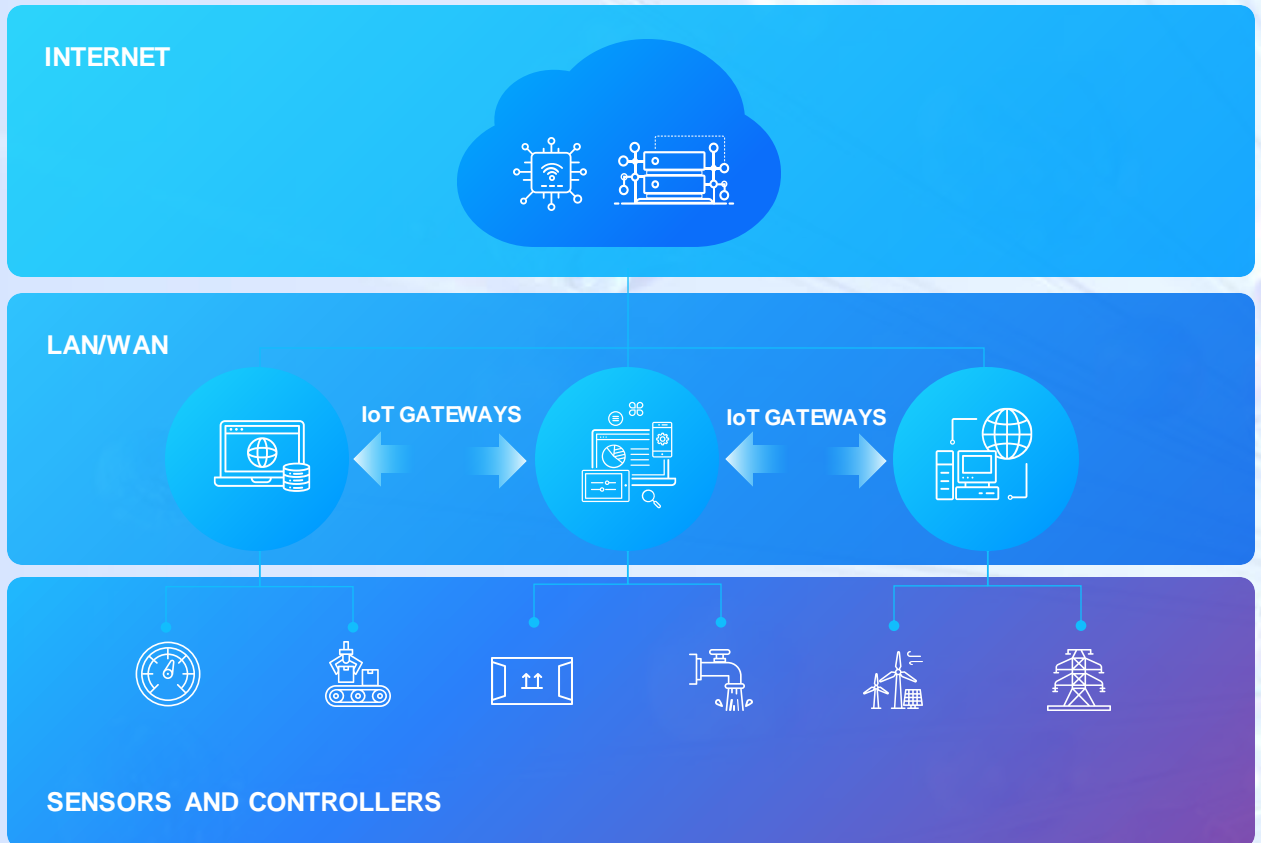




EnOS Edge

Unlocks operational data and accelerates industrial digitalization

From Massive IoT to Efficient IoT at Scale



Exponential growth in data from billions of IoT devices and operation systems is driving a shift in Energy Management. Rather than send large amounts of data from remote locations to the cloud for processing and storage, energy management leaders are embracing a distributed model where computing can occur at the edge of the network, closer to where the data is created.

EnOS Edge provides intelligent, configurable, industry-specialized solutions that can handle the increasing amount of data coming from heterogeneous devices, react in near real-time, and be resilient to network disconnection.

Unlock operational data and accelerate your path to digitization with EnOS

The next-generation intelligent gateway

EnOS™ Edge

EnOS™ Edge is a set of intelligent IoT gateways with edge computing software that adapts to heterogeneous devices and systems in the physical world and enables cost-effective IoT connectivity, edge computing, local control, and optimization solutions.

