

DER Communications Requirements Framework

Walt Johnson
EPRI

Angie Eide
Hawaiian Electric

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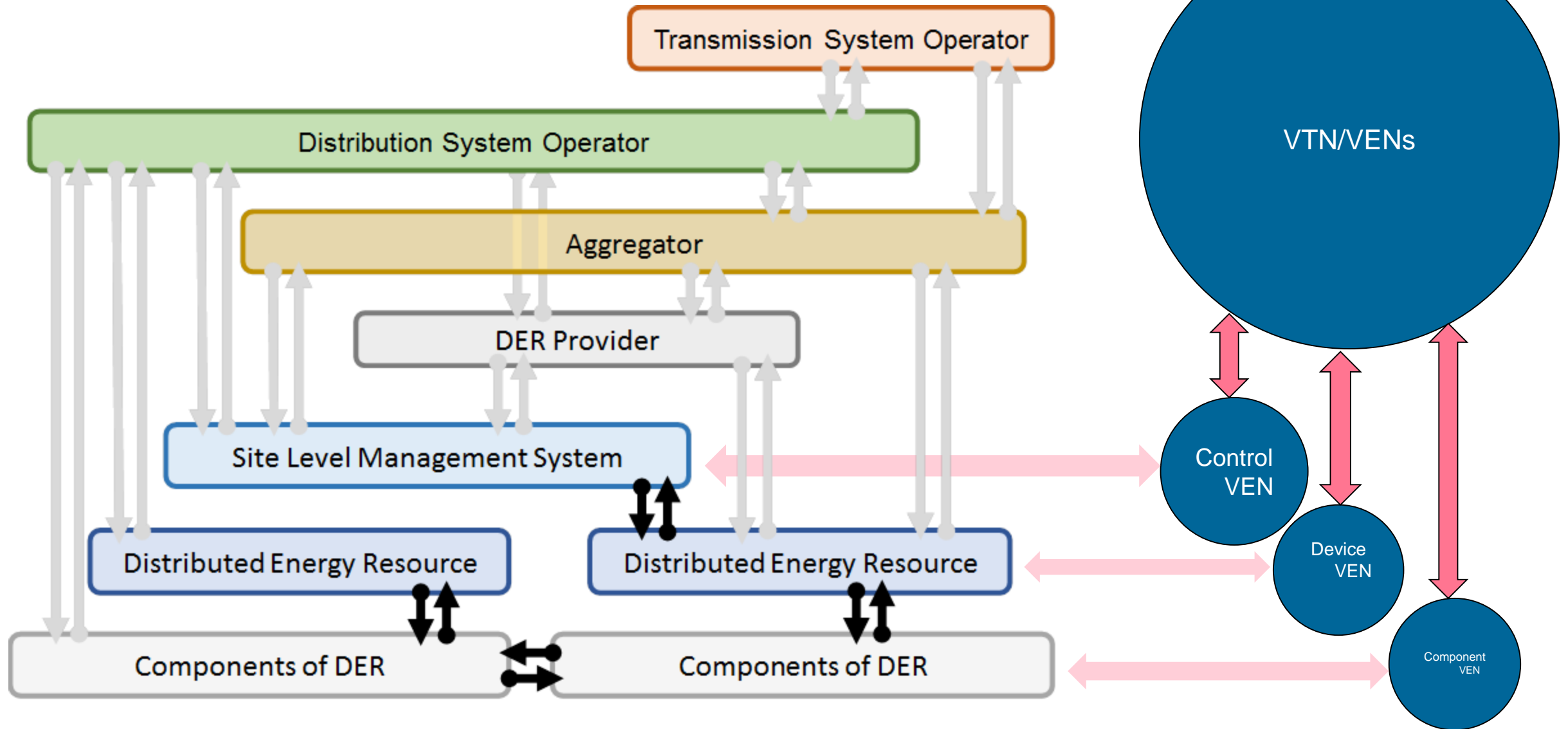
Approach

- Sources for Use Cases
- Organization of Information Operations
 - Deployment Models
 - Viewpoints
 - Communications Implications
- Non-functional Requirements
- The DER Information Message Requirements Matrix
- Working with the Matrix

