IronJacamar 1.1 Developer's Guide

Connecting your Enterprise Information Systems

IronJacamar 1.1 Developer's Guide: Connecting your Enterprise Information Systems

To all Java EE Connector Architecture users, and especially the IronJacamar community

Preface

1. About IronJacamar

The goal of the IronJacamar project is to provide an implementation of the Java Connector Architecture 1.7 specification.

The specification can be found here: http://www.jcp.org/en/jsr/detail?id=322.

The IronJacamar project is licensed under the GNU LESSER GENERAL PUBLIC LICENSE 2.1 (LGPL 2.1) license.

2. Why IronJacamar ?

The Java EE Connector Architecture container can be viewed as a foundation inside an application server as it provides connectivity to the other containers such that they can communicate with EISes. Iron is often used as foundation in building houses too.

The Jacamar bird family which lives in Central and South America are glossy elegant birds with long bills and tails. Why we picked the Jacamar family is left as an exercise for the reader :)

3. Versions

This section contains the highlights of the IronJacamar releases. A full description of each release can be found through our issue tracking system at http://issues.jboss.org/browse/JBJCA.

3.1. IronJacamar 1.1

Highlights as compared to IronJacamar 1.0:

- Java EE Connector Architecture 1.7 certified (standalone / Java EE7)
- Lazy connection manager (JCA chapter 7.16)
- Distributed work manager (JCA chapter 10.3.11)
- Advanced pool capacity policies and flush strategies
- Enhanced Arquillian integration
- Eclipse development plugin
- Enterprise Information System testing server
- Resource adapter information tool
- Migration tools

3.2. IronJacamar 1.0

Highlights as compared to previous Java EE Connector Architecture containers inside JBoss Application Server:

- Java EE Connector Architecture 1.6 certified (standalone / Java EE6)
- POJO container environment
- New configuration schemas which focuses on usability
- Fast XML and annotation parsing for quick deployment
- Reauthentication support
- Prefill support for security backed domains
- Support for pool flushing strategies
- Embedded environment for ease of development with Arquillian and ShrinkWrap integration
- New management and statistics integration for components
- Code generator for resource adapters
- Validator tool for resource adapters

4. The team

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5. Thanks to

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6. License

1

Introduction

The Java Connector Architecture (JCA) defines a standard architecture for connecting the Java EE platform to heterogeneous Enterprise Information Systems (EIS). Examples of EISs include Enterprise Resource Planning (ERP), mainframe transaction processing (TP), databases and messaging systems.

The connector architecture defines a set of scalable, secure, and transactional mechanisms that enable the integration of EISs with application servers and enterprise applications.

The connector architecture also defines a Common Client Interface (CCI) for EIS access. The CCI defines a client API for interacting with heterogeneous EISs.

The connector architecture enables an EIS vendor to provide a standard resource adapter for its EIS. A resource adapter is a system-level software driver that is used by a Java application to connect to an EIS. The resource adapter plugs into an application server and provides connectivity between the EIS, the application server, and the enterprise application. The resource adapter serves as a protocol adapter that allows any arbitrary EIS communication protocol to be used for connectivity. An application server vendor extends its system once to support the connector architecture and is then assured of seamless connectivity to multiple EISs. Likewise, an EIS vendor provides one standard resource adapter which has the capability to plug in to any application server that supports the connector architecture.

1.1. What's New

1.1.1. Java Connector Architecture 1.7

The Java Connector Architecture 1.7 specification adds the following areas:

- Adds an activation name for message endpoints to uniquely identify them
- Deployment annotations for connection factories and administration objects

> **Note**
>
> The deployment annotations are only meant for developer usage, and should not be used in test or production environments.

The IronJacamar standalone and embedded distributions doesn't support these annotations.

1.1.2. Java Connector Architecture 1.6

The Java Connector Architecture 1.6 specification adds the following major areas:

- Ease of Development: The use of annotations reduces or completely eliminates the need to deal with a deployment descriptor in many cases. The use of annotations also reduces the need to keep the deployment descriptor synchronized with changes to source code.
- Generic work context contract: A generic contract that enables a resource adapter to control the execution context of a Work instance that it has submitted to the application server for execution.
- Security work context: A standard contract that enables a resource adapter to establish security information while submitting a Work instance for execution to a WorkManager and while delivering messages to message endpoints residing in the application server.
- Standalone Container Environment: A defined set of services that makes up a standalone execution environment for resource adapters.

1.2. Overview

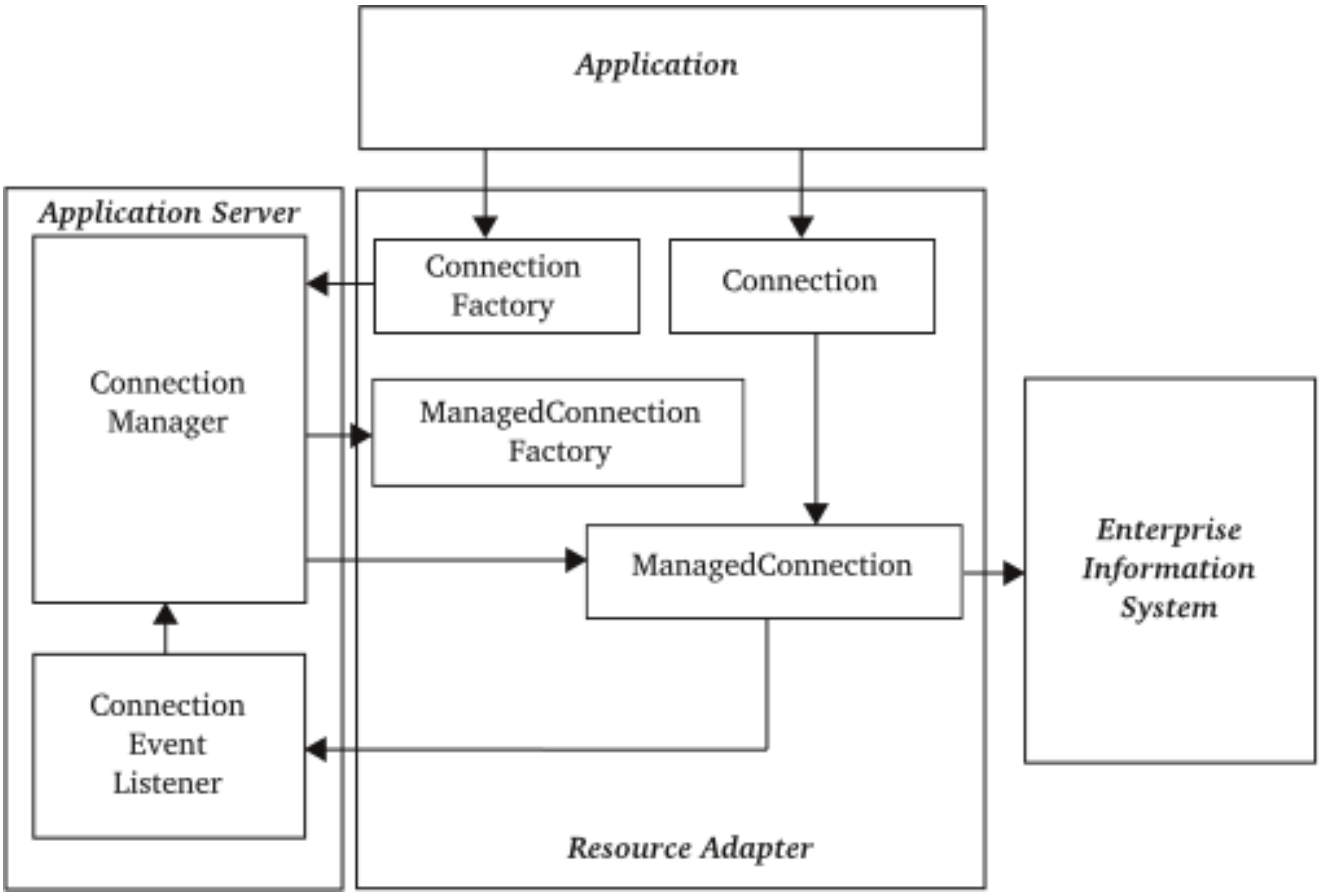
The Java EE Connector Architecture features three different types of resource adapters

- Outbound: The resource adapter allows the application to communicate to the Enterprise Information System (EIS).
- Inbound: The resource adapter allows messages to flow from the Enterprise Information System (EIS) to the application.
- Bi-directional: The resource adapter features both an outbound and an inbound part.

