

Pulsar Core - Release 4.13.0

Pulsar Documentation



Deneb Software Engineering

1 Table of Contents

1	Table of Contents.....	2
2	Introduction	12
2.1	Brief history	12
2.1.1	Release history	12
3	Concepts.....	15
3.1	Dictionary	15
3.1.1	Actions	15
3.1.2	Activators.....	15
3.1.3	Aliases	15
3.1.4	Applications.....	15
3.1.5	Artifacts.....	15
3.1.6	Configuration	15
3.1.7	Dependencies.....	16
3.1.8	Dependency injection	16
3.1.9	Life cycles	16
3.1.10	Modules	16
3.1.11	Packages.....	16
3.1.12	Pulsar.....	17
3.1.13	Repository	17
3.1.14	Resources	17
3.1.15	Services.....	17
3.1.16	Service notifications	17
3.1.17	Start level.....	17
3.1.18	Testing.....	17
3.1.19	Versioning.....	18
4	Development reference	19
4.1	Module system	19
4.1.1	Introduction	19
4.1.2	Some benefits of a modular architecture	19
4.1.3	Modules as building blocks	19
4.1.4	Module Versioning	20
4.1.5	The module activator.....	21
4.1.6	Services and Dependency Injection	22

4.1.7	Module Life cycle	27
4.1.8	Central design patterns	29
4.1.9	Notes on creating a dynamic modular architecture	30
4.2	Development environment	31
4.2.1	Notes on the Pulsar development environment	31
4.2.2	Setting up an application development environment.....	31
4.2.3	Directory structure and essential files	32
4.3	Build and Continuous Integration.....	36
4.3.1	Building a Pulsar module.....	36
4.3.2	Testing a module.....	39
4.3.3	Packaging of one module	39
4.3.4	Packaging several modules into package file.....	39
4.3.5	Continuous builds	39
4.3.6	Pushing changes from a continuous build system to a module repository.....	39
4.4	Pulsar Core Modules	40
4.4.1	Introduction	40
4.4.2	Architectural layers.....	40
4.4.3	Core Modules.....	41
4.4.4	Configuration Manager	43
4.4.5	Database Access.....	44
4.4.6	Frameworks.....	49
4.4.7	Message Manager	53
4.4.8	Message Router	54
4.4.9	Permission Manager	55
4.4.10	Persistent Queues	59
4.4.11	Search modules.....	59
4.4.12	Session Manager	61
4.4.13	SSO Manager	62
4.4.14	Template Manager	62
4.4.15	User Manager	66
4.5	Migrating from earlier versions	68
4.5.1	Introduction	68
4.5.2	Multiple services per module	68
4.5.3	Dependency injection	68
4.5.4	Module activator	68
4.5.5	Semantic versioning	68
4.5.6	Strictly defined API classes.....	69
4.5.7	Use SLF4J for logging.....	69

4.5.8	Changes to core module APIs	69
4.5.9	Coding details	69
4.5.10	Migrating published Web Services	69
4.5.11	Migrating files in the data area	70
4.6	JDK system packages and overrides	71
4.6.1	Introduction	71
4.6.2	Adding your own third party libraries	71
4.6.3	JDK packages exported in Pulsar	71
5	Development guides	75
5.1	Planning a module system	75
5.1.1	Naming a module	75
5.1.2	Dependencies should always be one-way	75
5.1.3	Splitting an application into sub modules	75
5.2	Creating a new module	75
5.2.1	Introduction	75
5.2.2	Steps for creating a new module	76
5.3	Logging for developers	78
5.3.1	Introduction	78
5.3.2	Implementing logging	78
5.3.3	Configuration	79
5.4	Working with Web Services and REST Services	79
5.4.1	Introduction	79
5.4.2	Web Service	80
5.4.3	REST service	81
5.5	Development troubleshooting	82
5.5.1	Introduction	82
5.5.2	Increase the logging output to troubleshoot	82
5.5.3	Use the debugger and set breakpoints	83
5.5.4	Using a command line shell to introspect	83
5.5.5	Using Hot Swap to deploy minor code changes	83
5.5.6	Coding considerations	83
5.6	Handling incoming SMTP-emails	83
5.6.1	Overview	83
5.7	How to access a file programmatically	84
5.7.1	Introduction	84
5.7.2	Warnings	86

5.8	Extending the Pulsar CLI and Shell	86
5.8.1	Publishing a command	86
5.8.2	Invoking a command	87
5.8.3	Invoking a script.....	87
5.8.4	Preventing Pulsar from shutting down after running a command or script from the command line.....	88
6	Operations reference	89
6.1	Installation and upgrades.....	89
6.1.1	Hardware and software requirements.....	89
6.1.2	Installing a new Pulsar instance.....	89
6.1.3	Starting an existing Pulsar instance.....	91
6.1.4	Installing, upgrading and uninstalling modules	92
6.1.5	Running Pulsar as a system service	92
6.1.6	Upgrading Pulsar	93
6.1.7	Removing a Pulsar instance	95
6.2	Repositories.....	95
6.2.1	What is a module repository?	95
6.2.2	Why use a module repository?	95
6.2.3	Different forms of repositories	95
6.2.4	Adding repositories to a Pulsar instance	96
6.2.5	Using an other directory for the repository files	96
6.2.6	Setting up a HTTP repository	96
6.3	Configuration	97
6.3.1	Deployment profiles	97
6.3.2	Module configurations.....	98
6.3.3	Apply configuration at launch	98
6.3.4	Editing Configuration in run time.....	100
6.4	Performance monitor	101
6.4.1	Performance monitoring.....	101
6.5	Logging.....	102
6.5.1	Logs created by Pulsar.....	102
6.5.2	General log	102
6.5.3	Warnings log.....	102
6.5.4	HTTP log	102
6.5.5	Boot log	102
6.5.6	Config log.....	102
6.5.7	Memory log.....	103
6.5.8	Service log	103

6.5.9	Configuration of logging	103
6.5.10	References	104
6.6	Operations troubleshooting.....	104
6.6.1	Recovering from errors during installation or upgrade	104
6.6.2	Recovering from runtime errors	106
6.6.3	Operations errors	106
6.7	SSO - Single Sign On	107
6.7.1	SSO - Integrated Windows Authentication	107
6.7.2	SSO - SAMLv2.....	109
6.8	SMTP Server	112
6.8.1	Features.....	113
6.9	Pulsar Shell.....	113
6.9.1	Built in commands	113
6.10	JDBC-drivers.....	114
7	Support.....	115
7.1	Collecting information for a support request.....	115
7.2	Contact	115
8	Licenses	116
8.1	Documentation License.....	116
8.2	Pulsar License	116
8.3	Open Source Licenses.....	116
9	Component Lifecycle Management (CLM) Policy.....	120
9.1	Background	120
9.2	General	120
9.3	Major components	120
9.3.1	Java Runtime.....	120
9.3.2	Eclipse Jetty	120
9.4	Minor components	120
9.5	Security related updates	120
9.6	License compliance	121
9.7	Notification.....	121

10	Release Notes.....	122
10.1	Release 4.13.0.....	122
10.1.1	Artifacts released in this version	122
10.1.2	Changes since 4.12.0.....	122
10.1.3	Known Issues.....	122
10.2	Release 4.12.0.....	123
10.2.1	Artifacts released in this version	123
10.2.2	Changes since 4.11.1.....	123
10.3	Release 4.11.1.....	123
10.3.1	Artifacts released in this version	123
10.3.2	Changes since 4.11.0.....	124
10.4	Release 4.11.0.....	124
10.4.1	Artifacts released in this version	124
10.4.2	Changes since 4.10.0.....	124
10.5	Release 4.10.0.....	124
10.5.1	Artifacts released in this version	124
10.5.2	Changes since 4.9.0.....	125
10.6	Release 4.9.0.....	125
10.6.1	Artifacts released in this version	125
10.6.2	Changes since 4.8.1.....	125
10.7	Release 4.8.1.....	125
10.7.1	Artifacts released in this version	125
10.7.2	Changes since 4.8.0.....	125
10.8	Release 4.8.0.....	126
10.8.1	Artifacts released in this version	126
10.8.2	Changes since 4.7.3.....	126
10.9	Release 4.7.3.....	126
10.9.1	Artifacts released in this version	126
10.9.2	Changes since 4.7.2.....	127
10.10	Release 4.7.2.....	127
10.10.1	Artifacts released in this version	127
10.10.2	Changes since 4.7.1.....	128
10.11	Release 4.7.1.....	128
10.11.1	Artifacts released in this version	128
10.11.2	Changes since 4.7.0.....	128

10.12 Release 4.7.0	128
10.12.1 Artifacts released in this version	128
10.12.2 Changes since 4.6.2	129
10.13 Release 4.6.3	129
10.13.1 Artifacts released in this version	129
10.13.2 Changes since 4.6.2	130
10.14 Release 4.6.2	130
10.14.1 Artifacts released in this version	130
10.14.2 Changes since 4.6.1	130
10.15 Release 4.6.1	130
10.15.1 Artifacts released in this version	130
10.15.2 Changes since 4.6.0	130
10.16 Release 4.6.0	131
10.16.1 Artifacts released in this version	131
10.16.2 Changes since 4.5.1	131
10.17 Release 4.5.1	132
10.17.1 Artifacts released in this version	132
10.17.2 Changes since 4.5.0	133
10.18 Release 4.5.0	133
10.18.1 Artifacts released in this version	133
10.18.2 Changes since 4.4.0	133
10.19 Release 4.4.0	133
10.19.1 Artifacts released in this version	133
10.19.2 Changes since 4.3.2	134
10.20 Release 4.3.2	134
10.20.1 Artifacts released in this version	134
10.20.2 Changes since 4.3.1	135
10.21 Release 4.3.1	135
10.21.1 Artifacts released in this version	135
10.21.2 Changes since 4.3.0	135
10.22 Release 4.3.0	135
10.22.1 Artifacts released in this version	135
10.22.2 Changes since 4.2.0	136
10.23 Release 4.2.0	136
10.23.1 Artifacts released in this version	136
10.23.2 Changes since 4.1.0	137

10.24 Release 4.1.0	137
10.24.1 Artifacts released in this version	138
10.24.2 Changes since 4.0.4	138
10.25 Release 4.0.4	139
10.25.1 Artifacts released in this version	139
10.25.2 Changes since 4.0.3	139
10.25.3 Release 4.0.3	139
10.25.4 Artifacts released in this version	139
10.25.5 Changes since 4.0.2	140
10.26 Release 4.0.2	141
10.26.1 Artifacts released in this version	141
10.26.2 Changes since 4.0.1	141
10.27 Release 4.0.1	141
10.27.1 Artifacts released in this version	141
10.27.2 Changes since 4.0.0	142
10.28 Release 4.0.0	142
10.28.1 Artifacts released in this version	142
10.28.2 Changes since 3.6.0	143
10.29 Release 3.6.0	143
10.29.1 Artifacts released in this version	143
10.29.2 Changes since 3.5.1	143
10.30 Release 3.5.1	144
10.30.1 Artifacts released in this version	144
10.30.2 Changes since 3.5.0	144
10.31 Release 3.5.0	144
10.31.1 Artifacts released in this version	144
10.31.2 Changes since 3.4.2	145
10.32 Release 3.4.2	145
10.32.1 Artifacts released in this version	145
10.32.2 Changes since 3.4.1	146
10.33 Release 3.4.1	146
10.33.1 Artifacts released in this version	146
10.33.2 Changes since 3.4.0	146
10.34 Release 3.4.0	146
10.34.1 Changes since 3.3.0	146
10.35 Release 3.3.0	148

10.35.1 Artifacts released in this version	148
10.35.2 Changes since 3.2.6.....	148
10.36 Release 3.2.6.....	149
10.36.1 Developer notes	149
10.36.2 Changes since 3.2.5.....	149
10.37 Release 3.2.5.....	150
10.37.1 Changes since 3.2.4.....	150
10.38 Release 3.2.4.....	150
10.38.1 Changes since 3.2.3.....	150
10.39 Release 3.2.3.....	150
10.39.1 Changes since 3.2.2.....	150
10.40 Release 3.2.2.....	151
10.40.1 Changes since 3.2.1.....	151
10.41 Release 3.2.1.....	152
10.41.1 Changes since 3.2.0.....	152
10.42 Release 3.2.0.....	152
10.42.1 Changes since 3.1.0.....	152
10.43 Release 3.1.0.....	152
10.43.1 Changes since 3.0.5.....	152
10.44 Release 3.0.5.....	153
10.44.1 Bug fixes.....	153
10.45 Release 3.0.4.....	153
10.45.1 Changes since 3.0.3.....	153
10.46 Release 3.0.3.....	153
10.46.1 Changes since 3.0.2.....	153
10.47 Release 3.0.2.....	154
10.47.1 Changes since 3.0.1.....	154
10.48 Release 3.0.1.....	154
10.48.1 Changes since 3.0.0.....	154
11 Documentation Notes.....	155

2 Introduction

Pulsar is both a platform and an architecture focused on web based systems. As a platform Pulsar contains a server runtime which can host a number of applications, built in and developed by third parties. The platform also contains a delivery system by which applications can be packaged, delivered and deployed to Pulsar instances. As an architecture Pulsar provides guidelines for the development of applications and provides tools to support the entire development process.

2.1 Brief history

The development of the Pulsar platform began in 1997 and version 1.5 was released in 1999. Pulsar 1.9 was released in 2006. The development of Pulsar 3.0 started in 2013 and constitutes a major redesign of the core framework.

