TorqueBox

The Ruby Application Platform

1.0.2-SNAPSHOT

by The TorqueBox Project

What is TorqueBox?

TorqueBox provides an enterprise-grade environment that not only provides complete Ruby-on-Rails and Rack compatibility, but also goes beyond the functionality offered in traditional Rails/Rack environments.

1. Built upon JBoss AS

Instead of building a Ruby Application Platform from the ground-up, TorqueBox leverages the existing ninja-grade functionality JBoss has been shipping for years in the JBoss Application Server. JBoss AS includes high-performance clustering, caching and messaging functionality. By building Ruby capabilities on top of this foundation, your Ruby applications gain more capabilities right out-of-the-box.

2. Built upon JRuby

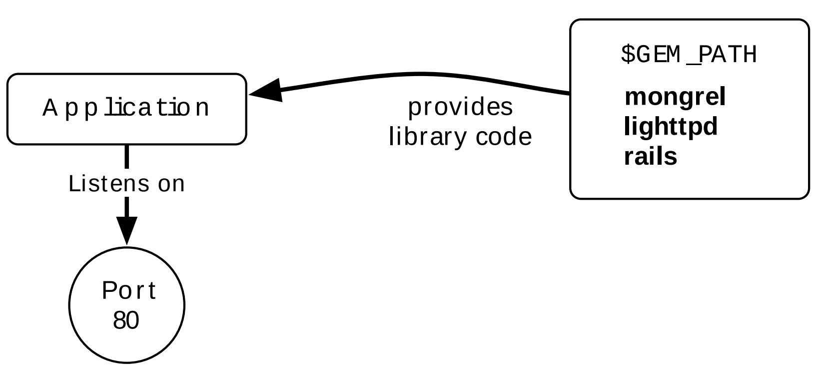
JRuby is a fast, compliant implementation of the Ruby language upon the Java Virtual Machine. Pure Ruby applications run un-modified within the JRuby interpreter. By binding JRuby to the components within JBoss, their functionality is exposed in a manner suitable to Rubyists.

3. Open-Source

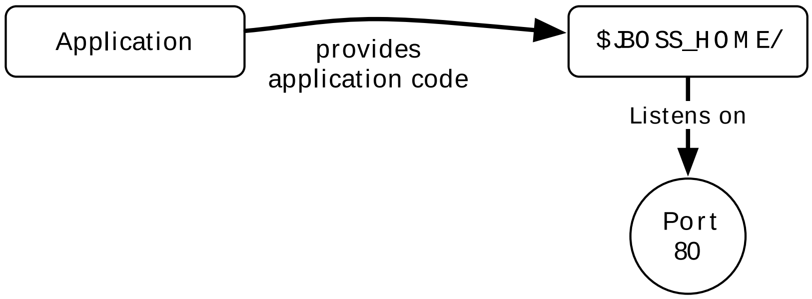
TorqueBox is a product of the JBoss Community, and is completely open-source software. TorqueBox is licensed under the LGPL. You may download the binaries or the source-code, modify it if you desire, and use it, even for profit, without any licensing costs.

4. The "application platform" concept

Traditionally, Ruby applications were responsible for their services from the ground-up. You literally ran the application. It would import support libraries to handle HTTP listening, for example.



An application platform provides the foundations for any and all application functionality. The deliverable application itself does not need to handle the networking layers, the messaging facilities or the clustering logic. This is provided to the application "for free".



Installation

1. Installation using Complete Binary Distribution

The latest Complete Binary Distribution contains:

- The TorqueBox server, ready-to-run
- A complete JRuby installation
- Additional RubyGems for use in other contexts

Note: these instructions assume you are running on a unix-like system. If you are using Windows, you will need to adjust the file-system paths and environment variables accordingly.

2. Ensure you have Java 6

TorqueBox requires Java JDK 6.

To determine which version, if any, is installed on your system, at a command-line, attempt to run the `java` command with the `-version` argument.

```
$ java -version
java version "1.6.0_07"
Java(TM) SE Runtime Environment (build 1.6.0_07-b06-153)
Java HotSpot(TM) 64-Bit Server VM (build 1.6.0_07-b06-57, mixed mode)
```

If the version is at least 1.6, your version of Java is sufficient.

If you have no Java installed, or a version less than 1.6, you'll need to install a Java Development Kit. For many systems, it is easy to install the open-source OpenJDK.

For installation on Ubuntu, Fedora, OpenSuse, or Debian, please refer to the installation instructions provided [http://openjdk.java.net/install/] by the OpenJDK project. If you find a `java` on your system, ensure that it is not actually `gcj`. The `gcj` is insufficient for running the TorqueBox server.

For Apple OSX systems, Apple provides a JDK version 6.

3. Get the latest version of TorqueBox binary package

You can obtain the latest version of TorqueBox from the TorqueBox repository. As of this writing, the latest version is 1.0.2-SNAPSHOT.

http://repository.torquebox.org/maven2/releases/org/torquebox/torquebox-dist/1.0.2-SNAPSHOT/torquebox-dist-1.0.2-SNAPSHOT-bin.zip [http://repository-torquebox.forge.cloudbees.com/release/org/torquebox/torquebox-dist/1.0.2-SNAPSHOT/torquebox-dist-1.0.2-SNAPSHOT-bin.zip]

4. Unzip it somewhere handy

We'll install TorqueBox under your user's `$HOME` directory.

```
$ unzip -q torquebox-dist-1.0.2-SNAPSHOT-bin.zip
```

Before using the TorqueBox server, you must set up your environment. To make it easier to upgrade without having to reconfigure your environment, it is useful to create a symlink to the versioned directory produced when you unpackaged the distribution.

```
$ ln -s torquebox-1.0.2-SNAPSHOT torquebox-current
```

Next, `$TORQUEBOX_HOME`, `$JBOSS_HOME` and `$JRUBY_HOME` need to be set, and adjusting your `$PATH` will make working with the package easier. You can either run the following commands each time on the command-line, or add them to your `.bash_profile`.

First, the various `$X_HOME` variables are set so that each subsystem can find its supporting files.

```
export TORQUEBOX_HOME=$HOME/torquebox-current
export JBOSS_HOME=$TORQUEBOX_HOME/jboss
export JRUBY_HOME=$TORQUEBOX_HOME/jruby
```

Next, we make sure that JRuby's binaries are first in our executable `$PATH`, before any previously-installed Ruby packages.

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

By doing this, commands such as `rake`, `gem`, and `rails` will load from the TorqueBox-provided JRuby installation.

You can also run TorqueBox using your own install of JRuby by installing the TorqueBox gems.

```
$ jruby -S gem install torquebox torquebox-capistrano-support
```

You will also need to set `$JRUBY_HOME` to point to your JRuby installation.

Note: if you are going to run a non-bundled JRuby with a prerelease build of TorqueBox, it is recommended that you either use a separate rvm [http://rvm.beginrescueend.com] gemset [http://rvm.beginrescueend.com/gemsets/] for each prerelease build, or be sure to reinstall the TorqueBox gems for the latest prerelease. There is a blog post [http://torquebox.org/news/2011/02/25/using-rvm-with-torquebox/] on torquebox.org describing how to set up your torquebox environment with RVM.

For prerelease builds, you will also need to ensure that your `gem` command can find the prerelease TorqueBox gems by adding http://rubygems.torquebox.org to your `~/.gemrc` file and including the `--pre` flag to `gem install`.

```
$ cat ~/.gemrc
---
:sources:
- http://rubygems.org
- http://rubygems.torquebox.org
```

5. How to run TorqueBox

Running TorqueBox essentially amounts to running JBoss:

```
$ $JBOSS_HOME/bin/run.sh
```

Alternatively, the top-level `$TORQUEBOX_HOME/Rakefile` provides a few rake tasks to help with deployment and installation.

```
$ cd $TORQUEBOX_HOME; jruby -S rake -T
(in /opt/torquebox)
rake torquebox:check             # Check your installation of the TorqueBox ...
rake torquebox:run               # Run TorqueBox server
rake torquebox:upstart:check     # Check if TorqueBox is installed as an ups...
rake torquebox:upstart:install   # Install TorqueBox as an upstart service
rake torquebox:upstart:restart   # Restart TorqueBox when running as an upst...
rake torquebox:upstart:start     # Start TorqueBox when running as an upstar...
rake torquebox:upstart:stop      # Stop TorqueBox when running as an upstart...
```

- `torquebox:check`: Check your TorqueBox installation
- `torquebox:run`: Run TorqueBox
- `torquebox:upstart:check`: Check if TorqueBox is installed as an upstart service
- `torquebox:upstart:install`: Install TorqueBox as an upstart service
- `torquebox:upstart:restart`: Restart TorqueBox when it is running as an upstart service
- `torquebox:upstart:start`: Start TorqueBox when it is installed as an upstart service
- `torquebox:upstart:stop`: Stop TorqueBox when it is installed as an upstart service

Note: The `upstart:install` task makes a couple of assumptions you need to take into account.

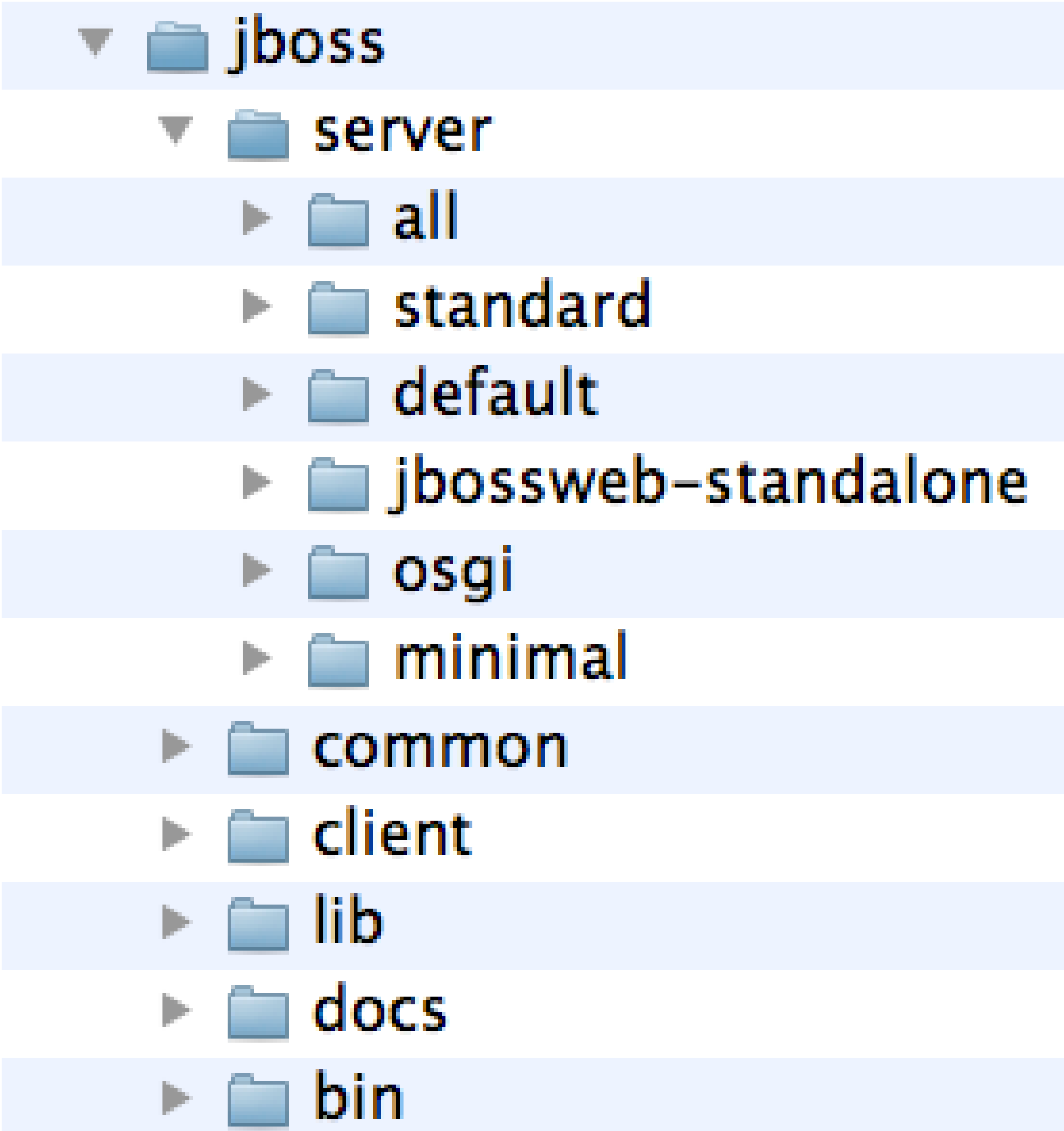
- You must have a 'torquebox' user on your system.
- The rake task attempts to create a symlink from $TORQUEBOX_HOME to /opt/torquebox. Run the task as a user with sufficient permissions so that this does not fail.

JBoss AS Crash Course

The JBoss Application Server (AS6) is the foundation upon which TorqueBox is built. You can go a long way with TorqueBox without knowing anything about the administration of JBoss AS, but for advanced applications, it's worth knowing something about how AS is configured and extended. Feel free to skip this section if you're just getting started with TorqueBox, and use it as a reference later.

