Featured Articles

IoT Platform that Expands the Social Innovation Business

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OVERVIEW: The IoT platform business has been centered in the USA until recently, with the mainstream type of businesses providing solutions for making effective use of equipment by collecting the equipment's data in the cloud, and analyzing them. However, just analyzing a company's own equipment data may not always be enough when attention shifts to solving the customer's management challenges. It should also try to connect various kinds of IT/OT systems encompassing existing and other companies' products, and feed the analysis results back into site operations to help improve overall efficiency. Hitachi has proposed an IoT platform with the features needed to achieve these goals. This article mainly presents the architecture of this IoT platform and the basic function groups comprising it. It also discusses the work Hitachi is doing with respect to security, an area that will become increasingly needed in the years ahead.

INTRODUCTION

AS companies work in various ways to prepare for the arrival of the Internet of Things (IoT) era, Hitachi plans to continue strengthening its Social Innovation Business in the digital solutions field, which is rapidly growing due to IoT, utilizing digital technology that is open (enabling collaborative creation with customers) and scalable (enabling horizontal deployment).The Social Innovation Business aims to rapidly co-create solutions while repeating the processes of issue analysis, hypothesis creation, prototyping, and value testing together with customers.

DIGITAL UTILIZATION IN SOCIAL INNOVATION BUSINESS AND ITS CHALLENGES

In addition to the information technology/operational technology (IT/OT) systems that belong to customers, an open IoT platform that can be linked to partner IT/OT systems and open source software (OSS) communities and can securely provide high-value digital solutions will become important for rapidly co-creating solutions with customers while repeating processes from issue analysis to value testing.This will require the ability to grow along with the customer by accumulating knowledge obtained from the processes of hypothesis testing and provided solutions, and then using this knowledge to provide subsequent new solutions.

IoT PLATFORM PROPOSED BY HITACHI

To achieve the rapid implementation of digital solutions, Hitachi has proposed an IoT platform Lumada[(1)]. Lumada is the common platform used to share the IoT solutions expertise and best practices that Hitachi has gained through experience over many years. The platform is designed to be able to sustainably adapt to business and technology changes by linking with customer and partner systems, and using OSS-based architectures.

Lumada architecture is comprised of a stack of solution functions and basic functions (see Fig. 1). The solution functions are a set of solution templates that are designed to enable the rapid implementation of IoT solutions for various business fields. The basic functions are a collection of functions that are independent of the business field. For example, the basic functions include analytics, artificial intelligence (AI), symbiotic autonomous decentralization, and security functions.

The next chapter presents some examples of basic functions derived from Hitachi core technologies: Pentaho software, Hitachi AI Technology/H (hereafter referred to as H), system virtualization, edge integration, and a common execution platform for highly reliable analytics.

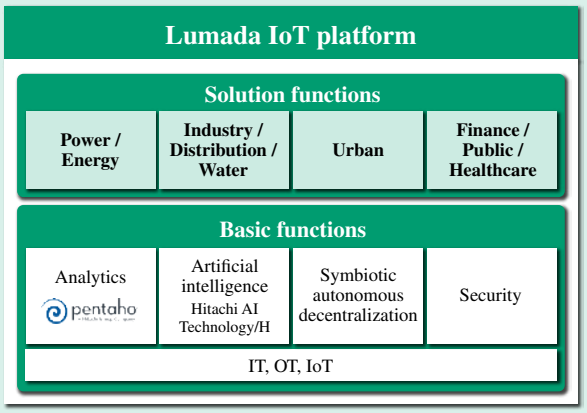


Fig. 1—Lumada IoT Platform.
Lumada is composed of solution functions and basic functions. The solution functions consist of solution templates, and the basic functions consist of Hitachi core technologies that are highly reliable and have been previously implemented.

BASIC FUNCTIONS COMPOSING THE IoT PLATFORM

Analytics: Pentaho Software

Analytics is one of the basic functions in the Lumada IoT platform, and requires two functional elements: data collection/integration and data analysis/visualization.

For data collection/integration, it must be easy to connect to commercial databases, files, and web systems used by various IT/OT systems. To ensure data integration processes are done efficiently, libraries for various data processes such as name aggregation, interpolation, and filtering must be provided that can be easily combined and used. To enable efficient processing of data from the recently increasing number of various sensors and devices, it must also be easy to link to big data processing platforms such as Hadoop[*1] and Spark[*2].

