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The Legacy of Log4shell

The Future of DevSecOps

DevOpsDays Chattanooga
2023-11-15

Hello World

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Fediverse: @pvn@mas.to

This is not a utopian talk with magic solutions

Agenda

01 Log4Shell Today

02 A Fundamental Shift

03 Software “Supply” Chains

04 Three Big Things

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The State of Log4Shell Today

Q12 Estimate how many hours you personally have spent to date on each of the following activities.

Answered: 195 Skipped: 15

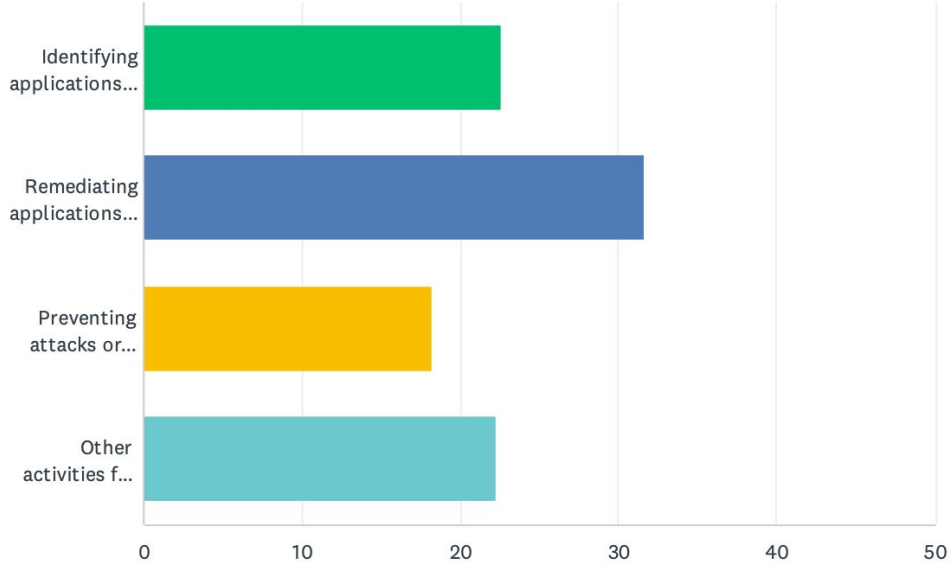

Table I: Top CVEs most used by Chinese state-sponsored cyber actors since 2020

Vendor	CVE	Vulnerability Type
Apache Log4j	CVE-2021-44228	Remote Code Execution
Pulse Connect Secure	CVE-2019-11510	Arbitrary File Read
GitLab CE/EE	CVE-2021-22205	Remote Code Execution
Atlassian	CVE-2022-26134	Remote Code Execution
Microsoft Exchange	CVE-2021-26855	Remote Code Execution


Fukishima Daiichi
Incident: 2011
Cleanup: at LEAST thirty years


Chernobyl
Incident: 1986
Cleanup: at LEAST until 2065

Home / Risk Management

With 40% of Log4j Downloads Still Vulnerable, Security Retrofitting Needs to B… Full-Time Job

Log4j flaw: Why it will still be causing problems a decade from now

Log4Shell ain't over until it's over, warns the US review board tasked with investigating the critical Apache Log4J flaw known as Log4Shell.

Written by Liam Tung, Contributing Writer on July 15, 2022

Mark Chmarny (He/Him) • Following
Product, Infra & DevEx at Cruise
4mo •

29% of Log4j consumption worldwide STILL uses versions that are known to be vulnerable (source: Sonatype)