1. Configuring

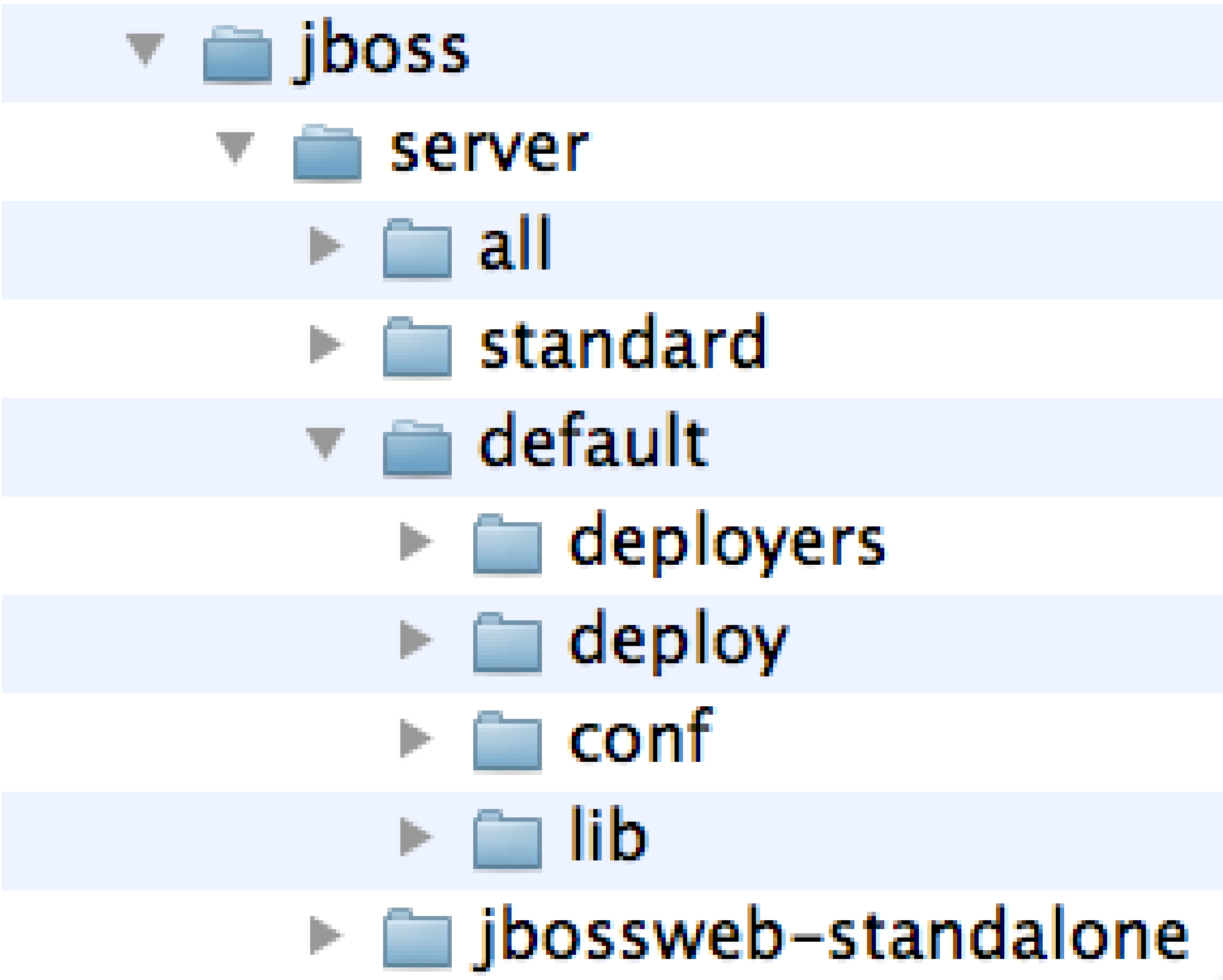
JBoss has a very simple way of representing server configurations. Each directory beneath `server/` denotes a single configuration profile.



TorqueBox provides two: default and all. A stock JBoss distribution will come with others, as you see above, and of course you're free to create your own custom profiles.

Some libraries and config files are common to all server configurations. To conserve disk space, these are kept in the `common/` directory. This is, in fact, where the TorqueBox deployers reside.

All configuration profiles have a common structure, and usually include the following directories: `conf/`, `lib/`, `deployers/`, and `deploy/`. In general, it isn't a good idea to remove anything from these directories that you didn't put there yourself.



In addition, some directories are created automatically at runtime, as needed: `tmp/`, `work/`, `data/`, and `log/`. Though not typically necessary, you may safely delete these when the server is not running to clear its persistent state.

2. Running

The `$JBOSS_HOME/bin/` directory contains the main JBoss entry point, `run.sh` (or `run.bat`), along with its config file, `run.conf`. Running the JBoss server is simple:

```
$ $JBOSS_HOME/bin/run.sh
```

By default, the `default` configuration profile is used. Use the `-c` option to specify a different configuration. For example, to put JBoss in "clustered" mode:

```
$ $JBOSS_HOME/bin/run.sh -c all
```

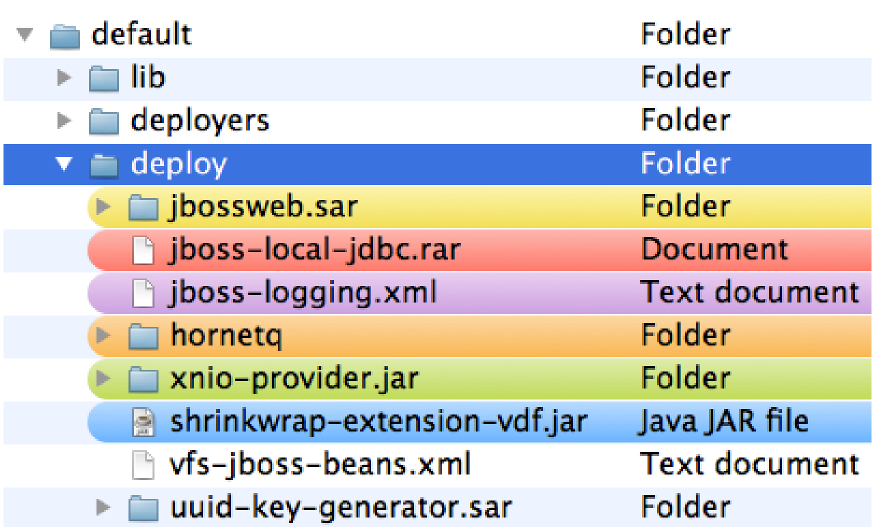
You may set Java system properties using the `-D` option. Pass `-h` for a list of all the available options.

Permanent runtime configuration of JBoss should go in `bin/run.conf`. For example, your application may require more memory (RAM) than the default allocated. Edit `run.conf` to increase the value of `-Xmx` to something reasonable.

Though Chapter 14, Capistrano Support doesn't strictly require it, in production you may prefer to control JBoss via a Unix "init script", examples of which may be found in `bin/`. Feel free to tweak one for your particular OS.

3. Deploying

Each server configuration has a `deploy/` subdirectory, the contents of which determine the applications and services JBoss runs. These apps and services are represented as archives, "exploded" folders, or text files called "deployment descriptors". JBoss constantly monitors changes to this directory, hot-deploying an artifact when it's added, undeploying it when it's removed, and "bouncing" (redeploying) it when it's changed.



TorqueBox also provides an additional deploy directory at `$TORQUEBOX_HOME/apps/` that is scanned from all server configurations, and any deployment descriptors or archives found there are loaded after the `deploy/` directory within the server configuration. This prevents your application from being loaded before all of the JBoss components have been deployed, and segregates your applications from the JBoss plumbing.

TorqueBox provides Rake tasks to create and copy a deployment descriptor for your Ruby application to `$TORQUEBOX_HOME/apps/`. For more details, see Chapter 5, Application Deployment and Chapter 6, Deployment Descriptors.

4. Logging

Each server configuration has a `log/` subdirectory (created at runtime, if necessary) that contains the log messages generated by JBoss as determined by its configuration.

JBoss provides a very sophisticated logging system that nobody completely understands. Logging configuration rules are contained in `deploy/jboss-logging.xml`, in which may be found example configs for categorized log message routing, complex file rotation, syslog integration, SMTP notifications, SNMP traps, JMS, JMX and more! It is WAY beyond the scope of this document to explain those rules, but by default you will see INFO messages on the console (the shell where you start JBoss) and persistently written to `log/server.log`. You can control the log level easily using the following system property:

```
$ $JBOSS_HOME/bin/run.sh -Djboss.server.log.threshold=DEBUG
```

Any messages written to `stdout` or `stderr` will also be displayed on the console and written to `log/server.log`.

4.1. The `TorqueBox::Logger`

Ruby Loggers work normally inside of TorqueBox, of course, and you'll find your Rails log files exactly where you expect them to be. But some users, especially those already familiar with JBoss logging, may prefer for their Ruby log messages to be passed to JBoss. This is easily achieved using the `TorqueBox::Logger`, constructed with an optional "category". For example, you may configure your Rails app like so:

```
config.logger = TorqueBox::Logger.new
```

This results in all Rails-generated log messages passed to JBoss, hence written to `log/server.log` in the default configuration. The category for these messages will be the application's name. You can override this by passing the category name in the constructor:

```
TorqueBox::Logger.new( "Billing" )
```

You can also pass a class in the constructor, as is common in Java applications:

```
@logger = TorqueBox::Logger.new( self.class )
```

This allows you to be more strategic with your logging, sending some messages to the normal Rails logs and others to JBoss for more "enterprisey" processing.

Web Applications

TorqueBox supports any and all Rack-based web application frameworks, including Ruby On Rails and Sinatra, among others. TorqueBox aims to be unobtrusive, requiring no unusual packaging of your app (e.g. no war files), and unless it depends on obscure native gems, no modifications whatsoever.

So why deploy your Ruby web app on TorqueBox? Because you get cool enterprisey features that every non-trivial app will need eventually if it's successful at all. Let's go over a few.

1. Performance

TorqueBox runs on JRuby, one of the fastest Ruby interpreters available. Because JRuby runs on the Java Virtual Machine, your app runs on real OS threads, so if your app supports multi-threaded invocations, you will make the most of your hardware resources.

Of course, running on the JVM has a drawback: "native" gems that rely upon machine-specific compiled code do not function with JRuby and TorqueBox. You must replace these gems with pure-Ruby or pure-Java implementations. Some native gems using FFI are usable within TorqueBox. Fortunately, gems that won't run on JRuby are becoming more and more rare.

2. Deployment

Most successful web apps evolve to the point that passively responding to HTTP requests is not enough. Before you know it, you may need background processes, scheduled jobs, messaging, and active daemons all in support of your web app.

With TorqueBox these things are an integral part of your app and as such, they share its life cycle. When your application is deployed under TorqueBox, so are your scheduled jobs, background tasks, services, etc. It's simply a matter of editing a single `torquebox.yml` configuration file within your app. This will make your operations staff very happy!

For more details, please see Chapter 5, Application Deployment.

3. Clustering

Clustering TorqueBox nodes is trivially easy:

```
$ $JBOSS_HOME/bin/run.sh -c all
```

And when those nodes are behind the JBoss mod_cluster Apache module [http://www.jboss.org/mod_cluster], you get automatic, dynamic configuration of workers, server-side load factor calculation, and fine-grained application lifecycle control.

But even without mod_cluster, TorqueBox clustering provides automatic web session replication and distributed caching, not to mention automatic load-balancing of message delivery, enabling smart distribution of any background processes spawned by your web app.

4. Sessions

By using the TorqueBox application-server-based session store, your application gets the benefits of clusterable sessions without having to setup and maintain a database. When clustered, session state is automatically replicated throughout an Infinispan [http://infinispan.org] data grid.

Additionally, by using the TorqueBox session store, your application can communicate between both the Java and Ruby sides through the HTTP session. Where possible, elemental scalar attributes of the Ruby session are synchronized to similar attributes in the Java session, and vice-versa.

For complex objects, they are retained in a Ruby hash, and serialized as a blob into a single attribute of the Java session.

When copying between the Ruby and Java sessions, attributes will be retained under symbol keys in the ruby session, and string keys in the Java session.

The supported scalar types are numerics, strings, booleans and nil.

5. Caching

TorqueBox provides an implementation of the Rails 3.x `ActiveSupport::Cache::Store` [http://guides.rubyonrails.org/caching_with_rails.html] that exposes your application to the sexy Infinispan [http://infinispan.org] data grid.

Backed by Infinispan, `ActiveSupport::Cache::TorqueBoxStore` supports all the options of the existing Rails implementations, including the advanced features of `MemCacheStore`, along with a few more to control how data replication occurs amongst the nodes in a cluster.

Although it does depend on the `ActiveSupport` Rails 3 gem, it may be used in any Rack-based application or any TorqueBox service, task or job that requires sophisticated caching.

5.1. Clustering Modes

Infinispan offers a number of clustering modes that determine what happens when an entry is written to the cache.

Local. This is the default mode when TorqueBox runs non-clustered, roughly equivalent to the Rails `MemoryStore` implementation, though it has some advantages over a simple memory store, e.g. write-through/write-behind persistence, JTA/XA support, MVCC-based concurency, and JMX manageability.

Invalidation. This is the default mode when TorqueBox runs clustered, i.e. `JBOSS_CONF=all`. No data is actually shared among the nodes in this mode. Instead, notifications are sent to all nodes when data changes, causing them to evict their stale copies of the updated entry. This mode works very well for Rails' fragment and action caching.

Replicated. In this mode, entries added to any cache instance will be copied to all other cache instances in the cluster, and can then be retrieved locally from any instance. This mode is probably impractical for clusters of any significant size. Infinispan recommends 10 as a reasonable upper bound on the number of replicated nodes.

Distributed. This mode enables Infinispan clusters to achieve "linear scalability". Cache entries are copied to a fixed number of cluster nodes (2, by default) regardless of the cluster size. Distribution uses a consistent hashing algorithm to determine which nodes will store a given entry.

5.2. `ActiveSupport::Cache::TorqueBoxStore` options

The TorqueBox cache store supports the following options:

Table 4.1. Cache store options

Option	Default	Description
`:mode`	`:invalidation`	Any of the following will result in replicated mode: • `:r` • `:repl` • `:replicated` • `:replication` Any of the following will result in distributed mode: • `:d` • `:dist` • `:distributed` • `:distribution` Any other value for `:mode` will result in invalidation when clustered and local otherwise.
`:sync`	false	The coordination between nodes in a cluster can happen either synchronously (slower writes) or asynchronously (faster writes).

Option	Default	Description
`:name`	{the application's name}	The `:name` option enables you to create multiple cache stores in your app, each with different options. It's also a way you can configure multiple apps to share the same cache store.

6. Ruby Web Frameworks

6.1. Rack

6.1.1. Rack Applications

Rack is a specification which describes how web server engines can integrate with additional logic written in Ruby. Rack is a akin to CGI or the Java Servlets Spec in terms of goals and functionality.

TorqueBox currently supports general `config.ru`-based applications. In your application's directory, your Rack application can be booted from a file named `config.ru` that you provide. The Ruby runtime provided to your application is quite rudimentary. If you desire to use RubyGems or other libraries, it is up to you to require the necessary files (for instance, `require 'rubygems'`).

```
app = lambda{|env| [
          200,
          { 'Content-Type' => 'text/html' },
          'Hello World'
        ] }
run app
```

The directory containing the `config.ru` is considered the current working directory, and is included in the load path.

6.1.2. Rack API

TorqueBox aims to provide complete Ruby Rack compatibility. Please refer to the Rack specification at http://rack.rubyforge.org/doc/SPEC.html for more information.

Applications implemented by the user must simply provide an object implementing a single-argument method in the form of `call(env)`.