2.1.1 Release history

Version	Release Date	Codename	Key feature
1.2	2001-01-15		
1.5	2001-02-22	Galahad	
1.6	2001-08-22	Zoot	
1.7	2002-03-06	Bedevere	
1.8	2004-09-14	Arthur	
1.9	2006-04-10	Camelot	
2.0	2007-09-21	Excalibur	
2.1	2008-05-27	Excalibur	Presentation and SQL frameworks.
2.2	2009-03-03	Excalibur	JDK 6.
2.3	2010-05-05	Excalibur	Grouped overviews in presentation framework.
2.4	2011-11-02	Excalibur	
2.5	2011-12-11	Excalibur	SSO support.
2.6	2013-03-28	Excalibur	Support for UI levels.

Version	Release Date	Codename	Key feature
3.0	2014-09-25	Merlin	New service oriented module system and dependency injection.
3.1	2014-11-14	Merlin	New search module for searching in filesystem and databases.
3.2	2014-12-08	Merlin	Support for auditing plugins in DatabaseAccess.
3.3	2015-05-12	Merlin	Support for IWA ¹ .
3.4	2015-08-21	Merlin	Support for incoming SMTP-mail.
3.5	2015-10-28	Merlin	Support for permission for HTTP-methods in RS/WS.
3.6	2016-03-10	Merlin	Support for loading of config files on installation.
4.0	2016-09-19	Lancelot	Support for service extension required to handle SPA-UI feature routing.
4.1	2017-06-21	Lancelot	JDK 8 is required.
4.2	2017-09-20	Lancelot	Upgraded HTTP-library Jetty to 8.2.0. Support for ANSI-joins in Frameworks.
4.3	2017-11-28	Lancelot	Support for separation of sessions per access scope, i.e. port.
4.4	2018-05-14	Lancelot	SSO SAMLv2 Support.
4.5	2018-06-27	Lancelot	New WatchDog module. Charts in PerformanceViewer.
4.6	2018-12-18	Lancelot	Support for shared repository files. Presentation of repository and directory information in AdminConsole. Automatic generation of dependency info files. Improved module shutdown handling. Multiple bug fixes.

¹ http://en.wikipedia.org/wiki/Integrated_Windows_Authentication

Version	Release Date	Codename	Key feature
4.7	2020-03-03	Lancelot	Support for batch commands, script automation and improved configuration automation.
4.8	2020-12-22	Lancelot	Pulsar Doctor
4.9	2021-01-18	Lancelot	Built with AdoptOpenJDK
4.10	2021-05-17	Lancelot	Time-based One-Time Password
4.11	2021-10-25	Lancelot	Upgraded libraries; mail (javax.mail 1.6.2) and Apache Commons Daemon (1.0.15)
4.12	2022-03-11	Lancelot	API for crypt/decrypt password
4.13	2023-01-16	Lancelot	Upgraded Microsoft SQL Server JDBC driver

3 Concepts

This section provides an introduction to and a definition of the concepts which are used in the rest of the Pulsar documentation.

3.1 Dictionary

3.1.1 Actions

An action is an event generated by a client. For example an HTTP request from a web browser to a specific page template provided by a specific module. The action is then defined by the template path and name. Other types of actions are calling a Pulsar method from JavaScript or invoking a REST or Web Service.

3.1.2 Activators

Each module can have zero or one activators. The activator is a class that the module uses to interact with the Pulsar lifecycle management. Methods in the activator are called by Pulsar when the module is installed, upgraded, started or stopped.

3.1.3 Aliases

Services and modules must all have unique names to identify them internally for dependency and versioning purposes. However these names may be too cumbersome or internal to use in contexts where they are exposed to end users, for example in URLs. Therefore aliases may be used to shorten service and module names and hide internal implementation details.

3.1.4 Applications

Applications consist of one or more Pulsar modules. An application is a loose grouping of, usually, interdependent bundles. There are no strict rules regarding what modules should define an application. The application concept is just a way of organizing Pulsar modules in a hierarchy and create artifact names based on this hierarchy. The hierarchy may be used to create a composed deployment artifact containing multiple modules but the modules may also be packaged as separate artifacts.

3.1.5 Artifacts

An artifact is a binary file created in the packaging (distribution preparation) process. Artifacts created by Pulsar may contain one or more modules and their resources.

3.1.6 Configuration

Pulsar provides a configuration model that every Pulsar module can use. The configuration model is based on a default module configuration which is packaged with the module. When first installed in a Pulsar instance the default configuration is applied. Pulsar provides services and user interfaces through which the configurations of

modules can be updated. The updated configurations are then persisted internally, between restarts, by the Pulsar instance.

3.1.7 Dependencies

Modules depend on functionality and resources in other modules. Dependencies are defined between packages and expressed as a version range for which the dependency is satisfied. Dependencies are handled transiently which means that the complete chain of dependencies will need to be satisfied for a consistent system state to be achieved.

3.1.8 Dependency injection

Dependency injection is a programming style which strives to make dependencies between code objects explicit. One of the benefits is that it makes code more testable. A very much simplified description is that all the dependencies (other objects) needed by an object should be provided as parameters when the object is created. Without some kind of library support for dependency injection the number of parameters that needs to be passed around can grow quite substantially. Therefore libraries and tools are often used to manage the process of dependency injection. Pulsar has adopted the Google Guice model of dependency injection and also uses Guice under the hood.

Pulsar provides dependency injection locally (local binding) within modules as well as between modules (service publish/consume).

The concept of dependency injection is well established within the software development community. See this [Wikipedia article](https://en.wikipedia.org/wiki/Dependency_injection)² for further information.

3.1.9 Life cycles

Modules and services have life cycles within the Pulsar lifecycle which means that a module can be loaded, started, stopped and unloaded while Pulsar is running. Similarly services have a lifecycle within the module. Services may be published and unpublished while a module is running, but usually they are published when a module starts and are unpublished when a module is stopped.

3.1.10 Modules

A Pulsar module is the typical modular building block. The Pulsar module can have import dependencies on packages and services and also export packages and services for use by other modules. Pulsar modules are packaged as jar-file artifacts. The Pulsar module concept is used both for development of the Pulsar platform and during application development using the Pulsar platform

3.1.11 Packages

A package in Pulsar is the same as a Java code package. Packages are versioned using the [semantic versioning](https://semver.org/)³ strategy.

The term package is also used to mean a packaged repository. See "Repository".

² https://en.wikipedia.org/wiki/Dependency_injection

³ <https://semver.org/>

3.1.12 Pulsar

Pulsar is a system architecture and a platform for running modules developed according to the architecture. Pulsar also provides development tools to support developers in the development of Pulsar modules.

Pulsar is more or less application agnostic but provides a lot of functionality specific to web centered applications. However, the core architecture of Pulsar can be used to develop any kind of Java application.

3.1.13 Repository

A repository is an indexed set of modules which can be searched by Pulsar to retrieve modules and all their dependencies. Multiple repositories can be used by one Pulsar instance and each repository may contain several different versions of each module. Repositories can be used to distribute modules both during development and in production systems.

A repository can reside on a HTTP server or a local disk as a number of jar-files and an index file. Repositories (index and jar-files) can also be packaged into files and are then given the file extension ".pulsar". Pulsar provides tools to create the index file and perform the packaging.

3.1.14 Resources

Pulsar resources include all non Java code resources that might be packaged within a module. For example html templates, stylesheets, localization data, configuration files or other static data.

3.1.15 Services

Services are Java objects which are published by one module and possibly consumed by one or more other modules. Services are usually published on module start and unpublished during module shutdown.

3.1.16 Service notifications

Service notifications are asynchronous callbacks which are invoked by Pulsar when a service becomes available or unavailable, i.e. when it is published or unpublished by the providing module. These notifications are used to utilize dynamic runtime service dependencies.

3.1.17 Start level

When installed, each module is assigned a start level. The start level is used to control the order in which modules are started (activated) when Pulsar is booted. Note that the start level only applies during Pulsar boot. When the system is booted modules may be installed/stopped/started independently of their start level.

3.1.18 Testing

When referring to testing, this means running an automated test suite. Each module should have a suite of tests that validate it's functionality. When a test validate functionality inside of one module without other modules being involved (they might be mocked or just not needed), it is called a Unit Test. When a test validates a module API from the "outside" and involves other modules in the test, it is called an Integration Test.

3.1.19 Versioning

Modules and packages are versioned which means that they are assigned a version number. The version number of a module is visible in the file name of the module artifact. The version number of each package is used internally to determine that all dependencies between modules are satisfied.

Pulsar uses [semantic versioning](http://semver.org/)⁴, which is a system of rules used to decide how the components of a version number should be incremented when the code in a package is changed or how a module version should be updated if package versions are changed.

⁴ <http://semver.org/>

4 Development reference

4.1 Module system

4.1.1 Introduction

Modules are the basic building block in the Pulsar architecture. A module is also the smallest deployment unit. Modules are then organized into layers or groups which are then composed into entire applications or systems. Pulsar defines the module but leaves the layering and composition open and to be guided by the specific requirements and architecture of the system.

Pulsar also combines modularity with dynamism which provides the capability to deliver and update modules in runtime, without the need for a restart of the application process.

Each module may publish services and consumes service, published by other modules. To keep the code syntax succinct and easy to understand Pulsar embraces the concept of Dependency Injection to deliver services used between modules. Dependency injection is also an enabler for better unit testing both for integration tests and unit tests.

4.1.2 Some benefits of a modular architecture

Structured modularity has enormous long term benefits both during system development, deployment and maintenance.

During system design it provides the ability to reason separately about well defined parts of the system without having to know the internals of each part. This provides the base for flexible system architecture which can be models and remodeled as the requirements change and the system evolves.

During development the boundaries between parts of the system become clear which makes it easier to reason about interfaces between modules and the responsibility of modules. Team responsibilities can be more easily assigned and work can be performed in parallel.

During deployment and maintenance the modular structure allows for flexible deployment and upgrades of newer versions or additional modules as the system evolves.

4.1.3 Modules as building blocks

Modules are the building blocks in Pulsar. Each module contains packages (defined in the Java code), published services (Java interfaces) and resources (any type of file).

Packages

The Java packages, and the Java classes belonging to these packages, are used to identify and limit what parts of the module code may be accessed by other modules. Pulsar uses a package name pattern to identify which packages should be exported for use in other modules. If a package contains a level called 'api' then it is automatically exported by Pulsar. Package dependencies is also used to determine transient module dependencies during installation and upgrades.

When a module is loaded in Pulsar the packages it exports are made available to other modules which require it's classes. Classes needs to be exported when they are used as parameters or return values in services i.e shared value objects. Packages dependencies doesn't need the module to be started and are removed when when a module is uninstalled.

Services

A service in Pulsar is basically a Java interface class. The service defines a set of Java methods which can be invoked by a service user. Services can be used internally and from other modules, using the same syntax. This makes it easy to create a service which one module and the extract it to a separate new module as part of a refactoring action. Services can only be published when a module is the started state. Services are even more dynamic than packages. In Pulsar services may be added by a module after it has been started. All services are automatically shut down when a module is stopped.

Resources

Resources are files that are used by the module like HTML files or configurations files. Resources are mostly accessed by Pulsar internally but may also be exposed and shared between modules. In most cases it is recommended to keep module resources private. If they should be available to other modules this can be achieved with more control through a published service API. Resources are not made available in Pulsar unless a module is started.

4.1.4 Module Versioning

Pulsar uses semantic versioning. For an introduction to semantic versioning please find more information at <http://www.semver.org>.

Modules

The module version is the version of the entire module and should be updated whenever anything in the module is changed. Module versions is a part of the filename used for module artifacts. Modules are versioned through the `@PulsarModule` annotation which placed the `package-info.java` file in the master package, together with the symbolic name (unique identifier) of the module and other meta data which is later used by Pulsar. A Pulsar module requires exactly one `package-info.java` file with the `@PulsarModule` annotation to be present.

package-info.java

```
@PulsarModule(
    symbolicName ="symbolic.name",
    version="1.2.3",
    startLevel="100",
    presentationName = "Presentation name",
    description = "Longer description of the module"
)
package ...;
import se.dse.pulsar.core.api.PulsarModule;
```

Optionally a "startLevel" attribute may be used. The start level determines the module start order and is used to roughly order the modules to allow them to publish their services in an order which corresponds to the module inter dependencies. Pulsar uses start levels 0 to 99 internally. Start levels 100 to 999 may be used for your modules.

Packages

Package are version through the standard Java mechanism for adding package meta data, the `package-info.java` file. Each api package must have this file and must be versioned according to the principle of semantic versioning. The package version is stored as meta data in the module artifact and used during dependency resolution.

`package-info.java`

```
@Version("3.5.0")
package com.example.api;
import aQute.bnd.annotation.Version;
```

Interfaces

Interface classes can have two different roles in a module system. The first, default role is consumer type interfaces. This means that the module exporting the package also provides an implementation for it and that any importers of the interface should not implement it. The second role is provider type interfaces, where (one of) the importing bundle is expected to provide an implementation of the interface (SPI model). The two roles differ in how the semantic versioning dependency should be handled.

Basically, any provider type interfaces should be annotated with `@ProviderType`. This will tighten the dependency from the importer to the exporter of the interface.

Services

Services interfaces are versioned through the Java package they reside in. As a consequence all services interfaces in the same package are versioned together. It is therefore useful to separate different API aspects in sub packages to the main api package to version them independently.

