Server Consolidation Using Virtualization Technology

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Summary

Consolidating servers using "virtualization technology" has become technically stable and is here to stay. In this paper, we will introduce the content we have studied in the course of implementation and the problems to be solved in the future, in order to achieve a balance between stable operation and cost cuts which should be of utmost importance to information systems for railway companies.

1. Introduction

Traditionally, automating the business process by the optimal use of IT has in itself led directly to the efficiency of business operations and the reduction of its cost. Nowadays, however, with the rapid growth in the use of IT, there are demands on us to pursue greater cost-effectiveness through IT utilization for itself with lower cost.

At the time when the business process had begun to be computerized, information systems were constructed on a scale specifically optimized for each business requirements. In order to achieve IT cost reduction, however, it becomes more important for us to proceed with the standardization and consolidation by conducting a review not from the viewpoint of individual optimization but from that of total optimization.

We are now in the process of promoting "server consolidation using virtualization technology" project, which combines server hardware resources together for further cost reduction.

2. Server consolidation using virtualization technology

(1) What is "Server consolidation using virtualization technology"?

In conventional system development, we have secured the hardware resources needed to specifically optimize each system when constructing a system environment.

Many of railway companies' systems, however, have different peak-periods for their processing: systems with their peak only during the busiest travel days of the year, systems with their peak process only during the settlement of account period, and so on. In such an environment where each system owns its hardware resources and runs independently, additional hardware resources will have to be secured so as to match respective peak performance.

Also, hardware resources during off-peak periods become redundant for those systems in which there are significant differences in performance between daytime and nighttime hours in a given day. This cannot be avoided when hardware resources are being physically separated from each other.

As illustrated in Fig.1, by implementing measures such as consolidating the physical hardware resources of multiple systems by the use of virtualization technology and making a mechanism to balance utilization rate, peak workloads could be balancing to other systems. This will help reduce to a minimum the redundant hardware resources deployed for the workload fluctuation.

Thus, total optimization of hardware resources of multiple systems using virtualization technology can maximize the utilization rate with less hardware resources required for each system.

In terms of cost for using virtualization technology, the representative advantages are the following three

1) Total cost reduction on maintenance and replacement due to the extension of software update cycle
2) Cost reduction on hardware procurement due to the economies of scale
3) Management cost reduction by collectively managing the hardware resources

What should be noted in 1), particularly, is that, as shown in Fig.2, with virtualization software (software for virtualization technology) intervening between hardware and software, it became possible for software to be updated to its original replacement cycle, which has conventional been replaced to the maintenance cycle of hardware. This will help reduce the maintenance and update cost.

The use of "virtualization technology" has become highly reliable in recent years with more companies beginning to introduce it at a rapid rate. There was apprehension about "performance guarantee" because of the lack of operational experience in the company. In the design stage, when hardware resources such as CPUs and memory were to be logically allocated onto multiple systems built on a server

