OpenADR
Business and User Requirements Document

(Phase 2)

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Bruce Bartell, Xtensible Solutions
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Document History

Revision History

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0.0	05/17/2011	Gerald Gray	Added PEV Use Cases in Section 6	N
0.2	05/17/2011	Bruce Bartell	Added DER Use Case stubs in Section 6	N
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			changes and deleted comments.	

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1.0 INTRODUCTION

1.1 Introduction to Automated Demand Response

The Open Smart Grid Open Automated Demand Response (OpenADR)[1] is an industry-led initiative under the Open Smart Grid (OpenSG) subcommittee within the UCA International Users Group (UCAIug). The OpenADR Task Force defines systems requirements, policies and principles, best practices, and services, required for business and data requirements for standardizing control and pricing signals for Demand Response (DR) and Distributed Energy Resources (DER) as part of the Smart Grid implementation[2].

OpenADR facilitates automated demand response for load shedding or shifting through demand response signals containing dynamic pricing or event objectives. Demand Response Events are in response to emergency or reliability conditions that affect the grid.

1.2 Purpose of Document

The Purpose of this Document is to define the business and user requirements for Open Automated Demand Response (hereafter OpenADR) for Phase 2.

The content of this document builds on the work of "Open ADR Functional Requirements and Use Case Document Version 1.0" and "OpenADR 1.0 System Requirements Specification" ("OpenADR SRS"). The existing OpenADR SRS contains the definitions of roles, actors, and data architecture that is built upon in this document. The Service Definitions that support the data architecture defined in the SRS are defined in "OpenADR 1.0 Service Definition – Common".

The functional areas addressed in OpenADR Phase 2 are based on priorities agreed upon by the OpenADR Task Force subsequent to the ratification of the OpenADR 1.0 System Requirements Specification and the associated OpenADR 1.0 Service Definitions.

Further definition of these functional areas and the resulting requirements is defined in Section 2.

[1] The OpenADR Task Force of the Open Smart Grid Users Group acknowledges the work coordinated by the Demand Response Research Center and funded by the California Energy Commission (Energy Commission), Public Interest Energy Research (PIER) Program in development of the *Open Automated Demand Response Communications Specification*, also known as OpenADR or Open Auto-DR. For the purposes of this document the specification will be cited using the full title. The term OpenADR SRS or SRS refers to the *OpenSG OpenADR System Requirements Specification*.

[2] *Requirements Specifications for Wholesale Standard DR Signals - for NIST PAP09, Requirements Specifications for Retail Standard DR Signals - for NIST PAP09*

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1.3 Terms and Definitions

This subsection provides the definition of select terms used in this document.

Term	Definition
Authorizing Entity	The entity (e.g. PUC, Utility, bonding agent, etc.) who approves a 3rd Party to utilize the OpenADE interface.
Authorized Request Token	A unique identifier (without Personal Information) shared between the Utility and 3rd Party, defined based on the authentication standard being used.
Automated Data Exchange (ADE)	System by which third parties can receive Consumer Utility Data from utilities.
Automatic Generation Control (AGC)	Often priced separately from power generation and procured as an ancillary service, these regulation services are used to continuously fine tune the balance between generation and demand.
Customer	A consumer who receives service from the Utility.
Consumer Utility Data	May include consumer electrical usage data, consumer energy management data, meter events, HAN information
Consumption Data	Generally, the collection of current and historical consumer electrical usage data.
Direct Device Control (DDC) aka Direct Load Control (DLC)	From the SAE PEV use cases, this acronym is used to describe a signal that may be sent to a device as part of a demand response program.
Personal Information	Information that pertains to a specific individual and can be used to identify that individual, such as Customer name, address, zip code, utility account number, or other information which identifies the individual customer in the utility back office system
OpenADE	A standard interoperable interface, as defined by OpenSG SG System Working Group, the business and user requirements of which are contained in this document.
Service Delivery Point (SDP)	Logical point on the network where the ownership of the service changes hands -- typically where a meter may be installed.
3rd Party	A party who has been authorized by an authorizing agent (e.g. utility, PUC, bonding agent, etc.) to receive customer information through the OpenADE interface at the request of the customer.
Utility	The electric service provider, which, at a minimum, is responsible for reading the electric meter, providing HAN access to the meter, and delivering energy to the consumer. This may be an integrated electric utility or a Transmission and Distribution utility.

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Term	Definition
Alternative Energy Supplier (AES) or ESCO	May act as an alternative to the utility in establishing a relationship with the customer. Also known as an ESCO, a Competitive (or alternative) supplier of commodity service
Energy Service Communications Interface (ECSI)	Used by the utility or AES for establishing a communication session
Electric vehicle (EV) -	
End Use Measurement Device (EUMD)	The device that measures and communicates energy usage information payload to Energy Services Communication Interface (ESCI).
Electric Vehicle Supply Equipment (EVSE)	PEV connects to the grid using an Electric Vehicle Supply Equipment (EVSE). Electric Vehicle Supply Equipment (EVSE) is the physical electrical cord and connectors that are specified by applicable SAE standards (e.g., SAE 2293, J1772, J2836 & J2847.) that provide transfer of electrical energy from energy portal to PEV. This can be 120V or 240V AC depending upon connection. Two type of connection include 1) EVSE cordset and 2) Premise Mounted version. The Premise EVSE would not include the charger for AC (Level 2) energy transfer described in J1772. This would expect the charger to be included with the vehicle. If the EVSE included a charger, DC (Level 3) energy transfer is expected and the vehicle would not include the charger since it was within the EVSE. This EVSE that includes the charger may also be capable of AC energy transfer at both 120V (Level 1) and 240V (Level 2) levels as described in J1772.

1.4 References

S. Bradner, Key words for use in RFCs to Indicate Requirement Levels,

http://www.ietf.org/rfc/rfc2119.txt, IETF RFC 2119, March 1997.Informative References

- Southern California Edison SmartConnect Program Use Case: P1 – Utility Provides Services to Plug-In Electric Vehicle (PEV) Customer
- Southern California Edison SmartConnect Use Case: P2 – Customer Connects Plug-In Electric Vehicle (PEV) to Premises Energy Portal
- Southern California Edison SmartConnect Use Case: P3 - Customer Enrolls in a PEV Demand-Side Management Program
- SAE Vehicle Use Case Task Force J2836/1™
- Energy Independence and Security Act of 2007

2.0 OPENADR BUSINESS RATIONALE

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This section describes the business rationale behind OpenADR – that is, the fundamental business justification for defining the system.

2.1 Background

In response to local and federal initiatives toward improving grid reliability and promoting consumer involvement in balancing supply and demand of energy resources, the Open Smart Grid (OpenSG) subcommittee within the UCA International Users Group has organized a number of working groups and task forces to develop requirements and specifications for Smart Grid needs. Subsequently, a task force (OpenADR) has been formed within OpenSG to gather requirements and use cases for ADR from all interested stakeholders, including utilities, 3rd parties, consumers, regulators, and others.

Under the Energy Independence and Security Act (EISA) of 2007, the National Institute of Standards and Technology (NIST) was given the "primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems…" [EISA Title XIII, Section 1305]. NIST has engaged a broad range of stakeholders in the development of a Smart Grid Interoperability Standards Roadmap and the formation of the SmartGrid Interoperability Panel (SGIP). The outcome of two workshops hosted by NIST was a list of critical standards and standards development activities needed for the Smart Grid. In an August 10, 2009 report, NIST proposed a set of fourteen Priority Action Plans (PAPs) (and still growing) for developing standards necessary to build an interoperable Smart Grid. PAP09: Standard DR and DER Signals[3] is one of these PAPs.

The UCA OpenSmartGrid organization, in conjunction with The North American Energy Standards Board (NAESB), developed the document "Framework for Integrated Demand Response (DR) and Distributed Energy Resources (DER) Models". This work was the foundation for the NAESB "Requirements Specification for Retail Standard DR Signals – for NIST PAP09". This document served as the Requirements Document for the "OpenADR 1.0 System Requirements Specification" which was ratified by the OpenSG Executive Committee in October 2010.

This document will build on the works cited above and describes only the new functionality to be addressed in OpenADR 2.0.

2.2 Opportunity

Define an open standard interoperable interface that addresses Automated Demand Response.

The initial scope of OpenADR 1.0 as defined in the System Requirements specification 1.0 excluded some functional areas that were targeted as part of the Framework and NAESB Requirements in order to allow the baseline work to be completed without attempting to keep aligned with on-going efforts within other PAPs or SGIP Working Groups.

[3] Details of the PAP09 Objectives and Task Plan can be found at: PAP09DRDER

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There is now the opportunity to address some of the broader or cross-cutting issues not addressed in OpenADR 1.0.

2.3 Objectives

Goal: Finish Phase 2 Business and User Requirements 2.0 and the System Requirements Specification (SRS) 2.0 document by August 2011..

2.4 Risks

- Other standards bodies or users groups with conflicting work or agendas.

2.5 Specific Business Requirements

The business requirements provide a frame of reference, or domain, in which to define a specific system. In some senses, the business requirements serve as constraints on a project's vision and scope. As such, they are generally defined independently and in advance of the vision and scope.

There may be a need (due to regulatory or other considerations) for alternate authorization approaches (in conjunction with federal and state law); however, specific conformance with the requirements outlined in this document is encouraged.

The key words MUST, MUST NOT, REQUIRED, SHALL, SHALL NOT, SHOULD, SHOULD NOT, RECOMMENDED, MAY, and OPTIONAL in this document are to be interpreted as described in [RFC2119].

The following table lists specific business requirements for OpenADR 2.0.

ID	Business Requirement
OADR BREV-1	The utility MAY offer the Customer a PEV tariff that provides a low rate for off-peak charging and a higher rate for on-peak charging. (SAE J2836/1 ™)
OADR BREV-2	The utility MUST provide services to support energy supplied to customer PEV (Reference SAE J2836/1 ™)
OADR BREV-3	The utility MUST implement an enrollment system for Customers with a PEV including registration and commissioning. (Reference SAE J2836/1 ™)
OADR BREV-4	The utility's Energy Services Communication Interface (ESCI) SHALL allow for the establishment of a communications session (communications binding), at a premise location each time a PEV plugs in for charging. (Reference SAE J2836/1 ™)
OADR BREV-5	Information related to utility PEV programs, energy usage, and PEV charging status/information SHOULD be made available to the Customer for viewing

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	via a website or other customer provided display equipment (Reference SAE J2836/1 ™)
OADR BREV-6	If available, the Customer MAY select green energy as a charging option for PEV vehicles (Reference SAE J2836/1 ™).
OADR BREV-7	The Customer MAY select the priority of the energy charging request which indicates the urgency of the charging need. (Reference: SAE J2836/1 ™)
OADR BREV-8	The Customer MAY select to optimize the charging of the PEV (Reference: SAE J2836/1 ™)
OADR BREV-9	The utility (or ESCO) MUST authenticate PEV enrollment requests (Reference: SAE J2836/1 ™)
OADR BREV-10	The Customer MAY elect a program that allows their PEV to discharge onto the grid
OADR BRDG-11	Distributed Generation may participate or Opt-out of a DR Event based on economic considerations regarding the cost of energy during the event. Price information during the event shall be sufficient to support the economic considerations.
OADR BRDG-12	Distributed Generation shall have the ability to communicate and Opt-out for a specific DR Event.
OADR BRDG-13	Distributed Generation shall have the ability to enroll (register) resources in DR Programs.
OADR BRDG-14	Distributed Generation resources should have the ability to consume DR Event signals for regulation services.
OADR BRFD-15	FastDR shall support dispatch frequencies from 4 seconds to many minutes.
OADR BRFD-16	FastDR shall support telemetry rates as fast as 4 seconds.
OADR BRFD-17	FastDR shall support DR Resources dispatched in the 1000's.
OADR BRFD-18	Add Demand Response communications must be secure and support the normal set of features including integrity, confidentiality, availability, and authenticity. Non-repudiation may also be required.
OADR BRFD-19	Demand Response Dispatches are typically usage levels and may represent either a specific usage set point (i.e. like a generator) or may be an offset from baseline.
OADR BRFD-20	Dispatches may have specific start and stop times or they may be open ended meaning it is a command that is followed until the resource is told otherwise.
OADR BRFD-21	All communications must be reliable.[4]

[4] Reliable messaging is the assurance that the correct messages have been delivered across a network exactly once, and in the correct order. The use of WS-ReliableMessaging protocol is not required to meet this requirement.

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3.0 OPENADR VISION

This section on OpenADR Vision attempts to define the full potential of OpenADR interface, rather than just those elements that will be part of the initial release.

3.1 Project Vision Statement

The vision of the OpenADR effort is that a consistent set of business requirements can be used to foster the development of standard interfaces to facilitate Demand Response. This work will be provided to stakeholders to develop standards and best practices that will foster innovation.

3.2 Major Features

This section attempts to delineate all features that are (and specifically are not) part of the broader OpenADR vision for Phase 2.

Feature	In	Out
Support for Plug-in Vehicles (PEV) communication in the context of Utility Programs	X	
Support for FastDR communication as defined in this document.	X	
Support for Distributed Generation communication for use cases defined as in scope in this document.		
Support for Distributed Generation communication by Utility Customers	X	
Support for Distributed Generation communication by non-utility Customers or Distributed Generation supplied outside of the customer's registered location (such as PEV or other roaming sources).		X

3.3 Assumptions and Dependencies

The following assumptions were made in development of these requirements.

- Use Cases for PEV are defined on other cited documents, and are assumed to be representative and complete.

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- Use Cases for FastDR are based on work done in conjunction with CAISO and others. The assumption is that variations in regional market structures do not affect the basic requirements.

4.0 OPENADR SCOPE

This section on OpenADR 2.0 Scope attempts to constrain the definition of the 2.0 version of OpenADR.

4.1 Scope of Initial Release

OpenADR 1.0 scope is limited to the items as defined in the Scope section of the "OpenSG OpenADR 1.0 System Requirements Specification".

4.2 Scope of OpenADR Phase 2

The 2.0 Version of OpenADR consists of addressing the following areas for Demand Response:

1. Plug-in Electric Vehicle (PEV)
2. Fast Demand Responses (FastDR)
3. Distributed Generation (DG)[5]
4. Security

Security Use Cases and Requirements are addressed in the "OpenADR Security Profile" which is being developed jointly with the SG Security (UtilSec) Team.

