NAME

INSTALL — Installation procedure for NetBSD/evbarm.

CONTENTS

DESCRIPTION

About this Document

This document describes the installation procedure for NetBSD 10.1_STABLE on the *evbarm* 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 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 many different different system architectures (ports) across a variety of distinct CPU families, and is being ported to more. The NetBSD 10.1_STABLE release contains complete binary releases for most of these system architectures, with preliminary support for the others included in source form. For more information please visit **https://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, NetBSD would not exist.

Changes Between The NetBSD 9 and 10 Releases

The NetBSD 10.1_STABLE release provides many significant changes, including support for many new devices, hundreds of bug fixes, new and updated kernel subsystems, and numerous userland enhancements. The result of these improvements is a stable operating system fit for production use that rivals most commercially available systems.

One important new feature in this release is the support for extended attributes and access control lists on FFS file systems.

For new installations the installer will by default disable these features, so the file system is compatible with older NetBSD releases (before 10), and allow other operating systems to mount this file systems at least in read-only mode.

If you want a new installed file system to support extended attributes, change the file system type from "FFSv2" to "FFSv2ea" in the partitioning menu. You can also convert file systems later, using the `fsck_ffs`(8) utility. More details are available in *this guide:*

https://wiki.netbsd.org/tutorials/acls_and_extended_attributes_on_ffs.

If you are upgrading from a version of NetBSD -current please also check the **Compatibility Issues With Previous NetBSD Releases**. It is impossible to completely summarize the massive development that went into the NetBSD 10.1_STABLE release. The complete list of changes can be found in

CHANGES:
https://nycdn.NetBSD.org/pub/NetBSD-daily/netbsd-10/latest/CHANGES

CHANGES-10.1:
https://nycdn.NetBSD.org/pub/NetBSD-daily/netbsd-10/latest/CHANGES-10.1

CHANGES-10.2:
https://nycdn.NetBSD.org/pub/NetBSD-daily/netbsd-10/latest/CHANGES-10.2

which are also present in the top level directory of the NetBSD 10.1 release tree.

Features to be removed in a later release

The following features are to be removed from NetBSD in the future:

- `groff`(1). Man pages are now handled with `mandoc`(1), and `groff`(1) can still be found in pkgsrc as `textproc/groff`.
- `pf`(4). This packet filter is obsolete and unmaintained in NetBSD. It will be eventually removed due to possible long-standing security issues and lack of multiprocessor support. New installations should use `npf`(7).

The NetBSD Foundation

The NetBSD Foundation is a tax exempt, not-for-profit 501(c)(3) corporation that devotes itself to the traditional goals and spirit of the NetBSD Project and owns the trademark of the word "NetBSD". It supports the design, development, and adoption of NetBSD worldwide. More information on the NetBSD Foundation, its composition, aims, and work can be found at: **https://www.NetBSD.org/foundation/**

Sources of NetBSD

Refer to *mirrors:* **https://www.NetBSD.org/mirrors/**

NetBSD 10.1_STABLE Release Contents

The root directory of the NetBSD 10.1_STABLE release is organized as follows:

`.../NetBSD-10.1_STABLE/`

`CHANGES`	Changes between the 9.0 and 10.0 releases.
`CHANGES-10.0`	Changes between the initial 10.0 branch and final release of 10.0.
`CHANGES-10.1`	Changes between the 10.0 and the 10.1 release.
`CHANGES-10.2`	Changes after the release of 10.1.
`CHANGES.prev`	Changes in previous NetBSD releases.
`README.files`	README describing the distribution's contents.
`images/`	Images (ISO 9660 or USB) for installing NetBSD. Depending on your system, these may be bootable.
`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 10.1_STABLE has a binary distribution.

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.

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.

src This set contains all of the base NetBSD 10.1_STABLE sources which are not in **gnusrc**, **sharesrc**, or **syssrc**.

syssrc This set contains the sources to the NetBSD 10.1_STABLE kernel for all architectures as well as the `config`(1) utility.

xsrc This set contains the sources to the X Window System.

