I'm Jon 👋

@jonhoo on the internet;
formerly MIT, now Rust at AWS

Supply Chain Security

MIT 6.5660 — 2023

All the software you use matters.

Not just “is the code insecure”, but *could* it be insecure/manipulated.

Supply Chain Attacks are increasing

Sonatype 8th State of the Software Supply Chain (2022)
https://www.sonatype.com/state-of-the-software-supply-chain/

IDENTIFYING EMERGING CYBER SECURITY THREATS AND CHALLENGES FOR 2030
March 2023

TABLE OF CONTENTS

According to the EU, top threat in the next 7 years

European Union Agency for Cybersecurity (ENISA)
was European Network and Information Security Agency
https://www.enisa.europa.eu/publications/enisa-foresight-cybersecurity-threats-for-2030

European Commission

English EN

Search

Home > Press corner > State of the Union: New EU cybersecurity rules

Press release | 15 September 2022 | Brussels

State of the Union: New EU cybersecurity rules ensure more secure hardware and software products

Stricter supply chain security rules in the EU

https://ec.europa.eu/commission/presscorner/detail/en/ip_22_5374

THE JAPAN TIMES
THE INDEPENDENT VOICE IN ASIA

13°C P/CLOUDY
TOKYO (5 a.m.)
TODAY'S PRINT EDITION

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MENU

BUSINESS

Japan passes economic security bill to guard sensitive technology

REUTERS, KYODO

SHARE May 11, 2022

Japan's parliament passed an economic security bill Wednesday aimed at guarding technology and reinforcing critical supply chains, while also imposing tighter oversight of Japanese firms working in sensitive sectors or critical infrastructure.

Measures in the legislation, which is primarily aimed at warding off risks from China, will be implemented over two years once it is enacted, according to the bill. It comes after the United States imposed restrictions on technology imports, such as on semiconductors, amid growing tension with Beijing.

Stricter supply chain security rules in Japan

https://www.japantimes.co.jp/news/2022/05/11/business/japan-passes-economic-security-bill-protect-sensitive-technology/

NATIONAL ARCHIVES

FEDERAL REGISTER

The Daily Journal of the United States Government

0 Sign in Sign up

Presidential Document

Improving the Nation's Cybersecurity

A Presidential Document by the Executive Office of the President on 05/17/2021

PUBLISHED DOCUMENT

Executive Order 14028 of May 12, 2021

Improving the Nation's Cybersecurity

By the authority vested in me as President by the Constitution and the laws of

Sec. 4. *Enhancing Software Supply Chain Security.* (a) The security of software used by the Federal Government is vital to the Federal Government's ability to perform its critical functions. The development of commercial software often lacks transparency, sufficient focus on the ability of the software to resist attack, and adequate controls to prevent tampering by malicious actors. There is a pressing need to implement more rigorous and predictable mechanisms for ensuring that products function securely, and as intended. The security and integrity of "critical software"—software that performs functions critical to trust (such as affording or requiring elevated system privileges or direct access to networking and computing resources)—is a particular concern. Accordingly, the Federal Government must take action to rapidly improve the security and integrity of the software supply chain, with a priority on addressing critical software.

Executive Order in the US

https://www.federalregister.gov/documents/2021/05/17/2021-10460/improving-the-nations-cybersecurity

NIST Special Publication
NIST SP 800-161r1

Cybersecurity Supply Chain Risk Management Practices for Systems and Organizations

Jon Boyens
Angela Smith
Computer Security Division
Information Technology Laboratory

Nadya Bartol
Kris Winkler
Alex Holbrook
Matthew Fallon
Boston Consulting Group

This publication is available free of charge from:
https://doi.org/10.6028/NIST.SP.800-161r1

May 2022

New supply chain security guidance; no laws (yet)

https://www.nist.gov/news-events/news/2022/05/nist-updates-cybersecurity-guidance-supply-chain-risk-management

National Cyber Security Centre

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Home | Information for... | Advice & guidance | Education & skills | Products & services | News, blogs, events...

