

Open-Source Operating Systems.

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Overview-

The aim of this article is to go in depth on everything you need to about open-source operating systems. This article is also designed to be used as a report by companies looking for all the important information about open-source operating systems.

For the ease of the readers understanding, while elaborating key points in this article, high-level (surface level) information is highlighted first followed by “**moreover**,” after which the information may go into more detail and more towards the lower-level (in-depth) aspects of the point of discussion.

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1- Brief description of Open-Source Operating Systems

Open source refers to computer software or programmes that permit users or third parties to access, view, and alter the product's source code thanks to the owners or copyright holders. An open-source operating system's source code is viewable and changeable by anybody. Most operating systems, including Microsoft

Windows, Apple's Mac OS, and Apple's iOS are closed platforms. It is legal to make many copies of and use open-source software anywhere you choose because of the way it is licenced. Because it lacks any code for licencing, advertising, promoting other goods, authenticating, attaching adverts, etc., it often utilises less resources than its commercial equivalent. [M]

2- History

In the early days of modern computing (that is, the 1950s), software generally came with source code. The original hackers (computer enthusiasts) at MIT's Tech Model Railroad Club left their programs in drawers for others to work on. "Homebrew" user groups exchanged code during their meetings. Company specific user groups, such as Digital Equipment Corporation's DECUS, accepted contributions of source-code programs, collected them onto tapes, and distributed the tapes to interested members. In 1970, Digital's operating systems were distributed as source code with no restrictions or copyright notice. Computer and software companies eventually sought to limit the use of their software to authorized computers and paying customers. Releasing only the binary files compiled from the source code, rather than the source code itself, helped them to achieve this goal, as well as protecting their code and their ideas from their competitors. Although the Homebrew user groups of the 1970s exchanged code during their meetings, the operating systems for hobbyist machines (such as CPM) were proprietary. By 1980, proprietary software was the usual case. [1]

With Linus Torvald's kernel integrated into the GNU operating system, the free software community obtained the first full-featured free operating system in the early 1990s. Ian Murdock pledged Debian to the GNU and FSF (The Free Software Foundation) ideals of free software when he started it in 1993. In the late 1990s, corporations and governments started to use Linux. [M]

Moreover, Early UNIX versions were issued by AT&T in the 1970s. Although the operating system was free, users were not permitted to alter or share it. Software businesses and computer providers started charging for licences to use their products in the late 1970s and early 1980s. Through the use of copyrights, trademarks, and other contracts, legal constraints were enforced. Legal action to enforce licences was initiated. Software theft emerged. [M]

3- Design

The Linux kernel is the foundation of majority of open-source operating systems today. Linus Torvalds created

Linux in 1991, which serves as the kernel for these operating systems and communicates with the hardware of a computer. It manages how information is processed and distributed into memory, how the system manages files, how it communicates with connected devices, and other essential functions. This kernel offers the core functionality each OS need.

Then, to construct an operating system, operating system developers create tools that connect into this Linux kernel. These technologies include anything from the windowing systems that operate graphical desktops to the systems for controlling background services. Under Torvalds' direction, the Linux kernel is still being developed.

4- How it compares

Comparing Open-Source operating systems to the more well-known Microsoft's and MacOS's of the world would bring forward numerous differences. Many positive, and many negative.

4.1 Advantages over Closed-Source

Cost effective-

Majority of the open-source operating systems are actually free! And the very few that are not, are indeed far cheaper than the commercial closed-source products.

According to the Red Hat State of Enterprise Open Source study, open-source software is frequently chosen by enterprises because it is less expensive, with 33% of enterprise customers identifying a reduced total cost of ownership (TCO) as its main advantage.

Learning/Studying Operating Systems-

There has never been a more interesting time to study operating systems, and it has never been easier. The open-source movement has overtaken operating systems, causing many of them to be made available in both source and binary (executable) format. The list of operating systems available in both formats includes Linux, BSD UNIX, Solaris, and part of macOS. The availability of source code allows us to study operating systems from the inside out. Questions that we could once answer only by looking at documentation or the behavior of an operating system we can now answer by examining the code itself. Operating systems that are no longer commercially viable have been open-sourced as well, enabling us to study how systems operated in a time of fewer CPU, memory, and storage resources. [1]

With current CEO Satya Nadella famously declaring "Microsoft loves Linux" Microsoft has undergone a sudden change of heart with regard to open-source. Wallen predicts that by the end of this year, in addition to the 60,000 patents already released, a sizable number of additional Microsoft patents will be made freely available under the Open Innovation Network licence. [2]

Large businesses implementing open-source OS's-

It is public knowledge that IBM has recently purchased RedHat.

