Featured Articles

Benefits and Uses of Private Cloud based on Next-generation Technology that Supersedes Virtualization

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OVERVIEW: Hitachi launched its Hitachi Cloud Platform Installation Solution for installing private clouds on customer systems in FY2011. While virtualization is the basis of current IT platforms, private clouds are attracting interest as a new approach that can overcome the problems of that technology. In addition to describing case studies of Hitachi private clouds that provide example applications of cloud technology, this article also considers use cases in which a private cloud is a useful option. Hitachi intends to supply this solution to universities as well as to other organizations such as local government or research institutions, and along with adding functions to keep up with market developments, Hitachi also plans to extend the technology to support the hybrid clouds that represent the next level for private clouds.

INTRODUCTION

THE use of virtualization to partition a server into a number of virtual machines enables efficient use to be made of available computing resources. However, there are clear limits to what is possible with virtualization, and this has led to interest in private clouds as a way of delivering the speed and efficiency improvements demanded of modern information technology (IT).

POTENTIAL OF PRIVATE CLOUDS

Limits of Virtualization

Virtualization is subject to a number of problems.

The first is that, because administration is performed manually, it can take between several days and several weeks to respond to user requests.

The second is the inadequate support for multi-tenant configurations (in which administration rights are delegated, and IT space is provided on a tenant-by-tenant basis). As server consolidation is extended from the departmental to the company-wide level, the same integrated platform can end up hosting business systems administered by different support organizations. Unfortunately, virtualization lacks adequate mechanisms for restricting access based on the delegation of administration rights for each system.

The third problem relates to the ability to manage and make available IT resources in an integrated manner. IT platforms are made up of a wide variety of components, including networking, storage, servers, and desktops, with multiple administration systems being needed if virtualization is to be used to virtualize each of these independently, and this requires administrators to have a high level of expertise and undertake complex procedures.

It has become apparent that virtualization on its own is inadequate for providing all of these resources required by IT, quickly and all at once.

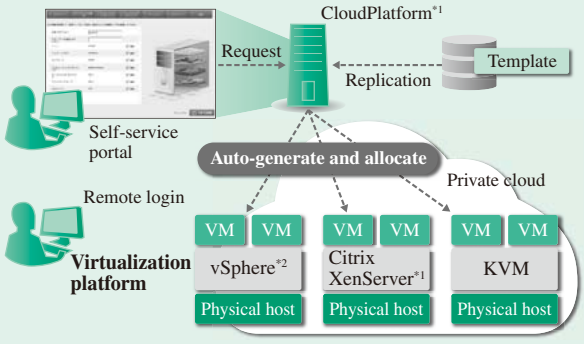
Public and Private Clouds

Another option for speeding up service delivery is the public cloud. Public clouds use a cloud management system with the features listed below to deliver services efficiently to a large number of users.

(1) Mechanisms for offering a menu of services and centralized management
(2) Mechanisms for automated service delivery
(3) Mechanisms for managing contracts with users (multi-tenant)
(4) Mechanisms for providing partitioned IT space to multiple users

The private cloud makes these same technologies available in on-premises IT systems.

A cloud management system provides integrated management of the core IT components for networking, storage, servers, and desktops, and makes them available in the form of a menu of options so that users can visit a self-service portal (a type of online



VM: virtual machine KVM: kernel-based virtual machine
*1 CloudPlatform and Citrix XenServer are trademarks of Citrix Systems, Inc. and/or one or more of its subsidiaries, and may be registered in the United States Patent and Trademark Office and in other countries.
*2 VMware vSphere is a registered trademark or trademark of VMware, Inc. in the United States and/or other jurisdictions.

Fig. 1—Cloud Management System.
The cloud management system automatically generates virtual machines and virtual networks as required rather than having this done manually by system administrators as in the past.

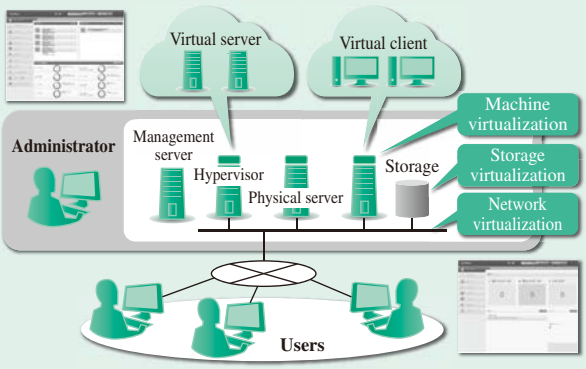


Fig. 2—Outline of Cloud Platform System.
CloudPlatform provides virtualization of physical servers, storage, and networking to provide users with what they need.

store) and automatically generate a virtual machine with the requested specifications on a virtualization platform (hypervisor)[(1)] (see Fig. 1).

