Data Distribution and Utilization Services Across Business Boundaries

● Yusuke Ejiri ● Eiji Ikeda ● Youji Nomura ● Satoshi Imai ● Akira Ito
● Toru Katagiri

The wide diffusion of IoT and devices such as smartphones today encourages the digitization and accumulation of various types of information about people and objects as data. A worldwide trend to create new value from this data by leveraging big data analysis and AI technology is gaining impetus. One of the initiatives in this trend is to enable businesses and institutions of different industries to mutually provide, share, and use their data. In order to realize this, it will be necessary to solve challenges in terms of security measures, privacy protection, and so on regarding data and to have a platform that facilitates safe and secure distribution of, and access to, this data. Hence, Fujitsu has developed Fujitsu VPX Technology for data distribution networks, applying blockchain technology to enable the distribution and use of this data. Fujitsu has also provided Fujitsu Intelligent Data Service Virtuora DX Data Distribution and Utilization Service based on this technology. This paper explains Fujitsu VPX Technology and Virtuora DX.

1. Introduction

Recently, as the IoT and smartphones and other devices become more widespread, various types of information about people and objects are increasingly digitized as data. In our society, an enormous amount of digital data are being stored, including those stored in corporate systems and generated from various network services such as e-commerce and social media.

There are growing expectations regarding digital transformation, in which these data are distributed to create new services and businesses by utilizing big data analysis and AI-driven analysis. One example is the mutual provision of data owned by various companies and institutions from different industries for their mutual utilization. This can lead to the creation of innovative services and products in large numbers, which raises expectations for the realization of an even more prosperous society.

For data distribution and utilization between different industries like this, a platform is required for the safe and secure distribution and utilization of data owned by companies and institutions, where this data remain in their own environments without entrusting them externally. It will also be necessary to solve challenges in terms of security measures and privacy protection.

Accordingly, in order to build an environment for data distribution between different industries, Fujitsu has developed Fujitsu Virtual Private Digital Exchange Technology (hereafter, VPX), which applies blockchain technology. In addition, as a product that makes use of VPX, we have started offering Fujitsu Intelligent Data Service Virtuora DX Data Distribution and Utilization Service (hereafter, Virtuora DX).

This paper presents issues with data distribution and utilization between different industries and describes the development of VPX and the features and a field trial of Virtuora DX.

2. Issues to be resolved to achieve data distribution and utilization

Many companies desire to create new businesses by making effective use of the large volumes of data that they own, but remain unable to find a way to share the data with other companies. Issues for the practical application of data distribution and utilization are described below.

1) Provision of systems for distributing data safely and securely

Before data utilization can be realized, a data distribution environment must be put in place where the data owned by companies are shared with other companies safely and securely.

2) Building of partnerships for co-creation between different industries

Individual companies are highly-motivated to introduce knowledge from other industries for the purpose of obtaining competitive advantages in the market and have a sense of urgency regarding the idea that co-creation with different industries is essential to survival. However, they face a dilemma of not knowing how to find a co-creation partner who fits their goal(s) or how to build a relationship of co-creation.

3) Building of an environment for generating ideas by utilizing data

It is difficult for a company to grasp the specific nature of the data they own and its value in a comprehensive manner. Even if many data are shared, analyzing them randomly is not sufficient to lead to the creation of good ideas. Therefore, the establishment of an efficient methodology to increase the success probability of data utilization is important.

3. Development of data distribution network technology

When data are distributed and utilized between different industries, the data are generally stored in clouds systems and other external environments. However, the entrustment of data to external environments poses many points that need to be considered such as costs of data storage, security measures in data management, and privacy protection.

