From Log4Shell to Log4SBOM

Piotr Karwasz, Apache Software Foundation

Who are we?

Apache Software Foundation:

- American 501(c)(3) nonprofit: (3)—Charitable organization
- More than 800 members
- More than 8000 contributors (committers)
- 200 Top-level projects
- Each TLP lead by a Project Management Committee
- Apache Logging Services PMC, since December 2003

https://apache.org/
https://logging.apache.org/

Piotr Karwasz:

- 2000: OSS *aficionado*.
- 2009: Ph.D. in Mathematics (UHP, Nancy).
- Father of three daughters: Mimi, Lili and Nati.
- 2017: I started my own IT company.
- 2022, January: start contributing to Log4j.
- 2022, July: Logging Services PMC member.
- 2024, March: ASF member.
- 2024, June: Logging Services PMC chair.

https://oss.copernik.eu/
https://linkedin.com/in/ppkarwasz/

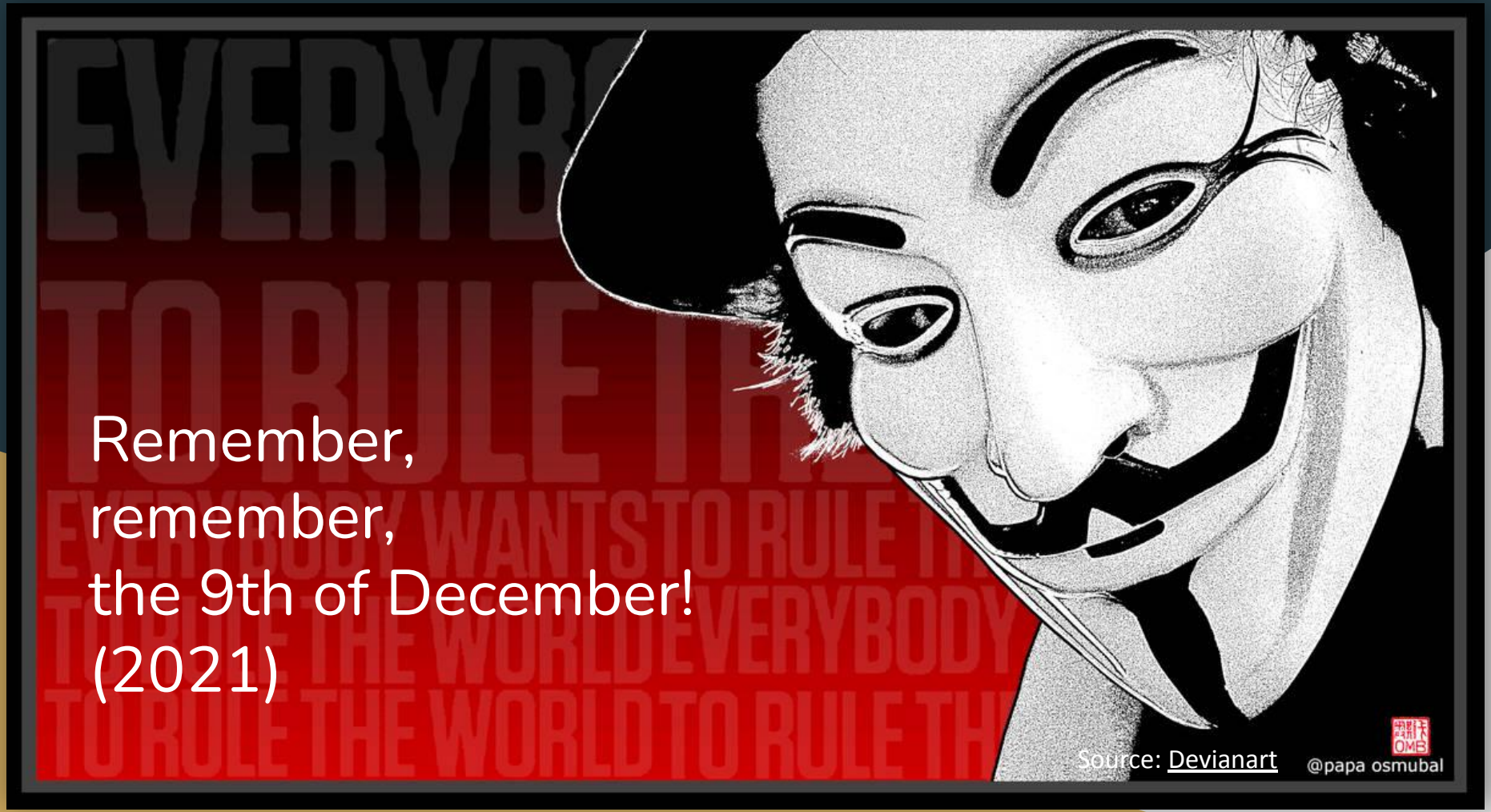
What is Log4j?

