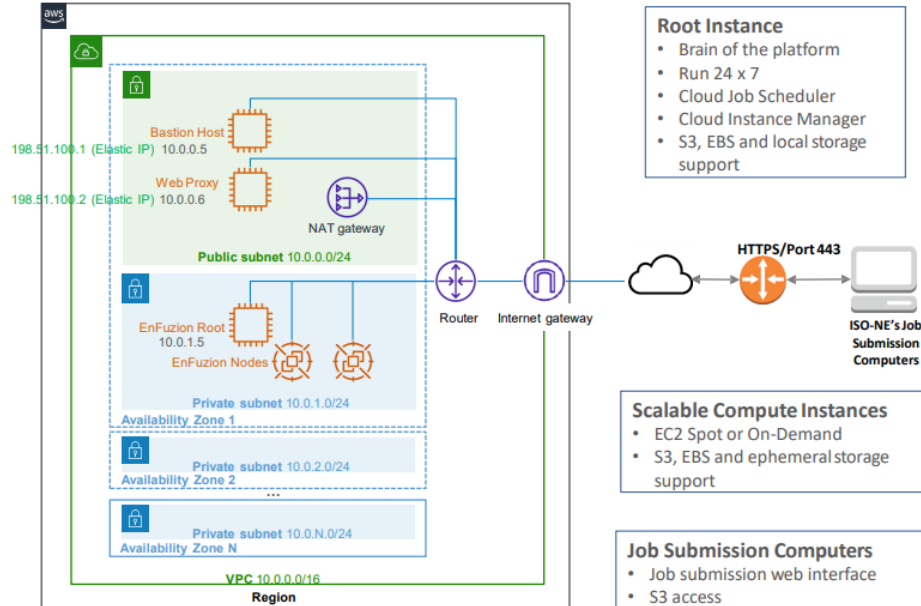


Securely Storing Archival Synchrophasor Data in the Cloud

Access Control and Usage for Energy Loss
Performance Detection Reporting on AWS

Case Study: ISO - NE

Cloud-hosted Elastic Computing Platform @ ISO-NE

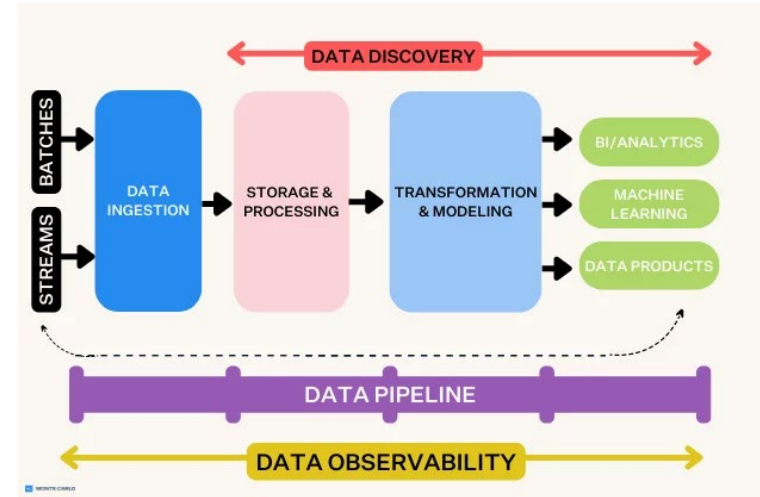


Pg 58



We'll Talk About....

