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Advanced Metering Infrastructure-to-Outage Management System Use Case Exploration

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ABSTRACT

This document provides the results of a research project aimed at addressing a concern in the Advanced Metering Infrastructure (AMI) to Outage Management System (OMS) family of use cases. Over the brief history of AMI, when a utility deploys smart meters the first use case that is implemented is meter-to-cash, essentially automating meter readings. However, since smart meters can also initiate events, generate alarms, and track information about power quality, they are a rich source of data about what is occurring within a utility's distribution system, often at a level of granularity that is much greater than that which can be provided by a supervisory control and data acquisition (SCADA) system. However, the level of usage of this data is dependent on the utility having the means to communicate, analyze, and act on it as it is generated.

Therein is both the challenge and the opportunity. In this space, two standards are usually brought to bear: MultiSpeak™ and the family of standards that comprise the Common Information Model (CIM). Of particular interest is IEC 61968-9 Meter Reading and Control. In these standards the reporting of outages has been harmonized, with both standards passing events in similar structures and using similar codes. From the perspective of the standards development community, support for AMI-to-OMS integration is essentially complete. From the utility perspective, however, challenges are still being reported in using the standards. These challenges stem from multiple sources, including the use of older versions of the standards, vendors not supporting the standards in their products, and a lack of understanding that the standards exist. This research has noted that there are significant opportunities for improvement to address integration challenges in the AMI-to-OMS domain.

This effort was guided by five use cases:

- An expansion of the core AMI-to-OMS outage
- Attempting to determine a non-communicating meter versus a meter in an outage
- Proactive communication to customers ahead of planned and unplanned outages
- Nested outages (meters that broadcast alarms after power is restored)
- Gaining a better understanding of the operation of the OMS in "blue sky" versus storm conditions

This work leveraged the EPRI use case template (albeit with some modifications) and through a series of webcasts with stakeholders, discussed the requirements, constraints, and experiences of the utilities. These results are captured in the step-by-step analysis of the use cases and within the resulting sequence diagrams that highlight the actors, the context for those actors, and the messages that need to be exchanged. Further, an attempt was made to distinguish between messages that already exist within the standards community such as an event/alarm message or meter reading (often used to "ping" a smart meter) and those messages that need to be explored by the standards community.

The findings from this research will be contributed to the respective standards organizations to accelerate the work required to have these requirements reflected in new editions of CIM and MultiSpeak.

Keywords
Common Information Model
CIM
MultiSpeak
FLISR
Outage
Restoration
Nested outage
Integration
Non-communicating meter
Planned outage
Unplanned outage

EXECUTIVE SUMMARY

AMI-to-OMS Additional Use Case exploration

Advanced Metering Infrastructure (AMI) to Outage Management System (OMS) integration is usually one of the high priority activities once a utility has deployed smart meters. After the initial meter reading use cases have been explored utilities usually look to take advantage of either the event or power quality reporting of which smart meters are also capable. However, this integration comes with its own set of challenges, such as differentiating communication failures from outages and Head-End Systems (HES) flooding the interface with outage and restoration messages during periods of storm activity.

The AMI-to-OMS domain also has some maturity with regard to the standards work that has been completed. Both MultiSpeak™ and the International Electrotechnical Committee (IEC) have data models and integration specifications that cover this topic. The challenge is that when discussing this topic with utility practitioners there is a sense that the standards may have some gaps, or that the implementation of standards are not reflected in vendors' products.

This document describes work that has been conducted by EPRI to explore use cases that are related to the AMI-to-OMS integration domain and to compare the requirements of these use cases with the capabilities of the relevant standards to determine where changes to either data models or interface specifications need to be made.

One of the problems in this space is that the step from a "standard data model" to using the model (CIM or MultiSpeak) in a consistent and predictable manner is large. Thus there may be any number of "APIs" developed that claim consistency with "the model" – which may in fact be true. However, using the APIs to do something in a way that is predictable and understood by all parties is a greater challenge. This becomes an interoperability problem. It requires significant effort and expertise to accomplish, which is in essence what this effort has attempted to do; to raise the level of understanding of the current relevant standards, and to address the gaps in understanding required to integrate these systems in an interoperable way.

Objectives

- Explore additional use cases related to the AMI-to-OMS domain
- Determine what gaps exist in the existing standards related to these use cases

Approach

This work formed and facilitated an industry collaborative to obtain feedback from utility subject matter experts. It sought to understand core requirements and to discern where current standards may have gaps related to the operation of the AMI-to-OMS interfaces and systems. This group met on a recurring basis and was polled to identify the high value use cases that they wished to explore. A standard use case methodology was employed to determine the requirements.

Results

While the base Advanced Metering Infrastructure (AMI) to Outage Management System (OMS) integration use case has been well understood and reflected in both the Common Information Model (CIM) and MultiSpeak standards, this report reveals some additional findings that inform the discussion around this integration and the communications and architecture alternatives. In particular the five use cases that were explored as part of this work showed:

- The standard reporting of events from a smart meter to the associated head-end system, then to a Meter Data Management System (MDMS) and finally on to the OMS (depending on architecture), had many architecture variants, sometimes even among utilities that had the same metering vendors.
- While attempting to communicate to a meter, it is difficult to distinguish between a non-communicating meter and a meter that has lost power. Non-communicating meters are usually flagged beforehand if they have not reported readings for a number of days. Instead of attempting to communicate to make this determination, the more practical approach is to simply inform the OMS of this list of meters so that they are not included in outage analysis.
- Anecdotally, it was understood that utilities may opt to turn off the interface if it is felt that the OMS is being overwhelmed with information. For some this is still considered an option, but this work revealed that some utilities choose to alter the algorithms used to perform the outage analysis in a way that compensates for the high volume of message traffic.
- There were not many new findings for the high/low voltage alarm after an outage restoration (sometimes referred to as a nested outage), other than the fact that users need to trust in their systems. Specifically, users need to trust that if smart meters are reporting power restored without communicating additional alarms or events, these outages can be closed, communicated, and then passed on to the crews so that they can quickly attend to more urgent work.
- In the customer "proactive communication" use case there were opportunities for standards communities to create new messages to support meaningful communication of estimated time to restoration from the OMS (dependent on algorithms to better predict this metric) to other systems, including communication mediums such as social media (which also depends on the utility being able to correlate CIS accounts with social media contacts). Also, for unplanned outages, utilities can get better at predicting areas of potential outages, but new messages will need to be created to facilitate acting on this information.

Applications, Value, and Use

This report will be of value for two communities. First, for utilities, there is clarity in the form of these use cases where the AMI-to-OMS integration subject has been covered. Particularly in the case of the base message exchange from an AMI Head End to an OMS. For CIM-based integration, this is the EndDeviceEvent message. This is one of the more robust and mature messages that is supported by both the MultiSpeak and CIM standards, down to supporting the same codes that are used to reflect the type and source of the event. There is essentially no good reason for any vendor to not support this message type. In addition, there is essentially no good reason to use a proprietary interface to support this functionality.

Second, for the CIM and MultiSpeak standards development organizations (SDOs) this document provides some clarity around *how* the various integrations are architected. It is clear that even when utilities use the same metering vendors, how they choose to architect a solution can vary widely. These options and alternatives have been captured in the following use case diagrams. Additionally, the SDOs will benefit from additional information around other needs for utilities, for example filtering meters that are known to be non-communicating so that they are not included in outage analysis, and creating messages to support communications to customers ahead of both planned and unplanned outages.

COMMON TERMS AND DEFINITIONS

Last Gasp	Refers to when the smart meter has sustained a loss of power. There is a capacitor in the meter that maintains power long enough for the meter to broadcast a loss of power event. AKA PON - Power Outage Notification
Alarms & events	Smart meters record a variety of alarms and events. These are usually based on ANSI C12.19 Decade 70 (see the appropriate ANSI reference) and the manufacturers custom event tables. The alarms and events are passed from the meter to the respective AMI Head End system
PUSH vs PULL	This refers to an architecture preference. In a PULL architecture one system requests data from another system when it is desired. In a PUSH architecture the system with the data broadcasts the information rather than waiting for a request.
Meter ping	Not the same as a TCP/IP ping (actually meter reading); some may do power quality ping
Power Quality	In this context this is data captured at the smart meter that may include voltage levels.
Momentary or “blink”	This is a power out situation that has occurred, but for less than the mandated time interval that is considered an outage. The meter will wait some period of time in case of an upstream event, such as a recloser restoring power to the circuit.
SAG	When power drops below nominal voltage, but is still present.
Swell	When power rises above nominal voltage.
Door hanger	This is a brochure with a cut-out for a door handle that allows field personal a way to notify customers that they have been working in the area.

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1
AMI-TO-OMS: EXISTING STANDARDS AND REFERENCES

Early in this project, a brainstorming session was conducted in which the subject matter experts (SMEs) were informally polled to determine AMI-to-OMS related use cases in which there were perceived gaps. Through this process, the SMEs identified the following nine use case topics:

- Work Management exchange with the AMI HES
- Determining a non-communicating meter vs. an outage
- Restoration/Low voltage – on a restoration, follow-up if the meter then sends a low voltage alarm
- Customer proactive notification – notifying the customer when the utility knows about the status of restoration efforts (recognizing the challenge of a "customer" vs. a property owner such as in a multi-unit dwelling)
- OMS to MDMS to CIS – is the VEE calculated correctly? For example, if the customer is out for four hours, does the system recognize this outage vs. some sort of leveling based on an algorithm?
- Demand Response Application Server (DRAS) – exploring information exchange with the AMI Head End; correlation of events
- Social media – communication to/from social media such as Twitter or Facebook
- DMS – outage/restoration information from an OMS or AMI HES
- OMS event limiting – understanding when to "throttle" the amount of events that are coming through during storm conditions

In the next step, a web survey was designed and SMEs were asked to rank the use cases in order of importance. The top five use cases served as the focus for the project and define the scope of this document. The survey invitation was sent to 301 people via email, with 28 complete responses for a response rate of 9.3%. Table 1-1 shows use case prioritization by average score.

Table 1-1
Use Case prioritization by average score

Use Case	Average Score
DMS Outage/Restoration from OMS/AMI HES	7.71
Non-communicating meter vs outage	6.07
Restoration with low voltage alarms	5.64
Customer proactive notification	5.43
OMS event limiting (storm conditions)	5.42
OMS->MDMS->CIS correct VEE calculation	5.21
Demand Response information exchange with AMI HES; event correlation	4.82
Work Management exchange with AMI HES	3.89
Communication to social media	3.32

2
USE CASE DEVELOPMENT

The top five use cases indicated by the SMEs are:

1. DMS – outage/restoration information from an OMS or AMI HES
2. Non-communicating meter vs. an outage
3. Restoration/Low Voltage – throwing a low voltage alarm after a restoration
4. Customer proactive communication
5. OMS event limiting (throttle messages in storm condition)

The challenges associated with each of these use cases were discussed in detail and are addressed in detail in the following sections.

Outage/restoration from OMS or AMI HES

1.0 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Sending of power out/restoration messages from the smart meter to back-office systems to determine whether this is an outage
Objective	Ensure that all of the alternative/optional scenarios and architectural configurations have been considered for this use case

1.1 Narrative of Use Case

Narrative of Use Case
Short description – max 3 sentences
Power outage/restoration messaging from the smart meter to outage management system for resolution
Complete description
This is the "base" outage use case. That is, the scope of this use case is focused on the enterprise operations that occur when receiving power outage/power restoration messages from the smart meter via the AMI HES. • Scenario 1: Outage event received from OMS or AMI HES • Scenario 2: Restoration received from OMS or AMI HES The evaluation of outage/restoration reporting from smart meters, considering several scenarios that included filtering on planned events, or previous known activities such as disconnect for non-pay, construction, or issues related to the distribution network. This use case also explores options for filtering at the meter (momentaries) and alternative scenarios for when an outage might be automatically cleared, versus an outage clearance that requires confirmation by a field crew. This is a well-established use case in terms of deployments and support by standards communities (IEC/MultiSpeak). The objective is to identify where there are gaps in the standards' support for the implementation.

