The NDMP-Plus Prototype Design and Implementation for Network Based Data Management

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Abstract: Network based data management/backup/restore is the key component in the data storage centre. This paper proposes a new network based data management --- NDMP-Plus. We firstly discuss the components of the NDMP-Plus architecture. Then, we detail two new techniques in NDMP-Plus --- VSL (Virtual Storage Layer) and the negotiation mechanism. VSL is the core component to implement the flexibility, which could avoid the network communication with the storage media directly. And the negotiation mechanism is the key mechanism to improve the performance. Furthermore, we carry out an experiment to evaluate the performance of NDMP-Plus. The result of it suggests that NDMP-Plus has stronger flexibility and higher performance than the original NDMP.

1. Introduction

In modern data storage centre, it is too difficult for the administrator to manage/backup/restore over thousands of millions of data using the distributed file systems (e.g. NFS, CIFS and DAFS [1]). To implement data backup/restore management, NDMP (Network Data Management Protocol) is then introduced [2]. However, because of the lack of flexibility of the NDMP framework, we introduce new techniques for NDMP in this paper to enhance the flexibility and performance. In particular, we propose the NDMP-Plus prototype originating from NDMP but differing in the interior design of the architecture. Compared with NDMP, the NDMP-Plus prototype has two new features as follows:

(1) NDMP-Plus introduces VSL (Virtual Storage Layer), by which it can erase the difference between the data service and the tape service of NDMP and provide a new uniform service --- the data+ service used as either the data provider or backup server dynamically. VSL could also avoid the network communication with the storage media directly.

(2) NDMP-Plus provides one negotiation mechanism, by which it can decide the data transmission format dynamically and enhance performance (e.g. the data can be transmitted in the form of the tape device or the file-system to the data backup server). While NDMP merely uses tape device format to transmit data, which will bring some unnecessary processes in some cases (e.g. backup data from one NAS to another) and decline performance.

2. The Architecture of NDMP-Plus

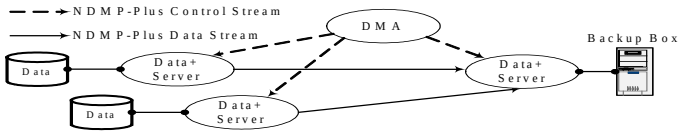

Fig. 1. The basic architecture of NDMP-Plus

The NDMP-Plus basic architecture, as shown in Fig. 1, provides DMA (Data Management Application) and the data+ service. The administrator uses DMA to manage, backup and restore data. The data+ service is a uniform service for all the NDMP-Plus compliant hosts. Compared with the data service and the tape service of NDMP, the data+ service of NDMP-Plus provides the uniform interface to all storage devices. In the glossary of NDMP-Plus, there is no primary or secondary storage device; all storage devices are the same to the data+ service and classified by the working method of the storage media.

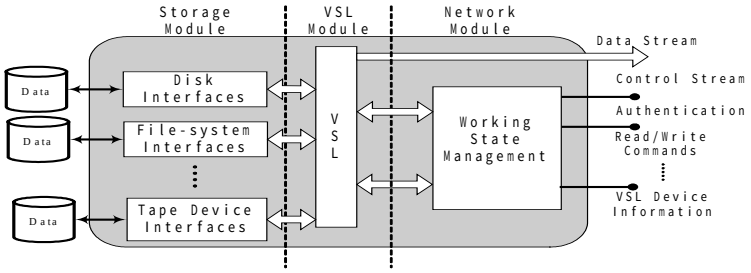

Fig. 2. The Components of The Data+ Service

A data+ service is composed of the VSL module, the network module and the storage modules, as shown in Fig. 2. A fundamental issue in the data+ service is how the backup/restore manipulation and the storage media are associated. To address it, this paper provides a media-independent module --- the VSL module. VSL instances one storage media to a VSL device entity and provides the information of that storage media to the network modules. The storage module involves one or more sub-storage media module. Each kind of sub-storage media modules is classified by the read/write method and the storage format of data.

3. The Implementation of VSL

VSL is a key component to realize the flexibility of the NDMP-Plus prototype, manage the storage modules and provide a series of uniform VSL interfaces. The internal frame of VSL is shown in Fig. 3.

