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- Java 유료화 대응방안 -

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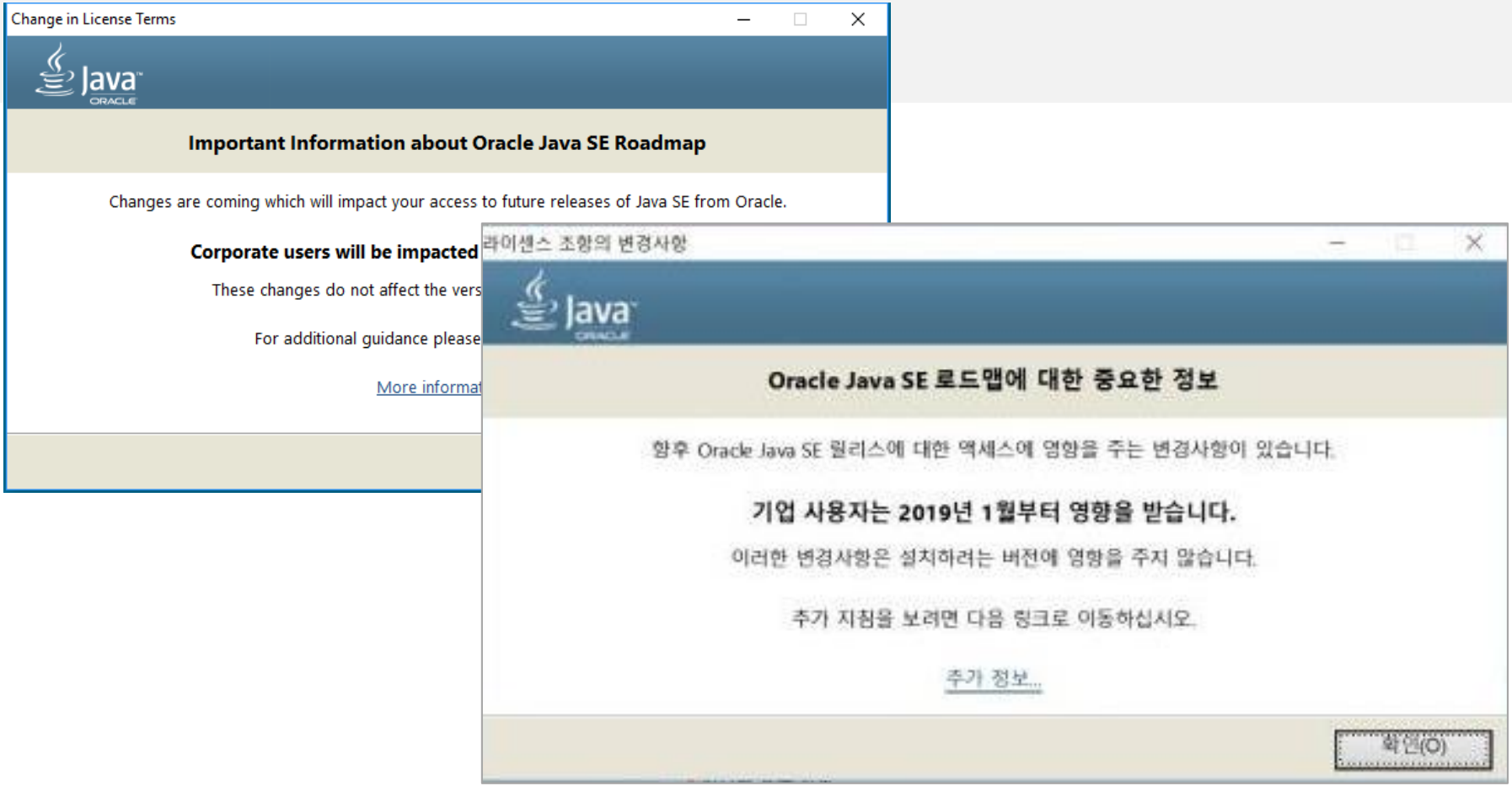

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Java

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Help Resources

- What is Java?
- Remove Older Versions
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- Troubleshoot Java
- What is Java Update?

Oracle Java SE 8 Release Updates

Public updates for Oracle Java SE 8 will remain available for individual, personal use through at least the end of 2020.

Public updates for Oracle Java SE 8 released after January 2019 will not be available for business, commercial or production use without a commercial license.

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If you are an ORACLE CUSTOMER who is licensed to use Java SE as part of another Oracle product, you continue to have access to Oracle Java SE 8 updates beyond 2019 for use with those Oracle products, see this My Oracle Support (MOS) note for more information.

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도움말 리소스

- Java란 무엇입니까?
- 이전 버전 제거
- Java 사용 안함
- Java 문제 해결
- Java 업데이트란 무엇입니까?

Oracle Java SE 8 릴리스 업데이트

Oracle Java SE 8에 대한 공용 업데이트는 최소한 2020년 말일까지 개인용으로 계속 사용할 수 있습니다.

2019년 1월 이후 릴리스되는 Oracle Java SE 8에 대한 공용 업데이트의 경우 상용 라이센스 없이는 업무용, 상업용 또는 운용용으로 사용할 수 없습니다.

개인용으
SE 8 업
케이션은
에서 개발
SE 8 업
션 지원을

개발자는
적절한 조

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Oracle Java SE 8 업데이트를 사용할 수 있는 액세스 권한이 계속 부여될 수 있습니다. 자세한 내용은 이 MOS(My Oracle Support) 노트를 참조하십시오.

추가 정보는 다음 사이트에서 제공됩니다.

- Oracle Java SE 지원 로드맵
- JavaFX 및 기타 Java 클라이언트 로드맵 업데이트
- Java 클라이언트 로드맵 업데이트(Oracle 백서, PDF)
- Oracle 제품에 필요한 경우 Java 업데이트 받기(오라클 고객지원센터 로그인 필요)

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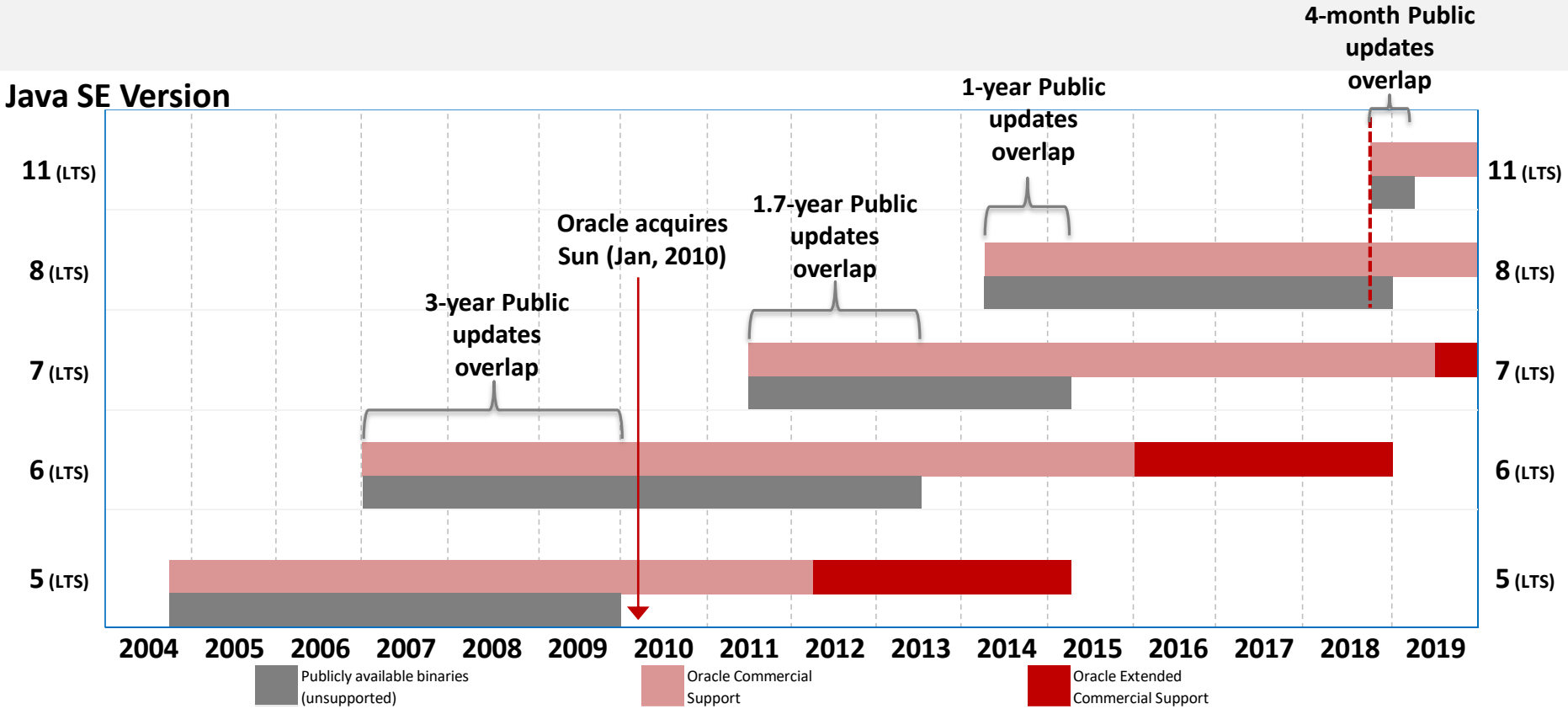
Java SE Lifecycle – Historical



