Red Hat JBoss Data Grid 7.2

Getting Started Guide

For use with Red Hat JBoss Data Grid 7.2

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Legal Notice

Abstract

This guide outlines introductory concepts and operations within Red Hat JBoss Data Grid 7.2

Table of Contents

PART I. INTRODUCING RED HAT JBOSS DATA GRID

CHAPTER 1. RED HAT JBOSS DATA GRID

1.1. RED HAT JBOSS DATA GRID

Red Hat JBoss Data Grid is a distributed in-memory data grid, which provides the following capabilities:

- Schemaless key-value store – JBoss Data Grid is a NoSQL database that provides the flexibility to store different objects without a fixed data model.
- Grid-based data storage – JBoss Data Grid is designed to easily replicate data across multiple nodes.
- Elastic scaling – Adding and removing nodes is simple and non-disruptive.
- Multiple access protocols – It is easy to access the data grid using REST, Memcached, Hot Rod, or simple map-like API.

1.2. SUPPORTED CONFIGURATIONS

The set of supported features, configurations, and integrations for Red Hat JBoss Data Grid (current and past versions) are available at the Supported Configurations page at https://access.redhat.com/articles/115883.

1.3. COMPONENTS AND VERSIONS

Red Hat JBoss Data Grid includes many components for Library and Remote Client-Server modes. A comprehensive (and up to date) list of components included in each of these usage modes and their versions is available in the *Red Hat JBoss Data Grid Component Details* page at https://access.redhat.com/articles/488833

1.4. RED HAT JBOSS DATA GRID USAGE MODES

1.4.1. Red Hat JBoss Data Grid Usage Modes

Red Hat JBoss Data Grid offers two usage modes:

- Remote Client-Server mode
- Library mode

1.4.2. Remote Client-Server Mode

Remote Client-Server mode provides a managed, distributed, and clusterable data grid server. In Client-Server mode the server runs as a self-contained process, utilizing a container based on JBoss EAP, allowing client applications to remotely access the data grid server using **Hot Rod**, **Memcached** or **REST** client APIs.

All Red Hat JBoss Data Grid operations in Remote Client-Server mode are non-transactional. As a result, a number of features cannot be performed when running JBoss Data Grid in Remote Client-Server mode.

There are a number of benefits to running JBoss Data Grid in Remote Client-Server mode if Library mode features are not required. Remote Client-Server mode is client language agnostic, provided there is a client library for your chosen protocol. As a result, Remote Client-Server mode provides:

- easier scaling of the data grid.
- easier upgrades of the data grid without impact on client applications.

Run the following commands to start a standalone JBoss Data Grid instance in Remote Client-Server mode.

For Linux:

```
$JBOSS_HOME/bin/standalone.sh
```

For Windows:

```
$JBOSS_HOME\bin\standalone.bat
```

Run the following commands to start a managed domain JBoss Data Grid instance in Remote Client-Server mode.

For Linux:

```
$JBOSS_HOME/bin/domain.sh
```

For Windows:

```
$JBOSS_HOME\bin\domain.bat
```

1.4.3. Library Mode

Library mode allows building and deploying a custom runtime environment. The Library mode hosts a single data grid node in the applications process, with remote access to nodes hosted in other JVMs. Tested containers for Red Hat JBoss Data Grid Library mode includes Red Hat JBoss Enterprise Web Server 2.x and JBoss Enterprise Application Platform 7.x.

A number of features in JBoss Data Grid can be used in Library mode, but not in Remote Client-Server mode.

The following features require Library mode:

- transactions
- listeners and notifications

JBoss Data Grid can also be run as a standalone application in Java SE. Standalone mode is a supported alternative to running JBoss Data Grid in a container.

1.5. RED HAT JBOSS DATA GRID BENEFITS

Red Hat JBoss Data Grid provides the following benefits:

Benefits of JBoss Data Grid

Performance

Accessing objects from local memory is faster than accessing objects from remote data stores (such as a database). JBoss Data Grid provides an efficient way to store in-memory objects coming from a slower data source, resulting in faster performance than a remote data store. JBoss Data Grid also offers optimization for both clustered and non clustered caches to further improve performance.

Consistency

Storing data in a cache carries the inherent risk: at the time it is accessed, the data may be outdated (stale). To address this risk, JBoss Data Grid uses mechanisms such as cache invalidation and expiration to remove stale data entries from the cache. Additionally, JBoss Data Grid supports JTA, distributed (XA) and two-phase commit transactions along with transaction recovery and a version API to remove or replace data according to saved versions.

Massive Heap and High Availability

In JBoss Data Grid, applications no longer need to delegate the majority of their data lookup processes to a large single server database for performance benefits. JBoss Data Grid employs techniques such as replication and distribution to completely remove the bottleneck that exists in the majority of current enterprise applications.

Massive Heap and High Availability Example

In a sample grid with 16 blade servers, each node has 2 GB storage space dedicated for a replicated cache. In this case, all the data in the grid is copies of the 2 GB data. In contrast, using a distributed grid (assuming the requirement of one copy per data item, resulting in the capacity of the overall heap being divided by two) the resulting memory backed virtual heap contains 16 GB data. This data can now be effectively accessed from anywhere in the grid. In case of a server failure, the grid promptly creates new copies of the lost data and places them on operational servers in the grid.

Scalability

A significant benefit of a distributed data grid over a replicated clustered cache is that a data grid is scalable in terms of both capacity and performance. Adding a node to JBoss Data Grid increases throughput and capacity for the entire grid. JBoss Data Grid uses a consistent hashing algorithm that limits the impact of adding or removing a node to a subset of the nodes instead of every node in the grid.

Due to the even distribution of data in JBoss Data Grid, the only upper limit for the size of the grid is the group communication on the network. The network's group communication is minimal and restricted only to the discovery of new nodes. Nodes are permitted by all data access patterns to communicate directly via peer-to-peer connections, facilitating further improved scalability. JBoss Data Grid clusters can be scaled up or down in real time without requiring an infrastructure restart. The result of the real time application of changes in scaling policies results in an exceptionally flexible environment.

Data Distribution

JBoss Data Grid uses consistent hash algorithms to determine the locations for keys in clusters. Benefits associated with consistent hashing include:

- cost effectiveness.
- speed.
- deterministic location of keys with no requirements for further metadata or network traffic. Data distribution ensures that sufficient copies exist within the cluster to provide durability and fault tolerance, while not an abundance of copies, which would reduce the environment's scalability.

Persistence

JBoss Data Grid exposes a **CacheStore** interface and several high-performance implementations, including the JDBC Cache stores and file system based cache stores. Cache stores can be used to populate the cache when it starts and to ensure that the relevant data remains safe from corruption. The cache store also overflows data to the disk when required to prevent running out of memory.

Language bindings

JBoss Data Grid supports both the popular Memcached protocol, with existing clients for a large number of popular programming languages, as well as an optimized JBoss Data Grid specific protocol called Hot Rod. As a result, instead of being restricted to Java, JBoss Data Grid can be used for any major website or application. Additionally, remote caches can be accessed using the HTTP protocol via a RESTful API.

Management

In a grid environment of several hundred or more servers, management is an important feature. JBoss Operations Network, the enterprise network management software, is the best tool to manage multiple JBoss Data Grid instances. JBoss Operations Network's features allow easy and effective monitoring of the Cache Manager and cache instances.

Remote Data Grids

Rather than scale up the entire application server architecture to scale up your data grid, JBoss Data Grid provides a Remote Client-Server mode which allows the data grid infrastructure to be upgraded independently from the application server architecture. Additionally, the data grid server can be assigned different resources than the application server and also allow independent data grid upgrades and application redeployment within the data grid.

1.6. RED HAT JBOSS DATA GRID AND INFINISPAN

Red Hat JBoss Data Grid is based on Infinispan, the open source community version of the data grid software. Infinispan uses code, designs, and ideas from JBoss Cache that are tried and tested under load in production deployments. For this reason, the initial release of JBoss Data Grid is version 6.0 to reflect integration of proven software.

The following table lists the correlation between JBoss Data Grid and Infinispan versions.

Table 1.1. JBoss Data Grid and Infinispan Versioning

JBoss Data Grid Version	Infinispan Version
JBoss Data Grid 6.0.0	Infinispan 5.1.5
JBoss Data Grid 6.0.1	Infinispan 5.1.7
JBoss Data Grid 6.1.0	Infinispan 5.2.4
JBoss Data Grid 6.2.0	Infinispan 6.0.1
JBoss Data Grid 6.3.0	Infinispan 6.1.0
JBoss Data Grid 6.3.1	Infinispan 6.1.1
JBoss Data Grid 6.4.0	Infinispan 6.2.0
JBoss Data Grid 6.4.1	Infinispan 6.2.1

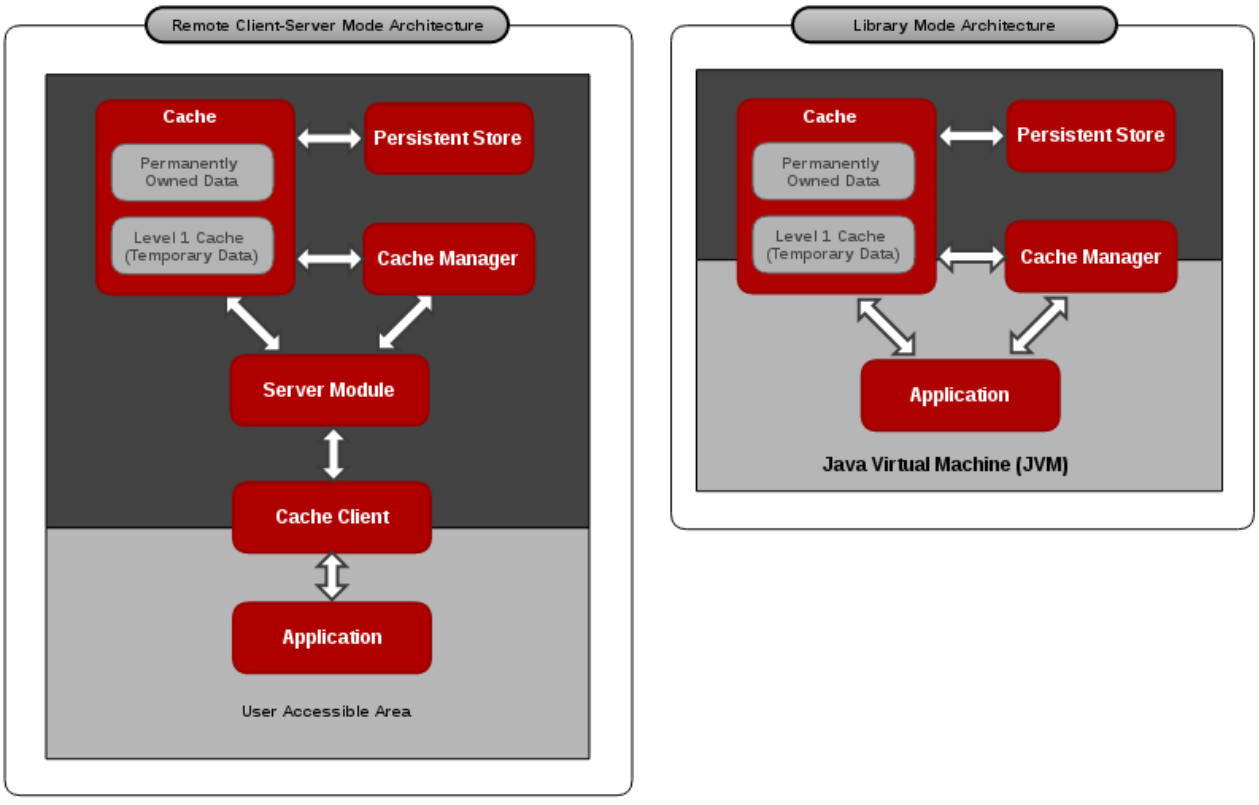
JBoss Data Grid Version	Infinispan Version
JBoss Data Grid 6.5.0	Infinispan 6.3.0
JBoss Data Grid 6.5.1	Infinispan 6.3.1
JBoss Data Grid 6.6.0	Infinispan 6.4.0
JBoss Data Grid 7.0.0	Infinispan 8.3.0
JBoss Data Grid 7.1.0	Infinispan 8.4.0
JBoss Data Grid 7.2.0	Infinispan 8.5.0

NOTE

As of Red Hat JBoss Data Grid 6.2.0, JBoss Data Grid versions do no do not directly correspond to Infinispan versions. In the preceding table, some Infinispan versions listed for JBoss Data Grid 6.3.0 and later are internal to Red Hat and might not be publicly available.

1.7. RED HAT JBOSS DATA GRID CACHE ARCHITECTURE

Figure 1.1. Red Hat JBoss Data Grid Cache Architecture



Red Hat JBoss Data Grid's cache infrastructure depicts the individual elements and their interaction with each other in each JBoss Data Grid Usage Mode (Library and Remote Client-Server). For clarity, each cache architecture diagram is separated into two parts:

- Elements that a user cannot directly interact with are depicted within a dark grey box in the diagram. In Remote Client-Server mode, this includes Persistent Store, Cache, Cache Manager, L1 Cache, and Server Module. In Library mode, user cannot directly interact with Persistent Store and L1 Cache.
- Elements that a user can interact directly with are depicted in a light grey box in the diagram. In Remote Client-Server mode, this includes the Application and the Cache Client. In Library mode, users are allowed to interact with the Cache and Cache Manager, as well as the Application.

Cache Architecture Elements

JBoss Data Grid's cache architecture includes the following elements:

1. The Persistent Store is an optional component. It can permanently store the cached entries for restoration after a data grid shutdown.
2. The Level 1 Cache (or L1 Cache) stores remote cache entries after they are initially accessed, preventing unnecessary remote fetch operations for each subsequent use of the same entries.
3. The Cache Manager controls the life cycle of Cache instances and can store and retrieve them when required.
4. The Cache is the main component for storage and retrieval of the key-value entries.

Library and Remote Client-Server Mode Architecture

In Library mode, the Application (user code) can interact with the Cache and Cache Manager components directly. In this case the Application resides in the same Java Virtual Machine (JVM) and can call Cache and Cache Manager Java API methods directly.

In Remote Client-Server mode, the Application does not directly interact with the cache. Additionally, the Application usually resides in a different JVM, on different physical host, or does not need to be a Java Application. In this case, the Application uses a Cache Client that communicates with a remote JBoss Data Grid Server over the network using one of the supported protocols such as Memcached, Hot Rod, or REST. The appropriate server module handles the communication on the server side. When a request is sent to the server remotely, it translates the protocol back to the concrete operations performed on the cache component to store and retrieve data.

1.8. RED HAT JBOSS DATA GRID APIS

Red Hat JBoss Data Grid provides the following programmable APIs:

- Cache
- Batching
- Grouping
- Persistence (formerly CacheStore)
- ConfigurationBuilder

- Externalizable
- Notification (also known as the Listener API because it deals with Notifications and Listeners)

JBoss Data Grid offers the following APIs to interact with the data grid in Remote Client-Server mode:

- The Asynchronous API (can only be used in conjunction with the Hot Rod Client in Remote Client-Server Mode)
- The REST Interface
- The Memcached Interface
- The Hot Rod Interface
  - The RemoteCache API

PART II. DOWNLOAD AND INSTALL RED HAT JBOSS DATA GRID

CHAPTER 2. DOWNLOAD RED HAT JBOSS DATA GRID

2.1. RED HAT JBOSS DATA GRID INSTALLATION PREREQUISITES

The only prerequisite to set up Red Hat JBoss Data Grid is an installed Java Virtual Machine (compatible with Java 8.0 or later).

2.2. JAVA VIRTUAL MACHINE

A Java Virtual Machine (JVM) is a virtual environment that runs and executes Java programs on a host operating system. The JVM acts as an abstract computer and is a platform-independent execution environment that converts the Java programming code into machine language. A Java Virtual Machine (JVM) makes Java portable by providing an abstraction layer between the compiled Java program and the underlying hardware platform and operating system.

Red Hat recommends using OpenJDK Java platform as it is an open source, supported Java Virtual Machine that runs well on Red Hat Enterprise Linux systems. For Windows users, Oracle JDK 1.8 installation is recommended.

2.3. INSTALL OPENJDK ON RED HAT ENTERPRISE LINUX

Install OpenJDK on Red Hat Enterprise Linux

1. Subscribe to the Base Channel
   Obtain the OpenJDK from the RHN base channel. Your installation of Red Hat Enterprise Linux is subscribed to this channel by default.

