



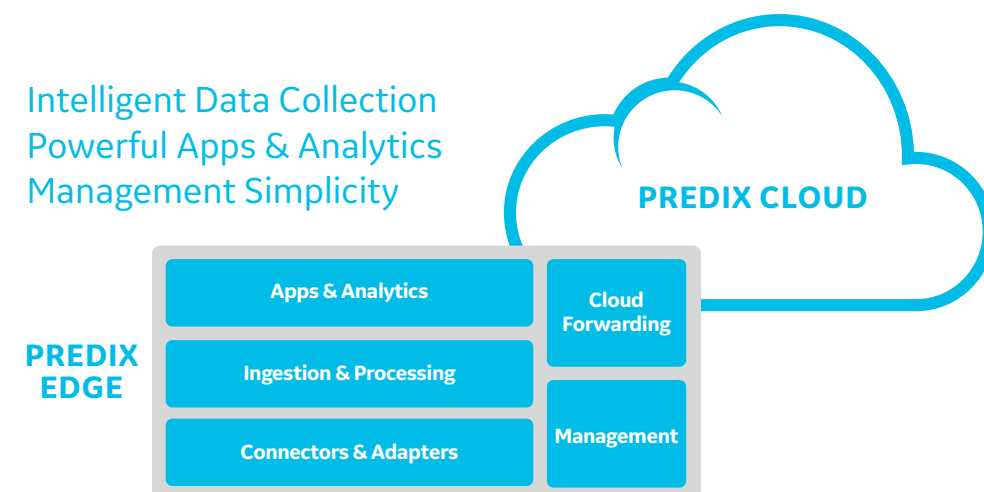
Predix Edge from GE Digital

IIoT connectivity, local applications and analytics, and secure cloud connection

Predix Edge is an IIoT computing platform positioned at the intersection of industrial control systems and the enterprise. Using Predix Edge, customers can:

- Collect data from assets and IT/OT sources
- Apply local machine learning analytics
- Execute container-based applications
- Securely and reliably forward data to Predix Cloud
- Rely on a secured stack with embedded OS
- Easily configure and manage edge devices and workloads

With powerful connectivity and management capabilities, support for container-based apps and analytics and scalable deployment options, Predix Edge simplifies data collection and supports edge computing needs from the device to the data center.



*Predix Edge is an integral part of the Predix Platform
— a complete Edge-to-Cloud industrial IoT solution*



Customer Benefits

Industrial IoT promises increased asset uptime, cost reductions, optimized operations, and insights that lead to strategic advantage. Predix Edge is a key enabler of these benefits, whether functioning standalone or in conjunction with Predix Cloud.

Connect, monitor and manage assets

Predix Edge provides the connectivity options and management features to:

- Easily connect to assets and data sources
- Monitor Edge instance status and health
- Scale to thousands of Edge instances and connected devices

Put analytics to work

Use Complex Event Processing engines or container analytics to:

- Apply rich analytics to data streams in near-realtime
- Locally detect anomalies in device or process operations
- Add intelligence to local equipment controls