VSL employs the pair --- {MediaID, DeviceID} to identify every logic storage partition the administrator can access. Both MediaID and DeviceID are globally exclusive numbers in the scope of VSL, hence DMA can use DeviceID to access the

right logic storage partition and VSL can use MediaID to redirect the access to the real storage media. In practice, VSL provides a structure (VSLStorage) to describe an abstract storage module and a structure (VSLPartition) to describe a logic storage partition. And then the two structures cooperate with each other to implement the management of VSL.

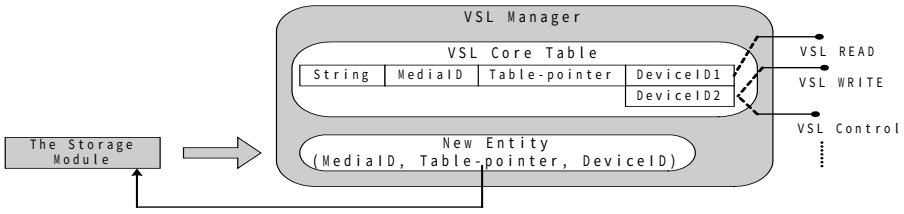

Fig. 3. The Internal Frame of VSL

4. The Negotiation Mechanism

In the glossary of NDMP-Plus, one session means that one connection between the data provider server and the data backup server can be used to do only one type of the procedure (either backup or restore) more than one time. Compared with NMDP, at the outset of one session, NDMP-Plus need do the negotiation mechanism for this session, as shown in Fig. 4.

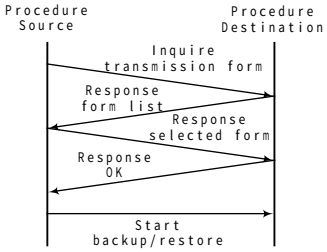

Fig. 4. The Negotiation Procedure

We take the backup procedure for example to illustrate the negotiation mechanism. After one connection is established, firstly, the procedure source inquires the procedure destination to provide the transmission form, and then the procedure destination provides the form list to the source. Secondly, the source selects the appropriate form as the transmission form of this session and notifies the destination. Finally, this backup or restore procedure can start up. The restore procedure is almost the same as the backup procedure, in which the backup server is the procedure source.

Based on the above discussion, the backup procedure is the same as the restore procedure from the network communication viewpoint. Through the negotiation mechanism, the procedure destination provides the transmission form to negotiate.

5. Evaluation and Conclusion

The NDMP-Plus prototype is implemented on the FreeBSD4.7 operation system. In our experimentation, we use two NAS boxes as the data provider host and the data backup host. We have done three types of testing methods to prove the performance enhancement of the NDMP-Plus prototype: (1) Using the traditionally distributed file systems --- CIFS, the administrator in Client backups the data from NAS1 to NAS2; (2) Using NDMP, the administrator uses the NDMP DMA to backup data from NAS1 to NAS2; (3) Using NDMP-Plus, the administrator uses the NDMP-Plus DMA to backup data from NAS1 to NAS2.

Our testing data come from the file-system --- "/usr". The results are shown in Table 1.

Table 1. The "/usr" Performance of Client Benchmarks

Method	Time-consumer (s)	Transmis-sion Speed (KB/s)	Network traffic (KB/s)	CPU Utilization (%)
CIFS	1813	399.36	794.7	30 - 50
NDMP	832	870.4	About zero	About 2
NDMP-Plus	759	952.32	About zero	About 2

Based on the data of Table 1, we can reach the conclusion as follows:

(1) Compared with CIFS, the average speed of the NDMP-Plus backup methods speedup 90%. The reason is that the data of NDMP-Plus are transmitted directly between NAS1 and NAS2, but the data of CIFS are transmitted from NAS1 to the client, and then to NAS2.

(2) Compared with NDMP, NDMP-Plus improves the transmission speed by about 9%. The reason is that NDMP-Plus provides one negotiation mechanism to select the data form; hence it can use an appropriate form to transmit data more efficiently, avoiding unnecessary steps.

We present a newly designed network based data management prototype (NDMP-Plus) in this paper. It has a more flexible architecture and a higher performance than NDMP. The future work may focus on further enhancing the performance of NDMP-Plus and implementing the snapshot technology [3].

References

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