

# Java模块化技术演进

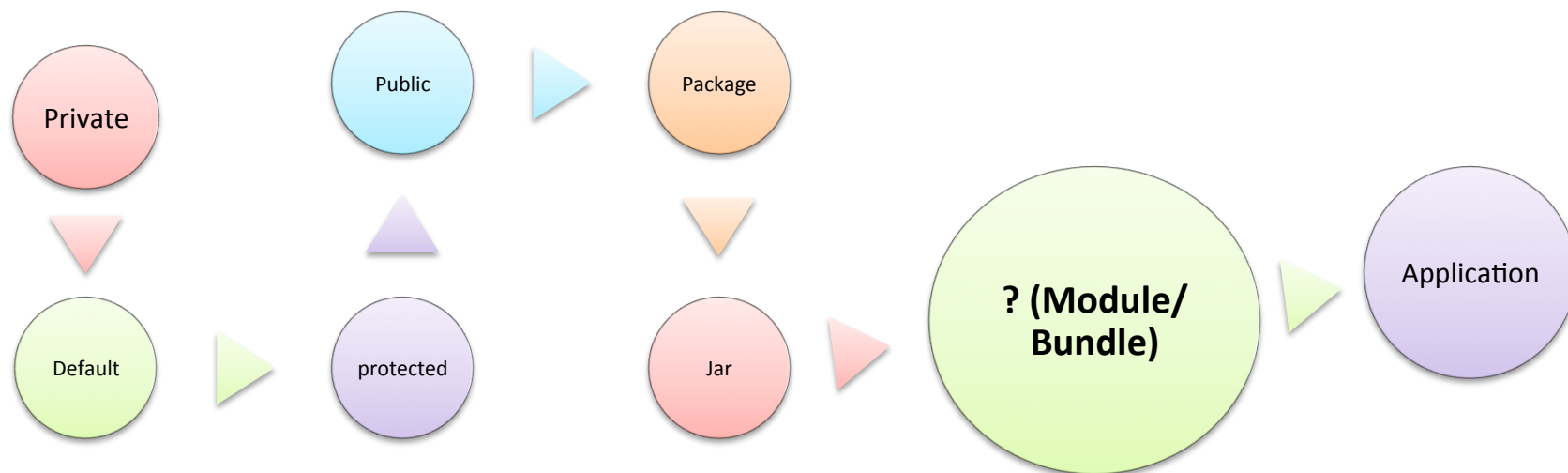
## 对现有应用微服务化的意义

SPEAKER

张建锋

# Java模块化需求

- 语言定义粒度缺失的一环
- 顺序加载带来的问题
- 多版本组件部署



# Java 模块化的实现

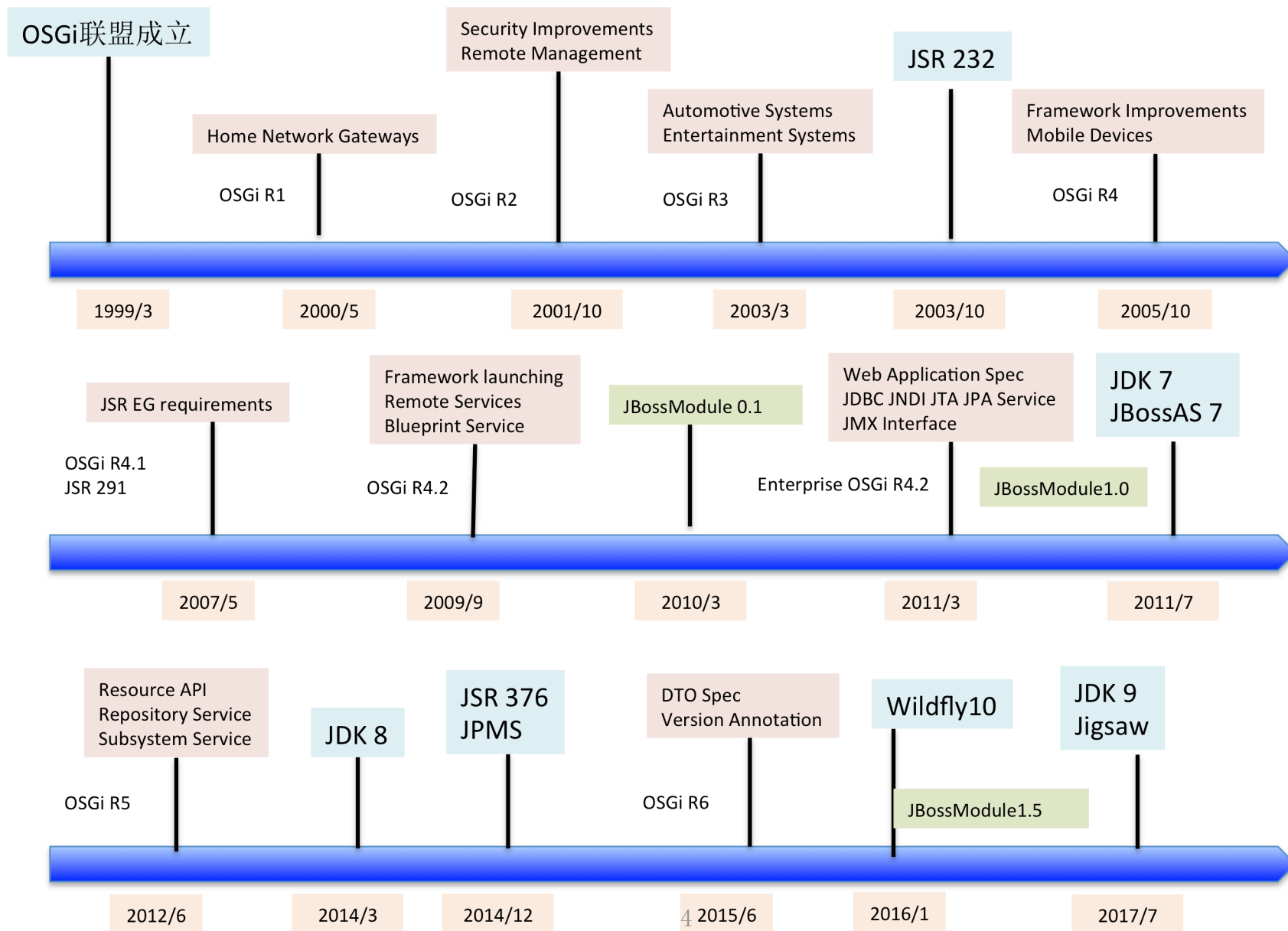


OSGi

Jigsaw

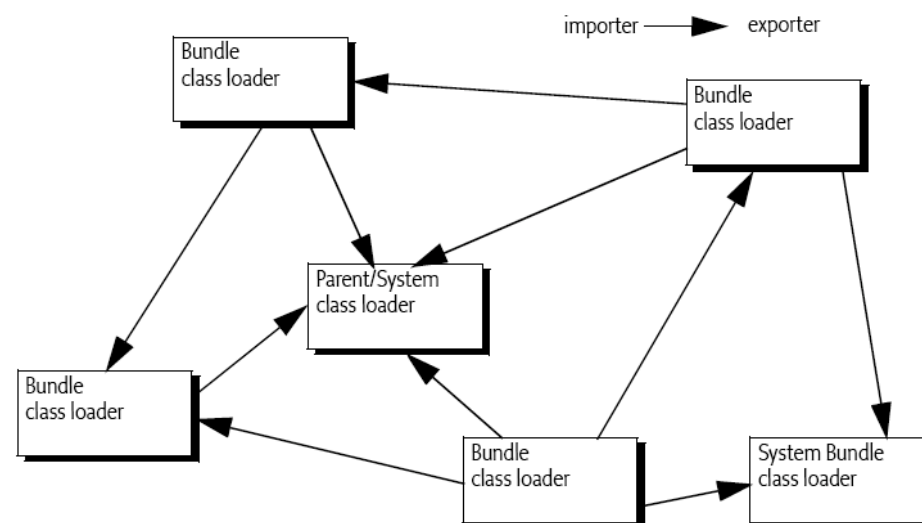
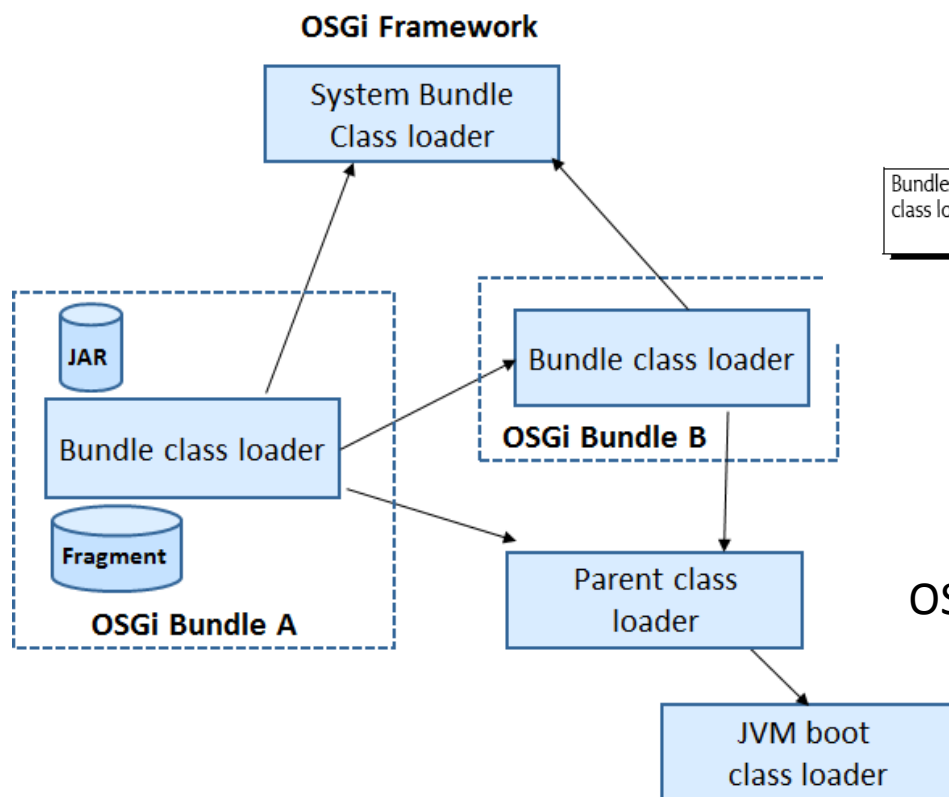
JBoss  
Module

# Java模块化发展里程碑图表



# OSGi的模块化技术

- OSGi模块化体系图



OSGi Bundle加载

# OSGi复杂性阐述

- 服务等概念复杂性
- META-INF/MANIFEST.MF文件

# javax.validation

```

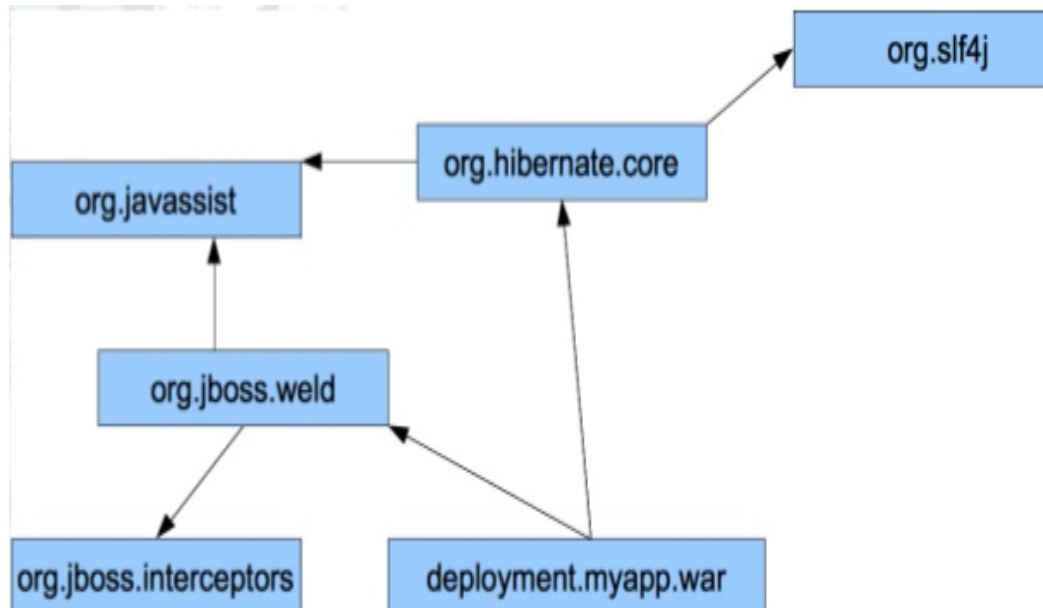
Manifest-Version: 1.0
Bnd-LastModified: 1407416520420
Build-Jdk: 1.7.0_65
Built-By: java_re
Bundle-Description: JSR 343's RI, Hibernate Validator version 5.0.0.Final
and its dependencies repackaged as OSGi bundle
Bundle-DocURL: http://www.oracle.com
Bundle-License: https://glassfish.java.net/nonav/public/CDDL+GPL_1_1.htm
l
Bundle-ManifestVersion: 2
Bundle-Name: javax.validation:1.1.0.Final as OSGi bundle
Bundle-SymbolicName: org.glassfish.hk2.external.bean.validator
Bundle-Vendor: Oracle Corporation
Bundle-Version: 2.3.0
Created-By: Apache Maven Bundle Plugin
DynamicImport-Package: javax.persistence; javax.persistence.*; version=
"2.0"
Embed-Dependency: *; artifactId=hibernate-validator; inline=true
Export-Package: javax.validation; version="1.1.0"; uses="javax.validation
.bootstrap,javax.validation.executable,javax.validation.metadata,javax.
validation.spi,javax.validation.bootstrap;version="1.1.0"; uses="javax
.validation",javax.validation.constraints;version="1.1.0"; uses="javax
.validation",javax.validation.constraints.validation;version="1.1.0",javax
.validation.executable;version="1.1.0"; uses="javax.validation",javax.v
alidation.groups;version="1.1.0",javax.validation.metadata;version="1.1
.0"; uses="javax.validation",javax.validation.spi;version="1.1.0"; uses
="javax.validation",org.hibernate.validator;version="5.0.0.Final"; uses
="javax.validation,javax.validation.spi,org.hibernate.validator.cfg.org
.hibernate.validator.spi.resourceloading",org.hibernate.validator.cfgv
ersion="5.0.0.Final"; uses="javax.validation,org.hibernate.validator.cf
