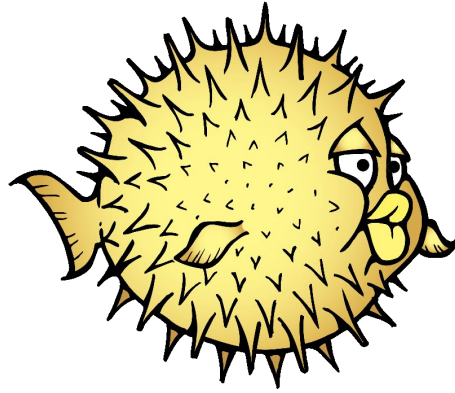


***Open*BSD**

Free, Functional, and Secure

Dante Catalfamo



What is OpenBSD?

Not Linux?

- Unix-like
- Similar layout
- Similar tools
- POSIX
- NOT the same



History

- Originated at AT&T, who were unable to compete in the industry (1970s)
- Given to Universities for educational purposes
- Universities improved the code under the BSD license



AT&T

The License

The license:

- Retain the copyright notice
- No warranty
- Don't use the author's name to promote the product



History Cont'd

- After 15 years, the partnership ended
- Almost the entire OS had been rewritten
- The university released the (now mostly BSD licensed) code for free

/*

```
* Copyright (c) 1982, 1986, 1989, 1991, 1993
*   The Regents of the University of California. All rights reserved.
* (c) UNIX System Laboratories, Inc.
* All or some portions of this file are derived from material licensed
* to the University of California by American Telephone and Telegraph
* Co. or Unix System Laboratories, Inc. and are reproduced herein with
* the permission of UNIX System Laboratories, Inc.
*
```

```
* Redistribution and use in source and binary forms, with or without
* modification, are permitted provided that the following conditions
* are met:
* 1. Redistributions of source code must retain the above copyright
*   notice, this list of conditions and the following disclaimer.
* 2. Redistributions in binary form must reproduce the above copyright
*   notice, this list of conditions and the following disclaimer in the
*   documentation and/or other materials provided with the distribution.
* 3. Neither the name of the University nor the names of its contributors
*   may be used to endorse or promote products derived from this software
*   without specific prior written permission.
```

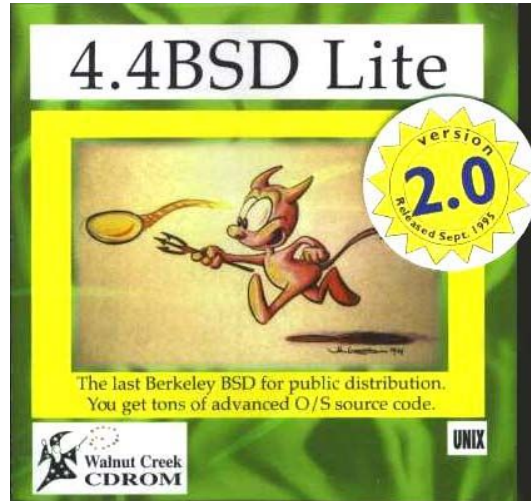
History Cont'd

- AT&T launching Unix System Laboratories (USL)
- Sued UC Berkeley
- Berkeley fought back, claiming the code didn't belong to AT&T
- 2 year lawsuit
- AT&T lost, and was found guilty of violating the BSD license



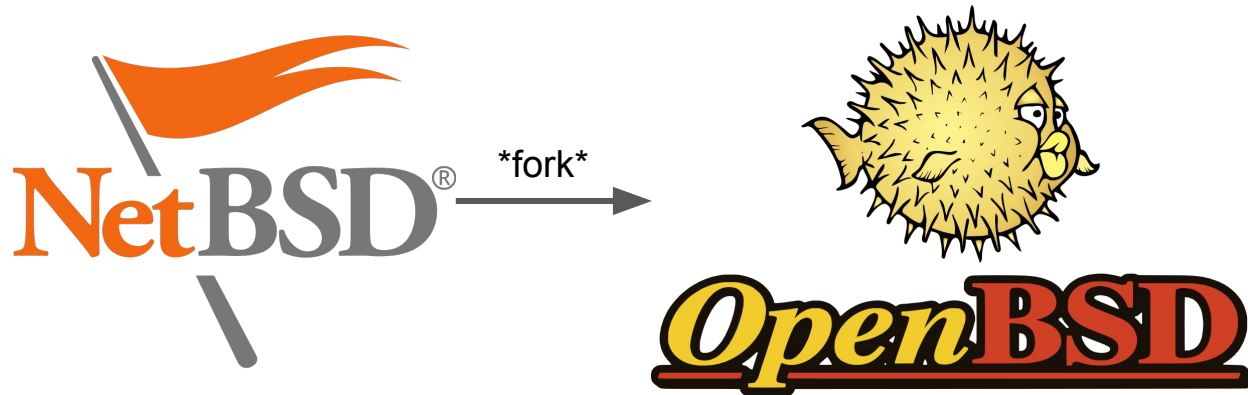
History Cont'd

- BSD4.4-Lite released
- The only operating system ever released incomplete
- This became the base of FreeBSD and NetBSD, and eventually OpenBSD and MacOS



History Cont'd

- Theo DeRaadt
 - Originally a NetBSD developer
 - Forked NetBSD into OpenBSD after disagreement the direction of the project

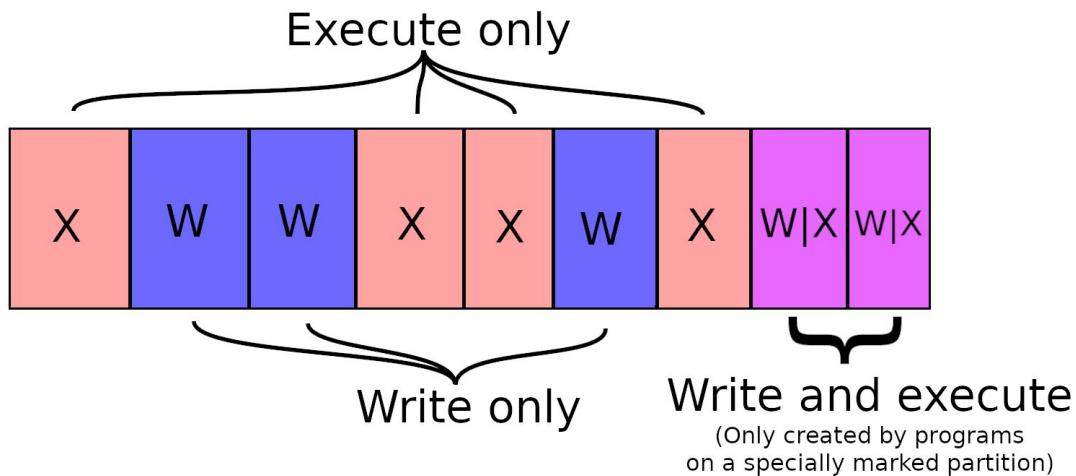


Innovations



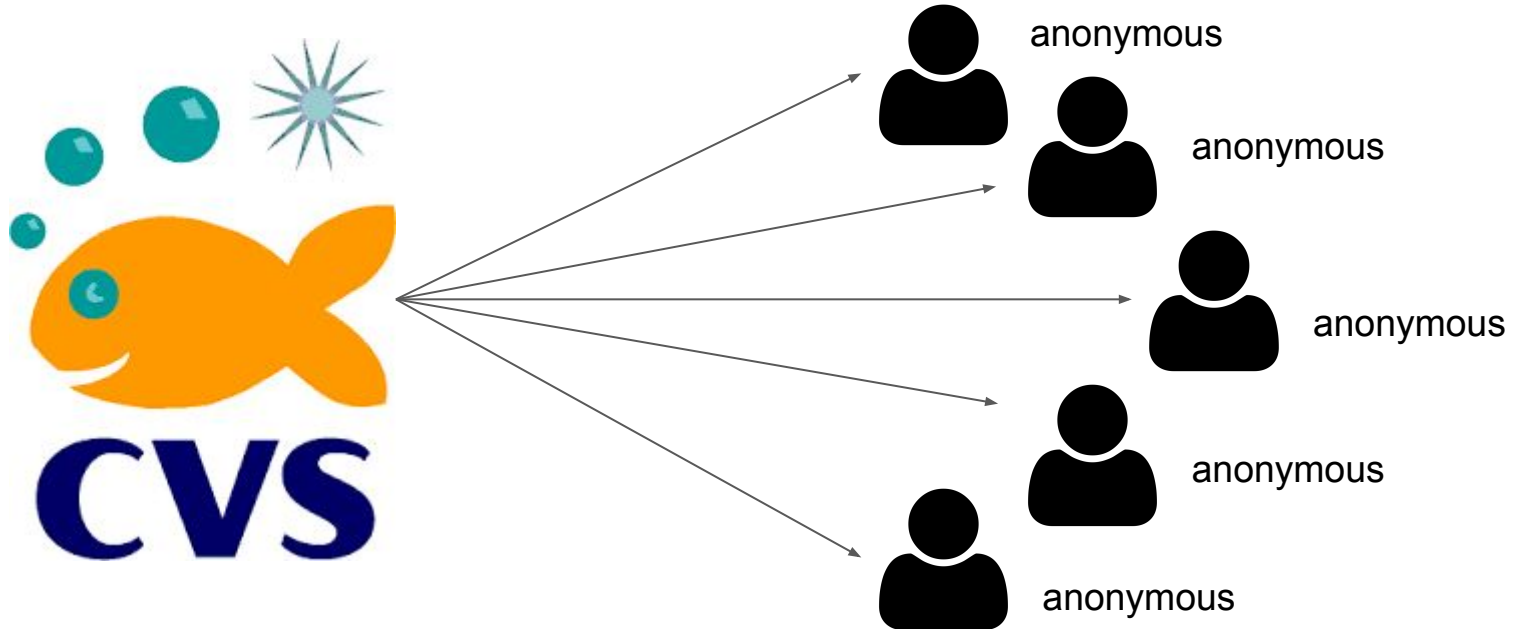
W^X

- Pioneered by the OpenBSD project in 3.3 in 2002, strictly enforced in 6.0
- Memory can either be write or execute, but not both (XOR)
- Similar to PaX Linux kernel extension (developed later)



AnonCVS

- First project with a public source tree featuring version control (1995)
- Now an extremely popular model of software development



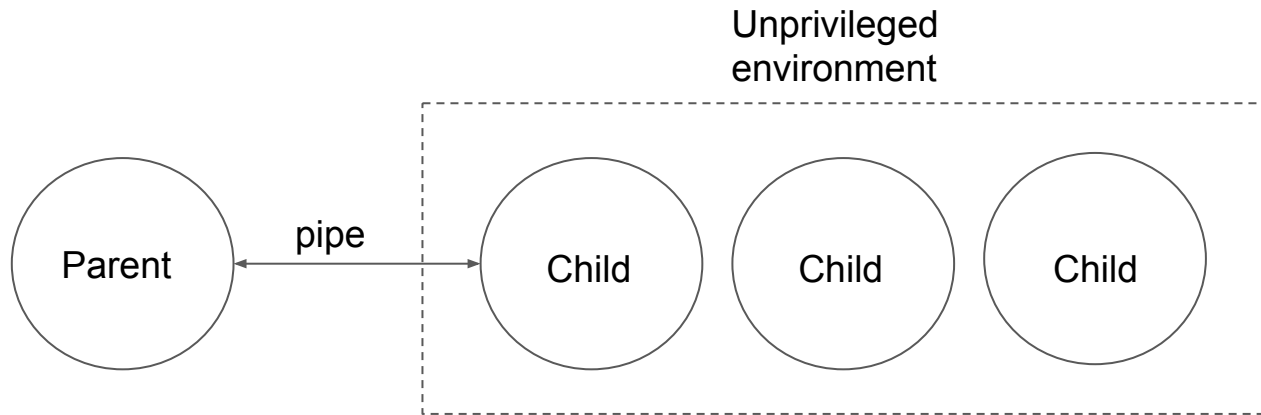
IPSec

- First free operating system to implement an IPSec VPN stack



Privilege Separation

- First implemented in 3.2
- Split a program into processes performing different sub-functions
- Now used in almost all privileged programs in OpenBSD like `httpd`, `bgpd`, `dhcpcd`, `syslog`, `sndio`, etc.



