The Interconnected Roles of DERMS and ADMS

A deep dive into complementary management systems

mPrest

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1 Executive Summary

The large, monolithic applications built over the last 30 years to support Distribution Management Systems (DMS) functionality are not suitable for the new paradigm of Distributed Resource Management Systems (DERMS) opportunities.

While advanced DMS (ADMS) have been available from a handful of vendors for approximately the last ten years, DERMS applications are new and are emerging as the system that will manage the growing impact of DERs.

While DERMS utilizes some of the same infrastructure as an ADMS, DERMS provides management of distinctly separate use cases that either aren't relevant to DMS/ADMS or would dilute the focus and possibly completely overwhelm the core purpose of a DMS.

ADMS must change and evolve to be DERMS aware and support DERMS functionality, but ADMS cannot act as a customer enablement platform, cannot scale to the level required by the DERMS market and cannot offer the response times expected from a DERMS system. This is not merely a technological infrastructure issue, but a philosophical and architectural issue as well. DERMS should not operate under an ADMS architecture — it should be integrated into the ADMS and share data with it.

This White Paper highlights the technology and business drivers that are transforming electric utilities, and the challenges they face in remotely monitoring and controlling an ever-increasing number of grid assets. The White Paper differentiates between the different distribution management systems, and explains each one's unique role and interconnection with the other. It explores the ideal way to offer a truly orchestrated platform with a DERMS that integrates with ADMS, demand response and other systems via a "Systems of Systems" platform — such as the mDERMS system from mPrest, a microservices-based "system of systems," built with an appropriate architecture to analyze and manage millions of DERs.

Transformation Drivers at Electric Utilities

Electric utilities are experiencing an unprecedented rate of change in technologies and business drivers. The rapidly decreasing cost of renewable energy, especially PV, coupled with the decreasing cost of battery storage is changing the utility system from one with a few, very large centralized generation centers that often run continuously to one with a very large number of small, edge-connected generators that may operate sporadically.

Grid modernization is underway and is exemplified by the transformation of manual processes and 100-year old operations strategies into smart, automated systems. These systems support millions of devices communicating to central control and edge control systems for maximum efficiency and maximum renewables integration.

The figure below focuses on business and technology drivers for distribution utilities' digital transformation.

Digital Transformation at Utilities

Technology and Business Drivers

The Internet of Things
- Smart Utility Devices
- Smart Electronics
- Smart Homes

Big Data

Edge Computing

Cloud vs On-Premise

Very High Growth of Renewables
- Cost is Decreasing
- Desire to Eliminate / Reduce Carbon Footprint

Consumer Choice
- CCAs, Retail Competition
- "Prosumers"

Desire to Lower Costs

Desire to Increase Efficiency

2 Utilities are Getting Smart about Control

To manage this new paradigm, utilities are investing in "smart" device technologies that enable them to remotely monitor and control more of their grid assets. Switches, capacitor banks and transformers that can be remotely monitored and controlled enable better management of voltage profiles and faster restoration of customers when faults or damage occur in the system. However, with the ever-increasing number of edge-connected devices such as Distributed Energy Resources (DERs) — including generation, storage and electric vehicles — and programs like demand response (DR), virtual power plants (VPPs) and microgrids, most of which are not owned by the utility, this isn't enough.

The emerging technology to manage edge-connected devices and programs is generally called DERMS (Distributed Energy Resource Management System). The challenges of the modern grid will change the focus of distribution operations from a one-way flow of power to a distribution system that includes peer-to-peer trading and market influences not seen today.

The New Grid Challenges

- Multi Directional Energy Flow
- Millions of Energy Sources
- Addressing 'Duck Curve' Challenges
- Realtime Asset Health
- Integration
- Cyber and Physical Security
- DER Flexibility & Susceptibility
- Prosumer Trading
- Dynamic Markets
- Evolving Policy and Regulations

3 DERMS: A New Focus

The Smart Electric Power Alliance defines DERs as "physical and virtual assets that are deployed across the distribution grid—typically close to load, and usually behind the meter—that can be used individually or in aggregate to provide value to the grid, individual customers, or both."

