Next-generation Cloud Operation Management Technologies

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The difficult business climate in which companies find themselves today is forcing them to make their business and technology processes more flexible and less costly in accordance with their business policies. Many companies are doing this by making greater use of cloud computing systems, and there is a growing number of companies that use hybrid clouds, which combine a private cloud with a public cloud. These trends are increasing the number and variety of resources that must be managed. Moreover, the resources themselves are changing, making it difficult to gain the bird's eye view of the entire information and communications technology (ICT) system that is needed to manage it. Furthermore, new issues are arising, such as the inability of information systems departments (ISDs) to control all the clouds used within companies or to optimize ICT resources on a company-wide basis. This paper introduces FUJITSU Software Systemwalker Software Configuration Manager, developed by Fujitsu to help companies meet the operation and management challenges presented by cloud environments and the technologies it uses for centrally managing and automatically acquiring configuration information for everything from hardware to virtual environments, operating systems, and software. It also introduces FUJITSU Software Systemwalker Service Catalog Manager and the technologies it uses for controlling cloud usage and automatically deploying services.

1. Introduction

Many companies are facing a difficult business environment that is forcing them to make their business and technology processes more flexible and less costly in accordance with their business policies. One approach to meeting this challenge is to make greater use of cloud computing systems, and there is a growing number of companies that use hybrid clouds, which combine a private cloud with a public cloud.

Moreover, the number and variety of resources that must be managed by operation administrators is growing as the result of data center aggregation and the use of multiple software vendors, and the resources themselves are changing, making it difficult to gain the bird's eye view needed to manage the entire information and communications technology (ICT) system. Furthermore, the use of hybrid clouds is creating new challenges, such as controlling all the clouds used by a company and optimizing ICT resources on a company-wide basis.

Fujitsu has developed two products to help companies meet these challenges: FUJITSU Software ServerView Resource Orchestrator,[1)] a product that manages the infrastructure resources of the cloud and FUJITSU Software Systemwalker Centric Manager,[2)] a product that monitors the operations of the cloud and that helped Fujitsu increase its domestic and global market share of the cloud. To further help companies meet the operation and maintenance challenges presented by hybrid cloud environments, Fujitsu has developed new technologies for the FUJITSU Software Systemwalker Software Configuration Manager (CF-MG),[3)] a product for integrated management of hardware and software, and FUJITSU Software Systemwalker Service Catalog Manager (CT-MG),[4)] a product for centrally managing both private and hybrid cloud environments.

This paper discusses the cloud configuration management technologies used by CF-MG and the service management technologies used by CT-MG.

2. Operation management challenges created by cloud environments

In cloud environments, ICT systems are built from virtualized logical resources, and system configurations are frequently changed to meet functional and performance requirements. In hybrid cloud environments, it is becoming increasingly common for clouds to be selected, contracted, and managed by individual end user departments instead of by information systems departments (ISDs).

This increasing complexity of corporate cloud environments has created the challenges described below. Effective cloud utilization is the first step in meeting them.

1) Centralized management and visualization of configuration information

A thorough grasp of system configuration information is essential for the operation of ICT systems. In addition to being used to identify the scope of impact when problems occur, configuration information is also used to create configuration modification plans in order to optimize corporate ICT systems on the basis of the latest configuration information. Failure to manage configurations can create severe problems, such as the inability to respond to incidents, discover the causes of outages, and manage changes. It is important to centrally manage configuration information for not only physical resources but also logical resources, which dynamically change as a result of virtualization. It is also important to keep corporate configuration information up to date.

2) Maintenance of patch levels and parameters

Server aggregation is increasing the number of servers that need to be managed, while the growing use of open source software and multiple software vendors is increasing both the number and variety of operating systems and software that require management. Hybrid cloud use is making cloud operating environments more diverse, making configuration management more difficult. The spreadsheet-based management approach used in the past is leading to degraded service quality due to failures to keep information updated and confirmation errors.