4.3 Limitations and Exclusions

The following table lists specific features associated within the areas in scope for 2.0 and listed as in or out of scope. These are features more specific than defined for Major Features which arise during the Use Case Analysis.

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Feature	In	Out

[5] Distributed Generation was originally described as Distributed Energy Resources (DER).

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Islanding of Distributed Generation		X
The context of advertise DER Capabilities within OpenADR is limited to the capabilities available as part of a Demand Response Program. Other capabilities are advertised into other markets in which the consumer wishes to participate. The definitions of these other markets is not in scope for OpenADR.		X

5.0 OPENADR CONTEXT

5.1 Stakeholder Profiles

Stakeholder	Stakeholder Goal
Consumer	Able to make informed decisions about their electric consumption by having timely access to current and historic consumption information; consumption is "more transparent"
	Able to grant 3rd Parties access to their Consumption Data in order to receive 3rd Party value-added products and services.
Utilities	Provide better / more appropriate services to consumers
	Provide the standard machine to machine interface to enable additional categories of services, as appropriate (including e.g. Demand Aggregation)
	"Social" benefit
	Increased customer satisfaction.
	Access to customer Consumption Data is a basic enabler of 3rd Party products and services
3rd Parties	Provide Smart Grid enabled products and

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	services to energy consumers
	Increases likelihood of utility providing 3rd Party access to consumer data.
	Simplifies the utility interface , versus a non-standard interface on a per-utility basis
PUC	Satisfies PUC goal of maximizing consumer value
	Lowers utility overall costs
	Lowers overall cost of data access implementations

6.0 OPENADR USE CASES

The following diagram shows an overview of the use cases involved in this recommendation.

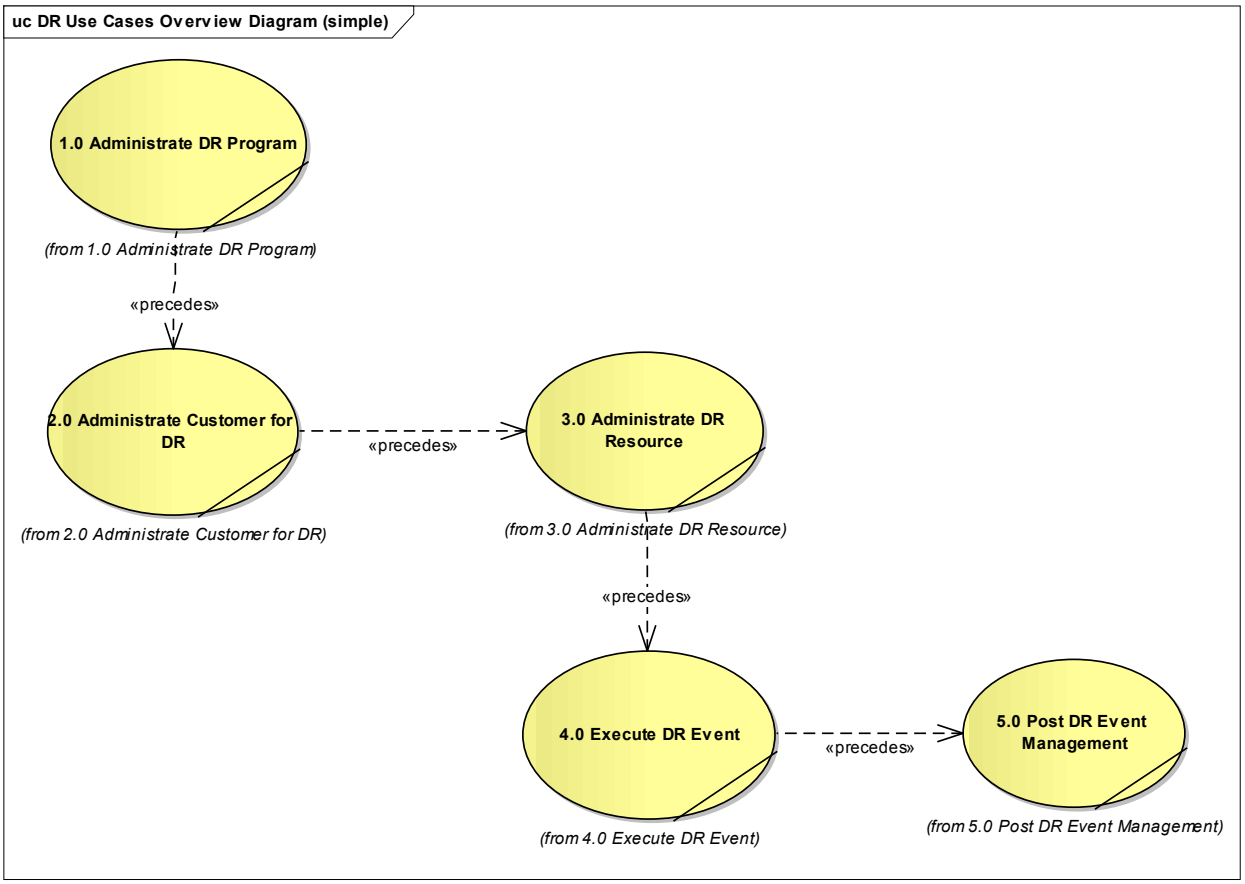

Figure 1 – DR Use Cases Overview

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Figure 1 is the high level overview of OpenADR. The scope is currently limited to the activities defined for 3.0 Administrate DR Resource (exclusive of 3.2 DR Bidding) and 4.0 Execute DR Event. The Figures 1-3 are provided for context of the OpenADR Use Cases defined below, and are fully defined in the NAESB PAP09 Retail Requirements.

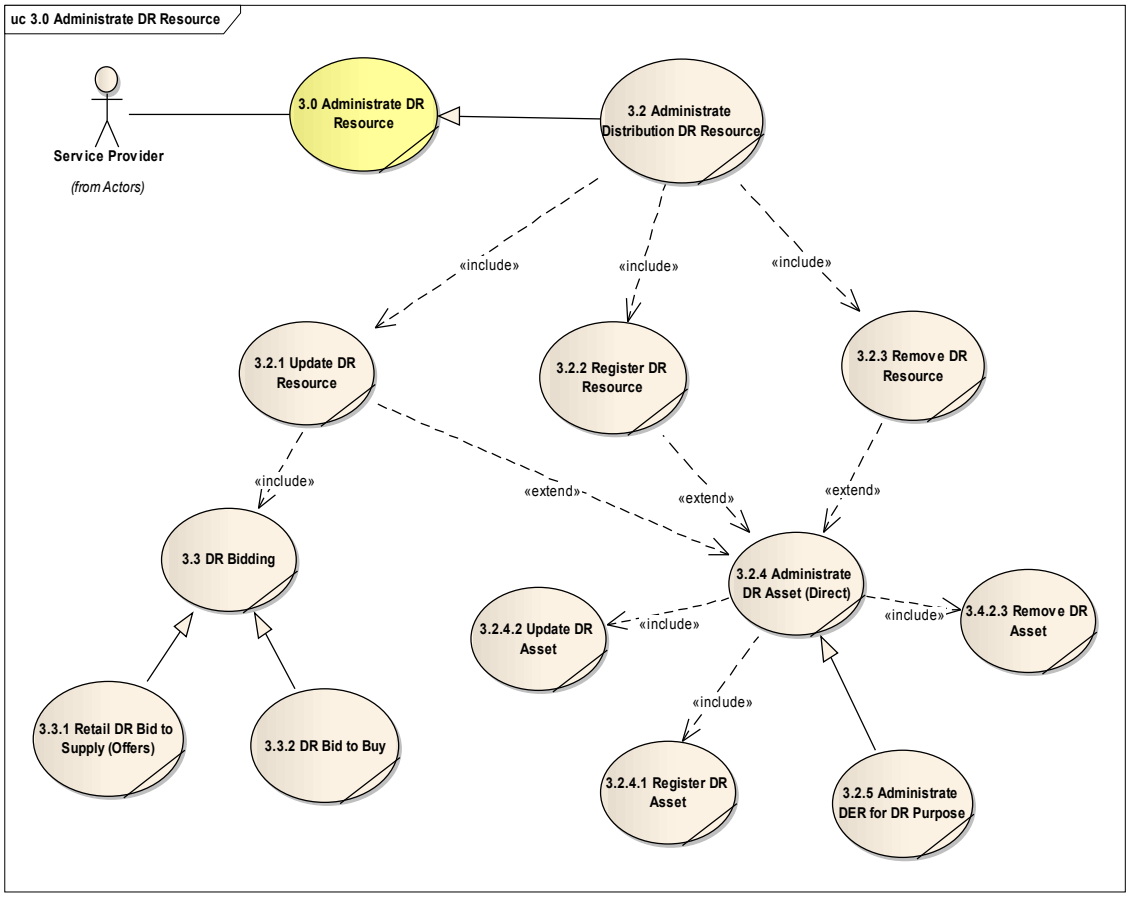

Figure 2 Administrate DR Resource

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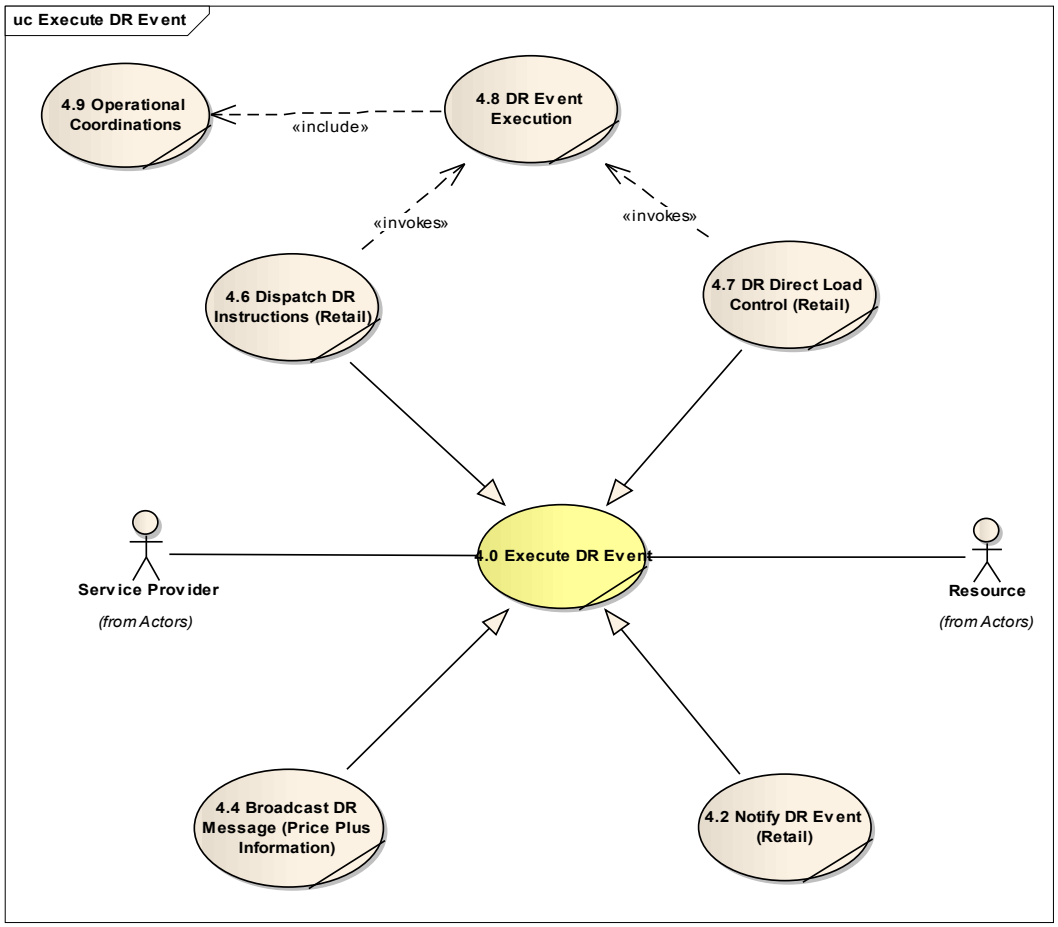

Figure 3 - Execute DR Event

6.1 OPENADR USE CASES for PEV

Before exploring the PEV use cases that are pertinent for the OpenADR 2.0 discussion it is important to understand the following use cases in the overall context of the use cases as they were developed by SAE. The focus of this exploration will be the utility related use cases (U1 – U5), but there are other related use cases that will inform the discussion as shown in the following figure.

