
jPOS
.org

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Part I. Introduction

Chapter 1. Project Overview

1.1. Background

Back in the late nineties, our company was awarded the development of a jPOS-based application for our local VISANet [1] acquirer.

At that time, we thought that going for a J2EE solution was the way to go. We went with the great Orion application server and we called the application **jPOS-EE**, it was kind of a jPOS "Enterprise" Edition.

But we soon got to hit some of the major problems of running an early J2EE application in a demanding 7x24x365 environment, the deployment of new versions was both stressful and costly in terms of time (a one minute downtime can feel like a week when you are manning the telephones in a call center). So we designed a lightweight solution that we could deploy and redeploy quickly, without obscure RMI-IIOP related issues that could only be solved with an application server restart.

In addition, we started to see how O/R mapping tools such as Hibernate offered greater sophistication than EJB 2.1 could offer, and EJB 3.0 was not on the horizon yet.

So we decided to build our own tiny environment and began by building **Q2**, our JMX-based IoC micro kernel. [2]

We consider jPOS-EE as a **Meta-Project** where we encompass many other compatible (from a technical as well as license perspective) Open Source projects such as:

- Hibernate
- Jetty
- Velocity
- XStream
- JDOM
- JDBM
- Apache Commons
- Etcetera

In order to easily assemble different types of jPOS-EE applications whilst fostering code reuse as much as possible, we have developed a very simple, module-based jPOS-EE Software Development Kit (jPOS-EE SDK), now replaced by Gradle [3].

[1] Visanet/Uruguay **http://visanet.com.uy**
[2] Q2 is QSP version 2, described in the jPOS Programmer's Guide
[3] Gradle Project **http://gradle.org/**

We kept the name jPOS-EE, but we replaced the first E from Enterprise to Extended. This document describes the **jPOS Extended Edition**.

We don't claim that using the jPOS-EE framework and our choice of supporting projects is the best way to write a jPOS application, people could argue that JEE is the way to go, or Spring is the way to go, or Pico/Nano container does better IoC, or that we should use JBoss/Jeronimo, Guice, OSGI, QI4J, you name it. In the same way, we choose to use Jetty but there's people that may say that Tomcat is the way to go.

jPOS-EE is just the way we at jPOS.org write our applications and we are sharing this "technology" on an as-is basis. You can use it, or you can write your jPOS application using whatever technology/framework you feel more comfortable with.

1.2. About this document

This is the official jPOS-EE documentation that intends to aggregate everything related to jPOS-EE, including but no limited to: its objectives, specifications, schedule, priorities, organizational chart, road map, change log, coding conventions, core modules, optional modules, license information, etc.

It complements, but doesn't replace the **jPOS Programmer's Guide**. It is not a user guide nor a tutorial, it is a development master workbook, written by developers for developers.

You're currently reading revision 2.0.9.

New versions of this document are regularly posted in **jpos.org/doc/jPOS-EE.pdf**.

1.3. Objectives

Our main objective is to avoid repeating ourselves. **DRY** [4] is a good paradigm to keep in mind.

We at jPOS.org have a small company with very limited development resources and a large number of customers. Most of our end user applications are very specific, yet they share a large number of features.

jPOS-EE is all about code reuse. We developed a very simple SDK based on a pluggable module architecture that can be bundled together at compile time to create — as fast as possible — highly reliable jPOS applications.

The more we use jPOS-EE to create applications for our customers, the more we tend to make these modules smaller, with as few dependencies on each other as possible.

We expect developers using jPOS-EE to create their own modules based upon our public ones, and to interact with the jPOS-EE community in order to engage into the formal process of requesting changes to the jPOS-EE codebase whenever it is deemed necessary.

Local changes to the jPOS-EE code base may seem the easy way to solve a given requirement, but it forces you to apply the same change over and over as new jPOS-EE versions become available.

[4] Do not repeat yourself

We encourage you to go the formal route and send us a pull request that can be included in jPOS-EE, reviewed by other jPOS-EE developers, tested in multiple platforms and disparate environments, properly documented and maintained in future releases.

1.4. Copyright and License

jPOS-EE is copyrighted code licensed under the GNU Affero General Public License version 3.

A copy of the copyright notice is available in every source file and can be found in link **Appendix A, *Copyright***.

A copy of the GNU Affero General Public License version 3 is also available in **Appendix B, *License***.

We strongly recommend you to review our license terms before using jPOS or jPOS-EE. You can find very useful information in the official Free Software Foundation GPL FAQ page (**www.fsf.org/licensing/licenses/gpl-faq.html**).

The AGPL covers applications that runs over the network (SaaS) such as most credit/debit card verification/authorization systems like those deployed by most people using jPOS, meaning that you probably need a commercial license.

If in doubt, you can contact us using **jpos.org/contact**

1.5. Getting involved

jPOS-EE is a centralized open source project. jPOS.org retain full control of the release cycle because the code placed in the jposee repository is regularly checked out by our production customers.

Whilst we have experimental modules, and a sandbox/incoming area where we can put alpha and even PoC code, there are fundamental modules that we use over and over at production sites. These modules may have been audited or even certified by third parties and we can't afford to modify them without being absolutely sure of their impact in the rest of the systems.

That said, we are very happy to accept contributions, and publish them for review by the jPOS-EE community.

We license jPOS-EE commercially, so companies or individuals willing to include code in the jPOS-EE distribution will need to sign a CLA (see **Appendix C, *Contributor License Agreement***) and if working for a company, a CCLA agreement (see **???**) as well.