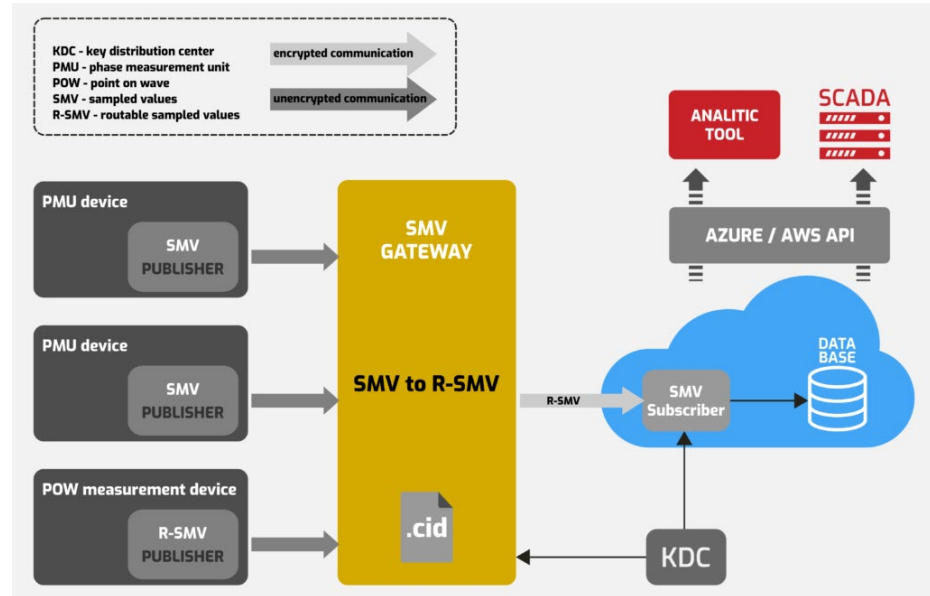
- Challenges with Synchrophasor data
- How to leverage the cloud for data storage, reporting, analytics, and compliance
- Modernization of systems to take advantage of AI/ML predictive analysis technology
- Scalability, Availability, Flexibility, Security and Cost Optimization
- Adhering to NERC CIP standards



Source: Monte Carlo Data

New Storage Challenges with Synchrophasor Data

- According to the Utility Analytics Institute:
 - 2.7ZB of digital grid data were collected in 2017
 - Expected to balloon to 175ZB by 2025
 - 65x more data collection in 8 years
 - Requires a more scalable, efficient storage solution
 - Advanced tools for complex analysis on large data sets
 - Source: [Using cloud-based, data-informed, power system models to engineer utility reliability](#)



Leveraging the Cloud as a Solution

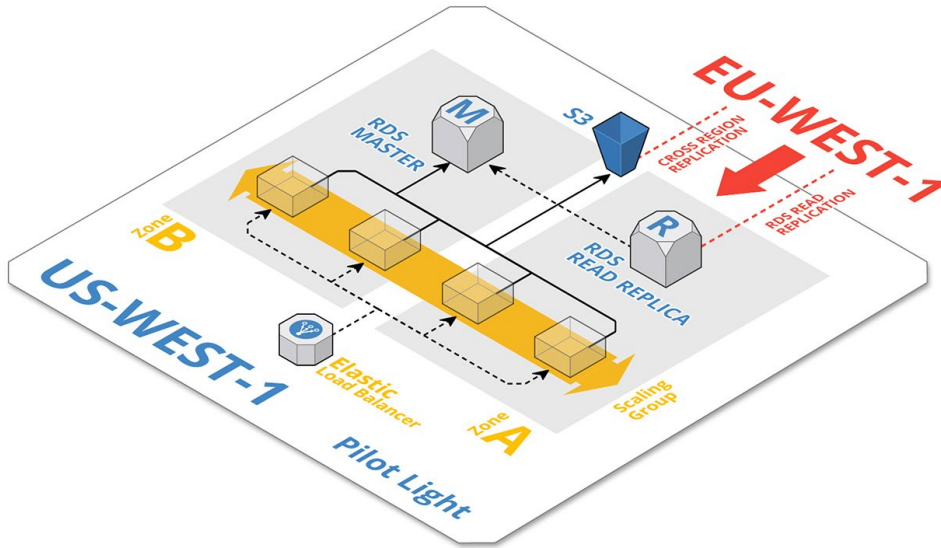


Amazon (AWS)

Microsoft (Azure)

Google (GCP)

Scalability, Availability and Flexibility Advantages of the Cloud

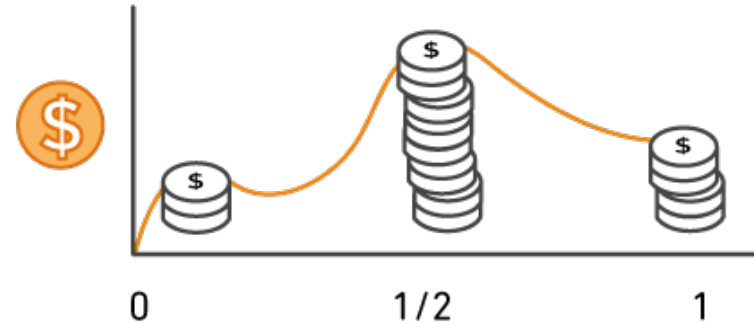


- Autoscaling and Availability
 - Autoscaling
 - Multi-Availability Zone (AZ) - High Availability
 - Multi-Region - Disaster Recovery
- Flexibility
 - Rapid Deployment
 - Infrastructure as Code
 - Development Environments



