

## Survey - Practitioner's Perspective on the MVN+ of Vulnerability Management in Maven Ecosystem

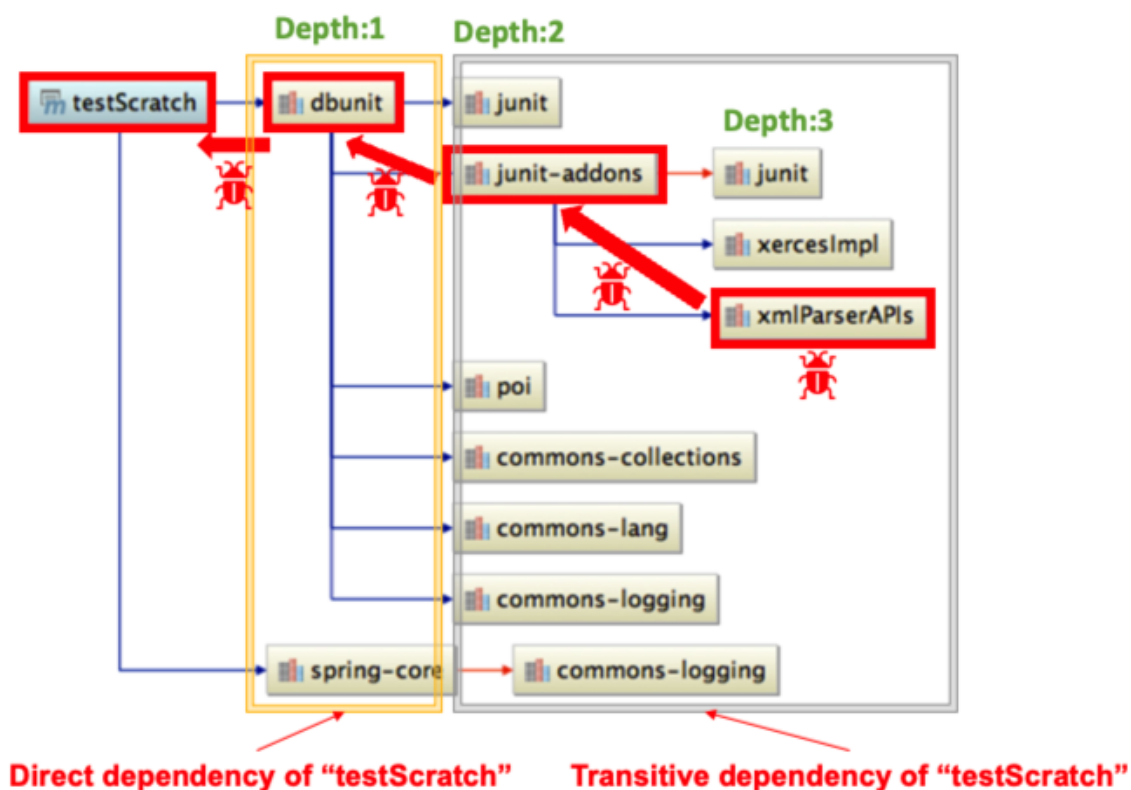
Dear Participant,

We are conducting a survey to understand practitioners' perceptions of vulnerability management in the Maven ecosystem. We are providing a vulnerability management tool, **MVN+**, and comparing it to the existing public platforms [the Maven Repository](#) and [the Open Source Insights](#). This survey will take you around 10 minutes.

### Background

Modern software often reuses functionality from other software libraries (i.e., dependencies) to provide a full working system. For Java projects, the Maven plays the central role of a software supply chain to manage software reuse.

### Vulnerability propagation in the supply chain



The figure above is an example of a Maven project **"testScratch"**.

- The dependency in the **yellow** box and the **gray** box are direct dependency and transitive dependency of **"testScratch"**, respectively.

- If we found a vulnerability from the dependency “**xmlParserAPIs**”, the vulnerability would **propagate** from the dependency chain to the project “**testScratch**”.

Although software reusing provides great convenience to developers, there are also potential risks related to the quality of the dependencies.

For developers, it's hard to know all vulnerabilities from downstream dependencies. Even if they collect all the downstream vulnerabilities, it is also hard to order the list of vulnerabilities. We believe that dependencies with greater depth may be less likely to be used, so vulnerabilities from deep dependencies may have a lower impact. And different vulnerability severity ratings will also affect the importance of vulnerabilities.

So, for the developers who reused other libraries, they will try to avoid the vulnerabilities impacting the whole project.

