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

1. RECOMMENDED ACTION:

X	Accept as requested
	Accept as modified below
	Decline

EFFECT OF EC VOTE TO ACCEPT RECOMMENDED ACTION:

X	Change to Existing Practice
	Status Quo

2. TYPE OF DEVELOPMENT/MAINTENANCE

Per Request:		Per Recommendation:	
X	Initiation	X	Initiation
	Modification		Modification
	Interpretation		Interpretation
	Withdrawal		Withdrawal
X	Principle	X	Principle
X	Definition	X	Definition
X	Business Practice Standard	X	Business Practice Standard
	Document		Document
	Data Element		Data Element
	Code Value		Code Value
	X12 Implementation Guide		X12 Implementation Guide
	Business Process Documentation		Business Process Documentation

3. RECOMMENDATION

SUMMARY:

The business process flows, use cases and data requirements presented in this document illustrate the standard interactions between Utility Distribution Operator, Service Provider (Demand Response) and Utility Customer for the administration and deployment of demand response resources retail markets.

RECOMMENDED STANDARDS:

In response to NIST's Priority Action Plan 9, this document provides requirements specification, in the form of business process flows, use cases and data requirements in certain areas, to support the standardization of the information exchange between Utility Distribution Operator, Service Provider (Demand Response) and Utility Customer. This document shares a standard set of actors and terminologies with the companion Requirements Specification for Wholesale Standard DR Signals.

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New Model Business Practices REQ.14 – Smart Grid Activities

RECOMMENDED STANDARDS:

Executive Summary

Specifications for Retail Standard Demand Response Signals

The North America Energy Standards Board (NAESB) Smart Grid Task Force (SGTF) took the responsibility of consolidating and developing DR use cases that provide requirements for developing DR control and pricing signal standards, which is called for by National Institute of Standards and Technology (NIST) Priority Action Plans (PAP) 03 and 09. This document addresses the business and data requirements for standardizing control and pricing signals for Retail level Demand Response (DR) and Distributed Energy Resources (DER) as part of the Smart Grid implementation. Wholesale market DR and DER information exchanges are outside the scope of this document and are addressed in the Requirements Specification for Wholesale DR signals. The first step of use case development is the development of the Framework for Integrated DR and DER Models document, which provides an overall business context for DR and DER Models.

According to the Framework Document findings:

1. DR signals standardization must support all four market types; i.e. regions with a) no open wholesale and no retail competition, b) open wholesale market only, c) open retail competition only, d) open wholesale and open retail competition. It must also consider key differences that exist and will continue to exist in all four market types.
2. Wholesale market DR and pricing signals have different characteristics than retail market DR and pricing signals, although commonality in format is feasible.
3. Most Customers (with a few exception of Commercial and Industrial (C&I) Customers) will not interact directly with wholesale market when it comes to DR and pricing signals.
4. Retail pricing models are complex, due to the numerous tariff rate structures that exist in both regulated and un-regulated markets. Attempts to standardize DR control and pricing signals must not hinder regulatory changes or market innovations when it comes to future tariff or pricing models.
5. New business entities (Energy Service Providers (ESP), Demand Response Providers (DRP), Service Providers, and Energy Information Service Providers (ESIP)) will play an increasing role in DR implementation.
6. DER may play an increasingly important role in DR, yet the development of tariff and/or pricing models that support DER's role in DR is still in its infancy.
7. The Customer's perspective and ability to react to DR control and pricing signals must be a key driver during the development of DR standards.

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The following deals exclusively with the retail level demand response signals requirements. The requirements are captured in the form of UML models, where business requirements are captured in Use Case narrative format, data requirements are captured in tabular format, and information exchange flows are captured in sequence diagram format. The top level use cases for retail DR are:

1. Administrate DR Program
2. Administrate Customer for DR
3. Administrate DR Resource
4. Execute DR Event
5. Post DR Event Management

Introduction

Specifications for Retail Standard Demand Response Signals

Purpose: The purpose of the following is to capture business and data requirements for Retail Level DR signals between entities that controls and manages the DR programs and entities that provide demand response with DR resources and assets. This is to fulfill the NAESB SGTF responsibility under the NIST Smart Grid Interoperability Standards development PAP09. This requirements document will then be used by other standards development organizations identified by NIST PAP09 for further development of DR signals technical specifications for both C&I customer and residential customer markets.

Scope: The scope of the following is to provide business and data requirements for standardizing Demand Response signals at the retail (distribution) level.

Assumptions: The following and its content have been developed with the consideration of the following key assumptions:

- The market focus of this framework is the power industry in United States of America with some overlaps to Canada, although much of the business models and practices may apply to other countries and markets.
- The scope of DER applications will be limited to the context of grid-connected DR use cases and does not include the other possible applications of DER.
- The focus of the document is business level and abstracted models of DR and DER, not specific technologies that enable DR/DER implementation.
- The wholesale (bulk power) level DR signals requirements will be captured by the companion document, yet the basic principles and definitions will be common between these two documents.

Commentary on Distributed Energy Resources: In the context of this report, Distributed Energy Resources (DER) are dispatchable energy generation and storage technologies, typically up to ten MWs in size, that are interconnected to the distribution grid to provide electric capacity and/or energy to a customer or a group of customers and potentially export the excess to the grid for economical purposes. DER systems can generate electric power, as opposed to curtailable or interruptible loads that can just reduce electric loading on the grid.

DER may be subdivided into distributed generation (DG), distributed storage, and plug-in electric vehicles (PEVs):
Distributed generation (DG) technologies can be divided into a) **Renewable Generation**, e.g., small wind power systems, solar photovoltaic (PV), Fuel Cells, Bio-fuel generators and Digesters, and other generation resources using renewable fuel, and b) **Non-Renewable Generation**, e.g., micro-turbines, small combustion turbines, diesel, natural gas and dual-fueled engines, etc.

Storage resources could be divided into a) **Electric Storage,** e.g., battery systems and uninterruptible power supplies (UPS), flywheel, superconducting magnetic energy storage (SMES), etc. and b) **Thermal Storage –** These convert electric power to thermal (cooling/heating) energy for later use, e.g., Ice-based air cooling system, and high-capacity brick-based air heating system.

Plug-in electric and hybrid vehicles (PEV/PHEV) may also be considered as DER, The electric vehicles may be used to supply stored electric energy back to the grid, a.k.a. Vehicle-to-grid (V2G).

Behind-the-meter DER may be bundled with regular load and managed alongside the demand response resources – such as a residential roof-top PV solar panel. But often, DER is treated separately in part due to its control capabilities. In addition to a regular retail tariff, behind-the-meter DER may be subject to net-metering or feed-in tariff, where excess generation can be exported to the grid at an established or a dynamic price.

Similar to DR resources, DER assets need to be registered and enrolled into a DR program. Furthermore, DER assets are typically required to meet additional technical requirements and certification for grid interconnection. Depending on the size of a DER and its export capabilities, sub-metering and telemetry capabilities may be required to monitor the impact of the DER operation on the distribution grid reliability and power quality. Also, renewable resources may receive Renewable Energy Credits (RECs) and may also qualify as a must-run resource, e.g., wind power in some regions. These need to be incorporated into pricing and control signals associated with DER operation.

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New REQ.14.2.B Technical Abbreviations/Acronyms and Defined Terms to be added to REQ.14 are included below for reference *(previously added in Recommendation 2010 WEQ Annual Plan Item 6(b) / 2010 Retail Annual Plan Item 9(b))*

REQ.14.2.B Technical Definitions

Abbreviations and Acronyms

Abbreviation / Acronym	Meaning
DDE	Designated Dispatch Entity
EA	Environmental Authority
ED	End Device'
FR	Federal Regulator
LA	Local Authority
LSE	Load Serving Entity
MA	Metering Authority
MP	Market Participant
RA	Reliability Authority
RM	Response Method
RMA	Response Method Aggregation
SE	Scheduling Entity
SO	System Operator
SP	Service Provider
SR	State Regulator
TDSP	Transmission/Distribution Service Provider
UC	Utility Customer
UDO	Utility Distribution Operator

REQ.14.2.1t **Business Entity**: The wholesale or retail entity that interacts with other entities in its market.

REQ.14.2.2t **Communication Method**: The method by which an object communicates with another object to instruct, measure or control.

REQ.14.2.3t **Control**: The role associated with the control of an End Device.

REQ.14.2.4t **Demand Response Objects**: Physical and logical types of demand response resource objects.

REQ.14.2.5t **Designated Dispatch Entity**: A role which carries the responsibility of receiving and processing demand resource dispatch instructions or market information and (optionally) providing response information.

REQ.14.2.6t **End Device**: A physical end-use device that consumes or supplies electricity.

REQ.14.2.7t **Environmental Authority**: A regulatory authority responsible for the development, reporting and enforcement of environmental activities.

REQ.14.2.8t **Facility**: The location at which connection to the transmission or distribution system is made.

REQ.14.2.9t **Federal Regulator**: A Federal regulatory authority.

REQ.14.2.10t **Load Serving Entity**: A role which carries the responsibility of serving end-users and selling electric energy to end-users.

REQ.14.2.11t **Local Authority**: A regulatory authority responsible for the oversight and administration of utility service-related functions within its jurisdiction.

REQ.14.2.12t **Market Enrollment**: The collection of enrollment or tariff data for a Demand Resource Object to provide a specific market product or service.

REQ.14.2.13t **Market Participant**: An organization registered with the System Operator that may take on roles such as SP, LSE, TDSP, DDE, SE, and/or MA in accordance with the System Operator's market rules.

REQ.14.2.14t **Measurement**: The role associated with the device or algorithm that measures the consumption or supply of an End Device.

REQ.14.2.15t **Metering Authority**: A role which carries the responsibility of providing data necessary to determine the performance of a Resource.

REQ.14.2.16t **P-Node**: The price location of the Facility in the transmission and/or distribution network.

REQ.14.2.17t **Participant**: The entity that represents resources to a market or distribution operator.

REQ.14.2.18t **Regulator:** A rule-making and enforcement entity.

REQ.14.2.19t **Reliability Authority:** A regulatory authority responsible for the development, reporting and enforcement of electric reliability-related activities.

REQ.14.2.20t **Response Method:** A measurable action taken in response to an instruction to change consumption.

REQ.14.2.21t **Response Method Aggregation:** A logical entity that has a reportable interval level consumption, e.g. a site may also be a physical entity that may have its own meter, a neighborhood of homes that has a net meter, or an estimate of consumption of an aggregation of retail customers.

REQ.14.2.22t **Resource:** A market-dependent group of Response Method Aggregations that represents a dispatchable entity.

REQ.14.2.23t **Scheduling Entity:** A role which carries the responsibility of submitting bids/offers and receives Schedules and Awards.

REQ.14.2.24t **Service Provider:** A role which carries the responsibility of coordinating resources to deliver electricity products and services to a market or distribution operator.

REQ.14.2.25t **State Regulator:** A regulatory authority responsible for the oversight and administration of electric utilities.

REQ.14.2.26t **Support Operator:** Objects that support the interaction of Business Entities and Demand Response Objects.

REQ.14.2.27t **System Operator:** An entity which carries the responsibility of administering the demand response process, from Resource enrollment to performance evaluation.

REQ.14.2.28t **Transmission/Distribution Service Provider:** A role which carries the responsibility of operating a local electricity transmission and/or distribution system.

REQ.14.2.29t **Utility Customer:** An end-use customer of the Utility Distribution Operator that takes on roles such as Facility or Resource.

REQ.14.2.30t **Utility Distribution Operator:** An entity which carries the responsibility of operating an electricity distribution system.

REQ.14.2.31t **Zone:** A physical or electrical region.

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Model Business Practices

REQ.14.3.2 Specifications for Retail Standard Demand Response Signals

The following describes general business processes for implementing demand response capacities at the retail market level. The following principles apply to the development and application of these business process requirements.

#	Name	Description	Rationale	Implication
1	Scalability	The architecture should allow for the management of millions of Customer premises devices	Scale-out, adding more low-cost machines, has proven to be superior to scale-up, using larger single machines, as a way to handle large loads. For example, high traffic web sites use farms of low-cost machines to serve pages to millions of simultaneous web users.	Architecture should allow the solution to scale-out as more devices are added.
2	Actionable, testable, and transferable work products	Any work (artifacts) that are created can be used by the audience for this work, e.g., utilities, vendors, regulators, etc. There needs to be clear, explicit guidance for how to use the artifacts. There is an expectation that the work products are useful at lower levels of design.	Such work products will promote market adoption and minimize the cost and risk of adoption, leverage open and best practices, and establish repeatable processes, patterns, and templates for all work products.	The use of common tools and methods will be fostered. Organizations that do not follow the use of the common tools and methods may have more difficulty implementing the artifacts.

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#	Name	Description	Rationale	Implication
3	Platform Independence, Vendor Neutral	Requirements and design artifacts shall be platform independent. Implementation technology shall be chosen due to its level of acceptance at the marketplace as open standards.	There is an expectation of differentiation and innovation in the marketplace. With greater dependence on a specific platform, there may be less architectural flexibility.	To achieve both technical and semantic interoperability, certain lower level technologies will need to be chosen. For example, Web Services technology is widely used for integration, and UML is widely used for modeling.
4	Cyber Secure	Architecture must incorporate latest secure computing techniques.	The integrity of the electric grid and market depend on preventing unauthorized actors from manipulating the DR and DER system.	Architecture must comply with the latest security guidance from the NIST SGIP Architecture Committee and CyberSecurity Task Group, when it comes to Web Services security related implementation.
5	Interoperability	DR signaling standards should utilize open, interoperable industry standard control and communication technologies to integrate with both common energy management and control systems that can conduct DR activities	Interoperability across different domains of Smart Grid is key to the success of DR signaling standards as it ensures level playing field for innovative solutions for all participants of the Smart Grid.	DR signaling standards must be developed in harmonization with others relevant standards as identified by the NIST SGIP.
6	Automatic Demand Response	The DR program (analysis, notification, event, action, monitoring, verification, settlement) should be automatic. DR signaling standards should provide secure, reliable communications with consumers for DR	Automation is the only way to ensure large scale and repeatable demand response implementation.	Security, reliability and testability must be ensured for DR automation.

#	Name	Description	Rationale	Implication
		operations		
7	Cover All Market Types	DR signaling standards should be supported and implementable in all four market types listed in this document	Standards development shall not get in the way of regulatory policy decisions.	DR signals design need to support a wide range of programs and tariff/pricing structures.

REQ.14.3.2.1 ACTORS

The following actor roles and actors are defined and used across NAESB documents related to NIST PAP03, 04 and 09 (Wholesale and Retail).

Actor Roles

Term	Acronym	Definition
Service Provider	SP	A role which carries the responsibility of coordinating resources to deliver electricity products and services to a market or distribution operator.
Designated Dispatch Entity	DDE	A role which carries the responsibility of receiving and processing demand resource dispatch instructions or market information and (optionally) providing response information.
Load Serving Entity	LSE	A role which carries the responsibility of serving end-users and selling electric energy to end-users.
Metering Authority	MA	A role which carries the responsibility of providing data necessary to determine the performance of a ***Resource.***
Scheduling Entity	SE	A role which carries the responsibility of submitting bids/offers and receives ***Schedules*** and ***Awards***.
System Operator	SO	An entity which carries the responsibility of administering the demand response process, from Resource enrollment to performance evaluation.
Transmission/Distribution Service Provider	TDSP	A role which carries the responsibility of operating a local electricity transmission and/or distribution system.

Actors List

Regulator	A rule-making and enforcement entity.
Federal Regulator (FR)	A Federal regulatory authority.
Reliability Authority (RA)	A regulatory authority responsible for the development, reporting and enforcement of electric reliability-related
Environmental Authority (EA)	A regulatory authority responsible for the development, reporting and enforcement of environmental activities.
State Regulator (SR)	A regulatory authority responsible for the oversight and administration of electric utilities.
Local Authority (LA)	A regulatory authority responsible for the administration of utility service-related functions within its jurisdiction.

Business Entity	The wholesale or retail entity that interacts with other entities in its market.
System Operator (SO)	An entity which carries the responsibility of administering the demand response process, from Resource enrollment to performance evaluation.
Market Participant (MP)	An organization registered with the System Operator that may take on roles such as SP, LSE, TDSP, DDE, SE, and/or MA in accordance with the System
Utility Distribution Operator (UDO)	An entity which carries the responsibility of operating an electricity distribution system.
Utility Customer (UC)	An end-use customer of the Utility Distribution Operator that takes on roles such as Facility or Resource.

Participant Role	The entity that represents resources to a market or distribution operator.
Service Provider (SP)	A role which carries the responsibility of coordinating resources to deliver electricity products and services to a market or distribution operator.
Load Serving Entity (LSE)	A role which carries the responsibility of serving end-users and selling electric energy to end-users.
Scheduling Entity (SE)	A role which carries the responsibility of submitting bids/offers and receives Schedules and Awards.
Designated Dispatch Entity (DDE)	A role which carries the responsibility of receiving and processing demand resource dispatch instructions or market information and (optionally) providing response information
Transmission/Distribution Service Provider (TDSP)	A role which carries the responsibility of operating a local electricity transmission and/or distribution system.
Metering Authority (MA)	A role which carries the responsibility of providing electric usage data necessary to determine the performance of a Resource.

