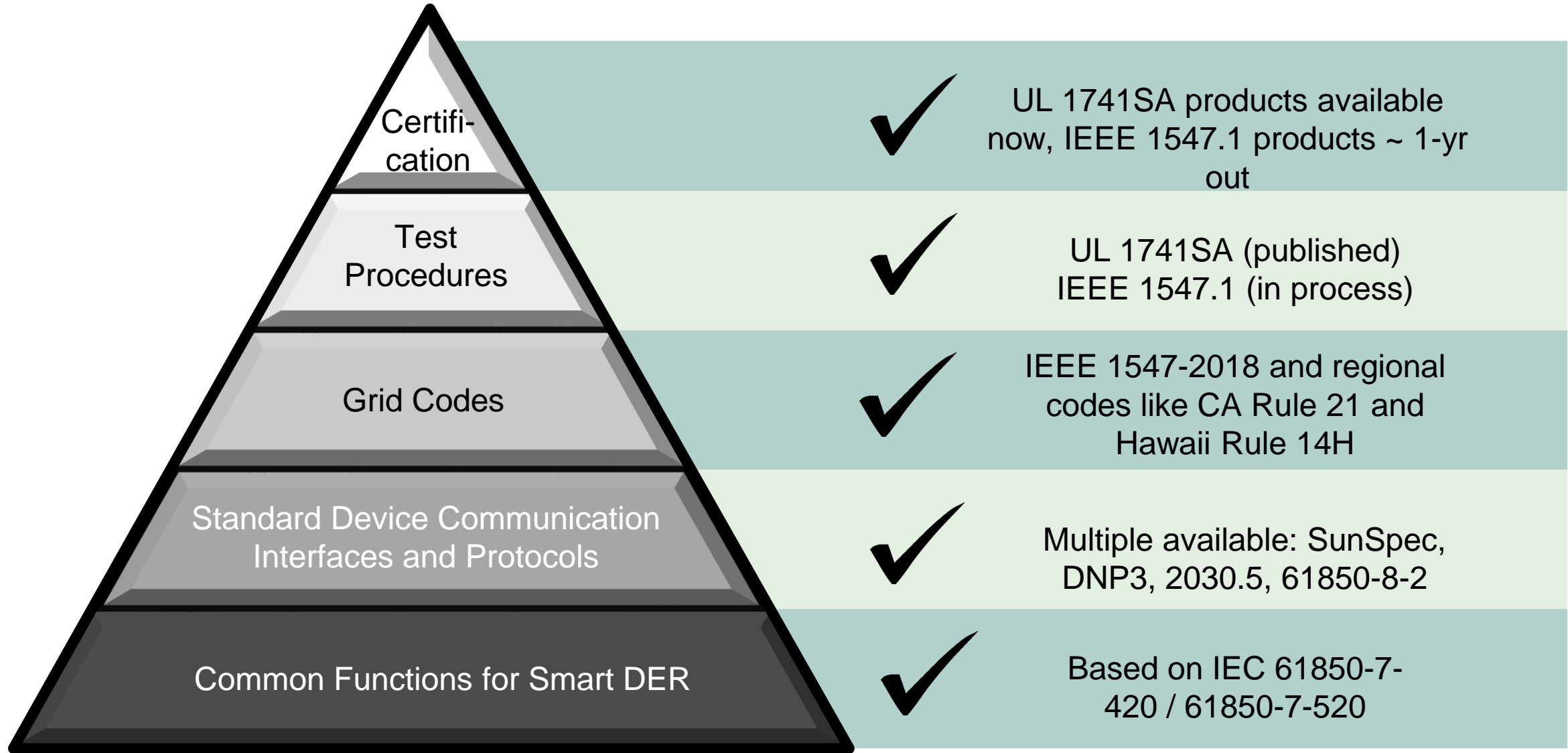


DER Group Management Functions

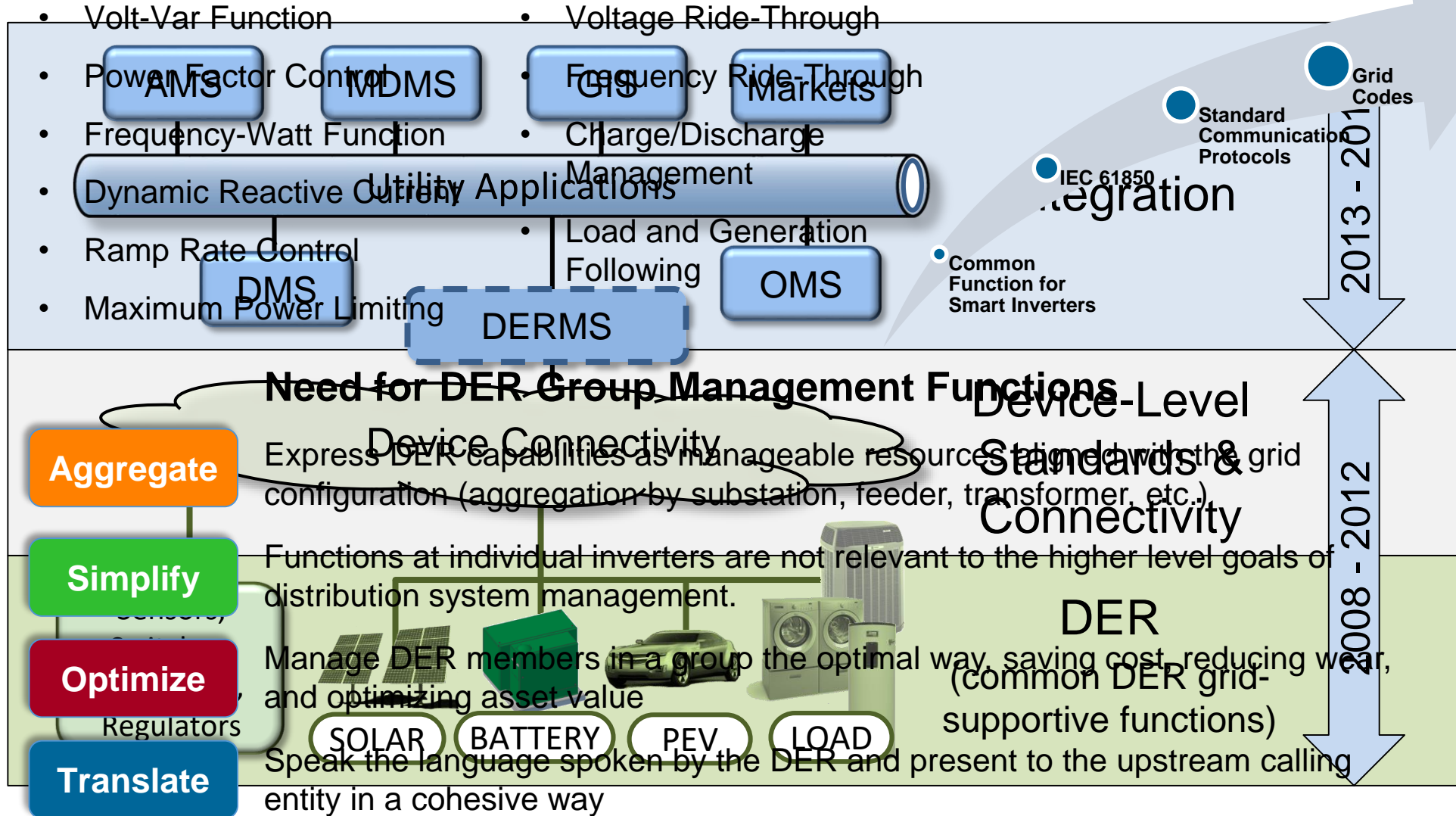
June 13, 2019
Ajit Renjit
Technical Leader - DERMS
EPRI



Framing the discussion: DER Devices are Ready

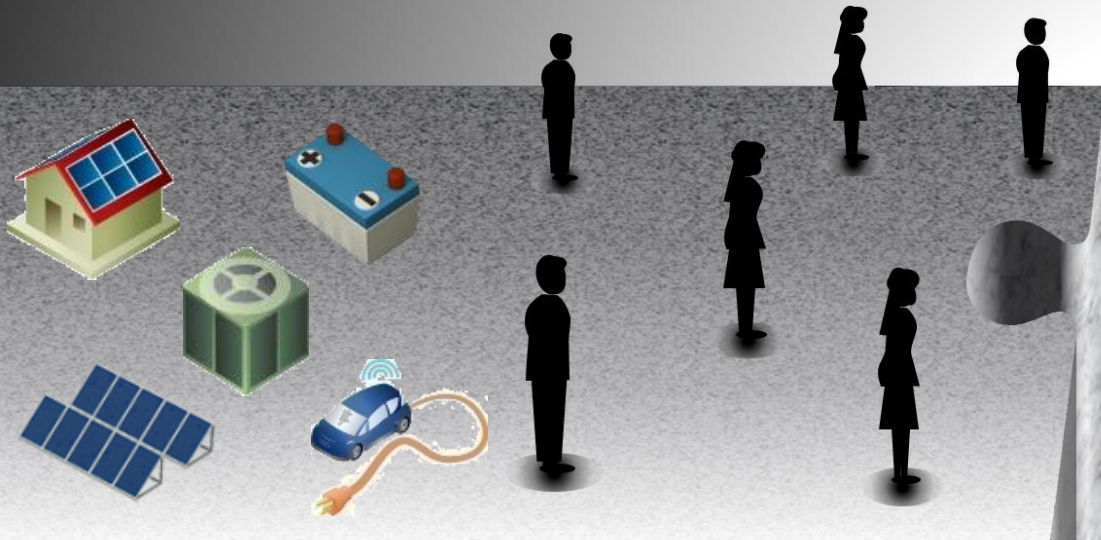


What is DER Group Management?