Distributed Resource Management Systems (DERMS) and Advanced Distribution Management Systems (ADMS) will be primary applications for electric utilities now and in the future. While ADMS has been available from a handful of vendors for approximately the last ten years, DERMS applications are new and are emerging as the system that will manage the growing impact of DERs.

Aside from managing DERs, DERMS augments existing utility systems and provides the scalability and adaptability to manage systems that may be dominated by assets that are not utility owned or controlled. While DERMS utilizes some of the same infrastructure as an ADMS, DERMS provides management of distinctly separate use cases that either aren't relevant to DMS/ADMS or would dilute the focus and possibly completely overwhelm the core purpose of a DMS.

Every ADMS vendor is offering or planning to offer DERMS as an extension of their existing platform. However, while DERMS data plays a role in the ADMS mission and ADMS systems must be modified to become "DER aware," most DERMS applications are well outside of the ADMS focus and should be managed separately for many reasons which are discussed in this paper.

Is ADMS the Best Tool for Managing DERs?

A key question that is still being discussed in the industry is how best to address the new issues and opportunities that DERs present. Some organizations have tried to augment existing demand response programs and systems (i.e. migrating a DRMS into a DERMS platform), some have explored additional applications for the ADMS (i.e. including a DERMS module as part of the ADMS), and even others have tested the implementation of DERMS functionality working from a basic energy storage control platform, system planning tools, or even from a virtual power plant aggregation system. Some vendors are building and deploying DERMS tools built from the ground up to supply the needed applications to manage DERs in the best interest of system operators, energy retailers, DER owners and aggregators.

The distillation of these considerations is often summarized as "should I rely on my ADMS to provide all of the DERMS capability I will need now and in the future?" or "should I have a separate DERMS to provide the functionality specific to DER issues and use cases" (with tight integration with the ADMS and its network model)?

To answer this question, a look at the primary use cases for ADMS and DERMS is useful.

4 DERMS vs. ADMS

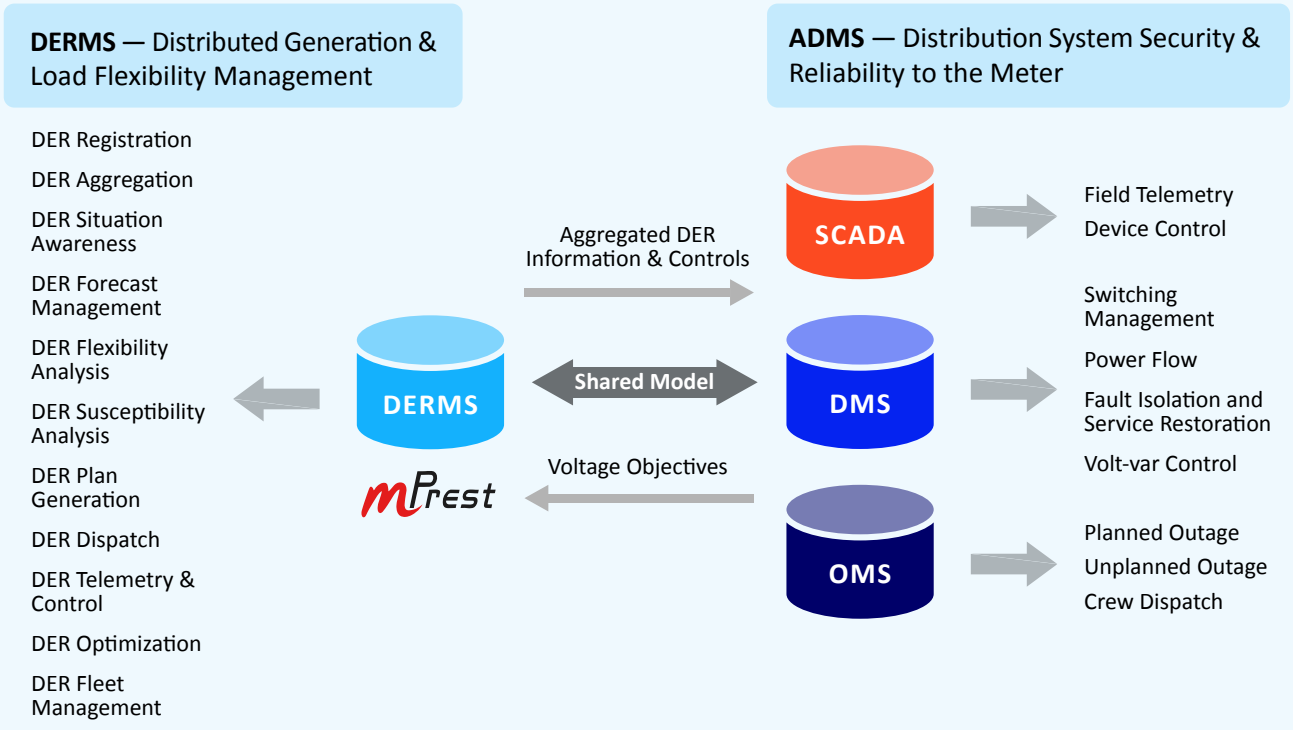
Grid modernization is increasing the numbers and types of systems and services that must be managed by operations. The primary goal is to "keep the lights on" with a secondary goal of restoring power as quickly as possibly following an outage due to weather, accidents, or equipment failure. As the number of "smart" devices has increased, so has the complexity of managing communications networks, data centers, applications integration and security and reliability of critical control systems that must operate 24x7.