Table 4.2. Rack environment

Variable	Description
`REQUEST_METHOD`	The HTTP request method, such as "`GET`" or "`POST`". This cannot ever be an empty string, and so is always required.
`SCRIPT_NAME`	The initial portion of the request URL's "path" that corresponds to the application object, so that the application knows its virtual "location". This may be an empty string, if the application corresponds to the "root" of the server.
`PATH_INFO`	The remainder of the request URL's "path", designating the virtual "location" of the request's target within the application. This may be an empty string, if the request URL targets the application root and does not have a trailing slash. This value may be percent-encoded when I originating from a URL.
`QUERY_STRING`	The portion of the request URL that follows the `?`, if any.
`SERVER_NAME`	
`SERVER_PORT`	
`HTTP_` variables	Variables corresponding to the client-supplied HTTP request headers (i.e., variables whose names begin with HTTP_). The presence or absence of these variables should correspond with the presence or absence of the appropriate HTTP header in the request.
`rack.version`	The Array [m, n], representing this version of Rack.
`rack.url_scheme`	`http` or `https`, depending on the request URL.
`rack.input`	Input stream
`rack.errors`	Error output stream
`rack.multithread`	Always `true`
`rack.multiprocess`	Always `true`
`rack.run_once`	Always `false`
`rack.session`	
`rack.logger`	Not implemented
`java.servlet_request`	The underlying Java `HTTPServletRequest`

6.2. Ruby on Rails

6.2.1. Ruby on Rails™ Applications

Ruby-on-Rails (also referred to as "RoR" or "Rails") is one of the most popular Model-View-Controller (MVC) frameworks for the Ruby language. It was originally created by David Heinemeier Hansson at 37signals [http://37signals.com/] during the course of building many actual Ruby applications for their consulting business.

Rails has straight-forward components representing models, views, and controllers. The framework as a whole values convention over configuration. It has been described as "opinionated software" in that many decisions have been taken away from the end-user.

It is exactly the opinionated nature of Rails that allows it to be considered a simple and agile framework for quickly building web-based applications. Additionally, since Ruby is an interpreted language instead of compiled, the assets of an application can be edited quickly, with the results being immediately available. In most cases, the application does not need to be restarted to see changes in models, views or controllers reflected.

6.2.2. Rails 2.3.x versus 3.x

TorqueBox supports both the 2.3.x and 3.x codelines of Rails. By default, all utilities prefer the latest version of a given gem, which in the current case is 3.0.5.

To specify a specific version of utilities such as the rails command used to create applications, simply specify the version number between underscores immediately following the command name.

```
$ rails _2.3.11_ myapp
```

6.2.3. Preparing your Rails application

While TorqueBox is 100% compatible with Ruby-on-Rails, there are a few steps that must be taken to ensure success. The biggest issues to contend with involve database access and native gems. The distribution includes a Rails application template to make the creation or adaptation of a codebase to TorqueBox easier.

6.2.3.1. Install Rails

Previous releases of TorqueBox bundled Rails but it is no longer included. You'll need to install the version needed by your application.

```
$ gem install rails
```

6.2.3.2. Using the application template

You can use the included application template to setup a new Rails application or modify an existing one to work with TorqueBox.

6.2.3.2.1. Creating a new Rails application

To create a new Rails application using the template, simply use the `-m` parameter when you execute the `rails` command.

Rails 2.3.x.

```
$ rails _2.3.11_ myapp -m $TORQUEBOX_HOME/share/rails/template.rb
```

Rails 3.x.

```
$ rails new myapp -m $TORQUEBOX_HOME/share/rails/template.rb
```

6.2.3.2.2. Applying template to an existing application

To apply the template to an existing application, simply use the `rails:template` rake task.

```
$ rake rails:template LOCATION=$TORQUEBOX_HOME/share/rails/template.rb
```

6.2.3.3. Manually configuring an application

6.2.3.3.1. Include the JDBC Gems for Database Connectivity

ActiveRecord applications deployed on TorqueBox benefit from using the Java-based JDBC database drivers. These drivers are provided as a handful of gems which you may include into your application through `config/environment.rb` or a `Gemfile`. For more information on database connectivity wihtin the TorqueBox environment, please see Chapter 12, Database Connectivity.

Rails 2.x. You simply must reference the `activerecord-jdbc-adapter` from your `environment.rb` within the `Rails::Initializer.run` block.

```
Rails::Initializer.run do |config|

  config.gem "activerecord-jdbc-adapter",
             :require=>'jdbc_adapter'

end
```

All databases will require inclusion of the `activerecord-jdbc-adapter`. No other gems need to be required or loaded, since ActiveRecord will perform further discovery on its own.

Rails 3.x. Rails 3 uses bundler to manage the dependencies of your application. To specify the requirement of the `activerecord-jdbc-adapter` with Rails 3, simple add it to your `Gemfile`. Additionally, any specific JDBC driver your application will require should be indicated.

```
gem 'activerecord-jdbc-adapter'
gem 'jdbc-sqlite3'
```

6.2.3.3.2. Configure Sessions

By default, both Rails 2 and Rails 3 use the simple cookie-based session store, which requires no support from the server. TorqueBox can leverage the cluster-compatible sessions provided by the application server to keep session state on the server. The TorqueBox session store requires no specific configuration of a database or other technology. To use the TorqueBox session store, you must adjust `config/initializers/session_store.rb`. The contents vary depending on the version of Rails your application uses.

In both cases, your application should require the torquebox RubyGem, which provides the implementation.

When using the TorqueBox Rails application template, described above, these modifications are made for you.

Rails 2.x. In `config/initializers/session_store.rb`

```
ActionController::Base.session_store = :torquebox_store
```

Rails 3.x. In `config/initializers/session_store.rb` (adjust for your application's name)

```
MyApp::Application.config.session_store :torquebox_store
```

6.2.4. Caching Configuration

You configure the TorqueBox cache store the same way you would any other Rails cache store, but we recommend setting it in `config/application.rb` because it will adapt to whichever environment it finds itself. Regardless of its configuration, it will always fallback to local mode when run in a non-clustered, even non-TorqueBox, environment.

In whatever context you use the cache store, you must include the torquebox RubyGem, which provides the implementation.

```
module YourApp
  class Application < Rails::Application

    config.cache_store = :torque_box_store

  end
end
```

Using this symbolized form causes Rails to load the appropriate Ruby file for you. Alternatively, you may load the file yourself and then refer to the fully-qualified class name, `ActiveSupport::Cache::TorqueBoxStore`.

By default, the `TorqueBoxStore` will be in asynchronous invalidation mode when clustered (`JBOSS_CONF=all`), and local mode when not. But you can certainly override the defaults:

```
      config.cache_store = :torque_box_store, {:mode => :distributed, :sync => true}
```

You can even create multiple cache stores in your app, each potentially in a different clustering mode. You should use the `:name` option to identify any additional caches you create, e.g.

```
    COUNTERS = ActiveSupport::Cache::TorqueBoxStore.new(:name => 'counters',
                                                        :mode => :replicated,
                                                        :sync => true)
```

6.2.5. Logging

By default, Rails logs where you would expect, but it's possible to tap into the JBoss log system for more sophisticated logging. For more information, see Section 4.1, “The `TorqueBox::Logger`”.

6.3. Sinatra

Sinatra [http://www.sinatrarb.com/] is a very simple DSL for creating web applications. And all the TorqueBox features available to Rails apps, e.g. clustering, session replication, and caching, will work for Sinatra app just as well.

6.3.1. Sessions

Because the TorqueBox session store is Rack compliant, you configure it the same way you would any other session store in Sinatra.

```
require 'sinatra''
require 'torquebox'

class SinatraSessions < Sinatra::Base

  use TorqueBox::Session::ServletStore

  get '/foo' do
    session[:message] = 'Hello World!'
    redirect '/bar'
  end

  get '/bar' do
    session[:message]   # => 'Hello World!'
  end

end
```

6.3.2. Caching Configuration

Because the TorqueBox cache store is derived from `ActiveSupport::Cache::Store`, you must include `activesupport-3.x` in your Sinatra app.

In whatever context you use the cache store, you must include the torquebox RubyGem, which provides the implementation.

```
require 'active_support/cache/torque_box_store'
class SinatraCache < Sinatra::Base
  set :cache, ActiveSupport::Cache::TorqueBoxStore.new
end
```

By default, the `TorqueBoxStore` will be in asynchronous invalidation mode when clustered (`JBOSS_CONF=all`), and local mode when not. But you can certainly override the defaults:

```
 set :cache, ActiveSupport::Cache::TorqueBoxStore.new(:mode => :distributed, :sync
=> true)
```

You can even create multiple cache stores in your app, each potentially in a different clustering mode. You should use the `:name` option to identify any additional caches you create, e.g.

```
COUNTERS = ActiveSupport::Cache::TorqueBoxStore.new(:name => 'counters',
                                                    :mode => :replicated,
                                                    :sync => true)
```

6.3.3. Logging

By default, Sinatra log support is minimal, sending most errors to stdout or stderr. For more sophisticated logging, see Section 4.1, “The `TorqueBox::Logger`”.

Application Deployment

The TorqueBox Application Server is capable of serving many applications simultaneously. To add your application to the server, you must deploy it. To deploy an application, you put some artifact in the apps/ directory of the TorqueBox AS. When the AS is running, it will detect that artifact and activate the associated application.

1. Rake tasks

TorqueBox includes a support package which includes Rake tasks which assist in the deployment to and undeployment from an instance of the TorqueBox Server.

First, the `$TORQUEBOX_HOME` and `$JBOSS_HOME` variables must be set to the path of the top of your TorqueBox Installation and the JBoss installation inside of it, respectively, as described in Chapter 2, Installation.

```
$ export TORQUEBOX_HOME=/path/to/torquebox
$ export JBOSS_HOME=$TORQUEBOX_HOME/jboss
```

If you're using any configuration other than `default`, you must also set `$JBOSS_CONF`.

```
$ export JBOSS_CONF=web
```

You need to include these tasks into your `Rakefile` using a `single` require statement.

```
require 'torquebox-rake-support'
```

Once these variables are set, you may perform a default deployment using the `torquebox:deploy` task to deploy either Ruby-on-Rails applications or plain Ruby Rack applications.

```
$ rake torquebox:deploy
```

To undeploy your application, the `torquebox:undeploy` task is available

```
$ rake torquebox:undeploy
```

The TorqueBox Server does not need to be running for these commands to work.

By default, these tasks deploy your application to root of your TorqueBox Server's web space, without any virtual host configuration. To access the application once deployed, you should use your browser to access `http://localhost:8080/`.

When the application is deployed, a deployment descriptor is written to the `$TORQUEBOX_HOME/apps/` directory with a filename based upon the directory name of your current directory.

For instance, if your application was deployed from /Users/bob/myapp/, the deployment descriptor would be named `myapp-knob.yml`.

Rewriting or simply updating the last-modified time (using a command such as `touch`) of this descriptor will cause the TorqueBox server to redeploy the application. The `torquebox:deploy` task simply emits this file.

Removing the descriptor will cause the TorqueBox server to undeploy the application. This is what the `torquebox:undeploy` task does.

1.1. Deploying a non-root context

By default, the `torquebox:deploy` task will attach your application to the root context. If you would rather deploy to a non-root context, you may provide it as an argument to the task invocation.

```
$ rake torquebox:deploy['/my-application']
```

The root of your application would then be accessible at `http://localhost:8080/my-application`.

1.2. Deploying to a non-development environment

By default, if otherwise unspecified, the variables `RAILS_ENV` and/or `RACK_ENV` are assumed to have the value of `development`, and are set appropriately when deploying an application. To alter these values, simply set the variable when executing the rake tasks.

For example:

```
$ RAILS_ENV=production rake torquebox:deploy
```

or

```
$ RACK_ENV=staging rake torquebox:deploy
```

2. Deploy using a descriptor

To customize some of the aspects of deployment, instead of using the Rake tasks, you may manually create a deployment descriptor.

A deployment descriptor is a small text file that is placed in the `apps/` directory of the TorqueBox server. This directory is constantly monitored for changes. To deploy an app, add a descriptor with a suffix of

`-knob.yml`. To redeploy or "bounce" the app, edit or `touch` the descriptor. To undeploy it, remove the descriptor. This is precisely what the `torquebox:deploy` and `torquebox:undeploy` rake tasks do.

For details on the various options for authoring deployment descriptors, see Chapter 6, Deployment Descriptors.

3. Deployment using a self-contained archive

Ruby web applications may be deployed as atomic self-contained archives. An archive is simply a packaging of the application's directory. The TorqueBox server deploys bundles created with the Java `jar` tool. Rake tasks are provided to assist with the creation and deployment of bundles.

3.1. Configuring an archive

Typically, an application is configured using a deployment descriptor suffixed by `-knob.yml` and placed in `$TORQUEBOX_HOME/apps/`. We refer to this file as an external descriptor, because it resides outside of the app's root directory.

An application archive may be configured using an internal descriptor as well. This descriptor should be named `torquebox.yml` and contained within the archive's `config/` directory for a Rails app or the root directory of a Rack app. This is described in more detail in Chapter 6, Deployment Descriptors.

When your application is packaged as a fully-described self-contained archive, you may override portions of the internal descriptor using an external descriptor. If you do, make sure that only the external descriptor resides beneath `$TORQUEBOX_HOME/apps/`. The archive containing the (possibly overridden) internal descriptors should reside elsewhere on the filesystem, its path referenced in the external descriptor. Having both the archive and the external descriptor beneath `$TORQUEBOX_HOME/apps/` will result in errors stemming from two separate deployments of the same app.

3.2. Creating an archive

After creating `torquebox.yml`, if necessary, the `torquebox:archive` rake task may be used to create a bundle of the application. The task invokes the Java `jar` commandline tool to bundle up the project directory, excluding the `tmp/`, `test/`, `spec/`, and `log/` directories.

```
$ rake torquebox:archive
```

The resulting archive will be placed at the root of the application, with a suffix of `.knob`. To inspect the contents, you may use the `jar` tool.

```
$ jar tf myapp.knob
META-INF/
META-INF/MANIFEST.MF
```

```
app/
app/controllers/
app/controllers/application_controller.rb
...
```

3.3. Deploying an archive

To deploy an archive, simply copy it to the `apps/` directory of the server. The `torquebox:deploy:archive` rake task may be used to both create and deploy an archive.

```
$ rake torquebox:deploy:archive
```

If you wish to deploy manually, a command similar to the following may be used

```
$ rake torquebox:archive
$ cp myapp.knob $TORQUEBOX_HOME/apps/
```

If you redeploy an archive, the server will remove the previous version, and hot-redeploy the new versions just copied.

To undeploy an archive, you can either run the `torquebox:undeploy` rake task, or manually remove the archive file from the `apps/` dir.

Deployment Descriptors

TorqueBox applications contain one central, but optional deployment descriptor. A deployment descriptor is simply a configuration file that affects how your components are woven together at deployment time. The primary deployment descriptor used by TorqueBox is known as `torquebox.yml`.

The deployment descriptor may be placed inside your application so that it is entirely self-contained. Alternatively, an additional descriptor may be used outside of your application, overriding portions of the descriptor contained within the application.

Each subsystem within TorqueBox may contribute one or more configurable sections to the descriptor. For more information on the variuos subsystem descriptor sections, please see: Chapter 7, Messaging, Chapter 8, Scheduled Jobs, and Chapter 13, Runtime Pooling.

1. External and Internal descriptors

Deployment descriptors are small, YAML-formatted text files. They may be "external", residing outside the application, or "internal", residing within it.

An external descriptor references an application somewhere on your filesystem. To deploy the application, the descriptor is placed in the `$TORQUEBOX_HOME/apps/` directory of the TorqueBox server. The external descriptor's name should have a suffix of `-knob.yml` .