Resource Objects	Physical and logical types of resource-related objects.
Resource	A group of Response Method Aggregations that represents a dispatchable entity. ***Also referred to as DR Resource in this document.***
Response Method Aggregation (RMA)	A logical entity that has a reportable interval level consumption, e.g. a site may also be a physical entity that may have its own meter, a neighborhood of homes that has a net meter, or an estimate of consumption of an aggregation of retail customers. ***Also referred to as DR Asset in this document.***
Facility	The location at which connection to the transmission or distribution system is made.

Resource Objects	Physical and logical types of resource-related objects.
Response Method (RM)	A measurable action taken in response to an instruction to change consumption.
End Device (ED)	A physical end-use device that consumes or supplies electricity.

Supporting Objects	Objects that support the interaction of Business Entities and Resource Objects
Measurement	The role associated with the device or algorithm that measures the consumption or supply of an End Device.
Control	The role associated with the control of an End Device.
Market Enrollment	The collection of enrollment or tariff data for a Demand Resource Object to provide a specific market product or service.
Zone	A physical or electrical region.
Communication Method	The method by which an object communicates with another object to instruct, measure or control.
P-Node	The price location of the Facility in the transmission and/or distribution network.

REQ.14.3.2.2 Conventions

The use case modeling technique is used for capturing business and date requirements relative to Retail Demand Response. There are two basic diagrams used in this document. The first one is the use case diagram, which shows the scope of business use cases for a given business scenario. The relationships used in the Use Case diagrams are as follows:

- Include: this indicates additional scenarios
- Extend: this indicates alternatives scenarios
- Generalization (line with triangle head): this indicates variations (sub-types) of the main use case.
- Precedes: this indicates a time sequence
- Invokes: this indicates a pre-condition or dependency

The second is the sequence diagram, which shows the information exchange flows between actors for a given use case. The message flows are shown in one way with the convention of verb and noun, verb indicating the action being taken, noun indicating the name of the information being exchanged. The return message flow is the acknowledgement of the main message flow.

REQ.14.3.2.3 Use Case Overview

Similar to the Wholesale Demand Response use cases, Retail Demand Response use cases generally follow five main steps, see the Figure 1.

1. Administrate DR Program
2. Administrate Customer for DR
3. Administrate DR Resource
4. Execute DR Event
5. Post DR Event Management

There are many programs that exist in today's retail markets with or without open competition. New programs will be defined and deployed in the future. The goal of this use case analysis is to find commonalities among these programs so that the derived DR signal messaging specification can be implemented to support a large number of DR programs.

The focus of the Standardized DR Signals is the step 4, Execute DR Event, where the DR signals will be communicated between the DR Providers and the DR resources. All other use cases are supporting materials to ensure that DR use case requirements are documented and understood in a complete picture.

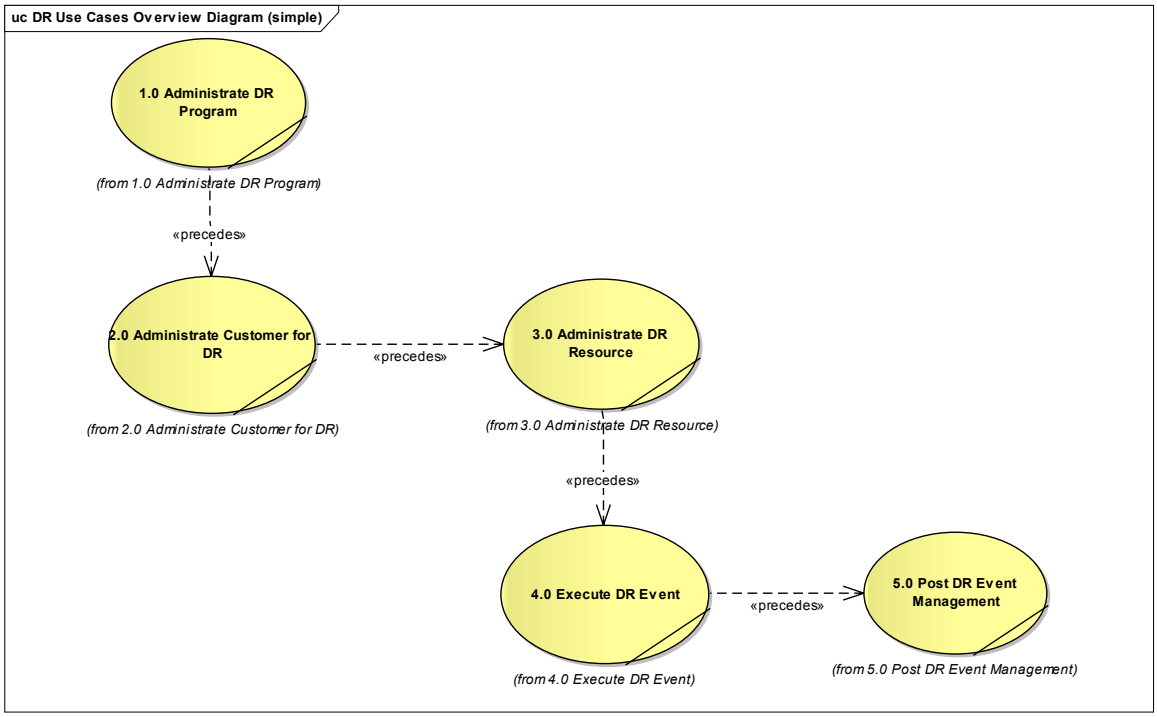


Figure 1. Retail Market DR Use Case Overview

REQ.14.3.2.4 Specific Use Cases

REQ.14.3.2.4.1 Administrate DR Program

Typically DR programs are created for specific business needs of demand side management. However, it is not required to affect demand behavior. It is also likely that DR programs will evolve over time. Figure 2 shows the actors and use cases involved in administrating DR programs. Following are the three main use cases concerning the creation, update and removal of DR programs. It is unlikely that this step of the DR management will be automated.

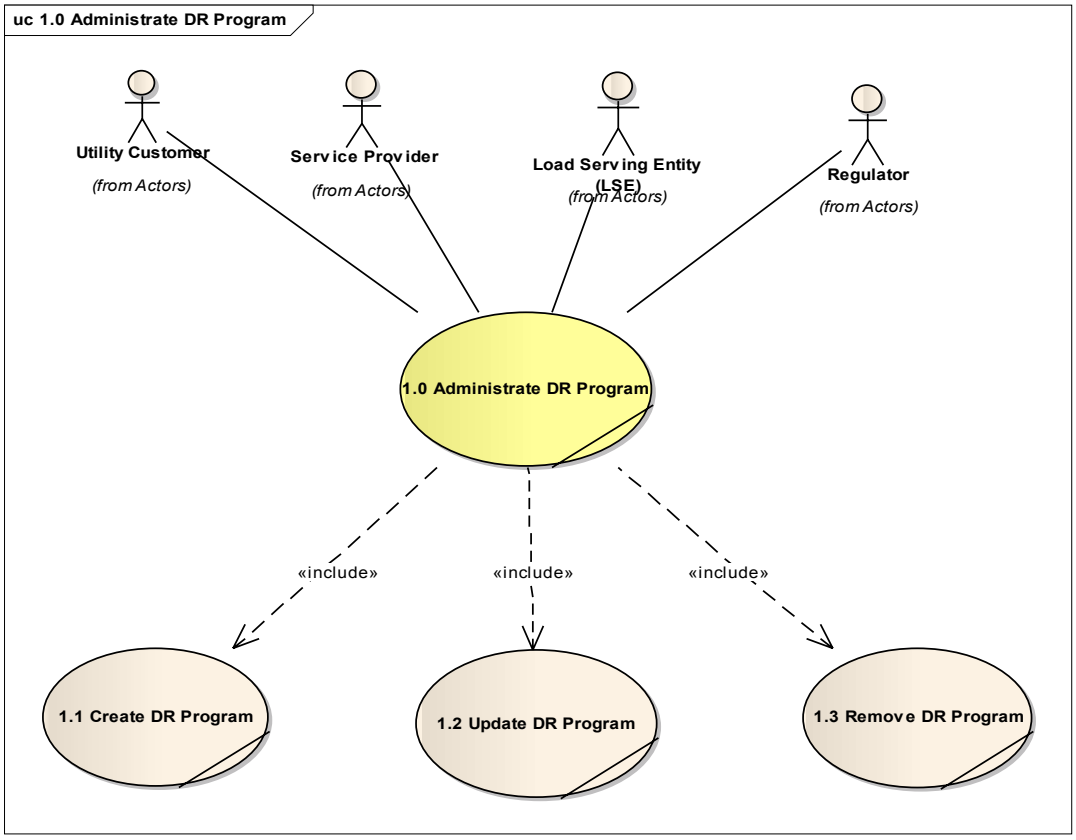


Figure 2. Administrate DR Program

REQ.14.3.2.4.1.2 Create DR Program

Description

A DR program is created to meet one of two, or both, situations. A DR program is created to meet a reliability need, i.e., a projected insufficient energy supply, and/or for economic purposes, i.e., when market prices are peaking.

A properly designed DR program will have a clearly stated goal or objective, Program Administrator, activation and operational

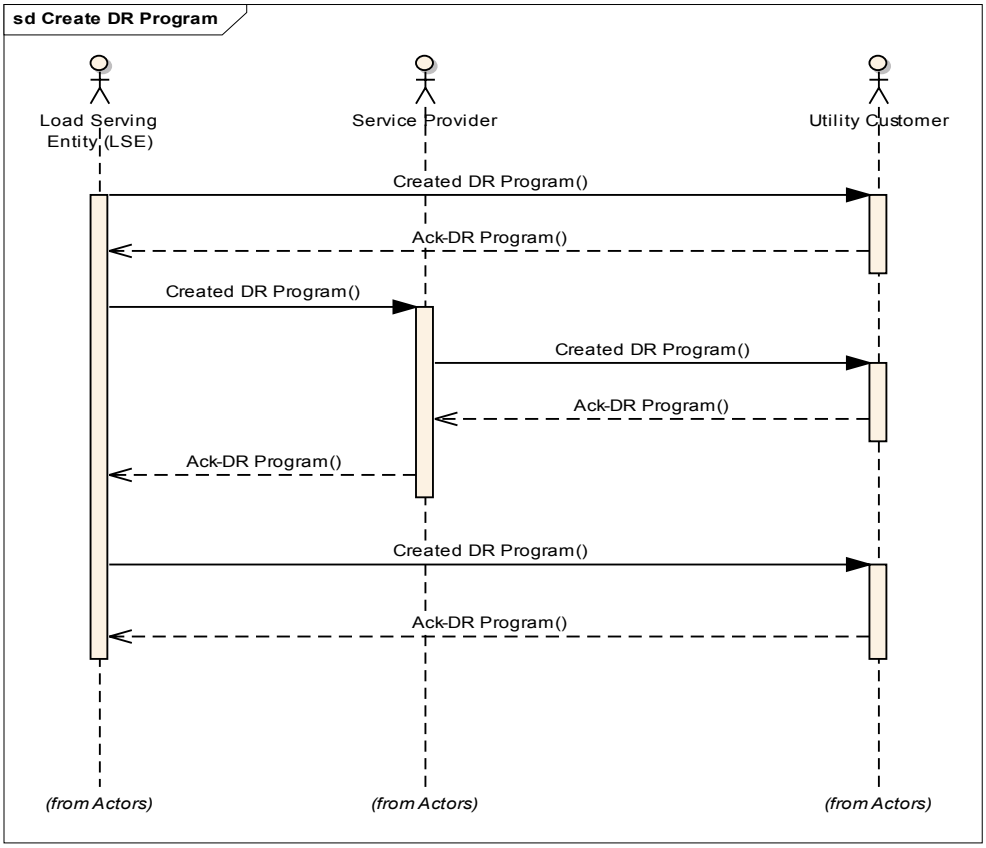
protocols, and responsibilities and obligations. The items that should be considered include, but are not limited to:

- The type and size of the target Customer;
- The type of program to be implemented, e.g., Direct Load Control, Firm Service Level, Guaranteed Load Drop, etc.;
- The type and level of granularity of metering and telemetry to be used/required;
- Any regulatory requirements;
- Method of communication;
- Activation protocol;
- Marketing and Sales activities;
- Customer Education activities;
- Duration;
- Delivery Period;
- LSE/UDO Compensation;
- Data Exchange Protocols;
- Customer Authorization;
- Third Party Participation;
- Registration / Enrollment Process;
- Approval Process;
- Baseline Calculations;
- Settlement Process;
- Payment Process;
- DR Resource enablement, including incentives;
- DR Resource deployment process;
- M&V Methodology;
- Contractual Agreements;
- Dispute Resolution Process;
- Phase-in or Roll-out Plan;
- Product type offering to the ISO/RTO; energy only, ancillary service (regulation up/down, spinning/non-spinning, etc.);
- If offering to ISO/RTO, specific metering/telemetry or other requirements needed to actively participate ;
- Address multiple participation in other DR programs (retail and wholesale);
- Include/Exclude full/partial co-generation system, back-up generation, DER, etc…;
- UDO verifying DR resource physical electric grid location.

Once the DR program is developed, it should be certified prior it implementation. Such testing may be accomplished through a pilot program. The results of the test/pilot should then be compared against the goal/objective of the program and any needed modifications made. Upon satisfactory results, the DR program should be filed with and approved by the Applicable Regulatory Authority, if any. Depending on which Entity is creating the DR program, it must also be submitted to and approved by the System Operator. Finally, the DR program must be implemented. Upon activation of a DR program, an observable demand reduction should occur.

Sequence Diagram

The following DR Program interaction assumes the initial steps of regulatory process are completed for the approval of a DR program. This shows the potential automation of the creation of DR programs from systems perspective.

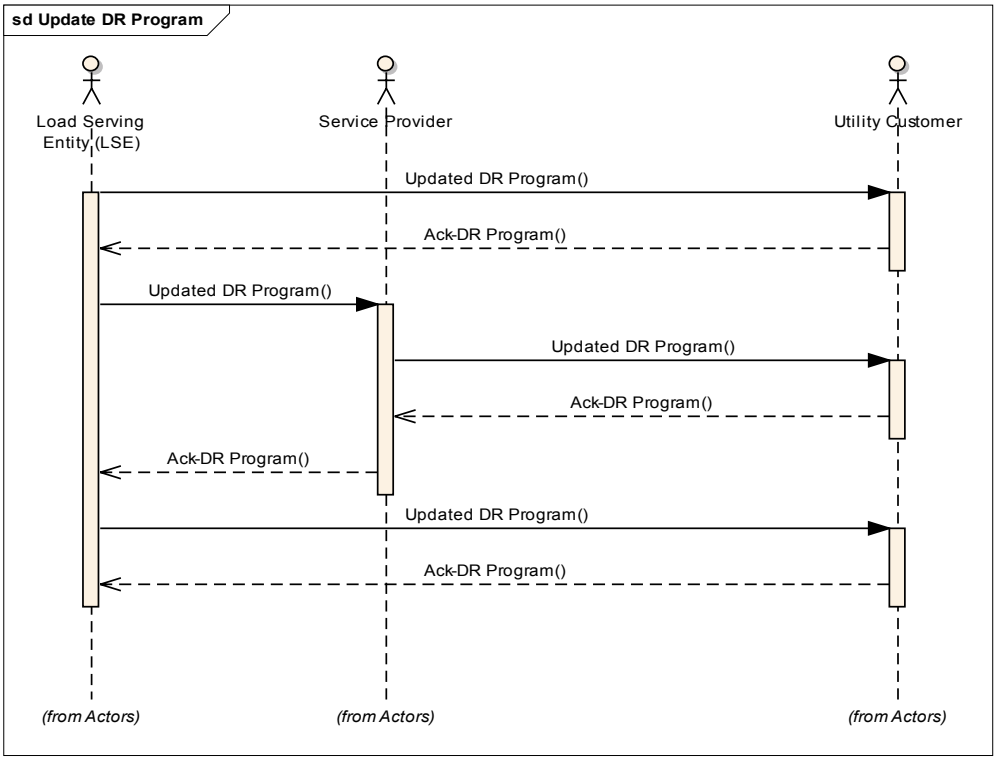


REQ.14.3.2.4.1.3 Update DR Program

Once a DR program is initiated, changes in various elements of the program may be required or desired. After identifying the specific modification required, each of the considerations identified in the "Create" step should be investigated to insure that no unintended impacts occur as a result of the modification. If such unintended impacts occur, further investigation of the modification is required prior to implementation.

A regulated Entity must then present the modifications to the Applicable Regulatory Authority for approval and, then to the System Operator for approval. Once approved, the modifications must be communicated to Customers.

