

Installation Guide

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Installation and Configuration Guide for Linux and Apache Web Server on Compaq Prosignia and ProLiant Servers

***Abstract:** This guide provides system specifications and driver selection for basic installation and configuration of the Linux operating system and the Apache Web Server software. These two applications form a solid basis for providing basic Web services.*

The information reported in this guide is limited to four prominent Linux distributions: Red Hat, SuSE, TurboLinux, and Caldera Systems.

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Installation and Configuration Guide for Linux and Apache Web Server on Compaq Prosignia and ProLiant Servers

Installation Guide prepared by E-Commerce Solutions Business Unit

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Introduction

Even with the recent growth of electronic commerce and application service suites, basic Web services remain the most widely used on the Internet. To be able to provide basic Web services, you will require a Web server that is the fundamental Internet server. The Linux operating system, coupled with the Apache HTTP server, forms a solid basis for providing basic Web services.

This guide discusses the basics of the Linux and Apache installation and the configuration on the Compaq *ProLiant* and *Prosignia* server platforms. The specific servers covered in this guide include:

Entry Level Servers

- [ProLiant 400](#)
- [Prosignia 720](#)
- [Prosignia 740](#)
- [Prosignia 200](#)

Workgroup/Departmental Servers

- [ProLiant 800](#)
- [ProLiant 1600](#)
- [ProLiant 1600R](#)
- [ProLiant 1850R](#)
- [ProLiant 3000](#)
- [ProLiant 3000R](#)

Enterprise Servers

- [ProLiant 5500 – with Intel Xeon](#)
- [ProLiant 5500R – with Intel Xeon](#)
- [ProLiant 6000 – with Intel Xeon](#)
- [ProLiant 6400R – with Intel Xeon](#)
- [ProLiant 6500R – with Intel Xeon](#)
- [ProLiant 7000 – with Intel Xeon](#)
- [ProLiant 8000](#)
- [ProLiant 8500](#)

Target Audience

This guide also provides a general overview of Linux and the Linux server setups. Compaq assumes that you have a basic working knowledge of Linux operations, including basic Linux setup and configuration. There is much detailed information currently available on the installation and configuration of the various distributions of Linux and Apache. This guide focuses on how to apply those existing methods to the Compaq servers listed above. Compaq recommends that you refer to the numerous references to external sources and materials used in this guide when additional software detail is needed.

Given the level of detail of this guide, Compaq recommends that you first familiarize yourself with the Linux and Apache applications. The following is a partial list of references to learn more about the software. See Appendix A for a more comprehensive list.

- <http://www.linux.org>: the website of Linux.
- <http://www.apache.org>: the website of the Apache project.

- <http://metalab.unc.edu/LDP>: the website of the Linux Documentation Project.
- <http://www.calderasystems.com>: the website of the Caldera Linux distribution.
- <http://www.redhat.com>: the website of the Red Hat Linux distribution.
- <http://www.suse.com>: the website of the S.u.S.E. Linux distribution.
- <http://www.turbolinux.com>: the website of the TurboLinux distribution.
- <http://www.compaq.com/linux>: the Compaq website for Linux information.

Many of these sites are also mirrored at other sites, and some of these sites (or portions of these) are published in languages other than English. As an exercise, Compaq recommends that you peruse these sites, along with others, to learn the basics of using Linux and Apache.

Distributions Overview

This guide discusses the following four prominent Linux distributions:

- Red Hat Software, Inc.
- TurboLinux, Inc.
- SuSE, Inc.
- Caldera Systems, Inc.

All of these distributions include large amounts of software that can run in conjunction with Linux, including the Apache Web Server. This guide will not analyze the available software by distribution nor give a comparison of the software from one distribution to another. This guide focuses exclusively on the base Linux operating system, the Apache Web Server, and the components common to all four distributions.

Red Hat

Red Hat is one of the more popular versions of Linux in the United States. It is maintained by Red Hat Software, Inc. and is available through its website located at <http://www.redhat.com>.

Red Hat has certified several Compaq servers. The complete list can be found at <http://developer.redhat.com/certification/> and includes the following Compaq servers:

Compaq Prosignia 720

Compaq Prosignia 740

Compaq ProLiant 400

Compaq ProLiant 800

Compaq ProLiant 1850R

Compaq ProLiant 1600R

Compaq ProLiant 3000R

Compaq ProLiant 5500R

Compaq ProLiant 6400R

TurboLinux

TurboLinux is the most popular version of Linux in Asia and is gaining in popularity in the United States. It is maintained by TurboLinux, Inc., formerly known as Pacific HiTech, and is available through its website located at <http://www.turbolinux.com>.

SuSE

SuSE is one of the more popular versions of Linux in Europe and is gaining in popularity in the United States. It is maintained by SuSE, Inc. and is available through its website located at <http://www.suse.com>.

Caldera

Caldera is another popular Linux distribution. It is maintained by Caldera Systems, Inc. and is available through its website at <http://www.calderasystems.com>.

Management Summary

Each distribution vendor includes operating system and application management tools that form a common base across one or more distributions. Red Hat's Package Management (RPM) format, for instance, is a commonly used software distribution mechanism. Other tools, such as each vendor's setup program, are specific to a particular distribution. This guide does not provide discussion of the Operating System Management (OSM). For this detailed information, refer to the individual distribution vendor.

Software Overview

Installation of Linux and the Apache Web Server was conducted on the Compaq server platforms listed above. Each server was tested using the following software:

- Caldera Systems OpenLinux 2.2
- TurboLinux Workstation 3.6
- Red Hat Linux 6.1
- SuSE Linux 6.2

The testing selected a default software configuration so that a minimum amount of software was included in the installation.

Hardware Overview

Compaq Hardware Basics

Configuration for the *Prosignia* and *ProLiant* servers is outlined in Tables 1 - 3. All of the servers used in the testing come equipped with standard bus-interface devices for which drivers already exist for Linux. All bus-interface devices detailed use the PCI bus. Detailed information on each particular bus-interface device can be found in a subsection of the appropriate software. Only the installation and configuration details that are necessary to clarify the hardware explanation are provided in this section. Basic and configuration instructions can be found in the section,

Installation Briefs.

Table 1. Entry Level Server Specifications

	<i>ProLiant 400</i>	<i>Prosignia 720</i>	<i>Prosignia 740</i>	<i>Prosignia 200</i>
Processor Speeds	Intel Pentium III 500, 550, and 600MHz Pentium II 350, 400, and 450MHz	Pentium III 500 and 600MHz Pentium II 350, 400, and 450MHz	Pentium III 500, 550, and 600MHz Pentium II 350, 400, and 450MHz	Pentium II 350, 400, and 450MHz
SMP Support	No	No	No	No
L2 Cache	512KB	512KB	512KB	512KB
Maximum Memory	Pentium III 768MB Pentium II 384MB	Pentium III 768MB Pentium II 384MB	1GB	384MB
Disk Controller	Integrated Wide-Ultra2 SCSI	Integrated Wide-Ultra2 SCSI	Integrated Wide-Ultra SCSI-3	Wide Ultra SCSI -3
Disk Controller Chipset	Symbios Logic 53C876	Symbios Logic 53C895	Symbios Logic 53C876	Symbios Logic 53C875J
Tape Drives Supported	DAT, SLR, DDS-3, DLT	DAT, SLR	DAT, SLR	DAT, SLR
NIC	Integrated <i>Compaq Netelligent</i> 10/100 TX PCI Intel UTP Controller (Intel 82558)	Integrated <i>Netelligent</i> 10/100 TX PCI Intel UTP Controller (Intel 82558)	Integrated <i>Netelligent</i> 10/100 TX PCI UTP Controller (ThunderLan)	Integrated <i>Netelligent</i> 10-T PCI UTP Controller (ThunderLan)
Video	1024KB, 1024x768 pixel resolution at 256 colors	1024KB, 1024x768 pixel resolution at 256 colors	1024KB, 1024x768 pixel resolution at 256 colors	1024KB, 1024 x 768 pixel resolution at 256 colors
Video Card	ATI Rage IIC	ATI Rage IIC	ATI Rage IIC	Cirrus Logic CL-5446

Table 2. Workgroup/Departmental Server Specifications

	<i>ProLiant 800</i>	<i>ProLiant 1600, 1600R</i>	<i>ProLiant 1850R</i>	<i>ProLiant 3000, 3000R</i>
Processor Speeds	Pentium III 500, 550, and 600MHz Pentium II 350e, 400, and 450MHz	Pentium III 500, 550, and 600MHz Pentium II 350, 400, and 450MHz	Pentium III 500, 550, and 600MHz Pentium II 400 and 450MHz	Pentium III 500, 550, and 600MHz Pentium II 300, 333, 400, and 450MHz
SMP Support	2P	2P	2P	2P
L2 Cache	512KB	512KB	512KB	512KB
Maximum Memory	1GB	1GB	1GB	6/300 512MB 6/333 3GB 6/400 – 6/600 4GB
Disk Controller	Integrated Dual Wide-Ultra SCSI-3	Integrated Dual Channel Wide-Ultra SCSI-3	Integrated Dual Channel Wide-Ultra SCSI-3	Integrated Dual Channel Wide-Ultra SCSI-3 <i>Smart Array 3200 Controller</i>
Disk Controller Chipset	Symbios Logic 53C876	Symbios Logic 53C876	Symbios Logic 53C876	Symbios Logic 53C875J (Integrated Controller)
Tape Drives Supported	DAT, SLR, DDS-3, DLT	DAT, SLR, DDS-3, DLT, AIT	DAT, SLR, DDS-3, DLT, AIT	DAT, SLR, DDS-3, DLT
NIC	Integrated <i>Netelligent</i> 10/100 TX UTP Controller (ThunderLan)	Integrated <i>Netelligent</i> 10/100 TX UTP Controller (ThunderLan)	Integrated <i>Netelligent</i> 10/100 TX UTP Controller (ThunderLan)	10/100 TX PCI UTP Controller (Intel 82558) <i>Netelligent</i> 10/100 TX PCI UTP (450 and below) (ThunderLan)
Video	1024KB, 1024x768 pixel resolution at 256 colors	1024KB, 1024x768 pixel resolution at 256 colors	1024KB, 1024x768 pixel resolution at 256 colors	1024KB, 1024x768 pixel resolution at 256 colors
Video Card	ATI Rage IIC	Cirrus Logic CL-5446B	ATI Rage IIC	ATI Rage II (400 and above) Cirrus Logic CL-54M30

Table 3. Enterprise Server Specifications

	<i>ProLiant 5500</i>	<i>ProLiant 6000</i>	<i>ProLiant 6400</i>	<i>ProLiant 6500</i>
Processor Speeds	Pentium III Xeon 500 and 550MHz Pentium II Xeon 450MHz	Pentium III Xeon 500MHz Pentium II Xeon 400 and 450MHz	Pentium III Xeon 500MHz	Pentium III Xeon 500MHz Pentium II Xeon 400 and 450MHz
SMP Support	4P	4P	4P	4P
L2 Cache	512KB, 1MB, 2MB	512KB, 1MB	512KB, 1MB, 2MB	512KB, 1MB, 2MB
Maximum Memory	4GB	8GB	4GB	4GB
Disk Controller	Integrated Dual Channel Wide-Ultra SCSI-3 Wide Ultra2 Dual Channel SCSI Controller in a PCI Slot (Pentium III Models w/LVD cages only)	Integrated Dual Channel Wide-Ultra SCSI-3 <i>Compaq Smart Array</i> 3100ES Controller	Integrated Dual Channel Wide-Ultra SCSI-3 Controller	Integrated Dual Channel Wide-Ultra SCSI-3 Controller
Disk Controller Chipset	Symbios Logic 53C867 (Integrated Controller) Symbios 53C879	Symbios Logic 53C875J (Integrated Controller)	Symbios 53C876	Symbios 53C876
Tape Drives Supported	DAT, SLR, DDS-3, DLT, AIT	DAT, SLR, DDS-3, DLT, AIT	DAT, SLR, DDS-3, DLT, AIT	DAT, SLR, DDS-3, DLT, AIT
NIC	<i>Netelligent</i> 10/100 TX PCI UTP (Intel 82558)	Dual-Port <i>Netelligent</i> 10/100 TX PCI UTP Controller (ThunderLan) NC3131 64 Dual Port 10/100 (Intel 82558)	NC3131 64 Dual Port 10/100 (Intel 82558)	NC3122 64 Dual Port 10/100 (Intel 82558)
Video	1024KB, 1024x768 pixel resolution at 256 colors	2MB, 1024x768 pixel resolution at 256 colors	2MB, 1024x768 pixel resolution at 256 colors	2MB, 1024x768 pixel resolution at 256 colors
Video Card	ATI Rage IIC	ATI Rage IIC Cirrus Logic CL-54C46	ATI Rage IIC	ATI Rage IIC

Table 3. Enterprise Server Specifications (cont.)