For more information about Java EE Connector Architecture see the specification.

1.2.1. Outbound resource adapter

The Java Connector Architecture specification consists of a number of outbound components:



The application uses the

- ConnectionFactory: The connection factory is looked up in Java Naming and Directory Interface (JNDI) and is used to create a connection.
- Connection: The connection contains the Enterprise Information System (EIS) specific operations.

The resource adapter contains

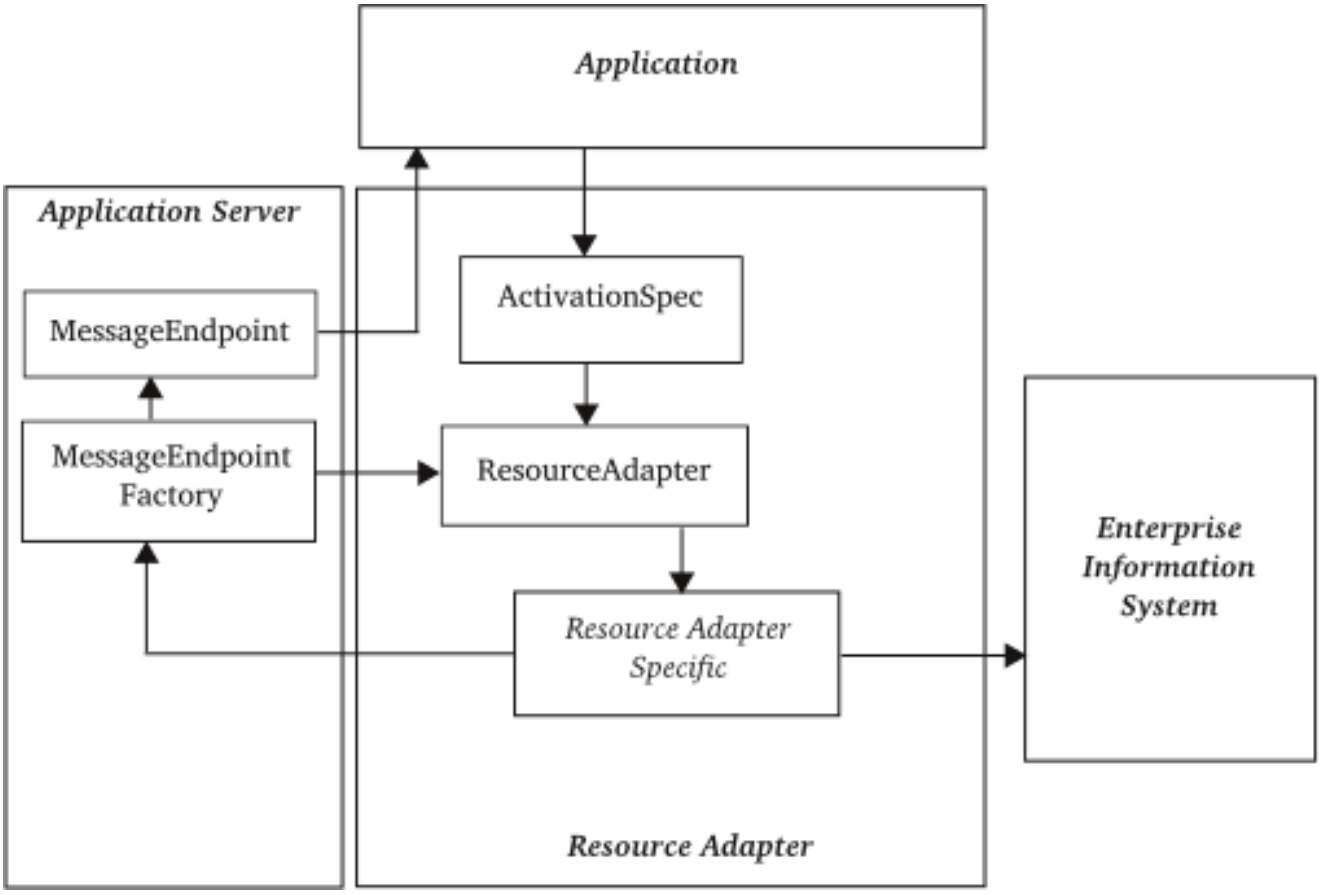
- ManagedConnectionFactory: The managed connection factory creates managed connections.
- ManagedConnection: The managed connection represents a physical connection to the target Enterprise Information System (EIS). The managed connection notifies the application server of events such as connection closed and connection error.

IronJacamar - the application server - contains

- ConnectionManager: The connection manager handles all managed connections in regards to pooling, transaction and security.
- ConnectionEventListener: The connection event listener allows the connection manager to know the status of each managed connection.

1.2.2. Inbound resource adapter

The Java Connector Architecture specification consists of a number of inbound components:



The application uses the

- ActivationSpec: The activation specification specifies the different properties that the application is looking for from the resource adapter and hence the Enterprise Information System (EIS). This specification can be hidden from the user by a facade provided by the application server.

The resource adapter contains

- ResourceAdapter: The resource adapter provides the activation point for inbound communication.
- Resource adapter specific: The resource adapter specific code handles communication with the Enterprise Information System (EIS) and deliver messages through the MessageEndpointFactory.

IronJacamar - the application server - contains

- MessageEndpointFactory: The MessageEndpointFactory is registered with the ResourceAdapter instance and creates the MessageEndpoint instances.

- MessageEndpoint: The MessageEndpoint contains the actual message from the Enterprise Information System (EIS) which the application uses. This could for example be a message driven Enterprise JavaBean (EJB/MDB).

2

Building

2.1. Prerequisites

2.1.1. Java Development Kit (JDK)

You must have the following JDK installed in order to build the project:

- Sun JDK 1.7.x
- OpenJDK 1.7.x

Remember to ensure that "javac" and "java" are in your path (or symlinked).

```
JAVA_HOME=/location/to/javahome
export JAVA_HOME

PATH=$JAVA_HOME/bin:$PATH
export PATH
```

2.1.2. Apache Ant

You must have Apache Ant 1.8.2+ installed on your system.

Remember to ensure that "ant" are in your path (or symlinked).

```
ANT_HOME=/location/to/anthome
export ANT_HOME

PATH=$ANT_HOME/bin:$PATH
export PATH
```

You may need to set the memory settings for the Apache Ant process like

```
```

```
ANT_OPTS="$ANT_OPTS -Xms128m -Xmx512m -XX:MaxPermSize=256m"
export ANT_OPTS
```

2.1.3. Apache Ivy

The IronJacamar project uses Apache Ivy for dependency management.

Apache Ivy is automatically downloaded and included in the development environment, so no additional setup is required.

