Virtual PC-Type Thin Client System

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Abstract

NEC has developed VirtualPCCenter, a thin client system with a completely new concept that virtualizes integrates entire personal computer environments on servers, and also developed the US100, a dedicated terminal for the system. Features that deserve special mention with regards to the VirtualPCCenter include a diverse range of functions intended to adjust the balance of the load on virtual PCs, as well as to improve operability. Furthermore, the US100 offers an animation playback accelerator capability, considered unsuitable for thin clients, as well as a software phone, featuring a superior sound quality and lower incidence of acoustic delay. This paper introduces features of the VirtualPCCenter and US100.

Keywords

thin client, virtualization, animation, software phone, superior sound quality, low incidence of acoustic delay, distributed RTP processing package

1. Introduction

A thin client is a client that does not store any data or application on a terminal computers. Instead, it performs all processes by accessing servers. At NEC, we observed the effect of a reduction in the total cost of ownership (TCO) with the "Screen Transfer System" and accumulated an array of performance records by providing a solution long before other manufacturers took an interest in it. Nowadays, NEC makes three thin clients methods available, "Virtual PC System," "Screen Transfer System" and "Network Booting System," in order to offer flexibility for selections based on the environments and applications, in response to a progressively diverse range of needs with security enhancements as an underlying requirement. The "Virtual PC System" in particular, is a new thin client system that is unique to NEC and a product based on a completely new concept, involving the complete virtualization of personal computer environments and the integration of such environments on servers (**Fig. 1**). By combining dedicated terminals, the VirtualPCCenter supports multimedia (an animation playback accelerator feature), which had been inadequate with conventional thin clients and offers a telecommunication feature (software phone) that is essential for offices.

2. VirtualPCCenter Platform Software

As mentioned above, the Virtual PC System runs its operating system and applications, which operate on client terminals in conventional virtual PC systems, on servers, leaving only the operating console and screen on the thin client. Features that deserve special mention, as technologies made available with the VirtualPCCenter platform software, are included below. These are described in detail later on.

1) Adjustment of load balance on virtual PCs
2) Improvement of operability

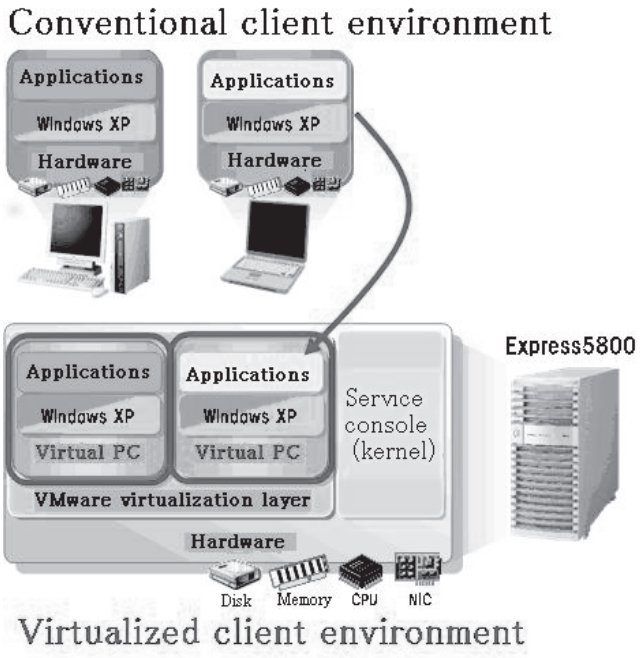

Fig. 1 Virtualization of PC.

2.1 Adjustment of Load Balance on Virtual PCs

In the virtual PC system, multiple client PCs that are virtualized on a single server (hereinafter referred to as "virtual PCs") are not only available for running operating systems and executing applications, but the allocation of an actual CPU, which is made available for use with individual virtual PCs, can also be freely adjusted. It is possible to set a certain sharing ratio (allocation ratio) whenever the load on a CPU is high, while the flexible allocation of a CPU, which does not depend on the sharing ratio, is available when the load on the CPU is not high (**Fig. 2**).