An internal descriptor should be named `torquebox.yml` and reside inside the application's `config/` directory, if present, otherwise at the root. Internal descriptors allow you to override the TorqueBox defaults but only for a single app. As such, they are not required. Values in the external descriptor override those in the internal descriptor which, in turn, override the TorqueBox defaults. The syntax for all application deployment descriptor files is identical.

2. Contents of the descriptor

The descriptor has several sections, grouped by subsystem, represented as top-level keys in a YAML associative array.

1. `application`: General application configuration
2. `web`: Web-specific configuration
3. `ruby`: Runtime version and JIT options
4. `environment`: Environment variables
5. `jobs`: Scheduled executions
6. `messaging`: Advanced message-handling
7. `pooling`: Runtime pooling control
8. `services`: low-level service daemons

2.1. General Application Configuration

Location & Environment. The application section describes the location and environment for the app itself, in Rails terms: `RAILS_ROOT` and `RAILS_ENV`. Under traditional (mongrel, lighttpd) deployments, this information is picked up through the current working directory or environment variables. Since the TorqueBox Server runs from a different location, the current working directory has no meaning. Likewise, as multiple applications may be deployed within a single TorqueBox Server, a single global environment variable to set `RAILS_ENV` is nonsensical.

Table 6.1. application

Variable	Description	Default
`root`|`RAILS_ROOT`|`RACK_ROOT`	Indicates the location of your application. It may refer to either an "exploded" application (a directory) or the path to a zipped archive. It is required for external descriptors and ignored in an internal descriptor. Regardless of which alias you use, RAILS_ROOT will be set in the ENV hash for Rails apps and RACK_ROOT will be set for Rack apps.	none
`env`|`RAILS_ENV`|`RACK_ENV`	Defines the environment under which the app and its framework will run, e.g. production, development, test, etc.	development

For example:

```
application:
  root: /path/to/myapp
  env: development
```

2.2. Web-specific configuration

Ruby web apps are often deployed individually, without respect to hostnames or context-path. Running under TorqueBox, however, you may host several apps under a single host, or multiple apps under different hostnames.

Table 6.2. web

Variable	Description	Default
`rackup`	The "rackup" script containing the complete logic for initializing your application.	`config.ru`
`host`	Virtual hosts allow one application to respond to www.host-one.com, while another running within the same JBoss AS to respond to www.host-two.com. This value can be either a single hostname or a YAML list of hostnames.	`localhost`
`context`	Applications within a single TorqueBox Server may be separated purely by a context path. For a given host, the context path is the prefix used to access the application, e.g. http://some.host.com/context. Traditional Ruby web apps respond from the top of a site, i.e. the root context. By using a context path, you can mount applications at a location beneath the root.	`/`
`static`	Any static web content provided by your app should reside beneath this directory.	none unless deploying a Rails application, then `public`.

For example:

```
web:
  rackup: alternative/path/to/my_config.ru
  context: /app-one
  static: public
  host: www.host-one.com
```

2.3. Ruby runtime configuration

TorqueBox exposes two of the JRuby runtime options: the ruby compatibility version, and the JIT compile mode. Both of these options are configured in the ruby: section of a deployment descriptor.

Note that these settings are per application, allowing you to run 1.8 and 1.9 applications in the same TorqueBox, or have one JIT'ed and another not.

Table 6.3. ruby

Variable	Description	Default
`version`	The ruby compatibility version for JRuby. Options are: • 1.8 - provides 1.8.7 compatibility • 1.9 - provides 1.9.2 compatibility	1.8
`compile_mode`	The JIT compile mode for JRuby. Options are: • jit - Tells JRuby to use JIT on code where it determines there will be a speed improvement • force - Tells JRuby to use JIT on all code • off - Turns off JIT completely	`jit`

For example:

```
ruby:
  version: 1.9
  compile_mode: off
```

2.4. Environment variables

Each application may have its own unique set of environment variables, no matter how many different apps are deployed under a single TorqueBox instance. Variables from internal and external descriptors are merged, with the external variables overriding any internal matching keys.

For example:

```
environment:
  MAIL_HOST: mail.yourhost.com
  REPLY_TO: you@yourhost.com
```

Any variable set in the environment section is accessible from within the Rack app using the ENV hash, e.g. ENV['MAIL_HOST']=='mail.yourhost.com'

3. Java Deployment Descriptors

In addition to Ruby, Rails and TorqueBox-specific descriptors, your application may also include any traditional JavaEE or JBoss-specific descriptors within its `config/` directory.

3.1. config/web.xml

A JavaEE `web.xml` deployment descriptor may be included in your application's `config/` directory. Additional Java Servlets, Filters or other configuration may be performed within this file. Its contents will be mixed with other information when your application is deployed. If desired, your `web.xml` may reference the components that TorqueBox implicitly adds.

Rack Filter. TorqueBox provides a Java Servlet™ `Filter` named `torquebox.rack`. This filter is responsible for delegating requests to Rack-based applications.

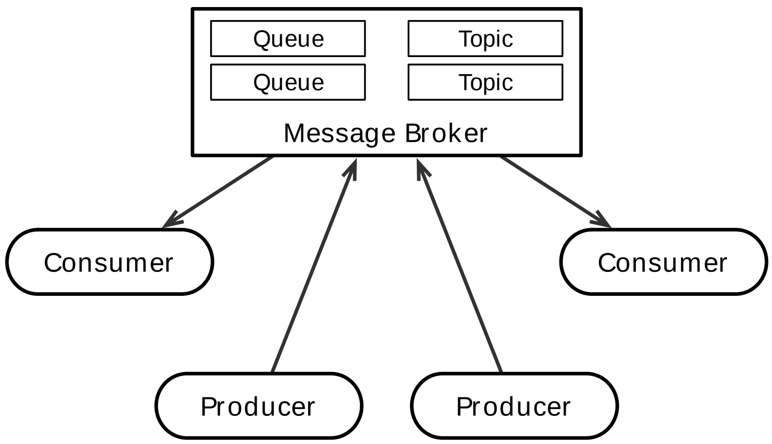
Static Resource Servlet. In order to serve files from the `public/` directory of your application, TorqueBox installs a `Servlet` named `torquebox.static`.

Messaging

1. Introduction

HornetQ. TorqueBox integrates the JBoss HornetQ message broker technology. It is automatically available to you, with no additional configuration required to start the messaging service. HornetQ supports clustered messaging, to allow for load-balancing, failover, and other advanced deployments.

The term "messaging" encompasses a large area of functionality. Messaging solutions are used to achieve loosely-coupled, asynchronous systems. The primary actors in a messaging-based system are messages, destinations, consumers, and producers. From an implementation perspective, a broker mediates the relationships between the other actors.

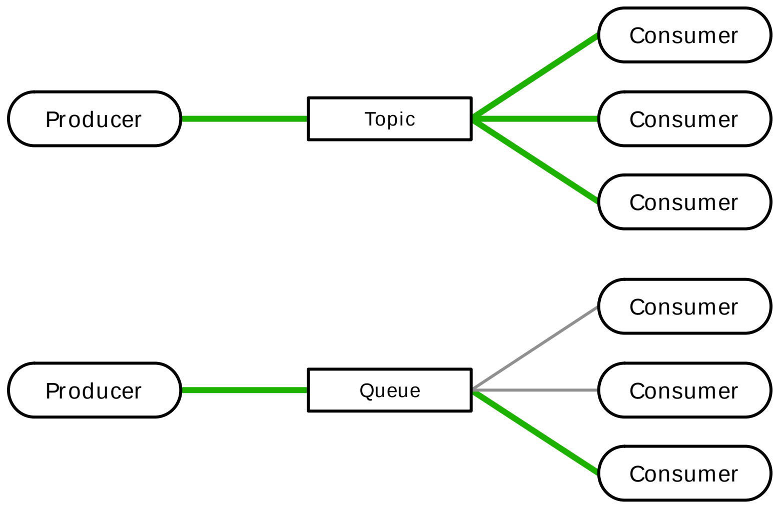


Messages. The unit of communication within a messaging system is a message. A message may either be simply a blob of octets, or it might have some higher-order, application-defined semantics. All messages include a set of headers, similar to email.

Destinations. A destination represents a rendezvous where messages are exchanged. A message may be sent to a destination by one actor, and received from the destination by another.

There are two main types of destinations: queues and topics. All destinations allow multiple actors to place messages with them. The type of destination affects what happens to the message once given to the destination. A queue delivers the message to a single recipient (possibly one of many candidate recipients). A topic delivers the message to multiple interested recipients.

In the image below, the green lines represent the flow of a single message from a producer to one-or-more consumers through a topic and a queue.



Producers. Any component or client code that creates messages and gives them to the message broker for delivery is considered a producer. Generally speaking, the producer does not know the details of the destination.

Consumers. Any component that waits for messages to be delivered to it by the message broker is consider a consumer. A consumer is unaware of the producer and any other consumers, potentially.

2. Deploying Destinations

Queues and topics (collectively known as destinations) may be deployed with your application, or separate from your application. Additionally, various parts of your application may also implicitly deploy and use some destinations. Furthermore you may have existing message destinations somewhere on your network which you would like to interact with.

Each method has advantages and disadvantages involving the expectations of your application and its interaction with resources outside the scope of the application.

2.1. Deployment Styles

2.1.1. Deploying destinations with your application

If you decide to deploy your queues and topics with your application, you automatically align their lifecycle to the deployment cycle of your application. If you undeploy your application, your queues and topics will also disappear, and be unable to receive messages. If the queues are used only internally to your application, and short lifespan semantics are useful to you, deploying destinations with your application reduces deployment steps and moving parts.

2.1.2. Deploying destinations apart from your application

If you deploy destinations separate and apart from your application, they become long-lived first-class component citizens in your environment. Applications may be deployed and undeployed, while the destinations continue to function, accepting and processing messages to the best of their ability.

If the consumers to a destination are offline, the destination may persist and store any unhandled messages until a consumer re-attaches.

The downside is that by making destinations first-class top-level components of your environment, you must also manage, deploy and undeploy them separate from any app, creating additional work.

2.2. Interacting with external message destinations

In the most common use-case all destinations and the apps which use them are deployed to the same TorqueBox server or cluster. Thus by default TorqueBox need only refer to its embedded messaging server when looking up destinations. However it is sometimes the case that you have several independent systems which all communicate via destinations deployed on a central messaging server. In these cases you simply need to let TorqueBox know where each of those destinations is hosted.

2.3. Deployment Descriptors

You have several options when deploying queues and topics, based on the lifecycle that suits your systems best.

2.3.1. `Long-lived queues and topics`

If your queues and topics have a lifecycle that extends beyond the deployment of any single app, you may want long-lived queues and topics. Long-lived destinations are first-order components, and may be deployed on their own. In this way, many applications can come and go over time, publishing and consuming from the same queues.

When using long-lived destinations, the corresponding deployment descriptors are placed directly into the `apps/` directory of TorqueBox AS.

Queues. To deploy queues, a simple YAML file is required, simply naming the queue, and providing additional configuration parameters. The file should either be named exactly `queues.yml` or have the suffix of `-queues.yml`, such as `these-queues.yml` or `those-queues.yml`. The only configuration option available on queues is the `durable` option.

Durability is enabled by default, and involves writing each message to disk so as to be able to recover in the event of failure or server restart. Disabling durability on queues may result in better performance, but increases the risk of losing messages.

Example 7.1. queues.yml

```
/queues/my_queue:

/queues/my_other_queue:
  durable: false
```

The name of the queue will be used when registering the queue in the naming-service, and is used to discover the queue for attaching consumers and producers.

By convention, queues are named with the prefix of `/queues`.

Topics. To deploy topics, a simple YAML file is required, simply naming the topic, and providing additional configuration parameters. The file should either be named exactly `topics.yml` or have the suffix of `-topics.yml`, such as `these-topics.yml` or `those-topics.yml`. Currently, no additional configuration parameters are allowed - topic durability is controlled via options on the attached processors (See Section 4.2.3.1, “Connecting consumers within TorqueBox”).

Example 7.2. topics.yml

```
/topics/my_topic:

/topics/my_other_topic:
```

The name of the queue will be used when registering the topic in the naming-service, and is used to discover the topic for attaching consumers and producers.

By convention, topics are named with the prefix of `/topics`.

2.3.2. Application-linked queues and topics

Some destinations are intimately tied to the lifecycle of some particular application. For example, internally in the asynchornous tasks implementation, an application-link queue is used.

Destinations deployed with your application also undeploy when your application is undeployed. These destinations are configuration through either your application's internal `torquebox.yml` descriptor, or through an external `*-knob.yml` descriptor.

Within either of these files, you may use a `queues:` section to define queues and a `topics:` section to define topics.

Example 7.3. Defining topics and queues in `torquebox.yml`

```
application:
  ..
queues:
  /queues/my_app_queue:

topics:
  /queues/my_app_topic:
```

2.3.3. External queues and topics

If you have destinations deployed on an external, dediated messaging server you will need to provide TorqueBox with some additional info in order to be able to interact with them.

Publishing to external destinations is straightforward and is covered in the Publishing Messages section below.

To consume messages from remote destinations, the configuration is identical to that for Application-linked queues and topics plus the addition of the "remote_host" property to your queue and/or topic definitions. This should be set to the hostname or IP address and port of the external messaging server's Naming Directory. If no port is provided the default of 1099 will be used.

Example 7.4. Defining external topics and queues in `torquebox.yml`

```
application:
  ..
queues:
  /members/new_member:
    remote_host: 192.168.1.100

topics:
  /members/member_tweets:
    remote_host: 192.168.1.100
  /news_aggregator/technology:
    remote_host: 192.168.1.200:1089
```

3. TorqueBox Ruby Classes

All classes in the `TorqueBox::Messaging` module reside in the Ruby gem, `torquebox-messaging`, so to use them in your Rails app, you'll need to configure your app to load the gem.

Rails 2.x. Add this to your `config/environment.rb`:

Example 7.5. To use `TorqueBox::Messaging` in a Rails 2.x app

```
Rails::Initializer.run do |config|
  ...
  config.gem 'torquebox-messaging'
  ...
```

Rails 3.x. Add this to your `Gemfile`:

Example 7.6. To use `TorqueBox::Messaging` in a Rails 3.x app

```
source 'http://rubygems.org'

gem 'rails', '3.0.4'
...
gem 'torquebox-messaging'
```

And to use them in any other JRuby script, it's even simpler. First, ensure that `rubygems` is loaded, then require the `torquebox-messaging` feature.

