SmartConnect Use Case:

E2 - Utility Procures Energy and Settles Wholesale Transactions Using Data from the SmartConnect System

January 13, 2009

Document History

Revision History

Revision Number	Revision Date	Revision / Reviewed By	Summary of Changes	Changes marked
(#)	(yymmdd)	(Name)	(Describe change)	(N)
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1.1	060310	Prafs Diwate	Updated the document according to E2W2 session notes	
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1.3	060411	G. Gilchrist	Architectural review	
1.4	060425	G. Gilchrist	Further edits based on discussion with Kevin Wood 060421	
1.5	060425	G. Gilchrist	Removed many of the comments	
1.6	060426	M Davis	Accepted changes and modified hyper by allowing for 2 minute data and removed super hyper data term and requirement.	
1.7	060502	M.C. Janssen	Removed comments and accepted tracked changes. Integrated all comments received during personal discussion with Muir Davis on April 27 and 28	
1.8	060505	G. Gilchrist	Minor touch-ups of text	
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Approvals

This document requires following approvals.

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Contents

1. Use Case Description

1.1 Use Case Title

Utility Procures Energy and Settles Wholesale Transactions Using Data from the SmartConnect System

1.2 Use Case Summary

Market Operations evaluates and prepares bids and then offers resources to the wholesale electricity market. They also prepare system demand bids for projected loads. To facilitate this process, Market Operations needs to know what supply resources such as traditional resources (hydro, fossil fuel, nuclear), distributed generation, or demand response, are available, for how long, and where they are physically located.

In a system without SmartConnect metering to provide interval data for all customers, resource information must be estimated from the historical load profiles averaged from a small set of selected meters. The meters used to build the load profiles may or may not be the same meters involved in the wholesale market transaction.

Using the SmartConnect system, Market Operations is able to access the actual aggregate load measured by a particular subset of the utility's meters to target only those of interest. For instance, a particular subset of meters may represent a single customer offering to supply distributed generation (DG) over a particular time period for a contracted price, a grouping of agriculture water pumps, a collection of PHEV energy storage units, or a number of customers offering an aggregated resource through a third-party aggregator to reduce their load.

Using the SmartConnect system Market Operations is able to make better decisions about what supply resources to bid because SmartConnect measurements are:

- Made from a meter sample that more closely resembles that portion of the resource or load subject to the wholesale transaction
- Taken very near to the time the transaction is to take place

Some time after a wholesale transaction is complete, Market Operations settles the transaction using actual usage data gathered by the SmartConnect system, which is aggregated for all meters included as a part of the transaction during the period specified in the transaction. Data from the SmartConnect system is then used to prepare bills and invoices to the multiple parties involved in the wholesale transaction based on existing contracts and tariffs.

1.3 Use Case Detailed Narrative

This use case can be applicable to the economic dispatch for a variety of different electricity markets, including the supply of energy and capacity resources into the hour-ahead and day-ahead markets, and ancillary services for the real-time markets. The ancillary services market is

considered the most challenging market due to the real-time reporting requirements. The use of demand response (DR) resources in a utility's economic dispatch scheme is discussed in Use Case E1.

This use case discusses three scenarios: one describes the events around the time Market Operations evaluates the bids and completes a transaction, and the other two describe how SmartConnect data is used to settle transactions either five days (T+5) or up to 45 days (T+45) after the transaction period.

The Meter Data Management System (MDMS) that is part of SmartConnect provides services to Market Operation's resource forecasting team. Resource Forecasting can request that MDMS compile a list of resources or customers to form a Custom Aggregation Group (CAG). MDMS can set meters in a specific CAG to record usage data at a higher rate than normal. Resource Forecasting uses this specially sampled data to develop forecasting models and pricing curves, which it uses to prepare and evaluate bids for the wholesale market.

MDMS responds to requests from Resource Forecasting by remotely re-programming individual meters to record at the higher special rates. Approximately one percent of the utility's meters are polled at intervals smaller than one hour in order to generate predictive load profiles based on common customer characteristics such as geography or climate. It is preferred to have 100 percent of the utility's meters sampled at these special rates for greater visibility of resources and improved forecasting, however this tends to be impractical. This special rate data can be retrieved in time to be used in market forecasts the next day.

In addition to generating general next-day profiles, Resource Forecasting also uses SmartConnect meter data gathered the same day wholesale transactions are completed. Resource Forecasting has MDMS sample this data at *hyper intervals* as small as every four seconds, from a much smaller subset of meters used for statistical sampling. MDMS returns the aggregated load information within a few minutes. The Energy Trader and Real-Time Trader are members of Market Operations who use forecasts generated from both the *hyper* and *special* samples to evaluate bids in real-time and complete the transactions.

Some time after a wholesale transaction is complete information gathered from the SmartConnect system and elsewhere is used in the settlement process to prepare bills and invoices for multiple parties based on contracts and tariffs. The data used for this settlement process is the actual data from the group of meters specified for the wholesale transaction. It is expected that forecasting and settlement can be executed at the wholesale level using CAG meter data, which represents aggregated sets of meters for a resource allocated to a Load Aggregation Point (LAP). The CAG can be a collection of common customers that all participate in a particular utility program (i.e. Critical Peak Pricing (CPP) tariff, Real-Time Pricing (RTP) tariff, Peak Time Rebate (PTR) tariff, AC cycling DR, renewable energy resources, building back-up generator, PHEV battery storage).

The benefits of using interval-based SmartConnect data sampled at a higher than normal rate to perform real-time resource forecasting for the purpose of procuring energy and settling wholesale transactions are:

1. It produces higher accuracy for forecasts reducing the risk and associated cost of forecasting error. These costs are part of the overall cost of service passed along to customers. The actual cost of forecast errors is presently unknown.

2. If the real-time position at the time of the transaction can be more accurately determined, there is the potential that the amount of energy unknowingly sold into the ex-post market can be reduced, resulting in annual saving in the millions of dollars.

