How Kalki.io data hub helps in accelerating digital transformation journey for utilities?

White Paper

Introduction

With increased penetration of DER resources in the grid and the increase in electric vehicle charging infrastructure, power utilities across the global are challenged with ensuring grid stability and balancing the cost of power purchase. Power utilities are adopting digital transformation with adoption of AI/ML technologies to leverage operational and non-operational data to drive informed decisions to improve grid stability, reduce power purchase cost, improve operational efficiency and asset performance management.

Major challenge faced by power utilities in digital transformation through OT-IT integrations are
- Unifying data acquisition from multiple sources and derive a canonical model of data to be made useful for such AI/ML based applications.
- Existing data acquisition systems like Consumer metering (AMI), DT Metering and monitoring (DTMS), Feeder monitoring (FMS), FPI monitoring, DER/ Solar SCADA etc. are all implemented as data silos. And lack end to end data security and scalability.
- Each data silos are attached to dedicated Applications like MDM, OMS, CIS, Billing ADMS, DR/ DER etc.
- Lack of flexibility in making operational data available to cross functional analytics application. Majority of asset health related data generated by devices in the field remain uncollected.
- Limited scalability of existing OT/IT systems to integrate large number of new devices such as EV charge controllers, Storage, renewables, smart meters and IoT sensors that are getting added in million+ scale to the power system.
- New IoT providers often provides end to end systems that form silos.

Utility data hub shall include data collection headend for telemetry data, metering data, DER data, and IoT data either directly or through an edge gateway to provide an All-In-One data collection system that helps migrate existing automation systems to address the challenges stated above. Kalki.io Utility data hub is a platform designed to address utility specific needs of data exchanging i.e., communicating between **any device** connected in the grid over **any communication network** and **any application** that process device data in **any deployment environment/infrastructure** such as cloud or on-premises. Kalki.io platforms address unique power utility requirements such as real time and continuous monitoring, domain specific information models, industry specific protocols for talking to all types of devices, enables multi stake holder involvement with role-based access of collected data, securing legacy systems through state-of-the-art identity and access management, support for coexistence of legacy devices and new IoT enabled sensors achieving IT-OT integration. In short, Kalki.io is **All-in-One data acquisition package** that can simplify the data acquisition requirements of a Utility.
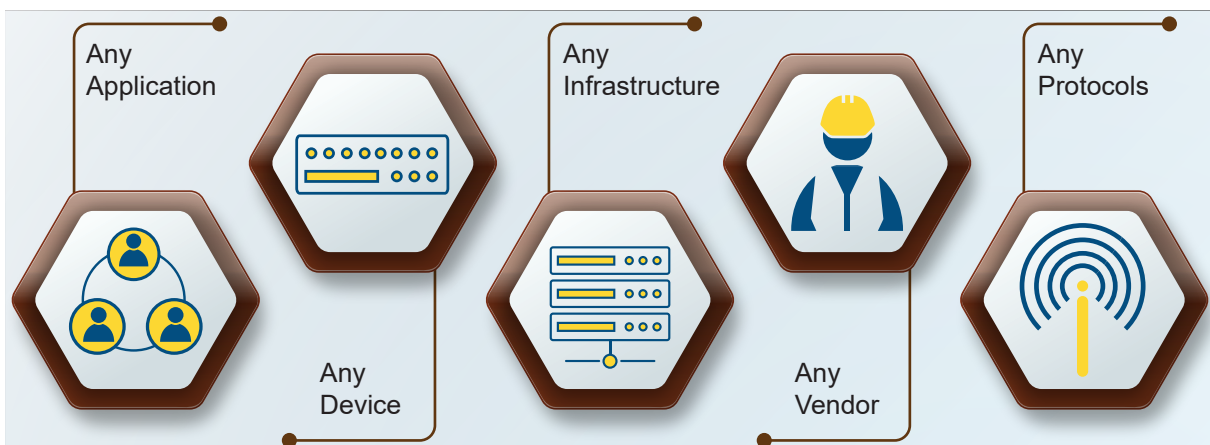
Interface Spokes required for utility data hub
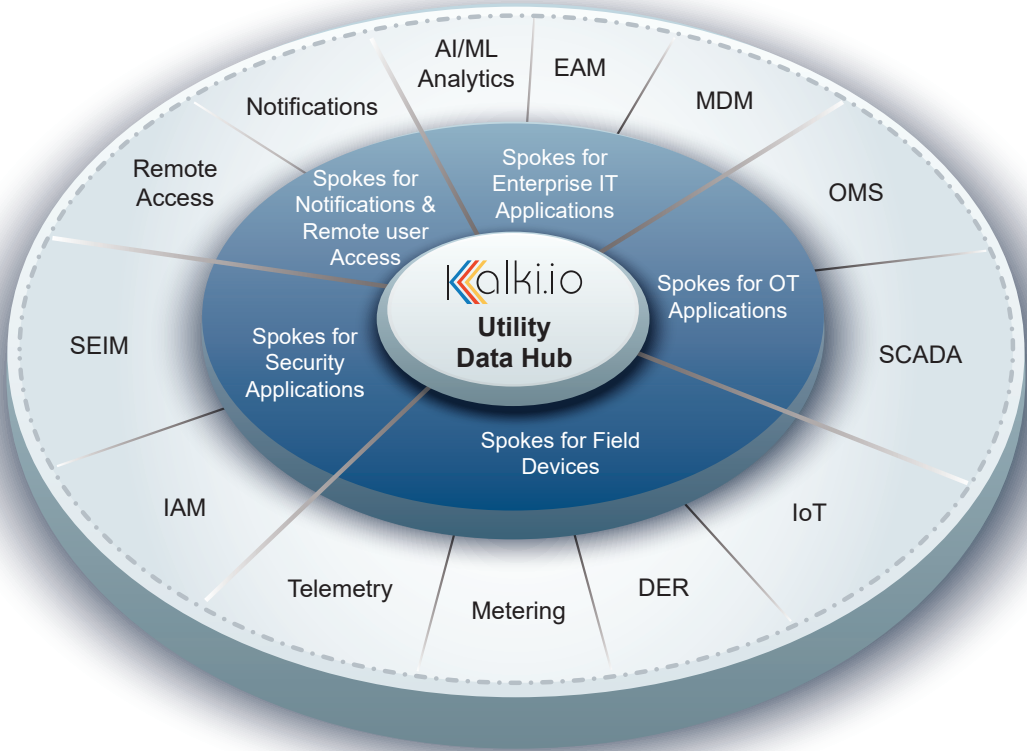
South bound spokes