Cost Advantages of Cloud Storage and Computing

- On-Prem Costs
- Pay-As-You-Go
- No Hardware Maintenance Costs
- Avoiding Obsolescence





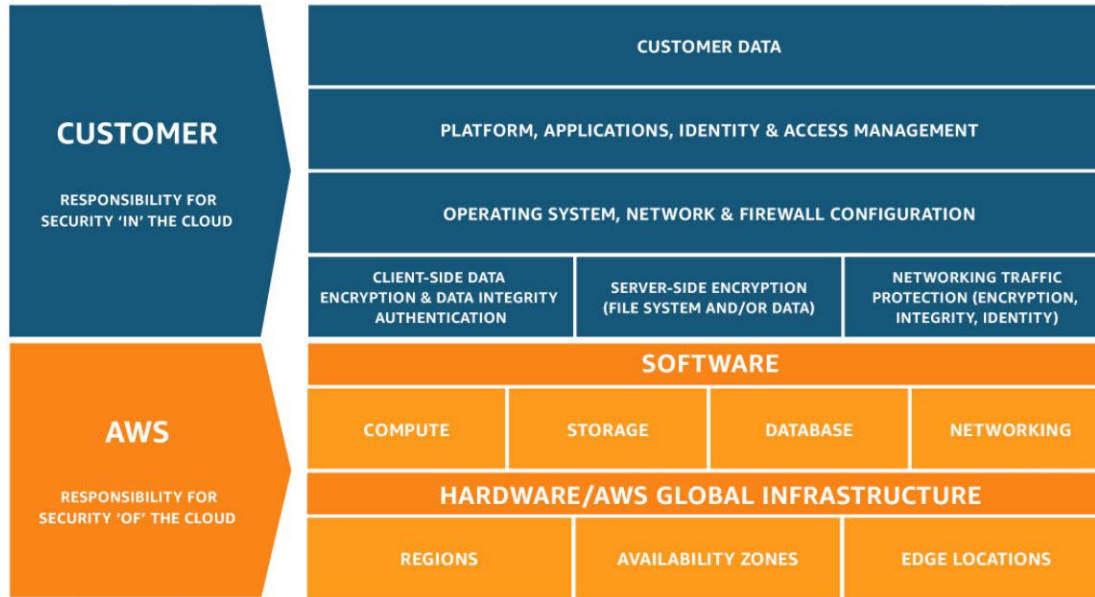
Cost Optimization of Cloud Storage and Computing

- Spending
 - AWS Cost explorer, AWS Cost and Usage reports
 - Detailed insights into spending and resource utilization, can make recommendations from there
- Well-Architected [Framework](#)
 - AWS Guidance on optimizing architecture
 - Well-Architected Framework: [Cost Optimization Pillar](#)





Enhancing Security Measures - Shared Responsibility Model



Enhancing Security Measures - NERC CIP

- Bulk Electric System (BES) Cyber System Information (BCSI) can now be managed [in the Cloud](#)
- In December 2021, (FERC) approved revisions to two NERC CIP standards [CIP-004-7](#) and [CIP-011-3](#)
- Defines standards for cloud architecture, allowing utilities to manage data in the cloud for BCSI data



