FIWARE, Information Platform for Implementing Data Utilization Based City Management

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Abstract

The enforcement of the Basic Act on the Advancement of Public and Private Sector Data Utilization in 2016 in Japan is expected to promote the use of the data possessed by national and local governments as well as private businesses in solving urban issues. However, there is no mechanism in place to distribute the utilized data, and this is developing into a growing issue. To address this issue, NEC has begun participating in the development of the FIWARE architecture since 2011. FIWARE is a platform developed and implemented to promote data utilization and service linkage across the boundaries of local governments and enterprises providing public services in Europe. Involvement in the project has allowed NEC to verify the quality of the platform for use in city management and businesses, leading to the launch of a security-enhanced platform service utilizing FIWARE.

Keywords
smart city, data utilization, open data, information platform, FIWARE, NGSI, Basic Act on the Advancement of Public and Private Sector Data Utilization

1. Introduction

NEC is promoting the smart city project aimed at creating social values that enable the realization of a "safe", "secure", "efficient" and "equal" society. Since the utilization of various data across the boundaries of organizations and business fields is important for the implementation of the smart city, the active utilization of an information platform is critical for this purpose.

NEC built a data utilization platform compliant with FIWARE, which is an open platform developed in Europe, and is using this information platform to provide services to local governments and area developers (**Fig. 1**).

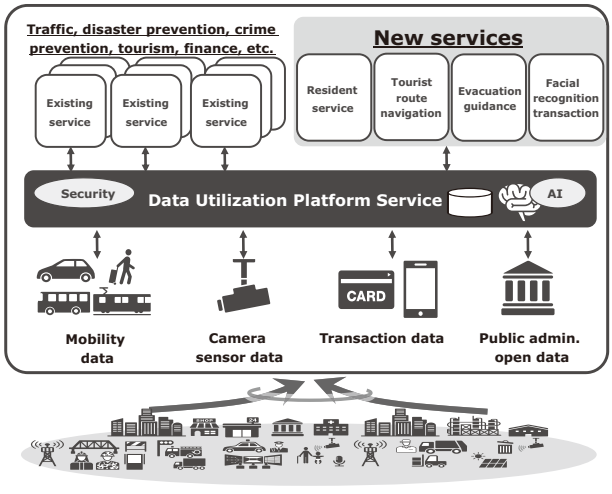

Fig. 1 FIWARE-compliant information platform.

2. Data Utilization Platform FIWARE

2.1 What is FIWARE

FIWARE is a typical example of efforts made under collaboration of the EU and private sectors aimed at developing a platform to enable data utilization in the social and public domains. It is an IoT platform development project for implementing a smart city in Europe in order to obtain various results out of those cities[1]. Many major business enterprises in Europe are participating in the project, and NEC has joined the development in 2011 as the first and only Japanese company to join the project.

FIWARE comprises a suite of software modules sup-

porting the development and dissemination of applications that support the next-generation Internet technologies. Platforms for different uses can be realized by combining existing open-source modules, and also by developing new modules (**Fig. 2**).

The modules are specified as Generic Enablers (GE) by FIWARE, and the implemented modules (GEri) are provided for reference. The GE interfaces are specified by the NGSI, which is standardized by OMA (Open Mobile Alliance), an organization of mobile carriers and vendors. Among the 14 standards of NGSI, NGSI-9 (interface for discovery of the data location) and NGSI-10 (for making a query of the data entity) have been adopted (**Fig. 3**).

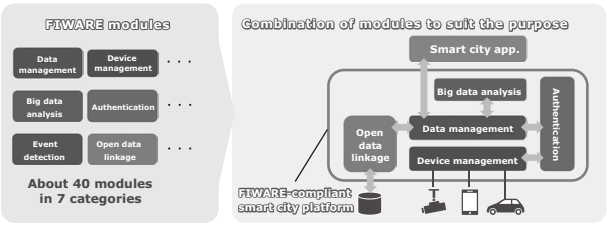

Fig. 2 FIWARE as platform software.

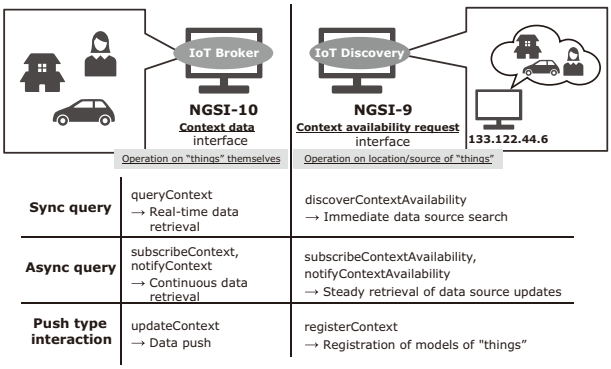

Fig. 3 NGSI-9, 10.