Principles for Requirements

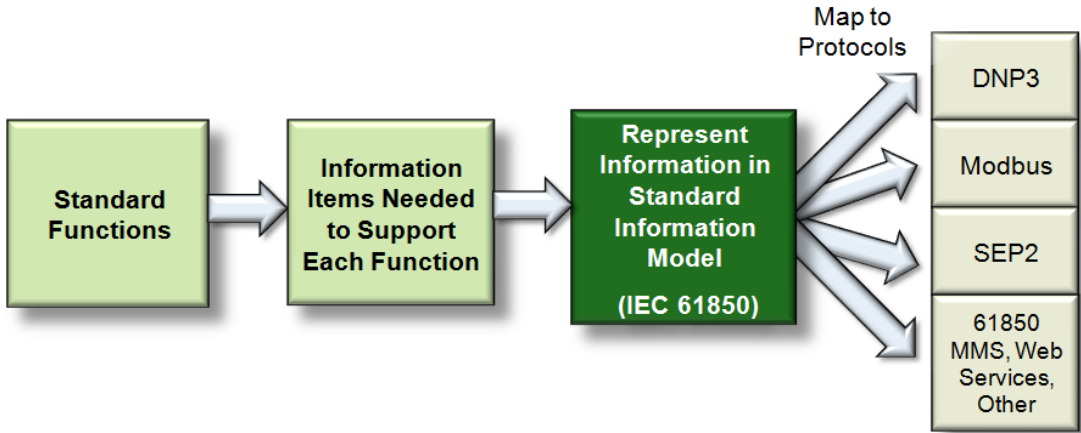
- **Focused:** Information operations that result in protocol messages between entities
- **Leveled:** Expressed at approximately the same level of detail
- **Orthogonal:** Ideally, independent of each other, without overlap
- **Vetted:** Vetted by the utility community and used as the basis for a protocol specification
- **Documented:** Well-documented, preferably by an SDO

Actors and Interactions



Common Data Models?

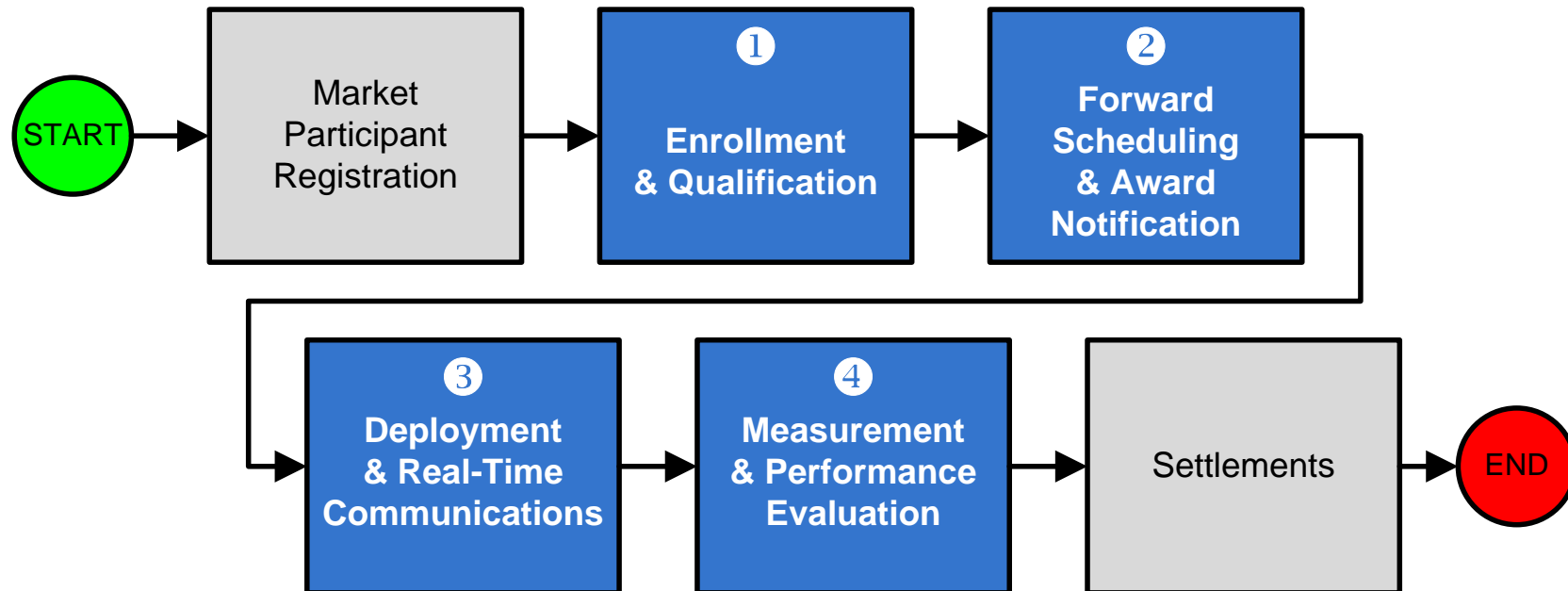
Industry Alliance	Web Service Interface	Common Data Model
IEC 61850	MMS, XMPP	IEC 61850-7-420, -90-7
IEEE 2030.5 (SEP 2.0)	REST/SOAP	IEC 61850 & 61968
OpenADR	REST/SOAP	OpenADR XML Models
SunSpec	REST	IEC 61850-7-420, -90-7



