Direct Load Control Event

5-6-2010

Version 3.0

1 Descriptions of Function

All prior work (intellectual property of the company or individual) or proprietary (non-publicly available) work should be so noted.

1.1 Function Name

Direct Load Control Event

1.2 Function ID

Identification number of the function

1.3 Brief Description

The DR solution shall provide the ability to manage direct load control programs. It accomplishes this by managing the transmission of direct load control actions to **HAN devices**, shown as **PEV**, Programmable Communicating Thermostat (**PCT**), **load control switch** and **smart appliances**. This solution will also provide interactions with customers to convey direct load control information via in home display (**IHD**).

FERC states that further development of key standards around Demand Response will enhance interoperability and communications between system operators, demand response resources (also called curtailment resources), and the systems that support them. The following Use Cases on Demand Response supports DOE's request to identify use cases and relevant standards, particularly around dispatchable curtailment to address loss or unavailability of other resources or shifting consumption to non-peak times.

Demand Response is a temporary change in electricity consumption by demand control devices in response to market or reliability conditions. Demand control devices control loads capable of measurably and verifiably providing temporary changes in demand. Demand Response may be used to support electricity demand or supply management opportunities for reliability or economic reasons. By managing loads through Demand Response the opportunity exists to:

- Engage the consumer by allowing market participation and consumption/billing choices;

- Introduce new markets for aggregators, micro-grid operators, distributed generation;

- Control peak power conditions and limit or remove brownout/blackout instances;

- Flatten consumption curves or peaks and shift consumption times;

- Respond to temporary grid anomalies;

- Maximize use of available power and increase system efficiencies through time-of-use (TOU) and dynamic pricing models.

1.4 Narrative

There are three scenarios described in this use case. Scenario #1 details a Demand Response (DR) event using a meter centric approach. (DR via AMI. No EMS.) Scenario #2 details a DR event using an EMS centric approach with the AMI System. (DR signals travel through the Smart Meter to the EMS and back through the Smart Meter.) Scenario #3 details a DR Event using an EMS centric approach with Internet Gateway. (DR signals travel from the DR Application through the internet, to the internet gateway, to the EMS. The Information travels from the devices to the EMS, to the internet Gateway, through the internet, back to the DR Application.)

Scenario #1 - The Demand Response (DR) solution shall provide the ability to manage direct load control programs. It accomplishes this by managing the transmission of direct load control actions to ***PEV, load-control switch, HAN device,*** and ***smart appliances***. This solution will also provide interactions with customers to convey direct load control information using an ***In Home Display (IHD)***. The initiation of a DR event is triggered by the ***DR application*** (a module) of the AMI system, shown as logically separated. The ***AMI Head-End*** module sends the DR command/message through the ***AMI network*** to the ***smart meter*** where is it is transmitted through the Home Area Network (HAN) to the direct load control devices. These commands and messages can include:

- The DR profile which can include

    o Temperature change

    o On/off parameters

    o Pricing information (CPP, TOU)

    o Informational messages

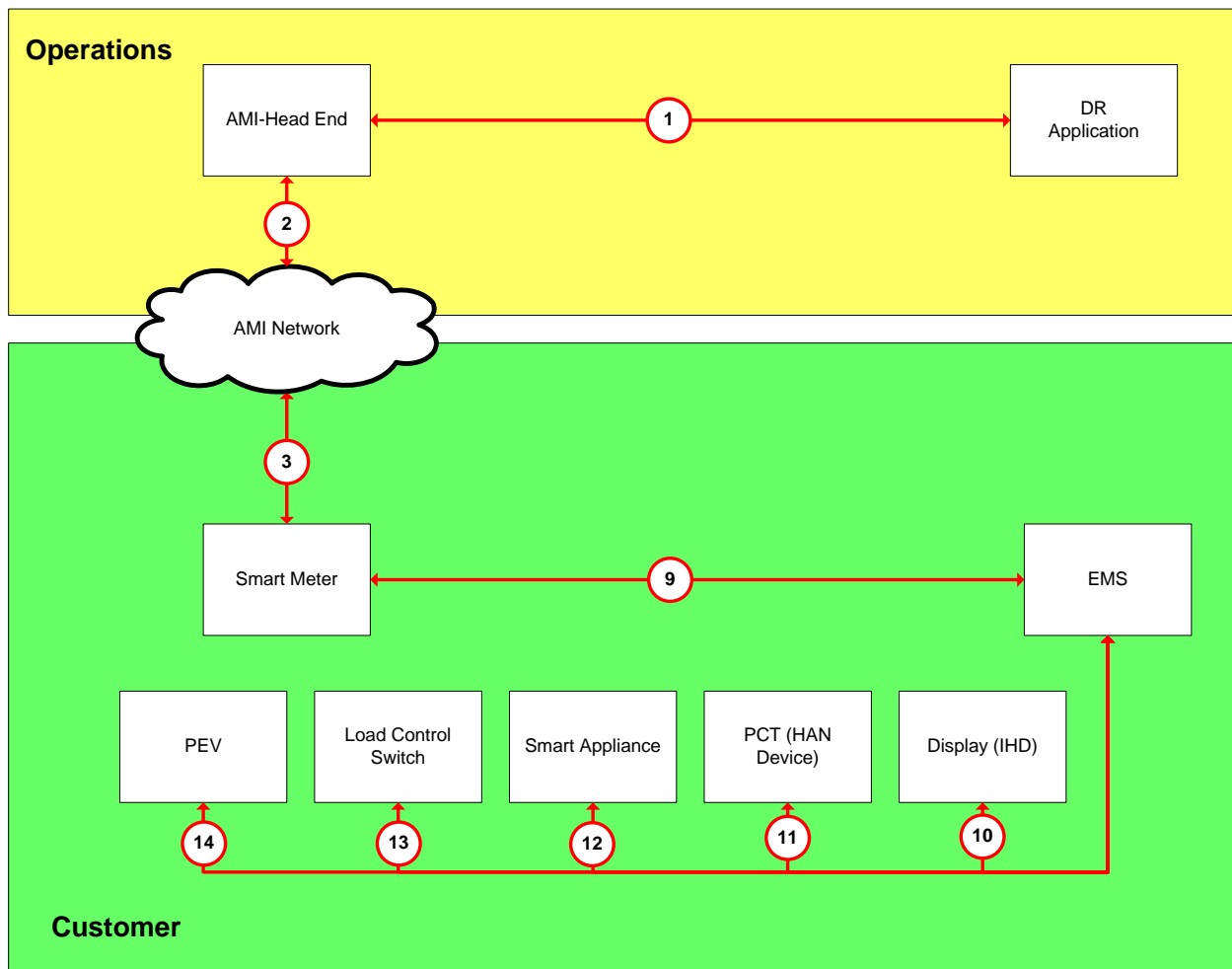- Curtailment requests (direct load control)
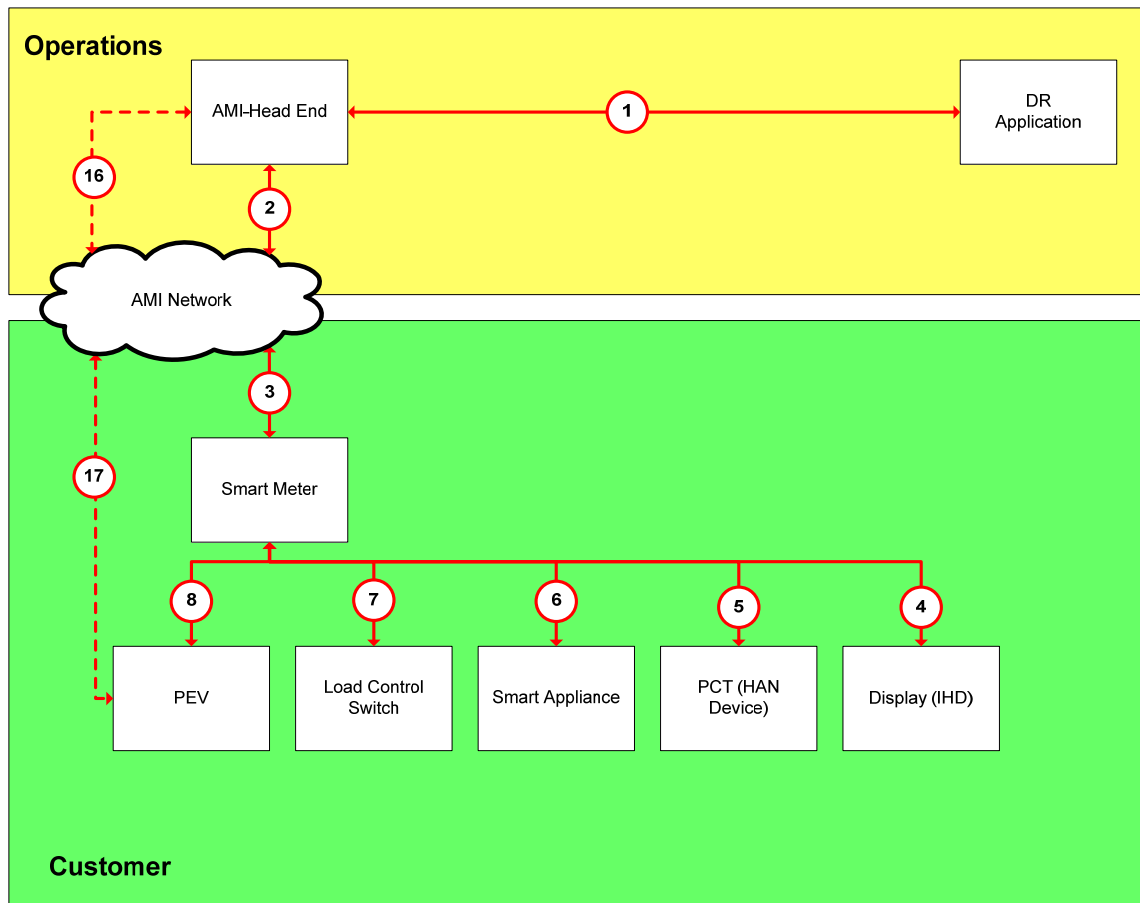
Figure 1-1
Context Diagram for DR Signal over AMI Network, Smart Meter Centric