WE ARE NEVER EVER EVER
GETTING RID OF LOG4SHELL
quickmeme.com

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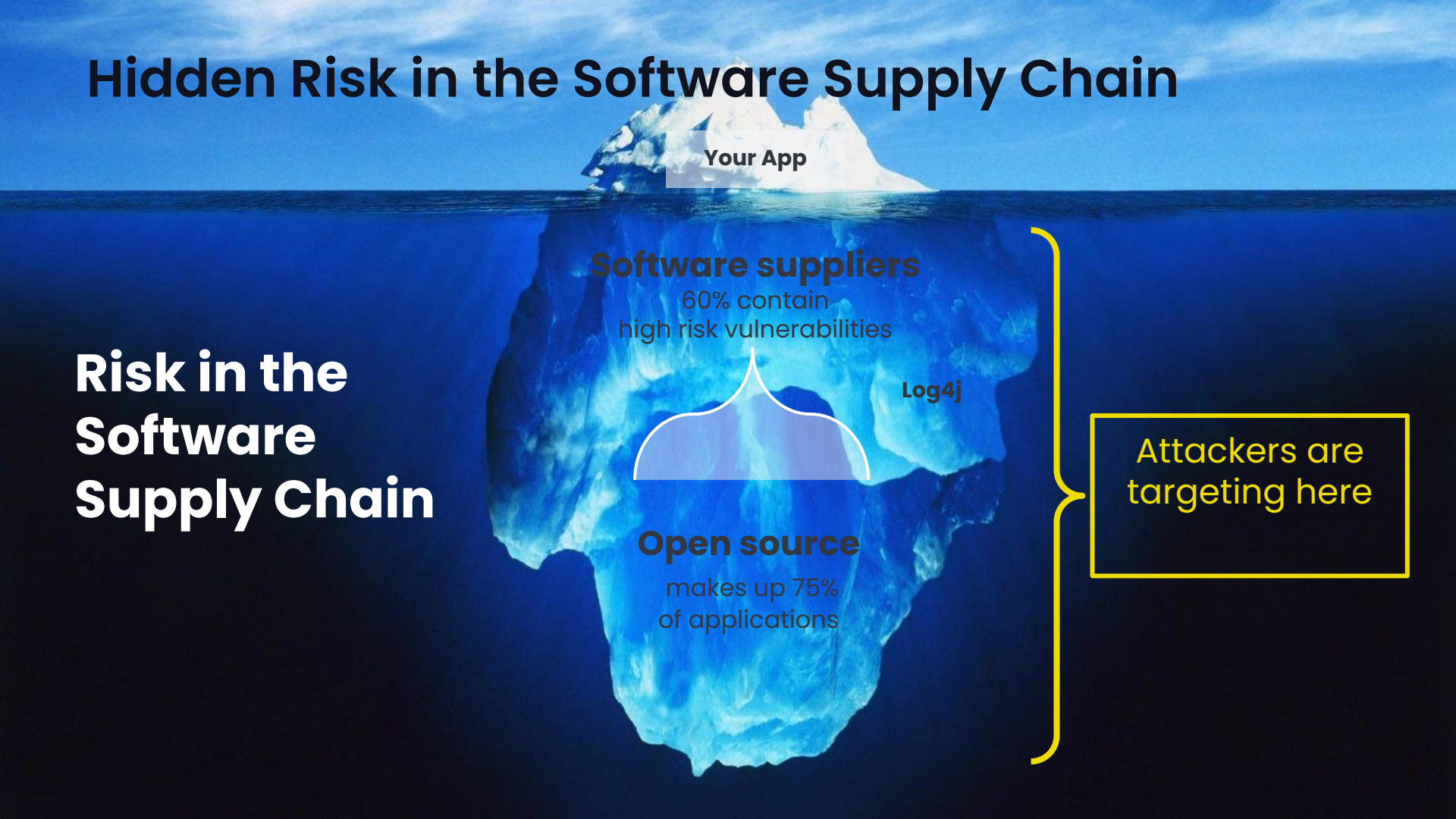
Log4Shell Highlighted a Fundamental Shift

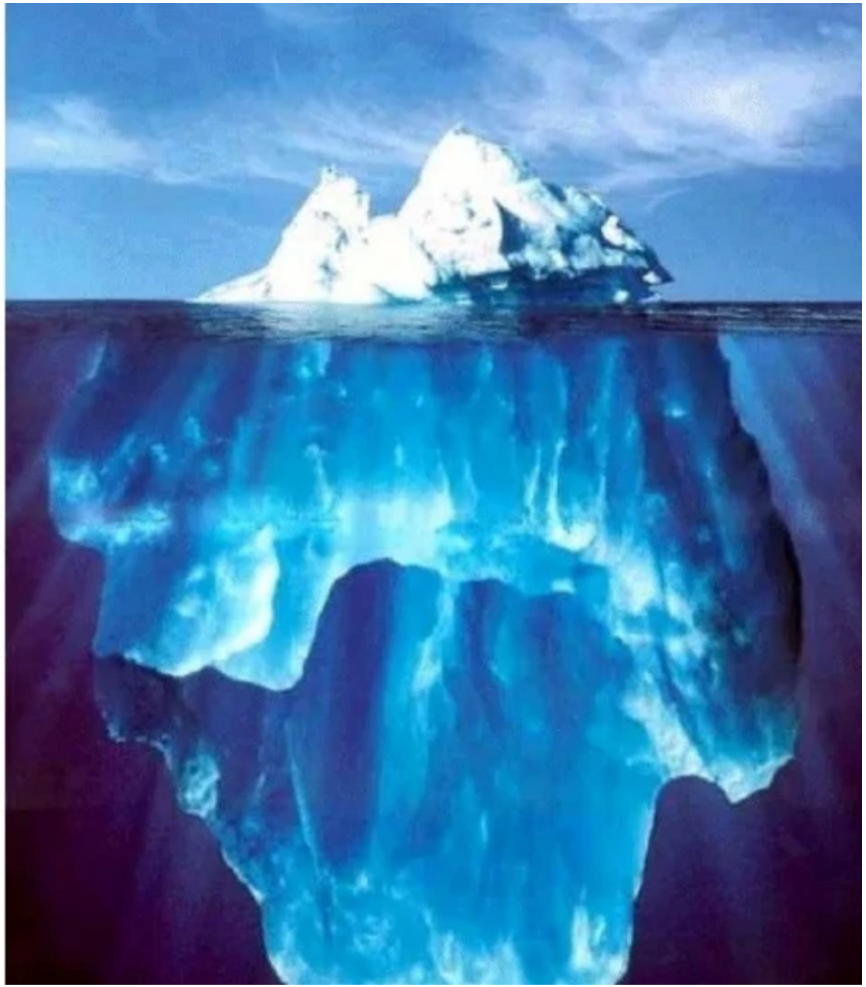
Hidden Risk in the Software Supply Chain

