JDK 9, 10 & 11: Pitfalls For The Unwary

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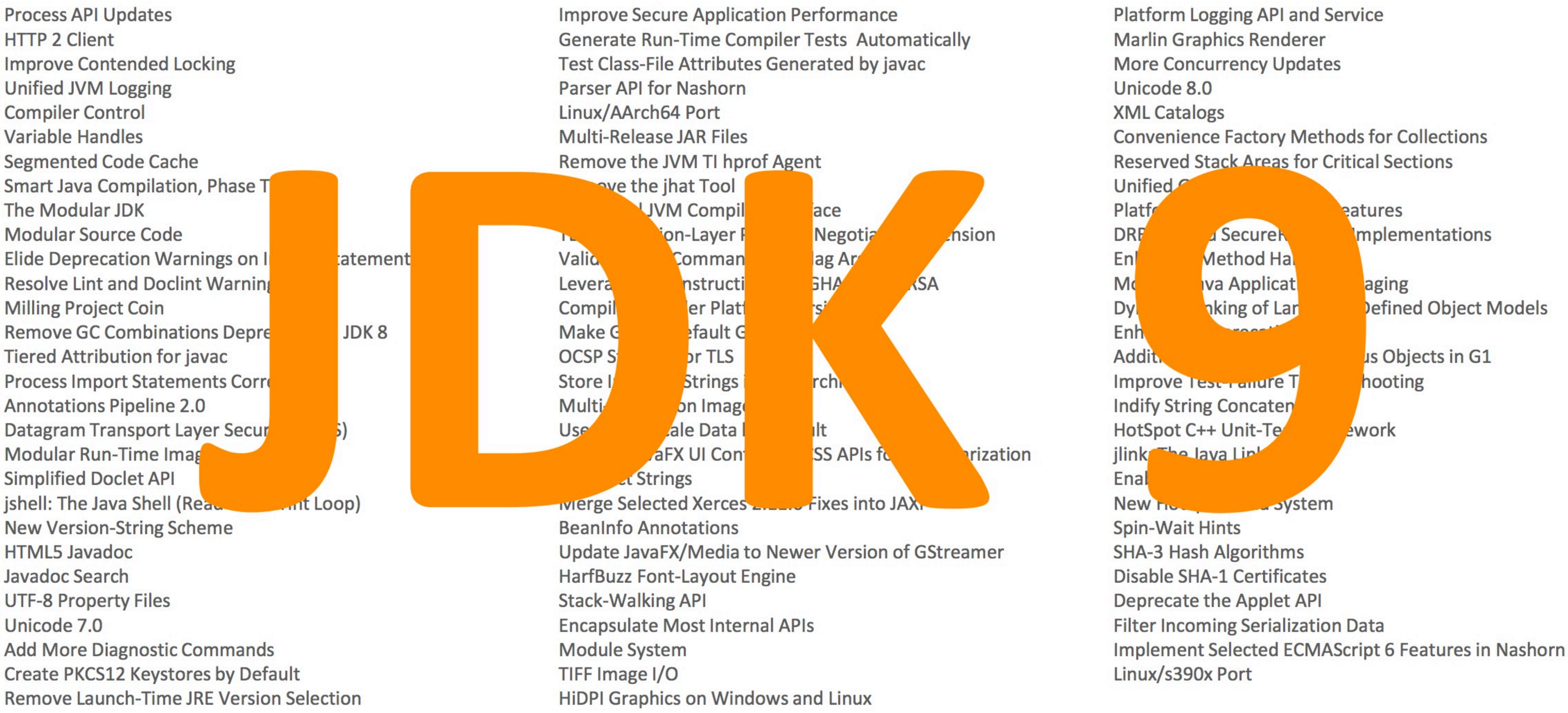
@speakjava

JDK 9: Big And Small Changes



JDK 9

Process API Updates
HTTP 2 Client
Improve Contended Locking
Unified JVM Logging
Compiler Control
Variable Handles
Segmented Code Cache
Smart Java Compilation, Phase T
The Modular JDK
Modular Source Code
Elide Deprecation Warnings on I atement
Resolve Lint and Doclint Warning
Milling Project Coin
Remove GC Combinations Depre JDK 8
Tiered Attribution for javac
Process Import Statements Corr
Annotations Pipeline 2.0
Datagram Transport Layer Secur S)
Modular Run-Time Imag
Simplified Doclet API
jshell: The Java Shell (Rea nt Loop)
New Version-String Scheme
HTML5 Javadoc
Javadoc Search
UTF-8 Property Files
Unicode 7.0
Add More Diagnostic Commands
Create PKCS12 Keystores by Default
Remove Launch-Time JRE Version Selection

