NAME

INSTALL – Installation procedure for NetBSD/i386.

CONTENTS

About this Document....2
Quick install notes for the impatient....2
What is NetBSD?....3
Upgrade path to NetBSD 1.6....3
Changes Between The NetBSD 1.5 and 1.6 Releases....3
Kernel....4
Networking....4
File system....5
Security....5
System administration and user tools....5
Miscellaneous....6
i386 specific....7
The Future of NetBSD....7
Sources of NetBSD....8
NetBSD 1.6.1 Release Contents....8
NetBSD/i386 subdirectory structure....9
Binary distribution sets....10
NetBSD/i386 System Requirements and Supported Devices....11
Supported devices....12
Floppy controllers....12
MFM, ESDI, IDE, and RLL hard disk controllers....12
SCSI host adapters....12
MDA, CGA, VGA, SVGA, and HGC Display Adapters....13
Serial ports....13
Parallel ports....13
Ethernet adapters....13
FDDI adapters....15
Token-Ring adapters....15
Wireless network adapters....15
High Speed Serial....15
Tape drives....15
CD-ROM drives....16
Mice....16
Sound Cards....16
Game Ports (Joysticks)....16
Miscellaneous....16
PCMCIA Controllers....17
RAID Controllers....17
Specific driver footnotes:....17
Unsupported devices....17
Required configurations....18
Getting the NetBSD System on to Useful Media....21
Preparing your System for NetBSD installation....23
Installing the NetBSD System....24
Running the sysinst installation program....24

Introduction.....24
Possible PCMCIA issues.....24
General.....26
Quick install.....26
Booting NetBSD.....27
Network configuration.....28
Installation drive selection and parameters.....28
Partitioning the disk.....28
Preparing your hard disk.....29
Getting the distribution sets.....30
Installation using ftp.....30
Installation using NFS.....30
Installation from CD-ROM.....31
Installation from a floppy set.....31
Installation from an unmounted file system.....31
Installation from a local directory.....31
Extracting the distribution sets.....31
Finalizing your installation.....31
Post installation steps.....31
Upgrading a previously-installed NetBSD System.....34
Compatibility Issues With Previous NetBSD Releases.....35
Issues affecting an upgrade from NetBSD 1.5 35
Issues affecting an upgrade from NetBSD 1.4 or prior 36
Using online NetBSD documentation.....36
Administrivia.....37
Thanks go to.....37
We are.....40
Legal Mumbo-Jumbo.....45
The End.....47

DESCRIPTION

About this Document

This document describes the installation procedure for NetBSD 1.6.1 on the *i386* platform. It is available in four different formats titled `INSTALL.`*`ext`*, where `.`*`ext`* is one of `.ps`, `.html`, `.more`, or `.txt`:

`.ps` PostScript.

`.html` Standard Internet HTML.

`.more` The enhanced text format used on UNIX-like systems by the `more`(1) and `less`(1) pager utility programs. This is the format in which the on-line *man* pages are generally presented.

`.txt` Plain old ASCII.

You are reading the *PostScript* version.

Quick install notes for the impatient

This section contains some brief notes describing what you need to install NetBSD 1.6.1 on a machine of the i386 architecture.

- Fetch the appropriate pair of boot floppy images from the `installation/floppy/` directory. Most people will need the `boot1.fs` and `boot2.fs` images, or possibly (but not necessarily) `bootlap1.fs` and `bootlap2.fs` if installing on a laptop.
- The actual binary distribution is in the `binary/sets/` directory. When you boot the install floppies, the installation program can fetch these files for you (using e.g. ftp), if you have a network connection. There are several other methods to get the binary sets onto your machine.

  You will at a minimum need one of the kernel sets, typically `kern-GENERIC.tgz`, as well as `base.tgz` and `etc.tgz`. In a typical workstation installation you will probably want all the installation sets.

- Write the floppy images directly to a pair of floppies. If you have problems writing a raw image to a floppy, the **`rawrite.exe`** MS-DOS program or the **`Rawrite32.exe`** Windows32 program (inside `rawrite32.zip`) in the `utilities/` directory may be of help.

  The disk(s) you just prepared will be used to boot the installation kernel, which contains all the tools required to install NetBSD.

- For third-party programs which are not part of the base NetBSD distribution, you will want to explore the **`pkgsrc`** system with its more than 3000 program packages.

What is NetBSD?

The NetBSD Operating System is a fully functional Open Source UNIX-like operating system derived from the University of California, Berkeley Networking Release 2 (Net/2), 4.4BSD-Lite, and 4.4BSD-Lite2 sources. NetBSD runs on fifty three different system architectures (ports), featuring seventeen machine architectures across eleven distinct CPU families, and is being ported to more. The NetBSD 1.6.1 release contains complete binary releases for thirty eight different system architectures. (The fifteen remaining are not fully supported at this time and are thus not part of the binary distribution. For information on them, please see the NetBSD web site at **http://www.netbsd.org/**.)

NetBSD is a completely integrated system. In addition to its highly portable, high performance kernel, NetBSD features a complete set of user utilities, compilers for several languages, the X Window System, firewall software and numerous other tools, all accompanied by full source code.

NetBSD is a creation of the members of the Internet community. Without the unique cooperation and coordination the net makes possible, it's likely that NetBSD wouldn't exist.

Upgrade path to NetBSD 1.6

If you are not installing your system ''from scratch'' but instead are going to upgrade an existing system already running NetBSD you need to know which versions you can upgrade with NetBSD 1.6.

NetBSD 1.6 is an upgrade of NetBSD 1.5.3 and earlier major and patch releases of NetBSD.

The intermediate development versions of code available on the main trunk in our CVS repository (also known as ''NetBSD-current'') from *after* the point where the release cycle for 1.6 was started are designated by version identifiers such as 1.6A, 1.6B, etc. These identifiers do not designate releases, but indicate major changes in internal kernel APIs. Note that the kernel from NetBSD 1.6 can *not* be used to upgrade a system running one of those intermediate development versions. Trying to use the NetBSD 1.6 kernel on such a system *will* probably result in problems.

Please also note that it is not possible to do a direct ''version'' comparison between any of the intermediate development versions mentioned above and 1.6 to determine if a given feature is present or absent in 1.6. The development of 1.6 and the subsequent ''point'' releases is done on a separate branch in the CVS repository. The branch was created when the release cycle for 1.6 was started, and during the release cycle of 1.6

and its patch releases selected fixes and enhancements have been imported from the main development trunk.

Changes Between The NetBSD 1.5 and 1.6 Releases

The NetBSD 1.6 release provides numerous significant functional enhancements, including support for many new devices, integration of hundreds of bug fixes, new and updated kernel subsystems, and many user-land enhancements. The result of these improvements is a stable operating system fit for production use that rivals most commercially available systems.

It is impossible to completely summarize over eighteen months of development that went into the NetBSD 1.6.1 release. Some highlights include:

Kernel

- Ports to new platforms including: algor, dreamcast, evbarm, hpcarm, hpcsh, newsmips, sandpoint, sgimips, sun2, and walnut.
- Unified Buffer Cache (UBC) removes size restriction of the file system's buffer cache to use all available RAM (if not otherwise used!) and improves overall system performance.
- Round-robin page colouring implemented for various ports for better cache utilisation, more deterministic run-time behaviour, and faster program execution.
- A rewritten SCSI middle layer to provide a cleaner interface between the different kernel layers, including a kernel thread to handle error recovery outside of the interrupt context. See `scsipi`(9).
- A new pipe implementation with significantly higher performance due to lower overheads, which uses the UVM Page Loan facility.
- New boot loader flags **`-v`** (*bootverbose*) and **`-q`** (*bootquiet*), to be used by kernel code to optionally print information during boot.
- An in-kernel boot time device configuration manager `userconf`(4), activated with the **`-c`** boot loader flag.
- A work-in-progress snapshot of ACPI support, based on the 20010831 snapshot of the Intel ACPICA reference implementation.
- USB 2.0 support, in the form of a preliminary driver for the `ehci`(4) host controller.
- Basic kernel support for IrDA in the form of the `irframe`(4) IrDA frame level driver. Serial dongles and the `oboe`(4) driver are currently supported.
- Kernel configuration files can be embedded into the kernel for later retrieval. Refer to `INCLUDE_CONFIG_FILE` in `options`(4) for more information.
- Many more kernel tunable variables added to `sysctl`(8).
- Linux binary emulation has been greatly improved, and now supports Linux kernel version 2.4.18.

Networking

- Hardware assisted IPv4 TCP and UDP checksumming and caching of the IPv6 TCP pseudo header. Support for checksum offloading on the DP83820 Gigabit Ethernet, 3Com 3c90xB, 3Com 3c90xC, and Alteon Tigon/Tigon2 Gigabit Ethernet cards.
- Zero-Copy for TCP and UDP transmit path achieved through page loaning code for **`sosend`**().
- In-kernel ISDN support, from the ISDN4BSD project.

- 802.1Q VLAN (virtual LAN) support. See `vlan`(4).
- IPFilter now supports IPv6 filtering.
- `ndbootd`(8) added; used to netboot NetBSD/sun2 machines.
- `racoon`(8) added; IKE key management daemon for IPsec key negotiation, from the KAME project.
- WEP encryption supported in `ifconfig`(8) and `awi`(4) driver.
- `wi`(4) and `wiconfig`(8) now support scanning for access points, and defaults to BSS instead of ad-hoc mode.
- Bridging support; currently only for ethernet. See `bridge`(4).
- In-kernel PPP over Ethernet (PPPoE) - RFC 2516, with much lower overhead than user-land PPPoE clients. See `pppoe`(4).
- `ifwatchd`(8) added; invokes up-script and down-script when a network interface goes up and down. Used by `pppoe`(4).

File system

- Enhanced stability of LFS version 2, the BSD log-structured file system.
- `dump`(8), `dumpfs`(8), `fsck_ffs`(8), `fsirand`(8), `newfs`(8), and `tunefs`(8) support a **`-F`** option to manipulate file system images in regular files.
- `makefs`(8) added; creates file system images from a directory tree. (Currently ffs only.)
- Enhanced **`ffs_dirpref`**( ) by Grigoriy Orlov, which noticeably improves performance on FFS file systems when creating directories, and subsequently manipulating them.
- Fixes for free block tracking and directory block allocation in FFS softdeps.
- Correctly support FFS file systems with a large number of cylinder groups.
- Fix the endian independant FFS (FFS_EI) support.
- `newfs`(8) calculates default block size from the file system size, and uses the largest possible cylinders/group (cpg) value if **`-c`** isn't given.
- `dpti`(4) driver added; an implementation of the DPT/Adaptec SCSI/I2O RAID management interface. Allows the use of the Linux versions of **`dptmgr`**, **`raidutil`**, **`dptelog`**, (etc).
- Support for Windows 2000 'NTFS' (NTFS5).
- Tagged queueing support for SCSI drivers based on the ncr53c9x controller.

Security

- Addition of a `chroot`(8) hierarchy for services including `named`(8), `ntpd`(8), and `sshd`(8).
- Additional `passwd`(5) ciphers: MD5, and DES with more encryption rounds. See `passwd.conf`(5).
- Several more code audits were performed.
- `/etc/security` performs many more checks and is far more flexible in how it monitors changes. See `security.conf`(5).

System administration and user tools

- `sushi`(8) added; a menu based system administration tool.
- `pgrep`(1) and `pkill`(1) added; find or signal processes by name or other attributes.
- System upgrades are made easier through the `etcupdate`(8) script which helps updating the `/etc` config files interactively, and the `/etc/postinstall` script which is provided to check for or fix configuration changes that have occurred in NetBSD.
- `stat`(1) added; a user interface to the information returned by the `stat`(2) system call.
- BSD `sort`(1) replaces GNU `sort`(1).
- The ''stop'' operation for `rc.d`(8) scripts waits until the service terminates before returning. This improves the reliability of ''restart'' operations as well.
- Swap devices can be removed at system shutdown by enabling `swapoff` in `rc.conf`(5).
- An optional watchdog timer which will terminate `rc.shutdown`(8) after the number of seconds provided in `rcshutdown_timeout` from `rc.conf`(5).

Miscellaneous

- Support for multibyte LC_CTYPE locales has been integrated from the Citrus project. Many Chinese, Japanese, Korean, and other encodings are now available.
- Full support for cross-compilation of the base system, even as a non-root user! `src/build.sh` is available for doing arbitrary cross-builds; see `src/BUILDING` for more information. At least 38 ports for the NetBSD 1.6.1 release were cross-built on a NetBSD/i386 system using this mechanism.
- Migrated the following CPU platforms to ELF: arm, and m68k (including amiga, hp300, mac68k, mvme68k, sun2, and x68k).
- Updates of most third party packages that are shipped in the base system to the following latest stable releases:
  - amd 6.0.6
  - BIND 8.3.3
  - binutils 2.11.2
  - bzip2 1.0.2
  - cvs 1.11
  - dhcp 3.0.1rc9
  - file 3.38
  - gcc 2.95.3
  - groff 1.16.1
  - Heimdal 0.4e
  - IPfilter 3.4.27
  - kerberos4 1.1
  - ksh from pdksh 5.2.14p2
  - less 374
  - nvi 1.79
  - OpenSSH 3.4
  - OpenSSL 0.9.6g
  - Postfix 1.1.11
  - ppp 2.4.0

  - routed 2.24
  - sendmail 8.11.6
  - tcpdump 3.7.1
  - XFree86 4.2.0 (i386 only)

- Many new packages in the *pkgsrc* system, including the latest open source desktop KDE3, OpenOffice, perl, Apache and many more. At the time of writing, there are over 3000 third party packages available in pkgsrc.
- Added AGP GART driver `agp`(4) for faster access to graphics boards.
- `init`(8) will create an mfs (memory based file system) `/dev` if `/dev/console` is missing.
- `vmstat`(8) displays kernel hash statistics with **`-H`** and **`-h`** *`hash`*.
- `wscons`(4) supports blanking of VGA consoles.

Kernel interfaces have continued to be refined, and more subsystems and device drivers are shared among the different ports. You can look for this trend to continue.

i386 specific

This is the ninth major release of NetBSD for the i386.

As is usual between releases, the i386 port has had many improvements made to it—too many to detail all of them here.

Numerous new drivers have been added. See the supported hardware list for details.

