Integrated Management of Virtualized Infrastructure That Supports Cloud Computing: ServerView Resource Orchestrator

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To meet the needs for building and operating private Clouds within enterprises, Fujitsu has globally launched ServerView Resource Orchestrator (ROR) in April 2010. As a resource pool that has virtualized the resources of servers, storage and networks, when operating a Cloud within an enterprise, this product automatically deploys a logical server (L-Server) to internal users while performing integrated management. L-Server is based on a template of the standardized L-Server. Able to handle VMware, Hyper-V, and Xen, which are widely used as virtual infrastructure, it is effective for integrated management of all Cloud environments. In addition, it supports the integrated operation of real servers that used the functions of ServerView Resource Coordinator VE. This paper describes Fujitsu's strategy for migrating enterprise systems to Cloud-based systems, and the concepts of ROR with an application that forms the foundation of the migration.

1. Introduction

In relation to information and communications technology (ICT), the trend is for companies to shift toward system optimization, faster development by using IaaS/PaaS/SaaS, and greater networking. This has placed a lot of attention on the use and application of Cloud computing.

A questionnaire on companies has indicated they have a high level of interest in Cloud computing, with user companies that may migrate to Cloud computing in the future accounting for nearly 70% of all respondents. In addition, among user companies that consider migrating, more than 40% of the users are considering a migration plan to introduce Cloud within one year, suggesting that Cloud computing is becoming common.[1)]

With this situation in the background, Fujitsu launched ServerView Resource Orchestrator (ROR), a product for building and operating private Clouds within enterprises, in April 2010.[2)] This paper outlines the trend of migration of enterprise systems to Cloud-based systems and gives a description of the concepts of ROR, which supports the migration, and an application to Cloud management.

2. From virtualization to Cloud

At present, many companies have individually created systems in which the system environment for servers, OSs, and middleware is built for individual business systems and the entire operation is not unified.

Among open systems, it is becoming popular to use server virtualization, or virtual machine (VM), technology for virtualization and consolidation of systems that have been associated with devices and reallocating resources according to system load.[3)] Moreover, application of Cloud computing technology to use systems built with VMs via networks for effectively using resources

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scattered within an enterprise is also becoming widespread.[4]

Cloud computing can be classified into a public Cloud, which is offered to the public via Internet lines, a private Cloud closed within an enterprise, and a hybrid Cloud, which appropriately uses both according to the requirements. From the perspective of the service layer provided for, Cloud can be classified into three types, namely SaaS, PaaS and IaaS, as shown in **Figure 1**.

To implement Cloud computing within an enterprise or Internet service provider (ISP), the following functions are necessary.[5]
1) Resource pooling

A mechanism for virtualizing resources owned and managing them as a resource pool.
2) On-demand self-service

A mechanism for taking out resources held in the resource pool according to user requests.
3) Rapid elasticity

A mechanism for allowing resources taken out to be combined and deployed as real resources and for the flexible addition and deletion of resources according to requests.
4) Broad network access

A mechanism for allowing users to access from various network clients.
5) Measured service

A mechanism for measuring and evaluating

the performance of the individual systems and overall performance.

In addition, from a manager's point of view, the following functions are required as well.
1) Role base access control

A mechanism for controlling access according to the department the user belongs to or the user's role.
2) Multi-tenancy

A mechanism for separating organizations when two or more organizations share a Cloud.
3) Scalability

A mechanism to allow flexible addition and deletion of real resources according to any excess or insufficiency of the resource pool.
4) Accounting

A system for charging according to the amount or period of use of the individual systems.

Fujitsu offers the following four products as middleware that satisfies these Cloud requirements.[6]
1) Systemwalker Service Catalog Manager (CT-MGR): support for the visualization of business services (visualization technology)
2) Systemwalker Software Configuration Manager (CF-MGR) and
3) Systemwalker Runbook Automation (RBA): realization of automatic deployment and operation (automation technology)
4) ServerView Resource Orchestrator (ROR): dynamic resource management (virtualization technology)

Combining these products makes it possible to virtualize the resources in individually created systems so that they can be pooled and automatically provided according to the requests of the respective departments. It also allows the server resources owned to be effectively used. ROR forms the foundation of this virtualization technology (**Figure 2**).
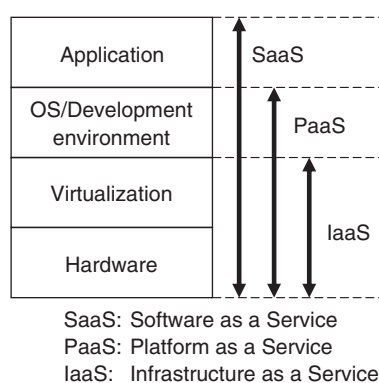
3. ROR design concept

