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VS

HOTSPOT VS J9

WHICH ONE TO CHOOSE TO CUT YOUR CLOUD BILLS

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www.bell-sw.com | 2023



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WHO WE ARE

Dmitry Chuyko

Performance architect with 20+ years of experience in IT

Active OpenJDK contributor

Areas of expertise:

- OpenJDK optimization for x86 and ARM
- Development of microcontainers for Java
- Enhancement of Java HotSpot

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About BellSoft

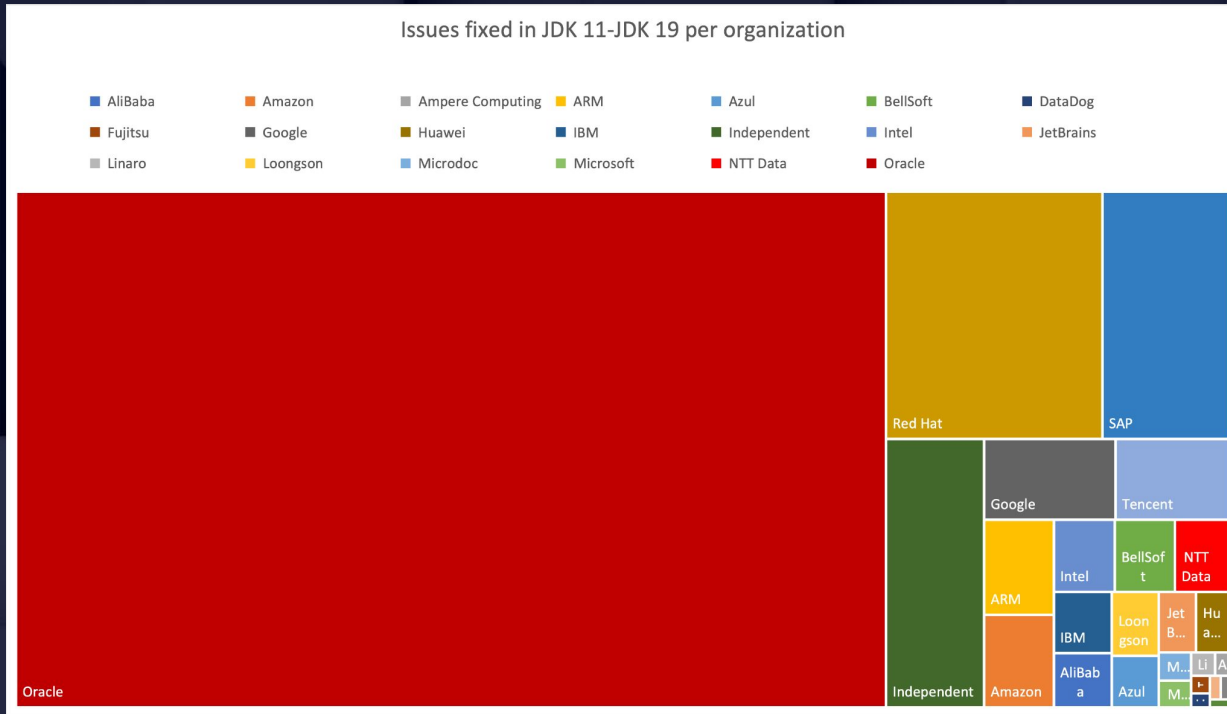
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BellSoft was founded in 2017 by Java and Linux experts with 10+ years of experience working in Sun/Oracle. Headquarters in San Jose, California.

Members of:

- JCP executive committee
- OpenJDK Vulnerability Group
- GraalVM advisory board
- Linux Foundation
- Cloud Native Computing Foundation





BellSoft's contributions to OpenJDK

- Leading OpenJDK contributor
- Developed and integrated JEP 315 (aarch64 optimization) and JEP 386 (Alpine Linux port)
- Maintain the upstream Arm port
- Brought musl libc support in GraalVM

Java



Liberica JDK

Liberica JDK is a 100% open-source vanilla Java 8, 11, and 17 implementation.



Liberica Native Image Kit

Liberica Native Image Kit JDK is a GraalVM based tool for creating performant native images.

Release schedule for all the products conforms to the LTS roadmap. All products are available for a large number of platforms.

Linux



Alpaquita

Alpaquita Linux is 100% Alpine compatible, secure, and optimized for Java.

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Some of Java features that made it great