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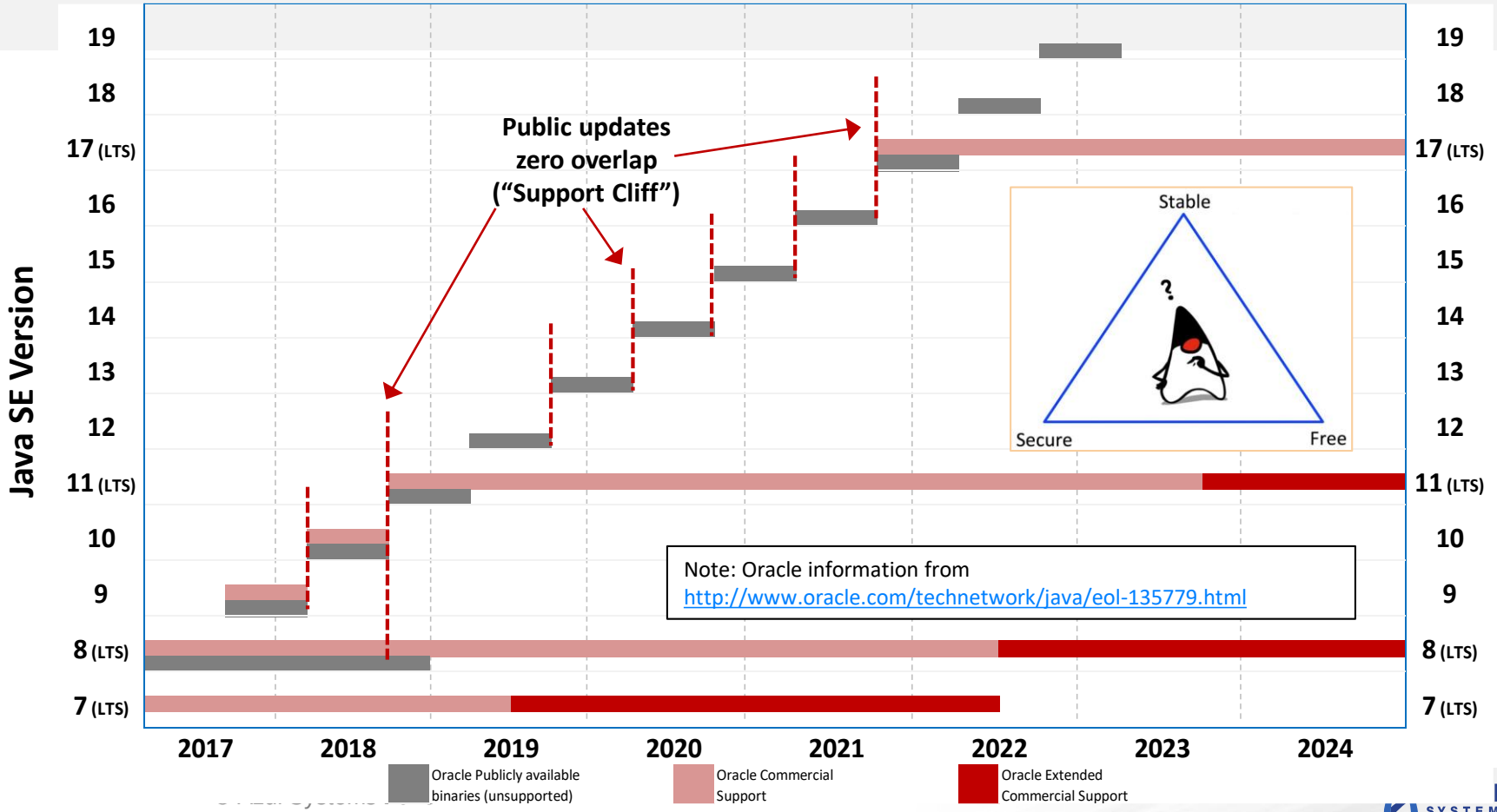
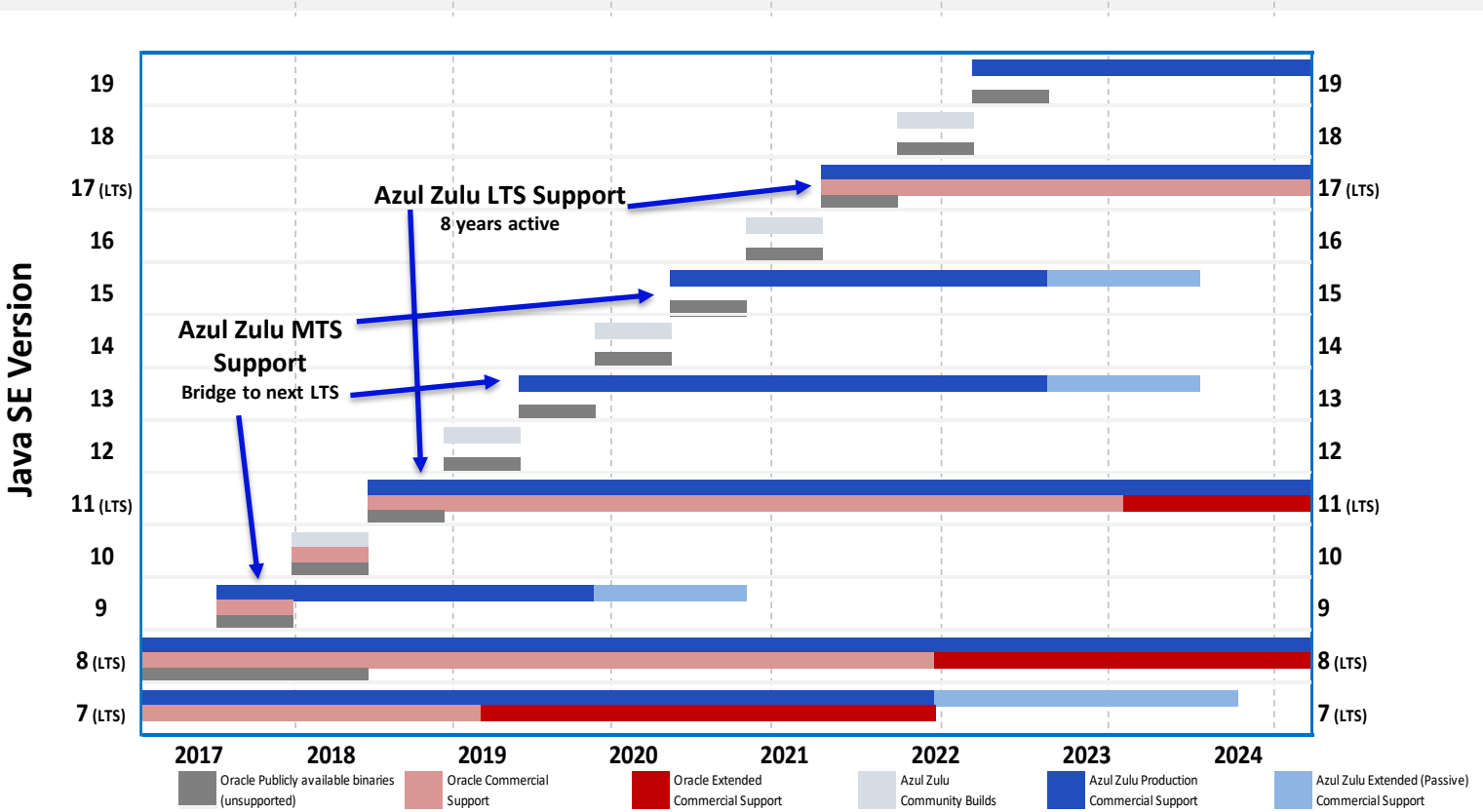
Java SE Lifecycle – 5+ Year Timeline

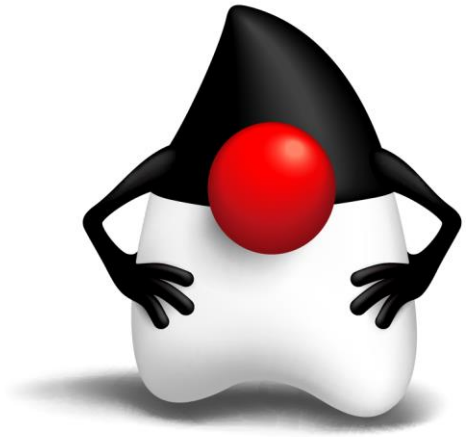


Java SE Lifecycle: 5+ Years



Easy Migration from Oracle JDK

Why Migrate Your Java?



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기존 JDK 버전 공개 정책

- 충분한 기간을 제공하던 기존 버전 공개 정책
  - JDK 6: 2 년 11 개월 (from public JDK 5 updates)
  - JDK 7: 1 년 9 개월 (from public JDK 6 updates)
  - JDK 8: 1 년 1개월 (from public JDK 7 updates)

- 새 플랫폼(버전)의 안정적인 상용화 적용을 위한 오버랩 기간 제공

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Open JDK: 새로운 버전 공개 정책

- 새로운 JDK 버전 공개 정책: 매 6개월
- (A new version of the JDK is being released “**every six months**”)

- **- 매년 3월, 9월 새 버전 출시**

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새로운 JDK Binary 배포 및 업데이트 정책 변화

- 새 OpenJDK는 다음 버전 출시되는 6 개월 동안만 업데이트 제공
  (will only be updated for six months until the next JDK is released)

- 그 중 오라클의 LTS가 제공되는 버전만 계약 하에 기술지원 가능
  (Long-term support(LTS) from Oracle will only be available for the Oracle JDK binary under the commercial support agreement)

- JDK 8 공개 업데이트는 2019년 1월까지 제공됨
  (Public updates for JDK 8 end in January 2019)

- 2019년 1월 이후, 기업사용자는 현재처럼 JDK 8을 사용할 수 있으나, 보안패치나 오류수정 업데이트는 받을 수 없음
  (After that, users will still be able to use JDK 8 in the same way they have previously, but there will be no more security patches or bug fixes)

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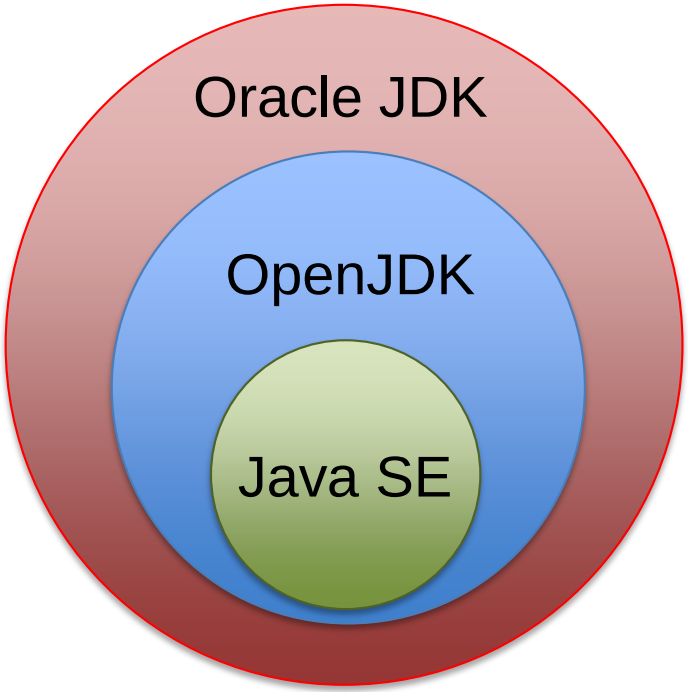
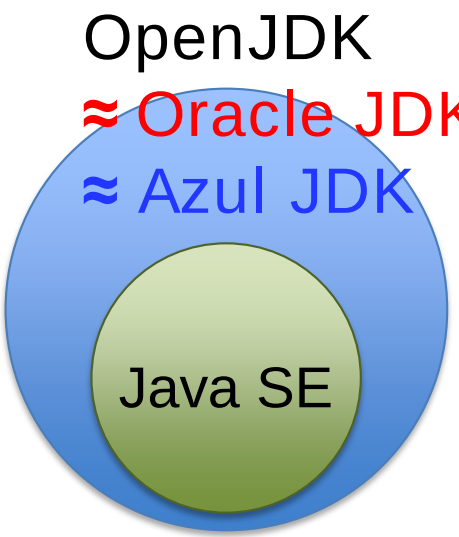
변경되는 Binaries 내용



JDK 10 and earlier



JDK 11 and later

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변경되는 Binaries 내용 (JDK 11)

- 기존 제공되던 일부 Binaries는 오픈소스화 됨(will be open-sourced)
  - Flight recorder (JDK 11)
  - Mission control ✓
  - Others ✓

- 기존 제공되던 일부 Binaries는 삭제됨 (will be removed)
  - Browser Plugin
  - Java Web Start
  - JavaFX

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정확한 정책 해석: Oracle JDK vs. Open JDK

- Oracle JDK (from JDK 11)는 상용계약 고객에 한하여 사용 가능
  (ONLY be used in production with a commercial support contract)

- 계속 무상 사용하고자 하는 기업고객은 OpenJDK만 사용 가능
  (The only free JDK 11 and later will be **OpenJDK** binaries)

- 그러나, OpenJDK를 사용하면서 계속 무상으로 보안패치 및 오류수정 업데이트 혜택을 받고자 하는 기업고객은 매 6개월마다 새로운 JDK 버전으로 업그레이드 해야함.
  (To continue to receive **free updates** to the JDK you MUST update your JDK **EVERY SIX MONTHS)**

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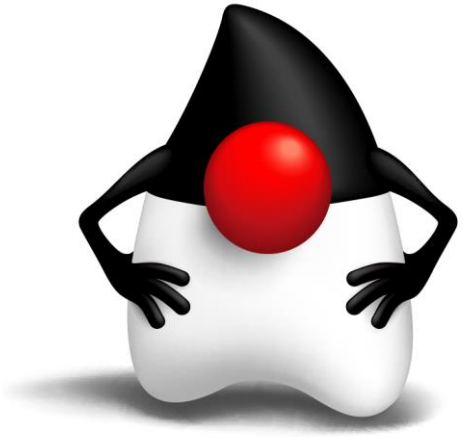
Example Customer case
In Java Decision



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기업고객 사례 (Example Customer case)

- 2018년 현재, 전세계에서 60,000이상의 서버를 운영중인 기업
- 오라클의 새 정책에 따라 2018년말까지 의사결정 목표 설정
- 향후 Java 정책에 대하여 4 가지 옵션 최종평가

(1) Oracle’s JDK 상용계약

(2) Red Hat’s IcedTea JDK 상용계약

(3) Open JDK 무상 사용 (Free Open JDK)

(4) Azul’s Zulu JDK 상용계약

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(1) Oracle JDK 상용계약 검토

- 기술적인 관점에서 변경사항 없음
- 다운로드 절차만 변경될 뿐, 상용화 적용을 위한 새로운 변경 불필요

- 경제성의 관점에서는 (On the business side)
- 가장 비싸고, 매우 높은 비용을 각오해야 함

(the huge, most expensive option)

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(2) Red Hat IcedTea JDK 상용계약 검토

- Red Hat은 2017년 12월 이후 자체 제품에 Oracle Java SE 번들 제공 중단
- 기존 고객도 2018년 11월 말까지만 Oracle Java SE 적용 가능

- Red Hat은 Open JDK 소스코드로부터 자체 제작한 JDK로 전환 중.
- 자체 JDK는 Open JDK 기준으로 2020년 10월까지만 제공 예정.

