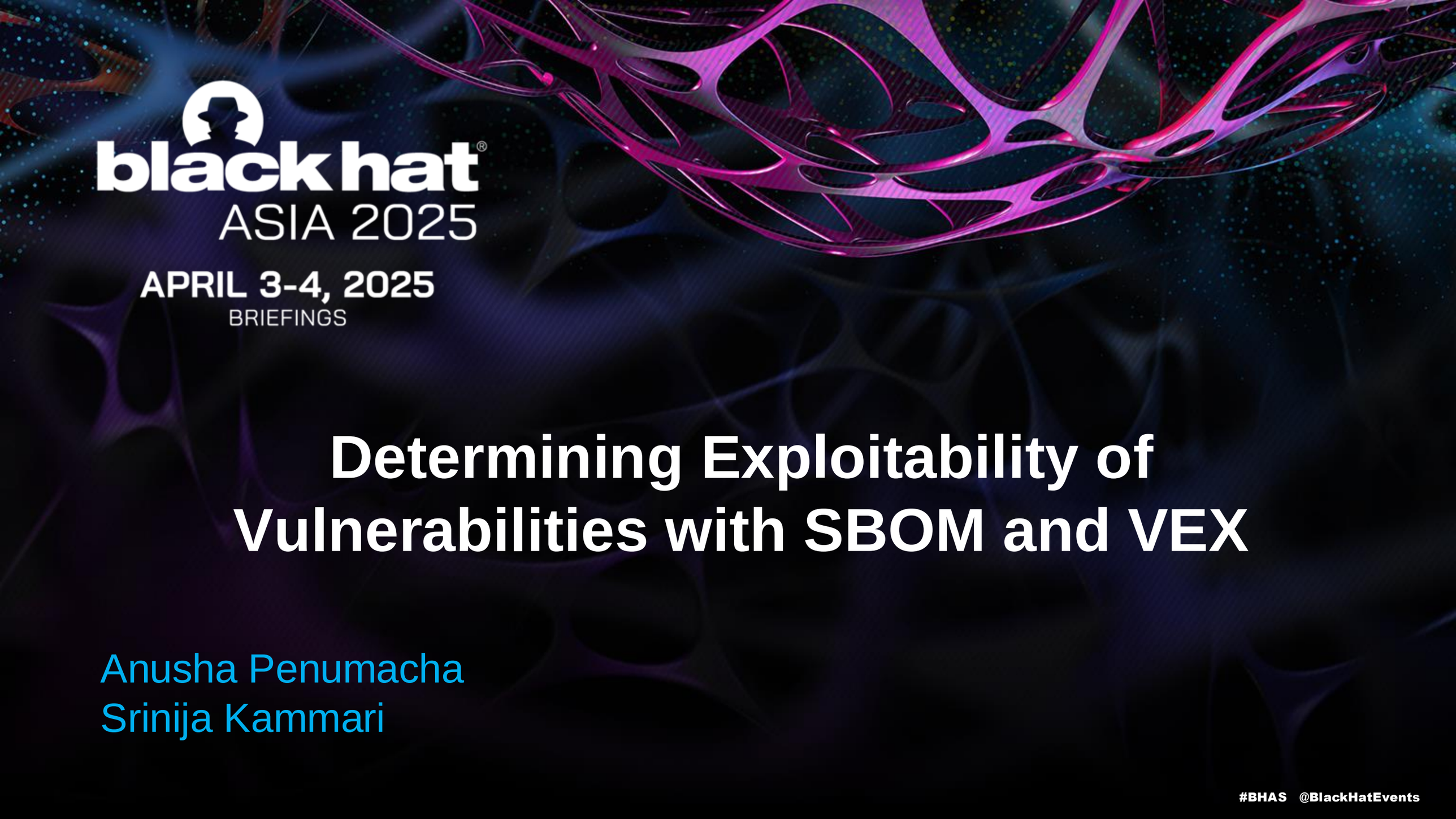


Determining Exploitability of Vulnerabilities with SBOM and VEX

Anusha Penumacha
Srinija Kammari

Software Composition Analysis

Software Bill Of Materials

Vulnerability Exploitability eXchange

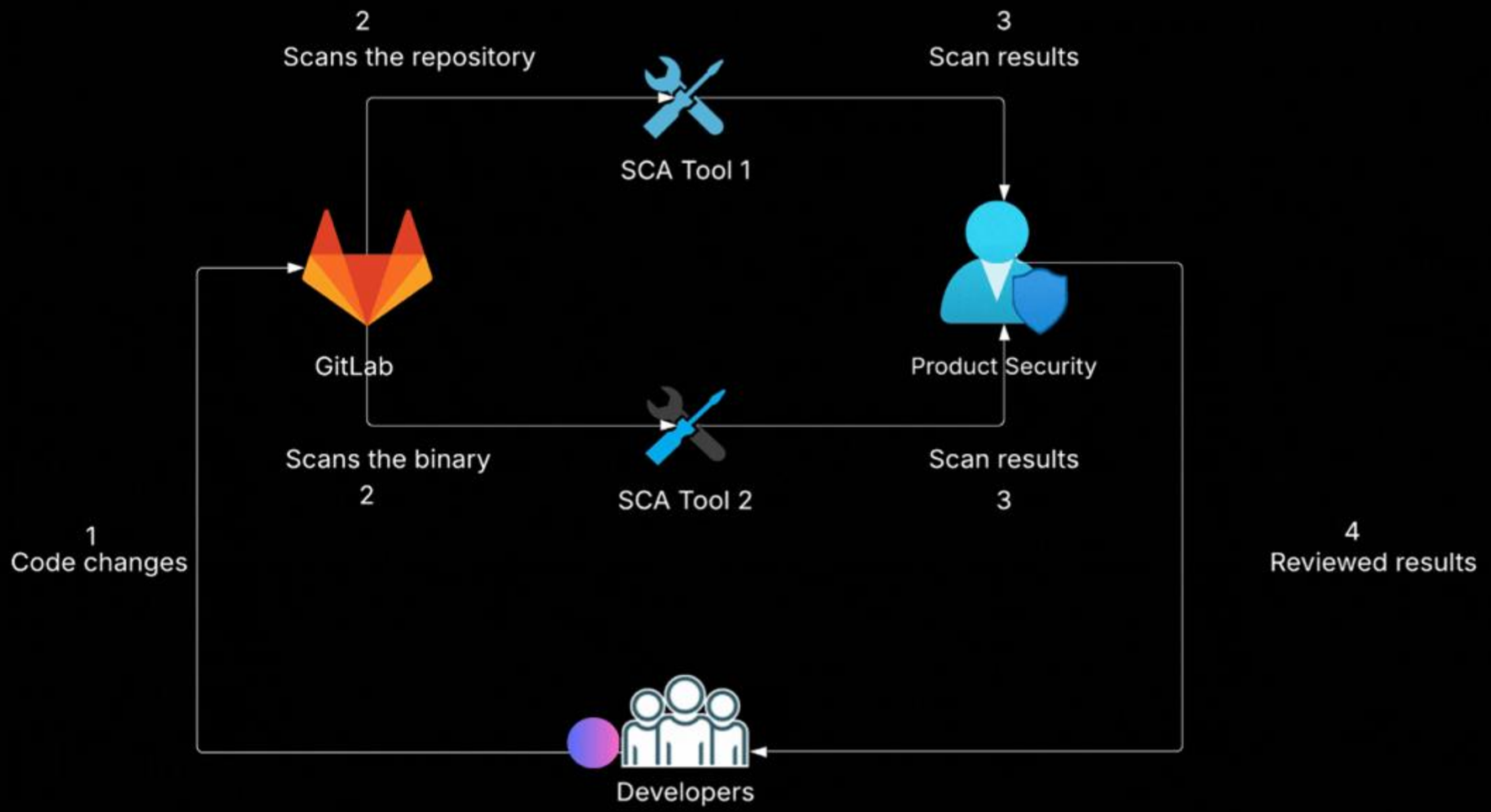
What is SBOM?

A Software Bill of Materials (SBOM) is a detailed inventory that lists all open source, custom and third party dependencies used by a software product.

Why is it important?

- By maintaining an accurate SBOM, organizations can gain insight into the composition of their software, allowing them to identify and remediate vulnerabilities effectively.
- To be compliant with U.S Cybersecurity Executive Order 14028 which highlights that every enterprise that develops critical software should be providing a purchaser a Software Bill of Materials (SBOM) for each product directly or by publishing it on a public website

Our Open-Source Security Posture ~ 2022



Our Open-Source Security Posture ~ 2022

Self Service, developer friendly

Shift left mechanism enabled developer ownership

Difficult to gather org-wide inventory

No holistic picture for Product Security

Here are some things we did before building telemetry

Building Asset Inventory	Building Centralized scan platform
Source of Truth for the product (repositories/artifacts)	Scalable centralized system for performing end-to-end operations

Step 1: Build an asset inventory + ownership mapping

- ❑ Executive Order for SBOM came in as an opportunity
- ❑ Emphasized the importance of asset inventory management
- ❑ Started mapping repos/artifacts towards products
- ❑ Need to build internal tooling to maintain this but necessary

CTS Portal

Welcome, Srinija Kammari!

Choose one of the options below to continue:

Repository Onboarding & Offboarding

Onboarding | Gitlab Group Onboarding | Offboarding