g.context,org.hibernate.validator.cfg.context;version="5.0.0.Final";us
es="org.hibernate.validator.cfg.org.hibernate.validator.spi.group,org
.hibernate.validator.cfg.defs;version="5.0.0.Final"; uses="javax.valida
tion.constraints,org.hibernate.validator.cfg.org.hibernate.validator.co
nstraints",org.hibernate.validator.constraints;version="5.0.0.Final";us
es="javax.validation,javax.validation.constraints",org.hibernate.valida
tor.constraints.br;version="5.0.0.Final"; uses="javax.validation,javax
.validation.constraints,org.hibernate.validator.constraints",org.hibern
e.validator.group;version="5.0.0.Final"; uses="org.hibernate.validator.r
spi.group,org.hibernate.validator.internal.cfg;version="5.0.0.Final"
;uses="org.hibernate.validator.cfg.org.hibernate.validator.cfg.context
,org.hibernate.validator.internal.cfg.context",org.hibernate.validator.
internal.cfg.context;version="5.0.0.Final"; uses="org.hibernate.validat
or.cfg.org.hibernate.validator.cfg.context,org.hibernate.validator.inte
rnal.metadata.core,org.hibernate.validator.internal.metadata.location,o
rg.hibernate.validator.spi.group,org.hibernate.validator.internal.con
straints.validators;version="5.0.0.Final"; uses="javax.validation,javax
.validation.constraints,org.hibernate.validator.constraints,org.joda.time"
,org.hibernate.validator.internal.engine;version="5.0.0.Final"; uses="j
avax.validation,javax.validation.executable,javax.validation.metadata,j
avax.validation.spi,org.hibernate.validator,org.hibernate.validator.cfg
,org.hibernate.validator.internal.engine.constraints.validation,org.hiber
nate.validator.internal.engine.path,org.hibernate.validator.internal.me
tadata,org.hibernate.validator.internal.metadata.core,org.hibernate.val
idator.internal.metadata.facets,org.hibernate.validator.internal.metada
ta.raw,org.hibernate.validator.messageinterpolation,org.hibernate.vali
dator.spi.resourceloading",org.hibernate.validator.internal.engine.con
straints.validators;version="5.0.0.Final"; uses="javax.validation,javax