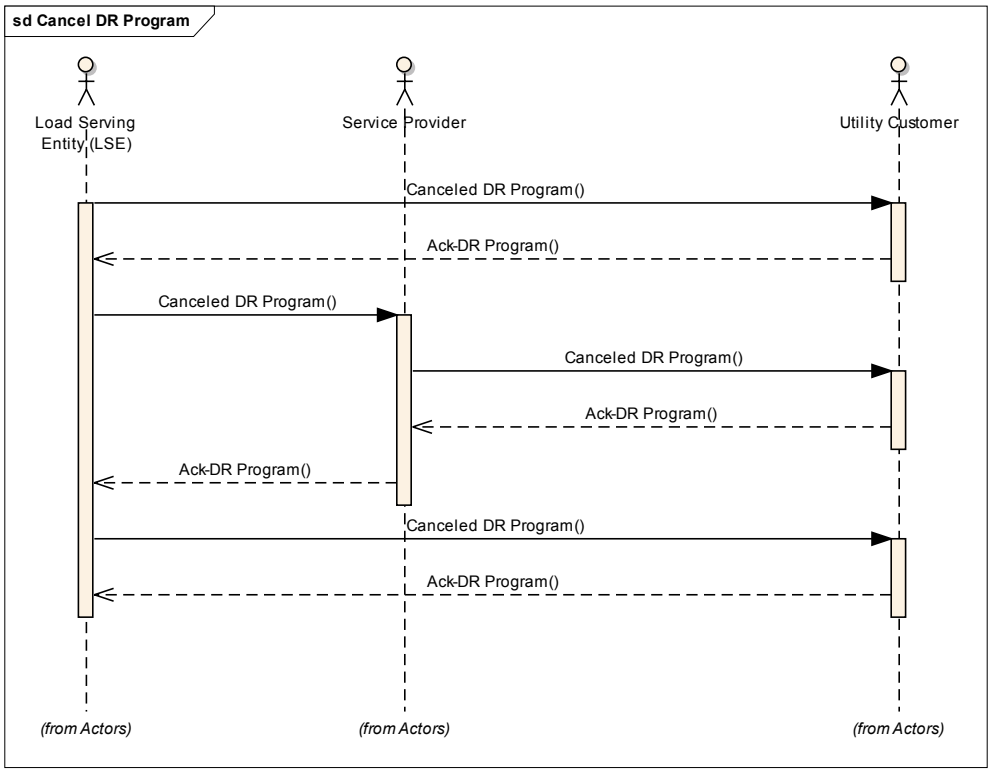
Sequence Diagram



REQ.14.3.2.4.1.4 Remove DR Program

Termination of a DR program must take into account any DR resource long term commitments in System Operator programs and contractual obligations with Service Provider (Service Providers, Energy Service Provider) or Load Serving Entities. In addition, State and or Federal regulatory agency filings and approvals must be considered prior to terminating a DR program. Termination of a DR program may involve the removal of DR infrastructure, such as Direct Load Control Devices and advanced metering and pulse devices used in the Measurement and Verification of the program. All outstanding payments to the DR resources should be completed prior to the termination of the DR program.

Sequence Diagram



REQ.14.3.2.4.2 Administrate Customer for DR

Once the DR programs are established, there will be campaigns from Service Provider to get customers enrolled into the programs. Figure 3 shows the actors and use cases involved in administrating customers into DR programs. Following are the three main use cases concerning the creation, update and removal of customers for a DR program. Enrollment may affect how a customer is compensated for demand responses. It is unlikely that this step of the DR management will be automated.

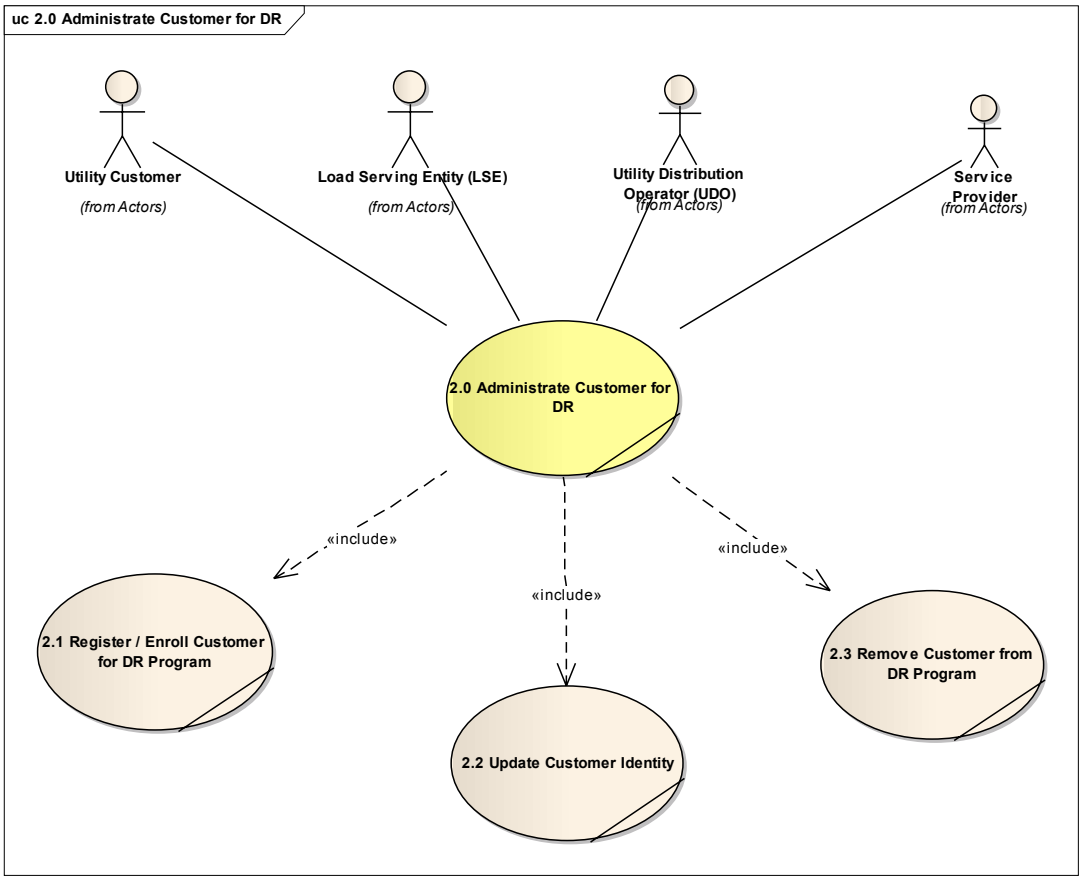


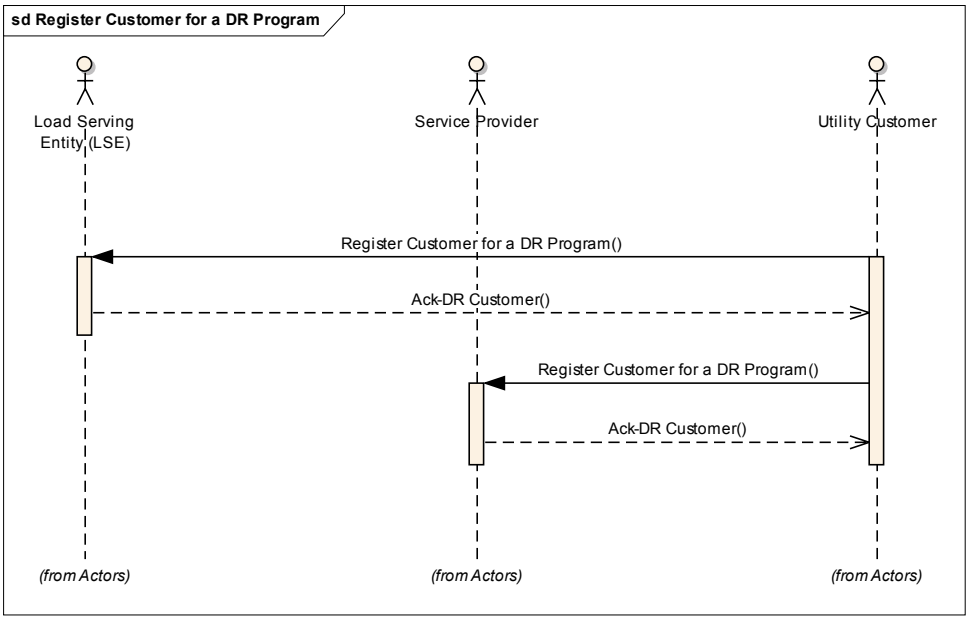
Figure 3. Administrate Customer for DR

REQ.14.3.2.4.2.1 Register / Enroll Customer for DR Program

Description

The registration/enrollment process must capture the key identifiers in order to enable accurate accounting and classification of DR resources, as well as to ensure customer understanding of the type and specific requirements of demand response service they are providing. A registration process to track registrations of System Operators or facilitating agencies and the movement of DR resources from one Service Provider to another as may occur from time to time is necessary. Internet-based applications for the registration/enrollment process are ideal for this type of program administration. There may be different applications for various service types and customer types.

Sequence Diagram



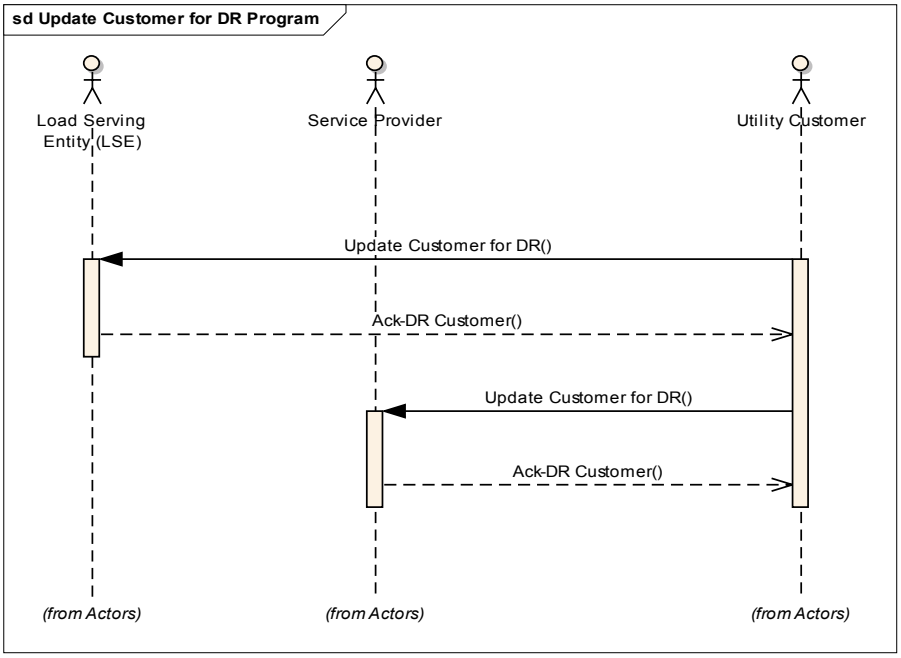
REQ.14.3.2.4.2.2 Update Customer Identity

Description

Once a DR registration is completed, changes in various elements of the registration may be required or desired. After identifying the specific modification required, each of the considerations identified in the register/enroll step should be investigated to ensure that it is accurate and complete.

All parties (Utility, Aggregators, Energy Consultants, DR resources, Regulatory Agencies) affected by the update should be given reasonable time to review, dispute, and approve/disapprove the update(s).

Sequence Diagram

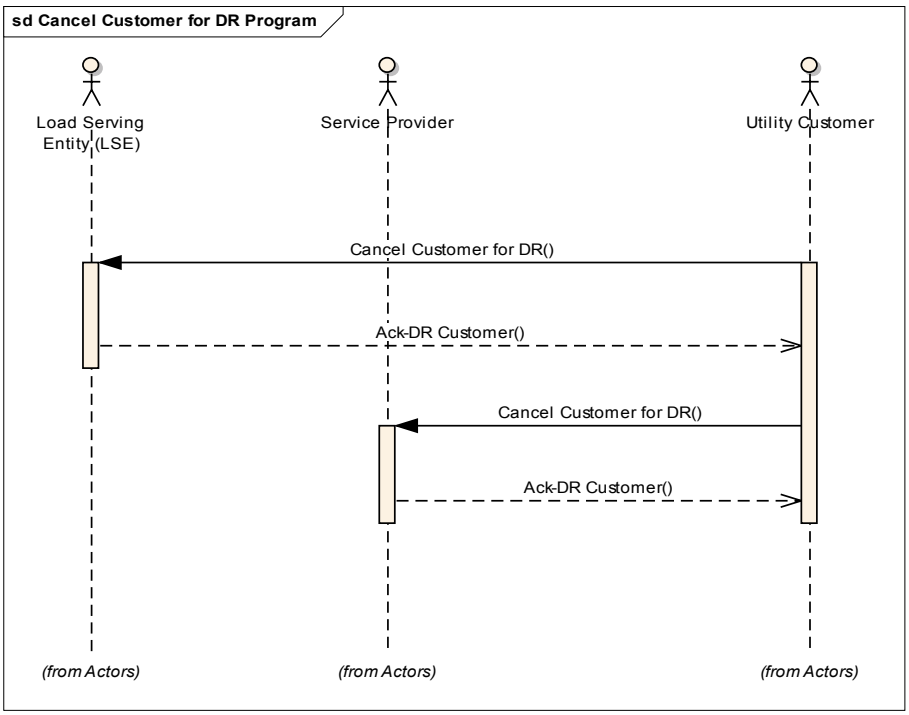


REQ.14.3.2.4.2.3 Remove Customer from DR Program

Description

Removing a Customer Entity from a DR Program enrollment must take into account any DR resource long term commitments in System Operator programs, and contractual obligations with Service Provider or Load Serving Entities. In addition, State and/or Federal regulatory agency filings and approvals must be considered prior to removing a customer enrollment from a DR program.

Sequence Diagram



REQ.14.3.2.4.3 Administrate DR Resource

DR Resource is an equivalent of Resource and DR Asset is an equivalent of Response Method Aggregation (RMA), defined in the actor list table.

As part of enrolling customers to a DR program, specific DR resources and assets that are associated with customers' accounts and premises will also need to be registered. Figure 4 shows the actors and use cases involved in administrating DR resources and/or assets into DR programs. The following use cases deal with the registration, update, and removal of DR resources and assets associated with a customer. When updating DR resources, there will also be potential use cases of DR bidding process, either for supplying or for buying power. There are also cases where Distributed Energy Resources will act as DR assets.

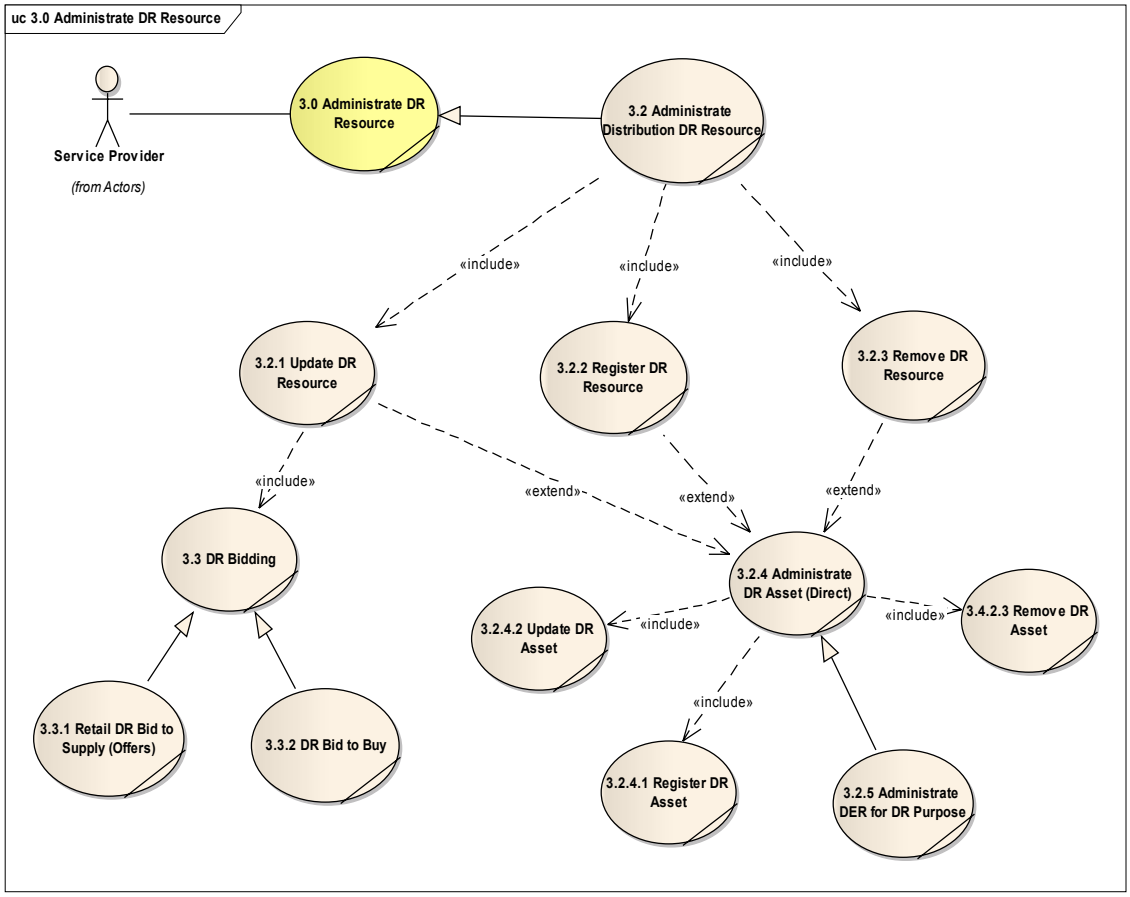


Figure 4. Administrate DR Resources and/or Assets into DR Programs

REQ.14.3.2.4.3.1 Administrate Distribution DR Resource

These activities are used to administer all of the DR Resources and Assets, including a variety of activities surrounding the registration of DR Resources and the management of information surrounding the DR Resources that a Service Provider may call upon during a DR event. Before a DR Resource may be called upon, it must be registered with the Service Provider. The administration of a DR Resource covers the following requirements:

- The need of the Service Provider to identify a DR Resource for communications purposes;
- The need of the Service Provider to establish DR Resource accounts for accounting purposes;
- The need of the Service Provider to collect information from DR Resources prior to DR events for the purposes of determining which DR Resources to call upon during a DR Event; and
- The need of the Service Provider to collect information from DR Resources prior to DR events for the purposes of determining the nature of the DR signals to send to the DR Resources.

