Electrical Engineering Senior Project

Custom Design Rack Mount System for FTP Server

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10/30/09

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I. Document Notes

- 1. Note "//" are used to indicate beginning of the comment for particular step.
- 2. Bold letters indicate the actual keyboard/mouse buttons to be pressed.
- 3. Guidelines provided in this document are general and summarize steps taken in the design, assembly, and testing of the demo system.
- 4. All OS installation procedures are outlined with general assumption that bios configuration, raid controller card settings, and memory test are completed as per guidelines provided in this document.
- 5. Content of Appendix D is subject to change frequently as it holds bibliography of the sources used which may be changed from time to time.

II. ESD Safety Guidelines

To avoid personal injury and property damage, carefully follow all the safety steps listed below when accessing your system or handling the components. Electric Static Discharge (ESD) can damage electronic components. To prevent damage to your system, it is important to handle it very carefully. The following measures are generally sufficient to protect your equipment from ESD.

- 1. Use a grounded heel strip and/or wrist strap designed to prevent static discharge.
- 2. Test yourself at the ESD test station before starting the assembly job.
- 3. Touch a grounded metal object before removing a component from the antistatic bag.
- 4. Handle the RAID card by its edges only; do not touch its components, peripheral chips, memory modules or gold contacts.
- 5. When handling chips or modules, avoid touching their pins.
- 6. Put the card and peripherals back into their antistatic bags when not in use.

General Safety Guidelines

- 1. Always disconnect power cables before installing or removing any components from the computer, including the backplane.
- 2. Disconnect the power cable before installing or removing any cables from the backplane.
- 3. Make sure that the backplane is securely and properly installed on the motherboard to prevent damage to the system due to power shortage.



Figure 1 ESD Gears Used During the Assembly procedure

1. Project Overview

For a very long time now I have been quite interested in having my personal web server. Senior project gave me the perfect opportunity to explore and to custom design web server that would fit my future storage/web needs.

There were multiple aspects of the project that I needed to research and plan in order to finish the project. The list and brief description of each of these categories is given bellow.

1. <u>Ftp Options</u>: There were several ftp options available. Some were open source and some were not, so I researched these options used the solution that worked best with my requirements. This was my first attempt at customizing server, so I wanted to stick to the open source. This way I can learn more without spending money. I ended up using Filezilla and putty as my FTP client.

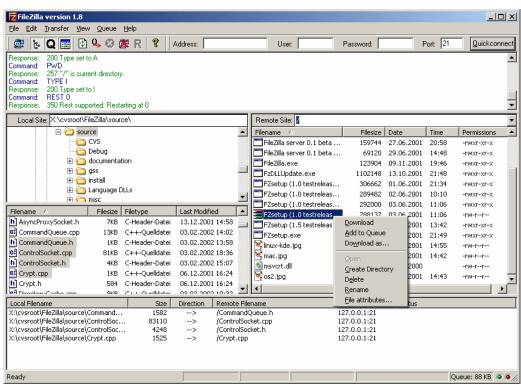


Figure 2 Filezilla Client Operating Window

2. <u>Number of Users</u>: One of the critical aspects of the server construction requirement is that each user should have access to sufficient amount of storage, processor power, and memory allocated to have flawless usage. Therefore, I needed to estimate my data sharing needs which would determine the type of processor and amount of RAM, and hard drive space required. For my system the usage was going to be moderate, so I ended up using Opteron quad core CPU with 8 GB of RAM. The configuration is used such that I can expand the system in future if needed.

- 3. <u>Security Issues</u>: This was one of the major parts of the project to determine the system environment for secure data sharing. Filezilla was once again reliable resource because it is free yet secure.
- 4. Required Storage: I have been using multiple relatively large hard drives for quite some time now, but with growing trends in technology gigabytes are turning into megabytes. Therefore I wanted to start with large storage up front, and still have options to increase storage in future. That is where the Supermicro Server Case comes in handy.

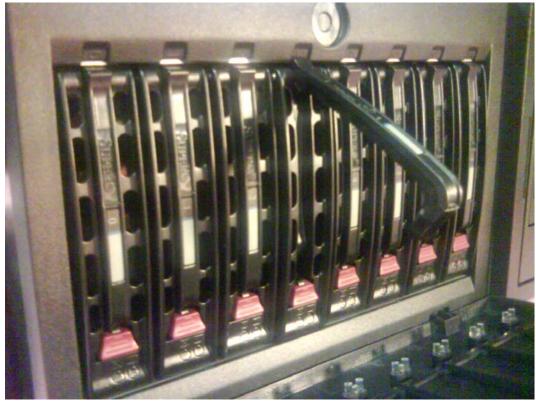


Figure 3 Supermicro Server Case with 8 Hard Drive Slots

- 5. <u>Power Efficiency</u>: Server by nature is going to be run all the time, so I implemented the system that is power efficient. It uses approximately 10 % less power then regular server.
- 6. <u>Minimum specification</u>: I researched growing market trends and my future server need to set the minimum system specification, so that I can have longer time before next hardware upgrade. This Specification is summarized here:

CPU: Dule Core or Higher

RAM: 4 GB or More HD: 1 TB or More DVD: Onboard Drive Floppy: Onboard Drive

- 7. Redundant Components: It is very common to have redundant system components in server system such as power supplies, and Ethernet ports. These components would provide uninterrupted access even if one of them fails. To minimize the cost, I carefully evaluated the need for redundant components, and I only ended up using redundant Ethernet ports.
- 8. Operating System Selection: There are many options available for OS ranging from Windows, Redhat, to open linux each of these have different functions, and so I analyzed these options in detail, and decided to use CentOS as operating system on my system. Some of these analysis criteria included Price, Reliability, Easy Use, Software Cost, Hardware Support, Open Source, and Security
- 9. <u>Hard Drive Raid Options</u>: There are several different types of hard drive raid options available, some are hardware based and some are software based. I evaluated these options to determine that hardware based raid is most reliable, and thus used it to implement my server system.

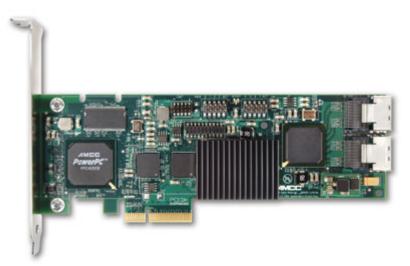


Figure 4 3Ware Raid Controller Card Used in the system

10. Cost and Benefit Analysis: Last but not least, I did cost and benefit analysis to see how much I am getting for the money I spend. Is it beneficial to choose the highest performance system? Or is it okay to go with second or third best in market? This way I would get most for the money I spend. With all the system components the cost is \$ 4000. It is seemingly high price for server, but I got very high-performance system that is also reliable. More details of the used component is shown in Table 1 of section 3.

I went through research, design, and implementation stages in designing the server. Overall this experience was fun and educational because not only I learned how to custom design server, but also how to assemble it in ESD secure place. The remainder of this report provides detail on each step.

2. Project Requirements

Once the topic of the project was finalized I outlined some of the requirements to increase the quality standards for my server system. These requirements are as listed bellow.

- 1. System shall be able to securely store large amount of data with relatively high speed
- 2. System shall have hardware raid controller cards to insure the safety of stored data
 - a. Controller card shall be able to provide variety of different raid such as raid 0, 1, 5, 6, and 10
- 3. The system shall at minimum provide 1 cpu and 2 GB RAM to each of the initial 4 users of the system
- 4. System shall have option to use as tower server or rack-mount server to save space
- 5. System shall have enough internal space for expansion for full size PCI cards such as high-end graphics cards
- 6. System shall allow hot-swapping of hard drives for quick replacement
- 7. System shall have way to lock and secure hard drives to prevent theft or unintended removal of hard drive
- 8. System shall have free hard drive slots for future addition
- 9. System shall have adequate amount of cooling fans and sensors to control and monitor system temperature
- 10. System shall have inbuilt floppy drive bay for OS level troubleshooting and installation of drivers

2.1 Project Design Summary

Table 1 here shows the summary of the components used in the server system. Each of these components were separately purchased to meet the custom design requirements.

