

JD Edwards EnterpriseOne Internet of Things Platform

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Introduction

Organizations across the world have been solving problems in the machine-to-machine (M2M) space for years. Collecting information from machines enables organizations to integrate this information into their business processes to make more intelligent decisions, reduce costs, and create new revenue streams.

These traditional systems work by attaching sensors to collect information (such as temperature, pressure or vibration) combined with actuators that control the machine. These sensors and actuators are managed by a control system, which in turn communicates back to a central server or operations center for integration into the organization's business processes. The problem with these traditional M2M systems is that they are largely proprietary and inflexible. They require specialized hardware, expensive network connectivity, and high system integration expenditure to build the machine information into an enterprise business process. They also lack the security, system management, and analytics capability that organizations require.

Oracle JD Edwards has helped thousands of organizations simplify, standardize, and optimize their ERP business processes in the areas of finance, procurement, manufacturing, capital asset management, and supply chain. This automation has resulted in better business decisions, cost savings and increased revenue. Just as this automation has helped organizations improve their business results, the step of simplifying how M2M information is collected and acted upon in the context of an organization's business process will enable organizations to further extend this value to their company assets, manufacturing operations, projects and services, and supply chain.

Welcome to the new world of the Internet of Things, where your machines, along with your people and processes, are all connected enabling solutions which were previously not possible.

This white paper focuses on how Oracle JD Edwards applications along with Oracle Fusion Middleware can provide a working Internet of Things platform which will revolutionize the industrial world by increasing operating effectiveness and revenue while at the same time reducing costs and helping to address compliance related needs.

The following sections will introduce you to the Internet of Things and suggest how you can start implementing this exciting technology today to further enhance your organization's business process:

- » What is the Internet of Things
- » Business Value of the Internet of Things
- » Components of the Internet of Things solution
- » Oracle JD Edwards Internet of Things Application Platform
- » Oracle Internet of Technology Platform
- » Conclusion and Call to Action

What is the Internet of Things

The Internet thus far has primarily been an internet of people who create and consume the data in an interconnected manner. The advent of the mobile revolution, however, has created a proliferation of cheap and capable microprocessors and networking devices, which, coupled with technological maturity, are ushering in a new age of Machine-to-Machine Internet. This M2M Internet is characterized by a number of interconnected machines and people that is higher by orders of magnitude than traditional internet based solutions. The complete platform comprised of sensors, network, gateway devices, device identity management, event processing and finally a new class of smart applications and services is referred to in the technology industry as the Internet of Things (IoT).

This interconnected platform where machines and software interact seamlessly promises to bridge the gap between the physical world and the world of software algorithms to bring about disruptive innovation heralding new smart enterprises and ushering in a revolution in modern manufacturing, agribusiness, utilities, energy, mining, real estate management, construction and other industry segments.

Business Value of the Internet of Things

Almost every organization can benefit from the technology advances described above. For example, where currently a person is needed to manually inspect a piece of equipment, automation reduces inspection costs, eliminates travel costs and avoids sending a person into a potentially dangerous location. Automation can help anticipate and therefore avoid failures to keep projects on schedule and on budget.

Currently, many organizations employ machine sensors for data acquisition and supervisory control. However, the number and variety of sensors and proprietary protocols which are very limited and rigid in their functionality can be daunting. The Internet of Things, by contrast, is a seamless appliance based on existing open standards, which allows you to gain unprecedented operational effectiveness and top-line revenue.

Let's explore some specific business challenges which can be solved with an IoT solution:

- » Perishable goods – what if you could continuously monitor the temperature, humidity, and location of your goods as they travel through your supply chain? Monitoring these critical factors and taking quick action on alerts enables you to significantly reduce spoilage and, as a result, increase revenue by reducing costs associated with wasted inventory.
- » Heavy machinery – what if you could track the location of your company's equipment along with environmental conditions and equipment operating conditions? By monitoring these factors, you can ensure that the equipment is being operated properly, prevent unforeseen machine failures, and ensure that the equipment is being used to deliver your organization's goods and services.
- » Product support – what if the products that you sell to your customers could communicate back to your maintenance organization the current status, diagnostic information, and available quantity of consumables? This information will allow you to deliver a better quality of service to your customers by capturing potential failures before they have an impact and also increase your revenue through expanded service offerings and replenishment of consumables.
- » Agribusiness – what if you could measure and monitor your entire business process from growing operations through your processing operations as opposed to requiring manual inspection at every step? This unprecedented insight into your operations can help you make timely decisions such as irrigation or timely movement through the manufacturing process.
- » Unsafe conditions – what if you could monitor the operating environment of a dangerous situation without endangering human lives? By monitoring atmosphere, radioactivity, sound, pressure, temperature, etc. using remote sensors you can ensure the safety of your workers before exposing them to a hazardous work environment.