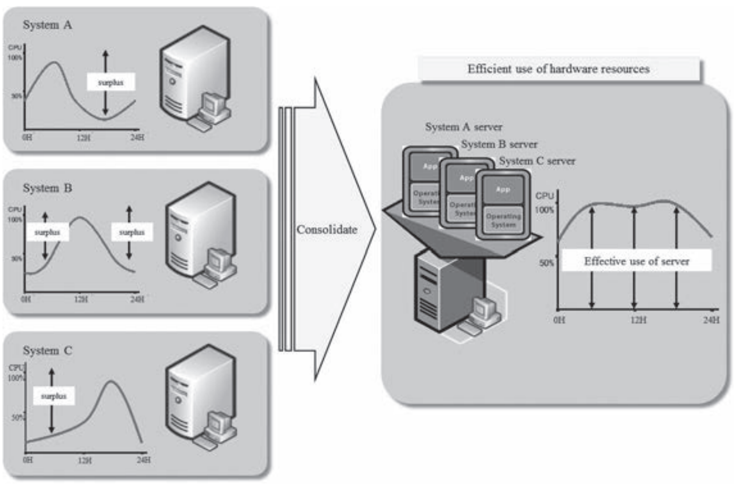

Fig.1 Image of hardware resource utilization

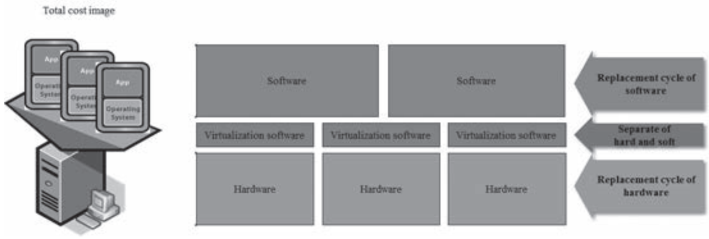

Fig.2 Separation of software and hardware replacement cycle

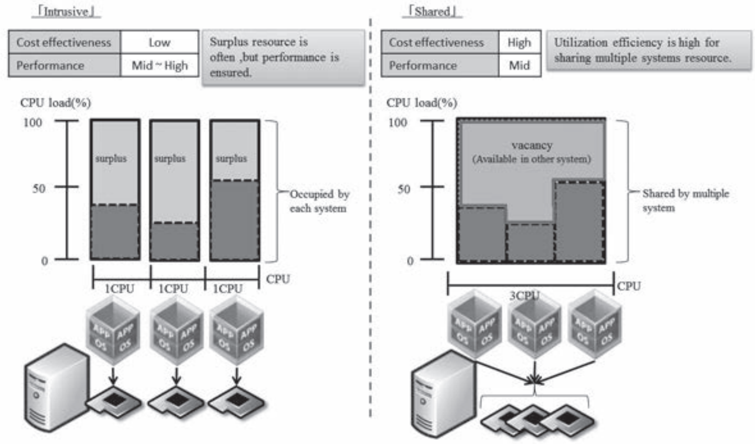

Fig.3 Images of "dedicated" and "shared"
Dedicated: hardware resources are dedicated to each system
Shared: hardware resources are shared by multiple systems

consolidation platform, two types of allocation- "dedicated type" and "sharing type" (Fig.3) – were considered.

It is true that "shared type" allocation of hardware resources is effective in order to achieve a significant cost reduction through efficient use of hardware resources, but we adopted "dedicated type" of hardware resource allocation by making use of the characteristics of a virtual environment in which allocated hardware resources could be reallocated afterward. Thus, we minimized the potential risk that multiple systems would influence each other on a server consolidation platform.

As a result, performance tests of each individual system confirmed the reliability of the system performance, as its performance exceeded that of existing systems in a physical server environment.

(2) Verification of cost reduction

Based on the actual building expenses, we conducted the comparison and verification between the specific costs of maintaining and updating on a physical server in conventional method and that of maintaining and updating on a server consolidation platform.

As the subject for an evaluation, we have selected "total cost" necessary over the system lifecycle, which includes the "initial costs" temporarily necessary to implement a new system or replace an aging system and the "continuing costs" for maintenance/operation necessary until the replacement time comes. The cost-reduction target criteria were set as follows:

1) Criteria of assessment on initial cost

The sum of hardware implementation cost using material procured for each system is more than the hardware purchase and implementing costs on the server consolidation platform, as there is no difference in software implementing costs.

2) Criteria of assessment on total cost

The sum of total cost which includes initial cost, and maintenance and operation costs is more than the maintenance and updating costs on the server consolidation platform.

In this case, we made the assessment that compares the model, which went through several update cycles at which the separation of software and hardware is taken into consideration on the server consolidation platform, with the model, which got updated software at the same time with hardware replacement using conventional methods. The image is illustrated in Fig.4.

Although there were factors for cost increase due to the rise of maintenance and operation expenses from the cost components evaluation result, we concluded that the evaluation result in which overall cost reduction effects were obtained as a total system, because of the optimization of software update cycle and hardware replacement cycle resulting from the separation effect using virtualization technology contributed greatly to the cost savings in a decrease in the number of system replacements.

(3) Effective usage of hardware resources

As mentioned above, "shared type" of hardware allocation is preferable to pursue optimal use of hardware resources. However, we took "dedicated" allocation approach, which had resulted in not enough resource usage, in view of avoiding the risk of performance degradation.

It is feared that "shared type" might cause a performance degradation of multiple systems due to temporary depletion of hardware resources from an unexpected fluctuation of their utilization or an overlap of their peak usages. To realize efficiency while minimizing these demerits of "shared type", we came up with the idea of "hybrid type" allocation, combining "shared type" and "dedicated type" together.

As illustrated in Fig.5, "hybrid type" allocates dedicated resources for routine workloads and shares fluctuating workloads with several systems from the usage result of each system hardware resources.

In order to verify its introduction effect, we conducted continuous measurement of its utilization (average utilization, maximum utilization) by monitoring hardware resources (CPU, memory) usage of each system for a period of one year.

As a result of utilization measurement, hardware resource utilization rate (CPU) averaged approximately 3% to 20% and peaked at 30% except some systems. With redundant resources large enough to be effectively used, we consider the way toward optimum allocation.