Table 1 Server System's Parts Summary

Parts	Model Numbers	Description
Chassis	SC743TQ-865b-SQ	Black 4U Pedestal Chassis
Motherboard	H8DME (Rev # 2.01)	Supermicro Motherboard
CPU	Opteron 2347	AMD Third Generation CPU
CPU Heatsink	SNK-P0023P Socket F (B)	CPU Heatsink
RAM	AH28K72L8BHE6S	2GB Memory DIMM
Air Shroud	CSE-PT0123 Rev.B	Airflow Guiding Cover
RAID Controller Card	3ware 9650SE-2LP 2-Port	8 Port RAID Controller Card
Hard Drives	ST31000340AS	1TB Hard Drives
DVD/CD Drive	AD-7191A	Sony Optiarc DVD/CD Drive

3. Server Assembly Procedure

This section is designed to assist technician with step-by-step approach in assembling the system, validation testing, and customizing servers; ranging from 1u-5u.

3.1 Unpacking the Server

Rack mount servers are shipped with all the necessary components and accessories that are needed for assembly and installation. The server box includes the following:

- A. The server chassis
- B. The Motherboard only if it is superserver
- C. Power cables
- D. Two set of rack rail assemblies
- E. Mounting screws
- F. Users manual
- G. HD, CD, FD cables and mounting kits.
- 1. Inspect the box in which the server was shipped-in and check for any damages. If the server is damaged, file a damage claim with the vendor or carrier who delivered it.
- 2. Select a suitable location near the rack unit that holds the server. The selected location must be clean, well-ventilated, and dust-free.
- 3. Place the server near a grounded power outlet.
- 4. Do not expose this equipment to excessive heat, electrical noise or strong electromagnetic fields.
- 5. Inspect the chassis to avoid any visible scratches, damage, or missing parts.
- 6. Inspect all computer components to avoid missing parts, or mismatched parts.

3.1.1 Unpacking the Motherboard

Use this section only if the system is not superserver. Motherboards are shipped with all the necessary components and accessories that are needed for assembly and installation. The motherboard box includes the following:

- A. The Motherboard
- B. Mounting Nuts and Screws
- C. Users manual
- D. Driver CDs
- E. Hard Drive, CD/DVD, and Floppy connection Cables
- 1. Inspect the box in which the motherboard was shipped-in and check for any damages. If the motherboard is damaged, file a damage claim with the vendor or carrier who delivered it.
- 2. Select a suitable location near the rack unit that holds the server chassis. The selected location must be clean, well-ventilated, and dust-free.
- 3. Place the motherboard near a grounded power outlet.
- 4. Do not expose this equipment to excessive heat, electrical noise or strong electromagnetic fields
- 5. Use extra caution in following ESD procedures when handling motherboard

3.1.2 Initial QC Procedures

BEFORE TOUCHING THE KIT – MAKE SURE THAT ALL ESD PRECAUSTIONS ARE TAKEN – WEAR HEEL STRIPS AND/OR WRIST GROUND CORDS, OPEN THE PACKAGES AT DEMARKETED ESD PRODUCTION AREA

Before the assembly of the systems, please check the following:

1. Work Order: Please make sure that all items you receive as kit are as per the Work

Order. Any missing items or items which should be there in wok order and not included should immediately be brought to notice of your supervisor.

2. Components: Check if any physical damage.

3. Chassis: Check if any scratch on the surface of the chassis.

4. CPUs: Check the CPUs' stepping numbers. (For Dual/Quad CPU systems all

CPU's should have the same stepping.)

5. HDs: Check the sizes and firmware version. (For multiple drive systems –

specially systems with RAID – the firmware should be the same for all

drives.)

6. Memory: Check the size, speed and brand name.

7. Power Supply: Compare the PS with the invoice.

8. Special Case: Carefully read if there are any special instructions with the Work Order.

9. Double check if there are any missing parts in the Work Order before assembly.

3.2 Assembling the Main Server Parts

This section is designed to provide step-by-step instruction on how to install all the main server parts in the system.

When assembling a system, you must be careful of the following:

1. Sr. # Record: Update the QC traveler with all serial numbers for various components.

2. Chassis Covers: Must be handled very carefully, don't make any scratches.

3. Airflow: Don't put any cables to block the airflow.

4. Cabling: Must be tied neatly.

5. Cables: Don't make any damage on the cables.

6. Screws: No loosing screws or missing screws. Be careful with the screws – make

sure none of the screws are damaged. If using power screwdrivers – use

proper torque settings.

If there are any questions about the system, such as needing additional fans and CD/FD, please research it online for more details.

3.2.1 Install Motherboard

- 1. Take full ESD precautions while working with motherboard for the system
- 2. Check to see if there are no physical damage to the board
- 3. Compare the order form and motherboard to verify that the model number of the motherboard is same
- 4. Clear the chassis, and prepare it for motherboard installation
 - a. Remove any foam packing used for shipping
 - b. Compare motherboard mounting holes with chassis to check there are not any unused nuts for motherboard screw
 - c. Remove any additional motherboard mounting nuts from chassis to prevent any possible short-circuit.
- 5. Apply bottom insulator sheet to chassis where motherboard will be installed later on
- 6. Carefully install motherboard into chassis and make sure that no presser is applied on any components while in installation
- 7. Install all the motherboard screws with suitable torque and avoid using excessive amount of torque.

For all Electronic Screw Drivers, the default torque is set to 4.

3.2.2 Install Hard Drives

To mount a SATA drive in a drive carrier, perform the following procedure:

- 1. Remove the plastic dummy drive by unscrew the two screws (see 4, Figure 1).
- 2. Insert the drive (see 1, Figure 1) into the carrier (see 2, Figure 1) with the printed circuit board side facing down so as to align the holes (see 3, Figure 1) on the drive with the holes (see 4, Figure 1) on the carrier.
- 3. Secure the drive to the carrier with the six screws (see 5, Figure 1).

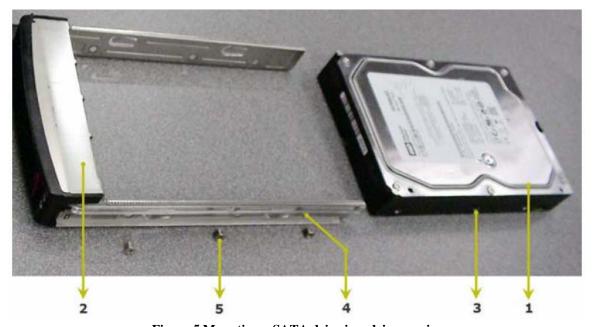


Figure 5 Mounting a SATA drive in a drive carrier

3.2.3 Install CPUs and Heatsink

Always unplug the power cord first before adding, removing or changing any hardware components. Make sure that you install the processor into the CPU socket before you install the CPU heatsink.

Make sure to install the motherboard into the chassis before you install the CPU heatsink and heatsink fans.

- 1. Locate the CPU location on the motherboard and remove the plastic cap to check that there are no bent pins. Use figure 2 for more details.
- 2. If there's only one CPU in Dual/Quad CPU MB, install the CPU in first CPU socket.
- 3. Open the CPU cover by using the latch given on the side
- 4. Use triangular pattern on the CPU to determine the correct position of CPU
- 5. Place CPU in the CPU holder and close the CPU harness. Use the latch to secure the harness

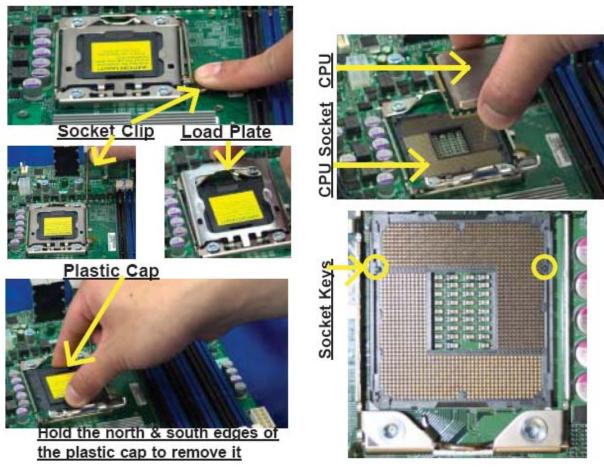


Figure 6 CPU Installation Guidelines

- 6. Check the presence of the thermal compound on the heatsink if not present then apply thermal compound on top of the CPU. Avoid using excessive amount of compound
- 7. Install correct model number of Heatsink
 - a. Gently place the CPU Heatsink on top of the CPU

- b. Adjust torque on the electric screw-driver to level 4 to eliminate excessive amount of torque
- c. Start screwing bolts in diagonal patterns. Ie. Tighten the screw #1 on one side then tighten the diagonal screw #2 and continue the process until all the screws are tightened. Refer to Figure 3 for details.