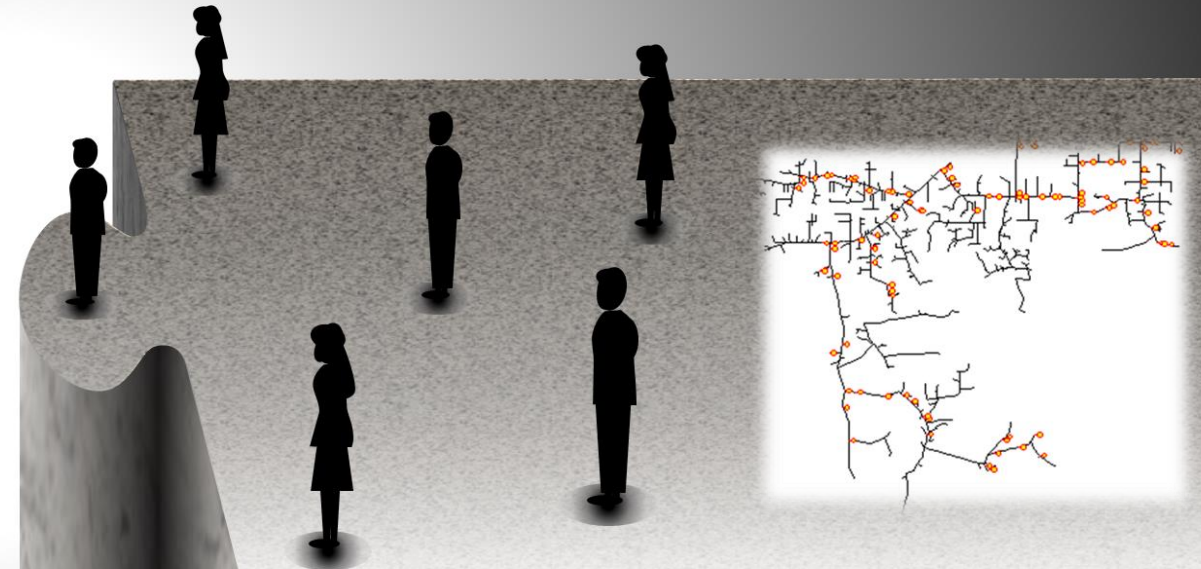
Need for DER Group Management Functions

**Device-Oriented
Functions are Ready**



- Many individual devices
- Complex settings
- DER-type-specific interactions

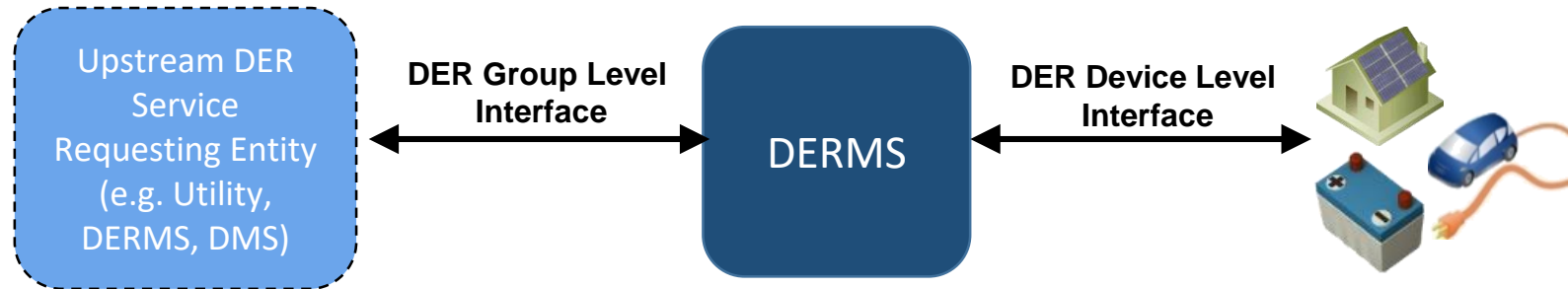
**Grid-Oriented
Services are Needed**



- Grid-aligned DER services
- Simple control actions
- Energy-centric interactions

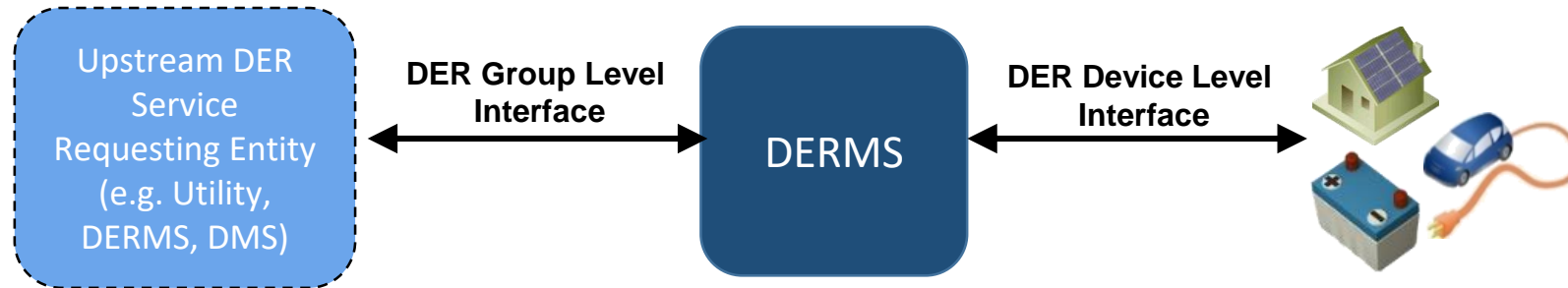
DERMS

DER Group vs Device Level Functions



<i>Attribute</i>	Group-Level Interface	Device-Level Interface
<i>Number of Connections</i>	Groups may be fewer in quantity	The number of individual DER is likely to be large
<i>Frequency of Interactions</i>	Group-level interactions may be less frequent.	At the device-level, interactions may happen frequently.
<i>Device-Type Awareness</i>	Group-level services are energy and grid-centric agnostic of the type of downstream DERs	Device-settings oriented. Function commands are described in a way that tells devices exactly what to do
<i>Function Complexity</i>	Group-level services are simple in nature.	Grid support functions at the device-level can be complex and involve a wide range of settings.

DER Group vs Device Level Functions



DER Group Level

- DER Group Status Monitoring
- DER Group Real Power Dispatch
- DER Group Reactive Power Dispatch
- DER Group Voltage Regulation Function
- DER Group Maximum Real Power Limiting
- DER Group Ramp Rate Limit Control
- DER Group Phase Balance Limiting
- Set DER Group Curve Functions
- Provide Price to DER Group
- Manage Power at a Point of Reference
- Connect/Disconnect DER Group

DER Device Level

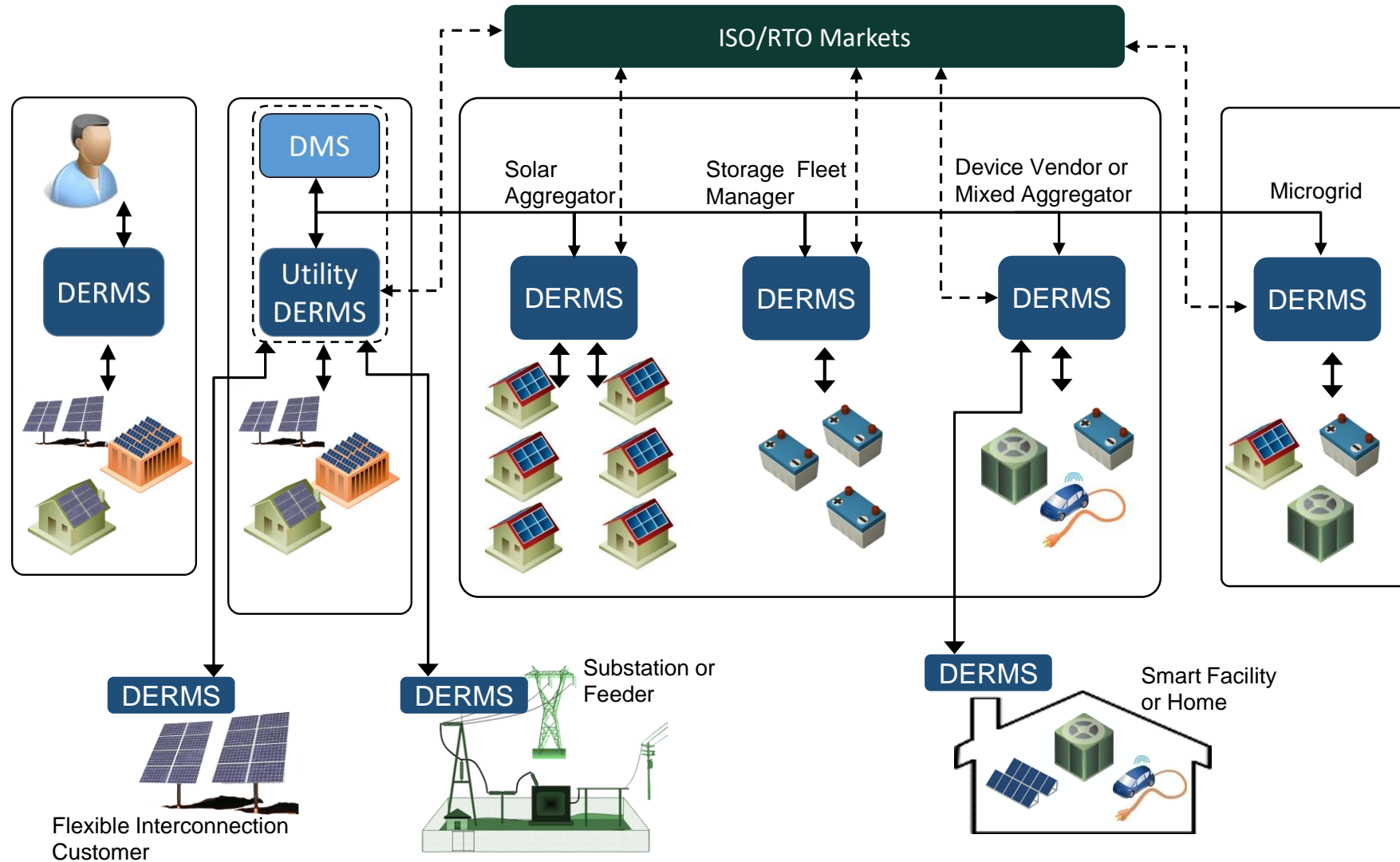
- Status Monitoring Points
- Limit DER Power Output Function
- Fixed Power Factor Function
- Volt-Var Function
- Watt-Var Function
- Volt-Watt Function
- Frequency-Watt Function
- Low/High Voltage Ride-Through Function
- Low/High Frequency Ride-Through Function
- Connect/Disconnect Function

