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What's new in Java SE Embedded?

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September 29, 2014



Safe Harbor Statement

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Program Agenda

- 1 Java SE Embedded Overview
- 2 Java SE Embedded 8
- 3 Java SE Embedded 8u6
- 4 Java SE Embedded 9?
- 5 Q & A

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Java Embedded (ME & SE)



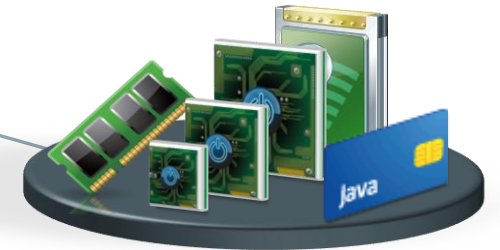
**Multi-function
Embedded Devices**



Smart Energy & mHealth



Personal Devices



Sensors & Micro controllers



Communications



**Industrial controls &
Network Appliances**



**Smart Appliances &
Consumer Electronics**

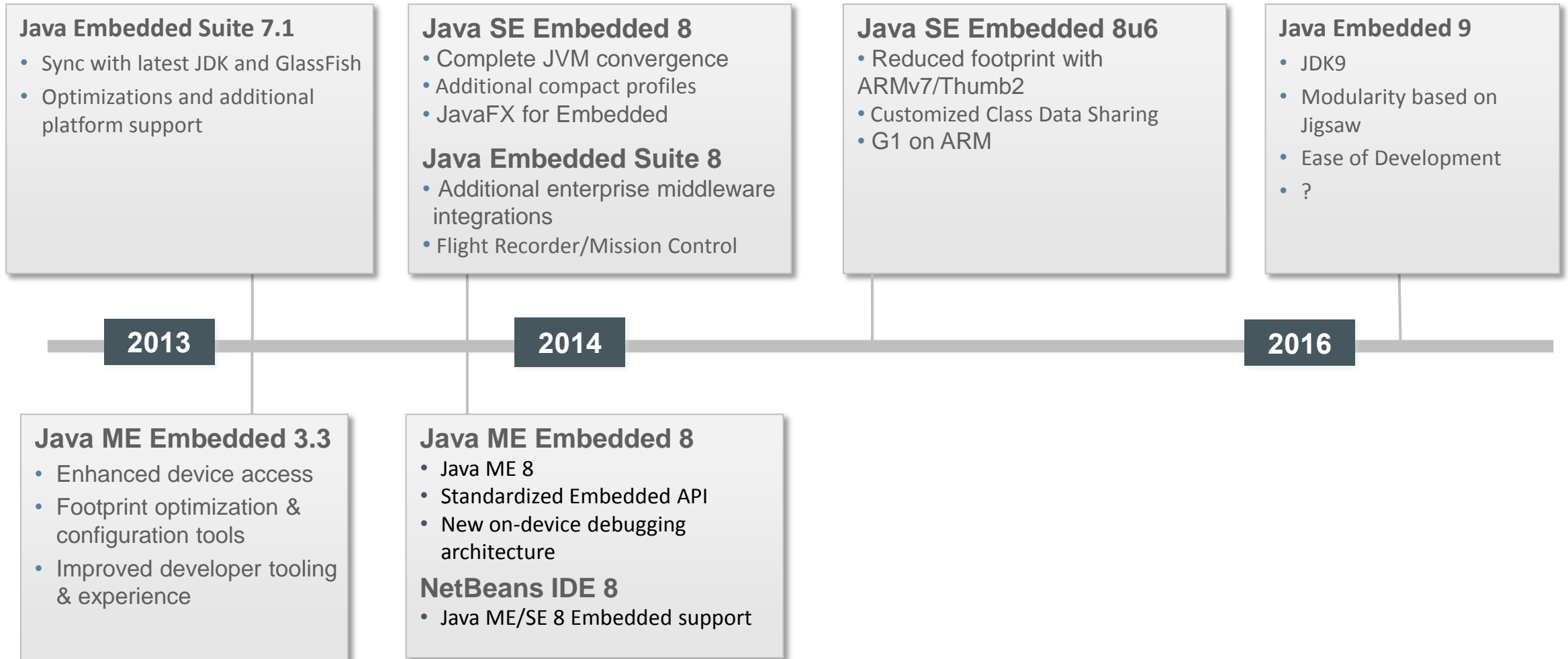


Connected Vehicles

Oracle Java Embedded Offering Today



Roadmap

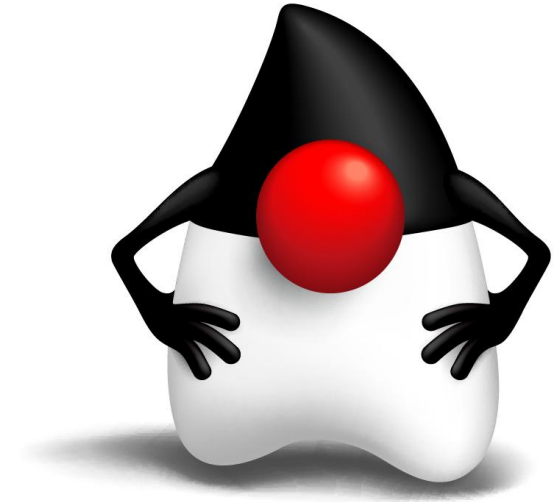


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Java SE 8 – Evolving the Java Platform

- Language evolution:
 - Lambdas & Default methods
- Library evolution
 - Streams framework for parallel computing
 - New Date/Time API's
- Hotspot evolution
 - PermGen removal; JSR-292 enhancements, Native Memory Tracking
 - Minimal VM
- Configuration evolution
 - Compact Profiles