- One of the logging libraries of Apache Logging Services, together with Log4cxx, Log4Net, Log4j Kotlin, Log4j Scala.
- 2001: Ceki Gülcü creates Log4j 1
- 2003: Ceki Gülcü brings Log4j to ASF
- 2005-2011: Ceki Gülcü starts working on SLF4J/Logback successor
- 2012: Last Log4j 1 release
- 2014: Log4j 2 API/Core is published by: G. Gregory, R. Goers, R. Popma, M. Sicker and others
- 2015: end-of-life of Log4j 1

```
logger.debug("Opening file {}!", file);

logger.info("Hello {}!", user);

logger.error("Failed to foo!", e);
```


Remember,
remember,
the 9th of December!
(2021)
Source: Devianart
@papa osmubal

CVE-2021-44228 (Log4Shell)

"An attacker who can control log messages or log message parameters can execute arbitrary code loaded from LDAP servers…"—NVD Database

Ingredients:

1. Log4j Core did expand placeholders like `${env:HOME}` in configuration files, but also in **log messages**.
2. JNDI is a Java technology to retrieve configuration values, services or (Easter egg)… download code.
3. Log4j Core supported `${jndi:…}`

Characteristics:

- Affects a lot of people:
  Log4j Core had already more than 10 M downloads monthly.
- Easily exploitable:
  For example Minecraft from Mojang AB passed all chat messages in the game to Log4j Core.
- Limited exploitability on up-to-date JDK versions.

Timeline of 2.15.0 release

November 24th, 7:51 UTC:
Chen Zhaojun reports the vulnerability

November 24th, 17:30 UTC:
Team discusses the report. It is bad.

November 25th: Thanksgiving!

November 26th, 4:00 UTC:
CVE number requested.

November 30th:
Patch supplied (public PR).

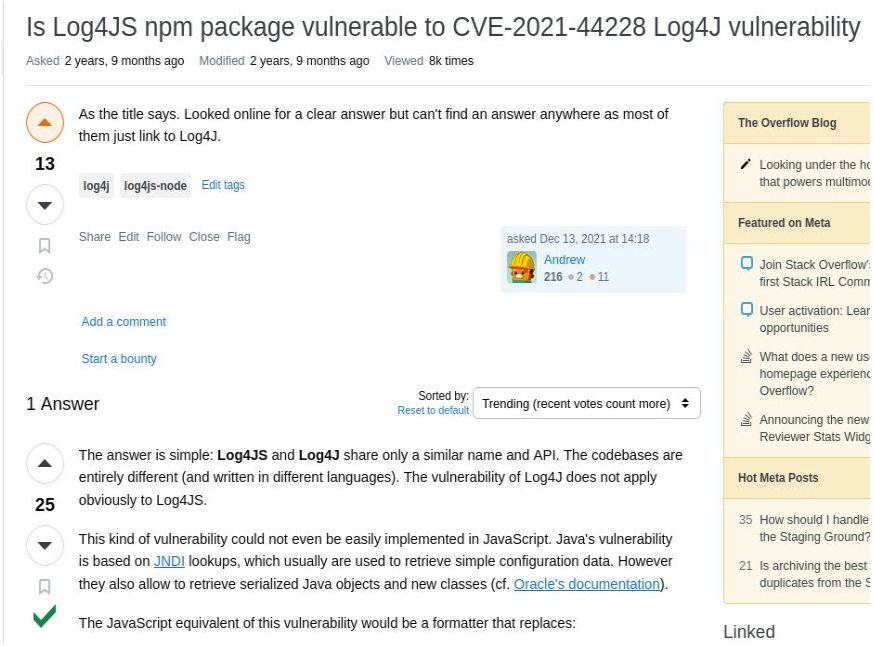
December 5th:
Patch amended, reviewed and merged.