Central Role of IEC 61850-7-420 DER Data Model for Device Control

Different Objectives Lead to Different Data Models

Business Process Scope



DER Deployment Models

Autonomous Behaviors

- *Defined* by controller configuration and settings (and forward behaviors)
- *Triggered* by sensed electrical characteristics
- *Opt* out possible
- *Examples*: Inverter following Volt-VAR curve; UFR tripping on underfrequency event

Directed (Mandatory) Actions

- *Defined* by explicit instructions (immediate dispatches or signals)
- *Triggered* by information in instructions received
- *Opt* out possible, but may be subject to penalties
- *Examples*: Following awarded energy schedule or regulation signal; modifying load during an event

Advisory (Optional) Responses

- *Defined* by grid information (prices or operating conditions)
- *Triggered* by analysis of information received and controller rules
- *Opt* in as desired
- *Examples*: Opting to supply power to the grid; choosing to charge an EV during off-peak period

DER Deployment Models – Communications Implications

Autonomous Behaviors

- *Receipt* of modifiable controller settings (curves, limits, etc.) and forward behaviors (power level schedules and events), tariffs
- *Receipt* of control signal (if not locally-sensed)
- *Reporting* of trips or inability to maintain behavior; performance data

Directed (Mandatory) Actions

- *Receipt* of explicit instructions (immediate dispatches or signals), disconnect/reconnect
- *Opt out* message communications
- *Reporting* (after the fact) of performance data

Advisory (Optional) Responses

- *Receipt* of grid information (prices or operating conditions)
- *Reporting* (after the fact) of performance data

Sources of Use Cases Considered

- ISOs/RTOs
 - CAISO
 - ISO-RTO Council
 - NYISO
- Government
 - CPUC
 - NIST
- Consultants
 - EnerNex
 - KEMA
 - UISOL
 - Xanthus
- Research Organizations
 - EPRI
 - LBNL
 - Sandia
- Utilities
 - TEPCO
 - SCE
- Standards Bodies/Industry Consortia
 - NERC
 - OpenSG
 - SAE
 - UCAIug