2.1.4. Git

You must have Git installed on your system.

Remember to ensure that "git" are in your path (or symlinked).

2.2. Obtaining the source code

2.2.1. Forking the repository

The IronJacamar repository is located at:

```
https://github.com/ironjacamar/ironjacamar
```

Press the "Fork" button in order to fork the repository to your own GitHub account.

Clone your repository to your machine using

```
git clone git@github.com:<your_account>/ironjacamar.git
```

Next add the upstream repository as a remote location:

```
cd ironjacamar
git remote add upstream git@github.com:ironjacamar/ironjacamar.git
```

2.2.2. Git branches

We have the following branches for the project:

- master

  The head of development targeting the next upcoming release.

- 1.0

  The development targeting the IronJacamar 1.0 releases.

- 1.1

  The development targeting the IronJacamar 1.1 releases.

2.3. Compiling the source code

In order to build the IronJacamar project you execute:

```
ant <target>
```

where target is one of

- jars

  Builds the JAR archives in the distribution.

- test

  Builds the JAR archives in the distribution and runs all the test cases.

- module-test

  Builds the JAR archives in the distribution and runs all the test cases for the specified module (`-Dmodule=<modulename>`).

- one-test

  Builds the JAR archives in the distribution and runs the specified test case (`-Dmodule=<modulename> -Dtest=<classname>`).

- docs

  Builds the API documentation for the project.

- aggregated-javadocs

  Builds the Aggregated API documentation for the project.

- aggregated-javadocs-api-spi

  Builds the Aggregated API documentation for API/SPI of the project.

- sjc

  Builds the standalone environment using IronJacamar/SJC.

- release

  Builds a release of the project.

- clean

  Cleans the project of temporary files.

- clean-cache

  Cleans the Apache Ivy repository.

See the full list of targets in the main build.xml file.

An example to get the IronJacamar/SJC built and running:

```
ant clean sjc
cd target/sjc/bin
./run.sh
```

2.4. Creating a patch

Our user guide explains in the "I would like to implement a feature" section how to get started on a writing a new feature or submitting a patch to the project.

You should develop your feature on a Git branch using

```
git checkout -b <feature_name>
```

Once you are done you will need to rebase your work with the latest master

```
git fetch upstream
git rebase -i upstream/master
```

You will need to resolve any conflicts of course. Note, that all pull requests must be rebased against upstream master in order to get merged.

Then push the feature to your repository

```
git push origin <feature_name>
```

Go to your account on GitHub.com and submit a pull request via the "Pull request" button

```
https://www.github.com/<your_account>/ironjacamar
```

Remember to select the correct branch, fill in the subject with a short description of the feature, and fill in the description with the full description of the feature.

If your feature / bug-fix applies to multiple branches you will need to submit multiple pull requests - one pull request per branch.

3

Releases

The chapter describes the various releases and their exit criteria.

3.1. Overview

Each release is labelled with a version number and an identifier.

```
ironjacamar-<major>.<minor>.<patch>[.<identifier>]
```

where

- Major: The major version number. Signifies major changes in the implementation.
- Minor: The minor version number. Signifies functional changes to a major version.
- Patch: The patch version number. Signifies a binary compatible change to a minor version.
- Identifier: The identifier. Identifies the level of the quality of the release.
  - None / Final: Stable release
  - CR: Candidate for Release quality. The implementation is functional complete.
  - Beta: Beta quality. The implementation is almost functional complete.
  - Alpha: Alpha quality. The implementation is a snapshot of the development.

3.2. Versioning

Each release will contain a version number which relates to the feature branch where it was created.

3.2.1. Major

A Major version identifier signifies major changes in the implementation such as a change in the architecture.

The features between major versions can be a lot different, and therefore feature regressions may appear.

A Major version will most likely also mean updates to the configuration and required metadata files for deployments.

3.2.2. Minor

A Minor version identifier signifies functional changes to a Major release.

This means that new features have been added to the Major release, and hence may have new configuration options and integration points.

The release is binary compatible to the previous releases - for example `1.0` vs. `1.1`.

3.2.3. Patch

A Patch version identifier signifies a binary compatible update to one or more components in a Minor release.

This means that one or more bug fixes to existing components have been integrated in the branch in question.

The release is binary compatible to the previous releases - for example `1.0.0` vs. `1.0.1`.

3.3. Identifiers

Each release will contain an identifier which relates to the release quality.

3.3.1. Alpha releases

An Alpha release is a snapshot of the main development branch which likely will contain new features.

> **Warning**
> Alpha releases are NOT production quality

An Alpha release are made each month (time-boxed) unless the branch is using an identifier as Beta or higher.

The exit criteria for an Alpha release is that the main test suite is passing.

3.3.2. Beta releases

A Beta release contains major features that are considered almost functional complete. This doesn't mean however that all aspects of each feature is complete and therefore not all options will be active.

> **Warning**
> Beta releases are NOT production quality

A Beta release will be made once one or more features are almost functional complete and therefore Beta releases aren't time-boxed, but feature-boxed instead.

The exit criteria for a Beta release is that all test suites are passing.

3.3.3. Candidate for Release releases

A Candidate for Release is considered functional complete and candidate for being promoted to a Final release.

> **Warning**
> Candidate for Release releases are NOT production quality

A Candidate for Release focuses on functionality, but they are time-boxed to a maximum of two weeks between each release.

The exit criteria for a Candidate for Release release is that all test suites are passing.

3.3.4. Final releases

A Final release is considered feature complete and stable.

Typically only one Final release will be released from each branch, unless critical or blocker issues are found in the release. Patch releases will be available from our source control system as tags.

The exit criteria for a Final release is that all test suites are passing.

3.4. Nexus

The IronJacamar artifacts are uploaded to the JBoss.org Nexus repository located at:

```
https://repository.jboss.org/nexus/content/groups/public/
```

The IronJacamar artifacts are deployed under the `groupId` of:

```
org.jboss.ironjacamar
```

See the User Guide for a complete list of artifacts.

3.4.1. Deploying a release

A release of IronJacamar is deployed using:

```
ant nexus
cd target
./deploy.sh
```

After the artifacts have been uploaded the release must be promoted in Nexus by logging in and choosing "Promote" and "Close". The path for the staging repository can be used for testing the release.

Note, that this requires Maven 3.0.5+.

3.4.2. Deploying a snapshot

A snapshot of IronJacamar is deployed using:

```
ant -Dsnapshot=true nexus
cd target
./deploy.sh
```

Note, that this requires Maven 3.0.5+.

3.4.3. Deploying a snapshot (locally)

A snapshot of IronJacamar is deployed to the local Maven repository `$HOME/.m2/repository` using:

```
ant -Dsnapshot=true nexus
cd target
./install.sh
```

Note, that this requires Maven 3.0.5+.

4

Issue tracking

4.1. Location

The JIRA issue tracking for the project is located at http://issues.jboss.org/browse/JBJCA
.

4.2. Components

The project is divided into the following components:

Table 4.1. Project components

Component	Description
Arquillian	The Arquillian integration for the project.
AS	The tools that focuses on integration with WildFly.
Build	The build environment for the project.
Code Generator	The resource adapter code generator.
Common	Common interfaces and classes that are shared between multiple components.
Core	The core implementation of the project.
Documentation	The documentation (Users Guide / Developers Guide) for the project.
Deployer	The deployers for the project.
Eclipse	The Eclipse plugin for IronJacamar.
EIS	The EIS test server.
Embedded	The embedded IronJacamar container.
JDBC	A JDBC resource adapter.
Performance	Performance related work.
Standalone	The standalone IronJacamar distribution.
Test Suite	The IronJacamar test suite.
Validator	The resource adapter validator.

