

Windows + OpenSolaris + CentOS Installation Guide

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- v1.0: Initial release, reviewed by The Linux Documentation Project (TLDP). A few minor structural changes and corrections incorporated; Chapters "Troubleshooting" and "Installing OpenBSD 3.2-RELEASE" added.
- v1.1: Further edits, corrections incorporated. FreeBSD section updated to cover 4.8-RELEASE and chapter "Installing NetBSD 1.6.1" added.
- v1.2: Chapter "Troubleshooting" updated. Information on Linux updated to cover Red Hat Linux 8.0 (Psyche Edition) and FreeBSD to FreeBSD 5.1-RELEASE.
- v2.0: Further edits, changes incorporated to replace entire BSD section with OpenSolaris 2008.11 and Red Hat Linux 8.0 with CentOS 5.2

This document exemplifies how three different operating systems (OSes) could be installed and configured on a single hard disk. The reader may choose from: Microsoft Windows NT/2K/XP + OpenSolaris 2008.11 + CentOS 5.2. Only x86 & x86-compatible architecture multi-booting is discussed and GNU GRUB is the boot loader of choice. Drop an email at [sghosh.oxon at yahoo dot co dot uk](mailto:sghosh.oxon@yahoo.co.uk) in case of queries/questions/comments. Thanks!

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1. Introduction

1.1 Purpose of this Guide

This document represented in the form of a *Guide*, is intended to help those Windows, OpenSolaris and Linux users who believe in the method of "learning by doing". Multiple-booting systems is not an exact science. You come across a document, you read it, find it interesting, do it yourself, make mistakes and then finally you achieve the desired aim. That is how you're supposed to learn. That is how I learnt. That is how the UNIX experts learnt a long time ago! Learning by doing!

By the end of this document, you would have a clear understanding of the basic topics required for successfully installing and configuring three different OSes on a single hard disk of a computer. I've tried my level best to describe each and every topic in a clear and easily understandable simple language.

Most multi-booting installation HOWTOs and guides available on the Internet are incomplete because either they assume too much leaving the readers to do most of the difficult stuff themselves or are blatantly simple. I've tried my best to find a perfect balance between the two!

1.2 What is Multiple-booting?

The Webster's New World Computer Dictionary (9th edition) by Bryan Pfaffenberger, defines the term "dual-booting" as: 'A computer that enables the user to choose between two OSes at boot time'. Rightly so. Considering this definition as our boilerplate, we may frame our own definition of a "multiple-booting" or (in short) a multi-boot system i.e., a computer that enables the user to choose between more than two OSes at boot time.

This document explains how three varying OSes can be successfully installed and configured on the same hard disk of a computer thus enabling it to become a "multi-boot" system. The OSes chosen for this illustration include: Microsoft Windows XP, OpenSolaris 2008.11 and CentOS 5.2. I would install a Microsoft Windows OS first, then proceed installing OpenSolaris and finally round-off by installing CentOS. GNU GRUB is the boot loader of choice.

1.3 Multi-booting Pros and Cons

An idea or thought as: *Hey! Dual and multi-booting computer systems have advantages only and absolutely no disadvantage* is wrong. Often an important question is: *Why would someone need to multi-boot a PC?*

Where does it make sense to multi-boot a PC? The answer to this question is simple: **Multi-booting systems only make sense where you would like to experiment with a number of configurations (or OS in general) than you have computers for and more significantly where data is NOT at risk.**

Let us consider a situation like this: Peter is a software programmer who works from home; has a single PC that runs Debian Linux. His significant documents and downloaded files from the Internet are stored on it. He now decides to learn and practice hacking the FreeBSD Kernel. Thus, he decides to make his PC a dual-

boot system. **Converting one's only or in other words, the primary PC at home or at work into a dual or multi-booting system is a bad choice.** If a primary home PC must be used as a dual or multi-booting system, it will be much safer to add a second hard disk and leave the first relatively untouched. A powerful boot loader like GRUB will allow booting from the other hard disk.

I personally have a test lab setup at home, with multiple PCs ranging from PI, PII, PIII to PIV running Windows XP (for playing games), Red Hat Enterprise Linux (for RHCE exam preparation), CentOS (used for doing office work at home), OpenSolaris (tweaking here-n-there), Ubuntu (do most of my daily tasks like checking mail in Evolution, surfing the Net and so on). One or more of these machines which does not have any significant data on themselves, is multi-booted. **This can be considered as an ideal situation for playing around with multi-booting.**

NOTE: Multi-booting Windows with OpenSolaris and CentOS on the same hard disk can lead to a fatal hard disk crash where all data contained therein could be lost! You have been warned! Backup any significant data that you maybe having.

1.4 List of Assumptions

- The reader possesses an intermediate (i.e. theoretical & practical) level of experience of partitioning hard disks utilizing Microsoft fdisk, BSD style partition table editor, Linux fdisk and so on.
- The reader understands hard disk geometries, concept of a primary partition, an extended partition, logical disks within an extended partition; Linux disk naming and partitioning schemes, BSD style disk labeling and partitioning schemes.
- The reader possesses an intermediate (i.e. theoretical & practical) level of experience of compiling and configuring custom Linux and OpenSolaris Kernels.
- The reader possesses knowledge of basic UNIX commands common to both Linux and BSD OS. E.g., mounting filesystems, editing configuration files etc.
- The reader is using an x86 or x86 compatible system.
- The reader is using a hard disk whose BIOS supports the **Logical Block Addressing (LBA)** mode of representing data on the disk. By using LBA mode, the 1024 Cylinder Limit on old hard disks is dealt with.

