Platform Technology "VALUMO" for Dynamic Collaboration

By Minoru TERAO,* Yasuo IWAOKA,† Kouichi HADANO,‡ Masato YAMAMOTO,§ Naoto ISHIKURA‡ and Junko ITOH‖

ABSTRACT Due to the rapid development of IT (Information Technology) such as the Internet, information systems are now positioned as important social infrastructures. This means that information systems are required to meet two basic requirements for social infrastructures, "robustness" and "flexibility." "Robustness" is the ability to run business 24 hours a day, 7 days a week, and "flexibility" is the ability to promptly respond to changes in market environments. In order to achieve such "robustness" and "flexibility," NEC has accumulated a large volume of experience in the construction of OMCS (Open Mission Critical Systems) while incorporating rich know-how obtained through experience with mainframes. Such experience-based know-how has been integrated into the platform technology for OMCS construction, "VALUMO." "VALUMO" stands for "Value More" indicating NEC's commitment to improving customers' corporate value. The corporate value discussed here has three aspects: "business continuity for non-stop business," "collaborative networking for business expansion," and "TCO (Total Cost of Ownership) reduction for lowering cost," and NEC will provide this value to customer companies through the use of our technology. VALUMO will contribute to the expansion of customers' businesses using systems ranging from super-large scale to middle/small scale, on platforms that support various industries and services, and systems that work with package software. This paper gives an overview of the VALUMO technology.

KEYWORDS **Platform technology, OMCS (Open Mission Critical Systems), Autonomy, Virtualization, Distribution, Cooperation**

1. ESSENTIAL TECHNOLOGIES CONSTITUTING VALUMO

Technological elements for realization of systems that VALUMO aims for are "autonomy," "virtualization," "distribution," and "cooperation" (**Fig. 1**).

1.1 Autonomy

Autonomy refers to a kind of technology that allows computers to operate autonomously in response to loads or failures.

Hardware and software currently provided already have self-management functions. More specifically, Phoenix technologies for storage devices (technologies to prevent business interruptions by using the disk drive self-recovery function and also by minimizing access delays from servers) or products such as SystemGlobe (a product that monitors server status, executes self-recovery in case of part failure, and executes self-optimization for processing loads) are provided.

NEC will further enhance these self-management functions to improve failure resistance, to maintain load balance, and to improve resistance to attacks on security.

1.2 Virtualization

Virtualization refers to a kind of technology that virtualizes various hardware and software so that users can use them without being aware of them.

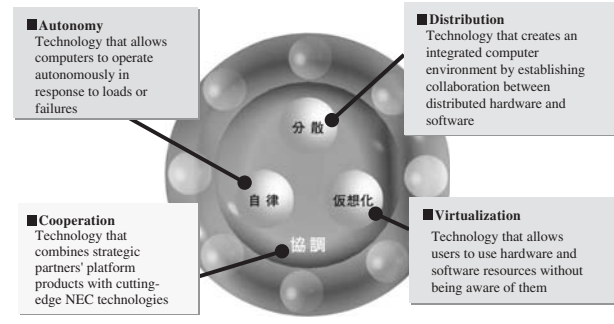


Fig. 1 Four technological elements that comprise VALUMO.

*System Software Operations Unit
†Computers Software Operations Unit
‡Middle Software Division
§1st Computers Software Division
‖Software Planning Division

This technology allows facilitation of operation management and system integration, and also contributes to achievement of TCO (Total Cost of Ownership) reduction. For example, system integration can be made easier through creation of multiple virtual servers by dividing processors in a server, memories, or resources such as I/O, and transformation of physical devices such as disks or tapes into virtual volumes, followed by free allocation of such virtual volumes to virtual servers.

Also, operating a data center can be made easier by selecting the necessary server group, storage, and network resources from a large-scale environment such as a data center, and by establishing virtual environments for execution of applications.