```

```
a.facets,org.hibernate.validator.internal.metadata.raw,org.hibernate.validator.spi.group",org.hibernate.validator.internal.metadata.aggregated.rule;version="5.0.0.Final";uses="org.hibernate.validator.internal.metadata.raw,org.hibernate.validator.internal.util.logging",org.hibernate.validator.internal.metadata.core;version="5.0.0.Final";uses="javax.validation,java.validation.constraintvalidation,org.hibernate.validator.internal.engine,org.hibernate.validator.internal.metadata.descriptor,org.hibernate.validator.internal.metadata.location",org.hibernate.validator.internal.metadata.descriptor;version="5.0.0.Final";uses="javax.validation,java.validation.metadata,org.hibernate.validator.constraints,org.hibernate.validator.internal.metadata.core",org.hibernate.validator.internal.metadata.facets;version="5.0.0.Final";uses="javax.validation,java.validation.metadata",org.hibernate.validator.internal.metadata.location;version="5.0.0.Final";uses="org.hibernate.validator.internal.metadata.raw",org.hibernate.validator.internal.metadata.provider;version="5.0.0.Final";uses="javax.validation,org.hibernate.validator.cfg,org.hibernate.validator.internal.metadata.core,org.hibernate.validator.internal.metadata.raw,org.hibernate.validator.spi.group",org.hibernate.validator.internal.metadata.raw;version="5.0.0.Final";uses="javax.validation,org.hibernate.validator.internal.metadata.core,org.hibernate.validator.internal.metadata.location,org.hibernate.validator.spi.group",org.hibernate.validator.internal.util;version="5.0.0.Final";uses="javax.validation,org.hibernate.validator.internal.metadata.raw",org.hibernate.validator.internal.util.annotationfactory;version="5.0.0.Final",org.hibernate.validator.internal.util.classhierarchy;version="5.0.0.Final",org.hibernate.validator.internal.util.logging;version="5.0.0.Final";uses="javax.validation,java.xml.bind,java.xml.stream,org.hibernate.validator.internal.metadata.descriptor,org.hibernate.validator.internal.metadata.raw",org.hibernate.validator.internal.util.privilegedactions;version="5.0.0.Final",org.hibernate.validator.internal.util.scriptengine;version="5.0.0.Final";uses="javax.script",org.hibernate.validator.internal.xml;version="5.0.0.Final";uses="javax.validation,java.validation.executable,java.validation.spi,java.xml.bind,java.xml.bind.annotation,java.xml.bind.annotation.adapters,java.xml.validation,org.hibernate.validator.internal.metadata.core,org.hibernate.validator.internal.metadata.location,org.hibernate.validator.internal.metadata.raw",org.hibernate.validator.messageinterpolation;version="5.0.0.Final";uses="javax.validation,org.hibernate.validator.spi.resourceloading",org.hibernate.validator.resourceloading;version="5.0.0.Final";uses="org.hibernate.validator.spi.resourceloading",org.hibernate.validator.spi.group;version="5.0.0.Final",org.hibernate.validator.spi.resourceloading;version="5.0.0.Final",org.glassfish.validation;version="5.0.0.Final",org.hibernate.validator.internal.cdi.interceptor;version="5.0.0.Final",org.hibernate.validator.internal.cdi;version="5.0.0.Final"
Implementation-Version: 5.0.0.Final
Import-Package: org.slf4j;version="1.7.7";resolution:=optional,org.slf4j.spi;version="1.7.7";resolution:=optional,java.persistence;version="2.0";resolution:=optional,org.joda.time;resolution:=optional;version="1.6.0.2.0.0",org.jsoup;resolution:=optional;version="1.5.2.2.0.0",org.jsoup.safety;resolution:=optional;version="1.5.2.2.0.0",org.apache.log4j;resolution:=optional,org.jboss.logmanager;resolution:=optional,java.xml;version="2.2.3";resolution:=optional,java.script,java.xml.bind,java.xml.bind.annotation,java.xml.bind.annotation.adapters,java.xml.namespace,java.xml.stream,java.xml.stream.events,java.xml.transform,java.xml.transform.stream,java.xml.validation,org.xml.sax,org.slf4j.helpers;version="1.7.7";resolution:=optional
Tool: Bnd-2.1.0.20130426-122213
```

# JBossModule

- 作为JBossAS/Wildfly应用服务器产品的基石
- 并行加载
- 不用改变已有发布的jar
- 类加载图



```
<module xmlns="urn:jboss:module:1.3" name="org.jboss.ironjacamar.impl">
  <properties>
    <property name="jboss.api" value="private"/>
  </properties>

  <resources>
    <resource-root path="ironjacamar-common-impl-1.3.4.Final.jar"/>
    <resource-root path="ironjacamar-core-impl-1.3.4.Final.jar"/>
    <resource-root path="ironjacamar-deployers-common-1.3.4.Final.jar"/>
    <resource-root path="ironjacamar-validator-1.3.4.Final.jar"/>
  </resources>

  <dependencies>
    <module name="sun.jdk"/>
    <!-- javax.security.auth.callback -->
    <module name="javax.api"/>
    <module name="javax.resource.api"/>
    <module name="javax.security.auth.message.api"/>
    <module name="javax.validation.api"/>
    <module name="org.hibernate.validator"/>
    <module name="org.jboss.as.naming"/>
    <module name="org.jboss.as.transactions"/>
    <module name="org.jboss.jboss-transaction-spi"/>
    <module name="org.jboss.ironjacamar.api"/>
    <module name="org.jboss.logging"/>
    <module name="org.jboss.threads"/>
    <!-- org.jboss.security -->
    <module name="org.picketbox"/>
    <module name="javax.xml.stream.api"/>
    <!-- jgroups -->
    <module name="org.jgroups"/>
  </dependencies>
</module>
```



# JBossModule在实际应用中

Stack-overflow  
网站上  
Wildfly  
问题和  
JBM有关  
系的最多  
(标记绿色)

**Q: WildFly deploying**  
When deploy application server **WildFly** 8.1.0, the following error occurs . Thu Oct 01 13:31:07 GMT+300 2015  
Failed to enable rest-api-0.1-SNAPSHOT.war: Unexpected HTTP response: 500 Request ...  
asked Oct 1 '15 by **LesharB**

**Q: Wildfly DuplicateServiceException**  
I have created simple EAR application using Maven archetype: **wildfly**-javaee7-webapp-ear-blank-archetype/8.2.0.Final http://s17.postimg.org/cy8zbpiu7/Zrzu1\_ekranu\_z\_2015\_02\_13\_23\_15\_10.png My log ...  
from starting **wildfly**: Java HotSpot(TM) 64-Bit Server VM warning: Ignoring option MaxPermSize=256m; support was removed in 8.0 23:08:04,244 INFO [org.jboss.modules] (main) JBoss Modules version ...  
asked Feb 13 '15 by **KamilJ**

