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As of 2014, the size of the Japanese cloud services market is predicted to reach 180 billion yen, even if limited to public clouds. If the extent to which cloud services are used is not taken into consideration, nearly 60 percent of Japanese companies have adopted cloud services. Even if usage is limited to "mission-critical or daily operations," more than 30 percent of Japanese companies are using cloud services. Whether companies should use cloud services is no longer a matter of deliberation. Companies are approaching the stage where they should examine the "extent to which they can use cloud services" and the "areas in which cloud services should not be used."

With the increased use of cloud services, the focus of IT spending by users has been shifting from equipment to services. In North America, as of 2010, server shipments to data centers already exceeded those to end-user companies. The idea of end-user companies individually introducing servers has now become marginal. Accelerating trends have been seen in making servers "white boxes" without a manufacturer's brand name as well as in "designating optimal specifications (applying market prices to MPU and memory and designating performance)." As such, rather than being office equipment, servers have now become similar to manufacturing equipment aimed at factories, dramatically changing the production and distribution of servers. Major communications providers are planning to place large volume orders directly with electronic manufacturing services (EMS) by bypassing server manufacturers. Because of this trend, the presence of equipment manufacturers has been rapidly shrinking.

While it has become common for companies to adopt and utilize cloud services, they are also looking for ways to adopt cloud computing or related technologies in the areas of systems. Even though companies are aware of the security and reliability problems presented by public clouds, they have been stepping up moves to transform system infrastructure to cloud-based environments. Specifically, companies are creating cloud portfolios depending on the required quality and price level such as those consisting of a cloud farm for each data center or highly reliable private cloud infrastructure.

I Current Status of and Future Trends in the Adoption of Cloud Services

1 Current status of the cloud services market

More than seven years have passed since the concept of cloud computing services was introduced around 2007 and commercial cloud computing services started to take off. Even if limited to "public clouds" (cloud services that are made available to the general public), the size of Japan's domestic cloud services market is predicted to reach 180 billion yen by 2014 (left bar graph in Figure 1). Some research reports estimate that the global public cloud services market has exceeded 2 trillion yen and is now approaching close to 3 trillion yen.

It is difficult to estimate the market size of "private clouds" (cloud services that are offered to specific organizations such as within a company, specific departments or a group of companies). Nevertheless, some research reports predict that the size is more than three times that of the public cloud services market. As such, cloud services occupy a significant portion of the information technology (IT) solution market.

While the percentage varies depending on the definition of cloud computing services, if the extent to which cloud services are used is not taken into consideration, nearly 60 percent of Japanese companies (those having 4 or more employees) have adopted cloud services as of 2014 (right bar graph in Figure 1). Even if usage is limited to mission-critical systems or systems for daily operations such as email, data sharing and schedule management, more than 30 percent of Japanese companies are assumed to be using cloud services.

Because of the need to ensure extremely high reliability, major financial institutions still take conservative approaches to adopting cloud services for their online systems. However, for companies in other business areas, whether they should use cloud services is no longer a matter of consideration. They are approaching the stage where they should examine the extent to which they can use cloud services, the areas in which cloud services can never be used and the reasons for not being able to use such services.