Garbage collection

Class library

Specifications

- JLS
- JVM
- TCK

Backward compatibility

JVM



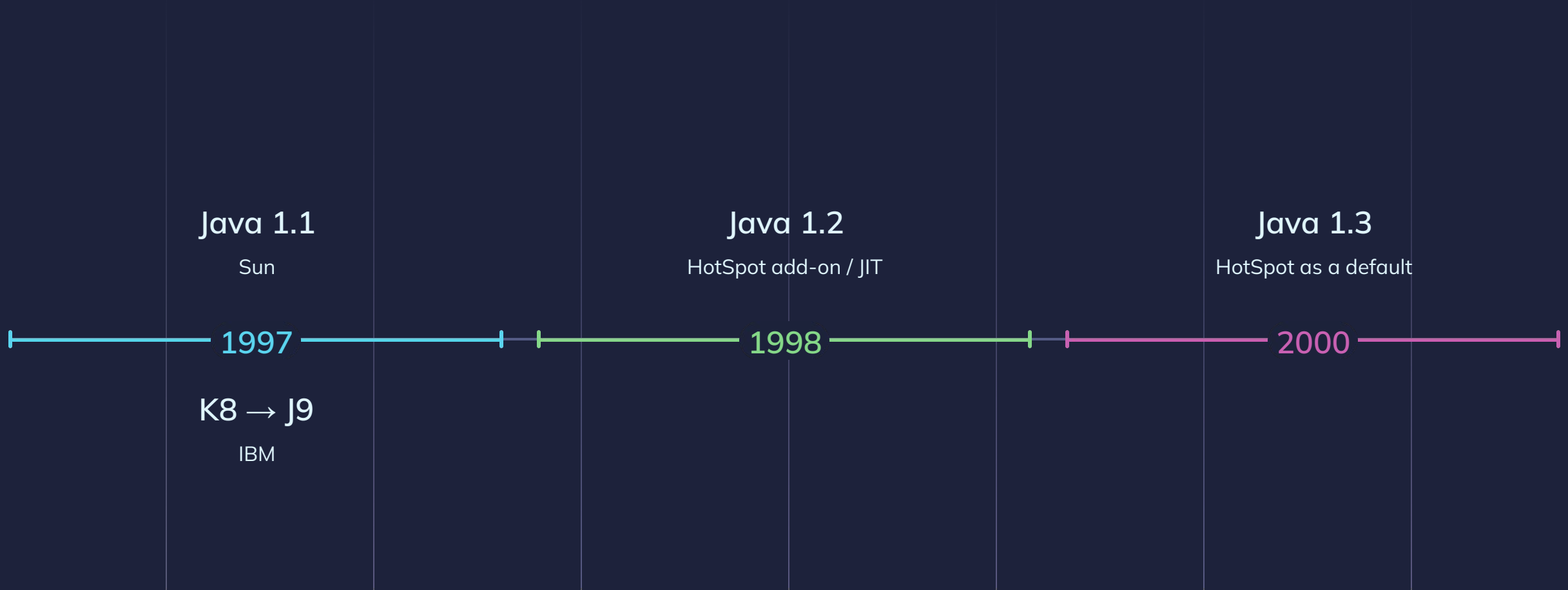
The Java Virtual Machine is the cornerstone of the Java platform. It is the component of the technology responsible for its hardware- and operating system independence, the small size of its compiled code, and its ability to protect users from malicious programs.





Dark ages

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Java 7

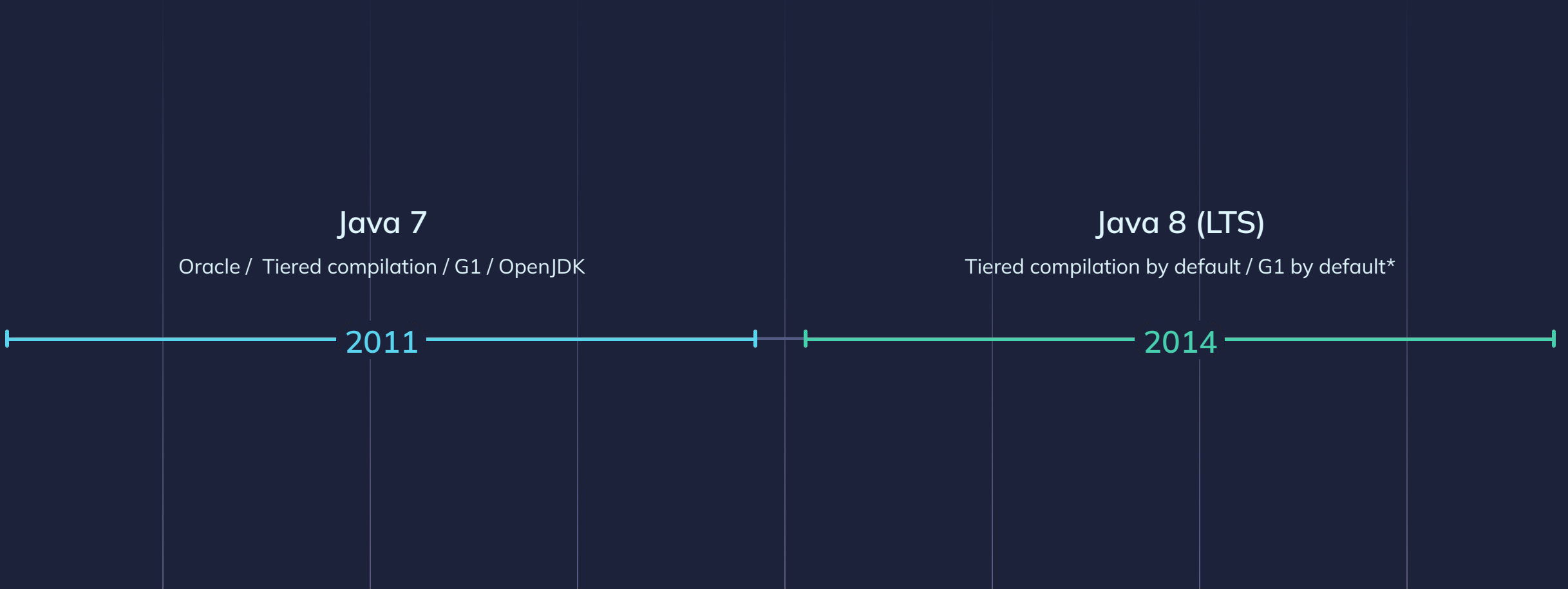
Oracle / Tiered compilation / G1 / OpenJDK

