



Open Liberty

# Masterclass: Hands-on Liberty for Developers

# Ready to get your hands dirty?



Online exercises: <https://ibm.biz/OpenLibertyMasterclass>

The Masterclass is Open Sourced at:

<https://github.com/OpenLiberty/open-liberty-masterclass>

Follow the instructions in the "Before you begin" section of the README.md to:

- Install Pre-requisites
- Prime Maven and Docker Caches

# Mastersclass hands-on content



- [The Application](#)
- [Module 1: Build](#)
- [Module 2: Dev Mode](#)
- [Module 3: Application APIs](#)
- [Module 4: Server Configuration](#)
- [Module 5: Externalizing Configuration](#)
- [Module 6: Integration Testing](#)
- [Module 7: Docker](#)
  - [Overriding Dev Server Configuration](#)
- [Module 8: Testing in Containers](#)
- [Module 9: Support Licensing](#)
- [Conclusion](#)

# Brief History



# Liberty Goals



- Efficient
- Simple to use
- Consistency
- Just enough runtime
- End of migration
- Agile-ready



# Liberty

- First shipped in WAS 8.5 in 2012
  - Servlet + JSP + JPA
- Web Profile 6 in 2014
- Java EE 7 in 2016 – first commercial product to certify
- Java EE 8 in 2018 – first to certify
- Jakarta EE 8 in 2019 – first to certify
- Eclipse MicroProfile – first to deliver 1.0-1.4, 2.0-2.1, 3.0



[Docs](#)[Get Started](#)[Support](#)[Fork the code](#)[openliberty.io](https://openliberty.io)

Launched September 2017

# Open Liberty

An IBM Open Source Project

**A lightweight open framework for building fast and efficient cloud-native Java microservices.**

Build cloud-native apps and microservices while running only what you need. Open Liberty is the most flexible server runtime available to Java™ developers in this solar system.

[Get Open Liberty](#)

# Liberty Architecture



# Fit for purpose

- You control which features are loaded into each server instance



```
<feature>jsf-2.3</feature>
```



# Liberty Zero Migration



- Zero config migration
  - Write once, run forever
- Zero migration for apps
  - No behavior changes in existing features
  - New behaviors in new features
- Choose your Java
  - Java 12, 11, 8
  - AdoptOpenJDK
  - IBM
  - OpenJDK
  - Oracle



# Features

  
**Open Liberty**

# Periodic Table of Liberty (20.0.0.3)

**ZOS**  
**ND**  
**Base**  
**Core**  
**Open Liberty**  
**New in 4Q19**  
**New in 3Q19**  
**New in 2Q19**  
**New in 1Q20**

		batchSMFLogging-1.0	zosLocalAdapters-1.0	zosTransaction-1.0	zosSecurity-1.0
ZOS	collectiveController-1.0	dynamicRouting-1.0	healthManager-1.0	scalingController-1.0	Security
	clusterMember-1.0		healthAnalyzer-1.0	scalingMember-1.0	
	cloudant-1.0		sipServlet-1.0		
	javaee-7.0			batchManagement-1.0	
	javaee-8.0			wsAtomicTransaction-1.2	
	jakartae-8.0				
	bells-1.0		mpContextPropagation-1.0		Operations
	concurrent-1.0		mpReactiveMessaging-1.0		
	javaMail-1.6		mpReactiveStreams-1.0		
	jaxb-2.2		opentracing-1.3		
	jdbc-4.3		osgiConsole-1.0		
	jpaContainer-2.2		springBoot-2.0		
	jsfContainer-2.3		webProfile-7.0		
	json-1.0		webProfile-8.0		
	jsonbContainer-1.0			usageMetering-1.0	
	jsonpContainer-1.1			restConnector-2.0	
	microProfile-3.2			sessionCache-1.0	