Bridge between OT and IT

With a combination of the best features from both IT and OT, EnOS™ Edge brings the synergies of Cloud native technologies and Edge computing (software and hardware) together. EnOS™ Edge easily connects to a wide range of devices, sensors, and OT systems and offers energy management leaders powerful remote configuration possibilities, advanced data processing, and high security standards from the Cloud.



With field-proven protocols and adaptors, easily and securely integrate millions of IoT devices and IT/OT systems for optimal OT control.

By adding edge gateways, field operations require no changes to OT systems (such as SCADA/PLCs) but run new applications such as AI-based analytics on EnOS™ Edge or Cloud.



With OTA (over-the-air) technology, device firmware upgrades can be done remotely and securely, eliminating the need to deploy personnel on site.



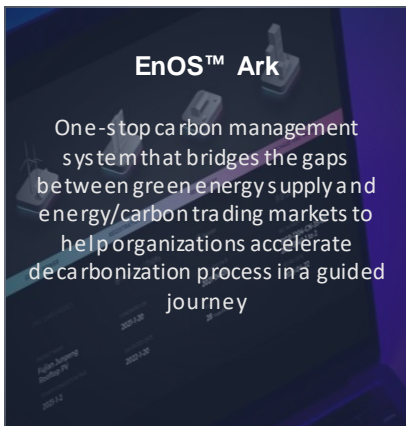
Passed IEC 62443-4-1 international security certification and State Grid Electric Power Research Institute Information Security Certification



Empower Deployment in ONE Powerful Package

EnOS™ Edge is part of the EnOS™ Suite, which provides field-proven tools to accelerate deployment, meaning a wide array of organizations can easily, reliably, and quickly deploy IoT projects at scale.

EnOS™ Suite

<h3>EnOS™ Renewable</h3> <p>Empowers the management of multiple-source and distributed energy systems (wind, solar, storage, etc.) for reduced O&M cost and increased power production efficiency</p> 	<h3>EnOS™ City</h3> <p>Orchestrates key elements of a smart city to build efficient, resilient, and sustainable city infrastructures (buildings, EV charging, grid, etc.)</p> 	<h3>EnOS™ Ark</h3> <p>One-stop carbon management system that bridges the gaps between green energy supply and energy/carbon trading markets to help organizations accelerate decarbonization process in a guided journey</p> 
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EnOS™ Cloud



EnOS™ Edge



Logger



IIoT Gateway



Edge Extensive



Edge Sensor Gateways



Packed with features

The EnOS™ Edge's array of products includes a variety of IoT gateways and edge servers, each designed to address the challenges of OT constraints in terms of architecture, security, and connectivity while also having the capability to bring algorithms and controls closer to the origin of the data.

Extensive Connectivity

- Millions of industry devices connect to EnOS with the world's leading protocol library
- 3000+ device models covering all major brands of wind turbines, solar inverters, storage, meters, EV chargers, etc.

Flexible Deployment

- Container-based edge deployment
- Scalable and configurable edge-cloud and edge-edge architecture

IT – OT Convergence

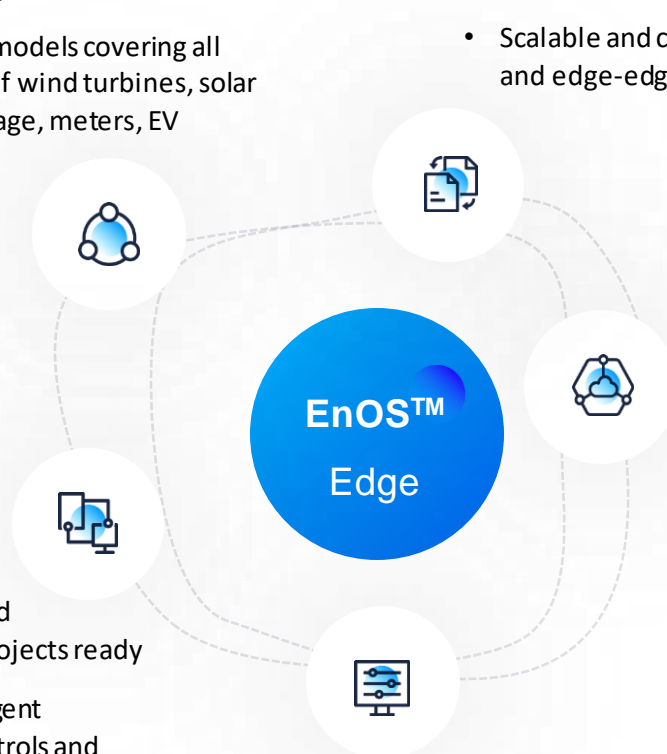
- Greenfield and Brownfield projects ready
- Enable intelligent industrial controls and advanced cloud-native applications

