Middleware for Creating Private Clouds

● Hiroshi Nagakura ● Akihiko Sakurai

Cloud computing has been attracting a lot of attention recently. This is because it can meet demands for speedy system implementation in pace with changes in the business environment and for reducing the rising costs of information and communications technology (ICT). Two forms of cloud computing are presently in use: public cloud computing (using ICT resources provided by service providers via the Internet) and private cloud computing (using a cloud "owned" and kept for private use by individual corporations). Although these two forms co-exist, different systems use them in different ways depending on requirements such as security, reliability, and cost. In addition to providing public-cloud-computing services, Fujitsu provides middleware products for constructing private clouds in accordance with the varied needs of our customers. This paper overviews our middleware products that support speedy system implementation and ICT cost reduction by making use of private cloud computing.

1. Introduction

By using cloud technology in companies' information and communications technology (ICT) systems, the aim is to lower implementation and operation costs and make such systems available more quickly. To construct private clouds, it is necessary to offer middleware as well as extended features of them for each layer, including the infrastructure layers, middleware layers and application layers.

This report describes the perceived challenges in each layer that are expected to emerge with the introduction of private clouds. It also explains the technologies involved and an outline of our middleware products that can be used to address these issues.

2. Fujitsu's middleware portfolio

Fujitsu's middleware portfolio is indicated in **Figure 1**.

The core part of this is comprised of three middleware platforms (Interstage, Symfoware, and Systemwalker) and the ServerView middleware for the infrastructure layer. We will briefly describe these pieces of Fujitsu middleware that can be used in private clouds and their roles in the next section.

2.1 Interstage (SOA middleware)

The products of the Interstage brand mainly support the area of application and service management, in addition to the area of information integration and utilization. The main products are application servers that function as a Java run-time environment in both cloud and on-premises environments, and a series of products that create a linkage between clouds and on-premises environments by using SOA technology.

1) Interstage Application Server (Java run-time environment)
2) Interstage Interaction Manager (front-end

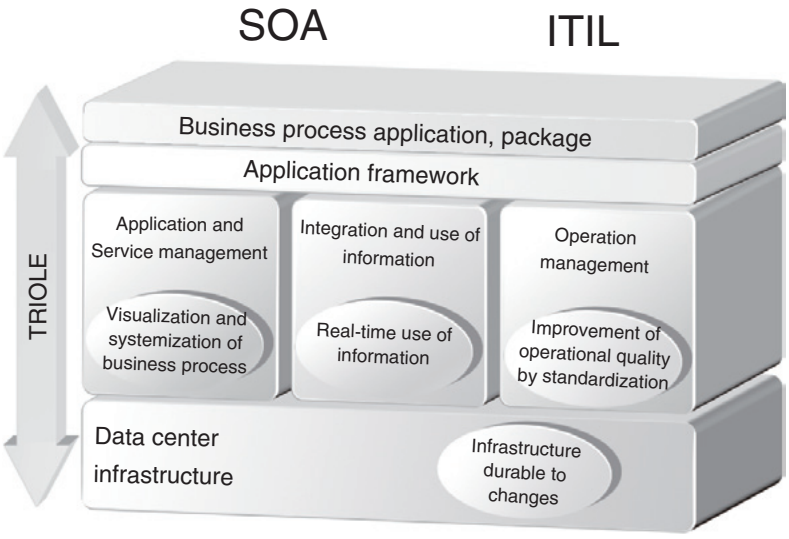


Figure1
Fujitsu's middleware portfolio.

integration)

3) Interstage Information Integrator (data integration)
4) Interstage Service Integrator (enterprise service bus)
5) Interstage Business Process Manager (process integration)
6) Interstage Business Process Manager Analytics (process visualization)

2.2 Symfoware

Symfoware Server (a high-reliability and high-performance database) is a product that plays a key role in the area of information integration and utilization. Of course, it can handle the conventional configuration where a database is arranged on physical servers and is accessed from applications on virtual servers. But in addition, it can handle the type of configuration where the database itself is deployed without human intervention on a virtual server.

2.3 Systemwalker (ITIL operation management)

Systemwalker brand products support mainly the area of operation management by integrating ITIL technology. Besides new products which are added for private clouds, the features of existing products are also reinforced for clouds.

1) Systemwalker Software Configuration Manager (automatic deployment and configuration management of software)
2) Systemwalker Runbook Automation V14g (operation automation)
3) Systemwalker Service Catalog Manager (service catalogue management and visualization of resource usage)
4) Systemwalker Centric Manager (management of monitoring and integration)
5) Systemwalker Operation Manager (job management and scheduling)
6) Systemwalker Service Quality Coordinator (visualization of service quality)
7) Systemwalker IT Change Manager (management of changes, releases and development)
8) Systemwalker IT Service Management (incident management and trouble management)

2.4 ServerView (infrastructure management)

ServerView products offer support for data center infrastructure. ServerView Resource Orchestrator (dynamic resource management) manages virtual resources and supports private clouds.