Red Hat is the world's leading provider of enterprise open source solutions, including high-performing Linux, cloud, container, and Kubernetes technologies. [3]

The acquisition was primarily considered as an entry point for IBM into the cloud datacenters, which are becoming more and more dependent on open-source software and technology to support their platforms. Red Hat has built a multi-billion dollar company on supporting open-source software/operating systems, and the company now owns organizations that are in charge of everything from developing the KVM hypervisor to providing integration services for the open-source OpenStack cloud platform.

Only 3% of businesses that had been questioned about their use of open-source technology in 2018 reported having intentions to reduce their commitment to them, while 59% planned to do the opposite.

Reliability/Workability-

With the whole point of open-source being that anyone can view and edit, identifying and fixing bugs is far more likely than software being closed-source. All kinds of open-source projects including operating systems are watched by thousands of people since the source code is available. Consequently, the world's top coders work to correct any faults or problems that may exist.

Certainly, open-source code has bugs, but open-source advocates argue that bugs tend to be found and fixed faster owing to the number of people using and viewing the code. [1]

In addition to debugging, development of version control systems makes open-source ever more powerful. For many open-source projects, the source code is contained in and controlled by a version control system. Version control systems allow a user to “pull” an entire source code tree to his computer and “push” any changes back into the repository for others to then pull. These systems also provide other features, including an entire history of each file and a conflict resolution feature in case the same file is changed concurrently. [4]

There are many versions control systems available. Like GitHub, GitLab, Beanstalk, Helicore and AWS CodeCommit to name a few.

All this also comes with a sense of creative freedom. The fact that you may modify it to meet your needs is a huge benefit.

4.2 disadvantages over Closed-Source

Security-

One of the biggest drawbacks of open-source operating systems is surely the slightly fragile security.

As we saw earlier, many people being able to view and identify bugs is certainly an advantage, but this does not always work. Open-source operating systems have at least one well-known instance of major security

flaws that persisted there for years before being discovered. Some well-known software engineers contend that because current software is so complicated, focused, expert examination by a small number of people is more necessary than broad examination by many people. [5]

There have been a number of recent unfavourable headlines from reports on open-source software security. For example, Sonatype's DevSecOps Community Survey, saw IT professionals report that open-source breaches have increased by 71% over the past five years. Meanwhile Synopsys' Open Source Security and Risk Analysis report, which analyzed the anonymized data of over 1,200 commercial codebases from 2018, found that up to 60% of codebases used by enterprises contain at least one vulnerability originating from open-source components. [6]

Less support options-

When you buy/install/use regular operating systems like Microsoft and MacOS, you have the confidence that you can get in touch with the manufacturer if something goes wrong. Open-source software, on the other hand, can be created by a number of different people, therefore you do not have this form of guarantee. This implies that you won't have a single assured and verified person to turn to for assistance if something goes wrong.

Open source software users frequently experience technical difficulties. If you decide to employ open source software, it is a good idea to have a technical staff in place that is knowledgeable in software development. As an alternative, you can get in touch with the service provider or hunt for third-party help services to fix the problem. All of these options will be more troublesome and costly compared to closed-source OS.

5- In the Industry

Open-source operating systems are massively popular and this popularity seems to be growing year on year. Some of the most prominent names in the industry adopting open-source would be OS's like android. Android too is indeed derived from the Linux kernel.