REQ.14.3.2.4.3.2 Update DR Resource

Description

When the base capacity of a DR Resource changes from when it was last registered with the DR provider, customer needs to provide updated information to the DR provider so that such information can be factored into the consideration for DR event planning.

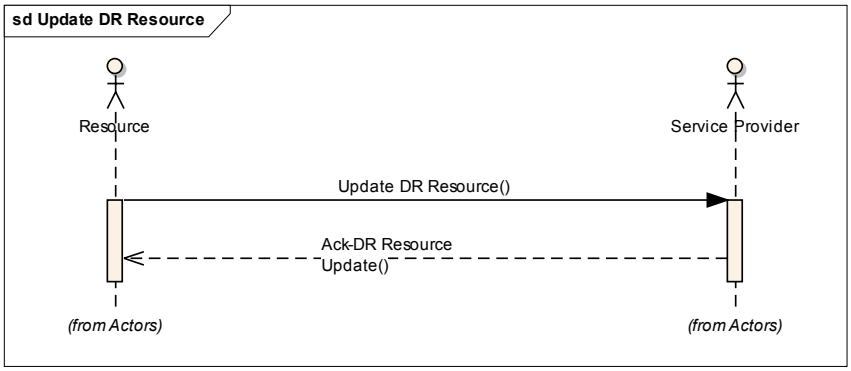
Data Requirements

Attribute Name	Description
Asset-ID	This uniquely identifies a DR Asset
DR Resource Operational Constraints	These are constraints that define the amount load that can be made available during a DR event, including the following: • Minimum load • Maximum load.
DR Resource Bid	This is a bid from the DR Resource. See the DR Bidding use case for a description of the information requirements.

Attribute Name	Description
DR Resource Schedule Constraints	These are a set of constraints that specify when the DR Resource will be available. It may contain such information as: • Time of day schedule constraints • Black out dates • Maximum consecutive days of participation • Maximum duration of DR event participation • Minimum duration of DR event participation • Max number of times per day the DR Resource may be called • Minimum advanced notification necessary. Provide details if DR asset or DR resource is in any other DR programs (wholesale and retail)
DR Resource Identifier	This identifies the DR Resource.
DR Resource Qualification	This shows the qualification of a DR resource for certain type(s) of DR programs
Effective-Start-Date	The date and time when the declared capabilities will be in effect.
Hourly-Capacity-Availability	The amount of capacity available for interruption by hour for the period defined by the effective start/end date, expressed in kW or MW with appropriate precision.
Message-Exchange-Pattern	The means by which price information is communicated to any party that is interested in this information. The following are valid options: • In-Only • Robust In-Only • In-Out. Refer to http://www.w3.org/TR/wsdl20-adjuncts/#patterns for complete descriptions.
Monthly-Capacity-Availability	The average capacity available for interruption by month for the period defined by the effective start/end date, expressed in Megawatts with appropriate precision.

Attribute Name	Description
Source-Authentication	The recipient must have some assurance that the message was produced by a reliable, authoritative party. This requires some ability to validate the authenticity of the source and integrity of the data (e.g., digital signature applied to a price message).
Temporary Opt-Out	This is used to temporarily opt out of DR Events and to override the normal operational constraints. The opt-out can be specified using the following criteria: • All events in a program indefinitely • Specific DR Event • All events in a specific time period. • Other triggered programs for which an asset or DR resource is already called upon (reduce double counting of available capacity)

Sequence Diagram



REQ.14.3.2.4.3.3 Register DR Resource

Description

A party with ownership, controlling interest, or administrative responsibilities for a DR Asset or DR Resource that communicates status-related operational information about the DR Asset or DR Resource to a Service Provider. For example, the owner of a DR Resource or Asset may wish to declare their inability to shed load (an outage) due to summer shutdown or may wish to reduce the available capacity of a resource/asset due to equipment maintenance or other causes.

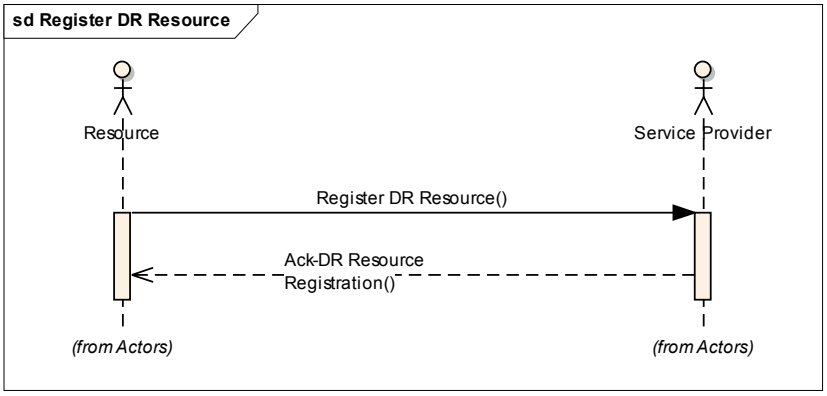
Data Requirements

Attribute Name	Description
Asset-ID	This uniquely identifies a DR Asset.
Available-Capacity	The total amount of power (megawatts) available from the asset/resource, expressed in integer format representing the amount of kilowatts available.
Customer Identifier	This is a customer identifier (e.g., account number) that signifies the owner of the DR Resource to the Utility.
DR Program Identifier	This identifies the DR program in which a DR Resource is participating.
DR Resource Identifier	This identifies the DR Resource that is being registered.
DR Resource Qualification	This shows the qualification of a DR resource for certain type(s) of DR programs
DR Resource Operational Constraints	These are constraints that define the amount load that can be made available during a DR event and includes the following: • Minimum load • Maximum load.
DR Resource Schedule Constraints	These are a set of constraints that specify when the DR Resource will be available. It may contain such information as: • Time of day schedule constraints • Black out dates • Maximum consecutive days of participation • Maximum duration of DR event participation • Minimum duration of DR event participation • Max number of times per day the DR Resource may be called • Minimum advanced notification necessary. • Provide details if DR asset or DR resource is in any other DR programs (wholesale and retail)
Effective-Start-Date-Time	The start date and time which an asset/resource is available.

Attribute Name	Description
Location	An identifier to indicate the location of the asset/resource.
Location-type	A value used to interpret the value contained in the Location element. Examples of Location-type include: • Zone • Node • Zip-code.
Maximum-Duration	The maximum amount of time the asset/resource is capable of delivering power (megawatts), this may be expressed in hours using decimal notation. For example, a value of 0.5 indicates a maximum duration of 30 minutes which the asset/resource can reduce power consumption by the level indicated in Available Capacity.
Message-Exchange-Pattern	The means by which price information is communicated to any party that is interested in receiving this information. The following are valid options: • In-Only • Robust In-Only • In-Out. Refer to http://www.w3.org/TR/wsdl20-adjuncts/#patterns for complete descriptions.
Minimum-Duration	The minimum amount of time that an Asset/Resource Owner is willing to allow the resource/asset to be utilized during a DR event. It may be expressed in decimal format representing hours. For example, a value of 1.5 indicates that an asset/resource must be utilized for no less than one hour and 30 minutes during any DR event.
Parent-Resource ID	This is used by an Asset to indicate that it "belongs to" a particular Resource. Assets may be aggregated into a Resource, but are not required to be so aggregated. Resources are autonomous and may not be aggregated.

Attribute Name	Description
Report-type	This indicates the type of report being issued by the Asset or Resource Owner. This is an enumerated value containing one of the following: • REGISTRATION (to register a new asset/resource) • CHANGE (refers to permanent changes) • RETIREMENT.
Response-time	The amount of time before an asset/resource is capable of meeting its full performance, in response to a request by a Service Provider to shed load, expressed as minutes in decimal format.
Source-Authentication	The recipient must have some assurance that the message was produced by a reliable, authoritative party. This will require some ability to validate the authenticity of the source and integrity of the data (e.g., digital signature applied to a price message).

Sequence Diagram



REQ.14.3.2.4.3.4 Remove DR Resource

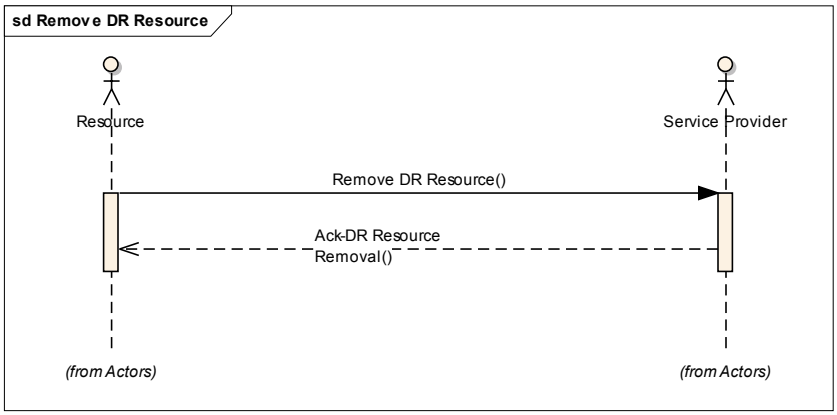
Description

When a DR resource is no longer available permanently for DR purpose, it needs to be removed from the DR program for that customer so that it will be accounted for DR event planning.

Data Requirements

Attribute Name	Description
DR Resource Identifier	This identifies the DR Resource that is being removed.
Removal Effective Date/time	Date/time when the DR resource is no longer available.

Sequence Diagram



REQ.14.3.2.4.4 Administrate DR Asset (Direct)

REQ.14.3.2.4.4.1 Register DR Asset

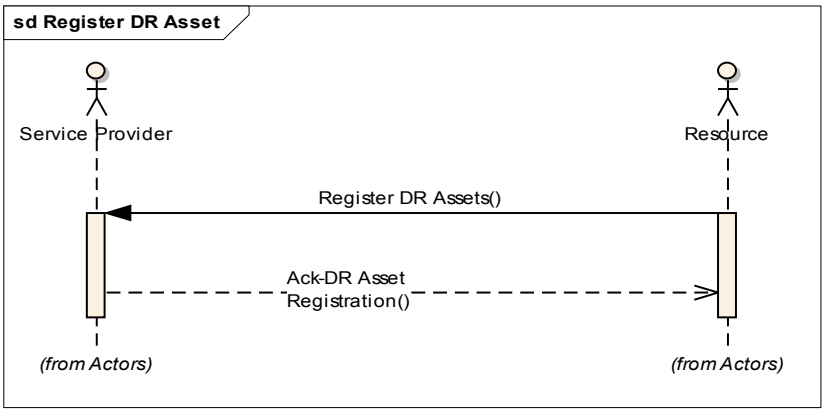
Description

The DR Asset registration process must capture key identifiers to enable accurate tracking of DR assets and their capabilities. A requirement for a System and Market Operator, Load Serving Entity, Service Provider, or other entity facilitating the registration process (hereinafter referred to as DR Asset Administrator) is to track assets. This is done through DR asset registration and association of physical DR assets to DR Resources to recognize the asset and its potential contribution as part of a DR Resource. The DR Asset Administrator ultimately administers the DR Asset registration process to recognize DR Assets that can serve as part of a DR Resource, although the Customer may be party to the registration process.

Data Requirements

Attribute Name	Description
Asset Operator	The business entity that operates the DR assets
Asset Owner	The business entity that owns the DR assets
Asset Physical Location	The location of where the DR assets reside
Authorized Asset Servicers	The authorized service providers of the operation and maintenance of DR assets
Date of Registration and Last Update	Date of which the DR Assets registered for DR purpose.
DR Asset Administrator	• System and Operator • Distribution Utility • Load Serving Entity • Service Providers
DR Asset Availability and Status	Run Status, Set point, Override status, etc.
DR Asset Identifier	The unique identifier and name of the DR Assets.
DR Asset Physical Capabilities	Ramp Up/Down Rate, Maximum Capacity
DR Asset Product	Manufacturer, Model, Version, Date of Manufacturer
DR Asset Type	(DG, renewable, storage, curtailable or interruptible load)
DR Resources	The identifier of DR resources that the DR Assets belong to
State of Registration Process	The state/status of the registration process of the DR assets.

Sequence Diagram



REQ.14.3.2.4.4.2 Update DR Asset

Description

Once a DR asset registration is completed, changes to elements of the registration may be required or desired. After identifying the specific required modification and verifying the authorization to perform the update, each of the considerations identified in the DR Asset registration step should be evaluated and utilized, where necessary, during the update of the DR Asset information. The ability to update DR Asset information helps to ensure the asset information on record is current and complete.

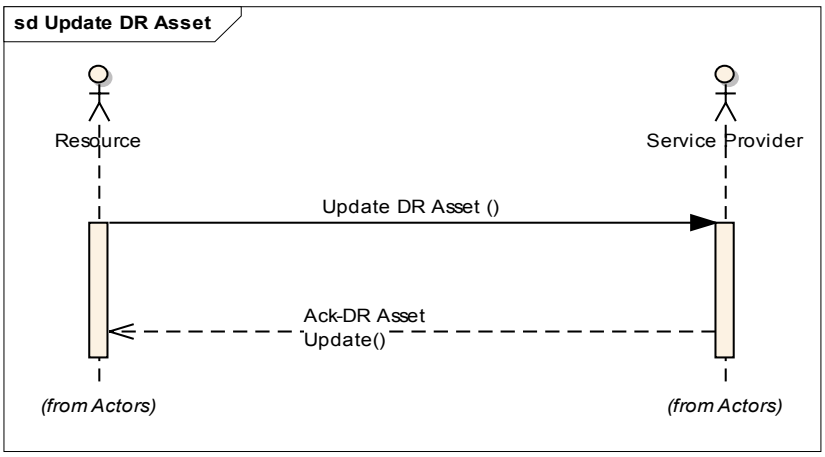
Parties that are privy to and rely on the update should be notified of updates as soon as practicable after they are made. Additionally, these parties should have access to review and, in some cases, to approve/disapprove the update(s).

Data Requirements

Attribute Name	Description
Asset Operator	The business entity that operates the DR assets
Asset Owner	The business entity that owns the DR assets
Asset Physical Location	The location of where the DR assets reside
Authorized Asset Servicers	The authorized service providers of the operation and maintenance of DR assets
Date of Registration and Last Update	Date of which the DR Assets registered for DR purpose.

Attribute Name	Description
DR Asset Administrator	• System and Operator • Distribution Utility • Load Serving Entity • Service Providers
DR Asset Availability and Status	Run Status, Set point, Override status, etc.
DR Asset Identifier	The unique identifier and name of the DR Assets.
DR Asset Physical Capabilities	Ramp Up/Down Rate, Maximum Capacity
DR Asset Product	Manufacturer, Model, Version, Date of Manufacturer
DR Asset Type	(DG, renewable, storage, curtailable or interruptible load)
DR Resources	The identifier of DR resources that the DR Assets belong to
State of Registration Process	The state/status of the registration process of the DR assets.

Sequence Diagram



REQ.14.3.2.4.4.3 Remove DR Asset

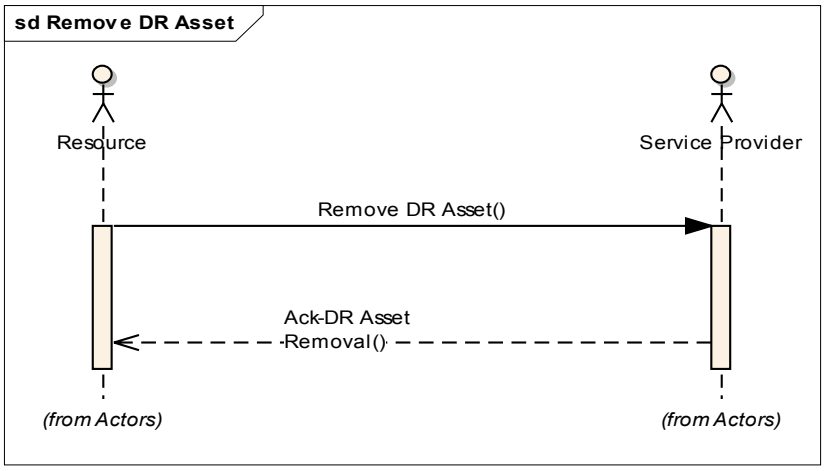
Description

Removing a DR Asset must take into account any DR Resource long term commitments in System Operator programs and contractual obligations with Service Providers or Load Serving Entities. In addition, State and or Federal regulatory agency filings and approvals must be considered prior to removing a DR Asset from a DR program.

Data Requirements

Attribute Name	Description
Contractual Agreements	Contractual agreement under which the DR assets could be removed.
DR Asset Administrator	• System and Operator • Distribution Utility • Load Serving Entity • Service Providers
DR Resources	The identifier of DR resources that the DR Assets belong to
Third Party Participation	The identification of third parties involved in the removal of DR assets.

Sequence Diagram



REQ.14.3.2.4.5 DR Bidding

Description

Demand Response Bidding occurs after the DR Assets and Resources that are to comprise the desired bid have been registered and a bid is to be formed. The DR Bidding use case has two sub-use cases, depending on the type of bid to be developed for submission: a bid to supply (i.e., an offer), or a bid to buy. The entity operating the DR bidding program (the Bid Receiver) receives bids from participants (the Bidders). The Bidder may be a Customer bidding with either an energy retailer (e.g., LSE, ESP), a Service Provider (e.g., CSP, DRP), or a power marketer (i.e., wholesale market participant). The Bidder may also be a Service Provider bidding up to a LSE or power marketer.

