NAME

INSTALL – Installation procedure for NetBSD/alpha.

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DESCRIPTION

About this Document

This document describes the installation procedure for NetBSD 1.6 on the *alpha* 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.

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 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 sys-

tem *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 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 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

- 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.

alpha specific

There have been many alpha-specific enhancements since the NetBSD 1.5 release. These include:

- Working Loadable Kernel Modules (LKMs)
- IEEE 754 floating point completion code.
- PowerStorm 4d20 graphics card support.
- Multiprocessor support for the following systems:
  - AlphaServer 1200
  - AlphaServer 4100
  - DEC/Alpha Processor, Inc. DP264
  - DEC/Alpha Processor, Inc. UP2000
  - DEC/Alpha Processor, Inc. UP2000+
  - API CS20
  - Compaq DS20

NetBSD 1.6 on alpha is, as usual, also fully backward compatible with old NetBSD/alpha binaries, so you don't need to recompile all your local programs.

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 Release Contents

The root directory of the NetBSD 1.6 release is organized as follows:

`.../NetBSD-1.6/`

`CHANGES`	Changes since earlier NetBSD releases.
`LAST_MINUTE`	Last minute changes.
`MIRRORS`	A list of sites that mirror the NetBSD 1.6 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 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 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 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/alpha subdirectory structure

The alpha-specific portion of the NetBSD 1.6 release is found in the `alpha` subdirectory of the distribution:

`.../NetBSD-1.6/alpha/`

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

`installation/`
`floppy/` alpha boot and installation floppies; see below.
`diskimage/`
`tapeimage/`
`cdhdtape` is included for the case where the installer is written to a CD, hard drive, or tape. This image file is the same for the CD, HD, and tape cases, but a separate `tapeimage/` directory exists to hold a copy of the `README` file and to meet the NetBSD `release`(7) standard.
`instkernel/`
contains a `netbsd.gz` installation kernel; this is the same installer kernel as in all the other install images, but without the various boot program and file system wrappers. It can be netbooted or diskbooted from a previous installation. no need to **`gunzip`** this image.
`misc/` contains `GENERIC.fs`, a `GENERIC` kernel in a bootable file system image. This is used in some unusual installations as described in the next section. Miscellaneous alpha installation utilities; see installation section, below.

Bootable installation/upgrade floppies

There are three bootable images in the NetBSD alpha distribution. One is for a dual-floppy boot and is split into two separate files. The other is a single-file image containing the same install kernel, but intended to be written to a CD, tape, or hard drive. The third image is a `GENERIC` kernel intended for production use in unusual cases. This can be useful at some sites when:

- You want to run diskless but SRM bugs prevent the firmware from netbooting. You can work around this problem by always booting the generic kernel from the floppy.
- SRM doesn't recognize your (hard) disk controller but NetBSD does. This happens more frequently than you might think. SRM will usually only boot from `ncr`(4) or `isp`(4) SCSI devices, and on most platforms will not boot from an IDE drive. NetBSD will happily operate with almost any SCSI root or an IDE root; the solution here is to netboot a kernel or always boot from floppy.

Binary distribution sets

The NetBSD alpha binary distribution sets contain the binaries which comprise the NetBSD 1.6 release for the alpha. There are eight binary distribution sets. The binary distribution sets can be found in the `alpha/binary/sets` subdirectory of the NetBSD 1.6 distribution tree, and are as follows:

base The NetBSD 1.6 alpha **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.

25 MB gzipped, 66 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.
19 MB gzipped, 80 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.
4 MB gzipped, 8 MB uncompressed

kern-GENERIC
This set contains a NetBSD/alpha 1.6 `GENERIC` kernel, named `/netbsd`. You *must* install this distribution set.
3 MB gzipped, 7 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, 7 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 3.3.6. 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.
4 MB gzipped, 11 MB uncompressed

xcomp The extra libraries and include files needed to compile X source code.
3 MB gzipped, 11 MB uncompressed

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

xfont Fonts needed by X.
6 MB gzipped, 7 MB uncompressed

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

xserver
3 MB gzipped, 6 MB uncompressed

The alpha binary distribution sets are distributed as gzipped tar files named with the extension **.tgz**, e.g. `base.tgz`.

