

# EXPERIMENTAL STUDY OF THE PROCESSOR AND DISK SUBSYSTEMS OF THE SERVER CLUSTER USING VMWARE TECHNOLOGY

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## **Abstract**

In recent years, the consolidation of physical servers into a virtual environment has been increasingly applied, in most cases resorting to the use of server clusters. The most popular choice for a virtual platform is the VMware technologies. To evaluate our cluster's performance, we will look at the processor and disk subsystems and make a comparison between a single virtualized server and a physical server.

**Keywords:** cluster, server, virtualization, performance.

## **1. INTRODUCTION**

Virtualization and server consolidation are becoming increasingly common even in small businesses. Experiments have been made with both physical server platforms and virtualized ones - single host and cluster. The purpose of the research in this article is to determine to what extent server consolidation can be achieved while maintaining their performance (processor and disk).

Virtualization refers to the creation of a virtual resource such as a server, desktop, virtual machine, file, storage, or network. The most common form of virtualization is virtualization at the operating system level. With it, it is possible to run multiple operating systems on the same hardware. Virtualization technology involves the separation of physical hardware and software by emulating hardware using software. When any operating system runs on top of the main operating system through virtualization, it is called a virtual machine.

For the needs of the experiment, a server cluster of two identical servers and a data server was built.

The purpose of this paper is to analyze the performance of the processor and disk subsystems of the server cluster in a real environment, and the results are used for student learning needs.

The engineering analysis of the model will be an industrial natural experiment, where all the main parameters of the model will be observed in real operating conditions.

## **2. PRELIMINARY NOTES**

The system consists of two servers (HOST A,B – Fig.1) HP Proliant DL 380 G9, 2x Intel(R) Xeon(R) CPU E5-2673 v3, 64GB ECC DD4 RAM, Smart Array P440ar, 4x 900GB SAS HDD, 4x NetXtreme BCM5719 Gigabit Ethernet, HPE Ethernet 10Gb 2-port 530FLR-SFP+ and storage server (Private Storage – Fig.1) HP Proliant DL 380 G7, 2x Intel(R) Xeon(R) CPU X5675, 64GB ECC DD3 RAM, HPE HBA 220, 8x 1200GB SAS HDD, 4x NetXtreme BCM5719 Gigabit Ethernet, HPE Ethernet 10Gb 2-port 530FLR-SFP+. To build the private networking – (Fig.1) are used 10Gb network cards of the servers and network switch Juniper EX3300-24T. Connection between infrastructure and internet is made through the 1Gb network cards of the servers. A hypervisor VMware vSphere 7 free is used for creating Hosts A and B, and for system management VMware vCenter 7 free. FreeNAS 12.U8 is used for creating storage server. Fig.1 below shows the system architecture.

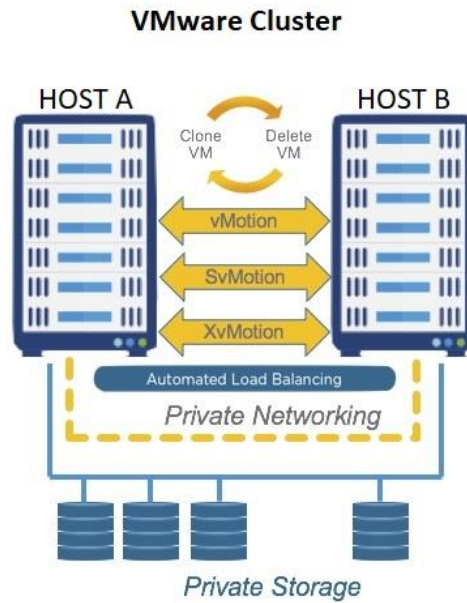


Fig. 1. Cluster Structure

### 3. MAIN RESULTS AND DISCUSSIONS

The infrastructure is built in the following sequence – Fig.2.

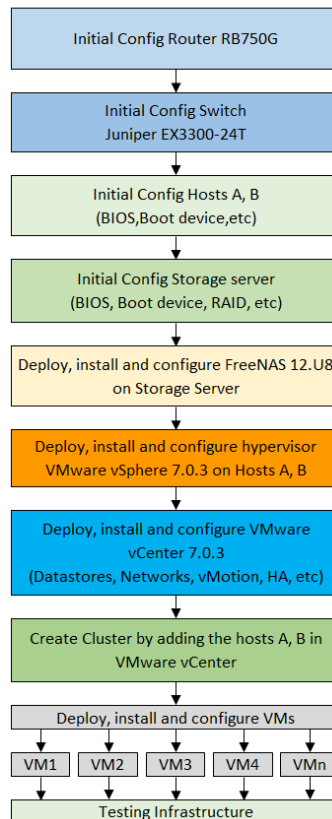


Fig. 2 Basic algorithm for creating cluster infrastructure

As you can see on Fig.2. building the infrastructure is made on stages, after each step everything is tested and if it works as expected the next step is started. Everything begins with installation and configuration of the VLAN, VPN, DHCP, DNS services of the router (Mikrotik RB750G). Next it's time

to install and configure the main switch (Juniper EX3300-24T) – setting up VLAN and uplink SFP+ ports are configured as network ports. Next step is setting up BIOS settings on server Hosts A, B (HP Proliant DL380 G9). It always needs to be the same, because otherwise the server cluster will fail. Next is setting up BIOS settings on storage server (HP Proliant DL380 G7) and after that installing and configuring FreeNAS 12.U8. Then RAIDZ1 is created with all 8 SAS disk, and NFS share is made. The next stage is deploying, installing and configuring hypervisor VMware vSphere ESXi 7.03 on both hosts A and B. Next is deploying, installing and configuring VMware vCenter 7.0.3 – creating Datacenter, adding hosts A, B, creating cluster, enabling High Availability (HA), creating Datastores, Management Network, Network for vMotion. After that the next stage consists of deploying, installing and configuring virtual machines (VMs). And last stage is testing infrastructure with selected software packages.

