NAME

INSTALL — Installation procedure for NetBSD/evbarm.

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DESCRIPTION

About this Document

This document describes the installation procedure for NetBSD 7.99.20 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 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 many different different system architectures (ports) across a variety of distinct CPU families, and is being ported to more. The NetBSD 7.99.20 release contains complete binary releases for most of these system architectures, with preliminary support for the others included in source form. Please see the NetBSD website at **http://www.NetBSD.org/** for information on them.)

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 6.0 and 7.0 Releases

The NetBSD 7.99.20 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.

It is impossible to completely summarize the massive development that went into the NetBSD 7.99.20 release. The complete list of changes can be found in the CHANGES:

http://ftp.NetBSD.org/pub/NetBSD/NetBSD-7.0/CHANGES

and CHANGES-7.0:

http://ftp.NetBSD.org/pub/NetBSD/NetBSD-7.0/CHANGES-7.0

files in the top level directory of the NetBSD 7.0 release tree.

Features to be removed in a later release

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

- `dhclient`(8) in favor of `dhcpcd`(8).
- `groff`(1). Man pages are now handled with `mandoc`(1), and `groff`(1) can still be found in pkgsrc as `textproc/groff`.
- `rtsol`(8) and `rtsold`(8).

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: **http://www.NetBSD.org/foundation/**

Sources of NetBSD

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

NetBSD 7.99.20 Release Contents

The root directory of the NetBSD 7.99.20 release is organized as follows:

`.../NetBSD-7.99.20/`

`CHANGES`	Changes between the 6.0 and 7.0 releases.
`CHANGES-7.0`	Changes between the initial 7.0 branch and final release of 7.0.
`CHANGES.prev`	Changes in previous NetBSD releases.
`LAST_MINUTE`	Last minute changes and notes about the release.
`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 7.99.20 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 7.99.20 sources which are not in **gnusrc**, **sharesrc**, or **syssrc**.

syssrc This set contains the sources to the NetBSD 7.99.20 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 7.99.20 release is found in the `evbarm` subdirectory of the distribution: `.../NetBSD-7.99.20/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/`
`kernel/`
`netbsd-GENERIC.gz`
A gzipped NetBSD kernel containing code for everything supported in this release.
`sets/` evbarm binary distribution sets; see below.

`installation/`
`misc/` Miscellaneous evbarm installation utilities; see installation section below.

Binary distribution sets

The NetBSD evbarm binary distribution sets contain the binaries which comprise the NetBSD 7.99.20 release for evbarm. The binary distribution sets can be found in the `evbarm/binary/sets` subdirectory of the NetBSD 7.99.20 distribution tree, and are as follows:

base The NetBSD 7.99.20 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.

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.

kern-INTEGRATOR
(see below)

kern-IQ80310
(see below)

kern-IQ80321
(see below)

kern-TEAMASA_NPWR

These sets contain a NetBSD/evbarm 7.99.20 kernel, named `/netbsd`. Some of these sets also contain a binary format kernel named `/netbsd.bin` and an S-record format kernel named `/netbsd.srec` that your firmware may need to boot. You *must* install the kernel that matches your hardware.

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.

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.

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.

The evbarm 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 -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

NetBSD 7.99.20 runs on the following ARM architecture evaluation boards:

- Technologic Systems TS-7200
- ARM, Ltd. Integrator
- Intel IQ80310
- Intel IQ80321
- Team ASA, Inc. Npwr
- Intel IXM1200
- Samsung SMDK2800
- ADI Engineering, Inc. BRH ("Big Red Head")
- Arcom Viper

Supported devices (Technologic Systems TS-7200)

For devices that have machine-independent drivers, this is not an exhaustive list, but merely reflects the devices that have been tested on this platform.

- TS-5620 Real Time Clock
- Serial ports
  - On-chip EP9302 UARTs
  - TS-SER1, TS-SER2, TS-SER4 PC/104 serial adapters
  - TS-MODEM, TS-MODEM2 PC/104 land-line/cellular modems
- Ethernet adapters
  - On-chip EP9302 10/100 ethernet
  - TS-ETH10 PC/104 expansion ethernet adapters
- Other on-board functions
  - CompactFlash socket
  - USB OHCI host
  - Text-mode HD44780 LCD display header
  - Matrix keypad/GPIO header
  - Board temperature sensor and watchdog timer

Supported devices (ARM, Ltd. Integrator)

For devices that have machine-independent drivers, this is not an exhaustive list, but merely reflects the devices that have been tested on this platform.