# Periodic Table of Liberty (20.0.0.3)

ZOS

ND

Base

Core

Open Liberty

New in 4Q19

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New in 1Q20

		batchSMFLogging-1.0			
collectiveController-1.0	dynamicRouting-1.0	appClientSupport-1.0	ejbHome-3.2	jacc-1.5	managedBeans-1.0
clusterMember-1.0		appSecurityClient-1.0	ejbPersistentTimer-3.2	jaxb-2.2	mdb-3.2
cloudant-1.0	sipServlet-1.0	batch-1.0	ejbRemote-3.2	jaxws-2.2	wasJmsClient-2.0
javaee-7.0		concurrent-1.0	j2eeManagement-1.1	jca-1.7	webProfile-8.0
javaee-8.0		ejb-3.2	javaMail-1.6	jms-2.0	wmqJmsClient-2.0
jakartaee-8.0		mpContextPropagation-1.0			
bells-1.0	mpReactiveMessaging-1.0	appSecurity-3.0	jaxrs-2.1	jsonp-1.1	websocket-1.1
concurrent-1.0	mpReactiveStreams-1.0	beanValidation-2.0	jaxrsClient-2.1	jsf-2.3	
javaMail-1.6		cdi-2.0	jdbc-4.2	jsp-2.3	
jaxb-2.2	opentracing-1.3	ejbLite-3.2	jndi-1.0	managedBeans-1.0	
jdbc-4.3	osgiConsole-1.0	el-3.0	jpa-2.2	servlet-4.0	
jpaContainer-2.2	springBoot-2.0	jaspic-1.1	jsonb-1.0	ssl-1.0	
jsfContainer-2.3	webProfile-7.0				
json-1.0	webProfile-8.0	cdi-2.0	jsonb-1.0	mpMetrics-2.2	mpOpenTracing-1.3
jsonbContainer-1.0		jaxrs-2.1	mpConfig-1.3	mpJwt-1.1	mpRestClient-1.3
jsonpContainer-1.1		jsonp-1.1	mpFaultTolerance-2.0	mpOpenAPI-1.1	mpHealth-2.1
microProfile-3.2					
APIs					

# Periodic Table of Liberty (20.0.0.3)

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cloudant-1.0	clusterMember-1.0	batch-1.0	ejbRemote-3.2	jaxb-2.2	mdb-3.2
javaee-7.0	sipServlet	concurrent-1.0	j2eeManagement-1.1	jaxws-2.2	wasJmsClient-2.0
javaee-8.0		ejb-3.2	javaMail-1.5	jca-1.7	webProfile-7.0
jakartaee-8.0		ejbHome-3.2	jacc-1.5	jms-2.0	wmqJmsClient-2.0
bells-1.0	mpContextPropagation-	appSecurity-2.0	jaxrsClient-2.0	jsp-2.3	wsSecurity-1.1
concurrent-1.0	mpReactiveMessaging-	beanValidation-1.1	jdbc-4.2	managedBeans-1.0	wsSaml-1.0
javaMail-1.6	mpReactiveStreams-1.0	cdi-1.2	jndi-1.0	servlet-3.1	wsstry-3.0
jaxb-2.2	opentracing-1.3	ejbLite-3.2	jpa-2.1	ssl-1.0	ws0
jdbc-4.3	osgiConsole-1.0	el-3.0	jsonp-1.0	websocket-1.1	connectClient-1.0
jpaContainer-2.2	springBoot-2.0	jaxrs-2.0	jsf-2.2		connectServer-1.0
jsfContainer-2.3	webProfile-7.0				
json-1.0	webProfile-8.0	cdi-2.0	jsonb-1.0	mpMetrics-2.2	mpOpenTracing-1.3
jsonbContainer-1.0		jaxrs-2.1	mpConfig-1.3	mpJwt-1.1	mpRestClient-1.3
jsonpContainer-1.1		jsonp-1.1	mpFaultTolerance-2.0	mpOpenAPI-1.1	mpHealth-2.1
microProfile-3.2					
APIs					

# Build

Module 1



# Support for Maven and Gradle



- Manage full server and application lifecycle through the two most popular build technologies.
- Maven
  - liberty-maven-plugin
  - liberty-archetype-\*
  - Docs & Source: <https://github.com/OpenLiberty/ci.maven>
- Gradle
  - liberty-gradle-plugin
  - Docs & Source: <https://github.com/OpenLiberty/ci.gradle>
- All the artefacts you need in Maven Central
  - <https://search.maven.org/search?q=io.openliberty>
  - <https://search.maven.org/search?q=com.ibm.websphere>

