Linux: At a Turning Point?

Neal Leavitt

L inux has been heralded as the first organically created operating system: an open-source OS enhanced and backed by thousands of programmers worldwide. In the process, it has grown in popularity.

However, Linux may have reached a turning point at which it can either address several important challenges or face problems that could limit future adoption.

Market research firm IDC reported that Linux accounted for 27 percent of server-OS shipments in 2000, as Figure 1 shows.

"Critics and nonbelievers can no longer dismiss the Linux market as a fad," said Al Gillen, research manager for IDC's operating-environments program. "If leading hardware vendors are willing to risk their credibility by endorsing and placing Linux systems in the market, it's easy for customers to conclude there must be something real about Linux."

A growing number of large companies and government agencies are using Linux. For example, Cisco Systems uses Linux to manage internal print servers. The US Bureau of Reclamation uses Linux to run its e-mail servers and network services, including anonymous FTP servers. And Home Depot, which operates a chain of home-improvement stores, has replaced Windows with Linux for its new point-of-sale systems.

But there are potential obstacles to future growth. According to Dan Frye, director of IBM's Linux Technology Center, a chief concern among IT decision makers is that there are close to 200 Linux distributions and that the OS thus might fragment into multiple commercial flavors, as Unix did.

"Unix started out with a great concept, too, but over time, the community diverged into distinct, incompatible camps," Frye said. "Technology companies saw commercial advantage coming out of differentiation on function rather than the implementation of standard component interfaces."

Meanwhile, there is still a lack of mainstream commercial Linux applications and almost no groupware. Companies thus often must hire programmers to develop software to run on Linux. Also, Linux offers limited support for databases containing more than a terabyte of data.

Enterprises may also be reluctant to consider Linux without a full framework of global service and support, vendor commitment, and a high level of functionality including scalability, availability, manageability, and security, said George Weiss, an analyst for market research firm Gartner.

In fact, a survey by the Miller Freeman media company concluded that the largest roadblock to implementing Linux is the perceived lack of commercial support and service, cited by almost a third of respondents.

Nonetheless, pushed in part by the growing demand for commercial implementations, Linux continues to develop and is beginning to address some of these concerns.

MULTIPLE LINUX DISTRIBUTIONS

Ten years ago, while studying at the University of Helsinki, Finland's Linus Torvalds wrote the first version of a Unix-like kernel as a toy project. He later posted the code on the Internet and asked programmers to help him build it into a working system. The result was Linux.

While both vendors and users can adapt Linux to produce different distributions that meet their needs, as Figure 2 shows, they are supposed to build on the basic Linux kernel (currently version 2.4). Torvalds oversees development of the kernel and owns its trademark. When someone submits a change or a feature, Torvalds and his core team of kernel developers review the merits of adding it to the source tree.

"Linus is a trusted architect. Everyone in the Linux community believes he'll do the right thing," said Eric Raymond, president of the nonprofit Open Source Initiative.

Basically, the OS services are supposed to stay the same, while modifications take place at the application level. Unix, on the other hand, has no kernel, which is one reason the OS has forked into incompatible code streams.

Linux vendors and software distributors download the latest kernel from the Internet, add utilities such as installation programs, and package their distributions on a CD-ROM with a manual.

Commercial vendors such as Caldera Systems, Red Hat Software, SuSE, and TurboLinux make money by selling their implementation, as well as installation, maintenance, and other services. Some of the most popular distributions include Caldera OpenLinux eServer 2.3, Red Hat 7.1, SuSE 7.1, TurboLinux Server 6.5, Linux-Mandrake 7.2, Connectiva, and Red Flag.

Linux is also distributed by the nonprofit Debian organization, which is developing a free OS and related software.

The existence of multiple Linux distributions frees users from being locked

into one vendor. Also, said SuSE president Dirk Hohndel, "It creates healthy competition, which furthers innovation. Additionally, the different versions of Linux have always catered to slightly different markets." For example, SuSE has long worked with users such as banks and telecommunications companies, and Connectiva has focused on South America.