Example 7.7. To use `TorqueBox::Messaging` in a shell script

```
#!/usr/bin/env jruby

require 'rubygems'
require 'torquebox-messaging'
```

4. Messaging Abstractions

4.1. Queues and Topics

There are two main messaging destination abstractions: `TorqueBox::Messaging::Queue` and `TorqueBox::Messaging::Topic`. Each has a `publish` and a `receive` method, and each must be constructed with a `name` and an optional hash of options:

Table 7.1. Message destination options

Option	Default	Description
`:naming_host`	localhost	Should be the hostname or ip address of the JNDI naming server containing the destination names.
`:naming_port`	1099	The port of the JNDI naming server.
`:ack_mode`	`:auto`	Corresponds to one of the three `javax.jms.Session` modes for message delivery acknowledgement: `:auto`, `:client` and `:dups_ok`.
`:transacted`	true	Indicates whether the underlying session is in transacted mode.
`:client_id`		A string to uniquely indentify the connecting client. Optional unless you are using the `:durable` option with `receive` on a `Topic`.

You can also set these options via the `connect_options` on the destination object.

Though sometimes convenient, these methods are fairly low-level and higher-level abstractions such as MessageProcessors, Tasks, and Backgroundable are often better-suited to the task.

4.1.1. Publishing Messages

It's trivial to publish a message to a JMS `Queue` or `Topic` with TorqueBox. And if all of your message consumers are Ruby clients, the contents of the messages can be any serializable Ruby or Java object. You just need to ensure that the type of content you produce resides in the runtime environments of both the producer and the consumer.

To send a message, you will need access to a `Topic` or `Queue` instance. The preferred method for accessing the destination instance is to use `inject(...)` (see Messaging Destinations for more details). If you need to pass options to the instance, or only have access to the destination name at runtime, construct either a `Topic` or a `Queue` instance with its name and options. Once you have a destination instance, simply call its publish method. The API's of both Topics and Queues are identical; they each simply represent a destination for your messages.

Example 7.8. Publish text messages

```
queue = inject('/queues/foo')
queue.publish "A text message"

topic = inject('/topics/foo')
```

```
topic.publish "A text message"
```

Example 7.9. Publish a Ruby Hash

```
queue = inject('/queues/foo')
queue.publish {:key => 'value', :list => %w{one two three}}
```

This is enormously convenient, as any serializable object is permitted, but it only makes sense if your queue consumers are also written in Ruby.

Example 7.10. Send message using a remote JNDI server

```
queue = TorqueBox::Messaging::Queue.new('/queues/foo',
                                        :naming_host => 'jndi.jboss.org',
                                        :naming_port => 1099)
queue.publish "Some message"
```

The `publish` method takes an optional second argument containing a hash of options:

Table 7.2. Publish options

Option	Default	Description
`:priority`	:normal	higher priority messages will be delivered before lower priority messages within the context of a queue. You can specify the priority as an integer in the range 0..9, or as one of the following convenience symbols (with the corresponding integer priorities in parentheses): • `:low` (1) • `:normal` (4) • `:high` (7) • `:critical` (9) Higher priority messages will be processed before lower priority ones for a specific message processor.

Option	Default	Description
:ttl		The maximum time the message will wait in a destination to be consumed, in milliseconds. If the message isn't consumed within this time it will be delivered to an expiry queue. By default, messages don't have a ttl (and therefore never expire). By default, expired messages end up on the /queue/ExpiryQueue queue. If you want to do something special with those messages, you'll need to add a processor for that queue.
:persistent	true	By default, queued messages will survive across AS restarts. If you don't want a message to be persistent, set the persistence to false (see Section 2.3.1, "Long-lived queues and topics" for controlling message durability globally for a queue).
:correlation_id	nil	The string value to set for the JMSCorrelationID [http://download.oracle.com/javaee/1.3/api/javax/jms/Message.html#setJMSCorrelationID%28java.lang.String%29] message header.
:reply_to	nil	The javax.jms.Destination value to set for the JMSReplyTo [http://download.oracle.com/javaee/1.3/api/javax/jms/Message.html#setJMSReplyTo%28javax.jms.Destination%29] message header.
:type	nil	The string value to set for the JMSType [http://download.oracle.com/javaee/1.3/api/javax/jms/Message.html#setJMSType%28java.lang.String%29] message header.

Option	Default	Description
`:properties`	nil	A hash of string key/value pairs to set as message properties. This can be used as application-specific headers and matched against in the `:selector` option of the `receive` method.
`:startup_timeout`	30000	The maximum time to wait for the destination to become ready on initial app startup, in milliseconds. On a very slow machine this may need to be increased from the default.

4.1.2. Receiving Messages

Receiving messages from a JMS `Queue` or `Topic` is very similar to publishing messages. To consume a message, simply construct either a `Queue` or `Topic` instance with its name, and then call its receive method. The API's of both Topics and Queues are identical.

Example 7.11. Receive messages

```
queue = TorqueBox::Messaging::Queue.new('/queues/foo')
message = queue.receive

topic = TorqueBox::Messaging::Topic.new('/topics/foo')
message = topic.receive
```

The `receive` takes an optional argument containing a hash of options:

Table 7.3. Receive options

Option	Default	Description
`:decode`	true	When `:decode` is set to true, `receive` returns the same value that was sent via `publish`. If `:decode` is false, the JMS TextMessage [http://download.oracle.com/javaee/1.3/api/javax/jms/TextMessage.html] object will be returned instead. This should be true unless you need to

Option	Default	Description
		access headers or properties of the JMS message.
`:timeout`	0	The amount of time to wait before giving up, in milliseconds. A value of 0 means to wait indefinitely. If `receive` times out it will return a `nil` value.
`:selector`	nil	The JMS selector string used to filter messages received by this consumer. For details see the "Message Selectors" section of the javax.jms.Message [http://download.oracle.com/javaee/1.3/api/javax/jms/Message.html] documentation. A `nil` value means all messages are received.
`:startup_timeout`	30000	The maximum time to wait for the destination to become ready on initial app startup, in milliseconds. On a very slow machine this may need to be increased from the default.
`:durable`	false	Specifies that the connection to a topic should be durable. This causes any messages that arrive on the topic to be queued. If false, messages that arrive on the topic when a `receive` is not waiting will be discarded. If `true`, you must also supply a `:client_id` in the connect options for the Topic. This option is ignored for Queues.

4.1.3. Synchronous Messaging

The `publish` and `receive` methods and our higher-level messaging abstractions are designed for asynchronous communication and are recommended for most uses. However, if you do need to send a message and wait for a response, TorqueBox also provides a synchronous messaging abstraction.

Example 7.12. Synchronous messaging

```
queue = TorqueBox::Messaging::Queue.new('/queues/foo')
```

```
Thread.new {
  queue.receive_and_publish(:timeout => 5000) { |message| message.upcase }
}
message = queue.publish_and_receive "ping", :timeout => 5000
# message equals "PING"
```

You send a message with the `publish_and_receive` method which blocks until the `:timeout` elapses or a response is received. This method has a default `:timeout` of 10 seconds since you'll rarely want to wait indefinitely for a response. In a separate thread (likely TorqueBox Services - Chapter 9, Services), you consume messages and publish responses with the `receive_and_publish` method. The return value of the block passed to this method is the message response. The options allowed in both these methods are a union of those from `publish` and `receive`. Synchronous messaging is only available with queues, not topics.

4.2. Message Processors

Message consumers may be implemented in Ruby and easily attached to destinations. A Ruby consumer may either interact at the lowest JMS-level, or take advantage of higher-level semantics.

4.2.1. Low-level message consumption

For the lowest-level implementation of a Ruby consumer, the class must simply implement `process!(msg)` which receives a `javax.jms.Message` as its parameter. Admittedly, this gets quite a lot of Java in your Ruby, but it's available if needed.

Example 7.13. Low-level message consumer

```
class MyLowConsumer
  def process!(msg)
    # manipulate the javax.jms.Message here
  end
end
```

If `process!` raises an exception, the message broker considers the message undelivered and will retry delivery up to some configurable limit (default is 10). If all of those attempts fail, the broker stores the message in a Dead Letter Queue (DLQ) that may be interrogated later.

4.2.2. Syntactic sugar for message consumers

Message consumers may extend `TorqueBox::Messaging::MessageProcessor` and implement an `on_message(body)` method which will receive the body of the JMS message.

Example 7.14. MessageProcessor subclass

```
class MyConsumer < TorqueBox::Messaging::MessageProcessor
  def on_message(body)
    # The body will be of whatever type was published by the Producer
    # the entire JMS message is available as a member variable called message()
  end
  def on_error(exception)
    # You may optionally override this to interrogate the exception. If you do,
    # you're responsible for re-raising it to force a retry.
  end
end
```

There is an accessor for the actual JMS message that is set by TorqueBox prior to invoking `on_message`, so it's there if you need it.

Just like with `process!`, if `on_message` raises an exception, the message broker considers the message undelivered. You may trap the error by overriding `on_error`, at which point you decide whether to re-raise the exception to force a retry. That is the default behavior if you do not override the method.

4.2.3. Connecting Consumers to Destinations

You can connect consumers hosted within a TorqueBox-based application, or in external scripts. The method for each environment is similar, but slightly different, since TorqueBox-hosted consumers get more baked-in support from the container.

4.2.3.1. Connecting consumers within TorqueBox

To connect consumers within a TorqueBox-deployed application, you need to add a messaging: section to your `torquebox.yml` (or external *-knob.yml descriptor).

This section will contain the mappings from your destinations (topics and queues) to your consumers. The section is a YAML hash, the keys of which are your destination names, which should correspond to existing queues and topics. These destinations may be deployed through the same `torquebox.yml` or as long-lived destinations.

Example 7.15. Messaging handlers in torquebox.yml

```
application:
  ..
queues:
```

```
  /queues/my_app_queue:

messaging:
  /queues/my_app_queue:     MyFooHandler
  /topics/long_lived_topic: MyBazHandler
```

The classes MyFooHandler and MyBazHandler would correspond to files available on the load path: `my_foo_handler.rb` and `my_baz_handler.rb`, respectively. In a Rails app, these files would typically reside beneath `lib/` or `app/models/`.

The above example shows the simplest possible configuration, but it's possible to alter the behavior of your message processor using the following options:

Table 7.4. Message processor options

Option	Default	Description
`concurrency`	1	May be used to throttle the throughput of your processor. Processors are single-threaded, by default, but you can increase this value to match the number of concurrent messages you expect to receive. Note that this value determines the number of consumers connected to the destination and thus you'll rarely want a concurrency greater than 1 for topics since that means you'll process duplicate messages.
`filter`		May be used to filter the messages dispatched to your consumer.
`durable`	false	Turns the processor into a durable subscriber. Once a processor durably subscribes to a topic, if it disconnects any messages sent will be saved and delivered once the processor reconnects. This setting only affects processors attached to topics, and is ignored for queue processors.
`config`		Should contain a hash of data which will be passed to your consumer's constructor, `initialize(Hash)`.

Example 7.16. Messaging configuration in `torquebox.yml` with options set

```
application:
  ...
messaging:
  /queues/foo:
    MyFooHandler:
      filter: "cost > 30"
      config:
        type: "premium"
        season: "fall"
      concurrency: 2
  /topics/bar:
    MyBarHandler:
      durable: true
```

Because the structure of the file is YAML [http://www.yaml.org], proper indentation is required.

Actually, YAML enables the configuration to get fairly sophisticated, allowing you to, for example, map a single destination to multiple processors or re-use configuration options in multiple processors. You may never have a need for this much flexibility, but it's available if you do.

Example 7.17. Advanced messaging configuration in `torquebox.yml`

```
application:
  ...

messaging:
  /topics/simple: SimpleHandler

  /topics/popular:
    - Handler
        concurrency: 5
    - Observer: &defaults
        filter: "x > 18"
        config:
          x: ex
          y: why
    - Processor

/queues/students:
    VerySimpleAnalyzer:
    YouthMonitor:
      filter: "y < 18"
```

```
      config:
        h: ache
        i: eye
    LookAndFeel:
      <<: *defaults
```

Here we have `/topics/simple` mapped to a single processor of type `SimpleHandler` using a YAML string, `/topics/popular` mapped to three processors (`Handler`, `Observer`, `Processor`) using a YAML list, and `/queues/students` mapped to three more processors (`VerySimpleAnalyzer`, `YouthMonitor`, `LookAndFeel`) using a YAML hash where each key in the hash corresponds to the processor type. This example also takes advantage of YAML's ability to merge hash's: the `Observer` and `LookAndFeel` processors are configured identically.

4.2.3.1.1. Connecting Consumers outside of TorqueBox

To support messaging outside of TorqueBox, i.e. outside of the JBoss Application Server (AS), two command-line utilities are provided: one that can deploy your `queues.yml` (or `topics.yml`) and one that can deploy your `messaging.yml` config file.

Example 7.18. Deploying your Consumers outside of the App Server

```
$ trq-message-processor-host --deploy messaging.yml
```

Optionally, you can pass `-N your.naming.host` if there's not a naming server running locally

Firing up the consumers doesn't do much good without the actual destinations, though...

Example 7.19. Deploying your Destinations outside of the App Server

```
$ trq-message-broker -s --deploy queues.yml
```

The `-s` option tells the broker to fire up its own naming service. Otherwise, it attempts to use a local one.

4.3. Tasks

A special case of message queues is to execute some task asynchronously, perhaps even remotely. Rails developers often want to spawn a potentially long-running task in response to a user request, without forcing the user to wait for its completion. TorqueBox makes this easy.

4.3.1. Task Classes

Task classes simply extend `TorqueBox::Messaging::Task` and implement one or more (usually long-running) methods that take a single object payload, a Ruby `Hash`.

In Rails applications, these tasks should be placed in the `app/tasks/` directory. For non-Rails applications, they should be placed in `tasks/`. The tasks should be suffixed with `_task.rb` for the file name, and suffixed with `Task` for the class name.

Any of the task's methods can be invoked asynchronously by calling the task's class method, `async`, which returns a FutureResult object that can be used to monitor the status of the task processing and retrieve the final return value.

Example 7.20. Example task class

```
class EmailerTask < TorqueBox::Messaging::Task
  def send_welcome(payload)
    to = "#{payload[:name]} <#{payload[:address]}>"
    # send welcome email to the user
  end

  def send_password_reset(payload)
    email = payload[:address]
    # send password-reset email to the user
  end
end
```

4.3.2. Invoke a task

Tasks can be invoked asynchronously from within any application running inside TorqueBox, e.g. your Rails app.

Example 7.21. Spawning a task from a Rails controller

```
class UserController < ApplicationController
  def register
    user = User.new(params[:user])
    ...
    EmailerTask.async(:send_welcome, :address => user.email, :name => user.name)
  end

  def reset_password
    ...
```

```
    future_result = EmailerTask.async(:send_password, :address => params[:email])
    ...
  end
end
```

The first parameter to the `async(...)` class method is a symbol indicating the method to execute asynchronously. Optional hash pairs comprising the payload of the message follow.