Assessing and maintaining the patch levels and parameters of operating systems and software used in individual cloud environments requires centralized configuration management. In addition to automatic patch and parameter information acquisition and visualization, it must also be possible to apply patches to multiple servers and set parameter configurations using a single, central view.

3) Centralized service management for multi-cloud environments

In addition to virtual environments, a large number of services are provided to individual business sectors. When creating new systems, it is now common for companies to take a cloud-first approach, looking first to the use of cloud services because of the speed with which it is possible to start up business and development environments in the cloud.

When using a cloud service, there is an increasing tendency for end user departments, such as sales departments and development departments, to enter into individual contracts for public cloud use. Public clouds individually contracted by end user departments cannot be used by other departments within the same company. This means that several departments may be using the same cloud service. These factors stand in the way of company-wide optimization of ICT resources.

3. Fujitsu's cloud configuration management measures

Fujitsu's CF-MG for managing cloud environment configurations uses discovery technology to automatically acquire, centrally manage, and visualize configuration information for everything from hardware to virtual environments, operating systems, and software. It also makes it possible to patch and set parameters for operating systems and software en masse. This makes it possible to constantly monitor OS and software patch levels and parameters, ensuring that they remain in accordance with system designs. **Figure 1** shows an overview of CF-MG.

3.1 Automatic acquisition and centralized management of infrastructure configuration information

A conventional business system configuration, based on physical resources, is decided upon when building the system and is seldom changed thereafter. However, with cloud environments, both physical and virtualized resources must be managed. Virtual servers with diverse specifications are dynamically created by user operations, and virtualization management