2011

Java 8 (LTS)

Tiered compilation by default / G1 by default*

2014



Java 9

AppCDS / Experimental Graal AOT & JIT

2017

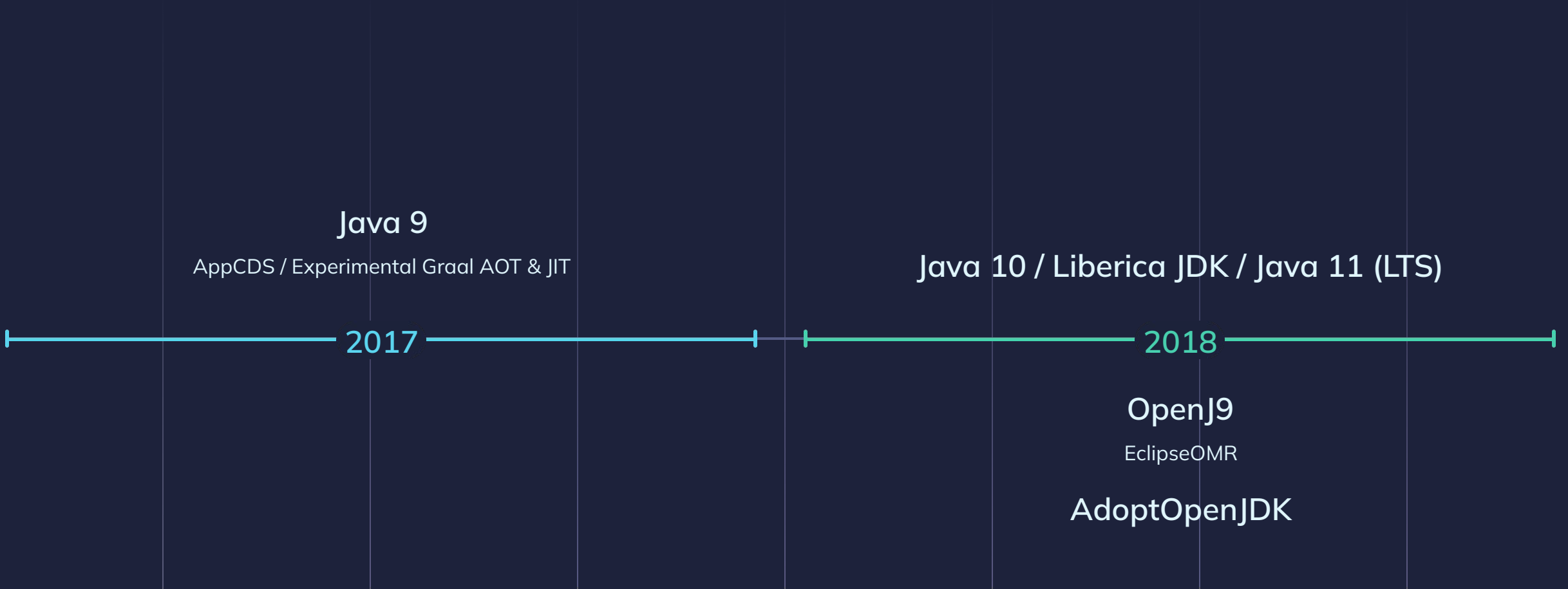
Java 10 / Liberica JDK / Java 11 (LTS)

2018

OpenJ9

EclipseOMR

AdoptOpenJDK



Modern age

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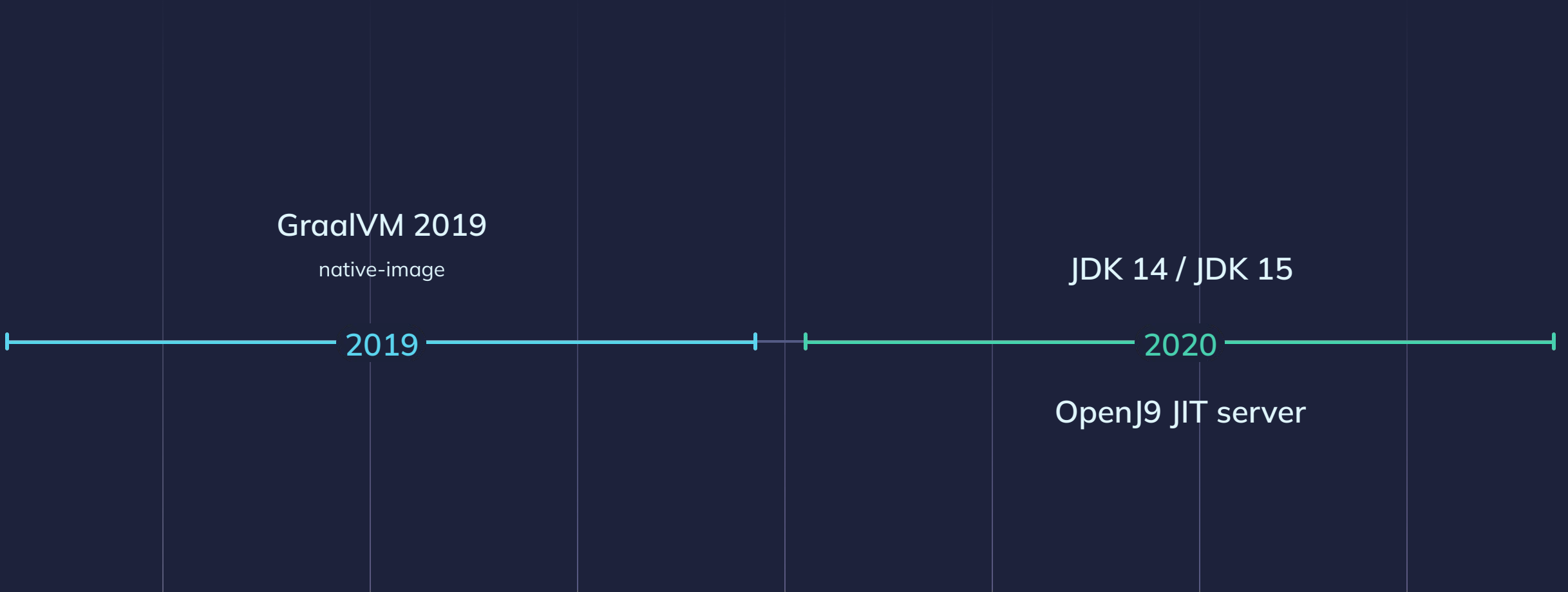
GraalVM 2019
native-image