Privilege Revocation

- `pledge(2)`
 - Restrict syscall permissions
- `unveil(2)`
 - Restrict file access



pledge (2)

- Implemented in OpenBSD 5.9
- Drop access to syscalls that are no longer needed
- `pledge("stdio dns inet", null)`
- Attempts to access any restricted syscalls after pledge cause the program to be killed



unveil (2)

- Implemented in OpenBSD 6.4
- Hide the filesystem and only expose parts you need
- `unveil("/home/zzz", "r")`
- Accessing anything other than `/home/zzz` will throw **ENOENT**
- Trying to write to `/home/zzz` will throw **EINVAL** or **EPERM**



Privilege Revocation

- Simple compared to other frameworks like capsicum or firejail
- Used in most of the base system



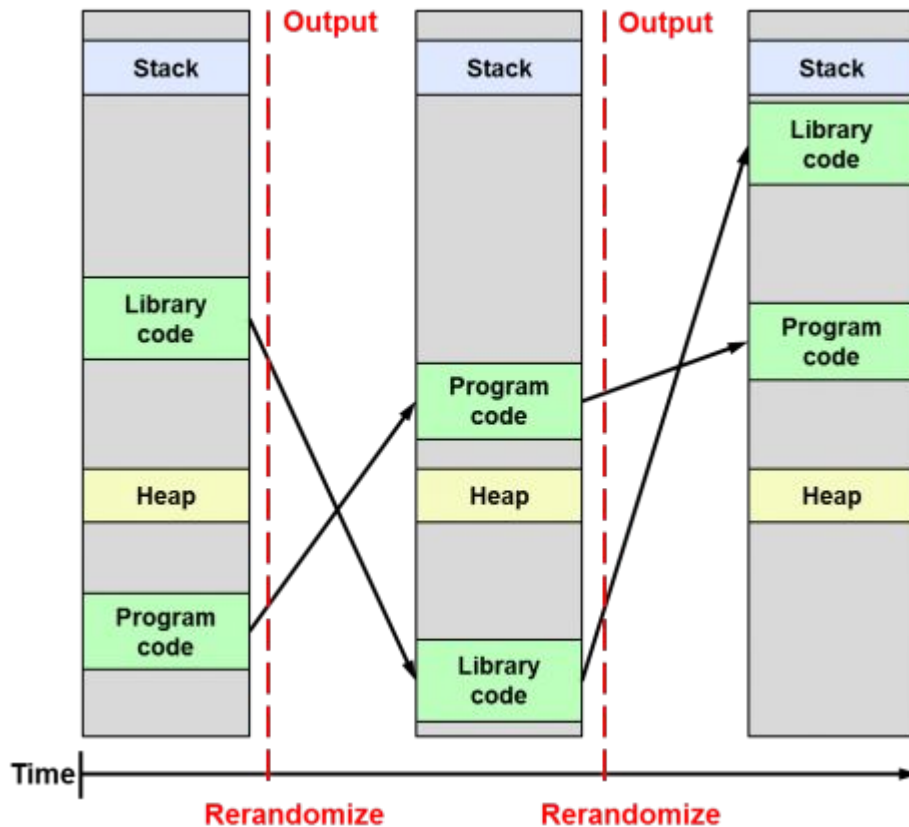
Randomization

- ASLR
 - First widely used operating system to provide this by default
- KARL
 - Unique kernel each reboot
- Library order randomization
 - Randomly relinks `libc.so`, `libcrypto` and `ld.so` on startup



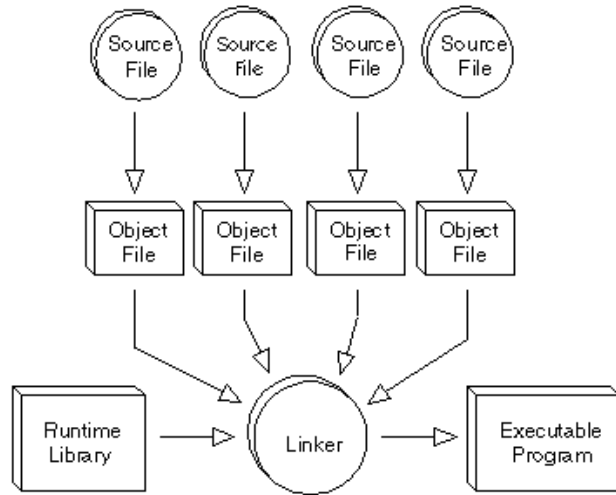
ASLR

- Libraries, heap, program code are randomly distributed through virtual memory each time the program starts
- Random stack offset



KARL

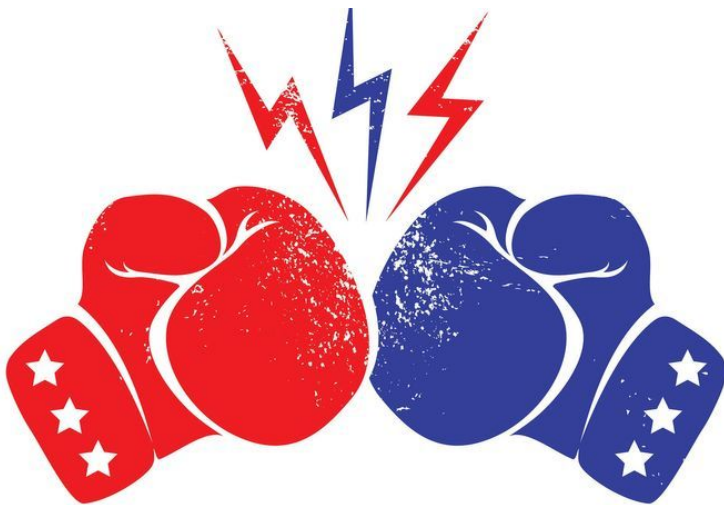
- Relinks kernel libraries in random orders
- Adds lot of randomization to the code itself



Relinking to create unique kernel... done

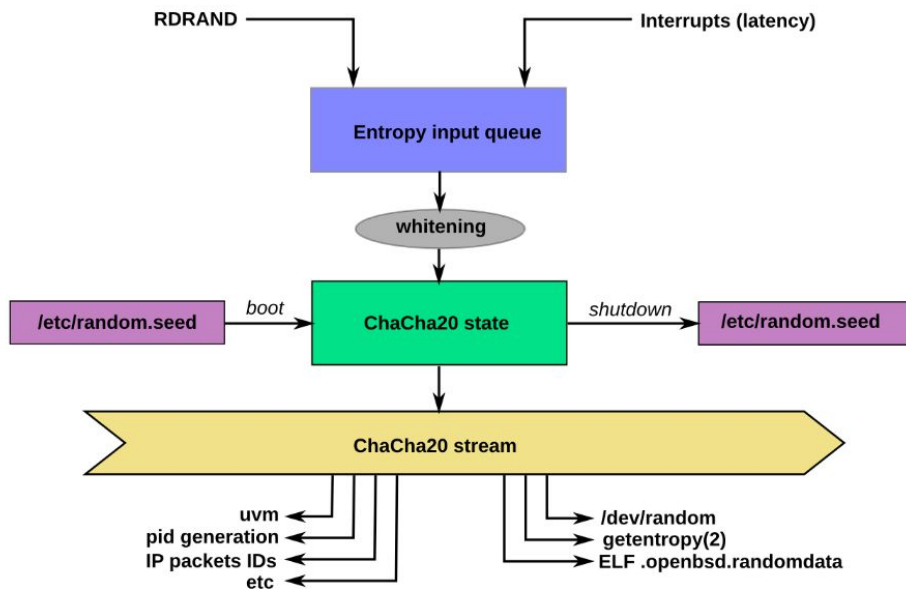
Kernel ASLR vs KARL

- Kernel ASLR
 - Same kernel binary
 - Address space randomized
- KARL
 - Unique binary each boot
 - Linking order randomized
- OpenBSD does BOTH!



arc4random (3)

- Very high quality random numbers
- Originally used RC4
- Now uses ChaCha20



Other

- Position-Independent Executables (PIE)
 - First OS to enable PIE by default
- RETGUARD
 - Mitigation against ROP exploits
 - Compiler-based exploit mitigation
- Randomized PIDs



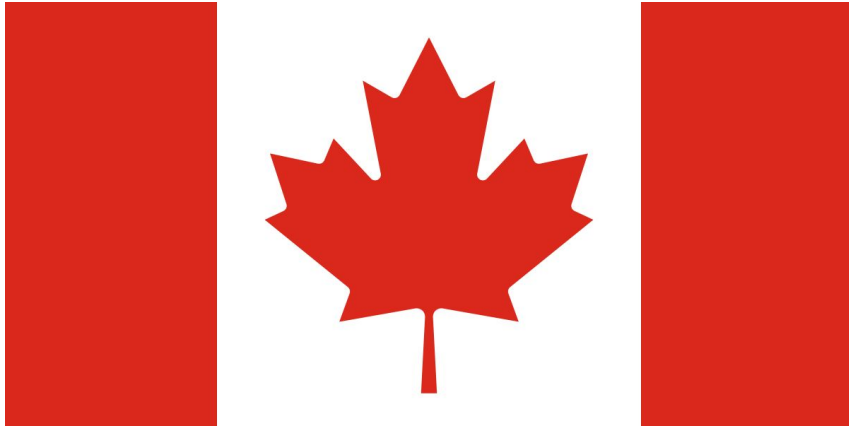
Philosophy

- Correctness
- Portability
- Documentation
- Rewriting bad code
- Keeping it simple



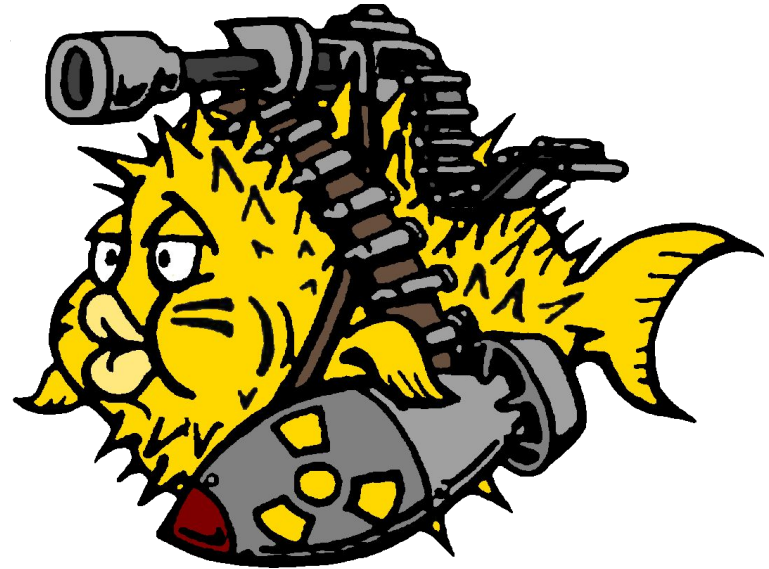
Crypto

- Founded in Canada
- Avoid US export controls



Security

- Widely considered to be the most secure general purpose operating system in the world
- Least privilege principle
- Under a constant audit from all developers



Cathedral Style Development

- One repo to rule them all
- All components properly integrated



Releases

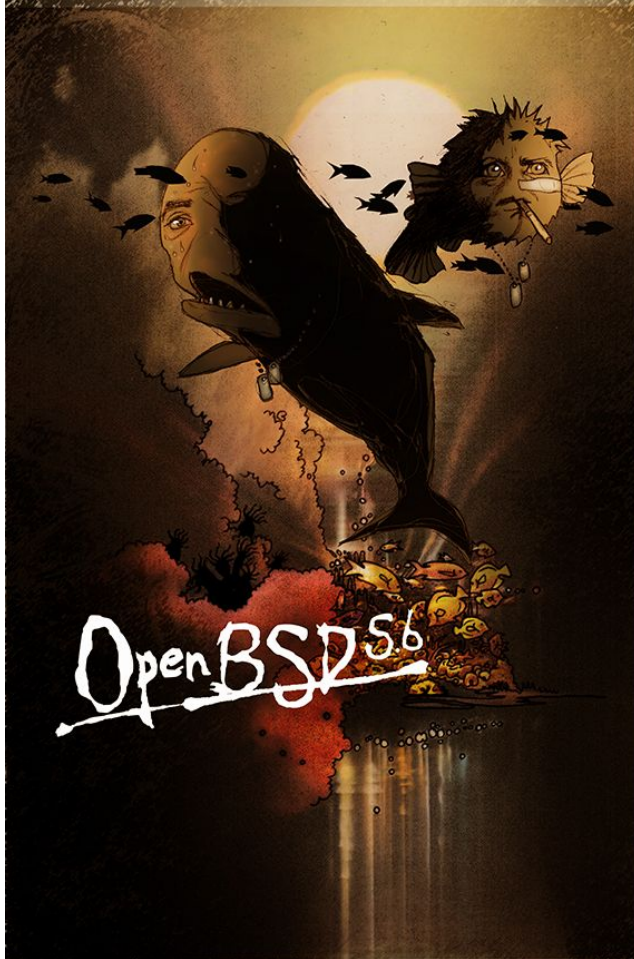
- The operating system base is released as a whole
- Patches to the OS are installed using `syspatch (1)`
- Upgrading is done with `sysupgrade (1)`
- Releases come out every 6 months
- Artwork and music



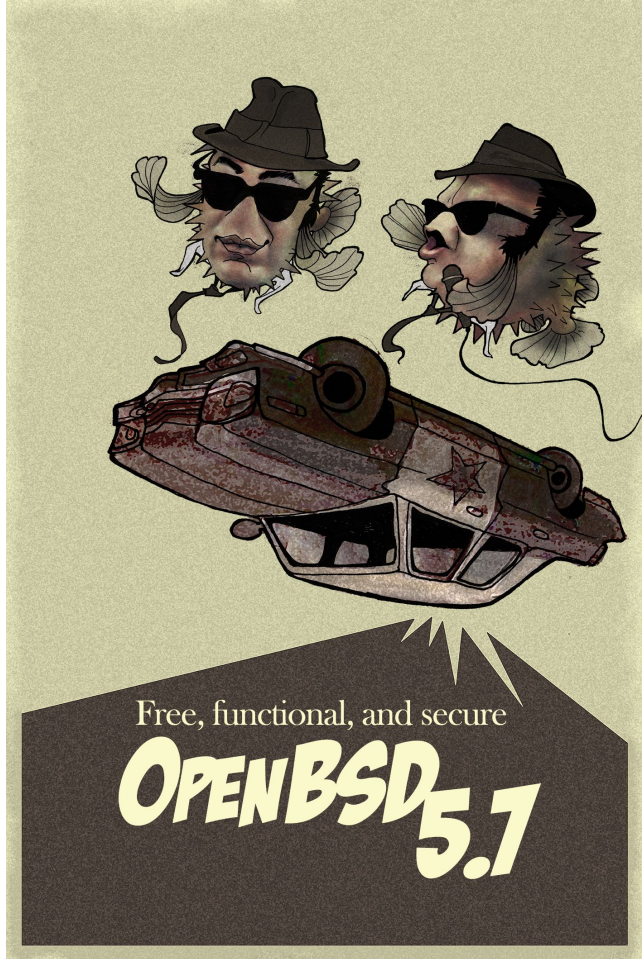
FREE, FUNCTIONAL, SECURE ...



