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JD Edwards EnterpriseOne Internet of Things Orchestrator

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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 provide an integrated 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.

This white paper 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

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 Internet of Things is the transformational interconnection of devices and sensors, such as machinery and appliances, with mobile and enterprise hardware and software to create a new breed of applications that integrate the physical and software assets to provide a quantum shift in optimizing business processes.

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 bridges the gap between operations and information technology and enables you to gain unprecedented operational effectiveness and top-line revenue.

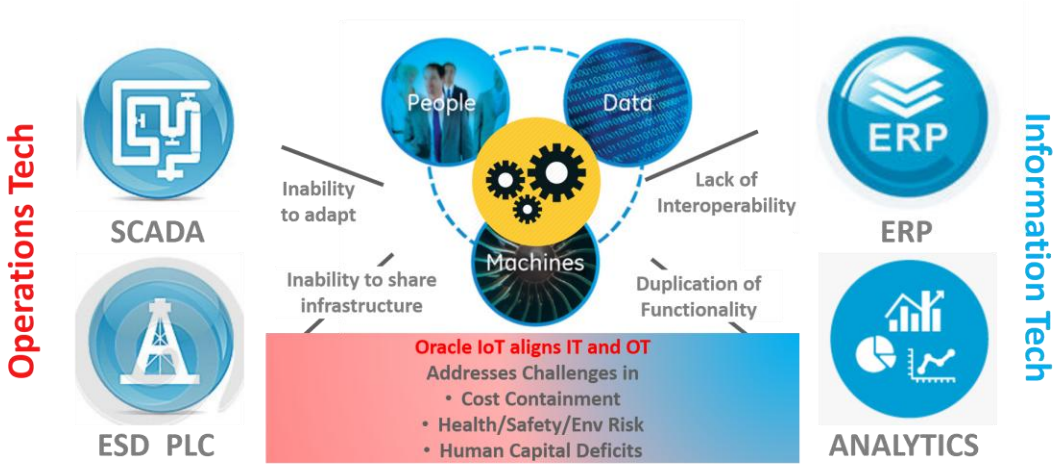

Figure 1: Connecting Operations with Information Technology[1]

1 *SCADA (supervisory control and data acquisition) is a system operating with coded signals over communication channels so as to provide control of remote equipment (using typically one communication channel per remote station); ESD PLC – Emergency Shut Down Programmable Logic Controller

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

- Perishable goods: Sensors can 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: By monitoring the locations of your company's equipment along with environmental conditions and equipment operating conditions, 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: 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: Measuring and monitoring your entire business process from growing operations through your processing operations would enable you to reduce or even eliminate 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: The ability to monitor the operating environment of a dangerous situation would significantly reduce risk to human lives. By monitoring atmosphere, sound, pressure, temperature, etc. using remote sensors you can enhance the safety of your workers.

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.

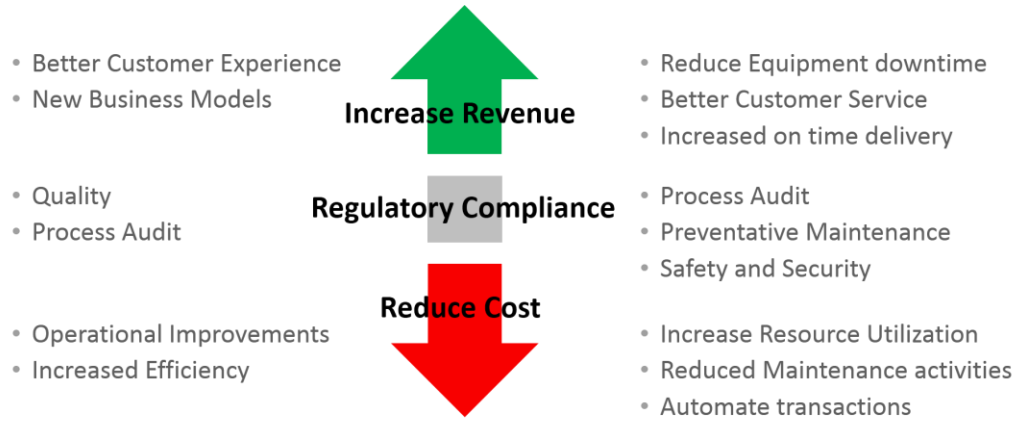

Figure 2: Business benefits of Internet of Things

Components of an Internet of Things Solution

To successfully deploy an IoT solution, several components are required. It starts with a process to acquire data from physical devices, machines, or third-party systems; it provides a way to analyze and interpret that data; and when warranted, it concludes with some informed decision, action, or transaction in a system such as JD Edwards.