In addition, it is not only possible to adjust the load balance on a single server, but also across multiple servers as well. A single virtual PC is a virtualization and as such it can be virtualized on different servers (**Fig. 3**). For this reason, it is possible to transfer a virtual PC across servers, as long as certain conditions are satisfied. By using this technology it becomes possible to distribute the loads on servers by transferring virtual PCs running on servers with higher loads to those with lower loads.

2.2 Improvement of Operability

Since PCs used by end users are centrally managed with VirtualPCCenter, improvement of operability becomes a critical issue. The VirtualPCCenter platform software has hardware status and fault management features for servers and other hardware. These features incorporate autonomous recovery technologies that have been incorporated into existing products from NEC and are capable of performing the detection of faults through to automatic recovery. By specifying the methods used to recover from faults in advance, the automatic recovery feature operates according to such a specification when faults are detected. If specified methods for recovery are too complex, this would result in a large load on operational managers and system designers. The virtualization technology is very useful for this purpose.

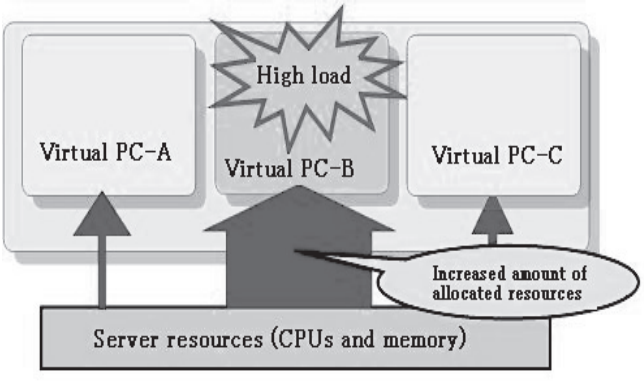

Fig. 2 Resource allocations within virtual PC server.

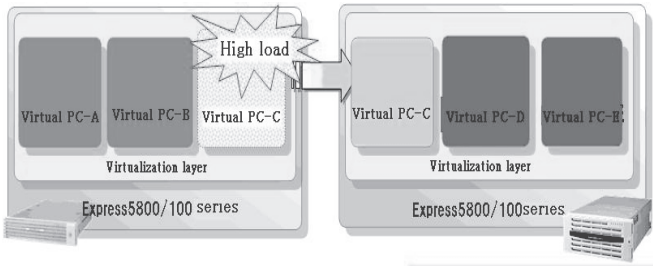

Fig. 3 Resource allocations across virtual PC servers.

With the VirtualPCCenter, the virtual PCs are not dependent on any hardware type. Unified management with the virtualization technology for operations is described here. Management operations of virtual PCs can be categorized into power supply operations, such as system booting and shutting down, operating machine management, such as the configuration of new and deletion of existing virtual PCs, as well as software management, such as software installation including batch installations. In actual operations executing procedures are performed by programs that install applications in software management, for example, with a variety of programs available for actual installations. When virtual PCs are configured, applications to be used must be installed and procedures may vary depending on the individual task at hand. It is possible to unify these using virtualization technologies, such as group management technologies, resource management technologies or even scenario execution technologies.

(1) Group Management

The number of systems subject to management, as well as operation types can be reduced by grouping virtual PCs into clusters. For example, if a business operation is known as the "Response Center," then there must be a list of specific applications to be installed or particular network settings required. In such an environment it is possible to manage the business operation unit of the "Response Center" as a group and respond to any fluctuations in the number of personnel involved with such business operations simply by controlling the number of necessary virtual PCs. When there is a need to install an additional application, the application list for the group can be updated and applied to all members of the group. The operational managers are released from the cumbersome management of virtual PCs.

(2) Resource Management

An important aspect of the group management is its ability to reduce the number of items subject to operation and management by gathering a number of virtual PCs into a single group. The essential technology for this purpose is the resource management technology.