Before proceeding any further, make sure you browse through the Frequently Asked Questions (FAQ) section of the guide.

1.5 Acknowledgements

I wish to offer my sincerest regards and thanks to:

1. **Guyllhem Aznar** <guyllhem@metalab.unc.edu>, Chief coordinator, main contact of TLDP for making this guide possible.
2. **Tabatha Persad** <tabatha@merlinmonroe.com>, Linux Documentation Project Review Coordinator, for technical reviews and for answering my million queries.
3. To every Open-Source community contributor around the world.

Additionally, whilst writing this document, I did consult the following books, online journals, magazines and official papers:

1. Modern Operating Systems, *by Andrew S. Tanenbaum*
2. Understanding the Linux Kernel, *by Daniel P. Bovet, Marco Cesati*
3. CentOS online documentation at <http://www.centos.org/docs/5>
4. OpenSolaris online documentation at <http://opensolaris.org/os/documentation/>

5. Free book authored for installing, configuring and managing OpenSolaris 2008.11, <http://dlc.sun.com/osol/docs/downloads/minibook/en/820-7102-10-Eng-doc.pdf>

1.6 Legalese

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Although the information given in this document is believed to be correct, the author will accept no liability for the content of this document. Use the tips and examples given herein at your own risk.

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1.7 About the Author

The author, currently aged 28, possesses a decade of hacking / administering experience on Linux (Red Hat, Fedora, Slackware, Debian, ASP Linux, ALT Linux), FreeBSD, OpenBSD, NetBSD, Sun OS 4.x, Sun Solaris, OpenSolaris platforms. He holds a BTech degree in "Informatics & Computer Science engineering" from Moscow Power Engineering Institute (Technical University); studied for an MSc at Oxford University. Holds MCSD & MCSE certifications from M\$; currently working towards Red Hat Certified Engineer (RHCE) certification.

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2. Frequently Asked Questions (FAQ)

This FAQ only reflects the installation guide in its present form, and various many queries which were present in the earlier versions have been edited and left out. If you have something to ask which is not listed herein, shoot an email at <[sghosh.oxon at yahoo dot co dot uk](mailto:sghosh.oxon@yahoo.co.uk)>

- **What is the aim/purpose of this guide?**

The information in this guide can be used for installing and configuring three different OSes on a single hard disk of a computer. Firstly, Windows XP is installed, then OpenSolaris 2008.11 is installed and finally, we round-off the guide by installing CentOS 5.2

- **Why have you used 3 OSes for this guide?**

I personally wouldn't want any more! I do have a system which has Windows XP, FreeBSD, Ubuntu & OpenSolaris installed, but the overall installation, configuration and post-installation configuration in the multi-boot loader is too cumbersome to exemplify in a written manner. Thus, I thought of sticking to three OSes.

- **Did you yourself try out the steps mentioned in this guide?**

Yes, I did test each and every step mentioned in this guide on my personal computer systems. Once successful, I often replicate the entire procedure on other systems of varying configurations to re-check and validate errors, if any.

- **What is the config of your test bed?**

My test bed consists of multiple machines with varying configurations. The PC which was used for this guide is an ACPI x86-based PC, Mercury PIG31T mainboard, Intel Celeron CPU @ 1.80GHz, 1.0 GB RAM, a single 150GB ATA HDD and other usual accessories which runs Microsoft XP (Service Pack 3), OpenSolaris 2008.11 and CentOS 5.2

- **All your installations are "CD/DVD-ROM" based installation types. What about "Ethernet", "FTP", "HTTP", "NFS" installation types?**

This guide has been kept as simple as possible. It is intended for all types of users, ranging from intermediate Linux users to the most experienced UNIX experts. Since, NFS, HTTP, FTP and other such installation types usually require network access with servers up and running, which is impossible for an ordinary home-user to have access to, I have only covered the CD/DVD-ROM based installation types.

- **Why would anyone ever need to run 3 OSes on the same hard disk of a computer?**

For lots of reasons. Fun, for learning new installing and booting methodologies, for gaining inside knowledge of multi-booting, partitioning schemes, how boot loaders operate and so on, or simply because you just cannot afford 2 separate hard disk drives for the 3 different OSes you want to tinker with. Last but not the very least, if you do wish, you can always install and configure your computer system with 3 varying OSes installed in 2 separate hard disks. Not only is it highly recommendable, but mandatory if you have significant data in question.

- **Why CentOS? Why *not* RHEL, Debian, Slackware, Caldera, SuSE, TurboLinux and others?**

Using CentOS is virtually same as using Red Hat Enterprise Linux (RHEL) which is virtually same as using earlier builds of Red Hat Linux. CentOS is a community-supported, freely-available OS which is a 100% compatible rebuild of the Red Hat Enterprise Linux. Since most of my past Linux projects and work in general has been related to RHEL and currently with CentOS; CentOS has been considered over other Linux distros. If you are using any other Linux distro, follow the same steps by replacing with adequate steps from your specific Linux distro. If something fails, shoot an email at [<sghosh.oxon@yahoo dot co dot uk>](mailto:sghosh.oxon@yahoo.co.uk)

- **Where can I get the CentOS and OpenSolaris CD/DVD installation media?**

CentOS can be freely downloaded from <http://isoredirect.centos.org/centos/5/isos/i386/>. OpenSolaris can be freely downloaded from <http://www.opensolaris.com/get/index.jsp> or register online to request for an OpenSolaris 2008.11 x86/x64 media kit. A media kit would be shipped from Sun Microsystems absolutely free of cost to your doorsteps.