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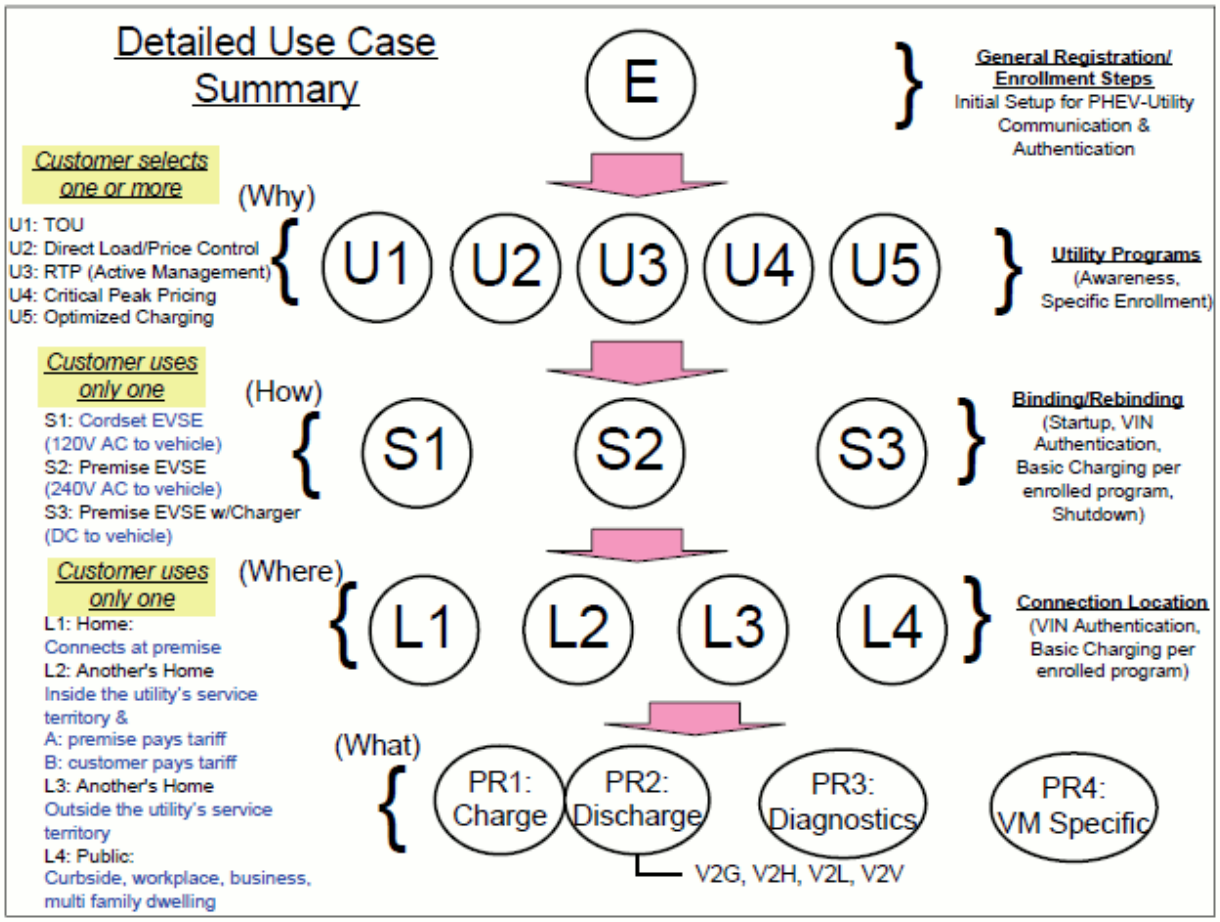

Figure 4 : SAE PEV use cases, relationships, and dependencies. Source: SAE J2836™ Vehicle Use Case Task Force

The SAE J2836 standard describes several use cases that can inform the discussion on the use of PEVs in a demand response context. There are two classes of communication; 1) that associated with enrolling the PEV in a specific utility program 2) the messages associated with the respective program once the PEV is enrolled.

For the purposes of demand response TOU is out of scope. While TOU covers location, amount of usage, and price associated with a particular load, TOU rates do not change very often and are usually associated with a tariff set by the local jurisdictional authority. The other programs noted in the SAE standard are within scope as they include various schemes whereby some signal is sent by a utility, aggregator, ESCO, or other entity that causes the load to change.

Additionally, in terms of enrollment there is a generic enrollment case and each of the U use cases cover one of the utility programs. However, the only difference between the uses cases is the program to be enrolled in and an alternative scenario where the enrollment may be handled by an ESCO. Other than those two distinctions the use cases are the same. Therefore for the purposes of the OpenADR assessment the enrollment use cases have been consolidated below.

One other point of interest in terms of PEV and DR related communications is the SAE assumption that the PEV connects to the ESI in a PULL method, that is, once the PEV connects it polls the ESI for any DR related event information. This must also assume that any DR related

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information must be sent to the ESI by the utility or other third party. Typcially sending information to an ESI employs a PUSH model, but a PULL model could also be used. This high level communication concept is illustrated below.

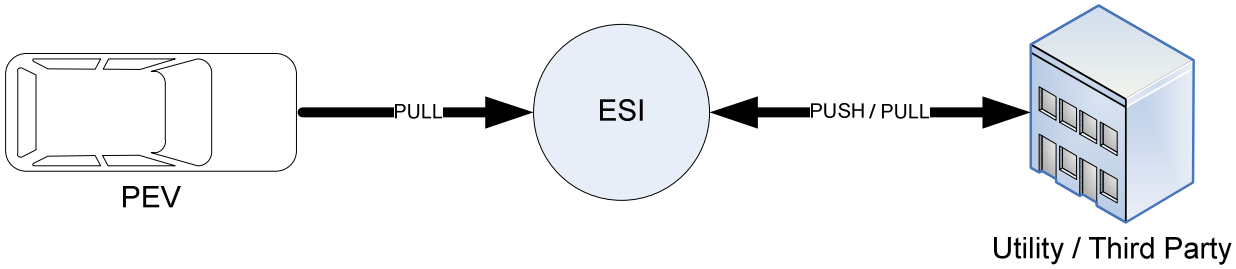

Figure 5 : High level conceptual model of PEV to ESI to Utility / Third Party communication

6.1.1 PEV – Consolidated Enrollment Use Case

Context: This use case presumes that the utility may have various programs associated with PEV ownership that may create an incentive for the PEV owner to partake in the respective programs. Of interest for demand response are the real-time pricing, direct load control, critical peak-pricing, and optjmized energy charging programs noted in J2836/1™.

Primary Actor: Consumer

Stakeholders and Interests: Utility, 3rd Party (ESCO)

Preconditions:

1. Customer has a PEV and wishes to enroll in TOU program;
2. Utility or ESCO offers PEV Programs to its customers.

Trigger(s):

The Customer acquires a PEV and contacts the Utility to enroll in a PEV-related program.

The customer may be prompted by the dealer, VM, retail store, utility and more for specific programs.

Post-Condition:

The Utility or ESCO has successfully enrolled the Customer PEV in the Program desired by the Customer.

Activity Diagram:

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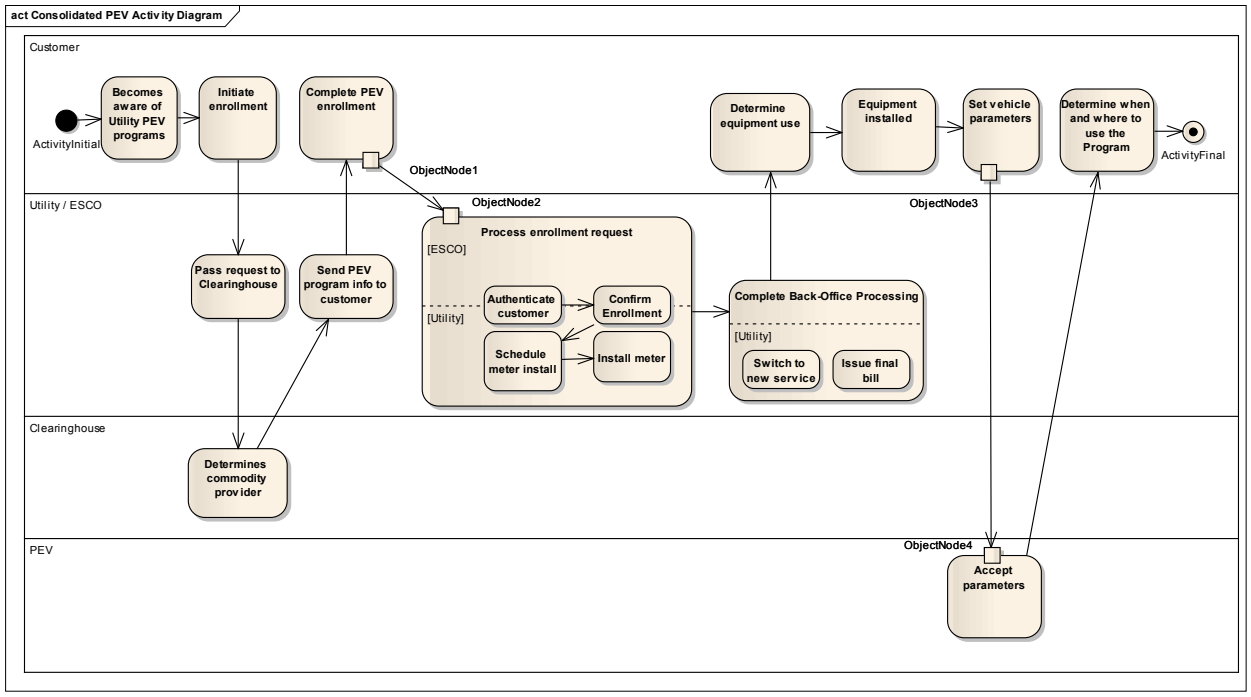

Figure 6 : Customer enrolls a PEV in a demand response related programm either through a Utility or ESCO

Main Success Scenario:

This consolidated series of steps has been synthesized from SAE J2836/1™ general use case E, and utility enrollment use case U1 – U5.

Step	Actor	Description	Notes
1	Customer	Informed of program's costs/benefits	
2	Customer	Initiates enrollment (enrolls) in a specific program with Utility or ESCO	Programs may be: TOU, RTP, CPP, DLC, Optimized Energy
3	Clearinghouse	Determines who provides the commodity	
4	ESCO / Utility	Presents Customer with PEV program information and selections	From use case E generic enrollment and each alternative scenario
5	Customer	Completes enrollment and returns it to the Utility or ESCO (web, mail, other)	
6	ESCO / Utility	Authenticates the customer, customer account, premise information, and collects PEV information (e.g. PEVID)	From use case E generic enrollment Authentication should occur before determining eligibility so only valid enrollments are processed

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7	ESCO / Utility	Confirms enrollment is complete, determine Customer eligibility and advises any next steps	Combined two previous steps
8	ESCO	Request meter installation from the Utility *based on program enrollment*	
9	Utility	Utility schedules meter installation, issues cut-over order, and notifies customer of meter installation (in-service) date	From use case U1, U2, U3, U4
10	Utility	Utility installs meter and completes back-office administrative action	From use case U1, U2, U3, U4
11	Utility	Utility switches service to TOU, CPP, Optimal Energy Charging, RTP, or DLC and issues final bill for old service	From use case U1, U2, U3, U4
12	Customer	Customer determines whether to use Cordset, EVSE, or Premise unit; purchases from vehicles dealership, retail store, utility or ESCO as available	
13	Customer	Customer self-installs or contracts installation of Cordset, EVSE, Premise unit	
14	Customer	Additional control devices could be installed, dependent on program	
15	Customer	Customer selects PEV program and sets parameters vehicle / EVSE / HAN to accept program objectives	From use case E generic enrollment
16	Customer	Customer determines when/why to use the program	

Extensions: None

Minimal Guarantees:

The Customer's enrollment data has not been exposed to parties that are not required to complete an enrollment.

Success Guarantees:

The Customer's enrollment request has been authenticated

The Customer's PEV is enrolled in the desired Program.

Frequency of Occurrence: Minimum frequency will be one. However, it is assumed that there may be a duration associated for the enrollment at the conclusion of which the Customer may have the option to extend the program that they are enrolled in, or enroll in a different PEV-related program.

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6.2 OPENADR USE CASES for Distributed Generation

Distributed generation, also called distributed energy, generates electricity from many small de-centralized energy sources.

As the concept of Demand Response is expanded to include generation as an equivalent to negative load, Distributed Generation offers additional options in response to DR Objective or Price Signals. Additionally Distributed Generation is capable of fulfilling other ancillary services which are identified in the use cases.

The Distributed Generation Resource is assumed to be in an existing state of generate, charge or discharge, with varying rates of buy, use, and sale of power, and capable of moving to another state in response to DR related signals.

The model for the Distributed Generation Use Cases assumes a constantly recurring evaluation of the relative costs and capabilities for each of the options. There is no sequence of states and only charge/discharge can not happen concurrently. The Energy Management System might decide on a mix of generate, buy, charge/discharge, load reduction an any given moment based on capabilities, constraints, and best economic choice available to the facility.

Use Cases 1 through 4 represent the four different outcomes of the decision process when impacted by the conditions of a Demand Response Event. The activity diagram below represents the consolidation of those use cases as a series of choices in a single diagram.

Activity Diagram

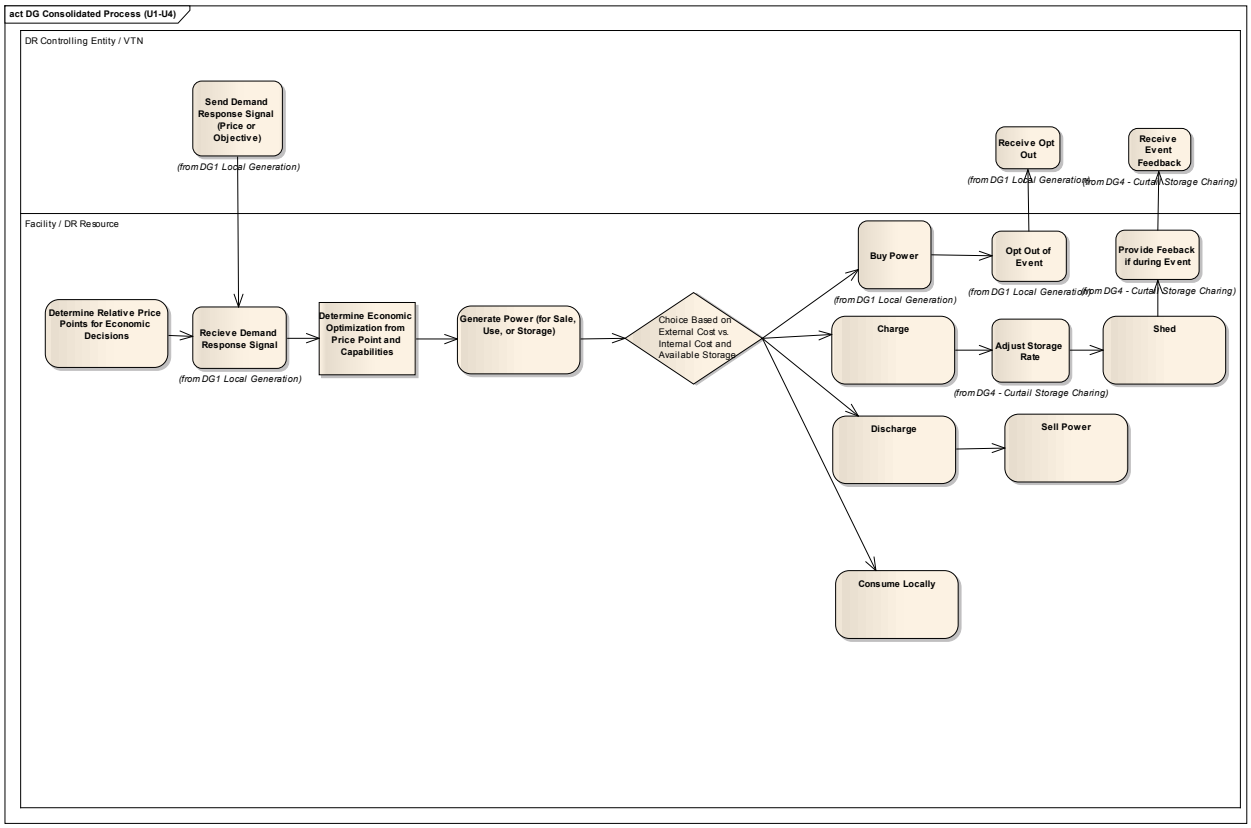

Figure 7 – UC 1-4 DG Consolidated Process

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412 ### 6.2.1 DG – Local Generation

413

414 **Context**: A facility that has its own local energy resources uses the market to make up for
415 shortfalls to meet local requirements. The customer has agreed to shed load based on the terms of
416 a Demand Response Program, but when the request comes in the facility cannot participate; for
417 example, because the load is in process or otherwise critical. The Program penalty may make it
418 worthwhile to ramp generation. Considerations are the cost of energy during critical event plus
419 the penalty may make it more economical to ramp up generation capacity.