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 alpha binary distribution also has its own checksum files, just as the source distribution does.

NetBSD/alpha System Requirements and Supported Devices

NetBSD/alpha 1.6 runs on most of the DEC Alpha PCI platforms, on all of the TURBOChannel models, on the high end 8200 and 8400 systems, and on the 4100 series.

The SRM console is required. This console can be distinguished from the ARC console (which is used to boot Windows NT) by the fact that it has a command line interface, rather than a menu-driven interface. The SRM prompt is '>>>'.

Some platforms have both the SRM console and the ARC console, and can switch between them, and other platforms have only one type of console loaded at any one time. If your system comes up with the ARC firmware, it may be possible to switch it to SRM with a menu or to download SRM from
ftp://gatekeeper.dec.com/pub/Digital/Alpha/firmware/index.html.
You may want to buy a firmware update CD from Compaq Computer Corporation.

More information on supported platforms and devices can be found on the alpha port web pages at **http://www.netbsd.org/**.

A basic system will fit on a 200 MB disk (including swap) without too much difficulty, but you will probably want at least 500 MB of disk to have any level of comfort.

Although it is actually possible to boot and install NetBSD/alpha in only 16 MB of RAM, you will want to have at least 32 MB. We support add-in devices on the PCI, ISA, EISA and TurboChannel buses. Because NetBSD has an extremely machine-independent device driver system, many device drivers are the same as used in other ports that use the same bus. For example, the *de* network card driver is shared by the i386 and alpha ports. Some drivers on inspection appear as if they will work on the alpha but have not been tested because that hardware was not available to NetBSD testers; these are marked as *UNTESTED* below. If you have one of these devices, and it does work, please get in touch with `port-alpha-maintainer@netbsd.org` and let us know that it works. If it doesn't work, do the same thing and we can probably fix it pretty easily.

Supported PCI bus devices

- Graphics Adapters
  - VGA-compatible video (*pcivga*)
  - ZLXp-E1 DECchip 21030-based video (*tga*)
  - ZLXp-E2 and ZLXp-E3 video (*tga*)
- Network Cards
  - DECchip 21x40-family 10 and 100 Mbps Ethernet (*de*, *tlp*)
  - DEC DEFPA FDDI (*fpa*)
  - PCI LANCE Ethernet (*le*; *UNTESTED*)
  - Efficient Networks ENI-155p ATM (*en*; *UNTESTED*)

- 3Com 3c59x and 3c90x (except 3c906) 10 and 100 Mbps Ethernet (*ep*)
- Intel EtherExpress Pro 10/100B PCI Ethernet (*fxp*)
- SMC EPIC/100 Fast Ethernet boards (*epic*)

- SCSI Controllers
  - Adaptec 291x, 2920, 2930C, 294x, 295x, 39xx, 19160, 29160 and AIC-78xx SCSI (*ahc*)
  - BusLogic 9xx SCSI (*bha*, Works on alpha PC164)
  - Qlogic ISP 10x0-family SCSI (*isp*)
  - NCR/Symbios 53c8xx-family SCSI (*siop, esiop*; NCR825 Doesn't always work)

- Miscellaneous Devices
  - Cyclades Cyclom-Y serial boards (*cy*; *UNTESTED*)
  - PCI-PCI bridges (*ppb*; Tested with the DECchip 21050, but should work with all bridges and system firmware revisions that comply with the PCI-PCI bridge specification)

Supported ISA bus devices

- Graphics Adapters
  - VGA-compatible video (*vga*; Text console only)

- Network Cards
  - 3Com 3c509 Ethernet (*ep*)
  - DEC DE200,DE201,DE202 (*le*)
  - DEC DE203,DE204,DE205 (*lc*)

- Miscellaneous Devices
  - PC-style parallel ports (*lpt*)
  - NS16450 and NS16550 UARTs (*com*)
  - ISA multi-port 16x50 boards (*ast*, *boca*; Only the latter has been tested)

Supported EISA bus devices

- Network Cards
  - DEC DEFEA FDDI (*fea*)
  - 3Com 3c5xx series (*ed*; *UNTESTED*)

- SCSI Controllers
  - Adaptec 274x and aic7770 SCSI (*ahc*; *UNTESTED*)
  - BusLogic 7xx SCSI (*bha*; *UNTESTED*)

Supported Turbochannel bus devices

- Graphics Adapters
  - CFB video (PMAG-BA, *cfb*)
  - SFB video (PMAGB-BA, *sfb*)

  Note: Although these boards are supported by NetBSD/alpha since there is no keyboard or mouse support available for the TurboChannel systems, they aren't very useful. XXX: is this still true now that the MI sfb.c is used???

