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Customer Services and Distributed Energy Resource Management System Integration

2018 TECHNICAL REPORT

Customer Services and Distributed Energy Resource Management System Integration

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Abstract

This report describes the customer services interactions with a distributed energy resource management system (DERMS), using the standard International Electrotechnical Commission (IEC) 61968-8, Interfaces for Customer Operations. Its focus includes the interaction between distribution system operator (DSO) or third-party DERMS implementations and Customer Support's role in DERMS operations. This report explains the changes necessary to the standard's existing use cases and provides new use cases describing incremental messages as well as processes needed to support DERMS.

Keywords

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PRIMARY AUDIENCE: Customer service business architects

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KEY RESEARCH QUESTION

Current distributed energy resource management system (DERMS) activities focus primarily on DERMS functional technical capabilities and have not sufficiently considered Customer Support's role to define how customer processes participate in DERMS functions. This report identifies missing Customer Support processes in the existing Customer Support (International Electrotechnical Commission [IEC] 61968 Part 6) use cases in addition to new Customer Support use cases regarding DERMS group formation and dissolvement.

RESEARCH OVERVIEW

This report describes the Customer Support interactions with DERMS, using the standard IEC 61968-8, Interfaces for Customer Support. Its focus includes the interaction between distribution system operator (DSO) or third-party DERMS implementations and Customer Support's role in DERMS operations. This report explains the changes necessary to the standard's existing use cases and provides new use cases describing incremental messages as well as processes needed to support DERMS.

KEY FINDINGS

- IEC 61968 Part 8 is missing Customer Support interactions necessary to support DERMS use.
- New or modified use cases were identified to address the gaps in IEC 61968-8.
- Many use cases minimize or ignore Customer Support's participation in their scenarios. Awareness needs to be socialized with Standards development organizations need to be aware of how Customer Support may affect or direct their use case development.
- All parts of IEC 61968 need review to ensure that Customer Support is appropriately documented and incremental Customer Support services identified.

WHY THIS MATTERS

Too often, use cases are more focused on the technical aspects required to accomplish a scenario's goals—as a result, critical processes are overlooked or addressed only to a level of depth that satisfies the technical objectives identified in the scenario. This report evaluates use cases from a more comprehensive business perspective, which encourages looking at the associated business processes that need to be included in the scenario. Ignoring this approach means that more work must be identified later when attempting to integrate Customer Support process and information flows.

HOW TO APPLY RESULTS

This report provides utilities and solution providers with insight on how Customer Services can support retail DERMS and DER integration. The results of this research provide the basis for several common information model (CIM) message classes that will be used as part of EPRI interoperability tests. They will provide the basis for incremental Customer Services and DERMS integration research. The results of these activities will be used as part of the CIM's (IEC 61968 Part 8) standard development activities.

LEARNING AND ENGAGEMENT OPPORTUNITIES

- This report will be used to further the development of interoperability tests to demonstrate vendors' compliance to the standard.
- The results of this research will be used by the CIM Users Group to further DERMS interoperability standards development.
- EPRI's ongoing DERMS efforts will be enhanced by the results of this research.
- These results can inform solution providers' development efforts as DER and DERMS become a growing opportunity.
- This research shall continue for the next two years, identifying where Customer Services is a participant in various CIM use cases.

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Section 1: Introduction

This report identifies the customer services interactions necessary to support a distributed energy resource management system (DERMS), using the standard IEC 61968-8, Interfaces for Customer Operations [1]. These interactions modify the existing use cases by adding incremental message flows that were either missing in the standard or are needed to support DERMS. These additions are detailed in this report.

This report does not go into the details of the impact of DERMS on grid operations or its architectural deployment strategies. Individuals interested in these details should refer to the following EPRI reports:

- 3002013049, *Understanding DERMS* [2]
- 3002009553, *Structuring Distribution Management Systems: DMS Applications for Accommodating High Penetrations of Distributed Energy Resources and Microgrids* [3]
- 3002010511, *A Guidebook to Centralized, Distributed, and Decentralized Intelligence* [4]

Current research on DERMS is focused primarily on the definition of DERMS, how DERMS may be used to offload workloads from a distribution system operator's (DSO's) centralized operations, and the ability of DERMS to virtualize groupings of distributed energy resources (DER) into logical entities independent of their location or other organizational criteria—for example, type of DER. These virtualized DER entities may be managed by a DSO or a third party that manages DER instead of the utility. Third-party entities may include retail aggregators, community solar installations, and microgrids. This report describes DERMS deployment and ownership options along with DERMS implementation reference architecture.

Section 2: DERMS Deployment and Ownership

This report focuses on the customer support requirements for a DERMS. DERMS are, by design, meant to support flexible implementations, allowing different deployment and ownership constructs. To support this flexibility, the relationship between customer support capabilities and DERMS varies according to the implementation architecture.

Three Deployment Options

Three deployment examples illustrate the importance of use cases.

