

# Experimental Analysis of Storage according to Number of Server in SAN Configuration

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## **Abstract**

*In order to measure the performance of storage systems, the most commonly used method is to use a benchmarking tool. Haran, the workload generated by the application depending on the type of service the I/O workload pattern depending on the configuration of the storage system's performance results have many influences. Benchmarking tools greatly to the file system level and block devices are split-level, file system-level tools and features, depending on the type of file system is affected a lot of the performance of the storage system can not accurately measure. IOPS is designed for the measurement of the workload, VDBench the block device level performance assessment tool for measuring the performance of the storage system by leveraging is performed.*

**Keywords:** *Storage Performance Test, Benchmark, Workload, IOPS, VDBench, SPC*

## **1. Introduction**

Today, in this world, the amount of information and the usage of it is rapidly increasing and the importance of storage and management of information is emphasized. Demand for a technique for developing a mass storage device, which can store data efficiently and provide quick access to users, is increasing. Accordingly, although, there is an example of storage media of hard disk accelerating access speed through various ways in order to keep up with increasing data access speed, it is still difficult to catch up with storage data access of storage media called SSD (Solid State Drive). For this, a number of solutions have been researched and developed [1, 2]. SSD is a storage medium for solving the slow output speed of the HDD (Hard Disk Drive) to a storage device using a semiconductor memory. As many papers and contributions have presented so far, the difference of two storage medias is that processing speed of CPU and memory has been increased 570 times, while the processing speed of HDD storage medium has been increased 20 times, thus data bottleneck was occurred, and the SSD storage media is the reinforcement for this bottlenecks [3, 4]. The environment for mass data storage and process in today's IT market has been changed from DAS to SAN(Storage Area Network), and the research on the performance evaluations of storage medias in a SAN environment are emerging as important issues [5, 6].

Although the performance of the storage media is important, in fact, even if fast access is available by using a high-performance storage media, the efficiency of x86 server resources, which used by data center, public institutions, local governments or corporations, is low. A large number of under-utilized servers exist, and CPU utilization is low for most of x86 servers. In reality, the need for virtualization technology to integrate physical servers or partition into logical consolidation has been issue. Therefore, in this paper, we analyze the performance of server-specific performance characteristics and storage media in a multi-server environment based on the current x86 server connection. First, we used the Benchmark Tool on a single server and at the same time stylized workload by sequentially increasing one server. And based on the results and the graphs that shows performances of each server or each storage media's performance when the workload was given simultaneously to eight servers, we researched that SSD than was necessary the HDD in cloud or in a multi-server connection environment.

## **2. Related Technologies**

## 2.1. Performance Evaluations Tool

There are various Benchmark test methods that are used for purposes of performance analysis. Also, there are many different conditional kinds of tools used according to the test. Test tools used in this study is postmark tool used by the file system level, which is recommended by NetApp as a benchmark test tools.

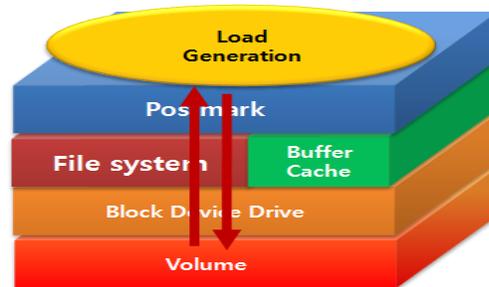
Three conditions are provided by postmark; low level, medium level, high level. The recommended block size and file size for each level is similar, but the number of files and transaction count is different [7].

**Table 1.** Postmark workload

<i>Condition</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>
<b>File size</b>	4KB ~ 327KB Random Generation		
<b>File number</b>	1000	20000	20000
<b>Transaction number</b>	5000	5000	100000
<b>Block size</b>	4KB, 8KB	4KB, 8KB	4KB, 8KB
<b>Sub DIR</b>	10	10	100
<b>Count</b>	10	30	30
<b>R/W ratio</b>	1:1	1:1	1:1

## 2.2. Postmark Option

Relatively widely used in postmark Benchmark tool is High option. In case of small amount of data, because it is difficult to compare the storage performances, high option is mostly used. And as much data I/O as possible should be generated. Though the size is randomly generated from 4k to 327k, the purpose is to know the amount of change in the same conditions than the performance of the change of the file size by using the biggest size 327K. This postmark has an OLTP (Online Transaction Processing) characteristics.



**Figure 1.** Postmark I/O

Sequence logic that is used when Postmark is performed once is as follows.