JDK 14 / JDK 15

2019

2020

OpenJ9 JIT server



JDK 16

Musl support / Liberica JDK Light

JDK 17 (LTS)

2021

DayTrader study

JDK 18 / JDK 19

2022

Eclipse Adoptium



The logo for bellsoft, featuring the word "bellsoft" in a white, lowercase, sans-serif font. The background of the slide is a dark blue with various abstract geometric patterns, including circles, lines, and dots, some of which are highlighted with a light blue glow.

DayTrader7 study claims

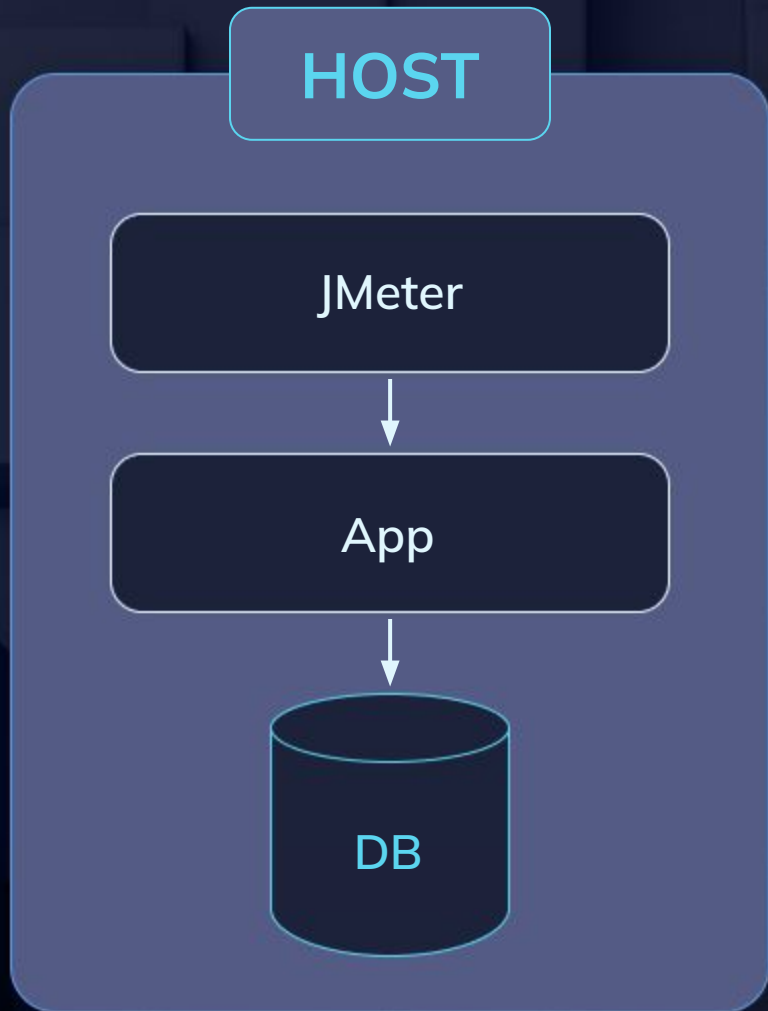
Setup

- Java 11. AdoptOpenJDK with HotSpot/OpenJ9
- Monolith app on OpenLiberty
- Desktop, 4 CPUs, 8 GB RAM (Xmx256m, Xmx1g)
- Linux
- 3 OpenJ9 configurations

Single (default) HotSpot configuration

Summary

- **51 - 55%** faster startup time
- **45 - 57%** smaller startup footprint
- **33%** smaller footprint during application ramp-up
- Comparable throughput



