

FreeBSD and the Early Unix Communities

BY WARNER LOSH

FreeBSD is a collaborative and supportive community that allows users to help each other build wonderful products on a common, open platform. We can trace the community's roots and dynamics back to the vibrant mid-1970s Unix users groups. This aspect of Unix history is often glossed over; however, without these mutually beneficial early communities, we would not have a FreeBSD story or even a Unix story to tell today.

Out of these early communities (and others for similar hardware and software of the 1960s and 1970s) grew the open source community that thrives today. These early communities, such as IBM's SHARE and DEC's DECUS, formed because computers of the time were quite expensive, and users often had similar problems that might not align with the manufacturer. Community members shared not only modifications to the vendor software, but also interesting programs that solved problems the vendors had no interest in solving.

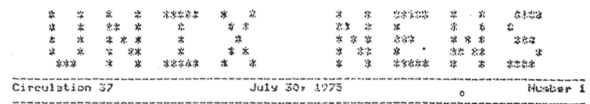
Batteries Not Included

Unix started out life as a reaction to a canceled project on cast-aside hardware as a skunk works project at Bell Labs, AT&T's research department in the early 1970s. At the 1973 ACM Symposium on Operating Systems Principles (SOSP), Ken Thompson and Dennis Ritchie presented the first public talk on Unix. The July 1974 edition of *The Communications of the ACM* published the first paper. For complicated legal reasons, AT&T had to give away, for the cost of duplication, any cool, non-telephone technology it created for non-commercial use. Requests for Unix started pouring in after this publication.

The first copies of Unix went out in early 1974. AT&T was also prohibited from offering support, so recipients were on their own. AT&T guaranteed the tape could be read, but little else. AT&T was also prohibited from selling any products that weren't telephone services, so these tapes were not a supported product. Technically, users had to figure out how to use and install the system on their own, but Ken Thompson was involved in many early installations. Once the system was installed, it was up to the users to figure out for themselves how to solve any problems they encountered. This stood in stark contrast to large computer makers like IBM or DEC, who provided extensive support to their users. If you wanted to run Unix, you really had to want it.

Shortly after the first tapes went out, the first user group meetings started in New York City. People would gather around and talk about Unix, how to use it, bugs they were encountering, etc. People from AT&T would attend some of these meetings in an unofficial capacity. After the first few meetings, word spread

about them, attendance grew, and a newsletter, Unix News, was soon published to record the interesting bits of news and gossip for people who couldn't attend. The first issue went out to 37 people, but it listed the names and addresses of about 50 Unix users—like a directory—so users could contact each other, exchange information, and help each learn how to use this new operating system.

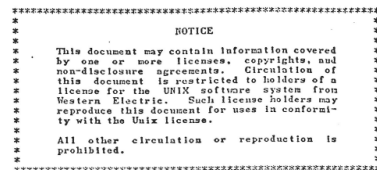


Although it's hard to get exact numbers for Unix's early popularity, we can make some educated guesses. In the first half of 1974, maybe 10 tapes went out. By the start of 1975, there were more than 50 installations. By mid-1975 there were almost a hundred. By the end of the year there were close to 200. Unix grew substantially inside of AT&T during this time as well.

These user groups weren't limited to the United States. Groups in the UK and Australia produced their own newsletters. In Canada and Europe, these groups operated as special interest groups inside of DECUS. Even the early *Unix News* address list included people from 10 different countries. Unix quickly became an international affair from a very early date. We know many of these details because sometimes the newsletters would republish pages from other groups using Unix.

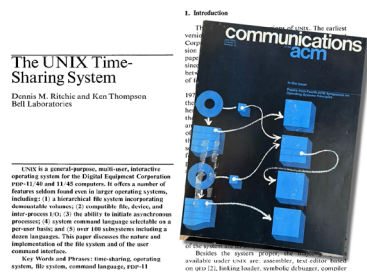
First Legal Battles

AT&T's legal department was good at protecting the Unix name and rights, but it wasn't very good at community relations. First, they objected to talking about Unix without a strict legal notice. The Unix license requires that the source, methods and concepts remain confidential, so the legal department forced *Unix News* to use a legal disclaimer.



Next, they didn't like the name *Unix News*, since it infringed on their trademark of Unix, so they forced them to change their name to *login: The Unix Newsletter*. It seemed like a needless fight to move the name to a subtitle.

Within a couple of years, other newsletters sprang up in the UK, Australia, and Europe. Each included this legal disclaimer. The confidentiality colored many of the early discussions about Unix, and limited publication of cool aspects of Unix in the early days, despite the fact that most of the methods and concepts were published in the CACM article. As you might imagine, this rubbed people the wrong way.



Tapes a Plenty

Unix users exchanged software from the very beginning. The preferred form of transfer was magnetic tape or removable hard disk (both of these could hold on the order of 10MB). Within a year of the CACM publication, a vibrant software swap had sprouted. The first two organized distributions were from Toronto and Harvard. Toronto's distribution contained a number of additional drivers and some bug fixes. Harvard's included optimizations to the system, improvements to the interactive responsiveness, and some security hardening needed for university computing. Both of these were discussed in the first *Unix News* in mid-1975 when there were only about 100 external Unix systems (and a few hundred users).

