

The free operating system that has taken over the world



ABOUT THE LINUX PROJECT

The Linux kernel which forms the core of the Linux operating system is the result of one of the largest cooperative software projects ever attempted. The Linux Foundation ensures the future of Linux and provides the platform for shared development. The Linux Foundation also sponsors Linus Torvalds and his second-in-command Greg Kroah-Hartman so they can remain independent while working full-time on the Linux kernel. They are but two of a growing number of The Linux Foundation's Fellows who are developing critical open source infrastructure. In addition, The Linux Foundation provides all the infrastructure for Kernel.org, the home of Linux, including the maintenance of the version control system and mailing lists to drive the success of the world's most far-reaching collaborative project.

www.kernel.org

HIGHLIGHTS

- Linux has provided a platform and was a catalyst for the growth of the web and virtually every emerging technology platform since (mobile, IoT, cloud, big data)
- 99.6% of the top 500 most powerful computing systems are running Linux
- Linux has become the largest and most successful proof point for open source ushering in a new era of shared R&D via open source collaboration

About Linux

Linux is the world's most dominant operating system. Launched in 1991 by Linus Torvalds, it's the quintessential example of user-led open source innovation, as it represented Linus' desire for an operating system that he could run on his personal computer. Eventually the world took notice and everyone from hardware companies to emerging technology providers found themselves participating in the development of Linux and construction of solutions to run on top of the open source OS.

Between 2005 and 2016, over 14,000 individual developers from more than 1,300 different companies contributed to the Linux kernel project, which has become a common, shared resource developed on a massive scale by companies that are otherwise fierce competitors in other their industry segments.

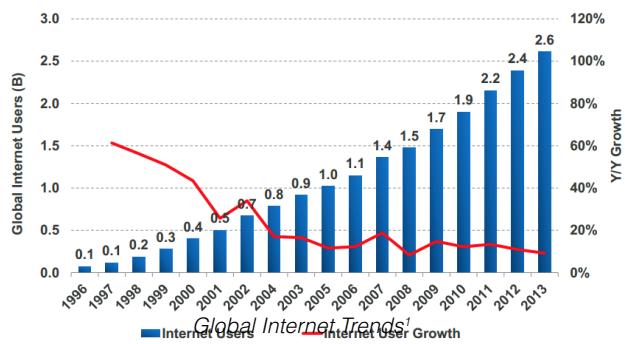
Regular two-to-three month releases deliver stable updates to Linux users, adding significant new features, enhanced device support, and improved performance. The rate of change in the kernel has been historically high and continues to increase, with over 10,000 patches going into each recent kernel release. Each of these releases contains the work of over 1,600 developers representing over 200 corporations.

The Challenge

Since leaving AT&T's Bell Laboratories in the 1970s, UNIX saw success as a powerful and, initially, free operating system. Through the 1980s the market for Unix systems had grown steadily but had become fragmented. Arguments arose as vendors slowly tied the operating

system and features to proprietary systems. This period marked what was often referred to as the Unix Wars. At the same time the open source community was seeing popularity rise and the cost of computing on x86 processors for both desktop and server was dropping. In tandem Internet usage was rising and the appetite for web consumption was insatiable. Companies were tasked with providing email and web on servers that could handle exceptional growth and had the flexibility to grow and even contract to handle online commerce (think Black Friday) and entertainment (think Super Bowl or World Cup soccer).

Global Internet Users, 1996 – 2013 (B)



Solaris had become a viable Unix operating system and it had been lauded for its scalability and security, albeit on the Sun SPARC system based on the PowerPC platform. At the same time, an industry weary from fighting about discrepancies of different UNIX systems saw promise in the Linux operating system and combined with the gaining momentum of the open source movement looked for a new opportunity.