2 Diagrams of Use Case

Figure 2-1 illustrates the scope of the base outage use case and associated actors.

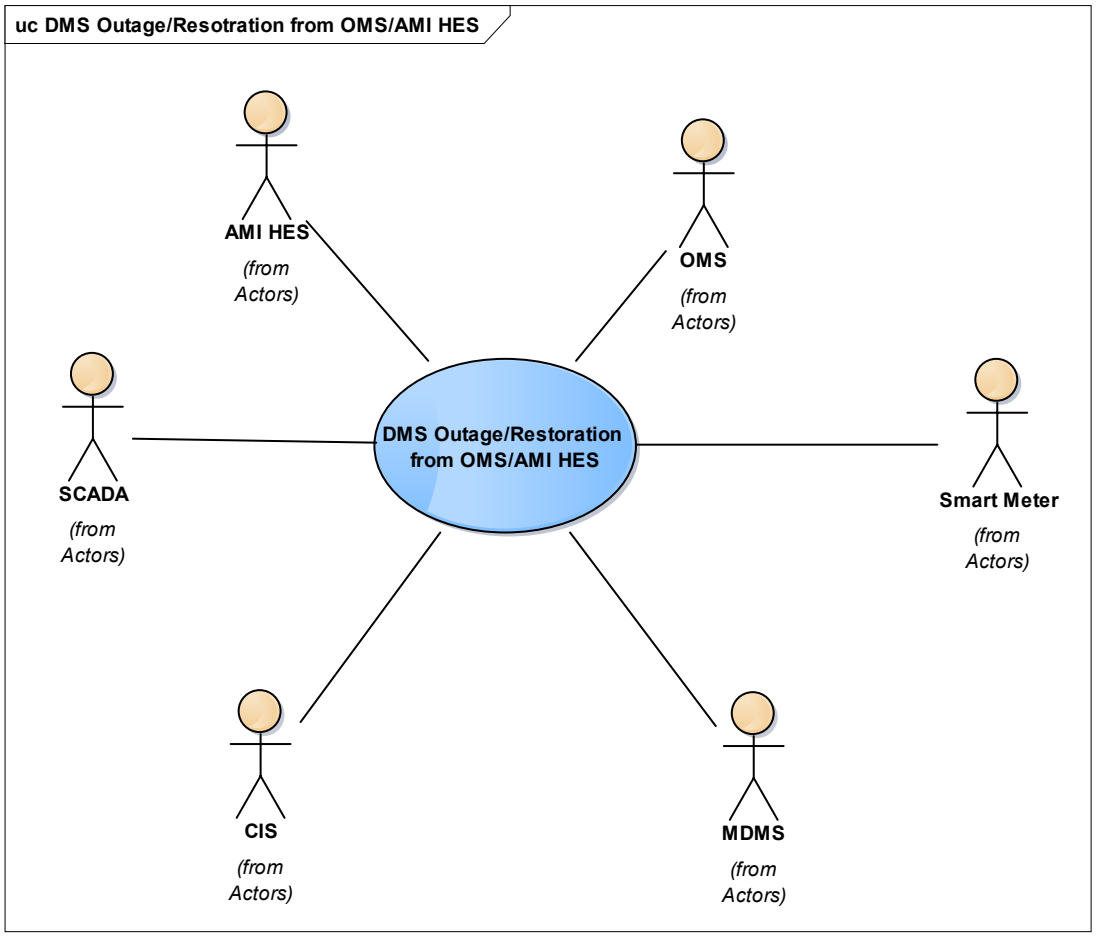


Figure 2-1
Scope of the base outage use case and associated actors

Figure 2-2 shows a base outage sequence diagram and Figure 2-3 shows SCADA sending events to OMS.

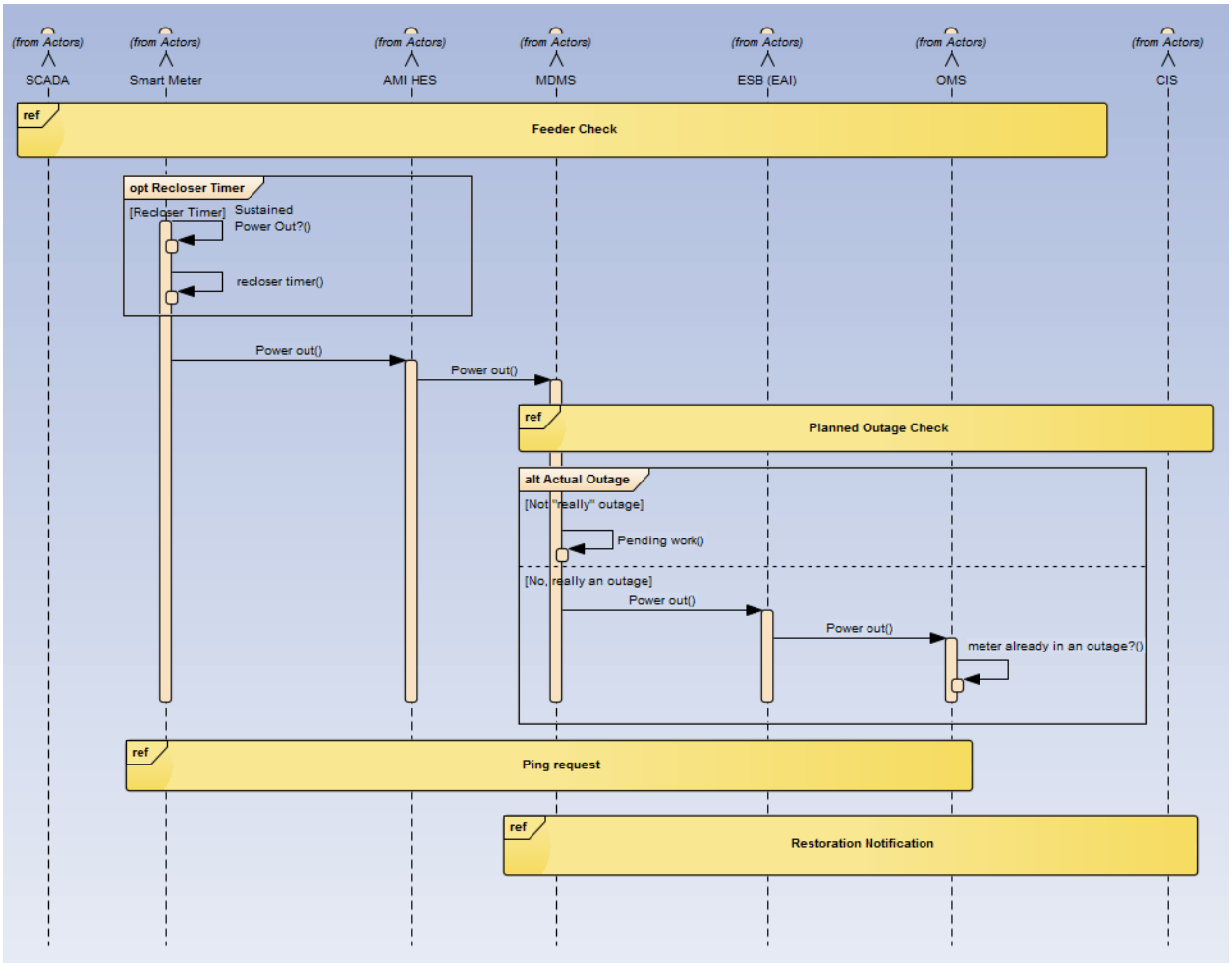


Figure 2-2
Base outage sequence diagram

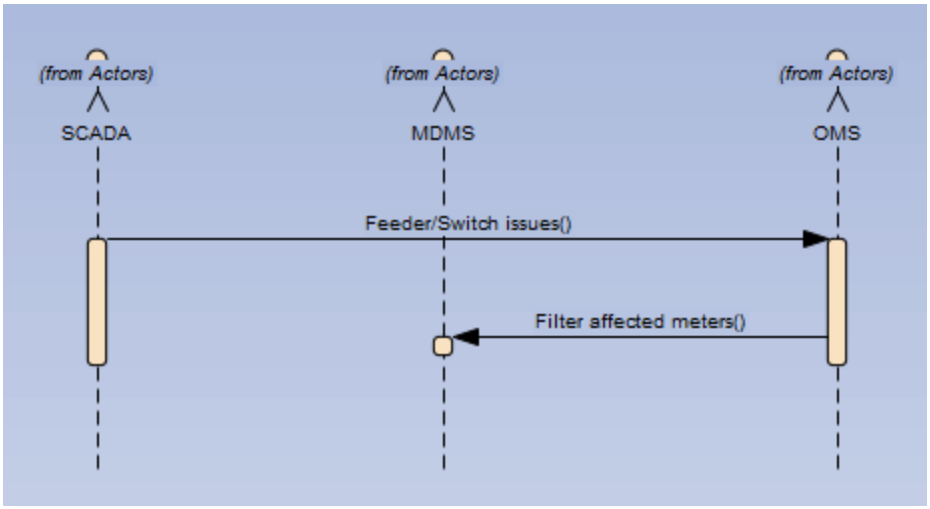


Figure 2-3
SCADA sends event to OMS. OMS uses this event information to send the MDMS filtering criteria

Figure 2-4 shows a planned outage check with alternative PUSH/PULL architecture alternatives.

