



OpenJDK 11

Using jlink to customize Java runtime environment

OpenJDK 11 Using jlink to customize Java runtime environment

Legal Notice

Copyright © 2021 Red Hat, Inc.

The text of and illustrations in this document are licensed by Red Hat under a Creative Commons Attribution–Share Alike 3.0 Unported license ("CC-BY-SA"). An explanation of CC-BY-SA is available at

<http://creativecommons.org/licenses/by-sa/3.0/>

. In accordance with CC-BY-SA, if you distribute this document or an adaptation of it, you must provide the URL for the original version.

Red Hat, as the licensor of this document, waives the right to enforce, and agrees not to assert, Section 4d of CC-BY-SA to the fullest extent permitted by applicable law.

Red Hat, Red Hat Enterprise Linux, the Shadowman logo, the Red Hat logo, JBoss, OpenShift, Fedora, the Infinity logo, and RHCE are trademarks of Red Hat, Inc., registered in the United States and other countries.

Linux[®] is the registered trademark of Linus Torvalds in the United States and other countries.

Java[®] is a registered trademark of Oracle and/or its affiliates.

XFS[®] is a trademark of Silicon Graphics International Corp. or its subsidiaries in the United States and/or other countries.

MySQL[®] is a registered trademark of MySQL AB in the United States, the European Union and other countries.

Node.js[®] is an official trademark of Joyent. Red Hat is not formally related to or endorsed by the official Joyent Node.js open source or commercial project.

The OpenStack[®] Word Mark and OpenStack logo are either registered trademarks/service marks or trademarks/service marks of the OpenStack Foundation, in the United States and other countries and are used with the OpenStack Foundation's permission. We are not affiliated with, endorsed or sponsored by the OpenStack Foundation, or the OpenStack community.

All other trademarks are the property of their respective owners.

Abstract

OpenJDK 11 is a Red Hat offering on the Red Hat Enterprise Linux platform. The Using jlink to customize Java runtime images guide provides an overview of Jlink, and explains how to create and use customize Java runtime image using jlink.

Table of Contents

| | |
|--|----|
| MAKING OPEN SOURCE MORE INCLUSIVE | 3 |
| PROVIDING FEEDBACK ON RED HAT DOCUMENTATION | 4 |
| CHAPTER 1. OVERVIEW OF JLINK | 5 |
| CHAPTER 2. CREATING A CUSTOM JAVA RUNTIME ENVIRONMENT FOR NON-MODULAR APPLICATIONS | 6 |
| CHAPTER 3. CREATING A CUSTOM JAVA RUNTIME ENVIRONMENT FOR MODULAR APPLICATIONS .. | 10 |

MAKING OPEN SOURCE MORE INCLUSIVE

Red Hat is committed to replacing problematic language in our code, documentation, and web properties. We are beginning with these four terms: master, slave, blacklist, and whitelist. Because of the enormity of this endeavor, these changes will be implemented gradually over several upcoming releases. For more details, see [our CTO Chris Wright's message](#).

PROVIDING FEEDBACK ON RED HAT DOCUMENTATION

We appreciate your feedback on our documentation. To provide feedback, you can highlight the text in a document and add comments.

This section explains how to submit feedback.

Prerequisites

- You are logged in to the Red Hat Customer Portal.
- In the Red Hat Customer Portal, view the document in **Multi-page HTML** format.

Procedure

To provide your feedback, perform the following steps:

1. Click the **Feedback** button in the top-right corner of the document to see existing feedback.



NOTE

The feedback feature is enabled only in the **Multi-page HTML** format.

2. Highlight the section of the document where you want to provide feedback.
3. Click the **Add Feedback** pop-up that appears near the highlighted text.
A text box appears in the feedback section on the right side of the page.
4. Enter your feedback in the text box and click **Submit**.
A documentation issue is created.
5. To view the issue, click the issue tracker link in the feedback view.

CHAPTER 1. OVERVIEW OF JLINK

Jlink is a Java command line tool that is used to generate a custom Java runtime environment (JRE). You can use your customized JRE to run Java applications.