# Dev Mode

Module 2

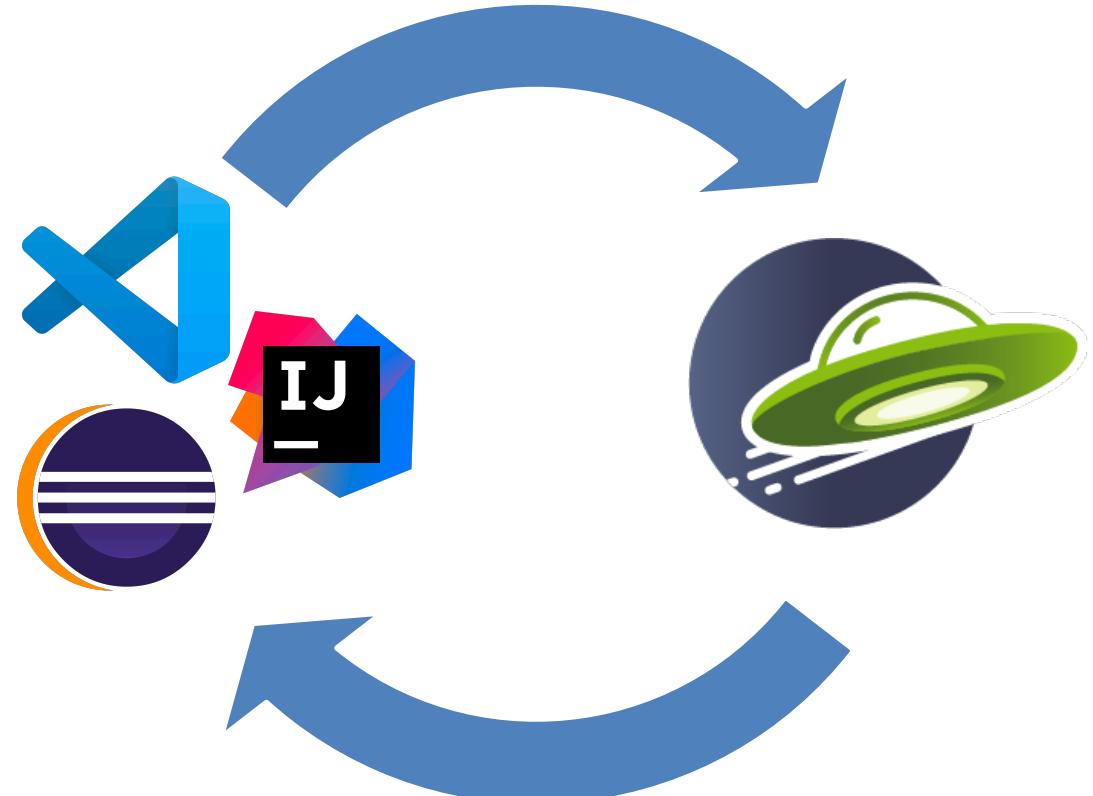


# dev mode



- Boosts developer productivity
- Immediate feedback for code and config changes
- No re-build necessary
- Hot deployment, testing and debugging

*mvn liberty:dev*  
*gradle libertyDev*



# Open Liberty Tools for VS Code



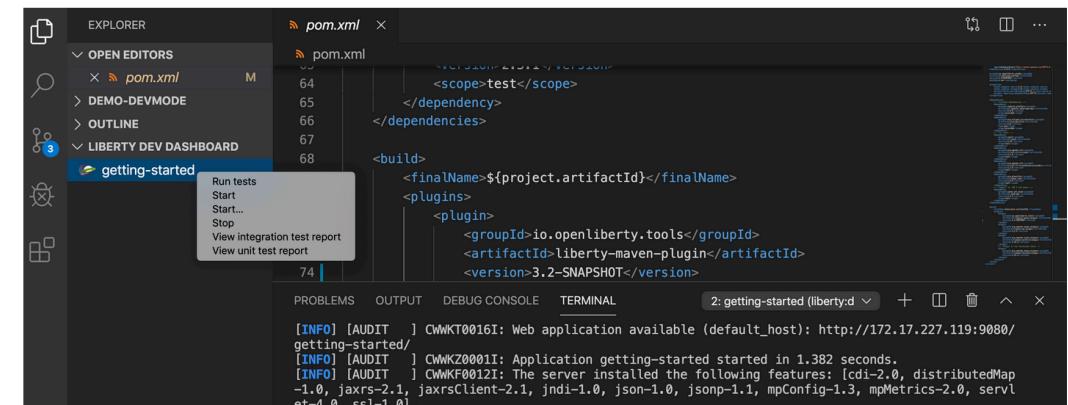
- Launch dev mode easily to build with Liberty from popular editor
- Auto detect Liberty projects
- View unit and integration test reports

