

WE ARE



GE VERNOVA

For the new era of energy...a new company with full focus on the energy transition

80K

Global employees

100+

Countries

12

Businesses + Accelerators

Digital

Financial Services

Gas Power

Grid Solutions

Solar and Storage Solutions

Hydro Power

Nuclear Power

LM Wind Power

Offshore Wind

Onshore Wind

Power Conversion

Steam Power

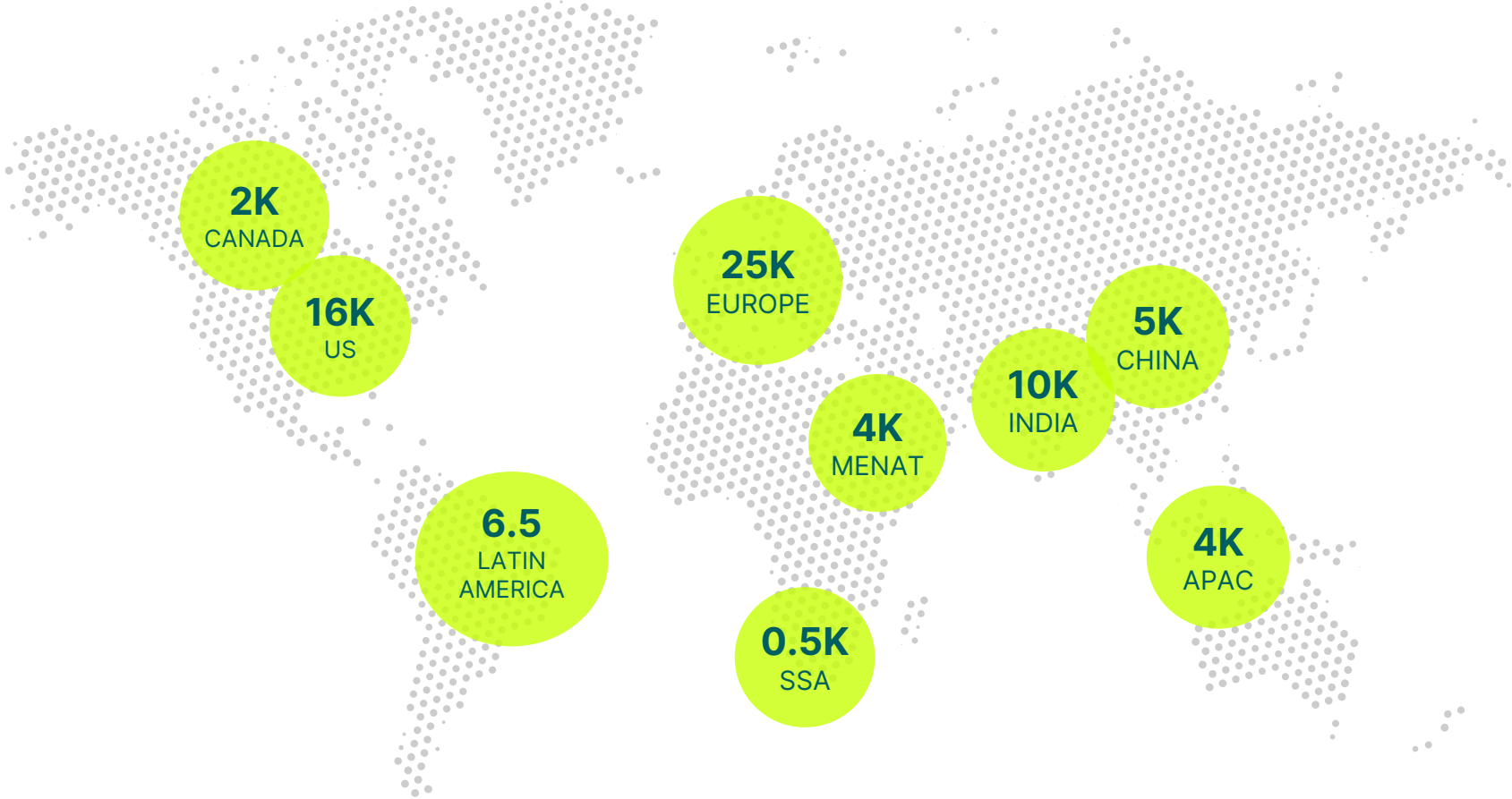
Advanced Research*

Consulting Services*

*Accelerators



Employees



Market Forces Impacting the Grid



Climate Events
Cyber Threats
Regulatory

RESILIENCY



Renewables
Distributed Energy
Resources
Green Gas Balance & Effects

SUSTAINABILITY



Customer Engagement with
DER Programs
Equitable Access
Infrastructure Costs

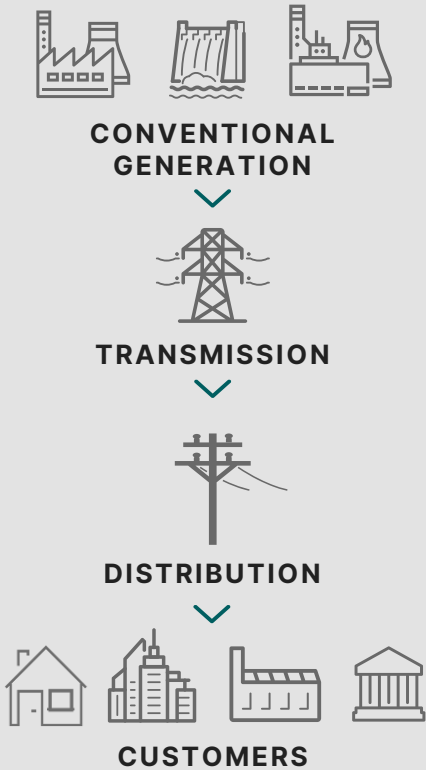
AFFORDABILITY

PACE OF CHANGE IS ACCELERATING

Increasing grid complexity requires software

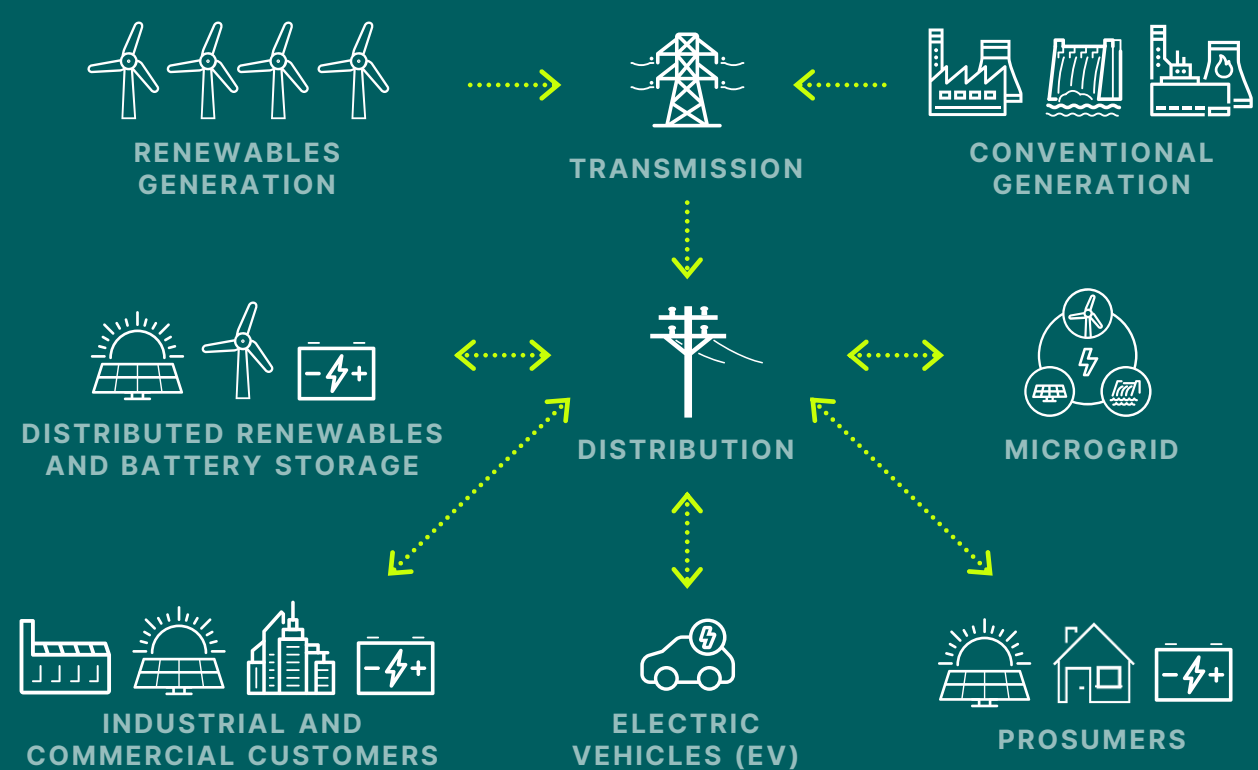
YESTERDAY

Centralized and predictable



TODAY

Constantly changing, unprecedented complexity



An aerial photograph of a river delta, showing a complex network of water channels and land. The water is a mix of dark blue, light blue, and green. The land is a mix of green and brown. The text is overlaid on the image.