Take advantage of Edge applications

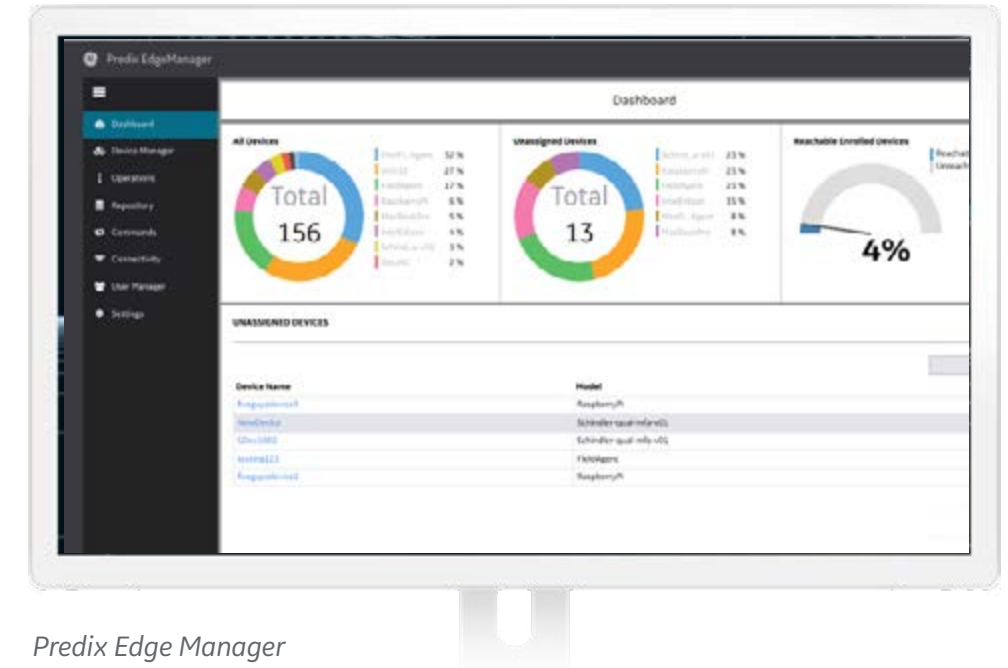
With Predix Edge you can use Edge applications to:

- Handle near-realtime monitoring and response needs
- Complement and extend existing solutions
- Comply with security and regulatory requirements

Simplify solution management

Predix Edge Manager simplifies and automates tasks to:

- Provision Edge instances and connected devices
- Provision and manage local apps and analytics
- Monitor and control secure operations



Predix Edge Manager

Predix Edge Manager is a Predix Cloud-based application that enables secure Edge management. It provides an intuitive and automated user experience to enroll and manage Edge and Edge-connected devices, manage Edge applications and analytics, and control all Edge operations.

With Edge Manager you can manage:

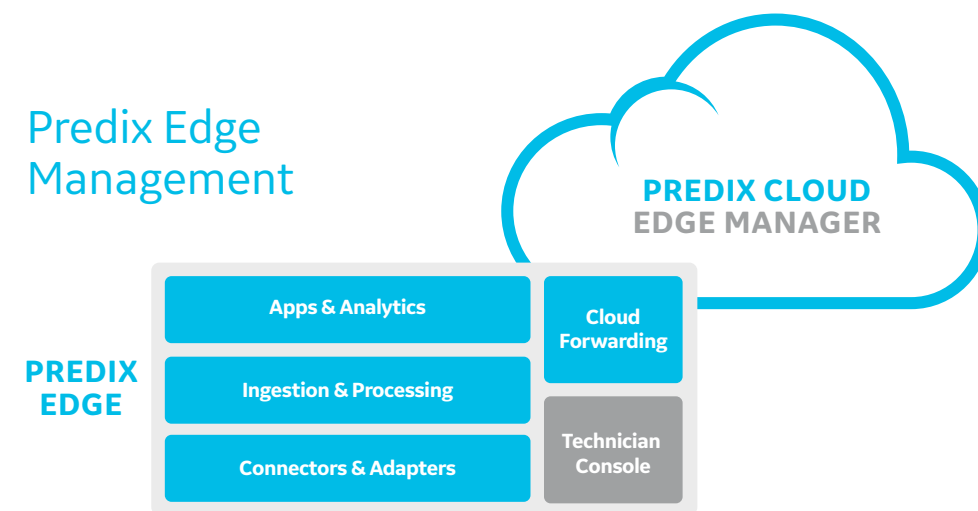
- Edge devices and fleets
- Connected devices and fleets
- Edge apps, analytics and workloads
- Predix Cloud data forwarding
- Secure end-to-end authentications
- Full remote updates

Predix Edge also supports local management via the browser-based Technician Console.



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Predix Edge management is provided by Predix Edge Manager or the local browser-based Technician Console.

Predix Edge Manager provides advanced tools and capabilities, but both options give you full control over Edge operations.