Centralized DSO DERMS

The most straightforward deployment is one in which a DSO uses a centralized DERMS, which may also be part of a distribution management system (DMS) along with the DSO's centralized customer support ecosystem, as shown in Figure 2-1. In this scenario, the DERMS is acting as a front-end to the DMS and passing information that is defined by DER grouping defined by the DMS (Operations). (See *Understanding DERMS* [2] for detailed discussion on this topic.)

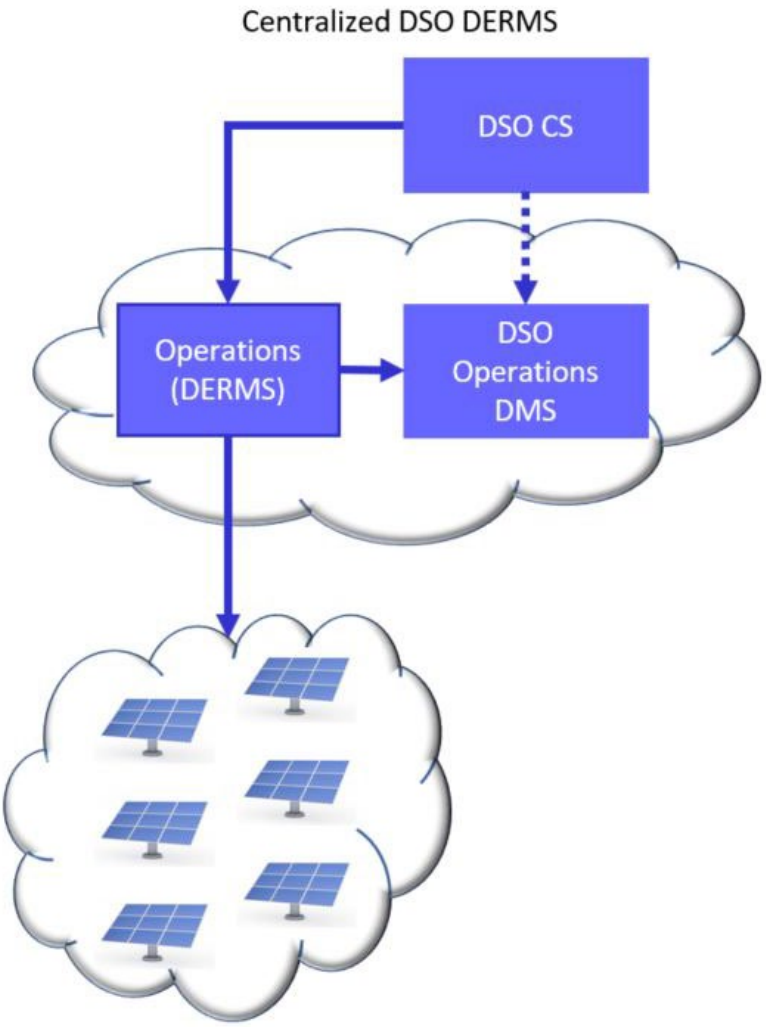

Figure 2-1
Centralized DSO DERMS

Distributed DSO DERMS

The second DSO-centric deployment is one in which a DSO uses distributed DERMS to directly manage retail customer DER. This option allows the DERMS to be closer to the physical DER installations to handle issues such as latency and to support islanding management and restoration procedures. A distributed DSO DERMS deployment option requires a centralized DMS and customer support ecosystem (see Figure 2-2).