On both public and private clouds, services are classified as software as a service (SaaS), platform as a service (PaaS), or infrastructure as a service (IaaS) depending on how the service is provided, with a desktop as a service (DaaS) option also available for providing desktop personal computers (PCs). This article looks in particular at private clouds that have adopted IaaS technology for virtualization.

HITACHI CLOUD PLATFORM INSTALLATION SOLUTION

Hitachi began supplying its Hitachi Cloud Platform Installation Solution for installing private clouds for IaaS and PaaS applications in FY2011, initially in the education market and expanding from FY2014 into the wider public-sector market that includes local government and government agencies. The service uses the CloudPlatform cloud management system of Citrix Systems, Inc. and adds an integration service and customization in the form of proprietary functions (see Fig. 2).

CASE STUDIES CLOUD BENEFITS

As of March 2015, the solution has been used to install seven private clouds at four different organizations. This chapter describes the objectives, features, and benefits of each private cloud.

Hokkaido University

In FY2011, Hokkaido University began operating the Hokkaido University academic cloud, an IaaS and PaaS private cloud that provides on-demand application servers and research computing resources that are available to users inside and outside the university[(2)].

The cloud runs on 114 physical servers [with 40 central processing unit (CPU) cores and 128 Gbyte of memory per server] and has the capacity to provide up to 2,000 virtual machines.

In addition to implementing the private cloud, Hitachi also supplied a proprietary portal and other additional functions. Users can gain immediate access via the proprietary portal to a message passing interface (MPI) cluster, Hadoop*1 cluster, online storage, blog server, and other resources that are spread across multiple computers.

Other features provided in the form of additional proprietary functions include a function that supports the creation of a cluster of virtual machines and a distributed input/output (I/O) function for storage. This automates most of the work involved in preparing a large number of virtual machines with the same configuration, and provides automatic system load balancing (see Fig. 3).

This is an example of a private cloud being used to provide IT resources to an organization's IT users, with its IT department acting as a service provider.

*1 Hadoop is a trademark of the Apache Software Foundation.

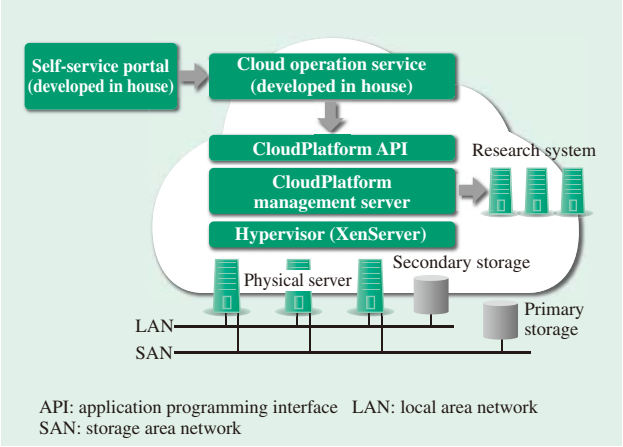


Fig. 3—Hokkaido University Academic Cloud.
By pooling the computing resources of the on-campus cloud to provide the required resources as necessary, researchers can get started on their work immediately without having to deal with hardware purchasing or configuration.

Among the benefits of the cloud are that users can gain access to IT resources in as little as 10 minutes without the need to purchase or configure hardware, and that the high availability (HA) functions of the cloud provide a high level of redundancy and reliability that would be difficult to fund out of departmental budgets.

Kyushu University

Kyushu University introduced a campus cloud from FY2012 that is used for on-site research (Hadoop environment and development servers), departmental servers (web and mail servers), and educational computing[(3)].

The cloud runs on a total of 496 CPU cores with 1,984 Gbyte of memory, provides on-demand educational support systems, and is being used for on-site research and business applications. Hitachi supplied proprietary functions for a single sign-on function using Shibboleth[*2, *3], a workflow function for the approvals process that handles the steps from user request to authorization, and an expiry function that prevents resources from being wasted on virtual machines that are not in use. This provides ways of effectively utilizing and recycling computing resources.

