

Grand Design for Next-Generation Data Centers

● Toru Kino

Along with changes in customers' businesses and social environments, there has been an evolution in the roles and capabilities that data centers should have. They play an increasingly important role because of the emergence of Cloud computing models and the expansion of IT for addressing major social challenges including the falling birthrate and aging population and environmental issues. The required capabilities are also becoming more sophisticated in all fields such as advanced IT, data analysis, operation technologies, risk and security management and environmental measures, in addition to facilities management as a consolidated center of technologies and know-how. In the future, utilization of these kinds of consolidated assets and their timely update and development according to changes in the social environment will become important activities. This paper discusses Fujitsu's latest activities accompanying the new roles and capabilities of data centers and the ideal type of data center to aim at in future.

1. Introduction

Along with changes in customers' businesses and social environments, there has been an evolution in the roles and capabilities expected of data centers. Their roles are gaining importance because of the emergence of Cloud computing models and the expansion of IT for addressing major social challenges including the falling birthrate and aging population and environmental issues. The capabilities they require are also becoming more sophisticated in all fields such as advanced IT, data analysis, operation technologies, risk and security management and environmental measures, in addition to facilities management as a consolidated center of technologies and know-how.

Fujitsu is continuing with its efforts for highly reliable data centers, which have been going on for over 14 years, and has used its leading-edge technologies in devices, products

and services in data centers to meet increasingly sophisticated needs.

This paper discusses Fujitsu's latest activities accompanying the new roles and capabilities of data centers and the ideal type of data center to aim at in future.

2. Development of data centers

This section describes the trends of IT challenges on which customers are working and the evolution of Fujitsu's data centers along with the trends.

2.1 Changes in customers' needs

As IT has become essential to business and a quick response to the changes in the business environment and continuity have increasingly become needed, the complexity and cost of operation and administration have increased. Along with such changes in customers' IT needs, the facility capabilities, IT and operation

technologies and human resources (skills and discipline, management ability, etc.) expected of data centers are becoming more and more sophisticated. Let us take a look at changes in the last five years as an example.

Fujitsu has conducted an annual questionnaire to analyze customers' needs and issues in relation to IT and issued a report (LS Research Committee IT White Paper),¹⁾ which contains a survey item called the issues facing IT systems department. The top five issues found as a result of the survey in fiscal years 2004 and 2009 are shown in **Figure 1**.

As of 2004, after the burst of the IT bubble, companies were beginning to make use of the Web on a practical level in line with the diffusion of broadband networks. For that reason, the issues that IT systems departments were facing were mainly focused on how to plan businesses taking advantage of the Web and what measures to take to ensure security and personal data protection in such businesses.²⁾

In response to this trend, data centers, which were originally intended mainly for hosting and physical security, concentrated their efforts on the development and operation of various ASP services and Web systems, network security monitoring and support for various security

standards and audits for Web-based business systems (B2C and B2B).

In 2009, the planning of information strategies directly linked to management strategy topped the list of challenges with needs for more effective and efficient IT investment. These needs arose because of the emergence of Cloud services and a sense of uncertainty about the future, caused by the economic downturn triggered by the collapse of Lehman Brothers. Furthermore, the focus rose from the level of individual approaches such as security and personal data protection to corporate business continuity due to the fact that IT is indispensable for the business continuity of companies.

For this reason, Fujitsu's data centers are striving to cut costs by standardization and automation. At the same time, they are working on wider activities such as global data center deployment to assist companies with their global strategy, help raise environmental awareness to address corporate social responsibility (CSR) issues and various regulations, disaster recovery (DR) between distributed data centers, and promptly responding to peak demand to ensure business continuity.

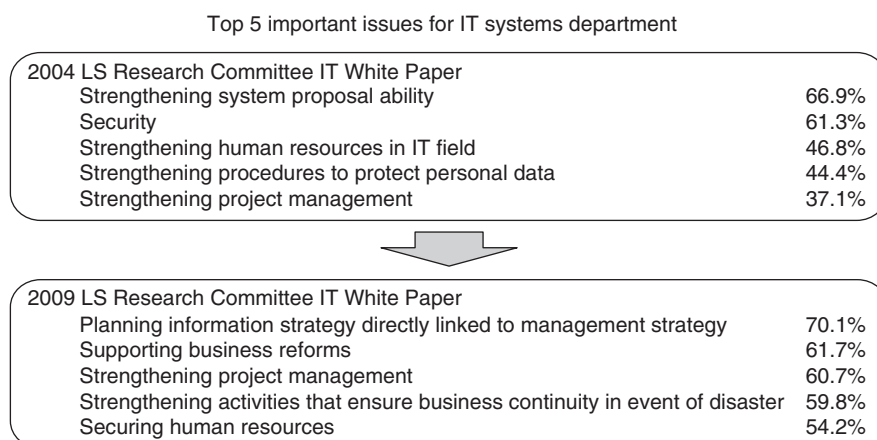


Figure 1
Changing customer needs.