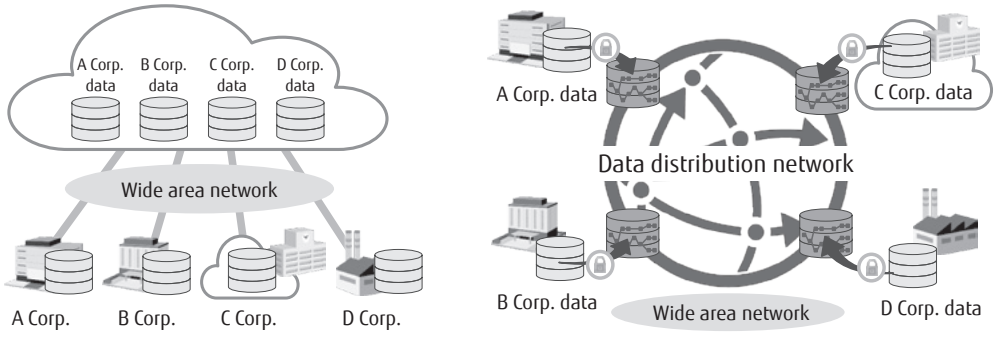
We have worked on the development of data distribution network technology for point-to-point transactions where required data is distributed to required parties when required, while the data are maintained in the owner environment (**Figure 1**). As a result, we have developed VPX, which applies blockchain technology to control distributed data distribution.[1)] This technology eliminates the need for companies to entrust their data to external environments in advance, which eliminates various anxieties relating to data distribution.

3.1 Application of blockchain technology

Blockchain technology is used for transactions of virtual currencies such as bitcoin. Blockchain technology realizes transaction and ledger sharing unlikely to cause fraud by having multiple computers participating in a network mutually verify the content of transactions and record only approved and authorized transactions. In this way, multiple computers participating in a network mutually verify and monitor the content of transactions, preventing alterations to transactions by specific attackers. In addition, this allows a decentralized system to be constructed that ensures high transparency and reliability without the need for centralized management tasks, as was conventionally the case.

As a system using the blockchains, there is a concept called smart contract, in which a contract described by a program is automatically executed. This provides a function for implementing a decentralized application (Dapp) in a blockchain. This function is raising expectations for applications in various fields in addition to virtual currency.

VPX realizes safe and secure data distribution in a



(a) Centralized platform (conventional)

(b) Decentralized platform (proposed)

Figure 1
Comparison of data distribution platforms.

decentralized environment by applying the ledger sharing and smart contract functions of the blockchain to the automation of procedures required for individual data distribution and communication control for each data.

Figure 2 outlines the processing by VPX. While the data storage location is maintained as is, the data provider registers the ID information, as metadata in the distributed ledger of a blockchain. The ID information is associated with the attribute of the data such as the type and the data storage location as metadata. At this time, the data provider states the scope of disclosure for each of their data in the metadata, which allows computers participating in the VPX network to share the scope of disclosure policy for each data. Furthermore, to ensure execution of data distribution with the scope of disclosure policy observed, multiple computers mutually monitor the transactions to make secure access control possible for each data.

Meanwhile, when a data user acquires and uses data, the user first applies for data utilization to the data owner. This application is executed by searching the metadata in the distributed ledger to acquire and specify the ID associated with the desired data. Subsequently, the data provider checks the user and intended usage based on the application information received and, only when data utilization is permitted, encrypts and sends the data to the user.

This ensures transparency and authenticity (non-alteration of data) of data distribution and allows data to be shared between companies quickly and easily.

3.2 Data jacket application and data value visualization

Data users use the data attribute distributed by VPX as the basis to decide whether or not the data is valuable for their company. Accordingly, for the data to be utilized more widely, effective communication of the value of data through the use of the attribute is key.

General data attribute includes changes in numerical values such as the date and time, latitude and longitude, and amount and the like, as well as data size and date of update, which are included in the database. However, deciding the utilization value of data with only mechanical information like this requires high expertise in data analysis. To realize a data utilization society with participation not only of some experts (such as data scientists) but also of all people, it is important to establish a method of assessing the potential value of data that does not require expertise.