420 **Primary Actors**: Consumer, Facility / Facility Management System, Utility or DR Aggregator
421 (DR Controlling Entity or Virtual Top Node)

422 **Stakeholders and Interests**: Customer, Utility, possible 3rd Party DR Aggregator

423 **Preconditions**:

424 1. Facility has its own energy resources and uses the market to make up shortfall.
425 2. Customer has enrolled facility as a Resource for a DR Program

426

427 **Trigger(s)**:

428 DR Event Signal is received or requested by the facility.

429 **Main Success Scenario:**

430 1. Facility receives DR Event Signal (objective or price).
431 2. Ramp generation in response to DR signal to support critical loads.
432 3. Price responsive generators ramp up when grid cost exceeds operational cost.

433 **Post-Condition:**

434 Provide local generation to reduce demand on the grid.

435

436 **Activity Diagram**:

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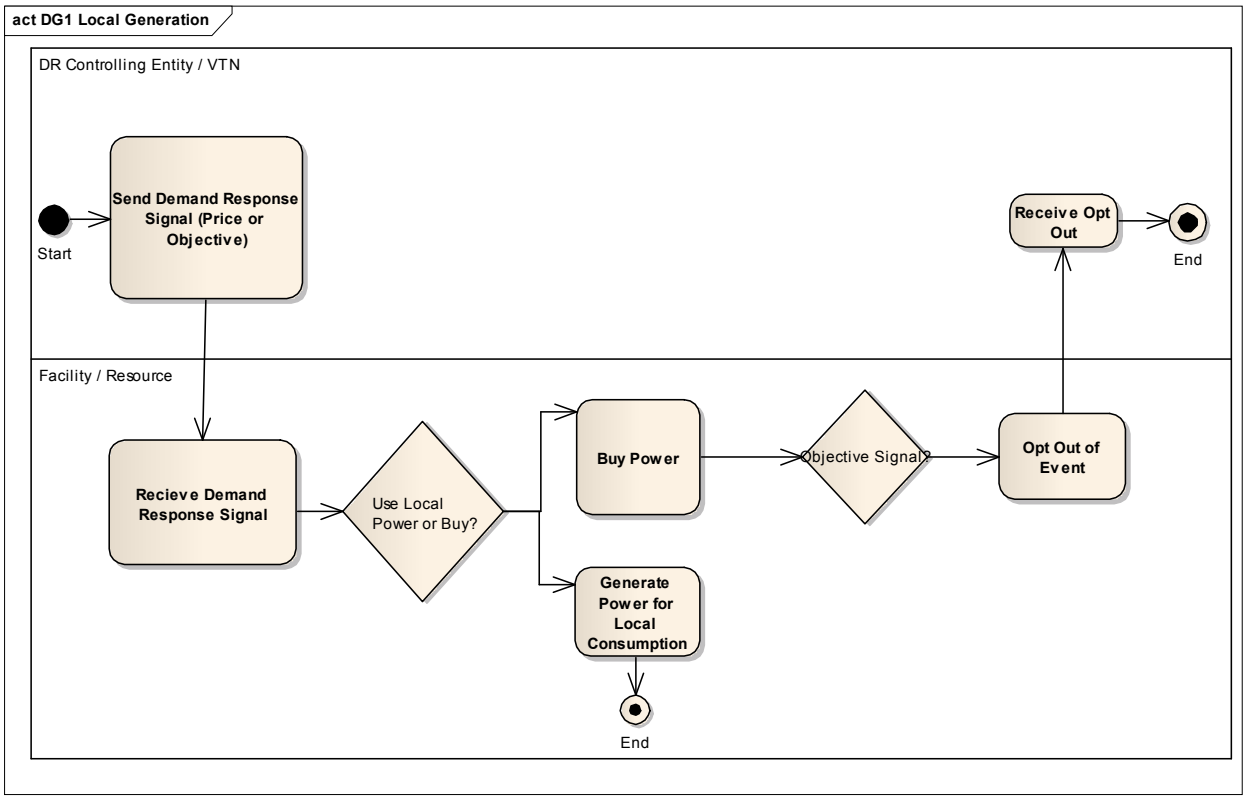

Figure 8 – DG1 Local Generation

6.2.2 DG - Charge Storage

Context: Consumer has onsite storage that can absorb excess energy or charge during off-peak / low-cost periods. The stored energy can later be discharged to support DR.

Primary Actor: Consumer, Facility / Facility Management System

Stakeholders and Interests: Customer, Utility, possible 3rd Party DR Aggregator

Preconditions:

1. Onsite storage is not already charged
2. A price point has been determined and set when it is economical to charge the storage device
3. Off peak rates (Nighttime) energy rates can be very low / negative
4. Consumer receives incentives to charge during over supply

Trigger(s):

Price point falls below the set point to begin the charge cycle..

Main Success Scenario:

1. Energy is economically stored such that a discharge results in a net cost saving to the consumer

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Post-Condition:

Consume excess supply by storing energy off-peak

Activity Diagram:

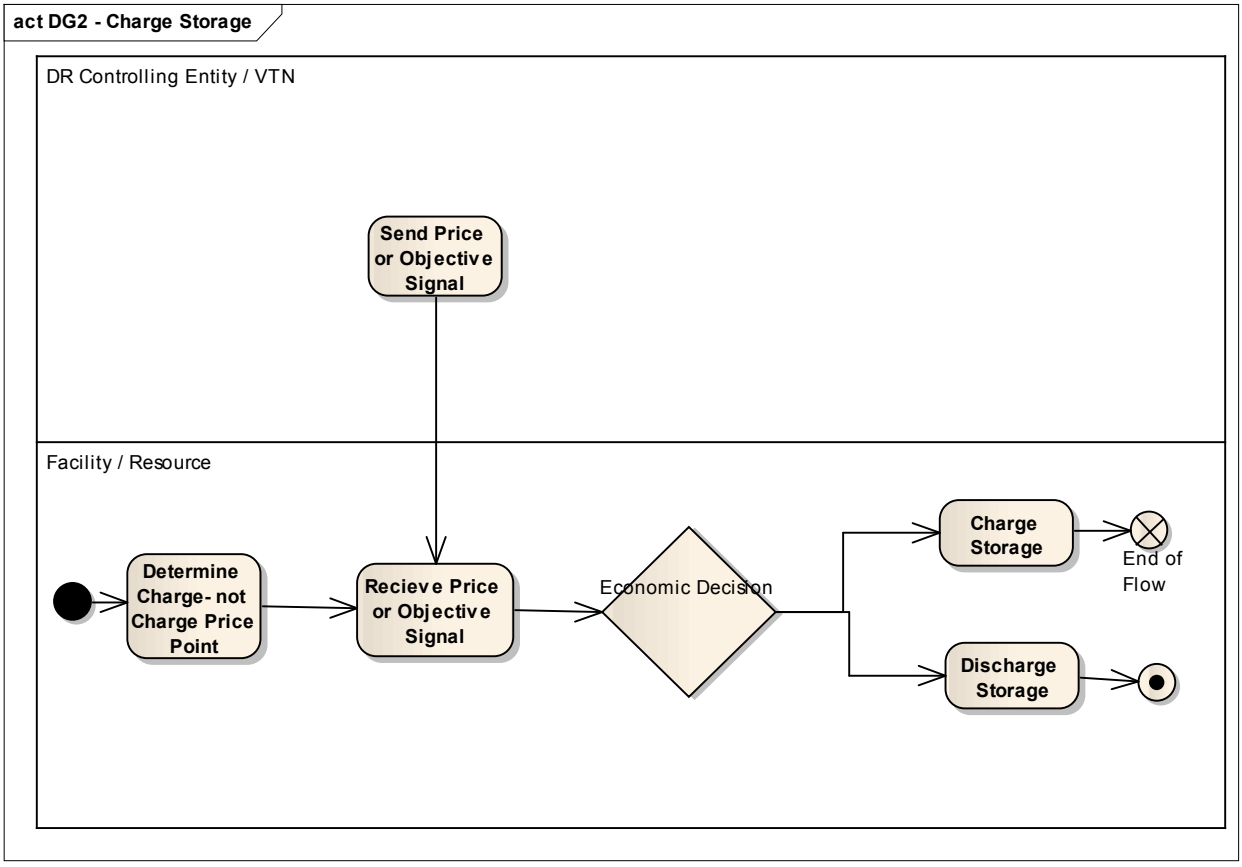

Figure 9 – DG2 Charge Storage

6.2.3 DG – Discharge energy stored during peak demands

Context: Consumer has onsite storage that is fully or partially charged and can be discharged to support critical loads, or brought to bear to in addition to, or in lieu of, load reductions during a DR event. Stored energy could be thermal or other forms that produce electricity upon discharge or otherwise offset the use of electricity (e.g. ice storage to offset HVAC load). Adequate amounts of storage can be used to reliably power critical loads for well defined durations during DR events or grid outages.

Primary Actor: Consumer, Facility / Facility Management System

Stakeholders and Interests: Customer, Utility, possible 3rd Party DR Aggregator

Preconditions:

1. Storage resource is fully or partially charged

2. A DR price signal, DR severity level, or demand limit threshold is used to determine the point at which the storage resource will discharge.

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Trigger(s):

Price point, DR signal severity level, or demand limit threshold is reached that triggers the storage resource to discharge.

Main Success Scenario:

1. DR load offset targets are achieved.
2. Demand limit thresholds are respected.
3. Facility requirements for power reliability to critical loads are met.

Post-Condition:

Energy is supplied to the grid or load is offset.

Activity Diagram:

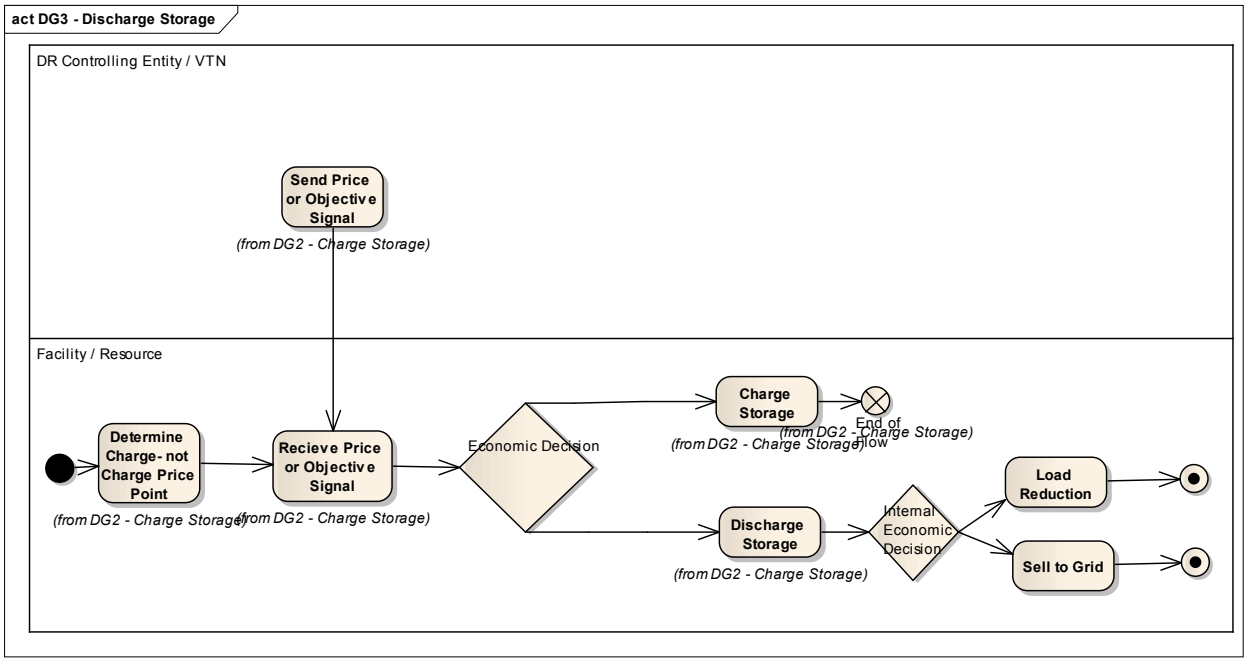

Figure 10 – DG3 Discharge Storage

6.2.4 DG – Curtail Storage Charging

Context: Consumer has energy storage resources whose charge cycle can be curtailed during a DR event.

Primary Actor: Consumer, Facility / Facility Management System

Stakeholders and Interests: Customer, Utility, possible 3rd Party DR Aggregator

Preconditions:

1. Storage resource is in the process of charging.
2. A DR price point, DR severity level, or demand limit threshold is used to determine when to suspend charging cycle.

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Trigger(s):

A DR price point, DR severity level, or demand limit threshold is reached that triggers the charge cycle to be suspended..

Main Success Scenario:

1. Load from the storage charging is shifted to when the price lowers, DR event ends, or demand thresholds can be respected.

Post-Condition:

Curtailment of storage for requested interval.