Using jlink, you can create a custom runtime environment that only includes the relevant class file.

CHAPTER 2. CREATING A CUSTOM JAVA RUNTIME ENVIRONMENT FOR NON-MODULAR APPLICATIONS

You can create a custom Java runtime environment (JRE) from a non-modular application using the **jlink** tool.

Prerequisites

- Install [OpenJDK 11](#).



NOTE

It is always recommended to use the [portable tarball](#) as a basis of jlink'ed runtime.

Procedure

1. Create a simple Hello World application using Logger class.
 - a. You have the base OpenJDK 11 available in the **jdk-11** folder:

```
$ ls jdk-11
bin conf demo include jmods legal lib man NEWS release
$ ./jdk-11/bin/java -version
openjdk version "11.0.10" 2021-01-19 LTS
OpenJDK Runtime Environment 18.9 (build 11.0.10+9-LTS)
OpenJDK 64-Bit Server VM 18.9 (build 11.0.10+9-LTS, mixed mode)
```

- b. Create a directory for your application:

```
$ mkdir -p hello-example/sample
```

- c. Create **hello-example/sample/HelloWorld.java** file with the following content:

```
package sample;

import java.util.logging.Logger;

public class HelloWorld {
    private static final Logger LOG = Logger.getLogger(HelloWorld.class.getName());
    public static void main(String[] args) {
        LOG.info("Hello World!");
    }
}
```

- d. Compile your application:

```
$ ./jdk-11/bin/javac -d . $(find hello-example -name \*.java)
```

- e. Run your application **without** a custom JRE:

```
$ ./jdk-11/bin/java sample.HelloWorld
Mar 09, 2021 10:48:59 AM sample.HelloWorld main
INFO: Hello World!
```

In this case, the base OpenJDK takes 311 MB to run a single class.

- f. (Optional) You can inspect the OpenJDK and see many non-required modules for your application:

```
$ du -sh jdk-11/
313M jdk-11/

$ ./jdk-11/bin/java --list-modules
java.base@11.0.10
java.compiler@11.0.10
java.datatransfer@11.0.10
java.desktop@11.0.10
java.instrument@11.0.10
java.logging@11.0.10
java.management@11.0.10
java.management.rmi@11.0.10
java.naming@11.0.10
java.net.http@11.0.10
java.prefs@11.0.10
java.rmi@11.0.10
java.scripting@11.0.10
java.se@11.0.10
java.security.jgss@11.0.10
java.security.sasl@11.0.10
java.smartcardio@11.0.10
java.sql@11.0.10
java.sql.rowset@11.0.10
java.transaction.xa@11.0.10
java.xml@11.0.10
java.xml.crypto@11.0.10
jdk.accessibility@11.0.10
jdk.aot@11.0.10
jdk.attach@11.0.10
jdk.charsets@11.0.10
jdk.compiler@11.0.10
jdk.crypto.cryptoki@11.0.10
jdk.crypto.ec@11.0.10
jdk.dynalink@11.0.10
jdk.editpad@11.0.10
jdk.hotspot.agent@11.0.10
jdk.httpserver@11.0.10
jdk.internal.ed@11.0.10
jdk.internal.jvmstat@11.0.10
jdk.internal.le@11.0.10
jdk.internal.opt@11.0.10
jdk.internal.vm.ci@11.0.10
jdk.internal.vm.compiler@11.0.10
jdk.internal.vm.compiler.management@11.0.10
jdk.jartool@11.0.10
jdk.javadoc@11.0.10
jdk.jcmd@11.0.10
jdk.jconsole@11.0.10
jdk.jdeps@11.0.10
jdk.jdi@11.0.10
```

```
jdk.jdwp.agent@11.0.10
jdk.jfr@11.0.10
jdk.jlink@11.0.10
jdk.jshell@11.0.10
jdk.jsobject@11.0.10
jdk.jstatd@11.0.10
jdk.localedata@11.0.10
jdk.management@11.0.10
jdk.management.agent@11.0.10
jdk.management.jfr@11.0.10
jdk.naming.dns@11.0.10
jdk.naming.ldap@11.0.10
jdk.naming.rmi@11.0.10
jdk.net@11.0.10
jdk.pack@11.0.10
jdk.rmic@11.0.10
jdk.scripting.nashorn@11.0.10
jdk.scripting.nashorn.shell@11.0.10
jdk.sctp@11.0.10
jdk.security.auth@11.0.10
jdk.security.jgss@11.0.10
jdk.unsupported@11.0.10
jdk.unsupported.desktop@11.0.10
jdk.xml.dom@11.0.10
jdk.zipfs@11.0.10
```