### **Current state-of-the-art in Vulnerability Management**

There are two platforms that provided the vulnerability information of libraries: **Maven repository** and **Open Source Insights**.

We found **Maven repository** and **Open Source Insights** have many limitations in practice. So we are designing a new approach **MVN+**. We compare them in the following parts.

Below, there are three links showing the vulnerability management result one library (org.apache.spark : spark-core\_2.11 : 1.2.2) on **Maven Repository**, **Open Source Insights** and our tool **MVN+**.

[Maven Repository result of library \(org.apache.spark : spark-core 2.11 : 1.2.2\)](#)

[Open Source Insights result of library \(org.apache.spark : spark-core 2.11 : 1.2.2\)](#)

[MVN+ result of library \(org.apache.spark : spark-core 2.11 : 1.2.2\)](#)

This library is the example we used in this questionnaire. You can click to visit each link to get the full results for the library on each platform. We also provide screenshots of relevant parts in the questions below.

The main goal of this survey is to investigate:

- (1) **user satisfaction** of three platforms;
- (2) examine the **importance** of each aspect;
- (3) **user feedback** on our approach.

We will not reveal your identity in any form of the research outcomes. All of the information provided in the survey will be used for research purposes only. We sincerely appreciate your participation in our study.

## Part 1: Information about the Participant

*In this part, we will ask you for some background information related to your role and experience.*

*For each question, please type your answer in the corresponding area.*

**Q1:** Which of the following best describes your primary job role?

- A. Developer B. Algorithm engineer C. Test engineer D. Project manager  
E. Researcher F. Data analyst G. Other (Please specify below)

**Answer:** A, E


**Q2:** How many years of experience do you have in software development/software maintenance/programming?

**Answer:** 5 years



## Part 2: Vulnerability Listing

**Maven Repository** shows the IDs and the total number of vulnerabilities from each dependency. If you want to know details of the vulnerabilities, you should click the link and go to the homepage of the dependency library (e.g., go to **netty-all** to find the details).

[Home](#) » [org.apache.spark](#) » [spark-core\\_2.11](#) » [1.2.2](#)

**Spark Project Core » 1.2.2**  
Core libraries for Apache Spark, a unified analytics engine for large

License	Apache 2.0
Categories	Distributed Computing
Tags	computing distributed spark apache
HomePage	<a href="http://spark.apache.org/">http://spark.apache.org/</a>
Date	Apr 05, 2015
Files	<a href="#">pom (18 KB)</a> <a href="#">jar (6.7 MB)</a> <a href="#">View All</a>
Repositories	Central BeDataDriven
Ranking	#199 in MvnRepository (See Top Artifacts) #1 in Distributed Computing
Used By	2,097 artifacts
Scala Target	Scala 2.11 (View all targets)
Vulnerabilities	<b>Direct vulnerabilities:</b> <a href="#">CVE-2022-33891</a> <a href="#">CVE-2021-38296</a> <b>Vulnerabilities from dependencies:</b> <a href="#">CVE-2022-23305</a> <a href="#">CVE-2022-23302</a> <a href="#">CVE-2021-4104</a> <a href="#">View 17 more ...</a>

Network Framework Apache 2.0	 <a href="#">io.netty</a> » <a href="#">netty-all</a> <b>2 vulnerabilities</b>	<a href="#">4.0.23.Final</a>	<a href="#">4.1.79.Final</a>
Logging Apache 2.0	 <a href="#">log4j</a> » <a href="#">log4j</a> <b>4 vulnerabilities</b>	<a href="#">1.2.17</a>	<a href="#">2.18.0</a>

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**Open Source Insights** shows a list of the vulnerabilities associated with a library. The vulnerabilities may or may not come from other dependencies.

## Security Advisories

100

In this package

Low severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11

9.8 CRITICAL

GHSA-phg2-9c5g-m4q7

MORE DETAILS

High severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11

7.8 HIGH

GHSA-8rhc-48pp-52gr

MORE DETAILS

Sensitive data written to disk unencrypted in Spark

7.5 HIGH

GHSA-fp5j-3fpf-mhj5

MORE DETAILS

Low severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11

4.7 MEDIUM

GHSA-6mqq-8r44-vmjc

MORE DETAILS

Moderate severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11

6.1 MEDIUM

GHSA-r34r-f84j-5x4x

MORE DETAILS

Moderate severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11

4.2 MEDIUM

GHSA-w4r4-65mg-45x2

MORE DETAILS

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**MVN+** shows a list of dependencies and their associated vulnerabilities grouped by different dependency types (e.g., direct vs transitive).