	<i>ProLiant 7000</i>	<i>ProLiant 8000</i>	<i>ProLiant 8500</i>
Processor Speeds	Pentium III Xeon 500MHz Pentium II Xeon 450MHz	Pentium III Xeon 550MHz	Pentium III Xeon 550MHz
SMP Support	8P	8P	8P
L2 Cache	512KB, 1MB, 2MB	512KB, 1MB, 2MB	512KB, 1MB, 2MB
Maximum Memory	8GB	8GB	8GB
Disk Controller	Integrated Dual Channel Wide- Ultra SCSI-3	<i>Smart Array 4250ES</i>	Integrated Wide Ultra2 SCSI Dual Channel <i>SmartArray</i> Controller
Disk Controller Chipset	Symbios Logic 53C875J		
Tape Drives Supported	DAT, SLR, DDS-3, DLT, AIT	DAT, SLR, DDS-3, DLT, AIT	DAT, SLR, DDS-3, DLT, AIT
NIC	NC3131 64 Dual Port 10/100 (Intel 82558)	NC3131 64 Dual Port 10/100 (Intel 82558)	NC3131 64 Dual Port 10/100 (Intel 82558)
Video	2MB, 1024x768 pixel resolution at 256 colors	2MB, 1024x768 pixel resolution at 256 colors	2MB, 1024x768 pixel resolution at 256 colors
Video Card	ATI Rage IIC	ATI Rage IIC	ATI Rage IIC

Processor

Both the *ProLiant* and *Prosignia* servers discussed in this guide use either the Intel Pentium II, Pentium III, or Pentium III Xeon processor. Since no specific Linux kernel optimizations are currently available for these processors, any kernels built should be modified to optimize for the Intel Pentium Pro processor. Custom kernels built for testing in preparation for this guide were all optimized for the Pentium Pro processor.

SCSI Controller

All servers examined, with the exception of the *ProLiant 8000* and *ProLiant 8500* servers, come equipped with a Symbios Logic SCSI controller. All of the servers include internal dual port SCSI interfaces, while the *Prosignia 720* server and *ProLiant 400* server have a single ULTRA-2 SCSI port. External SCSI ports are also built into the *ProLiant* servers examined here. During installation, the device driver for NCR53C8XX devices will be auto-detected by most distributions. The NCR53C8XX driver works fine with the Symbios chipset.

Note: The device driver for NCR53C8XX is different from the device driver for NCR53c7, 8xx SCSI devices.

Specific controllers tested in preparation for this guide are included in the following table:

Table 4. SCSI Controller Specifications

Compaq Servers	Built-in SCSI Controller
<i>ProLiant</i> 5500 server	Symbios 53c867
<i>Prosignia</i> 200 server <i>ProLiant</i> 3000 server <i>ProLiant</i> 6000 server <i>ProLiant</i> 7000 server	Symbios 53c875J
<i>Prosignia</i> 740 server <i>ProLiant</i> 400 server <i>ProLiant</i> 800 server <i>ProLiant</i> 1600 server <i>ProLiant</i> 1850R server <i>ProLiant</i> 6400R server <i>ProLiant</i> 6500R server	Symbios 53c876
<i>ProLiant</i> 5500 server	Symbios 53c879
<i>Prosignia</i> 720 server	Symbios 53c895
<i>ProLiant</i> 8000 server	Smart Array 4250ES
<i>ProLiant</i> 8500 server	Integrated Smart Array

Smart Array Controllers

The *Compaq Smart Array* controller is an option for all *ProLiant* Servers. The *ProLiant* 8000 and *ProLiant* 8500 come standard with a *Smart Array* controller. The *Smart Array* driver has been accepted into the 2.2.x kernel tree and is included with the tested distributions. Appendix C has detailed information for installing 2.0.x kernels using a *Smart Array* controller.

Note: The 2.2 kernel can only detect devices on PCI bus 0. The Smart controller on the *ProLiant* 8000 is not located on PCI bus 0. Compaq has developed a fix; and is working with the maintainer of the Linux PCI code to add the fix in the next revision. As of this writing, the only distribution that has included the fix is SuSE 6.2.

To install Red Hat 6.1 on a *ProLiant 8500*, you must select expert mode when booting from the Red Hat 6.1 installation CD.

CD-ROM

The built-in CD-ROM drive on each server is a standard ATAPI device.

Floppy Disk Drive

The built-in floppy disk drive on each server is a standard floppy device.

Mouse Port

The built-in mouse port on each server accepts standard PS/2 devices.

Keyboard Port

The built-in keyboard port on each server is a PS/2 style port and accepts keyboards that can plug into such a port.

Video Card and Monitors

When setting up the appropriate driver for X Windows, it is important to note that at this time there are no specific X-servers for the Cirrus Logic video cards. Regardless of which distribution is selected, the generic SVGA X server should be selected for servers set up with an SVGA monitor. Distributions that contain Xfree86 3.3.3.1 or later can use the XF86_Mach64 driver for servers that use the ATI Rage IIC video card. Lesser monitors – such as VGA or monochrome – should use an X-server appropriate for the particular monitor type. When you are setting up X, whether through the xf86config script or through a distribution vendor's setup program, select a monitor from the monitors list, or enter the video parameters included in the monitor documentation. The specifications for several Compaq monitors are included in Table 5. Since the instructions for the outlined video cards tell you not to auto-probe, it is best to enter the information manually. The video card specifications for each server are included in Table 5. Additional information on the video card can be found in Tables 1 - 3. Detailed monitor specifications can be found in Appendix B.

Table 5. Compaq Server Video Card Specifications

Servers	Built-in Video Card	Video RAM	Clocks Line	Resolution
Prosignia 720 Prosignia 740 ProLiant 400 ProLiant 800 ProLiant 1850R ProLiant 3000R	ATI Rage IIC	1024KB	None	1024x768 at 65M colors
ProLiant 5500R ProLiant 6000 ProLiant 6400R ProLiant 7000 ProLiant 8000R ProLiant 8500R	ATI Rage IIC	2048KB	None	1024x768 at 65M colors
ProLiant 1600R	Cirrus Logic CL-5446B	1024KB	None	1024x768 at 256 colors
Prosignia 200 ProLiant 6000	Cirrus Logic CL-54c46	1024KB	None	1024x768 at 256 colors
ProLiant 7000	Cirrus Logic CL-54M30	1024KB	None	1024x768 at 256 colors

Table 6. Compaq Monitor Specifications

Monitor	Horizontal Frequency	Vertical Frequency	Monitor	Horizontal Frequency	Vertical Frequency
14" Monitors			19" Monitors		
1024	30 - 60 kHz	50 - 100 Hz	P900	30 - 107 kHz	50 - 120 Hz
140	31 - 48 kHz	50 - 100 Hz	S900	30 - 95 kHz	50 - 160 Hz
V40	31 - 48.4 kHz	50 - 100 Hz	V90	30 - 94 kHz	48 - 160 Hz
V45	31 - 50 kHz	50 - 100 Hz	V900	30 - 96 kHz	48 - 160 Hz
SVGA	31.5 - 38 kHz	43 - 60 Hz			
15" Monitors			21" Monitors		
150	31 - 48 kHz	50 - 100 Hz	P110	30 - 107 kHz	48 - 160 Hz
151FS	30 - 60 kHz	50 - 100 Hz	P1100	30 - 121 kHz	50 - 160 Hz
P50	30 - 69 kHz	47.5 - 125 Hz	P1610	30 - 96 kHz	48 - 160 Hz
V50	31 - 60 kHz	47.5 - 115 Hz	V1000	30 - 107 kHz	50 - 160 Hz
V55	30 - 60 kHz	47.5 - 125 Hz	QVISION 200	30 - 82 kHz	50 - 160 Hz
V500	30 - 70 kHz	50 - 160 Hz	QVISION 210	31 - 94 kHz	48 - 110 Hz
S500	30 - 54 kHz	50 - 120 Hz			
QVISION 150	31.5 - 58 kHz	50 - 100 Hz			
17" Monitors			TFT Display		
171FS COLOR	30 - 60 kHz	50 - 100 Hz	TFT450	31.5 - 60.2 kHz	59 - 85 Hz
QVISION 170	31.5 - 58 kHz	50 - 100 Hz	TFT450R	31.5 - 60 kHz	56.3 - 85 Hz
QVISION 172	31.5 - 82 kHz	50 - 110 Hz	TFT500	31.5 - 60.2 kHz	59 - 85 Hz
S700	30 - 69 kHz	50 - 160 Hz	TFT5000	31.5 - 60.2 kHz	56 - 78.75 Hz
P70	30 - 92 kHz	50 - 150 Hz	TFT5000s	32 - 60 kHz	57 - 85 Hz
P75	30 - 85 kHz	50 - 150 Hz	TFT5000r	31.47 - 60 kHz	57 - 85 Hz
P700	30 - 92 kHz	50 - 120 Hz	TFT8000	31.5 - 80kHz	60 - 85 Hz
V70	30 - 69 kHz	60 - 125 Hz			
V75	30 - 69 kHz	47.5 - 125 Hz			
V700	30 - 85 kHz	50 - 160 Hz			

More detailed monitor specifications can be found in Appendix B.

Network Interface Controller

Two different Network Interface Controller (NIC) cards were examined in Compaq's testing reported in this guide. This testing identified the chipsets for *Prosignia* and *ProLiant* servers.