The screenshot shows the extension page for 'Open Liberty Tools' in the Visual Studio Marketplace. It features a large icon of a green alien in a spaceship, the title 'Open Liberty Tools' with a 'Preview' badge, and a summary card with the text 'Open Liberty | 564 installs | ★★★★★ (0) | Free'. Below the card are links for 'Install' and 'Trouble Installing?'. At the bottom, there are tabs for 'Overview' (which is selected), 'Q & A', and 'Rating & Review'.

## Open Liberty Tools for VS Code

Visual Studio Marketplace v0.1.5 license EPL 2.0

A VS Code extension for Open Liberty. The extension will detect your Liberty Maven or Liberty Gradle project if it detects the `io.openliberty.tools:liberty-maven-plugin` in the `pom.xml` or `io.openliberty.tools:liberty-gradle-plugin` in the `build.gradle`. Through the Liberty Dev Dashboard, you can start, stop, or interact with Liberty dev mode on all available [Liberty Maven](#) or [Liberty Gradle](#) projects in your workspace.



# Application APIs

Module 2



# Java EE 7



appClientSupport-1.0	ejbPersistentTimer-3.2	jaspic-1.1	managedBeans-1.0
batch-1.0	ejbRemote-3.2	jaxb-2.2	mdb-3.2
concurrent-1.0	j2eeManagement-1.1	jaxws-2.2	wasJmsClient-2.0
ejb-3.2	javaMail-1.5	jca-1.7	webProfile-7.0
ejbHome-3.2	jacc-1.5	jms-2.0	wmqJmsClient-2.0

appSecurity-2.0	jaxrsClient-2.0	jsp-2.3
beanValidation-1.1	jdbc-4.2	managedBeans-1.0
cdi-1.2	jndi-1.0	servlet-3.1
ejbLite-3.2	jpa-2.1	ssl-1.0
el-3.0	jsonp-1.0	websocket-1.1
jaxrs-2.0	jsf-2.2	