Activity Diagram:

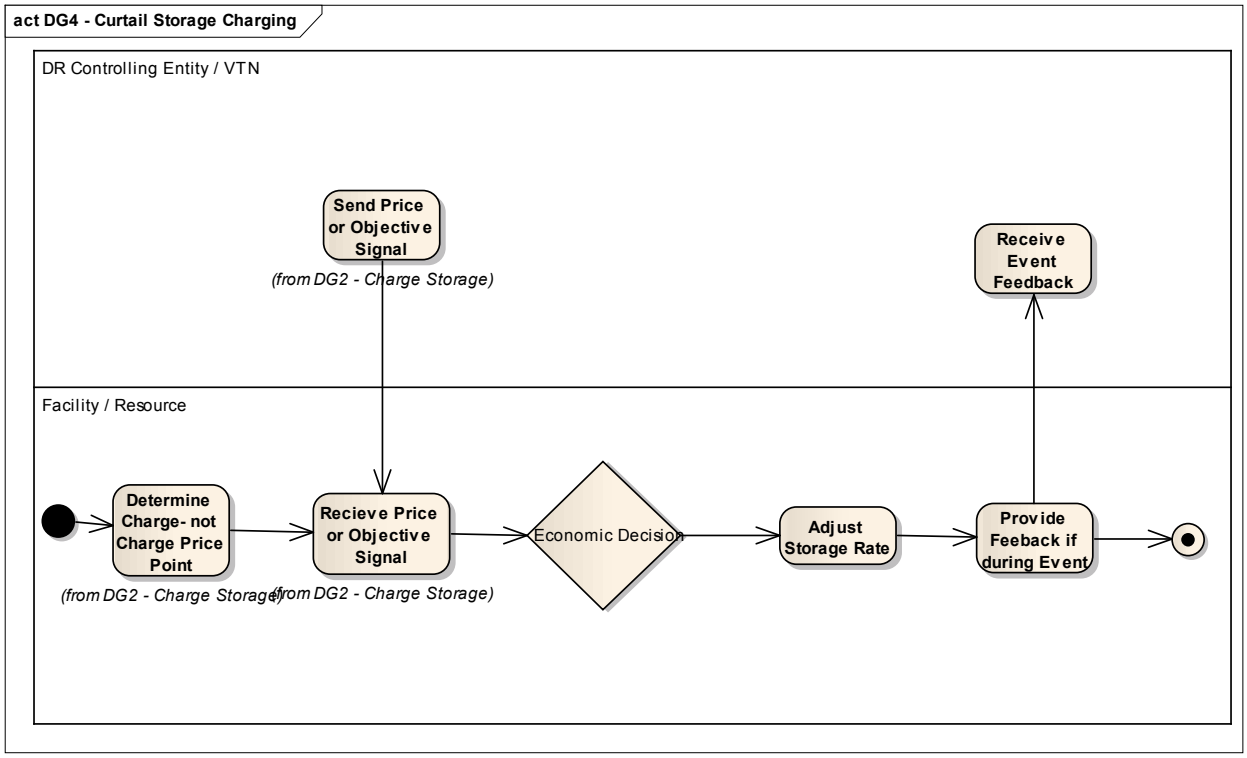

Figure 11 – DG4 Curtail Storage Charging

6.2.5 DG – Compensate for Variable DER

Context: Variable generation sources such as wind and solar can be compensated for by shedding or ramping load. The load response must be "fast". Sudden drops or ramps in the variable generation are generally forecastable in the short term (e.g. sunrise/sunset, approaching clouds, wind gusts/lulls).

Primary Actor: Consumer, Facility / Facility Management System

Stakeholders and Interests: Customer, Utility, possible 3rd Party DR Aggregator

Preconditions:

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1. Consumer has onsite variable generation resource.
2. Loads are available to shed in response to a drop in production
3. Loads or storage are available to ramp in response to an increase in production

Trigger(s):

Sudden drop or rise in variable generation.

Main Success Scenario:

1. Loads are shed to compensate for a drop in generation
2. Excess energy is supplied to the grid, additional loads, or onsite storage.

Post-Condition:

Loads are operating as normal.

Activity Diagram:

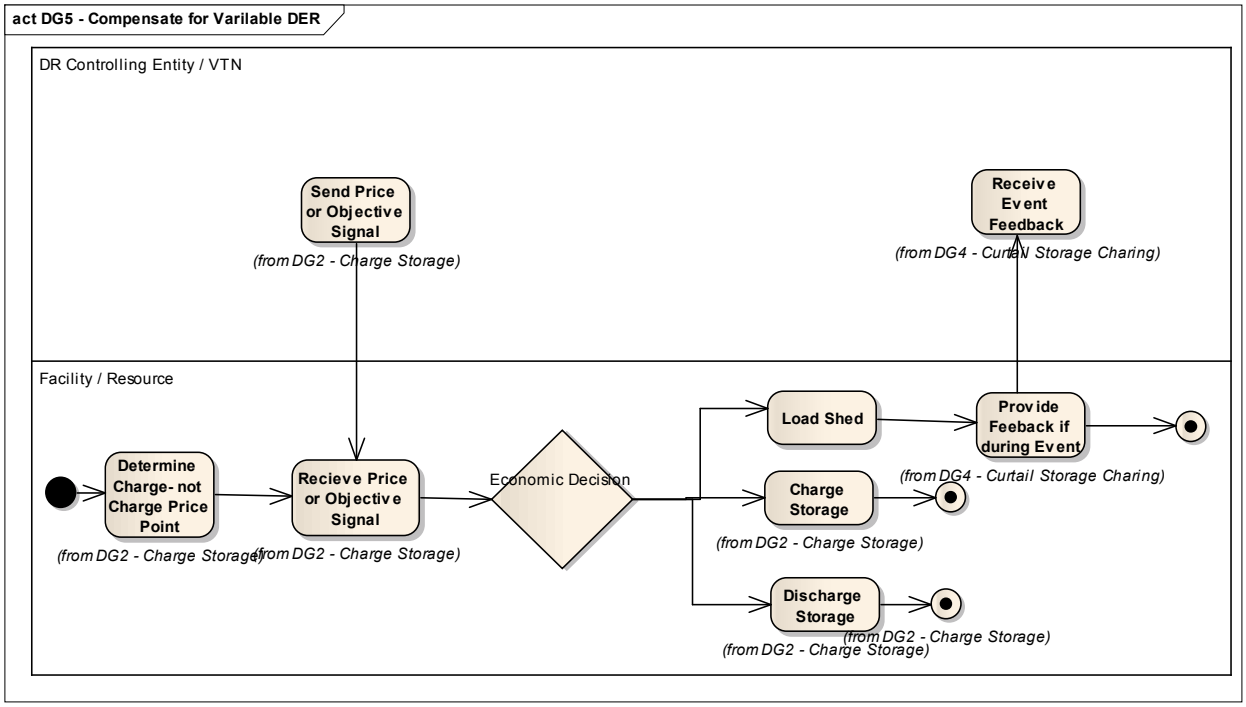

Figure 12 – DG5 Compensate for Variable DER

6.2.6 DG – Advertise DER Capabilities

Context: Consumer has onsite resources that can be offered to the utility to support grid operations and reliability. Base generation forecast is folded into the overall demand forecast while additional capacity or services are offered at market rates. The context of advertise DER Capabilities within OpenADR is limited to the capabilities available as part of a Demand

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Response Program. Other capabilities are advertised into other markets in which the consumer wishes to participate. The definitions of these other markets is not in scope for OpenADR.

The capabilities include:

- Expected kW / kWH
    - Contingency Reserve
- Ancillary Services
    - VAR Support (Voltage Control)
    - Voltage ride-through (stay connected, disconnect, provide Voltage Control Service)
    - Frequency regulation
- Associated costs
- Emissions characteristics
- Availability, Duration
    - Response Time
    - Ramp Time

Primary Actor: Consumer, Facility / Facility Management System

Stakeholders and Interests: Customer, Utility, possible 3rd Party DR Aggregator

Preconditions:

1. Distributed Resource has some pre-defined knowledge of its capabilities and constraints.
2. Generation resources are characterized according to:
    a. Type of resource – Watts, VARS, Hz, Volts, other
    b. Price of resource
    c. Emission characteristics
    d. Availability
    e. Duration
    f. Response time
    g. Ramp time
3. Utility is made aware of resources

Trigger(s):

Utility calls upon resource to be dispatched..

Main Success Scenario:

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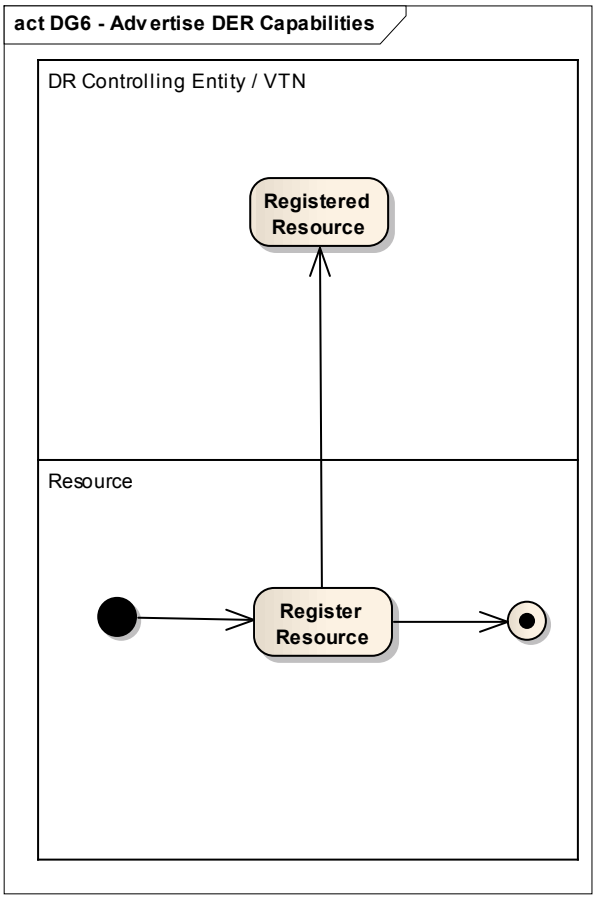
570 1. Grid reliability is maintained by operation of resource

571 **Post-Condition:**

572 Consumer is credited for performing requested service / dispatching of resource

573 **Activity Diagram**:



574

575 **Figure 13 – DG6 Advertise DER Capabilities**

576 ### 6.2.7 DG – Islanding

577

578 **Context**: Consumer has adequate onsite generation/storage resources to operate critical loads
579 independent from the grid. During times of grid instability or DR events, the consumer can
580 isolate the premise from the grid completely while maintaining operations.

581 **Primary Actor**: Consumer, Facility / Facility Management System

582 **Stakeholders and Interests**: Customer, Utility, possible 3rd Party DR Aggregator

583 **Preconditions**:

584 1. Consumer has a micro-grid capable of supporting operations while the grid is down or
585 under stress.

586

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Trigger(s):

Grid quality falls out of spec or a severe DR event is issued..

Main Success Scenario:

1. Consumer maintains operation of critical loads during event or outage
2. Consumer facility is reconnected to the grid when the event or outage has completed.

Post-Condition:

Consumer facility is reconnected to the grid and normal operations ensue.

Use Case Diagram:

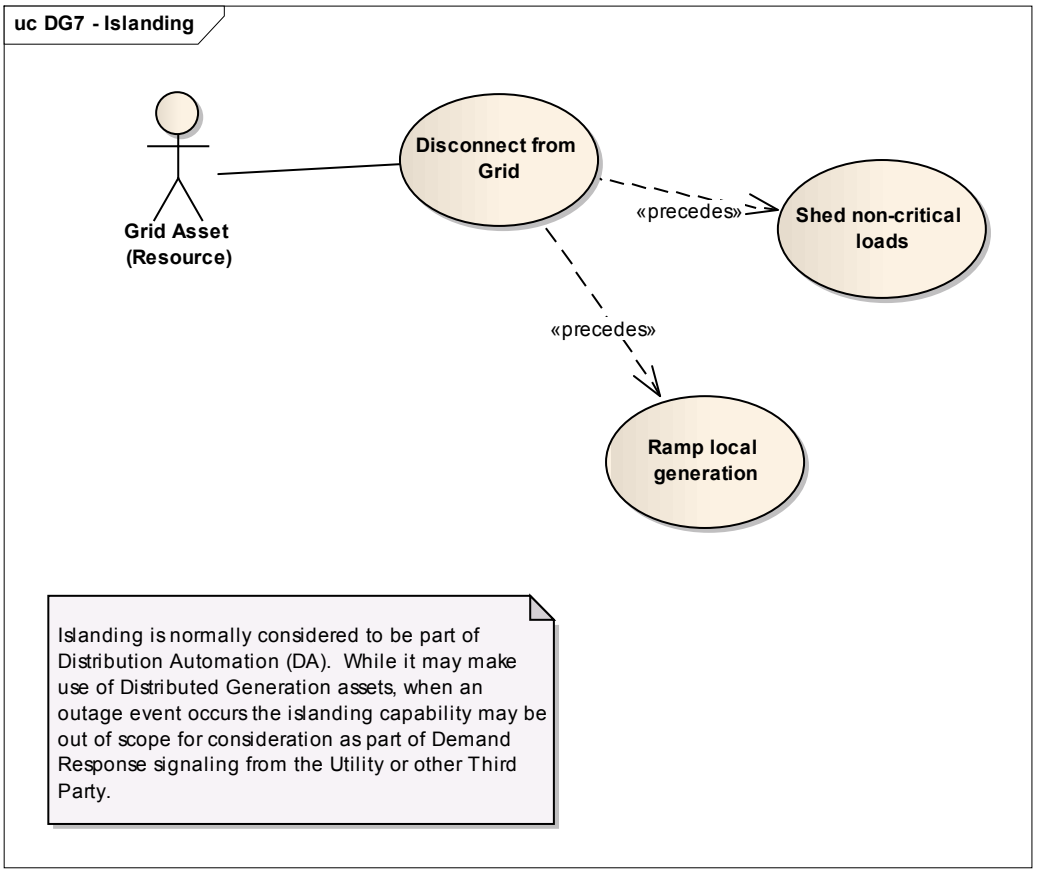

Figure 14 – DG7 Islanding

6.2.8 DG – Provide regulation services

Context: Consumer has generation devices capable of providing regulation services such as reactive power, voltage, and frequency regulation. These services may be dispatchable or operated autonomously by preprogramming of responses to prescribed conditions.