1.3 Distribution

Distribution refers to a kind of technology that creates an integrated system environment by establishing collaboration between distributed hardware and software.

NEC has so far successfully established "Hub & Spoke" that creates an integrated system environment by achieving collaboration among distributed servers and storage devices in the field of intra-enterprise collaboration or corporate integration. In the future, inter-enterprise collaboration will become important, and then NEC will use the Hub & Net architecture to improve not only the connectivity but also the stability, availability, and reliability of systems.

1.4 Cooperation

Cooperation refers to a kind of technology that combines the best breed of strategic partners' products with NEC's cutting-edge technologies.

Products at a global standard level are essential in order to provide an open environment. To combine strategic partners' platform products that are examined and approved by NEC with NEC's cutting-edge technologies, NEC will enhance its joint development system as well as support system, and will establish an open environment while maintaining mission-criticalness.

2. OVERVIEW OF AUTONOMY

Autonomy refers to a type of technology in which IT resources such as hardware (HW) and software (SW) are able to automatically optimize their own operation, avoid failures, and recover from failures by understanding their own loads or failure status.

This technology has three elements: recovery, adjustment, and protection.

"Self-recovery" is a type of technology in which systems autonomously recover from failures. This includes: technology to automatically isolate failure sites; technology to automatically correct errors; and technology to infallibly activate the fail-over function in times of system failure.

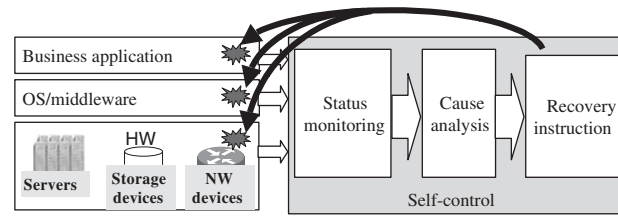
"Self-optimization" is a type of technology in which systems alter their own configurations so that their IT resources can be distributed optimally in response to changes by system loads. In VALUMO, highly-detailed resource distribution will be achieved by not only performing the conventional load balance adjustment for each server but also by performing load balance adjustment for each business application.

"Self-protection" is a type of technology used to protect systems from external attacks. Systems will autonomously implement security measures against malicious attacks, such as cyber-terrorism, and other unknown attacks, and achieve high level and stable protection (**Fig. 2**).

2.1 Self-Recovery and Self-Optimization Based on the Autonomous Processing Cycle

Self-recovery and self-optimization are achieved by first constructing the autonomous processing cycle (monitoring → analyzing → decision → action) in each layer of hardware, OS, middleware, and applications, that constitute an IT system, and by executing the cycle (**Fig. 3**).

Operation of the autonomous processing cycle is as follows. First, in the "monitoring" phase, relevant IT resources are monitored so that their loads or failure status will be understood. Next, in the "analyzing" phase, causes of performance problems or failures are analyzed by using knowledge necessary for speculation of failure causes or prediction of performance. In



Self-recovery	**Achievement of advanced recovery in response to failures**
Self-optimization	**IT resources change their own configuration to achieve optimal resource distribution**
Self-protection	**Protection against external attacks**

Fig. 2 Autonomy for stabilizing operations.

the "decision" phase, based on the analysis results, responses to the problems are then decided upon by referring to the policies that specify handling of each cause in advance. Finally, in the "action" phase, series of operations, such as separation and reconstruction of failure sites or addition of servers in response to deficiency in performance (SW deployment, installation, settings, and so on), are executed.

Also in hardware at a lower layer of an IT system, such an autonomous processing cycle exists as a function that automatically performs operations from failure detection to recovery. In VALUMO, the intelligent management platform, WebSAM, and the high availability system platform, SystemGlobe, will integrate individual components used in IT system construction, and run the autonomous processing cycle for self-recovery and optimization of the entire system.