- Network Cards
  - DEC LANCE Ethernet (PMAD-AA, *le*; *UNTESTED*)
  - DEC DEFTA FDDI (PMAF-F, *fta*)

Note that some devices, especially ISA-based devices, have to have certain settings set properly for the install and `GENERIC` kernels to detect them. (Once installed, you can always rebuild your own kernel to detect them anywhere you wish, of course.) Here is a list of such devices and the necessary settings:

```
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]

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

AHA-2X4X or AIC-7xxx-based SCSI host adapters
                ahc0    any     any     any

Bus Logic BT445, BT74x, or BT9xx SCSI host adapters
                bha0    0x330   any     any
                bha1    0x334   any     any

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

ATA disks       wd0, wd1, ...
SCSI 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 ...

3COM 3x59X or 3COM 3x90X PCI Ethernet boards
                ep0     any     any     [you must assign an interrupt in your
                                         PCI BIOS, or let it do so for you]

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]

DEC DE200,201,202 EtherWORKS II/Turbo ISA Ethernet boards
                le?   0x300   5       memory at D0000-DFFFF
                le?   0x200   10      memory at D8000-DFFFF

        You should enter the following SRM console command to enable the
        le device:
        >>> isacfg -mk -slot ? -dev 0 -handle DE200-LE -irq0 5
            -membase0 d0000 -memlen0 10000 -iobase0 300 -etyp 1 -enadev 1

DEC DE203,204,205 EtherWORKS III ISA Ethernet boards
```

```
            lc0    0x300   any
            lc1    0x320   any

        You should enter the following SRM console command to enable
        the device:
        >>> add_de205
```

Getting the NetBSD System on to Useful Media

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 sixth that number of 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.

Tape

To install NetBSD from a tape, you need to make a tape that contains the distribution set files, in 'tar' format.

If you're making the tape on a UNIX-like system, the easiest way to do so is probably something like:

```
# tar -cf tape_device dist_directories
```

where *tape_device* is the name of the tape device that describes the tape drive you're using; possibly `/dev/rst0`, or something similar, but it will vary from system to system. (If you can't figure it out, ask your system administrator.) In the above example, *dist_directories* are the distribution sets' directories, for the distribution sets you wish to place on the tape. For instance, to put the **misc, base,** and **etc** distributions on tape (in order to do the absolute minimum installation to a new disk), you would do the following:

```
# cd .../NetBSD-1.6
# cd alpha/binary
# tar -cf tape_device misc etc kern
```

Note: You still need to fill in *tape_device* in the example.

Once you have the files on the tape, 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.

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

If you have any data on your disks that you want to keep, *back it up* before starting. Note that NetBSD/alpha does not support booting more than one operating system from a single disk, although it's fine to have multiple operating systems on your machine if you have a separate disk for NetBSD, or if one of them uses a network boot.

Installing the NetBSD System

Installation of NetBSD/alpha is now easier than ever! For the latest news, problem reports, and discussion, join the port-alpha mailing list by mailing a line saying

```
subscribe port-alpha
```

to `majordomo@netsbd.org`. Also, see **http://www.netbsd.org** for more information.

If you encounter any problems, please report them via the mailing list or the `send-pr`(1) program so that they can be fixed for the next release.

To install or upgrade NetBSD, you need to first boot an installation program and then interact with the screen-menu program **`sysinst`**. The installation program actually consists of the NetBSD kernel plus an in-memory file system of utility programs.