Cloud computing offers services that may be

Figure 1
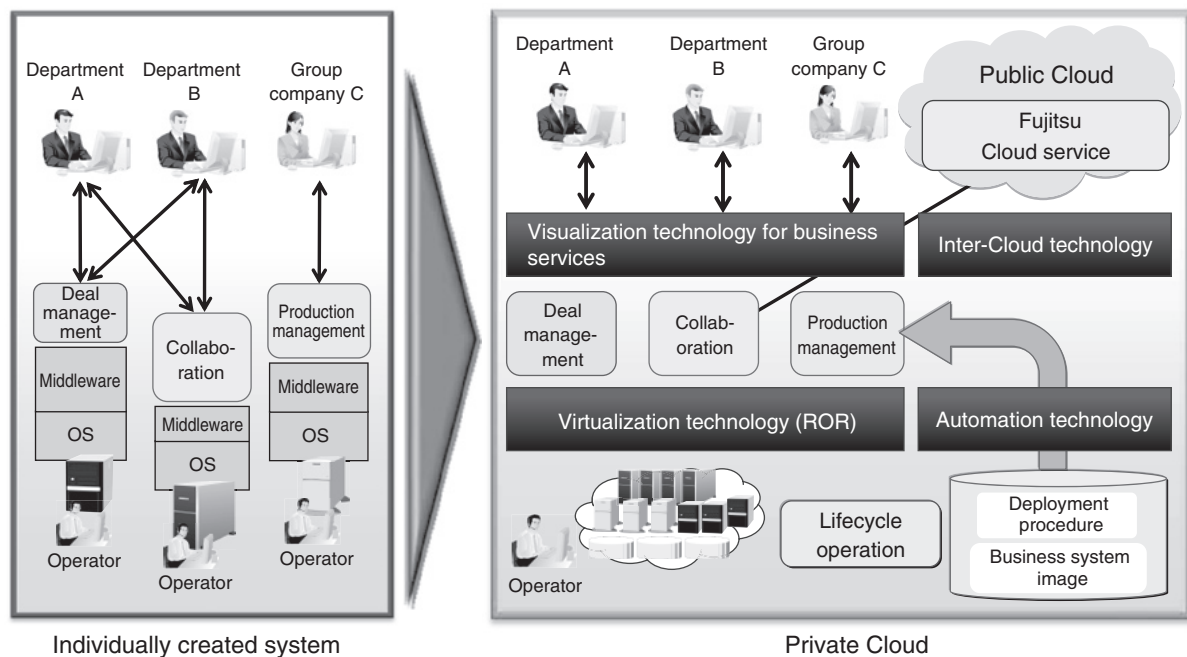Scope of services of Cloud computing.

Figure 2
Fujitsu's overall idea of private Cloud.

referred to as SaaS, PaaS or IaaS depending on the layer on which they are offered. Fundamentally, a service provider offers a system that makes the internal structure transparent to users who are provided with the services. These are based on virtualization technology and introduced as an extension to the conventional concept of virtualization.

In introducing virtualization, a key factor to success is the standardization of operations and systems. However, attempts at virtualization are spreading before consideration is given to standardization, and virtualization is becoming popular before a proper system has been put in place. For this reason, many data processing centers that have introduced virtualized systems have not implemented standardization. With this reality taken into account, the introduction of Cloud requires standardization without affecting the operation system developed through virtualization. Once standardization has been implemented, broad distribution of the same rule becomes easier. Standardization of operations

including procedures allows automation, which in turn realizes automation of services (**Figure 3**).

Within the conventional operation of virtual infrastructure, management of server hardware and server virtualization (hypervisor) was good enough. Fujitsu offered ServerView Resource Coordinator VE (RCVE)[7] included in the blade server to unify the management.

