



Platform Prime

Azul Platform Prime.

(formerly Zing)

**- For Exchanges,
Brokers and Trading
Desks**



Azul powers the world's most mission-critical and demanding Java applications.

Azul, provider of the Java platform for the modern cloud enterprise, is the only company 100% focused on Java. Millions of Java developers, hundreds of millions of devices, and the world's most highly regarded businesses trust Azul to power their applications with exceptional capabilities, performance, security, value, and success.

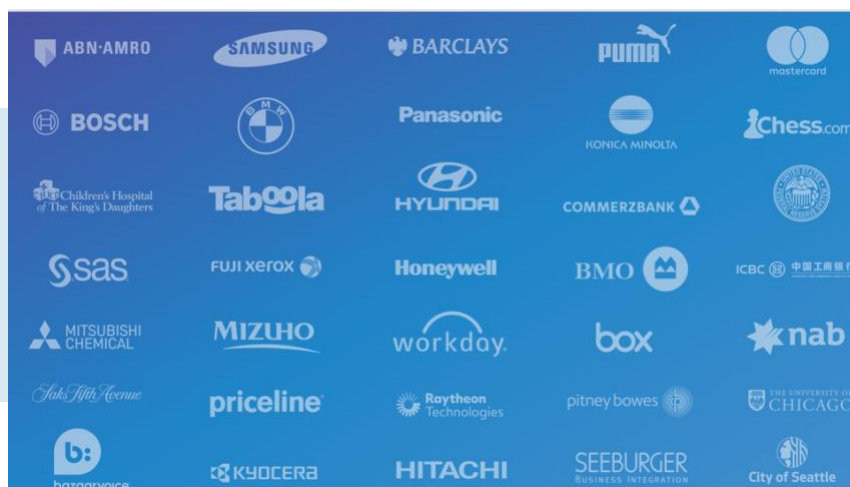
100% of the world's Top 10 Trading Companies

50% of Forbes Top 10 World's Most Valuable Brands

27% of the Fortune 100 Companies

| Azul Platform Core The world's most secure & stable builds of OpenJDK Low Cost Secure | Azul Platform Prime The world's most secure & stable builds of OpenJDK Start Fast, Run Faster, Stay Fast | Azul Intelligence Cloud Analyze & optimize your Java fleet with actionable intelligence More Focus, Awareness, Performance |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • TCK-tested and certified builds of OpenJDK • Stabilized builds for immediate deployment • Supports more versions of Java, including 6, 7, 8, 11, 13, 15, 17 & 18 • Millions of deployments • Curated to be production-ready • Support for Azul Zulu Builds of OpenJDK and Eclipse Temurin | <ul style="list-style-type: none"> • Optimized OpenJDK build with higher throughput and carrying capacity • Eliminates pauses, faster startup and efficient compilation • Save infrastructure costs, in cloud or on-prem • Improve responsiveness of Java-based technologies, e.g., Kafka, Cassandra, Spark, Solr, Hadoop • Low latency Java (in trading systems) | <ul style="list-style-type: none"> • Runtime analytics to deliver laser-focused visibility • Operational intelligence to keep runtimes dependable, secure and efficient • Cloud powered optimization for more performance with Cloud Native Compiler • Analytics providing teams with actionable intelligence • Powerful optimizations at reduced cost |
| Secure24x7x365 Support | Secure24x7x365 Support | Secure24x7x365 Support |

**World Class
Customers Who
Have Switched
to Azul.**





All 10 of the world's top 10 trading companies and six of the top 10 US financial companies have switched from Oracle to Azul Java

In this White Paper, we outline:

- How Azul Platform Prime is deployed in Financial Services, with reference to exchange and trading applications
- Security certifications for Azul Platform Prime and other Azul products
- Azul Platform Prime technical specifications
- About Azul

Azul in Financial Services

[Azul](#), provider of the world's most trusted open source Java platform, continues to gain momentum in the Financial Services industry as a growing number of the world's top financial institutions replace Oracle Java SE with Azul's Java platform products.

In the space of just two quarters, **17 banks** (including investment banks, retail banks, commercial banks, and private banks) bought Azul Java support for the first time or extended their contracts. So too did nine buy-side firms (hedge funds, asset managers and boutique traders), seven exchanges, six payments companies, and three brokerage software platforms. Today, Azul customers include all 10 of the world's top 10 trading companies and six of the top 10 US financial companies (measured by market cap).

A growing number of leading investment banks, hedge funds, exchanges, payments organizations, insurers, multilateral trading facilities, and cryptocurrency providers have switched from Oracle Java SE to Azul Builds of OpenJDK for their Java

support. Azul builds of OpenJDK - including Azul Platform Prime - are backed by tough security SLAs and a globally-distributed, highly responsive support team of Java experts and software engineers, frequently achieving a 100% customer satisfaction score.