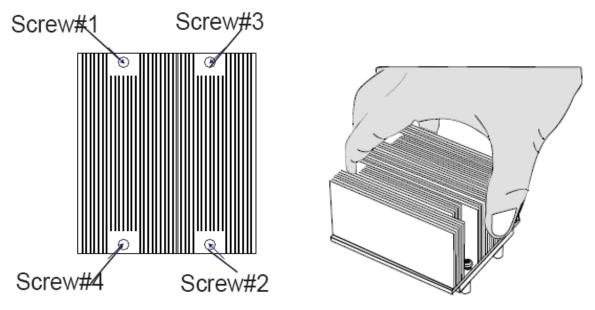


Figure 7 Heatsink Installation Process

3.2.4 Install Memory

- 1. Remove any cards or internal components necessary to give yourself unobstructed access to RAM sockets.
- 2. Pick up your DIMM (dual in-line memory module) by the ends without touching pins or chips.
- 3. Always refer to motherboard manual for the correct ways to install the memory. Insert the desired number of DIMMs into the memory slots, starting with P1-DIMM #1A. When populating multiple DIMM modules within a channel, always start with Bank1 first as shown in figure 4. (For best performance, please use the memory modules of the same type and same speed in the same bank.)
- 4. Press down the release tabs on the ends of a memory slot. Insert each DIMM module vertically into its slot. Pay attention to the notch along the bottom of the module to prevent inserting the DIMM module incorrectly. Gently press down on the DIMM module until it snaps into place in the slot. Repeat for all modules.
- 5. Gently try to pull the module out to ensure it is locked in position.

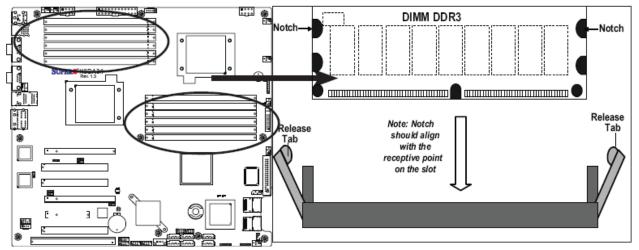


Figure 8 Memory DIMM Installation Process

3.2.5 Install RAID Controller Card

- 1. Open the RAID controller card and inspect for any physical damages
- 2. Check that controller model number and revision number is appropriate
- 3. Change the metal controller holder to low profile in necessary
- 4. Insert the card very carefully into the respective expansion slot
- 5. Secure the controller card with screw or latch
- 6. Attach controller cables to the controller such that no extra tension is applied to the controller card

3.2.6 Final Cabling check

Once the assembly process is over use these following steps to check the cabling:

- 1. Check power cables to see if they are connected to appropriate connectors on the motherboard
- 2. Use ties to bundle-up loose cables
- 3. Check if any cables are blocking air flow, and if they are then adjust cables such that air flow is uninterrupted
- 4. Check tension on each cables to make sure they cable tension is not transferred to the components

4. Quality Control Process

This section outlines steps taken in quality control with step-by-step approach. Please read these steps carefully before starting the QC process.

4.1 Assembly Check/Inspection

When a system is assembled and ready to be loaded with OS, you SHOULD NOT connect the power to the system yet. Open the cover or side panels of the system, and check the followings:

1. CPU: Heat sink with Fan must be mounted

2. Memory: Size and type must be matched with orders.

3. Hard Disks: Model number and quantity must be matched with order.

4. Floppy Disk: Check if included with the order.5. CD/DVD: Check if included with the order.

6. Power Supply: Check the voltage and Watt, Redundant, and Pings.

7. Motherboard: Check manufacturer and model number.

8. Power cords: Check all the components if connected with power cords.

9. Ribbon cables: Check if connect properly. Pin 1 must matched with motherboard. 10. Cable routing: Check if it blocks the airflow, if it tired and mounted properly.

11. Jumpers: Check if some jumpers must be set.

12. Raiser cards: Check if proper raiser card installed with the system.

13. Screws: Check if all screws are installed and tied.

14. Additional cards: Check if included with the order.

4.2 Burn-in Check

You need to connect PS/2 Keyboard, PS/2 Mouse, Network cables, Monitor, and Power cords to the system, and then turn on the system.

During Power On Self Test (POST), press either or <F2> to enter CMOS setting. If the system Make beeps or no display at all, turn off the power, and return the system to Assembler.

If the systems are POST, check the followings:

1. BIOS version: If it is not the latest, update it.

2. CPU Info: Check if CPU speed, Cache size, FSB, Stepping number.

3. Memory: Check Size, if size different, contact sales person.

4. Hard disk: Check size and quantity.

4.3 Burn-in BIOS Setting

Please read this section before continuing with BIOS setting changes. Use Section 5: General BIOS Configuration to get detailed step-by-step process in setting BIOS changes mentioned in this section.

Follow these BIOS Settings:

Press <F9> or <F7> to load the optimal Default Setting.

4.3.1 Main Setup

- 1. Change to current date and time.
- 2. Check CPU and Memory size.
- 3. Check BIOS Version.

4.3.2 Advanced settings

1. IDE Setting: Enable 32 bit transfer.

2. SATA: IDE only if no SATA HDs; Combine mode for SATA HDs.

3. Floppy: Disable if not in order.

4. PnP OS: Enable for windows, disable for all others.

5. Hyper Threading: Enable if this feature presents.

6. IO Configure: Disable COM2 if COM2 is not presented.
7. MPS: 1.4 for Windows and BSD OSs, 1.1 for Linux.
8. ACPI: Must be disabled for Solaris, enabled for all others.

4.3.3 Boot

- 1. Change boot order to Floppy, CDROM, Hard Disks.
- 2. Check if all Hard Disks Presented.
- 3. If IDE and SCSI HDs in system, IDE boot first.
- 4. IDE IDE and Raid in system, IDE boot first.

4.3.4 Power configuration

- 1. Restore on Power Loss must be enabled.
- 2. Watch Dog timer is disabled.

4.3.5 Event Log Configuration

1. Event logs must be cleared.

4.3.6 Remove Access Configuration

1. Disabled for Windows systems, must be enabled for all others.

4.3.7 System Health Monitor

1. CPU Temperature: Intel CPU is about 30° C

a. AMD CPU is about 50° C

2. Systems Temperature: Must be about 30° C.

- 3. Keep all other settings unchanged.
- 4. Check Motherboard for details. Contact you're your supervisor if you have any questions.

4.4 Memtest and CPU-Burn (Second QC)

- 1. All systems sold by Genstor must be burn-in before ship.
- 2. No burn-in, no shipping.
- 3. Burn-in is ensuring our product quality, to find out hardware problems before ship to customers.

Before the Operating System installation, all systems must pass second QC. Move the systems to the burning shelving, insert the Memtest CD or FD, and then turn on the system. Make sure the tests started before you continue to work on the second system.

After 24 hours of Memtest burning, connect the monitor to the systems to check if there are any errors. If Memtest reports some errors, inform the technician and removing it from the shelving. If the systems passed the Memtest burn-in, then move them to the OS install table.

Please use step-by-step procedure outlined in Section 6: Memory Test for more details

4.5 Final QC:

4.5.1 Manual bag Check Lists

- 1. Motherboard Manual
- 2. Motherboard CD
- 3. Work sheet
- 4. Screw back
- 5. Power cord
- 6. OS CDs if included
- 7. DVD CDs if DVD ROM included.
- 8. Raid CDs if Raid card included.
- 9. Sound CDs if Sound Card included.

4.5.2 Chassis Check

- 1. Screws: Check if all screws are tied and fasten.
- 2. Shake the system well; make sure no additional screws or materials are inside the system.
- 3. Check the Order sheet; make sure all components in order sheet are included in the system.
- 4. Check the chassis; make sure no scratches in both sides.
- 5. Check routing cables, make sure they are tied and fasten.
- 6. Check ribbon cables, make sure they are tied and fasten.

4.5.3 Power on Check

- 1. Connect KB, Mouse, Network cables and power cord to the system.
- 2. Check CPU and Systems Fans.
- 3. Check airflows, make sure CPU would not overheated.
- 4. Check Power Supply, make sure fans are running and check vibration

4.5.4 POST Check

- 1. Check Motherboard's Bios and BMC version.
- 2. Check CPU Speed and Cache size.
- 3. Check memory size and speed.
- 4. Check Raid controller cards firmware and BIOS version.
- 5. Check Hard disks Model number and quantity.
- 6. Check Hard Disk Firmware version.
- 7. Check to boot from Floppy
- 8. Check to boot from CDROM.