Primary Actor: Consumer, Facility / Facility Management System

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Stakeholders and Interests: Customer, Utility, possible 3rd Party DR Aggregator

Preconditions:

1. Consumer resources have been advertised to the utility for dispatch
2. Consumer resources have been preprogrammed to operate autonomously according to the utility requirements.

Trigger(s):

Regulation service is called upon by the utility and dispatched by the consumer. Or grid conditions invoke pre-programmed autonomous response.

Main Success Scenario:

1. Grid reliability and quality are maintained.

Post-Condition:

Consumer is compensated for dispatch or operation of regulation services.

Activity Diagram:

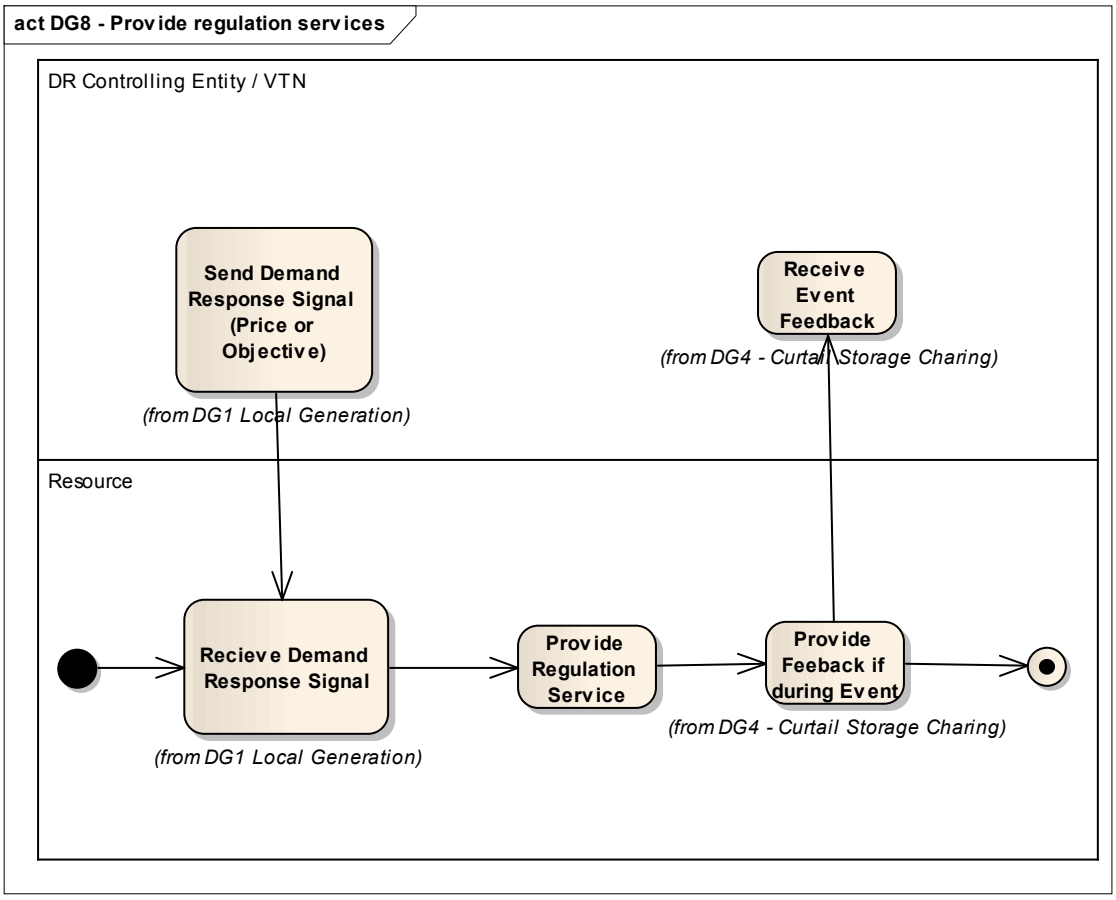

Figure 15 – DG8 provide Regulation Services

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6.3 OPENADR USE CASES for FastDR

Fast Demand Response (FastDR) is characterized by support of fast dispatch frequencies ranging from 4 seconds to several minutes. One of the intended uses is to support some types of ancillary services that require a response in the 4 second to 10 minute range. These services may include:

- Regulating Reserve
- Load Following or Fast Energy Markets
- Spinning Reserve
- Non-Spinning Reserve
- Replacement or Supplemental Reserve

The FastDR Use Cases are in three areas: Asynchronous Dispatch, Polled Dispatch and Telemetry.

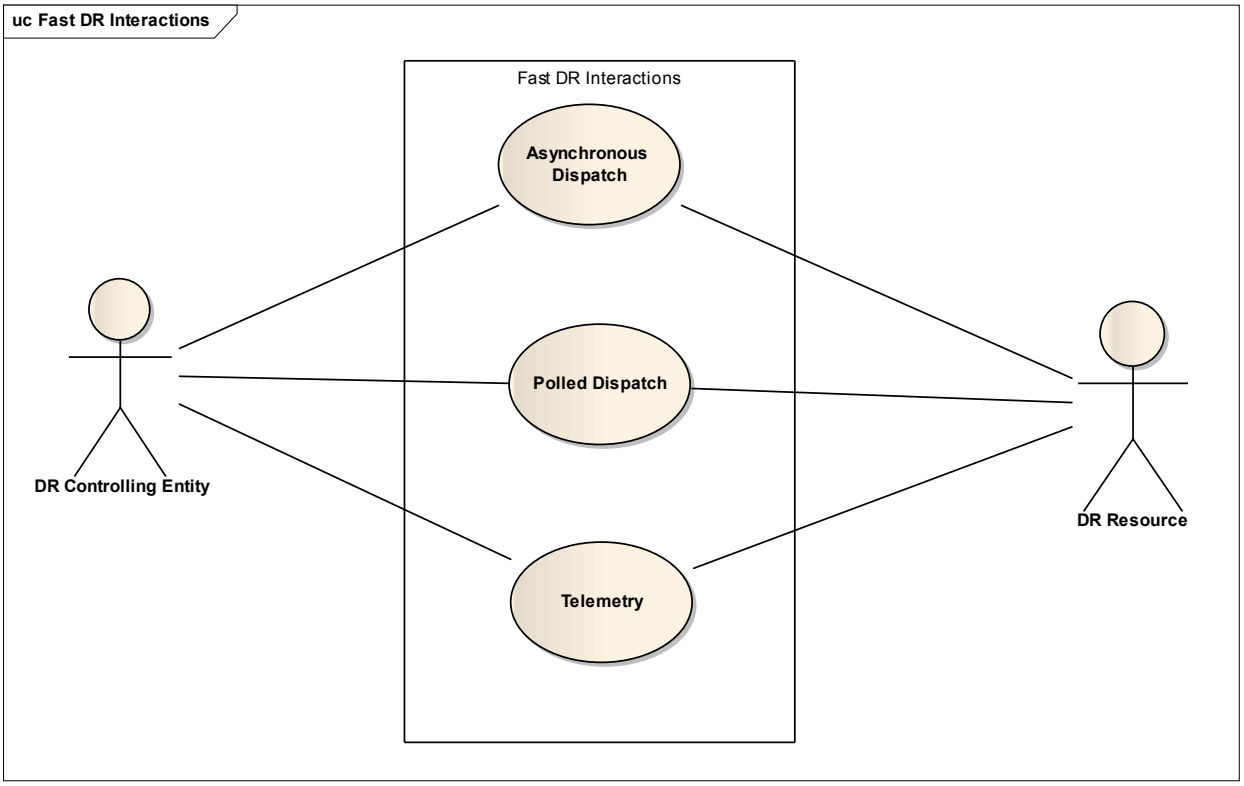

Figure 16 – Fast DR Interactions

6.3.1 FastDR – Asynchronous Dispatch

Context: Dispatch of DR Signals is supported in both a "push" and "pull" (a.k.a. Callback) interaction pattern. DR Resources of Asynchronous Dispatch must be capable of consuming a Dispatch that is sent without a preceding request for dispatch.

Primary Actors: DR Controlling Entity, DR Resource

Stakeholders and Interests: Utility, Customers, and 3rd Party service providers

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Preconditions:

1. The DR Controlling Entity and parties representing the DR Resource have enrolled in the same DR Program.

Trigger(s):

DR Event has been announced by a Market Operator or Utility.

Main Success Scenario:

1. DR Dispatch is sent to DR Resource.
2. Receipt Acknowledgement (if requested) is sent from Resource to originating DR Controlling Entity.

Post-Condition:

Sequence Diagram:

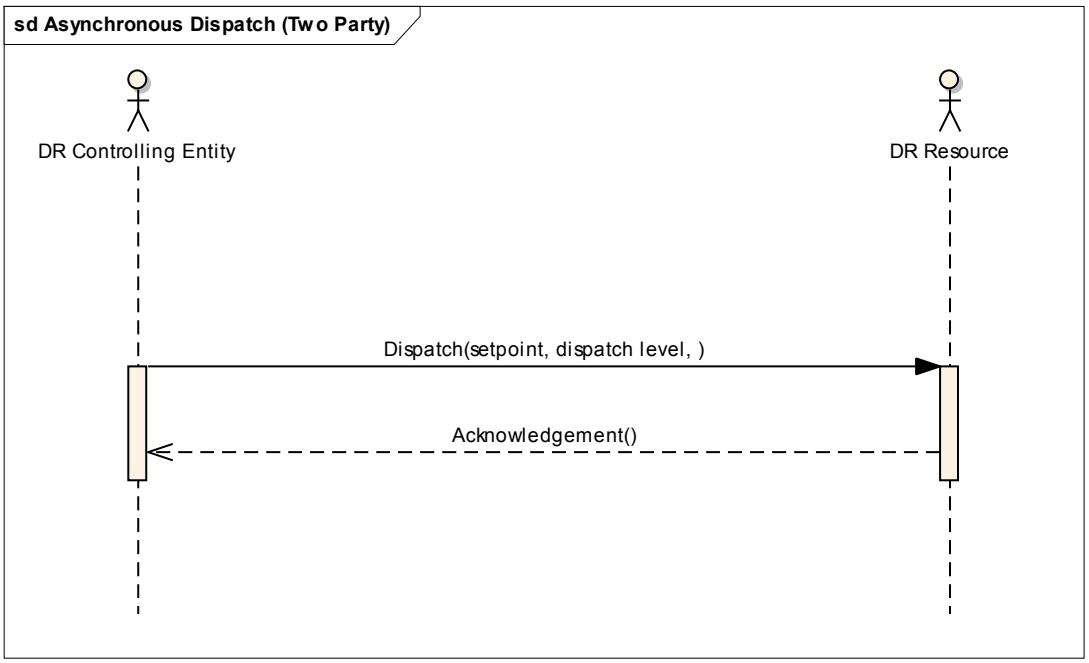

Figure 17 – Fast DR Asynchronous Dispatch (Two Party)

6.3.2 FastDR – Asynchronous Dispatch with Communications Hierarchy

Context: The Asynchronous Dispatch can occur through layers of service providers such as DR Aggregators or Communications Intermediaries. The latency requirements are measured from the time of initial dispatch to the point where the requested action is performed.

Primary Actors: DR Controlling Entity, DR Resource, DR Service Provider (Intermediary)

Stakeholders and Interests: Utility, Customers, and 3rd Party service providers

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663 **Preconditions**:

664 1. The DR Controlling Entity, Intermediaries and parties representing the DR Resource
665 have enrolled in the same DR Program

666

667 **Trigger(s)**:

668 DR Event has been announced by a Market Operator or Utility.

669 **Main Success Scenario:**

670 1. DR Dispatch is sent to Intermediary(ies).

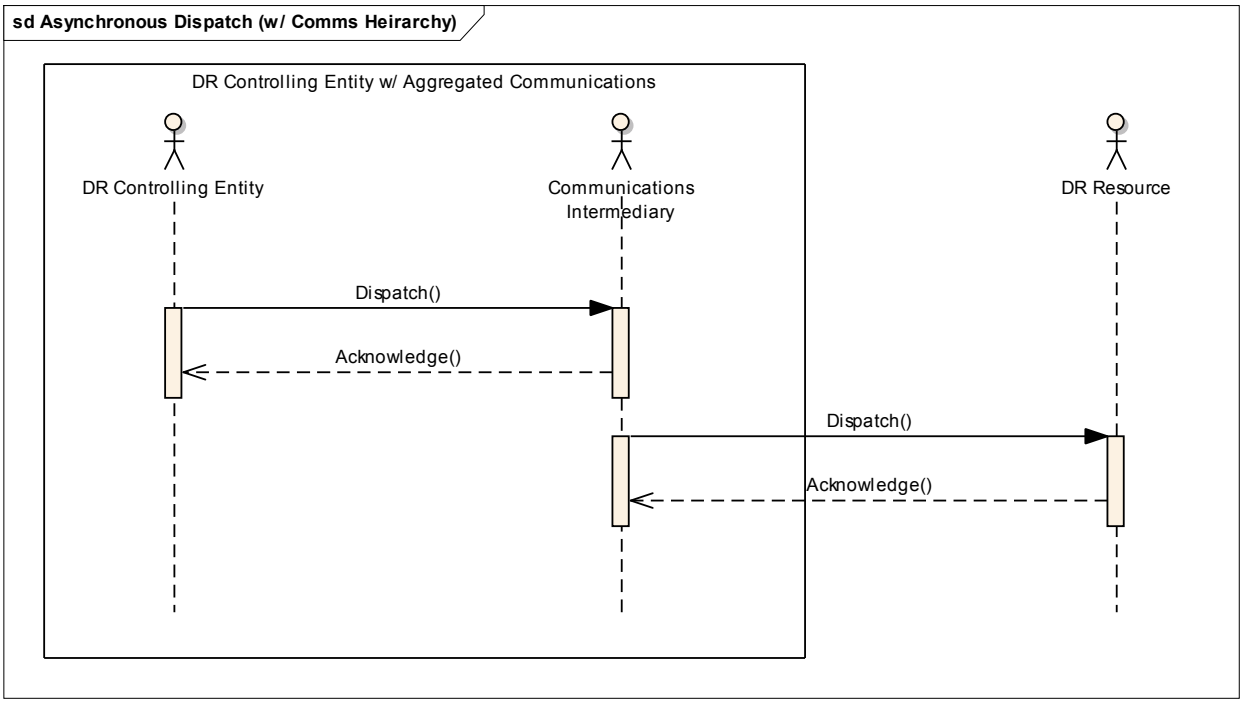
671 2. DR Dispatch is forwarded to another intermediary or the DR Resource.