For many companies in the finance industry, an essential key to running a successful Java operation is Azul Platform Prime®, a Java Virtual Machine (JVM) hyper-optimized to turbocharge Java performance. Azul Platform Prime is the chosen foundation for mission-critical Java-based trading and risk management for dozens of top banks. Running on Azul Platform Prime, online banking and trading platforms achieve fast, glitch-free performance, often driving down infrastructure costs as much as 50%. A [Total Economic Impact Study by Forrester](#) found that Azul Platform Prime pays for itself in less than three months, and over a three-year period delivers a 224% ROI and total benefits of \$2.2M.

"There are a few Java Virtual Machines available on the market. The most common and standard one is the Oracle Hotspot JVM," said Jad Sarmo, Head of Technology at Dsquare Trading Ltd., in a recent Medium article, [Why we chose Java for our High-Frequency Trading application](#). "For very demanding applications, there is a great alternative called Azul Platform Prime, by Azul. Azul Platform Prime is a powerful replacement of the Oracle Hotspot JVM and eliminates the latency issues common in Java."

In the adjacent world of equities block trade execution, BIDS Trading, operator of the BIDS Alternative Trading System (ATS) which emerged as the largest block-trading ATS by volume in the U.S., recently was acquired by Cboe Global Markets, Inc.

"Part of our secret recipe is Azul Platform Prime," said Brett Vasconcellos, CTO of BIDS Trading, who has led the way in expanding the use of Azul Platform Prime to drive the company's Java strategy over the last two years.

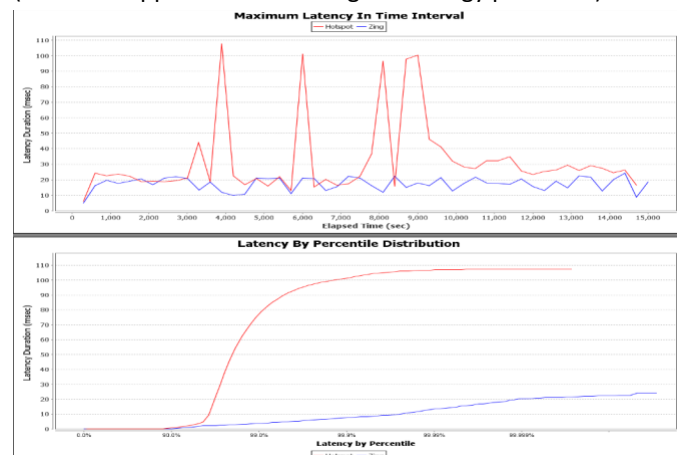
"Now, our engineering team is able to ignore performance maintenance and spend all their time

building features," said Vasconcellos. Less than 1% of the company's developers' efforts now goes to performance tuning. "Yet, we're a thousand times faster than your typical payment transaction or website. Azul Platform Prime is a big part of the reason for this."

Azul in Exchanges

For capital markets trading, latency is king. Trading applications make money largely by executing orders faster than their competition. While many electronic trading applications are written in C++, others are written in Java, because Java offers the best mix of performance **and** speed of development (agility). Java applications certainly deliver excellent speed (or latency, in trading parlance) of execution but struggle with consistency. Specifically, it takes time for Java to reach optimal speed, and even then, consistency of performance is not guaranteed. Prime addresses both of these performance issues, improving both speed and consistency. This results in, for instance, **higher hit rates** (percentage of orders that are executed successfully), **higher profits** and also, where applicable, happier customers.

For example, some exchanges provide their trading clients with (Java) libraries to connect to the exchange and deal. When those libraries deploy greater consistency and sustained speed, exchange clients are impressed by value-add (the same applies also to trading technology providers).



(Zing = Azul Platform Prime)



(Zing = Azul Platform Prime)

To learn more about Azul's offering to financial services companies, please visit:

<https://www.azul.com/industries/financial-services/>

OpenJDK

| min ▾ | median ▴ | p60 ▴ | p70 ▴ | p80 ▴ | p90 ▴ | p95 ▴ | p99 ▴ | p99.9 ▴ |
|-------|----------|-------|-------|-------|-------|-------|-------|---------|
| 50 | 76 | 77 | 79 | 80 | 84 | 91 | 216 | 17380 |

Azul Prime

| min ▴ | median ▴ | p60 ▴ | p70 ▴ | p80 ▴ | p90 ▴ | p95 ▴ | p99 ▴ | p99.9 ▴ |
|-------|----------|-------|-------|-------|-------|-------|-------|---------|
| 39 | 56 | 56 | 58 | 60 | 62 | 65 | 106 | 228 |

Why Platform Prime for Exchanges?

Compare the charts above and the latency plots on the prior page comparing OpenJDK (or Oracle HotSpot in Oracle Java SE) versus Azul Platform Prime. Especially note the performance differentials at the extremes. These STW ("Stop The World") pauses are fatal for users of Java that require consistently low latencies, all the time.