New 'supply chain mapping' guidance

The latest addition to the NCSC's suite of supply chain guidance is now available.

Supply chain mapping is the process of recording, storing and using information gathered from suppliers who are involved in a company's supply chain. Building on our existing supply chain guidance, we're pleased to announce new guidance that focusses explicitly on this process, aimed at at procurement specialists, risk managers and cyber security professionals.

Supply chain mapping follows the principles of all good risk management; organisations need to understand the risks inherent in

WRITTEN BY
Ian M
Deputy Director for Government Cyber Resilience, NCSC

PUBLISHED
16 February 2023

New supply chain security guidance in the UK

https://www.ncsc.gov.uk/blog-post/new-supply-chain-mapping-guidance

When you have a moment:

https://www.sonatype.com/resources/vulnerability-timeline

Compared to respondents working in information security, the IT managers are:

1.8 times more likely to strongly agree to

"We know the Software Bill of Materials (SBOM) for every application."

2.4 times more likely to strongly agree to

"We address remediation of security issues as a regular part of development work (i.e., security issues treated as normal defects)."

3.5 times more likely to respond with "Less than 1 day" to

"When our team becomes aware of a vulnerability in an open source software component that we use, how long does it take (estimated) to mitigate this vulnerability across our application(s)?"

In an ideal world, management's perception should align with information security's experiences.

The scariest part: many aren't even aware

(from Sonatype)

Do you know:

(the answer better be yes)
((but it probably isn't))

What you are deploying where?

Where it came from?

What's in it?

Do you know:

(the answer better be yes)
((but it probably isn't))

What you are deploying where?

Where it came from?

What's in it?

Questions you should be able to answer:

- What software is currently at each host?
- What software was on host H at time T?
- Why did a deploy happen to host H at time T?
- Where are artifacts of software version V deployed?
- When were artifacts of software version V no longer in use anywhere?
- What configuration did V have on host H at time T?

Some of these are for “where are known risks present”
Some are for “where and when were we vulnerable”
Some are for proactive analytics (e.g., “how many different versions are we using at once”)
Note: “artifacts of software version V”, not “software version V”. We’ll get back to that one.

Every deployment should be logged

- How was the deployment initiated?
- When did the deployment happen?
- What went into the deployment?
- What was deployed to?

This information must be append-only, durable, and kept long term.

The first one is important for cases like CI/CD credentials being leaked (Travis CI, GitHub Actions, etc.)
Append-only because even rollbacks are important. Don't let attackers hide their tracks.
Securing the deployment logging system is itself tricky!

Every host matters

Production hosts

Developer environments

Beta environments

Embedded devices

Customer devices

Other environments (e.g., Lambda, CloudFlare Workers)

Do you know:

(the answer better be yes)
((but it probably isn't))

What you are deploying where?

Where it came from?

What's in it?

Can you trace every artifact back to sources you trust?

Not quite a “turtles all the way down” problem, but close.

Verified path from only trust anchors

If you downloaded it:

- Do you trust the entity that built it?
- How do you know that entity actually built it?
- Did that entity verify ⬇⬇⬇ (and how do you know?)

If you built it yourself:

- How did you get the source?
- Is that source what the author intended to publish?
- Do you trust the tools you downloaded the source with?
- Do you trust the tools you verified the source with?
- Do you trust the tools you built the artifact with?
- Do you trust the host you're building the source on?

Trust anchor: a source you assume, rather than derive, is trustworthy
As an example, Maven Central serves binary JARs, and allows publishing source, but no requirement the two match up.
Note: you can sever this search at many different points. May trust "Microsoft", and that eliminates chunks of the graph.
Will need to choose authors you trust, mark particular source instances as trusted, or trust tools you run over the source they provide you.

Not quite a “turtles all the way down” problem, but close.

