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OSGi and Android – or how to train your appserver

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Me

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Background

- Android supports Java
 - But what does this really mean?
- OSGi has been shown to run on Android
 - Equinox on OSGi at EclipseCon '08 (Bartlett/IBM)
 - Felix on OSGi with EZDroid (Luminis)
 - Various commercial offerings (Prosvst mBS Mobile)

Don't cross the streams!

- No-one appears to be trying any full-fat apps on Android (i.e. non-phone apps)
- What happens if you try something big – like an application server, say?
- What problems do you run into?

The challenger

- OCEP
 - OSGi-based appserver (a bit like Virgo)
 - Spring
 - Spring DM
 - Glassfish JAXB
 - Jetty
 - Hessian
 - JCL
 - Commonj
 - And much more ...

The challenger at the weigh-in

- Default OCEP installation:
 - 224 OSGi bundles
 - 125 Mb on-disk
 - 162 Mb in-memory
- OCEP re-factored to create a minimal set of bundles
 - Straightforward thanks to OSGi
 - Supports a **helloworld** application, but not much else
 - 113 bundles
 - 24 Mb on-disk
 - 92 Mb in-memory

Android

- Google Phone OS
- Linux-based kernel and utilities
- Applications are written in Java
 - Dalvik VM runs applications
 - One VM per-application – no JIT! (except 2.2)
 - Proprietary bytecode format
 - Optimized for small CPU & memory footprint
 - Java bytecode can be translated
 - Package profile similar to Java ME
 - Many features missing, e.g. JNDI, parts of javax.xml, JMX and other enterprise features
 - Based on Apache Harmony class libraries

Android & OSGi

- Dalvik does not support dynamic class definition
 - Problem for OSGi, but there are some workarounds
- Felix (Apache) now works
 - Work by Luminis
 - EZdroid project based on Apache ACE
- Equinox demonstrated at EclipseCon 08
 - Fixes do not work with latest Android and Equinox
 - But can be made to work
- Other commercial offerings available

OCEP on Android

- OCEP re-packaged as dalvik bytecode jars
- Equinox issues resolved
- Minimal feature-set bundles will all install on Android emulator (256Mb RAM, 256Mb flash)
- But there many problems ...

Problems with dalvik profile

- Problem is the missing packages in the dalvik profile
 - For instance OCEP relies on Java SE XML features not present in profile
 - Very hard to simulate since some are in java.*
- In theory this can be worked around by providing the packages
 - Add xerces
 - Add Sun 1.2 JNDI impl
 - Add mx4j
- But the list is quite large

Developing a dalvik profile

- Easy to test without Android!
 - -Dosgi.java.profile allows the profile of any VM to be limited
 - Still does not simulate missing java.* packages
 - We have a Dalvik profile
 - If it works on Windows/Linux it may work on Dalvik
- We have a small footprint profile as a starting point

Really, really small profile

- JMX gone (no RMI)
- RMI gone (no RMI OP implementations)
- JNDI gone (no RMI)
- cglib gone (no dynamic class definition in Dalvik)
- JMS gone
- datasource gone (too many dependencies)
- transactions gone (no datasource)

Even with the small profile

- Missing packages cause problems
 - java.rmi
 - java.beans (some of; related to awt & swing)
 - javax.security.auth
 - javax.management
 - javax.naming
 - javax.annotation
 - javax.xml.validation & friends
 - java.sql.SQLXML
- javax outages can be fixed through apache libraries
- java outages more tricky

Start hacking!

- java.rmi
 - Engine dependent on Remote & RemoteException
 - Package these up, but ideally factor out dependency
 - Config requires java.rmi.dgc
 - Package up, but need to factor out
- java.beans
 - Particularly problematic. Android includes some classes
 - But not the useful ones (heavily used by Spring)!
 - Take harmony impl and hack out awt & swing references
 - Recompile & package up
- Both need to be included on bootclasspath

More hacking

- `java.sql.SQLXML`
 - Can make the dependency dynamic through `Class.forName()`
- XML parser problems
 - Cannot use Android and xerces together
 - Have to completely replace implementation
 - Implementation has assumptions about the `ContextClassLoader`
 - Hack Factory's to fallback to bundle classloader (changes submitted to apache)
 - Compiled versions contain bad bytecode!
 - Recompile

... and more ...

- JAXB Problems
 - Contains marshalling support for types that do not exist on Android
 - Hack to remove these dependencies
 - Issues with classloading (JAXB or Harmony bug)
 - `DynamicImport-Package: *`
 - Dalvik hasn't implemented `Package.getDeclaredAnnotations()`
 - Get a `LinkageError`
 - Hack JAXB to remove dependency

... and finally

- Dalvik doesn't like null as a parent classloader
 - Hack Spring DM and Equinox to remove (changes kindly incorporated by Thomas Watson)
- `Bundle.getResources()` can return null which is not the same semantic as `ClassLoader.findResources()`
 - Hack Spring DM and Equinox to return empty collection
- Many missing imports when classloading is more strict
- Logging requires boot delegation for META-INF.services to work

But it works!

- 12 extra bundles/jars
 - 3 vanilla SpringSource EBR bundles
 - 9 custom patched bundles/jars
- A few Android specific hooks in the product
 - Disable JMX
 - Disable cglib

But...

- It's really slow
 - The JIT blows up if you try it (not tried later JITs)
 - Java ME JIT is typically 6x faster than interpreted code
- It's really hard to debug
 - You can attach remotely
 - But the emulator blows up a lot
 - Did I mention it's slow?

The good

- If your application runs on OSGi, refactoring for footprint is relatively easy
- Equinox profiles makes testing easy
- Linux/Java on a phone makes for a very low developer barrier to entry (contrast with other platforms)
- You can run a full-fat application on Android/Dalvik
- Non-Dalvik offerings (e.g. Java ME) are in the works

The bad & ugly

- Android class libraries are just broken
 - What were they thinking!
 - Need to support some recognized VM profile or recognized subset
 - Standardization is necessary
- Dalvik VM limitations are a significant hindrance to development

Questions?

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