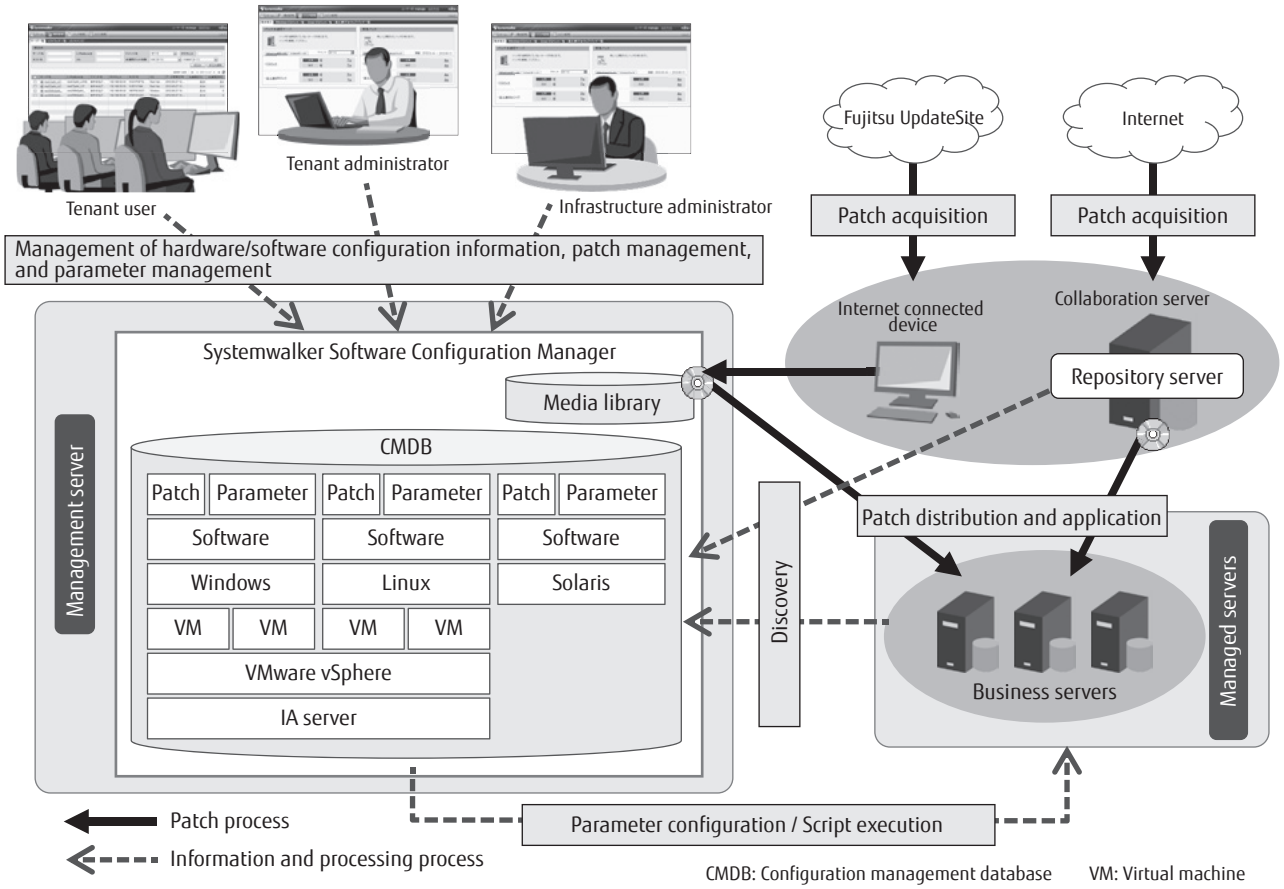

Figure 1
Overview of CF-MG.

software uses resource optimization and auto-scaling functions to make frequent configuration changes. CF-MG uses discovery technology to automatically acquire and centrally manage configuration information for virtual resources, which can change from being physical resources dynamically. It also provides functions that keep corporate infrastructure configuration information up to date (**Figure 2**).

The Intelligent Platform Management Interface (IPMI), a standard interface for monitoring and controlling servers, is used to automatically acquire configuration information from physical servers. This makes it possible to manage not only Fujitsu servers, but also servers made by other manufacturers.

Software configuration information is acquired from user-creatable plug-ins. By default, CF-MG supports the acquisition of parameter information for approximately 20 Fujitsu middleware products, and plug-ins can be created to enable it to also support independent software vendor (ISV) software.

Centralized management of configuration information makes the following possible.

1) Configuration management database usage

CF-MG uses a configuration management database (CMDB) to manage the configuration information it automatically acquires. In addition to automatically acquiring configuration information, the CMDB can be used to manage data center specific asset information, maintenance information, and the like, serving as a data center configuration information database. The configuration information can also be output in file format and used to create configuration ledgers and reports.

Data centers contain a diverse array of hardware and software, making it impossible to specify uniform configuration information data structures. Dependency relationships between hardware and software must also be managed, making it essential to have a

database that can store tree-structured data.

CF-MG uses FUJITSU Software Interstage Shunsaku Data Manager[5] as its CMDB database engine. It is an XML database product that can store tree-structured data, which makes it easy to extend data structures.

2) Problem root cause analysis and impact scope assessment

Gathering and visualizing information regarding dependencies between physical servers, virtual machine (VM) hosts, guest operating systems, and business systems speeds up problem troubleshooting. It also makes it easy to understand the scope of the impact of maintenance work (**Figure 3**).

3.2 Maintaining patch levels and parameters

The increased diversity of OS types, software types, and operating environments has led to increased