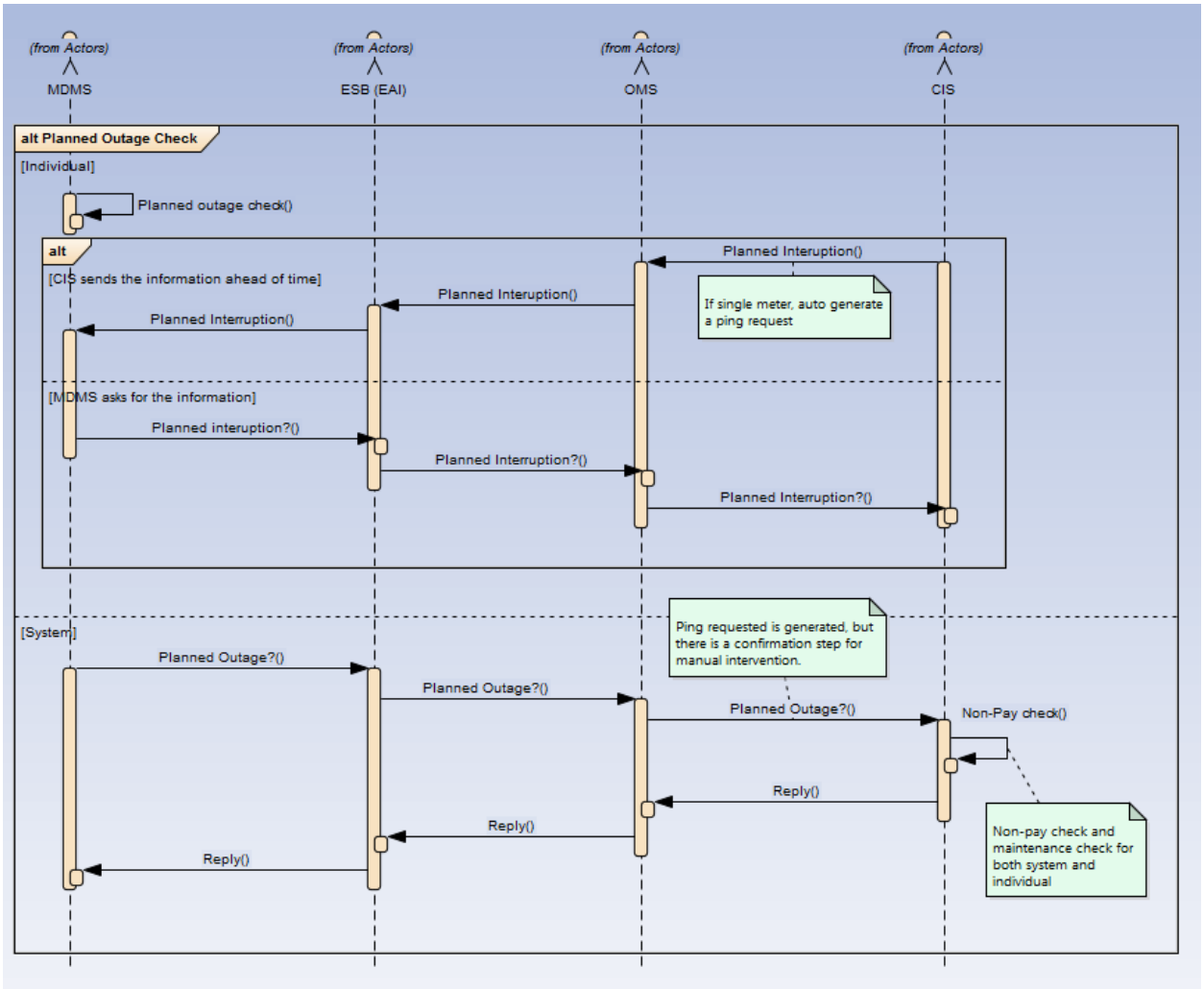


Figure 2-4
Planned outage check with alternative PUSH/PULL architecture alternatives (MDMS asks vs. CIS sends)

Figure 2-5 illustrates a ping response alternative.

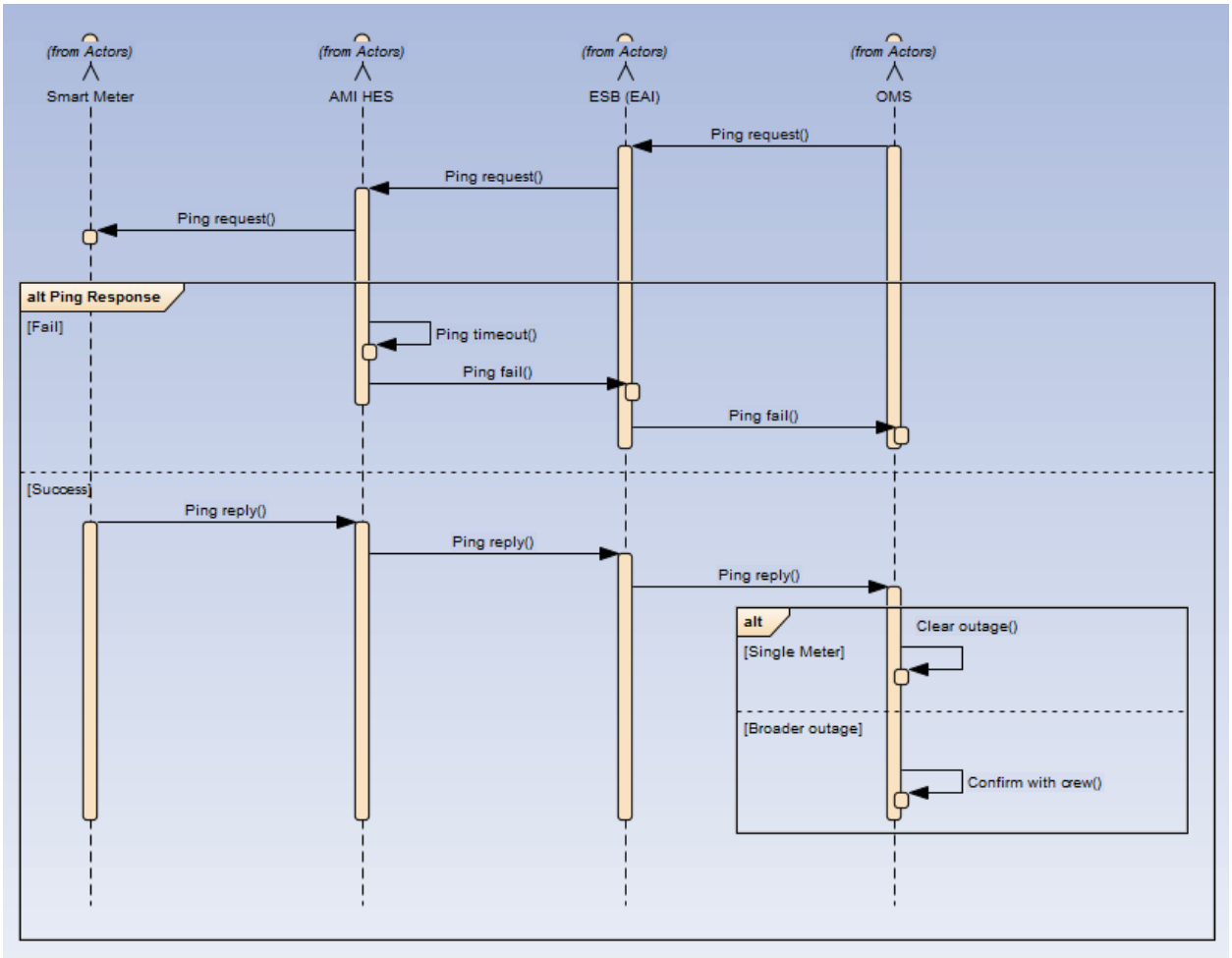


Figure 2-5
Ping response alternative - clearing an outage or confirming with crew

Figure 2-6 shows an optional customer restoration notification fragment.

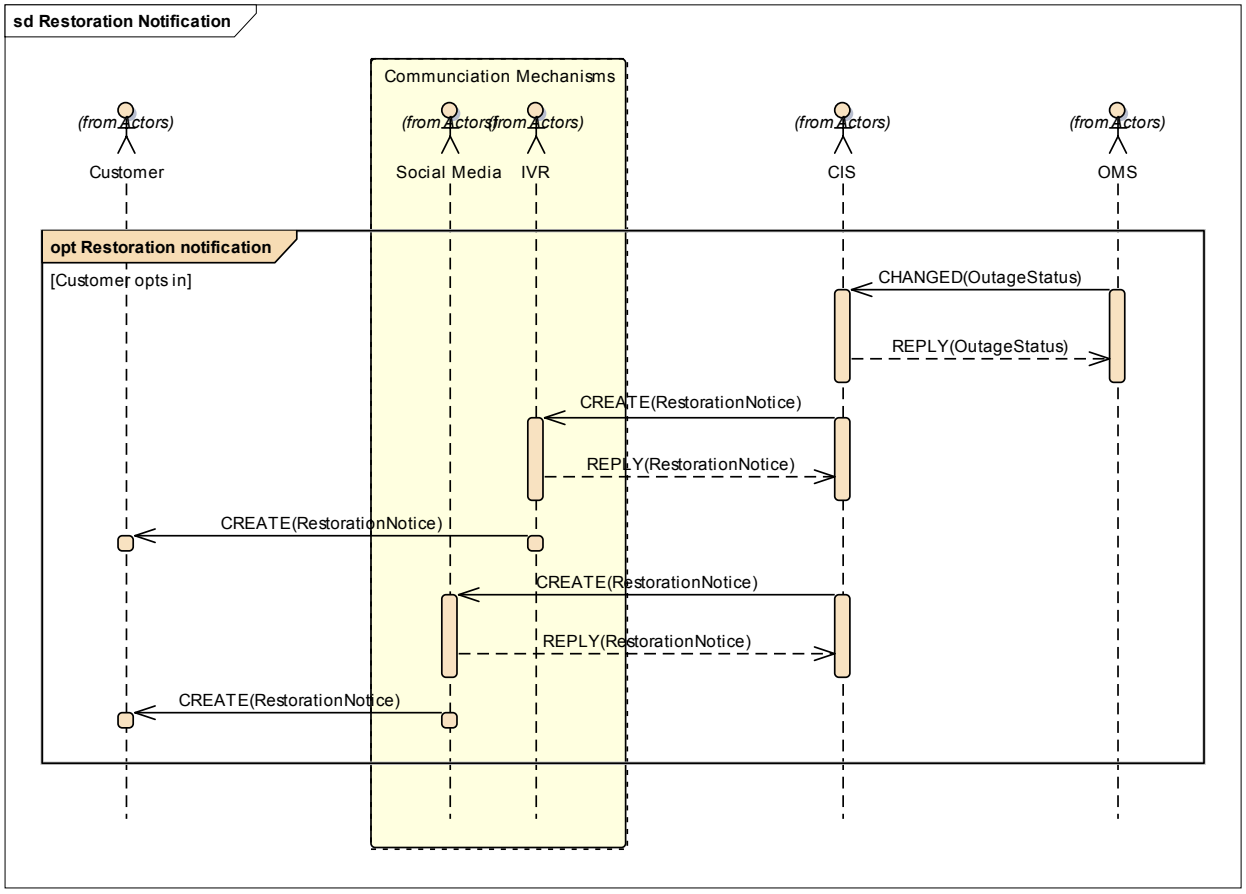


Figure 2-6
Optional customer restoration notification fragment

3 Technical Details

Actor Name see Actor List	Further information specific to this Use Case
Smart Meter	Smart meter may report a service interruption.
AMI HES	The AMI HES may receive the interruption from the smart meter. It will check against a list of meters to filter due to planned service interruptions.
MDMS	The MDMS may receive the interruption from the AMI HES. It will check against a list of meters to filter due to planned service interruptions.
OMS	Based on known service events or other issues, the OMS may send a list of meters to other systems to filter any events that it might otherwise receive and include in outage analysis algorithms.
CIS	Holds the customer information relative to the account and associated meters.
SCADA	In the feeder check scenario, the SCADA system may send information to the OMS that will allow the OMS to determine affected meters, which the OMS can then send to other systems as a filtering mechanism.

3.1 Preconditions, Assumptions, Post condition, Events

Use Case Conditions			
Actor / System / Information / Contract	**Triggering Event**	**Pre-conditions**	**Assumption**
Smart meter	Loss of power	Normal operation	The meter is communicating normally prior to the outage

4 Step by Step Analysis of Use Case

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**
4.1	Base outage and restoration case	OMS	Smart meter has reported a power outage or restoration	Normal operation	An assessment will be made by the OMS to determine if this is an outage (for power failures) and for restoration messages, whether an outage can be cleared
4.2	Feeder check	SCADA	Feeder Fault/Event e.g. switch opens	Normal operation	OMS has been notified of an issue on a feeder
4.3	Planned outage check	MDMS	Smart meter has reported a power outage or restoration	Normal operation	The MDMS will determine whether various filtering conditions apply, such as disconnect for non-payment, construction, or issues in the distribution network (Feeder Check 4.2)
4.3	Ping request	OMS	OMS sends a ping to confirm power outage / restoration	An outage notification had been received from the smart meter via AMI Head-End, MDMS or other intermediaries	Outage is cleared or confirmed (for a single meter) or for a broader outage, initiates a request to confirm via field crew

4.1 Steps – Normal

Scenario							
Scenario Name:	**Base Power Outage**						
Step No.	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
1	Loss of power	Smart meter losses power	Create	Smart meter	Smart meter	Power out AKA "last gasp"	
2	Momentary check	A timer will run either at the meter or optionally at the AMI Head-End to determine if this is momentary (typically less than 3 – 5 minutes) before sending the power loss on.	Internal	Smart meter	Smart meter / optionally the AMI Head-End	Time out	
3	Power out	If the momentary timer expires the power out is sent to the MDMS	Create	Smart meter or AMI Head-End	MDMS	Power out	Meter ID Event code
4	Filter check	When the MDMS receives the power outage it will check to see if the meter meets any filtering criteria, such as planned outage, construc-tion, feeder issues	Internal	MDMS	OMS	Filter criteria	List of 1-to-*n* meters
5	Outage check	If the meter does not meet the filtering criteria the OMS will attempt to ping the meter	Create	OMS	Smart meter	Meter ping	
6	Outage creation	If the meter does not respond an outage is created	Create	OMS	OMS	Meter id	

5 Information Exchanged

Information Exchanged		
Name of Information Exchanged	**Description of Information Exchanged**	**Requirements to information data R-ID**
Meter List	This is the list of meters with known communication issues that the OMS should not include in any outage analysis.	Meter ID

Table 2-1 shows standards-based messages and required extensions.