OpenBSD 5.5

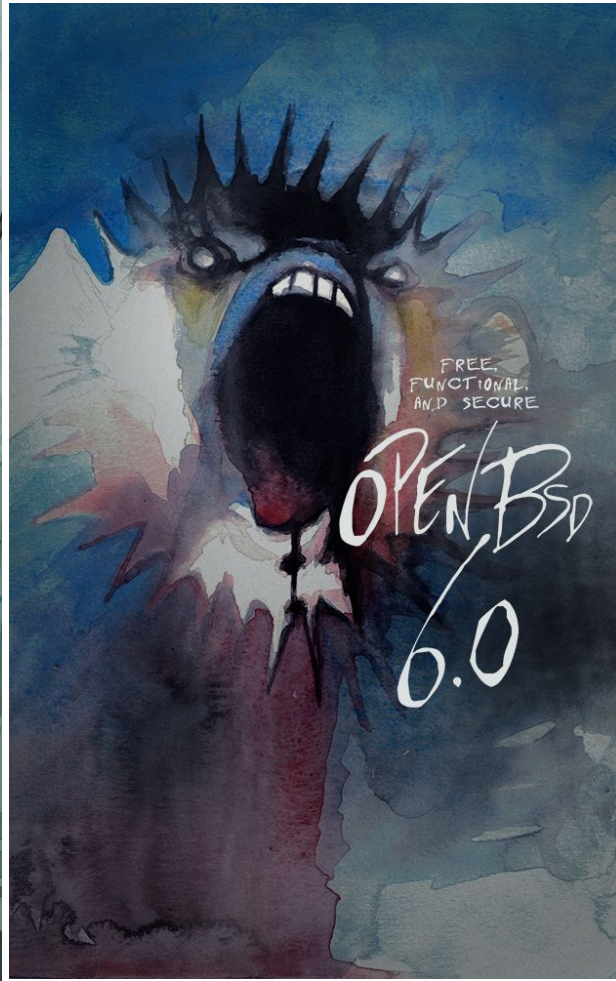
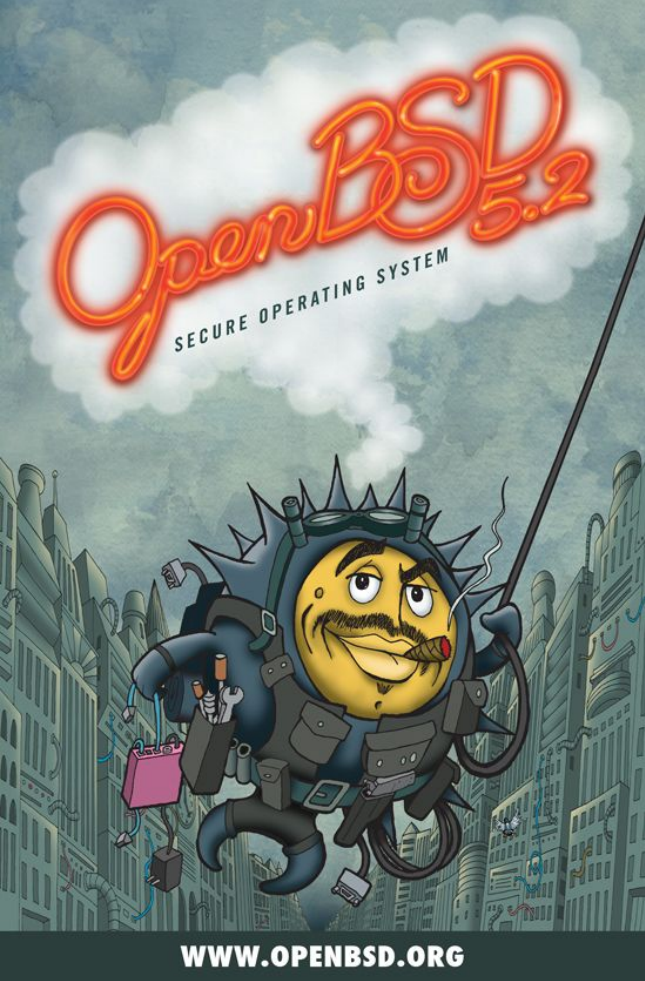


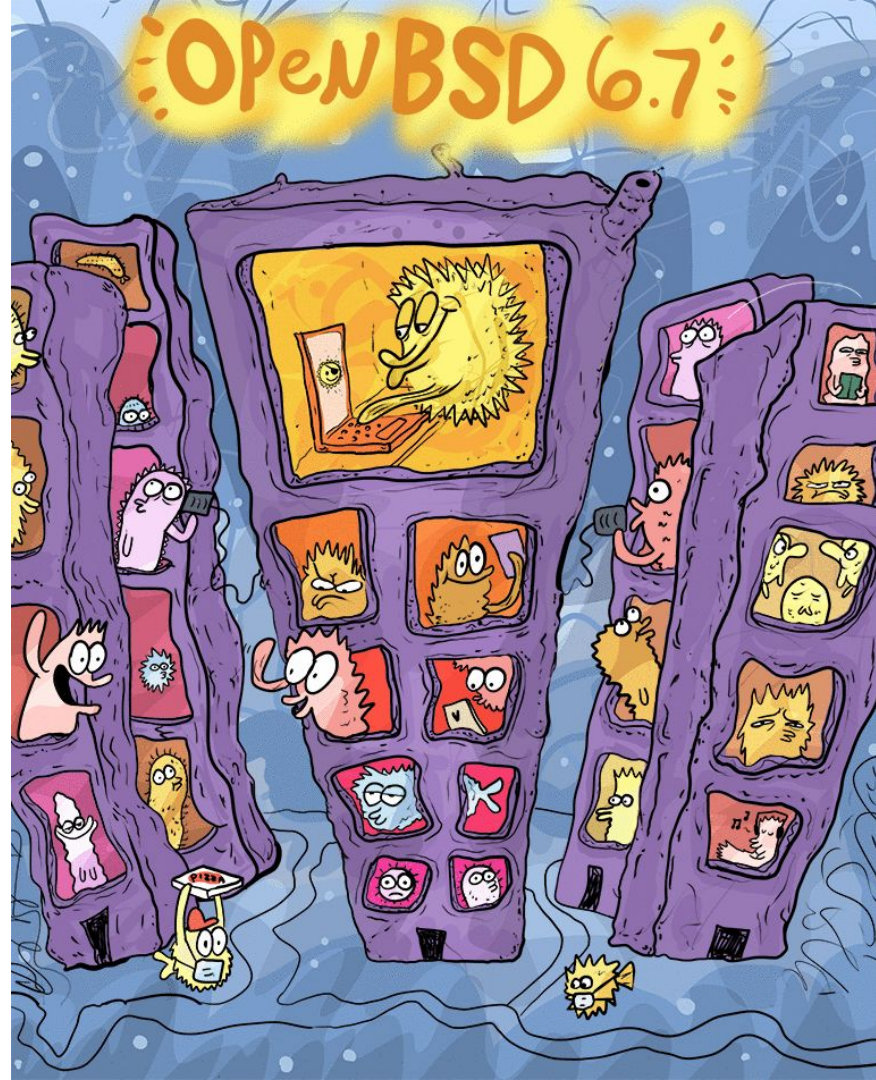
OpenBSD 5.6



Free, functional, and secure

OPENBSD 5.7







Projects

OpenSSH

- You already know it
- It's everywhere
- This is the upstream



LibreSSL

- Forked from OpenSSL during the Heartbleed vulnerability
- Massive effort
- Legacy code removal
- Vulnerability fixes
- Modernization
- libtls
 - Easy crypto for C!

LibreSSL



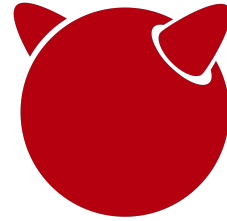
openrsync (1)

- Rewrite of `rsync` with a friendly BSD license
- Privilege separation and revocation, exploit mitigation



pf (4)

- Extremely simple configuration and administration
- Ported to many other OSs:
 - MacOS
 - iOS
 - FreeBSD
 - NetBSD
 - Solaris
 - QNX
 - Blackberry
 - Others



Some tools

- **signify**
 - cryptographic signature tool used to author releases and verify patches, very simple
- **mandoc toolchain**
 - Manpage utilities
- **sndio**
 - OpenBSD sound subsystem. Very simple and flexible
- **doas**
 - A sane `sudo` replacement
- **httpd, relayd**
 - http server and http/tcp relay



Some tools

- **vmm/vmd**
 - Homegrown virtual machines
- **switchd**
 - Software Defined Networking daemon, implements OpenFlow spec.
- **unwind**
 - Validating DNS resolver
- **xenocara**
 - Fork of X11
- **acme-client**
 - Client for LetEncrypt's ACME service



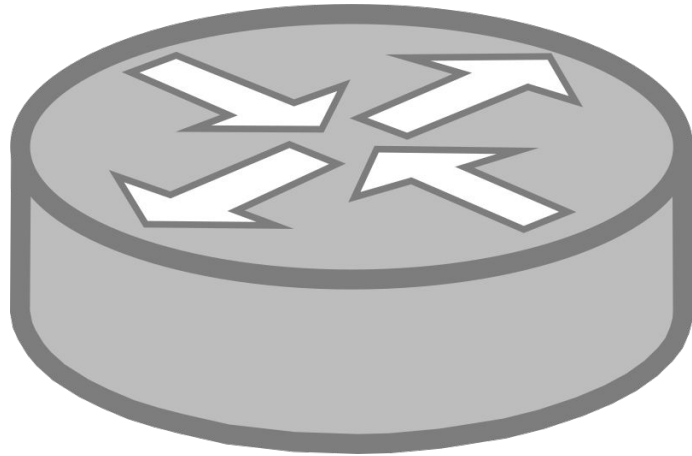
Networking Daemons

- OpenSMTPD
- OpenBGPD
 - RPKI-Client
- OpenNTPD
- OpenIKED



Additional networking daemons

- CARP
- DHCPd
- DNS
 - Authoritative - `nsd`
 - Resolving - `unbound`
- FTPd
- LDAP
- HostAPd
- NFS
- OSPF
- RADIUSd
- RIPD
- TFTPd
- More!



Fun Fact

Android's Bionic `libc` is heavily derived from OpenBSD's



android

OpenBSD in MY Shopify!?

It's more likely than you think!



- Office firewalls run PF
- Everyone uses OpenSSH
- Firewalls and network core use CARP
- Countless security mitigations ported from OpenBSD to MacOS, Linux

Use case considerations



- Network edge
 - Mail servers
 - DNS server
 - BGP server
 - Secure systems
 - Authentication server
 - High risk environments
 - Places where correctness and predictability are important
-
- Increased security causes a small performance hit
 - Multiprocessing kernel doesn't fully utilize multi-core processors
 - VMs are still experimental and not production ready, but getting better

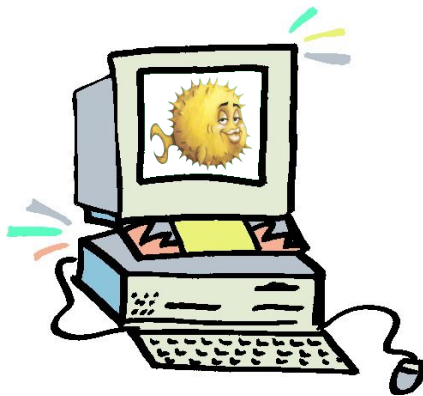
Hackathons & Conferences

Funded by the OpenBSD Foundation, many innovations in OpenBSD come from hackathons hosted all over the world.

The Canadian BSD conference takes place every year in Ottawa

- BSDCan - UOttawa





Installation

CD-ROM: E0

Loading /6.5/AMD64/CDBOOT

probing: pc0 mem[639K 1022M a20=on]

disk: hd0** cd0

>> OpenBSD/amd64 CDBOOT 3.42

boot>

```
vga1 at pci0 dev 2 function 0 "InnoTek VirtualBox Graphics Adapter" rev 0x00
vga1: aperture needed
wsdisplay1 at vga1 mux 1: console (80x25, vt100 emulation)
em0 at pci0 dev 3 function 0 "Intel 82540EM" rev 0x02: apic 1 int 19, address 08
:00:27:58:59:98
"InnoTek VirtualBox Guest Service" rev 0x00 at pci0 dev 4 function 0 not configur
red
"Intel 82801AA AC97" rev 0x01 at pci0 dev 5 function 0 not configured
ohci0 at pci0 dev 6 function 0 "Apple Intrepid USB" rev 0x00: apic 1 int 22, ver
sion 1.0
"Intel 82371AB Power" rev 0x08 at pci0 dev 7 function 0 not configured
usb0 at ohci0: USB revision 1.0
uhub0 at usb0 configuration 1 interface 0 "Apple OHCI root hub" rev 1.00/1.00 ad
dr 1
isa0 at mainbus0
pckbc0 at isa0 port 0x60/5 irq 1 irq 12
pckbd0 at pckbc0 (kbd slot)
wskbd0 at pckbd0: console keyboard, using wsdisplay1
softraid0 at root
scsibus1 at softraid0: 256 targets
root on rd0a swap on rd0b dump on rd0b
erase ^?, werase ^W, kill ^U, intr ^C, status ^T
```

Welcome to the OpenBSD/amd64 6.5 installation program.