The best way to stay up-to-date with jPOS and jPOS-EE is to monitor the following resources:

- **The jPOS Blog**
- **jPOS and jPOS-EE commit notifications**

- **jPOS users forum**
- **jPOS developers forum**
- **@jposcommits**
- **Issue Tracker**
- If tweeting about jPOS, please use the **#jPOS** hashtag

Resources Page

There is a handy **jpos.org/resources** page at our website.

Chapter 2. Contributing to the project

This project uses Fork & Pull collaborative development model as described in: **https://help.github.com/articles/using-pull-requests**.

The following sections provide the guidelines to follow before a contribution is made to the project.

2.1. GitHub Workflow

2.1.1. Quickfire Do's and Don't's

If you're familiar with git and GitHub, here's the short version of what you need to know. Once you fork and clone the jPOS-EE code:

- **Don't develop on the master branch**. Always create a development branch specific to the issue (see **https://jpos.org/issues/issues/jPOS-EE**) you're working on. Name it by issue # and description. For example, if you're working on Issue jPOS-EE-359, an aspect naming fix, your development branch should be called jPOS-EE-359-aspect-names. If you decide to work on another issue mid-stream, create a new branch for that issue—don't work on both in one branch.
- **Do not merge the upstream master with your development branch**; rebase your branch on top of the upstream master.
- **A single development branch should represent changes related to a single issue.** If you decide to work on another issue, create another branch.

Please note we use our own issue tracker system, YouTrack, hosted in jPOS.org. Please don't be confused with the excellent issue tracker provided by Github, we are currently not using that one.

2.1.2. Step-by-step (the short version)

- Fork on GitHub (click Fork button)
- Clone to computer (`$ git clone git@github.com:~you~/jPOS-EE.git`)
- Don't forget to cd into your repo: (`$ cd jPOS-EE/`)
- Set up remote upstream (`$ git remote add upstream git://github.com/jpos/jPOS-EE.git`)
- Create a branch for new issue (`$ git checkout -b 100-new-feature`, if you don't have a bug report no worries just skip the number)
- Develop on issue branch. [Time passes, the main jPOS repository accumulates new commits]

- Commit changes to issue branch. (`$ git add . ; git commit`)
- Fetch upstream (`$ git fetch upstream`)
- Update local master (`$ git checkout master; git pull upstream master`)
- Repeat steps 5-8 till dev is complete
- Rebase issue branch (`$ git checkout 100-new-feature; git rebase master`)
- Push branch to GitHub (`$ git push origin 100-new-feature`)
- Issue pull request (Click Pull Request button)

Extra reading material on forking can be found at : **http://gun.io/blog/how-to-github-fork-branch-and-pull-request/**

Item 11 (rebase) in the previous list is very often forgotten, but it's extremely important. Be kind with the rest of the team and do it. Read this **post by Git author Linus Torvalds** to understand why.

2.1.3. Commit messages

Please read **http://tbaggery.com/2008/04/19/a-note-about-git-commit-messages.html** for guidelines in creating good commit messages.

2.2. Coding conventions

We adhere to standard **Sun's java ® coding conventions** for the Java Language, that among other things it specifies: Four spaces should be used as the unit of indentation. The exact construction of the indentation (spaces vs. tabs) is unspecified. Tabs must be set exactly every 8 spaces (not 4).

Due to our revision control system, we also need that hard tabs (ASCII 0x09) are not used in source code and configuration files (in order for diff to work properly among platforms.

For *vi* users, we are using the following .vimrc:

```
set ts=8
set sts=4
set sw=4
set expandtab
```

For your Git commits and pull requests, we recommend you normalize your end of lines. This is specially important if you use a Windows platform.

```
git config --global core.autocrlf input
```

Eclipse users, go to Preferences -> Java -> Editor -> Typing and check the *Insert space for tabs* checkbox.

Part II. Modules

Chapter 3. Introduction to modules

In our traditional Ant based build system, the developer chooses which modules to use from the *opt* directory, and creates symbolic links to the *modules* directory. The build system merges them into a flat structure, and does some processing such as:

- Concatenate constants files from all modules into single addressable constant files.
- Create the hibernate configuration file from all the "mapping file" snippets from all the selected modules
- Resolve any property placeholders from all modules using property files

Compiled classes for all selected modules, static definitions for database connections, static constants file(s), etc. are then used to generate a jar archive (jposee.jar).

With the introduction of Gradle-based jPOS-EE project structure, we are also introducing a new module system, based on Maven type artifacts.

Some immediate benefits are:

- The SDK is built independently from your project.
- Your project just uses the modules as versioned dependencies. As a result your project's footprint is reduced, as now only need to track your code, not all the jPOS-EE dependencies in your version control system.
- The barrier to entry is greatly reduced, since a new developer could setup a jPOS-EE project 5 minutes.
- No need to track module dependencies.
- Each module contains "sample" configurations used during project setup at runtime.

3.1. How do modules work?

A module is nothing more than a simple jar artifact with special features.

3.1.1. Hibernate Mappings

A Module defines a "module descriptor", stored in **/META-INF/org/jpos/ee/modules**. This descriptor contains the hibernate mapping entries for the persistent entities defined in this module.

Here is an example,

```
<module name="status">

    <mappings>
        <mapping resource="org/jpos/ee/status/Status.hbm.xml" />
        <mapping resource="org/jpos/ee/status/StatusTag.hbm.xml" />
    </mappings>

</module>
```

It is best practice to name the module descriptor the same as the module name suffixed with the ".xml" extension.

Instead of defining them statically in a central *hibernate.cfg.xml*, the persistent class mappings are resolved at runtime from all the module descriptors visible in the classpath.

3.1.2. Installables

There's a very special resource path, **/META-INF/org/jpos/ee/installs**. Any resource stored below that path, gets installed to the filesystem during the setup process (as shown in the tutorial).