Before the start of the bidding process, it is assumed that DR Resources available for selection are already registered to provide the physical resource participating in the DR Bidding program. It is also assumed that the bidder has already registered to bid with the bid receiver and has been informed on the appropriate timing and parameters for bid participation. The DR bidding process starts with the decision of the Bidder to develop a bid for submission. The Bidder submits its bid to the Bid Receiver within the appropriate time window and following set guidelines for bidding. The Bidder receives information on the outcome of the submitted bid from the Bid Receiver, who notifies of the bid outcome (e.g., a resource award or other DR commitment).

Examples of retail DR Bidding programs include:

- Demand Bidding
- Capacity Bidding

Examples of types of ISO/RTO products that may be (or become) eligible for DR bidding include:

- Installed Capacity;
- Day-ahead Energy;
- Real-time Imbalance Energy;
- Ancillary Service Operating Reserve;
- Regulation

The above are wholesale products that retail DR capabilities may be (or become) aggregated to bid into. Required advances to establish linkages between purely retail DR bidding and ISO/RTO DR bidding programs are works in progress, and beyond the scope of this document.

REQ.14.3.2.4.5.1 DR Bid to Supply (Retail Offers)

Description

The Bid Receiver opens the forum/venue for receiving a bid. (This may include initiating the bidding process by sending initial information to Bidders indicating parameters of acceptability for bids to be made). The Bidder communicates an offer to supply a specified product/service and the pricing or other incentive structure the bidder is willing to accept for DR. (This may be as simple as the customer sending a response back to the Bid Receiver that accepts or rejects the initial bid sought, or may involve more complex bid structuring).

Each bid will have a clearly specified product or service that is being bid and the pricing/incentive structure being offered. The bidder also nominates the amount of and nature of supply being offered, the DR Resource to physically provide the service, and other physical parameters affecting resource availability and capability, in addition to the identity (or ID) of the bidder and resource(s) that comprise the bid.

The Bid Receiver reviews bids received and clears them, notifying the bidders of the outcome.

The Bidder receives the notification of awards or resource commitments and uses the information internally in preparation for DR Resource Dispatch.

Data Requirements (Generalized)

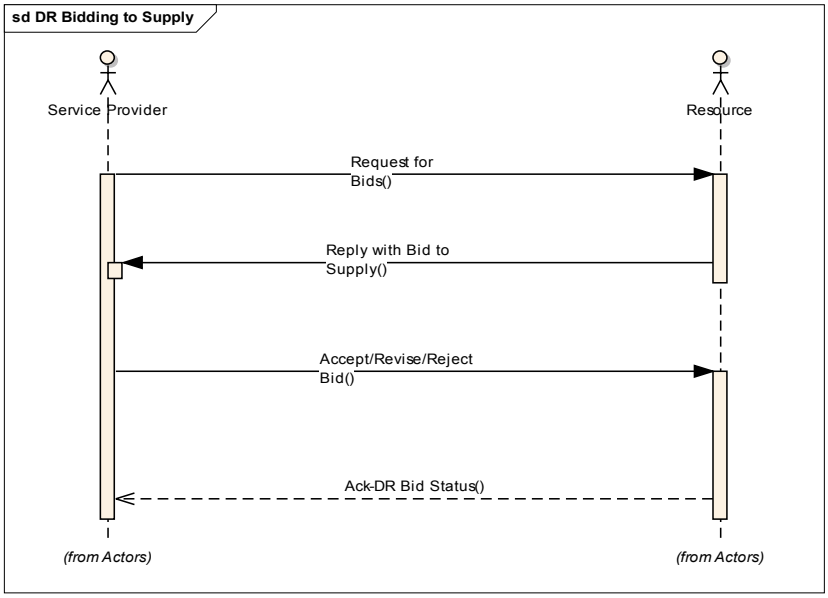
Attribute Name	Description
Bidder Identity	Identification of entity submitting a bid
Identity of Resource(s)	Identification of resources that physically support a bid
Bid structure	Prices and/or quantities in an offer to supply a service, or a supply schedule
Product/Service type	The Product/Service type offered to supply.
Quantity of offer	Instantaneous amount of demand response available for dispatch
Resource Capacity (Rated)	Rated or maximum capacity of a resource to supply a service
Resource Capability	Ramp up/down rate and other resource-specific operating characteristics and constraints
Resource Type	Type of distributed resource
Resource Type	Timing associated with a bid

Attribute Name	Description
Timestamp of Bid	The effective date(s) of an offer.

Data Requirements (Simplified Example of Retail DR Bidding)

Attribute Name	Description
DR Resource Identifier	This identifies the DR Resource for which the bid is being submitted.
Load Amount	This is the amount of load that the DR Resource can make available during the scheduled period.
Load Profile Schedule	This is the schedule during which the DR Resource's load profile will be available.
Offer Price	This is the price at which the DR Resource is offering to shed their resource.

Sequence Diagram



REQ.14.3.2.4.5.2 DR Bid to Buy

Description

The Bid Receiver opens the forum/venue for receiving a bid. (This may include initiating the bidding process by sending initial information to Bidders indicating parameters of acceptability for bids to be made). The Bidder communicates a bid to buy a specified product/service and the pricing or other incentive structure the bidder is willing to pay to avoid DR. (This may be as simple as the customer sending a response back to the Bid Receiver that accepts or rejects the initial bid sought, or may involve more complex bid structuring).

Each bid will have a clearly specified product or service that is being bid for purchase and the corresponding pricing structure that is acceptable to the Bidder. The Bidder also includes the quantity of product/service in the bid to buy, and specifies any DR Resource(s) that can physically substitute for the product/service in the event the bid to buy is not cleared (i.e., the bidder is unwilling to pay more than the going/market outcome price for the product/service). Other information submitted include physical parameters affecting resource availability and capability, in addition to the identity (or ID) of the bidder and resource(s) that comprise the bid.

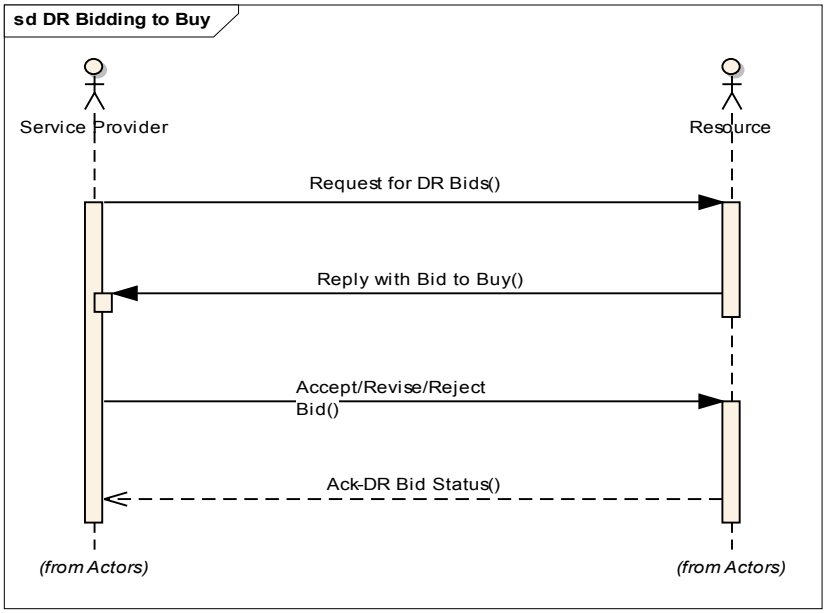
The Bid Receiver reviews bids received and clears all bids, notifying the bidders of the outcome. The Bidder receives the notification of resource commitments and uses the information internally in preparation for DR Resource Dispatch.

Data Requirements

Attribute Name	Description
Bidder Identity	Identification of entity submitting a bid
Identity of Resource(s)	Identification of resources that physically support a bid
Bid structure	Prices and/or quantities in a bid to buy a service, or a demand schedule
Product/Service type	The Product/Service type being bid for purchase
Resource Availability	Instantaneous amount of demand response available for dispatch
Resource Capacity (Rated)	Rated or maximum demand of a resource

Attribute Name	Description
Resource Physical Operating Capability	Ramp up/down rate and other resource-specific operating characteristics and constraints
Resource Type	Type of distributed resource
Timestamp of Bid	Timing associated with a bid
Trade Date or Period	The effective date(s) of a bid.

Sequence Diagram



REQ.14.3.2.4.6 Execute DR Event

The execution of a DR event takes different forms depending on operational situation and the type of DR programs being executed. Typically, they fall into one of the following four use cases, see Figure 5:

1. Advanced DR Notification
2. Broadcast DR Message (price plus information)
3. DR dispatch instruction
4. DR direct load control.

Operational considerations for DR event execution are also associated with DR programs where direct load control or dispatching instructions are carried out.

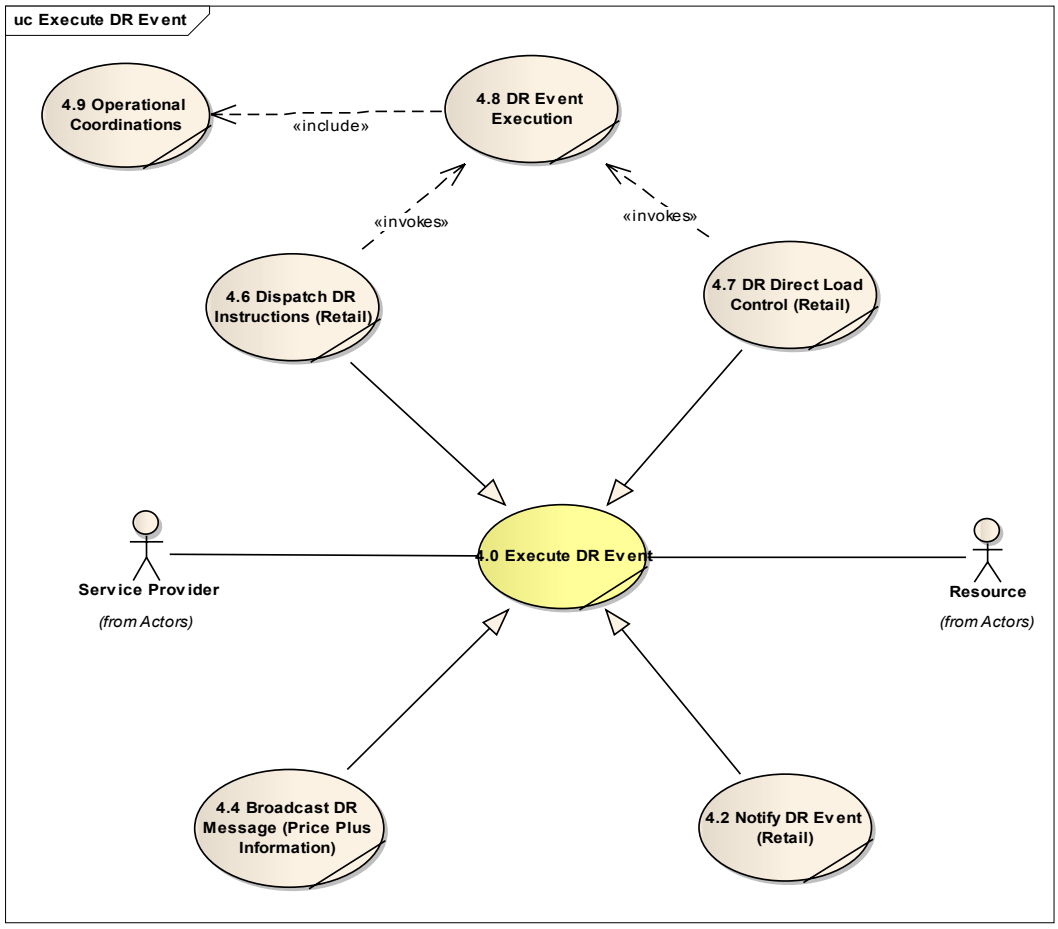


Figure 5. Execute DR Events

REQ.14.3.2.4.7 Notify DR Event (Retail)

REQ.14.3.2.4.7.1 Advanced Notification for DR (Retail)

Description

This is used by the Service Provider to send the DR Event notification (i.e., DR signal) to the DR Resource.

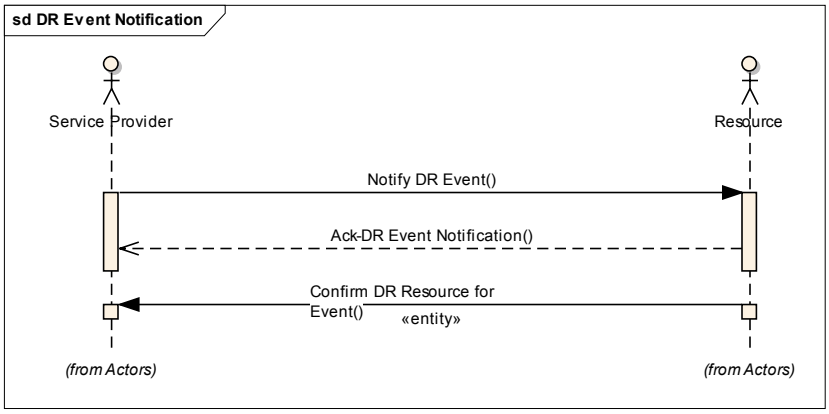
Data Requirements

Attribute Name	Description
Service Provider ID	An identifier for the Service Provider issuing the DR event.
DR Program ID	An identifier of the program for which a DR event was issued.
DR Resource Group ID	A group to which a DR Resource belongs. This can be used for multi-cast notifications.
DR Resource ID	An identifier of the DR Resource for which an Event is intended.
DR Resource Operation Mode (Schedule)	Operation modes are representations of how the DR Resource should respond to the Event Data that is part of an event. Operation modes allow DR logic to be implemented within the DR Service Provider and allow the DR Resource to respond to a much simpler representation of the DR Event data. Operation modes are simple enumerations of the values that may be scheduled during the DR Event active period. The possible values are the following: NORMAL - This value is used to signify that no response to the DR Event is necessary by the DR Resource. MODERATE - This value is typically used to signify a moderate level of response by the DR Resource. HIGH- This value is typically used to signify a high level of response by the DR Resource. SPECIAL- This value is typically used to signify a circumstance special to the DR Resource.

Attribute Name	Description
DR Resource Specifications	This specifies which DR Assets within a DR Resource should be used, and can be specified in the following fashion: • Geographic location • Grid location • DR Asset group ID.
DR Resource Type ID	A program specific field that can be used to identify a type of DR Resource within a DR program.
Event Data	A collection of information that is associated with a DR event. An instance of such information represents a specific type of information that was defined to exist for DR events when the program was first developed and implemented. For example, a DR program may have been developed and implemented to use real-time pricing as the values that are sent when DR events are issued. In that case, the information would be prices. Furthermore, each type of information may have a schedule of values that are valid across the entire period for which the DR event is active. Therefore, a single type of information may have multiple values, each of which are valid during a different time period during the event. Each type of information has the following attributes when it is defined: • name • data type. The following data types should be supported: • PRICE_ABSOLUTE - Price number • PRICE_RELATIVE - Change in price • PRICE_MULTIPLE - Multiple of current price • LOAD_LEVEL - Amount of load based on an enumeration, i.e. moderate, high, etc • LOAD_AMOUNT - Fixed amount of load to shed in kW • LOAD_PERCENTAGE - Percentage of load to shed, i.e. 10%

Attribute Name	Description
	• GRID_RELIABILITY - Number signifying the reliability of the grid.
Event ID	An identifier for the DR Event that was created when the DR event was first issued. This should be a globally unique identifier for each Service Provider.
Event Schedule	A Schedule for the DR Event periods that includes the following: • Notification date/time • Event start date/time • Ramp time (potentially randomized) • Event end date/time (possibly specified as the duration).
Test Event Flag	This attribute signifies whether this is a test event or not. Test events may be issued by the Utility/ISO like other DR audit events.

Sequence Diagram



REQ.14.3.2.4.7.2 Update a DR Event (Retail)

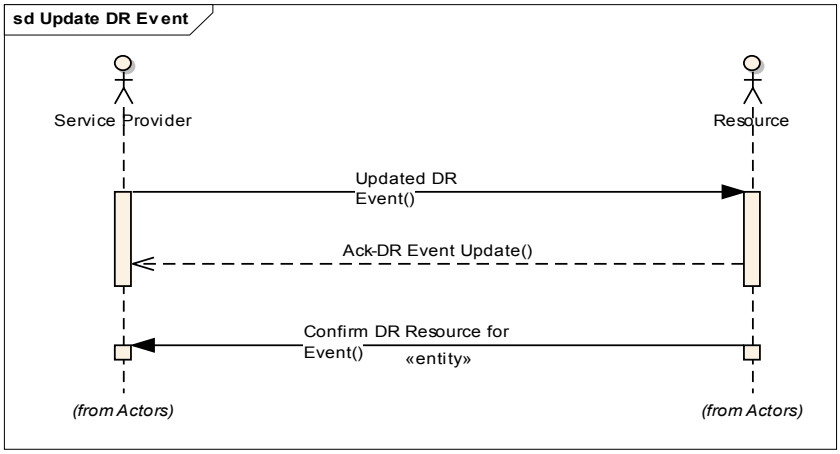
Description

This is used to update a DR event that has been previously notified. The requirements for this use case are the same as those for the "Advanced Notification for DR" use case.