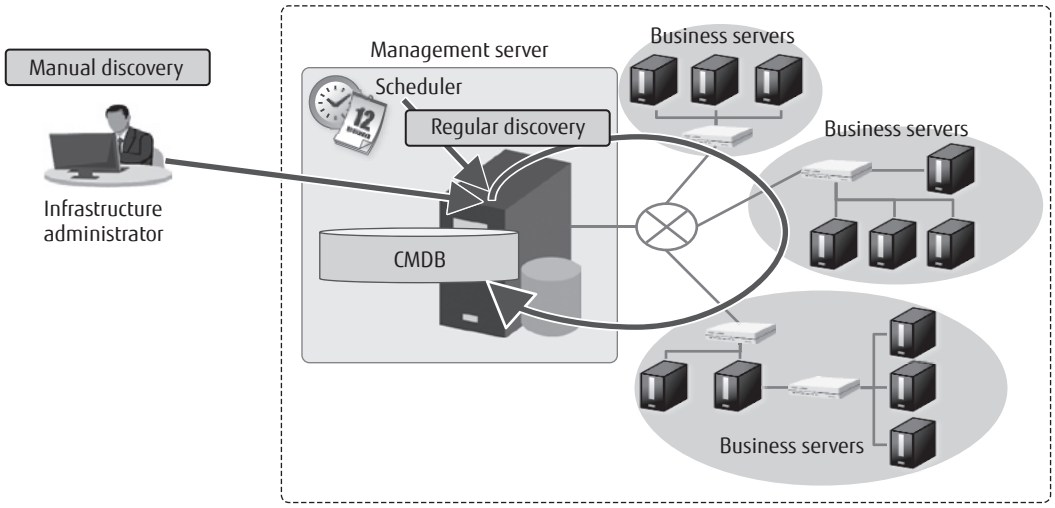

Figure 2
Overview of discovery.

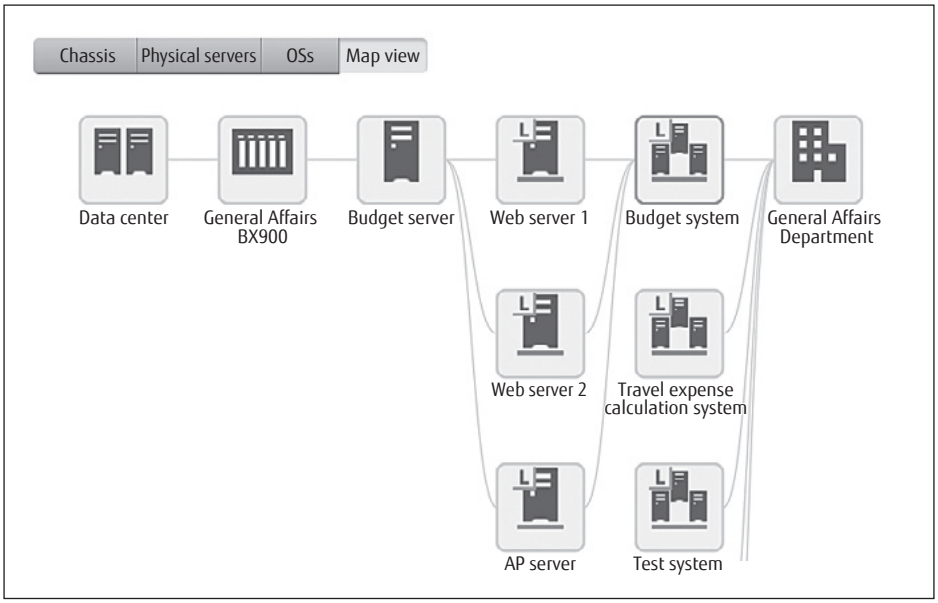

Figure 3
Dependency visualization.

complexity in managing patch levels and parameter information. CF-MG automatically acquires this information and centrally manages it using the CMDB. The patch levels and parameters in cloud environments can be maintained by batch configuring this information and keeping the configuration optimized.

1) Batch application of OS/software patches

The CF-MG console can be used to check information for patches that have been applied to operating systems and software as well as to apply patches. Alerts are shown for servers that need patching, preventing them from being overlooked. Windows, Linux, and Solaris OS patches are supported. Software patches are supported for Fujitsu middleware products, with support for ISV software planned for the future (**Figure 4**).

2) Batch configuration of software parameters

CF-MG performs management using discovery definitions, which are used to acquire actual parameter values, and configuration definitions, which are used to set parameters. These definitions are combined to set parameters on the basis of actual values determined using discovery. After the parameters are configured, the actual values are reacquired to confirm that the parameters were set correctly. Parameter values can also be logged in a file to enable parameter values to be checked against design values and compared across servers.

By default, CF-MG supports the configuration of parameter information for approximately 20 Fujitsu middleware products, and plug-ins can be created to enable it to also support ISV software.