The usual procedure is to write the installation system to a floppy disk set and then boot from the floppies, however, there are now six ways to boot the NetBSD/alpha installation system! Each approach loads the exact same installation bits. The six paths are:

- Floppy disk boot
- CD boot
- Hard Drive Boot
- Magnetic Tape Boot
- Existing Root FS Boot
- Network boot

In all cases, you need to transfer a bootable image of the installation system from the NetBSD CD or from an ftp site to the chosen media type. Although booting from floppy is the usual path, the hard drive boot is useful if you have another operating system (and a spare drive) already installed, or if you don't mind swapping hard drives from box to box. CD and tape boots are nice and fast if you have a CD writer or a tape format in common with another previously installed UNIX-like system. Finally, most versions of SRM can locate the NetBSD boot program **`netboot`** via bootp and download it via tftp, **`netboot`** then mounts the root file system (`/`) via NFS and loads the kernel.

Note that if you are installing or upgrading from a writable media, the media can be write-protected if you wish. These systems mount a root image from inside the kernel, and will not need to write to the media. If you booted from a floppy, the floppy disk may be removed from the drive after the system has booted.

- Floppy disk boot

  The 3.5", 1.44 MB boot floppy set is found under the NetBSD/alpha 1.6 distribution directory in `alpha/installation/floppy/` as two files called `disk1of2` and `disk2of2`. You need to put these two disk images on two floppy disks.

  If you have a UNIX-like system handy, you can do this with commands like the following:

  ```
  # dd if=disk1of2 of=/dev/rfd0a bs=18k
  # dd if=disk2of2 of=/dev/rfd0a bs=18k
  ```

  If the UNIX-like system you are using is not a NetBSD system, you will probably need to replace `/dev/rfd0a` with the name of the floppy device on your particular system.

  If you have an MS-DOS or Windows system available, you can use the **`rawrite.exe`** utility to transfer the image to a floppy disk. This utility is provided with the NetBSD/i386 install tools, under `i386/installation/misc`; a documentation file, **`rawrite.doc`** is available there as well.

  Once the floppy has been made, you simply need to put it in the drive and type

  ```
  >>> B DVA0
  ```

- CD boot
- Hard Drive boot
- Magnetic Tape Boot

  All three of these media types use the same initial image: `.../installation/diskimage/cdhdtape` The image can be written to a hard drive partition with a command like:

  ```
  # dd if=cdhdtape bs=16k of=/dev/rsd0c
  ```

  To boot from a magnetic tape device such as DAT or DLT, it is important to create the tape image with 512-byte records. Use a command like:

  ```
  # dd if=cdhdtape bs=512 of=/dev/rst0
  ```

  If the host system is not NetBSD, the names of the destination devices are likely to be different. Be sure to use a "raw partition" device that doesn't skip over labels!

  The use of CD-R devices varies greatly depending on the host OS and host software; it isn't possible to give typical instructions here.

- Existing Root FS Boot

  The installation subdirectory `instkernel/` contains `netbsd.gz`; this is the same install kernel but without a bootable file system image wrapped around it. You can perform an complete reinstall by beginning it as an upgrade, and booting this kernel in the normal way off the root file system (`/`) of a previous installation.

  The gzipped image can be booted directly; it is not necessary to uncompress it first.

- Network Boot

  Booting NetBSD/alpha 1.6 over a network requires a BOOTP or DHCP server, a TFTP server and an NFS server. (These are usually all run on the same machine.) There are three basic stages to the boot:

- alpha console software sends a BOOTP request to get its own address, the address of the TFTP server and the file to download. It downloads this file, which is the second stage bootstrap, via TFTP and then executes it.
- The secondary boot program resends the BOOTP request, this time also locating the NFS server and root path. It mounts the root path via NFS and reads in and transfers to the kernel: `/netbsd`.
- The kernel probes and configures the devices, and then sends out another BOOTP request so it can find out its address, the NFS server, and path. It then mounts its root (`/`) via NFS and continues.

You will need to set up servers for BOOTP, TFTP and NFS.