- **Why OpenSolaris? Why *not* Sun Solaris, Digital UNIX, HP-UX, IBM-AIX and others?**

OpenSolaris is an open source OS based on Sun Microsystems' commercial version of UNIX, Solaris. OpenSolaris is gaining wide popularity amongst students, Web 2.0 developers and deployment, open source OS developers worldwide, since apart from the source code which is 100% freely available, documentation & support is readily available as well. Since the motto of writing this document is to keep it as open-source and thereby as 'free' as possible, OpenSolaris has been chosen over other commercial versions of UNIX.

- **Which kernel version have you used for CentOS 5.2?**

Linux Kernel 2.6.18-92.el5 has been used for CentOS 5.2.

- **Which kernel version have you used for OpenSolaris 2008.11?**

OpenSolaris 2008.11 is based upon Solaris Nevada Build 101b with the Sun 5.11 kernel.

- **I installed 3 Oses on my computer; and then unfortunately, something went wrong somewhere. My hard disk crashed and I lost all the data. Would you be kind enough to take the responsibility for all this mess?**

Use the information in this guide at your own risk. Do not try this on your primary laptop or PC, and if you do, then backup any significant data that you maybe having. You have been warned. If your hard disk does crash, and you do end up losing valuable data, I shall not take responsibility for the mess.

- **I have Red Hat, FreeBSD and OpenBSD distributions and/or releases. Will they work?**

I am sure they would with a few modifications at places. All steps mentioned in this guide should behave in a normal manner if you are using Kernel 2.2.x or higher (for Linux). For FreeBSD users, if you are using not earlier than 4.X-RELEASES, there should not be any problems whatsoever.

- **My PC dual-boots WinXP and Linux. Is there any way to check out Solaris/OpenSolaris on Windows without actually installing the OS?**

You can run OpenSolaris 2008.11 as an application on Windows or Linux using VMware. VMware is an application that emulates a PC or runs as a virtual machine (VM). So basically when you run OpenSolaris on VMware, it acts as its own dedicated box, when actually, it is running as an application on Windows or Linux. This article takes you through the steps to get OpenSolaris up and running on VMware: http://wiki.genunix.org/wiki/index.php/Getting_Started_with_OpenSolaris_using_VMWare

- **I have WinXP, CentOS and OpenSolaris 2008.11 running on my PC. I reinstalled WinXP and my boot loader got overwritten. What do I do now?**

Do not worry! Reinstalling WinXP does not delete or render the boot loader permanently inactive. Recovering GRUB for Linux and OpenSolaris is a pretty straightforward procedure. This article takes you through the steps to recover the boot loader (GRUB) for Linux and OpenSolaris: <http://salmanjamali.blogspot.com/2008/04/recovering-opensolarissolairslinux.html>

- **I have never used OpenSolaris fdisk. Is it similar to MS-DOS fdisk and Linux fdisk?**

Yes and no. Yes in the sense, the underlying architecture and trick used for partitioning a hard disk drive space remains the same across all Oses, though terminology may change from one OS to another. OpenSolaris fdisk looks very similar to MS-DOS fdisk, but closer to NetBSD style partition editor in core functionality. Check out this link for an excellent treatise on OpenSolaris fdisk functionality: <http://docs.sun.com/app/docs/doc/819-2723/diskxadd-19036?a=view>

- **I am not very clear as to how GRUB helps in booting the 3 Oses. What is the functionality of a boot loader anyway?**

A PC when switched on can only execute program code found in ROM and RAM which does not include bigger software like Oses. Thus, a small program stored in ROM is executed which loads the bigger data set and programs (usually the OS) which are then executed from RAM. This small program which loads the bigger program and data into RAM and prepares the computer system for subsequent usage is the *boot loader* or *bootstrap loader*. Though it may sound very simple, the detailed functionality of a boot loader is indeed very complex and needs minute understanding of the underlying architecture of the computer system that it prepares to bootstrap.

- **Is there any specific reason as to why you first install WinXP, then OpenSolaris and round-off by installing CentOS?**

Yes, there is. It is explained in detail why this particular sequence was preferred to other sequences in Chapter 4: Installing CentOS.

More queries would be added in the future.

3. Organization

The content of this *guide* has been split into 5 distinct sections called *Chapters* as illustrated below:

Chapter 1: The first Chapter, *About the Operating Systems* covers a brief discussion on Linux and OpenSolaris OSes; their past and present, and contains some essential pointers that one may wish to check out.

Chapter 2: The second Chapter, *Installing Microsoft Windows* covers the installation of Microsoft WinXP that the reader chooses to install on a new hard disk. Disk partitioning and labeling schemes under Windows is discussed in detail herein.

Chapter 3: The third Chapter, *Installing OpenSolaris* covers the installation and configuration of OpenSolaris 2008.11 with the already existing Microsoft WinXP OS. Disk partitioning details are covered herein.

Chapter 4: The fourth Chapter, *Installing CentOS* covers the installation of CentOS 5.2 on the hard disk which already houses WinXP and OpenSolaris OSes.

