A HURWITZ WHITE PAPER

Essential Elements of an IoT Core Platform

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Introduction

The maturation of the enterprise cloud, advances in big data analytics and stream computing are dramatically impacting markets and emerging technologies, allowing companies to innovate in new ways. In addition, the cost of sensors has plummeted and continues to fall, making it economically feasible to deploy large numbers of connected devices. As these technologies continue to develop, they have formed the underpinning for the the Internet of Things (IoT). By taking advantage of connected devices and using massive amounts of data, many organizations across industries are exploring new business models and new service offerings. The three elements that have become the enabler of this new IoT era include:

The ability to act upon streaming data is becoming a prerequisite for many IoT applications.

Enterprise cloud - The scalability of the cloud, availability of massive amounts of compute, storage and networking at affordable prices, the ability to create shared services to address specific business problems and the establishment of cloud security services are making the cloud a safe and practical environment for many businesses.

Big data analytics - New technologies are allowing companies to better understand data and make more data-driven decisions. Some of these new technologies include predictive analytics, data management for big data in a highly distributed manner, and being able to blend structured and unstructured data from a variety of internal and external sources to bring context when solving complicated problems.

Streaming data and real-time analytics - To be effective in a dynamic, ever changing, process-driven world requires the ability to process data in real time. Many use cases that depend on data require fast analysis rather than waiting for data to be processed in batch. For example, when managing the flow of traffic in a congested city, data must be analyzed in real time and actions must be immediately taken to decrease delays. The ability to act upon streaming data is becoming a prerequisite for many IoT applications.

The Emergence of the Enterprise Internet and the Internet of Things

All of the elements described above are the foundational elements for the enterprise internet, its infrastructure and the Internet of Things. This foundation is changing the way organizations are able to leverage data to create efficiency and innovation in the physical world. While organizations have long relied on data-oriented systems to codify business transactions, companies have been unable to take advantage of the rich data emanating from sensors and connected devices. The advances in cloud computing, advanced analytics, and stream computing have changed the way we can understand and manage the physical world. These capabilities have enabled the emerging IoT environment to transform a variety of industries. In this paper, we will present the transformation brought about by IoT. We will also examine the role of an IoT core platform.

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Unlocking the value of data captured from connected devices requires critical elements be brought together to create a complete platform. This emerging IoT core requires that connected devices be managed in an efficient and effective manner so that data can be streamed and analyzed using sophisticated cloud services. This approach to managing IoT enables companies to unlock large volumes of hidden data that can provide significant insights. For example, manufacturing companies have the ability to gain real-time insights into how a production system is performing and make changes in near real time. Likewise, IoT-based environments can collect data from the sensors in a city's infrastructure to ensure the city operates most effectively while maximizing public services. Similarly, utility companies are tracking generator output and system usage to adjust capacity to match current demand and predict future requirements.

A flexible IoT core platform must be designed to accommodate change. This is in stark contrast to traditional IoT solutions that are purpose-built based on single use cases.

Supporting a Dynamic Internet-of-Things Environment

Systems have to be designed to meet complex environments that are both physical in nature and data driven. These systems require a consistent but flexible set of core platform services that can support the type of business processes that need to be automated. The promise of IoT is intended to create environments that are agile and flexible so that data can be used to anticipate change and react to conditions in near real time.

There are three major elements that have to be in place for this dynamic environment to be effective. The following foundational elements are interrelated and are requirements for a robust IoT core platform:

- Provide a flexible and modular platform
- Future-proof the environment
- Build an active partner ecosystem

The flexible and modular platform

The key to success with IoT requires an architecture and infrastructure based on scalable open-source technology. This means that the infrastructure itself needs to be designed to accommodate and integrate emerging data platforms such as Hadoop, Spark, and NoSQL. At the same time, the infrastructure needs to integrate existing data platforms into the environment. It also requires that the platform be agnostic to data platforms and protocols. It is critical to be able to leverage IoT sensor data from a variety of sensor types.

A flexible IoT core platform must be designed to accommodate change. This is in stark contrast to traditional IoT solutions that are purpose-built based on single use cases. When an IoT solution is purpose-built it becomes rigid and unable to adapt to changing technologies and changing business requirements.

