OSGi on Google Android using Apache Felix

Marcel Offermans
Karl Pauls

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Who are we?

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think broad, act bright

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Agenda

- Android
  - Introduction and architecture
  - Hello world demo
- OSGi
  - Introduction
  - Framework and compendium
- Apache Felix on Google Android
  - Getting it to run
  - Creating a dynamic application: paint program

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Android

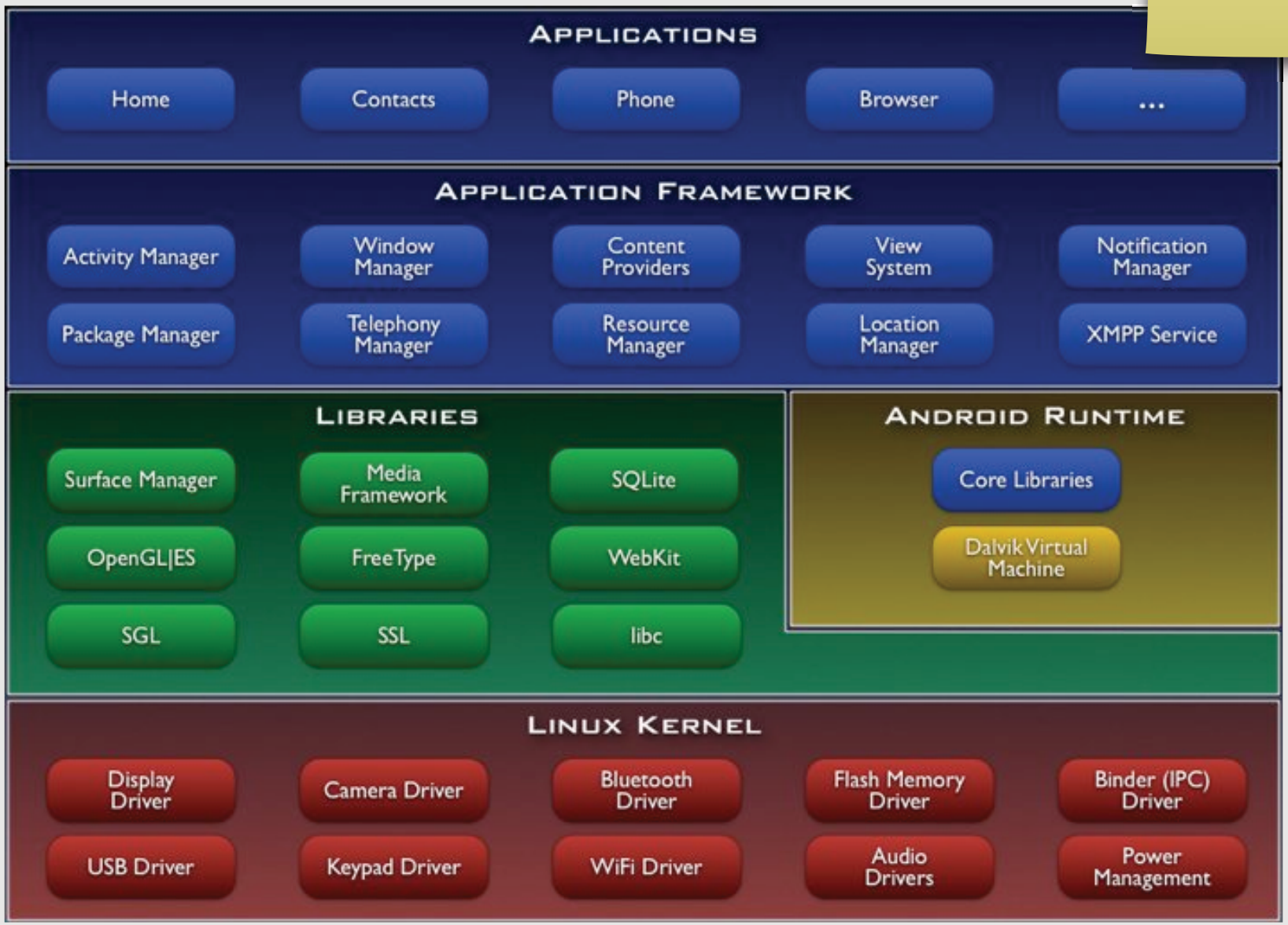
- First SDK release: november 2007
- Android Developer Challenge, $10M prize money
- Current SDK (M5 RC15): march 2008
- Phones: second half of 2008?

Android

- Device Architecture
- Dalvik Virtual Machine
- From source to deployment
- Anatomy of an application
- Application life cycles

Architecture

This image is rather low-res, so perhaps draw it again...



Dalvik Virtual Machine

- interpreter-only, register based virtual machine
- optimized to run multiple VM instances
- executes files in .dex format
- runs on posix-compliant operating systems
- looks like Java ;)

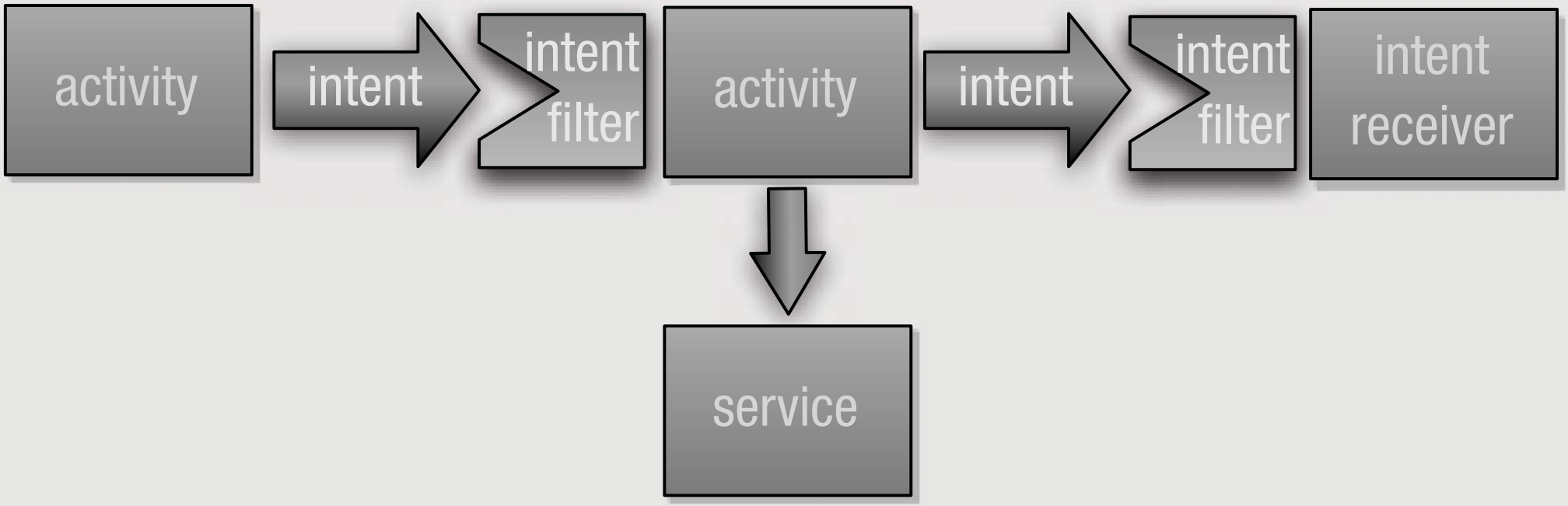
From source to deployment

- Eclipse Plugin: Android Development Tools
  - compiles and packages automatically
  - allows you to launch and debug in the emulator
- Command line: activityCreator.py
  - generates project structure
  - Ant build.xml file, optionally IntelliJ project files