The Problem: Electronic trading customers seek to increase their order hit rate by reducing the median latency and reducing the outliers (spikes in latency caused by any number of effects), which are more accentuated at the extremes (the P99, or 99th percentile; or P99.9, the 99.9% percentile). Prime offers specific improvements there, for example:

The Azul Platform Prime Solution

With the **C4 Garbage Collector**, fewer glitches

- Reduce outliers
- Increase hit rate
- Better handle market volatility

With the **Falcon JIT compiler**, better optimizations

- Lower median order latency

With ReadyNow!, faster warm-up

- Reduce warm-up time = Fast orders at market open

Additional Engineering Impact

- Minimal JVM tuning
 - No need to tune against GC
 - Simply adjust maximum heap size and compile threshold according to workload
 - Reduce DevOps spend
- Reduce warm-up time
 - Fast orders at market open



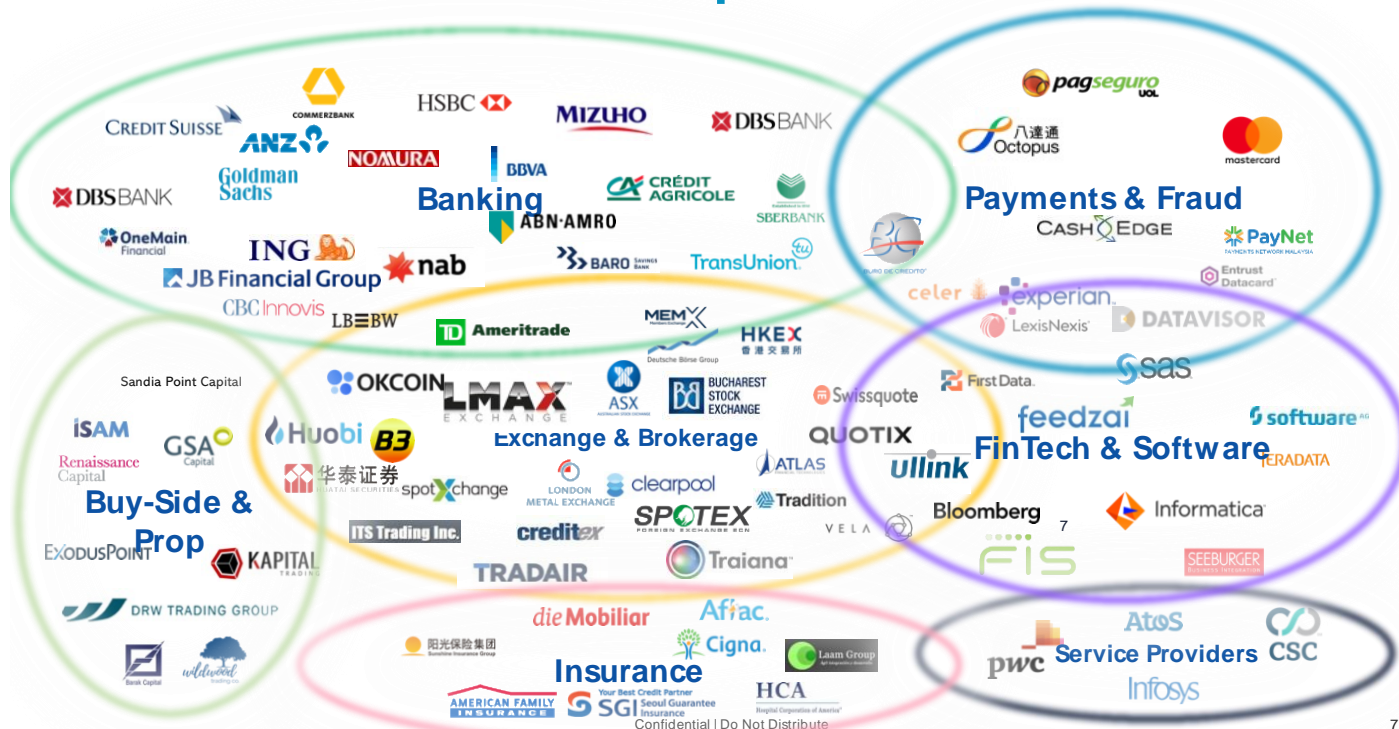
Customer Example

BID FX

www.bidfx.com

- Founded in January 2017, subsidiary of Singapore Exchange (SGX Group).
- Industry: BidFX is a leading cloud-based provider of electronic foreign exchange (FX) trading solutions.
- New start-up company, launched after an initial 2-year incubation period
- As a cloud-based provider, technology is a key differentiator
- Compelling Event: BidFX launch, securing market share.
- Key metric: reduce Trade Rejections caused by Garbage Collection saves significant \$\$.

