= FreeBSD =

FreeBSD is a free Unix @-@ like operating system descended from Research Unix via the Berkeley Software Distribution ( BSD ) . Although for legal reasons FreeBSD cannot use the Unix trademark , it is a direct descendant of BSD , which was historically also called " BSD Unix " or " Berkeley Unix " . The first version of FreeBSD was released in 1993 , and today FreeBSD is the most widely used open @-@ source BSD distribution , accounting for more than three @-@ quarters of all installed systems running open @-@ source BSD derivatives .

FreeBSD has similarities with Linux , with two major differences in scope and licensing : FreeBSD maintains a complete operating system , i.e. the project delivers kernel , device drivers , userland utilities and documentation , as opposed to Linux delivering a kernel and drivers only and relying on third @-@ parties for system software ; and FreeBSD source code is generally released under a permissive BSD license as opposed to the copyleft GPL used by Linux .

The FreeBSD project includes a security team overseeing all software shipped in the base distribution . A wide range of additional third @-@ party applications may be installed using the pkgng package management system or the FreeBSD Ports , or by directly compiling source code . Due to its permissive licensing terms , much of FreeBSD 's code base has become an integral part of other operating systems such as Juniper JUNOS and Apple 's OS X.

= = History = =

= = = Background = = =

FreeBSD 's roots go back to the University of California , Berkeley . The university acquired a UNIX source license from AT & T. Students of the university started to modify and improve the AT & T Unix and called this modified version Berkeley Unix or BSD , implementing features such as TCP / IP , virtual memory and the Unix File System . The BSD project was founded in 1976 by Bill Joy . But since BSD contained code from AT & T Unix , all recipients had to get a license from AT & T first in order to use BSD .

In June 1989 , " Networking Release 1 " or simply Net @-@ 1 ? the first public version of BSD ? was released . After releasing Net @-@ 1 , Keith Bostic , a developer of BSD , suggested replacing all AT & T code with freely @-@ redistributable code under the original BSD license . Work on replacing AT & T code began and , after 18 months , much of the AT & T code was replaced . However , six files containing AT & T code remained in the kernel . The BSD developers decided to release the " Networking Release 2 " without those six files . Net @-@ 2 was released in 1991 .

= = = Birth of FreeBSD = = =

In 1992 , several months after the release of Net @-@ 2 , William Jolitz and Lynne Jolitz wrote replacements for those six missing files and ported BSD to the Intel 80386 @-@ based microprocessors and called their new operating system 386BSD . They released 386BSD via an anonymous FTP server . 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 . The first version of FreeBSD was released on November 1993 .

In the early days of the project 's inception , a company named Walnut Creek CDROM , upon the suggestion of the two FreeBSD developers , agreed to release the operating system on CD @-@ ROM . In addition to that , the company employed Jordan Hubbard and David Greenman , ran FreeBSD on its servers , sponsored FreeBSD conferences and published FreeBSD @-@ related books , including The Complete FreeBSD by Greg Lehey . By 1997 , FreeBSD was Walnut Creek 's " most successful product " . The company itself later renamed to The FreeBSD Mall and later iXSystems .

Today , FreeBSD is used by many IT companies such as IBM , Nokia , Juniper Networks , and NetApp to build their product . Certain parts of Apple 's Mac OS X operating system are based on FreeBSD . The PlayStation 3 operating system also borrows certain components from FreeBSD , while the PlayStation 4 operating system is derived from FreeBSD 9 . Netflix , WhatsApp , and FlightAware are also examples of big , successful and heavily network @-@ oriented companies which are running FreeBSD .