So for example, if we have the *jposee-core* module as one of our dependencies, and the core modules has the following structure

```
META-INF
`-- org
    `-- jpos
        `-- ee
            `-- installs
                |-- cfg
                |   `-- README.txt
                |-- deploy
                |   |-- 00_logger.xml
                |   `-- 99_sysmon.xml
                `-- log
                    `-- q2.log
```

and we do:

```
$ java -jar q2.jar -cli
q2> setup .
```

We'd get the following structure copied to our current working directory:

```
.
|-- cfg
|   `-- README.txt
|-- deploy
|   |-- 00_logger.xml
|   `-- 99_sysmon.xml
`-- log
    `-- q2.log
```

If now we added the *jposee-db-mysql* module as one of our dependencies, which contains the following structure and ran setup again:

```
META-INF
`-- org
    `-- jpos
        `-- ee
            `-- installs
                `-- cfg
                    `-- db.properties
```

We'd end up with the following files in our filesystem:

```
.
|-- cfg
|   |-- README.txt
|   `-- db.properties
|-- deploy
|   |-- 00_logger.xml
|   `-- 99_sysmon.xml
`-- log
    `-- q2.log
```

Chapter 4. Essensial Modules

4.1. CORE

What	The core module contains all basic jPOS-EE functionality.
When	Available in all versions of jPOS-EE.
Who	The jPOS.org team.
Where	Directory modules/core available in git repository at github.
Why	This is a core module required in all jPOS-EE applications.
Status	Stable.
License	**GNU Affero General Public License version 3**

Maven Coordinates.

```
<dependency>
    <groupId>org.jpos.ee</groupId>
    <artifactId>jposee-core</artifactId>
    <version>${jposee.version}</version>
</dependency>
```

The core module serves two purposes:

- It includes all basic dependencies needed to run any jPOS-EE application.
- It contains base functionality shared by all jPOS-EE applications. === Transaction Support

What	The *txn* module contains **Transaction Manager** support code as well as common transaction manager participants.
When	Available in all versions of jPOS-EE.
Who	The jPOS.org team.
Where	Directory modules/txn available in git repository at github.
Why	This module if useful is your jPOS-EE application uses the **Transaction Manager**.
Status	Stable.
License	**GNU Affero General Public License version 3**

Maven Coordinates.

```
<dependency>
    <groupId>org.jpos.ee</groupId>
    <artifactId>jposee-txn</artifactId>
    <version>${jposee.version}</version>
</dependency>
```

There is nothing worse than re-inventing the wheel for every project. With this in mind, the jPOS team identified a series of activities that were common to almost every enterprise

grade jPOS-EE based project, and created a module to provide the basis for building great TransactionManager participants that follow best practice patterns.

Instead of showing a boring table with a description of what every component does, I think an example Transaction Manager instance is in order:

```
<txnmgr name="txnmgr" logger="Q2" class="org.jpos.transaction.TransactionManager">
    <property name="space" value="transient:default"/>
    <property name="queue" value="TXN"/>
    <property name="max-sessions" value="10"/>

    <participant class="org.jpos.transaction.Open" logger="Q2" realm="open-db">      ❶
        <property name="checkpoint" value="db-open"/>
    </participant>

    <participant class="com.mydemo.DemoParticipant"                                  ❷
                 logger="Q2" realm="demo-participant"/>

    <participant class="org.jpos.transaction.Close" logger="Q2" realm="close-db">    ❸
        <property name="checkpoint" value="close"/>
    </participant>
</txnmgr>
```

❶ The *Open* Participant opens a new DB session and transaction.
❷ Our demo participant does some processing
❸ The *Close* Participant commits or rollbacks the existing transaction based on overall outcome, and closes the session.

In our demo scenario, the transaction manager will open a database session, execute our DemoParticipant and close the database session (although our DemoParticipant does not need a DB session!).

In case we wanted to add some debugging, we could definitely add to the end of the file:

```
    <participant class="org.jpos.transaction.ProtectDebugInfo"
                 logger="Q2" realm="protect-debug">                                  ❶
        <property name="checkpoint" value="protect-debug-info"/>
        <!-- Wipes entries from context -->
        <property name="wipe-entry" value="PAN"/>
        <property name="wipe-entry" value="EXP"/>
        <!-- Protects contents from any ISOMsg in context -->
        <property name="protect-ISOMsg" value="2"/>
        <property name="protect-ISOMsg" value="35"/>
        <property name="protect-ISOMsg" value="45"/>
        <!-- Wipes contents from any ISOMsg in context -->
        <property name="wipe-ISOMsg" value="48"/>
        <property name="wipe-ISOMsg" value="52"/>
    </participant>

    <participant class="org.jpos.transaction.Debug" logger="Q2" realm="debug">      ❷
        <property name="checkpoint" value="debug"/>
    </participant>
```

❶ The *ProtectDebugInfo* Participant protects sensitive material from logs.
❷ The *Debug* participant dumps the contents of the context to the log.

This would result in the contents of the context being dumped to the log, protecting sensitive material on the way.

In case you are wondering what the `DemoParticipant` might look like:

```
public class DemoParticipant extends TxnSupport implements MyConstants          ❶
{
    protected int doPrepare(long id, Context ctx) throws Exception               ❷
    {
        ISOMsg message = (ISOMsg) ctx.get(REQUEST);
        ISOSource source = (ISOSource) ctx.get(SOURCE);

        assertNotNull(message,"A valid 'REQUEST' is expected in the context");   ❸
        assertNotNull(source,"A valid 'SOURCE' is expected in the context");
        assertTrue(message.hasField(4),                                          ❹
            "The message needs to have an amount (ISOMsg:4)");

        message.setResponseMTI();

        Random random = new Random(System.currentTimeMillis());
        message.set (37, Integer.toString(Math.abs(random.nextInt()) % 1000000));
        message.set (38, Integer.toString(Math.abs(random.nextInt()) % 1000000));

        if ("000000009999".equals (message.getString (4)))
            message.set (39, "01");
        else
            message.set (39, "00");

        source.send (message);
        return PREPARED | NO_JOIN | READONLY;
    }
    public void commit(long id, Serializable context) { }
    public void abort(long id, Serializable context)  { }
}
```

❶ Our demo participant extends TxnSupport, the supporting class provided by this module.
❷ TxnSupport overrides the "prepare" method and delegates to *doPrepare*
❸ As you can see, not-null assertions are quite easy!
❹ So are boolean assertions.