- 그러나, Red Hat 외 수많은 다양한 시스템 환경들을 고려할 때, 적합하지 않은 옵션임을 확인함.

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(3) 무료 Open JDK (Free OpenJDK Option)

- 무료 Open JDK를 사용하려는 기업고객은 매 6개월마다 새로운 JDK 버전으로 업그레이드해야 함.

- JDK 8 이하 버전에서 9 이상으로 업그레이드 할 경우, Java Platform Module System 으로의 변경으로 인해 잠재적으로 매우 중요한 검증과정 요구됨.

- 대부분의 third-party libraries & frameworks은 아직 이러한 높은 수준의 변경에 대하여 준비되어 있지 않은 상황임.

- 향후 출시될 JDK도 이와 같이, 하위버전에 대한 호환성 등 기업고객에게 상당한 부담을 초래할 수 있는 큰 변화를 포함할 수 있는 가능성이 많음.

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(4) Azul Zulu JDK 상용계약 검토

- Azul의 상용고객은 Open JDK 소스코드 기반으로 표준화된 JDK를 더 긴 기술지원 조건으로 사용 가능함.

- Azul의 모든 Java 버전에 대한 연장된 기술지원 정책은 기업고객의 시스템 운영에 있어서 지속적인 보안성과 안정성을 제공함.

- Azul은 Java Community Process (JCP)의 상임멤버기업으로 참여하고 있으며(the Executive Committee), Java SE 9, 10 and 11를 위한 전문가 그룹의 멤버기업으로 활동 중임.

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Azul's Java Background

- 100% Java 사업에만 집중
- 세계 최고 수준의 Java 기술지원 능력 보유 (Mission-critical JVM deployments)
- **기존 고객의 97% 이상이 계약 갱신**

- 검증된 전문성을 바탕으로 기술 중심의 JVM 상품 제공
- Java Community Process(JCP) 상임 임원멤버 기업 (Executive Committee, OpenJDK committers) → OpenJDK 6 프로젝트 리더 역할 수행
- 표준화, 호환성 제공 - TCK test suites 권한 보유
- 주요 Java 버전에 대한 10년 이상의 기술지원 정책 제공

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차별성 & 호환성 검증

1. *100% open source.*
   OpenJDK 기반으로 표준화 된 Java SE 호환성 제공

2. *Performance.*
   오라클도 동일한 Open JDK 소스코드를 사용하는 것처럼, 동일한 소스코드를 사용함으로 Performance는 크게 차이가 나지 않음.

3. *Certified Compliance.*
   Azul은 OpenJDK Community의 공식 TCK License Agreement (OCTLA)를 보유하고 있음.
   따라서, Zulu JDK는 정당성과 Java SE 호환성이 인증되어 있으며, Technology Compatibility Kit (TCK) 및 14년 이상 누적된 자체 품질 검증과정으로 100,000번 이상의 테스트를 거친 후 제공됨

4. *Certified Non-Contamination.*
   엄격한 사용권한 검증과정을 통해 추가적인 권한 확보나 요구사항이 발생하지 않도록 검증과정을 거친 후 제공됨

5. *Patent Indemnification.*
   더 안전한 권한을 위하여 JCP Specification licenses에서 제공되는 IP 권리 외, Azul 자체 IP 권한 제공

차별성 & 호환성 검증

1. *Oracle JVM vs. Azul JVM*
   - **A.** 동일한 소스코드로부터 개발 **(the same source code)**
   - B. 동일한 Java SE 호환성
   - C. 동일한 100,000 번 이상의 TCK 테스트 검증 (**same 100,000 TCK tests**)

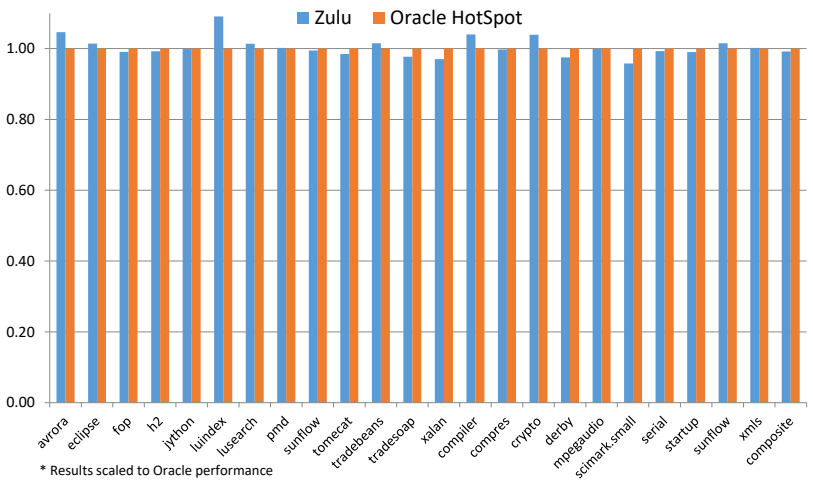
2. *Certification information*
   - A. Azul은 공식 TCK 테스트 권한을 보유하고 있음 (Azul is a TCK test suite licensee)
   - B. Azul은 제공되는 소스코드가 테스트 되었으며, 소스코드 내 어떠한 사용권한 문제가 없음을 검증

3. *OpenJDK is the reference implementation for Java SE*
   - A. Java 7 이후, 모든 Java 개발은 오픈소스 기반 하에 진행됨
   - B. 오라클 및 다른 상임멤버 기업들의 엔지니어들이 Open JDK 프로젝트를 위해 협력 중

4. *There is **no secret source** in Oracle JDK, including performance*
   - A. 오라클 또한 Open JDK 소스코드를 기반으로 하는 JDK 제공함

벤치마킹 테스트 사례

Performance Comparison



Performance differences are not significant; similar differences can occur when running the same benchmark twice on the same JVM.

SpecJVM2008 Benchmark

SpecJVM2008 Benchmark	Azul Zulu 8u112 vs. Oracle Java SE 8u111
compiler.compiler	14% Worse
compress	Same
crypto.aes	4% Better
crypto.rsa	22% Better
crypto.signverify	9% Better
derby	6% Worse
mpegaudio	4% Better
scimark.fft.small	5% Worse
scimark.lu.large	Same
scimark.lu.small	Same
scimark.monte_carlo	6% Worse
scimark.sor.large	Same
scimark.sor.small	Same
scimark.sparse.large	Same
scimark.sparse.small	1% Worse
serial	4% Worse
startup.compiler.compiler	7% Worse
startup.compress	2% Better
startup.crypto.aes	6% Better
startup.crypto.rsa	22% Better
startup.crypto.signverify	10% Better
startup.helloworld	26% Better
startup.mpegaudio	3% Better
startup.scimark.fft	1% Worse
startup.scimark.lu	2% Better
startup.scimark.monte_carlo	1% Worse
startup.scimark.sor	2% Better
startup.scimark.sparse	1% Worse
startup.serial	4% Worse
startup.sunflow	Same
startup.xml.transform	Same
startup.xml.verification	6% Worse
sunflow	2% Worse
xml.transform	24% Better
xml.validation	9% Better
geometric mean	1% Better

Azul's Java Portfolio: Zing, Zulu and Zulu Embedded

- **Zing:** A better runtime for Java Workloads
  - Azul's flagship JVM focused on better metrics
  - **Removed GC** as a concern for Java-based operations
  - Applications range from web-based systems to low-latency systems
  - **Proven in on-premise servers, in containers, and in the Cloud**
- **Zulu Enterprise:** Java with Superior Support
  - Free and Open Source Java (builds of OpenJDK)
  - Certified Java SE 9,8,7,6 – fully compliant with Java standards
  - **Identical performance vs. OpenJDK and Oracle HotSpot**
  - **Long support lifetime (10+ years)**
  - Timely security updates – quarterly and out-of-band, as needed
- **Zulu Embedded:** Java for Embedded & IoT
  - Custom Java SE builds for target form factors
  - 100% open source builds of OpenJDK
  - Certified Java SE builds
  - Verified "non-contaminating" open source license
  - Support for Linux and Windows -- Intel, ARM, PowerPC

Azul 상품의 기술지원 정책

Java SE Release	Azul Lifecycle	Java SE GA Date	End of Oracle Public Updates	End of Commercial Support			
				Oracle Java SE	Azul Zulu Enterprise	Azul Zulu Embedded	Azul Zing
CURRENT OFFERINGS							
Java 6	**LTS**	Dec 2006	Apr 2013	Dec 2018 (12 yrs)	Dec 2019 (13 yrs)	Dec 2019 (13 yrs)	Apr 2017 (11 yrs)
Java 7	**LTS**	Jul 2011	Apr 2015	Jul 2022 (11 yrs)	Jul 2023 (12 yrs)	Jul 2023 (12 yrs)	Dec 2021 (10.5 yrs)
Java 8	**LTS**	Mar 2014	Jan 2019	Mar 2025 (11 yrs)	Mar 2026 (12 yrs)	Mar 2026 (12 yrs)	Mar 2025 (11 yrs)
Java 9	MTS	Sept 2017	Mar 2018	Mar 2018 (6 mo)	Mar 2020 (2.5 yrs)	Community Only	Community Only
Java 10	Preview	Mar 2018	Sept 2018	Sept 2018 (6 mo)	Community Only	Community Only	Community Only
FUTURE OFFERINGS (est.)							
Java 11	**LTS**	Sept 2018	Mar 2019	Sept 2026 (8 yrs)	Sept 2027 (9 yrs)	Sept 2027 (9 yrs)	Sept 2026 (8 yrs)
Java 12	Preview	Mar 2019	Sept 2019	Not Supported	Community Only	Community Only	Community Only
Java 13	MTS	Sept 2019	Mar 2020	Not Supported	Mar 2023 (3.5 yrs)	Community Only	Community Only
Java 14	Preview	Mar 2020	Sept 2020	Not Supported	Community Only	Community Only	Community Only
Java 15	MTS	Sept 2020	Mar 2021	Not Supported	Mar 2023 (2.5 yrs)	Community Only	Community Only
Java 16	Preview	Mar 2021	Sept 2021	Not Supported	Community Only	Community Only	Community Only
Java 17	**LTS**	Sept 2021	Mar 2022	Sept 2029 (8 yrs)	Sept 2030 (9 yrs)	Sept 2030 (9 yrs)	Sept 2029 (8 yrs)
Java 18	Preview	Mar 2022	Sept 2022	Not Supported	Community Only	Community Only	Community Only
Java 19	MTS	Sept 2022	Mar 2023	Not Supported	Mar 2026 (3.5 yrs)	Community Only	Community Only