Data Requirements

Attribute Name	Description
Event	See the "Advanced Notification for DR" use case.
Event Modification Number	This is Modification number of the DR event. It is used to indicate that the DR Event has been modified by the Utility. Each time a DR Event is modified, this number is incremented.
Modification reason code	The reason the event was modified.

Sequence Diagram



REQ.14.3.2.4.7.3 Cancel a DR Event (Retail)

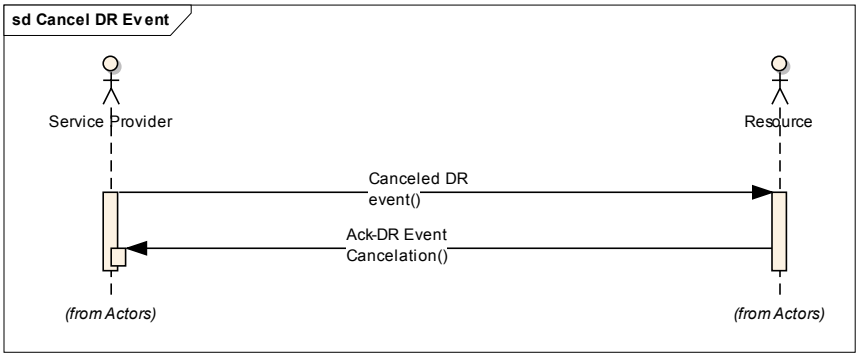
Description

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



REQ.14.3.2.4.7.4 DR Resource Confirmation (Retail)

Description

This is a confirmation message that is sent by a DR Resource to the Service Provider as a result of receiving a DR Signal form the Service Provider. It may be used as an acknowledgement of the receipt of the DR signal, but it may also contain various information used to signify how the DR Resource will respond to the DR Signal.

Data Requirements

Attribute Name	Description
DR Assets Characteristics	The expected response characteristics of each DR Asset that is part of the DR Resource. These may be needed for aggregated DR Assets and may be as simple as whether a DR Asset is participating or its actual load profile. For each DR Asset, the following should be given: • Location of Asset, either geographic or grid location • Asset schedule of participating • Asset load profile (schedule).
DR Resource ID	The identifier of the DR Resource.
DR Resource Load Profile Response	The load profile response characterization of the DR Resource in response to getting the DR signal.
Notification Received Acknowledgement	This is an acknowledgement of the receipt of a DR notification or dispatch. It should include any necessary provisions for non-repudiation.
Opt in/out	This is used to temporarily opt in/out of DR Events and to override the normal operational constraints. The opt-in/out can be specified using the following criteria: • All events in a program indefinitely • Specific DR Event • All events in a specific time period. In addition, there may be a schedule associated with the opt in/out state.

Sequence Diagram

REQ.14.3.2.4.8 Broadcast DR Message (Price Plus Information)

Description

Demand Response programs are designed to address different power system concerns caused by the imbalance between generation, transmission and consumption, or environmental concerns. Some DR programs are conducted on a voluntary basis, where the customer can opt to maintain the level or load. Some DR programs are mandatory, where either the customer loads will be curtailed under certain conditions or the customer will incur financial penalties for noncompliance.

In retail market, certain "DR Messages" can be broadcasted to DR resources either directly or through Service Providers. DR Message is defined as information about the DR signals that may affect the demand behaviors of the energy consumers. Obviously, the main component of the DR Message is the pricing information. However, there are other attributes of energy being delivered that may be of interest to energy consumers and could be included in the DR Message.

Based on the OpenADR discussion, the broadcasting function is mainly used for volunteer or non-mission critical DR messages. Therefore, message acknowledgement or confirmation is optional.

DR Source of Power/Generation

"DR Message" also can be source of power or generation. ANSI C12.19-2008 defined the following source of power/generation in Standard Table 12.

Precondition:

The DR Service Provider sends the DR message to service providers. In the case of DR pricing, the DR Service Provider calculates the wholesale price per location and communicates the appropriate price associated with the DR product to service providers.

Post Condition:

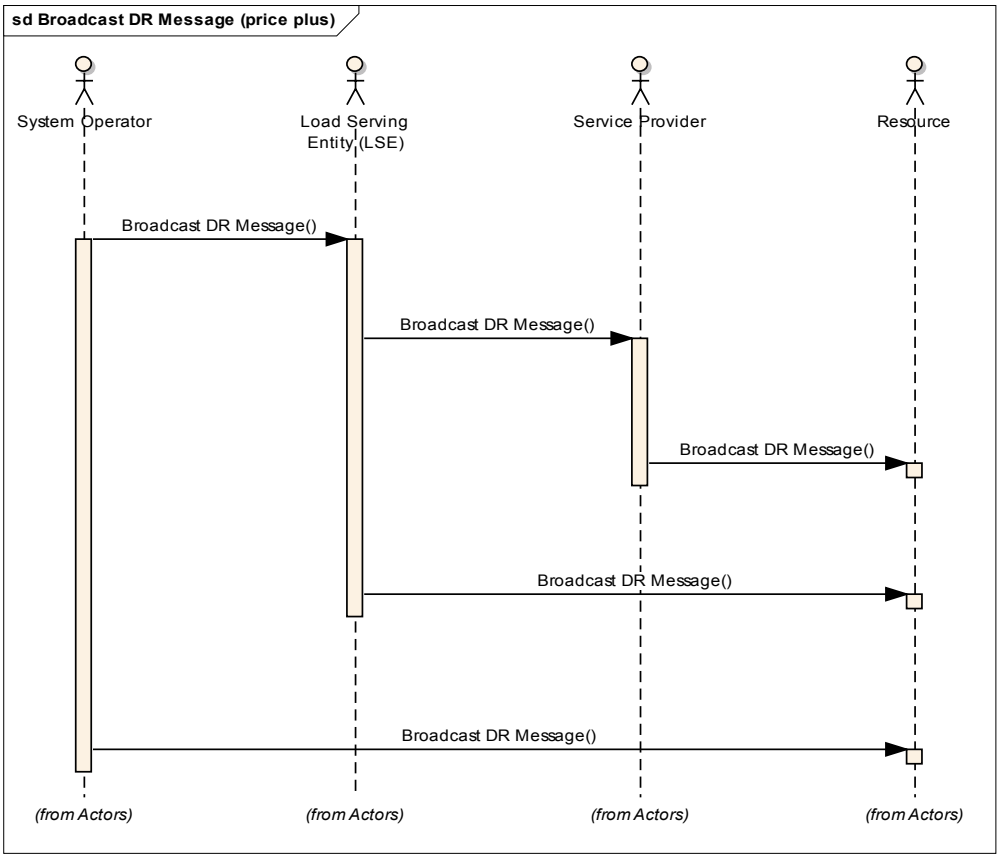
DR Resources received the DR pricing information, and may or may not act based on the DR agreement or contract.

Data Requirements

Attribute Name	Description
Currency	Identifier used to interpret the price element. MUST follow **ISO 4217** standard.
Duration	The amount of time for which this price is valid, commencing at the Effective-Date-Time specified. A value of zero means price is valid until next price broadcast override. Specified in decimal notation where integers represent minutes and decimals represent fractions of minutes. For example: • 5 indicates that prices will be published every 5 minutes • .5 indicates that prices will be published every 30 seconds
Effective-Date-Time	The date and time which the price is in effect. In ISO 8601 standard format.
Location	An identifier used to indicate an area which this price is in effect. A value of "null" indicates that the price is in effect for all areas.
Location-type	A value used to interpret the value contained in the Location element. Examples of Location-type include: • Zone • Node • Zip-code • USNG
Message-Exchange-Pattern	The means by which price information is communicated to any party that is interested in receiving this information. The following are valid options: • In-Only • Robust In-Only • In-Out Refer to http://www.w3.org/TR/wsdl20-adjuncts/#patterns for complete descriptions.

Attribute Name	Description
Price	Expressed in decimal notation with a precision up to 6 decimal places. Prices MAY be either positive or negative
Product-Identifier	Identifies the type of product (e.g. energy, regulation, etc.) which this price pertains. Contains an enumeration of various products that may be offered. Extensibility MUST be supported in order to accommodate multiple jurisdictions and markets.
Publishing-Interval	Indicates the frequency with which price information is expected to be published. Specified in decimal notation where integers represent minutes and decimals represent fractions of minutes. For example: • 5 indicates that prices will be published every 5 minutes • .5 indicates that prices will be published every 30 seconds
Source-Authentication	The recipient of a "Price Message" must have some assurance that the message was produced by a reliable, authoritative party. This will require some ability to validate the authenticity of the source and integrity of the data (e.g. digital signature applied to a price message).
TimeStamp	Indicates the Date and Time when this information was published. MUST follow ISO 8601 standard representation.
Unique-Identifier	An identifier used to identify the message. Should be expressed as a URI in accordance with http://www.w3.org/TR/uri-clarification/#uri-schemes
Unit-of-Measure	Indicates the unit of measure for which the price pertains. MUST be complaint with the International System of Units as defined by NIST SP 330, ref: http://physics.nist.gov/Pubs/SP330/sp330.pdf Examples of NIST compliant units of measure include: • kWh • MWh

Sequence Diagram



REQ.14.3.2.4.9 Dispatch DR Instructions (Retail)

Description

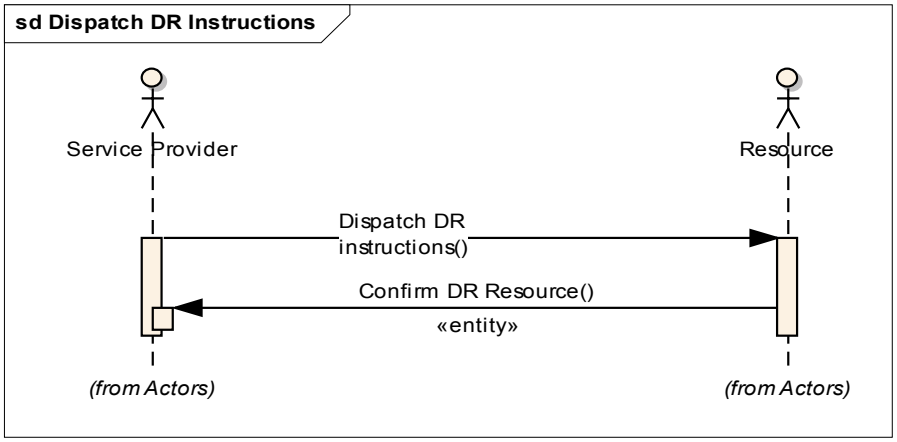
This interaction is used to dispatch DR Resources. This type of interaction is used when the Service Provider needs to achieve specific objectives from the DR Resources during DR events. This means that specific instructions will be given to the DR Resource with objectives (e.g. shed 100 kW) for the load profile of the DR Resource.

Note that for the retail use cases, a Dispatch is considered a special type of DR Notification, and thus, it is very similar in nature to the requirements given for that interaction.

Data Requirements

Attribute Name	Description
Dispatch Instructions	A collection of dispatch instructions that is associated with a DR event. An instance of such instructions represents a specific type of instruction that was defined specifically for the DR program. Each type of instruction may have a schedule of values that are valid across the entire period for which the DR event is active. Therefore, a single type of instruction may have multiple values, each of which are valid during a different time period during the event. Each type of instruction has the following attributes when it is defined: • name • Instruction type. The following instruction types should be supported: • LOAD_LEVEL - Amount of load based on an enumeration, i.e., moderate, high, etc • LOAD_AMOUNT - Fixed amount of load to shed in kW • LOAD_PERCENTAGE - Percentage of load to shed, i.e., 10%.
DR Program Name	An identifier of the program for which a DR event was issued.
DR Resource ID	An identifier of the DR Resource for which a dispatch is intended.
Event ID	An identifier for the DR event that was created when the DR event was first issued.
Event Modification Number	A modification number for the DR event. This is used to indicate if the DR Event has been modified by the Utility. Each time it is modified, this number is incremented.
Event Schedule	Schedule for the DR Event periods, which includes the following: • Notification date/time • Event start date/time • Event end date/time.
Test Event Flag	This attribute signifies whether this is a test event or not. Test events may be issued by the Utility/ISO like other DR Events.

Sequence Diagram



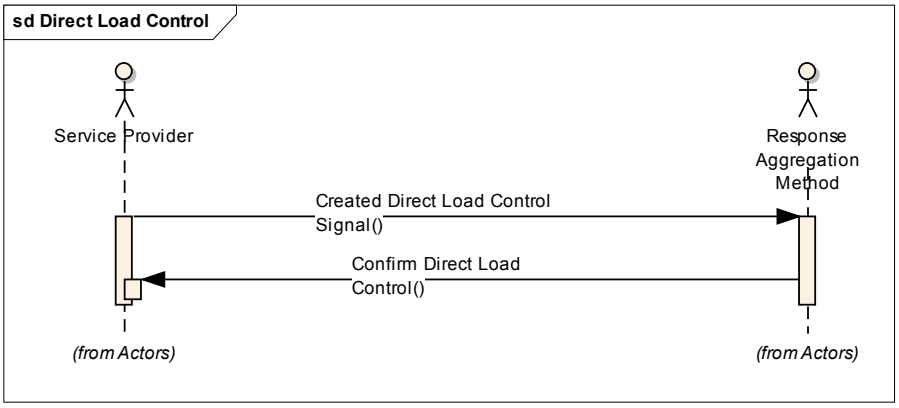
REQ.14.3.2.4.10 DR Direct Load Control (Retail)

Description

This use case covers direct interactions between the DR Service Provider and a specific DR Asset for the purposes of putting that asset into a specific load control state (e.g., to turn it on or off). In this case, the DR Asset is a DR Resource with only one DR Asset, and thus, the interaction is directly with the DR Asset.

See REQ.14.3.2.4.11.3, DR Execution - Direct Load Control (DLC) for more details.

Sequence Diagram



REQ.14.3.2.4.10.1 Monitor DR Event (DR Resource)

Description

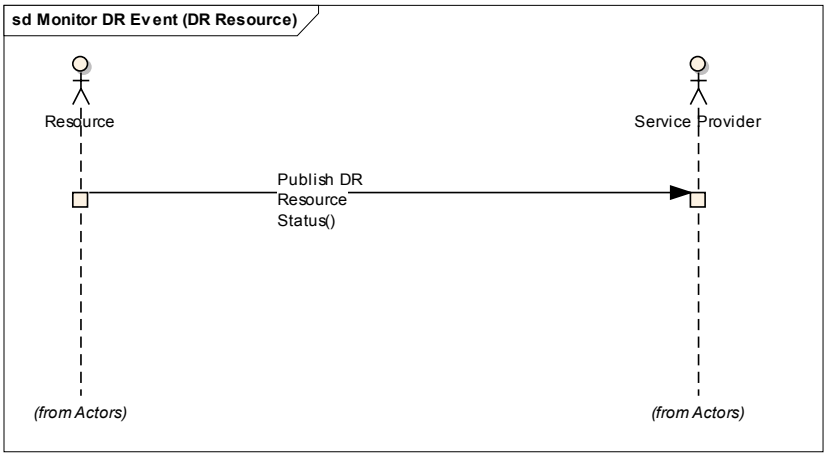
This interaction is used to monitor a DR Resource's behavior. It may be executed as a result of the DR Resource receiving a DR signal or it may be conducted continuously.

Data Requirements

Attribute Name	Description
Operational Constraints	This is used to supply information about when and how a DR Resource may participate in a DR Event. The following items may be supplied: • Limits on load profile performance • Schedule of participation. Note that this information may also be supplied as part of the administration of the DR Resource, and thus, it may not be necessary that it be part of this interaction.
Opt in/out state	This is used to temporarily opt in/out of DR Events and to override the normal operational constraints. The opt-in/out can be specified using the following criteria: • All events in a program indefinitely • Specific DR Event • All events in a specific time period. In addition, there may be a schedule associated the opt in/out state.
Usage Information	Information about the near real time electricity usage of the DR Resource.
Latency	Allowable time between dispatch launch and load de-energize. Examples: 4 Seconds Response for Regulation Dispatch, 1 Minute Response for Reserve Dispatch, Sub-second Response to Frequency Deviation, 10 Minute Response to Energy Market
Dispatch Trigger	Examples: Market Bid (Energy Price > Offer Price), Reliability Event Based Dispatch from System Operator, Frequency Deviation, Peak Period Time

Attribute Name	Description
Response Duration – Time Out or Held Until Released	Examples: Variable with Signal Up or Down (Regulation), 20 Minutes with Dispatched Release (Responsive Reserve), 1 or 2 Hour Time Out (Emergency Interruption), Multiple Hours (Peak Shifting)

Sequence Diagram



REQ.14.3.2.4.10.2 Monitor DR Event (DR Asset)

Description

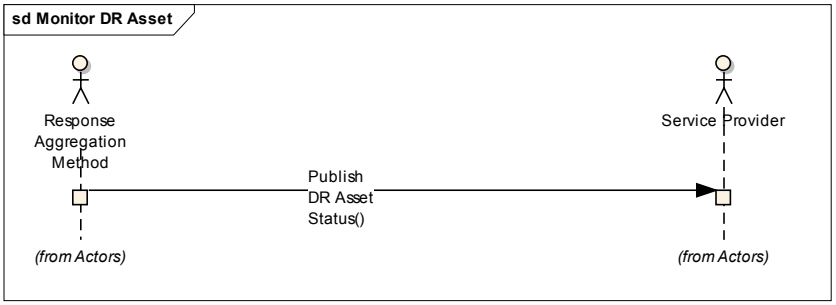
This interaction is used to monitor the state of a DR Asset. It may be executed as a result of the DR Asset receiving a DR signal or it may be conducted continuously.

