

NORTHWEST NAZARENE UNIVERSITY

Diagnosing and Rebuilding a Server System After a Major Failure

THESIS

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in partial fulfillment of the requirements for the requirements
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Glen Luengen
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ABSTRACT

Diagnosing and Rebuilding a Server System After a Major Failure.

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After a power failure, the Computer Science Lab server system failed to connect to the outside network. After examining the individual systems, it was discovered that the Network File System Server, which contained all the important virtual machines, was down. Using a Linux Rescue Disk and an external hard drive, all the information from the NFS server was backed up to troubleshoot the system safely without loss of data. After running through a multitude of troubleshooting steps to repair the system with the current system intact, it was decided that the server had to be completely wiped and reset. The new operating system was installed and the redundant array of independent disk structure of the server recreated. The virtual machines were restored from the backup and the network restored. Finally, the shared network drive was recreated on which students could store files and run web pages. The drive also contained specific folders on which faculty and researchers could store files and images. All the lab systems were restored to pre-power failure level and, in some cases, improved.

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Background

In May of 2016, the Computer Science Lab had a power outage that lasted about an hour. Since the UPS (Uninterrupted Power Source) for the departmental server rack lasted only 22 minutes, the server system was manually powered down. The document that had the correct procedure to power down the server in the case of a power outage was inaccessible as the new lab administrator at the time did not know that it existed in the Google Drive documentation. The result was that the servers were powered down incorrectly due to unavailable documentation.

On resumption of power, the servers were turned on again, but in the wrong order. It is unknown whether the problems with the server were directly or indirectly caused by the incorrect order of power down and power up but it could not have helped. After the power, had been restored and the servers restarted, none of the lab computers could connect to the Internet through the Computer Science Network. At this point it became necessary to diagnose what had gone wrong and find the source of the failure.

Diagnosing the Problem

The first step in solving the issue with the network was determining the cause of the failure. The first theory was that the problem was with the DNS (Domain Name Server). Our server setup has two DNS servers with one being physical and the other being a virtual machine. Upon accessing the physical machine (byss.cs.nmu.edu), the system appeared to have everything working correctly on it. But a potential problem was

that it had a DNS redirect to the virtual machine (alderaan.cs.nnu.edu). This would cause the DNS to possibly redirect to a non-working server and thus fail.

VMware vSphere is used to access the virtual machine management server (moriarty.cs.nnu.edu) which runs alderaan. When VMware vSphere was connected to Moriarty none of the virtual machines appeared. In their place greyed out placeholders called “Unknown Machine” appeared. To determine the cause, the Network File System (NFS) Server that contains all the virtual machines was checked. This machine was throwing a kernel panic whenever it was booted up, which prevented any of the virtual machines from being accessed, including the firewall, and which was causing the Internet failure.

```
Kernel panic - not syncing: Attempted to kill init!
Pid: 1, comm: init Not tainted 2.6.32-279.el6.x86_64 #1
Call Trace:
[<ffffffff814fd11a>] ? panic+0xa0/0x168
[<ffffffff81070bd2>] ? do_exit+0x862/0x870
[<ffffffff8117ca75>] ? fput+0x25/0x30
[<ffffffff81070c38>] ? do_group_exit+0x58/0xd0
[<ffffffff81070cc7>] ? sys_exit_group+0x17/0x20
[<ffffffff8100b0f2>] ? system_call_fastpath+0x16/0x1b
```

Figure 1: Kernel Panic on Network File System

Attempts to repair existing system

In repairing the system, the first main problem encountered was that the user could not run any commands on the NFS server because it would not boot up. But, because the operating system was CentOS, a version of Linux, a Linux live disk could be created. A live disk that ran completely off the CD inserted into the system bypassed the

hard drives and operating system on the machine, whereas it still allowed access to the system.

From the live disk, fsck (File System Check) was run on the file system.

The Linux command fsck detects data corruption in the system and attempts to fix the corruption. No corruption was detected in running this command, but it was noticed that one of the hard drives on the system was failing. Before replacing the hard drive, it was necessary to back up all the files on the server onto an external hard drive to prevent loss of data when attempting more complicated fixes and hardware replacement. The failed hard drive did not cause any data loss due to the system being set up as a redundant array of independent disks (RAID), which mirrored information on the drives to prevent loss of information. After replacing the failed drive with a new drive, the system was still throwing kernel panics when it was booted up.

