FreeBSD: 28 years of Code, Community, and Collaboration

FOSSASIA 2021

The FreeBSD World

FreeBSD is an open source Unix-like **operating system** descended from the Unix developed at the University of California, Berkeley in the 1970s.

The FreeBSD Project is an active open source community since 1993 with hundreds of committers and thousands of contributors around the world.

The FreeBSD Foundation is a 501(c)3 **non-profit organization** registered in Colorado, USA in 2000 dedicated to supporting the FreeBSD Project, its development and its community.

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What is FreeBSD?

- Free and Open Source Computer Operating System
- Complete operating system including kernel, userland, documentation, and tools
- Descended from Berkeley Unix a descendent of the original Unix
- Used by universities, corporations, and users for over 27 years!

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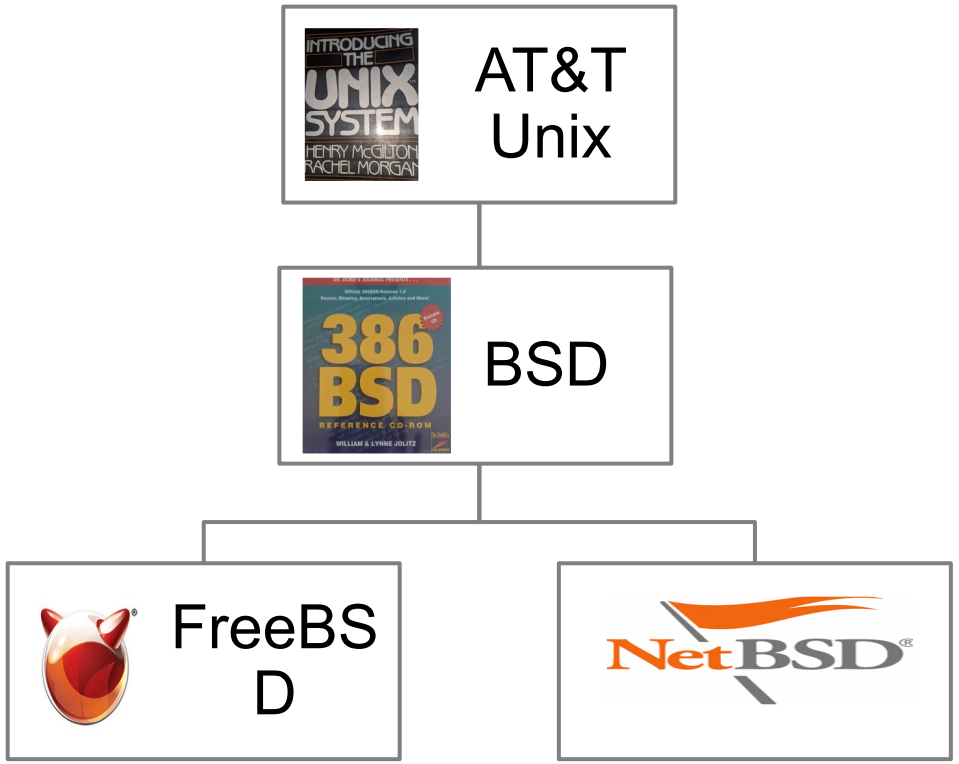
Abridged BSD Family Tree



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UNIX

In 1969 Ken Thompson, Dennis Ritchie and others started working on a program that utilized the full capabilities of new powerful computer systems. This program was called Unix.

1969

BSD

In 1974 The Computer Systems Research Group at UC Berkeley started to modify and improve AT&T Research Unix. They called this modified version "Berkeley Unix" or "BSD".

1974

386/BSD

386/BSD was released in 1992. This was the first freely redistributable full BSD operating system with 100% unencumbered files.

1992

BSDi Lawsuit

BSDi found itself in legal trouble with AT&T's Unix System Laboratories, then the owners of the System V copyright, and the Unix trademark. The USL v. BSDi lawsuit was filed in 1992.

1992

FreeBSD

The development flow of 386BSD was slow and after a period of neglect, a group of 386BSD users decided to branch out on their own and create FreeBSD so that they could keep the operating system up to date. On 19 June 1993, the name FreeBSD was chosen for the project.