Some (but not all!) notable i386-specific improvements include:

- Support for booting off RAIDframe RAID-1 mirrors
- Increase the maximum number of partitions per disklabel from 8 to 16.

NetBSD 1.6.1 on i386 is, as usual, also fully backward compatible with old NetBSD/i386 binaries, so you don't need to recompile all your local programs provided you set the appropriate binary compatibility options in your kernel configuration.

The Future of NetBSD

The NetBSD Foundation has been incorporated as a non-profit organization. Its purpose is to encourage, foster and promote the free exchange of computer software, namely the NetBSD Operating System. The foundation will allow for many things to be handled more smoothly than could be done with our previous informal organization. In particular, it provides the framework to deal with other parties that wish to become involved in the NetBSD Project.

The NetBSD Foundation will help improve the quality of NetBSD by:

- providing better organization to keep track of development efforts, including co-ordination with groups working in related fields.
- providing a framework to receive donations of goods and services and to own the resources necessary to run the NetBSD Project.
- providing a better position from which to undertake promotional activities.
- periodically organizing workshops for developers and other interested people to discuss ongoing work.

We intend to begin narrowing the time delay between releases. Our ambition is to provide a full release every six to eight months.

We hope to support even *more* hardware in the future, and we have a rather large number of other ideas about what can be done to improve NetBSD.

We intend to continue our current practice of making the NetBSD-current development source available on a daily basis.

We intend to integrate free, positive changes from whatever sources submit them, providing that they are well thought-out and increase the usability of the system.

Above all, we hope to create a stable and accessible system, and to be responsive to the needs and desires of NetBSD users, because it is for and because of them that NetBSD exists.

Sources of NetBSD

Refer to **http://www.netbsd.org/Sites/net.html**.

NetBSD 1.6.1 Release Contents

The root directory of the NetBSD 1.6.1 release is organized as follows:

`.../NetBSD-1.6.1/`

`CHANGES`	Changes since earlier NetBSD releases.
`LAST_MINUTE`	Last minute changes.
`MIRRORS`	A list of sites that mirror the NetBSD 1.6.1 distribution.
`README.files`	README describing the distribution's contents.
`TODO`	NetBSD 's todo list (also somewhat incomplete and out of date).
`patches/`	Post-release source code patches.
`source/`	Source distribution sets; see below.

In addition to the files and directories listed above, there is one directory per architecture, for each of the architectures for which NetBSD 1.6.1 has a binary distribution. There are also `README.export-control` files sprinkled liberally throughout the distribution tree, which point out that there are some portions of the distribution that may be subject to export regulations of the United States, e.g. code under `src/crypto` and `src/sys/crypto`. It is your responsibility to determine whether or not it is legal for you to export these portions and to act accordingly.

The source distribution sets can be found in subdirectories of the `source` subdirectory of the distribution tree. They contain the complete sources to the system. The source distribution sets are as follows:

gnusrc This set contains the ''gnu'' sources, including the source for the compiler, assembler, groff, and the other GNU utilities in the binary distribution sets.
55 MB gzipped, 247 MB uncompressed

pkgsrc This set contains the ''pkgsrc'' sources, which contain the infrastructure to build third-party packages.
12 MB gzipped, 94 MB uncompressed

sharesrc This set contains the ''share'' sources, which include the sources for the man pages not associated with any particular program; the sources for the typesettable document set; the dictionaries; and more.
4 MB gzipped, 16 MB uncompressed

src This set contains all of the base NetBSD 1.6.1 sources which are not in **gnusrc**, **sharesrc**, or **syssrc**.
27 MB gzipped, 136 MB uncompressed

syssrc This set contains the sources to the NetBSD 1.6.1 kernel for all architectures; `config`(8); and `dbsym`(8).
22 MB gzipped, 114 MB uncompressed

xsrc This set contains the sources to the X Window System.
78 MB gzipped, 394 MB uncompressed

All the above source sets are located in the `source/sets` subdirectory of the distribution tree.

The source sets are distributed as compressed tar files. Except for the **pkgsrc** set, which is traditionally unpacked into `/usr/pkgsrc`, all sets may be unpacked into `/usr/src` with the command:

```
# ( cd / ; tar -zxpf - ) < set_name.tgz
```

The `sets/Split/` subdirectory contains split versions of the source sets for those users who need to load the source sets from floppy or otherwise need a split distribution. The split sets are named `set_name.`*`xx`* where `set_name` is the distribution set name, and *xx* is the sequence number of the file, starting with "aa" for the first file in the distribution set, then "ab" for the next, and so on. All of these files except the last one of each set should be exactly 240,640 bytes long. (The last file is just long enough to contain the remainder of the data for that distribution set.)

The split distributions may be reassembled and extracted with **cat** as follows:

```
# cat set_name.?? | ( cd / ; tar -zxpf - )
```

In each of the source distribution set directories, there are files which contain the checksums of the files in the directory:

`BSDSUM` Historic BSD checksums for the various files in that directory, in the format produced by the command:
cksum -o 1 *file*.

`CKSUM` POSIX checksums for the various files in that directory, in the format produced by the command:
cksum *file*.

`MD5` MD5 digests for the various files in that directory, in the format produced by the command:
cksum -m *file*.

`SYSVSUM` Historic AT&T System V UNIX checksums for the various files in that directory, in the format produced by the command:
cksum -o 2 *file*.

The MD5 digest is the safest checksum, followed by the POSIX checksum. The other two checksums are provided only to ensure that the widest possible range of system can check the integrity of the release files.

NetBSD/i386 subdirectory structure

The i386-specific portion of the NetBSD 1.6.1 release is found in the `i386` subdirectory of the distribution:

```
.../NetBSD-1.6.1/i386/
INSTALL.html
INSTALL.ps
```

`INSTALL.txt`

`INSTALL.more` Installation notes in various file formats, including this file. The `.more` file contains underlined text using the `more`(1) conventions for indicating italic and bold display.

`binary/`

`kernel/`

`netbsd-GENERIC.gz`
: A gzipped NetBSD kernel containing code for everything supported in this release.

`netbsd.GENERIC_LAPTOP.gz`
: A version of `GENERIC` that has USB, PCMCIA and CardBus enabled to allow installing on laptop machines.

`netbsd.GENERIC_TINY.gz`
: A version of `GENERIC` intended to run on machines with less than 8 MB.

`netbsd.GENERIC_PS2TINY.gz`
: A version of `GENERIC` intended to run on IBM PS/2 machines.

`netbsd.INSTALL.gz`
: The install kernel.

`netbsd.INSTALL_TINY.gz`
: A version of `INSTALL` intended to run on machines with less than 8 MB.

`netbsd.INSTALL_SMALL.gz`
: A version of `INSTALL` intended to fit on a 5.25"/1.2 MB diskette.

`netbsd.INSTALL_LAPTOP.gz`
: A version of `INSTALL` that has USB, PCMCIA and CardBus enabled to allow installing on laptop machines.

`netbsd.INSTALL_PS2.gz`
: A version of `INSTALL` that has MCA stuff enabled to allow installing on IBM PS/2 machines.

`sets/` i386 binary distribution sets; see below.

`installation/`

`floppy/` i386 boot and installation floppies; see below.

`misc/` Miscellaneous i386 installation utilities; see installation section, below.

Binary distribution sets

The NetBSD i386 binary distribution sets contain the binaries which comprise the NetBSD 1.6.1 release for the i386. There are eight binary distribution sets. The binary distribution sets can be found in the `i386/binary/sets` subdirectory of the NetBSD 1.6.1 distribution tree, and are as follows:

base The NetBSD 1.6.1 i386 **base** binary distribution. You *must* install this distribution set. It contains the base NetBSD utilities that are necessary for the system to run and be minimally functional. It includes shared library support, and excludes everything described below.
19 MB gzipped, 45 MB uncompressed

comp Things needed for compiling programs. This set includes the system include files (`/usr/include`) and the various system libraries (except the shared libraries, which are included as part of the **base** set). This set also includes the manual pages for all of the utilities it contains, as well as the system call and library manual pages.
15 MB gzipped, 54 MB uncompressed

etc This distribution set contains the system configuration files that reside in `/etc` and in several other places. This set *must* be installed if you are installing the system from scratch, but should *not* be used if you are upgrading.
1 MB gzipped, 1 MB uncompressed

games This set includes the games and their manual pages.
3 MB gzipped, 7 MB uncompressed

kern-GENERIC
This set contains a NetBSD/i386 1.6.1 `GENERIC` kernel, named `/netbsd`. You *must* install this distribution set.
3 MB gzipped, 6 MB uncompressed

man This set includes all of the manual pages for the binaries and other software contained in the **base** set. Note that it does not include any of the manual pages that are included in the other sets.
7 MB gzipped, 27 MB uncompressed

misc This set includes the (rather large) system dictionaries, the typesettable document set, and other files from `/usr/share`.
3 MB gzipped, 8 MB uncompressed

text This set includes NetBSD's text processing tools, including `groff`(1), all related programs, and their manual pages.
2 MB gzipped, 6 MB uncompressed

NetBSD maintains its own set of sources for the X Window System in order to assure tight integration and compatibility. These sources are based on XFree86, and tightly track XFree86 releases. They are currently equivalent to XFree86 4.2.0. Binary sets for the X Window System are distributed with NetBSD. The sets are:

xbase The basic files needed for a complete X client environment. This does not include the X servers.
5 MB gzipped, 12 MB uncompressed

xcomp The extra libraries and include files needed to compile X source code.
4 MB gzipped, 14 MB uncompressed

xcontrib Programs that were contributed to X.
1 MB gzipped, 1 MB uncompressed

xfont Fonts needed by X.
15 MB gzipped, 19 MB uncompressed

xmisc Miscellaneous X programs.
1 MB gzipped, 1 MB uncompressed

xserver All XFree86 X servers. Because all of them are included, this set is large. However, you will only need one of the servers provided in this set. (Typically, **`XF86_SVGA`**).
8 MB gzipped, 20 MB uncompressed

The i386 binary distribution sets are distributed as gzipped tar files named with the extension **.tgz**, e.g. `base.tgz`. They are also available in split form; catted together, the members of a split set form a gzipped tar file.

The instructions given for extracting the source sets work equally well for the binary sets, but it is worth noting that if you use that method, the filenames stored in the sets are relative and therefore the files are extracted *below the current directory*. Therefore, if you want to extract the binaries into your system, i.e. replace

the system binaries with them, you have to run the **tar -xpf** command from the root directory (/) of your system. This utility is used only in a Traditional method installation.

Note: Each directory in the i386 binary distribution also has its own checksum files, just as the source distribution does.

NetBSD/i386 System Requirements and Supported Devices

NetBSD 1.6.1 runs on ISA (AT-Bus), EISA, MCA, PCI, and VL-bus systems with 386-family processors, with or without math coprocessors. The minimal configuration is said to require 4 MB of RAM and 50 MB of disk space, though we do not know of anyone running with a system quite this minimal today. To install the entire system requires much more disk space (the unpacked binary distribution, without sources, requires at least 65 MB without counting space needed for swap space, etc), and to run X or compile the system, more RAM is recommended. (4 MB of RAM will actually allow you to run X and/or compile, but it won't be speedy. Note that until you have around 16 MB of RAM, getting more RAM is more important than getting a faster CPU.)

Supported devices

Explanation of bracketted footnote tags [] follows this listing.

- Floppy controllers.
- MFM, ESDI, IDE, and RLL hard disk controllers.
  There is complete support (including IDE DMA or Ultra-DMA) for the following PCI controllers
  - Acard ATA-850 and 860 based IDE Controllers
  - Acer labs M5229 IDE Controller
  - Advanced Micro Devices AMD-756, 766 and 768 IDE Controllers
  - CMD Tech PCI0643, 0646, 0648 and 0649 IDE Controllers
  - Contaq Microsystems/Cypress CY82C693 IDE Controller
  - HighPoint HPT366 and HPT370
  - IBM ESDI Fixed Disk Controllers [m]
  - Intel PIIX, PIIX3 and PIIX4 IDE Controllers
  - Intel 82801 (ICH/ICH0/ICH2/ICH4) IDE Controllers
  - Promise PDC20246 (Ultra/33), PDC20262 (Ultra/66), PDC20265/PDC20267 (Ultra/100), PDC20268 (Ultra/100TX2 and Ultra/100TX2v2) and Ultra/133, Ultra/133TX2 and Ultra/133TX2v2.
  - Silicon Integrated System 5597/5598 IDE controller
  - VIA Technologies VT82C586, VT82C586A, VT82C596A, VT82C686A and VT8233A IDE Controllers

  Most of these controllers are only available in multifunction PCI chips. Other PCI IDE controllers are supported, but performance may not be optimal. ISA, ISA Plug and Play and PCMCIA IDE controllers are supported as well.
- SCSI host adapters
  - Adaptec AHA-154xA, -B, -C, and -CF
  - Adaptec AHA-1640 cards (MCA variant of AHA-1540) [m]
  - Adaptec AHA-174x
  - Adaptec AIC-6260 and AIC-6360 based boards, including the Adaptec AHA-152x, Adaptec APA-1460 (PCMCIA) and APA-1480 (CardBus), and the SoundBlaster SCSI host adapter.

    Note: You cannot boot from these boards if they do not have a boot ROM; consequently only the AHA-152x and motherboards using this chip are likely to be bootable.

- Adaptec AHA-2910, 2915, 2920, and 2930C adapters.
- Adaptec AHA-2x4x[U][2][W] cards and onboard PCI designs using the AIC-7770, AIC-7850, AIC-7860, AIC-7870, AIC-7880 and AIC-789x chipsets.
- Adaptec AHA-394x[U][W] cards [b]
- Adaptec AHA-3950U2 cards
- Adaptec AHA-3960, 19160 and 29160 Ultra-160 adapters
- AdvanSys ABP-9x0[U][A] cards
- AdvanSys ABP-940UW[68], ABP-970UW[68], ASB3940UW-00 cards
- AMD PCscsi-PCI (Am53c974) based SCSI adapters, including Tekram DC-390
- BusLogic 54x (Adaptec AHA-154x clones)
- BusLogic 445, 74x, 9xx (but not the new 'FlashPoint' series of BusLogic SCSI adapters)
- Qlogic ISP [12]0x0 SCSI/FibreChannel boards
- Seagate/Future Domain ISA SCSI adapter cards
  - ST01/02
  - Future Domain TMC-885
  - Future Domain TMC-950
- Symbios Logic (NCR) 53C8xx-based PCI SCSI host adapters
  - Acculogic PCIpport
  - ASUS SC-200 (requires NCR BIOS on motherboard to boot from disks)
  - ASUS SC-875
  - ASUS SP3[G] motherboard onboard SCSI
  - DEC Celebris XL/590 onboard SCSI
  - Diamond FirePort 40
  - Lomas Data SCSI adapters
  - NCR/SYM 8125 (and its many clones; be careful, some of these cards have a jumper to set the PCI interrupt; leave it on INT A!)
  - Promise DC540 (a particularly common OEM model of the SYM 8125)
  - Tekram DC-390U/F
  - Tyan Yorktown
- Symbios Logic (NCR) 5380/53C400-based ISA SCSI host adapters [*]
- Ultrastor 14f, 34f, and (possibly) 24f
- Western Digital WD7000 SCSI and TMC-7000 host adapters (ISA cards only)

- MDA, CGA, VGA, SVGA, and HGC Display Adapters.