From the next section, we will demonstrate the increasing importance of being able to offer features that are consistent throughout the entire middleware portfolio, accompanying the spread of clouds.

3. Approaches to private clouds

Fujitsu envisages taking an approach to ICT system optimization by using private clouds. In this approach, standardization and automation are repeated along with the evaluation of their effects, based on the virtualization of infrastructure. First of all, servers owned by a company are virtualized upon their physical consolidation. Then, business systems are integrated on their virtual servers. By using this platform as the basis, jobs related to construction and operation of systems are standardized in a phased way to improve efficiency through automatic executing. In this case, it is necessary to visualize business process services that help you shift from "owning" hardware and system resources to "renting them." Besides, a linkage between clouds needs to be established when part of the existing system is deployed in public clouds (**Figure 2**).

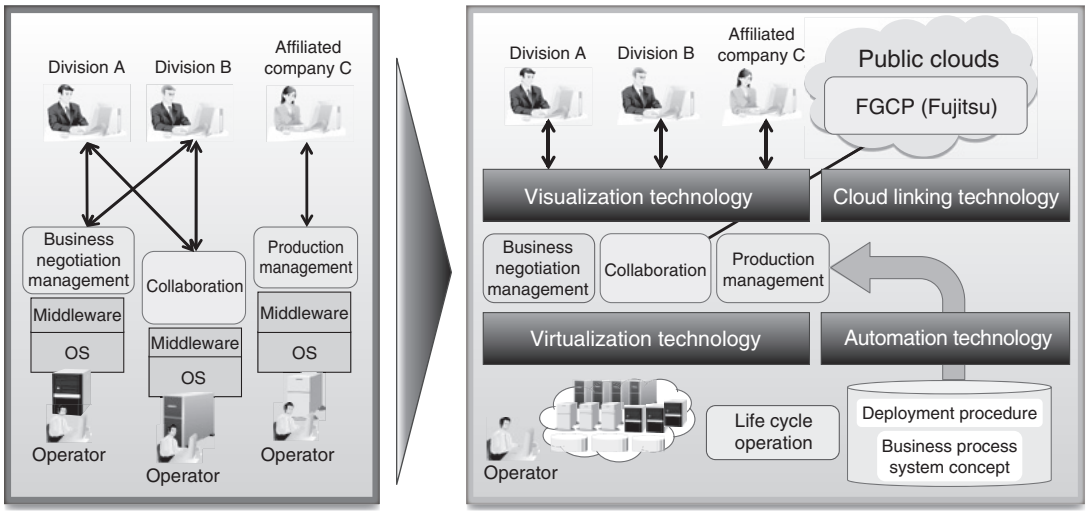
The architecture of the middleware necessary for private clouds is indicated in **Figure 3**. The right frame shows the execution roles such as hardware to execute applications and package software, as well as the application servers that serve as an execution infrastructure. The left frame indicates the roles of pieces of cloud operation management software that manage and control each of the layers on the right.

1) Dynamic resource management

This role is realized as middleware for data center infrastructure. This function virtualizes and manages hardware resources comprised of servers, storage, and networks.

2) Automatic deployment and automatic operation

This role is realized as middleware for operation management. This helps you automate



(a) Silo-type system

(b) Private clouds

FGCP: Fujitsu Global Cloud Platform

Figure 2
Approach to private cloud.

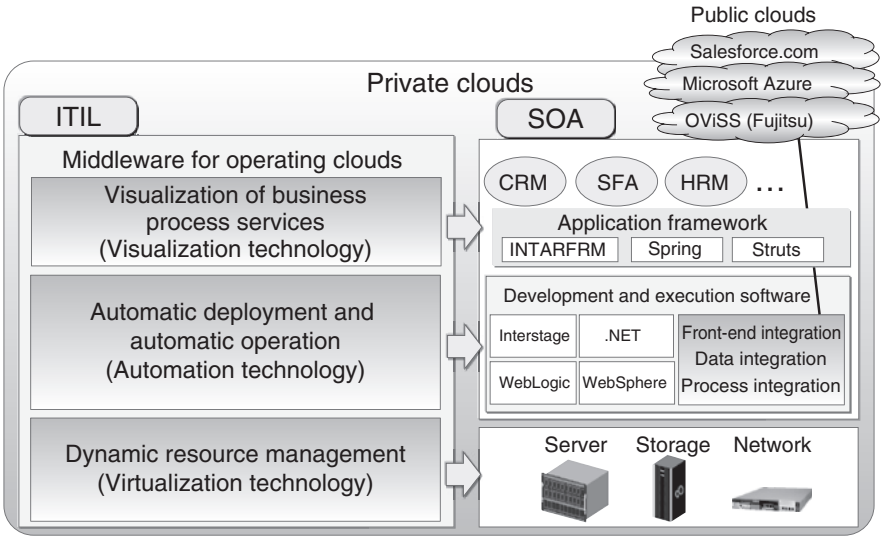


Figure 3
Private cloud architecture.