672 3. The DR Resource that actually supplies the service is able to respond within the required
673 response time.

674 **Post-Condition:**

675

676 **Sequence Diagram**:



677

678 **Figure 18 – Fast DR Asynchronous Dispatch (with Communications Hierarchy)**

679 ### 6.3.3 FastDR – Asynchronous Dispatch with Load Aggregation

680

681 **Context**: The Asynchronous Dispatch can occur through layers of service providers such as DR
682 Aggregators or Communications Intermediaries. The latency requirements are measured from
683 the time of initial dispatch to the point where the requested action is performed.

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Primary Actors: DR Controlling Entity, DR Resource, DR Service Provider (Aggregator)

Stakeholders and Interests: Utility, Customers, and 3rd Party service providers.

Preconditions:

1. The DR Controlling Entity, DR Aggregators and parties representing the DR Resource have enrolled in the same DR Program.

Trigger(s):

DR Event has been announced by a Market Operator or Utility.

Main Success Scenario:

1. DR Dispatch is sent to Aggregator(s).
2. DR Dispatch is forwarded (with de-aggregated requirements applied) to another aggregator or the DR Resource.
3. The DR Resource that actually supplies the service is able to respond within the required response time

Post-Condition:

Sequence Diagram:

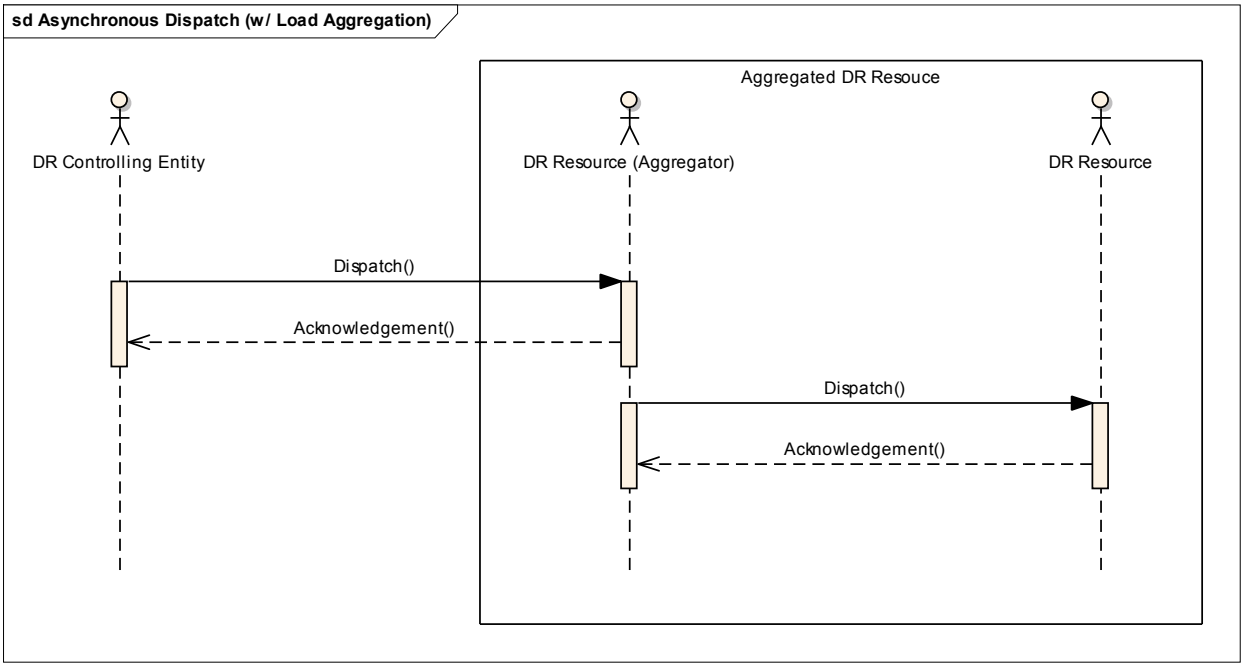

Figure 19 – Fast DR Asynchronous Dispatch (with Load Aggregation)

6.3.4 FastDR – Polled Dispatch – Two Party

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Context: Dispatch of DR Signals is supported in both a "push" and "pull" (a.k.a. Callback) interaction pattern. DR Resources of a Polled Dispatch will request the latest Dispatch from the DR Controlling Entity.

Primary Actors: DR Controlling Entity, DR Resource

Stakeholders and Interests: Utility, Customers, and 3rd Party service providers

Preconditions:

1. The DR Controlling Entity and parties representing the DR Resource have enrolled in the same DR Program.

Trigger(s):

DR Event has been announced by a Market Operator or Utility..

Main Success Scenario:

1. DR Resource requests latest DR Dispatch from DR Controlling Entity.
2. DR Dispatch is sent to DR Resource.

Post-Condition:

Sequence Diagram:

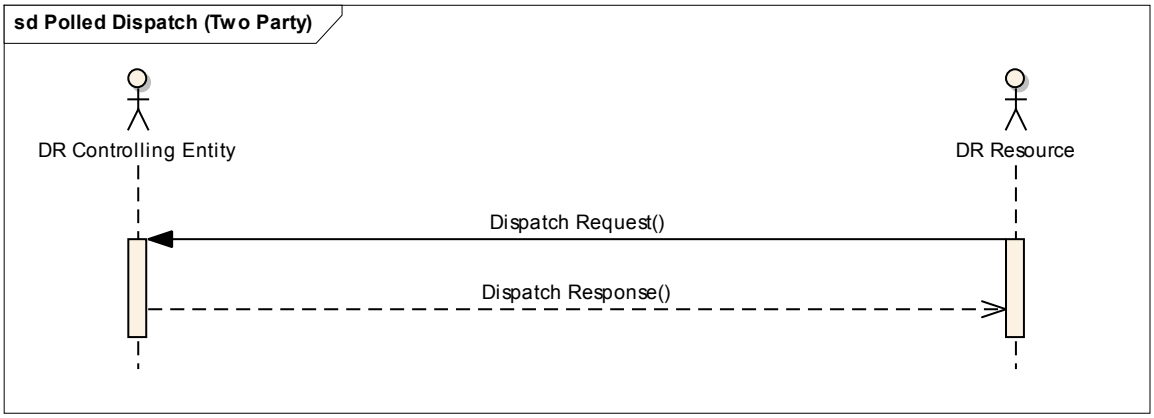

Figure 20 – Fast DR Polled Dispatch (Two Party)

6.3.4 FastDR – Polled Dispatch with Communications Hierarchy (Pull)

Context: The Polled Dispatch can occur through layers of service providers such as DR Aggregators or Communications Intermediaries. The latency requirements are measured from the time of initial dispatch to the point where the requested action is performed. Note that the "pull" scenario is only applicable to the interaction with the Resource associated with the final end point in this case.

Primary Actor: DR Controlling Entity, DR Resource, DR Service Provider (Intermediary)

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Stakeholders and Interests: Utility, Customers, and 3rd Party service providers

Preconditions:

1. The DR Controlling Entity, Intermediaries and parties representing the DR Resource have enrolled in the same DR Program.

Trigger(s):

DR Event has been announced by a Market Operator or Utility.

Main Success Scenario:

1. DR Dispatch is sent to Intermediary
2. DR Resource requests the latest Dispatch.
3. DR Dispatch is forwarded to the DR Resource.
4. The DR Resource that actually supplies the service is able to respond within the required response time

Post-Condition:

Sequence Diagram:

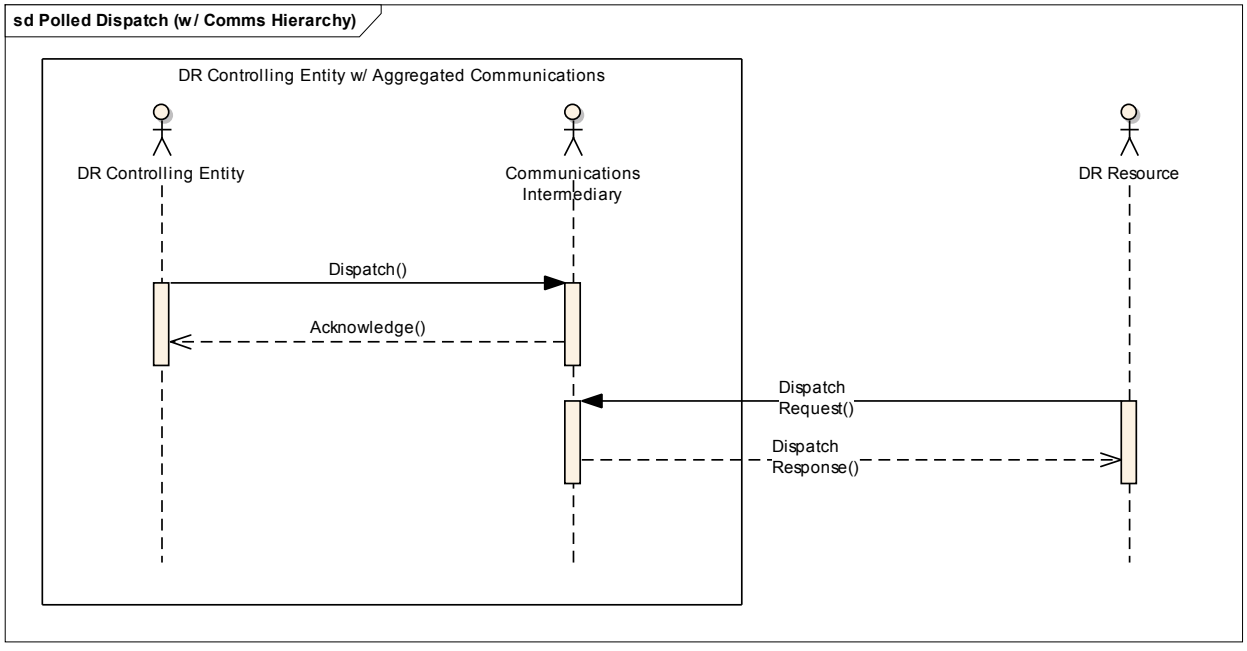

Figure 21 – Fast DR Polled Dispatch (with Communications Hierarchy)

6.3.5 FastDR – Polled Dispatch with Load Aggregation (Pull at End Point Only)

Context: The Polled Dispatch can occur through layers of service providers such as DR Aggregators or Communications Intermediaries. The latency requirements are measured from

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the time of initial dispatch to the point where the requested action is performed. Note that the "pull" scenario is only applicable to the interaction with the Resource associated with the final end point in this case.

Primary Actor: DR Controlling Entity, DR Resource, DR Service Provider (Aggregator)

Stakeholders and Interests: Utility, Customers, and 3rd Party service providers

Preconditions:

1. The DR Controlling Entity, Aggregators and parties representing the DR Resource have enrolled in the same DR Program.

Trigger(s):

DR Event has been announced by a Market Operator or Utility.

Main Success Scenario:

1. DR Dispatch is sent to Aggregator
2. DR Resource requests the latest Dispatch.
3. DR Dispatch is sent to the DR Resource.
4. The DR Resource that actually supplies the service is able to respond within the required response time

Post-Condition:

Sequence Diagram:

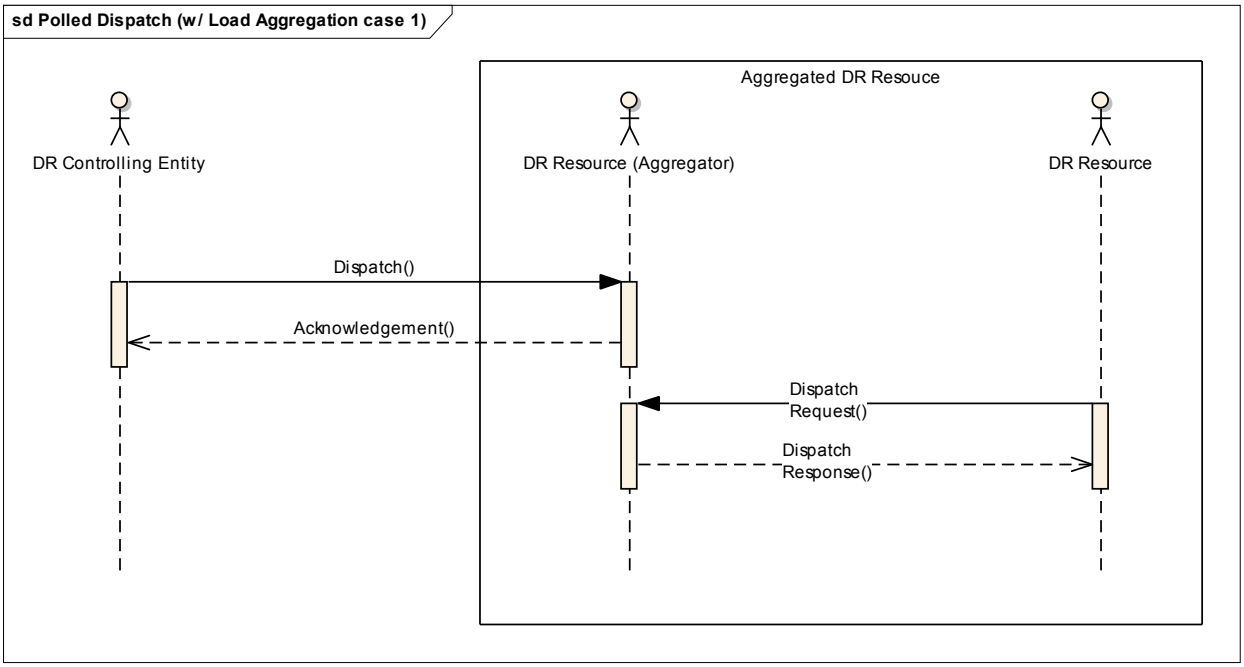

Figure 22 – Fast DR Polled Dispatch (with Load Aggregation)

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6.3.6 FastDR – Polled Dispatch with Load Aggregation (Pull at Each Level)

Context: The Polled Dispatch can occur through layers of service providers such as DR Aggregators or Communications Intermediaries. The latency requirements are measured from the time of initial dispatch to the point where the requested action is performed. Note that the "pull" scenario is only applicable to the interaction with both Aggregators and the Resource associated with the final end point in this case.