The next fix attempted was to adjust SELinux privileges which are the security privileges for the Linux operating system and was referenced as possibly causing the version of kernel panic that was being encountered. No change occurred when the system was restarted with the security privileges set to “off.”

```
dracut-initqueue[536]: Warning: Could not boot.  
[ OK ] Started Show Plymouth Boot Screen.  
[ OK ] Reached target Paths.  
[ OK ] Reached target Basic System.  
dracut-initqueue[536]: Warning: Could not boot.  
dracut-initqueue[536]: Warning: /dev/root does not exist  
Starting Dracut Emergency Shell...  
Warning: /dev/root does not exist  
  
Generating "/run/initramfs/rdsosreport.txt"
```

Figure 2: Dracut warning showing that the system cannot find root partition

To attempt to find out what was going on with the system before the kernel panic was thrown the GRand Unified Bootloader (GRUB) settings were changed. The GRUB menu setting was told to run in verbose mode and to show all the steps when booting up and the graphical boot screen was disabled to allow the user to see the system boot up instructions as they occurred. Through this process it was found that the system was throwing a Dracut warning before the system threw the kernel panic. Dracut is a process that is run during the initial boot up of the system and provides the information to properly boot the system.

Knowing that the problem was with the Dracut process, the Dracut shell was started. The shell starts before the system is loaded and throws the kernel panic, allowing commands to be run on the Dracut process. Through several of these commands it was discovered that the system was not able to see the boot, root, or swap partitions on the server and that was the reason that the system was throwing kernel panics.

In an attempt to fix this issue, two different approaches were tried. The first was to rebuild the GRUB. This action would have fixed any problem with the initial boot settings being damaged and causing the dracut issue. The process was successfully completed, but it did not affect the problems with the system. The other action attempted was to replace or upgrade the kernel. This action could not be taken because of the lack of Internet access due to the firewall being down and the failure of the system to recognize the Ethernet connection when routing Wi-Fi through a laptop to the server.

It was at this point where it was decided that the NFS server was a loss. Debugging options at the time were exhausted and the system was still non functional. It was decided that the best option at this point was to completely wipe the system and

rebuild it from the ground up. The choice was also made to perform upgrades to the system, replacing the four existing four-terabyte hard drives with eight terabyte drives and upgrading the operating system from version 6.5 to 7.

Installing the new NFS server

The process for setting up the new operating system was straight forward, compared with the debugging process. The first step was to download the disk image from CentOS.org, the homepage of the distribution of Linux. The iso was then burned onto a CD to make a bootable drive. When the disk installer is run, it walks the installer through the process with a graphical interface. The operating system was installed on the solid-state drive with the boot, root, and swap being created there. The only non-default operating system features installed on the NFS

server were the NFS libraries allowing the drive to be used as a network share. When installing the operating system, the installer needs to make sure the network ports are turned on by default or the user will need to turn them on every time the system is restarted.

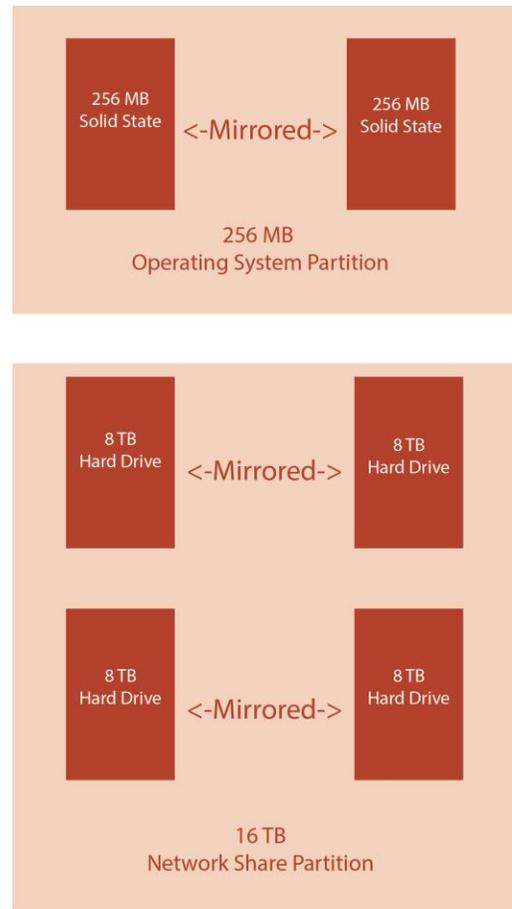


Figure 3: Network File Server Setup

The next action was to set up RAID for the network share. Originally it was decided that RAID 5 would be used for the setup, which allows the user to have space available equal to 3 of the drives if the user were to use four disks like the network share was using. The drawbacks to this setup were that it was more complex, would take more time to rebuild after a drive was replaced, and only allows one drive to fail before data starts to be lost. The setup selected was RAID 10, which allows two drives to fail as long as they are not both sides of the mirrored drive. In addition, this software was simpler to implement. A drawback to this decision was that it provided only half of the total space available on the drives due to the mirroring.

Once the network share was created, the virtual machines were recopied from the backup drive created at the beginning of the process. The next step at this point was to use VMware vSphere to connect with Moriarty and command it to look for the virtual machines on the new server instead of the old one. After it was redirected to the new server location, the virtual machines were powered on and the connectivity to the Internet was restored to the lab.