3. It resolves marketability issues associated with load forecasting error and real-time markets. These ex-post markets issues expose the utility to liquidity risks. There are cost risks associated with buying and selling into the real-time market because price is unknown and it is a small market. Due to the volume of energy transacted in the ex-post market, the purchase or sale is more costly than the hour-ahead or day-ahead market where there is more control over what is being bought and sold.

Capturing high-rate interval data will significantly increase the quality of meter data reported to the independent system operator (ISO) and provide a more accurate estimate of the actual cost of the energy. Settlement accuracy will improve based on 100 percent of customer (small and large) resource meter data being utilized. Presently, misreporting occurs due to the inaccuracy of the resource profiles. The economic impact to the utility customers could be positive or negative.

An additional benefit to using interval-based SmartConnect to report this type of data is it makes it possible to decrease the time needed to provide accurate data for settlement, reducing associated labor costs.

1.4 Business Rules and Assumptions

- All meters are converted to SmartConnect metering and/or are able to provide interval-based usage data at interval sizes appropriate for accurate forecasting and settlement with the ISO.
- Large customers with a load greater than 200 kW provide 15-minute interval data.
- Large real-time energy meter (RTEM) customers with a load greater than 200kW support 5-minute interval reads.
- Aggregation of ancillary services bids and offers is out of scope of this use case.

2. Actors

Describe the primary and secondary actors involved in the use case. This might include all the people (their job), systems, databases, organizations, and devices involved in or affected by the Function (e.g. operators, system administrators, customer, end users, service personnel, executives, meter, real-time database, ISO, power system). Actors listed for this use case should be copied from the global actors list to ensure consistency across all use cases.

Actor Name	Actor Type (person, device, system etc.)	Actor Description
Market Operations	Organization	A generic term for those actors within the normal process flow of data for energy sales and marketing (ES&M). The actors include the resource forecasting group, the planning group, the day-ahead traders, the schedulers, and real time operations.
Power Procurement System	System	Maintains the system resource stack of available supply and demand resources and their price parameters. Energy traders use the PPS to select resources for bids to the ISO. The stack of resources, generally considered supply resources, listed from cheapest to most expensive allows traders to balance supply with forecasted system load. In this use case, the amount of demand response available for any given market window is considered a resource in the stack.
Resource Forecasting	Organization	Portion of the Market Operations organization responsible for predicting what the system demand will be in a given market window and the available supply resources.
Energy Trader	Person	Purchases and sells electricity in the day-ahead market. The day-ahead market typically closes sufficiently before the scheduling deadline (9 to 12 hours before midnight), allowing the ISO the time to review matched schedules (trades between market participants).
Real Time Trader (RTT)	Person	Purchases and sells electricity in the day-of market. Responsible for submitting requests for resources not committed in the day-ahead market. The day-of market typically deals with time frames from 5 minutes to 5 hours. Resources can include energy, capacity and ancillary services.
Energy Scheduler	Person	Prepares the system demand bids from forecasts and submits these to the ISO.
Power Procurement Finance	Organization	The group inside Market Operations responsible for acquiring energy data related to resources accepted and delivered by an ISO. May require daily kWh and kVARh readings and calculated kW and kVAR from Meter Data Warehouse. Provides accurate invoices to ISO and other market participants.

Actor Name	*Actor Type (person, device, system etc.)*	*Actor Description*
Independent System Operator (ISO)	Agency	Also referred to as a Regional Transmission Organization. Responsible for the economic and reliable operation of the transmission grid. Creates a functioning market for energy, capacity, and ancillary services in compliance with federal and state rules and regulations. Operates the regional grid independent from suppliers and load aggregators. Performs much like a "traffic cop" charged with balancing electricity and flow on the grid.
Meter Data Management system (MDMS)	System	Gathers, validates, estimates, and permits editing of meter data such as energy usage, generation and meter logs. Stores this data for a limited amount of time before it goes to the Meter Data Warehouse and makes the data available to authorized systems.
Meter Data Warehouse (MDW)	System	Responsible for long-term storage of meter data including energy usage, demand, generation, events, logs, and other time-related information measured by the meter or calculated from that data. Does not contain information on the configuration, management, diagnostics, and maintenance of the meters themselves. Includes certain software applications responsible for filtering, analyzing, and reporting meter data.
SmartConnect Meter	Device	Advanced electric revenue meter capable of two-way communications with the utility. Serves as a gateway between the utility, customer site, and customer's load controllers. Measures, records, displays, and transmits data such as energy usage, generation, text messages, and event logs to authorized systems (i.e., the SmartConnect NMS) and provides other advanced utility functions.

3. Step-by-Step Analysis of Each Scenario

Describe steps that implement the scenario. The first scenario should be classified as either a primary scenario or an alternate scenario by starting the title of the scenario with either the word "Primary" or "Alternate". A scenario that successfully completes without exception or relying heavily on steps from another scenario should be classified as Primary; all other scenarios should be classified as Alternate. If there is more than one scenario (set of steps) that is relevant, make a copy of the following section (all of 3.1, including 3.1.1 and tables) and fill out the additional scenarios.

3.1 Primary Scenario: Energy Scheduler procures energy from wholesale market based on information from the SmartConnect system.

This scenario describes how the Energy Scheduler uses customer usage data from the SmartConnect system to determine whether to purchase energy. It can help an Energy Scheduler anticipate customer response to time-of-use tariffs (CPP, RTP, etc.) that can be imposed to lower individual customer demand, localized demand, or overall system demand.

Resource Forecasting selects the customer or customer aggregation group (CAG) that makes up a demand resource before providing a bidding requirement to ISO. Resource Forecasting sends the request to the Meter Data Warehouse (MDW) for a customer or CAG's long-term historical energy usage. A day or more prior to the wholesale transaction, Resource Forecasting uses the MDMS to commence sampling data from the customer/CAG at a special sub-hourly rate. MDMS then begins sending commands to the appropriate meters to sample at the special recording interval rate and the SmartConnect Meters transmit the usage data back to the MDMS. The MDMS forwards this special interval energy usage data to the MDW for storage. MDW forwards the customer or CAG special meter interval data to Resource Forecasting. Resource Forecasting develops load estimates based on the special interval rate data and historical patterns.