2.2 Self-Recovery and Self-Optimization Based on the Backup Pool

In a computing system that is increasing in scale, an increase in operation costs becomes a serious problem. One of the operational cost reduction methods is called consolidation, in which business application are consolidated in high performance servers. For example, consolidating business applications that were conventionally handled by ten servers into a single high performance server is believed to dramatically reduce operational cost.

For such consolidation, partitioning technology is used in order to avoid interference among business applications. With this technology, a high performance server equipped with a large number of CPUs can be divided into many virtual cells and used as an independent server.

The self-recovery function provided by VALUMO reconstructs partition servers in accordance with the predetermined policies by separating failed hardware and automatically assigning new hardware from the backup pool in case of CPU or memory failures.

Such unattended recovery will reduce the time needed for recovery. Also, maintenance work that was conventionally conducted every time failures occurred can be done on a regular basis, resulting in improved maintenance work efficiency.

The self-optimization function provided by VALUMO monitors the status of CPU or memory loads. When a heavy-load status is detected, then the server automatically uses CPU or memory from the backup pool so that its capability will be enhanced. When there is no backup pool, CPU or memory assigned to low-priority business application can be automatically reassigned to higher-priority business application, in accordance with the predetermined policies. Also, if it is possible to predict the server will experience a heavy-load status on a particular day, or if operational loads are different between daytime and nighttime, then the schedule function can be used to reconstruct partitions before the loads become high.

In the future, VALUMO will expand the scope of application of its self-recovery and self-optimization functions through collaboration with SystemGlobe and WebSAM. For failures other than CPU or memory failures, WebSAM will identify the cause and select an appropriate recovery method in accordance with policies for the entire system (**Fig. 4**). Software installation or network and storage settings can be automatically handled not only to replace CPU or memory but also to replace failed servers with other servers.

2.3 Self-Optimization at a "Business Application" Level

In DiosaGlobe, which constitutes a part of

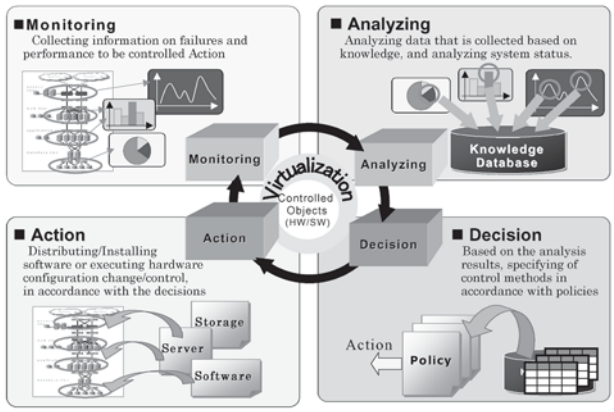


Fig. 3 The autonomous processing cycle.

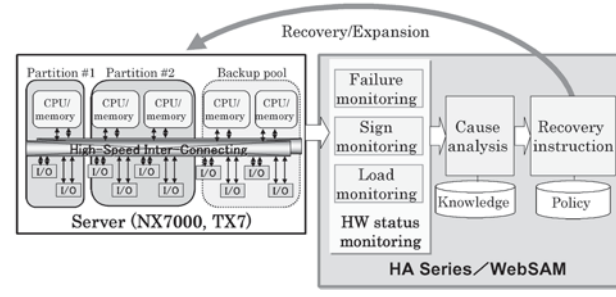


Fig. 4 The self-optimization function of SystemGlobe/WebSAM.

VALUMOware as a business application platform, services provided by the system are managed in virtual units of "business application," and load balancing and failure recovery are autonomously executed at a "business application" level. By using the concept of "business application," system availability and operational manageability are achieved.

The system consists of an extremely large number of programs that influence each other in intricate ways. Since it is difficult to monitor or control behavior of individual programs, DiosaGlobe incorporates the concept of "business application" for operational efficiency. "Business application" is the smallest unit of service that the system provides. For example, in online shopping, member registration, product search, and order placement are individually considered as specific "business application." Although a "business application" may involve multiple programs, it can be treated as a virtual unit, and for each unit, monitoring, load distribution, halt and reboot, and additions and changes can be performed.

