



Architecture diagrams for power and utilities

# Utility Volt-VAR Management Framework



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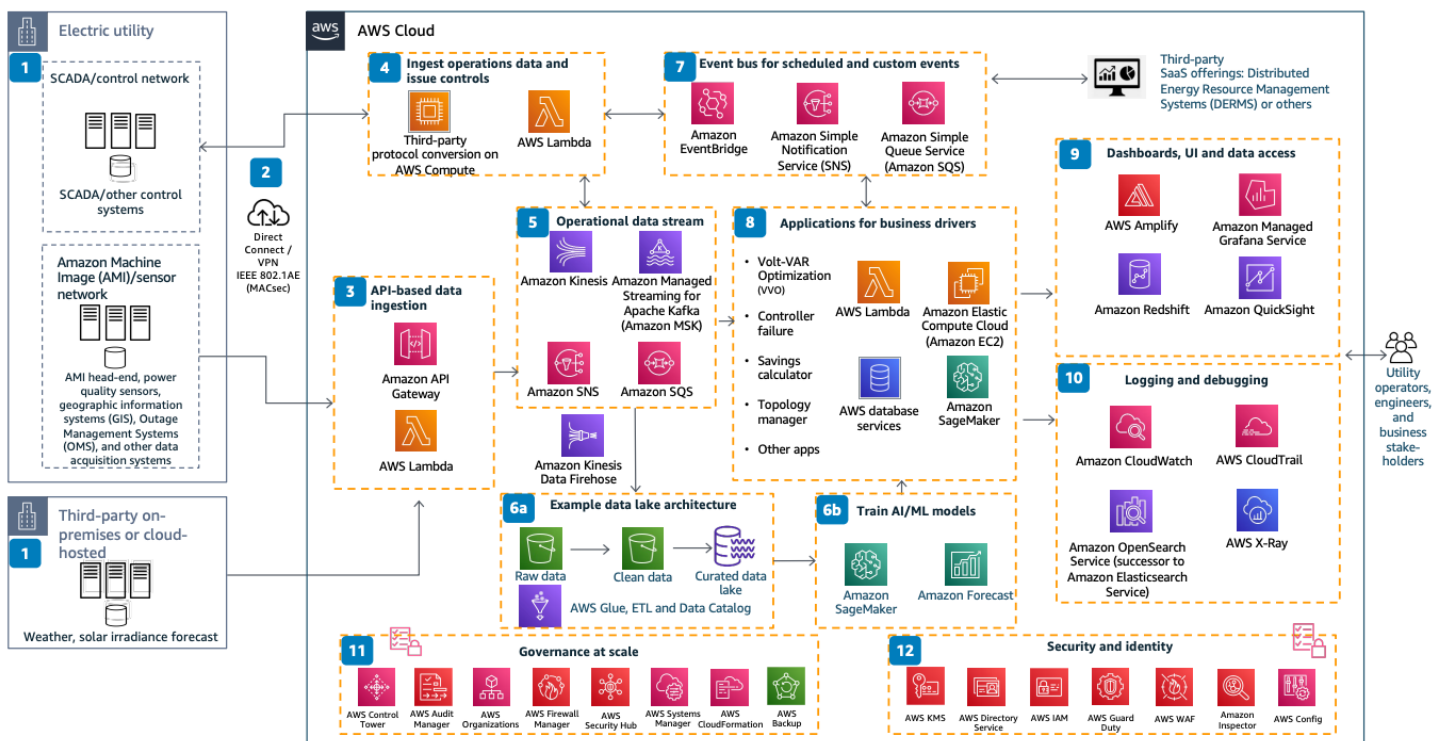
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# Utility Volt-VAR Management Framework

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With this architecture, you can build highly scalable distribution grid management applications such as Volt-VAR Optimization (VVO). You can also build sensor and controller abnormality detection and grid analytics applications. The solution uses an event-driven, microservices-oriented framework with [Amazon Managed Streaming for Apache Kafka](#) for streaming, [AWS Lambda](#) for serverless compute, and [Amazon SageMaker AI](#) for machine learning (ML).