1993

https://www.freebsdfoundation.org/freebsd/timeline/

2020

27 YEARS OF INNOVATION AND GROWTH

Who Uses FreeBSD

Most Likely You Use FreeBSD!

- iPhone or Apple computer
- Streaming Netflix NETFLIX
- Planning your next vacation trivago®
- Sony PlayStation 4

GROUPON® Getting an awesome deal!

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Why Use FreeBSD?

- Friendly and Approachable Community
- Excellent Documentation
- Good Tooling and Modern Compilers
- Consistent Development and Release Processes
- Wide Variety of Architectures Supported
- 2-clause BSD license - Does not restrict what you can do with your own code!
- Secure, Stable, and Reliable

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FreeBSD Project Goal

Provide software that may be used for any purpose and without strings attached

How the FreeBSD Project Works

- Independent of the FreeBSD Foundation
- Developer elected 9-person Core Team - 2 year terms
- Mentorship for Commit Bit
- One community with different functional teams developing the operating system as a whole.

(core, release engineering, security, ports, documentation)

- Collaborative Development Environment

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FreeBSD Project Model

- FreeBSD followed the model set up at Berkeley, improving over the years.
- Thousands of contributors/developers who maintain, write documentation, and make improvements who can submit changes and improvements as PRs or through committers.
- Hundreds of committers who can submit changes and improvements to the source tree.
- Nine member elected core team who governs and leads the Project.
- Strong mentorship culture, where a committer will mentor a new contributor
- We have no “benevolent” dictators for life, meaning anyone can make a huge impact.

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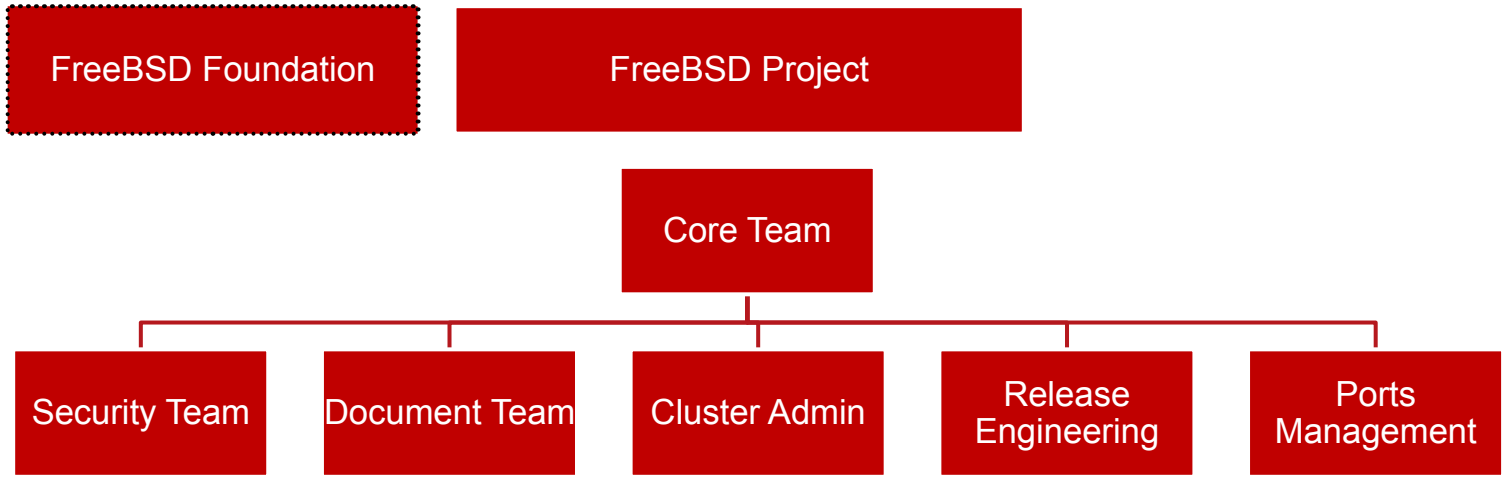
FreeBSD Project Org Chart



Other Teams include:

- Ports Secteam
- Security Officer
- Bugmeisters
- Ports Security Team
- Continuous Integration Testing Admins
- Postmaster Team
- Webmaster Team
- Phabricator Code Review Administration

- Core Team - 9
- Committers - ~400
- Contributors - Thousands

We need your help!