In addition, Resource Forecasting conveys to MDMS that is should begin sampling data from a particular subset of customers at a hyper rate, sufficient enough to perform real-time resource forecasting. MDMS commands the appropriate meters to begin sampling at this hyper rate. SmartConnect Meters begin sending kW, kWH, kVAR, kVARh data to Resource Forecasting at the hyper rate.

Demand resource forecasts, requirements and bid curves are developed by Resource Forecasting based, in part, on this special interval energy usage data. These forecasts are in turn used by Energy Scheduler to make decisions regarding the procurement of wholesale energy at an identified custom LAP when submitting demand resource requirement bids to the ISO.

Triggering Event	Primary Actor	Pre-Condition	Post-Condition
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
A market window is approaching	Energy Scheduler	SmartConnect system has been gathering usage data at normal recording intervals (e.g. hourly data); pulling raw interval data from the SmartConnect meters.	The Energy Scheduler has made a decision to bid demand resource requirement to ISO.

3.1.1 Steps for this scenario

Describe the normal sequence of events required to complete the scenario.

Step #	Actor	Description of the Step	Additional Notes
#	*What actor, either primary or secondary is responsible for the activity in this step?*	*Describe the actions that take place in this step. The step should be described in active, present tense.*	*Elaborate on any additional description or step values to help support the descriptions. Short notes on architecture challenges, etc. may also be noted in this column.*
1	Resource Forecasting	Selects CAG that make up demand resource before bidding requirement into ISO.	
2	Resource Forecasting	Sends request to MDW for CAG historical energy usage.	
3	MDW	Provides CAG historical energy usage including special and hyper sampling rate data to Resource Forecasting.	
4	Resource Forecasting	The day before evaluation of demand resource bid sends request to MDMS including CAG list to start sampling at special and hyper sampling interval recording rate.	
5	MDMS	Sends to CAG list SmartConnect Meters request to start sampling at special and hyper interval recording rate and new reporting requirement.	

Step #	Actor	Description of the Step	Additional Notes
6	SmartConnect Meter	Provides MDMS energy usage data for requested special and hyper interval sampling recording rate at new reporting rate.	
7	MDMS	Provides CAG special and hyper interval energy usage data to MDW and to Resource Forecasting.	
8	Resource Forecasting	Uses historical and special and hyper interval energy usage to generate load profiles, bid demand curve, and demand forecasts for the CAG under consideration. Provides demand resource requirement and demand bid curve to Energy Scheduler.	
9	Energy Scheduler	Determines appropriate demand resource requirement and demand price curve and bids to ISO.	
10	ISO	Accepts and confirms demand resource requirement and price curve from Energy Scheduler.	For awarded bid, repeat steps 4 – 7 to capture real-time data for real-time resource forecasting. May require alternative broadband delivery mechanism by-passing SmartConnect System.

3.2 Primary Scenario: Energy Trader supplies energy to wholesale market based on information from the SmartConnect system.

This scenario describes how the Energy Trader or Real-Time Trader uses customer usage data from the SmartConnect system to determine whether to supply energy. This scenario may be used by the Energy Trader or Real-Time Trader to determine the response by traditional supply resource or demand response resource to programs and tariffs (e.g. PTR, AC cycling, Flex-Alert, etc.) resulting in increased energy supply to an individual customer, localized area or the overall system.

Resource Forecasting selects supply resource or CAG before bidding supply resource requirement information to the ISO. Resource Forecasting sends request to MDW for long-term supply resource or CAG historical energy generation/usage. A day or more prior to the wholesale transaction, Resource Forecasting tells MDMS to begin sampling data from a supply resource or CAG at a special sub-hourly rate. MDMS commands the appropriate meters to begin sampling at the special recording interval rate and the SmartConnect Meters begin sending energy generation/usage data to MDMS at the special reporting rate. MDMS forwards special interval energy generation/usage data to the Meter Data Warehouse for storage. MDW forwards the supply resource or CAG special meter interval data to Resource Forecasting. Resource Forecasting develops supply estimates based on the special interval rate data and historical patterns.

Resource forecasting asks MDMS to begin sampling data from a particular subset of customers at a hyper rate sufficient to perform real-time resource forecasting. MDMS sends commands to the appropriate meters to begin sampling at the hyper rate. SmartConnect Meters begin sending kW, kWH, kVAR, kVARh data to Resource Forecasting at the hyper rate.

Supply resource forecasts and bid curves are produced by Resource Forecasting based, in part, on this special interval energy generation/usage data. These forecasts are in turn used by the Energy Trader or Real-Time Trader to make decisions regarding the supply of wholesale energy at an identified LAP when submitting supply resource bids to the ISO.

Triggering Event	***Primary Actor***	***Pre-Condition***	***Post-Condition***
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
A market window is approaching.	Energy Trader or Real-Time Trader	SmartConnect system has been gathering usage data at normal recording intervals (e.g. hourly data); pulling raw interval data from the SmartConnect meters.	The Energy Trader or Real-Time Trader decides to sell energy.

3.2.1 Steps for this scenario

Describe the normal sequence of events required to complete the scenario.

Step #	***Actor***	***Description of the Step***	***Additional Notes***
#	*What actor, either primary or secondary is responsible for the activity in this step?*	*Describe the actions that take place in this step. The step should be described in active, present tense.*	*Elaborate on any additional description or step value to help support the descriptions. Short notes on architecture challenges, etc. may also be noted in this column.*
1	Resource Forecasting	Selects customer or CAG that make up the supply resource before sending bidding requirement to the ISO.	