- **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.

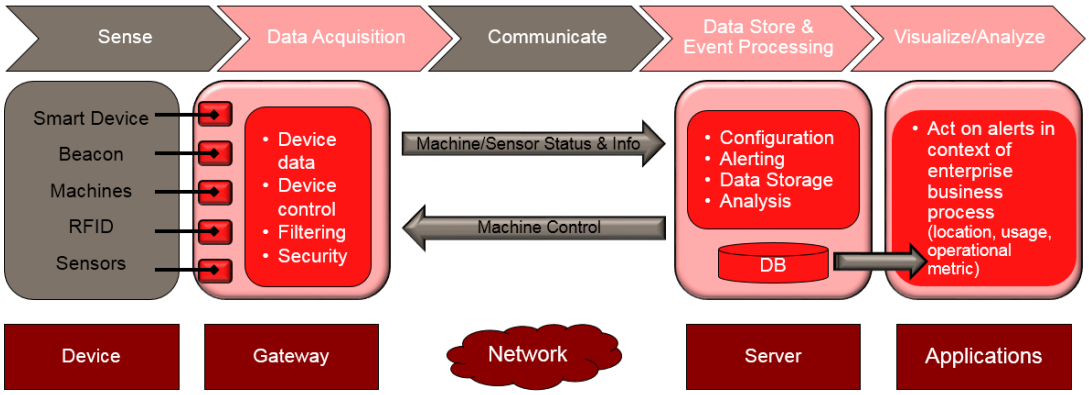

Figure 3: Components of an Internet of Things solution

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.

JD Edwards and the Internet of Things: The Industry's Best Enterprise Applications Ignited by Real-Time IoT Data

Oracle JD Edwards applications are uniquely well positioned to leverage the capabilities of Internet of Things technologies and to offer highly differentiated solutions to customers. For four decades the JD Edwards team has been developing, innovating, and delivering enterprise applications to customers across many industries, of all sizes, and across all geographies. The result is a mature, stable, yet modern suite of enterprise applications with deep industry functionality. JD Edwards customers depend on these applications to manufacture things, maintain and repair things, sell things, rent things, transport and warehouse things, and grow things. And now, in this emerging era of the Internet of Things, it is a natural extension to invite those things into direct participation with the JD Edwards applications. In this way, the Internet of Things ignites an entirely new level of value and possibilities from the JD Edwards applications in which customers have already invested. Further, the JD Edwards architecture is based on a unified data model and a metadata-based technology layer which supports the complete suite of

applications. This layered architecture allows the underlying foundation to leverage new capabilities which, in turn, enable the 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. Because of JD Edwards' flexible architecture customers are able to adopt positively disruptive technologies to transform their businesses without suffering the negatively disruptive consequences of major infrastructure shifts.

This is also true for the adoption of IoT in a JD Edwards deployment.

JD EnterpriseOne Internet of Things (IoT) Orchestrator – The Technology Framework

With the JD Edwards EnterpriseOne IoT Orchestrator, JD Edwards is delivering a solution that integrates the operational with the information side of technology by providing the mechanism and processes to receive and aggregate the data from various types of devices, integrate and secure those data, and then to pass them to JD Edwards ERP applications for analysis and action.

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

This integration is encapsulated in the JD Edwards EnterpriseOne IoT Orchestrator which provides the critical processing capability that enables JD Edwards applications to use the data received from devices to enable business processes that were either not possible or very difficult, manual, and time-consuming previously.