4.3.3. Task invocation options

When invoking a task, you can override the default priority, time-to-live, and persistence options by passing an options hash to `async`. The available options are:

Table 7.5. Task invocation options

Option	Default	Description
`:priority`	:normal	higher priority messages will be delivered before lower priority messages within the context of a queue. You can specify the priority as an integer in the range 0..9, or as one of the following convenience symbols (with the corresponding integer priorities in parentheses): • `:low` (1) • `:normal` (4) • `:high` (7) • `:critical` (9) Higher priority messages will be processed before lower priority ones for a specific message processor.
`:ttl`		The maximum time the message will wait in a destination to be consumed, in milliseconds. If the message isn't consumed within this time it will be delivered to an expiry queue. By default, messages don't have a ttl (and therefore never expire). By default, expired messages end up on the `/queue/ExpiryQueue` queue. If you

Option	Default	Description
		want to do something special with those messages, you'll need to add a processor for that queue.
`:persistent`	true	By default, queued messages will survive across AS restarts. If you don't want a message to be persistent, set the persistence to `false`.

The options are passed as the third argument to `async`:

Example 7.22. Passing options to `async`

```
SomeTask.async(:an_important_action, {:id => 28}, :priority => :high)
SomeTask.async(:a_timeboxed_action, {:some_value => :foo}, :ttl => 5000)
```

The message options are passed as a `Hash` after the payload argument.

4.3.4. Task message processor options

You can set options for the message processors for each task in `torquebox.yml`. Currently, the concurrency is the only available option:

Table 7.6. Task message processor options

Option	Default	Description
`concurrency`	1	May be used to throttle the throughput of your processor. Processors are single-threaded, by default, but you can increase this value to match the number of concurrent messages you expect to receive.

The options are set in the `torquebox.yml` by keying the options to the task class name:

Example 7.23. Task message processor options in `torquebox.yml`

```
application:
  ...
tasks:
  SomeTask:
```

```
    concurrency: 2
  SomeOtherTask:
    concurrency: 5
```

4.4. Backgroundable Methods

In addition to task classes for background proccessing, TorqueBox also provides `Backgroundable` methods. `Backgroundable` allows you to process any method on any object asynchronously. You can mark a method to always execute in the background, or send a method to the background on an ad hoc basis. Backgrounded methods return a FutureResult object that can be used to monitor the status of the method invocation and retrieve the final return value.

4.4.1. always_background

`Backgroundable` provides the `always_background` class method that allows you to flag a method to always be executed in the background:

Example 7.24. Having a method always execute in the background

```
class User < ActiveRecord::Base
  always_background :send_signup_notification

  def send_signup_notification
    ...
  end
end

user = User.find(id)

# executes in the background, returning immediately
future_result = user.send_signup_notification
```

The `always_background` method can be called before or after the method being backgrounded is defined, and can take multiple method symbols: `always_background :foo, :bar`.

You can also call `always_background` from outside of the class definition if you prefer:

Example 7.25. Alternative `always_background` usage

```
class User < ActiveRecord::Base
```

```
  def send_signup_notification
    ...
  end
end

User.always_background(:send_signup_notification)
```

4.4.2. background

If you have not marked an instance method with `always_background`, you can background it at call time with the `background` instance method. A method called via `background` will also return a FutureResult object that can be used to monitor the status of the method invocation and retrieve the final return value.

Example 7.26. Backgrounding a method ad hoc

```
class User < ActiveRecord::Base
  def process_avatar(image_data)
    ...
  end
end

user = User.find(id)

# executes in the background, returning immediately
future_result = user.background.process_avatar(the_image)

# executes in the foreground (this thread)
regular_result = user.process_avatar(the_image)
```

4.4.3. The Backgroundable module

To use `Backgroundable` methods in a class, you will need to include the `TorqueBox::Messaging::Backgroundable` module into the class:

Example 7.27. Including the `Backgroundable` module

```
class User
  include TorqueBox::Messaging::Backgroundable
  ...
end
```

Including Backgroundable provides both the always_background class method and the background instance method.

If your appplication uses Rails and you use the rails template that ships with TorqueBox ($TORQUEBOX_HOME/share/rails/template.rb), you should have an initializer (RAILS_ROOT/config/initializers/active_record_backgroundable.rb) that already includes Backgroundable into ActiveRecord::Base.

4.4.4. Object/argument marshalling

We serialize the receiver and arguments using Marshal and include them in the message that gets enqueued. The message processors run in a separate ruby runtime from the application, which may be on a different machine if you have a cluster. The marshaling works well for ActiveRecord objects and basic ruby objects. It may not work as well for objects that expect a lot of plumbing in place (ActionControllers, for example).

4.4.5. Backgroundable method invocation options

The priority, time-to-live, and persistence options that are available to available to task classes are available to Backgroundable methods as well:

Example 7.28. Passing options to Backgroundable methods

```
class Widget
  always_background :productize, :priority => :low
  def productize
    ...
  end

  def monetize
    ...
  end
end

widget = Widget.new

widget.background(:ttl => 1000, :persistent => false).monetize
```

The message options are passed as a Hash as the last argument to always_background, and as the only argument to background. Options passed to always_background affect every background invocation of the specified methods, while options passed to `background` affect only that particular invocation.

4.4.6. `Backgroundable` message processor options

The concurrency option that is available to task class message processors in `torquebox.yml` is available to `Backgroundable` message processors as well. Instead of a task class name, you specify `Backgroundable`:

Example 7.29. Task message processor options in `torquebox.yml`

```
application:
  ...
tasks:
  Backgroundable:
    concurrency: 2
  SomeTask:
    concurrency: 5
```

By default, every application you deploy will have a queue for `Backgroundable` methods, even if you don't use it. To turn off the queue, set the `concurrency` to 0.

5. Future Objects

Both `Task.async` and methods backgrounded via `Backgroundable` return `FutureResult` objects that allow you to monitor the progress of the asynchronous processing.

Table 7.7. FutureResult instance methods

Method	Description
started?	Returns `true` if the task processing has started.
complete?	Returns `true` if the task processing has completed without error. If `true`, The result is available via the `result` method.
error?	Returns `true` if an error occurred during the task processing. If `true`, The actual error is available via the `error` method.
status	Returns the last status message returned from the task. This will only have meaning if you signal status information from within your task. See the status notifications section for more details.
result	Returns the result of the remote processing. This method takes a `timeout` (in milliseconds), and will

Method	Description
	block for that amount of time if processing has started but not completed, or up to twice that time if processing has yet to start. If no result is available after timing out, a `TorqueBox::Messaging::TimeoutException` is raised. The `timeout` defaults to 30 seconds. The recommended pattern is to wait for `complete?` to return `true` before calling `result`.
method_missing	Delegates any missing methods to the `result`, using the default timeout.
error	Returns the remote error object if an error occurred during task processing.

5.2. Sending status notifications to the FutureResult from within the task

From within a task or backgrounded method invocation, you can send a status notification to the `FutureResult` for this call by using the `TorqueBox::Messaging::FutureResult.status=` method. The status can be any marshalable object, and its semantics are defined by your application.

Example 7.30. Sending a status message

```
class Something
  include TorqueBox::Messaging::Backgroundable

  always_background :process_some_stuff
  ...
  def process_some_stuff
    stuff.each_with_index do |thing, index|
      thing.process_it
      # report the % complete
      TorqueBox::Messaging::FutureResponder.status = (index * 100)/stuff_count
    end
  end
end

future = Something.new.process_some_stuff
# time passes
future.started? # => true
future.status   # => 22
# time passes
future.status   # => 87
```

Scheduled Jobs

1. What Are Scheduled Jobs?

Scheduled jobs are simply components that execute on a possibly-recurring schedule instead of in response to user interaction. Scheduled jobs fire asynchronously, outside of the normal web-browser thread-of-control. Scheduled jobs have full access to the entire Ruby environment. This allows them to interact with database models and other application functionality.

2. Ruby Job Classes

Each scheduled job maps to exactly one Ruby class. The path and filename should match the class name of the job contained in the file.

File name	Class name
`mail_notifier.rb`	MailNotifier
`mail/notifier.rb`	Mail::Notifier

Example 8.1. Skeleton scheduled job class (`mail/notifier.rb`)

```
module Mail
  class Notifier

    # implementation goes here

  end
end
```

Each job class should implement a no-argument `run()` method to perform the work when fired.

Example 8.2. Scheduled job implementation (`mail/notifier.rb`)

```
module Mail
  class Notifier

    def run()

      # perform work here

    end
```

```
  end
end
```

From within the class's `run()` method, the full application environment is available.

3. Scheduling Jobs

The job schedule defines the time(s) that a job should execute. This may be defined to be single point in time, or more often, as recurring event. The job schedule is defined with a jobs section of your `torquebox.yml`.

3.1. YAML Configuration Format

Within the global torquebox.yml descriptor (or through an external *-knob.yml descriptor), scheduled jobs are configured using the a `jobs:` section.

Within the `jobs`, a block of information is provided for each job. The block starts with arbitrary name for the job. Each block must also define the job class and the schedule specification. Optionally a description may be provided.

Example 8.3. Example `torquebox.yml`

```
application:
  ..
jobs:
  mail.notifier:
    job:         Mail::Notifier
    cron:        '0 */5 * * * ?'
    description: Deliver queued mail notifications
```

The cron attribute should contain a typical crontab-like entry. It is composed of 7 fields (6 are required).

Seconds	Minutes	Hours	Day of Month	Month	Day of Week	Year
0-59	0-59	0-23	1-31	1-2 or JAN-DEC	1-7 or SUN-SAT	1970-2099 (optional)

For several fields, you may denote subdivision by using the forward-slash (`/`) character. To execute a task every 5 minutes, `*/5` in the minutes field would specify this condition.

Spans may be indicated using the dash (`-`) character. To execute a task Monday through Friday, `MON-FRI` should be used in the day-of-week field.

Multiple values may be separated using the comma (`,`) characeter. The specification of `1,15` in the day-of-month field would result in the job firing on the 1st and 15th of each month.

Either day-of-month or day-of-week must be specified using the `?` character, since specifying both is contradictory.

4. Resource Injection with Jobs

If a job requires access to other resources, such as messaging topics and queues, or Java CDI components these should be injected using the resource injection facilities provided by TorqueBox (see Chapter 10, Resource Injection).

In order for resource injection to function with scheduled jobs, they must reside either at the root of your application directory (typical for simple Rack applications), or underneath an `app/jobs/` directory. If you place the job anywhere else, it may still funciton, but resources injection will not be available.

Services

1. What Are Services?

Services are persistent background Ruby daemons deployed and managed by TorqueBox. Common uses for services include connecting to a remote service (IRC bot, Twitter Streaming API client) or starting a server to listen for incoming connections. A service may be deployed as part of a web application or as its own application without any web component. Services have full access to the entire Ruby environment. This means that a service deployed as part of a web application can interact with database models and other application functionality.

2. Service Classes

Each service maps to exactly one Ruby class that should optionally implement `initialize(Hash)`, `start()` and `stop()` methods which should each return quickly. Typically the `start` method will spawn a new thread to start an event loop or other long-running task.

Example 9.1. Service implementation (`my_service.rb`)

```
class MyService
  def initialize(opts={})
    @name = opts['name']
  end

  def start
    Thread.new { run }
  end

  def stop
    @done = true
  end

  def run
    until @done
      puts "Hello #{@name}"
      sleep(1)
    end
  end
end
```

This example service prints a message every second until stopped. By convention the long-running task is executed in a `run` method but could also reside inside the block passed to Thread.new in the `start` method.

3. Deploying Services

Services are deployed by creating a services section inside your application's `torquebox.yml`.

3.1. `torquebox.yml` Services Format

Services reside under a `services` key of `torquebox.yml`. Each key underneath `services` references a Ruby class. Any nested key/value pairs underneath the class will be passed in as parameters to the service's `initialize` method.

Example 9.2. `torquebox.yml`

```
services:
  MyService:
    name: TorqueBox User

  AnotherService:
```

This deploys two services - `MyService` which corresponds to the example above and `AnotherService` which doesn't take any initialization parameters.

Service classes should be available in Ruby's load path. For Rails applications, the convention is to put your service classes in `$RAILS_ROOT/app/services/` and ensure this directory is on your load path.

```
config.autoload_paths += %W(#{config.root}/app/services)
```

4. Clustered Services

4.1. Services Running on Every Node

By default, if a service is deployed to every node in a cluster it will run on each node. This is useful for stateless services.

4.2. High Availability Singleton Services

TorqueBox also supports high availability singleton services. In this scenario, the service only runs on one node in the cluster and if that node goes down it automatically starts on a new node.

To use high availability singleton services, you must start TorqueBox with a JBoss profile that supports clustering. In our binary distribution, this is the `all` profile.

```
$ JBOSS_CONF=all jruby -S rake torquebox:run
```

You also need to add a special `singleton` key with a value of `true` to your services section of `torquebox.yml`. If no `singleton` key is defined or it has a value of `false` the service will run on every node in the cluster.

Example 9.3. `torquebox.yml`

```
services:
  MyService:
    singleton: true
    name: TorqueBox User

  AnotherService:
```

This is the same `torquebox.yml` from the example above but this time `MyService` is marked as a singleton and will only run on one node in the cluster. `AnotherService` will run on all nodes in the cluster since a `singleton` key isn't specified.

5. Resource Injection with Services

If a service requires access to other resources, such as messaging topics and queues, or Java CDI components these should be injected using the resource injection facilities provided by TorqueBox (see Chapter 10, Resource Injection).

In order for resource injection to function with services, they must reside either at the root of your application directory (typical for simple Rack applications), or underneath an `app/services/` directory. If you place the service anywhere else, it may still funciton, but resources injection will not be available.

Resource Injection

1. What is Resource Injection?

Resource injection is the term given a software architectural strategy that moves the responsibility of finding and connecting components to a container, allowing components to remain simple and testable. Components declare what they need, and when instantiated by the container, the container also satisfies those needs.

What's a resource? A resource may be any component within your application, ranging from instances of Java classes, to messaging destinations.

2. Basics of Resource Injection

TorqueBox supports injection within the context of jobs, services, messaging-handlers and web applications. The two key components of using the injection capabilities are:

- Include `TorqueBox::Injectors` in any source file that needs to perform injection. If injection occurs in a super-class, the super class must include `TorqueBox::Injectors`. If injection also occurs in a sub-class, the sub-class must also include `TorqueBox::Injectors`. By including this module, you indicate to the injection analyzer that a given source file should be considered. Inclusion of it does not inherit.
- To inject a value, use the `inject(...)` method (or a variant) with a literal value. Variable interpolation is not supported within the argument list of `inject(...)`. For convenience, the result of the `inject(...)` call would be assigned to an instance value, but this is not required.

For instance:

```
class MyService

  include TorqueBox::Injectors

  def initialize()
    @queue = inject( '/queues/new-accounts' )
  end

  def that_thing()
    inject( com.foo.ThatThing )
  end

end
```

`TorqueBox::Injectors` also provides an `__inject__(...)` method that can be used in classes that override the `inject(...)` method (classes that include `Enumerable`, for example). It is interchangeable with the `inject(...)` calls in any of the injection examples.