Step #	Actor	Description of the Step	Additional Notes
2	Resource Forecasting	Sends request to MDW for supply resource or CAG historical energy generation/usage.	
3	MDW	Provides supply resource or CAG historical energy generation/usage including special and hyper sampling rate data to Resource Forecasting.	
4	Resource Forecasting	The day before evaluation of supply resource bid, sends request to MDMS including supply resource or CAG list to start sampling at special and hyper sampling interval recording rate.	
5	MDMS	Sends to supply resource or CAG list SmartConnect Meters request to start sampling at special and hyper interval recording rate and new reporting requirement.	
6	SmartConnect Meter	SmartConnect Meter provides MDMS generation/energy usage data for requested special and hyper interval sampling recording rate at new reporting rate.	
7	MDMS	Provides customer or CAG special and hyper interval energy generation/usage data to MDW and to Resource Forecasting.	
8	Resource Forecasting	Uses historical and special and hyper interval energy usage to generate load profiles, bid supply curves, and supply forecasts for the customer or CAG under consideration. Provides demand resource requirement and supply bid curve to Energy Trader or Real-Time Trader.	
9	Energy Trader or Real-Time Trader	Determines appropriate supply resource and supply price curve and bids to ISO.	
10	ISO	Accepts and confirms supply resource and price curve from Energy Trader or Real Time-Trader.	For awarded bid, repeat steps 4 – 7 to capture real-time data for real-time resource forecasting. May require alternative broadband delivery mechanism by-passing SmartConnect System.

3.3 Primary Scenario: Power Procurement Finance settles wholesale invoices - T+5 (Payment acceleration)

This scenario describes how SmartConnect data is used to make it possible to invoice wholesale energy transactions within five days of the completed transaction.

Triggering Event	*Primary Actor*	*Pre-Condition*	*Post-Condition*
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete scenario*
Wholesale transaction completed.	MDW	Scenario 1 completed with the required subset of meters still gathering data at the necessary rate.	Meter data is issued to the participant in the wholesale transaction within five days.

3.3.1 Steps for this scenario

Describe the normal sequence of events required to complete the scenario.

Step #	*Actor*	*Description of the Step*	*Additional Notes*
#	*What actor, either primary or secondary is responsible for the activity in this step?*	*Describe the actions that take place in this step. The step should be described in active, present tense.*	*Elaborate on any additional description or step value to help support the descriptions. Short notes on architecture challenges, etc. may also be noted in this column.*
1	MDMS	Gathers meter data (kWh + Meter I.D.) from individual customer meters and conducts daily validation/editing/estimation (VEE) processes as required.	
2	MDMS	Provides information on the missing reads (rate group, voltage level) prior to T+4.	Some data may be missing due to network or equipment problems.
3	MDMS	On a periodic basis provides meter data and updates to the MDW.	

Step #	Actor	Description of the Step	Additional Notes
4	MDW	Aggregates the meter data across all the customers specified in the wholesale transaction (differentiated/grouped by CAG), over the time interval of the transaction.	
5	MDW	Provides aggregated interval-based usage data, differentiated by CAG as needed, to Power Procurement Finance on T+1, 2, 3, 4 within increased accuracy.	Increased accuracy results from the retrieval of missing meter data in days following T+1.
6	Power Procurement Finance	Power Procurement Finance generates meter data settlement documents (preliminary data) and submits to the ISO and third parties.	

3.4 Primary Scenario: Power Procurement Finance settles wholesale invoices – T+45 (Revenue quality meter data)

This scenario describes how SmartConnect data is used to make it possible to invoice wholesale energy transactions as part of the normal billing cycle within 45 days of the completion of the transaction.

Triggering Event	*Primary Actor*	*Pre-Condition*	*Post-Condition*
Identify the name of the event that initiate the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to completes the scenario*
Wholesale transaction completed.	MDW	Scenario 1 was completed with the required subset of meters still gathering data at the necessary rate.	Settlement Quality Meter Data (SQMD) is issued to the participant in the wholesale transaction within 45 days.

3.4.1 Steps for this scenario

Describe the normal sequence of events required to complete the scenario.

Step #	*Actor*	*Description of the Step*	*Additional Notes*
#	*What actor, either primary or secondary is responsible for the activity in this step?*	*Describe the actions that take place in this step. The step should be described in active, present tense.*	*Elaborate on any additional description or step value to help support the descriptions. Short notes on architecture challenges, etc. may also be noted in this column.*
1	MDMS	Gathers meter data (kWh + Meter I.D.) from individual customer meters and conducts daily VEE processes as required.	Same procedure as described in Use Case B1. This step may result in additional accuracy improvement resulting from retrieval of missing reads that were still not available at T+5.

Step #	Actor	Description of the Step	Additional Notes
2	MDMS	Completes billing cycle VEE at end of billing cycle. Result is billing quality usage data.	
3	MDMS	Provides billing quality meter data to MDW at the end of a billing cycle.	
4	Meter Data Warehouse	Aggregates meter data across all the customers specified in the wholesale transaction (differentiated/grouped by CAG), over the time interval of the transaction	
5	Meter Data Warehouse	Provides aggregated interval-based usage data, differentiated by CAG as needed, to Power Procurement Finance	
6	Power Procurement Finance	Generates SQMD documents to ISO.	

4. Requirements

Detail the Functional, Non-Functional and Business Requirements generated from the workshop in the tables below. If applicable list the associated use case scenario and step.