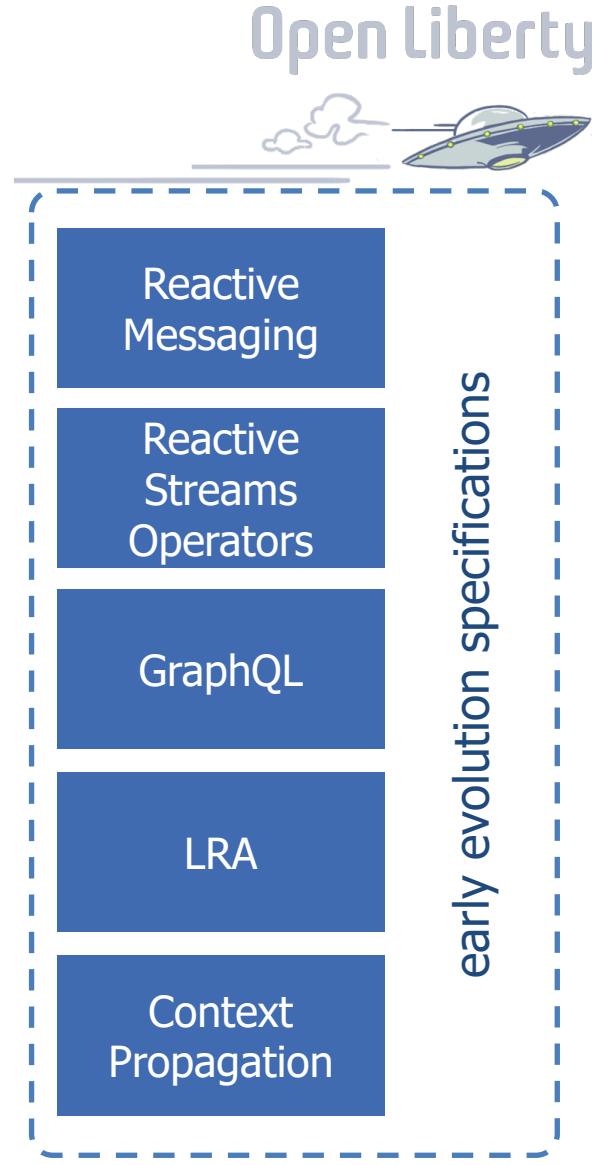
# Jakarta EE or Java EE 8



appClientSupport-1.0	ejbHome-3.2	jacc-1.5	managedBeans-1.0
appSecurityClient-1.0	ejbPersistentTimer-3.2	jaxb-2.2	mdb-3.2
batch-1.0	ejbRemote-3.2	jaxws-2.2	wasJmsClient-2.0
concurrent-1.0	j2eeManagement-1.1	jca-1.7	webProfile-8.0
ejb-3.2	javaMail-1.6	jms-2.0	wmqJmsClient-2.0

appSecurity-3.0	jaxrs-2.1	jsonp-1.1	websocket-1.1
beanValidation-2.0	jaxrsClient-2.1	jsf-2.3	
cdi-2.0	jdbc-4.2	jsp-2.3	
ejbLite-3.2	jndi-1.0	managedBeans-1.0	
el-3.0	jpa-2.2	servlet-4.0	
jaspic-1.1	jsonb-1.0	ssl-1.0	

# Eclipse MicroProfile



# Eclipse MicroProfile

- Builds on Java EE
- By the Java EE community
- Open Source at Eclipse
- Multiple Implementations

```
@Path("/")
public class RestEE {

    @GET
    @Counter
    @Traced
    public String hello() {
        return "Hello MicroProfile!!";
    }
}
```

# Server Configuration

Module 4



# Simple Config



```
<server>
  <featureManager>
    <feature>jsp-2.3</feature>
  </featureManager>

  <webApplication location="myweb.war" contextRoot="/" />

  <applicationManager autoExpand="true"/>
</server>
```

server.xml

-Xmx1g  
-Dsystem.prop=value

jvm.options

WLP\_OUTPUT\_DIR=/usr/wlp-out/

server.env

# Composing Config



```
<server>
  <httpEndpoint id="defaultHttpEndpoint" host="${host}"
                httpPort="${http}"
                httpsPort="${https}"/>
</server>
```

configDropins/defaults/common-http.xml

```
<server>
  <include location="https://myHost/ports.xml" />
  <variable name="host" value="${my.host}" />
  <variable name="http" value="${my.host.http}" />
  <variable name="https" value="${my.host.https}" />
</server>
```