- PrimeCell PL030 Real Time Clock
- Serial ports
  - PrimeCell PL010 UART
- SCSI host adapters
  - Adaptec AHA-2910, 2915, 2920, and 2930C adapters.

  - Adaptec AHA-2x4x[U][2][W] cards and onboard PCI designs using the AIC-7770, AIC-7850, AIC-7860, AIC-7870, AIC-7880 and AIC-789x chipsets.
  - Adaptec AHA-394x[U][W] cards [b]
  - Adaptec AHA-3950U2 cards
  - Adaptec AHA-3960, 19160 and 29160 Ultra-160 adapters
- Ethernet adapters
  - Intel i82557, i82558, i82559, i82550

Supported devices (Intel IQ80310)

For devices that have machine-independent drivers, this is not an exhaustive list, but merely reflects the devices that have been tested on this platform.

- Serial ports
  - On-board ST16c550 UARTs
- Ethernet adapters
  - Intel i82557, i82558, i82559, i82550
- i80312 Companion I/O functions
  - General Purpose I/O unit

Supported devices (Intel IQ80321)

For devices that have machine-independent drivers, this is not an exhaustive list, but merely reflects the devices that have been tested on this platform.

- Serial ports
  - On-board TI 16550 UART
- Ethernet adapters
  - Intel i82542, i82543, i85244 Gigabit Ethernet
- i80321 I/O Processor functions
  - Application Accelerator Unit
  - Watchdog timer

Supported devices (Team ASA Npwr)

The Npwr is a storage appliance based on the Intel IOP310 I/O processor chipset. This is an exhaustive list of devices supported on the Npwr as the Npwr has no expansion capability.

- Serial ports
  - On-board TI 16550 UART
- SCSI host adapters
  - On-board LSI Logic 53c1010 Ultra160 SCSI adapter
- Ethernet adapters
  - On-board Intel i82544 Gigabit Ethernet

Supported devices (Intel IXM1200)

For devices that have machine-independent drivers, this is not an exhaustive list, but merely reflects the devices that have been tested on this platform.

- Serial ports

- IXP1200 on-chip serial port

- Ethernet adapters
  - Intel i82557, i82558, i82559, i82550

Supported devices (Samsung SMDK2800)

For devices that have machine-independent drivers, this is not an exhaustive list, but merely reflects the devices that have been tested on this platform.

- Serial ports
  - S3C2800 on-chip serial ports

Supported devices (ADI BRH)

For devices that have machine-independent drivers, this is not an exhaustive list, but merely reflects the devices that have been tested on this platform.

- Serial ports
  - On-board TI 16752 DUART

- Ethernet adapters
  - Intel i82557, i82558, i82559, i82550
  - Intel i82544, i82546 Gigabit Ethernet

Supported devices (Arcom Viper)

Current this is an exhaustive list, since expansion ports such as PC/104 and USB are not yet supported.

- Serial ports
  - On-chip PXA255 UARTs

  Ethernet adapters
  - On-board SMC91C111

Getting the NetBSD System on to Useful Media

Installation is supported from several media types, including:

- CD-ROM / DVD
- 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 / DVD Find out where the distribution set files are on the CD-ROM or DVD. Likely locations are `binary/sets` and `evbarm/binary/sets`.

Proceed to the instructions on installation.

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. If you don't have DHCP available on your network, you will 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.

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.

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 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 you don't have DHCP available on your network and 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.

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_sets
```

where *tape_device* is the name of the tape device that represents the tape drive you're using. This might be `/dev/rst0`, or something similar, but it will vary from system to system. In the above example, *dist_sets* is a list of filenames corresponding to the distribution sets that you wish to place on the tape. For instance, to put the **kern-GENERIC, base,** and **etc** distributions on tape (the absolute minimum required for installation), you would do the following:

```
# cd .../NetBSD-7.99.20
# cd evbarm/binary
# tar -cf tape_device kern-GENERIC.tgz base.tgz etc.tgz
```

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.

Preparing your System for NetBSD installation

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

Preparation for the Technologic Systems TS-7200

The TS-7200 uses RedBoot firmware which supports loading the kernel via serial port and the on-chip Ethernet. These notes assume that the Ethernet will be used to load the kernel. RedBoot can either use TFTP or HTTP to load the kernel via the network.

These notes also assume the TS-7200 will be run from the CompactFlash; that a FFS filesystem on the CompactFlash card will provide the root file system. The minimum size of the CompactFlash card is 64MB with 512MB being the recommended minimum size if attempting a full installation.

The first step to install NetBSD is to interrupt normal system bootup and drop to the RedBoot prompt by hitting Ctrl-C immediately after applying power. To load both the installation kernel and the generic post-installation TS7200 kernel you will need network connectivity from RedBoot which you will have to configure using the RedBoot **fconfig** command; see the RedBoot documentation for more information.

A compressed kernel image and loader suitable for placing into flash is provided with the distribution. Use of this image is optional; a kernel that can be directly loaded over the network by RedBoot is also provided.

The image for the TS-7200 can be found under the NetBSD/evbarm 7.99.20 distribution directory in `evbarm/binary/gzimg/gzimg_TS7200_flash_0x60660000.gz`, and corresponds to the kernel in `evbarm/binary/kernel/netbsd-TS7200.gz`. The following steps describe how to copy the compressed kernel image into flash.

1. Uncompress the gzimg file and place it into the TFTP server's download area (note, the kernel inside the gzimg is still compressed after this step).

   ```
   server# gzcat gzimg_TS7200_flash_0x60660000.gz > /tftpboot/gzimg_TS7200_flash_0x60660000
   ```

2. Load the gzimg from the TFTP server.

   ```
   RedBoot> load -r -b 0x00200000 gzimg_TS7200_flash_0x60660000
   Raw file loaded 0x00200000-0x00605fe0
   ```

3. Use the RedBoot **fis** command to copy the image into flash. For more information on the RedBoot Flash Image System, see the RedBoot documentation. The factory default Linux image may already be present in flash and must be deleted before continuing.

   ```
   RedBoot> fis delete vmlinux
   RedBoot> fis create -b 0x00200000 -f 0x60660000 -l 0x00160000 netbsd.gz
   ```

Once the compressed kernel image has been copied into flash, it may be started by jumping to the flash address of the image:

```
RedBoot> g 0x60660000
```

Preparation for the Intel IQ80310

The IQ80310 uses RedBoot firmware from Red Hat, Inc. RedBoot supports loading the kernel via the serial port and the on-board Ethernet. These notes assume that the Ethernet will be used to load the kernel. RedBoot uses the Trivial File Transfer Protocol (TFTP) to load the kernel via the network.

These notes also assume that the IQ80310 will be run as a diskless system; that an NFS server will provide the root file system. The NetBSD kernel uses the Dynamic Host Configuration Protocol (DHCP) to obtain network address and root file system information.

The first step is to configure your DHCP, NFS, and TFTP server software. You will need the MAC address for the on-board Ethernet, which RedBoot can provide; see the RedBoot documentation for more information.

The next step is to configure RedBoot to obtain its IP address from your DHCP server; see the RedBoot documentation for more information.

Once your DHCP server and RedBoot are properly configured, you should see information similar to the following when the IQ80310 is reset or powered-up:

```
RedBoot(tm) debug environment - built 17:16:14, Feb 12 2001
Platform: IQ80310 (XScale)
Copyright (C) 2000, Red Hat, Inc.

RAM: 0xa0000000-0xa2000000
FLASH: 0x00000000 - 0x00800000, 64 blocks of 0x00020000 bytes each.
IP: 192.168.0.10, Default server: 192.168.0.1
RedBoot>
```

A compressed kernel image and loader suitable for placing into flash is provided with the distribution. Use of this image is optional; a kernel that can be directly loaded over the network by RedBoot is also provided.

The image for the IQ80310 can be found under the NetBSD/evbarm 7.99.20 distribution directory in `evbarm/binary/gzimg/gzimg_IQ80310_flash_0x00080000.gz`, and corresponds to the kernel in `evbarm/binary/kernel/netbsd-IQ80310.gz`. The following steps describe how to copy the compressed kernel image into flash.

1. Uncompress the gzimg file and place it into the TFTP server's download area (note, the kernel inside the gzimg is still compressed after this step).

   ```
   server# gzcat gzimg_IQ80310_flash_0x00080000.gz > /tftpboot/gzimg_IQ80310_flash_0x00080000
   ```

2. Load the gzimg from the TFTP server.

   ```
   RedBoot> load -r -b 0xa0200000 gzimg_IQ80310_flash_0x00080000
   Raw file loaded 0xa0200000-0xa0305fe0
   ```

3. Use the RedBoot **fis** command to copy the image into flash. For more information on the RedBoot Flash Image System, see the RedBoot documentation.

   ```
   RedBoot> fis create -b 0xa0200000 -f 0x00080000 -l 0x00200000 netbsd.gz
   ... Erase from 0x00080000-0x00280000: ....................
   ... Program from 0xa0200000-0xa0400000 at 0x00080000: .....................
   ... Unlock from 0x007e0000-0x00800000:.
   ... Erase from 0x007e0000-0x00800000:.
   ... Program from 0xa1fd0000-0xa1ff0000 at 0x007e0000:.
   ... Lock from 0x007e0000-0x00800000:.
   ```

Once the compressed kernel image has been copied into flash, it may be started by jumping to the flash address of the image:

```
RedBoot> g 0x00080000

>> NetBSD/IQ80310 Gzip Boot, Revision 1.1
>> (root@tgm, Thu Mar 28 18:32:45 PST 2002)
>> RAM 0xa0000000 - 0xaffffff, heap at 0xaffd0000
>> Load address: 0xa0200000
>> Image size: 741244
Uncompressing image...done.
Jumping to image @ 0xa0200000...
```

```
NetBSD/evbarm (IQ80310) booting ...
Resetting secondary PCI bus...
initarm: Configuring system ...
physmemory: 65536 pages at 0xa0000000 -> 0xafffffff
init subsystems: stacks vectors undefined pmap irq done.
[ using 155084 bytes of netbsd ELF symbol table ]
Copyright (c) 1996, 1997, 1998, 1999, 2000, 2001, 2002
    The NetBSD Foundation, Inc.  All rights reserved.
Copyright (c) 1982, 1986, 1989, 1991, 1993
    The Regents of the University of California.  All rights reserved.

NetBSD 1.5ZC (IQ80310) #20: Fri Mar 29 10:25:53 PST 2002
    root@tgm:/u1/netbsd/src/sys/arch/evbarm/compile/IQ80310
total memory = 256 MB
avail memory = 232 MB
using 1228 buffers containing 13208 KB of memory
mainbus0 (root)
cpu0 at mainbus0: i80200 step A-0 (XScale core)
cpu0: DC enabled IC enabled WB enabled LABT
cpu0: 32KB/32B 32-way Instruction cache
cpu0: 32KB/32B 32-way write-back-locking Data cache
obio0 at mainbus0: board rev. F, CPLD rev. D, backplane present
com0 at obio0 addr 0xfe810000: ns16550a, working fifo
com0: console
com1 at obio0 addr 0xfe800000: ns16550a, working fifo
iopxs0 at mainbus0: i80312 Companion I/O, acting as PCI host
iopxs0: configuring Secondary PCI bus
pci0 at iopxs0 bus 1
pci0: i/o space, memory space enabled
ppb0 at pci0 dev 7 function 0: Digital Equipment DECchip 21154 PCI-PCI Bridge (rev. 0
pci1 at ppb0 bus 2
pci1: i/o space, memory space enabled
fxp0 at pci1 dev 0 function 0: i82559S Ethernet, rev 9
fxp0: interrupting at iq80310 irq 1
fxp0: Ethernet address 00:80:4d:46:0b:b9
inphy0 at fxp0 phy 1: i82555 10/100 media interface, rev. 4
inphy0: 10baseT, 10baseT-FDX, 100baseTX, 100baseTX-FDX, auto
clock: hz=100 stathz=0 profhz=0
boot device: <unknown>
root device:
```

Preparation for the Intel IQ80321

The IQ80321 uses RedBoot firmware from Red Hat, Inc. RedBoot supports loading the kernel via the serial port and the on-board Ethernet. These notes assume that the Ethernet will be used to load the kernel. RedBoot uses the Trivial File Transfer Protocol (TFTP) to load the kernel via the network.

These notes also assume that the IQ80321 will be run as a diskless system; that an NFS server will provide the root file system. The NetBSD kernel uses the Dynamic Host Configuration Protocol (DHCP) to obtain network address and root file system information.

The first step is to configure your DHCP, NFS, and TFTP server software. You will need the MAC address for the on-board Ethernet, which RedBoot can provide; see the RedBoot documentation for more information.

The next step is to configure RedBoot to obtain its IP address from your DHCP server; see the RedBoot documentation for more information.

Once your DHCP server and RedBoot are properly configured, you should see information similar to the following when the IQ80321 is reset or powered-up:

```
Ethernet eth0: MAC address 00:07:e9:03:38:40
IP: 192.168.0.11, Default server: 192.168.0.1

RedBoot(tm) bootstrap and debug environment [ROM]
Non-certified release, version UNKNOWN - built 11:21:56, Feb  1 2002

Platform: IQ80321 (XScale)
Copyright (C) 2000, 2001, 2002, Red Hat, Inc.