**MONOLITHIC
APPLICATIONS**

**SILO'D
DATA**

**LEGACY
TECH STACK**

“SILO'D DATA” BREAKS INNOVATION

Key integration gaps slowing down digital transformation

88%

of Organizations report Major Integration Gaps slowing down Digital Transformation

Companies struggle with data & system integration

89%

of Companies struggle with Data and System Integration

Data silos persistently breaking innovation

90%

of Organizations cite Data Silos are persistent Breaks on Innovation

GridOS[®] Orchestration Software

First software portfolio designed for grid orchestration



Zero Trust grid security model



Federated grid data fabric & one network model



A suite of intelligent grid applications



Hybrid cloud architecture



GridOS applications

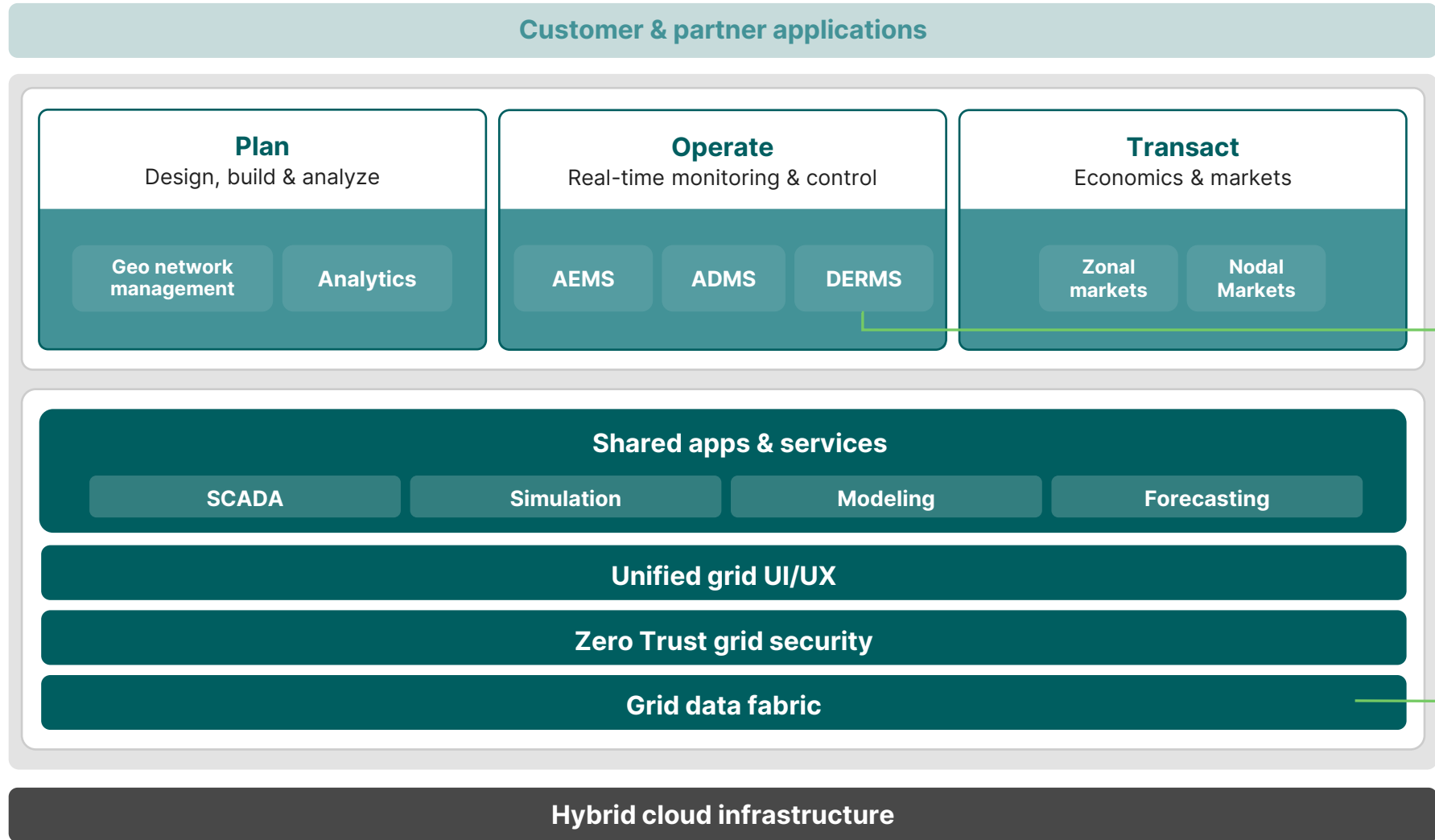
AI/ML-enabled,
composable, scalable

GridOS platform

Open, federated,
extensible,
micro-services

Infrastructure

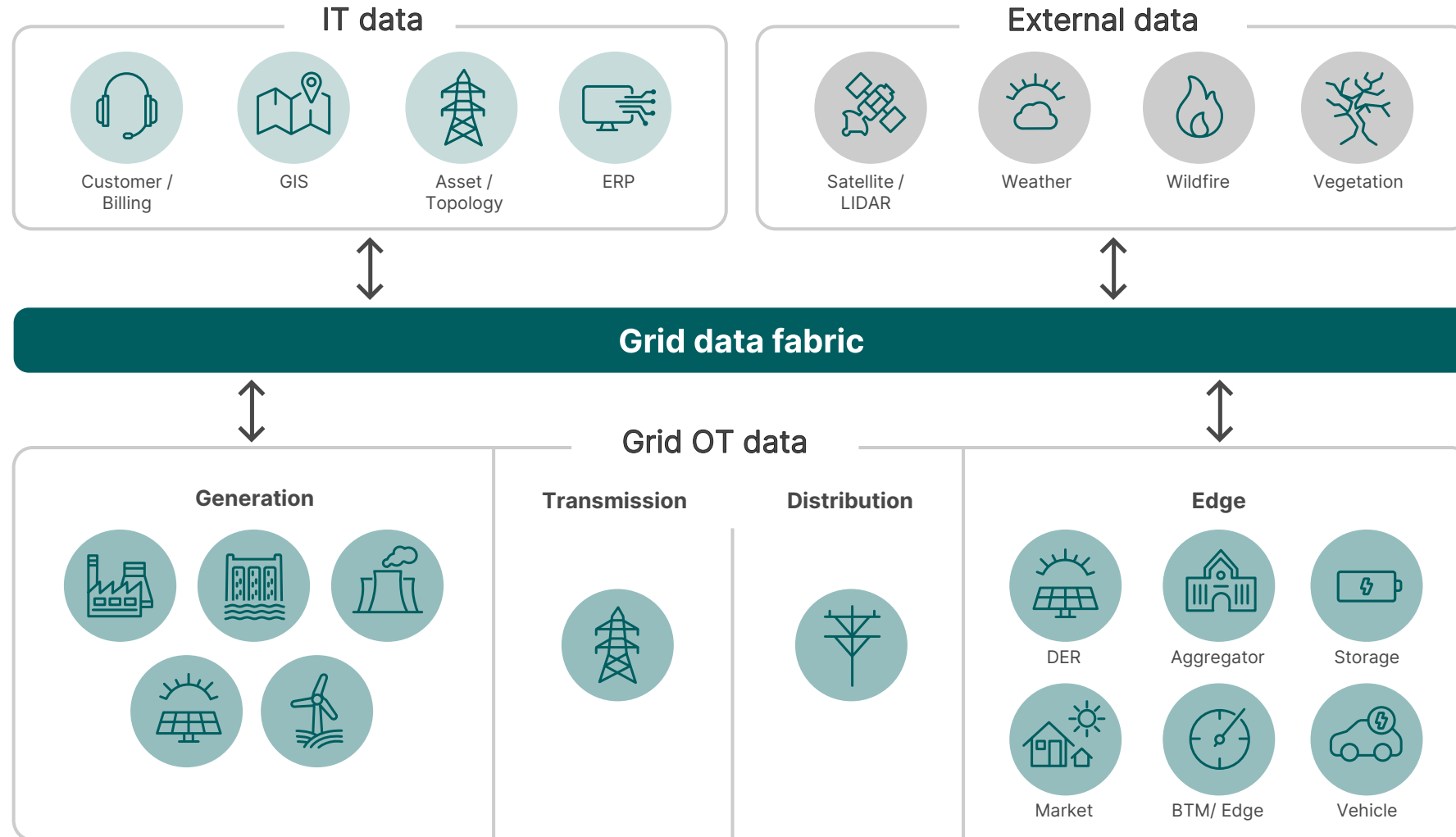
Cloud, on-prem,
edge-certified
configurations &
deployment



GridOS[®] **DATA FABRIC**

UNLOCK THE INTELLIGENT GRID

Distributed grid data necessitates a grid data fabric



What it does?