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FreeBSD Core Team

9-member elected management body

- Elections held every two years
- Active committers vote for core members
- Non-voting core team secretary is selected by the core team

- Responsibilities
  - Administrative (commit bits, hats, team charters)
  - Strategic (project direction, coordination, cajoling)
  - Rules, conflict resolution, enforcement

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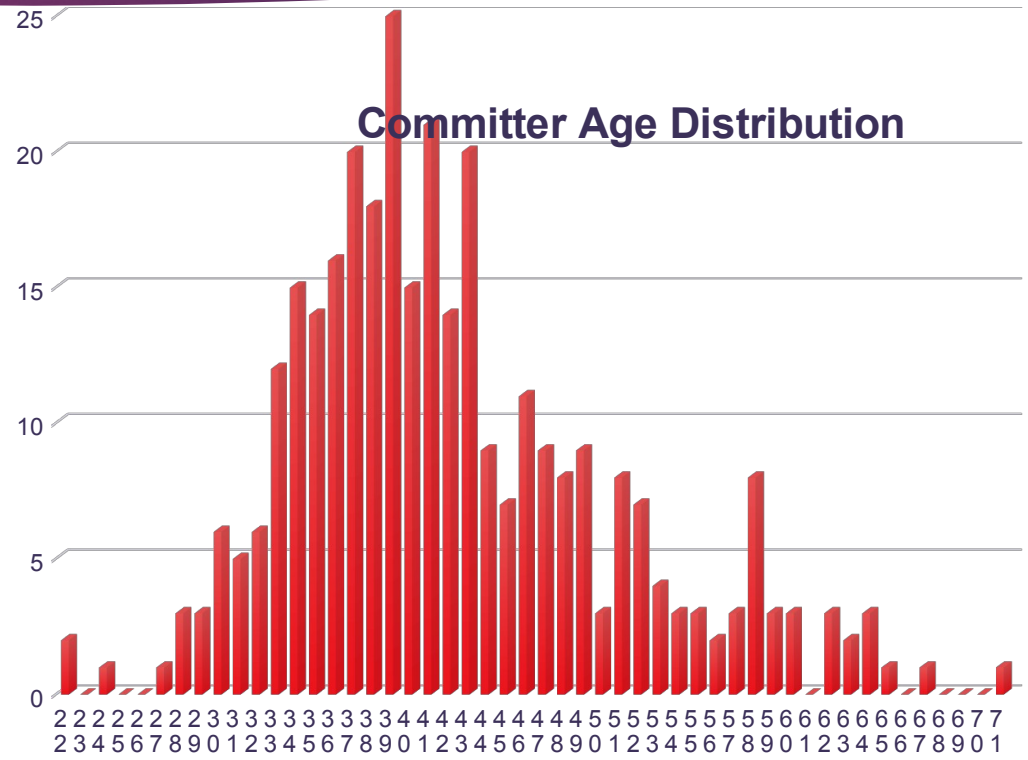
Who are the FreeBSD committers

- Locations
  - 34 countries
  - 6 continents
- Ages
  - Oldest (documented) committer born in 1948
  - Youngest (documented) committer born in 1997
  - Average age 42
  - Data from circa June 2019



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FreeBSD Releases

FreeBSD Operates on the Principle Of Least Astonishment (POLA):
Don't break things that work!
Upgrades are generally painless even across major releases.

Two Types of Releases:

Major Release
(Dot Release) –13.0
Around every two years
(supported for 5 years)

Point Release – 12.2
Around every 9 months –
ABI/API compatibility

Two Types of Branches:

Current – Head
All changes to base system committed here. Dot releases built from here.

Stable –
After testing, most changes in current moved here. Point releases built from stable.

Weekly snapshots available for current and stable branches

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How to Contribute to FreeBSD

- Code, writing documentation, maintaining ports, and advocacy.
- Easy to get started contributing.

https://www.freebsd.org/projects/newbies/

Some Suggestions:

- Start by translating or improving our documentation
- Pick one of the many ports to maintain or add
- Go through the PR list and fix some bugs

Check out FreeBSD Fridays and our How-To Guides for more getting started information

https://freebsdfoundation.org/freebsd-fridays/

https://freebsdfoundation.org/freebsd-project/resources/

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Exciting Things!