Resources are resources essential for performing actual operations, such as server hardware involved with the setting and actual operation of virtual PCs belonging to the group, as well as other network devices. The VirtualPCCenter platform software incorporates resource list management and assignment management features, made available by resource management technologies. Resource lists are prepared in close collaboration with features that have resources and status detection functions. For example, a server hardware status is obtained from a server management feature, whereas virtual PC information is acquired from a virtualization machine feature. The details of such multiple resource providers are summarized by the VirtualPCCenter platform software, which are then managed simply as resources and information that varies individually is detached as "properties" to enable unified operations for operators (**Fig. 4**).

(3) Scenario Management

Scenario is one of the resources for managing information relating to the necessary steps for the actual execution of software, as well as the results of actual executions when implemented. As with resource management, such complex procedures are separated into application installation data, execution procedures and information of the server holding installation data. These are all managed as a single scenario, thereby simplifying the execution of complex program installations and the management of lists for installed applications. In order to configure a new virtual PC a manager can allocate a scenario to a group to automatically and sequentially implement complex procedures, including procedures that must be taken for installing the selection of software and designation of servers from which to obtain such software.

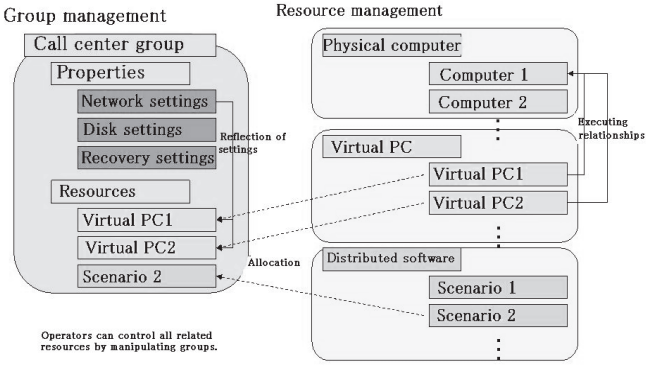

Fig. 4 Relationship between groups and resources.

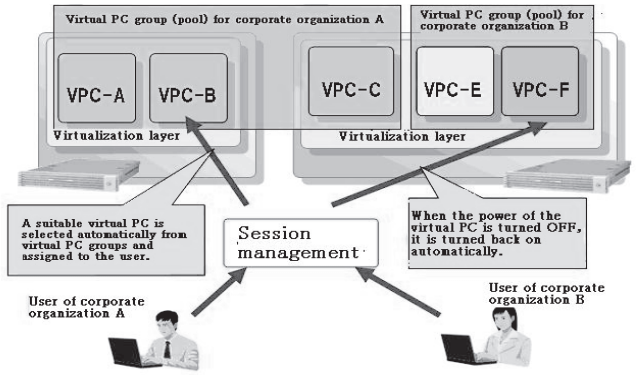

Fig. 5 Assignment of virtual PCs that are suitable for users.

(4) Session Management

Session management is the management of sessions between thin client terminals and virtual PCs, which are integrated on the servers. Session management is used to reduce the management work and improve operability for users. By allocating suitable virtual PCs to users and user organizations from grouped virtual PCs (or pools) in group management, described earlier, users are able to use virtual PCs without being aware of the virtual PCs to which they are connected (**Fig. 5**). Furthermore, the sort of management in which it is possible to keep track of who is using which virtual PC, also becomes possible at the same time.

3. US100 Dedicated Terminal for Thin Clients

We now continue with the introduction on the features of the US100.

3.1 Summary of Terminal

The US100 (**Photo**) was developed as a terminal to support virtual PC systems. The product is in a compact housing that measures 34 (H) × 155 (W) × 104 (D) mm, weighs merely 370g and operates with a low power consumption of 11W. Its most prominent features are its animation playback accelerator feature, which is considered to be unsuitable for thin clients, as well as a software phone feature. These hardware features are achieved through functions necessary for thin clients, offered by a single chip solution. This chip is a system on chip (SoC) integrated with the 0.13µm technology and is comprised of an

Photo External view of US100.