2. Install the Package
   Use the yum utility to install OpenJDK:

   ```
   $ sudo yum install java-1.8.0-openjdk-devel
   ```

3. Verify that OpenJDK is the System Default
   Ensure that the correct JDK is set as the system default as follows:

   a. Log in as a user with root privileges and run the alternatives command:

      ```
      $ /usr/sbin/alternatives --config java
      ```

   b. Select */usr/lib/jvm/java-1.8.0-openjdk-${java-version}.x86_64/bin/java* .

   c. Use the following command to set *javac* :

      ```
      $ /usr/sbin/alternatives --config javac
      ```

   d. Select */usr/lib/jvm/java-1.8.0-openjdk-${java-version}.x86_64/bin/javac* .

2.4. DOWNLOAD AND INSTALL JBOSS DATA GRID

2.4.1. Download and Install JBoss Data Grid

Use the following steps to download and install Red Hat JBoss Data Grid:

1. Download JBoss Data Grid from the Red Hat Customer Portal.
2. Verify the downloaded files.
3. Install JBoss Data Grid.

2.4.2. Download Red Hat JBoss Data Grid

Follow the listed steps to download Red Hat JBoss Data Grid from the Customer Portal:

Download JBoss Data Grid

1. Log into the Customer Portal at https://access.redhat.com.
2. Click the **Downloads** button near the top of the page.
3. In the **Product Downloads** page, click *Red Hat JBoss Data GridRed Hat JBoss Data Grid.
4. Select the appropriate JBoss Data Grid version from the **Version** drop down menu.
5. Download the appropriate files from the list that is displayed.

2.4.3. About the Red Hat Customer Portal

The *Red Hat Customer Portal* is the centralized platform for Red Hat knowledge and subscription resources. Use the *Red Hat Customer Portal* to do the following:

- Manage and maintain Red Hat entitlements and support contracts.
- Download officially-supported software.
- Access product documentation and the Red Hat Knowledgebase.
- Contact Global Support Services.
- File bugs against Red Hat products.

The Customer Portal is available here: https://access.redhat.com.

2.4.4. Checksum Validation

Checksum validation is used to ensure a downloaded file has not been corrupted. Checksum validation employs algorithms that compute a fixed-size datum (or checksum) from an arbitrary block of digital data. If two parties compute a checksum of a particular file using the same algorithm, the results will be identical. Therefore, when computing the checksum of a downloaded file using the same algorithm as the supplier, if the checksums match, the integrity of the file is confirmed. If there is a discrepancy, the file has been corrupted in the download process.

2.4.5. Verify the Downloaded File

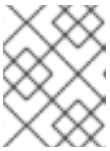
Verify the Downloaded File

1. To verify that a file downloaded from the Red Hat Customer Portal is error-free, access the

portal site and go to that package's Software Details page. The Software Details page displays the *MD5* and *SHA256* checksum values. Use the checksum values to check the integrity of the file.

2. Open a terminal window and run either the **md5sum** or **sha256sum** command, with the downloaded file as an argument. The program displays the checksum value for the file as the output for the command.

3. Compare the checksum value returned by the command to the corresponding value displayed on the Software Details page for the file.



NOTE

Microsoft Windows does not come equipped with a checksum tool. Windows operating system users have to download a third-party product instead.

Result

If the two checksum values are identical then the file has not been altered or corrupted and is, therefore, safe to use.

If the two checksum values are not identical, then download the file again. A difference between the checksum values means that the file has either been corrupted during download or has been modified since it was uploaded to the server. If, after several downloads, the checksum will still not successfully validate, contact Red Hat Support for assistance.

2.4.6. Install Red Hat JBoss Data Grid

Prerequisite

Locate the appropriate version, platform, and file type and download Red Hat JBoss Data Grid from the Customer Portal.

Install JBoss Data Grid

1. Copy the downloaded JBoss Data Grid package to the preferred location on your machine.

2. Run the following command to extract the downloaded JBoss Data Grid package:

```
$ unzip JDG_PACKAGE
```

   Replace **JDG_PACKAGE** with the name of the JBoss Data Grid usage mode package downloaded from the Red Hat Customer Portal.

3. The resulting unzipped directory will now be referred to as **$JDG_HOME**.

2.4.7. Red Hat Documentation Site

Red Hat's official documentation site is available at https://access.redhat.com/site/documentation/. There you will find the latest version of every book, including this one.

CHAPTER 3. INSTALL AND USE THE MAVEN REPOSITORIES

3.1. ABOUT MAVEN

Apache Maven is a distributed build automation tool used in Java application development to create, manage, and build software projects. Maven uses standard configuration files called Project Object Model (POM) files to define projects and manage the build process. POM files describe the module and component dependencies, build order, and targets for the resulting project packaging and output using an XML file. This ensures that the project is built correctly and in a uniform manner.

IMPORTANT

Red Hat JBoss Data Grid requires Maven 3 (or better) for all quickstarts and general use.

Visit the Maven Download page (http://maven.apache.org/download.html) for instructions to download and install Maven.

3.2. REQUIRED MAVEN REPOSITORIES

Red Hat JBoss Data Grid Quickstarts require the following Maven repositories to be set up as a prerequisite:

- The JBoss Data Grid Maven Repository, installed using the instructions in Install the Maven Repository
- The **ga-all-repository** (https://maven.repository.redhat.com/ga/all/)

Both Maven repositories are installed in the same way. As a result, the subsequent instructions are for both repositories.

3.3. INSTALL THE MAVEN REPOSITORY

3.3.1. Install the Maven Repository

There are three ways to install the required repositories:

1. On your local file system (Local File System Repository Installation).
2. On Apache Web Server (Apache httpd Repository Installation).
3. With a Maven repository manager (Maven Repository Manager Installation).

Use the option that best suits your environment.

3.3.2. Local File System Repository Installation

This option is best suited for initial testing in a small team. Follow the outlined procedure to extract the Red Hat JBoss Data Grid and JBoss Enterprise Application Platform Maven repositories to a directory in your local file system:

Local File System Repository Installation (JBoss Data Grid)

1. Log Into the Customer Portal
   In a browser window, navigate to the Customer Portal page (https://access.redhat.com/home) and log in.

2. Download the JBoss Data Grid Repository File
   Download the *jboss-datagrid-{VERSION}-maven-repository.zip* file from the Red Hat Customer Portal.

3. Unzip the file to a directory on your local file system (for example *$JDG_HOME/projects/maven-repositories/*).

The above procedure will create a new *jboss-datagrid-${jdg-version}-maven-repository* directory, which contains the Maven repository in a subdirectory entitled *maven-repository/* .

3.3.3. Apache httpd Repository Installation

This example will cover the steps to download the JBoss Data Grid Maven Repository for use with Apache httpd. This option is good for multi-user and cross-team development environments because any developer that can access the web server can also access the Maven repository.

NOTE

Apache httpd must be configured for the following steps to work. For instructions on configuring Apache refer to the Apache HTTP Server Project.

1. Open a web browser and access
   https://access.redhat.com/jbossnetwork/restricted/listSoftware.html?product=data.grid

2. Find **Red Hat JBoss Data Grid 7.2.1 Maven Repository** in the list.

3. Click the **Download** button to download a .zip file containing the repository.

4. Unzip the files in a directory that is web accessible on the Apache server.

5. Configure Apache to allow read access and directory browsing in the created directory.

3.3.4. Maven Repository Manager Installation

This option is ideal if you are already using a repository manager.

The Red Hat JBoss Data Grid and JBoss Enterprise Application Server repositories are installed using a Maven repository manager using its documentation. Examples of such repository managers are:

- Apache Archiva: link: http://archiva.apache.org/
- JFrog Artifactory: http://www.jfrog.com/products.php
- Sonatype Nexus: http://nexus.sonatype.org/ For details, see Install the JBoss Enterprise Application Platform Using Nexus.

3.4. CONFIGURE THE MAVEN REPOSITORY

3.4.1. Configure the Maven Repository

To configure the installed Red Hat JBoss Data Grid Maven repository, edit the *settings.xml* file. This file may be configured in one of two locations:

1. User level - Maven user settings are located in the *${user.home}/.m2/* directory:
   - For Linux or Mac environments this is typically *~/.m2/*
   - For Windows environments this is typically *\Documents and Settings\.m2* or *\Users\.m2*
2. Global level - Settings for all users on a machine, assuming they are all using the same Maven installation, is typically provided in *${maven.home}/conf/settings.xml*

See to view sample Maven configurations, and refer to the Maven Documentation for more information about configuring Maven.

3.4.2. Configuring the JBoss Data Grid Maven Repository in an Offline Environment

In certain environments it is preferred to have the Maven repository available offline.

To accomplish this configuration perform the following steps:

Prerequisites:

- The Red Hat JBoss Data Grid Maven repository has been downloaded to the internal network where it will be referenced.
- JBoss Data Grid 7.0 and later depends on the JBoss EAP Maven repository. You should also download this repository to the internal network where it will be referenced.
- An internal repository, such as Sonatype Nexus or Apache Archiva, is available on the network that contains Maven dependencies.

Configure the JBoss Data Grid Maven Repository for Offline Usage

1. Install the downloaded JBoss Data Grid Maven repository locally, following the instructions in Local File System Repository Installation.
2. Update the *settings.xml* to point to the locally extracted repository, as seen in Configure the Maven Repository. A sample configuration is shown below:

```
<?xml version="1.0" encoding="UTF-8"?>

<settings xmlns="http://maven.apache.org/SETTINGS/1.0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://maven.apache.org/SETTINGS/1.0.0
http://maven.apache.org/xsd/settings-1.0.0.xsd">

  <profiles>
    <profile>
      <id>jboss-datagrid-repository</id>
      <repositories>
        <repository>
          <id>jboss-datagrid-repository</id>
          <name>JBoss Data Grid Maven Repository</name>
          <url>file:///path/to/jboss-datagrid-7.2.0-maven-repository/maven-repository</url>
          <layout>default</layout>
```

```
            <releases>
              <enabled>true</enabled>
              <updatePolicy>never</updatePolicy>
            </releases>
            <snapshots>
              <enabled>false</enabled>
              <updatePolicy>never</updatePolicy>
            </snapshots>
          </repository>
        </repositories>
        <pluginRepositories>
          <pluginRepository>
            <id>jboss-datagrid-repository</id>
            <name>JBoss Data Grid Maven Repository</name>
            <url>file:///path/to/jboss-datagrid-7.2.0-maven-repository/maven-repository</url>
            <layout>default</layout>
            <releases>
              <enabled>true</enabled>
              <updatePolicy>never</updatePolicy>
            </releases>
            <snapshots>
              <enabled>false</enabled>
              <updatePolicy>never</updatePolicy>
            </snapshots>
          </pluginRepository>
        </pluginRepositories>
      </profile>
    </profiles>
    <activeProfiles>
      <!-- make the profile active by default -->
      <activeProfile>jboss-datagrid-repository</activeProfile>
    </activeProfiles>

  </settings>
```

3. Ensure that projects may now be built locally.

3.4.3. Next Steps

After the newest available version of Red Hat JBoss Data Grid is installed and Maven is set up and configured, see to learn how to use JBoss Data Grid for the first time.

3.5. MAVEN TRANSITIVE DEPENDENCIES

When building projects with Maven it will discover and download the dependencies of any included libraries. These additional libraries are referred to as Transitive, or Transient, Dependencies, and are discussed in Maven's documentation at Transitive Dependencies.

As JBoss Data Grid jar files contain all necessary dependencies to use the product, it is possible to have the same dependency included multiple times if both these jars and individual JBoss Data Grid Maven artifact(s) are specified.

To prevent this issue only **one** of the following should be used per Maven project:

- Use the included uberjars, **infinspan-embedded** and **infinispan-remote** as the only

dependency for JBoss Data Grid. Defining the uberjar will pull in all necessary components for that distribution (Library or Remote Client-Server Mode), and instructions for including these dependencies are found in Run JBoss Data Grid With Maven .

- Use the individual components from JBoss Data Grid, such as **infinispan-core**. Each component should either be defined in the parent **pom.xml**, or be a dependency of a defined component.

Alternatively, if the individual components are known they may be excluded. The following example assumes that **infinispan-core** is being included twice; once from a defined dependency and the second time as a transient dependency.

```
...
<dependencies>
  <dependency>
    <groupId>org.infinispan</groupId>
    <artifactId>infinispan-embedded</artifactId>
    <version>${infinispan.version}</version>
    <scope>compile</scope>
    <exclusions>
      <exclusion>  <!-- declare the exclusion here -->
        <groupId>org.infinispan</groupId>
        <artifactId>infinispan-core</artifactId>
      </exclusion>
    </exclusions>
  </dependency>
</dependencies>
...
```

PART III. SUPPORTED CONTAINERS FOR JBOSS DATA GRID

CHAPTER 4. USING JBOSS DATA GRID WITH SUPPORTED CONTAINERS

4.1. USING JBOSS DATA GRID WITH SUPPORTED CONTAINERS

Red Hat JBoss Data Grid can be used in the following runtimes:

- Java SE, started by your application.
- As a standalone JBoss Data Grid server.
- Bundled as a library in your application, deployed to an application server, and started by your application. For example, JBoss Data Grid can be used with Tomcat or Weblogic.
- Inside an OSGi runtime environment, in this case, Apache Karaf.

For a list of containers supported with Red Hat JBoss Data Grid, see the Release Notes or the support information here: https://access.redhat.com/articles/2435931

4.2. DEPLOY JBOSS DATA GRID IN JBOSS EAP (LIBRARY MODE)

Red Hat JBoss Data Grid provides a set of modules for Red Hat JBoss Enterprise Application Platform 7.x. Using these modules means that JBoss Data Grid libraries do not need to be included in the user deployment. To avoid conflicts with the Infinispan modules that are already included with JBoss EAP, the JBoss Data Grid modules are placed within a separate slot and identified by the JBoss Data Grid version (**major**.**minor**).

NOTE

The JBoss EAP modules are not included in JBoss EAP. Instead, navigate to the Customer Support Portal at http://access.redhat.com to download these modules from the Red Hat JBoss Data Grid downloads page.

To deploy JBoss Data Grid in JBoss EAP, add dependencies from the JBoss Data Grid module to the application's classpath (the JBoss EAP deployer) in one of the following ways:

- Add a dependency to the *jboss-deployment-structure.xml* file.
- Add a dependency to the *MANIFEST.MF* file.
- Generate the *MANIFEST.MF* file via Maven.

Add a Dependency to the jboss-deployment-structure.xml File

Add the following configuration to the *jboss-deployment-structure.xml* file:

```
<jboss-deployment-structure xmlns="urn:jboss:deployment-structure:1.2">
  <deployment>
    <dependencies>
      <module name="org.infinispan" slot="jdg-7.2" services="export"/>
    </dependencies>
  </deployment>
</jboss-deployment-structure>
```

NOTE

For details about the *jboss-deployment-structure.xml* file, see the Red Hat JBoss Enterprise Application Platform documentation.

Add a Dependency to the MANIFEST.MF File.

Add a dependency to the *MANIFEST.MF* files as follows:

MANIFEST.MF File

```
Manifest-Version: 1.0
Dependencies: org.infinispan:jdg-7.2 services
```

The first line remains the same as the example. Depending on the dependency required, add one of the following to the second line of the file:

- JBoss Data Grid Core:

  ```
  Dependencies: org.infinispan:jdg-7.2 services
  ```

- Embedded Query:

  ```
  Dependencies: org.infinispan:jdg-7.2 services, org.infinispan.query:jdg-7.2 services,
  org.infinispan.query.dsl:jdg-7.2 services
  ```

- JDBC Cache Store:

  ```
  Dependencies: org.infinispan:jdg-7.2 services, org.infinispan.persistence.jdbc:jdg-7.2
  services
  ```

- JPA Cache Store:

  ```
  Dependencies: org.infinispan:jdg-7.2 services, org.infinispan.persistence.jpa:jdg-7.2 services
  ```

- LevelDB Cache Store:

  ```
  Dependencies: org.infinispan:jdg-7.2 services, org.infinispan.persistence.leveldb:jdg-7.2
  services
  ```

- CDI:

  ```
  Dependencies: org.infinispan:jdg-7.2 services, org.infinispan.cdi:jdg-7.2 meta-inf
  ```

Generate the MANIFEST.MF file via Maven

The *MANIFEST.MF* file is generated during the build (specifically during the JAR or WAR process). As an alternative to adding a dependency to the *MANIFEST.MF* file, configure the dependency directly in Maven by adding the following to the *pom.xml* file:

```
<plugin>
 <artifactId>maven-war-plugin</artifactId>
 <version>2.4</version>
```

```
 <configuration>
  <failOnMissingWebXml>false</failOnMissingWebXml>
  <archive>
   <manifestEntries>
    <Dependencies>org.infinispan:jdg-7.2 services</Dependencies>
   </manifestEntries>
  </archive>
 </configuration>
</plugin>
```

4.3. DEPLOY JBOSS DATA GRID IN JBOSS EAP (REMOTE CLIENT-SERVER MODE)

4.3.1. Deploy JBoss Data Grid in JBoss EAP (Remote Client-Server Mode)

Red Hat JBoss Data Grid provides a set of modules for Red Hat JBoss Enterprise Application Platform 7.x. Using these modules means that JBoss Data Grid libraries do not need to be included in the user deployment. To avoid conflicts with the Infinispan modules that are already included with JBoss EAP, the JBoss Data Grid modules are placed within a separate slot and identified by the JBoss Data Grid version (**major**.**minor**).