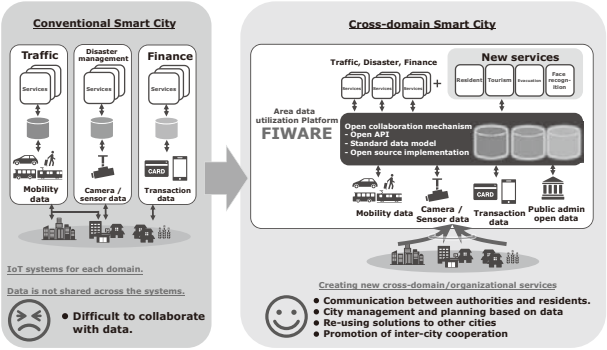

Fig. 4 Acceleration of cross-domain innovations by FIWARE

Conventional systems for smart cities have been built for individual domains and thus had only limited effects for improving the efficiency of city management. Meanwhile, as FIWARE is configured of open sources and defined to use open interfaces, it enables cross-domain and cross-organizational data utilizations in addition to traditional service building. It is therefore expected to create more new services and values[2) 3)] (**Fig. 4**).

2.2 Features of FIWARE

NEC regards the following four features as FIWARE's defining features.

(1) Standardization of data models

The data handled in FIWARE, including individual identifiers, attributes and additional information, is managed as context by using standardized data model.

As a result, any module included in FIWARE can utilize the accumulated data (**Fig. 5**).

(2) Advanced data query

FIWARE uses standardized data models and standardized interfaces called the NGSI (**Fig. 6**). Con-

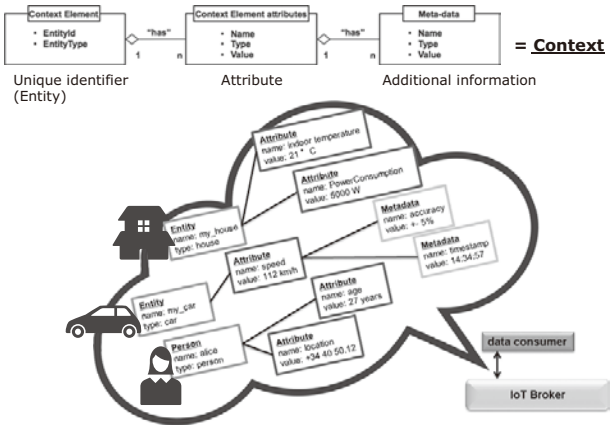

Fig. 5 Standardization of data models.

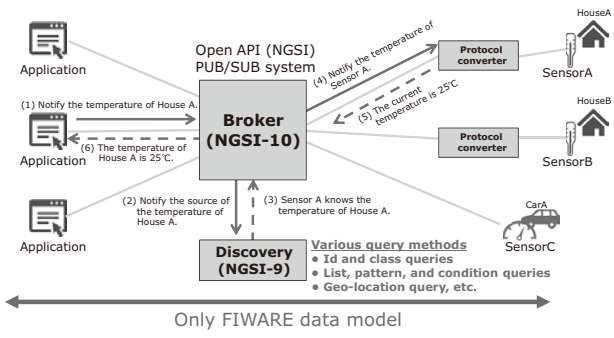

Fig. 6 Context Broker and IoT Discovery.

text Broker and IoT Discovery are GEs which typically characterize FIWARE. Context Broker has an interface compliant to NGSI-10 and retrieves data from sensors according to requests from the application. During this process, the GE that selects the sensor to retrieve data is IoT Discovery, which uses the NGSI-9 interface. In this way, FIWARE achieves advanced data query by combining the unified data models and NGSI.

(3) Distributed data management

Although FIWARE was developed as an IoT platform, the interfaces of applications and sensors are specified as NGSI. This allows FIWARE to connect to other platforms using the same interface, enabling the management of distributed data.

(4) Connectivity to existing systems

FIWARE unifies data models, but also provides the GE for converting the data formats so that it can handle data from previous systems. In the future, there is a plan in place to increase the number of compatible data formats.

2.3 Dissemination of FIWARE and FIWARE Foundation

More than 1,000 startups from over 100 cities already participate in the FIWARE community. Furthermore, the FIWARE Foundation, e.V. (hereinafter, referred to as FF), which is a nonprofit organization established under the private sector's leadership in 2016 to disseminate FIWARE, has 180 organizational members as of 2018, including NEC as one of the Platinum members[4].

The FIWARE Lab is one of the achievements of FIWARE that provides cloud environments for the FIWARE developers as well as related app developers. NEC and NEC Technologies India built a FIWARE Lab node environment in India to perform global co-creation activities based on FIWARE and started to provide the environment in April 2018[5].