It has been reported how Kyushu University, since FY2013, has been promoting the use of PC-based textbooks whereby students receive lessons on their own PCs, with a lot of work going in to ensuring uniformity in things like hardware and operating systems (OSs)[(4)]. A feature of this cloud is the distribution of educational environments set up on the cloud for teaching purposes to student PCs, which started in FY2014.

Accordingly, this is an example of how a private cloud needs support mechanisms in order to handle the highly efficient turnover of computing resources that prevent them from being left idle.

The distribution of educational environments to individuals' PCs also demonstrates how these PCs can be used for both application and educational purposes by having the cloud provide a uniformly regulated application environment on a heterogeneous environment of individual PCs.

Toyohashi University of Technology

In collaboration with Nagaoka University of Technology and the National Institute of Technology, the Toyohashi University of Technology launched a wide-area integrated information system for education and research in FY2014. The system provides a cloud platform for education and research for students and researchers from the three institutions, both in Japan and overseas[(5)].

The cloud runs on 32 physical servers (with 640 CPU cores and 4,096 Gbyte of memory), providing an on-demand environment for research and education to a combined campus that uses a network to interlink Toyohashi University of Technology, Nagaoka University of Technology, the 51 technical colleges of the National Institute of Technology, Japan, and their overseas affiliates (see Fig. 4).

This is an example of a cloud used jointly by a community made up of two universities and 51 technical colleges and is characterized by its provision of a platform for research and educational activities that is utilized by other facilities around the world as well as its provision of cloud-based storage of application data for research and education.

Clouds like this are called "community clouds" and they are recognized as having the potential to optimize costs through the synergies and resource sharing made possible by cloud-based collaboration while also avoiding concerns about public clouds where data is held by a third party.

There is scope for this system to be deployed in applications such as a community cloud for a local authority or as an education platform cloud for elementary or junior high schools run by a board of education.

*2 Shibboleth is an open source software authentication and authorization platform technology supplied under the Apache 2 license that provides for single sign-on across multiple organizations.
*3 Shibboleth is a registered trademark of Internet2.

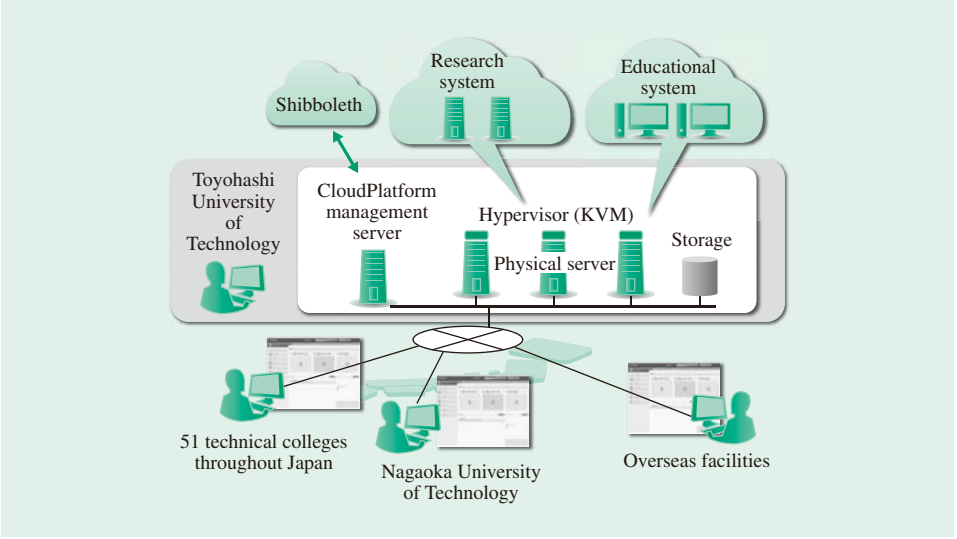


Fig. 4—Wide-area Integrated Information System for Education and Research at Toyohashi University of Technology.
In addition to providing computing resources to community organizations around the country, the cloud acts as a hub for encouraging innovation by providing a forum for joint research.

National Research Institute for Earth Science and Disaster Prevention

The National Research Institute for Earth Science and Disaster Prevention launched a public information cloud system in FY2014 that forms part of its disaster prevention information system. The disaster prevention information system includes a large simulation system as well as the public information cloud system, the latter being used to provide on-demand servers for publishing the results of analysis undertaken by researchers on the simulation system[6].

Servers are generated based on cloud templates, and the templates are regularly updated. Because the volume of accesses to the public information service increases when a disaster strikes, while demands on the analysis system decrease, the public information cloud system and large simulation system share some of their physical servers so that resources can be redirected to web servers during a disaster (see Fig. 5).