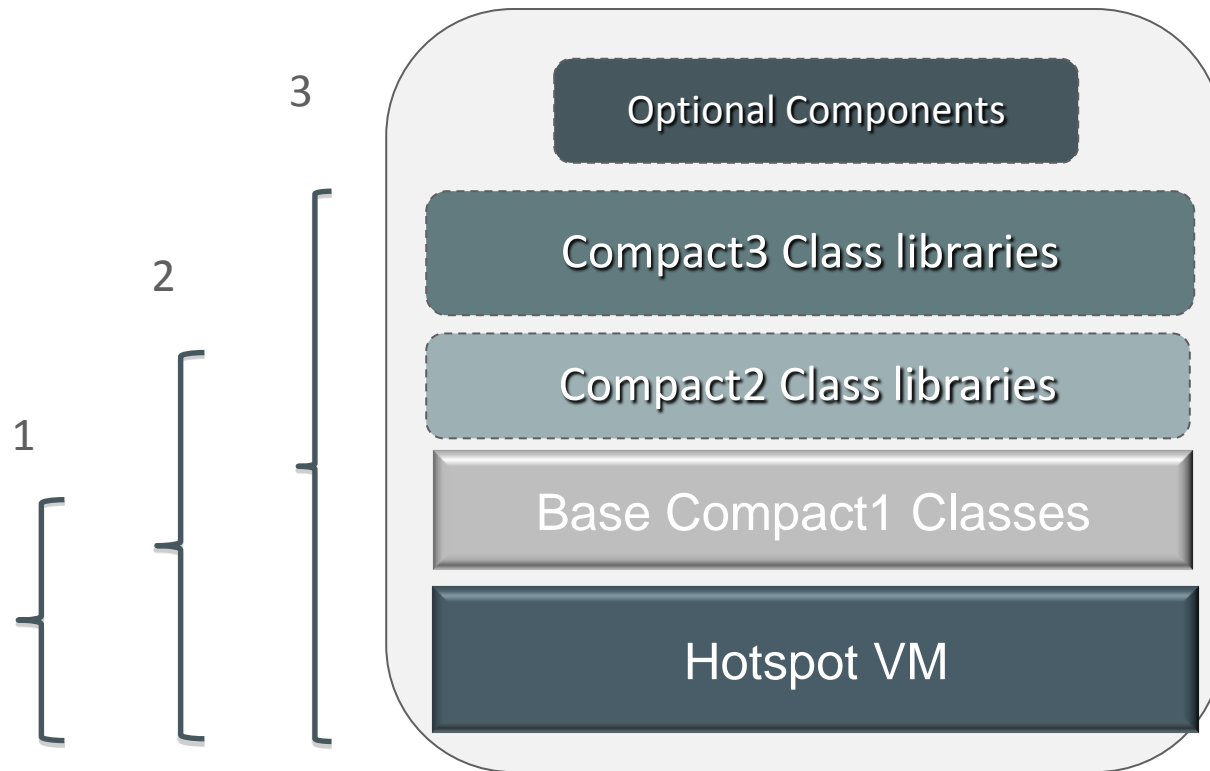


Compact Profiles and SE Embedded

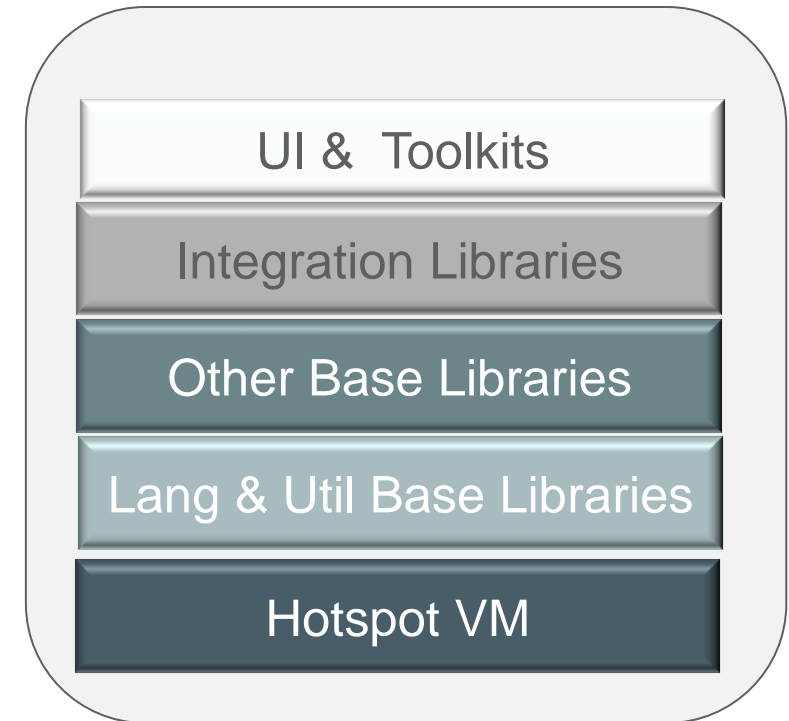
- Three new Java SE Runtimes (Compact Profiles) in JDK 8
 - Well-defined Java SE compatible subsets
 - Described in Java Enhancement Proposal 161 (<http://openjdk.java.net/jeps/161>)
- Benefits
 - Significantly smaller base Java runtime
 - Platform for smaller FX only graphical UI stack
 - New tool for Java SE Embedded which allows selection of runtime options
 - Developers select an appropriate runtime for their target hardware
- Basis for Java ME / CDC Converged product
 - Similar to Foundation profile & optional packages
 - Enables migration of CDC headless applications

Java SE 8 Compact Profiles

SE 8 Compact Profiles



SE Full JRE



Java SE 8 API Subsets for Compact Profiles

```
java.io
java.lang
java.lang.annotation
java.lang.invoke
java.lang.ref
java.lang.reflect
java.math
java.net
java.nio
java.nio.channels
java.nio.channels.spi
java.nio.charset
java.nio.charset.spi
java.nio.file
java.nio.file.attribute
java.nio.file.spi
java.security
java.security.cert
java.security.interfaces
java.security.spec
java.text
java.text.spi
java.time
java.time.chrono
java.time.format
java.time.temporal
java.time.zone
java.util
java.util.concurrent
java.util.concurrent.atomic
java.util.concurrent.locks
java.util.function
java.util.jar
java.util.logging
java.util.regex
java.util.spi
java.util.stream
java.util.zip
javax.crypto
javax.crypto.interfaces
javax.crypto.spec
javax.net
javax.net.ssl