**Q: Wildfly ClassNotFoundException**  
I'm trying to deploy my application to a **Wildfly** Application server but I keep getting the following error: Failed to execute goal org.wildfly.plugins:wildfly-maven-plugin:1.1.0.Alpha1:deploy ...  
asked May 8 '15 by **Schokeo**

**Q: WildFly + https**  
Using **WildFly** 8.1.0.Final I have issues connecting to a https resource (JAX-RS). I have the following web.xml:  
<web-app version="3.1" xmlns="http://xmlns.jcp.org/xml/ns/javaee" xmlns:xsi="http://..."/> <handlers> <filters>  
<response-header name="server-header" header-name="Server" header-value="**WildFly**8"/> <response-header  
name="x-powered-by-header" ...  
asked Oct 6 '15 by **Puce**

**Q: Wildfly: org.xnio.channels.FixedLengthOverflowException**  
Until now we used JBoss AS 7.1 which has a tomcat as front-server. We now upgraded to **Wildfly** (JBoss 8.0)  
which ships with undertow as a tomcat replacement. For our filedownloads, we are reading ... Update: Found  
the problem. It has to do with the change of the server engine. Just not sure if it is directly related to undertow, or  
more an error with **wildfly** / JSF (or if it was an error ...  
asked May 8 '14 by **dognose**

**Q: Wildfly Transactions**  
My **Wildfly** server is running a copy method which takes 30 minutes to finish. For every copied item I got a log  
message. After 10 minutes the server is printing following message for around 20 seconds ... ] metaData=  
(jms-session=resource-adapter=inbound.))@62eae143)) failed with exception XAException:XA\_RBOTHER:  
javax.transaction.xa.XAException And again all transactions are rolledback. The **Wildfly** ...  
asked Jun 30 by **Dennis**

**Q: Wildfly error start**  
(ServerService.java:331) [**wildfly** ly-server-8.0.1.Final-SNAPSHOT.jar:8.0.1.Final-SNAPSHOT] at  
org.jboss.as.controller.AbstractControllerService\$1.run(AbstractControllerService.java:256) [**wildfly** ... I got  
some issues with **Wildfly**. I got this Exception but I don't know how to fix it... I don't know what I could do know to  
fix this Problem..... 21:58:09,529 INFO ...  
asked Mar 19 '14 by **user3069881**

**Q: Duplicate resource Wildfly**  
I'm getting below error in **Wildfly** 8.2: 05:17:12,202 INFO [org.jboss.msc] (main) JBoss MSC version 1.2.2.Final  
05:17:12,285 INFO [org.jboss.as] (MSC service thread 1-6) JBAS015899: **Wildfly** 8.2.0 ...  
asked Jan 31 '15 by **Passionate Developer**

**Q: Wildfly Unsupported major.minor version 52.0**  
I have downloaded **Wildfly** 10 (final), and was trying to configure it, like adding a user or register a driver, but  
each time I try to execute any of the bat scripts such as add-user.bat or the jboss ... -cli.bat I keep getting  
Unsupported major.minor version 52.0. I know that **Wildfly** 10 supports only Java8, and im actually using Java8 ..  
C:\programming\wildfly-10.0.0.Final\bin>java -version java ...  
asked May 21 by **Ouerghi Yassine**

**Q: Asynch class in Wildfly**  
in JBOSS versions prior to **Wildfly** there is the class org.jboss.ejb3.asynchronous.Asynch which one can use  
the make asynchronous call. I can't find this class anywhere in **Wildfly**. I'm ... not intending to use the  
@Asynchronous annotation. This is the error that I get: java.lang.ClassNotFoundException:  
org.jboss.ejb3.asynchronous.Asynch The class actually come from the jboss-ejb3.jar which is not available on  
**Wildfly** Thanks in advance ...  
asked Jan 30 '15 by **edmond**

**Q: Eclipse Luna + WildFly 9**  
Can I use Eclipse Luna with **WildFly** 9 server ? Or should I move to Eclipse Mars ? I'm asking because I can't  
create a **WildFly** 9 server on my Eclipse but I can create a **WildFly** 8 server. I checked my ...  
asked Oct 9 '15 by **cheb1k4**

**Q: Does wildfly kills another wildfly?**  
We experienced a (at least in our eyes) strange problem: We have two **Wildfly** 8.1 installations on the same linux  
machine (CentOS 6.6) running the same applications in different versions ...  
asked Jan 8 '15 by **Alexander Rühl**

**Q: Wildfly Infinispan cache compatibility**  
In Infinispan 6.0.x version is there but what is property for in **wildfly** 8.2 ? Thanks&Regards Shankar ...  
asked Sep 16 '15 by **Shankar S**

**Q: User wildfly does not exist**  
I am trying to run **wildfly**-init-debian.sh to run **wildfly** on startup but when I run the file it gives "user **wildfly** does  
not exist..." error. How can I define this user? ...  
asked Jun 5 '15 by **xxdial**

**Q: Wildfly Custom auth-method**  
How do you add a custom authenticator in **Wildfly**? I used to do this in JBoss 4.2: In <JBoss>\jboss-as\server  
'production\deploy\jboss-web-deployer\META-INF\jboss-service.xml, add the following ... -ha.sar\portal-  
server.war\WEB-INF\web.xml, modify : ... <login-config> <auth-method>MY-CUSTOM-AUTH</auth-method> ...  
**Wildfly** does not have jboss-service.xml anymore. ...  
asked Feb 9 '15 by **jersey-city-ninja**

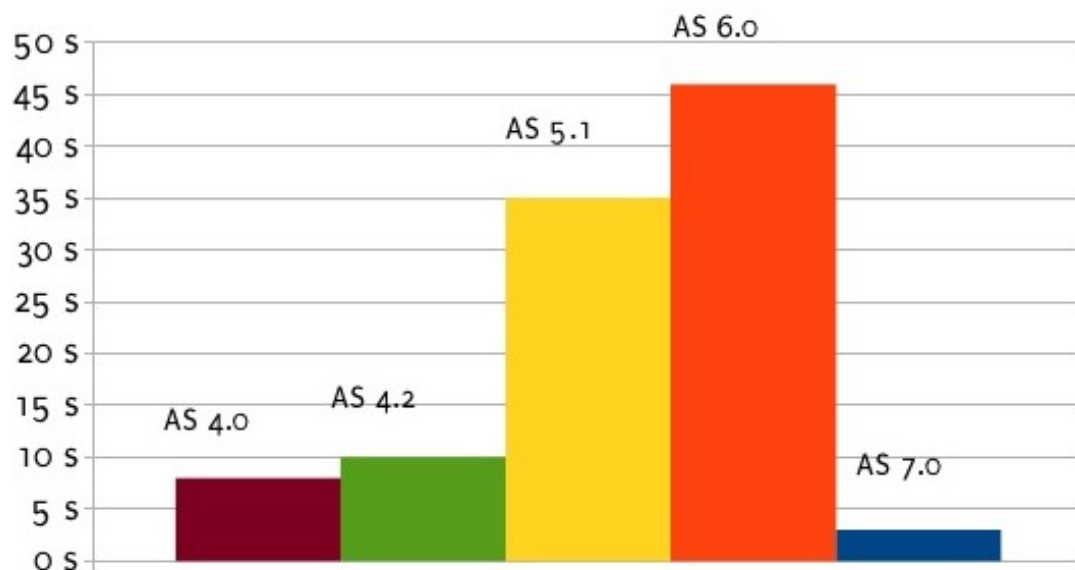
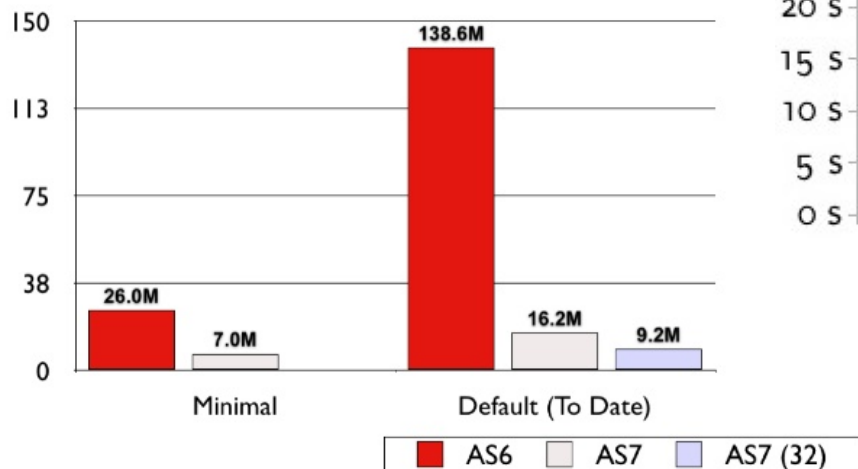
**Q: Wildfly Servlet Deployment Error**  
I'm migrating from JBoss 4.0.4GA to **Wildfly** 8.1.0. During deployment, I'm getting the following error:  
server.default-host/L UndertowDeploymentInfoService: org.jboss.msc.service.StartException ...  
asked Aug 27 '14 by **Shankar S**