If you want to run a full system from the network, untar the NetBSD snapshot or distribution into a directory on your server and NFS export that directory to the client. Make sure you put a kernel there as well, and create the device nodes in `/dev` with **`sh ./MAKEDEV all`**. Detailed instructions on netbooting can be found by visiting the NetBSD alpha platform page: **http://www.netbsd.org/Ports/alpha**

At the time of this release, the URL for the netbooting instructions is:
http://www.netbsd.org/Documentation/network/netboot/

You'll want to map root to `root` (rather than the default `nobody`) when you export your root file system (`/`). A typical `/etc/exports` line on a NetBSD system would be:

```
/usr/export/alpha -maproot=0 myclient.mydom.com
```

One option is to load just the install kernel over the network but then proceed to a normal disk-based install and disk-based operation. (Perhaps the alpha doesn't have a floppy drive, or you just don't want to use a Windows system to make the floppy; we understand.)

For this case, you still need to export an NFS root, but the only thing it needs to have in it is the `instkernel` image from the distribution.

The gzipped image can be booted directly; it is not necessary to uncompress it first.

The console will be using TFTP to load the NetBSD boot program, so for the TFTP setup, you need to copy the second stage bootstrap, **`netboot`**, into an appropriately named file such as `boot.netbsd.alpha` in the directory used by your TFTP server. If you extracted a full snapshot, you can get the netboot program from `/usr/mdec/netboot`; if not, you can get this from the `installation/netboot` directory where you found the alpha distribution.

For the BOOTP server you need to specify the:
- hardware type (Ethernet)
- hardware address (Ethernet MAC address)
- IP address of the client
- subnet mask of the client
- address of of the TFTP/NFS server
- name of the second stage bootstrap loaded via TFTP
- path to the root for the client (mounted via NFS)

Here's an example for a UNIX-like system running **`bootpd`**:

```
myhost.mydom.com:        :ht=ethernet:ha=0000c0391ae4:\
        :ip=192.168.1.2:sm=255.255.255.0:\
        :sa=192.168.1.1:bf=boot.netbsd.alpha:rp=/usr/export/alpha:
```

And here's an example for a UNIX-like system running the ISC **`dhcpd`**:

```
host axp {
        hardware ethernet 0:0:c0:39:1a:e4;
        fixed-address 192.168.1.2;
```

```
        option host-name "myhost.mydom.com";
        filename "boot.netbsd.alpha";
        option root-path "/usr/export/alpha";
        option domain-name-servers 192.168.1.1;
        option broadcast-address 255.255.255.0;
        option domain-name "my.domain";
}
```

The only Ethernet device the console on most alpha systems knows how to boot from is the onboard Ethernet interface or a DEC Tulip (21040, 21041, 21140) PCI Ethernet card. Some older SMC 100 Mbps cards that use this chip have been known to work as well. Many older systems will not be able to use the newer 2.0 stepping of the 21140, however. If your system appears not to be receiving packets, this may be the problem. (You may or may not be able to update your firmware to fix this; see the alpha port pages on www.netbsd.org for more information on this.) In general, 10 Mb cards from manufacturers other than DEC will work, and 100 Mb cards not from DEC will not.

Once you're set up, you should be able to boot with:

```
>>> boot -proto bootp ewa0
```

You should permanently set your protocol to BOOTP with:

```
>>> set ewa0_protocols bootp
```

The 3000 series of Turbochannel systems and certain other models use *old SRM*, do not have a **-proto** option and use different device names. They also tend to not netboot very well so you probably don't need to worry about this section. However, if you want to give it a try, note the following differences:

- There is no **-proto** argument, or **ewa0_protocols** variable. Old SRM uses bootp if the device name is given as **ez0**.
- The use of the setnetbootinfo(8) program will probably also be necessary, as it is unlikely that an SRM from that era will properly communicate the ethernet HW address to the boot program.
- Example:

```
>>> boot ez0
```

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 question 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.

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 floppy disks.
     - A CD-ROM drive (SCSI or ATAPI), a harddisk and a minimum of 32 MB of memory installed.
     - The harddisk should have at least 200 + *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\i386\installation\misc
     rawrite
     ```

     When asked for a source filename, answer
     (...alpha installation root)`\floppy\disk1of2`

     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. Boot the computer. Type

    ```
    >>> B DVA0
    ```

    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.

   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. 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 sec-

ond, etc.

Note that once the system has finished booting, you need not leave the floppy in the disk drive.

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`.

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.

9. *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**. Some partitions in the disklabel have a fixed purpose.

   `a` Root partition (`/`)

   `b` Swap partition.

