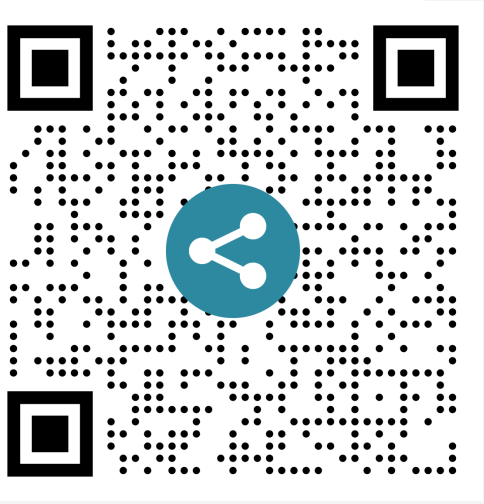


Who are my roommates?

SBOM to know better your dependencies

$ whoami

Olivier Gatimel, Java developer since 2009
Lead dev @CARL Berger-Levrault, a CMMS software editor

Agenda

- What is a SBOM ?
- SPDX and CycloneDX explained
- Tools to generate SBOM
- Tools to analyze SBOM
- Some formats to exchange vulnerabilities

What is a SBOM ?

Software Bill of Materials

- A list of ingredients that make up software components
- Machine-readable document
- Provides mainly component identifier, hashes, license

➡️ For Java users: not to be confused with Maven BOM, which is an indication of versions to use in a project

Usages

- Legal department: license compliance
- Exploitation: current vulnerabilities
- Others: OSS libraries health check, Readme, ...

SPDX

Software Package Data eXchange

- Started in 2010, hosted by Linux Foundation
- ISO/IEC 5962:2021
- Made first for license management: https://spdx.dev/ids/
- Open standard for SBOMS

CycloneDX

- Started in 2017, backed by OWASP Foundation
- Last release in January 2022 with version 1.4
- More than SBOM : VEX, HardwareBOM, VDR, ...

SPDX or CycloneDX

- SPDX license list is the reference (~300 entries)
- CycloneDX is more efficient for vulnerability management
- Conversion tools exists (but some information could be lost)

Identifiers are important !

- You want to be precise about what you have
- Fuzzy matching is not perfect

Some identifier types

- Package URL (purl)
  - https://github.com/package-url/purl-spec
  - Maven example: `pkg:maven/group/barfoo@2.14.2`
  - Npm example: `pkg:npm/foobar@12.3.1`
- Common Platform Enumeration (CPE)
  - https://nvd.nist.gov/products/cpe
  - Example: `cpe:2.3:a:ntp:ntp:4.2.8:p3:*:*:*:*:*:*`

SPDX identifier

```
"name": "jackson-core",
"SPDXID": "SPDXRef-Package-java-archive-jackson-core-3475e1f30056bc6a",
"versionInfo": "2.14.2",
```

with sometimes

```
"externalRefs":[{
  "referenceCategory":"PACKAGE-MANAGER",
  "referenceLocator":"pkg:maven/com.fasterxml.jackson.core/jackson-core@2.14.2",
  "referenceType":"purl"}
  ]}
```

CyloneDX identifier


```
"bom-ref":"pkg:maven/com.fasterxml.jackson.core/jackson-core@2.14.2
?package-id=3475e1f30056bc6a",
"cpe":"cpe:2.3:a:jackson-core:jackson-core:2.14.2:*:*:*:*:*:*:*",
"group":"com.fasterxml.jackson.core",
"name":"jackson-core",
"purl":"pkg:maven/com.fasterxml.jackson.core/jackson-core@2.14.2",
"type":"library","version":"2.14.2"
```

Tools to generate

- syft: for containers or archives (CycloneDX, SPDX)
  - paketo: use Syft to include sboms in app image
- cdxgen : various supported languages (CycloneDX)
  - Maven or Gradle plugin
- SPDX Maven plugin
- Using GitHub dependency graph (SPDX)
- OpenTelemetry had an idea to create SBOM from traces metadata
- And probably many more!