2.2 Evolution of data centers

Along with the changes in customers' needs (or changes in business environment) mentioned in the previous subsection, the expectations for data centers have changed as well. Here is a quick recap of the history of Fujitsu's data centers.

1) System data centers (since the late 1990s)

The first data center was intended for backup applications mainly with mainframes and located in a sturdy place geographically distant from a metropolitan area. It had excellent physical security thanks to its characteristics such as earthquake resistance and circle lock doors, and was used as a center for storing media containing mission-critical data and for relocating mission-critical systems in outsourcing.

2) Internet data centers (since the early 2000s)

As the Internet grew more popular and the degree of openness of IT technologies increased, the inside of data centers underwent significant changes. Standard IDC racks were introduced for storing open servers, and air conditioning was optimized for this rack configuration. Operating such centers became more complex to include multi-vendor support, network peak monitoring and security monitoring. In addition, a shared infrastructure for Internet connection (such as backbone connection, FW and DNS) was put in place in data centers.

3) On-demand data centers (since the late 2000s)

The diffusion of broadband networks caused an explosive increase in the volume of data exchanged over networks. To process an enormous amount of data, the levels of function and integration of IT devices were enhanced, and this began to reveal problems such as a lack of electrical power and floor load of data centers. The ratio of multi-vendor systems increased even more and ITIL was introduced to standardize operation and management. In addition, analysis of past problems progressed

and efforts were started to prevent problems by checking for risks in advance. At the same time, there were increased needs for efficient use of high-performance IT resources according to the changes in business and on-demand hosting services were launched, which can be seen as a pioneer of the present-day Cloud computing.³⁾

In this way, we have responded to changes in the customers' environment by:

- Striving to increase increasing reliability and standardization by implementing the latest technologies,
- Ensuring continuous business operation (with no data center accidents in 14 years), and
- Building relationships of trust to establish long-term partnerships.

These efforts have received recognition, and we have captured the top market share in Japan for five years running.

2.3 Global deployment

In addition to the 59 locations within Japan, Fujitsu has deployed data centers on a global scale to meet the needs of customers outside Japan. We have maintained and expanded more than 90 data centers in regions including North America, Europe and Asia. We use a common indicator (Tier standards) to evaluate the capabilities of global data centers in terms of providing services, and identified data centers best suited to the requirements of global companies.

3. Trends of Cloud computing

Thanks to the diffusion of high-speed networks, Web-related and virtualization technologies have also advanced. As a result, a computing model allowing use of IT capacity and applications at data centers as required, anytime and anywhere, or so-called Cloud computing, has entered the practical application stage, and this has been raising social expectations.⁴⁾

3.1 Data centers intended for Cloud services

A Cloud computing model of providing uniform services globally has come from mega data centers that store hundreds of thousands of servers exclusively for data centers, which are available from U.S. vendors. And the model has become popular, starting mainly with services for consumers and Internet companies, and established itself. At these data centers specialized in the volume operation of uniform services, technological innovations in the thorough pursuit of automation and energy saving have been implemented.

Meanwhile, data centers that started by hosting mission-critical systems are characterized by finely-tuned service management for individual companies and have accumulated know-how developed through day-to-day improvement activities for standardization and labor saving in diverse operational environments.

In reality, the business systems of customers who use data centers are made of a wide variety of subsystems linked together. Some subsystems can enjoy a significant benefit (in areas such as speed and cost) from the use of standardized Cloud environments and others have individual configuration and operational requirements. Overall, Cloud computing alone is not enough to handle all customer operations.

For this reason, a mixed and linked environment together with a Cloud and dedicated systems (hybrid environment) is required, where the capability of optimized integration and service management across a hybrid environment becomes indispensable to data centers.