= = = Lawsuit = = =

386BSD and FreeBSD were both derived from 1992 's BSD release . In January 1992 , BSDi started to release BSD / 386 , later called BSD / OS , an operating system similar to FreeBSD and based on 1992 's BSD release . AT & T filed a lawsuit against BSDi and alleged distribution of AT & T source code in violation of license agreements . The lawsuit was settled out of court and the exact terms were not all disclosed . The only one that became public was that BSDi would migrate their source base to the newer 4.4BSD @-@ Lite sources . Although not involved in the litigation , it was suggested to FreeBSD that they should also move to 4.4BSD @-@ Lite . FreeBSD 2 @.@ 0 , which was released on November 1994 , was the first version of FreeBSD without any code from AT & T.

= = Features = =

= = = Uses = = =

As a general purpose operating system , FreeBSD could be used in various scenarios :
Servers
FreeBSD contains a significant collection of server @-@ related software in the base system and the ports collection , it is possible to configure and use FreeBSD as a mail server , web server , Firewall , FTP server , DNS server and a router , among other applications .
Desktop
Although FreeBSD does not install the X Window System by default , it is available in the FreeBSD ports collection . A number of Desktop environments such as GNOME , KDE and Xfce , and lightweight window managers such as Openbox , Fluxbox and dwm are also available to FreeBSD .
Embedded systems
Although it explicitly focuses on the x86 and x86 @-@ 64 platforms , FreeBSD also supports others such as ARM , PowerPC and MIPS to a lesser degree .

= = = Networking = = =

FreeBSD 's TCP / IP stack is based on the 4.2BSD implementation of TCP / IP which greatly contributed to the widespread adoption of these protocols . FreeBSD also supports IPv6 , SCTP , IPSec , and wireless networking ( Wi @-@ Fi ) . The IPv6 and IPSec stacks were taken from the KAME project . Also , FreeBSD supports IPX and AppleTalk protocols , but they are considered old and it is planned to drop support of them in the upcoming FreeBSD 11 @.@ 0 .
As of FreeBSD 5 @.@ 4 , support for the Common Address Redundancy Protocol ( CARP ) was imported from the OpenBSD project . CARP allows multiple nodes to share a set of IP addresses . So if one of the nodes goes down , other nodes still can serve the requests .

= = = Storage = = =

FreeBSD has several unique features related to storage . Soft updates can protect the consistency of the UFS filesystem ( widely used on the BSDs ) in the event of a system crash . Filesystem snapshots allow an image of a UFS filesystem at an instant in time to be efficiently created . Snapshots allow reliable backup of a live filesystem . GEOM is a modular framework that provides

RAID ( levels 0 , 1 , 3 currently ) , full disk encryption , journaling , concatenation , caching , and access to network @-@ backed storage . GEOM allows building of complex storage solutions combining ( " chaining " ) these mechanisms . FreeBSD provides two frameworks for data encryption : GBDE and Geli . Both GBDE and Geli operate at the disk level . GBDE was written by Poul @-@ Henning Kamp and is distributed under the two @-@ clause BSD license . Geli is an alternative to GBDE that was written by Pawel Jakub Dawidek and first appeared in FreeBSD 6 @.@ 0 .

From 7 @.@ 0 onward , FreeBSD supports the ZFS filesystem . ZFS was previously an open source filesystem that was first developed by Sun Microsystems , but when Oracle acquired Sun , ZFS became a proprietary product . However , the FreeBSD project is still developing and improving its ZFS implemention via the OpenZFS project .

= = = Security = = =

FreeBSD provides several security @-@ related features including access control lists ( ACLs ) , security event auditing , extended file system attributes , mandatory access controls ( MAC ) and fine @-@ grained capabilities . These security enhancements were developed by the TrustedBSD project . The project was founded by Robert Watson with the goal of implementing concepts from the Common Criteria for Information Technology Security Evaluation and the Orange Book . This project is ongoing and many of its extensions have been integrated into FreeBSD . The project is supported by a variety of organizations , including the DARPA , NSA , Network Associates Laboratories , Safeport Network Services , the University of Pennsylvania , Yahoo ! , McAfee Research , SPARTA , Apple Computer , nCircle Network Security , Google , the University of Cambridge Computer Laboratory , and others .