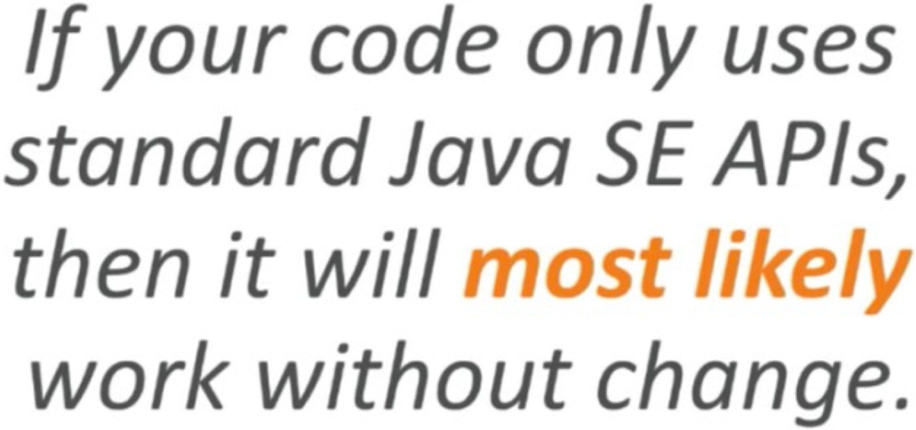
Improve Secure Application Performance
Generate Run-Time Compiler Tests Automatically
Test Class-File Attributes Generated by javac
Parser API for Nashorn
Linux/AArch64 Port
Multi-Release JAR Files
Remove the JVM TI hprof Agent
ove the jhat Tool
JVM Compil ace
T ion-Layer P Negoti nsion
Valid Comman lag Ar
Levera nstructi GHA SA
Compil er Plat rsi
Make G efault G
OCSP S r TLS
Store I Strings rch
Multi on Imag
Use ale Data lt
aFX UI Con SS APIs fo rization
t Strings
Merge Selected Xerces Fixes into JAX
BeanInfo Annotations
Update JavaFX/Media to Newer Version of GStreamer
HarfBuzz Font-Layout Engine
Stack-Walking API
Encapsulate Most Internal APIs
Module System
TIFF Image I/O
HiDPI Graphics on Windows and Linux

Platform Logging API and Service
Marlin Graphics Renderer
More Concurrency Updates
Unicode 8.0
XML Catalogs
Convenience Factory Methods for Collections
Reserved Stack Areas for Critical Sections
Unified G
Platf eatures
DRE Secure mplementations
Enh Method Ha
Mo va Applicat aging
Dy nking of Lar Defined Object Models
Enh
Addit us Objects in G1
Improve Test-Failure T hooting
Indify String Concaten
HotSpot C++ Unit-Te ework
jlink: The Java Lin
Enal
New H System
Spin-Wait Hints
SHA-3 Hash Algorithms
Disable SHA-1 Certificates
Deprecate the Applet API
Filter Incoming Serialization Data
Implement Selected ECMAScript 6 Features in Nashorn
Linux/s390x Port

JDK Compatibility

- Compatibility has always been very important
  - Minor issues in JDK 1.4 and JDK 5
- Deprecation introduced in JDK 1.1
  - JDK 8 has 492 deprecated API elements
  - None had ever been removed
  - At least one release warning of removal
- JDK 9 starts an overdue cleanup of the Java platform
  - APIs and features removed
  - Process will continue in future releases

JDK 9 Onwards And Compatibility



If your code only uses standard Java SE APIs, then it will ***most likely*** *work without change.*