• Metering Head end

Kalki.io provides AMI head end functionality that can scale to multiple millions of meters with proven adaptors to all leading meter makes and models. Functions include connection management, data push, periodic polling, commands such as connect/disconnect, firmware updates, ToU setting, prepayment event. Kalki.io is compatible with any make and model of smart meters connected over IPv6/4 networks such as cellular/RF/PLC/LoRa/NB-IoT and supports complete functionality offered by protocols such as DLMS/COSEM. Kalki.io optimizes data collection and provide options to incrementally update data to MDM systems with bulk data transfer in MDM native formats as well as using APIs for critical events and commands.

Kalki.io is benchmarked with a Million Meter simulator to optimize the deployment compute footprint based on use cases and SLA requirements of power utilities.

- **DER Data Hub**

Kalki.io DER Data Hub provides remote monitoring and management of Distributed Energy Resources (DER) including solar PV, energy storage, CHP, EV, wind power generation units. DER Data Hub can enable predictive maintenance, degradation monitoring, inventory management and generation forecasting which would help to optimize the ROI by integrating all associated components in a DER plant including inverters, weather stations, irradiance sensors, revenue and power meters, transformers, and energy storage units etc.

Data hub for DER is extended with Kalki.io Edge Gateway software with ready-made templates to connect with standard inverters available in market and support for standard protocols such as IEEE2030.5, Sun-Spec Modbus, IEC61850-90-7, and Modbus which helps to integrate any inverters, string combiners, weather sensors and energy meters seamlessly. It also supports commonly used utility protocols like IEC-60870, DNP3.0, DLMS-COSEM to connect with grid operator. KALKI.IO enables secure connectivity with field assets (devices or software) remotely for configuration and maintenance purpose.

