From Log4j to XZ

Unsolvable Issues in the Software Supply Chain

BSidesRedRocks

2024-11-15

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Agenda

1. The Before Times
2. Log4Shell
3. SBOMs
4. XZ Utils

- Patch Faster is Broken (“dumpster fire”)
  - Most things don’t even need to be fixed
- The “Zero CVE” Goal is Wrong
  - “number go down”
- What we Should Worry About
- And what’s not Important

My Biases

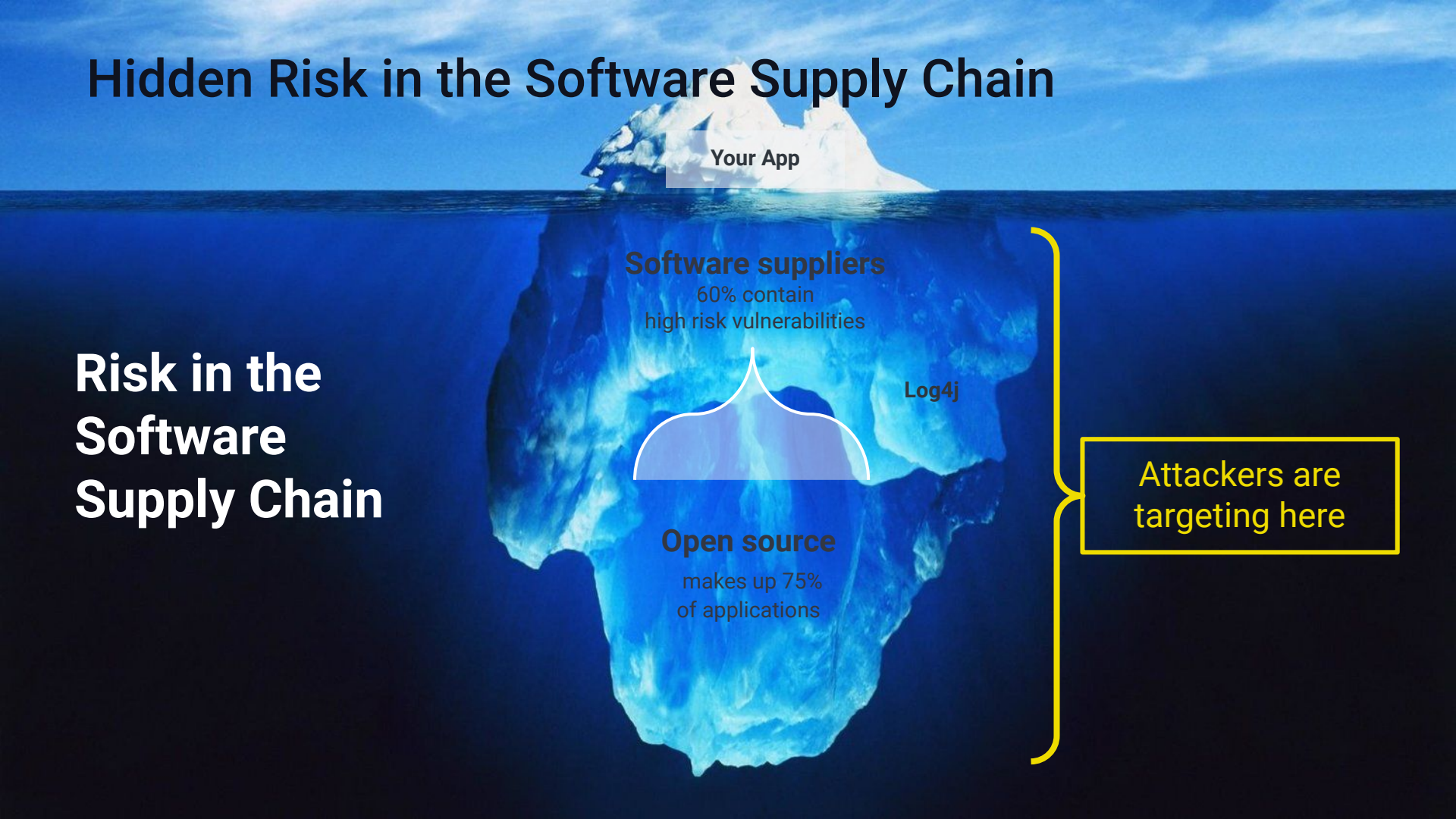
- This talk is mainly about vulnerability management
  - (as opposed to regulatory compliance)
- My background is more Ops than Dev
- I empathize more with blue teams
- My day job is soaked in cloud native woo woo
- I have spent most of my career working in open source

The Before Times

Everything before Log4Shell


080

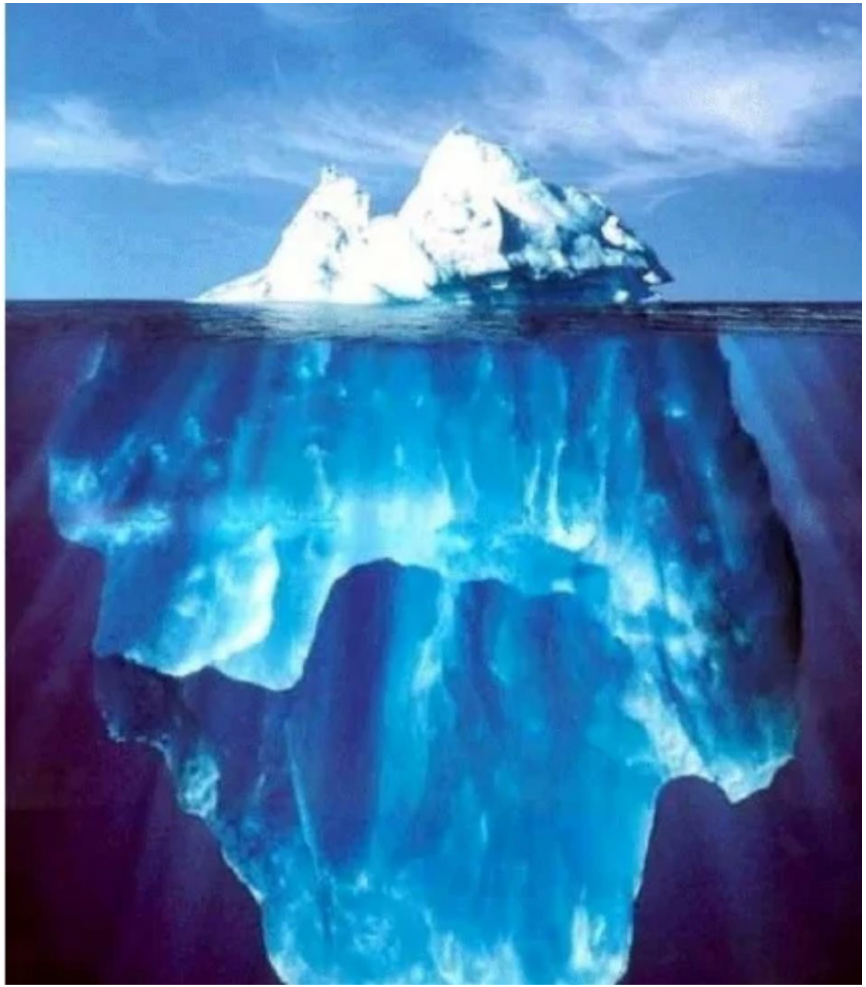
Hidden Risk in the Software Supply Chain