- svn to git transition
- Merged our code into the OpenZFS repository! Now a variety of improvements and features will be available to FreeBSD.
  https://freebsdfoundation.org/blog/project-update-toolchain-modernization/
- CHERI/CheriBSD
- Improving desktop experience – wifi, graphics, latest hardware support, support obs, Audacity, video conferencing webapps
- Removed GCC 4.2.1 marking a significant milestone in FreeBSD's move to an integrated, modern, permissively licensed tool chain. This milestone marks the completion of a major journey to modernize the FreeBSD toolchain.

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CHERI

What is CHERI?

CHERI (Capability Hardware Enhanced RISC Instructions) extends conventional hardware Instruction-Set Architectures (ISAs) with new architectural features to enable fine-grained memory protection and highly scalable software compartmentalization.

What is Morello?

What's exciting is ARM and University of Cambridge are collaborating on an experimental CHERI-extended multicore, superscalar ARMv8-A processor (*the instruction-set architecture used in almost all mobile devices in the world*), that will run CheriBSD – Morello Program.

The program may radically change the way Arm designs and programs processors in the future to enable better built-in security

What is CheriBSD?

CheriBSD is a FreeBSD-based operating system that companies and universities will turn to, if they want to explore and use Morello, because it is the only OS that fully integrates CHERI support today and for several years to come.

https://www.cl.cam.ac.uk/research/security/ctsrd/cheri/ https://freebsdfoundation.org/freebsd-fridays/

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Why Companies Use FreeBSD?

- History of innovation
- High performance
- Great tools
- ABI stability within major releases – Remember POLA
- Mature release model
- Excellent documentation
- Business Friendly License
- ZFS
- Open community
- Smaller footprint than most operating systems

"We choose FreeBSD for many of our internal services and product service offerings because we know we can rely on its consistent reliability and performance. Its portability not only allows us to run it on almost any commodity or enterprise server, but allows for the possibility to move a hard drive from one server to another, boot, and get back to normal operation with minimal fuss."

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The Power to Connect – Excerpt from Netflix Case Study

Netflix Open Connect Appliance
2RU 40Gb/s Storage Appliance with 248TB storage

Application

Open Connect is the name of the global network that delivers Netflix TV shows and movies to members world-wide.

- The building blocks are purpose-built Open Connect Appliances (OCAs).
- FreeBSD was selected as the operating system for OCA because of its balance of stability and features, strong development community, staff expertise, and license.

Results

- **Delivers over 100 Tb/second globally at peak**
- **90 Gb/s from an OCA – using commodity parts and FreeBSD**
- FreeBSD is central to pushing this much content **cost-effectively**. By minimizing kernel to userspace copies, data stays in the kernel as long as possible
- Async Sendfile, a Netflix and NGINX innovation, is available to all FreeBSD users
  - Web server tells kernel to send this chunk of this file out over this socket
  - Kernel returns to userspace so the web server can do other things
  - Kernel continues in background sending files to users

https://freebsdfoundation.org/blog/freebsd-case-study-netflix/

Other Features

- **Robust file systems** including UFS and ZFS (Active work happening on ZFS)
- **DTrace** - an advanced event-based performance analysis and troubleshooting tool. DTrace can help you identify and quantify the root cause of virtually any performance issue, in both user-level and kernel code. It can be executed using custom and powerful one-liners and scripts.
- **Jails** – Lightweight virtualization added to FreeBSD in the early 2000s.
- **bhyve** – Full-blown hypervisor. This hypervisor supports a number of guests, including FreeBSD, OpenBSD, Microsoft Windows, and many Linux distributions.
- **TCP/IP** was originally developed on BSD and FreeBSD remains the reference implementation for several network protocols.
- **Capsicum** – Capsicum is a lightweight OS capability and sandbox framework developed at the University of Cambridge Computer Laboratory. Capsicum extends the POSIX API, providing several new OS primitives **to support object-capability security** on UNIX-like operating systems

Containerization

- FreeBSD pioneered containers with **Jails**
- **Linuxulator -** provides binary compatibility with Linux®
- **bhyve** – Full-blown hypervisor. This hypervisor supports a number of guests, including FreeBSD, OpenBSD, Microsoft Windows, and many Linux distributions.
- **Pot** – Another container framework based on jails, to run FreeBSD containers on FreeBSD
- **Bastille** - is an open-source system for automating deployment and management of containerized applications on FreeBSD.
- **Iocage** – Convenient, lightweight, and easy container management

Why Linux and FreeBSD Should Work Together

- May work on multiple operating systems during your employment
- Learn from each other. We both have successes and failures.
- Different coding methodologies and philosophies – Understanding the reasons for both.
- FreeBSD's smaller code base makes it a great reference platform.
- "Using and learning FreeBSD made me a better Linux admin and systems engineer."