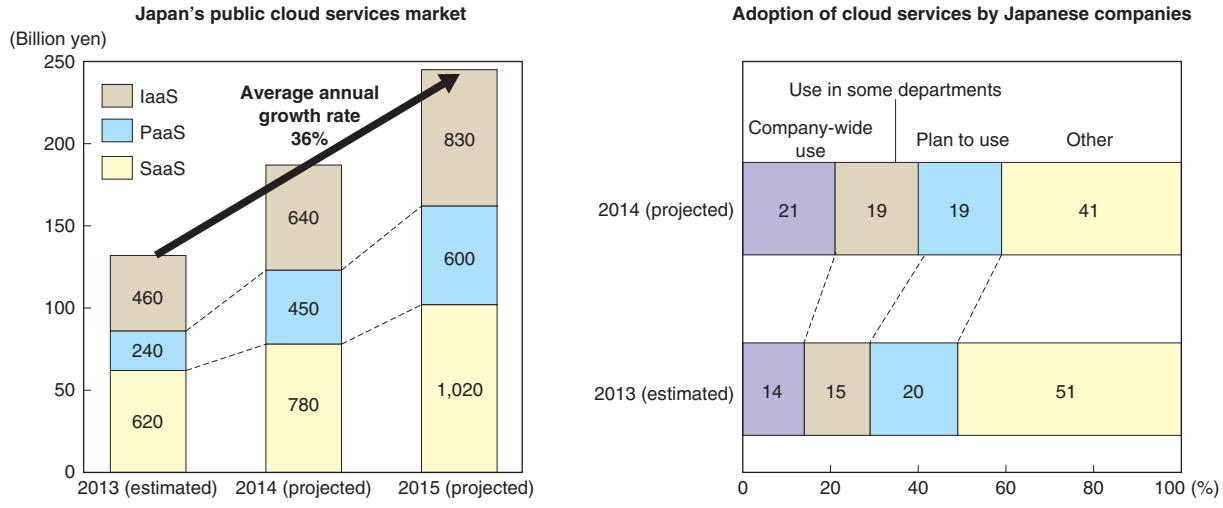
2 The use of cloud services by industry

Considering the origins of cloud computing, since its introduction, a high rate of use by Internet-related service providers was naturally expected. Even currently, use by Internet and IT venture companies and online game providers still constitutes the majority, accounting for a little less than 70 percent of the revenue of major cloud service providers.

Generally, these user companies do not have existing systems from which they shift to the cloud, and must develop new systems. Therefore, in order to reduce initial investment and expand resources quickly as their businesses grow, they have a high affinity for cloud services. As their business scale expands, they are highly likely to continue to use and even expand their use of cloud services even though the issue of the quality of system operations remains as one of the challenges posed by the use of cloud services.

Following these companies as users of cloud services are solution providers that offer systems and services to end users. The use of cloud services by solution providers has also been growing. If IT venture companies

Figure 1. Current status and projections of cloud services market



Notes: IaaS = Infrastructure as a Service, SaaS = Software as a Service, PaaS = Platform as a Service.
Sources: Left bar graph: Nomura Research Institute. Right bar graph: Japan's Ministry of Internal Affairs and Communications (2013), Nomura Research Institute (2014).

(since 2012, their use of cloud services has been expanding) are included, they together are estimated to account for about 60 percent of the revenue of major cloud service providers. Similar to other companies that are wary of the use of cloud services, solution providers appear to be somewhat cautious about migrating their existing systems to cloud-based systems in consideration of the balance between reliability and cost. Nevertheless, especially for new customers and new projects, they have increasingly been proposing the adoption of commercial cloud services. In the future, the number of such proposals is expected to further increase.

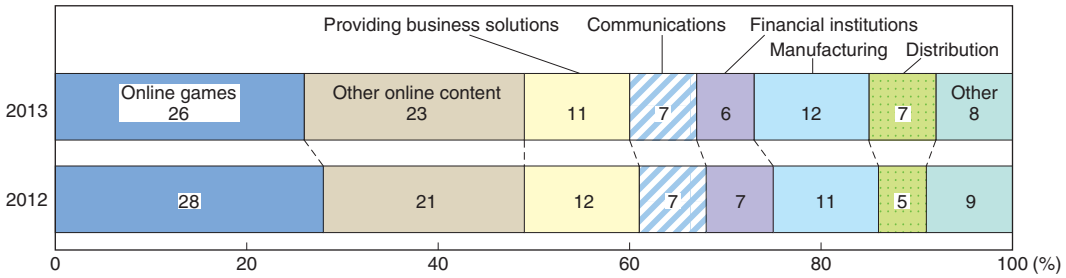
The number of areas in which end users adopt cloud services has also been increasing. Except for financial institutions where stringent internal controls are imposed, the number of companies that consider the use of cloud computing as the first option for services related to mobile phones, data sharing, email and web environments is growing. The manufacturing and distribution industries have also been increasingly adopting cloud services (Figure 2).

Viewed from the perspective of applications, cloud services have generally been used to develop new systems, rather than in the migration of existing systems to cloud computing. Ahead of other infrastructures, cloud services were first adopted for communications infrastructure such as data sharing, email, calendar/schedule, in-house blogs and intranets (Figure 3).