**AWS
CloudTrail**



**AWS
Config**

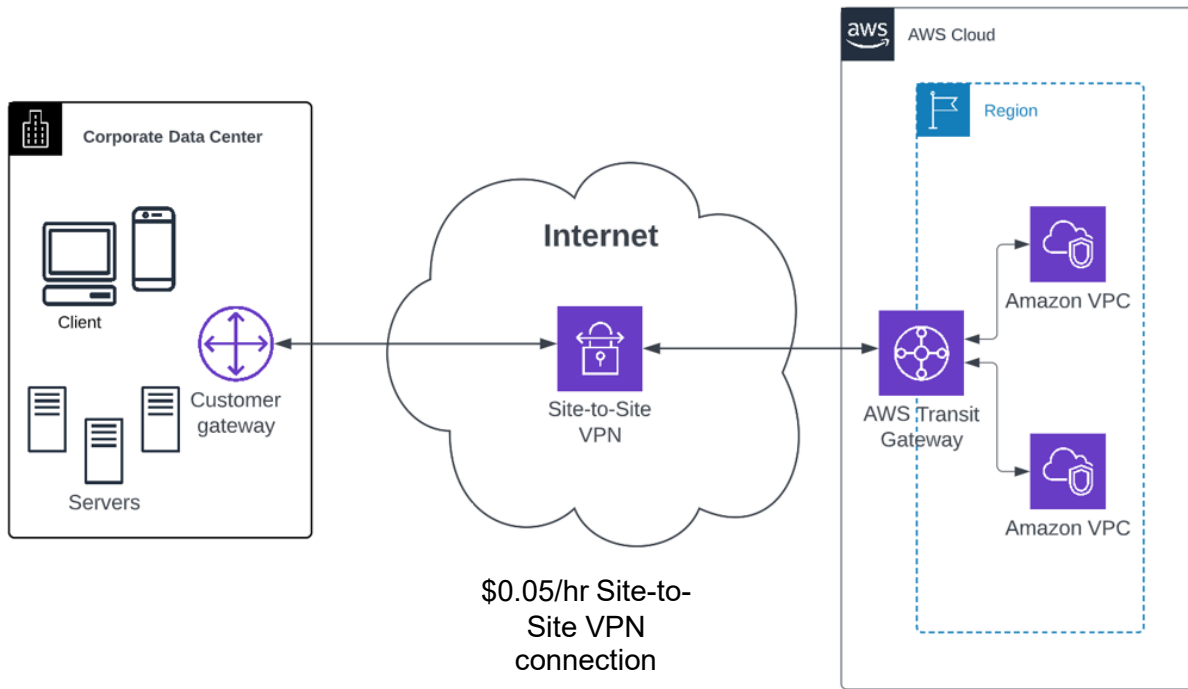


**Amazon
CloudWatch**

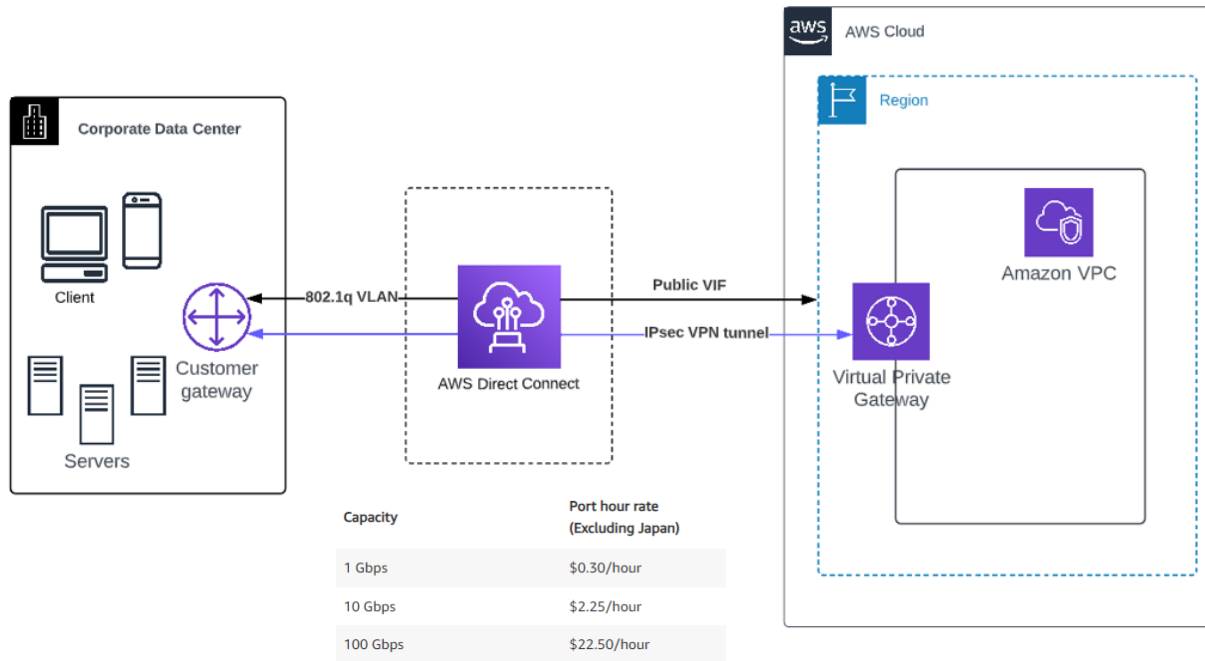


**AWS Trusted
Advisor**

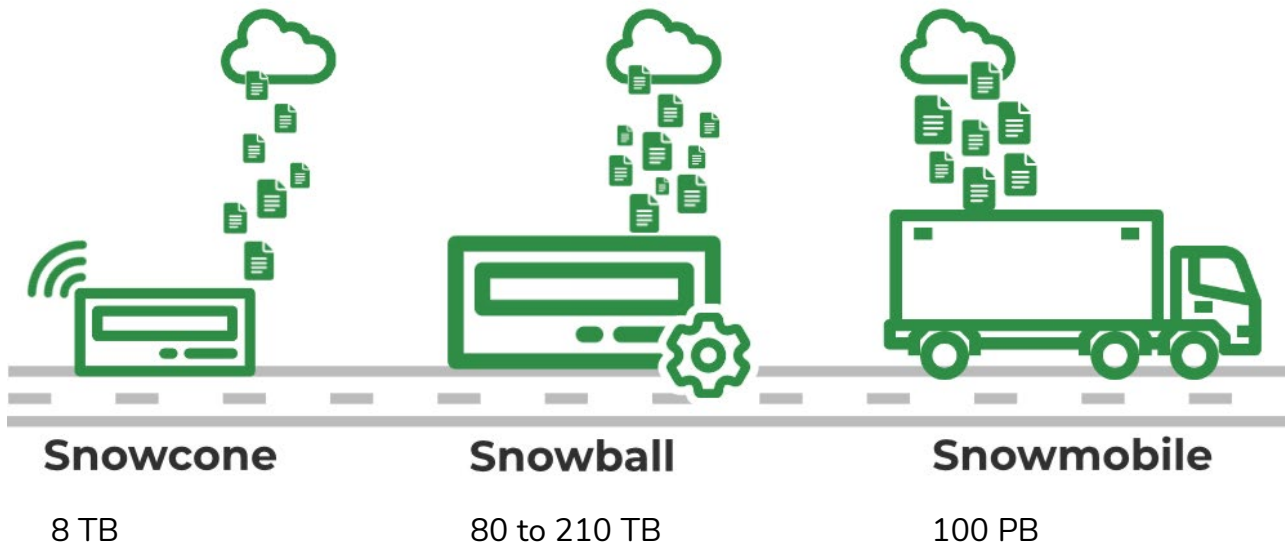
Online Data Migration - VPN



Online Data Migration - Direct Connect



Offline Data Migration





How to Choose a Migration Strategy

Connection	Data Scale	Method
Less than 10 Mbps	Less than 500 GB	Unmanaged