Thus you can envision a new revolution in the industry allowing your software and hardware assets to work in tandem to increase your top line revenue, address regulatory compliance requirements, and reduce your operating costs.

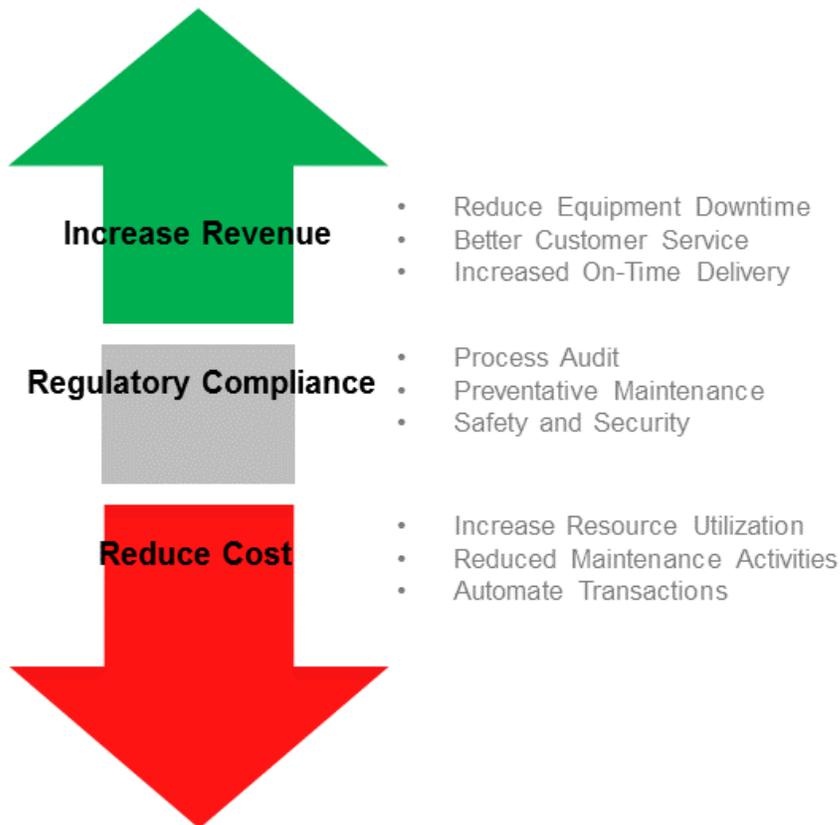


Figure 1: Business benefits of Internet of Things

Components of an Internet of Things Solution

To successfully deploy an IoT solution, several components are required:

- » **Device** or machine equipped with sensors to monitor the device and actuators to control key aspects of the device. The device information collected can span location information (such as current location, motion), operational information (such as temperature, humidity, vibration), and usage information (such as machine activity, production metrics).
- » **Gateway**, which collects and processes information from one or more devices, converts the information to a platform-independent format and communicates this information over the internet. The gateway usually deploys intelligence to filter sensor data, secure data transfer, automate software updating, run diagnostics, start or stop the device, and support other features.
- » **Network**, which is a heterogeneous collection of reliable networking technologies (PAN, LAN, WAN) allowing the gateway to communicate with central servers over the Internet.
- » **Server** infrastructure, which filters, stores and aggregates the machine “big” data. The server is capable of analyzing and acting upon the data collected.

» **Application** business process, which is the key to delivering an end-to-end solution. The application acts on the information received by alerting users to required activities and in some cases automatically controlling the device for repair or preventative action.