  Note: Not all of the display adapters NetBSD/i386 can work with are supported by X. See the XFree86 FAQ for more information.

- Serial ports
  - 8250/16450-based ports
  - 16550/16650/16750-based ports
  - AST-style 4-port serial cards [*]
  - BOCA 8-port serial cards [*]
  - BOCA 6-port (ioat) serial cards [*]
  - IBM PC-RT 4-port serial cards [*]
  - TCOM TC-400 (4-port), TC-800 (8-port) serial cards [*]
  - Single-port Hayes ESP serial cards [*]
  - Cyclades Cyclom-Y serial cards [*] [+]
  - Addonics FlexPort 8S 8-port serial cards [*]
  - Byte Runner Technologies TC-400 and TC-800 serial cards [*]
  - PCI universal communication cards

- Parallel ports. [*] [+]
- Ethernet adapters
  - AMD LANCE and PCnet-based ISA Ethernet adapters [*]
    - Novell NE1500T
    - Novell NE2100
    - Kingston 21xx
    - Digital EtherWORKS II ISA adapters (DE200/DE201/DE202)
  - AMD LANCE and PCnet-based MCA Ethernet adapters [m]
    - SKNET Personal
    - SKNET MC+
  - AMD PCnet-based PCI Ethernet adapters
    - Addtron AE-350
    - BOCALANcard/PCI
    - SVEC FD0455
    - X/Lan Add-On Adapter
    - IBM #13H9237 PCI Ethernet Adapter
  - AT&T StarLAN 10, EN100, and StarLAN Fiber
  - 3COM 3c501
  - 3COM 3c503
  - 3COM 3c505 [*]
  - 3COM 3c507
  - 3COM 3c509, 3c579, 3c589, and 3c59X
  - 3COM 3c523 EtherLink/MC [m]
  - 3COM 3c529 EtherLink III [m]
  - 3COM 3c90X (including 3c905B), 3c450, 3c55X, 3c575, 3c980, 3cSOHO100
  - Digital DC21x4x-based PCI Ethernet adapters
    - Accton EN2242
    - ASUS PCI-DEC100TX+
    - Cogent EM1X0, EM960 (a.k.a. Adaptec ANA-69XX)
    - Cogent EM964 [b]
    - Cogent EM4XX [b]
    - Compex Readylink PCI
    - DANPEX EN-9400P3
    - Digital Celebris GL, GLST on-board ethernet
    - DEC (Digital) PCI Ethernet/Fast Ethernet adapters (all)
    - DLINK DFE500-TX
    - JCIS Condor JC1260
    - Linksys PCI Fast Ethernet
    - SMC EtherPower 10, 10/100 (PCI only!)
    - SMC EtherPower^2 [b]
    - Sundance ST-201 based ethernet adapters (including DLINK DFE550-TX and DFE580-TX)
    - SVEC PN0455
    - SVEC FD1000-TP
    - Znyx ZX34X
  - Digital EtherWORKS III ISA adapters (DE203/DE204/DE205) [*]
  - Digital DEPCM-BA (PCMCIA) and DE305 (ISA) NE2000-compatible cards
  - BICC Isolan [* and not recently tested]

- Efficient Networks EN-155 and Adaptec AIC-590x ATM interfaces
- Essential Communications Hippi (800 Mbit/s)
- Fujitsu MB86960A/MB86965A based cards
  - Fujitsu FMV-180 series
  - Allied-Telesis AT1700 series
  - Allied-Telesis AT1700 series MCA [m]
  - Allied-Telesis RE2000 series
- Intel EtherExpress 16
- Intel EtherExpress PRO/10
- Intel EtherExpress 100 Fast Ethernet adapters
- Novell NE1000, NE2000 (ISA, PCI, PCMCIA, ISA PnP)
- RealTek 8129/8139 based boards
- SMC/WD 8003, 8013, and the SMC 'Elite16' ISA boards
- SMC/WD 8003, 8013 and IBM PS/2 Adapter/A MCA boards [m]
- SMC/WD 8216 (the SMC 'Elite16 Ultra' ISA boards)
- SMC 91C9x-based boards (ISA and PCMCIA)
- SMC EPIC/100 Fast Ethernet boards
  - SMC Etherpower-II
- Texas Instruments ThunderLAN based ethernet boards
  - Compaq Netelligent 10/100 TX
  - Compaq ProLiant Integrated Netelligent 10/100 TX
  - Compaq Netelligent 10 T (untested)
  - Compaq Integrated NetFlex 3/P
  - Compaq NetFlex 3/P in baseboard variant (the PCI variant doesn't use the same chip!)
  - Compaq Dual Port Netelligent 10/100 TX
  - Compaq Deskpro 4000 5233MMX (untested)
  - Texas Instruments TravelMate 5000 series laptop docking station Ethernet board
- VIA VT3043 (Rhine) and VT86C100A (Rhine-II) based ethernet boards
  - D-Link DFE530TX

- FDDI adapters
  - Digital DEFPA PCI FDDI adapters [*] [+]
  - Digital DEFEA EISA FDDI adapters [*] [+]

- Token-Ring adapters
  - IBM Token-Ring Network PC Adapter [+]
  - IBM Token-Ring Network PC Adapter II [+]
  - IBM Token-Ring Network Adapter/A [+]
  - IBM Token-Ring Network 16/4 Adapter [+]
  - IBM Token-Ring Network 16/4 Adapter/A [m]
  - IBM 16/4 ISA Adapter [+]
  - IBM Auto 16/4 Token-Ring ISA Adapter [+]
  - 3COM 3C619 TokenLink [+]
  - 3COM 3C319 TokenLink Velocity [+]

- Wireless network adapters
  - 3Com AirConnect Wireless LAN
  - AT&T/Lucent/Agere WaveLAN/ORiNOCO IEEE (802.11) PCMCIA cards
  - Aironet 4500/4800 and Cisco 340 series PCMCIA cards
  - BayStack 650 802.11FH PCMCIA cards [*] [+]
  - Corega Wireless LAN PCC-11 cards [*] [+]

- DEC/Cabletron RoamAbout 802.11 DS High Rate cards [*] [+]
- ELSA AirLancer MC-11 card [*] [+]
- Intersil Prism II
- Melco AIR CONNECT WLI-PCM-L11 cards [*] [+]
- NetWave AirSurfer PCMCIA cards [*] [+]

- High Speed Serial
  - LAN Media Corporation SSI/LMC10000 (up to 10 Mbps) [*] [+]
  - LAN Media Corporation HSSI/LMC5200 [*] [+]
  - LAN Media Corporation DS3/LMC5245 [*] [+]

- Tape drives
  - Most SCSI tape drives
  - Seagate and OnStream ATAPI tape drives, possibly others
  - QIC-02 and QIC-36 format (Archive- and Wangtek- compatible) tape drives [*] [+]

- CD-ROM drives
  - Non-IDE Mitsumi CD-ROM drives [*] [+]

    Note: The Mitsumi driver device probe is known to cause trouble with several devices!

  - Most SCSI CD-ROM drives
  - Most ATAPI CD-ROM drives.

    Note: Some low-priced IDE CD-ROM drives are known for being not or not fully ATAPI compliant, and thus require some hack (generally an entry to a quirk table) to work with NetBSD.

- Mice
  - "Logitech" -style bus mice [*] [+]
  - Microsoft-style bus mice [*] [+]
  - "PS/2" -style mice [*] [+]
  - Serial mice (no kernel support necessary)

- Sound Cards
  - Aria based sound cards [*]
  - Cirrus Logic CS461x, CS4280 and CS4281 audio [*] [+]
  - Ensoniq AudioPCI [*] [+]
  - ESS Technology ESS 1688 Audiodrive, ES1777/1868/1869/1887/1888/888, Maestro 1/2/2E and Solo-1 ES1938/1946 [*] [+]
  - Gravis Ultrasound Plug and Play [*] [+]
  - Gravis Ultrasound and Ultrasound Max [*] [+]
  - NeoMagic MagicMedia 256AV / 256ZX AC'97 audio [*] [+]
  - Personal Sound System [*] [+]
  - ProAudio Spectrum [*] [+]
  - S3 SonicVibes [*] [+]
  - SoundBlaster, SoundBlaster Pro, SoundBlaster 16 [*] [+]
  - VIA VT82C686A southbridge integrated AC97 audio [*] [+]
  - Windows Sound System [*] [+]
  - Yamaha YMF724/740/744/754 audio (DS-1 series) [*] [+]
  - Yamaha OPL3-SA3 audio [*] [+]

- Game Ports (Joysticks) [*] [+]

- Miscellaneous

- Advanced power management (APM) [*]

- Universal Serial Bus (USB)
  - UHCI host controllers [*] [+]
  - OHCI host controllers [*] [+]
  - Hubs [*] [+]
  - Keyboards using the boot protocol [*] [+]
  - Mice [*] [+]
  - Printers [*] [+]
  - Modems using Abstract Control Model [*] [+]
  - Generic support for HID devices [*] [+]
  - Ethernet adapters [*] [+]
  - Audio devices [*] [+]
  - driver for FTDI based serial adapters [*] [+]
  - Mass storage devices such as disks, ZIP drives and digital cameras [*] [+]
  - driver for the Prolific host-to-host adapter [*] [+]
  - Handspring Visor driver [*] [+]

- PCMCIA Controllers.
  ISA, PCI, and ISA Plug and Play attachments
  - Intel 82365 PCIC, rev 0 and rev 1
  - Cirrus PD6710
  - Cirrus PD672X

  Note: This will work with most laptops as well as with ISA cards which provide PCMCIA slots for desktops.

- RAID Controllers
  - 3ware Escalade family of controllers
  - Compaq Integrated Array (PCI) [b]
  - Compaq IAES (EISA)
  - Compaq IDA, IDA-2 (EISA)
  - Compaq Smart Array 221, 3100ES, 3200, 4200, 4250ES (PCI) [b]
  - Compaq Smart Array 431, RAID LC2 [b]
  - Compaq SMART 2, 2/E (EISA)
  - Compaq SMART 2/E, 2/P, 2DH, 2SL (PCI) [b]
  - DPT SCSI RAID boards (ISA [*], EISA and PCI)
    - SmartCache III
    - SmartCache IV
    - SmartRAID III
    - SmartRAID IV

Specific driver footnotes:

[*] Drivers are *not* present in kernels on the distribution floppies. Except as noted above, all drivers are present on all disks. Also, at the present time, the distributed kernels support only one SCSI host adapter per machine. NetBSD normally allows more, though, so if you have more than one, you can use all of them by compiling a custom kernel once NetBSD is installed.

[+] Support *is* included in the `GENERIC` kernels, although it is not in the kernels which are on the distribution floppies.

[b] Devices require BIOS support for PCI-PCI bridging on your motherboard. Most reasonably modern Pentium motherboards have this support, or can acquire it via a BIOS upgrade.

[m] Devices are only supported by MCA-enabled kernels.

Unsupported devices

Hardware the we do *not* currently support, but get many questions about:

- Multiprocessor systems. NetBSD will run, but only use one processor.
- PCI WD-7000 SCSI host adapters.
- QIC-40 and QIC-80 tape drives. (Drives that connect to the floppy disk controller.)

We are planning future support for many of these devices.