DISCOVER



Leverages **centralization of metadata** to discover grid data in a siloed application environment

GOVERN



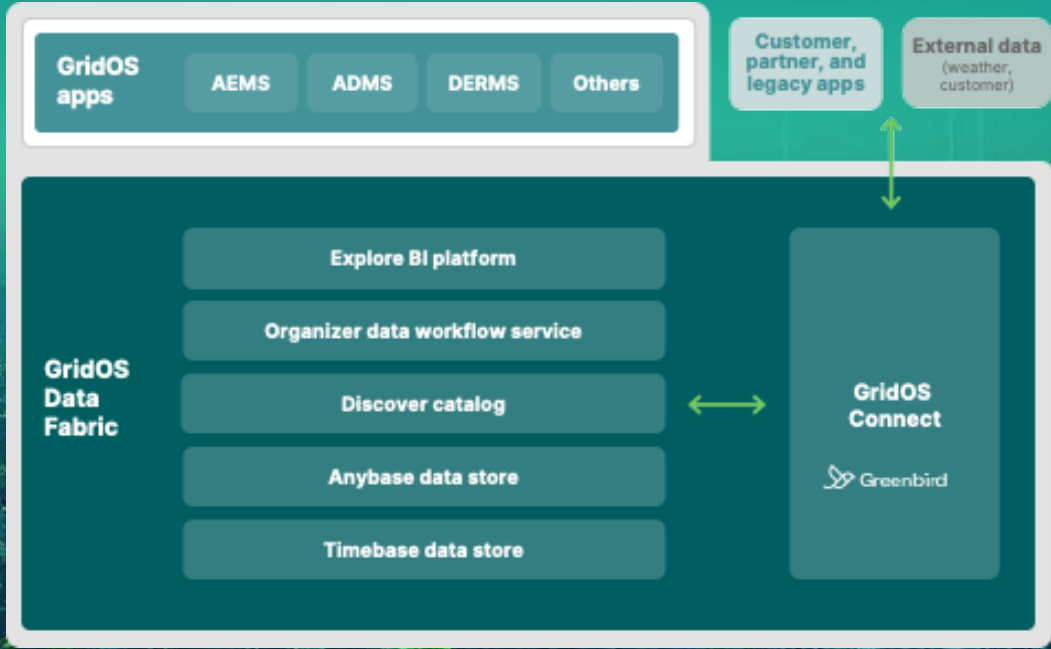
Uses a **metadata catalog** to accelerate data governance workflows, increasing accuracy and confidence in the lineage and quality of data

UTILIZE



Enables users and applications to **access** data with secure, process-driven, self-service (user friendly) tools like **query functions and dashboards**

**Accelerate solution development and deployment
with a low code development platform**



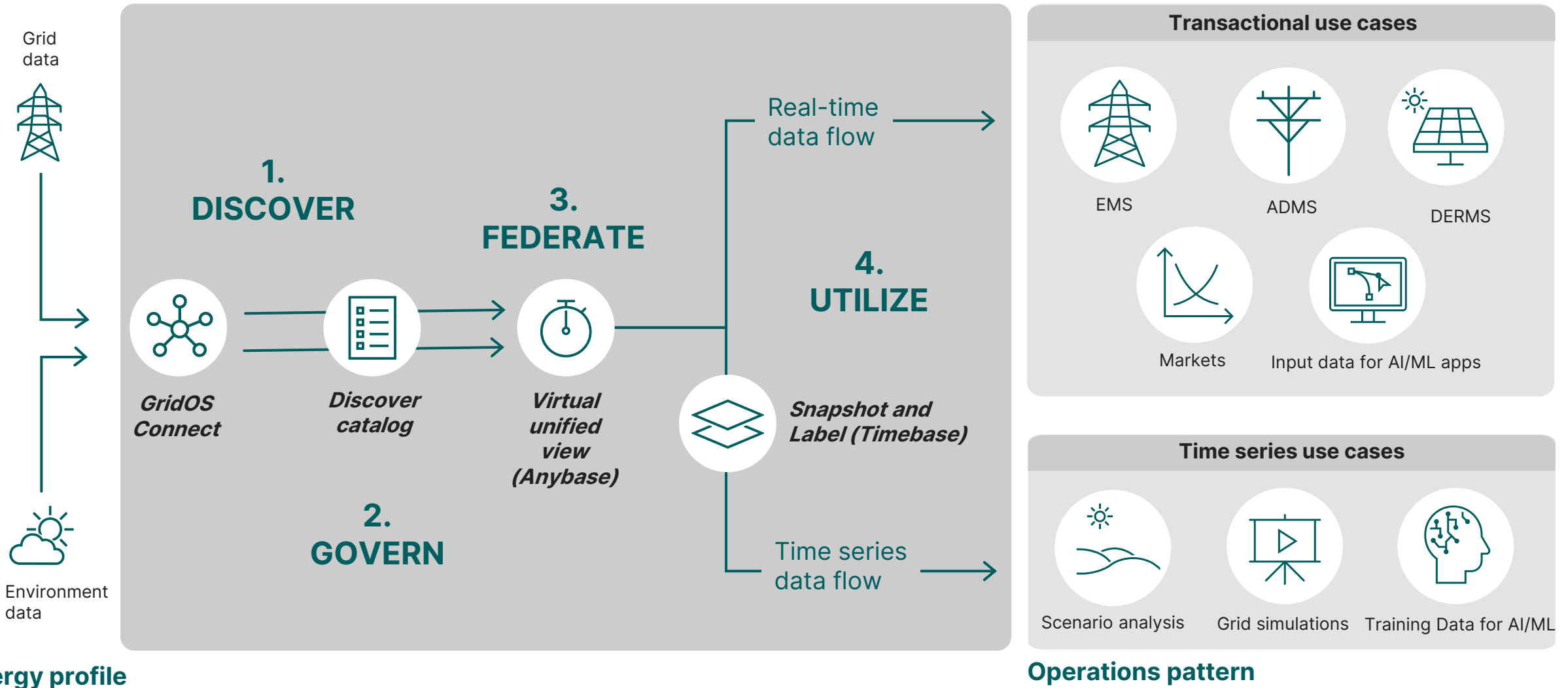
Integrate Disparate Data Sources at Scale

Store & Organize Operational and Temporal Data

Compose & Govern Data Products

Explore & Federate Data Products

How does it all work?



Explore BI platform

What is it?

A self-service business intelligence (BI) platform with user-friendly web tools for performing data analytics functions.

Benefits

The self-service environment allows operators and analysts to explore, visualize, and enrich datasets, making data extraction easier so that users can focus on analysis. This can help users get the insights they need for more efficient and effective grid orchestration.



Organizer data workflow service

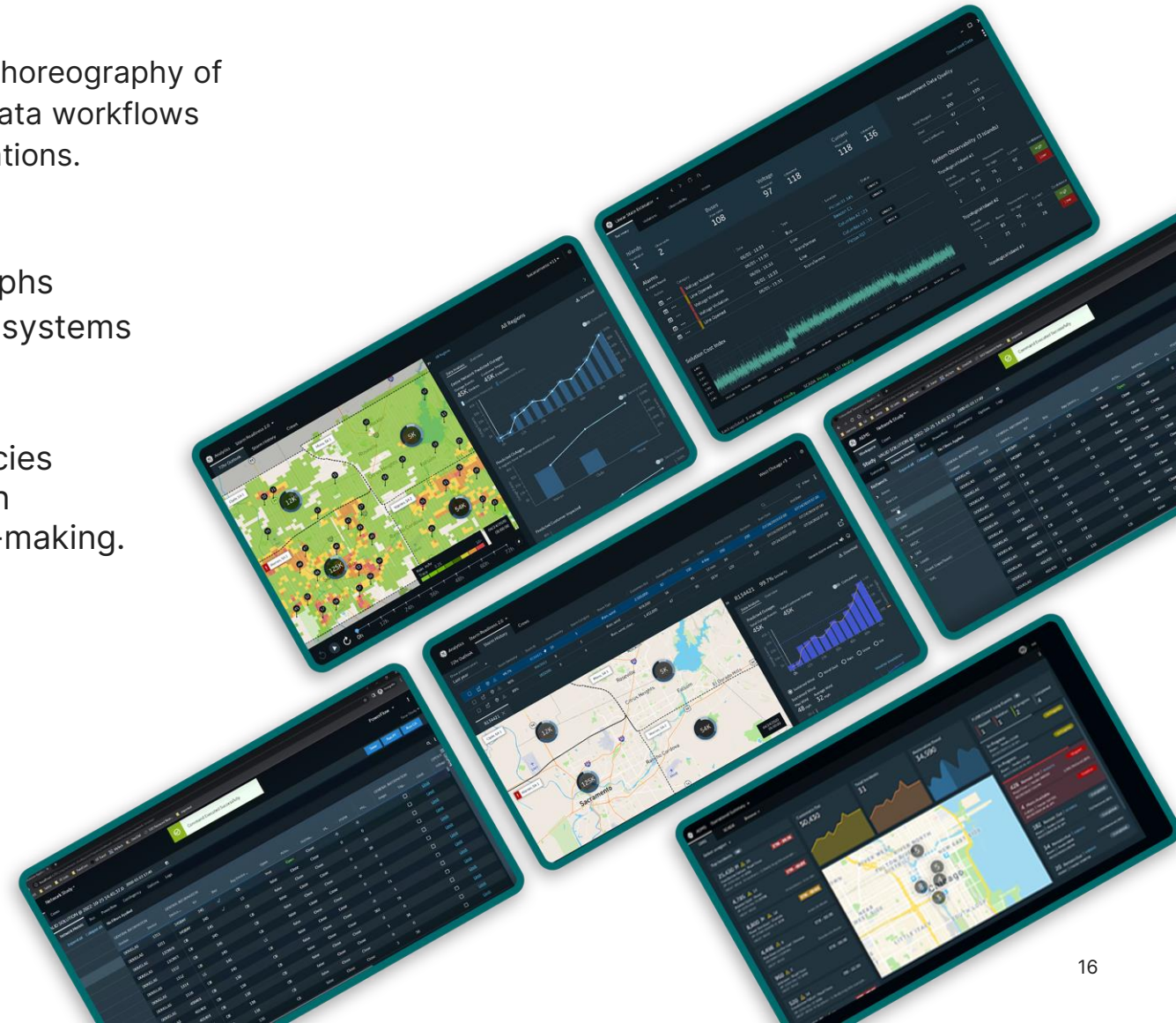
What is it?

A modular, flexible middleware engine enabling coordination and choreography of data workflows with a low code interface. The service organizes data workflows across the GridOS platform, data stores and intelligent grid applications.