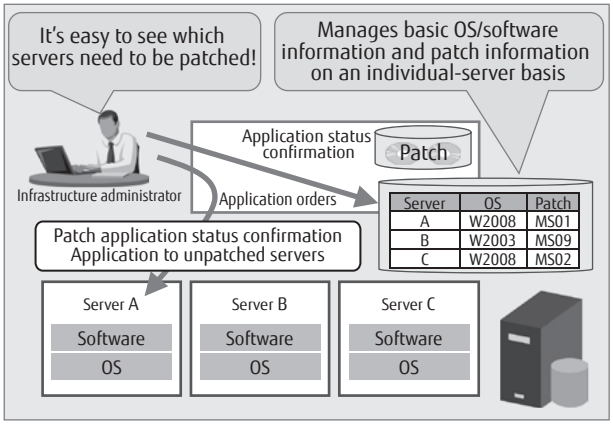

Figure 4
Overview of patch management.

4. Service management technologies for multi-cloud environments

Fujitsu provides CT-MG as middleware for integrated management of the services used in companies. The CT-MG software uses service catalogs to manage clouds supplied by service providers and corporate business systems and provides these catalogs to end users as services accessible from a service portal. **Figure 5** shows an overview of CT-MG.

4.1 Cloud service broker

In the past, ISD operations have focused on the creation of internal company systems and services to be supplied to end users. Advances in cloud utilization have created a need for ISDs to serve as cloud service brokers (CSBs), selecting clouds, signing contracts, and using service catalogs to provide clouds to end users within their companies.

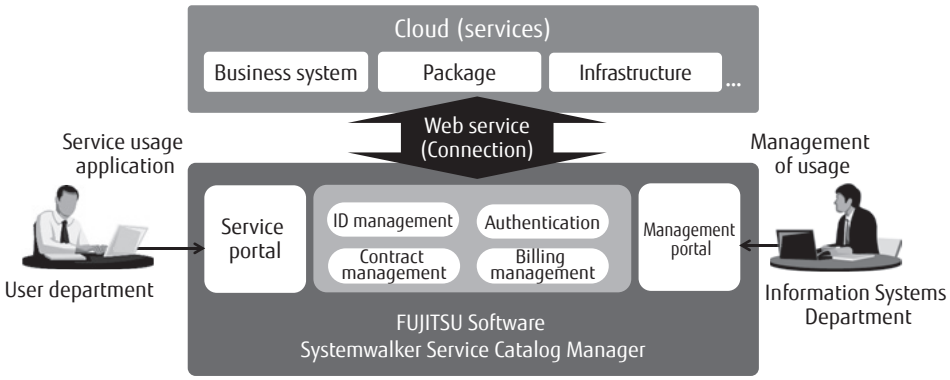

Figure 5
Overview of CT-MG.

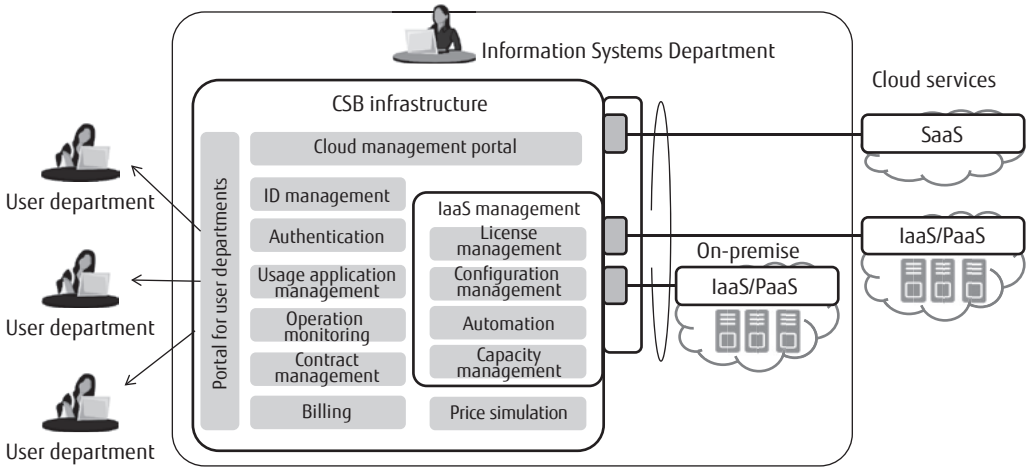

Figure 6
Cloud service broker (CSB) model.