Artifact Onboarding & Offboarding

Onboarding | Offboarding

More CTS Info

CTS Docs | Onboarding Help | CTS Features

CTS Portal

CTS Repository Onboarding

ONBOARDING FORM:

The full url for your repository. Answer must start with "https://" and should not end with a slash. *

* = required

E.g. [redacted]

Which branch are you onboarding? (For Github repos, you can only choose the first option) *

- (•) Specific branch(es). For multiple branches, please separate them with a comma.
  E.g. main, develop, release123
- ( ) Default branch (Recommended option for group onboarding)

Who would you like the tickets to be assigned to? *

- (•) Specific assignees. Please specify exactly 3 users in order, separated by a comma.
  E.g. user1@splunk.com, user2@splunk.com, user3@splunk.com
- ( ) Most recent committer to the branch
- ( ) The developer who first made the commit (to introduce the vulnerability)
- ( ) Privileged user from the CODEOWNERs file

The jira watcher(s) you would like set on your tickets. For multiple users, please separate them with a comma (max 3).

The JIRA label(s) that you want on your tickets. For multiple labels, separate them with a comma (max 3).

The product area that you would like set on your tickets: *

The mission team that you would like set on your tickets:

The [redacted] program team that you would like set on your tickets:

The release version that you would like set on your tickets:

Would you like to opt-in to full ticketing (ticketing for low/medium severities)? *

⚠ [NOTE]: Except for Product Area and "Full Ticketing opt-in", all dropdown values are optional. If any dropdowns are missing the values you're looking for, please STOP and reach out on #cvm-sbom-queries to get those values added before continuing. It is important that these values are accurate for your tickets to be routed correctly.