Table 2-1
Standards messages and required extensions

#	Sequence	Standards-based messages
1	Feeder check	CIM EndDeviceEvents (Extension: need applicable EndDeviceEventType(s) MultiSpeak uses the same codes as the CIM EndDeviceEvents so there will need to be alignment on these additions.
2	SCADA meter filter	CIM Extension MultiSpeak Extension
3	Recloser timer	N/A – occurs at the meter or within the AMI Head-End
4	Power out	CIM EndDeviceEvents; MultiSpeak
5	Planned Interruption/Outage	CIM meterList MultiSpeak meterList
6	Planned outage filter	CIM meterList MultiSpeak meterList
7	Ping meter	CIM GetMeterReadings; MultiSpeak GetMeterReadingsBy (MultiSpeak provides multiple methods to retrieve meter readings)

Non-communicating meter vs. an outage

1.0 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Related business case	Base power outage
Scope	Limited to filtering those meters that are in a non-communicating status as far as the AMI HES knows.
Objective	Filter meters so that they are not included in outage analysis.

1.1 Narrative of Use Case

Narrative of Use Case
Short description – max 3 sentences
A meter may have lost communications. These meters should not be included in the normal outage analysis that the OMS will perform so there needs to be a filtering mechanism.
Complete description
The trigger would be that a meter hasn't been heard from in some time. Because at any given point in time there may be thousands of meters out of communication, the SME group indicated that some time limit would be set before further steps would be initiated; that there would be no attempt to ping all of these meters right away (pings not being "free"). One example was to wait up to five days before doing anything else. It was suggested that a request might be made of the network manager to determine if there was an issue with an access point. In this way affected meters may be determined. One out might be to initiate a service order for a non-responding access point. If a meter was not part of a network issue and had exceeded the wait time limit (however many days that might be), then an attempt would be made to ping the meter. If the meter responded, the meter readings would be picked up. If it did not respond, a service order for the meter would be initiated.

1.2 General Remarks

General Remarks
Figure 2-7 shows a related use case that might be used to initiate a service order for non-communicating meters. However, this is out of scope for this particular use case and is only included for informative purposes.

2 Diagrams of Use Case

Figure 2-7 illustrates a non-communicating meter and actors.

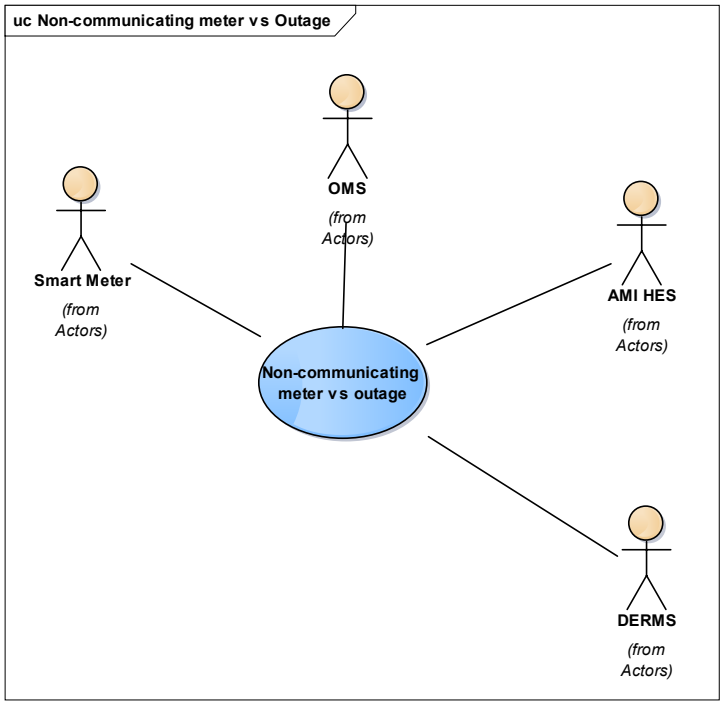


Figure 2-7
Non-communicating meter and actors

Figure 2-8 illustrates a base non-communicating meter sequence diagram and Figure 2-9 shows that HES provides a meter list of non-communicating meters for the OMS.

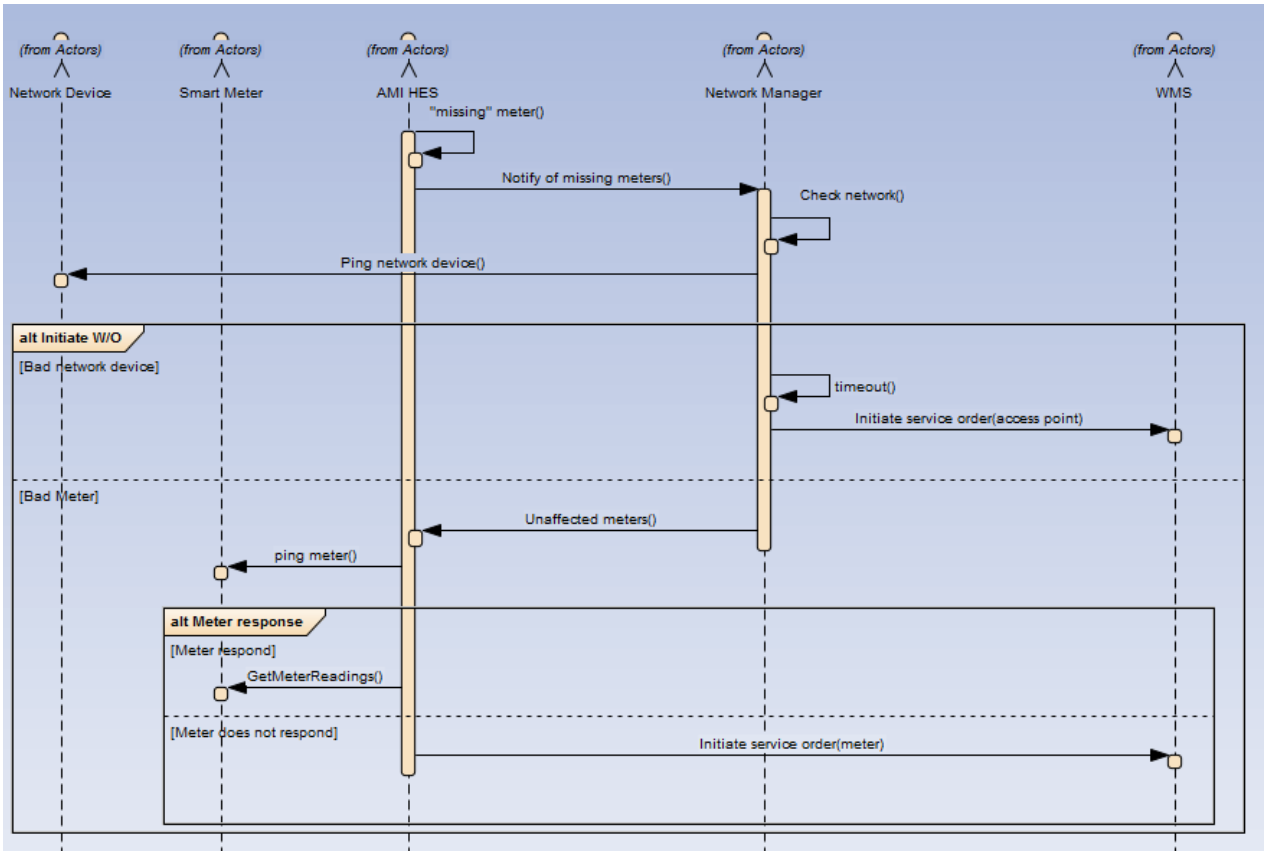


Figure 2-8
Base non-communicating meter sequence diagram; this particular sequence is deemed out of scope for the OMS as it is more relevant to the WMS.

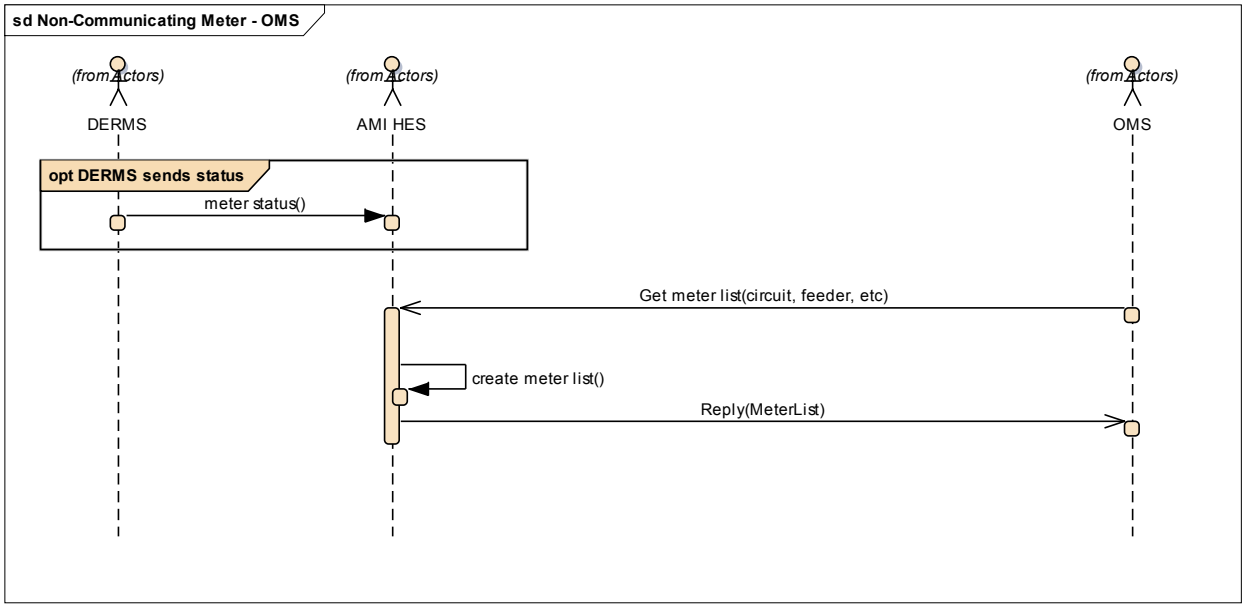


Figure 2-9
HES provides meter list (PUSH or PULL) of non-communicating meters for the OMS

3 Technical Details

Actor Name see Actor List	Further information specific to this Use Case
AMI HES	Has the list of known non-communicating meters (typically meters that have not sent readings for about five days
OMS	Needs to filter non-communicating meters so that they are not included in outage analysis
DERMS	DER Management System – for the purposes of this use case, it is assumed that if there is a sub-meter associated with some sort of Distributed Generation and if this meter has a communication issue, the main meter that it is associated with will know, and this information will be passed to the AMI HES and/or DERMS (if a DERMS exists)

3.1 Preconditions, Assumptions, Post condition, Events

Use Case Conditions			
Actor/System/ Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**
Smart meter	Loss of communications	Nominal operation	Assumed to be a communication issue rather than a loss of power.
AMI HES	Loss of communication	Nominal operation	It is expected that the AMI HES will not have received meter readings or other information from the meter for some period of time; typically five days.