The latest trends of FIWARE can be found on the FIWARE website[6] run by FF as well as in the FIWARE Global Summit[7] (hereinafter referred to as "FIWARE Summit") held in the spring and fall every year. The FIWARE Summit of May 2018 held in Portugal gathered more than 500 participants from 135 cities in 36 countries around the world, and over 50 lectures were presented. Besides NEC, which is an FF member, other participants from regional and local governments in Japan, such as from Takamatsu City, gave lectures, the number of which succeeded that of Europe and India. The topics of discussions covered the applications of FIWARE in agriculture, smart city and industry as well as the energy domain. For the industry domain, in particular, the concept of a platform called the Industrial Data Space was announced for implementing data distribution in various domains, including the manufacturing industry. At the FIWARE Summit, active discussions regarding this concept were also held on the implementation method, architecture and future orientation.

3. Utilizing FIWARE to Implement Society 5.0

3.1 Trend of public-private sector data utilization

The enactment of the Basic Act on the Advancement of Public and Private Sector Data Utilization in 2016 triggered anticipation for the utilization of data possessed by the national government, local government and private enterprises in solution of urban issues. This act was enacted to promote data utilization toward the implementation of Society 5.0[8]. Society 5.0 refers to a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space (super-smart society). With Society 5.0, the Japanese Government aims at linking systems in 11 domains composing such a system through service platforms (**Fig. 7**). This policy was deployed, for example, into the

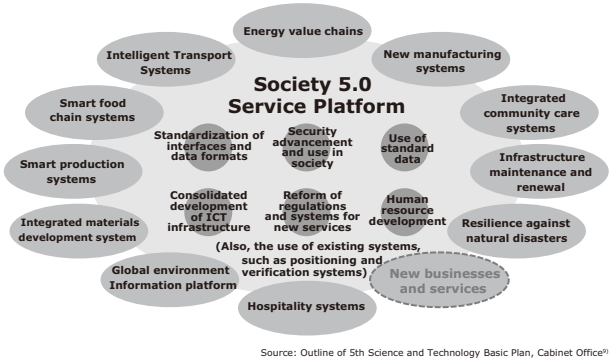

Fig. 7 Eleven domains composing the "super-smart society".

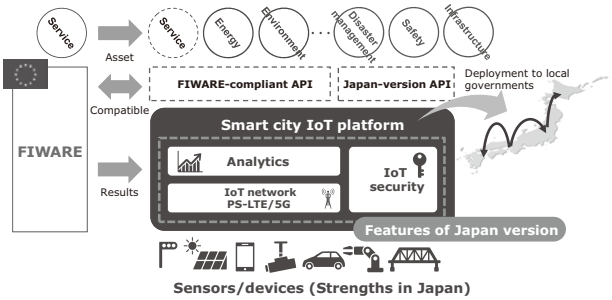

Fig. 8 Platform compliant to FIWARE.

Data Utilization Smart City Project in the FY 2017 budget of the Ministry of Internal Affairs and Communications, setting the year 2017 as the first year of public-private sector data utilization.

NEC recommended a FIWARE-compliant platform to the Liberal Democratic Party as an implementation of the service platform (**Fig. 8**), and it was also published in the LDP's ICT policy named "Digital Nippon 2016/2017"[10]. In addition, NEC also supported the introduction of FIWARE in the Takamatsu and Kakogawa municipalities that were selected as the targets of the data utilization smart city promotion project.

3.2 Data utilization platform service using FIWARE

To make FIWARE applicable in city management and businesses, NEC verified the quality on its own and provided it as a platform service by enhancing the security, etc[11].

3.3 Features and functions

NEC's data utilization platform service has the following two features.

- Creating new services through cross-sector, cross-domain and cross-regional accumulation and linkage of data.
- Provisioning strong security essential for data utilization and one-stop support.

Thanks to these features, integrating urban data into the service for collection and accumulation and sharing the data mutually will enable the creation of new cross-sector services. This in turn will enable to provide standard services comprised of a wide array of functions required for the realization of smart cities, such as a data publication site listing the collected data, and a geographical information system that visualizes a city. (**Table**).

3.4 Actual cases of applications

3.4.1 Takamatsu City, Kagawa Prefecture

Takamatsu is the first Japanese city to use FIWARE to build a common platform allowing open data utilization for the local government as well as residents and local enterprises. Furthermore, the local government is working together with NEC and STNet to build a trial environment on which various players in the industry, academia, government and private sectors can utilize data freely[12]. There is anticipation that this platform will be used by the enterprises and organizations that make up "Partnership for Smart City Takamatsu" established by Takamatsu City and others to conduct experiments of new services in a myriad of fields (**Fig. 9**).

Table Function list.