4.3. Categories

The system contains the following categoies:

Table 4.2. JIRA categories

Category	Description
Feature Request	Request for a feature made by the community.
Bug	Software defect in the project.
Task	Development task created by a member of the team.
Release	Issue which holds informations about a release.
Component Update	Identifies a thirdparty library dependency.

The other categories in the JIRA installation are not used by this project.

4.4. Life cycle

All issues folows the following life cycle:

Table 4.3. JIRA Lifecycle

Lifecycle	Description
Open	An issue currently not implemented.
Coding in Progress	An issue currently being worked on.
Resolved	An issue which has been implemented.
Closed	An issue that has been resolved and is included in a release.

Note: 'Component Update' issues can't be resolved nor closed during a development cycle. These are resolved and closed as part of the release procedure of the project. The reason for this is that the library in question can receive further updates during the active development cycle.

4.5. Priorities

All issues are assigned one of the following priorities:

Table 4.4. JIRA Priorities

Priority	Description
Blocker	An issue that needs to be fixed before the release.
Critical	An issue that is critical for the release.
Major	The default priority for an issue.

Priority	Description
Minor	An issue that is optional for a release.
Trivial	An issue that is optional for a release and have a lower priority than Minor.

5

Testing

5.1. Overall goals

The overall goals of our test environment is to execute tests that ensures that we have full coverage of the JCA specification as well as our implementation.

The full test suite is executed using

```
ant test
```

A single test case can be executed using

```
ant -Dmodule=embedded -Dtest=org.jboss.jca.embedded.unit.ShrinkWrapTestCase one-test
```

where `-Dmodule` specifies which module to execute the test case in. This parameter defaults to `core`. The `-Dtest` parameter specifies the test case itself.

You can also execute all test cases of a single module using

```
ant -Dmodule=embedded module-test
```

where `-Dmodule` specifies which module to execute the test cases in. This parameter defaults to `core`.

The build script does not fail in case of test errors or failure.

You can control the behavior by using the `junit.haltonerror` and `junit.haltonfailure` properties in the main `build.xml` file. Default value for both is `no`.

You can of course change them statically in the `build.xml` file or temporary using `-Djunit.haltonerror=yes`. There are other `jnuit.*` properties defined in the main `build.xml` that can be controlled in the same way.

5.1.1. Specification

The purpose of the specification tests is to test our implementation against the actual specification text.

Each test can only depend on:

- The official Java Connector Architecture API (javax.resource)
- Interfaces and classes in the test suite that extends/implements the official API

The test cases should be created in such a way such that they are easily identified by chapter, section and paragraph. For example:

```
org.jboss.jca.core.spec.chaper10.section3
```

5.1.2. IronJacamar specific interfaces

The purpose of the IronJacamar specific interfaces tests is to test our specific interfaces.

Each test can depend on:

- The official Java Connector Architecture API (javax.resource)
- The IronJacamar specific APIs (org.jboss.jca.xxx.api)
- Interfaces and classes in the test suite that extends/implements these APIs

The test cases lives in a package that have a meaningful name of the component it tests. For example:

```
org.jboss.jca.core.workmanager
```

These test cases can use both the embedded JCA environment or be implemented as standard POJO based JUnit test cases.

5.1.3. IronJacamar specific implementation

The purpose of the IronJacamar specific implementation tests is to test our specific implementation. These tests should cover all methods are not exposed through the interface.

Each test can depend on:

- The official Java Connector Architecture API (javax.resource)
- The IronJacamar specific APIs (org.jboss.jca.xxx.api)
- The IronJacamar specific implementation (org.jboss.jca.xxx.yyy)
- Interfaces and classes in the test suite

The test cases lives in a package that have a meaningful name of the component it tests. For example:

```
org.jboss.jca.core.workmanager
```

These test cases can use both the embedded JCA environment or be implemented as standard POJO based JUnit test cases.

5.2. Testing principle and style

Our tests follows the Behavior Driven Development (BDD) technique. In BDD you focus on specifying the behaviors of a class and write code (tests) that verify that behavior.

You may be thinking that BDD sounds awfully similar to Test Driven Development (TDD). In some ways they are similar: they both encourage writing the tests first and to provide full coverage of the code. However, TDD doesn't really provide a guide on which kind of tests you should be writing.

BDD provides you with guidance on how to do testing by focusing on what the behavior of a class is supposed to be. We introduce BDD to our testing environment by extending the standard JUnit 4.x test framework with BDD capabilities using assertion and mocking frameworks.

The BDD tests should

- Clearly define `given-when-then` conditions
- The method name defines what is expected: f.ex. shouldReturnFalseIfMethodXIsCalledWithNullString()
- Easy to read the assertions by using Hamcrest Matchers [http://code.google.com/p/hamcrest/]
- Use `given` facts whenever possible to make the test case more readable. It could be the name of the deployed resource adapter, or using the BDD Mockito class [http://mockito.googlecode.com/svn/branches/1.8.0/javadoc/org/mockito/BDDMockito.html] to mock the fact.

We are using two different kind of tests:

- Integration Tests: The goal of these test cases is to validate the whole process of deployment, and interacting with a sub-system by simulating a critical condition.
- Unit Tests: The goal of these test cases is to stress test some internal behaviour by mocking classes to perfectly reproduce conditions to test.

5.2.1. Integration Tests

The integration tests simulate a real condition using a particular deployment artifacts packaged as resource adapters.

The resource adapters are created using either the main build environment or by using ShrinkWrap [http://community.jboss.org/wiki/ShrinkWrap]. Using resource adapters within the test cases will allow you to debug both the resource adapters themself or the JCA container.

The resource adapters represent the [given] facts of our BDD tests, the deployment of the resource adapters represent the [when] phase, while the [then] phase is verified by assertion.

Note that some tests consider an exception a normal output condition using the JUnit 4.x `@Exception(expected = "SomeClass.class")` annotation to identify and verify this situation.

5.2.2. Unit Tests

We are mocking our input/output conditions in our unit tests using the Mockito [http://mockito.googlecode.com] framework to verify class and method behaviors.

An example:

```
@Test
public void printFailuresLogShouldReturnNotEmptyStringForWarning() throws Throwable
{
   //given
   RADeployer deployer = new RADeployer();
   File mockedDirectory = mock(File.class);
   given(mockedDirectory.exists()).willReturn(false);

   Failure failure = mock(Failure.class);
   given(failure.getSeverity()).willReturn(Severity.WARNING);

   List failures = Arrays.asList(failure);
   FailureHelper fh = mock(FailureHelper.class);
   given(fh.asText((ResourceBundle) anyObject())).willReturn("myText");

   deployer.setArchiveValidationFailOnWarn(true);

   //when
   String returnValue = deployer.printFailuresLog(null, mock(Validator.class),
                                                  failures, mockedDirectory, fh);

   //then
   assertThat(returnValue, is("myText"));
}
```

As you can see the BDD style respects the test method name and using the `given-when-then` sequence in order.

5.3. Quality Assurance

In addition to the test suite the IronJacamar project deploys various tools to increase the stability of the project.

The following sections will describe each of these tools.

5.3.1. Checkstyle

Checkstyle is a tool that verifies that the formatting of the source code in the project is consistent.

This allows for easier readability and a consistent feel of the project.

The goal is to have zero errors in the report. The checkstyle report is generated using

```
ant checkstyle
```

The report is generated into

```
reports/checkstyle
```

The home of checkstyle is located here: http://checkstyle.sourceforge.net/.

5.3.2. Findbugs

Findbugs is a tool that scans your project for bugs and provides reports based on its findings.

