Performance & Security Improvements

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Virtual Threads in Detail:

What's New in Java 21

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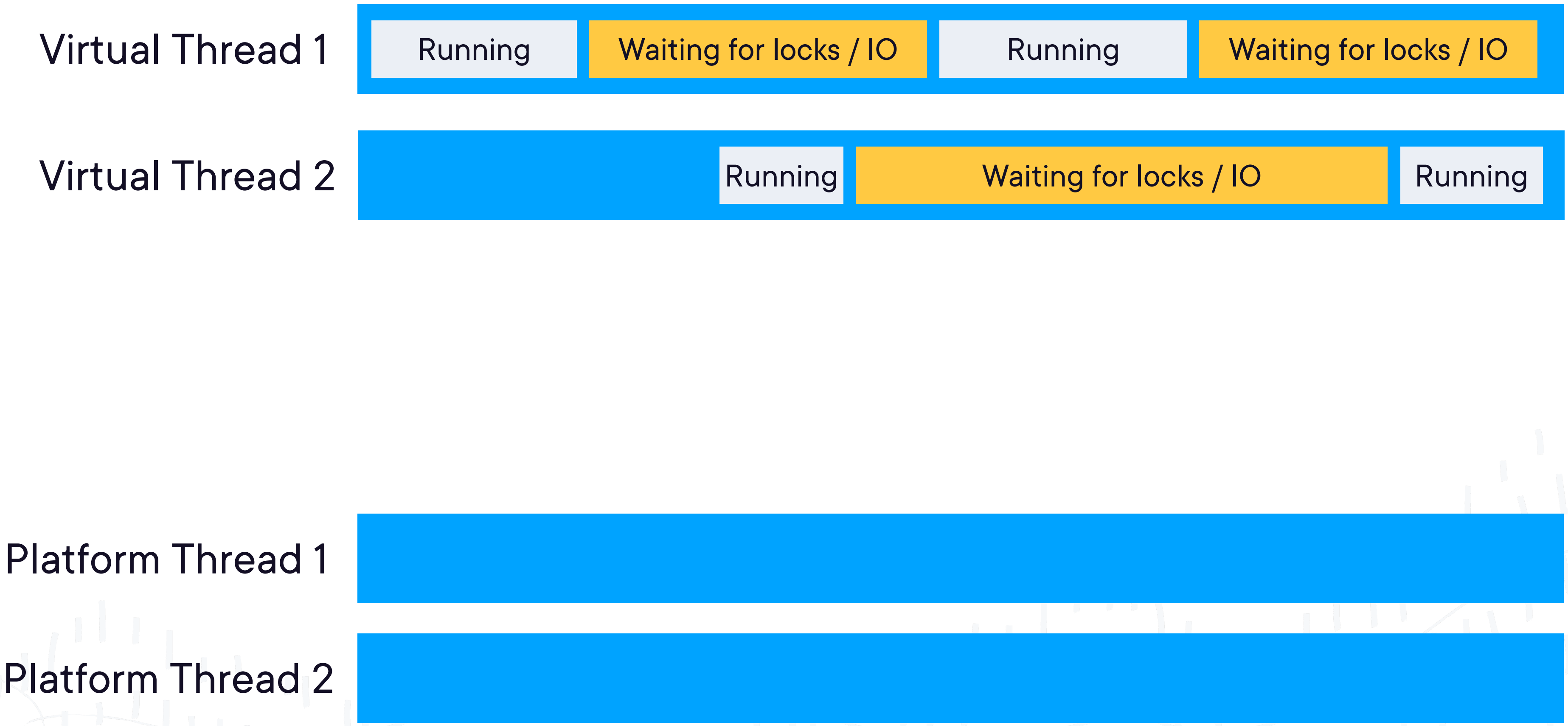
Virtual Threads