4.5.5 Operating Systems Check:

- 1. Login as root and admin to check password.
- 2. Login as user to check the password.
- 3. Check the X windows.
- 4. Check networks.
- 5. Check sounds.
- 6. Check the partition tables.
- 7. Check the UDMA.

4.5.6 System Check:

- 1. Check the cold boot and power switch.
- 2. Check the warm boot reset switch.
- 3. Check Power Light.
- 4. Check the Hard Disk Light.
- 5. Check the Network light.
- 6. Check the MB's Network Ports Light.

4.5.7 Final General checklists:

- 1. Reboot the system three times, including warm boot and cool boot.
- 2. Login the system with root, admin, and users.
- 3. Check network connection by surfing www.genstor.com.
- 4. Check network ports one by one if more than one ports.
- 5. Check CD and DVD if included with the system.
- 6. Check USB connection.
- 7. Check COM Ports and Parallel Port.
- 8. Check audio and sounds if sound card included.
- 9. Check all LEDs, power light, HD light, and network light.
- 10. Check power switch, reset button.

4.5.8 Additional Tasks:

- 1. Tap the System's serial number on the back of the system.
- Tap our company's logo in front of the system.
 Make a copy of the Order sheet and Work order

5. General Bios Configuration

- 1. Connect the system and run memory test to ensure that the system memory has no issues //generally it is preferred to run about 4-5 runs of memory test
- 2. Reboot the system and as it is starting press **Delete** key enter the Bios
- 3. Press **F9** to reset all the default settings
- 4. Under Main tab Set correct Date and Time
- 5. Depending on system configuration Enable/Disable CD and Floppy drives // Note that if CD or Floppy are connected via SATA port then onboard SATA must be Enabled otherwise if there is PATA cable used and there is RAID card installed then disable the onboard SATA
- 6. Under SATA, change the native mode from "Auto" to "Serial ATA"
- 7. Go to Advanced tab
- 8. Select Boot Features and make following changes // Use **Esc** key to go to Advanced tab
 - o Quick Boot Mode Enabled
 - o Quiet Boot Disabled
 - Power loss Control Last State
- 9. Select PCI Configuration under Advanced tab and make following changes
 - Onboard G-LAN1 OPROM Configure Enabled
 - o Onboard G-LAN2 OPROM Configure Disabled // If not specified otherwise
- 10. Select Advanced Processor Options under Advanced tab and make following change
 - o Intel(R) Virtualization Technology Enabled
- 11. Select DMI Event Logging under Advanced tab and make following changes
 - o View DMI event log // Check if there is any errors logged already
 - o Clear al DMI event logs yes
- 12. Select Console Redirection under Advanced tab and make following changes
 - o Com Port Address On-board COM A
 - o Baud Rate 115.2K
 - o Console Type VT100+ // If VT100+ is not available then choose VT100
 - o Continue C.R. after POST On
- 13. Select Hardware Monitor under Advanced tab and make following change
 - o Fan Speed Control Modes -3/4 pin (Server) // Use what is available
 - o Check if all Fans are working
- 14. Go to Boot tab
- 15. Make following order in "Boot priority order"
 - CD/DVD DriveHuse onboard not USBFloppy DriveUse onboard not USB
 - o Hard Drive // This would be Raid controller card if installed
 - o Network
- 16. Go to Exit tab and choose Exit Saving Changes
- 17. At this point the system will reboot now Raid controller card must be configured // If the Raid controller card is 3ware then use **Alt+3** to enter into 3ware bios
- 18. Configure the system and choose appropriate Raid # // OS will have problem if you choose larger then 1TB partition to install the OS, so allocate 100GB separately to Boot Volume size for OS when you configure the Raid controller card

19. At the end of the configuration system will reboot, so make sure that raid controller card is at the appropriate order under Boot tab in System Bios

6. Memory Test

- 1. This procedure assumes that Bios is configured correctly as shown in section 5
- 2. Upon restart the system will connect to production main server and will prompt you for option to choose
- 3. boot: mem
- 4. c // to enter configuration mode
- 5. 6 // to enter ECC option
- 6. 2 // Turn on ECC
- 7. 0 // to exit configuration mode
- 8. Let the mem test run for about 10 pass
- 9. Esc // to exit mem test after 10 pass

<u>Alternate Method</u> // Use this if Ethernet port is not available for some reason

- 1. This procedure assumes that Bios is configured correctly as shown in section 5
- 2. Insert mem test CD in CD drive and restart
- 3. mem test will start running once the system is restarted
- 4. c // to enter configuration mode
- 5. 6 // to enter ECC option
- 6. 2 // Turn on ECC
- 7. 0 // to exit configuration mode
- 8. Eject the CD from CD drive as it is not needed for the remaining of the test
- 9. Let the mem test run for about 10 pass
- 10. Esc // to exit mem test after 10 pass

7 Software Installation

This section outlines step-by-step procedure in installing CentOS on Supermicro Server.

7.1 Installing Centos 5.3-32 by PXE on Supermicro Servers

- 1. Upon restart the system will connect to production main server and will prompt you for option to choose
- 2. boot: cent5.3-64 text // note if you don't write text then it will install OS using graphical interface which is same thing as text mode, but some of the options are worded different
- 3. Choose a Language English
- 4. Keyboard Type us
- 5. Installation Method NFS image
- 6. Networking Device // leave default settings and ok it
- 7. Configure TCP/IP uncheck "Enable IPv6 support and ok it
- 8. NFS Step
 - o NFS Server name 192.168.2.6 // Maybe different for other network
 - o CentOS directory /export/cent5.3-64 // note you would chose appropriate version if you are not installing cent5.3-64
- 9. Would you like to use VNC? Use text mode
- 10. CentOS OK
- 11. Warning Yes // Make sure you don't have any important data on these partitions
- 12. Partitioning Type
 - o Highlight "Create custom layout" and ok it
- 13. Partitioning
 - o Choose New
 - Add Partition
 - Mount Point /boot
 - File system type ext3
 - Allowable Drives Only have one primary drive selected which is "sda"
 - Size (MB) 100
 - Check Fixed Size
 - Check Force to be a primary partition
 - ok
 - o Choose New
 - Add Partition
 - Mount Point swap
 - File system type swap
 - Allowable Drives Only have one primary drive selected which is "sda"
 - Size (MB) Twice the installed RAM size
 - Check Fixed Size
 - Check Force to be a primary partition
 - ok
 - o Choose New
 - Add Partition

- Mount Point /
- File system type ext3
- Allowable Drives Only have one primary drive selected which is "sda"
- Size (MB) –
- Check Fill all available space
- Check Force to be a primary partition
- ok
- o ok
- 14. Boot Loader Configuration Use GRUB Boot Loader
- 15. Boot Loader Configuration
 - o ok
- 16. Boot Loader Configuration
 - o Check Use a GRUB Password
 - o Boot Loader Password user
 - o Confirm user
- 17. Boot Loader Configuration
 - o Keep default settings and select ok
- 18. Boot Loader Configuration
 - o Keep default settings and select ok
- 19. Network Configuration
 - o Choose eth0: Active on boot, DHCP
 - o ok
- 20. Hostname Configuration
 - o Choose Manually
 - o Write "genstor.genstor.com"
 - o ok
- 21. Time Zone Selection
 - o Keep default settings and select Los Angeles time
 - o ok
- 22. Root Password
 - o Password user
 - o Confirm user
 - o ok
- 23. Package Selection
 - o Keep default selection as it is
 - o Choose Customize Software Selection
 - o ok
- 24. Package Group Selection
 - o Keep default selection as it is and add following // uncheck Virtualization
 - Administration Tools
 - Development Libraries
 - o Development Tools
 - o Legacy Network Server
 - o Legacy Software Development
 - Legacy Software Support
 - o Server Configuration Tools