December 7th:
Release vote for `2.15.0` RC1 (72 hours)

December 9th:
Users notice the PR solves a security issue.
Problem with RC1, RC2 vote (7 hours)
Version `2.15.0` released with 7 votes.

Note: Release `2.15.0` was the first of 4 releases that patched a total of 4 CVEs and ended on December 28th with the `2.17.1` release.

Reactions



Is Log4JS npm package vulnerable to CVE-2021-44228 Log4J vulnerability

Asked 2 years, 9 months ago Modified 2 years, 9 months ago Viewed 8k times

13

As the title says. Looked online for a clear answer but can't find an answer anywhere as most of them just link to Log4J.

log4j log4js-node Edit tags

Share Edit Follow Close Flag

asked Dec 13, 2021 at 14:18
Andrew
216 • 2 • 11

Add a comment

Start a bounty

1 Answer

Sorted by: Reset to default Trending (recent votes count more)

25

The answer is simple: **Log4JS** and **Log4J** share only a similar name and API. The codebases are entirely different (and written in different languages). The vulnerability of Log4J does not apply obviously to Log4JS.

This kind of vulnerability could not even be easily implemented in JavaScript. Java's vulnerability is based on JNDI lookups, which usually are used to retrieve simple configuration data. However they also allow to retrieve serialized Java objects and new classes (cf. Oracle's documentation).

The JavaScript equivalent of this vulnerability would be a formatter that replaces:

The Overflow Blog

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that powers multimo

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Hot Meta Posts

35 How should I handle
the Staging Ground?

21 Is archiving the best
duplicates from the S

Linked

- Log4j questions on StackOverflow increased tenfold to 2‰.
  Do they use Log4j?
- There is a considerable increase in upgrades from Log4j 1 (not affected, EOL 2015) to Log4j 2.
- Some companies upgraded Log4j Core multiple times during December 2021.
- Others didn't…

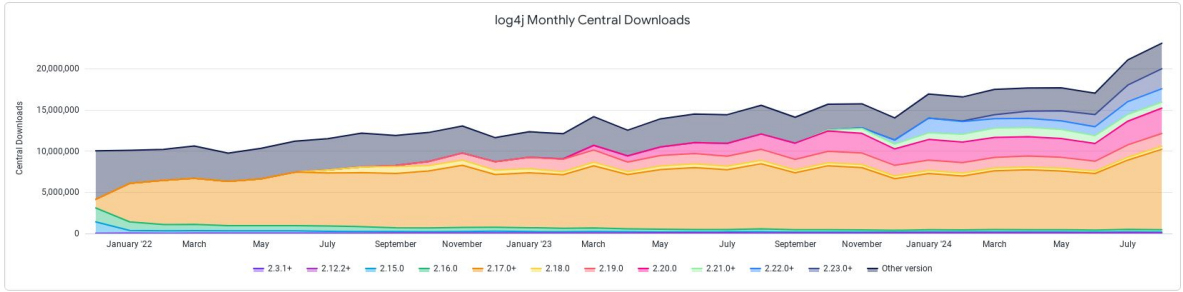
log4j Latest Statistics

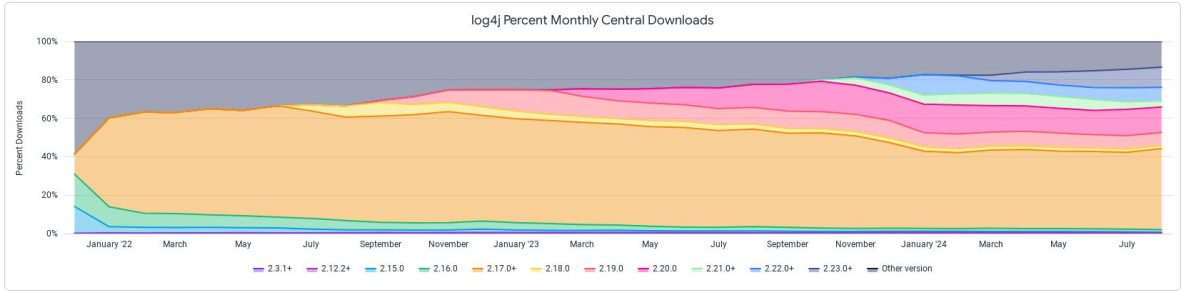
471,179,072

Total Downloads Since Dec 10, 2021
24 % vulnerable

16 %

Vulnerable Downloads Last 7 Days
5,239,729 total downloads





Source: Sonatype [Log4j Updates and Vulnerabilities]

Apache Log4j Reactions

Lessons learned

Too many bundled features:

learn to say NO (intelligently).