Alex Birsan Follow
Feb 9, 2021 · 11 min read · · Listen

Dependency Confusion: How I Hacked Into Apple, Microsoft and Dozens of Other Companies

The Story of a Novel Supply Chain Attack

Ever since I started learning how to code, I have been fascinated by the level of trust we put in a simple command like this one:

```
pip install package_name
```

BLEEPINGCOMPUTER

Researcher hacks over 35 tech firms in novel supply chain attack

By Ax Sharma

February 9, 2021 01:04 PM 2

A researcher managed to breach over 35 major companies' internal systems, including Microsoft, Apple, PayPal, Shopify, Netflix, Yelp, Tesla, and Uber, in a novel software supply chain attack.

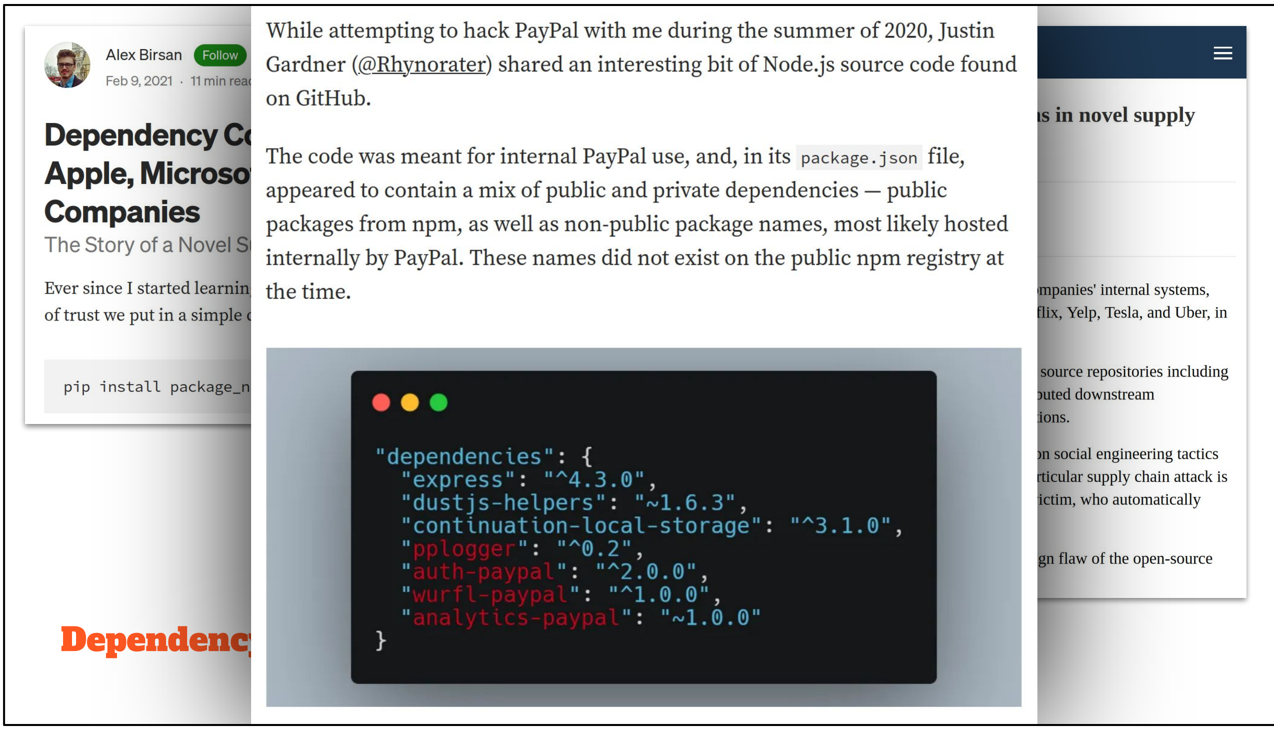
The attack comprised uploading malware to open source repositories including PyPI, npm, and RubyGems, which then got distributed downstream automatically into the company's internal applications.

Unlike traditional typosquatting attacks that rely on social engineering tactics or the victim misspelling a package name, this particular supply chain attack is more sophisticated as it needed no action by the victim, who automatically received the malicious packages.