The project has also ported the NSA 's FLASK / TE implementation from SELinux to FreeBSD . Other work includes the development of OpenBSM , an open source implementation of Sun 's Basic Security Module ( BSM ) API and audit log file format , which supports an extensive security audit system . This was shipped as part of FreeBSD 6 @.@ 2 . Other infrastructure work in FreeBSD performed as part of the TrustedBSD Project has included GEOM and OpenPAM .

Most components of the TrustedBSD project are eventually folded into the main sources for FreeBSD . In addition , many features , once fully matured , find their way into other operating systems . For example , OpenPAM has been adopted by NetBSD . Moreover , the TrustedBSD MAC Framework has been adopted by Apple for OS X.

FreeBSD ships with three different firewall packages : IPFW , pf and IPFilter . IPFW is FreeBSD 's native firewall. pf was taken from OpenBSD and IPFilter was ported to FreeBSD by Darren Reed .

Taken from OpenBSD , the OpenSSH program was included in default install . OpenSSH is a Free implementation of the SSH protocol and is a replacement for telnet . Unlike telnet , OpenSSH encrypts all information ( including username and password ) .

In November 2012 , The FreeBSD Security Team announced that hackers gained unauthorized access on two of the project 's servers . These servers were turned off immediately . More research demonstrated that the first unauthorized access by hackers occurred on 19 September . Apparently hackers gained access to these servers by stealing SSH keys from one of the developers , not by exploiting a bug in the operating system itself . These two hacked servers were part of the infrastructure used to build third @-@ party software packages . The FreeBSD Security Team checked the integrity of the binary packages and announced that no unauthorized change was made to the binary packages , but they stated that they can 't guarantee the integrity of packages that were downloaded between 19 September and 11 November .

= = = Portability = = =

FreeBSD has been ported to a variety of processor architectures . The FreeBSD project organizes architectures into tiers that characterize the level of support provided . Tier 1 architectures are mature and fully supported . Tier 2 architectures are undergoing major development . Tier 3

architectures are experimental or are no longer under active development and Tier 4 architectures have no support at all .
As of March 2016 , FreeBSD has been ported to the following architectures :
The ARM and MIPS support is mostly aimed at embedded systems , however FreeBSD / ARM runs on a number of single @-@ board computers , including the BeagleBone Black , Raspberry Pi and Wandboard .

= = = Third @-@ party software = = =

FreeBSD has a repository of over 24 @,@ 000 applications that are developed by third parties . Examples include : windowing systems , web browsers , email clients , office suites and so forth . In general , the project itself does not develop this software , only the framework to allow these programs to be installed , which is known as the Ports collection . Applications may either be compiled from source ( " ports " ) , provided their licensing terms allow this , or downloaded as pre @-@ compiled binaries ( " packages " ) . The Ports collection supports the current and stable branches of FreeBSD . Older releases are not supported and may or may not work correctly with an up @-@ to @-@ date Ports collection .
Ports use Makefile to automatically fetch the desired application 's source code , either from a local or remote repository , unpack it on the system , apply patches to it and compile it . Depending on the size of the source code , compiling can take a long time , but it gives the user more control over the process and its result . Most ports also have package counterparts ( i.e. pre @-@ compiled binaries ) , giving the user a choice . Although this method is faster , the user has fewer customisation options .
FreeBSD version 10 @.@ 0 introduced the package manager pkg as a replacement for the previously used package tools . It is functionally similar to apt and yum in Linux distributions . It allows for installation , upgrading and removal of both ports and packages . In addition to pkg , PackageKit can also be used to access the Ports collection .

= = = Jails = = =

First introduced in FreeBSD version 4 , jails is a security mechanism and an implementation of operating @-@ system @-@ level virtualization that enables the user to run multiple instances of a guest operating system on top of a FreeBSD host . It is an enhanced version of the traditional chroot mechanism . A process that runs within such a jail is unable to access the resources outside of it . Every jail has its own hostname and IP address . It is possible to run multiple jails at the same time , but the kernel is shared among all of them . Hence only software supported by the FreeBSD kernel can be run within a jail .

