Why Does Distribution Grid Model Management Matter?

Newsletter

What is Grid Model Management?

Since their earliest days, utilities have needed to grasp grid behavior. They did this with various tools. First, they built elaborate analog tools. Next came digital models such as early load flow and short circuit programs. Later, real-time systems such as SCADA and energy management systems emerged. Finally, they created tools to identify unstable conditions after the first Northeast Blackout. In addition, they modeled the impact of lightning and switching surges. They did this to be able to plan better and operate the grid.

The problem was, and is, that each one of these tools require a somewhat different representation of the same grid. In effect, each program or system abstracts the complete grid information into a manageable form for the task at hand. Many different representations of the same data create data management nightmares. For example, whenever a change in the grid happens, workers must remember to change the data for each application. This lack of coordination and manual intervention is recipe for data errors. And data errors result in incorrect analysis.

Grid Model Management (GMM) solves this problem by standardizing the source of data for each one of the present and future systems that deal with grid behavior. It also solves the migration of data from one upgrade of a system to another and the exchange of grid data among grid participants. The GMM ideas began in transmission. There, utilities needed grid modeling for many types of analysis. In addition, there was obvious duplication of modeling effort and increasing demand for rapid generation of accurate models supporting sophisticated analysis. The value proposition for a single source of truth grid model management was straightforward (even if the solution itself required some thought).



"To meet the energy transition, enduring success will depend on breaking open application-centric data silos and riding on a unified data-centric grid model."

-Neil Belford, NetworkEdge

Why Grid Model Management for Distribution?

The drivers are different for distribution (although the distribution GMM solution is—spoiler alert—surprisingly similar, which is a good thing because ultimately, the industry also needs seamless grid data management between transmission and distribution). In distribution, the dominant data activity is the never-ending cycle of designing new projects (based on existing facility records), followed by work management of project execution, ultimately resulting in an update of facility records. The duplicated, manual modeling common in transmission is much less common in distribution because of the volume of activity. The majority of utilities have GIS-based management of facility data that is already a single source of truth, at least for the physical as-built grid models used in distribution operations.

So, if we already have a single source of truth, where's the problem? Well, for starters, the single source of truth data 'grew up' organized around facility design and work, not electric system analysis. Earlier GIS's were map-centric. That is, utilities created GIS to streamline the electric map-making processes. Later, utilities realized that the source of much of their analytic and operating data could come from their GIS. However, the migration of their old paper maps often did not accurately represent the correct electrical connectivity. In addition, the data did not contain needed information such as impedance or load data for analysis and real-time simulation.

When analysis is required, the usual practice has been to extract a backbone model from facility-oriented data, transform it to forms compatible with analytical tools, and supplement it in the analytical tools as necessary with other information or with corrections. These extract/transforms are usually implemented as a custom connection between the utility's GIS data structure and a data structure that each consumer system can handle.

As a result of the legacy map-centric approach, such connections are complex and often imperfect. They are costly to implement and costly to maintain as requirements change. As organizations replace or add systems, the temptation is strong to contain costs (i.e., to implement 'band-aid' solutions), but this typically adds to complexity, driving up the cost of future efforts to save a few present dollars. (A good information approach should encourage good data structure, not invite complexity!)



"GIS is migrating from a map-centric approach to a model approach, simplifying the heavy lifting from GIS to a standardized grid model."

-Bill Meehan, Esri

The Distribution Grid Is Rapidly Evolving

On top of the custom connection problem, distribution system business requirements, largely dormant for decades, have come to life and become an area of very active change. We disaggregated the utility structure; we enabled distributed privately-owned energy resources; we implemented field automation; we introduced markets; we made meters smart. The distribution grid was a nice quiet passive downhill delivery system but is now an active component with intelligent actors sitting out there making decisions for themselves. As a result, today's distribution utility must plan and operate a completely different sort of grid.



"As the proliferation of DER continues, Grid Model Management becomes essential for the efficient Planning and Operation of the Distribution Grid.

-Jerry Day, IPS

Result? Lots of analysis is required. Maybe not all at once, but as the grid grows more complex, smarter analysis (and better modeling data) is needed to plan and operate the grid. Analysis has already grown significantly, especially in the operations center, and this trend is not going to stop. New kinds of analysis require data of a greater depth and accuracy, and in operations, it is needed in real-time. Trying to patch the existing custom connection architecture to meet each increment of requirements is an exercise in futility (and expense). Instead, a solid data foundation is required on which to meet future needs.



"As our physical network migrates to a distributed energy system, our information systems are migrating to a digital twin that provides a single view of the truth across multiple source systems."

