Glencoe SOFTWARE

OMERO.server & Java support

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OME Weekly Meeting Tech Session - 30.04.2024

Outline

1. Java & OpenJDK
2. State of the OpenJDK LTS support
3. State of Java support in OME
4. Running OMERO.server on JDK 17
5. Next steps

Java programming language

- Object-oriented programming language
- Former developed by Sun Microsystems, now Oracle Corporation
- Releases
  - Java Platform, Standard Edition or Java Standard Edition or Java SE
  - Java Platform, Enterprise Edition or Jakarta EE
- Java language evolution
  - Governed via Java Community Process (JCP) https://jcp.org/
  - Java Enhancement Proposal (JEP)
  - Java Specification Requests (JSR), review and approval process
- Release frequency
  - Now time-driven every 6 months (March and September)
  - Some releases classified as long-term support (8, 11, 17, 21)
  - Specifications available from https://docs.oracle.com/javase/specs/

Java & OME project

- 30 repositories marked as Java
  https://github.com/ome?q=&type=all&language=java&sort=
- Formats translation & conversion
  - Bio-Formats
  - Conversion tools
- Image data management
  - OMERO.server
  - OMERO.insight
  - Micro-services
- All latest releases require Java 8+, some require at least Java 11+

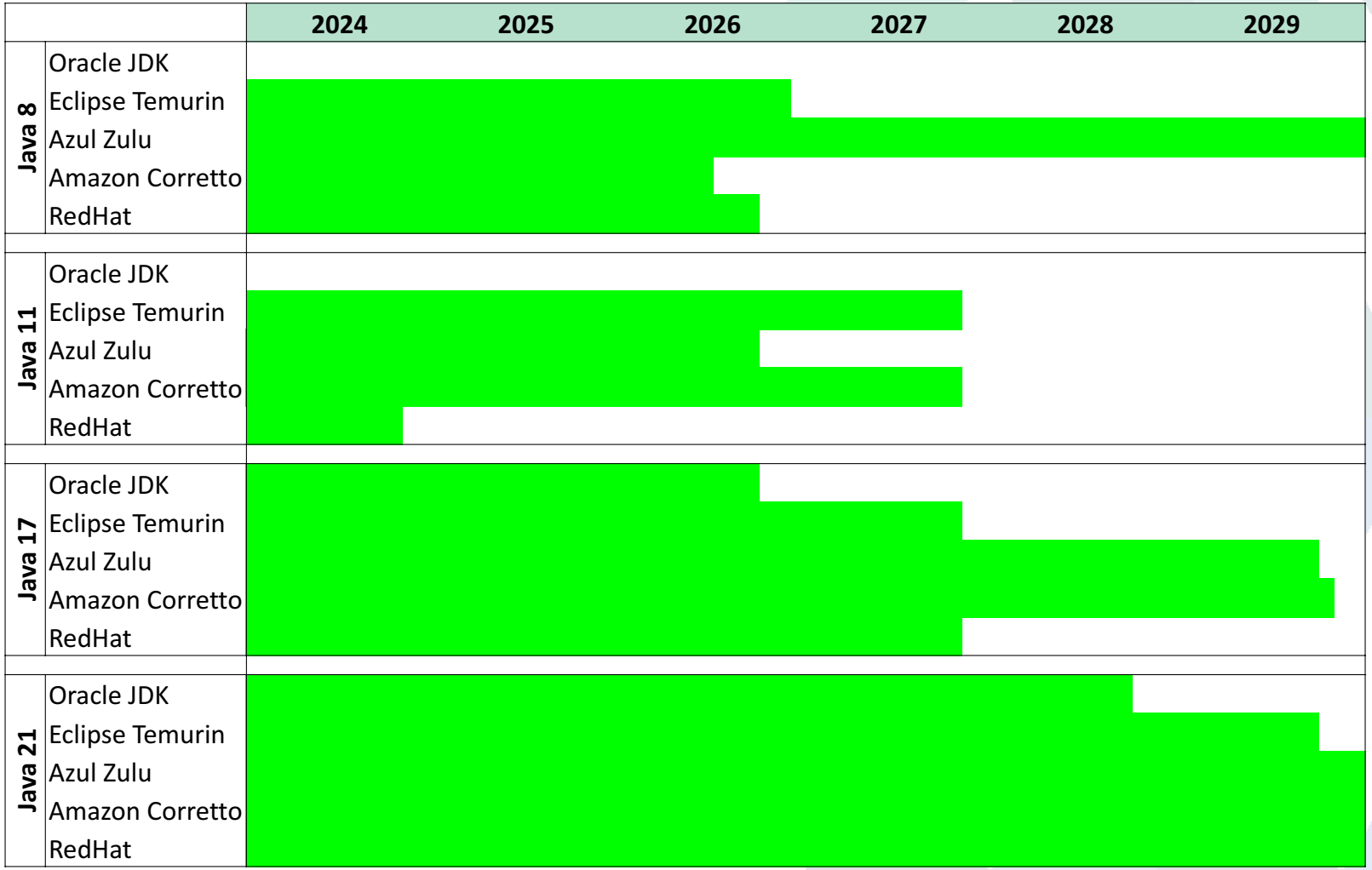
OpenJDK

- Java Virtual Machine (JVM)
- Java Runtime Environment (JRE)
- Java Development Kit (JDK)
- OpenJDK == Open Java Development Kit
  - Free and open-source implementation of the Java SE platform
  - Release in 2007 by Sun Microsystems
