Storage Centric Network Architecture

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Abstract

We have developed a prototype storage centric network. By consolidating the built-in storage of personal computers (PCs) into external storage on a network, this system aims to centralize everyday management of multiple office PCs with a system management department while ensuring business continuity by rapidly restoring PC environments after unexpected disasters.

1. Growing concerns regarding PC management

In recent years, as the performance of business information-technology (IT) systems has risen, the use of personal computers (PCs) in the office has become commonplace. At the same time, however, the threat of disruption of PC environments from computer viruses and worms is becoming ever more serious. Accordingly, businesses are demanding full-time security measures to protect their systems from such threats. They must not only provide protection such as firewalls to stop break-ins from outside but also manage security within PCs. The three main requirements for such PC management are:

- Rapid installation of security patches for the operating system (OS) and application programs
- Regular updating of definition files in antivirus software and regular scanning for viruses
- Aborting and deleting unnecessary application programs and services

Usually, the OS and application programs are stored in the PC's built-in storage (i.e., hard disk). This means that each user spends a lot of time on PC management. Companies often expect regular employees to handle all PC management tasks; however, in the current situation, it is difficult for them to do PC management thoroughly.

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Meanwhile, the computerization of businesses is increasing the opportunities to create important data and documents on office PCs. As a result, when disasters like earthquakes or fires occur, there is a high risk of important data stored on PCs being completely lost. Although data loss can be averted by backing up files, backing up large amounts of data in PC files is difficult and bothersome. After the destruction of the World Trade Center in New York, it was found that data in mainframe-class systems had been adequately backed up, so data recovery was successfully completed in a short time, but the data on many desktop PCs had not been backed up and was thus irretrievably lost.

2. Features of a storage centric network

To solve the above-mentioned problems, NTT Information Sharing Platform Laboratories are conducting research and development of a storage centric network [1]. The storage centric network is designed to provide centralized PC management and disaster recovery by replacing the built-in storage in PCs by external storage on the network. At present, we are developing a prototype and tackling technical problems before putting it to practical application. The main features of this prototype storage centric network are explained in sections 2.1–2.3.

2.1 Centralization of PC management

A typical client PC used in an office contains all the

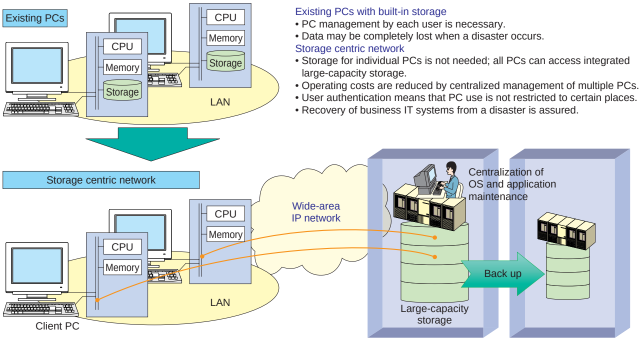

Fig. 1. Overview of a storage centric network.

devices it requires, such as the CPU (central processing unit), memory, and storage. On the other hand, in the storage centric network, the storage for each client PC is incorporated in a large-capacity storage system (with distributed backup) on the network (**Fig. 1**). By accessing this network storage via a wide-area IP network, client PCs connected to a LAN (local area network) can boot up and run by using externally stored OSs, application programs, and data. This offers several advantages. Consolidating the OS, application programs, and data of all PCs in an office on the large-capacity storage allows PC management to be carried out by a system management department in a centralized fashion. This makes it possible to maintain uniform quality of PC management and reduce operating costs by eliminating individual PC management by each user. In addition, having no data at all stored on client PCs is beneficial from the viewpoint of preventing the leakage of confidential information from PCs.

Server-based computing (SBC) also aims at centralized PC management, but all application programs are installed and executed on the server. Client PCs just display windows of the application programs. Therefore, SBC requires a high-performance application server. A storage centric network, on the other hand, does not need an application server because a client PC runs application programs on its own CPU.

Fig. 2. Example of a client PC connected to the storage centric network.