There are some types of technologies for balancing loads caused by execution of applications, but the majority of them involve balancing based on physical information such as the number of sessions or application components (EJB, for example). However, when a service consists of multiple application units or when a particular session suffers heavy loads, it is difficult to adjust load balance.

In response to this problem, DiosaGlobe first monitors loads at the service level; for example, it will monitor response time or the number of executions for each "business application." And it conducts autonomous load balancing (**Fig. 5**). It is also possible to set a priority for each "business application." This will result in maintenance of service level and stable response for urgent business application.

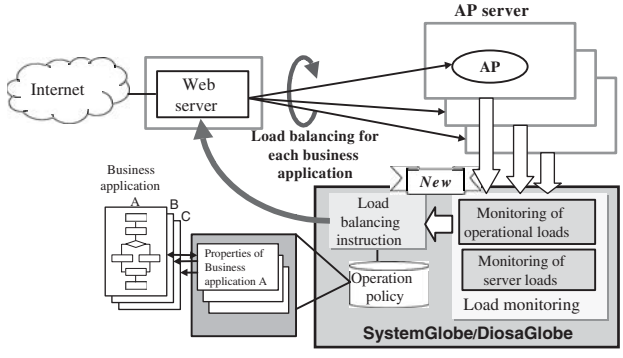


Fig. 5 The self-optimization function of DiosaGlobe.

2.4 Self-Protection by Integrated Security Management

Risks caused by illegal access to systems connected to the Internet have become a serious problem.

With the integrated security management function of WebSAM for intelligent management platform, a unified security level for the entire system can be maintained and necessary counter-attacks against illegal access can be made in real-time.

For events reported by security products that require some sort of handling, policies to be used by the security system must be set in advance. Then, when there is an event report, the integrated security management function will refer to the preset policies. By using these policies, the information on settings will be generated for individual security products under management, and then the information will be deployed and used with each relevant product. Such self-protective behavior allows maintenance of security for the entire system.

3. OVERVIEW OF VIRTUALIZATION

Virtualization refers to a type of technology to hide the complexity of IT infrastructure environments. With this technology, users can easily use the necessary functions, performance, and capacities of each piece of hardware and software without being aware of their complicated configurations. Resources of each hardware and software are virtualized, and only the necessary volume of resources can be assigned (**Fig. 6**). This will lead to reduction of system integration and operation costs.

By appropriate allocation of servers and storage devices that users need through the use of with large-scale servers or storage devices, it will be possible to achieve effective use of resources in accordance with changes in business application loads. For example, virtualization of one large-scale server into multiple virtual servers will allow flexible changes in throughput capacity through dynamic server resource assignment to heavy-load business applications.

3.1 Reduction of Operational Cost and Effective Use of Resources

In large-scale and heterogeneous computing environment, there are two issues in addition to the issue of preparation for hardware failures or load fluctuation.

First, due to heterogeneous system, setting methods differ with individual models, and this leads to an increase in time spent on installation or expansion of the system, time necessary for operator education,

and an increase in cost. Also, due to such complexity, much caution will be required when making changes to system configurations.

Second, there will be wasted computing resources. Loads on hardware are continuously changing. Therefore, when there is some hardware under a heavy load, there will also be hardware under a light load.

In the virtualized computing environment with VALUMO, various models of computers will be virtualized so that information unique to each model can be hidden and the same operation can be used to construct or change configurations (**Fig. 7**). Business application operators no longer need to learn how to operate each model. Remote hardware maintenance and addition can be executed through terminal consoles instead of in machine rooms. For example, when adding CPUs due to increased server loads in a virtualized computing environment, a system operator clicks on the relevant icon on the screen of the management console to call up a menu for CPU addition. The configuration management software will find available servers equipped with a large number of CPUs, automatically create the same environment as the one in which server loads have increased, and then replace servers. Business application operators or users, however, will not be aware of such server replacement.