  - Licensed under GPL 2.0 with ClassPath Exception (https://openjdk.org/legal/gplv2+ce.html)
  - Reference implementation since Java SE 7

Towards multiple OpenJDK distributions

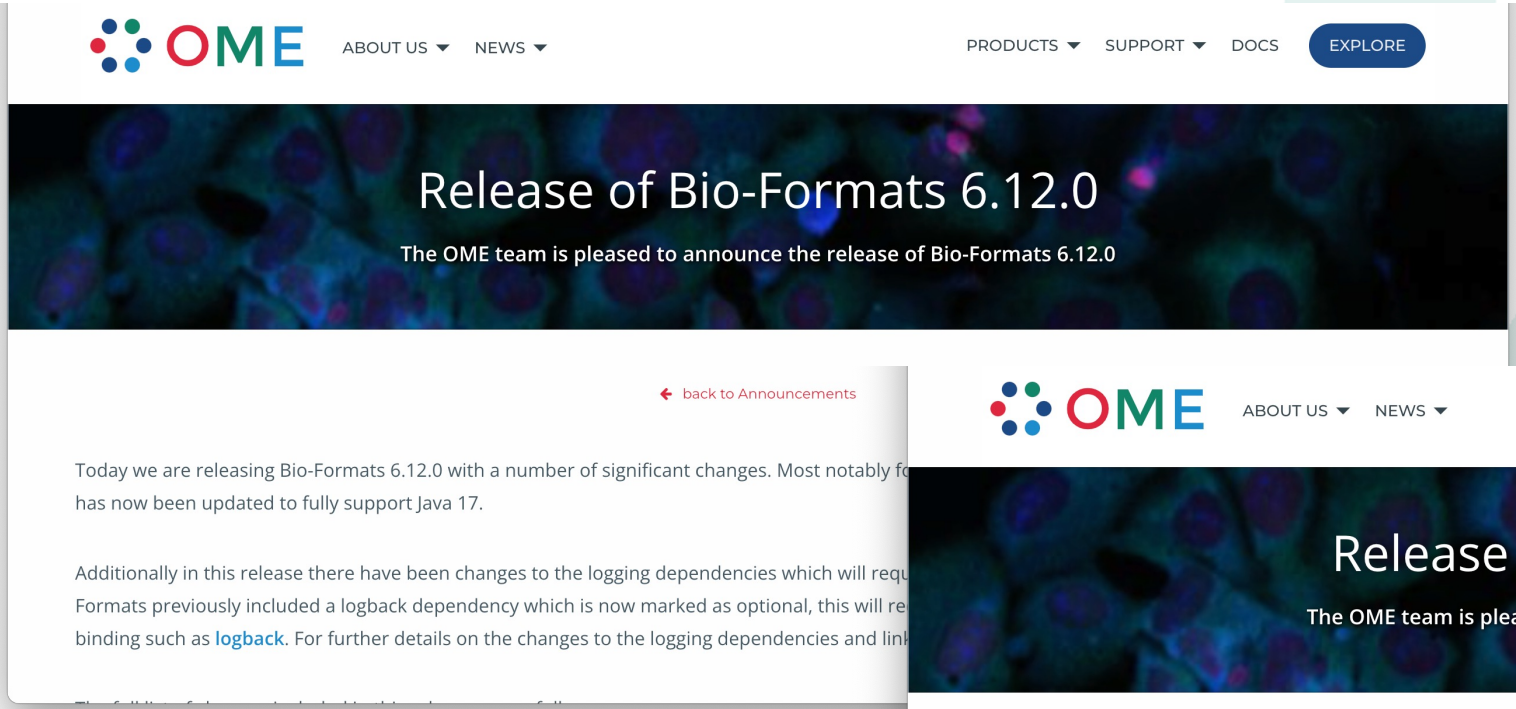
- 2009 Oracle Corporation acquires Sun Microsystems
- 2009-2018: Oracle releases Java under 2 builds
  - OpenJDK (GPLv2 + CE)
  - OracleJDK (Oracle Binary Code License)
- 2018: Oracle Technology Network License Agreement (OTNLA)
  - Introduces distinction between personal and commercial users
- 2019: Oracle announces end of support for OpenJDK 8
- Future OpenJDK builds only get support for 6 months
- Many vendors now build and ship their distribution of OpenJDK
  - Oracle JDK
  - Azul
  - Eclipse Temurin
  - Amazon Corretto
  - RedHat build of OpenJDK