Fujitsu intends to work on the technological innovations of mega data centers to provide Cloud services and also integrate the finely-tuned service management capability into Cloud to fully meet customers' requirements to provide next-generation data centers of the Cloud age that are practical in a true sense.⁵⁾

3.2 Data centers for social infrastructure

Meanwhile, fields of IT application are expanding outside of companies as well.

Activities for making use of IT as solutions to many different challenges in present-day society as shown below have started.

- 1) Deterioration in the quality of business, social security and life and inefficient handing down of skills due to fewer births and an aging population
- 2) Global depression and the necessity to create new businesses and increase employment opportunities
- 3) Population growth, environmental deterioration, food shortages and widening disparity in developing countries

As a way to apply IT to the field of agriculture for example, visualization of agricultural work and knowledge, preventive and predictive analysis, production site information and traceability in logistics are expected to help organizations achieve their main goals including increased production efficiency and in turn improved food self-sufficiency.

In addition to this, Fujitsu is working on social contribution activities in new fields of application such as healthcare, the environment and regional development.

In applying data centers as IT to social infrastructure in this way, we need to change their role from the conventional equipment-intensive data centers to knowledge-intensive data centers. The role of data centers will be increasingly important as a main way to contribute to society. This will be achieved through analyzing the massive amounts of data and knowledge stored inside them to produce new findings such as how to prevent and predict problems.

4. Launch of state-of-the-art data center

To quickly respond to the significant changes in society described in the previous section, Fujitsu opened the new annex of the Tatebayashi

System Center, a state-of-the-art flagship data center (hereafter “Tatebayashi annex”), located in Gunma Prefecture in Japan, in November 2009.

The Tatebayashi annex consolidates Fujitsu’s all-round technologies, know-how and experience, as shown in **Figure 2**.

1) Operation technologies

- Integrated remote operation

We present activities that have incorporated cutting-edge technologies for the one-stop monitoring and operation of customers’ business systems, which are increasingly hybrid and decentralized in a Cloud environment, from an integrated remote control center.

- ITIL for data centers

In addition to the ITIL management for individual corporate internal systems, operation at a data-center-level requires multi-layered and strict access control and consideration of high scalability. We present the latest activities for configuration management and incident management, which are especially important for

managing customers’ business systems that have become hybrid and decentralized.

2) Green

We present the optimization of energy by visualization, having an air-conditioning system and having environment-conscious facilities, on which we are working at the Tatebayashi annex as a green, environmentally friendly data center.

3) Security

We have built different security architectures ranging from physical security to network security, implemented and audited them and operated highly reliable data centers up to now. What will gain importance in the future is how a reliable computing platform can be constructed and operated in a Cloud environment. We show an overview of Fujitsu’s Cloud security architecture to achieve this purpose.

4) Network

The Tatebayashi annex is aggressively introducing optical technologies. We present an optical network platform that makes use of