For data analysis/visualization, online analytical processing (OLAP) functions must be provided that can analyze integrated data from various perspectives such as region, time, and product, and it must be easy to link with statistical analysis tools such as R and Weka. To output the analysis results so they are easy to read, a dashboard with various visualization libraries such as pie charts and graphs. should be provided, the results should be customized to match the customer's environment, and they must be easy to bidirectionally embed with the customer's existing visualization tools.

Pentaho software[(2)] is analytics software that provides two functional elements, data collection/integration and data analysis/visualization, and has a graphical user interface (GUI) that enables program-free development and execution of all processes ranging from data collection/integration to analysis/visualization, just by plotting data flows (see Fig. 2). Being used by over 1,500 companies in 180 countries worldwide, it is an OSS-based product with an operation track record of over 10,000 production systems. Its strength lies in its ability to link with dozens of partner products that provide data processing, analysis, and visualization functions.

*1 Hadoop is a trademark of The Apache Software Foundation.
*2 Spark is a trademark of The Apache Software Foundation.

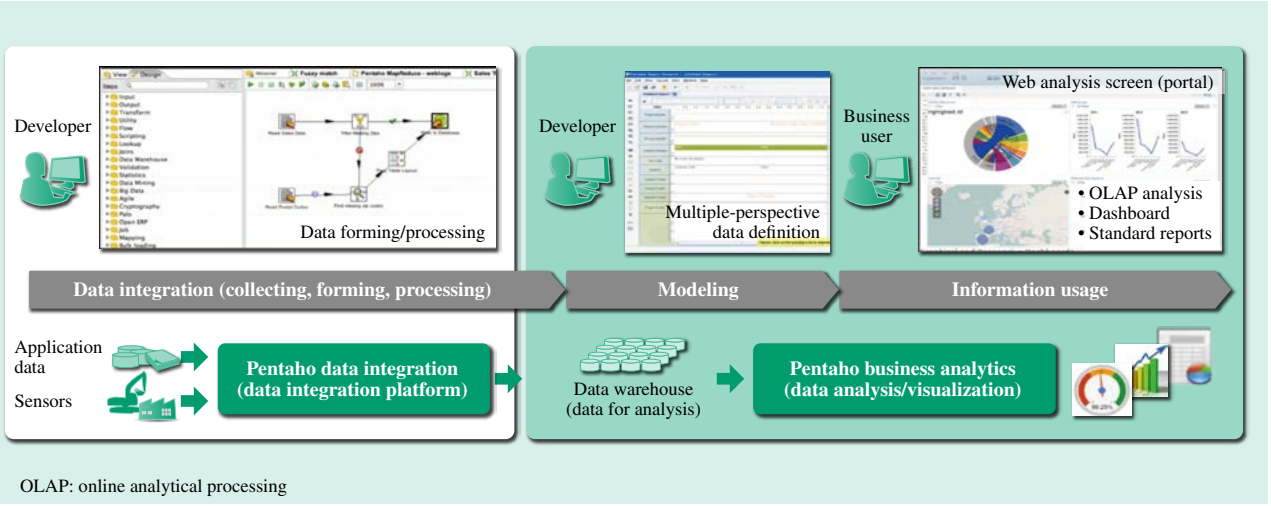


Fig. 2—Overview of Pentaho Software.
Pentaho software is composed of Pentaho data integration (for collecting and integrating data), and Pentaho business analytics (for analyzing and visualizing data).

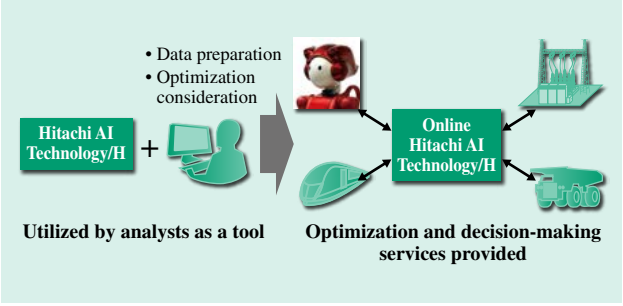


Fig. 3—Optimization/Decision-making Provided as Services by Hitachi AI Technology/H.
Hitachi AI Technology/H connects to systems and automates optimization and decision-making.