4.1.5 The module activator

A module activator is a special Java class used to activate a module. Modules must have exactly one activator and it is defined by that it extends the class `PulsarActivator`. The only requirement is that the `init(ModuleContextBuilder)` method is implemented. The `PulsarActivator` is used to publish services, consume services and perform any initialization or cleanup needed during the starting or stopping of the module. Service publishing and consumption is handled through the `ModuleContextBuilder` interface which is provided as a parameter to the `init` method.

For details on the methods in `PulsarActivator` please see the JavaDoc.

The example below shows a complete activator which consumes the `MessageManager` service which is provided by Pulsar.

```
package com.example.module.alfa;
import se.dse.pulsar.core.api.ModuleContextBuilder;
```

```
import se.dse.pulsar.core.api.PulsarActivator;
import se.dse.pulsar.module.messagemanager.api.MessageManager;

public class AlfaActivator extends PulsarActivator {
    @Override
    public void init(ModuleContextBuilder i_contextBuilder) {
        i_contextBuilder.consume(MessageManager.class);
    }
}
```

4.1.6 Services and Dependency Injection

Service publication

A published service must be a Java interface. The publication can be backed by either a class or an object instance which implements the interface. To enable customized services where the behavior somehow is dependent on the consumer, a service factory can be used. See JavaDoc for details.

```
i_contextBuilder.publish(MyService.class).usingClass(MyServiceImpl.class); // publish using a class

MyOtherService l_otherService = new MyOtherService();
i_contextBuilder.publish(MyOtherService.class).usingInstance(l_otherService); // publish using an
instance

PulsarServiceFactory l_myFactory = new MyFactory()
i_contextBuilder.publish(MySpecialService.class).usingFactory(l_myFactory); // publish using a factory
```

Service publishing and local binding must be uniquely resolvable. Therefore a module may not publish or bind locally the same service interface more than once. Sometimes multiple services of the same interface (variants) needs to be published, then each publication needs to be uniquely named using the `ModuleContextBuilder` at publication/bind time.

```
i_contextBuilder.publish(MyService.class).usingClass(MyServiceImpl.class); //
default implementation
i_contextBuilder.publish(MyService.class).usingClass(MyServiceSecureImpl.class).named("secure"); //
secured implementation
```

Scopes

A service published with an implementation class always have a scope which determines when a new instance of the service should be created. The scope is determined by the implementation class and defined through annotations.

Scope	Implementation class annotation used	Description	Instantiation
Module	none	A new instance of the service is provided to each module which is using it. Each injection within a module will share the same service instance.	Once for each consuming module.
Singleton	@Singleton	A single instance is used during the entire lifecycle of the publishing module. All consumers share this instance.	Once when module starts (during injector creation).
Instance	-	When an object instance is published this instance is always used.	Manually before publication.
Custom	-	A PulsarServiceFactory can be used to create new instances depending on custom parameters. The factory may also decide whether consuming module or inject points should share service instances to receive separate ones.	Factory is instantiated manually and the factory then controls service instantiations.

Service consumption (injection)

Any service published by any Pulsar module can be consumed by any other module, including the publisher, through dependency injection. All services that a module wants to consume must be declared in the module activator.

```
i_contextBuilder.consume(MessageManager.class);
i_contextBuilder.consume(MyService.class);
```

Once the service is declared through `consume()` it may be injected in any constructor in any module class using dependency injection.

```
@Inject
public MyClass(MessageManager i_messageManager, MyService i_myService) {...}
```

To inject a specific service variant use the `@Named` annotation.

```
@Inject
public MyClass(MessageManager i_messageManager, @Named("secure") MyService i_myService) {...}
```

To inject all available instances of a service an `Iterable` is used at inject time. The iterable service injection is used to implement the [Whiteboard design pattern](#)(see page 29).

```
@Inject
public MyClass(Iterable<MyService> i_myServices) {...}
```

Standard module services

Pulsar provides standard services to all modules by making them automatically available for constructor injection. To avoid collision with module defined services the Pulsar standard services require the use of parameter annotation `@Module` when injected. The difference between standard module services and other services is that the standard services doesn't have to be explicitly consumed by the module, they are always available for constructor injection.

Service	Example	Description
ExecutorService	<p>In consuming class:</p> <pre>@Inject public MyClass(@Module ExecutionService i_eService) {...}</pre>	<p>The <code>ExecutorService</code> has been available in the JDK since 1.5. Pulsar provides a instance of this service to each module. The service is created during module startup and is shutdown automatically when the module is stopped.</p> <p>When module functionality requires concurrency this service is the recommended way to perform tasks asynchronously since the threads are automatically monitored by Pulsar and is handled within the Pulsar Module Lifecycle.</p> <p>The service provided is created using <code>Executors.newCachedThreadPool()</code>. See JDK documentation for more information.</p> <p>Important note: Since threads are reused in the <code>ExecutorService</code> exceptions thrown needs to handled either within the <code>Runnable</code> or <code>Callable</code> provided or according to the <code>Future</code> api, see JDK documentation.</p>
ModuleInjector	<p>In consuming class:</p> <pre>@Inject public MyClass(@Module ModuleInjector i_injector) {...}</pre>	<p>The <code>ModuleInjector</code> is used to consume services or construct locally bound objects. When objects needs to be dynamically constructed or when services are consumed dynamically the <code>ModuleInjector</code> should be used.</p> <p>Important note: Sub contexts created in method <code>PulsarActivator.start()</code> are not supported for injection through the standard <code>ModuleInjector</code> service. Only</p>

Service	Example	Description
		bindings defined in <code>PulsarActivator.init()</code> will be available.

Service notifications

Since services may be published or unpublished by their providing module at any time it is useful to be able to register a notification callback when consuming a service. Pulsar supports notification callbacks for injected services. A notification listener is registered with the injected service object and notifications are then provided by Pulsar.

To register a notification listener, first cast the service object to a `PulsarServiceNotifier` and then use `registerListener()` to add the listener.

```
private volatile boolean serviceInitalized = false; // volatile since multiple threads may access it
concurrently

@Inject
public MyClass(MyService i_myService) {
    PulsarServiceNotifier l_myServiceNotifier = (PulsarServiceNotifier)i_myService;
    l_myServiceNotifier.registerListener(new PulsarServiceNotifier.ServiceListener() {
        @Override
        public void onAvailable() {
            try {
                i_myService.setup();
                serviceInitalized = true;
            } catch (ServiceUnavailableException e) {
                // Note: Service may become unavailable at any time, so we need to be prepared to
                handle that.
            }
        }
        @Override
        public void onUnavailable() {
            serviceInitalized = false;
        }
    });
}

// ... more code using the serviceInitalized field ...
```

Some important notes on service notifications:

- All invocations to the listener methods are made using separate threads. The event receiver may preform any kind of work on these thread and there are no restrictions on the duration for which these events are processed. However only one event may be processed at a time. Pulsar will hold any subsequent notifications until the current event has finished processing.

- The `onAvailable()` method will be invoked directly if the service is available when the listener is registered. If the service is not available when the listener is registered `onAvailable()` will be invoked asynchronously when the service becomes available.
- Pulsar guarantees the invocation order between `onAvailable()` and `onUnavailable()`. I.e. when an `onAvailable()` event has been fired `onAvailable()` will only be invoked again if `onUnavailable()` has been invoked in between.
- If the service state changes, one or multiple times, during event processing, these changes will be dampened until the current processing is complete. I.e if an available-event is being processed, two concurrent unavailable and available-events will cancel each other out.
- Since services may become unavailable at any time there is no guarantee that service invocations made within the `onAvailable()` method won't throw a `ServiceUnavailableException`.

Listener unregistration is optional. Any remaining listeners will be automatically cleaned up when the Pulsar module is stopped.

Service invocation

When a service has been injected it's methods can be invoked as any other java object. However, since modules can come and go in runtime, as a result of modules being installed, uninstalled and upgraded there is no guarantee that a the backing service still will be available when invoked. To handle this dynamism Pulsar uses service proxies on injection. The proxy then invisibly handles the invocation according to the invocation strategy selected when the service was consumed.

Services may be consumed using three different strategies

Consume strategy	Description	Code example
Default	When a matching service is not available at invocation time a <code>ServiceUnavailableException</code> is thrown directly.	<pre>i_contextBuilder.consume(MessageManager.class);</pre>
Timeout	When a matching service is not available at invocation time the invocation will be halted until a matching service becomes available or a timeout expires.	<pre>i_contextBuilder.consume(MessageManager.class) .invokeTimeout(5000); // waits for service, // max 5 seconds</pre>
Block	When a matching service is not available at invocation time, block the invocation until a matching service becomes available.	<pre>i_contextBuilder.consume(MessageManager.class) .invokeBlocking(); // waits for service // indefinitely</pre>

As long as a service is available when an invocation is done Pulsar guarantees that the service will not be unloaded until an ongoing method invocation is completed. Even if the module providing the service is requested to stop during the ongoing invocation the release of the service will be delayed until the invocation is complete and the service is no longer in active use.

Local binding (injection)

Every Pulsar module may also use internal dependency injection where the bound objects can be injected in the same way as consumed services. Locally bound services are not available to other modules and can only be used within the module.

```
i_contextBuilder.bindLocal(MyService.class).usingClass(MyServiceImpl.class);
```

Pulsar also support assisted injection through factory interfaces.

Important notes on Constructors and Dependency Injection

Avoid placing any method calls and logic in a class constructor To ensure that the code which uses dependency injection can be easily debugged, never do any real work in the objects constructor. Ideally the constructor should only assign `private final` variable with the injected constructor parameters. When an exception is thrown in a constructor during dependency injection this exception is handled by the dependency injection code and the complete stack trace is not displayed and debugging is much more difficult. Therefore the dependency injection and other types of initialization should be clearly separated.

A constructor in a class that uses dependency injection should look like the following example:

```
package com.example.good

import javax.inject.Inject;

public class GoodExample {

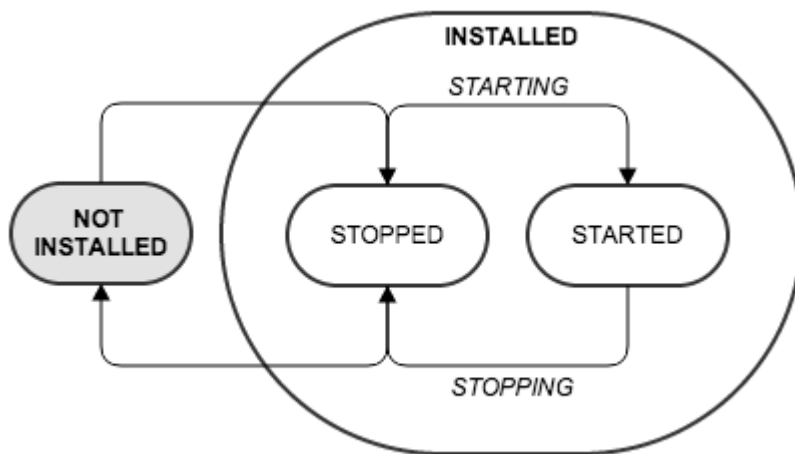
    private final ExampleService exampleService;
    private final OtherService otherService;

    @Inject
    public GoodExample(ExampleService i_exampleService, OtherService i_otherService) {
        exampleService = i_exampleService;
        otherService = i_otherService;
        // do nothing more here!
    }

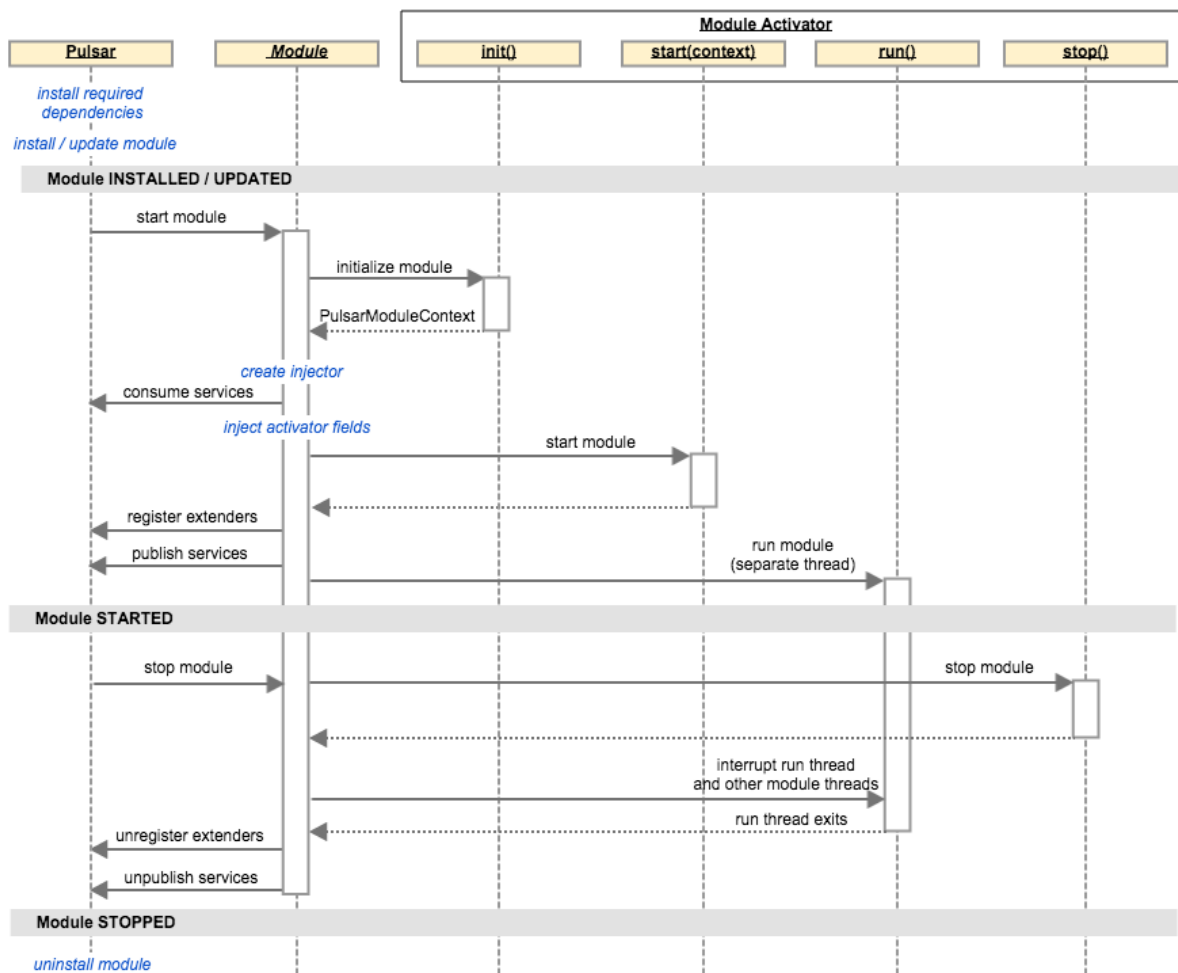
    ...
}
```

4.1.7 Module Life cycle

Pulsar defines the lifecycle of each module. The module lifecycle has two levels, deployment state and activation state. The deployment states are NOT INSTALLED and INSTALLED. And the activation states, which are sub states of the INSTALLED deployment state are STOPPED and STARTED. The activation state also has two transient modes which are STARTING and STOPPING.