Therefore, we have employed Data Jacket (hereafter, DJ),[2] a data utilization technology developed by Ohsawa Lab at the University of Tokyo, to use as the data attribute stated in the metadata stored in the distributed ledger of VPX.

DJ is a format for describing a data summary to facilitate an understanding of the utilization value of data by more people and encouraging their utilization. A DJ does not contain the content of the actual data

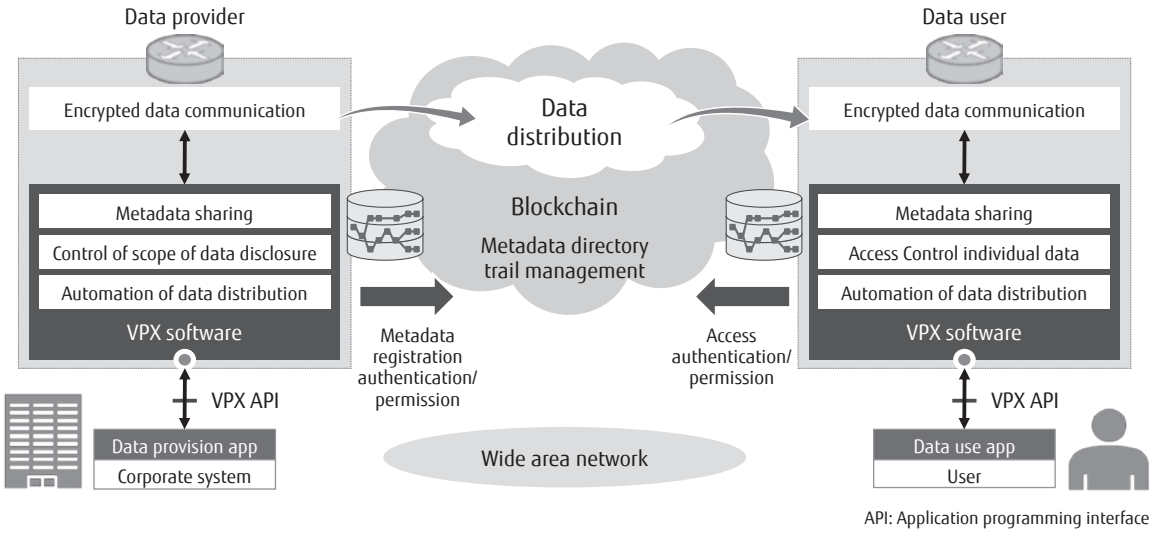


Figure 2
Overview of VPX.

itself but includes data attribute directly related to the database as described above, in addition to the data title, summary, data collection method and cost, and conditions of sharing. For example, the summary describes in natural language what the data is like, how it should be utilized, and how it has actually been utilized. Descriptions in DJs including the data provider's intention and expectations encourages the user to be imaginative about how the data can be utilized.

In addition, by text mining the described content of DJs, the frequency of occurrence of information elements such as words in many DJs and the strength of their mutual connections can be analyzed, making visible the correlation between DJs. This allows relevant information to be grasped intuitively, and useful information that could not be obtained by conventional simple keyword searches is made discoverable.

In this way, the application of DJs to attribute in a data distribution network provided by VPX allows the value of data to be safely and securely exchanged between companies linked with each other by VPX. This creates an environment where anybody can generate ideas.

3.3 Building of consortium

VPX uses a consortium-based blockchain technology, and it has the feature which allows access to a distributed ledger of the blockchain only to members given permission in advance. This feature can be taken advantage of creating a closed space where data are distributed by VPX. Members participating in this space have a mutually-shared purpose and constitute a co-creation community with connection between different industries. Various players gather in this consortium, where they safely and securely exchange DJs, actual data, and ideas for data utilization to realize open innovation.

To further improve the value of data utilization platform, it is necessary to increase the number of players participating in the consortium and the amount of data to be distributed. Therefore, we are working on enhancing the VPX technology to expand data distribution and utilization across multiple consortiums.