This tool helps lower of the number of bugs found in the IronJacamar project.

The goal is to have zero errors in the report and as few exclusions in the filter as possible. The findbugs report is generated using

```
ant findbugs
```

The report is generated into

```
reports/findbugs
```

The home of findbugs is located here: http://findbugs.sourceforge.net/.

5.3.3. JaCoCo

JaCoCo generates a test suite matrix for your project which helps you identify where you need additional test coverage.

The reports that the tool provides makes sure that the IronJacamar project has the correct test coverage.

The goal is to have as high code coverage as possible in all areas. The JaCoco report is generated using

```
ant jacoco
```

The report is generated into

```
reports/jacoco
```

The home of JaCoCo is located here: http://www.eclemma.org/jacoco/.

5.3.4. Tattletale

Tattletale generates reports about different quality matrix of the dependencies within the project.

The reports that the tool provides makes sure that the IronJacamar project doesn't for example have cyclic dependencies within the project.

The goal is to have as no issues flagged by the tool. The Tattletale reports are generated using

```
ant tattletale
```

The reports are generated into

```
reports/tattletale
```

The home of Tattletale is located here: http://www.jboss.org/tattletale.

5.4. Performance testing

Performance testing can identify areas that needs to be improved or completely replaced.

5.4.1. JProfiler

Insert the following line in `run.sh` or `run.bat`:

```
-agentpath:<path>/jprofiler6/bin/linux-x64/libjprofilerti.so=port=8849
```

where the Java command is executed.

The home of JProfiler is located here: http://www.ej-technologies.com/products/jprofiler/overview.html.

5.4.2. OProfile

OProfile can give a detailed overview of applications running on the machine, including Java program running with OpenJDK.

The home of OProfile is located here: http://oprofile.sourceforge.net.

5.4.2.1. Installation

Enable the Fedora debug repo:

```
/etc/yum.repos.d/fedora.repo

[fedora-debuginfo]
name=Fedora $releasever - $basearch - Debug
failovermethod=priority
mirrorlist=https://mirrors.fedoraproject.org/metalink?repo=fedora-debug-$releasever&arch=
$basearch
enabled=1
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-fedora-$basearch
```

Install:

```
yum install -y oprofile oprofile-jit
yum install -y yum-plugin-auto-update-debug-info
yum install -y java-1.6.0-openjdk-debuginfo
```

```
```

5.4.2.2. Running

Insert the following line in `run.sh` or `run.bat`:

```
-agentpath:/usr/lib64/oprofile/libjvmti_oprofile.so
```

for 64bit JVMs or

```
-agentpath:/usr/lib/oprofile/libjvmti_oprofile.so
```

for 32 bit JVMs where the Java command is executed.

Now execute:

```
opcontrol --no-vmlinux
opcontrol --start-daemon
```

and use the following commands:

```
opcontrol --start # Starts profiling
opcontrol --dump  # Dumps the profiling data out to the default file
opcontrol --stop  # Stops profiling
```

Once you are done execute:

```
opcontrol --shutdown  # Shuts the daemon down
```

A report can be generated by:

```
```

```
opreport -l --output-file=<filename>
```

Remember that this is system wide profiling, so make sure that only the services that you want included are running.

More information is available at http://oprofile.sourceforge.net/doc/index.html.

6

Metadata

6.1. Core Metadata

The metadata for the IronJacamar project is split up into the following areas

- Java Connector Architecture Metadata
- IronJacamar Metadata
- Resource adapter deployment Metadata
- DataSource deployment Metadata

All metadata parsing is done using the StAX model (`javax.xml.stream`) for optimal performance.

The implementation of these areas is done within the common module of the project.

6.1.1. Java Connector Architecture Metadata

The Java Connector Architecture (JCA) metadata implement the metadata defined in the JCA specifications. We have metadata representing the following standards:

- Java Connector Architecture 1.0
- Java Connector Architecture 1.5
- Java Connector Architecture 1.6

An instance of the metadata is bundle with the resource adapter archive as

```
META-INF/ra.xml
```

The implementation is split into two package hierarchies - the API in

```
org.jboss.jca.common.api.metadata.ra
```

and the implementation in

```
org.jboss.jca.common.metadata.ra
```

.

6.1.2. IronJacamar Metadata

The IronJacamar metadata can provide overrides for the values specified in the standard Java Connector Architecture metdata. It is also possible to specify deployment metadata, which will active an instance of the resource adapter without any other deployment plans.

Supported versions of the metadata:

- IronJacamar 1.0

An instance of the metadata is bundle with the resource adapter archive as

```
META-INF/ironjacamar.xml
```

The implementation is split into two package hierarchies - the API in

```
org.jboss.jca.common.api.metadata.ironjacamar
```

and the implementation in

```
org.jboss.jca.common.metadata.ironjacamar
```

.

6.1.3. Resource adapter deployment Metadata

The resource adapter deployment metadata provides a deployment plan for the specified resource adapter archive. It is possible to override metadata specified as part of the Java Connector Architecture metadata or the IronJacamar metadata.

Supported versions of the metadata:

- Resource adapter deployment 1.0

The implementation is split into two package hierarchies - the API in

```
org.jboss.jca.common.api.metadata.resourceadapters
```

and the implementation in

```
org.jboss.jca.common.metadata.resourceadapters
```

.

6.1.4. Datasource deployment Metadata

The datasource deployment metadata provides a deployment plan for datasources. The metadata allows the developer to setup connection parameters, pooling settings and security.

Supported versions of the metadata:

- Datasource deployment 1.0

The implementation is split into two package hierarchies - the API in

```
org.jboss.jca.common.api.metadata.ds
```

and the implementation in

```
org.jboss.jca.common.metadata.ds
```

.

6.1.4.1. Datasource mapping

The table below specifies how each attribute/element map to the resource adapter or the container.

Table 6.1. Datasource mapping

Tag	Resource Adapter	Container
min-pool-size		Pool
max-pool-size		Pool
prefill		Pool
user-name	X	
password	X	
connection-url	X	
driver-class	X	
transaction-isolation	X	
connection-property	X	
url-delimiter	X	
url-selector-strategy-class-name	X	
new-connection-sql	X	
xa-datasource-property	X	
xa-datasource-class	X	
is-same-rm-override		TxConnectionManager
interleaving		TxConnectionManager
prepared-statement-cache-size	X	
share-prepared-statements	X	
pad-xid		TxConnectionManager
wrap-xa-resource		TxConnectionManager
no-tx-separate-pools		Pool
jndi-name		ConnectionManager
pool-name		X
enabled		X
use-java-context		X
valid-connection-checker-class-name	X	
check-valid-connection-sql	X	
validate-on-match	X	

Tag	Resource Adapter	Container
background-validation		Pool
background-validation-minutes		Pool
use-fast-fail		Pool
stale-connection-checker-class-name	X	
exception-sorter-class-name	X	
blocking-timeout-millis		Pool
idle-timeout-minutes		Pool
set-tx-query-timeout		
query-timeout	X	
use-try-lock	X	
allocation-retry		ConnectionManager
allocation-retry-wait-millis		ConnectionManager
xa-resource-timeout		TxConnectionManager
track-statements	X	
prepared-statement-cache-size	X	
share-prepared-statements	X	

6.2. Metadata Repository

The metadata repository serves as a central point for all the metadata in the systems.

6.2.1. Interface

The interface of the metadata repository is located in:

```
org.jboss.jca.core.spi.MetaDataRepository
```

providing methods to query and update the repository.