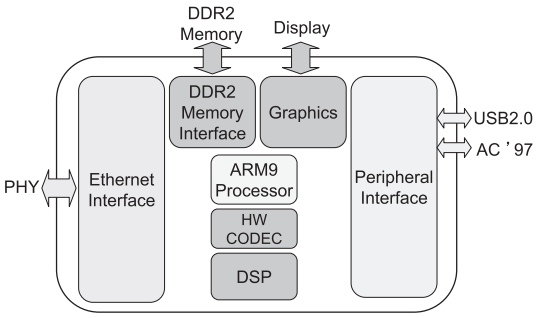

Fig. 6 Structural outline of dedicated chip.

ARM9 CPU core, DDR2 memory interface, GPU core, Ethernet interface, peripheral interface, video engine (HW-CODEC) and DSP (**Fig. 6**).

The system conversion to SoC inhibits power consumption, realizes miniaturization and a fanless configuration and features an animation playback accelerator not available with ordinary thin clients, as well as software phone features through the collaborative operation of individual components.

3.2 Realization of Animation Playback Accelerator Feature

When animated images are played back on remote desktop computers or conventional thin client systems for display transfer systems, animation data must be decoded and sent by a server to the intended terminal. The amount of data that is transferred becomes enormous, making it impossible to playback animated images smoothly. With systems that use the US100, however, an RTP connection is established for the transfer of animation data between a virtual PC and a US100 once the playback of MPEG1 or MPEG2 animation starts as shown in **Fig. 7**. Animation data is sent to the US100 through the RTP connection via the dedicated Multimedia Acceleration Filter prior to decoding. The US100 decodes data that has been

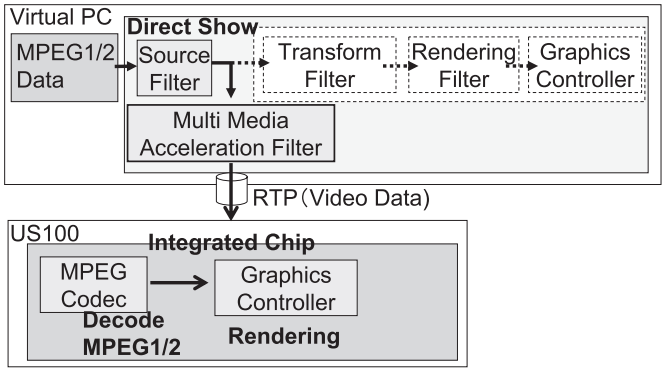

Fig. 7 Method for realizing animation playback accelerator feature.

sent using a dedicated hardware decoder to smooth out the image display for playing back animated images.

3.3 Realization of Superior Sound Quality for Software Phone Feature

Assuring the sound quality is the most significant issue for the realization of a software phone on thin client systems. In particular, the issue of acoustic delays must be resolved. If an attempt is made to realize a software phone feature on a conventional thin client system, even when ordinarily the transmission and reception of RTP (Real-time Transport Protocol; a protocol used for real-time transmission of audiovisual data) packets can be completed through a single communication from one terminal to another (P2P communication), the system requires the input and output of sound at the terminal while the RTP processing must be executed on a server, thereby requiring three communications starting from a thin client terminal to a server to the server of the destination thin client and then finally the destination thin client, as shown in **Fig. 8**. As a result, an excessive amount of communication causes acoustic delays, which are so significant that realistically it would be difficult to use such a system for making phone calls. We developed a distributed RTP processing package system to realize P2P communications with thin client systems in order to resolve this acoustic delay problem and to offer software phone features that rival those of conventional personal computers (**Fig. 9**).