configDropins/overrides/ports.xml

# Externalizing Configuration

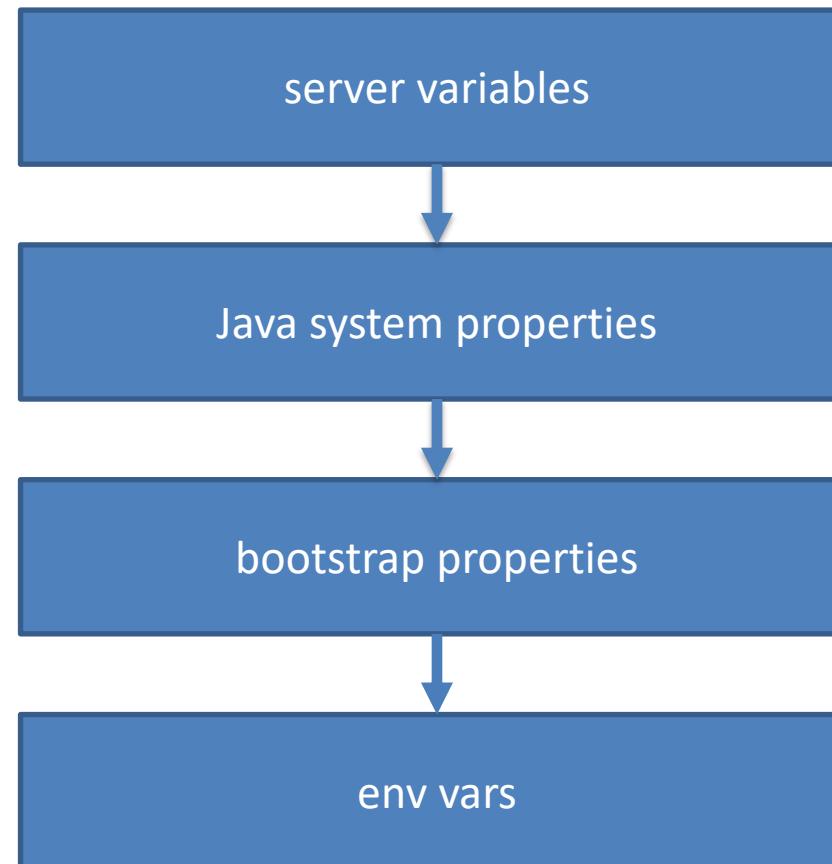
Module 5



# Variable Resolution



- Liberty variable resolution happens top to bottom



# Externalizing Config



```
<server>
  <httpEndpoint id="defaultHttpEndpoint" host="*"
    httpPort="${env.SERVER_HTTP_PORT}"
    httpsPort="${env.SERVER_HTTPS_PORT}"/>
</server>
```

configDropins/defaults/common-http.xml

# Eclipse MicroProfile

- Inject Configuration
- Sourced from
  - Properties file
  - Java system properties
  - Environment

```
@Path("/")
public class RestEE {

    @Inject
    @ConfigProperty("name")
    private String name;

    @GET
    @Counter
    @Traced
    public String hello() {
        return "Hello " + name;
    }
}
```

# Testing

Module 6



# Testing



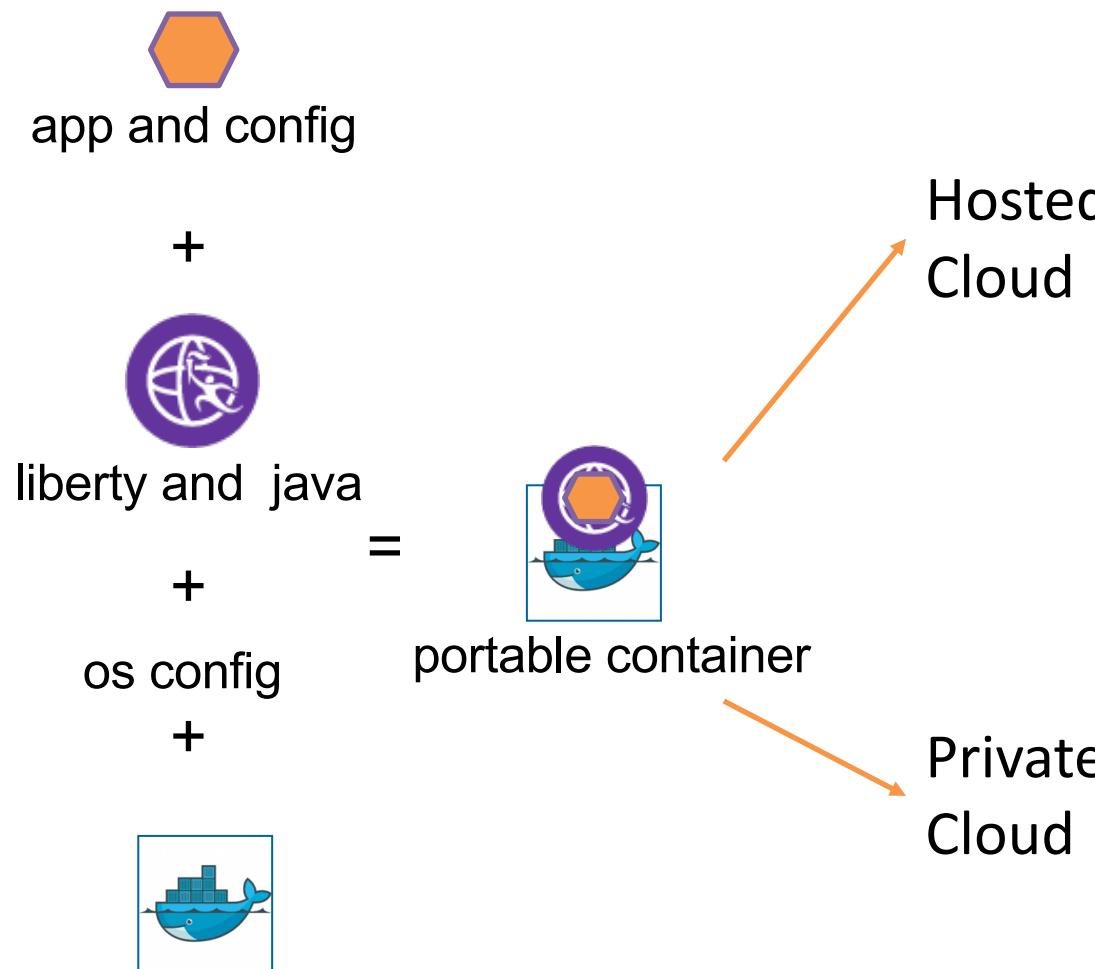
- Use maven-surefire-plugin to run unit test
  - Use CDI dependency injection to make your code is easy to mock & unit test
- Use maven-failsafe-plugin to run integration test
  - liberty-maven-app-parent predefined executions help
- Use Liberty Arquillian integration to run tests on a Liberty server
- Use MicroShed Testing for system testing in Containers (Module 8)

