



AI-Ready Edge Data Platform for Distributed Energy Resources

Unifying Device Data, Enabling Edge AI, and Scaling Fleet Operations Across DER Deployments

Executive Summary

Distributed Energy Resources (DERs)—including battery storage, solar systems, wind turbines, EV charging, and site-level control systems—are reshaping the global energy landscape. Yet the diversity of equipment, protocols, and data models creates significant integration and operational challenges. Centralized cloud architectures cannot meet the real-time, high-frequency, and reliability requirements of grid-connected assets.

IOTech's AI-ready edge data platform provides a unified, standards-based foundation for **real-time intelligence** across DER fleets. By normalizing heterogeneous data, executing analytics at the edge, and enabling **secure, scalable deployment**, the platform empowers DER vendors and operators to deliver safer, more efficient, and more cost-effective energy solutions.



Market & Operational Challenges

Modern DER deployments face a common set of technical and operational barriers.



Heterogeneous Devices and Protocols

DER fleets span batteries, inverters, solar/wind systems, EV chargers, meters, and site controllers—each using different protocols and data models.



High-Volume, High-Frequency Data

DERs generate continuous telemetry and events that are too costly and slow to centralize in the cloud. Operators require local processing for timely insight and action.



Real-Time Response Requirements

Grid-interactive assets must react to frequency, voltage, and dispatch signals in milliseconds. Cloud-only architectures cannot meet these deterministic performance needs.



Fragmented Data Models

Equipment vendors map and name data differently, with partial or inconsistent adherence to standards such as SunSpec.



Security and Zero-Trust Requirements

Distributed assets increase the attack surface. Operators must secure thousands of remote endpoints and ensure data integrity from device to edge to cloud.



Scaling to Fleet-Level Operations

Growing deployments require consistent onboarding, configuration, monitoring, and lifecycle management. Manual, site-by-site engineering does not scale.



IOTech's AI-Ready Edge Data Platform

IOTech's platform provides a unified, scalable, and secure foundation for real-time DER operations and AI-driven intelligence.

Unified Data Integration

- Vendor-agnostic data acquisition across all DER assets.
- Automatic normalization into industry-standard models such as SunSpec.
- Protocol-agnostic connectors supporting Modbus, OPC UA, BACnet, MQTT JSON / Sparkplug, REST / HTTP, and more.

AI-Ready Data Infrastructure

- High-quality, time-aligned data for forecasting, optimization, anomaly detection, and autonomous control.
- Local compute for real-time feature extraction and AI model execution.
- Hybrid edge-cloud workflows for advanced analytics.

Scalable, Federated Architecture

- Handles millions of data points and hundreds of thousands of changing metrics per second.
- MQTT Sparkplug-based messaging backbone for efficient, interoperable data distribution.
- Supports large, distributed DER fleets with consistent performance.

Secure, Software-Defined Deployment

- Zero-trust security from device to edge to cloud.
- Containerized rollout, remote updates, and centralized fleet management.
- Scales from pilot deployments to thousands of sites with minimal OPEX.

High-Performance Historian

- PostgreSQL-based time-series historian capable of massive data storage.
- Ingest rates exceeding 100,000 data points per second.
- Supports SCADA functions and BI tools such as Grafana and Tableau.

Real-Time Edge Intelligence

- Microsecond-scale response to DER telemetry and grid events.
- Local analytics and control logic execution.
- Deterministic behavior for grid-connected assets.



Solution Architecture Overview

IOtech's extensible platform architecture provides a cohesive, modular foundation for DER data, control, and integration.

