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Failover Cluster Nodes and ISCSI Storage Area Network on Virtualization Windows Server 2016

Moh. Thoip Abdullah[1], Sulhan Qidri[2], Wadi Nuryadi[3], Septian Rheno Widianto[4]
[1,2,3,4] Department of Information System, STMIK LIKMI Bandung, Indonesia

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ABSTRACT

The use of data in this current digital era, the traditional model of connecting the storage media with servers, cannot meet the need for fast access to a very large amount of data. Storage Area Network can be the solution because this technology can handle a large amount of storage media (TeraByte), enable to be a share of storage resources, as well as giving data access in real-time, quick, and easy. Internet Small Computer System Interface (iSCSI) is a concept of storage media that use Internet Protocol as a medium for connecting storage media and data transfer through network service. Testing of availability server in this research use failover cluster technology, after testing done, then the result is obtained, when a failure or error occurs on the primary server, the primary server role will be automatically replaced by backup server with the same resource as the main server. As for the time automatic displacement server, when an active server makes failure, then it will only take less than 5 seconds. So, it can be concluded that this technology can minimize the value of the downtime in the system.

Corresponding Author:

Moh. Thoip Abdullah,
Department of Information System,
STMIK LIKMI Bandung,
Jl. Ir. H. Juanda No.96 Badung, Indonesia
Email: mthoip@gmail.com

1. INTRODUCTION

The need of storage media which increasingly large, especially for large companies and also medium companies that can manage and store various data of company which amount to thousands and even millions in every day, it is much needed a technology that can provide access to fast data traffic and store data in large quantities. Several storage technologies that can handle high-speed storage and access of data, one of which is the Internet Small Computer System Interface Storage Area Network (iSCSI SAN).

iSCSI is a storage media based on the internet protocol as a link between storage servers and other servers and clients or users. In other words, iSCSI is useful for connecting storage media such as hard disk drive (HDD) or Solid State Drive (SSD) with an internet network or intranet as data transfer media. Building this iSCSI infrastructure requires a server that functions as a storage sharing service provider to server clients or users that can be called a storage server.

iSCSI is an extension of the Internet Small Computer System Interface is a way to connect storage media over TCP/IP network, with the presence of high-speed Local Area Network (LAN) technology such as 1 Gigabit Ethernet and 10 Gigabit Ethernet, iSCSI based on the Internet Protocol (IP) network that IP-SAN is becoming more commonly used, if it is compared by using fiber channel, that is SAN-FC which requires higher cost [1].

Storage Area Network (SAN) is a special, very high-speed network, consisting of servers and storage. The main purpose of SAN is to handle large amounts of data traffic between servers and storage equipment, without reducing the bandwidth available on the LAN/WAN[2]

Storage Area Network is another form of the separation of storage media from hosts that will use it. In SAN, storage media are accessed based on the block rather than the file system, and the data traffic sent will be similar to the traffic data that is sent by a host to a block-device through the media via ATA or SCSI [3].

The function of the server as a shared storage service provider is very important. Therefore the server must be as minimal possible failure or damage to software or hardware failure. Because it can be ascertained when the server fails, the computer system resources will not be used. In this implementation, it takes at least three servers, one as iSCSI SAN Server and two as iSCSI Initiator Server, where iSCSI SAN Server functions as a target server for storage sharing and iSCSI Initiator Server functions as a failover cluster and target server storage management. But for implementation, it can be minimized by simply maximizing one server resource, namely by utilizing server virtualization technology.

Virtualization is the division of the physical server into several virtual servers to optimize the use of resources on the physical server. Server virtualization use hypervisor, which is used to divide physical server resource into several virtual environments or often called as Virtual Private Server (VPS), Guests, instance, or emulation[4].

High Availability Cluster or often also called failover cluster, is a solution to ensure server resources can be used optimally. High availability is a different server working together to ensure that downtime of resources is reduced to a minimum. The purpose of the High Availability Cluster is to ensure that the resource of the server can be used to maximum as possible [5].