Scenario #2 - The DR solution shall provide the ability to manage direct load control programs. It accomplishes this by managing the transmission of direct load control actions to *PEV, load-control switch, HAN device,* and *smart appliances*. This solution will also provide interactions with customers to convey direct load control information using an *IHD*. The initiation of a DR event is triggered by the *DR application* (a module) of the AMI system, shown as logically separated. The *AMI head end* module sends the DR command/message through the *AMI network* to the *smart meter.* The *smart meter* relays the information, needed by the home *Energy Management System* (*EMS*) which

acts as the home control center for electricity consumption. The *EMS* provides various facilities for the home owner to track his consumption verify trends and be savvier with his electricity consumption. The *EMS* transmits through the HAN to the direct load control devices. These commands and messages can include:

- The DR profile which can include

    o   Temperature change

    o   On/off parameters

    o   Start & Duration

    o   Pricing information (CPP, TOU)

    o   Informational messages, other SEP1.0 DRLC cluster parameters

- Curtailment requests (direct load control)

Figure 1-2
Context Diagram for DR Signal over AMI EMS Centric

Scenario #3 - The DR solution shall provide the ability to manage direct load control programs. It accomplishes this by managing the transmission of direct load control actions to *PEV, load-control switch, HAN device,* and *smart appliances*. This solution will also provide interactions with customers to convey direct load control information using an *In Home Display IHD*. The initiation of a DR event is triggered by the *DR application* (a module) of the AMI system, shown as logically separated. The *smart meter* relays simple meter data needed by the home *Energy Management System (EMS)*. The DR application, through the internet and *internet gateway* transmits DR commands to the *EMS* which acts as the home control center for electricity consumption. The *EMS* provides various facilities for the home owner to track their consumption verify trends and be savvier with his electricity consumption. The *EMS* transmits through the HAN to the direct load control devices. These commands and messages can include:
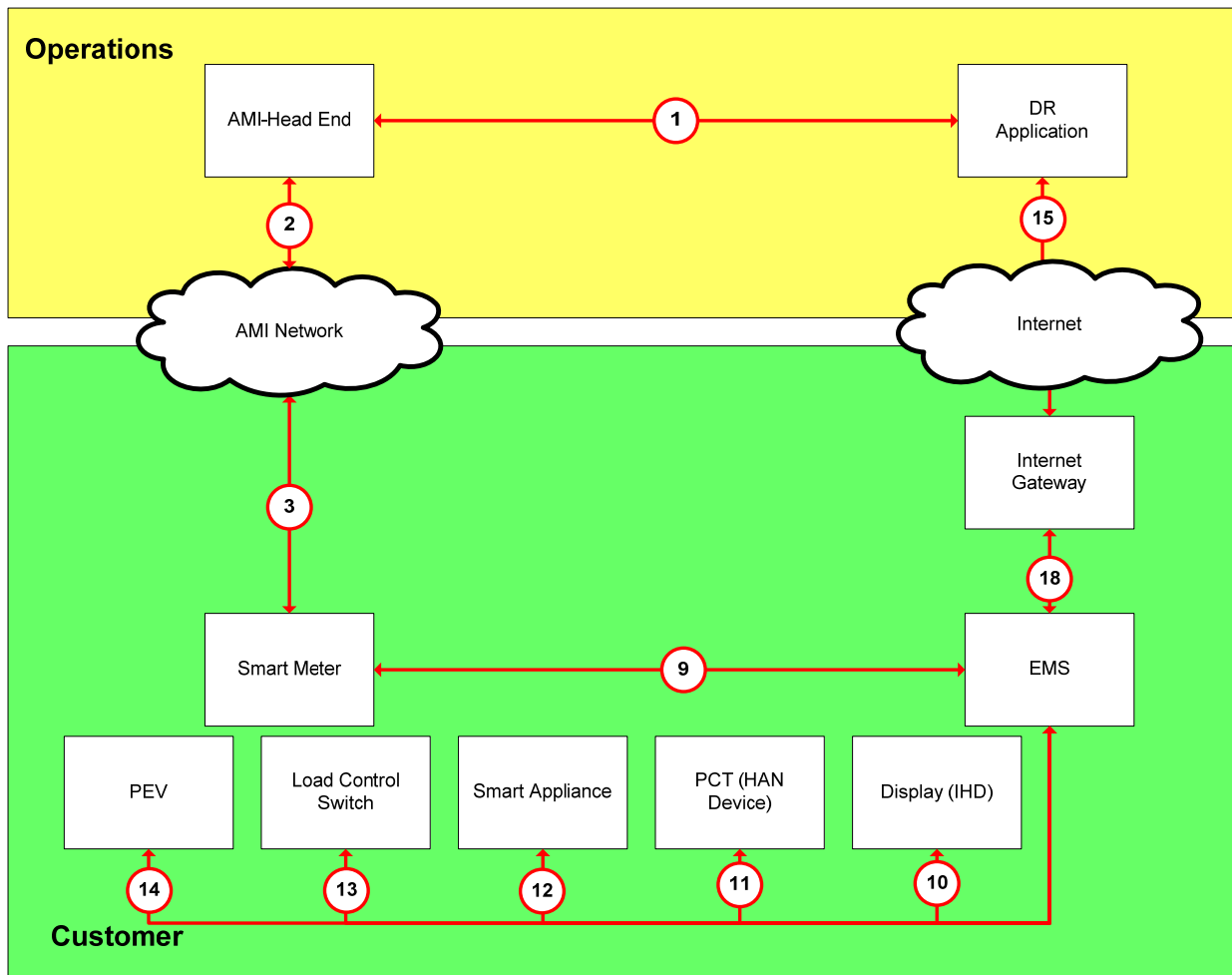
- The DR profile which can include
    - o Temperature change
    - o On/off parameters
    - o Pricing information (CPP, TOU)
    - o Informational messages
- Curtailment requests (direct load control)

Figure 1-3
Context Diagram for DR Signal over Internet Gateway EMS Centric

1.5 Actor (Stakeholder) Roles

Grouping (Community) '		Group Description
Actor Name	**Actor Type (person, organization, device, system, or subsystem)**	**Actor Description**
Access Point	Sub-System	The Access Point is a sub-system within the AMI system that performs high volume data transport capabilities.
The Utility's NOC/Human	Organization	The NOC is the Network Operations center for Telecom activities
AMI Head End	System	The AMI Head-End is the back office system than controls the Advanced Metering Infrastructure.
AMM Module	System	Automated Meter Management (predecessor to the DR module of the AMI Head-End)
Customer	Person	Customer of the Electric Service Provider. Contracts with the ESP to receive quality electrical service. Agrees to participate in Demand Response program. May or may not (at time of system operation) choose to participate
Customer Portal	System	Interactive Web-site that is accessible via the internet that enables the exchange and display of information for the customer.
Distribution Management	Organization	Organization within the utility in charge of the distribution of electricity.
Distribution Operations	Organization	Organizational Group within the utility responsible for the operations of the distribution system.
DR Application	Sub-System	Demand Response Application is a sub-system of the AMI System used to issue demand response commands.