NOTE

The JBoss EAP modules are not included in JBoss EAP. Instead, navigate to the Customer Support Portal at http://access.redhat.com to download these modules from the Red Hat JBoss Data Grid downloads page.

To deploy JBoss Data grid in JBoss EAP, add dependencies from the JBoss Data Grid module to the application's classpath (the JBoss EAP deployer) in one of the following ways:

- Add a dependency to the *jboss-deployment-structure.xml* file.
- Add a dependency to the *MANIFEST.MF* file.

Add a Dependency to the jboss-deployment-structure.xml File

Add the following configuration to the *jboss-deployment-structure.xml* file:

```
<jboss-deployment-structure xmlns="urn:jboss:deployment-structure:1.2">
   <deployment>
      <dependencies>
         <module name="org.infinispan.commons" slot="jdg-7.2" services="export"/>
         <module name="org.infinispan.client.hotrod" slot="jdg-7.2" services="export"/>
      </dependencies>
   </deployment>
</jboss-deployment-structure>
```

NOTE

For details about the *jboss-deployment-structure.xml* file, see the Red Hat JBoss Enterprise Application Platform documentation.

Add a Dependency to the MANIFEST.MF File.

Add a dependency to the *MANIFEST.MF* files as follows:

Example MANIFEST.MF File

```
Manifest-Version: 1.0
Dependencies: org.infinispan.commons:jdg-7.2 services, org.infinispan.client.hotrod:jdg-7.2 services
```

The first line remains the same as the example. Depending on the dependency required, add one of the following to the second line of the file:

- Basic Hot Rod client:

```
org.infinispan.commons:jdg-7.2 services, org.infinispan.client.hotrod:jdg-7.2 services
```

- Hot Rod client with Remote Query functionality:

```
org.infinispan.commons:jdg-7.2 services, org.infinispan.client.hotrod:jdg-7.2 services,
org.infinispan.query.dsl:jdg-7.2 services, org.jboss.remoting3
```

4.3.2. Using Custom Classes with the Hot Rod client

Either of the following two methods may be used to use custom classes with the Hot Rod client:

- **Option 1:** Reference the deployment's class loader in the configuration builder for the Hot Rod client, as seen in the below example:

  Referencing the custom class loader in the ConfigurationBuilder instance

```
import org.infinispan.client.hotrod.configuration.ConfigurationBuilder;
[...]
ConfigurationBuilder config = new ConfigurationBuilder();
config.marshaller(new
GenericJBossMarshaller(Thread.currentThread().getContextClassLoader()));
```

- **Option 2:** Install the custom classes as their own module within JBoss EAP, and a dependency on the newly created module should be added to the JBoss Data Grid module at *${EAP_HOME}/modules/system/layers/base/org/infinispan/commons/jdg-7.x/module.xml* .

4.4. DEPLOY JBOSS DATA GRID IN JBOSS ENTERPRISE WEB SERVER

Red Hat JBoss Data Grid supports JBoss Enterprise Web Server in Library and Remote Client Server mode. To use JBoss Data Grid with JBoss Enterprise Web Server, bundle the JDG libraries in a web application and deploy the application on the server.

For further information on how to deploy JBoss Data Grid on JBoss Enterprise Web Server, see the Carmart Non-Transactional Quickstart in Red Hat JBoss Data Grid Quickstarts .

4.5. DEPLOY WEB APPLICATIONS ON WEBLOGIC SERVER (LIBRARY MODE)

Red Hat JBoss Data Grid supports the WebLogic 12c application server in Library mode. The following procedure describes how to deploy web applications on a WebLogic server.

Prerequisites

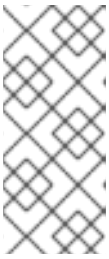
The prerequisites to deploy the web applications are as follows:

1. WebLogic Server 12c.
2. JBoss Data Grid Library (Embedded) mode.

Deploying Web Applications on a WebLogic Server

1. Create Web Applications
   Create a web application and add the libraries in the *WEB-INF* folder.
2. Create a weblogic.xml Deployment Descriptor
   Create a *weblogic.xml* deployment descriptor with the following elements in it:

```
<?xml version="1.0" encoding="UTF-8"?>
<weblogic-web-app
      xmlns="http://www.bea.com/ns/weblogic/90"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.bea.com/ns/weblogic/90
http://www.bea.com/ns/weblogic/90/weblogic-web-app.xsd">
   <container-descriptor>
      <prefer-web-inf-classes>true</prefer-web-inf-classes>
   </container-descriptor>
</weblogic-web-app>
```



NOTE

The **prefer-web-inf-classes** class indicates that the libraries and the classes in the *WEB-INF/lib* folder is preferred over the default libraries bundled in the WebLogic server. For example, the *commons-pool.jar* file in the WebLogic server has version 1.4 and is automatically loaded by the classloader, but the Hot Rod client uses a newer version of this library.

3. Pack the Web Application into a Web Archive File
   Create a web application archive (WAR) file of the web application and verify that the JBoss Data Grid libraries are in the *WEB-INF* folder along with the WebLogic deployment descriptor file.
4. Deploy the Application onto the WebLogic Server
   To deploy the web application using the Infinispan CDI module, stop the WebLogic server if it is running, apply the patch on it (Patch file *p17424706_121200_Generic.zip*) and restart the WebLogic server. If the Infinispan CDI module is not being used, deploy the web application normally.

   For more information about applying patch to the WebLogic Server, see the *Oracle patch database* on the Oracle website.

4.6. DEPLOY WEB APPLICATIONS ON WEBLOGIC SERVER (REMOTE CLIENT-SERVER MODE)

Red Hat JBoss Data Grid supports the WebLogic 12c application server in Remote Client-Server mode. The following procedure describes how to deploy web applications on a WebLogic server.

Deploying Web Applications on a WebLogic Server

1. To install the WebLogic server, see http://docs.oracle.com/cd/E24329_01/doc.1211/e24492/toc.htm.

2. Configure JBoss Data Grid in Remote Client-Server mode, define cache, cache container, and endpoint configuration. After configuration, start JBoss Data Grid to confirm that the Hot Rod endpoint is listening on the configured port. For information about configuring JBoss Data Grid in Remote Client-Server, see Run Red Hat JBoss Data Grid in Remote Client-Server Mode .

3. Create a web application and add the *infinispan-remote* library as a dependency if Maven is used.

4. Create a *weblogic.xml* deployment descriptor with the following elements in it:

```
<?xml version="1.0" encoding="UTF-8"?>
<weblogic-web-app
      xmlns="http://www.bea.com/ns/weblogic/90"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.bea.com/ns/weblogic/90
http://www.bea.com/ns/weblogic/90/weblogic-web-app.xsd">
   <container-descriptor>
      <prefer-web-inf-classes>true</prefer-web-inf-classes>
   </container-descriptor>
</weblogic-web-app>
```

NOTE

The **prefer-web-inf-classes** class indicates that the libraries and classes in the *WEB-INF/lib* folder are preferred over the default libraries bundled in the WebLogic server. For example, the *commons-pool.jar* file in the WebLogic server has version 1.4 and is automatically loaded by the classloader, however the Hot Rod client uses a newer version of this library.

5. Add deployment descriptor file in the *WEB-INF* folder.

6. Ensure that the **infinispan-remote** dependency is added to the *pom.xml* file, then use a Maven plugin to create a web archive.
   Alternatively, create the web archive manually and add the library manually.

7. Deploy the application in the WebLogic server and verify that the Hot Rod client embedded inside the web application connects to the remote JBoss Data Grid server.

4.7. RUNNING RED HAT JBOSS DATA GRID IN KARAF (OSGI)

4.7.1. Running Red Hat JBoss Data Grid in Karaf (OSGi)

Apache Karaf is a powerful, lightweight OSGi-based runtime container into which components and applications are deployed. OSGi implements a dynamic component model that does not exist in standalone JVM environments. OSGi containers such as Karaf include a rich set of tools for managing the life cycle of an application.

All dependencies between individual modules, including version numbers, must be explicitly specified. Where more than one class of the same name exists, the strict rules of OSGi specify which of the classes will be used by your bundle.

4.7.2. Running a Deployment of JBoss Data Grid in Karaf (Remote Client-Server)

The Red Hat JBoss Data Grid Hot Rod client can be run in an OSGi-based container such as Karaf, allowing client applications deployed in Karaf to connect to pre-existing JBoss Data Grid servers.

Use the path in the JBoss Data Grid Maven repository to set up Karaf. Additionally, JBoss Data Grid requires a *features* file, located in *org/infinispan/infinispan-remote/${VERSION}* . This file lists all dependencies for the Hot Rod client in OSGi, while also making it simpler to install the feature into Karaf (version 2.3.3 or 3.0).

4.7.3. Installing the Hot Rod client feature in Karaf

Red Hat JBoss Data Grid's Hot Rod feature is installed in Karaf as follows:

Prerequisite

Configure the Red Hat JBoss Data Grid Maven Repository.

Install the Hot Rod Feature in Karaf

1. Karaf 2.3.3
   For Karaf 2.3.3 use the following commands:

   ```
   karaf@root features:addUrl mvn:org.infinispan/infinispan-remote/${VERSION}/xml/features
   ```

   ```
   karaf@root features:install infinispan-remote
   ```

   Verify that the feature was successfully installed as follows:

   ```
   karaf@root features:list
    //output
   ```

2. Karaf 3.0.0
   For Karaf use the following commands.

   ```
   karaf@root feature:repo-add mvn:org.infinispan/infinispan-remote/${VERSION}/xml/features
   ```

   ```
   karaf@root feature:install infinispan-remote
   ```

   Verify that the feature was successfully installed:

   ```
   karaf@root feature:list
   ```

Alternatively, use the **-i** command parameter to install the Hot Rod Client feature using the following:

```
karaf@root() feature:repo-add -i mvn:org.infinispan/infinispan-remote/${VERSION}/xml/features
```

4.7.4. Installing Red Hat JBoss Data Grid in Karaf (Library Mode)

The Red Hat JBoss Data Grid JAR files contain the required OSGi manifest headers and are used inside OSGi runtime environments as OSGi bundles. Additionally, the required third-party dependencies must be installed. These can be installed individually, or altogether via the *features* file, which defines all required dependencies.

To install bundles using the *features* file:

- Register the feature repositories inside Karaf.
- Install the features contained in the repositories.

Installing bundles using the *features* file

1. Start the Karaf console
   Start the Karaf console using the following commands:

```
$ cd $APACHE_KARAF_HOME/bin
$ ./karaf
```

2. Register a feature repository
   Register a feature repository as follows:

   a. For Karaf 2.3.3:

```
karaf@root() features:addUrl mvn:org.infinispan/infinispan-embedded/${VERSION}/xml/features
```

```
karaf@root features:install infinispan-embedded
```

   b. For Karaf 3.0.0:

```
karaf@root() feature:repo-add mvn:org.infinispan/infinispan-embedded/${VERSION}/xml/features
```

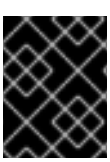
```
karaf@root feature:install infinispan-embedded
```

The URL for feature repositories is constructed from the Maven artifact coordinates using the following format:

```
mvn:<groupId>/<artifactId>/<version>/xml/features
```

IMPORTANT

The JPA Cache Store is not supported in Apache Karaf in JBoss Data Grid 7.2.



IMPORTANT

Querying in Library mode (which is covered in the JBoss Data Grid *Developer Guide*) is not supported in Apache Karaf in JBoss Data Grid 7.2.

CHAPTER 5. RUNNING RED HAT JBOSS DATA GRID WITH APACHE CAMEL

5.1. RUNNING RED HAT JBOSS DATA GRID WITH APACHE CAMEL

Apache Camel is an open source integration and routing system that allows transference of messages from various sources to different destinations, providing an integration framework that allows interaction with various systems using the same API, regardless of the protocol or data type. Using Camel with Red Hat JBoss Data Grid and Red Hat JBoss Fuse simplifies integration in large enterprise applications by providing a wide variety of transports and APIs that add connectivity.

JBoss Data Grid provides support for caching on Camel routes in JBoss Fuse, partially replacing Ehcache. JBoss Data Grid is supported as an embedded cache (local or clustered) or as a remote cache in a Camel route.

5.2. THE CAMEL-JBOSSDATAGRID COMPONENT

The Red Hat JBoss Data Grid **camel-jbossdatagrid** component includes the following features:

- **Local Camel Consumer**

  Receives cache change notifications and sends them to be processed. This can be done synchronously or asynchronously, and is also supported with a replicated or distributed cache.

- **Local Camel Producer**

  A producer creates and sends messages to an endpoint. The **camel-jbossdatagrid** producer uses **GET**, **PUT**, **REMOVE**, and **CLEAR** operations. The local producer is also supported with a replicated or distributed cache.

- **Remote Camel Producer**

  In Remote Client-Server mode, the Camel producer can send messages using Hot Rod.

- **Remote Camel Consumer**

  In Client-Server mode, receives cache change notifications and sends them to be processed. The events are processed asynchronously.

In JBoss Data Grid 7.2 the Camel component added the following features:

- Aggregation Repository
- Continuous Queries
- Remote Cache Configuration (Hot Rod client configuration via properties)
- Idempotent Repository
- Cache Statistics
- Store Results in Header
- GetOrDefault Operation

The following **camel-jbossdatagrid** dependency must be added to the *pom.xml* file to run JBoss Data Grid with Camel:

```
<dependency>
   <groupId>org.apache.camel</groupId>
   <artifactId>camel-jbossdatagrid</artifactId>
   <version>7.2.0.Final-redhat-9</version>
</dependency>
```

NOTE

The **camel-jbossdatagrid** component ships with JBoss Data Grid, and is not included in JBoss Fuse 6.3.

Camel components are the main extension point in Camel, and are associated with the name used in a URI, and act as a factory of endpoints. For example, a **FileComponent** is referred to in a URI as **file**, which creates **FileEndpoints**.

URI Format

The following URI format is used for **camel-jbossdatagrid**:

```
infinispan://cacheName?[options]
```

URI Options

The producer can create and send messages to a local or remote JBoss Data Grid cache configured in the registry. If a **cacheContainer** is present, the cache will be either local or remote, depending on whether the **cacheContainer** instance is a **DefaultCacheManager** or **RemoteCacheManager**. If it is not present, the cache will try to connect to remote cache using the supplied hostname/port.

A consumer listens for events from the local JBoss Data Grid cache accessible from the registry.

Table 5.1. URI Options

Name	Details
configuration	**Default Value**: null **Type**: InfinispanConfiguration **Context**: common **Description**: The default configuration shared among endpoints.
cacheContainer	**Default Value**: null **Type**: BasicCacheContainer **Context**: common **Description**: The default cache container.

Name	Details
resolveProperty Placeholders	**Default Value**: true **Type**: boolean **Context**: advanced **Description**: Whether the component should resolve property placeholders on itself when starting. Only properties which are of String type can use property placeholders.

The JBoss Data Grid endpoint is configured with the following URI syntax:

```
infinispan://cacheName?[options]
```

This endpoint can take the following path and query parameters:

Table 5.2. Path Parameters

Name	Details
cacheName	**Default Value**: null **Type**: string **Description**: This is a required parameter that specifies the cache to use.

Table 5.3. Query Parameters

Name	Details
hosts	**Default Value**: null **Type**: string **Context**: common **Description**: Specifies the host of the cache on the JBoss Data Grid instance.
queryBuilder	**Default Value**: null **Type**: InfinispanQueryBuilder **Context**: common **Description**: Specifies the query builder.

Name	Details
bridgeErrorHandler	**Default Value**: false **Type**: boolean **Context**: consumer **Description**: Allows for bridging the consumer to the Camel routing Error Handler which mean any exceptions occurred while the consumer is trying to pickup incoming messages or the likes will now be processed as a message and handled by the routing Error Handler. By default the consumer will use the **org.apache.camel.spi.ExceptionHandler** to deal with exceptions that will be logged at **WARN** or **ERROR** level and ignored.
clusteredListener	**Default Value**: false **Type**: boolean **Context**: consumer **Description**: If true the listener will be installed for the entire cluster.
customListener	**Default Value**: null **Type**: InfinispanCustomListener **Context**: consumer **Description**: Returns the custom listener in use if provided
eventTypes	**Default Value**: null **Type**: string **Context**: consumer **Description**: Specifies the set of event types to register by the consumer. Multiple event can be separated by comma. The possible event types are: CACHE_ENTRY_ACTIVATED CACHE_ENTRY_PASSIVATED CACHE_ENTRY_VISITED CACHE_ENTRY_LOADED CACHE_ENTRY_EVICTED CACHE_ENTRY_CREATED CACHE_ENTRY_REMOVED CACHE_ENTRY_MODIFIED TRANSACTION_COMPLETED TRANSACTION_REGISTERED CACHE_ENTRY_INVALIDATED DATA_REHASHED TOPOLOGY_CHANGED PARTITION_STATUS_CHANGED
sync	**Default Value**: true **Type**: boolean **Context**: consumer **Description**: If true the consumer will receive notifications synchronously.