**Table 2.** Postmark order logic

<i>Process order</i>	<i>Execution</i>
1	subdirectories
2	creating files
3	performing transactions
4	deleting files
5	deleting subdirectories

As table 2, it generates subdirectories, and generates a file size according to the condition. The first result can be achieved by processing the generated file through transaction process, and deleting the

files by early-generated subdirectories. These results can be repeated and the average can be compared and analyzed [5, 6].

The result when the Postmark is operated once is as follows.

1. Total Elapsed Time
2. Transaction Elapsed Time
3. Trans Per Sec.
4. Created
5. Created Per Sec.
6. Created Alone.
7. Reading per Sec.
8. write
9. delete
10. deletion per sec.
11. number of deletion per sec.
12. Read bytes
13. Write byte

Performances are analyzed by the 12 values above and among those 12, Total Elapsed Time, Trans Per Sec. Read bytes, Write bytes are mainly for performance analysis.

### 3. Test Environment and Test Condition

#### 3.1. Test Environment Configuration

Test environment for performance measurement is divided into HDD Storage test environment, DRAM SSD Storage test environment. HDD Storage test environment, as shown in figure 2, is composed of 8 Agent Server, 1 SAN Switch, 1 Ethernet Switch, 1 HDD Storage. Physical interface is composed of HBA card of 4Gbps and SAN (Storage Area Network) by FC (Fiber Channel), and this configuration did Port Zoning and WWN Zoning to each server and storage.

When it comes to volume, HDD Storage assigned volumes to each server through EVA Storage system Management App, and DRAM SSD Storage assigned the volumes to each server through Data Core App. SSD Storage test environment is identical with HDD Storage test environment, but only the storage media is formed DRAM SSD Storage.

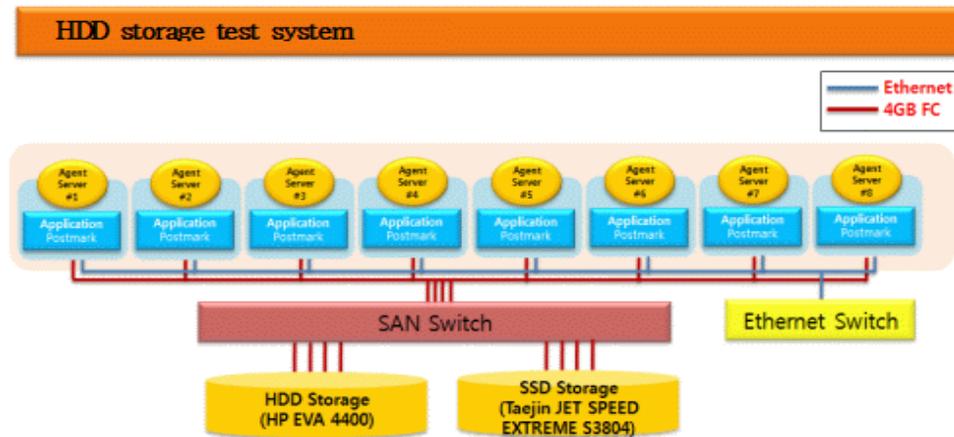


Figure 2. Test environment configuration

#### 3.2. Test Equipment Composition

In this paper, we analyze the differences in performance characteristics in a multi-server environment by using a number of server platforms. When it comes to detailed specifications, the CPU is the product specification of each server, Memory is composed of DDR2 4GB \* 4, HBA card is

composed of 4Gbps 2port, and OS (Operating System) of each server used CentOS 6.0. When it comes to the detailed specifications for storage, it used two 4Gps 2 port interface, and for capacity, HDD Storage is composed of 3.2TB, and SSD Storage is composed of 512GB.

### 3.3. Test Scenarios

We increased the serve based on the Agent server # 1 and used postmark and vdbench tool.