Anatomy

- activity, a single screen
- intent, describes what the application wants done
- intent filter, describes intents that can be handled
- intent receiver, non UI code that reacts to intent
- service, background process with API
- content provider, for shared data access

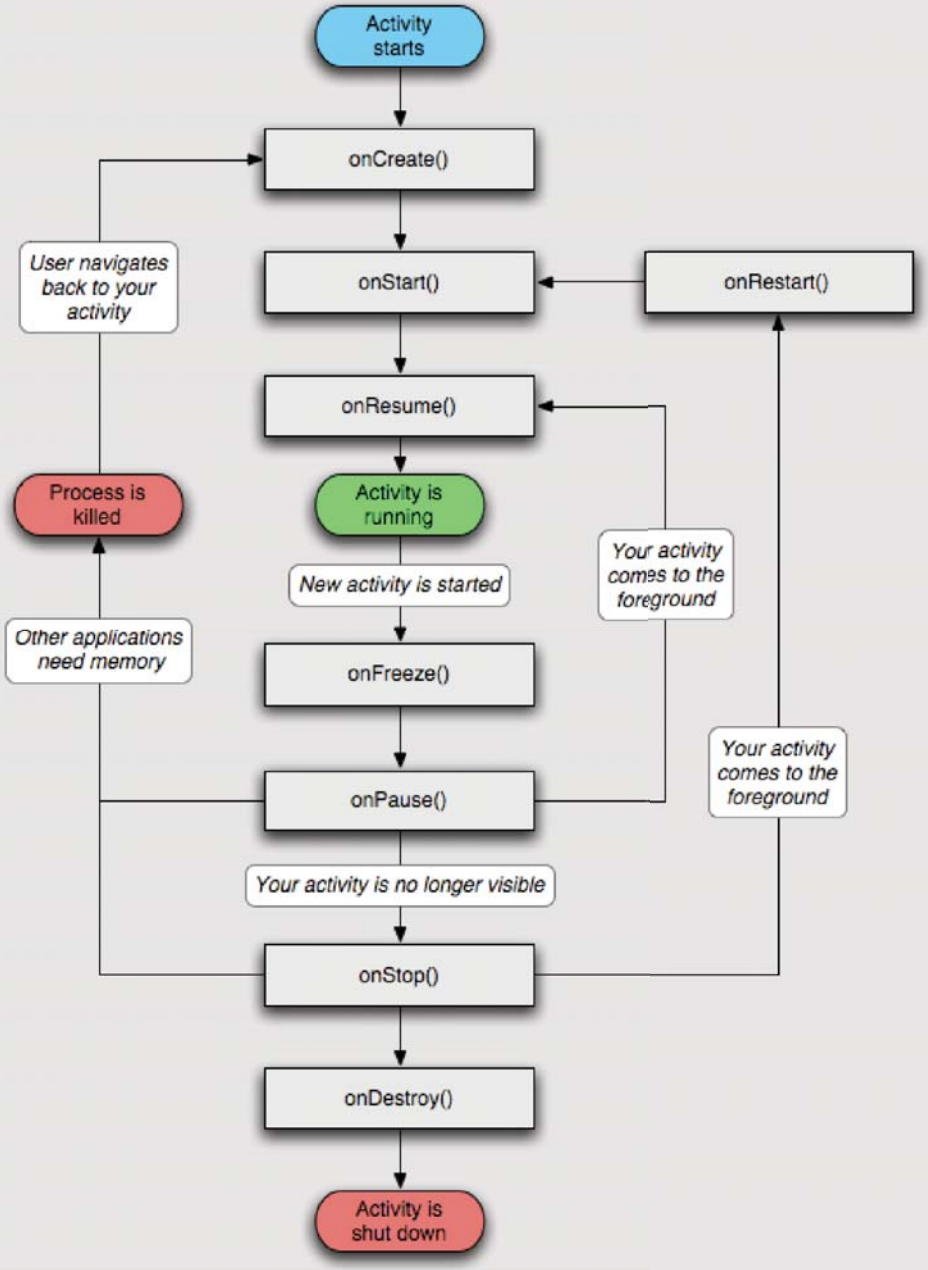
Anatomy Example



Life cycle

- Application life cycle is not controlled by the application itself
- Android maintains an “importancy hierarchy” based on the components and their state:
  - foreground process
  - visible process
  - service process
  - background process
  - empty process

Life cycle (Activity)



Hello world demo!

- Create an application with an activity in Eclipse
- Set “hello world” text
- Create a breakpoint
- Deploy and debug the application

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OSGi history

- Started as an embedded platform for the “home gateway”
- Originally under the JCP as JSR-8 (1999)
- OSGi alliance, consists of a large number of big companies, with the following mission:
  - Maintaining and publicizing the OSGi specification.
  - Certifying implementations.
  - Organising events.
- Current version: OSGi Release 4.1 (JSR-291)