Name	Details
exceptionHandler	**Default Value**: null **Type**: ExceptionHandler **Context**: consumer **Description**: To let the consumer use a custom ExceptionHandler. Notice if the option bridgeErrorHandler is enabled then this options is not in use. By default the consumer will deal with exceptions that will be logged at WARN or ERROR level and ignored.
exchangePattern	**Default Value**: null **Type**: ExchangePattern **Context**: consumer **Description**: Sets the exchange pattern when the consumer creates an exchange.
operation	**Default Value**: PUT **Type**: InfinispanOperation **Context**: producer **Description**: The operation to perform.
cacheContainer	**Default Value**: PUT **Type**: BasicCacheContainer **Context**: advanced **Description**: Specifies the cache container to connect
cacheContainerConfiguration	**Default Value**: null **Type**: object **Context**: advanced **Description**: The CacheContainer configuration
configurationProperties	**Default Value**: null **Type**: map **Context**: advanced **Description**: Implementation specific properties for the CacheManager

Name	Details
configurationUri	**Default Value**: null **Type**: string **Context**: advanced **Description**: An implementation specific URI for the CacheManager
flags	**Default Value**: null **Type**: string **Context**: advanced **Description**: A comma separated list of Flag to be applied by default on each cache invocation not applicable to remote caches.
resultHeader	**Default Value**: null **Type**: object **Context**: advanced **Description**: Store the operation result in a header instead of the message body. By default resultHeader == null and the query result is stored in the message body any existing content in the message body is discarded. If **resultHeader** is set the value is used as the name of the header to store the query result and the original message body is preserved. This value can be overridden by an in message header named: **CamelInfinispanOperationResultHeader**
synchronous	**Default Value**: false **Type**: boolean **Context**: advanced **Description**: Sets whether synchronous processing should be strictly used or Camel is allowed to use asynchronous processing (if supported).

Camel Operations

A list of all available operations, along with their header information, is found below:

Table 5.4. Put Operations

Operation Name	Description

Operation Name	Description
InfinispanOperation.PUT	**Context**: Embedded / Remote **Description**: Puts a key/value pair in the cache, optionally with expiration **Required Headers**: CamelInfinispanKey, CamelInfinispanValue **Optional Headers**: CamelInfinispanLifespanTime, CamelInfinispanLifespanTimeUnit, CamelInfinispanMaxIdleTime, CamelInfinispanMaxIdleTimeUnit, CamelInfinispanIgnoreReturnValues **Result Header**: CamelInfinispanOperationResult
InfinispanOperation.PUTASYNC	**Description**: Asynchronously puts a key/value pair in the cache, optionally with expiration
InfinispanOperation.PUTIFABSENT	**Description**: Puts a key/value pair in the cache if it did not exist, optionally with expiration
InfinispanOperation.PUTIFABSENTASYNC	**Description**: Asynchronously puts a key/value pair in the cache if it did not exist, optionally with expiration

Table 5.5. Put All Operations

Operation Name	Description
InfinispanOperation.PUTALL	**Context**: Embedded / Remote **Description**: Adds multiple entries to a cache, optionally with expiration **Required Headers**: CamelInfinispanMap **Optional Headers**: CamelInfinispanLifespanTime, CamelInfinispanLifespanTimeUnit, CamelInfinispanMaxIdleTime, CamelInfinispanMaxIdleTimeUnit **Result Header**: None
CamelInfinispanOperation.PUTALLASYNC	**Description**: Asynchronously adds multiple entries to a cache, optionally with expiration

Table 5.6. Get Operations

Operation Name	Description

Operation Name	Description
InfinispanOperation.GET	**Context**: Embedded / Remote **Description**: Retrieves the value associated with a specific key from the cache **Required Headers**: CamelInfinispanKey **Optional Headers**: None **Result Header**: None
InfinispanOperation.GETORDEFAULT	**Context**: Embedded / Remote **Description**: Retrieves the value, or default value, associated with a specific key from the cache **Required Headers**: CamelInfinispanKey **Optional Headers**: None **Result Header**: None

Table 5.7. Contains Key Operation

Operation Name	Description
InfinispanOperation.CONTAINSKEY	**Context**: Embedded / Remote **Description**: Determines whether a cache contains a specific key **Required Headers**: CamelInfinispanKey **Optional Headers**: None **Result Header**: CamelInfinispanOperationResult

Table 5.8. Contains Value Operation

Operation Name	Description

Operation Name	Description
InfinispanOperation.CONTAINSVALUE	**Context**: Embedded / Remote **Description**: Determines whether a cache contains a specific value **Required Headers**: CamelInfinispanKey **Optional Headers**: None **Result Headers**: None

Table 5.9. Remove Operations

Operation Name	Description
InfinispanOperation.REMOVE	**Context**: Embedded / Remote **Description**: Removes an entry from a cache, optionally only if the value matches a given one **Required Headers**: CamelInfinispanKey **Optional Headers**: CamelInfinispanValue **Result Header**: CamelInfinispanOperationResult
InfinispanOperation.REMOVEASYNC	**Description**: Asynchronously removes an entry from a cache, optionally only if the value matches a given one

Table 5.10. Replace Operations

Operation Name	Description
InfinispanOperation.REPLACE	**Context**: Embedded / Remote **Description**: Conditionally replaces an entry in the cache, optionally with expiration **Required Headers**: CamelInfinispanKey, CamelInfinispanValue, CamelInfinispanOldValue **Optional Headers**: CamelInfinispanLifespanTime, CamelInfinispanLifespanTimeUnit, CamelInfinispanMaxIdleTime, CamelInfinispanMaxIdleTimeUnit, CamelInfinispanIgnoreReturnValues **Result Header**: CamelInfinispanOperationResult
InfinispanOperation.REPLACEASYNC	**Description**: Asynchronously conditionally replaces an entry in the cache, optionally with expiration

Table 5.11. Clear Operations

Operation Name	Description
InfinispanOperation.CLEAR	**Context**: Embedded / Remote **Description**: Clears the cache **Required Headers**: None **Optional Headers**: None **Result Header**: None
InfinispanOperation.CLEARASYNC	**Context**: Embedded / Remote **Description**: Asynchronously clears the cache **Required Headers**: None **Optional Headers**: None **Result Header**: None

Table 5.12. Size Operation

Operation Name	Description
InfinispanOperation.SIZE	**Context**: Embedded / Remote **Description**: Returns the number of entries in the cache **Required Headers**: None **Optional Headers**: None **Result Header**: CamelInfinispanOperationResult

Table 5.13. Stats Operation

Operation Name	Description
InfinispanOperation.STATS	**Context**: Embedded / Remote **Description**: Returns statistics about the cache **Required Headers**: None **Optional Headers**: None **Result Header**: CamelInfinispanOperationResult

Table 5.14. Query Operation

Operation Name	Description
InfinispanOperation.QUERY	**Context**: Remote **Description**: Executes a query on the cache **Required Headers**: CamelInfinispanQueryBuilder **Optional Headers**: None **Result Header**: CamelInfinispanOperationResult

NOTE

Any operations that take **CamelInfinispanIgnoreReturnValues** will receive a null result.

Table 5.15. Message Headers

Name	Description
CamelInfinispanCacheName	**Default Value**: null **Type**: String **Context**: Shared **Description**: The cache participating in the operation or event.
CamelInfinispanMap	**Default Value**: null **Type**: Map **Context**: Producer **Description**: A Map to use in case of the **CamelInfinispanOperationPutAll** operation.
CamelInfinispanKey	**Default Value**: null **Type**: Object **Context**: Shared **Description**: The key to perform the operation to or the key generating the event.
CamelInfinispanValue	**Default Value**: null **Type**: Object **Context**: Producer **Description**: The value to use for the operation.

Name	Description
CamelInfinispanOperationResult	**Default Value**: null **Type**: Object **Context**: Producer **Description**: The result of the operation.
CamelInfinispanEventType	**Default Value**: null **Type**: String **Context**: Consumer **Description**: For local cache listeners (non-clustered), one of the following values: **CACHE_ENTRY_ACTIVATED**, **CACHE_ENTRY_PASSIVATED**, **CACHE_ENTRY_VISITED**, **CACHE_ENTRY_LOADED**, **CACHE_ENTRY_EVICTED**, **CACHE_ENTRY_CREATED**, **CACHE_ENTRY_REMOVED**, **CACHE_ENTRY_MODIFIED**. For remote HotRod listeners, one of the following values: **CLIENT_CACHE_ENTRY_CREATED**, **CLIENT_CACHE_ENTRY_MODIFIED**, **CLIENT_CACHE_ENTRY_REMOVED**, **CLIENT_CACHE_FAILOVER**.
CamelInfinispanIsPre	**Default Value**: null **Type**: Boolean **Context**: Consumer **Description**: Infinispan fires two events for each operation when local non-clustered listener is used: one before and one after the operation. For clustered listeners and remote HotRod listeners, Infinispan fires only one event after the operation.
CamelInfinispanQueryBuilder	**Default Value:** null **Type**: InfinispanQueryBuilder **Context**: Producer **Description**: An instance of**InfinispanQueryBuilder** that, in its **build()**, defines the query to be executed on the cache.

Name	Description
CamelInfinispanLifespanTime	**Default Value**: null **Type**: long **Context**: Producer **Description**: The Lifespan time of a value inside the cache. Negative values are interpreted as infinity.
CamelInfinispanTimeUnit	**Default Value**: null **Type**: String **Context**: Producer **Description**: The Time Unit of an entry Lifespan Time.
CamelInfinispanMaxIdleTime	**Default Value**: null **Type**: long **Context**: Producer **Description**: The maximum amount of time an entry is allowed to be idle for before it is considered as expired.
CamelInfinispanMaxIdleTimeUnit	**Default Value**: null **Type**: String **Context**: Producer **Description**: The Time Unit of an entry Max Idle Time.
CamelInfinispanOperationResultHeader	**Default Value**: null **Type**: String **Context**: Producer **Description**: Store the operation result in a header instead of the message body.

5.3. ROUTING WITH CAMEL IN JBOSS DATA GRID

Camel routing is a chain of processors that move messages in the background. The following is an example of a route that retrieves a value from the cache for a specific key.

```
from("direct:start")
   .setHeader(InfinispanConstants.OPERATION).constant(InfinispanOperation.GET)
   .setHeader(InfinispanConstants.KEY).constant("123")
   .to("infinispan?cacheContainer=#cacheContainer");
```

Routing can also be performed using XML configuration. The following example demonstrates camel-jbossdatagrid's **local-camel-producer**, a camel route that uses the **camel-jbossdatagrid** component to send data to an embedded cache created by the **local-cache** module.

```
<camelContext id="local-producer" xmlns="http://camel.apache.org/schema/blueprint">
    <route>
        <from uri="timer://local?fixedRate=true&amp;period=5000"/>
        <setHeader headerName="CamelInfinispanKey">
            <constant>CamelTimerCounter</constant>
        </setHeader>
        <setHeader headerName="CamelInfinispanValue">
            <constant>CamelTimerCounter</constant>
        </setHeader>
        <to uri="infinispan://foo?cacheContainer=#cacheManager"/>
        <to uri="log:local-put?showAll=true"/>
    </route>
</camelContext>
```

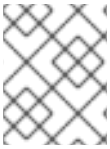
The provided example requires the **cacheManager** to be instantiated.

The **cacheManager** bean for Spring XML can be instantiated as follows:

```
<bean id="cacheManager" class="org.infinispan.manager.DefaultCacheManager" init-method="start"
destroy-method="stop">
    <constructor-arg type="java.lang.String" value="infinispan.xml"/>
</bean>
```

The following demonstrates how to instantiate the **cacheManager** bean using Blueprint XML.

```
<bean id="cacheManager" class="org.infinispan.manager.DefaultCacheManager" init-method="start"
destroy-method="stop">
    <argument value="infinispan.xml" />
</bean>
```



NOTE

Both the Spring XML and Blueprint XML examples use the configuration file *infinispan.xml* for configuration of the cache. This file must be present on the classpath.

5.4. REMOTE QUERY

When executing remote queries the cacheManager must be an instance of **RemoteCacheManager**, and an example configuration utilizing a **RemoteCacheManager** is found below for both Java and blueprint.xml:

Example 5.1. Using only Java

```
from("direct:start")
    .setHeader(InfinispanConstants.OPERATION, InfinispanConstants.QUERY)
    .setHeader(InfinispanConstants.QUERY_BUILDER,
      new InfinispanQueryBuilder() {
        public Query build(QueryFactory<Query> queryFactory) {
```

```
            return queryFactory.from(User.class).having("name").like("%abc%")
                    .build();
        }
       })
    .to("infinispan://localhost?
cacheContainer=#cacheManager&cacheName=remote_query_cache") ;
```

Example 5.2. Using Blueprint and Java

Java RemoteCacheManagerFactory class:

```
public class RemoteCacheManagerFactory {
    ConfigurationBuilder clientBuilder;
    public RemoteCacheManagerFactory(String hostname, int port) {
        clientBuilder = new ConfigurationBuilder();
        clientBuilder.addServer()
            .host(hostname).port(port);
    }
    public RemoteCacheManager newRemoteCacheManager() {
        return new RemoteCacheManager(clientBuilder.build());
    }
}
```

Java InfinispanQueryExample class:

```
public class InfinispanQueryExample {
    public InfinispanQueryBuilder getBuilder() {
        return new InfinispanQueryBuilder() {
            public Query build(QueryFactory<Query> queryFactory) {
                return queryFactory.from(User.class)
                        .having("name")
                        .like("%abc%")
                        .build();
            }
        }
    }
}
```

blueprint.xml:

```
<bean id=”remoteCacheManagerFactory”
class=“com.jboss.datagrid.RemoteCacheManagerFactory”>
    <argument value=”localhost”/>
    <argument value="11222”/>
</bean>

<bean id=”cacheManager”
    factory-ref=”remoteCacheManagerFactory”
    factory-method=“newRemoteCacheManager”>
</bean>

<bean id="queryBuilder" class="org.example.com.InfinispanQueryExample"/>
```

```
<camelContext id="route" xmlns="http://camel.apache.org/schema/blueprint">
   <route>
      <from uri="direct:start"/>
         <setHeader headerName="CamelInfinispanOperation">
            <constant>CamelInfinispanOperationQuery</constant>
         </setHeader>
         <setHeader headerName="CamelInfinispanQueryBuilder">
            <method ref="queryBuilder" method="getBuilder"/>
         </setHeader>
      <to uri="infinispan://localhost?
cacheContainer=#cacheManager&cacheName=remote_query_cache"/>
   </route>
</camelContext>
```

The **remote_query_cache** is an arbitrary name for a cache that holds the data, and the results of the query will be a list of domain objects stored as a **CamelInfinispanOperationResult** header.

In addition, there are the following requirements:

- The **RemoteCacheManager** must be configured to use **ProtoStreamMarshaller**.
- The **ProtoStreamMarshaller** must be registered with the **RemoteCacheManager**'s serialization context.
- The .proto descriptors for domain objects must be registered with the remote JBoss Data Grid server.

For more details on how to setup a **RemoteCacheManager**, see the **Remote Querying** section of the *Red Hat JBoss Data Grid Infinispan Query Guide* .

5.5. CUSTOM LISTENERS FOR EMBEDDED CACHE

Custom Listeners for an embedded cache can be registered through the **customListener** parameter as shown below:

Using Java

```
from("infinispan://?
cacheContainer=#myCustomContainer&cacheName=customCacheName&customListener=#myCustom
Listener")
  .to("mock:result");
```

Using Blueprint

```
<bean id="myCustomContainer" org.infinispan.manager.DefaultCacheManager"
     init-method="start" destroy-method="stop">
     <argument value="infinispan.xml" />
</bean>

<bean id="myCustomListener" class="org.example.com.CustomListener"/>

<camelContext id="route" xmlns="http://camel.apache.org/schema/blueprint">
   <route>
```

```
        <from uri="infinispan://?
cacheContainer=#myCustomContainer&cacheName=customCacheName&customListener=#myCustom
Listener"/>
        <to uri="mock:result"/>
    </route>
</camelContext>
```

The instance of **myCustomListener** must exist. Users are encouraged to extend the **org.apache.camel.component.infinispan.embedded.InfinispanEmbeddedCustomListener** and annotate the resulting class with the **@Listener** annotation from org.infinispan.notifications .