Operation of Cloud-based systems also requires a way to manage all the storage and networks in addition to servers. To achieve this, Fujitsu has developed ROR as a product that governs RCVE for managing servers, ETERNUS SF for managing storage, and network manager for managing networks. **Figure 4** shows the internal structure of ROR. ROR dynamically manages resources by pooling and standardizing the respective resources of servers, storage and networks. It also has a plug-in interface to incorporate the individual management tools. This means that, for example, introducing new storage only requires the incorporation of
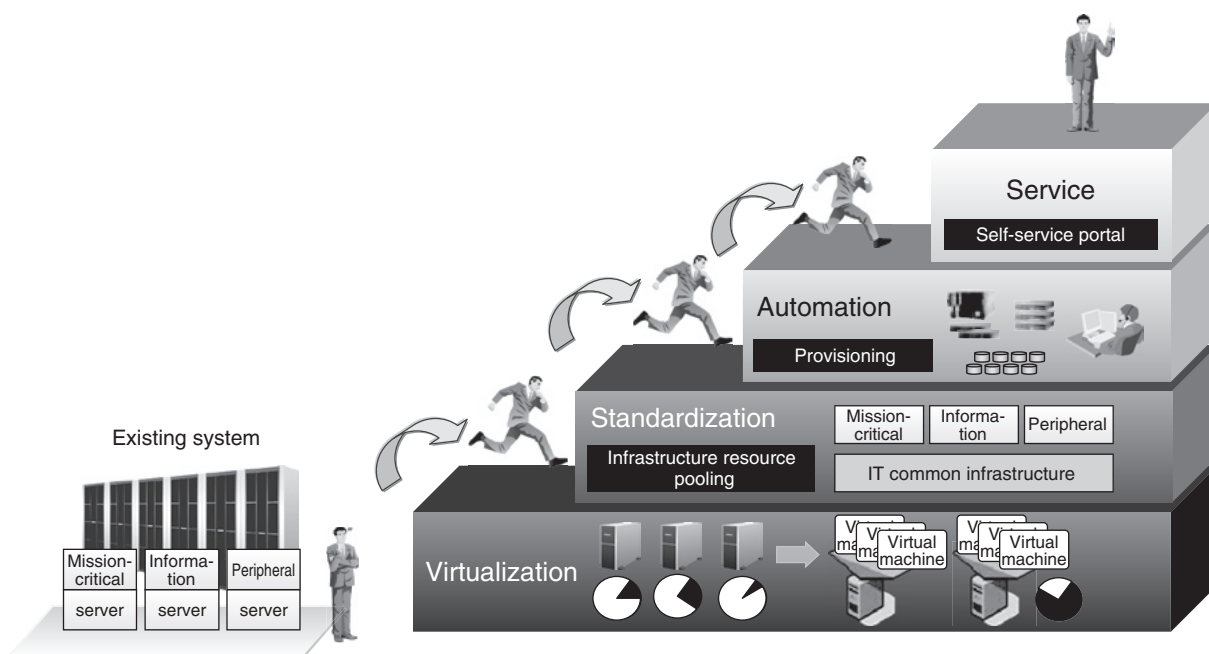
Figure 3
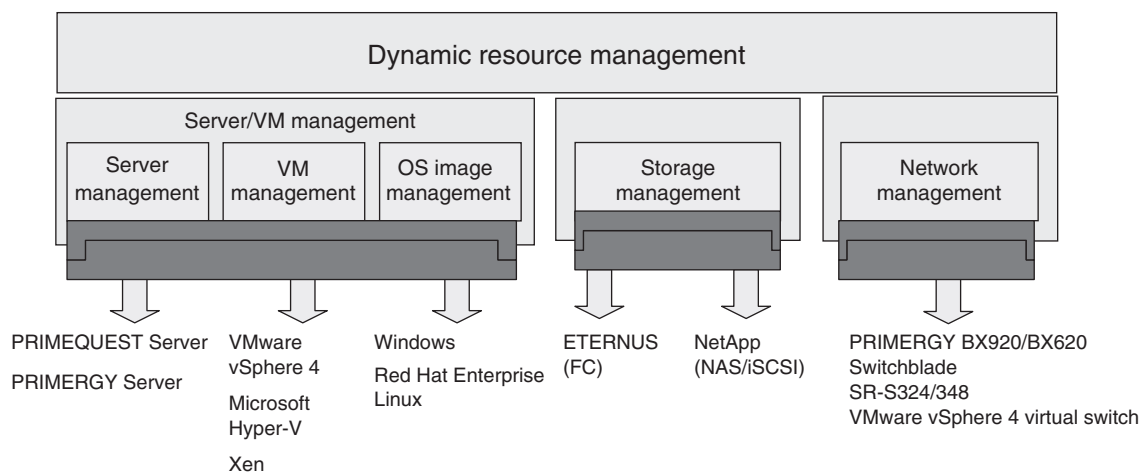Steps toward realizing private Cloud.