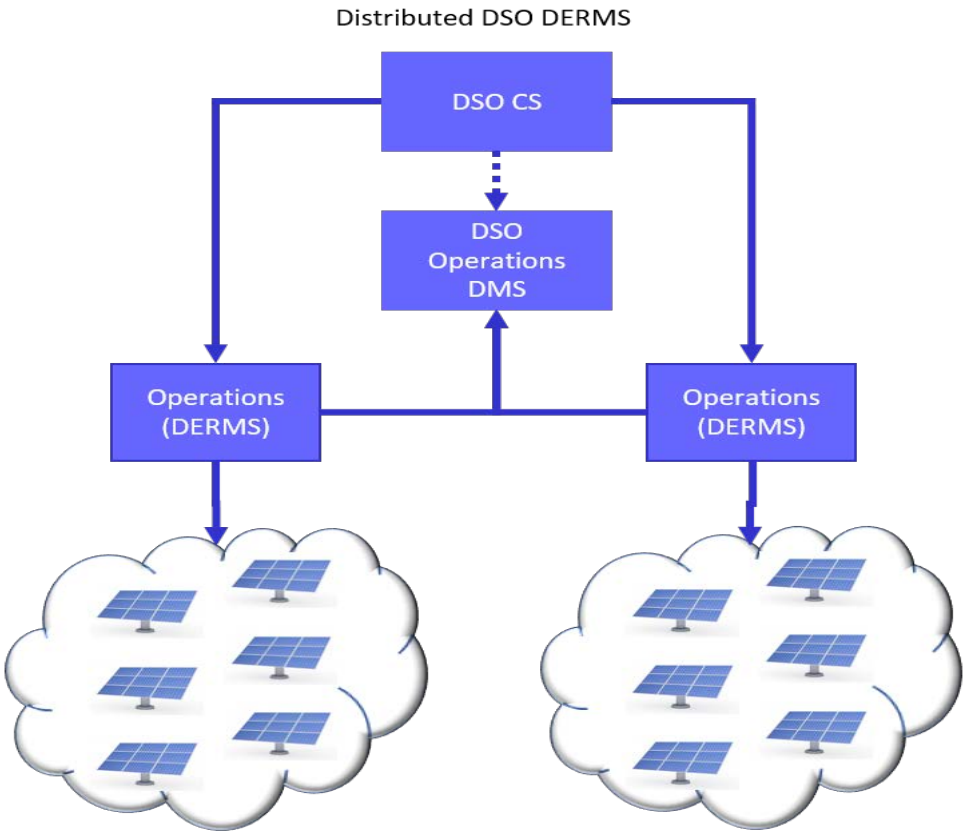

Figure 2-2
Distributed DSO DERMS

Third-Party DERMS

The third type of deployment is one in which a third party owns—or has retail customer contracts to provide—a virtualized pool of DER. These DER may or may not be on the DSO's distribution network; an example is a customer with a single utility service point, such as a military base, microgrid, or industrial or university campus. In Figure 2-3, configuration of the third-party provider has a customer support capability like a DSO's to manage customers' contracts, allowing the third party to map DER groups to discrete customers as well as provide payment and invoicing capabilities. A third party may also have a DMS-like system; however, this capability may well reside in its DERMS. For this report, we are disregarding what DMS-like capabilities a third party's DERMS implementation may be able to perform, focusing instead only on the relevant customer-service-to-DERMS interaction.

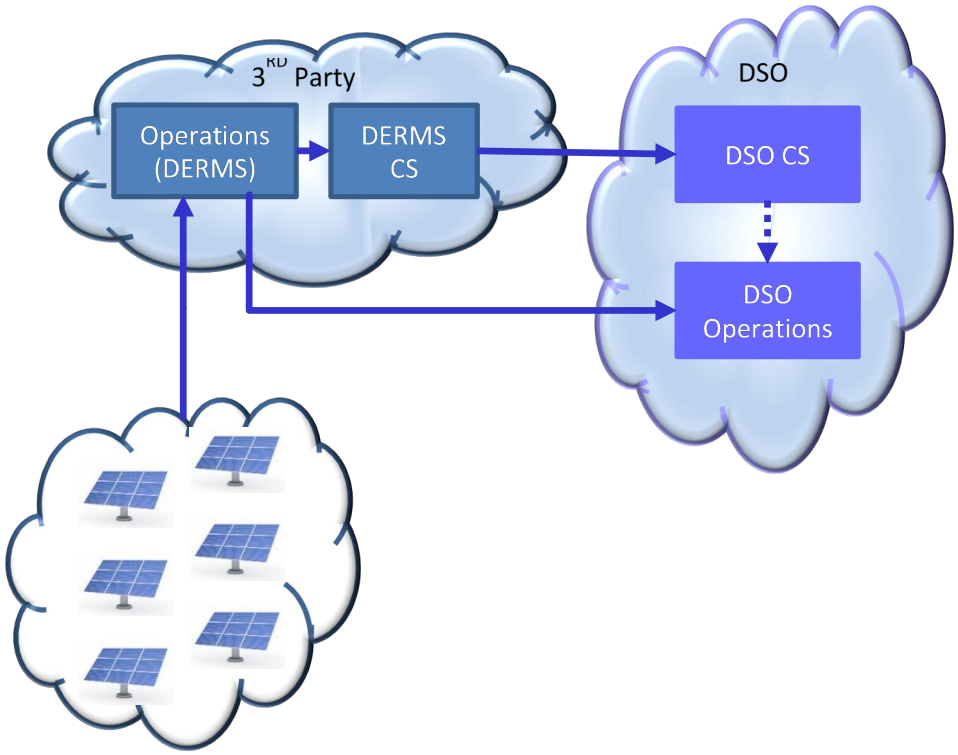

Figure 2-3
Third-Party DERMS

Section 3: DERMS Implementation Reference Architecture

Each DERMS implementation changes the relationship among the DER assets and customer in terms of monitoring and control responsibilities. These relationships and the corresponding information exchanges between the functional entities for two deployment approaches (the DSO centralized and distributed DERMS) are described next. The reference diagrams show the information flow between functions; the sequence of the information flow is implied.

To document the use case diagrams, EPRI used the Open Group's ArchiMate language to describe the use cases' attributes. This language is documented in the Open Group's ArchiMate landing page [5]. Rather than relying on static representations such as Microsoft VISIO, PowerPoint, or other vendor depiction technologies, ArchiMate provides a repository that allows multiple views of the same information using standardized elements and methodology for employing those elements in a standardized way—which supports future development and interoperability efforts.

DSO Owned DERMS Reference Architecture

From a reference architecture perspective, the two DSO deployment approaches, as shown in Figure 2-1 and Figure 2-2, are identical. Therefore, only one diagram is used to describe both deployment approaches (see Figure 3-1).