57. click on Monitor tab

o Click on Batter Backup

```
    System Tools

       o ok
25. Installation to begin – ok
26. When installation is complete select Reboot
27. Setup Agent
       o Run tools
28. genstor login – root
29. Password – genstor
30. Following steps are only needed for 3ware Raid controller cards
31. ftp -i 192.168.2.6
32. Nave (192.168.2.6:root) – ko
33. Password – ko
34. cd /export/3ware/linux-64
                                // can use ls to see what is inside linux-64
35. mget *
                  // Let it copy files and when it says it is done copying go to next step
                  // This will brake you out of ftp
36. quit
          // make sure that following file is listed under the list
37. ls
   3DM2 CLI-Linux-x86 64-9.5.2.tgz
38. tar -xvzf 3DM2_CLI-Linux-x86_64-9.5.2.tgz
39. ls
40. chmod 7 setupLinux_x64.bin
41. ls
42. ./setupLinux x64.bin -console
43. At this point it will ask for several options one after another, but we just want all default
   selection. Therefore, press Enter several times.
44. You must approve to continue – 1
45. Again press Enter key several times and then you see process completed
46. ls
47. rm 3DM2_CLI-Linux-x86_64-9.5.2.tgz
48. y
49. rm setupLinux x64.bin
50. y
51. startx
52. Add terminal window shortcut to the top bar
                                                       // you can drag and drop it from
   applications > Accessories > Terminal
53. Right click Desktop and choose "Create Launcher"
       o Click on "No Icon" and select "redhat-tools.png as your icon
       \circ Name – 3dm2
       o Command – firefox https://localhost:888
54. Double click the new icon created on the desktop
55. add certificate and then login
       o User – Administrator
       o Password – 3ware
56. click remember password
```

summary

82. At this point you are done with installation

o Click on test Battery Capacity // only click this if you see 0 hours for Estimated backup capacity and let it run over night o ok 58. System $> \log$ out root 59. df -h // This will list all the mounted partitions 60. parted /dev/sdb 61. p and press Enter // This will show partition info. Verify that partition table is gpt if not then use mklable gpt and type y for the next question 62. mkpart primary xfs 0 "partition size" GB 64. yum install xfsprogs 65. y 66. y 67. yum install kmod-xfs xfsdump 68. y 69. mkdir /data 70. mkfs.xfs /dev/sdb1 71. mount /dev/sdb1 /data // At this point if you do df –h then new volume should show up as mounted with correct HD space. 72. vi /etc/fstab 73. Go to the end of the file then press latter o // It will insert new line /data xfs defaults 1 1 74. /dev/sdb1 75. Esc 76. Shift+z // Save the changes 77. Shift+z // Exit 78. umount -a // should unmont everything if in df –h // should mount all volumes including the new large volume 79. mont -a // should show all mounted volumes 80. df -h 81. At this point you can use "tw_cli info c0" or "tw_cli /c0 show all". This will provide

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7.2 Adding 3ware Driver/Firmware

If 3ware raid controller card is installed then the driver must be installed to run the utility. Follow following steps to load the 3ware driver after Linux OS installation is complete.

- ftp -i 192.168.2.6
 user name: ko
 password: ko
 cd /export/3ware/linux-64 // use linux-64 for 64bit OS and linux-32 for 32bit OS
 ls
 mget * // copies files into root directory
 quit // takes you to root
 ls // conform that files were copied correctly
- 9. tar -xvzf 3DM2_CLI-Linux-x86_64-9.5.2 // can use **Tab** key to fill in the file name
- 10. chmod 7 setuplinux.... // use **Tab** key to complete the file name
- 11. ls
- 12. ./setuplinux.... -console // use **Tab** key to complete and then type -console
- 13. Let the system install the driver. Choose all default settings for the installation options
- 14. startx // To start the graphical mode
- 15. Go to Application and then select Accessory and drag and drop Terminal icon to the top quick launch bar.
- 16. Right click on Desktop
 - o Choose create launcher
 - o Name: 3dm2
 - o Command: Firefox https://localhost:888
 - o Choose Icon image: Redhat tools.png icon for the Desktop icon image
- 17. **Double-click** the launcher
 - o Add exception
 - Get certificate
 - Conform the certificate
- 18. Lon-in using following information
 - o User: admin
 - o Password: 3ware
 - o Log-in and **click** on remember password for Firefox option
- 19. Go to monitor tab and select Battery back-up
 - O Test battery capacity // Only perform this test if you have battery installed in 3ware card and it shows 0 for battery capacity and let it run over night
- 20. Verify and initialize the raid if you have not already done this // This process takes several minutes, so finish this before running bonnie++ or any other burn-in test
- 21. At this point 3ware driver is successfully installed and the controller card is ready to use // note that some controller cards may require updated firmware procedure to install firmware is shown in section 9.1 bellow.

7.2.1 Upgrading 3ware (3dm2) Firmware

- 1. Go to the text mode in Linux to first conform that firmware upgrade is needed.
- 2. tw_cli /c0 show firmware // check to see if you need to update the firmware
- 3. ftp -i 192.168.2.6
- 4. home: ko
- 5. password: ko
- 6. cd /export/3ware/9650 // here 9650 is version of the 3ware controller card so choose appropriate version to upgrade the firmware
- 7. ls // to check if firmware is there
- 8. mget * // copies firmware to root directory
- 9. quit // to return to the root directory
- 10. ls // to check if file/s got copied correctly
- 11. tw_cli update fw=prom0006.img // prom0006 is file name and may be different for different system
- 12. Warning want to update choose yes
- 13. Let the installer update the firmware and reboot at the end of the installation for update to take place
- 14. Log-in at system restart
- 15. chmod 755 tw cli
- 16. tw_cli /c0 show firmware // check to see if the firmware is upgraded or not
- 17. tw_cli /c1 show firmware // do this only if there are two controllers. "tw_cli info" to see how many controllers are present in the system
- 18. tw_cli /c0 show all // verify all the information to conform that there are not discrepancy between the desired system configuration and actual system configuration
- 19. tw_cli /c1 show all // verify all the information to conform that there are not discrepancy between the desired system configuration and actual system configuration
- 20. rm prom0006.img
- 21. y // to conform the removal
- 22. rm installshield
- 23. y // to conform the removal

7.3 Steps to Verify Whether or Not Raid is Initialized

Verification Using Graphical Mode

- 1. Log-in to 3dm2 and see if raid shows as initialized or initializing. If it is not showing either of these two then go to step 2, or skip to step 3.
- 2.
- 3. Go to Management and choose Controller Settings and choose following
 - o Enable write cache
 - o Choose intelligent for read cache
 - o No for Auto Verify
 - o No for over ride ECC
 - o Yes for Queuing
 - o Choose Balance for Stor-Save
 - o Choose All for Rapid Raid
- 4. Apply all the settings and let it initialize the raid // Note it may take long time depending on raid volume to initialize it
- 5. At the end of the process conform that the verification is done correctly and utility shows drives and raid, healthy and initialized // Do not run Bonnie++ while it is verifying

Verification Using Text Mode

- 1. tw cli/c0 show all
- 2. see if raid volume is initialized or not
- 3. Don't do anything if the system is initializing or verifying. If not then continue to step 4
- 4. chmod 755 tw_cli // May not need to do this if tw_cli is already in green writings
- 5. tw_cli maint verify c4 u0 //This starts the verifying process (double check the syntax)
- 6. Can use following commands to verify
 - o top
 - o tw_cli info
 - o tw cli into c0
 - o tw cli c0/c0 controller 0
 - o tw cli c1/c1 controller 1
 - o tw_cli /c1 show all
 - o tw_cli /c0 show all
- 7. Do not run bonnie++ while the system is verifying the Raid
- 8. Verify step 3 from the "Verification using Graphical Mode"

8 Bonnie++ Test to verify Hard Disk Quality

Note: If you have installed Ubuntu or Debian on system then start with I-III and skip steps 5 - 14

- I. apt_get install bonnie++ // installs bonnie++ form internet
- II. apt_get install cpuburn-in // installs cpuburn-in from internet
- III. Go to step 15 to continue
- 1. This procedure assumes that you have already configured system in Bios with Genstor default setup and Linux OS is installed
- 2. Start system and log-in // You can use either text mode or graphical mode to run the bonnie test. This procedure outlines steps using graphical mode
- 3. startx // It will start graphical mode
- 4. open terminal window
- 5. ftp –i 192.168.2.6
- 6. Nave (192.168.2.6:root) ko
- 7. Password ko
- 8. cd test // can use ls to see what is inside test folder
- 9. mget * // Let it copy files and when it says it is done copying go to next step
- 10. quit // This will brake you out of ftp
- 11. chmod 755 1
- 12. ll // This is same as ls -l
- 13. ./1 // sh 1 –execute file 1
- 14. ls // make sure that following file is listed under the list bonnie++
- 15. cd /data // here "/data" is directory created on large Raid volume or on separate Hard Disks
- 17. Run 1 bonnie++ file per Hard Disk or per Raid
 // If hard drives are not using Raid
 then run bonnie++ in each of the
 hard drives
- 18. cat /proc/cpuinfo // can use "cat /proc/meminfo" to get memory information
- 19. top // conform all the parameters and see if there are any discrepancies in system
- 20. open new terminal
- 21. ./cpuburn-in 5000 // here 5000 is number of minutes
- 22. open new terminal
- 23. ./cpuburn-in 5000 // Generally 4-5 cpuburn-in should give you about 90% cpu usage
- 24. Continue adding "cpuburn-in" in new terminals until you get 95% for cpu usage
- 25. Let this test run overnight
- 26. Next day you can use **Ctrl+c** to stop the "bonnie++" and "cpuburn-in" each of the terminals