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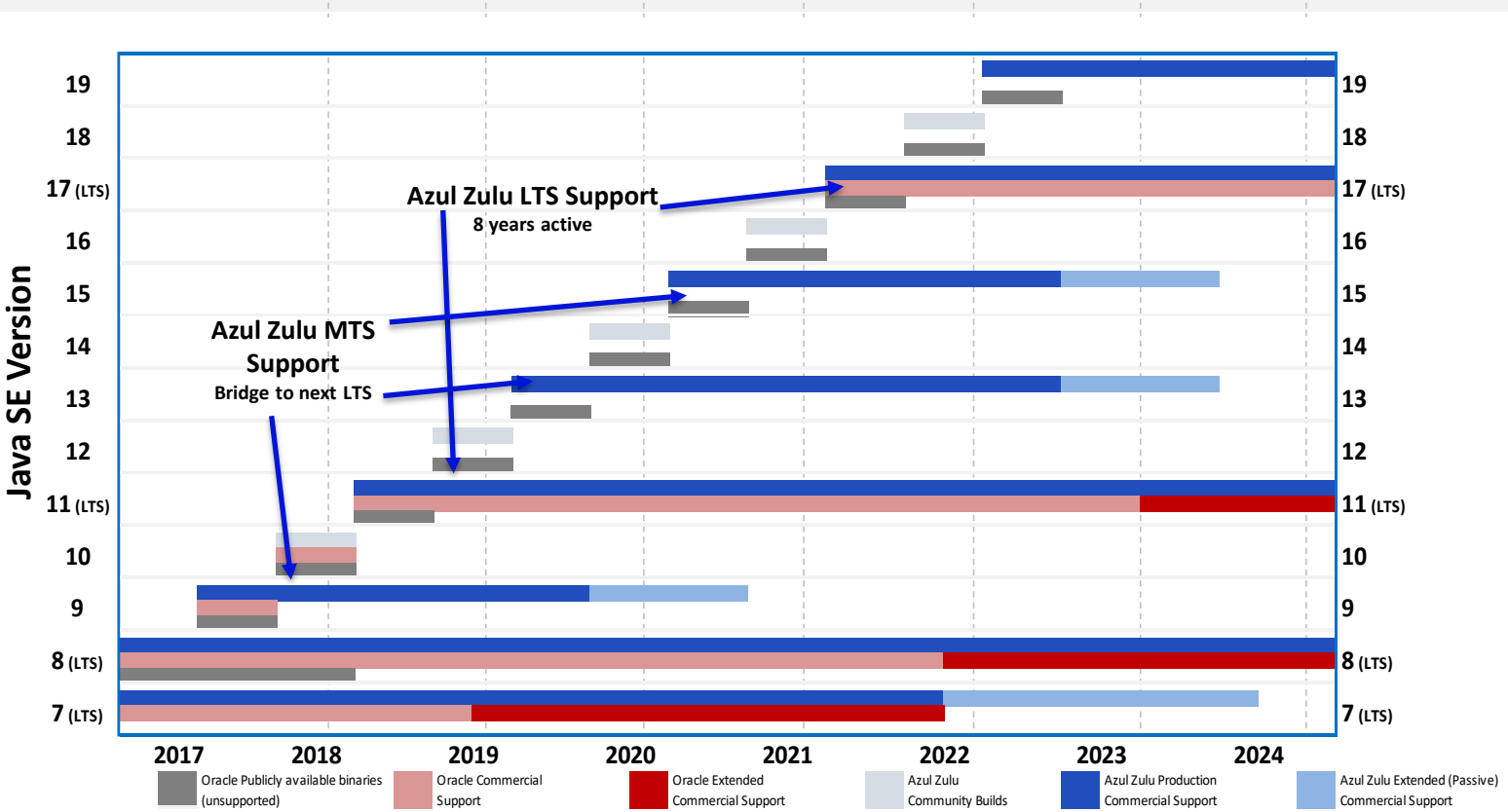
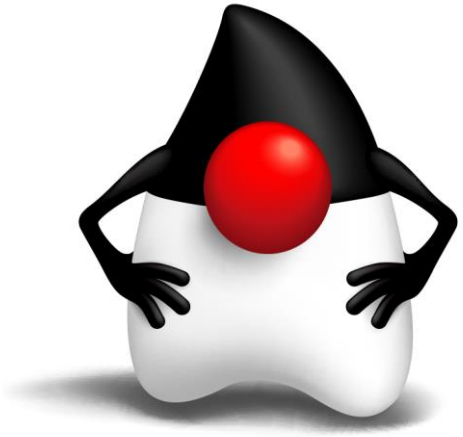
Java SE Lifecycle: 5+ Years



Migrating
From Oracle JDK



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Simple Migration

1. Determine JDK version for migration and download
2. Install new JDK binary
3. Modify JAVA_HOME and PATH variables
4. Test application
5. Deploy

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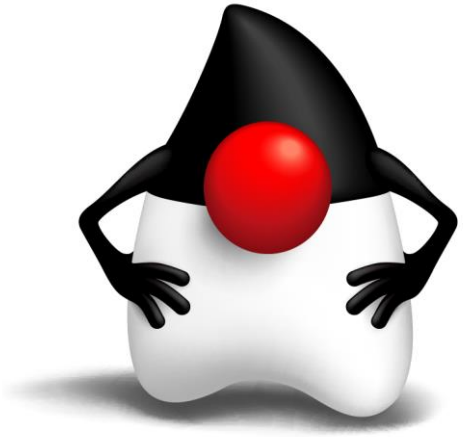
Conclusion



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Java Is Changing

- New JDK release cadence
- No more free Oracle JDK in production and commercial
- OpenJDK updates only for six-months

- Consider your JDK migration options

- Azul can help!
  - Extended support available for more releases
  - Easy migration path for applications
  - Tested and supported (not just porting fixes)

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별첨 1. Oracle 가격 구조

Java SE Desktop Subscription Pricing

Volume	Subscription Metric	Monthly Subscription Price	Annual Subscription Price
1-999	Named User Plus	US$2.50	US$30.00
1,000-2,999	Named User Plus	US$2.00	US$24.00
3,000-9,999	Named User Plus	US$1.75	US$21.00
10,000-19,000	Named User Plus	US$1.50	US$18.00
20,000-49,999	Named User Plus	US$1.25	US$15.00
50,000+	Contact for details		

Java SE Subscription Pricing

Volume	Subscription Metric	Monthly Subscription Price	Annual Subscription Price
1-99	Processor	US$25.00	US$300.00
100-249	Processor	US$23.75	US$285.00
250-499	Processor	US$22.50	US$270.00
500-999	Processor	US$22.00	US$264.00
1,000-2,999	Processor	US$17.50	US$210.00
3,000-9,999	Processor	US$15.00	US$180.00
10,000-19,999	Processor	US$12.50	US$150.00
20,000+	Contact for details		

1 JAVA SE 데스크톱 가격 정보

- 가격 예시 : 5000 명의 데스크톱 사용자의 경우, 사용자는 3,000-9,999 명이며 이는 21 달러입니다.
- 1 년 Java SE Desktop 구독 가격은 US $ 21 * 5000 * 1 = US $ 105,000
- 3 년 Java SE Desktop 구독 가격은 US $ 21 * 5000 * 3 = US $ 315,000입니다.

2 JAVA SE 가격 정보(서버)

- 가격 예시 : 8 개의 코어를 갖춘 1 개의 Intel Xeon 시리즈 프로세서의 경우 Oracle Java SE 구독 가격은 US $ 25 * 12 = 연간 단가 US $ 300입니다.
- 300 달러 (단가) * 8 (코어 번호) * 1 (연도 번호) * 0.5 (핵심 요소) = US $ 1200

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Thank You

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Azul's Flagship Java Runtime

Zing®

A Better JVM with Better Metrics

Consistent Low Latency & Pauseless Operation	Slashes Java Warm-Up Time Reduces Troubleshooting	Improves Business Outcomes
		

Completely Removes Java GC as a Factor
Better behavior across a wide variety of workloads and use cases
Pauseless Operation with JVM Heaps up to 2 TB

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Powering Zing: 3 Key Technologies

Enabled by the **C4 Collector**, **Falcon JIT compiler**, and **ReadyNow!** technology, Zing completely eliminates traditionally problematic Garbage Collection and Warm-up issues, along with the hiccups, stalls, freezes, jitters, and long tails that are typically associated with Java performance.

C4: Azul's GC technology eliminates Java stalls, pauses and jitter

Falcon: Zing's high-performance JIT compiler based on LLVM

ReadyNow!: Zing runtime technology that solves Java's Warm-up problem

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Zing's Falcon JIT Performance

- Falcon consistently surpasses C2-based Oracle HotSpot and performance of prior versions of Zing (C2 was the default Zing JIT compiler until 17.03 release)
- SPECjvm 2008
  - 3.5x faster than Oracle HotSpot on crypto workloads
  - 15-19% faster than Zing using C2
- Low-latency workload (existing Zing customer, trading infrastructure):
  - 18-24% faster than prior release of Zing
  - 2-5% faster than Oracle HotSpot (…and HotSpot is unable to meet latency SLAs)
- 10% faster that Oracle HotSpot on Cassandra benchmarks using Skylake-based servers (Intel Xeon E5-xxxx)
- 24% faster than HotSpot running MonteCarlo Simulations
  - 10% faster than Zing when using C2
- Note: All benchmark results using JDK8 versions of Zing 17.03

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Zing, Falcon and the analyst community

“By adopting LLVM for its next-generation JIT compiler, Azul is leveraging an innovative and dynamic global community that is continually upgrading performance across multiple languages and technologies. Bringing LLVM to the Zing runtime will help enterprises drive additional value from their ongoing investments in Java-based applications and infrastructure.”

-- John Abbott, 451 Research

Zing Drives Down CAPEX and OPEX

- Zing was designed to be a “drop-in” replacement for Oracle HotSpot
  - No need to change your application code in order to gain benefit from Zing
  - No need to re-architect
- Requires fewer servers or AWS instances to meet the same SLA
  - Gain 2X-3X or more in additional capacity
  - Keep the same AWS instance size and core count
- Eliminates the need for constant JVM tuning
  - Fewer JVM tuning flags = fewer ways to go wrong
  - Zing is designed to “just work” from startup
- Reduces the need for JVM performance specialists
  - Now your best engineers can focus on building competitive new features
- ELA-based pricing and flexible subscriptions simplify your budgeting

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Zing and Zero-GC Frameworks

- Zero-GC Frameworks are widely deployed throughout capital markets
- When rules are followed, very few GC artifacts
- Zing helps ensure that Zero-GC frameworks stay that way
  - Even when developers make coding errors
  - When 3rd-party libraries get included
- Zing solves Java warm-up issues that Zero-GC frameworks can't touch
  - Only Zing has ReadyNow technology
  - Make sure your systems are ready at market open or other critical times
  - Make the right compilation decisions automatically based upon prior runs
- Zing delivers better JIT-compiled code
  - Falcon replaces the C2 JIT compiler in Oracle HotSpot (and older versions of Zing)
  - More optimization PLUS better use of new Intel and AMD hardware instructions

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Zing and the Cloud: Customer Use Case

Video advertising company

- Cassandra cluster running on 6x AWS i3.2xlarge instances
- Approx. 80/20 write/read split
- Data read and written with quorum consistency
- 6 client machines sending requests collocated in the same Azs

- SLA requirements for read operations:
  - 20ms at 99.9%
  - 50ms at 99.99%
  - 100ms at 99.998% (not a typo, last 9 hard to maintain on AWS)

- Oracle HotSpot w/G1GC can maintain ~4K TPS before SLA breach

- Zing: can maintain ~21K TPS before SLA breach

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Proven Zing Advantages for Kafka Deployments

Lower average and peak message latency

- Regardless of message size and read/write transaction mix
- Meet performance targets and SLAs
- Deliver better quality of service to human-facing Web applications
- Get diagnostic data to downstream systems quickly

Reduced Engineering and Operational Effort

- Improved developer productivity and app time to market
- Less operational risk
- Eliminates constant JVM tuning as Kafka cluster utilization increases

Improved Infrastructure Economics

- Better server efficiency and utilization
- In SLA-sensitive environments, fewer AWS instances are required when using Zing