Clear

< Back

Continue

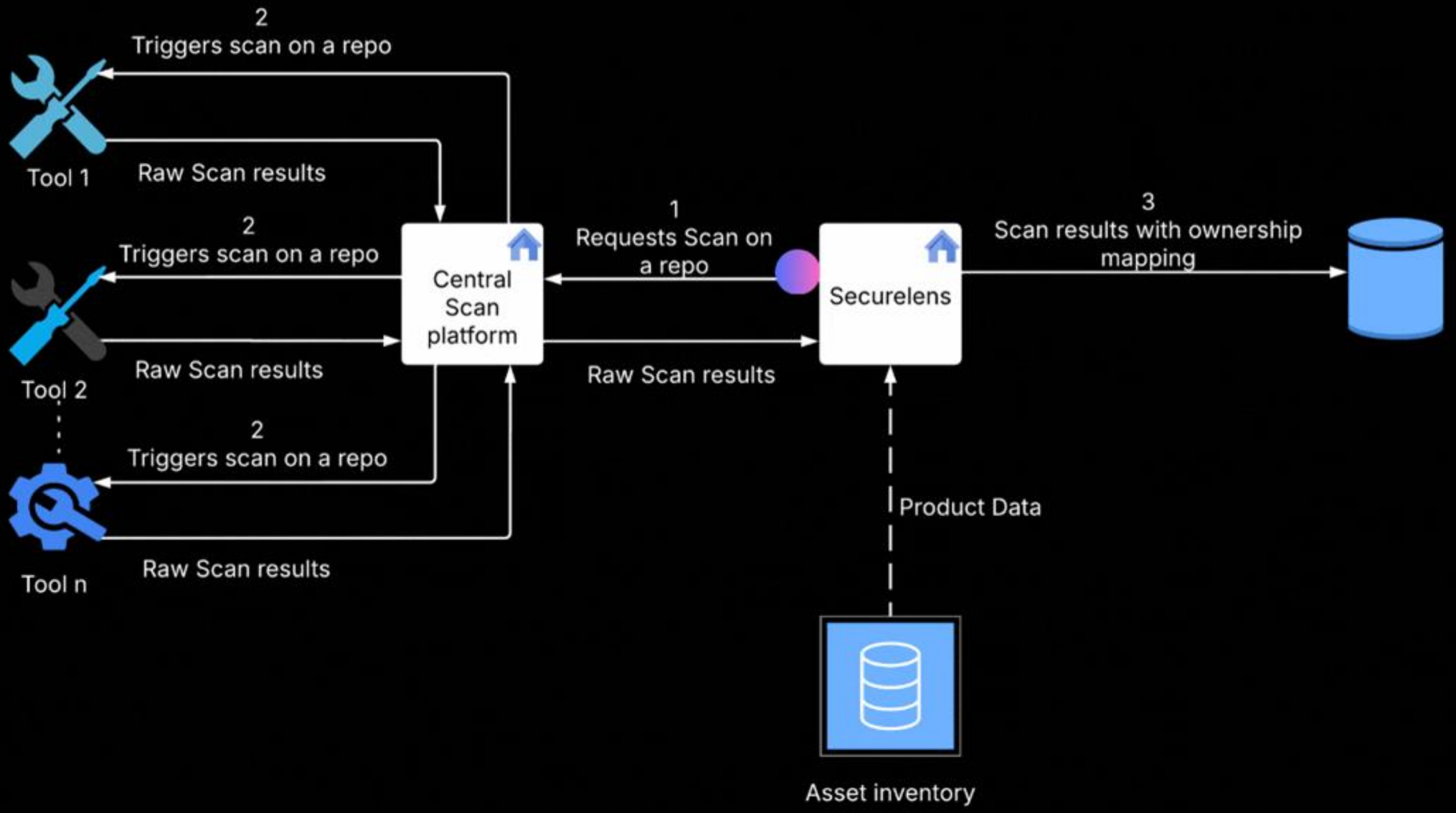
Step 1: Build an asset inventory + ownership mapping

- **Advantages:**
  - Scalability
  - Product-level Telemetry
- **Disadvantages:**
  - Operational costs
  - Keeping the product inventory data up-to-date

Step 2: Build a Centralized System

- ❑ Enabling easy scanning, user-friendly, less involvement of Product teams
- ❑ Processes scan results and ownership attribution
- ❑ Creates tickets, assigns and notifies owners


2000 YEARS
LATER


2
Triggers scan on a repo
Tool 1
Raw Scan results
2
Triggers scan on a repo
Tool 2
Raw Scan results
2
Triggers scan on a repo
Tool n
Raw Scan results
Central Scan platform
1
Requests Scan on a repo
Raw Scan results
Securelens
3
Scan results with ownership mapping
Product Data
Asset inventory

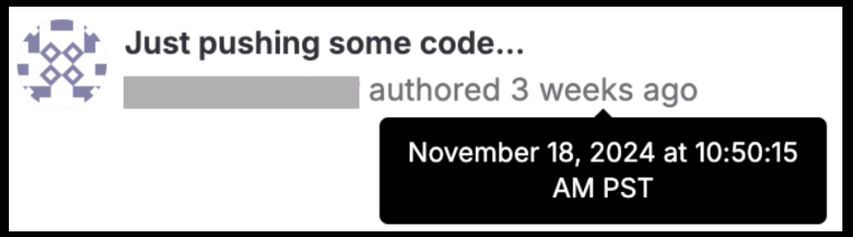
Step 2: Build a Centralized System

- **Advantages:**
  - Plug-n-play mechanism
  - Not purely relying on CI/CD for scan results
- **Disadvantages:**
  - Less scope for customizing the scan configuration
  - Delayed feedback to developers about the discovered vulnerabilities in the latest code changes

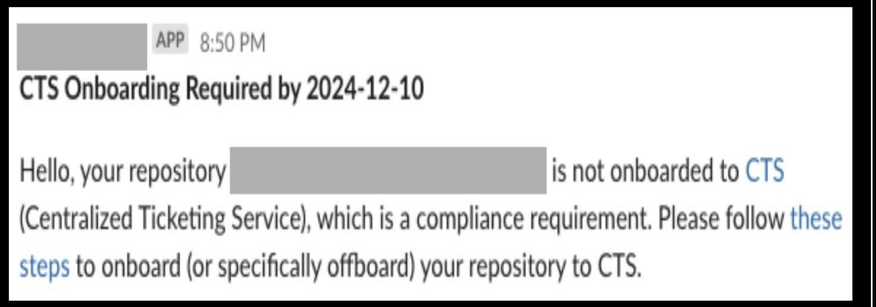
Scanning in Action!