Table 7. Network Interface Controller Specifications

Server	Built-in Network Interface Controller
<i>Prosignia</i> 720 <i>ProLiant</i> 400 <i>ProLiant</i> 3000 <i>ProLiant</i> 5500 <i>ProLiant</i> 6000 <i>ProLiant</i> 6400R <i>ProLiant</i> 6500R <i>ProLiant</i> 7000 <i>ProLiant</i> 8000R <i>ProLiant</i> 8500R	Intel 82558 (Intel Etherexpress Pro 100)
<i>Prosignia</i> 200 <i>Prosignia</i> 740 <i>ProLiant</i> 800 <i>ProLiant</i> 1600 <i>ProLiant</i> 1850R <i>ProLiant</i> 3000R <i>ProLiant</i> 6000	Texas Instruments ThunderLAN (TLAN)

Note: All four distributions covered in this guide, either detect the cards automatically or allow for manual selection. At the time of installation, you can use either card to configure the network for all covered distributions, making it possible to install Linux from a FTP server, a NFS mount, or a SMB share.

One method to determine the type of built-in NIC card available on a particular server is to examine the System Configuration using the *Compaq SmartStart* utility included with every *Compaq ProLiant* and *Prosignia* server. You can do this by performing the following steps, starting at the main menu:

1. Choose System Configuration.
2. Select **Configure Hardware**.
3. Select **Review or Modify Hardware Settings**.
4. Select **View or Edit Details**.
5. Scroll until the network controllers can be viewed.

Testing performed with the ThunderLAN-based cards demonstrated that the following cards are based on the ThunderLAN chipset:

- *Compaq Netflex-3/P* controller
- *Compaq* Integrated UTP/BNC controller
- *Compaq* Integrated 10/100 TX UTP controller
- *Compaq* Dual 10/100 TX UTP controller
- *Compaq Netelligent* 10/100 TX PCI UTP controller

The following entries are generated by an Intel-based NIC:

- *Netelligent* 10/100 TX WOL PCI UTP Intel controller
- *Compaq* NC3122 Fast Ethernet NIC.

If the System Configuration utility does not identify one of the above, directly examine the PCI NIC or the motherboard of the server. If a chip with the Texas Instruments, state of Texas logo, and the TLAN designation is located, then the card or embedded controller is based on the ThunderLAN chipset. If this logo is not present, and an Intel logo is present, then it is likely that the card is based on the Intel chipset. The Etherexpress Pro 100 driver should be used. You can distinguish between an Intel NIC chip and another type of Intel chip by reading the numeric information on the chip itself. An 82558 chip, for example, is stamped as “Intel sb 82558B”.

Note: The 2.2 kernel can only detect devices on PCI bus 0. By default, the NIC on the *ProLiant* 8000 and *ProLiant* 8500 servers is not located on PCI bus 0. Before beginning installation, move the NIC to a slot located on PCI bus 0 (Primary PCI Bus).

Version 1.05c of the `eeepro100.c` driver included with Red Hat 6.1 does not work properly with all Intel Ether Express Pro based NICS. Version 1.06c does not appear to have any issues with the Intel chipsets on the Compaq Intel-based NICs. The latest version of the driver can be found at <http://cesdis.gsfc.nasa.gov/linux/drivers/eeepro100.html>

APIC Settings (SMP)

The default APIC interrupt settings for multi-processor capable servers will not allow for Linux SMP support. However, the APIC settings can be modified to be compatible through the Compaq System Configuration Utility included with *Compaq SmartStart*. Using the System Configuration Utility, you can select the APIC setting in one of two ways.

Using The OS type to set the APIC mode:

1. Enter the System Configuration Utility.
2. Select **Configure Hardware**.
3. Use the menu to select **View or Edit Details**.
4. Select Unixware 2 as the Operating System.

Manually selecting APIC Settings:

1. Enter the System Configuration Utility.
2. At the main screen, press **control-A** to enable advanced mode.
3. Use the menu to select **Configure Hardware**.

4. Use the menu to select **View or Edit Details**.
5. Scroll down to where the APIC settings are located and modify the default setting to be in **“FULL TABLE MAPPED”** mode.

This configuration will make the server Intel-SMP compliant, and any such Intel-SMP compliant kernel will now recognize and boot this machine as SMP (provided, of course, that two or more processors and their respective processor power modules are present).

Note: During initial configuration of the server from within *SmartStart*, the APIC mode is automatically set when specifying the Operating System. Specifying UnixWare 2, the APIC mode is set to “Full Table Mapped” Mode. Selecting UnixWare 7 sets the APIC to “Full Table” mode. Compaq recommends the Operating System type be set to UnixWare 2. Having the APIC set to “Full Table Mapped” mode has been tested on all listed servers. Running in ‘Full Table Mapped’ mode does introduce a slight performance hit. Once your system is configured and functional, to increase performance the APIC can be changed to “Full Table” mode. If the system develops problems i.e. won’t boot, system hangs, disk corruption, etc, change the APIC setting back to “Full Table Mapped” mode.

Compaq Smart Array Controller

The *Compaq Smart Array* controller device driver discussed in this guide is available at <ftp://ftp.compaq.com/pub/products/drivers/linux/released>. The following array controllers have been tested for basic compatibility with the driver:

- *Compaq Smart* controller (EISA)
- *Compaq Smart-2/E Array* controller (EISA }
- *Compaq Smart-2/P Array* controller
- *Compaq Smart-2DH Array* controller
- *Compaq Smart-2SL Array* controller
- *Compaq Smart Array 221* controller
- *Compaq Smart Array 3100ES* controller
- *Compaq Smart Array 3200* controller
- *Compaq Integrated Smart Array* controller
- *Compaq Smart Array 4200* controller
- *Compaq Smart Array 4250ES* controller

As of this writing, the latest *Compaq Smart2-1.0.5* driver has been accepted into the kernel tree and is included in 2.2.10 and later kernels.

Note: With the exception of the *ProLiant 8000* and *8500* servers, the array controllers are add-on options for the *ProLiant* servers. Only the PCI-based *Smart Array* controllers were tested with the above-mentioned device driver in preparation for this document. However, according to the documentation available with the device drivers, EISA-based *Smart Array* controllers will also work. Other Compaq or third-party array controllers will not work with this driver.

Apache Server Overview

The Apache Web Server has been well documented by the Apache Server Project and the various distribution vendors. In addition, several other sites within the Linux community have provided additional insights into the operations and management of the Apache Web Server. The main pages for httpd are also helpful. This guide is not intended to improve upon the information already publicly available.

Installation Briefs

Compaq SmartStart

ProLiant Servers

The Compaq servers discussed in this guide are all based on industry-standard components; installation of Linux for all distributions is straightforward. There are several steps common to all distributions. The following are for the *ProLiant* servers:

1. To configure a server, insert the *Compaq SmartStart* CD included with the server into the CD-ROM drive, and turn server on. The *Compaq SmartStart* process will begin, allowing the hardware to be configured and setting up the Compaq System Partition so that subsequent hardware updates can be easily made.
2. Boot the *SmartStart* CD.
3. When prompted, choose Manual Configuration.
4. Accept all defaults except where *SmartStart* prompts for the Operating System Selection. In testing, UnixWare 7 was selected as the operating system for *ProLiant* server setups.
5. After building the system partition, the system will boot again.
6. The system now prompts you to build support software diskettes. These are useful for configuring hardware in the event the Compaq System Partition (partition ID 0x12) is accidentally deleted during the subsequent installation of Linux. Since the System Partition has already been installed to the hard drive, these diskettes are optional.
7. The *SmartStart* now prompts you to remove the *SmartStart* CD to prepare for the operating system installation.
8. Insert the boot media for the Linux distribution of your choice into either the floppy drive or CD-ROM drive.
9. When *SmartStart* completes, it will reboot a final time to set up the operating system.

This system partition is a bootable partition that the server must be able to bootstrap in order to access server configuration programs after the Linux installation. Therefore, for *ProLiant* servers, a Linux Loader (LILO) section must be set after the Linux installation for this partition. Specifics are covered in the respective setup section.

Prosignia Servers

On the *Compaq Prosignia* servers, the *SmartStart* process is fundamentally different in two ways:

- The *SmartStart* process for a *Prosignia 720* server asks for only a few configuration parameters, including the locale, date, and time, and an option to build support software diskettes.
- The *SmartStart* process for a *Prosignia* server does not install a system partition and does not request that you supply a specific operating system.

Since *Prosignia* servers do not install a system partition to handle server configuration, a ROM-based setup utility can be invoked at boot time by pressing the F10 key. This ROM-based utility is invoked before the server attempts to boot from a particular medium (floppy, CD, or hard drive). Therefore, it affects the LILO setup since LILO does not need to boot the setup program from the hard-drive. Thus, no additional LILO section is necessary for *Prosignia* server configurations. Specifics are covered in the respective setup sections for each distribution.

Now that the differences are noted, the details of a *Prosignia* server *SmartStart* setup will be discussed. Each server is shipped with a *SmartStart* CD and Server Profile Diskette (SPD). The following steps should be taken for the *SmartStart* setup:

1. You must boot the *SmartStart* CD.
2. After *SmartStart* boots, you will be asked to choose a language.
3. A screen prompts you to set locale, date, and time parameters.
4. You are asked to create support software diskettes, if desired.
5. You must exit to reboot the server.
6. At this point, remove the *SmartStart* CD and replace with the appropriate setup media for the Linux distribution you have chosen.

Either before or after the Linux setup, you can press the F10 key at the server startup screen to invoke the ROM-based setup utility to change hardware configurations.

Linux Installation

SCSI Installation

The installation programs of all tested distributions perform well in auto-detecting any known hardware. All Compaq servers used in this testing have Symbios 53C8XX SCSI controllers. This chipset is auto-detected by all the distributions as the NCR 53C8XX. Use either fdisk or the distribution vendors partitioning tool to partition the hard disk. The System Partition (ID 0x12) should be left intact when creating operating system and swap partitions. Once these partitions are set up, you are prompted for the mount-points and software installation. You should then choose the configuration you find most useful.

IMPORTANT: The Compaq System Partition created during the *SmartStart* portion that precedes Linux setup should not be deleted. This partition is a bootable partition that can be used to configure new or changed hardware. Its partition identification is 0x12.

Initial Network Setup

When setting up the network, all distributions tested will either auto-detect the NIC, or you can select the correct driver manually. (See the section, Network Interface Controller, for assistance in identifying what type of NIC card is present in the server.) If a *Netelligent* Intel NIC card is present then the auto-detect program will identify it as an Intel Etherexpress Pro 100 card. *Netelligent* Intel NIC cards can be controlled by this driver.

In addition, some network repeaters and switches do not adequately broadcast the specific port configurations for network bandwidth and duplex settings. This can prevent the driver from correctly auto-detecting these parameters. In the case of the TLAN card, the driver will send a kernel message (viewable from a tty console) reading "TLAN: Giving auto-negotiation more time." If this occurs, it is necessary to force the bandwidth and duplex settings of the driver, and it is useful to force the settings on the network repeater or switch. The README file included in the TLAN distribution documents provides explicit instructions for the TLAN driver to determine what duplex and network bandwidth (10baseT or 100baseTx) settings to use. These parameters can be entered into `/etc/conf.modules` (you should consult the distributions documentation for editing `/etc/conf.modules` directly).

LILO

The final portion of the setup is the LILO configuration. In addition to the Linux installation, you should set up the System Partition (ID 0x12) in LILO when setting up a *ProLiant* server.

Note: This is not necessary for Servers that do not have a system partition.