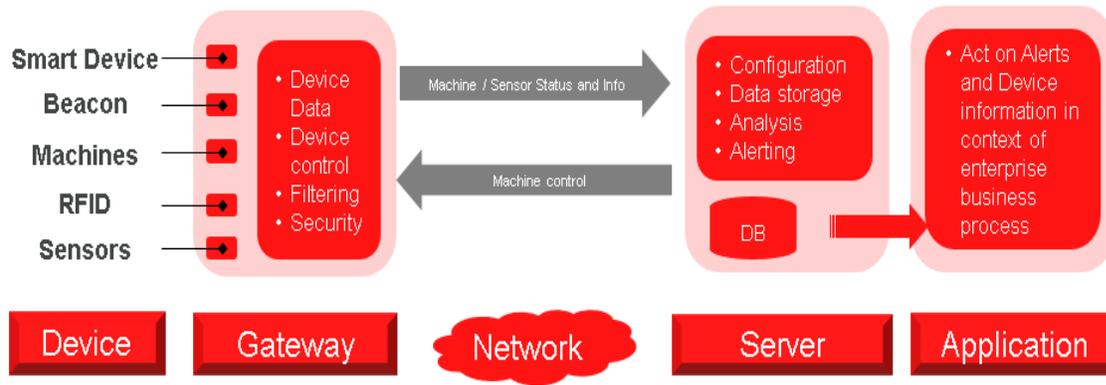


Figure 2: Components of an Internet of Things solution

A number of technology advances driven by the proliferation of home networks, smartphones, and enterprise applications are enabling this new category of smart applications and services. These advances include:

- » Low-cost processors for the device and gateway.
- » Small footprint solutions, including Oracle Java ME, running on the device or gateway.
- » Low-power circuits which consume very little power and run on battery for extended time periods.
- » Digital Mesh, Zigbee and other point-to-point communication technology for communicating between device and gateway where no commercial internet or cellular service exists.
- » Standardized communication protocols and availability of Internet connectivity between the gateway and server, which, while not available everywhere, is very pervasive.

Oracle JD Edwards Internet of Things Application Platform

Oracle JD Edwards applications, combined with a layered architecture, is uniquely well positioned to leverage the capabilities of Internet of Things technologies and to offer highly differentiated solutions to its customers. Oracle JD Edwards architecture is based on a unified data model and a metadata-based technology layer which supports a complete suite of applications. This layered architecture allows the underlying Foundation to leverage new capabilities which allows for rapid infusion of new technologies and business applications. For example, with the explosion of mobile smartphone and tablet devices, the applications were easily extended to support these new devices.

This is also true for the delivery of a complete IoT solution.