Sample **Hello World** application has very few dependencies. You can use jlink to create custom runtime images for your application. These images help you run your application with only required OpenJDK dependencies.

2. Determine module dependencies of your application using **jdeps** command:

```
$/jdk-11/bin/jdeps -s ./sample/HelloWorld.class
HelloWorld.class -> java.base
HelloWorld.class -> java.logging
```

3. Build a custom java runtime image for your application:

```
$/jdk-11/bin/jlink --add-modules java.base,java.logging --output custom-runtime
$ du -sh custom-runtime
50M custom-runtime/
$/custom-runtime/bin/java --list-modules
java.base@11.0.10
java.logging@11.0.10
```



NOTE

The size of your custom java runtime image is being reduced to 50M runtime image from 313M runtime image.

4. You can verify the reduced runtime of your application:

```
$ ./custom-runtime/bin/java sample.HelloWorld  
Jan 14, 2021 12:13:26 PM HelloWorld main  
INFO: Hello World!
```

The generated JRE with your sample application does not have any other dependencies.

You can distribute your application together with your custom runtime for deployment.



NOTE

Rebuild the custom java runtime images for your application with every security update of your base OpenJDK.

CHAPTER 3. CREATING A CUSTOM JAVA RUNTIME ENVIRONMENT FOR MODULAR APPLICATIONS

You can create a custom Java runtime environment from a modular application using the **jlink** tool.

Prerequisites

- Install [OpenJDK 11](#).



NOTE

It is always recommended to use the [portable tarball](#) as a basis of Jlink'ed runtime.

Procedure

1. Create a simple Hello World application using Logger class.
 - a. You have the base OpenJDK 11 available in the **jdk-11** folder:

```
$ ls jdk-11
bin conf demo include jmods legal lib man NEWS release
$ ./jdk-11/bin/java -version
openjdk version "11.0.10" 2021-01-19 LTS
OpenJDK Runtime Environment 18.9 (build 11.0.10+9-LTS)
OpenJDK 64-Bit Server VM 18.9 (build 11.0.10+9-LTS, mixed mode)
```

- b. Create a directory for your application:

```
$ mkdir -p hello-example/sample
```

- c. Create **hello-example/sample/HelloWorld.java** file with the following content:

```
package sample;

import java.util.logging.Logger;

public class HelloWorld {
    private static final Logger LOG = Logger.getLogger(HelloWorld.class.getName());
    public static void main(String[] args) {
        LOG.info("Hello World!");
    }
}
```

- d. Create **hello-example/module-info.java** file with the following content:

```
module sample
{
    requires java.logging;
}
```

- e. Compile your application:

```
$ ./jdk-11/bin/javac -d example $(find hello-example -name \*.java)
```

- f. Run your application **without** a custom JRE:

```
$ ./jdk-11/bin/java -cp example sample.HelloWorld
Mar 09, 2021 10:48:59 AM sample.HelloWorld main
INFO: Hello World!
```

In this case, the base OpenJDK takes 311 MB to run a single class.