Unlike major companies that were operating and managing information system assets prior to the introduction of the cloud, cloud-based services and applications are commonly adopted by Internet and IT venture companies for standard back office applications such as finance/accounting, personnel affairs management and sales management.

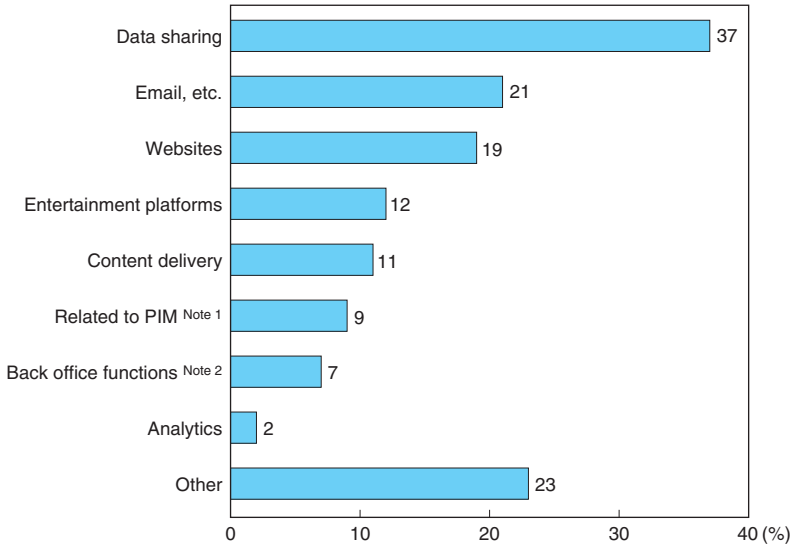
Nevertheless, the number of major companies that use cloud-based software-as-a-service (SaaS) providers in specific departments or for specific projects (such as new business/service development projects) with respect to applications related to customer relationship management (CRM) and human resource management has been increasing. As such, major companies are also

Figure 2. Use of cloud services by industry (in terms of monetary amount)



Source: Estimated based on interviews with major cloud service providers.

Figure 3. Applications for which cloud computing is used (2013, multiple choice)



Notes: 1) PIM = Personal Information Management (calendar, schedule, contact management, etc.). 2) Back office functions include finance, accounting, personnel management and sales management.

moving in the same direction as are Internet and IT venture companies.

In addition, it is noteworthy that the use of cloud services for e-commerce website platforms and applications has been growing significantly. Regarding e-commerce website platforms in particular, while it is natural to assume the increased use of cloud services by Internet and IT venture companies, major distributors and manufacturers have also been considering and adopting cloud services in their efforts to strengthen their approaches to omni-channel marketing and to review their sales channels. During the process toward these goals, they are making an active effort to develop direct online sales channels and to build direct marketing and sales promotion systems. Because cloud services provide benefits such as small initial start-up investment, quick response to rapid market expansion and being able to promptly cut back or close down a system in the event of business/service failure, they have been considering and adopting cloud-enabled applications.

Since 2013, the use of cloud services in the areas of research and development (R&D) and analytics has gradually increased. In particular, for the development of systems related to big data, in the preliminary stage of building a large full-scale system, trial operations to confirm the effectiveness of big data are often implemented in cloud-based environments. In these cases, specific objectives of the use of cloud services include securing a temporary data storage infrastructure and data preprocessing before the start of analysis.

While the extent to which cloud-based environments are used is not as large as that to which such environments are used by rapidly growing e-commerce website platforms, the demand for cloud-based systems has been growing, especially among manufacturers, distributors and Internet-related service providers.

Rather than migrating existing system assets to cloud-based infrastructure, currently, cloud services are often used for "small start" and "new start" projects so that new online systems and services can be developed and started in a short time and at low cost. Consequently, when companies start to use cloud services, they tend to use multiple cloud service providers in parallel (Figure 4).

In addition to their own private cloud infrastructure, companies are using multiple external cloud services that are divided into small sections such as a cloud point of sales (POS) system, CRM and office applications. The case of "using one external cloud service provider in addition to a company's own private cloud" is exceptional. Most companies are using at least two or three providers.