Filtering the Use Cases

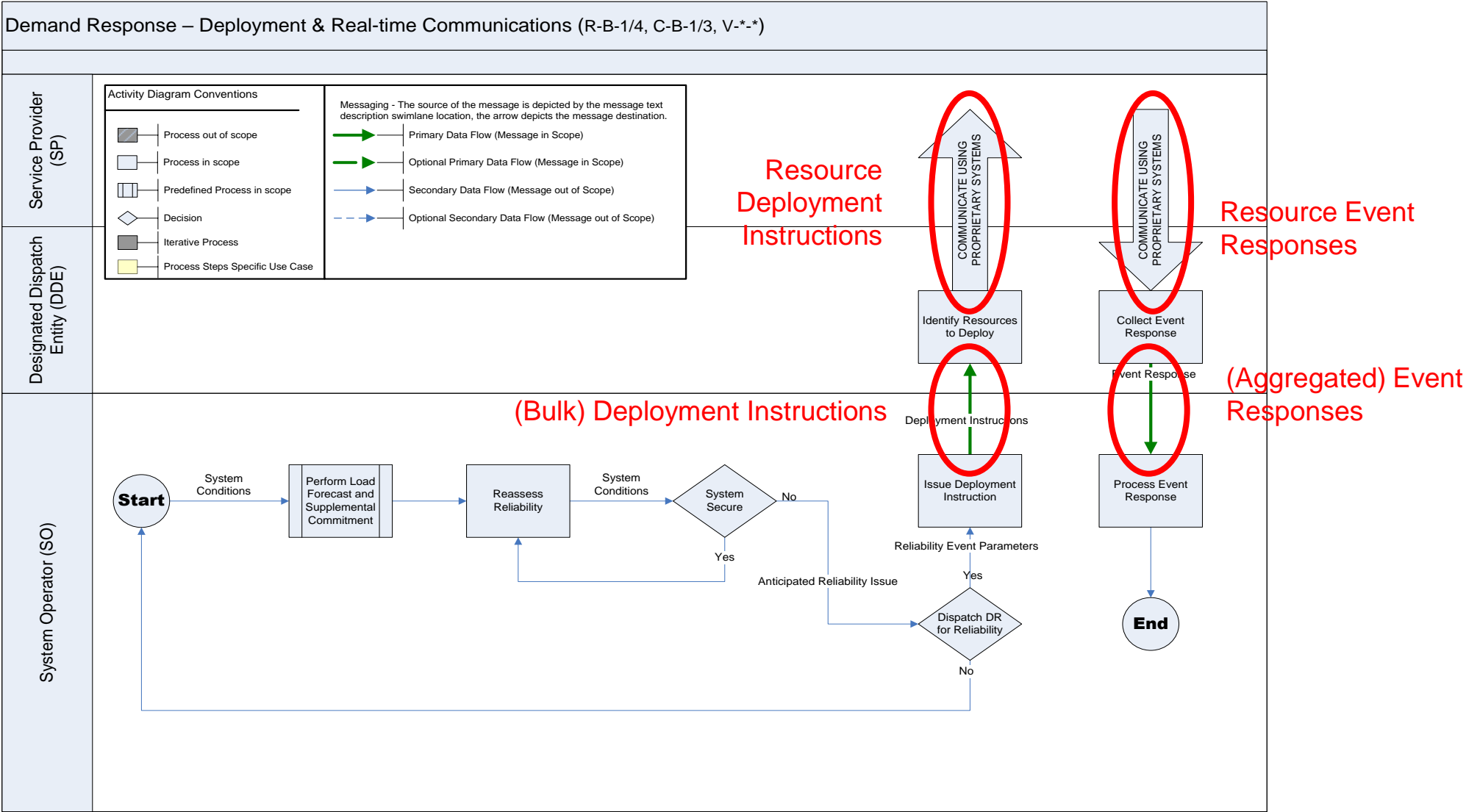
ISOs/RTOs
CAISO
ISO-RTO Council
NYISO
Government
CPUC
NIST
Consultants
EnerNex
KEMA
UISOL
Xanthus
Research Organizations
EPRI
LBNL
Sandia
Utilities
TEPCO
SCE
Standards Bodies/Consortia
NERC
OpenSG
SAE
UCAIug




NAESB Retail
NAESB Wholesale
CA Rule 21
A Few Others



Extracting Communication Requirements from Use Cases



Extracting Communication Requirements from Use Cases



RECOMMENDATION TO NAESB EXECUTIVE COMMITTEE

For Quadrant: Retail Electric Quadrant (REQ)
Requesters: NAESB Smart Grid Task Force (SGTF)
Request No.: 2010 Retail Annual Plan Item 9(c)
Request Title: Requirements Specifications for Retail Standard DR Signals - for NIST PAP09