Some examples

Made from [paketo Java samples] (spring-boot3 project)

📝 sample-java.plugin.cdx.json

```
# Gradle plugin
$ gradle cyclonedxBom
```

📝 sample-java.plugin+syft.cdx.json

```
# Enriched with Syft
$ syft packages file:sample-java.plugin.cdx.json -o cyclonedx-json
```

📝 sample-java.paketo.cdx.json

```
# Extracted from paketo layers
$ pack sbom download samples/java --output-dir ./
cd layers/sbom/launch/paketo-buildpacks_executable-jar
```

📝 sample-java.syft.cdx.json

```
# Paketo image analyzed by Syft
$ syft packages docker:samples/java -o cyclonedx-json
```

With some differences between tools

Source	Number of deps
Gradle (project)	58
Syft (Gradle CycloneDX)	58
Paketo (layer)	54
Syft (image)	341

Gradle plugin ≠ Gradle+Syft

\+

cpe: `cpe:2.3:a:jackson-core:jackson-core:2.14.2:*:*:*:*:*:*:*"`
properties: syft properties

—

description: pom description
externalReferences: project vsc
group: maven group
hashes: jar hashes
modified: deprecated field

Gradle plugin ≠ Paketo

➕ `spring-boot-starter-*`

➡️ Because in another paketo layer

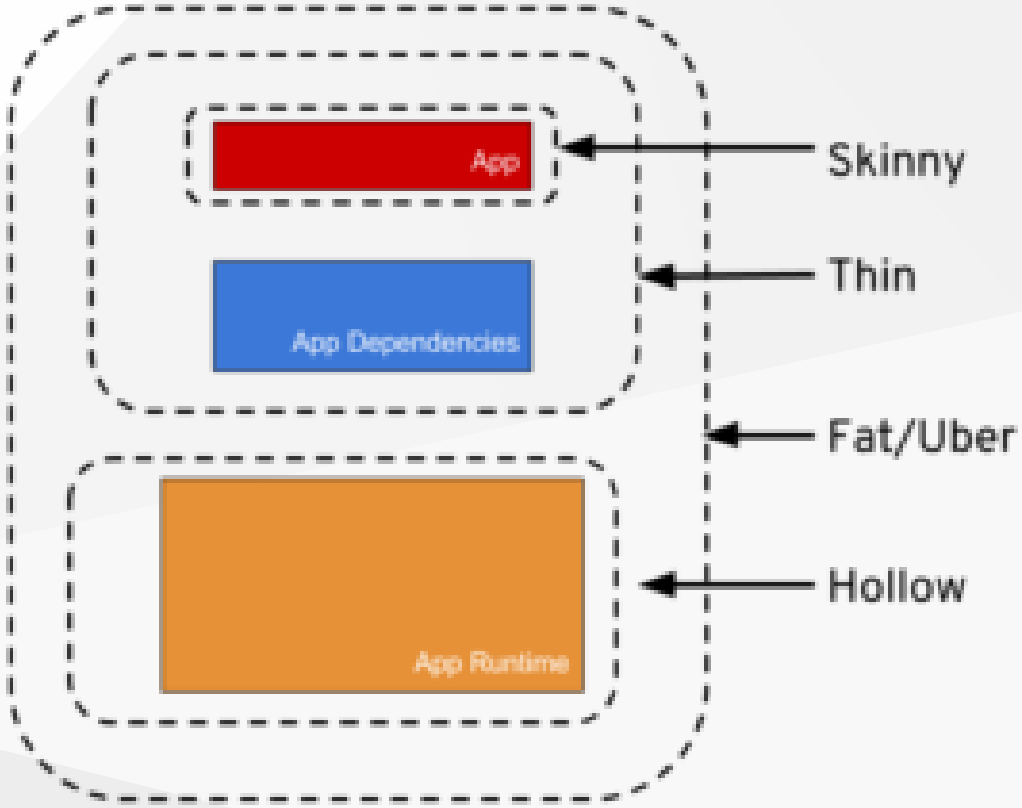
➖ `jctools-core`

➡️ Not found by Gradle plugin?

The fat-jar hidden roommates

- Fat/uber jars don't have transitive dependencies
- But they include dependencies in their archive

➡️ SBOM should show them



Example with netty-common

Shade `org.jctools` as `io.netty.util.internal.shaded.org.jctools`

- Not in pom dependencies
- But information in `META-INF/maven` poms in fat-jar archive

➡️ Syft uses Jar and Gradle plugin uses graph dependencies

Mixing tools is important!