(I)nstall, (U)pgrade, (A)utoinstall or (S)hell? _


```
red
"Intel 82801AA AC97" rev 0x01 at pci0 dev 5 function 0 not configured
ohci0 at pci0 dev 6 function 0 "Apple Intrepid USB" rev 0x00: apic 1 int 22, ver
sion 1.0
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Choose your keyboard layout ('?' or 'L' for list) [default] _

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ohci0 at pci0 dev 6 function 0 "Apple Intrepid USB" rev 0x00: apic 1 int 22, ver  
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```

```
"Intel 82371AB Power" rev 0x08 at pci0 dev 7 function 0 not configured
```

```
usb0 at ohci0: USB revision 1.0
```

```
uhub0 at usb0 configuration 1 interface 0 "Apple OHCI root hub" rev 1.00/1.00 ad  
dr 1
```

```
isa0 at mainbus0
```

```
pckbc0 at isa0 port 0x60/5 irq 1 irq 12
```

```
pckbd0 at pckbc0 (kbd slot)
```

```
wskbd0 at pckbd0: console keyboard, using wsdisplay1
```

```
softraid0 at root
```

```
scsibus1 at softraid0: 256 targets
```

```
root on rd0a swap on rd0b dump on rd0b
```

```
erase ^?, werase ^W, kill ^U, intr ^C, status ^T
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```

```
Choose your keyboard layout ('?' or 'L' for list) [default]
```

```
System hostname? (short form, e.g. 'foo')
```

```
"Intel 82371AB Power" rev 0x08 at pci0 dev 7 function 0 not configured
usb0 at ohci0: USB revision 1.0
uhub0 at usb0 configuration 1 interface 0 "Apple OHCI root hub" rev 1.00/1.00 ad
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pckbc0 at isa0 port 0x60/5 irq 1 irq 12
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System hostname? (short form, e.g. 'foo') OpenBSD

Available network interfaces are: em0 vlan0.

Which network interface do you wish to configure? (or 'done') [em0] _

```
usb0 at ohci0: USB revision 1.0
uhub0 at usb0 configuration 1 interface 0 "Apple OHCI root hub" rev 1.00/1.00 ad
dr 1
isa0 at mainbus0
pckbc0 at isa0 port 0x60/5 irq 1 irq 12
pckbd0 at pckbc0 (kbd slot)
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IPv4 address for em0? (or 'dhcp' or 'none') [dhcp] _

```
dr 1
isa0 at mainbus0
pckbc0 at isa0 port 0x60/5 irq 1 irq 12
pckbd0 at pckbc0 (kbd slot)
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Available network interfaces are: em0 vlan0.

Which network interface do you wish to configure? (or 'done') [em0]

IPv4 address for em0? (or 'dhcp' or 'none') [dhcp]

em0: bound to 10.0.2.15 from 10.0.2.2 (52:54:00:12:35:02)

IPv6 address for em0? (or 'autoconf' or 'none') [none] _

```
pckbc0 at isa0 port 0x60/5 irq 1 irq 12
pckbd0 at pckbc0 (kbd slot)
wskbd0 at pckbd0: console keyboard, using wsdisplay1
softraid0 at root
scsibus1 at softraid0: 256 targets
root on rd0a swap on rd0b dump on rd0b
erase ^?, werase ^W, kill ^U, intr ^C, status ^T
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Which network interface do you wish to configure? (or 'done') [done]

```
scsibus1 at softraid0: 256 targets
```

```
root on rd0a swap on rd0b dump on rd0b
```

```
erase ^?, werase ^W, kill ^U, intr ^C, status ^T
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```
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```

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```

```
Choose your keyboard layout ('?' or 'L' for list) [default]
```

```
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```

```
Available network interfaces are: em0 vlan0.
```

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```
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```

```
IPv6 address for em0? (or 'autoconf' or 'none') [none]
```

```
Available network interfaces are: em0 vlan0.
```

```
Which network interface do you wish to configure? (or 'done') [done]
```

```
Using DNS domainname ott0150.net.shopify.io
```

```
Using DNS nameservers at 10.65.0.53 1.1.1.1 8.8.8.8
```

```
Password for root account? (will not echo) _
```

```
root on rd0a swap on rd0b dump on rd0b
```

```
erase ^?, werase ^W, kill ^U, intr ^C, status ^T
```

```
Welcome to the OpenBSD/amd64 6.5 installation program.
```

```
(I)nstall, (U)pgrade, (A)utoinstall or (S)hell? i
```

```
At any prompt except password prompts you can escape to a shell by  
typing '!'. Default answers are shown in []'s and are selected by  
pressing RETURN. You can exit this program at any time by pressing  
Control-C, but this can leave your system in an inconsistent state.
```

```
Choose your keyboard layout ('?' or 'L' for list) [default]
```

```
System hostname? (short form, e.g. 'foo') OpenBSD
```

```
Available network interfaces are: em0 vlan0.
```

```
Which network interface do you wish to configure? (or 'done') [em0]
```

```
IPv4 address for em0? (or 'dhcp' or 'none') [dhcp]
```

```
em0: bound to 10.0.2.15 from 10.0.2.2 (52:54:00:12:35:02)
```

```
IPv6 address for em0? (or 'autoconf' or 'none') [none]
```

```
Available network interfaces are: em0 vlan0.
```

```
Which network interface do you wish to configure? (or 'done') [done]
```

```
Using DNS domainname ott0150.net.shopify.io
```

```
Using DNS nameservers at 10.65.0.53 1.1.1.1 8.8.8.8
```

```
Password for root account? (will not echo)
```

```
Password for root account? (again) _
```


erase ^?, werase ^W, kill ^U, intr ^C, status ^T

Welcome to the OpenBSD/amd64 6.5 installation program.

(I)nstall, (U)pgrade, (A)utoinstall or (S)hell? i

At any prompt except password prompts you can escape to a shell by typing '!'. Default answers are shown in []'s and are selected by pressing RETURN. You can exit this program at any time by pressing Control-C, but this can leave your system in an inconsistent state.

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System hostname? (short form, e.g. 'foo') OpenBSD

Available network interfaces are: em0 vlan0.

Which network interface do you wish to configure? (or 'done') [em0]

IPv4 address for em0? (or 'dhcp' or 'none') [dhcp]

em0: bound to 10.0.2.15 from 10.0.2.2 (52:54:00:12:35:02)

IPv6 address for em0? (or 'autoconf' or 'none') [none]

Available network interfaces are: em0 vlan0.

Which network interface do you wish to configure? (or 'done') [done]

Using DNS domainname ott0150.net.shopify.io

Using DNS nameservers at 10.65.0.53 1.1.1.1 8.8.8.8

Password for root account? (will not echo)

Password for root account? (again)

Start sshd(8) by default? [yes]

Welcome to the OpenBSD/amd64 6.5 installation program.

(I)nstall, (U)pgrade, (A)utoinstall or (S)hell? i

At any prompt except password prompts you can escape to a shell by typing '!'. Default answers are shown in []'s and are selected by pressing RETURN. You can exit this program at any time by pressing Control-C, but this can leave your system in an inconsistent state.

Choose your keyboard layout ('?' or 'L' for list) [default]

System hostname? (short form, e.g. 'foo') OpenBSD

Available network interfaces are: em0 vlan0.

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Using DNS nameservers at 10.65.0.53 1.1.1.1 8.8.8.8

Password for root account? (will not echo)

Password for root account? (again)

Start sshd(8) by default? [yes]

Do you expect to run the X Window System? [yes] _

Welcome to the OpenBSD/amd64 6.5 installation program.

(I)nstall, (U)pgrade, (A)utoinstall or (S)hell? i

At any prompt except password prompts you can escape to a shell by typing '!'. Default answers are shown in []'s and are selected by pressing RETURN. You can exit this program at any time by pressing Control-C, but this can leave your system in an inconsistent state.

Choose your keyboard layout ('?' or 'L' for list) [default]

System hostname? (short form, e.g. 'foo') OpenBSD

Available network interfaces are: em0 vlan0.

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Using DNS domainname ott0150.net.shopify.io

Using DNS nameservers at 10.65.0.53 1.1.1.1 8.8.8.8

Password for root account? (will not echo)

Password for root account? (again)

Start sshd(8) by default? [yes]

Do you expect to run the X Window System? [yes]

Do you want the X Window System to be started by xenodm(1)? [no] _

(I)nstall, (U)pgrade, (A)utoinstall or (S)hell? i

At any prompt except password prompts you can escape to a shell by typing '!'. Default answers are shown in []'s and are selected by pressing RETURN. You can exit this program at any time by pressing Control-C, but this can leave your system in an inconsistent state.

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Password for root account? (again)

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Do you want the X Window System to be started by xenodm(1)? [no]

Setup a user? (enter a lower-case loginname, or 'no') [no]

At any prompt except password prompts you can escape to a shell by typing '!'. Default answers are shown in []'s and are selected by pressing RETURN. You can exit this program at any time by pressing Control-C, but this can leave your system in an inconsistent state.

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Password for root account? (will not echo)

Password for root account? (again)

Start sshd(8) by default? [yes]

Do you expect to run the X Window System? [yes]

Do you want the X Window System to be started by xenodm(1)? [no]

Setup a user? (enter a lower-case loginname, or 'no') [no] dante

Full name for user dante? [dante]

typing '!'. Default answers are shown in []'s and are selected by pressing RETURN. You can exit this program at any time by pressing Control-C, but this can leave your system in an inconsistent state.

Choose your keyboard layout ('?' or 'L' for list) [default]

System hostname? (short form, e.g. 'foo') OpenBSD

Available network interfaces are: em0 vlan0.

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Password for root account? (again)

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Do you expect to run the X Window System? [yes]

Do you want the X Window System to be started by xenodm(1)? [no]

Setup a user? (enter a lower-case loginname, or 'no') [no] dante

Full name for user dante? [dante] Dante

Password for user dante? (will not echo) _

pressing RETURN. You can exit this program at any time by pressing Control-C, but this can leave your system in an inconsistent state.

Choose your keyboard layout ('?' or 'L' for list) [default]

System hostname? (short form, e.g. 'foo') OpenBSD

Available network interfaces are: em0 vlan0.

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IPv4 address for em0? (or 'dhcp' or 'none') [dhcp]

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Setup a user? (enter a lower-case loginname, or 'no') [no] dante

Full name for user dante? [dante] Dante

Password for user dante? (will not echo)

Password for user dante? (again)

Choose your keyboard layout ('?' or 'L' for list) [default]

System hostname? (short form, e.g. 'foo') OpenBSD

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Setup a user? (enter a lower-case loginname, or 'no') [no] dante

Full name for user dante? [dante] Dante

Password for user dante? (will not echo)

Password for user dante? (again)

WARNING: root is targeted by password guessing attacks, pubkeys are safer.

Allow root ssh login? (yes, no, prohibit-password) [no]

Choose your keyboard layout ('?' or 'L' for list) [default]

System hostname? (short form, e.g. 'foo') OpenBSD

Available network interfaces are: em0 vlan0.

Which network interface do you wish to configure? (or 'done') [em0]

IPv4 address for em0? (or 'dhcp' or 'none') [dhcp]

em0: bound to 10.0.2.15 from 10.0.2.2 (52:54:00:12:35:02)

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Setup a user? (enter a lower-case loginname, or 'no') [no] dante

Full name for user dante? [dante] Dante

Password for user dante? (will not echo)

Password for user dante? (again)

WARNING: root is targeted by password guessing attacks, pubkeys are safer.

Allow root ssh login? (yes, no, prohibit-password) [no]

What timezone are you in? ('?' for list) [America/Toronto]

```
Available network interfaces are: em0 vlan0.
Which network interface do you wish to configure? (or 'done') [em0]
IPv4 address for em0? (or 'dhcp' or 'none') [dhcp]
em0: bound to 10.0.2.15 from 10.0.2.2 (52:54:00:12:35:02)
IPv6 address for em0? (or 'autoconf' or 'none') [none]
Available network interfaces are: em0 vlan0.
Which network interface do you wish to configure? (or 'done') [done]
Using DNS domainname ott0150.net.shopify.io
Using DNS nameservers at 10.65.0.53 1.1.1.1 8.8.8.8

Password for root account? (will not echo)
Password for root account? (again)
Start sshd(8) by default? [yes]
Do you expect to run the X Window System? [yes]
Do you want the X Window System to be started by xenodm(1)? [no]
Setup a user? (enter a lower-case loginname, or 'no') [no] dante
Full name for user dante? [dante] Dante
Password for user dante? (will not echo)
Password for user dante? (again)
WARNING: root is targeted by password guessing attacks, pubkeys are safer.
Allow root ssh login? (yes, no, prohibit-password) [no]
What timezone are you in? ('?' for list) [America/Toronto]

Available disks are: wd0.
Which disk is the root disk? ('?' for details) [wd0]
```

```
IPv4 address for em0? (or 'dhcp' or 'none') [dhcp]
em0: bound to 10.0.2.15 from 10.0.2.2 (52:54:00:12:35:02)
IPv6 address for em0? (or 'autoconf' or 'none') [none]
Available network interfaces are: em0 vlan0.
Which network interface do you wish to configure? (or 'done') [done]
Using DNS domainname ott0150.net.shopify.io
Using DNS nameservers at 10.65.0.53 1.1.1.1 8.8.8.8

Password for root account? (will not echo)
Password for root account? (again)
Start sshd(8) by default? [yes]
Do you expect to run the X Window System? [yes]
Do you want the X Window System to be started by xenodm(1)? [no]
Setup a user? (enter a lower-case loginname, or 'no') [no] dante
Full name for user dante? [dante] Dante
Password for user dante? (will not echo)
Password for user dante? (again)
WARNING: root is targeted by password guessing attacks, pubkeys are safer.
Allow root ssh login? (yes, no, prohibit-password) [no]
What timezone are you in? ('?' for list) [America/Toronto]

Available disks are: wd0.
Which disk is the root disk? ('?' for details) [wd0]
No valid MBR or GPT.
Use (W)hole disk MBR, whole disk (G)PT or (E)dit? [whole]
```

```
Password for user dante? (will not echo)
Password for user dante? (again)
WARNING: root is targeted by password guessing attacks, pubkeys are safer.
Allow root ssh login? (yes, no, prohibit-password) [no]
What timezone are you in? ('?' for list) [America/Toronto]

Available disks are: wd0.
Which disk is the root disk? ('?' for details) [wd0]
No valid MBR or GPT.
Use (W)hole disk MBR, whole disk (G)PT or (E)dit? [whole]
Setting OpenBSD MBR partition to whole wd0...done.
The auto-allocated layout for wd0 is:
#          size          offset  fstype  [fsize  bsize      cpg]
a:        439.8M           64  4.2BSD   2048 16384      1 # /
b:        659.7M       900832    swap
c:       16384.0M           0  unused
d:        583.7M       2251872  4.2BSD   2048 16384      1 # /tmp
e:        833.6M       3447328  4.2BSD   2048 16384      1 # /var
f:       1589.8M       5154464  4.2BSD   2048 16384      1 # /usr
g:        557.9M       8410432  4.2BSD   2048 16384      1 # /usr/X11R6
h:       1893.5M       9552992  4.2BSD   2048 16384      1 # /usr/local
i:       1415.9M      13430880  4.2BSD   2048 16384      1 # /usr/src
j:       5351.9M      16330688  4.2BSD   2048 16384      1 # /usr/obj
k:       3052.9M      27291296  4.2BSD   2048 16384      1 # /home
Use (A)uto layout, (E)dit auto layout, or create (C)ustom layout? [a] _
```

```
27 cylinder groups of 202.47MB, 12958 blocks, 25984 inodes each
/dev/rwd0i: 1415.9MB in 2899808 sectors of 512 bytes
7 cylinder groups of 202.47MB, 12958 blocks, 25984 inodes each
/dev/rwd0e: 833.6MB in 1707136 sectors of 512 bytes
5 cylinder groups of 202.47MB, 12958 blocks, 25984 inodes each
/dev/wd0a (1119922661c467e8.a) on /mnt type ffs (rw, asynchronous, local)
/dev/wd0k (1119922661c467e8.k) on /mnt/home type ffs (rw, asynchronous, local, no
odev, nosuid)
/dev/wd0d (1119922661c467e8.d) on /mnt/tmp type ffs (rw, asynchronous, local, no
dev, nosuid)
/dev/wd0f (1119922661c467e8.f) on /mnt/usr type ffs (rw, asynchronous, local, no
dev)
/dev/wd0g (1119922661c467e8.g) on /mnt/usr/X11R6 type ffs (rw, asynchronous, loc
al, nodev)
/dev/wd0h (1119922661c467e8.h) on /mnt/usr/local type ffs (rw, asynchronous, loc
al, nodev)
/dev/wd0j (1119922661c467e8.j) on /mnt/usr/obj type ffs (rw, asynchronous, local
, nodev, nosuid)
/dev/wd0i (1119922661c467e8.i) on /mnt/usr/src type ffs (rw, asynchronous, local
, nodev, nosuid)
/dev/wd0e (1119922661c467e8.e) on /mnt/var type ffs (rw, asynchronous, local, no
dev, nosuid)
```

