NIST SG Interaction use case template

DGH ver. 3 8/25/08

1 Smart Grid interaction description

1.1 SG interaction name

Demand Response (DR) – Load profile management via reliability based signals

1.2 Description

Energy provider affects load profiles of their customers during a specific time period by using a reliability notification mechanism. Reliability refers to the fact that the energy provider needs to change their load profile to protect the integrity of the electricity supply. This mechanism is different than so called Real Time Pricing in that the energy provider is actively trying to influence consumption based upon a pre-arranged agreement and probably involves specific objectives on how much load to shed overall during the desired period.

Note that the phrase "load profile" refers to the facility's load consumption as perceived from the energy provider or "grid's" point of view, i.e. how much electricity from the grid it is consuming. Thus it is theoretically possible that a facility's load profile could go to near zero consumption from the grid's point of view yet remain unchanged from the facility's point of view if it used some sort of distributed generation to offset the reduced power from the grid.

In contract to load profiling via a pricing mechanism which attempts to "influence" a customer's usage, reliability typically has a much more direct correlation between the desired effects and the actions taken by the customers to modify their load profiles. Reliability is thus used in situations where a much higher sense of urgency exists than would exist in a price based DR scenario.

Within the context of this use case an "energy provider" may be any of a number of different entities that are responsible for interacting with facilities for either providing energy or managing its consumption and may include a Utility, ISO, Energy Service Provider, or an aggregator.

This use case is meant to be distinctly different than the following scenarios:

- DR programs that utilize direct load control
- DR programs that utilize pricing information as the basis for load management
- DR programs that manage customers adding generation capacity to the grid.

Note that although this use case does not cover adding capacity to the grid it does not preclude the use of distributed generation by a customer to manage their own load profile.

1.3 Interaction use case narrative

The interactions outlined in this narrative are intentionally meant to be prototypical and as such are as general and high level as possible. It is quite feasible that a DR program could be implemented that left out many of the steps listed below.

The interactions below are those that occur for a specific DR event period and assume that there exist an agreed upon contract between the energy provider and their customers that spell out how the DR program will operate. Such an agreement would dictate many of the details concerning each of the interactions below and may vary considerably between different DR programs.

(1) Energy provider collects information concerning what a customer's load profile may be in response to various reliability signals. This information may be based upon the following:
    a. Pre-arranged contracts
    b. Bids from the customer that specify how they intend to participate. Bids may be placed according to some pre-arranged schedule or in response to a call for bids related to a specific time period.
    c. Feedback from the customer that specifies how they intend to participate. This feedback may come from a facility's load control system and can be as simple as whether they will opt in or out of participation in a DR event or may be as sophisticated as giving projected load profiles for the period in question. Note that in order to collect this feedback from the customer it may be necessary for the energy provider to provide information concerning the upcoming DR event.
    d. Statistical load models based on past performances
    e. Scio-economic and environmental conditions that may influence energy consumption such as weather, natural disasters, etc.
(2) The information from step (1) is used by the Energy provider to decide which customers and their facilities they will try to actively influence.
(3) The energy provider sends a DR signal in the form of a reliability signal (e.g. amount of load to shed) to the customers and their facilities so that they may respond appropriately. The signal may also contain ancillary information such as power quality, etc. Also note that the DR signal will typically arrive prior to the event period based upon some predetermined notification period. This may range anywhere from minutes to hours to days, depending on the nature of the agreement between the energy provider and the customer. Not that because of the potentially higher sense of urgency reliability signals can arrive with very little notice. The DR signal may be sent to humans, third party service providers (e.g. aggregators and ESCO's), or a facilities automation system.
(4) The customer's and/or their facilities confirm their anticipated response to the DR signal with the energy provider and may give an up to date prediction of what their response during the DR Event period will be.
(5) During the DR event period facilities adjust load according to a predetermined "shed strategy" that is based upon the information contained in the DR signal. The shed strategy is responsible for translating the information contained in the DR signal to specific actions to be taken within the facility. The shed strategy is typically encapsulated within the facility itself and its control system. The shed strategy may also reside within a third party such as an aggregator, ESCO, or facilities management service provider In all cases the information in the reliability signal is processed and eventually converted into specific actions to control loads and their consumption within the facilities. The level of urgency related to a specific reliability based program may dictate the acceptable latency at which the facility must respond.
(6) During the DR event period the energy provider monitors the customer's response to the DR event to insure that they are responding in the anticipated fashion. The level of urgency related to a specific reliability based program may dictate the rate and acceptable latency at which this information is collected.
(7) Based upon feedback from the customers the energy provider may make adjustments by adjusting the reliability signal or calling on additional customers to participate.
(8) After the DR event period the energy provider collects information from each of the customers that allow them to audit the performance of the customers during the DR event

period. This is necessary to perform whatever settlement may be required according to a pre-arranged contract between the energy provider and the customer. This information is typically meter data and may be derived from the information collected while monitoring the performance of a customer during the DR event or it may simply be the normal meter data that is collected as part of a facility's normal operations.