4 Step by Step Analysis of Use Case

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**
4.1	Non-communicating meter	AMI HES	Non-communicating status of the smart meter	Nominal operation	The OMS has a list of the non-communicating meters so that they are not included in outage analysis.

4.1 Steps – Normal

Scenario							
Scenario Name :	**Non-communication meter list is exchanged with the OMS**						
Step No.	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
1	Retrieve meter list	OMS asks the AMI HES for the list of non-communicating meters	GET	OMS	AMI HES	Request for non-communicating meters	
2	Process meter list request	Query is processed and handled by AMI HES internal DB	N/A	AMI HES	AMI HES	None – the list is built	
3	Send meter list	Message is built containing all non-communicating meters	REPLY	AMI HES	OMS	Meter List	

4.2 Steps – Alternative, Error Management, and/or Maintenance/Backup Scenario

Scenario							
Scenario Name :	**DER Management System (DERMS) sends notification**						
Step No.	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Inform-ation Producer (Actor)**	**Inform-ation Receiver (Actor)**	**Inform-ation Exchanged**	**Requirements R-ID**
1	DERMS notification	As an alternative, for customers that have sub-meters connected to smart inverters, status and event may be sent to the DERMS. The DERMS would pass events on to the AMI HES	CreateDER Status	DERMS	AMI HES	Events	

5 Information Exchanged

Information Exchanged		
Name of Information Exchanged	**Description of Information Exchanged**	**Requirements to information data R-ID**
Meter List	A list of meter IDs or other identifying information	For CIM this is the meter mRID For MultiSpeak this is the electricMeter objectID
DERMS events	Status or events from smart inverters	See EPRI report *Enterprise Integration Functions for Distributed Energy Resources*, Phase 1, 3002001249, Technical Update, October 2013

Low Voltage Alarm after restoration

1.0 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Related business case	Base power outage
Scope	Within a pre-existing outage, those meters that might have additional issues
Objective	Determine which work orders can be closed and which meters may need further attention.

1.1 Narrative of Use Case

Narrative of Use Case
Short description – max 3 sentences
This is essentially a use case to explore nested outages or conditions related to additional issues after an initial power restoration. This may include tree limbs on a line, high or low voltage alarms even after "lights are on."
Complete description

2 Diagrams of Use Case

Figure 2-10 shows scope, actors, and related information flow.

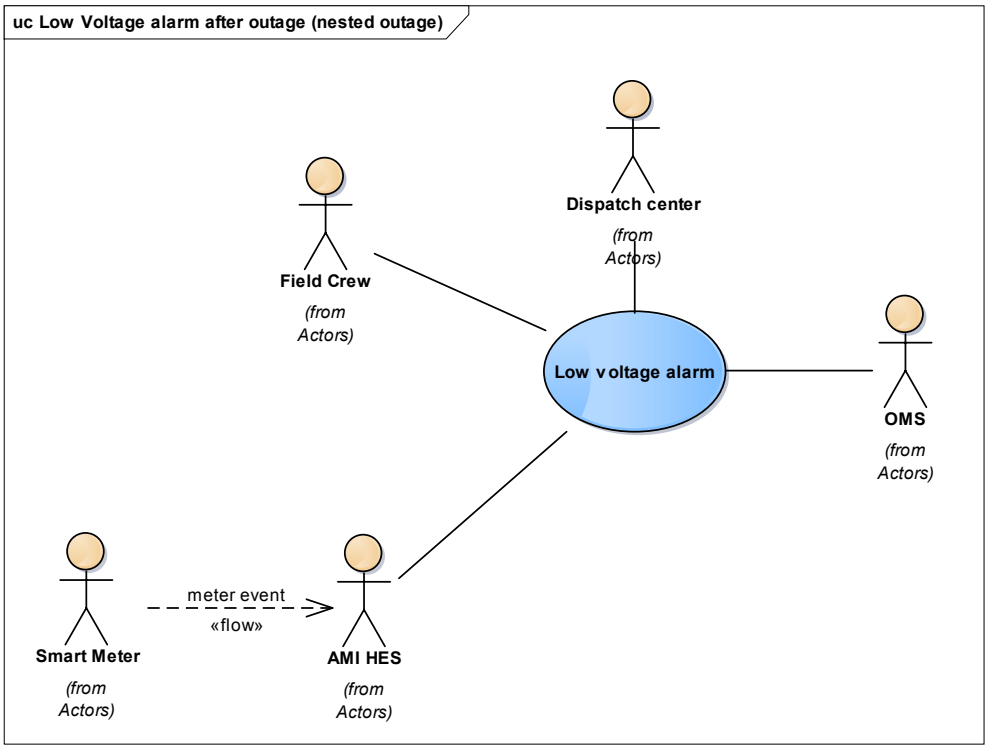


Figure 2-10
Scope, actors, and related information flow

Figure 2-11 is a sequence diagram for the high/low voltage use case.

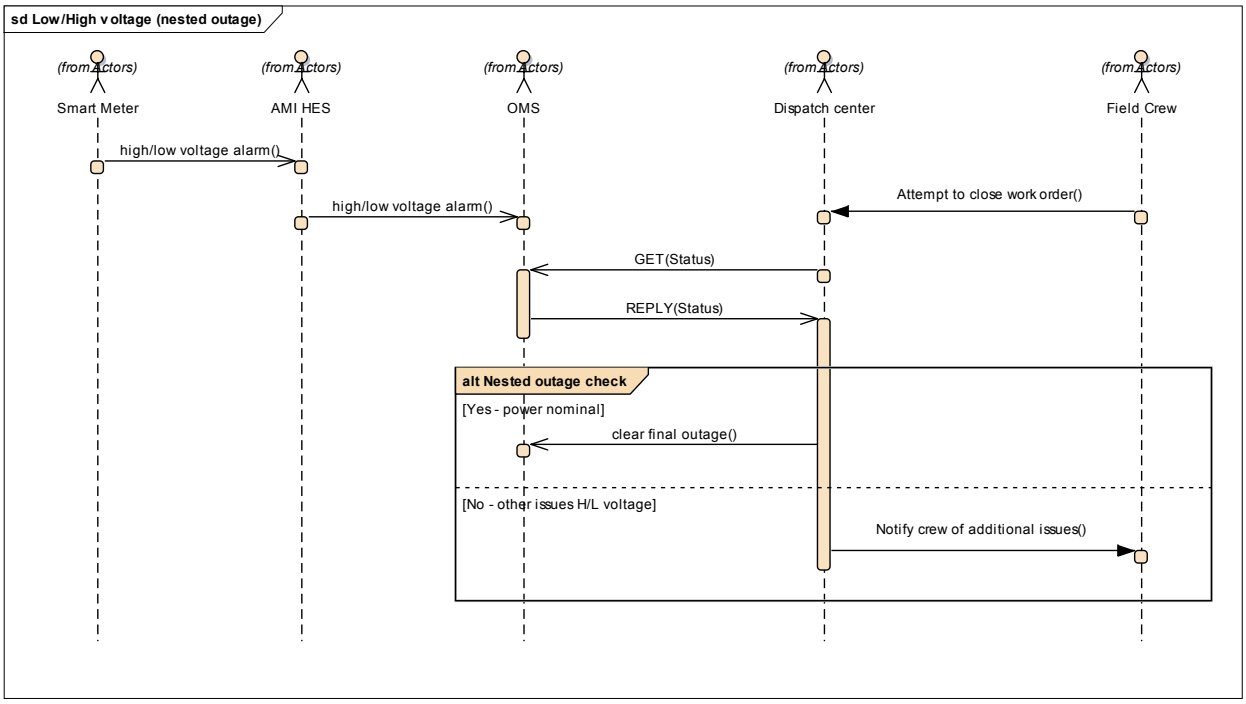


Figure 2-11
Sequence diagram for the high/low voltage (nested outage) use case

3 Technical Details

3.1 Preconditions, Assumptions, Post condition, Events

Use Case Conditions			
Actor / System / Information / Contract	**Triggering Event**	**Pre-conditions**	**Assumption**
OMS	Power has been partially restored but additional alarms are broadcast	An outage has already occurred, but in the restoration attempts, additional issues may be uncovered	There is a crew in the area and the utility wants to take advantage of this to save an additional truck roll and to facilitate faster restoration in a trouble area.
Smart meter	Meter continues to throw events/alarms	Recently involved in a power restoration	Once power is restored to the meter it will communicate a power restoration event, but it may follow with other events, e.g. voltage alarm
AMI HES	May have received additional events/alarms after a power restoration event	Is collecting and passing on events to the OMS/MDMS	There is a pre-existing outage that the utility crew is responding too. The AMI HES may begin collecting other events once power is restored to the meter
Field Crew	Completes an original work order resulting in at least a partial restoration		Lights may be on, but the crew may not be aware of other issues
Dispatch Center	Field crew requests the closing of a work order	Monitoring crew restoration progress/ confirming restoration status	

4 Step by Step Analysis of Use Case

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**
4.1	Voltage Issue after power restoration	AMI HES	Power has been restored from a previous outage	No power	Nominal operation

4.1 Steps – Normal

Step No.	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirement, R-ID
1	Event	Smart meter broadcasts an event after a power restoration	EndDevice Event	Smart meter	AMI HES	Meter event	
2	Event	AMI HES send the event to either the OMS or MDMS	EndDevice Event	AMI HES	OMS	Meter event	

4.2 Steps – Alternative, Error Management, and/or Maintenance/Backup Scenario

Scenario							
Scenario Name :	**Check power status**						
Step No.	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements R-ID**
1	Check meter status	The dispatcher may initiate a status check to determine the status of a meter	GetMeter Reading AKA "meter ping"	AMI HES	Smart meter		
2	Clear Check	If the meter reports back nominal then the outage will be cleared; if not, the crew will be notified of additional actions	MeterRead ing	Smart meter	AMI HES		

5 Information Exchanged

Information Exchanged		
Name of Information Exchanged	**Description of Information Exchanged**	**Requirements to information data R-ID**
EndDeviceEvent	This is the standard CIM event message. MultiSpeak supports a similar message, BlinkAlarmsNotification	
Meter Ping	A status check or a meter "ping" is really just a request for a meter reading. Both CIM-based and MultiSpeak support meter readings messages.	

Customer proactive communication

1.0 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Related business case	Base outage
Scope	Communications to and from the customer prior to planned or unplanned outages
Objective	Identify the actors and situations related to the need to get ahead of communication to the customer for both planned and unplanned outages

1.1 Narrative of Use Case

Narrative of Use Case
Short description – max 3 sentences
When the utility knows about planned outages, or based on algorithms and storm tracking can determine ahead of time with some certainty which areas may be affected by an unplanned outage, proactively notify the customers of this situation.
Complete description
For planned outages there are four scenarios: three primarily related to size and scope of the outage, and the other customer initiated. 1. Door hanger – a technician is in the area and may knock on the door to notify local homeowners, leaving a "door hanger" if no one is present. 2. Scheduled/Switching – typically larger scale, e.g. 12 – 15 customers. CIS will correlate customers to the circuit. IVR will auto-dial (opportunity for other media) to notify customers of the schedule. 3. Larger scale outage – this is where the utility may work with a community and businesses in the planned affected area and collaboratively determine when it's the best time to schedule the outage. 4. Customer is planning to take their meter out of service for some work. Depending on the jurisdiction, this may need to be coordinated with the utility. For unplanned outages 1. Storm tracking scenario – utility can use GIS/OMS to determine traditionally "brittle" areas of the network. When the storm track is determined, customers in the affected areas are notified.