-Brian Flett, Bentley

EPRI's Grid Model Data Management Project

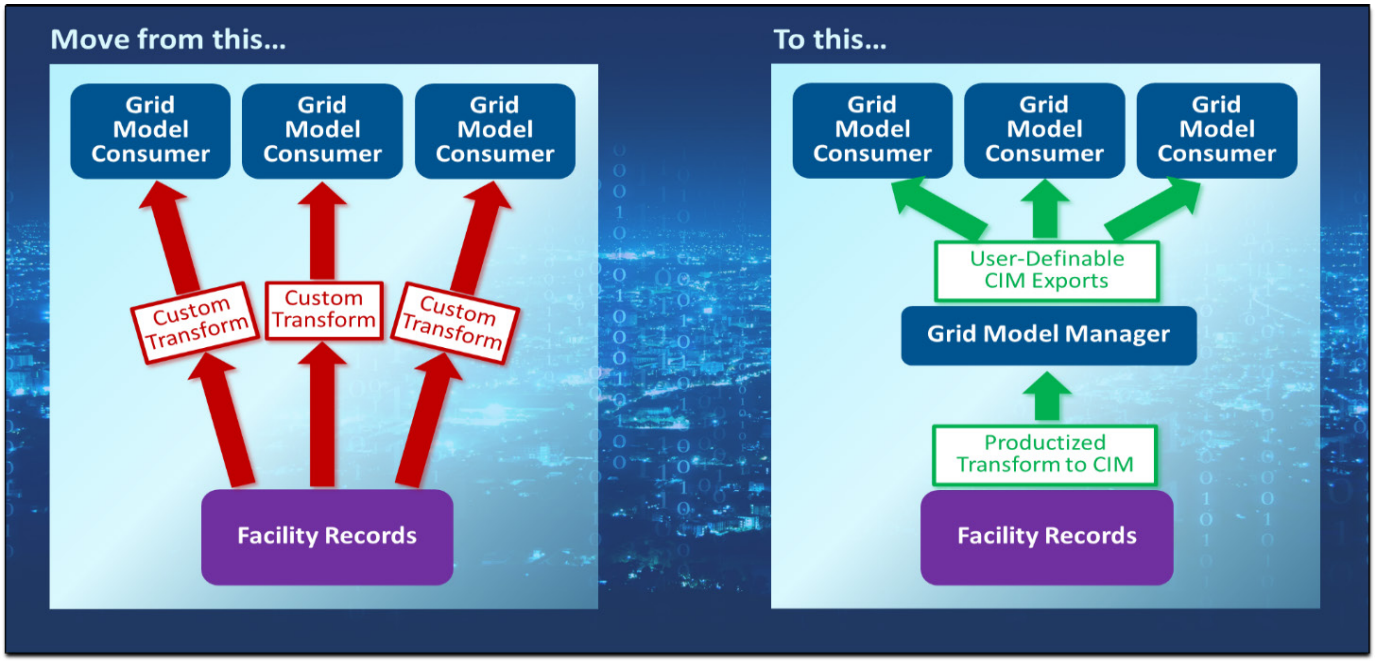
During the last three years, EPRI's Grid Model Data Management project has been focused on developing just such a foundation for the electric distribution industry. Combining the efforts and perspectives of utilities, vendors, and world-class integration experts, it has developed the GMM information architecture to guide utilities in implementing effective, enterprise-wide model management.

The GMM information architecture introduces a grid model manager function that converts, once, the facility records information into a suitable (and Common Information Model (CIM)-based) foundation model of the electric system. It then provides CIM-based exports to distribution analytical consumers in planning and operations. The result is one complex transformation (between facility records and CIM network modeling) into the grid model manager and simpler network model extractions into consumer environments. More importantly, though, this approach frames these interfaces in a form that allows vendor product support on all sides and reduces the utility's burden to maintain custom interfaces. (This is why EPRI's Grid Model Data Management research has included both vendor and utility participants.)



"The GMDM focus on CIM XML as an interoperability standard opens up new utility frontiers by advancing capabilities that support enterprise integration, cross system data exchange and automation."

-Safe Software



The GMM information architecture calls for interfaces that leverage CIM-based data exchange 'building blocks' and articulates best practice approaches for designing data management solutions based on them. The 'building blocks' allow distribution utilities to design their own grid model data management solutions to meet local requirements while at the same time allowing vendors to develop a finite set of re-usable standards-based interfaces on their tools (freeing them to focus on product enhancements instead of custom interface development).

"Operating the modern grid requires a single source of truth of the grid model. GMM project is expected to show us the 'way'!"

-Young Ngo, Survalent

Next Steps

The ideas presented here are disruptive. They require utilities to take ownership of their data and actively manage data flows between applications. A GMM-based solution calls for a utility to think first about its data and then about its applications. It ultimately means changes to a utility's people, processes and technology. But all integration is expensive and challenging. Building a solid data management foundation, instead of adding to a tangle of ad hoc interfaces, will ultimately reduce costs and position a utility to more easily and quickly deploy new solutions. It is not only the best value choice a distribution utility can make, it is also a choice that enables a utility to optimize grid reliability and safety while contributing to society's carbon reduction goals.

"It's breaking down silos and streamlining life-cycle data management so everyone can leverage its value and continuous improvement."

-Brad Williams, Oracle

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The EPRI Grid Model Data Management Vendor Forum is a collaborative, vendor-funded initiative open to any vendor or consultant interested in standards-based distribution grid model management. The Forum is planning an Interoperability Event for May, 2022. For information on the GMDM Vendor Forum contact Pat Brown, pbrown@epri.com or Randy Rhodes, rrhodes@epri.com.

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3002022737

September 2021

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