When one of the servers fails or if the primary server resources stop, HA Cluster provides monitoring and ensure that resource is restarted at another place in the cluster system, so that the same resource can be used on other servers in the cluster system. The concept is related to the ability of the system to resolve the occurrence of disruption, hardware damage, crash or down, network error, even the server failure caused by software that fails to perform its duties properly. The offered solution is in the form of data backup or failover data that is done in real-time. When the primary server stops running, then the backup server will take over the role of the primary server with the same input and output handling quality as the primary server. The system will always synchronize data between the two or maybe more to get data redundancy [6].

2. METHOD

The method used in this research is an experimental, an exploration method of observing model on the virtualization system failover cluster and iSCSI Storage Area Network that was built. Exploration criteria of this research are considered successful if storage virtualization can be accessed by clients or users, and the backup server can replace the role of the primary server when a failure occurs on the primary server.

3. RESULTS AND DISCUSSION

3.1. System Needs

In this implementation, how to build a server infrastructure that can handle centralized data storage needs, allow storage resources to be shared, and provide data access continuously, quick, and easy. This implementation requires the iSCSI SAN server as a storage pool, which will then be carried out by the server storage management in the same cluster, and iSCSI initiator as failover cluster that function as storage management of iSCSI SAN, and as storage sharing management for clients or users.[7]

Specification of the physical server requirements on the implementation of failover cluster node iSCSI SAN is described in table 1.

Table 1. Physical Server Specification

No	Hardware	Specifications	Amount
1	Server	Processor Intel Core i7 RAM 32 GB SSD 320 GB	1
2	Client	Processor Intel Core i3 RAM 4 GB HDD 250 GB	1
3	Switch	Switch 100/1000 Mbps	1
4	Cable LAN	UTP Cable CAT-5e	3

Specification of the virtual machine server requirements on the implementation is described in table 2.

Table 2. virtual machine Specification

No	Hardware	RAM	Hard Disk	CPU Core
1	iSCSI SAN Server	8 GB	30 GB	4
2	iSCSI Initiator Node 1	8 GB	30 GB	4
3	iSCSI Initiator Node 1	8 GB	30 GB	4

While software needed on the implementation is described in table 3.

Table 3. Software Needed

No	Software	Description
1	VMware ESXi 7.0	Server Virtualization
2	Windows Server 2016	Server Operating System
3	Windows 10	Client Operating System
4	iSCSI Target Server	iSCSI SAN Server
5	Failover Clustering	iSCSI Initiator Server 1, iSCSI Initiator Server 2
6	File Server	iSCSI Initiator Server 1, iSCSI Initiator Server 2

3.2. System Architecture

System Architecture is the illustration of network topology on implementation of failover cluster node iSCSI SAN as follows:

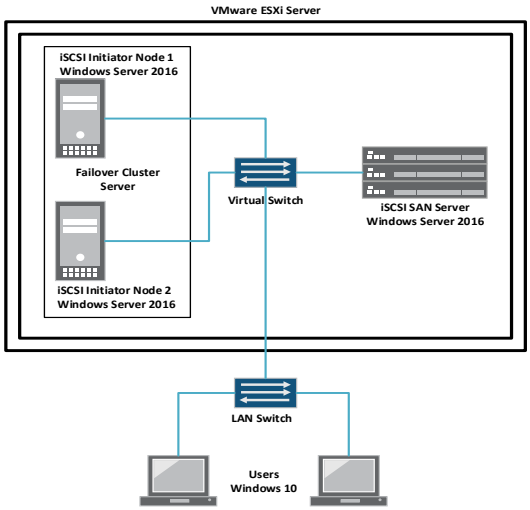

Figure 1. System Architecture

In figure 1 it takes at least three servers, where iSCSI SAN Server is installed with the Windows Server 2016 operating system with application packages that need to be installed are iSCSI Target Server, iSCSI Initiator Node 1 and iSCSI Initiator Node 2 are installed with the Windows Server 2016 operating system with the application package must be installed is Failover Clustering and File Server.[8]

IP address description of each server in the architecture above, as shown in table 3.