NOTE

Custom filters and converters for embedded caches are currently not supported.

5.6. CUSTOM LISTENERS FOR REMOTE CACHE

Custom listeners for a remote cache can be registered in the same way as an embedded cache, with the exception that **sync=false** must be present. For instance:

Example 5.3. Using only Java

```
from(infinispan://?
cacheContainer=#cacheManager&sync=false&customListener=#myCustomListener")
  .to(mock:result);
```

Example 5.4. Using Blueprint and Java

Java class:

```
public class RemoteCacheManagerFactory {
    ConfigurationBuilder clientBuilder;
    public RemoteCacheManagerFactory(String hostname, int port) {
        clientBuilder = new ConfigurationBuilder();
        clientBuilder.addServer()
            .host(hostname).port(port);
    }
    public RemoteCacheManager newRemoteCacheManager() {
        return new RemoteCacheManager(clientBuilder.build());
    }
}
```

blueprint.xml:

```
<bean id=”remoteCacheManagerFactory”
class=“com.jboss.datagrid.RemoteCacheManagerFactory”>
    <argument value=”localhost”/>
    <argument value="11222”/>
</bean>

<bean id=”cacheManager”
    factory-ref=”remoteCacheManagerFactory”
```

```
    factory-method="newRemoteCacheManager">
  </bean>

  <bean id="myCustomListener" class="org.example.com.CustomListener"/>

  <camelContext id="route" xmlns="http://camel.apache.org/schema/blueprint">
    <route>
      <from uri="infinispan://?
cacheContainer=#cacheManager&sync=false&customListener=#myCustomListener"/>
      <to uri="mock:result"/>
    </route>
  </camelContext>
```

The instance of **myCustomListener** must exist. Users are encouraged to extend the **org.apache.camel.component.infinispan.remote.InfinispanRemoteCustomListener** class and annotate the resulting class with **@ClientListener**; this annotation is found in org.infinispan.client.hotrod.annotation .

Remote listeners may also be associated with custom filters and converters as shown below:

```
@ClientListener(includeCurrentState=true, filterFactoryName = "static-filter-factory",
converterFactoryName = "static-converter-factory")
 private static class MyCustomListener extends InfinispanRemoteCustomListener {
}
```

In order to use custom filters or converters classes annotated with **@NamedFactory** must be implemented. A skeleton that implements the necessary methods is shown below:

```
import org.infinispan.notifications.cachelistener.filter;

@NamedFactory(name = "static-converter-factory")
public static class StaticConverterFactory implements CacheEventConverterFactory {
 @Override
 public CacheEventConverter<Integer, String, CustomEvent> getConverter(Object[] params) {
   ...
 }

 static class StaticConverter implements CacheEventConverter<Integer, String, CustomEvent>,
Serializable {
   @Override
   public CustomEvent convert(Integer key, String previousValue, Metadata previousMetadata,
                              String value, Metadata metadata, EventType eventType) {
     ...
   }
 }
}

@NamedFactory(name = "static-filter-factory")
public static class StaticCacheEventFilterFactory implements CacheEventFilterFactory {
 @Override
 public CacheEventFilter<Integer, String> getFilter(final Object[] params) {
   ...
 }
```

```
  static class StaticCacheEventFilter implements CacheEventFilter<Integer, String>, Serializable {
    @Override
    public boolean accept(Integer key, String previousValue, Metadata previousMetadata,
                          String value, Metadata metadata, EventType eventType) {
      ...
    }
  }
}
```

Custom filters and converters must be registered with the server. Registering these classes is documented in the **Remote Event Listeners** section of the *Red Hat JBoss Data Grid Developer Guide* .

NOTE

In order to listen for remote HotRod events the cacheManager must be of type **RemoteCacheManager** and instantiated.

5.7. RED HAT JBOSS DATA GRID AND RED HAT JBOSS FUSE

5.7.1. Installing camel-jbossdatagrid for Red Hat JBoss Fuse

Red Hat JBoss Fuse is an OSGi container based on the Karaf container. To run Red Hat JBoss Data Grid and JBoss Fuse using **camel-jbossdatagrid**, ensure that both JBoss Data Grid 7.2 and JBoss Fuse 6.1 (Full Installation) are installed.

Installing JBoss Data Grid

For information about installing JBoss Data Grid, see Download and Install Red Hat JBoss Data Grid . Only the following JBoss Data Grid components are required to run the camel component in JBoss Fuse: * JBoss Data Grid Maven repository. * The JBoss Data Grid Server package (to use the Hot Rod client).

The **camel-jbossdatagrid** library is also available in a separate distribution called *jboss-datagrid-7.2.0-camel-library*

Installing JBoss Fuse

Before attempting to install and use Red Hat JBoss Fuse, ensure your system meets the minimum requirements. For supported Platforms and recommended Java Runtime platforms, see the *Red Hat JBoss Fuse Installation Guide*

The following hardware is required for the JBoss Fuse 6.1 Full Installation:

- 700 MB of free disk space
- 2 GB of RAM

In addition to the disk space required for the base installation, a running system will require space for caching, persistent message stores, and other functions.

1. Download the JBoss Fuse Full Installation
   You can download the Red Hat JBoss Fuse archive from the *Red Hat Customer Portal>Downloads>Red Hat JBoss Middleware>Downloads* page, after you register and login to your customer account.

   When logged in:

a. Select **Fuse** , listed under **Integrated Platforms** in the sidebar menu.

b. Select **6.1.0** from the Version drop-down list on the Software Downloads page.

c. Click the **Download** button next to the Red Hat JBoss Fuse 6.1.0 distribution file to download.

JBoss Fuse allows you to choose between installations that contain different feature sets. To run JBoss Data Grid with JBoss Fuse, the Full installation is required. The Full installation includes the following:

- Apache Karaf
- Apache Camel
- Apache ActiveAMQ
- Apache CXF
- Fuse Management
- Console (hawtio)
- JBI components

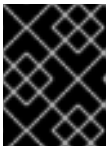
2. Unpacking the Archive
Red Hat JBoss Fuse is installed by unpacking an archive on a system. JBoss Fuse is packaged as a zip file. Using a suitable archive tool, unpack Red Hat JBoss Fuse into a directory to which you have full access.

WARNING

Do not unpack the archive file into a folder that has spaces in its path name. For example, do not unpack into *C:\Documents and Settings\Greco Roman\Desktop\fusesrc*.

Additionally, do not unpack the archive file into a folder that has any of the following special characters in its path name: #, %, ^, ".

3. Adding a Remote Console User
The server's remote command console is not configured with a default user. Before remotely connecting to the server's console, add a user to the configuration.



IMPORTANT

The information in this file is unencrypted so it is not suitable for environments that require strict security.

To add a user:

a. Open *InstallDir/etc/users.properties* in your favorite text editor.

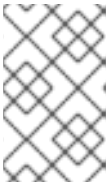
b. Locate the line **#admin=admin,admin**. This line specifies a user **admin** with the password **admin** and the role **admin**.

c. Remove the leading # to uncomment the line.

d. Replace the first **admin** with a name for the user.

e. Replace the second **admin** with the password for the user.

f. Leave the last **admin** as it is, and save the changes.



NOTE

To access the Fuse Management Console to monitor and manage your Camel routes, ActiveMQ brokers, Web applications, and so on, open a browser to , after starting Red Hat JBoss Fuse.

4. Red Hat JBoss Fuse Maven Repositories
To use Maven to build projects, specify the location of the artifacts in a Maven *settings.xml* file.

The following JBoss Fuse Maven repository contains the required dependencies for Camel and must be added to the *settings.xml* file.

```
https://repo.fusesource.com/nexus/content/groups/public/
```

The JBoss Fuse repository runs alongside the JBoss Data Grid repository.

JBoss Data Grid includes a *features.xml* file for Karaf that deploys all artifacts required for the **camel-jbossdatagrid** component. This file is not included in the JBoss Fuse container distribution. The *features.xml* file is in *jboss-datagrid-7.2.0-maven-repository/org/apache/camel/camel-jbossdatagrid/${version}/* . No further configuration of the JBoss Data Grid repository is required.

For more information about installing and getting started with JBoss Fuse, see the Red Hat JBoss Fuse documentation on the Red Hat Customer Portal.

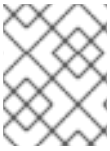
5.8. RED HAT JBOSS DATA GRID AND RED HAT JBOSS EAP

5.8.1. Installing camel-jbossdatagrid for Red Hat JBoss Enterprise Application Platform

Red Hat JBoss Enterprise Application Platform 7 (JBoss EAP 7) is a middleware platform built on open standards and compliant with the Java Enterprise Edition 8 specification.

As Camel is only supported through Red Hat JBoss Fuse valid entitlements for all of the following products will be necessary:

- Red Hat JBoss EAP
- Red Hat JBoss Fuse
- Red Hat JBoss Data Grid



NOTE

Entitlement to Red Hat JBoss Fuse Service Works includes entitlements to Red Hat JBoss EAP and Red Hat JBoss Fuse.

The following variables are used instead of specific version numbers in the installation procedures below:

- **jdg.version** - the latest version of Red Hat JBoss Data Grid
- **fuse.version** - the latest version of Red Hat JBoss Fuse
- **infinispan.version** - the version of Infinispan that is included in the latest version of Red Hat JBoss Data Grid
- **camel.version** - the version of Apache Camel that is included in the latest version of Red Hat JBoss Fuse

> For more information on tested integrations for ``camel-jbossdatagrid``, please refer to https://access.redhat.com/articles/115883.

Procedure: Installing JBoss Data Grid

For information about installing JBoss Data Grid, see Download and Install Red Hat JBoss Data Grid . Only the following JBoss Data Grid components are required to run the camel component in JBoss EAP: * JBoss Data Grid Maven repository. * The JBoss Data Grid Server package (to use the Hot Rod client).

The **camel-jbossdatagrid** library is also available in a separate distribution called *jboss-datagrid-${jdg.version}-camel-library* .

Installing JBoss EAP

1. Before attempting to install and use Red Hat JBoss EAP ensure your system meets the minimum requirements as documented in Red Hat JBoss EAP Installation Guide .
2. Unpacking the Archive
   Red Hat JBoss EAP is installed by unpacking an archive on a system, as JBoss EAP is packaged as a zip file; using a suitable archive tool, unpack Red Hat JBoss EAP into a directory to which you have full access.

WARNING

Do not unpack the archive file into a folder that has spaces in its path name. For example, do not unpack into *C:\Documents and Settings\Greco Roman\Desktop\JBoss*.

Additionally, do not unpack the archive file into a folder that has any of the following special characters in its path name: #, %, ^, ".

3. Once the archive has been extracted JBoss EAP will have been successfully installed. For more information on installation options refer to the appropriate section, based on how JBoss EAP was installed, under Red Hat JBoss EAP Installation Guide .

4. If JBoss Data Grid is being used in Library mode then refer to Deploy JBoss Data Grid in JBoss EAP (Library Mode) to ensure the necessary dependencies have been installed.

5. If JBoss Data Grid is being used in Remote Client-Server mode then refer to Deploy JBoss Data Grid in JBoss EAP (Remote Client-Server Mode) to ensure the necessary dependencies have been installed.

5.8.2. Deploy Camel with EAP

5.8.2.1. Add development and runtime dependencies

In order to compile your application the dependent libraries for Camel and JBoss Data Grid will have to be added to the **pom.xml** (if using Maven).

Add Camel from Fuse

1. Ensure that the Fuse repository has been added to the **pom.xml**:

```
<repository>
  <id>fusesource</id>
  <name>FuseSource Release Repository</name>
  <url>https://repo.fusesource.com/nexus/content/groups/public/</url>
  <snapshots>
    <enabled>false</enabled>
  </snapshots>
  <releases>
    <enabled>true</enabled>
  </releases>
</repository>
```

2. Add the Camel components as a dependency in the **pom.xml**:

```
<dependency>
  <groupId>org.apache.camel</groupId>
  <artifactId>camel-core</artifactId>
  <version>${camel.version}</version>
</dependency>
```

Add camel-jbossdatagrid to the deployment.

1. Follow the instructions in Install and Use the Maven Repositories to add the maven repository.

2. Add camel-jbossdatagrid as a dependency in the **pom.xml**:

```
<dependency>
  <groupId>org.apache.camel</groupId>
  <artifactId>camel-jbossdatagrid</artifactId>
  <version>${jdg.version}</version>
</dependency>
```

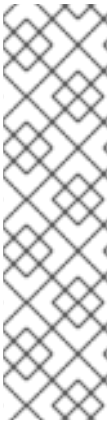
3. Add in the remaining JBoss Data Grid dependencies depending on which functionality is in use:

```
<!-- If Remote Camel Producer is used add the following dependency -->
<dependency>
 <groupId>org.infinispan</groupId>
 <artifactId>infinispan-remote</artifactId>
 <version>${infinispan.version}</version>
</dependency>

<!-- If the Local Camel Producer or Local Camel Consumer are in use add -->
<!-- the following dependency -->
<dependency>
 <groupId>org.infinispan</groupId>
 <artifactId>infinispan-embedded</artifactId>
 <version>${infinispan.version}</version>
</dependency>
```

5.8.2.2. Optionally: Add runtime dependencies as a JBoss EAP Module

Sometimes it is preferable to maintain other product libraries in JBoss EAP as modules. This requires some additional procedures to create these modules.



NOTE

When using modules for dependencies the **pom.xml** will need to have the **scope** set to "provided" for any dependencies provided as modules. For example:

```
<dependency>
 <groupId>org.apache.camel</groupId>
 <artifactId>camel-jbossdatagrid</artifactId>
 <scope>provided</scope>
 <version>${jdg.version}</version>
</dependency>
```

Download **jboss-datagrid-${jdg.version}-camel-library.zip** from the customer portal.

Extract the **apache-camel-${camel.version}.zip** found in Red Hat JBoss Fuse's **extras/** directory:

```
user@example modules] unzip /path/to/jboss-fuse-${fuse.version}/extras/apache-camel-
${camel.version}
```

Add in the Camel components from JBoss Fuse

1. Create a directory under $EAP_HOME/modules:

```
user@example jboss-eap-7.0] cd modules
user@example modules] mkdir -p org/apache/camel/core
```

2. Create a **main** subdirectory to store the jars:

```
user@example modules] mkdir org/apache/camel/core/main
```

3. Copy over the camel-core jar from **apache-camel-${camel.version}.zip** to the newly created **main** directory:

```
user@example modules] cp /path/to/jboss/fuse/extras/apache-camel-
${camel.version}/lib/camel-core-${camel.version}.jar ./org/apache/camel/core/main/
```

4. Create the **module.xml** descriptor by adding in the following text to **org/apache/camel/core/main/module.xml**:

```
<?xml version="1.0" encoding="UTF-8"?>
<module xmlns="urn:jboss:module:1.1" name="org.apache.camel.core">
  <resources>
    <resource-root path="camel-core-${camel.version}.jar"/>
  </resources>
</module>
```

5. Repeat the above steps to create a module for each dependency in use; note that modules may have dependencies on other modules as described in the *Red Hat JBoss Administration and Configuration Guide* .

Add in Camel components from JBoss Data Grid.

1. Create a **main** subdirectory for the JDG Camel components:

```
user@example jboss-eap-7.0] mkdir -p modules/org/apache/camel/main
```

2. Unzip **jboss-datagrid-${jdg.version}-camel-library.zip**.

3. Copy **camel-jbossdatagrid-${jdg.version}.jar** into the newly created directory:

```
user@example jboss-eap-7.0] cp jboss-datagrid-${jdg.version}-camel-library/camel-
jbossdatagrid-${jdg.version}.jar modules/org/apache/camel/main/
```

4. Create a **module.xml** descriptor by adding in the following text to **org/apache/camel/main/module.xml**:

```
<?xml version="1.0" encoding="UTF-8"?>
<module xmlns="urn:jboss:module:1.1" name="org.apache.camel">
  <resources>
    <resource-root path="camel-jbossdatagrid-${jdg.version}.jar"/>
  </resources>
  <dependencies>
    <module name="org.apache.camel.core" />
  </dependencies>
</module>
```

Create a **jboss-deployment-structure.xml** in the **WEB-INF** of the war, and add dependencies on the newly created module:

```
<?xml version="1.0" encoding="UTF-8"?>
<jboss-deployment-structure>
   <deployment>
      <dependencies>
         <module name="org.apache.camel" meta-inf="import"/>
```

```
        <!-- Add the following lines if Library mode is used -->
        <module name="org.infinispan" slot="jdg-7.2" />
        <module name="org.jgroups" slot="jdg-7.2" />

        <!-- Add the following lines if Remote Client-Server mode is used -->
        <module name="org.infinispan.client.hotrod" slot="jdg-7.2" />
      </dependencies>
    </deployment>
</jboss-deployment-structure>
```

PART IV. RUNNING RED HAT JBOSS DATA GRID WITH MAVEN

CHAPTER 6. RUN RED HAT JBOSS DATA GRID WITH MAVEN

6.1. DEFINING MAVEN DEPENDENCIES FOR USE WITH JBOSS DATA GRID (REMOTE CLIENT-SERVER MODE)

Use the following instructions to run Red Hat JBoss Data Grid with Maven in Remote Client-Server mode.