Chapter 5: The fifth Chapter, *Configuring a Tri-boot with GRUB* covers the details of what GRUB is and the corresponding configuration of a tri-boot system using GRUB in detail.

3.1 About the Operating Systems

These are my personal views and not related to the views of the Linux and/or OpenSolaris, or in general, the Open-Source community.

Linux: Linux is the kernel or core of an OS called GNU/Linux system, where the GNU Project provides the software and applications that runs on the Linux kernel. The Linux kernel, originally written by Linus Benedict Torvalds, is a UNIX-clone, which is POSIX compliant and was initially targeted towards the Intel x86 architecture. As rightly mentioned in the *Linux Information Sheet* by Michael K. Johnson at <http://www.tldp.org>, "*Linux is a completely free reimplementation of the POSIX specification, with SYSV and BSD extensions (which means it looks like Unix, but does not come from the same source code base), which is available in both source code and binary form. Its copyright is owned by Linus Torvalds <torvalds@transmeta.com> and other contributors, and is freely redistributable under the terms of the GNU General Public License (GPL)*".

OpenSolaris: Linux powering a GNU/Linux system is a good system, but is it the best? Probably *no*. And if the same query involves running a mission-critical real-time million dollar system, probably "guaranteed" no for many years to come. Thus, we choose to tread carefully into the realm of the 'big boys'; either SVR4 or BSD Unixes like HP Tru64 Unix, HP-UX, IBM-AIX and the ultimate commercial UNIX of all, Sun Microsystems' SOLARIS. OpenSolaris is the open-source build of SOLARIS; with initial release 2008.11 meant for x86 platform and on June 1, 2009, OpenSolaris 2009.06 was released, with support for both the x86 and SPARC platforms.

The power of Solaris comes from the 100% pre-emptive nature of its underlying kernel *SunOS*. The SunOS architecture is way too complicated to explain here in detail, but quintessentially speaking, one of the very preliminary distinguishing feature that separates SunOS kernel from Linux/FreeBSD/OpenBSD/NetBSD and other such OSES is the *killer* real-time multi-threading support that SunOS has for applications/binaries running on it. Solaris is the ONLY OS kernel on earth which is 100% pre-emptive in nature, running not processes but threads in Kernel space simultaneously and not alternatively; this technically speaking means, SunOS has a LWP threading model (*see document link later on for details*) which maps a single user-space process with a single kernel-space thread. Thus, SunOS kernel supports a real-time 1:1 scheduling model wherein each application thread has its own LWP, and the SunOS kernel is used to schedule all application threads. As a result, a SPARC system running Solaris 10 serves out Apache webserver requests much faster than on Linux. Additionally, Sun focuses on high performance computing whereas the main function of the Linux kernel is portability, ease of use etc. A must read for all to understand what makes Solaris one of the best commercial UNIXes on earth:

<http://www.sun.com/software/whitepapers/solaris9/multithread.pdf>

To be precise, on a non-SMP system, there isn't much to choose from between Linux and OpenSolaris. But, once you start scaling to multiple processors heavily, the difference between Linux and Solaris (OpenSolaris included), is apparent. Solaris wins hands down! It is *the killer* OS for serious people!

3.2 Installing Microsoft Windows

One can use the Windows **fdisk** and **format** tools for partitioning a new unformatted hard disk. I have assumed that the reader has a new unformatted hard disk which he/she wishes to partition and then format for installing a copy of Microsoft WindowsXP. If you wish to upgrade from previous versions of Windows, only 98, 98SE and ME users can upgrade directly to WinXP Home whereas users of 98, 98SE, ME, NT and 2000 Professional can upgrade themselves to WinXP Professional.

Please note that I have assumed that you own a computer system which runs without glitches and that you have access to a bootable Microsoft WinXP CD/DVD installation media. If you do run into problems booting from the CD/DVD-ROM or using Start-up disks, please consult your hardware manufacturer to obtain the CD/DVD-ROM device driver(s).

== STEPS TO FOLLOW ==

Step1: I fire up my PC and when it is booting up, I press the key on the keyboard to access my PC's American Megatrends, Inc. CMOS Setup Utility. I then change: **1st Boot Device : MOSER BAER DH-**

20A6S so as to access and boot from WinXP bootable installation media directly. If you are not sure about the specific key sequence on your keyboard, you can find your BIOS manufacturer and the desired key sequence here: http://michaelstevestech.com/bios_manufacturer.htm

Step2: After the change, press F10 to save and exit.

Step3: The system restarts, and before it does, make sure you insert the bootable WinXP CD/DVD in your CD/DVD-ROM drive. After a few seconds, the screen will clear and you will see a '**press any key to boot from CD**' prompt. Press <ENTER> to start the install.

Step4: The installer program will begin copying files from the installation media.

Step5: Press F8 to accept WinXP Licensing Agreement.

Step6: The partition editor is then displayed on your screen. If any prior partition(s) exists, delete prior partition(s) using **D = Delete Partition**.

Step7: After all partition(s) have been deleted, it shows unpartitioned space on your screen. Press **C** to create a new partition. Enter partition size in MB: 30000 (*in my case*) which means, 30GB space reserved for WinXP. Keep in mind that 1000MB = 1 GB.

Step8: This takes you back to the partition editor which now displays: **C: Partition1 [New (Raw)]** and corresponding size in MB. Select this partition and press <ENTER>.