Mark Reinhold
Chief Architect of the OpenJDK

Module System

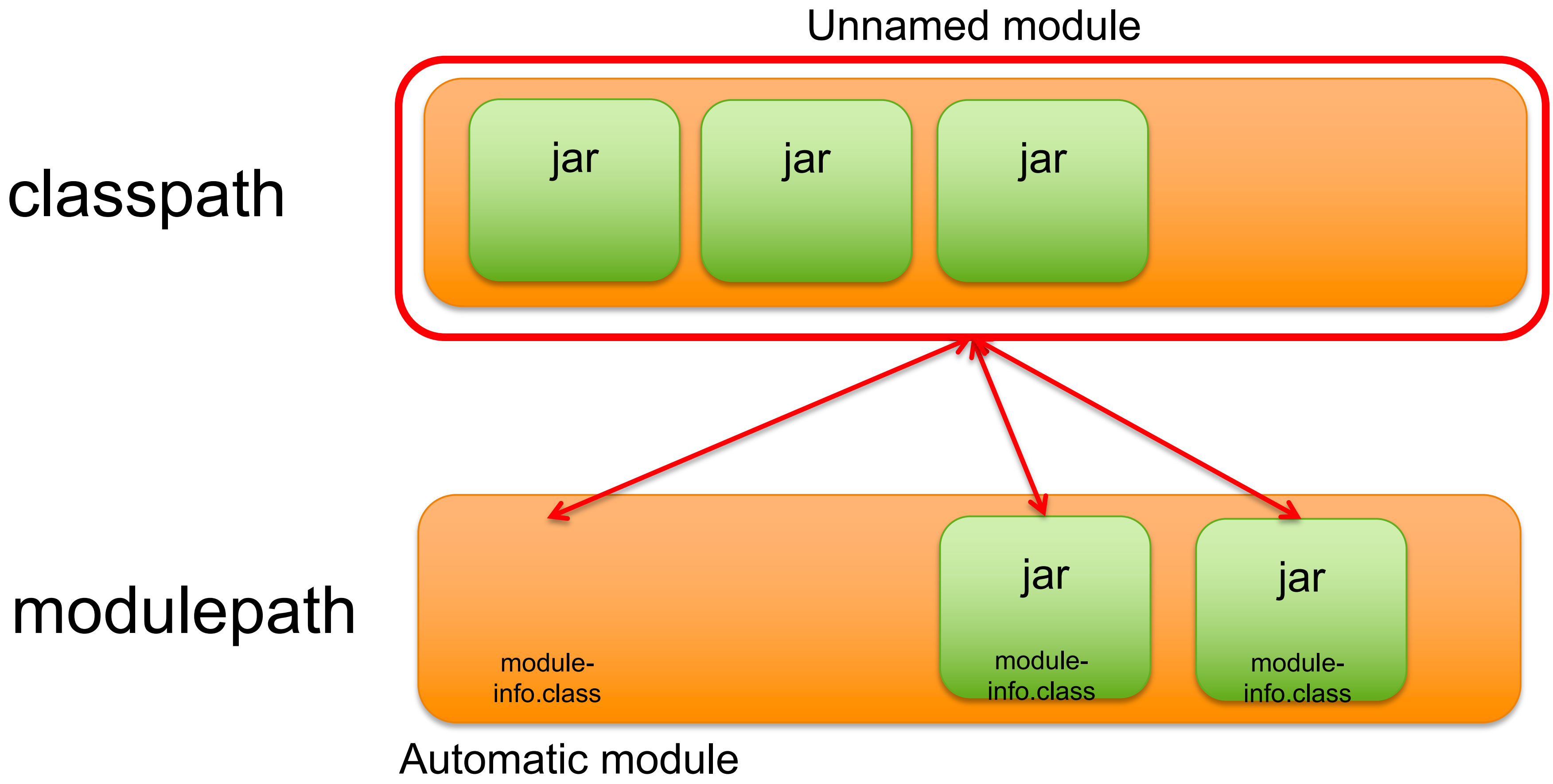
Java Platform Module System (JPMS)

- The core Java libraries are now a set of modules (JEP 220)
  - 75 OpenJDK modules: 27 Java SE, 48 JDK
  - Oracle JDK: 14 additional JDK, 8 JavaFX, 2 Oracle specific
- Most internal APIs now encapsulated (JEP 260)
  - `sun.misc.Unsafe`
  - Some can be used with command line options

Migrating Applications to JPMS

- Initially, leave everything on the classpath
- Anything on the classpath is in the unnamed module
  - All packages are exported
  - The unnamed module depends on all modules
- Migrate to modules as required
  - Try automatic modules
  - Move existing jar files from classpath to modulepath

Classpath v Modulepath



Reversing Encapsulation

- "The Big Kill Switch" to turn off encapsulation
  - `--illegal-access`
    - `permit`: Warning for first use of an encapsulated API
    - `warn`: Warning for every use of an encapsulated API
    - `debug`: Warning and stack trace for every use
    - `deny`: No access to encapsulated APIs

Reversing Encapsulation

- Allowing direct access to encapsulated APIs
  - `--add-exports`

```
--add-exports java.management/com.sun.jmx.remote.internal=mytest
--add-exports java.management/sun.management=ALL-UNNAMED
```