Benefits

The Organizer service organizes, orchestrates and choreographs data workflows to automate data processing across different systems and applications.

This reduces data services complexity, supporting dependencies between applications and improving application accuracy with high-quality and contextual data for more intelligent decision-making.



Discover catalog

What is it?

A search engine that uses metadata to enable the discovery and governance of data assets and curation of a business semantic layer across the GridOS portfolio and other applications.

Benefits

This centralizes key information associated with decentralized data, making it faster and easier to discover and model data and enabling policy-based data governance to improve data integrity, consistency, and accuracy.

The Discover catalog is the backbone of GridOS® Data Fabric because it provides a clear understanding of data lineage to increase data confidence.



Anybase data store

What is it?

A highly scalable, available, columnar data store service that enables federated data access to operational data from multiple sources across the grid ecosystem while leveraging the Zero Trust capabilities of the GridOS platform.

Benefits

Anybase provides operational storage and data federation capabilities that allow quick access to disparate data and efficient delivery of that data to the applications and displays needed for grid operations and analysis.

Operational storage scales to meet the sizes and demands of today's grid, while data federation enables decision makers using secure, user-friendly tools like SQL query functions and dashboards to take advantage of time-sensitive opportunities without the need to perform any extract-transform-load (ETL) effort.



Timebase data store

What is it?

A specialized database for storage, retrieval, and archiving of temporal and/or time series data.

Benefits

Timebase is designed to provide APIs and integrations optimized for grid use cases, such as forecasting, schedule management, simulations, scenario planning, and study modes.

The database will also provide training data for AI/ML models where historical data is critical to represent the state of the grid and to understand responses to specific environments in the past.

Timebase, coupled with Anybase, builds a foundation for prescriptive actions like prediction, optimization, and automation.





CONNECT

What is GridOS Connect?

Integration Platform purpose-built for utilities.

Empowers utilities to deliver **mission-critical energy application integration** and big energy data management solutions faster and smoother than the traditional approach to System Integration.

Elastic scalable and **highly available distributed** platform supporting public cloud (AWS, GCP, Azure), private cloud, on premise and hybrid deployments.

Part of **GridOS Data Fabric** and **standalone iPaaS** solution.



Robust & modern platform built to scale

Event Driven Architecture

All internal services and flows are event driven, enabling highly scalable and resilient data integrations

Reactive Systems and Micro-services

Micro-services are the dominating design pattern, outperforming SOA (Service Oriented Architecture)

Service Mesh

Connect leverages the concept of Service Mesh to manage the network of reactive micro services, to provide the high performing, scalable and elastic infrastructure required for mission critical utility integrations

DevOps

DevOps is a set of practices aiming to shorten development life cycles and provide continuous delivery of high-quality software.

Low Code Integration

GridOS Connect is developed and configured using low code tools, to secure high performing integration logic, maximum level of re-use and simplified maintenance and support.

Technology stack

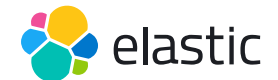
GridOS Connect is built on cloud native technology components:



RKE 2



Apache CASSANDRA



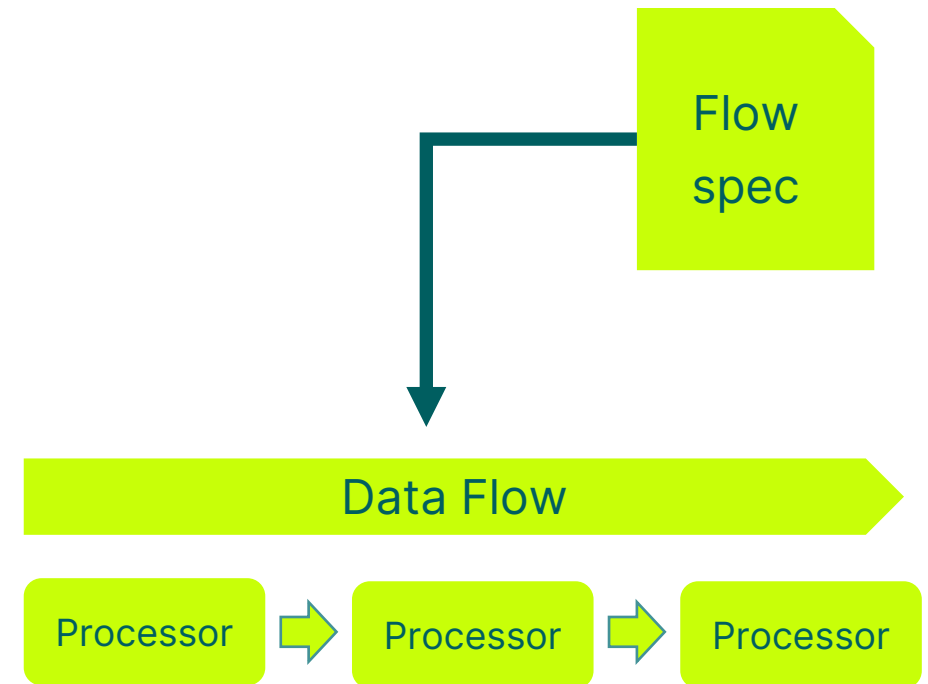
Core concepts

FLOW: Message processing **pipeline** that acts as the **integration layer between systems**. When deployed, the flow exposes an inbound endpoint that can receive messages, transform them, and deliver them to other endpoints.

FLOW SPECIFICATION: Flows are created by writing a flow specification that the flow server will then turn into a message processing pipeline. **Flows are specified / configured in the GridOS Connect (F)Lowcode DSL.**

PROCESSORS: Processors represent **one processing step**. Starting from the inbound endpoint, the message is passed through a **chain of processors** that either manipulate the data internally or send it to an external/outbound endpoint before passing the result on to the next step.

FLOW TRACE: Runtime Information such as log data or metrics.



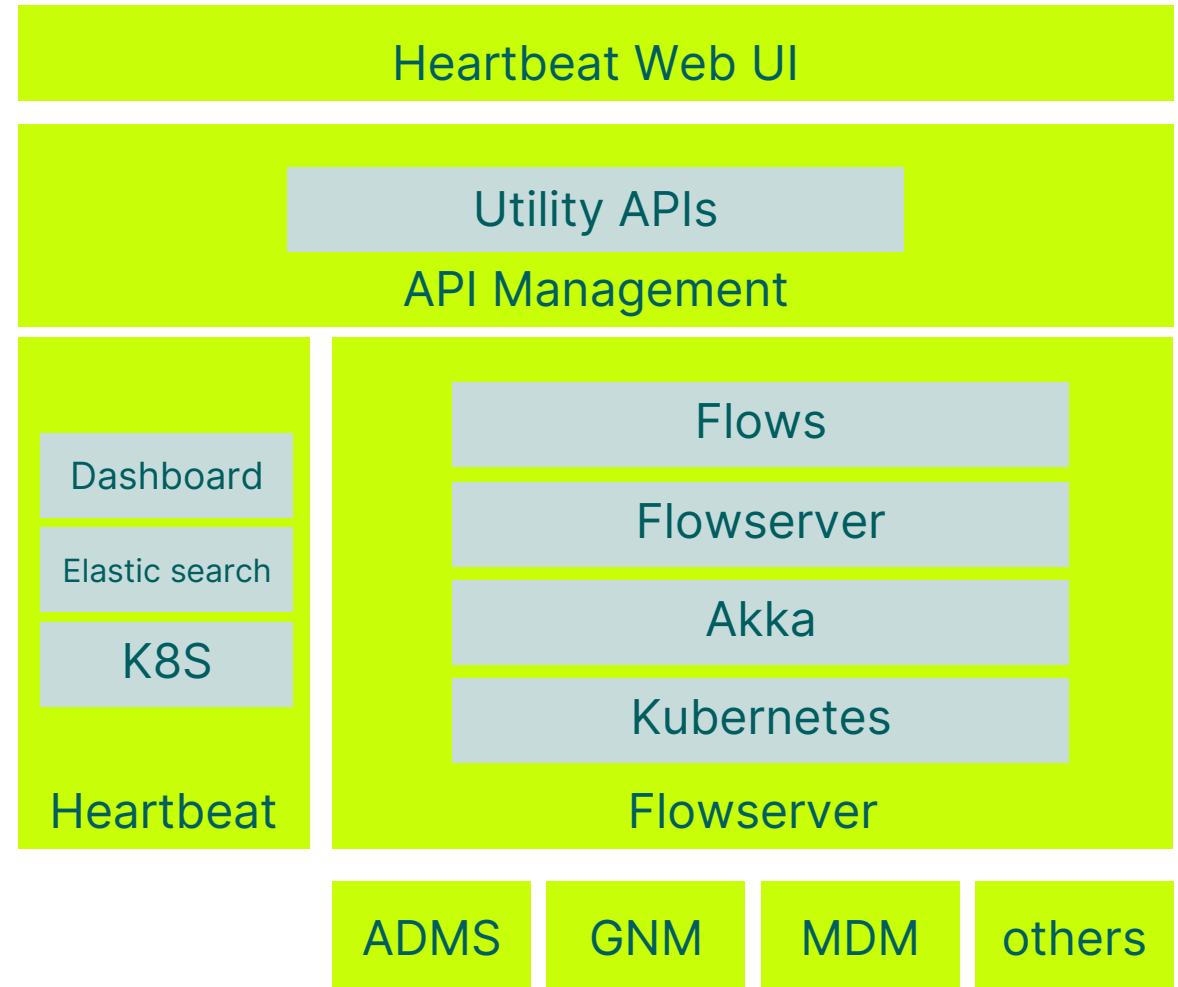
Core Modules

Flowserver: Built-in Integration Engine executing, managing and monitoring all integrations, data flows, APIs and interfaces specified using the Connect (F)Lowcode DSL.