Step9: You will be prompted to format the partition with one of four filesystems: NTFS quick, FAT quick, NTFS, or FAT. Since FAT filesystems work the best owing to compatibility reasons, especially whilst handling data access/read/write/transfer functionality when multi-booting systems with Linux/FreeBSD/OpenBSD/NetBSD/OpenSolaris, I select the fourth option: **Format the partition using the FAT file system**. Press <ENTER> to continue.

Step10: The system now formats the partition. After formatting, the system copies the necessary files to install a graphical user interface (GUI) with mouse support which handles the rest of the OS installation. The system reboots and one proceeds with the GUI mode of the installation after this.

The steps following this are self-explanatory and am sure the reader does not need much assistance and guidance and can manage themselves without any effort.

After creating this Primary Partition (30GB), we do not (*I repeat: do not*) need to create any more partitions using Microsoft fdisk utility. E.g. I have a 150GB ATA HDD. I create a primary partition of 30GB during WinXP installation. The obvious question from the reader is: What about the rest? What happens to it? Well the answer is simple. I leave it untouched because I would be dividing this available space into 2 halves for installing OpenSolaris 2008.11 and CentOS 5.2. So, no need to worry absolutely and just take the ride with me. By the time you are done reading this guide, not a single MB on your HDD would be wasted.

Thus, before we finally move on to the next section where we install and configure OpenSolaris 2008.11, I wish to round-off this chapter with a "Partition check". I have the following partition table on my computer after this step (as observed from Microsoft fdisk):

Display Partition Information						
Partition	Status	Type	Volume_Label	Mbytes	System	Usage
C:1	A	FAT32	WIN	30000	FAT32	20%

That is all for this section; take a break, have some coffee and proceed to the next chapter, Installing OpenSolaris.

3.3 Installing OpenSolaris

OpenSolaris 2008.11 can be obtained in various many ways. I ordered mine from OpenSolaris Free CD/DVD shipment program from Sun directly. OpenSolaris can be freely downloaded from <http://www.opensolaris.com/get/index.jsp> as well.

== STEPS TO FOLLOW ==

Step1: Put the OpenSolaris 2008.11 Installation media in your CD/DVD-ROM drive and restart the computer.

Step2: GNU GRUB version 0.95 screen is displayed. I receive 5 options on the screen:

```

OpenSolaris 2008.11 snv_101b_rc2 X86
OpenSolaris 2008.11 snv_101b_rc2 X86 test console
Boot from Hard Disk
OpenSolaris 2008.11 snv_101b_rc2 X86 with magnifier
OpenSolaris 2008.11 snv_101b_rc2 X86 with screen reader

```

Select '**OpenSolaris 2008.11 snv_101b_rc2 X86**' and press <ENTER> to continue.

Step3: Live image from the installation media is loaded onto RAM and prepared for use. Once mounting Live image is accomplished, we get the '**Choose keyboard layout**' screen. Choose the layout that you wish to work with; I choose the default one, **US-English**. Press <ENTER> to continue.

Step4: We are provided with the '**Choose Desktop Language**' screen. I choose the default one, **3: English**, press <ENTER> to continue.

Step5: Devices are configured, cdroms are mounted, and we receive the OpenSolaris Live CD desktop.

Step6: To start the installer from the Live CD desktop, select the "**Install OpenSolaris**" icon on the Live CD desktop and double click on it. If you are prompted to log in to the Live CD, both the user name and password are *jack*. The root password is *opensolaris*. The OpenSolaris 2008.11 Installer begin and presents you with a Welcome screen. Click on 'Next' to continue.

Step7: Disk panel is presented wherein you can see the complete break-up of your current hard disk drive(s) and partitions therein. Note that recommended partition size is 8GB, whereas minimum partition size is

2GB. E.g. in my case, I see my 150GB ATA HDD being exhibited in the Disk panel. There are two options on the screen:

OpenSolaris can be installed on the whole disk or on a partition on the disk.

Use the whole disk

Partition the disk

Step8: Choose the 2nd option, and in the **Partition Type** and **Size (GB)** drop-down list, choose **Solaris**. Allocate size as you feel thought fit; I allocated a 30GB partition space for my OpenSolaris partition. Click 'Next' to continue. Additional essential information for the reader here is that the partitions are displayed in physically sequential order as they are laid out on the disk. Resizing a Solaris partition destroys the data on that partition and all physically subsequent partitions. If you have unallocated chunks of space in your hard disk between two already existing partitions and you wish to utilize this free space, this is not possible by the installer. In such a case, you need to use the Solaris **fdisk** utility which creates new partitions that use the free space between existing partitions.

Step9: Time Zone, Date and Time screen is displayed, wherein choose your current location from the map and click 'Next' to continue.

Step10: Choose the default language support and locale specific data formats in the next screen. I choose **English** as Language and **United States** as Territory. Click 'Next' to continue.

Step11: Enter root password, create an account for yourself and enter computer name for this system. Click 'Next' to continue.

Step12: A final installation review screen is displayed. You can go back to make further changes or exit the installation here by clicking on the **Quit** button. For commencing installation, click on the 'Install' button.

Step13: You are presented with the **Installing** screen wherein you can review the installation progress bar.

Step14: Finished screen appears wherein you can check and study the *OpenSolaris installation log* file. Click on 'Reboot' to restart the system.