the deployment, configuration and operation of a software stack as a whole, including the middleware that serves as an execution infrastructure.

3) Visualization of business process services

This role is realized as middleware for managing applications or services. This function visualizes each business service unit down to applications and package software.

4) Development and execution software

This role is realized as middleware for managing applications or services, integrating information, and sharing information. This function offers a running environment for Java and COBOL applications and ensures a linkage with public clouds.

We will describe each of these pieces of middleware in more detail below.

3.1 Dynamic resource management

Virtualization technology supports private clouds. In the conventional system construction, an individual server to satisfy the maximum demand is procured for each business process system. As a result, the number of servers is increasing, with a lower level of average CPU usage and disk usage due to hardware performance that has improved in recent years. Besides, even if the servers to be used during development and maintenance are kept to maintain the running environment, it may lead to a deterioration of the overall availability because they are used only during the development and modification.

However, virtualization technology has allowed us to operate multiple independent virtual servers on just a single physical server. Therefore, it has become easier to have shared resources on physical servers among multiple systems for difficult purposes. Thanks to this sharing, it is possible to effectively use CPU and disk resources. On the other hand, depending on the way the systems are allocated to virtual servers, risks related to a deficiency or too much surplus of resources may occur. Operation administrators need to appropriately control the allocation of virtual servers to each physical server in order to ensure effective use of resources. This kind of resource management is a new type of management that emerged with virtualization.

To make this management easier, we

developed technologies that pool hardware resources including servers, storages, and networks, to enable resources to be allocated without waste and immediately when needed. This is a dynamic resource management feature, and we offer it as ServerView Resource Orchestrator. For details of this product, please refer to reference 1) cited at the end of this article.

Further, to appropriately control the allocation of resources, operators must always be aware of how hardware resources and virtual resources are being used and the remaining resource pools. A visualization feature for such operations is offered in our products, cloud infra-management software and Systemwalker Service Catalog Manager. For details of this feature, please refer to reference 2) cited at the end of this article.

3.2 Automatic deployment and automatic operation

3.2.1 Automatic deployment

If the allocated virtual server has not yet been prepared adequately for the users' purposes, the users themselves need to, for example, install the required pieces of middleware and configure them correctly. Our automatic deployment technology mitigates this workload. With this, someone can prepare templates for the servers that run users' applications, the networks, the middleware on the servers, and the configuration information for all of them in advance. Then, the function prepares the virtual server images according to the template specified. Finally it provides users with the set of virtual server instances on demand for immediate use. This allows the users to obtain a set of multiple virtual servers automatically that integrate the required virtual images at the users' request.

In this automatic deployment, administrators will determine the specifications of a virtual server (number of CPUs, amount of memory, etc.), OS and the middleware configuration to build the disk image of the virtual server. Then, these are registered as a "template" together with the parameters for small variations. Just by selecting a template when needed, users can obtain a set of required virtual servers automatically at anytime.

This automatic deployment is a feature included in the middleware that controls the clouds. We offer this feature as Systemwalker Software Configuration Manager. For details of this product, please refer to reference document 3) cited at the end of this article.

However, automatic deployment cannot be achieved using this product alone. Within the scope of automatic deployment, some pieces of middleware need to be able to change their parameters after they are installed. For instance, some middleware serves as an execution environment, such as application servers. In this case, parameters such as the amount of memory that the application servers can make exclusive use of should be changeable from Systemwalker Software Configuration Manager.

The following types of popular middleware are already ready for automatic deployment. The scope of these products will be expanded in future.

1) Interstage Application Server
2) Symfoware Server
3) Systemwalker Centric Manager,
   Systemwalker Operation Manager
4) Interstage Information Integrator,
   Interstage Service Integrator,
   Interstage Interaction Manager
5) Interstage List Creator

3.2.2 Automatic operation

In private clouds, large numbers of systems that have so far been deployed independently in each section are consolidated. This may result in an increase in the operator's workload sometimes, because the latent operation workloads are also consolidated. To avoid this increased operational workload associated with

the greater number of servers, it is imperative to standardize operational procedures and adopt automatic execution.