6.2.2. Bean

The implementation of the metadata repository can be defined as:

```
<bean name="MetaDataRepository"
      interface="org.jboss.jca.core.spi.MetaDataRepository"
      class="org.jboss.jca.core.mdr.SimpleMetaDataRepository">
</bean>
```

which is a simple implementation of the metadata repository service provider interface (SPI).

7

Deployers

The deployer chains for the project is located in the `deployers` module.

7.1. RAR Deployer

The responsibility of the RAR deployer is to deploy a resource adapter archive (.RAR) file.

7.1.1. Fungal

The Fungal kernel features a simple deployment framework, so only three classes are needed for the deployer chain.

The classes are located in the

```
deployers/src/main/java/org/jboss/jca/deployers/fungal
```

directory.

7.1.1.1. RADeployer

This class represent a resource adapter deployer and implements the

```
com.github.fungal.spi.deployers.Deployer
com.github.fungal.spi.deployers.MultiStageDeployer
com.github.fungal.spi.deployers.DeployerOrder
```

interfaces.

The responsible of the class is to

- Create a classloader for the deployment
- Retrieve metadata and annotations such that they can be merged

- Perform archive validation using the JCA validator
- Perform bean validation
- Register the metadata in the metadata repository
- Register the resource adapter in the metadata repository
- Identify and activate the resource adapter objects - if JNDI information is available
- Bind connection factories and admin objects into JNDI - if JNDI information is available

If the resource adapter isn't activated in this step based on an `ironjacamar.xml` file, the deployment will advance to the next step in the deployer chain.

7.1.1.2. RADeployment

This class represent a resource adapter deployment and implements the

```
com.github.fungal.spi.deployers.Deployment
```

interface.

The responsible of the class is to

- Unregister the resource adapter from the metadata repository
- Unregister the JNDI bindings in the metadata repository - if the deployment was activated
- Unbind connection factories and admin objects in JNDI - if the deployment was activated
- Close the classloader
- Clean up any temporary files

7.1.1.3. RaXmlDeployer

This class represent a resource adapter deployer and implements the

```
com.github.fungal.spi.deployers.Deployer
com.github.fungal.spi.deployers.MultiStageDeployer
com.github.fungal.spi.deployers.DeployerOrder
com.github.fungal.spi.deployers.DeployerPhases
```

interface.

The class deploys resource adapter archives based on a `-ra.xml` which provides the necessary deployment information.

The responsible of the class is to

- Create a classloader for the deployment
- Retrieve metadata from the metadata repository
- Merge metadata from the deployment descriptor
- Perform archive validation using the JCA validator
- Perform bean validation
- Register the metadata in the metadata repository
- Identify and activate the resource adapter objects
- Bind connection factories and admin objects into JNDI

Since multiple resource adapter archives can be activated within a single `-ra.xml` file the class uses the `DeployerPhases` callbacks to unregister these from the container. If there is only a single resource adapter activation the deployer acts as part of the normal deployer chain.

7.1.1.4. RaXmlDeployment

This class represent a resource adapter deployment from the `RaXmlDeployer` and implements the

```
com.github.fungal.spi.deployers.Deployment
```

interface.

The responsible of the class is to

- Unregister the JNDI bindings in the metadata repository
- Unbind connection factories and admin objects in JNDI
- Close the classloader

7.1.1.5. RAActivator

This class will activate all resource adapters which hasn't been deployed by a previous step. The class implements the

```
```

```
com.github.fungal.spi.deployers.DeployerPhases
```

interface. This interface allows the class to hook into the deployer lifecycle of the kernel and receive callback notifications.

The responsible of the class is to

- Find any resource adapters which hasn't been deployed through the metadata repository
- Perform a deployment like `RADeployer`
- Register each deployment with the kernel through the main deployer

7.1.1.6. RAActivatorDeployment

This class represent a resource adapter deployment activated by the `RAActivator` and implements the

```
com.github.fungal.spi.deployers.Deployment
```

interface.

The responsible of the class is to

- Unregister the JNDI bindings in the metadata repository
- Unbind connection factories and admin objects in JNDI
- Close the classloader

7.2. DataSource Deployer

The responsibility of the datasource deployer is to deploy a datasource deployment (-ds.xml) file.

7.2.1. Fungal

The Fungal datasource deployer chain consists of two classes.

The classes are located in the

```
deployers/src/main/java/org/jboss/jca/deployers/fungal
```

directory.

7.2.1.1. DsXmlDeployer

This class represent a datasource deployer and implements the

```
com.github.fungal.spi.deployers.Deployer
```

interface.

The responsible of the class is to

- Locate metadata about JDBC in the metadata repository
- Activate each `DataSource` using `jdbc-local.rar` as a template
- Activate each `XaDataSource` using `jdbc-xa.rar` as a template

7.2.1.2. DsXmlDeployment

This class represent a datasource deployment and implements the

```
com.github.fungal.spi.deployers.Deployment
```

interface.

The responsible of the class is to

- Unbind the datasource in JNDI
- Close the classloader

8

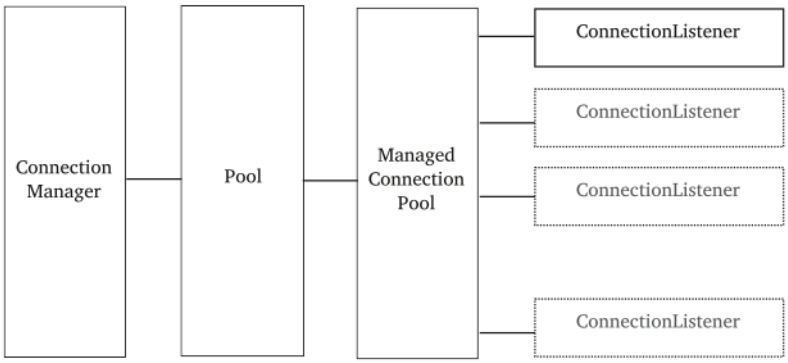
Connection manager

8.1. Overview

The connection manager defines the interface for resource adapters to allocate connections, which are associated with the physical connections to the target Enterprise Information System, such as a database.

It is up to the connection manager to use the pool, and enlist the connection listeners in the transactions, if supported.

The connection manager architecture



Note

Each of the components in the connection manager architecture can be accessed by multiple threads at the same time, hence each component needs to make sure that thread safely is maintained.

8.2. Public API

The public API defines the API that programs external to the IronJacamar project can use to configure, and use the connection manager.

The `ConnectionManager` interface allows to associate and dissociate a managed connection with a connection.

The `ConnectionListener` interface provides with IronJacamar contract for `javax.resource.spi.ConnectionEventListener`.

The package for the public API is `org.jboss.jca.core.api.connectionmanager`.

8.3. Private API

The private API defines the API that can be used internally IronJacamar to control the connection manager. The API extends the public API where it makes sense in order to provide a more uniform interface to the implementation.

The `ConnectionManagerFactory` class can create a `ConnectionManager` instance.

The `ConnectionManager` interface defines the internal API of the connection manager used by IronJacamar.

The `NoTxConnectionManager` interface defines the internal API of a non-transactional connection manager.

The `TxConnectionManager` interface defines the internal API of a transactional connection manager.

The `ConnectionListener` interface defines the internal API of a connection listener, which is associated with a managed connection.

The package for the private API is `org.jboss.jca.core.connectionmanager`.

8.4. Implementation

The implementation of the connection manager is split in two classes, with a shared base class for common functionality.

8.4.1. AbstractConnectionManager

`AbstractConnectionManager` provides the methods that are shared across both implementations, `NoTxConnectionManagerImpl` and `TxConnectionManagerImpl`.