RAM: 0x00000000-0x08000000, 0x00017008-0x01ddd000 available
FLASH: 0xf0000000 - 0xf0800000, 64 blocks of 0x00020000 bytes each.
RedBoot>
```

A compressed kernel image and loader suitable for placing into flash is provided with the distribution. Use of this image is optional; a kernel that can be directly loaded over the network by RedBoot is also provided.

The image for the IQ80321 can be found under the NetBSD/evbarm 7.99.20 distribution directory in `evbarm/binary/gzimg/gzimg_IQ80321_flash_0xf0080000.gz`, and corresponds to the kernel in `evbarm/binary/kernel/netbsd-IQ80321.gz`. The following steps describe how to copy the compressed kernel image into flash.

1. Uncompress the gzimg file and place it into the TFTP server's download area (note, the kernel inside the gzimg is still compressed after this step).

   ```
   server# gzcat gzimg_IQ80321_flash_0xf0080000.gz > /tftpboot/gzimg_IQ80321_flash_0xf0080000
   ```

2. Load the gzimg from the TFTP server.

   ```
   RedBoot> load -r -b 0x00200000 gzimg_IQ80321_flash_0xf0080000
   Raw file loaded 0x00200000-0x00305fe4
   ```

3. Use the RedBoot **fis** command to copy the image into flash. For more information on the RedBoot Flash Image System, see the RedBoot documentation.

   ```
   RedBoot> fis create -b 0x00200000 -f 0xf0080000 -l 0x00200000 netbsd.gz
   * CAUTION * about to program 'netbsd.gz'
               at 0xf0080000..0xf027ffff from 0x00200000 - are you sure (y/n)? y
   ... Erase from 0xf0080000-0xf0280000: ......................
   ... Program from 0x00200000-0x00400000 at 0xf0080000: ......................
   ... Unlock from 0xf07e0000-0xf0800000:.
   ... Erase from 0xf07e0000-0xf0800000:.
   ... Program from 0x01ddf000-0x01dff000 at 0xf07e0000:.
   ... Lock from 0xf07e0000-0xf0800000:.
   ```

Once the compressed kernel image has been copied into flash, it may be started by jumping to the flash address of the image:

```
RedBoot> g 0xf0080000

>> NetBSD/IQ80321 Gzip Boot, Revision 1.1
>> (root@tgm, Thu Mar 28 18:32:45 PST 2002)
```

```
>> RAM 0xa0000000 - 0xa7ffffff, heap at 0xa7fd0000
>> Load address: 0xa0200000
>> Image size: 739495
Uncompressing image...done.
Jumping to image @ 0xa0200000...

NetBSD/evbarm (IQ80321) booting ...
initarm: Configuring system ...
physmemory: 32768 pages at 0xa0000000 -> 0xa7ffffff
init subsystems: stacks vectors undefined pmap irq done.
[ using 155076 bytes of netbsd ELF symbol table ]
Copyright (c) 1996, 1997, 1998, 1999, 2000, 2001, 2002
    The NetBSD Foundation, Inc.  All rights reserved.
Copyright (c) 1982, 1986, 1989, 1991, 1993
    The Regents of the University of California.  All rights reserved.

NetBSD 1.5ZC (IQ80321) #1: Thu Mar 28 18:31:58 PST 2002
    root@tgm:/u1/netbsd/src/sys/arch/evbarm/compile/IQ80321
total memory = 128 MB
avail memory = 113 MB
using 1228 buffers containing 6656 KB of memory
mainbus0 (root)
cpu0 at mainbus0: i80321 step A-0 (XScale core)
cpu0: DC enabled IC enabled WB enabled LABT
cpu0: 32KB/32B 32-way Instruction cache
cpu0: 32KB/32B 32-way write-back-locking Data cache
obio0 at mainbus0
com0 at obio0 addr 0xfe800000: ns16550a, working fifo
com0: console
iopxs0 at mainbus0: i80321 I/O Processor, acting as PCI host
iopxs0: configuring PCI bus
pci0 at iopxs0 bus 0
pci0: i/o space, memory space enabled, rd/line, rd/mult, wr/inv ok
wm0 at pci0 dev 4 function 0: Intel i82544 1000BASE-T Ethernet, rev. 2
wm0: interrupting at iop321 irq 27
wm0: Ethernet address 00:07:e9:03:38:40
makphy0 at wm0 phy 1: Marvell 88E1000 Gigabit PHY, rev. 0
makphy0: 10baseT, 10baseT-FDX, 100baseTX, 100baseTX-FDX, 1000baseT, 1000baseT-FDX, au
clock: hz=100 stathz=0 profhz=0
boot device: <unknown>
root device:
```

Installing the NetBSD System

Installation for the Technologic Systems TS-7200

The following steps describe how to set up a CompactFlash card for the TS-7200. The TS-7200 can use the interactive installation program **sysinst** to perform an internet installation from ftp.netbsd.org on the CompactFlash.

1. Place the netbsd-TS7200_INSTALL.bin kernel into the TFTP server's download area. It must be decompressed from the gzipped image in the release directory evbarm/installation/instkernel/netbsd-TS7200_INSTALL.srec.gz