# Docker

Module 7



# Liberty in Containers



- IBM Cloud Kubernetes Service
- Azure Kubernetes Service
- Google Kubernetes Engine
- Amazon Elastic Kubernetes Service
- Jelastic
  
- Red Hat Open Shift Container Platform
- Pivotal Kubernetes Service
- Pivotal Cloud Foundry

```
FROM open-liberty  
ADD myapp.war /config/dropins/myapp.war
```

# Making the most of Docker



# Testing in Containers

Module 8



# MicroShed Testing

- Integration tests that are easy to setup, write, and run
- Test your apps the same way they run in production...in Containers
- Can run multiple containers on same network (e.g. test DB integration)
- <https://microshed.github.io/>

```
@MicroShedTest
public class MyTest {

    // Search for Dockerfile.
    // Start app in Container.
    // Wait for Container before running tests.
    @Container
    public static MicroProfileApplication app
        = new MicroProfileApplication()
            .withAppContextRoot("/myservice");

    // Inject JAX-RS REST Client
    @Inject
    public static MyService mySvc;

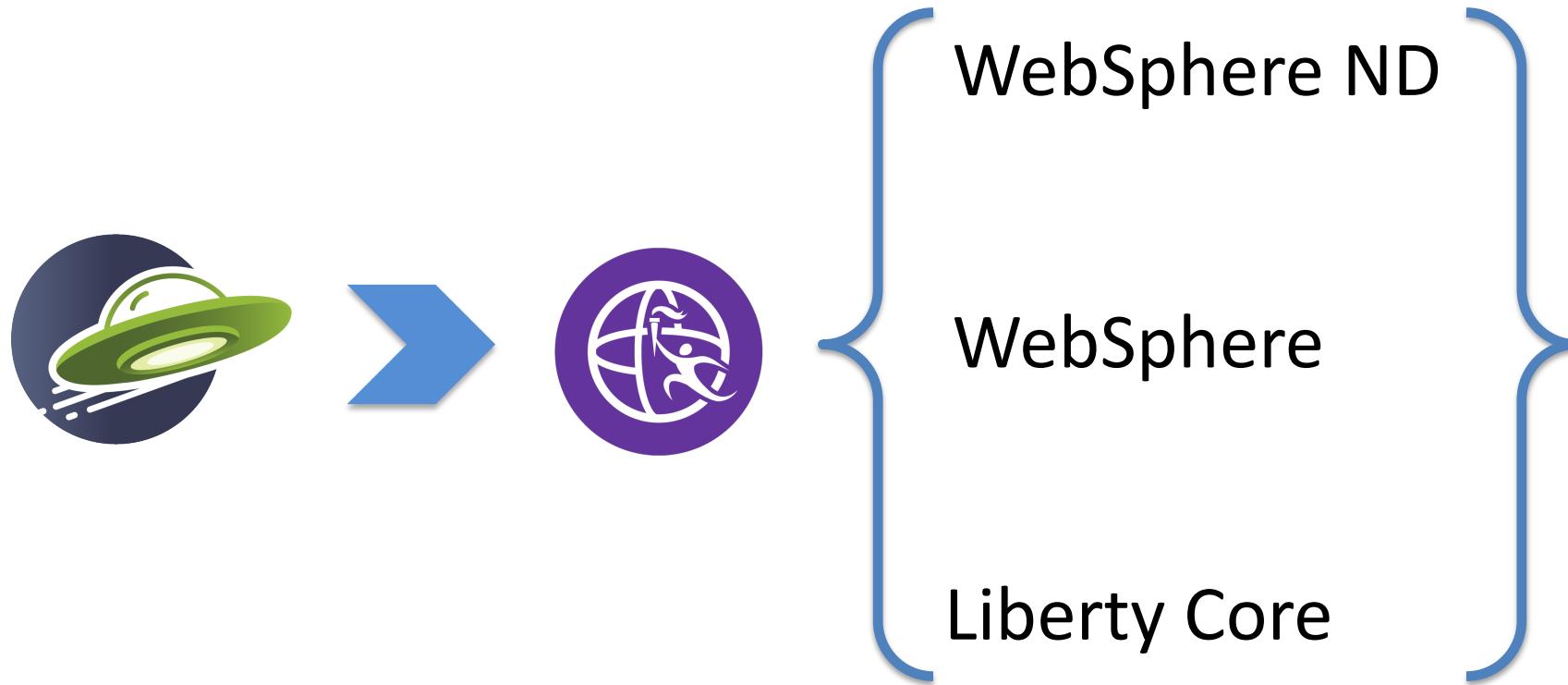
    // A test method like any other
    @Test
    public void testMyService() {
        ...
    }
}
```