Hot Rod Client with Querying

Add the following dependencies to the *pom.xml* file:

1. Add **infinispan-remote** dependency:

```
<dependency>
  <groupId>org.infinispan</groupId>
  <artifactId>infinispan-remote</artifactId>
  <version>${infinispan.version}</version>
</dependency>
```

2. For instances where a **Remote Cache Store** is in use also add the **infinispan-embedded** dependency as shown below:

```
<dependency>
  <groupId>org.infinispan</groupId>
  <artifactId>infinispan-embedded</artifactId>
  <version>${infinispan.version}</version>
</dependency>
```

3. For instances where **JSR-107** is in use, ensure that the **cache-api** packages are available at runtime. Having these packages available can be accomplished by any of the following methods:

   a. **Option 1:** If JBoss EAP is in use, then add the JBoss Data Grid modules to this instance as described in Section 4.3, "Deploy JBoss Data Grid in JBoss EAP (Remote Client-Server Mode)".
   Add the javax.cache.api module to the application's **jboss-deployment-structure.xml**. An example is shown below:

```
<jboss-deployment-structure xmlns="urn:jboss:deployment-structure:1.2">
  <deployment>
    <dependencies>
      <module name="javax.cache.api" slot="jdg-7.2" services="export"/>
    </dependencies>
  </deployment>
</jboss-deployment-structure>
```

   b. **Option 2:** Download the **jboss-datagrid-${jdg.version}-library** file from the customer portal.
   Extract the downloaded archive.

   Embed the **jboss-datagrid-${jdg.version}-library/lib/cache-api-${jcache.version}.jar** file into the desired application.

c. **Option 3:** If the JBoss Data Grid Maven repository is available then add an explicit dependency to the **pom.xml** of the project as seen below:

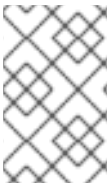
```
<dependency>
   <groupId>javax.cache</groupId>
   <artifactId>cache-api</artifactId>
   <version>${jcache.version}</version>
</dependency>
```

WARNING

The Infinispan query API directly exposes the Hibernate Search and the Lucene APIs and cannot be embedded within the *infinispan-embedded-query.jar* file. Do not include other versions of Hibernate Search and Lucene in the same deployment as *infinispan-embedded-query* . This action will cause classpath conflicts and result in unexpected behavior.

6.2. DEFINING MAVEN DEPENDENCIES FOR USE WITH JBOSS DATA GRID (LIBRARY MODE)

Use the provided instructions to run Red Hat JBoss Data Grid with Maven in Library mode.



NOTE

To simplify embedding Red Hat JBoss Data Grid directly in your application, the distribution of JBoss Data Grid contains fewer, consolidated jars. For the list of supported jar files, see the Packaging Revisions in the *Release Notes*.

Infinispan Embedded without Querying

Add the **infinispan-embedded** dependency to the *pom.xml* file:

```
<dependency>
   <groupId>org.infinispan</groupId>
   <artifactId>infinispan-embedded</artifactId>
   <version>${infinispan.version}</version>
</dependency>
```

Infinispan Embedded with Querying

Add the **infinispan-embedded-query** dependency to the *pom.xml* file:

```
<dependency>
   <groupId>org.infinispan</groupId>
   <artifactId>infinispan-embedded-query</artifactId>
   <version>${infinispan.version}</version>
</dependency>
```

WARNING

The Infinispan query API directly exposes the Hibernate Search and the Lucene APIs and cannot be embedded within the *infinispan-embedded-query.jar* file. Do not include other versions of Hibernate Search and Lucene in the same deployment as *infinispan-embedded-query* . This action will cause classpath conflicts and result in unexpected behavior.

CHAPTER 7. RUN RED HAT JBOSS DATA GRID IN REMOTE CLIENT-SERVER MODE

7.1. PREREQUISITES

The following is a list of prerequisites to run Red Hat JBoss Data Grid in Remote Client-Server mode for the first time:

- Ensure an appropriate version of OpenJDK is installed. For more information, see Install OpenJDK on Red Hat Enterprise Linux.
- Download and install the latest version of JBoss Data Grid. For more information, see Download Red Hat JBoss Data Grid.

7.2. RUN RED HAT JBOSS DATA GRID IN STANDALONE MODE

Standalone mode refers to a single instance of Red Hat JBoss Data Grid operating in local mode. In local mode, JBoss Data Grid operates as a simple single node in-memory data cache.

Run the following script to start JBoss Data Grid in standalone mode:

```
$JDG_HOME/bin/standalone.sh
```

This command starts JBoss Data Grid using the default configuration information provided in the *$JDG_HOME/standalone/configuration/standalone.xml* file.

7.3. RUN RED HAT JBOSS DATA GRID IN CLUSTERED MODE

Clustered mode refers to a cluster made up of two or more Red Hat JBoss Data Grid standalone instances.

Run the following script to start JBoss Data Grid in clustered mode:

```
$JDG_HOME/bin/standalone.sh -c clustered.xml
```

This command starts JBoss Data Grid using the default configuration information provided in the *$JDG_HOME/standalone/configuration/clustered.xml* file.

7.4. RUN RED HAT JBOSS DATA GRID IN A MANAGED DOMAIN

A managed domain allows multiple server instances and groups to be centrally managed from the Administration Console of the domain controller.

Run the following script to start JBoss Data Grid in a managed domain:

```
$JDG_HOME/bin/domain.sh
```

This command starts JBoss Data Grid using the default configuration information provided in the *$JDG_HOME/domain/configuration/domain.xml* and *$JDG_HOME/domain/configuration/host.xml* files.

7.5. RUN RED HAT JBOSS DATA GRID WITH A CUSTOM CONFIGURATION

To run Red Hat JBoss Data Grid with a custom configuration, add a configuration file to the *$JDG_HOME/standalone/configuration* directory.

Use the following command to specify the created custom configuration file for standalone mode:

```
$JDG_HOME/bin/standalone.sh -c ${FILENAME}
```

The **-c** used for this script does not allow absolute paths, therefore the specified file must be available in the *$JDG_HOME/standalone/configuration* directory.

If the command is run without the **-c** parameter, JBoss Data Grid uses the default configuration.

As a managed domain is configured with two separate files, *domain.xml* and *host.xml* by default, there are two separate flags for specifying custom configuration files.

To define the custom configuration file for the server group profiles, use the **-c** parameter as described above, and demonstrated in the following command:

```
$JDG_HOME/bin/domain.sh -c ${FILENAME}
```

To define the custom configuration file for the servers use the **--host-config** parameter, as demonstrated in the following command:

```
$JDG_HOME/bin/domain.sh --host-config=${FILENAME}
```

7.6. SET AN IP ADDRESS TO RUN RED HAT JBOSS DATA GRID

For production use, the Red Hat JBoss Data Grid server must be bound to a specified IP address rather than to **127.0.0.1**/**localhost**. Use the **-b** parameter with the script to specify an IP address.

For standalone mode, set the IP address as follows:

```
$JDG_HOME/bin/standalone.sh -b ${IP_ADDRESS}
```

For domain mode, set the IP address for the host controller and any servers as follows:

```
$JDG_HOME/bin/domain.sh -b ${IP_ADDRESS}
```

CHAPTER 8. RUN A RED HAT JBOSS DATA GRID AS A NODE WITHOUT ENDPOINTS

8.1. RUN A RED HAT JBOSS DATA GRID AS A NODE WITHOUT ENDPOINTS

Services send messages using channels to communicate with each other. An endpoint is a communications point for these services and is used to send and receive the messages sent through the channels. As a result, a node with no endpoints can communicate with other nodes in the same cluster, but not with clients.

8.2. BENEFITS OF A NODE WITHOUT ENDPOINTS

The primary benefit for creating a node without endpoints in Red Hat JBoss Data Grid involves data replication.

A node without any endpoints cannot be accessed by the client directly. As a result, they are primarily used to replicate data from other nodes that can communicate with clients. The result is a node with a backup copy of the data that cannot be accessed by the client, which protects it from failure via an error sent by the client.

8.3. SAMPLE CONFIGURATION FOR A NODE WITHOUT ENDPOINTS

Red Hat JBoss Data Grid provides a sample configuration to configure a node without an endpoint:

Find the JBoss Data Grid Sample Configuration for a Node Without Endpoints

1. Extract the JBoss Data Grid ZIP
   Extract the ZIP file for JBoss Data Grid Remote Client-Server mode. This is named *jboss-datagrid-server-${version}* . Add the relevant version to the file name.

2. Navigate to the Appropriate Folder
   In the extracted folder, navigate to the *$JDG_HOME/docs/examples/configs* folder.

3. Find the Configuration File Sample
   View the *clustered-storage-only.xml* file, which contains the configuration for a node with no endpoints.

8.4. CONFIGURE A NODE WITH NO ENDPOINTS

A standard configuration, such as a standalone high availability configuration, can be changed into a configuration for a node with no endpoints by removing the **endpoints** subsystem from the configuration file.

Remove the XML element that begins with the following:

```
<subsystem xmlns="urn:infinispan:server:endpoint:8.0">
```

Removing the endpoints subsystem ensures endpoints are removed from the configuration and that clustering is not possible.

CHAPTER 9. RUN RED HAT JBOSS DATA GRID IN LIBRARY MODE

9.1. RUN RED HAT JBOSS DATA GRID IN LIBRARY MODE

This part includes information about using Red Hat JBoss Data Grid in Library Mode.

- As a prerequisite for the subsequent chapters, set up a new project using the instructions in Create a New Red Hat JBoss Data Grid .
- Next, use JBoss Data Grid either as an embedded cache (see Run Red Hat JBoss Data Grid in Library Mode (Single-Node Setup) for more information) or as a clustered cache (see Run Red Hat JBoss Data Grid in Library Mode (Multi-Node Setup). Each tutorial is based on an Infinispan quickstart.
- Finally, monitor Red Hat JBoss EAP applications using JBoss Data Grid using the instructions in Monitor Red Hat JBoss Data Grid Applications in Red Hat JBoss EAP .

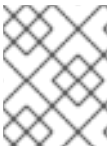
9.2. CREATE A NEW RED HAT JBOSS DATA GRID PROJECT

This chapter is a guide to creating a new Red Hat JBoss Data Grid project. The tasks prescribed are a prerequisite for the quickstart tasks provided in Run Red Hat JBoss Data Grid in Library Mode (Single-Node Setup) and Run Red Hat JBoss Data Grid in Library Mode (Multi-Node Setup)

9.3. ADD DEPENDENCIES TO YOUR PROJECT

Set up Red Hat JBoss Data Grid by adding dependencies to your project. If you are using Maven or other build systems that support Maven dependencies, add the following to your *pom.xml* file, located in the Maven repository folder:

```
<dependency>
        <groupId>org.infinispan</groupId>
        <artifactId>infinispan-embedded</artifactId>
        <version>$VERSION</version>
</dependency>
```



NOTE

Replace the **version** value with the appropriate version of the libraries included in JBoss Data Grid.

9.4. ADD A PROFILE TO YOUR PROJECT

To enable the JBoss Maven repository for your project, add a profile to your *settings.xml* file in *$HOME/.m2/settings.xml* as follows:

Adding a Profile

```
<profiles>

  <!-- Configure the JBoss GA Maven repository -->
  <profile>
```

```
    <id>jboss-ga-repository</id>
    <repositories>
      <repository>
        <id>jboss-ga-repository</id>
        <url>http://maven.repository.redhat.com/ga/all</url>
        <releases>
          <enabled>true</enabled>
        </releases>
        <snapshots>
          <enabled>false</enabled>
        </snapshots>
      </repository>
    </repositories>
    <pluginRepositories>
      <pluginRepository>
        <id>jboss-ga-plugin-repository</id>
        <url>http://maven.repository.redhat.com/ga/all</url>
        <releases>
          <enabled>true</enabled>
        </releases>
        <snapshots>
          <enabled>false</enabled>
        </snapshots>
      </pluginRepository>
    </pluginRepositories>
  </profile>
  <!-- Configure the JBoss Early Access Maven repository -->
  <profile>
    <id>jboss-earlyaccess-repository</id>
    <repositories>
      <repository>
        <id>jboss-earlyaccess-repository</id>
        <url>http://maven.repository.redhat.com/earlyaccess/all/</url>
        <releases>
          <enabled>true</enabled>
        </releases>
        <snapshots>
          <enabled>false</enabled>
        </snapshots>
      </repository>
    </repositories>
    <pluginRepositories>
      <pluginRepository>
        <id>jboss-earlyaccess-plugin-repository</id>
        <url>http://maven.repository.redhat.com/earlyaccess/all/</url>
        <releases>
          <enabled>true</enabled>
        </releases>
        <snapshots>
          <enabled>false</enabled>
        </snapshots>
      </pluginRepository>
    </pluginRepositories>
  </profile>
```

```
  </profiles>

 <!-- Add active profiles information here -->
```

Enable the profile by ensuring the following is included in the *settings.xml* file:

Enable the Profile

```
<activeProfiles>
  <!-- Optionally, make the repositories active by default -->
  <activeProfile>jboss-ga-repository</activeProfile>
  <activeProfile>jboss-earlyaccess-repository</activeProfile>
</activeProfiles>
```

If you are using a build system that does not support declarative dependency management, ensure all used libraries, such as infinispan-embedded, are found on the build classpath.

CHAPTER 10. RUN RED HAT JBOSS DATA GRID IN LIBRARY MODE (SINGLE-NODE SETUP)

10.1. CREATE A SIMPLE CLASS

Create a Simple Class

1. Create a new Maven project and Java file, entitled **SimpleLibraryExample.java**:
   In your editor of choice create a new Maven project. Add a Java file, entitled **SimpleLibraryExample.java**, in the **org.jdg.example** package in this project.

2. Define the references to a **DefaultCacheManager**:
   Define the basic imports, and create a **DefaultCacheManager**. This will then obtain a local reference to the **default** cache, as no cache name is specified:

```
package org.jdg.example;

import org.infinispan.Cache;
import org.infinispan.manager.DefaultCacheManager;

public class SimpleLibraryExample {

  public static void main(String args[]) throws Exception {
    Cache<Object, Object> c = new DefaultCacheManager().getCache();
  }

}
```

3. Define the Maven dependencies
   In your pom.xml define the **infinispan-embedded** dependency:

```
<groupId>org.infinispan</groupId>
<artifactId>infinispan-embedded</artifactId>
<version>{FullInfinispanVersion}</version>
```

4. Run the Main Method
   Use the following command to run the main method:

```
mvn compile exec:java -
Dexec.mainClass="org.infinispan.quickstart.embeddedcache.Quickstart
```

5. Exit
   Once compiled the class should execute, continuing to run until the process is terminated. This process may be exited by entering Ctrl+C on the command line where it was launched.

10.2. USE THE DEFAULT CACHE

10.2.1. Add and Remove Data from the Cache

Red Hat JBoss Data Grid offers an interface that is similar to the proposed JSR-107 API to access and alter data stored in a cache.

The following procedures demonstrate adding and removing data from the cache:

Add and Remove Data from the Cache

1. Add an entry, replacing **key** and **value** with the desired key and value:

```
cache.put("key", "value");
```

2. Confirm that the entry is present in the cache:

```
assertEquals(1, cache.size());
assertTrue(cache.containsKey("key"));
```

3. Remove the entry from the cache:

```
Object v = cache.remove("key");
```

4. Confirm that the entry is no longer present in the cache:

```
assertEquals("value", v);
assertTrue(cache.isEmpty());
```

10.2.2. Adding and Replacing a Key Value

Red Hat JBoss Data Grid offers a thread-safe data structure.

The following procedure is an example that demonstrates conditionally adding values into the cache: file does:

Adding and Replacing a Key Value

1. Add an entry **key** with **value** as the key's value.

```
cache.put("key", "value");
```

Replacing a Key Value.

1. The following code searches for keys (named **key** and **key2**). If the two specific keys beings searched for are not found, JBoss Data Grid creates two new keys with the specified key names and values. In this example only **key2** will be added to the cache, as **key** is already present.

```
cache.putIfAbsent("key", "newValue");
cache.putIfAbsent("key2", "newValue2");
```

2. The following code confirms that the value of the stored key equals the value we wanted to store.

```
assertEquals(cache.get("key"), "value");
assertEquals(cache.get("key2"), "newValue2");
```

10.2.3. Removing Entries

Separate methods are used to remove entries depending on how JBoss Data Grid is used:

Library Mode

All of the following methods are found on **org.infinispan.Cache** and its subclasses.