- **Telemetry Head-end**

Kalki.io offers advanced front-end processing which can collect operational and non-operational data in real time from field assets such as remote terminal units (RTU), data concentrators/controller, IEDs, sensors, gateways over telemetry protocol using 40+ built in protocol adaptors. Kalki.io enable highly secure and reliable communication with on-premises enterprise applications such as SCADA, historians, data-lakes or with IoT applications deployed on public/private or hybrid cloud infrastructure.

- **IoT Data Hub**

Kalki.io supports Internet of Things (IoT) protocols such as MQTT, CoAP, AMQP which helps in connecting latest IoT based sensors/edge devices in the field. Kalki.io device profile-based modelling helps in creating virtual replica of the devices and perform remote setting and configuration management of the field devices. Grouping of devices and group-based management of devices helps to roll out configuration and firmware updates faster. Kalki.io provides various connectors on Web-socket, REST APIs, MQTT etc for integrating with IT applications, it also has native connectors for popular cloud platforms and asset performance management applications. Kalki.io can auto scale to million+ device connections as system scales horizontally or vertically.

North Bound spokes

- **OT System Integration**

Kalki.io provides OT protocols-based integration to SCADA applications to exchange raw or processed data from OT systems and enterprise applications. Integration with Cyber security systems to enable Identity and access management of the utility and integrate with monitoring tools such as SEIM. There are notifications services to send critical notification to operators on SMS, Email and webhooks to push events. Secure remote access enables role-based access to field devices for troubleshooting and updating of field devices using vendor specification tools. RBAC build on x.509 PKI infrastructure complies with IEC62351-8 security standard.

- **IT System/Enterprise Integration**

For Enterprise system integration, Kalki.io provide connector framework which helps to build custom connectors to ESBs or direct integration with IT applications. RESTful APIs are also provided as standard option to push or pull data from Kalki.io data hub.

- **IoT Platform/Cloud Integration**

Connector framework support in utility data hub have specialized connectors for cloud platforms such as Azure, AWS. Connectors expose field devices or assets as device twin in the IoT platform. Device twin connector works provides IoT platform device identity on behalf of the downstream devices. The translation module is responsible for understanding the protocol used by the downstream devices, providing them identity, and translate their messages into IoT primitives. Downstream devices appear in IoT platform as first-class devices with twins and methods. A user can interact with the devices in IoT platform and is unaware of the intermediate data hub and the complexity of the communication protocol to connect with the physical devices.

Identity translation provides the benefits of protocol translation and additionally allows for full manageability of downstream devices from the cloud. All devices in the IoT solution show up in IoT platform regardless of the protocol they use. Each device can have its own device twin in IoT platform and can address each device individually. Utility data hub also throttles and manages communication quotas at device level.

The communication flow from IoT platform/cloud can trigger downstream action in utility data hub or the connected devices will follow protocol conversion gateway pattern – This corresponds to the utility data hub.
- Device Configuration
- On demand data collection/ commands & settings
- Device Management requests