- Allowing reflective access to encapsulated APIs
  - `--add-opens`

```
--add-opens java.base/java.util=ALL-UNNAMED
```

Reversing Encapsulation

- Using the JAR file manifest

```
Add-Exports: java.base/sun.security.provider
```

Finding Dependencies: jdeps

```
> jdeps --module-path /opt/javafx-sdk-11/lib
--add-modules=javafx.controls --list-deps FlightTracker.jar
JDK removed internal API/com.sun.media.jfxmediaimpl.platform.ios
java.base
java.datatransfer
java.desktop/java.awt.dnd.peer
java.desktop/sun.awt
java.desktop/sun.awt.dnd
java.desktop/sun.swing
java.logging
java.scripting
java.sql
java.xml
jdk.jsobject
jdk.unsupported
jdk.unsupported.desktop
jdk.xml.dom
```

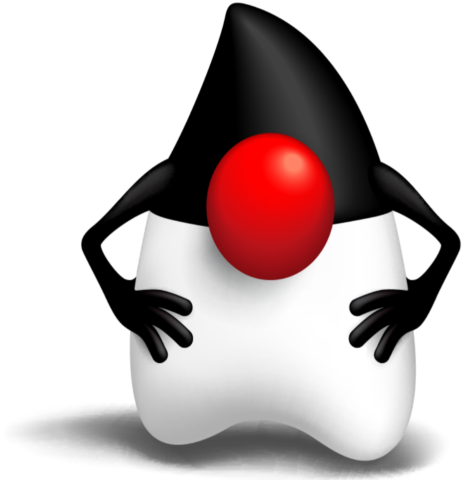
"Missing" Modules

- Remember, "Clean applications that only use java.se..."
- The `java.se.ee` module not included by default (JDK 9/10)
  - Compilation and runtime
- Affected modules
  - `java.corba`
  - `java.transaction`
  - `java.activation`
  - `java.xml.bind`
  - `java.xml.ws`
  - `java.xml.ws.annotation`

Using "Missing" Modules

- Use the command line option
  - `--add-modules java.corba`
- All modules (except CORBA) have standalone versions
  - Maven central
  - Relevant JSR RI
- Deploy standalone version on the upgrade module path
  - `--upgrade-module-path <path>`
- Deploy standalone version on the classpath

Small Incompatibilities



Milling Project Coin (JEP 213)

- A single underscore is now a keyword in Java

```
error: as of release 9, '_' is a keyword, and may not be used as
an identifier
```

- Fear not, two or more underscores can still be used

Deleted Deprecated Methods

- Classes
  - `java.util.jar.Pack200`
  - `java.util.jar.Unpack200`
  - `java.util.logging.LogManager`
- Methods
  - `addPropertyChangeListener()`
  - `removePropertyChangeListener()`

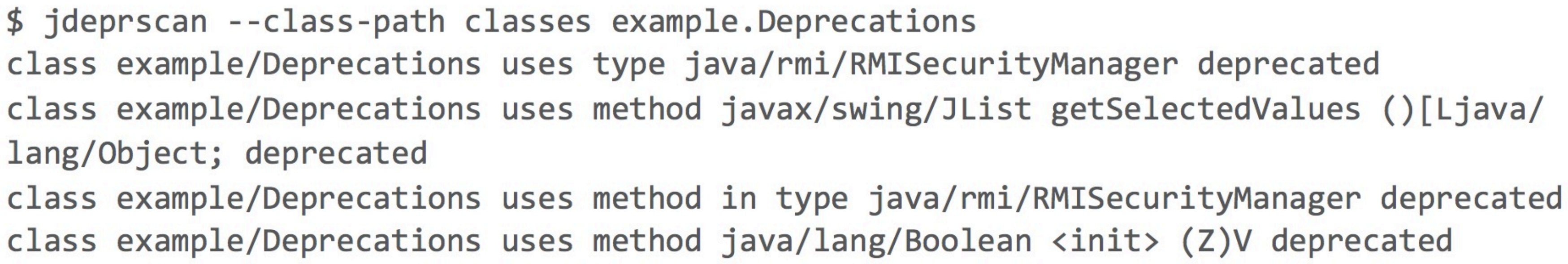
- Removal required for clean modularisation

Deleted Deprecated Class

- `com.sun.security.auth.callback.DialogCallbackHandler`
- Part of the Java Authentication and Authorisation Service
  - JAAS
  - Deprecated in JDK 7