OSGi today

OSGi technology is the dynamic module system for Java™

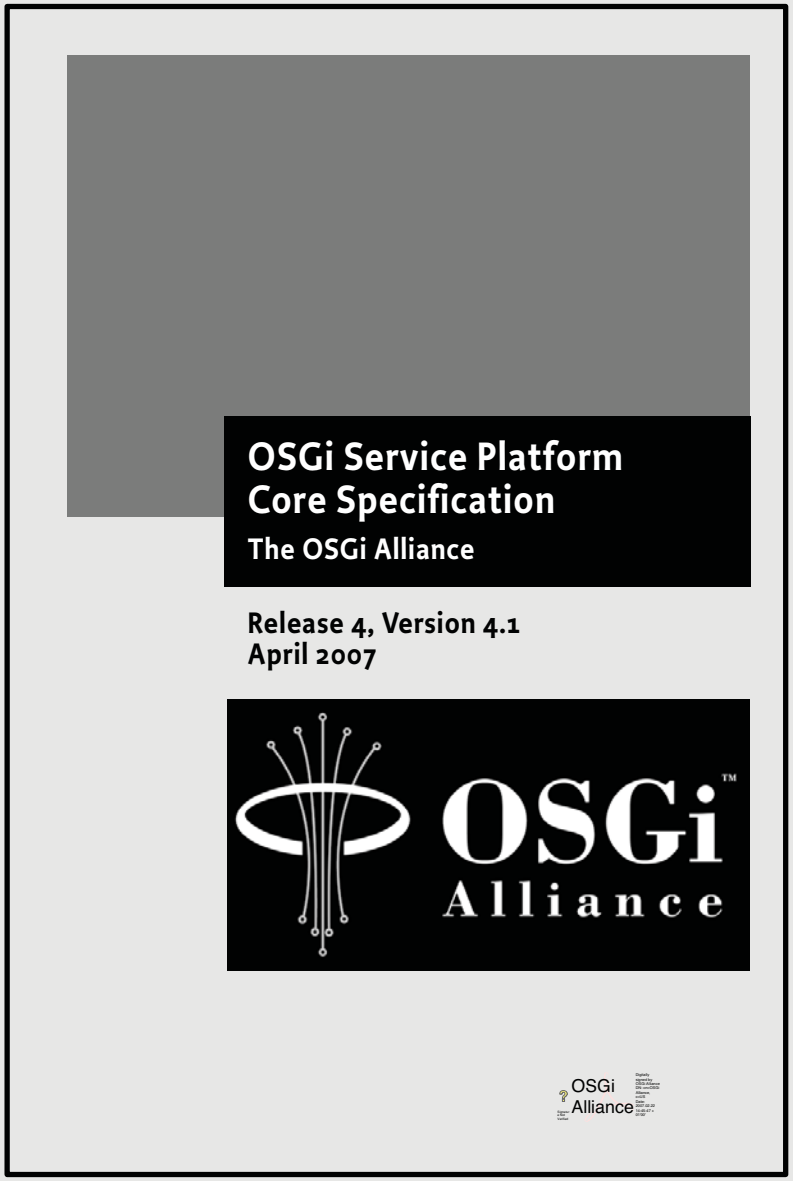
OSGi technology is Universal Middleware.

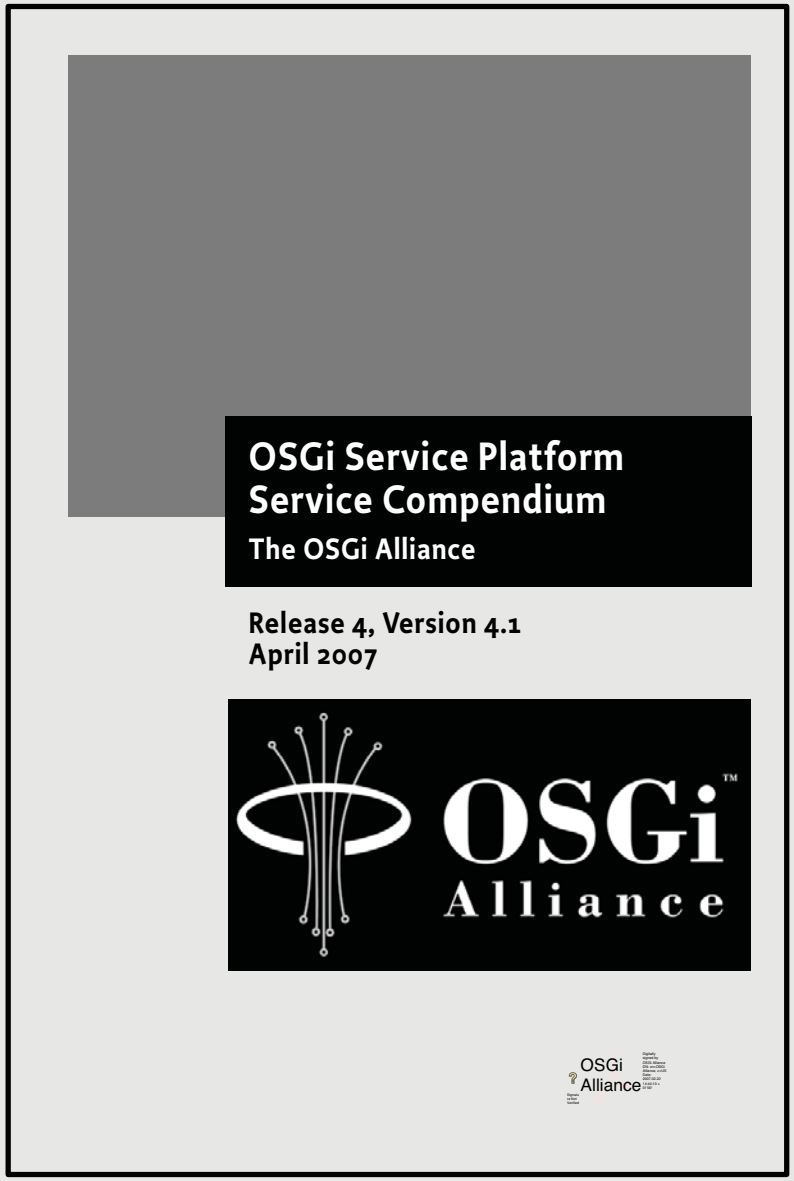
OSGi technology provides a service-oriented, component-based environment for developers and offers standardized ways to manage the software lifecycle. These capabilities greatly increase the value of a wide range of computers and devices that use the Java™ platform.