Let's install the sets!

Location of sets? (cd0 disk http or 'done') [cd0]

```
/dev/rwd0i: 1415.9MB in 2899808 sectors of 512 bytes
7 cylinder groups of 202.47MB, 12958 blocks, 25984 inodes each
/dev/rwd0e: 833.6MB in 1707136 sectors of 512 bytes
5 cylinder groups of 202.47MB, 12958 blocks, 25984 inodes each
/dev/wd0a (1119922661c467e8.a) on /mnt type ffs (rw, asynchronous, local)
/dev/wd0k (1119922661c467e8.k) on /mnt/home type ffs (rw, asynchronous, local, no
udev, nosuid)
/dev/wd0d (1119922661c467e8.d) on /mnt/tmp type ffs (rw, asynchronous, local, no
udev, nosuid)
/dev/wd0f (1119922661c467e8.f) on /mnt/usr type ffs (rw, asynchronous, local, no
udev)
/dev/wd0g (1119922661c467e8.g) on /mnt/usr/X11R6 type ffs (rw, asynchronous, loc
al, nodev)
/dev/wd0h (1119922661c467e8.h) on /mnt/usr/local type ffs (rw, asynchronous, loc
al, nodev)
/dev/wd0j (1119922661c467e8.j) on /mnt/usr/obj type ffs (rw, asynchronous, local
, nodev, nosuid)
/dev/wd0i (1119922661c467e8.i) on /mnt/usr/src type ffs (rw, asynchronous, local
, nodev, nosuid)
/dev/wd0e (1119922661c467e8.e) on /mnt/var type ffs (rw, asynchronous, local, no
udev, nosuid)
```

Let's install the sets!

Location of sets? (cd0 disk http or 'done') [cd0]

Pathname to the sets? (or 'done') [6.5/amd64]

```
/dev/wd@d (1119922661c467e8.d) on /mnt/tmp type ffs (rw, asynchronous, local, no
dev, nosuid)
/dev/wd@f (1119922661c467e8.f) on /mnt/usr type ffs (rw, asynchronous, local, no
dev)
/dev/wd@g (1119922661c467e8.g) on /mnt/usr/X11R6 type ffs (rw, asynchronous, loc
al, nodev)
/dev/wd@h (1119922661c467e8.h) on /mnt/usr/local type ffs (rw, asynchronous, loc
al, nodev)
/dev/wd@j (1119922661c467e8.j) on /mnt/usr/obj type ffs (rw, asynchronous, local
, nodev, nosuid)
/dev/wd@i (1119922661c467e8.i) on /mnt/usr/src type ffs (rw, asynchronous, local
, nodev, nosuid)
/dev/wd@e (1119922661c467e8.e) on /mnt/var type ffs (rw, asynchronous, local, no
dev, nosuid)
```

Let's install the sets!

Location of sets? (cd@ disk http or 'done') [cd@]

Pathname to the sets? (or 'done') [6.5/amd64]

Select sets by entering a set name, a file name pattern or 'all'. De-select sets by prepending a '-', e.g.: '-game*'. Selected sets are labelled '[X]'.

- | | | | |
|---|---|---|--|
| <input checked="" type="checkbox"/> [X]bsd | <input checked="" type="checkbox"/> [X]comp65.tgz | <input checked="" type="checkbox"/> [X]xbase65.tgz | <input checked="" type="checkbox"/> [X]xserv65.tgz |
| <input checked="" type="checkbox"/> [X]bsd.rd | <input checked="" type="checkbox"/> [X]man65.tgz | <input checked="" type="checkbox"/> [X]xshare65.tgz | |
| <input checked="" type="checkbox"/> [X]base65.tgz | <input checked="" type="checkbox"/> [X]game65.tgz | <input checked="" type="checkbox"/> [X]xfont65.tgz | |

Set name(s)? (or 'abort' or 'done') [done]

dev, nosuid)

/dev/wd0f (1119922661c467e8.f) on /mnt/usr type ffs (rw, asynchronous, local, no
dev)

/dev/wd0g (1119922661c467e8.g) on /mnt/usr/X11R6 type ffs (rw, asynchronous, loc
al, nodev)

/dev/wd0h (1119922661c467e8.h) on /mnt/usr/local type ffs (rw, asynchronous, loc
al, nodev)

/dev/wd0j (1119922661c467e8.j) on /mnt/usr/obj type ffs (rw, asynchronous, local
, nodev, nosuid)

/dev/wd0i (1119922661c467e8.i) on /mnt/usr/src type ffs (rw, asynchronous, local
, nodev, nosuid)

/dev/wd0e (1119922661c467e8.e) on /mnt/var type ffs (rw, asynchronous, local, no
dev, nosuid)

Let's install the sets!

Location of sets? (cd0 disk http or 'done') [cd0]

Pathname to the sets? (or 'done') [6.5/amd64]

Select sets by entering a set name, a file name pattern or 'all'. De-select
sets by prepending a '-', e.g.: '-game*'. Selected sets are labelled '[X]'.

[X] bsd [X] comp65.tgz [X] xbase65.tgz [X] xserv65.tgz

[X] bsd.rd [X] man65.tgz [X] xshare65.tgz

[X] base65.tgz [X] game65.tgz [X] xfont65.tgz

Set name(s)? (or 'abort' or 'done') [done]

Directory does not contain SHA256.sig. Continue without verification? [no]

Let's install the sets!

Location of sets? (cd0 disk http or 'done') [cd0]

Pathname to the sets? (or 'done') [6.5/amd64]

Select sets by entering a set name, a file name pattern or 'all'. De-select sets by prepending a '-', e.g.: '-game*'. Selected sets are labelled '[X]'.

[X] bsd	[X] comp65.tgz	[X] xbase65.tgz	[X] xserv65.tgz
[X] bsd.rd	[X] man65.tgz	[X] xshare65.tgz	
[X] base65.tgz	[X] game65.tgz	[X] xfont65.tgz	

Set name(s)? (or 'abort' or 'done') [done]

Directory does not contain SHA256.sig. Continue without verification? [no] yes

Installing bsd	100%	|*****|	15163 KB	00:01
----------------	------	-------	----------	-------

Installing bsd.rd	100%	|*****|	9984 KB	00:00
-------------------	------	-------	---------	-------

Installing base65.tgz	100%	|*****|	190 MB	00:20
-----------------------	------	-------	--------	-------

Extracting etc.tgz	100%	|*****|	260 KB	00:00
--------------------	------	-------	--------	-------

Installing comp65.tgz	100%	|*****|	71916 KB	00:09
-----------------------	------	-------	----------	-------

Installing man65.tgz	100%	|*****|	7385 KB	00:01
----------------------	------	-------	---------	-------

Installing game65.tgz	100%	|*****|	2741 KB	00:00
-----------------------	------	-------	---------	-------

Installing xbase65.tgz	100%	|*****|	20140 KB	00:02
------------------------	------	-------	----------	-------

Extracting xetc.tgz	100%	|*****|	6937	00:00
---------------------	------	-------	------	-------

Installing xshare65.tgz	100%	|*****|	4447 KB	00:01
-------------------------	------	-------	---------	-------

Installing xfont65.tgz	100%	|*****|	39342 KB	00:05
------------------------	------	-------	----------	-------

Installing xserv65.tgz	100%	|*****|	16268 KB	00:02
------------------------	------	-------	----------	-------

Location of sets? (cd0 disk http or 'done') [done] _

```
Let's install the sets!
Location of sets? (cd0 disk http or 'done') [cd0]
Pathname to the sets? (or 'done') [6.5/amd64]

Select sets by entering a set name, a file name pattern or 'all'. De-select
sets by prepending a '-', e.g.: '-game*'. Selected sets are labelled '[X]'.
  [X] bsd                [X] comp65.tgz        [X] xbase65.tgz    [X] xserv65.tgz
  [X] bsd.rd            [X] man65.tgz          [X] xshare65.tgz
  [X] base65.tgz        [X] game65.tgz        [X] xfont65.tgz
Set name(s)? (or 'abort' or 'done') [done]
Directory does not contain SHA256.sig. Continue without verification? [no] yes
Installing bsd          100% |*****| 15163 KB    00:01
Installing bsd.rd      100% |*****| 9984 KB     00:00
Installing base65.tgz  100% |*****| 190 MB     00:20
Extracting etc.tgz     100% |*****| 260 KB     00:00
Installing comp65.tgz  100% |*****| 71916 KB   00:09
Installing man65.tgz   100% |*****| 7385 KB    00:01
Installing game65.tgz  100% |*****| 2741 KB    00:00
Installing xbase65.tgz 100% |*****| 20140 KB   00:02
Extracting xetc.tgz    100% |*****| 6937      00:00
Installing xshare65.tgz 100% |*****| 4447 KB    00:01
Installing xfont65.tgz 100% |*****| 39342 KB   00:05
Installing xserv65.tgz 100% |*****| 16268 KB   00:02
Location of sets? (cd0 disk http or 'done') [done]
Time appears wrong. Set to 'Thu Jun 20 11:59:58 EDT 2019'? [yes] _
```

```
Directory does not contain SHA256.sig. Continue without verification? [no] yes
Installing bsd 100% |*****| 15163 KB 00:01
Installing bsd.rd 100% |*****| 9984 KB 00:00
Installing base65.tgz 100% |*****| 190 MB 00:20
Extracting etc.tgz 100% |*****| 260 KB 00:00
Installing comp65.tgz 100% |*****| 71916 KB 00:09
Installing man65.tgz 100% |*****| 7385 KB 00:01
Installing game65.tgz 100% |*****| 2741 KB 00:00
Installing xbase65.tgz 100% |*****| 20140 KB 00:02
Extracting xetc.tgz 100% |*****| 6937 00:00
Installing xshare65.tgz 100% |*****| 4447 KB 00:01
Installing xfont65.tgz 100% |*****| 39342 KB 00:05
Installing xserv65.tgz 100% |*****| 16268 KB 00:02
Location of sets? (cd0 disk http or 'done') [done]
Time appears wrong. Set to 'Thu Jun 20 11:59:58 EDT 2019'? [yes]
Saving configuration files... done.
Making all device nodes... done.
Relinking to create unique kernel... done.
```

CONGRATULATIONS! Your OpenBSD install has been successfully completed!

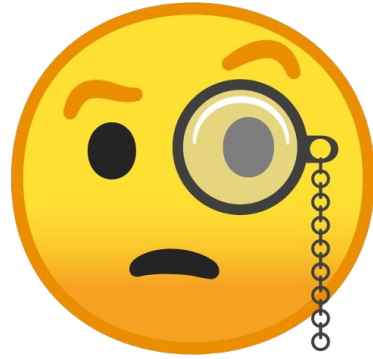
When you login to your new system the first time, please read your mail using the 'mail' command.