4.1 Functional Requirements

Functional Requirements	*Associated Scenario # (if applicable)*	*Associated Step # (if applicable)*
Resource Forecasting shall be capable of selecting the CAG that make up demand or supply resource before bidding to ISO.	1 2	1 1
Resource Forecasting shall be capable of sending request to MDW for CAG historical energy usage.	1	2
Resource Forecasting shall be capable of sending request to MDW for CAG historical energy generation/usage.	2	2
MDW shall be capable of providing CAG historical energy usage including special and hyper sampling rate data to Resource Forecasting. In addition to the aggregate data, MDW shall also be capable of supplying detailed individual energy usage data for analysis.	1 2	3 3
Resource Forecasting, the day before evaluation of resource bid shall be capable of sending request to MDMS that a CAG list of SmartConnect Meters start sampling at special and hyper sampling interval recording rate.	1 2	4 4
MDMS shall be capable of sending to a CAG list of SmartConnect Meters a request to start sampling at special and hyper interval recording rate and new reporting requirement.	1 2	5 5
SmartConnect Meter shall be capable of providing MDMS energy usage data for requested special and hyper interval sampling recording rate at new reporting rate.	1 2	6 6
MDMS shall be capable of providing CAG list of SmartConnect Meters special and hyper interval energy usage data to MDW and Resource Forecasting.	1 2	7 7
Resource Forecasting shall be capable of using historical and special and hyper interval energy usage to generate load profiles, bid demand curve, and demand forecasts for the CAG under consideration. Shall provide demand resource requirement bid and demand bid curve to Energy Scheduler.	1	8

Functional Requirements	*Associated Scenario # (if applicable)*	*Associated Step # (if applicable)*
Resource Forecasting shall be capable of using historical and special and hyper interval energy usage to generate load profiles, bid supply curve, and supply forecasts for the customer or CAG under consideration. Resource Forecasting provides demand resource requirement and supply bid curve to Energy Trader or Real-Time Trader.	2	8
Energy Scheduler shall be capable of determining appropriate demand resource requirement and demand price curve and bid to ISO.	1	9
Energy Trader or Real-Time Trader shall determine the appropriate supply resource and supply price curve and bid to ISO.	2	9
ISO shall be capable of accepting and confirming demand resource requirement and price curve from Energy Scheduler.	1	10
ISO shall accept and confirm supply resource and price curve from Energy or Real-Time Trader.	2	10
Meter shall provide the reading for kW, kWh, kVAR, kVARh. The information shall be provided for each interval. The average values for kW and kVAR shall be monitored during the interval	1 2 3 4	3,6 3,6 1 1
Programmable interval shall be flexible to support market requirements. (1 second, 5 minute, 15 minute, 60 minute). The intervals shall be configured depending on its use.	1 2	3,6 3,6
MDW shall provide indication of missing data for T+5 data. T is the trade date related to energy delivered for today, T+5 shall be 5 days from the trade date.	3	2
MDW shall generate a T+1 daily and will retain that data for 5 days.	3 4	1 1
The meter shall be capable of being configured for sampling consumption data at a rate (hyper-interval) sufficient to support Resource Forecasting's effort to generate accurate forecasts. The regular billing cycle shall continue.	1 2	3,6 3,6
Resource Forecasting shall be capable of selecting which meters shall sample consumption data at hyper intervals.	1 2	4 4
MDMS shall request re-programming of meters selected for hyper sampling rate.	1 2	5 5
MDW shall provide statistical information about a given CAG such as: number of customers, percentage of total customers, size/percentage of load, etc.	3 4	4 4
MDW shall provide analytical support tools for the settlement analyst in order to drill down to a particular account level.	3 4	1,2,3 1,2,3

Functional Requirements	*Associated Scenario # (if applicable)*	*Associated Step # (if applicable)*
Settlement analyst shall have access to viewing data in the MDW.	3,4	1,2,3
ISO settlements shall have the same access to data as the Power Procurement Finance.	3,4	5,5
Power Procurement Finance shall be capable of generating meter data settlement documents (preliminary data) and submits them to the ISO and third parties.	3	6
Power Procurement Finance shall be capable of generating SQMD documents to the ISO.	4	6
Aggregated revenue quality data shall be provided to the ISO. Presently, required intervals are hourly; future requirements may be reduced to 5 minute intervals. The MDW is the source of aggregated revenue quality data. The MDW shall store the detail data and be capable of reporting aggregated information.	3 4	5,6 5,6

4.2 Non-Functional Requirements

Non-Functional Requirements	*Associated Scenario # (if applicable)*	*Associated Step # (if applicable)*
Interval data of 4 seconds to 60 minutes shall be programmable and delivered 8 times a day.	1 2	3,6 3,6
Aggregation interval shall be ≤ 1 hour. The MDW shall aggregate the intervals.	3 4	4,5 4,5
Data timestamps shall be provided by SmartConnect Meters and be accurate to 3 minutes or less.	3 4	1 1
The special (hyper) sampling rate for real-time load forecasting shall be every 4 seconds to 2 minutes	1 2	3,6 3,6
The number of meters expected to be configured for the special sampling rate for real-time load forecasting is around 60,000 meters based on random sampling and/or from pre-selected profile groups (e.g. climate zones, customer profiles, etc.). All meters shall have this capability.	1 2	3,6 3,6
Once configured for the special rate, the selected meters shall run in this mode for hours to months to forever.	1 2	3,6 3,6
The elapsed time from the time a meter is selected to be included in the special rate group until it is recording data at this rate shall be days or weeks	1 2	3,6 3,6
Once collected, the hyper rate data shall be retrieved within 3 hours of capture (8 times per day).	1 2	3,6 3,6
The special rate data shall not be considered useful if there is more than a 2 day delay (latency) in receiving the data.	1 2	3,6 3,6
A smaller subset of meters (< 10,000) shall be capable of spontaneously reporting in real-time (hyper data) the 4 second rate data within 2 minutes of capture.	1 2	3,6 3,6
The meter shall retain hyper sampling interval data for 4 hours.	1 2	3,6 3,6
MDW shall provide, at a minimum, two CAG groups: 1) DA Customers 2) Bundled Customers.	1,2	2
MDW shall provide aggregated interval data to the Resource Forecasting within 24 hours, by 5 a.m. and/or within 2 hours after the end of a resource delivery.	3 4	1 1