The Compaq System Partition is a bootable partition, generally invoked by pressing F10 at a prompt prior to booting the operating system. However, with LILO installed on the master boot record, pressing F10 invokes LILO instead of the Compaq System Utilities. If LILO is installed on a bootable partition of a hard drive, F10 functions normally. If you install LILO on the MBR, you will need another entry in `/etc/lilo.conf` to invoke the system partition from the hard drive. A good name for this entry would be "F10". The distributions tested recognize the 0x12 partition as bootable and allows the user to set this up during the LILO configuration. If you need to set this up manually, a sample `/etc/lilo.conf` file is provided in the next section.

Memory Beyond 64MB

Another issue seen with the some distributions is that it may not automatically recognize available RAM greater than 64MB. In Compaq's testing, circumstances were seen where additional RAM was correctly detected and others where it was not. To enable access to RAM above 64MB, edit the `/etc/lilo.conf` file so that it includes an append line:

```
append="mem=xxxM"
```

where `xxx` is the sum total of RAM available to the system in MBs. A sample `/etc/lilo.conf` file follows (remove the "other=" section when setting up a *Prosignia* 720 server):

Note: Not all distributions use the `initrd` section

```
# begin global section
boot=/dev/sda
map=/boot/map
install=/boot/boot.b
prompt
timeout=50
# begin Linux section
```

```

image=/boot/vmlinuz-2.2.12.6
label=linux
append="mem=128M" # allow access for greater than 64MB RAM
root=/dev/sda2
initrd=/boot/initrd-2.2.12-0.6.img
read-only
# begin System Partition section
other=/dev/sda3
label=F10
table=/dev/sda

```

Be sure to run `/sbin/lilo` after adding the `append` line, and reboot. You can determine if the larger amount of RAM was made available to the system by typing *free* as root:

```
[root@cpqlnx ~]#: free
```

	Total	Used	Free	Shared	Buffers	Cached
Mem:	127960	119600	8360	24332	45728	43496
-/+ buffers/cache:		30376	97584			
Swap:	143632	304	143328			

Examine the “total” column. If it shows the amount of RAM installed on the system in kilobytes (each kilobyte calculated by free is 1024 bytes), then the system recognizes that amount of RAM.

Memory 1GB and Beyond

The default Linux kernel cannot access more than 1GB of memory. When configuring a new system, at the boot prompt type “`linux mem=960M`”. Kernel version 2.2.10 and later can be configured to work with up to 2GB of memory. After installation you will need to rebuild the kernel with the memory option set correctly.

Video Setup

Setup automatically identifies the video cards of the listed Compaq servers. Most distributions select the Generic SVGA X Server. Systems with ATI video controllers can select the X86_Mach64 X Server. Most Compaq monitors are not present in the monitor database. To manually configure these, see the settings outlined in the previous section, Video Card and Monitors.

Building a SMP Kernel

This guide is not intended to cover the specifics of building a Linux kernel. For this background information on how to build a new Linux kernel, see the kernel HOWTO document. The `/usr/src/linux/README` file, distributed with all Linux kernel sources, also provides good background for kernel compilation.

There are two basic stages to building a SMP kernel and getting it to run on a *Compaq ProLiant* or *Prosignia* server. The first stage is to build the kernel itself. This will be necessary to enable SMP functionality with distributions that do not include an SMP kernel. Currently, the only distributions in this document that includes an SMP kernel are Red Hat and TurboLinux.

To build an SMP kernel, it is necessary to install the sources for the Linux kernel. All of the distributions covered in this document include the kernel sources as an install package. A good place to install the kernel sources is in `/usr/src/<kernel-source-identifier>` where `<kernel-source-identifier>` is a directory name that identifies the source, such as `Linux-2.2.5` or `Linux-2.2.10`. Once the kernel sources are installed, it is necessary to create a soft link from `/usr/src/linux` to `/usr/src/<kernel-source-identifier>`. This allows `/usr/src/linux` to indirectly refer to the particular source distribution you choose to use. Assuming that kernel Version 2.2.10 is used, do the following:

```
[root@cpqlnx lnxusr]# cd /usr/src
[root@cpqlnx src]# rm -f linux # removes any old soft links from linux
[root@cpqlnx lnxusr]# ln -s linux-2.2.10 linux # creates /usr/src/linux
soft link to point to /usr/src/linux-2.2.5
```

These steps are useful since they allow you to always compile from `/usr/src/linux`, and are necessary since compilation scripts refer to `/usr/src/linux` explicitly.

Run ***make menuconfig*** (from a command prompt) or ***make xconfig*** (from a *xterm*) from `/usr/src/linux`. It is necessary to make the following kernel modifications:

- Under the Character Devices menu, enable Real Time Clock support. According to the Linux Kernel Configuration help, “People running SMP (= multiprocessor) versions of Linux should enable this option to read and set the RTC clock in an SMP compatible fashion.”
- Also under the Character Devices menu, disable Advanced Power Management BIOS Support. According to the SMP FAQ (mirrored at <http://www.phy.duke.edu/brama/smp-faq/smp-howto-3.html>), and citing Jakob Oestergaard and Alan Cox, “APM and SMP are not compatible”.
- Be sure that other kernel configuration options are properly set. Some distributions install the kernel sources with a default configuration identical to the kernel that is shipped with the distribution others do not. It is necessary to build a kernel with proper support for *Compaq ProLiant* or *Prosignia* server hardware in order for these guidelines to work. See section, Hardware Overview, for documentation on which device drivers need to be built into the kernel or configured to be loadable as modules.

Once this is completed, type “***make dep; make clean***” at the command line. Then type “***make zImage***”. This last command invokes the script that builds a new kernel. Making `zImage` will sometimes fail, usually because the kernel to be compiled turns out to be too big. If this is the case, then type “***make bzImage***” instead. Making `bzImage` builds a kernel with fewer constraints than those placed on `make zImage`. Once the kernel finishes compiling, the kernel image (either `zImage` or `bzImage`) will be in `/usr/src/linux/arch/i386/boot`. Copy this kernel image to the same directory where other Linux kernels are located (often `/` or `/boot` – look for filenames such as `vmlinux` or `vmlinuz`, or create a new directory off of `/` to hold kernels).

Again, from the `/usr/src/linux` directory, type “***make modules***”. When this is complete, type, “***make modules_install***”. These script commands build and install the necessary modules in an SMP compliant fashion. Once this is done, all kernel and module binaries are built. At this point, you can edit the `/etc/lilo.conf` file to include a pointer to the new kernel image just built. Compaq recommends you keep the old LILO entry (and a LILO boot floppy) in case something should fail with the new SMP kernel.

You can also do all of the above on one command line:

```
make dep clean modules zImage modules_install
```

After the kernel, modules, and `initrd` pieces (see `initrd` in section below) are rebuilt for SMP, shutdown the server and reboot into the System Configuration Utility. Follow the instructions in section, APIC Settings (SMP), to place the Compaq server into an Intel SMP-compliant mode.

Distributions Which Use an Initial Ram Disk (`initrd`) Entry in `/etc/lilo.conf`

An Initial Ram Disk is an area reserved in Ram at boot-up time into which a valid Linux file system is copied. This area of Ram is then mounted briefly during the boot-up process in order for the kernel to gain access to necessary device drivers – such as SCSI controller drivers – which enable the kernel to continue its boot process. This initial Ram disk is mounted as the root of the file system, and after appropriate drivers are loaded, the root hard disk – such as, `/dev/sda1` – is mounted at the root of the file system instead.

Initial RAM disk (`initrd`) is a LILO tag that tells LILO to unpack a gzipped file system image for loading into a RAM disk immediately after booting. Distributions that use an `initrd` tag often do so because no disk support is built directly into the kernel. In such cases, disk support must be available in a module; however, since most modules reside on disk, the disk-support module is unavailable. To resolve this bootstrapping problem, module-based disk device driver support is placed into a gzipped file system image, which the kernel can load into RAM early in the boot process. This RAM disk then becomes the basis from which the kernel gains access (through the disk device driver module) to the hard disk.

The problem that arises when rebuilding a kernel for SMP is that all modules, including the disk device driver module, must also be rebuilt for SMP. This means that the `initrd` file must be modified so that the compressed file system image contains an appropriate device driver.

The following was taken from “The Kernel Update HOWTO on Red Hat’s website <http://www.redhat.com/corp/support/docs/kernel-upgrade/kernel-upgrade.html> section 3.4.

“The final steps of the upgrade are to make the initial ram disk for your machine, and to manipulate LILO to boot the new kernel. These steps will require you to edit the `/etc/lilo.conf` file.

The purpose of the initial ram disk is to allow a modular kernel to have access to modules that it might need to boot from *before* the kernel has access to the device where the modules normally reside. Thus, you end up with a chicken and egg problem, where you need a driver to talk to the hardware where the driver resides on. This problem normally occurs on systems with SCSI controllers.

To make this ramdisk, you will first need to find out what the kernel in `/boot` is called and then using the `mkinitrd` command.

To find out what the kernel we need to link against, we will list the `/boot` directory, and look for what kernels are installed. The Red Hat kernel RPM install should create a symbolic link from the file `/boot/vmlinuz` to the kernel that it installed.

```
# ls -l /boot/vmlinuz*
lrwxrwxrwx  1 root    root                16 Dec  2 18:31
/boot/vmlinuz -> vmlinuz-2.0.36-1
-rw-r--r--  1 root    root                454325 Oct 13 22:41
/boot/vmlinuz-2.0.36-0.7
-rw-r--r--  1 root    root                454349 Nov 17 13:11
/boot/vmlinuz-2.0.36-1
```

In the above example, the kernel is `/boot/vmlinuz-2.0.36-1` and we can feed this data to the `mkinitrd` command.

```
# mkinitrd /boot/initrd-2.0.36.img 2.0.36-1
# ls -l /boot/initrd-2.0.36*
-rw-r--r--  1 root    root          210885 Nov 20 09:57
/boot/initrd-2.0.36-0.7.img
-rw-r--r--  1 root    root          212043 Dec  2 18:47
/boot/initrd-2.0.36.img
```

The initial ram disk called `/boot/initrd-2.0.36.img` is successfully created and the LILO files can now be edited.”

Note: Keep an intact copy of the `initrd` file used as a basis to build an SMP-compliant `initrd`, and a non-SMP kernel can still reference it for booting, in case the SMP kernel fails to boot properly.

Note: Not every Linux system is setup with an `initrd` compressed file system image named `initrd.gz`. Examine the `/etc/lilo.conf` file to discover the name and location of this compressed file image. If there is no `initrd` tag in `/etc/lilo.conf`, then there is no compressed file system image to reconstruct for SMP. In this case, appropriate disk driver support should be built directly into the kernel.

Apache Installation

All of the distributions examined here allow you to install the Apache Web Server using the basic installation program. Once completed and the TCP/IP networking is properly set up, the Apache Web Server should function.

Each of the Linux distributions discussed in this guide includes the Apache Web server and in every case, the three basic configuration files control how the server runs. In each of these cases, the description is quoted from the comments included in their respective files:

- `httpd.conf` – general server-wide configuration
- `srm.conf` – sets up the user name-space parameters and also how the requests are serviced and responses formatted
- `access.conf` – sets up what type of services are allowed and under what circumstances

Note: Apache now recommends putting all information in the `httpd.conf` file. All distributions still include `srm.conf` and `access.conf` but only a few still utilize these files.