Figure 4
Internal structure of ServerView Resource Orchestrator.

a component that manages the devices of the vendor, which facilitates multi-vendor support.

The individual resources are pooled and made reusable as shared resources of the entire user system. As individual systems recognized by users, the concept of a logical server (L-Server) is introduced. Generally, a server refers to a single piece of server hardware but here it means the entire system image to be distributed based on a configuration including storage and networks and OS images. That is, L-Server is the very system that is distributed to users. ROR distributes servers (VM guests), storage, networks and OS images from their respective pools to users in the form of L-Server. Resources that have become unnecessary by stopping L-Server are returned

to the original pools, which make them reusable.

In order to standardize the system configuration, templates containing patterns of resources used by L-Server are prepared. Simply selecting a template when applying for resource allocation completes the selection of a system configuration. Further, users do not need to consider making a configuration design or unnecessarily introducing a configuration different from other systems.

Moreover, ROR supports multiple tenants. When two or more organizations (tenants) reside in a Cloud environment, it is necessary to create an environment in which they do not conflict with each other. This is why management of templates and the like being closed to tenants has been made available. This independence is ensured by defining settings that keep the scope of commands or information about other tenants off the view of the administrator role. This flow is shown in **Figure 5**.

4. Characteristics of operation management by ROR

ROR is capable of abstracting types of servers and the virtualization technology under them for management. It can manage various Clouds of different sizes with standardized images, regardless of whether they are public or private. Different configurations are available according to the size of the Cloud by combining storage with the PRIMERGY RX series of rack-mounted servers or BX series[8] of blade servers. In this case, virtualized systems run on the individual server racks and blades, which are operated as Cloud-based systems by ROR.

In large-scale Clouds, the PRIMERGY CX series of high-density servers, which is optimized for Cloud services, can be used as well. CX1000 accommodates 38 units of small and simple two-way servers (CX120 S1) in one rack and allows servers to be housed at a higher density than the conventional rack-mounted servers

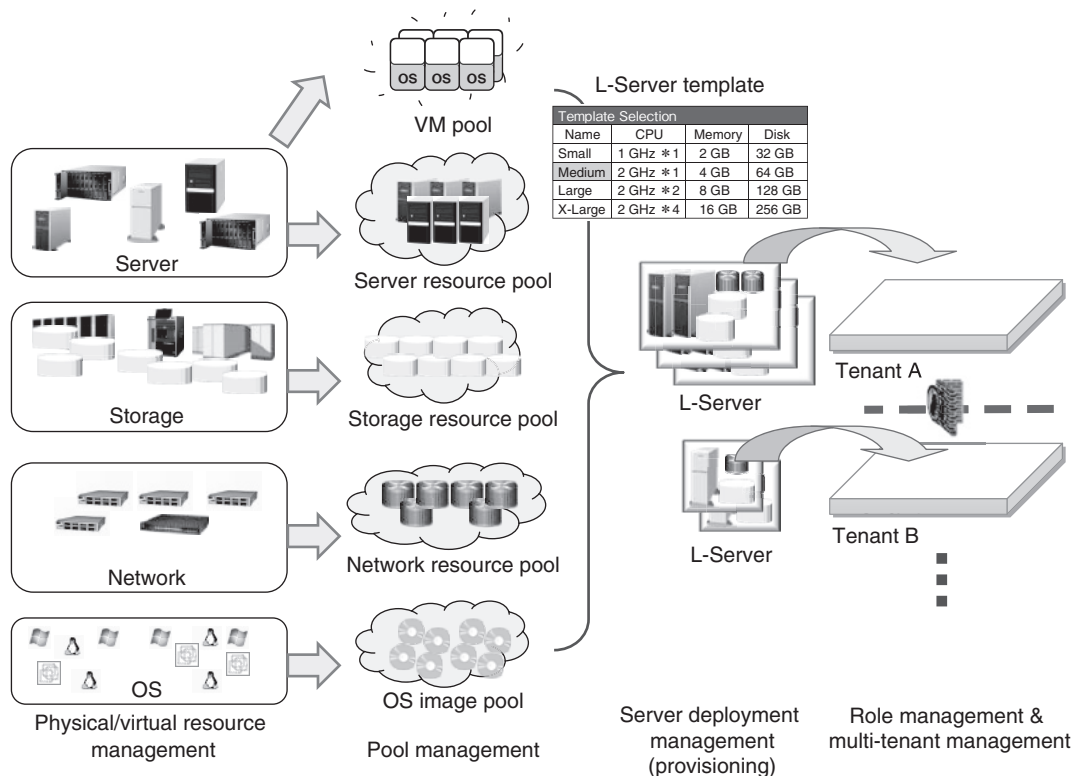| Template Selection			
Name	CPU	Memory	Disk
Small	1 GHz ∗1	2 GB	32 GB
Medium	2 GHz ∗1	4 GB	64 GB
Large	2 GHz ∗2	8 GB	128 GB
X-Large	2 GHz ∗4	16 GB	256 GB