Virtual Thread 1

Running | Waiting for locks / IO | Running | Waiting for locks / IO

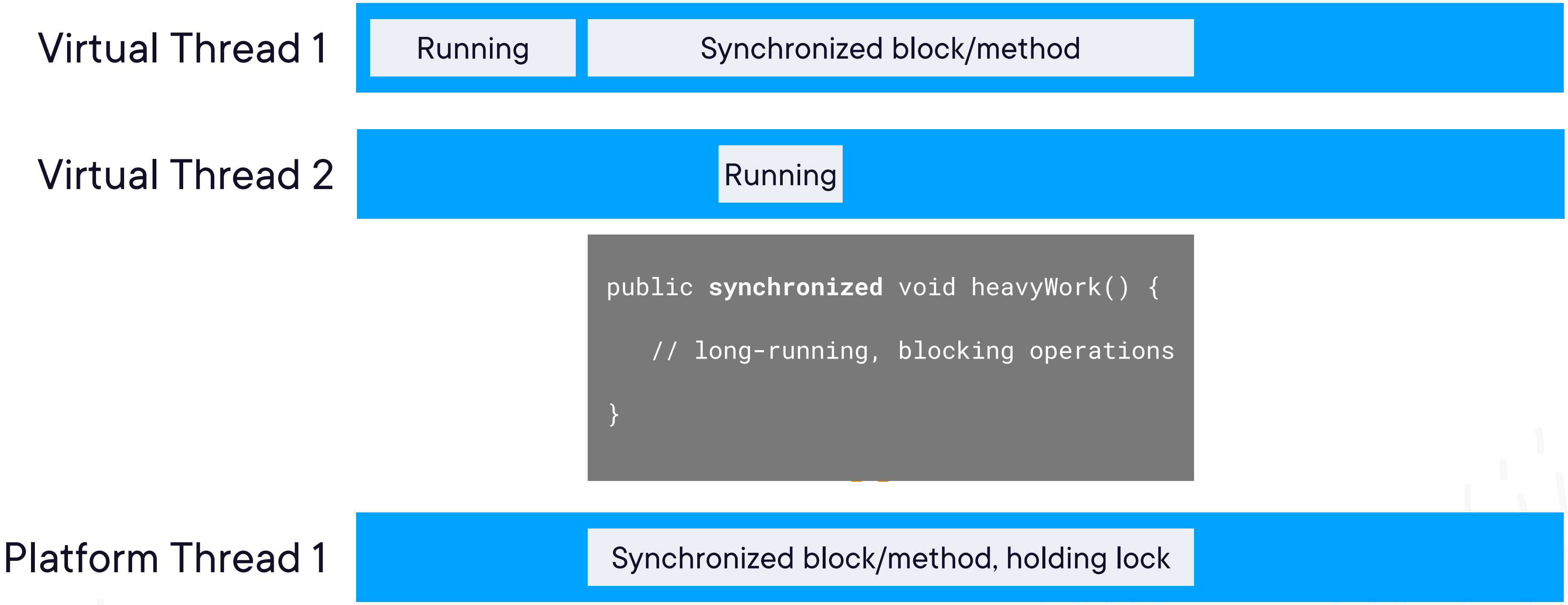
Virtual Thread 2

Running | Waiting for locks / IO | Running

Platform Thread 1

Platform Thread 2

Virtual Threads: Pinning



Virtual Thread 1

Running

Synchronized block/method

Virtual Thread 2

Running

```
public synchronized void heavyWork() {
   // long-running, blocking operations
}
```

Platform Thread 1

Synchronized block/method, holding lock

Virtual Threads: Synchronize without Pinning

As of Java 24, no more pinning within `synchronized` blocks

Replacing `synchronized` with `java.util.concurrent.locks.*` no longer required

Virtual threads can still be pinned through native code execution

Security Improvements

`sun.misc.Unsafe`

Direct memory access methods

Deprecated in Java 23

Log run-time warning in Java 24

`VarHandle` (JDK 9)

Foreign Function & Memory API (JDK 22)

Java Native Integration (JNI)

Opt-in for unsafe functionality in future, warning for now

```
--enable-native-access
--illegal-native-access
```

Security Improvements: Quantum Resistant Cryptography

Module-Lattice-Based Key-Encapsulation Mechanism (ML-KEM)

Module-Lattice-Based Digital Signature Algorithm (ML-DSA)