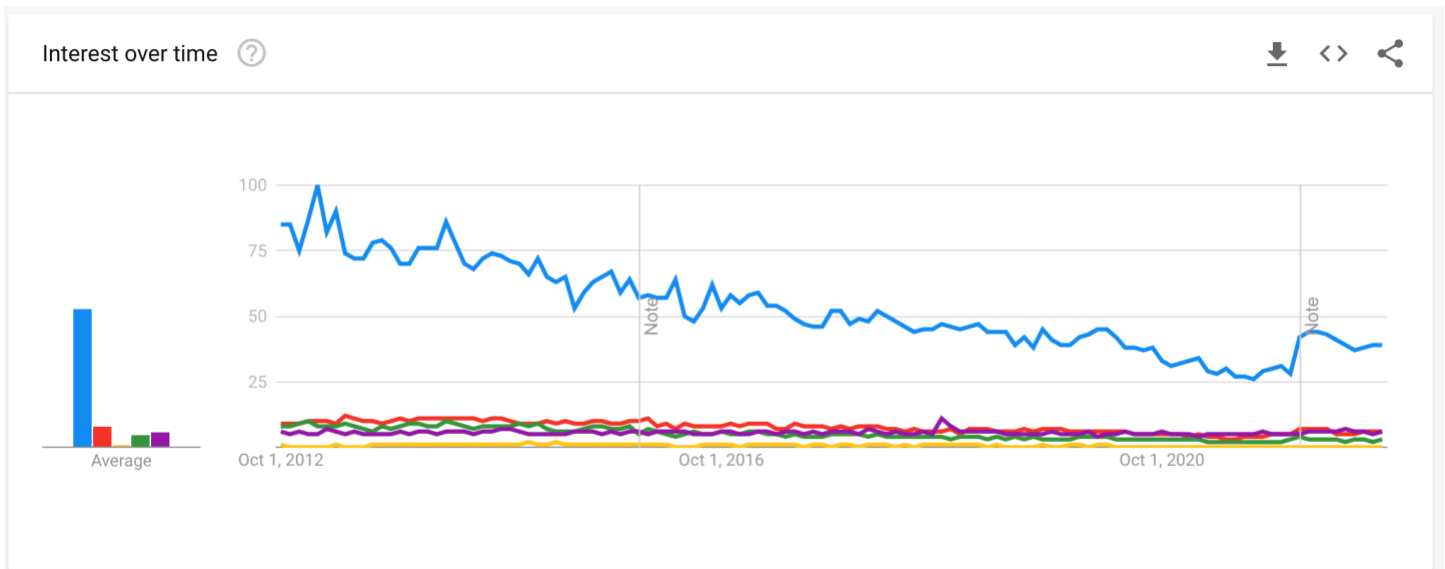
However what most people consider Android to be, is not really open-source. The Android Open Source Project, the open source foundation of the Android operating system, is surrounded by closed-source Google-branded applications.

Additionally, there is Chromium OS, an open-source operating system made specifically for using web applications. Chromium OS, albeit not commonly used on its own, serves as the foundation for the Chrome OS that powers Chromebooks, which are incredibly common in the education sector.

Market Share-

Open-source operating systems certainly do not dominate the market share as of now, but it is definitely the platform that developers use most frequently, according to the Stack Overflow survey in 2019. With 42.3% using Linux based systems, 40.2% on windows and 17.6% on MacOS.

Withing this share, there are remarkably many derivates of Linux. OS's such as Ubuntu and Debian have been along for a while and new and emerging ones such as Elementary OS and Linux mint are also slowly become favourites in the community.



Screenshot from google trends taken by me showing trends in popular Linux derivatives

References

- [1] A. Silberschatz, P.B. Galvin, G. Gagne, "Operating System Concepts," 10th Edition: Section 1.11, "Free and Open-Source Operating Systems" Page 47-51.
- [2] Microsoft CEO- Satya Nadella. Article Available at, <https://www.idginsiderpro.com/article/3584911/how-microsoft-went-from-linux-is-a-cancer-to-microsoft-loves-linux.html>
- [3] RedHat Website. Available at, <https://www.redhat.com/en>
- [4] A. Silberschatz, P.B. Galvin, G. Gagne, "Operating System Concepts," 10th Edition: Section 1.11, "Free and Open-Source Operating Systems" Page 47-51. **Changed context of this passage from focused on BSD UNIX only to a more generic point that makes sense for all open-source OS.**
- [5] Eric Raymond, in "The Cathedral and the Bazaar". Made argument based on the quote in this article. Available at, <https://blog.codinghorror.com/given-enough-money-all-bugs-are-shallow/>
- [6] Nick Heath in "What are open-source operating systems? Everything you need to know". Available at <https://www.zdnet.com/article/what-are-open-source-operating-systems-everything-you-need-to-know/>