Also, less than a year after the CACM article, Unix had been adopted to run on a multiprocessing system (MUNIX). The MUNIX paper discussed now-familiar ways to make a kernel that depended on global variables that could have locking added to make it thread safe. This software was also available on tapes from the Naval Research Station in Monterey Bay. One processor handled all the data acquisition, while the other handled displaying the data and status to the user.

Net Unix, from the University of Illinois, connected PDP-11s to the ARPAnet, the precursor to the Internet. Net Unix, also produced within a year of the CACM article, was discussed in the first *Unix News*, and would make the PDP-11 the most popular computer on the ARPAnet by the following year. Since it was easily available in source form, many networking protocol researchers based their work on Net Unix. It would go on to influence the TCP/IP stack that BBN gave to Berkeley, which formed the basis for almost all early TCP/IP networking stacks in the 1980s and 1990s.

First Public Use

The Boston Children's Museum appears to be the first museum to have used Unix in its exhibits. Mere months after the CACM article, the museum had already childproofed this complicated system so that even children could interact with it. The museum exhibit allowed children to explore programming through a fun graphical game.

How on earth could this have happened? The museum, which had close ties to Harvard, was running the Harvard modifications of Unix. The museum would share several more versions of its Unix innovations over the years.

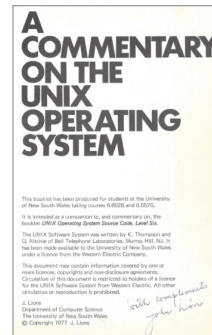
Porting Unix

Three groups completed ports of Unix to completely different machines at about the same time. Richard Miller and Ross Neelson at the Wollongong University ported Unix to the Intersil 7/32 (a 32-bit machine). Tom Lyon and Eric Schmidt, students at Princeton, ported Unix to IBM's VM/360. And AT&T did its own port of Unix to the Intersil 8/32.

The Wollongong port was by far the most interesting. Professor Miller was hired on to the University with the promise that a PDP-11 would be purchased to allow him to run Unix. Instead, when he arrived, he discovered that the school had purchased an Intersil 7/32 instead, and there was no money for the PDP-11. So, he carefully modified the C compiler to produce Intersil code. But he had no way to run this C compiler, since it required Unix. So, he drove the 90 minutes to Sydney to use a PDP-11 there, running Unix a couple of times to bootstrap the compiler. He then ported the rest of Unix to the Intersil 7/32, first as a user library, then with

the Unix kernel as a user process and then a native port—all of this in under six months, with the system being robust enough to go live after nine months. It was an incredibly inspiring effort from someone who had never used Unix before, getting the tape and beginning this undertaking.

Community Commentary



John Lions, also at Wollongong, wrote a book about the Unix kernel to use while teaching his Operating Systems class. Initially, AT&T gave him permission to distribute this book, but later withdrew the permission because the book was too good. AT&T's legal department yet again created bad PR for AT&T in the Unix community.

Things turned out well for Professor Lions, however. His fame from the book helped him to secure a sabbatical at Bell Labs. Of course, John wrote back to the Australian Unix User Group with the story, who published it in their newsletter. He wrote with news of his travels to this group, much as one would write an old friend:

Dear everybody,

Well I made it at last ... the promised land. However the plumbing is not all old-plated and contrary to rumour there is not a PDP11 in every room. On my first day here I met a whole lot of people whom I am now in the process of re-meeting and getting their names straight. So many things have occurred in quick succession, it is hard to get them all into perspective or even a reasonable order.

(lots of information about the forthcoming 7th Edition, and other info about AT&T omitted)

Cheers for now,

John Lions

P.S. (i) Have you seen Ritchie's & Kaufman's book on C yet?
It is very good
(ii) Bell has two patents on UNIX
(a) seti-user-id bit
(b) on "4spc"!

One of Professor Lions' graduate students, David Hunt, went on sabbatical from Rutgers University. Ian Johnstone, the editor of the AUUGN, published Hunt's report about safeguarding copies of the Lions commentary.

Dear Ian:

Many thanks for sending the tape of goodies and especially for all the work that you and Peter Ivanov and perhaps others put in.

I have found myself a nice friendly small group of Nuclear Physicists and I am now a local user.

We saw John Lions and his family on Saturday at our beach house--yes, we are 50 yards from the beach. He reckons that much of what you have done at UNSW is well ahead of Bell. Apparently his notes on UNIX are a best seller and copies are locked in safes, etc. The local people at Rutgers were very pleased to have just received a copy of John's notes. I shall write again later when the locals have tried out some of your goodies.

Many thanks.

Yours sincerely,

David Hunt
David Hunt

Conferences and More Tapes

The informal USENIX meetings grew in size and complexity. By 1977, gatherings featuring formal presentations were happening on both coasts in the US. In September 1977, over 100 people attended the gathering in Menlo Park. Usenix collected innovative

software from about 30 different early Unix users for the oldest surviving tape, known as "The Third Software Distribution." This innovative tape included original software to make it easier to produce future tapes.