Recreating the Student Share

The last thing that was left nonfunctional at this point that was operational before the power outage was the student web server and file share. The first step was to set up an Internet Small Computer System Interface (iSCSI) share on the NFS server. This share is the iSCSI target, which allows another computer to use an iSCSI initiator and iSCSI Qualified Name (IQN) to connect to the share. Once that share was set up, the student web server (corellia.cs.nnu.edu) was started and the iSCSI initiator setup on the

server. The initiator was then pointed to target and the share connected. The next step was to format the share to allow Windows files to be put on it. The server manager on corellia was then used to tell the server to share the newly formatted drive with other computers on the network.

Future Work

In the future, security and folder redirection will need to be set up for the student file share. At this moment anyone can access anything else on the folder. This needs to be changed to allow users to access only files to which they have access. Students should have access only to the Students folder unless they are Administrators or Student Researchers and have access to those files. In addition, folder redirection needs to be set up so that when students access a computer the documents folder is their shared folder and if they have not logged on previously a folder is created for them. Other work to be done on the servers is getting a working database server up and getting PHP working on the web server.

The other major work that needs to be completed is that new hardware should be purchased for the servers. Three new servers will replace the current two virtual machine management servers (moriarty.cs.nnu.edu and tython.cs.nnu.edu). In addition, a firewall server has been purchased to replace the virtual machine firewall server. This will prevent the system from losing Internet access if the virtual machines go down again. All this new hardware is planned to be installed in Summer 2017.

Conclusion

During the course of this project, I have learned a lot about server management and the Linux operating system. Before the power outage, I had never used Linux and was completely unfamiliar with any server management protocols or tools. During the project, I learned a wide variety of commands in trying to diagnose the problem with the server and had a crash course in how to use Linux.

I would say that personally the best two things I learned from this project had nothing to do with the servers themselves. The first thing I learned was patience. Throughout the debugging stage, I repeatedly thought that I had figured out how to get the system to work only to have the attempt fail. The other thing I learned was the willingness to take up projects and be flexible. I did not need to step in when the servers failed. I could have just worked on the website design and not messed with the servers. Instead I volunteered for the job and learned a considerable amount of valuable information in the process that will serve me well in the future.

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Appendix 1: List of Virtual Machine Servers

<i>Name</i>	Operating System	Purpose
<i>Acherin.cs.nnu.edu</i>	CentOS 6	Software Mirror
<i>Anaxes.cs.nnu.edu</i>	Windows 2012R2	IIS Password Tool
<i>Ando.cs.nnu.edu</i>	CentOS 6	NTP Server
<i>Anteevy.cs.nnu.edu</i>	Windows 2012R2	WDS Server
<i>Aruza.cs.nnu.edu</i>	Windows 2012R2	Foreman Smart Proxy
<i>Bastion.cs.nnu.edu</i>	Windows 2012R2	DHCP Server (Not Sure if used)
<i>CSVolData</i>	Windows 2012R2	Web Server
<i>db.student.cs.nnu.edu</i>	CentOS 7	New Database Server
<i>Departmental Mail Server (yith)</i>	Gentoo	Old Mail Server
<i>DNS Server</i>	Red Hat Linux 6	External Domain Name Server
<i>Firemap Server</i>	Debian Linux 6	Unknown
<i>Internal Firewall</i>	PFSense	Firewall (to be replaced)
<i>Kuat.cs.nnu.edu</i>	CentOS 6	Foreman Server
<i>Moriarty Management</i>	Windows 2008R2	Old Management Server
<i>Nervepoint</i>	Debian Linux	Unknown
<i>Pix4D Remote</i>	Windows 7	Unknown
<i>PowerPanel Tython</i>	Debian Linux	Old Management Server
<i>Public DNS</i>	CentOS 6	Replace Csaplar in Future
<i>Public DNS Server (Csaplar)</i>	Other Linux	Public Domain Name Server
<i>Public Mirror Server</i>	CentOS 6	Public Mirror Server
<i>Server 2012 DC</i>	Windows 2012R2	Domain Controller
<i>SSL Proxy/Load Balancer</i>	CentOS 6	SSL Termination
<i>Student DNS</i>	Ubuntu Linux	Student Domain Name Server
<i>Student VM Portal (aurora)</i>	Other Linux	Unknown
<i>Student Webserver (CentOS 7)</i>	CentOS 7	Used to mount Home Drives
<i>Team Taction DB Project</i>	Debian Linux	Multitaction Board
<i>Ubuntu-NFS</i>	Ubuntu Linux	Unknown At Time
<i>Vcenter.cs.nnu.edu</i>	Windows 2012R2	Management Server
<i>Voxyn</i>	Ubuntu Linux	Web Server of Sorts
<i>Web Server (fondor)</i>	Ubuntu Linux	Web Server Drupal

Appendix 2: Computer Science Network Diagram