   `c` The NetBSD portion of the disk.

   `d-h` Available for other use. Traditionally, `d` 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.

10. *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.

11. *Getting the distribution sets*

    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'.

12. *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.

13. *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.

14. *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.

15. *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.

16. *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.

17. *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.

18. *Finalizing your installation*

    Congratulations, you have successfully installed NetBSD 1.6. You can now reboot the machine, and boot NetBSD from harddisk.

Manual and script-assisted installation

All of the installation procedures consist of putting a label on the disk to provide information on the sizes and placement of the partitions into which the disk is divided, putting the boot blocks on the disk, creating the file systems on the partitions, and unpacking the distribution tar archives.

1. Disk prep: label, boot block, and file system setup

   A. Manual Install from the Shell Prompt

      The normal installation involves running the install shell script and interactively configuring the file systems, and then simply unpacking the tar files into these followed by running MAKEDEV.

      However, as stated above it is also possible to do the installation yourself from the shell, and in any case it is helpful to understand what the install script does. The procedure is:

      - create `/etc/disktab`, see `disktab`(5)
      - run `disklabel`(8),
      - run `newfs`(8)
      - `mount`(8) the new root on `/mnt`

- cd to /usr/mdec and run installboot(8)

If you are reviewing man pages on NetBSD platforms other than alpha, be sure that when reading installboot(8) you read the alpha version by typing:

```
# man 8 alpha/installboot
```

At this point you need only unpack the distribution sets by running tar(1) as described below.

B. /install and /upgrade traditional installation scripts

The install and upgrade scripts are still there, so by exiting the **sysinst** program you can type install or upgrade at the shell prompt and run them as you did in the good old days.

You may install on either a SCSI or an IDE disk; you will be prompted for the disk to install on. The disks in your system will be numbered starting at *x*d0 (where *x* is an 's' for SCSI disks, 'w' for IDE disks) based on the SCSI-ID or IDE drive order; if you have more than one disk, watch the boot messages carefully to see which ones are probed as which numbers.

Once you've selected a disk to install on, you'll be prompted for the geometry. This is also displayed in the boot messages, and you'll be given a chance to review the boot messages again to get the exact figures for the number of cylinders, heads and sectors.

After this you must specify the size of your partitions. Generally you'll be giving the sizes in cylinders; the install program will tell you how many bytes there are in each cylinder.

The swap partition is the second thing you specify, after the / (root) partition. Regardless of the size of your disk, you'll want to specify a swap partition that's at least as large as the amount of RAM you have, and probably not less than 64 MB in any case.

If you have a small disk (under 500 MB), it's probably best to devote all of the disk (excepting 64 MB or more for the swap) to the / (root) partition.

If you have more space, we recommend devoting at least 32 MB, and preferably 48 MB, to the / (root) partition. /usr will need 150 MB or so if you're not installing X, 200 MB or so if you are. A typical organization is 50 MB for / (root), 150-250 MB for swap, and the remaining space for /usr. With enough swap space configured, you can make /tmp a nice, fast mfs. See mount_mfs(8), and note that the mfs will require swap space for the largest planned amount of /tmp storage. It doesn't return space when files are deleted, but just keeps it its own freelist so the swap space required is equal to the highwater mark of /tmp use, plus space required to back up main memory and store inactive images.

Once you've specified this information, the install script will write the disklabel, install boot blocks to make the disk bootable, initialise the file systems, and mount them all under /mnt. You are now ready to go on to the next step.

2. Configuration: arranging access to the distribution sets

After doing the disk and file system setup with either shell commands or the script assist, you then need only unpack the distribution sets with the tar(1) command. To do this you will need access from the target host to the tar files that contain the operating system in order to extract them to your disk. This is done via an NFS or FTP transfer over a network, via a CD-ROM archive, a tape archive, or by preloading an accessible hard drive with the necessary tar files.