Although every distribution includes the Apache Web Server, each distribution sets it up in a different location. Table 8 documents the location of the default storage configuration and the content files for each distribution.

Table 8. Default Location Configurations

Distribution	Default Configuration File Location	Default Log File Location	Default Static Content Location	Default Dynamic (CGI) Content Location
Caldera Systems OpenLinux 2.2	<code>/etc/httpd/apache/conf</code>	<code>/var/log/httpd/apache</code>	<code>/home/httpd/html</code>	<code>/home/httpd/cgi-bin</code>
TurboLinux Workstation 3.6	<code>/etc/httpd/conf</code>	<code>/var/log/httpd</code>	<code>/home/httpd/html</code>	<code>/home/httpd/cgi-bin</code>
Red Hat Linux 6.1	<code>/etc/httpd/conf</code>	<code>/var/log/httpd</code>	<code>/home/httpd/html</code>	<code>/home/httpd/cgi-bin</code>
S.u.S.E. Linux 6.2	<code>/etc/httpd</code>	<code>/var/log</code>	<code>/usr/local/httpd/htdocs</code>	<code>/usr/local/httpd/cgi-bin</code>

Compaq has created a companion Tuning and Performance of Apache document. Along with a Sizing Solution for Linux and Apache. These and other Linux related documents can be found on the *Compaq ActiveAnswers* website at <http://www.compaq.com/activeanswers>.

Appendix A

Linux and Apache Links

This is a partial list of available links. If you would like to submit additional sites, please e-mail the author at LinuxInfo@compaq.com. Every attempt will be made to include pertinent sites in future document revisions.

- <http://www.compaq.com/linux>: the Compaq website for Linux information
- <http://www.compaq.com/activeanswers>: *Compaq ActiveAnswers website that includes Linux solutions*
- <http://www.linux.org>: useful Linux news and information
- <http://www.linux.com>: useful Linux news and information
- <http://www.gnu.org> the GNU project and the Free Software Foundation website
- <http://www.apache.org>: the Apache project website
- <http://metalab.unc.edu/LDP>: the Linux Documentation Project
- <http://www.calderasystems.com>: the website of the Caldera Linux distribution
- <http://www.redhat.com>: Red Hat Linux distribution website
- <http://www.turbolinux.com>: TurboLinux distribution website
- <http://www.suse.com>: SuSE Linux distribution website
- <http://potter.ieee.uh.edu/compaq.html>: General Compaq Linux configuration issues
- <http://www.samba.org/>: the site of the Samba project, Linux, and Windows integration.
- <http://www slashdot.org/>: a useful site for Linux news.
- <http://www.freshmeat.net/>: a useful site for Linux software news.
- <http://www.linux.org.uk/SMP/title.html>: link to useful information on Symmetric Multi-Processing under Linux.
- <http://www.phy.duke.edu/brama/smp-faq>: Linux SMP FAQ
- <http://www.xfree86.org>: the Xfree86 Project. Most Linux distributions include the free X server developed by this organization.

Appendix B

Compaq Monitor Specifications

Compaq V40 Monitor			Compaq 140 Monitor		
Display Resolutions / Refresh Rates (All Non-Interlaced)			Display Resolutions / Refresh Rates (All Non-Interlaced)		
1024 x 768		60 Hz	1024 x 768		60 Hz
800 x 600		60 and 75 Hz	800 x 600		60 and 75 Hz
720 x 400 (Text mode)		70 Hz	720 x 400 (Text mode)		70 Hz
640 x 480		60 and 75 Hz	640 x 480		60 and 75 Hz
640 x 350		70 Hz			
Bandwidth		50 MHz	Bandwidth		75 MHz
Horizontal Frequency		31 to 48.4 kHz Continuous	Horizontal Frequency (Banded/Continuous)		31 to 48 kHz Banded
Vertical Frequency		50 to 100 Hz	Vertical Frequency		50 to 100 Hz
Factory Pre-Set Display Modes			Factory Pre-Set Display Modes		
Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.5	70.0	640 x 350	31.5 +	70.0 -
640 x 480	31.5	60.0	640 x 480	31.5 -	60.0 -
640 x 480	37.8	75.0	640 x 480	37.5 -	75.0 -
720 x 400	31.5	70.0	720 x 400	31.5 -	70.0 +
800 x 600	37.8	60.0	800 x 600	37.8 +	60.0 +
800 x 600	46.9	75.0	800 x 600	46.9 +	75.0 +
1024 x 768	48.4	60.0	1024 x 768	48.4 -	60.0 -

Note: The "+" and "-" indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor's video recognition circuits utilize the sync polarities to determine which preset mode to display.

Compaq 1024 Monitor		Compaq SVGA Monitor	
Display Resolutions / Refresh Rates (Non-Interlaced)		Display Resolutions / Refresh Rates (Non-Interlaced)	
1024 x 768	60, 70 and 75 Hz	1024 x 768 (Interlaced)	87 Hz
1024 x 768	87 Hz (Interlaced)	800 x 600	60 Hz
800 x 600	60, 72 and 75 Hz	640 x 480	60 Hz
720 x 400 (Text mode)	70Hz	640 x 350	70 Hz
640 x 480	60, 72 and 75 Hz	640 x 200	70 Hz
640 x 350	70 Hz	720 x 400 (Text Mode)	70 Hz
Bandwidth	75 MHz	Bandwidth	50 MHz
Horizontal Frequency (Banded/Continuous)	30 to 60 kHz	Horizontal Frequency	31.5 to 38 kHz
Vertical Frequency	50 to 100 Hz	Vertical Frequency	43 to 60 Hz

Compaq 150/150i Monitor		Compaq 151 FS Monitor	
Display Resolutions / Refresh Rates (All Non-Interlaced)		Display Resolutions / Refresh Rates (All Non-Interlaced)	
1024 x 768	60 Hz	1024 x 768	60, 70, and 75 Hz
800 x 600	60 and 75 Hz	1024 x 768	87 Hz (Interlaced)
720 x 400 (Text mode)	60 Hz	800 x 600	60, 72, and 75 Hz
640 x 480	60 and 75 Hz	720 x 400 (Text mode)	70 Hz
		640 x 480	60, 72, and 75 Hz
		640 x 350	70 Hz
Bandwidth	65 MHz	Bandwidth	75 MHz
Horizontal Frequency	31 to 48 kHz	Horizontal Frequency	30 to 60 kHz
Vertical Frequency	50 to 100 Hz	Vertical Frequency	50 to 100 Hz

Factory Preset Display Modes			Factory Preset Display Modes		
Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.5 +	70.0 -	640 x 350	31.5	70.0
640 x 480	31.5 -	60.0 -	720 x 400	31.5	70.0
640 x 480	37.5 -	75.0 -	640 x 480	31.5	60.0
720 x 400	31.5 -	70.0 +	640 x 480	37.86	72.0
800 x 600	37.8 +	60.0 +	800 x 600	37.88	60.0
800 x 600	46.9 +	75.0 +	800 x 600	48.077	72.0
1024 x 768	48.4 -	60.0 -	1024 x 768	48.363	60.0
			1024 x 768	56.48	70.0
			1024 x 768	60.23	75.0

Compaq P50 Monitor		S500 15" Monitor	
Display Resolution / Refresh Rates (All Non-Interlaced)		Display Resolution / Refresh Rates (All Non-Interlaced)	
1600 x 1200	65 Hz	1024 x 768	60 Hz

1280 x 1024	60 Hz	832 x 624 (Mac mode)	74.5 Hz
1024 x 768	60, 75, and 85 Hz	800 x 600	75 and 85 Hz
800 x 600	60, 70 and 85 Hz	720 x 400 (Text mode)	70 Hz
832 x 624 (Mac Mode)	74.5 Hz	640 x 480	60 and 75 Hz
720 x 400 (Text Mode)	70 Hz		
640 x 480	60 and 75 Hz		
Bandwidth	85 MHz	Pixel Clock Speed	60 MHz
Horizontal Frequency	30 to 69 kHz	Horizontal Frequency	30 kHz to 54 kHz
Vertical Frequency	47.5 to 125 Hz	Vertical Frequency	50 Hz to 120 Hz

Compaq V50 Monitor		Compaq V55 Monitor	
Display Resolution / Refresh Rates (All Non-Interlaced)		Display Resolution / Refresh Rates (All Non-Interlaced)	
1024 x 768	75Hz		
800 x 600	60, 75 and 85 Hz		
720 x 400 (Text mode)	70 Hz		
640 x 480	60, 75, and 85 Hz		
640 x 350	70 Hz		
Video Bandwidth	27 MHz		
Pixel Clock	78.75 MHz		
Horizontal Frequency	31.5 to 60 kHz	Horizontal Frequency	30 to 60 kHz
Vertical Frequency	47.5 to 126 Hz	Vertical Frequency	47.5 to 125 Hz

Factory Preset Display Modes			Factory Preset Display Modes		
Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.5 +	60.0-	640 x 480	31.5	60
640 x 480	31.5 -	60.0-	640 x 480	37.5	75
640 x 480	37.5 -	75.0-	640 x 480	43.3	85
640 x 480	43.3 -	85.0 -	720 x 400	31.5	70
720 x 400	31.5 -	70.0 +	800 x 600	37.8	60
800 x 600	37.8 +	60.0 -	800 x 600	46.9	75
800 x 600	46.9 +	75.0 +	800 x 600	53.7	85
800 x 600	53.7 +	85.0 +	1024 x 768	48.4	60
1024 x 768	48.4 +/-	60.0 +/-	1024 x 768	60	75
1024 x 768	60.0 +	75.0 +			

Note: The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq V500 Monitor		Compaq QVision 150 Monitor	
Display Resolution / Refresh Rates (All Non-Interlaced)		Display Resolution / Refresh Rates (All Non-Interlaced)	
Optimal Resolution Setting	1024 x 768 @ 85 Hz		
640 x 350	60 Hz	512 x 480	60 Hz
640 x 480	60, 75, and 85 Hz	640 x 480	60 Hz
800 x 600	60, 75, and 85 Hz	640 x 480	60, 70, and 75 Hz
720 x 400 (Text mode)	70 Hz	720 x 400 (Text mode)	70 Hz
1024 x 768	60, 75, and 85 Hz	800 x 600	72 Hz
1152 x 864	75 Hz	1024 x 768	72 Hz
1280 x 1024	60 Hz		
1600 x 1200	---		
1800 x 1440	---		
Video Bandwidth	100 MHz	Bandwidth	75 Hz
Pixel Clock Speed	148.5 MHz		
Horizontal Frequency	30 to 70 kHz	Horizontal Frequency	31.5 to 58 kHz
Vertical Frequency	50 to 160 Hz	Vertical Frequency	50 to 100 Hz