When the system does come up, you shall see the GNU GRUB screen in blue with the following options:

OpenSolaris 2008.11 snv_101b_rc2 X86

Windows

OpenSolaris 2008.11 snv_101b_rc2 X86 test boot

Selecting **OpenSolaris 2008.11 snv_101b_rc2 X86** and pressing `<ENTER>` boots OpenSolaris, whereas **Windows** boots WinXP. You can also login to a text console via the 3rd alternative. Congratulations! You already have a dual-boot system up and running... and check out the features of your new OpenSolaris system. Let's now move on to installing CentOS 5.2 on our system, configuring GRUB and multi-booting the entire system.

3.4 Installing CentOS

A pal of mine at work burnt me the CentOS 5.2 DVD that I am currently tinkering with. You can download a copy at: <http://isoredirect.centos.org/centos/5/isos/i386/>.

== STEPS TO FOLLOW ==

Step1: Put the CentOS 5.2 Installation media in your CD/DVD-ROM drive and restart the computer. I am booting from a CentOS 5.2 DVD.

Step2: Press `<ENTER>` at the boot prompt.

Step3: Though an optional one, this step is necessary if you wish to test your installation media prior to installation. Since it can take a long time, we skip the test here. Select "Skip", and press the '**Space Bar**' key on your keyboard.

Step4: The welcome screen of CentOS appears. Click on 'Next' to continue. You can click on the '**Release Notes**' button to check out the online links for further information. The release notes for CentOS 5.2 is available online at: <http://wiki.centos.org/Manuals/ReleaseNotes/CentOS5.2>

Step5: I choose English as the language for the installation process. Click on 'Next' to continue.

Step6: I choose U.S.English as the appropriate keyboard layout for the system. Click on 'Next' to continue.

Step7: This brings us to the most significant stage of the CentOS installation process, i.e. partitioning the hard disk drive. In the drop-down list, you can see the following options:

Remove all partitions on selected drives and create default layout.

Remove linux partitions on selected drives and create default layout.

Use free space on selected drives and create default layout.

Create custom layout.

Choosing **Remove all partitions on selected drives and create default layout** would remove all existing primary and secondary partitions on the hard disk drive and thus, erase all data on these partitions as well. We select the final option, **Create custom layout**. Click on 'Next' to continue.

Step8: You shall see your hard disk drive geometry laid out on the screen. In my case, I have:

Drive /dev/sda (152625 MB) (Model: ATA WDC WD1600AAJS-6)		
sda1 29996 MB	sda2 30822 MB	Free 91806 MB

Here, **sda1 @ size = 30GB** is our Microsoft WinXP FAT-32 primary partition which we created in Chapter 2: Installing Microsoft Windows section.

sda2 @ size = 30GB is our OpenSolaris 2008.11 primary partition, or correctly in Solaris terminology, *slice* which we created in Chapter 3: Installing OpenSolaris section.

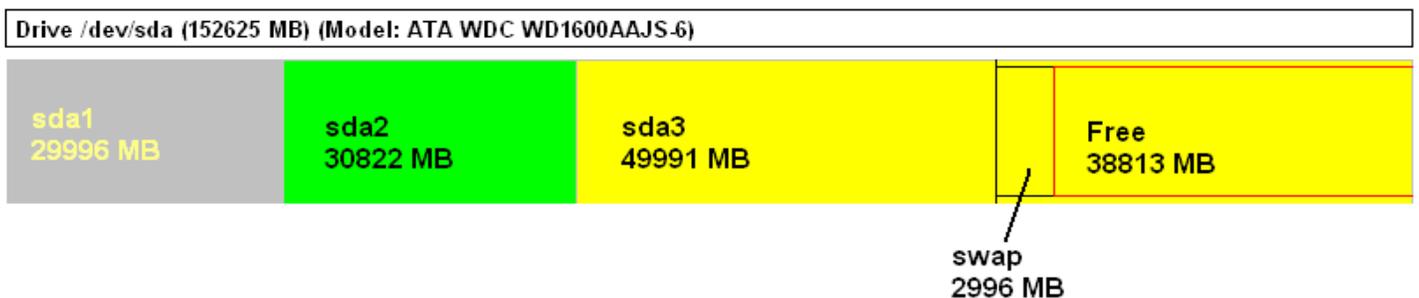
The Free @ size = 90GB is where we shall be creating a CentOS Linux ext3 filesystem partition.

Step9: Select **Free** partition, and click on the 'New' button, which brings up a "Add Partition" window. From the drop-down list, select **File System Type:** ext3, **Mount Point:** /, **Size (MB):** 50000, **Additional Size Options:** Fixed size, Select **Force to be a primary partition**. Click on 'OK'. This creates the 3rd primary partition of the hard disk, i.e. /dev/sda3 which will be formatted with the Linux ext3 partition hosting CentOS.