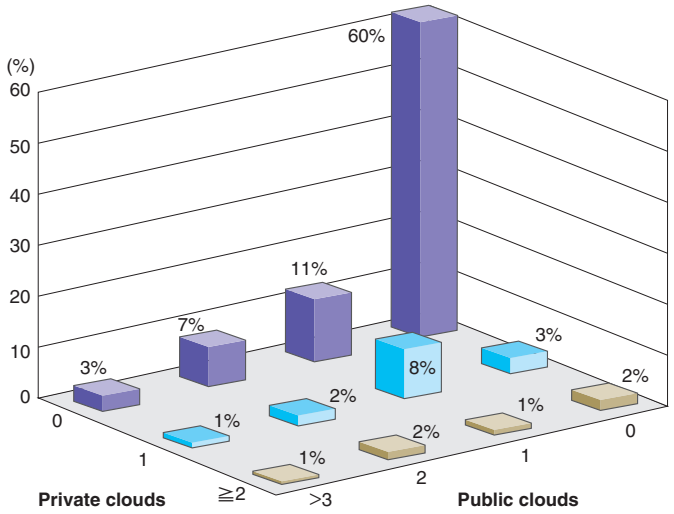
II The Shift to Cloud Services and Its Impact on Current IT Spending and Business Models

1 Increased use of cloud-based resources changes server business models

The spread of cloud services is having a considerable impact on existing solution providers and server business models.

Before the adoption of cloud computing, it was common for most companies to install servers and storage devices separately for each department or each system. These companies made efforts to increase the rate of resource utilization by proactively introducing virtualization technology or by integrating servers for each department or system. Nevertheless, because of factors such as differences between servers' busy and

Figure 4. Increase in the percentage of companies using multiple cloud service providers



Note: Figures indicate the number of cloud service providers used in addition to a company's own private cloud.

idle periods and differences in system life cycles, a company's average utilization of resources such as servers was estimated to be less than 30 percent in terms of any general indicators such as microprocessor units (MPU) and storage.

After many of these servers and storage devices have been integrated into cloud-based infrastructure, resource utilization has increased over the period prior to the introduction of cloud services. Consequently, the rate of resource utilization of major cloud service providers is expected to have grown rapidly to about 60 to 70 percent. On the other hand, the number of required servers and storage devices is projected to have decreased (Figure 5).

Strictly speaking, the number of server units in use would not drop sharply in a short period of time because of the emergence of new, unprecedented Internet services as well as due to overlapped investments/operations of IT assets at the stage of migrating existing systems to cloud-based environments. However, in the future when such migration gains momentum, except for servers that are required for new services and applications, the number of server units theoretically required for business operations can be reduced by as much as half, and in terms of actual status, by about 30 to 40 percent.

As part of the preliminary trends before the migration to cloud services leads to the increase in the rate of server utilization and the decrease in the total number of servers in use, server business models have already been changing significantly. Specifically, the conventional flow of "server manufacturers → distributors (including system integrators) → end users" is changing to a new flow of "server manufacturers → cloud service providers." As such, on the part of the server manufacturers, factors related to product development and sales such as shipping unit, product specifications and marketing, which have been tailored for end users, are now being targeted at vendors such as cloud service providers.

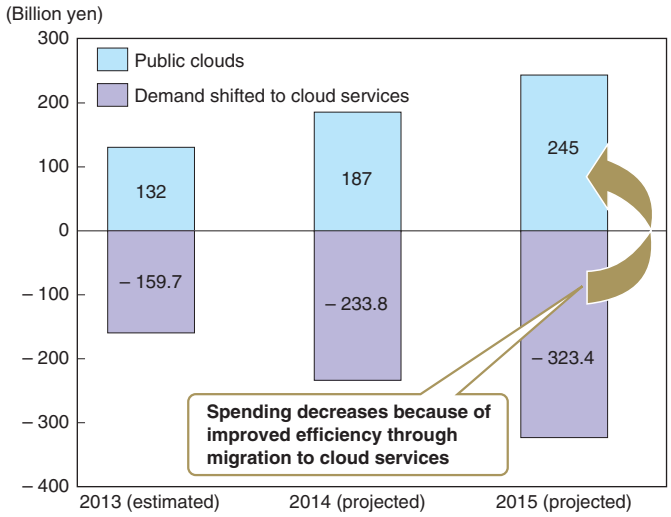
In North America, which already has a large cloud services market, nearly 70 percent of server shipments are targeted at cloud service providers. Server shipments per order have grown to be considerably larger than those for orders issued from end users to distributors.