Required configurations

To be detected by the distributed kernels, the devices must be configured as follows:

```
Device          Name    Port    IRQ     DRQ     Misc
------          ----    ----    ---     ---     ----
Serial ports    com0    0x3f8   4               [8250/16450/16550/clones]
                com1    0x2f8   3               [8250/16450/16550/clones]
                com2    0x3e8   5               [8250/16450/16550/clones]

Parallel ports  lpt0    0x378   7               [interrupt-driven or polling]
                lpt1    0x278                   [polling only]
                lpt2    0x3bc                   [polling only]

Floppy controller
                fdc0    0x3f0   6       2       [supports two disks]

AHA-154x, AHA-174x (in compatibility mode), or BT-54x SCSI host adapters
                aha0    0x330   any     any
                aha1    0x334   any     any

AHA-174x SCSI host adapters (in enhanced mode)
                ahb0    any     any     any

AHA-152x, AIC-6260- or AIC-6360-based SCSI host adapters
                aic0    0x340   11      6

AHA-2X4X or AIC-7xxx-based SCSI host adapters   [precise list: see NetBSD
                ahc0    any     any     any      System Requirements and
                                                 Supported Devices]

AdvanSys ABP-9x0[U][A] SCSI host adapters
                adv0    any     any     any

AdvanSys ABP-940UW[68], ABP-970UW[68], ASB3940UW-00 SCSI host adapters
                adw0    any     any     any

AMD PCscsi-PCI based SCSI host adapters
                pcscp0  any     any     any

BusLogic BT445, BT74x, or BT9xx SCSI host adapters
                bha0    0x330   any     any
```

```
                bha1    0x334   any     any

Seagate/Future Domain SCSI
                sea0    any     5       any     iomem 0xd8000

Symbios Logic/NCR 53C8xx, 53c1010 and 53c1510D based PCI SCSI host adapters
                siop0   any     any     any
                esiop0  any     any     any

Ultrastor 14f, 24f (if it works), or 34f SCSI host adapters
                uha0    0x330   any     any
                uha1    0x340   any     any

Western Digital WD7000 based ISA SCSI host adapters
                wds0    0x350   15      6
                wds1    0x358   11      5

PCI IDE hard disk controllers
                pciide0 any     any     any     [supports four devices]

MFM/ESDI/IDE/RLL hard disk controllers
                wdc0    0x1f0   14              [supports two devices]
                wdc1    0x170   15              [supports two devices]

ATA disks       wd0, wd1, ...
SCSI and ATAPI disks sd0, sd1, ...
SCSI tapes      st0, st1, ...
SCSI and ATAPI CD-ROMs cd0, cd1, ...
        For each SCSI and IDE controller found, the SCSI or ATA(PI) devices
        present on the bus are probed in increasing ID order for SCSI and
        master/slave order for ATA(PI).  So the first SCSI drive found will
        be called sd0, the second sd1, and so on ...

StarLAN cards
                ai0     0x360   7       any     iomem 0xd0000

FMV-180 series cards
                fmv0    0x2a0   any

AT1700 cards
                ate0    0x2a0   any

Intel EtherExpress/16 cards
                ix0     0x300   10

Intel EtherExpress PRO 10 ISA cards
                iy0     0x360   any

CS8900 Ethernet cards
                cs0     0x300   any     any

3Com 3c501 Ethernet cards
```

```
                el0     0x300   9

3Com 3c503 Ethernet cards
                ec0     0x250   9               iomem 0xd8000

3Com 3c505 Ethernet cards
                eg0     0x280   9

3Com 3c507 Ethernet cards
                ef0     0x360   7               iomem 0xd0000

Novell NE1000, or NE2000 Ethernet boards
                ne0     0x280   9
                ne1     0x300   10

Novell NE2100 Ethernet boards
                ne2     0x320   9       7

BICC IsoLan cards
                ne3     0x320   10      7

SMC/WD 8003, 8013, Elite16, and Elite16 Ultra Ethernet boards
                we0     0x280   9               iomem 0xd0000
                we1     0x300   10              iomem 0xcc000

3COM 3c509 or 3COM 3c579 Ethernet boards
                ep0     any     any

3COM 3x59X PCI Ethernet boards
                ep0     any     any     [you must assign an interrupt in your
                                         PCI BIOS, or let it do so for you]

3COM 3x90X PCI Ethernet boards
                ex0     any     any     [you must assign an interrupt in your
                                         PCI BIOS, or let it do so for you]

Intel EtherExpress PRO 10 ISA
                iy0             0x360   any

Intel EtherExpress 100 Fast Ethernet adapters
                fxp0    any     any     [you must assign an interrupt in your
                                         PCI BIOS, or let it do so for you]

SMC91C9x based Ethernet cards
                sm0     0x300   10

PCnet-PCI based Ethernet boards; see above for partial list
                le0     any     any     [you must assign an interrupt in your
                                         PCI BIOS, or let it do so for you]

DC21x4x based Ethernet boards; see above for partial list
                de0     any     any     [you must assign an interrupt in your
```

```
                                                PCI BIOS, or let it do so for you]

    Digital EtherWORKS III (DE203/DE204/DE205) LEMAC
                    lc0     0x320   any

    Qlogic ISP [12]0x0 SCSI/FibreChannel boards
                    isp0    any     any

    Efficient Networks EN-155 and Adaptec AIC-590x ATM interfaces
                    en0     any     any

    SMC EPIC/100 Fast Ethernet boards
                    epic0   any     any

    Texas Instruments ThunderLAN based ethernet boards
                    tl0     any     any

    VIA VT3043(Rhine) and VT86C100A(Rhine-II) based ethernet boards
                    vr0     any     any

    IBM TROPIC based Token-Ring cards
                    tr0     0xa20   any             iomem 0xd8000
                    tr1     0xa24   any             iomem 0xd0000
                    tr2     any     any
```

Getting the NetBSD System on to Useful Media

If you are not booting off a CD-ROM, you will need to have some floppy disks to boot off; either two 1.44 MB floppies or one 1.2 MB floppy.

For laptops that have cardbus slots, you should use the `bootlap1.fs` and `bootlap2.fs` floppy images.

For older machines with little RAM, use `boot-tiny.fs`. This image is tailored towards old, small-memory systems, and thus does not contain any PCI or SCSI support. It should work on systems with 4M of RAM. Note that this means 4M available to NetBSD; systems that are said to have 4M may have 640k of base memory and 3072k of extended memory, which currently will not work, as this is a total of 3712k.

For old machines that may have EISA, SCSI and more RAM, but only have an 1.2M floppy drive, use `boot-small.fs`.

For old IBM PS/2 machines with MCA, use `boot-ps2.fs`.

For all other systems, use `boot1.fs` and `boot2.fs`

For the 2-floppy sets (and the CD boot image), utilities to repair a badly crashed systems are included. The -small and -tiny images have separate rescue floppy images because of lack of space.

If you are using a UNIX-like system to write the floppy images to disks, you should use the `dd` command to copy the file system image(s) (.fs file) directly to the raw floppy disk. It is suggested that you read the `dd`(1) manual page or ask your system administrator to determine the correct set of arguments to use; it will be slightly different from system to system, and a comprehensive list of the possibilities is beyond the scope of this document.

If you are using MS-DOS to write the floppy image(s) to floppy disk, you should use the **`rawrite`** utility, provided in the `i386/utilities` directory of the NetBSD distribution. It will write a file system image

(.fs file) to a floppy disk. A **rawrite32** is also available that runs under MS Windows.

Installation is supported from several media types, including:

- CD-ROM
- MS-DOS floppy
- FTP
- Remote NFS partition
- Tape
- Existing NetBSD partitions, if performing an upgrade

The steps necessary to prepare the distribution sets for installation depend upon which installation medium you choose. The steps for the various media are outlined below.

CD-ROM Find out where the distribution set files are on the CD-ROM.

Proceed to the instruction on installation.

MS-DOS floppy Count the number of `set_name.`*xx* files that make up the distribution sets you want to install or upgrade. You will need one fifth that number of 1.2 MB floppies, or one sixth that number of 1.44 MB floppies. You should only use one size of floppy for the install or upgrade procedure; you can't use some 1.2 MB floppies and some 1.44 MB floppies.

Format all of the floppies with MS-DOS. Do *not* make any of them bootable MS-DOS floppies, i.e. don't use `format /s` to format them. (If the floppies are bootable, then the MS-DOS system files that make them bootable will take up some space, and you won't be able to fit the distribution set parts on the disks.) If you're using floppies that are formatted for MS-DOS by their manufacturers, they probably aren't bootable, and you can use them out of the box.

Place all of the `set_name.`*xx* files on the MS-DOS disks.

Once you have the files on MS-DOS disks, you can proceed to the next step in the installation or upgrade process. If you're installing NetBSD from scratch, go to the section on preparing your hard disk, below. If you're upgrading an existing installation, go directly to the section on upgrading.

FTP The preparations for this installation/upgrade method are easy; all you need to do is make sure that there's an FTP site from which you can retrieve the NetBSD distribution when you're about to install or upgrade. You need to know the numeric IP address of that site, and, if it's not on a network directly connected to the machine on which you're installing or upgrading NetBSD, you need to know the numeric IP address of the router closest to the NetBSD machine. Finally, you need to know the numeric IP address of the NetBSD machine itself. If you don't have access to a functioning nameserver during installation, the IP address of **ftp.netbsd.org** is `204.152.184.75` (as of June, 2002).

Once you have this information, you can proceed to the next step in the installation or upgrade process. If you're installing NetBSD from scratch, go to the section on preparing your hard disk, below. If you're upgrading an existing installation, go directly to the section on upgrading.

Note: This method of installation is recommended only for those already familiar with using BSD network configuration and management commands. If you aren't, this documentation should help, but is not intended to be all-encompassing.

NFS Place the NetBSD distribution sets you wish to install into a directory on an NFS server, and make that directory mountable by the machine on which you are installing or upgrading NetBSD. This will probably require modifying the `/etc/exports` file on of the NFS server and resetting its mount daemon (mountd). (Both of these actions will probably require superuser privileges on the server.)

You need to know the numeric IP address of the NFS server, and, if the server is not on a network directly connected to the machine on which you're installing or upgrading NetBSD, you need to know the numeric IP address of the router closest to the NetBSD machine. Finally, you need to know the numeric IP address of the NetBSD machine itself.

Once the NFS server is set up properly and you have the information mentioned above, you can proceed to the next step in the installation or upgrade process. If you're installing NetBSD from scratch, go to the section on preparing your hard disk, below. If you're upgrading an existing installation, go directly to the section on upgrading.

Note: This method of installation is recommended only for those already familiar with using BSD network configuration and management commands. If you aren't, this documentation should help, but is not intended to be all-encompassing.

Upgrade If you are upgrading NetBSD, you also have the option of installing NetBSD by putting the new distribution sets somewhere in your existing file system, and using them from there. To do that, you must do the following:

Place the distribution sets you wish to upgrade somewhere in your current file system tree. Please note that the `/dev` on the floppy used for upgrades only knows about `wd0`, `wd1`, `sd0`, `sd1`, and `sd2`. If you have more than two IDE drives or more than three SCSI drives, you should take care not to place the sets on the high-numbered drives.

At a bare minimum, you must upgrade the **base** and **kern** binary distributions, and so must put the **base** and **kern** sets somewhere in your file system. If you wish, you can do the other sets, as well, but you should *not* upgrade the **etc** distribution; it contains contains system configuration files that you should review and update by hand.

Once you have done this, you can proceed to the next step in the upgrade process, actually upgrading your system.

Preparing your System for NetBSD installation

First and foremost, before beginning the installation process, *make sure you have a reliable backup* of any data on your hard disk that you wish to keep. Mistakes in partitioning your hard disk may lead to data loss.

Before you begin, you should be aware of the geometry issues that may arise in relation to your hard disk. First of all, you should know about sector size. You can count on this to be 512 bytes; other sizes are rare (and currently not supported). Of particular interest are the number of sectors per track, the number of tracks per cylinder (also known as the number of heads), and the number of cylinders. Together they describe the disk geometry.

The BIOS has a limit of 1024 cylinders and 63 sectors per track for doing BIOS I/O. This is because of the old programming interface to the BIOS that restricts these values. Most of the big disks currently being used have more than 1024 real cylinders. Some have more than 63 sectors per track. Therefore, the BIOS can be instructed to use a fake geometry that accesses most of the disk and the fake geometry has less than or equal to 1024 cylinders and less than or equal to 63 sectors. This is possible because the disks can be addressed in a way that is not restricted to these values, and the BIOS can internally perform a translation. This can be ac-

tivated in most modern BIOSes by using *Large* or *LBA* mode for the disk.

NetBSD does not have the mentioned limitations with regard to the geometry. However, since the BIOS has to be used during startup, it is important to know about the geometry the BIOS uses. The NetBSD kernel should be on a part of the disk where it can be loaded using the BIOS, within the limitations of the BIOS geometry. The install program will check this for you, and will give you a chance to correct this if this is not the case.

If you have not yet installed any other systems on the hard disk that you plan to install NetBSD on, or if you plan to use the disk entirely for NetBSD, you may wish to check your BIOS settings for the 'Large' or 'LBA' modes, and activate them for the hard disk in question. While they are not needed by NetBSD as such, doing so will remove the limitations mentioned above, and will avoid hassle should you wish to share the disk with other systems. Do *not* change these settings if you already have data on the disk that you want to preserve!

In any case, it is wise to check your the BIOS settings for the hard disk geometry before beginning the installation, and write them down. While this should usually not be needed, it enables you to verify that the install program determines these values correctly.

The geometry that the BIOS uses will be referred to as the *BIOS geometry*, the geometry that NetBSD uses is the *real geometry*.

sysinst, the NetBSD installation program, will try to discover both the real geometry and BIOS geometry.

It is *important* that **sysinst** know the proper BIOS geometry to be able to get NetBSD to boot, regardless of where on your disk you put it. It is less of a concern if the disk is going to be used entirely for NetBSD. If you intend to have several OSes on your disk, this becomes a much larger issue.

Installing the NetBSD System

Running the sysinst installation program

1. *Introduction*

   Using **sysinst**, installing NetBSD is a relatively easy process. You still should read this document and have it in hand when doing the installation process. This document tries to be a good guideline for the installation and as such covers many details for the sake of completeness. Do not let this discourage you; the install program is not hard to use.

2. *Possible* PCMCIA *issues*

   Machines with PCMCIA slots may have problems during installation. With the improvements of the PCMCIA code in this release, this will not happen very frequently. If you do not have PCMCIA on your machine (PCMCIA is only really used on laptop machines), you can skip this section, and ignore the "[PCMCIA]" notes. If you do have PCMCIA in your machine, you can safely ignore this section and the "[PCMCIA]" the first time, as you are likely to not have problems. Should troubles occur during floppy boot, they may be PCMCIA specific. You should then re-read this section and try again, following the instructions in the "[PCMCIA]" notes.

   This section explains how to work around the installation problem.

   The kernel keeps careful track of what interrupts and I/O ports are in use during autoconfiguration. It then allows the PCMCIA devices to pick unused interrupts and I/O ports. Unfortunately, the INSTALL kernel may not detect all devices in your system. This may be because the INSTALL kernel only supports the minimum set of devices to install NetBSD on your system, or it may be that NetBSD does not have support for the device causing the conflict.

   For example, suppose your laptop has a soundblaster device built in; the INSTALL kernel has no sound support. The PCMCIA code might allocate your soundblaster's IRQ and I/O ports to PCMCIA devices, causing them not to work, or to lock up the system. This is especially bad if one of the devices in ques-

tion is your ethernet card.

As of NetBSD 1.5, the kernel attempts to probe for available interrupts that are usable by the PCIC (PCMCIA interrupt controller). Assuming that this functions correctly, it should alleviate interrupt conflicts; however, I/O port conflicts are still possible.

This problem will impact some, but not all, users of PCMCIA. If this problem is affecting you, watch the "[PCMCIA]" notes that will appear in this document.

It can be difficult to distinguish an interrupt conflict from an I/O space conflict. There are no hard-and-fast rules, but interrupt conflicts are more likely to lock up the machine, and I/O space conflicts are more likely to result in misbehavior (e.g. a network card that cannot send or receive packets).

