Snapshot Lifecycle Management - SLM

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Abstract

This paper sets forth "Snapshot Lifecycle Management", an innovative way to manage snapshot data rather than using Information Lifecycle Management. There are two major problems occurs in snapshot management by ILM: "inappropriate migration" and "redundancy". SLM manages snapshot data elaborately according to its characteristic to eliminate the twin problems. In addition, this paper also proposes "Snapshot Support for iLVM (Internet Logical Volume Management)", integrating SLM into iLVM. Use Copy-on-Write technique to update data between local site and remote site and replace the "Remote Region Time Parity" scheme in remote data checking.

Keywords: Snapshot Lifecycle Management, ILM, image-based, iLVM, and mirror.

1. Introduction

The twenty-first century is the age of knowledge-based economy where success or failure of data protection will be the major key to enterprise's competitiveness and survival. Depending on the type of organization, data are growing at rates up to 50 percent or more annually [2]. There were about 5 exabytes of new information produced in 2002. And almost 800 MB of recorded information is produced per person each year [3]. With the progress of technology, the issue of storage area turns from "how to store great quantity data" into "how to find the desired information from great quantity data". It is considered not efficiently uses the storage resource to just purchasing new storage device when storage space is not enough.

The concept of Information Lifecycle Management (ILM) was proposed few years ago. According to the value of data, data store in appropriate storage. Therefore, only the important or access-frequent files are stored on the online storage device, to the contrary, others are stored on near-line or off-line storage device. Besides reducing the TCO (Total cost of ownership) of storage, regulatory compliance also is another major reason to introduce ILM [5]. But the management policy in ILM is file-based. In mention to snapshot, block-based technique to create multiple versions of file, file-based management is not suitable to it. In order to solve this issue, hence this paper proposes a novel concept of "Snapshot Lifecycle Management" (SLM). SLM is an image-based mechanism to manage snapshot images. This theory is mainly based on that the access probabilities of different versions of data are not equal. The recent snapshot images have larger probability to be access than the formerly ones. SLM can make use of storage in a more efficient way by migrating the formerly snapshot images to near-line storage and keeping the recent ones on the on-line storage.

This paper also improves the "remote data checking" in [6]. Remote Region Time Parity (RRTP) is used in the paper. Using snapshot to update mirrored volumes can reduce computation (parity computation) and improve performance.

2. Background

Along with the economic times of physical labor of past, the times of the knowledge-based economy has already come. Therefore how to protect the data, further management data in an efficient way, and get the biggest benefit from data is the key of competition between enterprises. ILM means the enterprise can manage the capture, create, retain, backup, and destroy processes throughout lifecycle of data. The ILM system migrates the data to proper medium according to access frequency or importance or how old the data is. Information Lifecycle Management (ILM) is defined by Storage Networking Industry Association (SNIA): The policies, processes, practices, services and tools used to align the business value of information with the most appropriate and cost-effective infrastructure from the time information is created through its final disposition. Information is aligned with business requirements through management policies and service levels associated with applications, metadata and data [7].

EMC [8], HP [9], IBM [10], NetApp [11], Sun [12], and many other companies advocate ILM and declare ILM is the best solution for information management. ILM can be concluded in several phases

which shown in Fig. 1 according to some researches [13] and [14] and so on about ILM.

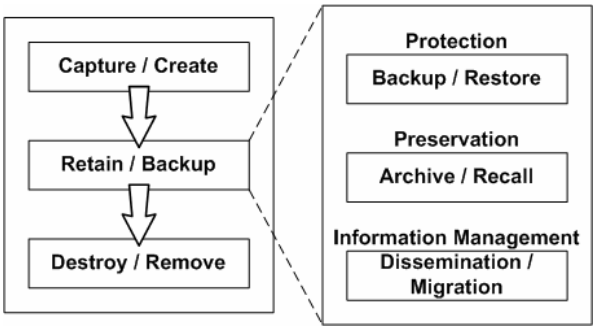

Fig. 1: Information Lifecycle Management

There are two schemes proposed to do remote data checking in [6]. The first one use Remote Region Global Parity (RRGP) to make hierarchical region checking. In this scheme, every LE (Logical Extent) parity is calculated by XOR all data blocks in the LE. Then XOR all the LE extent parities to get RRGP. But this scheme need to do parity computation through all blocks in the volumes. The second one is limited in semi-synchronous mode. Remote Region Time Parity (RRTP) is obtained by only XOR all varied blocks. Although the second scheme can reduce the parity computation compared to first one. The computation still causes performance decrease when great deal of block is overwritten.