More than 10 Mbps	More than 500 GB	Managed service

Number of days = (Total Bytes)/(Megabits per second * 125 * 1000 * Network Utilization * 60 seconds * 60 minutes * 24 hours)

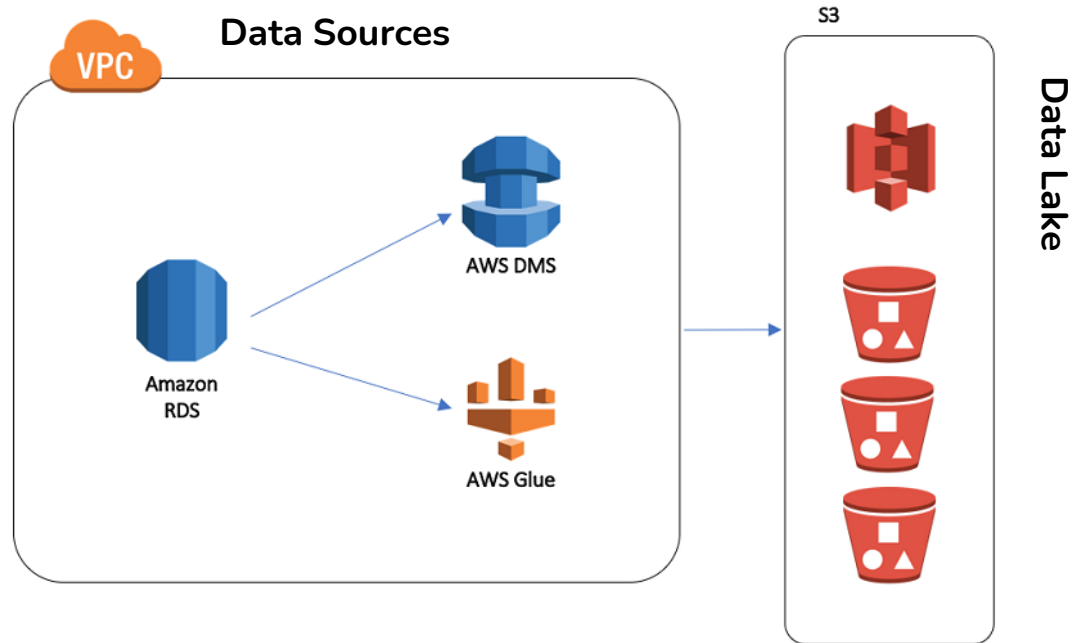
For example: if you have a T1 connection (1.544Mbps) and 1TB (1024 * 1024 * 1024 * 1024 bytes) to move in or out of AWS the theoretical minimum time it would take to load over your network connection at 80% network utilization is 82 days.