3. Injectable Resources

A variety of resources may easily be injected with the `inject(...)` method.

CDI Resources. The Java Context and Depedency Injection (CDI) spec defines a method for managing relationships between components. CDI-enabled components may be injected by providing a fully-qualified Java class name to the `inject(...)` method. Typically CDI components should be packaged in a JAR archive, and placed in your application's `lib/` or `vendor/jars/` directory.

TorqueBox uses the JBoss Weld implementation of CDI. Please see the Weld website [http://seamframework.org/Weld] for more information.

```
class MyService

  include TorqueBox::Injectors

  def initialize()
    @java_service = inject( com.mycorp.MyJavaService )
  end

end
```

JRuby explicitly supports the simple syntax for common US-centric package names starting with `com`, `org`, `net`, `java`, and javax, amongst others. For other top-level packages based on country codes, such as `pl`, `de`, or `za`, to perform injection you should reference your class through the Java ruby package.

```
inject( Java::pl.softwaremine.PolishingService )
```

Messaging Destinations. Message destinations, such as queues and topics, may be injected into your components. If the argument to `inject(...)` includes the string fragment `"/queue"` or `"/topic"`, TorqueBox will inject the relevant `TorqueBox::Messaging::Queue` or `TorqueBox::Messaging::Topic`.

Using injection is the preferred method for obtaining a reference to a destination, to ensure that your job, service or web application relying upon the destination does not begin operation until the destination has been completely provisioned.

```
class MyController < ApplicationController

  include TorqueBox::Injectors

  def create
    notify_topic = inject( '/topics/new-accounts' )
  end

end
```

Naming & Directory Entries. Arbitrary items within the application's naming environment may be injected if the argument to `inject(...)` begins with `"java:comp/env"`.

```
class MyController < ApplicationController

  include TorqueBox::Injectors

  def create
    jndi_item = inject( 'java:comp/env/that_thing' )
  end

end
```

JBoss Microcontainer Beans (MCBeans, MBeans). JBoss Microcontainer is the container that drives the entire TorqueBox AS. Many components are accessible as MCBeans or Java JMX MBeans. These may be injected by passing an MBean style name to `inject(...)`.

```
class MyController < ApplicationController

  include TorqueBox::Injectors

  def create
    the_actual_webserver = inject( 'jboss.web:service=WebServer' )
  end

end
```

4. Variants of `inject(...)`

While the `inject(...)` method is overloaded to detect the correct type of resource, there are occasions where it may guess incorrectly. To overcome this, variant are provided that explicitly direct the injection analyzer to look for a specific type of resource. For string-based injections, the previously mentioned matching rules do not apply to the injection method variants.

`inject_cdi(...)`. Injects CDI resources by literal class name.

`inject_queue(...)`. Injects a messaging queue by literal name.

`inject_topic(...)`. Injects a messaging topic by literal name.

`inject_naming(...)`. Injects JNDI resources by literal name.

`inject_mc(...)`. Injects MCBeans by literal name.

5. Internals and Testing

At runtime, each `inject(...)` method looks up the injected resource through the `TorqueBox::Registry` singleton. In test environments, you may desire to populate this registry, using the `merge!(...)` method, which accepts a key/value `Hash`.

The key for each entry should match either the string argument used with `inject(...)`, or the Ruby version of the Java class name, if performing CDI injection. The value should be an appropriate object.

For instance, the Java class of `java.util.Set` should be converted into a string of `"Java::JavaUtil::Set"` when used as an injection lookup key.

Authentication

TorqueBox provides a simple Ruby interface to the underlying JAAS security framework built into the JBoss Application Server. JAAS (Java Authentication and Authorization Service) is a pluggable security framework which intends to shield application developers from the underlying security implementation. We kept with this approach for TorqueBox and have hidden most all of the implementation details so you can focus on writing your applications.

TorqueBox applications can authenticate against any security policy that you have specified in your JBoss login configuration. To learn more about how JBoss security works and is configured, refer to the JBoss documentation [http://www.jboss.org/jbossas/docs/6-x/Core-Documentation/security.html]. The TorqueBox integration, however, makes authenticating against a corporate JAAS data store trivial.

1. Security Domains

The JBoss Application Server provides security policy functionality that allows application developers to authenticate against one of many named and configured security policies. We refer to these policy names as "domains". TorqueBox ships with a simple authentication domain, named `torquebox-auth` pre-configured in the Application Server. The `torquebox-auth` domain authenticates against a simple users properties file found in `$TORQUEBOX_HOME/jboss/server/default/conf/props/torquebox-users.properties`. There is no need, however, to edit this file directly. To add a new username and password to the security domain, use our rake task:

```
rake torquebox:auth:adduser CREDENTIALS=user:pass
```

The `torquebox-auth` domain is loaded and configured by default when your application is deployed. To authenticate against a different security domain, for example `jmx-console`, configure this in your deployment descriptor as described in the YAML Configuration section.

2. YAML Configuration

TorqueBox authentication is configured in the `torquebox.yml` file or in a separate `auth.yml` by adding an `auth` section. Within this, you may add one or more named authentication handles. For example, let's say your application is a dashboard which allows users to access JMX and HornetQ data. Most of the time, you're going to be using the hornetq domain, but on occasion, you'll want to authenticate against the JMX domain. You can do this within Ruby code by configuring your `auth` section:

```
auth:
  default:
    domain: hornetq
```

```
  jmx:
    domain: jmx-console
```

A handle to the HornetQ authentication domain is now available to you with:

```
authenticator = TorqueBox::Authentication.default
```

and the JMX authentication domain can be obtained with:

```
authenticator = TorqueBox::Authentication['jmx']
```

3. Ruby API

The Ruby API has 3 methods:

- `default`
- `[]( name )`
- `authenticate( username, password )`

The first two methods, `default` and `[]` are used to get the default authentication domain or to lookup an authenticator by name. The last is to actually authenticate a user. To use the Ruby API, include `torquebox` and `org/torquebox/auth/authentication` as shown below. This code shows a simple Ruby authentication module that authenticates agains the JAAS security configuration.

```

require 'torquebox'
require 'org/torquebox/auth/authentication'

module MyApp
  module Authentication

    def login_path
      "/login"
    end

    def authenticated?
      !session[:user].nil?
    end

    def authenticate(username, password)
      return false if username.blank? || password.blank?
      authenticator = TorqueBox::Authentication.default
      authenticator.authenticate(username, password) do
        session[:user] = username
```

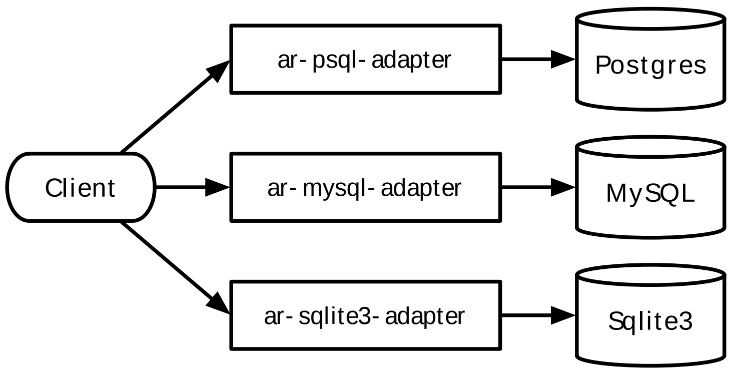
```
      end
    end

    def require_authentication
      return if authenticated?
      redirect login_path
    end

    def logout
      session[:user] = nil
      redirect login_path
    end

  end
end
```

The `authenticate` method accepts a block, allowing you to execute code within an authenticated context.

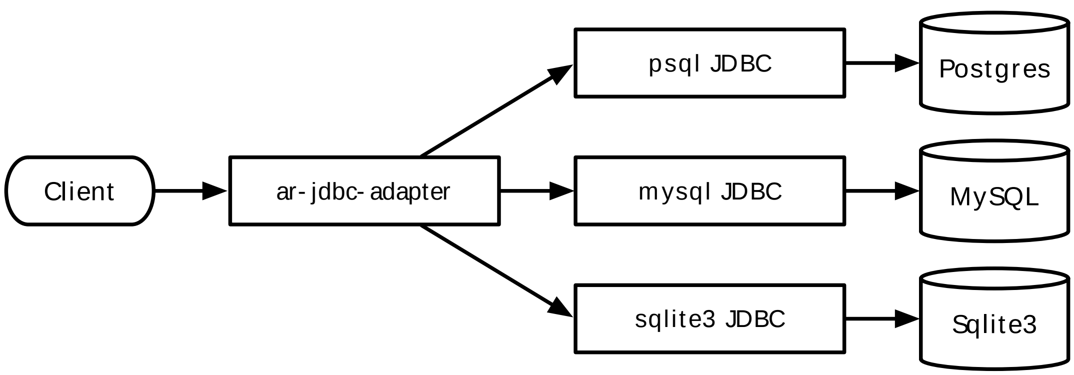
Database Connectivity

1. ActiveRecord

Typical applications require the use of databases. Within the Rails community, ActiveRecord is one of the more popular database connectivity libraries. With traditional Ruby-based applications, you needed to require the correct ActiveRecord adapter for the database you were connecting to. Each adapter managed the communication between the client and the end database, directly mediating the connection.



Since TorqueBox is based on the JBoss Java environment, it has the capability to use enterprise-grade JDBC (Java Database Connectivity API) drivers. Rails applications can take advantage of these drivers by using the generic ActiveRecord JDBC adapter. The adapter will locate and activate the correct underlying Java JDBC adapter for the target database.



The most visible change required of applications using the JDBC-based ActiveRecord adapter involves the gems your application must rely on. Primarily you must rely on the `activerecord-jdbc-adapter`. This adapter is adjusts ActiveRecord configuration to use the JDBC version of any specified driver.

Additional gems need to be available to your system, depending on your target database:

- `jdbc-postgres`
- `jdbc-mysql`
- `jdbc-sqlite3`

These gems simply embody the Java JAR holding the actual underlying JDBC driver.

No changes to your application's database configuration is required. You still specify the correct driver name for the database, such as `postgresql` or `sqlite3`.

2. DataMapper

Not everyone uses ActiveRecord to connect to a database. TorqueBox also works well with DataMapper, and you don't have to do anything special. A Gemfile for an application which uses DataMapper to connect to a PostgreSQL database looks like this.

```
gem 'data_mapper', '~>1.1'
gem 'dm-core', '~>1.1'
gem 'dm-postgres-adapter', '~>1.1'
gem 'dm-migrations', '~>1.1'
gem 'dm-timestamps', '~>1.1'
gem 'dm-observer', '~>1.1'
```

Initializing DataMapper is unchanged.

```
DataMapper.setup(:default, 'postgres://user:pass@localhost/databasename')
```

Runtime Pooling

To run Ruby code inside a Java application server, the TorqueBox platform requires a Ruby interpreter, provided by JRuby [http://www.jruby.org]. TorqueBox provides a simple but flexible means of mapping the app server's threads of execution to one or more Ruby interpreters, giving you complete concurrency control, but the defaults should be reasonable.

1. Types of Runtime Pools

TorqueBox defines three types of pools from which a Ruby interpreter may be obtained:

- Bounded
- Shared
- Global

Bounded pools. A bounded pool is a typical resource pool with minimum and maximum capacity. Each interpreter managed by the pool is given out to a single client at a time. It is unavailable for any other client until the current owner returns it to the pool. The pool will ensure that a minimum number of interpreters are kept in the pool at all times. Additionally, a maximum capacity is specified to ensure that the pool does not grow unbounded. Clients requesting an interpreter from a pool with no available interpreters will block until an interpreter becomes available. Interpreters may become available through other clients returning an existing interpreter, or by the pool spinning up additional interpreters, if it has not reached its maximum capacity.

Shared pools. A shared pool is a false pool. A shared pool contains one Ruby interpreter that is allowed to be shared, concurrently, with an unbounded number of clients. A shared pool may only be used in cases where the application is considered threadsafe. An application's threadsafety may be affected by both framework code and deployment factors. These issues are discussed below.

Global pool. The global pool is a special instance of a shared pool. Advanced applications may take advantage of multiple subsystems, each of which has its own pool. To effectively have subsystems share the same pool, the global pool may be used. Use of the global pool requires extreme care, and should not be undertaken lightly.

2. Subsystem Pools

As noted above, an advanced application may use the functionality of multiple subsystems. Each susbsystem is configured to use a distinct pool in order to provide a modicum of isolation and prevent wayward interaction. The configuration of various subsystem pools are affected by how the application is deployed. Each subsystem is automatically configured using reasonable defaults, but may be completely configured manually through the `pooling.yml` deployment descriptor.

Web (Rack). The web subsystem, powering Rack applications, defaults to deploying a shared pool. Modern frameworks have mostly moved away from their assumption of single-threaded applications.

By using a shared pool, resources are conserved, and a single Ruby interpreter may handle all requests from web clients.

Scheduled Jobs. The pool deployed for the scheduled jobs subsystem varies based on the deployment mode of the application. In `development` mode, automatic code-reloading is desirable, but multiple jobs executing and/or resetting the application within a single interpreter causes race conditions and poor interactions. For this reason, a non-shared bounded pool is configured when the application is deployed in `development` mode. In non-`development` deployments, reloading is disabled, and the race conditions do not exist. In the non-development cases, a more efficient shared pool is configured for the application.

Message Processors. As with the jobs subsystem, asynchronous message processing introduces race conditions between processors executing and processors attempted to reset the application. Likewise, the pool for the message processor subsystem uses a bounded pool when the application is deployed in development mode, otherwise it uses the more efficient shared pool strategy.

3. YAML Configuration

If your application is not designed to be thread-safe, you can instead pool the interpreters resulting in a single-threaded model. You can do this for jobs, messaging, and/or web requests. Typically, if your application creates and uses global variables to manage state for a single web request, you may have problems with the default multi-threaded behavior.

To modify the default interpreter pool configuration, you can add pooling: section to either your application's internal `torquebox.yml` deployment descriptor, or through an external `*-knob.yml` descriptor. This section is always optional, and only required if you wish to modify the defaults.

3.1. Syntax

Within `pooling.yml`, a section may be added for each susbsystem you desire to explicitly configure. Any subsystem not mentioned will be configured with its defaults. Configuration of each type of pool is slightly different.

Subsystem	Key
Web/Rack	`web`
Scheduled jobs	`jobs`
Message Processors & Async Tasks	`messaging`
Services	`services`

Bounded pools. A bounded pool requires two parameters: `min` and `max`. The `min` parameter specifies the minimum number of managed interpreters that pool should initialize itself with. The `max` parameter specifies the largest capacity the pool should ever grow to in order to satisfy client requests.

Example 13.1. Configuring a bounded pool

```
pooling:
  web:
    min: 3
    max: 10
```

Shared pools. A shared pool has no configuration other than indicating a subsystem should use a shared pool.