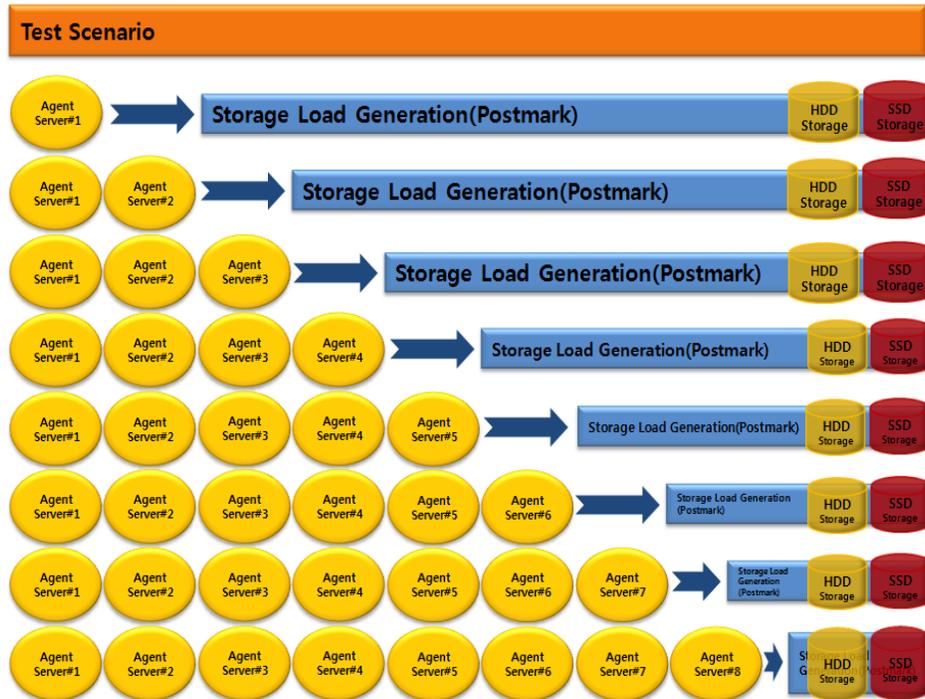


Figure 3. Test scenarios

Table 3. Execution order of test

Sever	Test Scenario (HDD, SSD)
Agent Server#1	(1), (1,2), (1,2,3), (1,2,3,4), (1,2,3,4,5), (1,2,3,4,5,6), (1,2,3,4,5,6,7), (1,2,3,4,5,6,7,8) - Total 8 Servers

Test scenarios, as figure X, increased the agent servers one by one, and generation was down at the same time when each server is increased, and both the HDD Storage environment and DRAM-SSD Storage environment was identically organized.

## 4. Test Result Analysis

In this section, we present the server according to the performance characteristics of the storage medium, in a multiple access environment on the basis of the three chapters of the test environments and scenarios.

### 4.1. Storage media Characteristics when connected to a multi-server

In a multi-server environment presented in chapter 2, Postmark Benchmark Tool test scenarios tested by increasing the servers one by one with total of eight servers.

We are going to research the variation of performance of each storage media when connected to the integrated multi-server storage.

As a result analyzed by Postmark Benchmark Tool, we could find total elapsed time, number of transactions per second, and IOPS.

**4.1.1. Measuring Time(Elapsed Time) Criteria Analysis**

1) HDD Measuring Results

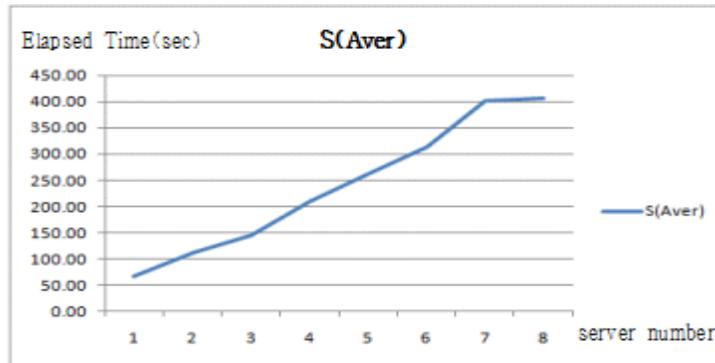
**Table 4. HDD Elapsed time**

	1	2	3	4	5	6	7	8
S1 (Aver)	67.10	111.80	114.27	245.00	307.70	361.27	461.63	517.13
S2 (Aver)		110.30	110.33	239.77	295.67	371.43	461.63	527.63
S3 (Aver)			208.00	104.07	96.30	191.87	306.17	134.87
S4 (Aver)				244.70	300.37	379.10	481.83	540.90
S5 (Aver)					312.67	380.97	457.23	536.37
S6 (Aver)						195.70	299.50	127.27
S7 (Aver)							339.33	354.00
S8 (Aver)								514.00
S (Aver)	67.10	111.05	144.20	208.38	262.54	313.39	401.05	406.52

Through the table x, we found the following results from the HDD unified storage environments.

Increase of the processing server in the HDD based environment has led to an increase in processing time (Elapsed Time) in the integrated server environment. It took 67.1 second for a server to process a work in the integrated storage environment, as the server increased, the process time also increased, and ultimately, it took 407 seconds for 8 servers to process the work.