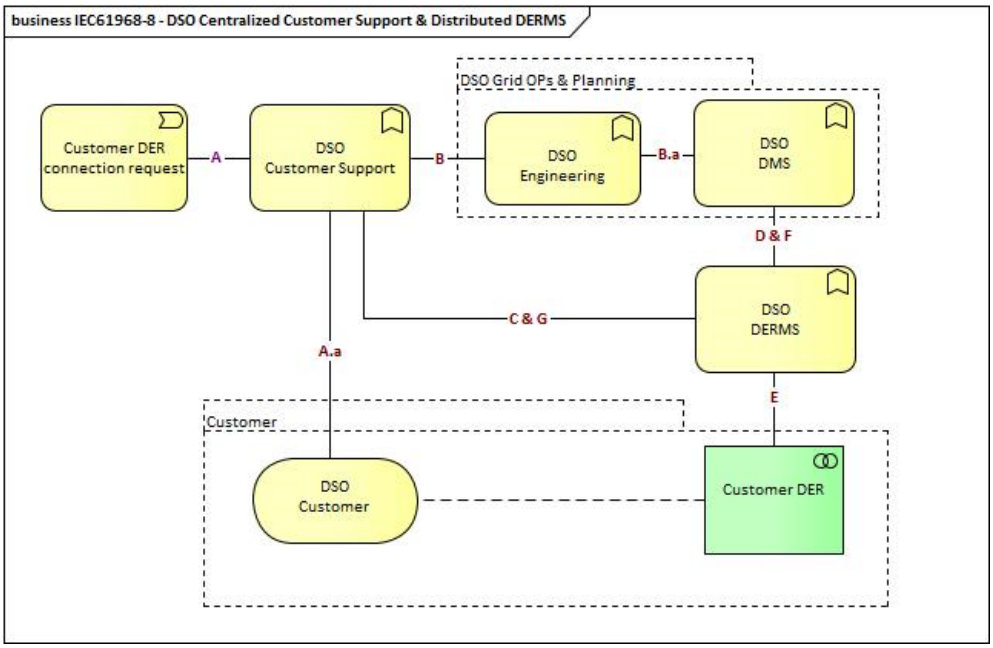

Figure 3-1
DSO Centralized Customer Support and Distributed DERMS

DSO Centralized Customer Support and Distributed DERMS

In this deployment scenario, the contractual arrangement is directly between the customer and the DSO. A notable change from the existing IEC 61968-8 standard is that Engineering was added to the diagram, representing the fact that Engineering must approve the request to connect DER—considering whether it has the capability to perform according to the tariff and whether its location on the grid can accommodate its capabilities. This determination also requires modeling by Operations to provide Engineering with the expected results. Once Engineering and Operations approval is obtained, the customer receives an acknowledgment that its DER can be connected.

If the DSO allows the customer to select multiple types of tariffs under which they may operate, the utility must track which tariff (grouping) is being used.

Separately, the DSO must track when a DER is part of a group for auditing reasons.

Figure 3-1 shows the relationship among functions but does not show the flow sequence. The relationships are indicated by letters as follows:

A. A DSO customer must register its DER and accept the DSO tariff (service agreement) requirements. The agreement is provided to the DSO Customer Support function.

    a. The DSO Customer Support function notifies the customer when its DER application is accepted.

B. The DSO Customer Support function provides the DER details to Engineering, including planning and modeling, before approving the DER's connection.

    a. DSO Engineering coordinates its approval with DSO Operations to ensure that the DER request can be accommodated once DER are connected to the grid. If not, approval may be held until the appropriate network upgrades are made to support those DER.

C. The DSO Customer Support function provides the DER details to DSO DERMS for monitoring and control.

D. The DSO DMS function forms or dissolves groups and informs the DSO DERMS of the groups and their constituents.

E. The DSO DERMS manages individual DER assigned to it and the groups in which each distributed energy resource participates.

F. The DSO DERMS acquires DER usage information and sends the group' aggregated performance to the DSO DMS.

G. The DSO DERMS acquires DER usage information and sends it to the DSO Customer Support function.

H. The DSO Customer Support function issues DER participation and production information to the DSO Customer.

DSO Connected DER and Third-Party DERMS

The implementation example shown in Figure 2-2 is more complicated because the DSO owns the distribution network and must continue to ensure the safety and reliability of the grid. In this case, the contractual arrangement is between the customer and the third-party provider. This scenario excludes microgrids and other situations in which the DSO does not own the electrical network behind the DSO's service point.

The DSO-connected DER and third-party DERMS deployment resemble the previous deployment type in that the utility sees only the service point and other abstracted nameplate information. An important difference between this and the previous deployment example is that discrete DER information is retained by the DSO to:

- Document the DER connection request application and its electrical connectivity to ensure that the DSO has an accurate model of the distribution network to safely operate the network.
- Ensure that the thirty-party provider has a record of the DER's DSO registry and other pertinent information about the installation required by the DSO's connection agreement.