Ultimately, the question is: how quickly do you need the data migrated, and what is your budget?



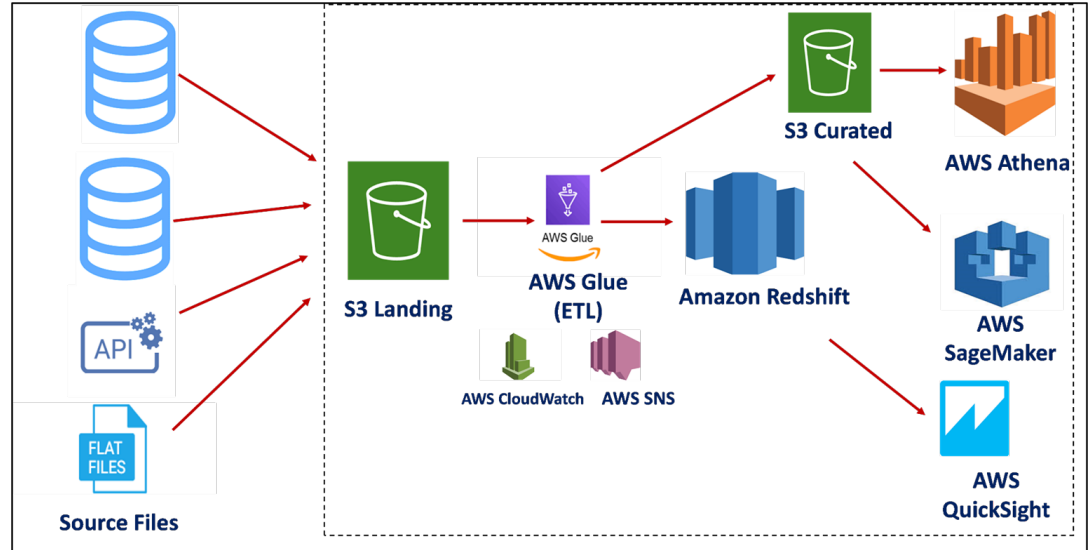
Data Lakes With the Cloud

- Data Lake
 - Central repository for all collected data
 - Structured
 - Unstructured
- Why AWS S3
 - Super Simple Storage
 - Near infinite ability to scale and remain performant
 - Standard, Infrequent Access, and Glacier Deep Archive



Extract Transform Load Process

- Extract Transform Load (ETL)
 - Structure data for analysis
 - AWS Glue
- Data Warehouse
 - AWS Redshift
 - Structured and refined data for reporting in a central repository



Reporting and Analysis

- Create insights with Business Intelligence tools
- These connect to curated data or the data warehouse in the ETL pipeline