The new generation of IoT solutions require an underlying infrastructure based on a flexible IoT core platform. The framework that supports this is a set of underlying services can apply to many different business situations. There are also analytics frameworks that support a variety of data types. Foundational

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services include a variety of types of middleware that support both transactional and streaming data. In addition, compliance and security services must be part of the foundation. By creating independent services that can be used in a variety of situations, organizations can more easily create efficient solutions.

Once an organization has access to these foundational services, it allows a business to focus on innovative solutions to complex problems rather than beginning from scratch with a new platform.

The benefit of beginning with a framework is that it provides the ability to future-proof the solution so that it can integrate new technologies.

Future-Proof the Environment

The benefit of beginning with a framework is that it provides the ability to future-proof the solution so that it can integrate new technologies. This means that the platform can evolve as the business itself changes, as well as when new and emerging technologies become available. For example, a manufacturer may determine that there is an emerging market where they can apply their services. Entering the new market will mean that the manufacturer will need to create new business processes and integrate new connected assets and sources of data. Likewise, there may be some new technologies that have come to the market and will help the company move faster.

If the underlying platform is designed in a modular and flexible manner it can adapt to emerging technologies and business change. A future-proof IoT core platform needs to incorporate open standards and open APIs (Application Programming Interfaces). This IoT core platform will change as new innovative technology, standards, and APIs are developed. Therefore, the IoT core platform has to be malleable enough to adopt to changing requirements and technologies.

The Partner Ecosystem

No one vendor or company can develop every IoT solution. A rich ecosystem of partners is critical for an IoT platform to meet business requirements. Solutions can be template-based and tackle industry-specific challenges. For example, a technology company with deep experience in the building management sector might create a specific building automation and monitoring solution on top of the IoT platform. Similarly, a technology company focused on the oil and gas market can build industry-specific IoT solutions using the same template and deploying them on the same IoT core platform. A platform that facilitates open innovation and co-creation is critical to avoid vendor lock-in or an investment with limited lifespan.

How the IoT Can Address Organizational Challenges

Physical systems have been equipped with sensors for decades. What the enterprise cloud, the proliferation of low-cost sensors and the Internet of Things have changed is how data from connected devices is utilized. In the past, physical systems were connected in closed loops and it was only possible to understand the current state of a system. Now, with the maturation of the

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enterprise cloud and the emergence of the Internet of Things, systems and devices are being connected to the outside and data is being fed to other systems.

Below are a few examples of specific IoT solutions that can be built on top of a flexible, future-proof IoT core platform. These solutions might be developed by an ecosystem partner or the platform provider. In all of these use cases, partners can also help customers customize the solution for their specific business or industry.

By gathering and analyzing data during the manufacturing process, the number of quality tests can be greatly reduced, which lowers testing time.

Predictive Maintenance – The emergence of IoT as well as the need for organizations to reduce costs, improve asset productivity and increase quality, have led organizations to implement predictive maintenance programs. Predictive maintenance solutions alert a company that a failure will likely occur. A well implemented solution will prevent an organization from taking equipment off-line for unneeded preventative maintenance and will also prevent equipment from unexpectedly failing. Predictive maintenance solutions built on top of an IoT core platform allow organizations across verticals to monitor, maintain and optimize assets for better availability, utilization and performance. In addition, the organization can predict asset failure and identify poor quality parts faster to better optimize operations and supply chain processes. Ultimately an IoT predictive maintenance solution allows organizations to reduce guesswork and incorporate experiential knowledge into the business process.

Factory optimization – Factories and manufacturing companies have been using data-driven approaches for years. As with other industries, the explosion of data and the ability to analyze big data is changing the way factories and manufacturers operate. For example, manufacturers are using IoT and big data analytics to reduce testing time. By gathering and analyzing data during the manufacturing process, the number of quality tests can be greatly reduced, which lowers testing time. In addition, manufacturers are using the enterprise internet and IoT to optimize their existing supply chain processes for better asset utilization and production planning. Finally, manufacturers are using IoT to change their business model. For example, an HVAC (heating ventilation and air conditioning) manufacturer that has traditionally just sold equipment may shift to a solutions model where it offers embedded software and services, or HVAC-as-a-Service, allowing customers to purchase a consistent temperature and humidity for their offices rather than HVAC equipment.