Direct Compile Dependency ( 39 ) (Priority:CRITICAL) Directly used			
Depth	Group / Artifact	Version	Vulnerabilities
1	log4j » log4j	1.2.17	CVE-2019-17571 (9.8) CVE-2022-23305 (9.8) CVE-2022-23302 (8.8) CVE-2021-4104 (7.5)
1	org.eclipse.jetty » jetty-server	8.1.14.v20131031	CVE-2017-7657 (9.8) CVE-2017-7656 (7.5) CVE-2015-2080 (7.5) CVE-2019-10241 (6.1) CVE-2019-10247 (5.3) CVE-2021-34428 (3.5)

Direct Test Dependency ( 10 ) (Priority:LOW) Only be used In test scope			
Depth	Group / Artifact	Version	Vulnerabilities
1	junit » junit	4.10	CVE-2020-15250 (5.5)
1	asm » asm	3.3.1	
1	com.novocode » junit-interface	0.10	

\* Note: By default, test dependencies *will not* be included in the final binary. Hence, MVN+ shows that vulnerabilities in test dependencies have a low priority.

**Q3:** On a scale of 1 (negative) to 5 (positive), how would you rate Maven repository's vulnerability listing approach?

**Answer: 2**

**Feedback (optional):** The list shows no priorities as well as causes of vulnerabilities.

**Q4:** On a scale of 1 (negative) to 5 (positive), how would you rate Open Source Insights' vulnerability listing approach?

**Answer: 3**

**Feedback (optional):** The list shows the priority of vulnerabilities which is friendly to developers.

**Q5:** On a scale of 1 (negative) to 5 (positive), how would you rate MVN+'s vulnerability listing approach?

**Answer: 4**

**Feedback (optional):** The list shows both the priority and cause (i.e., the dependent package where the vulnerability is introduced) of vulnerabilities. Hence, it gets one more grade compared to Q4 and two more grades compared to Q3.

**Q6:** On a scale of 1 (negative) to 5 (positive), how useful is listing every single vulnerability that is **from each dependency** helpful for developers (e.g., DependencyA has Vulnerability1 and Vulnerability2)?

**Answer: 5**

**Feedback (optional):**

**Q7:** On a scale of 1 (negative) to 5 (positive), how useful is grouping the dependencies/vulnerabilities based on dependency scope (e.g., direct dependency and test dependency)?

**Answer: 3**


**Feedback (optional):** I don't think developers care much about the dependency scope. Developers mostly care about the priority and cause (the dependent package where the vulnerability is introduced). For vulnerabilities in test dependency, nearly all the priorities are "LOW". Given a vulnerability with "LOW" priority, developers will probably ignore it (that is the biggest usage of priority). In other words, the priority helps save developers' time to diagnose the vulnerabilities. In this way, I do not get the point to show the test dependency in the list of vulnerabilities because they will mostly be ignored.

## Part 3: Vulnerability Severity Score and Ranking

**Maven Repository** only shows the vulnerability from direct dependencies (**depth=1**) and does not show the vulnerability severity score. If you want to know the details of the vulnerabilities, you need to click the link and go to the homepage of the dependency library (e.g., go to **netty-all** to find the details) and search based on the CVE ID for the severity score by yourself.

Network Framework Apache 2.0	io.netty » netty-all	2 vulnerabilities	4.0.23.Final	4.1.79.Final
Logging Apache 2.0	log4j » log4j	4 vulnerabilities	1.2.17	2.18.0

Home » io.netty » netty-all » 4.0.23.Final

 **Netty/All In One » 4.0.23.Final**  
Netty is a NIO client server framework which enables quick and easy

License	Apache 2.0
Categories	Network App Frameworks
Tags	network socket framework netty io
Date	Aug 15, 2014
Files	<a href="#">pom (16 KB)</a> <a href="#">jar (1.7 MB)</a> <a href="#">View All</a>
Repositories	<a href="#">Central</a> <a href="#">BeDataDriven</a> <a href="#">Redhat GA</a> <a href="#">Sonatype</a>
Ranking	#180 in MvnRepository ( <a href="#">See Top Artifacts</a> ) #1 in Network App Frameworks
Used By	2,278 artifacts
	<b>Direct vulnerabilities:</b> <a href="#">CVE-2019-16869</a> <a href="#">CVE-2016-4970</a>

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**Open Source Insights** shows the vulnerability from direct dependencies (**depth=1**) and transitive (**depth>1**) dependencies. OSI does not show the dependency depth information. OSI ranks the vulnerabilities by severity score (as illustrated below by the red arrow).