Finding Deprecated API Use

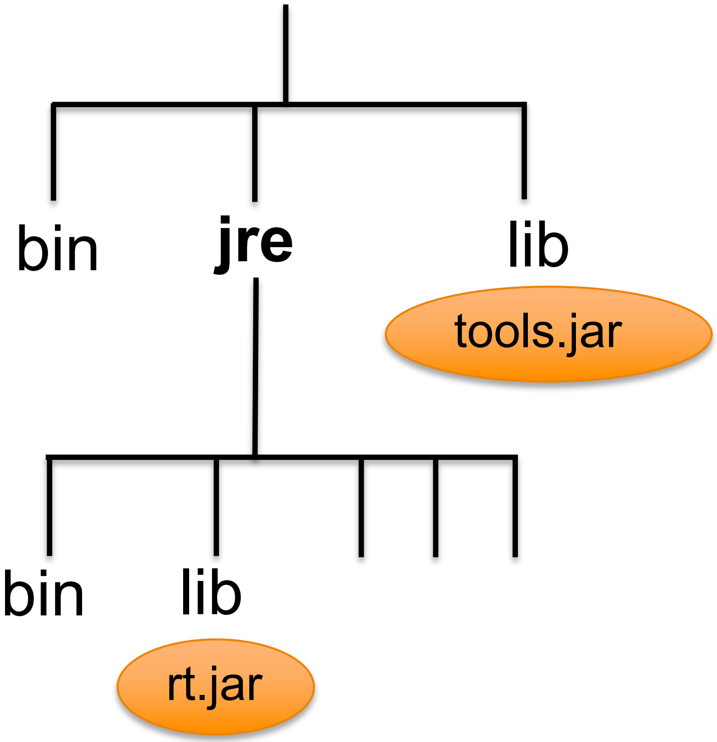
- `jdeprscan`
  - New tool in JDK 9
  - Statically analyses class files and jar files against Java SE APIs
  - Looks for and reports usage of deprecated Java SE APIs



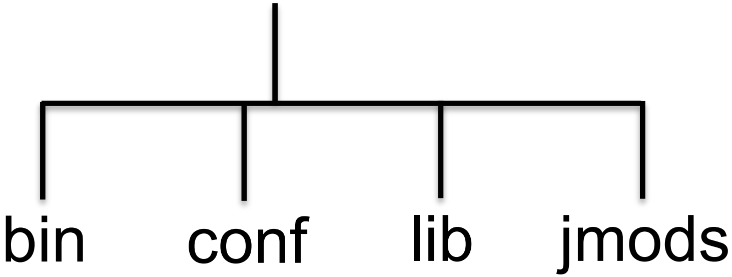
```
$ jdeprscan --class-path classes example.Deprecations
class example/Deprecations uses type java/rmi/RMISecurityManager deprecated
class example/Deprecations uses method javax/swing/JList getSelectedValues ()[Ljava/
lang/Object; deprecated
class example/Deprecations uses method in type java/rmi/RMISecurityManager deprecated
class example/Deprecations uses method java/lang/Boolean <init> (Z)V deprecated
```

JDK/JRE File Structure (JEP 220)

Pre-JDK 9



JDK 9



~~jre directory~~

~~tools.jar~~

~~rt.jar~~

New Version String Format (JEP 223)

- Old
  - Download: Java SE 8u131

```
$ java -version
java version "1.8.0_131"
```

  - Which has more patches, JDK 7u55 or JDK 7u60?
- New
  - ${FEATURE}.${INTERIM}.${UPDATE}.${PATCH}
  - Easy to understand by humans and apps
  - Semantic versioning

Non-Programmatic Issues

- Java Network Launch Protocol (JNLP) [JSR 52]
  - Now uses strict parsing of configuration files
  - Some files that did parse may now fail
- Extension mechanism/Endorsed Standards Override mechanisms removed
  - Directories removed
    - $JAVA_HOME/lib/ext
    - $JAVA_HOME/lib/endorsed

```
<JAVA_HOME>/lib/ext exists, extensions mechanism no longer
supported; Use -classpath instead.
Error: Could not create the Java Virtual Machine.
Error: A fatal exception has occurred. Program will exit.
```

Removed GC Options (JEP 214)

- Deprecated in JDK 8 (JEP 173)

```
DefNew + CMS       : -XX:-UseParNewGC -XX:+UseConcMarkSweepGC
ParNew + SerialOld : -XX:+UseParNewGC
ParNew + iCMS      : -Xincgc
ParNew + iCMS      : -XX:+CMSIncrementalMode -XX:+UseConcMarkSweepGC
DefNew + iCMS      : -XX:+CMSIncrementalMode -XX:+UseConcMarkSweepGC
                     -XX:-UseParNewGC
CMS foreground     : -XX:+UseCMSCompactAtFullCollection
CMS foreground     : -XX:+CMSFullGCsBeforeCompaction
CMS foreground     : -XX:+UseCMSCollectionPassing
```