Financial Services: A Sample of Customers



7

Exchanges, Brokerages and Other Relevant Institutions



Many trading system vendors such as Itiviti and Cinnober (Part of Nasdaq) highly recommend Azul Platform Prime as the de-facto JVM to run their trading platform. For example, *Nasdaq's Product arm Cinnober recommends using Azul Prime and bundles Prime JVM on their TradeExpress platform.* Click on each logo to read more



Customer Case Study

**Brand-new, Fast Growing Stock Exchange
MEMX Relies on the Azul Platform for Best
Cost, Performance, and Support across Its
Java Estate**



With a diverse group of financial leaders as founding investors, MEMX seeks to change how stock trading is done.

- On May 5, 2020, MEMX received approval from the Securities and Exchange Commission to operate as a national securities exchange.
- On Sept. 21, 2020, MEMX went live with its first sale (100 shares of Consolidated Edison Inc. for \$73.90 a share).
- On Oct. 29, 2020, MEMX extended its initially-limited trading to all U.S. exchange-listed securities.

This is the story of the role of Java and the Azul Platform in MEMX's development.

To Create a New Kind of Stock Exchange

In 2019, nine major financial organizations joined together in founding a new, members-owned stock exchange, the Members Exchange, or MEMX. The goal was to deliver a lower-cost, more transparent, more end-user-focused exchange platform that would compete with the major equity exchanges—NYSE, Nasdaq, and CBOE—which, many felt, had a

stranglehold on the market and were charging exorbitant fees.

MEMX's nine founding members included Bank of America, Charles Schwab, Citadel, E*Trade, Fidelity Investments, Morgan Stanley, TD Ameritrade, UBS, and Virtu Financial. Several other financial services giants joined the membership with additional strategic financing in subsequent rounds, including BlackRock, Flow Traders, Goldman Sachs, Jane Street, JPMorgan, Manikay Partners, Wells Fargo, and Williams Trading. Overall, the initial investment exceeded \$135 million.

"This is a very well-funded and supported startup," says MEMX Chief Operating Officer Tom Fay. "I knew if we built a state-of-the-art exchange, we would be able to take advantage of our position and benefit from some fairly stiff tail winds."

MEMX's explicit mission from the beginning was "to increase competition, improve operational transparency, reduce fixed costs, and simplify the execution of equity trading in the U.S." To achieve these goals, MEMX needed to create a simpler trading platform that would benefit both retail and institutional investors, including:

- Limiting the number of order types to promote simple and transparent interactions
- Investing in the best and latest technology to deliver fast and efficient execution
- Reducing pricing on market data, connectivity, and transaction fees

The Choice of Java for a Greenfield Exchange

"The thing that attracted me to MEMX, was the chance to build something from scratch," says Fay. "The greenfield opportunity at MEMX was very real and unequivocally encouraged and supported. Given my years of experience in the space, I felt that accumulated technical debt and complex change driven by the regulatory apparatus had made innovation and technology insertion increasingly difficult over time. Having the opportunity for a fresh

look at the problem in the context of new and emerging technologies that could be brought to bear, was an incredible opportunity.”

Chief Technology Officer Dominick Paniscotti remembers the situation in a similar way. “We were very much looking to be the technology thought leaders in this space, to bring modern technology to bear and to put our best tech foot forward,” he says. “Java has become the dominant language in the financial services space because of its portability, stability, reliability, security, and ease of update.”

The Choice of Azul

But, there’s always a but. “The business logic of our trading platform is much better served with Java than with C++, but—” says Paniscotti, “Java also has several shortcomings that Azul has helped us address.”

“Given our size and launch timeline, we had to thoughtfully consider where we wanted to take technology risk and where we didn’t,” said Fay. “We knew we wanted the portability and stability of Java but didn’t want to expend resources addressing runtime performance nor be exposed to unnecessary commercial licensing and support costs.

“We chose to work with Azul to de-risk the technology build and allow our team to focus on developing business logic”, continued Paniscotti, “We got our Java signed, sealed, and delivered from the Java experts, and could keep our singular focus on creating the best exchange.”

MEMX deploys many Azul products and components, including **Azul Platform Core**, **Azul Platform Prime**, Azul Mission Control and other curated components. The game-changer however, especially for mission-critical, performance-sensitive Java platforms, is **Azul Platform Prime**, powered by a runtime that delivers superlative performance, scale, consistency, efficiency, and improves capacity. One such platform is the mission-critical Exchange application, where execution speed must be as consistent as it is fast. Eliminating pauses/delays in

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Dominick Paniscotti

Chief Technology Officer MEMX

application performance, and ensuring rapid application warm up led MEMX to deploy Azul Platform Prime. From inception to deployment, the integral platform took less than a year to build, delivering microsecond performance for critical processes.