Compaq P700 17" Monitor			Compaq P70 Monitor		
Display Resolution / Refresh Rates Maximum/Presets			Display Resolution / Refresh Rates (All Non-Interlaced)		
640 x 350	120 Hz / n/a		640 x 350	70 Hz	
640 x 480	120 Hz / 60 Hz, 85 Hz		640 x 480	60, 75, and 85 Hz	
720 x 400 (Text Mode)	70 Hz Maximum		720 x 400 (Text Mode)	70 Hz	
800 x 600	120 Hz / 85 Hz		800 x 600	60, 75, and 85 Hz	
832 x 624 (Mac Mode)	75 Hz Maximum		832 x 624 (Mac Mode)	74.5 Hz	
1024 x 768	110 Hz / 85 Hz		1024 x 768	60, 75, and 85 Hz	
1152 x 870 (Mac Mode)	75 Hz Maximum		1152 x 870 (Mac Mode)	75 Hz	
1280 x 1024	85 Hz / 60 Hz, 85 Hz		1280 x 1024	60, 75, and 85 Hz	
1600 x 1200	70Hz / 70 Hz		1600 x 1200	65 Hz	
1792 x 1344	n/a				
1800 x 1440	n/a				
1920 x 1440	n/a				
Dual Video Inputs	No		Bandwidth (3dB)	80 MHz	
Max Pixel Clock Speed	189 MHz				
Horizontal Frequency	30 to 92 kHz		Horizontal Frequency	30 to 92 kHz	
Vertical Frequency	50 to 120 Hz		Vertical Frequency	50 to 150 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
			640 x 350	31.47 +	70.09 -
			640 x 480	31.47 +	59.94 -
			640 x 480	37.50 -	75.00 -
			640 x 480	43.27 -	85.01 -
			720 x 400	31.47 -	70.08 +
			800 x 600	37.88 +	60.32 +
			800 x 600	46.88 +	75.00 +
			800 x 600	53.67 +	85.06 +
			832 x 624	49.72 +/-	74.55 +/-
			1024 x 768	48.36 -	60.00 -
			1024 x 768	60.02 +	75.03 +
			1024 x 768	68.68 +	85.00 +
			1152 x 870	68.68 +/-	75.06 +/-
			1280 x 1024	63.98 +	60.02 +
			1280 x 1024	79.98 +	75.02 +
			1280 x 1024	91.15 +	85.02 +
			1600 x 1200	81.25 +	65.00 +

Note: The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq P75 Monitor			Compaq V70 Monitor		
Display Resolution / Refresh Rates			Display Resolution / Refresh Rates (All Non-Interlaced)		
640 x 350	70 Hz		640 x 350	125 Hz, 56 kHz	
640 x 480	60, 75, and 85 Hz		640 x 480	125 Hz, 63 kHz	
720 x 400 (Text Mode)	70 Hz		720 x 400	125 Hz, 55 kHz	
800 x 600	60, 75, and 85 Hz		800 x 600	109 Hz, 69 kHz	
832 x 624 (Mac Mode)	74.5 Hz		1024 x 768	86 Hz, 69 kHz	
1024 x 768	60, 75, and 85 Hz		1152 x 864	76 Hz, 69 kHz	
1280 x 1024	60 and 75 Hz		1280 x 1024	64 Hz, 69 kHz	
1152 x 864 (Mac Mode)	75 Hz				
Input Impedance	75 ohms +/- 2%		Bandwidth	85 MHz	
Pixel Clock Speed	135 MHz				
Horizontal Frequency	30 to 85 kHz		Horizontal Frequency	30 to 69 kHz Continuous (Banded/Continuous)	
Vertical Frequency	50 to 150 Hz		Vertical Frequency	60 to 125 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
			640 x 480		60
			640 x 480		75
			720 x 400		70
			800 x 600		60
			800 x 600		75
			800 x 600		85
			832 x 624		74.5
			1024 x 768		60
			1024 x 768		75
			1024 x 768		85
			1280 x 1024		60

Compaq V75 Monitor			Compaq V700 Monitor		
Display Resolution / Refresh Rates			Display Resolution / Refresh Rates (All Non-Interlaced)		
640 x 480	60 and 75 Hz		640 x 480	60, 75, and 85 Hz	
720 x 400 (Text Mode)	70 Hz		720 x 400	70 Hz	
800 x 600	60, 75, and 85 Hz		800 x 600	75 and 85 Hz	
832 x 624 (Mac Mode)	74.5 Hz		832 x 624 (Mac Mode)	74.5 Hz	
1024 x 768	60, 75, and 85 Hz		1024 x 768	75 and 85 Hz	
1280 x 1024	60 Hz		1152 x 870	75 Hz	
			1280 x 1024	75 Hz	
			1600 x 1200	65 Hz	
Input Impedance	75 ohms +/- 10%		Bandwidth	85 MHz	
Pixel Clock Speed	108 MHz				
Horizontal Frequency	30 to 69 kHz		Horizontal Frequency	30 to 85 kHz	
Vertical Frequency	47.5 to 125 Hz		Vertical Frequency	50 to 160 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
			640 x 480	31.5 -	60.0 -
			640 x 480	37.5 -	75.0 -
			640 x 480	43.3 -	85.0 -
			720 x 400	31.5 -	70.0 +
			800 x 600	46.9 +	75.0 +
			800 x 600	53.7 +	85.0 +
			832 x 624	49.7 -	74.5 -
			1024 x 768	60.0 +	75.0 +
			1024 x 768	68.7 +	84.99 +
			1152 x 870	68.7 -	75.06 -
			1280 x 1024	80.0 +	75.0 +
			1600 x 1200	81.25 +	65.0 +

Note: The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq 171FS Monitor			Compaq QVision 170 Monitor		
Display Resolution / Refresh Rates (All Non-Interlaced)			Display Resolution / Refresh Rates (All Non-Interlaced)		
640 x 350	70 Hz		512 x 480	60 Hz	
640 x 480	60, 72, and 75 Hz		640 x 400	60 Hz	
720 x 400 (Text Mode)	70 Hz		640 x 480	60, 70, and 75 Hz	
800 x 600	60, 72, and 75 Hz		720 x 400 (Text Mode)	70 Hz	
1024 x 768	87 Hz (Interlaced)		800 x 600	72 Hz	
1024 x 768	60, 70, and 75 Hz		1024 x 768	72 Hz	
Bandwidth	75 MHz		Bandwidth	75 MHz	
Horizontal Frequency	30 to 60 kHz		Horizontal Frequency	31.5 to 58 kHz	
Vertical Frequency	50 to 100 Hz		Vertical Frequency	50 to 100 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.5	70			
640 x 480	31.5	60			
640 x 480	37.86	72			
640 x 480	45	75			
720 x 400	31.5	70			
800 x 600	37.88	60			
800 x 600	48.077	72			
800 x 600	46.8	75			
800 x 600	54	75			
1024 x 768/i	35.5	87			
1024 x 768	48.363	60			
1024 x 768	56.48	70			
1024 x 768	57.5	72			
1024 x 768	60.023	75			

Compaq QVision 172 Monitor			Compaq S700 Monitor		
Display Resolution / Refresh Rates (All Non-Interlaced)			Display Resolution / Refresh Rates (All Non-Interlaced)		
640 x 350	70 Hz		640 x 350	85 Hz	
640 x 480	60 and 72 Hz		640 x 480	60, 75, and 85 Hz	
720 x 400 (Text Mode)	70 Hz		720 x 400	85 Hz	
800 x 600	60, 72, and 75 Hz		800 x 600	60, 75, and 85 Hz	
1024 x 768	60, 70, 75, and 76 Hz		832 x 624 (Mac Mode)	74.5 Hz	
1280 x 1024	75 Hz		1024 x 768	60, 75, and 85 Hz	
			1280 x 1024	60 Hz Maximum	
			Scan Frequency	30 to 70 KHz	
Bandwidth	120 MHz		Bandwidth	85 MHz	
Horizontal Frequency	31.5 to 82 kHz		Horizontal Frequency	30 to 69 kHz	
Vertical Frequency	50 to 110 Hz		Vertical Frequency	50 to 160 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
V1024 x 768	56.5 -	70.0 -	640 x 350	37.86 +	85.08 -
640 x 350	31.5 +	70.0 -	640 x 480	31.47 -	59.94 -
720 x 400	31.5 -	70.0 +	640 x 480	37.50 -	75.00 -
640 x 480	31.5 -	60.0 -	640 x 480	43.27 -	85.01 -
640 x 480	5.0 -	75.0 - *	720 x 400	37.93 -	85.04 +
512 x 480	45.0 +	75.0 - *	800 x 600	37.88 +	60.32 +
640 x 400	45.0 -	89.0 +	800 x 600	46.88 +	75.00 +
800 x 600	54.0 +	75.4 +	800 x 600	53.67 +	85.06 +
800 x 600	47.6 +	75.3 +	832 x 624	49.72 -	74.55 -
1024 x 768	57.5 +	72.0 +	1024 x 768	48.36 +/-	60.00 +/-
1024 x 768	61.0 +	76.0 +	1024 x 768	60.02 +	75.03 +
1024 x 768	81.0 +	76.0 +	1024 x 768	68.68 +	85.00 +
			1280 x 1024	63.98 +	60.02 +

Note: *The monitor will treat these two modes as the same pre-set mode. All adjustments made to one mode will affect the other mode.

The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq P900 19" Monitor		Compaq S900 Monitor			
Maximum / Preset Display Resolution / Refresh Rates		Display Resolution / Refresh Rates (Non-Interlaced)			
640 x 350	120 Hz / n/a	1600 x 1200 pixel	Non-interlaced maximum		
640 x 480	120 Hz / 85 Hz				
720 x 400 (Text Mode)	70 Hz				
800 x 600	120 Hz / 85 Hz				
832 x 624 (Mac Mode)	75 Hz				
1024 x 768	120 Hz / 85 Hz				
1152 x 870 (Mac Mode)	75 Hz				
1280 x 1024	100 Hz / 85 Hz				
1600 x 1200	85 Hz / 85 Hz				
1792 x 1344	75 Hz / 75 Hz				
1800 x 1440	70 Hz / n/a				
1920 x 1440	70 Hz / 60 Hz				
Pixel Clock Speed	261 MHz	Pixel Clock Speed			
Maximum Horizontal Frequency	107 kHz for preset modes	Bandwidth	150 MHz		
Horizontal Frequency	30 to 107 kHz	Horizontal Frequency	30 to 95 kHz automatically		
Vertical Frequency	50 to 120 Hz	Vertical Frequency	50 to 160 Hz automatically		
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
			640 x 350	37.86 +	85.08 -
			640 x 480	31.47 -	59.94 -
			640 x 480	37.50 -	75.00 -
			640 x 480	43.27 -	85.01 -
			720 x 400	37.93 -	85.04 +
			800 x 600	46.88 +	75.00 +
			800 x 600	53.67 +	85.06 +
			832 x 624	49.72 -	74.55 -
			1024 x 768	60.02 +	75.03 +
			1024 x 768	68.68 +	85.00 +
			1152 x 870	68.68 +	75.06 +
			1280 x 1024	79.98 +	75.02 +
			1280 x 1024	91.15 +	85.02 +
			1600 x 1200	75.00 +	60.00 +
			1600 x 1200	93.75 +	75.00 +

