OKI's IoT Business Platform

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Currently, attention is focused on digital technologies such as IoT (Internet of Things), big data and artificial intelligence (AI), and it is expected not only to improve operational efficiency but also to create new businesses. Many organizations including companies, countries and local governments have begun strategically adopting these new digital technologies in various efforts to solve their own or customer problems. Organizational or operational change utilizing these digital technologies is known as digital transformation.

This article introduces the IoT business platform OKI is developing to realize the customers' Digital Transformation.

Creating New Value

In realizing digital transformation, the following two aspects can be considered as use of digital technologies to create new value and build a competitive advantage.

1) Utilization to improve operational efficiency
2) Utilization to create new value

Previous ICT's were primarily used for improving the efficiency of an organization's own operation. However, the application of new digital technologies is characterized by a customer-oriented aspect of creating new value for customers in addition to improving operational efficiency.

At the center of the new digital technologies is IoT. With IoT, all sorts of objects and people are connected to the Internet, and it is possible to acquire a wide variety of data. Through optimization and analysis of the various data collected from objects and people, information that was overlooked in the past becomes visible. When machine learning inference or artificial intelligence is applied to the new information, new value is created. This process is expected to create new business models, improve efficiency, and expand sales in new areas.

Process for Utilizing IoT

Figure 1 shows the process for utilizing IoT to handle large volumes of various data and establishing a business model that creates new value.

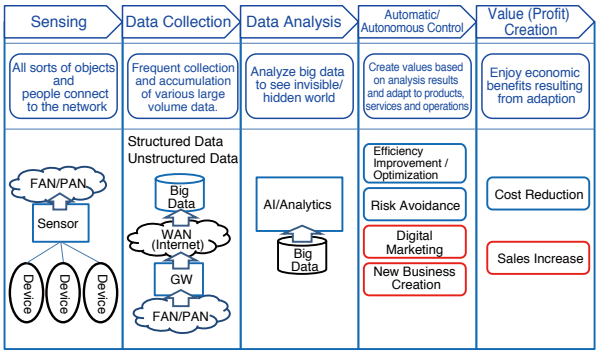

Figure 1. Process for Utilizing IoT

(1) Sensing

Miniaturization, power saving and lower cost have made it feasible to equip sensors in industrial equipment and handheld devices such as smart phones and wearable devices. As a result, sensing internal and external conditions including image, position, temperature, vibration, operating condition, blood pressure and heart rate of various objects and people have become possible.

(2) Data Collection

Data obtained from sensors connected to each device includes both structured data and unstructured data such as audio, video and text. A network provides the function to transmit and receive data to/from the cloud center and an enterprise, home, or moving condition.

A network consists of a PAN (Personal Area Network), FAN (Field Area Network) and LAN (Local Area Network), which data from the sensor connected to each device passes through to reach the Internet, and WAN (Wide Area Network), which connects to the Internet via IoT gateway, etc. For each network, it is important to select installation environment, distance, data volume, and cost for optimum configuration depending on use and establish a communication environment that can collect necessary data when required.

(3) Data Analysis

From the large volume of collected data, it is possible to discover regularity and patterns, perform analysis useful for later processing, and find "meaning" from the data.

In order to seek out "meaning" from the large volume of data, similar looking data are gathered together and

the process of extracting data similar to the target data is repeated until a useful pattern is discovered. This process is machine learning.

Since the collected data also contain media data (unstructured data) such as voice and video, high-speed machine learning for processing the media is required. Currently, high-speed processing is possible with the use of fast CPUs and in-memory computing technology.

Through this high-speed machine learning, AI/analytics analyzes past data, makes predictions for the future and realizes computerized decision-making. Decision-making that is conventionally done by humans can be automated using AI/analytics.

(4) Automatic/Autonomous Control and Value Creation

Incorporating an automatic or autonomous control of the decisions that are made into the business process, intellectual tasks that relied on humans will be automated. This will lead to benefits that include operational efficiency, cost reduction, risk avoidance and enhanced customer perspective marketing.

Examples of operational efficiency are (1) efficient, automated production process using parts and manufacturing equipment with RFID/sensors for the analysis of parts inventory and automated control of manufacturing equipment, and (2) optimally controlled operation of industrial equipment depending on operating condition/environment with use of operation data and temperature/humidity sensors.

An example of cost reduction is reduction of maintenance cost through fault sign detection of equipment with remote motoring of operation status and analysis of operation data.

Effort to minimize or prevent damages by predicting natural disasters and early detection of aging infrastructures is an example of risk avoidance.

As products/services connect to the Internet, strengthening customer contact through an omni-channel utilizing tablets/smartphones, digital signage and SNS in additional to traditional online channels such as websites and call centers is an example of enhanced marketing.