OSGi Alliance

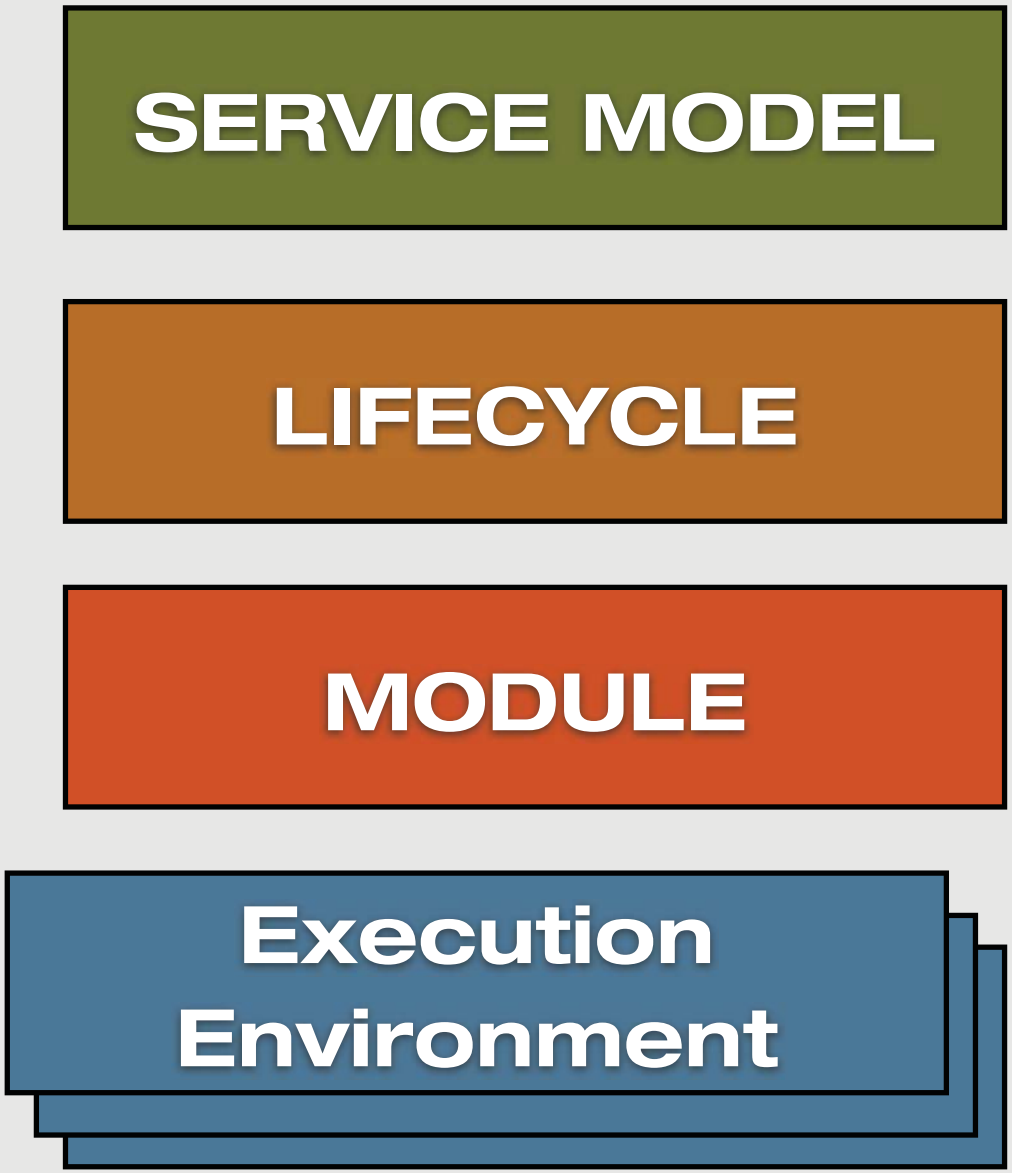
- Expert Groups:
  - core platform (CPEG)
  - mobile (MEG)
  - vehicle (VEG)
  - enterprise (EEG)
  - residential (REG)
- Working Groups:
  - marketing
  - requirements

OSGi specification





OSGi Framework Layering



L3 - Provides a publish/find/bind service model to decouple bundles

L2 - Manages the life cycle of a bundle in a framework without requiring the vm to be restarted

L1 - Creates the concept of a module (aka. bundles) that use classes from each other in a controlled way according to system and bundle constraints

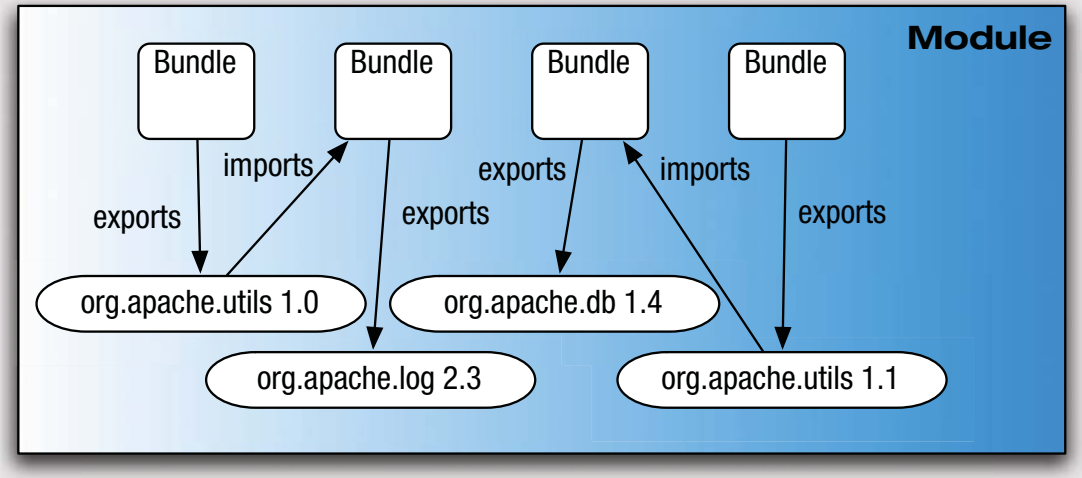
L0 -

OSGi Minimum Execution Environment
CDC/Foundation
JavaSE

Module Layer (1/3)

- Unit of deployment
  is the bundle i.e., a JAR
- Separate class loader
  per bundle
  - Class loader graph
  - Independent namespaces
  - Class sharing at the Java package level

Module Layer (1/3)



- Unit of deployment is the bundle i.e., a JAR
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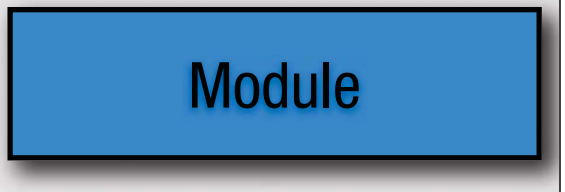
Module

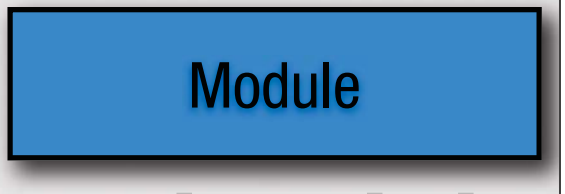
Module Layer (2/3)

- Multi-version support
  - i.e., side-by-side versions
- Explicit code boundaries and dependencies
  - i.e., package imports and exports
- Support for various sharing policies
  - i.e., arbitrary version range support
- Arbitrary export/import attributes
  - Influence package selection



Module Layer (3/3)

- Sophisticated class space consistency model
  - Ensures code constraints are not violated
- Package filtering for fine-grained class visibility
  - Exporters may include/exclude specific classes from exported package
- Bundle fragments
  - A single logical module in multiple physical bundles
- Bundle dependencies
  - Allows for tight coupling when required



Life-cycle Layer

- Managed life cycle
  - States for each bundle;
- Allows updates of existing bundles.
  - Dynamically install, start, update, and uninstall