This is because the attack leveraged a unique design flaw of the open-source ecosystems called **dependency confusion.**

Dependency Confusion (2021)

https://medium.com/@alex.birsan/dependency-confusion-4a5d60fec610
https://www.bleepingcomputer.com/news/security/researcher-hacks-over-35-tech-firms-in-novel-supply-chain-attack/



Alex Birsan Follow
Feb 9, 2021 · 11 min read

Dependency Co… Apple, Microso… Companies

The Story of a Novel S…

Ever since I started learnin… of trust we put in a simple c…

```
pip install package_n…
```

Dependenc…

While attempting to hack PayPal with me during the summer of 2020, Justin Gardner (@Rhynorater) shared an interesting bit of Node.js source code found on GitHub.

The code was meant for internal PayPal use, and, in its `package.json` file, appeared to contain a mix of public and private dependencies — public packages from npm, as well as non-public package names, most likely hosted internally by PayPal. These names did not exist on the public npm registry at the time.

```
"dependencies": {
  "express": "^4.3.0",
  "dustjs-helpers": "~1.6.3",
  "continuation-local-storage": "^3.1.0",
  "pplogger": "^0.2",
  "auth-paypal": "^2.0.0",
  "wurfl-paypal": "^1.0.0",
  "analytics-paypal": "~1.0.0"
}
```

…s in novel supply

…mpanies' internal systems, …flix, Yelp, Tesla, and Uber, in

… source repositories including …buted downstream …ions.

…n social engineering tactics …rticular supply chain attack is …ictim, who automatically

…gn flaw of the open-source

It's hard to get this right! Very briefly: widely used tool for IT monitoring (oh the irony) with auto-updates. A (signed) update from SolarWinds included a backdoored DLL. Attackers either access build hosts or got access to signing creds (updates lived on FTP server with bad pw ("solarwinds123")). How would you detect this?

https://www.politico.eu/article/solarwinds-largest-cyberattack-ever-microsoft-president-brad-smith/
https://www.nytimes.com/2020/12/14/us/politics/russia-hack-nsa-homeland-security-pentagon.html

On the Feasibility of Stealthily Introducing Vulnerabilities in Open-Source Software via Hypocrite Commits

Qiushi Wu and Kangjie Lu
University of Minnesota
{wu000273, kjlu}@umn.edu

***Abstract*—Open source software (OSS) has thrived since the forming of Open Source Initiative in 1998. A prominent example is the Linux kernel, which has been used by numerous major software vendors and empowering billions of devices. The higher availability and lower costs of OSS boost its adoption, while its openness and flexibility enable quicker innovation. More importantly, the OSS development approach is believed to produce more reliable and higher-quality software since it typically has thousands of independent programmers testing and fixing bugs of the software collaboratively.**

In this paper, we instead investigate the insecurity of OSS from

Its openness also encoura
thousands of independent
of the software. Such an
not only allows higher fl
evolution, but is also belie
security [21].

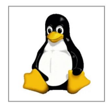
A prominent example o
one of the largest open-so
lines of code used by bil

phoronix

Search

University Banned From Contributing To Linux Kernel For Intentionally Inserting Bugs

Written by Michael Larabel in Linux Kernel on 21 April 2021 at 07:48 AM EDT. 117 Comments