The Technician Console main functions include:

- Edge commissioning and configuration
- Management of system software
- Applications and analytics management
- Cloud connectivity monitoring
- System log access

Edge Manager Overview

Edge Manager is a Predix Cloud SaaS application that enables remote management of Predix Edge instances. From a single instance to large-scale fleets, Edge Manager provides a single pane of glass to monitor and centrally administer all edge operations.

Key functionality includes:

- **Edge lifecycle management** – securely commission Edge instances and perform device configuration for large-scale Edge fleets
- **End-to-end data flows** – use automation and templates to define connectivity, local processing and forwarding flows for any new source
- **Fleet management** – organize Edge instances in groups, apply filters, and schedule bulk operations on multiple instances collectively
- **Application lifecycle management** – deploy, install, and update edge applications, and configuration packages to Edge instances
- **Cloud connectivity** – monitor connectivity status, signal strength and data usage of cellular links; manage OpenVPN tunnels
- **Alerts management** – centrally monitor and manage alerts from edge instances and connected assets
- **User management** – control authorized users and assign roles and responsibilities
- **Complete system management** – update Predix Edge OS, related systems software, and configurations without limitation
- **API support** – access Edge Manager functionality via a graphical web interface or via a REST API for integration with other applications
- **Security** – depend on certificate-based device enrollment, role-based access and extensive end-to-end security controls

Edge Manager Benefits

Edge Manager delivers an intuitive and automated user experience to enroll and manage Edge instances, connected devices, applications and analytics, and control all Edge operations.

Edge Manager is key to helping customers:

- Increase IIoT solution reliability and uptime
- Reduce operational cost and complexity
- Harness the power of edge computing

Centrally monitor and manage edge connectivity

- Utilize guided setup tools to rapidly configure devices, connected devices, and edge-to-cloud data processing flows
- Track availability, status and performance of devices and connected machines
- Create schedules and packaged profiles for an Edge device or device groups