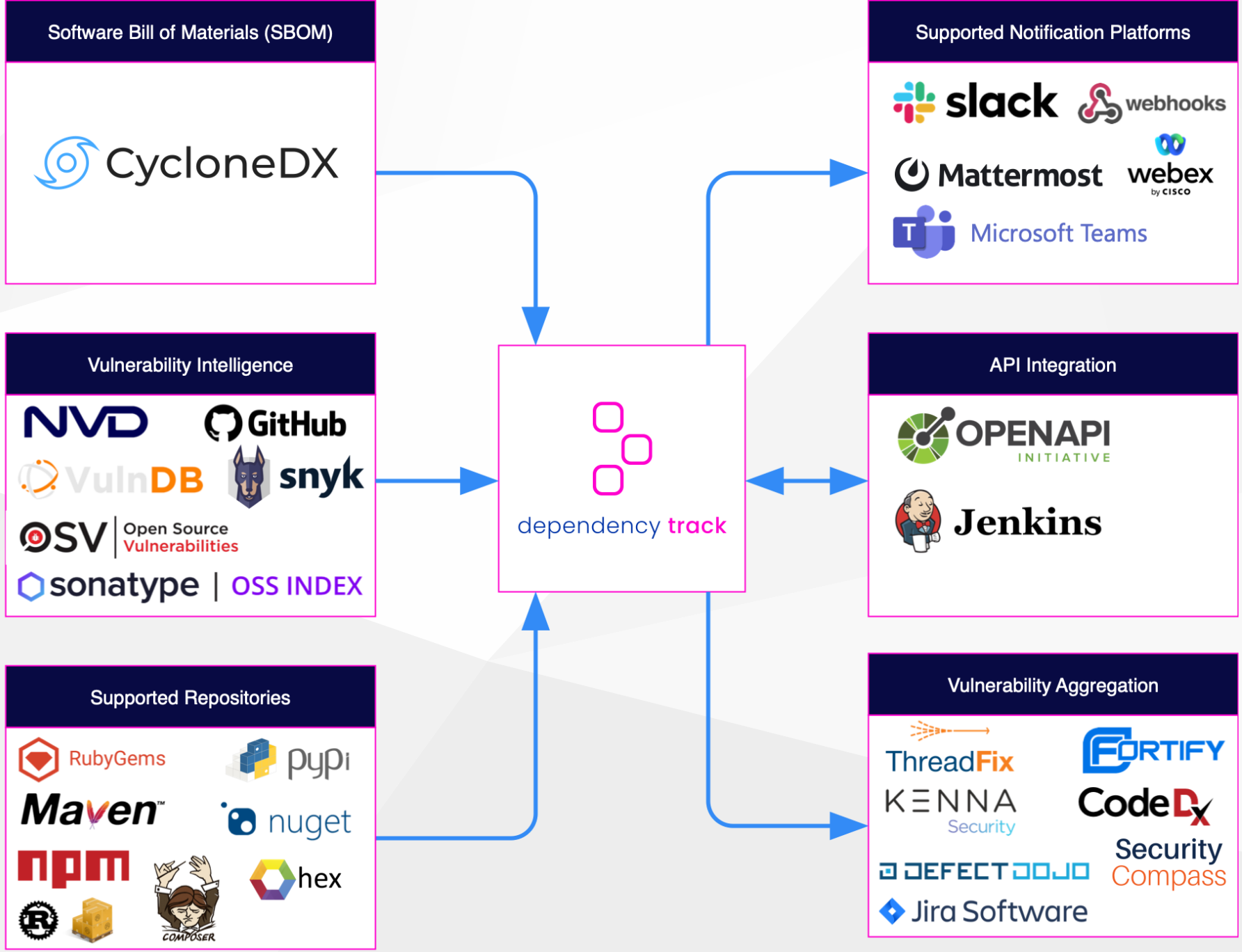
and you have to override some information sometimes

Some tools to analyze SBOM

- Sonatype BOM Doctor : online CycloneDX SBOM scanner
  - https://bomdoctor.sonatype.com/
- Dependency-track: self-hosted webapp
  - https://dependencytrack.org/
- Grype: cli tool
  - https://github.com/anchore/grype
- Trivy: cli tool
  - https://github.com/aquasecurity/trivy

Dependency-track

- OSS project, developed by OWASP since 2013
- Only support CycloneDX
  - Won't support SPDX (GH#1222)
- CSAF in progress
- Multiple vulnerabilities sources : NVD, Github, Snyk, ...
- Policy management for license and vulnerabilities
- Multiple projects and tracking over time


Software Bill of Materials (SBOM)
CycloneDX
Supported Notification Platforms
slack
webhooks
Mattermost
webex
by CISCO
Microsoft Teams
Vulnerability Intelligence
NVD
GitHub
VulnDB
snyk
OSV
Open Source Vulnerabilities
sonatype | OSS INDEX
dependency track
API Integration
OPENAPI INITIATIVE
Jenkins
Supported Repositories
RubyGems
pypi
Maven
nuget
npm
hex
COMPOSER
Vulnerability Aggregation
ThreadFix
FORTIFY
KENNA Security
CodeDx
DEFECTDOJO
Security Compass
Jira Software