Customer Case Study

Build and Deploy Java-based low-latency applications faster with Coral Blocks and Azul

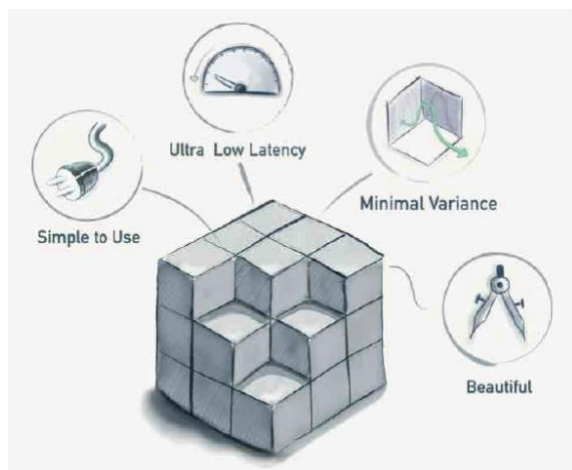
The underlying Java runtime

The Java programming language is a favorite of many developers due in part to the rich set of tools and libraries that greatly enhance developer productivity. However, this productivity can some-times be runtime, or JVM.

The combination of low-latency components and messaging middle-ware from Coral Blocks plus the Azul Platform Prime JVM from Azul creates a powerful toolkit for Java developers and engineers building ultra-low-latency, performance-sensitive financial applications.

Coral Blocks Overview

The Coral Blocks mission is to create a compatible series of software components for use by Java developers who need to build and maintain systems that are easy to manage, support ultra-low latency with



minimal variance, create zero garbage, are JIT-friendly and are engineered for maximum performance.

The Coral Blocks stack includes the following components:

CoralFIX: an ultra-low latency, garbage-free FIX engine with an intuitive API. On average, its FIX parser delivers a complete FixMessage object in under 480 nanoseconds.

CoralQueue is an ultra-low-latency, lock-free, garbage-free, concurrent queue, supporting latencies as low as 15 nano-seseconds and throughput up to 97 million messages per second.

CoralReactor: an ultra-low-latency, asynchronous, non-blocking network I/O library with a simple API that delivers latencies under 2 microseconds.

CoralSequencer is highly reliable software-based messaging middleware for developing distributed systems based upon asynchronous messages.

CoralFIX-HA allows CoralFIX servers to run in a high-availability cluster.

"Building and operating a national securities exchange requires robust, efficient, and reliable code. CoralBlocks offers just that with a unique CoralSequencer architecture. But that was expected. Where I was most pleasantly surprised was their high-touch customer service. In an environment where immediate action is needed at any moment's notice, CoralBlocks is there for us every single time. We enjoy working with CoralBlocks and look forward to doing so in the future."

Hyon Lee, Software Architect, LTSE

Coral Blocks and Azul

CoralBlocks high-performance and ultra-low-latency components and APIs with the Azul Platform Prime JVM ensures that performance engineers, architects, and low-latency system developers can access a toolkit that based on standard Java APIs and is optimized for the most demanding message-based workloads.

Summary

For new Java-based financial applications with tight SLAs and demanding low latency requirements, proven modules and APIs from CoralBlocks used with the Azul Platform Prime JVM deliver consistent, jitter-free operation.

Product Data Sheet

Azul Platform Prime: The best JVM for Java Workloads

Reduce Infrastructure Costs With Azul Platform Prime

Today, Java is ubiquitous across the enterprise, the ideal choice for development, DevOps and operations teams worldwide.

Azul Platform Prime builds upon Java's advantages by delivering a robust, highly scalable Java Virtual Machine (JVM) that provides great ROI and reduce infrastructure spending to run existing workloads through greater carrying capacity, lower latency, and elimination of garbage collection-related outliers. Supporting newly-developed microservice-based applications in addition to long-running legacy systems, Azul Platform Prime is the best JVM choice for **all** Java workloads, including online retail, SaaS or Cloud-based deployments, insurance portals, multi-user gaming platforms, or Big Data. Azul Platform Prime is also widely deployed in low-latency trading systems - and ensures smooth operation anywhere predictable, glitch-free Java is essential. Azul Platform Prime is proven with Kubernetes and in Docker and LXC containers, too.

Azul Platform Prime enables Java developers to make efficient and effective use of server resources or VM instances -- without the random stalls, pauses and jitter that have been part of Java's heritage. Azul Platform Prime also solves Java "warm-up" problems that can degrade performance at the start of trading or other time-sensitive operations. With improved memory-handling and a more stable, consistent runtime platform, Java developers can rely upon Azul Platform Prime as they build and deploy richer applications, driving new revenue streams and supporting new innovations.

Whether your application requires human-scale response times or is machine-scale, measuring peak response time in microseconds, Azul Platform Prime allows you to meet even the most demanding service level agreements without re-architecting or depending upon JVM tuning experts -- helping you take advantage of new business opportunities faster and with lower operating cost

Inside Azul Platform Prime

At its heart, the Azul Platform Prime Java Virtual Machine

comprises such unique components as C4 garbage collector, Falcon compiler, and ReadyNow! technology.