Grouping (Community) '		Group Description

Actor Name	Actor Type (person, organization, device, system, or subsystem)	Actor Description
DR Service Provider	Organization	
EMS (customer)	Device	A logical or physical device typically located at the customer facility that acts as a home electricity control center. The EMS is typically connected to the HAN and sends/receives information from various communications means depending on the customer scenario.
EVSE (Electric Vehicle Supply Equipment)	Device	Electric Vehicle Supply Equipment manufacturers are delivering Smart charging stations for electric vehicles. These smart charging stations will typically be located at customers' premises, or at other private and public parking facilities.
EVSE Radio	Device	The radio within the EVSE that sends and receives information through the HAN
HAN	System	Home Area Network (Network of communicating energy consuming devices)
HAN Device	Device	Device owned by customer, utility or third party that is registered on the Home Area Network (HAN). It communicates in a secure way between other HAN devices.
IHD (In-Home Display)	Device	In-Home Display presents basic information to the customer such as consumption data, price information or demand response signals.
IHD Radio	Device	The radio with the IHD that receives and sends the data to the HAN.
Load Control	Device	Electric switch that can be remotely commanded to open or close.

Grouping (Community)'		Group Description
Actor Name	Actor Type (person, organization, device, system, or subsystem)	Actor Description
Switch (LCS)		
Load Control Switch Radio	Device	The radio that sends and receives data between the controller and the LCS
Meter	Device	A smart meter electronically tracks how much electricity is used and when it is used. The smart meter is also equipped to send and receive information from/to the AMI network and also from/to the HAN
Metering Department/Human	Organization	The Department within the utility in charge of metering electricity consumption
Metering System	System	Also called Advanced Metering Infrastructure it is the collection of devices (such as smart meters), systems (such as MDM) and sub-systems (such as relays or Access points) that enable the automated metering solution
NIC	Device	Network Interface Card within the meter that has 3 elements (NIC - ESI, NIC - ESP & Metrology board)
NIC - ESI	Device	HAN side of the Network Interface Card within the meter. (Energy Services Interface). Device and software that permits applications such as load control device or in-home display to receive information in a secure fashion.
NIC - ESP	Device	AMI side of the network interface card within the smart meter.
PCT (Programmable	Device	Device on the Home Area Network that is programmable and controllable.

Grouping (Community) '		Group Description
Actor Name	**Actor Type (person, organization, device, system, or subsystem)**	**Actor Description**
Communicating Thermostat)		
PCT Radio	Device	The radio that sends and receives data between the HAN and the PCT
PEV	Device	Plug-In Electric Vehicle
PEV Radio	Device	The radio with the PEV that sends and receives information through the HAN
Relay (AMI)	Device	A sub-system of the AMI system that typically relays the data using radio signals between the meters and the access points.
Smart Appliance	Device	Smart Appliances can react to remote management, whether to price, grid integrity, or other energy management signaling.
Smart Appliance Radio	Device	The radio that sends and receives data between the smart appliance and the HAN
Smart Meter	Device	A digital meter used in measuring watts, vars, var-hours, volt-amperes, or volt-ampere-hours. The Smart Meter is a 2-way communicating device that includes a NIC and is part of an advanced metering infrastructure (AMI). It is located on the customer premise and owned by the distributor or retail provider.

1.6 Information Exchanged

Information Object Name	Information Object Description
Inadequate generation resources	
Direct Load Control Event	
(1) Data elements to trigger for Direct Load Control	
(2) Data elements to trigger for Direct Load Control Event	
(3) Data elements concerning DR Event for In-Home Display	
Communications Acknowledgement	
Information for DR Event	
(4) Data elements to trigger for Direct Load Control Event	
Communications Acknowledgement	
(5) Data elements to trigger for Direct Load Control Event	
Communications Acknowledgement	
(6) Data elements to trigger for Direct Load Control Event	
Communications Acknowledgement	
(7) Data elements to trigger for Direct Load Control Event	

Information Object Name	Information Object Description
Communications Acknowledgement	
System Updates	

1.7 Activities/Services

Describe or list the activities and services involved in this Function (in the context of this Function).

Activity/Service Name	Activities/Services Provided

1.8 Contracts/Regulations

Identify any overall (human-initiated) contracts, regulations, policies, financial considerations, engineering constraints, pollution constraints, and other environmental quality issues that affect the design and requirements of the Function.

Contract/Regulation	Impact of Contract/Regulation on Function
Opt Out Clause	Customer may not exceed 5 hours a day

Policy	From Actor	May	Shall Not	Shall	Description (verb)	To Actor

Constraint	Type	Description	Applies to

2 Step by Step Analysis of Function

Describe steps that implement the function. If there is more than one set of steps that are relevant, make a copy of the following section grouping (Steps to implement function, Preconditions and Assumptions, Steps normal sequence, Post-conditions) and provide each copy with its own sequence name.

2.1 Steps to implement function – Name of Sequence

Scenario #1 DR via AMI. No EMS.

2.1.1 Preconditions and Assumptions

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

Actor/System/Information/Contract	Preconditions or Assumptions
NIC - ESP	It is understood that the ESP is part of the Network Interface Card (NIC) inside the Smart Meter.
NIC - ESI	It is understood that the ESI is part of the Network Interface Card (NIC) inside the Smart Meter.

2.1.2 Steps – Name of Sequence

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.[1]*	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section0.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*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. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section0.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section0.* (Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
1.1	Energy Service Provider (ESP) determines that the available generation is inadequate to fulfill the system loads	ESP	ESP contacts Distribution Operations	ESP contacts Distribution Operations to report inadequate generation resources	ESP	Distribution Operations	Inadequate generation resources		
1.2		Distribution Operations	Direct Load Control Event Called	Distribution Operations calls a Direct Load Control Event using the Demand Response Application (demand response event).	Distribution Operations	Demand Response Application	Direct Load Control Event		