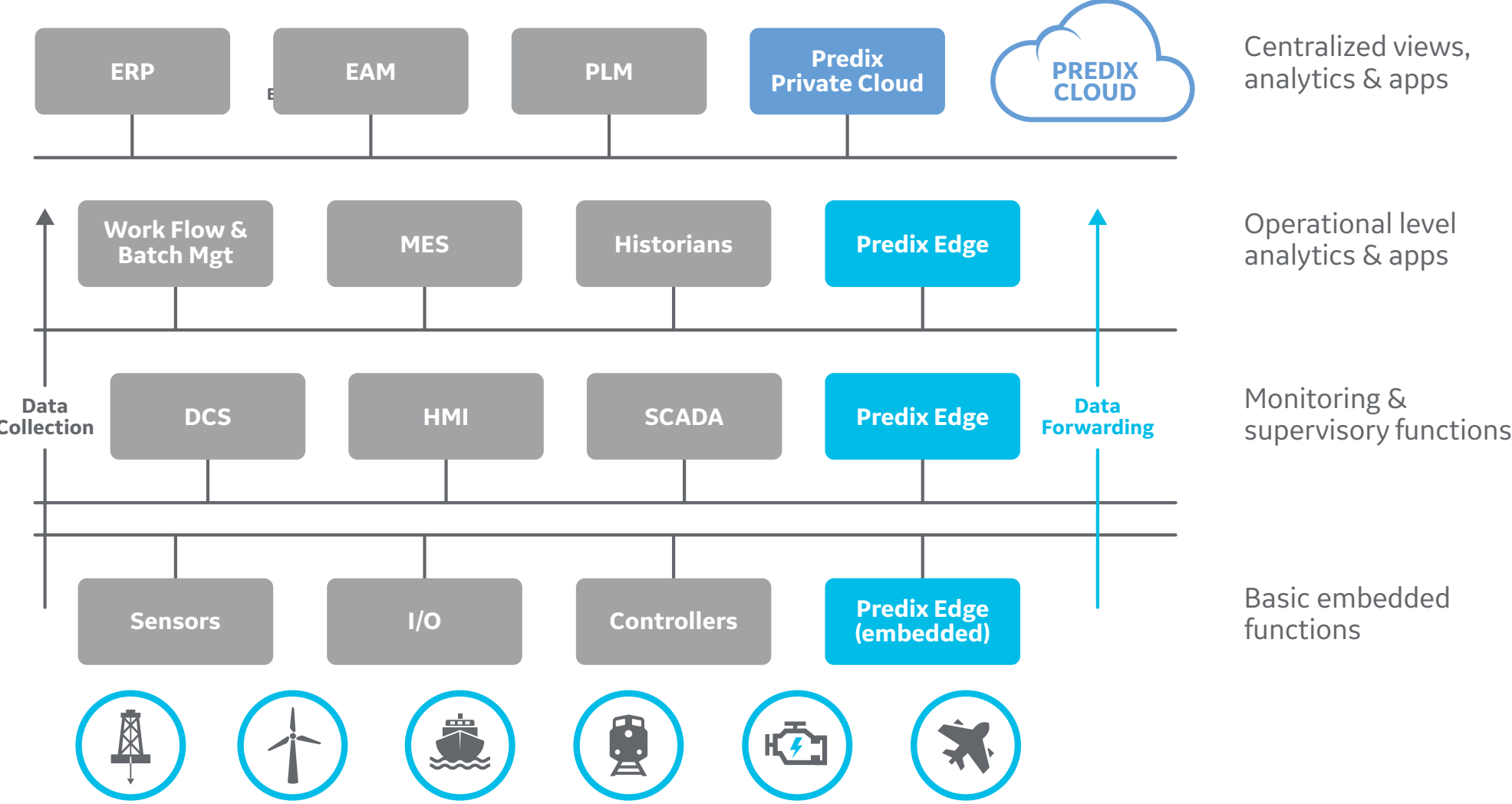
Simplify and automate edge operations

- Centrally manage the entire lifecycle of thousands of devices from anywhere, anytime
- Deploy and schedule container-based applications, analytics and OS updates
- Monitor and control all aspects of workload processing and system performance



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Edge computing in action

Industrial IoT needs are driving a rapid evolution in Edge computing. Local data processing – whether in tandem with cloud/datacenter or standalone – is becoming a cornerstone of IIoT.

Edge systems can play an important role at several levels of the modern industrial architecture, deployable from an embedded systems to a server-based application platform. Typical use cases for Predix Edge include:

Intelligent connection and collection

The foundational use of Predix Edge is to connect assets, ingest and process data, and forward data to Predix Cloud or Predix Private Cloud. It can filter, pre-process and aggregate data, apply stream analytics for additional local and pre-processing value, and provide a reliable and secure connection to the cloud.

Analytics and machine learning

Edge analytics enable data analysis, precision device/process monitoring

and anomaly detection, and other valuable functions in support of local or cloud-based applications. Predix Edge provides a flexible analytics data fabric enabling both commercial analytics engines and container-based analytics.

Intelligent equipment controls

Edge computing can apply sophisticated machine learning analytics to equipment data streams to detect subtle anomalies and even predict issues. With manufactures increasingly opening controller APIs, it's now possible to leverage these powerful analytic results to issue direct control commands to industrial equipment.

Monitoring and supervisory applications

Edge computing brings the opportunity to deploy applications to aid local operators in monitoring devices and rapidly responding to emerging issues. With support for container-based applications and analytics, Predix Edge solutions can augment HMI/SCADA capabilities and operations efficiency and reliability.

Operational level applications

Predix Edge applications can integrate OT data with data from external sources or applications in order to provide users with rich unified views to their fleet or plant operations. These new applications can be used standalone or to augment the views and capabilities of standard MES-type solutions.