Not surprisingly, delivery procedures have also changed. Unlike deliveries to end users, servers are delivered to and installed at data centers four or five times a month. If the unit prices of major components such as memory, MPU and storage change between deliveries, the selling prices of these components also change as market prices. Because, to begin with, product specifications have become subject to vendor requirements, no fixed product model names are used. The production of servers is now managed based on "common specifications" and "additional specifications" that are specified at the time of issuing orders. As such, rather than being products aimed at end users, servers have now become similar to producer goods such as manufacturing equipment aimed at factories.

These trends are already common in the area of a personal computer, which is known as a "white box" without a well-known brand name. Similar moves are also seen in the server manufacturing industry. Because plain-colored material is used for packaging, servers have become white boxes both in name and in reality.

Some of North America's leading communications providers have been pushing these moves forward even further. They plan to place large volume orders for servers that are developed based on their own specifications directly with electronic manufacturing service (EMS) vendors. With these so-called "bypassing server manufacturers" moves, the server market has now become an arena of strong power plays for major communications providers with robust customer bases and considerable capital as well as for over-the-top (OTT) content providers, who provide content and services via the Internet and bypass traditional distribution channels.

Figure 5. Decrease in demand for server equipment due to migration to cloud services



2 Expanding virtualization from server and storage to network to enable trinity virtualization

Thus far, the use of cloud services has grown with a focus on server and storage virtualization. However, recently, moves to use software-defined networking (SDN) technology to enable network virtualization have been making rapid progress. In addition to employing virtualization technology to control and manage large-scale complex networks, attempts are also being made to enable the integrated management of all resources (server, storage and network) by virtualization (Figure 6).

These attempts are being made with an eye to completing all necessary steps within the framework of managing virtualized resources. Such steps include building networks that connect multiple data centers and business offices, creating paths that connect related clouds and allocating resources.

3 Barriers facing cloud service providers in entering the market and the pursuit of economies of scale

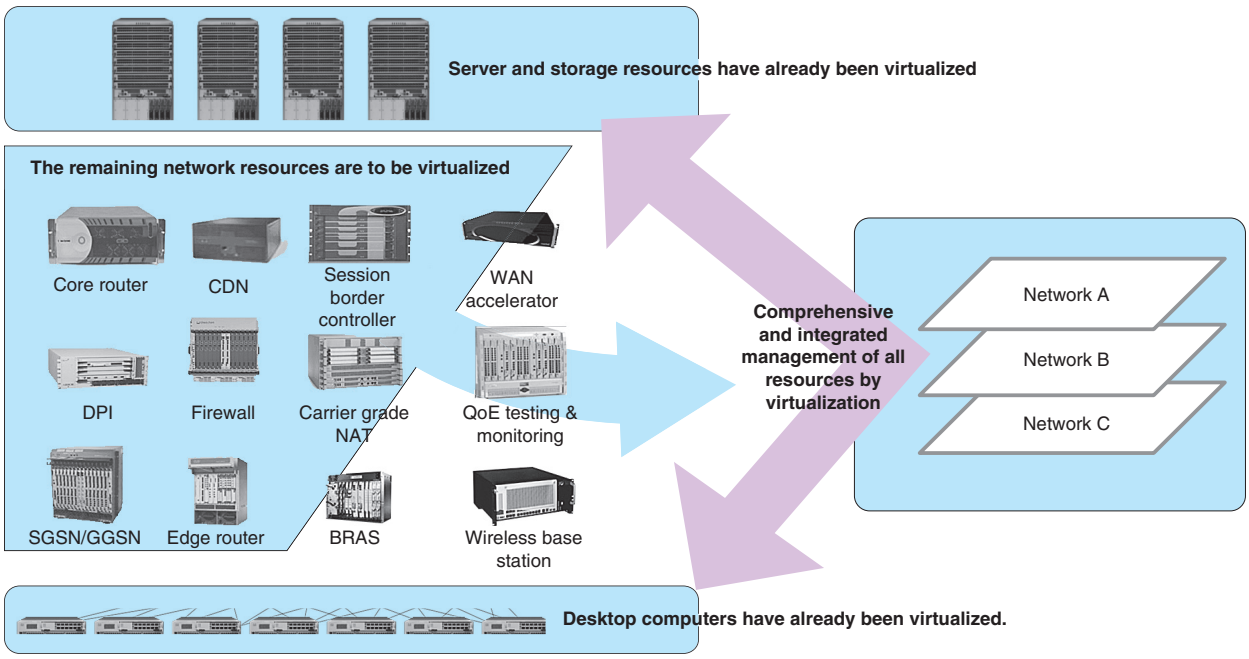
Today's advances in cloud technology have made it easier and more convenient for start-up companies to use cloud services as well as for companies to develop new services.