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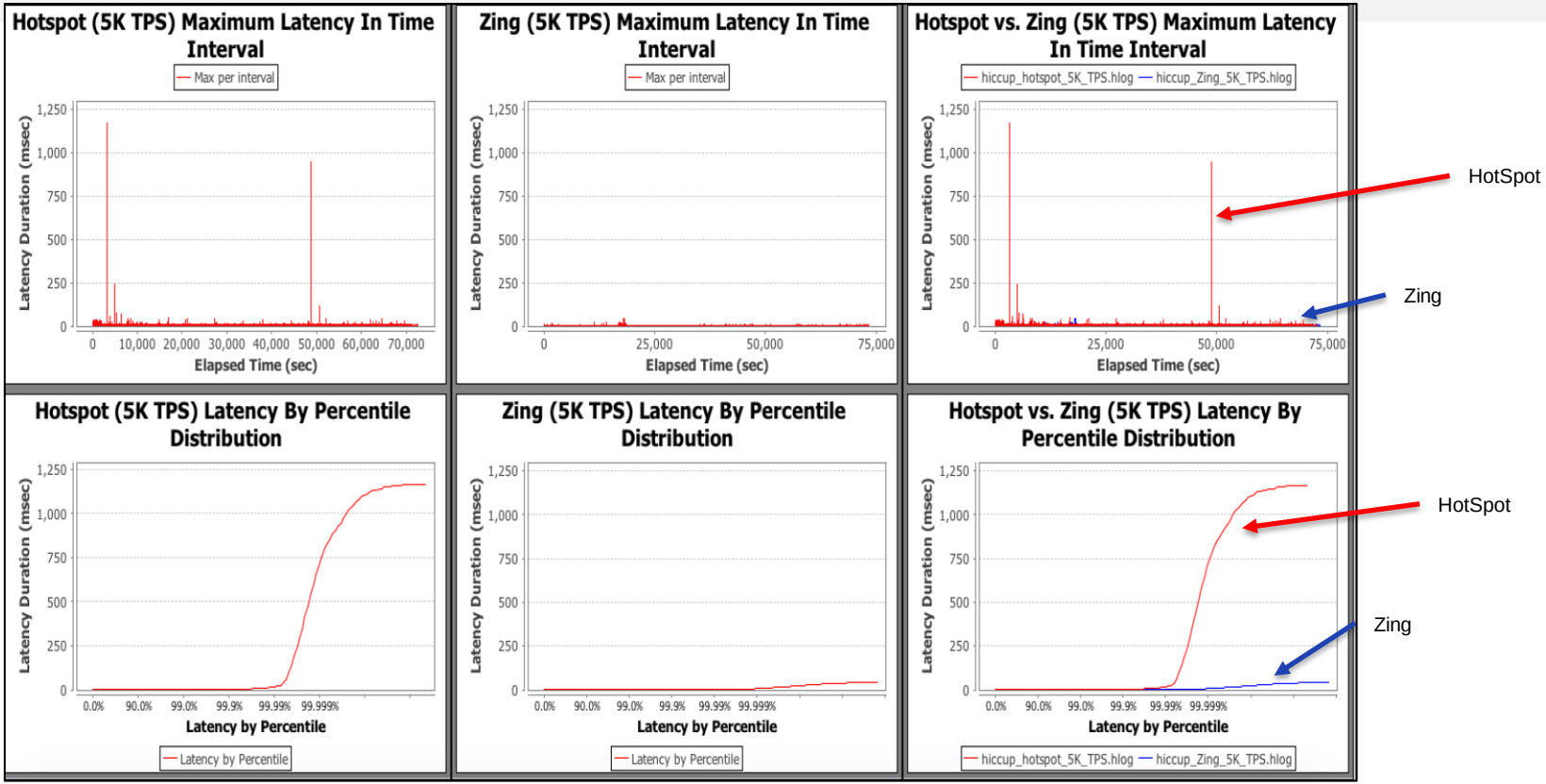
Kafka on HotSpot with G1GC vs. Zing C4 Collector



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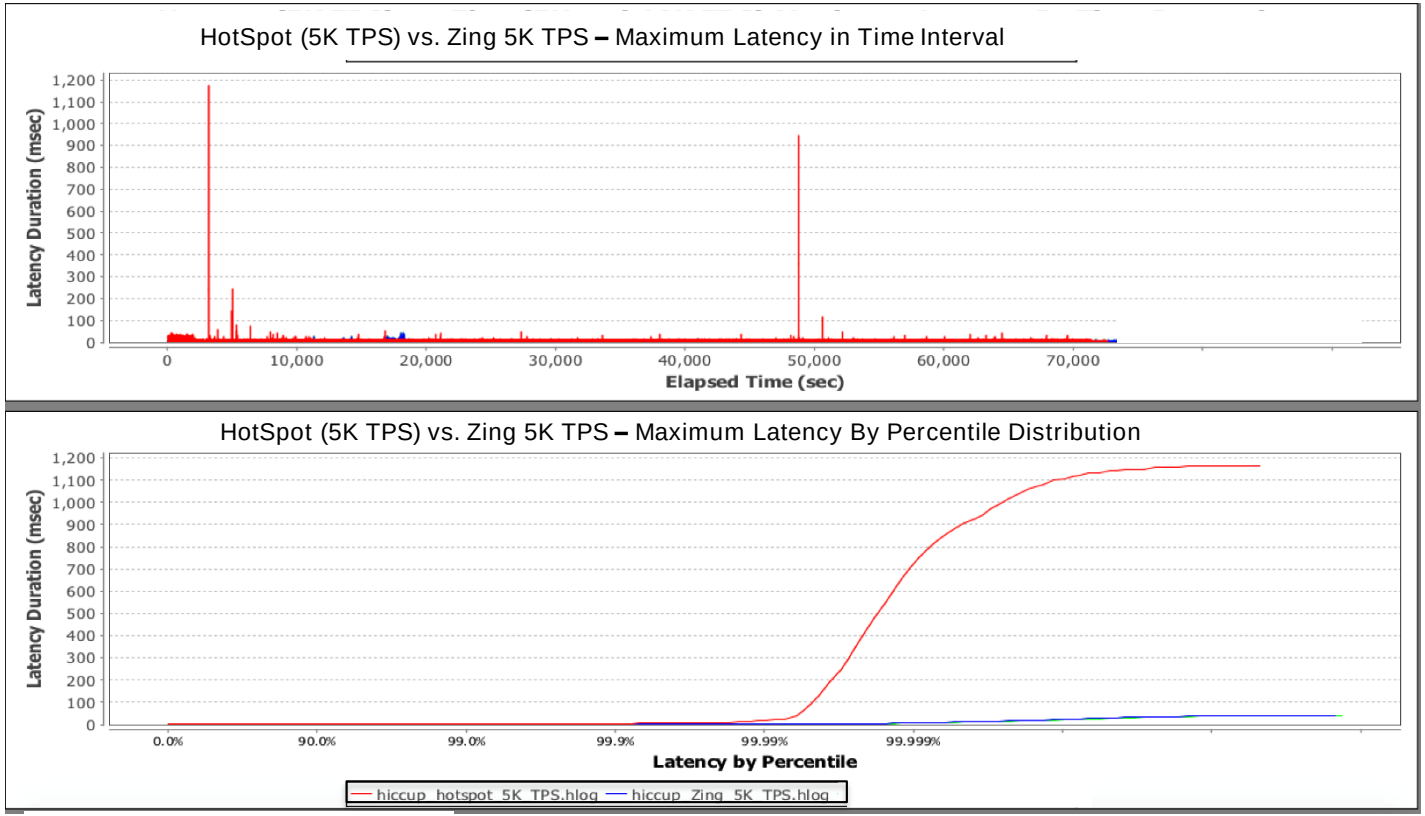
Kafka Read-Only Workload – HotSpot vs. Zing



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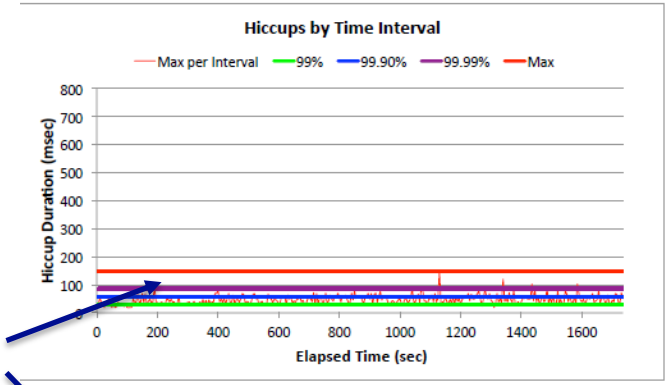
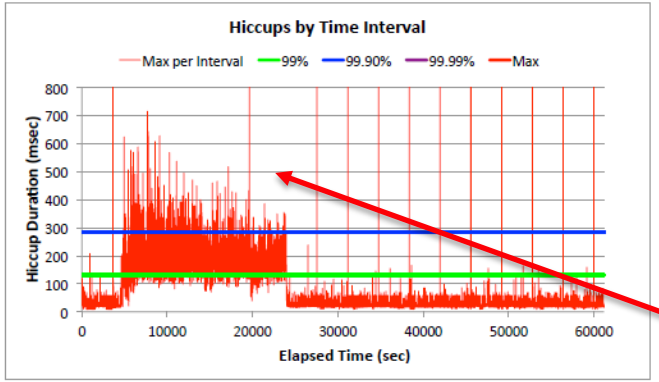
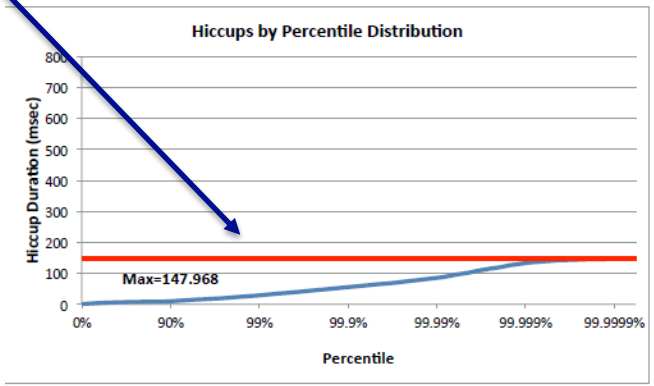
Zing on Amazon Cloud (AWS)

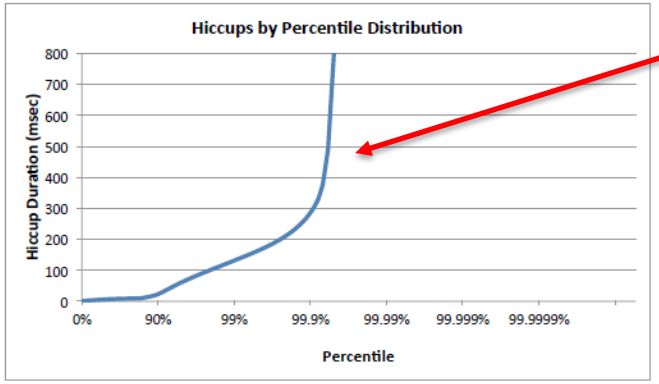
Azul Zing



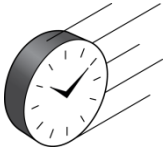


Oracle HotSpot





Zing Benefits for Cassandra Deployments



Better Raw Performance

- Real-time requirement demands fast execution
- From machine scale to human scale, Zing delivers

Unmatched Reliability

- Eliminates Java-based disruptions, glitches and pauses
- Better customer experience = more revenue

Meet M2M and human-scale SLAs

- Competitive and Time-to-Market Challenges
- Meet your Cassandra service delivery standards

Increased Value

- Gain efficiency and maximize utilization
- Stop spending on JVM tuning
- Minimize missed opportunity cost
- Lower Capex and Opex

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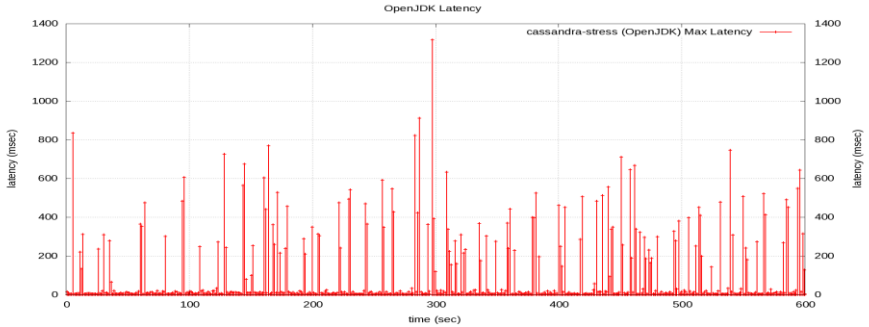
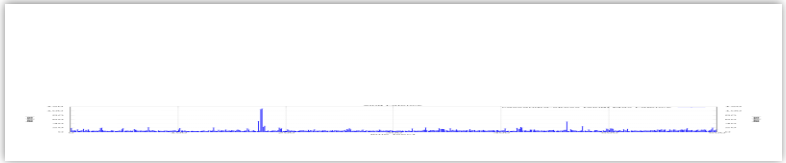
A Simple Visual Summary

This is Cassandra on HotSpot



This is Cassandra on Zing



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Zing delivers value for Cassandra sites