As a result of this, operations and IT staff have become knowledgeable in each other's expertise to create a synergistic capability of installing and maintaining these complex systems.

The graphic below illustrates some basic requirements of DERMS and ADMS systems, as well as some of the common or shared data they both may utilize.

DERMS and ADMS

DERMS and ADMS are separate applications. Each needs to be aware of and able to support the other.



5 Role of DERMS

The primary role of a DERMS is to manage the DER-specific information flows. The full lifecycle of an individual DER is tracked and managed from the time a DER is registered and comes online (or is unregistered/uncontrolled and added to a customer's system) until the DER reaches the end of life and is retired. One critical consideration is the scaling that may be required for DERs. While the ADMS may track the characteristics of individual customers (or meters) that run into the millions, each customer can represent multiple DER types, including one or more demand response (DR) devices (A/C, water heater, pool pump, etc.), residential or commercial PV, energy storage batteries, and more, which may be in the tens of millions.

The DERMS must track the location, characteristics and rules for any usage of these devices and programs, as well as potentially provide measurement and verification when they are used as a resource. It is also critical that the system understand and be able to forecast uncontrolled DERs' operations and impacts on the system so that these can be taken into consideration when switching as well as when planning the dispatch of controllable DER/DR.

DER management functions include both program activity like demand response and EV charging dispatch management, as well as the forecasting, monitoring and potential dispatching of devices that have smart 4-quadrant inverters and battery storage. The analysis and dispatch of these resources often involve competing objectives that have different values to different stakeholders.

Having the ability to provide multi-objective function optimization analysis that considers and properly addresses the value to all stakeholders is important to DER dispatch planning, but not necessarily a key issue for an ADMS, which focuses on reliability and security of the distribution system.

Another key aspect of a DERMS system is that of resource forecasts and schedules. As most DERs are not managed or telemetered, AMI/MDM analysis is used to locate unregistered DERs and understand their operating behavior. This information is used to generate disaggregated load and DER forecasts that are necessary to ensure proper system operation and analysis.

Finally, DERMS manages resource allocation over time, creating forecasts and flexibility analysis that is used to create a dispatch plan (typically for the next 24 hours). DERMS provides an optimal utilization of resources and ensures fair consideration of distribution system constraints and objectives as well as owner preferences and market conditions.

6 Role of ADMS

The traditional role of an ADMS is to provide tools and situational awareness of the distribution system and to safely and efficiently manage switching and tagging, manage system restoration after storms or other unexpected events, and ensure power quality for every customer. The ADMS also enables control of the system for centralized volt-var control and automated fault location, isolation and service restoration. The primary role of an ADMS is best described as one of ensuring the reliability and security of the distribution system.

The roles of the ADMS and of the DERMS are not 100% exclusive. ADMS must be DER aware, capable of using DER characteristics in computing power flow, and understand the impact of switching when DER are present. DERMS must be system aware and reference the model of the as-operated system conditions when determining the optimum usage of DERs to achieve certain objectives.