4. Virtuora DX to realize data distribution and utilization between different industries

We have developed Virtuora DX which makes it easy to find the desired data from DJs of each consortium created by VPX and to accelerate co-creation between different industries in the cloud.[3)]

Service users can use the portal screen of Virtuora DX to participate in existing consortiums grouped by specific themes for data utilization. This facilitates co-creation activities that utilize data between different industries.

Consortium members can easily share data in the same way as operating an ordinary website and consider data for utilization. The following functions are provided by Virtuora DX.

1) Listing of DJs

Allows DJs shared in a consortium to be grasped intuitively.

2) Visualization of data connection (**Figure 3**)

Encourages the discovery of combinations of data highly likely to have correlation and the generation of ideas for their utilization by connecting DJs with highly relevant keywords and making them visible.

3) Communication function

Allows real-time discussion on ideas for data utilization in a consortium

4) Transfer of actual data

Transfers actual data to data users according to the access permission (policy) which is set by data owners.

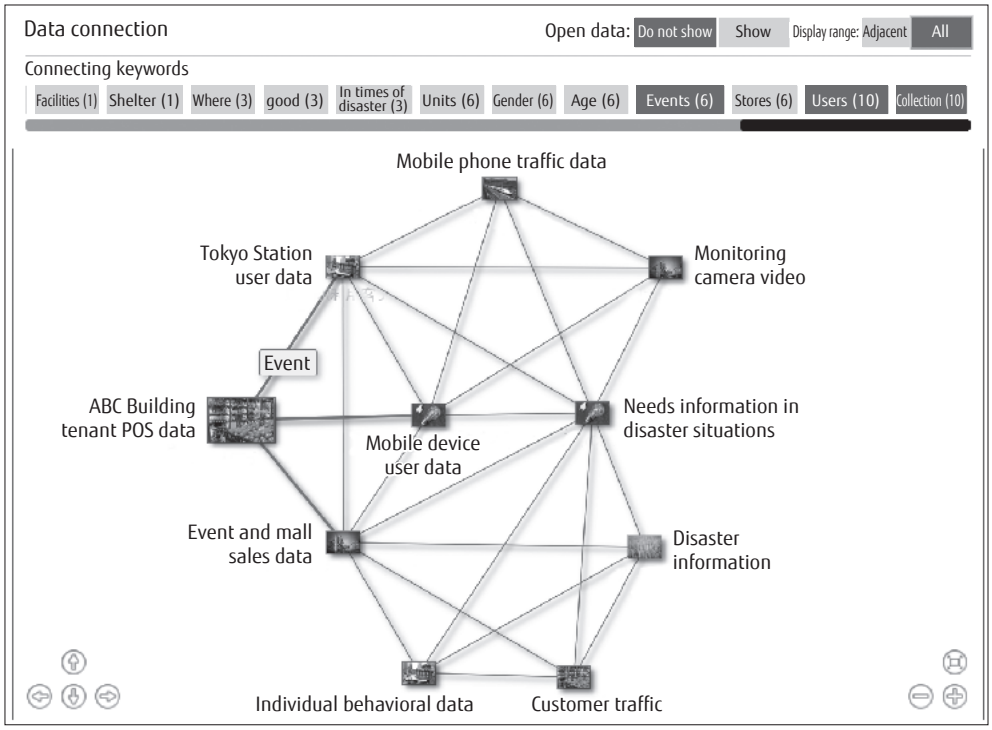
5) Display of blockchain trail

Allows for viewing the history of user actions recorded in a blockchain ledger.

5. Field trial

This section presents a field trial of the data utilization by different industries in community of the Marunouchi area of Tokyo, as an example of a cross-industry consortium making use of Virtuora DX.[4)]

The Marunouchi area, located between Tokyo Station and the Imperial Palace, is one of Japan's top tourist spots and an important point of traffic, connecting with airports and various parts of the country. It is also a business district where many companies have offices. In this multifarious area, we tried a field trial together with Mitsubishi Estate, SoftBank, and the University of Tokyo from May to December 2018 aiming at creating new services and businesses. In this trial, we aim to utilize data in such a way that new value is generated from combinations of data that appear to have no relations to each other. One example is the formulation of effective sales promotion measures by combining



POS: Point of sales

Figure 3
Visualization of data connection.