Edge - Cloud Synergy

- Off-the-shelf integration with EnOS™ Cloud with uniform asset models, APIs, common services, etc.
- Remotely and securely manage the lifecycle of edge devices and edge applications

Edge Intelligence & Control

- Data aggregation, normalization, quality and real-time analytics based on complex event and user-defined pipelines
- AI inference engine to deliver real-time insights
- Model-driven optimization and real-time close-loop controls



Extensive Connectivity

EnOS™ Edge excels in extensive device connectivity and fast device onboarding to meet diverse needs with the following.

- **200+ field-proven protocols and sensor adaptors** covering all major industry standard protocols
- **3000+ device models** to enable digital twins of all major brands of wind turbines, solar inverters, storage, meters etc.
- A comprehensive set of **end-to-end device onboarding tools and processes** built from industrial best practices



* EnOS™ Edge Gateway is officially certified by [BACnet Testing Laboratories \(BTL\)](#)

Flexible Deployment

As each enterprise has its unique network infrastructure, EnOS Edge supports a variety of deployment models, with different layer models of edge gateways and servers that can be easily configured and scaled up to meet the specific needs of each use case.

The EnOS™ Edge software is a **modular, scalable, and easy to manage platform with high availability**. The Edge container platform, built based on KubeEdge, can easily deploy its core services and cloud-native applications in containerized mode. EnOS™ Edge **supports flexible and economic deployments vertically** (from end points to edge to cloud), **horizontally** (from edge gateways to edge servers), **as well as a mix-and-match of both**.

3 – Layer Model



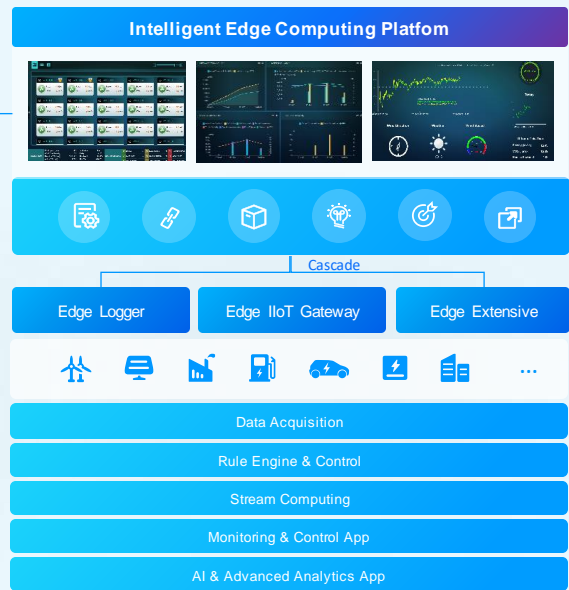
- Application and management services are deployed centrally in the cloud
- Data flows from end points (devices, sensors, local systems, etc.) to edge gateways and cloud
- Control actions can be generated from local real-time decisions and from cloud

Typical Use Cases

- Retail stores
- Renewable farms
- Smart buildings

4 – Layer Model

Multiple Sites – Small Scale



- Large amount of data and local edge/cloud native applications are deployed on edge servers
- Data flows from end points to edge gateways, edge servers and/or cloud

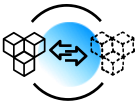
Typical Use Cases

- Data centers
- Microgrids and industry parks
- Regional monitoring and control centers

Edge – Cloud Synergy

Combine cloud technologies and edge computing to boost digitalization

Edge and cloud computing are two important foundations for industry digital transformation. The collaboration between them in terms of network, service, application, and intelligence will help support more scenarios and unleash greater value in industry digitalization.



Data Modelling

Shared asset modelling language that enables seamless asset synchronization



Device Management

Provide centralized edge device life-cycle management services and edge application life-cycle management services that enable remote batch operations for mass deployments.