Non-Functional Requirements	*Associated Scenario # (if applicable)*	*Associated Step # (if applicable)*
MDW shall have an aggregation interval of 15 minutes or less on commercial accounts.	3 4	4 4
MDW shall build an *aggregation end* to target problems for the top 50, 100, or 500 accounts.	3 4	4 4

4.3 Summary of Data Requirements

Name of Data	Customer Group	Recording Interval	Gathered	Preferred Latency	Maximum Latency	Time Retained in Meter	Value
Special Rate Data	1-2% of customers, selected randomly, by geographic area, climate, or other common factor	1-15 minutes	Continuously, with daily reports to be used for the next days' forecasts	4 hours	2 days	(not defined yet)	For day-ahead or longer forecasts
Hyper Rate Data	Up to 0.2% of customers – a more specialized set selected by Resource Forecasting	4 seconds – 2 minutes	Continuously for up to 4 updates per hour of the day-ahead forecasts	less than 1 hour	24 hours	4 hours	For hour-ahead and longer forecasts. The 4 second data rolls up to 2 minute data and is then used as the basis for the hour-ahead forecasts that are made daily at predefined times

4.4 Business Requirements

Business Requirement	*Associated Scenario # (if applicable)*	*Associated Step # (if applicable)*

5. Use Case Models (optional)

This section is used by the architecture team to detail information exchange, actor interactions and sequence diagrams.

5.1 Information Exchange

For each scenario detail the information exchanged in each step.

Scenario #	Step #, Step Name	Information Producer	Information Receiver	Name of Information Exchanged
#	Name of the step for this scenario	What actors are primarily responsible for producing the information?	What actors are primarily responsible for receiving the information?	Describe the information being exchanged
1	2	Resource Forecasting	MDW	Request for CAG historical energy usage
2	2	Resource Forecasting	MDW	Request for CAG historical energy generation/usage
1 2	3 3	MDW	Resource Forecasting	CAG historical energy usage including special and hyper sampling rate data Aggregated customer usage estimate: • kWH • kVARh • AveragekKW • Average kVAR
1 2	4 4	Resource Forecasting	MDMS	Request that CAG list of SmartConnect Meters start sampling at special and hyper sampling interval recording rates
1 2	5 5	MDMS	SmartConnect Meter	Request to start sampling at special and hyper interval recording rates and new reporting requirement

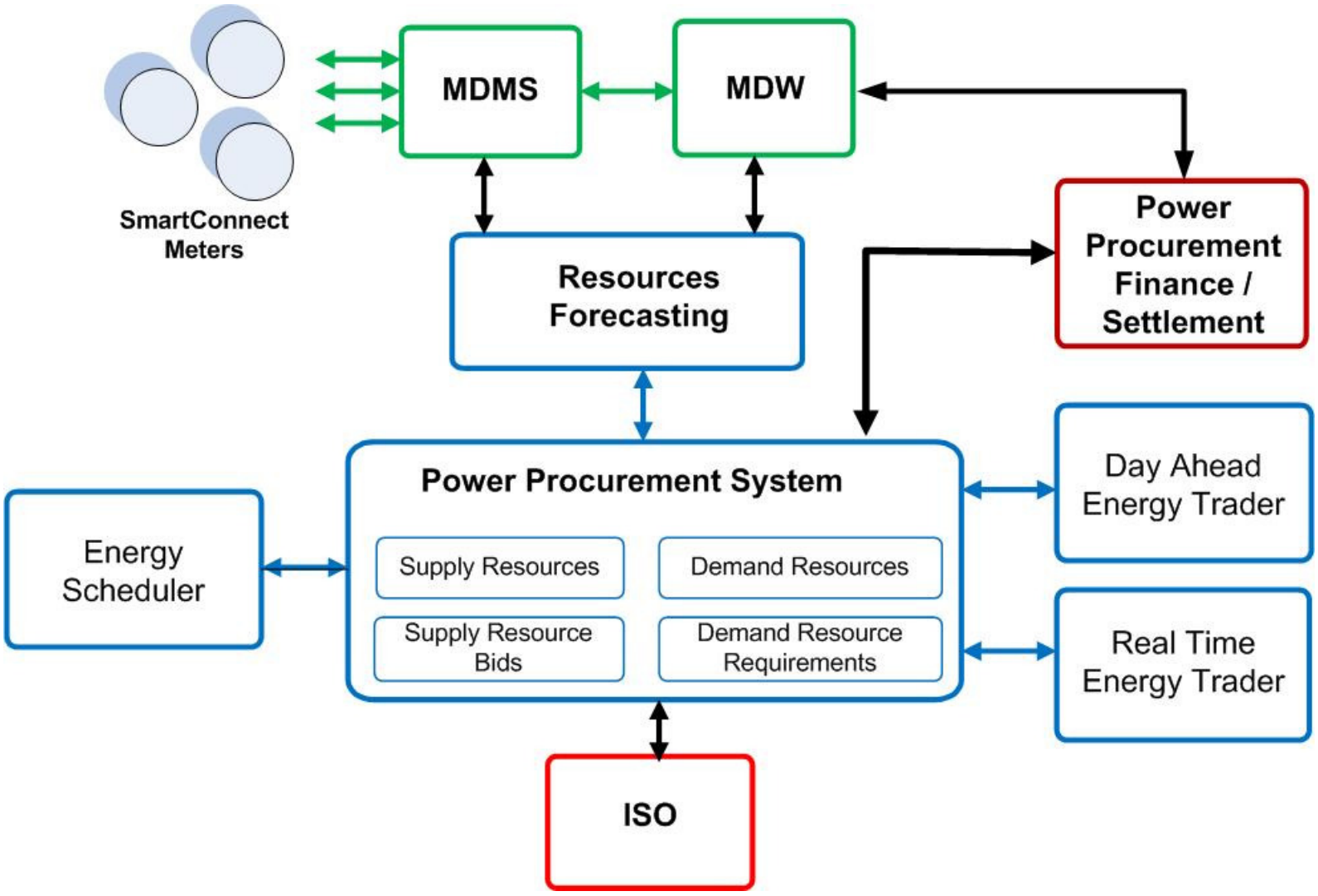
Scenario #	Step #, Step Name	Information Producer	Information Receiver	Name of Information Exchanged
1 2	6 6	SmartConnect Meter	MDMS	Energy usage data for requested special and hyper interval sampling recording rate at new reporting rate: • kWh • kVARh • Average kW • Average kVAR
1 2	7 7	MDMS	MDW and Resource Forecasting	Special interval energy usage data for CAG list of SmartConnect Meters • kWH • kVARh • Average kW • Average kVAR
1	8	Resource Forecasting	Energy Scheduler	Demand resource requirement bid and demand bid curve Forecast usage for given market window: • kWh • kVARh
2	8	Resource Forecasting	Energy Trader Real-Time Trader	Supply resource requirement and supply bid curve Forecast usage for given market window: • kWh • kVARh
1	9	Energy Scheduler	ISO	Demand resource requirement bid and demand price curve
2	9	Energy Trader Real Time Trader	ISO	Supply price curve and bid
1	10	ISO	Energy Scheduler	Confirmation of receipt of demand resource requirement bid
2	10	ISO	Energy Trader Real-Time Trader	Confirmation of supply resource bid