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
```

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

`MD5` MD5 digests in the format produced by the command:
`cksum -a MD5` *`file`*.

`SHA512` SHA512 digests in the format produced by the command:
`cksum -a SHA512` *`file`*.

The SHA512 digest is safer, but MD5 checksums are provided so that a wider range of operating systems can check the integrity of the release files.

NetBSD/evbarm subdirectory structure

The evbarm-specific portion of the NetBSD 10.1_STABLE release is found in the `evbarm` subdirectory of the distribution: `.../NetBSD-10.1_STABLE/evbarm/`. It contains the following files and directories:

`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/`
- `gzimg/`
  - `armv7.img.gz` A gzipped writable image containing the complete NetBSD operating system for a range of 32-bit devices (includes a GENERIC kernel).
  - `arm64.img.gz` A gzipped writable image containing the complete NetBSD operating system for a range of 64-bit devices (includes a GENERIC64 kernel).
  - `rpi.img.gz` A gzipped writable image containing the complete 32-bit NetBSD operating system for Raspberry Pi variants only (includes RPI kernels).
- `kernel/`
  - `netbsd-GENERIC.gz` A gzipped Armv7 kernel which supports a range of 32-bit devices that do not need board-specific kernels.
  - `netbsd-GENERIC64.gz` A gzipped AArch64 kernel which supports a range of 64-bit devices that do not need board-specific kernels.
  - `netbsd-RPI.gz` A gzipped Armv6 kernel which supports the Raspberry Pi 1 only.
  - `netbsd-RPI2.gz` A gzipped Armv6 kernel which supports the Raspberry Pi 2 only.
- `sets/` evbarm binary distribution sets; see below.

`installation/`
- `miniroot/` evbarm kernel modules providing memory disk root file systems for expert usage.
- `misc/`
  - `bootaa64.efi` AArch64 EFI bootloader

Binary distribution sets

The NetBSD 10.1_STABLE release for evbarm is comprised of the following binary sets, which can be found in the `evbarm/binary/sets` subdirectory of the NetBSD 10.1_STABLE distribution tree:

base The NetBSD 10.1_STABLE evbarm **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.

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.

debug This distribution set contains debug information for all base system utilities. It is useful when reporting issues with binaries or during development. This set is huge, if the target disk is small, do not install it.

dtb Devicetree hardware descriptions for specific boards.

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.

games This set includes the games and their manual pages.

gpufw This set includes firmware for graphical drivers.

kern-GENERIC
This set contains a NetBSD/evbarm 10.1_STABLE `GENERIC` kernel, named `/netbsd`. You *must* install this distribution set.

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.

misc This set includes the system dictionaries, the typesettable document set, and other files from `/usr/share`.

modules This set includes kernel modules to add functionality to a running system.

rescue This set includes the statically linked emergency recovery binaries installed in `/rescue`.

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

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 X.Org. 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.

