Special Edition on System Components

"Storage over IP": a Virtual Storage Solution Net Bridge 2000

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Abstract

*With the rapid growth of the Internet and proliferation of services providing content, and with the progress being made to convert documents to electronic files, requirements for data storage continue to grow steadily. The work of system administrators in relation to the maintenance and management of data storage is becoming a big burden. For example, administrators must decide on the data storage capacity required each time a server of any type is installed and, to respond to operating requirements, must plan equipment expansions recognizing the expansion limitations of each server. We have sought to solve these problems by providing the features needed for the operation and management of storage systems in the form of "Net Bridge 2000," our "Storage over IP" [*1] virtual storage solution. Net Bridge 2000 is a solution that allocates virtual drives to each server (file server, Web server, mail server, etc.) and provides centralized control of increasing/decreasing allocated drive capacity, backup capability, etc.*

The environment surrounding storage

In the past, storage was allocated to each server machine and managed by it. In other words, each server which required data storage, such as file servers, Web servers, mail servers, etc. was given storage capacity. Moreover, whenever expanded storage capacity was needed, a requirements forecast had to be done for each server considering its properties and it additional hardware had to be purchased. Today, however, due to such factors as expansion of the Internet, increase in the frequency of using email on every mail server, and the tremendous increase in the size of attached files due to the availability of broadband, it is already quite difficult to forecast accurately the amount of data which will be handled. Moreover, data losses due to capacity shortage and the time required to procure and install storage facilities upgrade directly result in business opportunity losses. To deal with this situation, a solution is needed for centralized management of system change requirements, such as expanding data capacity without system downtime, reallocating resources, etc.[1]

Nowadays, two storage architectures are gaining attention: NAS (Network Attached Storage) and SAN (Storage Area Network). One frequently hears discussions comparing NAS vs. SAN, but these are not approaches which can be compared in the same arena; each has a character which suits certain applications.

NAS is a type of storage equipment which integrates a file server and storage into one body; it has the advantage of easy attachment to IP-based LAN's (Local Area Networks). Many types of NAS can support different OS's as NAS clients, and because one objective is sharing at the file level, in many cases NAS is used in small-scale to medium-scale group servers, etc. NAS has the demerit that, when the data communication volume at remote backups, etc. becomes large, due to performing IP-based data communication, there will be pressure on the LAN bandwidth. On the other hand, it has the merit that connection is easy and no particular skill is needed for operation and management.

In contrast, SAN has the merits of [a] being outstanding in terms of expandability in networks which connect numerous server and storage groups in a mesh pattern and [b] reducing the LAN load by means of "LAN-free backup." Because one feature is high-speed I/O access at the block level, SAN is used in medium-scale to large-scale database servers, etc. In most cases, the networks among storage servers use FC (Fiber Channel) connections, so for operation and management, besides knowledge of LAN's, skill in the area of FC networks is needed.

Summary of Net Bridge 2000

Net Bridge 2000 is an appliance server which incorporates IPStor software (from FalconStor Software Inc.) on a server based on the Linux OS and creates one large virtual storage pool from various storage devices (SCSI, FC, iSCSI, etc.) and, logically allocating the storage to each application server, enables integrated management. Either of the NAS or SAN approaches mentioned above can be used and the application servers can use the virtual drives via the IP network with the physical structure for connecting to the storage being "invisible." (See Figure 1.)

In other words, it is possible for two kinds of servers to co-exist: application servers which perform block access, as in a normal SAN environment with software called SANclient installed, and application servers which act as NAS clients and do file level sharing using a protocol like NFS or CIFS. In order for Net Bridge 2000 to access from a number of application servers when

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*1 Storage over IP: A recently coined word meaning the accessing of storage resources via an IP network. It is becoming popular in the storage field.