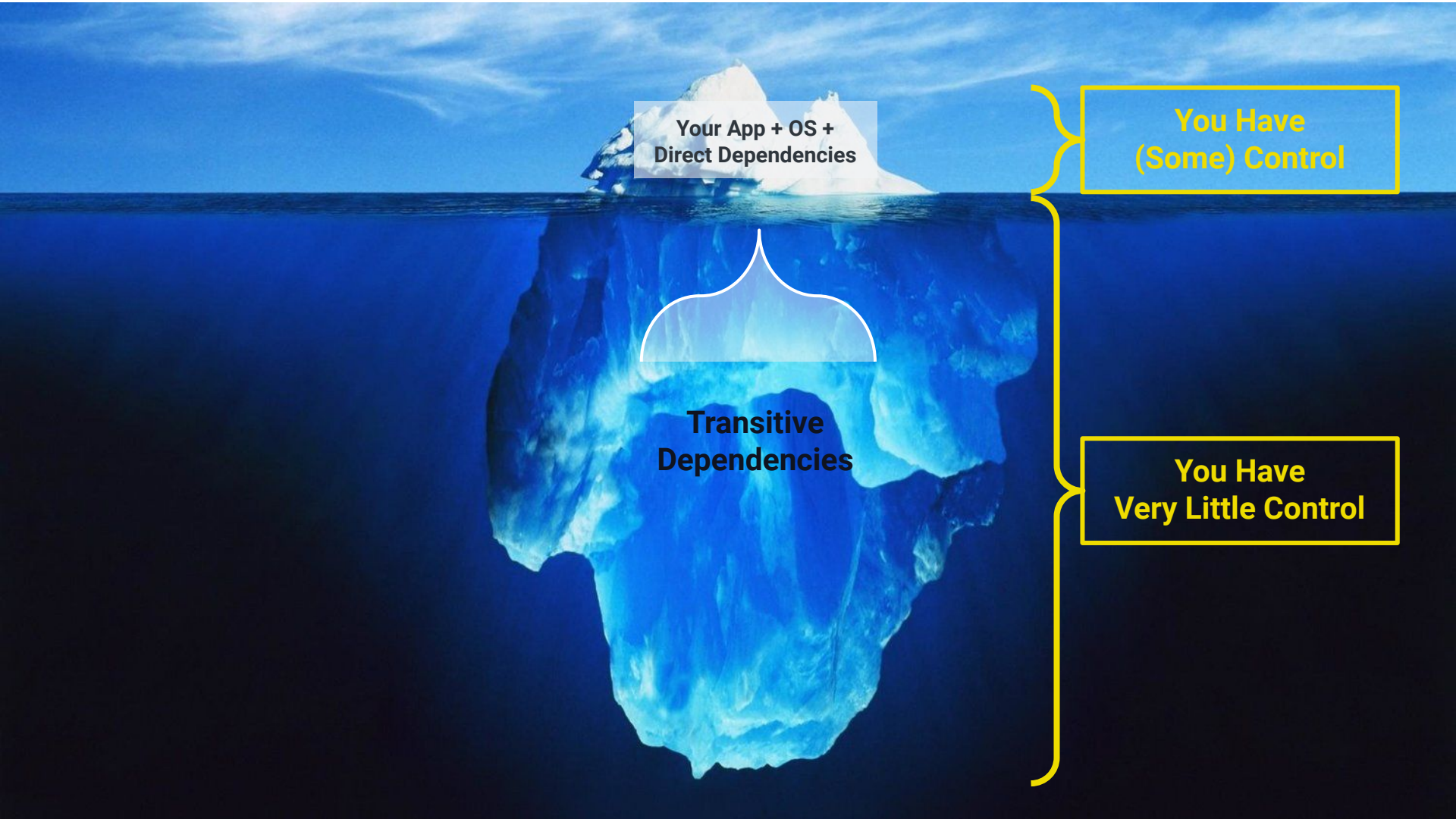


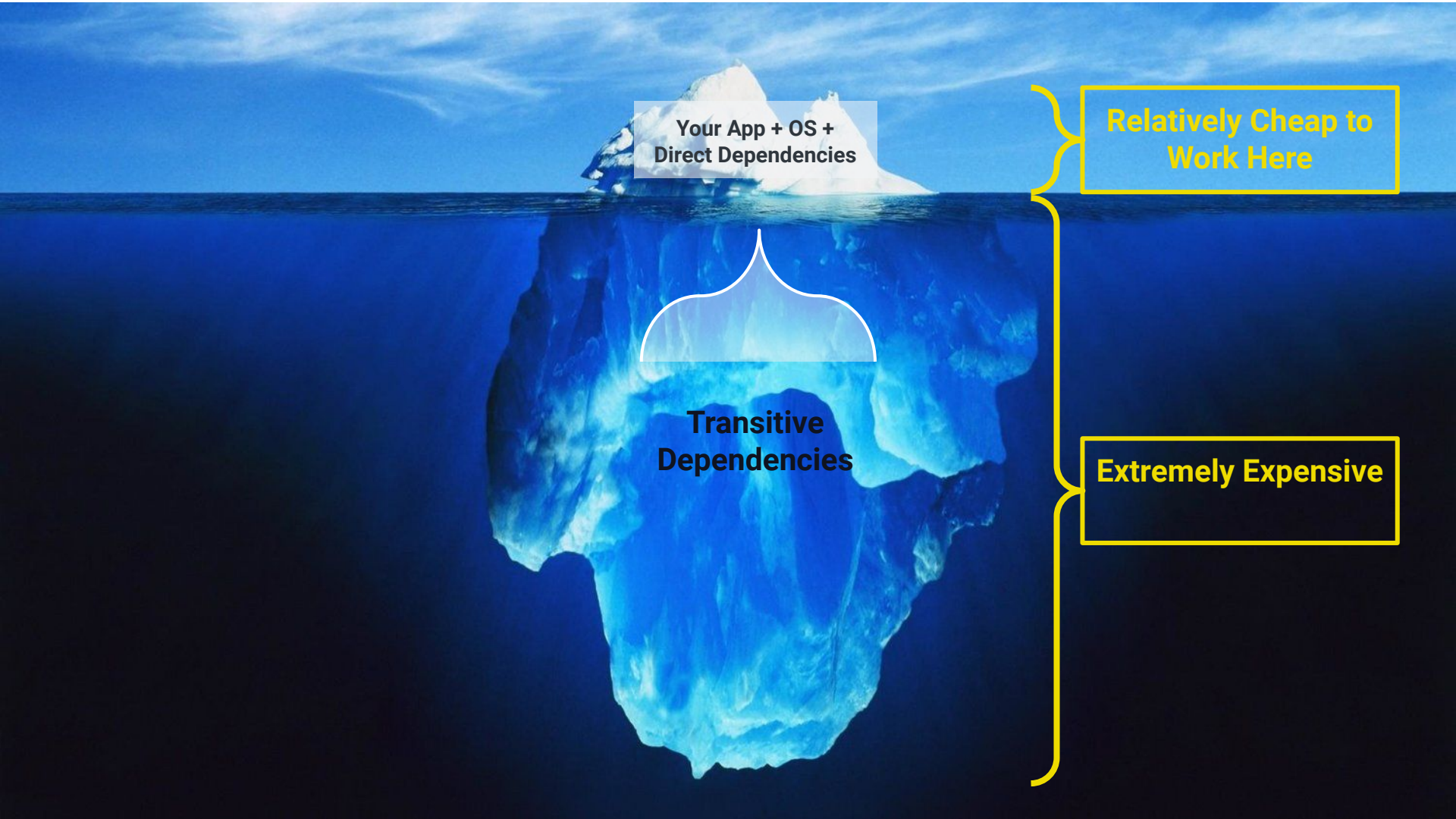
Risk in the Software Supply Chain

Free is Just the Tip of the Iceberg: Open Source Library System Software

Lori Bowen Ayre
lori.ayre@galecia.com
METRO Webinar
October 6, 2009



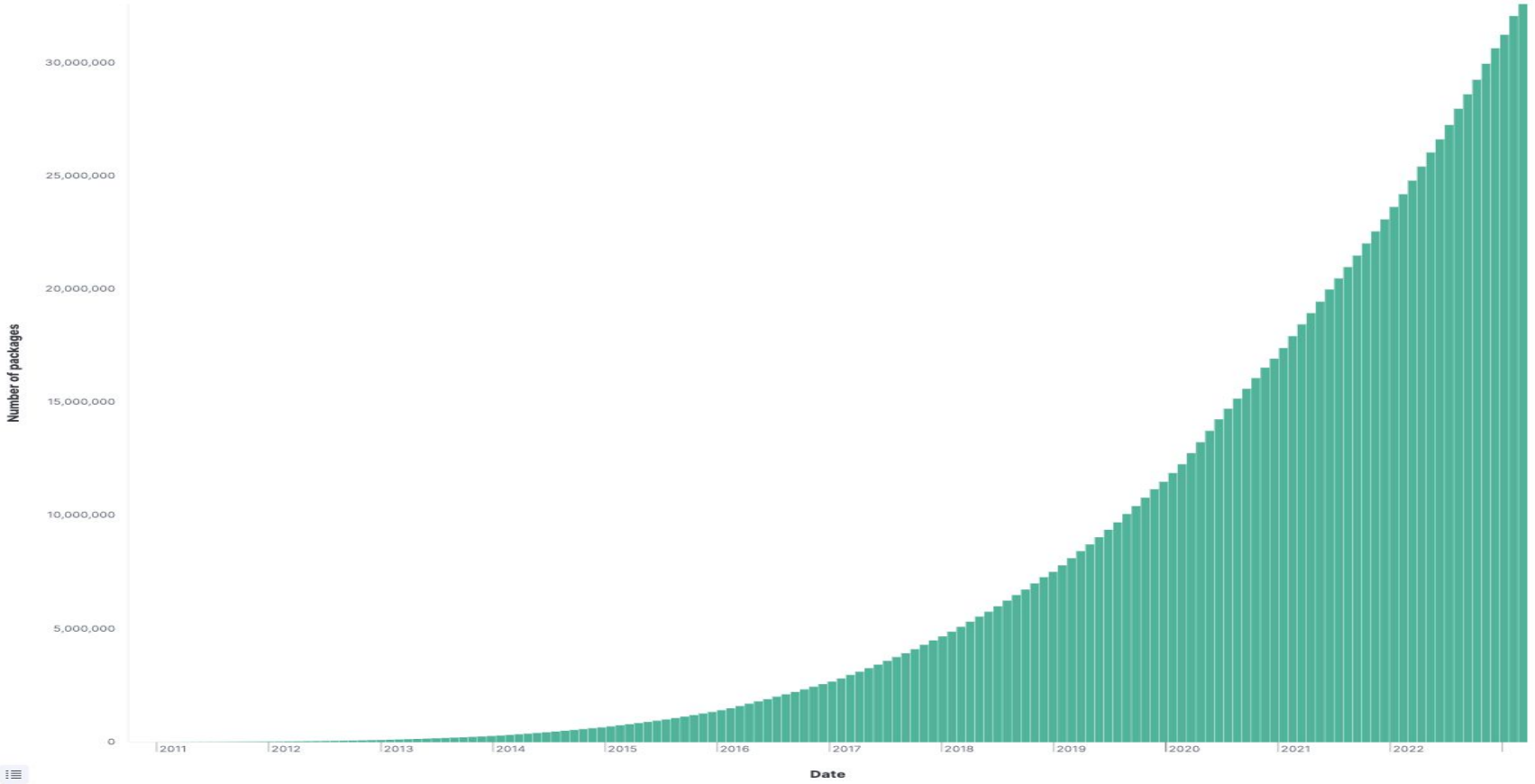

Your App + OS +
Direct Dependencies
You Have
(Some) Control
Transitive
Dependencies
You Have
Very Little Control