- **remove(key)** - remove a single key from the cache.
- **removeAsync(key)** - remove a single key from the cache, asynchronously.
- **clear()** - removes all of the mappings from the cache, leaving it empty once the call completes.
- **clearAsync()** - asynchronously remove all of the mappings from the cache, leaving it empty once the call completes.
- **cache.evict(key)** - remove the entry from the cache, moving it to the cache store if one is defined. With no cache store defined the entry is removed from the cache and is lost.

Remote Client-Server Mode

All of the following methods are found on **org.infinispan.client.hotrod.RemoteCache** and its subclasses.

- **remove(key)** - remove a single key from the cache.
- **removeAsync(key)** - remove a single key from the cache, asynchronously.
- **clear()** - removes all of the mappings from the cache, leaving it empty once the call completes.
- **clearAsync()** - asynchronously remove all of the mappings from the cache, leaving it empty once the call completes.
- **removeWithVersion(key, version)** - remove a single key from the cache only if its current version matches the supplied version.
- **removeWithVersionAsync(key, value)** - asynchronously remove a single key from the cache only if its current version matches the supplied version.

For additional information on any of the above methods refer to the *API Documentation* .

10.2.4. Placing and Retrieving Sets of Data

The **AdvancedCache** and **RemoteCache** interfaces include methods to either put or get a **Map** of existing data in bulk. These operations are typically much more efficient than an equivalent sequence of individual operations, especially when using them in server-client mode, as a single network operation occurs as opposed to multiple transactions.

When using the bulk operations the memory overhead is higher during the operation itself, as the **get** or **put** operation must accommodate for the full **Map** in a single execution.

The methods for each class are found below:

- **AdvancedCache**:
  - **Map<K,V>getAll(Set<?> keys)** - returns a **Map** containing the values associated with the set of keys requested.

- void **putAll(Map<? extends K, ? extends V> map, Metadata metadata)** - copies all of the mappings from the specified map to this cache, which takes an instance of **Metadata** to provide metadata information such as the lifespan, version, etc. on the entries being stored.

- **RemoteCache**:
  - **Map<K,V>getAll(Set<? extends K> keys)** - returns a **Map** containing the values associated with the set of keys requested.
  - void **putAll(Map<? extends K, ? extends V> map)** - copies all of the mappings from the specified map to this cache.
  - void **putAll(Map<? extends K, ? extends V> map, long lifespan, TimeUnit unit)** - copies all of the mappings from the specified map to this cache, along with a lifespan before the entry is expired.
  - void **putAll(Map<? extends K, ? extends V> map, long lifespan, TimeUnit lifespanUnit, long maxIdleTime, TimeUnit maxIdleTimeUnit)** - copies all of the mappings from the specified map to this cache, along with both a timespan before the entries are expired and the maximum amount of time the entry is allowed to be idle before it is considered to be expired.

10.2.5. Adjust Data Life

Red Hat JBoss Data Grid entries are immortal by default, but these settings can be altered.

The following procedure is an example that demonstrates defining key mortality:

Adjust the Data Life

1. Alter the key's **lifespan** value:

```
cache.put("key", "value", 5, TimeUnit.SECONDS);
```

2. Check if the cache contains the key:

```
assertTrue(cache.containsKey("key"));
```

3. After the allocated **lifespan** time has expired, the key is no longer in the cache:

```
Thread.sleep(10000);
assertFalse(cache.containsKey("key"));
```

10.2.6. Default Data Mortality

As a default, newly created entries do not have a life span or maximum idle time value set. Without these two values, a data entry will never expire and is therefore known as immortal data.

10.2.7. Register the Named Cache Using XML

To configure the named cache declaratively (using XML) rather than programmatically, configure the *infinispan.xml* file.

An example **infinispan.xml** file is located in https://github.com/jboss-developer/jboss-jdg-quickstarts/ within the **secure-embedded-cache/src/main/resources/** folder, and the full schema is available in the **docs/schema/** directory of the *Red Hat JBoss Data Grid Library* distribution.

CHAPTER 11. RUN RED HAT JBOSS DATA GRID IN LIBRARY MODE (MULTI-NODE SETUP)

11.1. SHARING JGROUP CHANNELS

Red Hat JBoss Data Grid offers an easy to use form of clustering using JGroups as the network transport. As a result, JGroups manages the initial operations required to form a cluster for JBoss Data Grid.

All caches created from a single CacheManager share the same JGroups channel by default. This JGroups channel is used to multiplex replication/distribution messages.

In the following example, all three caches used the same JGroups channel:

Shared JGroups Channel

```
EmbeddedCacheManager cm = $LOCATION
Cache<Object, Object> cache1 = cm.getCache("replSyncCache");
Cache<Object, Object> cache2 = cm.getCache("replAsyncCache");
Cache<Object, Object> cache3 = cm.getCache("invalidationSyncCache");
```

Substitute **$LOCATION** with the CacheManager's location.

An example of a clustered setup is found in the Hello World Quickstart.

11.2. CONFIGURE THE CLUSTER

11.2.1. Configuring the Cluster

Use the following steps to add and configure your cluster:

Configure the Cluster

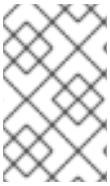
1. Add the default configuration for a new cluster.
2. Customize the default cluster configuration according to the requirements of your network. This is done declaratively (using XML) or programmatically.
3. Configure the replicated or distributed data grid.

11.2.2. Add the Default Cluster Configuration

Add a cluster configuration to ensure that Red Hat JBoss Data Grid is aware that a cluster exists and is defined. The following is a default configuration that serves this purpose:

Default Configuration

```
new ConfigurationBuilder()
   .clustering().cacheMode(CacheMode.REPL_SYNC)
   .build()
```



NOTE

Use the new **GlobalConfigurationBuilder().clusteredDefault()** to quickly create a preconfigured and cluster-aware **GlobalConfiguration** for clusters. This configuration can also be customized.

11.2.3. Customize the Default Cluster Configuration

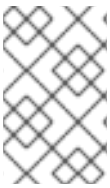
Depending on the network requirements, you may need to customize your JGroups configuration.

Programmatic Configuration:

Use the following GlobalConfiguration code to specify the name of the file to use for JGroups configuration:

```
manager = new DefaultCacheManager(
      new GlobalConfigurationBuilder()
      .clusteredDefault()
      .transport().addProperty("configurationFile", "default-configs/default-jgroups-tcp.xml")
      .build(),
   new ConfigurationBuilder()
      .clustering().cacheMode(CacheMode.REPL_SYNC)
   .build());
```

Replace **default-configs/default-jgroups-tcp.xml** with the desired file name.



NOTE

To bind JGroups solely to your loopback interface (to avoid any configured firewalls), use the system property **-Djgroups.bind_addr="127.0.0.1"**. This is particularly useful to test a cluster where all nodes are on a single machine.

Declarative Configuration:

Use the following XML snippet in the **infinispan.xml** file to configure the JGroups properties to use Red Hat JBoss Data Grid's XML configuration:

```
<?xml version="1.0" encoding="UTF-8"?>
<infinispan
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="urn:infinispan:config:8.5 http://www.infinispan.org/schemas/infinispan-
config-8.5.xsd"
      xmlns="urn:infinispan:config:8.5">

   <jgroups>
      <stack-file name="jgroupsStack" path="${infinispan.jgroups.config:default-configs/default-
jgroups-udp.xml}"/>
   </jgroups>

   <cache-container name="default" default-cache="localCache" statistics="true">
      <transport stack="jgroupsStack" lock-timeout="600000" cluster="default" />
      <serialization></serialization>
      <jmx>
         <property name="enabled">true</property>
      </jmx>
```

```
    <local-cache name="localCache"/> <!-- this is here so we don't ever mistakingly use the default
cache in a test (local cache will give superb results) -->
  </cache-container>

</infinispan>
```

11.2.4. Configure the Replicated Data Grid

Red Hat JBoss Data Grid replicated mode ensures that every entry is replicated on every node in the data grid.

This mode offers security against data loss due to node failures and excellent data availability. These benefits are at the cost of limiting the storage capacity to the amount of storage available on the node with the least memory.

Programmatic Configuration:

Use the following code snippet to programmatically configure the cache for replication mode (either synchronous or asynchronous):

```
private static EmbeddedCacheManager createCacheManagerProgramatically() {
  return new DefaultCacheManager(
    new GlobalConfigurationBuilder()
      .clusteredDefault()
      .transport().addProperty("configurationFile", "default-configs/default-jgroups-tcp.xml")
      .build(),
    new ConfigurationBuilder()
      .clustering().cacheMode(CacheMode.REPL_SYNC)
      .build()
  );
}
```

Declarative Configuration:

Edit the *infinispan.xml* file to include the following XML code to declaratively configure the cache for replication mode (either synchronous or asynchronous):

```
<?xml version="1.0" encoding="UTF-8"?>
<infinispan
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="urn:infinispan:config:8.5 http://www.infinispan.org/schemas/infinispan-
config-8.5.xsd"
      xmlns="urn:infinispan:config:8.5">

  <jgroups>
    <stack-file name="jgroupsStack" path="${infinispan.jgroups.config:default-configs/default-
jgroups-udp.xml}"/>
  </jgroups>

  <cache-container name="default" default-cache="localCache" statistics="true">
    <transport stack="jgroupsStack" lock-timeout="600000" cluster="default" />
    <serialization></serialization>
    <jmx>
      <property name="enabled">true</property>
    </jmx>
```

```
        <local-cache name="localCache"/>
        <replicated-cache name="replCache" mode="SYNC" remote-timeout="60000" statistics="true">
            <locking acquire-timeout="3000" concurrency-level="1000" />
        </replicated-cache>
    </cache-container>

</infinispan>
```

Use the following code to initialize and return a DefaultCacheManager with the XML configuration file:

```
private static EmbeddedCacheManager createCacheManagerFromXml() throws IOException {
  return new DefaultCacheManager("infinispan.xml");}
```

NOTE

JBoss EAP includes its own underlying JMX. This can cause a collision when using the sample code with JBoss EAP and display an error such as **org.infinispan.jmx.JmxDomainConflictException: Domain already registered org.infinispan**.

To avoid this, configure global configuration as follows:

```
GlobalConfiguration glob = new GlobalConfigurationBuilder()
 .clusteredDefault()
        .globalJmxStatistics()
          .allowDuplicateDomains(true)
          .enable()
        .build();
```

11.2.5. Configure the Distributed Data Grid

Red Hat JBoss Data Grid's distributed mode ensures that each entry is stored on a subset of the total nodes in the data grid. The number of nodes in the subset is controlled by the **numOwners** parameter, which sets how many owners each entry has.

Distributed mode offers increased storage capacity but also results in increased access times and less durability (protection against node failures). Adjust the **numOwners** value to set the desired trade off between space, durability and availability. Durability is further improved by JBoss Data Grid's topology aware consistent hash, which locates entry owners across a variety of data centers, racks and nodes.

Programmatic Configuration:

Programmatically configure the cache for distributed mode (either synchronous or asynchronous) as follows:

```
new ConfigurationBuilder()
   .clustering()
      .cacheMode(CacheMode.DIST_SYNC)
      .hash().numOwners(2)
   .build()
```

Declarative Configuration:

Edit the *infinispan.xml* file to include the following XML code to declaratively configure the cache for distributed mode (either synchronous or asynchronous):

```
<?xml version="1.0" encoding="UTF-8"?>
<infinispan
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="urn:infinispan:config:8.5 http://www.infinispan.org/schemas/infinispan-
config-8.5.xsd"
      xmlns="urn:infinispan:config:8.5">

   <jgroups>
      <stack-file name="jgroupsStack" path="${infinispan.jgroups.config:default-configs/default-
jgroups-udp.xml}"/>
   </jgroups>

   <cache-container name="default" default-cache="localCache" statistics="true">
      <transport stack="jgroupsStack" lock-timeout="600000" cluster="default" />
      <serialization></serialization>
      <jmx>
         <property name="enabled">true</property>
      </jmx>
      <local-cache name="localCache"/>
      <distributed-cache name="distCache" mode="SYNC" remote-timeout="60000" statistics="true"
l1-lifespan="-1" owners="2" segments="512" >
         <locking acquire-timeout="3000" concurrency-level="1000" />
         <state-transfer timeout="60000" />
      </distributed-cache>
   </cache-container>
</infinispan>
```

CHAPTER 12. MONITOR RED HAT JBOSS DATA GRID APPLICATIONS IN RED HAT JBOSS EAP

12.1. MONITOR RED HAT JBOSS DATA GRID APPLICATIONS IN RED HAT JBOSS EAP

Red Hat JBoss Data Grid library applications (in the form of WAR or EAR files) can be deployed within JBoss Enterprise Application Server 6 (or better) and then monitored using JBoss Operations Network.

12.2. PREREQUISITES

The following are prerequisites to monitor a Red Hat JBoss Data Grid library application in JBoss Enterprise Application Platform:

- Install and configure JBoss Enterprise Application Platform 6 (or better).
- Install and configure JBoss Operations Network 3.2.2 (or better).
- Install and configure JBoss Data Grid (6.3 or better) Library mode plug-in.

12.3. MONITOR RED HAT JBOSS DATA GRID APPLICATIONS IN RED HAT JBOSS EAP

Ensure that all requirements outlined as prerequisites are met. Follow the listed steps to monitor Red Hat JBoss Data Grid applications in JBoss Enterprise Application Platform using JBoss Operations Network or RHQ.

Monitor JBoss Data Grid Applications in JBoss Enterprise Application Platform

1. Configure RHQ/JBoss Operations Network
   Add an RHQ/JBoss Operations Network specific property (named **org.rhq.resourceKey**) to the */bin/*[path]*standalone.conf* file as follows:

   ```
   JAVA_OPTS="$JAVA_OPTS -Dorg.rhq.resourceKey=MyEAP"
   ```

   This command adds the property to the JBoss Enterprise Application Platform's command line indirectly.

2. Check RHQ/JBoss Operations Network is Running Using a Full JDK
   Ensure that the RHQ/JBoss Operations Network agent started using a full JDK instead of a JRE. This is because the agent requires access to the JDK's *tools.jar* file.

   To configure your RHQ/JBoss Operations Network agent to use the JDK, follow the instructions relevant to your operating system:

   a. For Linux users, set the **RHQ_AGENT_JAVA_HOME** environment variable to the JDK home directory in the agent's *rhq-agent-env.sh* file.

   b. For Windows users, set the **RHQ_AGENT_JAVA_HOME** environment variable to the JDK home directory in the agent's *rhq-agent-env.bat* file.

3. Ensure the Agent is Local to the JBoss Enterprise Application Platform Instance

Ensure that the RHQ/JBoss Operations Network agent runs locally to and under the same user as the JBoss Application Platform instance. This is required for the Java Attach API to connect to the process.

4. Import Resources to the Agent Inventory
RHQ/JBoss Operations Network can now discover resources. These resources can subsequently be imported into the agent inventory.

When a JBoss Data Grid user deployment enables JMX statistics to expose JBoss Data Grid Cache Managers or caches, the resources appear as children resources of the JBoss Enterprise Application Platform instance.

PART V. SET UP A CACHE MANAGER

CHAPTER 13. CACHE MANAGERS

13.1. CACHE MANAGERS

A Cache Manager is the primary mechanism to retrieve a cache instance in Red Hat JBoss Data Grid, and is a starting point for using the cache.

In JBoss Data Grid, a cache manager is useful because:

- it creates cache instances on demand.
- it retrieves existing cache instances (i.e. caches that have already been created).

13.2. TYPES OF CACHE MANAGERS

Red Hat JBoss Data Grid offers the following Cache Managers:

- **EmbeddedCacheManager** is a cache manager that runs within the Java Virtual Machine (JVM) used by the client. Currently, JBoss Data Grid offers only the **DefaultCacheManager** implementation of the **EmbeddedCacheManager** interface.
- **RemoteCacheManager** is used to access remote caches. When started, the **RemoteCacheManager** instantiates connections to the Hot Rod server (or multiple Hot Rod servers). It then manages the persistent *TCP* connections while it runs. As a result, **RemoteCacheManager** is resource-intensive. The recommended approach is to have a single **RemoteCacheManager** instance for each Java Virtual Machine (JVM).

13.3. CREATING CACHEMANAGERS

13.3.1. Create a New RemoteCacheManager

Configure a New RemoteCacheManager

```
import org.infinispan.client.hotrod.RemoteCache;
import org.infinispan.client.hotrod.RemoteCacheManager;
import org.infinispan.client.hotrod.configuration.Configuration;
import org.infinispan.client.hotrod.configuration.ConfigurationBuilder;

Configuration conf = new
ConfigurationBuilder().addServer().host("localhost").port(11222).build();
RemoteCacheManager manager = new RemoteCacheManager(conf);
RemoteCache defaultCache = manager.getCache();
```

1. Use the **ConfigurationBuilder()** constructor to create a new configuration builder. The **.addServer()** method adds a remote server, configured via the **.host(<hostname|ip>)** and **.port(<port>)** properties.
2. Create a new **RemoteCacheManager** using the supplied configuration.
3. Retrieve the default cache from the remote server.