JVM Logging

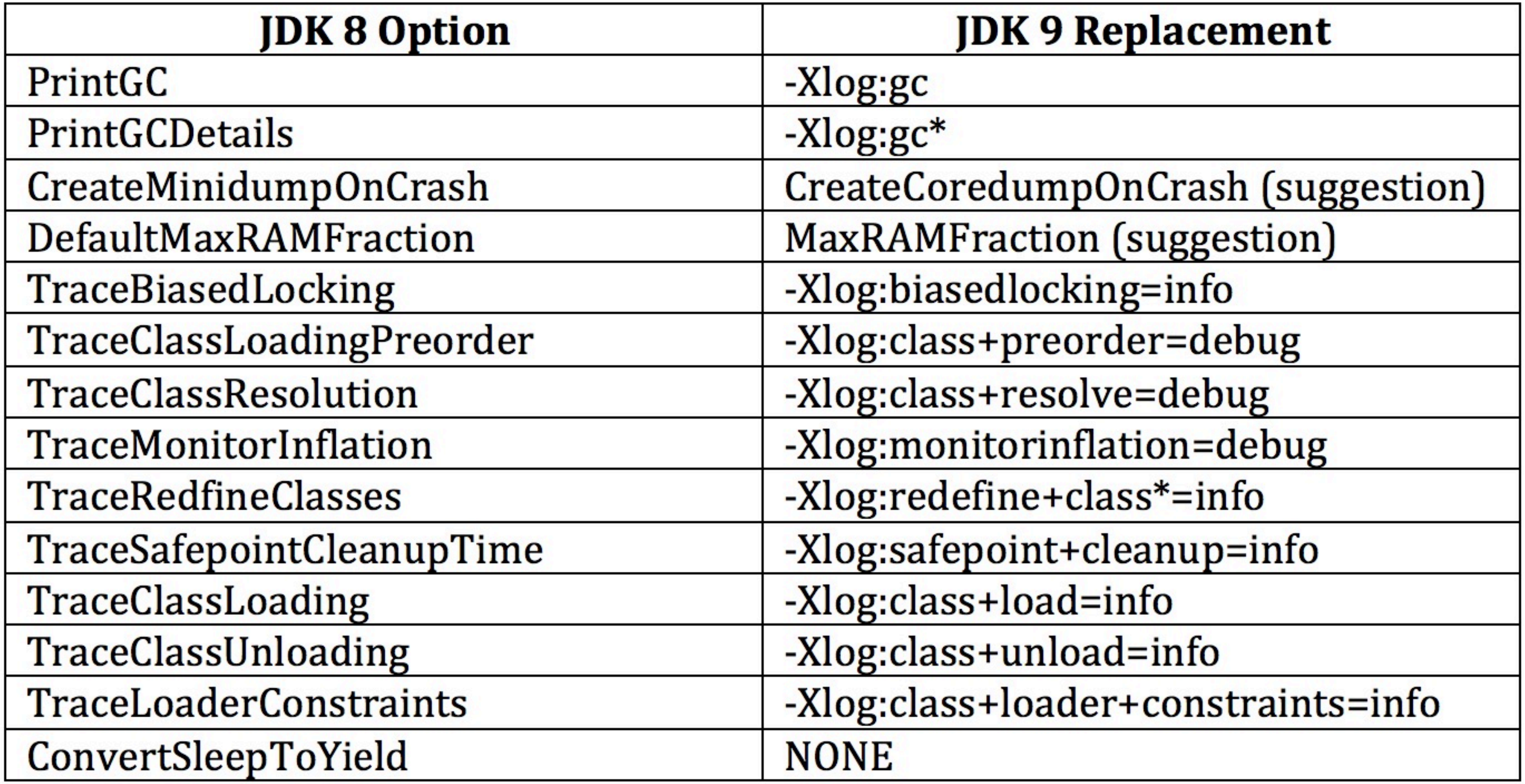
- Unified JVM logging (JEP 158)
  - Common logging system for all components of JVM
- Unified GC logging (JEP 271)
  - Re-implement GC logging using unified JVM logging
  - Many command line options changed