Your App + OS +
Direct Dependencies
Transitive
Dependencies
Relatively Cheap to
Work Here
Extremely Expensive

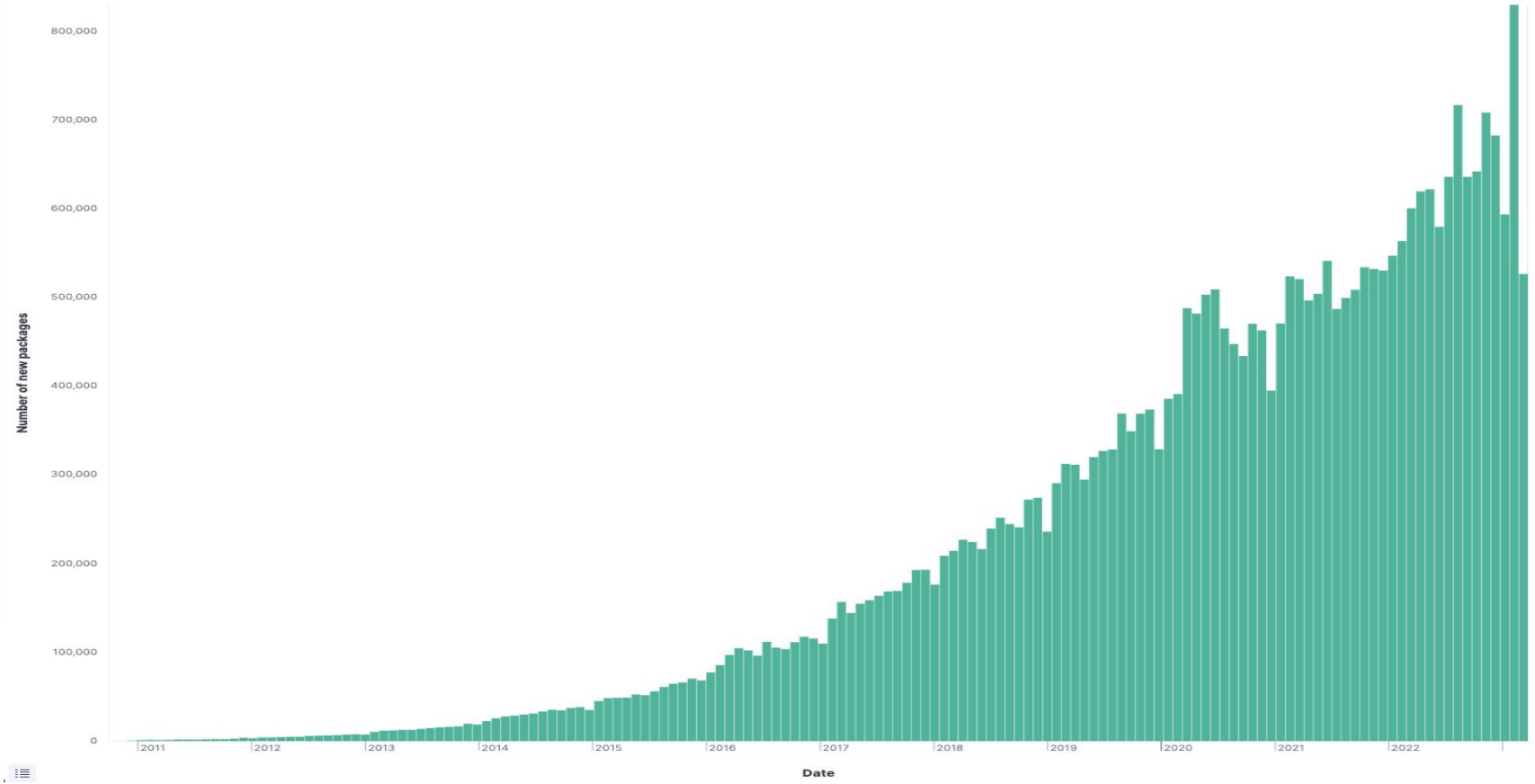
Notes on this Metaphor

- You've seen this iceberg metaphor. I've used this metaphor 100 times, I've criticized this metaphor.
- This is an OLD metaphor
- Things have changed a lot but we're still thinking about old systems
- https://www.slideshare.net/loriayre/open-source-library-system-software-free-is-just-the-tip-of-the-iceberg
- They're attacking the bottom now - that's a supply chain attack
- But really, the top isn't "your code" - the top is your direct dependencies, bottom is transitive
- You can only directly control what's at the top
- They're attacking the whole iceberg, but you probably only know about the stuff at the top
- The change is largely due to the massive rise in software package managers
- The CVE system predates this change and hasn't really evolved

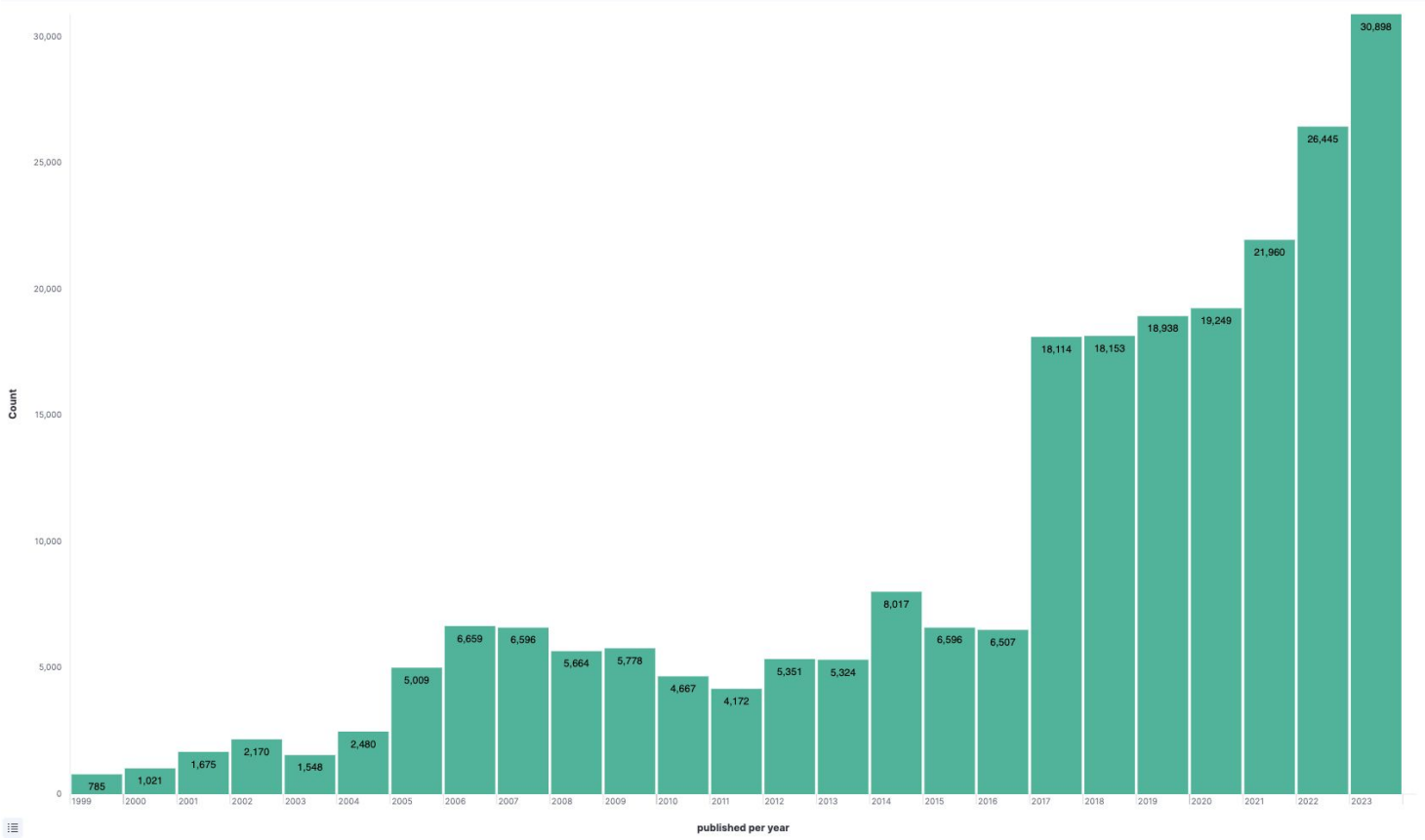
Open Source is Bigger Than You Can Imagine



