

liblzma - OSS and Backdoors

Exploring the xz-utils Backdoor, its Emergence and its Impact on FOSS and OSS

9525469

xnacy.me

Applied Computer Science

DHBW Mosbach

June 24, 2024

Abstract

In recent years, several vulnerabilities in the open-source software supply chain were discovered. The most recent being the intentionally placed backdoor in the compression library named *liblzma*. This paper aims to explore the implementation of said backdoor while highlighting the insertion of the backdoor and the inserters use of social engineering enabling their placement in the leadership of the project. Furthermore ways of preventing similar attacks are presented and evaluated on the example of the *liblzma* situation.

1 Introduction

FOSS¹ is generally defined as software the user can “[...] *run, copy, distribute, study, change and improve* [...]” [2]. This requires the source to be available and enables the dependence of other software on subsets or the entirety of the code. On the other hand, source available or OSS² are distinct from FOSS software. Some licenses do not require the resulting product to be licensed under the same license as its dependencies, such as the

MIT license³. It therefore differs from the GPL⁴ and software licensed with the MIT-Licence can therefore not be referred to as free open-source software, but rather as open-source software.

Most OSS-projects accept contributions from individuals and enterprises. This is wanted and required to support the actuality of said software. Most OSS projects accept changes matching their pre-defined contribution guidelines and credit the contributor for their addition. These contributors often use the software they are contributing to and therefore make changes they care for, such as adding drivers for new devices to the Linux kernel [5].

However, other independent OSS contributors are abusing the contribution system by exploiting the trust the unpaid maintainers have in the quality of the submitted changes. Specifically, this refers to manipulating maintainers and inserting oneself into the group of by applying pressure on said group. As was the case with *liblzma* or the *xz-utils* OSS library.

¹Free and Open-Source Software [1]

²Open-Source Software

³Requires the license to be present in “*all copies or substantial portions of the Software*” [3]

⁴Requires all copies of the software to be licensed as GPL [4]

1.1 Dependence on FOSS and OSS

Open source software is often divided into reusable components, such as libraries or toolkits implementing a specific feature, and built upon by other software. The goal is to use tried and tested components in the creation of new OSS, thus building on field tested and established software found in the OSS community.

Not only does OSS depend on other libraries from the OSS ecosystem. Proprietary software also makes use of said OSS components, while being forced to adhere to their terms, as declared in their respective licenses [6].

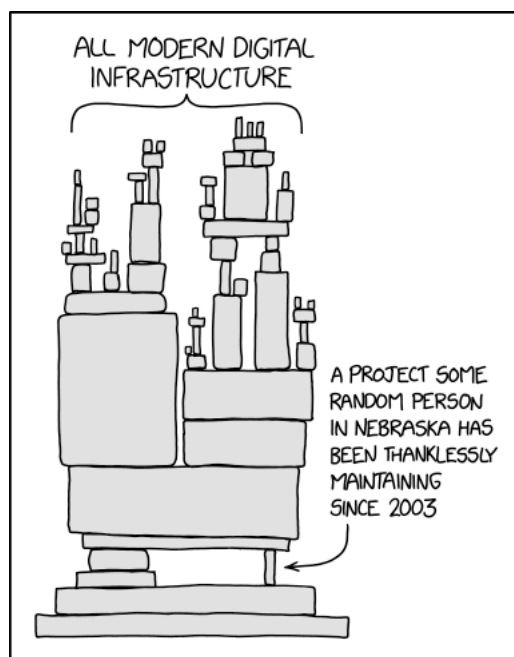


Figure 1: Dependency [7]

Commonly used examples for said libraries are `libcurl`, which provides multi protocol file transfers [8], `raylib` which is a library for video games programming [9] and the `sqlite` library, that implements a in process database [10]. These library examples are so widely used, a vulnerability in them would impact the security of the whole software space.

1.2 Supply Chain Security

Supply chain security is referring to the fact of ensuring the dependencies of a given software are to be considered secure and making sure this property can be accessed to be true. This can be achieved by keeping the development tool-chain used for creating said software up to date, thus patching and removing found vulnerabilities [11]. Other ways of establishing the security of a dependency is to manually evaluate the source code of the given dependency.

However most largely used open source software is thoroughly tested and famously so. `sqlite` prides itself as being the *"most used and deployed database engine"* [12] and *"[...] the project has 590 times as much test code and test scripts [as lines of source code]"* [13].