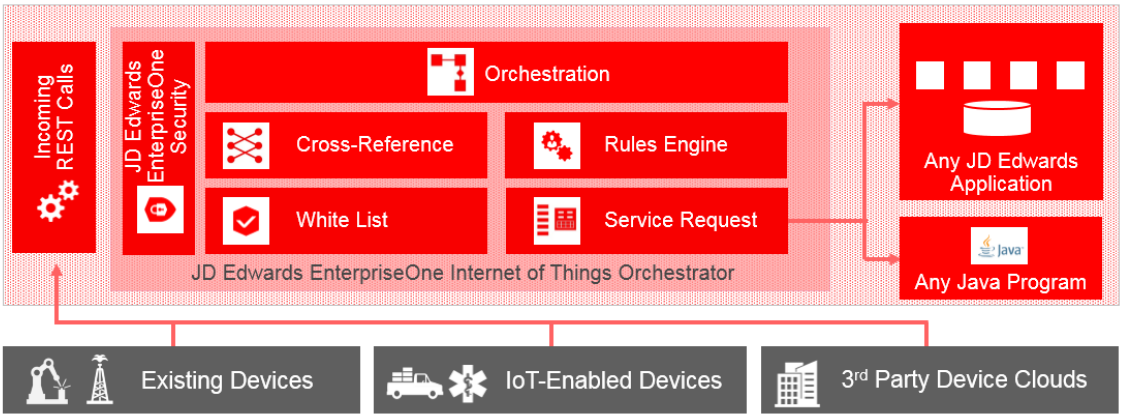

Figure 4: JD Edwards EnterpriseOne IoT Orchestrator

The process starts when third-party devices and a gateway collect and process 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.

The process culminates in JD Edwards applications analyzing the data and initiating the appropriate transactions.

The JD Edwards EnterpriseOne IoT Orchestrator constitutes the bridge by contextualizing the input from the devices, filtering out "noise" and mapping events, conditions or states to actions. The JD Edwards EnterpriseOne IoT Orchestrator encompasses the following components:

COMPONENT	DESCRIPTION
Orchestration	The master process that provides a unique name for the orchestration process in the IoT Orchestrator. The orchestration uses the next four components in this list to run a single orchestration instance.
White List	An initial rudimentary pass/fail check of the incoming message's device signature against a predefined list of signatures. A white list provides an additional layer of security to the IoT Orchestrator security.
Rules Engine	A set of conditions against which the input from the IoT devices is evaluated to produce a true or false state. Rules can be nested to produce complex evaluations. You design the rules that the engine uses to determine how to act upon the data. You can also use custom Java to define additional rules.
Cross-Reference	A set of data relationships defined by the designer of the orchestration that enriches the minimal input from devices. For example, a cross-reference can convert an incoming ID into an EnterpriseOne value for use in service requests
Service Request	An invocation of a JD Edwards EnterpriseOne interactive application or a Java application via a REST service call to the EnterpriseOne Application Interface Services (AIS) Server

Benefits of Implementing the JD Edwards EnterpriseOne IoT Orchestrator

Previously, much of the data that can now be collected from devices was entered by users. Implementing an Internet of Things solution involves removing human agency from data collection and, to some extent, processing, thus reducing time delay and the potential for error. The JD Edwards EnterpriseOne IoT Orchestrator essentially makes the input devices the equivalent of JD Edwards users without the potential for error or lack of availability.

Another benefit is the fact that the deployment of the JD Edwards EnterpriseOne Internet of Things Orchestrator can be driven by business analysts. The business analyst is the individual who knows the business intimately, has expertise on identifying critical conditions and events, and knows what to do about it. The business analyst knows which data are needed, knows which need to be filtered out and what rules and cross-references are needed to make the data usable for JD Edwards EnterpriseOne applications.

The JD Edwards EnterpriseOne IoT Orchestrator can be put to work for all JD Edwards EnterpriseOne applications. You select applications based on what your business requires. For example, if your business involves operating machinery remotely, your primary focus for feeding data into your JD Edwards EnterpriseOne system will likely involve asset management applications.

If your company already collects data via Internet of Things devices and imports them into the JD Edwards system using existing integration technology, such as batch processing or business services, the JD Edwards EnterpriseOne IoT Orchestrator offers the benefit of significantly lowering the cost and complexity of this integration.