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Our setup

Desktop

- AMD Ryzen 5 3600X @ 3.79GHz, 1x6x1
- 8 GB RAM
- Windows 10 / Ubuntu 20.04.3

Server

- Intel Xeon Platinum 8268, 1x24x2
- 128 GB RAM
- CentOS 7

Java

- AdoptOpenJDK 11.0.11 with OpenJ9
- Liberica JDK 11.0.12 LTS
- Xmx256m, Xmx1g

Methodology

Main VM configuration types

- OpenJ9 (1) (heap)
- OpenJ9 (2) (heap, class cache)
- OpenJ9 (3) (heap, class cache, fast compilation)
- HotSpot (heap)
HotSpot (heap, AppCDS, C1)

Startup

- RSS
- Application reports it's started

No load

- RSS

Under load

- RSS
- Throughput (TPS): JMeter, simple and mixed
- Latency (ms) – WRK2, simple and mixed

Repeated experiments

Desktop startup and no load. Configurations

OpenJ9 (1) (heap 256 MB):

- “-Xmx256m”

OpenJ9 (2) (heap 256 MB, class cache):

- “-Xmx256m -Xshareclasses:name=mvn”

OpenJ9 (3) (heap 256 MB, class cache, fast compilation):

- “-Xmx256m -Xshareclasses:name=mvn -Xtune:virtualized -Xscmx200m”

HotSpot (heap 256 MB) aka default:

- “-Xmx256m”

HotSpot (heap 256 MB, AppCDS, C1):

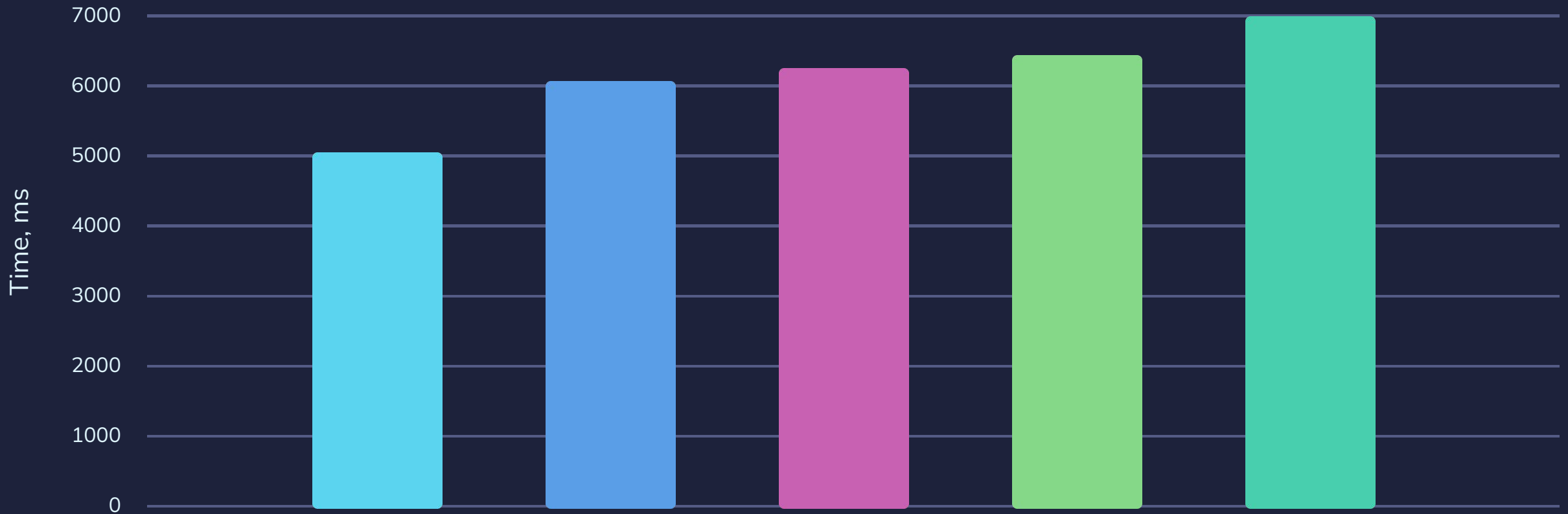
- “-Xmx256m -XX:SharedArchiveFile=app-cds.jsa -XX:TieredStopAtLevel=1”

Startup time on desktop (lower is better)

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Liberica OpenJ9 (2) OpenJ9 (3) Liberica (default) OpenJ9 (1)

Application Startup Time (Windows)