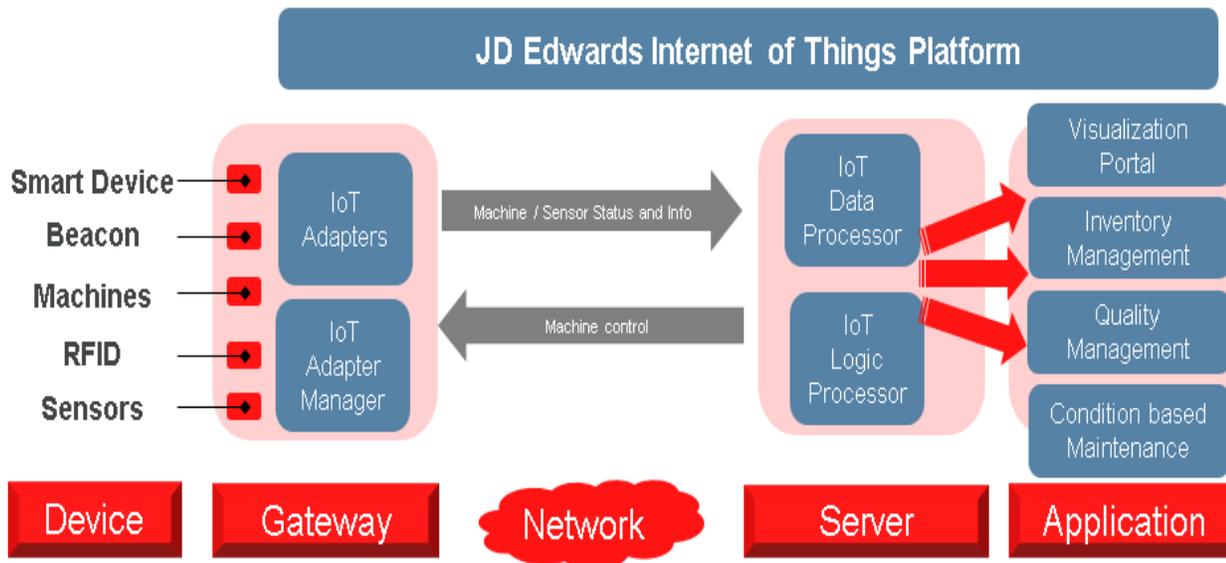


Figure 3: Oracle JD Edwards Applications Internet of Things Platform

The Oracle JD Edwards IoT platform is built on an extension of existing interoperability architecture that is suited for an M2M network. This will provide a familiar modern platform for customers, partners, and other service providers for integrating the machine information into their existing and new JD Edwards applications. The building blocks of this platform are:

- » Client-side IoT adapters: This component resides on the gateway devices which interface with the machine sensors or PLCs and transport the data to Oracle JD Edwards in an encrypted and secure manner using standards-based protocols such as web services or Java message service (JMS) events. This gateway component provides several utility services to developers to create simple rules for the acquisition, processing, and intended endpoint destination of the data.
- » JD Edwards server-side components: The highly scalable JD Edwards EnterpriseOne server architecture can be deployed in a clustered, high-availability configuration which can respond to the highest volume requirements. This server architecture has everything needed to interface either directly with machine sensors or the client gateway components to process the incoming data, store and analyze the information, and trigger actions in the application business processes configured for your industry and user task. This component is transaction-aware and processes the data for urgent notifications, usage patterns, or long term data storage.
- » JD Edwards applications: This broad set of applications, combined with a high degree of application configuration and extensibility, enables you to extend the capabilities of an existing out-of-the-box suite of applications or create new processes. In many cases, your JD Edwards applications already have the interface readily available to use such as the ability to update a meter reading or automatically create a work order.

Potential IoT solutions powered by JD Edwards EnterpriseOne are shown in the following examples:

Applications Based on Operational Conditions Metrics

- » These applications monitor the location and “operating conditions” of the physical entities specified in the business use cases. The operating conditions can include any variety of conditions such as vibration of machines, temperature of shop-floor assets, moisture or humidity in an agricultural container bin, turbidity of water flow, or acoustic patterns denoting the structural integrity of a pipeline. These metrics measure boundary or edge conditions, usage trends and long-term usage, and trigger work-orders in the Condition-Based Maintenance suite of applications. The elegance of the solution is that it uses real-time data from equipment monitoring devices to assess equipment conditions against predefined, normal operating parameters.
- » IoT-enabled Condition-Based Maintenance will enable you to make maintenance decisions based on actual equipment condition, rather than time or usage intervals. You can identify equipment problems early, when they



are less costly to correct, and perform maintenance only when needed, thereby increasing asset utilization, extending equipment life, and reducing maintenance costs. JD Edwards EnterpriseOne Condition-Based Maintenance is part of Oracle's JD Edwards EnterpriseOne Asset Lifecycle Management family of applications.

- » The system provides real-time alerts (via pager, e-mail, or other messaging systems) when equipment is operating outside of normal bounds to signal the need for appropriate maintenance action, and automatically initiates appropriate maintenance action, including investigation, creation of a work order, and condition-based maintenance schedule updates.