Note: The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq V90 Monitor			Compaq V900 Monitor		
Display Resolution / Refresh Rates (All Non-Interlaced)			Display Resolution / Refresh Rates		
640 x 350	70 and 85 Hz		640 x 480	60, 75, and 85 Hz	
640 x 480	60, 75, and 85 Hz		720 x 400 (Text Mode)	70 and 85 Hz	
720 x 400 (Text Mode)	70 and 85 Hz		800 x 600	60, 75, and 85 Hz	
800 x 600	60, 75, and 85 Hz		832 x 624 (Mac Mode)	75 and 85 Hz	
832 x 624 (Mac Mode)	74.5 Hz		1024 x 768	60, 75, and 85 Hz	
1024 x 768	60, 75, and 85 Hz		1152 x 870 (Mac Mode)	75 and 85 Hz	
1152 x 870	75 Hz		1280 x 1024	60, 75, and 85 Hz	
1280 x 1024	60, 75, and 85 Hz		1600 x 1200	60 and 75 Hz	
1600 x 1200	60 and 75 Hz				
			Max Pixel Clock Speed	202.5 MHz	
Bandwidth	150 MHz (typical)		Bandwidth	150 MHz	
Horizontal Frequency	30 to 94 kHz Continuous		Horizontal Frequency	30 to 96 kHz	
Vertical Frequency	48 to 160 Hz		Vertical Frequency	48 to 160 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.5 +	70.0 -	640 x 350	31.47 +	70.09 -
640 x 350	37.9 +	85.0 -	640 x 350	37.86 +	85.08 -
640 x 480	31.5 -	60.0 -	640 x 480	31.47 -	59.94 -
640 x 480	37.5 -	75.0 -	640 x 480	37.50 -	75.00 -
640 x 480	43.3 -	85.0 -	640 x 480	43.27 -	85.01 -
720 x 400	31.5 -	70.0 +	720 x 400	31.47 -	70.08 +
720 x 400	37.9 -	85.0 +	720 x 400	37.93 -	85.04 +
800 x 600	37.8 +	60.0 +	800 x 600	37.88 -	60.32 +
800 x 600	46.9 +	75.0 +	800 x 600	46.88 +	75.00 +
800 x 600	53.7 +	85.0 +	800 x 600	53.67 +	85.06 +
832 x 624	49.7 -	74.5 -	832 x 624	49.72 -	74.55 -
1024 x 768	48.4 -	60.0 -	1024 x 768	48.36 +/-	60.00 +/-
1024 x 768	60.0 +	75.0 +	1024 x 768	60.02 +	75.03 +
1024 x 768	68.7 +	85.0 +	1024 x 768	68.68 +	85.00 +
1152 x 870	68.7 +/-	75.0 +/-	1152 x 870	68.68 +	75.06 +
1280 x 1024	63.9 +	60.0 +	1280 x 1024	63.98 +	60.02 +
1280 x 1024	80 +	75.0 +	1280 x 1024	79.98 +	75.02 +
1280 x 1024	91.1 +	85.0 +	1280 x 1024	91.15 +	85.02 +
1600 x 1200	75.0 +	60.0 +	1600 x 1200	75.00 +	60.00 +

1600 x 1200	93.8 +	75.0 +	1600 x 1200	93.75 +	75.00 +
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Note: The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq P110 Monitor			Compaq P1100 21" Monitor		
Display Resolution / Refresh Rates (All Non-Interlaced)			Display Resolution / Refresh Rates Maximum/Preset		
640 x 350	70 and 85 Hz		640 x 350	160 Hz / n/a	
640 x 480	60, 75, and 85 Hz		640 x 480	160 Hz / 60, 85 Hz	
720 x 400 (Text Mode)	70 and 85 Hz		720 x 400 (Text Mode)	70 Hz	
800 x 600	60, 75, and 85 Hz		800 x 600	160 Hz / 75, 85 Hz	
832 x 624 (Mac Mode)	75 Hz		832 x 624 (Mac Mode)	75 Hz	
1024 x 768	60, 75, and 85 Hz		1024 x 768	140 Hz / 75, 85 Hz	
1152 x 870	75 Hz		1152 x 870 (Mac Mode)	75 Hz	
1280 x 1024	60, 75, and 85 Hz		1280 x 1024	110 Hz / 60, 75, 85 Hz	
1600 x 1200	60, 75, and 85 Hz		1600 x 1200	95 Hz / 70, 85 Hz	
1800 x 1440	60 Hz		1792 x 1344	85 Hz / 60, 75 Hz	
			1800 x 1440	75 Hz / n/a	
			1920 x 1440	75 Hz / 60, 75 Hz	
Bandwidth	150 MHz		Max Pixel Clock Speed	297 MHz	
Horizontal Frequency	31 to 107 kHz Continuous		Horizontal Frequency	30 to 121 kHz	
Vertical Frequency	60 to 160 Hz		Vertical Frequency	50 to 160 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.5 +	70.0 -			
640 x 350	37.9 +	85.0 -			
640 x 480	31.5 -	60.0 -			
640 x 480	37.5 -	75.0 -			
640 x 480	43.3 -	85.0 -			
720 x 400	31.5 -	70.0 +			
720 x 400	37.9 -	85.0 +			
800 x 600	37.8 +	60.0 +			
800 x 600	46.9 +	75.0 +			
800 x 600	53.7 +	85.0 +			
832 x 624	49.7 +/-	75.0 +/-			
1024 x 768	48.4 -	60.0 -			
1024 x 768	60.0 +	75.0 +			
1024 x 768	68.7 +	85.0 +			
1152 x 870	68.7 +/-	75.0 +/-			
1280 x 1024	63.9 +	60.0 +			
1280 x 1024	79.9 +	75.0 +			

1280 x 1024	91.2 +	85.0 +
1600 x 1200	75.0 +	60.0 +
1600 x 1200	93.8 +	75.0 +
1600 x 1200	106.3 +	85.0 +
1800 x 1440	89.5 +	60.0 +

Note: The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq P1610 Monitor			Compaq V1000 Monitor		
Display Resolution / Refresh Rates (All Non-Interlaced)			Display Resolution / Refresh Rates		
640 x 480	60 Hz		640 x 350	70 and 85 Hz	
720 x 400 (Text Mode)	70 Hz		640 x 480	60, 75, and 85 Hz	
1024 x 768	85 Hz		800 x 600	60, 75, and 85 Hz	
1280 x 1024	75, and 85 Hz		1024 x 768	60, 75, and 85 Hz	
1600 x 1200	75 Hz		1280 x 1024	60, 75, and 85 Hz	
1920 x 1035	60 Hz (interlaced HDVT)		1600 x 1200	60, 75, and 85 Hz	
1920 x 1080	60 and 72 Hz		1800 x 1440	60 Hz	
1920 x 1200	76 Hz				
			Max Pixel Clock Speed	202.5 MHz	
Bandwidth	170 MHz		Bandwidth	150 MHz	
Horizontal Frequency	30 to 96 kHz Continuous		Horizontal Frequency	30 to 107 kHz	
Vertical Frequency	48 to 160 Hz		Vertical Frequency	50 to 160 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 480	31.5 -	60.0 -	640 x 350	31.47 +	70.09 -
720 x 400	31.5 -	70.0 +	640 x 350	37.86 +	85.08 -
1024 x 768	68.7 +	85.0 +	640 x 480	31.47 -	59.94 -
1280 x 1024	80 +	75.0 +	640 x 480	37.50 -	75.00 -
1280 x 1024	91.2 +	85.0 +	640 x 480	43.27 -	85.01 -
1600 x 1200	93.8 +	75.0 +	720 x 400	31.47 -	70.08 +
1920 x 1035	33.8 -	60.0 - (interlaced)	720 x 400	37.93 -	85.04 +
1920 x 1080	67.5 -	60.0 -	800 x 600	37.88 -	60.32 +
1920 x 1080	84.4 -	72.0 -	800 x 600	46.88 +	75.00 +
1920 x 1200	95.0 -	76.0 -	800 x 600	53.67 +	85.06 +

	832 x 624	49.72 +/-	74.55 +/-
	1024 x 768	48.36 -	60.00 -
	1024 x 768	60.02 +	75.03 +
	1024 x 768	68.68 +	85.00 +
	1152 x 870	68.68 +/-	75.06 +/-
	1280 x 1024	63.98 +	60.02 +
	1280 x 1024	79.98 +	75.02 +
	1280 x 1024	91.15 +	85.02 +
	1600 x 1200	75.00 +	60.00 +
	1600 x 1200	93.75 +	75.00 +
	1600 x 1200	106.25 +	85.00 +
	1800 x 1440	89.46 +	60.04 +

Note: The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq QVision 200 Monitor		Compaq QVision 210 Monitor	
Display Resolution / Refresh Rates (All Non-Interlaced)		Display Resolution / Refresh Rates (All Non-Interlaced)	
640 x 350	70 Hz	640 x 350	70 Hz
640 x 480	72.9 and 60 Hz	640 x 480	60 and 75 Hz
720 x 400 (Text Mode)	70 Hz	720 x 400 (Text Mode)	70 Hz
800 x 600	60, 72, and 75 Hz	800 x 600	72 and 75 Hz
1024 x 768	60, 70, 75, and 76 Hz	1024 x 768	60, 70, 72, and 75 Hz
1280 x 1024	79.9 Hz	1280 x 1024	60, 75, and 85 Hz
		1600 x 1200	60, 70, 75 Hz
		1792 x 1344	85 Hz / 60, 75 Hz
		1800 x 1440	75 Hz / n/a
		1920 x 1440	75 Hz / 60, 75 Hz
Bandwidth	150 MHz	Bandwidth	100 MHz
Horizontal Frequency (Banded/Continuous)	30 to 82 kHz Continuous	Horizontal Frequency (Banded/Continuous)	31 to 94 kHz Continuous
Vertical Frequency	50 to 160 Hz	Vertical Frequency	48 to 160 Hz

Factory Preset Display Modes			Factory Preset Display Modes		
Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.5 +	70.0 -	640 x 350	31.50 +	70.00 -
640 x 480	31.5 -	60.0 -	640 x 480	31.50 -	60.00 -
640 x 480	37.86 -	72.9 -	640 x 480	37.50 -	75.00 -

720 x 400	31.5 -	70.0 +	720 x 400	31.50 -	70.00 +
800 x 600	37.88 +	60.0 +	800 x 600	46.88 +	75.00 +
800 x 600	48.077 +	72.0 +	800 x 600	48.08 +	72.19 +
800 x 600	54.0 +	75.4 +	1024 x 768	48.36	60.00
1024 x 768	56.5 -	70.0 -	1024 x 768	56.48	70.07
1024 x 768	48.363 -	60.0 -	1024 x 768	57.52 +	71.89 +
1024 x 768	60.023 +	75.0 +	1024 x 768	60.02 +	75.03 +
1024 x 768	61.9 +	76.0 +	1280 x 1024	63.98 +	60.02 +
1280 x 1024	79.976 +	75.025 +	1280 x 1024	79.98 +	75.02 +
			1280 x 1024	91.15 +	85.02 +
			1600 x 1200	75.00 +	60.00 +
			1600 x 1200	87.50 +	70.00 +
			1600 x 1200	93.75 +	75.00 +

Note: The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq TFT 450 Flat Panel Monitor			Compaq TFT450R Flat Panel Monitor		
Display Resolution / Refresh Rates			Display Resolution / Refresh Rates		
1024 x 768	75 Hz		1024 x 768	75 Hz	
Bandwidth	80 MHz		Bandwidth	80 MHz	
Horizontal Frequency	31.5 to 60 kHz		Horizontal Frequency	31.5 to 60 kHz	
Vertical Frequency	56.3 to 85 Hz		Vertical Frequency	56.3 to 85 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.5 +	70.1 -	640 x 350		70
640 x 480	31.5 -	60.0 -	640 x 480		60
640 x 480	37.5 -	75.0 -	640 x 480		70
640 x 480	43.3 -	85.0 -	640 x 480		75
720 x 400	31.5 -	70.1 +	800 x 600		60
800 x 600	37.8 +	60.0 +	800 x 600		70
800 x 600	46.9 +	75.0 +	800 x 600		75
800 x 600	53.7 +	85.0 +	1024 x 768		60
832 x 624 *	49.7 -	74.6 -	1024 x 768		70
1024 x 768	48.4 -	60.0 -	1024 x 768		75
1024 x 768	56.5 -	70.0 -			
1024 x 768	60.0 +	75.0 +			

Note: * Macintosh compatible.