Module

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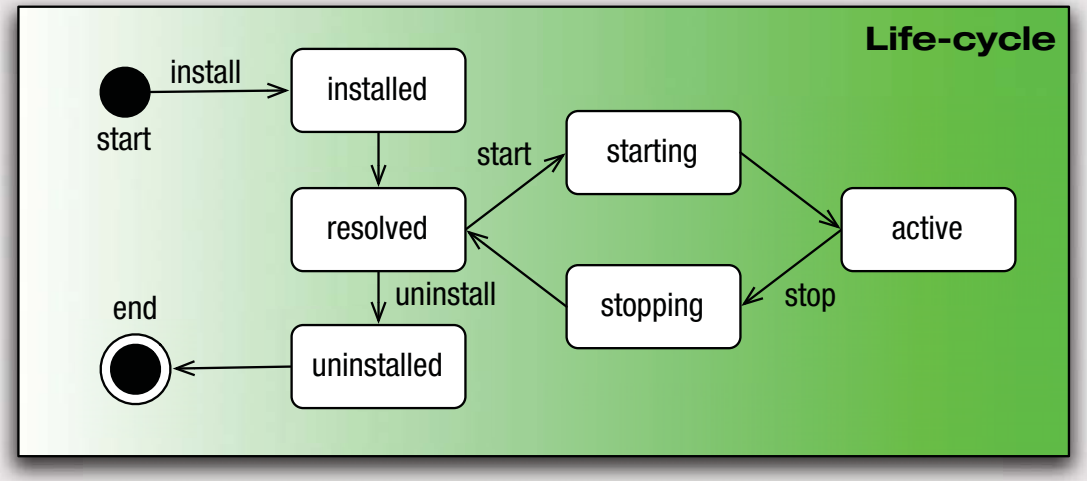
Life-cycle Layer



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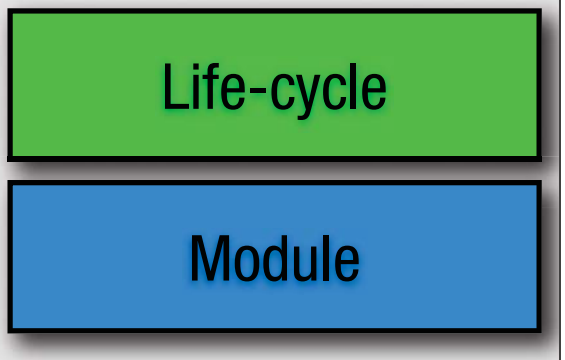
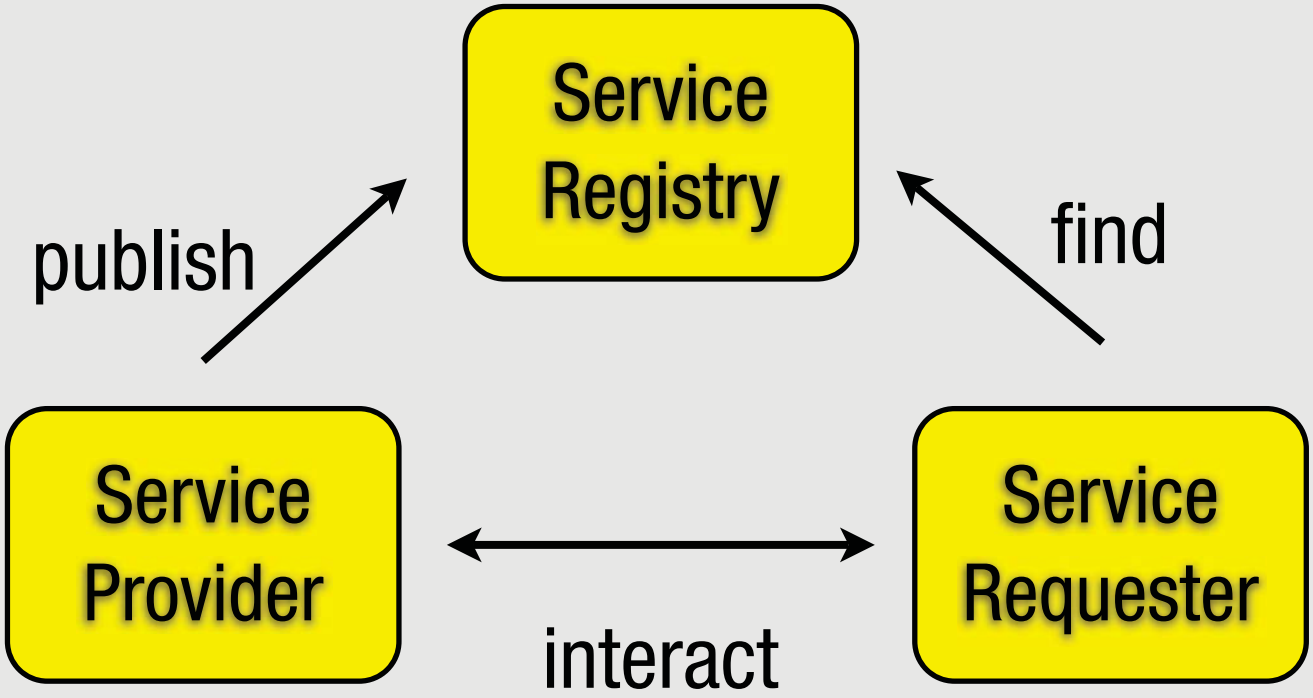
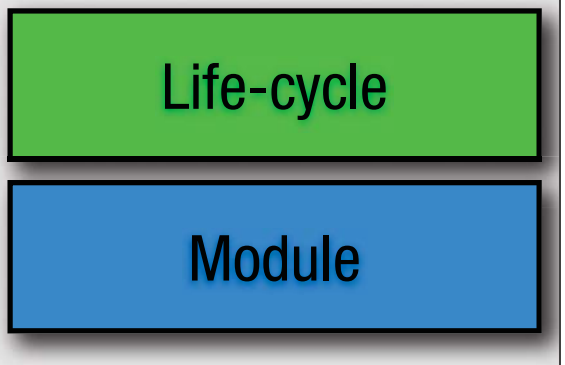