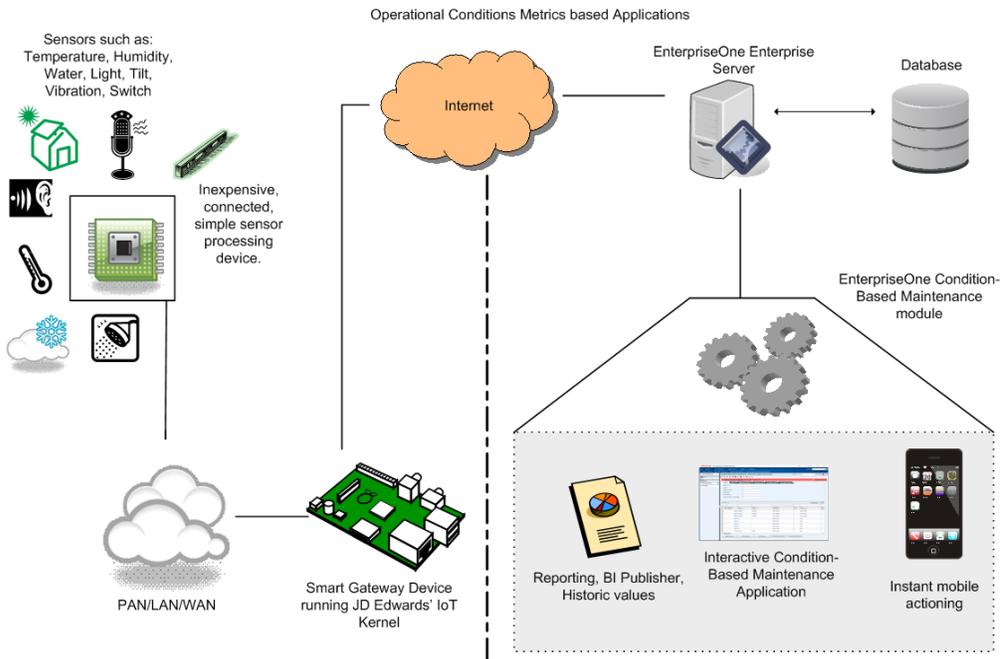


Figure 4: Applications based on operational conditions metrics

Inventory Management Applications Based on Location Services

- » These applications track two types of location information for the targeted assets: Their gross geographical location, such as at a job site or the GPS location of a mobile asset, or their fine-tuned spatial location within a defined space, such as a hospital wing or a mine shaft. This set of applications can provide both a historical or present location for the asset. This provides an instantaneous insight into inventory tracking and all the related assets which are located close to the targeted asset.
- » IoT-enabled Inventory Management allows for pinpoint accuracy of product quantities and locations and instant access to item availability information—both within the facility and throughout the enterprise. You also gain the ability to administer consignment sites and vendor-managed inventories from a single database.
- » Inventory Management offers complete tracking of inventory from the time you receive items from the vendor to the instant you ship the goods to your customer. Extending your reach beyond the immediate supply chain enables you to also track shipped items for the purpose of returns and warranties. To meet regulatory compliance, the country of origin can also be tracked at the inventory item level.