Removed JVM Flags: Ignored

- AdaptiveSizePausePolicy
- CodeCacheMinimumFreeSpace
- DefaultThreadPriority
- JNIDetachReleasesMonitors
- LazyBootClassLoader
- NmethodSweepCheckInterval
- NmethodSweepFraction
- PrintOopAddress
- ReflectionWrapResolutionErrors
- StarvationMonitorInterval
- ThreadSafetyMargin
- UseAltSigs
- UseBoundThreads
- UseCompilerSafepoints
- UseFastAccessorMethods
- UseFastEmptyMethods
- BackEdgeThreshold
- PreInflateSpin

```
Java HotSpot(TM) 64-Bit Server VM warning: Ignoring option
<Option>; support was removed in 9.0
```

Replaced JVM Flags



JDK 8 Option	JDK 9 Replacement
PrintGC	-Xlog:gc
PrintGCDetails	-Xlog:gc*
CreateMinidumpOnCrash	CreateCoredumpOnCrash (suggestion)
DefaultMaxRAMFraction	MaxRAMFraction (suggestion)
TraceBiasedLocking	-Xlog:biasedlocking=info
TraceClassLoadingPreorder	-Xlog:class+preorder=debug
TraceClassResolution	-Xlog:class+resolve=debug
TraceMonitorInflation	-Xlog:monitorinflation=debug
TraceRedfineClasses	-Xlog:redefine+class*=info
TraceSafepointCleanupTime	-Xlog:safepoint+cleanup=info
TraceClassLoading	-Xlog:class+load=info
TraceClassUnloading	-Xlog:class+unload=info
TraceLoaderConstraints	-Xlog:class+loader+constraints=info
ConvertSleepToYield	NONE

Deprecated JVM Flags

- Two forms of warning message

```
warning[gc] -XX:+PrintGC is deprecated. Will use -Xlog:gc instead.
```

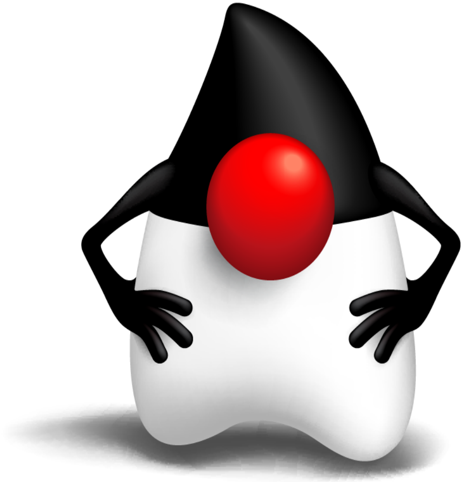
```
Java HotSpot(TM) 64-Bit Server VM warning: Option
CreateMinidumpOnCrash was deprecated in version 9.0 and will likely
be removed in a future release. Use option CreateCoredumpOnCrash
instead.
```

JVM Flags: Non-Starters

- 50 command line flags from JDK 8
  - Many related to incremental CMS
  - Many for old-style logging
    - `-XX:+PrintHeapAtGC`
    - `-XX:+TraceDynamicGCThreads`, etc.
- Use will cause the JVM to abort at start
  - It won't run your application

```
Unrecognized VM option '<Option>'
Error: Could not create the Java Virtual Machine.
Error: A fatal exception has occurred. Program will exit.
```

JDK 10



Local Variable Type Inference

- var is now a reserved type

```
var var = new ArrayList<String>();
```

✓

```
public class var {
  public var(String x) {
    ...
  }
}
```

✗

Deprecated Things Removed

- `jdk.security.auth` module
- `com.sun.security.auth` package
  - `PolicyFile`
  - `SolarisNumericGroupPrincipal`
  - `SolarisNumericUserPrincipal`
  - `X500Principal`
- `com.sun.security.auth.module` package
  - `SolarisLoginModule`
  - `SolarisSystem`

Deprecated Things Removed

- java.lang.SecurityManager
- inCheck field
- Methods
  - classDepth
  - classLoaderDepth
  - currentClassLoader
  - currentLoadedClass
  - getInCheck
  - inClass
  - inClassLoader

Deprecated Things Removed

- `java.lang.Runtime`
- Obsolete internationalisation methods removed
  - `getLocalizedInputStream`
  - `getLocalizedOutputStream`