Common Functions for DER Group Management

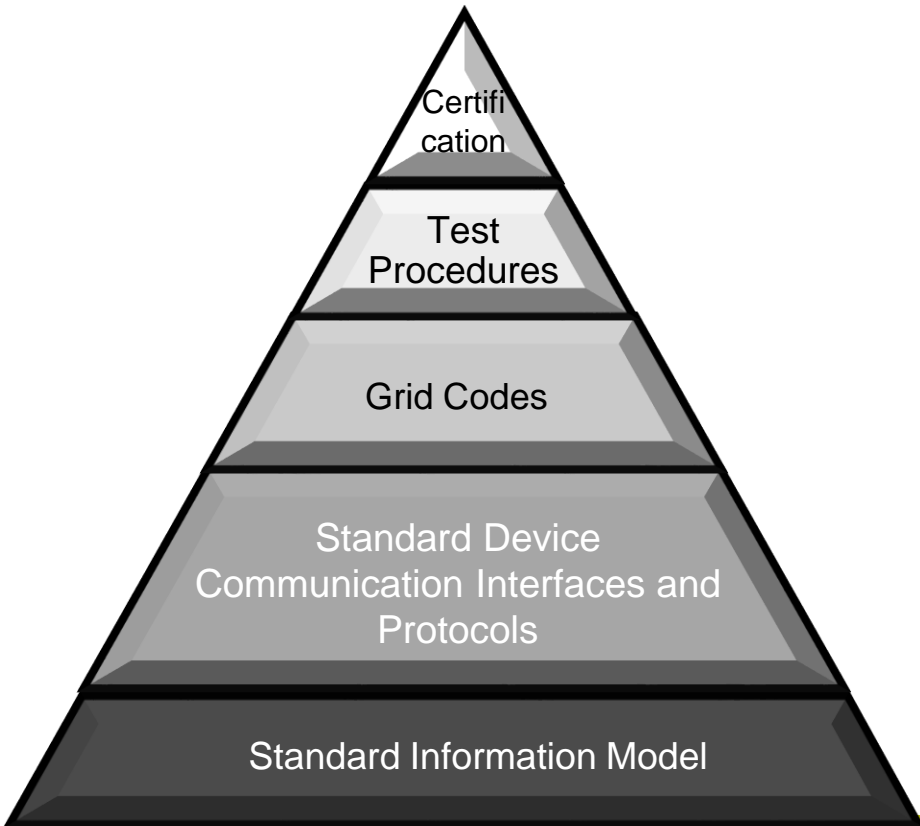
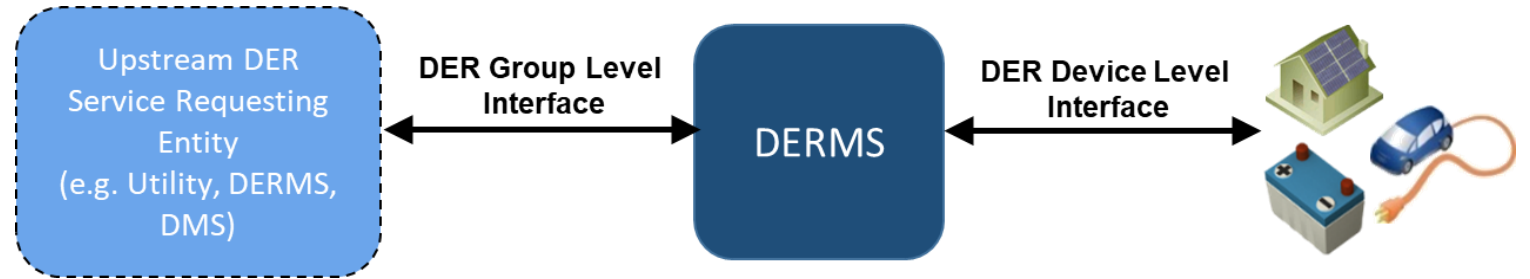


Common Functions for Smart Inverters: 4th Edition. EPRI, Palo Alto, CA: 2016. 3002008217
Common Functions for DER Group Management, Third Edition. EPRI, Palo Alto, CA 3002008215

Architectural Extensibility Provided by DER Group Management Functions



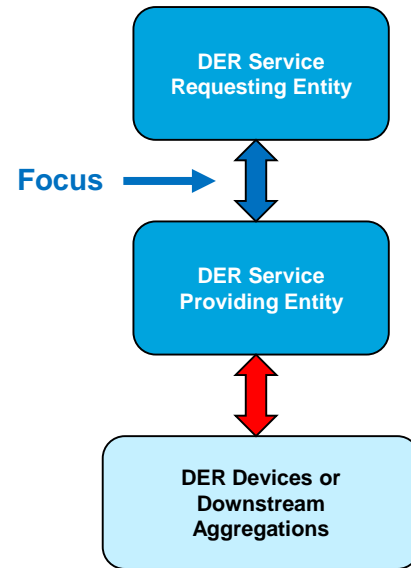
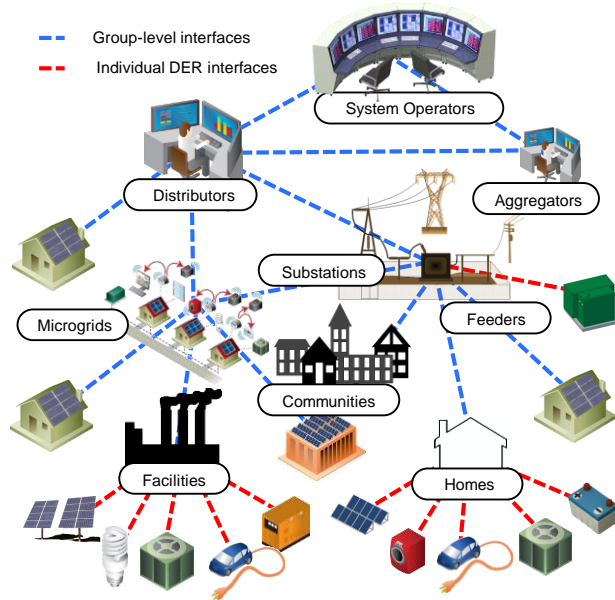
Communication Protocols for DER Group Management



UCAI Users Group, CIM for DER certification and listing.	<ul style="list-style-type: none"> • IEEE 1547.1 • UL1741SA • SunSpec Alliance
UCAI Users Group, CIM for DER compliance testing	<ul style="list-style-type: none"> • IEEE 1547.1 • UL1741SA • SunSpec Alliance
Not Applicable	<ul style="list-style-type: none"> • Multiple worldwide, unique by region • IEEE 1547-2018 (specific set) • CA Rule 21 (specific set)
<ul style="list-style-type: none"> • IEC 61968-100-2013 • Multispeak 5.0 • OpenFMB • OpenADR (mapping considered) • IEEE 2030.5 (mapping considered) 	<ul style="list-style-type: none"> • SunSpec Modbus • DNP3 AN2013-001, AN2018-001 • IEEE 2030.5 • IEC 61850-8-2
IEC 61968-5 (CIM for DER)	IEC 61850-7-420

New Industry Wide Interest Group: DER Aggregations/Group Management for Coordinated T&D Interface Operations

Scope

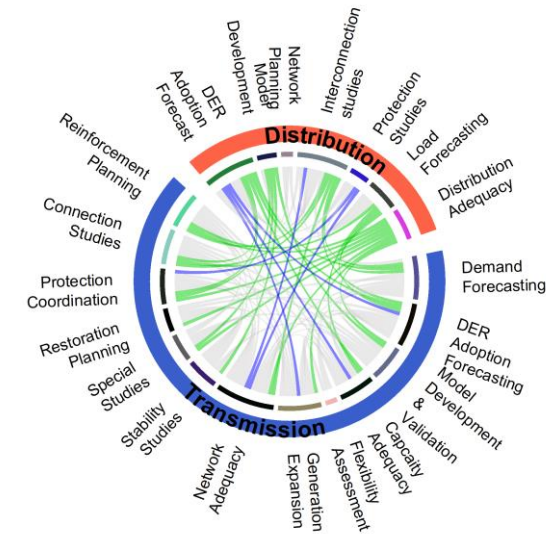


Approach

- Weekly meetings: every Tuesday, 1p-2p ET, 10a-11a PT, 7p-8p CET
- Collaborative, incremental learning and specification of gaps, use cases, functions

Background and Context

- Initiative started in 2012
- Open forum, diverse stakeholders, consensus
- Outputs codified in national and international standards, e.g., IEC CIM 61968-5
- Methods developed thus far have been implemented, tested, and certified in test events and workshops
- Latest report “Common Functions for DER Group Management, 3rd Edition”
 - Still lacking in regard to the **TSO/DSO interface**



EPRI DERMS Activities

Research Initiatives

- DERMS Working Group
 - 2018: Reference Control Methods for Group-to-Device Interactions
 - 2019: Update to DER Group Management Functions
- DERMS Utility Interest Group
- DERMS Reference RFP for Utilities
- DERMS Testbed & Integration Platform
- Evaluation of DERMS Architecture: Centralized vs Decentralized
- Value of DERMS: Active & Reactive Power Management of DER

Active Projects

- PECO Integrated ADMS/DERMS/Microgrid Project (DOE)
- Tucson Electric Power DERMS Interoperability Demonstration Project
- HydroOne DERMS for Dynamic Management of DER
- DOE ENERGISE (NREL, EPRI, Schneider, Varentec, Xcel Energy, Austin Energy)