27. If you need to abort the bonnie++ test before it complete use following steps to clear the bonnie++ data from hard disks

```
o cd /data // go to the directory where the bonnie++ is running o ls // check to see if there are bonnie++ files present
```

- o rm -rvf * // This will remove all the bonnie++ files from the directory
- o Use these steps to remove bonnie++ files from other directories if any
- 28. At this point you are done with bonnie++ test

Appendix A: Overview of Raid Technology and Raid Options

RAID Technology

The RAID is actually a technology which is implemented with the intellectual capability to improve the performance of the system. There are many types of RAID drives available. But most of the drives originally will have the same properties as those of its types. The technology that is used for the a typical RAID drive is that, data is duplicated and stored, using the mirroring and the redundancy of the data is carried out by using the parity check. This technique eventually increases the performance of the system and finally leads to a reliable system. Considering the different types of the RAID system; they include the following: RAID 0, RAID1, RAID 1+0, RAID 2, RAID 3, RAID 4, RAID 5, Adaptive RAID, and RAID 6.

The mirroring is the process where in the data is duplicated on the two drives. The same copy of the data is kept on two different systems. The data mirroring helps a lot where there is the disk failure. It may also help when the system crashes considerably. The process of evolving the mirroring is the logic of keeping the copy of the data on the two different drives. This makes the sense when one of the drives crashes and if there is any problem accessing the data from one drive. The other storage drive is always there to provide the backup.

Hence the process of mirroring ensures that there is security involved in the duplication of the data. More over the problem of data backup and data recovery from any system crash is also solved. The mirroring also helps in maintaining the credibility of the system. The reliability and the performance also have the rise. The fault tolerant systems provide a lot of reliability in the case of a system crash or disk failure.

In such case that is if one drive fails and the other is still running well, the RAID controller automatically rebuilds the data from the other devices and restores the same to the crashed system. This is done according to the importance and the credibility of the data that was crashed. The backup may be essential. The important noticeable thing is that the RAID controller is so designed so as to restore the data automatically from the other systems.

The data is restored back and the system works wells as usual. If the other drive that is crashed is completely not recoverable or has sustained some major damage or there is some sort of physical corruption then the process may proceed to form a solution in altogether different way. There may be a slight change in the technological implementations of the different types of RAID but almost the typicality remains the same. A brief description is provided below describing the technology used in the different types of RAID.

A1. RAID 0

Almost all the different types of RAID utilize the SAN storage system. The SAN stands for the Storage Area Network. This SAN is a storage network that is especially designed for establishing the connections between the different storage systems or the subnets. The importance is that it

has a high speed of connection. The RAID is a specific system that utilizes the normal hardware but the technological implementations make it most complex. The RAID 0 also has the same typicality as that in other types of the RAID. But the difference between the RAID 0 and others types of RAID is that it is purposely used in "disk stripping". The <u>disk stripping</u> is done by interleaving the data in specific groups. The data is spread in lots of chunks across disk in the RAID set.

Since the data is spread out in chunks, hence the load also gets divided. Hence the RAID 0 has a better performance as compared to the other drives. The basis of the performance is due to the distribution of the data in other words the distribution of the load over the system. Hence the term disk stripping is used here. Also the physical load of the storage disk gets reduced due to the distribution. The load over the operating system also gets reduced considerably. The RAID 0 is one among the most widely used storage system.

The most eye catching feature of the RAID 0 is that there is no parity generation over here. This feature of the non parity generation makes sure that there is no overhead to write the data to the RAID 0 disks. Since the data is spread over the different parts of the system hence RAID 0 is better for high performance and not for the availability. The RAID 0 specifications can be combined with the other <u>RAID types</u> to form a completely altogether different RAID system. For example the RAID 0 can be combined in the formation of RAID 1+0 by combining it with the RAID 1.

Hence the RAID 0 has a performance that is well suited for a storage server system. Moreover since the data is spread over the entire storage system the availability of the data is may become a problem for the RAID server. The practical problems regarding the sorting and searching of large databases also need to be observed while utilizing the services of the RAID 0 storage drive. The RAID 0 is still, despite the problems encountered in the availability of data a widely used storage system.

The large data bases may develop serious practical problems in the query execution. The RAID 0 disk is better in the performance but the availability of the data is a problem when the RAID 0 is used. The parity is not generated for the RAID 0 storage disks. It means that the redundancy check for the parity is not generated here.

The practical implementation of the RAID 0 disk requires the usage of two storage disks. At least two physical storage hard disks are required while implementing the RAID 0 drive. The duplicated data may be stored in the other disk as well. The other method of distinguishing the different types of the disks is by referring them as the Level 0, Level 1 and so on. In that sense of terminology the RAID 0 is referred to as the Level 0 disk. This RAID 0 disk interleaves the data across multiple disks which increases the performance. The word performance here refers to the speed of access of the system. The RAID 0 is most widely used for the purpose of gaming.

Related Information:

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A2. Raid 1

The RAID 1 is the second type of RAID disk that is used for the purpose of utilizing on the property of fault tolerance. There are many models in the RAID like the SAN and the NAS etc. These are the examples of the models that are called as the floor standing models. Usually the RAID systems are available in many models that range in all the sizes from the large ones to those called as the floor standing models. The stand alone systems are also there in the RAID subsystems. The stand alone systems also have a large amount of cache available. The name also specifies that the RAID system is redundant in nature. There is also a redundant power supply.

The RAID system was actually used with the servers but these days the RAID is being used extensively with the desktop computers or the personal computers. The RAID controller is being added in addition to the extra IDE or the SCSI disks. The motherboards might not have the RAID controller but the modern or the advanced motherboards have the RAID controller as the default option available in them. The motherboard may also have the option to enable such controllers or to continue with the existing one.

The sole purpose of having the RAID 1 disk is its importance in the fault tolerance systems. The mirroring technique is used in the implementation of the RAID 1 server. The idea behind the mirroring is that it is used to duplicate the data on the system and provide a true copy to the other disk. This technique is very much important when the data is important and the backup is necessary. The data duplication involves reduced risk of data failure. Any how all the data is backed up and the system can recover it at any specified given time.

The data duplication in the case of RAID 1 is 100%. That means the data is copied in its entirety to the other storage disk. This type of technique is quite important in case of highly important data. For example the data in the case banking systems, database of the defense system, large corporate systems etc. The RAID 1 by its application increases the reliability of the data. This is the major advantage for the usage of the RAID 1. But at the same time apart from increases the reliability of the data, it also increases the credibility of the cost involved in the implementation and the maintenance of the system.

The cost increases in the RAID 1 system because the duplication of the data requires the storage of data on the other disks. Hence a huge secondary memory is obviously required. The RAID 1 implants are mainly used in the business solutions. The business solutions like the database of the banking system software, commercial data bases of the customers, airline reservations of the customers, railway reservations, stock and shares databases and many applications or computers and the software industry in the business world.

Hence the RAID 1 is one among the most important storage disk that is commonly used for the storage of the data. Among all the other storage systems or even the other RAID types this is the most widely used and the one that provides as well as offers the maximum reliability as far as the sensitivity of the data is concerned. The data access also becomes faster with this technique of

mirroring. But the writing process is quite slower when compared to the reading process, because the writing has to be done twice to both the physical disks.

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A3. Raid 1+0

The RAID 1+0 is the combination of the RAID 0 and the RAID 1. The RAID 1+0 is also called as the RAID 10. The purpose of combining the RAID 0 and the RAID 1 is that to combine the technology of both the <u>data stripping</u> and the data mirroring. The data stripping is for the speed of the RAID system and the data mirroring is for the fault tolerance of the system. Hence by combining the properties of two different RAID systems we are combining the associated properties and thus increasing the efficiency of the system. Hence in this particular RAID drive that is the RAID 1+0 the speed as well as the fault tolerance; both are combined. This feature is obtained by simply combining the two different concepts.

Some of the important features of the RAID 1+0 are discussed below. The consideration in the sense of explanation for the single RAID 1+0 can be termed as similar to that of explaining the two different RAID's that is the RAID 0 and the RAID 1. Hence the below description provides the explanation as per the standards of the RAID Advisory committee. Common name for the RAID 0 or Level 0 is in regard with the data stripping. Data is distributed across the disk in the arrays and there is no redundancy information provided.