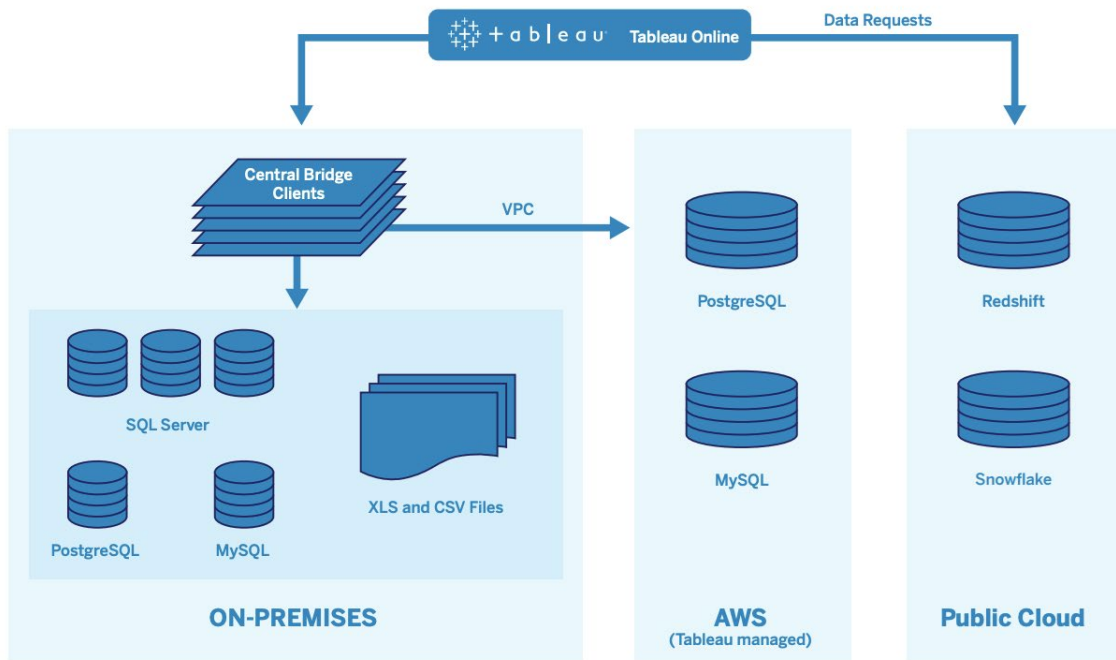
Source: [Dig deeper into your energy and utilities data to maximize profit](#)





Hybrid Data Sources

- Agile migrations
- Connecting to On-Prem and Cloud data sources for BI
 - Amazon Quicksight
 - On-Prem Connection
 - Cloud Connection
 - Tableau
 - Tableau Bridge



AI/ML Analysis

- [Energy Loss Detection Performance](#)
- [Redshift ML](#)
 - Deploy ML models directly with Redshift
 - No separate ML environment required
- [QuickSight ML](#)
 - ML Insights with built in models
 - Trends, anomalies, forecasts
- [Tableau AI](#)
 - Einstein Discovery





More Case Studies

More to explore...

[PGE Migrates to AWS, Significantly Improves Energy Loss Detection Performance](#)

- Replaced vendor software, increased performance, reduced costs
- Snowflake data warehouse in AWS
- S3 data lake

[Pacific Gas and Electric Case Study - Data Analysis on AWS](#)

- Improved insights for energy loss detection and triage through more reliable data storage and architecture
- Switched to AWS from On Premise systems for data analytics
- [Amazon Aurora](#), [Amazon Kinesis](#), and [Amazon Glacier](#), and more



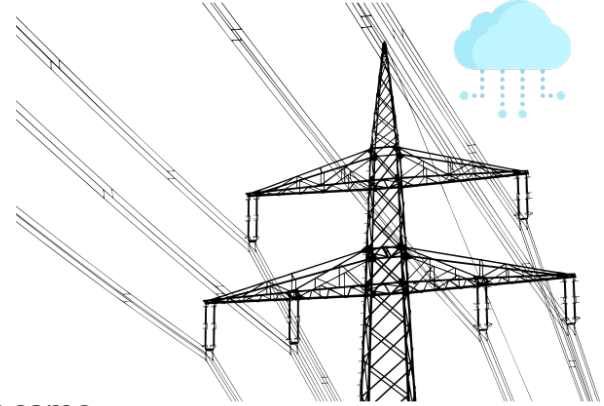
In 2020, PGE confronted historic wind, wildfire, and weather events. Our capabilities on AWS helped us support our customers better than we could have otherwise."

Uma Venkatachalam

Principal Information Architect, Portland General Electric



Conclusion, Q&A



- The power industry has been rocked by revolutionary synchrophasor technology and the avalanche of data that came with it
- Cloud architecture makes ingesting, transforming, processing, storing and reporting that data more secure and less expensive than ever before
- With the help of cloud architecture, the power industry can create accurate reports using data collected with synchrophasors.
- Q&A



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