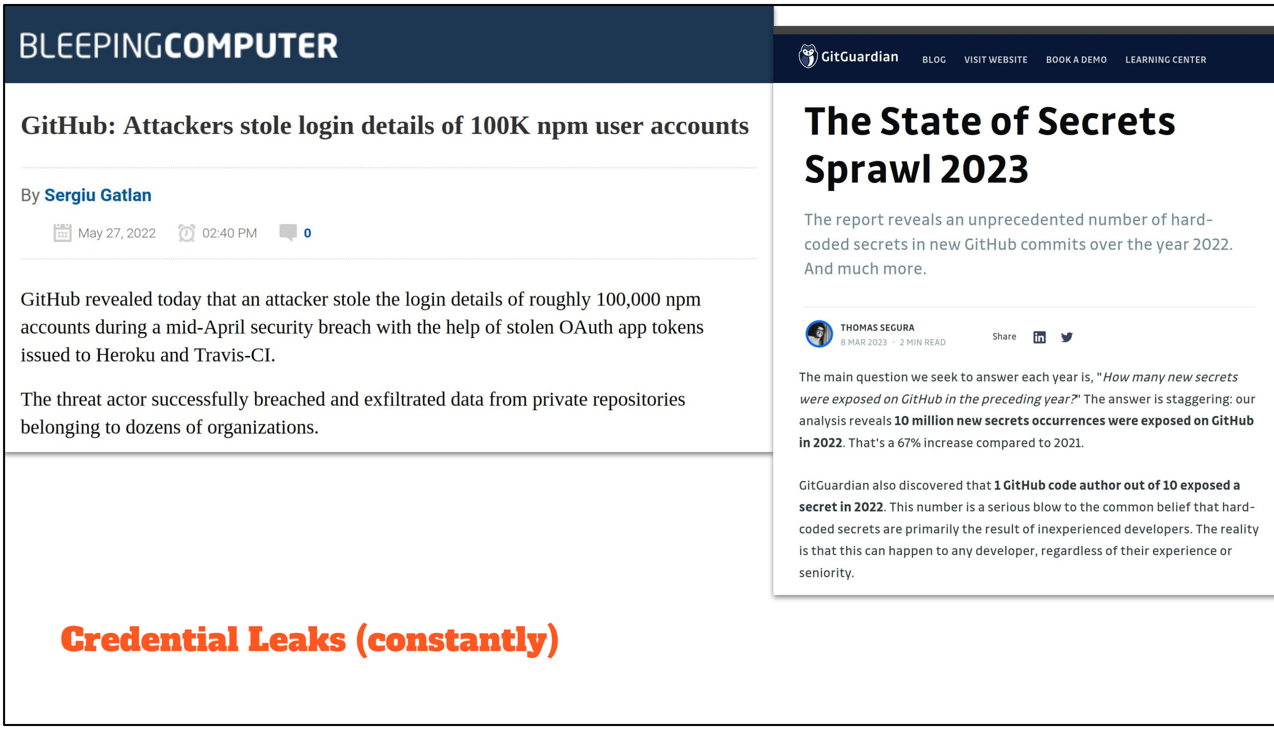
Greg Kroah-Hartman has banned a US university from trying to mainline Linux kernel patches over intentionally submitting questionable code with security implications and other "experiments" in the name of research.

Stemming from this research paper where researchers from the University of Minnesota intentionally worked to stealthy introduce vulnerabilities into the mainline Linux kernel. They intentionally introduced use-after-free bugs into the kernel covertly for their research paper.

University of Minnesota & Linux (2021)

The commits did not ultimately land, but the attack vector is real (and scary).

https://raw.githubusercontent.com/QiushiWu/qiushiwu.github.io/main/papers/OpenSourceInsecurity.pdf
https://www.phoronix.com/news/University-Ban-From-Linux-Dev


BLEEPINGCOMPUTER

GitHub: Attackers stole login details of 100K npm user accounts

By Sergiu Gatlan

May 27, 2022 02:40 PM 0

GitHub revealed today that an attacker stole the login details of roughly 100,000 npm accounts during a mid-April security breach with the help of stolen OAuth app tokens issued to Heroku and Travis-CI.

The threat actor successfully breached and exfiltrated data from private repositories belonging to dozens of organizations.

GitGuardian BLOG VISIT WEBSITE BOOK A DEMO LEARNING CENTER

The State of Secrets Sprawl 2023

The report reveals an unprecedented number of hard-coded secrets in new GitHub commits over the year 2022. And much more.

THOMAS SEGURA 8 MAR 2023 · 2 MIN READ Share

The main question we seek to answer each year is, "*How many new secrets were exposed on GitHub in the preceding year?*" The answer is staggering: our analysis reveals **10 million new secrets occurrences were exposed on GitHub in 2022**. That's a 67% increase compared to 2021.

GitGuardian also discovered that **1 GitHub code author out of 10 exposed a secret in 2022**. This number is a serious blow to the common belief that hard-coded secrets are primarily the result of inexperienced developers. The reality is that this can happen to any developer, regardless of their experience or seniority.