2 Diagrams of Use Case

Figure 2-12 shows the scope and actors related to a customer proactive communication/notification use case.

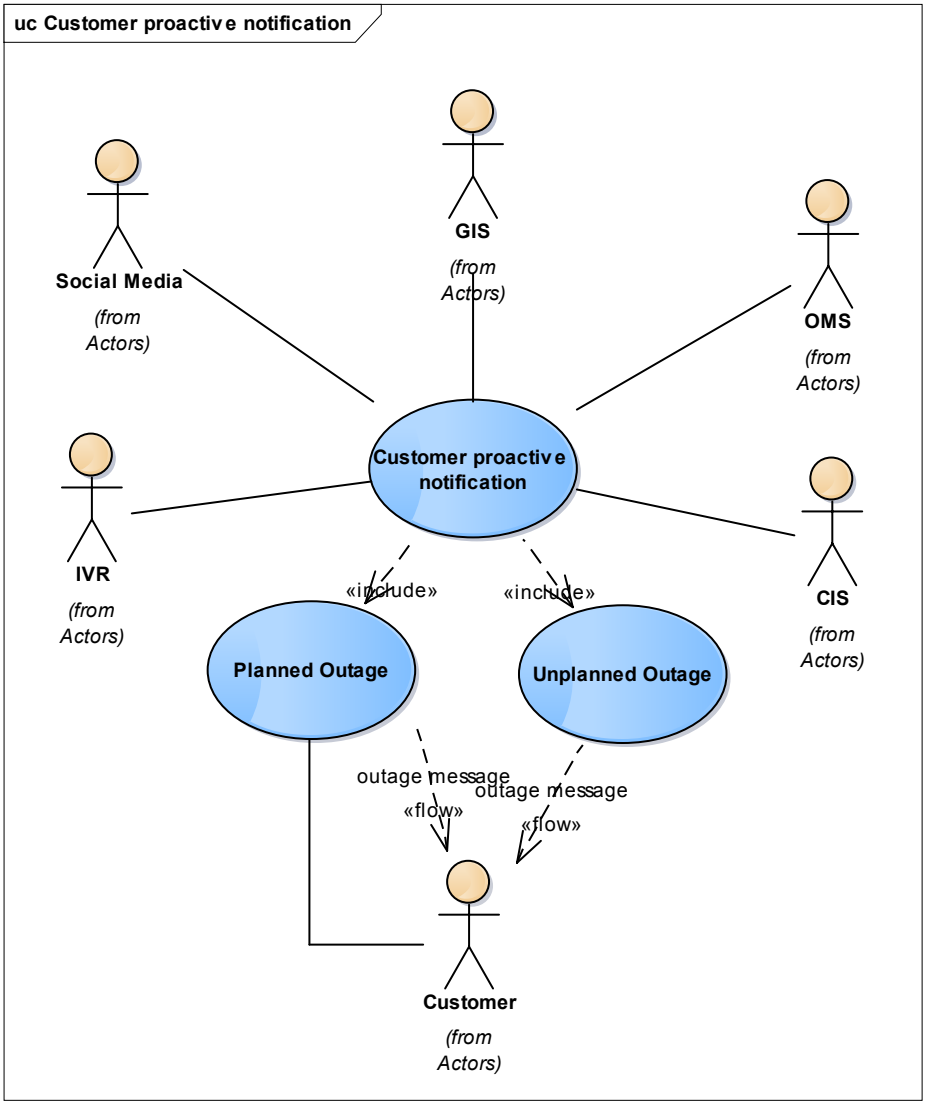


Figure 2-12
Scope and actors related to customer proactive communication/notification use case

Figure 2-13 illustrates scenario 1 of a planned outage.

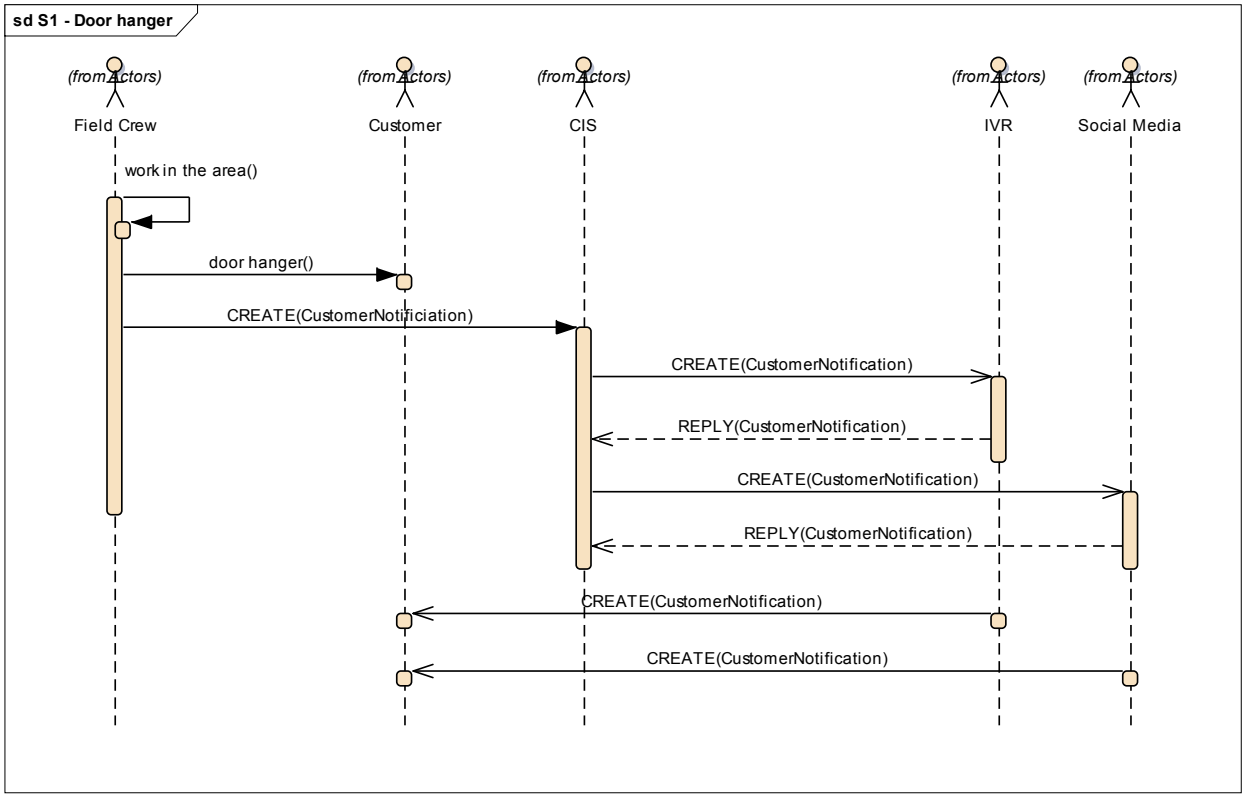


Figure 2-13
Planned outage, scenario 1 - Field Crew leaves door hanger, initiates out-of-band communication via enterprise systems

Figure 2-14 illustrates scenario 2 of a planned outage.

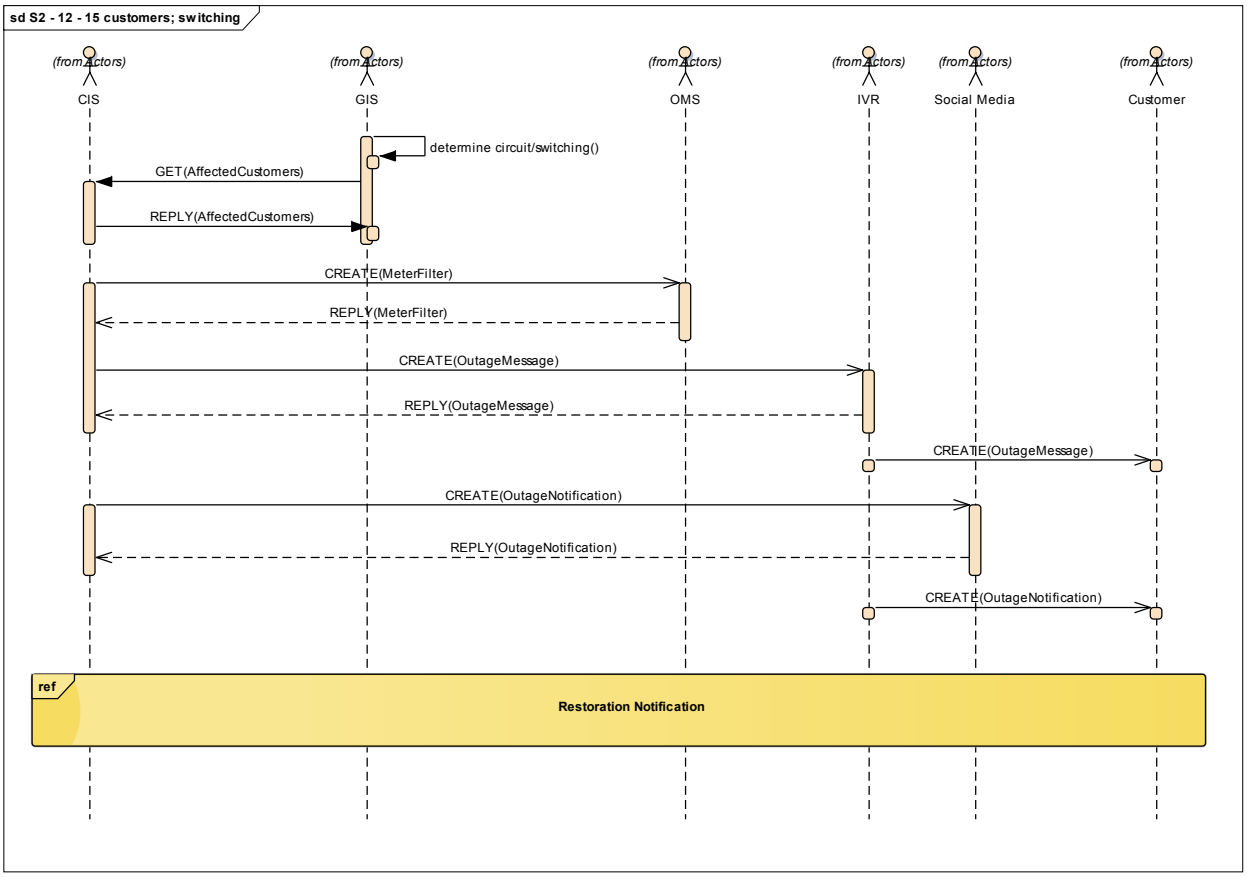


Figure 2-14
Planned outage - scenario 2; larger scale outage determine by circuit/switching

Figure 2-15 illustrates determining and communicating with customers ahead of a potential outage.