1.4 Actors

List the actors (stakeholder roles) involved in the use case (e.g., Energy service provider, DR aggregator, customer, energy management system, end device).

Name	*Role description*
Actor 1	Provide a brief description of the role that an Actor has in this particular use case. An Actor can be a human or a system. The same Actor can play different roles in different use cases but only one role in one use case. If the same Actor does play multiple roles in one use case, list these separately.
Actor 2	

1.5 Information exchanged

Describe any information exchanged in this interaction.

Information Object Name	*Information Object Description*

1.6 Services

Describe or list the services involved in this Interaction (in the context of this Interaction). A service can be provided by a computer system, a set of applications, or manual procedures. These services should be described at an appropriate level, with the understanding that sub-services should be described if they are important for operational issues, automation needs, and implementation reasons. Other sub-services could be left for later analysis.

Service Name	*Services Provided*

1.7 Contracts, regulations, other contraints

Identify any human-initiated contracts, regulations, policies, financial considerations, engineering constraints, pollution constraints, or other issues that affect the design and requirements of the interaction.

Contract/Regulation	*Impact of Contract/Regulation on Interaction*

Policy	*From Actor*	*May*	*Shall Not*	*Shall*	*Description (verb)*	*To Actor*
ProvideEnergy	ESP			X	Provide power on demand	Customer

Constraint	*Type*	*Description*	*Applies to*

2 Smart Grid context, standards, and interfaces

2.1 Business Objective

What is the reason we need this interaction/service? How is this service necessary for the future smart grid to be what we want it to be?

2.2 Smart Grid domain and stakeholders

What parts of the smart grid does this interaction/service touch on (for example what Intelligrid environments)? Who owns the system components, employs the system operators, and which trade organizations represent these stakeholders?

2.3 Standards landscape

What standards exist for this application area? Who is involved? Where are gaps and harmonization efforts?

Standard/ guideline/ standardization effort	*SDO/ organizations involved*	*Gaps/ harmonization efforts*

2.4 Key Interfaces

Note key interfaces between interaction stakeholders. For each interface, discuss GWAC interoperability framework cross-cutting issues (shared meaning of content, resource identification, time synch and sequence, security and privacy, logging and auditing, transaction and state management, system preservation, quality of service, discovery and configuration, system evolution and scalability).

Interface between	*Cross-cutting issues*

3 Step by step analysis of interaction

3.1 Pre-conditions and assumptions

Describe conditions that must exist prior to the initiation of the Interaction, such as prior state of the actors and activities.

Identify any assumptions, such as what systems already exist, what contractual relations exist, and what configurations of systems are probably in place.

Identify any initial states of information exchanged in the steps in the next section. For example, if a purchase order is exchanged in an activity, its precondition to the activity might be ‘filled in but unapproved’.

Actor/System/Information/Contract	*Preconditions or Assumptions*

3.2 Normal sequence

Describe the normal sequence of events, and focus on steps that identify new types of interactions, new information, or new issues to address. Should the sequence require detailed steps that are also used by other interactions, consider creating a new “sub” interaction and then referring to that “sub-routine” in this interaction.

Step	*Event*	*Sender to receiver*	*Description of process/action*	*Information to be exchanged*	*Response to action*
1.	Triggering event	What actor or system is sending to what other actor or system	Describe the actions that take place in active and present tense. The step should be a descriptive noun-verb phrase that portrays an outline summary of the step.	Identify the information that will be exchanged. Indicate special conditions such as accuracy, security, and availability requirements.	Describe the response to the action in present tense form as for the “Actor action.” “If…Then…Else” scenarios can be captured as multiple responses or as separate steps.
2.					
3.					
4.					

3.3 Alternative/exception sequences

Describe any alternative or exception sequences that may be required that deviate from the normal course of activities.

Step	*Event*	*Sender to receiver*	*Description of process/action*	*Information to be exchanged*	*Response to action*
1.					
2.					
3.					
4.					

3.4 Post-conditions

Describe conditions that must exist at the conclusion of the Interaction. Identify significant items similar to that in the preconditions section.

Describe any significant results from the Interaction

Actor/Activity	*Post-conditions Description and Results*

3.5 Diagram

For clarification, draw (using UML diagram conventions, as appropriate) the interactions described above and identify the steps where possible.

4 Additional items

4.1 References and contacts

Documents and individuals or organizations used as background to the interaction described; other interactions referenced by this interaction, or acting as "sub" interactions; or other documentation that clarifies the requirements or activities described. All prior work (intellectual property of the company or individual) or proprietary (non-publicly available) work must be so noted.

ID	*Title or contact*	*Reference or contact information*

4.2 Outstanding Issues

As the use case is developed, identify issues that need clarification, resolution, or other notice taken of them. This can act as an action item list.

ID	*Description*	*Status*

4.3 Revision history

No.	*Date*	*Author*	*Description*