Heartbeat (Backend): Built-in Big Data Log Analytics platform to log all integration traces system logs and/or metrics.

Heartbeat (Frontend): Built-in Role Based UI to manage & monitor GridOS Connect.

APIGateway: Built-in API Gateway that automatically exposed / manages service endpoints facing 3. party applications (e.g. customers enterprise systems).



Integration capabilities

Reliable Messaging: Synchronous, Asynchronous, Request & Reply, Store & Forward, Fire & Forget

Message Handling: Batch-style, streaming, online / real-time, etc.

Connectivity: HTTPs, SOAP, REST, sFTP, JMS, KAFKA, MQTT, JDBC, GCP Pub/Sub, AWS SQS, AWS S3, MS Azure IoT Hub, Redshift, etc.

Protocol Mediations: Mediation between protocols and endpoints

Validations: Message / Data Validations

Enrichment: Message / Data Enrichment

Data Processing: Aggregation, Splitting, Parsing of messages / data

Transformation: Message / Data Transformation, Data Mapping and Formatting

Routing: Filtering and Routing

Orchestration: Orchestration and management of data flows and integration processes

API Management: Management of APIs and service endpoints

Data Operations: Management & Monitoring



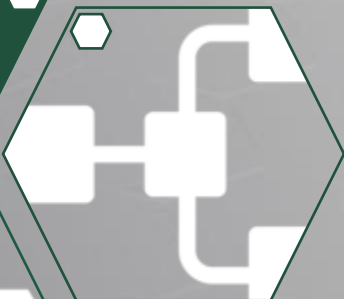


Network of
Reactive
Microservices



Containerized
Platform

Low Code
Integration
Design & SDK

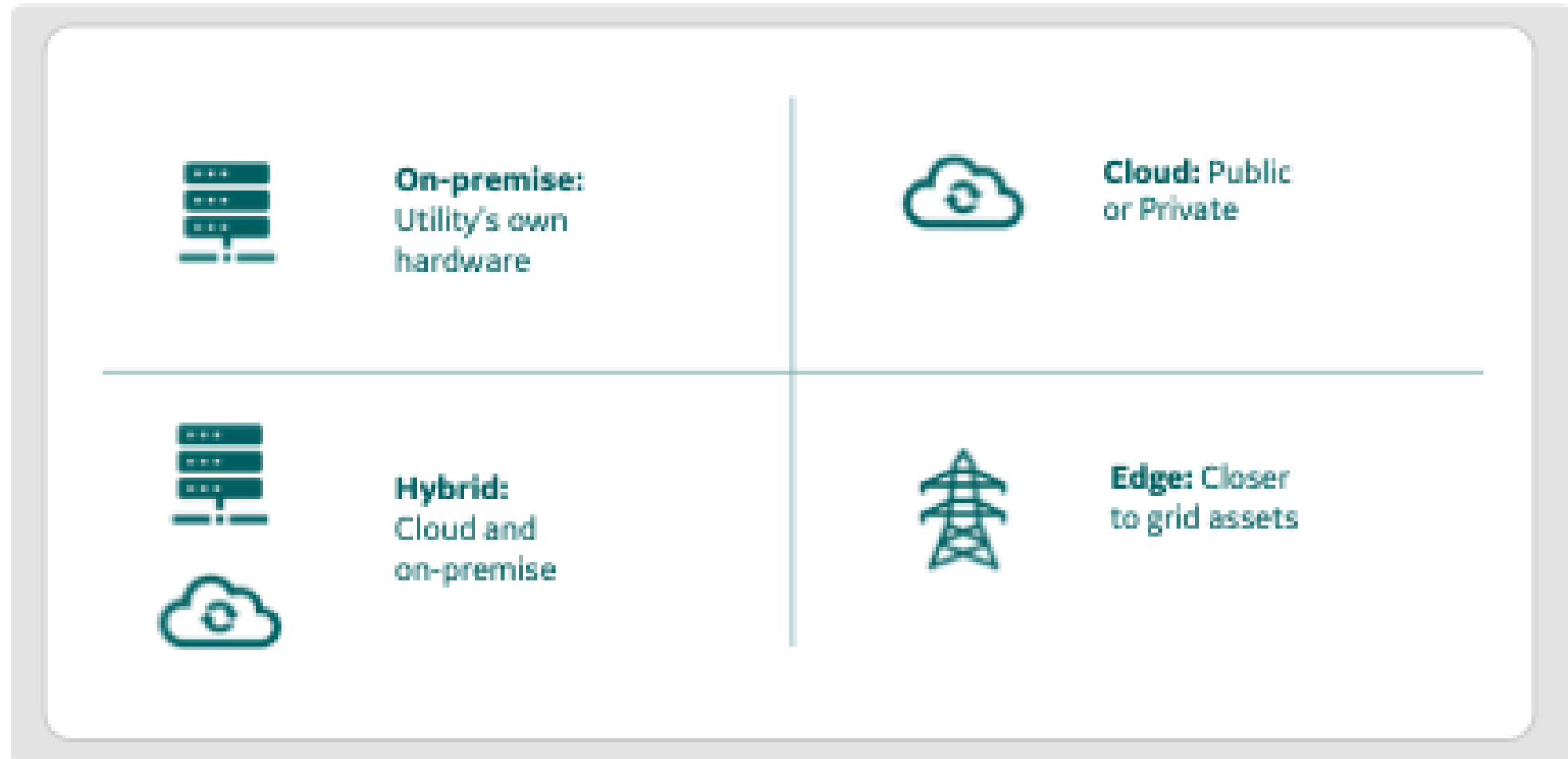


Event Driven
Architecture



Cloud Native
Technologies

CLOUD NATIVE & AGNOSTIC IPAAS DESIGNED FOR CHANGE



EDGE DERMS & FLEXIBILITY

→ Leverage incremental DER flexibility to resolve grid constraints



GEO NETWORK MODEL VERIFICATION

→ Verify Accuracy / Completeness of Geo Network Model

T&D INTEGRATION

→ Manage multi-directional energy flows across the grid



DISRUPTION MANAGEMENT

→ Manage Disruptions proactively and resolve reactively faster

AMI ENRICHED POWER FLOW (ADMS)

→ Improve Accuracy / Quality of Power Flow Results to better Load Management



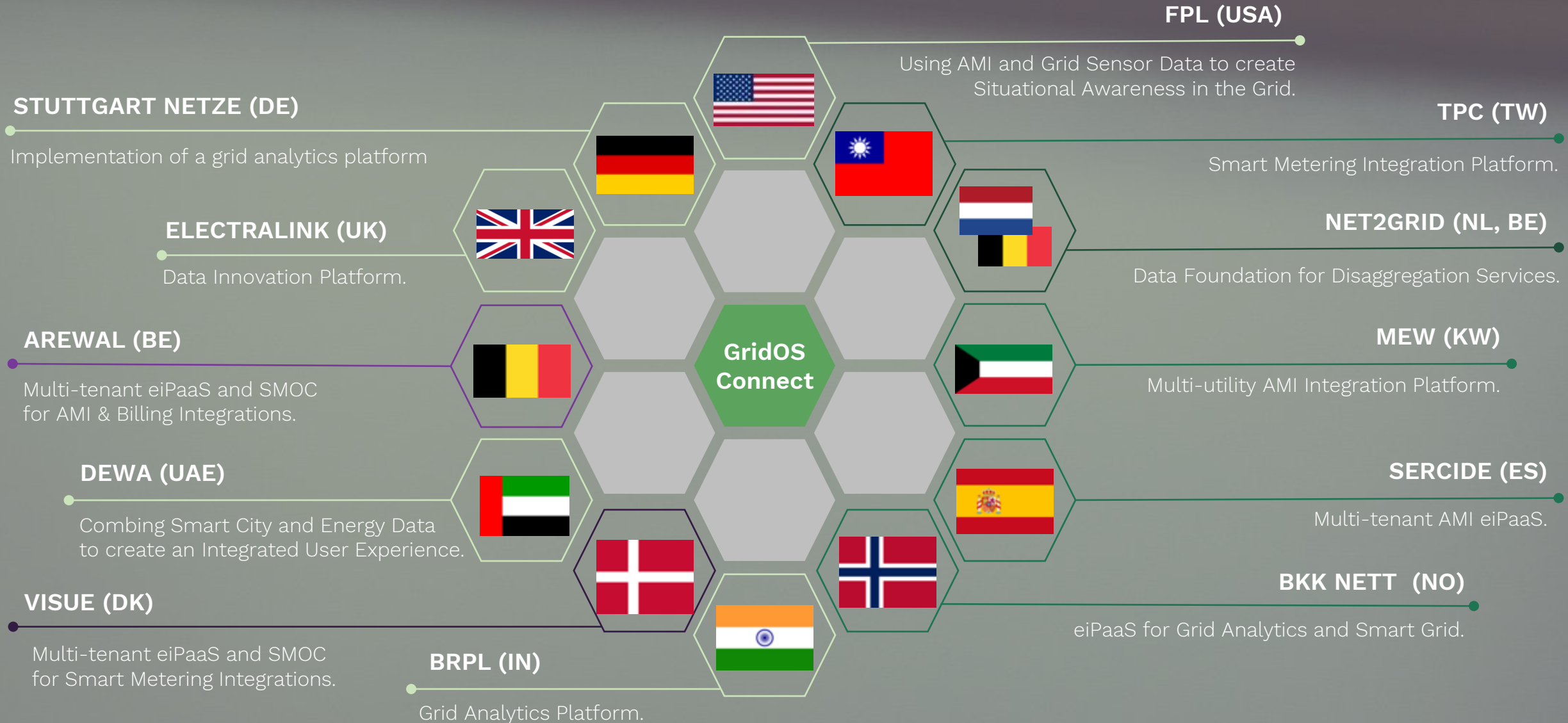
AI/ML DRIVEN DER OPTIMIZATION

→ Achieve techno-economic DER Optimization

GridOS
Data Fabric



DATAFY'ING UTILITIES SINCE 2010





GridOS[®] PLAN APPLICATIONS

GridOS® Plan Apps

Geo Network Management

Design and update the connected network model with geo, internal, and schematic representations for all physical assets including structures and related service connections



Visual Intelligence

Optimize grid resilience by efficiently planning, monitoring, and managing vegetation, asset inspections and other AI/ML powered risk-based assessments and action planning



Disruption Planning & Recovery

Prepare and respond to disruptions - forecast damage & crew staging, visual damage detection, field damage assessment and restoration coordination



Field Apps

Visibility to the network model on mobile devices for various types of work done in the field - as-built updates, inspections, surveys, damage assessments, etc.