[1] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.3		Demand Response Application	Demand Response Application creates appropriate transactions	Demand Response Application creates appropriate transactions (to send to Customers and Customer's Devices) to send to the AMI Head End	Demand Response Application	AMI Head End	(1) Data elements to trigger for Direct Load Control	The AMI is ultimately passing data thru the meter to the HAN to the Controllable Devices	IEC 61968
1.4		AMI Head End	AMI Head End send data elements	AMI Head End sends Data elements to trigger for Direct Load Control Event to the NIC - ESP via the AMI Network	AMI Head End	NIC - ESP	(2) Data elements to trigger for Direct Load Control Event	Use AMI Network Use Case scenario AMI Head End to Smart Meter	
1.5		NIC - ESP	NIC - ESP send Data elements	NIC - ESP send Data elements to trigger for Direct Load Control Event to the NIC - ESI	NIC - ESP	NIC - ESI	(2) Data elements to trigger for Direct Load Control Event		
1.6 A.1		NIC - ESI	NIC - ESI sends Data elements	NIC - ESI sends Data elements concerning DR Event for IHD to IHD Radio	NIC - ESI	IHD Radio	(3) Data elements concerning DR Event for IHD		
1.6 A.1. 1		IHD Radio	IHD Radio receives the signal	IHD Radio receives the signal and sends a Communications Acknowledgement to the NIC - ESI	IHD Radio	NIC - ESI	Communications Acknowledgement		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.6. A.2		IHD Radio	IHD Radio sends Data elements	IHD Radio sends Data elements concerning DR Event for IHD to IHD	IHD Radio	IHD (In-Home Display)	(3) Data elements concerning DR Event for IHD		
1.6 A.3		IHD (In-Home Display)	IHD displays information	IHD displays information for DR Event	IHD (In-Home Display)	IHD (In-Home Display)	Information for DR Event		
1.6 B.1		NIC - ESI	NIC - ESI sends Data elements	NIC - ESI sends Data elements to trigger for Direct Load Control Event to PCT Radio	NIC - ESI	PCT Radio	(4) Data elements to trigger for Direct Load Control Event		
1.6 B.1.1		PCT Radio	PCT Radio receives the signal	PCT Radio receives the signal and sends a Communications Acknowledgement to the NIC - ESI	PCT Radio	NIC - ESI	Communications Acknowledgement		
1.6 B.2		PCT Radio	PCT Radio sends data elements	PCT Radio sends Data elements to trigger for Direct Load Control Event to the PCT Controller	PCT Radio	PCT Controller	(4) Data elements to trigger for Direct Load Control Event	Cycling vs. temperature control - ???	
1.6 B.3		PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat) functions	PCT (Programmable Communicating Thermostat) functions accordingly	PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.6 C.1		NIC - ESI	NIC - ESI sends Data elements	NIC - ESI sends Data elements to trigger for Direct Load Control Event to Smart Appliances Radio	NIC - ESI	Smart Appliances Radio	(5) Data elements to trigger for Direct Load Control Event		
1.6 C.1.1		Smart Appliances Radio	Smart Appliances Radio receives the signal	Smart Appliances Radio receives the signal and sends a Communications Acknowledgement to the NIC - ESI	Smart Appliances Radio	NIC - ESI	Communications Acknowledgement		
1.6 C.2		Smart Appliances Radio	Smart Appliances Radio sends data elements	Smart Appliances Radio sends Data elements to trigger for Direct Load Control Event to Smart Appliance Device Controller	Smart Appliances Radio	Smart Appliance Device Controller	(5) Data elements to trigger for Direct Load Control Event		
1.6 C.3		Smart Appliance	Smart Appliance responds	Smart Appliance responds accordingly	Smart Appliance Device Controller	Smart Appliance Device Controller	(5) Data elements to trigger for Direct Load Control Event		
1.6 D.1		NIC - ESI	NIC - ESI sends Data elements	NIC - ESI sends Data elements to trigger for Direct Load Control Event to the Load Control Switch Radio	NIC - ESI	Load Control Switch Radio	(6) Data elements to trigger for Direct Load Control Event		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.6 D.1.1		Load Control Switch Radio	Load Control Switch Radio receives the signal	Load Control Switch Radio receives the signal and sends a communications acknowledgement to the NIC - ESI	Load Control Switch Radio	NIC - ESI	Communications Acknowledgement		
1.6 D.2		Load Control Switch Radio	Load Control Switch Radio sends data elements	Load Control Switch Radio sends Data elements to trigger for Direct Load Control Event to Load Control Switch Device Controller	Load Control Switch Radio	Load Control Switch Device Controller	(6) Data elements to trigger for Direct Load Control Event		
1.6 D.3		Load Control Switch Device Radio	Load Control Switch Device Radio responds	Load Control Switch Device Radio responds accordingly	Load Control Switch Device Radio	Load Control Switch Device Radio	(6) Data elements to trigger for Direct Load Control Event		
1.6 E.1		NIC - ESI	NIC - ESI sends data elements	NIC - ESI sends Data elements to trigger for Direct Load Control Event to EVSE Radio	NIC - ESI	EVSE Radio	(7) Data elements to trigger for Direct Load Control Event		
1.6 E.1.1		EVSE Radio	EVSE Radio receives the signal	EVSE Radio receives the signal and sends a Communications Acknowledgement to the NIC - ESI	EVSE Radio	NIC - ESI	Communications Acknowledgement		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.6 E.2		EVSE Radio	EVSE Radio sends data elements	EVSE Radio sends Data elements to trigger for Direct Load Control Event to EVSE	EVSE Radio	EVSE	(7) Data elements to trigger for Direct Load Control Event		
1.6 E.3		EVSE	EVSE responds	EVSE responds accordingly	EVSE	EVSE	(7) Data elements to trigger for Direct Load Control Event		
1.7		NIC - ESI	NIC - ESI collects and delivers Communications Acknowledges	NIC - ESI collects and delivers Communications Acknowledges to NIC - ESP	NIC - ESI	NIC - ESP	Communications Acknowledgements		
1.8		NIC - ESI	NIC - ESP delivers Communications Acknowledgements	NIC - ESP delivers Communications Acknowledgements to the AMI Head End via the AMI Network	Smart ESP	AMI Head End	Communications Acknowledgements	Use AMI Network Use Case Scenario NIC - ESP to AMI Head End	
1.9		AMI Head End	AMI Head End delivers Communications Acknowledgements	AMI Head End delivers Communications Acknowledgements to the DR Application	AMI Head End	DR Application	Communications Acknowledgements		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.10		DR Application	DR Application displays updates	DR Application displays updates	DR Application	DR Application	System Updates		

2.1.3 *Post-conditions and* Significant Results

Actor/Activity	*Post-conditions Description and Results*
Distribution Operations	Load control event successfully implemented
Supplier of Demand Response Application	It is delivered as expected

2.2 *Steps to implement function – Name of Sequence*

DR signals travel through the Smart Meter to the EMS and back through the Smart Meter

2.2.1 Preconditions and Assumptions

Actor/System/Information/Contract	*Preconditions or Assumptions*
NIC - ESP	It is understood that the ESP is part of the Network Interface Card (NIC) inside the Smart Meter.
NIC - ESI	It is understood that the ESI is part of the Network Interface Card (NIC) inside the Smart Meter.
Internet Gateway	There is a functional Internet Gateway

2.2.2 Steps – Name of Sequence

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.[2]*	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section0.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*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. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section0.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section0.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
2.1	Energy Service Provider determines that the available generation is inadequate to fulfill the system loads	ESP	ESP contacts Distribution Operations	ESP contacts Distribution Operations to report inadequate generation resources	ESP	Distribution Operations	Inadequate generation resources		
2.2		Distribution Operations	Direct Load Control Event Called	Distribution Operations calls a Direct Load Control Event using the Demand Response Application (demand response event).	Distribution Operations	Demand Response Application	Direct Load Control Event		