`getManagedConnection(Transaction, Subject, ConnectionRequestInfo)` obtains a `ConnectionListener` instance from the pool. If an error occurs a retry is performed, if configured.

`returnManagedConnection(ConnectionListener, boolean)` returns a `ConnectionListener` instance to the pool. If an error occurs a retry is performed, if configured.

`allocateConnection(ManagedConnectionFactory, ConnectionRequestInfo)` allocates a connection for the managed connection attached to the `ConnectionListener` instance.

`associateManagedConnection(Object, ManagedConnectionFactory, ConnectionRequestInfo)` associates a `ManagedConnection` with the passed in connection. This is a `LazyAssociatableConnectionManager` extension of IronJacamar.

`dissociateManagedConnection(Object, ManagedConnection, ManagedConnectionFactory)` dissociates a connection with its `ManagedConnection` instance. This is a `LazyAssociatableConnectionManager` extension of IronJacamar.

`shutdown` shuts down the connection manager, and its related pool instance.

8.4.2. NoTxConnectionManagerImpl

`NoTxConnectionManagerImpl` provides the implementation for a connection manager configured with `NoTransaction`.

`createConnectionListener(ManagedConnection, ManagedConnectionPool)` creates a `NoTxConnectionListener` and associates it with the `ManagedConnection` instance.

8.4.3. TxConnectionManagerImpl

`TxConnectionManagerImpl` provides the implementation for a connection manager configured with `LocalTransaction` or `XATransaction`.

`createConnectionListener(ManagedConnection, ManagedConnectionPool)` creates a `TxConnectionListener` and associates it with the `ManagedConnection` instance. In case of `LocalTransaction` a `XAResource` is created to wrap the local transaction methods of the resource adapter. In case of `XATransaction` the underlying `XAResource` instance is wrapped with product information, if configured.

`getManagedConnection(Subject, ConnectionRequestInfo)` verifies that a valid transaction exists before creating a `ManagedConnection`, since there is no point in spending resources on work that is going to be rolled back. `ironjacamar.allow_marked_for_rollback` overrides this behavior.

`managedConnectionReconnected(ConnectionListener)` enlist the `ConnectionListener` in the transaction.

`managedConnectionDisconnected(ConnectionListener)` delist the `ConnectionListener` from the transaction.

`lazyEnlist(ManagedConnection)` handles lazy enlistment scenarios as defined by `LazyEnlistableConnectionManager`.

8.4.4. AbstractConnectionListener

`AbstractConnectionListener` provides the methods that are shared across both implementations, `NoTxConnectionListener` and `TxConnectionListener`. This base class keeps track off the connection handles used for the associated `ManagedConnection`.

`connectionErrorOccurred(ConnectionEvent)` logs the application error, and flushes either the `Pool` or `ManagedConnectionPool` depending on the strategy configured.

`controls(ManagedConnection, Object)` checks if the `ManagedConnection` and optional connection is controlled by this connection listener.

`compareTo(Object)` is used to sort the connection listeners based on their last used time.

8.4.5. NoTxConnectionListener

`NoTxConnectionListener` is the listener for `NoTransaction` scenarios.

`connectionClosed(ConnectionEvent)` dissociates the connection handles, and if there are no handles associated anymore the `ManagedConnection` is returned to the pool.

8.4.6. TxConnectionListener

`TxConnectionListener` is the listener for `LocalTransaction` and `XATransaction` scenarios.

`used()` updates the last used time, and resets the timeout value for the underlying `XAResource` if in `XATransaction` mode.

`enlist()` enlists the `XAResource` instances in the transaction through `TransactionSynchronization` including resources picked up by the `CachedConnectionManager`.

`delist()` delists the `XAResource` from the transaction in interleaved scenarios.

`dissociate()` dissociates the `ConnectionListener` with the transaction.

`connectionClosed(ConnectionEvent)` dissociates a connection handle through `wasFreed(Object)` and returns the `ManagedConnection` in interleaved scenarios.

`connectionErrorOccurred(ConnectionEvent)` clears any `TransactionSynchronization` object such that the `ManagedConnection` can be returned for destruction.

`tidyup()` will rollback any left over `LocalTransaction` instance.

`isManagedConnectionFree()` checks if there is exists a `TransactionSynchronization` object in track by transaction scenarios, since the `ManagedConnection` can't be returned in that case.

`wasFreed(Object)` dissociates a connection handle from the `ConnectionListener`, or resets the track by transaction flag if `null` such that the `ManagedConnection` can be returned.

The `TransactionSynchronization` class takes care of enlisting the `XAResource` in the transaction, in track by transaction scenarios. This is done in its `enlist()` and its result can be verified in `checkEnlisted()`. The `beforeCompletion()` method delists the `XAResource` from the transaction. The `afterCompletion(int)` method returns the `ManagedConnection` to the pool.

9

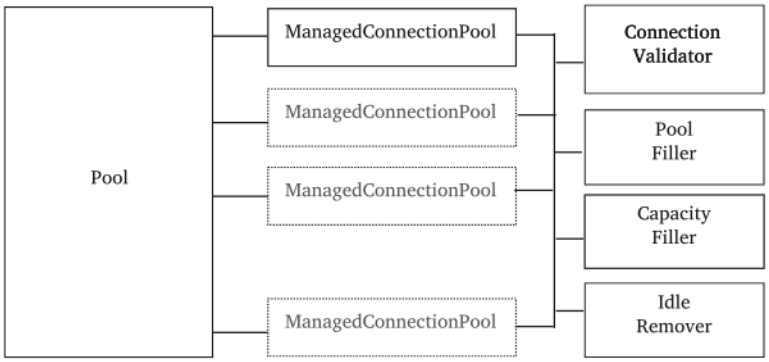
Pool

9.1. Overview

The pool controls the physical connection to the target Enterprise Information System, such as a database.

It is up to the pool to create, hand out and destroy connections in the defined lifecycle based on the configuration parameters supplied by the user.

The pool architecture



Note

Each of the components in the pool architecture can be accessed by multiple threads at the same time, hence each component needs to make sure that thread safely is maintained.

9.2. Public API

The public API defines the API that programs external to the IronJacamar project can use to configure, and use the pool.

The `Pool` interface allows access to the name of the pool, flushing connections, and verifying if a connection can be obtained from the pool.

The `PoolConfiguration` class holds the configuration parameters for the pool.

The `FlushMode` enum defines the different flush modes supported.

The `PoolStatistics` interface defines the statistics available for a pool.

The package for the public API is `org.jboss.jca.core.api.connectionmanager.pool`.

9.3. Private API

The private API defines the API that can be used internally IronJacamar to control the pool. The API extends the public API where it makes sense in order to provide a more uniform interface to the implementation.

The `PoolFactory` class will create a `Pool` based upon the passed in configuration.

The `PoolStrategy` enum defines how the pool is split based on credential equallity.

The `Pool` interface extends the public API with methods that should only be available from with IronJacamar such as getting a connection listener, returning a connection listener, and shutting down the pool.

The `PrefillPool` interface defines the contract for pool implementations that supports prefilling of connections upon startup, such as `OnePool` and `PoolBySubject`.

The `Capacity` interface provides a handle to the policies used for increasing and decreasing the pool.

The `CapacityIncrementer` interface defines if a physical connection should be created given the input parameters.

The `CapacityDecrementer` interface defines if a physical connection should be destroyed given the input parameters.

The package for the private API is `org.jboss.jca.core.connectionmanager.pool.api`.

9.4. Implementation

The pool implementation provides a concrete implementation of the contracts defined by the public and private APIs.

The package for the pool implementation is `org.jboss.jca.core.connectionmanager.pool`.