Makes it hard to trust that third-party artifacts (or code!) you download is actually from the author.
"But Jon, just sign it" — many repositories don't even support signing!
Also watch out for outright compromised registries.

https://www.bleepingcomputer.com/news/security/github-attackers-stole-login-details-of-100k-npm-user-accounts/
https://blog.gitguardian.com/the-state-of-secrets-sprawl-2023/

BLEEPINGCOMPUTER

PHP's Git server hacked to add backdoors to PHP source code

By **Ax Sharma**

March 29, 2021 03:32 AM 1

In the latest software supply chain attack, the official PHP Git repository was hacked and the code base tampered with.

Yesterday, two malicious commits were pushed to the *php-src* Git repository maintained by the PHP team on their *git.php.net* server.

The threat actors had signed off on these commits as if these were made by known PHP developers and maintainers, Rasmus Lerdorf and Nikita Popov.

PHP git repository compromise (2021)

What did they do? Inject an RCE backdoor into PHP itself. Found a few hours later.

https://www.bleepingcomputer.com/news/security/phps-git-server-hacked-to-add-backdoors-to-php-source-code/

https://www.theverge.com/2022/1/9/22874949/developer-corrupts-open-source-libraries-projects-affected —colors.js (23M/wk), faker.js — infinite loop weird characters
https://jfrog.com/blog/malware-civil-war-malicious-npm-packages-targeting-malware-authors/ — many masquerading as colors.js! some are _for_ writing malware, but are _also_malicious
https://snyk.io/blog/peacenotwar-malicious-npm-node-ipc-package-vulnerability/ — overwrite all files with ♥ if origin is Russia or Belarus

TREND

Entreprises | Pour particuliers

Linux Mint Website Hacked; ISO Downloads Replaced with a Backdoor

22 février 2016

The systems of users who downloaded Linux Mint on February 20 may be at risk after it was discovered that Hackers from Sofia, Bulgaria managed to hack into Linux Mint, currently one of the most popular Linux distributions available. According to Linux Mint's report, the hacker tricked users into downloading a version of Linux Mint ISO with a backdoor installed by replacing the download links on the site. The link leads to one of their servers offering malicious ISO images of the Linux Mint 17.3 Cinnamon edition. The website has been down since February 21, Sunday, resulting in the loss of thousands of downloads.

Linux Mint ISO hack (2016)

https://www.trendmicro.com/vinfo/fr/security/news/cybercrime-and-digital-threats/linux-mint-website-hacked-iso-downloads-replaced-with-a-backdoor

Fighting tainted sources is difficult

SigStore to have authors sign what they publish.

The Update Framework (TUF) to check that registries behave.

Mandate 2FA for publishing to mitigate leaked credentials.

Automated continuous monitoring of known risks (like CVEs).

Ultimately, you're at the mercy of authors…

…so choose the authors you'll depend on wisely.

There's more, such as if the author's publish box is compromised!
Automated code scanning may help, if you have the source…

If you wish to make an apple pie from scratch, you must first invent the universe.

Carl Sagan

Do you know:

(the answer better be yes)
((but it probably isn't))

What you are deploying where?

Where it came from?

What's in it?

Whether you download or run `make` yourself, how do you know all the things that ended up in the artifact?
Need to know that list so that we know what we've deployed!

One artifact, many inputs

Regular dependencies.

Dependencies from the build host.

Downloads during the build.

Vendored or inlined sources.

Bundled binary artifacts.

Any of the above transitively...

Finding all of these is tricky even if you have the source.
If you don't doubly so.
Software that tries to do this does exist, although it's best-effort.

Heuristics will only get you so far.

Software Bill of Materials

This is a trust exercise too — do you trust that authors included everything?
But it's better than only relying on heuristics/detection.

BoMs have existed elsewhere for ages

- Started in car manufacturing, since **everywhere**.
- Helps for:
  - **Design**: which part should go there?
  - **Sales**: what parts do I order?
  - **Manufacturing**: which part goes here?
  - **Repair**: which part broke?
  - **Recall**: is the affected part present?
- Similar benefits for software.

