

jPOS Extended Edition

jPOS Software SRL

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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].

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 not 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 2.2.10-SNAPSHOT.

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.

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 [Copyright](#).

A copy of the GNU Affero General Public License version 3 is also available in [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 [Contributor License Agreement](#)) and if working for a company, a CCLA agreement (see [Corporate CLA](#)) 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.

[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/>

[4] Do not repeat yourself

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.

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://tbagery.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.

Chapter 3. Getting Started

3.1. Prerequisites

jPOS-EE-SDK assumes that the following software is installed in your development environment:

- JDK 1.8 or higher
- A git client

While jPOS and jPOS-EE can be used in a Windows environment, we develop it in an Unix environment, so you'll find many useful Unix scripts with no Windows counterpart. If you use windows, you may choose to install a Unix-like environment such as [Cygwin](#) so you can make use of the unix scripts directly.

3.2. Using an IDE

jPOS-EE is known to work with most modern IDEs such as Eclipse, NetBeans, JetBrains' IDEA®. The Gradle configuration uses the IDEA and Eclipse plugins allowing you to create suitable IDE configurations by running `gradle idea` or `gradle eclipse`.

3.3. Using an application server

jPOS-EE is a stand-alone application that runs off jPOS' Q2 container.

We are aware that there are companies and institutions that standardize on using a given application server or JEE container. That's great, but jPOS-EE is a stand-alone application. If you master your application server, you will certainly be able to integrate jPOS-EE, either as a client EJB application, as a Resource Adapter, a WAR, EAR, etc. In addition, some application servers have proprietary extensions that facilitates such integration.

But let us repeat this one more time. jPOS-EE is a stand alone application. If you know how to run it inside application server XYZ, that's perfect; if we can make your life easier by doing something on our end that makes that integration easier, and you have the expertise in both jPOS-EE and your application server to provide us detailed instructions on what you need, and the changes won't break any existing jPOS or jPOS-EE functionality, then we are willing to do so, but if you decide to go that route, you'll be on your own.

3.4. Preparing your environment

In this chapter we will work through setting up the development environment consisting of:

- Downloading the jPOS-EE SDK source code using Git.
- Compiling and installing the components locally on your system.

3.5. Maven coordinates

jPOS-EE modules are regularly published to jPOS' maven repository. You can use its dependencies by adding

```
<repository>
  <id>jpos-ee</id>
  <name>jPOS Maven Repository</name>
```

```
<url>http://jpos.org/maven</url>
</repository>
```

to your Maven or

```
repositories {
    ...
    maven { url 'http://jpos.org/maven' }
    ...
}
```

to your Gradle configuration.



We recommend you use the [jPOS Template](#), in particular its **multimodule** branch when building jPOS-EE based applications.

3.6. Downloading the sources

In order to get a copy of it, and keep your copy up-to-date with the latest revision, you need to use a Git client.

Git installation instructions for Windows, Linux and MacOS X are available here: [Git Setup](#).

jPOS-EE is hosted at [GitHub](#). By visiting the project page you will be provided information on how to Checkout, Browse and see a history of changes to the system.

If you are on an Unix/Unix-like environment, an initial checkout would look something like :-

```
$ git clone https://github.com/jpos/jPOS-EE.git
Cloning into 'jPOS-EE'...
remote: Counting objects: 627, done.
remote: Compressing objects: 100% (355/355), done.
remote: Total 627 (delta 250), reused 528 (delta 151)
Receiving objects: 100% (627/627), 127.72 KiB, done.
Resolving deltas: 100% (250/250), done.
$
```

This will create a new directory “jPOS-EE” containing a clone of what’s currently in the master branch at our central GitHub repository.

3.7. Installing the SDK

If you’re not using jPOS Maven repo, you can install your dependencies locally by calling:

```
gradle install
```

If your build completes with “BUILD SUCCESSFUL”, you are ready to proceed to create your first project!



Gradle just built and installed all of its components into your local Maven repository, where they can be accessed by any of your projects.

If you have made local changes to the jPOS-EE sources, followed by a call to **gradle install**, make sure that your **mavenLocal()** repository comes **before** <http://jpos.org/maven> in your repository list so that dependencies are taken from your local `$HOME/.m2/repository` directory.

Please note that while this is OK during development, it's a bad practice if you expect to produce repeatable builds.

3.8. Five minute tutorial

3.8.1. Initial setup, jPOS project

Once you have jPOS-EE installed, in order to create your own project, you can take advantage of our companion “jPOS Template”.

Download the latest copy of the jPOS Template in **zip** (<https://github.com/jpos/jPOS-template/archive/master.zip>) or **tar.gz** format (<https://github.com/jpos/jPOS-template/archive/master.tar.gz>).

Move the directory **jPOS-template-master** into your desired project name, i.e.: “myjposproject”.

For an initial sanity test, let's build a simple jPOS application first before moving to jPOS-EE.

Call **gradle installApp** (or **gradlew installApp** if you don't have Gradle installed)

Then go to the directory **build/install/myjposproject/bin** and you will find a script called **q2** (along with a Windows version **q2.bat**). Running it should start jPOS, that you can stop using **Ctrl-C**.

Here is a full transcript of this session:

```
$ cd /tmp
$ wget https://github.com/jpos/jPOS-template/archive/master.tar.gz
...
...
Saving to: 'master.tar.gz'

$ tar zxvf master.tar.gz
x jPOS-template-master/
x jPOS-template-master/.gitignore
x jPOS-template-master/COPYRIGHT
x jPOS-template-master/LICENSE
x jPOS-template-master/README.md
x jPOS-template-master/build.gradle
x jPOS-template-master/gradle/
...
...
...

$ mv jPOS-template-master myjposproject
```

```

$ cd myjposproject
$ ./gradlew installApp
:compileJava UP-TO-DATE
:processResources UP-TO-DATE
:classes UP-TO-DATE
:jar
:installApp

BUILD SUCCESSFUL

$ build/install/myjposproject/bin/q2

...
...
<log realm="Q2.system" at="Fri Jan 25 18:30:37 UYST 2013.335">
  <info>
    deploy:/private/tmp/myjposproject/build/install/myjposproject/deploy/99_sysmon.xml
  </info>
</log>
...
...

```

The jPOS template creates a standard jPOS application with its **lib**, **deploy**, **cfg** and **log** directories that you can review in the **build/install/myjposproject** directory.

3.8.2. Adding a jPOS-EE Module

Now lets add a jPOS-EE module. We'll start with a simple one, the [Server Simulator](#).

Edit **build.gradle** and add the following dependency:

```

compile group:'org.jpos.ee',
        name:'jposee-server-simulator',
        version:'2.0.2-SNAPSHOT'

```

so that the dependencies would look like this:

```

dependencies {
    compile group:'org.jpos', name:'jpos', version:'1.9.2'
    compile group:'org.jpos.ee',
            name:'jposee-server-simulator',
            version:'2.0.2-SNAPSHOT'
    testCompile group:'junit', name:'junit', version:'4.8.2'
}

```

If you build again the system by calling **gradle installApp** and you review the generated **lib** directory now in **build/install/myjposproject/lib** you'll see two new libraries:

- `jposee-core-2.0.2-SNAPSHOT.jar` and
- `jposee-server-simulator-2.0.2-SNAPSHOT.jar`

3.8.3. Pulling configuration from modules

Now a little hack: jPOS-EE modules contain sample configuration files inside their distributed jars. Those are intended as a reference and need to be reviewed by the developer, but they provide a good starting point.

If you try the command:

```
jar tvf build/install/myjposproject/lib/jposee-server-simulator-2.0.2-SNAPSHOT.jar
```

You'll see content like this:

```
META-INF/
META-INF/MANIFEST.MF
META-INF/org/
META-INF/org/jpos/
META-INF/org/jpos/ee/
META-INF/org/jpos/ee/installs/
META-INF/org/jpos/ee/installs/cfg/
META-INF/org/jpos/ee/installs/cfg/serversimulator.bsh ①
META-INF/org/jpos/ee/installs/deploy/
META-INF/org/jpos/ee/installs/deploy/05_serversimulator.xml ②
```

- ① Server Simulator configuration script
- ② Server Simulator QBean descriptor

If you try `gradle tasks` you'll see that there's a task called "installResources" which is defined in `jpos-app.gradle` like this:

```
task installResources(dependsOn: 'classes', type: JavaExec) {
    classpath = sourceSets.main.runtimeClasspath
    main = 'org.jpos.q2.install.Install'
    args = ["--outputDir=src/dist"]
}
```

This basically pulls all the sample configuration files from jPOS-EE modules and place them into the `src/dist` directory of your application, where you can edit them, add them to your SCM, etc.

So if we call `gradle installResources` in the previous example, we would end up with a couple of new files in `src/dist`:

- `src/dist/cfg/serversimulator.bsh`
- `src/dist/deploy/05_serversimulator.xml`

Those files will land in the `build/install/myjposproject` on your next call to `gradle installApp` or inside your distribution in `build/distributions` the next time you call `gradle dist`.

At this point, you should be able to run `q2` from the install directory and have a server listening to port 10000 (the default port). It's an XML server so you can `telnet localhost 10000` and fire an XML message like this.



```
<isomsg>
  <field id="0" value="0800" />
  <field id="3" value="000000" />
  <field id="11" value="000001" />
  <field id="41" value="00000001" />
  <field id="70" value="901" />
</isomsg>
```

If everything works alright, you should get a 0810 response.



You may want to visit the jPOS [Tutorials](#) page for additional tutorials.

Modules

Chapter 4. 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 in five minutes.
- No need to track module dependencies.
- Each module contains "sample" configurations used during project setup at runtime.

4.1. How do modules work?

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

4.1.1. 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.

4.1.2. 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 module 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 5. Core Modules

5.1. 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

Listing 1. 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.

5.2. Transaction Support

What	The <i>txn</i> 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 is useful if your jPOS-EE application uses the Transaction Manager .
Status	Stable.
License	GNU Affero General Public License version 3

Listing 2. 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"> ①
    <property name="checkpoint" value="db-open"/>
  </participant>

  <participant class="com.mydemo.DemoParticipant" ②
    logger="Q2" realm="demo-participant"/>

  <participant class="org.jpos.transaction.Close" logger="Q2" realm="close-db"> ③
    <property name="checkpoint" value="close"/>
  </participant>
</txnmgr>
```

- ① The *Open* Participant opens a new DB session and transaction.
- ② Our demo participant does some processing
- ③ 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" ①
  logger="Q2" realm="protect-debug">
  <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"> ②
  <property name="checkpoint" value="debug"/>
</participant>
```

① The *ProtectDebugInfo* Participant protects sensitive material from logs.

② The *Debug* participant dumps the contents of the context to the log.



As of jPOS 2.1.1 and beyond, the *TransactionManager* automatically logs the *Context*, as well as profiling information, whenever the *debug* property is set to *true*. The *Debug* participant is hence not required (and actually useless/annoying as it would log the *Context* twice).

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 ①
{
    protected int doPrepare(long id, Context ctx) throws Exception ②
    {
        ISOMsg message = (ISOMsg) ctx.get(REQUEST);
        ISOSource source = (ISOSource) ctx.get(SOURCE);

        assertNotNull(message, "A valid 'REQUEST' is expected in the context"); ③
        assertNotNull(source, "A valid 'SOURCE' is expected in the context");
        assertTrue(message.hasField(4), ④
            "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) { }
}
```

- ① Our demo participant extends `TxnSupport`, the supporting class provided by this module.
- ② `TxnSupport` overrides the "prepare" method and delegates to `doPrepare`
- ③ As you can see, not-null assertions are quite easy!
- ④ So are boolean assertions.



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

5.3. TxnId

The `txn` module has a handy `TxnId` class that can be used to generate ids in a distributed way.

The id is composed of:

- 1-digit century
- 2-digits year
- 3-digits day of year
- 5-digits second of day
- 3-digits node id
- 5-digits transaction id

A typical ID long value would look like this: `173000348000000001`, and the `toString()` method would show as `017-300-03480-000-00001`.

`TxnId` also has a handy `toRrn()` method that can be used to create (and parse) 12-characters strings suitable to be used as retrieval reference numbers.

`TxnId` can be used instead of UUIDs. It puts less pressure in the database index and provides chronological order.



The last two groups, `node-id` and `transaction-id` are supposed to be unique. `transaction-id` is easy to get from the transaction manager. `node-id` is a tricky one, use has to ensure each node has a unique `node-id` to avoid collisions.

5.4. QI Basics

5.4.1. Main XML

The main configuration is done on `00_qi.xml`

The main contents of this file are:

5.4.1.1. Title

Example: `<title>jPOS QI</title>`

Indicates the title for the app.

5.4.1.2. Locale

Indicates the available locales for the app, it can have more than one. The first one will be the default locale.

Examples:

```
<locale>en-US</locale>
```

```
<locale>es-UY</locale>
```

5.4.1.3. Messages

Indicates the names of the `.properties` files available. It can contain more than one.

Example:

```
<messages>qí-core-messages</messages>
```

```
<messages>qí-eeuser-messages</messages>
```

```
<messages>qí-sysconfig-messages</messages>
```

The naming convention for these files is: `packagename_locale.properties`

5.4.1.4. Menubar

A menubar represents the horizontal menu at the top of the app. It is represented with the `<menubar>` element. It contains "menus".

5.4.1.4.1. Menu

It represents the menu item. It has a `name`, an `icon`, a `style`, and an `action`.

Example:

```
<menu name="System" icon="COG" style="icon-cog" action="system" />
```

5.4.1.5. Sidebar

Represents the sidebar, it can contain `sections` and `options`. It is represented with the `sidebar` element. It can also be identified by an `id`. Example: `<sidebar id="info"> ... </sidebar>`

5.4.1.5.1. Section

Represents a section of the sidebar, represented with the `<section>` element. It has the following properties:

- `name`: String, required.

Example: `<section name="System"/>`

5.4.1.5.2. Option

Represents an option on the sidebar, represented with the `<option>` element. It has the following properties:

- **name** (string, required). The name that will be shown on the sidebar.
- **action** (string, required). What will be executed on click.
- **perm** (string, optional). The permission required to execute the action.

Example:

```
<option name="Exception log" action="exceptions"/>
```

5.4.1.6. View

Represents a view, it has the following properties:

- **route** (string, required). The **route** of the view to show.
- **class**
- **perm** (* means any perm).
- **sidebar** optional sidebar id. Indicates to which sidebar the view corresponds.

Example:

```
<view route="home" class="org.jpos.qi.views.DefaultView" perm="*" sidebar = "system"/>
```

Views can **can/will** contain different [properties](#) & [attributes](#).

5.4.1.6.1. Properties

Represented with the `<property>` element. It has a **name** and a **value**. Some views require:

- **entityName** (string, required for entities). The name of the entity. For example, for **users**, it is **user**. It must be included like this: `<property name="entityName" value="aName"/>`
- **name** (string, required when extending a class). The name for the view. When extending a class (Ex: when extending from SysConfig), it is a required field. It must be included like this: `<property name="name" value="aName"/>`

5.4.1.6.2. Attribute

Represented with the `<attribute>` element. It has:

- **name** (string, required) The name of the attribute, it will be shown on the column, or field.
- **field** (boolean, optional) Boolean value indicating whether the attribute should be shown as a field, on the specific view.
- **column** (boolean, optional) Boolean value indicating whether the attribute should be shown as a column on the general view.
- **read-only** (boolean, optional) Boolean value indicating if the attribute should be editable
- **required** (boolean, optional) Indicates if the field is required. Default is false.
- **regex** (string, optional) A string indicating the regex used for validating the field.

- **length** (numeric, optional) A number, indicating the max length for the field value.
- **expand-ratio** (numeric, optional) A number, indicating if the field's `expandRatio` to be used. (Check link: <https://vaadin.com/docs/-/part/framework/layout/layout-settings.html#layout.settings.size.expanding> [Vaadin docs] [Vaadin Docs] for more info).
- **perm** (string, optional) The permission needed to access the field.
- **link** (string, optional) The URL for which the link will be generated.
- **position** (string, optional) left/center/right/bottom: Indicates if field is displayed on the left, center, right or bottom of form layout.

Example:

5.4.1.6.3. Different classes of views - TabView

If the view has a class of type **TabView**. It can contain views within the `<view>` elements. This views accept an additional property:

- **caption** Indicates the caption for the tab.

5.4.2. QI Permissions

- *sysadmin* : Needed to access `/roles`, `/permissions` and roles field in `/users`.
- *login* : Needed to login to **QI** and access `/about`, `/memory`, `/log`.
- *sysconfig* : Needed to access `/sysconfig`.
- *users.write*: Needed to access `/users`.
- *accounting*: Needed to access `/accounts` and `/transactions`.

5.5. SAF

The **SAF** (Store And Forward) module is responsible for managing and retransmitting messages, ensuring reliable and resilient message processing. It provides a mechanism to temporarily store messages when the network or MUX (Multiplexer) is unavailable and forwards them automatically when connectivity is restored.

5.5.1. Key Features

- Persistent message storage using configurable storage mechanisms (e.g., **JESpace**).
- Automatic retry for message forwarding based on user-defined configurations.
- Support for valid and retry response codes for retransmission logic.
- Automatic handling of expired messages and maximum number of retransmission.
- Thread-safe operations using jPOS's space-based architecture.
- Logging and status monitoring.

5.5.2. Configuration

The **SAF** module is configured using a Q2 XML descriptor file. Below is an example configuration:

```

<saf name='saf' logger='Q2' realm='saf' class='org.jpos.saf.SAF'>
  <property name='space' value='je:saf' />
  <property name='mux' value='mux' />
  <property name='flag-retransmissions' value='no'>
    if MTI is in list, messages would be retransmitted as xxx1
  </property>
  <property name='initial-delay' value='60000' />
  <property name='inter-message-delay' value='1000' />
  <property name='wait-for-response' value='60000' />
  <property name='max-retransmissions' value='1000' />
  <property name='expire-after' value='86400'>
    in seconds
  </property>
  <property name='valid-response-codes' value='*' />
  <property name='retry-response-codes' value='91,ZZ' />
</saf>

```

5.5.2.1. Available Properties

- **space** Defines the persistence space where messages are stored. (e.g., **je:saf**)
- **mux** Specifies the **MUX** instance used for sending messages.
- **flag-retransmissions** If set to **yes**, messages with specific MTIs are retransmitted as **xxx1**.
- **initial-delay** Sets the delay (in milliseconds) before starting the SAF process (default: **30,000** ms).
- **inter-message-delay** Delay (in milliseconds) between subsequent messages (default: **1,000** ms).
- **wait-for-response** Time (in milliseconds) to wait for a response after sending a message (default: **60,000** ms).
- **max-retransmissions** Maximum number of times a message can be retransmitted (default: **0**, unlimited).
- **expire-after** The expiration time for a message (in seconds). Expired messages are removed from the queue (default: **0**, unlimited).
- **valid-response-codes** A list of response codes considered valid (default: **00**). Use ***** to accept all response codes.
- **retry-response-codes** List of response codes that trigger message retransmission (optional).
- **pre-message-delay** Delay before moving messages from a delayed queue to the main queue (default: **0**).

5.5.3. Example Usage

The following example demonstrates how to use the **SAF** module in your application to queue and process messages:

```

import org.jpos.iso.ISOMsg;
import org.jpos.saf.SAF;

// Obtain an instance of the SAF service
SAF saf = SAF.getSAF("saf");

```

```
// Create a sample message
ISOMsg msg = new ISOMsg();
msg.setMTI("0200");
msg.set(4, "1000");
msg.set(11, "123456");
msg.set(41, "000001");

// Send the message
saf.send(msg);
```

5.5.4. Inner Class: Entry

The `Entry` class represents a queued message and its metadata.

5.5.4.1. Attributes

- `msg`: The `ISOMsg` object representing the message.
- `time`: The timestamp when the message was added to the queue.
- `count`: The number of transmission attempts for the message.
- `responseKey`: The key used to store the response in the space (optional).
- `responseTimeout`: The timeout in milliseconds for the response (optional).
- `wipePreviousResponse`: Whether to clear previous responses for the same key.

5.5.4.2. Methods

5.5.4.2.1. Public Methods

- `void send(ISOMsg msg)`: Queues a message for transmission.
- `void send(ISOMsg msg, String responseKey, long responseTimeout, boolean wipe)`: Queues a message for transmission with additional response options.
- `String getStatus()`: Retrieves the current status of the SAF service.
- `static SAF getSAF(String name)`: Retrieves an instance of `SAF` from the `NameRegistrar`.

5.5.4.2.2. Private Methods

- `Entry send(Entry entry)`: Handles the actual transmission of a message.
- `boolean shouldIgnore(Entry entry)`: Determines if a message should be ignored (expired or max retransmissions reached).
- `LogEvent createLogEvent(String type, Entry entry)`: Creates a log event for a specific entry.

5.5.5. How It Works

- **Initialization**: The `SAF` service reads its configuration and sets up the necessary persistence space and `MUX` instance.
- **Message Queueing**: Messages are queued into the configured persistence space.

- **Message Processing:** Messages are sent sequentially based on the configuration (e.g., delay between messages and retry logic).
- **Response Handling:** If a response is received, it is validated against the `valid-response-codes`. If invalid, the message is retried based on the `retry-response-codes` property.
- **Message discarding:** If a message expires or exceeds the maximum retransmission attempts, it is discarded.

5.5.6. Thread Safety

The `SAF` module is thread-safe, allowing concurrent processing of messages. Synchronization mechanisms are implemented where needed to ensure safe interaction with shared resources.

5.5.7. Logging and Monitoring

The module integrates with the jPOS `Logger` and `LogEvent` utilities to provide extensive monitoring capabilities:

- Logs transmission attempts and responses.
- Reports expired or ignored messages.
- Provides status information using the `getStatus()` method.

Chapter 6. Database Support

Several jPOS-EE components rely on the `dbsupport` module to configure and access the underlying database (or databases) using Hibernate.

One of the most used class is `org.jpos.ee.DB` and its usage is straightforward:

```
DB db = new DB();
db.open();
...
...
db.close();
```

If you want to update the database, your code may look like this:

```
DB db = new DB();
db.open();
db.beginTransaction();
...
...
db.commit();
db.close();
```

The DB object implements the `Closeable` interface, so you can use the try-with-resources construct like this:

```
try (DB db = new DB()) {
    db.open();
    db.beginTransaction();
    ...
    ...
    db.commit();
} ①
```

① No need to call `db.close()` as `DB` implements `Closeable`.

Also, the `DB` object provides a couple of functional alternatives to the code above:

```
DB.exec ((db) -> {
    return db.session().get(YourObject.class, yourId);
});
```

or `execWithTransaction` that encloses your function within a `beginTransaction/commit` block.

```
DB.execWithTransaction((db) -> {
    db.session().save(obj);
    return obj;
});
```

```
});
```



Very often we find ourselves answering the question WHY (on earth) we have this **DB** object instead of just using Hibernate session factory and sessions directly. The answer comes from the history of jPOS-EE, which initially used an object-oriented database (ObjectStore). ObjectStore had a **DB** object that one had to instantiate to access the database, and we were used to it. Interesting enough, ObjectStore helped model JDO, which in turn influenced the JPA we have today.

Once we moved away from the object-oriented database to Hibernate, we found it useful to keep that DB object around used by our code, slightly isolating us from Hibernate and providing some helper functionality, and that's the only reason there's a DB object in jPOS-EE.

6.1. DB Support configuration

Hibernate applications are usually configured by means of a single **hibernate.cfg.xml** file that looks like this:

```
<!DOCTYPE hibernate-configuration PUBLIC
    "-//Hibernate/Hibernate Configuration DTD 3.0//EN"
    "http://www.hibernate.org/dtd/hibernate-configuration-3.0.dtd">

<hibernate-configuration>
  <session-factory>
    ...
    ...
    <mapping class="org.jpos.ee.SysConfig"/>
    <mapping resource="org/jpos/ee/User.hbm.xml" />
    <mapping resource="org/jpos/ee/Consumer.hbm.xml" />
    <mapping resource="org/jpos/ee/Revision.hbm.xml" />
    <mapping resource="org/jpos/ee/Role.hbm.xml" />
    <mapping class="com.your.company.entity.YourEntity" />
    ...
    ...
  </session-factory>
</hibernate-configuration>
```

Besides standard configuration (c3p0, jdbc, transaction isolation), the **hibernate.cfg.xml** file has a collection of mappings for your application's entities, but jPOS-EE applications are built *à la carte* picking modules from the jPOS-EE modules offering, as well as customer specific modules.

So if an application wants to use jPOS-EE DB support using say PostgreSQL backend, and wants to use the **sysconfig** module, and **eeuser** module, you would add the following dependencies:

```
compile "org.jpos.ee:jposee-db-postgresql:${jposeeVersion}" ①
compile "org.jpos.ee:jposee-sysconfig:${jposeeVersion}"
compile "org.jpos.ee:jposee-eeuser:${jposeeVersion}"
```


① the `db-postgresql` depends on `db-support` so no need to include it explicitly

But upon adding these modules as a dependency, the developer would have to manually add these mappings to the `hibernate.cfg.xml`.

In addition, as part of the edit work, you need to specify the Hibernate dialect to be used (i.e. `org.hibernate.dialect.MySQL5InnoDBDialect` for MySQL, or `PostgreSQLDialect` for PostgreSQL), JDBC URL, etc.

jPOS-EE uses a simple convention to dynamically create the Hibernate configuration file based on the following rules:

- It uses an initial `hibernate.cfg.xml` template available in the application's CLASSPATH as starting point.
- It scans the classpath looking for XML configuration files in each dependency jar inside the `META-INF/org/jpos/ee/modules`, for example, the `eeuser` module has the file:

```
<module name="eeuser">
  <mappings>
    <mapping resource="org/jpos/ee/User.hbm.xml" />
    <mapping resource="org/jpos/ee/Consumer.hbm.xml" />
    <mapping resource="org/jpos/ee/Revision.hbm.xml" />
    <mapping resource="org/jpos/ee/Role.hbm.xml" />
  </mappings>
</module>
```

So those mappings become part of the main Hibernate configuration. See `eeuser.xml`

- Finally, it searches for a `cfg/db.properties` file in the current working directory for additional configuration and overrides.

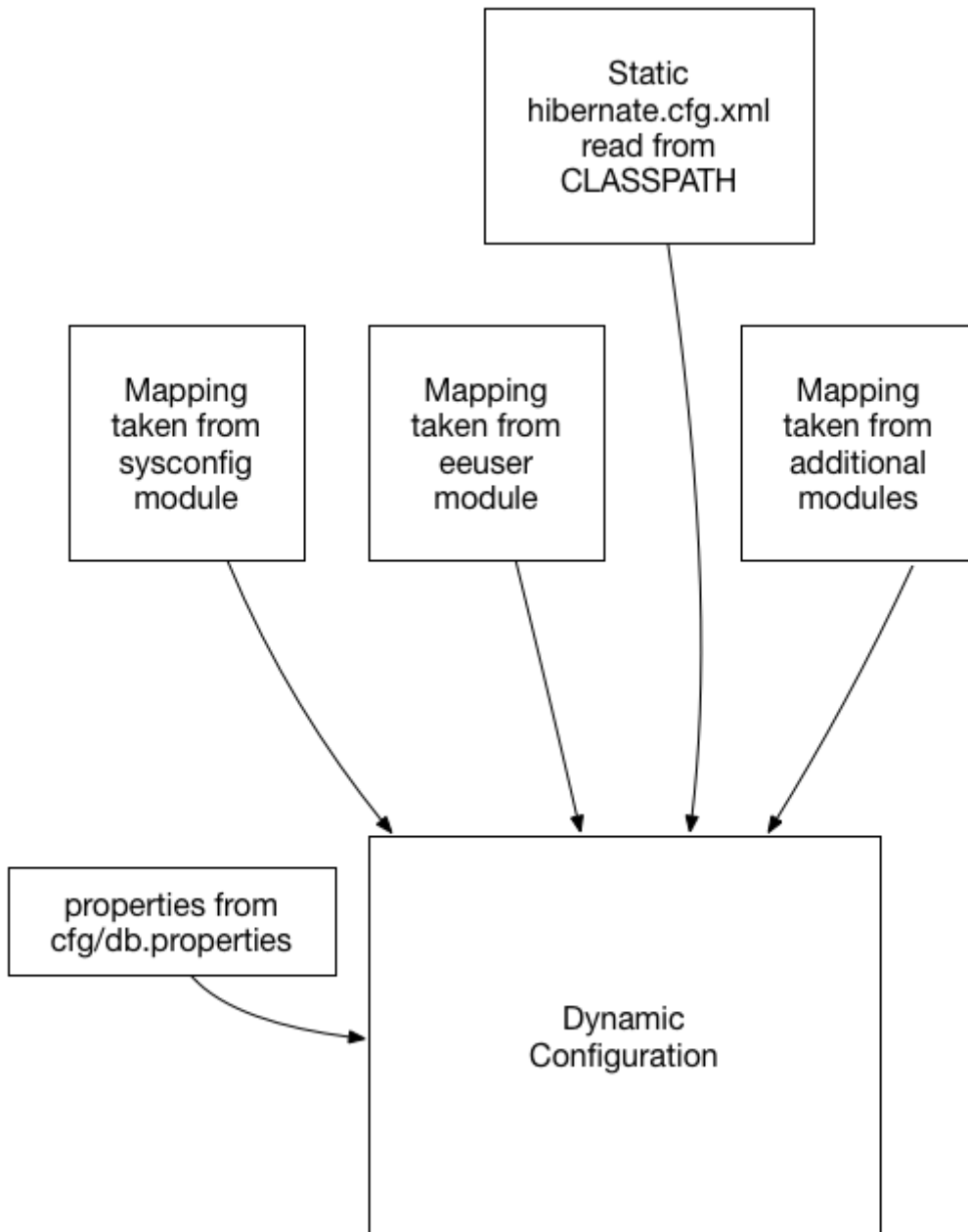
Here is a sample `db.properties`:

```
hibernate.connection.username=sa
hibernate.connection.password=password
hibernate.hbm2ddl.auto=validate
hibernate.connection.url=jdbc:postgresql://localhost:5432/jposee
hibernate.connection.driver_class=org.postgresql.Driver
hibernate.dialect=org.hibernate.dialect.PostgreSQLDialect
```



In addition to the XML module mapping file available in each module's classpath, the `db-*` set of modules (such as `db-mysql`, `db-postgresql`, etc.) has a sample `db.properties` file included in its `META-INF/q2/installs/cfg` directory, so a call to `gradle installResources` or the `install` CLI command (that you can invoke by calling `q2 --cli`) will export it to the operating system, where you can easily edit it.

So to recap, the following diagram shows how a dynamic `hibernate.cfg.xml` configuration is created when we call `DB db = new DB()` with no arguments:



remember, the **mapping** files are taken from the special **META-INF/org/jpos/ee/modules/*.xml**.



This configuration is suitable for situations where you have to connect to a single JDBC endpoint and access and map a unique set of entities. If that's not your case, read below for additional options.

6.1.1. Accessing a secondary/slave database

If you want to access an alternate database, you can use a modifier when instantiating your DB object, for example:

```
DB db = new DB ("slave");           ①
db.open();
db.session().setDefaultReadOnly(true); ②
```

...
...

- ① We call this constructor parameter a *config modifier*
- ② If this is a real **slave**, you may want to set the underlying Hibernate session to read-only mode.

In this case, jPOS-EE will operate in a very similar way as the one described in the previous section, but instead of reading properties from the `cfg/db.properties` file, it would read them from `cfg/slave:db.properties`.

The previous example works for situations where the set of entities mapped to tables in your secondary database are the same as the primary database. If that's not the case, in addition to read an alternate JDBC configuration from your `slave:db.properties` you want to map a different set of entities.

If your config modifier has actually two modifiers, separated by a colon (e.g. `slave:legacy`), then we'd read JDBC and optional properties from the `cfg/slave:db.properties`, but when we scan for mapping files, we use the following pattern `META-INF/org/jpos/ee/modules/legacy:*.xml`.

Finally, if this black magic feels confusing, you can always call

```
DB db = new DB("path/to/your/hibernate.cfg.xml");
```



The `DB` class uses an internal cache of sessions factories, so the first time you call it with no args or a given modifier, it will create a sessionFactory (an expensive operation that requires access to the database), but after that slow first time, creating new DB objects is a very cheap operation.

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>
```

For MS-SQL database:

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



Only one of these dependencies should be defined in your project.

6.2. 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 ①
hibernate.connection.password=password ②
hibernate.hbm2ddl.auto=update ③
#
hibernate.connection.url=jdbc:mysql://localhost/jposee?autoReconnect=true ④
hibernate.connection.driver_class=com.mysql.jdbc.Driver
hibernate.dialect=org.hibernate.dialect.MySQL5InnoDBDialect
```

① Replace value with your database username

- ② Replace value with your database password
- ③ 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.
- ④ Replace the host and database (jposee) to match your database settings.



You want to change those defaults.

6.3. 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 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 . 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                                ①
hibernate.connection.password=password                          ②
hibernate.hbm2ddl.auto=update                                   ③
hibernate.connection.url=jdbc:postgresql://localhost:5432/jposee ④
hibernate.connection.driver_class=org.postgresql.Driver
hibernate.dialect=org.hibernate.dialect.PostgreSQLDialect

```

- ① Replace value with your database username
- ② Replace value with your database password
- ③ 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.
- ④ Replace the host and database (jposee) to match your database settings.



You want to change those defaults.

6.4. 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 ①
hibernate.connection.password= ②
hibernate.hbm2ddl.auto=update ③
hibernate.connection.url=jdbc:h2:./data/jposee;LOCK_TIMEOUT=5000 ④
hibernate.connection.driver_class=org.h2.Driver
hibernate.dialect=org.hibernate.dialect.H2Dialect
```

- ① Replace value with your database username
- ② Replace value with your database password
- ③ 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.
- ④ Replace the host and database (jposee) to match your database settings.



You want to change those defaults

6.5. MSSQL Database support

What:	This module configures Hibernate to use MS-SQL as its back end.
When:	Available since v2.2.4
Who:	The jPOS.org team.
How:	Posted by the jPOS-EE team.
Where:	Directory modules/db-mssql 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 ①
hibernate.connection.password=password ②
hibernate.hbm2ddl.auto=update ③
hibernate.connection.url=jdbc:sqlserver://localhost:1433;databaseName=jposee ④
hibernate.connection.driver_class=com.microsoft.sqlserver.jdbc.SQLServerDriver
hibernate.dialect=org.hibernate.dialect.SQLServerDialect ⑤
```

- ① Replace value with your database username
- ② Replace value with your database password
- ③ 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.
- ④ Replace the host and database (jposee) to match your database settings.
- ⑤ `SQLServer2012Dialect` is also available.



You want to change those sample defaults

6.6. FlyWay Support

The `db-flyway` module can be used to run FlyWay migrations from the jPOS command line interface.

It picks the DataSource configuration from the standard DB configuration used by jPOS (that can be defined in the `db.properties` file, or a target *Environment*).

When running `q2 --cli` (or reaching a running Q2 server using SSH), there's a new `flyway` subsystem. Inside the `flyway` subsystem you can find the following commands:

- `clean`
- `info`
- `baseline`
- `migrate`
- `validate`
- `repair`

All Flyway commands take into account possible environment variables, defined in `cfg/default.yml`, i.e.:

```
flyway:
  table: schema_version ①
```

- ① Sets `flyway.table` property, in this example, we override the new default value `flyway_schema_history` for backward compatibility.



By default, the `clean` command is disabled, unless `flyway.cleanDisabled: false` is placed in the environment.



The migrate command accepts an optional `--out-of-order` parameter.

In addition to CLI support, there's also a `FlywayService` that can be configured as a QBean. We recommend to use a low filename (such as `01_flyway.xml`) so that the service starts before other services that may require the schema to be impacted in the database.

The QBean descriptor looks like this:

```
<flyway class="org.jpos.flyway.FlywayService" logger="Q2">  
  <property name="out-of-order" value="true" /> ①  
  <commands>  
    info  
    migrate  
  </commands>  
</flyway>
```

- ① Optional property used by Flyway migrate.

Valid commands are:

- info
- baseline
- repair
- migrate
- validate
- clean



For security, the `clean` command is disabled by default. The `flyway.cleanDisabled` property can be set to `false` in order to enable it.



These Flyway commands use stdout for their output. We recommend to add `<property name="redirect" value="stdout, stderr" />` to your `00_logger.xml` configuration in order to get unified logs.

Chapter 7. Binary Log

7.1. BinLog

What	General purpose binary log
When	Implemented during 2.2.4
Who	The jPOS Software team.
Where	Directory modules/binlog
Why	Used by local Q2 nodes as audit trail or to SAF its transactions
Status	Experimental
License	GNU Affero General Public License version 3

Listing 3. Maven Coordinates

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

The jPOS BinLog has the following features:

- multiple readers and writers can be used from the same JVM
- multiple readers and writers can be used from different JVMs



Make sure you read and understand the implementation notes at the end of this section before you attempt to use it.

Here is a sample Writer:

```
File dir = new File("/tmp/binlog");
try (BinLogWriter bl = new BinLogWriter(dir)) {
  ① bl.add( ... ); // byte array
    bl.add( ... ); // byte array
    bl.add( ... ); // byte array
}
```

① The BinLogWriter implements `AutoCloseable` so `try-with-resources` can be used

A reader would look like this:

```
File dir = new File("/tmp/binlog");
try (BinLogReader bl = new BinLogReader(dir)) {
  while (bl.hasNext()) {
```

```

        byte[] b = bl.next().get();
        // do something with the byte[]
    }
}

```

The `BinLogReader` implements an `Iterator<BinLog.Entry>`. Each `BinLog.Entry` has two main methods:

- `BinLog.Ref ref()`
- `byte[] get()`

While iterating over a `BinLog`, it might make sense to persistently store its `BinLog.Ref` in order to be able to restart the iterator at a given point if required (this is useful if using the `BinLog` to implement a Store and Forward).

The `BinLogReader` has two constructors:

- `BinLogReader(File dir)`
- `BinLogReader(File dir, BinLog.Ref ref)`

the latter can be used to restart the iterator at a given reference point obtained from a previous run.

In addition to the standard `hasNext()` method required by the `Iterator` implementation, `BinLogReader` also has a `hasNext(long millis)` method that waits a given number of milliseconds once it reaches the end of the log, attempting to wait for a new entry to be available.

7.1.1. Implementation notes

The goal behind the `BinLog` implementation is to have a future proof file format easy to read from any language, 10 years down the road. We found that the Mastercard simple IPM file format, that's basically a two-byte message length followed by the message itself was suitable for that. The payload on each record can be ISO-8583 (like Mastercard), JSON, FSDMsg based, Protocol buffers or whatever format the user choose.

