Implementation and performance evaluation of an iSCSI-Based Storage Virtualization
Yang Guang, Zhou Jingli, Liu Chao
Department of Computer Science
Huazhong University of Science and Technology
Wuhan, Hubei, 430074 P.R. China
yangchgang@gmail.com

Abstract
Storage virtualization can be implemented at three layers: server-layer, storage-device-layer and network-layer. iSCSI-based storage virtualization is to implement storage virtualization at network-layer, and the implementation includes three sides: host, manager, and store. Manager manages some stores and generates a unified, logical store pool to provide store services to host. According the method of forwarding at the manager side, iSCSI-based store virtualization was implemented in two ways: in-band and out-of-band. Manager must transmits data stream and command stream to host and store in in-band way. After the two ways of implementation, the performance test results indicated that the performance of out-of-band was better than in-band.

1. Introduction
The purpose of storage virtualization is to separate physical storage from logical storage entity. The implementing way is that an abstract layer is added between physical storage equipment and the customer side that can provide a simple and universal storage pool to customer through uniting various storage employments. The network-layer storage virtualization in SAN is implemented by a special device. This special device is a server platform that contains storage virtualization management and application software. We call the server that manages storage network as Manager (storage virtualization controller).

The way that data stream and command stream are passed through manager is in-band. On the contrary the way is out-of-band. Comparing with in-band virtualization, as command stream is passed through custom, Manager and storage devices, and data stream is only communicated between appliance server and storage device. So the performance of out-of-band virtualization is better than that of in-band virtualization.

2. Related Work
Storage virtualization refers to the technology that allows creation of a set of logical volumes from some physical storage resources. Each such logical storage device could then serve as a storage server for a separate server for a particular function. The most popular virtualization software is volume managers. The two most advanced open-source volume managers currently are EVMS and GEOM. EVMS [7], is a user-level distributed volume manager for Linux. It uses the MD [8] and device-mapper kernel modules to support user-level plugins called features. GEOM [9] is a stackable BIO subsystem under development for FreeBSD. The concepts behind it GEOM are, to our knowledge, the closest to Violin.

3. The architecture of storage virtualization based on iSCSI
The architecture of out-of-band storage virtualization based on iSCSI is illustrated in Figure 1.

4. The execution process of iSCSI-based out-of-band storage virtualization system
In out-of-band way Login has three phases: First stage: Manager’s Initiator registers multi-Store that Manager manages. Second stage: Host registers Manager. Third stage: Host registers every Store that Manager manages. The execution process of a writing command is illustrated in Figure 2.
5. The implementation of out-of-band storage virtualization

5.1. The implementation of the FFP phase in Host

Firstly we take a writing command as an example to illustrate the realization of Host in out-of-band way. The realization is shown in Figure 3.

Figure 3: The execution process of a writing command in Host

5.2. The implementation of the FFP phase in Manager

The process is illustrated in Figure 4.

Figure 4: The execution process of a writing command in Manager

6. Performance Evaluation

In Figure 5 we can see the sequential writing performance of in-band way, out-of-band way and two levels iSCSI.

Performance analysis in In-band, Out-of-band and Two levels

Figure 5 Performance analyses in In-band, Out-of-band and Two levels

In Figure 6 we can know that the effect of the performance of server on out-of-band system in Host

Figure 6: The effect of the performance of server on iSCSI

7. Conclusions

This paper introduces a design means of implementing out-of-band storage virtualization in iSCSI. Command stream and data stream are detached to transmit. Server is only responsible for the request from customer and a mass of data is directly transferred between customer and storage devices. From the above analysis, the out-of-band system emancipates server from burdensome data transmission. Therefore server is absorbed in data processing and the performance of the system is advanced.

8. References