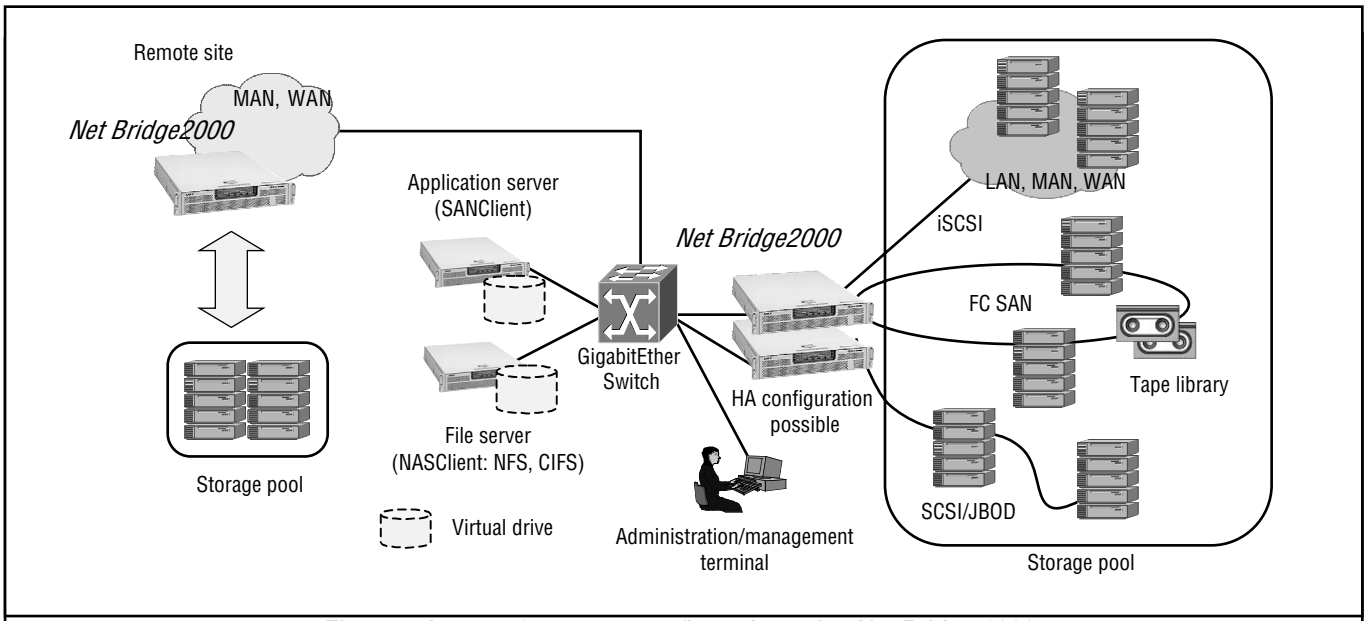

Figure 1: Image of a system configuration using Net Bridge 2000

reading or writing files, Gigabit Ethernet is used between Net Bridge 2000 and the application servers, thus achieving a high-speed storage network.

In addition, in order to provide itself with redundancy, Net Bridge 2000 can put together an HA (High Availability) two-unit configuration (without the need for special third party software) and, by means of HeartBeat, the units can do "alive or dead" checks on each other. When one Net Bridge 2000 unit goes down, service can be continued with the other Net Bridge 2000 ("failover"). In this way, data centers or xSP's can provide 24-hour, 365 days a year online service.

The Storage Service Provided

Net Bridge 2000 provides not only management of virtual storage but also the following storage features:

- Synchronized "mirroring"
- Remote replication
- Zero-impact backup
- Snapshot

Synchronized mirroring is a function that provides data redundancy in order to keep downtime to a minimum in the event of a fault in the physical storage apparatus.

Remote replication, by copying the data of a primary site and keeping it at a secondary site, enables speedy data recovery in the event of a disaster at the primary site.

Zero impact backup is a function that performs backup of virtual drives without placing a load on the application server. Zero impact backup uses the "snapshot" feature to back up the virtual drive image at specified times.

Snapshot is a function that copies virtual drive images at specified times. It is executed by a trigger from impact backup or remote replication.

Below we describe in detail these storage services.

Synchronized mirroring

Synchronized mirroring keeps downtime in the event of a fault in the physical storage apparatus to a minimum, thus providing high system availability. With the mirroring design of Net Bridge 2000, at the same time as writing data into the primary disk (the disk that is normally accessed from the application server) the same data is written into a "mirror disk," so that this mirror disk keeps an accurate copy of the primary disk. In the event of damage to the primary disk, the mirror disk takes over the role of the primary disk. The two disks are connected to a single Net Bridge 2000.

In the case where it is necessary to exchange the physical disk itself due to damage to the primary disk, it is necessary to resume mirroring to synchronize the disks again.