But that format isn't crash proof. If a system crashes while a record is being written to disk, the file can get easily corrupted. So we picked some ideas from Square's *tape* project that implements a highly crash proof on-disk persistent circular queue using a very small header. Tape is great and we encourage you to consider it instead of this binlog for some use cases, but we didn't want a circular queue, we wanted a place to securely store events for audit or store and forward purposes, and we also wanted to be able to access the same binlog from multiple JVMs with access to the same file-system, so we had to write our own.

The on-disk file format looks like this:

```

Format:
  256 bytes Header
  ... Data
  ... Data

Header format (256 bytes):
  4 bytes header length
  2 bytes version
  2 bytes Status (00=open, 01=closed)

```

```
8 bytes Last element position
4 bytes this log number
4 bytes next log number
232 bytes reserved
```

Element:

```
4 bytes Data length
...      Data
```

Each record has a length prefix (four bytes in network byte order) followed by its data. The header has a fixed length of 256 bytes but we found useful to make it look like a regular record too by providing its length at the very beginning. An implementation in any language reading a jPOS binlog can just be programmed to skip the first record.

At any given time (usually at end of day), a process can request a **cut-over** by calling the `BinLogWriter.cutover()` method in that case, all writers and readers will close the current file and move to the next one (Readers can choose to not-follow to the next file, for example while producing daily extracts).

In order to achieve file crash resilience, each write does the following:

- Lock the file
- Write the record's length and data
- Sync to disc
- Write the last element position to the header
- Sync to disc
- Unlock the file



In an MBP with SDRAM we've managed to achieve approximately 6000 writes per second. On an iMac with regular disk the numbers go down to approximately 1500 writes per second for regular ISO-8583 message lengths (500..1000 bytes per record).

Due to the fact that the header is small enough to fit in an operating system block, the second write where we place the last element position happens to be atomic. While this works OK for readers and writers reading the file from different JVMs, that's not the case for readers and writers running on the same JVM, even if they use a different file descriptor to open the file, the operating system stack has early access to the header that under high concurrency can lead to garbage values, that's the reason the code synchronizes on a `mutex` object at specific places.

7.1.2. Supporting CLI commands

The `binlog` CLI command is a subsystem that currently has three commands:

- `monitor` (to visually monitor a binlog)
- `cutover` (to force a cutover)
- `exit` (builtin command)

`binlog` accepts a parameter with the binlog's path, i.e: `binlog /tmp/binlog`

So a cutover can be triggered from cron using the following command:

```
q2 --command="binlog /tmp/binlog; cutover; exit; shutdown --force"
```

7.1.3. BinLog Quartz Support

The `binlog-quartz` provides support for automatic cutover, for example:

```
<cron class="org.jpos.q2.QuartzAdaptor" logger="Q2">
  <job id="1" class="org.jpos.binlog.cron.CutoverJob" when="59 59 23 * * ?"
    logger="Q2" realm="binlog-cutover">
    <property name="binlog" value="/tmp/binlog" />
  </job>
</cron>
```

Chapter 8. Rest Support

8.1. QRest

What	Lightweight REST server
When	Implemented during 2.2.5
Who	The jPOS Software team.
Where	Directory modules/qrest
Why	Useful in situations where a full blown Jetty/Jersey is overkill
Status	Used in production
License	GNU Affero General Public License version 3

Listing 4. Maven Coordinates

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

Traditionally, jPOS based REST applications use the Jetty module, Jersey, etc. as described in the [jPOS Tutorials](#). But we have situations where we just need to provide a little **ok** response to say a **/health** endpoint on each Q2 running (for monitoring purposes).

Configuring Jetty/Jersey and deploying a **war** seems like overkill for these use cases so we've created a little **QRest** module that can be configured like this:

```
<qrest class='org.jpos.qrest.RestServer' logger='Q2'>
  <property name='port' value='8081' /> ①
  <property name='queue' value='TXNMGR' /> ②
  <property name='TLS' value='true' /> ③
  <property name='server-auth' value='false' /> ④
  <property name='client-auth' value='false' /> ⑤
  <property name='keystore' value='cfg/keystore.jks' /> ⑥
  <property name='storepassword' value='jposjposjposjpos' /> ⑦
  <property name='keypassword' value='jposjposjposjpos' /> ⑧
  <property name='enabled-cipher' value='TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA' /> ⑨
  <property name='enabled-cipher' value='TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256' />
  <property name='enabled-cipher' value='TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384' />
  <property name='enable-protocol' value='TLSv1.2' /> ⑩
  <property name='enable-protocol' value='TLSv1.3' />
  ...
  ...
</qrest>
```

- ① Listening port
- ② Transaction manager queue name (if no specific routes are present)
- ③ `true` to enable TLS
- ④ Set to `false` in order to allow self-signed certificates
- ⑤ `true` requires client-side certificates
- ⑥ Keystore location
- ⑦ Store password
- ⑧ Key password
- ⑨ Enabled cipher suites (optional, defaults to *all* if not present)
- ⑩ Enabled protocols (optional, defaults to *all* if not present)

Once the server receives an HTTP request, it creates a `org.jpos.transaction.Context`, places a reference to the http request (under the Constant name `REQUEST` defined in the `org.jpos.qrest.Constants` enum), and to the session in the `SESSION` constant (so that a `SendResponse` participant can reply) and send it off to the `TransactionManager` for processing.

If no specific `<route>` entries are present in the QRest configuration, incoming messages are sent to the `queue` specified in the `queue` property, but you can override those with a route like this:

```
<qrest class='org.jpos.qrest.RestServer' logger='Q2'>
  <property name='port' value='8081' />
  <property name='queue' value='TXNMGR' />
  ...
  ...
  <route path="/v2/**" method="GET" queue="TXNMGR.2"/> ①
  <route path="/v2/**" method="POST" queue="TXNMGR.2"/> ②
</qrest>
```

- ① All `GET` methods starting with `/v2` will get queued to `TXNMGR.2` instead of the standard `TXNMGR` queue.
- ② Likewise, `POST` starting with `/v2` will get queued to the `TXNMGR.2` too.

The `TransactionManager` is configured like this:

```
<txnmgr class="org.jpos.transaction.TransactionManager" logger="Q2">
  <property name="queue" value="TXNMGR"/>
  <property name="sessions" value="2"/>
  <property name="max-sessions" value="128"/>
  <property name="debug" value="true"/>

  <participant class="org.jpos.qrest.participant.Router">
    <route path="/jpos/myroute/{myPathParam}*" method="GET" name="mygroup1"/>
    <route path="/jpos/myroute/{myPathParam}*" method="POST" name="mygroup2"/>
    <route path="/jpos/fixedroute" method="POST" name="..." />
    <route path="/q2*" method="GET" name="q2"/> ①
  </participant>
```

```

<group name="q2">
  <participant class="org.jpos.qrest.participant.Q2Info" />
</group>
..
..
<group name="group1">
  ..
  ..
</group>
<group name="group2">
  ..
  ..
</group>
<participant class="org.jpos.qrest.SendResponse" logger="Q2"/>
</txnmgr>

```

① This route is special, see below, route processing gets delegated to the Q2Info class

In situations where multiple routes are defined at the QRest server configuration, classes like `Q2Info` that internally process routes may need to know about the prefix in use. This can be configured using the `prefix` property, i.e.:

```

<group name="q2">
  <participant class="org.jpos.qrest.participant.Q2Info">
    <property name="prefix" value="/v2" />
  </participant>
</group>

```

①

① `prefix` property should match the route's prefix



This old [Blog Post](#) explained how the `TransactionManager` could be used to implement REST based APIs. The QRest service can be used to simplify a lot of Jetty/Server/Jersey boilerplate.

The `Router` participant is actually a `GroupSelector` (from the `TransactionManager`'s standpoint) and takes care of parsing and placing in the Context both *Path Parameters* as well as *Query Parameters* (under the `PATHPARAMS` and `QUERYPARAMS` constants).

So if we define a route like this:

```

<route path="/jpos/muxes/{muxname}" method="GET" name="muxes"/>

```

and we fire `curl localhost:8081/jpos/muxes/ABC`, we'll see that the Context will have a:

```

o.j.r.Constants.PATHPARAMS: {muxname=ABC}

```

If we add query parameters to the call, i.e.: `curl "localhost:8081/jpos/muxes/XYZ?a=1&b=2&c=3"`

the query parameters will be available under the `QUERYPARAMS` constant.

```
o.j.r.Constants.QUERYPARAMS: {a=[1], b=[2], c=[3]}
o.j.r.Constants.PATHPARAMS: {muxname=XYZ}
```

In addition to having the Router participant parse the route, one can define wildcard handlers for some routes. This is the case of the `Q2Info` participant that — although work in progress — intends to provide useful information about a running Q2 system.

So anything that starts with `/q2` (or whatever one choose to set in the XML configuration) will be handled by `Q2Info`.

`Q2Info` itself has its own routes, but those are hardcoded. So if we call `/q2/version`, we get output like this:

```
{
  "version" : "jPOS 2.1.2-SNAPSHOT master/0a14e5c (2018-04-30 22:34:16 UTC)"
}
```

`/q2/uptime` would give us:

```
{
  "uptime" : 601483
}
```

`/q2/diskspace`:

```
{
  "diskspace" : {
    "free" : 616271151104,
    "usable" : 616009007104
  }
}
```

`Q2Info` also provides now information about the MUXES, and we plan to expand it to provide information about other components (servers, transaction manager, space).

i.e.: `curl localhost:8081/q2/muxes`

```
"muxes" : [ {
  "name" : "clientsimulator-mux",
  "type" : "QMUX",
  "connected" : true,
  "rx" : 21,
  "tx" : 21,
  "txExpired" : 0,
  "txPending" : 0,
```



```

"rxExpired" : 0,
"rxPending" : 0,
"rxUnhandled" : 0,
"rxForwarded" : 0,
"metrics" : {
  "all" : {
    "autoResize" : false,
    "highestTrackableValue" : 60000,
    "lowestDiscernibleValue" : 1,
    "numberOfSignificantValueDigits" : 2,
    "tag" : null,
    "maxValue" : 18,
    "minNonZeroValue" : 3,
    "totalCount" : 21,
    "estimatedFootprintInBytes" : 10752,
    "startTimeStamp" : 9223372036854775807,
    "endTimeStamp" : 0,
    "maxValueAsDouble" : 18.0,
    "mean" : 6.190476190476191,
    "stdDeviation" : 3.141413809994408,
    "neededByteBufferCapacity" : 11560,
    "minValue" : 3
  },
  "ok" : {
    "autoResize" : false,
    "highestTrackableValue" : 60000,
    "lowestDiscernibleValue" : 1,
    "numberOfSignificantValueDigits" : 2,
    "tag" : null,
    "maxValue" : 18,
    "minNonZeroValue" : 3,
    "totalCount" : 21,
    "estimatedFootprintInBytes" : 10752,
    "startTimeStamp" : 9223372036854775807,
    "endTimeStamp" : 0,
    "maxValueAsDouble" : 18.0,
    "mean" : 6.190476190476191,
    "stdDeviation" : 3.141413809994408,
    "neededByteBufferCapacity" : 11560,
    "minValue" : 3
  }
},
"last" : "2018-05-02 17:56:48",
"idle" : 1306237
} ]
}

```

If we use the mux name as part of the URI, we get information for a particular MUX, i.e.: `curl localhost:8081/q2/muxes/clientsimulator-mux`

Here is a copy of the internal Q2Info route configuration:

```

private void initInternalRoutes() {
    routes.add(new Route<>("/q2/version**", "GET",
        (t,s) -> mapOf("version", q2Version())));
    routes.add(new Route<>("/q2/applicationVersion**", "GET",
        (t,s) -> mapOf("applicationVersion", Q2.getAppVersionString())));
    routes.add(new Route<>("/q2/instanceId**", "GET",
        (t,s) -> mapOf("instanceId", q2.getInstanceId())));
    routes.add(new Route<>("/q2/uptime**", "GET",
        (t,s) -> mapOf("uptime", q2.getUptime())));
    routes.add(new Route<>("/q2/started**", "GET",
        (t,s) -> mapOf("started", new Date(System.currentTimeMillis() -
            q2.getUptime()))));
    routes.add(new Route<>("/q2/diskspace**", "GET",
        (t,s) -> diskSpace()));
    routes.add(new Route<>("/q2/muxes/{muxname}**", "GET",
        (t,s) -> muxInfo(t,s)));
    routes.add(new Route<>("/q2/muxes**", "GET",
        (t,s) -> muxes()));
}

```

If we just call `/q2`, it will output them all.

8.1.1. Static and Dynamic HTML content

QRest is by no means a full fledged web server, but it can still serve static and dynamic HTML pages using the `StaticContent` and `DynamicContent` participants.