```
server# gunzip netbsd-TS7200_INSTALL.srec.gz
server# cp netbsd-TS7200_INSTALL.srec
/tftpboot/netbsd-TS7200_INSTALL
```

2. Load the kernel from the TFTP server.

```
RedBoot> load netbsd-TS7200_INSTALL
```

3. Start the kernel running.

```
RedBoot> go
```

The kernel will display boot messages, probe for devices, and invoke the interactive sysinst installation tool. Once sysinst has completed installation, the system will reboot back into RedBoot. If the preparation instructions above have been followed, the post-installation NetBSD kernel will be in the FIS ready to be jumped into. You can have RedBoot automatically start NetBSD by putting the command **go 0x60660000** into the RedBoot bootscript using the **fconfig** command.

Installation for the Intel IQ80310

The following steps describe how to set up an NFS root environment for the IQ80310 and how to boot the IQ80310.

1. Place the kernel into the TFTP server's download area.

RedBoot only loads S-Records, so select a kernel with the ".srec" filename suffix. In this example, we will boot the kernel hard-wired to use the on-board Ethernet as the root device.

```
server# cp netbsd-fxp0.srec /tftpboot/netbsd-iq80310-fxp0
```

2. Unpack the distribution sets into the target's root directory.

```
server# cd /export/client/iq80310
server# gzcat .../base.tgz | tar xvpf -
server# gzcat .../etc.tgz | tar xvpf -
[repeat for all sets you wish to unpack]
```

3. Load the kernel from the TFTP server.

```
RedBoot> load netbsd-iq80310-fxp0
Entry point: 0xa0200000, address range: 0xa0200000-0xa035e07c
RedBoot>
```

4. Start the kernel running. The kernel will display boot message, probe for devices, and mount the root file system. If you used a kernel hard-wired to use the on-board Ethernet, it will attempt to mount the root file system automatically. Otherwise, it will prompt for the root device to use.

Since the system's run-time environment has not yet been configured, the system should boot into single-user mode.

```
RedBoot> go

NetBSD/evbarm (IQ80310) booting ...
Resetting secondary PCI bus...
initarm: Configuring system ...
physmemory: 65536 pages at 0xa0000000 -> 0xafffffff
init subsystems: stacks vectors undefined pmap irq done.
[ using 155084 bytes of netbsd ELF symbol table ]
Copyright (c) 1996, 1997, 1998, 1999, 2000, 2001, 2002
    The NetBSD Foundation, Inc.  All rights reserved.
```

```
Copyright (c) 1982, 1986, 1989, 1991, 1993
    The Regents of the University of California.  All rights reserved.

NetBSD 1.5ZC (IQ80310) #20: Fri Mar 29 10:25:53 PST 2002
    root@tgm:/u1/netbsd/src/sys/arch/evbarm/compile/IQ80310
total memory = 256 MB
avail memory = 232 MB
using 1228 buffers containing 13208 KB of memory
mainbus0 (root)
cpu0 at mainbus0: i80200 step A-0 (XScale core)
cpu0: DC enabled IC enabled WB enabled LABT
cpu0: 32KB/32B 32-way Instruction cache
cpu0: 32KB/32B 32-way write-back-locking Data cache
obio0 at mainbus0: board rev. F, CPLD rev. D, backplane present
com0 at obio0 addr 0xfe810000: ns16550a, working fifo
com0: console
com1 at obio0 addr 0xfe800000: ns16550a, working fifo
iopxs0 at mainbus0: i80312 Companion I/O, acting as PCI host
iopxs0: configuring Secondary PCI bus
pci0 at iopxs0 bus 1
pci0: i/o space, memory space enabled
ppb0 at pci0 dev 7 function 0: Digital Equipment DECchip 21154 PCI-PCI Bridge (rev
pci1 at ppb0 bus 2
pci1: i/o space, memory space enabled
fxp0 at pci1 dev 0 function 0: i82559S Ethernet, rev 9
fxp0: interrupting at iq80310 irq 1
fxp0: Ethernet address 00:80:4d:46:0b:b9
inphy0 at fxp0 phy 1: i82555 10/100 media interface, rev. 4
inphy0: 10baseT, 10baseT-FDX, 100baseTX, 100baseTX-FDX, auto
clock: hz=100 stathz=0 profhz=0
boot device: <unknown>
root on fxp0
nfs_boot: trying DHCP/BOOTP
nfs_boot: DHCP next-server: 192.168.0.1
nfs_boot: my_name=iq80310.lab.wasabisystems.com
nfs_boot: my_domain=wasabisystems.com
nfs_boot: my_addr=192.168.0.10
nfs_boot: my_mask=255.255.255.0
nfs_boot: gateway=192.168.0.254
root on 192.168.0.1:/export/client/iq80310
/etc/rc.conf is not configured.  Multiuser boot aborted.
Enter pathname of shell or RETURN for sh:
```

Installation for the Intel IQ80321

The following steps describe how to set up an NFS root environment for the IQ80321 and how to boot the IQ80321.

1. Place the kernel into the TFTP server's download area.

   RedBoot only loads S-Records, so select a kernel with the ".srec" filename suffix. In this example, we will boot the kernel hard-wired to use the on-board Ethernet as the root device.