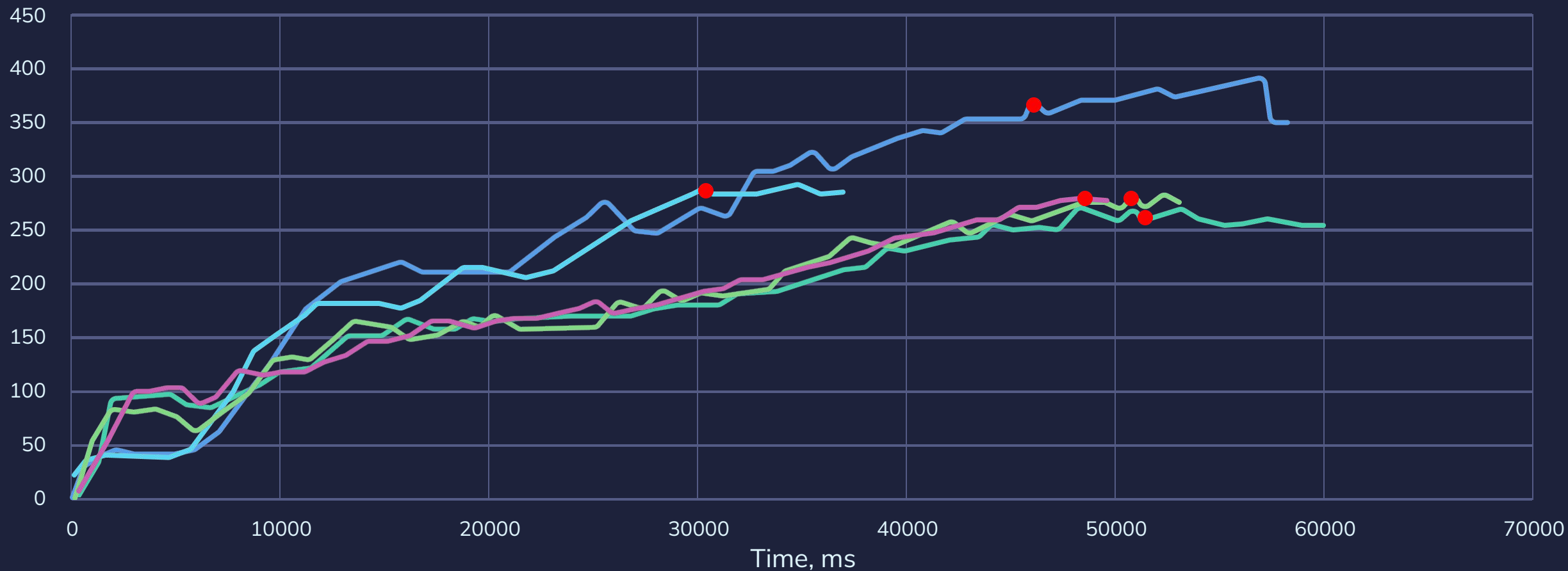


No load footprint on desktop (lower is better)

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OpenJ9 (1) OpenJ9 (2) OpenJ9 (3) Liberica Liberica (default)

Working Set Size, Mbytes

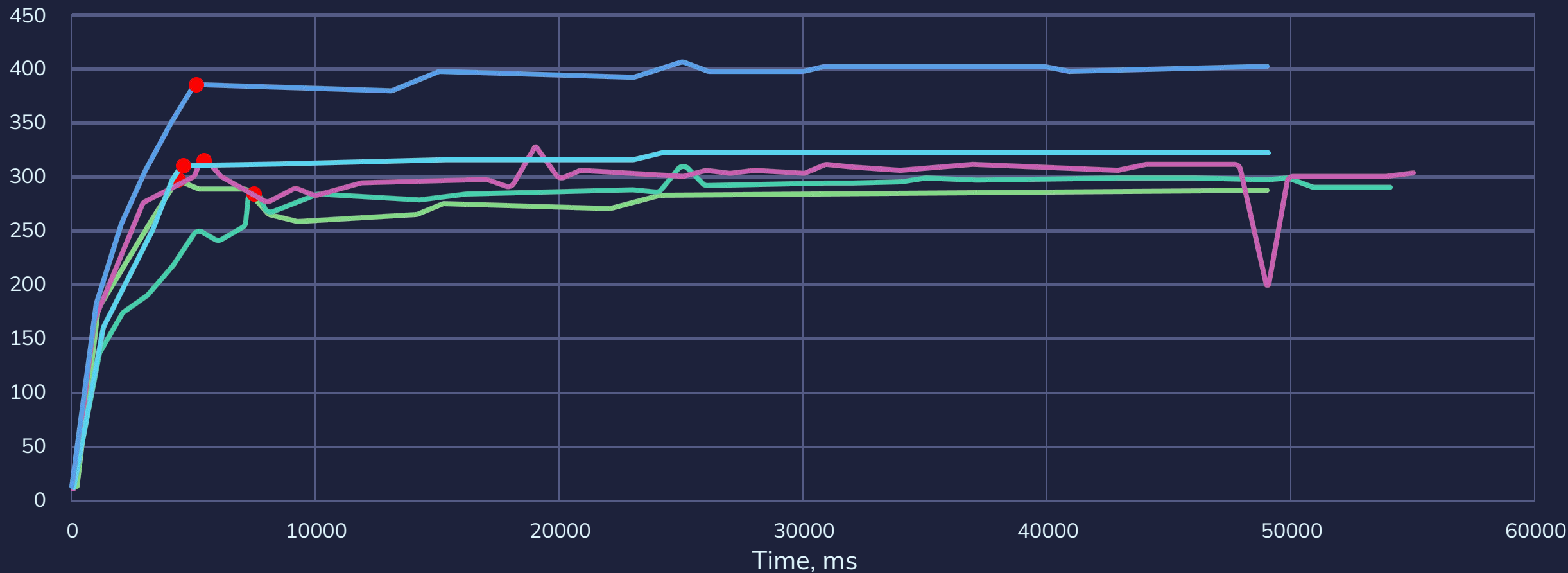


No load footprint on desktop (lower is better)

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OpenJ9 (3) OpenJ9 (2) OpenJ9 (1) Liberica Liberica (default)

Working Set Size (Linux), Mbytes



Server under load. Configurations

OpenJ9 (1) (heap 1G):

- “-Xmx1G”

OpenJ9 (2) (heap 1G, class cache):

- “-Xmx1G -Xshareclasses:name=mvn”

OpenJ9 (3) (heap 1G, class cache, fast compilation):