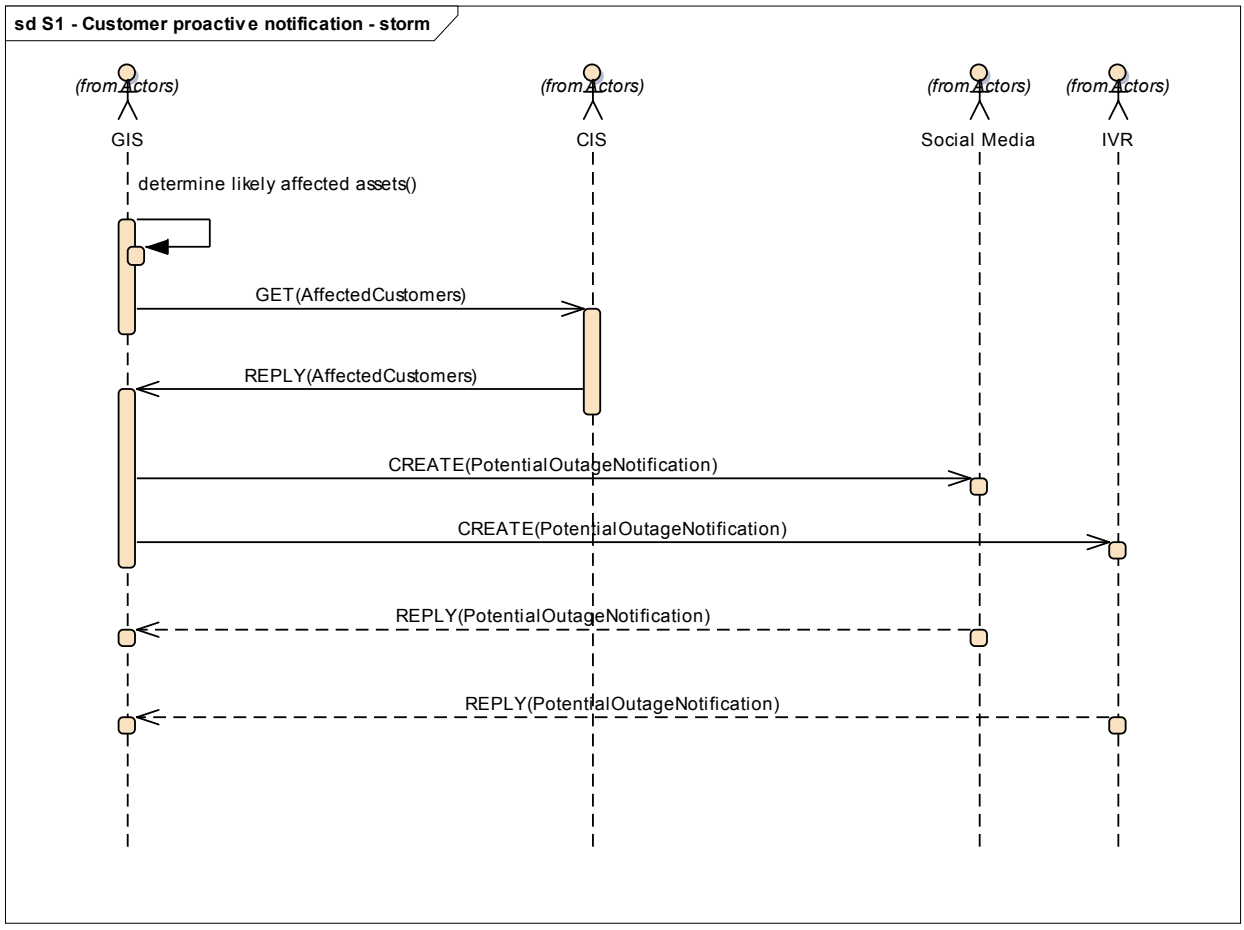


Figure 2-15
Unplanned outage, determining and communicating with customers ahead of a potential outage

Figure 2-16 illustrates unplanned outage notification using storm tracking and social media.

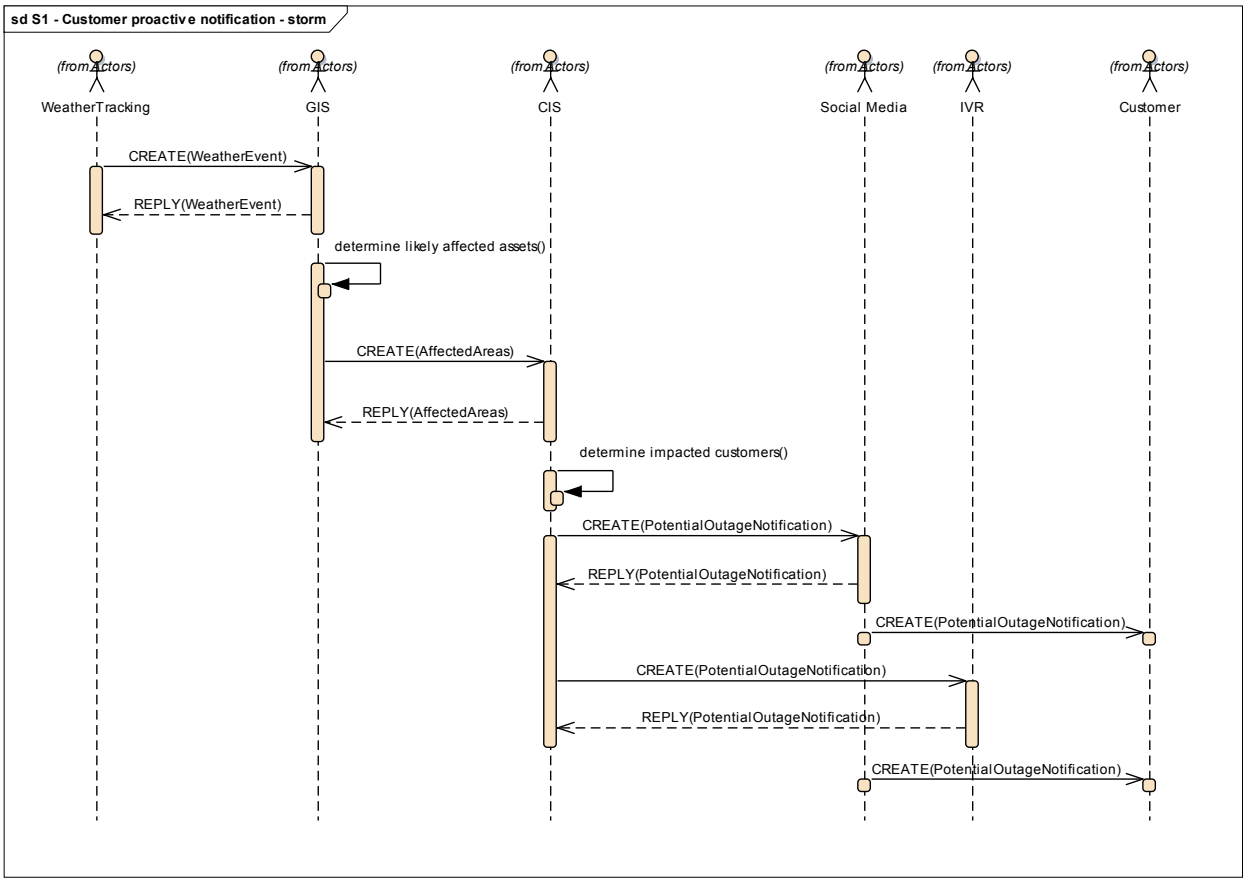


Figure 2-16
Unplanned outage notification, using storm tracking and social media (or traditional means) to get in front of proactive customer notification

3 Technical Details

Actor Name see Actor List	Further information specific to this Use Case
AMI HES	
GIS/OMS	Using the GIS with the OMS, in terms of storm tracking and analysis, the utility may already know where the traditional affected areas are, or be able to predict outage areas based on storm tracking.
IVR	Notification based on planned/unplanned outage may be sent via this medium.
Social Media	This actor encompasses channels such as Twitter, Facebook, or non-traditional communication examples such as text messaging.
Weather Tracking	This actor may be able to monitor storm conditions, and based on storm tracking and forecasts, provide information to a GIS so that it can determine the most likely assets to be impacted.

3.1 Preconditions, Assumptions, Post condition, Events

Use Case Conditions			
Actor / System / Information / Contract	**Triggering Event**	**Pre-conditions**	**Assumption**
	Service work	Meters are functioning normally. Power nominal.	
	Storm is tracking into an area	Meters are functioning normally. Power nominal.	

4 Step by Step Analysis of Use Case

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**
4.1	"Door Hanger"	CIS	Field Crew initiates planned work in an area	Nominal operation, service work is required in the area	Nominal operation
4.2	Broader Outage	GIS	Planned work that involves a switching scenario	Nominal operation, but planned work requires network reconfiguration.	Nominal operation

4.1 Steps – Normal

Scenario							
Scenario Name :	**Door Hanger, small, local planned outage**						
Step No.	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Informa-tion Producer (Actor)**	**Informa-tion Receiver (Actor)**	**Informa-tion Exchanged**	**Require-ments, R-ID**
1	Door hanger	The Field Crew working in the area may contact the customer before work is initiated.	Create Customer Notification	CIS	IVR, Social Media, Customer	Planned outage notification, date, time, duration of the outage	
2	Work Completed	Once the work is completed, if the customer has indicated a desire to be notified, another notification will go out to inform them that work has been completed	Create Customer Notification	CIS	IVR, Social Media, Customer	Notification of Power Restoration	

4.2 Steps – Alternative, Error Management, and/or Maintenance/Backup Scenario

Broader Outage (greater than the normal "door hanger" noted above							
Step No.	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
1	Planned work	Work that is broad enough to indicate a switching plan is required	Get Affected Customers	CIS	GIS	Customer locations	
2	Meter list	The CIS will create the list of affected meters and send this to the OMS for filtering.	Create Affected Meter List	CIS	OMS	Meter IDs	
3	Customer notification	This can use the same process for notifying customers as the normal 4.1 scenario	Create Customer Notification	CIS	IVR, Social Media, Customer	Planned outage notification, date, time, duration of the outage	

4.3 Steps – Alternative, Error Management, and/or Maintenance/Backup Scenario

Unplanned Outage							
Step No.	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements , R-ID**
1	Weather events	Weather service can provide notification and storm tracking service	Create Weather Event	Weather Service	GIS	Customer locations	
2	Determine affected areas	GIS determines based on tracking and historical analysis of service territory, a detailed list of likely impacted areas	Create Affected Meter List	CIS	IVR, Social Media, Customer	Date, Time, Location, potential expected duration, and potentially, the confidence in the outage likelihood.	
3	All clear Customer notification	This can use the same process for notifying customers as the normal 4.1 scenario, except that this is the "all clear" and/or an update on ETR	Create Customer Notification	CIS	IVR, Social Media, Customer	Updated ETR (if applicable) or the "All Clear" for customers that have not been affected.	

OMS Event Limiting

1.0 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Related business case	Base power outage
Scope	Communications from the OMS to other enterprise systems.
Objective	Determine the conditions under which the OMS communications may be throttled or discontinued.

1.1 Narrative of Use Case

Narrative of Use Case
Short description – max 3 sentences
Under storm conditions, communications to/from the OMS may overwhelm the bandwidth of other systems to handle new messages, impacting other systems; or the capability of the utility to respond to the message traffic.
Complete description
As part of outage analysis, the OMS may process events from smart meters, the IVR, SCADA, or other inputs. During a "blue sky" day this operation normally does not threaten the bandwidth, processing power of systems, or the capabilities of systems operators and dispatchers. However, during storm conditions the utility may want to take steps to either throttle the amount of events it receives, or adjust the algorithms it uses to perform the outage analysis. In extreme circumstances an operator may even choose to simply turn off the processing until crews have had a chance to deal with conditions in the field. Figure 2-17 (courtesy of Oncor), illustrates some of the findings from the operation of their AMI-to-OMS system during normal operations compared with storm conditions.