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[2] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.3		Demand Response Application		Demand Response Application creates appropriate transactions (to send to Customers and Customer's Devices) to send to the AMI Head End	Demand Response Application	AMI Head End	(1) Data elements to trigger for Direct Load Control	The AMI is ultimately passing data thru the meter to the HAN to the Controllable Devices	IEC 61968
2.4		AMI Head End	AMI Head End sends transactions	AMI Head End sends Data elements to trigger for Direct Load Control Event to the NIC - ESP via the AMI Network	AMI Head End	NIC - ESP	(2) Data elements to trigger for Direct Load Control Event	Use AMI Network Use Case scenario AMI Head End to Smart Meter	
2.5		NIC - ESP	NIC - ESP send Data elements	NIC - ESP send Data elements to trigger for Direct Load Control Events to the NIC - ESI	NIC - ESP	NIC - ESI	(2) Data elements to trigger for Direct Load Control Event		
2.6		NIC - ESP	NIC - ESP send Data elements	NIC - ESI send Data elements to trigger for Direct Load Control Events to the EMS	NIC - ESI	EMS	(2) Data elements to trigger for Direct Load Control Event		
2.7 A.1		EMS	EMS sends Data elements	EMS sends Data elements concerning DR Event for IHD to IHD Radio	EMS	IHD Radio	(3) Data elements concerning DR Event for IHD		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.7 A.1.1		IHD Radio	IHD Radio receives the signal	IHD Radio receives the signal and sends a Communications Acknowledgement to the EMS	IHD Radio	EMS	Communications Acknowledgement		
2.7.A.2		IHD Radio	IHD Radio sends data elements	IHD Radio sends Data elements concerning DR Event for IHD to IHD	IHD Radio	IHD (In-Home Display)	(3) Data elements concerning DR Event for IHD		
2.7 A.3		IHD (In-Home Display)	IHD (In-Home Display) displays information	IHD (In-Home Display) displays information for DR Event	IHD (In-Home Display)	IHD (In-Home Display)	Information for DR Event		
2.7 B.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements to trigger for Direct Load Control Event to PCT Radio	EMS (customer)	PCT Radio	(4) Data elements to trigger for Direct Load Control Event		
2.7 B.1.1		PCT Radio	PCT Radio receives the signal	PCT Radio receives the signal and sends a Communications Acknowledgement to the EMS (customer)	PCT Radio	EMS	Communications Acknowledgement		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.7 B.2		PCT Radio	PCT Radio sends data elements	PCT Radio sends Data elements to trigger for Direct Load Control Event to the PCT (Programmable Communicating Thermostat)	PCT Radio	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event	Cycling vs. temperature control - ???	
2.7 B.3		PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)functions	PCT (Programmable Communicating Thermostat)functions accordingly	PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event		
2.7 C.1		EMS	EMS sends data elements	EMS sends Data elements to trigger for Direct Load Control Event to Smart Appliances Radio	EMS	Smart Appliances Radio	(5) Data elements to trigger for Direct Load Control Event		
2.7 C.1.1		Smart Appliances Radio	Smart Appliances Radio receives the signal	Smart Appliances Radio receives the signal and sends a Communications Acknowledgement to the EMS	Smart Appliances Radio	EMS	Communications Acknowledgement		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.7 C.2		Smart Appliances Radio	Smart Appliances Radio sends data elements	Smart Appliances Radio sends Data elements to trigger for Direct Load Control Event to Smart Appliance	Smart Appliances Radio	Smart Appliance	(5) Data elements to trigger for Direct Load Control Event		
2.7 C.3		Smart Appliance Device	Smart Appliance responds	Smart Appliance responds accordingly	Smart Appliance	Smart Appliance	(5) Data elements to trigger for Direct Load Control Event		
2.7 D.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements to trigger for Direct Load Control Event to the Load Control Switch Radio	EMS (customer)	Load Control Switch Radio	(6) Data elements to trigger for Direct Load Control Event		
2.7 D.1.1		Load Control Switch Radio	Load Control Switch Radio receives the signal	Load Control Switch Radio receives the signal and sends a Communications Acknowledgement to the EMS	Load Control Switch Radio	EMS (customer)	Communications Acknowledgement		
2.7 D.2		Load Control Switch Radio	Load Control Switch Radio sends data elements	Load Control Switch Radio sends Data elements to trigger for Direct Load Control Event to Load Control Switch Device Controller	Load Control Switch Radio	Load Control Switch Device Controller	(6) Data elements to trigger for Direct Load Control Event		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.7 D.3		Load Control Switch	Load Control Switch responds	Load Control Switch responds accordingly	Load Control Switch	Load Control Switch	(6) Data elements to trigger for Direct Load Control Event		
2.7 E.1		EMS (customer)	EMS (customer) sends data elements	EMS (customer) sends Data elements to trigger for Direct Load Control Event to EVSE Radio	EMS (customer)	EVSE Radio	(7) Data elements to trigger for Direct Load Control Event		
2.7 E.1.1		EVSE Radio	EVSE Radio receives the signal	EVSE Radio receives the signal and sends a Communications Acknowledgement to the EMS	EVSE Radio	EMS (customer)	Communications Acknowledgement		
2.7 E.2		EVSE Radio	EVSE Radio sends data elements	EVSE Radio sends Data elements to trigger for Direct Load Control Event to EVSE	PEV	EVSE	(7) Data elements to trigger for Direct Load Control Event		
2.7 E.3		EVSE	EVSE responds	EVSE responds accordingly	EVSE	EVSE	(7) Data elements to trigger for Direct Load Control Event		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.8		EMS (customer)	EMS (customer)delivers Communications Acknowledgements	EMS (customer)delivers Communications Acknowledgements to NIC - ESI	EMS (customer)	NIC - ESI	Communications Acknowledgements		
2.9		NIC - ESI	NIC - ESI collects and delivers Communications Acknowledgements	NIC - ESI collects and delivers Communications Acknowledgements to NIC - ESP	NIC - ESI	NIC - ESP	Communications Acknowledgements		
2.10		NIC - ESP	NIC - ESP delivers Communications Acknowledgements	NIC - ESP delivers Communications Acknowledgements to the AMI Head End via the AMI Network	NIC - ESP	AMI Head End	Communications Acknowledgements	Use AMI Network Use Case Scenario NIC - ESP to AMI Head End	
2.11		AMI Head End	AMI Head End delivers Communications Acknowledgements	AMI Head End delivers Communications Acknowledgements to the DR Application	AMI Head End	DR Application	Communications Acknowledgements		
2.12		DR Application	DR Application displays updates	DR Application displays updates	DR Application	DR Application	System Updates		

2.2.3 Post-conditions and Significant Results

Actor/Activity	Post-conditions Description and Results
Distribution Operations	Load control event successfully implemented
Supplier of Demand Response Application	It is delivered as expected

2.3 Steps to implement function – Name of Sequence

DR signals travel from the DR Application through the internet, to the internet gateway, to the EMS. The Information travels from the devices to the EMS, to the internet Gateway, through the internet, back to the DR Application

2.3.1 Preconditions and Assumptions

Actor/System/Information/Contract	Preconditions or Assumptions
NIC - ESP	It is understood that the ESP is part of the Network Interface Card (NIC) inside the Smart Meter.
NIC - ESI	It is understood that the ESI is part of the Network Interface Card (NIC) inside the Smart Meter.
Internet Gateway	There is a functional Internet Gateway

2.3.2 Steps – Name of Sequence

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.[3]*	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section0.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*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. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section0.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section0.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
3.1	Energy Service Provider determines that the available generation is inadequate to fulfill the system loads	ESP	ESP contacts Distribution Operations	ESP contacts Distribution Operations to report inadequate generation resources	ESP	Distribution Operations	Inadequate generation resources		
3.2		Distribution Operations	Direct Load Control Event Called	Distribution Operations calls a direct load control or demand response event using the Demand Response Application.	Distribution Operations	Demand Response Application	Direct Load Control Event		

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[3] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.3		Demand Response Application	Demand Response Application creates appropriate transactions	Demand Response Application creates appropriate transactions (to send to Customers and Customer's Devices) to send to the Internet Gateway via the internet	Demand Response Application	Internet Gateway	(1) Data elements to trigger for Direct Load Control	The AMI is ultimately passing data thru the meter to the HAN to the Controllable Devices	IEC 61968
3.4		Internet Gateway	Internet Gateway sends transactions	Internet Gateway sends transactions to the EMS (customer)	Internet Gateway	EMS (customer)	(2) Data elements to trigger for Direct Load Control Event		
3.5 A.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements concerning DR Event for IHD to IHD Radio	EMS (customer)	IHD Radio	(3) Data elements concerning DR Event for IHD		
3.5 A.1.1		IHD Radio	IHD Radio receives the signal and sends a Communications Acknowledgement	IHD Radio receives the signal and sends a Communications Acknowledgement to the EMS	IHD Radio	EMS	Communications Acknowledgement		
3.5 A.2		IHD (In-Home Display)	IHD Radio sends data elements	IHD Radio sends Data elements concerning DR Event for IHD to IHD	IHD Radio	IHD (In-Home Display)	(3) Data elements concerning DR Event for IHD		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.5 A.3		IHD (In-Home Display)	IHD (In-Home Display)displays information	IHD (In-Home Display)displays information for DR Event	IHD (In-Home Display)	IHD (In-Home Display)	Information for DR Event		
3.5 B.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements to trigger for Direct Load Control Event to PCT Radio	EMS (customer)	PCT Radio	(4) Data elements to trigger for Direct Load Control Event		
3.5 B.1.1		PCT Radio	PCT Radio receives the signal and sends a Communications Acknowledgement	PCT Radio receives the signal and sends a Communications Acknowledgement to the EMS	PCT Radio	EMS (customer)	Communications Acknowledgement		
3.5 B.2		PCT (Programmable Communicating Thermostat)	PCT Radio sends data elements	PCT Radio sends Data elements to trigger for Direct Load Control Event to the PCT (Programmable Communicating Thermostat)	PCT Radio	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event	Cycling vs. temperature control - ???	