Figure 5
Allocation from pools to individual tenant's logical servers.

(40% less installation space needed compared with rack-mounted servers) and with lower power consumption (13% less than that of rack-mounted servers). It achieves this by having a centralized cooling system at the top of the rack and having no fans for individual servers. Operating CX1000 with ROR makes it possible to build a space-saving, low-power-consumption and powerful Cloud environment. In addition, with the scale-out architecture of CX1000, the scale of the Cloud can be freely increased. When there are a large number of servers, the initial installation of the system is a considerable burden. But this issue can be solved by using the cloning and master image distribution functions of ROR to collectively distribute the OS image installed on the first server used as the master to the remaining servers (**Figure 6**). This completes installation in one-twelfth of the time conventionally spent. Other functions supported by ROR are shown in **Table 1**.

5. Points in development

Fujitsu supports virtualization solutions currently in wide use in the market such as VMware, Hyper-V and Xen to support customers' systems.[9] In addition, Fujitsu has accumulated know-how in server hardware management through developing server management tools in RCVE. ROR is a compilation of these technological accumulations that has achieved standardized operational images and stability independent of the virtualization solution directly in use.

Table 1
Functions offered by ROR.

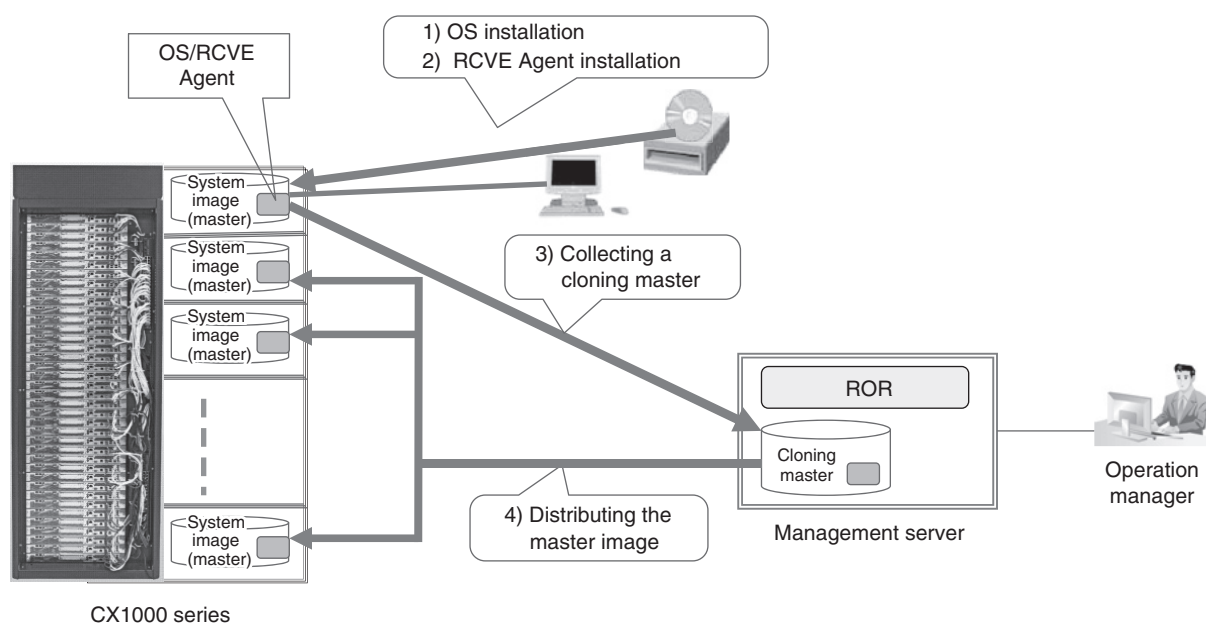| Function	Description
Construction of platform	Resource pool management
	Prompt construction of platform
	Standardization of system configuration by template
Effective use of resources	Visualization of ICT resources (servers, storage and networks)
	Multi-platform and multi-vendor support
Resource access control	Separation of duties by role management
	Infrastructure resource access control
	Separation of duties by layering of management servers

Figure 6
Diagram showing distribution in large-scale Cloud by using cloning.