Evergreen

Improve total cost of ownership and time to value with continuous integration and deployment automation lifecycle management



Digital Dynamic Line Rating

Predict and set line rating settings based on various inputs such as weather, powerflow, etc.



GridOS applications

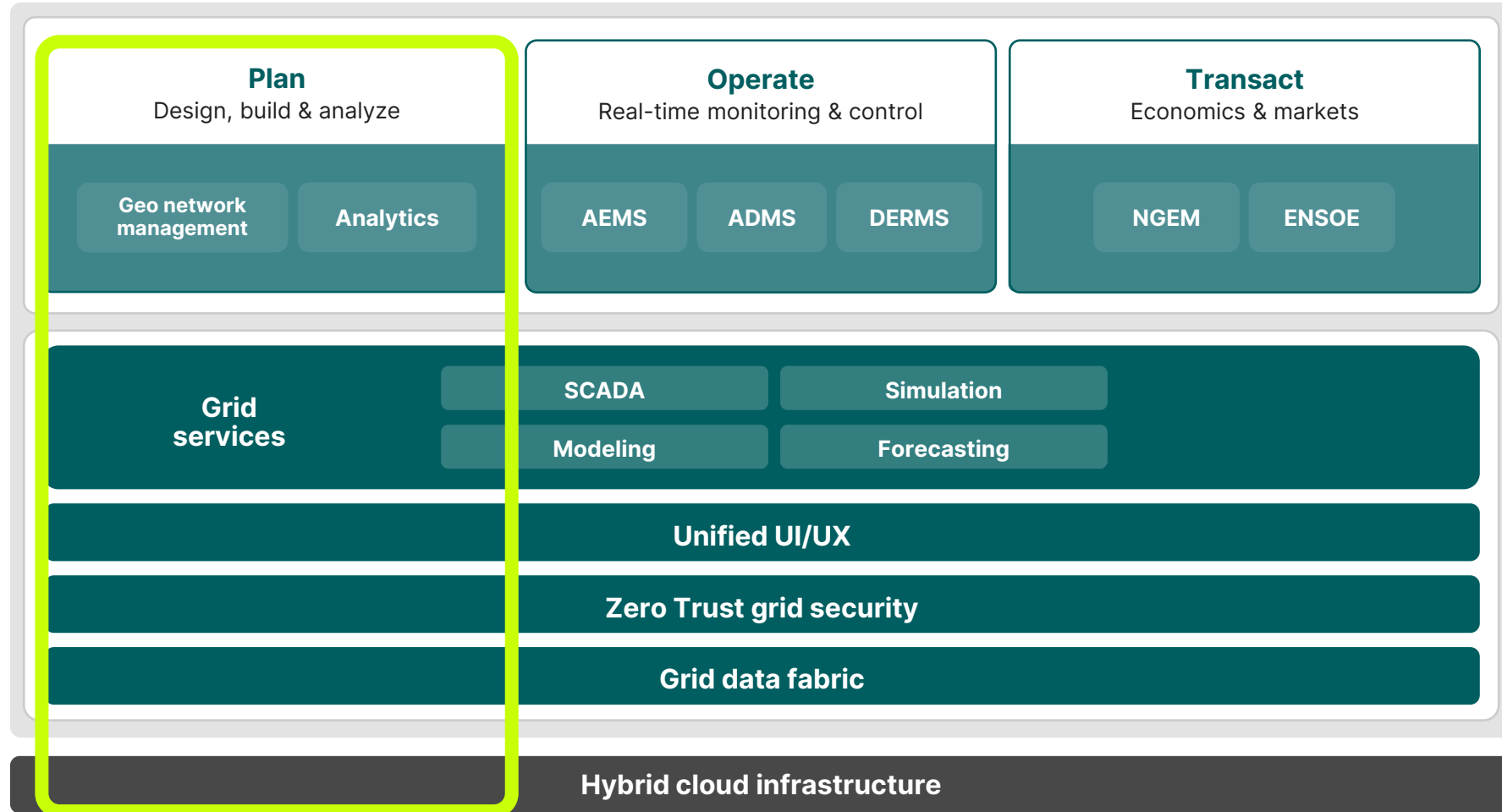
AI/ML-enabled,
composable, scalable

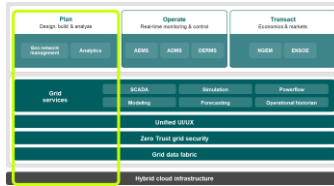
GridOS platform

Open, federated,
extensible,
micro-services

Infrastructure

Cloud, On-Prem,
Edge Certified
configurations
Certified deployment



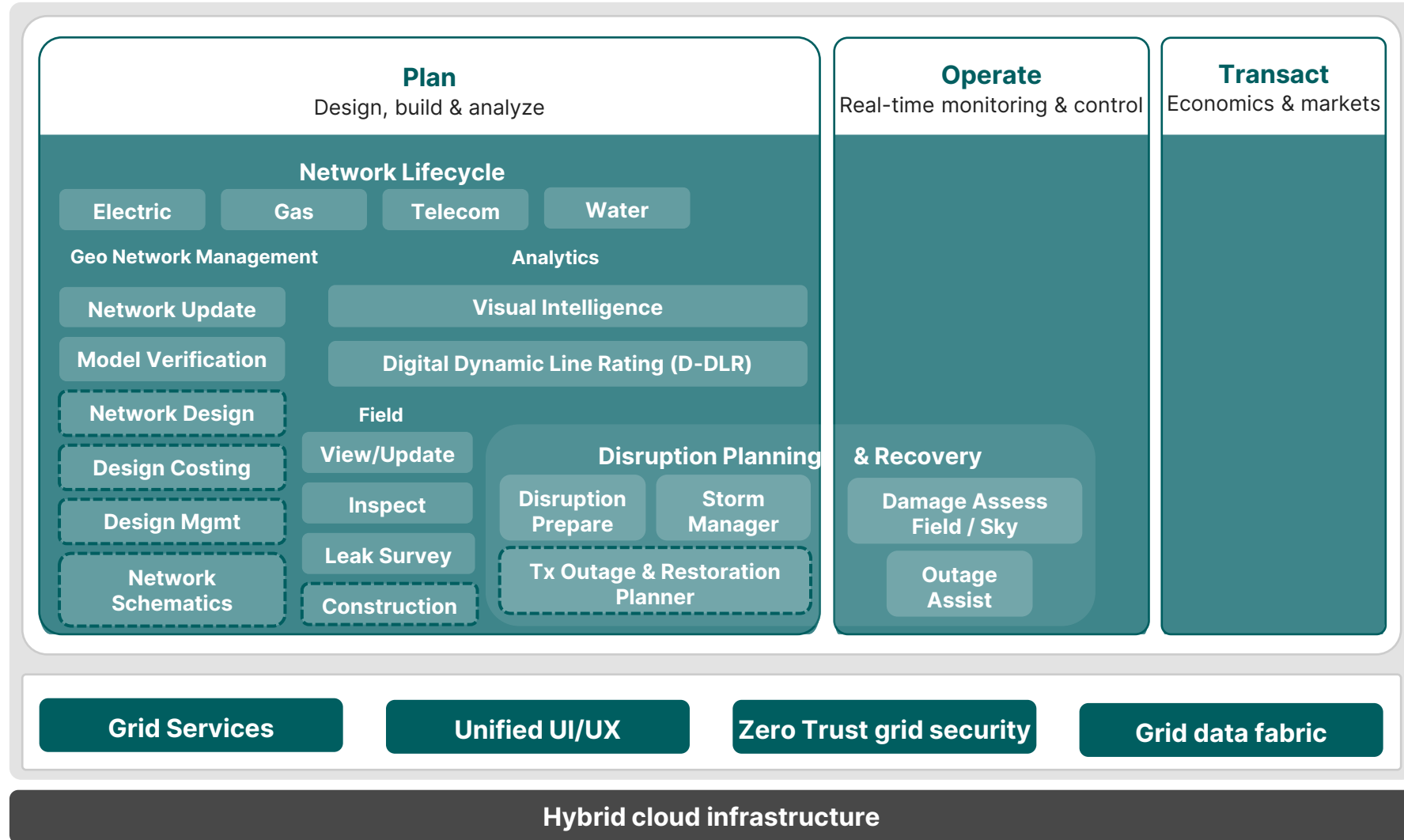


GridOS applications

AI/ML-enabled,
composable, scalable

GridOS platform

Infrastructure



VMDS DATABASE EVOLUTION

VMDS and VMDS Cloud

A key contributor to Smallworld's success as the most scalable platform to geospatially document and design complex networks is ...