Since it is easy to change configurations of virtualized hardware, it will be possible to provide necessary resources at an optimal level as needed.

At servers, logical servers can be configured with partition technology or blade servers, and CPU capabilities or I/O throughput capabilities can be adjusted

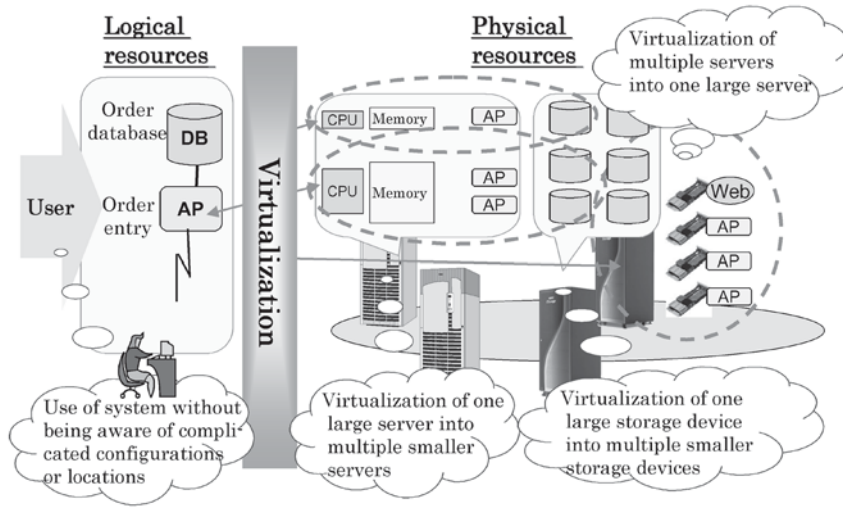


Fig. 6 Virtualization to reduce costs for development and operations.

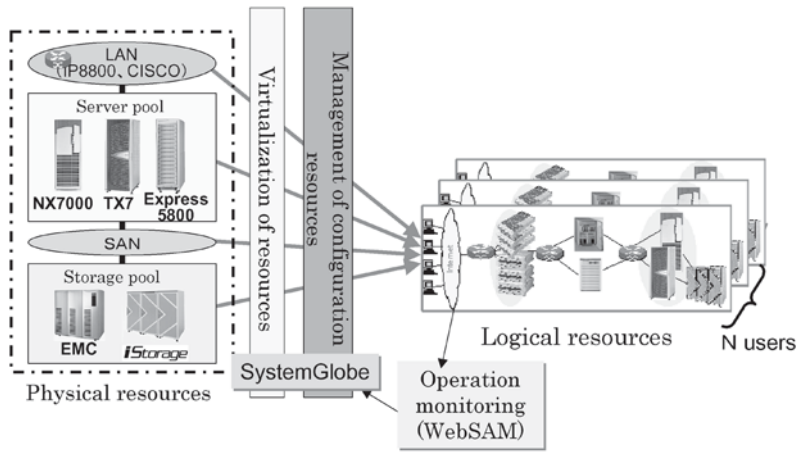


Fig. 7 "Virtualization" with WebSAM/SystemGlobe.

as required, or failed parts can be replaced with common backup hardware. Especially in large-scale systems, sharing of backup hardware will allow efficient use of resources.

As for storage, with the SAN (Storage Area Network) technology and storage device virtualization technology, it is now possible to freely cut out necessary data space independent of its physical configuration and to provide it to users. As for networks, with VLAN technology, it is possible to establish virtual LAN connections without making any changes to physical LAN connections.

3.2 Version Management of Applications through Virtualization of Business Applications

As described in the sections related to "autonomy," services making use of multiple applications are virtualized as "business applications" in the DiosaGlobe, a business application platform.