Our qrest TXNMGR configuration can include static content like this:

```

<participant class="org.jpos.qrest.participant.Router">
    <route path="/welcome.html" method="GET" name="welcome" />
</participant>

<group name="welcome">
    <participant class="org.jpos.qrest.participant.StaticContent">
        <property name="documentRoot" value="html" />
        <property name="content" value="welcome.html" />
    </participant>
</group>

```

So a call to `http://localhost:8080/welcome.html` will land in group named `welcome` that will serve the file `html/welcome.html`. If instead of hitting `welcome.html` the user tries anything else, it will fail with a 404 error.

In order to serve *any* file inside the `documentRoot`, one can omit the property `content`, i.e.:

```

<participant class="org.jpos.qrest.participant.Router">
    <route path="/static/**" method="GET" name="static" />

```

```

</participant>

<group name="static">
  <participant class="org.jpos.qrest.participant.StaticContent">
    <property name="documentRoot" value="static" />
  </participant>
</group>

```

In this case, any file in the `static` directory will be served, if present.

In addition to static files, QRest can render dynamic content using Freemarker.

The configuration looks like this:

```

<participant class="org.jpos.qrest.participant.Router">
  <route path="/dynamic" method="GET" name="dynamic" />
</participant>

<group name="dynamic">
  <participant class="org.jpos.qrest.participant.DynamicContent">
    <property name="documentRoot" value="templates" />
    <property name="content" value="dynamic.html" /> ①
    <property name="page.ctx.include" value="_include.html" />
    <property name="page.ctx.myprop" value="myvalue" />
  </participant>
</group>

```

① For security, the template file has to be specified.

The `DynamicContent` class uses a special qrest Constant `RENDER_CONTEXT` with a map to be passed to the Freemarker template engine. Properties starting with the prefix `page.ctx.` will be processed at participant initialization time and handed to the template engine at process time. In this example, a property called `include` and `myprop` will be available to the template engine, and can be used to write a template like this:

```

<h1> Dynamic Content </h1>

Processing transaction ${id} ①

<#include include>

```

① The `id` property is also provided by the `DynamicContent` participant using the transaction id.

8.1.2. CORS configuration

QRest supports CORS that can be configured like this:

```

<qrest class='org.jpos.qrest.RestServer' logger='Q2'>
  ...
  ...

```

```

<cors path="/api/abc"                                ①
    max-age="600"
    allow-null-origin="false"
    allow-credentials="true">
  <origin>http://jpos.org</origin>                    ②
  <origin>https://jpos.org</origin>
  <allow-method>GET</allow-method>                    ③
  <allow-method>POST</allow-method>
  <allow-method>PUT</allow-method>
  <allow-method>REMOVE</allow-method>
  <expose-header>Content-Type</expose-header>         ④
  <expose-header>Authorization</expose-header>
  <request-header>consumer-id</request-header>       ⑤
</cors>
<cors path="/api/xyz" ...>
  ...
  ...
</cors>
</qrest>

```

- ① The optional `cors` element supports `max-age`, `allow-null-origin` and `allow-credentials` attributes.
- ② One or more `origin` elements can be added. If no `origin` element is specified, we assume *any* origin.
- ③ Multiple `allow-method` elements can be specified.
- ④ Multiple `expose-header` elements can be specified.
- ⑤ Multiple `request-header` elements can be specified.



CORS can be configured on a system-wide basis by not providing a `path` attribute.

The last entry with no path is taken as the system's default.

8.2. HttpClient

What	HttpQuery participant
When	Implemented during 2.2.6
Who	The jPOS Software team.
Where	Directory modules/http-client
Why	Lightweight asynchronous Http Participant
Status	Experimental
License	GNU Affero General Public License version 3

Listing 5. Maven Coordinates

```

<dependency>
  <groupId>org.jpos.ee</groupId>
  <artifactId>jposee-http-client</artifactId>

```

```
<version>${jposee.version}</version>
</dependency>
```

The `HttpQuery` participant has the following configuration properties:

- `url`: a *hardcoded* url for the request (it will be used as is, so it must be valid as per `java.net.URI`). Can be overridden in the transaction context by the value of the `HTTP_URL` entry (or whatever the entry key has been changed to by the `urlName` configuration property).
- `connect-timeout`: milliseconds to wait for connection (default 10000)
- `timeout`: milliseconds to wait for an HTTP response (based on socket activity; default 15000)
- `contentType`: defaults to `"application/json"`
- `httpHeader`: a *repeatable* configuration property representing an HTTP request header, where the value is of the form `header_name:header_value`
- `redirect-strategy`: Sets the strategy to use when the remote HTTP server returns a redirect. If the property is undefined, or has the "default" value, it will use Apache's `DefaultRedirectStrategy`. If the value is `lax` it will use `LaxRedirectStrategy` (see: <https://hc.apache.org/httpcomponents-client-ga/tutorial/html/fundamentals.html>)
- `preemptiveAuth`: if doing Basic Authentication (by presence of context value), do it on the first request (default `false`)
- `responseBodyOnError`: should an HTTP response body be included for responses with error status code? (`boolean`, default `false`);
- `maxConnections`: set the maximum number of concurrent client connections; if unset it will default to 25 concurrent connections. + **NOTE**: This value is overridable by the `http.maxConnections` Java system property, and it applies globally to the whole process.

In addition, `HttpQuery` picks a few *configurable* entries from the `Context`:

- `HTTP_URL`: with the remote host's URL
- `HTTP_METHOD`: currently one of `GET`, `POST`, `PUT`
- `HTTP_VERSION`: allows forcing an older version. Defaults to JVM default.
- `HTTP_PARAMS`: the *query string* (must be correctly encoded), and it's appended to the previously computed URL, with a `?` separating both parts
- `HTTP_REQUEST`: a request payload (i.e., JSON String)
- `HTTP_CONTENT_TYPE`: overrides the one given with the `contentType` configuration property
- `HTTP_HEADERS`: HTTP request headers that will be dynamically added to whatever was configured by the set of `httpHeader` properties. The value of the `HTTP_HEADERS` entry in the `Context` can be of three different types:
 - a `String[]` where each item follows the `header_name:header_value` syntax
 - a `List<String>` where each item follows the `header_name:header_value` syntax
 - a `Map<String,String>` where the keys represent *header names*, and the values the corresponding *header values*
- `.HTTP_BASIC_AUTHENTICATION`: A String of the form `<username>:<password>` used for HTTP Basic Authentication.

NOTE: The default `Context` name starts with a period (`.`), meaning it will be hidden in the logs during a context dump.

After successful completion (which may include normal HTTP errors such as `404` or `500`), `HttpQuery` stores the result back into the `Context`:

- `HTTP_STATUS`: integer with the HTTP status code.
- `HTTP_RESPONSE`: a `String` with the response body, if any.

Here is a sample configuration taking all the defaults:

```
<participant class="org.jpos.http.client.HttpQuery" />
```

The default names used above can be overridden, e.g.:

```
<participant class="org.jpos.http.client.HttpQuery">
  <property name="urlName" value="MY_HTTP_URL" />
  <property name="methodName" value="MY_HTTP_METHOD" />
  <property name="versionName" value="MY_HTTP_VERSION" />
  <property name="paramsName" value="MY_HTTP_PARAMS" />
  <property name="headersName" value="MY_HTTP_HEADERS" />
  <property name="requestName" value="MY_HTTP_REQUEST" />
  <property name="responseName" value="MY_HTTP_RESPONSE" />
  <property name="responseStatusName" value="MY_HTTP_STATUS" />

  <property name="contentType" value="application/json" /> ①
  <property name="contentTypeName" value="MY_HTTP_CONTENT_TYPE" /> ②

  <property name="basicAuthenticationName" value=".MY_BASIC_CREDENTIALS" /> ③
</participant>
```

- ① Content-Type defaults to `application/json`
- ② Name of the Context variable where user can **override** the default content type.
- ③ We recommend that the context key starts with a period, so it will be a hidden entry during a context dump in the logs.

Here is a sample use:

```
TransactionManager mgr = ... // somehow get a reference to a TransactionManager
Context ctx = new Context();
ctx.put("HTTP_URL", "http://localhost/q2/version");
ctx.put("HTTP_METHOD", "GET");
mgr.queue(ctx); ①
Integer sc = ctx.get("HTTP_STATUS", 10000L); ②
String response = ctx.get("HTTP_RESPONSE");
```

- ① Enqueue `ctx` to be processed by `mgr` that has an `HttpQuery` in its list of participants.

② Wait up to 10 seconds for a response

Chapter 9. Tools

9.1. 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.

Listing 6. Maven Coordinates

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

9.1.1. 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 ①
config-files=cfg/config.properties ②
```

- ① This property tells Q2 to use the FreemarkerDecoratorProvider as its decorator.
- ② This property defines a comma separated list of files which will be used as configuration files.

9.1.2. 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>

```

9.2. Groovy Support

What	Add Groovy support.
When	Since 2.2.1.
Who	The jPOS.org team.
Where	Directory modules/groovy.

Why	Allows seamless integration with Groovy from Q2 applications.
Status	Experimental.
License	GNU Affero General Public License version 3

Listing 7. Maven Coordinates

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



Although not strictly required by this particular QBean Groovy adaptor, the `jposee-groovy` module also includes the handy `groovy-sql` dependency.

In all the modules described below, the `src` attribute honors the `${...}` syntax. So, you could have, for example, `src="${groovy.scriptdir}/MyGroovyScript.groovy`.

You can explicitly resolve the value from a system property using `$sys{...}`, or from the environment using `$env{...}`.

9.2.1. Groovy QBean

In jPOS 2.0.7 (and later), `QFactory.properties` maps the `groovy` keyword to `org.jpos.q2.qbean.Groovy` so one can use a simple configuration like this:

```
<groovy logger='Q2' src='deploy/test.groovy' />
```

or

```
<groovy logger='Q2'><![CDATA[
  // ... your groovy code here
]]></groovy>
```

The following variables are automatically exposed:

- `log` has a reference to the QBean's `Log` object
- `qbean` has a reference to the running QBean
- `cfg` has a reference to the QBean's configuration

9.2.2. GroovyParticipant

The module provides a `org.jpos.transaction.participant.GroovyParticipant` class, which allows the writing TransactionManager `TransactionParticipant`'s in Groovy.

Separate scripts can be specified for the `prepare`, `prepare-for-abort`, `commit`, and `abort` phases of the

participant.

The `prepare` and `prepare-for-abort` methods are expected to return an `Integer` object with the `TransactionManager` standard result values (`PREPARED`, `ABORTED`, etc.).

The Groovy script code can be placed as part of the element's content (a CDATA section is recommended), or in an external file pointed to by the `src` attribute. We also recommend adding a `realm` attribute to identify errors in the logs, especially if you have several instances of `GroovyParticipant` in your transaction manager.

The following variables will be bound to each Groovy script's `Binding`:

- `id` - the transaction `int id` passed to the participant's method
- `ctx` - the transaction `Serializable ctx` passed to the participant's method
- `log` - a reference to `this` instance (since this class extends `org.jpos.util.Log`)
- `cfg` - this `TransactionParticipant`'s `Configuration` properties
- `tm` - a reference to the `TransactionManager`'s executing this transaction

By default, scripts are pre-compiled by a `GroovyClassLoader`. If you want the script to be evaluated on each run, then set the `compiled` property to `false`.

If your script depends on other scripts, you can add one or more `classpath` properties.

Add a transaction participant like this:

```
<participant class="org.jpos.transaction.participant.GroovyParticipant"
             logger="Q2" realm="groovy-test">

  <property name="classpath" value="cfg/scripts" />

  <prepare src="deploy/prepare.groovy" />
  <commit src="deploy/commit.groovy" />
  <abort>
    <![CDATA[
      import static org.jpos.transaction.TransactionConstants.*
      // ... embedded script
      return PREPARED
    ]]>
  </abort>
</participant>
```

9.2.3. GroovyRequestListener

The module provides a `org.jpos.groovy.GroovyRequestListener` class, which allows the writing of `org.jpos.iso.ISORequestListener`'s in Groovy.

The script's return value will be used as the return value from the `process` method. A non-null return value is interpreted to be *true-ish*. An explicit `null` return is interpreted to be `false`. A `boolean/Boolean` value will be returned as such.

The Groovy script code can be given as text within the `<script>` element (a `CDATA` section is recommended), or in an external file pointed to by the `src` attribute. The `src` path attribute will override the text `/CDATA` script (to avoid confusion, only one of the options should be used).

By default, scripts are pre-compiled by a `GroovyClassLoader`. If you want the script to be evaluated each time, then set the `compiled` property to `false`.

As a convenience, a comma-separated list of *ISO-8583* MTT's can be given in the `whitelist` property. If given, the script will be called *only* for requests having those MTT's. For requests not in the whitelist, the `ISORequestListener#process(ISOSource, ISOMsg)` method will return `false`, so the request can be handled by another `ISORequestListener` down the line.

The following variables will be bound to the Groovy script's `Binding`:

- `message` - the `ISOMsg` for this request
- `source` - the `ISOSource` for message
- `log` - a reference to `this` instance (since this class extends `org.jpos.util.Log`)
- `cfg` - this `ISORequestListener's Configuration` properties
- `xmlCfg` - this `ISORequestListener's` configuration `Element`

We also recommend adding a `realm` attribute to the `<request-listener>` element, to identify errors in the logs.