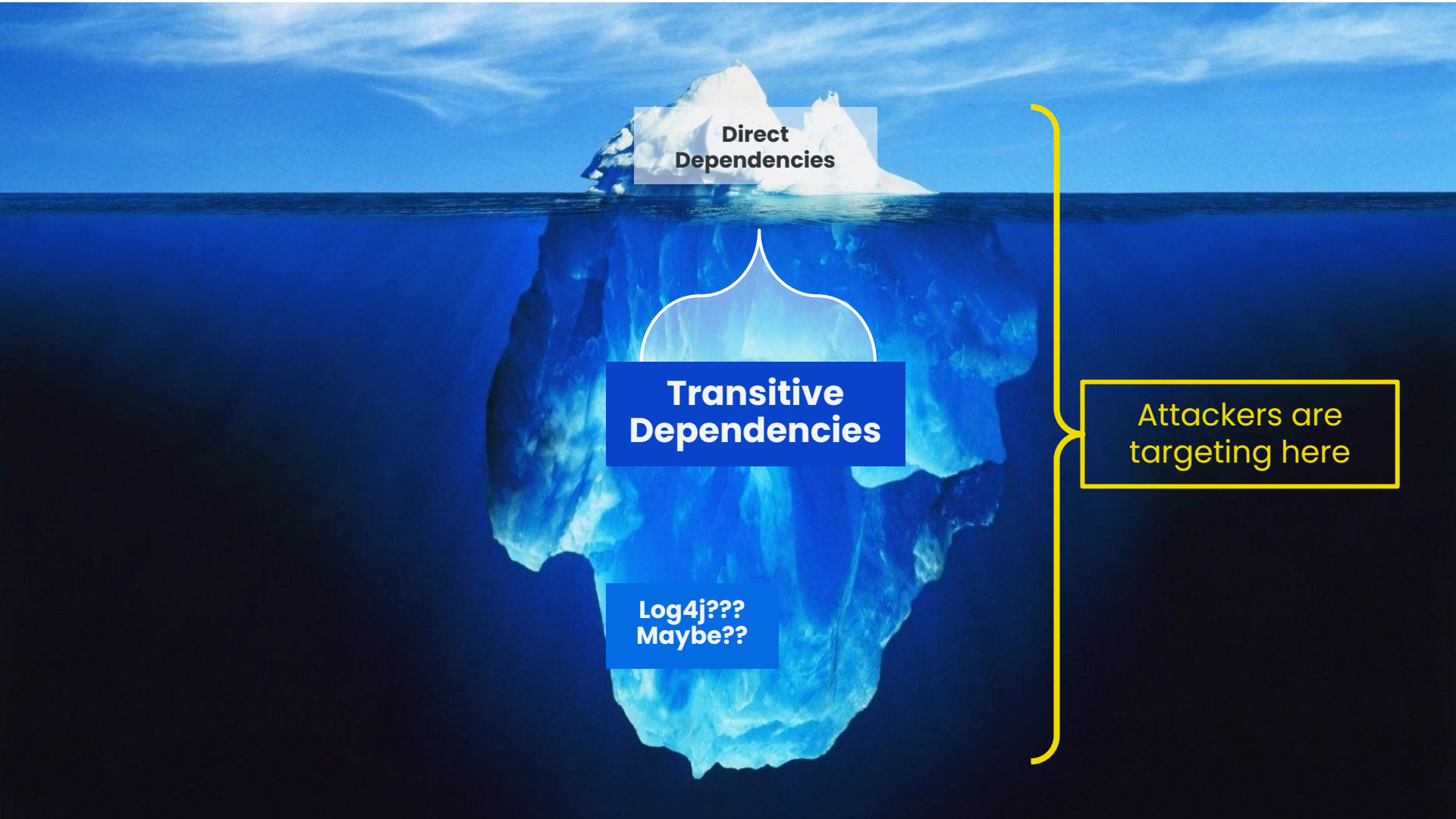


Risk in the Software Supply Chain

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

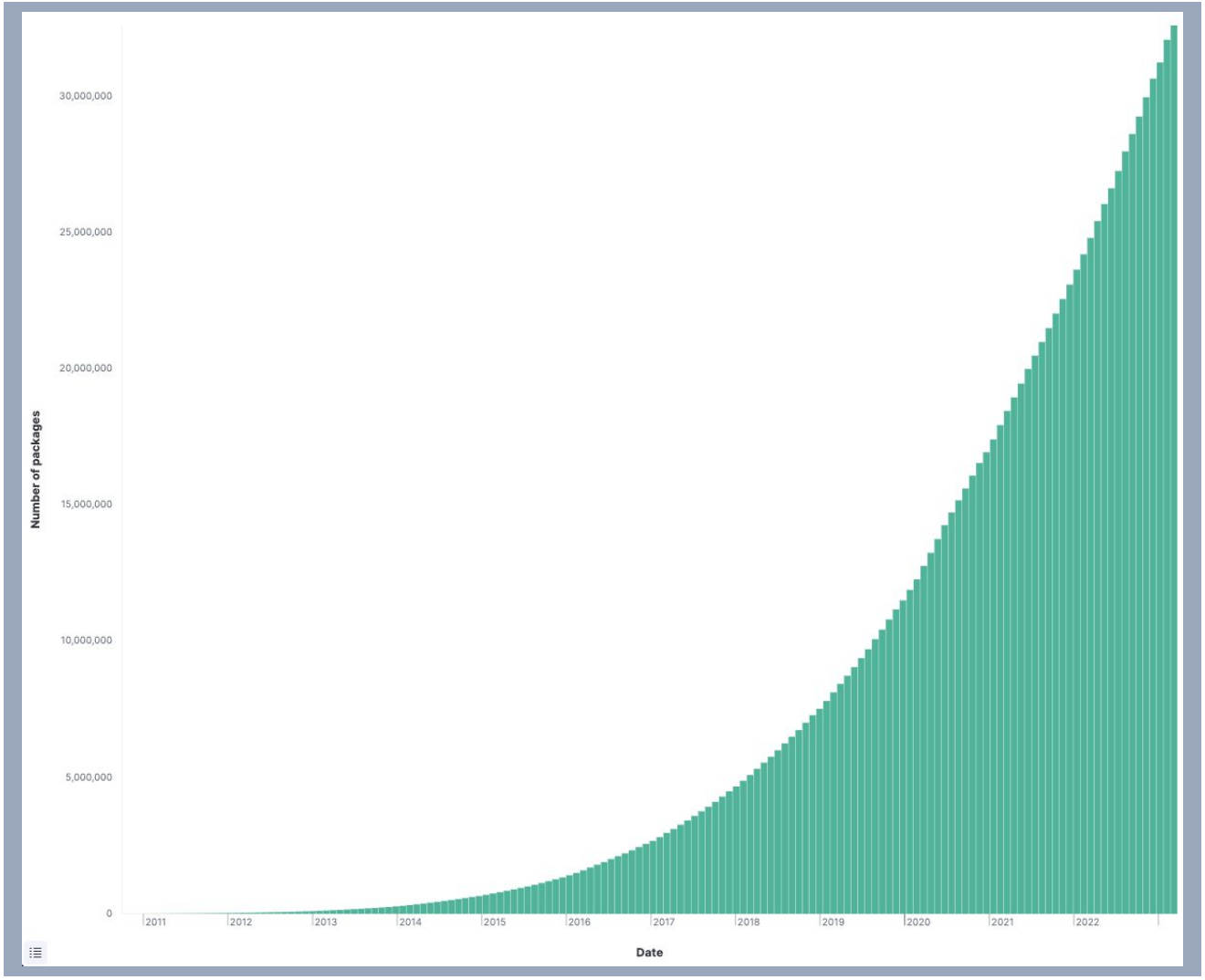