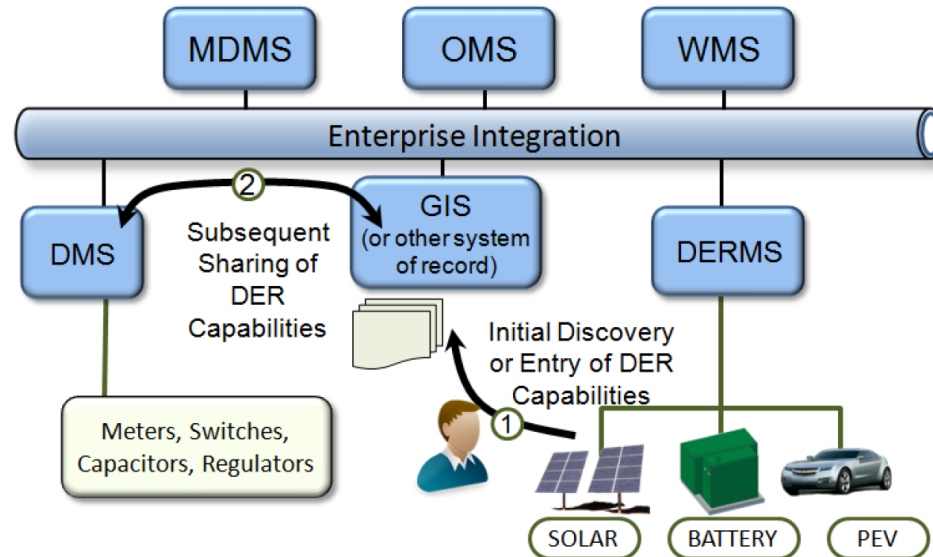
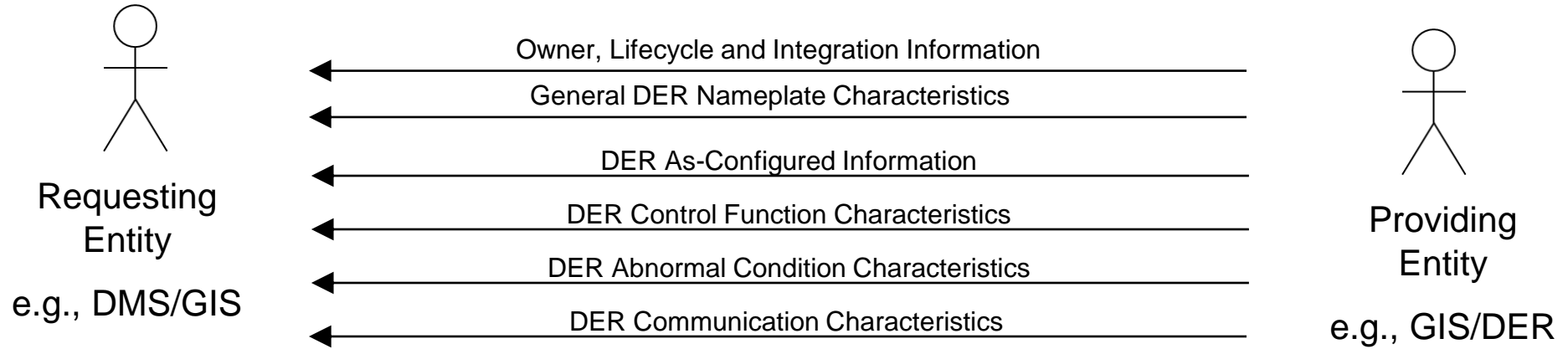
List of DERMS Related Public References

- EPRI, Common Functions for Smart Inverter. 28 December 2016. [Online]. Available: <https://www.epri.com/#/pages/product/000000003002008217/?lang=en-US>
- EPRI, Common Functions for DER Group Management, Third Edition. 04 November 2016. [Online]. Available: <https://www.epri.com/#/pages/product/000000003002008215/>
- EPRI, Understanding DERMS. 13 July 2018. [Online]. Available: <https://membercenter.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002013049>
- Test Script for IEC 61968-5 Distributed Energy Optimization, Third Edition. [Online]. Available: <https://www.epri.com/#/pages/product/000000003002014703/?lang=en-US>
- EPRI, Structuring Distribution Management Systems: DMS Applications for Accommodating High Penetrations of Distributed Energy Resources and Microgrids. 05 October 2017. [Online]. Available: <https://membercenter.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002009553>
- EPRI, A Guidebook to Centralized, Distributed, and Decentralized Intelligence. 31 December 2017. [Online]. Available: <https://membercenter.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002010511>
- EPRI, Tucson Electric Power Project RAIN: October 2018 Update. 07 November 2018. [Online]. Available: <https://www.epri.com/#/pages/product/000000003002014812/?lang=en-US>