The “+” and “-“ indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Compaq TFT500 Flat Panel Monitor			Compaq TFT5000 Flat Panel Monitor		
Display Resolution / Refresh Rates			Display Resolution / Refresh Rates		
1024 x 768	75 Hz				
Bandwidth	175 MHz				
Horizontal Frequency	31.5 to 60 kHz		Horizontal Frequency	32 to 60 kHz	
Vertical Frequency	56.3 to 85 Hz		Vertical Frequency	57 to 85 Hz	
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.5	70.1	640 x 350	31.5	70
640 x 480	31.5	60.0	640 x 480	31.5	60
640 x 480	37.5	75.0	640 x 480	37.5	75
640 x 480	43.3	85.0	640 x 480	43.3	85
720 x 400	31.5	70.0	720 x 400	31.5	70
800 x 600	37.8	60.0	800 x 600	37.9	60
800 x 600	46.9	75.0	800 x 600	46.9	75
800 x 600	53.7	85.0	800 x 600	53.7	85
832 x 764*	49.7	75.0	832 x 624 *	49.7	75
1024 x 768	48.4	60.0	1024 x 768	48.4	60
1024 x 768	56.5	70.0	1024 x 768	56.5	70
1024 x 768	60.0	75.0	1024 x 768	60	75

Note: * Macintosh compatible.

Compaq TFT5000S Flat Panel Monitor			Compaq TFT5000R Flat Panel Monitor		
Display Resolution / Refresh Rates			Display Resolution / Refresh Rates		
1024 x 768		75 Hz			
			Pixel Clock Speed		80 MHz
Horizontal Frequency		32 to 60 kHz	Horizontal Frequency		31.47 to 60 kHz
Vertical Frequency		57 to 85 Hz			
Factory Preset Display Modes			Factory Preset Display Modes		
Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)	Resolution	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
			640 x 350		70
			640 x 480		60
			640 x 480		75
			640 x 480		80
			720 x 400		70
			800 x 600		60
			800 x 600		75
			800 x 600		85
			832 x 764		75
			1024 x 768		60
			1024 x 768		70
			1024 x 768		75

Compaq TFT 8000 Flat Panel Monitor

Display Resolution / Refresh Rates

640 x 350	70 Hz
640 x 480	60, 75, and 85 Hz
720 x 400 (Text Mode)	70 Hz
800 x 600	60, 75, and 85 Hz
832 x 624 (Mac Mode)	74.5 Hz
1280 x 1024	60 and 75 Hz
Max Pixel Clock Speed	135.0 MHz
Horizontal Frequency	31.5 to 80.0 kHz
Vertical Frequency	60 to 85 Hz

Factory Preset Display Modes

Resolution (Pixel Format)	Horizontal Sync Rate (kHz)	Vertical Sync Rate (Hz)
640 x 350	31.47 +	70.09 -
640 x 480	31.47 -	59.94 -
640 x 480	37.50 -	75.00 -
640 x 480	43.27 -	85.01 -
720 x 400	31.47 -	70.08 +
800 x 600	37.88 -	60.32 +
800 x 600	46.88 +	75.00 +
800 x 600	53.67 +	85.06 +
832 x 624	49.72 +/-	74.55 +/-
1024 x 768	48.36 -	60.00 -
1024 x 768	60.02 -	75.03 -
1024 x 768	68.68 +	85.00 +
1152 x 870	68.68 +/-	75.06 +/-
1152 x 900	61.80 +/-	65.96 +/-
1280 x 1024	63.98 +	60.02 +
1280 x 1024	79.98 +	75.02 +

Note: The “+” and “-” indicators are the polarities of the vertical and horizontal sync signals coming from the PC video controller. The monitor’s video recognition circuits utilize sync polarities to determine which preset mode to display.

Appendix C

Compaq SMART-2 Array Controller Configuration on 2.0.36 Kernel

If a *Compaq SMART-2 Array* controller is used, it must be set up during the *SmartStart* portion of the Linux installation using the following steps:

1. Be certain the System Configuration utility identifies the operating system as Unixware 7 on *ProLiant* server setups if you intend to use the array controller as a boot device. Some issues have arisen with the interrupt settings if other operating systems are configured for a Linux installation that boots from a *Compaq Array* controller. The operating system selection affects how the *Compaq Array Configuration Utility* sets up an array. Since the operating system selection is not a part of the *Prosignia* server configuration, this portion of the setup can be safely ignored.
2. When exiting the System Configuration utility, *SmartStart* will automatically invoke the *Compaq Array Configuration Utility* after the initial setup. Follow the instructions included in the utility to build a RAID-0, RAID-1, RAID-4 or RAID-5 array set and to create logical drives as desired. Be sure to save the configuration before rebooting. A wizard button will be at the end of the wizard-based configuration process and it allows you to save the configuration. Alternatively, you may select File...Save in the *Array Configuration Utility*, which is launched after completing the configuration through the wizard. When complete, exit from the utility.
3. The system will reboot to configure the hardware and install the system partition.
4. When completed, you will be prompted to either save the configuration and reboot, or to view or edit details. If you plan to boot from a *SMART-2 Array* controller, choose to view or edit details and scroll down to where the array controller appears in the hardware list. Be certain that the array controller's boot order is set first. A problem can arise if there are no bootable SCSI devices attached to one of the SCSI controllers on the Compaq server. Even though a bootable partition exists, connected to the array controller, bootstrapping will die if the SCSI controllers are set to boot before being connected to a bootable device (such as a disk drive).

SuSE 6.1 and Red Hat 6.0 support installation to the *Compaq RAID* controller; the following information does not apply to these distributions. Caldera and TurboLinux currently do not support installation to *RAID* devices (they look like `/dev/ida/c0d0p1`), for these distributions it is necessary to install the initial system to a SCSI device and move it to *RAID* after the fact. Since the driver is currently considered beta, this guide does not provide the details to do this, but an overview for advanced users is provided.

First, a custom kernel must be built to include *RAID* support. To do this, follow these steps:

1. Obtain the driver from <http://www.insync.net/~frantzc/cpqarray.html>. Follow the instructions in the README file included with the *Smart2* driver to patch the kernel.
2. Configure and build the custom kernel (be sure to include appropriate SCSI support as well since Linux will be copied from the SCSI partition to the *RAID* partition).
3. Once the custom kernel is correctly built, a LILO entry must be created for it. This LILO entry should still boot to the SCSI partition.
4. After the *RAID* custom kernel is successfully booted, you should patch and rebuild LILO.

5. Execute the *mkdev.ida* script to construct the *RAID* block devices.
6. Run *fdisk* to configure the *RAID* partitions (a pointer to a patch for *fdisk* is included in the information for the device driver – this patch is useful but not necessary). Be sure to run *fdisk* for the appropriate device explicitly. For instance, to run *fdisk* for the first array attached to the array controller, run


```
[root@cpqlnx lnxusr]# fdisk /dev/ida/c0d0
```
7. Create appropriate partitions.
8. Write these partitions to the partition table.
9. Exit *fdisk*.
10. Sync the system.
11. Reboot into the same custom kernel.

Note: Even if it is not necessary to reboot the system, it is recommended you reboot since it is the safest way to ensure that all partition tables are properly updated.

12. After rebooting, you can format the partition using *mk2efs*. For the first partition on the first array, do the following:

```
[root@cpqlnx lnxusr]# mke2fs /dev/ida/c0d0p1
```

Subsequent partitions take the form */dev/ida/c0d0p2*, and so forth. Separate arrays might have the form */dev/ida/c0d1* or */dev/ida/c1d0*, and they will include their respective partitions as created with *fdisk*. For additional parameters that can be used with *mke2fs*, consult the appropriate man pages.

Once a partition is formatted, it can be set up to boot Linux. First, the Linux system must be archive-copied to the array controller device. The easiest thing to do is to copy the entire system from the root to a single partition controlled by the array controller. Since it is necessary to mount the array controller device to do this, it is useful to do archive copies of each directory subordinate to the root individually:

```
[root@cpqlnx lnxusr]# mkdir /array
[root@cpqlnx lnxusr]# mount -t ext2 /dev/ida/c0d0p1 /array
[root@cpqlnx lnxusr]# cp -a /root /array
[root@cpqlnx lnxusr]# cp -a /etc /array
[root@cpqlnx lnxusr]# cp -a /usr /array
```

... for the remaining directories

Next, edit the */etc/fstab* file that has been copied to the array controller (that is, */array/etc/fstab*) so that the swap space (which can also be manually configured on the array controller using *mkswap*) and file systems are mounted appropriately. Finally, add a LILO entry for the array controller in */etc/lilo.conf*, build and install the patched version of LILO that is array-controller-aware, and run the new version of LILO. Assuming the patched LILO is installed in */sbin*,

```
[root@cpqlnx lnxusr]# /sbin/lilo
Added Linux *
Added Array
Added F10
```

Provided all preceding steps were performed properly, you can now boot into the new array partition.

There are other ways to use *RAID* without booting to it. For example, HTML data files can be moved to a *RAID* partition that has been mounted in an appropriate portion of the file system. Those procedures are beyond the scope of this Solution Guide.

Glossary

A

Availability - Refers to the amount of time that an application is available to perform work, typically measured in percentage of uptime.

Array Controllers – Add-on options for the *ProLiant* servers.

B

Bootstrap – The act of passing control over a computer to an operating system following system power-up.

C

CPU – Central Processing Unit

D

E

E-Commerce – Electronic Commerce

F

G

GB – Gigabytes

H

I

IDE – Integrated Development Environment

IP – Internet Protocol – The part of TCP/IP Protocol set that provides the routing mechanism.

J

K

L

LILO – Linux Loader

LISA – The setup and configuration utility provided by Caldera Systems for their Linux distribution.

M

Man pages - Manual pages

MIB – Management Information Base – Set of monitored items that management application and management agents use to monitor, analyze, and control the operation of managed devices.

MB - Megabytes

N

NIC – Network Interface Card

O

P

Q

R

RAID – Redundant Array of Independent Disks

S

System Partition – The name of the bootable partition used to configure *Compaq ProLiant* servers.

Switch – A switch is a network device that selects a path or circuit for sending a unit of data to its next destination.

T

TCP/IP – Protocol that manages the transmission of packets on a network and checks for errors.

U

URL – Universal Resource Locator – the name of a specific resource on the Internet.

V**W****XYZ**

YaST – The setup and configuration utility provided by S.u.S.E. for their Linux distribution.