```
server# cp netbsd-wm0.srec /tftpboot/netbsd-iq80321-wm0
```

2. Unpack the distribution sets into the target's root directory.

```
server# cd /export/client/iq80321
server# gzcat .../base.tgz | tar xvpf -
server# gzcat .../etc.tgz | tar xvpf -
[repeat for all sets you wish to unpack]
```

3. Load the kernel from the TFTP server.

```
RedBoot> load netbsd-iq80321-wm0
Entry point: 0x00200000, address range: 0x00200000-0x00396a40
RedBoot>
```

4. Start the kernel running. The kernel will display boot message, probe for devices, and mount the root file system. If you used a kernel hard-wired to use the on-board Ethernet, it will attempt to mount the root file system automatically. Otherwise, it will prompt for the root device to use.

   Since the system's run-time environment has not yet been configured, the system should boot into single-user mode.

```
RedBoot> go

NetBSD/evbarm (IQ80321) booting ...
initarm: Configuring system ...
physmemory: 32768 pages at 0xa0000000 -> 0xa7ffffff
init subsystems: stacks vectors undefined pmap irq done.
[ using 156468 bytes of netbsd ELF symbol table ]
Copyright (c) 1996, 1997, 1998, 1999, 2000, 2001, 2002
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    The Regents of the University of California.  All rights reserved.

NetBSD 1.5ZC (IQ80321) #1: Thu Mar 28 18:20:34 PST 2002
    root@tgm:/u1/netbsd/src/sys/arch/evbarm/compile/IQ80321
total memory = 128 MB
avail memory = 113 MB
using 1228 buffers containing 6656 KB of memory
mainbus0 (root)
cpu0 at mainbus0: i80321 step A-0 (XScale core)
cpu0: DC enabled IC enabled WB enabled LABT
cpu0: 32KB/32B 32-way Instruction cache
cpu0: 32KB/32B 32-way write-back-locking Data cache
obio0 at mainbus0
com0 at obio0 addr 0xfe800000: ns16550a, working fifo
com0: console
iopxs0 at mainbus0: i80321 I/O Processor, acting as PCI host
iopxs0: configuring PCI bus
pci0 at iopxs0 bus 0
pci0: i/o space, memory space enabled, rd/line, rd/mult, wr/inv ok
wm0 at pci0 dev 4 function 0: Intel i82544 1000BASE-T Ethernet, rev. 2
wm0: interrupting at iop321 irq 27
wm0: Ethernet address 00:07:e9:03:38:40
makphy0 at wm0 phy 1: Marvell 88E1000 Gigabit PHY, rev. 0
```

```
makphy0: 10baseT, 10baseT-FDX, 100baseTX, 100baseTX-FDX, 1000baseT, 1000baseT-FDX,
clock: hz=100 stathz=0 profhz=0
boot device: <unknown>
root on wm0
nfs_boot: trying DHCP/BOOTP
nfs_boot: DHCP next-server: 192.168.0.1
nfs_boot: my_name=iq80321.lab.wasabisystems.com
nfs_boot: my_domain=wasabisystems.com
nfs_boot: my_addr=192.168.0.11
nfs_boot: my_mask=255.255.255.0
nfs_boot: gateway=192.168.0.254
root on 192.168.0.1:/export/client/iq80321
/etc/rc.conf is not configured.  Multiuser boot aborted.
Enter pathname of shell or RETURN for sh:
```

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 in-line 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_fxp0="inet 192.0.2.123 netmask 255.255.255.0"
   ```