The overall characteristic curve of Elapsed Time in HDD integrated storage environment is as follows.



**Figure 4. HDD Elapsed time graph**

2) SSD Measured Results

**Table 5. SSD Elapsed time**

	1	2	3	4	5	6	7	8
S1 (Aver)	72	63	57	56	58	58	58	66
S2 (Aver)		63	59	55	60	66	64	65
S3 (Aver)			57	53	53	65	60	65
S4 (Aver)				52	52	54	57	59
S5 (Aver)					64	64	80	81
S6 (Aver)						70	67	68
S7 (Aver)							68	65
S8 (Aver)								59
S (Aver)	72	63	57	54	57	62	64	66

We confirmed the following result from the integrated SSD storage environment. From table 5, we confirmed specific results that 70 seconds were taken for one server to process the work, and as N number of servers increased, within 25% of error range. As shown in table 5, as the number of server increased in the integrated SSD storage environment, the total elapsed time in SSD Storage was constant. As servers sequently increase from server 1 to server 8, the elapsd time in SSD integrated storage had the average range withint 54 to 72 seconds. The overall characteristic curve of Elapsed Time in HDD integrated storage environment is as follows. Like the characteristics of the graph in Figure 5, when various servers share the SSD Storage, we confirmed that even if the number of server connection increases, it did not affect the performance because the elapsed time was process regularly.

As shown in Figure 6, HDD Storage draw certain curve as the server increased, and SSD Storage draw regular curve.

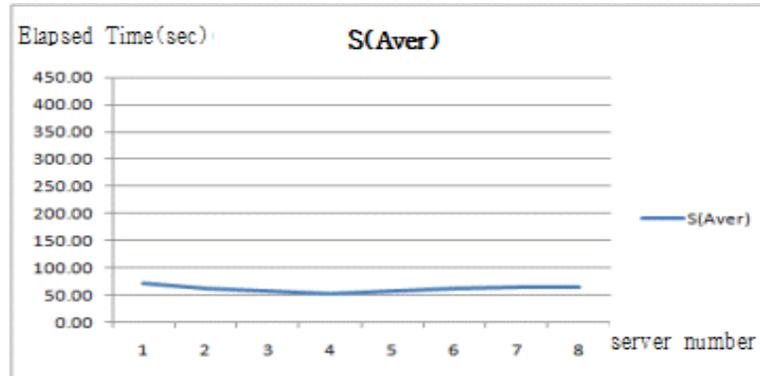


Figure 5. SSD Elapsed time graph

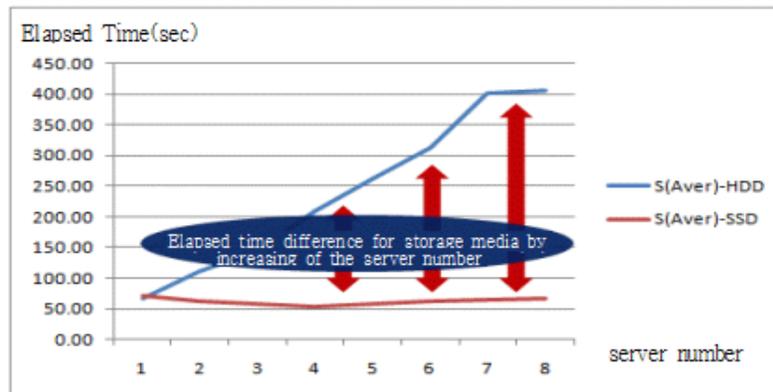


Figure 6. HDD & SSD Elapsed time comparison graph

Finally, we confirmed that the elapsed time is not affected by the increase of server in SSD based environment, unlike the HDD case.

## 5. Conclusion

In this paper, we investigated the performance analysis of storage media connected to multiple servers in a SAN environment. Most performance evaluation of the existing disk or storage was achieved through studies in the DAS environment, nowadays, it is a trend to use SAN environment due to multiple servers and storages. Postmark, generating random IO workloads, was used as the performance measurement tools in a SAN environment, and for servers, 8 Linux OS-based servers were used. Among the performance evaluation of postmark, when the total elapsed time was compared, the elapsed time for HDD increased as number of servers increased, but in case of DDR-SSD, increase of servers does not affect the elapsed time. However, since the result the test is only done by one

benchmark test tool, more analysis based on test connected to many servers or another benchmark test tools is required. The absence of volatility and capacity limitation of DDR-SSD indicates that the additional verification experiment is necessary to replace the HDD by DDR-SSD.

## 6. References

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