However, companies providing cloud services face the need for creating increasingly large-scale cloud infrastructure such as building data centers and managing networks. Because of such need, they have further accelerated their moves to pursue economies of scale in expectation of network effects (the greater the number of users, the higher the benefits) and in their efforts to meet the increasing investment/operation cost as they find themselves becoming a capital-intensive industry.

For example, take data centers, which are their essential facilities. Small-scale office buildings that were used as data centers in the past are no longer sufficient in terms of reliability-based design such as communications, electric power and floor load. A plan to construct a single new data center would require an investment of more than several billion yen with minimum necessary conditions, which include a floor space of more than 5,000 m^2, floor load of more than one ton per square meter for essential equipment, and power supply redundancy. Companies must construct and operate multiple data centers that meet these conditions. Furthermore, to meet growing demand for cloud services, companies must continuously construct new data centers.

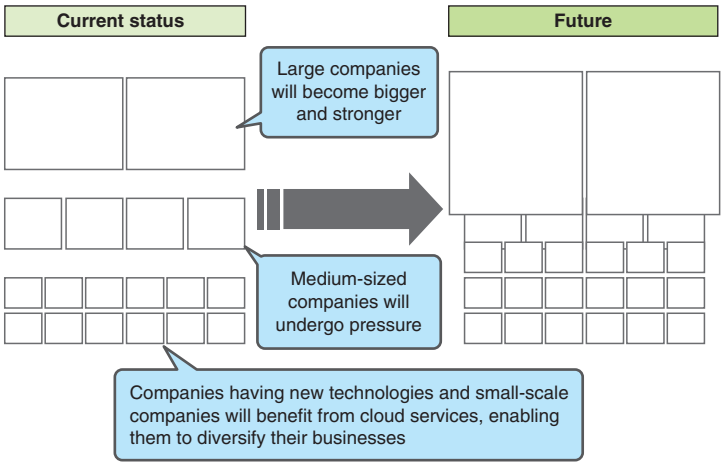
If a company's plan also includes the provision of services in overseas markets, there is no doubt that companies other than large companies, which are able to make required investments and meet required costs, would become unable to respond to these needs for continuously building and operating new cloud facilities. On the part of cloud service users, being able to easily build a small-scale system or create a small-scale service in a short period is very attractive. However, on the part of cloud service providers, being able to bear the huge burden of making capital investments such as those for networks and data centers is essential. As such, from

Figure 6. "Server, storage and network" trinity virtualization



Notes: BRAS = broadband remote access server, CDN = content delivery network, DPI = deep packet inspection, NAT = network address translation, QoE = quality of experience, SGSN/GGSN = serving GPRS support node/gateway GPRS support node, GPRS = general packet radio service.

Figure 7. Structural change in the Japanese cloud services industry



the perspective of enhancing cost competitiveness, it has become very important for providers to boost economies of scale. In other words, large companies obviously occupy a dominant position in the cloud services market. Sooner or later, medium-sized companies are predicted to increasingly move towards consolidation/integration (Figure 7).