AI: Hitachi AI Technology/H

In terms of artificial intelligence, one of the Lumada IoT platform's major basic functions, Hitachi is developing H, which automates optimization and decision-making[3]. Using a variety of mixed numerical data as input, H is characterized by recursively deriving models related to outcomes such as performance and productivity from large-scale data. It is designed for data-driven modeling of outcomes instead of building up and precisely modeling business processes.

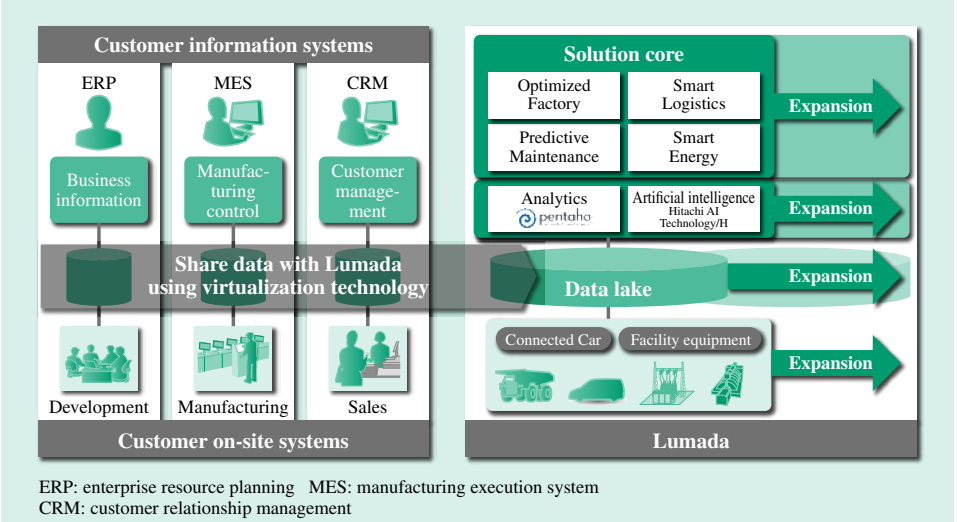
Inside H, comprehensive combinations of input data are generated to produce a massive volume of combination feature values. By systematically calculating the relationships between these feature values and outcomes, it discovers complex correlations hidden in the data, using statistical processing. The output from H consists of equations that explain the correlations between the outcomes and combination feature values. These equations can be used as optimization functions and incorporated into business systems or control systems online, along with outcome improvement prototype designs and methods for providing execution, enabling continuous improvement of outcomes that conform to the data even when the environment has been altered or an order has been changed (see Fig. 3). For example, H can be used to automatically track changing on-site conditions in order to improve outcomes in various environments including manufacturing lines, warehouses, and stores.

Symbiotic Autonomous Decentralization: System Virtualization Technology

Solving the customer's management challenges with digital technology requires not only connecting Hitachi's equipment to the platform, but also being able to connect to the customer's existing assets, and being able to progressively expand the field to be connected. Hitachi is therefore developing system virtualization technology as a possible basic function for the IoT platform. This technology extends the concept of "autonomous decentralized systems," which are used for the progressive extension of railway and industrial control systems, to the "system of systems" level as the concept of symbiotic autonomous decentralization. This concept helps in developing storage virtualization technology to share data in an open and secure way, while leaving existing systems unchanged (see Fig. 4).

IT/OT/IoT: Edge Integration, Highly Reliable Common Execution Platform for Analytics

With the increasing demand for utilizing a wide variety of large-volume data generated at work sites, the concentration of processing load in the cloud



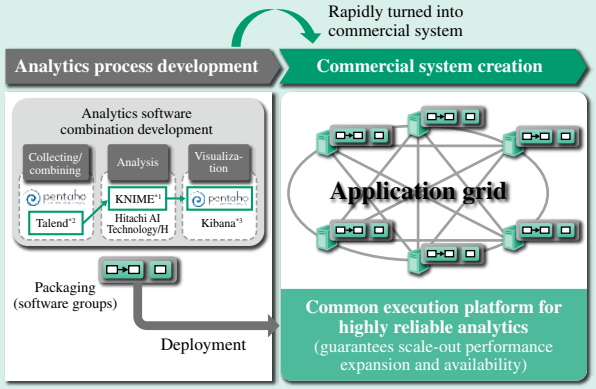
ERP: enterprise resource planning MES: manufacturing execution system
CRM: customer relationship management

Fig. 4—Virtualization Technology that Enables Data Sharing with Existing Systems.
Using storage virtualization technology, etc. enables the customer's systems to share data with Lumada right away, and enables digital solutions to be added or expanded.

and the increase of communications data volume are causing scalability problems. Hitachi has developed an edge integration technology as a candidate for a basic function to challenge these problems. The edge integration technology enables application processing at the place where data are generated in order to reduce the concentration of processing load and the increase of communications data volume.