If you are serious about jPOS-EE development involving Transaction Manager, we advise you to study the `TxnSupport` class further.

Chapter 5. Database Support

Many jPOS-EE applications use Hibernate ® as its supporting Object/Relational mapping engine.

Database support is enabled by adding a database backend dependency module to your project.

For MySQL:

```
<dependency>
    <groupId>org.jpos.ee</groupId>
    <artifactId>jposee-db-mysql</artifactId>
    <version>${jposee.version}</version>
</dependency>
```

For PostgreSQL:

```
<dependency>
    <groupId>org.jpos.ee</groupId>
    <artifactId>jposee-db-postgresql</artifactId>
    <version>${jposee.version}</version>
</dependency>
```

For H2 Embedded database:

```
<dependency>
    <groupId>org.jpos.ee</groupId>
    <artifactId>jposee-db-h2</artifactId>
    <version>${jposee.version}</version>
</dependency>
```

Only one of these dependencies should defined in your project.

5.1. MySQL ® Support

What:	This module configures Hibernate to use MySQL as its back end.
When:	Available in all versions of jPOS-EE.
Who:	The jPOS.org team.
How:	Posted by the jPOS-EE team.
Where:	Directory modules/db-mysql available in the jPOS-EE GitHub repository.
Why:	An RDBMS back end is required by Hibernate.
Status:	Stable.
License:	The jPOS-EE code related to this module is licensed under the **GNU Affero General Public License version 3**. Hibernate ® itself is released under the GNU LGPL v2.1 license. See **Hibernate's License FAQ** for details and up-to-date information. The MySQL JDBC connector is licensed under the GNU GPL license. See **Connector/J page**.

Upon running *setup*, your runtime directory will contain a file: cfg/db.properties.

```
hibernate.connection.username=sa                                          ❶
hibernate.connection.password=password                                    ❷
hibernate.hbm2ddl.auto=update                                             ❸
#
hibernate.connection.url=jdbc:mysql://localhost/jposee?autoReconnect=true ❹
hibernate.connection.driver_class=com.mysql.jdbc.Driver
hibernate.dialect=org.hibernate.dialect.MySQL5InnoDBDialect
```

❶ Replace value with your database username
❷ Replace value with your database password
❸ Makes hibernate automatically update the contents of the DB to match the entities defined. This is good to keep during development, but should be set to **NONE** in a production environment.
❹ Replace the host and database (jposee) to match your database settings.

You want to change those defaults.

5.2. PostgreSQL ® support

What:	This module configures Hibernate to use PostgreSQL as its back end.
When:	Available starting in jPOS-EE v1r104.
Who:	The jPOS.org team.
How:	Posted by the jPOS-EE team.
Where:	Directory modules/db-postgresql available in the jPOS-EE GitHib repository.
Why:	An RDBMS back end is required by Hibernate.
Status:	Stable.
License:	The jPOS-EE code related to this module is licensed under the **GNU Affero General Public License version 3**. As of jPOS-EE v1r98, Hibernate ® itself is released under the GNU LGPL v2.1 license. See **Hibernate's License FAQ** for details and up-to-date information. The PostgreSQL JDBC connector is licensed under the BSD license. See **Postgresql.org**.

Upon running *setup*, your runtime directory will contain a file: cfg/db.properties.

```
hibernate.connection.username=sa                                    ❶
hibernate.connection.password=password                              ❷
hibernate.hbm2ddl.auto=update                                       ❸
#
hibernate.connection.url=jdbc:postgresql://localhost:5432/jposee    ❹
hibernate.connection.driver_class=org.postgresql.Driver
hibernate.dialect=org.hibernate.dialect.PostgreSQLDialect
```

❶ Replace value with your database username
❷ Replace value with your database password
❸ Makes hibernate automatically update the contents of the DB to match the entities defined. This is good to keep during development, but should be set to **NONE** in a production environment.

❹ Replace the host and database (jposee) to match your database settings.

You want to change those defaults.

5.3. H2 Embedded Database support

What:	This module configures Hibernate to use H2 as its back end.
When:	Available in all versions of jPOS-EE since v2.0.0.
Who:	The jPOS.org team.
How:	Posted by the jPOS-EE team.
Where:	Directory modules/db-h2 available in the jPOS-EE GitHib repository.
Why:	An RDBMS back end is required by Hibernate.
Status:	Stable.
License:	The jPOS-EE code related to this module is licensed under the **GNU Affero General Public License version 3**. As of jPOS-EE v1r98, Hibernate ® itself is released under the GNU LGPL v2.1 license. See **Hibernate's License FAQ** for details and up-to-date information. The H2 JDBC connector is licensed under the EPL license. See **h2database.com**.