# JBoss AS5和AS7加载速度的改进

- 类加载速度提升起到很大的作用
- 启动时长比较图

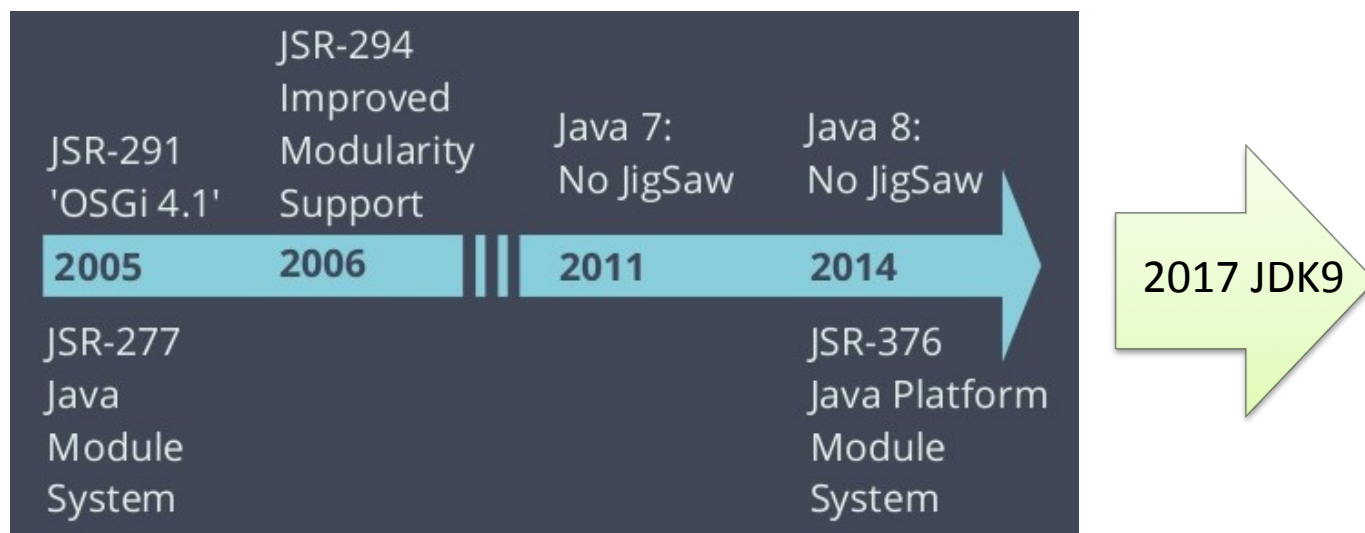
## Memory Comparison



## 占用内存比较图

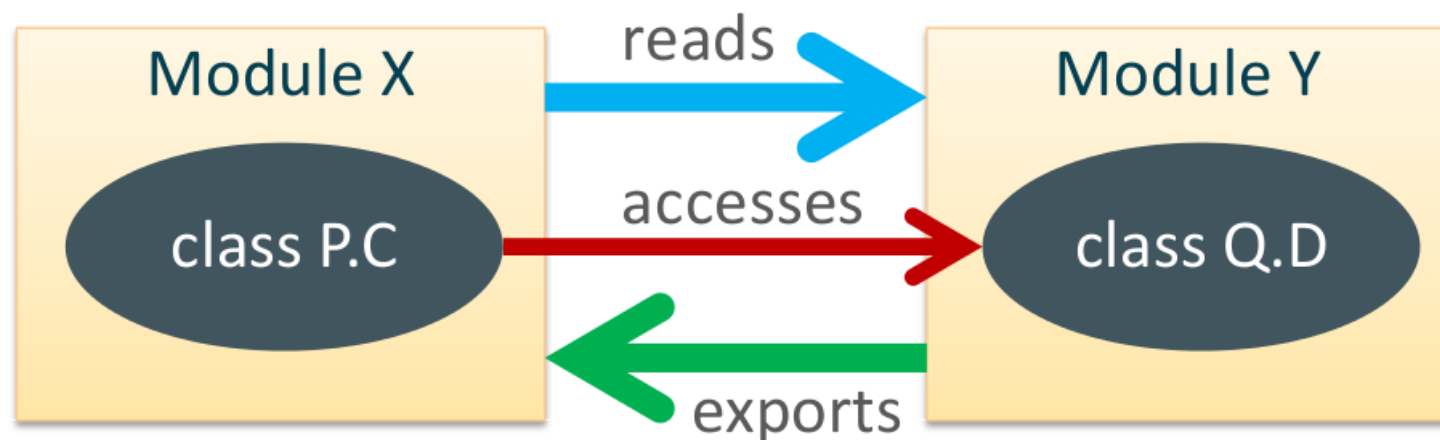
# Java语言的模块化

- Jigsaw项目
- Java Platform Module System (JSR 376)
- 推迟到Java9时发布
- JDK9 EA 111合并入Jigsaw



# JDK9模块化介绍

- 模块化示意图形



```
module X {  
    requires Y;  
}
```

```
module Y {  
    exports Q;  
}
```