The kernel selects a free interrupt according to a mask of allowable interrupts, stored in the kernel global variable *pcic_isa_intr_alloc_mask*. This mask is a logical-or of power-of-2s of allowable interrupts:

IRQ	Val	IRQ	Val	IRQ	Val	IRQ	Val
0	0x0001	4	0x0010	8	0x0100	12	0x1000
1	0x0002	5	0x0020	9	0x0200	13	0x2000
2	0x0004	6	0x0040	10	0x0400	14	0x4000
3	0x0008	7	0x0080	11	0x0800	15	0x8000

For example, 0x0a00 allows both IRQ 9 and IRQ 11. By default, the `INSTALL` kernel permits all IRQs other than IRQs 5 and 7, so the corresponding mask is 0xff5f. The `GENERIC` kernel, however, allows all IRQs. (The presumption here is that IRQ 10 may be assigned to a device that the `GENERIC` kernel supports, but that the `INSTALL` does not.) Because of support for interrupt probing, it is no longer necessary to exclude IRQs 3 and 5 explicitly; if they are in use, they should not be assigned to PCMCIA.

The kernel selects IO space by assigning cards IO space within a predefined range. The range is specified as a base and size, specified by the kernel global variables *pcic_isa_alloc_iobase* and *pcic_isa_alloc_iosize*. For systems with 12-bit addressing (most systems), the kernel defaults to a base of 0x400 and a size of 0xbff (a range of 0x400-0xfff). For systems with 10-bit addressing, the kernel defaults to a base of 0x300 and a size of 0xff (range of 0x300-0x3ff).

Unfortunately, these ranges may conflict with some devices. In the event of a conflict, try a base of 0x330 with a size of 0x0bf (range of 0x330-0x3ff).

In order to work around this at installation time, you may boot the `INSTALL` kernel with **`boot -d`**, in order to enter ddb(4) (the in-kernel debugger), and then use the **`write`** command to alter the variable values:

```
db> write pcic_isa_intr_alloc_mask 0x0a00
pcic_isa_intr_alloc_mask            0xff5f = 0xa00
db> write pcic_isa_alloc_iobase 0x330
pcic_isa_alloc_iobase               0x400 = 0x330
db> write pcic_isa_alloc_iosize 0x0bf
pcic_isa_alloc_iosize               0xbff = 0xbf
db> continue
```

Note that, since some floppy images may not have symbol information in the kernel, you may have to consult the matching `.symbols` file in the `binary/kernel` directory in the installation tree. Find the pcic_ symbols used above, look at the hexadecimal value in the first column, and write, for example (if *pcic_isa_intr_alloc_mask* is equal to c0513e3c):

```
db> write 0xc0513e3c 0x0a00
```

After installation, this value can be permanently written to the kernel image directly with:

```
# cp /netbsd /netbsd.bak
# gdb --write /netbsd
(gdb) set pcic_isa_intr_alloc_mask=0x0a00
(gdb) set pcic_isa_alloc_iobase=0x330
(gdb) set pcic_isa_alloc_iosize=0x0bf
(gdb) quit
#
```

or you could specify these value when configuring your kernel, e.g.:

```
options PCIC_ISA_INTR_ALLOC_MASK=0x0a00
options PCIC_ISA_ALLOC_IOBASE=0x330
options PCIC_ISA_ALLOC_IOSIZE=0x0bf
```

If you can get your PCMCIA card to work using this hack, you may also ignore the [PCMCIA] notes later in this document.

We hope to provide a more elegant solution to this problem in a future NetBSD release.

3. *General*

   The following is a walk-through of the steps you will take while getting NetBSD installed on your hard disk. **sysinst** is a menu driven installation system that allows for some freedom in doing the installation. Sometimes, questions will be asked and in many cases the default answer will be displayed in brackets ("[ ]") after the question. If you wish to stop the installation, you may press CONTROL-C at any time, but if you do, you'll have to begin the installation process again from scratch by running the /sysinst program from the command prompt. It is not necessary to reboot.

4. *Quick install*

   First, let's describe a quick install. The other sections of this document go into the installation procedure in more detail, but you may find that you do not need this. If you want detailed instructions, skip to the next section. This section describes a basic installation, using a CD-ROM install as an example.

   - What you need.
     - The distribution sets (in this example, they are on CD).
     - Two 1.44 MB 3.5" floppy disks.
     - A PC with a 386 or newer processor.
     - A CD-ROM drive (SCSI or ATAPI), a harddisk and a minimum of 4 MB of memory installed.
     - The harddisk should have at least 70 + *n* megabytes of space free, where *n* is the number of megabytes of main memory in your system. If you wish to install the X Window System as well, you will need at least 60 MB more.
   - Creating the boot floppies. You can create the floppies needed for installation under MS-DOS or Windows. Supposing your 1.44 MB floppy drive is drive A:, and your CD is drive E: do the following from an MS-DOS command prompt:

     ```
     e:
     cd \NetBSD-1.6.1\i386\installation\misc
     rawrite
     ```

     When asked for a source filename, answer

     ```
     ..\floppy\boot1.fs
     ```

     for the first diskette and

     ```
     ..\floppy\boot2.fs
     ```

for the second diskette.

When asked for a destination drive answer '**a**'.

- To create a bootfloppy under NetBSD or other UNIX-like system, you would type something like:

  ```
  # dd if=.../boot1.fs bs=18k of=/dev/rfd0a
  ```

- The Quick Installation
  - Insert the first boot floppy you just created. Restart the computer. When prompted, insert the second boot floppy. The main menu will be displayed.

    ```
    .*********************************************.
    * NetBSD-1.6 Install System                    *
    *                                              *
    *>a: Install NetBSD to hard disk               *
    * b: Upgrade NetBSD on a hard disk             *
    * c: Re-install sets or install additional sets *
    * d: Reboot the computer                       *
    * e: Utility menu                              *
    * x: Exit Install System                       *
    .*********************************************.
    ```

  - If you wish, you can configure some network settings immediately by choosing the **Utility menu** and then **Configure network**. It isn't actually required at this point, but it may be more convenient. Go back to the main menu.
  - Choose **install**.
  - You will be guided through some steps regarding the setup of your disk, and the selection of distributed components to install. When in doubt, refer to the rest of this document for details.
  - After your disk has been prepared, choose **CD-ROM** as the medium. The default values for the path and device should be ok.
  - After all the files have been unpacked, go back to the main menu and select **reboot**, after you have removed the bootfloppy from the drive.
  - NetBSD will now boot. If you haven't already done so in **sysinst**, you should log in as `root`, and set a password for that account. You are also advised to edit the file `/etc/rc.conf` to match your system needs.
  - Your installation is now complete.
  - For configuring the X window system, if installed, see the files in `/usr/X11R6/lib/X11/doc`. Further information can be found on **http://www.xfree86.org/**.

5. *Booting NetBSD*

   [PCMCIA] Unplug your PCMCIA devices, so that they won't be found by NetBSD.

   Boot your machine. The boot loader will start, and will print a countdown and begin booting.

   If the boot loader messages do not appear in a reasonable amount of time, you either have a bad boot floppy or a hardware problem. Try writing the install floppy image to a different disk, and using that.

   If that doesn't work, try booting after disabling your CPU's internal and external caches (if any). If it still doesn't work, NetBSD probably can't be run on your hardware. This can probably be considered a bug, so you might want to report it. If you do, please include as many details about your system config-

uration as you can.

It will take a while to load the kernel from the floppy, probably around a minute or so, then, the kernel boot messages will be displayed. This may take a little while also, as NetBSD will be probing your system to discover which hardware devices are installed. You may want to read the boot messages, to notice your disk's name and geometry. Its name will be something like `sd0` or `wd0` and the geometry will be printed on a line that begins with its name. As mentioned above, you may need your disk's geometry when creating NetBSD 's partitions. You will also need to know the name, to tell **sysinst** on which disk to install. The most important thing to know is that `wd0` is NetBSD 's name for your first IDE disk, `wd1` the second, etc. `sd0` is your first SCSI disk, `sd1` the second, etc.

Note that once the system has finished booting, you need not leave the floppy in the disk drive. Earlier version of the NetBSD install floppies mounted the floppy as the system's root partition (`/`), but the new installation floppies use a ramdisk file system and are no longer dependent on the floppy once it has booted.

Once NetBSD has booted and printed all the boot messages, you will be presented with a welcome message and a main menu. It will also include instructions for using the menus.

6. *Network configuration*

   [PCMCIA] You can skip this section, as you will only get data from floppy in the first part of the install.

   If you will not use network operation during the installation, but you do want your machine to be configured for networking once it is installed, you should first go to the **Utility menu**, and select the **Configure network** option. If you only want to temporarily use networking during the installation, you can specify these parameters later. If you are not using the Domain Name System (DNS), you can give an empty response in reply to answers relating to this.

7. *Installation drive selection and parameters*

   To start the installation, select **Install NetBSD to hard disk** from the main menu.

   The first thing is to identify the disk on which you want to install NetBSD. **sysinst** will report a list of disks it finds and ask you for your selection. Depending on how many disks are found, you may get a different message. You should see disk names like `wd0`, `wd1`, `sd0` or `sd1`.

   sysinst next tries to figure out the real and BIOS geometry of your disk. It will present you with the values it found, if any, and will give you a chance to change them.

   Next, depending on whether you are using a `wd`*X* or `sd`*X* disk, you will either be asked for the type of disk (`wd`*X*) you are using or you will be asked if you want to specify a fake geometry for your SCSI disk (`sd`*X*). The types of disk are be IDE, ST-506 or ESDI. If you're installing on an ST-506 or ESDI drive, you'll be asked if your disk supports automatic sector forwarding. If you are *sure* that it does, reply affirmatively. Otherwise, the install program will automatically reserve space for bad144 tables.

8. *Partitioning the disk*

   - Which portion of the disk to use.

     You will be asked if you want to use the entire disk or only part of the disk. If you decide to use the entire disk for NetBSD, it will be checked if there are already other systems present on the disk, and you will be asked to confirm whether you want to overwrite these.

   If you want to use the entire disk for NetBSD, you can skip the following section and go to *Editing the NetBSD disklabel*.

9. *Editing the Master Boot Record*

   First, you will be prompted to specify the units of size that you want to express the sizes of the partitions in. You can either pick megabytes, cylinders or sectors.

   After this, you will be presented with the current values stored in the MBR, and will be given the opportunity to change, create or delete partitions. For each partition you can set the type, the start and the size. Setting the type to **unused** will delete a partition. You can also mark a partition as active, meaning that this is the one that the BIOS will start from at boot time.

   Be sure to mark the partition you want to boot from as active!

   After you are done editing the MBR, a sanity check will be done, checking for partitions that overlap. Depending on the BIOS capabilities of your machine and the parameters of the NetBSD partition you have specified, you may also be asked if you want to install newer bootcode in your MBR. If you have multiple operating systems on the disk that you are installing on, you will also be given the option to install a bootselector, that will allow you to pick the operating system to start up when your computer is (re-)started.

   If everything is ok, you can go on to the next step, editing the NetBSD disklabel.

10. *Editing the NetBSD disklabel*

    The partition table of the NetBSD part of a disk is called a *disklabel*. There are 4 layouts for the NetBSD part of the disk that you can pick from: **Standard, Standard with X, Custom** and **Use Existing**. The first two use a set of default values (that you can change) suitable for a normal installation, possibly including X. With the **Custom** option you can specify everything yourself. The last option uses the partition info already present on the disk.

    You will be presented with the current layout of the NetBSD disklabel, and given a chance to change it. For each partition, you can set the type, offset and size, block and fragment size, and the mount point. The type that NetBSD uses for normal file storage is called **4.2BSD**. A swap partition has a special type called **swap**. You can also specify a partition as type **MSDOS**. This is useful if you share the disk with MS-DOS or Windows; NetBSD is able to access the files on these partitions. You can use the values from the MBR for the MS-DOS part of the disk to specify the partition of type **MSDOS** (you don't have to do this now, you can always re-edit the disklabel to add this once you have installed NetBSD).

    Some partitions in the disklabel have a fixed purpose.

    `a` Root partition (`/`)

    `b` Swap partition.

    `c` The NetBSD portion of the disk.

    `d` The entire disk.

    `e-p` Available for other use. Traditionally, `e` is the partition mounted on `/usr`, but this is historical practice and not a fixed value.

    You will then be asked to name your disk's disklabel. The default response is "**mydisk**". For most purposes this will be OK. If you choose to name it something different, make sure the name is a single word and contains no special characters. You don't need to remember this name.

11. *Preparing your hard disk*

    You are now at the point of no return. Nothing has been written to your disk yet, but if you confirm that you want to install NetBSD, your hard drive will be modified. If you are sure you want to proceed, enter `yes` at the prompt.

The install program will now label your disk and make the file systems you specified. The file systems will be initialized to contain NetBSD bootstrapping binaries and configuration files. You will see messages on your screen from the various NetBSD disk preparation tools that are running. There should be no errors in this section of the installation. If there are, restart from the beginning of the installation process. Otherwise, you can continue the installation program after pressing the return key.

Note: In previous versions of NetBSD, the kernel from the install floppy was copied onto the hard drive in a special step. In the current install system, the kernel on the floppy is unsuited to being copied onto the hard drive. Instead, a new set, **kern**, has been added which contains a generic kernel to be unloaded onto the drive. So, you can not boot from your hard drive yet at this point.

12. *Getting the distribution sets*

[PCMCIA] Load a kernel tar file (i.e. the `kern-GENERIC.tgz` set file) on to your hard disk, for example by mounting the hard disk first, copying the `kern-GENERIC.tgz` file from floppy and unpacking it. Example:

```
# mount /dev/wd0a /mnt
# cd /mnt

repeat the following 3 steps until all kern.* files are there
# mount -t msdos /dev/fd0a /mnt2
# cp /mnt2/kern.* .
# umount /mnt2
# cat kern.* | tar zxpvf -
```

Then halt the machine using the **halt** command. Power the machine down, and re-insert all the PCMCIA devices. Remove any floppy from the floppy drive. Start the machine up. After booting NetBSD, you will be presented with the main **sysinst** menu. Choose the option to re-install sets. Wait for the file system checks that it will do to finish, and then proceed as described below.

The NetBSD distribution consists of a number of *sets*, that come in the form of gzipped tarfiles. A few sets must be installed for a working system, others are optional. At this point of the installation, you will be presented with a menu which enables you to choose from one of the following methods of installing the sets. Some of these methods will first load the sets on your hard disk, others will extract the sets directly.

For all these methods, the first step is making the sets available for extraction, and then do the actual installation. The sets can be made available in a few different ways. The following sections describe each of those methods. After reading the one about the method you will be using, you can continue to section labeled 'Extracting the distribution sets'.