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.5 B.3		PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)functions	PCT (Programmable Communicating Thermostat)functions accordingly	PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event		
3.5 C.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements to trigger for Direct Load Control Event to Smart Appliances Radio	EMS (customer)	Smart Appliances Radio	(5) Data elements to trigger for Direct Load Control Event		
3.5 C.1. 1		Smart Appliances Radio	Smart Appliances Radio receives the signal	Smart Appliances Radio receives the signal and sends a Communications Acknowledgement to the EMS (customer)	Smart Appliances Radio	EMS (customer)	Communications Acknowledgement		
3.5 C.2		Smart Appliance Radio	Smart Appliances Radio sends data elements	Smart Appliances Radio sends Data elements to trigger for Direct Load Control Event to Smart Appliance	Smart Appliance Radio	Smart Appliance	(5) Data elements to trigger for Direct Load Control Event		
3.5 C.3		Smart Appliance	Smart Appliance responds	Smart Appliance responds accordingly	Smart Appliance	Smart Appliance	(5) Data elements to trigger for Direct Load Control Event		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.5 D.1		EMS (customer)	EMS (customer) sends data elements	EMS (customer) sends Data elements to trigger for Direct Load Control Event to the Load Control Switch Radio	EMS (customer)	Load Control Switch Radio	(6) Data elements to trigger for Direct Load Control Event		
3.5 D.1. 1		Load Control Switch Radio	Load Control Switch Radio receives the signal and sends a Communications Acknowledgement	Load Control Switch Radio receives the signal and sends a Communications Acknowledgement to the EMS	Load Control Switch Radio	EMS	Communications Acknowledgement		
3.5 D.2		Load Control Switch Radio	Load Control Switch Radio sends data elements	Load Control Switch Radio sends Data elements to trigger for Direct Load Control Event to Load Control Switch	Load Control Switch Radio	Load Control Switch	(6) Data elements to trigger for Direct Load Control Event		
3.5 D.3		Load Control Switch	Load Control Controller responds	Load Control Switch responds accordingly	Load Control Switch	Load Control Switch	(6) Data elements to trigger for Direct Load Control Event		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.5 E.1		EMS (customer)	EMS (customer)sends data elements to trigger	EMS (customer)sends Data elements to trigger for Direct Load Control Event to EVSE Radio	EMS (customer)	EVSE Radio	(7) Data elements to trigger for Direct Load Control Event		
3.5 E.1.1		EVSE Radio	EVSE Radio receives the signal and sends a Communications Acknowledgement	EVSE Radio receives the signal and sends a Communications Acknowledgement to the EMS	EVSE Radio	EMS	Communications Acknowledgement		
3.5 E.2		EVSE Radio	EVSE Radio sends data elements	EVSE Radio sends Data elements to trigger for Direct Load Control Event to the EVSE	EVSE Radio	EVSE	(7) Data elements to trigger for Direct Load Control Event		
3.5 E.3		EVSE	EVSE responds	EVSE responds accordingly	EVSE	EVSE	(7) Data elements to trigger for Direct Load Control Event		

| #	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.6		EMS (customer)	EMS (customer)collects and delivers Communication Acknowledgements	EMS (customer)collects and delivers Communication Acknowledgements to Internet Gateway	EMS (customer)	Internet Gateway	Communication Acknowledgements		
3.7		Internet Gateway	Internet Gateway delivers Communication Acknowledgements	Internet Gateway delivers Communication Acknowledgements to the DR Application via the Internet Gateway	Internet Gateway	DR Application	Communication Acknowledgements		
3.8		DR Application	DR Application displays updates	DR Application displays updates	DR Application	DR Application	System Updates		

2.3.3 Post-conditions and Significant Results

| *Actor/Activity*	*Post-conditions Description and Results*
Distribution Operations	Load control event successfully implemented
Supplier of Demand Response Application	It is delivered as expected