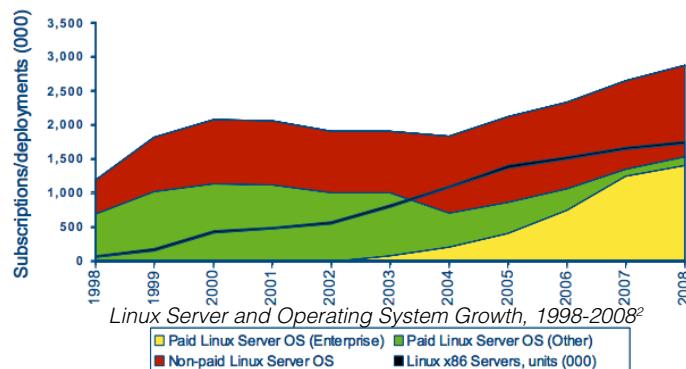
By the mid-1990s, Linux started to gain traction most notably in web hosting, network and simple database applications hosted on open source MySQL and Postgres. Though the use of the operating system for finance and other mission-critical systems was modest at best. Additionally, as the importance of web became evident, so did the need for a strong level of standardization, free of dominance by any one vendor. The Apache Web Server was born and provided a level playing field for web and drove a de facto web standard. The extensibility of Apache via compiled modules allowed for many developers to concurrently add features without requiring a highly

coordinated or centralized development process.

The Approach

As personal web usage increased; Linux was in steady development. People hosting web content needed an operating system that could handle exponential traffic growth without seeing their expenses also rise exponentially. Meanwhile, the costs for proprietary systems was high and the options for proprietary operating systems were becoming increasingly unattractive. Enter Linux. It offered utility in a world where server operating systems were at a premium. Price and performance over other options was better, and so was the flexibility in how to deploy and modify.

Linux Server and Operating System Growth, 1998–2008



DECENTRALIZED DEVELOPMENT AND SHARED R&D

One key to the success of Linux was the decentralized development model implemented by the Linux kernel developers. A meritocracy of code evolved in which developers could provide their patches on equal footing regardless of their corporate affiliation. Heated debates happened in the open and were often mediated by Linus, an authoritarian figure who provided consistency in the development process throughout the rapid development history of Linux without exerting tight control. The architecture of kernel loadable modules allowed for many groups to deliver specific subsystems without the need for a high degree of coordination. This allowed many disparate solutions to be developed independently to extend Linux without slowing the speed of core development. This collective intelligence and design made for an operating system that could meet the needs

of vendors and users without locking any group out of the ecosystem.

ACCESSIBILITY AND USER-LED INNOVATION

Historically, end-users of software were left to the mercy of corporate vendors. These pools of users were limited by their ability to pay for the software and were often unable to have access to the underlying code. Features were requested and users either paid for changes or waited in hope that their feature or bug would be fixed in the next release. In Linux, and open source software in general, the software and the means to fix or update the software became accessible to anyone. Users who were dealing with problems first hand could provide relevant feedback directly into the development process. Traditionally software products were solutions looking for problems, now users could freely use open source software to solve their own problems.

PRAGMATISM

The main thing that drove Linux was a pragmatic view to open source. While some open source software factions preached about freedom above all else, Linux was driven by a need to solve a problem. Initially that was for Linus to run a Unix-like operating system on a PC. But over time that has been expanded to provide for a common extensible platform for mobile, specifically Android, or to allow for highly specialized and adaptable operating systems for specific form factors like embedded devices. The fact of the matter was that Linux wasn't an end unto itself. The Linux kernel was simply a building block needed to create and deliver an operating system for running applications. Developing this non-differentiating technology through shared research and development freed resources for companies to develop high-value technologies like management and applications.

The Results

Linux has become the ultimate Cinderella story. A young Finnish grad student who revolutionized the computing world. Everyone loves an underdog but that chapter

has closed. Linux is now the operating system of choice among users throughout the world and open source has become the default development methodology of those users bringing solutions to market.