The sequence diagram below describes the details of the module lifecycle and how the module and Pulsar interacts.



Lifecycle methods

Starting

Pulsar defines four lifecycle methods in a Module Activator, only one `init()` is mandatory to implement. The methods `init()` and `start()` are executed synchronously but on separate threads, taken from a thread pool. The `run()` method is executed on the same thread pool but in an asynchronous way which allows the implementor of the activator to hold on to the run-thread for any long running tasks.

To provide a consistent runtime environment Pulsar uses a module specific thread group to monitor all the threads used for lifecycle management, and all threads spawned from these. This also allows Pulsar to define the thread context class loader as the module class loader.

Stopping

Before invoking the `stop()` method Pulsar will shut down the dedicated thread pool for the module and then check for any active threads. If active threads are found these are passed, as an array parameter, to the `stop() - m` method. The `stop()` method is expected to shut down the threads which are still active and release any other resources which otherwise risks to be left behind as leaks.

If the `stop()` method fails to shut down all active threads Pulsar will log a warning for each surviving thread since this is a possible resource leak. To prevent false warnings when execution services are used, parked threads are not flagged as leaks.

The `stop()` method is executed synchronously directly on the event thread and should never perform allocation of new resources. Its implementation should also be quick to execute and never block.

Module dependencies and Lifecycle

When a module is stopped its services are also unpublished automatically. This means that other modules will not be able to access these services until the module publishing them is started again. Calling a service which is not available will throw a runtime exception of type `ServiceUnavailable`. See "Service invocation" for different options/strategies on invocation.

When a module is uninstalled all modules which import packages from that module will be stopped, since the classes in the packages imported are no longer available. This may result in a cascade of modules being stopped. To control the lifecycle behavior of dependent module it is necessary to have a carefully planned module structure. Undesirable dependencies can often be refactored into a structure where updates to one module will cause minimal disruption to others.

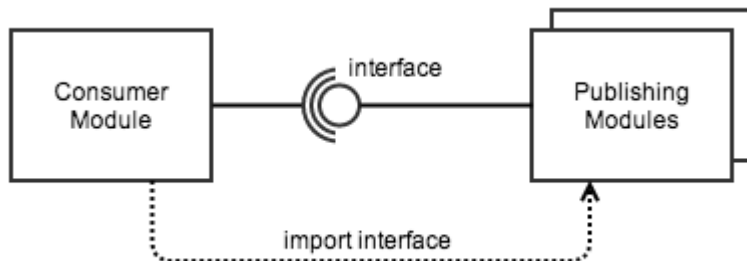
4.1.8 Central design patterns

Whiteboard

The whiteboard design pattern is central to service oriented architectures. Modules participating in the Whiteboard pattern typically consists of one listener module and zero or more modules publishing services. In a nutshell this pattern allows developers who wants to add functionality to the system, to do so simply by publishing services. Or in other words publish something on a board where it is then picked up by the system. The system then handles

these service publications appropriately. In a dynamic service environment it is usually easier to publish a service compared to consuming one. This pattern also loosens the coupling between modules, which is good.

Pulsar supports the Whiteboard pattern through its publish consume model. The publishing part simply publishes the service according to the interface specified by the consumer module. The consumer consumes the same interface and injects an iterable over the same interface to be able to find all the service instances.



Extenders

The extender pattern describes how a module can act as an extender of another module. In this context extending means adding functionality to. An extender needs to know when an extendable module becomes available or is removed from the system, therefore extenders are implemented as listeners which can receive events about other modules and their services.

Module extenders

The extender pattern complements the whiteboard pattern since it can act on the configuration or resources of a module without the module having to publish any services. An extender may even publish services on behalf of a module it extends. In Pulsar, module extenders are classes registered through the `ModuleContextBuilder` using the `extendUsing()` method. When a module matches the given header or resource the implementation of the `PulsarModuleExtender` gets notified.

NOTE: If multiple extenders are used it is advisable not to have dependencies between these extenders. The order in which the different extenders are notified about a module becoming available or disappearing is currently undefined.

Service extenders

A service extender works the same way as a module extender, but instead of extending entire modules, it listens for services with specific properties. Service extenders are typically used to collect different instances or implementations of a service interface and facilitate the delegation to these services using some given criteria.

Service extenders are registered through the `ModuleContextBuilder` using the `extendServicesUsing()` method. When a service matches the given interface or property filter the implementation of the `PulsarServiceExtender` gets notified.

4.1.9 Notes on creating a dynamic modular architecture

The first step towards creating a modular architecture is to decide on which modules are needed. These general rules may help:

1. Avoid complex dependencies by never allowing circular dependencies between modules. The module graph should be directed and not contain any loops.
2. Identify common value objects and refactor them to separate modules which can be reused throughout the system.
3. When designing a modules public API it is essential to keep it simple. Avoid API state where possible.
4. Keep the value objects, parameters and return values, simple and immutable where possible.
5. Module APIs should be fairly stable (forward compatible) to avoid unnecessary downstream adaption work.

4.2 Development environment

4.2.1 Notes on the Pulsar development environment

The development environment is the set of directories, files, tools and processes used to develop modules for the Pulsar system. Pulsar dictates some core parts of the directory structure. But most of the development environment is up to the developer or architect to decide up on. This documentation will describe what is mandatory and what the best practices are for setting up a development environment for Pulsar module development.

There are many different integrated development editor (IDEs) and Pulsar module development should be possible using any of them. Here the general case is described, using the command line for scripts and any code editor for file editing.

4.2.2 Setting up an application development environment

Setting up Pulsar

Pulsar is distributed, by DSE, in five components/files:

Component	Distribution file	Description
Launcher	pulsar.launcher-version.jar	The launcher is an executable jar file.
Pulsar Core Modules	pulsar-modules-version.pulsar	A packaged artifact containing the core modules needed to run Pulsar.
Pulsar Apps	pulsar-apps-version.pulsar	A packaged artifact containing essential applications which are used to monitor, configure and manage the Pulsar instance.
Pulsar Services (optional)	pulsar-services-version.pulsar	A packaged artifact containing essential services which are used to communicate with an instance via REST or Web services.

Component	Distribution file	Description
Endorsed Libraries	pulsar- endorsed-version.pulsar	A packaged artifact containing third party libraries used by Pulsar Core Modules and Pulsar Apps.

4.2.3 Directory structure and essential files

The directory structure used during application development, using a deployed version of the pulsar runtime. Directories and files marked with red are created in runtime or manually added and should be excluded from version control. Files and directories marked in red are generated as part of the build process or created in runtime, these should never be put under version control.

Directories and files					Description
<pulsar> /					Pulsar installation directory.
	.pulsar- runtime/				Internal runtime directory. Contains the runtime cache and internal persistence. Created and managed by Launcher ⁵ .
	apps/				Application modules.
		<modulegroup>/...			A series of application module directories. Modules can be ordered into an arbitrary directory structure where every leaf contains a module.
		<module>/			A module being developed.
			conf/		Module configuration files.
				<module>.conf	Module main configuration file. This file contains the configuration specification of the module, i.e. all allowed configuration parameters, their descriptions and value domains. The configuration is automatically picked up by the Configuration Manager (see page 43) when the module is installed

⁵ <http://confluence.dse:8080/display/PULSAR/Launcher>

					and presented through the Pulsar Configuration Editor. See Configuration Manager (see page 43) and Configuration (see page 97) for configuration features and syntax.
				permissions.xml	Module permission configuration. See Permission Manager (see page 55) for features and syntax.
				resources.xml	Module resource configuration. See Permission Manager (see page 55) for features and syntax.
			depend/		Dependencies needed for compilation, testing and distribution.
			dist/		Output directory for packaged distributable versions of the module.
			docs/		Generated JavaDoc.
			lib/		
				exported/	Libraries (jar) which should be exported as part of the module's public API. These libraries will become available for import from other modules.
				internal/	Libraries (jar) which are internal to the module. These libraries will not be accessible to other modules.
				native/	Native libraries (dll, so, dyl) to be used internally.
			resources /		
				static/	Static resources.

				stylesheets/	Stylesheet resources (XSL).
				templates/	Templates with dynamic content.
			script/		
				build.xml	Module build file. Imports build.macro.xml.
			src/		Java source code for module
			src-gen/		Generated module specific Java source code.
			src-test/		Java tests source code for module.
	conf/				
		logback.xml			Logging configuration (SLF4J/ Logback format). Can be included in version control to keep a shared default between developers on the project.
	data/				The data directory is used to provide a data area for each Pulsar module where module specific runtime data may be stored and accessed. Typically this is used for module specific resource files which may be updated in runtime. Resource files in the data area will shadow any resources packaged in the module artifact.
	dist/				Destination for application packages and local development repository.
		repository.xml			Development repository index. Includes all modules which are developed within the project.

	lib/				<p>Pulsar libraries and tools needed to build and package modules and applications.</p> <p>Note: Dynamic compile time dependency resolution will be available in a future versions of Pulsar. This will eliminate the need for most of the files in the lib structure and further ease module development.</p>
		compile/			<p>Compile time libraries, including libraries to use for logging (SLF4J) and the Pulsar Module APIs. The contents of this directory should be available on the classpath when compiling modules.</p>
		dist/			<p>Libraries needed by the Pulsar scripts to package modules.</p>
		test/			<p>Libraries needed to run test cases. Should be available on the test classpath.</p>
		tools/			<p>Tool libraries needed by the build scripts.</p>
	logs/				<p>Runtime logs.</p>
	script/				<p>Build and package scripts. Scripts are written for Ant.</p>
		build.macro.xml			<p>Macro definitions needed by module build scripts.</p>
		build.properties			<p>Global build properties.</p>
		build.xml			<p>Master build script. Used to compile/test/dist all modules in the project.</p>
		package.macro.xml			<p>Macro definitions used by the package script.</p>

		<code>package.xml</code>			Master package script. Used to compose modules into packages.
	<code>pulsar.launcher-version.jar</code>				Pulsar Launcher.
	<code>pulsar-modules-version.pulsar</code>				Pulsar Core Modules.
	<code>pulsar-apps-version.pulsar</code>				Pulsar Apps.
	<code>pulsar-endorsed-version.pulsar</code>				Pulsar endorsed libraries.

Libraries

Pulsar provides a number of core modules. Most of these modules have interfaces which provide functionality for an application developer. During compile time these interfaces are provided through the packaged module files (jar file) which are distributed together with Pulsar.

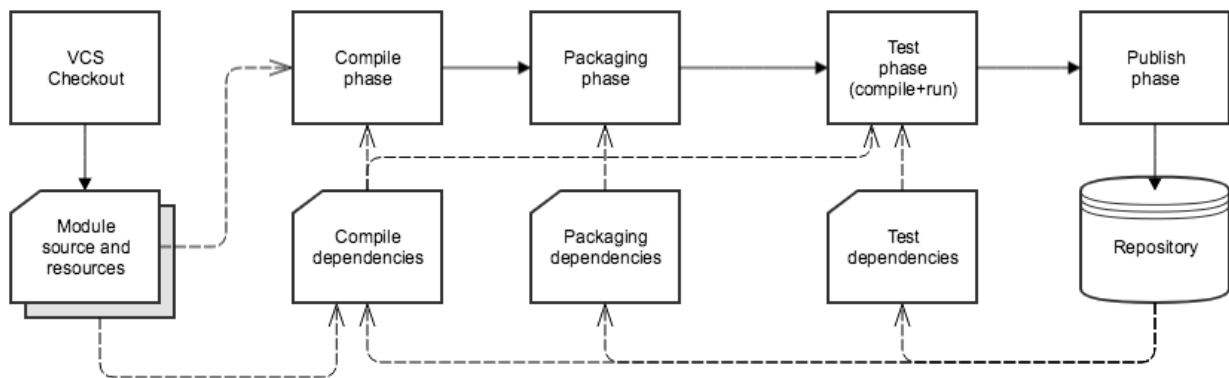
The Pulsar core modules also requires a set of third party libraries to work. These third party libraries are called endorsed libraries and are provided in a separate package within the Pulsar distribution. Most of these libraries are only used internally but a handful are also required for application development. For example the Google Guice libraries for dependency injection are required whenever a Pulsar module is compiled, also we recommend using the SLF4J libraries for logging.