- Preparing to Install from a CD-ROM

  All you need to do is mount the CD-ROM, which will generally be device cd0. (The initial boot messages will tell you what the CD-ROM drive is probed as.) This would be done with:

```
# mount -r -t cd9660 /dev/cd0a /mnt2
```

- Preparing to Install from the Network

  The first thing you need to do is configure the loopback network interface, which is done with the command

  ```
  # ifconfig lo0 127.0.0.1
  ```

  Then you will have to configure your Ethernet card. The command

  ```
  # ifconfig -l
  ```

  will give you a list of the network interfaces on your system. It will show you your ethernet cards first, followed by lo0 (the loopback interface that we configured above), ppp0 (the PPP interface) and sl0 (the SLIP interface).

  To configure your ethernet card, type **ifconfig** *if* `inet` *addr* `[netmask] [media` *media*`]` where *if* is the network card (interface), almost always `de0`, *addr* is the IP address, the optional *netmask* parameter is the network mask, and the optional *media* parameter is one of:

10base2	BNC connector	10 Mbps
AUI	AUI connector	10 Mbps
10baseT/UTP	Twisted pair connector	10 Mbps
100baseTX	Twisted pair connector	100 Mbps
100baseFX	Fibre-optic connector	100 Mbps
100baseT4	T4 twisted pair interface	100 Mbps

  If the host you are getting the data files from is not on the local network, you will also have to configure a gateway into your system. Do this with

  ```
  # route add default <gateway-IP-address>
  ```

  One improvement over the good old days is that the resolver is now present; by configuring `/etc/resolv.conf` you can get name resolution during any install NFS or FTP operations.

  Once networking has been configured, you may mount the directory with the install files via NFS, or download them via FTP.

  To mount them via nfs, type

  ```
  # mount -t nfs <hostname:/path/to/nfs/volume> /mnt2
  ```

  If this volume has been exported read-only, you may need the **-r** option to mount.

  To download the install sets with ftp, create a directory in which to put them and then use the ftp client to download them. Mirror sites are listed at: **http://www.netbsd.org/Sites/net.html** A typical session might be:

  ```
  # mkdir /mnt/usr/release
  # cd /mnt/usr/release
  # ftp ftp.netbsd.org
  ```
  the following commands are given to the **ftp** *program after logging in*
  ```
  ftp> prompt
  ftp> cd /pub/NetBSD/NetBSD-1.6/alpha/binary/sets
  ftp> mget *
  ftp> quit
  ```

  Feel free, of course, to leave off the sets that you don't need if you don't plan to install everything.

3. Unpack distribution sets: Extracting the Operating System Files

   Change to the root directory of your hard drive (which is `/mnt` if you've used the standard install script to this point) by typing

   ```
   # cd /mnt
   ```

   For this and the following commands, replace `/mnt/usr/release/` with the path to your NFS volume or CD-ROM if that's how you chose to access your install files instead.

   The sets and kernel are extracted with:

   ```
   # cd /mnt
   # for i in base kern comp etc games man misc text; do
       tar -zxpf /mnt/usr/release/$i.tgz;
   # done
   ```

   or perhaps:

   ```
   # cd /mnt
   # for i in /mnt/usr/release/*.tgz; do
       echo $i
       tar -zxpf $i
   # done
   ```

   Now make the device nodes:

   ```
   # cd /mnt/dev
   # sh ./MAKEDEV all
   ```

4. Restart your system

   Unmount the file systems and halt. The exact instructions to type here will depend on the file systems you created, but typically the commands are:

   ```
   # cd /
   # umount /mnt/usr
   # umount /mnt
   # sync
   ```
   (**sync** *is not strictly necessary but it is traditional*)
   ```
   # halt
   ```

   You should now be at the SRM console's >>> prompt and can reboot into the new configuration (possibly after an optional power cycle) with a command such as:

   ```
   >>> boot dka0
   ```

   This command might be: **boot dka100** if your drive is on ID 1. You can usually use **show device** to see a full list of bootable devices in your system. Your system will come up in single-user mode, ready for you to configure it.

You can create the floppy 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\installation\misc
rawrite
```

When asked for a source filename, answer

```
...\floppy\disk1of2
```

When asked for a destination drive answer

```
a
```

(Repeat the procedure for `installation/floppy/disk2of2`.)

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.

   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/alpha/All` subdir. You can install them with the following commands:

     ```
     # PKG_PATH=ftp://ftp.netbsd.org/pub/NetBSD/packages/1.6/alpha/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 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 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.

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.

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
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