III Reappraisal of Private Clouds and Trends toward Adopting Hybrid Clouds

The use of public clouds will continue to grow for the time being. However, user companies are still concerned about adopting public clouds in mission-critical areas such as for core businesses because of security and reliability problems presented by public clouds, and their use of public clouds is still limited. Thus far, the general view is that for most user companies, the matter of whether to migrate their existing information system assets and infrastructure to private clouds remains as a matter that should be addressed from a mid-term perspective.

However, with the spread of cloud services, we are approaching the stage where the overall strategic center of gravity for building and operating information systems has gradually been shifting toward cloud-based environments. Specifically, companies have been pursuing the development of new systems with shorter lead times as well as cloud-based integration of operation and management.

Even with respect to systems and their infrastructure that have high reliability requirements, for which the use of cloud computing was generally considered difficult, moves have been intensifying to promote migration to private clouds (public clouds are partially used in companies' cloud-based environments). In so doing, companies are again looking to cloud services to improve the productivity of their overall information system infrastructure, reduce maintenance costs and integrate management (Figure 8).

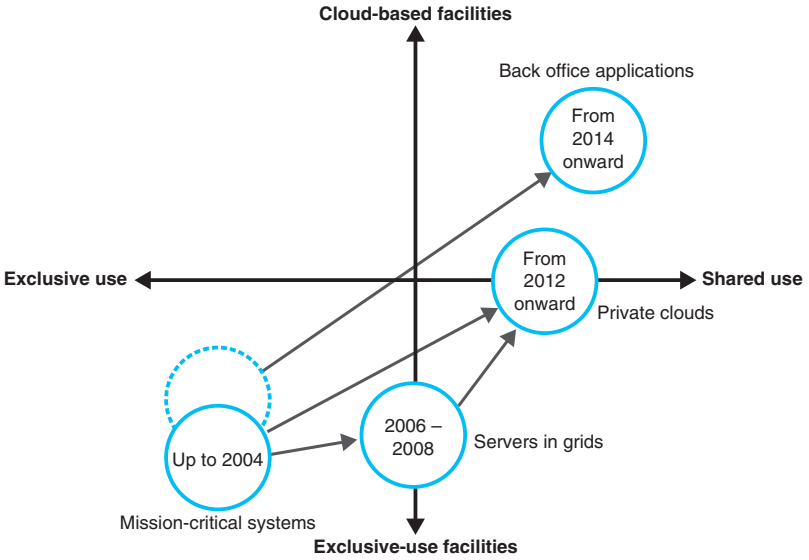
Since before the collapse of Lehman Brothers in 2008, these moves were already being made by foreign investment banks and major manufacturers in the forms of servers in grids and server integration. Currently, with the spread of and advances in server virtualization technology, virtualization not only within a data center but also among multiple data centers or across different system groups is adopted as a practical approach.

The difference between the moves before the collapse of Lehman Brothers and current moves is that because of the introduction of software-defined networking (SDN) technology on the network side, as explained in Chapter II, the virtualization-based management of networks has become practicable, greatly increasing the possibility of including networks as the target for virtualization and integration, together with server and storage resources. Another major advantage of cloud services is the ability to flexibly balance load and allocate resources by using and linking both private and public clouds in order to address the issues of differences between busy and idle periods in processing big data, etc. and rapid increases in data volume during peak times.

Because companies have begun to use a combination of multiple clouds, new expertise and experience of using hybrid clouds has been acquired. The fact that companies have been forced to meet the requirements for repeating the "scrap and build" process to enable shorter lead times and the initial analysis of big data is a factor that has contributed to the rapid spread of the use of a combination of multiple clouds as the "general principle" in developing and operating new cloud-based systems.

Companies started to use cloud services in their attempts to address the need for handling rapid increases in data volume during peak times in the form of using a combination of multiple clouds and for purposes such as

Figure 8. Reappraisal of private clouds



enabling the initial analysis of big data. However, at present, user companies have increasingly greater needs for establishing cloud-based infrastructure over which a company can retain control. Because of these needs, they are pressuring cloud service providers for creating their own private cloud infrastructure that is built based on linkages with external clouds and multitenant architecture. In this sense, cloud computing has already passed the initial stage of learning what is cloud computing and promoting its use. Now, the stage is approaching where efforts are being made to enable optimal deployment of cloud-based infrastructure consisting of multiple clouds including private clouds for a company's overall information system.

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