For each "business application," related multiple applications will be grouped, and in accordance with the attributes of each operation, settings of each application will be treated as policies. Virtualization will hide the application groups, and automatic distribution in times of version upgrade or environmental settings after distribution will be autonomously executed (**Fig. 8**). This will contribute to reducing operation as well as management costs, and also to reducing system failures due to operational mistakes. As a result, stable system operation will be achieved.

4. DISTRIBUTION TECHNOLOGY

This section will illustrate the technology for realization of distribution.

4.1 Inter-Enterprise Integrated System Operation

The distribution technology used in inter-enterprise integrated system operation implemented in Hub & Net will be described (**Fig. 9**).

In a B to B computing environment, business application services of the company work together with integrated operation services of partner companies. Therefore, integrated management of the system as well as service status of the partner companies is necessary in order to determine if the business application services of the company are running smoothly, or to determine how much influence there will be on the company's business application services when failures occur in business application services of the partner companies.

Currently, integrated operation management is conducted by agents that are in charge of individual intra-enterprise subsystems and managers that collect management information submitted by the agents and that comprehensively manage such information.

In collaboration between companies, intra-enterprise operation management is achieved by agents and managers as in the conventional way, and inter-enterprise operation management is achieved by exchanges of messages or management information between managers that manage the operation information of each company.

In inter-manager communications between companies, information defined by CIM (Common Information Model) is communicated by SOAP (Simple Object Access Protocol).

In such communications, confidentiality becomes an important issue since it is necessary to determine how much information on the company can be

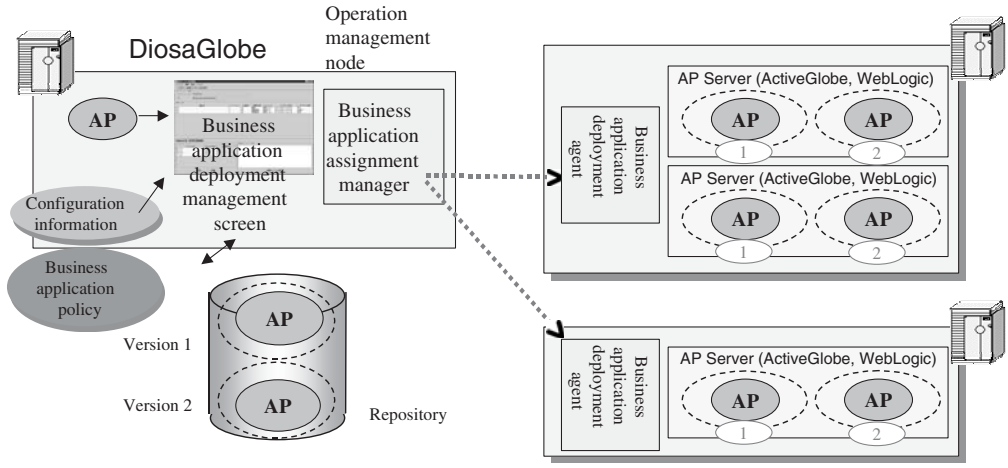


Fig. 8 The Version management of business applications with virtualization.

disclosed to the partner companies. In response to this problem, managers of each company manage operation policies, contracted at the time of inter-enterprise collaboration establishment, that specify how much information should be provided to each of the partner companies.

WebSAM, that realize inter-enterprise integrated system operation, provides the distribution technology of VALUMO. WebSAM is distributed operation management middleware that supports non-stop/multi-platform/heterogeneous environments and centrally manages operation monitoring or handling.

As seen above, by using the distribution technology of VALUMO in inter-enterprise integrated system operation, a highly reliable inter-enterprise collaboration system can be established. Also, using services not provided by the company but provided by a partner company through inter-enterprise collaboration can contribute to reduction of initial costs.