Remote replication

Just as synchronized mirroring ensures redundancy against damage to local disks, remote replication ensures redundancy in regard to so-called "regional damage." Replication is a process for maintaining remote copies of virtual devices themselves. (See Figure 2.)

A snapshot is fetched from the virtual drive at time intervals specified ahead of time and that snapshot is transmitted to a secondary site, so that a remote replica is synchronized. Particularly in cases where data centers and xSP's are regionally distributed, this function is very effective as a means for protecting a customer's important data.

In case a fatal fault occurs at a primary site, the application server is immediately redirected to the replica at a secondary site and normal storage access can be continued without significant downtime or loss of data.

However, replica storage normally is connected to a Net Bridge 2000 in a remote location and application servers do not have access rights to the replica storage. To deal with

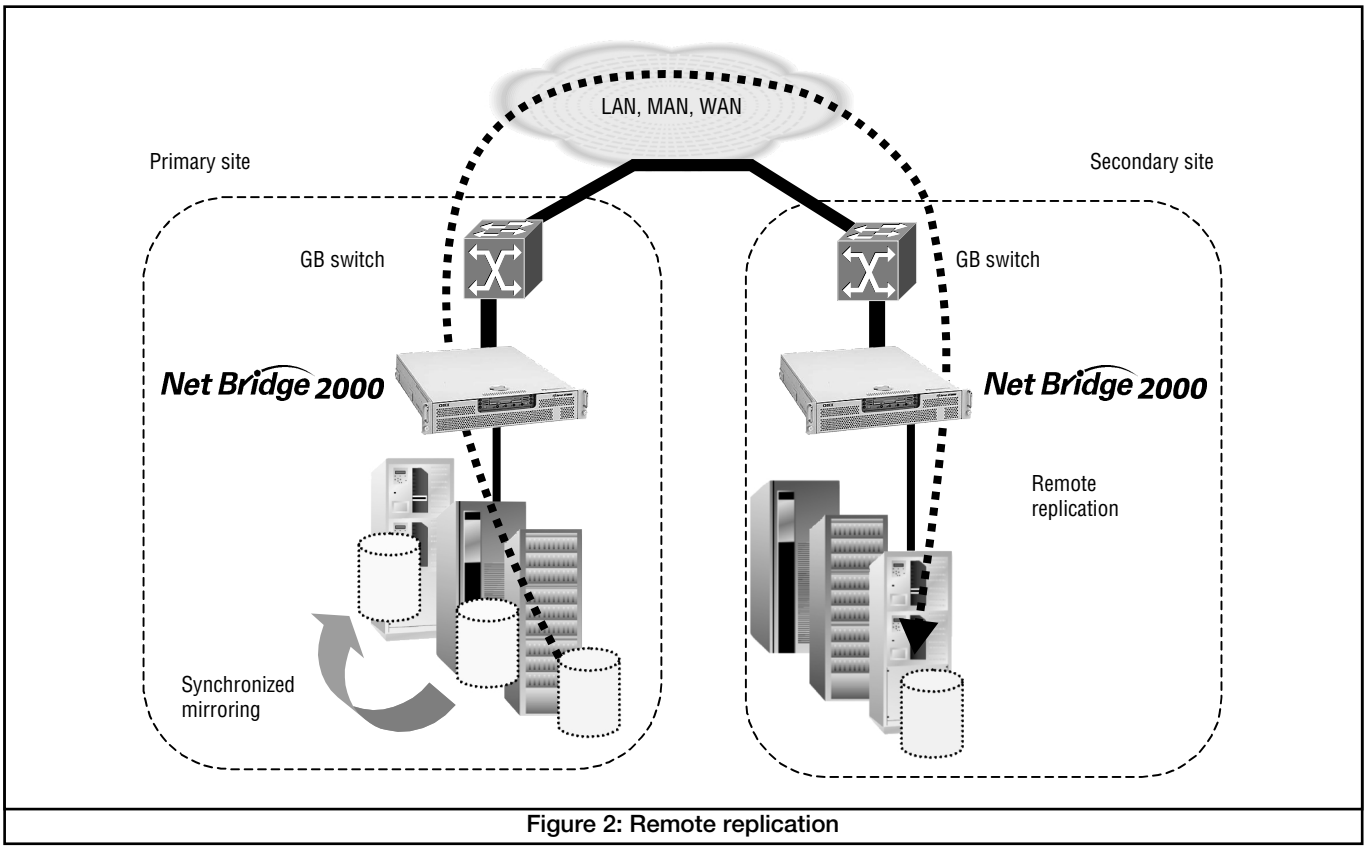

Figure 2: Remote replication

this, after an accident occurs and a replica is needed, it is necessary to refine the replica as the primary disk so the administrator can gain access from an application server.