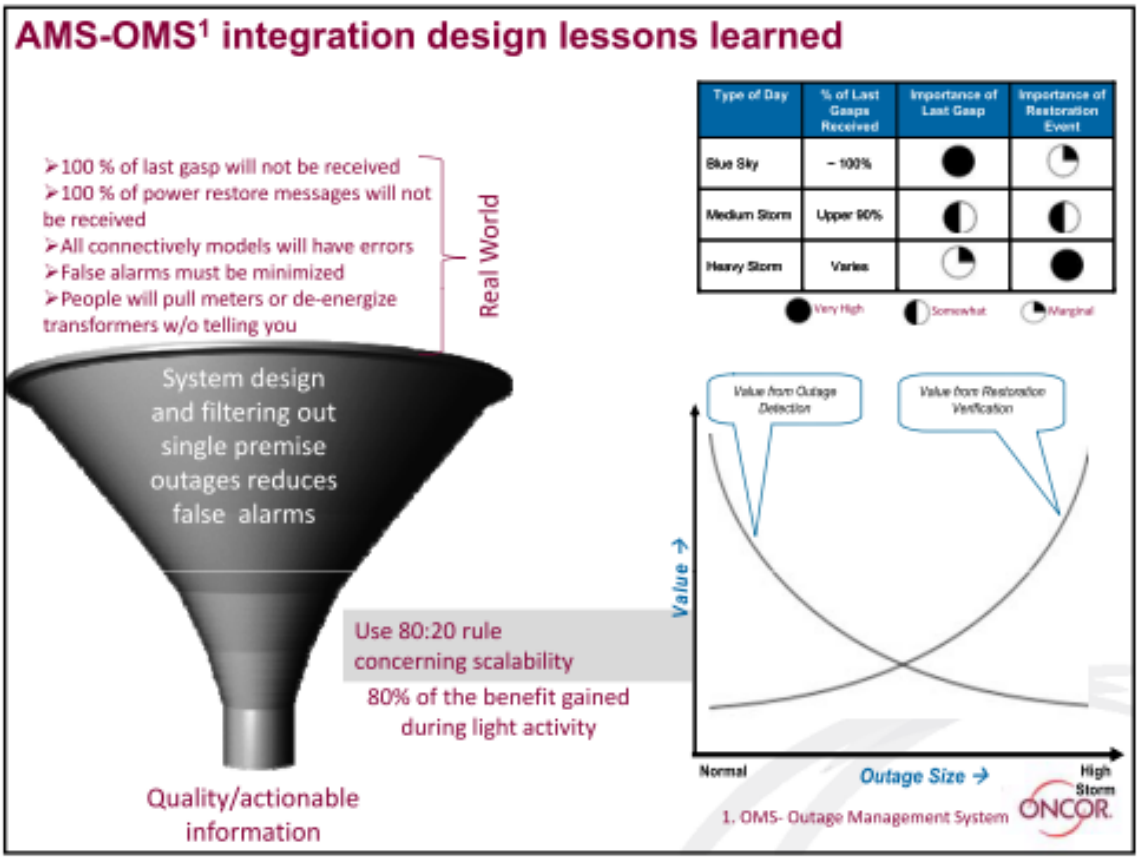


Figure 2-17
Oncor "lessons learned" from their AMI-OMS integration

2 Diagrams of Use Case

Figure 2-18 shows a sequence diagram that highlights both the adjustment of an algorithm on outage analysis and the more extreme option of turning the analysis off completely.

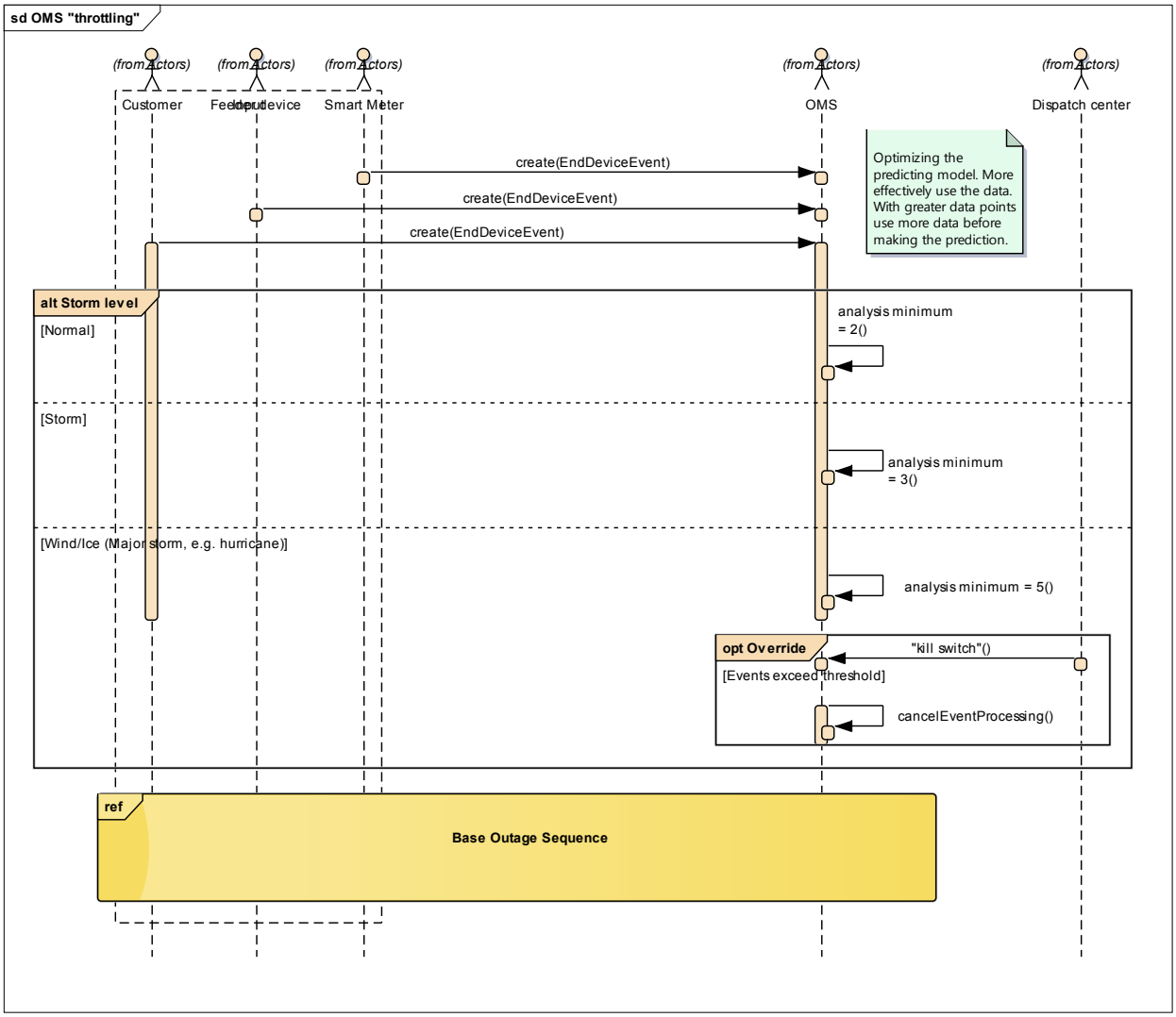


Figure 2-18
Sequence diagram that highlights both the adjustment of an algorithm on outage analysis and also the more extreme option of turning the analysis off completely

3 Technical Details

3.1 Preconditions, Assumptions, Post condition, Events

Use Case Conditions			
Actor/System /Information/ Contract	**Triggering Event**	**Pre-conditions**	**Assumption**
OMS	Storm conditions	Nominal operation	The utility has entered a storm mode where filtering criteria to limit the amount of messages received or processed by the OMS has started
Edge systems (IVR, AMI HES, etc.)	Storm conditions	Nominal operation	The utility has entered a storm mode where filtering criteria to limit the amount of messages received or processed by the OMS has started

4 Step by Step Analysis of Use Case

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**
4.1	Normal Operations	OMS	Event received from AMI Meter, IVR, Customer, SCADA, etc.	Nominal operation	Nominal operation
4.2	Storm Conditions	OMS	Event received from AMI Meter, IVR, Customer, SCADA, etc.	Nominal operation	Nominal operation

4.1 Steps – Normal

Scenario							
Scenario Name :							
Step	**Name of Process/ Activity**	**Desc. of Process/ Activity**	**Service**	**Info. Producer (Actor)**	**Info. Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
1	Event processing normal		create	IVR, SCADA, AMI HES	OMS	EndDeviceEvent	
2	Outage Analysis		Internal				

4.2 Steps – Alternative, Error Management, and/or Maintenance/Backup Scenario

Scenario							
Scenario Name :	**“Kill switch” scenario**						
Step No.	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
1	“Kill switch”	This is where the human actor determines that there is too much data coming in and turns off the interface	N/A	N/A	N/A	N/A	

5 Information Exchanged

Information Exchanged		
Name of Information Exchanged	**Description of Information Exchanged**	**Requirements to information data** **R-ID**
EndDeviceEvents	This is a standard CIM-based message (IEC 61968-9). MultiSpeak uses a similar method to send EndDeviceEvents (BlinkAlarmsNotification) and can also turn off events by sending a CancelEndDeviceEventMonitoring	

3
REFERENCES

1. IEC 61968-100 Application Integration Guidance for IEC 61968, www.iec.ch
2. IEC 61968-9 Meter Reading and Control, www.iec.ch
3. MultiSpeak Release Candidate v5.0.4, www.multispeak.org

A
ACTORS

Name	Actor Type	Description
AMI HES	Logical	Advanced Metering Infrastructure Head End System. This is the system that is responsible for command and control and event handling for the smart metering system.
CIM	Logical	Common Information Model. This is the UML representation of the common model used to manage the taxonomy that encompasses three IEC standards families: ICE 61968, 61970, and 62325.
DERMS	Logical	DER Management System – a utility data center system that is an "edge" system similar to an AMI HES. The DERMS communicates with various DER via IEC 61850 or DNP3 protocols and manages the communications with other back-office systems such as a DMS, typically using CIM or MultiSpeak based messaging.
DMS	Logical	Distribution Management System
GIS	Logical	Geospatial Information System – typically contains the specific asset location and nameplate capabilities of assets in the distribution system
MDMS	Logical	Meter Data Management System
OMS	Logical	Outage Management System. Responsible for outage analysis and responding to incidents.
Smart Meter	Physical	This is the physical meter that is on a premise. It contains a meteorology function and a communication function that allows it to transmit data to/from a collection point.
Weather Service	Conceptual	Utilities may use their own internal weather service, or contract with a third party for storm events/alerting, and storm tracking analysis.

B
NEEDED MESSAGES

Source	Destination	Message
SCADA	OMS	Notification of equipment issues (extension of CIM/MultiSpeak EndDeviceEvents This message already exists, the enumerations need to be expanded to include the range of SCADA devices
OMS	MDMS/AMI HES	Filter of meters known to be in an outage
CIS	MDMS/AMI Head-End	Notification of planned outage; list of meters to filter, begin and end date/times of the planned outage
AMI HES	CIS	Planned outage check; in the event of an outage check to see if this was a disconnect for non-pay or service in the area
CIS	Customer	Customer notification as to duration, location, date/time of planned outages
CIS	Customer	For unplanned outages, customer notification as to duration, location, date/time of planned outages, confidence of outage.
CIS	Customer	“All clear” for customers that are interested in the notification, either an updated ETR for customers that are out of power, or an “All Clear” for when storms have cleared the area.

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