= = = Virtualization = = =

bhyve , a new virtualization solution was introduced in FreeBSD 10 @.@ 0 @.@ bhyve allows a user to run a number of guest operating systems ( FreeBSD , OpenBSD , Linux , and Microsoft Windows ) simultaneously . Other operating systems such as Illumos are planned. bhyve was written by Neel Nato and Peter Grehan and was announced in the 2011 BSDCan conference for the first time . The main difference between bhyve and FreeBSD jails is that jails are an operating system @-@ level virtualization and therefore limited to only FreeBSD guests ; but bhyve is a type 2 hypervisor and is not limited to only FreeBSD guests . For comparison , bhyve is a similar technology to KVM whereas jails are closer to LXC containers or Solaris Zones .

= = = OS compatibility layers = = =

Most software that runs on Linux can run on FreeBSD using an optional built @-@ in compatibility layer . Hence , most Linux binaries can be run on FreeBSD , including some proprietary applications

distributed only in binary form . This compatibility layer is not an emulation ; Linux 's system call interface is implemented in the FreeBSD 's kernel and hence , Linux executable images and shared libraries are treated the same as FreeBSD 's native executable images and shared libraries . Additionally , FreeBSD provides compatibility layers for several other Unix @-@ like operating systems , in addition to Linux , such as BSD / OS and SVR4 , however , it is more common for users to compile those programs directly on FreeBSD .

No noticeable performance penalty over native FreeBSD programs has been noted when running Linux binaries , and , in some cases , these may even perform more smoothly than on Linux . However , the layer is not altogether seamless , and some Linux binaries are unusable or only partially usable on FreeBSD . There is support for system calls up to version 2 @.@ 6 @.@ 18 , available since FreeBSD 7 @.@ 0 . As of release 10 @.@ 3 , FreeBSD can run 64 @-@ bit Linux binaries .

FreeBSD has implemented a number of Microsoft Windows native NDIS kernel interfaces to allow FreeBSD to run Windows @-@ only network drivers .

= = = Kernel = = =

FreeBSD 's kernel provides support for some essential tasks such as managing processes , communication , booting and filesystems . FreeBSD has a monolithic kernel , with modular design . Different parts of the kernel such as drivers , are designed as modules . The user can load and unload these modules at any time . ULE is the default scheduler in FreeBSD since version 7 @.@ 1 , it supports SMP and SMT . The FreeBSD kernel has also a scalable event notification interface , named kqueue . It has been ported to other BSD @-@ derivatives such as OpenBSD , NetBSD . Kernel threading was introduced in FreeBSD 5 @.@ 0 , using an M : N threading model . This model works well in theory , but it is hard to implement and few operating systems support it . Although FreeBSD 's implementation of this model worked , it did not perform well , so from version 7 @.@ 0 onward , FreeBSD started using a 1 : 1 threading model , called libthr .

= = = Documentation and support = = =

FreeBSD 's documentation consists of its handbooks , manual pages , mailing list archives , FAQs and a variety of articles , mainly maintained by The FreeBSD Documentation Project . FreeBSD 's documentation is translated into several languages . All official documentation is released under the FreeBSD Documentation License , " a permissive non @-@ copyleft free documentation license that is compatible with the GNU FDL " . FreeBSD 's documentation is described as " high @-@ quality " .

The FreeBSD project maintains a variety of mailing lists . Among the most popular mailing lists are FreeBSD @-@ questions ( general questions ) and FreeBSD @-@ hackers ( a place for asking more technical questions ) .

Since 2004 , the New York City BSD Users Group database provides dmesg information from a collection of computers ( laptops , workstations , single @-@ board computers , embedded systems , virtual machines , etc . ) running FreeBSD .