Open Source is Bigger Than You Can Imagine

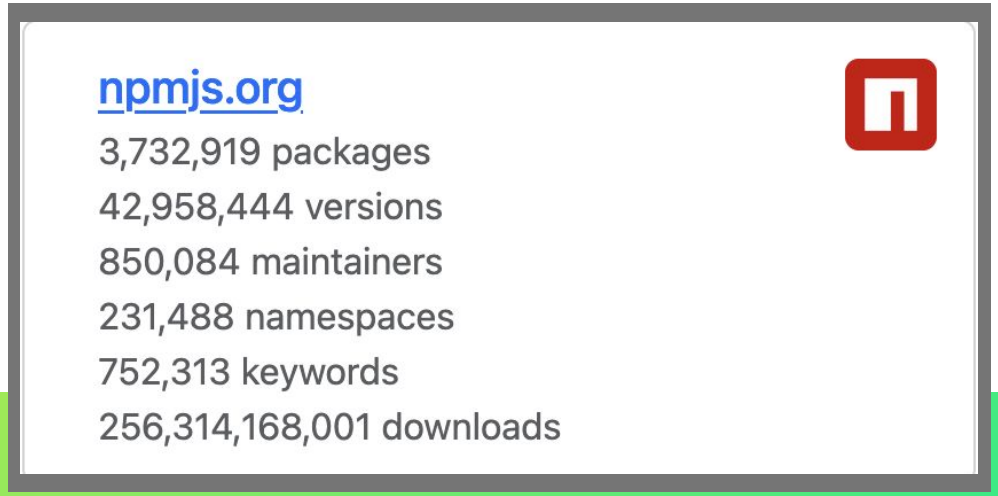


And CVE Growth



Open Source is Huge

- NPM introduced 2010
- 43 million packages (as of April)
- Approx 1,000,000 new packages **per month**
- That’s just NPM!



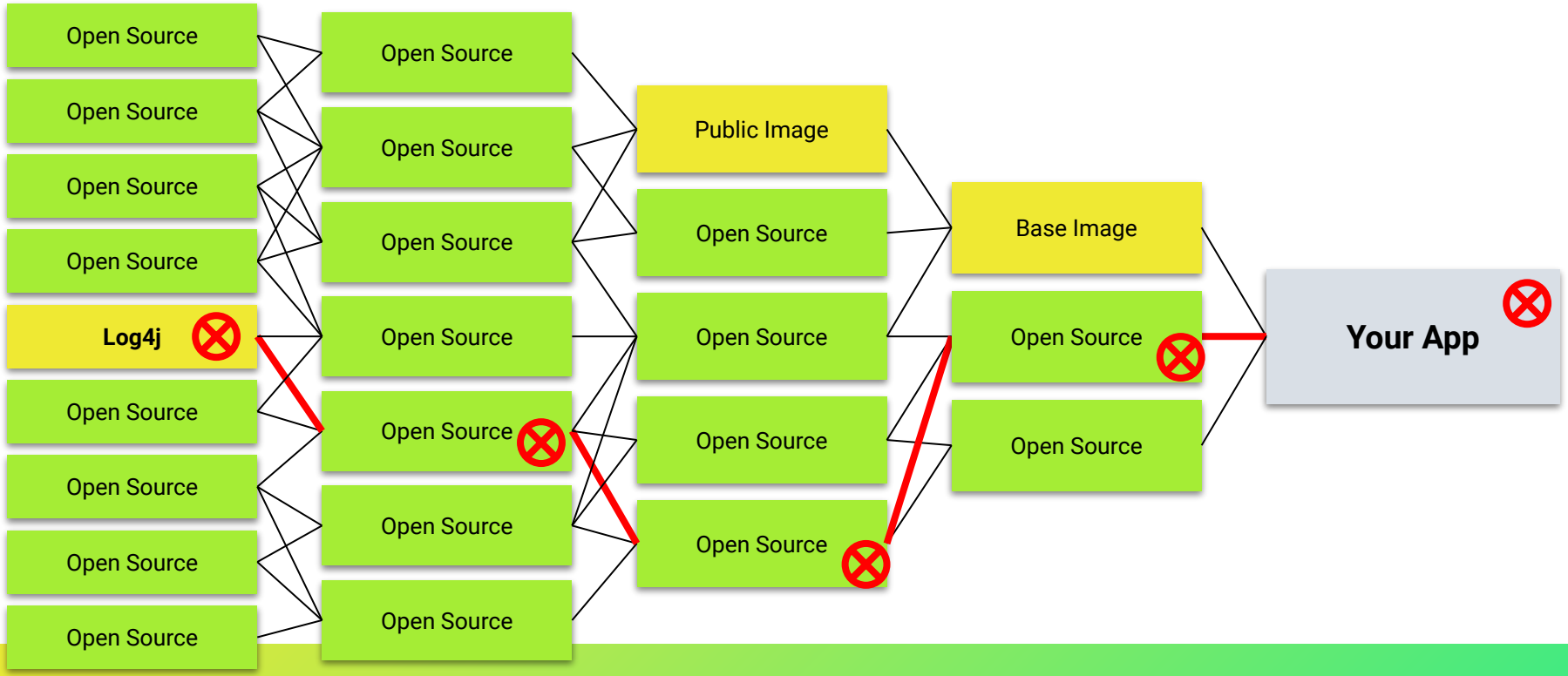
Log4Shell

The Awakening

Log4Shell Recap

- Growth of dependencies is now obvious
- The term “software supply chain” starts to show up
- Many people hear about SBOMs for the first time
- STILL to this day on CISA’s Top 15 Frequently Exploited List
  - (Also the only open source component on that list)

The Software Supply Chain



Stop Thinking About Open Source like a Vendor

This

Not this

Summary of Open Source Software Supply Chains

- Red Hat **IS** a supplier (if you are paying them)
  - they assume responsibility in exchange for money
- npm is **NOT** a supplier
- A lot of critical plumbing is maintained by unpaid guys who have day jobs, take vacations, etc.

SBOMs

A brief note

What is an SBOM?

If We Knew What We are Consuming

- People spent insane amounts of time just finding log4j, because nobody knew where (or even if) it was hiding
- Knowing = Faster Remediation
- SBOMs help, a LOT, but… “a phone book is not illuminating”
  - They aren’t a silver bullet
  - Scanners aren’t perfect (e.g. can’t penetrate binary blobs, cf. OpenSSL3.)
  - Not all SBOMs are equal
  - SBOMs aren’t ubiquitous (yet) (producers aren’t reliably supplying them)
  - SBOMs are more accurate and useful when producers/maintainers generate them BUT something is better than nothing
  - SBOM management is hard
  - Any SBOM generated before an actual build is suspect (transitive deps)
  - SBOM Everywhere: https://github.com/ossf/sbom-everywhere

XZ and Beyond

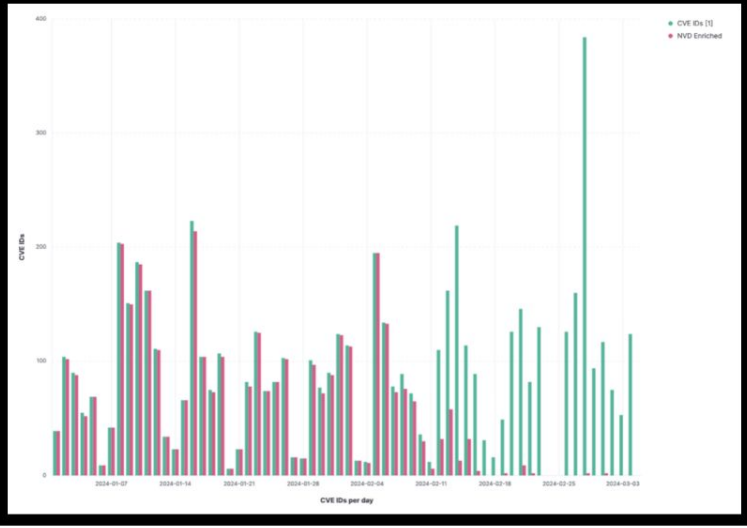
An Amazing Thing Happened at a Unique Moment in Time