Step10: Select **Free** partition again, and click on the 'New' button, which brings up a "Add Partition" window. From the drop-down list, select **File System Type:** swap, **Size (MB):** 3000 (*ideally swap should be 3 times your system's RAM*), **Additional Size Options:** Fixed size. Click on 'OK'. **DO NOT select "Force to be a primary partition" since Solaris/x86 and Linux swap partitions use the same filesystem ID: 0x82 and thus, BOTH CANNOT EXIST AS PRIMARY PARTITIONS on the same hard disk drive.** Thus, if you wish to install Solaris on a hard disk drive which already has a Linux swap filesystem sitting on it, the Solaris filesystem shall install on the Linux swap partition. You can opt out of this ignominious situation by:

- a) not choosing to create/use a dedicated Linux swap partition if you have enough RAM on the system;
- b) shifting the existing Linux swap partition on another hard disk drive to prevent clash between the titans;
- c) **you can choose to install Linux after Solaris has been installed and configured on the system.** This is what I have opted for in this guide and in Step10 whilst creating the 3GB Linux swap partition did not choose the 'Force to be a primary partition' option. Thus, once created, the Linux swap partition is created as /dev/sda4 which is an EXTENDED partition consisting of: i) /dev/sda5 which is the Linux swap, ii) Free space which I shall be utilizing in the future. Probably shall install FreeBSD on it!

After **step10**, you ought to have a hard disk geometry breakup on your screen which resembles:



Here, **sda1 @ size = 30GB** is our Microsoft WinXP FAT-32 primary partition which we created in Chapter 2: Installing Microsoft Windows section.

sda2 @ size = 30GB is our OpenSolaris 2008.11 primary partition, or correctly in Solaris terminology, *slice* which we created in Chapter 3: Installing OpenSolaris section.

sda3 @ size = 50GB is our CentOS 5.2 ext3 primary partition.

swap @ size = 3GB is our Linux swap partition.

Step11: Click on 'Next' to continue.

Step12: We reach the GNU GRUB boot loader screen. Select '**The GRUB boot loader will be installed on /dev/sda**'. In the default, tick on option: **CentOS mounted on device /dev/sda3** and change 'Other' label to Windows by clicking on the Edit button. Leave rest of the options as it is and click on 'Next' to continue.

Step13: In the network settings screen, the default setting here is to configure the network interfaces with DHCP, but if you wish to setup server services on CentOS, static IP addresses would be a better option. Configure the Ethernet interface by using '**Enable IPv4 support**', and then selecting option: '**Manual configuration**'. Input the IP address/netmask, hostname, gateway, primary dns, secondary dns and click on 'Next' to continue.

Step14: Choose your time zone, and click on 'Next' to continue.

Step15: Enter a root password and confirm it by entering the same. Click on 'Next' to continue.

Step16: Now we select the software that we wish to run on CentOS. I select: **Desktop - Gnome, Server, Server GUI**. Select '**Customize now**', and click on 'Next' to continue.

Step17: We select the package groups that we want to install. Since we may need to compile the Linux kernel for read/write support on Solaris/x86 partitions later on, definitely select **Development Libraries, Development Tools**; choose **Administration Tools** in Base System category. Click on 'Next' to continue.

Step18: The installer checks for dependencies of the selected packages.

Step19: A screen appears asking us to commit for the installation. Click on 'Next' to commence CentOS 5.2 installation.

When the system does come up, you shall see the GNU GRUB screen in blue with the following options:

CentOS (2.6.18-92.e15) Windows

Selecting **CentOS (2.6.18-92.e15)** and pressing `<ENTER>` logs you into CentOS wherein a few more system-wide configuration needs to be done. Selecting **Windows** boots your system into WinXP. But where is our dear old friend OpenSolaris 2008.11 which we installed in Chapter 3: Installing OpenSolaris section? Read the next Chapter on how to configure the GRUB boot loader so as to boot all three OSes: WinXP, OpenSolaris and CentOS from the GRUB menu.

3.5 Configuring a Tri-boot with GRUB

For GRUB experts, kindly proceed and make the modifications as required in the menu.lst file in CentOS. For GRUB newbies, there is a wealth of information available at: <http://www.gnu.org/software/grub/grub.html> most of which is self-explanatory and easy to understand. If there is something that you do not understand, shoot me a mail.

GNU GRUB stands for the **GRand Unified Bootloader**, which is a very powerful boot loader program for PCs. Detailed manual for GRUB (version 0.97) can be accessed by:

- **Online:** <http://www.gnu.org/software/grub/manual/> wherein different formats are available for easy perusal.

- **CentOS**: Open a terminal, type in: **info grub** which opens up the Detailed manual for GRUB (version 0.97) on your screen.

In Section 4.1 of the manual for GRUB (version 0.97), lies the secret of how to boot OSes successfully. As mentioned therein, GRUB has two distinct boot methods - either booting the OS directly or when GRUB is unable to provide native support to the OS in question, it fires the boot loader of the OS via a *chain-loading mechanism*; thereby enabling the OS to boot successfully. For CentOS 5.2, GRUB loads the OS directly, whereas for WinXP it needs to fire up the boot loader for Windows via *chain-loading mechanism*. One point which readers ought to keep in mind is that chain-loading mechanism normally operates on the assumption that the boot loader is embedded in the *boot sector* of the *active partition* on which the OS is installed.

== STEPS TO FOLLOW ==

Step1: Login to CentOS 5.2, open a terminal, gain superuser rights (referred to as **root**) by using the **su** command and providing the password that you had provided whilst installation.

```
[ghosh@pluton ~]$ su
```

Step2: Once you have **root** access, type the following commands at the terminal:

```
[root@pluton ghosh]# cd /
```

```
[root@pluton /]# cd /boot/grub
```

```
[root@pluton grub]# ls -al
```

```
[root@pluton grub]# cp grub.conf grub.conf.bak
```

This creates a backup file for the grub.conf file which is the configuration file for GNU GRUB boot loader. In the listing of all files on the screen, you can also see menu.lst -> ./grub.conf which means menu.lst is a soft or symbolic link to the GRUB configuration file grub.conf.