3. Snapshot Lifecycle Management

As shown in Fig. 2 (a), ILM is a file-based information management system, the access-frequent files or important files (Ex: File A, B, and C) are store in online storage (Ex: Serial SCSI disks with RAID 5 protection). Files which are retrieved occasional (Ex: File D, E, and F) are store in near-line storage (Ex: Serial ATA disks). The archives or backup files (Ex: File G, H, and I) are store in off-line storage (Ex: tape library). Information management base on file is not suitable for snapshot. Therefore, this paper proposes a novel thinking way to make more proper management for snapshot.

3.1. Prototype Architecture

The concept of Snapshot Lifecycle Management (SLM) is illustrated in Fig. 2 (b). To the same but different versions of files, SLM align the value of snapshot image with the most appropriate and cost-effective infrastructure from the time snapshot image is created through its final disposition. As shown in Fig. 2 (b), File S has eight versions according to the timeline. Because the different versions of file have dissimilar values. SLM can align value of snapshot images more precise than ILM. SLM migrates different versions of file to proper medium which is suitable to them. For instance, File S comprises two blocks. The first block indicates the second one is a value, and it didn't be changed through the timeline. The second block of File S is a value changed in some point-in-time in timeline, and the value varied as shown in Fig. 2 (b). Because snapshot is usually used to make short-term protection, the probability to retrieve recent snapshot images is always lager than retrieve formerly ones. So the SLM can keep two newest versions of File S in online storage (number of versions to keep depends on policy).

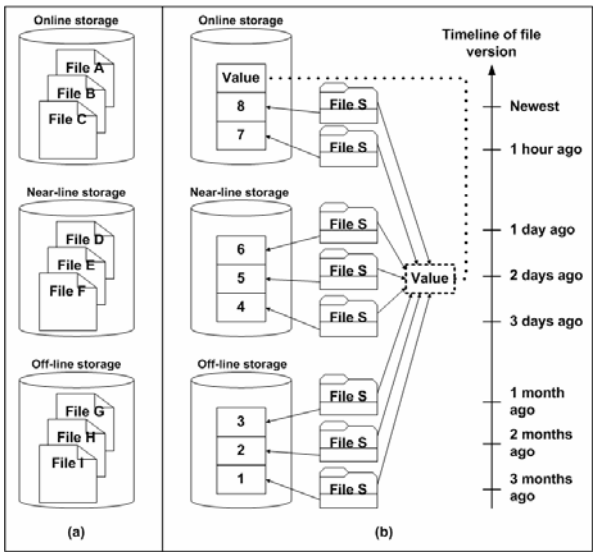

Fig. 2: (a) File-based management (ILM); (b) Image-based management (proposed Snapshot Lifecycle Management)

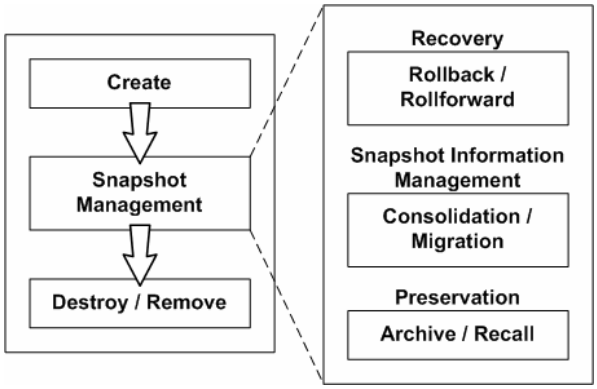

Fig. 3: Proposed Snapshot Lifecycle Management

The method shown in Fig. 1 in ILM is not appropriate to manage snapshot images. There are two problems if ILM treats different versions of file as different files during migration. The first one is inappropriate migration: migrate the old version of file may move part of the newest version to unsuitable medium because the unchanged part is unique. Inappropriate migration will reduce the performance when retrieve this file. The second problem is redundancy problem: make different versions of file into real different files in order to avoid the first problem. But this may waste storage space due to several copes of unchanged part of original file.