Low severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11  
**9.8 CRITICAL** · GHSA-phg2-9c5g-m4q7 [MORE DETAILS](#)

High severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11  
**7.8 HIGH** · GHSA-4hc-48pp-52gr [MORE DETAILS](#)

Sensitive data written to disk unencrypted in Spark  
**7.5 HIGH** · GHSA-5j-3fpf-mhj5 [MORE DETAILS](#)

Low severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11  
**4.7 MEDIUM** · GHSA-6mq-8r44-vmjc [MORE DETAILS](#)

Moderate severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11  
**6.1 MEDIUM** · GHSA-r34r-f84j-5x4x [MORE DETAILS](#)

Moderate severity vulnerability that affects org.apache.spark:spark-core\_2.10 and org.apache.spark:spark-core\_2.11  
**4.2 MEDIUM** · GHSA-w4r4-65mg-45x2 [MORE DETAILS](#)

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**MVN+** shows the dependencies ranked by dependency depth. Then, MVN+ ranked the dependency based on the highest severity score.

Depth	Group / Artifact	Version	Vulnerabilities
3	net.sourceforge.htmlunit » htmlunit	2.14	<b>CVE-2020-5529 (8.1)</b>
3	org.apache.httpcomponents » httpclient	4.3.2	<b>CVE-2014-3577 (5.8)</b> <b>CVE-2020-13956 (5.3)</b> <b>CVE-2015-5262 (4.3)</b>
3	commons-io » commons-io	2.4	<b>CVE-2021-29425 (4.8)</b>
4	commons-collections » commons-collections	3.2.1	<b>CVE-2015-6420 (7.5)</b>
4	xerces » xercesImpl	2.11.0	<b>CVE-2012-0881 (7.5)</b> <b>CVE-2022-23437 (6.5)</b>
4	com.google.guava » guava	15.0	<b>CVE-2018-10237 (5.9)</b> <b>CVE-2020-8908 (3.3)</b>
5	org.eclipse.jetty » jetty-io	8.1.14.v20131031	<b>CVE-2021-28165 (7.5)</b>

**Q8:** On a scale of 1 (negative) to 5 (positive), how would you rate Maven repository's vulnerability listing approach?

**Answer: 2**

**Feedback (optional):** The same to the response to Q3.

**Q9:** On a scale of 1 (negative) to 5 (positive), how would you rate Open Source Insights' vulnerability ranking approach?

**Answer: 3**

**Feedback (optional):** The same to the response to Q4.

**Q10:** On a scale of 1 (negative) to 5 (positive), how would you rate MVN+'s ranking approach?

**Answer: 3**

**Feedback (optional):** Regarding the security score, MVN+'s ranking is totally as same as that of OSI. In this point, it has no contributions compared to OSI. Hence, the score is as same as that of Q9. Regarding the depth, I did not get the usage of it. *"We believe that dependencies with greater depth may be less likely to be used, so vulnerabilities from deep dependencies may have a lower impact."* I donot agree with it. *"We believe that dependencies with greater depth may be less likely to be used"* may be true. *"vulnerabilities from deep dependencies may have a lower impact"* is not always true. Take the example of *"org.eclipse.jetty>>jetty.io"* with depth 5, it is widely used and the fundamental of so much software. Any variabilities in this package will surely affect the software severely. For example, most functions like IO in a web application depend on it. Developers can not simply ignore the variabilities in it.

**Q11:** On a scale of 1 (negative) to 5 (positive), how is **depth** and **rank of dependency by depth**, helpful for developers?

(e.g.,

- (1) {Dependency A (depth=2) [CVE-1 (9), CVE-2 (5)]},
- (2) {Dependency B (depth=3) [CVE-3 (9.8)]},
- (3) {Dependency C (depth=3) [CVE-4 (8), CVE-5 (6)]}

)

**Answer: 2**

**Feedback (optional):** I think developers care more about the severity and the rank of severity. The same to Q10.

**Q12:** On a scale of 1 (negative) to 5 (positive), how would you rate the **ranking of vulnerabilities by their severity score**? (e.g.,

- (1) CVE-3 (9.8)
- (2) CVE-1 (9)
- (3) CVE-4 (8)
- (4) CVE-5 (6)
- (5) CVE-2 (5)

)

**Answer: 5**

**Feedback (optional):**