Upon running *setup*, your runtime directory will contain a file: cfg/db.properties.

```
hibernate.connection.username=sa                                    ❶
hibernate.connection.password=                                      ❷
hibernate.hbm2ddl.auto=update                                       ❸
#
hibernate.connection.url=jdbc:h2:./data/jposee;LOCK_TIMEOUT=5000    ❹
hibernate.connection.driver_class=org.h2.Driver
hibernate.dialect=org.hibernate.dialect.H2Dialect
```

❶ Replace value with your database username
❷ Replace value with your database password
❸ Makes hibernate automatically update the contents of the DB to match the entities defined. This is good to keep during development, but should be set to **NONE** in a production environment.
❹ Replace the host and database (jposee) to match your database settings.

You want to change those defaults

Chapter 6. Tools

6.1. Freemarker Decorator

What	This module contains a text processor which decorates deployable descriptors for Q2.
When	Available in all versions of jPOS-EE since v2.0.0.
Who	The jPOS.org team.
Where	Directory modules/freemarker-decorator available in git repository at github.
Why	Install this module to better parameterize your applications.
Status	Stable.
License	The jPOS-EE code related to this module is licensed under the **GNU Affero General Public License version 3**. FreeMarker ® itself is released under the BSD license. See **http://freemarker.sourceforge.net/docs/app_license.html** for details and up-to-date information.

Maven Coordinates.

```
<dependency>
    <groupId>org.jpos.ee</groupId>
    <artifactId>jposee-freemarker-decorator</artifactId>
    <version>${jposee.version}</version>
</dependency>
```

6.1.1. Activation steps

This module remains dormant unless it finds its configuration resource.

In order to activate this module, you need to create a resource in your project residing at *META-INF/org/jpos/config/Q2-decorator.properties* of your classpath (not the filesystem!).

This file should contain two properties:

```
config-decorator-class=org.jpos.q2.freemarker.FreemarkerDecorationProvider    ❶
config-files=cfg/config.properties                                            ❷
```

❶ This property tells Q2 to use the FreemarkerDecoratorProvider as its decorator.
❷ This property defines a comma separated list of files which will be used as configuration files.

6.1.2. Introduction

A typical jPOS-EE application has this standard directory structure:

```
.
|-- cfg
|   |-- README.txt
|   `-- db.properties
|-- deploy
|   |-- 00_logger.xml
|   `-- 99_sysmon.xml
|-- lib
|-- log
|   `-- q2.log
`-- q2.jar
```

Whatever descriptor you install inside the *deploy* directory gets immediately deployed. Once this descriptor is removed, it gets undeployed.

Many of these descriptors require information specific to the target environment, such as hostnames, ports, ports to listen to, etc. Wouldn't it be great if you could define all of these in a single location?

The FrameMarker decorator processes **ANY** descriptor in memory giving Q2 the resulting text after processing. This opens a myriad of opportunities, such as declaring macros, and executing them :)

Let's see an example! Let's assume you have a file *cfg/config.properties* in your runtime directory that looks like this:

```
###### GENERAL INFO
NODE = NODE001
######  Environment
env=DEV
######  Ports we listens to
server_listen_port = 9999
######  Target host information
myBankHostPrimary=app.yourbank.com
myBankPortPrimary=2000
###### DEBUG STUFF
debugParticipant=true
```

and we had a deployable file: *deploy/10_mybank_channel.xml*

```
<channel-adaptor
      name="mybank-channel-adaptor-pri"
      class="org.jpos.q2.iso.ChannelAdaptor" logger="Q2">

    <channel
          name="mybank-channel-pri"
          packager="org.jpos.iso.packager.GenericPackager"
          class="org.jpos.iso.channel.CSChannel" logger="Q2"
          realm="channel.mybank">

        <property name="timeout" value="3600000"/>
        <property name="host" value="${mybankHostPrimary}"/>
        <property name="port" value="${mybankPortPrimary}"/>
        <property name="packager-config" value="cfg/packager/mybank.xml" />
        <property name="keep-alive" value="true" />
    </channel>

    <in>from-mybank-pri</in>
    <out>to-mybank-pri</out>
    <reconnect-delay>5000</reconnect-delay>
</channel-adaptor>
```

As you can see, we externalized the deployable's configurable over to a central location.

If you change the settings in the configuration file, you still need to redeploy the deployable (touch it).

But wait, there's more! FreeMarker being a macro processor, brings a lot of nice things for things like TransactionManager descriptors:

For example, ever wanted to have conditional participants?

```
[#if debugParticipant == 'true']
<participant class="org.jpos.transaction.Debug" logger="Q2" realm="debug">
    <property name="checkpoint" value="debug"/>
</participant>
[/#if]
```

Or maybe define a macro for things you'll use over and over?

```
[#macro OutputToSyslog msg]
<participant class="com.mycorp.txn.OutputToSyslog"
    logger="Q2" realm="output-to-syslog">
    <property name="node" value="${NODE}"/>
    <property name="message" value="${msg}"/>
</participant>
[/#macro]

<!-- And then invoke it -->
<group name="myGroup">
    [@OutputToSyslog msg="This is a test"/]
    .... Do some other stuff
</group>
```

Chapter 7. Simulators

7.1. Server Simulator

What:	The Server Simulator is an extremely simple, BSH-based simulator that can be used to test ISO-8583 based client software. It listens to port (default 10000), and forwards all incoming requests to a BeanShell based script that can be customized to meet your needs.
When:	Available in all versions of jPOS-EE.
Who:	The jPOS.org team.
How:	Posted by the jPOS-EE team.
Where:	Directory modules/server-simulator available in the repository at GitHub.
Why:	When writing ISO-8583 based client applications the ability to easily simulate a server is usually very useful.
Status:	Stable.
Dependencies:	module jpos
License:	**GNU Affero General Public License version 3**

The server simulator is a simple QServer with a BSHRequestListener that handle incoming messages and provide suitable responses.

The default configuration uses an XMLChannel along with an XMLPackager, but you are free to use any channel/packager combination.