# 模块化代码范例

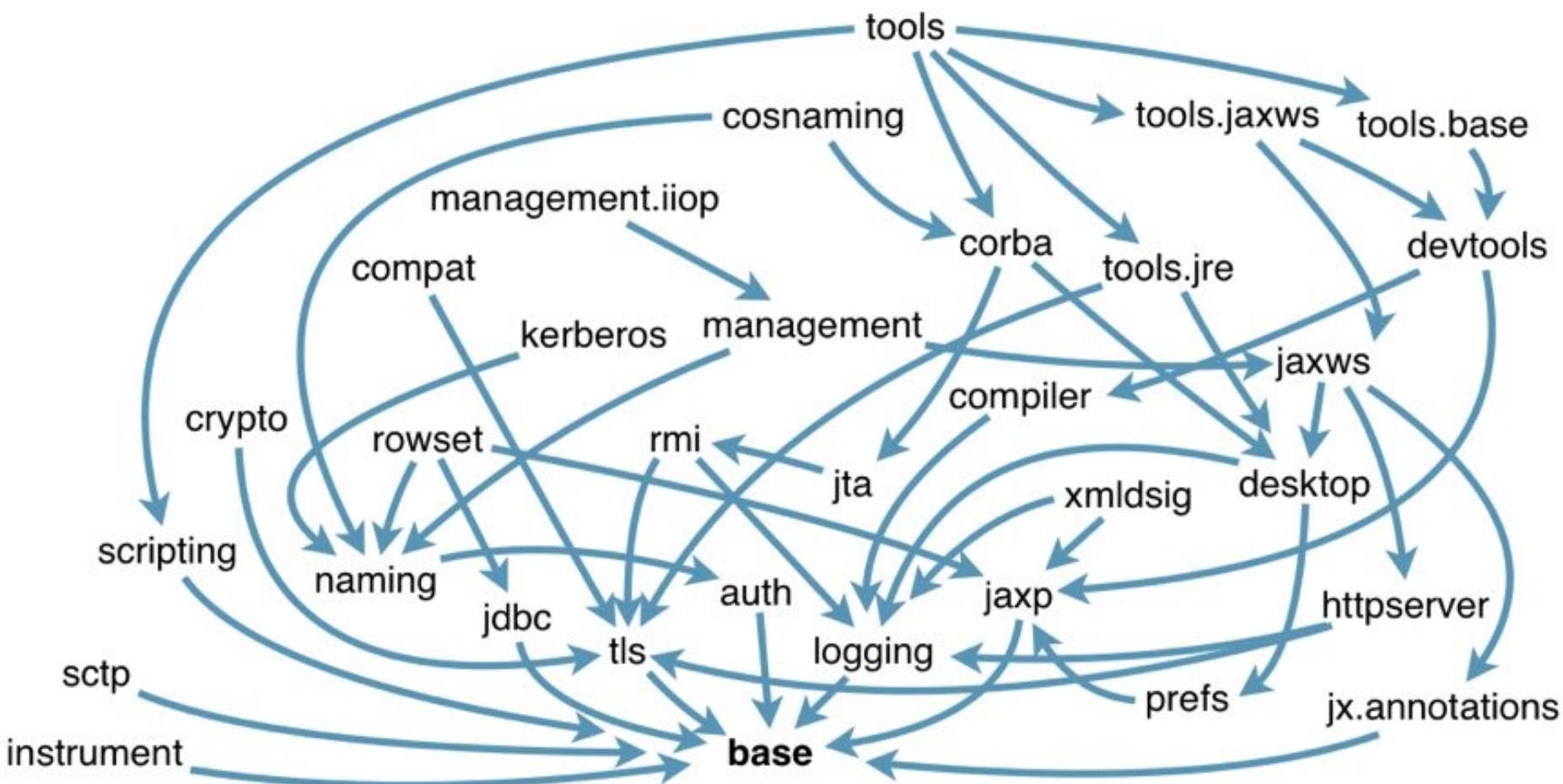
```
module java.sql {  
    requires java.logging;  
    exports java.sql;  
}
```

```
package java.sql;  
import java.util.logging.Logger;  
public class DriverManager {  
    new Logger() {..}  
}
```

```
module java.logging {  
    exports java.util.logging;  
}
```

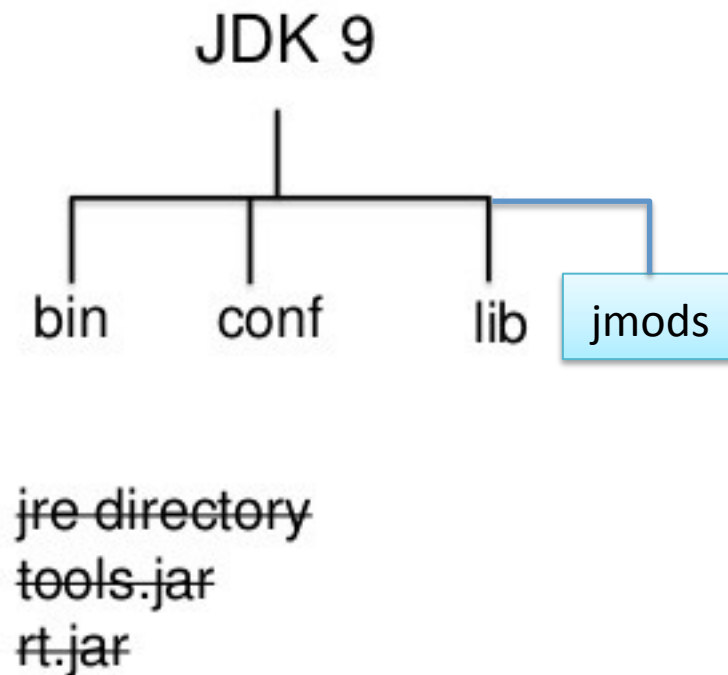
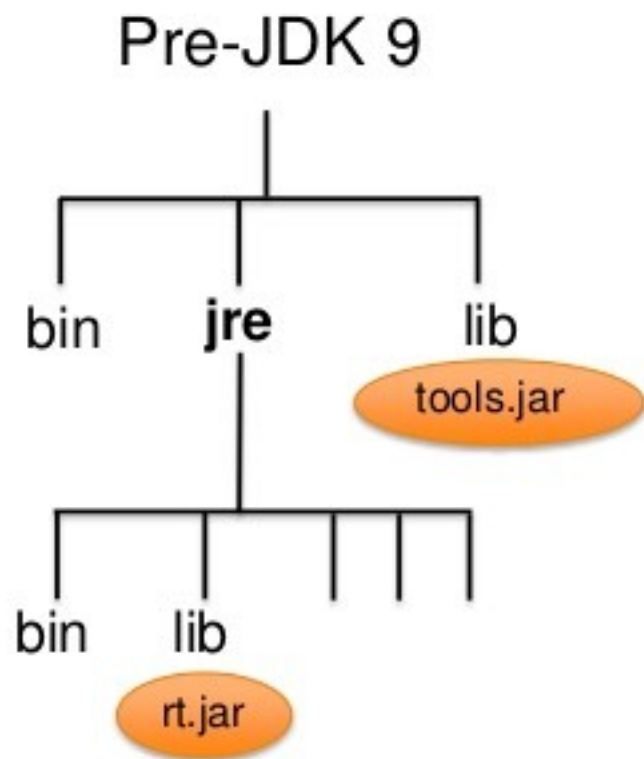
```
package java.util.logging;  
public class Logger {  
    ...  
}
```

# jmods模块图



# JDK9体系变化

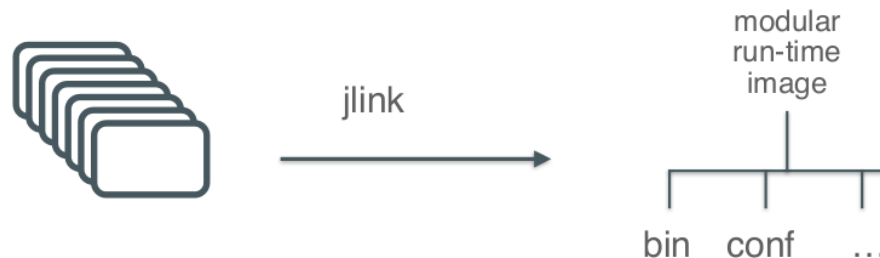
- JDK目录结构发生变化



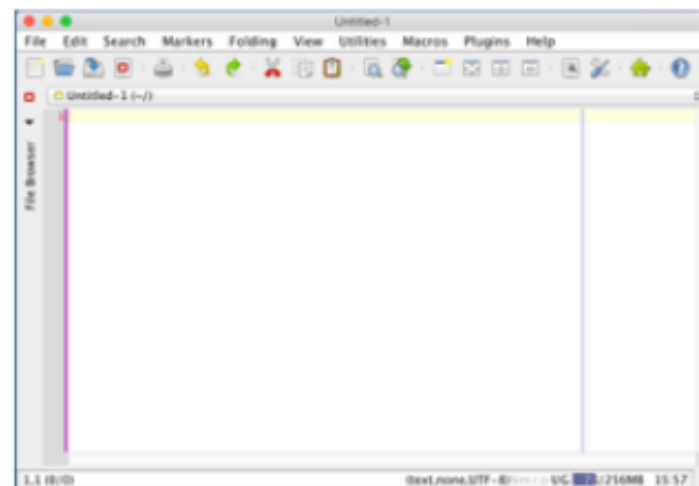
# 发布应用为可执行文件

```
$ jlink --module-path jmods/ --add-modules java.desktop --output myimage
```

```
$ myimage/bin/java --list-modules  
java.base@9  
java.datatransfer@9  
java.desktop@9  
java.prefs@9  
java.xml@9
```



```
$ myimage/bin/java -jar jedit.jar
```