In the CSB model (**Figure 6**), brokers decide which service providers' clouds to use and contract for the use of services. They then provide these clouds in the form of services to end users, using internal company service catalogs.

We next describe how ISDs can use CT-MG to automate cloud usage control and service deployment.

4.2 Cloud usage control

Controlling usage requires ISDs to assess which services are frequently used within their companies, which services are essential, and the like and to select clouds to be used to provide these services. Below is an overview of the procedure used by an ISD, after selecting clouds, to control cloud usage by using the service catalog and service usage application functions of CT-MG.

1) Service catalog registration

CT-MG is used to register the cloud services available to end users in a catalog describing the services and their cost. The catalog can be browsed in multiple languages because it is based on Unicode. This makes it possible for the same service catalog to be displayed in Web browsers in different languages, which means the same services can be provided in different regions. Likewise, service billing settings can be defined using 161 ISO 4217-conformant currencies, and billing/payment amounts can be calculated using currencies specified by global sites. After registering the clouds in the service catalog, the ISD makes the catalog available to end users, enabling them to apply for a cloud service.

2) Service usage application and approval

CT-MG provides an event notification interface. When an end user submits a service usage application through the service portal, CT-MG sends a notification of the usage application event via a Web service to the specified endpoint. The ISD receives the usage application event from CT-MG and approves or rejects the application in accordance with the company-defined approval process.

4.3 Service deployment automation

ISDs should have functions for one-stop provision of cloud services to end users. In particular, it is important that the process of deploying services to the cloud be automated in order to ensure that end users can immediately begin using the service when their service usage application is approved.

1) Service deployment automation

CT-MG provides connectivity adapters for software such as FUJITSU Cloud IaaS Trusted Public S5, FUJITSU Cloud A5 for Microsoft Azure, and OpenStack. These connectivity adapters can be used to automate service deployment and operation. When a service usage application is approved, CT-MG uses the connectivity adapter to notify the provisioning application programming interface (API) of the corresponding cloud service, thereby automatically deploying the service. This automation frees the ISD from the need to deploy services

on their own and makes it possible for end users to rapidly begin using cloud services.

2) Resource operation automation

End users can use the service catalog to perform operations, such as startup and shutdown, on virtual servers for resources for which they have contracted via the CT-MG service portal.

- Virtual server startup/shutdown

Virtual servers can be started up or shut down on the basis of actual usage conditions, such as shutting down unused virtual servers at night.

- Configuration changes

The configurations of deployed virtual servers can be changed as desired, such as scaling systems and adding virtual servers during periods of heavy processing loads.

5. Conclusion

ICT systems are subject to strict demands for configuration change flexibility and cost reduction, and cloud service utilization is expected to become essential. This paper discussed the cloud configuration management and service management technologies provided by CF-MG and CT-MG, which were developed by Fujitsu to help companies meet the operation and management challenges presented by cloud environments.

We plan to make the following CF-MG enhancements.

1) Patch management

CF-MG will be provided with patch management functions for firmware and hypervisors so that it will be capable of comprehensive management, from infrastructure to software patch management.

2) Software distribution

A function will be added that will make it possible to place and install software on managed servers.

We also plan to make the following CT-MG enhancements.

1) Connectable clouds

We will increase the number of cloud connectivity adapters, which will expand and diversify the range of connectable clouds.

2) Billing estimation

End user usage trends and characteristics will be used to estimate overall billing for deployed cloud resources.

We plan to continue developing both products in order to meet the operation challenges being created by cloud environments.

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