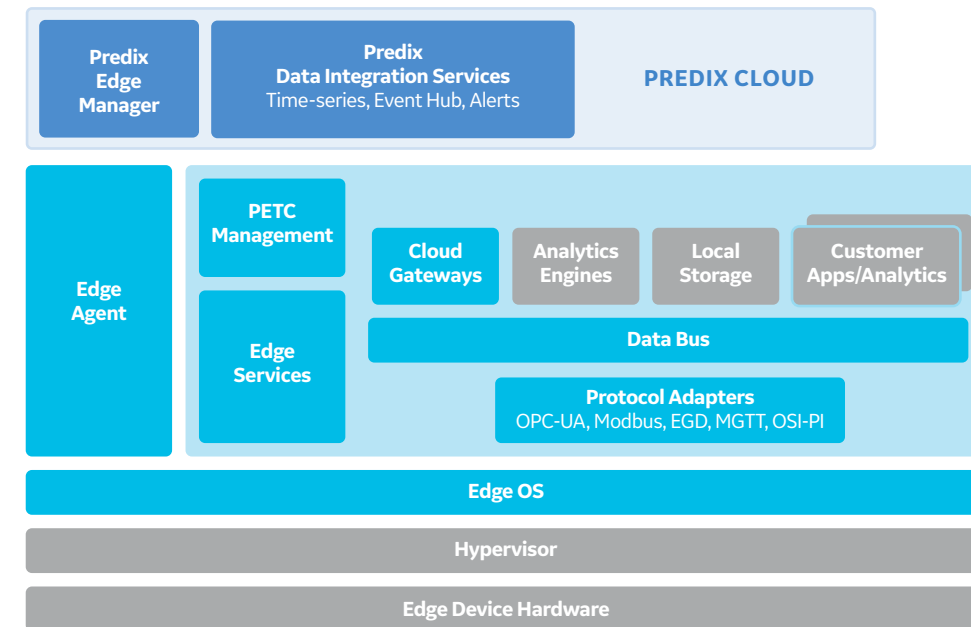
Guest applications platform

With a scalable platform and standard Docker-based container processing and management, Predix Edge can also host “guest” applications, reducing hardware costs and systems management overhead. These applications can function independently but also benefit from the app services offered by Predix Edge.



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Edge architecture overview

Main components:

Predix Edge OS is a hardened, small footprint Yocto Linux operating system that is the foundation of Predix Edge, enabling it to operate on a variety of hardware or virtual environments, and support containerized apps and analytics.

Predix Edge Agent interfaces with Edge Manager and PETC to control Edge operations, including: scheduling and managing workloads, enrolling and monitoring devices, and executing management functions.

Predix Edge Apps and Services provide the container-based framework for executing Edge workloads and functions, including protocol adapters, data bus, Edge app services, and customer-developed apps and analytics.

Predix Edge Manager is a Predix Cloud-based application that enrolls and manages end devices, manages Edge applications and analytics and controls the Edge platform itself.

Predix Edge Technician Console (PETC) provides a local management via secured browser-based Edge device access.

Customer-supplied components can include analytics and CEP engines, data storage, and container-based apps and analytics.

Additional specifications

Device connectivity and protocols

Predix Edge ships with adaptors for OPC UA, Modbus, OSI PI, MQTT and EGD. Predix Edge can also connect to the optional GE IGS Server, which supports hundreds of additional protocols.

Applications & Analytics

Docker container-based applications and analytics can be developed using the following languages: C, C++, Python, Node.js or Java.

Security

Predix Edge creates a secure end-to-end operating environment via key functionality and design principles, including:

- Management console security and role-based access
- Certificate-based device connection
- Hardened embedded OS
- Secure, trusted boot
- Data encryption

Deployment options

Today, Predix Edge can be deployed as a VMware ESXi virtual machine. A range of pre-integrated HW options will be made available throughout 2018.

VM deployment – minimum requirements:

- VMware ESXi 6.5.0 U1
- CPU Cores: 1
- RAM: 1GB
- Disk Size: 5GB (1GiB *2 root partitions, 2GiB data partition, 100MiB boot, 20MiB conf = 4308992 bytes = 4.31GB or 4.11GiB)
- Disk Type: SCSI
- Network Interface Type: Bridged

About GE

GE (NYSE: GE) is the world's Digital Industrial Company, transforming industry with software-defined machines and solutions that are connected, responsive and predictive. GE is organized around a global exchange of knowledge, the "GE Store," through which each business shares and accesses the same technology, markets, structure and intellect. Each invention further fuels innovation and application across our industrial sectors. With people, services, technology and scale, GE delivers better outcomes for customers by speaking the language of industry.

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