Supply chain problems:

- Tests are flaky (slow down release),
- Site generation is slow,
- Release procedure is complex,
- Keep dependencies up-to-date (and tell about it).

Documentation problems:

- Is hard to find,
- Is not complete, some obscure features are not documented,
- Does not contain best practices.

Helped solving the problems:

- **Tidelift** supports Log4j since January 2023,
- German **Sovereign Tech Fund** with a grant to Christian Grobmeier, Volkan Yazıcı and me, since September 2023.

Handling features

Securing optional features

Handling features is hard:

- Features bring users,
- Features bring security exposure,
- OSS is a meritocracy:

  Maintainers have the right to their features in exchange for their work.

- Log4j created a `3.x` branch in 2018 to split each optional dependency, including JNDI into its own artifact.
  Completed: IX 2024
- Removal of seldom downloaded artifacts.
- Ramp-up program:

  We accept new modules with a proven user base and a maintainer. These modules start as third-party.

Supply chain

Preparing a release

We need an expert Release Manager to:

- Select the changes for a new release,
- Run all the test suites,
- Build the website,
- Sign the release,
- Prepare the release notes,
- Handle the voting procedure,
- Release the new version.

Now, as one of the first ASF projects, we (almost) fully automate:

- Running tests,
- Upgrading dependencies,
- Deploying snapshots,
- Staging the new website,
- Staging and signing the artifacts and source archives,
- Staging the voting procedure.

Key supply chain elements

- Can we trust automation?
  ASF policy requires the RM to create the binaries.
  Reproducible Builds Project:
  All our Java builds are reproducible!
- Dependabot: upgrades dependencies since 2017.
  We accept those upgrades automatically if tests pass.
- GitHub Actions is the CI/CD engine we use.
- Lots of Maven plugins and test libraries
  that don’t get credit enough!

Software Bill of Materials

An SBOM is:

- An inter-ecosystem format to list dependencies.
- A useful tool to manage dependencies and their versions.
- A worldwide network of machine-readable and interconnected security documents.

Present:

- Publishing of SBOM for all Log4j artifacts. The dependency versions are not enforced, but merely suggested.
- Maven specificity: dependents don't profit from all version suggestions.
- Usage of SBOM links to point to a machine-readable VDR.
- Features contributed back to CycloneDX Maven Plugin 2.8.0

SBOMs future (?)

- Integration of SBOMs into ecosystem-specific dependency management systems.

Transparency Exchange API for:

- Automatically import VDR/VEX entries from dependencies to stage VEX entries. “Vulnerability Bot”
- Push our VDR, VEX and version suggestions to consumers/dependents.

Documentation

Security through education

Logging is not always safe:

- Unstructured logging:
  CWE-93 CRLF Injection
- Presence of sensitive information in logs:
  CWE-215: SI in Debug Code
- Injection of {} Log4j formatting patterns:

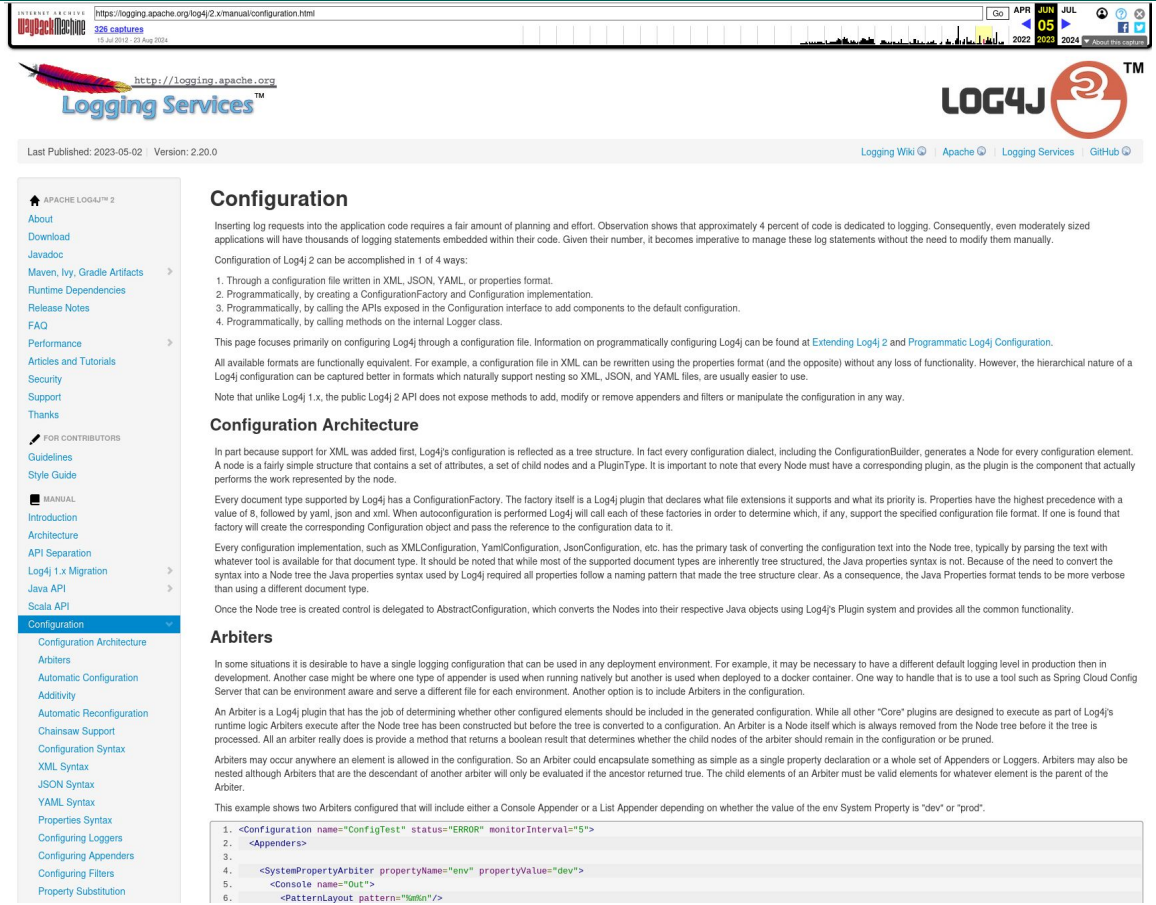
```
String user = “root {}”;
String what = “login”;
log.(user + “failed to {}”, what);
```

- Reliable and secure transport.

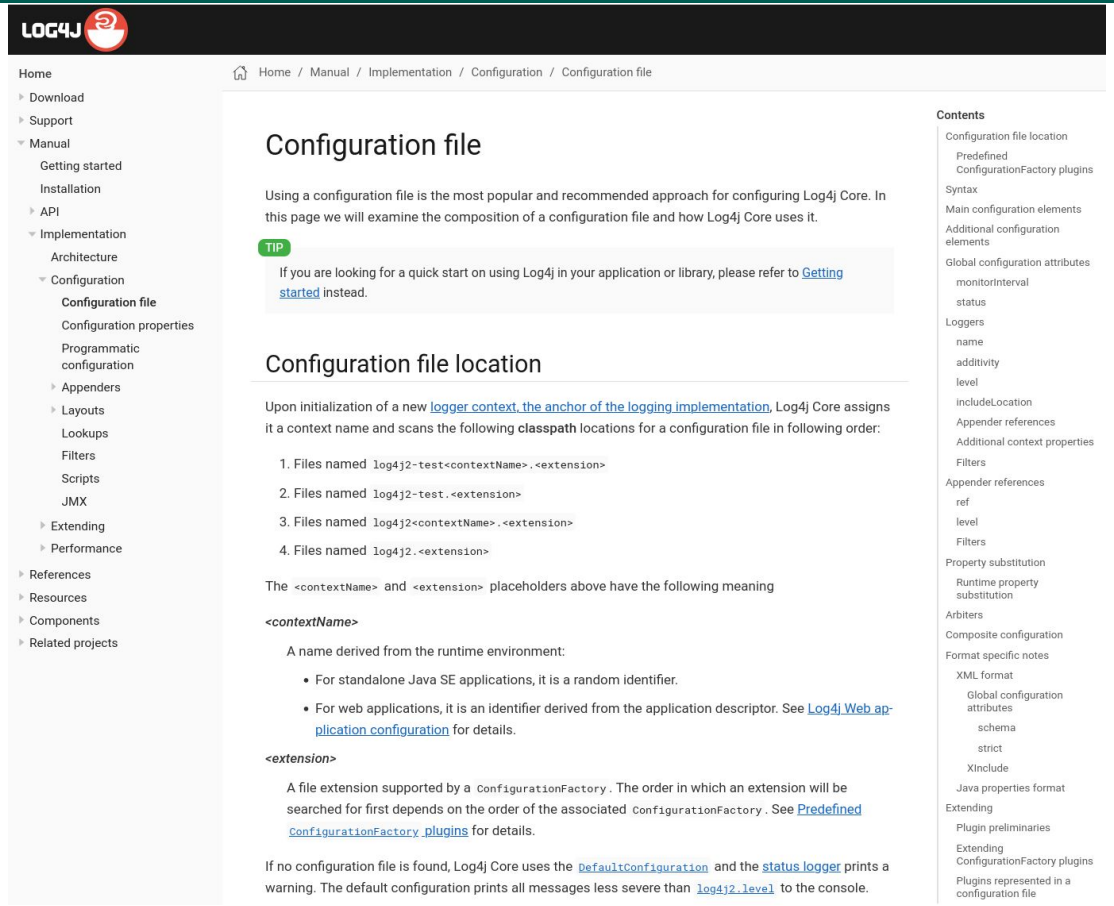
Solutions:

- Rewrite of documentation website.
  Learn from the source, not ChatGPT.
- Generation of reference from code:
  Living documentation,
  Developers can not forget.
- Provide best practices and tips:
  The maintainers knowledge base was mainly unwritten.

Tip: there will be an in-depth book by Christian Grobmeier published by Manning.



Status June 2024



LOG4J

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Configuration file

Using a configuration file is the most popular and recommended approach for configuring Log4j Core. In this page we will examine the composition of a configuration file and how Log4j Core uses it.

TIP

If you are looking for a quick start on using Log4j in your application or library, please refer to Getting started instead.

Configuration file location

Upon initialization of a new logger context, the anchor of the logging implementation, Log4j Core assigns it a context name and scans the following **classpath** locations for a configuration file in following order:

1. Files named `log4j2-test<contextName>.<extension>`
2. Files named `log4j2-test.<extension>`
3. Files named `log4j2<contextName>.<extension>`
4. Files named `log4j2.<extension>`

The `<contextName>` and `<extension>` placeholders above have the following meaning

<contextName>

A name derived from the runtime environment:

- For standalone Java SE applications, it is a random identifier.
- For web applications, it is an identifier derived from the application descriptor. See Log4j Web application configuration for details.

<extension>

A file extension supported by a `ConfigurationFactory`. The order in which an extension will be searched for first depends on the order of the associated `ConfigurationFactory`. See Predefined `ConfigurationFactory` plugins for details.

If no configuration file is found, Log4j Core uses the `DefaultConfiguration` and the status logger prints a warning. The default configuration prints all messages less severe than `log4j2.level` to the console.