The data reliability is lower than the single disks. Suppose the data A is on one disk the data B will be on the other disk and again the data C on the first disk and data D on the second disk and so on. But the performance measured in terms of the speed is high. The data transfer is also higher because of the speed and the data involved in the I/O operations is also higher in terms of the read and write operations. Maximum I/O rate is provided in the case of the RAID 0. But the reliability of the data is much lower.

Now, let us consider the features of the RAID 1. The sole purpose of using the RAID 1 is because the system to be made a fault tolerant one. The performance in terms of the speed is not well here. The technique of data mirroring is done here. The data mirroring involves the duplication of the data. The duplication is almost 100%. This symbolizes that the two copies of the data are kept on the two different systems. This also means that if one of the disks fails then the other must provide back up. Hence in this sense the data is secured.

The sensitive data has the security in terms of the technique called as the data mirroring. This gives the data the 100% redundancy. The common name is mirroring and all the data is

replicated on almost all the N number of disks used for the RAID 1 duplication. Usually there are only two disks in any of the RAID 1 systems. The data reliability is higher in comparison with the other RAID types i.e. the RAID 2, RAID 3, RAID 4, and RAID 5. But in the case of the RAID 6 the data reliability is the highest. The data transfer is higher than the single disk operation in the case of Reading of data. But at the time it is almost similar to the data write operation in the single disk.

The maximum input output rate of the data transfer can be slightly compared to the single disk as twice the read operation and the write I/O transfer is as same to that of the single disk. Usually the data is mirrored first and then stripped in the RAID 1+0. First Mirroring and then stripped set is less fault tolerant than the set that is first stripped and then mirrored. In the RAID 1+0 set there is no parity.

Related Information:

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A4. Raid 3

The implementation of the RAID 3 is done using the parity information. The parity check is a necessary condition for this type of RAID system. The procedure of performing the parity calculation is mentioned and explained below. Even though the process may be a bit complex but still it is the most widely used concept of providing standard to the technological aspects of the RAID parity check. The manner in which the parity check is done is this way: a bit from the first drive is XOR'd with the bit from the drive second and the corresponding result is stored in the third drive. The bit is the smallest amount of data that is stored on any storage medium.

The bits that are XOR'd or eXclusively OR'd are stored in the third drive. Hence the data redundancy is parity checked. The XOR is the Boolean operation that is performed for the parity checking. The result for the XOR operation is true only if any one of the inputs is true. Even if the two inputs are true then also the output result is false. Hence the Boolean truth table can be explained as in the next section.

The truth table says that for the input of 0 and 0 the output will be a 0. For the input being provided as the 1 and the 1 the output again will be a 0. Hence the result is false for both the types of the input streams that are both inputs false as well as both the inputs true. Now for the other combinations of the inputs like if one input is true and the other is false the result is true. Also for the other combination of the inputs like the first input being false and the other one being the true the output result is again true. So the overall result can be rated as the true for only one input as true. For all other possible combinations the result is false. Hence the parity checking is done in the way as described above.

In this way the system can be made as the fault tolerant system. The mirroring and the fault tolerance properties can provide a much stable system. Such stability is a needed must for the purpose of providing a server that is much capable of handling operations. Hence for this reasons most of the companies uses the RAID drives as the servers. This obviously increases the performance and the stability of the system.

The most important thing the RAID provides is the excellent speed as well as the fault tolerance to the system in which it is used as a server. When there are a lot of little requests from the data base the performance of the RAID 3 drops considerably. In this situation this is not much helpful and it should be avoided to be used as a server. But it performs extremely well when the long sequential data is to be accessed; and also for the long and the sequential transfer of the data. The servers that are used as the video servers are also used well with this type of RAID i.e. the RAID 3.

The data is stripped across the three or more drives. The maximum performance of RAID 3 can be measured in terms of the speed when the data transfer is at its peak because all the drives are operated in parallel. The concept of parity involves the parity bits to be stored on the different drives. In the contrast to the RAID 2 the RAID 3 is has the difference as stated: in the RAID 2 the data in the form of the bits is interleaved between the multiple data disks that are used. The word bits is used here rather than the bytes or referring as the group of bytes to specify the level of operation that is performed. But these days this is a rare method.

A5. Raid 4

The RAID used here is specifically designed to perform in the speed as well as the fault tolerant system. Both the properties provide better support for the system as an efficient server. The implantation design and the disk are similar to the RAID 3 but the only slight difference is that it manages the multiple disks independently. But the case in the RAID 3 involves the disks to be managed in unison. Hence this property stands out apart when the difference is considered between the RAID 4 and the RAID 3. Also the RAID 4 is not mostly used as compared to the RAID 3. This RAID 4 is not used often. RAID 4 has a better performance and is good when it is used for the purpose of sequential data access. So in comparison with the RAID 3 it stands apart in its application. Along with this feature also this is most rarely used.

When it is mentioned that the parity check is used then the concept of stripping and fault tolerance also plays the prominent role. The method used in the implementation of the technology of the RAID 4 can be explained as below: let us suppose that there are three drives in the RAID server then the data A is in the first disk and the data B is in the disk second. Now the data C is in the first disk. The data D is in the second disk again and the data E in the first disk and the data F in the second disk. But the parity A+B is in the third disk drive due to the parity checking that is carried out.

Similarly the parity E+F is also stored in the in the third disk drive. The parity C+D is also stored in the third disk drive. In this way the information about the parity check is stored in the three disks in the considered example. The common name given to the RAID 3 is the Parallel Transfer Disk with Parity which is based on the concept used in it. It is similar to the RAID 4. The

description regarding the RAID 4 is that the data sectors distributed as the with disk stripping. The redundant information is stored in the dedicated parity disk.

But the contrast and the major difference in the description with the RAID 3 is that each and every data sector is subdivided and it is distributed across all the data disk drives. And also the information that is redundant is normally stored in the dedicated disk drives that are used for storing the parity information. The reliability of the data in the case of the RAID 3 is much higher than the other RAID drives like the RAID 4, RAID 2 and RAID 5.

The reliability is also much higher in comparison with the single drives. But in the case of the RAID 4 the reliability can be considered as comparable to the RAID 3 but the reliability is much higher than the RAID 2, RAID5 etc. The speed of the data transfer in the case of RAID 3 is the highest as compared to the other RAID types. But the RAID 4 has the data transfer speed in consideration with the Read operation as similar to the disk stripping that is done.

The data transfer speed when the write operation is considered is much lower than the single disk write operation. The rate of I/O (Input Output) for the RAID 3 is similar to the 2x or double the speed in the case of a single disk operation. The same Input Output speed in the RAID 4 is similar to the disk stripping in the case of the Read operation. The same in the case of the write operation for the RAID 4 is much lower than the single disk operation. The RAID 4 drive also has many applications similar to that of the RAID 3 but it rarely used in the comparison of the RAID 3.

A6. Raid 5

The technology used in the RAID 5 is that of the disk stripping in combination along with the parity. The concept of parity and the method of calculating the parity are similar to the one in the RAID 3 and RAID 4 with a slight modification that differs much in the results. The data is stripped across the three disks (there may be more or less; but for consideration example let us just consider the three). The data is stripped across all the disk drive of the RAID server and the information regarding the parity is stored differing from the RAID 3 or RAID 4.

The data A is stored for example in the first disk drive. The data B is stored in the second disk drive. Now as in the case of the RAID 3 or RAID 4 the data the data C is not stored again on the first disk drive. But instead of this the data C is stored in the third disk drive. Here occurs the major difference in comparison with the RAID 3 and RAID 4.

Now again the data D is stored in the first disk drive and the data E in the second disk drive but the data F is stored in the third disk drive. In the case of the RAID 3 and the RAID 4 the data is stored in the two drives only and the parity is stored completely in an altogether different disk drive. But the case with the RAID 5 involves the parity to be mixed up along the data storage disk drives. The parity A+B is now stored in the third drive where only the data c and data F resides.

The parity C+D is stored in the second drive where only the data B and data E is in storage. The parity E+F is stored in the first disk drive where in only the data A and the data D is stored. Hence the data distribution and the data stripping are done this way. Along with this the parity is stored in the above explained way in all the disk drives along with the combination of the data.