Azul Platform Prime

Azul Platform Prime is a better JVM. Period. With Azul Platform Prime, Java applications simply show better runtime behavior and help you meet interactive and machine-machine SLAs.

Azul Mission Control

When coupled with open source Flight Recorder technology, Mission Control delivers low-overhead, interactive open source monitoring and management capabilities for Java workloads.

ReadyNow! Technology

Solves Java warm-up problems.

C4 Garbage Collector

Continuous, concurrent, and consistent operation.

Falcon JIT Compiler

Modern, modular server tier compiler leveraging LLVM.

- Azul's Continuously Concurrent Compacting Collector (C4) eliminated the "stop-the-world" garbage collection (GC) pauses that limit the scalability of legacy JVMs like Oracle's HotSpot and garbage collectors built into OpenJDK
- Azul's Falcon Compiler leverages the LLVM compiler engine, for rock solid performance.
- Azul's ReadyNow! and compile stashing technologies are built into Azul Platform Prime to improve Java applications to start fast and stay fast, even across reboots.

For production instance monitoring, Azul Platform Prime ships with Java Flight Recorder and readily integrates with Mission Control. Azul Platform Prime is simple to install and requires no coding changes to existing applications. You don't need to recompile. Because Azul Platform Prime has been optimized for today's servers, configuration and setup are typically reduced to just a few parameters, instead of the myriad of JVM tuning flags necessary to reach peak performance that characterize many Java-based production environments. Simply point your application or startup scripts to Azul Platform Prime, and you're running on the most robust, scalable JVM with the fastest time-to-market for any business application.

Azul Platform Prime Features

- Ships as part of a complete JDK -- easy to get started, easy to use
- Azul Platform Prime supports Java SE 17, 15, 13, 11, 8
- Eliminates the stalls, jitter, and latency outliers caused by Java Garbage Collection

- Unique garbage collector technology: Azul C4 (Continuously Concurrent Compacting Collector)
- Optimized for 64-bit Linux on x86
- Choose the Java memory configuration and heap size you need, from 512MB to 20TB
- Optimistic Thread Concurrency for CPUs supporting hardware transactional memory
- Quarterly and as-needed security-only Critical Patch Updates
- Azul-optimized Falcon server-tier JIT compiler
- ReadyNow! technology plus compile stashing technology resolve Java "warm-up" problems
- Improves operating metrics even when used in zero-GC environments and frameworks
- Supports JVM languages beyond Java (e.g., Scala, JRuby, and others)
- Try Azul Platform Prime hassle-free -- download from <http://www.azul.com/products/prime/trial-download/>

"Having a product that I don't have to adjust and change and modify and work with and turn a bunch of switches and dials has been great, and the support has been excellent. The best that I've ever dealt with."

Ted Boehm

Chief Platform Architect,



Azul Platform Prime Management and Diagnostic Tools:

- Ultra-low-overhead Java profiling and analysis
- Debug performance and resource consumption issues on running JVMs in production. No need to stop/restart them
- Supports Azul Builds of OpenJDK 8, 11, and 17
- Save all the fine-grained information of the JVM execution during a specified period-of-time to a separate log file with Flight Recorder
- In-depth analysis without the need for physical presence on the site for additional data collection
- Automated summaries and custom scripts
- 100% Open Source
- Java Flight Recorder and Azul Mission Control are free for use

Selected Azul Platform Prime use cases:

- Java-based infrastructure: Cassandra, Kafka, Zookeeper, Hadoop, Spark, Feedzai, Elasticsearch, Lucene, Solr, Hazelcast, JBoss Data Grid, GridGain, Tomcat and many more
- AWS, Microsoft Azure, Google Cloud Platform plus private and hybrid Clouds
- Big Data platforms and in-memory data grids
- Low latency trading, fraud detection, large-scale online gaming, advertising networks
- Complex event processing, real-time messaging, web-scale IT, and search
- Online retail
- SaaS deployments

Supported Platforms

CPU Requirements

Azul Platform Prime runs on machines with the following 64-bit x86 CPUs:

- Intel: Xeon server class processors released 2009 and later
- AMD EPYC & Opteron server class processors released 2010 and later

Memory and CPU Cores Recommended

- 512 MB or more
- 2 cores or more
- Depending on the available free RAM, up to 2.5 TB (2,500 GB) Java heap size in the default mode is possible and 20 TB with ZST

Supported Operating Systems

- Red Hat Enterprise Linux/CentOS 7.3 or later
- CoreOS 4.13.16
- CentOS 6-8.3 SUSE
- Linux Enterprise Server 12 SP3 or later
- Oracle Linux Server 7 or later
- Ubuntu 18.04 LTS or later
- Amazon Linux 1, 2
- Debian 9 (Stretch), 10 (Buster) or later
- Photon O/S 3.0 or later

Supported Java Versions

- Java 17, 15, 13, 11, 8

Quality and Security Across the Azul Platform

This section describes quality and security aspects of Azul products, including Azul Platform Prime and the upstream open source project [OpenJDK](#) on which Azul Platform Prime is based.