javax.script
javax.security.auth
javax.security.auth.callback
javax.security.auth.login
javax.security.auth.sspi
javax.security.auth.x500
javax.security.cert
```

compact1

```
java.rmi
java.rmi.activation
java.rmi.dgc
java.rmi.registry
java.rmi.server
java.sql
javax.rmi.ssl
javax.sql
javax.transaction
javax.transaction.xa
javax.xml
javax.xml.datatype
javax.xml.namespace
javax.xml.parsers
javax.xml.stream
javax.xml.stream.events
javax.xml.stream.util
javax.xml.transform
javax.xml.transform.dom
javax.xml.transform.sax
javax.xml.transform.stax
javax.xml.transform.stream
javax.xml.validation
javax.xml.xpath
org.w3c.dom
org.w3c.dom.bootstrap
org.w3c.dom.events
org.w3c.dom.ls
org.xml.sax
org.xml.sax.ext
org.xml.sax.helpers
```

compact1

compact2

```
java.lang.instrument
java.lang.management
java.security.acl
java.util.prefs
javax.annotation.processing
javax.lang.model
javax.lang.model.element
javax.lang.model.type
javax.management
javax.management.loading
javax.management.modelmbean
javax.management.monitor
javax.management.openmbean
javax.management.relation
javax.management.remote
javax.management.remote.rmi
javax.management.timer
javax.naming
javax.naming.directory
javax.naming.event
javax.naming.ldap
javax.naming.spi
javax.security.auth.kerberos
javax.security.sasl
javax.sql.rowset
javax.sql.rowset.serial
javax.sql.rowset.stream
javax.sql.rowset.spi
javax.tools
javax.xml.crypto
org.w3c.dom
org.w3c.dom.bootstrap
org.w3c.dom.events
org.w3c.dom.ls
org.xml.sax
org.xml.sax.ext
org.xml.sax.helpers
```