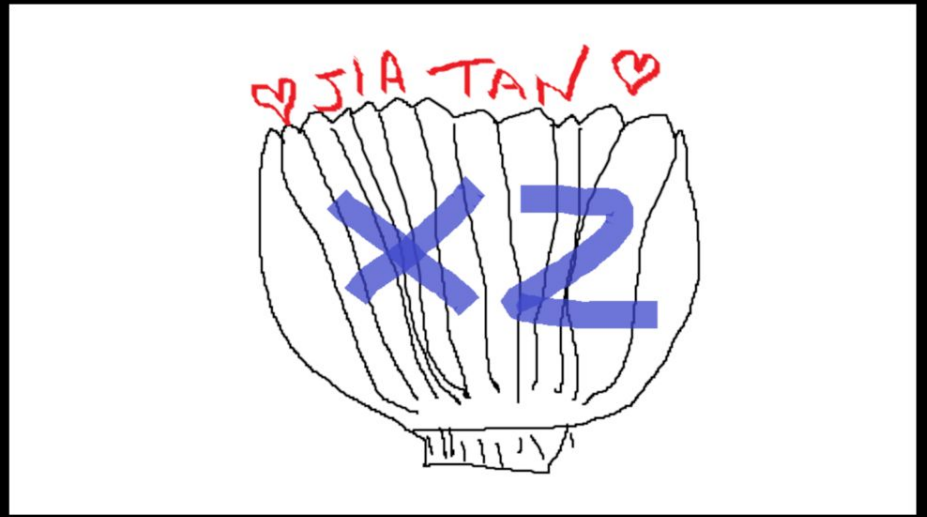
NATIONAL VULNERABILITY DATABASE

NIST NATIONAL VULNERABILITY DATABASE NVD

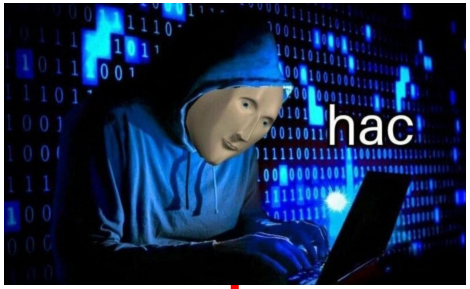
NOTICE

NIST is currently working to establish a consortium to address challenges in the NVD program and develop improved tools and methods. You will temporarily see delays in analysis efforts during this transition. We apologize for the inconvenience and ask for your patience as we work to improve the NVD program.





The Jia Tan Reverse Funnel Plan



XZ

Fedora

Suse

Debian

Docker Images

RHEL

SLES

Ubuntu

etc

Base Image

Open Source

Open Source

Open Source

Open Source

Open Source

Open Source

Your Organization

Enterprise

Government Agency

Nonprofit

Enterprise

Enterprise

NGO

Government Agency

Enterprise

The Takeaways

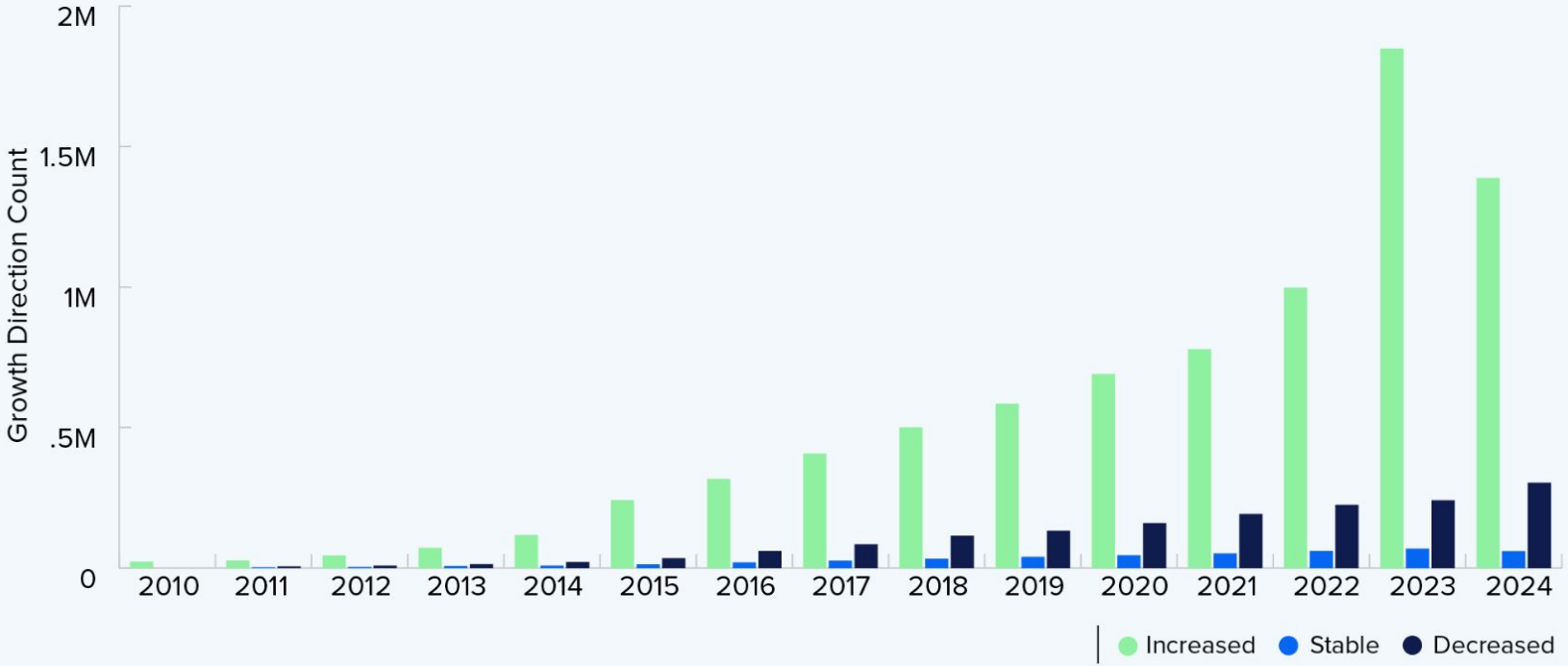
Open source is different

There’s nothing wrong with open source, this is how it works

There’s something wrong with what we expect from open source

FIGURE 1.2

Release Frequency of Open Source Projects

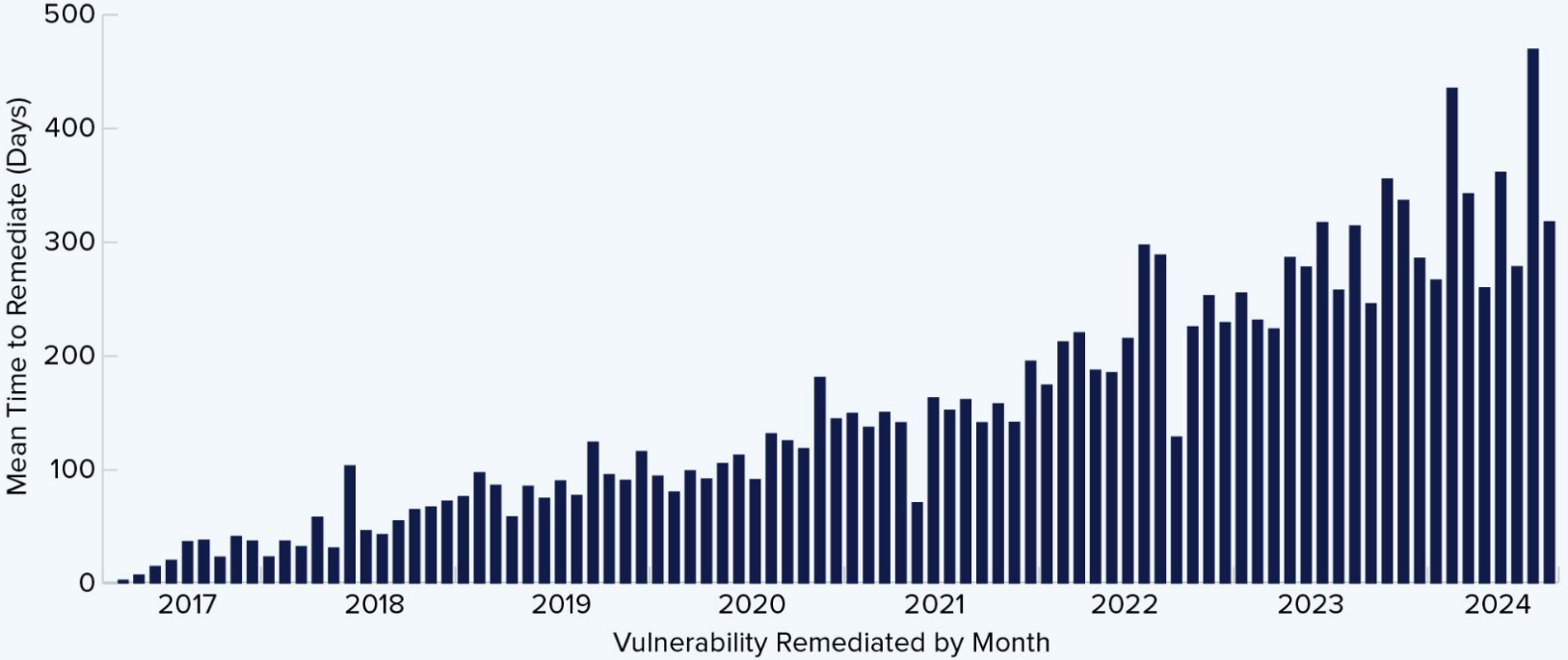


Projects that released faster, slower or the same as the prior year.

Sonatype State of the Software Supply Chain: https://www.sonatype.com/state-of-the-software-supply-chain/introduction

FIGURE 1.3

Rate of Vulnerability Remediation Over Time



How long a project took to remediate known vulnerabilities in their dependencies.