As various objects and people connect, things that were hidden become visible and creation of value including new business models/businesses that go beyond existing business models can be expected.

OKI's IoT Business Platform

In order to realize the customer's digital transformation, OKI provides an IoT business platform with "sensing," "data collection," "data analysis" and "automatic/autonomous control" functions, which are basic requirements of IoT. IoT business platform consists of sensors, network infrastructure, application infrastructure, security and operation (**Figure 2**).

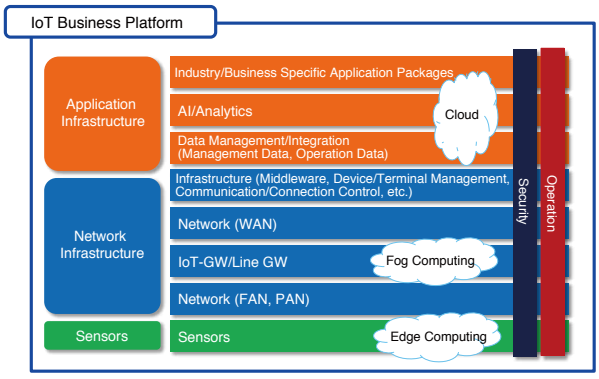

Figure 2. IoT Business Platform Configuration

(1) Sensors

A wide variety of generic sensors and sensors with OKI's own sensing technology are provided for collecting information from various devices.

In order to sense information from all sorts of devices and people, sensing by sounds, videos, radio waves and lights is an important element in addition to the so-called conventional sensors. OKI holds sensing technology expertise in the areas of acoustics, images/videos, radio waves and optical propagation characteristics analyses.

Acoustic analysis makes the identification of sound, distance and direction possible enabling drone detection or monitoring equipment status (normal, abnormal).

Through image/video analysis, a person's gender, age and identification/authentication of an individual as well as size, shape and identification of an object can be determined. Continuous analysis of those data allows events to be recognized from human behavior/object movement.

In radio analysis, by analyzing the propagation characteristics utilizing the reflection of radio waves, changes in objects/positions (object movements) and human vital signs (human conditions) can be observed.

Optical propagation characteristics analysis analyzes the propagation of light through an optical fiber to determine condition changes from temperature and amount of strain at each point along the fiber (specific position of abnormality) or detect abnormal vibrations (intrusion, equipment failure).

The use of these sensing technologies allows various information about equipment and people, which were previously unmeasurable, to be collected and realizes a more precise and real-time information gathering.

(2) Network Infrastructure

The network infrastructure consists of the PAN/

FAN, IoT gateway, WAN and infrastructure on the cloud center side (middleware, device/terminal management, communication connection control). This is an area where OKI can leverage the reliable communication technology it has cultivated over many years.

Combination of OKI's specified radio and communication technologies (no disconnect, low delay/no packet loss, security assured) with general-purpose wired/wireless communication technologies provides a highly reliable and efficient communication network environment that has a quality level close to a dedicated line even when using the Internet.

Communication environment to tie objects together is realized using 920MHz multi-hop technology and DSRC (Dedicated Short Range Communication), which OKI has abundant experience with in ITS. Effort is being made to improve efficiency further using video compression and broadband data transmission technologies.

These communication technologies provide processing and control to ensure an easy yet highly reliable connection for collecting and transmitting information from various sensors.

Additionally, connection with generic cloud infrastructure allows a multi-IoT business platform so that an optimal cloud environment can be selected for each customer.

(3) Application Infrastructure

The application infrastructure consists of management/integration of collected data, data accumulation, AI/analytics to analyze stored data and industry/business specific application packages.

OKI is developing and verifying various analytical tools to construct an application infrastructure that will enable optimal business use of data analyzed using data lake processing, which is suitable for managing unstructured data such as social media, image/video and audio, and analytical processing suited for each industry.

OKI believes the following steps to be important in the data collection/analysis process for optimum utilization of data, and they will be included in the provided analysis engine.

1) Clarification by collecting data that grasp the current situation (visualization)
2) Automatic recognition by analysis of collected data (predictive recognition)
3) Automatic control by predictive analysis of data (autonomous operation)

Through these steps, status of various objects and predicted movements, which were previously not visible, become clear and can lead to the creation of new results.

For example, voice (sound) and video (image) can be converted to data using voice and image recognitions. Then applying machine learning or data mining, application to substitute a person's communication job such as an AI-equipped call center becomes possible.

Application packages for specific industries/businesses include packages geared toward various industries such as financial institutions that OKI has been providing for over the years with its strengths and packages for businesses such as call center systems, as well as packages created through co-creation with customers. These various packages are being assembled and an environment built to provide solutions that address customer issues quickly.