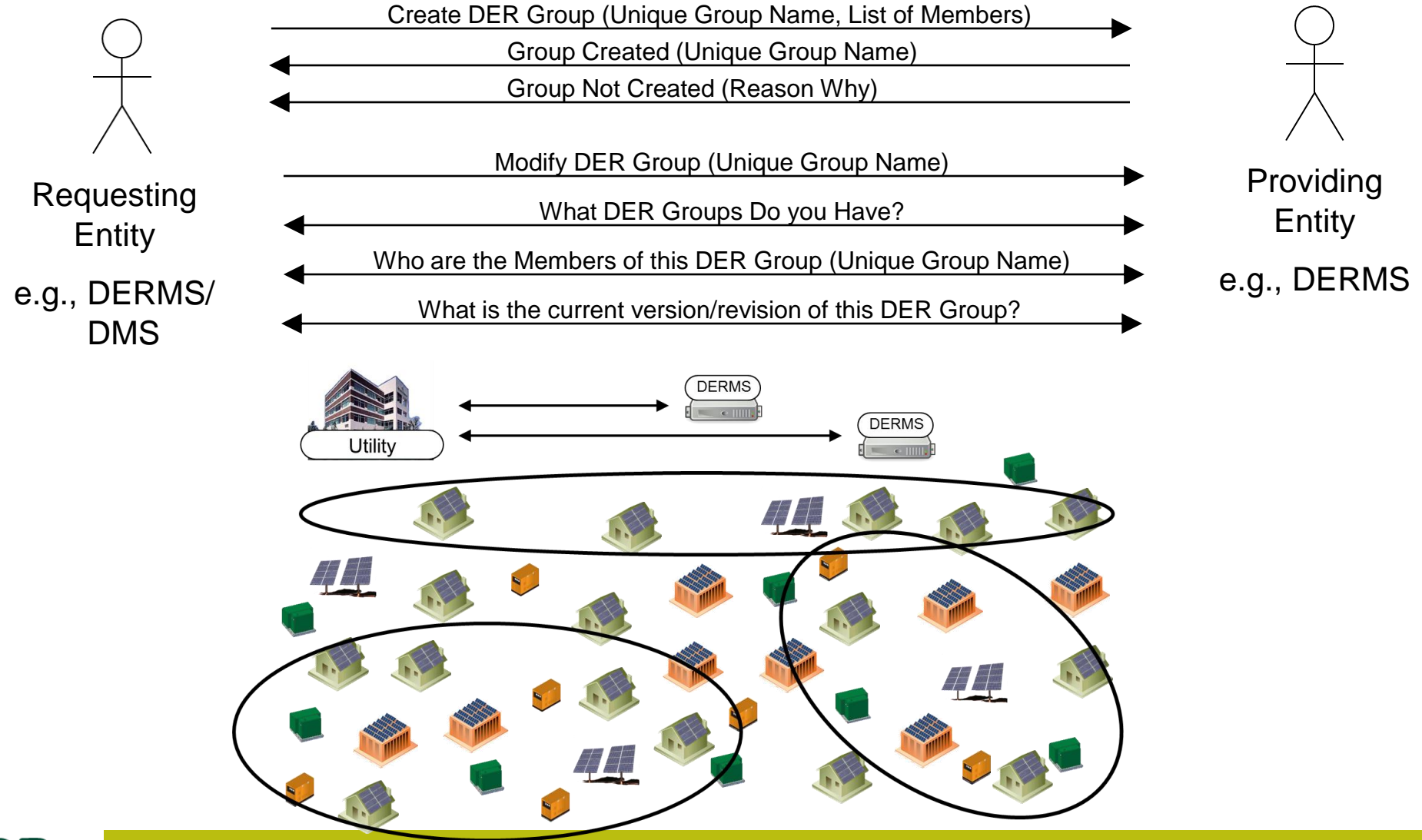
Thank You

Back-up Slides

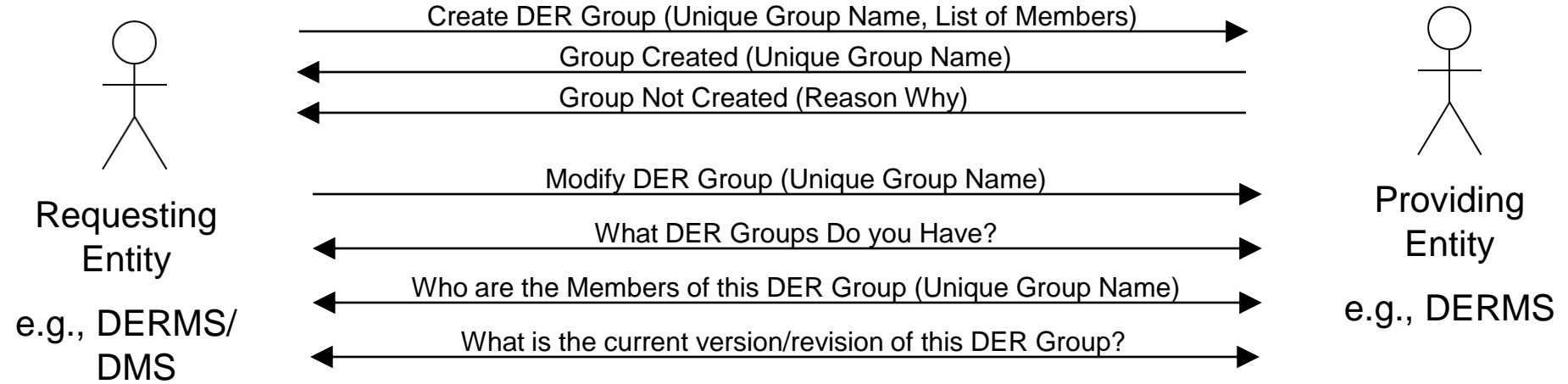
DER Registration



DER Group Setup



DER Group Setup

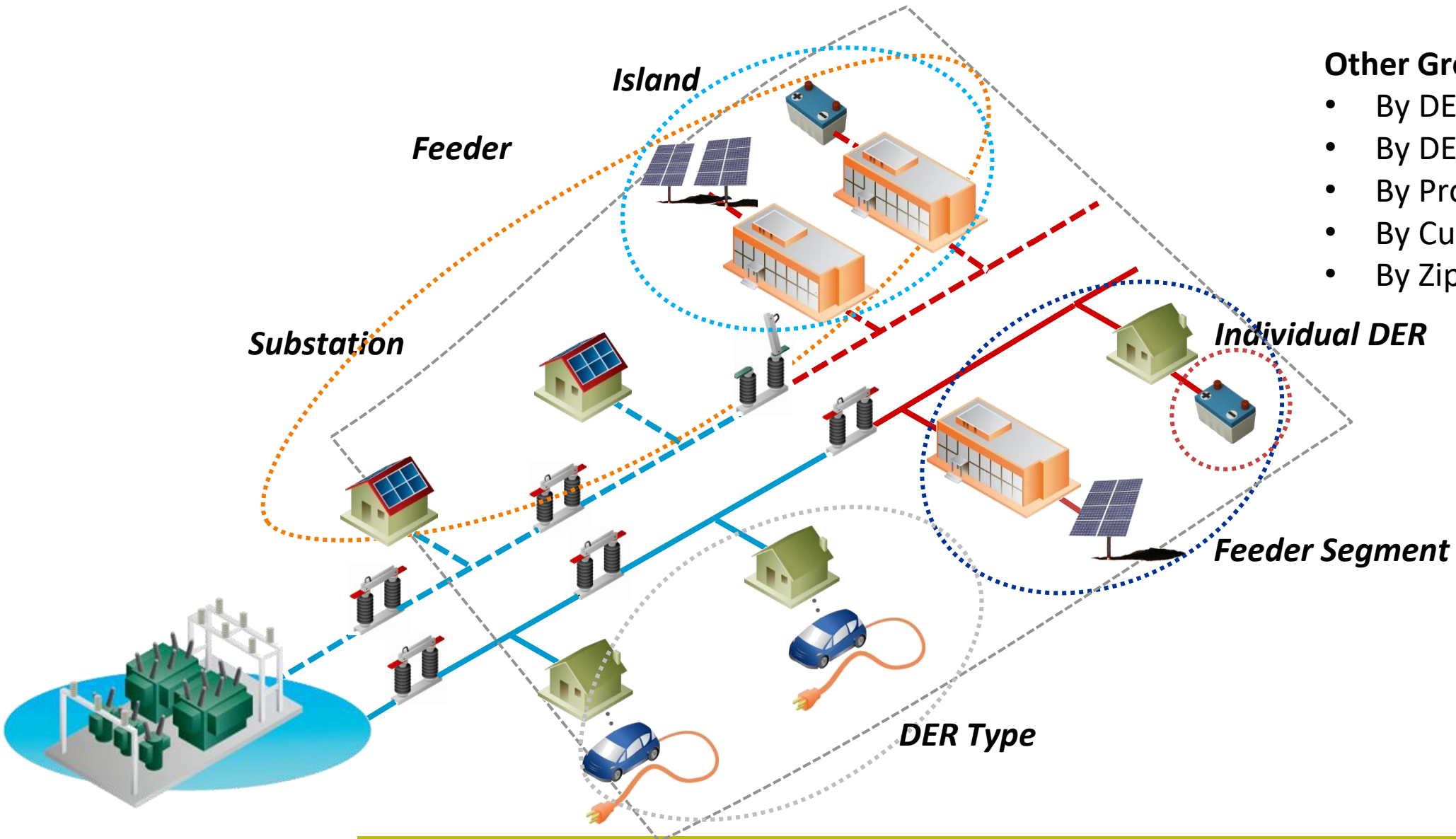


#	Type	Vendor	kW	kVar	...
1	PV	Tesla	4	3	...
2	Storage	Engie	10	10	...
3	EVSE	ABB	7	0	...
4	Storage	LG	7	7	...
5



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1	PV	Tesla	4	3	...
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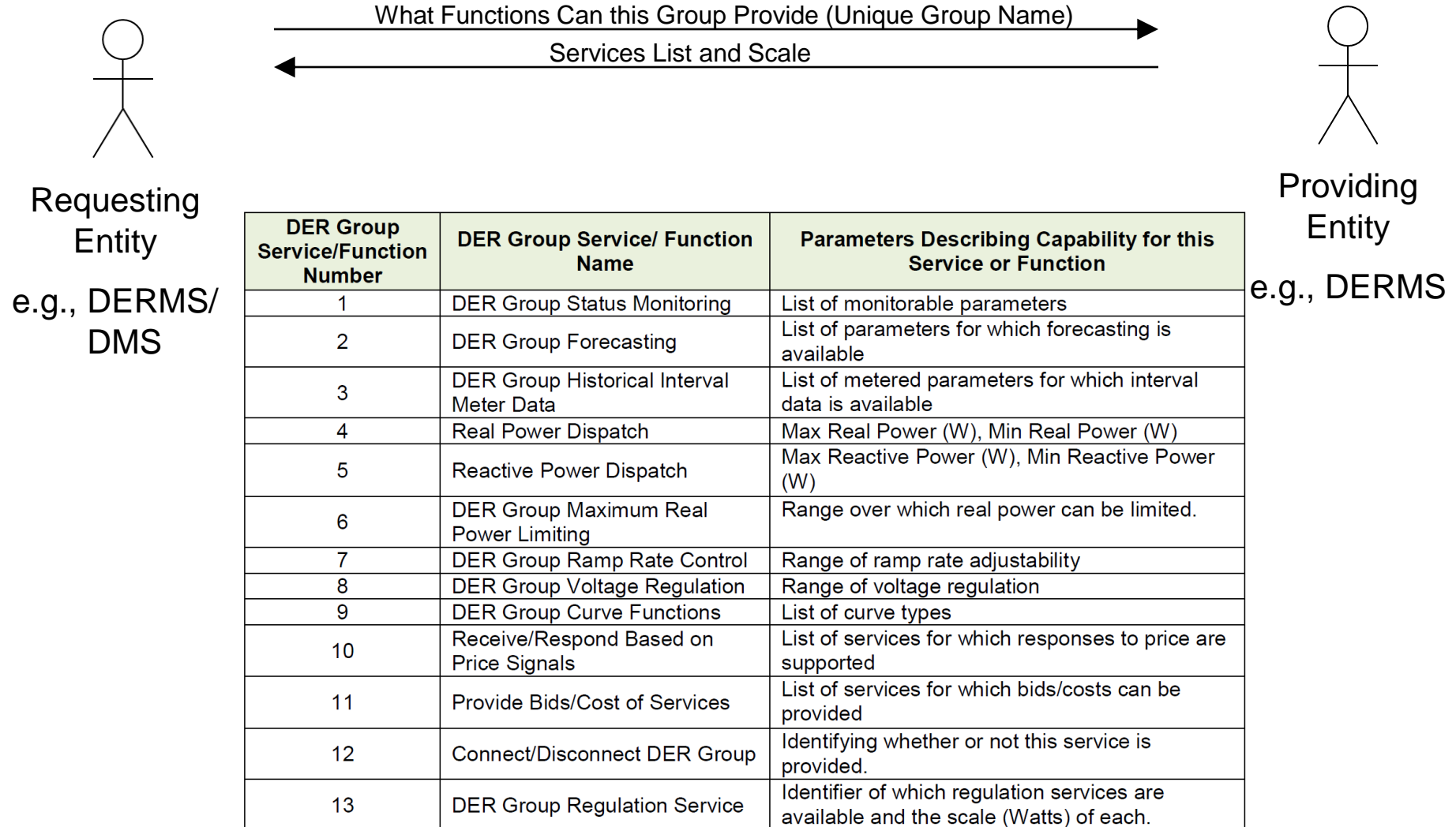
DER Group Setup – DER Group Creation