13.3.2. Create a New Embedded Cache Manager

Use the following instructions to create a new EmbeddedCacheManager without using CDI:

Create a New Embedded Cache Manager

1. Create a configuration XML file. For example, create the *my-config-file.xml* file on the classpath (in the *resources/* folder) and add the configuration information in this file.

2. Use the following programmatic configuration to create a cache manager using the configuration file:

```
EmbeddedCacheManager manager = new DefaultCacheManager("my-config-file.xml");
Cache defaultCache = manager.getCache();
```

The outlined procedure creates a new EmbeddedCacheManager using the configuration specified in *my-config-file.xml* .

13.3.3. Create a New Embedded Cache Manager Using CDI

Use the following steps to create a new EmbeddedCacheManager instance using CDI:

Use CDI to Create a New EmbeddedCacheManager

1. Specify a default configuration:

```
public class Config
  @Produces
  public EmbeddedCacheManager defaultCacheManager() {
    ConfigurationBuilder builder = new ConfigurationBuilder();
    Configuration configuration =
builder.eviction().strategy(EvictionStrategy.LRU).maxEntries(100).build();
    return new DefaultCacheManager(configuration);
  }
}
```

2. Inject the default cache manager.

```
<!-- Additional configuration information here -->
@Inject
EmbeddedCacheManager cacheManager;
<!-- Additional configuration information here -->
```

13.4. MULTIPLE CACHE MANAGERS

13.4.1. Multiple Cache Managers

Cache managers are an entry point to the cache and Red Hat JBoss Data Grid allows users to create multiple cache managers. Each cache manager is configured with a different global configuration, which includes settings for things like JMX, executors and clustering.

13.4.2. Create Multiple Caches with a Single Cache Manager

Red Hat JBoss Data Grid allows using the same cache manager to create multiple caches, each with a different cache mode (synchronous and asynchronous cache modes).

13.4.3. Using Multiple Cache Managers

Red Hat JBoss Data Grid allows multiple cache managers to be used. In most cases, such as with replication and networking components, cache instances share internal components and a single cache manager is sufficient.

However, if multiple caches are required to have different network characteristics, for example if one cache uses the *TCP* protocol and the other uses the *UDP* protocol, multiple cache managers must be used.

13.4.4. Create Multiple Cache Managers

Red Hat JBoss Data Grid allows users to create multiple cache managers of various types by repeating the procedure used to create the first cache manager (and adjusting the contents of the configuration file, if required).

To use the declarative API to create multiple new cache managers, copy the contents of the *infinispan.xml* file to a new configuration file. Edit the new file for the desired configuration and then use the new file for a new cache manager.

PART VI. RED HAT JBOSS DATA GRID QUICKSTARTS

CHAPTER 14. RED HAT JBOSS DATA GRID QUICKSTARTS

The **Hello World** quickstart is included to demonstrate a sample, clustered, Library mode deployment, and instructions for it are included in The Hello World Quickstart.

The table below lists the Quickstarts included in the quickstarts zip file which can be downloaded from the Customer Portal using similar procedures as outlined in 2.4 Download and Install JBoss Data Grid .

For instructions on using these quickstarts refer to the **README.md** file found in the root directory of each individual quickstart.

Table 14.1. Quickstarts Information

Quickstart Name	Container	JBoss Data Grid Mode
Hello World	JBoss EAP	Library mode
camel-jbossdatagrid-fuse	JBoss Fuse	Library mode
Carmart Non-Transactional	JBoss EAP and JBoss Enterprise Web Server	Library mode
Carmart Non-Transactional	JBoss EAP and JBoss Enterprise Web Server	Remote Client-Server mode
Carmart Transactional	JBoss EAP and JBoss Enterprise Web Server	Library mode
cdi-jdg (Infinispan Injection)	JBoss EAP	Library mode
eap-cluster-app	JBoss EAP	Library mode
hadoop (Football Championship)	No container	Remote Client-Server mode
hotrod-endpoint (Football Manager)	No container	Remote Client-Server mode
hotrod-endpoint-js (Football Manager javascript)	No container	Remote Client-Server mode
hotrod-secured (Football Manager secured auth)	No container	Remote Client-Server mode
memcached-endpoint (Football Manager)	No container	Remote Client-Server mode
rapid-stock-market	No container	Remote Client-Server mode

Quickstart Name	Container	JBoss Data Grid Mode
remote-query (AddressBookManager/SnowForecast)	No container	Remote Client-Server mode
remote-tasks-with-streams (Library manager)	No container	Remote Client-Server mode
rest-endpoint (Football Manager)	No container	Remote Client-Server mode
secure-embedded-cache	JBoss EAP	Library mode
spark (Temperature sensors)	No container	Remote Client-Server mode
spring	JBoss EAP	Library mode
spring (Tomcat)	Tomcat	Library mode
spring-session (embedded Tomcat)	Tomcat	Library
spring-session (JWS/Tomcat)	JWS/Tomcat	Library

CHAPTER 15. THE HELLO WORLD QUICKSTART

15.1. THE HELLO WORLD QUICKSTART

Hello World is a simple quickstart that illustrates how to store and retrieve data from a cache using Red Hat JBoss Data Grid. For this quickstart, users can access the cache in two ways:

- from a servlet.
- from a **JSF** page using request scoped beans.

All libraries (JAR files) bundles with the application are deployed to JBoss Enterprise Application Platform 7.x. JBoss Data Grid's Library mode only allows local access to a single node in a distributed cluster. This mode also allows the application to access the data grid functionality within a virtual machine in the target container.

IMPORTANT

The Hello World quickstart works only in JBoss Data Grid's Library mode.

Location

JBoss Data Grid's Hello World quickstart is available at the following location: *jboss-datagrid-{VERSION}-quickstarts/*

15.2. QUICKSTART PREREQUISITES

The prerequisites for this quickstart are as follows:

- Java 8.0 (Java SDK 1.8) or better
- JBoss Enterprise Application Platform 7.x or JBoss Enterprise Web Server 2.x
- Maven 3.0 or better
- Configure the Maven Repository. For details, see Install and Use the Maven Repositories .

15.3. START TWO APPLICATION SERVER INSTANCES

Before deploying the Hello World quickstart, start two instances of your application server (JBoss Enterprise Application Platform 7.x).

Start the First Application Server Instance

1. Navigate to the Root Directory
   In the command line terminal, navigate to the root for your JBoss server directory.

2. Start the First Application Server
   Depending on your operating system, use the appropriate command from the following to start the first instance of your selected application server:

   a. For Linux:

   ```
   $JBOSS_HOME/bin/standalone.sh
   ```

b. For Windows:

```
$JBOSS_HOME\bin\standalone.bat
```

Start the Second Application Server Instance

1. Clone the Application Server
   Create a copy of the selected JBoss Server to create a second instance.

2. Navigate to the Root Directory
   In the command line terminal, navigate to the root for your JBoss server directory.

3. Start the Second Application Server
   Use the appropriate command for your operating system from the following commands. This command starts the server with the provided port offset to ensure that both the server instances run on the same host.

   a. For Linux:

   ```
   $JBOSS_HOME2/bin/standalone.sh -Djboss.socket.binding.port-offset=100
   ```

   b. For Windows:

   ```
   $JBOSS_HOME2\bin\standalone.bat -Djboss.socket.binding.port-offset=100
   ```

15.4. BUILD AND DEPLOY THE HELLO WORLD QUICKSTART

Before building and deploying the quickstart, ensure that all the listed prerequisites are met and that the two application server instances are running (see for details).

Build and Deploy the Hello World Quickstart

1. Navigate to the Required Directory
   In the command line terminal, navigate to the root directory of the quickstart on the command line interface.

2. Build and Deploy to the First Application Server Instance
   Use the following command to build and deploy the quickstart to the first application server instance as follows:

   ```
   # mvn clean package wildfly:deploy
   ```

   This command deploys *target/*[path]*jboss-helloworld-jdg.war* to the first running server instance.

3. Build and Deploy the Second Application Server Instance
   Use the following command to build and deploy the quickstart to the second application server instance with the specified ports as follows:

   ```
   # mvn clean package wildfly:deploy -Dwildfly.port=10090
   ```

This command deploys *target/*[path]*jboss-helloworld-jdg.war* to the second running server instance.

15.5. ACCESS THE RUNNING APPLICATION

The Hello World quickstart application runs on the following URLs:

- First Server Instance: http://localhost:8080/jboss-helloworld-jdg
- Second Server Instance: http://localhost:8180/jboss-helloworld-jdg

15.6. TEST REPLICATION ON THE APPLICATION

Use the following instructions to test that cache entries are replicating from the first server instance to the second as desired.

Test Replication on the Application

1. Access the First Server
   Access the first application server and enter the key and value.
   a. Access the first application server in a browser window using the following URL:

      ```
      http://localhost:8080/jboss-helloworld-jdg
      ```

   b. Insert the key **foo**.
   c. Insert the value **bar**.
2. Access the Second Server
   Access the second application server and enter the key and value.
   a. Access the second application server in a browser window using the following URL:

      ```
      http://localhost:8180/jboss-helloworld-jdg
      ```

   b. Click **Get Some**.
   c. Get the key **foo**.
   d. Click **Put Some More**.
   e. Insert the key **mykey**.
   f. Insert the value **myvalue**.
3. Get All Keys and Values
   Access the first server and request all keys.
   a. Access the first application server in a browser window using the following URL:

      ```
      http://localhost:8080/jboss-helloworld-jdg
      ```

   b. Click **Get Some**.

c. Click **Get All** to request all key and values.

As the results of the last step show, all the data added at each server has been replicated to the other server.

NOTE

Entries expire after **60** seconds from the most recent update.

Directly Access Keys in the Cache

To interact with predefined servlets or to directly store and retrieve keys from the cache, use the following URLs:

```
http://localhost:8080/jboss-helloworld-jdg/TestServletPut
```

```
http://localhost:8180/jboss-helloworld-jdg/TestServletGet
```

15.7. REMOVE THE APPLICATION

Use the following procedure to remove the Hello World application:

Remove the Application

1. Start the Application Servers
   Ensure that both server instances are running.

2. Navigate to the Root
   In the command line terminal, navigate to the root directory of the quickstart.

3. Remove the Archive
   Use the following commands to remove the archive from both the server instances.

   a. Remove the archive from the first server as follows:

   ```
   mvn wildfly:undeploy
   ```

   b. Remove the archive from the second server as follows:

   ```
   mvn wildfly:undeploy -Dwildfly.port=10090
   ```

PART VII. UNINSTALL RED HAT JBOSS DATA GRID

CHAPTER 16. REMOVE RED HAT JBOSS DATA GRID

16.1. REMOVE RED HAT JBOSS DATA GRID FROM YOUR LINUX SYSTEM

The following procedures contain instructions to remove Red Hat JBoss Data Grid from your Linux system.

WARNING

Once deleted, all JBoss Data Grid configuration and settings are permanently lost.

Remove JBoss Data Grid from Your Linux System

1. Shut Down Server
   Ensure that the JBoss Data Grid server is shut down.

2. Navigate to the JBoss Data Grid Home Directory
   Use the command line to change into the level above the *$JDG_HOME* folder.

3. Delete the JBoss Data Grid Home Directory
   Enter the following command in the terminal to remove JBoss Data Grid, replacing **$JDG_HOME** with the name of your JBoss Data Grid home directory:

   ```
   $ rm -Rf $JDG_HOME
   ```

16.2. REMOVE RED HAT JBOSS DATA GRID FROM YOUR WINDOWS SYSTEM

The following procedures contain instructions to remove Red Hat JBoss Data Grid from your Microsoft Windows system.

WARNING

Once deleted, all JBoss Data Grid configuration and settings are permanently lost.

Remove JBoss Data Grid from Your Windows System

1. Shut Down Server
   Ensure that the JBoss Data Grid server is shut down.

2. Navigate to the JBoss Data Grid Home Directory

Use the Windows Explorer to navigate to the directory in which the *$JDG_HOME* folder is located.

3. Delete the JBoss Data Grid Home Directory
   Select the *$JDG_HOME* folder and delete it.

APPENDIX A. REFERENCES

A.1. ABOUT KEY-VALUE PAIRS

A key-value pair (KVP) is a set of data consisting of a key and a value.

- A key is unique to a particular data entry. It consists of entry data attributes from the related entry.
- A value is the data assigned to and identified by the key.

APPENDIX B. MAVEN CONFIGURATION INFORMATION

B.1. INSTALL THE JBOSS ENTERPRISE APPLICATION PLATFORM REPOSITORY USING NEXUS

This example outlines the steps to install the JBoss Enterprise Application Platform 7 Maven Repository using Sonatype Nexus Maven Repository Manager. For further instructions, see http://www.sonatype.org/nexus/.

Procedure: Download the JBoss Enterprise Application Platform 7 Maven Repository ZIP archive

1. Open a web browser and access the following URL: https://access.redhat.com/jbossnetwork/restricted/listSoftware.html?product=appplatform.
2. Find **Application Platform 7 Maven Repository** in the list.
3. Click **Download** to download a ZIP file that contains the repository.
4. Unzip the files into the desired target directory.

Procedure: Add the JBoss Enterprise Application Platform 7 Maven Repository using Nexus Maven Repository Manager.. Log into Nexus as an Administrator.

a. Select the **Repositories** section from the **Repositories** menu to the left of your repository manager.

b. Click the **Add...** drop-down menu, then select **Hosted Repository**.

c. Provide a name and ID for the new repository.

d. Enter the unzipped repository path in the **Override Local Storage Location** field.

e. Continue if the artifact must be available in a repository group. If not, do not continue with this procedure.

f. Select the repository group.

g. Click on the **Configure** tab.

h. Drag the new JBoss Maven repository from the **Available Repositories** list to the **Ordered Group Repositories** list on the left.

NOTE

The order of this list determines the priority for searching Maven artifacts.

B.2. MAVEN REPOSITORY CONFIGURATION EXAMPLE

A sample Maven repository file named *example-settings.xml* is available in the root directory of the Maven repository folder after it is unzipped. The following is an excerpt that contains the relevant parts of the *example-settings.xml* file:

Sample Maven Repository Configuration

```
<?xml version="1.0" encoding="UTF-8"?>

<settings xmlns="http://maven.apache.org/SETTINGS/1.0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://maven.apache.org/SETTINGS/1.0.0
http://maven.apache.org/xsd/settings-1.0.0.xsd">

  <profiles>
    <profile>
      <id>jboss-datagrid-repository</id>
      <repositories>
        <repository>
          <id>jboss-datagrid-repository</id>
          <name>JBoss Data Grid Maven Repository</name>
          <url>JDG_REPOSITORY_URL</url>
          <layout>default</layout>
          <releases>
            <enabled>true</enabled>
            <updatePolicy>never</updatePolicy>
          </releases>
          <snapshots>
            <enabled>false</enabled>
            <updatePolicy>never</updatePolicy>
          </snapshots>
        </repository>
      </repositories>
      <pluginRepositories>
        <pluginRepository>
          <id>jboss-datagrid-repository</id>
          <name>JBoss Data Grid Maven Repository</name>
          <url>JDG_REPOSITORY_URL</url>
          <layout>default</layout>
          <releases>
            <enabled>true</enabled>
            <updatePolicy>never</updatePolicy>
          </releases>
          <snapshots>
            <enabled>false</enabled>
            <updatePolicy>never</updatePolicy>
          </snapshots>
        </pluginRepository>
      </pluginRepositories>
    </profile>
  </profiles>
  <activeProfiles>
    <!-- make the profile active by default -->
    <activeProfile>jboss-datagrid-repository</activeProfile>
  </activeProfiles>

</settings>
```

The **JDG_REPOSITORY_URL** may be found by following the instructions in Determining the URL of the JBoss Data Grid Repository.

B.3. DETERMINING THE URL OF THE JBOSS DATA GRID REPOSITORY

The repository URL depends on where the repository is located. You can configure Maven to use any of the following repository locations:

- To use the online JBoss Data Grid Maven repository, specify the following URL: https://maven.repository.redhat.com/ga/
- To use a JBoss Data Grid Maven repository installed on the local file system, you must download the repository and then use the local file path for the URL. For example: *file:///path/to/repo/jboss-datagrid-7.2.0-maven-repository/maven-repository/*
- If you install the JBoss Data Grid Maven repository using the Nexus Repository Manager, the URL will look something like the following: https://intranet.acme.com/nexus/content/repositories/jboss-datagrid-7.2.0-maven-repository/maven-repository/