November 18th, 2024

10:50 AM
Created a repository and pushed code

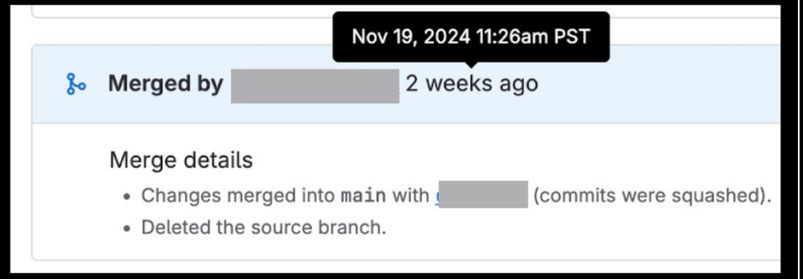


8:50 PM
Slack bot sends CTS Onboarding notification via Slack



November 19th, 2024

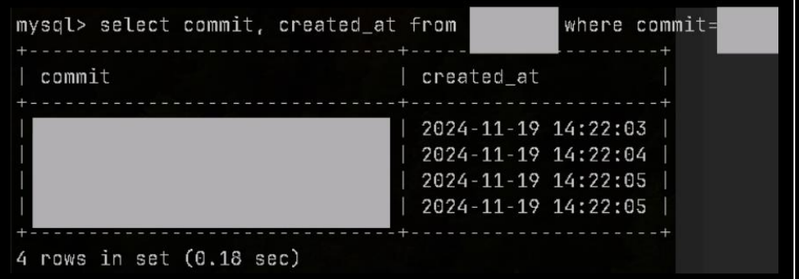
11:26 AM
Product inventory data is stored



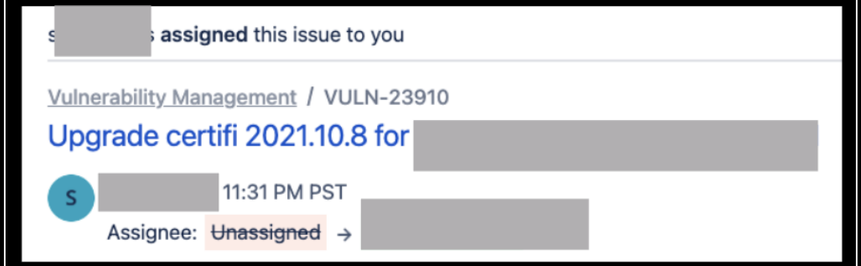
8:58 PM
Slack bot sends CTS Onboarding confirmation via Slack

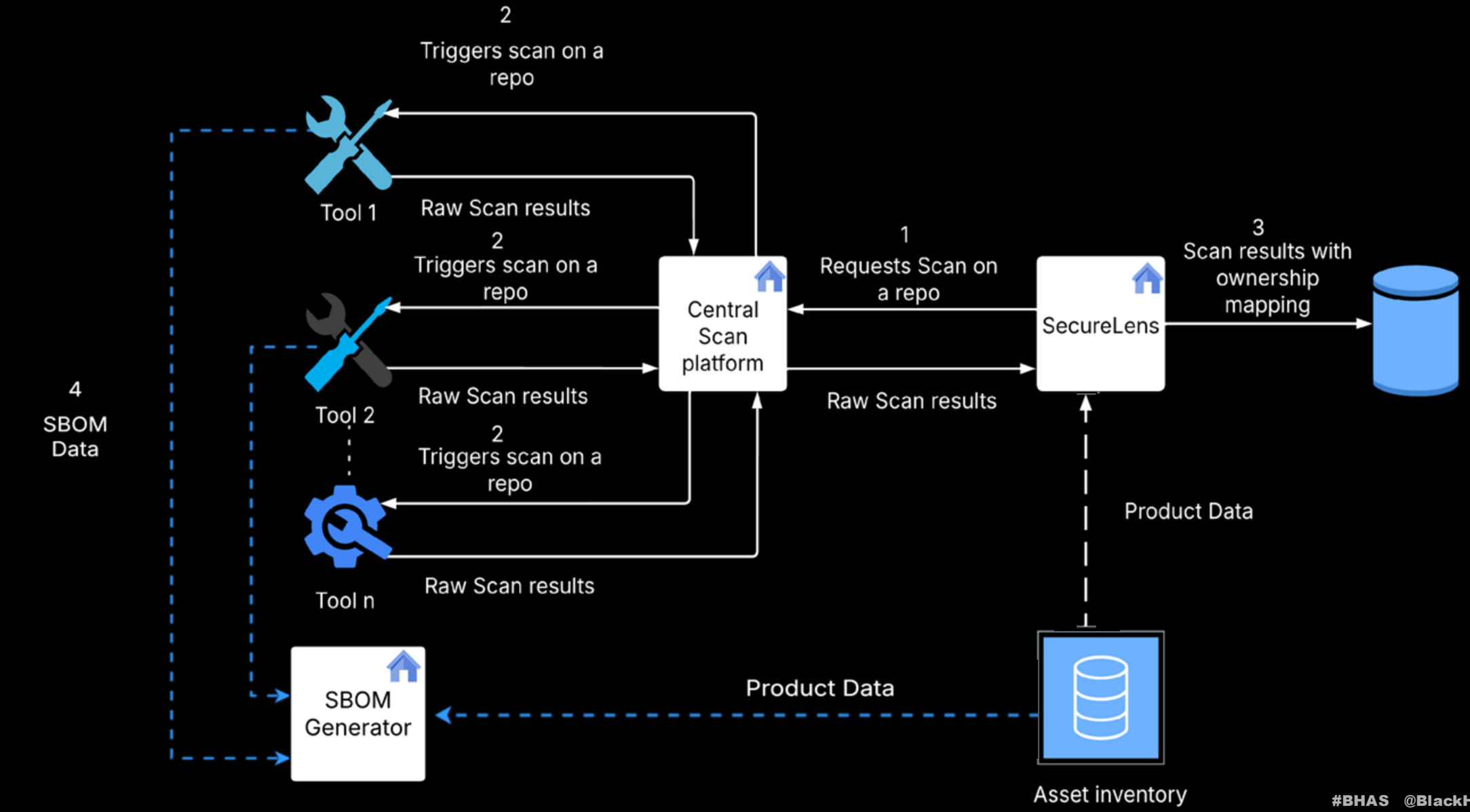
November 20th, 2024

2:22 PM
Central scan system scans repo



11:31 PM
SecureLens creates and assigns Jira tickets and assigns Jira tickets

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Requests Scan on a repo
SecureLens
3
Scan results with ownership mapping
Raw Scan results
4
SBOM Data
Product Data
SBOM Generator
Product Data
Asset inventory