Service Layer

- OSGi framework promotes service oriented interaction pattern among bundles





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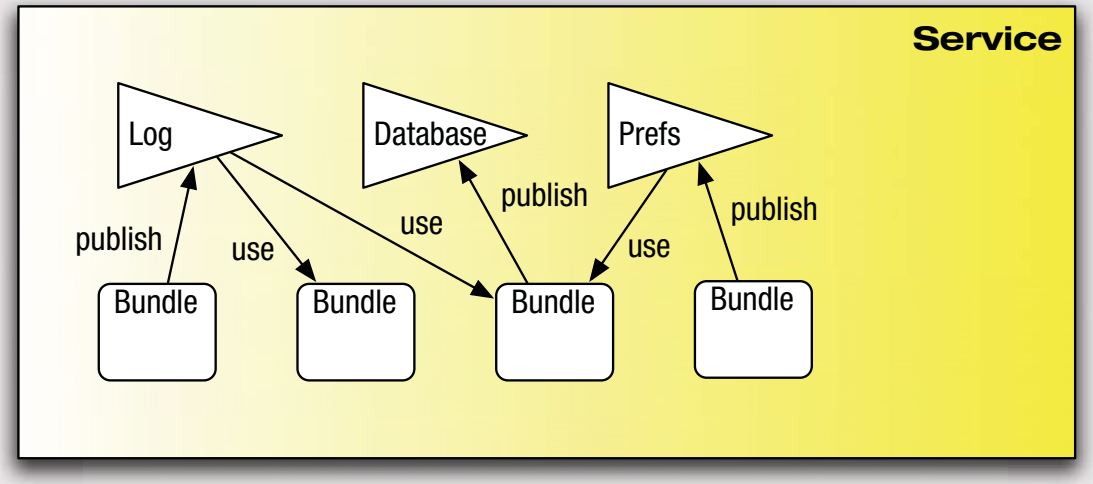
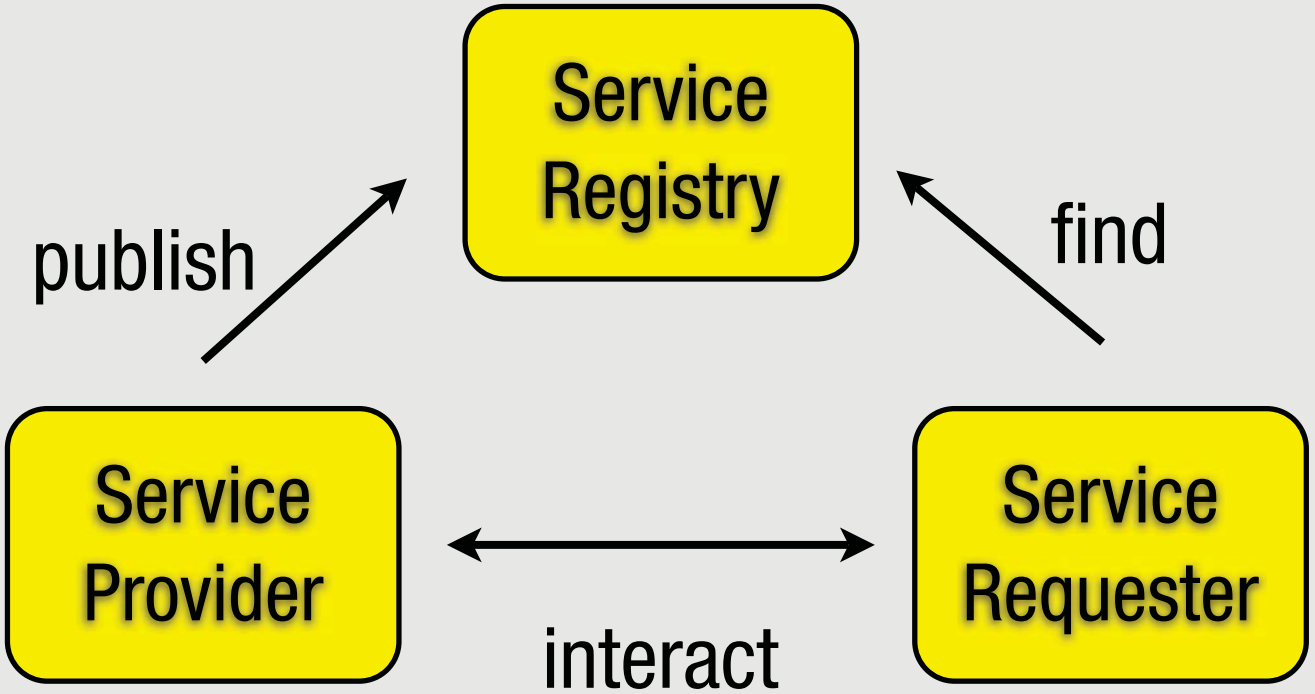
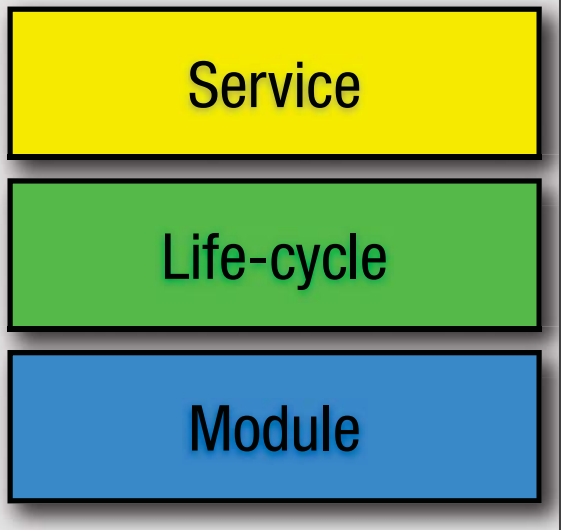
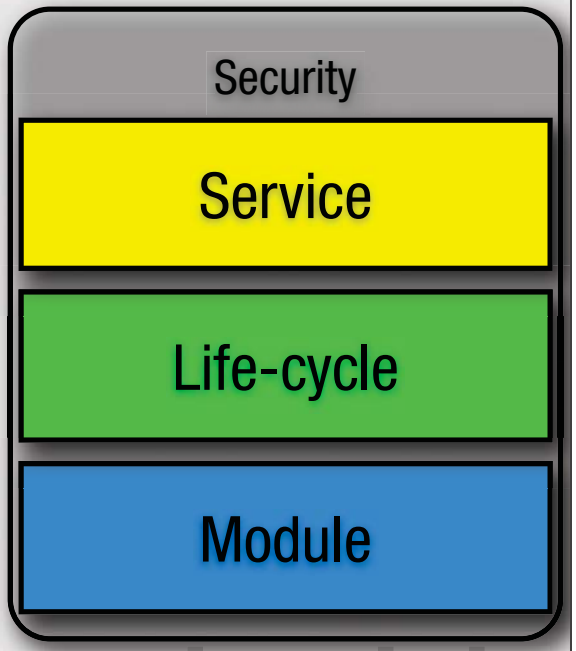






Security

- Optional Security Layer based on Java permissions
- Infrastructure to define, deploy, and manage fine-grained application permissions
- Code authenticated by location or signer
- Well defined API to manage permissions
  - PermissionAdmin
  - ConditionalPermissionAdmin



Shameless plug:

if you want to know more about security in OSGi, come to our talk about

Building Secure OSGi Applications

Leveraging standard services

- Specification:
  - OSGi compendium – catalog of standard service descriptions
- Implementations:
  - OBR repository at bundles.osgi.org – over 1400 bundles, implement compendium and other services
  - Maven repository and third party OBR's
  - More and more projects are made OSGi compatible, for example:
    - Apache Commons OSGi