xcomp The extra libraries and include files needed to compile X source code.

xdebug This distribution set contains debug information for all X11 binaries. It is useful when reporting issues with these binaries or during development. This set is huge, if the target disk is small, do not install it.

xfont Fonts needed by the X server and by X clients.

xetc Configuration files for X which could be locally modified.

xserver The X server. This includes the modular X.Org server.

The evbarm binary distribution sets are distributed as tar files compressed with **gzip** 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 -xzpf`** command from the root directory (`/`) of your system.

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

NetBSD/evbarm System Requirements and Supported Devices

32-bit SoCs supported by GENERIC kernels (Armv7-A)

QEMU:

https://wiki.netbsd.org/ports/evbarm/qemu_arm/

is also supported.

- Allwinner A10, A13, A20, A32, A80, A83T, H3 (e.g. Cubieboard, OLinuXino, LeMaker Banana Pi...)
- Amlogic S805 (e.g. ODROID-C1)
- Broadcom BCM2836 (e.g. Raspberry Pi 2)
- Freescale/NXP i.MX6 Dual/DualLite/Quad, i.MX7 Dual (e.g. Wandboard, UDOO, Hummingboard...)
- Samsung Exynos 5422 (e.g. ODROID-XU3/XU-4)
- Texas Instruments AM335x and OMAP3 (e.g. BeagleBoard, BeagleBone Black...)
- Xilinx Zynq (e.g. Zedboard, Parallella...)
- NVIDIA Tegra K1

For a full list of supported devicetree-based boards, see the contents of the `dtb.tgz` set.

64-bit SoCs supported by GENERIC64 kernels

Devices conforming to the Arm "ServerReady" (SBBR and SBSA) specifications, and *QEMU:*

https://wiki.netbsd.org/ports/evbarm/qemu_arm/

are also supported.

- Allwinner H5, H6, A64 (e.g. PINE64, Pinebook, NanoPi A64, OLinuXino...)
- Amlogic G12, S905, S805X, S905D, S905W, S905X (e.g. ODROID-N2+, Le Potato, NanoPi K2...)
- Broadcom BCM2837, BCM2711 (e.g. Raspberry Pi 3 and 4)
- Freescale/NXP i.MX8MQ (e.g. Hummingboard...)
- Rockchip RK3328, RK3328 (e.g. Pinebook Pro, RockPro64, Firefly...)
- NVIDIA Tegra X1

For a full list of supported devicetree-based boards, see the contents of the `dtb.tar.xz` set.

Getting the NetBSD System on to Useful Media

Generally, NetBSD is installed on Arm devices by writing a live image (armv7.img, or arm64.img for 64-bit devices) to a SD card or USB device. For Armv6 Raspberry Pi 1s, this image is rpi.img.gz. The storage device should be at least 2GB.

If you're on Windows rather than a Unix variant, you can use *rawrite32:*

https://www.netbsd.org/˜martin/rawrite32/index.html

instead of `dd`(1) to write images, and *7-Zip:* **https://www.7-zip.org/** to decompress .gz files.

Arm devices generally also ship with a vendor-specific U-Boot bootloader, which may be replaced with a board-specific "mainline" U-Boot image from pkgsrc for an optimal NetBSD experience.

Preparing your System for NetBSD installation

After writing an SD card image, there are generally no specific preparation steps needed for Arm.

Once the system is booted, the init system will resize the root partition to take up the entire disk. Afterwards, the system can be configured to your liking.

Installing the NetBSD System

Installation for Armv7 and AArch64 devices with U-Boot

- Download or build armv7.img.gz (32-bit) or arm64.img.gz (64-bit).
- Decompress the .gz image, using `gunzip`(1) on Unix.
- Write the image to disk:

  ```
  # dd if=armv7.img of=/dev/rld0 bs=1m conv=sync progress=1
  ```
- If you are using Microsoft Windows, you can use *rawrite32:*

  https://www.netbsd.org/~martin/rawrite32/

  to write SD card images, which can handle decompression too.
- To replace the vendor U-Boot bootloader with a "mainline" U-Boot, obtain a board-specific image. Bootloaders are provided by the `sysutils/u-boot-*` packages in *pkgsrc:* **https://www.pkgsrc.org/**.

  If you're using pkgsrc on an UNIX-like operating system that isn't NetBSD, you must bootstrap first (see the `README` file in the root directory of pkgsrc).

  You can also extract the U-Boot image from u-boot-*.tgz archive in an existing *NetBSD binary package set:*

  https://cdn.netbsd.org/pub/pkgsrc/packages/NetBSD/aarch64/9.0/All/.

  Install the board-specific U-Boot to the SD card, e.g. for Allwinner devices (PINE H64 in this case):

  ```
  # dd if=/usr/pkg/share/u-boot/pine-h64/u-boot-sunxi-with-spl.bin of=/dev/rld0 bs=1k seek=8 conv=sync progress=1
  ```

  Or a Rockchip device (e.g. RockPro64):

  ```
  # dd if=/usr/pkg/share/u-boot/rockpro64/rksd_loader.img of=/dev/rld0 seek=64 conv=sync progress=1
  ```

Installing NetBSD/evbarm to a SATA hard disk

Some Arm boards offer a SATA interface, and you might want to install NetBSD to a hard disk after you've got it running from an SD card. You can do this using `sysinst`(8) from within NetBSD.

There are instructions for using *sysinst on Arm:*

https://wiki.netbsd.org/ports/evbarm/install_using_sysinst/

on the NetBSD wiki. The main difference from installing on other ports is that a FAT32 partition is required for /boot.

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. The most important steps are described below.

1. Before all else, read `postinstall`(8).

2. Configuring `/etc/rc.conf`

   If you or the installation software haven't done any configuration of `/etc/rc.conf` (**sysinst** normally 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 inline documentation may be found. More complete documentation can be found in rc.conf(5).

When you have finished editing /etc/rc.conf, type **exit** at the prompt to leave the single-user shell and continue with the multi-user boot.

Other values that may need to be set in /etc/rc.conf for a networked environment are *hostname* and possibly *defaultroute*. You may also need to add an *ifconfig_int* for your ⟨int⟩ network interface, along the lines of

```
ifconfig_awge0="inet 192.0.2.123 netmask 255.255.255.0"
```

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

```
ifconfig_awge0="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.

Instead of manually configuring networking, DHCP can be used by setting dhcpcd=YES in /etc/rc.conf.

3. Logging in

   After reboot, you can log in as root at the login prompt. If you didn't set a password in **sysinst**, there is no initial password. You should create an account for yourself (see below) and protect it and the "root" account with good passwords. By default, root login from the network is disabled (even via ssh(1)). One way to become root over the network is to log in as a different user that belongs to group "wheel" (see group(5)) and use su(1) to become root.

4. Adding accounts

   Use the useradd(8) command to add accounts to your system. Do not edit /etc/passwd directly! See vipw(8) and pwd_mkdb(8) if you want to edit the password database.

5. The X Window System

   If you installed the X Window System, you may want to read the chapter about X in the *NetBSD Guide:*
   https://www.NetBSD.org/docs/guide/en/chap-x.html:

6. 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, pkgsrc. pkgsrc automatically handles any changes necessary to make the software run on NetBSD. This includes the retrieval and installation of any other packages the software may depend upon.

   - More information on the package system is available at
     https://www.NetBSD.org/docs/software/packages.html
   - A list of available packages suitable for browsing is at
     https://cdn.NetBSD.org/pub/pkgsrc/current/pkgsrc/README.html
   - Precompiled binaries can be found at
     https://cdn.NetBSD.org/pub/pkgsrc/packages/NetBSD/
     usually in the evbarm/10.1_STABLE/All subdir. If you installed pkgin(1) in the **sysinst** post-installation configuration menu, you can use it to automatically install binary packages over the network. Assuming that /usr/pkg/etc/pkgin/repositories.conf is correctly configured, you can install

them with the following commands:

```
# pkgin install tcsh bash perl apache xfce4 firefox
...
```

The above command will install the Tenex-csh and Bourne Again shells, the Perl programming language, Apache web server, Xfce desktop environment and the Firefox web browser as well as all the packages they depend on.

If it was not automatically installed, pkgin(1) can be installed on a fresh NetBSD system with pkg_add(1):

```
export PKG_PATH=https://cdn.netbsd.org/pub/pkgsrc/packages/NetBSD/$(uname -p)/$(uname -r | cut -d_ -f1)/All
pkg_add pkgin
```

- If you wish to use the pkgsrc(7) framework for compiling packages and did not install it from the sysinst(8) post-installation configuration menu, you can obtain it by retrieving the file
  https://cdn.NetBSD.org/pub/pkgsrc/stable/pkgsrc.tar.gz.
  It is typically extracted into /usr/pkgsrc (though other locations work fine) with the commands:

  ```
  # cd /usr
  # tar -zxpf pkgsrc.tar.gz
  ```

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

7. Misc

- Edit /etc/mail/aliases to forward root mail to the right place. Don't forget to run newaliases(1) afterwards.
- 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 easiest way to upgrade to NetBSD evbarm 10.1_STABLE is by using the sysutils/sysupgrade package from pkgsrc.