9.2.3.1. Examples:

A Groovy script given as embedded text in a `CDATA` section. The script will be pre-compiled, and called only for requests of the MTT's given in the `whitelist` property.

```
<request-listener class="org.jpos.groovy.GroovyRequestListener"
                 logger="Q2" realm="groovy-test-one">
  <property name="whitelist" value="0100, 0420" />
  <script>
    <![CDATA[
      // ... embedded script
    ]]>
  </script>
</request-listener>
```

A Groovy script given in an external file. The `compiled` property is set to `false`, so the script will be interpreted and evaluated for each request. The script will be called for *all* MTT's.

```
<request-listener class="org.jpos.groovy.GroovyRequestListener"
                 logger="Q2" realm="groovy-test-two">
  <property name="compiled" value="false" />
  <script src="../cfg/reqlistener2.groovy" />
</request-listener>
```

9.2.4. GroovyGroupSelector

The module also provides a `org.jpos.transaction.participant.GroovyGroupSelector` class, which allows the writing of `GroupSelector`'s in Groovy.

9.2.4.1. Examples:

```
<participant class="org.jpos.transaction.participant.GroovyGroupSelector" logger="Q2"
    realm="groovy-select">

    <select src="deploy/select.groovy" />
    <property name="0800" value="network" />
    <property name="0200" value="supported" />
</participant>
```

A Groovy script given in an external file.

```
import org.jpos.iso.ISOMsg;
import org.jpos.transaction.Context;
import org.jpos.transaction.ContextConstants;

ISOMsg m = (ISOMsg) ((Context)ctx).get (ContextConstants.REQUEST.toString());
String groups = cfg.get (m.getMTI(), null);
return groups;
```

9.3. Crypto Service

The `cryptoservice` module uses AES-256 to encrypt sensitive data, such as primary account numbers, and protects the encryption key using PGP.

At startup and at regular intervals, the crypto service generates a new AES-256 key, encrypts it using PGP with one or more recipient IDs (custodians), and stores the resulting encrypted message using a `KeyStoreProvider`.

```
id: key.f55fe6ec-ed9e-47a1-a0fe-c63dcbf128cb
value:
-----BEGIN PGP MESSAGE-----
Version: BCPG v1.56

hQEMA6Nw6GrTY6BpAQgAs1pUIK3n2FkMyNmfxSZgpPMNFKz39TcfExiwDRtuw+Zg
wRgFw86SJiL1BB+IE+mPAeCz4hrUkzliu/760NiXHQysIasWEvUZZqFRA+ecNrK
zARgB8vgGTNgxPHoYPafVD5TrxY9LdRpJc0//Wm2fEVw0xc4Q7vxbH7e9gDQfIUa
gcNYk96rVCdbZFKxyMC8fpM9ng6M4V9lxp5TXihzJQEKHWavctIrU2rBoLE1WCY2
Oobs1hELW4rfMpVwfGQDtxcFSNDYkd9IO/WnFTtTAxGHs0u1/miRVxNHadLINDke
wXx6au9vq12tqlYaJY+BAEtJaAInwwT5/irHj5dlwtJ0AW2w03Mwh+A+pGJvSd2T
xyep1pNtm7tMbZys0TiGz+6BX6F5ZKCG5UuvsIvTHd/VLp2uajE5NVPe92Y1F
lLbbMyUfxzBwNhwhdfoEWwRAMrt7AbMyAQHUCZAXgwXn7SXsdh8TTzLMsssViD9+
h7lfP9w=
```

```
=YyZk
-----END PGP MESSAGE-----
```

The key is used to encrypt subsequent data for a given period of time (defaults to one day) until a new key is automatically generated.

Here is a sample usage:

```
private void encryptCardData (TLCapture tl, Card card) ①
    throws Exception {
        Map<String,String> m = new HashMap<>();
        m.put ("P", card.getPan());
        m.put ("E", card.getExp());
        SecureData sd = getCryptoService().aesEncrypt( ②
            Serializer.serializeStringMap(m)
        );
        tl.setKid(sd.getId()); ③
        tl.setSecureData(sd.getEncoded()); ④
    }
```

- ① TLCapture in this example is a general purpose capture table.
- ② `getCryptoService()` just locates the `CryptoService` using the `NameRegistrar`
- ③ `kid` stands for Key ID, we store the key UUID here
- ④ `secureData` is a general purpose blob

The crypto service can be configured using a QBean descriptor like this:

```
<crypto-service class='org.jpos.crypto.CryptoService' logger='Q2'>
    <property name="custodian" value='demo@jpos.org' /> ①
    <property name="pubkeyring" value='cfg/keyring.pub' /> ②
    <property name="privkeyring" value='cfg/keyring.priv' /> ③
    <property name="lazy" value="false" /> ④
    <property name="keylength" value="256" /> ⑤
    <property name="duration" value="86400000" /> ⑥
    <property name="ttl" value="3600000" /> ⑦
    <ks-provider
        class="org.jpos.crypto.SysConfigCryptoServiceKeyStoreProvider" /> ⑧
    </crypto-service>
```

- ① custodian PGP id, there can be many `custodian` entries.
- ② path to the public keyring.
- ③ path to the password-protected private keyring.
- ④ if `lazy=true`, a key is generated the first time we call `aesEncrypt`, otherwise, a new one is created at service start.
- ⑤ key length defaults to 256. Can be reduced if AES-256 is not supported by the JVM due to export restrictions.

- ⑥ key duration
- ⑦ internal key cache time-to-live (in millis).
- ⑧ CryptoServiceKeyStoreProvider class configuration.



We currently support two CryptoServiceKeyStoreProvider classes: `SysConfigCryptoServiceKeyStoreProvider` and `JESpaceCryptoServiceKeyStoreProvider`

This allows jPOS nodes to encrypt data securely without storing the encryption key to disk.



The transient encryption key for the current session is still in memory, so core dumps and swap should be disabled at the operating system level. This approach is still more secure than obfuscating encryption keys.

Decryption — that can of course run in a different node, at a different time — requires access to the private keyring, with its optional password. Said password can be entered manually, obtained from a remote service or HSM, etc. and it's a two step process.

First the key has to be *loaded* into memory, using the `loadKey` method. Once the key is loaded, the `aesDecrypt` can be called.

These are the method's signatures:

```
public void loadKey (String jobId, String keyId, char[] password) throws Exception;  
public byte[] aesDecrypt (String jobId, String keyId, byte[] encoded) throws  
Exception;
```

Here `keyId`, `password`, and `encoded` cryptogram don't require too much explanation, but `jobId` does and here is the rationale. We could have a one-shot `aesDecrypt` method accepting the private key password, but decrypting the AES-256 key using PGP is an expensive operation. In situations where you have to extract a daily file, probably encrypted by just a handful keys, you don't want to decrypt the key on every `aesDecrypt` call. We don't want to expose the key to the caller either, so the CryptoService keeps it in a private field. In order to do that, `loadKey` caches the key (until it's unloaded), so it's cheap to call `loadKey` followed by `aesDecrypt`, after the first call where the key is actually decrypted, subsequent calls will be pretty fast.

In order to protect different clients from accessing keys loaded by other ones, we use a `jobId` that can be something as simple as a `UUID` or any nonce, only known to the caller. That `jobId` can then be used to `unload` those keys, using the `unloadKey` and `unloadAll` methods:

```
public boolean unloadKey (String jobId, String keyId);  
public void unloadAll(String jobId);
```

There's also a no-args `unloadAll()` that unloads all keys, and should be used with care.

For some use cases (i.e. long running crypto-service based micro-service), it is possible to "UNLOCK" the system by calling

```
public boolean unlock (char[] password);
```


For completeness, there's also a `lock()` method.



In order to simplify development and testing, and eventually to troubleshoot problems, we've also created a couple of CLI commands: `encrypt`, `decrypt`, `lock` and `unlock` in the `crypto` CLI subsystem.



If you're accessing the CLI using the command line `q2 --cli`, remember that the default `deployDir` is `deploy-cli` instead of `deploy`. You need a copy (or symlink) of `25_cryptoservice.xml` in that directory.

If you `ssh` to a running Q2 to reach the CLI, then you can ignore this tip.

For testing purposes, it is possible to set the `unlock-password` property in the crypto service configuration QBean, i.e.:

```
<property name="unlock-password" value="demo" />
```



This is of course highly insecure, the whole PGP based crypto service scheme makes no sense at all when unlocking the private key in such a way.

9.3.1. Using GnuPG to generate keys

- Generate key

```
gpg --full-generate-key
```

- Export custodian public keys into `keyring.pub`

```
gpg --armor --export xxx@domain.com yyy@domain.com > cfg/keyring.pub
```

- Export custodian private keys into `keyring.priv`

```
gpg --armor --export-secret-keys xxx@domain.com yyy@domain.com > cfg/keyring.priv
```

9.3.2. Rotating custodian keys

The list of custodians defined in the `CryptoService` can vary over time. New custodians can be added, and old ones can be revoked. Existing custodians may also rotate or update their encryption key-pairs. To migrate custodian keys, it is possible to do so in real time without disrupting operations by temporarily keeping both the old and new custodian keys in the public keychain.

For example, if the system is configured with one custodian:

```
<crypto-service class='org.jpos.crypto.CryptoService' logger='Q2'>  
  <property name="custodian" value='custodian-1@jpos.org' />  
</crypto-service>
```

```
...
...
</crypto-service>
```

all dynamic keys are encrypted with this particular custodian. You can add a second custodian, provided that their public key is available in the public keyring, by using a configuration like this:

```
<crypto-service class='org.jpos.crypto.CryptoService' logger='Q2'>
  <property name="custodian" value='custodian-1@jpos.org' />
  <property name="custodian" value='custodian-2@jpos.org' />
  ...
  ...
</crypto-service>
```

Keys registered before the change are encrypted using only **custodian-1**'s public key, while newly autogenerated keys after the change will use both recipients (**custodian-1** and **custodian-2**).

The CryptoService's **rekey(UUID uuid)** operation can be triggered by a batch process to transition the key from the old set of custodians to the new ones. Alternatively, the convenient **REKEY** CLI command, available under the crypto subsystem, can be used to achieve the same result.

Once all of the old keys have been transitioned to the new set of custodians, the node's private keys can be updated to use custodian-2 with its appropriate unlock passphrase.

After all nodes have been updated with the new private key, the process can be repeated by removing custodian-1 from the list of recipients.



The REKEY process is highly sensitive. It is recommended to back up the JE store or sysconfig table (depending on the provider in use) before proceeding.

9.4. Crypto Server

The **cryptoserver** module offers a REST (qrest based) API to encrypt and decrypt using the **cryptoservice**.

It supports the following operations

9.4.1. encrypt

- Path: **/encrypt**
- Body:

```
{
  "text" : "The quick brown fox jumps over the lazy dog 0123456789"
}
```

Sample response:

```
{
```

```
"kid": "d7e82270-7041-4434-8cf9-c4d0f26f620d",  
"cryptogram": "rp5uz7QMjRaEqPIbXzOZNI6bLuWYcdP0sH3I0FSKpRk...."  
}
```

9.4.2. decrypt

- Path: `/decrypt`
- Body:

```
{  
  "kid": "d7e82270-7041-4434-8cf9-c4d0f26f620d",  
  "cryptogram": "rp5uz7QMjRaEqPIbXzOZNI6bLuWYcdP0sH3I0FSKpRk...."  
}
```

```
{  
  "text" : "The quick brown fox jumps over the lazy dog 0123456789"  
}
```



The node running `cryptoserver` has to be `unlocked` (see [Crypto Service](#) module).

Chapter 10. Simulators

10.1. 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 ();
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))) ②
    message.set (39, "01");
else
    message.set (39, "00");

source.send (message);

```

① Sets the response MTI (i.e: 0800/0810, 1201/1220...)

② 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.

10.2. 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 <code>modules/client-simulator</code> available in the repository at GitHub.
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

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 exist two template 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>
```



If the response template file (i.e. `echo_r` in the previous example) is not present, client simulator blindly sends the message to the server, ignoring the response. A *response ignored* note is added to the test log.

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 `#` character 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 11. Operation services

11.1. 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

Listing 8. 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>
  <auth-username>admin</auth-username>
  <authorized-keys-file>cfg/authorized_keys</authorized-keys-file>
</sshd>
```

- ① The SSHD server will listen on this port.
- ② The username the ssh client will use to connect to the SSHD server.
- ③ 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
```

```
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): ②  
Enter same passphrase again:  
Your identification has been saved in /home/myuser/.ssh/id_rsa. ③  
Your public key has been saved in /home/myuser/.ssh/id_rsa.pub. ④  
The key fingerprint is:  
f6:61:a8:27:35:cf:4c:6d:13:22:70:cf:4c:c8:a0:23 myuser@nexus
```

- ① The command `ssh-keygen -t rsa` initiated the creation of the key pair.
- ② No passphrase was entered (Enter key was pressed instead).
- ③ The private key was saved in `.ssh/id_rsa`.
- ④ 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+EE0+F8WL2Y/jK4ZkUoQgoi+n7DWQVOHsR  
ijcS3Lvt0+50Np4yjXYWJkh29JL6GHcp8o7+YKEyVUMB2CSD0P99eF9g5Q0d+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 12. Contributed modules

12.1. FSDMsgX

What:	This field/message packager can be used to wire a message parser with java code. Its a utility library that enables 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 in all versions of jPOS-EE.
Who:	The jPOS.org team.
How:	Posted by the jPOS-EE team.
Where:	Directory modules/fsdmsgX available in the jPOS-EE main subversion repository at google code.
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

12.1.1. Introduction to using the packagers

12.1.1.1. FixedFieldPackager

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

Example 1. 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<fsgmsgX name="Example1">
dump    <field id="Field1" value="123456"/>
dump    <field id="Field2" value="AB"/>
dump</fsgmsgX>
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 unpack 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

Example 2. 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(ISUtil.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 vbyte array outstream is the same as the hexdump of the container.