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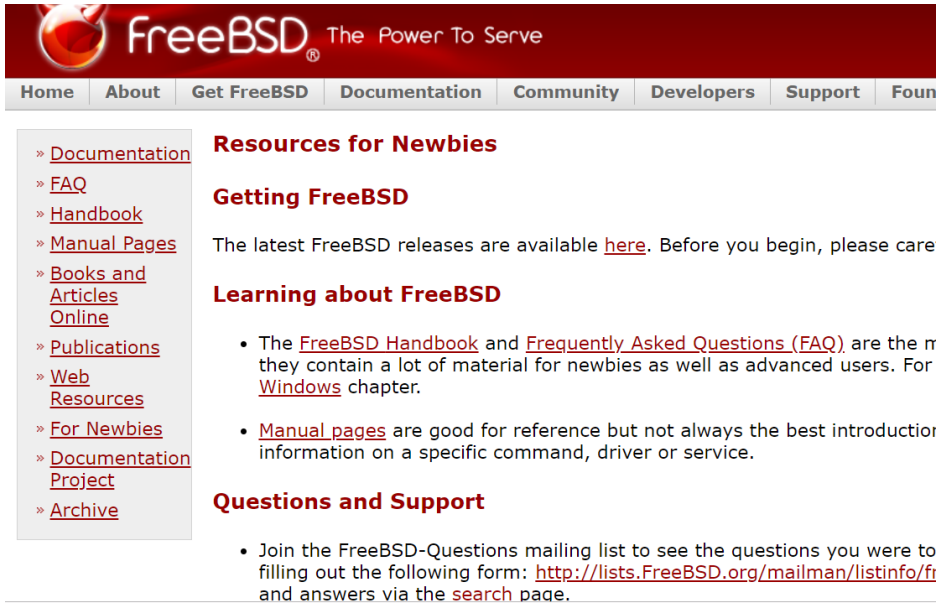
Why Contribute to FreeBSD

- Be part of an inclusive and welcoming community with a strong mentoring culture
- Great way to learn systems programming and study operating systems.
- The size of the project allows for a greater chance for anyone to make a notable impact.
- Some of the most notable BSD and FreeBSD Founders are still involved in the Project – And, they are approachable!
- Democratically run open source project allowing committers to commit their changes directly to the source tree without having to go through hierarchy of lieutenant model.



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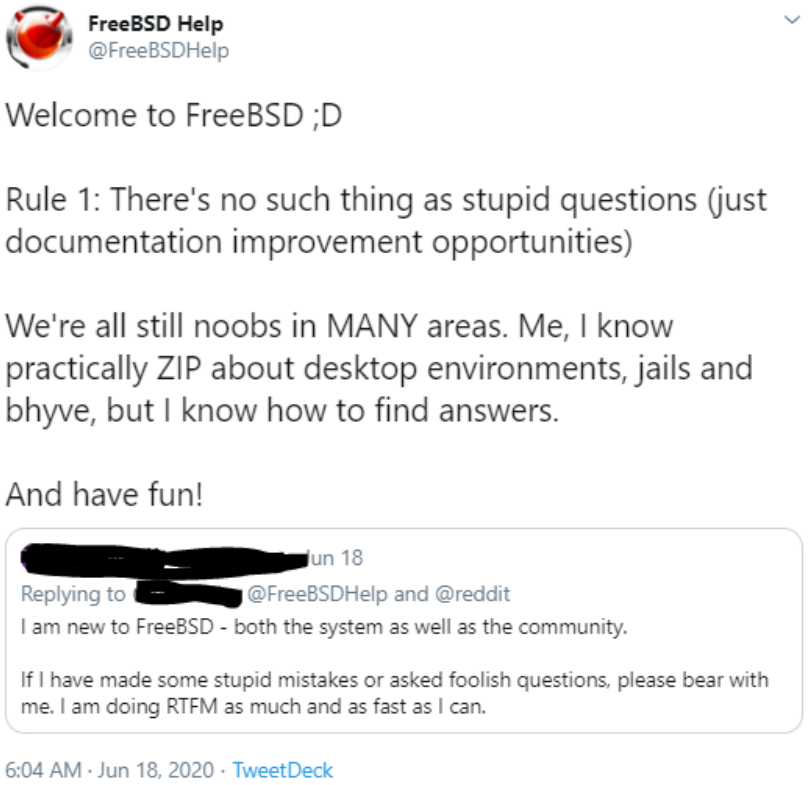
Helpful Community