First, edit /usr/pkg/etc/sysupgrade.conf. Make sure RELEASEDIR and ARCHIVE_EXTENSION are correct:

```
# Replace evbarm-aarch64 with evbarm-earmv7hf on a 32-bit system, evbarm-earmv6hf on the original RPI
RELEASEDIR="https://cdn.netbsd.org/pub/NetBSD/NetBSD-10.1_STABLE/evbarm-aarch64/"
ARCHIVE_EXTENSION=tar.xz
```

Make sure /boot is mounted, and copy the new board-specific *.dts device tree file into place. Note that the device tree files are sorted into SoC-type subdirectories in /boot/dtb, e.g. allwinner, amlogic, broadcom, freescale, nvidia, rockchip.

For example, for the Allwinner-based PINE A64 LTS:

```
$ ftp https://cdn.netbsd.org/pub/NetBSD/NetBSD-10.1_STABLE/evbarm-aarch64/binary/sets/dtb.tar.xz
$ unxz dtb.tar.xz
# cp ./boot/dtb/allwinner/sun50i-a64-pine64-lts.dtb /boot/dtb/allwinner/
```

Also copy bootaa64.efi if applicable:

```
$ ftp https://cdn.netbsd.org/pub/NetBSD/NetBSD-10.1_STABLE/evbarm-aarch64/installation/misc/bootaa64.efi
# cp bootaa64.efi /boot/EFI/BOOT/bootaa64.efi
```

Finally:

```
# sysupgrade fetch
# sysupgrade kernel
# sysupgrade modules
# reboot
# sysupgrade sets
# sysupgrade etcupdate
# sysupgrade postinstall
# reboot
```

This is the most careful possible path with sysupgrade that makes sure the kernel and userland are always fully compatible, by making sure the kernel and boot files are newer than the userland. It is also possible to:

```
# sysupgrade auto
# reboot
```

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 10.1_STABLE.

Note that **sysinst** will automatically invoke

```
postinstall fix
```

and thus all issues that are fixed by **postinstall** by default will be handled.

In NetBSD 9 and earlier, filesystems listed in `/etc/fstab` would be mounted before non-legacy **zfs** filesystems. Starting from NetBSD 10 this order has been reversed.

If you have ever run a version of NetBSD -current between April 18, 2020 and September 23, 2022 (the version numbers used in the affected time range are between 9.99.56 and 9.99.106) your FFS file systems might have broken extended attributes stored.

You should follow this *guide:*
https://wiki.netbsd.org/features/UFS2ea/
before booting the updated system multi-user for the first time.

Note that you do not need to do anything special if you never did run any affected kernel, especially if you have never run NetBSD -current.

The display drivers used for modern GPUs and the whole subsystem supporting it (DRM/KMS) have been updated to a newer version. Unfortunately not all issues with this have been resolved before the NetBSD 10.0 release. You can find a list of issues in the *Open issues with new DRM/KMS:*
https://wiki.netbsd.org/releng/netbsd-10/
section of the release engineering wiki page.

A number of things have been removed from the NetBSD 10.1_STABLE release. See the "Components removed from NetBSD" section near the beginning of this document for a list.

Using online NetBSD documentation

Documentation is available if you installed 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`. See **https://www.NetBSD.org/mailinglists/** for details.

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.

Bugs also can be submitted and queried with the web interface at
https://www.NetBSD.org/support/send-pr.html

There are also port-specific mailing lists, to discuss aspects of each port of NetBSD. Use majordomo to find their addresses, or visit **https://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 NetBSD, and have an idea as to how you could be useful, send us mail or subscribe to: `netbsd-users@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. 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 work on BSD systems, support, and encouragement.

- The Internet Systems Consortium, Inc. for hosting the NetBSD FTP, CVS, AnonCVS, mail, mail archive, GNATS, SUP, Rsync and WWW servers.
- The Internet Research Institute in Japan for hosting the server which runs the CVSweb interface to the NetBSD source tree.
- The Columbia University Computer Science Department for hosting the build cluster.
- The many organizations that provide NetBSD mirror sites.
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- 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 be mentioned, tell us!)

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