- Ensure that the utility can track which third-party provider owns the relationship with the DSO.

Generally, the flow is like that of the DSO Centralized Customer Support and Distributed DERMS in that the interplay of DSO Customer Support and Engineering/Operations is the same. Although the third-party's Customer Support function must track the same items as the DSO Centralized and Distributed DERMS, the flows diverge—the third party must map its customers' DER to a group. The third party decides which customer becomes a member of which group (the customer does not know, or care, if it is a member of a group), based on group formation criteria such as size or when resources can be dispatched. In addition, the third party must track customer invoicing and provide information on the groups identified to the DSO. For payment, the Third-Party Customer Support informs customers only when their DER were dispatched and the amount of power they dispatched.

As with the previous diagram (Figure 3-1), this reference diagram in Figure 3-2 shows the relationship among functions and does not show the flow sequence.

The relationships indicated by the letters in Figure 3-2 are as follows:

A. A DSO customer must register its DER and accept the DSO tariff (service agreement) requirements. The agreement is provided to the DSO Customer Support function.

    a. The DSO Customer Support function notifies the customer when its DER application is accepted.

B. The DSO Customer Support function provides the DER details to Engineering, including planning and modeling approval.

    a. DSO Engineering works with DSO Operations once DER are connected to the grid.

C. The DSO Customer Support function provides DER details to Third-Party Customer Support to ensure that DER groups and individual DER are being mapped internally by the third-party provider.

    a. The DSO DMS contains the DER's performance characteristics for situational awareness, for example.

D. The DSO DMS function forms or dissolves groups, and the third-party DERMS determines the individual DER that can fulfill the group formation requirements.

E. The third party's DERMS informs the Third-Party DSO Invoicing function regarding the DER participants that make up a group.

F. The Third-Party DSO Invoicing function maps DER groups to the individual DER and to their respective contracts and sends that decomposition to the Third-Party Customer Invoicing.

G. The Third-Party DERMS function passes the group's individual DER performance information to the Third-Party Customer Invoicing function.

H. The third-party DERMS acquires DER usage information.

I. DER usage information is sent to the Third-Party DSO Invoice function to be aggregated to the DSO according to group contract details.