Business Scenarios for JD Edwards EnterpriseOne IoT Solutions

The exponential growth of the Internet of Things is driven not only by the rapid proliferation of devices, but also by the expanding realm of potential business applications. The following illustration captures the areas that offer an array of opportunities for IoT deployment from infrastructure to healthcare.

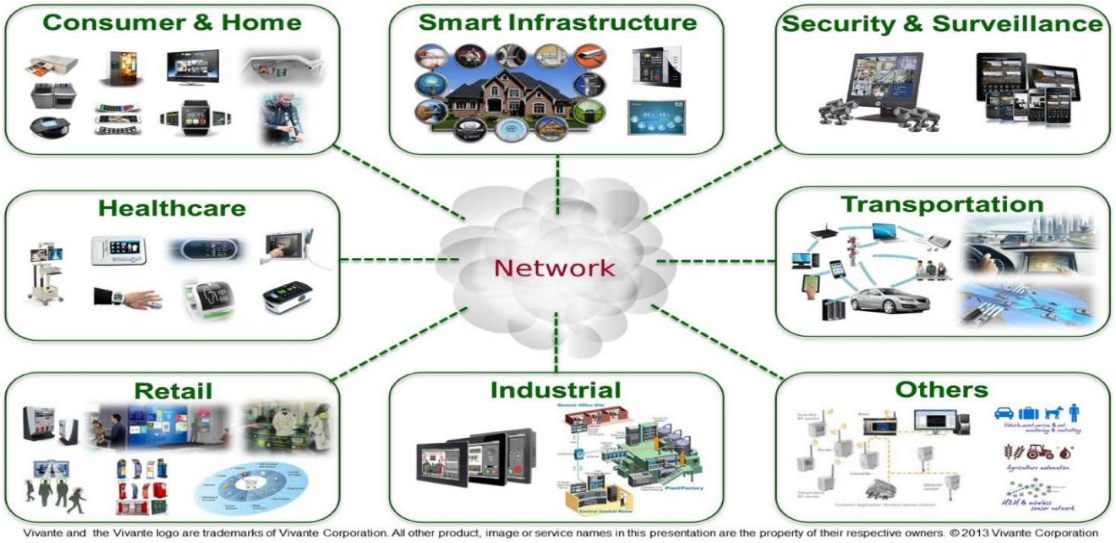

Figure 5: IoT Opportunities[2]

JD Edwards' Internet of Things practice is, of course, informed by the challenges and opportunities our customers face. Companies have to deal with issues such as:

- Asset performance
- Danger and volatility
- Scarcity of resources
- Aging workforce
- Regulated industries
- Mandate on safety

All of these, and many other, issues involve scenarios that can benefit from deploying the JD Edwards EnterpriseOne IoT Orchestrator. This section reviews some business scenarios to illustrate potential applications of the JD Edwards IoT Orchestrator.

In many industries, production equipment is a major investment and also a significant source of costs for maintenance and replacement. JD Edwards EnterpriseOne offers several modules that help companies manage and maintain their equipment. The effectiveness of these applications can be enhanced by improving the data they receive. More and better data will ultimately result in improved operations at a lower cost.

Asset Health – Operational State and Metrics

If your business involves the use of any kind of equipment, you have a vested interest in ensuring this equipment is ready to perform consistently and continually. Any down-time or sub-optimal performance is a cost against the investment represented by the equipment. The ability to continually track when an asset is in use and to capture and evaluate key operational metrics represents a significant benefit. The JD Edwards EnterpriseOne Condition-Based Maintenance system can generate work orders as needed based on a continuous flow of real-time measurements of boundary conditions, usage trends, and long-term usage performed by equipment monitoring devices. The real-time data can then be evaluated against predefined normal operating parameters.

2 Image courtesy of Vivante Corporation.

Asset Usage

Another potential application is the ability measure how equipment is being used. Devices can, for example, monitor run hours, fuel usage, and mileage to determine need for maintenance. Instead of relying on a maintenance schedule, you can the need for bringing in the asset or sending out a maintenance technician based on the data transmitted to and processed by a JD Edwards EnterpriseOne application. JD Edwards EnterpriseOne Equipment Maintenance applications can send real-time alerts based on an analysis of the data received.