DISLOCATION OF UNIX IN CARRIER DATA CENTER

In 2002, when the Carrier Grade Linux (CGL) initiative was launched, UNIX dominated the data center marketplace, with Solaris hosting over 95% of telecommunications applications. To qualify as a "carrier grade" platform, Linux needed to cross myriad gaps in performance, API standards, scalability, reliability, availability and tooling. Undaunted, the CGL work groups set about tackling these challenges incrementally, enlisting players from across the IT industry who would also benefit from such new capabilities. The result? Within five years Linux was competing on an equal footing with legacy UNIX for telecoms, and today, Linux is considered the gold standard for carrier data center and cloud deployment.

FINANCIAL MARKETS

In the world of stock trading and financial transactions, speed is everything. Once tied to proprietary systems with long release cycles, today's financial exchanges—NASDAQ, the London Exchange, the Tokyo Stock Exchange and the majority of others—run on Linux. The New York Stock Exchange (NYSE) Euronext, the largest exchange, runs on a Linux system that can generate 1.5 million quotes and process 250,000 orders every second, offering acknowledgments of each transaction within two milliseconds.³ Features such as the speed of open source innovation, ability to customize, and a revamped scheduler that keep processes, like trades, from being interrupted, made Linux the gold standard in the financial industry.

CLOUD COMPUTING

A recent survey by the Uptime Institute found that 50% of senior enterprise IT executives expect the majority of IT workloads to reside off-premise in cloud or colocation site in the future.⁴ Of those, 70% expect the shift to happen in the next four years. With more than 75% of cloud-enabled

enterprises running Linux as their primary cloud platform, we can expect a dramatic increase in Linux deployments to support the move to the cloud.

SMARTPHONE

In 2014 the Linux-based Android smartphones reached an incredible milestone. Over 1 billion units shipped, eclipsing the previous year's total smartphone sales.⁵

SUPERCOMPUTING

In a world once dominated by highly specialized hardware and operating systems, Linux has risen to become a dominant force. In November 2016, Top500, an organization that ranks systems based on industry standard benchmarks, listed 99.6% of the top 500 most powerful computing systems to be running Linux. Commercial UNIX (specifically AIX) accounted for the other 0.4%.⁶

EMBEDDED LINUX SUCCESS

In a once highly-fragmented marketplace of 300+ embedded operating systems, Linux now serves nearly every segment of intelligent device design, from industrial control to communications and networking to mobile/wireless, to automotive, to medical, and beyond. With over 40% design share, Linux spans the gamut of embedded systems types and form factors, from small, deeply embedded systems and IoT nodes to standards-based, single-board computers and clusters of massively parallel blades.

From humble beginnings, Linux has grown into a vital technology, revolutionizing entire industries. We can expect that the open source development model, proven successful by Linux, will continue to empower developers around the world to create similar communities to solve technical challenges together long into the future.

“It didn’t even start by people contributing code, it was more that people started contributing ideas. And just the fact that somebody else takes an interest in your project—and I’m sure it’s true of other things, too, but it’s definitely true in code—and looks at it enough to actually give you feedback and give you ideas. That was a huge thing for me.”

- Linus Torvalds, *Linux creator*

Sources:

¹ @KPCB United Nations/International Telecommunications Union, US Census Bureau, Euromonitor International. <http://www.xelisionmedia.com/wp-content/uploads/2014/05/Graph7.png>

² IDC, 2009

³ PC World, http://www.pcworld.com/article/238068/how_linux_mastered_wall_street.html retrieved July 7, 2016

⁴ ZDNet <http://www.zdnet.com/article/it-runs-on-the-cloud-and-the-cloud-runs-on-linux-any-questions/> retrieved July 7, 2016

⁵ IDC - <http://www.idc.com/getdoc.jsp?containerId=prUS25450615> retrieved June 8, 2016

⁶ Top 500.org: <http://www.top500.org/statistics/list/> retrieved April 3, 2017

To learn more about Linux visit www.linuxfoundation.org/projects/Linux.

For more information on projects hosted at The Linux Foundation, visit www.linuxfoundation.org/projects