Exit to (S)hell, (H)alt or (R)eboot? [reboot] _

```
em0: bound to 10.0.2.15 from 10.0.2.2 (52:54:00:12:35:02)
reordering libraries: done.
openssl: generating isakmpd/iked RSA keys... done.
ssh-keygen: generating new host keys: RSA DSA ECDSA ED25519
starting early daemons: syslogd pflogd ntpd.
starting RPC daemons:.
savecore: no core dump
checking quotas: done.
clearing /tmp
kern.securelevel: 0 -> 1
creating runtime link editor directory cache.
preserving editor files.
starting network daemons: sshd smtpd sndiod.
running rc.firsttime
Path to firmware: http://firmware.openbsd.org/firmware/6.5/
Installing: intel-firmware
Checking for available binary patches...
Run syspatch(8) to install:
001_rip6cksum    002_srtp        003_mds         004_bgpd        005_libssl
starting local daemons: cron.
Thu Jun 20 12:05:37 EDT 2019
```

```
OpenBSD/amd64 (OpenBSD.ott0150.net.shopify.io) (ttyC0)
```

```
login:
```



Sysadmin basics



Editors

Three choices in base:

- `ed` - The standard editor
- `vi` - Skinny ViM
- `mg` - Micro Gnu emacs

Comes with `tmux` (1) by default!



```
running rc.firsttime
Path to firmware: http://firmware.openbsd.org/firmware/6.5/
Installing: intel-firmware
Checking for available binary patches...
Run syspatch(8) to install:
001_rip6cksum    002_srtp          003_mds           004_bgpd          005_libssl
starting local daemons: cron.
Thu Jun 20 12:05:37 EDT 2019
```

```
OpenBSD/amd64 (OpenBSD.ott0150.net.shopify.io) (ttyC0)
```

```
login: root
```

```
Password:
```

```
OpenBSD 6.5 (GENERIC) #3: Sat Apr 13 14:42:43 MDT 2019
```

```
Welcome to OpenBSD: The proactively secure Unix-like operating system.
```

```
Please use the sendbug(1) utility to report bugs in the system.
Before reporting a bug, please try to reproduce it with the latest
version of the code.  With bug reports, please try to ensure that
enough information to reproduce the problem is enclosed, and if a
known fix for it exists, include that as well.
```

```
You have mail.
```

```
OpenBSD#
```

Run syspatch(8) to install:

001_rip6cksum 002_srtp 003_mds 004_bgpd 005_libssl

starting local daemons: cron.

Thu Jun 20 12:05:37 EDT 2019

OpenBSD/amd64 (OpenBSD.ott0150.net.shopify.io) (ttyC0)

login: root

Password:

OpenBSD 6.5 (GENERIC) #3: Sat Apr 13 14:42:43 MDT 2019

Welcome to OpenBSD: The proactively secure Unix-like operating system.

Please use the sendbug(1) utility to report bugs in the system.

Before reporting a bug, please try to reproduce it with the latest version of the code. With bug reports, please try to ensure that enough information to reproduce the problem is enclosed, and if a known fix for it exists, include that as well.

You have mail.

OpenBSD# mail

Mail version 8.1.2 01/15/2001. Type ? for help.

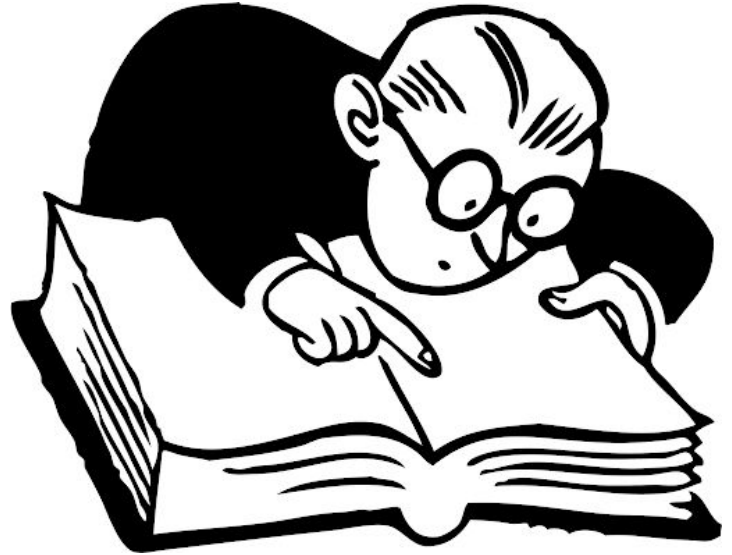
"/var/mail/root": 1 message 1 new

>N 1 deraadt@do-not-re Wed May 1 06:30 74/3997 Welcome to OpenBSD 6.5!

&

man (1) pages

- Contain everything
- `apropos`
- `man afterboot`
- `man hier`
- Manpage sections: `man <#> intro`
 - Section 1 - General commands
 - Section 2 - System calls
 - Section 3 - C library functions
 - Section 4 - Device drivers
 - Section 5 - File formats
 - Section 6 - Games
 - Section 7 - Miscellaneous
 - Section 8 - System management
 - Section 9 - Kernel development



Filesystem hierarchy

- `/bsd` - The kernel
- `/bsd.mp` - The multiprocessing kernel, of you're on a platform that supports it
- `/bsd.rd` - The ramdisk kernel, used for installation
- `/bin/` - Statically-linked essential user tools
- `/sbin/` - Statically-linked essential superuser tools
- `/etc/` - Configuration files
- `/dev/` - Device files
- `/home/` - User home directories
- `/mnt/` - Empty mount point
- `/root/` - Root user home directory
- `/var/` - Persistent non-user data: logs, mail, databases, websites, etc.
- `/usr/bin/` - Most other user tools
- `/usr/sbin/` - Most other superuser tools
- `/usr/{lib,include,share}` - Program resources
- `/usr/local/{bin,lib,include}` - All package provided files, except for configuration files

User management

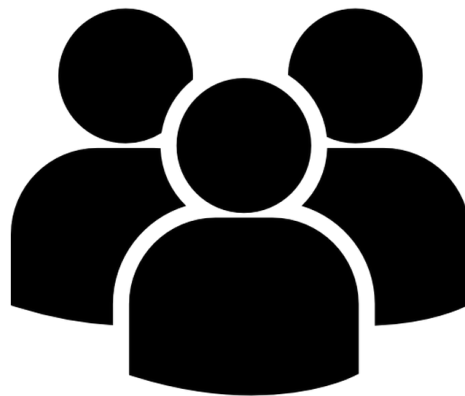
- `adduser` - Interactively add users
- `chpass` - Interactively change user info

- `useradd` - Non-interactively add users
- `usermod` - Non-interactively modify user info
- `userinfo` - Get information on a user
- `userdel` - Delete a user account



Group management

- `groupadd` - Create a group
- `groupmod` - Modify a group
- `groupinfo` - Get information on a group
- `groupdel` - Delete a group



doas (1)

```
# Sample /etc/sudoers file.
# This file MUST be edited with the 'visudo' command as root.
# See the sudoers man page for the details on how to write a sudoers file.

##
## Override built-in defaults
##
Defaults    env_reset += "BLOCKSIZE"
Defaults    env_keep += "COLORFGBG COLORTERM"
Defaults    env_keep += "___CF_USER_TEXT_ENCODING"
Defaults    env_keep += "CHARSET LANG LANGUAGE LC_ALL LC_COLLATE LC_CTYPE"
Defaults    env_keep += "LC_MESSAGES LC_MONETARY LC_NUMERIC LC_TIME"
Defaults    env_keep += "LINES COLUMNS"
Defaults    env_keep += "LS_COLORS"
Defaults    env_keep += "SSH_AUTH_SOCK"
Defaults    env_keep += "TZ"
Defaults    env_keep += "DISPLAY XAUTHORIZATION XAUTHORITY"
Defaults    env_keep += "EDITOR VISUAL"
Defaults    env_keep += "HOME MAIL"

Defaults    lecture_file = "/etc/sudo_lecture"

##
## User alias specification
##
# User_Alias  FULLTIMERS = millert, mikef, dowdy

##
## Runas alias specification
##
# Runas_Alias OP = root, operator

##
## Host alias specification
##
# Host_Alias  CUNETS = 128.138.0.0/255.255.0.0
# Host_Alias  CSNETS = 128.138.243.0, 128.138.204.0/24, 128.138.242.0
# Host_Alias  SERVERS = master, mail, ww, ns
# Host_Alias  CDROM = orion, perseus, hercules

##
## Cmnd alias specification
##
# Cmnd_Alias PAGERS = /usr/bin/more, /usr/bin/pg, /usr/bin/less

##
## User specification
##
# root and users in group wheel can run anything on any machine as any user
root        ALL = (ALL) ALL
dante       ALL = (ALL) ALL
%admin      ALL = (ALL) ALL

## Read drop-in files from /private/etc/sudoers.d
## (the '#' here does not indicate a comment)
#includedir /private/etc/sudoers.d
```



```
permit persist dante
```

- `man doas`
- `man doas.conf`

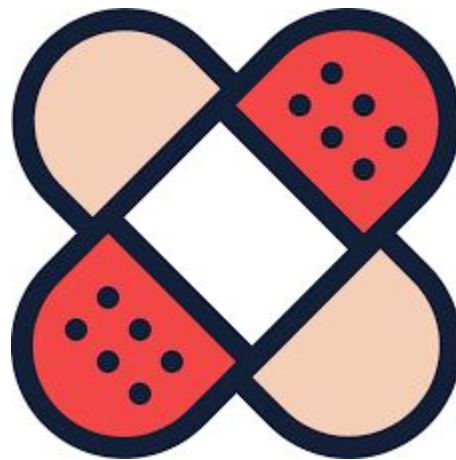
```
OpenBSD# mg /etc/doas.conf
```

```
permit persist dante
```

```
-
```

syspatch (8)

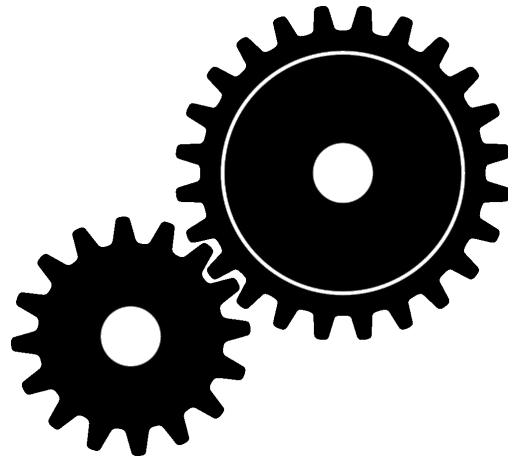
- Dead simple to use
- Fast
- Should something go wrong
 - Rollback the last patch with `-r`
 - Rollback all patches with `-R`




```
OpenBSD# syspatch
Get/Verify syspatch65-001_rip6cks... 100% |*****|      196 KB      00:00
Installing patch 001_rip6cksum
Get/Verify syspatch65-002_srtp.tgz 100% |*****|     4316 KB      00:02
Installing patch 002_srtp
Get/Verify syspatch65-003_mds.tgz 100% |*****|    49488 KB      00:34
Installing patch 003_mds
Get/Verify syspatch65-004_bgpd.tgz 100% |*****|      173 KB      00:00
Installing patch 004_bgpd
Get/Verify syspatch65-005_libssl.tgz 100% |*****|     4316 KB      00:07
Installing patch 005_libssl
Relinking to create unique kernel... done; reboot to load the new kernel
Errata can be reviewed under /var/syspatch
OpenBSD#
```

rc (8)

- The command invoked by `init(8)`
- Very simple
- `rcctl(8)`
- Split up into several parts:
 - `/etc/rc` - Startup command script
 - `/etc/rc.conf` - System daemon configuration database (don't touch)
 - `/etc/rc.conf.local` - System local configuration
 - `/etc/rc.d` - Location of `rc.d(8)` scripts



rc.conf[.local]



- `<daemon>_flags=<args>`
 - `apmd_flags=NO` - Daemon disabled
 - `apmd_flags=` - Daemon enabled
 - `apmd_flags=-A` - Daemons enabled with special flags
- Special services (`pf`, `ipsec`, etc.) only have a YES/NO option
 - `pf_enable=YES`
- `pkg_scripts` - Services that have to startup and shutdown in order
 - Example: `pkg_scripts=messagebus cupsd`

rcctl (8)



- `rcctl enable <daemon>` - Enable a daemon/service at boot
- `rcctl disable <daemon>` - Disable a daemon/service at boot

- `rcctl get <daemon>` - Get the configuration of a daemon
- `rcctl set <service> <variable> <args>` - Set daemon variables
 - Example: `rcctl set apmd flags -A`
 - Example: `rcctl set dhcp user _dhcp`

- `rcctl order [daemon]` - Move daemon to the beginning of `pkg_scripts`

- `rcctl getdef <daemon>` - Get the default config of a daemon

rcctl (8)



- `rcctl ls <arg>` - Display a list of services/daemons, one of:
 - `rcctl ls all` - All services and daemons
 - `rcctl ls failed` - All enabled but stopped daemons
 - `rcctl ls on` - All enabled daemons
 - `rcctl ls off` - All disabled daemons
 - `rcctl ls started` - All started daemons
 - `rcctl ls stopped` - All stopped daemons
- `rcctl [-df] <action> <daemon>` - Pass a command to the rc.d script
 - `rcctl [-f] start <daemon>` - Start the daemon (-f start regardless of daemon_flags)
 - `rcctl stop <daemon>` - Stop the daemon
 - `rcctl restart <daemon>` - Restart the daemon
 - `rcctl check <daemon>` - Check if the daemon is running

```
OpenBSD# rcctl get apmd
```

```
apmd_class=daemon
```

```
apmd_flags=NO
```

```
apmd_rtable=0
```

```
apmd_timeout=30
```

```
apmd_user=root
```

```
OpenBSD# _
```

```
OpenBSD# rcctl get apmd
apmd_class=daemon
apmd_flags=NO
apmd_rtable=0
apmd_timeout=30
apmd_user=root
OpenBSD# rcctl enable apmd
OpenBSD#
```

```
OpenBSD# rcctl get apmd
apmd_class=daemon
apmd_flags=NO
apmd_rtable=0
apmd_timeout=30
apmd_user=root
OpenBSD# rcctl enable apmd
OpenBSD# rcctl get apmd
apmd_class=daemon
apmd_flags=
apmd_rtable=0
apmd_timeout=30
apmd_user=root
OpenBSD#
```



```
OpenBSD# rcctl get apmd
apmd_class=daemon
apmd_flags=NO
apmd_rtable=0
apmd_timeout=30
apmd_user=root
OpenBSD# rcctl enable apmd
OpenBSD# rcctl get apmd
apmd_class=daemon
apmd_flags=
apmd_rtable=0
apmd_timeout=30
apmd_user=root
OpenBSD# rcctl set apmd flags -A
OpenBSD#
```

```
OpenBSD# rcctl get apmd
apmd_class=daemon
apmd_flags=NO
apmd_rtable=0
apmd_timeout=30
apmd_user=root
OpenBSD# rcctl enable apmd
OpenBSD# rcctl get apmd
apmd_class=daemon
apmd_flags=
apmd_rtable=0
apmd_timeout=30
apmd_user=root
OpenBSD# rcctl set apmd flags -A
OpenBSD# rcctl get apmd
apmd_class=daemon
apmd_flags=-A
apmd_rtable=0
apmd_timeout=30
apmd_user=root
OpenBSD# _
```

```
OpenBSD# cat /etc/rc.conf.local
```

```
apmd_flags=-A
```

```
OpenBSD# _
```