FreeBSD Help
@FreeBSDHelp

Welcome to FreeBSD ;D

Rule 1: There's no such thing as stupid questions (just documentation improvement opportunities)

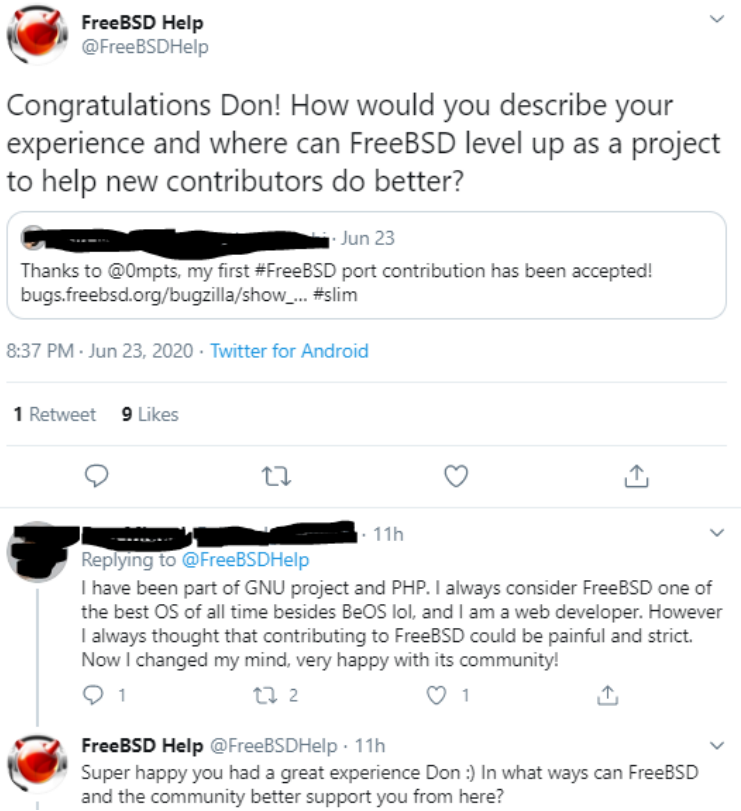
We're all still noobs in MANY areas. Me, I know practically ZIP about desktop environments, jails and bhyve, but I know how to find answers.

And have fun!

[redacted] · Jun 18
Replying to [redacted] @FreeBSDHelp and @reddit
I am new to FreeBSD - both the system as well as the community.

If I have made some stupid mistakes or asked foolish questions, please bear with me. I am doing RTFM as much and as fast as I can.

6:04 AM · Jun 18, 2020 · TweetDeck



FreeBSD Help
@FreeBSDHelp

Congratulations Don! How would you describe your experience and where can FreeBSD level up as a project to help new contributors do better?

[redacted] · Jun 23
Thanks to @0mpts, my first #FreeBSD port contribution has been accepted!
bugs.freebsd.org/bugzilla/show_... #slim

8:37 PM · Jun 23, 2020 · Twitter for Android

1 Retweet **9** Likes

[redacted] · 11h
Replying to @FreeBSDHelp
I have been part of GNU project and PHP. I always consider FreeBSD one of the best OS of all time besides BeOS lol, and I am a web developer. However I always thought that contributing to FreeBSD could be painful and strict. Now I changed my mind, very happy with its community!