After reconstructing the primary site, the restoration work is done from the primary site, following the recovery procedures.

Zero impact backup

Zero impact backup is a function which performs tape backup/restructuring of the raw devices of the virtual drives. Backup/restructuring of virtual disks is performed using only the Net Bridge 2000, without putting a burden on the application server (hence, zero impact). (See Figure 3.)

By creating at least one snapshot "reserved" area, when this backup function is initiated, the snapshot function is triggered and fetching of a snapshot at a specified point in time is done. During this time it is possible to continue to write into virtual devices, so in fact from the standpoint of the application server, there is "zero impact."

This function demonstrates good results in environments where there are a number of application servers and the services running on each server cannot be stopped.

Fields for application of Net Bridge 2000

Net Bridge 2000 can be selected for use in any of a broad range of application areas, such as the following situations:

- User has a problem because the work of expanding disk capacity is bothersome.

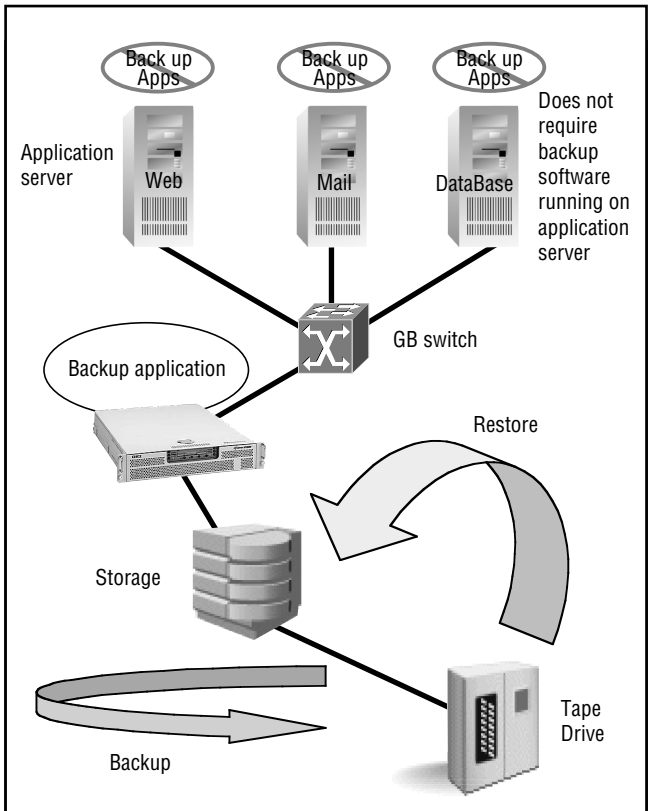

Figure 3: Zero Impact Backup

- There is a lot of idle disc capacity which creates waste.
- User does not want to stop applications whenever expanding disk capacity.
- User worries whether only backing up local data in enough.
- A lot of time is required because the job of daily backup must be done on each server.
- Distributed storage can be applied to any user facing the problem of not having enough administrators, whether a company, a communications carrier, data center, xSP, or etc. Moreover, minimization of TCO (Total Cost of Ownership) and maximization of ROI (Return on Investment) can be expected.

Conclusion

Everyone knows that, with further development of the Internet, e-business, etc. in the future, there will be increases not only in the volume of data which businesses have, but also in asset value of this data. However, the facts that forecasting data volume is extremely difficult and present architectures and operating methods hobble companies in their efforts to achieve storage integration and centralized management.

In this paper, we introduced Net Bridge 2000, a Storage over IP virtual storage solution based on IP networks. Net Bridge 2000 is creating a stir as the first step toward the era of storage integration, and at Oki Electric we plan to go on to develop new storage solutions from a variety of starting points.

We began selling Net Bridge 2000 in October, 2001.

Reference

1. Computer Age, Inc. Monthly "Computopia," Special Edition on Data Storage, Report, 2001.