4.2 Disaster Recovery Using a Wide-Area Distributed System

Since 9-11, awareness of the importance of disaster recovery (recovery from failures or disasters) has risen. In terms of OMCS (Open Mission Critical Systems), the basic premise is that systems must not stop business, and the stoppage of business and services greatly affect relevant companies. System downtime can be calculated as a huge cost, and when downtime continues, some companies may no longer be able to resume their operations.

In OMCS environments, it is necessary to store important information and data in data centers or backup centers in remote locations in order to protect them from disasters or terrorism.

An example case of data backup will be described here. For intra-enterprise data backup, a synchronized data replication system with a storage function is used. Here, duplicates of business application volumes defined for each logical disk will be created, and they can be isolated at any given point in time (**Fig. 10**).

These replicated volumes will be used for intra-enterprise data backup. Therefore, business application does not have to be stopped while backing up. Also, these replicated volumes will be allowed to store in remote data centers or backup centers by using asynchronous data replication system. Furthermore, by integrating intra-enterprise systems with systems in remote data centers or backup centers through the distribution technology of VALUMO, and by monitoring system failures, prompt system recovery and continuation of business operations as well as services will be achieved in remote locations.

4.3 Inter-Enterprise Collaboration for Web Services

Web service is a service-oriented architecture. It uses standardization technologies specified by the Web service to establish intra- and inter-enterprise collaboration in distributed environments. Examples of standardized technologies in Web services will be described below (**Fig. 11**).

SOAP is a message infrastructure and serves as a protocol for Web service access. In SOAP, data is exchanged through XML (Extensible Markup Language), a text data format developed for text data conversion.

UDDI (Universal Description, Discovery, and Integration) is a directory service in which names, contents, and locations of Web services, and also information on service providers are registered so that the location and nature of Web services can be searched for. UDDI is used by service users when they wish to search for necessary Web services.

WSDL (Web Service Description Language) is a

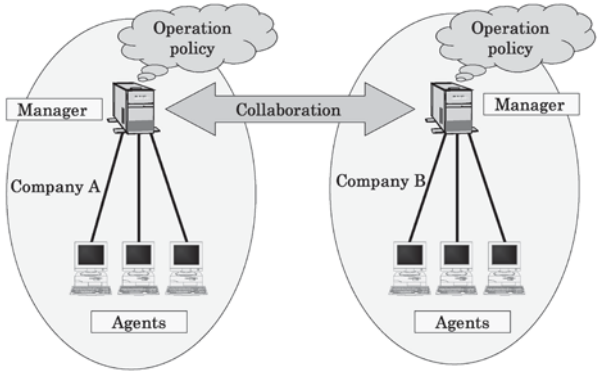


Fig. 9 Application of system unification.

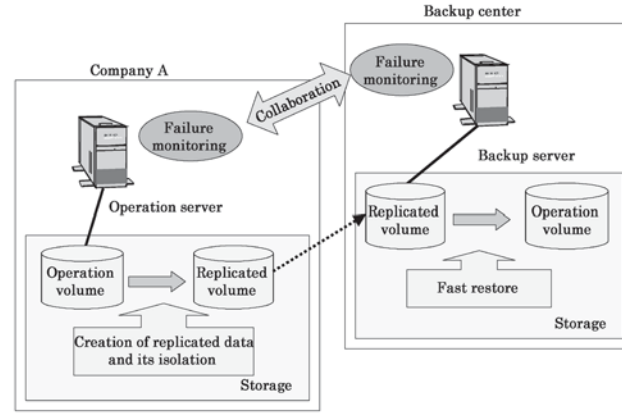


Fig. 10 Backup of distributed system.