License compliance

- A SBOM with license info can be an artifact for OpenChain conformance
  - An open source license compliance program (ISO/IEC 5230)
  - https://www.openchainproject.org/
- Should (must ?) use SPDX license id to help analysis

Vulnerabilities report

- A SBOM is quickly huge!
- Not all vulnerabilities on all dependencies are applicable
- Clients want to know exploitable vulnerabilities

VDR (Vulnerability Disclosure Report)

A list of all known vulnerabilities from a vendor

In a nut shell:

- SBOM for dependencies list
- VDR for vulnerabilities list

But is it exploitable ?

- CVSS: **C**ommon **V**ulnerability **S**coring **S**ystem
  - A base score from 0 to 10, but the detail (CVSS Vector) is also important
- EPSS: **E**xploit **P**rediction **S**coring **S**ystem
  - Community driven effort to give a score (0 to 1) about the exploitation of a vulnerability
- KEV: **K**nown **E**xploited **V**ulnerabilities (Catalog)
  - A list of vulnerabilities exploited in the wild (maintened by CISA)

⚠ CVE-2022-22965 is in the CISA Known Exploited Vulnerabilities Catalog

CISA vulnerability name:
Spring Framework JDK 9+ Remote Code Execution Vulnerability

CISA required action:
Apply updates per vendor instructions.

CISA description:
Spring MVC or Spring WebFlux application running on JDK 9+ may be vulnerable to remote code execution (RCE) via data binding.

Added on 2022-04-04 Action due date 2022-04-25

Exploit prediction scoring system (EPSS) score for CVE-2022-22965

Probability of exploitation activity in the next 30 days: 97.50%

Percentile, the proportion of vulnerabilities that are scored at or less: ~ 100 % EPSS Score History EPSS FAQ

CVSS scores for CVE-2022-22965

Base Score	Base Severity	CVSS Vector	Exploitability Score	Impact Score	Source
7.5	HIGH	AV:N/AC:L/Au:N/C:P/I:P/A:P	10.0	6.4	nvd@nist.gov
Access Vector: Network	Access Complexity: Low	Authentication: None	Confidentiality Impact: Partial	Integrity Impact: Partial	Availability Impact: Partial				
9.8	CRITICAL	CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:H/I:H/A:H	3.9	5.9	nvd@nist.gov
Attack Vector: Network	Attack Complexity: Low	Privileges Required: None	User Interaction: None	Scope: Unchanged	Confidentiality: High	Integrity: High	Availability: High		

https://www.cvedetails.com/cve/CVE-2022-22965/

VEX (Vulnerability Exploitability eXchange)

- Concept defined by CISA (Cybersecurity and Infrastructure Security Agency)
- Machine-readable document
- Indicate if software is affected by a vulnerability
- Contains statements:
  - vulnerability details
  - status: (not) affected, fixed, under investigation

Are you affected by CVE-XXXX ?

- A vulnerability is not in your VDR or VEX
  - Because it is not linked to your dependencies
  - And you don't have a false positive (thanks to good identifiers)
- But this vulnerability made the news (think Log4J...)
- Now you have to communicate about it 😑

➡️ Some people suggest to list **all** vulnerabilities in VEX file

A word about CSAF

- Managed by OASIS Open
- Version 2.0 out since last november
- Enable to disclose and consume security advisories in machine readable format
- Specify distribution and discovery of CSAF documents
- Not a CVE replacement
- https://oasis-open.github.io/csaf-documentation/faq.html

Example with RedHat

CSAF 2.0 publishing since February 2023

- https://www.redhat.com/fr/blog/csaf-vex-documents-now-generally-available
- https://access.redhat.com/security/data/csaf/v2/advisories/

To sum up

- Mix tools to generate SBOM
- Use clear identifiers for components (purl, cpe)
- Load SBOM in various tools to check if identifiers are understood
- Track your dependencies
- Still a debate between publishing
  - a document of only exploitable vulnerabilities
  - a document of all vulnerabilities responses
  - or both ?

Some links to go deeper

- CISA definitions : https://www.cisa.gov/sbom
- CycloneDX specification : https://cyclonedx.org/specification/overview/
- CSAF FAQ : https://oasis-open.github.io/csaf-documentation/faq.html
- VDR vs VEX : https://owasp.org/blog/2023/02/07/vdr-vex-comparison