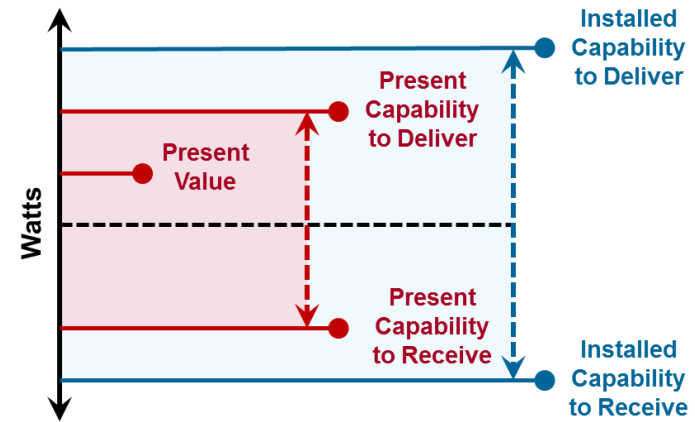
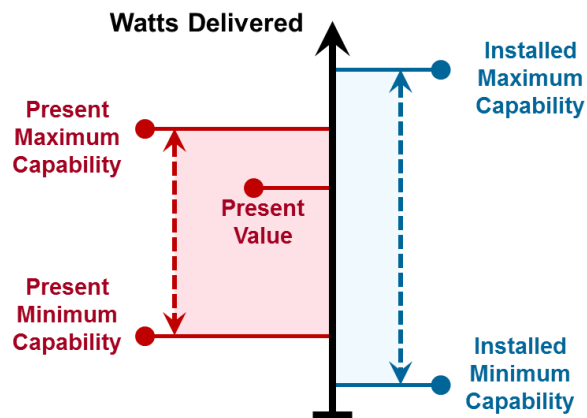
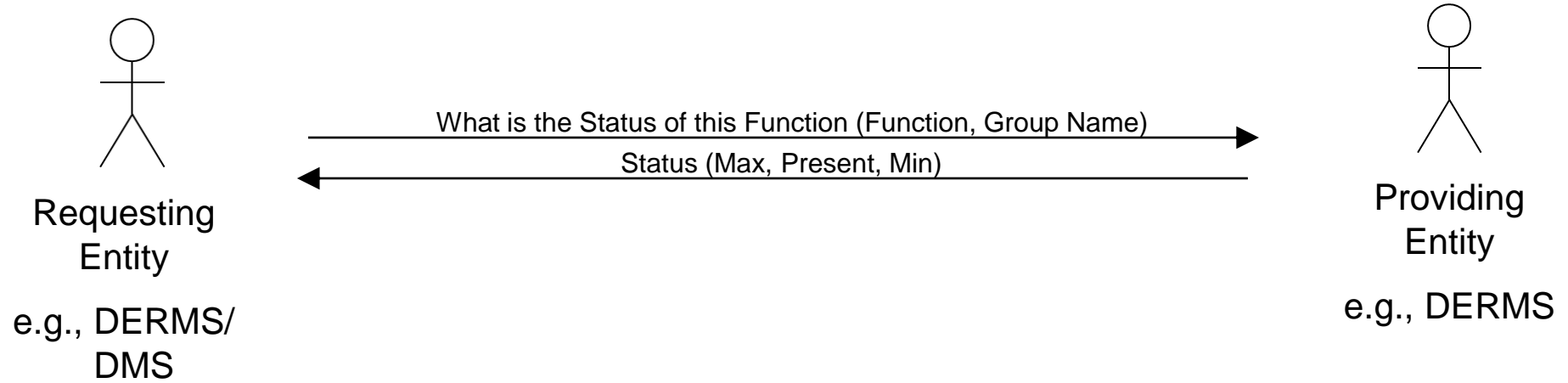
Other Grouping Methods

- By DER Circuit Phase
- By DER Owner
- By Program Enrollment
- By Customer Class
- By Zipcode etc.

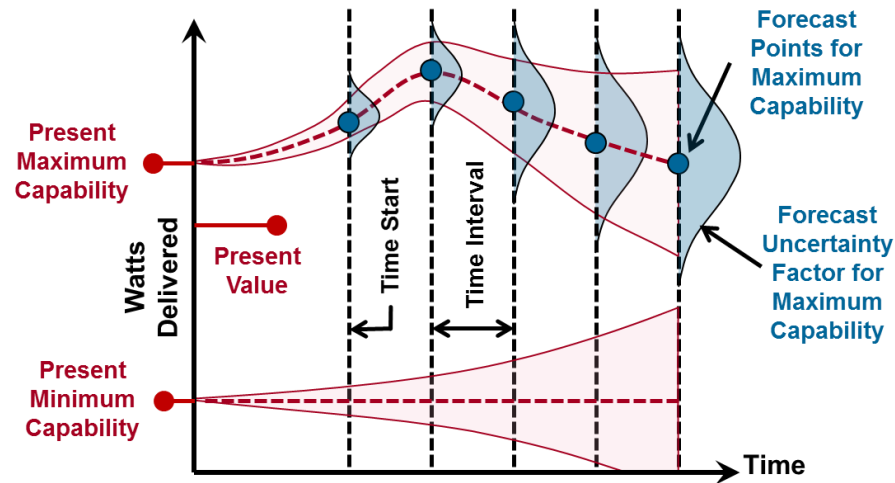
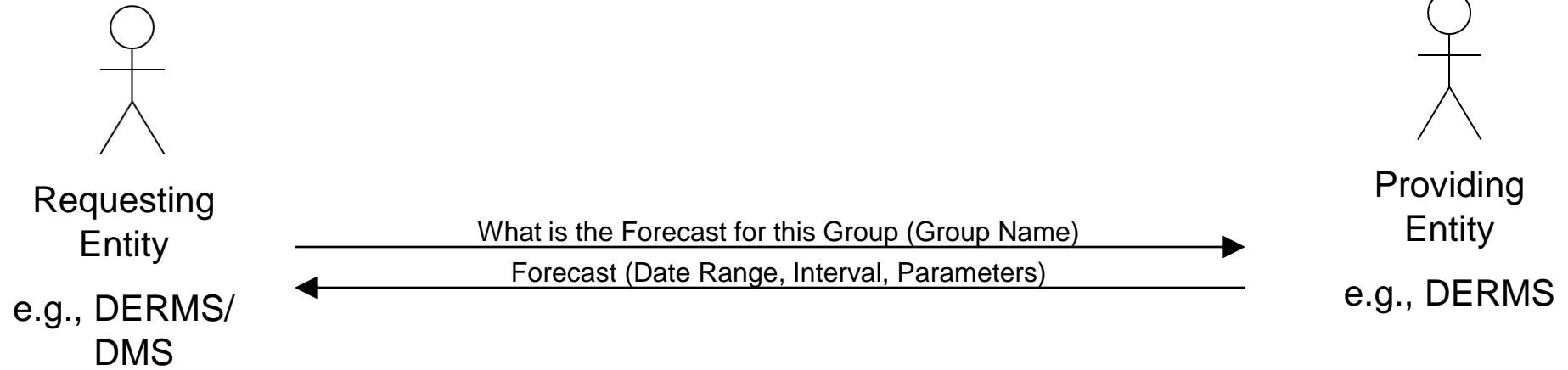
DER Group Monitoring, Capabilities, Status



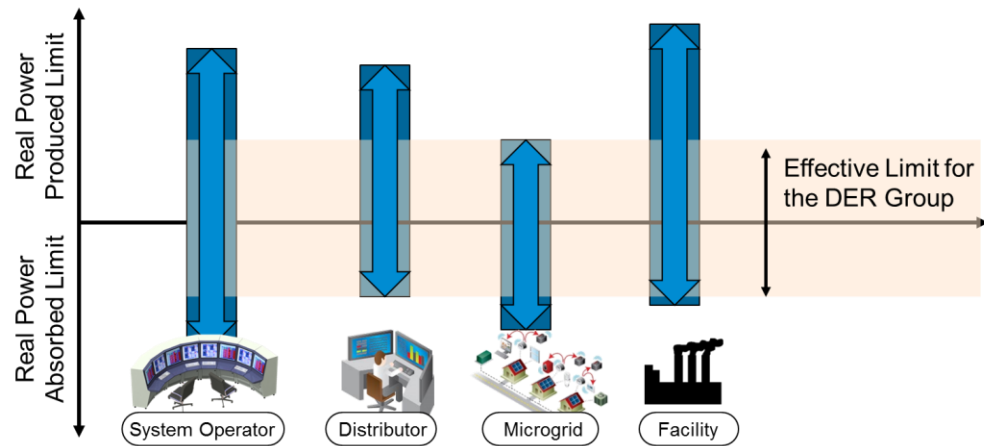
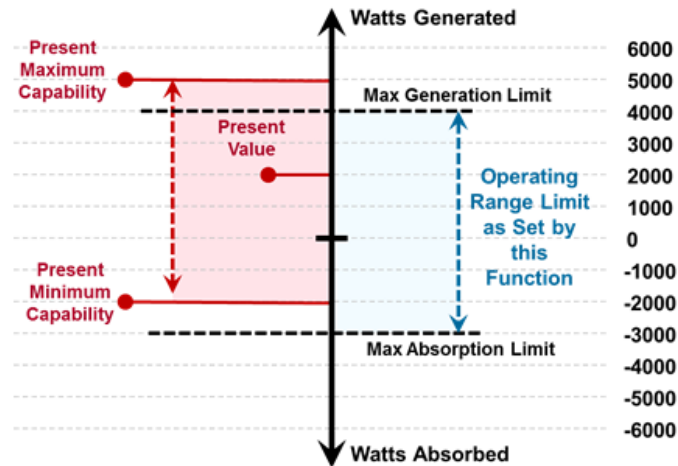
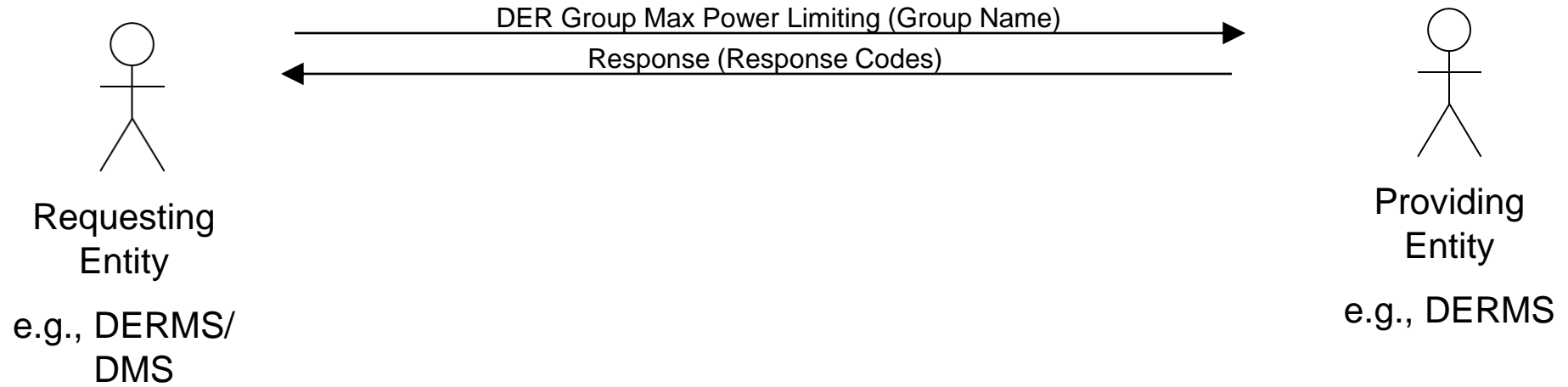
DER Group Monitoring, Capabilities, Status