Direct Dependencies
Transitive Dependencies
Log4j??? Maybe??
Attackers are targeting here

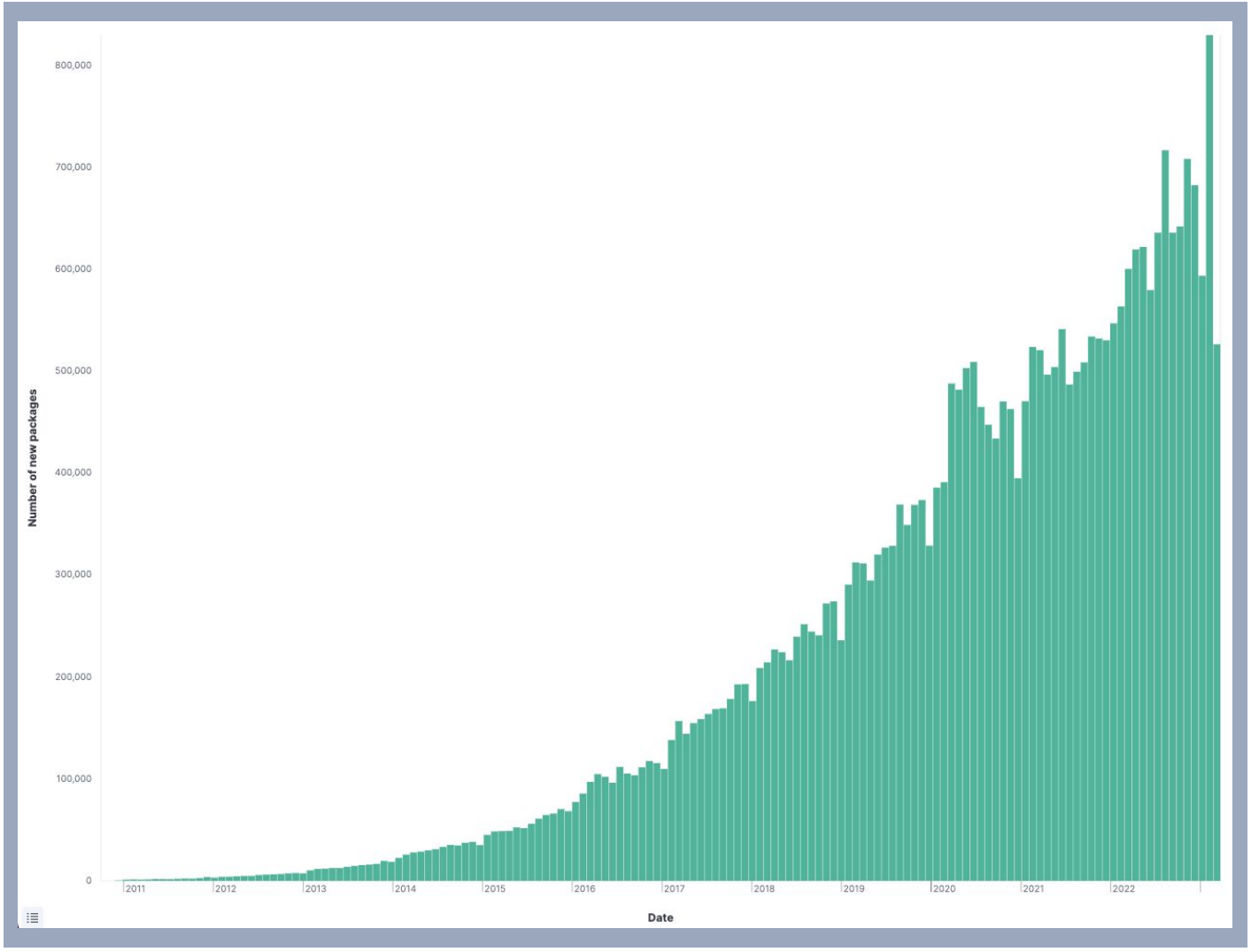
This metaphor...