Asset Operations and Output

A related question to ask is how a given piece of equipment is operating and whether it is performing at peak output. These questions can be addressed by collecting the appropriate data for the equipment, for example, pressure, vibration, temperature, viscosity, purity, flow, compare them with standard measurements and generating alerts and transactions to address deviations immediately. Doing so makes it easier to avoid having an asset work under less than optimal conditions for any length of time. The corresponding benefits are increased asset utilization, extended equipment life, and reduced maintenance costs.

Environmental Impact on Asset Performance

Another factor affecting equipment performance is the environment in which the equipment is placed. In addition, environmental conditions are also critical for grower operations with a focus on environmental data such as weather, humidity levels, water levels, soil moisture content, and so on. This information has application to decision on what crops to grow and where in agribusiness, but can also be used to move equipment out of hams way.

Asset Location

An integration of sensor data with JD Edwards EnterpriseOne equipment application can also make it possible to keep track of physical asset locations in real time. This information is relevant for any kind of movable asset, from a herd of livestock to machines. In combination with environmental data, this information can help determine whether a given asset is at risk in the current location due to environmental conditions.

Inventory Management

Maintaining enough but not too much inventory to support production is a key capability for lean manufacturing practices. Instead of having to manually check inventory to avoid disruption, sensors can check inventory levels, for example by weight or number of items. They can then trigger Kanban check-in if bin weight or the number of items fall below a predetermined level, with the Kanban check-in in turn triggering replenishment transactions

Product Quality Tracking

Quality monitoring is another production process that can significantly benefit from ongoing monitoring and resulting alerts and quality operations. Sensors in a production tank, for example can quickly and in real time signal values that are out of tolerance for the product. The application receiving the signal can then trigger an operation to correct the condition.

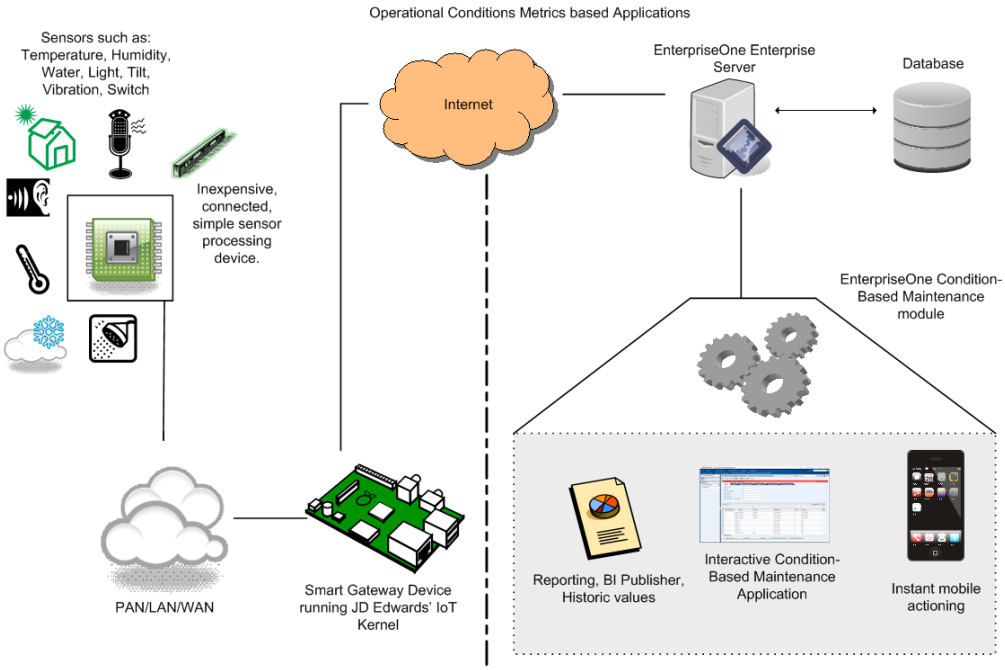

Figure 6: Applications based on operational conditions metrics

These examples represent use cases that can easily be addressed by integrating devices of your choice with JD Edwards EnterpriseOne applications using the JD Edwards EnterpriseOne IoT Orchestrator.