The BSHRequestListener (documented in jPOS programmer's guide) exposes two objects: message (the incoming ISOMsg) and source (the ISOSource).

Here is the default configuration (05_serversimulator.xml):

```
<server class="org.jpos.q2.iso.QServer" logger="Q2" name="simulator_10000">
<attr name="port" type="java.lang.Integer">10000</attr>
<channel class="org.jpos.iso.channel.XMLChannel"
       logger="Q2" packager="org.jpos.iso.packager.XMLPackager">
</channel>
<request-listener class="org.jpos.bsh.BSHRequestListener" logger="Q2">
 <property name="source" value="cfg/serversimulator.bsh" />
</request-listener>
</server>
```

And the BSH script looks like this:

```
message.setResponseMTI ();                                          ❶

Random random = new Random (System.currentTimeMillis());
message.set (37, Integer.toString(Math.abs(random.nextInt()) % 1000000));
message.set (38, Integer.toString(Math.abs(random.nextInt()) % 1000000));

if ("000000009999".equals (message.getString (4)))                  ❷
    message.set (39, "01");
else
    message.set (39, "00");

source.send (message);
```

❶ Sets the response MTI (i.e: 0800/0810, 1201/1220…)
❷ We use the special amount value $99.99 to decline the transaction

Never ever use this simulator even close to a production environment, or you may end up blindly authorizing transactions.

7.2. Client Simulator

What:	The Client Simulator can be used to fire a suite of unit tests against an ISO-8583 server. The suite is defined by a set of XML files representing messages to be sent and their expected responses.
When:	Available in all versions of jPOS-EE.
Who:	The jPOS.org team.
How:	Posted by the jPOS-EE team.
Where:	Directory opt/clientsimulator available in the jPOS-EE main subversion repository at google code.
Why:	When writing ISO-8583 based server applications the ability to easily simulate a client is usually very useful. We at jPOS.org use it as a high level self test for our applications.
Status:	Stable.
Dependencies:	module jpos
License:	**GNU Affero General Public License version 3** The Client Simulator can be used to fire a suite of unit tests against an ISO-8583 server. The suite is defined by a set of XML files representing messages to be sent and their expected responses.

In order to simulate complex ISO-8583 interchanges, the client simulator uses BSH scripting support to customize the content of ISO-8583 fields at runtime. This can be used to specify constant values, such as terminal IDs, merchant IDs, card numbers, as well as dynamic values such as trace numbers, retrieval reference numbers, pinblocks, key exchange related stuff, etc.

Let's have a look at the simulator's QBean configuration:

```
<qbean name="clientSimulator" logger="Q2" realm="client-simulator"
      class="org.jpos.simulator.TestRunner">

 <property name="mux"     value="clientsimulator-mux" />
 <property name="timeout" value="30000" />
 <property name="sessions" value="1" />
```

We specify a mux (that's the name of a QMUX running on the same JVM) and a timeout to wait for a given response. Then we define an initialization block, i.e:

```
 <init>
    import org.jpos.space.*;
    int cnt = 1;
    String terminal = "29110001";
    String merchant = "000000001001";
    String pinblk   = "0123456789ABCDEF";
    Space sp = SpaceFactory.getSpace();
 </init>
```

The initialization block is basically a BSH script. You can do whatever you want there, such as defining constants for later use, references to jPOS objects (such as Space instances, Security module, etc.).

And then the test suite:

```
    <test-suite>
     <path>cfg/</path>
     <test file="echo" count="10" continue="yes" name="Simple Echo Test" />
     <test file="echo" count="20" continue="yes" name="Simple Echo Test 2">
      <init>
       // optional init script
       // the variable 'testcase'references  _this_ testcase instance
       // the variable 'request' references the ISOMsg that is to be sent
      </init>
      <post>
       // optional post script
       // the variable 'testcase' references  _this_ testcase instance
       // the variable 'response' references the received message
      </post>
     </test>

     <path>cfg/anotherpath</path>
     <test file="mytest">MyTest</test>
     ...
     ...
    </test-suite>
  </qbean>
```

The suite can be separated in different paths, in the previous example, we assume that there are files named: cfg/echo_s and cfg/echo_r.

The letter **s** in cfg/echo_s stands for **send** and the **r** in cfg/echo_r stands for **receive**.

cfg/echo_s:

```
  <isomsg>
   <field id="0" value="1800" />
   <field id="7" value="1025080500" />
   <field id="11" value="000001" />
   <field id="41" value="29110001" />
  </isomsg>
```

cfg/echo_r:

```
  <isomsg>
   <field id="0" value="1810" />
   <field id="39" value="00" />
  </isomsg>
```

In the previous example, we send a 1800 message with some fixed data, and we expect to receive a 1810 message, with a 00 content in field 39.

While using fixed content may be okay for most fields and test cases, there are situations where you want to use dynamic content.

Our simulator supports BSH scripts at the field level. Everything that starts with a bang character (!) is considered a script and evaluated as such, so you can write:

```
<isomsg>
 <field id="0" value="1800" />
 <field id="7" value="ISODate.getANSIDate (new Date())" />
 <field id="11" value="! System.currentTimeMillis() % 1000000" />
 <field id="41" value="! terminal" />
 <field id="52" value="@ pinblk" />
</isomsg>
```

Please note that in our example terminal is a runtime script variable that we've defined in our block. The @ characters operates in a similar way as the *!* character, but the resulting value which is supposed to be an hexadecimal string, is converted to byte[] using ISOUtil.hex2byte(String) in order to produce an ISOBinaryField.