- 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

Number of
NPM packages



Number of
NEW packages

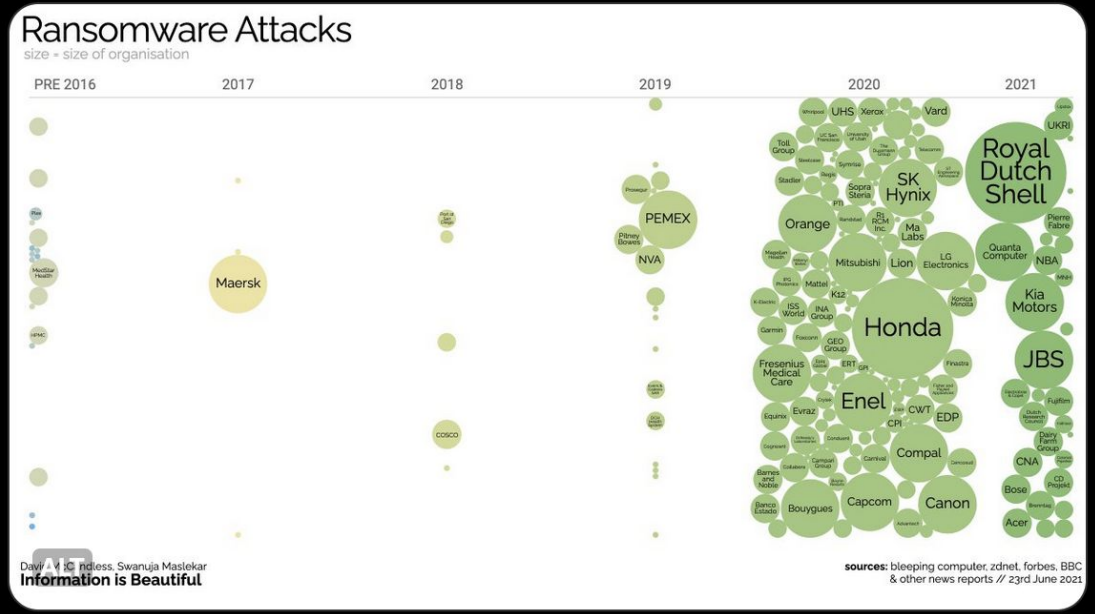


Open source is huge

- NPM introduced 2010
- 32 million packages (as of March 2023)
- Approx. 1,000,000 new packages **per month**
- That’s just NPM!

Information is Beautiful
@infobeautiful

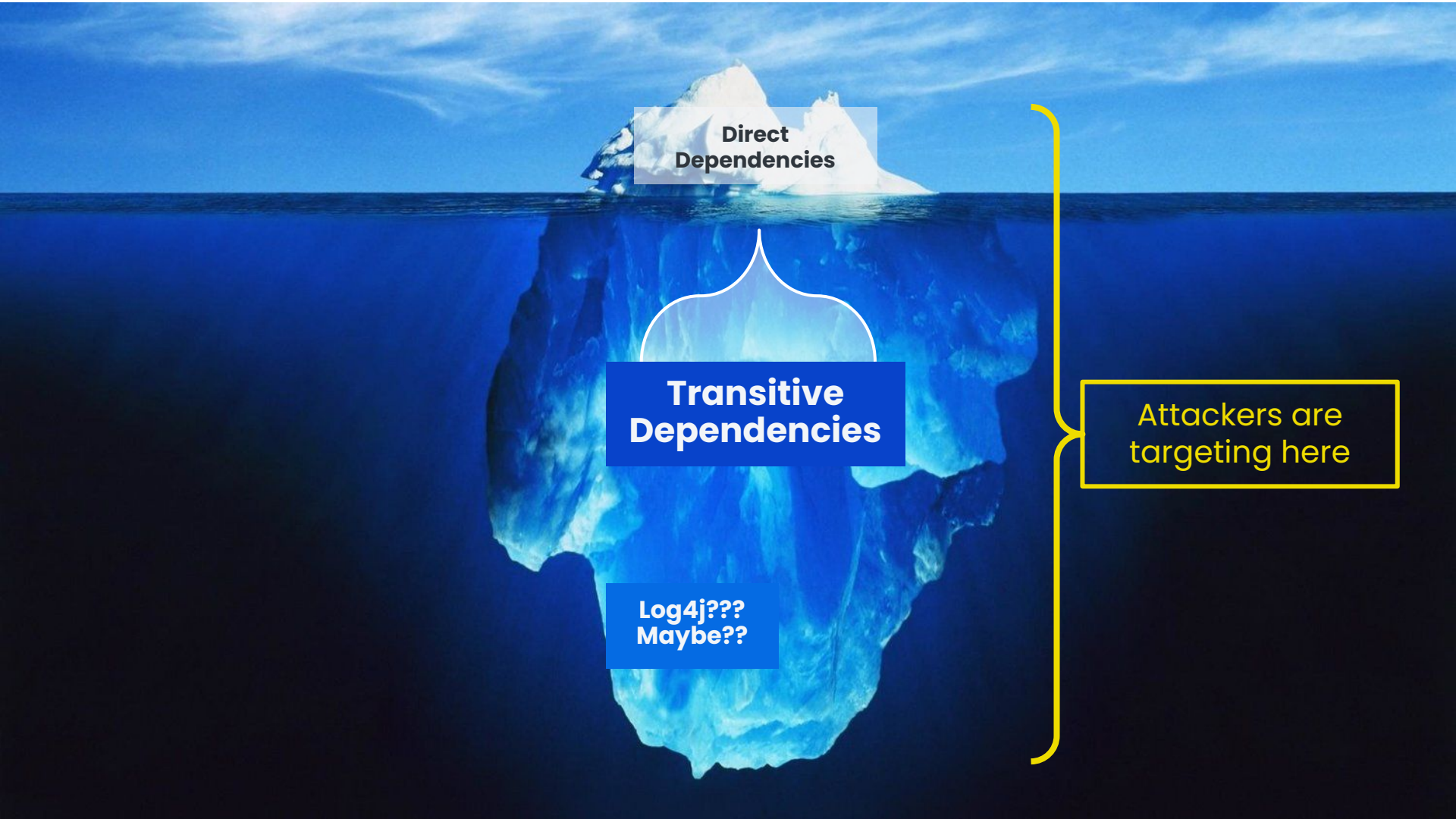
Are #Ransomware attacks increasing? I think #Ransomware attacks are increasing...
interactive: bit.ly/3h1IYPs