Native libraries

Native libraries also needs to be configured in `<module>/conf/manifest.conf`.

4.3 Build and Continuous Integration

4.3.1 Building a Pulsar module



A Pulsar module is built through the phases of compilation and packaging (also referred to as "dist", as in "distribution"). Both these phases have dependencies on other modules. For example a module has a compile time dependency on all the modules which APIs are used. Since the Pulsar Core Module is used by all other modules this is required during compile time. All modules have a "dist" dependency on the Pulsar Packager Module since it is needed for packaging.

The dependencies that are required for each phase can be found in the current project if we are developing multiple modules together or through a repository. The repository may be local (a repository XML file), a ".pulsar" file or a ".pulsarlink" file containing a URL pointing to the location of the repository. See [Repositories](#)(see page 95).

Pulsar provides scripts for building modules. These scripts also handle dependencies and fetches the required set of dependencies for each phase.

Build scripts

The standard Pulsar build scripts are written for the [Ant](#)⁶ tool. Each module build script `<module>/script/build.xml` includes the master script `script/build.macro.xml` and uses it's macro definitions to specify the module build.

Example of a simple module build script:

```

<project name="my-module" default="dist" basedir=".">
  <import file="../../script/build.macro.xml"/>
  <pulsar-module
    dir="."
    pulsar.dir="../../"
  />
</project>

```

The `pulsar-module` entry is expanded (by Ant macros) into a set of tasks corresponding to the different build phases. The following attributes may be passed to the `pulsar-module` macro:

Attribute	Default	Description
pulsar.dir		A reference to the Pulsar directory, which usually is the root of the project.

⁶ <http://ant.apache.org>

Attribute	Default	Description
dir		A reference to the root directory of the current module.
dependencies-compile		A comma separated list of the other modules needed to compile this module.
dependencies-compile-test		A comma separated list of the other modules needed to compile the tests in this module.
dependencies-test		A comma separated list of the other modules needed to run the tests in this module.
dependencies-dist		A comma separated list of the other modules needed package (dist) this module.
generate-param-signatures	true	Turn on or off the generation of Param Manager signatures for Pulsar Methods.
moveinternalclasses	true	Hide internal classes (non api) within JAR when creating a dist.
generate-javadoc	true	Generate javadoc for apis.
clean-src-gen	true	Delete the <code>src-gen</code> directory in clean phase.

The tasks generated by the Pulsar build macro are:

Task	Description
clean	Deletes all generated or downloaded data, classes, javadoc, test reports, dependencies and module packages.
compile	Compiles the module source into class files and creates meta-data for the methods annotated with <code>@PulsarMethod</code> .
compile-test	Compiles the module test sources.
dist	Builds a packaged version of the module (calls "compile" if needed)
test	Runs the tests (calls "compile" and "compile-test" if needed)

Other Ant scripts may be added as required, for example we recommend having a master build script which can perform tasks for all modules in a project.

4.3.2 Testing a module

Testing of a module adds two more phases apart from the build phases (compilation and packaging), these are test compilation and test running. These two phases also have their own dependencies. To compile the tests JUnit and the Pulsar Test Module are usually required. The running of the tests might have further dependencies on modules which are used as part of an integration test.

4.3.3 Packaging of one module

Each Pulsar module is packaged as a separate jar file. The packaging is handled by the Pulsar Packager, which is invoked by the ant script. Since Pulsar Core 4.6 the packager generates a `package-dependencies.txt` next to the `package-info.java` file which contains the `PulsarModule` annotation defining the module. The `package-dependencies.txt` should be checked into version control so that the changes made to it by the Pulsar Packager can be monitored. This is required in the case where a dependency of the module is updated in its major version but the module has not had its version bumped, because no changes were required by the dependency upgrade. In this case the module must be bumped in micro version otherwise a required module upgrade will be undetected in runtime, causing dependency resolution errors in runtime.

4.3.4 Packaging several modules into package file

Modules may be arbitrarily grouped and packaged into package files to be used for deployment. The package files have a ".pulsar" suffix and are zipped archives containing both the individual module jar files and a repository index listing the contents of the deployment file.

Pulsar provides a packaging macro (`script/package.macro.xml`) which can be used to create these repository files.

4.3.5 Continuous builds

Pulsar modules can easily be build using a continuous build system such as Jenkins or Bamboo. The provided Ant scripts can be configured to be invoked by the continuous build engine and the artifacts (repositories and package files) can be collected in the dist directories.

4.3.6 Pushing changes from a continuous build system to a module repository

Best practice is to automatically publish successfully built modules to a module repository where they are available for installation and upgrades. Different repositories can be set up for different versions of the modules. Usually separate repositories are set up at least for a development branch and a master branch.

Pulsar provides scripts for adding a set of module artifacts to a repository and update the repository index. See [Repositories](#)(see page 95) for more information.

4.4 Pulsar Core Modules

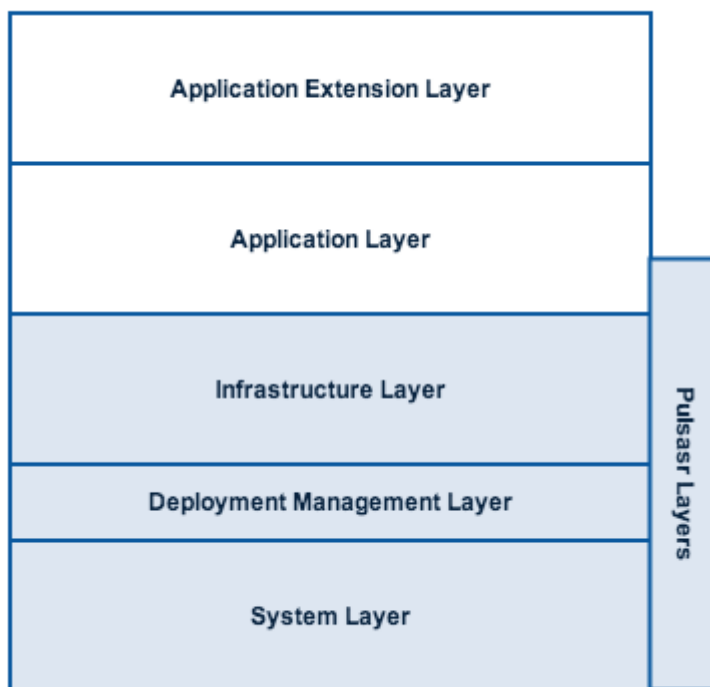
4.4.1 Introduction

The Pulsar Core modules contains the essential Pulsar packages and services. Together they make up the Pulsar framework and platform. The Core modules are packaged in the `pulsar-modules` package and are contained in the system, deployment management and infrastructure layers, as described below. Generally the Core modules have no end user interfaces, only APIs designed to be used through packages and services.

The documentation of the Core Modules consists of this reference document together with the JavaDoc published for each module. The purpose of the reference documentation is to give an overview of each module and to document configuration or usages which is not apparent in the API JavaDoc.

4.4.2 Architectural layers

The Pulsar architecture is layered into a number of different sections, where each section is responsible for it's functional domain. The lower layers contains the internals of Pulsar and should be more static than the upper layers which will change whenever applications are developed.



System Layer

The system layer contains the Pulsar Launcher and core libraries needed to bootstrap the platform. The primary focus of the system layer is to set up a minimalistic environment which is being able to load and start the deployment management, which is a module it self. Updates to the system layer should be very rare.

Deployment Management Layer

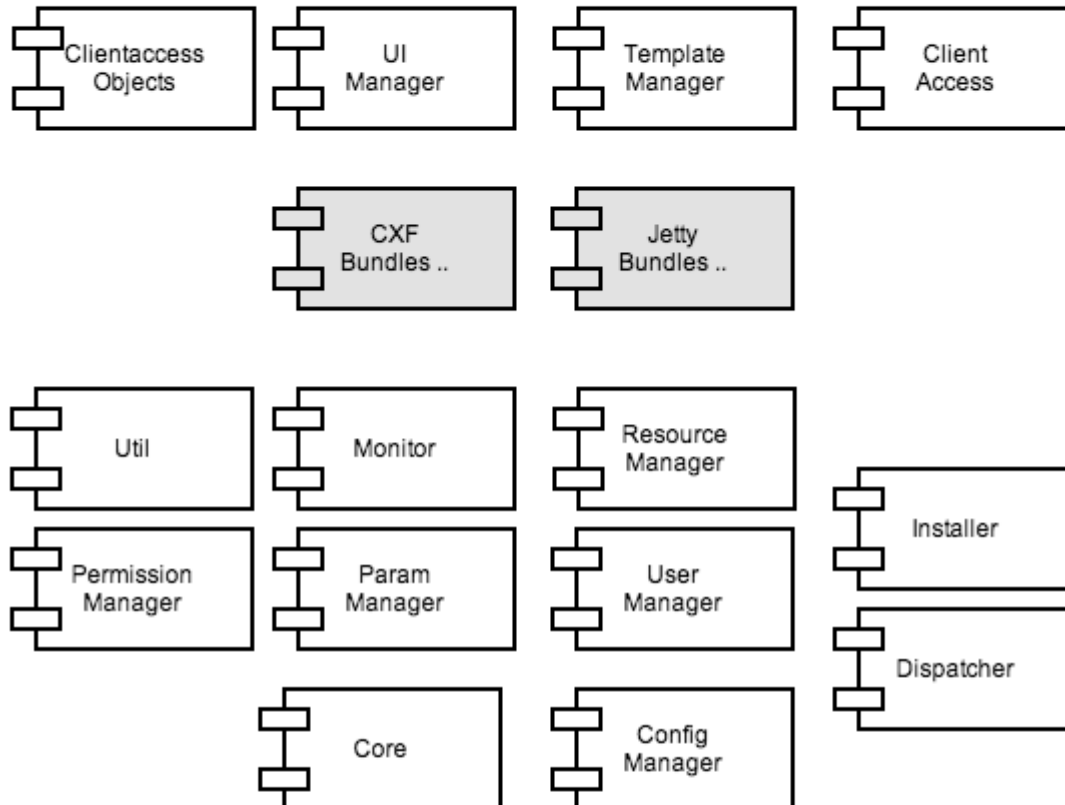
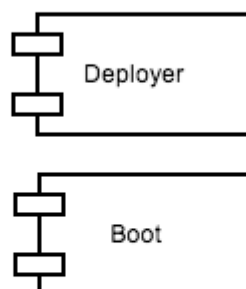
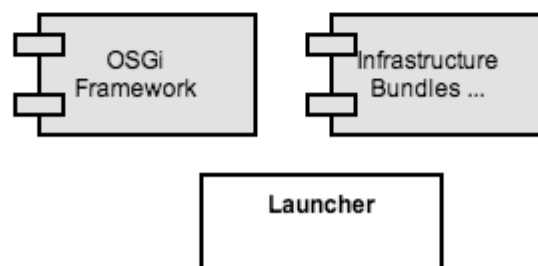
The deployment management layer is responsible for loading all other modules, either from local packages or repositories. The deployment management layer is also responsible for finding and loading any transitively required resources. When Pulsar is first installed the deployment layer initializes the instance according to a built in profile. Profiles can be used to pick different modules from the Core modules to build a platform with or without a specific capability, for example a developer instance or an instance with support for web services and rest services. For more information about available profiles see [Installation and upgrades](#)(see page 89).

Infrastructure Layer

The infrastructure layer contains the bulk of the Pulsar API packages and services. The infrastructure modules works together to provide the framework services which can be used by application module developers.

4.4.3 Core Modules

Pulsar provides a number of Core modules which provides the core Pulsar functionality. Each Core module belongs to one of the architectural layers.

Applications**Infrastructure****Deployment Management****System**

4.4.4 Configuration Manager

Introduction

The Configuration Manager module provides functionality for persisting and managing configurations for modules. Each module may choose to keep its configuration in Configuration Manager which then provides the module with a set of configuration related functionality.

Features

Accessing the configuration programmatically

The configuration is delivered to the module as a `Config` object. The `Config` is provided as a service from Configuration Manager and may be retrieved in the module activator. The basic use case involves consuming the configuration and making it available to the rest of the module, by dependency injection:

```
public class MyModuleActivator extends PulsarActivator {
    @Override
    public void init(ModuleContextBuilder i_moduleContextBuilder) {
        i_moduleContextBuilder.consume(Config.class);
    }
}
```

In the case where the activator needs to act on the configuration information during activation, for example to decide which services should be published and consumed, this is achieved by looking up the configuration service directly in the activator:

```
public class MyModuleActivator extends PulsarActivator {

    private Config config;

    @Override
    public void init(ModuleContextBuilder i_moduleContextBuilder) {
        config = lookupService(Config.class);
        // also make config available through dependency injection
        i_moduleContextBuilder.bindLocal(Config.class).usingInstance(config);
    }
}
```

Configuration templates

The Configuration Manager looks for `config/module_symbolic_name.conf` whenever a module is loaded into Pulsar. If the template file is present it is loaded by Configuration Manager.