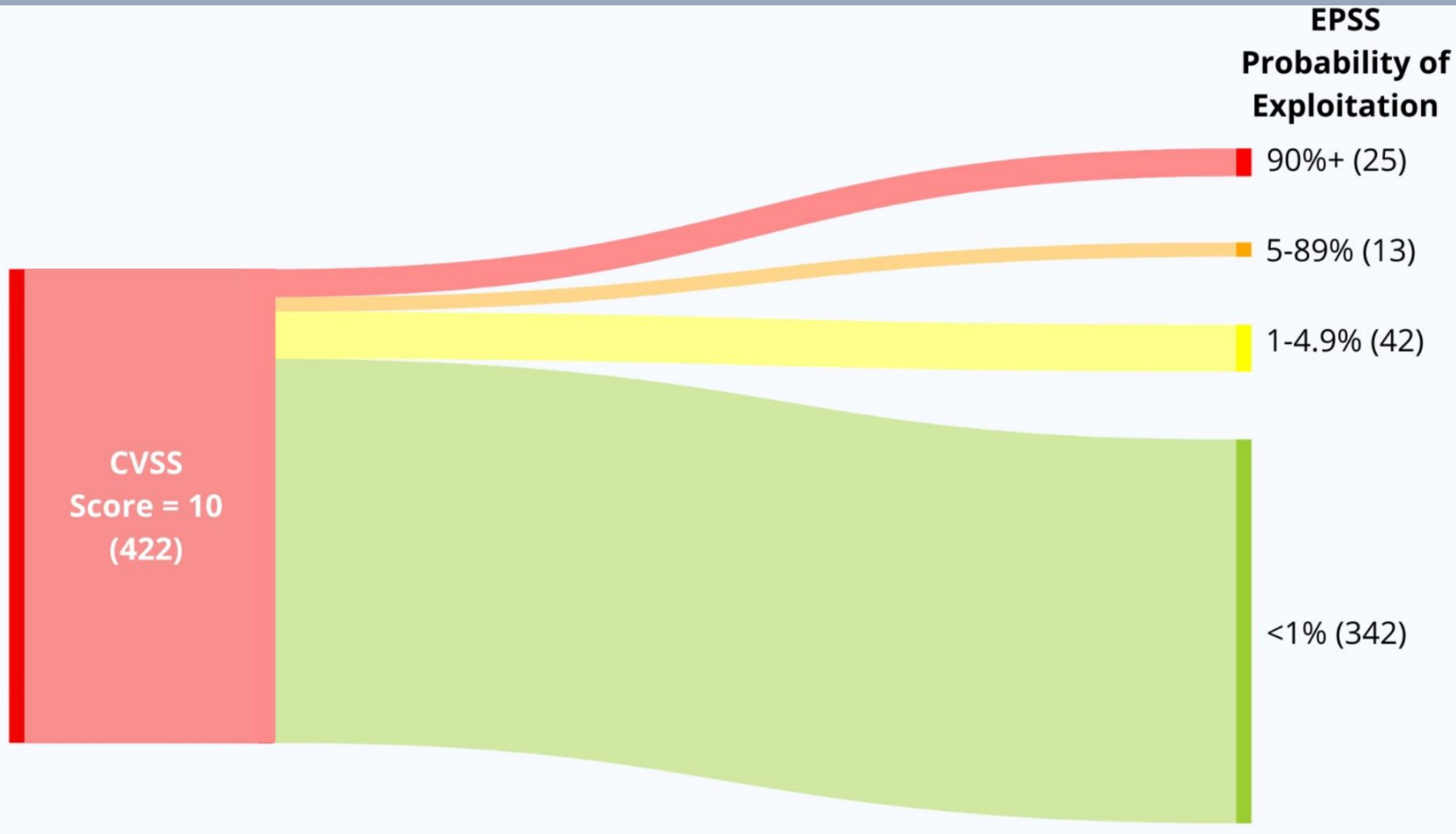
Sonatype State of the Software Supply Chain: https://www.sonatype.com/state-of-the-software-supply-chain/introduction


YOUR
SCORE
HIGH
SCORE


WHAC
-A-
MOLE
WHAC
-A-
MOLE
WHAC
-A-
MOLE
WHAC
-A-
MOLE
WHAC
-A-
MOLE
FREE
PLAY

Takeaway: Patch Faster is Broken and Chasing CVE 0 is a Losing Battle

- CVEs increasing faster than they can be fixed
- Most of these are not important anyway
- But they all have CVSS scores > 9.8 so you can't tell which ones ARE important
- GHSAs (more transparent than CVEs)
- **CISA KEV + EPSS**
- VEX, CSAF, OpenSSF Malicious Packages Repository are helpful
- GitHub Insights and other project health metrics
    - This is (currently) a very manual process
    - But it's getting a lot easier


EPSS
Probability of
Exploitation
CVSS
Score = 10
(422)
90%+ (25)
5-89% (13)
1-4.9% (42)
<1% (342)

Takeaway: Open Source Project Health/Insights

- This is PROACTIVE (better advisory data, etc is about reactive improvements)
- This is (currently) a manual process (getting easier)
- Evaluating project health isn't directly about safety, it's about all keeping track of all those deps in the iceberg
- **Are the projects you're depending on healthy, will you be able to work with them?**
- **Ransomware attacks and the software supply chain as a vector are peanut butter and chocolate**

anchore / syft

Type / to search

Code | Issues 372 | Pull requests 43 | Actions | Projects | Wiki | Security 1 | Insights

- Pulse
- Contributors
- Community Standards
- Commits
- Code frequency
- Dependency graph
- Network
- Forks
- Actions Usage Metrics
- Actions Performance Metrics

November 4, 2024 – November 11, 2024

Period: 1 week

Overview

13 Active pull requests

6 Active issues

4	9	1	5
Merged pull requests	Open pull requests	Closed issue	New issues

Excluding merges, **5 authors** have pushed **4 commits** to main and **12 commits** to all branches. On main, **3 files** have changed and there have been **13 additions** and **1 deletions**.

4 Pull requests merged by **4** people

- **Restore log on UI teardown**
  #3427 merged 3 days ago
- **doc: Add official Syft logo license information**
  #3421 merged 4 days ago
- **chore(deps): bump anchore/sbom-action from 0.17.6 to 0.17.7**
  #3418 merged 5 days ago
- **chore: build release sbom from go.mod**
  #3417 merged last week

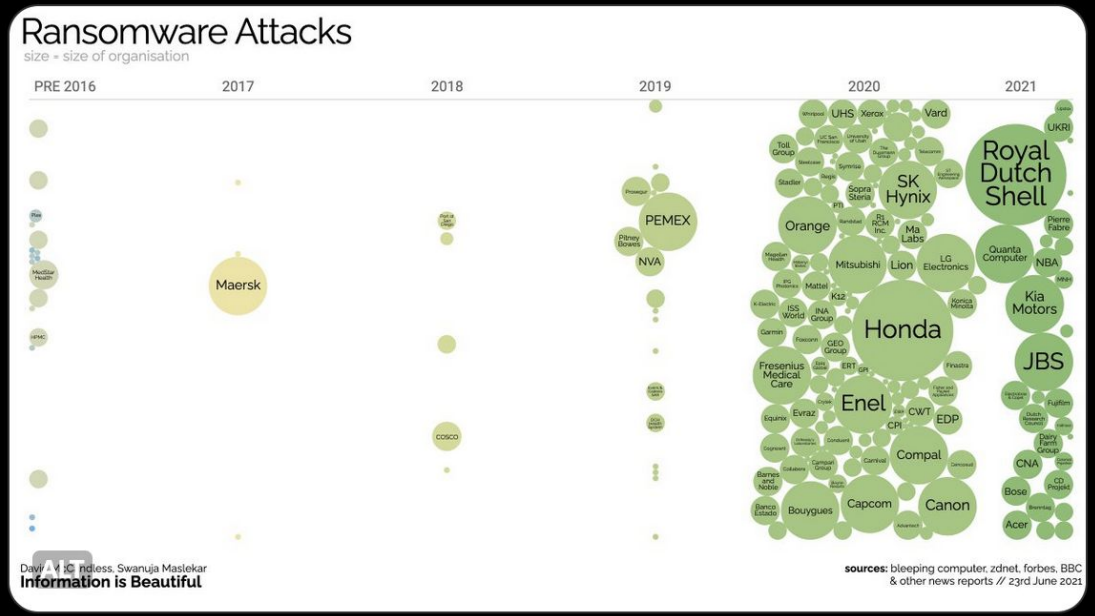
9 Pull requests opened by **4** people

- **update node classifier to support 6.x**
  #3419 opened 5 days ago
- **Support scanning files in mount namespaces**
  #3423 opened 4 days ago
- **chore(deps): update stereoscope to 120d9ea511e2f7a9887b443c52e66cd19bb80b43**
  #3424 opened 4 days ago