Table 3. IP Address

No	IP Address	Server	Computer Name
1	101.1.1.10	iSCSI SAN Server	WIN-CLUSTER
2	101.1.1.11	iSCSI Initiator Node 1	WIN-NODE1
3	101.1.1.12	iSCSI Initiator Node 2	WIN-NODE2

Before the implementation process, make sure the server operating system has been installed with VMware ESXi, which will be used as a virtualization server, as shown in Figure 2.

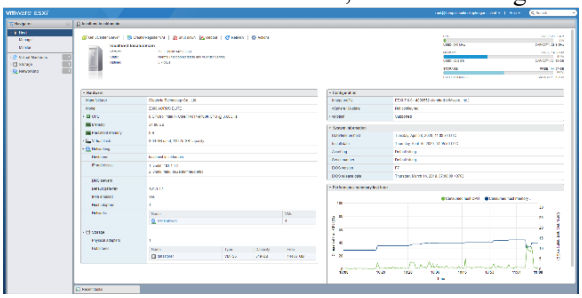

Figure 2. VMware ESXi

The first implementation process is to prepare all the server has been installed in VMware ESXi, as shown in figure 3.

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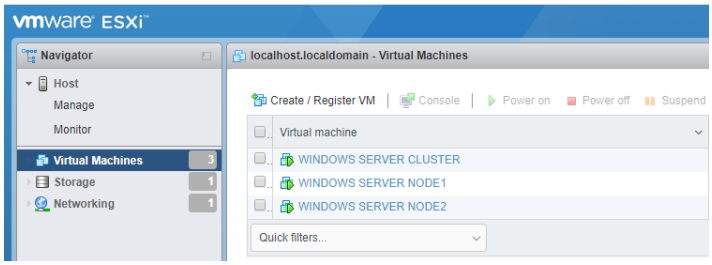

Figure 3. VMware ESXi Virtual Machines

Configuring the target server as a storage sharing provider on the iSCSI SAN Server by installing and configuring the iSCSI target server, at this stage, several virtual disks will be created, which will then function as storage sharing, with the results shown in Figure 4.

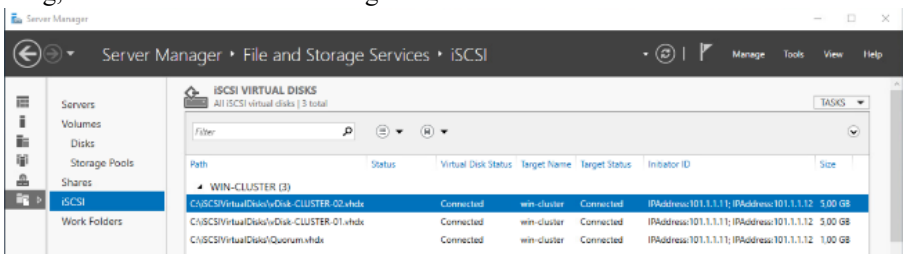

Figure 4. iSCSI Target Server

The configuration of the failover cluster for stage sharing on WIN-NODE1 and WIN-NODE2 by installing and configure the package of failover clustering and file server on both servers, in this configuration made two virtual disks for storage sharing and one virtual disk as a witness disk, with the result as on figure 5.

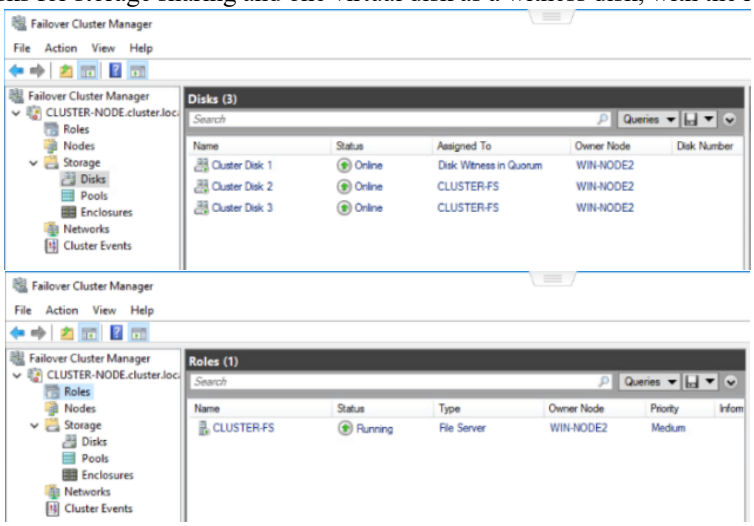

Figure 5. Failover Cluster Manager

3.3. System Testing

The purpose of testing this system is to see the behavior of the clustering server that has been previously configured. The parameters of the tests include:

1. Failover Clustering
   Failover Clustering will make the backup server when the primary server makes failure or damage. So, if failure, death, or damage occurs on the primary server, then the backup server will be active to replace the role of the primary server automatically. So that users or clients can still use service of storage sharing because the function of the primary server has been replaced by the backup server.
2. Throughput
   The test was carried out to measure network capability in terms of packet delivery speed performed on storage sharing services.
3. CPU, Disk and Memory Utilization

The test was conducted to review the use of CPU, Disk, and Memory resources from the primary server and backup server.

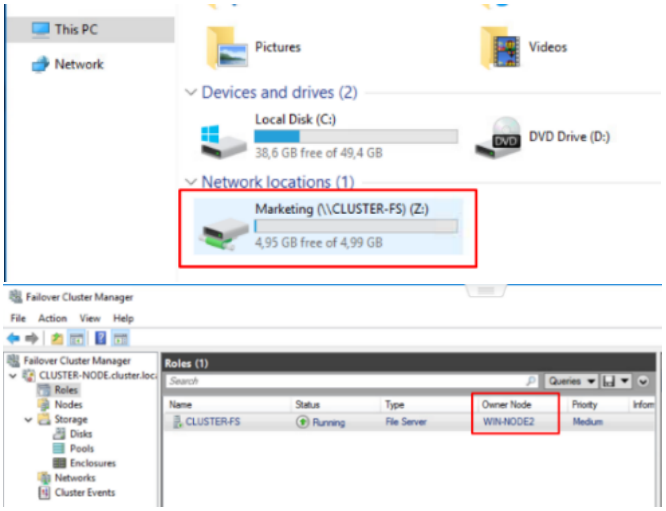

Figure 6. Storage Sharing of Primary Server

In figure 6, WIN-NODE2 as primary failover server that serves storage sharing of clients or users. As long as WIN-NODE2 does not fail or get corrupted, storage sharing services will still be run by WIN-NODE2. However, when the primary server makes failure or die, then the service of storage sharing will be replaced by the backup server automatically, as shown in figure 7.

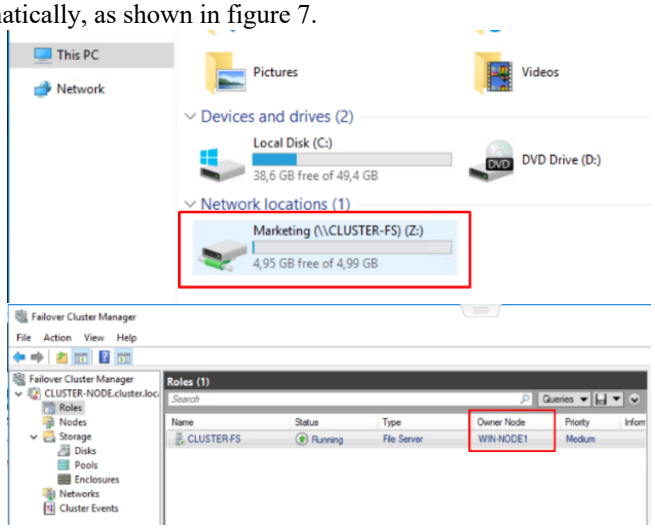

Figure 7. Storage Sharing of Backup Server

In this case, to ensure that the technology of the failover cluster can minimize downtime of the system, the testing was conducted to determine the length of time automatic displacement when the active server makes a failure. The scenario is as follows:

1. Scenario: both iSCSI initiators are turned on then the primary server is turned off with 100% free space sharing.
2. Scenario: The backup server is off, and the primary server is on, then the backup server is simultaneously turned on, and the primary server is turned off with 100% free space sharing.
3. Scenario: both iSCSI initiators are turned on then the primary server is turned off with 50% free space sharing.
4. Scenario: The backup server is off, and the primary server is on, then the backup server is simultaneously turned on, and the primary server is shut down with 50% free storage sharing.
5. Scenario: both iSCSI initiators are turned on, then the primary server is turned off with a 10% free storage space.
6. Scenario: The backup server is off, and the primary server is on, then the backup server is simultaneously turned on, and the primary server is turned off with a 10% free storage sharing space.[8]

Testing is done with a down scenario on the server, the primary server will be made as if down by shutting down the server, so it can be concluded how much influence the failover cluster on the availability of storage sharing services.