11:33 AM · Jun 23, 2021

The predictable consequence

- Ransomware has exploded along with transitive dependencies and open source in general
- I don’t believe in coincidences


Direct Dependencies
Transitive Dependencies
Log4j??? Maybe??
Attackers are targeting here

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
  - I don’t know what the end game is but generating them is better than nothing, figure out the details later

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Software “Supply” Chains

An Example Project Health Metric:

Number of Maintainers

daniel:// stenberg://
@bagder

If you are a multi billion dollar company and are concerned about log4j, why not just email OSS authors you never paid anything and demand a response for free within 24 hours with lots of info? (company name redacted for *my* peace of mind)

Dear Haxx Team Partner,

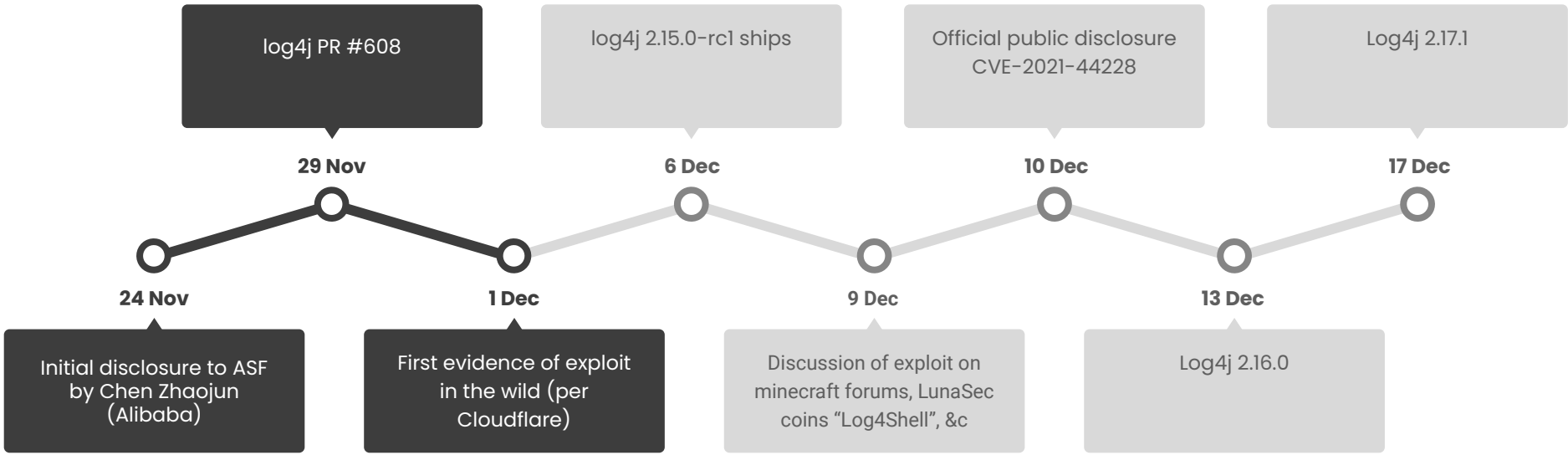
You are receiving this message because [redacted] uses a product you developed. We request you review and respond within 24 hours of receiving this email. If you are not the right person, please forward this message to the appropriate contact.

As you may already be aware, a newly discovered zero-day vulnerability is currently impacting Java logging library Apache Log4j globally, potentially allowing attackers to gain full control of affected servers.

The security and protection of our customers' confidential information is our top priority. As a key partner in serving our customers, we need to understand your risk and mitigation plans for this vulnerability.

Please respond to the following questions using the template provided below.

log4shell Timeline



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Stop thinking about open source like a vendor

This

Not this

Summary of Software Supply Chains

- Red Hat is a supplier - 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.

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Three Big Things

CVE-2020-19909

On August 25 2023, we got an email to the curl-library mailing list from Samuel Henrique that informed us that "someone" had recently created a CVE, a security vulnerability identification number and report really, for a curl problem.

```
I wanted to let you know that there's a recent
curl CVE published and it doesn't look like it
was acknowledged by the curl authors since it's
not mentioned in the curl website: CVE-2020-19909
```

We can't tell who filed it. We just know that it is now there.

Paul Novarese (He/Him) • You
Software Supply Chain Security at Anchore
1yr • Edited •

The #log4j debacle is going to have ramifications far beyond the vulnerability itself. There has been a lot of inertia in how issues are evaluated and classified, how information about those issues is disseminated, and how organizations respond to them, and #log4shell has exposed a lot of these problems. This will be a catalyst for a lot of changes that are way overdue.