Logs

- Most logs are stored in `/var/logs` as you'd expect
 - Auth, pf, mail, daemons, etc.
- `httpd` logs are stored in `/var/www/logs`



Network interfaces

- `/etc/myname` - Hostname
- `/etc/mygate` - Static default gateway
 - Ignored by DHCP
- `/etc/resolv.conf` - Nameserver config
 - Overwritten by DHCP



ifconfig (8)

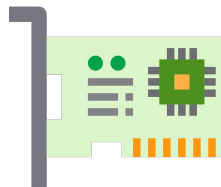
- Used for all network configuration
- No ip/iwconfig/wpa_supplicant/vconfig/brctl/nmcli
- Join wifi:
 - `ifconfig iw0 join MySSID wpakey ThePassword`
- Create vlan:
 - `ifconfig vlan5 create`
 - `ifconfig vlan5 parent em1 192.168.5.1/24`

Network interfaces

- `/etc/hostname.<if>` where `<if>` is the name of the interface

- To enable DHCP on interface `re0`:

- `echo "dhcp" > /etc/hostname.re0`



- To set a static IP on interface `re0`:

- `echo "inet <ip addr> <subnet mask> NONE" > /etc/hostname.re0`

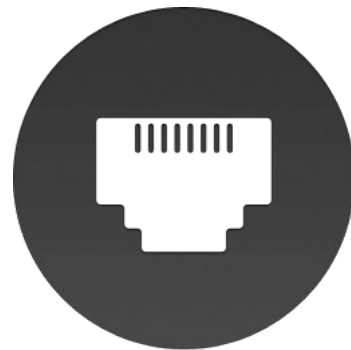
- `echo "inet 192.168.2.23 255.255.255.0 NONE" > /etc/hostname.re0`

- To auto-join a wireless network when it's around on `iw0`:

- `echo "join <NWID> wpakey <password>" > /etc/hostname.iw0`

Network interfaces

- `man hostname.if`
- `man ifconfig`
- Anything that doesn't match the configuration syntax is passed to `ifconfig`
 - Example: `join Shopify wpakey NotThePassword`
- Lines starting with a bang are run as commands
 - Example: `!route add 10.0.5.0/24 10.0.1.1`

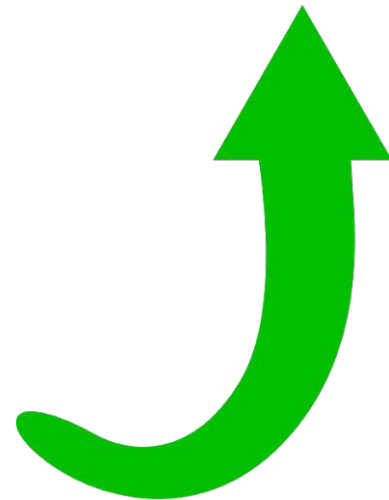


Network interfaces

- `/etc/netstart` - Network startup script, configures:

- hostname
- loopback
- bridges
- Etc.

- To re-apply a configuration to an interface: `sh /etc/netstart <if>`



```
OpenBSD# ifconfig
lo0: flags=8049<UP,LOOPBACK,RUNNING,MULTICAST> mtu 32768
    index 3 priority 0 llprio 3
    groups: lo
    inet6 ::1 prefixlen 128
    inet6 fe80::1%lo0 prefixlen 64 scopeid 0x3
    inet 127.0.0.1 netmask 0xff000000
em0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    lladdr 08:00:27:58:59:98
    index 1 priority 0 llprio 3
    groups: egress
    media: Ethernet autoselect (1000baseT full-duplex)
    status: active
    inet 10.0.2.15 netmask 0xfffff00 broadcast 10.0.2.255
enc0: flags=0<>
    index 2 priority 0 llprio 3
    groups: enc
    status: active
pflog0: flags=141<UP,RUNNING,PROMISC> mtu 33136
    index 4 priority 0 llprio 3
    groups: pflog
OpenBSD# _
```

```
OpenBSD# cat /etc/hostname.em0
```

```
dhcp
```

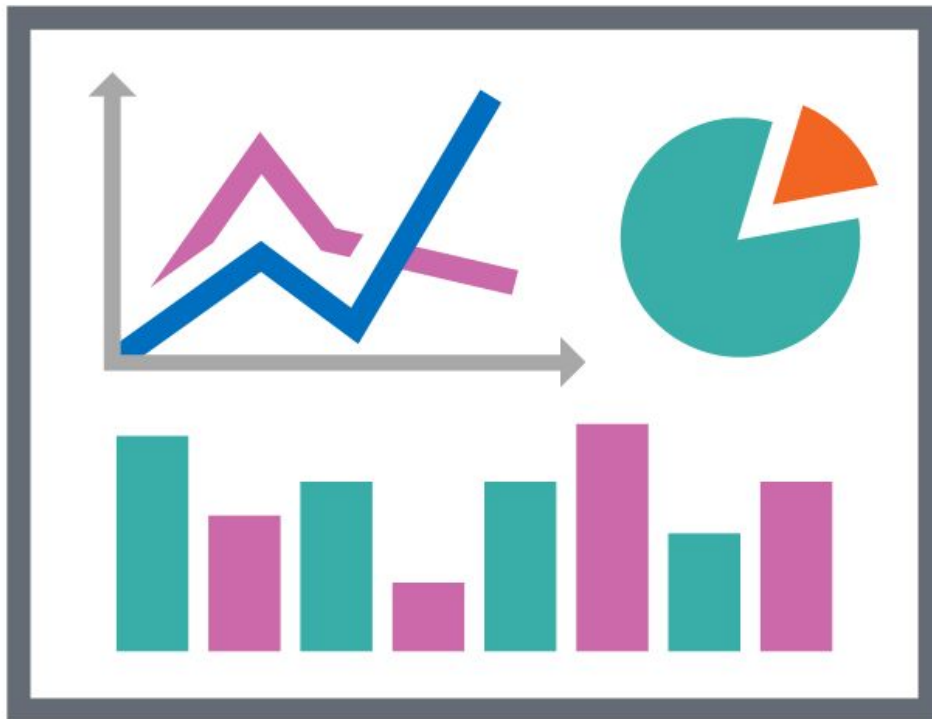
```
OpenBSD#
```

```
OpenBSD# cat /etc/myname
OpenBSD.ott0150.net.shopify.io
OpenBSD# _
```

```
OpenBSD# cat /etc/resolv.conf
# Generated by em0 dhclient
search ott0150.net.shopify.io
nameserver 10.65.0.53
nameserver 1.1.1.1
nameserver 8.8.8.8
lookup file bind
OpenBSD#
```

sysstat (1)

- Memory usage
- Memory allocations
- CPU usage
- Pigs (greedy processes)
- Network usage
- Interface usage
- I/O usage
- Sensors
- Firewall rules
- Firewall connections
- More



1 users Load 0.00 0.00 0.00

OpenBSD.ott0150.net 13:17:16

			memory totals (in KB)			PAGING		SWAPPING		Interrupts	
			real	virtual	free	in	out	in	out	100 total	
Active			25036	25036	556648	ops				100 clock	
All			443252	443252	1232148	pages				pciide0	
											em0
Proc:r	d	s	w	Csw	Trp	Sys	Int	Sof	Flt	forks	
				27		25		100	5	fkppw	
										fksum	
										pwait	
										relck	
										rlkok	
										noram	
										ndcpy	
										fltcp	
										zfod	
										cow	
Disks	wd0	cd0							8332	fmin	
seeks									11109	ftarg	
xfers										itarg	
speed	1K							1	wired		
sec	0.0								pdfre		IPKTS
											pdscn
											OPKTS

2 users Load 0.07 0.06 0.08

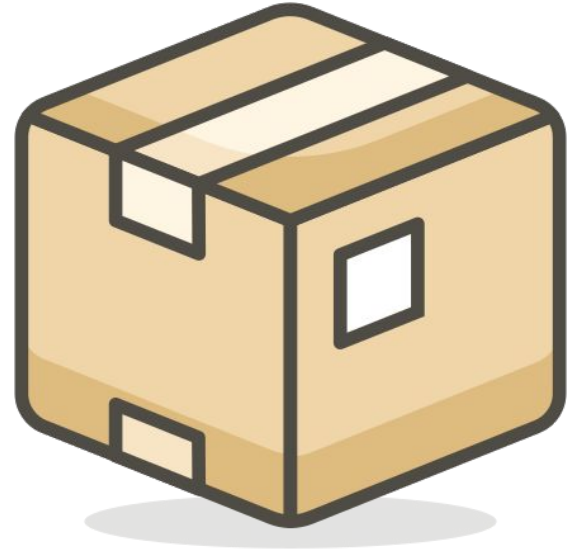
vfwall.home 14:37:29

RULE	ACTION	DIR	LOG	Q	IF	PR	K	PKTS	BYTES	STATES	MAX	INFO
0	Block	Any						236021	19846313	0		return all
1	Pass	Out			vio0	udp	K	0	0	0		inet from any to [REDACTED]/32 port = 1194
2	Pass	Out			vio0	udp	K	0	0	0		inet from any to 1.1.1.1/32 port = domain
3	Pass	In			vio0		K	220443K	91228M	768910		all
4	Pass	Out			tun0		K	220189K	91157M	711038		all
5	Match	Out			tun0			220158K	91155M	0		inet from [REDACTED]/24 to any
6	Block	In			!lo0	tcp		0	0	0		return from any to any port 6000:6010
7	Block	Out	Log			tcp		0	0	0		return all user = 55
8	Block	Out	Log			udp		0	0	0		return all user = 55

PR	DIR	SRC	DEST	STATE	AGE	EXP	PKTS	BYTES	RATE	PEAK	AVG	RULE	GW
udp	Out			MULTIPLE: MULTIPLE	115:56:01	00:01:00	220536K	102655M	464335	690533	257910	*	
udp	In			NO_TRAFFIC: SINGLE	67:37:37	00:00:20	61450	9309669	0	121	38	*	
tcp	In			ESTABLISHED: ESTABLISHED	23:06:24	00:57:25	1931	1687148	0	0	20	3	
tcp	Out			ESTABLISHED: ESTABLISHED	23:06:24	00:57:25	1931	1687148	0	0	20	4	
tcp	In			ESTABLISHED: ESTABLISHED	11:41:33	12:33:10	3525	2670728	0	0	63	3	
tcp	Out			ESTABLISHED: ESTABLISHED	11:41:33	12:33:10	3525	2670728	0	0	63	4	
tcp	In			ESTABLISHED: ESTABLISHED	11:24:48	12:39:37	731	524815	0	0	12	3	
tcp	Out			ESTABLISHED: ESTABLISHED	11:24:48	12:39:37	731	524815	0	0	12	4	
tcp	In			ESTABLISHED: ESTABLISHED	04:03:20	19:57:38	254	104369	0	0	7	3	
tcp	Out			ESTABLISHED: ESTABLISHED	04:03:20	19:57:38	254	104369	0	0	7	4	
tcp	In			ESTABLISHED: ESTABLISHED	02:53:22	21:39:46	10710	7876787	0	0	757	3	
tcp	Out			ESTABLISHED: ESTABLISHED	02:53:22	21:39:46	10710	7876787	0	0	757	4	
udp	In			MULTIPLE: MULTIPLE	02:35:52	00:01:00	6738585	2608338K	268444	348209	285600	3	
udp	Out			MULTIPLE: MULTIPLE	02:35:52	00:01:00	6738585	2608338K	268444	348209	285600	4	
udp	In			MULTIPLE: MULTIPLE	02:23:01	00:01:00	581945	447000K	20118	42277	53342	3	
udp	Out			MULTIPLE: MULTIPLE	02:23:01	00:01:00	581945	447000K	20118	42277	53342	4	
tcp	In			ESTABLISHED: ESTABLISHED	02:11:18	21:50:36	190	141915	0	0	18	3	
tcp	Out			ESTABLISHED: ESTABLISHED	02:11:18	21:50:36	190	141915	0	0	18	4	
tcp	In			ESTABLISHED: ESTABLISHED	01:23:51	22:40:47	179	140322	0	0	27	3	
tcp	Out			ESTABLISHED: ESTABLISHED	01:23:51	22:40:47	179	140322	0	0	27	4	
udp	In			NO_TRAFFIC: SINGLE	00:41:38	00:00:28	389	63796	65	65	25	3	
udp	In			NO_TRAFFIC: SINGLE	00:41:38	00:00:28	778	127592	131	131	51	3	
tcp	In			ESTABLISHED: ESTABLISHED	00:22:45	23:59:53	22	2969	0	54	2	3	
tcp	Out			ESTABLISHED: ESTABLISHED	00:22:45	23:59:53	22	2969	0	54	2	4	
tcp	In			FIN_WAIT_2: ESTABLISHED	00:14:15	00:01:44	49	25455	0	0	29	3	
tcp	Out			ESTABLISHED: FIN_WAIT_2	00:14:15	00:01:44	49	25455	0	0	29	4	
tcp	In			ESTABLISHED: FIN_WAIT_2	00:11:02	00:04:09	7	809	0	0	1	3	
tcp	Out			FIN_WAIT_2: ESTABLISHED	00:11:02	00:04:09	7	809	0	0	1	4	
tcp	In			FIN_WAIT_2: ESTABLISHED	00:08:55	00:06:06	7	709	0	0	1	3	
tcp	Out			ESTABLISHED: FIN_WAIT_2	00:08:55	00:06:06	7	709	0	0	1	4	
tcp	In			ESTABLISHED: FIN_WAIT_2	00:08:48	00:06:23	7	448	0	0	0	3	
tcp	Out			FIN_WAIT_2: ESTABLISHED	00:08:48	00:06:23	7	448	0	0	0	4	
tcp	In			ESTABLISHED: ESTABLISHED	00:08:43	23:59:55	1099	277490	371	6241	530	3	
udp	In			MULTIPLE: MULTIPLE	00:07:10	00:00:32	323	114362	0	214	265	3	
udp	Out			MULTIPLE: MULTIPLE	00:07:10	00:00:32	323	114362	0	214	265	4	
udp	In			NO_TRAFFIC: SINGLE	00:05:35	00:00:00	32	2496	0	0	7	3	
tcp	In			FIN_WAIT_2: FIN_WAIT_2	00:05:26	00:00:57	37	5863	0	0	17	3	
tcp	Out			FIN_WAIT_2: FIN_WAIT_2	00:05:26	00:00:57	37	5863	0	0	17	4	
tcp	In			TIME_WAIT: TIME_WAIT	00:05:25	00:01:08	26	8058	0	0	24	3	
tcp	Out			TIME_WAIT: TIME_WAIT	00:05:25	00:01:08	26	8058	0	0	24	4	
udp	In			MULTIPLE: MULTIPLE	00:05:11	00:01:00	42777	20308065	43498	59969	65299	3	
udp	Out			MULTIPLE: MULTIPLE	00:05:11	00:01:00	42777	20308065	43498	59969	65299	4	
udp	In			MULTIPLE: MULTIPLE	00:04:35	00:00:50	54	7662	0	62	27	3	
udp	Out			MULTIPLE: MULTIPLE	00:04:35	00:00:50	54	7662	0	62	27	4	
udp	In			NO_TRAFFIC: SINGLE	00:04:21	00:00:15	16	1536	0	38	5	3	
udp	In			NO_TRAFFIC: SINGLE	00:03:22	00:00:00	24	1392	0	0	6	3	
udp	In			MULTIPLE: MULTIPLE	00:03:22	00:00:20	20	4390	0	0	21	3	
udp	Out			MULTIPLE: MULTIPLE	00:03:22	00:00:20	20	4390	0	0	21	4	
udp	In			MULTIPLE: MULTIPLE	00:03:18	00:01:00	25964	10822845	78620	78620	54660	3	
udp	Out			MULTIPLE: MULTIPLE	00:03:18	00:01:00	25964	10822845	78620	78620	54660	4	