NIST & FIPS compliant

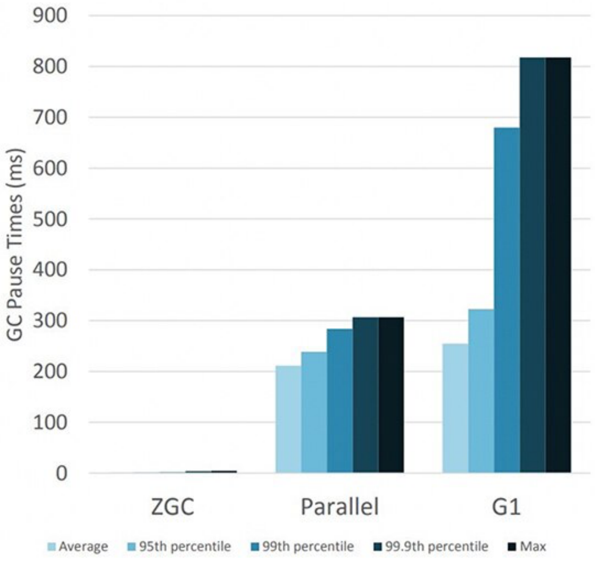
Performance Improvements

Garbage Collection

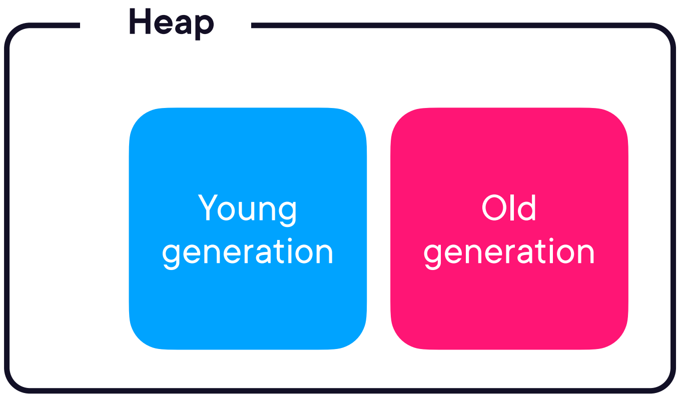
Ahead-of-Time (AOT)
Class Loading and Linking

Generational ZGC

```
-XX:+UseZGC
```



bit.ly/zgc-benchmark


Heap

Young generation

Old generation

AOT Class Loading and Linking

Decreasing JVM start-up time by making application classes instantly available, creating an ahead-of time cache containing their loaded and linked representations.

AOT Class Loading and Linking

Training run for AOT cache

```
java -XX:AOTMode=record \
     -XX:AOTConfiguration=myapp.aotconf \
     -cp myapp.jar com.ps.MyApp
```

1

Create AOT cache file

```
java -XX:AOTMode=create \
     -XX:AOTConfiguration=myapp.aotconf \
     -XX:AOTCache=myapp.aot \
     -cp myapp.jar
```

2

Run application with pre-loaded & linked classes

```
java -XX:AOTCache=myapp.aot \
     -cp myapp.jar com.ps.MyApp
```