April King
@CubicleApril

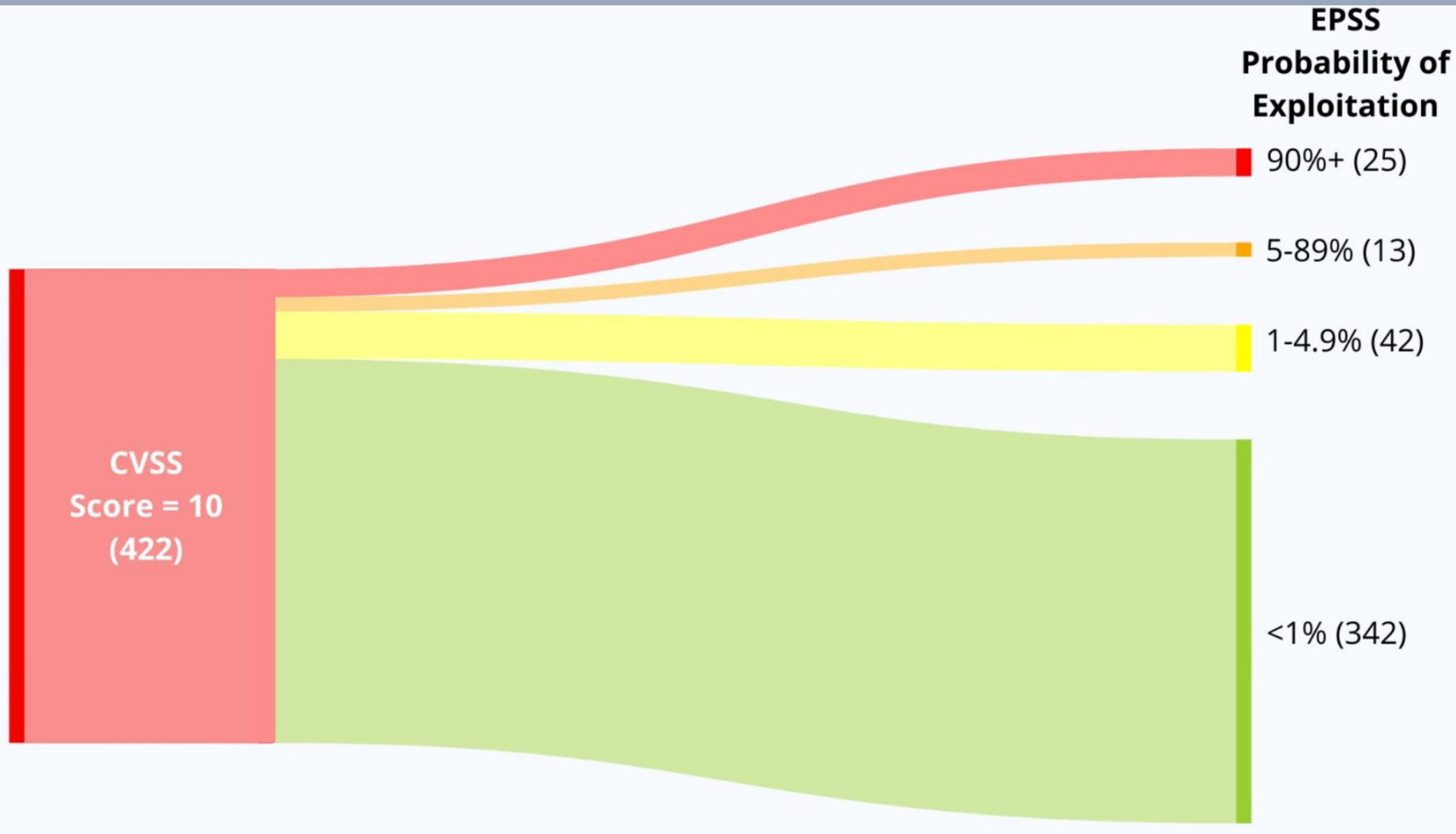
The fact that there are almost 10,000 CVEs with the same CVSS score as the Log4j vulnerability suggests to me that maybe the scale should be logarithmic.

6:26 PM · Dec 11, 2021 · Twitter for iPhone

71 Retweets **6** Quote Tweets **736** Likes

Big Thing #1: If Not CVE/CVSS, Then What?

- GHSAs (more transparent than CVEs)
- CISA KEV, EPSS, VEX, CSAF, &c
- OpenSSF Malicious Packages Repository
- 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)

Big Thing #2: Project Health/Insights

- This is PROACTIVE (the better advisory data, scoring etc is about reactive improvements)
- This is (currently) a manual process (getting easier)
- Evaluating project health isn't directly about safety, it's about tracking all of those deps in the iceberg,
- Are the projects you're depending on healthy, will you be able to work with them?

September 4, 2023 – September 11, 2023

Period: 1 week

Overview

20 Active pull requests

13 Active issues

16	4	6	7
Merged pull requests	Open pull requests	Closed issues	New issues

Excluding merges, **9 authors** have pushed **16 commits** to main and **21 commits** to all branches. On main, **20 files** have changed and there have been **240 additions** and **124 deletions**.