(1) Feature 1

With the distributed RTP processing package system, audio input and output, as well as RTP transmissions and receptions are detached from software phone that operate on a server, completing the feature of the thin client terminal. As a result, the RTP transmissions and receptions take place be-

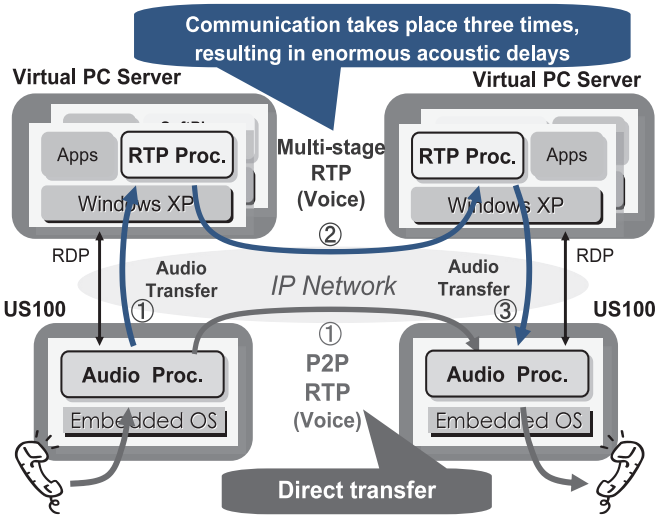

Fig. 8 Acoustic delay issue for thin clients.

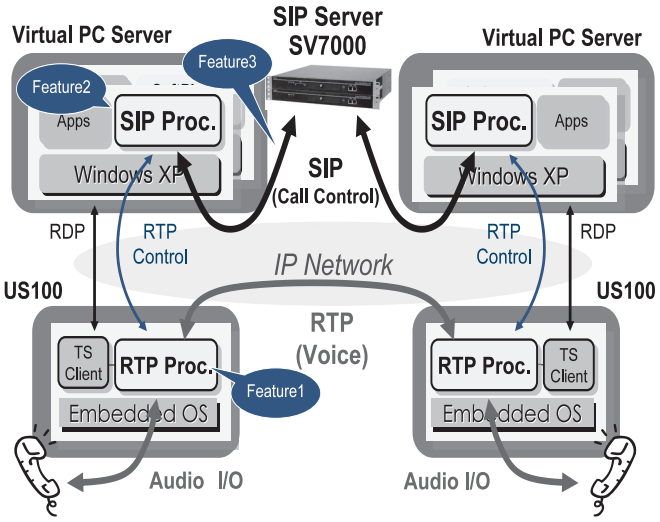

Fig. 9 Distributed RTP processing package system.

tween terminals as P2P communications, thereby minimizing acoustic delays. Furthermore, since the RTP process is detached from processes on the server, incidents of inhibition on RTP processes, due to sudden bursts of high loads arising from virus scans that occur on ordinary personal computers, are eliminated. As a result, a sound quality is realized that is even more stable than those available on ordinary personal computers.

(2) Feature 2

On the other hand, all functions other than the RTP process are performed by the software phone. Although the RTP processing is an important component of the overall software phone, it is a process that is not visible and thus all other functions can be performed with the software phone on a server. Users are provided with features that are practically identical to those available on ordinary personal computers. The compatibility of telephone functions and a user interface is maintained at an extremely high level. Furthermore, one of the benefits provided by thin clients is the high level of security. All personal information, such as directory or call history, reside only on a server and the high level of security provided by the thin client will not diminish in any way.

(3) Feature 3

This system performs the SIP (Session Initiation Protocol; a call control protocol used by IP telephones) control processing by the software phone (executed by the server), as with conventional systems, but this is actually beneficial for the SIP server also. The SIP servers can handle calls without distinguishing between software phones on ordinary personal computers and those on thin clients.

We were able to realize a software phone on thin client systems rivaling those on ordinary personal computers and which feature high compatibility with conventional systems using the distributed RTP processing package system. Since the software phone for thin clients is a product field that did not exist previously challenges lay ahead. Still, we intend to continue with our efforts to create attractive products in the future.

4. Conclusion

Out of the three connection methods available for thin clients, features of the VirtualPCCenter, based on our new concept, as well as the dedicated terminal US100, have been introduced. We expect further demand for enhanced convenience, high-speeds and flexibility as thin clients become more and more prevalent in the future. At NEC, we intend to identify the changes in customer needs and requirements in order to strive for the creation of attractive products.

* Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

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