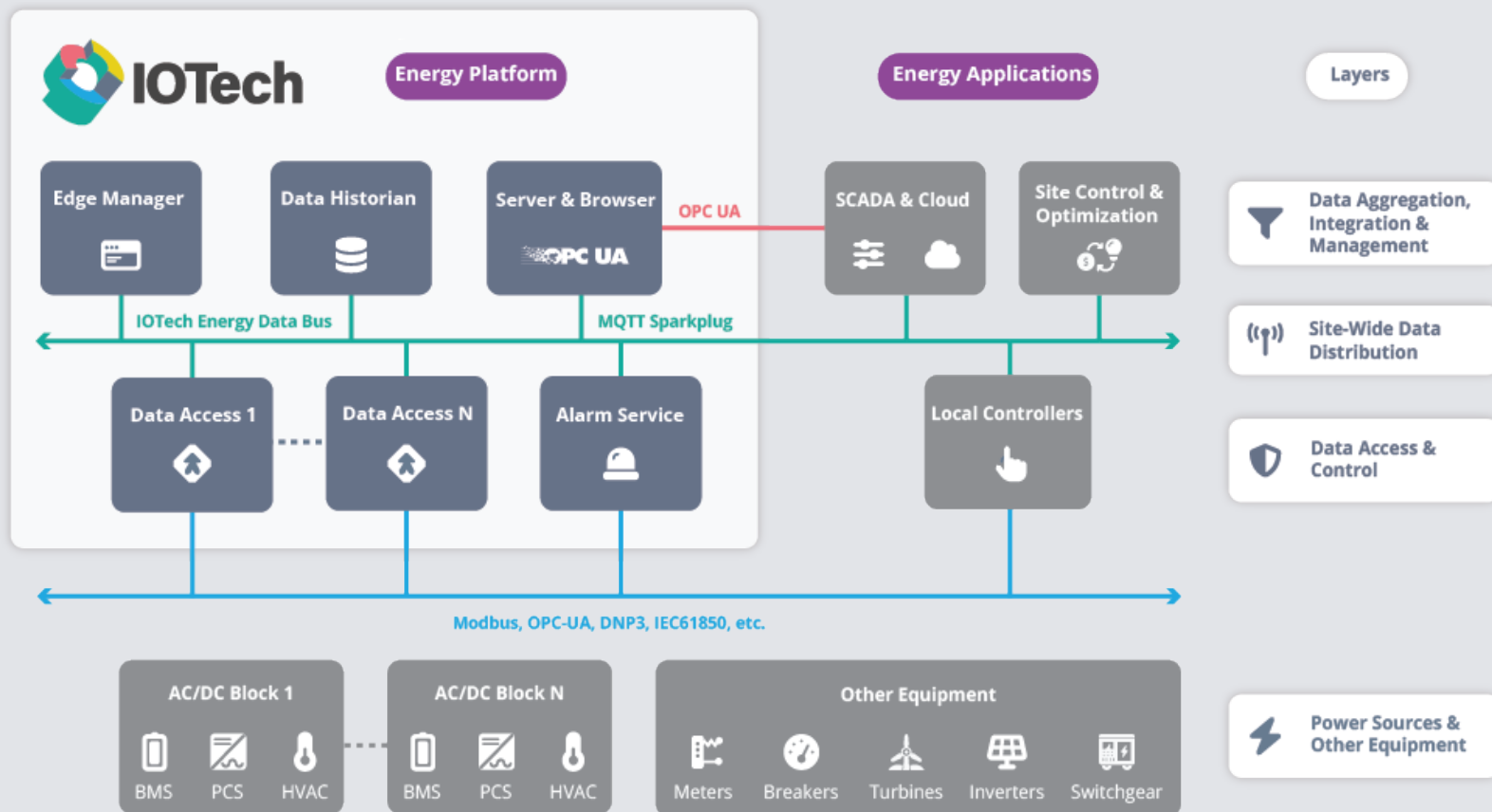


Figure: Edge-native architecture for DER integration and control



Solution Architecture Overview

IOTech's AI-Ready Edge Data Platform consists of the following core layers:

Data Access & Control Layer

- Platform-independent data acquisition that runs on any edge device, supporting both ARM and x86 architectures.
- Protocol-agnostic connectors enabling secure read/write access to DER assets including batteries, inverters, solar and wind systems, EV chargers, HVAC, meters, and site controllers.

Site-Wide Data Distribution Layer

- MQTT Sparkplug-based messaging for high-performance, interoperable, and scalable data exchange across the site.
- Robust pub-sub communication enabling real-time coordination between DER subsystems and on-site applications.

Data Aggregation, Integration & Management Layer

- Standards-based northbound integration via OPC UA or MQTT for EMS, DERMS, SCADA, AMS, cloud analytics, and customer-facing applications.
- Selective data filtering and streaming to optimize bandwidth and deliver only what downstream systems need.
- Massively scalable local historian for high-resolution time-series storage and analytics at the edge.
- Fleet-scale edge management for deploying, monitoring, and orchestrating DER applications across all sites.



Use Cases & Value Realization

IOTech's platform enables DER vendors and operators to deliver differentiated, high-value solutions.



Faster Commissioning and Integration

Standardized data models and protocol abstraction reduce engineering effort and accelerate deployment.



Improved Asset Performance

Real-time analytics and deterministic control enhance reliability and operational efficiency.



Predictive Maintenance

AI-ready data enables early detection of anomalies, reducing downtime and maintenance costs.



Optimized Market Participation

High-quality, time-aligned data supports automated bidding and dispatch optimization.



Scalable Fleet Operations

Centralized management simplifies updates, monitoring, and configuration across thousands of sites.



Customer Use Case: Powering a 500 MW Grid-Scale Battery with Real-Time Edge Intelligence

A major 500 MW / 1,000 MWh grid-forming Battery Energy Storage System (BESS) in Australia is helping transform a former fossil-fuel site into a modern renewable energy hub. The system provides essential grid-forming capability, renewable firming, and frequency services to support the stability of the National Electricity Market as thermal generation retires.



Grid-Scale Battery Energy Storage System

To operate an asset of this scale, the operator uses a multi-layered software ecosystem that includes real-time local control, predictive maintenance analytics, and automated market bidding. These systems depend on fast, clean, and consistent data from thousands of devices and sensors across the site.

The Challenge: Turning High-Volume DER Data into Actionable Intelligence

Operating a 500 MW grid-forming battery requires:

- Real-time response to grid events and dispatch signals.
- Harmonized data from diverse hardware.
- Huge data throughput from thousands of batteries.
- AI-ready data quality for predictive maintenance and market optimization.
- Scalable fleet-level management.



How IOtech Enables Real-Time Control and Optimization for this Customer

- **Unified data integration** standardizes data from battery modules, inverters, meters, and site systems.
- **Real-time intelligence at the edge** enables millisecond-level response for grid-forming control and frequency services.
- **Scalable, federated architecture** ingests millions of data points per second with deterministic performance.
- **AI-ready data** supports predictive maintenance and automated bidding engines.
- **Secure, software-defined deployment** ensures safe, scalable operations across distributed assets.

Customer Benefits

- Higher system stability through reliable, low-latency data.
- Reduced integration cost across diverse devices.
- Improved asset availability via predictive maintenance.
- Optimized market performance with accurate data.
- Scalable operations as renewable portfolios expand.
- Lower OPEX through harmonized data and automated updates.





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