13. *Installation using ftp*

To be able to install using ftp, you first need to configure your network setup, if you haven't already at the start of the install procedure. **sysinst** will do this for you, asking you to provide some data, like IP address, hostname, etc. If you do not have name service set up for the machine that you are installing on, you can just press `RETURN` in answer to these questions, and DNS will not be used.

You will also be asked to specify the host that you want to transfer the sets from, the directory on that host, the account name and password used to log into that host using ftp, and optionally a proxy server to use. If you did not set up DNS when answering the questions to configure networking, you will need to specify an IP address instead of a hostname for the ftp server.

sysinst will proceed to transfer all the default set files from the remote site to your hard disk.

14. *Installation using NFS*

    To be able to install using NFS, you first need to configure your network setup, if you haven't already at the start of the install procedure. **sysinst** will do this for you, asking you to provide some data, like IP address, hostname, etc. If you do not have name service set up for the machine that you are installing on, you can just press RETURN in answer to these questions, and DNS will not be used.

    You will also be asked to specify the host that you want to transfer the sets from, and the directory on that host that the files are in. This directory should be mountable by the machine you are installing on, i.e. correctly exported to your machine.

    If you did not set up DNS when answering the questions to configure networking, you will need to specify an IP address instead of a hostname for the NFS server.

15. *Installation from CD-ROM*

    When installing from a CD-ROM, you will be asked to specify the device name for your CD-ROM player (usually cd0), and the directory name on the CD-ROM where the distribution files are.

    sysinst will then check if the files are indeed available in the specified location, and proceed to the actual extraction of the sets.

16. *Installation from a floppy set*

    Because the installation sets are too big to fit on one floppy, the floppies are expected to be filled with the split set files. The floppies are expected to be in MS-DOS format. You will be asked for a directory where the sets should be reassembled. Then you will be prompted to insert the floppies containing the split sets. This process will continue until all the sets have been loaded from floppy.

17. *Installation from an unmounted file system*

    In order to install from a local file system, you will need to specify the device that the file system resides on (for example sd1e) the type of the file system, and the directory on the specified file system where the sets are located. **sysinst** will then check if it can indeed access the sets at that location.

18. *Installation from a local directory*

    This option assumes that you have already done some preparation yourself. The sets should be located in a directory on a file system that is already accessible. **sysinst** will ask you for the name of this directory.

19. *Extracting the distribution sets*

    After the install sets containing the NetBSD distribution have been made available, you can either extract all the sets (a full installation), or only extract sets that you have selected. In the latter case, you will be shown the currently selected sets, and given the opportunity to select the sets you want. Some sets always need to be installed (**kern, base**) and **etc** they will not be shown in this selection menu.

    Before extraction begins, you can elect to watch the files being extracted; the name of each file that is extracted will be shown. This can slow down the installation process considerably, especially on machines with slow graphics consoles or serial consoles.

    After all the files have been extracted, all the necessary device node files will be created. If you have already configured networking, you will be asked if you want to use this configuration for normal operation. If so, these values will be installed in the network configuration files. The next menu will allow you to select the time zone that you're in, to make sure your clock has the right offset from UTC. Finally you will be asked to select a password encryption algorithm and can than set a password for the "root" account, to prevent the machine coming up without access restrictions.

20. *Finalizing your installation*

    Congratulations, you have successfully installed NetBSD 1.6.1. You can now reboot the machine, and boot NetBSD from harddisk.

Post installation steps

Once you've got the operating system running, there are a few things you need to do in order to bring the system into a properly configured state, with the most important ones described below.

1. Configuring `/etc/rc.conf`

   If you or the installation software haven't done any configuration of `/etc/rc.conf` (**sysinst** usually will), the system will drop you into single user mode on first reboot with the message

   ```
   /etc/rc.conf is not configured. Multiuser boot aborted.
   ```

   and with the root file system (/) mounted read-only. When the system asks you to choose a shell, simply press RETURN to get to a `/bin/sh` prompt. If you are asked for a terminal type, respond with **vt220** (or whatever is appropriate for your terminal type) and press RETURN. You may need to type one of the following commands to get your delete key to work properly, depending on your keyboard:

   ```
   # stty erase '^h'
   # stty erase '^?'
   ```

   At this point, you need to configure at least one file in the `/etc` directory. You will need to mount your root file system read/write with:

   ```
   # /sbin/mount -u -w /
   ```

   Change to the `/etc` directory and take a look at the `/etc/rc.conf` file. Modify it to your tastes, making sure that you set `rc_configured=YES` so that your changes will be enabled and a multi-user boot can proceed. Default values for the various programs can be found in `/etc/defaults/rc.conf`, where some in-line documentation may be found. More complete documentation can be found in `rc.conf`(5).

   If your `/usr` directory is on a separate partition and you do not know how to use **ed**, you will have to mount your `/usr` partition to gain access to **ex** or **vi**. Do the following:

   ```
   # mount /usr
   # export TERM=vt220
   ```

   If you have `/var` on a separate partition, you need to repeat that step for it. After that, you can edit `/etc/rc.conf` with `vi`(1). When you have finished, type **exit** at the prompt to leave the single-user shell and continue with the multi-user boot.

   Other values that need to be set in `/etc/rc.conf` for a networked environment are *hostname* and possibly *defaultroute*, furthermore add an *ifconfig_int* for your <int> network interface, along the lines of

   ```
   ifconfig_de0="inet 123.45.67.89 netmask 255.255.255.0"
   ```

   or, if you have *myname.my.dom* in `/etc/hosts`:

   ```
   ifconfig_de0="inet myname.my.dom netmask 255.255.255.0"
   ```

   To enable proper hostname resolution, you will also want to add an `/etc/resolv.conf` file or (if you are feeling a little more adventurous) run `named`(8). See `resolv.conf`(5) or `named`(8) for more information.

   Other files in `/etc` that may require modification or setting up include `/etc/mailer.conf`, `/etc/nsswitch.conf`, and `/etc/wscons.conf`.

2. Logging in

   After reboot, you can log in as `root` at the login prompt. Unless you've set a password in **sysinst**, there is no initial password. If you're using the machine in a networked environment, you should create an account for yourself (see below) and protect it and the "root" account with good passwords. Unless you have connected an unusual terminal device as the console you can just press `RETURN` when it prompts for `Terminal type? [...]`.

3. Adding accounts

   Use the `useradd`(8) command to add accounts to your system; *do not* edit `/etc/passwd` directly. See `useradd`(8) for more information on how to add a new user to the system.

4. The X Window System

   If you have installed the X Window System, look at the files in `/usr/X11R6/lib/X11/doc` for information.

   You will need to set up a configuration file, see `/usr/X11R6/lib/X11/XF86Config.eg` for an example. The `xf86config`(1) utility can interactively create a first version of such a configuration file for you. See **http://www.xfree86.org/** and the XFree86 manual page for more information.

   Don't forget to add `/usr/X11R6/bin` to your path in your shell's dot file so that you have access to the X binaries.

5. Installing third party packages

   If you wish to install any of the software freely available for UNIX-like systems you are strongly advised to first check the NetBSD package system. This automatically handles any changes necessary to make the software run on NetBSD, retrieval and installation of any other packages on which the software may depend, and simplifies installation (and deinstallation), both from source and precompiled binaries.

   - More information on the package system is at
     http://www.netbsd.org/Documentation/software/packages.html
   - A list of available packages suitable for browsing is at
     ftp://ftp.netbsd.org/pub/NetBSD/packages/pkgsrc/README.html
   - Precompiled binaries can be found at
     ftp://ftp.netbsd.org/pub/NetBSD/packages,
     usually in the `1.6.1/i386/All` subdir. You can install them with the following commands:

     ```
     # PKG_PATH=ftp://ftp.netbsd.org/pub/NetBSD/packages/1.6.1/i386/All
     # export PKG_PATH
     # pkg_add -v tcsh
     # pkg_add -v apache
     # pkg_add -v perl
     ...
     ```

     The above commands will install the tcsh shell, the Apache web server and the perl programming language as well as all the packages they depend on.

   - Package sources for compiling packages on your own can be obtained by retrieving the file
     ftp://ftp.netbsd.org/pub/NetBSD/NetBSD-current/tar_files/pkgsrc.tar.gz
     They are typically extracted into `/usr/pkgsrc` (though other locations work fine), with the commands:

     ```
     # mkdir /usr/pkgsrc
     # ( cd /usr/pkgsrc ; tar -zxpf - ) < pkgsrc.tar.gz
     ```

After extracting, then see the `README` file in the extraction directory (e.g. `/usr/pkgsrc/README`) for more information.

6. Misc

   - Edit `/etc/mail/aliases` to forward root mail to the right place. Don't forget to run `newaliases`(1) afterwards.
   - The `/etc/mail/sendmail.cf` file will almost definitely need to be adjusted; files aiding in this can be found in `/usr/share/sendmail`. See the README file there for more information.
   - Edit `/etc/rc.local` to run any local daemons you use.
   - Many of the `/etc` files are documented in section 5 of the manual; so just invoking

     ```
     # man 5 filename
     ```

     is likely to give you more information on these files.

Upgrading a previously-installed NetBSD System

The upgrade to NetBSD 1.6.1 is a binary upgrade; it can be quite difficult to update the system from an earlier version by recompiling from source, primarily due to interdependencies in the various components.

To do the upgrade, you must have the boot floppy set available. You must also have at least the **base** and **kern** binary distribution sets available, so that you can upgrade with them, using one of the upgrade methods described above. Finally, you must have sufficient disk space available to install the new binaries. Since files already installed on the system are overwritten in place, you only need additional free space for files which weren't previously installed or to account for growth of the sets between releases. If you have a few megabytes free on each of your root (`/`) and `/usr` partitions, you should have enough space.

Since upgrading involves replacing the boot blocks on your NetBSD partition, the kernel, and most of the system binaries, it has the potential to cause data loss. You are strongly advised to *back up* any important data on your disk, whether on the NetBSD partition or on another operating system's partition, before beginning the upgrade process.

The upgrade procedure using the **`sysinst`** tool is similar to an installation, but without the hard disk partitioning. The original `/etc` directory is renamed to `/etc.old`, and no attempt is made to merge any of the previous configuration into the new system except that the previous `/etc/fstab` file is copied into the new configuration. Getting the binary sets is done in the same manner as the installation procedure; refer to the installation part of the document for how to do this. Also, some sanity checks are done, i.e. file systems are checked before unpacking the sets.

After a new kernel has been copied to your hard disk, your machine is a complete NetBSD 1.6.1 system. However, that doesn't mean that you're finished with the upgrade process. You will probably want to update the set of device nodes you have in `/dev`. If you've changed the contents of `/dev` by hand, you will need to be careful about this, but if not, you can just cd into `/dev`, and run the command:

```
# sh MAKEDEV all
```

Finally, you will want to delete old binaries that were part of the version of NetBSD that you upgraded from and have since been removed from the NetBSD distribution.

NetBSD/i386 has switched its executable format from the old a.out format to ELF, the now more commonly used and supported format. Your old binaries will continue to work just fine. The installation procedure will try to take the necessary steps to accomplish this. The most important step is to move the old a.out shared libraries in `/usr/lib` and `/usr/X11R6/lib` (if X was installed) to `/emul/aout`, where they will be automatically found if an older a.out binary is executed. **`sysinst`** will use an existing `/emul` and / or `/emul/aout` directory if available, and will create it (as a symbolic link to `/usr/aout`) if necessary.

If you already had a /emul directory, or a symbolic link by that name, **sysinst** should rename it and tell you about it.

Compatibility Issues With Previous NetBSD Releases

Users upgrading from previous versions of NetBSD may wish to bear the following problems and compatibility issues in mind when upgrading to NetBSD 1.6.1.

Issues affecting an upgrade from NetBSD 1.5

The following issues can generally be resolved by extracting the **etc** set into a temporary directory and running *postinstall*:

```
mkdir /tmp/upgrade
cd /tmp/upgrade
pax -zrpe -f /path/to/etc.tgz
./etc/postinstall -s `pwd` check
./etc/postinstall -s `pwd` fix
```

Issues fixed by *postinstall*:

- Various files in /etc need upgrading. These include:
  - /etc/defaults/*
  - /etc/mtree/*
  - /etc/daily
  - /etc/weekly
  - /etc/monthly
  - /etc/security
  - /etc/rc.subr
  - /etc/rc
  - /etc/rc.shutdown
  - /etc/rc.d/*
- The following files are now obsolete: /etc/rc.d/NETWORK and /etc/rc.d/gated.
- The following rc.conf(5) entries are now obsolete: amd_master, ip6forwarding, defcorename, and nfsiod_flags. critical_filesystems_beforenet has been replaced by critical_filesystems_local. critical_filesystems has been replaced by critical_filesystems_remote.
- The users and groups 'named', 'ntpd', and 'sshd' need to be created.
- The configuration files for ssh(1) and sshd(8) were moved from /etc to /etc/ssh, including ssh_known_hosts* files and the host key files ssh_host*_key*. /etc/ssh.conf was renamed to /etc/ssh/ssh_config, and /etc/sshd.conf was renamed to /etc/ssh/sshd_config.
- The **mux** entries in wscons.conf(5) are now obsolete.

The following issues need to be resolved manually:

- postfix(8) configuration files require upgrading.

```
cd /usr/share/examples/postfix
cp post-install postfix-files postfix-script /etc/postfix
postfix check
```

- The *de* ethernet driver was replaced with the *tlp* driver. This may require the renaming of the files `/etc/ifconfig.de*` to `/etc/ifconfig.tlp*`, renaming of `rc.conf`(5) entries `ifconfig_de*` to `ifconfig_tlp*`, and the reconfiguration of files such as `/etc/dhclient.conf` and `/etc/ipf.conf`.

Issues affecting an upgrade from NetBSD 1.4 or prior

- `/etc/rc` modified to use `/etc/rc.d/*`

  Prior to NetBSD 1.5, `/etc/rc` was a traditional BSD style monolithic file; each discrete program or subsystem from `/etc/rc` and `/etc/netstart` has been moved into separate scripts in `/etc/rc.d/`.

  At system startup, `/etc/rc` uses `rcorder`(8) to build a dependency list of the files in `/etc/rc.d` and then executes each script in turn with an argument of 'start'. Many `rc.d` scripts won't start unless the appropriate `rc.conf`(5) entry in `/etc/rc.conf` is set to 'YES.'