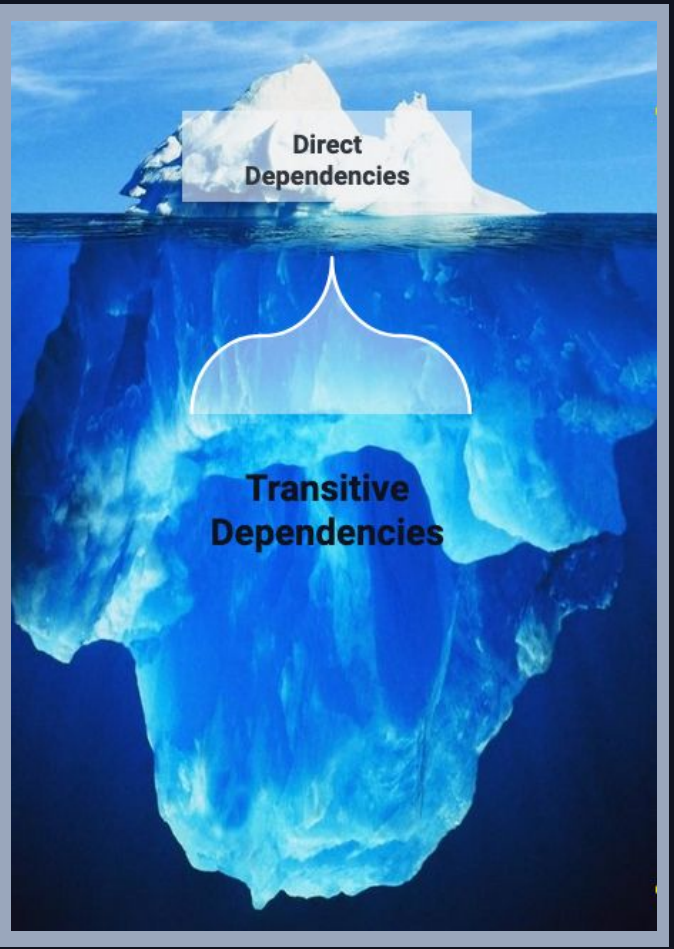
```
"purl": "pkg:gem/zlib@2.0.0",
"metadataType": "GemMetadata",
"metadata": {
  "name": "zlib",
  "version": "2.0.0",
  "files": [
    "ext/zlib/extconf.rb",
    "zlib.so"
  ],
  "authors": [
    "Yukihiro Matsumoto",
    "UENO Katsuhiro"
  ],
  "homepage": "https://github.com/ruby/zlib"
```

Information is Beautiful
@infobeautiful

Are #Ransomware attacks increasing? I think #Ransomware attacks are increasing...
interactive: bit.ly/3h1IYPs



11:33 AM · Jun 23, 2021



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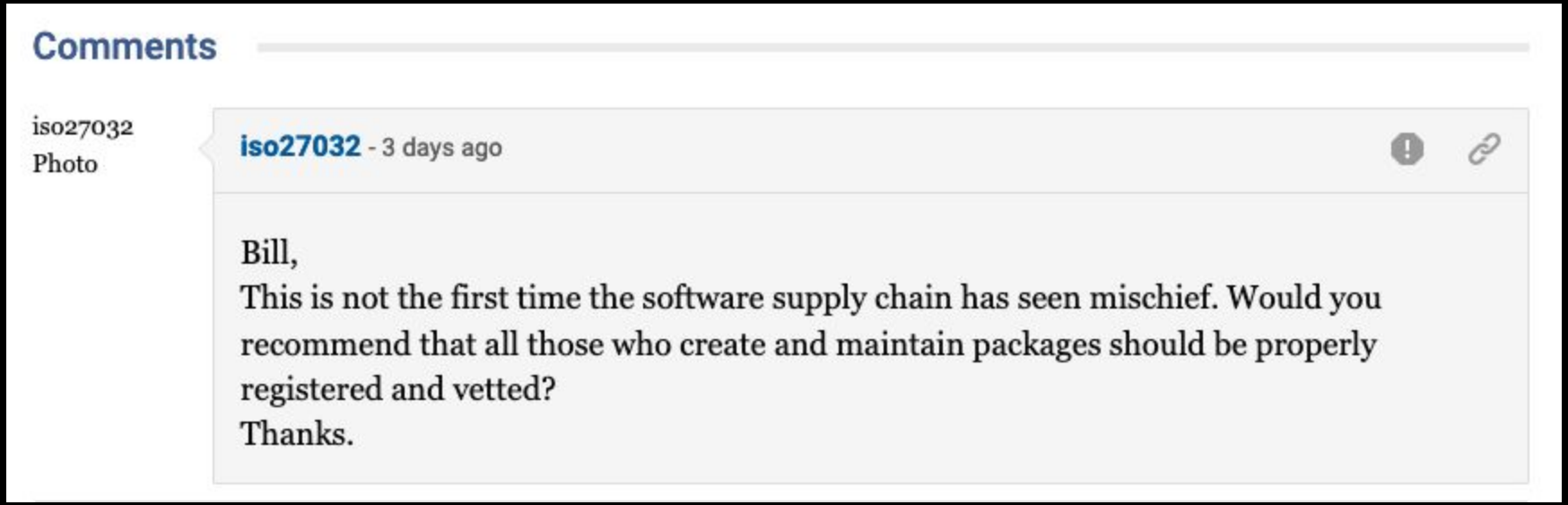
THE PROBLEM



HUNTED LABS

THE “SOLUTION”

HUNTED LABS

HUNTED LABS

HUNTED

LABS

Footnotes

- Sonatype: State of the Software Supply Chain
  https://www.sonatype.com/state-of-the-software-supply-chain/introduction
- Tidelift: State of the Open Source Maintainer
  https://explore.tidelift.com/2024-survey/2024-tidelift-state-of-the-open-source-maintainer-report
- Anchore: Software Supply Chain Security Report
  https://get.anchore.com/2024-software-supply-chain-security-report/
- Thomas Depierre: I am not a Supplier
  https://www.softwaremaxims.com/blog/not-a-supplier
- The Double-Edged Sword of Increased Vulnerability Data
  https://github.blog/security/supply-chain-security/securing-the-open-source-supply-chain-the-essential-role-of-cves/
- Open Source is Bigger Than You Can Imagine
  https://anchore.com/blog/open-source-is-bigger-than-you-imagine/
- 2023 Top Routinely Exploited Vulnerabilities
  https://www.cisa.gov/news-events/cybersecurity-advisories/aa24-317a
- Patrick's CVE Diagrams
  https://www.linkedin.com/posts/patrickmgarrity_the-evolution-of-patricks-sankey-matics-activity-7118334146728357888-zxxn/
- possible origin of the iceberg
  https://www.slideshare.net/loriayre/open-source-library-system-software-free-is-just-the-tip-of-the-iceberg
- Log4Shell logo: https://en.wikipedia.org/wiki/File:Log4Shell_logo.png
- xz logo: https://infosec.exchange/@jerry/112186387514069376

XZ Reading List

Technologist vs spy: the XZ backdoor debate
https://lcamtuf.substack.com/p/technologist-vs-spy-the-xz-backdoor

General XZ roundups
https://boehs.org/node/everything-i-know-about-the-xz-backdoor
https://arstechnica.com/security/2024/04/what-we-know-about-the-xz-utils-backdoor-that-almost-infected-the-world/

FAQ on the XZ compromise/backdoor CVE-2024-3094
https://gist.github.com/thesamesam/223949d5a074ebc3dce9ee78baad9e27

examination of claims of technical solutions to XZ and why they're wrong
https://federated.saagarjha.com/notice/AgPahhBPr9xHXMAPWi

OSS backdoors: the folly of the easy fix
https://lcamtuf.substack.com/p/oss-backdoors-the-allure-of-the-easy

deep inspection of the backdoor injection
https://research.swtch.com/xz-script
https://gynvael.coldwind.pl/?lang=en&id=782

interactions in open source projects (examination of XZ infiltration)
https://robmensching.com/blog/posts/2024/03/30/a-microcosm-of-the-interactions-in-open-source-projects/

thread from november 2023 theorizing about a long con threat actor assuming control of a major project
https://infosec.exchange/@mariuxdeangelo/111348817163534252

thread exploring pressure on XZ maintainer to hand off control of the project
https://twitter.com/robmen/status/1774067844785086775

bullying as a vulnerability in open source
https://www.404media.co/xz-backdoor-bullying-in-open-source-software-is-a-massive-security-vulnerability

tracking Jia Tan's commit timestamps
https://twitter.com/birchb0y/status/1773871381890924872

examining Jia Tan's complete github commit history
https://huntedlabs.com/where-the-wild-things-are-a-complete-analysis-of-jiat95-github-history

looking into the "Jia Tan" persona
https://www.wired.com/story/jia-tan-xz-backdoor/

Sloppy OpenSSF statement (later redacted) implying Scorecard indicated XZ issues
https://web.archive.org/web/20240331024907/https://openssf.org/blog/2024/03/30/xz-backdoor-cve-2024-3094/

Lessons from XZ Utils: Achieving a More Sustainable Open Source Ecosystem
https://www.cisa.gov/news-events/news/lessons-xz-utils-achieving-more-sustainable-open-source-ecosystem

Log4Shell Reading List

Dealing with log4shell (detection, mitigation, workarounds)
https://cloudsecurityalliance.org/blog/2021/12/14/dealing-with-log4shell-aka-cve-2021-44228-aka-the-log4j-version-2/

Keeping up with log4shell (post mortem)
https://cloudsecurityalliance.org/blog/2021/12/16/keeping-up-with-log4shell-aka-cve-2021-44228-aka-the-log4j-version-2/

Mysterious tweet hinting at the exploit
https://twitter.com/sirifu4k1/status/1468951859381485573