2.4 Architectural Issues in Interactions

Elaborate on all architectural issues in each of the steps outlined in each of the sequences above. Reference the Step by number.
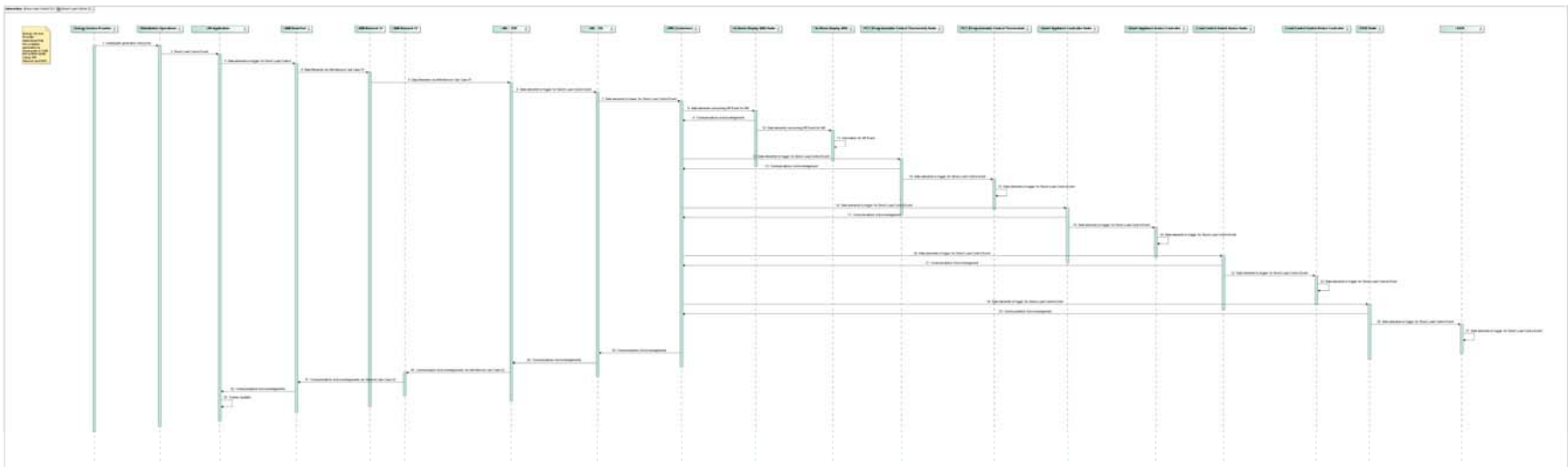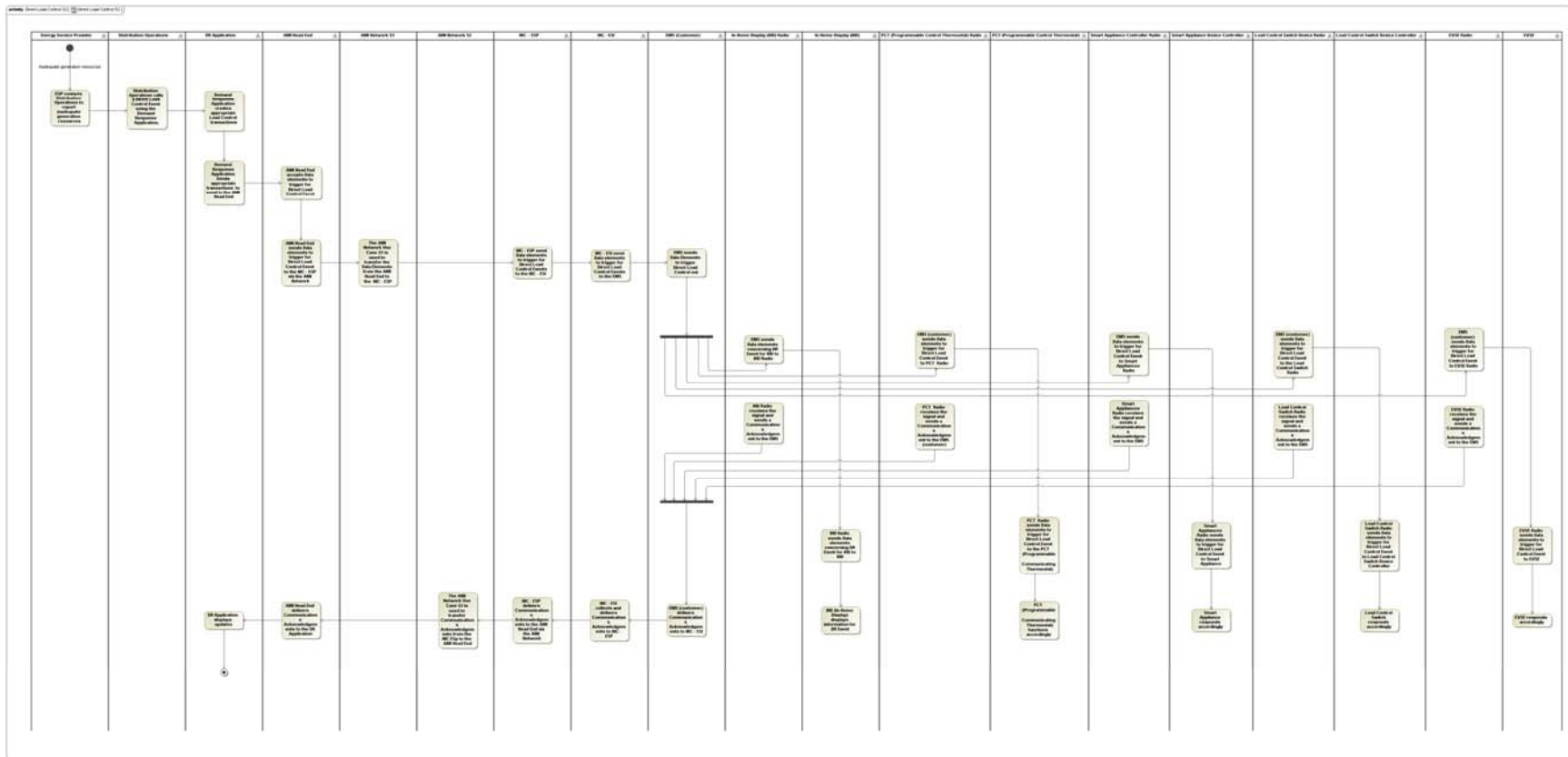
2.5 Diagrams
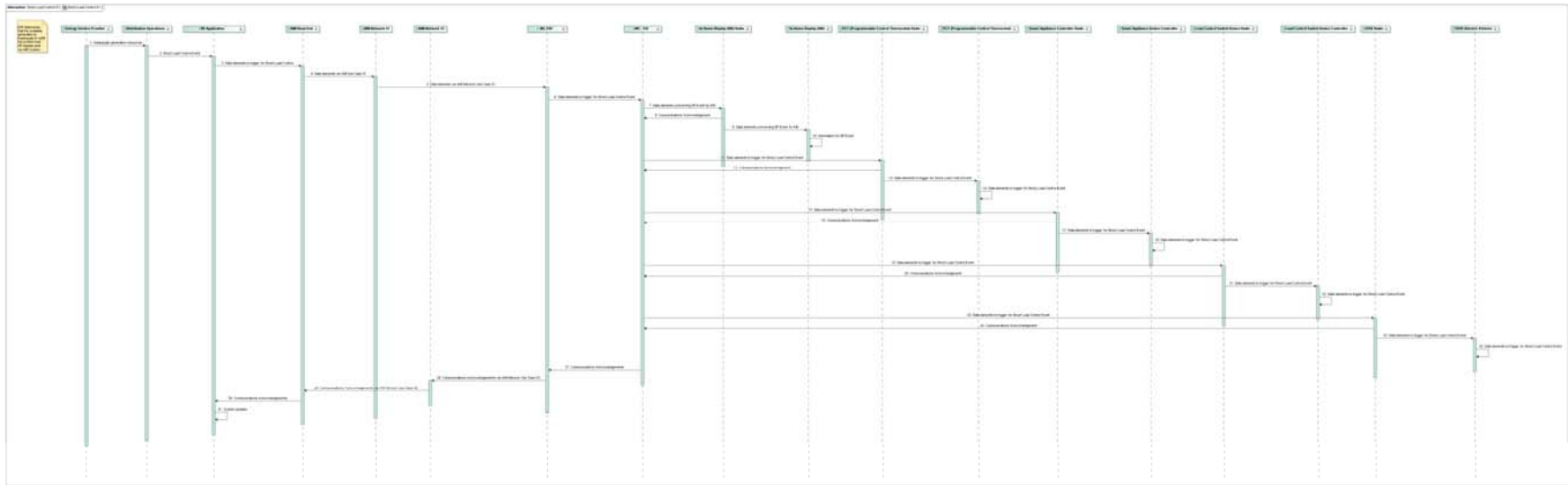
Direct Load Control Scenario 1 Sequence Diagram
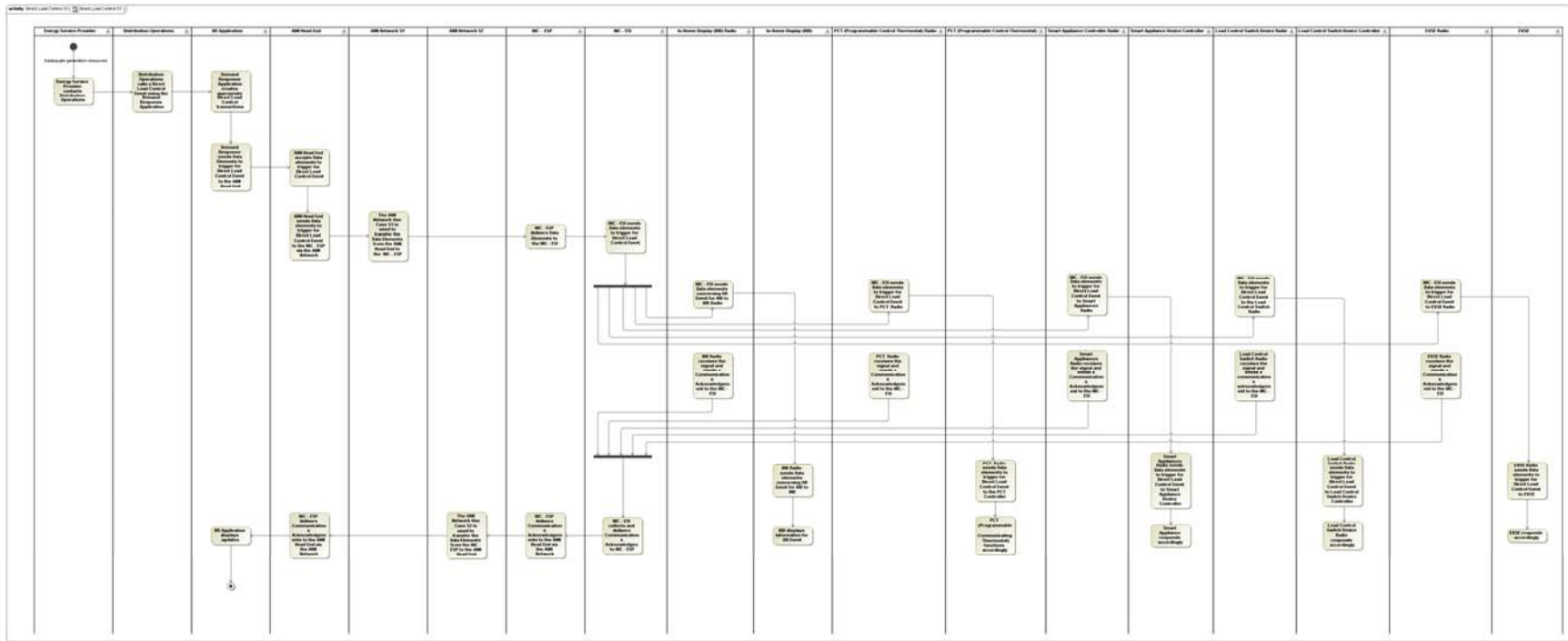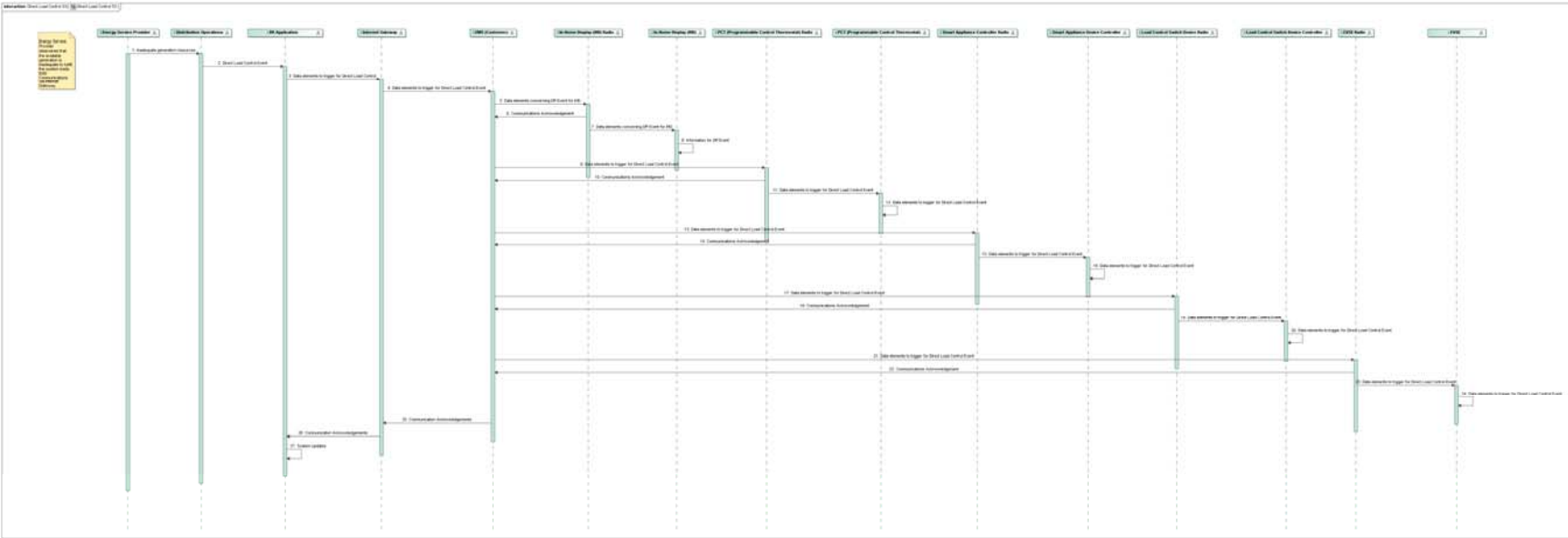
Direct Load Control Scenario 1 Activity Diagram
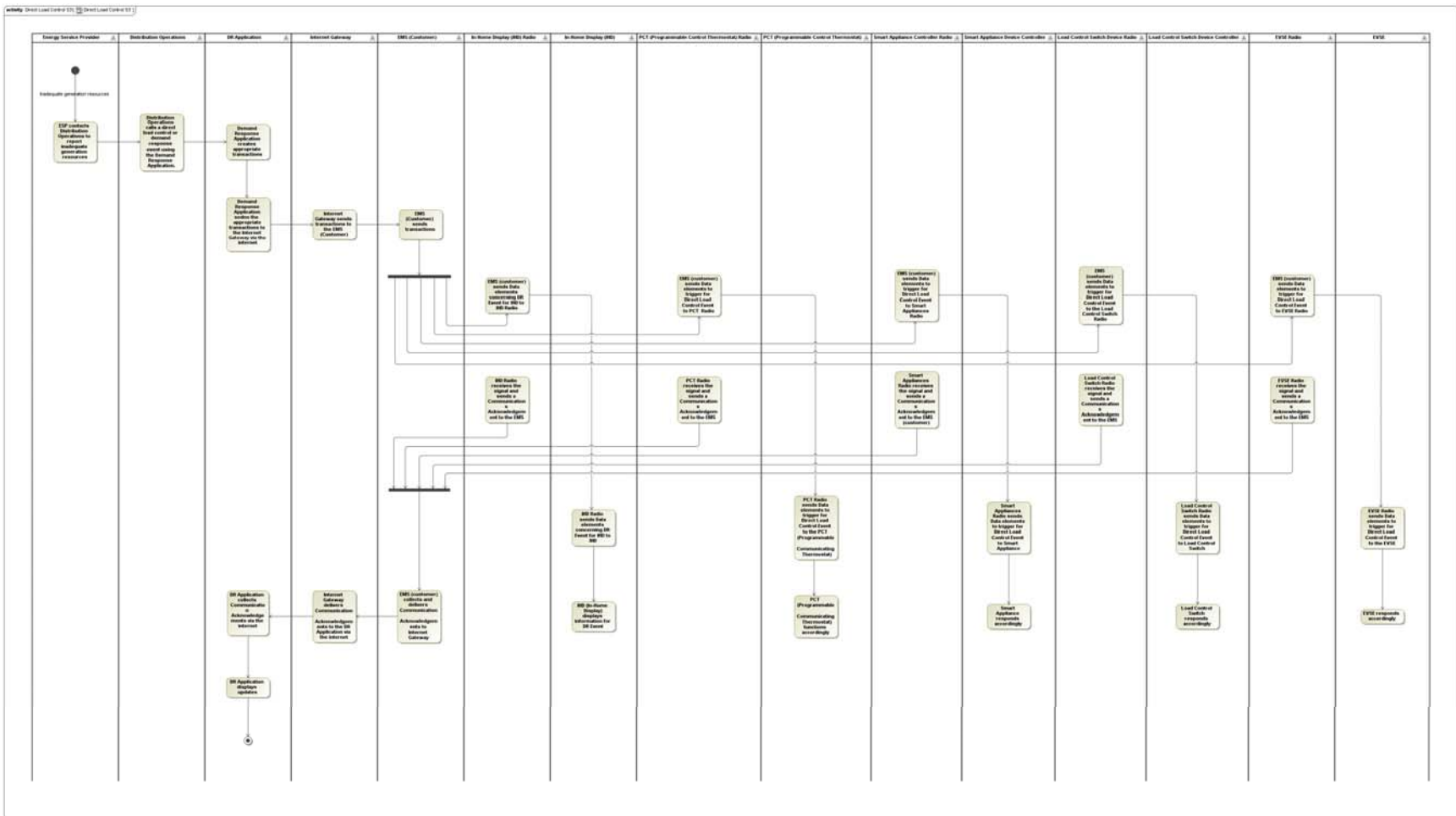
Direct Load Control Scenario 2 Sequence Diagram

Direct load Control Scenario 2 Activity Diagram

Direct Load Control Scenario 3 Sequence Diagram

Direct Load Control Scenario 3 Activity Diagram

3 Auxiliary Issues

3.1 References and contacts

Documents and individuals or organizations used as background to the function described; other functions referenced by this function, or acting as "sub" functions; 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
[1]		

3.2 Action Item List

ID	Description	Status
[1]		

3.3 Revision History

No	Date	Author	Description
1.1	3/22/2010	Brian D. Green	Initial Use Case
1.2	3/24/2010	J.R. Cote	Actor Name Review
1.3	3/30/2010	Brian D. Green	Clean up Diagrams
2.0	4/11/2020	John J. Simmins	Fill in some blanks
3.0	5/6/2010	Brian D. Green	Minor Changes and add activity diagrams