M2M and Big Data to Realize the Smart City

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Abstract

M2M technology enables us to control "things" and to collect various kinds of information from "things." NEC provides the M2M solution CONNEXIVE with the aim of building the next-generation "Ambient Information Society." This will help realize a safe and secure lifestyle and a revitalized industrial base. While making the best use of big data processing technology in analyzing and studying information acquired from CONNEXIVE we aim to realize a rich and innovative Smart Society. This will include the imminent Smart City and Smart Communities that will be centered on the city-based social infrastructures of the future.

Keywords

M2M, horizontal integration, CONNEXIVE, big data, smart city

1. Introduction

M2M plays a role in digitizing "things," which means that it materializes something called "feeling" or "intuition" in our real life by the use of digital data. The big data technology combines this and other digital data for examining and analyzing. It is expected that all "things" will be materialized in the big data era of the future. Both M2M and big data technologies are expected to play important roles as platforms for the construction of futuristic intelligent societies such as the Smart city and the Smart community, etc. The predicted favorable growth of the M2M and big data markets indicates such a trend. It is expected that the M2M market will expand to approximately 330 billion yen by the year 2015, and that the big data market will expand to 630 billion yen by the year 2017 and will exceed 1 trillion yen by the year 2020.

This paper describes NEC's M2M solution CONNEXIVE. This is an ICT platform to help build secure cities and to support their industrial revitalization. It also introduces usage examples of big data together with describing data collected from such cities.

2. Horizontal Integrated M2M

M2M is an abbreviated expression of "Machine to Machine" that stands for a mechanism that "things (machines)" are connected to each other via networks using all sorts of communication tools (**Fig. 1**). With the M2M mechanism, every single "thing," not only information equipment such as PCs, servers, etc. but also other equipment such as home appliances, vehicles, sensors, etc., are connected via the network to communicate with each other by autonomic operation. Also such connected "things" are able to exchange information with each other and to control themselves automatically without the need for manned operation.

Several M2M services have already started such as "Telemetering" and "Telematics."

"Telemetering" or "Telemetry" is a technology for monitoring or controlling devices located remotely. This technology is also used to check gas meters, vending machine inventories, the malfunction status of elevators and for parking lot management, etc. "Telematics" is a technology that mounts communication systems in a moving object such as in vehicles, etc. and provides real-time information services. Incorporating a communication module in a car-mounted navigation system enables the system to receive and provide information services via mobile telephone lines.

M2M service described above collects information from



Fig. 1 Illustration of M2M configuration.

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Source: New Generation M2M Consortium Fig. 2 Conceptual diagram of vertically integrated M2M service.

monitoring points via communication modules mounted in devices, and provides users with visualized data of various "things" such as work efficiency, etc. by customizing collected data to be optimized for individual users. For the optimized vertically integrated M2M service, the collected information or data is only used inside a specific service or within the system (**Fig. 2**). In order to enhance society with intelligence and innovation, it is required to construct a comprehensive service platform. More devices must be connected to each other and the information from these devices must be collected, not individually but all at once. To achieve this, we must shift our service platform from that of a conventional vertically integrated platform system (or individually optimized service) to a horizontally integrated platform system so that we may then provide better services to users.

As shown in **Fig. 3**, the horizontally integrated M2M service employs a "data sharing architecture." It shares data collected from various devices and utilizes them for various services. This is expected to play an important role in the markets of cloud computing services and Big Data businesses that will be greatly expanded in the future. Moreover, users can construct an M2M system with less investment cost than for those systems that are constructed individually. As explained above, innovative services that could not be achieved with the conventional M2M service platforms will become available via the horizontally integrated M2M service platform.



Fig. 3 Conceptual diagram of the horizontally integrated M2M service.

With the best use of the M2M platform, an M2M service mechanism that covers a cross-section of industries and businesses can be built as shown in **Fig. 4**. This will enable the materialization of lifestyles uninfluenced by the characteristic anomalies of differing industries. It will also enable control en bloc of the various kinds of data to be used for analyzing and investigating Big Data businesses, so that a wider and more dynamic information spectrum is acquired.

There are a great many varieties of sensor on the market. Instead of accumulating the required sensors to construct a desired system, employment of a horizontally integrated M2M platform enables availability of the information acquired from specific sensors for efficient use by various services. For example, when an acceleration sensor is installed in each building for disaster prevention, the data acquired from the sensor can be used also to support the building maintenance. Moreover, if a major earthquake occurs, the device can be used to provide information on safe areas and evacuation routes by determining the affected parts of destroyed buildings. When studying aspects of evacuation routes, even more efficient and precise evacuation routes may be defined by combining the information collected from all of the other buildings, roads, public transportation systems, etc. This is how to use big data to play a role as important as that of the horizontally integrated M2M platform in realizing the future smart society.

Section 3 describes big data.



Fig. 4 M2M platform utilization model.

3. Big Data

By linking M2M and Big Data, a new information based society, the "Ambient Information Society" will be materialized. Moreover, by creating desired lifestyles, the world will become an information based society that is linked to the "Ubiquitous Information Society."

The "Ambient Information Society" stands for an information based society in which computers and IT devices will be ubiquitous in our social infrastructures and people will be able to receive benefits from them without noticing their existence. The conventional "Ubiquitous Information Society" aims to offer humans a choice in accessing IT devices. However, the "Ambient Information Society" will evolve even further and will provide us with a society in which machines detect various conditions by using their sensors. They will be able to access the human condition in an autonomic manner. This is the significant feature of the "Ambient Information Society."

Ambient Information Society

- collects information by using devices such as sensors existing on the network, and observes the environment and conditions of users' everyday lives.

- accumulates, analyzes and judges the collected information.
- provides services that match analyzed needs.

Ubiquitous Information Society

- utilizes various devices existing on the network and materializes an information society that includes "whenever, wherever and whoever is connected to the network."

- enables control of devices remotely via networks.

As described above, an innovative information based society or "Ambient Information Society" will be materialized by adding the concepts and technologies of Big Data that accumulate, analyze and study the collected information. This is the major difference to the "Ubiquitous Information Society." **Fig. 5** shows a conceptual diagram of such an innovative information based society.

By combining the M2M and big data technologies and also by providing services via cloud computing, a PDCA (Plan-Do-Check-Act) cycle beyond the boundaries of different industries can be built, and at the same time a supply chain management across industries can become available. As an example, **Fig. 6** shows linkages between agriculture, the engineering industry and commerce via agricultural ICT.

As described above, a unique "Ambient Information Society"

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Fig. 6 Linkages between agriculture, commerce and engineering industries that employ agricultural ICT.

exclusively created to suit each industry can be built by combining M2M and big data. This will also result in the creation of an ICT society beyond the boundaries of different industries.

4. Conclusion

This paper has described the M2M and Big Data technologies



Fig. 7 Outline of CONNEXIVE.

that are system platforms for materializing a smart society.

NEC will deal with the unresolved issues that still exist in M2M while providing "CONNEXIVE" (**Fig. 7**) as our solution to materialize a horizontally integrated M2M platform to enable the connection of "things" at anytime and anywhere (Network of Things). Moreover, by combining with the Big Data technology that analyzes and assesses data from various sources we will be able to create even more innovative services to support future city scenarios, such as the Smart City and Smart Communities, etc.

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