Data Requirements

Attribute Name	Description
Exception Conditions	This is used to report that the load controller may not behave as commanded because of a variety of conditions including: • Faults in device • Customer override.
Load Control State	The state of the load, which includes both commanded states and user settings. This may include a schedule of future states if a particular control algorithm for the load controller is being executed.

Attribute Name	Description
Operational Constraints	Constraints on how the load may be controlled. This may include limits on the state of the load controller as well as schedules upon those constraints.

Sequence Diagram



REQ.14.3.2.4.11 DR Event Execution

Demand Response is deployed for economic or a reliability purposes. At high penetration levels, demand response has to be integrated with the power supply scheduling process, and it may impact the distribution grid operation and reliability, and perhaps the transmission grid operation and reliability. Thus it is important that include the required considerations for the grid and system level operations when developing DR Use Cases and DR signal standards. Such impacts may not be significant at low penetration levels; however, proper considerations must be given to support scalability and expandability for future deployments.

Power system operates based on a real-time balancing of supply and demand. To economically schedule the supply, an accurate load forecast is needed. Traditionally, load forecast was generated using the historical consumption patterns, weather forecast and other similar parameters. With the potential of high-penetration of DR, it will be necessary to incorporate the planned or forecasted DR levels into the load forecast. Also, DR capabilities can be used to support the power system capacity or emergency supply (ancillary service) needs. Such services require proper scheduling and monitoring capabilities.

A demand response event may be initiated by a power system operator in response to a reliability event, e.g., loss of a generating station causing a lack of supply to meet demand, or an uncontrolled set of PEVs overloading of a distribution transformer. A demand response event may also be initiated by utility operational systems based on economic considerations, e.g., reducing or shifting peak load at the system level or at specific feeder or facility. Demand response may also be initiated by a customer in response to a market pricing signal

Considering that the distribution grid in the US is typically a three-phase imbalance circuit, i.e., many customers are on a single-phase or two-phase of the three-phase system. Thus significant changes in customer load patters could result in undesirable imbalanced conditions on a feeder. Also, load pickup following the termination of a major DR event could possibly cause overloads and other operational problems, if the load pickup is not properly scattered/managed.

The following provides three representative use cases to highlight some the key interactions. These include:

- Dynamic Price-based DR
- Notification-based DR
- Direct Load Control

REQ.14.3.2.4.11.1 DR Execution – Retail Time Pricing (RTP)

Description

Traditionally, retail tariff has based on a fixed or tiered rate structure with possible considerations of static rates for pre-established time of use (TOU) conditions. Real time or dynamic pricing (RTP) represent retail electricity rate that could vary as a function of time and is intended to modify demand. It requires interval metering for accurate billing based on time-varying prices. A number of states have implemented RTP or other dynamic pricing tariffs for large customers. With a broader deployment of advanced meters, RTP rates may become more common nation-wide.

The scenario presented here is represents a case where a location-dependent real-time retail pricing for energy is established based on the wholesale Locational Marginal Price (LMP) for that location. LMP values are typically established by an ISO (for regions covered by an ISO/RTO) on a day-ahead (hourly resolution) and real-time basis, typically on a five minute resolution. For the RTP, it will be appropriate to use the real-time LMP as the basis for computing the retail dynamic tariff. However, decisions should be made on the time and the spatial resolution of the RTP. For example, an hourly RTP averaging the five minute pricing values, or a Critical Peak Pricing model to reflect the extreme conditions only, may be adopted. In addition to the wholesale energy price, the retail RTP rate may also include the appropriate uplift charges to cover for distribution wire/services charges and for the power loss compensations. Note that the uplift charges are typically subject to a regulatory review and approval.

Special care must be given to the RTP rate design to ensure customer acceptance and adaptation. Also grid operational issues may have to be addressed. For example, during low LMP (RTP) periods (e.g., at night), certain distribution circuits may get over loaded (congested), with customers shifting consumption, e.g., charging PEVs, to that period. This improves the overall system economy, but may cause circuit congestion. To combat this, some have proposed use of demand charges or an additional incentive payment for load reduction, a locational incentive to relief congestion.

Data Requirements

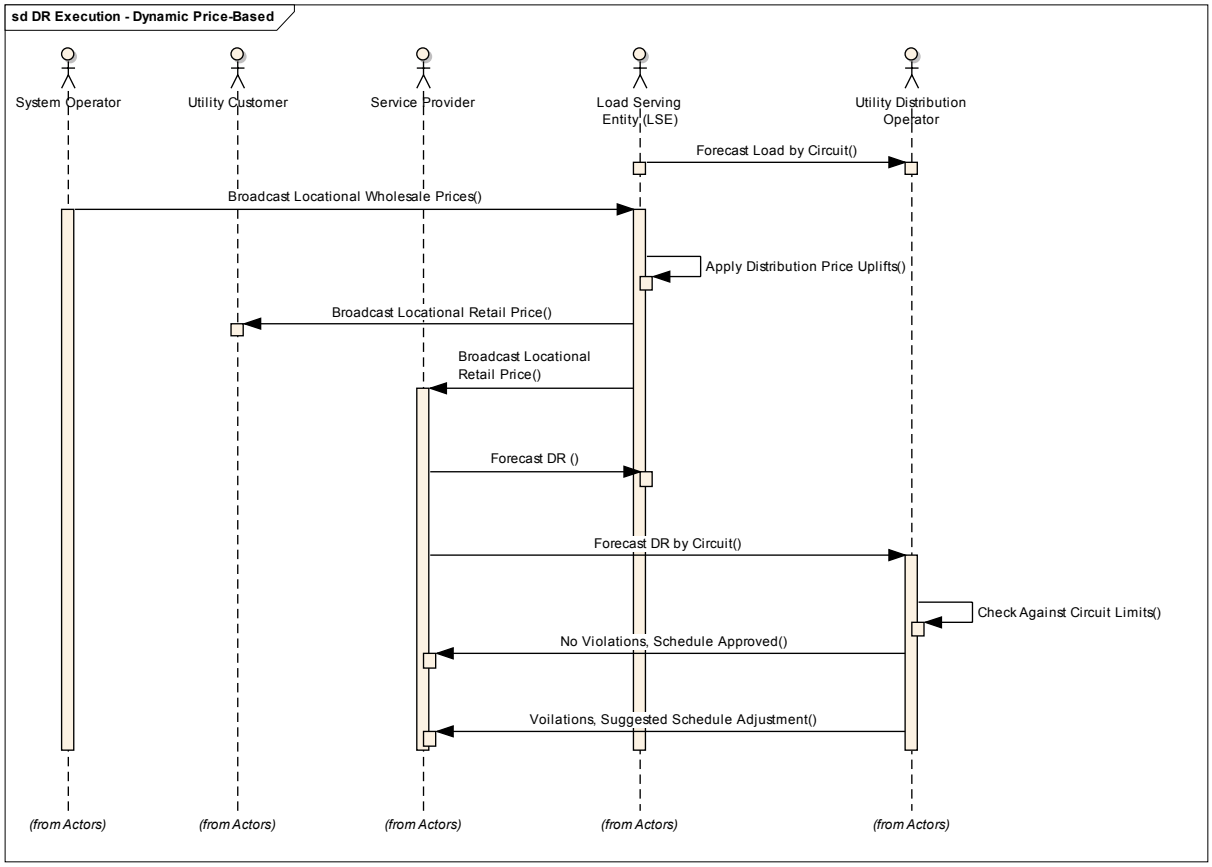
The real-time DR price (RTP) signal requirements are similar to those specified in the DR signal specified in REQ.14.3.2.4.8.

RTP Price Data

Attribute Name	Description
Effective-Date-Time Interval	The date and time interval which the price is in effect.
Price	Single of multiple valued price (e.g., for energy, demand, etc.) Expressed in decimal notation with a precision up to 6 decimal places. Prices MAY be either positive or negative
Currency	Identifier used to interpret the price element.
Unit-of-Measure	Indicates the unit of measure for which the price pertains (e.g., kW).
Product-Identifier	Identifies the type of product (e.g. energy, spinning reserve, etc.) which this price pertains.
Location	Location Identifier for the applicable price.
Location-type	A value used to interpret the value contained in the Location element. Examples of Location-type include: • Zone (Load Aggregation Point) • Zip-code • USNG
Time Stamp	Indicates the Date and Time when this information was published.
Duration	The amount of time for which this price is valid, commencing at the Effective-Date-Time specified.

Attribute Name	Description
Source-Authentication	The recipient of a "Price Message" must have some assurance that the message was produced by a reliable, authoritative party.
Message-Exchange-Pattern	The means by which price information is communicated to any party that is interested in receiving this information. The following are valid options: • In-Only • Robust In-Only • In-Out Refer to http://www.w3.org/TR/wsdl20-adjuncts/#patterns for complete descriptions.
Unique-Identifier	An identifier used to identify the message. Should be expressed as a URI in accordance with http://www.w3.org/TR/uri-clarification/#uri-schemes

Sequence Diagram



REQ.14.3.2.4.11.2 DR Execution – Notification Based

Description

Notification-based DR is mostly used for economic purposes based on a day-ahead or hours or hour-ahead basis. Notification-based DR may also be used for reliability events when the system operator expects a contingency or operating condition (e.g., congestion or planned outage) on the distribution or the transmission grid that requires a reduction (or an increase) on the load at a given location.

Considering that the business processes for demand response have not yet been standardized across the nations, the following is a representative scenario that captures some of the interactions between the key stakeholders (actors).

At high penetration levels, the DR operation, especially on a day-ahead or hour ahead basis, need to be coordinated with the overall operations and supply scheduling process. As is shown in the Sequence Diagram below, this may require a

timely update of the "locational" load forecast and an up-to-date nomination of the DR capabilities. This information may be supplied to the "system" and/or market operator to be incorporated in the overall supply and demand scheduling process. The DR capabilities are specified by the DR Provider to the System Operator based on a DR Program, a price curve, or other nomination protocol. The DR Provider may also inform the Load Serving Entity (LSE) of the locational available DR capabilities.

The notification-based DR dispatch process is typically initiated by the System or Market Operator; the process may also be initiated by an LSE or UDO. It is also possible that the DR Provider be the initiator of the DR process based on a market opportunity (economic operation) or based on a pre-established program.

At high DR penetration levels, it is expected that the DR provider will need to clear the DR schedule with the Distribution Grid Operator, the UDO. This is to insure that the high penetration DR has no adverse impact on the distribution grid reliability and power quality, e.g., cause of excessive imbalances, voltage violation, or an overload during load pickup period. The UDO, in a timely fashion, will inform the DR Provider, if the schedule is cleared or requires an adjustment. Please note that if the DR deployed by a utility company that includes both LSE and UDO functions, such coordination is performed within the company's operational systems (e.g., DRMS, DMS, etc.), or it can be an integral part of the DR scheduling application.

Following the clearing the DR schedule, notifications are sent to customers for DR operation. Under this scenario, the Market Operator and the LSE are also informed of the final DR schedule.

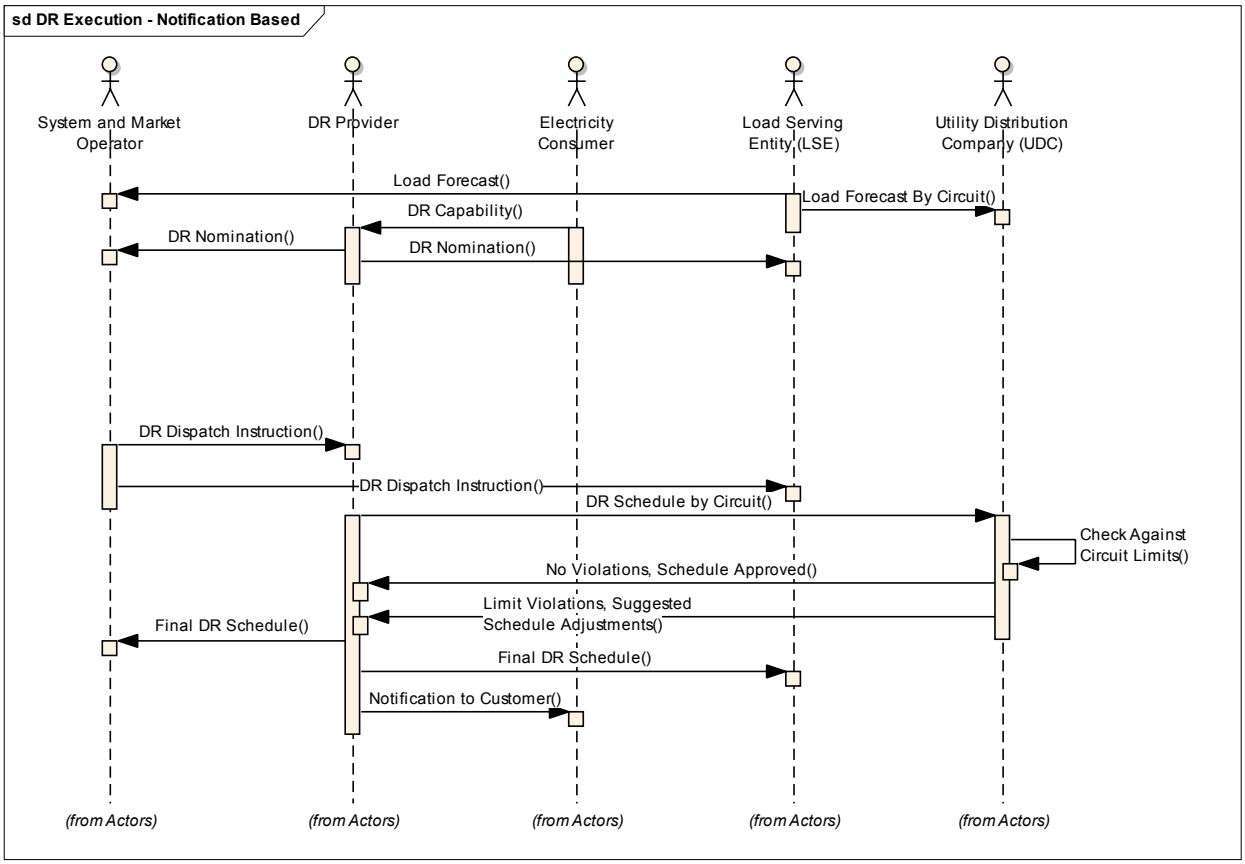
Data Requirements

The notification data elements are described in more detail in REQ.14.3.2.4.9.

Attribute Name	Description
Dispatch Instructions	A collection of dispatch instructions that is associated with a DR event. This will include the amount of load to be reduced (or increased – in the cases of very low load levels and excess generation, e.g., wind)

Attribute Name	Description
DR Program Name	An identifier of the program for which a DR event was issued.
DR Resource ID	An identifier of the DR Resource for which a dispatch is intended.
Event ID	An identifier for the DR event that was created when the DR event was first issued.
Event Modification Number	A modification number for the DR event.
Event Schedule	Schedule for the DR Event periods, which includes the following: • Notification date/time • Event start date/time • Event end date/time.
Test Event Flag	This attribute signifies whether this is a test event or not.
Source-Authentication	This is for authentication of the notification signal.

Sequence Diagram



REQ.14.3.2.4.11.3 DR Execution – Direct Load Control (DLC)

Description

Direct-Load Control is typically used for reliability-based events such as contingency and emergency support, supply of balancing energy or other ancillary service. Many of these programs require quick response time, e.g., five minutes or faster, that is practically only possible through a DLC capability. Direct-Load Control may also be used for economic operations, e.g., water heater programs to reduce or shift peak load.

Considering that the business processes for demand response have not yet been standardized across the nations, the following is a representative DLC scenario that captures the interactions between the key stakeholders (actors).

Direct Load Control is typically called for by a system operator, a transmission or distribution operator. It could be also issued by a Market Operator based on an ancillary service DR award,

or by an LSE or DRP for an economic purpose. At high penetration levels, DLC operation needs to be coordinated with the distribution grid operator, the UDO.

As is shown in the sequence diagram below, the customer DR capabilities are aggregated by location and specified/nominated to the Distribution Grid Operator, Load Serving Entity, and/or to the System/Market Operator. In addition to location, the capabilities may also be aggregated by the DR response time, e.g., four seconds, five minutes, 30 minutes, etc.

The DLC Dispatch process is typically initiated by the Transmission or Distribution Operator. The process may also be initiated by the Market Operator or the LSE. The actual control of the DR resources may be done by the DR provider based on the dispatch signal received.

At high DR penetration levels, it is expected that the DLC activation schedule to be coordinated with the Distribution Grid Operator, the UDO. This is to insure that there are no adverse impact on the distribution grid reliability and power quality, e.g., voltage violation, excessive phase imbalances, or an overload during load pickup period. If the DLC deployed by a utility company such coordination can be accomplished within the company's DR and distribution management systems, or performed as an integral part of the DR control functions.