12.1.1.2. 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 maximum 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 one could have a name Tom, Tommy, Thomas to indicate the end of a name a delimiter is needed. If I did not have a FirstName, a semi colon would be needed to indicate there is no first name.

```
@Test
public void unpackTest02() throws ISOException {
```

```
    VariableFieldPackager f1 = new VariableFieldPackager("F1", 20, new Byte((byte)
    0x1c),
        AsciiInterpreter.INSTANCE);
    VariableFieldPackager f2 = new VariableFieldPackager("F2", 5, new Byte((byte)
    0x1d), AsciiInterpreter.INSTANCE);
```

```
    FSDMsgX msg = new FSDMsgX("Test1");
    msg.add("F1", f1);
    msg.add("F2", f2);
```

```
    String inStream = "123456" + (char) 0x1c + "ABC" + (char) 0x1d;
    msg.unpack(inStream.getBytes());
```

```
    assertEquals("123456", msg.get("F1"));
    assertEquals("ABC", msg.get("F2"));
```

```
    FSDMsgX msg2 = new FSDMsgX("Test2");
    msg2.add("F1", f1);
    msg2.add("F2", f2);
    byte[] outStream = msg2.pack();
```

```
    System.out.println(msg2.getParserTree("Msg2"));
    assertEquals(inStream.getBytes(), outStream);
    System.out.println(msg2.hexDump(""));
    System.out.println(msg.hexDump(""));
}
```

Output

```
Msg2[TestPack]
Msg2Field [F1] : VAR[0..20] delimiter[0x1C] or EOM : 123456
Msg2Field [F2] : VAR[0..5] delimiter[0x1D] or EOM : ABC
0000 31 32 33 34 35 36 1C 41 42 43 1D          123456.ABC.
0000 31 32 33 34 35 36 1C 41 42 43 1D          123456.ABC.
```

- Create a variable length field F1 that can be a max of 20 wide terminated by a 0x1C.
- Create a variable length field F2 that can be a max of 5 wide terminated by a 0x1D.
- Add them to the Test1 container.
- Use raw input to test unpacking.
- Expect F1 to be 123456 and F2 to be ABC.
- Create a new container Test2 to test packing of the same fields to get byte array. The packing process will add the delimiter, you dont set it.
- Expect the packed array to be identical to the raw input used for unpacking.
- See the hexdumps are identical for both the containers,operations show equivalence.

12.1.1.3. BranchFieldPackager

Consider a specification where you need to parse fields differently based on a particular field. Typically you will see a pattern where, if the value of the field is X the fields following it are Y1,Y2..Yn.

As an example: There is a field F1 which is fixed. There is a fixed field F2 that can have values 01 or 02. If the value is 01, 2 fields following it are Fixed 3 and Fixed 3. If the value is 02, 2 fields following it are Fixed 4 and Fixed 4. .BranchFieldPackager Usage

```
@Test
public void unpackTest06() throws ISOException{
```

```
AFSDFieldPackager f1 = new FixedFieldPackager("F1", 5, AsciiInterpreter.INSTANCE);
AFSDFieldPackager f2 = new FixedFieldPackager("F2", 2, AsciiInterpreter.INSTANCE);
```

```
FSDMsgX innerFSDCase01 = new FSDMsgX("inner-1");
AFSDFieldPackager f7 = new FixedFieldPackager("F7", 3, AsciiInterpreter.INSTANCE);
AFSDFieldPackager f6 = new FixedFieldPackager("F6", 3, AsciiInterpreter.INSTANCE);
innerFSDCase01.add("F7",f7);
innerFSDCase01.add("F6",f6);
```

```
FSDMsgX innerFSDCase02 = new FSDMsgX("inner-2");
AFSDFieldPackager f8 = new FixedFieldPackager("F8", 4, AsciiInterpreter.INSTANCE);
AFSDFieldPackager f9 = new FixedFieldPackager("F9", 4, AsciiInterpreter.INSTANCE);
innerFSDCase02.add("F8",f8);
innerFSDCase02.add("F9",f9);
```

```
Map<String, AFSDFieldPackager> caseMap = new HashMap<String, AFSDFieldPackager>();
caseMap.put("01", innerFSDCase01);
caseMap.put("02", innerFSDCase02);
AFSDFieldPackager f3 = new BranchFieldPackager("F3", "F2", caseMap, null);
```



```
FSDMsgX msg = new FSDMsgX("Test");
msg.add("F1", f1);
msg.add("F2", f2);
msg.add("F3", f3);
```

```
System.out.println(msg.getParserTree(""));
```

```
msg.unpack("ABCDE0244445555".getBytes());
System.out.println(msg.dump(""));
assertEquals("ABCDE", msg.get("F1"));
assertEquals("02", msg.get("F2"));
```

```
assertEquals("4444", msg.get("F8"));
assertEquals("5555", msg.get("F9"));
```

```
}
```

Output

```
[Test]
Field [F1] : Fixed [5]
Field [F2] : Fixed [2]
Field [F3] : [Branch]
  switch (F2)
    01:
      [inner-1]
      Field [F7] : Fixed [3]
      Field [F6] : Fixed [3]
    02:
      [inner-1]
      Field [F8] : Fixed [4]
      Field [F9] : Fixed [4]
  default:
    [Not Set]
<fsdmsgX name="Test">
  <field id="F1" value="ABCDE"/>
  <field id="F2" value="02"/>
  <fsdmsgX name="inner-1">
    <field id="F8" value="4444"/>
    <field id="F9" value="5555"/>
  </fsdmsgX>
</fsdmsgX>
```

- Define Fixed F1.
- Define Fixed F2.
- Set up the individual case formatters for cases 01 and 02 based on value in F2 (inner-1 and inner-2)
- Add the cases to a map where the key is the values F2 can hold and the maps value is the packager it should follow.
- Set up the branchfield packager field F3. the constructor takes the existing fields name, the name of the field whose value we will make the branching decision off [F2], the map that has the value to packager map, the last one is the default packager to use if the value of F2 is not in the map, here we have chosen null as we dont want a default path.
- Add the F1,F2 and F3 to the container. You dont add the other packagers as the those are basically used indirectly by F3. So once the container unpacks F1, then F2 and then when it unpacks F3, it will follow the packagers in container F3.
- The output shows you the parsetree based on how you have setup your parser, you can see f1,F2 as fixed and the branch showing you the switch on F2 and the cases wit their packagers.
- You can try tpo change the input stream and use ABCDE01222333 to see case 01 gets used.
- When you do a pack, it will check to see what value is set in F2 and pick the packagers to follow accordingly.

jPOS-EE Entities

Chapter 13. SysConfig

C SysConfig
String id; String value; String readPerm; String writePerm;

The **SysConfig** entity ^[1] is a general purpose entity used by jPOS-EE to store configuration parameters.

It contains the following properties:

- **id**
- **value**
- **readPerm**
- **writePerm**

readPerm and **writePerm** properties can be optionally used by the user interface in order to limit access to specific entries.

Most jPOS applications typically use a prefix, for example:

id	value
perm.sysadmin	System Administrator
perm.login	Login
perm.sysconfig.read	View System Configuration
perm.sysconfig.write	Edit System Configuration
perm.users.write	Write permission on Users
perm.users.read	Read permission on Users
perm.accounting	Full access to accounting records

When shown in the user interface, that **perm.** prefix is discarded, e.g.:

System	Permissions + Add	
Info	ID	VALUE
Log	login	User can log into the system
Exception log	sysadmin	Has administrator privileges
Users	test	test permission
Consumers	users.read	Has read access to system's users information
Roles	users.write	Can administer system's users
Permissions		
SysConfig		
Audit Log		
Revision History		

This prefix is configured in **00_qi.xml** like this:

```
<view route="permissions" class="org.jpos.qi.sysconfig.SysConfigView"
  perm="sysadmin" sidebar="system">
  <property name="name" value="permissions"/>
  <property name="entityName" value="permission"/>
  <property name="prefix" value="perm." />
  <property name="title" value="Permissions" />
  <attribute name="id" read-only="true" required="true"/>
  <attribute name="value" regex="&TEXT_PATTERN;" required="true"/>
</view>
```

①

① There goes the `perm.` prefix.

Using this technique, it's easy to create CRUD operations for different kind of configuration groups (roles, permissions, hosts, cryptograms, etc.) just by copying that little XML element snippet inside the application's `00_qi.xml`.

Chapter 14. SysLog

C SysLog
int id; Date date; String source; int severity; String summary; String detail; String trace; boolean deleted;

The **SysLog** entity is a general purpose entity used by jPOS-EE to record an audit trail of relevant events.

The table has the following columns:

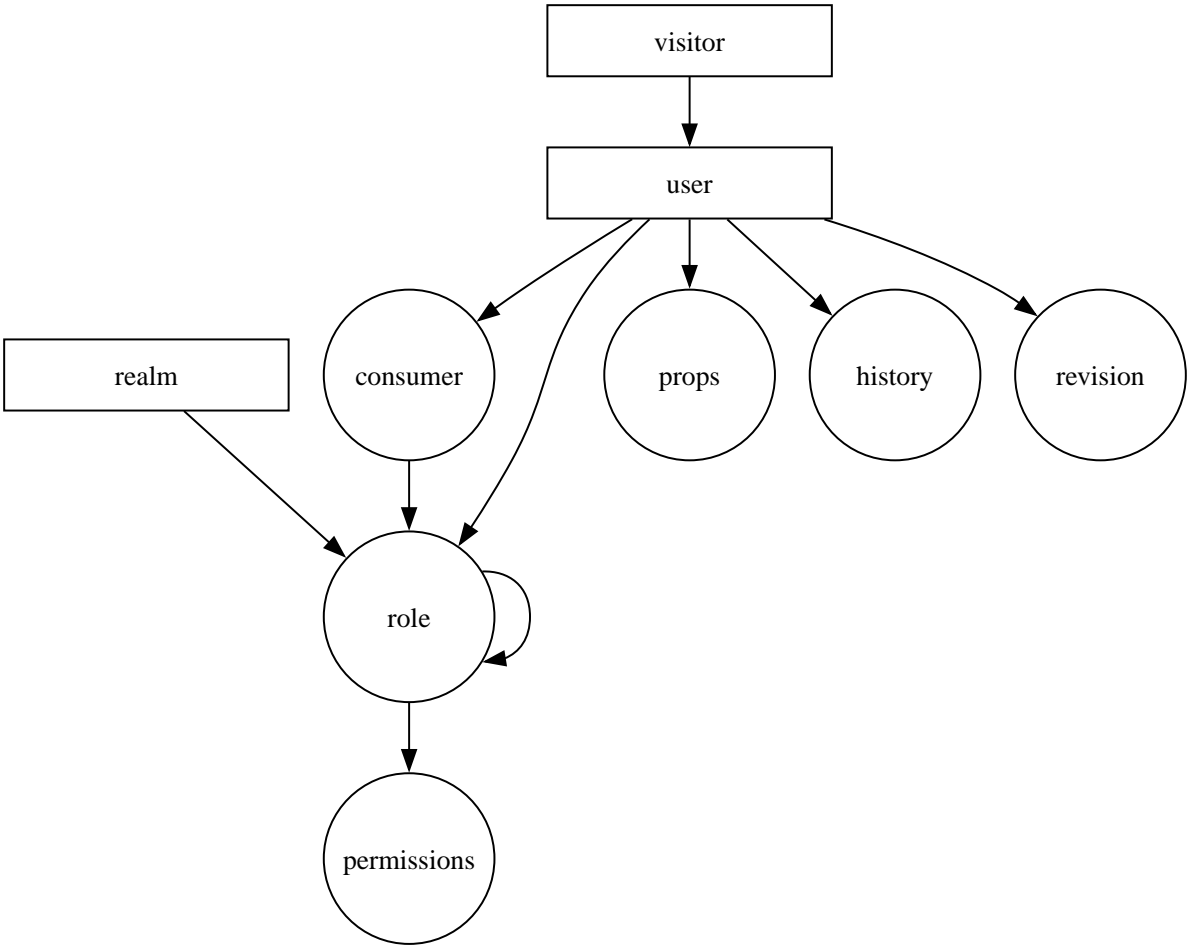
- **id** : auto-generated ID
- **date**: timestamp
- **deleted**: logical delete indicator
- **source**: application specific source (i.e. node name)
- **severity**: we use DEBUG = 0, TRACE = 1, INFO = 2, WARN = 3, ERROR = 4, CRITICAL=5
- **summary**: a brief description of the event, suitable to be printed by the UI in a column
- **detail**: specific info about the event
- **trace**: additional information (i.e. dumps)
- **deleted**: logical delete

Here is a sample use:

id	date	source	type	severity	summary
1102	2018-10-15 21:02:31.544	N01	SYSTEM	2	Start
1607	2018-10-15 21:02:43.028	N01	SYSTEM	2	Stop (uptime 11s)
1608	2018-10-16 16:43:10.318	N01	SYSTEM	2	Start
1609	2018-10-16 17:00:20.428	N01	SYSTEM	2	Stop (uptime 17m10s)
1610	2018-10-16 17:00:31.798	RESTAPI01	SYSTEM	2	Start
1613	2018-10-16 17:14:43.698	RESTAPI01	SYSTEM	2	Stop (uptime 14m13s)
1614	2018-10-16 17:14:50.987	N01	SYSTEM	2	Start
1618	2018-10-16 19:46:20.14	N01	SYSTEM	2	Stop (uptime 2h31m29s)

Chapter 15. EEUser module

The `eeuser` module can be used to represent visitors and users of the system with their respective roles and permissions. Roles can be system-wide, or per-Resource (tenant).