Security Central

Show Preferences

Product Area

All Product Areas × Show unassigned tickets only Hide Filters

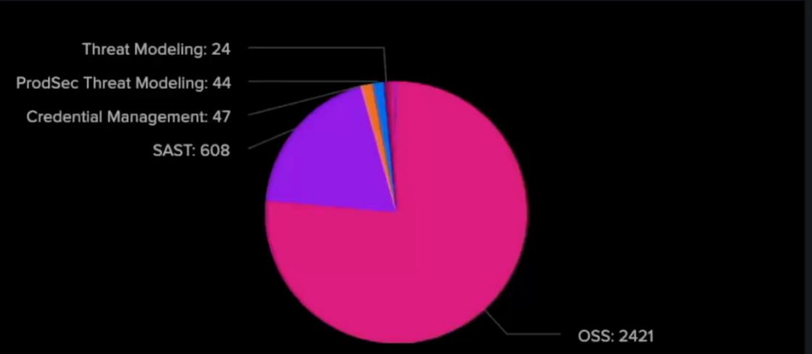
Give Feedback here! Security Central FAQ

Product Security

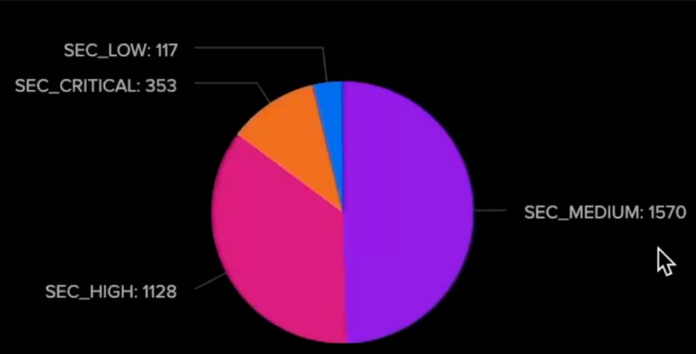
Last Dataset Refreshed at 2025-03-25T09:02:00.000-07:00

Show Findings by Version

Distribution of Findings by Type



Distribution of Findings by Severity



9m ago

Attention Needed

PAST ASSIGNED DUE DATE

SEC_CRITICAL	SEC_HIGH	SEC_MEDIUM	SEC_LOW
224	524	475	62

PAST SLO

SEC_CRITICAL	SEC_HIGH	SEC_MEDIUM	SEC_LOW
232	567	298	9

NEARING SLO

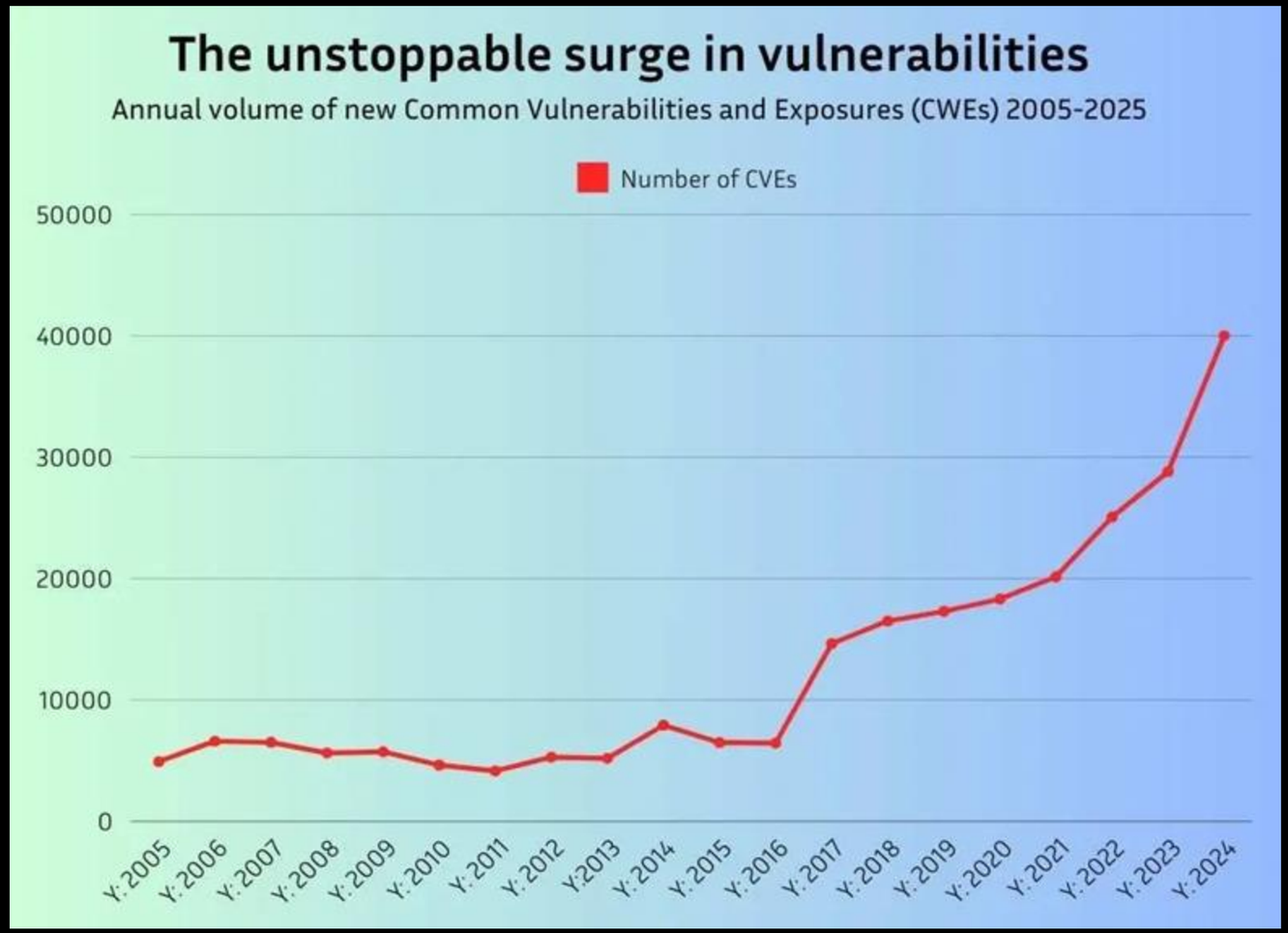
SEC_CRITICAL	SEC_HIGH	SEC_MEDIUM	SEC_LOW
11	459	181	0