For the purposes of the experiment, licensed software products of Microsoft Windows 10 Pro [3], Microsoft Windows Server 2016 Standard [3] were used. The following software programs were used to test the processor and disk subsystems: ATTO Disk Benchmark 4.01.0f1[5], CrystalDiskMark 8.0 Standard Edition [6], SilverBench (<https://silver.urih.com/>) [7], CPU-Z 2.0 Classic Version [8]. For a more precise measurement, the experiments were performed in several series:

1. first series – only one working virtual machine (Microsoft Windows Server 2016 Standard Edition);
2. second series – running two virtual machines (Microsoft Windows Server 2016 Standard Edition – 1VM, Microsoft Windows 10 Pro – 1VM);
3. third series – running six virtual machines (Microsoft Windows Server 2016 Standard Edition – 1VM, Microsoft Windows 10 Pro – 5VMs);

The tables Table 1, Table 2 and Table 3 below summarize the average values obtained after a series of 5 consecutive CPU tests:

Physical Server								
Silverbench, points			CPU-z, single core points			CPU-z, multi core points		
	Windows Server 2016	Windows 10 Pro		Windows Server 2016	Windows 10 Pro		Windows Server 2016	Windows 10 Pro
CPU, cores	48	48	CPU, cores	48	48	CPU, cores	48	48
1st series	123007	121986	1st series	326	302	1st series	20127	20021

Table 1

Single Host								
Silverbench, points			CPU-z, single core points			CPU-z, multi core points		
	Windows Server 2016	Windows 10 Pro		Windows Server 2016	Windows 10 Pro		Windows Server 2016	Windows 10 Pro
CPU, cores	8	8	CPU, cores	8	8	CPU, cores	8	8
1st series	40427	-	1st series	326	-	1st series	4203	-
2nd series	32060	31472	2nd series	302	298	2nd series	3883	3521
3rd series	21846	20334	3rd series	302	296	3rd series	2405	2247

Table 2

Cluster								
Silverbench, points			CPU-z, single core points			CPU-z, multi core points		
	Windows Server 2016	Windows 10 Pro		Windows Server 2016	Windows 10 Pro		Windows Server 2016	Windows 10 Pro
CPU, cores	8	8	CPU, cores	8	8	CPU, cores	8	8
1st series	43007	-	1st series	326	-	1st series	4203	-
2nd series	39841	39660	2nd series	302	298	2nd series	4012	3857
3rd series	36750	36560	3rd series	302	296	3rd series	3485	3361

Table 3

As you can see, the CPU performance of the physical server (Table 1) used by one operating system is quite sufficient to support more than one large software package such as MS SQL Server or a combination of several smaller ones. The single host CPU performance is also good and even with 6 VMs the server is not overloaded and if you need you can add a few more VMs. The CPU performance of a cluster is huge compared to a physical server and much better than a virtualized host. In the test samples it handled 15 VMs without any problems, you can even add a few more, but then the amount of RAM needs to be upgraded. A cluster, even compared with two separate hosts, has more capacity because it can distribute the load between its hosts.

The tables Table 4, Table 5 and Table 6 below summarize the average values obtained after a series of 5 consecutive Disk tests:

Physical Server, RAID5 x8 SAS								
	ATTO Disk Benchmark 4, MB/s				CrystalDiskMark 8.0, MB/s			
	Windows Server 2016		Windows 10 Pro		Windows Server 2016		Windows 10 Pro	
	read	write	read	write	read	write	read	write
1st series	2035	2076	1988	2069	1979	2065	2072	2057

Table 4

Single Host, RAID5 x8 SAS								
	ATTO Disk Benchmark 4, MB/s				CrystalDiskMark 8.0, MB/s			
	Windows Server 2016		Windows 10 Pro		Windows Server 2016		Windows 10 Pro	
	read	write	read	write	read	write	read	write
1st series	1894	1913	1829	1897	1865	1907	1833	1874
2nd series	1205	1226	1196	1201	1197	1219	1182	1194
3rd series	443	451	437	440	438	422	441	428

Table 5

Cluster, RAIDZ1 x8 SAS								
	ATTO Disk Benchmark 4, MB/s				CrystalDiskMark 8.0, MB/s			
	Windows Server 2016		Windows 10 Pro		Windows Server 2016		Windows 10 Pro	
	read	write	read	write	read	write	read	write
1st series	880	897	865	883	897	904	873	899
2nd series	580	595	588	602	593	601	598	607
3rd series	288	303	291	305	299	313	294	309

Table 6

As with the CPU tests and here with the disk tests, it is clear from the tables above that the performance of the physical server (Table 4) is more than sufficient, but it can be used by only one operating system. The same can be said for the single host (Table 5), which also has very good performance and has the ability to use more VMs without overloading the disk system. The cluster on the other hand doesn't have as much power, but it does quite well and it's no problem to load more VMs.

#### 4. CONCLUSIONS

In conclusion, it can be said that consolidating servers is possible without greatly affecting performance, thereby optimizing the possibilities of using available equipment - testing new products and operating systems, for example. On the other hand, different RAID configurations can also be tested to achieve even better performance. When you use a cluster, you can easily stop one of the hosts for maintenance, for example, and keep more of your primary VMs running smoothly.

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