Table 5. Downtime Testing

Scenario	Downtime for Each Testing (second)			Average
	1	2	3	
1	4,3	4,39	4,24	4,31
2	17,27	16,85	17	17,04
3	4,86	4,62	4,72	4,73
4	17,3	17,38	17,27	17,32
5	4,56	4,77	4,83	4,72
6	17,29	17,3	17,46	17,35

Source: research result (2020)

In table 5 is the result of downtime testing with several scenarios that have been made. The test results show testing with scenarios 1st, 3rd and 5th obtained the average value of the transfer from the primary server to the backup server only takes more or less 4 seconds even with different storage sharing capacities. Whereas for the 2nd, 4th, and 6th scenarios, the average value of the server transfer takes longer, due to the condition of the backup server not in standby when the primary server is down.[9]

Table 6. Availability Testing

Scenario	Uptime Average	Downtime Average	Average
1	86.395,69	4,31	99,99
2	86.382,96	17,04	99,98
3	86.395,27	4,73	99,99
4	86.382,68	17,32	99,97
5	86.395,28	4,72	99,99
6	86.382,65	17,35	99,97
Average	86.389,09	10,91	99,98

Source: research result (2020)

In table 6 shows the availability value of testing that has been done with several scenarios. Theoretically, the value of availability is measured with the equation: [10]

$$\text{Availability} = \frac{\text{Operation Time} - \text{Down Time}}{\text{Operation Time}} \text{ x } 100\% \quad (1)$$

By using the failover cluster method, it can increase the value of server availability which is very high, from several tests that have been done with several scenarios, the average availability value is 99.98%. So it can be concluded that the failover cluster is very effective in increasing the availability of storage sharing services.[11]

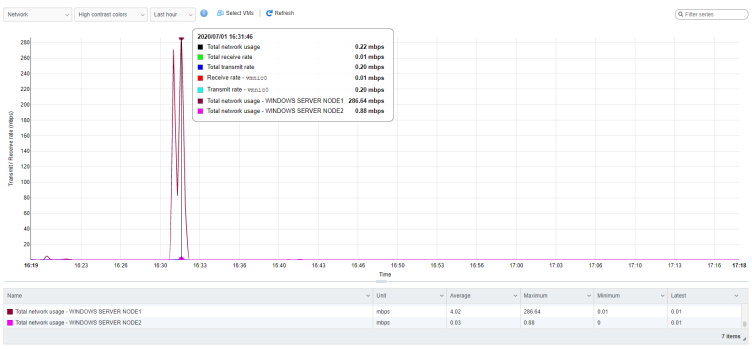

Figure 8. Network Throughput

In figure 8, it can be seen that the main server has a greater throughput compared to the backup server. This is because the main server is used as the main access for storage sharing. So that when there is packet delivery, the main server will be the media link between the client and the iSCSI SAN Server.[12]

Figure 9. CPU, Disk, and Memory Utilization

In figure 9, it can be seen that the main server CPU, Disk, and Memory usage is greater than the backup server. This is because the main server is used as the main access for storage sharing. So when there is a packet delivery, the main server will process requests from the client.[13]

4. CONCLUSION

The implementation of this research will produce an infrastructure that can provide service of storage media in the network with internet protocol as connector media between storage area network and users or clients, by using clustering server technology that will produce high availability cluster, so that when the primary server failure such as failure software function or network access, the role of the primary server will be replaced by backup server with services and information obtained will be the same as the function of the primary server. Also, the time needed to move an active server to a passive server when a failure, the test results obtained the availability value of 99.98%, so that storage sharing services can be effectively utilized by the user or client.

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