- g. (Optional) You can inspect the OpenJDK and see many non-required modules for your application:

```
$ du -sh jdk-11/
313M jdk-11/
```

```
$ ./jdk-11/bin/java --list-modules
java.base@11.0.10
java.compiler@11.0.10
java.datatransfer@11.0.10
java.desktop@11.0.10
java.instrument@11.0.10
java.logging@11.0.10
java.management@11.0.10
java.management.rmi@11.0.10
java.naming@11.0.10
java.net.http@11.0.10
java.prefs@11.0.10
java.rmi@11.0.10
java.scripting@11.0.10
java.se@11.0.10
java.security.jgss@11.0.10
java.security.sasl@11.0.10
java.smartcardio@11.0.10
java.sql@11.0.10
java.sql.rowset@11.0.10
java.transaction.xa@11.0.10
java.xml@11.0.10
java.xml.crypto@11.0.10
jdk.accessibility@11.0.10
jdk.aot@11.0.10
jdk.attach@11.0.10
jdk.charsets@11.0.10
jdk.compiler@11.0.10
jdk.crypto.cryptoki@11.0.10
jdk.crypto.ec@11.0.10
jdk.dynalink@11.0.10
jdk.editpad@11.0.10
jdk.hotspot.agent@11.0.10
jdk.httpserver@11.0.10
jdk.internal.ed@11.0.10
jdk.internal.jvmstat@11.0.10
jdk.internal.le@11.0.10
jdk.internal.opt@11.0.10
jdk.internal.vm.ci@11.0.10
```

```
jdk.internal.vm.compiler@11.0.10
jdk.internal.vm.compiler.management@11.0.10
jdk.jartool@11.0.10
jdk.javadoc@11.0.10
jdk.jcmd@11.0.10
jdk.jconsole@11.0.10
jdk.jdeps@11.0.10
jdk.jdi@11.0.10
jdk.jdwp.agent@11.0.10
jdk.jfr@11.0.10
jdk.jlink@11.0.10
jdk.jshell@11.0.10
jdk.jsobject@11.0.10
jdk.jstatd@11.0.10
jdk.localedata@11.0.10
jdk.management@11.0.10
jdk.management.agent@11.0.10
jdk.management.jfr@11.0.10
jdk.naming.dns@11.0.10
jdk.naming.ldap@11.0.10
jdk.naming.rmi@11.0.10
jdk.net@11.0.10
jdk.pack@11.0.10
jdk.rmic@11.0.10
jdk.scripting.nashorn@11.0.10
jdk.scripting.nashorn.shell@11.0.10
jdk.sctp@11.0.10
jdk.security.auth@11.0.10
jdk.security.jgss@11.0.10
jdk.unsupported@11.0.10
jdk.unsupported.desktop@11.0.10
jdk.xml.dom@11.0.10
jdk.zipfs@11.0.10
```

Sample **Hello World** application has very few dependencies. You can use jlink to create custom runtime images for your application. These images help you run your application with only required OpenJDK dependencies.

2. Create your application module:

```
$ mkdir sample-module
$ ./jdk-11/bin/jmod create --class-path example/ --main-class sample.HelloWorld --module-version 1.0.0 -p example sample-module/hello.jmod
```

3. Create a custom JRE with the required modules and a custom application launcher for your application.

```
$ ./jdk-11/bin/jlink --launcher hello=sample/sample.HelloWorld --module-path sample-module --add-modules sample --output custom-runtime
```

4. List the modules of the produced custom JRE.
Observe that only a fraction of the original OpenJDK remains.

```
$ du -sh custom-runtime
50M custom-runtime/
```



```
$ ./custom-runtime/bin/java --list-modules
java.base@11.0.10
java.logging@11.0.10
sample@1.0.0
```

**NOTE**

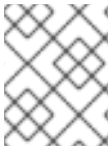
The size of your custom java runtime image is being reduced to 50M runtime image from 313M runtime image.

5. Launch the application using the **hello** launcher.

```
$ ./custom-runtime/bin/hello
Jan 14, 2021 12:13:26 PM HelloWorld main
INFO: Hello World!
```

The generated JRE with your sample application does not have any other dependencies other than **java.base**, **java.logging**, and **sample** module.

You can distribute your application bundled with the custom runtime in **custom-runtime**. It includes your application.

**NOTE**

Rebuild the custom java runtime images for your application with every security update of your base OpenJDK.

Revised on 2021-07-21 14:56:00 UTC