The prototype that we have constructed supports the Linux OS. **Figure 2** shows an example of a client PC constructed for use with the prototype. Transparent material is used for the main body of the PC so that its internal structure can be seen (on the right of the figure). It does not contain any storage devices (hard disk, floppy disk, CD-ROM, etc.) at all. Even so, the Linux OS can be operated normally, and the usual desktop views can be displayed.

2.2 User authentication

In a storage centric network, when a client PC is powered up, the user can be authenticated. Conventionally, the user of each PC is usually predetermined. That is to say, the PC's hard disk contains the OS and application programs customized by the user. In a storage centric network, on the other hand, since storage is not built into the PCs, the concept of a specified user does not apply. Instead, a specific region for each user (referred to as a user region) is reserved on the large-capacity storage system on the network. A client PC performs user authentication when it is booted up, selects the user region according to the authentication result, and starts up the user's personal PC environment by accessing the OS saved in that region.

To assure more secure authentication, in addition to using the usual user name and password, our prototype system uses a USB key simultaneously. From the viewpoint of a storage centric network—which stores data outside of PCs—user authentication is extremely important, so the prototype utilizes both hardware (USB key) and software (user name and password) information for authentication. **Figure 3** schematically shows the design of the prototype. The main office is used for regular business. Employees use client PCs at that office to perform their work. Large-capacity storage is set up in the main data center connected to the main office by a wide-area IP network, and the OS, application programs, and data used by each client PC are stored there. After turning on the PC, the user inserts a USB key into the client PC and then inputs his/her user name and password. If authentication is successful, the client PC receives permission to access the user region assigned to that user ("user A" in the figure) and boots up accordingly. The user-authentication method implemented in our prototype is only an example. For even higher security, another authentication method (e.g., fingerprint recognition) could be used.

This user-authentication function lets the storage centric network allow the user to access from anywhere instead of from a particular place. In other words, any client PC that the user sits down at acts as his/her personal terminal with a familiar personalized environment.

2.3 Wide-area IP network connection and disaster recovery

The storage centric network uses the iSCSI protocol* (which is based on IP storage technology) for wide-area connections between client PCs and the large-capacity storage. The iSCSI protocol can transmit SCSI commands on an IP network. This protocol is more suitable than conventional SCSI for transmission over longer distances.

The prototype system simulates a wide-area network (connected via a 100-km optical-fiber cable) and disaster recovery. As shown in Fig. 3, when a disaster occurs, the functions of the main office are taken over by the backup office, which also contains client PCs. Similarly, if the main data center encounters any problems, its role can be taken over by the backup data center, which contains a large-capacity backup

* iSCSI is currently being standardized by IETF (Internet Engineering Task Force).

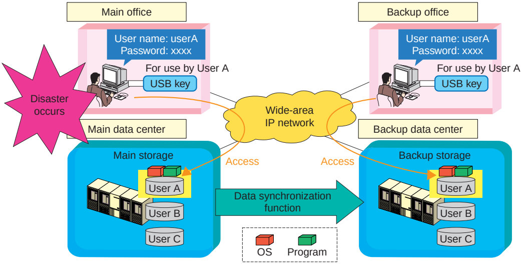

Fig. 3. Schematic design of the prototype storage centric network.

storage. The data synchronization function of the storage system synchronizes the data stored in the main and backup storage systems. These four locations are connected by an IP network via a 100-km fiber-optic cable, so this prototype network is set up as a pseudo-WAN environment.

Normally, a client PC in the main office accesses the main storage of the main data center. However, if a disaster makes it impossible to use both of the main office and the main data center, an employee can go to the backup office, be authenticated at a client PC as usual, and use that PC. In this case, the client PC accesses the backup storage and boots up with the same operating environment as the main-office PC. Thus, the employee can continue his/her work in the same manner as in the main office.

3. Future developments

NTT Information Sharing Platform Laboratories has set up a prototype storage centric network, whose main functions are centralization of PC management, user authentication, wide-area connection, and disaster recovery. Access to storage via a LAN or wide-area IP network involves many technical problems, such as slow response, network congestion due to storage traffic flow on LANs, and support for other OSs, such as Microsoft Windows, as well as Linux. We are solving these technical problems one by one and working toward a practical storage centric network.

Reference

[1] http://www.ntt.co.jp/news/news03e/0311/031120.html

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