Example of a configuration template:

```

settingA = DEFAULT VALUE
#description: A description of the setting and when it should be used and if it may be changed in runtime.

settingB = DEFAULT
#description: A setting which is presented as a drop-down with a limited set of values in the editor.
#values: DEFAULT,HIGH,MIDDLE,LOW

settingC = false
#description: A setting which is presented as a checkbox in the editor.

```

Web based configuration editing

The parameters defined by the configuration template is made available for viewing and editing through the Configuration Editor application. The Configuration Editor is part of the Admin Console.

Import export

Configurations can be imported and exported. The file format is a plain text format based on the Apache Configuration format.

Live updates

When a configuration for a module is updated in the web user interface, or imported, the module is automatically restarted and provided with the new functionality.

Configuration

The Configuration Manager itself currently doesn't have any configuration parameters.

4.4.5 Database Access

Introduction

The Database Access module is used to interact with any JDBC accessible database. The Database Access module also handles connection pooling, caching and provides an easy to use interface for accessing data in a database. Database Access handles any number of concurrent pool configurations. The pools can also be shared between several Pulsar modules.

Configuration

To configure a database connection copy the following Database-config block into the module configuration file. Enter the values directly in the copied configuration file, or use the ConfigEditor to change the values.

Configuration file

```
<Database DbPoolName>
```

```

    DbURL = jdbc:...
    #description: A database connection URL is a string that your DBMS JDBC driver uses to connect to a
    database. It can contain information such as where to search for the database, the name of the database to
    connect to, and configuration properties. The exact syntax of a database connection URL is specified by
    your DBMS.

    DriverClassName =
    #description: The JDBC driver to use for this database connection.

    User =
    #description: User name to use to connect to the database.

    Password =
    #description: The users password to use to connect to the database.

    InitialConnections = 2
    #description: The number of initial connection to create at startup. The pool will always try to have
this number connections available.

    MaxConnections = 10
    #description: Max number of connection that the pool will create.

    UseCache = false
    #description: Specify if caching will be used. If this parameter is set to false, the parameters
    TableStatusHandler and CheckType is ignored.

    TableStatusHandler =
    #description: A class that implements the interface TableStatusHandler that returns a status string for
    a table. Pulsar bundles two handlers which can be used: MySQL -
    se.dse.pulsar.module.databaseaccess.cache.handlers.MySQLTableStatusHandler and for Oracle -
    se.dse.pulsar.module.databaseaccess.cache.handlers.OracleTableStatusHandler

    InitStatement =
    #description: One or more statement separated with semi colon which will be executed every time a new
    connection is created.
</Database>

```

Invoke the `processConfig` method to make the Database Access module process the configuration.

```

public class MyModule extends PulsarActivator {
    private Config config;

    @Override
    public void init(ModuleContextBuilder i_contextBuilder) {
        config = lookupService(Config.class);
    }

    @Inject
    DatabaseAccess databaseAccess;

    @Override
    public void run() {
        try {
            databaseAccess.processConfig(config);
        }
    }
}

```

```

        } catch (Exception e) {
            // Log problem with config file
        }
    }
}

```

Using a database pool

To use a configured Database a reference to a `DatabaseAccessPool` is needed. To get the pool reference, make a *named consume*, where the name is the same name as in the config.

```

public class MyModule extends PulsarActivator {
    private Config config;

    @Override
    public void init(ModuleContextBuilder i_contextBuilder) {
        i_contextBuilder.consume(DatabaseAccessPool.class).named("PoolName");
    }
}

```

To get the actual referens to the `DatabaseAccessPool` , use a *named inject*.

```

public class MyModuleServiceImpl implements MyModuleService {
    private DatabaseAccessPool databaseAccessPool;

    @Inject
    public MyModuleServiceImpl(@Named("PoolName") DatabaseAccessPool i_databaseAccessPool) {
        databaseAccessPool = i_databaseAccessPool;
    }
}

```

Logging

To make the module log the SQL statement that is executing, there is different logging packages that can be configured:

- `se.dse.pulsar.module.databaseaccess.sql.user` - SQL that are run in web requests.
- `se.dse.pulsar.module.databaseaccess.sql.background` - SQL that are run in background threads.
- `se.dse.pulsar.module.databaseaccess.sql.internal` - SQL that are run in internally in the Database Access module.

All `SELECT` statements are logged in `TRACE` , and all other SQL are logged in `DEBUG` .

Cache files

When the cache is enabled, database cache files are stored under the temporary directory assigned to the process by the operating system. The temporary directory created will have a prefix of "pulsar.dataaccess.cache.". Files in

this temporary directory are automatically deleted when the JVM exits. Cache files that fails to be cleaned up automatically (for example, they may be in used by anti virus scanning software) may be removed manually.

Exclude SQL from caching

Sometimes you don't want to use the cache mechanism for a certain SQL query. To exclude them, add a comment `/* for update */` to the SQL-string.

```
databasePool.select("SELECT name FROM person /* for update */");
```

Table Status Handlers

A table status handler is a class that is used to check if a table in a database has been changed. This is needed to be able to use the database cache, where a cached result from the database can be quickly returned instead of a slower call to the database. A change of a table happens for this events in the table:

- Data in a row has been updated (UPDATE).
- A row has been added (INSERT).
- A row has been deleted (DELETE).

A table status handler implements the interface `se.dse.pulsar.module.databaseaccess.api.cache.TableStatusHandler`. The interface consists of two methods:

- `String[] getTableStatus(Connection i_con, String i_dbSchema, String[] i_tables)` - this method returns a status string for each of the given tables. The status string is used by the cache handler to be able to tell if a table has been changed. If the status string is the same, i.e. the table content is the same, as the last time an SQL was executed the cached result can be used.
- `boolean isCachable(String i_sql)` - this method is used to exclude certain SQL from the caching mechanism. There could for example be SQL that uses functions with side effects.

Pulsar comes bundled with three Table status handlers;

- `se.dse.pulsar.module.databaseaccess.cache.handlers.OracleTableStatusHandler` - this handler is used for Oracle databases.
- `se.dse.pulsar.module.databaseaccess.cache.handlers.MySQLTableStatusHandler` - this handler is used for MySql databases.
- `se.dse.pulsar.module.databaseaccess.cache.handlers.NoExternalUpdateTableStatusHandler` - this handler is used if there are no external changes in the database. I.e. all updates, inserts and deletes are done by the `DatabaseAccessPool`.

Database permissions for OracleTableStatusHandler

If the `OracleTableStatusHandler` is used, the database user needs permissions in the database to create triggers and a table:

- For every table that is used a trigger named `PULSAR_STATUS_TABLENAME` is created for the table.
- The table `PULSAR_TABLE_STATUS` is created. It contains the change count for every table.

If a trigger or the status table is deleted, it will automatically be created again. If triggers or the status table can't be created due to permissions, the database cache will not be activated, but the system will function anyway, but with worse performance.

Adding JDBC drivers

Any JDBC compliant driver may be used with Database Access. To add a specific JDBC driver which is not already packaged for Pulsar the easiest way is to create a new module and put the driver jar in the `lib/exported` directory. The driver is selected through the connection URL specified by the `DbURL` configuration parameter.

SQL translation

Database Access provides general plugin functionality for performing translation on a SQL string level. For example, a translator can be used to modify the SQL syntax if a specific JDBC-driver is used, to handle syntax differences between database vendors. Each translator can decide which database connection pools it should be applied to. Multiple translators can be published and applied to one or more database connection pools. A module that wishes to provide translation of SQL statements should implement the interface (SPI) called `se.dse.pulsar.module.databaseaccess.api.translator.SQLTranslator`. For detailed information see the JavaDoc of the API class.

To enable logging of the translations that are applied enable `TRACE` logging for `se.dse.pulsar.module.databaseaccess.translator`.

Command line support

Database Access supports the following commands in the gogo shell in the `dbaccess` scope.

```
deleteConnectionPool <alias>
    Removes a database alias and destroys the connection pool, disconnecting any open connections
    alias - The name of the database alias

createConnectionPool <alias> <dbUrl> <dbUser> <dbPassword> <driverClassName> <initialDatabaseConnections>
<maxDatabaseConnections> <initStatement>
    Adds a database alias to the current pool configuration
    alias - The name of the database alias
    dbUrl - The JDBC url of the database. Example: jdbc:oracle:thin:@localhost:1521:XE,
jdbc:sqlserver://server\\database:1433
    dbUser - The database user
    dbPassword - The database user password
    driverClassName - The name of the JDBC driver class to use. Example:
oracle.jdbc.driver.OracleDriver, com.microsoft.sqlserver.jdbc.SQLServerDriver
    initialDatabaseConnections - The number of initial database connections
    maxDatabaseConnections - The number of initial database connections
    initStatement - One or more statement separated with semi colon which will be executed every
time a new connection is created

sleepConnections <dbAlias> <connections> <seconds>
    Put a given number of database connections to sleep (used for testing) [ORACLE ONLY]
    dbAlias - The name of the database alias
    connections - The number of connections to put to sleep
    seconds - The number of seconds to make each connection sleep
```


4.4.6 Frameworks

Introduction

The Frameworks module provide standard functionality used to present information from a database in a user interface.

Configuration and database tables are used to define views which can be presented in overview mode (a table of data) or one row (one post) mode. Rules stored in configuration files are used to define the columns of the views and the frameworks allows the uses to dynamically configure new column sets and data filters. The setup for a dynamically configured view can also be stored and retrieved at a later time.

The Frameworks module handles the interaction with the database according to the configuration supplied. Usually a Java class is created for each data view to be set up. Data which can be used to render a data view is returned as XML which can be presented in HTML by applying XSLT.

Features

Sorting

Views may be sorted descending or ascending based on data in one of the columns.

Groupings

Data may be grouped according based ont the leftmost `n` columns. The rows are then collapsed into groups according to their values int the group columns.

Column selections

Columns can be dynamically selected from the configured set of columns. A column may be marked as locked which means that it's viewing status (shown or hidden) may not be changed by the user, for the specific view.

Functions on columns

Functions, such as sum and average may be applied to columns.

Filtering

Columns may have filters which acts on the rows. Filters may contain expressions, for example to select only rows with a value within a certain range.

Formatting and links

Row values may be formatted according to custom rules and types. Links, units and custom formats can be added.

Modes and functions

Modes are used to create custom views for different user interface modes, for example a mobile mode may contain fewer columns for a specific view than the desktop mode of the same view. Functional flags are similar but used to

indicate that a certain feature is enabled or not enabled. Functional flags are often used to enable special columns which are dependent on a certain function/feature being enabled.

Configuration

Configuration of the overviews can be done programmatically or in configuration files. The configuration is done in three levels where each level inherits the config from the level above. The main principle is that if nothing has been told in a lower level, the config from the level above is intact. Only changes need to be configured.

Default configuration

The default configuration is placed in a config file call `systemdefault.conf`. The syntax of this file:

```
<System>
  <Module Aaa>
    columnDefinitions = \
      { flag:_flag1_ flag:_flag2_ ... mode:_mode1_ ... }
    _COLUMN_1_ID[ _attribute1:_attribute2=_value2_: ... ], \
      { _flags_ _modes_ }_COLUMN_2_ID[ _attributes_], \
      ...
      { _flags_ _modes_ }_COLUMN_N_ID[ _attributes_]
  </Module>
  <Module Bbb>
    ...
  </Module>
  ...
</System>
```

Custom configuration

User configuration

Configurations of the overviews can be done programmatically or via configuration files. The configuration files is contained in the LEB/conf/modules folder. Configurations are done in three levels where the next level inherits from the previous one if no override is defined. These three levels are system settings, system override and user overrides. The basic principle is that if the overrides are empty the system settings are applied.

System settings

Every data view needs a configuration where a complete list of available columns are specified. This list is also the system default configuration.

Syntax for system settings:

```
<System>
  <Module Aaa>
    columnDefinitions = \
      { flag:_flag1_ flag:_flag2_ ... mode:_mode1_ ... }
    _COLUMN_1_ID[ _attribute1:_attribute2=_value2_: ... ], \
      { _flags_ _modes_ }_COLUMN_2_ID[ _attributes_], \
```

```

...
{ _flags_ _modes_ }_COLUMN_N_ID_[ _attributes_]
</Module>
<Module Bbb>
...
</Module>
...
</System>

```

Column configuration

Each column is configured in three steps:

1. First the filter flags are specified as a space separated string within curly braces. Usually these are flags which indicates for which functions and modes the columns should be available. The order of the modes and flags doesn't matter.
2. Next the column ID is specified. This string ID must match the column definition in the source code for the data view. Note that a column may defined multiple times, for example if it should be available for different modes with different settings.
3. Last comes a set of attributes which are to be applied to the column. The set is string separated with colon and surrounded by square braces. Ordering is irrelevant. Note, the square braces are mandatory, even if no attributes are specified.

1. Flags

Flags can be used to dynamically (per instance) decide if a column should be available or not. The flags are defined in the filter part of the data views (source code) and are therefore data view dependent.

All flags are specified with the `flag:` prefix. The flag value can be set in a HTML-template and may then affect how data is presented. The flags may also be set programmatically or through the request parameters. Flags may be specified directly or using negation, for example `flag:!integrationEnabled` will present the column if the flag `integrationEnabled` is set to `false` when the data view is rendered.