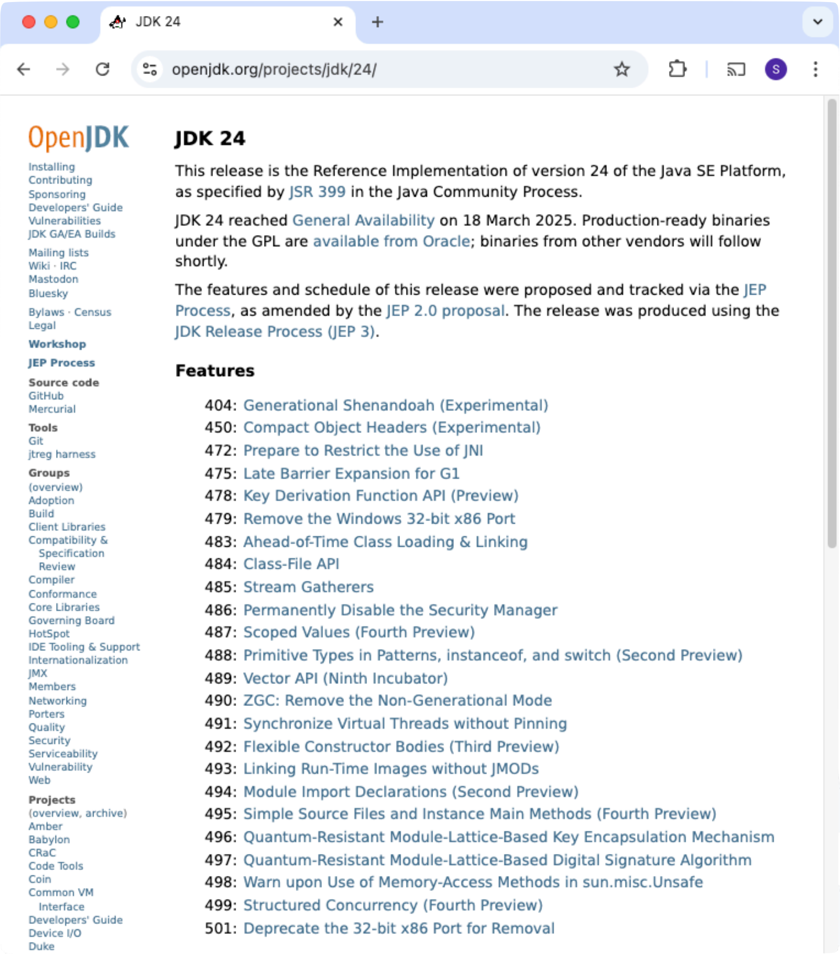
3

~40% decrease in start-up time observed

Course Wrap-up

JEPs for all major features

https://openjdk.org/projects/jdk/24/



JDK 24

This release is the Reference Implementation of version 24 of the Java SE Platform, as specified by JSR 399 in the Java Community Process.

JDK 24 reached General Availability on 18 March 2025. Production-ready binaries under the GPL are available from Oracle; binaries from other vendors will follow shortly.

The features and schedule of this release were proposed and tracked via the JEP Process, as amended by the JEP 2.0 proposal. The release was produced using the JDK Release Process (JEP 3).

Features

404: Generational Shenandoah (Experimental)
450: Compact Object Headers (Experimental)
472: Prepare to Restrict the Use of JNI
475: Late Barrier Expansion for G1
478: Key Derivation Function API (Preview)
479: Remove the Windows 32-bit x86 Port
483: Ahead-of-Time Class Loading & Linking
484: Class-File API
485: Stream Gatherers
486: Permanently Disable the Security Manager
487: Scoped Values (Fourth Preview)
488: Primitive Types in Patterns, instanceof, and switch (Second Preview)
489: Vector API (Ninth Incubator)
490: ZGC: Remove the Non-Generational Mode
491: Synchronize Virtual Threads without Pinning
492: Flexible Constructor Bodies (Third Preview)
493: Linking Run-Time Images without JMODs
494: Module Import Declarations (Second Preview)
495: Simple Source Files and Instance Main Methods (Fourth Preview)
496: Quantum-Resistant Module-Lattice-Based Key Encapsulation Mechanism
497: Quantum-Resistant Module-Lattice-Based Digital Signature Algorithm
498: Warn upon Use of Memory-Access Methods in sun.misc.Unsafe
499: Structured Concurrency (Fourth Preview)
501: Deprecate the 32-bit x86 Port for Removal

More Information

What's New in Java 9-21

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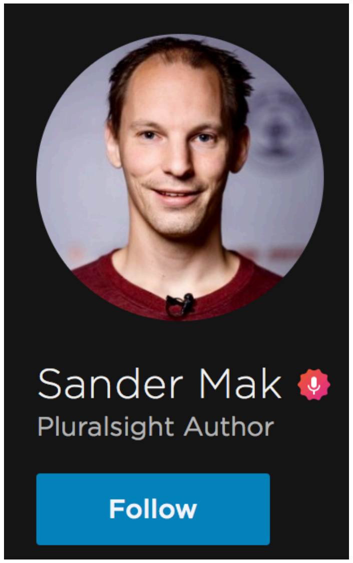
Follow for course updates



bit.ly/ps-sander