For the development of ROR, efforts were made to achieve shared use with the dynamic resource management for a service-oriented platform (SOP). SOP is the management function of Fujitsu's On-Demand Virtual System Service (IaaS)[10] developed around the same time as a trusted public Cloud service. For example, the concept of a VSYS package[11] introduced in SOP has been inherited by ROR as an L-Server. This has made standard hybrid virtualization possible based on Distributed Management Task Force (DMTF) Open Virtualization Format (OVF).[12] Fujitsu has gained a detailed understanding of how to operate Xen, which has been adopted as a virtual infrastructure for SOP. Further, Fujitsu has developed know-how to stably operate it through development activities in the open source community.[13] Incorporation of original functions such as a guest VM personalization has been easily achieved.

The dynamic resource management of SOP developed earlier has been confirmed to be capable of stably operating physical servers on a 10 000-unit scale or virtual system on a scale of 100 000 units with the beta-service launched in May 2010. This suggests that ROR is expected to have a level of stability comparable to that of a public Cloud.

6. Conclusion

For resource management in the age of Cloud computing, the virtualization technologies for servers, storage and networks, which have been independently developed, must be integrated. In this way, it will be possible to shift from the discrete management implemented up to date to a unified management system that makes the individual systems transparent to users.

In the future, application of Cloud computing, in which a public Cloud and private Cloud are appropriately used according to the requirements while forming a link between them, is expected to become popular. If it does, both resources will need to be strictly managed in keeping with management policies such as cost and importance. At the same time, there must be no need for anybody but the administrator to be aware of which Cloud the resources come from. To meet these expectations, we intend to evolve ROR in accordance with the progress of virtualization technology and changes in Cloud management systems.

References
1) JEITA: Report on the Survey of User Needs Regarding Secure Platform 2009. (in Japanese). *http://spf.jeita.or.jp/library_top.html*
2) Fujitsu: ServerView Resource Orchestrator. *http://ts.fujitsu.com/products/standard_servers/ system_management/serverview_ror.html*
3) All about Virtualization 2011. (in Japanese). Nikkei Business Publications, Inc., October 2010.
4) IPA: "Study Group for the Infrastructure of Cloud Computing Society" Report. (in Japanese). *http://www.ipa.go.jp/about/research/ 2009cloud/*
5) NIST: Definition of Cloud Computing v15. *http://csrc.nist.gov/groups/SNS/ cloud-computing/*
6) Fujitsu: Software to support private Cloud. (in Japanese). *http://software.fujitsu.com/jp/middleware/ cloud/*
7) Fujitsu: ServerView Resource Coordinator VE. *http://www.fujitsu.com/global/services/ software/systemwalker/products/rcve/*
8) Fujitsu: Server PRIMERGY. *http://ts.fujitsu.com/products/standard_servers/*
9) Fujitsu's efforts for virtualization: virtualization technology and products. (in Japanese). *http://jp.fujitsu.com/solutions/theme/ infrastructure/virtual/products/*
10) Fujitsu: Cloud computing On-Demand Virtual System Service. (in Japanese). *http://jp.fujitsu.com/solutions/cloud/paas-iaas/ sop.html*
11) H. Yoshida et al.: Service Oriented Platform. *Fujitsu Sci. Tech. J.*, Vol. 46, No. 4, pp. 410–419 (2010). *http://www.fujitsu.com/global/news/ publications/periodicals/fstj/archives/ vol46-4.html*
12) DMTF: Open Virtualization Format Specification Version: 1.1.0. *http://dmtf.org/sites/default/files/standards/ documents/DSP0243_1.0.0.pdf*
13) Y. Oguchi: Enhancing Xen for Mission Critical Systems. (in Japanese). *Journal of Information Processing Society of Japan*, Vol. 49, No. 3, pp. 321–324 (2008).

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