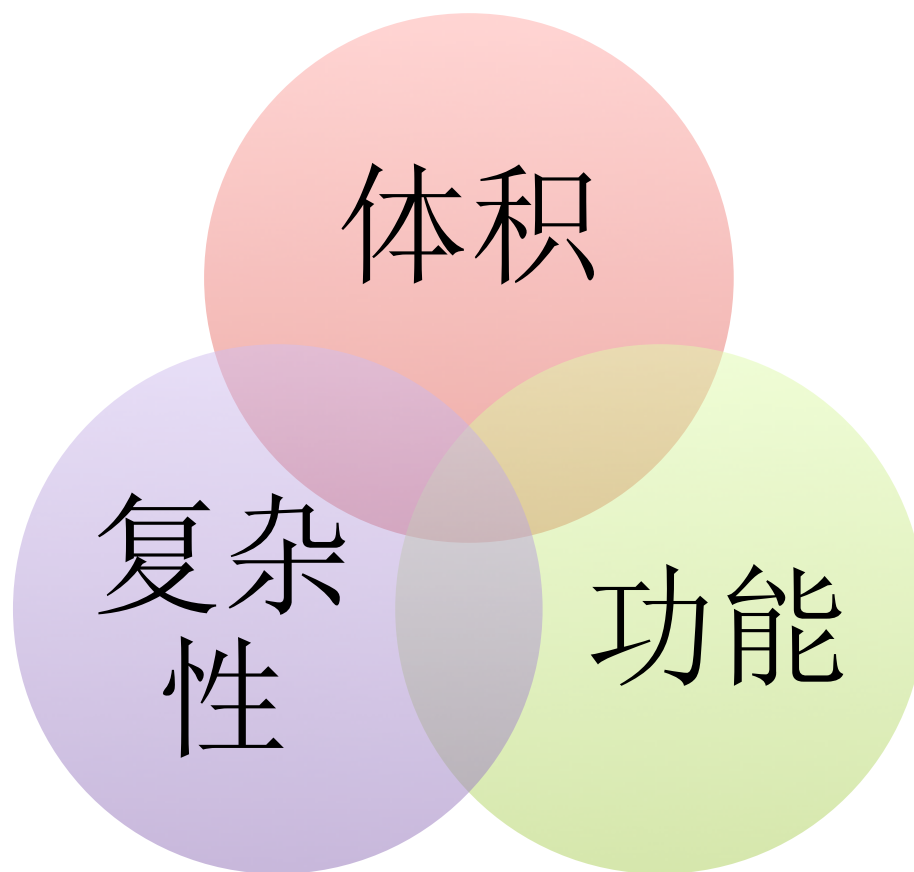
- 操作系统相关
- 容器友好
- 更“微”的微服务
- Java 等工具支持module相关参数



# 3 种模块化实现特性比较

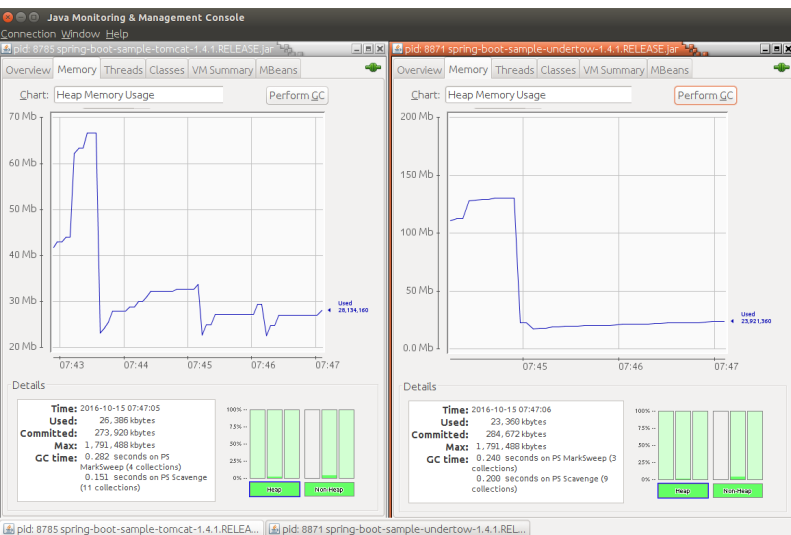
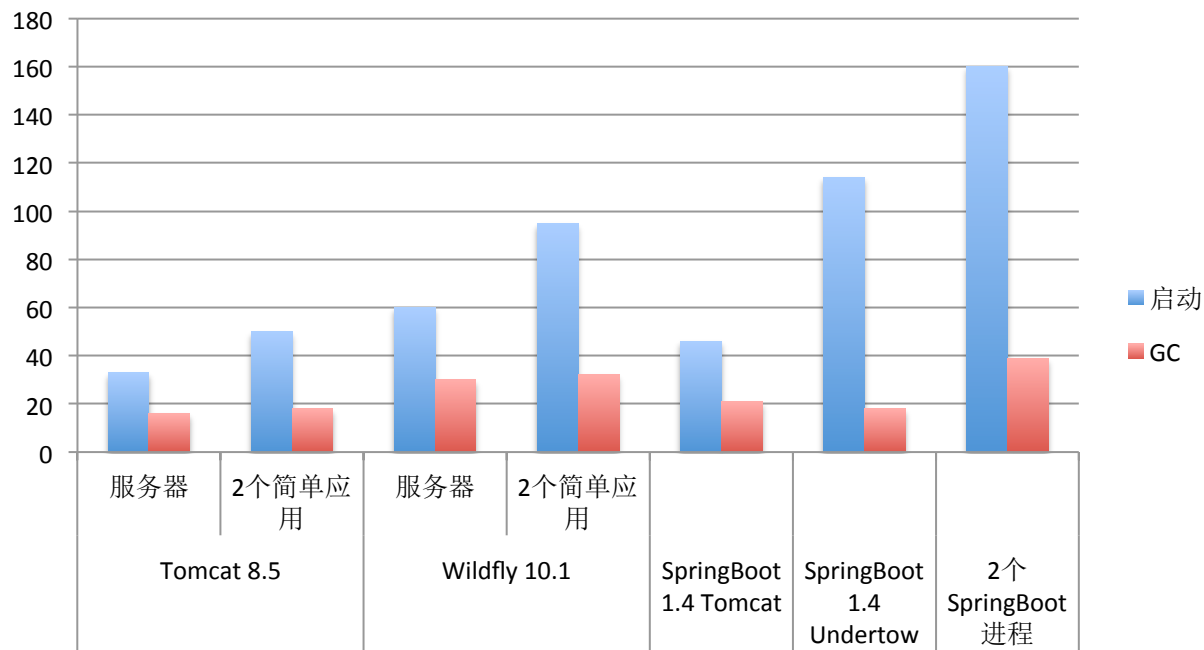
	Java 9 / Jigsaw	OSGi	JBoss Module
metadata	module-info.java	META-INF/MANIFEST.MF	module.xml
classpath	exports/requires	Import-Package/Export-Package	depend/export
classpath++	transitive imports	fragment bundle/dynamic import	dependency
classloader	unspecified classloader	strict , per bundle	per bundle
service layer	static	dynamic (get implementations + start/stop listeners)	static by jbossmsc
version	no	yes	yes

# 微服务体系思考



# 占用空间比较

- 磁盘体积
- 内存占用(单位M, 分别表示启动时和GC后)