- “-Xmx1G-Xshareclasses:name=mvn -Xtune:virtualized -Xscmx200m”

HotSpot (max heap 1G, initial heap 80 MB):

- “-Xmx1G -Xms80m”

HotSpot (max heap 1G, initial heap 80 MB, AppCDS, C1):

- “-Xmx1G -Xms80m-XX:SharedArchiveFile=app-cds.jsa -XX:TieredStopAtLevel=1”

HotSpot (max heap 1G, initial heap 80 MB, SerialGC):

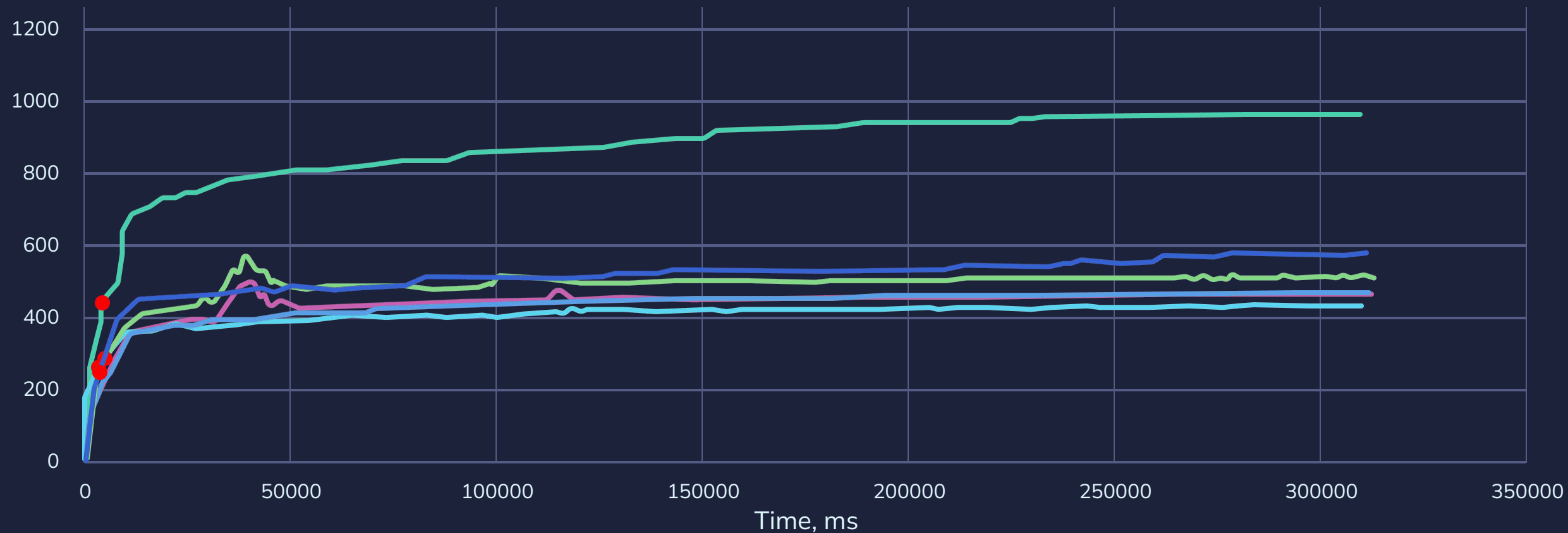
- “-Xmx1G -Xms80m-XX:SharedArchiveFile=app-cds.jsa
-XX:TieredStopAtLevel=1 -XX:+UseSerialGC”

Footprint on server under load (lower is better)

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- OpenJ9 (3)
- Liberica (-Xmx1G -Xms80m -XX:+UseSerialGC -Xverify:none - XX:TieredStopAtLevel=1)
- OpenJ9 (2)
- OpenJ9 (1)
- Liberica (-Xmx1G -Xms80m -Xverify:none - XX:TieredStopAtLevel=1)
- Liberica (default)(-Xmx1G -Xms80m)