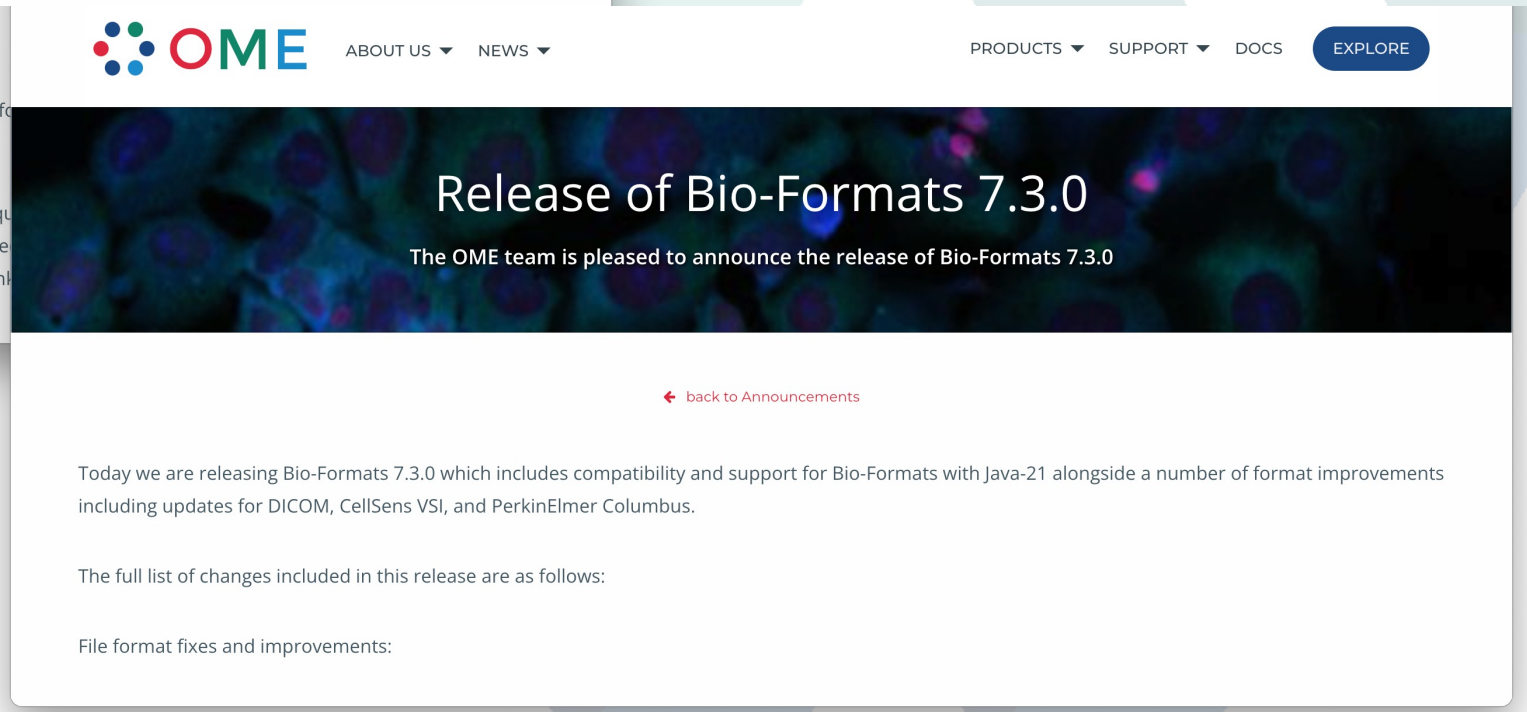
OpenJDK support by distribution



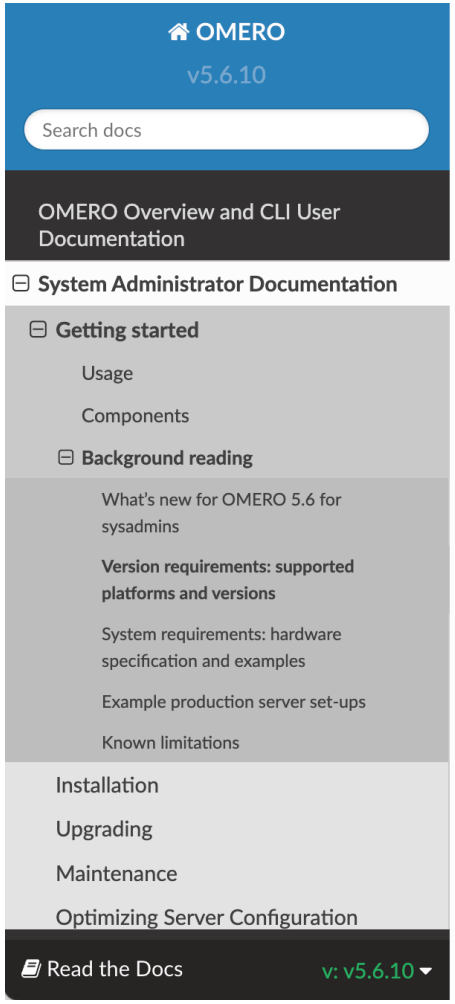
https://endoflife.date/

Bio-Formats & Java support





OMERO & Java support



If no version is provided, a suitable repository is indicated.