Another mysterious tweet:
https://twitter.com/CattusGlavo/status/1469010118163374089

“THE” pull request:
https://github.com/apache/logging-log4j2/pull/608

Cloudflare digs for evidence of pre-disclosure exploits in the wild:
https://twitter.com/eastdakota/status/1469800951351427073

Open Source Reconnaissance Reading List

NPM Provenance: The Missing Security Layer in Popular JavaScript Libraries
https://medium.com/exaforce/npm-provenance-the-missing-security-layer-in-popular-javascript-libraries-b50107927008

Your dependencies have dependencies: new features to assess risk
https://dev.to/stacklok/your-dependencies-have-dependencies-new-features-to-assess-risk-3f1b

Repo Swatting
https://www.bsidesmelbourne.com/2024-repo.html
https://github.com/6mile/repo-swatting (hopefully slides will be posted soon)

Securing open source software: Whose job is it, anyway?
https://www.theregister.com/2024/03/08/securing_opensource_software_whose_job/

Maltego Cyber Investigation Platform &c
https://www.maltego.com/

The US Federal Government Understands that open source is not a supplier
https://www.linkedin.com/feed/update/urn:li:activity:7073021512030511104/

identifying vulnerabilities in open source codebases at scale
https://github.com/chebuya/SASTsweep

Bad Ideas Around Enforced Contributor Identity and Authentication:

Malicious PyPI package with 37,000 downloads steals AWS keys
https://www.bleepingcomputer.com/news/security/malicious-pypi-package-with-37-000-downloads-steals-aws-keys/

LLM Code Authorship Detection (this is a bad idea and will probably make things worse)
https://apiiro.com/blog/llm-code-author-detection-unmasking-malicious-package-contributions/

Digital Identity Attestation Roundup
https://openssf.org/blog/2021/01/27/digital-identity-attestation-roundup/

Building Trust Within Open Source Software
https://www.identity.com/building-trust-within-open-source-software/

This isn't a problem specific to Open Source:

North Korean hacker got hired by US security vendor, immediately loaded malware
https://arstechnica.com/tech-policy/2024/07/us-security-firm-unwittingly-hired-apparent-nation-state-hacker-from-north-korea/

Twitter employee is convicted in Saudi spy case
https://www.cnn.com/2022/08/09/tech/former-twitter-employee-conviction/index.html

Projects and Data Sources

NPM Provenance: The Missing Security Layer in Popular JavaScript Libraries
https://medium.com/exaforce/npm-provenance-the-missing-security-layer-in-popular-javascript-libraries-b50107927008

Your dependencies have dependencies: new features to assess risk
https://dev.to/stacklok/your-dependencies-have-dependencies-new-features-to-assess-risk-3f1b

Repo Swatting
https://www.bsidesmelbourne.com/2024-repo.html
https://github.com/6mile/repo-swatting (hopefully slides will be posted soon)

Securing open source software: Whose job is it, anyway?
https://www.theregister.com/2024/03/08/securing_opensource_software_whose_job/

Maltego Cyber Investigation Platform &c
https://www.maltego.com/

The US Federal Government Understands that open source is not a supplier
https://www.linkedin.com/feed/update/urn:li:activity:7073021512030511104/

identifying vulnerabilities in open source codebases at scale
https://github.com/chebuya/SASTsweep

OpenSSF Malicious Packages Repository:
https://openssf.org/blog/2023/10/12/introducing-openssfs-malicious-packages-repository/

Common Security Advisory Framework
https://oasis-open.github.io/csaf-documentation/

Exploit Prediction Scoring System
https://www.first.org/epss/

CISA Known Exploited Vulnerability Catalog
https://www.cisa.gov/known-exploited-vulnerabilities-catalog

Vulnerability Exploitability Exchange
https://cyclonedx.org/capabilities/vex/

GitHub Advisory Database
https://github.com/advisories

GitHub Insights
https://docs.github.com/en/issues/planning-and-tracking-with-projects/viewing-insights-from-your-project/about-insights-for-projects

Open Source Insights
https://deps.dev/

CVE/NVD Brokenness Reading List

Filling the NVD data gap
https://github.com/anchore/nvd-data-overrides

NVD Chaos Podcast
https://resilientcyber.substack.com/p/s6e11-josh-bressers-and-dan-lorenc

Identifying Software
https://guix.gnu.org/en/blog/2024/identifying-software/

CVEs CWEs CVSS and It's Discontents
https://www.linkedin.com/pulse/cves-cwes-cvss-its-discontents-sherif-mansour

Open Source Security Podcast Episode 392 – Curl and the calamity of CVE
https://opensourcesecurity.io/2023/09/10/episode-392-curl-and-the-calamity-of-cve/

Shedding Light on CVSS Scoring Inconsistencies
https://arxiv.org/abs/2308.15259

My previous DevOpsDays 2022 talk (Learn From Log4Shell):
https://www.youtube.com/watch?v=PlNtIL_oN0k
https://github.com/pvnovarese/2022-devopsdays

Probably Don't Rely on EPSS Yet:
https://insights.sei.cmu.edu/blog/probably-dont-rely-on-epss-yet/

CVE-2020-19909 is everything that is wrong with CVEs:
https://daniel.haxx.se/blog/2023/08/26/cve-2020-19909-is-everything-that-is-wrong-with-cves/

Software Supply Chains Reading List

Hackers poison source code from largest Discord bot platform
https://www.bleepingcomputer.com/news/security/hackers-poison-source-code-from-largest-discord-bot-platform/

Overcoming Software Supply Chain Attacks
https://blog.karambit.ai/overcoming-software-supply-chain-attacks-c8746a0236ab

iconburst NPM supply chain attack
https://www.scmagazine.com/news/iconburst-supply-chain-attack-uses-typo-squatting-to-spread-malicious-javascript-packages-via-npm

Deceptive Deprecation: The Truth About npm Deprecated Packages
https://blog.aquasec.com/deceptive-deprecation-the-truth-about-npm-deprecated-packages

aquasec/CIS supply chain security guide
https://www.aquasec.com/news/software-supply-chain-security-guide-cis-aqua-security/

OWASP kube top ten risks #2: supply chain vulnerabilities
https://github.com/OWASP/www-project-kubernetes-top-ten/blob/main/2022/en/src/K02-supply-chain-vulnerabilities.md

Git Checkout Authentication to the Rescue of Supply Chain Security
https://archive.fosdem.org/2023/schedule/event/security_where_does_that_code_come_from/

Software supply chain security practices are maturing — but it's a work in progress
https://www.reversinglabs.com/blog/openssf-survey-supply-chain-security-practices

Open Source Supply Chain Security at Google
https://research.swtch.com/acmscored

CVE Half-Day Watcher
https://github.com/Aqua-Nautilus/CVE-Half-Day-Watcher

Few Open Source Projects are Actively Maintained
https://www.infoworld.com/article/3708630/report-finds-few-open-source-projects-actively-maintained.html

The Massive Bug at the Heart of NPM
https://blog.vlt.sh/blog/the-massive-hole-in-the-npm-ecosystem

A Study on Navigating Open-Source Dependency Abandonment:
https://courtney-e-miller.github.io/static/media/WeFeelLikeWereWingingIt.dc3c76d3b3c2d12f4fee.pdf

SBOM Reading List

Making Better SBOMs
https://kccncna2022.sched.com/event/182GT/
https://www.youtube.com/watch?v=earq775L4fc

Reflections on Trusting Trust
https://www.cs.cmu.edu/~rdriley/487/papers/Thompson_1984_ReflectionsonTrustingTrust.pdf
https://web.mit.edu/6.033/2002/wwwdocs/handouts/h25-review2slides2.pdf

Introduction to SBOMs - What is it and do I need one?
https://www.youtube.com/watch?v=jVl6K5h6PzY

Generate sboms with syft and jenkins
https://www.youtube.com/watch?v=nMLveJ_TxAs

Profound Podcast - Episode 10 (John Willis and Josh Corman)
https://www.buzzsprout.com/1758599/8761108-profound-dr-deming-episode-10-josh-corman-captain-america

GitHub Self-Service SBOMs
https://github.blog/2023-03-28-introducing-self-service-sboms/

Do SBOMS Need VEX?:
https://www.linkedin.com/posts/aph10_sbom-softwaresupplychainsecurity-vex-activity-7108017924384137216-VARV/

Glossary

- CVE - Common Vulnerabilities and Exposures - https://cve.mitre.org/
- CVSS - Common Vulnerability Scoring System - https://nvd.nist.gov/vuln-metrics/cvss
- CISA - cybersecurity and infrastructure security agency - https://cisa.gov
- KEV - Known Exploited Vulnerabilities https://www.cisa.gov/known-exploited-vulnerabilities-catalog
- EPSS - Exploit Prediction Scoring System - https://www.first.org/epss/
- SBOM - Software Bill of Materials - https://www.cisa.gov/sbom
- VEX - Vulnerability Exploitability eXchange - https://github.com/openvex/spec
- CSAF - Common Security Advisory Framework - https://oasis-open.github.io/csaf-documentation/
- GHSA - GitHub Security Advisory - https://github.com/advisories
- OpenSSF - Open Source Security Foundation - https://openssf.org/

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