1 2 1

FreeBSD Help @FreeBSDHelp · 11h
Super happy you had a great experience Don :) In what ways can FreeBSD and the community better support you from here?

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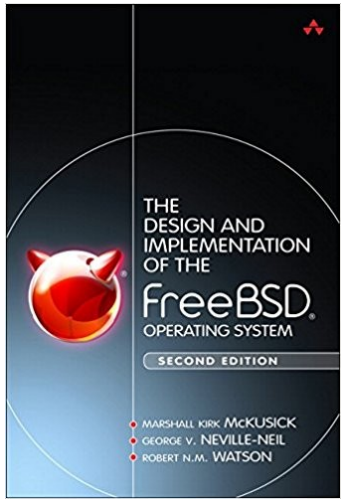
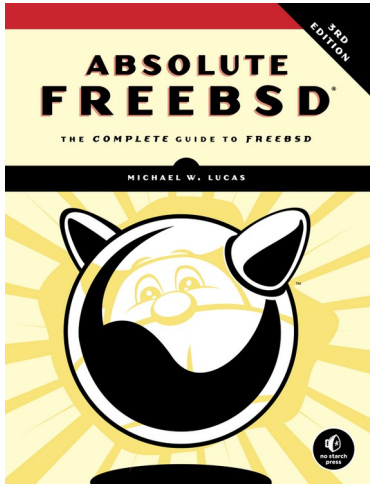
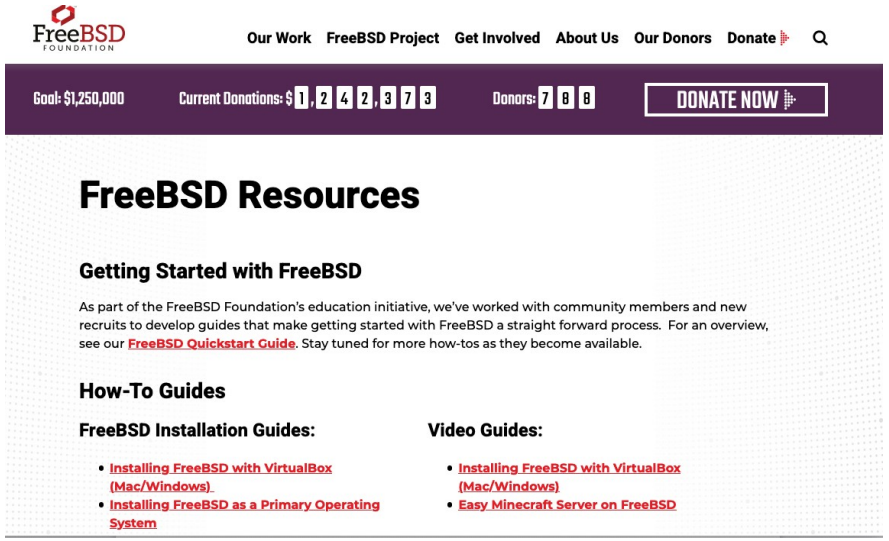
Resources

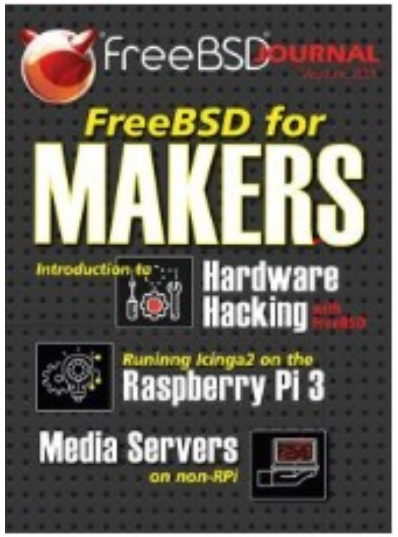
- Mailing Lists
  Forums, Mailing Lists, IRC and Events (https://www.freebsd.org/community.html)
- Contributing to FreeBSD (https://www.freebsd.org/doc/en_US.ISO8859-1/articles/contributing/)
- FreeBSD Handbook
  https://www.freebsd.org/doc/handbook/book.html
- History
  https://www.mckusick.com/history/
- Forums:
  http://forums.freebsd.org/







https://freebsdfoundation.org/freebsd-project/resources/



https://www.freebsdfoundation.org/journal/