

Close enough to UNIX POSIX COMPLIANT

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Although GNU/Linux is the most popular free UNIX-like operating system (OS) on the block, it's not the only one. With so many interesting free OSs offering Linux-compatible programs, even the most penguin- fixated can choose alternative ways of doing things.

The ancient war between *vi* and *emacs* may still be raging, but the battle between BSD and System V has effectively been settled by POSIX. The POSIX guidelines give a standard for UNIX-like operating systems. Although few pay the certification fee, many OSs aim for POSIX-compliance. This means that programs written for one UNIX-like system should compile on another with little trouble. Our new column gives Linux Magazine readers a view of some alternative OSs, most of which offer the Bash shell and other GNU tools, but first some history.

UNIX grew quickly in the 1970s and early 1980s. This was largely due to its portability and the ease with which it could be enhanced. Another central factor was the open availability of the source code, which had been rewritten in C, the new high level language of choice.

In the 1970s, AT&T was prevented from profiting from computer development by the US government, due to their telephone access monopoly. By the end of the decade several companies were making their own versions of UNIX, based on the AT&T code. Looking for a way to commercialise UNIX, AT&T established UNIX

System Laboratories (USL) to develop a product version. This resulted in the 1983 release of System V Release 1 (SVR1), a new commercial baseline.

The following year AT&T ended its monopoly control over telephone access and entered the computer business, marketing its own commercial UNIX and releasing SysVR2.

BSD

Meanwhile, the open development of UNIX continued in academia. Bill Joy and Chuck Haley, of the University of California at Berkeley (UCB), started working with UNIX in 1975, leading two years later to the first Berkeley Software Distribution (1BSD). 2BSD followed in the next year with a new full screen WYSIWYG text editor called *vi*. Work with DARPA and the American Department of Defence lead eventually to the 1984 4.2BSD with virtual memory and TCP/IP networking. The Berkeley Domain Name Server, included in the 1986 4.3BSD release in 1986, expanded the number of sites able to implement Internet networking. Commercial uptake of BSD was strong, however vendors needed to pay AT&T a licence for the SystemV code included in it. Licence costs increased, whilst many vendors only wanted the Berkeley code. In 1989, UCB published Networking Release 1 containing their TCP/IP networking system for the first time without any AT&T code and released under an open license, allowing free source code modification and distribution. The next release was a full rewrite of hundreds of AT&T utilities without any AT&T code.

At the same time, groups such as X/Open and IEEE POSIX tried to prevent AT&T UNIX standard domination. In 1987, AT&T entered into an alliance with Sun Microsystems to develop a standard UNIX version. Two years later they released SVR4, which

Success story

Dozens of different operating systems have been developed, but only UNIX has so many varieties. Four factors have facilitated this growth:

Portability: *The first widely used operating system written in a high level programming language, making it easier to port to different hardware architectures*

Modifiability: *Written in C, modifications and enhancements are easily made*

Open Source: *Developed at AT&T Bell Labs, a non-profit research institution, enabling publication of source code*

Open System: *Designed as an open, modular system, with a host of features to assist with the development and integration of applications*

integrated the System V and BSD UNIX baselines. Vendors of other commercial Unices reacted with alarm and united to form the Open System Foundation (OSF). The UNIX wars effectively ended in 1993, when AT&T sold System V to Novell, who assigned the rights to UNIX to X/Open. In 1996 The Open Group was formed by the merger of OSF and X/Open. The Open Group now works with the IEEE on the POSIX family of standards.

POSIX

"The nice thing about standards is that there are so many of them to choose from." - Professor Andrew S. Tanenbaum (among other things, the author of MINIX)

POSIX.1 (IEEE1003.1), published in 1988, set out a standard Application Programming Interface (API) enabling source compatibility amongst several UNIX and UNIX-like systems. Torvalds aimed for POSIX compliance from the earliest development of the Linux kernel. This enabled GNU tools and many applications from BSD and other Unices to be used. This same compliance means that today we can take many applications written for Linux and compile them for AtheOS, BeOS or OSX (Darwin). POSIX.2 (IEEE1003.2) is an enhancement rather than a replacement of the original. Even though Linux is not certified as POSIX compliant the aim of compliance, where appropriate, ensures that POSIX remains a meaningful standard.

No alternative?

GNU/Linux continues to improve in scalability and performance and is a wonderful general purpose OS, which is also adapting well to embedded systems. However, one tool won't always be the best for every job. By choosing different design goals other OSs are often better adapted in particular areas of performance. It will be the purpose of this

column, over the coming months, to explore the potential of some of these alternative OSs.

A new desktop UNIX

Apple's decision to abandon Copland for OSX, and move to a FreeBSD core, named *Darwin*, running on the *Mach* microkernel, made many in the Linux world take notice. Apple's leadership in perceived user-friendliness of the GUI and the robustness of UNIX sounds like a winning formula to many. As the Apple developers and open source community contribute bug-fixes and improvements OSX will be watched with interest. It could even mean Microsoft Office and Internet Explorer running on a desktop UNIX - an interesting thought to say the least.

And then there were three

The common view is that FreeBSD is robust, NetBSD is on every platform and OpenBSD is secure. FreeBSD vs Linux is certainly the new Holy war for the UNIX community. In the commercial world, however, uptake of FreeBSD has been seen due in part to the licence, which allows closing off of the source code into proprietary software - something which the GPL does not permit. For many, this difference is far more important than the different development model for FreeBSD or indeed, technical considerations.

Whilst the BSDs (including Apple OSX) are the most obvious alternative to Linux, many smaller projects have considerable merit. A trawl of the Web reveals dozens of OS projects that are little more than an alpha kernel and a bootloader written in assembler, but there are many serious projects out there, some with impressive pedigrees (see What's on the Bootloader Today box). Next month we start by examining real-time OSs.

"Those who don't understand Linux are doomed to reinvent it, poorly." - Anonymous

Info

The Portable Application Standards Committee of the IEEE develops the POSIX family of standards and can be found at <http://www.pasc.org>.

Feedback

Over the next few months we shall be featuring articles on the BSDs, OSX, QNX, AtheOS and microkernels. However we welcome suggestions and input for coverage in the Freeworld column.

What's on the bootloader today

Operating System	Comments
AtheOS	UNIX-like with consistent GUI, written from the ground up
BeOS	Awaiting release of hardware OpenGL and new network stack. Excellent multithreading and large file handling for demanding media apps. Proprietary, but binaries freely downloadable
Commercial Unices (eg AIX, HP_UX, Tru64 et al)	Some good enterprise-level OSs, but mostly expensive and closed source
Darwin	Very interesting project, particularly the i386 port
ecos	Now managed by Red Hat. Supports many embedded platforms
FreeBSD	Powers Yahoo, Google and many other seriously busy sites without breaking into a sweat
GNU Hurd	Closer to usability than it was 10 years ago but don't hold your breath
MINIX	No longer under active development
NetBSD	Runs on <i>anything</i> . Try it on your toaster.
Oberon	Small, modular OS, written in Oberon. Open source for non-commercial use.
OpenBSD	The only OS to have every line of code security audited. Secure out-of-the-box.
Plan 9	Opened the source too late and failed to develop enough interest.
QNX	Very mature commercial real-time OS, available to download and as a single floppy edition
RTEMS	Real-time executive developed for the U.S. Army
Solaris	Solaris8 binaries are available for download under a restrictive licence
V2_OS	Written in i386 assembler to be fast and light. Active development since open sourcing.