Zing reduces Cassandra compaction delays & eliminates client disconnects

Zing improves uptime, reliability, and performance efficiency

Zing eliminates the need for tedious GC and JVM troubleshooting and tuning

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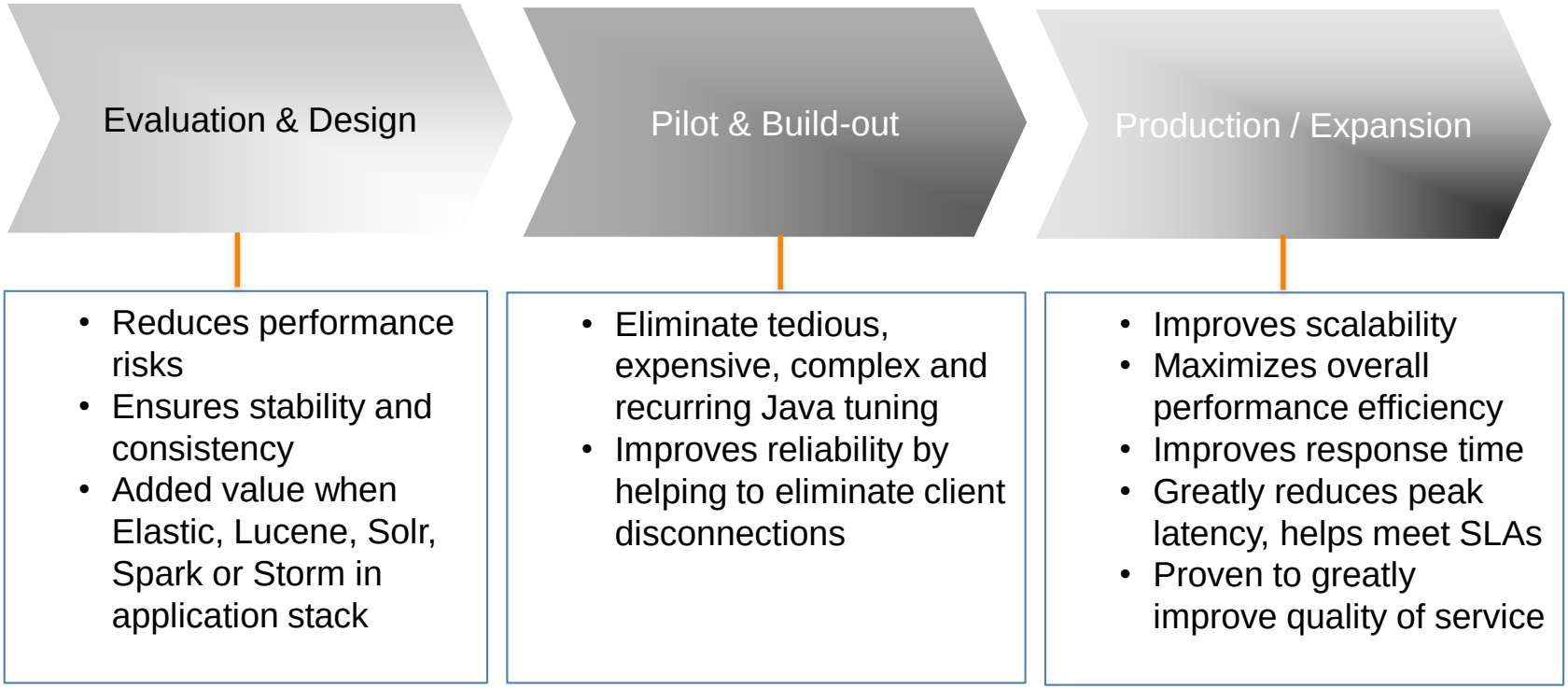
Zing adds value throughout the Cassandra lifecycle



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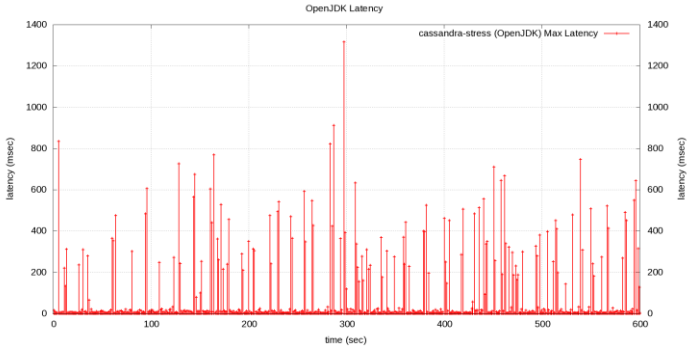
Azul's Real-life Cassandra Experience

Customer using Cassandra with Zing	Specific Use Case
Top online digital media service provider	Recommendation engine
Smartphone manufacturer	Fraud detection and security
Large discount retailer in US	Global SKU catalog
Social marketing firm	HA social infrastructure
Credit Card Processing Firm	CC fraud machine learning
Online gaming company	Authentication system for online game users
Online digital media service provider	Data storage for user personalization/profile
Online auction site	Data storage for user profile + recommendation system
Capital market trading firm	Market order system
Financial services firm	Market Tick consolidator
Major online discount travel site	Pricing application
US cable operator	Web based DVR / Advertisement delivery system
Mobile marketing firm	Mobile advertisement delivery / tracking
Global messaging solution provider	Data store / metadata archiving
Video advertising platform company	Digital advertising real-time marketplace (write-intensive)

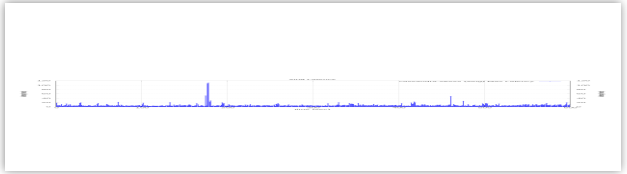
Cassandra Performance: Oracle JVM vs. Zing

Oracle JVM: 200-1400 msec stalls




```
op rate                   : 40001
partition rate            : 26996
row rate                  : 26996
latency mean              : 30.6 (0.7)
latency median            : 0.5 (0.5)
latency 95th percentile   : 244.4 (1.1)
latency 99th percentile   : 537.4 (2.0)
latency 99.9th percentile : 1052.2 (8.4)
latency max               : 1314.9 (1312.8)
```

Zing (drawn to scale)



```
op rate                   : 40001
partition rate            : 26961
row rate                  : 26961
latency mean              : 0.6 (0.5)
latency median            : 0.5 (0.5)
latency 95th percentile   : 1.0 (0.9)
latency 99th percentile   : 2.7 (1.9)
latency 99.9th percentile : 13.3 (3.8)
latency max               : 110.6 (28.2)
```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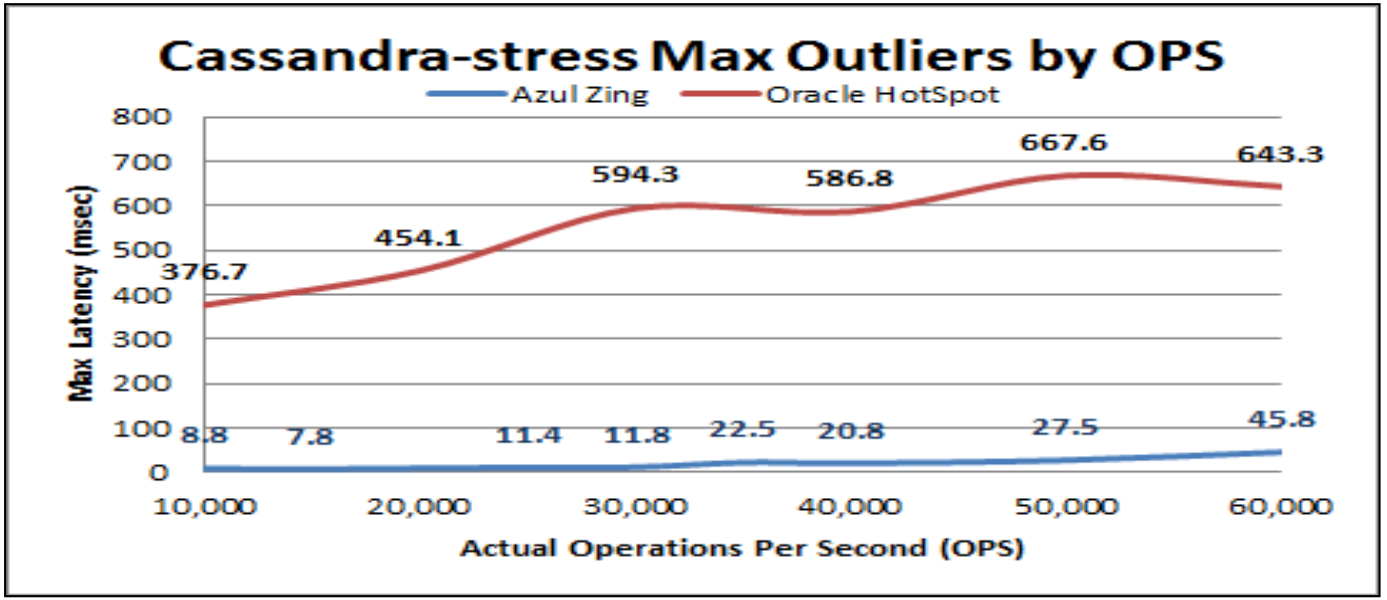
Some Cassandra-stress Benchmarking Results



Max Latencies by Operations per Second.
Cassandra setup 3 nodes, Replication Factor of 3,
Quorum set to 3, across three physical servers.

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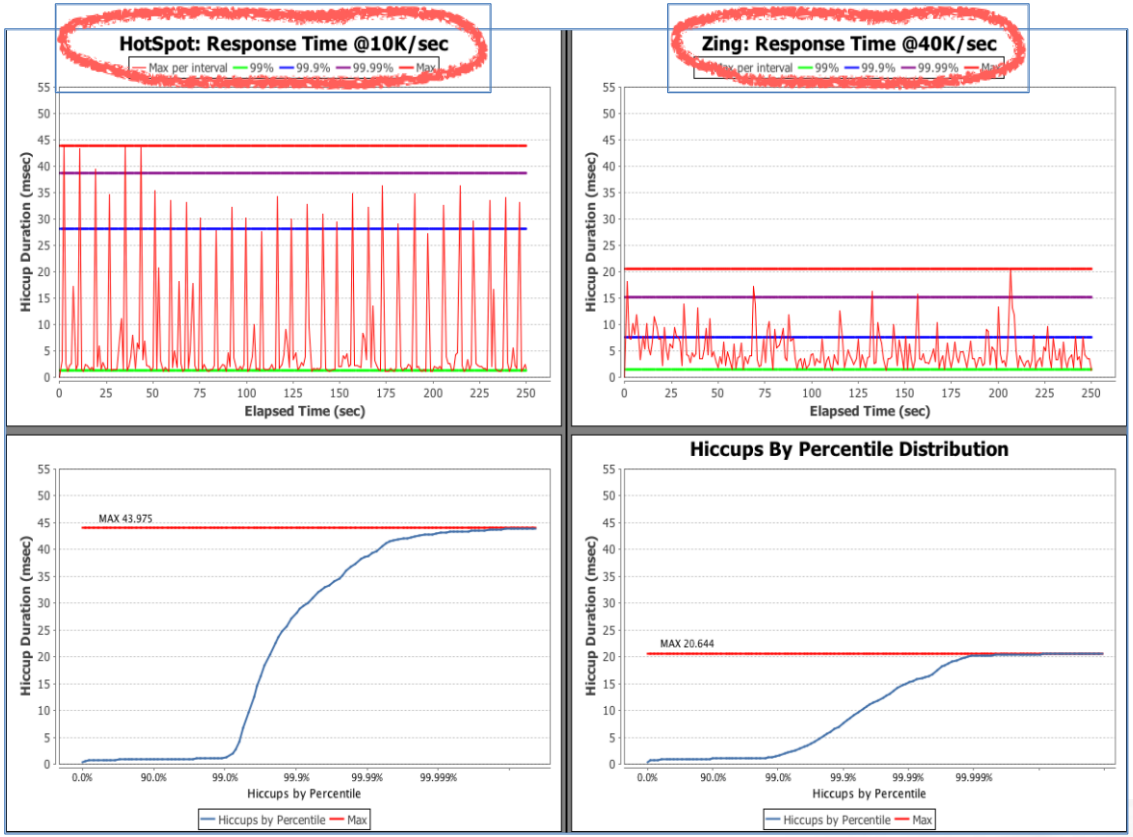
Zing: Better Cassandra Performance at 4X the Workload



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Zing and Cassandra: When SLAs Matter

“In our business speed is critical, but speed means nothing if you fail SLAs. Using the latest versions of Zing we were able to reliably maintain our SLA standards at dramatically higher speeds than we were able to previously do with the Oracle HotSpot JVM.”