  At system shutdown, `/etc/rc.shutdown` uses `rcorder`(8) to build a dependency list of the files in `/etc/rc.d` that have a "KEYWORD: shutdown" line, reverses the resulting list, and then executes each script in turn with an argument of 'stop'. The following scripts support a specific shutdown method: `cron`, `inetd`, `local`, and `xdm`.

  Local and third-party scripts may be installed into `/etc/rc.d` as necessary. Refer to the other scripts in that directory and `rc`(8) for more information on implementing `rc.d` scripts.

- `named`(8) leaks version information.

  Previous releases of NetBSD disabled a feature of `named`(8) where the version number of the server could be determined by remote clients. This feature has not been disabled in NetBSD 1.5, because there is a `named.conf`(5) option to change the version string:

```
option {
        version "newstring";
};
```

- `sysctl`(8) was moved from `/usr/sbin/sysctl` to `/sbin/sysctl`. If you have hardcoded references to the full pathname (in shell scripts, for example) please be sure to update those.

- `sendmail`(8) configuration file pathname changed.

  Due to `sendmail`(8) upgrade from 8.9.x to 8.10.x, `/etc/sendmail.cf` is moved to `/etc/mail/sendmail.cf`. Also, the default `sendmail.cf`(5) refers different pathnames than before. For example, `/etc/aliases` is now located at `/etc/mail/aliases`, `/etc/sendmail.cw` is now called `/etc/mail/local-host-names`, and so forth. If you have customized `sendmail.cf`(5) and friends, you will need to move the files to the new locations. See `/usr/share/sendmail/README` for more information.

Using online NetBSD documentation

Documentation is available if you first install the manual distribution set. Traditionally, the "man pages" (documentation) are denoted by '`name(section)`'. Some examples of this are

- `intro`(1),
- `man`(1),
- `apropos`(1),
- `passwd`(1), and
- `passwd`(5).

The section numbers group the topics into several categories, but three are of primary interest: user commands are in section 1, file formats are in section 5, and administrative information is in section 8.

The *man* command is used to view the documentation on a topic, and is started by entering **man** [*section*] *topic*. The brackets [ ] around the section should not be entered, but rather indicate that the section is optional. If you don't ask for a particular section, the topic with the lowest numbered section name will be displayed. For instance, after logging in, enter

```
# man passwd
```

to read the documentation for passwd(1). To view the documentation for passwd(5), enter

```
# man 5 passwd
```

instead.

If you are unsure of what man page you are looking for, enter **apropos** *subject-word*

where *subject-word* is your topic of interest; a list of possibly related man pages will be displayed.

Administrivia

If you've got something to say, do so! We'd like your input. There are various mailing lists available via the mailing list server at majordomo@netbsd.org. To get help on using the mailing list server, send mail to that address with an empty body, and it will reply with instructions.

There are various mailing lists set up to deal with comments and questions about this release. Please send comments to: netbsd-comments@netbsd.org.

To report bugs, use the send-pr(1) command shipped with NetBSD, and fill in as much information about the problem as you can. Good bug reports include lots of details. Additionally, bug reports can be sent by mail to: netbsd-bugs@netbsd.org.

Use of send-pr(1) is encouraged, however, because bugs reported with it are entered into the NetBSD bugs database, and thus can't slip through the cracks.

There are also port-specific mailing lists, to discuss aspects of each port of NetBSD. Use majordomo to find their addresses, or visit **http://www.netbsd.org/MailingLists/**. If you're interested in doing a serious amount of work on a specific port, you probably should contact the 'owner' of that port (listed below).

If you'd like to help with this effort, and have an idea as to how you could be useful, send us mail or subscribe to: netbsd-help@netbsd.org.

As a favor, please avoid mailing huge documents or files to these mailing lists. Instead, put the material you would have sent up for FTP or WWW somewhere, then mail the appropriate list about it, or, if you'd rather not do that, mail the list saying you'll send the data to those who want it.

Thanks go to

- The former members of UCB's Computer Systems Research Group, including (but not limited to):

  Keith Bostic
  Ralph Campbell
  Mike Karels
  Marshall Kirk McKusick

  for their ongoing work on BSD systems, support, and encouragement.

- Also, our thanks go to:

  Mike Hibler
  Rick Macklem
  Jan-Simon Pendry
  Chris Torek

for answering lots of questions, fixing bugs, and doing the various work they've done.

- UC Berkeley's Experimental Computing Facility provided a home for sun-lamp in the past, people to look after it, and a sense of humor. Rob Robertson, too, has added his unique sense of humor to things, and for a long time provided the primary FTP site for NetBSD.
- Vixie Enterprises for hosting the NetBSD FTP, SUP, and WWW servers.
- Redback Networks, Inc. for hosting the NetBSD mail and GNATS server.
- The Helsinki University of Technology in Finland for hosting the NetBSD CVS server.
- The Internet Research Institute in Japan for hosting the server which runs the CVSweb interface to the NetBSD source tree.
- The many organisations that provide NetBSD mirror sites.
- Without CVS, this project would be impossible to manage, so our hats go off to Brian Berliner, Jeff Polk, and the various other people who've had a hand in making CVS a useful tool.
- Dave Burgess `burgess@cynjut.infonet.net` has been maintaining the 386BSD/NetBSD/FreeBSD FAQ for quite some time, and deserves to be recognized for it.
- The following individuals and organizations (each in alphabetical order) have made donations or loans of hardware and/or money, to support NetBSD development, and deserve credit for it:

  Steve Allen
  Jason Birnschein
  Mason Loring Bliss
  Jason Brazile
  Mark Brinicombe
  David Brownlee
  Simon Burge
  Dave Burgess
  Ralph Campbell
  Brian Carlstrom
  James Chacon
  Bill Coldwell
  Charles Conn
  Tom Coulter
  Charles D. Cranor
  Christopher G. Demetriou
  Scott Ellis
  Hubert Feyrer
  Castor Fu
  Greg Gingerich
  William Gnadt
  Michael Graff
  Guenther Grau
  Ross Harvey
  Charles M. Hannum
  Michael L. Hitch
  Kenneth Alan Hornstein
  Jordan K. Hubbard
  Søren Jørvang
  Scott Kaplan

Noah M. Keiserman
Harald Koerfgen
John Kohl
Chris Legrow
Ted Lemon
Norman R. McBride
Neil J. McRae
Perry E. Metzger
Luke Mewburn
Toru Nishimura
Herb Peyerl
Mike Price
Dave Rand
Michael Richardson
Heiko W. Rupp
Brad Salai
Chuck Silvers
Thor Lancelot Simon
Bill Sommerfeld
Paul Southworth
Eric and Rosemary Spahr
Ted Spradley
Kimmo Suominen
Jason R. Thorpe
Steve Wadlow
Krister Walfridsson
Rob Windsor
Jim Wise
Reinoud Zandijk
Christos Zoulas

AboveNet Communications, Inc.
Advanced System Products, Inc.
Avalon Computer Systems
Bay Area Internet Solutions
Brains Corporation, Japan
Canada Connect Corporation
Co-operative Research Centre for Enterprise Distributed Systems Technology
Demon Internet, UK
Digital Equipment Corporation
Distributed Processing Technology
Easynet, UK
Free Hardware Foundation
Innovation Development Enterprises of America
Internet Software Consortium
MS Macro System GmbH, Germany
Numerical Aerospace Simulation Facility, NASA Ames Research Center
Piermont Information Systems Inc.
Precedence Technologies Ltd
Salient Systems Inc.
VMC Harald Frank, Germany
Warped Communications, Inc.

Whitecross Database Systems Ltd.

(If you're not on that list and should be, tell us! We probably were not able to get in touch with you, to verify that you wanted to be listed.)

- Finally, we thank all of the people who've put sweat and tears into developing NetBSD since its inception in January, 1993. (Obviously, there are a lot more people who deserve thanks here. If you're one of them, and would like to mentioned, tell us!)

We are...

(in alphabetical order)

The NetBSD core group:

Jun-ichiro itojun Hagino	itojun@netbsd.org
Frank van der Linden	fvdl@netbsd.org
Luke Mewburn	lukem@netbsd.org
Christos Zoulas	christos@netbsd.org

The portmasters (and their ports):

Simon Burge	simonb@netbsd.org	**pmax**
Simon Burge	simonb@netbsd.org	**sbmips**
Jeremy Cooper	jeremy@netbsd.org	**sun3x**
Matt Fredette	fredette@netbsd.org	**sun2**
Chris Gilbert	chris@netbsd.org	**cats**
Ross Harvey	ross@netbsd.org	**alpha**
Jun-ichiro itojun Hagino	itojun@netbsd.org	**sh3**
Ben Harris	bjh21@netbsd.org	**acorn26**
Eduardo Horvath	eeh@netbsd.org	**sparc64**
Darrin Jewell	dbj@netbsd.org	**next68k**
Søren Jørvang	soren@netbsd.org	**cobalt**
Søren Jørvang	soren@netbsd.org	**sgimips**
Wayne Knowles	wdk@netbsd.org	**mipsco**
Paul Kranenburg	pk@netbsd.org	**sparc**
Frank van der Linden	fvdl@netbsd.org	**i386**
Anders Magnusson	ragge@netbsd.org	**vax**
Phil Nelson	phil@netbsd.org	**pc532**
NISHIMURA Takeshi	nsmrtks@netbsd.org	**x68k**
Tohru Nishimura	nisimura@netbsd.org	**luna68k**
NONAKA Kimihiro	nonaka@netbsd.org	**prep**
Scott Reynolds	scottr@netbsd.org	**mac68k**
Kazuki Sakamoto	sakamoto@netbsd.org	**bebox**
Noriyuki Soda	soda@netbsd.org	**arc**
Wolfgang Solfrank	ws@netbsd.org	**ofppc**
Ignatios Souvatzis	is@netbsd.org	**amiga**
Jonathan Stone	jonathan@netbsd.org	**pmax**
Shin Takemura	takemura@netbsd.org	**hpcmips**
Jason Thorpe	thorpej@netbsd.org	**alpha**
Jason Thorpe	thorpej@netbsd.org	**hp300**
Tsubai Masanari	tsubai@netbsd.org	**macppc**

Tsubai Masanari	tsubai@netbsd.org	**newsmips**
Izumi Tsutsui	tsutsui@netbsd.org	**news68k**
Leo Weppelman	leo@netbsd.org	**atari**
Nathan Williams	nathanw@netbsd.org	**sun3**
Steve Woodford	scw@netbsd.org	**mvme68k**
Steve Woodford	scw@netbsd.org	**mvmeppc**
Reinoud Zandijk	reinoud@netbsd.org	**acorn32**

The NetBSD 1.6.1 Release Engineering team:

Erik Berls	cyber@netbsd.org
Håvard Eidnes	he@netbsd.org
Perry Metzger	perry@netbsd.org
Luke Mewburn	lukem@netbsd.org
Jason Thorpe	thorpej@netbsd.org
Todd Vierling	tv@netbsd.org

NetBSD Developers:

Nathan Ahlstrom	nra@netbsd.org
Steve Allen	wormey@netbsd.org
Julian Assange	proff@netbsd.org
Lennart Augustsson	augustss@netbsd.org
Christoph Badura	bad@netbsd.org
Bang Jun-Young	junyoung@netbsd.org
Dieter Baron	dillo@netbsd.org
Robert V. Baron	rvb@netbsd.org
Jason Beegan	jtb@netbsd.org
Erik Berls	cyber@netbsd.org
Hiroyuki Bessho	bsh@netbsd.org
John Birrell	jb@netbsd.org
Mason Loring Bliss	mason@netbsd.org
Rafal Boni	rafal@netbsd.org
Manuel Bouyer	bouyer@netbsd.org
John Brezak	brezak@netbsd.org
Allen Briggs	briggs@netbsd.org
Mark Brinicombe	mark@netbsd.org
Aaron Brown	abrown@netbsd.org
Andrew Brown	atatat@netbsd.org
David Brownlee	abs@netbsd.org
Frederick Bruckman	fredb@netbsd.org
Jon Buller	jonb@netbsd.org
Simon Burge	simonb@netbsd.org
Robert Byrnes	byrnes@netbsd.org
D'Arcy J.M. Cain	darcy@netbsd.org
Dave Carrel	carrel@netbsd.org
James Chacon	jmc@netbsd.org
Bill Coldwell	billc@netbsd.org
Julian Coleman	jdc@netbsd.org

Jeremy Cooper	jeremy@netbsd.org
Chuck Cranor	chuck@netbsd.org
Alistair Crooks	agc@netbsd.org
Aidan Cully	aidan@netbsd.org
Johan Danielsson	joda@netbsd.org
Matt DeBergalis	deberg@netbsd.org
Rob Deker	deker@netbsd.org
Chris G. Demetriou	cgd@netbsd.org
Tracy Di Marco White	gendalia@netbsd.org
Jaromír Dolecek	jdolecek@netbsd.org
Andy Doran	ad@netbsd.org
Roland Dowdeswell	elric@netbsd.org
Emmanuel Dreyfus	manu@netbsd.org
Matthias Drochner	drochner@netbsd.org
Jun Ebihara	jun@netbsd.org
Håvard Eidnes	he@netbsd.org
Stoned Elipot	seb@netbsd.org
Enami Tsugutomo	enami@netbsd.org
Bernd Ernesti	veego@netbsd.org
Erik Fair	fair@netbsd.org
Gavan Fantom	gavan@netbsd.org
Hubert Feyrer	hubertf@netbsd.org
Jason R. Fink	jrf@netbsd.org
Matt Fredette	fredette@netbsd.org
Thorsten Frueauf	frueauf@netbsd.org
Castor Fu	castor@netbsd.org
Ichiro Fukuhara	ichiro@netbsd.org
Thomas Gerner	thomas@netbsd.org
Simon J. Gerraty	sjg@netbsd.org
Justin Gibbs	gibbs@netbsd.org
Chris Gilbert	chris@netbsd.org
Adam Glass	glass@netbsd.org
Michael Graff	explorer@netbsd.org
Brian C. Grayson	bgrayson@netbsd.org
Matthew Green	mrg@netbsd.org
Andreas Gustafsson	gson@netbsd.org
Jun-ichiro itojun Hagino	itojun@netbsd.org
Juergen Hannken-Illjes	hannken@netbsd.org
Charles M. Hannum	mycroft@netbsd.org
Ben Harris	bjh21@netbsd.org
Ross Harvey	ross@netbsd.org
Eric Haszlakiewicz	erh@netbsd.org
John Hawkinson	jhawk@netbsd.org
HAYAKAWA Koichi	haya@netbsd.org
René Hexel	rh@netbsd.org
Michael L. Hitch	mhitch@netbsd.org
Christian E. Hopps	chopps@netbsd.org
Ken Hornstein	kenh@netbsd.org
Marc Horowitz	marc@netbsd.org