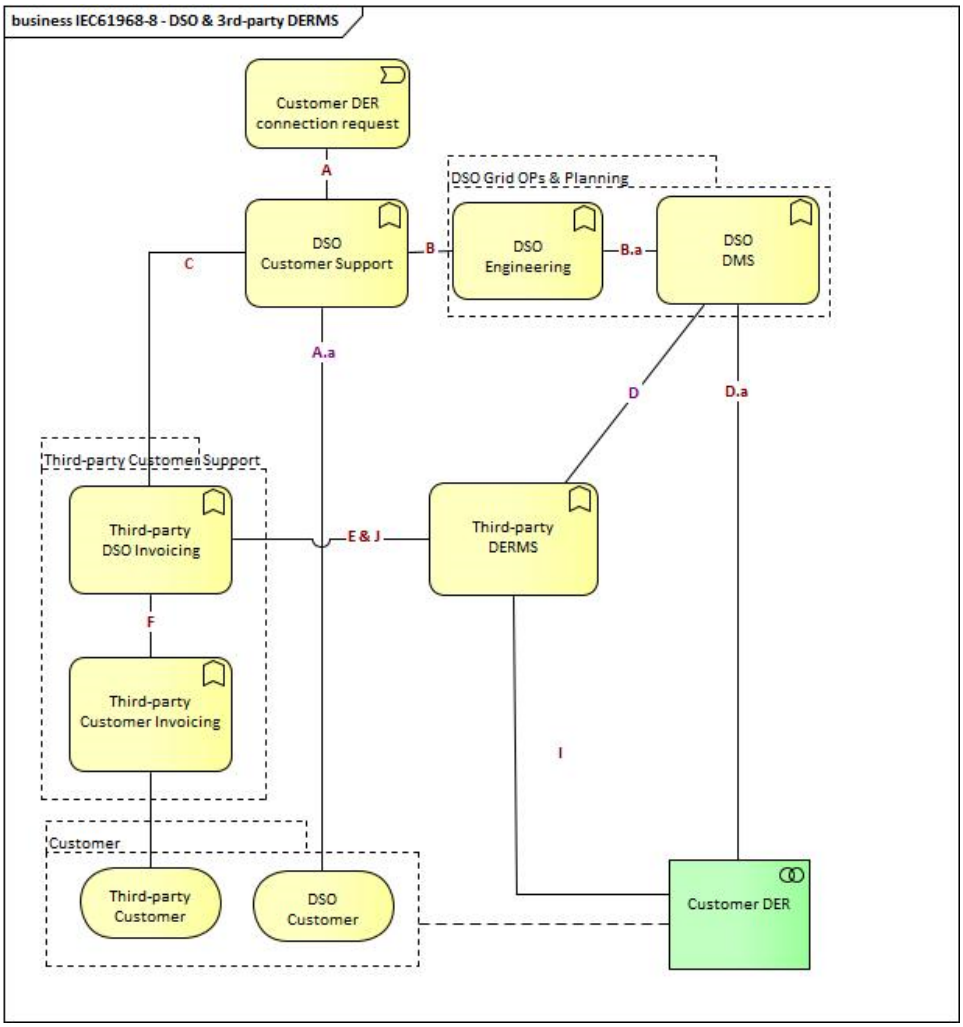

Figure 3-2
DSO and Third-Party DERMS

Section 4: Reference Document: IEC 61968-8-Use Cases

The IEC 61968 and Common Information Model (CIM) Users Group's focus on the interaction and integration requirements to operate and maintain the grid and energy markets. The existing IEC 61968 Part 8 (Customer Support) use case and capabilities were created by other working groups to support their respective integration requirements. This report expands the existing Customer Support use cases, adding incremental detail to the processes along with what is new in requirements to support a DERMS.

The following sections are labeled according to the use cases described in the IEC 61968 standard. They are used here for traceability back to the standard.

Section 5.4 Service Request Use Case

Although complete for the requirements of a DERMS, this use case glosses over rooftop solar installs as Enroll/De-Enroll. In a customer program, this is inadequate because of the customer's electrical connectivity (capable of injecting power into the grid). When this version of IEC 61968-8 was written, DER programs were seen as contractual without addressing the safety-related issues that rooftop DER pose (or safety issues of any other customer power injection facility, for example, batteries and wind).

In addition, the DERMS concept did not exist at the time the service request use case was developed. Modifications to the standard's existing use case, in the form of additional requirements, are needed to address these two considerations. A list of the service requests by customer in the standard are shown in the original standard text (indented and italicized).

5.4.1 Service Request General

Customers initiate service requests as their main point of contact with the utility. Service requests by a customer may include but are not limited to:

- Request to turn an existing service on or off (move in/move out, seasonal, etc.)
- Request a new service (electrification of a garage, new house, etc.)
- Request investigation into power quality or other concern about an existing service (not a trouble or outage call)

- Enroll or de-enroll in a customer program (demand response, etc.)
- Account issues (billing inquiries, high bill complaints, etc.)

To support DERMS in this use case, there are several incremental service request requirements:

- Customer obtains/selects appropriate tariff agreement for the service. The tariff selected establishes a customer relationship that can survive a potential change in the customer's third-party provider.
- Register DER nameplate capabilities and physical connectivity. This ensures that the DSO can support the DER on its grid from a capability perspective.
- If the tariff requires it, there must be a requirement to communicate with the DER inverters for monitoring (and possibly controlling) them. This ensures that the DER can be operated safely.
- The DSO's Customer Service function must communicate with the DERMS Customer Support function to inform DERMS Customer Service that the customer's DER are approved.

The existing flow in Section 5.4 Service Request indicates only that the work management system (WMS) is interacting with the Customer Support function. The revised use cases add steps that were missing from the original use cases: 1) having Engineering ensure that the installation does not cause grid issues, 2) having a work order issued to verify that the installation meets the tariff terms before it is connected to the grid, and 3) notifying the customer that the request is completed.

The modified flow is shown in Figure 4-1.

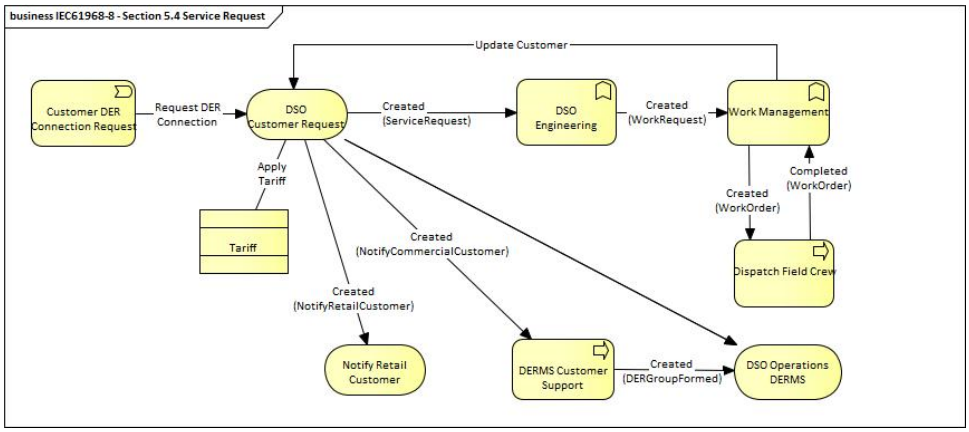

Figure 4-1
Section 5.4 Service Request

Section 5.5 Service Order Use Case

Service Orders are needed for issues related to the rooftop DER that a DERMS detects. However, a DERMS does not affect the workflow or messaging defined by this use case. The existing verbiage and information flow do not need modification. For DER connected to a DSO's grid, these Service Orders would use the same process regardless of whether a DERMS is involved. In cases in which a third party owns the electrical network that is behind the DSO's service point, the DSO will not see the DER issue.