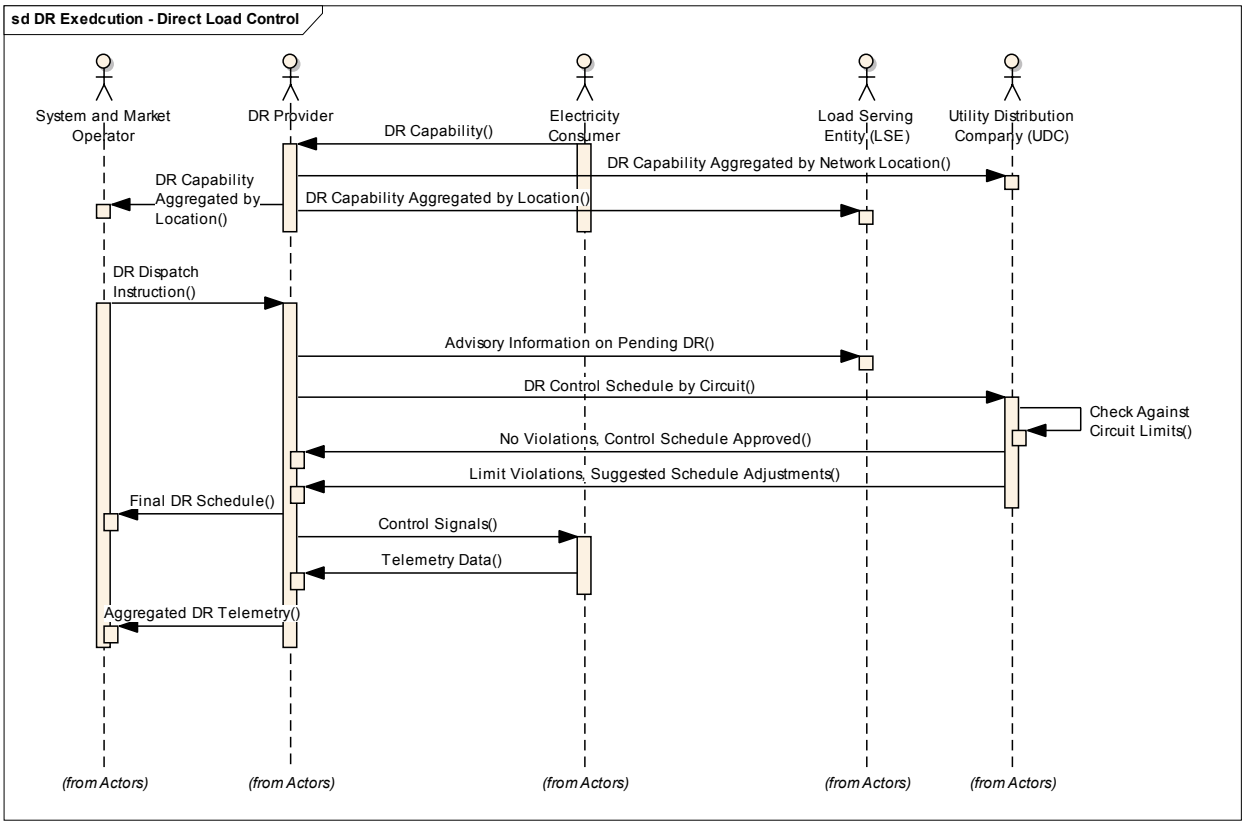
For a "fast" DR, e.g., provision of ancillary services, a telemetry capability is required to enable the real-time monitoring of the resource condition and its response to the DR control signal.

Data Requirements

Attribute Name	Description
DR Resource ID	An identifier of the DR Resource for which the control is intended.
Status Check	A signal to inquire the DR resource status to be sent back
Pending DLC Notification	A signal indicating a pending DLC operation – A multi-value signal indicating the start time, duration, and the magnitude (kW, or resource specific options) of the control.

Attribute Name	Description
DR Control Command	This may include multiple parameters Schedule for the DR initiation, or termination, and type/level of control. Please note that the control signal may be sent to a building EMS or a smart device with a multi-function control capability.
Source-Authentication	This is for authentication of the control signal.
Unique-Identifier	An identifier used to identify the message.

Sequence Diagram



REQ.14.3.2.4.12 Operational Coordination

Due to the existing differences in the regional retail energy market regulations, wholesale market structure and protocols, and supply and demand conditions, currently there are regional differences in business practices and processes governing demand response. As a result, operational coordination requirements for demand response somewhat vary from region to region, depending on the available retail tariff, retail market structure, available wholesale market for DR and the market mechanics.

The following table summarizes the major roles and responsibilities of the key stakeholders with respect to demand response operation. As can be seen in this table, a significant level of stakeholder coordination is required for an end-to-end DR operation spanning from the wholesale markets to the end-use customers.

Stake Holder	Key Responsibilities
Wholesale Market Operator	• Establish, administer, and operate wholesale demand response programs and markets; • Determine and publish locational prices for wholesale demand response products; • Improve energy market efficiencies (economics) by integrating demand response products and capabilities; • Monitor compliance to wholesale DR instructions and financially settle with the participating stakeholders.
Transmission Grid / System Operator - Balancing Authority	• Monitor and maintain transmission grid reliability, and call upon wholesale demand-side (demand response) capabilities to address contingency/emergency conditions; • Dispatch demand-side capabilities to balance supply and demand, e.g., mitigating impact of variable generation (e.g., wind). • In regions with no organized wholesale energy market, economically dispatch available generation and demand resources including demand response to optimize supply economics.

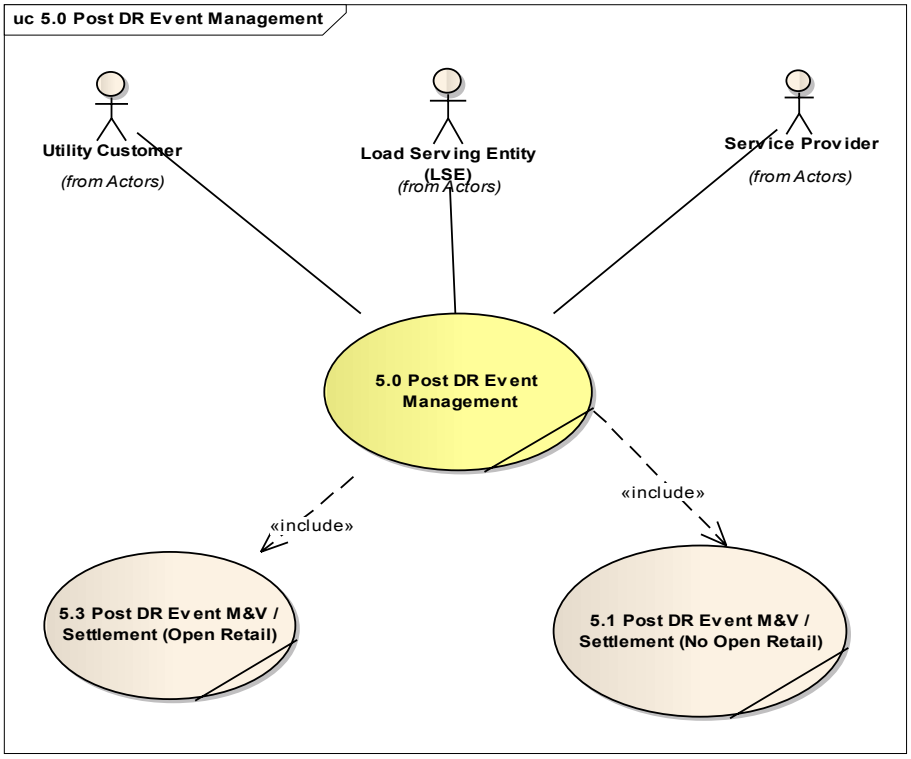
Stake Holder	Key Responsibilities
Distribution Grid Operator – Utility Distribution Company	• Monitor and maintain the distribution grid reliability and the quality of power supply (e.g., voltage levels). Call upon DR to mitigate the distribution contingencies and reliability concerns. • Review and approve the integration of distributed energy resources with the distribution grid. • Assess the operational impact of distributed resources and demand response (DR/DER) on power quality and reliability of the distribution grid, approve high-penetration DR schedules (especially cold-load pickup operation). • Coordinate with the respective Load Serving Entity and Energy Service Providers for the assessment of distribution service and loss compensation charges to retail customers.
Load Serving Entity	• Forecast load and economically schedule supply to meet demand at all times. Incorporate demand response capabilities to improve load factor, reducing/shifting peak load. • Establish and obtain regulatory approval for a fair and unbiased retail tariff for all customer classes. For real-time dynamic pricing (RTP) tariff, apply distribution service, loss compensation and other uplifts to the wholesale locational prices. • Establish and administer demand response and distributed resource management programs including DR tariff. • Meet regional requirements for Renewable Portfolio Standards compliance for power delivery. • Aggregate and schedule DR capabilities in wholesale markets, manage DR programs. • Manage customer metering and billing process.

Stake Holder	Key Responsibilities
Power Marketer	• Forecast load and economically schedule supply to meet demand at all times. Incorporate demand response capabilities to improve load factor, reducing/shifting peak load. • Establish and obtain regulatory approval for a fair and unbiased retail tariff for all customer classes. For real-time dynamic pricing (RTP) tariff, apply distribution service, loss compensation and other uplifts to the wholesale locational prices. • Operate a wholesale and/or retail demand response programs with wholesale and/or retail customers.
Energy Service Provider	• Operate only in regions with competitive retail market • Be an alternative supplier of electric power to end-use customers by offering competitive products, services and prices. • Forecast aggregated load of the enrolled customers by location as required. • Coordinate the power supply with the respective LSE and UDO. • Support demand response programs (DR/DER) for enrolled customers. • Aggregate demand and demand-side capabilities; schedule the aggregated load and DR capabilities in wholesale markets. • Provide for DR telemetry and other monitoring requirements, on a resource or aggregated basis. • Apply the necessary uplifts (e.g., distribution service and loss compensation charges) to the wholesale locational prices. • Meet regional requirements for Renewable Portfolio Standards compliance for power delivery. • Bill and settle with customers for energy supply and DR operation.

Stake Holder	Key Responsibilities
Demand Response Provider	• Offer competitive demand response services to the end-use customers. • Design and manage DR programs, establish pricing structure and signals for DR operation • Aggregate demand and demand-side capabilities; and offer/schedule these capabilities with the respective LSE or the wholesale market. • Provide for DR telemetry and other monitoring requirements, on a resource or aggregated basis. • Bill and settle with customers for energy supply and DR operation.
Electricity Customer	• Subscribe to a DR program, and update DR availability and capability information as appropriate • Maintain DR resources, data communications, telemetry, metering and control devices as required. • Respond to pricing signals, DR notifications, or control signals as appropriate.

REQ.14.3.2.4.13 Post DR Event Management

Post DR event management mainly concerns with the reconciliation of the actual consumption of energy within the duration of a DR event with the expected behavior so that proper financial reward or penalties could be carried out. The NAESB M&V standard for DR defines the requirements for most of the post event management. The following use cases describe post DR event management for three different market types.

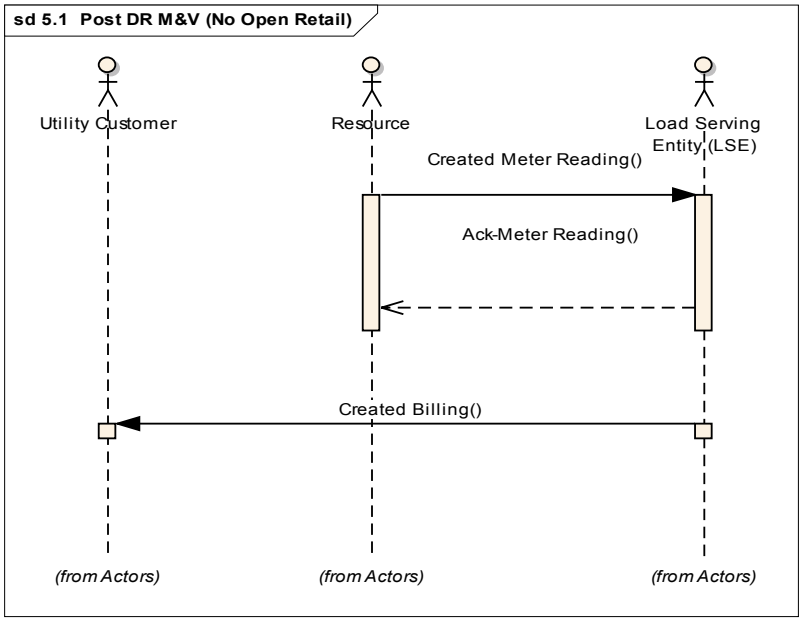


REQ.14.3.2.4.13.1 Post DR Event M&V / Settlement (No Open Retail)

Description

After DR Event has been completed, then Measurement and Verification (M&V) can confirm whether action has been taken or to measure the impact of the response. After the M&V, then the Financial Settlement is calculated and sent to the Electricity Customer[1]. This Use Case covers the scenarios with no Open Retail Markets.

Sequence Diagram



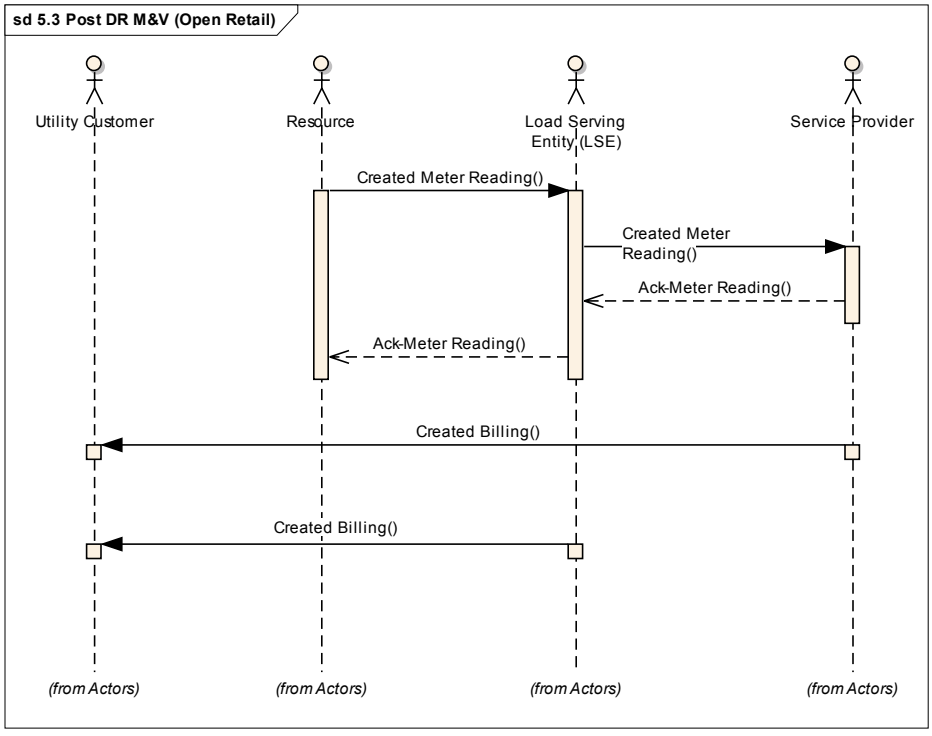
[1] In wholesale markets, the settlement for a DR Event is between the System Operator and Market Participant and possibly between the Market Participant and the Electricity Customer.

REQ.14.3.2.4.13.2 Post DR Event M&V / Settlement (Open Retail)

Description

After DR Event has been completed, Measurement and Verification (M&V) can confirm action has been taken or to measure the impact of the response. After the M&V, the Financial Settlement is calculated and sent to the Electricity Customer. This Use Case covers the scenarios with Open Retail Markets.

Sequence Diagram



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**

4. Supporting Documentation

a. Description of Request:

On September 30, 2009 the National Institute of Standards and Technology officially assigned NAESB the responsibility to develop Requirements and Use Cases pertinent to Priority Action Plan items 3, 4 and 9. A complete description of each item is available on the NIST Web site located at http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP09DRDER

This recommendation specifically pertains to PAP 09[2], "Standard DR and DER Signals".

b. Description of Recommendation:

See Section 3 Summary

c. Business Purpose:

This recommendation has been developed in response to a request from NIST to provide use cases and requirements germane to the development of standard DR and DER signals.

d. Commentary/Rationale of Subcommittee(s)/Task Force(s):

Joint Smart Grid Standards Task Force and Fix Protocol Meeting Notes/Documents:

- September 17, 2009 Meeting Notes – To be posted
- October 1, 2009 Meeting Notes – To be posted
- October 15, 2009 Meeting Notes – To be posted

NAESB Smart Grid Standards Task Force Sub-Group Meeting Notes/Documents:

- October 13, 2009 Meeting Notes – To be posted
- October 20, 2009 Meeting Notes – To be posted
- October 27, 2009 Meeting Notes – To be posted
- November 3, 2009 Meeting Notes – To be posted
- November 4-6, 2009 Meeting Notes – To be posted
- November 10, 2009 Meeting Notes – To be posted

NAESB Smart Grid Standards Task Force Meeting Notes/Documents:

- October 22, 2009 Meeting Notes – http://naesb.org/pdf4/smart_grid_ssd102209notes.doc
- October 29, 2009 Meeting Notes – To be posted
- November 5, 2009 Meeting Notes – To be posted
- November 13, 2009 Meeting Notes – To be posted
- December 3, 2009 Meeting Notes – To be posted

[2] http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP09DRDER

- December 10, 2009 Meeting Notes – http://naesb.org/pdf4/smart_grid_ssd121009notes.doc
- December 17, 2009 Meeting Notes – http://naesb.org/pdf4/smart_grid_ssd121709notes.doc
- January 7, 2010 Meeting Notes – To be posted
- January 14, 2010 Meeting Notes – To be posted
- January 21, 2010 Meeting Notes – To be posted
- January 28, 2010 Meeting Notes – To be posted
- February 5, 2010 Meeting Notes – To be posted
- February 15, 2010 Meeting Notes – To be posted
- February 25, 2010 Meeting Notes – To be posted