The description is that regarding the RAID 5 the data sectors are distributed across all the disk drives. Similarly the data distribution is carried out according to the lines of the disk stripping as explained in the above mentioned general example. The information that is redundant is interspersed with that of the data that the user utilizes for him. In short the redundant information is interspersed with the user data. The reliability of the data is much higher that that involved in the single disk. But the data reliability can be considered to be in parallel with the RAID 2, RAID 3, and the RAID 4.

The data transfer speed for the RAID 5 in the read operation is similar to the <u>disk stripping</u>. The disk stripping method is different in this specific case. But the speed of the data transfer is lower for the write operation in the RAID 5 as in comparison with the single disk drive. The speed of the I/O (Input Output) operation for the RAID 5 for Read is that similar to the speed in disk stripping. But in the case for the write operation in the RAID 5 the speed of the data transfer for the Input Output operation is usually lower than the speed of Input Output operation for the single disk drive. Usually the data is stripped across the multiple drives and for the fault tolerance the concept of the parity bits is used.

The RAID is most widely used for the servers to provide the fault tolerance. In RAID 5 the most important thing to be noticed is that the parity is stored on the third disk and is interspersed along with the user data. The RAID 5 achieves a good performance between the performance in terms of the speed and also in terms of the availability.

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A7. Raid 6

The RAID 6 has one of the highest reliability but this is also not used much widely in the sense of implementations. RAID 6 is much similar to RAID 5 in the type of its design and implementation, but it performs two different types of the parity calculations. It may also do the same calculations on the data that has the subsets that are overlapping. In comparison with the RAID 5, it has the additional independently calculated information that is redundant. This comparison was drawn on the lines of the disk description that can be provided along with the RAID 6. In the terms of the data reliability the RAID 6 has the highest degree of reliability. This

is the highest degree of reliability even if all the other drives are considered. The reliability is the major supporting characteristic of the RAID 6 disk drive.

The reliability is the highest one in comparison with the other RAID devices like the RAID 3, RAID 2, RAID 4, RAID 5, RAID 1 and the RAID 1+0. In the terms of the data transfer the speed of the RAID 6 is similar to the one involved in the data stripping and that is for the read operation. But the write operation in the case of the RAID 6 is much slower than the RAID 5. In fact the RAID 5 had the write operation very much slower than even the single disk operation. So in comparison the RAID 6 has the much slower data transfer rate when we talk about the write operation. This might also be the reason for the non usage of the RAID 6 in contrast with the other types of RAID available.

Even the I/O (Input/Output) operation for the RAID is much similar to the data transfer of the operations. In the Input Output operations the read operations speed is similar to that of the operation in the drives that have the data stripping, that is it is similar to the one in the other RAID drives that provide the data stripping; for example the RAID 5.

In the case of the write operations the Input Output speed is much similar to the speed of operations in the data transfer. The Input Output speed of the write operation in the RAID 6 is very much slower than the speed of write operation in the RAID 5. And as obvious fact the speed of write operation in the RAID 5 was much slower than in the case of the single disk operation.

The RAID 6 has the increased reliability of the data. It does this by utilizing the two parity stripes. These two parity stripes allows for two disk failures that may occur within the RAID disk drive set even much before the data is lost. The application of the RAID 6 is that in the <u>SATA</u>, <u>IDE</u> and the <u>SCSI</u> environments. Most of the solutions may require a large and the longer retention of the data that is the data retention period. The example for the above explained feature is such as back up based on the disk and the data archiving.

The RAID is actually a technique of joining the physical disk drives to form a large group set called or known as the RAID set. The important aspect or the feature of the RAID 6 is its data availability and the reliability. Also the RAID 6 has a disadvantage regarding the writing speed; hence this is a major issue while implementing the RAID 6 server. Most the data bases require high speed of writing for the implementation of the RAID server. The write operation's speed may limit the future prospects of the RAID 6. But this RAID 6 is the most suitable server for the small and the medium sized databases. The high density or the large data bases may not be suitable for the RAID 6.

A8. Adaptive Raid

When we talk about the RAID there should also be some controller available for the purpose of the installation of the RAID. Suppose that for the server used the two different types of RAID's for example the RAID 3 and the RAID 5 are both considered then the concept of <u>Adaptive RAID</u> pops up. This Adaptive RAID helps the controller to figure out how the parity is stored on the disk drive. The main function of the Adaptive RAID is that it should choose between the RAID 3

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and the RAID 5 that which among them has the better performance over the other. The performance is measured in the terms of the data transfer for the write operation during the Input Output operations.

The performance in the case of the Adaptive RAID is increased due to its ability to improve the disk array performance. The performance is also increased by simplifying the RAID system administration and the setup. During the installation and the setup itself the care should be taken to exclude the unnecessary conditions for the Adaptive RAID. This really simplifies the operations occurring that are not much of importance and there by reduces the extra load over the system. The developer of the Adaptive RAID is the Borg Adaptive technologies. This is considered a next generation technology of combining the properties of the other most important RAID drives. The real power of the Adaptive RAID lies in its ability to improve the performance of the system with respect to the disk array. This technology of the Adaptive RAID can be implemented in almost any of the Storage Network solutions and is a bench mark in the revolution of providing better support for the server systems in accordance with the RAID. The technology of this kind can be implemented to provide the support for the single and the shared user networks. The networks may be the application storage servers. The Adaptive RAID can also be implemented over the SAN (Storage Area Networking) and also on the NAS that is the Network Attached Storage server solution.

Most of the system administrators have a huge difficulty in administrating the performance in the case of the RAID systems but the Adaptive RAID has made their way easier by providing a simpler administration policies. The security in the redundant array of the independent storage disks is a matter of concern for the system administrators. But the administrators may not like to choose the RAID levels for the usage of their applications. Hence the Adaptive RAID has a solution to their woes. More over software is specifically designed for the Adaptive RAID to further simplify the process of the administration. The example for this is the Adaptive RAID package from the nStor Corporation that is located in the Lake Mary Fla. This software that is being provided for the Adaptive RAID is optional and the features include the monitoring of the Input Output traffic. Also the important feature adjusting the storage levels dynamically is possible. This dynamic adjustment is provided without any intervention. The package is also provided along with the Windows NT operating system. Here the Windows NT administrator can add to the drive capacity. This feature also utilizes the complete capacity of the data disk drive even if it is much higher than the capacity of the other drives. Unisys Corporation has also contributed to the Adaptive RAID by adding automatic RAID management to its NAS 2000.

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Appendix B: General Linux Commands

B1. Basic Commands

Command	Description	
man cmd	cmd Brings up a manual page for command cmd (very useful)	
exit	Logout of system (very important)	
cd d	Change to directory d	
mkdir d	Make directory (folder) d	
mv f1 d	Move File f1 to Directory d	
mv f1 f2 f3 d	Move multiple files (f1,f2,f3) to Directory d	
cp f1 d	Copy File f1 to directory d	
cp f1 f2 f3 d	Copy multiple files (f1,f2,f3) to Directory d	
ls	List files in current directory	
ls -al	List all files in directory with details	
wc f1	Outputs Line, Word and Character counts for File f1	
wc -l f1	Outputs Line count for File f1	
cat f1	Lists contents of File f1	
more f1	Lists contents of File f1 by screen	
cat f1 f2	Concatinates (joins) file f1 with file f2	
mv f1 f2	Renames file f1 as f2	
rm f1	Deletes file f1	
rm -rf d	Deletes Directory d and all contents within it (use with care)	
head f1	Outputs beginning of file f1	
tail f1	Outputs end of file f1	
cmd < file	Takes contents of file as input to command	
cmd > file	Puts output of command in file	
cmd1 cmd2	Takes output from cmd1 as input to cmd2	
pwd	prints your current directory	

B2. Text Editors

Command	Editor
pico	Opens Pico Text Editor
pico f1	Opens File f1 in Pico
emacs	Opens Emacs Text Editor
emacs f1	Opens file f1 in Emacs
vi	Opens vi text editor
vi f1	Opens file f1 in vi

B3. C++ Compilers

Command	Description
gcc f1.cc	Compiles f1.cc and outputs object code a.out
g++ f1.cc	Compiles f1.cc and outputs object code a.out
gcc f1.cc -o file	Compiles f1.cc and outputs to object code file
./file	Runs object code file

Use following links for detailed discretion on Linux commands http://wiki.freespire.org/index.php/Linux_Commands http://www.computerhope.com/unix/overview.htm http://www.computerhope.com/unix.htm#02

Appendix C: Useful Online Resources for Dos Commands

http://www.computerhope.com/msdos.htm http://en.wikipedia.org/wiki/List_of_DOS_commands

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