According to the existing standard, following are the cases in which a Service Order is required.

> A service order is an IEC 61968-6 message and is created when customer service needs to have some work done at a customer premise. The service order is created as one possible response to a service request.
>
> The service order contains the information for a field service technician or crew to perform the work required by the customer such as:
>
> - Service connection/disconnection
> - Power quality/high bill investigation
> - Meter service, such as meter replacement

The existing message format for Section 5.5 Service Order is located in IEC 61968-6 and remains unchanged.

Section 5.6 Work Request Use Case

Work Request was created to support an advanced metering infrastructure (AMI) requirement for IEC 61968 Part 9. The team that created these use cases for Part 8 (Customer Support) considered only what was needed to complete its AMI use cases for Part 9. IEC recognizes this shortcoming, and EPRI is leading IEC and CIM Users Groups' efforts to move use cases in which Customer Support is the originator to Part 8.

The existing Work Request flow is incorrect and is inconsistent with the text describing the flow. It is missing Engineering work that must be accomplished before work begins. It is also missing any notification to the customer. According to the existing standard, Work Request is part of Service Order.

Below is the existing standard's text for this use case:

> The work request is the main point of contact between the customer service organization and the engineering or maintenance organization. Figure 4-2 shows the work request message exchange between the CIS and WMS.

Typical reasons for customer service to create a work request include:

- A new customer wishes a new service to be created, such as when a new house is built
- An existing customer wishes to extend their service, such as adding power to previously unpowered garage
- An existing customer wishes to modify their service, such as upgrading from 100 Amp to 200 Amp service

The modified flow is shown in Figure 4-2.

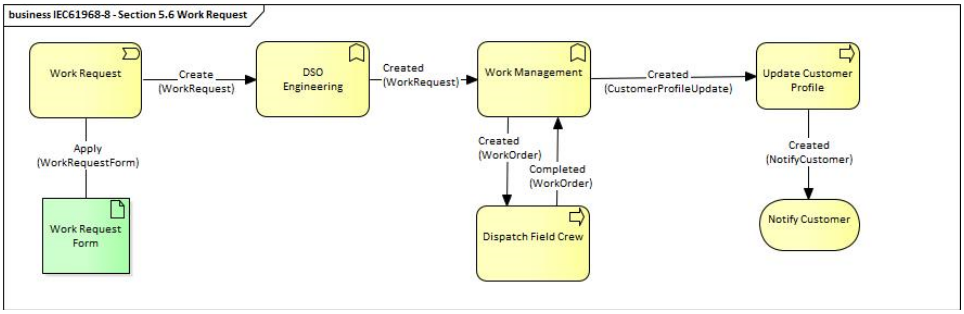

Figure 4-2
Section 5.6 Work Request

The existing message format for Section 5.6 Work Request is located in IEC 61968-6 Maintenance and Construction. The formats for the proposed flows are to be developed.

Section 5.7 Customer Agreement Use Case

Customer Agreement was created to support an AMI requirement for IEC61968 Part 9. As with Work Request, the team that created these Part 8 use cases considered only what was needed to complete its work for AMI.

This use case is incrementally updated to include tariffs because they are the legal/regulatory contract that a customer must agree to adhere to. This report uses the California Public Utility Commission (CPUC) [6] *tariff* definition, which is as follows:

> A tariff is a pricing schedule or rate plan that utilities offer to customers. Along with the pricing plan, there may be certain rules for each tariff a utility offers, such as the times or seasons when prices will vary, eligibility for a tariff, when/how a customer can join or leave the tariff, what type of meter must be installed, and more. Other things that can be found in a utility's tariff book include sample forms that customers may be required to fill out, rules for applications for service, bill adjustment, low-income programs, and service area maps.

A Customer Agreement is simply the customer acknowledgment to the tariff's terms. For third-party DERMS, a customer agreement is necessary to define a third-party's customer DER details to ensure that Planning and Operational considerations are captured and that the DER are identified independently from the relationship that customer has with a third-party DERMS provider. For these reasons, the existing standard's text is incorrect:

> Not all utilities require a customer service agreement; however, utilities will assign the rate appropriate for the requested customer connection.

The proposed modified flow is shown in Figure 4-3.

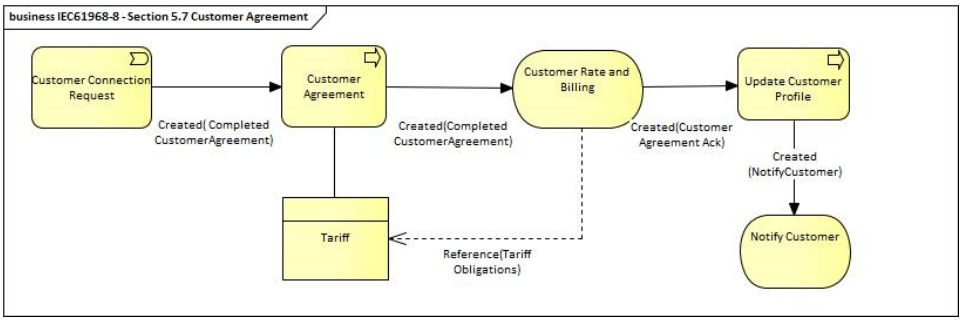

Figure 4-3
Section 5.7 Customer Agreement

Section 5.7.2 Message Format, in the documented flow from tariff to customer agreeing to/enrolling in it, does not require any changes.