Example 13.2. Configuring a shared pool

```
pooling:
  web: shared
```

Global pool. A global pool has no configuration other than indicating a susbsystem should use the global pool.

Example 13.3. Configuring a global pool

```
pooling:
  web: global
```

3.2. Examples

Example 13.4. Default development-mode pooling

```
application:
  ...

pooling:
  jobs:
    min: 1
    max: 2
  messaging:
    min: 1
    max: 2
  web: shared
```

The following is the implicit default configuration for an application deployed in `development` mode.

Example 13.5. Default non-development-mode pooling

```
application:
  ...

pooling:
  jobs: shared
  messaging: shared
  web: shared
```

The following is the implicit default configuration for an application deployed in a mode other than `development`.

Capistrano Support

1. What is Capistrano?

Capistrano is a deployment tool to assist in moving code from a repository to a production server. It's a set of tools used from one machine (the deployer), to get an application running on a remote machine (the server).

In many cases, the deployer is a developer working from his or her laptop. Capistrano is installed here. The deployer invokes the tooling locally on his laptop, and Capistrano reaches across the network to set up the right version of the application and activate it within TorqueBox.

2. Installing Capistrano

The TorqueBox distribution includes support for Capistrano, but does not include Capistrano itself. Capistrano requires a few other gems in order to function effectively. It is easy to install everything.

```
$ jruby -S gem install jruby-openssl ffi-ncurses capistrano
```

3. Capify your Application

You can skip this section if you're already using Capistrano with your application. Otherwise, you'll need to `capify` your application to set it up for use with Capistrano.

Ensure that you are in the root of your application's source tree, and run the `capify` command.

```
$ jruby -S capify .
```

This creates a Capfile in the root of your application, which delegates to another file it created: `config/deploy.rb`. The deploy.rb file is the primary location for configuring your deployment strategy.

3.1. Basic deploy.rb configuration

All applications, whether using TorqueBox or another server, require some common settings to be used with Capistrano. The default deploy.rb indicates some typical variables you should customize for your deployment.

4. TorqueBox-specific deploy.rb configuration

Within your deploy.rb, there are a few additional steps and variables you may configure in order to deploy to a remote TorqueBox server.

4.1. Include TorqueBox recipes

First, you should include the Capistrano recipes which support TorqueBox deployments. If you use Bundler, you should also include the Bunlder recipes at this point.

```
require 'torquebox-capistrano-support'
require 'bundler/capistrano'
```

4.2. Set up home variable(s)

Capistrano needs to know some details about how TorqueBox is installed on the remote server. Primarily, it needs to be able to locate JBoss and JRuby.

If you've installed TorqueBox by unzipping the distribution, you only need to set `:torquebox_home` in your `deploy.rb`.

```
set :torquebox_home,    '/opt/torquebox/current'
```

If you have a non-standard installation of the TorqueBox components, you may instead set `:jboss_home` and `:jruby_home` individually.

```
set :jboss_home,        '/opt/jboss-as6'
set :jruby_home,        '/usr/local/jruby'
```

Capistrano uses these values in order to control the TorqueBox AS process, deploy applications to the correct location, and execute Bundler on the remote server if required. If required, you may also set `:jruby_opts` variable to pass to all invocations of JRuby.

4.3. Optionally configuration application variables

Typical usage of Capistrano expects production values to be embedded into your application's `torquebox.yml` file. In the event you need to override some values when deploying with Capistrano, several application variables may be set. If these are un-set, they will not be emitted by Capistrano into the `*-knob.yml` it deploys.

Table 14.1. Application variables

Name	Description
:app_host	String to use a the web virtual host.
:app_context	Application web context.
:app_environment	Hash of name/values for environment variables.

Name	Description
:app_ruby_version	Ruby compatibility version (defaults to 1.8)

4.4. Configure server control style

The TorqueBox AS can be controlled in two different ways. By default, the init.d method is used, but using the bin/ scripts that ship with JBoss is also supported.

init.d. Using a /etc/init.d script, the TorqueBox AS can be integrated into the server's normal service boot sequence and controlled using standard tools and methods enjoyed by sysadmins. By default, Capistrano support assumes the init.d script is located at `/etc/init.d/jbossas`. If you use a differently-named script, simply specify it using the `:jboss_init_script` variable.

```
set :jboss_init_script,    '/etc/init.d/jboss-as6m3'
```

When using an `init.d` script, it is assumed that other details, such as bind IP address, server configuration selection, and other details are set through `/etc/sysconfig` files.

bin/ scripts. If you do not have access to modify scripts under `/etc/init.d`, you may desire to simply use the `run.sh` and `shutdown.sh` scripts under `$JBOSS_HOME/bin` to control the server process. To enable this method of server control, you must set the `:jboss_control_style` variable.

```
set :jboss_control_style,    :binscripts
```

When using `bin/` scripts, you may control additional server properties through your `deploy.rb` file.

Table 14.2. Variables affecting bin/ script server control

`:jboss_config`	`default`	The server profile to use when launching the AS.
`:jboss_bind_address`	`0.0.0.0`	The IP address to bind when launching the AS.

4.5. Perform deployments

Once your application is setup and configured, and your deployment server is prepared, you can begin performing deployments as you normally would.

Disable the AS. TorqueBox AS can work behind another webserver such as Apache httpd. Capistrano supports placing a `maintenance.html` page to be served by Apache when you desire to take down the app server.

```
$ jruby -S cap deploy:web:disable
```

Capistrano will provide instructions for setting up Apache to stop directing requests to the AS when the maintanence page is in-place. When using TorqueBox behind Apache, these rules normally should live in the <VirtualHost> section of your httpd.conf, instead of within an .htaccess.

```
ErrorDocument 503 /system/maintenance.html
RewriteEngine On
RewriteCond %{REQUEST_URI} !.(css|gif|jpg|png)$
RewriteCond %{DOCUMENT_ROOT}/system/maintenance.html -f
RewriteCond %{SCRIPT_FILENAME} !maintenance.html
RewriteRule ^.*$  -  [redirect=503,last]
```

Deploy the application. The Capistrano deployment workflow can occur even if the TorqueBox AS is not currently running. Deployment will not automatically start the AS if it is not running. Deployment will also never restart the server, as new application deployments are automatically recognized by the running AS.

```
$ jruby -S cap deploy
```

Control the TorqueBox AS. You can start and stop the TorqueBox AS independent of deployment activities. When started, all applications that were running when last shutdown will be redeployed.

```
$ jruby -S cap deploy:stop
```

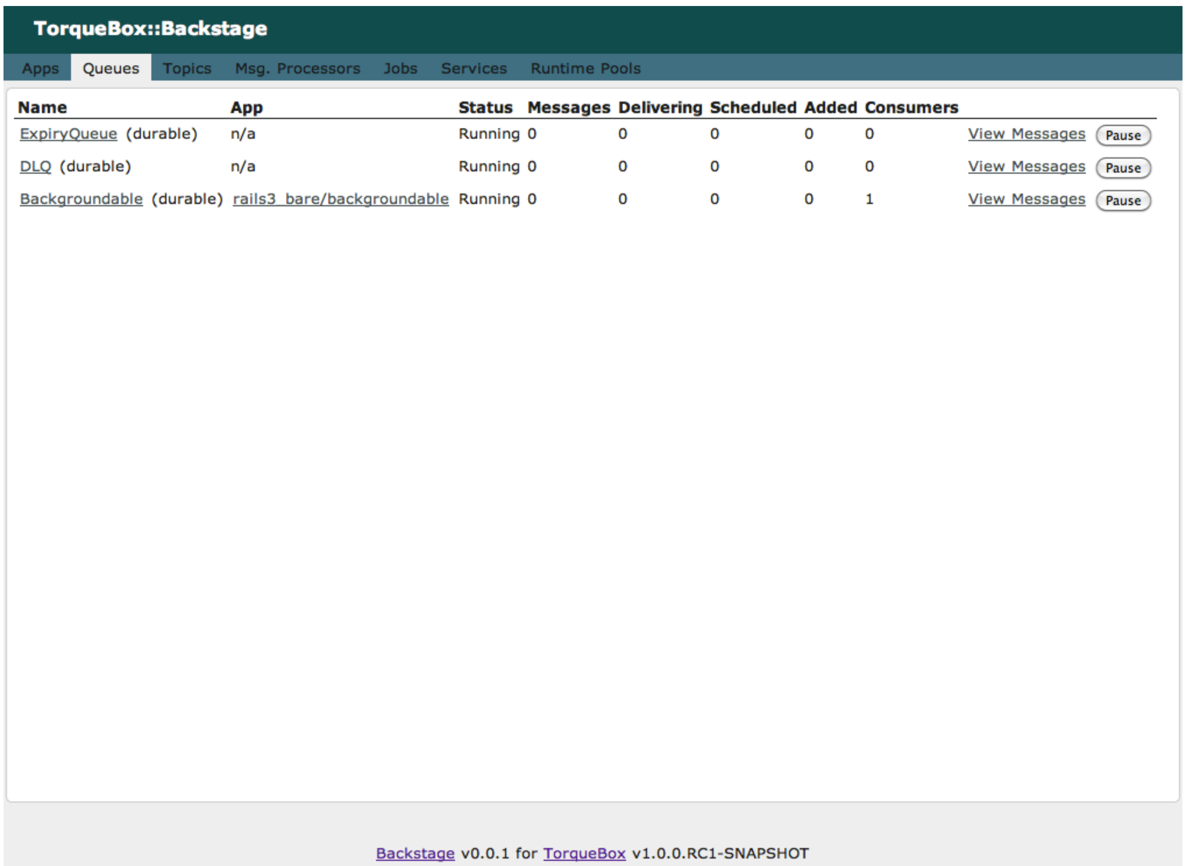
To start the TorqueBox AS and re-deploy all previously-running applications:

```
$ jruby -S cap deploy:start
```

Additional Resources

1. BackStage

BackStage is a Sinatra app that you may deploy within TorqueBox to get additional views and control into your application's components.



1.1. Features

Applications. View all deployed Ruby applications.

Destinations. Enumerate and interrogate messaging queues and topics. Allows browsing of messages within queues.

Message Processors. Control message processors, including pausing their execution.

Scheduled Jobs. Scheduled jobs can be paused.

Ruby Runtime Pools. View information about the runtime pools for all applications. Allows arbitrary script execution within a runtime from a pool.

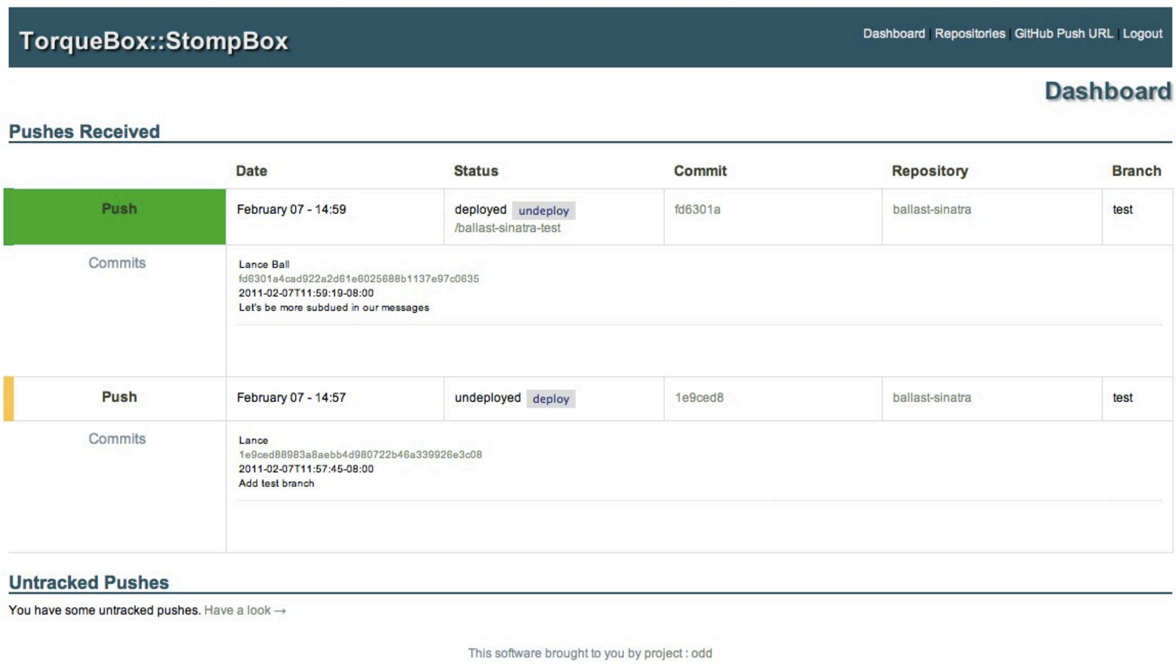
1.2. More Information

More Information About Backstage May Be Found On The Torquebox Website. The Source For Backstage Is Hosted At Github.

- Http://torquebox.org/backstage [http://torquebox.org/backstage]
- Http://github.com/torquebox/backstage [http://github.com/torquebox/backstage]

2. StompBox

StompBox enables easy Git-based deployments to a TorqueBox AS.



By using a post-commit POST-back hook, StompBox is able to check your application code out of the repository and deploy it into the running server.

2.1. Features

Deploy via Git. Using POST-back hooks, deploy code using `git push`.

Multiple Revisions. Roll forward or backward through revisions of your application code.

2.2. More Information

More Information About StompBox May Be Found On The TorqueBox Website. [http://torquebox.org/stompbox] The Source For StompBox Is Hosted At Github.

- Http://torquebox.org/stompbox [http://torquebox.org/stompbox]
- Http://github.com/torquebox/stompbox [http://github.com/torquebox/stompbox]

Appendix A. Licensing

A variety of third-party components are used in the construction of TorqueBox.

JBoss AS & TorqueBox.

JBoss AS and TorqueBox are licensed under the LGPL (see Appendix B, GNU Lesser General Public License version 3). The TorqueBox documentation is licensed under a Creative-Commons license (see Appendix N, Creative Commons Attribution-ShareAlike 3.0).

JRuby and JRuby-Rack.

Portions of code have been borrowed from JRuby (see Appendix C, JRuby Licenses) and JRuby-Rack (see Appendix D, JRuby-Rack License).

Appendix B. GNU Lesser General Public License version 3

JBoss AS and TorqueBox License

Version 3, 29 June 2007

This version of the GNU Lesser General Public License incorporates the terms and conditions of version 3 of the GNU General Public License, supplemented by the additional permissions listed below.

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Version 3, 29 June 2007

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You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

a. Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.

b. Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.

c. Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.

d. Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.

e. Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.

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Appendix H. GNU Lesser General Public License

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Version 2.1, February 1999

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In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

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   (For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

2.5. Section 4

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If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

2.6. Section 5

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However, linking a “work that uses the Library” with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a “work that uses the library”. The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a “work that uses the Library” uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

2.7. Section 6

As an exception to the Sections above, you may also combine or link a “work that uses the Library” with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

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