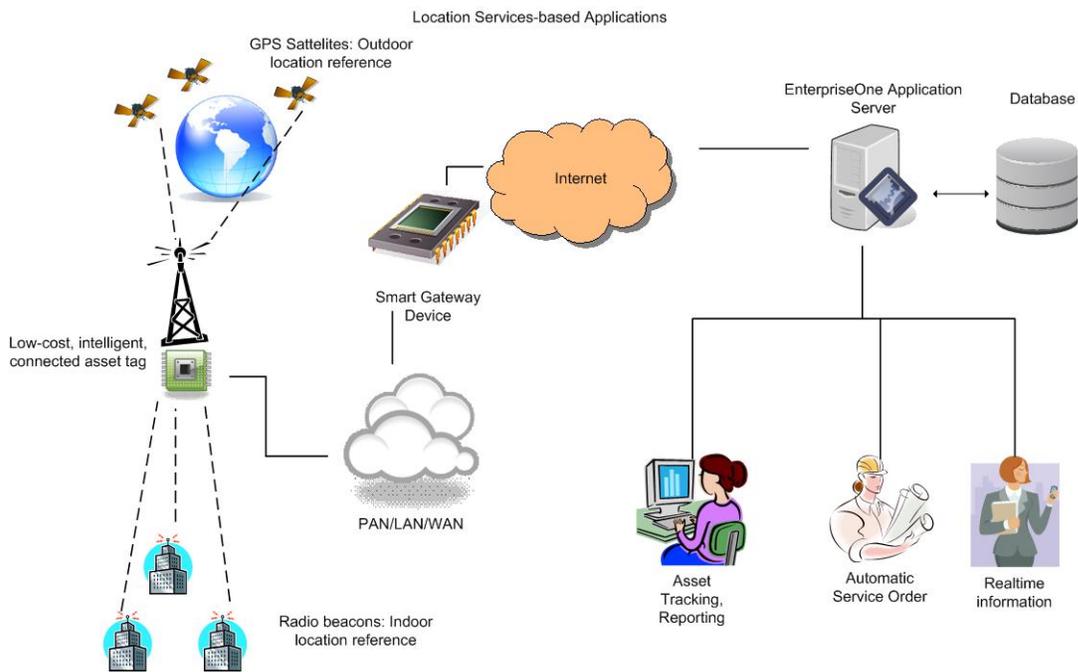


Figure 5: Inventory Management applications based on location services

Usage, Quality, and Efficiency-Tracking Applications

- » This functionality provides more advanced insight into the effectiveness of the machines and other operating assets. The focus of the use cases ranges from an operational “uptime” of machine assets in a plant to more sophisticated quality of end product based on efficiency of the output of shop floor assets spread across hundreds of plants across the world.
- » The benefits of IoT is that the system can read all of this data coming from the shop floor assets to determine which assets are not working efficiently or are in need of preventive maintenance, and automatically create work orders for the problems to be solved.
- » IoT-enabled JD Edwards EnterpriseOne Quality Management from Oracle provides a consistent, controlled approach to quality management, helping you identify defects at the source. By incorporating user-defined checkpoints for key operations, you can verify that items meet standards, tolerances, and design specifications from material receipt to the shipment of the end product. For example, the system could automatically kick off entering a service call when scrap is reported.
- » Additionally, this functionality allows a customer to determine which action to perform at each stage of production:
 - » Print a certificate of analysis automatically at the time of shipment confirmation that shows the results of all tests performed for a specific lot.
 - » Take advantage of flexible reporting options that allow you to print test results by lot number or work order.
 - » Trace an item’s lot and serial number quickly throughout its entire lifecycle. This purpose is accomplished by kicking off an inventory issue when a serialized component is used.

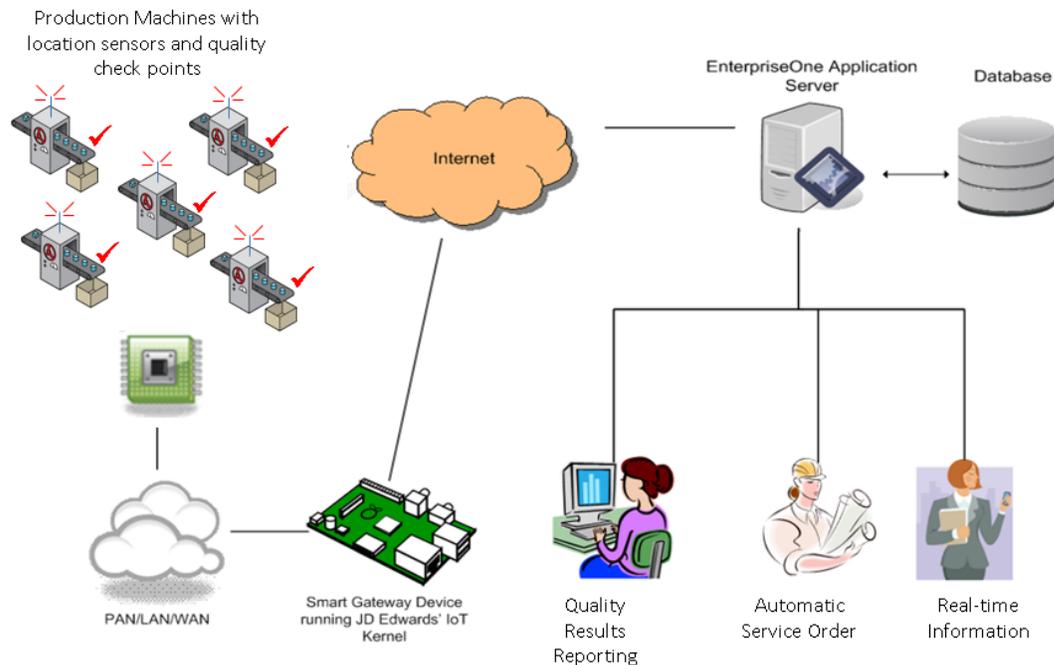


Figure 6: Usage, quality, and efficiency-tracking applications

Oracle Internet of Things Technology Platform

The Oracle JD Edwards IoT platform nests seamlessly within the Oracle IoT platform.

Whereas the JD Edwards IoT platform focuses on the application-centric solution, the Oracle IoT platform solves even the most complex technical and scale challenges.

Following the same model as in other areas, customers would use the application-centric JD Edwards solution for a simple, entry-level solution. This approach would enable them to gain IoT capabilities very quickly with very low TCO.

However for complex and very large-scale implementations, one would need to bolster the JD Edwards IoT platform with one or more components of the Oracle IoT platform such as complex event-processing, device identity management, long-term and high-volume data storage, and big data analysis.