9.4.1. AbstractPool

`AbstractPool` provides the methods that are shared across all pool implementations.

`getKey(Subject, ConnectionRequestInfo, boolean)` defines the key used to lookup the `ManagedConnectionPool` instance. The implementation of this method is different for each pool type.

`getManagedConnectionPool(Object, Subject, ConnectionRequestInfo)` retrieves the correct `ManagedConnectionPool` instance. If the `ManagedConnectionPool` doesn't yet exists then one is created, and initialized.

`emptyManagedConnectionPool(ManagedConnectionPool)` removes a `ManagedConnectionPool` instance, if unused.

`flush` flushes the `ManagedConnectionPool` instances, based on the `FlushMode`.

`getConnection(Transaction, Subject, ConnectionRequestInfo)` returns a `ConnectionListener` instance, which has the physical connection to the Enterprise Information System attached. The method uses 3 sub methods to return the correct listener instance. `getSimpleConnection` returns a `ConnectionListener` if there is no transaction associated. `getTransactionOldConnection` returns the `ConnectionListener` already associated with the transaction, if any. `getTransactionNewConnection` creates a new `ConnectionListener`, and associates it with the transaction.

`findConnectionListener` finds a specific `ConnectionListener` instance.

`returnConnectionListener` returns a `ConnectionListener` instance to the correct `ManagedConnectionPool`.

`shutdown` shuts down the pool.

`internalTestConnection(ConnectionRequestInfo, Subject)` tries to obtain a `ConnectionListener` based on the input given.

9.4.2. AbstractPrefillPool

The `AbstractPrefillPool` enables the pool to prefill connections during startup, and through its lifecycle.

`prefill(Subject, ConnectionRequestInfo, boolean)` handles the prefilling process.

9.4.3. Pool types

IronJacamar features 5 different pool types. Each pool type has its own `getKey` method implementation that defines how a `ManagedConnectionPool` instance is located.

`OnePool` uses one `ManagedConnectionPool` instance to hold all `ConnectionListeners`.

`PoolByCri` splits the `ManagedConnectionPool` instances based on the `ConnectionRequestInfo` instance.

`PoolBySubject` splits the `ManagedConnectionPool` instances based on the `Subject` instance.

`PoolBySubjectAndCri` splits the `ManagedConnectionPool` instances based on both the `ConnectionRequestInfo` instance and the `Subject` instance.

`ReauthPool` allows the `ConnectionListener` instances to reauthenticate, so the `ManagedConnectionPool` instances can change over time based on the `ConnectionRequestInfo` and `Subject` instances.

The package for the pool types is `org.jboss.jca.core.connectionmanager.pool.strategy`.

9.5. ManagedConnectionPool

The `ManagedConnectionPool` controls the `ConnectionListener` instances, which each has a physical connection (`ManagedConnection`) associated.

The package is `org.jboss.jca.core.connectionmanager.pool.mcp`

9.5.1. Private API

`ManagedConnectionPool` instances should only be accessed from within IronJacamar, so they only have a private API.

The `ManagedConnectionPoolFactory` class creates a `ManagedConnectionPool` instance.

The `ManagedConnectionPool` interface defines the methods exposed to the pool, connection validator, and idle remover. These methods includes getting a connection listener, finding a connection listener, and returning a connection listener.

The `ManagedConnectionPoolStatistics` interface defines the statistics for the `ManagedConnectionPool` instance.

The `ManagedConnectionPoolUtility` class defines utility methods for the `ManagedConnectionPool` instance.

9.5.2. Implementation

There are three different implementations of the `ManagedConnectionPool` interface. `SemaphoreArrayListManagedConnectionPool` which uses a `Semaphore` to guard an `ArrayList` which holds the `ConnectionListeners`. `ArrayBlockingQueueManagedConnectionPool` which uses an `ArrayBlockingQueue` to hold the `ConnectionListeners`. And `LeakDumperManagedConnectionPool` which extends `SemaphoreArrayListManagedConnectionPool`, but reports any leaks upon shutdown.

`getConnection(Subject, ConnectionRequestInfo)` provides a `ConnectionListener`. The method requires a lock in order to obtain a listener, using the specified timeout value. If a listener is avaiable in the pool then it is matched against the `ManagedConnectionFactory` to verify it is valid, and returned - otherwise it is destroyed. If no listener is available then a new listener is created and returned. In the latter case both prefill and a capacity increase is scheduled in order to prefill to the minimum size, and increase the pool by the specified capacity policy.

`returnConnection(ConnectionListener, boolean, boolean)` returns a `ConnectionListener` into the pool.

`flush(FlushMode)` flushes the `ConnectionListeners` according to the mode. Any listeners marked as bad will be destroyed. Prefill is scheduled at the end in order to maintain the minimum pool size.

`removeIdleConnections` is invoked from the idle remover in order to decrement the pool to the desired size based on the `CapacityDecrementer` policy. If any listeners are destroyed the pool is either scheduled for prefill, or for removal through `emptyManagedConnectionPool` if empty.

`shutdown` shuts the instance down. All listeners are removed.

`fillTo(int)` fills the pool to the specified size. The pool filler component uses this method.

`increaseCapacity(Subject, ConnectionRequestInfo)` increases the pool based on the `CapacityIncrementer` policy. The capacity filler component uses this method.

`validateConnections` validates that the listeners are valid according to `ValidatingManagedConnectionFactory`. Any invalid listeners are destroyed and prefill scheduled. The connection validator component uses this method.

`detachConnectionListener` disassociates the connections attached to the `ManagedConnection` such that it can be reused in another request through `DissociatableManagedConnection`.

10

Standalone

10.1. Overview

The standalone IronJacamar container implements Chapter 3 Section 5 of the JCA 1.6 specification which defines a standalone JCA environment.

The standalone container has the following layout:

- `$IRON_JACAMAR_HOME/bin/`

  contains the run scripts and the SJC kernel.

- `$IRON_JACAMAR_HOME/config/`

  contains the configuration of the container.

- `$IRON_JACAMAR_HOME/deploy/`

  contains the user deployments.

- `$IRON_JACAMAR_HOME/doc/`

  contains the documentation.

- `$IRON_JACAMAR_HOME/lib/`

  contains all the libraries used by the container.

- `$IRON_JACAMAR_HOME/log/`

  contains the log files.

- `$IRON_JACAMAR_HOME/system/`

  contains system deployments files.

- `$IRON_JACAMAR_HOME/tmp/`

  contains temporary files.

To start the container execute the following

```
cd $IRON_JACAMAR_HOME/bin
./run.sh
```

.

10.2. IronJacamar/SJC

> **Warning**
> This standalone configuration is for development purposes only.

The IronJacamar/SJC uses the Fungal kernel for its run-time environment.

The homepage for the Fungal is http://jesperpedersen.github.com/fungal
.

SJC is short for "Simple JCA Container".

Appendix A. Licenses

All licenses can be found in the `doc/licenses` directory.

A.1. GNU Lesser General Public License 2.1

GNU LESSER GENERAL PUBLIC LICENSE

Version 2.1, February 1999

Copyright (C) 1991, 1999 Free Software Foundation, Inc. 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

[This is the first released version of the Lesser GPL. It also counts as the successor of the GNU Library Public License, version 2, hence the version number 2.1.]

A.1.1. Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public Licenses are intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users.

This license, the Lesser General Public License, applies to some specially designated software packages--typically libraries--of the Free Software Foundation and other authors who decide to use it. You can use it too, but we suggest you first think carefully about whether this license or the ordinary General Public License is the better strategy to use in any particular case, based on the explanations below.

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