Name of function	Overview
Data publication site	A portal site that lists up the types of data collected and accumulated in the platform and publicizes the access methods to the data for data users
Geographical information system	A function that provides geographical information to applications
Real-time analysis	A function that analyzes the collected data in real time and outputs the results
Context information management	A function that controls things and information that exist in cities as data (context information) in an integrated manner and provides open API to data providers and data users
Historical data storage	A function that accumulates and refers to the history of context information
Binary data storage	A storage function that controls binary data from images and videos
API management	A management function for administrators to support the handling of Web API and secure proxy settings
Identity management	A management function for administrators to support the handling of user life-cycle functions

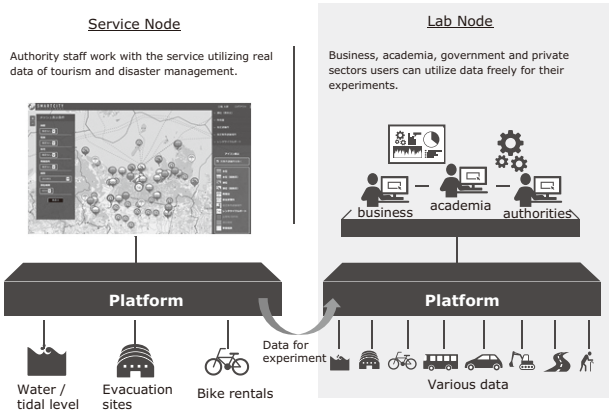

Fig. 9 Image of FIWARE platforms utilized in Takamatsu city.

3.4.2 Kakogawa City, Hyogo Prefecture

In FY 2017, Kakogawa City introduced a FIWARE-based platform that accumulates data from various sectors and publicizes them as open data in an aim to improve convenience and comfort for citizens; create a safe and secure city through public-private sector collaboration; activate the economy; create new businesses; and improve the transparency and reliability of the local government (**Fig. 10**).

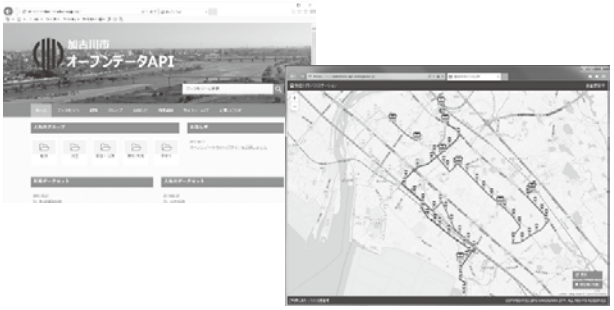

Fig. 10 Open data platform of Kakogawa City.

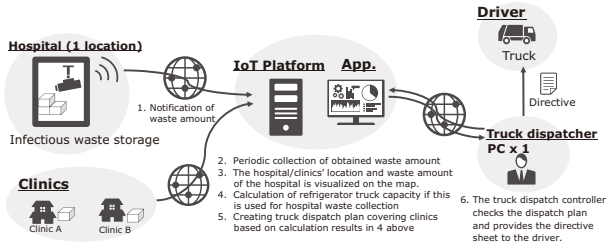

Fig. 11 Optimal route system in Kawasaki City.

3.4.3 Kawasaki City, Kanagawa Prefecture

Kawasaki City conducted an experiment aiming to achieve low carbonization with a view to support local and industrial environmental revitalization efforts. This project was subsidized by the "FY 2016/2017 CO_2 Emission Control Project Expense Fund (Low-Carbon Waste Management Project)" of the Ministry of the Environment. As part of this experiment, FIWARE-based system measures the amount of waste in the hospital, then provide the optimum route for the garbage truck drivers based on the gathered data from the hospital and registered data by the clinics (**Fig. 11**)[13].

4. Conclusion, Future Perspective

The enforcement of the Basic Act on the Advancement of Public and Private Sector Data Utilization is expected to increase the public-private sector collaborations for data utilization in Japan from the first year of data utilization in FY 2017. What is important for promoting the data utilization is the presence of an open platform that implements a data economy with participation from players from the business, academia, public and private sectors. To turn the platform into reality, it is not enough to standardize the open API and data format in the collaborative areas. It is also necessary to develop guidelines pertaining to the distribution of data through the platform that address the quality assurance of distributed data, the system for securely exchanging data between data owners and users, and the handling of anonymously processed data or personal data. There are also technical issues that need to be addressed.

In Europe, the General Data Protection Regulation (GDPR) was enforced on May 25, 2018, requiring businesses handling personal data to guarantee the right of individuals to control their own personal data. These trends are a challenging concern which we cannot ignore as issues arise in tandem with the greater use of data. It is important to consider the utilization of data from both the perspectives of globalization and the shift from the public sector to the private sector.

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