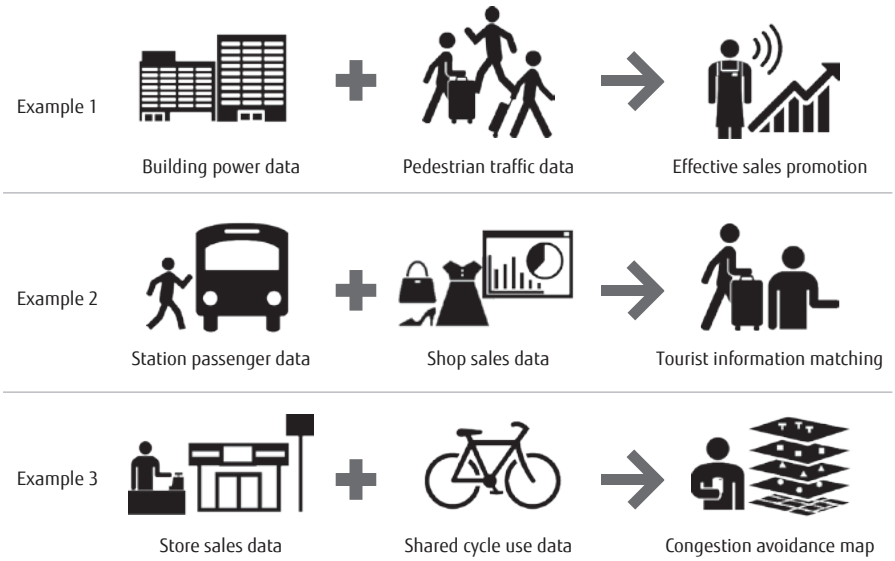


Figure 4
Visual representation of data utilization.

building power usage data and commercial facilities-related data owned by Mitsubishi Estate and pedestrian traffic flow-related data owned by SoftBank (**Figure 4**). Furthermore, we intend to study new community development by making use of cross-industry data such as applications to urban planning and transportation

systems, in addition to providing a service like this for workers in and visitors to the Marunouchi area.

In this field trial, we could lower the barriers for sharing owned data with other companies by forming a reliable organizational group in the form of consortium and sharing of summary information (DJs). We think that it has significantly contributed to this initiative of sharing and mutually utilizing data between different industries.

6. Conclusion

This paper described Fujitsu's VPX technology, which is a network technology to accelerate and collaborate data distribution and utilization between different industries. It also presented the FUJITSU Intelligent Data Service Virtuora DX Data Distribution and Utilization Service, which safely and securely distributes data between different industries to facilitate the realization of open innovation.

In the future, we intend to establish various consortiums that accelerate co-creation activities making use of Virtuora DX and gradually expand and deploy support services to promote data utilization. By taking this approach, we aim to build a society in which anybody can mutually utilize data safely and securely to create new value.

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Yusuke Ejiri
Fujitsu Ltd.
Mr. Ejiri is currently engaged in the sales promotion of data distribution and utilization services.

Eiji Ikeda
Fujitsu Ltd.
Mr. Ikeda is currently engaged in the sales promotion of data distribution and utilization services.

Youji Nomura
Fujitsu Ltd.
Mr. Nomura is currently engaged in the development of data distribution and utilization services.

Satoshi Imai
Fujitsu Laboratories Ltd.
Dr. Imai is currently engaged in the research and development of future network architectures.

Akira Ito
Fujitsu Laboratories Ltd.
Mr. Ito is currently engaged in the research and development of data distribution networks.

Toru Katagiri
Fujitsu Laboratories Ltd.
Mr. Katagiri is currently engaged in the research and development of virtual network systems.