2. Modes

Modes are used to adapt the columns for different modes of presentation. Modes are specified with the `mode:` prefix. The set of available modes are defined in the data view source code and may be specified entirely by the application. If no mode flag is present the column configuration is applied for all modes.

3. Attributes

Attributes are used to further control the presentation of the column, when it is selected for presentation (by flags and modes). The following attributes are supported:

Attribut	Värden	Beskrivning
<code>hidden</code>		Defined the column as hidden.
<code>locked</code>		Define the column as locked. This means that a overriding level may not change the value of the hidden attribute. I.e. if a column is hidden and locked it may an overriding configuration may not make it unhidden. However a column may be <code>unlocked</code> by a overriding level.

Attribut	Värden	Beskrivning
<code>unlocked</code>		Unlocks a column if it was locked in a previous configuration. When unlocked the column may be hidden or unhidden again.
<code>filter=</code>	<i>filter text</i>	Defines a default filter for a column. May be specified and overridden on all levels.
<code>width=</code>	<i>pixel width</i>	Defines the presentation width of the column. May be specified and overridden on all levels.
<code>sort=</code>	ASCENDING DESCENDING NONE	Specifies sorting. The value <code>NONE</code> is used to revoke an inherited sort order.
<code>filtertype=</code>	TEXT LIST NONE	Type of filter.
<code>groupfunction=</code>	SUM NONE	Type of grouping function.
<code>showlink=</code>	TRUE FALSE	Specifies whether links from the presented values should be available or not.

Example of a system configuration:

```
<Module PU>
  columnDefinitions = \
    COL1[width=80], \
    COL2[width=160], \
    {mode:PORTAL}COL3[locked:hidden:filtertype=LIST], \
    {mode:PORTAL}COL4[width=160], \
    {mode:PORTAL}COL5[], \
    {mode:PORTAL}COL6[filtertype=LIST], \
    {flag:specialFunc}COL7[locked:hidden:width=40:filtertype=LIST], \
    {flag:specialFunc}COL9[locked:hidden:filtertype=LIST], \
    {flag:specialFunc}COL8[], \
    {flag:specialFunc mode:PORTAL}NIV2[width=80], \
    COLX[width=66], \
    {mode:PORTAL}COLY[groupfunction=SUM], \
    {mode:PORTAL}COLZ[groupfunction=SUM]
</Module>
```

System overrides

System overrides are usually used to configure a system for different instances. For example different clients may want a different default setup.

When flags are used in the column definitions, all flags in the system configuration is checked first, then the system override flags are checked. For the column to be enabled both sets of flags needs to be enabled.

User overrides

Each user may be allowed to customize their data views. This is most commonly used to select columns and their order in each data view, for each available mode.

4.4.7 Message Manager

Introduction

Message Manager is a module that is used to send mail or SMS via Pulsar in a synchronous or asynchronous fashion.

Other than sender, receiver, subject and message, Message Manager include the ability to send other types of data related to the message such as:

- [cc](#)⁷ (Carbon copy)
- [bcc](#)⁸ (Blind carbon copy)
- [Multipart](#)⁹

Features

Synchronized and asynchronous messages

Messages can be sent synchronously or asynchronously. Asynchronous messages are stored in a send queue and are then dispatched by a separate thread after the send method has returned to the caller. When a synchronous method is used the send method will block until the message has been dispatched or the dispatch failed.

Every method that include sending a message gives feedback on transport status. The feedback tells if the message could be sent or not.

Broadcasting messages

Message Manager has the ability to send messages or SMS to a multiple of receivers. Broadcasting can be done in a synchronous or asynchronous fashion. Broadcasting include the ability to send cc (Carbon copy) or bcc (Blind carbon copy).

Multipart

If the message need additional data related to the message a multipart containing this data can be appended and sent with the message.

⁷ http://en.wikipedia.org/wiki/Carbon_Copy

⁸ http://en.wikipedia.org/wiki/Blind_Carbon_Copy

⁹ http://www.w3.org/Protocols/rfc1341/7_2_Multipart.html

Status

Message Manager contain the ability to retrieve the current status of messages that has been sent or not sent. The data that is checked are

- Successfully sent mails
- Not successfully sent mails
- Successfully sent SMS
- Not successfully sent SMS
- Current queue of mails and SMS to be sent

Configuration

To send messages with Message Manager it is required to configure the name of the mail server and the port to connect to. If the mail server demands authentication, you could configure the name, password and TLS-setting.

4.4.8 Message Router

Introduction

Message Router is a module that is used to retrieve and parse SMTP emails from [PersistentQueues](#)(see page 59) and deliver these to the correct MessageHandler. The SMTP emails is created by the [SMTP-server-module](#)(see page 112).

Features

Handling incoming SMTP-mail

A client can publish a `MessageHandler` to get callback when an mail i received by the SMTP-server.

```
public class ExampleActivator extends PulsarActivator {

    @Override
    public void init(ModuleContextBuilder i_moduleContextBuilder) {
        i_moduleContextBuilder
            .publish(MessageHandler.class)
            .usingClass(MessageHandlerImpl.class)
            .withConfigurator(new MessageHandlerConfigurator("queue-id"));
    }
}
```

Each MessageHandler has a unique queue-id that should correlate with the queue-id that is configured in the SMTP-server.

The incoming message is handled in the `MessageHandler::handle` method.

```

public class MessageHandlerImpl implements MessageHandler {
    ConversationExtractor conversationExtractor = new DelimiterConversationExtractorImpl("-----")

    @Override
    public void handle(final Message i_message) throws MessageHandlerException, MessageRejectedException {
        String l_messageId = i_message.getMessageId();
        String l_from = i_message.getFrom();
        String l_message = conversationExtractor.extractPlainText(i_message);
        List<MessageContentPart> l_contentPars = i_message.getContents();
        List<MessageAttachment> l_attachments = i_message.getAttachments();

        ...
    }
}

```

Extract plain text from a mail

MessageRouter offers a help class `DelimiterConversationExtractorImpl` for extraction of plain text from a `Message`. The Delimiter is used to separate the old thread in the message from the new text.

Configuration

The poll frequency, the time before resending a message that could not be delivered and the number of retries can be configured.

4.4.9 Permission Manager

- [Introduction](#)(see page 55)
- [Usage](#)(see page 56)
 - [resources.xml](#)(see page 56)
 - [permissions.xml](#)(see page 56)
- [Group and user plugin permissions](#)(see page 57)
- [Features](#)(see page 57)
 - [General mandatory permission control](#)(see page 57)
 - [Custom permission control](#)(see page 57)
 - [Custom resource paths](#)(see page 57)
 - [Permission tags](#)(see page 57)
 - [Permissions with REST](#)(see page 58)
- [Configuration](#)(see page 58)

Introduction

Permission Manager handles permissions for all resources (templates, methods or custom paths) in Pulsar. Permission Manager provides an API to test if a user has access to a specified resource.

The permission information is separated into resource groups and grants. Resource groups are collections of resources. Each resource group may contain any number of resources of different types. Grants then define the link

between users or groups of users and the resource groups. Users and groups are handled by [User Manager](#)(see [page 66](#)).

Permissions can be given to a certain user or user group. A resource in Pulsar module can be an HTML-template, a method or a static resource, such as an image.

Permissions are inherited, for example if a group is assigned a permission all the users and groups belonging to this group are also given the assigned permission.

Permission Manager is used internally by Pulsar to check which users have access to which templates, methods (including REST) or other resources. Developers using Pulsar may also create custom path based permission hierarchies which can then be enforced using the same permission framework.

Usage

The permission are specified in two XML-files that is place in the module conf-folder:

resources.xml

Defines the resource groups.

Note: ' * ' matches any path element and ' ** ' matches any set of path elements.

```
<resources>
  <resourcegroup name="alfa">
    <template path="public/**"/>
    <method path="com.corp.public.UserFeedback.postFeedback"/>
  </resourcegroup>
  <resourcegroup name="beta">
    <template path="admininterface/**"/>
    <method path="com.corp.admin.AdminModule.shutdownService"/>
  </resourcegroup>
</resources>
```

permissions.xml

Defines the grants that link users and groups with the resource groups.

```
<permissions>
  <grant>
    <resourcegroup name="alfa"/>
    <group plugin="pulsar" id="everyone"/>
  </grant>
  <grant>
    <resourcegroup name="beta"/>
    <group plugin="myPlugin" id="Administrators"/>
    <user plugin="myPlugin" id="adminGuest"/>
  </grant>
</permissions>
```


Group and user plugin permissions

A group or user can be delegated a plugin with specific permissions. There are some predefined group and user permission in pulsar which can be utilized out of the box. Please read more about each level of permission [here](#)¹⁰.


Features

General mandatory permission control

Permission Manager checks all access to resources provided by Pulsar modules. By default no access is allowed and all exceptions needs to be configured in `resources.xml` and `permissions.xml`.

Custom permission control

Permission Manager also offers a plugin model for modules wishing to add custom permission checks. When a module implements the `PermissionControl` interface and publishes it Permission Manager will invoke the `check` method for all requests to resources belonging to this module.

 Currently at most one `PermissionControl` service may be published for each module, if more than one services with this interface are published the result is undefined.

Custom resource paths

Custom paths can be used to assign permissions to virtual resources within an application. For example, a custom permission hierarchy could be used to assign update or delete privileges in an object type hierarchy.

```
<resources>
  <resourcegroup name="alfa">
    <custom path="/objects/*/update"/>
  </resourcegroup>
  <resourcegroup name="beta">
    <custom path="/objects/*/delete"/>
  </resourcegroup>
</resources>
```

The effective permissions can then be checked programmatically using either permission tags or by calling `PermissionManager.checkModulePermission(...)`.

Permission tags

Permission tags can be used in templates to include content based on a permission check. See [Template Manager](#)(see page 62).

¹⁰ <http://confluence.dse:8080/display/PULSARDOC/User+Manager#UserManager-Bundledplugin:PulsarDefaultPlugin>

Permissions with REST

REST utilize the different http methods GET PUT POST DELETE for accessing resources via the http protocol. A common REST-call for a resource consists of a path and what type of http method that should be performed. To tackle this, a `httpmethod`-attribute is introduced to the `method` tag in `resource.xml`. The `httpmethod`-attribute takes five values "get put post delete *" where asterix gives access to all four http methods. If no `httpmethod`-tag is used access is granted to all four http methods. A combination of multiple http methods can be used for the same path if required.

Lets give an example; a REST-call is performed on the resource with path=`http://127.0.0.1:8080/pulsar/rs/se.dse.pulsar.examples.wsrsservice.api.RSEExample/example/hello/world` and permission has to be constrained to only allow a GET for this resource.

Interface

```
@GET
@Path("hello/{name}")
String hello(@PathParam("name") String i_name);
```

resource.xml

```
<resources>
  <resourcegroup name="restResources">
    <method path="se.dse.pulsar.examples.wsrsservice.api.RSEExample/example/hello/*" httpmethods="get"/>
    <method path="se.dse.pulsar.examples.wsrsservice.api.RSEExample/example/hello2/*" httpmethods="get
put"/> <!-- multiple http methods -->
    <method path="se.dse.pulsar.examples.wsrsservice.api.RSEExample/example/hello3/*" httpmethods="*/>
  <!-- all http methods -->
  </resourcegroup>
</resources>
```

permission.xml

```
<permissions>
  <grant>
    <resourcegroup name="restResources"/>
    <group plugin="pulsar" id="anonymous"/>
  </grant>
</permissions>
```

Configuration

Permission manager uses caching of templates to increase performance. The cache invalidation timeout and clean interval can be configured.

4.4.10 Persistent Queues

Introduction

The persistent queues module provides local persistent storage in the Pulsar data area. The queue is an [First-In-First-Out-queue \(FIFO\)](#)¹¹.

Features

Adding objects to a queue

Objects can be added to a queue by using the method `add(String i_queue, Serializable i_object)`. The `i_queue` argument is a reference to which queue the object should be added to. If the queue doesn't exist, it is automatically created. Any type of objects can be added to a queue as long as it is `Serializable`.

Removing objects from a queue

The method `remove(String i_queueId)` removes an object from the queue.

Other methods in the API

- `peek` - Gets the first object in the queue without removing it.
- `clear` - Clears an entire queue.
- `size` - Gets the size of a queue.
- `hasQueue` - Checks if a queue exists.
- `deleteQueue` - Removes the queue completely.
- `isEmpty` - Checks if a queue is empty.
- `size` - Gets the size of a queue.

Configuration

You can configure limits for how many different queues that Pulsar should handle. On each queue you can limit the length and size.

4.4.11 Search modules

Introduction

The search modules provides a search engine for indexing and searching together with helper modules to index content from documents on disc and data from a database.

¹¹ [http://en.wikipedia.org/wiki/FIFO_\(computing_and_electronics\)](http://en.wikipedia.org/wiki/FIFO_(computing_and_electronics))

The search modules consists of three main modules:

- Engine
- DBScanner
- FileScanner

Engine

The Engine contains the search engine that is responsible for indexing and searching.

Indexing

To be able to put documents into the index you need an `Indexer` .

```
Indexer l_indexer = SearchEngine.getIndexer("indexName", "sourceId");
Map<String, Object> l_map = new HashMap<>();
l_map.put("name", "John Smith");
l_indexer.put("id", "type", l_document);
```

Searching

Searching in an index is done by a `Searcher` .

```
Searcher l_searcher = SearchEngine.getSearcher("indexName");
Map<String, String> l_map = new HashMap<>();
l_map.put("name", "John*");
SearchResponse l_response = l_searcher.search("type", l_map, 10);
```

DBScanner

The DBScanner is used index data from a Database. Either you configure the module it self or you provide the config programmatically, as in the example below.