2个SpringBoot进程内存占用

# 复杂度

- 微服务需要考虑的设计要素



Werner Kell



Other recipients: willh...@gmail.com

---

Well if you try to squeeze

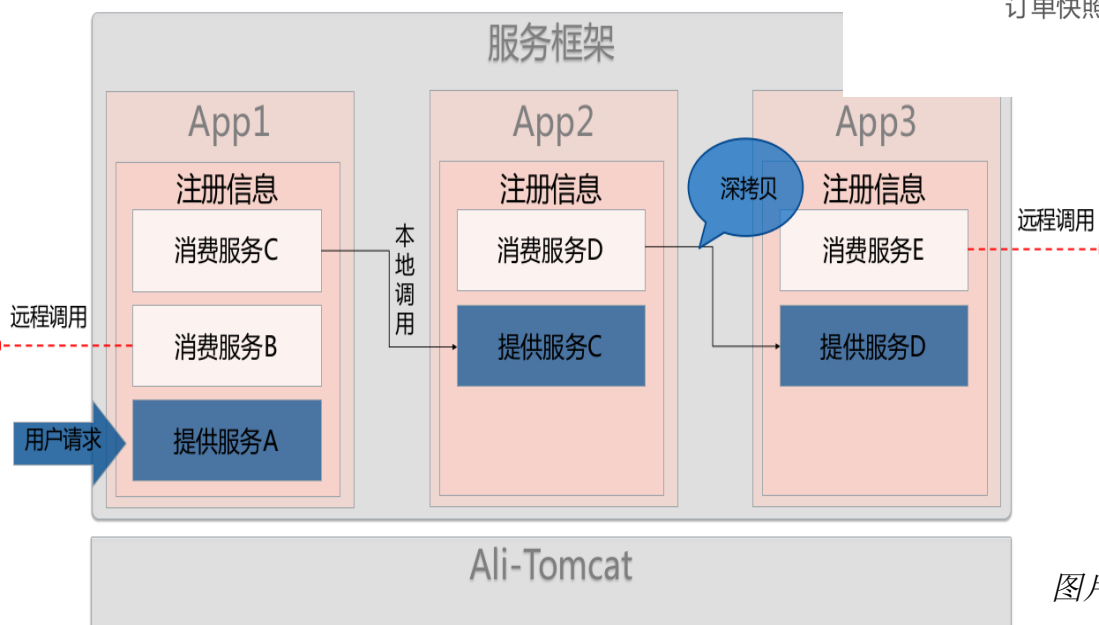
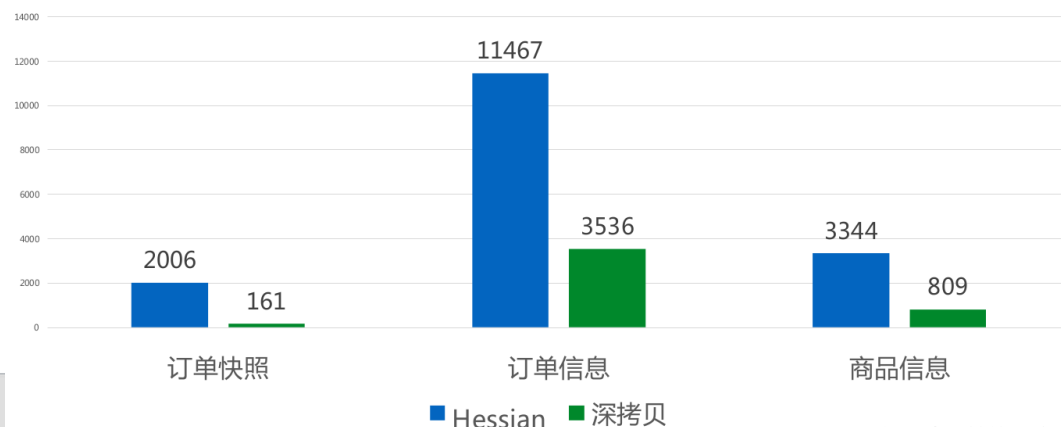
- Core netflix OSS technologies: eureka, ribbon, hystrix, proxy, turbine, archaius
- Swagger and API management
- Role-based auth
- Web SSO
- monitoring/eventing/alerting
- Testing
- logging/traceability
- Versioning
- repository/registry
- Load balancing
- Messaging
- Distributed data, transactions and caching
- Immutability (not necessarily via Linux containers)
- Configuration
- CI/CD
- orchestration/composition
- Dependency management.

all into a "micro" profile, where's the "micro"? ;-O

# 容器粒度考虑

- 多个应用部署
- 设计原则之一：避免分布
- 远程调用的效率损失
- 性能对比图表

Hessian序列化与深拷贝对比



图片来源于阿里巴巴在线峰会

# 模块化技术对微服务的意义

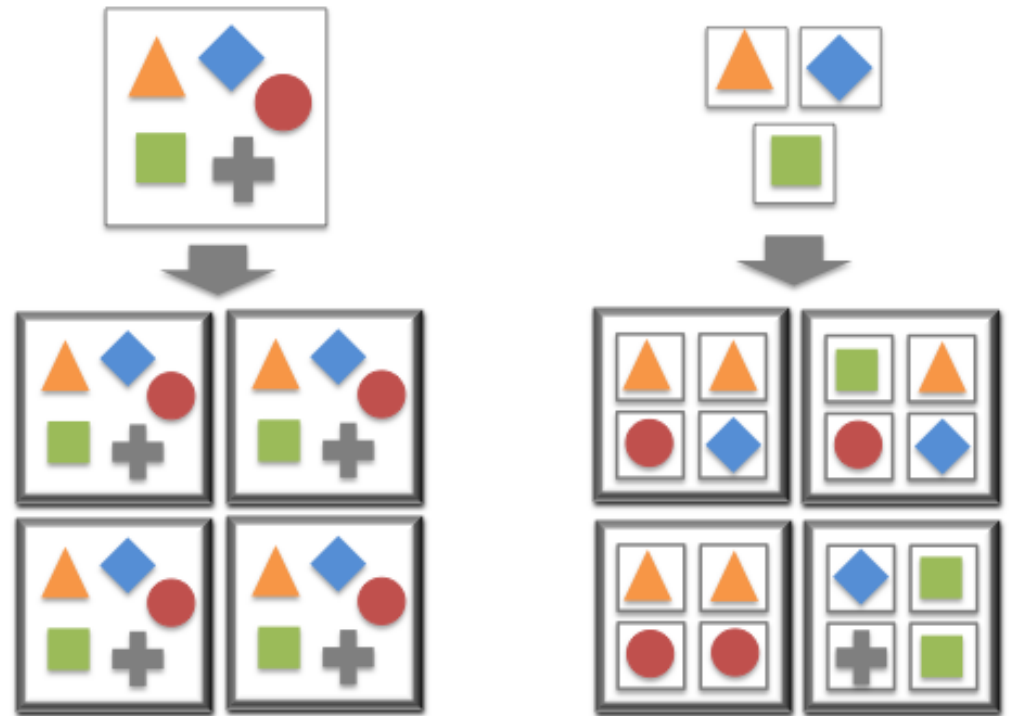
- 设计更加灵活
- 模块化是必须的基础设施
- 和容器技术配合
  - 运用Docker的层叠式文件系统
  - Kubernetes自动扩展机制的结合



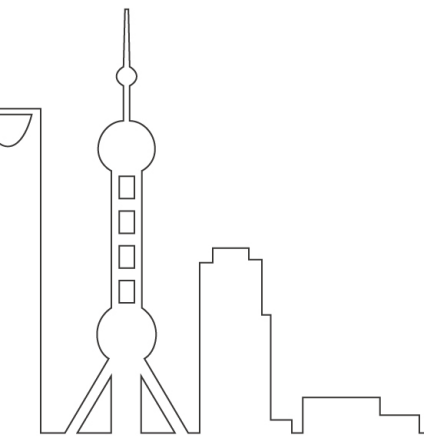
# 开发架构的变化

- 应用架构按照层次进行模块化改造
- 语言级进行支持
- 逐步适应
- 长期的过程

## APPLICATION MONOLITHIQUE VS MICROSERVICES







# Thanks!

International Software Development Conference

[jeff.zhang@useopen.net](mailto:jeff.zhang@useopen.net)

永源中间件共同创始人  
GreenTea JUG member

受条件和时间限制，部分图片来源于网络，版权归原所有者。特此感谢！

主办方 **Geekbang**  **InfoQ**   
极客邦科技