Eduardo Horvath	eeh@netbsd.org
Nick Hudson	skrll@netbsd.org
Shell Hung	shell@netbsd.org
Martin Husemann	martin@netbsd.org
Dean Huxley	dean@netbsd.org
Bernardo Innocenti	bernie@netbsd.org
Tetsuya Isaki	isaki@netbsd.org
ITOH Yasufumi	itohy@netbsd.org
IWAMOTO Toshihiro	toshii@netbsd.org
Matthew Jacob	mjacob@netbsd.org
Lonhyn T. Jasinskyj	lonhyn@netbsd.org
Darrin Jewell	dbj@netbsd.org
Chris Jones	cjones@netbsd.org
Søren Jørvang	soren@netbsd.org
Takahiro Kambe	taca@netbsd.org
Antti Kantee	pooka@netbsd.org
Masanori Kanaoka	kanaoka@netbsd.org
Mattias Karlsson	keihan@netbsd.org
KAWAMOTO Yosihisa	kawamoto@netbsd.org
Mario Kemper	magick@netbsd.org
Thomas Klausner	wiz@netbsd.org
Klaus Klein	kleink@netbsd.org
Wayne Knowles	wdk@netbsd.org
John Kohl	jtk@netbsd.org
Paul Kranenburg	pk@netbsd.org
Martti Kuparinen	martti@netbsd.org
Kevin Lahey	kml@netbsd.org
Johnny C. Lam	jlam@netbsd.org
Martin J. Laubach	mjl@netbsd.org
Ted Lemon	mellon@netbsd.org
Frank van der Linden	fvdl@netbsd.org
Joel Lindholm	joel@netbsd.org
Mike Long	mikel@netbsd.org
Warner Losh	imp@netbsd.org
Tomasz Luchowski	zuntum@netbsd.org
Federico Lupi	federico@netbsd.org
Brett Lymn	blymn@netbsd.org
Paul Mackerras	paulus@netbsd.org
Anders Magnusson	ragge@netbsd.org
MAEKAWA Masahide	gehenna@netbsd.org
David Maxwell	david@netbsd.org
Dan McMahill	dmcmahill@netbsd.org
Gregory McGarry	gmcgarry@netbsd.org
Jared D. McNeill	jmcneill@netbsd.org
Neil J. McRae	neil@netbsd.org
Perry Metzger	perry@netbsd.org
Minoura Makoto	minoura@netbsd.org
Luke Mewburn	lukem@netbsd.org
der Mouse	mouse@netbsd.org

Joseph Myers	jsm@netbsd.org
Ken Nakata	kenn@netbsd.org
Phil Nelson	phil@netbsd.org
Bob Nestor	rnestor@netbsd.org
NISHIMURA Takeshi	nsmrtks@netbsd.org
Tohru Nishimura	nisimura@netbsd.org
NONAKA Kimihiro	nonaka@netbsd.org
Jesse Off	joff@netbsd.org
Tatoku Ogaito	tacha@netbsd.org
Masaru Oki	oki@netbsd.org
Atsushi Onoe	onoe@netbsd.org
Greg Oster	oster@netbsd.org
Herb Peyerl	hpeyerl@netbsd.org
Matthias Pfaller	matthias@netbsd.org
Chris Pinnock	cjep@netbsd.org
Dante Profeta	dante@netbsd.org
Chris Provenzano	proven@netbsd.org
Michael Rauch	mrauch@netbsd.org
Darren Reed	darrenr@netbsd.org
Scott Reynolds	scottr@netbsd.org
Michael Richardson	mcr@netbsd.org
Tim Rightnour	garbled@netbsd.org
Gordon Ross	gwr@netbsd.org
Heiko W. Rupp	hwr@netbsd.org
David Sainty	dsainty@netbsd.org
SAITOH Masanobu	msaitoh@netbsd.org
Kazuki Sakamoto	sakamoto@netbsd.org
Curt Sampson	cjs@netbsd.org
Wilfredo Sanchez	wsanchez@netbsd.org
Ty Sarna	tsarna@netbsd.org
SATO Kazumi	sato@netbsd.org
Jan Schaumann	jschauma@netbsd.org
Matthias Scheler	tron@netbsd.org
Karl Schilke (rAT)	rat@netbsd.org
Amitai Schlair	schmonz@netbsd.org
Konrad Schroder	perseant@netbsd.org
Reed Shadgett	dent@netbsd.org
Tim Shepard	shep@netbsd.org
Takeshi Shibagaki	shiba@netbsd.org
Takao Shinohara	shin@netbsd.org
Takuya SHIOZAKI	tshiozak@netbsd.org
Chuck Silvers	chs@netbsd.org
Thor Lancelot Simon	tls@netbsd.org
Jeff Smith	jeffs@netbsd.org
Noriyuki Soda	soda@netbsd.org
Wolfgang Solfrank	ws@netbsd.org
SOMEYA Yoshihiko	someya@netbsd.org
Bill Sommerfeld	sommerfeld@netbsd.org
Ignatios Souvatzis	is@netbsd.org

Bill Squier	groo@netbsd.org
Jonathan Stone	jonathan@netbsd.org
Bill Studenmund	wrstuden@netbsd.org
Kevin Sullivan	sullivan@netbsd.org
SUNAGAWA Keiki	kei@netbsd.org
Kimmo Suominen	kim@netbsd.org
Shin Takemura	takemura@netbsd.org
TAMURA Kent	kent@netbsd.org
Shin'ichiro TAYA	taya@netbsd.org
Matt Thomas	matt@netbsd.org
Jason Thorpe	thorpej@netbsd.org
Christoph Toshok	toshok@netbsd.org
Tsubai Masanari	tsubai@netbsd.org
Izumi Tsutsui	tsutsui@netbsd.org
UCHIYAMA Yasushi	uch@netbsd.org
Masao Uebayashi	uebayasi@netbsd.org
Shuichiro URATA	ur@netbsd.org
Todd Vierling	tv@netbsd.org
Aymeric Vincent	aymeric@netbsd.org
Paul Vixie	vixie@netbsd.org
Krister Walfridsson	kristerw@netbsd.org
Lex Wennmacher	wennmach@netbsd.org
Leo Weppelman	leo@netbsd.org
Assar Westerlund	assar@netbsd.org
Todd Whitesel	toddpw@netbsd.org
Nathan Williams	nathanw@netbsd.org
Rob Windsor	windsor@netbsd.org
Dan Winship	danw@netbsd.org
Jim Wise	jwise@netbsd.org
Michael Wolfson	mbw@netbsd.org
Steve Woodford	scw@netbsd.org
Colin Wood	ender@netbsd.org
YAMAMOTO Takashi	yamt@netbsd.org
Yuji Yamano	yyamano@netbsd.org
Reinoud Zandijk	reinoud@netbsd.org
Maria Zevenhoven	maria7@netbsd.org
Christos Zoulas	christos@netbsd.org

Other contributors:

Dave Burgess	burgess@cynjut.infonet.net
Brian R. Gaeke	brg@dgate.org
Brad Grantham	grantham@tenon.com
Lawrence Kesteloot	kesteloo@cs.unc.edu
Waldi Ravens	waldi@moacs.indiv.nl.net

Legal Mumbo-Jumbo

All product names mentioned herein are trademarks or registered trademarks of their respective owners.

The following notices are required to satisfy the license terms of the software that we have mentioned in this document:

This product includes software developed by the University of California, Berkeley and its contributors.
This product includes software developed by The NetBSD Foundation, Inc.
This product includes software developed by the NetBSD Foundation, Inc. and its contributors.
This product includes software developed by the Computer Systems Engineering Group at Lawrence Berkeley Laboratory.
This product includes software developed by Adam Glass and Charles Hannum.
This product includes software developed by Adam Glass and Charles M. Hannum.
This product includes software developed by Adam Glass.
This product includes software developed by Alistair G. Crooks.
This product includes software developed by Amancio Hasty and Roger Hardiman.
This product includes software developed by Berkeley Software Design, Inc.
This product includes software developed by Bill Paul.
This product includes software developed by Charles D. Cranor and Washington University.
This product includes software developed by Charles D. Cranor.
This product includes software developed by Charles Hannum, by the University of Vermont and State Agricultural College and Garrett A. Wollman, by William F. Jolitz, and by the University of California, Berkeley, Lawrence Berkeley Laboratory, and its contributors.
This product includes software developed by Charles Hannum.
This product includes software developed by Charles M. Hannum.
This product includes software developed by Chris Provenzano.
This product includes software developed by Christian E. Hopps.
This product includes software developed by Christopher G. Demetriou for the NetBSD Project.
This product includes software developed by Christopher G. Demetriou.
This product includes software developed by Christos Zoulas.
This product includes software developed by David Jones and Gordon Ross.
This product includes software developed by Dean Huxley.
This product includes software developed by Eric S. Hvozda.
This product includes software developed by Ezra Story.
This product includes software developed by Gardner Buchanan.
This product includes software developed by Gordon Ross.
This product includes software developed by Gordon W. Ross and Leo Weppelman.
This product includes software developed by Gordon W. Ross.
This product includes software developed by Hauke Fath.
This product includes software developed by HAYAKAWA Koichi.
This product includes software developed by Hellmuth Michaelis and Joerg Wunsch.
This product includes software developed by Herb Peyerl.
This product includes software developed by Holger Veit and Brian Moore for use with "386BSD" and similar operating systems.
This product includes software developed by Hubert Feyrer for the NetBSD Project.
This product includes software developed by Iain Hibbert.
This product includes software developed by Ian W. Dall.
This product includes software developed by Ignatios Souvatzis for the NetBSD Project.
This product includes software developed by Jason R. Thorpe for And Communications, http://www.and.com/.
This product includes software developed by Joachim Koenig-Baltes.
This product includes software developed by Jochen Pohl for The NetBSD Project.
This product includes software developed by John Polstra.
This product includes software developed by Jonathan Stone and Jason R. Thorpe for the NetBSD Project.
This product includes software developed by Jonathan Stone for the NetBSD Project.
This product includes software developed by Jonathan Stone.
This product includes software developed by Julian Highfield.
This product includes software developed by Kenneth Stailey.
This product includes software developed by Leo Weppelman.
This product includes software developed by Lloyd Parkes.
This product includes software developed by Manuel Bouyer.
This product includes software developed by Marc Horowitz.
This product includes software developed by Mark Brinicombe for the NetBSD Project.
This product includes software developed by Mark Brinicombe.
This product includes software developed by Mark Tinguely and Jim Lowe.
This product includes software developed by Markus Wild.
This product includes software developed by Martin Husemann and Wolfgang Solfrank.
This product includes software developed by Mats O Jansson and Charles D. Cranor.
This product includes software developed by Mats O Jansson.
This product includes software developed by Matthias Pfaller.
This product includes software developed by Michael L. Hitch.
This product includes software developed by Niels Provos.
This product includes software developed by Paul Kranenburg.
This product includes software developed by Paul Mackerras.
This product includes software developed by Peter Galbavy.
This product includes software developed by Philip A. Nelson.

This product includes software developed by Rodney W. Grimes.
This product includes software developed by Roland C. Dowdeswell.
This product includes software developed by Rolf Grossmann.
This product includes software developed by Scott Bartram.
This product includes software developed by SigmaSoft, Th. Lockert.
This product includes software developed by Tatoku Ogaito for the NetBSD Project.
This product includes software developed by Terrence R. Lambert.
This product includes software developed by Theo de Raadt and John Brezak.
This product includes software developed by Theo de Raadt.
This product includes software developed by Tohru Nishimura for the NetBSD Project.
This product includes software developed by TooLs GmbH.
This product includes software designed by William Allen Simpson.
This product includes software developed by Winning Strategies, Inc.
This product includes software developed by Zembu Labs, Inc.
This product includes software developed by the Center for Software Science at the University of Utah.
This product includes software developed by the Computer Systems Laboratory at the University of Utah.
This product includes software developed by the University of Calgary Department of Computer Science and its contributors.
This product includes software developed by the University of Vermont and State Agricultural College and Garrett A. Wollman.
This product includes software developed for the FreeBSD project.
This product includes software developed for the Internet Software Consortium by Ted Lemon.
This product includes software developed for the NetBSD Project by Frank van der Linden.
This product includes software developed for the NetBSD Project by Jason R. Thorpe.
This product includes software developed for the NetBSD Project by John M. Vinopal.
This product includes software developed for the NetBSD Project by Matthias Drochner.
This product includes software developed for the NetBSD Project by Matthieu Herrb.
This product includes software developed for the NetBSD Project by Perry E. Metzger.
This product includes software developed for the NetBSD Project by Piermont Information Systems Inc.
This product includes software developed for the NetBSD Project by Ted Lemon.
This product includes software developed for the NetBSD Project by Wasabi Systems, Inc.
This product includes software developed by LAN Media Corporation and its contributors.
This product includes software developed by Michael Graff for the NetBSD Project.
This product includes software developed by Niklas Hallqvist, C Stone and Job de Haas.
This product includes software developed by Eric Young (eay@mincom.oz.au).
This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/).
This product includes software developed by the University of Oregon.
This product includes software developed by the University of Southern California and/or Information Sciences Institute.
This product includes software developed by Internet Initiative Japan Inc.
This product includes software developed by Reinoud Zandijk.
This product includes software developed at the Information Technology Division, US Naval Research Laboratory.

In the following statement, "This software" refers to the Mitsumi CD-ROM driver:

> This software was developed by Holger Veit and Brian Moore for use with "386BSD" and similar operating systems. "Similar operating systems" includes mainly non-profit oriented systems for research and education, including but not restricted to "NetBSD" , "FreeBSD" , "Mach" (by CMU).

In the following statement, "This software" refers to the parallel port driver:

> This software is a component of "386BSD" developed by William F. Jolitz, TeleMuse.

The End