Version	CentOS/RHEL	Ubuntu
3.6	9 (zeroc-ice-rhel9-x86_64)	22.04 (zeroc-ice-ubuntu2204-x86_64)

Java

General overview

OMERO support policies

Version	Release date	Supported until	OMERO 5.6	Details
7	Jul 2011	Apr 2015	✗	Reference
8	Mar 2014	Nov 2026	✓	Reference
11	Sep 2018	Oct 2024	✓	Reference
17	Sep 2018	Oct 2027	^	Reference

Version provided by distribution

Version	CentOS/RHEL	Ubuntu
11	9	22.04
Details		Reference

OMERO.server & Java 17: reflection issue

- Ubuntu 22.04
- OMERO.server 5.6.10
- Default configuration

- OpenJDK 11 pass
- OpenJDK 17 fail
- OpenJDK 21 fail

https://github.com/sbesson/omero-server-jep403

Strong encapsulation in the JDK

- JEP 403: Strongly Encapsulate JDK Internals (https://openjdk.org/jeps/403)
  - Disallows usage of reflection to access parts of the JDK that are meant for internal use only
- JDK 9 through JDK 16
  - Allowed the reflection to continue
  - Emitted warnings about illegal reflective access
  - Can be controlled via `--illegal-access`
- JDK 17 and later
  - Strongly encapsulated
  - Reflection no longer permitted by default
  - `--illegal-access` flag obsolete

https://docs.oracle.com/en/java/javase/17/migrate/migrating-jdk-8-later-jdk-releases.html#GUID-7BB28E4D-99B3-4078-BDC4-FC24180CE82B