= = = Installers = = =

From version 2 @.@ 0 to 9 @.@ 0 , FreeBSD used the sysinstall program as its main installer . It was written in C by Jordan Hubbard . It uses a text user interface , and is divided into a number of menus and screens that can be used to configure and control the installation process . It can also be used to install Ports and Packages as an alternative to the command @-@ line interface .

The sysinstall utility is now considered deprecated in favor of bsdinstall , a new installer which was introduced in FreeBSD 9 @.@ 0 @.@ bsdinstall is " a lightweight replacement for sysinstall " that was written in sh . According to OSNews , " It has lost some features while gaining others , but it is a much more flexible design , and will ultimately be significant improvement " .

= = Development = =

FreeBSD is developed by a volunteer team located around the world . The developers use the Internet for all communication and many have not met each other in person . In addition to local user groups sponsored and attended by users , an annual conference , called BSDcon , is held by USENIX . BSDcon is not FreeBSD @-@ specific so it deals with the technical aspects of all BSD operating systems , including OpenBSD and NetBSD . In addition to BSDcon , three other annual conferences , EuroBSDCon , AsiaBSDCon and BSDCan take place in Europe , Japan and Canada respectively .

= = = Governance structure = = =

The FreeBSD Project is run by around 500 committers , or developers who have commit access to the master source code repositories and can develop , debug or enhance any part of the system . Most of the developers are volunteers and few developers are paid by some companies . There are several kinds of committers , including source committers ( base operating system ) , doc committers ( documentation and web site authors ) and ports ( third party application porting and infrastructure ) . Every two years the FreeBSD committers select a 9 @-@ member FreeBSD Core Team who are responsible for overall project direction , setting and enforcing project rules and approving new commiters , or the granting of SVN commit access . A number of responsibilities are officially assigned to other development teams by the FreeBSD Core Team , for example , responsibility for managing the ports collection is delegated to the Ports Management Team .

In addition to developers , FreeBSD has thousands of " contributors " . Contributors are also volunteers outside of the FreeBSD project who submit patches for consideration by committers , as they don 't have direct access to FreeBSD 's source code repository . Committers then evaluate contributors submissions and decide what to accept and what to reject . A contributor who submits high @-@ quality patches is often asked to become a committer .

= = = Branches = = =

FreeBSD developers maintain at least two branches of simultaneous development . The -CURRENT branch always represents the " bleeding edge " of FreeBSD development . A -STABLE branch of FreeBSD is created for each major version number , from which -RELEASE are cut about once every 4 ? 6 months . If a feature is sufficiently stable and mature it will likely be backported ( MFC or Merge from CURRENT in FreeBSD developer slang ) to the -STABLE branch .

= = = Foundation = = =

FreeBSD development is supported in part by the FreeBSD Foundation . The foundation is a non @-@ profit organization that accepts donations to fund FreeBSD development . Such funding has been used to sponsor developers for specific activities , purchase hardware and network infrastructure , provide travel grants to developer summits , and provide legal support to the FreeBSD project .

In November 2014 , the FreeBSD Foundation received 1 million USD donation from Jan Koum , Co @-@ Founder and CEO of WhatsApp , - the largest single donation to the Foundation since its inception . Jan Koum himself is a FreeBSD user since the late 1990s and WhatsApp uses FreeBSD on its servers .

= = License = =

FreeBSD is released under a variety of open source licenses . The kernel code and most newly created code is released under the two @-@ clause BSD license which allows everyone to use and

redistribute FreeBSD as they wish . This license was approved by Free Software Foundation and Open Source Initiative as a Free Software and Open Source license respectively . Free Software Foundation described this license as " a lax , permissive non @-@ copyleft free software license , compatible with the GNU GPL " . There are parts released under three- and four @-@ clause BSD licenses , as well as Beerware license . Some device drivers include a binary blob , such as the Atheros HAL of FreeBSD versions before 7 @.@ 2 . Some of the code contributed by other projects is licensed under GPL , LGPL , CDDL and ISC . All the code licensed under GPL and CDDL is clearly separated from the code under liberal licenses , to make it easy for users such as embedded device manufacturers to use only permissive free software licenses . ClangBSD aims to replace some GPL dependencies in the FreeBSD base system by replacing the GNU compiler collection with the BSD @-@ licensed LLVM / Clang compiler . ClangBSD became self @-@ hosting on 16 April 2010 .