An advantage of the edge integration technology is its ability to find required data from a large volume of data groups, with high efficiency, and at low cost. This advantage is achieved by executing primary processes, such as the extraction of data feature values and the filtering of unnecessary data, at work sites in coordination with analysis processes in the cloud.

Along with supporting the development of data collection, integration, analysis, and visualization processes using the Pentaho software, Lumada also supports development approaches using analytics processing software, such as OSS, with existing systems, and utilizing development expertise. To satisfy the need for a framework that guarantees the availability of stable operation and expandability for a given data volume (which cannot be achieved just by combining software), Hitachi has developed a common execution platform for highly reliable execution of various analytics programs.



*1 KNIME is an open source workflow platform developed at the University of Konstanz in Germany. The KNIME trademark is used by KNIME.com AG under license from KNIME GmbH.
*2 Talend is an open-source data integration/coordination platform provided by Talend, and a trademark of Talend, Inc.
*3 Kibana is an open-source log data analysis/visualization tool provided by Elastic, and a trademark of Elasticsearch BV, registered in the U S and in other countries.

Fig. 5—Common Execution Platform for Highly Reliable Analytics Software.
This platform guarantees expandability and availability for combining the processes of widely diverse analytics software, enabling rapid development of commercial-grade systems.

An advantage of this common execution platform is its ability to package a series of processes developed with a combination of analytics programs and to automatically form a grid that executes an application only by deploying the package on multiple nodes (see Fig. 5). This ability provides availability and expandability for analytics processes developed with a wide variety of software including OSS, and realizes the extension of systems to meet commercial quality criteria.

SECURITY

As the IoT becomes used for an ever greater range of applications, security threats tend to become larger and more widespread. By providing sensing and cyber-countermeasures in cyberspace and the real world (physical space), Hitachi would like to respond to these threats by developing speedy risk handling technology and supplying it as a basic function in the Lumada IoT platform. Using this basic function could enable the creation of security operation centers (SOCs) that provide integrated monitoring of cyberspace and physical space (see Fig. 6). IT monitoring and facility monitoring could be handled by a single provider, reducing the customer's monitoring costs, and lowering the workload for routine high-volume monitoring.

Physical Security

To provide facility access control for large traffic volumes at key customer locations such as buildings, plants, and airports, Hitachi is developing high-speed finger vein authentication technology with the same throughput as an automatic ticket gate in a train station. The technology rigorously authenticates individuals by reading and comparing the finger vein patterns that are unique to each individual. This enables an SOC to prevent identity fraud from unauthorized ID card use, control access to surveillance areas, and coordinate and manage various types of surveillance information and personal attribute information for surveillance subjects.

To reduce the surveillance staff workload during wide-area surveillance, Hitachi is also developing a multiple-perspective search technology that uses video from multiple installed surveillance cameras to analyze surveillance subjects from multiple perspectives (such as facial information, clothing, and personal property), enabling high-speed detection and tracking of suspicious persons.