Provenance (origin info) is useful

- Security breadcrumbs
  - Tells you if something is at-risk (e.g., via CVE + NVD)
  - May tell you **how** it is at-risk
  - Can also tell you if it is not!
- License and compliance information
- Supply chain funding (in theory)
- Waste identification
- Quality assessment (e.g., maintenance status/EoL)

Less important to an attacker

A list of potential weak-points, true.

But in practice, attackers:

- already have decent heuristics and other incomplete channels;
- can probe for weaknesses directly;

The SBOM is **more** incrementally-useful to defenders.

SBOMs are hierarchical lists of contents

I produce one for my software.

It includes a list of records, each one holding:

Component name	Version string	Hash	UID
Supplier name	Author	Relationship	Relationship assertion

Multiple data formats exist. Two common ones are:

- Software Package Data Exchange (SPDX)
- Software Identification Tagging (SWID)

Why is author and supplier different? Quoth spec: “Until this state of transcendent SBOM utopia is achieved, SBOM authors may want to make non-authoritative claims or assertions about SBOMs for which the authors are not the suppliers.”
Relationship is usually “included in”. Can be “self”.

Assertion is “what do I know of these relationships?”, such as: “unknown”, “partial” (I know there at at least these, but there may be more), “known” (I know there are only these), and “root” (I know there are none).
https://www.ntia.gov/files/ntia/publications/framingsbom_20191112.pdf
Multiple formats exist; SPDX and SWID are two common ones. SPDX = Software Package Data Exchange; SWID = Software Identification (tagging)

SBOMs can be combined

If you use my software, you can concatenate my SBOM.

Incomplete SBOMs are okay — there’s incremental benefit!

Don’t even need to publish your SBOMs!

SBOMs are not required to be signed, but it’s vital if you want the trust anchor, especially around author == supplier.

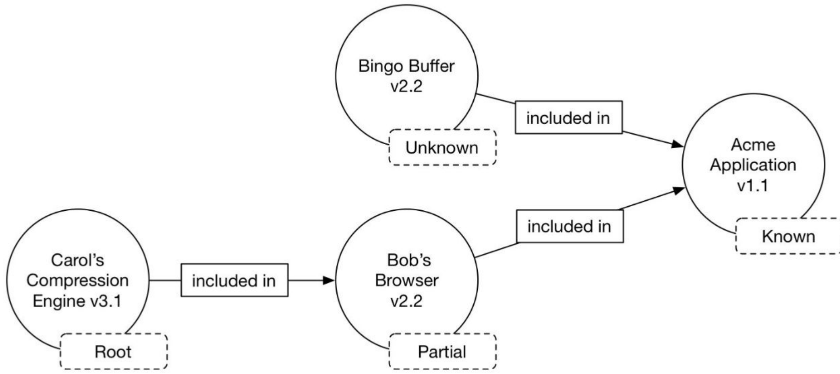


Figure 2: Conceptual SBOM tree with upstream relationship assertions

Component Name	Supplier Name	Version String	Author	Hash	UID	Relationship	Relationship Assertion
Application	Acme	1.1	Acme	0x123	234	Self	Known
|--- Browser	Bob	2.1	Bob	0x223	334	Included in	Partial
|--- Compression Engine	Carol	3.1	Acme	0x323	434	Included in	Root
|--- Buffer	Bingo	2.2	Acme	0x423	534	Included in	Unknown

Imagine here for example that this was concatenated with an SBOM signed by Carol that asserts Supplier = Author = Carol for Compression Engine with a _different_ hash for same version.

https://www.ntia.gov/files/ntia/publications/framingsbom_20191112.pdf

SBOMs also combine horizontally

Doesn't have to be "included in":

- "was built by"
- "was present when built"
- "generated by"
- "patched with"
- "read data from"
- etc.

You can keep adding info and improving analysis independently.

Also "runtime/test" dependencies

Do you know:

(the answer better be yes)

What you are deploying where?

Where it came from?

What's in it?