- Test suites such as the **TCK** (Technology Compatibility Kit) and **jtreg**
- Security Vulnerability Management
- Coding Guidelines
- Code Reviews and Code Quality

TCK Test Suite

The **TCK** (Technology Compatibility Kit) is the official Java SE test suite, originally developed and licensed by Sun Microsystems, used to test compatibility as well as performance of the JRE/JDK against the Java SE specifications. The TCK suite contains more than 100,000 individual tests (~126K for Java 8, ~139K for Java 11) and running the complete test suite on a single computer may require several days. To achieve manageable execution times on embedded platforms the TCK suite can be partitioned.

The TCK test suite contains tests for a wide range of areas, including, but not limited to the following:

- Testing the Java SE APIs
- Testing runtime performance of the JIT compiled Java code
- Testing performance of API implementations
- Testing correctness of the JIT compilers
- Testing correctness of the Byte Code interpreter
- Testing correctness of the Byte Code parsers, verifiers
- Testing correctness of the `javac` compiler
- Testing the correct implementation of the Java memory model in the JVM (memory layout, memory barriers, thread synchronization, atomic access)
- Testing the garbage collectors

Any JRE/JDK individual binary must pass the TCK to be allowed to be labelled "Java SE compatible". It is insufficient to test a "representative binary" or to declare other binaries compiled from the same source as compatible.

TCK License and Access

The TCK is Oracle Intellectual Property, licensed by Oracle to certain third parties; it is not open source. Further TCK related information:

- Access conditions: <https://openjdk.java.net/groups/conformance/JckAccess/>
- Current licensees: <https://openjdk.java.net/groups/conformance/JckAccess/jck-access.html>
- Documentation: <https://jcp.org/en/resources/tdk>

jtreg Test Suites

jtreg is the test harness for regression and unit testing used by the JDK test framework. Azul runs the jtreg tests in addition to the TCK tests.

jtreg complements TCK but does not replace it. Both together allow production of a good quality OpenJDK distribution. The tests implemented with jtreg are open source functional tests provided by the contributors of features (as opposed to the TCK/JCK, which is not open source, but Oracle proprietary).

The TCK is used for official compatibility and performance tests. jtreg is used for all other tests, for example functional tests. As jtreg is open source it can be used as a regression test by developers contributing to or customizing OpenJDK.

jtreg was developed by Sun starting in 1997 before Junit, ANT and other common tools were available. jtreg is specific to the OpenJDK project and not commonly used in other projects.

Number of tests in jtreg: 24,758 for Java 8, and 43,731 for Java 11

See also:

- <https://openjdk.java.net/jtreg/index.html>
- <https://openjdk.java.net/projects/code-tools/jtreg/intro.html>

Security Vulnerability Management

Within the OpenJDK project there is group named the [OpenJDK Vulnerability Group](#) which (i) receives and discusses reports about security vulnerabilities in

OpenJDK, (ii) implements and tests fixes for vulnerabilities, and (iii) coordinates the release plan for such fixes. Unlike all other activities in OpenJDK which are public (mailing lists and archives are accessible [here](#)), the Vulnerability Group works behind closed doors. Security vulnerabilities are only disclosed at the time that an OpenJDK update, which fixes those vulnerabilities, is publicly released. The Vulnerability Group currently has 29 members, including 4 Azul employees.

Azul has early access and insights regarding upcoming fixes for vulnerabilities in OpenJDK, which allows Azul to (i) backport fixes found in recent Java versions to older Java versions, and (ii) deliver fully tested and certified updates to its customers at the same time as when Oracle and others deliver their updates. Any security vulnerabilities identified by Azul, or reported by an Azul customer, will be handled as per the policies of the OpenJDK Vulnerability Group. Each update provided by Azul comes with a [Release Notes](#) document which lists all the CVE and non-CVE security vulnerabilities ([CVE security fix example](#) and [non-CVE security fix example](#)).

OpenJDK Coding Guidelines

No exhaustive coding guidelines have been published for the OpenJDK project. Sub-components in the OpenJDK come from a variety of sources with their own diverse set of guidelines.

Development guides can be found here:

- <https://openjdk.java.net/guide/>
- <https://wiki.openjdk.java.net/display/OpenJFX/Committing+the+Code>
- <https://wiki.openjdk.java.net/display/OpenJFX/Code+Reviews>

Some organizational guides and style guides can be found here:

- <https://openjdk.java.net/contribute/>
- <https://github.com/openjdk/jdk/blob/master/doc/hotspot-style.md>
- <https://wiki.openjdk.java.net/display/OpenJFX/Code+Style+Rules>

Code Reviews and Code Quality

Quality of code contributions is controlled by Reviewers in charge of the code repository of a given OpenJDK subproject. Up-streamed changes from contributors must pass through those gatekeepers who apply the processes defined by the **JCP** (Java Community Process, <https://jcp.org/>) for approving changes and new features.