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

   ```
   ifconfig_fxp0="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:
   http://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
     http://www.NetBSD.org/docs/software/packages.html
   - A list of available packages suitable for browsing is at
     ftp://ftp.NetBSD.org/pub/pkgsrc/current/pkgsrc/README.html
   - Precompiled binaries can be found at
     ftp://ftp.NetBSD.org/pub/pkgsrc/packages/NetBSD/
     usually in the `evbarm/7.99.20/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
     # pkgin install bash
     # pkgin install perl
     # pkgin install apache
     # pkgin install kde
     # pkgin install firefox
     ...
     ```

     Note: Some mirror sites don't mirror the `/pub/pkgsrc` directory.

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

- If you did not install it from the **sysinst** post-installation configuration menu, the pkgsrc(7) framework for compiling packages can be obtained by retrieving the file
  ftp://ftp.NetBSD.org/pub/pkgsrc/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 7.99.20 is with binaries, and that is the method documented here.

To do the upgrade, you must have one form of boot media available. You must also have at least the **base** and **kern** binary distribution sets available. 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.

Since upgrading involves replacing the kernel, boot blocks, 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 the NetBSD partition or on another operating system's partition on your disk before beginning the upgrade process.

The upgrade procedure is similar to an installation, but without the hard disk partitioning.

Fetching the binary sets is done in the same manner as the installation procedure; refer to the installation part of the document for help. 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 7.99.20 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
```

sysinst will attempt to merge the settings stored in your /etc directory with the new version of NetBSD using the postinstall(8) utility. However, postinstall(8) is only able to deal with changes that are easily automated. It is recommended that you use the etcupdate(8) tool to merge any remaining configuration changes.

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 7.99.20.

Note that **sysinst** will automatically invoke

```
postinstall fix
```

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

A number of things have been removed from the NetBSD 7.99.20 release. See the "Components removed from NetBSD" section near the beginning of this document for a list.

Important note regarding ABI change on ARM ports

In NetBSD 7.0, most ARM ports (all but acorn26, acorn32, and epoc32) have switched to the official standard ABI (EABI5) which is recommended by ARM for ELF binaries.

Backwards compatibility is provided for binaries using the previous ABI (oabi). A NetBSD 7.99.20 kernel with the `COMPAT_NETBSD32` option enabled will allow you to execute oabi binaries. This option is enabled in the kernels distributed with this release.

However, new binaries can not be mixed with old libraries, and shared libraries are incompatible.

sysinst does not provide an automatic mechanism to partlially upgrade an old installation. There are two ways to handle the transition:

1. Do a complete update.

   This means updating your system with **sysinst**, then deleting and recompiling all other binaries, whether they were installed locally or through pkgsrc. This is the preferred, cleanest approach.

2. Move your old binaries and libraries to `/compat/netbsd32` and replace them one by one.

   For example, move all of `/usr/pkg` to `/compat/netbsd32/usr/pkg` and add `/compat/netbsd32/usr/pkg/bin` to the end of your PATH. Most binaries should still run, and can be replaced over time with recompiled packages, which will install to `/usr/pkg` again.

Issues affecting an upgrade from NetBSD 5.x releases

See the section below on upgrading from NetBSD 6.x as well.

The following users need to be created:

- _mdnsd
- _tests
- _tcpdump
- _tss

The following groups need to be created:

- _mdnsd
- _tests
- _tcpdump
- _tss

The implementation of SHA2-HMAC in KAME_IPSEC as used in NetBSD 5.0 and before did not comply with current standards. FAST_IPSEC does, with the result that old and new systems cannot communicate over IPSEC if one of the affected authentication algorithms (hmac_sha256, hmac_sha384, hmac_sha512) is used.

Issues affecting an upgrade from NetBSD 6.x releases

The following user needs to be created:

- _rtadvd

The following groups need to be created:

- _gpio
- _rtadvd

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 **http://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
http://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 **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 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

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  Ralph Campbell
  Mike Karels
  Marshall Kirk McKusick

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- 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.
- 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.
- We list the individuals and organizations that have made donations or loans of hardware and/or money, to support NetBSD development, and deserve credit for it at **http://www.NetBSD.org/donations/** (If you're not on that list and should be, tell us! We probably were not able to get in touch with you, to verify that you wanted to be listed.)
- Finally, we thank all of the people who've put sweat and tears into developing NetBSD since its inception in January, 1993. (Obviously, there are a lot more people who deserve thanks here. If you're one of them, and would like to be mentioned, tell us!)

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