System Architecture
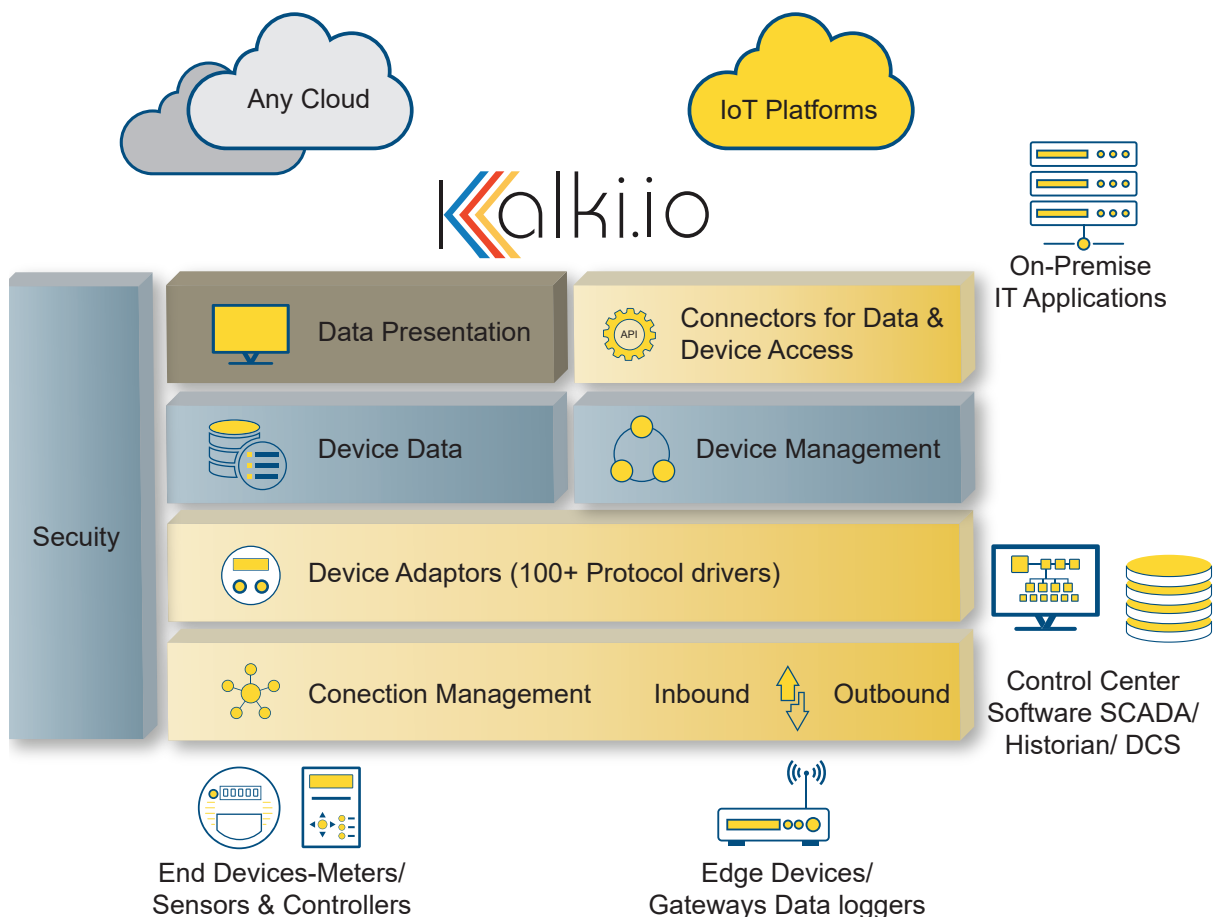
Software Details
- Micro services-based architecture deployed in containers
- Application-level clustering and load balancing
- Layered architecture to plug in different components
- Incremental backups

Connection Management
- Auto discovery and registration
- Inbound & Outbound Communication
- Device & Protocol Profile library

Device Management
- End device & Edge device management
- Remote firmware & configuration update
- Remote Maintenance Access

Security
- TLS1.3 encrypted communication
- Role based access (X.509) control
- Extensive audit trail & communication logs
- Strong regulatory compliance measures

Connectors/APIs for 3rd Party Integration
- REST APIs with JSON data format
- Framework to build connectors to applications
- Data sources for JDBC SQL queries
- Domain specific data modelling aligned to standards such as IEEE2030.5, DLMS/COSEM, IEC61850, CIM

Engineering & Configuration
- Effortless configuration using device templates
- REST API configuration from external system
- Excel based configuration importing

Visualization and Data Presentation
- Inbuild configurable dashboards & reports
- Alert Management & Notification (email/SMS)
- Asset Monitoring & Fault Management
- Prebuild availability Reports & communication logs

Conclusion

Kalki.io provides a quick, easy, and secure way for IT applications to access field data. The rich set of secured REST APIs simplifies access to field device data alleviating the complexity of acquiring it.

Kalki.io offers flexible deployment option with SaaS & License options are sized based on number of devices and users that get connected to the data hub. Kalki.io deployment options include cloud based as well as on-premises systems which can be tailored to meet specific customer requirements.

Kalki.io data hub is a data collection software enabling field data acquisition for enhancing business intelligence, improving operational efficiency and providing systemwide visibility for businesses, industries and utilities. By aggregating data from field devices regardless of protocol or vendor, kalki.io creates a single secure data source accessible by third party applications for performing robust analytics. kalki.io supports many legacies and standards-based industry/utility protocols as well as new IoT protocols for field data acquisition and control.