-- Garry Turkington, CTO, Improve Digital

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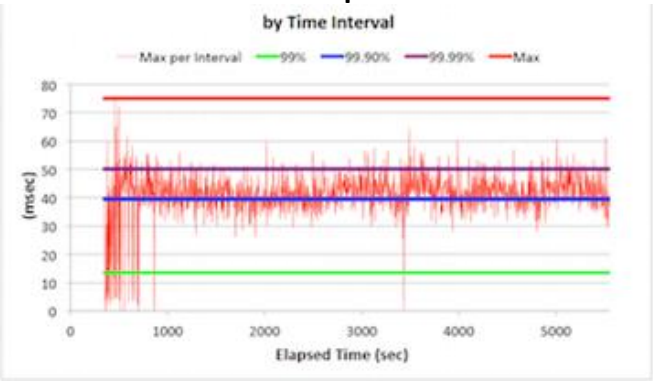
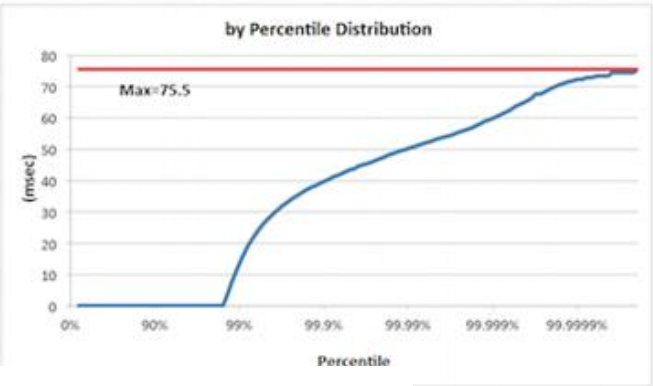
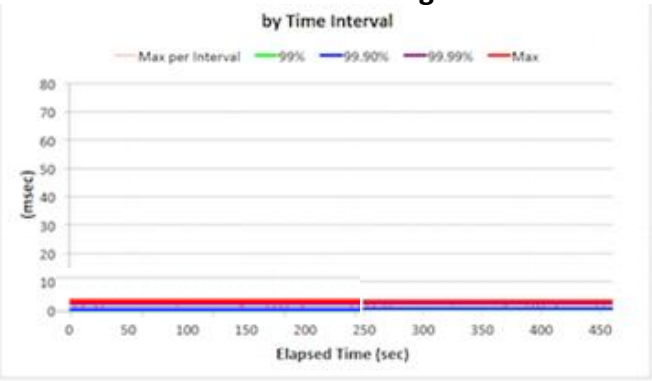
Zing Eliminates Java-Based Cassandra Issues

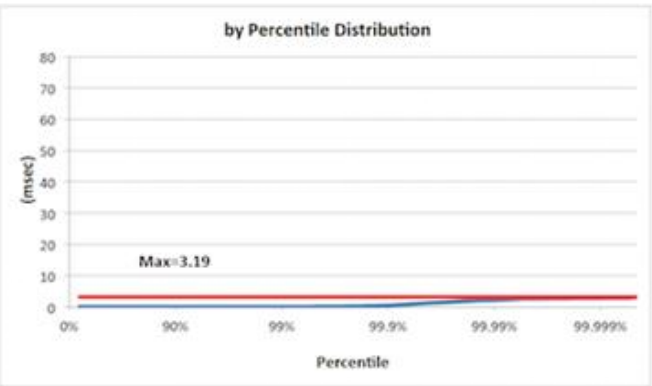
Oracle HotSpot





Azul Zing





Zing Powers Search for Elastic, Lucene and Solr

FIXME

- Lucene-based Search products, including Elastic and Solr, are built in Java and Scala, both of which run on a JVM
- JVM-based performance artifacts can impact search and sharding latency, ultimately threatening SLAs and even cluster stability
- With legacy Java runtimes like Oracle HotSpot, search implementations face the tradeoff of larger indices and more in-memory data structures vs. GC pauses and other JVM glitches that limit performance and availability
- Zing removes all practical limits on Java heap size – Elastic, Lucene and Solr can take full advantage of the memory in today's servers
- Zing also simplifies search application engineering and support costs, and takes the need for JVM tuning off the table

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Solr Benchmark Results

- Zing C4 vs. HotSpot with G1 results were conclusive
- In both use cases, using large (16G) and smaller (4G) heaps, Zing delivered better performance for different Solr workloads
- Max application pauses for Workload 1 (fulltext) were 1661ms with G1, and 67ms with Zing
- Max application pauses for Workload 2 (metadata) were even more dramatic – G1's worst pause was 184,684ms vs 107ms for Zing
- G1 performance started degrading at the 99th percentile
- In all use cases Zing pause time is flat past 5 nines
- Results were charted using the open source jHiccup tool

- Conclusion: Zing's C4 collector delivers better and more consistent performance vs. HotSpot's G1 in multiple Search benchmarks

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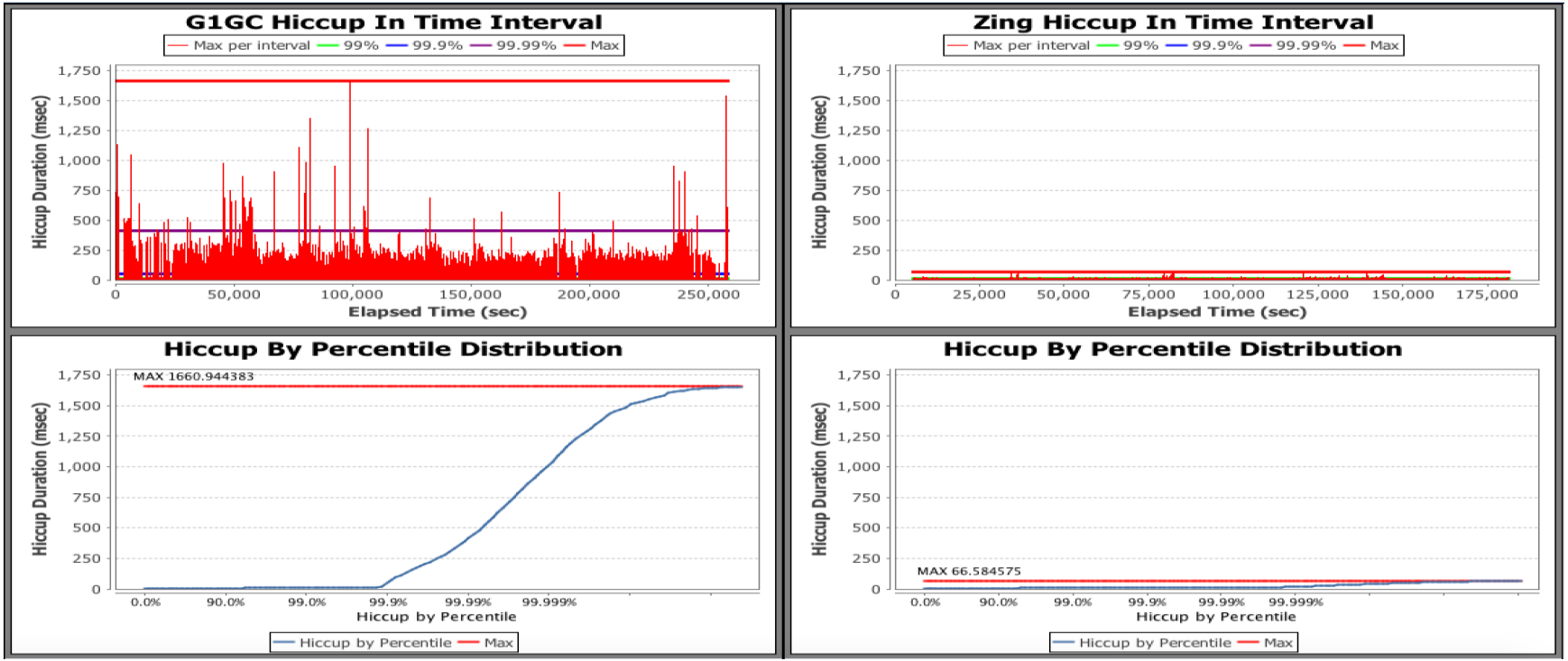
Workload #1 (Fulltext) benchmark: 32G RAM, 16G Java Heap



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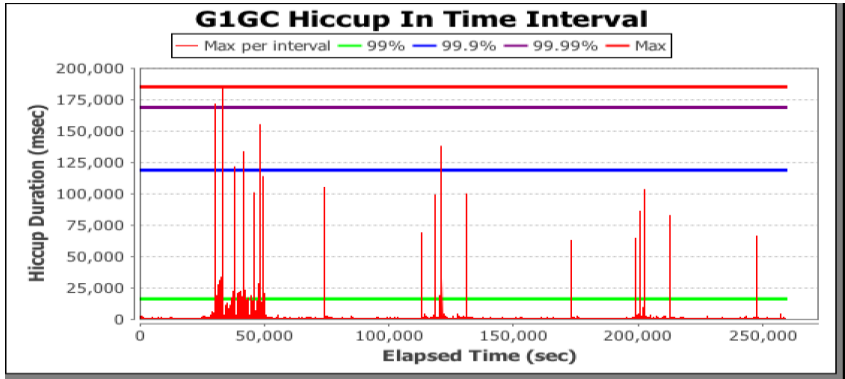
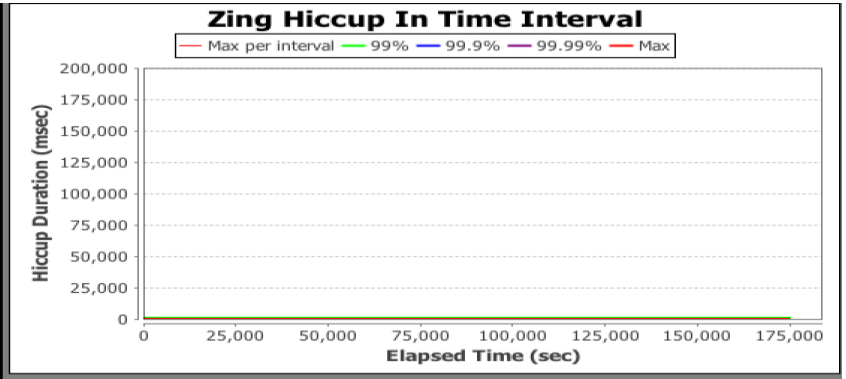
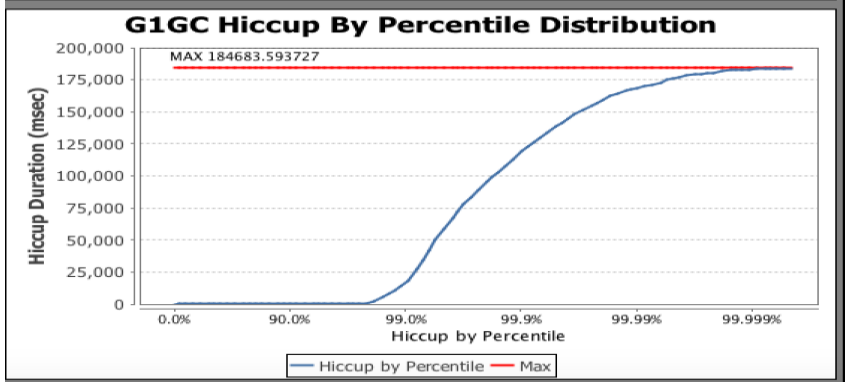
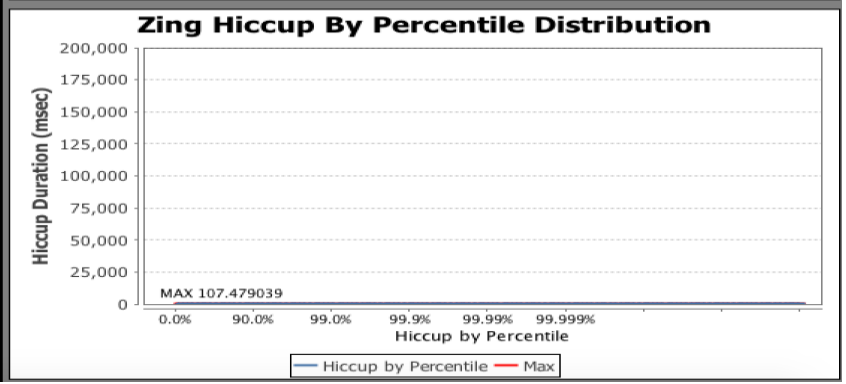
Metadata Search Workload -- 8GB RAM, 4GB Heap