A good, if not exact, analogy for the DERMS and ADMS applications is to compare them to the existing EMS and market management systems that exist today. While the EMS is the key arbiter of system reliability, a separate market system analyzes prices, costs and availability to determine the optimum usage of available generation and ancillary resources. While these applications are separated to help ensure fairness in the marketplace for power and services procurement, they also share a system model and other data to enable them to operate in synchrony. Separation also reduces the applications' exposure to a single hardware or system event that may take both applications out of service.

Distribution markets are being designed and tested today that will require additional consideration for DERMS analysis to ensure distribution system reliability and security for market-based dispatch of DERs. The final form that these market designs will take are not yet determined, but will almost certainly require some type of "security-constrained economic dispatch" analysis.

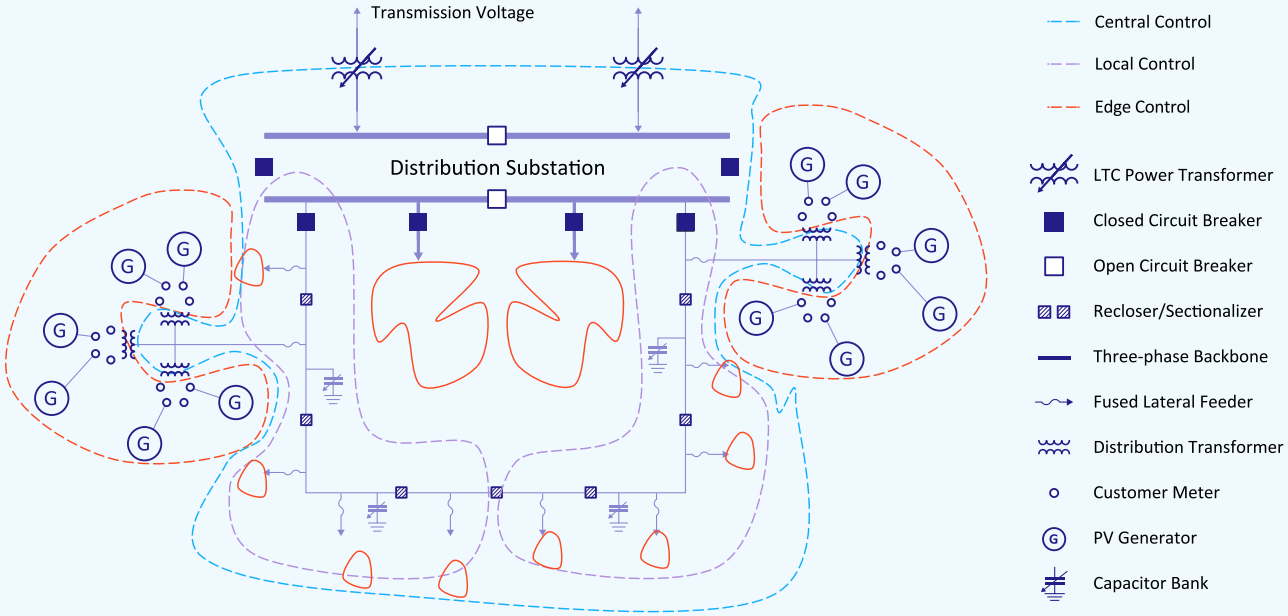
A key factor is that the DERMS and ADMS provide significantly different focus and functions. While they ideally share a common system model and other data, the analysis performed and the criticality of each of the applications are very different, which speaks to the need to seperate the functions/systems.

DERMS and ADMS do share certain data and functions. The model of the distribution system is the primary overlap between the two applications. We believe that CIM (Common Information Model) will be used to share the distribution model across the enterprise regardless of which system is the "owner of the truth" (it may be GIS, ADMS or DERMS). Interfaces will provide updated information in real-time as the model is changed to enable all systems to have a synchronized version of the "as-operated" model for analysis.

ADMS and DERMS — Application Overlap

- Grid-Scale DER may be SCADA controlled and modeled in ADMS
- DERMS may use power flow and VVC analytics for DER Plan Generation
- ADMS and DERMS use the “as-operated” system model

Coordinating Central, Local and Edge Control



While there is overlap between ADMS and DERMS functions, there is a major difference in focus. When both systems are deployed, we believe that the DERMS will manage devices beyond the meter. While the ADMS may connect to large utility-owned grid-scale DER (typically 1MW or larger) via SCADA, DERMS will provide forecasting, visualization, coordination and orchestration of the central, local and edge control systems. This will ensure that consistent operational objectives are known and respected. DERMS, if designed as part of a system-of-systems orchestration platform, allows all distribution systems to act as a single OT and IT integrated platform, thus enabling automated end-to-end OT and IT processes.