Primary Actor: DR Controlling Entity, DR Resource, DR Service Provider (Aggregator)

Stakeholders and Interests: Utility, Customers, and 3rd Party service providers

Preconditions:

1. The DR Controlling Entity, Aggregators and parties representing the DR Resource have enrolled in the same DR Program.

Trigger(s):

DR Event has been announced by a Market Operator or Utility.

Main Success Scenario:

5. DR Dispatch is sent to Aggregator
6. DR Resource requests the latest Dispatch.
7. DR Dispatch is sent to the DR Resource.
8. The DR Resource that actually supplies the service is able to respond within the required response time

Post-Condition:

Sequence Diagram:

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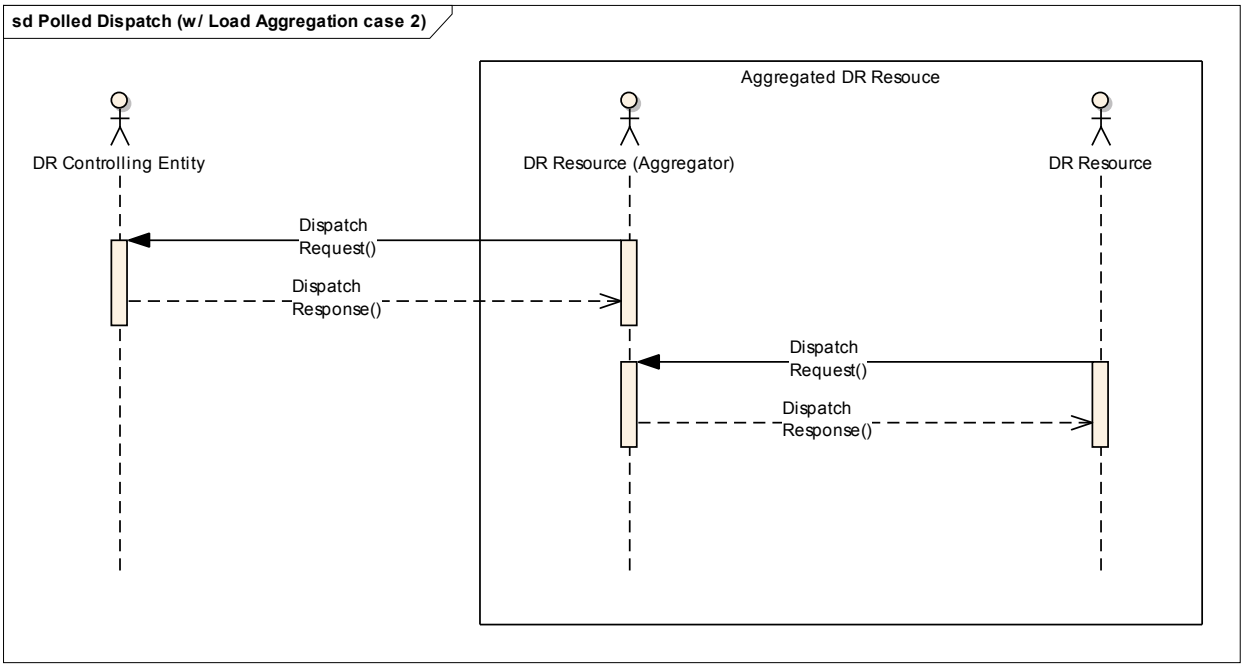

Figure 23 – Fast DR Polled Dispatch (with Load Aggregation Pull at Each Level)

6.3.7 FastDR – Telemetry

Context: FastDR Telemetry Use Cases represent the upstream telemetry from the DR Resource and is used by the DR Controlling entity to verify and monitor the response DR Resource to the dispatch in real time. In the simplest case, Telemetry is provided from the DR Resource to the DR Controlling Entity.

Primary Actors: DR Controlling Entity, DR Resource.

Stakeholders and Interests: Utility, Customer

Preconditions:

1. DR Controlling Entity and DR Resource are enrolled in the same DR Program.
2. DR Controlling Entity has successfully sent the DR Resource a DR Event Message.

Trigger(s):

DR Resource receives DR Event message with Telemetry requirements.

Main Success Scenario:

1. DR Resource sends a Telemetry Message to the DR Controlling Entity within an agreed upon interval.
2. DR Controlling Entity sends acknowledgment to DR Resource.

Post-Condition:

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Sequence Diagram:

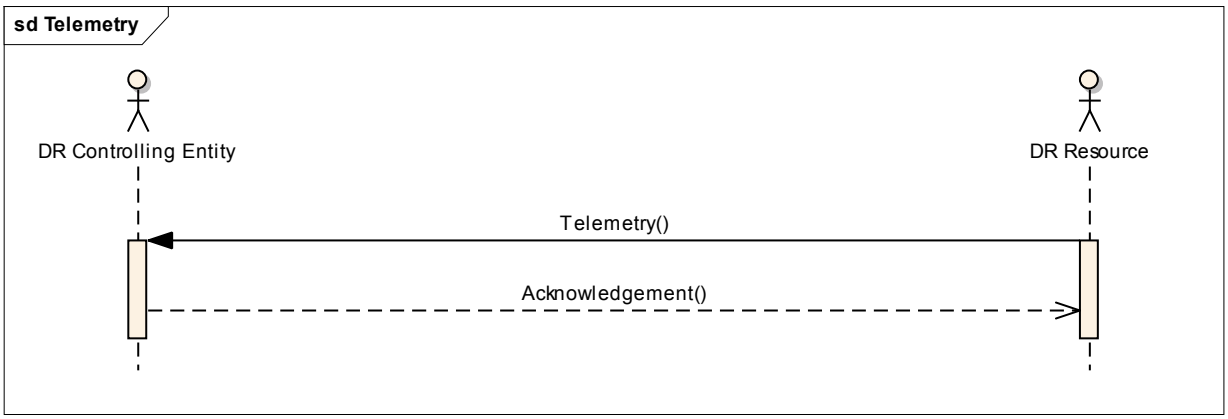

Figure 24 – Fast DR Telemetry

6.3.8 FastDR – Telemetry with Communications Hierarchy

Context: FastDR Telemetry Use Cases represent the upstream telemetry from the DR Resource and is used by the DR Controlling entity to verify and monitor the response DR Resource to the dispatch in real time. Telemetry with a Communications Hierarchy is the case where the DR Event message was sent via an Intermediary as defined in Use Case "FastDR – Asynchronous Dispatch with Communications Hierarchy" (either "Push" or "Pull").

Primary Actors: DR Controlling Entity, DR Resource, Intermediary

Stakeholders and Interests: Consumers, Utility, DR Service Providers

Preconditions:

1. DR Controlling Entity and DR Resource are enrolled in the same DR Program.
2. DR Controlling Entity has successfully sent the DR Resource a DR Event Message via an Intermediary.

Trigger(s):

DR Resource has received a DR Event Message via an Intermediary.

Main Success Scenario:

1. DR Resource sends Telemetry Message to Communications Intermediary.
2. Communications Intermediary sends Acknowledgment Message to DR Resource.
3. Communications Intermediary sends Telemetry Message to DR Controlling Entity.
4. DR Controlling Entity sends Acknowledgement Message to Communications Intermediary.

Post-Condition:

Sequence Diagram:

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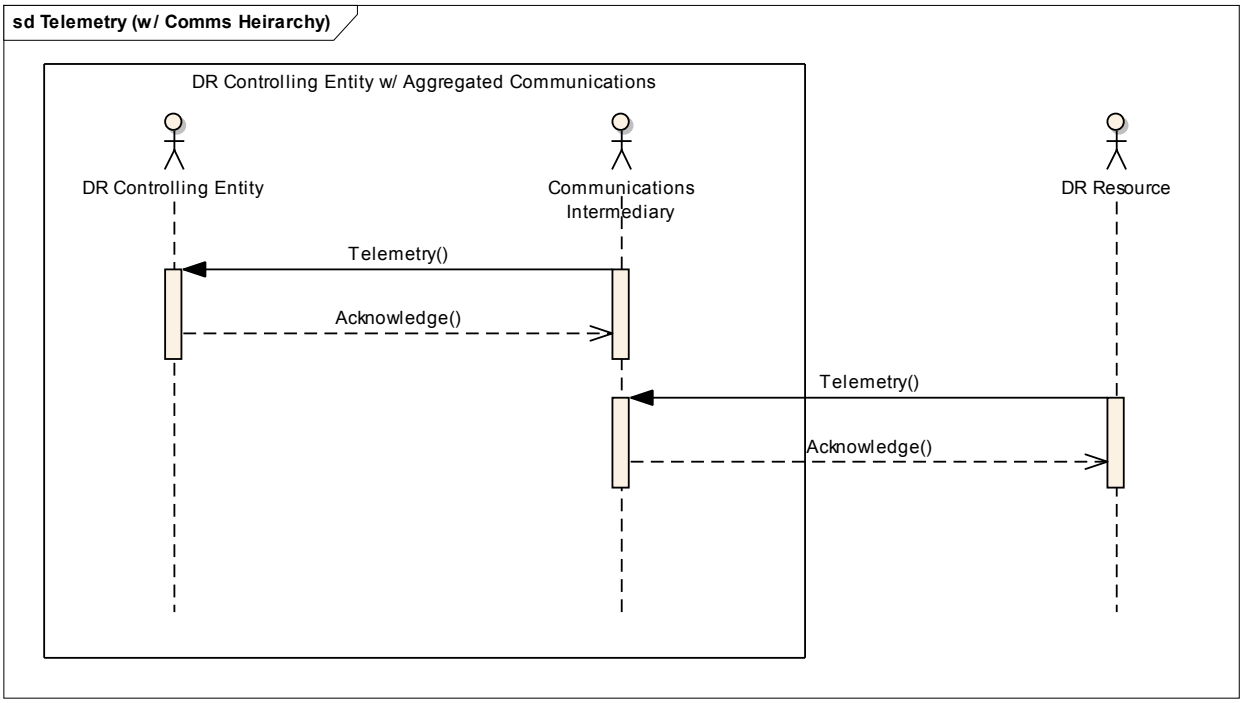

Figure 25 – Fast DR Telemetry

6.3.9 FastDR – Telemetry with Load Aggregation

Context: FastDR Telemetry Use Cases represent the upstream telemetry from the DR Resource and is used by the DR Controlling entity to verify and monitor the response DR Resource to the dispatch in real time. Telemetry with a Communications Hierarchy is the case where the DR Event message was sent via an Intermediary as defined in Use Case "FastDR – Asynchronous Dispatch with Load Aggregation" (either "Push" or "Pull").

Primary Actors: DR Controlling Entity, DR Resource, DR Aggregator

Stakeholders and Interests: Consumers, Utility, DR Service Providers

Preconditions:

1. DR Controlling Entity, DR Aggregator and DR Resource are enrolled in the same DR Program.
2. DR Controlling Entity has successfully sent the DR Resource a DR Event Message via the DR Aggregator.

Trigger(s):

DR Resource has received a DR Event Message via a DR Aggregator.

Main Success Scenario:

1. DR Resource sends Telemetry Message to DR Aggregator.
2. DR Aggregator sends Acknowledgment Message to DR Resource.

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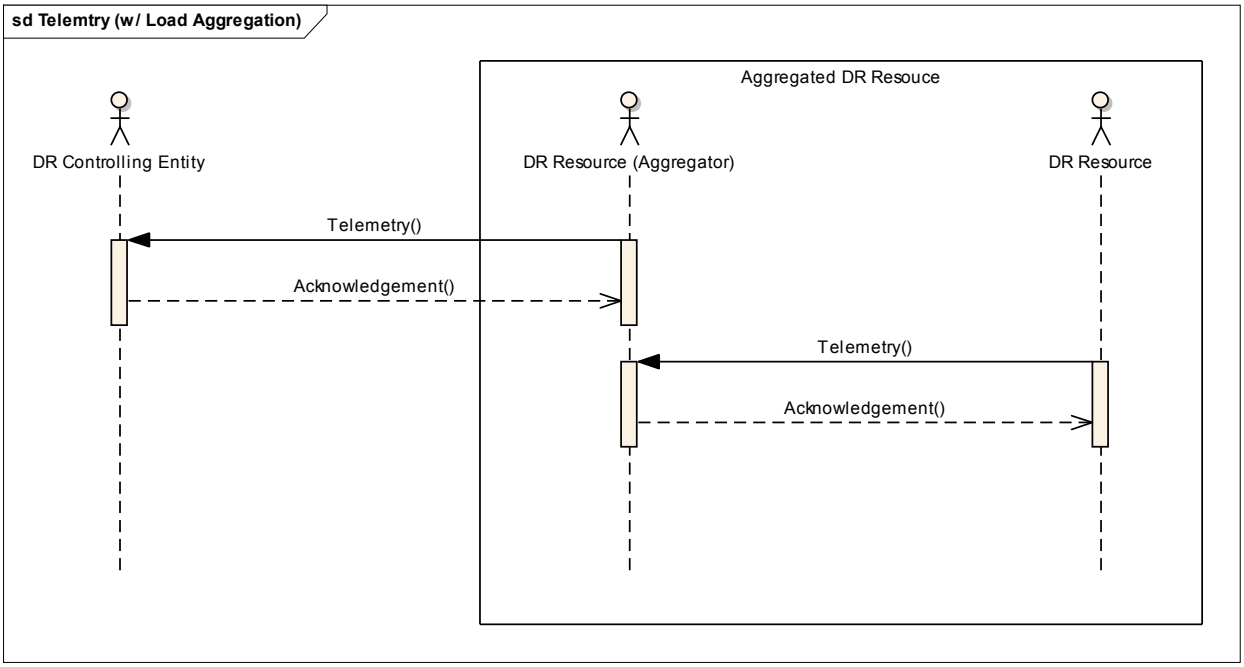
867 3. DR Aggregator sends Telemetry Message to DR Controlling Entity.

868 4. DR Controlling Entity sends Acknowledgement Message to Communications
869 Intermediary.

870 **Post-Condition:**

871

872 **Sequence Diagram**:



873

874 **Figure 26 – Fast DR Telemetry (with Load Aggregation)**

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