OSGi compendium

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OSGi compendium

User Admin

Initial Provisioning

Wire Admin

Log

Device Access

XML Parser

Measurement and State

Preferences

UPnP™ Device

Configuration Admin

Position

Metatype

Service Tracker

Event Admin

HTTP

IO Connector

Execution Environment Spec

Declarative Services

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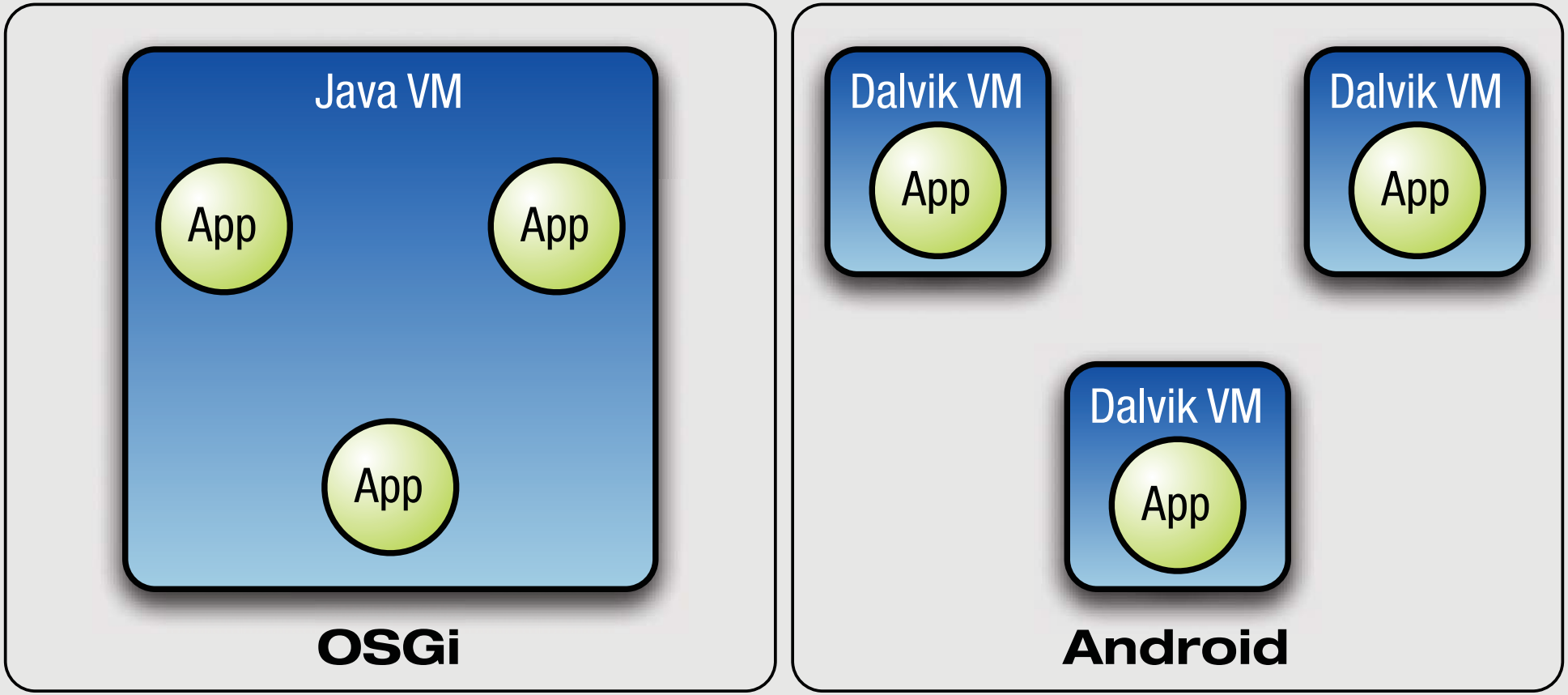
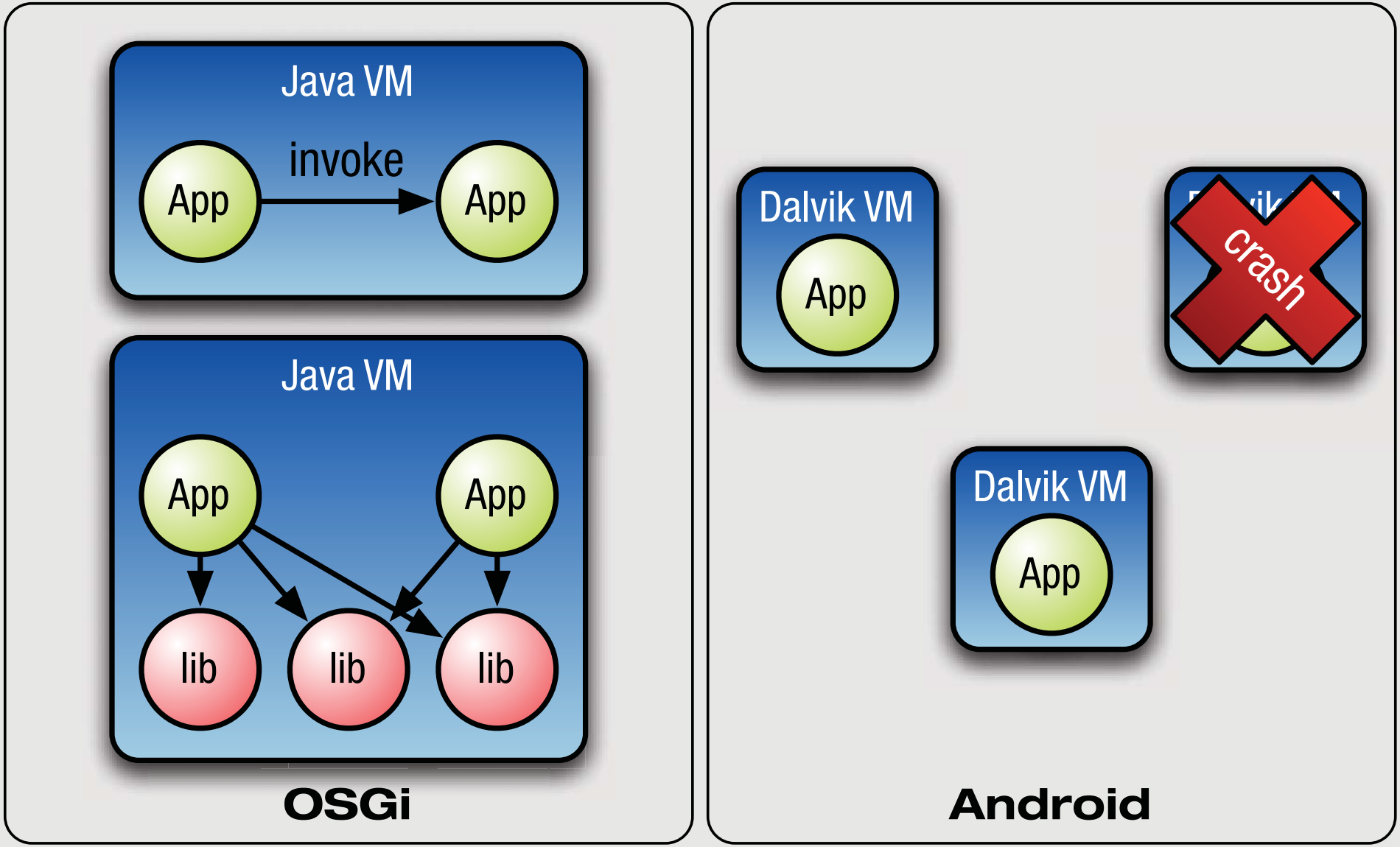
Why OSGi and Android?