The primary difference in DERMS installations with or without an existing ADMS is where the model will be “mastered.” This could be done in GIS, DMS, OMS or in the DERMS. While ADMS may offer some similar analysis functionality as DERMS, we do not believe the look-ahead dispatch and DER optimization functions are appropriate for ADMS, nor are the significant aggregation and fleet management requirements.

7 mPrest DERMS Solution

mPrest already supports multiple DERMS-related use cases. These include:

- Asset and System Constraint Management, utilizing DERs
- Grid Edge volt-var control
- Demand Response and curtailment
- Asset Health Management Integration
- Energy Arbitrage
- DER Susceptibility (Analysis of "Phantom Load")
- Dynamic Network Topology
- DER Fleet Management
- Solar field and PV analytics
- Behind the Meter (BTM) analytics integration

mPrest intends to lead the market with complete coverage of DERMS applications. Additionally, we will be able to deliver projects faster and at the lowest competitive costs as project-specific development content is dramatically reduced as compared to other vendors in the DERMS market with different backgrounds.

Segment Vendors — Three Types

mPrest — mDERMS

- Integrates with EMS, Markets, ADMS, DR, VPP, et al — 'system of systems' enterprise integration
- Highly Scalable, Secure, Reliable, Flexible
- Can manage real-time constraints and look-ahead optimization
- Full suite of DERMS use cases
- Supports installations with or without ADMS
- Can supply some DMS functionality
- Provides security-constrained economic dispatch (like markets and EMS for transmission today)
- Completely vendor agnostic
- Leverages existing & future system investments

Control Room SW OEMS

- Focus is security, reliability, and restoration of distribution system
- Most struggle to scale with NAM model size and number of SCADA points
- Real time vs. multi-interval and look-ahead dispatch analysis ("what is" vs. "what should be")

DR, VPP, Planning, Services SW

- Strengths tend to be focused on limited applications
- Working from a limited core competency to become a DERMS system — a long trek
- Real-time applications are a new frontier
- Control room experience is required

There is no shortage of vendors who want to supply DERMS solutions to the market. The more notable vendors can be classified as shown above. No vendor has a dominant position in the market today. mPrest is unique in approaching the market from a "systems" perspective for grid orchestration. In the market, there are three primary types of vendors:

- DMS/ADMS
- Demand Response/VPP/Planning
- Customer and system operations DERMS (mPrest)

There are significant differences between these products that drive fundamental differences in approach and philosophy.

DMS/ADMS is an operational and reliability-based platform. It is critical. However, is not an agile platform, it is not designed to support many millions of SCADA points and is not a holistic customer enablement platform.