Package management

- `pkg_add` - Install packages
- `pkg_delete` - Remove packages
 - `pkg_delete -a` - Remove unused dependencies
- `pkg_info` - Get package information
 - `pkg_info -Q` - Search for packages



```
OpenBSD# pkg_info -Q emacs
```

```
OpenBSD# pkg_info -Q emacs
emacs-26.1p5-gtk2
emacs-26.1p5-gtk3
emacs-26.1p5-no_x11
emacs-anthy-9100hp4
uemacs-4.0p0
xemacs-21.4.22p24
xemacs-21.4.22p24-mule
xemacs-sumo-21.20100727p1
xemacs-sumo-21.20100727p1-mule
OpenBSD#
```

```
OpenBSD# pkg_add emacs_
```

```
OpenBSD# pkg_add emacs
quirks-3.124 signed on 2019-04-15T12:10:16Z
quirks-3.124: ok
Ambiguous: choose package for emacs
a      0: <None>
      1: emacs-26.1p5-gtk2
      2: emacs-26.1p5-gtk3
      3: emacs-26.1p5-no_x11
Your choice:
```

```
OpenBSD# pkg_add emacs
quirks-3.124 signed on 2019-04-15T12:10:16Z
quirks-3.124: ok
```

```
Ambiguous: choose package for emacs
```

```
a      0: <None>
      1: emacs-26.1p5-gtk2
      2: emacs-26.1p5-gtk3
      3: emacs-26.1p5-no_x11
```

```
Your choice: 3
```

```
emacs-26.1p5-no_x11:libiconv-1.14p3: ok
emacs-26.1p5-no_x11:xz-5.2.4: ok
emacs-26.1p5-no_x11:libxml-2.9.8p1: ok
emacs-26.1p5-no_x11:gettext-0.19.8.1p3: ok
emacs-26.1p5-no_x11:libffi-3.2.1p5: ok
emacs-26.1p5-no_x11:libtasn1-4.13p0: ok
emacs-26.1p5-no_x11:p11-kit-0.23.15p0: ok
emacs-26.1p5-no_x11:libunbound-1.9.1: ok
emacs-26.1p5-no_x11:gmp-6.1.2p3: ok
emacs-26.1p5-no_x11:libnettle-3.4.1p0: ok
emacs-26.1p5-no_x11:libunistring-0.9.7: ok
emacs-26.1p5-no_x11:libidn2-2.0.0p0: ok
emacs-26.1p5-no_x11:gnutls-3.6.7: ok
emacs-26.1p5-no_x11 (extracting)!*****
```



```
quirks-3.124: ok
Ambiguous: choose package for emacs
a      0: <None>
      1: emacs-26.1p5-gtk2
      2: emacs-26.1p5-gtk3
      3: emacs-26.1p5-no_x11
Your choice: 3
emacs-26.1p5-no_x11:libiconv-1.14p3: ok
emacs-26.1p5-no_x11:xz-5.2.4: ok
emacs-26.1p5-no_x11:libxml-2.9.8p1: ok
emacs-26.1p5-no_x11:gettext-0.19.8.1p3: ok
emacs-26.1p5-no_x11:libffi-3.2.1p5: ok
emacs-26.1p5-no_x11:libtasn1-4.13p0: ok
emacs-26.1p5-no_x11:p11-kit-0.23.15p0: ok
emacs-26.1p5-no_x11:libunbound-1.9.1: ok
emacs-26.1p5-no_x11:gmp-6.1.2p3: ok
emacs-26.1p5-no_x11:libnettle-3.4.1p0: ok
emacs-26.1p5-no_x11:libunistring-0.9.7: ok
emacs-26.1p5-no_x11:libidn2-2.0.0p0: ok
emacs-26.1p5-no_x11:gnutls-3.6.7: ok
emacs-26.1p5-no_x11: ok
Running tags: ok
New and changed readme(s):
  /usr/local/share/doc/pkg-readmes/emacs
OpenBSD#
```

```
OpenBSD# pkg_delete emacs
```

```
OpenBSD# pkg_delete emacs
emacs-26.1p5-no_x11: ok
Read shared items: ok
OpenBSD# _
```

```
OpenBSD# pkg_delete -a
```

```
OpenBSD# pkg_delete -a
libiconv-1.14p3:gnutls-3.6.7: ok
libiconv-1.14p3:p11-kit-0.23.15p0: ok
libiconv-1.14p3:gettext-0.19.8.1p3: ok
libiconv-1.14p3:libidn2-2.0.0p0: ok
libiconv-1.14p3:libunistring-0.9.7: ok
libiconv-1.14p3:libxml-2.9.8p1: ok
libiconv-1.14p3: ok
libnettle-3.4.1p0: ok
xz-5.2.4: ok
libffi-3.2.1p5: ok
gmp-6.1.2p3: ok
libunbound-1.9.1: ok
libtasn1-4.13p0: ok
Running tags: ok
Read shared items: ok
--- -libxml-2.9.8p1 -----
You should also remove /var/db/xmlcatalog
OpenBSD#
```

OpenBSD partitions

- Disks identified with DUID in `/etc/fstab`
- Disklabel partitions
 - Partition `c` is the whole disk
- Fast FileSystem (FFS)
 - Stable
 - Old
 - Updated frequently by OpenBSD



OpenBSD# fdisk wd0

Disk: wd0 geometry: 2088/255/63 [33554432 Sectors]

Offset: 0 Signature: 0xAA55

#:	id	Starting			Ending			LBA Info:		
		C	H	S -	C	H	S [	start:	size]	
0:	00	0	0	0 -	0	0	0 [	0:	0]	unused
1:	00	0	0	0 -	0	0	0 [	0:	0]	unused
2:	00	0	0	0 -	0	0	0 [	0:	0]	unused
*3:	A6	0	1	2 -	2087	254	63 [	64:	33543656]	OpenBSD

OpenBSD# _

```
OpenBSD# disklabel wd0
# /dev/rwd0c:
type: ESDI
disk: ESDI/IDE disk
label: VBOX HARDDISK
duid: 1119922661c467e8
flags:
bytes/sector: 512
sectors/track: 63
tracks/cylinder: 255
sectors/cylinder: 16065
cylinders: 2088
total sectors: 33554432
boundstart: 64
boundend: 33543720
drivedata: 0
```

16 partitions:

#	size	offset	fstype	[fsize	bsize	cpgr	
a:	900768	64	4,2BSD	2048	16384	7009	# /
b:	1351010	900832	swap				# none
c:	33554432	0	unused				
d:	1195456	2251872	4,2BSD	2048	16384	9302	# /tmp
e:	1707136	3447328	4,2BSD	2048	16384	12958	# /var
f:	3255968	5154464	4,2BSD	2048	16384	12958	# /usr
g:	1142560	8410432	4,2BSD	2048	16384	8890	# /usr/X11R6
h:	3877888	9552992	4,2BSD	2048	16384	12958	# /usr/local
i:	2899808	13430880	4,2BSD	2048	16384	12958	# /usr/src
j:	10960608	16330688	4,2BSD	2048	16384	12958	# /usr/obj
k:	6252416	27291296	4,2BSD	2048	16384	12958	# /home

OpenBSD# mount

/dev/wd0a on / type ffs (local)

/dev/wd0k on /home type ffs (local, nodev, nosuid)

/dev/wd0d on /tmp type ffs (local, nodev, nosuid)

/dev/wd0f on /usr type ffs (local, nodev)

/dev/wd0g on /usr/X11R6 type ffs (local, nodev)

/dev/wd0h on /usr/local type ffs (local, nodev, wxallowed)

/dev/wd0j on /usr/obj type ffs (local, nodev, nosuid)

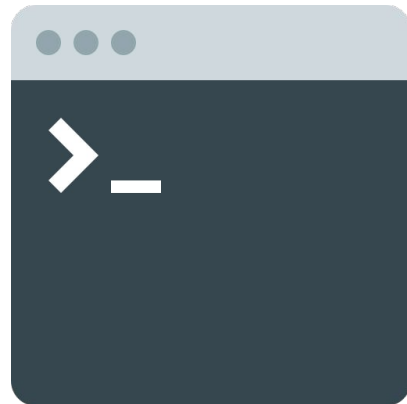
/dev/wd0i on /usr/src type ffs (local, nodev, nosuid)

/dev/wd0e on /var type ffs (local, nodev, nosuid)

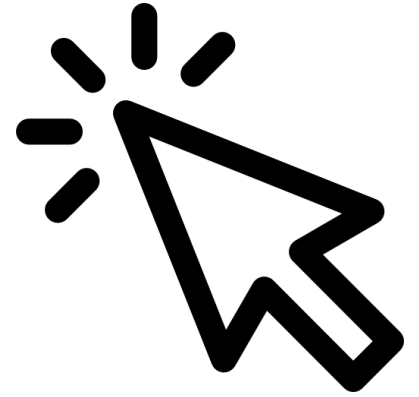
OpenBSD# _

Commonly used commands

- `ksh(1)` default shell
- `sysctl(8)` manage kernel state
- `usbdevs(8)` to list usb devices
- `pcidump(8)` to list pci devices
- `disklabel(8)` to format OpenBSD disks
- `sysctl hw.disknames` to list disks
- `vmstat(8)` to check ram usage



Graphical Interface



Options

- FVWM - Full featured, complicated to configure
- CWM - Minimalist and keyboard oriented
- TWM - Old
- Install another one
 - Mate
 - GNOME
 - LXQt
- Change default WM in `$HOME/.xsession`



Enable Xenodm (Display Manager)

- `rcctl enable xenodm`
- `rcctl start xenodm`



```
OpenBSD# rcctl enable xenodm
```

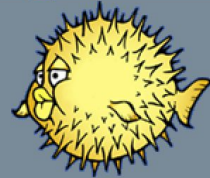
```
OpenBSD# rcctl start xenodm
```

OpenBSD.ott0150.net.shopify.io

OpenBSD

Login:

Password:



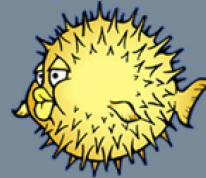
Console log for OpenBSD.ott0150.net.shopify.io

OpenBSD.ott0150.net.shopify.io

OpenBSD

Login:

Password:



Console log for OpenBSD.ott0150.net.shopify.io



Useful resources

- The FAQ - <https://www.openbsd.org/faq/index.html>
- Man pages online - <https://man.openbsd.org/>
- Mailing list - <https://www.openbsd.org/mail.html>
- IRC - #openbsd on Freenode
- OpenBSD Journal - <https://undeadly.org/>
- Planet OpenBSD - <https://bronevichok.ru/openbsdnow/>
- Reddit - <https://www.reddit.com/r/openbsd/>
- Mastodon - <https://bsd.network/>
- Awesome-openbsd - <https://github.com/ligurio/awesome-openbsd>
- Me 😏 - <https://blog.lambda.cx/>



Any Questions?





Thanks!