= = Logo = =

For many years FreeBSD 's logo was the generic BSD daemon , also called Beastie , a distorted pronunciation of BSD . First appearing in 1976 on Unix T @-@ shirts purchased by Bell Labs , the more popular versions of the BSD daemon were drawn by animation director John Lasseter beginning in 1984 . Several FreeBSD @-@ specific versions were later drawn by Tatsumi Hosokawa .

However , Beastie was not unique to FreeBSD . In lithographic terms , the Lasseter graphic is not line art and often requires a screened , four color photo offset printing process for faithful reproduction on physical surfaces such as paper . Also , the BSD daemon was thought to be too graphically detailed for smooth size scaling and aesthetically over @-@ dependent on multiple color gradations , making it hard to reliably reproduce as a simple , standardized logo in only two or three colors , much less in monochrome . Because of these worries , a competition was held and a new logo designed by Anton K. Gural , still echoing the BSD daemon , was released on 8 October 2005 . However , it was announced by Robert Watson that , the FreeBSD project is " seeking a new logo , but not a new mascot " and that the FreeBSD project will continue to use Beastie as its mascot .

The name " FreeBSD " was coined by David Greenman on 19 June 1993 , other suggested names were " BSDFree86 " and " Free86BSD " . FreeBSD 's slogan , " The Power to serve " , is a trademark of The FreeBSD Foundation .

= = Derivatives = =

There are a number of software distributions based on FreeBSD including :
OpenServer 10 ( server )
PC @-@ BSD ( aimed at home users and workstations )
DesktopBSD ( desktop @-@ oriented operating system , originally based on KDE )
GhostBSD ( MATE @-@ based distribution , which also offers other desktop environments )
FreeSBIE ( live CD )
Frenzy ( live CD )
HardenedBSD ( exploit mitigation and hardening development )
m0n0wall ( firewall )
pfSense ( firewall )
FreeNAS ( for Network @-@ attached storage devices )
NAS4Free ( for Network @-@ attached storage devices )
AuthServ / Zilux - ( for network servers & storage )

All these distributions have no or only minor changes when compared with the original FreeBSD base system . The main difference to the original FreeBSD is that they come with pre @-@ installed and pre @-@ configured software for specific use cases . This can be compared with Linux distributions , which are all binary compatible because they use the same kernel and also use the same basic tools , compilers and libraries , while coming with different applications , configurations

and branding .

Besides these distributions , there are some independent operating systems based on FreeBSD . DragonFly BSD is a fork from FreeBSD 4 @.@ 8 aiming for a different multiprocessor synchronization strategy than the one chosen for FreeBSD 5 and development of some microkernel features . It does not aim to stay compatible with FreeBSD and has huge differences in the kernel and basic userland . MidnightBSD is a fork of FreeBSD 6 @.@ 1 borrowing heavily from NeXTSTEP , particularly in the user interface department .

Darwin , the core of Apple OS X , includes a virtual file system and network stack derived from the FreeBSD virtual file system and network stack , and components of its userspace are also FreeBSD @-@ derived .

Some subscription services that are directly based on FreeBSD are :

WhatsApp - processes 2 million concurrent TCP connections per server .

Embedded devices and embedded device operating systems based on FreeBSD include :

NetApp 's Data ONTAP 8.x and the now superseded ONTAP GX ( only as a loader for proprietary kernel @-@ space module )

Netflix 's Open Connect Appliance to handle content delivery .

The PlayStation 4 ( " Orbis OS " )

Parts of FreeBSD were also used in PlayStation 3 .

= = Version history = =