Case Study

Industry
Solution Focus Area

Preparing the Future Grid with the vPAC Alliance

How utilities like Southern California Edison are charting their path to a more sustainable and reliable energy future.

"The goal of the vPAC system is to convert the traditional appliances that we have in substations to software defined applications. So instead of physical devices, we have virtualized applications installed on a server."

—Jesse Silva, Senior Engineer at Southern California Edison's Grid Technology Innovation team

The vPAC Alliance is working to drive substation digitalization by developing a standards-based, open, flexible, scalable, adoptable, remotely manageable, cyber secure, and interoperable software-defined architecture.

Executive Summary

Southern California Edison, the primary electric utility company for much of Southern California, exemplifies the challenges utilities face, including rising demand for electric power, changing dynamics of distribution systems, and a fundamental change in nature of how energy is provided due to integration with distributed energy resources (DER). To address these industry issues, Intel helped form the Virtualization of Protection Automation and Control (vPAC) Alliance, a strategic partnership of industry leaders, to work together to future proof the energy grid by standardizing hardware and virtualizing substation automation and control operations.

The Problem

Like many energy providers across the United States, Southern California Edison, which provides electricity for 15 million people in Central and Southern California, is faced with a profound change in customer electrical demands driven by decarbonization, building electrification and adoption of electric vehicles, all of which will increasingly stress today's power grid. The modern grid architecture was not designed to handle the future demands of a changing energy landscape, as the need for electricity has grown and evolved.

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—Farzad Khalipour, Senior Engineer, Southern California Edison

Electric power grids were originally designed as one-way highways for electrons from centralized generating stations to homes and businesses. The global shift towards DER has led to a bi-directional flow in which solar and other weather-dependent sources can feed surplus energy back into the grid. Additionally, the variability of these resources changes the strength and stability of the system based on time of day, day of the year, and weather condition. These new conditions are requiring a fundamental shift in grid planning, operation, and management to meet the future needs. Additionally, the systems are expected to experience significant load growth due to electrification of transportation through electric vehicles, electrification of building heating loads, and the increasing power demand for data centers. In addition, extreme weather events spurred by climate change are putting stress on the grid and causing more frequent service disruptions.

"Our main motivations are to improve the amount of sustainable energy we deliver to our customers and to prepare the grid to meet California's decarbonization goals," says Farzad Khalilpour, Senior Engineer with Southern California Edison's

Grid Technology Innovation (GTI) team. "To do this, we must fundamentally change how our grids are planned, implemented, and operated."

Recognizing the pressing need for the future grid the utilities and industry leaders have been working together to develop a new paradigm for a more adaptive, resilient, secure, and intelligent grid, taking advantage of advances in virtualization and digital technologies.

> "Partnerships and coalitions are invaluable for grid modernization. Intel has been driving this partnership, bringing everyone to the table with the expertise, resources, and diverse perspectives to tackle complex challenges."
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> *—Brant Heap, Manager of PAC Strategy, Salt River Project, Chair vPAC Alliance*

One critical aspect for the future of the grid is the standardization of the vPAC system components, such as hardware, virtual environment, protection and control applications to meet the utility industries' current and future needs. Electrical grids often incorporate various manufacturers and models of devices, making integration and scalability challenging. Grid virtualization is also essential to maximize the utilization of renewable energy and enable rapid adaptation. Data-driven designs, running on a virtual platform, offer insights that can lead to more informed decision-making.

"Building intelligent, data-driven systems at the edge of the grid, particularly at substations, is paramount," says Prithpal Khajuria, Global Segment Leader in Energy and Manufacturing Sector at Intel. "For us to more intelligently manage the grid, we need to collect more data at the edge. Then we need to extract more intelligence out of the data using next-generation technologies like machine learning and AI." A new data-based approach can help minimize service disruptions and mitigate the impact of climate change-induced stress on the grid.

The Solution

To address these challenges and facilitate the future grid modernization, Intel helped create the Virtualization of Protection Automation and Control (vPAC) Alliance. The group is a coalition of over a dozen utilities and industry partners, including Intel, Dell, ABB, VMware, Salt River Project, and Southern California Edison. Its mission is to drive substation digitalization by developing a standards-based, open, flexible, scalable, adoptable, remotely manageable, cyber secure, and interoperable software-defined architecture for the vPAC systems for the next-generation digital substations.

The Alliance focuses on the virtualization of protection, automation, and control systems within substations, says Jesse Silva, Senior Engineer at Southern California Edison's Grid Technology Innovation (GTI) team. "The goal of the vPAC system is to convert the traditional appliances that we have in substations to software defined applications. So instead of physical devices, we have virtualized applications installed on a server."

The alliance has had the opportunity to work with Salt River Project in Arizona and see some positive results.

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"Our work with Salt River Project shows that we can reduce the number of devices in the substation by 50%, and reduce the operation and maintenance cost by 76%," says Khajuria. "This benefits the utilities on both sides, by reducing their operational cost and as well as their emissions by requiring fewer maintenance truck rolls."

Intel, with its reliable hardware and security features, provides the core technology that underpins the vPAC solution layers. Dell contributes its own hardware technologies, while VMware offers software-defined virtualization infrastructure. ABB, with over a century of experience in the power industry, adds its power-centric technologies to the mix.

Unlike traditional fixed-function devices, vPAC based solutions are designed to adapt to changing conditions, reduce complexity, lower costs, simplify maintenance, and increase reliability. Virtualized protection relays (VPR) within substations can lower cost, reduce complexity, simplify maintenance, and increase reliability. The vPAC Alliance has created a reference implementation guide for VPR which adheres to the IEC-61850 standard to promote a resilient grid and enhances public safety, especially in cases of extreme weather conditions.

Intel has been instrumental in driving the vPAC solution forward, bringing the entire power sector ecosystem together to build a scalable and more secure infrastructure with focus on virtualization, standardization, and interoperability. Their strategic partnership has played an important role in shaping the forward-looking efforts of the broader utility market.

"Partnerships and coalitions are invaluable for grid modernization," says Brant Heap of Arizona's Salt River Project and Chair of the vPac Alliance. "Intel has been driving this partnership, bringing everyone to the table with the expertise, resources, and diverse perspectives to tackle complex challenges."

"We need great partners that see the value and potential in the solution to work together to provide their expertise and knowledge to form the future of grid technology," says Jesse Koskela, Product Marketing Specialist at ABB. "Nobody can do this alone."

By adopting a forward-thinking approach, this coalition of industry leaders has set a course for a more adaptive, resilient, secure, and intelligent grid that can meet the challenges of the 21st century. Through these efforts, the vPAC Alliance is contributing to a more sustainable and reliable energy future for energy customers worldwide.

For More Information

vPAC Alliance

Dell

VMware

Intel

ABB

Salt River Project

Southern California Edison