The same thing happens at receive time, when we are trying to simulate voids, reversals, we usually need information received in previous transactions, such as retrieval reference numbers, audit numbers, etc. so we can save that information for later use using a receive-time script:

```
<isomsg>
 <field id="0" value="1810" />
 <field id="11" value="! previousTrace=value" />
 <field id="37" value="! rrn=value" />
 <field id="39" value="00" />
</isomsg>
```

There's a special variable name called value where we put the received content, so in the previous example, the received retrieval reference number (field 37), is stored in the variable named rrn for later use.

The receive script may optionally return true or false, so we can write code like this:

```
<isomsg>
 <field id='39' value='! return value.equals(EXPECTED_RETVALUE)' />
</isomsg>
```

where EXPECTED_RETVALUE is initialized in a previous init block.

In fact, the previous example is equivalent to the following:

```
<isomsg>
 <field id='39' value='! EXPECTED_RETVALUE' />
</isomsg>
```

where the string value of EXPECTED_RETVALUE is used (unless it is a boolean).

There is a special string ***E** to test for echo. To ensure that the received content of a field is the same as the content we sent, we can write code like this:

```
<isomsg>
 <field id='4' value='*E' />
</isomsg>
```

The special string ***M** can be used to check for mandatory field presence, regardless its content. Likewise, ***E** can be used to check for mandatory echo, and ***O** can be used to check for optional echo. You can also use ***A** to check for mandatory *absence* of a field.

Test cases supports a count attribute that can be used to fire the same test n times.

It also supports a continue attribute. If continue="yes" then the test runner would just log an exception if something goes wrong, and it would continue with the next test.

The default timeout is 60 seconds, but one can specify a different timeout using the timeout attribute of the testcase element.

At the end, you get a ticket with the test results.

```
<log realm="org.jpos.simulator.TestRunner" at="......">
  <results>
    Simple Echo Test        [OK] 58ms.
    Simple Echo Test        [OK] 38ms.
    Simple Echo Test        [OK] 70ms.
    Simple Echo Test        [OK] 23ms.
    Simple Echo Test        [OK] 56ms.
    Simple Echo Test        [OK] 24ms.
    Simple Echo Test        [OK] 73ms.
    Simple Echo Test        [OK] 107ms.
    Simple Echo Test        [OK] 20ms.
    Simple Echo Test        [OK] 50ms.
    Simple Echo Test        [OK] 23ms.
    Simple Echo Test        [OK] 24ms.
    Simple Echo Test        [OK] 86ms.
    Simple Echo Test        [OK] 24ms.
    Simple Echo Test        [OK] 24ms.
    Simple Echo Test        [OK] 23ms.
    Simple Echo Test        [OK] 26ms.
    Simple Echo Test        [OK] 21ms.
    Simple Echo Test        [OK] 22ms.
    Simple Echo Test        [OK] 79ms.
    Simple Echo Test 2      [OK] 22ms.
    elapsed server=893ms(62%),
    simulator=526ms(37%), total=1419ms
  </results>
</log>
```

Chapter 8. Operation services

8.1. SSHD

What	The SSHD let's you establish an ssh connection to a running Q2 instance.
When	Available in all versions of jPOS-EE since v2.0.0.
Who	The jPOS.org team.
Where	Directory modules/sshd available in git repository at github.
Why	Remote secure login is an often desired featured in production systems.
Status	Stable.
License	**GNU Affero General Public License version 3**

Maven Coordinates.

```
        <dependency>
            <groupId>org.jpos.ee</groupId>
            <artifactId>jposee-sshd</artifactId>
            <version>${jposee.version}</version>
        </dependency>
```

The SSHD module provides remote secure logic to a running Q2 instance. It features:

- Simple configuration
- Authentication by username/public key.
- Allows for CLI customization through alternate command stores.

The `setup` process will create a default deployment descriptor in *deploy/05_sshd.xml*:

```
<sshd name="sshd" class="org.jpos.ee.cli.SshCLI">
    <port>2222</port>                                                    ❶
    <auth-username>admin</auth-username>                                 ❷
    <authorized-keys-file>cfg/authorized_keys</authorized-keys-file>     ❸
</sshd>
```

❶ The SSHD server will listen on this port.
❷ The username the ssh client will use to connect to the SSHD server.
❸ Points to a file containing public keys for every user who will be able to login

If you have not setup a personal public/private key pair, now it's the time to do this. The instructions we will provide here are for OpenSSH on a Unix system, but we'll provide some links for Windows systems as well.

To generate your key pair:

```
$ ssh-keygen -t rsa                                                    ❶
Generating public/private rsa key pair.
Enter file in which to save the key (/home/myuser/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):                            ❷
Enter same passphrase again:
Your identification has been saved in /home/myuser/.ssh/id_rsa.        ❸
Your public key has been saved in /home/myuser/.ssh/id_rsa.pub.        ❹
The key fingerprint is:
f6:61:a8:27:35:cf:4c:6d:13:22:70:cf:4c:c8:a0:23 myuser@nexus
```

❶ The command `ssh-keygen -t rsa` initiated the creation of the key pair.
❷ No passphrase was entered (Enter key was pressed instead).
❸ The private key was saved in .ssh/id_rsa.
❹ The public key is saved in .ssh/id_rsa.pub.

In this case, the content of file id_rsa.pub is:

```
ssh-rsa AAAAB3NzaC1yc2EAAAABIwAAAIEArkwv9X8eTVK4F7pMlSt45pWoiakFkZMw
G9BjydOJPGH0RFNAy1QqIWBGWv7vS5K2tr+EEO+F8WL2Y/jK4ZkUoQgoi+n7DWQVOHsR
ijcS3LvtO+50Np4yjXYWJKh29JL6GHcp8o7+YKEyVUMB2CSDOP99eF9g5Q0d+1U2WVdB
WQM= myuser@nexus
```

It is one line in length.