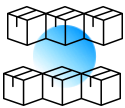
AI

Cloud and edge machine learning and rule engines that enable machine learning inference models and control rules that can be deployed from cloud and run on edge.



Application Management

Seamless application migration based on consistent APIs and SDKs, and containerization (K8S and KubeEdge), enabling cloud-native applications to run across cloud and edge.



Common Building Blocks (CBBs)

Shared application CBBs such as data visualization tools and data services to enable low code and no code application customization.



Resilience

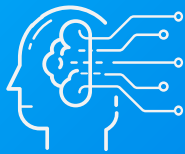
Edge autonomy is enabled when Cloud-Edge communication is interrupted. Edge software modules can run continuously by storing data locally to avoid data loss and deliver data to cloud after the network is restored.

Edge Intelligence and Control

Bridging the IT (AI and machine learning capabilities) and the OT (control capabilities) together, the EnOS™ Edge software enables cutting edge scenarios such as controlling HVAC temperature output based on analysed data from building and device sensors.

From analyzing data at the Edge - close to where it is produced - to making local decisions in a real-time closed loop, EnOS™ Edge can work with or without cloud connection, reacting autonomously with fast response time and low network latency.

EnOS™ Edge



IT – Edge Intelligence

- **Define cloud or local events/rules**
Via script and rule engine (time – based, condition – based rule engine)
- **Complex data and event streaming**
via streaming engine (data quality check engine, data filtering)
- **AI/machine learning**
inference modules (anomaly detection, forecasting)
- **Common building blocks(CBBs)**
ensuring consistent look-and-feel visualization capability at the Edge and in the Cloud (Digital Twin Visualization)



OT – Edge Control

- **Execute cloud or local events/rules**
via script and rule engine (time-based, condition-based rule engine)
- **Advanced rule engine**
via streaming engine (data quality check engine, data filtering, data cleaning)
- **Real-time optimized predictive and close-loop controls**
such as zero-export and real-time energy dispatch
- **Autonomous Edge**
enabling low latency mode in mission critical scenarios

IT-OT Convergence

EnOS™ Edge provides an end-to-end solution that consists of both cloud and edge computing technology stacks to tackle legacy OT pain points.

Challenges

- **Unable to adopt** the best-of-breed products and technologies.
- **Expensive to modify** existing applications or develop new apps to support business needs.
- Diverse devices and assets with **different communication protocols**.
- **Lack of visibility and capability** to manage the entire life cycle of data, device, and application.

Solutions

- **Easily integrates** asset models (metadata) and device templates (physical data points) **to automate data onboarding process**.
- **Reduces costs by consolidating traditional OT applications** such as SCADA and IoT-centric edge applications on a single platform with a complete data processing suite to simplify management.
- **OEM agnostic**, providing field-proven device drivers, communication protocols, and digital twin (asset models) to connect industrial devices and OT systems.
- **Adopts containerization** to allow module/service encapsulation and **provide centralized device and application**.

EnOS™ Edge Product Series

Edge Logger

Standard Data Acquisition and Control

Intelligent IoT Gateway that can be used for retail stores, industrial park IoT solutions, solar C&I PV plants, malls, large buildings etc.

- Device connectivity and fast device onboarding
- Real-time data acquisition, buffering, forwarding
- Local controls, over-the-air update and built-in security chips
- Flexible product configuration



LCU



DTU



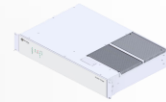
HPU / HPU Lite

Edge IIoT Gateway

Medium and Large-Scale Data Acquisition, Edge Computing & Control

Intelligent General-Purposed Industrial IoT Gateway that can be used for renewable (wind, solar, storage), hydro, thermal, microgrid, plants, factories, ports, data centers, buildings etc.

- Device and OT system connectivity
- No/low code edge computing and AI engines
- Containerization and hardware agnostic for flexible deployments



All-in-one PC

Edge Extensive

Large-Scale Data Acquisition, Edge Computing & Control, Application Enablement

High Performance Advanced Edge Server that can be used as an intelligent edge platform to support local monitoring & control or advanced analytics in smart wind farms, micro-grids, power distribution cabinets, industrial parks, and buildings etc.