Scenario #	Step #, Step Name	Information Producer	Information Receiver	Name of Information Exchanged
1 2 3 4	3,6 3,6 1 1			Meter shall provide readings for kW, kWh, kVAR, kVARh. The information shall be provided for each interval. The average values for kW and kVAR shall be monitored during the interval
3	1	SmartConnect Meter	MDMS	Meter data (kWh and I.D.)
3	4	MDMS	Aggregation system	Meter data
3	4	MDMS	Aggregation system	Missing meter data information
3	5	Aggregation system	Power Procurement Finance	
3	6	Power Procurement Finance	Wholesale Transaction Party	Invoice
4	3	SmartConnect Meter	MDMS	Meter data (kWh and I.D.)
4	3	MDMS	~~VEE~~ MDW	Meter data warehouse within MDMS
4	4	MDW	Aggregation system	Meter data
4	4	MDMS	Aggregation system	Missing meter data information
4	5	Aggregation system	Power Procurement Finance	
4	6	Power Procurement Finance	Wholesale Transaction Party	Invoice

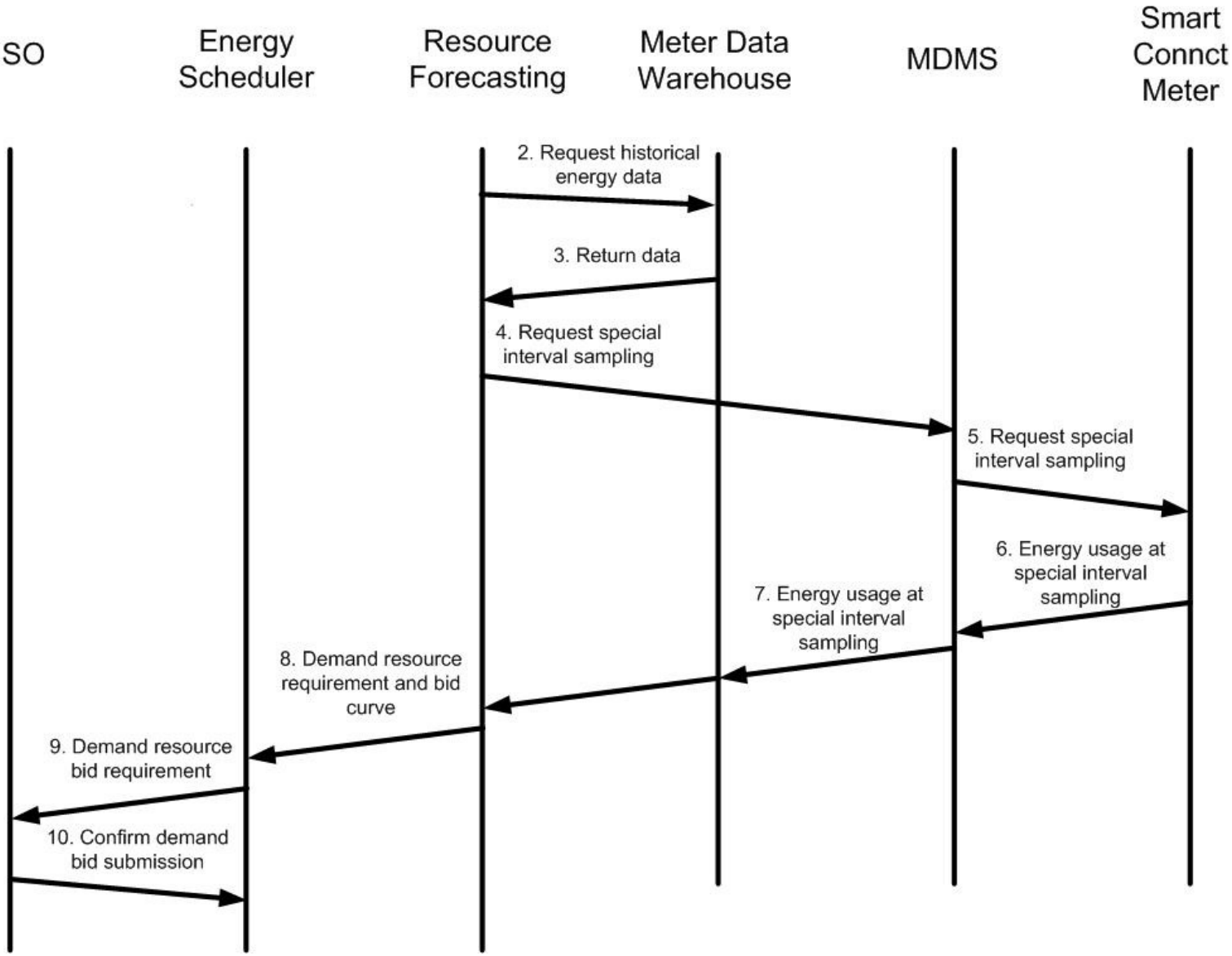
5.2 Diagrams

The architecture team will use this section to develop an interaction diagram that graphically describes the step-by-step actor-system interactions for all scenarios. The diagrams are to use standard UML notation. Additionally, sequence diagrams may be developed to help describe complex event flows.