Models are different



Benefits of each model



Services in Android

- Must be declared in AndroidManifest.xml
- Can be started and stopped: Context.startService and Context.stopService()
- You can bind to a service if you want to talk to it
- Services can run in remote processes, in which case there is an Android IDL compiler to generate stubs
  - handles primitives, some collections and Parcelable's by value
  - handles other AIDL interfaces by reference

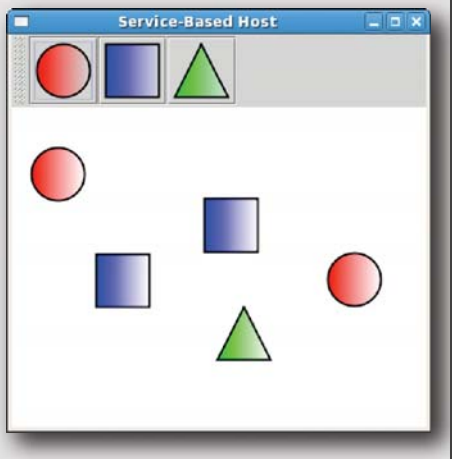
Getting Felix to run...

- First step, getting the framework to run
  - Apache Felix is very portable, so we just dex'ed it
  - found a couple of issues, fixed in release 1.0.3
- Second step, dynamically loading bundles
  - the hard part was finding a way to load classes
  - found undocumented internal class
  - **Google, we need an official API for this!**
- For more details:
  http://blog.luminis.nl/roller/luminis/entry/osgi_on_google_android_using

...others soon followed

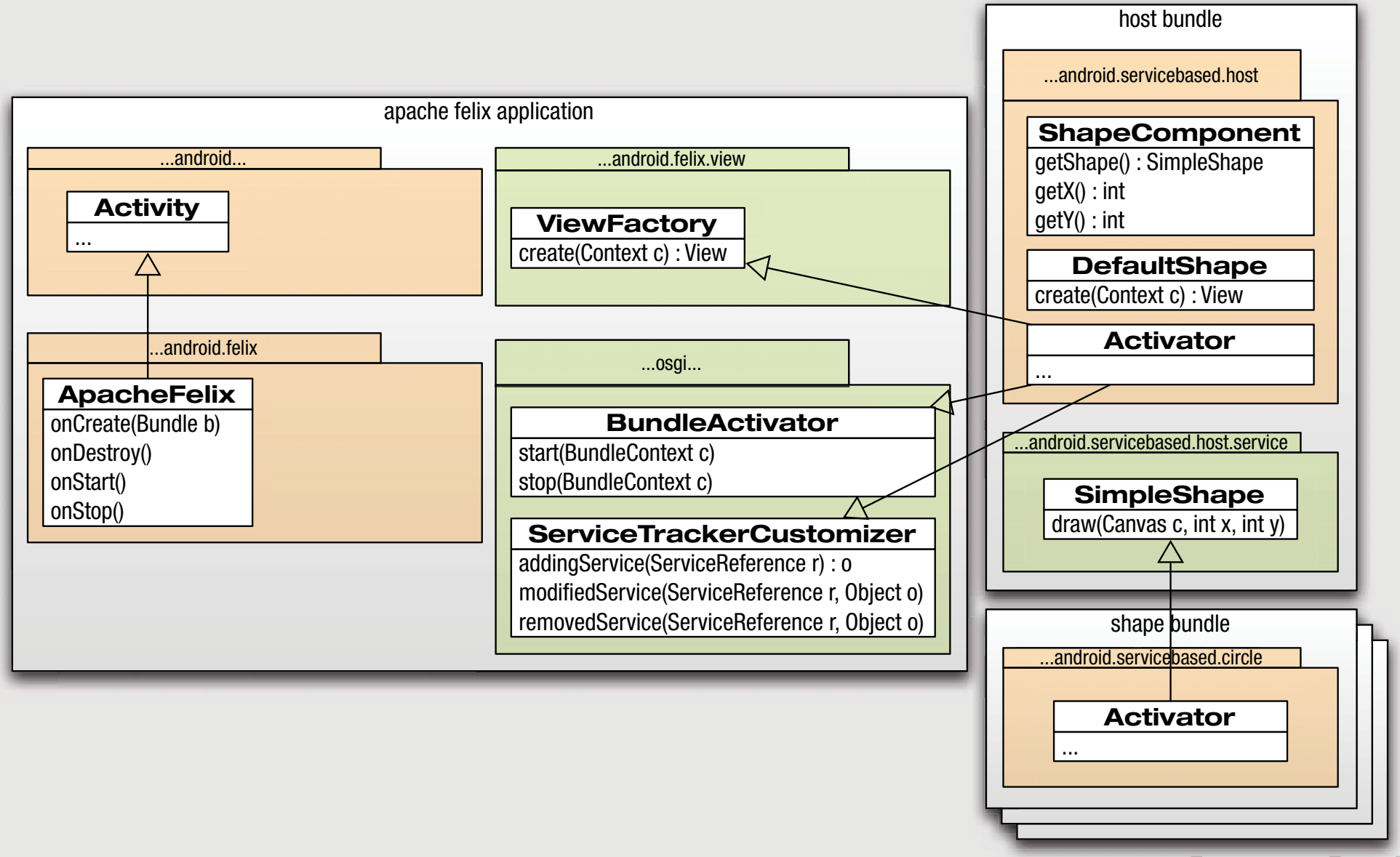
- At EclipseCon 2008, Santa Clara:
  - Neil Bartlett and BJ Hargrave, ported both Equinox and Concierge to Android
  - Slides at: https://eclipsecon.greenmeetingsystems.com/attachments/download/390
- ProSyst announced:
  - A port of their mBedded Server: http://www.adon-line.de/kunden/prosystBlog/?p=24
- Knopflerfish
  - We talked to Eric Wistrand and Christer Larsson of MakeWave but they have no plans yet

A dynamic application



- Apache Felix framework
  - embeds an activity to hook into;
  - embeds file install bundle for easy deployment.
- Host bundle that provides a canvas and a toolbar
- Shape bundles that add new shapes
- Based on example from Apache Felix website:
  http://felix.apache.org/site/apache-felix-application-demonstration.html

Architecture



Live demo!

- Deploying Felix to the Phone Emulator
- Installing the first bundle, the host application
- Adding and removing plugins: square, circle and triangle

Links

- Slides, docs and code:
  http://opensource.luminis.net/
- Android SDK:
  http://code.google.com/android/
- Open Handset Alliance:
  http://www.openhandsetalliance.com/
- Apache Felix and OSGi:
  http://felix.apache.org/
  http://www.osgi.org/
- Karl Pauls: karl.pauls@luminis.nl
  Marcel Offermans: marcel.offermans@luminis.nl

Questions?!

? & !