Its content is then copied to cfg/authorized_keys of your Q2 instance.

If all is well, you should be able to run your Q2 instance and type:

```
ssh -p 2222 admin@localhost
```

And you should be given access to Q2 Remote CLI.

Windows Users can use Putty and use this **link** as a guide to get the contents for the *authorized_keys* file.

Chapter 9. Contributed modules

9.1. FSDMsgX

What:	This field/mesage packager can be used to wire a message parser with java code. Its utility library to enable you to parse grammar usually used by text (can be binary as well) messages that are field separator delimited, fixed length, branching based on data parsed, looking ahead in the stream for a specific byte and base future parsing decisions. Provides out of the box PCI compliance and ability to add java objects to meet you compliance needs.
When:	Available as of jPOS-EE 2.0.9
Who:	The jPOS.org team (contributed by @chhil)
How:	Posted by the jPOS-EE team.
Where:	Directory modules/fsdpackager available in the jPOS-EE main git repository
Why:	When schema based FSD does not meet your parsing needs to write more complex parsing rules.
Status:	Production grade
Dependencies:	module jpos
License:	**GNU Affero General Public License version 3**

9.1.1. Using the packagers

FixedFieldPackager

Consider a specification that states field 1 is a fixed field of 6 and field 2 is a fixed stram of 3 bytes. Stream of bytes=123456AB If the specification is followed: Field1 = 123456 Field2 = AB

FixedFieldPackager Usage [unpacking raw bytes].

```
FSDMsgX msg = new FSDMsgX("Example1");
FixedFieldPackager field1 = new FixedFieldPackager(
    "Field1", 6, AsciiInterpreter.INSTANCE
);
FixedFieldPackager field2 = new FixedFieldPackager(
    "Field2", 2, AsciiInterpreter.INSTANCE
);
msg.add(field1);
msg.add(field2);

String s = "123456ABEXTRA";// there are EXTRA bytes in the stream

int offset = msg.unpack(s.getBytes());
System.out.println("Offset="+offset);
System.out.println("Field1="+msg.get("Field1"));
System.out.println("Field2="+msg.get("Field2"));
System.out.println(msg.dump("dump"));
System.out.println(msg.getParserTree("tree>"));
System.out.println(msg.hexDump(""));
```

Output

```
Offset=8
Field1=123456
Field2=AB
dump<fsdmsgX name="Example1">
dump <field id="Field1" value="123456"/>
dump <field id="Field2" value="AB"/>
dump</fsdmsgX>
tree>[Example1]
tree>Field [Field1] : Fixed [6] : 123456
tree>Field [Field2] : Fixed [2] : AB
0000  31 32 33 34 35 36 41 42            123456AB
```

- Create the main container object FSDMsgX.
- Create the individual field packagers for field1 and field2.
- Add the individual field packagers to the container.
- Call the unpack method on the input bytes to parse the stream.
- The unpac method returns the offset in the stream where the parser has reached, we parsed a total of 8 bytes, the offset is 8 (its 0 based so its at the 9th position.
- Notice the fields are accessible via the containers get method.
- The containers dump method, provides a pretty xml (the prefix of "dump" to identify it in the output.
- The container has a getParseTree method that display your composite packager. This will help once you get into complex composite packager. The use of of the prefix "tree" is used to identify its output.
- The container has a hexdump method that dumps the hex equivalent of the unpacked stream. Notice EXTRA is not there as there was no rule to unpack it.
- If the input string was s = "123456" then an ISOException would be thrown telling you precisely what was wrong. org.jpos.iso.ISOException: Field [Field2] at offset [6]:Expecting 2 bytes found 0

FixedFieldPackager Usage [packing object into bytes].

```
    FSDMsgX msg = new FSDMsgX("Example1");
    FixedFieldPackager field1 = new FixedFieldPackager(
        "Field1", 6, AsciiInterpreter.INSTANCE
    );
    FixedFieldPackager field2 = new FixedFieldPackager(
        "Field2", 2, AsciiInterpreter.INSTANCE
    );

    msg.add(field1);
    msg.add(field2);

    msg.set("Field1", "ABCDEF");
    msg.set("Field2", "12");

    byte[] outStream = msg.pack();

    System.out.println(msg.dump("dump"));
    System.out.println(msg.getParserTree("tree>"));
    System.out.println(msg.hexDump(""));
    System.out.println(ISOUtil.hexdump(outStream));
```

Output

```
dump<fsdmsgX name="Example1">
dump <field id="Field1" value="ABCDEF"/>
dump <field id="Field2" value="12"/>
dump</fsdmsgX>
tree>[Example1]
tree>Field [Field1] : Fixed [6] : ABCDEF
tree>Field [Field2] : Fixed [2] : 12
0000  41 42 43 44 45 46 31 32                ABCDEF12
0000  41 42 43 44 45 46 31 32                ABCDEF12
```

- Set the fields in the container.
- Call the unpack method on the container to serialize the object into a byte array.
- You can verify that data looks accurate in dump method.
- You can verify that the parser parsed it correctly.
- You can verify the hexdump of the actual packed vyte array outstream is the same as the hexdump of the container.

VariableFieldPackager

Used when the size of the field is variable and needs a delimiter to indicate the end of the field.

Consider a specification that indicates a field FirstName can have a maximulm of 20 characters and will be terminate/delimited by a semi colon followed by a Lastname with a maximum of 10 characters terminated by a period. The delimiter is important because I could have a name Tom, Tommy, Thomas to indicate the end of a name a delimiter is needed. If I did bot have a FirstName, a semi colon would be needed to indicate there is no first name.

Part III. Appendices

Appendix A. Copyright

Appendix B. License

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Version 3, 19 November 2007

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