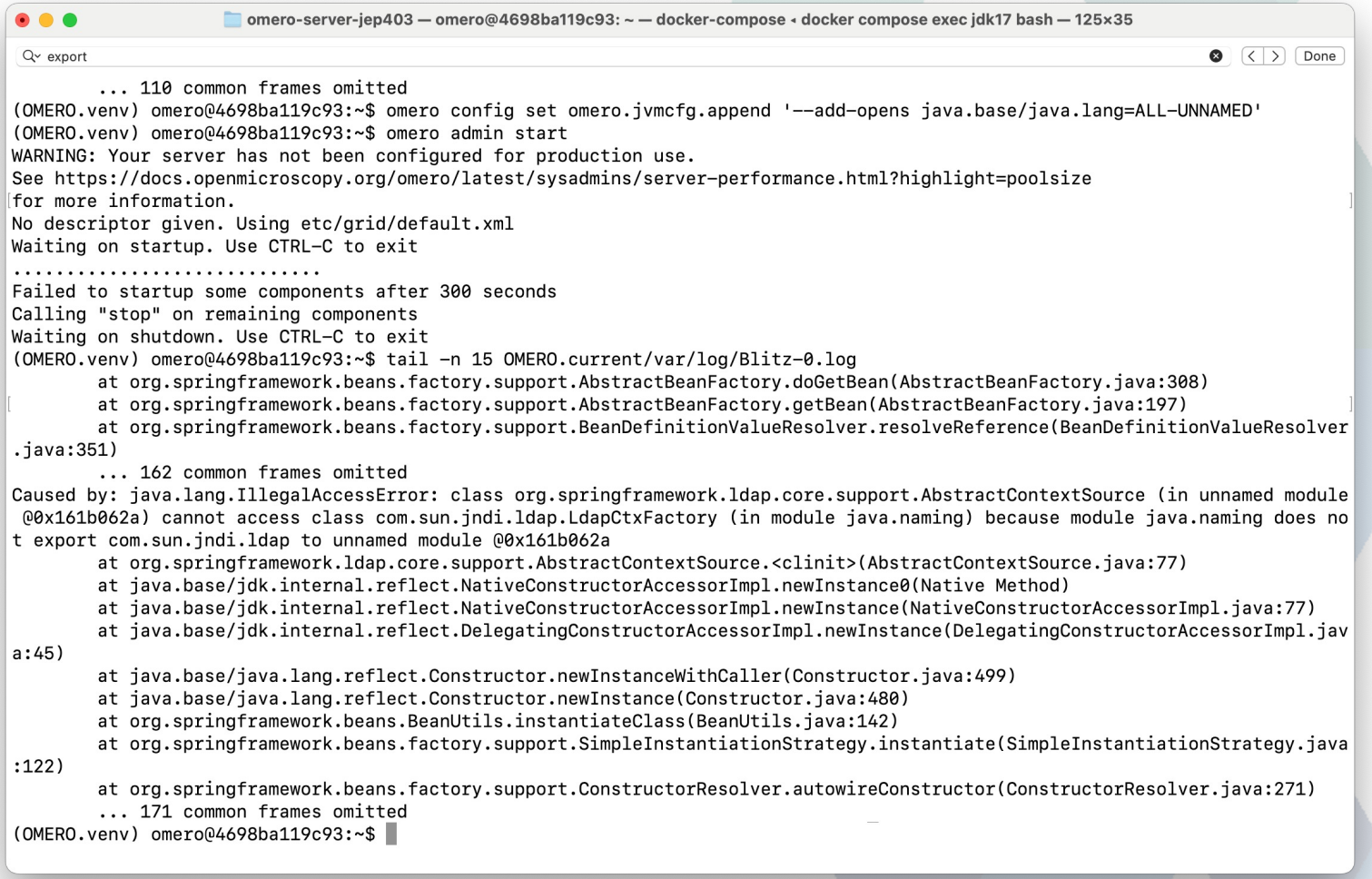
Strong encapsulation: --add-opens

- `java.lang.reflect.InaccessibleObjectException`
- Usage of reflection API to access protected/private methods of Java API
- Workaround: use --add-opens
  - `--add-opens <module>/<package>=<target-module>(,<target-module>)*`
  - `--add-opens java.management/sun.management=ALL-UNNAMED`
- OMERO configuration: omero.jvmcfg.append

```
$ omero config set omero.jvmcfg.append '--add-opens
java.base/java.lang=ALL-UNNAMED'
```

https://docs.oracle.com/en/java/javase/17/migrate/migrating-jdk-8-later-jdk-releases.html#GUID-7BB28E4D-99B3-4078-BDC4-FC24180CE82B