Disadvantage of ticketing every vulnerability

- Tools generate a flood of vulnerabilities
- Not all of them are valid and actionable

Internally, we've discovered that >26% of vulnerabilities found by these tools are non-exploitable / not-fixable.

The CVE count keeps increasing every year.



How do we handle this flood of vulnerabilities and enhance developer experience?

Exploitability

Potential or likelihood of a vulnerability being exploited

Can be determined using three ways

- ❏ Use publicly available data sources
- ❏ Perform reachability analysis
- ❏ **Ask the developers themselves!!**

Vulnerability Exploitability Exchange (VEX)

- A VEX statement indicates the state of a software product or component w.r.t. to the vulnerability. A common VEX use case is to indicate if a software is or is not affected by a vulnerability.

- Statuses:
  - Not affected
  - Affected
  - Fixed
  - Under Investigation

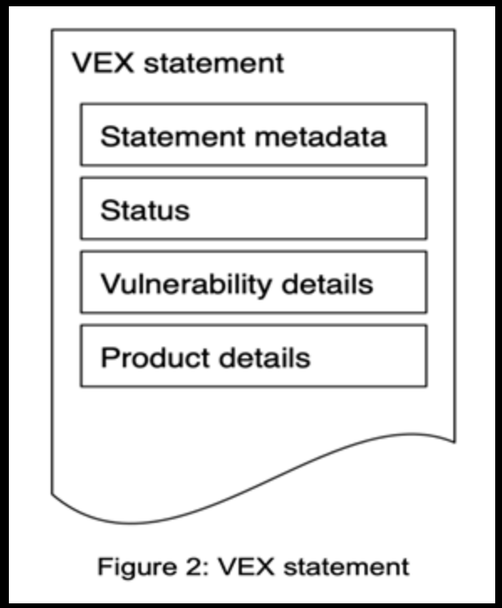


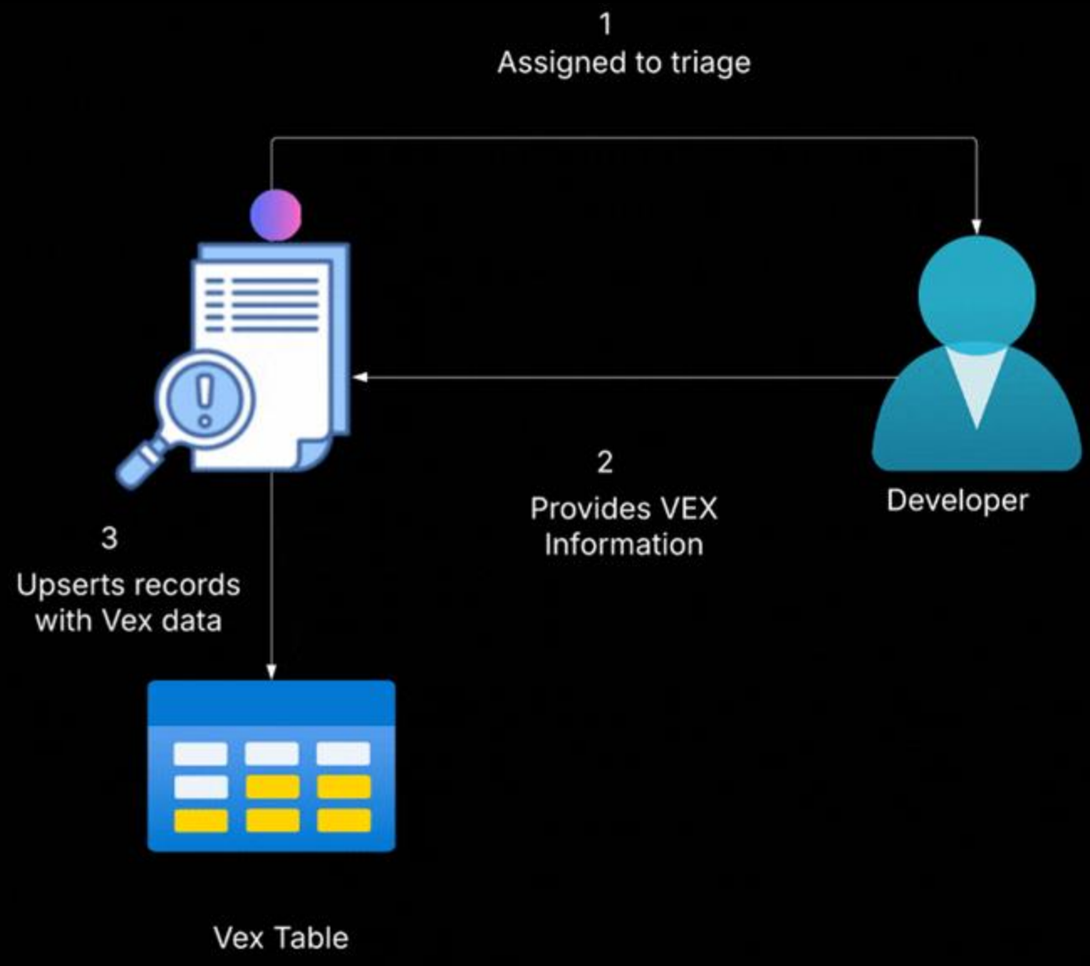
Figure 2: VEX statement

Tracking Remediation with VEX

- ❑ Start tracking remediation status of security issues by product
- ❑ Mandate VEX as part of remediation and resolution

Developer feedback loop is essential

- Cannot purely rely on tool feedback and public sources
  - False positives and negatives
  - With complex build systems, it's tricky to determine dependencies shipped in the final product.