Considering the large amount of memory safety errors⁵, often caused by invalid or maliciously crafted input, projects entirely focussed around detecting said vulnerabilities, such as `OSS-Fuzz` [15], saw their inception.

1.3 xz-utils and liblzma

`xz-utils` refers to a c implementation of the `xz` compression algorithm and format using the Lempel–Ziv–Markov-Chain. It is written to comply with the C99 standard and consists of several components. One of these components is, as previously introduced, a library providing an API for compression and decompression, named `liblzma` [16]. According to the components documentation, its API is based on the `lzma` SDK but includes heavy modifications necessary for the `xz-utils` suite [17].

⁵70% according to [14]

2 Backdoor Exploration

According to [18], a backdoor refers to a hidden method of gaining entry to a system bypassing security measures, such as biometric or password based authentication. They can be implemented in cryptographic algorithms, on the hardware level or in an application. Backdoors can be used to remotely access systems and are often hidden inside commonly used non-malicious software.

2.1 Implementation

2.2 Social Engineering

2.3 Pressure on OSS Maintainer

2.4 Affected Systems

3 Response

3.1 Patches

3.2 Releases on Hold

3.3 Vetting Source Code

4 Prevention

4.1 Funding FOSS and OSS

4.2 Vetting Dependency

4.3 Appreciation for FOSS Maintainers

References

- [1] R. M. S. (RMS). (2021), [Online]. Available: <https://www.gnu.org/philosophy/pragmatic.html> (visited on 06/04/2024).

- [2] F. S. Foundation. (2024), [Online]. Available: <https://www.gnu.org/philosophy/free-sw.html> (visited on 06/04/2024).
- [3] Opensource.org. (2024), [Online]. Available: <https://opensource.org/license/MIT> (visited on 06/04/2024).
- [4] Opensource.org. (2024), [Online]. Available: <https://opensource.org/license/gpl> (visited on 06/04/2024).
- [5] T. kernel development community. "Linux - introduction - device drivers." (2021), [Online]. Available: <https://linux-kernel-labs.github.io/refs/heads/master/lectures/intro.html#device-drivers> (visited on 06/10/2024).
- [6] D. Stenberg. "Companies using curl in commercial environments." (2024), [Online]. Available: <https://curl.se/docs/companies.html> (visited on 06/09/2024).
- [7] xkcd. "Dependency." (), [Online]. Available: <https://xkcd.com/2347/> (visited on 06/09/2024).
- [8] D. Stenberg. "Libcurl - the multi-protocol file transfer library." (2024), [Online]. Available: <https://curl.se/libcurl/> (visited on 06/09/2024).
- [9] raysan5. "Raylib is a simple and easy-to-use library to enjoy videogames programming." (2024), [Online]. Available: <https://www.raylib.com/> (visited on 06/09/2024).
- [10] D. R. Hipp. "What is sqlite?" (2024), [Online]. Available: <https://www.sqlite.org/index.html> (visited on 06/09/2024).

Appendix

- [11] M. Stapelberg. "Supply chain security with go." (2024), [Online]. Available: <https://media.ccc.de/v/gpn22-438-supply-chain-security-with-go> (visited on 06/07/2024).
- [12] J. M. Dwayne Richard Hipp Dan Kennedy. "Most widely deployed and used database engine." (2022), [Online]. Available: <https://www.sqlite.org/mostdeployed.html> (visited on 06/20/2024).
- [13] J. M. Dwayne Richard Hipp Dan Kennedy. "How sqlite is tested." (2022), [Online]. Available: <https://www.sqlite.org/testing.html> (visited on 06/20/2024).
- [14] T. C. Project. "Memory safety." (), [Online]. Available: <https://www.chromium.org/Home/chromium-security/memory-safety/> (visited on 06/10/2024).
- [15] G. O. Source. "Oss-fuzz." (2024), [Online]. Available: <https://google.github.io/oss-fuzz/> (visited on 06/20/2024).
- [16] L. Collin. "Xz utils." (2024), [Online]. Available: https://tukaani.org/xz/#_introduction (visited on 06/21/2024).
- [17] cy. "Common code <> different backdoors." (2024), [Online]. Available: <https://media.ccc.de/v/gpn22-304-common-code-different-backdoors> (visited on 06/05/2024).
- [18] C. Wysopal and C. Eng. "Static detection of application backdoors." (2007), [Online]. Available: <https://www.veracode.com/sites/default/files/Resources/Whitepapers/static-detection-of-backdoors-1.0.pdf> (visited on 06/24/2024).