VMDS (version managed datastore)

- A foundation of Smallworld products for >30 years, with continual improvements for performance, security and deployment.
- Unique version management enables 1000s of concurrent users to perform geospatial updates and resolve conflicts.

VMDS Cloud (vmSQL) continues this by providing the **option** of all these VMDS qualities running on an industry standard relational database. GE's initial target is **PostgreSQL**.

Shift from proprietary to mainstream IT

- Common IT deployment and management, including high availability (HA) and disaster recovery (DR)

Accelerate cloud transition

- Managed databases available from multiple vendors as a service

Innovate through open data access

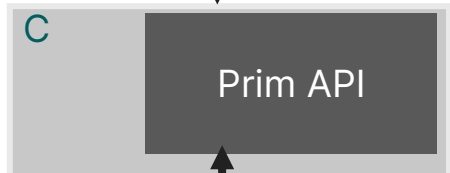
- **VMDS Cloud** is a key component in GE's GridOS data fabric

VMDS to VMDS Cloud

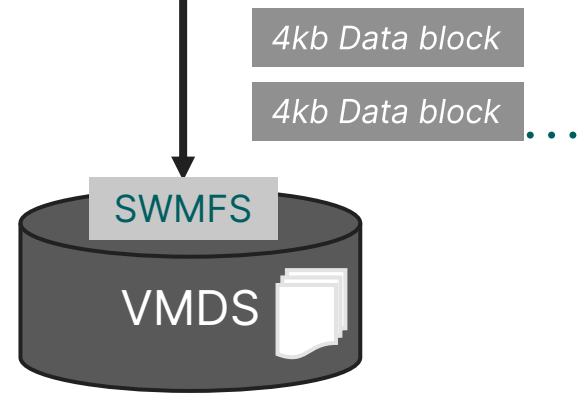
Application



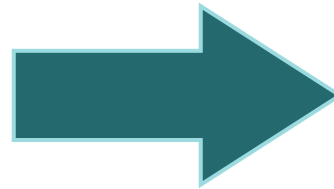
Database access



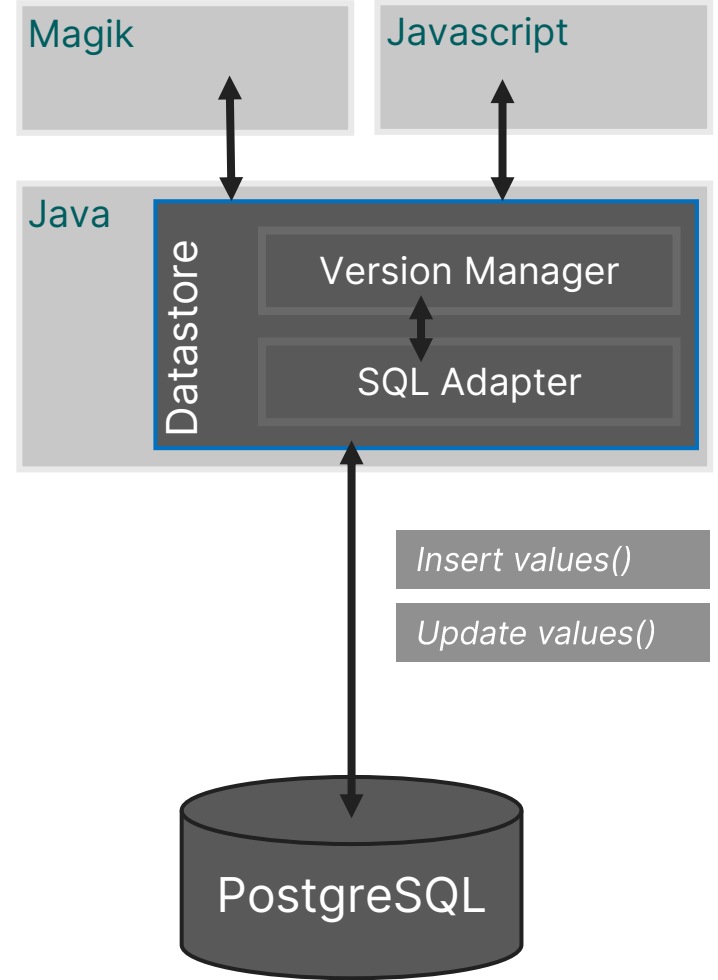
Persistence



- Lift & Shift VMDS relational model into PostgreSQL with version indexing
- Replace block persistence with record persistence



- **Transparent** data access from **Magik** and **Typescript/Javascript**
- **Replace SWMFS** user connection and rights management