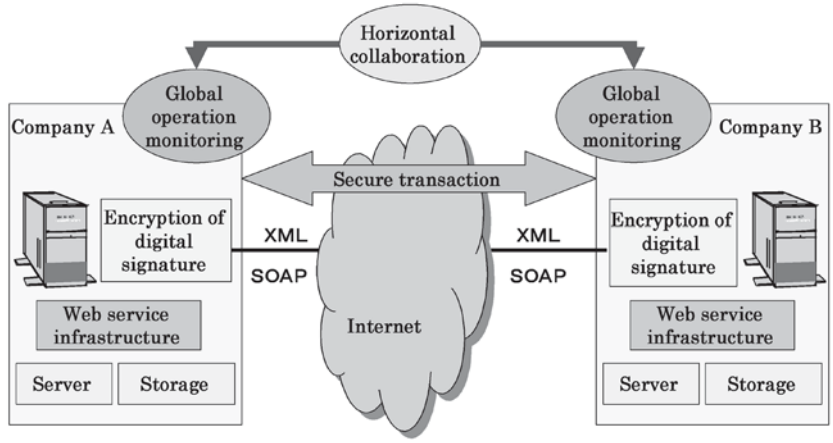


Fig. 11 Business-to-business collaboration for Web service.

language to describe interface specifications such as parameters for calling up Web services. It is used to write in the UDDI directory the contents of Web services and how to use them.

XML messages specify methods of requesting services or making responses for message exchange in Web services. Therefore, Web services can operate on a multi-platform basis and are also independent of programming languages. Also, in Web services, HTTP (Hyper Text Transfer Protocol) is used for data transfer. Therefore, no special settings are necessary to handle firewalls for inter-enterprise communications. As seen above, with Web services, it is possible to establish inter-enterprise collaboration without being aware of the systems of partner companies.

As the VALUMO distribution technology, the major products that efficiently establish and operate inter-enterprise system collaboration in Web services are the following: ActiveGlobe WebOTX, ActiveGlobe BizEngine, and WebSAM WebServiceManager.

ActiveGlobe WebOTX is an application server for integration business systems through Web services. It is compatible with the latest Web service specifications and has advanced component parts and development environment. By using these features, ActiveGlobe WebOTX allows development of object-oriented applications. Also, ActiveGlobe WebOTX provides a Web service infrastructure that enables Web services to smoothly establish wide-area operational collaboration.

ActiveGlobe BizEngine is compatible with standard e-business frameworks and provides a system platform that supports improvement of intra-enterprise Internet-based business process efficiency and collaboration of business processes between companies. Also, through highly reliable, safe, and sure Internet-based business document exchange or digital signatures on business documents, ActiveGlobe BizEngine will provide an inter-enterprise collaboration infrastructure with a high level of security.

WebSAM WebServiceManager attempts to improve reliability of B to B systems by detecting failures or lowered responses of Web services and then by automatically informing operation administrators. Also, by monitoring and filtering transaction data from inter-enterprise collaboration, WebSAM WebServiceManager prevents abnormal or illegal transactions and supports improvement of operational efficiency of wide-area operational collaboration through Web services.

As seen above, the VALUMO distribution technologies are capable of realizing efficient and secure inter-enterprise collaboration functions for Web services.

5. CONCLUSION

Systems are becoming increasingly complicated, turning themselves into mixed models based on combinations of various products, such that operations handled by IT systems have become diversified and widely spread out. VALUMO will maintain operation continuity of such complicated systems, reduce TCO of entire systems, and introduce products that incorporate autonomy and virtualization technologies as well as distribution technology in order to improve the reliability of IT systems.

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Minoru TERAO joined NEC in 1971, and currently the Director of the System Software Operations Unit.

Masato YAMAMOTO joined NEC in 1980, and currently the Director of the 1st Computers Software Division.

Yasuo IWAOKA joined NEC in 1972, and currently the Director of the Computers Software Operations Unit.

Naoto ISHIKURA joined NEC in 1969, and currently the General Manager of the Middle Software Division.

Kouichi HADANO joined NEC in 1977, and currently the Director of the Middle Software Division.

Junko ITOH joined NEC in 1981, and currently the Manager of the Software Planning Division.

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