Oracle is bringing its vaunted technology middleware to create standards-based middleware solutions in the IoT space. The technology challenges facing the development of an IoT ecosystem are quite complex and can be effectively solved only by a company of Oracle's technical depth and maturity. The challenges and Oracle solutions include:

- » **Common development platform:** The sensor chipsets, smart devices, intelligent gateway devices are all based on rapidly evolving hardware technologies. Without common development standards and programming paradigms, the resultant IoT software solutions are very susceptible to being fragmented and incompatible. Oracle is working with various leading sensor and gateway manufacturers to provide Oracle's Java Embedded Technologies. Oracle Java provides the gold standard for device agnostic code portability in M2M environments and taps into the existing worldwide ecosystem of more than nine million java developers. Using Oracle Java ME Embedded in sensor devices and intelligent gateways ensures that software solutions are built in a standards-based manner which is cost-effective, device-agnostic and backed by world-class security and software support.

- » Sensor data event processing: The M2M devices produce a high velocity of data which needs a simple rules engine to process and sort data. Oracle Event Processing provides a standards-based rules engine for rapid data processing.
- » Machine data interpretation: The data generated from millions of sensors over thousands of locations can quickly degenerate into background noise unless it is subjected to rigorous processing, storage, and analysis. Oracle provides world-class big data solutions for structured and unstructured data via inline database analysis using Oracle Data Miner and Oracle R Engine or Oracle Hadoop Solutions. This allows enterprises to gather actionable insights over long-term data usage patterns enabling business to make predictions, detect patterns, and find underlying associations.
- » Seamless scalability and long-term data storage: Oracle Engineered Systems provide an ideal platform for M2M data acquisition and storage. These pre-tested and pre-configured systems provide a cost-effective platform that supplies a high degree of reliability, performance, and flexible scalability for growth to meet business demands.

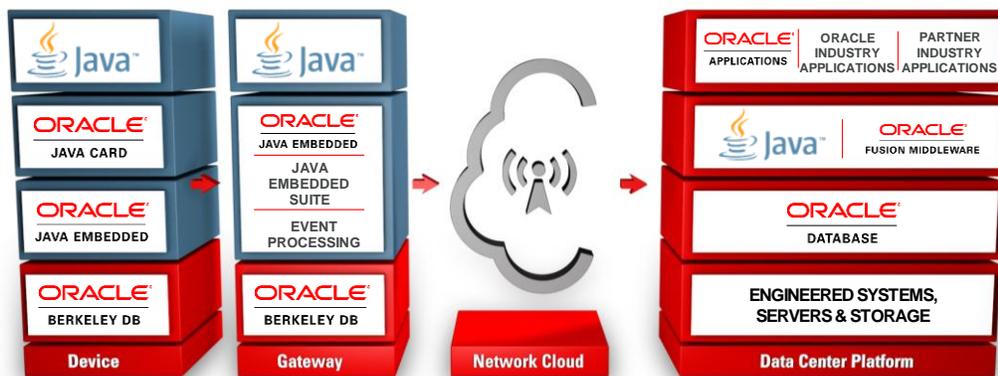


Figure 7: Oracle Fusion Middleware Internet of Things Platform

Oracle's engineering teams work seamlessly in providing an end-to-end coverage from creating Java ME platform on edge devices, sensor data event processing, ERP application platform, and data analytics technologies to highly scalable engineered systems to provide an integrated, scalable and secure platform for IoT Solutions.

Conclusion and Call to Action

- » So, let's get started with integrating your machines into your business processes. Here is how you can get started today by leveraging:
- » The JD Edwards IoT platform described in this paper. This is a complete set of server and application technologies providing a framework that allows very fast development of sensor-to-server connections.
- » Server-side support from data capture to analysis and reporting and beyond, backed by Oracle's advanced analytics, middleware and database solutions.
- » Partner network with up-to-speed business partners ready to help you further improve your business processes by leveraging IoT technologies.
- » The familiar and robust JD Edwards technology and application development framework upon which to craft the new Oracle JD Edwards IoT Applications.

To learn more about how you can leverage the Oracle JD Edwards Internet of Things Platform to create game-changing differentiated business solutions, contact your local Oracle representative or partner.



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Hardware and Software, Engineered to Work Together

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