Step3: [root@pluton grub]# **vi grub.conf**

Step4: My grub.conf is displayed on the screen:

```
# grub.conf generated by anaconda
```

```
#
```

```
# Note that you do not have to rerun grub after making changes to this file
```

```
# NOTICE: You do not have a /boot partition. This means that
```

```
#         all kernel and initrd paths are relative to /, e.g.
```

```
#         root (hd0,2)
```

```
#         kernel /boot/vmlinuz-version ro root=/dev/sda3
```

```
#         initrd /boot/initrd-version.img
```

```
# boot=/dev/hda
```

```
default=1
```

```
timeout=60
```

```
splashimage=(hd0,2)/boot/grub/splash.xpm.gz
```

```
hiddenmenu
```

```
title CentOS (2.6.18-92.el5)
```

```
    root (hd0,2)
```

```
    kernel /boot/bzImage.2.6.18-92.el5 ro root=LABEL=/ rhgb quiet crashkernel=512M@16M
```

```
    initrd /boot/initrd-.2.6.18-92.el5.img
```

```
title Windows
```

```
    rootnoverify (hd0,0)
```

```
    chainloader +1
```

Step5: Edit the file contents and add the lines which are marked in blue.

```
# grub.conf generated by anaconda
#
# Note that you do not have to rerun grub after making changes to this file
# NOTICE: You do not have a /boot partition. This means that
#         all kernel and initrd paths are relative to /, e.g.
#         root (hd0,2)
#         kernel /boot/vmlinuz-version ro root=/dev/sda3
#         initrd /boot/initrd-version.img
# boot=/dev/hda
default=1
timeout=60
splashimage=(hd0,2)/boot/grub/splash.xpm.gz
hiddenmenu

title Windows
    rootnoverify (hd0,0)
    chainloader +1

title OpenSolaris
    rootnoverify (hd0,1)
    savedefault
    makeactive
    chainloader +1

title CentOS (2.6.18-92.el5)
    root (hd0,2)
    kernel /boot/bzImage.2.6.18-92.el5 ro root=LABEL=/ rhgb quiet crashkernel=512M@16M
    initrd /boot/initrd-.2.6.18-92.el5.img
```

Step6: I have rearranged the code in accordance to the geometrical layout of the partitions in the hard disk. WinXP first, followed by OpenSolaris slice and finally, the CentOS partition. Save and exit vi editor.

Step7: [root@pluton grub]# **/sbin/reboot**

This restarts the PC. When the system finally comes up, press any key to see the GNU GRUB version 0.97 screen, which displays:

Windows
OpenSolaris
CentOS (2.6.18-92.el5)

- Selecting **Windows** and pressing `<ENTER>` boots your system into WinXP.
- Selecting **OpenSolaris** and pressing `<ENTER>` loads the OpenSolaris GRUB boot loader via *chain-loading mechanism*. It has our earlier OpenSolaris entries plus the WinXP boot entry. Check whether all working correctly or not.
- Selecting **CentOS (2.6.18-92.el5)** and pressing `<ENTER>` boots CentOS 5.2.

Thus, as *promised*, we have:

- a) Successfully partitioned a new single hard disk drive into primary and extended partitions with WinXP FAT32, OpenSolaris ZFS and Linux ext3 filesystems on them.
- b) Successfully installed Microsoft WinXP on the first primary partition of the hard disk.
- c) Successfully installed OpenSolaris 2008.11 on the second primary partition of the hard disk.

- d) Successfully installed CentOS 5.2 on the third primary partition of the hard disk (*with Linux swap on a logical disk drive of the extended partition*).
- e) Successfully edited the GRUB configuration file `/boot/grub/grub.conf` and configured a tri-boot system with WinXP, OpenSolaris and CentOS OSes.
-
-

4. Conclusion

Earlier versions of this guide can be found online at:

- **Windows + BSD + Linux Installation Guide, version 1.0**, last updated: April 7th, 2003
<http://www.linux.sgi.com/LDP/LDP/Win+BSD+Linux-Install/html/index.htm>
- **Windows + BSD + Linux Installation Guide, version 1.1**, last updated: August 21st, 2003
<http://ploug22.free.fr/doc/guide-windows-bsd-linux.pdf>
- **Windows + BSD + Linux Installation Guide, version 1.2**, last updated: January 5th, 2004
<http://jamesthornton.com/linux/Win+BSD+Linux-Install/>

Each one of these include a detailed Troubleshooting section. Since I have replaced FreeBSD/OpenBSD/NetBSD with OpenSolaris in this particular version of the guide, most of the problems listed therein would not apply in the current scenario. Thus, the Troubleshooting section has been removed.

The plan in the near future is to include a highly informative Troubleshooting section for this version of the guide as well.

Ultimately, though, the responsibility for any errors or omissions you might find is mine and mine alone, so please address your ire to me at [sghosh.oxon at yahoo dot co dot uk](mailto:sghosh.oxon@yahoo.com). For those who would like to send PRs (Problem Reports), please make sure you send enough valid and related information for me to work with. I cannot help you if you just send an email with messages like "This screwed up!", "That doesn't work!" and so on. Try sending detailed PRs. You may very well find your comments, suggestions and corrections reflected in the next version of this guide. Thank you!