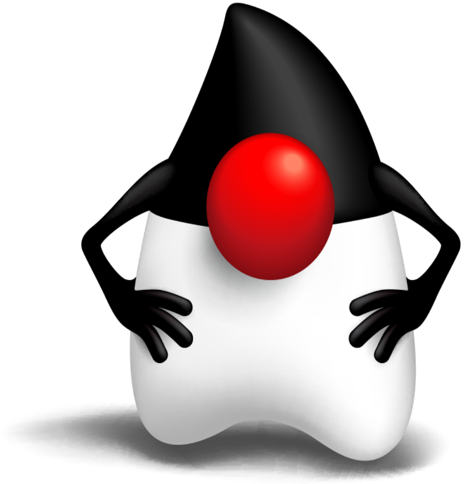
Miscellaneous Things

- `javah` removed
  - Use `javac -h`
- `policytool` removed

Command Line Flags

- `-d32` and `-d64` no longer valid
  - JVM will fail to start
- Also, 5 -X options
  - `-Xoss`
  - `-Xsqnopause`
  - `-Xoptimize`
  - `-Xboundthreads`
  - `-Xusealtsigs`

JDK 11



Oracle JDK & OpenJDK

- Oracle now produce two binary JDK distributions
  - Oracle JDK (now under commercial license)
  - Oracle OpenJDK JDK (GPLv2 with CPE)
- All functional differences eliminated
  - Significant changes that impact users switching to OpenJDK builds

Major Absent Features

- JavaFX
  - Available via OpenJFX project and Gluon for binaries
- Browser plugin
  - Is anyone still using this?
- Java Web Start
  - This will hit some people
  - No easy solution
    - Oracle not open sourcing Web Start
    - Some alternatives but no drop in replacement

Tools Affected

- No more:
  - appletviewer
  - jcontrol
  - CORBA tools
    - idlj
    - orbd
    - servertool
    - tnamesrv
  - Monitoring tool
    - jmc (now standalone package)
  - Java web service tools
    - schemagen
    - wsgen
    - wsimport
    - xjc
  - Java deployment tools
    - javapackager
    - javaws

APIs Removed

- `java.se.ee` aggregator module removed completely
- Others
  - `javax.security.auth.Policy`
  - `java.lang.Runtime.runFinalizersOnExit`
  - `java.lang.SecurityManager.checkAwtEventQueueAccess`
  - `java.lang.SecurityManager.checkMemberAccess`
  - `java.lang.SecurityManager.checkSystemClipboardAccess`
  - `java.lang.SecurityManager.checkTopLevelWindow`
  - `java.lang.System.runFinalizersOnExit`
  - `java.lang.Thread.destroy`
  - `java.lang.Thread.stop(java.lang.Throwable)`

Miscellaneous Things

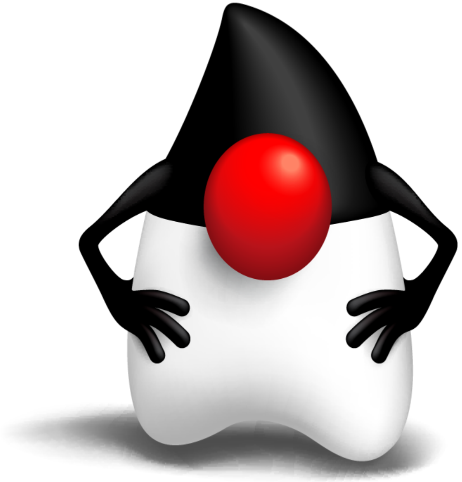
- SNMP monitoring support
  - `jdk.snmp` module removed
  - `JVM-MANAGEMENT-MIB.mib` removed
- Desktop
  - T2K font rasteriser removed
  - Lucida fonts removed
    - JDK now relies entirely on fonts from the operating system
- Security certificates
  - Several root certificates removed from truststore

Command Line -XX Flags

- Big changes
- JDK 9
  - Removed 187, added 123
- JDK 10
  - Removed 36, added 26
- JDK 11
  - Removed 27, added 53

chriswhocodes.com/hotspot_option_differences.html

Conclusions



Migrating To JDK 9, 10 or 11

- Simple applications will run [almost] unchanged
  - Leave everything on the classpath
  - May need to change JVM flags
- Encapsulation
  - Additional JVM flags
  - Identify and rectify issues
- Smaller changes may cause issues
  - Removed APIs
  - JVM flag changes

Zulu Java

- Azul’s binary distribution of OpenJDK
  - Passes all TCK tests
- JDK 6, 7, 8, 9,10 and 11 available
- Wider platform support:
  - Intel 32-bit Windows and Linux
  - ARM 32 and 64-bit
  - PowerPC

www.azul.com/downloads/zulu

Thank You!

Simon Ritter

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