## Utility Volt-VAR Management Framework diagram



The following steps describe the data ingestion, processing, and application components for this architecture:

1. Integrate with existing utility Operations Technology (OT) systems and third-party systems to activate the distribution Volt-VAR management framework. Connect the Advanced Metering Infrastructure (AMI) head-end, power quality sensors, Geographic Information Systems (GIS), Outage Management Systems (OMS), SCADA, and other data acquisition systems.
2. Connect to AWS through a VPN with high reliability. For guaranteed bandwidth, use [AWS Direct Connect](#) with IEEE 802.1AE (MACSec) encryption.

3. Ingest API-based data by using serverless technologies such as [Amazon API Gateway](#) and Lambda. This provides cost-effective and highly scalable data ingestion from measurement and topology source systems.
4. Ingest data and issue controls through existing on-premises supervisory control and data acquisition (SCADA) systems with protocol-based integration. Maintain supervisory control of AWS-based applications through the existing SCADA system.
5. Stream all measurement data by using the technology or service of your choice. Trade off ease of use against real-time streaming needs with [Amazon Kinesis](#) or Amazon MSK.
6. 6A. Load real-time data streams reliably into a data lake by using [Amazon Data Firehose](#). Store data durably and cost-effectively in [Amazon Simple Storage Service](#) for your data lake. Automate the extract, transform, and load (ETL) process with [AWS Glue](#) to clean and transform data into business-ready formats.  
  
6B. Derive valuable insights from your curated data lake by using AI/ML services such as SageMaker AI and [Amazon Forecast](#). Retrain ML models every few hours or days and publish an inference endpoint for use by real-time applications.
7. Activate event-driven architectural patterns with a serverless event bus by using [Amazon EventBridge](#) or a combination of [Amazon Simple Notification Service](#) and [Amazon Simple Queue Service](#). Use Amazon EventBridge for integration with third-party SaaS offerings such as Distributed Energy Resource Management Systems (DERMS).
8. Develop event-driven VVO applications. Use real-time operational data streams as input. Build cost-effective, highly scalable microservices with serverless Lambda. Use high performance computing (HPC)-optimized [Amazon Elastic Compute Cloud](#) instances for power-flow-based calculations. Choose from a broad selection of database services for application-specific data access patterns. Run online inferences on pre-trained ML models by using SageMaker AI endpoints.
9. Create real-time operational dashboards by using [Amazon Managed Service for Grafana](#). Create BI dashboards by using [Amazon Quick Sight](#). Accelerate custom web application UI development and hosting with [AWS Amplify](#). Query petabytes of data across your data warehouse and data lake by using standard SQL with [Amazon Redshift](#).
10. Log all account activity with [AWS CloudTrail](#). Monitor cloud resources and applications by using [Amazon CloudWatch](#) to collect and track metrics, monitor log files, and set alarms. Search, analyze, and visualize logs for real-time insights with [Amazon OpenSearch Service](#). Analyze and debug distributed, microservices-based VVO applications by using [AWS X-Ray](#).

- 11 Govern cloud resources and apply security controls at scale from a centralized location by using services such as [AWS Control Tower](#), [AWS Audit Manager](#), AWS Systems Manager, [AWS Firewall Manager](#), and [AWS Security Hub CSPM](#).
- 12 Control access with [AWS Identity and Access Management](#) and [Directory Service](#). Monitor network traffic for malicious activity by using [Amazon GuardDuty](#). Encrypt all data at rest with [AWS Key Management Service](#) and data in transit by using Transport Layer Security (TLS) encryption. Use [AWS Config](#) to assess all cloud configurations and any changes.

## Further reading

For additional information, see the following resources:

- [AWS Architecture Icons](#)
- [AWS Architecture Center](#)
- [AWS Well-Architected](#)

## Diagram history

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