compact2

compact3

```
java.applet
java.awt.*(13 packages)
java.beans
java.beans.beancontext
javax.accessibility
javax.activation
javax.activity
javax.annotation
javax.imageio
javax.imageio.event
javax.imageio.metadata
javax.imageio.plugins.bmp
javax.imageio.plugins.jpeg
javax.imageio.spi
javax.imageio.stream
javax.jws
javax.jws.soap
javax.print
javax.print.attribute
javax.print.attribute.standard
javax.print.event
javax.rmi
javax.rmi.CORBA
javax.sound.midi
javax.sound.midi.spi
javax.sound.sampled
javax.sound.sampled.spi
javax.swing.*(18 packages)
javax.xml.bind
javax.xml.bind.annotation
javax.xml.bind.annotation.adapters
javax.xml.bind.attachment
javax.xml.bind.helpers
javax.xml.bind.util
javax.xml.soap
javax.xml.ws
javax.xml.ws.handler
javax.xml.ws.handler.soap
javax.xml.ws.http
javax.xml.ws.soap
javax.xml.ws.soap
javax.xml.ws.ssi
javax.xml.ws.ssi.http
javax.xml.ws.wsaddressing
org.omg.*(28 packages)
```

compact3

Full Java SE

SE Embedded 8 Features

- Java Flight Recorder (JFR) support
 - But no Mission Control and requires full JRE
- Hotspot minimal VM
 - Reduced footprint client VM with all optional services stripped out
 - 3.5MB or smaller, static footprint
 - Serial GC only; no JVMTI, NMT, CDS, Flat Profiler, JFR, Management APIs
- General performance improvements on ARM/PPC
 - Code cache management
- Optimized vector operations on ARM:
 - Leverage ARM Advanced SIMD (NEON™) in server JIT compiler

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SE Embedded 8u6

- First release post JDK 8
 - Independent of SE release (8u20)
 - Incorporates 8u5 CPU release
- Key features for SE Embedded
 - Reduced static footprint
 - Increased performance on server platforms
 - ARM specific enhancements
 - Additional Java FX support on i.MX6 platform



Reduced Static Footprint

- ARMv7 builds using Thumb-2 ISA mode
 - Reduces binary size
 - Supports JNI compiled in both ARM/Thumb-2
- Link-Time Optimization (LTO) used with minimal VM
 - Improves visibility between independently compiled object files
 - Reduces static footprint as well as runtime dynamic footprint
 - Further info: <http://gcc.gnu.org/wiki/LinkTimeOptimization>

Tiered Compilation for Server VM

- Tiered compilation combines C1 (client) and C2 (server) JIT compilers into one binary
- Initial C1 compilation gives benefit of C1's faster startup
- C1 inserts profiling probes to determine when to invoke C2
- C2 compiles to higher optimization level to improve long running performance
- Feature is disabled by default:
 - Use `-XX:+TieredCompilation` to enable it

Tiered Compilation Benchmark Results

- The benchmarks were run on a server class system to satisfy the minimum of 4 cores requirement
- DaCapo benchmark on first iteration showed on average an 11% improvement
- Linpack showed a 33% improvement in time measurement and 100% improvement in Mflops/sec measurement
- **Caveat:** as with all performance improvements, results will be application and platform dependent

Provide G1 for JDK on ARM

- G1 (Garbage First):
- One of the garbage collectors in Java SE, still evolving.
 - Refer to SE documents for details, tools and tips
- Developed and tuned for big heaps
 - Explicitly deactivated for all SE Embedded builds
- Ported to ARM for 8u6
 - JDK on ARM only
 - Technology preview release and thus is **not officially supported**

Customized Class Data Sharing (CDS)

- CDS dumps an archive of boot classes that can be preloaded by the JVM:
 - Reduces dynamic footprint when shared by multiple JVM instances
 - Reduces startup time even when used by a single JVM instance
 - List of boot classes to dump is ‘hard-wired’ in SE
- SE Embedded 8u6 allows customization of the archive for each application
 - `-XX:DumpLoadedClassList=<classlist_file>`
 - Dumps a list of all classes loaded from the bootclasspath when application exits
 - `-XX:SharedClassListFile=<classlist_file>`
 - Allows user to specify their own classlist when creating archive via `-Xshare:dump`
 - `-XX:SharedArchiveFile=<archive_file>`
 - Allows user to specify the location of the shared archive file to dump or use

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Java SE Embedded 9?

- What will it look like?
 - Jigsaw adds modularity to the platform
 - jlink allows you to configure a JRE with what you need
 - No need for compact profiles or embedded images
- ??? ... to be continued ...

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