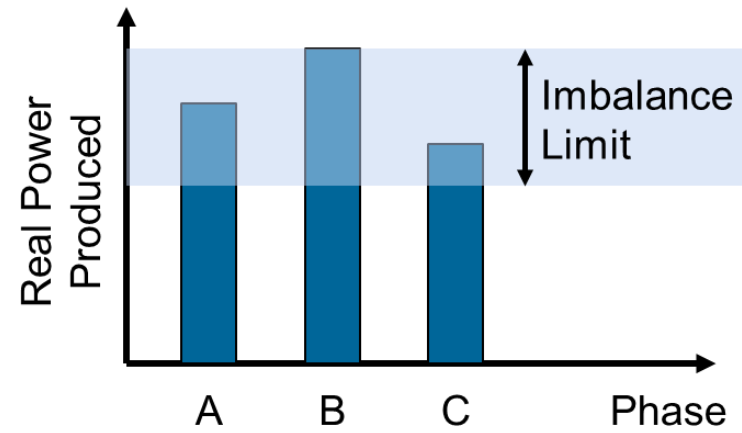
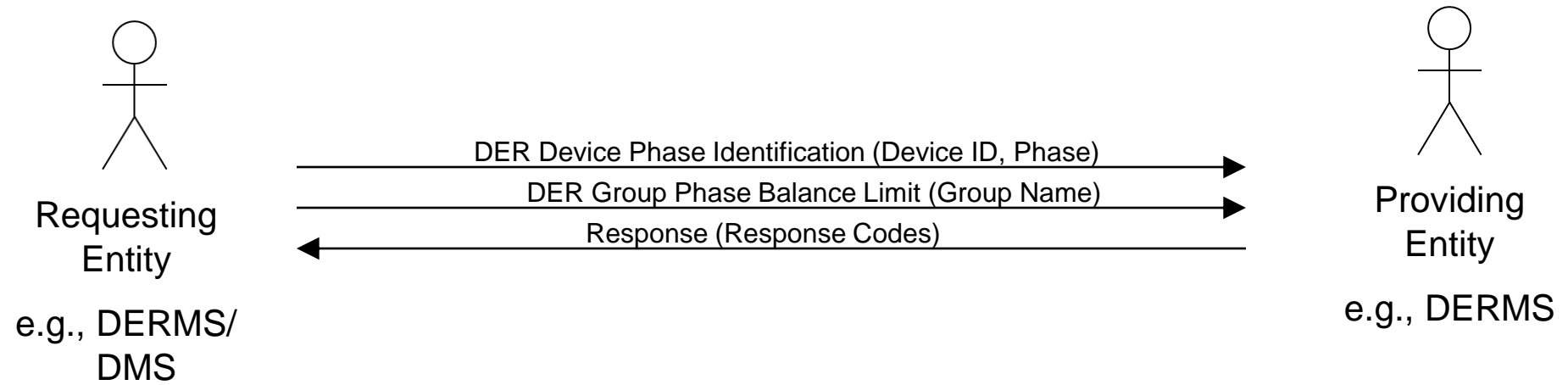
DER Group Monitoring, Capabilities, Status



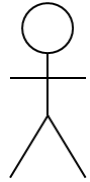
DER Group Operational Limits Boundaries



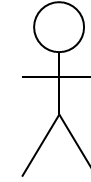
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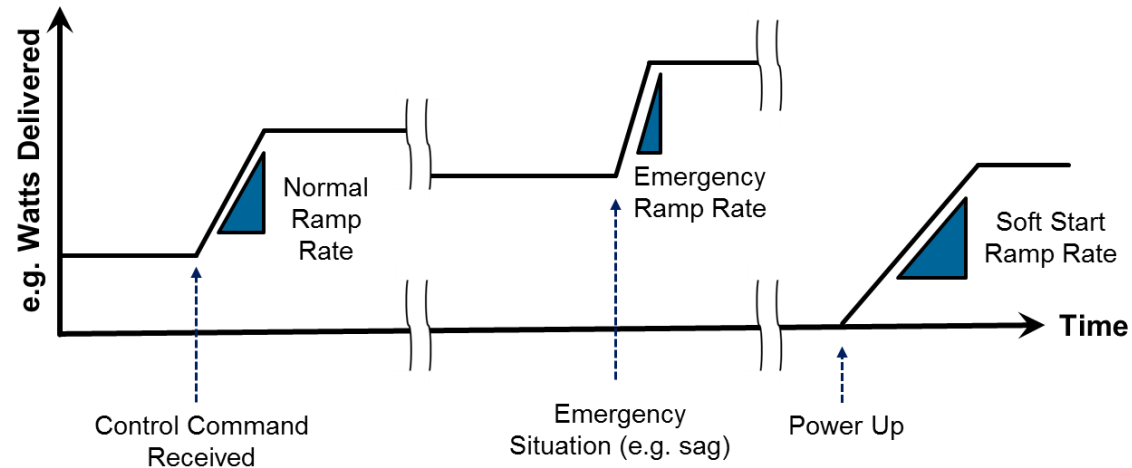
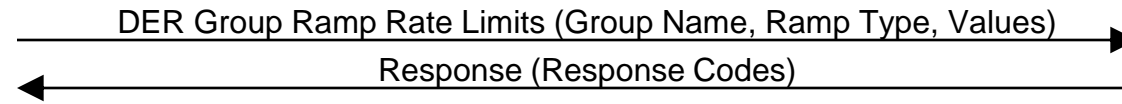
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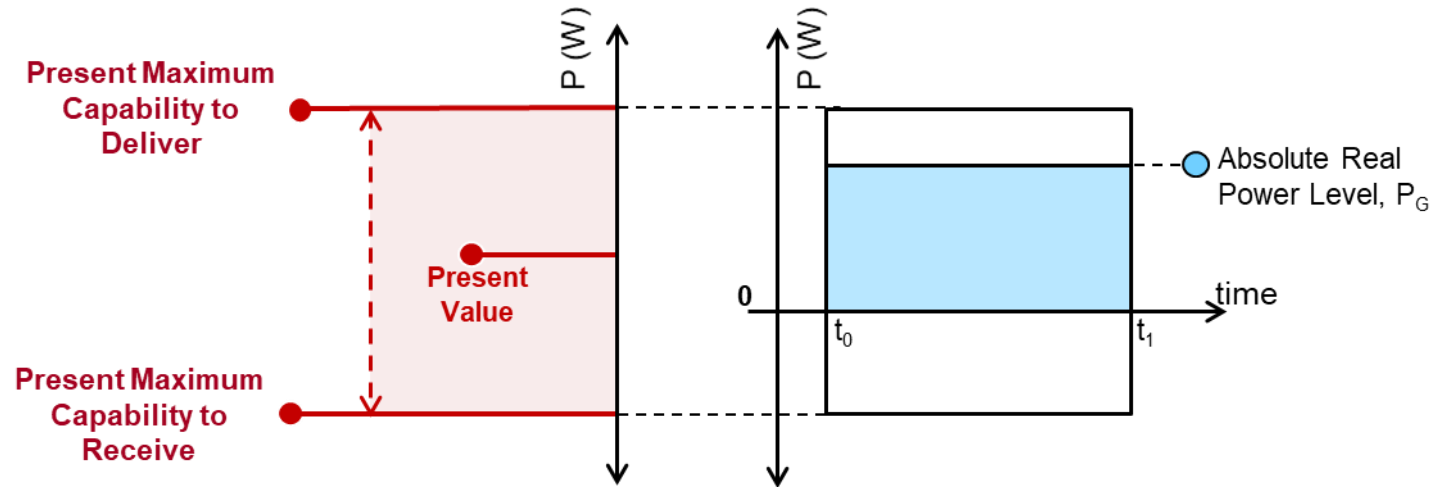
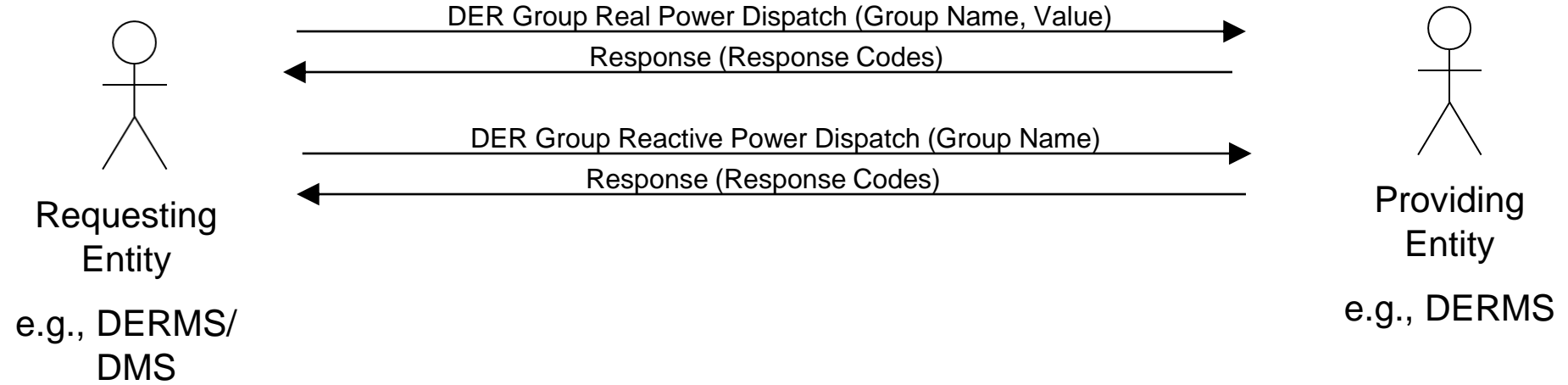
Requesting Entity
e.g., DERMS/
DMS