- APIs / SDKs / Application Portal / built-in common services for application enablement
- Edge-to-edge and Edge-to-cloud connectivity
- High performance edge computing resources



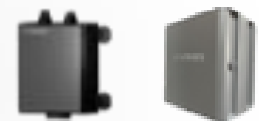
Server

Edge Sensor Gateway

Vertical Domain Use

Non-intrusive Sensor Gateway that can be used for lift and escalator management, wind farms, solar sites etc.

- Non-intrusive sensors with built-in sensor adaptors
- High resolution of data acquisition
- Edge AI with field-proven domain algorithms



Edge Sensor Gateway

Optimize Solar Operations with EnOS™ Edge

Challenges for Solar Asset Owners and Operators

Solar asset owners and operators face multiple issues when managing assets at scale in a variety of global locations. Many solar sites are located in areas with low network capabilities and low voltage grids. This combination of challenges can make it difficult to ensure grid stability in these challenging environments.

Some countries and jurisdictions even mandate “Zero Export” policies, where injecting excess power into local grids can result in penalties for solar asset owners and/or operators. These policies are designed to protect lower voltage grids and the residents that rely on them, especially during weekends and holidays when electricity demand may be lower at the industrial sites where solar assets are often co-located.

EnOS Edge is designed to address challenging sites where low network bandwidth and/or low voltage grids may preclude cloud-based monitoring solutions. EnOS Edge also connects to a diverse array of heterogeneous solar assets, from inverters, weather stations, power meters and more. By harmonizing data and insights from multiple systems, EnOS Edge provides the real-time solar asset observability to ensure any site can safely operate in harmony with local infrastructure and regulations.

EnOS Edge enables asset owners and operators to manage heterogeneous assets and sites with confidence

Efficient Cost Savings

- Saved up to 20% on PV operation costs and achieved **100% fulfilment of grid limitations**.
- Logger operation within a wide temperature range (-20 to 70°C) without failure.

Domain – Specific Know – How Benefits

- Equipped with solar domain specified EMS application for active and reactive power control.
- Limited microgrid export to zero based on grid requirements by curtailing the PV output.

Flexible Device Integration

- Inverter agnostic, supporting over 90% different brands, collecting and consolidating data to EnOS™ Cloud for monitoring and control.
- Use the same solar inverter logger to integrate all kinds of power meters and irradiance and weather stations and gathered data for further analysis at the cloud.

Boost Energy Efficiency in Buildings with EnOS™ Edge

Challenges for City Buildings

The power distribution cabinet, used to control and protect lines and equipment, is deployed in every corner of the buildings and infrastructures throughout the country. Its maintenance can pose some difficulties, especially for those placed in hard-to-access or deserted areas, resulting in long durations of infrastructure blackout and risk of fire hazards.

Connectivity to the legacy PLC, high deployment and maintenance costs, especially on firmware and software updates, poses a huge challenge for the mass rollout.

Monitor power distribution cabinets with BACnet certified Edge loggers and Gateways to increase productivity and reduce maintenance costs

Easy Deployment

- With more than 200+ protocol adapters, cabinet PLCs can be easily connected.
- With one-click Edge Installer app, the deployment time is shortened substantially, saving huge deployment costs.

Reduced Maintenance Costs

OTA (over-the-air) technology enabled remote upgrades for thousands of devices with one simple click, lowering upgrade and maintenance costs.

Increased Productivity

- Data consolidated, analysed, and managed by EnOS™ Cloud enabled operators to get real-time information for all power distribution cabinets.
- Maintenance managers can gain insights on how often an asset is underperforming and the duration since the last work order was performed.
- In emergency situations such as the tripping of circuit breakers, technicians can be sent to the site immediately, reducing disruptions caused by electrical failure.

Reduce Carbon Emissions in Retail with EnOS™ Edge

Challenges for Retail Stores

A global F&B chain aims to move towards a "Greener Store" with technology by digitizing their stores to reduce greenhouse emissions.

To achieve this, it is necessary to monitor the power and water consumption of the F&B stores and send an alert if any of the stores detect a higher-than-normal usage of power and water consumption while providing their customers with a cosy environment at the same time.

Univers enables intelligent data monitoring for better energy efficiency and customer experience

Improved Customer Experience

Constant monitoring and adjusting of the air quality in-store improved the customer experience, resulting in higher revenue.

Real – Time Monitoring

Store managers can identify areas to improve their stores' energy efficiency with real-time data.

Reduced Power Consumption

- Automated sensor monitoring and alerting on abnormal power and water usage.
- Auto setting of HVAC based on environmental situation to save power.