For instance, with regard to the system initiation procedure, which is one of the basic operations of ICT systems, the following workflow is often required:

1) Virtual server start-up
2) OS and middleware start-up
3) Confirmation of start-up
4) Business process application start-up
5) Confirmation of normal operation
6) Announcement to users

If any abnormality is detected during these operations, the process thereafter should be interrupted and a report may need to be issued to the concerned parties.

An automatic operation feature allows users to define a series of operations, shown in 1) through 6) (issue of command to server and network devices, result matching, authorization and confirmation request to administrator, feature to send E-mail to the concerned parties, etc.) as an operation flow and executes it. This is considered to enable greater work efficiency while preventing human errors and ensuring operation logs are preserved.

We offer the automatic operation function as our Systemwalker RunBook Automation. For details of this product, please refer to reference document 4) cited at the end of this article.

3.3 Visualization of business process services

In private clouds, accounting for payback from individual business processes becomes rather difficult, because the cost of ICT infrastructure is shared among many users who rent their virtual resources. You can no longer allocate procurement costs of hardware such as a server and storage to a specific business process system in a fixed manner.

Therefore, when introducing clouds, it is important to measure the rate of resources used by each business process system and to calculate time-based costs (billing management). Measuring the amount of resources and time spent by each user serves as the basis of such billing management. Further, from the users' point of view, they need a catalog of services that tells them what specification of resources or services is available at what price. This is a so-called service catalogue, which is a function that works as an "index" in using a cloud environment.

The service catalogue is comprised of a list of the services offered, a self-management function to check and operate rented systems, an authorization flow for lending and returning, and a visualization feature to enable resource usage to be monitored. We offer this as our Systemwalker Service Catalog Manager. For details of this product, please refer to reference document 5) cited at the end of this article.

3.4 Development and execution software

The development and execution software need extended functions when they are used on clouds. As already mentioned, the system used for automatic deployment is one such function. With this, it is possible to offer an environment for developing and executing an application promptly when needed. A similar function is one that makes it easier to link between the systems in public clouds and on-premises systems.

To promote the implementation of clouds, we sometimes adopt services offered by public clouds, for instance, in front-office business processes as a part of the intended business system. In such a case, a linkage should be established to use the common customer master record by both existing on-premises business process systems and the services offered by pubic clouds.

To do this, we offer products to incorporate three types of integration technologies (front-end integration, data integration, process integration). They are Interstage Information

Integrator, Interstage Interaction Manager and Interstage Service Integrator, respectively. For details of these products, please refer to reference document 6) cited at the end of this article.

4. Conclusion

In this article, we outlined Fujitsu's middleware in private clouds. Private clouds have consolidated a series of processes including procurement, configuration, operation and cost assignment that have so far been carried out independently. It is hoped that private clouds will allow these processes to be automatically controlled and executed and thereby improve efficiency. To achieve this, the key is to establish a linkage between management middleware and the middleware (application development and running environment) to be managed, as well as a linkage between management middleware products. Fujitsu will continue to contribute to the entire optimization of ICT systems via private clouds, while making the best use of its products that offer middleware for both management and execution.

References

1) H. Matsumoto et al.: Dynamic Resource Management in Cloud Environment. *Fujitsu Sci. Tech. J.*, Vol. 47, No. 3, pp. 270–276 (2011).
2) T. Shiratori et al.: Operations Visualization for Private Clouds. *Fujitsu Sci. Tech. J.*, Vol. 47, No. 3, pp. 311–315 (2011).
3) K. Murata et al.: Provisioning of Standardized Business Systems. *Fujitsu Sci. Tech. J.*, Vol. 47, No. 3, pp. 293–299 (2011).
4) H. Ito: Operation Efficiency Improvements for IT Infrastructure through Runbook Automation Technology. *Fujitsu Sci. Tech. J.*, Vol. 47, No. 3, pp. 300–304 (2011).
5) M. Funabashi et al.: Fujitsu's Approach to Hybrid Cloud Systems. *Fujitsu Sci. Tech. J.*, Vol. 47, No. 3, pp. 285–292 (2011).
6) T. Nakai: Private Cloud Using Service Catalog. *Fujitsu Sci. Tech. J.*, Vol. 47, No. 3, pp. 305–310 (2011).

Hiroshi Nagakura
Fujitsu Ltd.
Mr. Nagakura is currently engaged in promoting the planning and development of an entire portfolio of middleware products.

Akihiko Sakurai
Fujitsu Ltd.
Mr. Sakurai is currently engaged in promoting middleware applications for clouds.