# Support Licensing

Module 9



# Buy WebSphere Liberty



<https://www.ibm.com/cloud/websphere-application-server/pricing>

# Licensing Options

You are not alone...

**Whether you're an enterprise or a smaller crew, there's Open Liberty support for all**

IBM Cloud Pak for  
Applications

I'm an IBM customer wanting to  
modernize to OpenShift.

IBM Support

WebSphere  
Application Server

I just want support for Open  
Liberty.

IBM Support

Red Hat Runtimes

I'm a Red Hat customer wanting  
to deploy into OpenShift.

Red Hat Support

# Wrap-up



# Mastersclass hands-on content

- [Open Liberty Masterclass](#)
  - [Table of Contents](#)
  - [Before you begin](#)
    - [Install Pre-requisites](#)
    - [Prime Maven and Docker Caches](#)
  - [The Application](#)
  - [Module 1: Build](#)
  - [Module 2: Dev Mode](#)
  - [Module 3: Application APIs](#)
  - [Module 4: Server Configuration](#)
  - [Module 5: Externalizing Configuration](#)
  - [Module 6: Integration Testing](#)
  - [Module 7: Docker](#)
    - [Overriding Dev Server Configuration](#)
  - [Module 8: Support Licensing](#)
  - [Conclusion](#)



# Guides

The quickest way to learn all things Open Liberty, and beyond!

Filter guides

## DEVELOP (29 guides)

[Getting started](#)[RESTful service](#)[Reactive service](#)[Configuration](#)[Fault tolerance](#)[Observability](#)[Security](#)[Persistence](#)[Client side](#)

## BUILD AND TEST (8 guides)

[Build](#)[Test](#)[Containerize](#)

## DEPLOY (8 guides)

[Kubernetes](#)[Cloud deployment](#)

## Developing your cloud-native application

### Getting started

#### Getting started with Open Liberty

Learn how to develop a Java application on Open Liberty with Maven and Docker.

25 minutes

#### Injecting dependencies into microservices

Learn how to use Contexts and Dependency Injection (CDI) to manage and inject dependencies into microservices.

15 minutes

### RESTful service

#### Creating a RESTful web service

Learn how to create a REST service with JAX-RS, JSON-B, and Open Liberty.

#### Consuming RESTful services with template interfaces

Learn how to use MicroProfile Rest Client to invoke RESTful services over HTTP in a type-safe way.

#### Consuming a RESTful web service

Explore how to access a simple RESTful web service and consume its resources in Java using JSON-B and JSON-P.

#### Documenting RESTful APIs

Explore how to document and filter RESTful APIs from code or static files by using MicroProfile OpenAPI.

# Thank You