Section 5: New DERMS Related Messages for Part 8

Part 6 of IEC 61968 discusses the formation of groups; however, it does not include DSO Customer Support messages to inform a DERMS Customer Support function when a group or individual distributed energy resource is added to a group when it is formed, dispatched, or dissolved.

Group Formation/Dissolvement

Forming a DER group begins with a request either from a third party that wishes to participate in a tariff by offering a portion of its DER fleet that can provide the tariff's requirements or from a DSO that uses DERMS to manage DER in its network. That request is sent to the DSO's Customer Support group to ensure that it complies with the tariff rules (a prerequisite is that the third-party's DER members are registered with the DSO). The DERMS (either the DSO's or third-party's) Customer Services receives approval to form the group, updates its contracts, and notifies Operations that the DER group is to be added to the DERMS (see Figure 5-1).

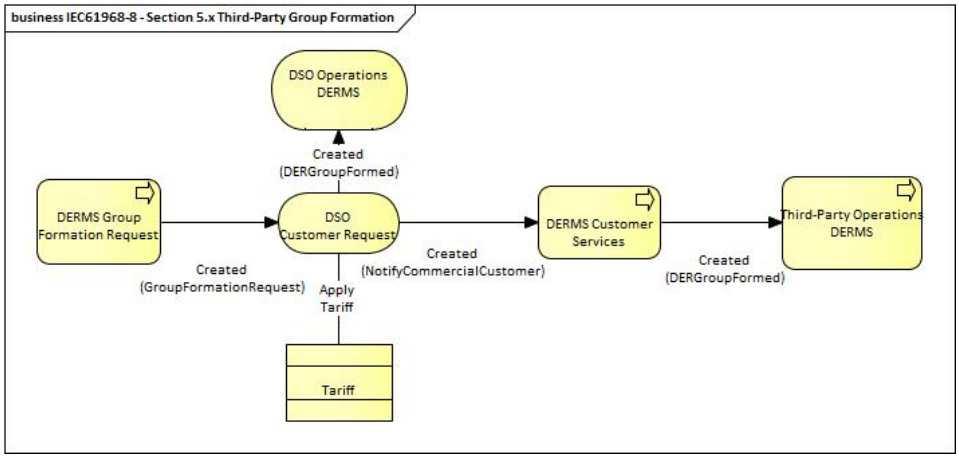

Figure 5-1
Third-Party Group Formation

Dissolving a DER group begins with a request from a third party or the DSO for groups defined internally for use by a DSO-owned DERMS to discontinue participating in or changing a group's members. That request is processed by the DSO Customer Request function (described in Figure 5-2) and sent to the DERMS (either the DSOS's or third-party's) Customer Service function, where it dissolves the group or individual DER participants in that group and updates its contracts. DERMS Customer Service then notifies DERMS Operations that the group, or specified DER in the group, is no longer available (see Figure 5-2).

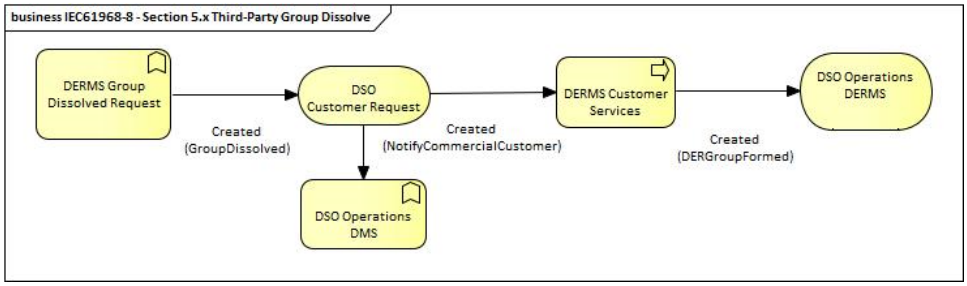

Figure 5-2
Third-Party Group Dissolve

Section 6: Summary

This initial effort defines the first set of use cases within Part 8 that contain DERMS/Customer Support integration requirements. In 2019, this effort will continue by addressing the following:

- Defining the message formats that correspond to the use cases described in this report.
- Developing an interoperability test script for a 2019 EPRI-hosted interoperability event.
- Submitting the resulting set of changes to IEC's Working Group 14 for discussion and inclusion in the standard. This may include scheduling conference calls and face-to-face meetings on these use cases to work through any suggested changes that may arise.
- Expanding the scope to examine other potential IEC 61968 Part 9 (AMI) use cases that require DERMS and Customer Support.
- Participate in IEC task force efforts on DERMS/DER development calls to ensure that Customer Support integration is represented.

Section 7: References

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