In this area, an environment will be provided that realizes the most optimal data utilization for a customer's business not only with OKI's products alone but also with the best combination of OKI and partner products.

(4) Security

While connection of objects and information to the network gives way to convenience and service efficiency, there is a possibility security risks will expand.

In the business platform, appropriate security measures are required for all devices, sensors, networks, clouds and data management as well as software and applications running on them. Based on the achievements and operational knowledge of CSIRT (Computer Security Incident Response Team) operated in-house, OKI will implement necessary functions, establish a structure and reflect it in products and services.

(5) Operation

Conforming to ITIL and ISO 20000, the operation service provides advanced security and operation standards fit for use by financial institutions. Furthermore, maintenance service with bases located throughout Japan enables operation and maintenance services to be offered 24 hours a day, 365 days a year. As a result, functions along with operation/maintenance services are offered for each product service.

Supporting Customer's Digital Transformation

Due to the diversification of values and needs of "piece/individual" in the digital society, customers' product/service demands and the environment are changing. The management tasks to cope with the changes will require new efforts to solve. However, it is becoming difficult for customers to determine the best course of response on their own. For such customers, OKI believes that it is important to build a co-creation service and place where OKI and the customers can think together to create new values. OKI will support customers' digital transformation

by sequentially creating optimum business applications for customers through co-creation activities utilizing the IoT business platform (**Figure 3**).

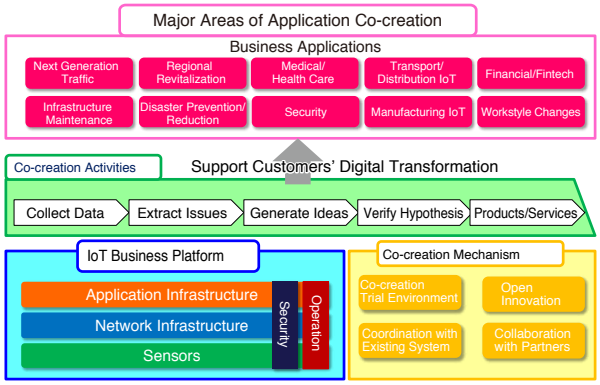

Figure 3. Application Co-creation with Customers

Co-creation in various application fields are targeted including those listed below.

1) Next-generation traffic services such as ETC 2.0 and automatic driving
2) Maintenance of aging social infrastructure
3) Addressing shortage of personnel/improving work efficiency at medical and nursing care facilities
4) Improving efficiency of transport/inventory management and utilization of diverse customer information in the transport/distribution field
5) Improving efficiency of production process/ inventory management and predicting equipment failures at factories
6) New financial services utilizing the latest digital technologies such as Fintech (financial Technology)

Co-creation activities will be driven by the following steps.

1) Collect various data to see things that were unseen
2) Analyze accumulated data and work contents and extract unnoticed issues
3) Joint study of ideas to resolve issues
4) Establish a created idea hypothesis and co-verify the effect
5) Provide effective products and services

In proceeding with the these steps, co-creation mechanism, which includes prototype development and provision trial environment for efficient verification, provision of external interfaces to link customer's existing system, adoption of devices/sensors that make full use of the latest technologies through open innovation, selection/ verification of partner products other than OKI's, will be actively utilized.

OKI believes the mechanism to create new value obtained through the co-creation activities and the accumulation/use of knowledge will help in contributing to more customers.

Future Efforts

In a goal to make digital transformation its main business, OKI will continue to provide products and services on its IoT business platform.

To that end, in addition to its core products and services, OKI recognizes that coordination with suitable partner products and services, OKI's own maintenance network and comprehensive integration capability for co-creation with customers are required. With that in mind, OKI will drive forward the provision of a platform capable of creating new business models and values for customers.

Conclusion

The environment surrounding enterprises in the digital age changes dramatically both socially and technically. The changes come so swiftly that as soon as a response to one change is completed, the next change is required. The response to those changes will be the key for the continuous growth of an enterprise. For this reason, not only must OKI group's total strength be brought together, but also building partnerships with various industries are indispensable as well.

Authors

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【Glossary】

Digital Transformation
The concept "IT penetration will change people's lives better in all aspects" advocated in 2004 by then Professor Erik Stolterman of Umeå University in Sweden. (Erik Stolterman, Anna Croon Fors, "Information Technology and The Good Life," Umeå University, 2004)

Data lake
Big data processing architecture advocated by General Electric (GE).

ITIL (Information Technology Infrastructure Library)
Guidelines formulated by the Office of Government Commerce (OGC) that systematically summarizes IT related operation and management methods.