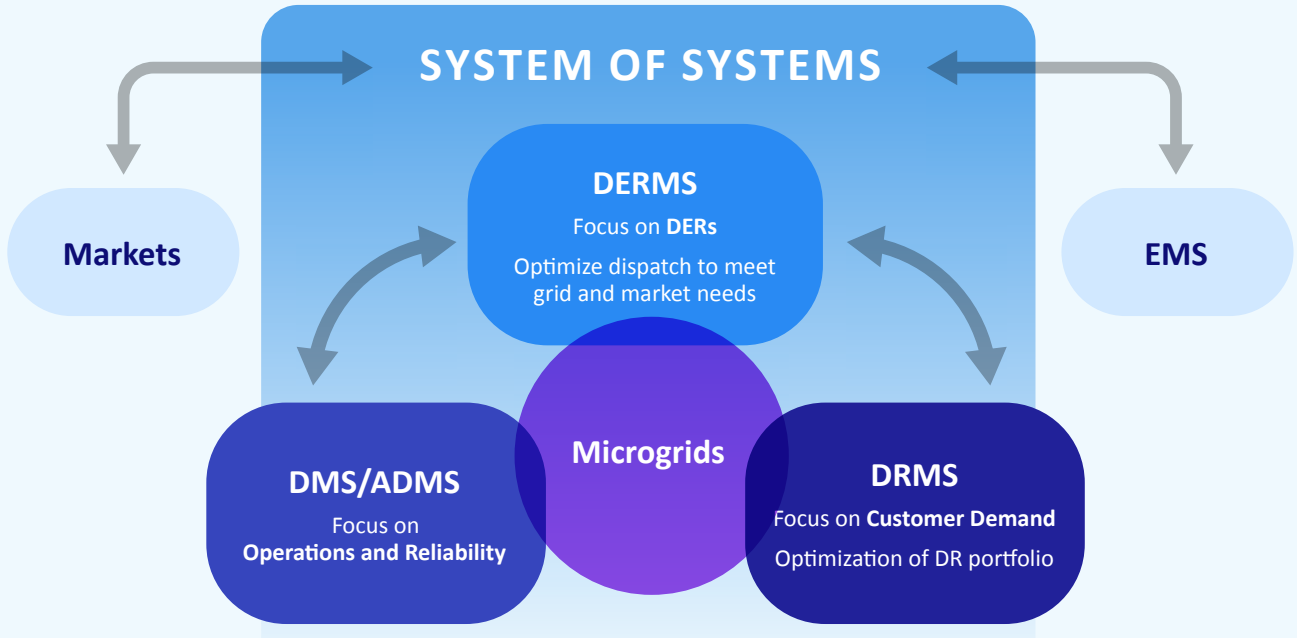
Demand Response (DR) is a customer-facing system. However, it clearly isn't a standalone application and requires an intelligent, central system to determine when and how to use DR programs to optimize their benefit and arbitrate their use against other technologies for achieving demand and supply balance (e.g., VVC, storage batteries, et al).

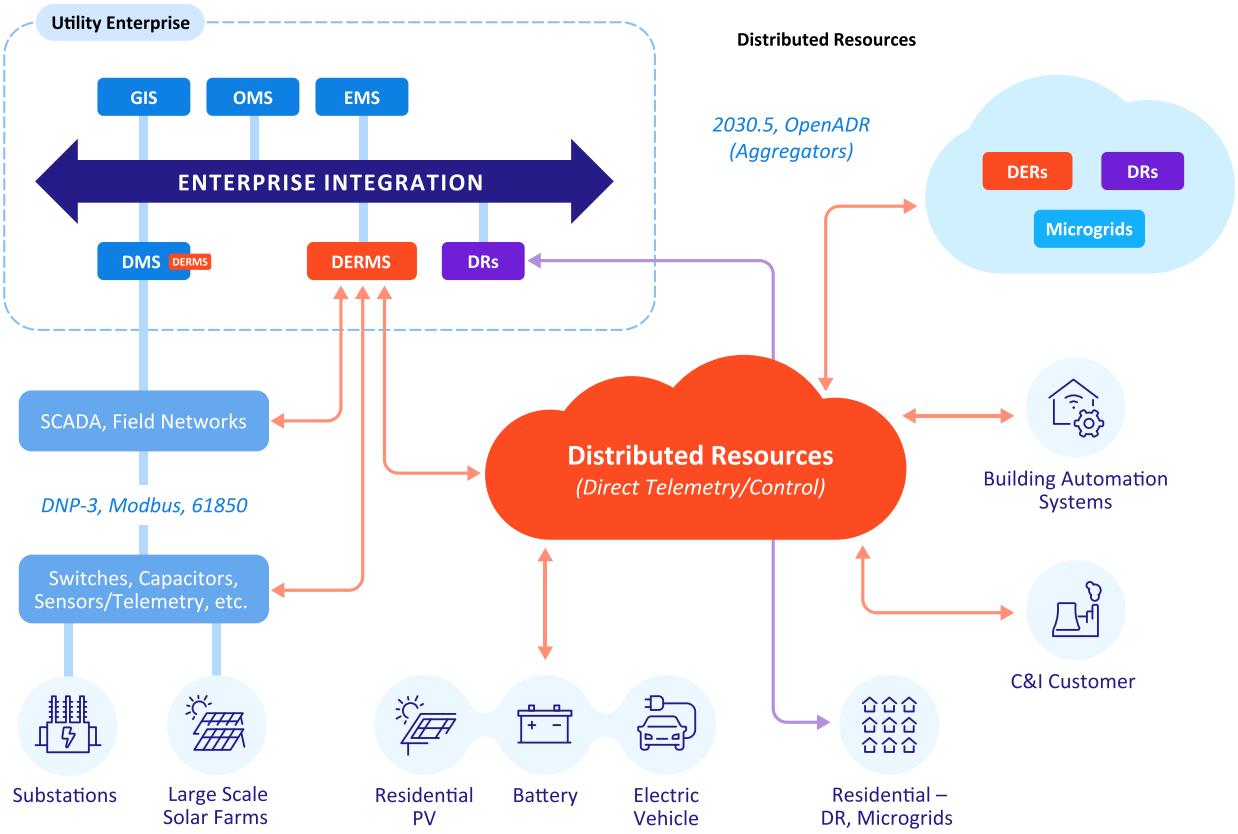
System of Sytems (SOS)