The content the user communities created for Unix helped Unix to grow. The user group newsletters spread the word and created connections between people. In fact, user groups published articles from each other's newsletters frequently, increasing and strengthening the connections between the user group communities. The generous sharing of code and welcoming atmosphere would serve as the basis for today's thriving open source communities, like FreeBSD.

Enabling Unix

Unix wasn't the only operating system for the PDP-11. DEC produced several other operating systems, aimed at different niche industries. For real-time control, they offered RT-11. For business and numerical applications, they offered RSX/11M. DEC also had the best FORTRAN compiler at the time (much better than the one in Unix). Many universities had data collection PDP-11s running RT-11, with other PDP-11s running RSX/11M to do the data analysis. So, there was resistance to running Unix, initially, because it couldn't run programs written for these environments. Many resorted to running the DEC OS during the day, when professors were typically around, and Unix at night, when the weirdos that hung out and used Unix were around.

At the time, DEC distributed many of its programs to universities in source form. So, within a couple of years of the CACM article, they had ported FORTRAN and other programs to Unix using emulation libraries that translated what would be RT-11 or RSX/11M system calls into Unix system calls. If you had all the right licenses, and could provide the right paperwork, you could get copies of these programs from the university that did the port.

However, that was too cumbersome, so some clever people noticed that PDP-11 had many ways to make system calls. Fortunately, RT-11 and RSX/11M used one method, and Unix used a different method. These clever folks then added trap handlers in the Unix kernel, translating them into signals to the program. They used this to create emulation programs for RT-11 and RSX/11M, so users didn't need the source code to run the DEC software on Unix. In addition, university professors who had programs running on RT-11 could run them unmodified on Unix with the help of these emulation programs. Bill Webb at the University of British Columbia wrote the earliest emulators in 1976.

Suddenly, Unix could run 24 hours a day because it did everything these proprietary OSes did, paving the way for it to expand beyond computer labs to wider scientific applications. Unix users had created something useful that not only enabled the community to grow larger, but also broadened its sphere of influence. Unix could do more than these proprietary OSes, thanks to the cooperation of its users and their generously shared code.

DARPA Funding

I came across this interesting notice in one of the AUUGN issues:

miscellaneous rumours

Level 7 Unix is ready to "go out the door" BUT the lawyers are still fiddling.

First UNIX/VAX licence has gone to U. C. Berkeley, under some special agreement.

These two sentences, presented as just rumors, announce two of the biggest developments for Unix. "Level 7 Unix" announced

the Seventh Edition of Unix, the last version of Unix from Bell Labs. The Seventh Edition would launch AT&T's Unix commercialization efforts and bring Unix to non-academic users.

The "special agreement" was AT&T giving Berkeley an early version of the Seventh Edition, ported to the VAX known as "32V". Berkeley would enhance 32V and turn it into the Berkeley Software Distribution (BSD). The US Government, through DARPA, funded Berkeley to add advanced features to Unix for the VAX. It funded their addition of the network stack to Unix. Although AT&T had a version of Unix for the VAX, nearly everybody ran the Berkeley version of Unix. Even Bell Labs would base its later research versions of Unix on BSD.

Coda

The highly collaborative community continued developing innovative and beneficial systems and software. Berkeley's releases brought a robust Unix to many universities and companies. It too was widely ported. The companies porting it, like Sun, would often make major contributions back to the community. Tiring of the ever-increasing legal burdens from Unix, Berkeley rewrote the few remaining parts of the Unix system they hadn't already enhanced and released an unencumbered distribution dubbed Net/2.

Net/2 was quickly ported to the IBM PC. In addition to a free version anyone could download, companies produced their own versions that also included support. BSD Unix was poised to take over the world. But in a final act of self-destruction, AT&T's legal folks sued over these releases. The resulting confusion and uncertainty led to the rise of Linux, which would put AT&T out of the Unix business several years later. This story, though, is too long to tell in more detail.

Nevertheless, the BSD community in general, and the FreeBSD community specifically, survived. A spirit of mutual competition developed between FreeBSD and Linux, leading to an active exchange of ideas and techniques. The same spirit of community and sharing has survived the last 30 years and continues to thrive today. FreeBSD's community of mutual support carries on the traditions of the early Unix user groups on a scale that's many times larger than those early efforts. FreeBSD is used on hundreds of thousands of computers worldwide.

It has attracted corporate users who give back as well to keep their storage and network appliances competitive. Isilon and NetApp use FreeBSD for their storage appliances. Netflix uses it to deliver all its videos. Juniper's routers use it to move network packets. These corporate users have also contributed back to the project, as do numerous other users, both old and new. The community remains strong and has welcomed several new generations of Unix users since the original ones who founded the *Unix News*. We all owe a debt of gratitude to the Unix pioneers whose early perseverance and innovation have blossomed into the robust and supportive open source community we enjoy today.

WARNER LOSH has been contributing to open source since before the FreeBSD project existed or the term "open source" was formally defined. He's recently been delving into the early history of Unix to discover its rich, hidden legacy. He lives in Colorado with his wife and daughter in a strawbale house heated by the sun, a small boiler, and the occasional antique computer.