Resident Set Size under Load, MB

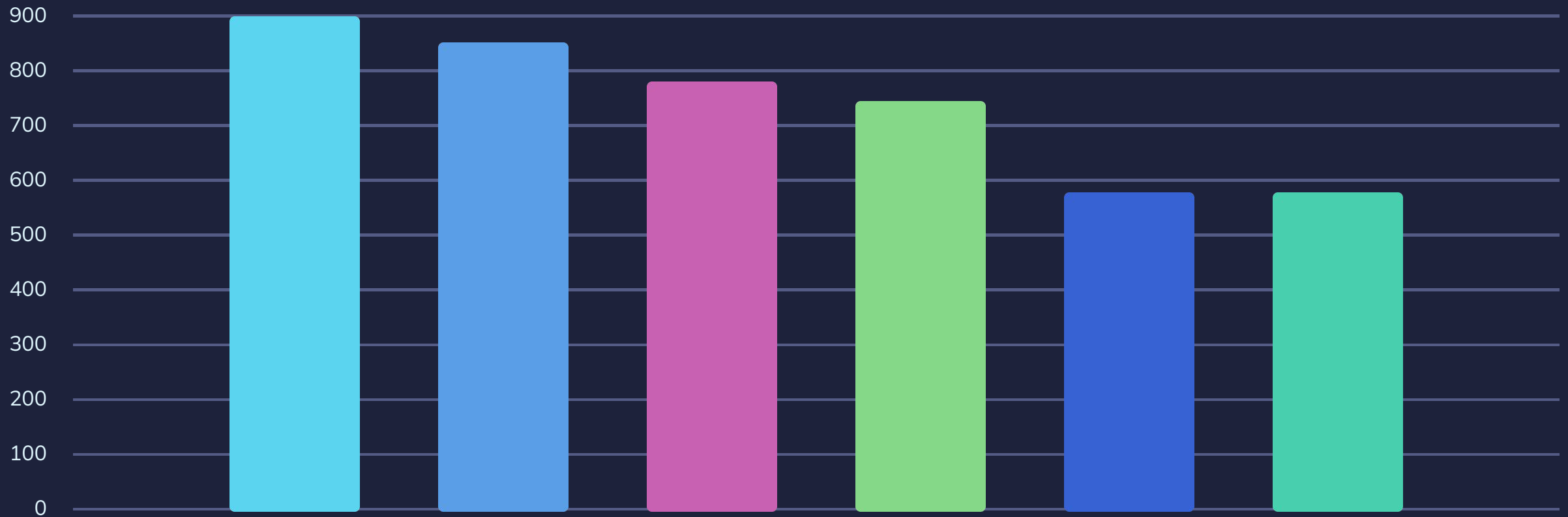


Throughput on server after warmup

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- HotSpot (max heap 1G, initial heap 80 MB)
- OpenJ9 (1) (heap 1G)
- OpenJ9 (2) (heap 1G, class cache)
- OpenJ9 (3) (heap 1G, class cache, fast compilation)
- HotSpot (max heap 1G, initial heap 80 MB, AppCDS, C1)
- HotSpot (max heap 1G, initial heap 80 MB, SerialGC)

Latency, ms

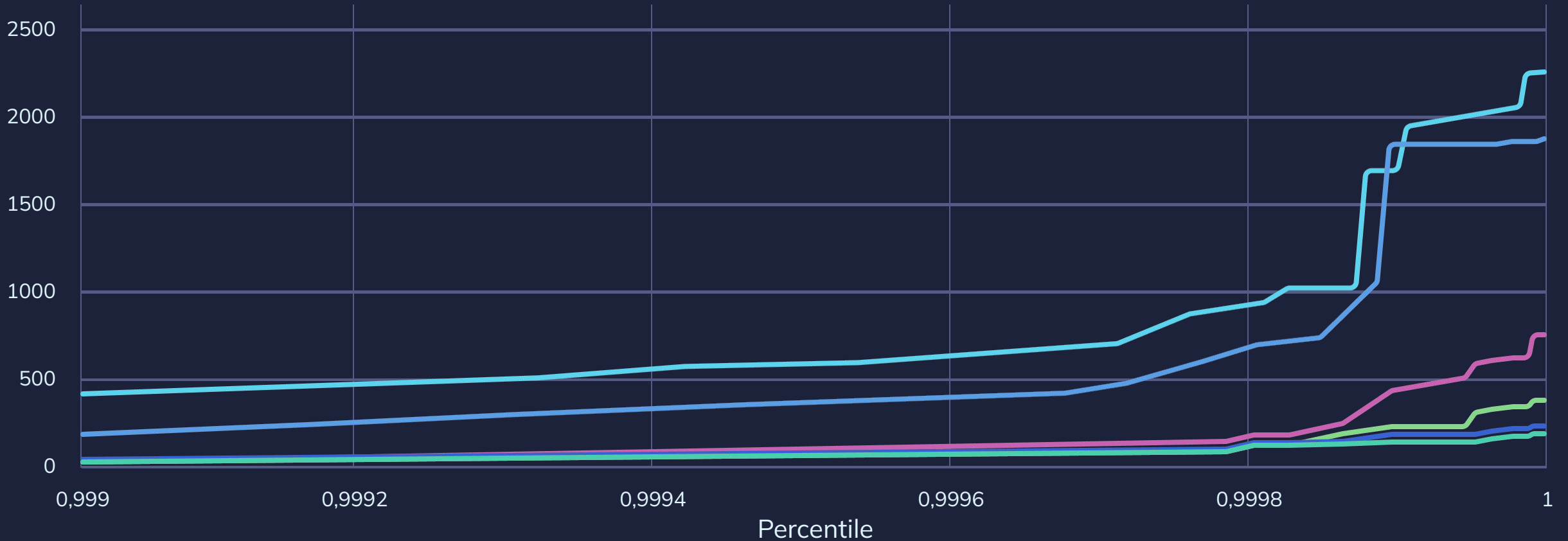


Latency on server after warmup

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- OpenJ9 (1) (heap 1G)
- HotSpot (max heap 1G, initial heap 80 MB, AppCDS, C1)
- OpenJ9 (3) (heap 1G, class cache, fast compilation)
- OpenJ9 (2) (heap 1G, class cache)
- HotSpot (max heap 1G, initial heap 80 MB)
- HotSpot (max heap 1G, initial heap 80 MB, SerialGC)

Latency, ms



Conclusions

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Takeaways

Every benchmark lies differently

- Check your setup
- Check your app

HotSpot and OpenJ9 show great results

- Years of optimizations, many similarities
- Some configurations may differ significantly, any side may “win”

Tuning gives you a lot

- Defaults are usually good
- Study your app and JVM



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Thank you for
your attention!



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