REQ.14.3.2.4.7.3 Cancel a DR Event (Retail)

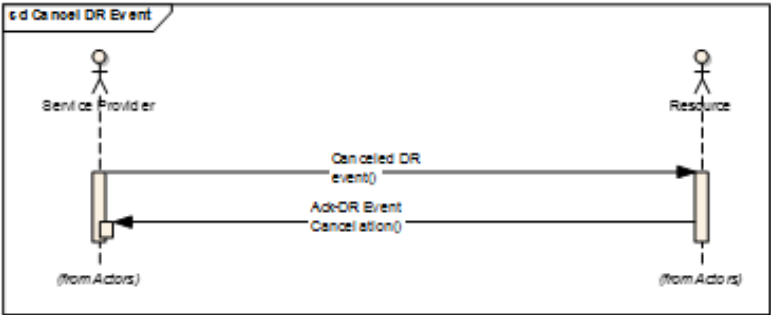
Description

This is used by the Service Provider to notify the DR Resource that a DR Event is being cancelled. It should only be executed if a DR Resource has previously received notification of a DR Event and that event has subsequently been cancelled.

Data Requirements

Attribute Name	Description
Cancellation reason code	The reason the event is being cancelled.
DR Event Identifier	An identifier for the event that is being cancelled.
Effective date/time	The date and time a cancellation takes effect.

Sequence Diagram



Canceled DR event

Ack-DR Event Cancellation

Cyber Security and DER Protocols

- All of these protocols operate over a TCP/IP network stack.
- Mechanisms for securing TCP/IP connections (such as Transport Layer Security [TLS] and various Wi-Fi mechanisms) are well developed and can be used for DER communications.
- Cyber security requirements can be burdensome, particularly for lower-end devices.
- Authentication of client and server systems is often specified to require the use of PKI certificates, which can lead to complications associated with key distribution and management.
- Some protocols, such as OpenADR, have the option of adding additional layers of security through the use of XML signatures.

Cyber Security Is Necessary, but Can Be Challenging

The DER Information Message Requirements Matrix

Structure of the Matrix

- Category
 - Subcategory
 - Information Operation
 - Viewpoint
 - Device
 - Resource
 - Operator

The Management and Transactions Categories

Category	Subcategory	Information Operation	Viewpoint		
			Device	Resource	Operator
Management	Registration (not enrollment)	Send Resource Registration Request (NAESBR)		X	
		Send Resource Registration Update (NAESBR)		X	
		Send Resource Registration Removal (NAESBR)		X	
		Send Device Registration Request (NAESBR)	X		
		Send Device Registration Update (NAESBR)	X		
		Send Device Registration Removal (NAESBR)	X		
	Identification and Grouping	Initiate and/or respond to device discovery messages (CAR21)	X	X	X
		Send group assignments and updates for devices (CAR21)		X	
		Send Aggregated Capabilities for Groups of Devices (CAR21)		X	
		Send List of Specific Devices in a Group (CAR21)		X	
	Software Update	Receive Device Software Update (CAR21))	X		
Transactions	Bids & Offers	Send Bids and Offers (NAESBW)		X	X
		Receive Bids and Offers (TE)		X	X
	Scheduling & Award Notification	Send Awarded Schedule (TE)		X	X
		Receive Awarded Schedule (NAESBW)		X	