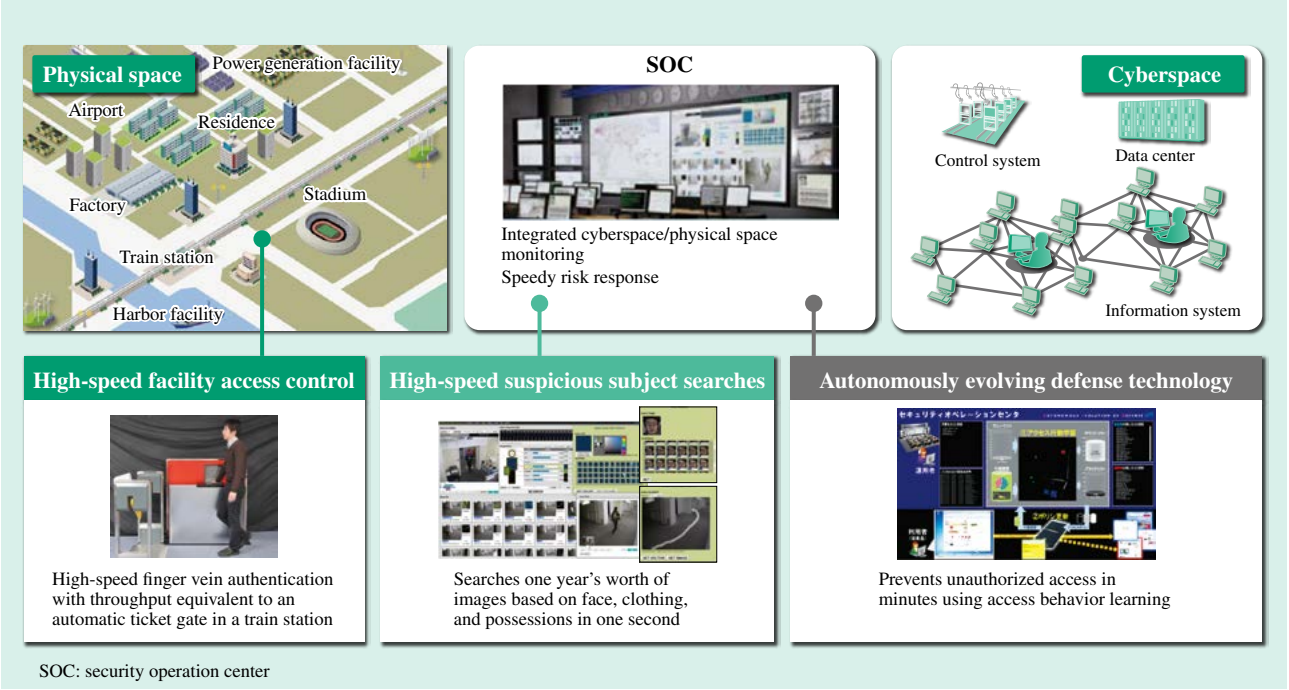


Fig. 6—SOC Providing Integrated Monitoring in Cyberspace and Real Space.
A single provider handles cyberspace and physical space monitoring using high-speed facility access control, high-speed suspicious subject search, and autonomously evolving defense technology.

Hitachi will enhance these high-speed surveillance technologies and Hitachi proprietary video content analysis technologies as basic functions composing Lumada's security features. In addition to this, by using the symbiotic autonomous decentralization concept to enable flexible connection to customers' conventional equipment, Hitachi would like to provide these technologies in the form of surveillance solutions that rapidly respond to a variety of surveillance needs.

Cyber Security

Protecting data that is being stored for customers or data that is provided by customers is a crucial requirement for enabling customers to connect securely to the platform. To enable secure and safe data processing, Hitachi is developing confidential information processing technology that performs processes such as searches and statistical processing. while keeping data encrypted.

Advanced cyber attacks that defeat multiple levels of security measures have recently started to emerge. To counter these attacks, security functions need to be designed and implemented by incorporating risk analysis at the design stage, and security incidents need to be monitored and handled rapidly during operation. Using the security operations knowledge it has accumulated for IT systems, Hitachi is developing various technologies for making security operations more efficient and labor-saving. Examples include a technology that manages the vulnerabilities that exist in systems, a technology that detects multilevel attacks, and an autonomously evolving defense technology that analyzes malware behavior. Hitachi also plans to position these technologies within the Lumada IoT platform.

FUTURE OUTLOOK

Open coordination among different business types and industries will be encouraged by refining the process of building platforms that provide services individually in different business fields using the basic functions described in this article. It is thought that this open coordination could boost innovations in the customer's value chain, leading to the further creation of new value. A symbiotic ecosystem that creates solutions by linking individual autonomous platforms could be progressively built in this way.

CONCLUSIONS

This article has presented the architecture and basic functions of Hitachi's Lumada IoT platform along with technologies that help achieve cyber security and physical security.

Hitachi will continue to help rapidly solve customers' management challenges by utilizing platforms that help customers analyze challenges, create hypotheses, and prove the value of solutions while also supplying and operating those solutions. Hitachi plans to drive its growth by incorporating Lumada into various sectors such as energy, industry, and urban development as a starting point to build an ecosystem of social innovations that span different industries.

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