So this paper proposed a modified architecture for snapshot lifecycle management. SLM comprises three phase, from create, snapshot management, and destroy/remove. In snapshot management of SLM, there are three subsets: Recovery, Snapshot Information Management, and Preservation. Recovery should include rollback and rollforward in order to get the maximum fault-tolerant ability. Snapshot Information Management should comprise consolidation and migration. Consolidation can make multiple contiguous snapshot images to become single snapshot image. The consolidated snapshot image will be marked as the newest point-in-time snapshot images before consolidation. For those files changed many times but only the final version is needed, consolidation can save lot of storage space. Introduction of consolidation can make more flexible management for snapshot. Migration's purpose is just same with ILM but for snapshot images rather than files. SLM is customized for snapshot, and enterprises can benefit from snapshot management with SLM rather than ILM.

4. Application of SLM

This paper also proposes combination of SLM and novel snapshot technique [15] to improve performance in updating remote sites between local site [6]. The semi-synchronous updating scheme in [6] is as shown in Fig.4 (a):

1. Initialize the RRTP and against record to zero.
2. After completing each write operation, then XOR the varied data block to RRTP.
3. Against record += 1, and go to step 4 if against record reach the threshold.
4. Update remote sites between local site using RRTP. Then, the application or client in local site can access the data now.

On the other hand, this paper proposes another method illustrated in Fig. 4 (b):

1. Suspend the write request when file system receive it.
2. Local site redirect the request to buffer after transmitting the data block which its block address is destination of this write request. Then, the application or client in local site can access the data.
3. Remote site apply the data block after receiving the data block, then send an acknowledgement to local site.
4. After get the acknowledgement from remote site, local site change the pointer to original block address and free the block in buffer.

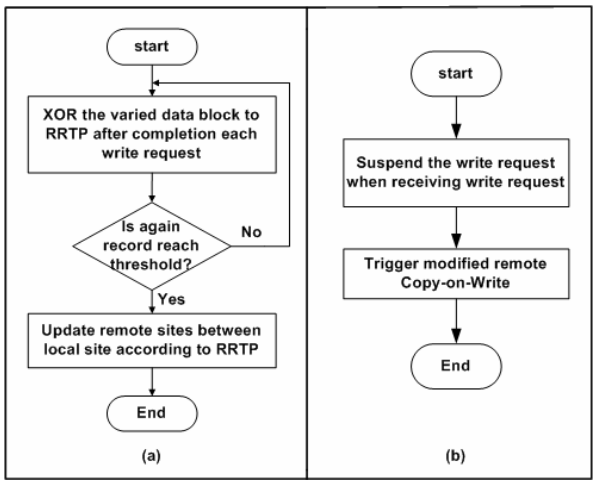

Fig. 4: (a) Remote data checking mechanism in [6], (b) Using novel remote snapshot technique [15] to update the remote sites

The difference between adjacent snapshots can be used to update mirror. Furthermore, local site can take several snapshots to protect import data. The consolidation of SLM can eliminate the unnecessary data and transmits the final data of the overlapped block address to the destination of mirror.

The proposed scheme makes the use of combination of SLM and iLVM more flexible. And it also makes iLVM have a shorter backup window than original.

5. Conclusions and Future Work

ILM try to align the business value of information with the most appropriate and cost-effective infrastructure. But the file-based management method is not suitable for snapshot. This paper proposes a

novel Snapshot Lifecycle Management (SLM) according to the characteristics of snapshot, unchanged part is shared between several snapshot images. SLM can really align the values of snapshot images with the most appropriate infrastructures, and that's ILM can't do. This paper also improves the remote data checking mechanism using novel remote snapshot technique to avoid parity computation.

The present SLM is focus on information system protected by snapshot technique which is implemented in Copy-on-Write. Nevertheless, there are several ways to implement snapshot. This SLM needs to evolve in order to support all kinds of snapshot. And what effect will appear when snapshot is used with other data protection technique is another issue. Migration policy is the core of SLM, therefore the future SLM system should have self-adaptive ability to learn from pattern of snapshot images.

6. Acknowledgement

This paper is supported by Home Network Technology Center, Industrial Technology Research Institute / South, R.O.C. Project title: Research IP storage application: Architecture and Techniques of Mirror and Snapshot. Project No. T1-94026-5. Brief description about this project: Mirror and Snapshot are two important technologies to realize storage backup. We hope to realize the storage application influence regarding the storage system. Expected achievements: Providing implementation of test software which will apply to storage system, and reducing the develop time as short as possible.

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