1 Release published by **1** person

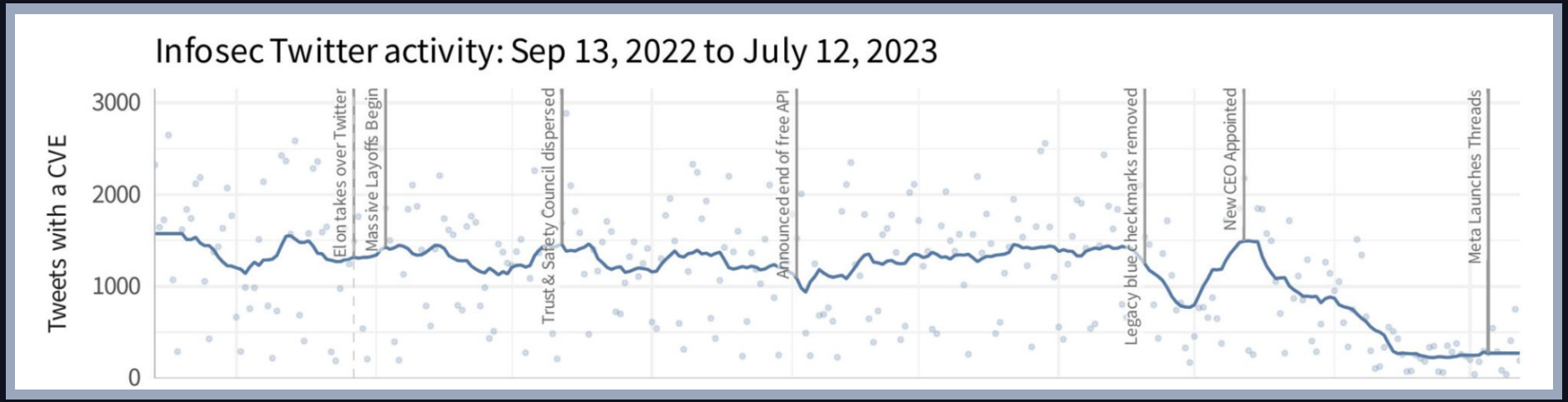
v0.90.0
published 3 hours ago

16 Pull requests merged by **7** people

fix the help output of power-user
#2113 merged 8 hours ago

Big Thing #3: Twitter is Dead

- Twitter was incredibly central to Log4Shell reaction, forming consensus, and generally just figuring out what was happening
- If log4shell dropped today, this reaction/recovery would be notably worse because of infosec splintering to (e.g.) mastodon, linkedin, bsky, threads
- None of these networks have the critical mass that Twitter had and it doesn't seem to be improving


Infosec Twitter activity: Sep 13, 2022 to July 12, 2023
Tweets with a CVE
3000
2000
1000
0
Elon takes over Twitter
Massive Layoffs Begin
Trust & Safety Council dispersed
Announced end of free API
Legacy blue checkmarks removed
New CEO Appointed
Meta Launches Threads

Big Changes

1. Better Metrics and Data Sources are Coming
2. Tracking Dependencies is More Proactive
3. Twitter is Over

Call to Action

SBOM Everywhere: https://github.com/ossf/sbom-everywhere
I don't know what the end game is but generating them is better than nothing, figure out the details later
The (first two) "big things" are still very embryonic and probably not ready for prime time but tools are starting to adopt a lot of this

SBOMs: https://github.com/anchore/syft
Vulnerabilities: https://github.com/anchore/grype
Webinars: https://anchore.com/webinars/

Recap

- Log4Shell is radioactive and immortal
- How software gets made has changed
- We don’t know what’s in our software
- We don’t know who is supplying it
- We have to change how we evaluate it
- GitHub is uniquely positioned
- Try to be proactive

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Q&A

Download Syft

https://github.com/anchore/syft

Download Grype

https://github.com/anchore/grype

Let us know if you like it by giving us a star on GitHub

Get an invite to our open source community Slack:
https://anchore.com/slack/

These slides and lab examples archived here:
https://github.com/pvnovarese/2023-11-legacy-of-log4shell

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Notes, &c.

Footnotes

Log4Shell's immortality:
https://www.zdnet.com/article/log4j-flaw-why-it-will-still-be-causing-problems-a-decade-from-now/
https://securityintelligence.com/articles/log4j-downloads-vulnerable/

possible origin of the iceberg - https://www.slideshare.net/loriayre/open-source-library-system-software-free-is-just-the-tip-of-the-iceberg
Open Source is Bigger Than You Can Imagine - https://anchore.com/blog/open-source-is-bigger-than-you-imagine/
State of the Software Supply Chain - https://www.sonatype.com/hubfs/9th-Annual-SSSC-Report.pdf
log4j survey etc - https://anchore.com/log4j/
Half Day Vulnerabilities - https://github.com/Aqua-Nautilus/CVE-Half-Day-Watcher
The Death of Infosec Twitter - https://www.cyentia.com/the-death-of-infosec-twitter/

Patrick Garrity discussing EPSS and Improved Metrics:
https://www.linkedin.com/posts/patrickmgarrity_the-evolution-of-patricks-sankey-matics-activity-7118334146728357888-zxxn/

Various tweets &c:
https://twitter.com/CubicleApril/status/1469825942684160004
https://www.linkedin.com/posts/novarese_log4j-log4shell-activity-6876206319238463488-8bEA
https://twitter.com/bagder/status/1484672924036616195
https://lists.haxx.se/pipermail/daniel/2023-September/000032.html

Projects and Data Sources

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/

Reading List

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/

I am not a Supplier::
https://www.softwaremaxims.com/blog/not-a-supplier
https://opensourcesecuritypodcast.libsyn.com/episode-365-i-am-not-your-supplier-with-thomas-depierre

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

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

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/

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

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

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

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

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/

SBOM Takeaways

00 SBOMs enable continuous, automated security/compliance checks, reduce time spent identifying and remediating issues

01 SBOMs improve a lot of things but do not solve every problem you have

02 Log4j is extremely easy to find, OpenSSL 3 is often obscured

03 SBOMs are more effective when created by maintainers rather than consumers, but something is better than nothing

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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

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/