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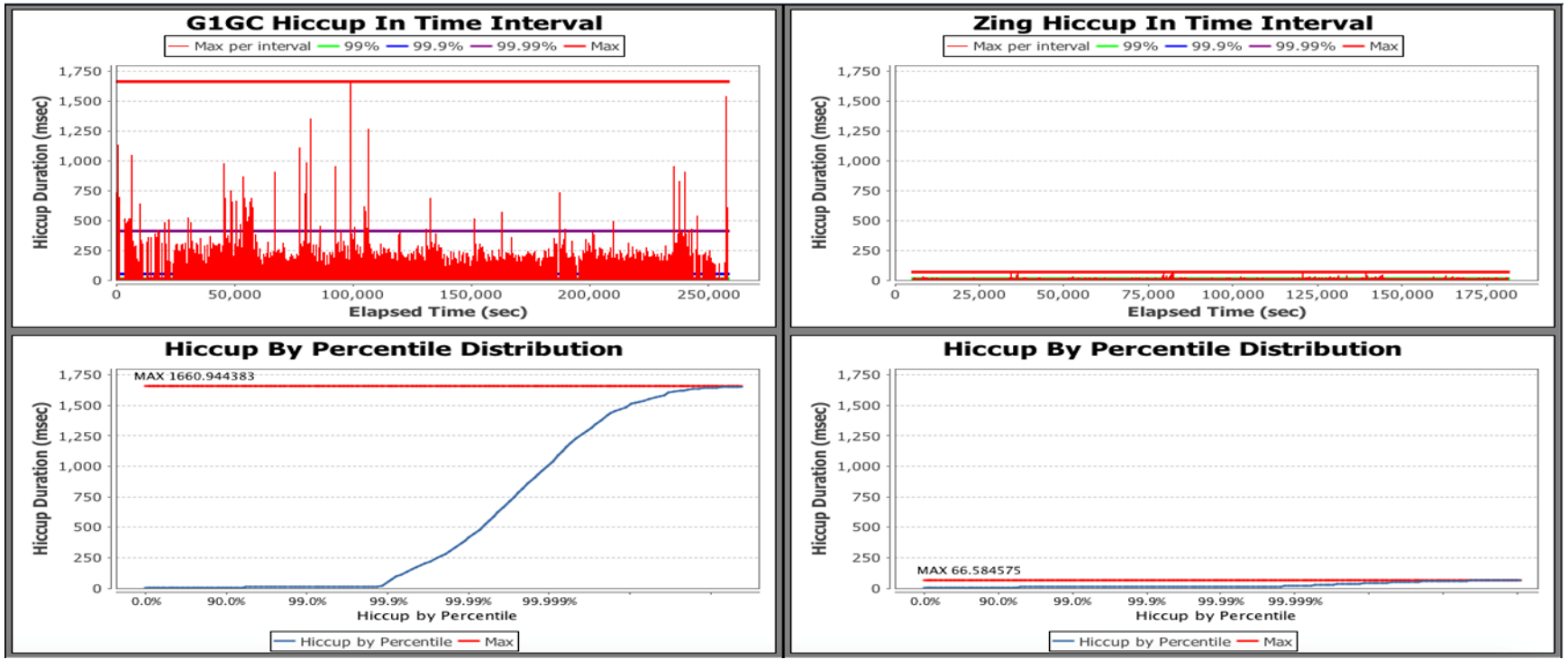
Fulltext Search Workload: 32 GB RAM, 16 GB Heap



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Zing: proven value for online retail

- Since 2005, Azul has been powering online retail sites like Belk, Saks 5th Avenue and J Crew across dozens of Black Fridays and Cyber Mondays
- Why Azul?
  - ✓ User experience is absolutely critical for online retail
  - ✓ Glitches, pauses and stalls lead to unpredictable and unacceptable application performance
  - ✓ Once customers churn away, they often move to a competitor – and they don't return
  - ✓ Worse, they share their dissatisfaction with social media, and can damage a brand within minutes

Look familiar?

Creating the Best Digital Experience Drives Competitive Advantage for Online Retail

90%

of users expect a website to perform well, even during peak periods

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But online buyers are often disappointed!

61%

had a poor experience
on a retail site
during the holidays

38%

had a poor experience
on a travel site
during a peak period

65%

had a poor experience
on a brokerage site
during a peak period

AZUL SYSTEMS®

Keep Users Happy and Beat the Competition

60X LOWER peak response time

2-3X MORE throughput

...simply by Deploying on Zing®

Source: http://www.compuware.com/content/dam/compuware/apm/assets/pdfs/Users_Still_Disappointed_Infographic.pdf

Zing Supported Platforms

All Major Linux Distros:

- RHEL 5.2 or later and 6.0/7.0 or later
- Amazon Linux (5.10)
- SLES 11 sp1, sp2 and sp3
- CentOS 5.2 or later, 6.0 or later, 7.0 or later
- Ubuntu 10.04 LTS, 12.04 and 14.04 LTS
- Debian: Stretch, Wheezy and Jessie
- Oracle Linux
- Alpine Linux
- Red Hat MRG

VMware, KVM, Docker

Amazon AWS, Azure & Multiple Private Clouds

Java Versions: 8, 7, 6

Hardware: Intel/AMD x64

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Zing summary: choose a “better behaving” Java

- As a drop-in alternative to existing JDK or JRE packages, Zing runs unmodified Java applications and infrastructure components while delivering better responsiveness, improved carrying capacity, reduced timeouts and error counts under load, and an overall smoother execution experience.
- Zing completely eliminates traditionally problematic Garbage Collection issues, along with hiccups, stalls, freezes, jitters, and long tails that are typically associated with Java applications.
- Using Zing leads to operational efficiencies in production, in Engineering, operations, and DevOps processes, in time-to-market and time-to-performance, and often in application design and performance tuning efforts.

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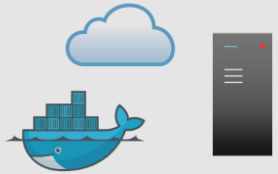
Zulu: Our Multiplatform Builds of OpenJDK

Zulu

100% Open Source Java

Tested and Certified Java 9, 8, 7 and 6 Flexible Support Plans and Pricing	Linux, Windows, & Mac OS X	Server, Desktop, Cloud, Client, Virtualized, Juju & Docker
		

Backed By Azul's Global Support Organization
Free to Download and Use Without Restriction
Fixes Upstreamed to the OpenJDK Community

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Looking for a Better Java Support Alternative?

- Choose **Zulu Enterprise** – Certified, tested builds of OpenJDK
- Economical, world-class Java support
- Windows, Linux or Mac; simple subscription model
- 10+ year lifetime for major Java releases:
  - *You* control your upgrade timing
- Rapid out-of-release cycle access to security updates
- Free downloads -- 100% Open Source
- Cloud and Virtualization-ready
- Compliant with Java SE versions 6, 7, 8 and 9
- Docker Hub, Azure, AWS, Canonical Charm Store, plus Azul.com

Why Adopt Zulu Enterprise vs Oracle HotSpot ?

Java SE Advanced is expensive, inflexible and un-necessary

Oracle's field-of-use licensing policies are restrictive

Same code base as Oracle HotSpot same performance, 100% open source

OpenJDK

Leverage Java Community for new Embedded and IoT designs

9+ Million

AZUL SYSTEMS®

Zulu: the Largest Commercial OpenJDK distribution

Zulu Platform/OS Support

Linux: 32/64-bit

- RHEL 7, 6 and 5.9+ or later
- SLES 12 sp1, 11 sp1/2/3/4
- CentOS 7, 6, and 5.9+ or later
- Ubuntu 16.04, 14.04, 12.04 LTS
- Debian Stretch, Wheezy, Jessie
- Wind River Linux
- Oracle Linux 6 and 7 or later
- Alpine Linux

Windows: 32/64-bit

- Client 10, 8.1, 8, 7, IoT/Mobile/Nano 10, Server 2016, 2012 R2, 2012, 2008 R2

Mac OS X

VMware, Hyper-V, KVM

Intel, ARM, PowerPC 32 and 64-bit

Azure, AWS, Google, Snappy, Docker, Cloud Foundry, Juju

JDK Versions: Java SE 6, 7, 8 & 9

AZUL SYSTEMS

Introducing Zulu Embedded: OpenJDK for the IoT

- Customizable
  - Multiple 32 and 64-bit processor architectures
  - Customized form factors to meet the specific requirements of the target device
  - Builds as small as 14 MB (Compact 1) available today
  - Custom packaging or standard file types such as ZIP, MSI and .deb
  - Java SE 6, 7 and 8; Java SE 9 EA
- Shipping since November 2014
- Millions of devices using Zulu Embedded in the field today

Why Zulu Embedded ?

Oracle's Embedded Java licensing is expensive

Oracle's field-of-use licenses are restrictive

Same code base as Oracle HotSpot same performance, 100% open source

OpenJDK

Leverage Java Community for new Embedded and IoT designs

9+ Million

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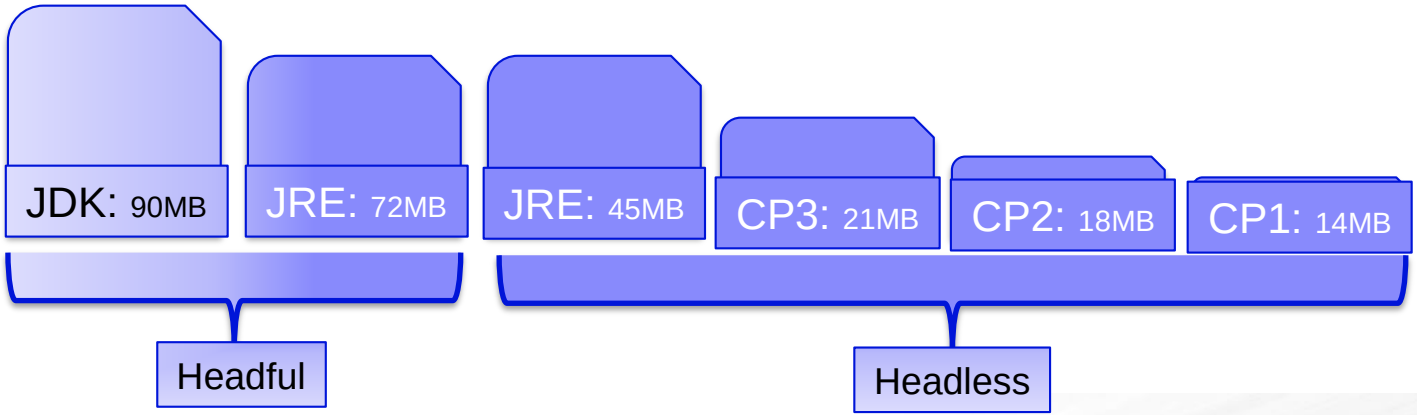
Zulu Embedded: Customizable Packages

- Multiple OS options: Windows (client/server), all Linux distros
- CPUs & Bitness: 32/64 for x86, ARM, and PPC
- Java versions: all patch levels for Java 6, 7, 8, 9 EA
- Packages: ZIP, RPM, DEB, MSI
- Bundles: 6 unique versions



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