15.1. Visitor

For web-based applications, a *visitor* represents a remote user, either anonymous or logged into the system. The *Visitor* entity allows implementing the optional *remember me* feature. When its *User* is not null, that means the user is already logged in. A Cookie is used to locate a given visitor.

C

Visitor

String id;
User user;
Date lastUpdate;
Map props;

Property	Description
id	Application specific, QI uses a UUID string
user	If the user is already logged into the system, points to a valid User (in <code>eeuser</code> table)

Property	Description
lastUpdate	timestamp with last session initiation
props	application specific properties (i.e. host/ip address)

- The visitor id format is application specific, QI uses a UUID string

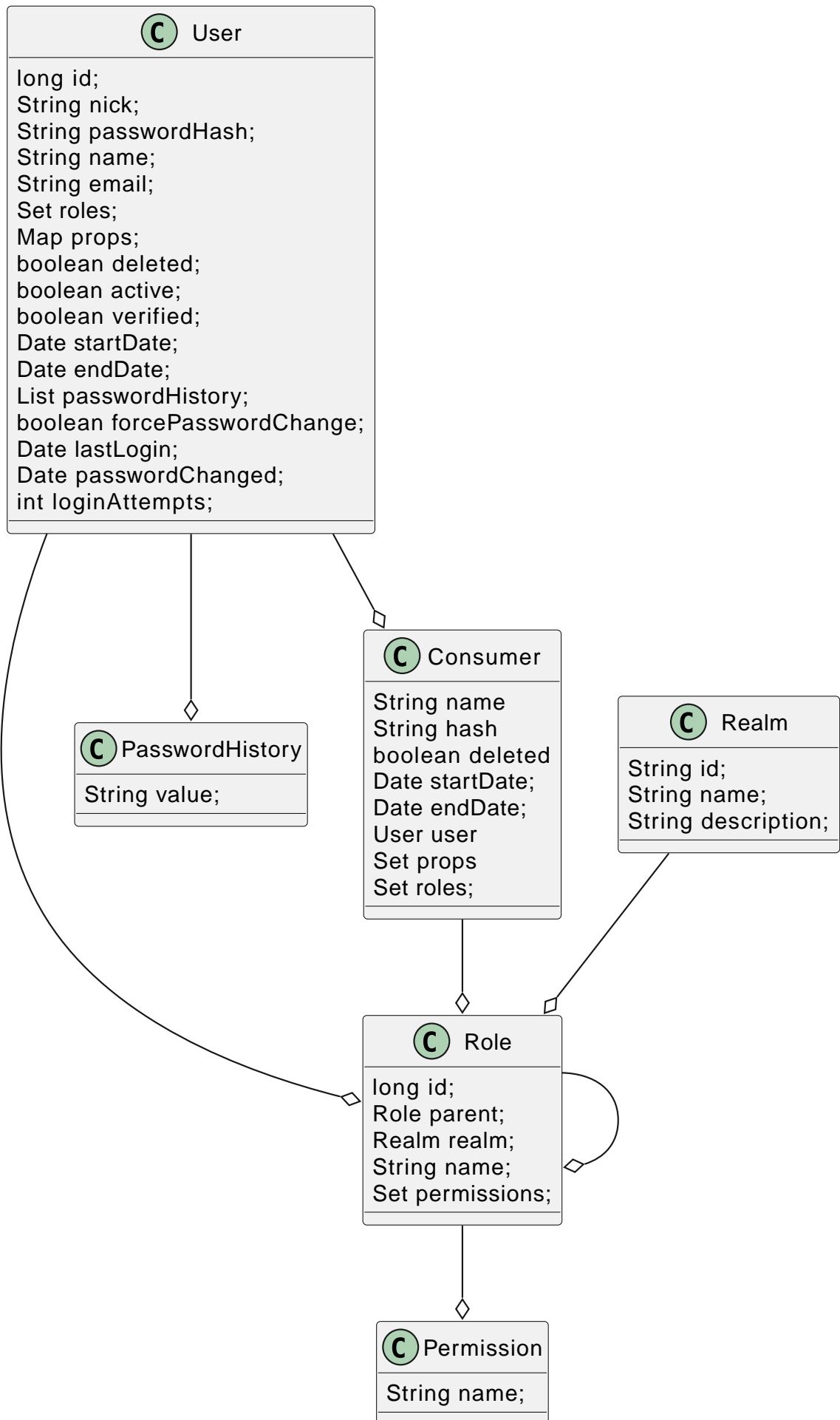
15.2. User

Users, in turn have *roles* containing *permissions*.

Roles can be limited to certain realms. Roles can have a parent, in which case, it inherits its permissions.



Because **user** is usually a reserved word in SQL, we use the name **eeuser** for the users table.



Property	Description
id	internal id
nick	unique system-wide nick name
passwordHash	current strategy (<code>HashVersion.ONE</code>) uses <code>PBKDF2WithHmacSHA256</code>
name	the user name
email	primary e-mail address - additional email addresses can be stored in the <code>User.props</code> map
roles	user roles (which in turn have a permissions set)
props	a general purpose map used to store application-specific data associated with the user
deleted	logical delete
active	true if the user is active
verified	true if user has been verified. The verification process is application specific
startDate	if not null, user is not valid before this date
endDate	if not null, user is not valid after this date
passwordHistory	stores previous password hashes in order to implement password reuse feature
forcePasswordChange	if true, QI forces the user to change his/her password
lastLogin	QI updates this entry on every login
passwordChanged	last password change, use to force users to change password after X time
loginAttempts	invalid login counter, can be used to lock users (by setting <code>active=false</code>)



jPOS-EE support multiple password hash strategies. The current one (`VERSION.ONE`) uses `PBKDF2WithHmacSHA256`. Entries with an older version (`ZERO`) get automatically upgraded to version `ONE` on the next login.

15.3. Roles and Permissions

Users have roles, which in turn have permissions.

Here is a sample `role` entry:

```
# select * from role where name='admin';

id | name
----+-----
64 | admin

# select * from role_perms where role=64;

role |      name
```

```

-----+-----
64 | sysadmin
64 | login
64 | sysconfig.read
64 | sysconfig.write
64 | users.read
64 | users.write
64 | accounting

```

The permission and role names are application specific. QI (the jPOS UI) uses the `sysconfig` (see [SysConfig schema](#)) table in order to assist the UI with permission options, e.g.

```

# select * from sysconfig where id like 'perm%';
      id      | readperm | value | writeperm
-----+-----+-----+-----
perm.accounting | sysconfig.read | Full access to accounting records | sysadmin
perm.login      | sysconfig.read | Login | sysadmin
perm.sysadmin   | sysadmin      | System Administrator | sysadmin
perm.sysconfig.read | sysconfig.read | View System Configuration | sysadmin
perm.sysconfig.write | sysconfig.read | Edit System Configuration | sysadmin
perm.users.read | sysconfig.read | Read permission on Users | admin
perm.users.write | sysconfig.read | Write permission on Users | admin

```

As mentioned, the permission names are totally application specific. QI checks that a given user has a role that in turn has the `perm.login` in order to allow access to the system. These permissions can be configured in the `00_qi.xml` (see [QI module](#)) file to allow access to different parts of the system, e.g.:

```

<view route="profile" class="org.jpos.qi.eeuser.ProfilesView"
  perm="login" sidebar="system">                                ①
  <property name="entityName" value="user"/>
  <attribute name="id" field="false"/>
  <attribute name="nick" length="64" regex="&WORD_PATTERN;"/>
  <attribute name="name" length="128" regex="&TEXT_PATTERN;"/>
  <attribute name="email" length="128" />
  <attribute name="active"/>
  <attribute name="roles" column="false" perm="sysadmin"/>
</view>
<view route="roles" class="org.jpos.qi.eeuser.RolesView"
  perm="sysadmin" sidebar="system">                                ②
  <property name="entityName" value="role"/>
  <attribute name="id" field="false"/>
  <attribute name="name" regex="&WORD_PATTERN;" length="64"/>
  <attribute name="permissions" column="false"/>
</view>

```

- ① user can access its own profile
- ② but needs `sysadmin` permission in order to administer roles

15.4. Role's realm

In multi-tenant systems, a user may have a role `admin` within a given realm (e.g., a given `Issuer`) but not on others. A `role` can have an optional `realm` to limit its scope.

The permissions granted to a role restricted to a given realm are automatically prefixed with the realm's name, for example, if a given role `realm=accounting, role=admin` has the permissions `read` and `post`, the permissions granted to the user are `accounting:read` and `accounting:post` instead of just `read` and `post`.

As shown in the previous diagram, a Role has permissions, but it also has a parent (that points to another Role).

If we have a generic `accounting-admin` role with permissions `read` and `post`, we can have a realm-scoped `accounting-admin` role that don't need to be configured with said permissions.

Id	Realm	Role	Permissions	Parent
1		accounting-admin	read, post	(no parent)
2	company_1	accounting-admin		1
3	company_2	accounting-admin		1
4	company_3	accounting-admin		1
5	company_4	accounting-admin		1

A user that has Role 1 (`accounting-admin` with no realm restriction) will have the generic permissions:

- `read` and
- `post`

A user that has Role 2 (`company_1`) and 4 (`company_3`) will have the permissions:

- `company_1:read`
- `company_1:post`
- `company_3:read`
- `company_3:post`



The permission is formed out of the realm name, plus a colon and the real permission name.

15.5. Consumer

A *Consumer* is used to represent an API client (i.e. a mobile device). If the API is being hit by a mobile application, the Consumer would represent an instance of that application.

A Consumer belongs to a user, but it has its own set of roles and permissions.

Property	Description
id	application-specific ID (i.e. UUID)

Property	Description
hash	current strategy (<code>HashVersion.ONE</code>) uses <code>PBKDF2WithHmacSHA256</code>
active	true if the user is active
deleted	logical delete
startDate	if not null, user is not valid before this date
endDate	if not null, user is not valid after this date
user	Consumers belong to a given user
roles	set of roles (which in turn has permissions)
props	application-specific properties


15.6. Password History

In order to support the optional *do not repeat passwords* feature, we have a companion password history entity where the UI keeps track of the password hashes of the last N passwords used.

15.7. User/Consumer properties

Application-specific data associated with the user can be stored in this general purpose key/value map. Typical information stored there are alternate email addresses, UI preferences, etc.

Chapter 16. SeqNo

 SeqNo
String id; long value; long lockedBy; long lockUntil;

The **SeqNo** entity ^[1] is a general purpose entity used by jPOS-EE to store application specific sequencers.

Typical use case would be terminal-level STANS, Voucher IDs and the like.

The **SeqNoManager** supports two operating modes:

- Synchronous
- Asynchronous

In Synchronous mode, the transaction life-cycle is handled by the caller, e.g.:

```
private long next(String id) {  
    try (DB db = new DB()) {  
        SeqNoManager mgr = new SeqNoManager(db);  
        db.open();  
        db.beginTransaction();  
        long l = mgr.next(id, 999999L);  
        db.commit();  
        return l;  
    }  
}
```



In *sync* mode, a second thread trying to obtain a sequence number will block until the former is committed.

In Asynchronous mode, the JDBC connection is released and an explicit call to **SeqNoManager.release** has to be issued, e.g.:

```
SeqNoManager mgr = new SeqNoManager(new DB());  
long l = mgr.next("sync", id, 60000L, 60000L, 999999L);  
// ... do something, e.g.: query remote host  
mgr.release("sync", id);  
return l;
```

Interesting thing about async mode, is that while one calls a remote host (i.e. using **QueryHost**), the JDBC connection gets released back to its pool.

[1] *seqno* table

Appendices

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Version 3, 19 November 2007

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