A DERMS, which would also have "system of system" capabilities would qualify as a holistic customer enablement platform, enabling correlation of physical, as well as analytical data from millions of end points and optimizing their utilization. Furthermore, it's important to manage the DERs via such a platform versus from a purely operational/reliability platform.

In the very near future, managing DERS will dwarf DMS/DRMS requirements. This is our view, the view of many of our customers and has been expressed by other industry thought leaders, as well.

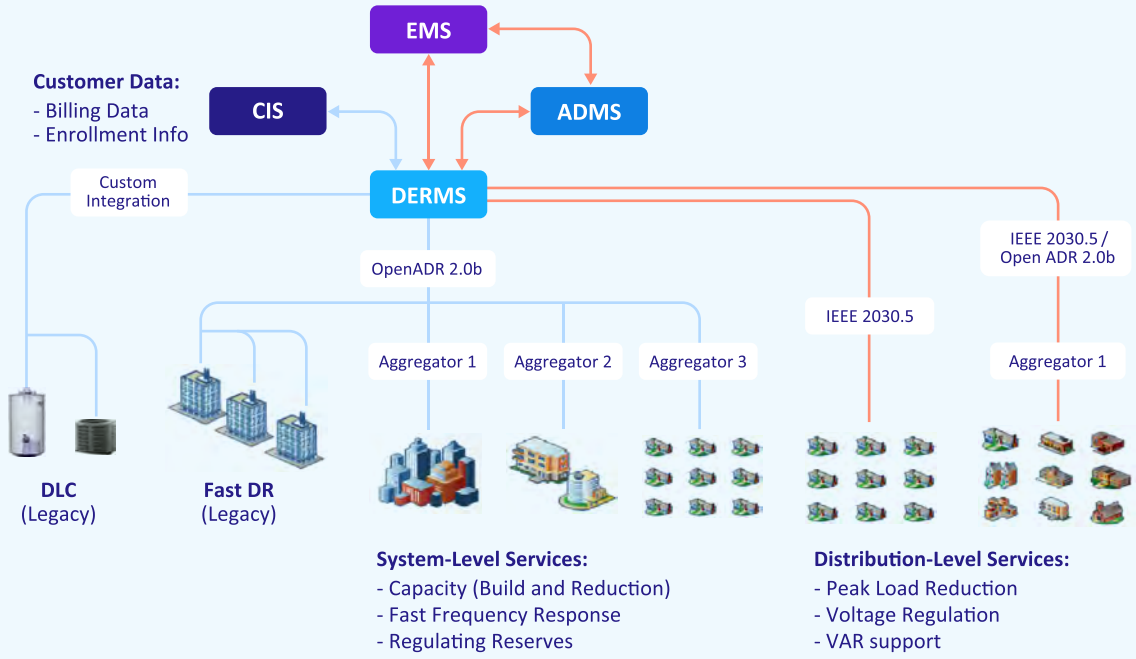
SOS Enables the modernized grid ecosystem