The Operations Category

Operations	Autonomous Deployment (Information to Control Future Automatic Responses)	Receive Updates to Immediate Controls, Curves, and Programs, Real and Reactive Power Functions, Frequency Support, Frequency/Voltage Ride-Through, and Must-Trip Settings and Schedules (at least daily and as defined by UL 1741-SA, IEEE 1547.1, and CA Rule 21) (CAR21)	X		
		Receive Periodic, Daily, Weekly, and Seasonal Schedules (CAR21)	X	X	
		Receive TOU Prices, CPP, or Real-Time Price (WJ)		X	
	Advisory (Nondispatchable) Deployment (Information Used for Optional Responses)	Receive Advance Notification of Voluntary Grid Event (NAESBR)		X	
		Receive Updated [Future] Voluntary Grid Event Information (NAESBR)		X	
		Receive Cancellation of Voluntary Grid Event (NAESBR)		X	
		Send Confirmation [of Receipt] of Voluntary Resource Event (NAESBR)		X	
		Receive RTP Notification [Non-binding "Economic Dispatch"] (NAESBR)		X	
	Directed (Dispatchable) Deployment (Instructions for Immediate Mandatory Action)	Receive [Real-Time Resource] Dispatch Instruction (NAESBW; NAESBR)		X	
		Receive [Real-Time Device] Direct Control Instruction (NAESBR)	X		
		Receive [Real-Time] Reliability Event (NAESBW)		X	
		Receive Regulation Signal (NAESBW) [Special Case?]		X	
		Receive [Immediate] Disconnect/Reconnect Command (CAR21)	X	X	
		Receive Command to Activate/Deactivate Modes, etc. (CAR21)	X	X	
	EV	Send Energy Request (SAE J2836)	X	X	
		Receive Energy Availability and Schedule (SAE J2836)	X	X	
		Send Energy Status (SAE J2836)	X	X	

The Reporting Category

Reporting	Status	Send Aggregated Analog Data (Watts VARs, Hz, etc.) (NAESBR, CAR21)		X	
		Send Meter Reading of Real Power Output (in Watts), Reactive Power (in VARs), Frequency (in Hz), Frequency [sic] (voltage) (in Volts) (NAESBR, CAR21)	X		
		Send Real-Time Telemetry (NAESBW)	X	X	
		Receive Request for Management and Status Information, Including Current Settings and Configuration (HE)	X	X	
		Send Management and Status Information, Including Current Settings and Configuration (CAR21, HE)	X	X	
		Send Status for Device (Percent of Rated Capacity, Charge Rate, Apparent Power, Reactive Power, Active Power, and PF Displacement) (CAR21)	X		
		Send Active Curves (CAR21)	X		
		Send Connection Status, Inverter Status, etc., Aggregated by FDEMS (CAR21)		X	
	Configuration	Send Aggregator Admin Information (ID and Timestamp Headings; Aggregator Info, Capabilities, DER UUIDs; and Group Ratings [Watts VA, VARs, Ohms [?], PF]) (NAESBR, CAR21)		X	
		Send Device Location ID (CAR21)	X		
		Send Device Nameplate Info and Ratings (Watts, VA, etc.) (CAR21)	X		
	Performance	Send Performance Data (at least daily) (CAR21)	X	X	
	Notifications & Alarms	Send Notification of Disconnect/Reconnect (CAR21)	X	X	
		Send Reduced Aggregated Group or Individual Inverter Rating Alarm Due to Changes in Operational Status Such as Failures, Maintenance, etc. (CAR21)		X	
		Send Inverter Online/Offline Alarm Due to Operational Changes Such as Failures, Maintenance, etc. (CAR21)	X		
		Send Loss-of-Inverter-Communication Alarm (CAR21)	X		

Other Assumptions/Requirements - 1

- OpenADR assumes that clients maintain time; other protocols (such as 2030.5) synchronize time
 - NTP works
- Deployment Architectures
 - Pub/Sub (such as 2030.5)
 - Client/Server (OpenADR)
 - Device Discovery?
- Presentation Layer
 - HTTP (most)
 - XMPP (optional for OpenADR)

Other Assumptions/Requirements - 2

- Cyber Security
 - Authentication
 - Lightweight alternative(s) to PKI?
 - Data encryption
 - Is it required for nonfinancial messages?
- Performance
 - Requirements for meeting some services (like regulation)
 - Scalability to thousands of devices? To millions?

Working with the Matrix

Angie Eide
Hawaiian Electric

Questions to Get Us Started

- Any feedback on deployment scenarios?
- Is the matrix something you can work with? Does it pass the sniff test?
- Did we hit the right level, that is, we didn't include enrollment or settlement, would it have been better to include them?
- Do the categories/sub-categories make sense?
- Is there a better way to organize and present the requirements than this matrix?

Questions for the Breakout Groups

- What do you think of the framework and requirements?
- How would you use this material?
- What's missing or can be improved?
- What do we report back?
- Who reports out the results of each group?



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