According to Hohndel, the principal differences among distributions include the tool chain, library version, number and quality of applications, documentation, support, and service.

Nazmul Ula, a Linux authority and associate professor at Loyola Marymount University, said that the kernel, essential services, and most utilities and productivity components are open source but that some commercial applications and utilities are not.

Linux is primarily licensed under the General Public License (GPL), which requires users to return any modifications and extensions to the programmer community. The goal is to promote innovation while keeping developers from permanently maintaining incompatible Linux versions.

The GPL minimizes Linux fragmentation because users are free to implement changes but must support their own version, a resource-intensive process, if they diverge from a standard implementation, said Stacey Quandt, an analyst with Giga Information Group, a market research firm.

"However, the GPL has never been tested in court," Quandt said, so someone could theoretically violate the license and maintain an incompatible Linux version.

CHALLENGES FOR DEVELOPERS

The variety of Linux distributions has created numerous challenges. For example, there are relatively few commercial Linux-based applications, Loyola Marymount's Ula said, because of commercial vendors' misconceptions about the open-source community.

"They think they have to give the product away or publish their source code," he explained. "[But] more commercial vendors are realizing that devel-oping software for Linux is like developing for other platforms."

Nonetheless, Linux has not made inroads on the desktop. Dave McAllister, director of strategic technologies with Linux hardware vendor eGenera, said Linux won't dominate the desktop because Windows has had such a huge head start.

Supporting multiple Linux versions

"Developers don't have to develop different versions of their program for different Linux distributions," Ula said. "The only time they have to create different binary executables is when they are using shared libraries and other non-standard system-support utilities."

Nonetheless, he said, commercial software should be tested on every version of Linux it runs on and every version of the libraries and services it requires.

Free-software proponent Richard Stallman, a computer consultant who started the Free Software Foundation and its GNU Project, said, "It's not terribly hard to support multiple versions. All the distributions use the same kernel, the same C library, and the same [command] shell (the GNU Project's Bash, http://www.gnu.org/software/bash/bash.html). Most of the things you want to do in a program simply work the same in all distributions."
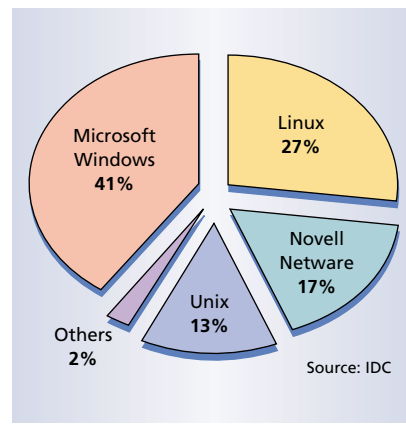
Figure 1. Linux accounted for the second-highest number of server operating systems shipped in 2000, according to market research firm IDC.

Nonetheless, Stallman said, there are some technical hurdles. For example, he said, "Debian and Red Hat have different setups for the scripts that run at system startup and shutdown. This means that programs that want to run as daemons may need slightly different setups for Debian and for Red Hat."