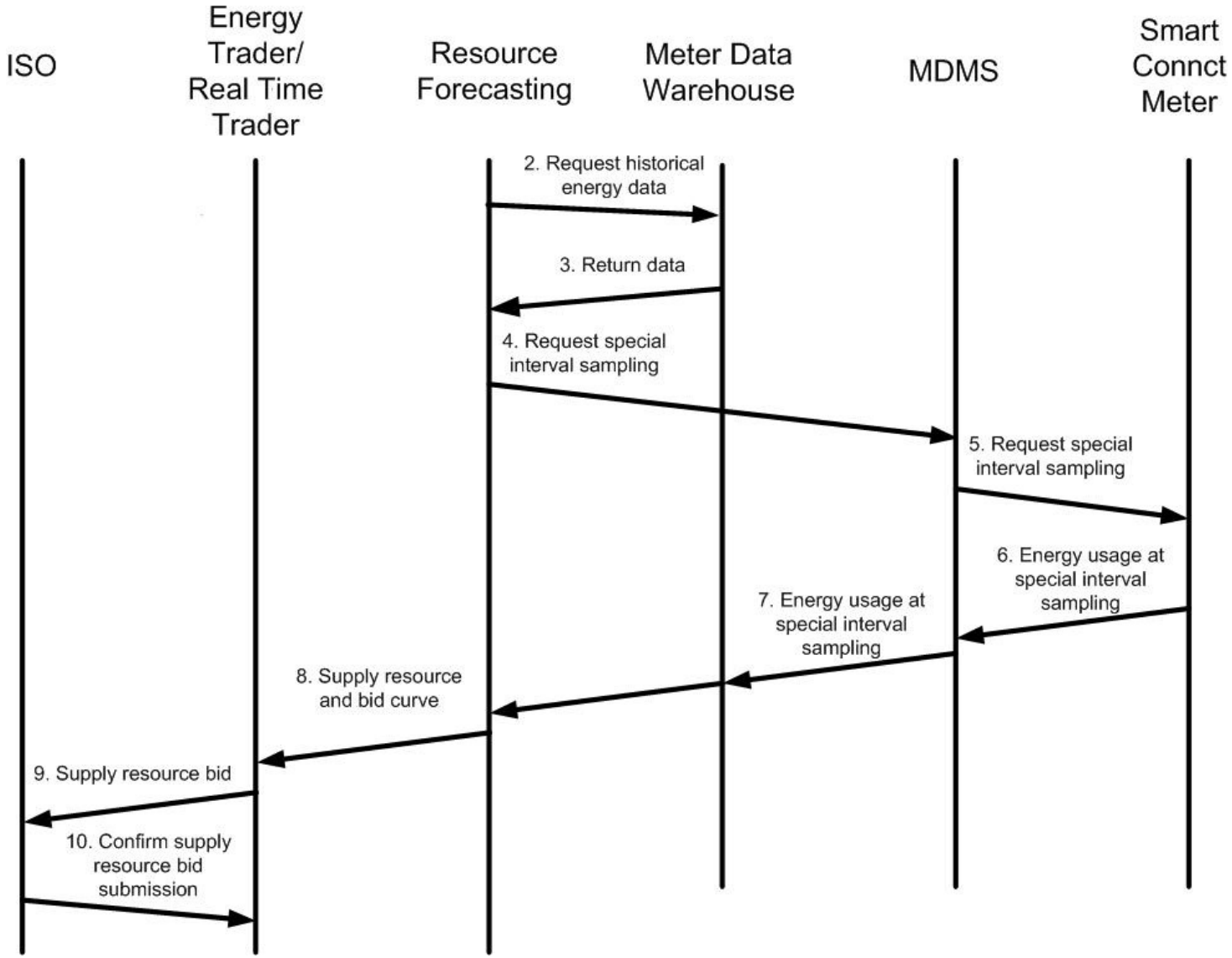
5.2.1 System Diagram



5.2.2 Sequence Diagrams – Scenario 3.1



5.2.3 Sequence Diagrams – Scenario 3.2



6. Use Case Issues

Capture any issues with the use case. Specifically, these are issues that are not resolved and help the use case reader understand the constraints or unresolved factors that have an impact of the use case scenarios and their realization.

Issue
Describe the issue as well as any potential impacts to the use case.
Parking Lot: Shadow settlements need to be investigated.

7. Glossary

Insert the terms and definitions relevant to this use case. Please ensure that any glossary item added to this list should be included in the global glossary to ensure consistency between use cases.

Glossary	
Term	**Definition**
Ex-post market	ISO after-the-fact market. A price applied at settlement time.
T+5	The practice of invoicing for wholesale energy transactions within five days of completing the transaction. Known as payment acceleration.
T+45	The practice of invoicing for wholesale energy transactions as a part of the normal monthly billing cycle, i.e. within 45 days of the transaction completion.
Settlement	The process of calculating invoices and bills based on wholesale energy trading.
Wholesale Transaction Completion	The moment at which a wholesale resource bid or offer is accepted.
RTEM	Real-Time Energy Meter
Load Aggregation Point	A physical location on the grid that is used as the delivery point for any aggregated resource, demand or supply.

8. References

Reference any prior work (intellectual property of companies or individuals) used in the preparation of this use case.

9. Bibliography (optional)

Provide a list of related reading, standards, etc. that the use case reader may find helpful.