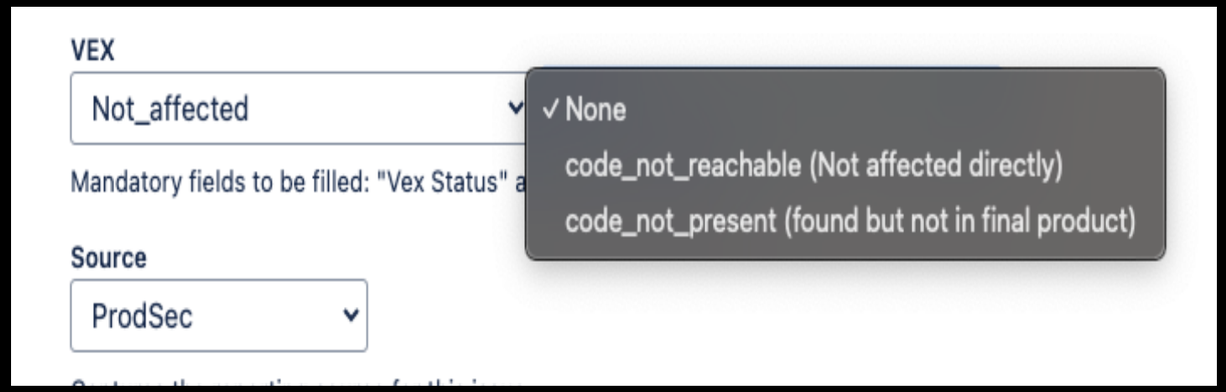
Design Choice :

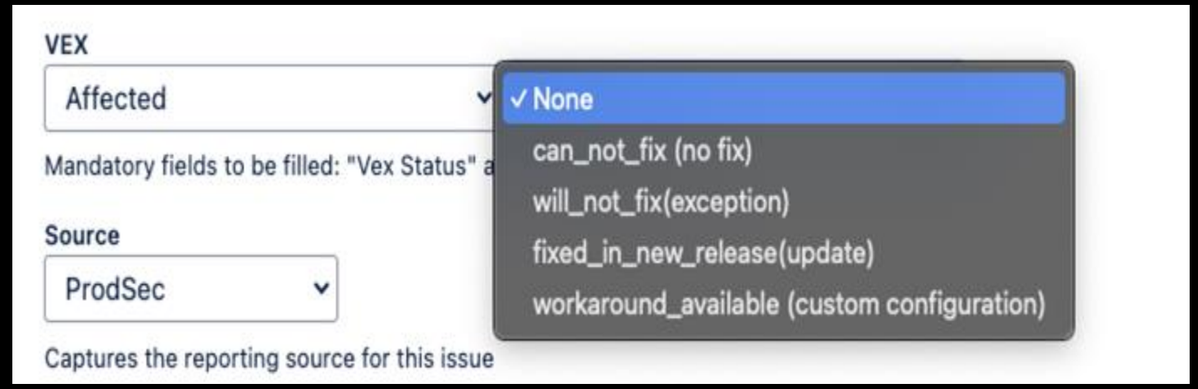
Why use issue tracking systems to collect this information?

- Abstraction layer on top of our security scanning and tooling
- Mandate necessary information that the security teams need. It also works as a medium of back and forth communication
- Minimal learning curve for Engineering teams
- Once a generic issue template is agreed upon, it’s easy to scale and incorporate additional tooling