"For developers with experience in the Linux world, porting between any Linux version is trivial," said Raymond. "All Linux distributions use the same format for binary execution and the same system call interface. But if an application
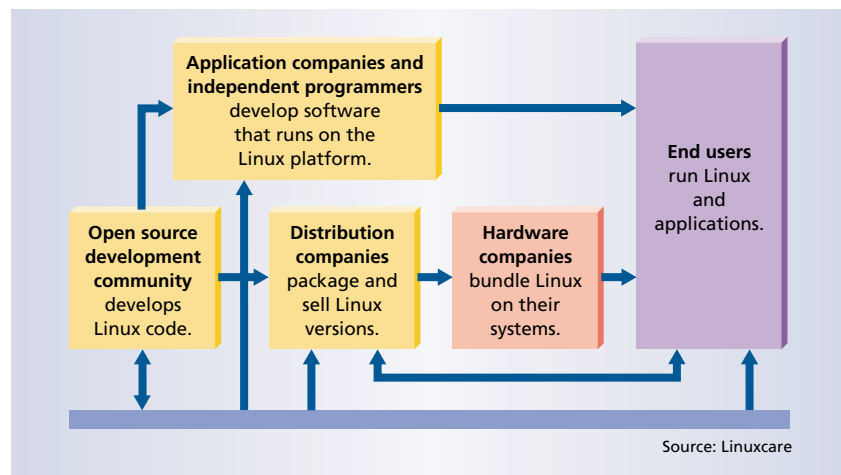
Figure 2. Various parties are involved in the Linux development process. The open-source community works on the operating-system kernel, distribution companies sell various Linux versions, application vendors and programmers build software that works on the distributions, hardware companies include Linux in their products, and users run the OS and applications.

has to access administrative files, this can be a problem. And if you link to shared libraries, you would have to have the right shared library to link to."

File formats

There are currently two Linux file formats: Red Hat Package Manager (RPM) and the Debian packaging system (DEB). Red Hat pioneered RPM, which is available at no cost for anyone to use.

RPM has become the de facto Linux standard. It lets users install and uninstall files, reconfigure settings, add users, and submit queries to groups of related files and to RPM databases.

While RPM's widespread adoption has broadened support for Linux, it does present some technical challenges. For example, a system using RPM as the package manager cannot install a DEB file, said Ganesh C. Prasad, the author of many Linux white papers and the chief Web architect for Reply2, an Australian vendor of Internet customer communications products and services.

> **Keeping system files in different places can be annoying when users move to another distribution.**

Libraries

Most Linux developers use the Free Software Foundation's GNU C library (glibc, http://www.gnu.org/software/libc/libc.html). Sophisticated users can recompile open-source applications supplied in source-code form to run with the libraries their systems use.

However, Prasad said, Linux distributions may not keep the required library files in the same directory. "If only the main executable file of a third-party application is installed, it may fail to run on one or more distributions because it can't find a required library file or the current version," he said. "This problem does not usually occur with source-code distributions [as opposed to binary-code distributions] because all [required] files, including those for libraries, are generally provided."

Adding applications to user menus

One of Linux's problems is that different distributions keep their system files in different places. This can be frustrating for application vendors, who must specify how and where users can add their programs to menus.

"It's not a major problem, but it can be annoying if you move to another distribution and don't know where to find an application in the menu," Prasad said.

In some cases, IBM's Frye said, vendors must tweak their applications to work with different Linux distributions.

WHAT THE FUTURE HOLDS

To enhance application portability to the various Linux distributions, most commercial Linux software vendors and distributors are participating in developing a base set of libraries, application programming interfaces, a file-system hierarchy standard, and interoperability measures called the Linux Standard Base (http://www.linuxbase.org).

The LSB has already released the Filesystem Hierarchy Standard, which SuSE and other companies are using. FHS aims to standardize file and directory locations within Linux systems, which would make it easier for the different distributions to run and compile applications without developers having to write multiple versions of their programs. The LSB expects to complete version 1.0 of its overall standard this summer.

"Standards are important in order for Linux to reach a critical mass," said Drew Spencer, Caldera's chief technology officer.

> **Standardizing file and directory locations would make it easier to run and compile applications.**

L inux is still coming of age. IBM recently announced it will spend more than $1 billion on Linux this year because the company wants the technology, which is considerably less expensive than Windows and is not controlled by a single vendor, to become a standard.

This could be important because major corporations may hesitate to adopt Linux until the OS receives widespread support from such industry leaders as IBM.

"We have entered into an era of open standards and protocols," said Reply2's Prasad. "The lessons of the past 40 years tell us that open standards win over proprietary ones."

However, said Gartner's Weiss, "A market change of such magnitude usually requires several years of maturity and evolution." ✳

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