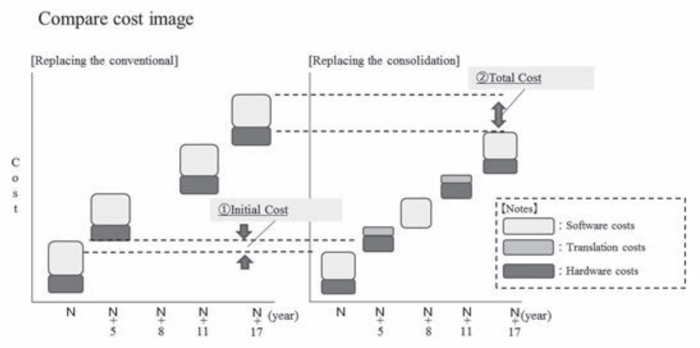

Fig.4 Image of cost comparison

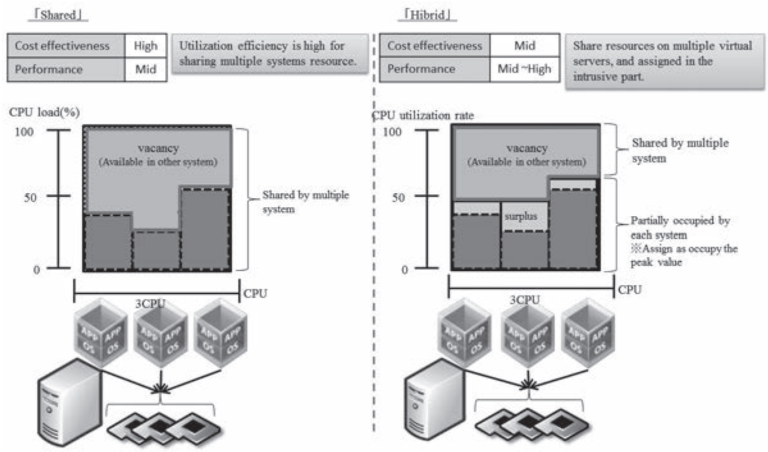

Fig.5 Images of “hybrid” type

By changing its resource allocation from “dedicated” to “hybrid”, approximately 56% CPUs and 15% memory resources have figured out to be available to be utilized. In time, we are going to change its resource allocation setting and switchover to an operation phase.

(4) Towards further cost reduction

We are going to further promote continuous system maintenance cost reduction centering on the following four approaches:

1) Maintenance level optimization

We have provided a 24-hour-a-day, 365-days-a-year maintenance support for overall server consolidation platform in order to keep the availability level of large scale system onto which servers have been consolidated. This turned out to be too excessive for small scale systems, some optimizations may be needed for it.

2) Reduction of operation cost

We are going to establish a method to start up with low cost operation from the beginning by examining the criteria on allocating appropriate hardware resources for newly connected systems

3) Broadening of consolidation target while minimizing cost

We are going to reduce the price by creating competitive environment based on the advantages of virtualization technology in which you need not to take the application requirement expertise into consideration when selecting construction partners because of its versatility as well as its low reliance on hardware.

4) Extension of software update cycle

The possibility of sudden system failures is very low when programs have been running stably for a long time through generations of simple porting software without changing the application requirements. We will therefore evaluate if it is possible to reduce maintenance costs while keeping stable operations by continuously using the time-proven software after its support expires.

3. Closing remark

We have so far introduced the efforts directed toward reducing the IT cost. Focusing too much on it, however, if we take a risky approach lacking in balance by misjudging the influence and importance for its business, we may end up jeopardizing stable system operation which should be required for a railway business system. We are going forward with the cost reduction measures balancing both “low cost” and “stable operation”.

NEWS

○J-TREC – Completion of a Battery-Powered Vehicle and Start of Operation in March 2014 on the Karasuyama Line

Japan Transport Engineering Company (J-TRECK) belonging to East Japan Railway Company (JR East) group hold the completion ceremony of the series EV-E301 battery-powered vehicles (nickname ACCUM) on January 20th at its Yokohama work place. This first stainless steel EMU in Japan can run non-electrified section with large-capacity storage battery, and many effects are expected such as exhaust gas dissolution, reduction of carbon dioxide emissions and noise reduction. JR East starts the operation according to the revised diagram on March 15 on the Karasuyama line.

J-TREC has been working on plan and produce for next-generation stainless-steel vehicles, brand name “sustina” which substantialize change of the vehicle structure with new technology, great energy savings during operations with light weight body and improved body rigidity. J-TREC and Tokyu Corporation jointly developed series 5050 No.5576 vehicle for Tokyu Co. as first edition domestic series in April 2013.

The second edition “sustina”, series EV-E301, is a two-car train set with lithium ion batteries on each car. In the electrified sections the train runs with power via a pantograph as the same as normal EMU, and charges a storage battery. Series EV-E301 operates by battery power over the non-electrified sections and is charged by a special charging facility at the stop time in Karasuyama station.

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