This is an example of how hosting multiple application systems on a private cloud enables computing resources to be used effectively by reallocating them as required. It also demonstrates the value of template functions on the cloud, which provide a consistent baseline for dealing with vulnerabilities in the OS or applications and enable ongoing improvement.

FUTURE OUTLOOKS

This chapter describes Hitachi's future outlooks to supply private clouds for local government and research institutions and support for hybrid clouds.

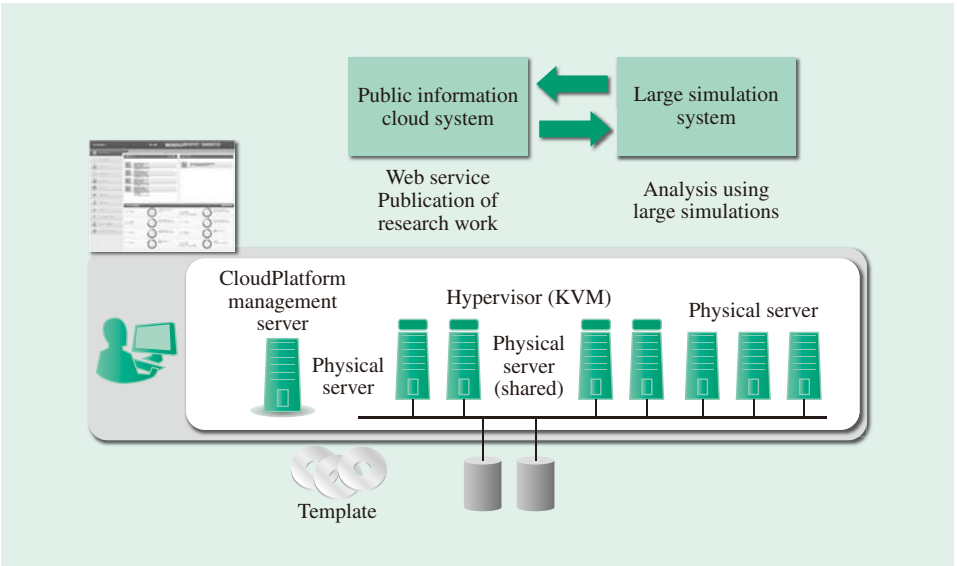


Fig. 5—Disaster Prevention Information System of National Research Institute for Earth Science and Disaster Prevention.
The integrated management of computing resources at the research institute helps optimize its overall computing resources by providing them as and when required to systems that have different demand peaks.

Deployment of IaaS and DaaS in Local Government Markets

Hitachi intends to provide two forms of private cloud to local government markets: common application platforms for hosting core business systems in their entirety, and virtual desktop platforms for hosting office PCs and dedicated terminals for accessing the core business systems.

Because the business systems hosted on a common application platform will be administered by different departments, the platform can benefit from multi-tenant functions (delegation of administration rights, provision of IT space on a tenant-by-tenant basis). Furthermore, by using the common platform (IaaS) management system to deploy the virtual desktop (DaaS), spare resources on the desktops, which significantly outnumber the servers, can be reassigned between servers and desktops as needed.

By reducing the amount of IT investment required to deliver services to residents, this enables the focus to shift toward application development and has the potential to also save on the investment needed for a trial and error approach to providing new resident services.

Deployment of High-performance DaaS at Research Institutions

Hitachi will supply research institutions with high-performance desktop clouds that utilize graphic processing units (GPUs). The shift to a cloud configuration will allow computer-aided design (CAD) and computer-aided engineering (CAE) work conducted on high-end workstations to be undertaken in tandem with overseas facilities while keeping the data in Japan.

As the high-performance screen transfer software that is particularly important in this field is a more mature technology than virtual desktop software, Hitachi is looking at the possibility of providing this high-performance screen transfer software on private clouds.

Hybrid Clouds

One of the requirements of the public sector is the ability to offload processing load during times of peak activity. Hitachi intends to add functions to support hybrid clouds that can offload processing from information systems on private clouds by providing a proprietary function for automatically scaling up based on the load and also integrating it with the federated cloud function of Hitachi Cloud.

CONCLUSIONS

This article has described how private clouds can overcome the limitations of virtualization to help optimize IT systems and enhance their efficiency. Hitachi intends to continue utilizing private cloud technologies in the future to provide IT platforms that can respond to change.

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