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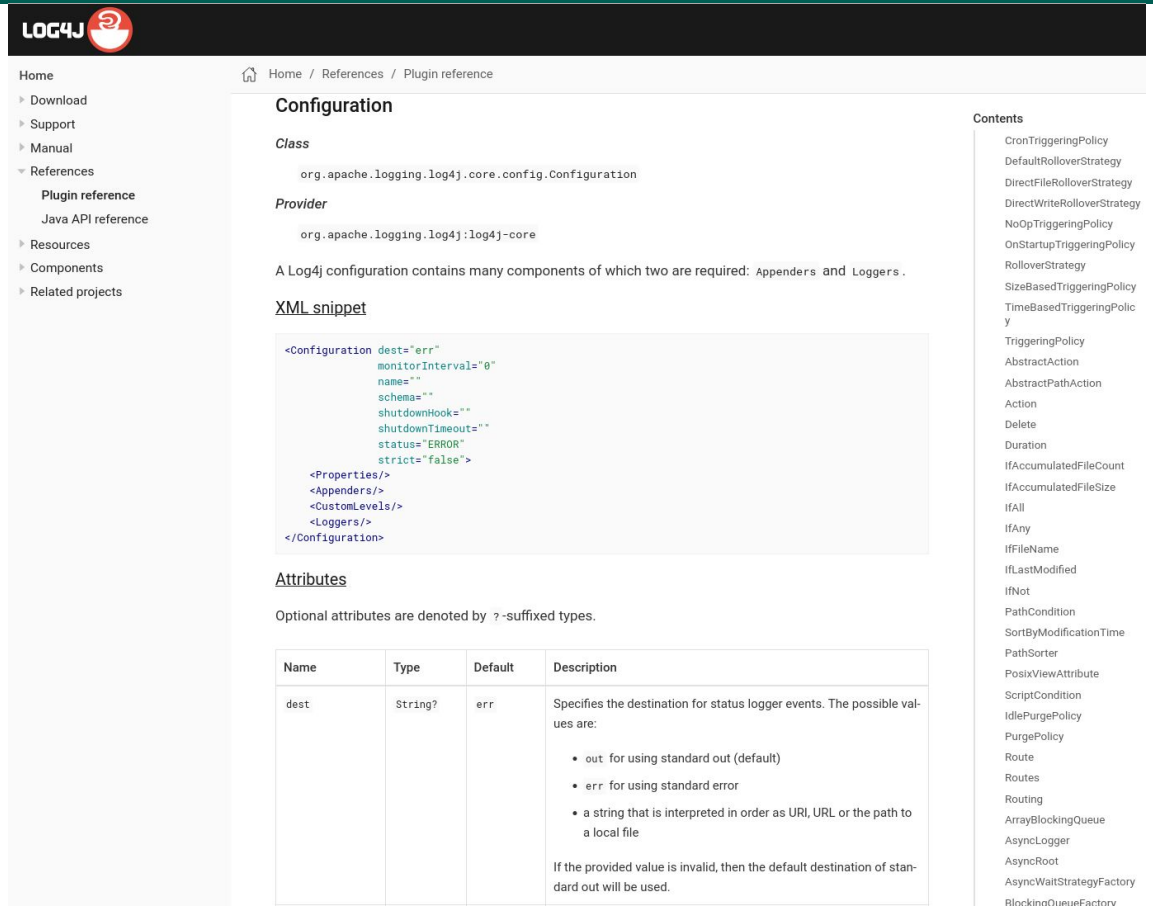
Current status



Automatically generated Plugin Reference

Testing quality

Test quality requirements

All software component should have tests that:

- Provide 73,9% of coverage,
- Are supplied with each PR,
- Test the required **behaviour,**
- Do not test implementation details,
- Do not have false negatives,
- Do not have false positives (flakiness).

September 2023:

- Sequential tests,
- 30-40% of test runs failed for no reason,
- Build times up to 60 minutes.

September 2024:

- Parallel tests,
- Dynamic tests (fuzzing),
- 8% of test runs fails (21% flaky),
- Build + deploy around 30 minutes.
- Searchable build failure database: Gradle Develocity

Q & A

https://logging.apache.org/

Thanks

Agnieszka Karwasz and my angels:
Milena, Liliana, Natalia

Apache Logging Services team:
C. Kozak, D. McColl, D. Psenner, G. Gregory,
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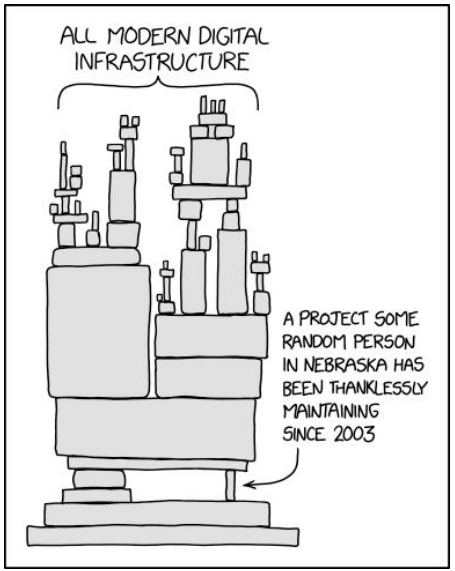
R. Popma, R. Middleton, R. Grabowski, S. Deboy,
S. Webb and Th. Schöning.
See also https://logging.apache.org

Partners in crime (STF project):
Christian Grobmeier and Volkan Yazıcı

Financial supporters:
Tidelift and Sovereign Tech Fund

Remember about:



Source: XKCD