Overall quality and compatibility are assured through the TCK suite. All new features, compatibility breaking changes and reproducible bugs must be submitted with TCK tests cases.

Currently, within the umbrella OpenJDK project, there are 21 Azul engineers who have Committer status, and there are 4 projects which are led by Azul engineers (JDK 7 updates, JDK 13 updates, JDK 15 updates, CRaC).

Additional Notes Specific to Azul Platform Prime

Builds and runtimes provided with Azul Platform Prime are TCK-certified.

The ZST has general security certification, which has already been forwarded to the NSE.

Azul Platform Prime is about Consistent, Exceptional Performance AND Risk Mitigation.

Satisfy Corporate Compliance, Governance Requirements and SLAs.

- Guaranteed timely access to secured and updated binaries and out-of-band emergency patches - because hackers don't wait
- Real Support 24x7x365 - because Java isn't perfect, and regressions can cause outages and customer failures
- Whatever your Java versions: 17, 15, 13, 11, 8, - all Azul Builds of OpenJDK are ALWAYS up to date because engineering teams need flexibility on when to move to newer releases
- Azul Products are used by Barclays, ABN Amro, Federal Reserve, Netflix, Lombard Odier, National Australia Bank, SAS, and hundreds more organizations

Azul Platform Security Key Benefits

Timely updates and security fix-dedicated releases

for Critical Vulnerability Exposures included with Azul Platform Prime: Only Azul and Oracle provide security-only "CPU" Releases.

Certified Compliance

Azul Platform JDK builds and runtimes are certified Java SE compliant and compatible, using 120,000+ Technology Compatibility Kit (TCK) tests, and tens of thousands of other Java quality tests developed by Azul over 20 years.

Dedicated to the Java Community for Security

Azul are active members of the OpenJDK Vulnerability Group. We were the first vendor to support TLS 1.3 standard for Java 8 and have back-ported several other key protocols.

What does Azul Platform Prime Support include?

Azul Platform Prime-supported OpenJDK binaries are fully supported by Azul, with contractually mandated SLAs. If you encounter a critical production issue with Azul Platform Prime, you will get the support you need, right away, for as long as it takes. This includes phone support. It also means that, if necessary, we will escalate an issue and work it 24x7 until resolution. By contrast, community builds of OpenJDK are not supported, and there is no time frame for security updates.

Compare Azul Platform Prime to Oracle Java SE

| Features | Azul Platform Prime | Oracle Java SE |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------|
| Garbage Collection pauses eliminated, ensuring Java applications deliver consistent micro-to-millisecond performance requirements of exchanges and high frequency trading | ● | ○ |
| Just in Time (JIT) and Warm-Up compiler optimizations, that deliver performance improvements compared to Oracle HotSpot of around 30% | ● | ○ |
| Proven to deliver infrastructure cost savings (compared to Java SE or OpenJDK standards) | ● | ○ |
| ZST (Reserved Memory Capabilities) | ● | ○ |
| Dedicated Global Java Support team, 24x7x365 live Support | ● | ● |
| Security-only Quarterly Updates | ● | ● |
| Commercial Support Production Lifecycle for Java 8 / Java 11 | 2030 / 2026 | 2030 / 2026 |
| Engineering capacity to root-cause & fix bugs (independent to OpenJDK) | ● | ● |

Leaders with a passion for Java.



Scott Sellers

President, CEO &
Co-Founder



Gil Tene

CTO & Co-Founder

More performance. More value. More success.

Our leadership team has held key leadership positions in renowned companies across the world.

Scott Sellers, CEO, has more than 28 years of leadership experience, creating and growing technology companies.

Gil Tene, CTO, is an accredited technology specialist with over 40 technology patents and holds a coveted JavaOne “RockStar” status.

Together with the executive team they provide strategic, technical leadership and visionary direction.

Java Champions. Leaders of the Java community.



@giltene



@GeertjanW

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@speakjava



@hansolo_



@prpatel

Gil Tene

Simon Ritter

Geertjan Wielenga

Gerrit Grunwald

Pratik Patel

The Java Champion programme was founded in 2005 to recognize outstanding achievements and service of community members.

“We have the people who carry the maintenance and development work, and employ over 100 full time engineers that work solely on JVMs and JDKs. We lead OpenJDK maintenance projects, and employ a multitude of active maintenance leads, reviewers, and contributors. We’ve been successful in supporting product Java deployments for well over a decade, and have the critical mass of capabilities, experience, expertise and resources.”

Gil Tene, CTO & Co-Founder, Azul

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