Data exchange services – An IoT core platform allows organizations to bring together internal and external data that they have never previously correlated. The platform can give internal users as well as partners and customers an environment to explore the data and build applications that take advantage of the data. One example is a capital city in Europe that has recently developed a city data exchange. The goal of the city data exchange is to collect data from public and private data sources and make it available to public and private stakeholders. Important data masking, privacy and security measures are taken to ensure citizen data is

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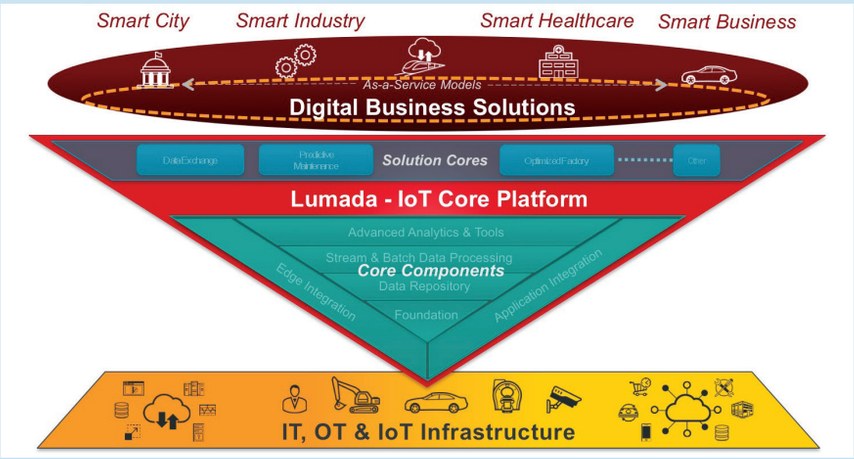
Hitachi's approach to an IoT core platform and digital transformation

Hitachi has been working with customers and partners to create IoT solutions for the last several years. Hitachi codified best practices gained from these early IoT engagements into Lumada, it's IoT core platform. The Lumada platform is composed of a variety of components, including security, messaging, complex event processing, stream processing, workflow execution and application integration. In addition to the Lumada platform, Hitachi has built a number of IoT solutions to address both vertical and horizontal business challenges.

The figure below represents the Hitachi digital transformation architecture that includes its Lumada platform. At the base layer is the actual OT, IT and IoT infrastructure. The base layer of the architecture includes the connected devices, gateways, storage, etc. The triangular layer at the center is Lumada, the IoT core platform, which consists of two sub-layers. The first sub-layer includes a number of core IoT services, such as advanced analytics and security. The other sub-layer in the Lumada platform includes the solution cores or blueprints which include predictive maintenance, optimized factory and data exchange. These solution cores allow easy re-use and rapid adoption of vertical and horizontal IoT use cases.

Finally, at the top layer of the digital transformation architecture are the actual digital business solutions created for smart business, industrial and government applications. The digital business solutions enable organizations to interconnect data to augment the way they conduct business and deliver services by taking advantage of the Internet of Things.

Figure 1: Hitachi Digital Transformation Architecture



Source: Hitachi, Ltd. 2016

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anonymized when made available for commercial purposes. In addition, the city data exchange had to comply with privacy laws regarding personally identifiable information. The data exchange will integrate data from a variety of sources, such as demographics, crime statistics, energy consumption, air quality sensors, and traffic sensors among others. Private businesses will have the opportunity to use the data (for a fee) to offer data-driven services to other businesses or citizens. In addition, the city will work with vendors to create solutions that use the data in order to provide better services, and a cleaner, safer city.

Conclusion

As the amount and variety of data expands, it is critical that we have a technology framework with data processing and analytic engines that support this industrial transformation. Until recently, the economics of data storage and big data analytics did not make sense for wide adoption of connected devices. With the enterprise cloud maturing and Internet of Things being adopted across industries, organizations are transforming the way they conduct business. To be successful, organizations need to be able to capture all types of data and analyze that data in context with the business problem being addressed. We have passed an important milestone that has given organizations the ability to create new solutions and support innovation.

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