As indicated previously, you can build an Internet of Things orchestration for any JD Edwards EnterpriseOne application to optimize how you run your business.

The benefit of an Internet of Things solution can extend beyond the wall of your business. For example, by building sensors into the product you sell and continuing to monitor product conditions, you open up new business opportunities by offering monitoring and maintenance services to enhance a product's lifespan.

Oracle Internet of Things Technology Platform

The JD Edwards EnterpriseOne IoT Orchestrator nests seamlessly within the Oracle IoT technology platform.

Whereas the JD Edwards EnterpriseOne IoT Orchestrator 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 JD Edwards EnterpriseOne IoT Orchestrator to gain IoT capabilities very quickly with very low TCO. Designing an IoT solution using the JD Edwards EnterpriseOne IoT Orchestrator does not require IT development. It can be done by a business analyst who knows the business, can identify critical conditions and events, and knows what to do about them.

For complex and very large-scale implementations, customers 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. However, the Oracle IoT platform is not a required component for all JD Edwards EnterpriseOne IoT Orchestrator implementations.

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 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 that 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 businesses 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.

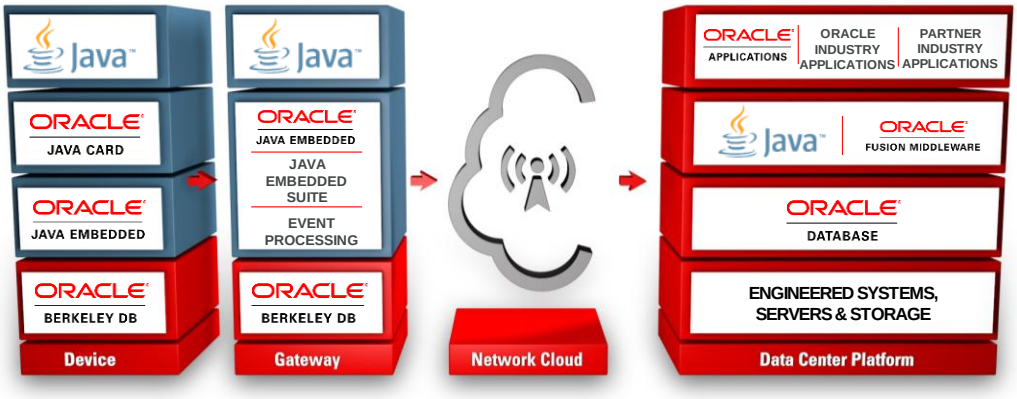

Figure 7: Oracle Fusion Middleware Internet of Things Platform

Oracle's engineering teams work seamlessly in providing 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.

In June 2015, Oracle announcement the Oracle Internet of Things Cloud Service, planned for availability in Oracle fiscal year 2016. The Oracle Internet of Things Cloud Service is designed to serve critical requirements of enterprise-class IoT deployments, such as device management, enterprise connectivity, event processing, and guaranteed delivery. Many JD Edwards customers will find value in the complementary benefits provided by the Oracle IoT Cloud Service. However, the Oracle IoT Cloud Service is not a strict prerequisite for implementing the JD Edwards EnterpriseOne IoT Orchestrator.

Conclusion and Call to Action

The JD Edwards EnterpriseOne IoT Orchestrator enables customers to gain quick and uninterrupted access to real-time data with the ability to process the data continuously for optimized operations, nimble responses, clearer analytics and better regulatory compliance.

This technology offers the opportunity to greatly reduce the cost and complexity of collecting data, preparing them for JD Edwards applications to be turned into actions. You can capitalize on your JD Edwards EnterpriseOne investment by opening your JD Edwards EnterpriseOne applications to data, analysis, visibility and action that is real-time, continuous, accurate, and secure.

To prepare for implementing the JD Edwards EnterpriseOne IoT Orchestrator:

- Talk with JD Edwards partners and device vendors about how IoT is evolving.
- Brainstorm about how Internet of Things connected devices could transform your operations.
- Estimate the Return on Investment if you could:
  - Eliminate manual input
  - Increase visibility into real-time status
- Engage Oracle experts to help you build a solution.

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

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