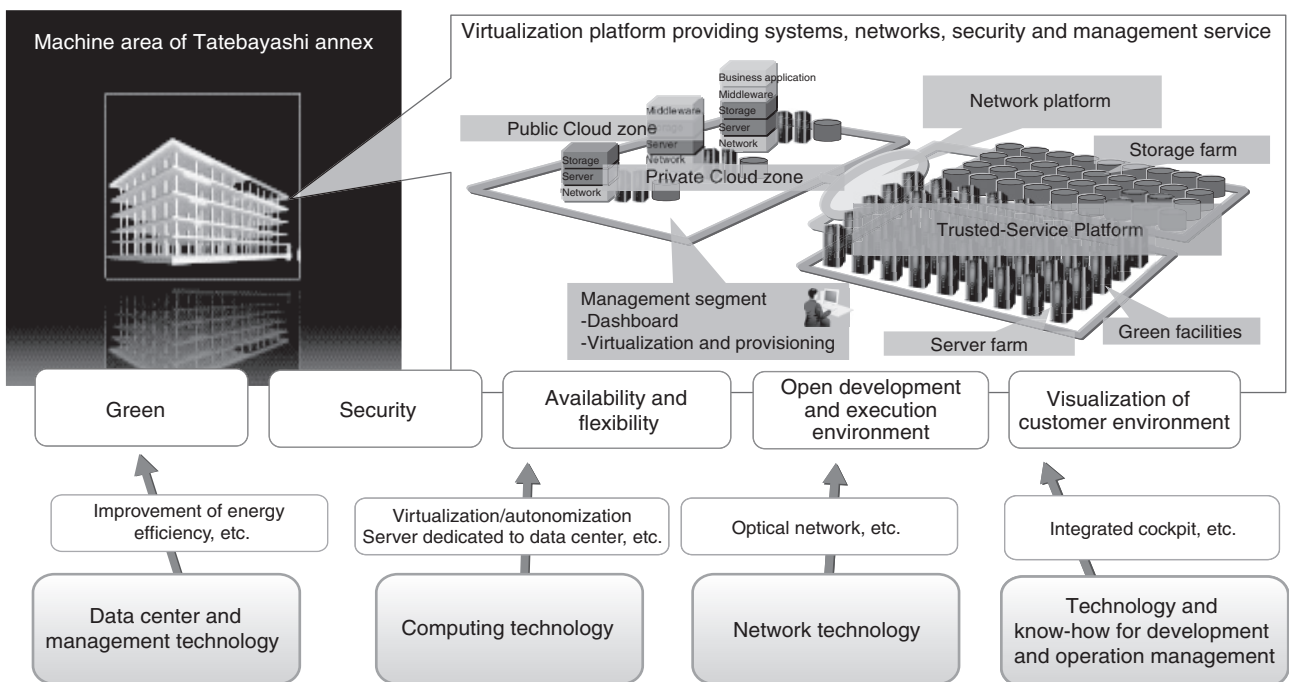


Figure 2
Consolidating technologies into data center.

the wide-area Ethernet technology to provide customers with an even higher-speed network environment and give examples of adopting an environment monitoring optical sensor network that uses ad-hoc communication technologies.

5) Next-generation platform (Cloud platform)

We present the activities for putting in place a platform optimized for large data centers by integrating Cloud services characterized by convenience, which has been dramatically improved, for superior speed and flexibility with the virtualization and operation technologies to support the services.

6) New fields of application

The convenience of a Cloud has made possible the practical implementation of IT even in fields in which IT was not fully utilized in the past. We showcase new examples in which data centers are used as social infrastructure by focusing on the field of agriculture.

5. From intensive to recycling-based data centers

Data centers have now been consolidating all efforts, technology and know-how in relation to the use of IT such as facilities, IT resources, applications, data, operation management, risk and security management, advanced technologies and environmental measures.

In the future, utilizing these kinds of consolidated assets and ensuring their timely update and development according to changes in the social environment will become important activities. Assets, no matter how valuable, would be no more than relics if simply held without undergoing continuous evolution and utilization, and it will be necessary to build a framework to ensure that they are constantly recycled. The following subsections describe the recycling of assets expected of recycling-based data centers and their roles.

1) Resource recycling

New environments such as Cloud computing have just started to appear, and large-scale IT

resource pools are being built and reinforced for them. In the future, when the constituent components of the resources need to be updated, how to update them in a sustainable way and on a large scale without affecting the systems in operation will determine the true capability of a Cloud vendor. In the next-generation platform, Fujitsu has incorporated from the beginning a “resource metabolizing” architecture for such large-scale update of resources in the future without affecting the users.

2) Technology recycling

Data centers have been taking on the role of a collection center of technologies, which is changing the direction of technological development. Traditionally, technologies and products for the general market were introduced into data centers. From now on, data centers will be a place for creating and practically implementing technologies and the technologies enhanced at the data centers will be fed back to products for the general market. In other words, a rotating cycle where there is integration, creation, implementation, diffusion and further integration of technologies will exist in data centers.

3) Knowledge recycling

To further utilize the data accumulated at data centers to make the best use of them for society, open innovation activities, which include safe publication of data, open collection of analysis and utilization ideas and sharing of the acquired knowledge widely in society are important. Data centers will be used as a place in a society where knowledge is passed on and used, in which participants from various fields can be providers and users of knowledge. Data centers have so far needed to ensure the safety and privacy of companies, and they will also be expected to serve as a safe and open place for use in the future.

6. Conclusion

Along with changes in customers’ businesses

and social environments, there has been an evolution in the roles and capabilities that data centers should have. They play an increasingly important role and the capabilities they require are also becoming more sophisticated in all fields.

Fujitsu is committed to continuing to pursue high reliability and standardization by implementing new technologies and contributing to society while putting the priority on building trusting relationships with customers by continuous business operation.



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Mr. Kino is engaged in planning, development, and delivery of Cloud services.

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