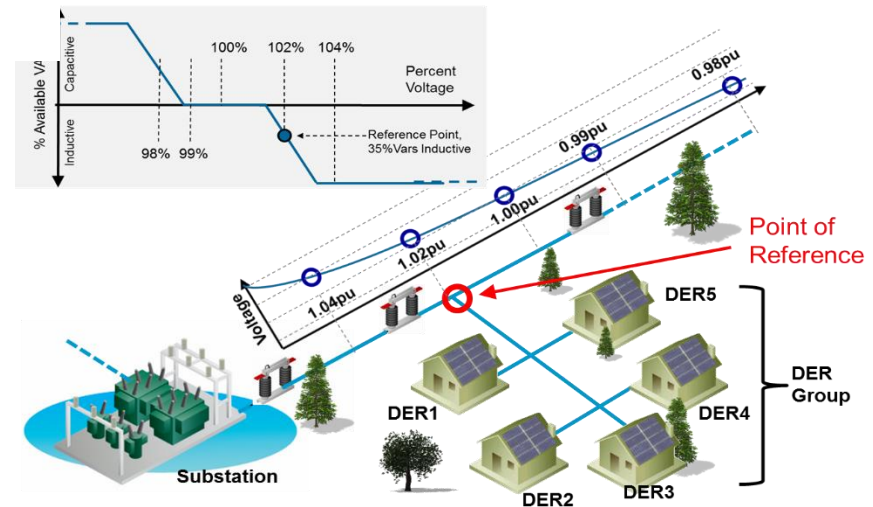
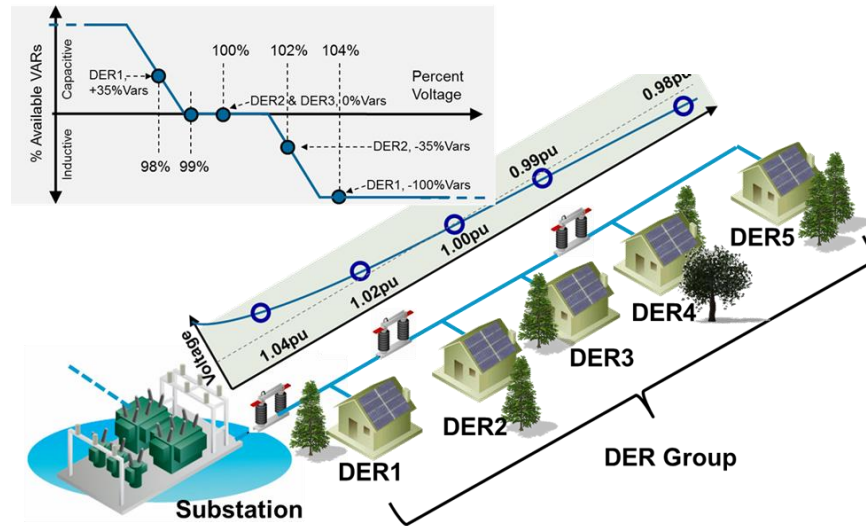
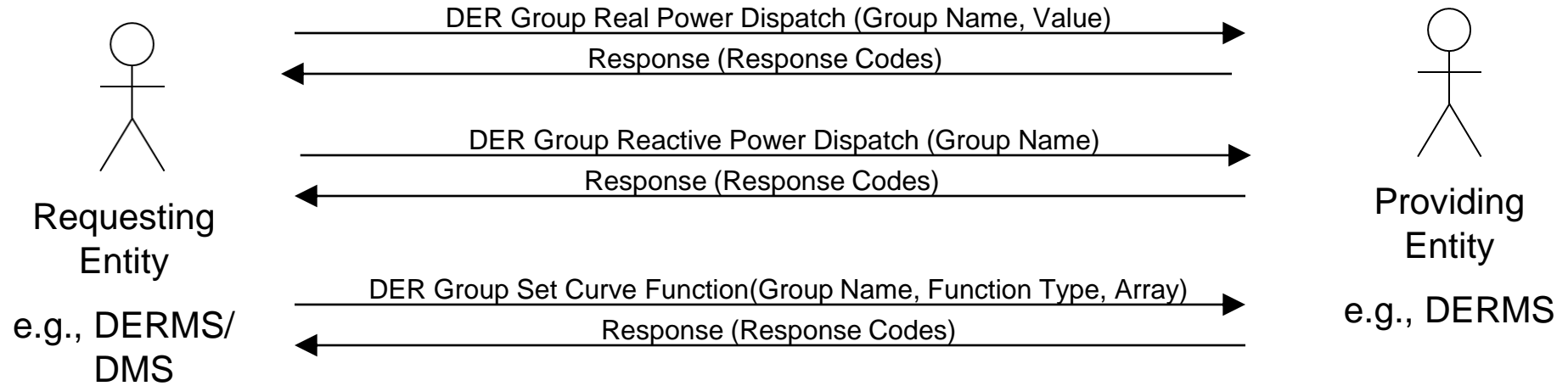
Providing Entity
e.g., DERMS



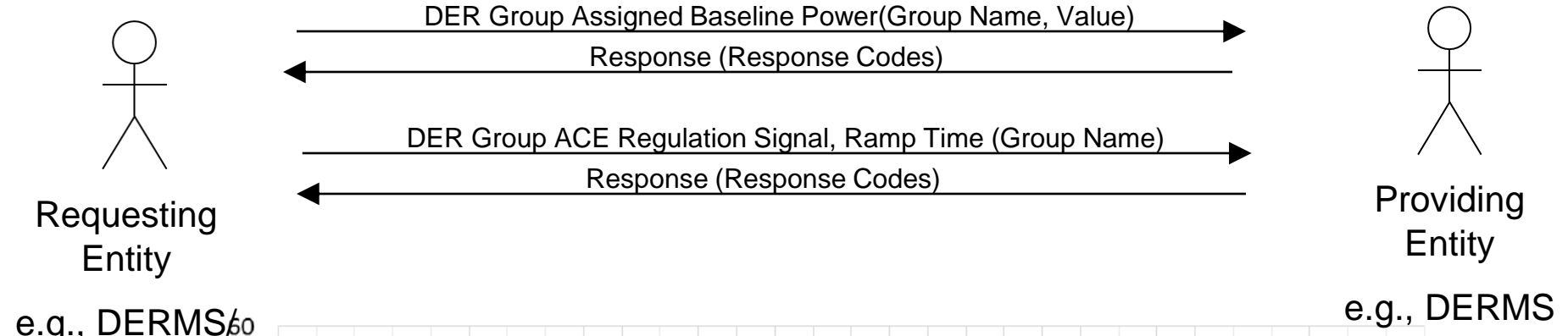
DER Group Control Functions



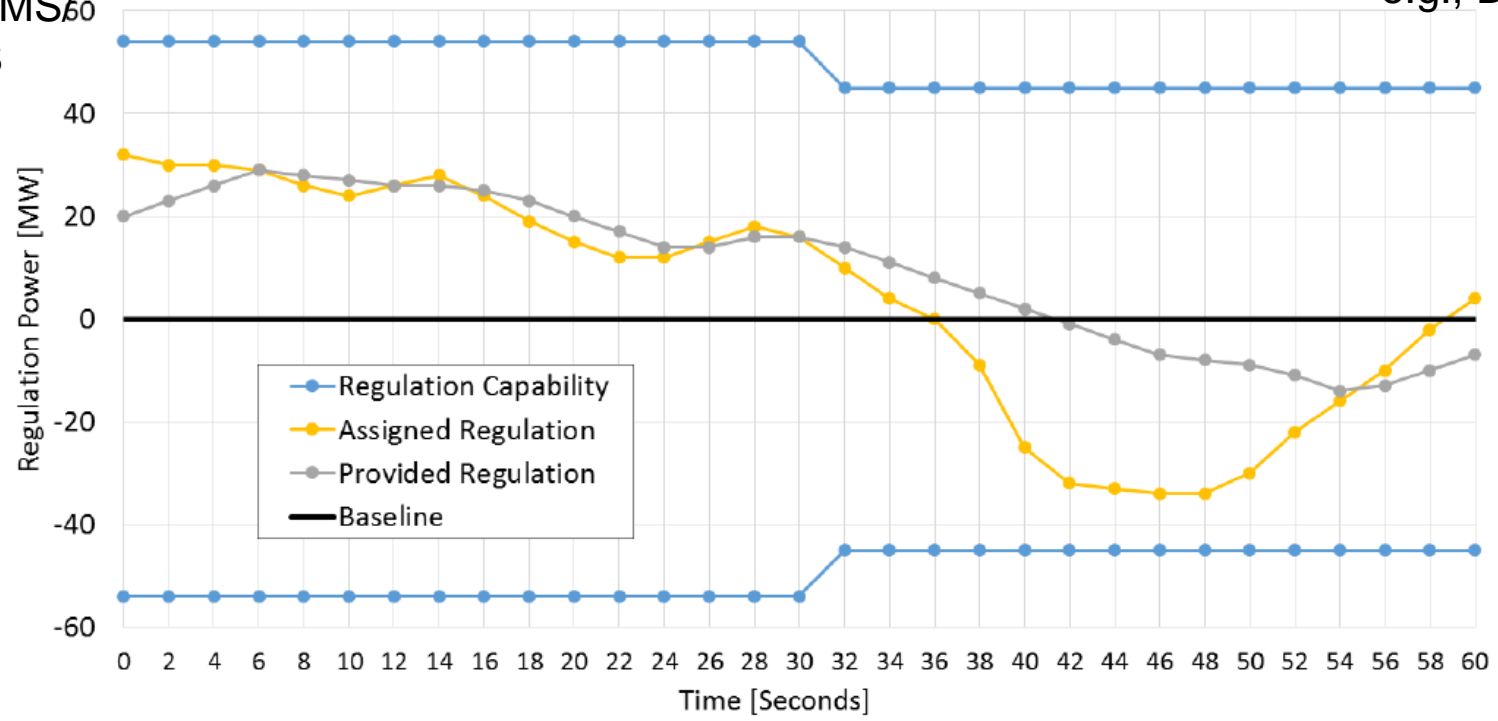
DER Group Control Functions



DER Group Regulation Function



e.g., DERMS
DMS



e.g., DERMS