Advantage 1: Getting a clear answer on exploitability

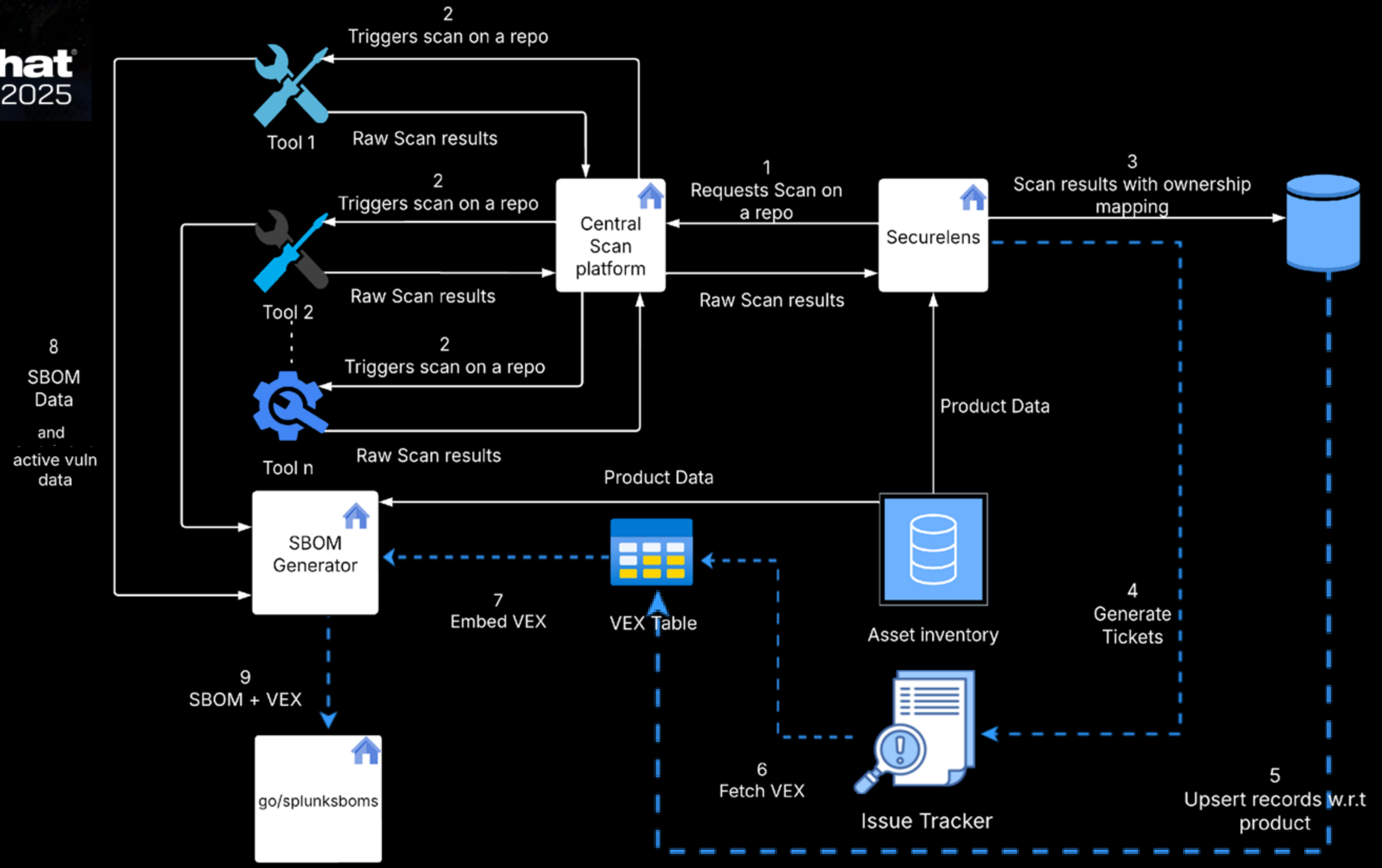
- ❑ Clear answer on exploitability based on usage
- ❑ Allows developer ownership
- ❑ Provides clear audit trail





Advantage 2 :

Automated VEX Generation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Scan results with ownership mapping
8
SBOM Data
and
active vuln data
Product Data
Product Data
SBOM Generator
7
Embed VEX
VEX Table
Asset inventory
4
Generate Tickets
9
SBOM + VEX
go/splunksboms
6
Fetch VEX
Issue Tracker
5
Upsert records w.r.t product

VEX Table Information

```
mysql> select * from VexTable limit 1;
+---------+---------+-------------------------------------------------------------------+-----------------------------
------------------+--------------+------------+---------------------------------------+--------------+-------------
-----------------+------------------------------+
| product | version | component                                                         | jira_ticket
                  | issue_status | vex_status | vex_justification                     | product_area | created_at
                 | updated_at                   |
+---------+---------+-------------------------------------------------------------------+-----------------------------
------------------+--------------+------------+---------------------------------------+--------------+-------------
-----------------+------------------------------+
| [redacted] | [redacted] | Spark Project Core:3.2.1:[redacted] | https://[redacted]
/browse/VULN-7775 | Closed       | Fixed      | Vulnerable code not in execution path | [redacted]     | 2023-09-14T0
7:19:46.807-0700 | 2024-06-25T12:21:24.359-0700 |
+---------+---------+-------------------------------------------------------------------+-----------------------------
------------------+--------------+------------+---------------------------------------+--------------+-------------
-----------------+------------------------------+
1 row in set (0.37 sec)
```

The table is periodically updated every 30 minutes to accommodate the dynamic nature of issue tracking systems

Advantage 3 : Context based Auto Closing and Smart Insights

We try to auto close issues based on previous context (tool agnostic) and also provide some additional insights into the issues that are open.
The key idea is to improve developer experience and reduce triage time

- **External sources** : We can auto close these issues if we are able to determine from public sources that the vulnerability is not exploitable/cannot be fixed.
- **Internal sources** :
  - Multiple tools can repeatedly detect an issue that is non exploitable. Auto close any possible future occurrences.
  - Provide additional help on issues based on dependency information and historical data.

Closing ticket because we found related duplicates for the same. Here are the related issues :

- VULN-23722: XRAY : Upgrade pypi://lxml from 4 CLOSED
- VULN-23689: XRAY : Upgrade pypi://lxml from CLOSED
- VULN-23627: XRAY : Upgrade pypi://lxml from 4 CLOSED
- VULN-19037: XRAY : Upgrade pypi://lxml from 4 CLOSED
- VULN-15284: XRAY : Upgrade pypi://lxml from 4 CLOSED
- VULN-13002: XRAY : Upgrade pypi://lxml from 4 CLOSED

S February 3, 2025 at 6:28 PM

Closing ticket because the there is no fix available for the package

S [redacted] February 3, 2025 at 6:44 PM

Found some open tickets that have the same path. Please use them for analysis Here are the related issues :

- VULN-27166: Container Scan: Upgrade com.google.protobuf:protobuf-java from [redacted]
- VULN-27155: Container Scan: Upgrade org.apache.avro:avro from [redacted]
- VULN-27146: Container Scan: Upgrade org.apache.[redacted]
- VULN-25750: XRAY : Upgrade gav://org.apache.avro:avro from [redacted]
- VULN-23700: XRAY : Upgrade gav://com.google.protobuf:protobuf-java [redacted]

md64.deb OPEN

- VULN-23699: XRAY : Upgrade gav://org.apache.avro:avro from [redacted]

CLOSED

Future Scope

- ❏ Using agentic AI to determine if a package is exploitable or not based on historic developer feedback and open source resources.
- ❏ Improved Insights accuracy and detail
- ❏ Ability to generate and open source VEX statements alongside our product releases.
- ❏ Open sourcing goals

Thank you!