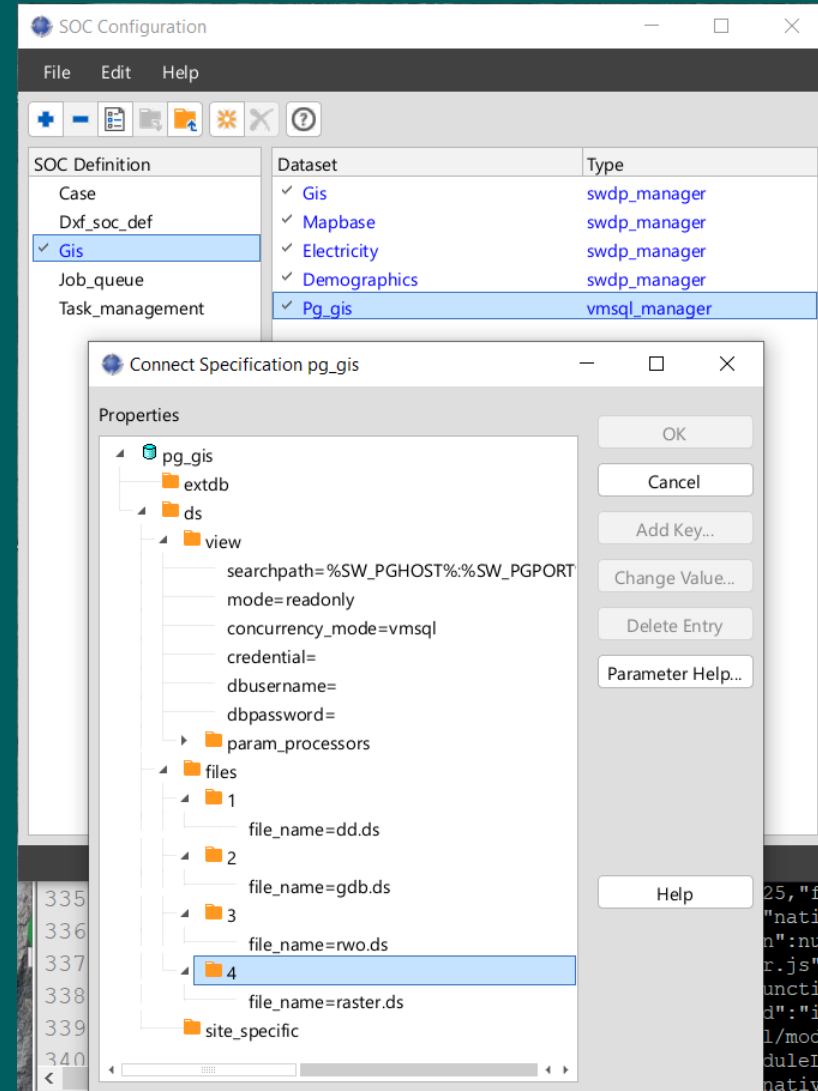


Dataset specification

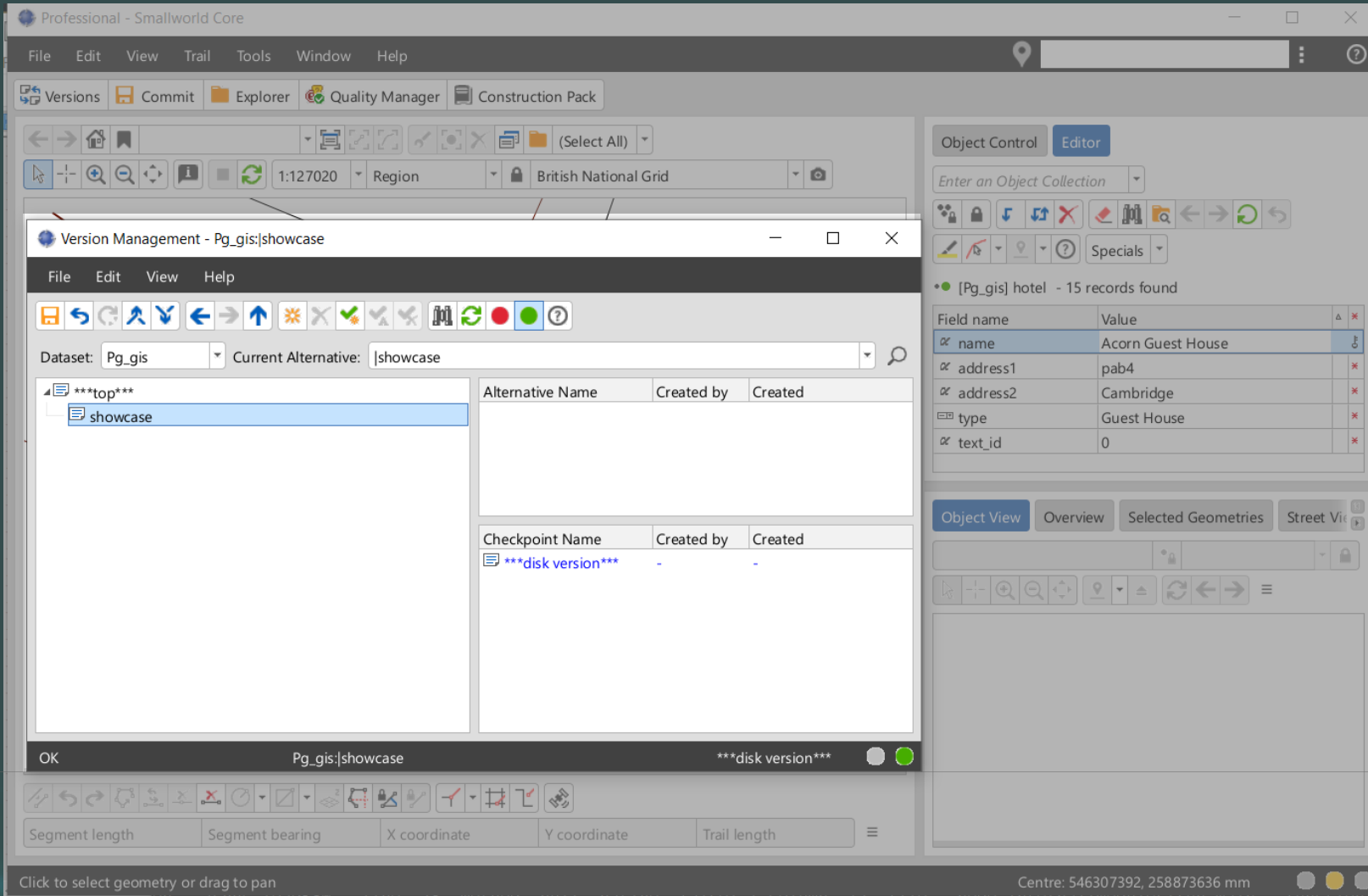
New vmsql dataset manager class for handling PostgreSQL data

Additional to current vmds swdp dataset manager

Concurrency mode of vmsql is unique to PostgreSQL



VMDS Cloud | versioned attributes access



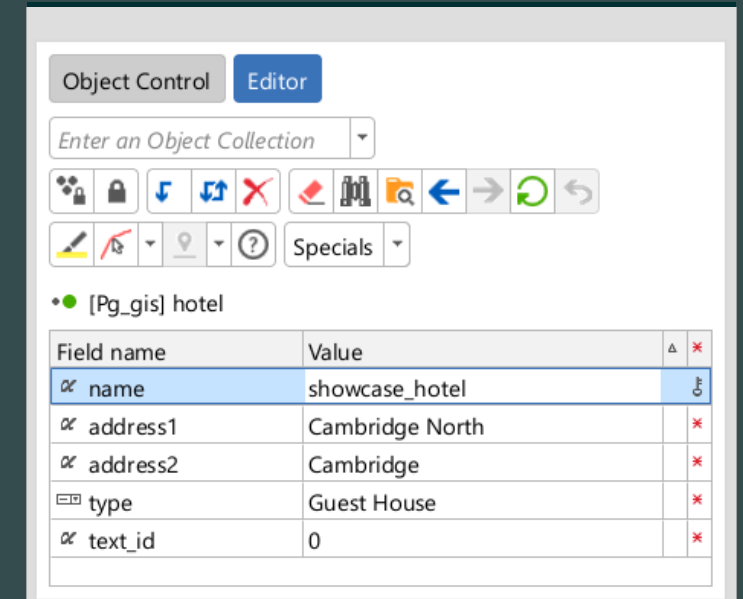
The screenshot displays the Bentley MicroStation Professional interface. The main window shows a map with a version management dialog box open. The dialog box is titled "Version Management - Pg_gis:|showcase" and contains a tree view on the left with "showcase" selected. Below the tree view are two tables: "Alternative Name" and "Checkpoint Name".

Alternative Name	Created by	Created

Checkpoint Name	Created by	Created
disk version	-	-

The "Object Control" panel on the right shows the "Editor" tab. It displays a table of attributes for a selected object:

Field name	Value
α name	Acorn Guest House
α address1	pab4
α address2	Cambridge
type	Guest House
α text_id	0



This inset screenshot shows the "Object Control" panel in the "Editor" tab. It displays a table of attributes for a different object selection:

Field name	Value
α name	showcase_hotel
α address1	Cambridge North
α address2	Cambridge
type	Guest House
α text_id	0

SMALLWORLD DNA

Smallworld DNA Research

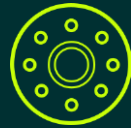


Open standards and technologies

Adoption of mainstream technology with capabilities evolving from Magik

From a Magik only application stack to a multiple-language technology

Manual and heuristic based prototype porting of code to Javascript and Groovy (JVM)



Microservice architecture

Evolution towards full microservice architecture and modular capability

From monolithic Magik server to small focused services

Cloud Native approach

Designed for GridOS



Automated code translation

Working with corporate GE Research Center

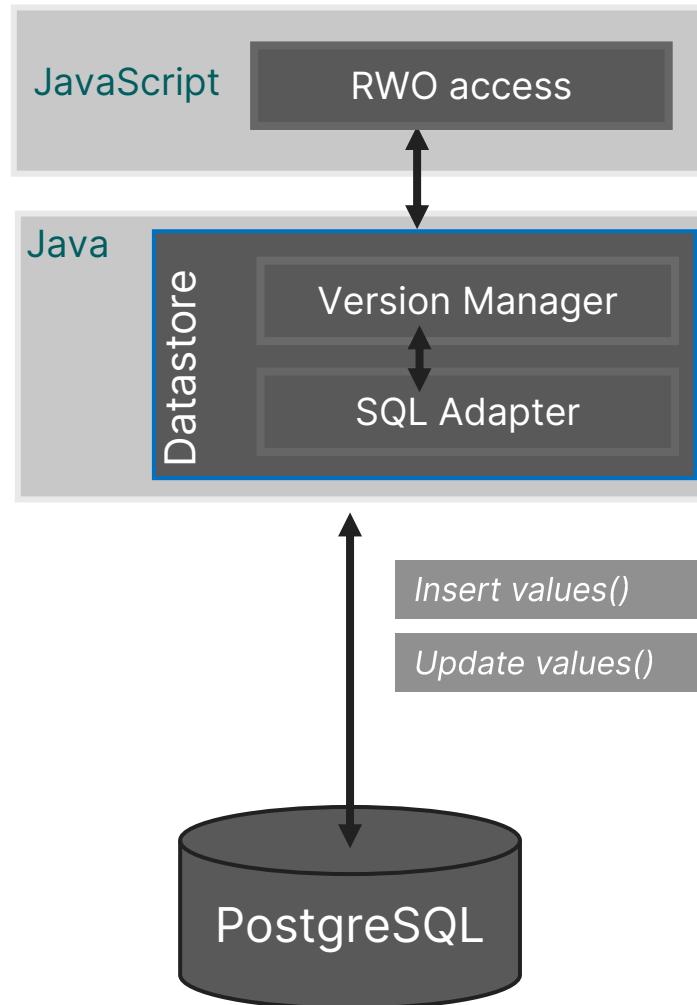
Leverage 30+ years of investment by customers, partners and GE in valuable business logic in Magik code

Prototyping automated code translation from Magik to Javascript and Python

Service

Database access

Persistence



VMDS Cloud microservices

What if?

VMDS Cloud Java library with mainstream languages (e.g. JavaScript) with assisted code translation from Magik

Benefits

- Data access *micro* services running on GridOS
- JavaScript developer knowledge is widespread (v narrow for Magik)
- Deliver essential code unbundled from monolithic Magik server
- Reuse large investment in business logic



JOURNEY TO GridOS[®]

ORCHESTRATE THE GRID OF THE FUTURE

Address ever-growing complexity of modern power systems

- Set the pace of change for the energy transition – innovate, build, deliver faster
- Zero Trust security model to protect every resource
- Continuous time to value - end forklift upgrades
- Manage uncertainty with coordinated T&D
- Data-driven, distributed AI - corrective & preventative
- Cloud architected and delivered on-prem, cloud, and edge

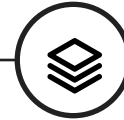
ENABLE CUSTOMERS TO DO MORE NOW



Run GridOS applications next to existing real-time systems

- Leverage benefits of proven applications, while utilizing new technologies & AI to solve new use cases
- Don't have to 'wait for 100% GridOS'
- Incrementally add capabilities
- Adopt & apply IT best practice

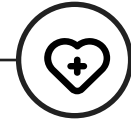
BUILD THE ESSENTIAL GRID PLATFORM



Secure, data-centric, cloud architected & AI enabled

- Prevent disruptions & potential breaches
- Transform data into actionable intelligence
- Deploy and scale where applications are needed
- Productization & operational integration of AI/ML applications through integrated ML Ops

DELIVER FULLY INTEGRATED GridOS[®]



Move mission critical platforms to GridOS

- GridOS native real-time applications
- Not a "big bang" disruption
- Migration processes and tooling to get you there

ENERGY TRANSITION IS A TEAM SPORT



The GridOS[®] platform unifies partners from the grid to the edge to enable end to end orchestration of the energy network.



We are

Nosotros somos

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МЫ

CHÚNG TÔI LÀ

Nous sommes

Είμαστε

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