OMERO.server & Java 17: export issue



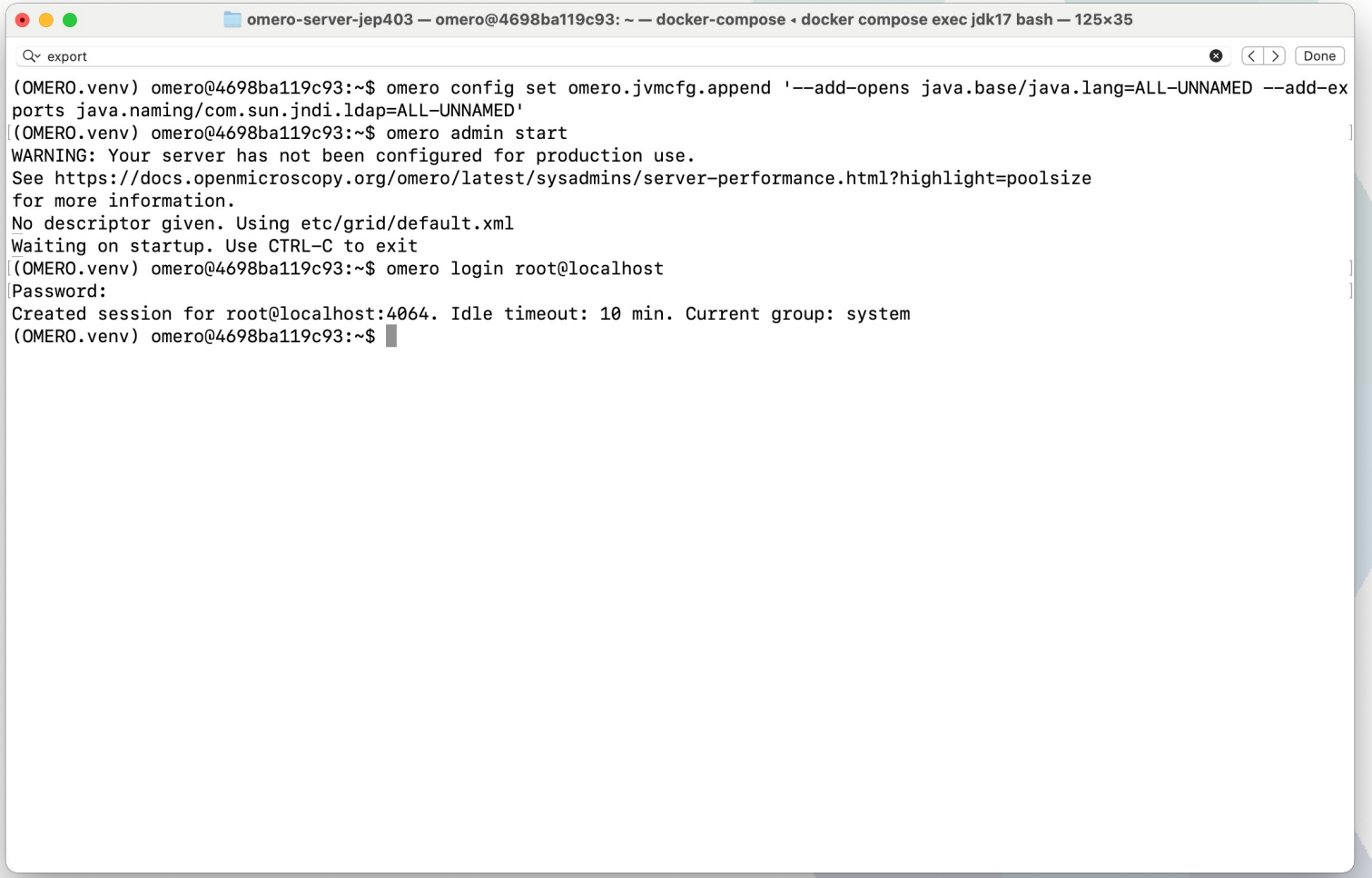
Strong encapsulation: --add-exports

- `java.lang.IllegalAccessError`
- Direct import of internal API that has been strongly encapsulated
- Workaround: use --add-exports
  - `--add-exports <source-module>/<package>=<target-module>(,<target-module>)*`
  - `--add-exports java.management/sun.management=ALL-UNNAMED`
- OMERO configuration: omero.jvmcfg.append

```
$ omero config set omero.jvmcfg.append '--add-opens
java.base/java.lang=ALL-UNNAMED --add-exports
java.naming/com.sun.jndi.ldap=ALL-UNNAMED'
```

https://docs.oracle.com/en/java/javase/17/migrate/migrating-jdk-8-later-jdk-releases.html#GUID-7BB28E4D-99B3-4078-BDC4-FC24180CE82B

OMERO & Java 17



OMERO & Java 17+: next steps

- Limitations
  - Test coverage
  - --add-opens/--add-exports only valid for Java 9+
    See https://github.com/glencoesoftware/bioformats2raw/issues/239 for an example of impact on Java 8
  - Possible candidate for troubleshooting section
- Server dependencies upgrade
  - com.github.marcus-nl.btm:btm / org.javassist:javassist
  - org.springframework.security:spring-security-ldap/spring-ldap-core
- Opportunity to audit server dependencies

Summary

- Evolution of the Java ecosystem
- Current support
  - Bio-Formats: all Java LTS releases (8, 11, 17, 21) tested and supported
  - OMERO: Java 8 supported, Java 11 recommende
  - Running OMERO.server on Java 17/21 possible with configuration changes
  - See https://github.com/ome/openmicroscopy/issues/6383 for more details
- Next steps
  - Define roadmap for Java 17 & 21 OMERO support
  - Review and upgrade server dependencies
  - Integrate Java 17, 21 in the daily testing
  - Building OMERO components on JDK 17, 21

Questions?