An Example of a Utility's Proposed DERMS Architecture

Future DERMS Architecture

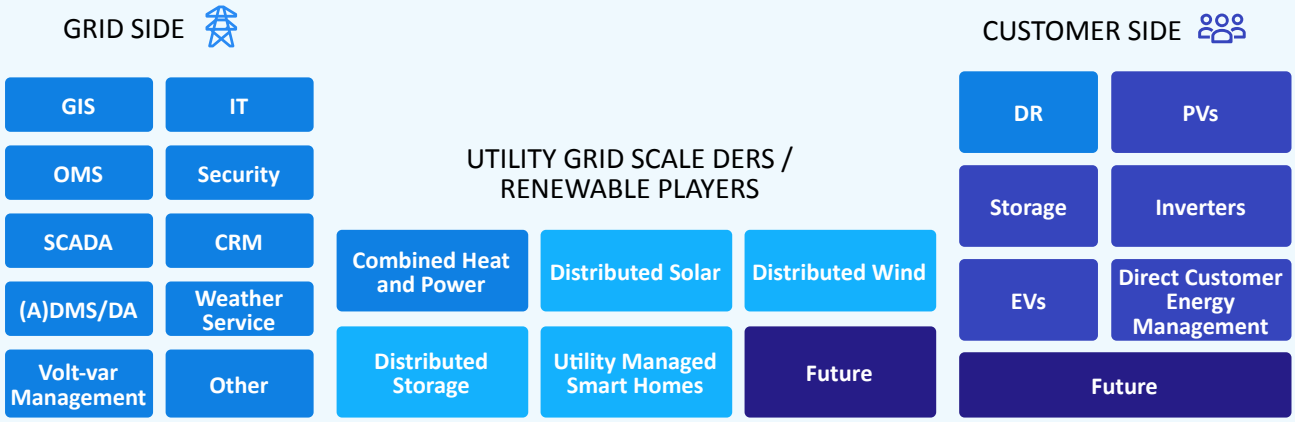


Another Example of a Utility's Proposed DERMS Architecture

In summary, many utilities will implement an ADMS, and for those utilities an ADMS will add value. However, even though ADMS vendors may claim to also offer DERMS as part of their ADMS offering, such a DERMS system cannot act as a customer enablement platform, cannot scale to the level required by the DERMS market and cannot offer the response times expected from a DERMS. This is not only a technological and infrastructure issue, it is an operational and architectural issue. A DERMS cannot scale and function properly under an ADMS architecture; it should be integrated with the ADMS and share data with it.

On the other hand, simply installing a DERMS alongside the ADMS is not an adequate solution, as there would still not be an end-to-end single integrated and holistic system. The only way to offer a truly orchestrated platform is with a system that integrates with ADMS, demand response and to all other systems via a "system of systems" platform — such as the one mPrest is offering.

Smart Grid System of Systems



8 DERMS — Now or in the Future?

Another discussion that has been frequently debated is "Do I need DERMS if I'm not having any problems today?" sometimes phrased as "I don't have enough DER in my system to worry about DERMS or DER issues."

In reality, it is not just another "which came first — the chicken or the egg?" problem. Utilities have the choice to develop the understanding of DER use cases, the mitigation of issues created by DERs, and the ability to optimize DER usage to minimize operational costs today. By doing so now, DER benefits are achieved by leading customers, regulators and DER owners, promoting a mutually beneficial relationship.

By any measure, continued cost reductions in PV and battery storage have made renewable energy more cost effective than other technologies even when not considering the cost of environmental impacts of fossil fuel alternatives. The increasing popularity of the all-electric home, coupled with the accelerating growth of electric vehicles and the ability to use the accompanying charging infrastructure as a resource, is increasing the breadth and depth of demand response programs.

The tipping point for actively dealing with these technologies has already occurred in many utility jurisdictions and it is inevitable in almost all jurisdictions. Arguably, the worst approach is to wait for the tsunami of DERs to force a response. It is preferable to put the tools in place today and get ahead of the opportunity.

9 Summary

The large, monolithic applications built over the last 30 years to support DMS functionality are not suitable for the new paradigm of DERMS opportunities. ADMS must change and evolve to be DERMS aware and support DERMS functionality, but ADMS cannot act as a customer enablement platform, cannot scale to the level required by the DERMS market and cannot offer the response times expected from a DERMS. This is not merely a technological infrastructure issue, but a philosophical and architectural issue as well. A DERMS should not operate under an ADMS architecture — it should be integrated with the ADMS and share data with it.

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