Configuration

```
<DbSearch>
  indexName = indexName
  databasPoolName = db
  sql.1 = SELECT id, name, age FROM persons
</DbSearch>
```

```
public void initIndex() {
    Config l_dbSearchConfig = searchConfig.getParameters("DbSearch", "");
    dbScanner.start(l_dbSearchConfig);
}
```

FileScanner

The FileScanner is used to index files on a file system. In the same manner as the `DBScanner` the module can be configured by it self or getting a config programmatically.

Configuration

```
<FileSearch>
  indexName = indexName
  dir.1 = c:\documents
</FileSearch>
```

```
public void initIndex() {
    Config l_fileSearchConfig = searchConfig.getParameters("FileSearch", "");
    fileScanner.start(l_fileSearchConfig);
}
```

The content of the files are extracted by the `FileExtractor` module.

FileExtractor

The FileExtractor is a helper module for FileScanner, but it can be used separately to extract content from files.

4.4.12 Session Manager

Introduction

Session Manager is responsible for the state of user sessions. A session is usually initiated when a client (browser) instance first connects to the system. Sessions are then tied to a user through an authentication step and then lives until the user disconnect, logs out or the session times out. Web sessions are tracked through cookies.

Features

Get the current session

Use the method `getCurrentSession` to get a `Session` object representing the current Session. The current session is determined through a thread local context. This means that sessions are assigned to the request thread servicing a certain browser request. Other threads may also have sessions assigned to them programmatically.

Connect a user to a session

To connect a user to a session, typically in a log in method, you use the method `setUser`.

Time limit of a session

Time limits can be set on a session in order for it to expire after a given time of inactivity. This can be useful if the session contain steps with sensitive information.

Save and retrieve data from/to the session

The `Session` object has methods (`putValue` , `getValue` and `removeValue`) to connect data to the Session. The data is persistent as long as the session is alive. When the session is removed, the data connected to the sessions is removed.

Automatic data conversion for session data on upgrades

Since modules using the session to store data may be upgraded at any time the implementation of the value object classes may also change. Session manager can therefore automatically convert any session objects which are retrieved by an updated version of a module.

Configuration

Sessions will time out after a configured time of inactivity.

4.4.13 SSO Manager

Introduction

SSO Manager is responsible for handling the process of SSO for different SSO providers. Currently the only implemented provider, shipped with Pulsar Core, provides support for SAMLv2.

More information

See the section [SSO - SAMLv2](#)(see page 109) in the operations manual for details on how to use the module.

4.4.14 Template Manager

Introduction

The Template Manager module provides a set of template tags which are used to extend HTML templates with different functionality for generating dynamic HTML content. Template Manager is responsible for parsing these HTML templates for Pulsar tag. The set of tags and the tag functionality is provided also by Template Manager.

Pulsar Tags

`<pulsar:echo ...>`

The echo-tag is used to output variables from the Scope.

Attributes for the echo-tag:

Attribute	Description
name	The name of the variable in the scope that will be printed
encode	This attribute controls how the echo tag escapes characters on the output stream. There are three options: <ol style="list-style-type: none"> 1. "html" which is the most secure option and escapes every character on the output stream. (THIS IS SET BY DEFAULT) 2. "url" escapes only for url purposes 3. "none" equals no escaping on the output stream which is not recommended.
urlencode	Set this attribute to <code>true</code> if the output should be url-encoded (percent-encoded) ¹² (THIS ATTRIBUTE IS DEPRECATED, USE ENCODE INSTEAD!)

<pulsar:if ...>

The if-tag is used to make output based on a condition.

Attributes for the if-tag:

Attribute	Description
test	A boolean expression that will be tested
eval	A boolean expression what will be evaluated with Bean Shell ¹³
true	This content of this attribute will be the result of the tag if the expressions is true
false	This content of this attribute will be the result of the tag if the expressions is false
file	If the expression is true, the template specified will be included and parsed for other pulsar tags, as it was included by the pulsar:include-tag

The test and the eval attribute can't be used together. One of them can only be used in every pulsar:if-tag.

Note that if the expression evaluates to true everything between the enclosing tag will be outputted. The content will be parsed and can contains other Pulsar-tags.

¹² <http://en.wikipedia.org/wiki/Urlencode>

¹³ <http://www.beanshell.org/>

```
<pulsar:if test="flag">
  This is outputted if flag is true
  <pulsar:method service="service" method="thisMethodIsCalledIfFlagIsTrue"/>
</pulsar:if>
```

<pulsar:method ...>

The method-tag is used to execute a Java-method annotated with `@PulsarMethod`.

Attributes for the method-tag:

Attribute	Mandatory	Default	Description
module	No	The same module as the template is loaded from.	The name of the module where method exists.
service	Yes		The name of the service where the method exists.
method	Yes		The name of the method which is called.
stylesheet	No		A name of a stylesheet which the XML from the method will be transformed with

Parameters to the method

Parameters to the method is coming from the request scope. If parameters are to be overridden, values can be passed to the methods argument by using the `<param name="..." value/variable="..." />` -tag, as the example below.

```
<pulsar:method service="service" method="method">
  <param name="param1" value="value1"/>
  <param name="param2" variable="variable2"/>
</pulsar:method>
```

Parameters to the stylesheet

Parameters to the stylesheet is coming from the request scope the same way as the parameters to the method. If parameters are to be overridden, this can be done by using the `<param name="..." value/variable="..." />` -tag, but a reference to the stylesheet from a separate tag must be declared.

```
<pulsar:method service="service" method="method">
  <stylesheet name="stylesheet.xml">
```



```

    <param name="param1" value="value1"/>
    <param name="param2" variable="variable2"/>
  </stylesheet>
</pulsar:method>

```

Different parameters to the method and the stylesheet

Different parameters can be specified to the method and the stylesheet.

```

<pulsar:method service="service" method="method">
  <param name="param" value="This value goes only to the method"/>
  <stylesheet name="stylesheet.xml">
    <param name="param" value="This value goes only to the stylesheet"/>
  </stylesheet>
</pulsar:method>

```

<pulsar:stylesheet ...>

The stylesheet-tag is used to execute a XSL-stylesheet without to call any java method. The XML-provided to the XSLT is:

```

<pulsar:stylesheet name="stylesheet.xml"/>

```

The provided XSL-stylesheet can use variables from the scope as input parameters.

Attributes for the stylesheet-tag:

Attribute	Mandatory	Description
name	No	A name of a stylesheet which the XML from the method will be transformed with

<pulsar:include ...>

The include-tag is use to include a separate template. The included file is parsed for pulsar-tags.

Attributes for the include-tag:

Attribute	Mandatory	Description
file	No	Name of the template to be included.
module	No	The name of the module where template exists.
template	No	The name of the template to be included

NOTE: Either use the file-attribute OR the module-attribute together with the template-attribute.

<pulsar:permission ...>

The permission-tag is use to do conditionally output, based on the current users permissions.

Attributes for the permission-tag:

Attribute	Mandatory	Default	Description
module	No	The same module as the template is loaded from.	The name of the module where the permission should be tested in.
type	Yes		The path of the resource as specified in resources.xml.
path	Yes		The type of the resource as specified in resources.xml.

Example:

```
<pulsar:permission type="template path="page1.html">
This is outputed if the user has permission to page1.html. The section can contain other pulsar-tags that
are parsed.
</pulsar:permission>
```

4.4.15 User Manager

- [Introduction](#)(see page 66)
- [Features](#)(see page 67)
 - [Plugin support](#)(see page 67)
 - [Bundled plugin: Pulsar Default Plugin](#)(see page 67)
 - [Bundled plugin: User XML Plugin](#)(see page 67)
 - [Cascading \(hierarchical\) dependencies](#)(see page 67)
 - [Attributes](#)(see page 67)
- [Configuration](#)(see page 67)

Introduction

User Manager provides interfaces with the functionality to manage users and groups in Pulsar. User Manager can create, search or retrieve attributes for specified users and groups.

Relations between user to groups and groups to groups is also managed by User Manager. The relation structure is hierarchical, starting with a root group or user.

The actual backend for user and group data is pluggable through the `UserPlugin` interface. Multiple plugins may be used in one Pulsar instance.

Features

Plugin support

User Manager provides a unified view of users and groups from different sources. Plugins can be developed to add new sources of users and groups to the system. Each plugin specifies its own capabilities, for example if it supports updates or is read only. Usually extending `AbstractUserPlugin` is a good starting point when developing a new user plugin.

Bundled plugin: Pulsar Default Plugin

The Pulsar Default Plugin is always available and has the following groups defined:

Group	Description
everyone	Contains all users.
identified	Contains all logged in users.
anonymous	Contains all anonymous (not logged in) users.
none	Contains no users.

Bundled plugin: User XML Plugin

The XML plugin provides a simple XML format for providing users and groups data. The plugin also supports updating of the information.

Cascading (hierarchical) dependencies

If User/Group A is member of group B, and group B is member of group C then A is a member of C.

Attributes

Each user or group object has a set of mandatory attributes but may also have extra attributes as specified by a specific plugin.

Configuration

In the configuration for User Manager the superusers login and password is configurable.

4.5 Migrating from earlier versions

4.5.1 Introduction

This section describes the most important things that needs to be considered when migrating from Pulsar 2 to Pulsar 3.

4.5.2 Multiple services per module

In Pulsar 2 each module/service could only publish one service interface. In Pulsar 3 each module may publish any number of services defined by the same or different interface classes. When migrating from Pulsar 2 the old service interface will have to be extracted into a separate Java interface and published specifically. Since the service now needs to be specified separately from the module this affects calls to Pulsar methods both in templates and direct method calls, through HTTP POST/GET and javascript methods.

What was called service in Pulsar 2 now has to be referenced through both a module and a service. Both modules are uniquely identified through their symbolic name and a service instance is identified through the module symbolic name together with the symbolic name of the service (which is the same as the fully qualified Java interface name).

4.5.3 Dependency injection

Pulsar 3 used dependency injection with Guice. Dependency injection is a very important part of Pulsar since it is the primary channel for modules to exchange information and functionality, through services. Dependency injection can be done in different manners but the most usual way to do it is to consume and inject a service.

When migrating from Pulsar 2 the old service interface classes is replaced with service injection in the constructor.

The dependency injection model and dynamic modularity generally clashes with using static class member variables and static methods which initialized these variables. To utilize dynamic modularity and dependency injection static member variables needs to be converted into singleton classes which are then injected into the objects that needs them. This conversion not only allows for dependency injection and dynamic modularity but also makes the code testable.

4.5.4 Module activator

Pulsar 2 used the service class to interact with the lifecycle model. In Pulsar 3 the module lifecycle is implemented in a special activator class which needs to extend `PulsarActivator`.

4.5.5 Semantic versioning

To develop and release in semantic context semantic versioning must be followed in order for the application to behave properly. Semantic versioning is a key to create well defined dependencies in when developing in pulsar. See [Concepts\(see page 15\)](#).

4.5.6 Strictly defined API classes

All classes (interfaces and value objects) must be placed in an "api"-package in Pulsar 3. Only classes in the "api"-package will be available to other modules. This means that services which should be available as Pulsar methods have to be placed in "api"-packages and published as services.

4.5.7 Use SLF4J for logging

Pulsar 3 uses SLF4J instead of standard Java logging (JUL). Best practice is to provide every class with its own SLF4J logger. See [Logging for developers](#) (see page 78).

4.5.8 Changes to core module APIs

Database Access changes

The Database Access module has been updated and is no longer backwards compatible with Pulsar 2. The service used is now `DatabaseAccessPool` and the usage of a `poolName` parameter is no longer supported.

4.5.9 Coding details

pulsar:method - calls from XSL

In Pulsar 2 you made a `pulsar:method` call with **two** arguments: `pulsar:method('method', true/false)` where the second parameter indicated if the XSL should be cachable. In Pulsar 3 you only need **one** argument: `pulsar:method('method')`. When pulsar methods are called from the XSL the result of the XSL transformation will never be cached.

Modules and services

Since Pulsar 3 redefines services and modules any reference to a service in Pulsar 2 needs to be expressed as a reference to a service for a specific module in Pulsar 3. To make the migration easier Pulsar 3 allows each module to define a default service, which means that only the module and method is needed to invoke a default service.

4.5.10 Migrating published Web Services

When migrating existing Web Services from Pulsar 2 to Pulsar 3.x, with backwards compatibility, the following concerns need to be addressed:

1. Pulsar 2 used AEGIS data binding per default, Pulsar 3 uses JAXB per default.
2. The default endpoint URL is changed in Pulsar 3, to avoid service name clashes. In Pulsar 2 the endpoint was "http://host/pulsar/ws/WSEExample", the default endpoint created in Pulsar 3 would be "http://host/pulsar/ws/se.dse.pulsar.examples.wsexample.WSEExample".
3. The target namespace of the generated WSDL may change if the package structure is changed. Any change of target namespace will break backwards compatibility.

4. The service name may affect backwards compatibility, this can be adjusted in the same way as the namespace.
5. Method parameters were defines as NOT NILLABLE by default in Pulsar 2. Pulsar 3.0 allows for all parameters to be NULL by default.

The following code example shows how to customize your service publication and service definition to be backwards compatible with Pulsar 2.0:

```
// publish the service with AEGIS data binding in your module activator at the location http://host/pulsar/
ws/WSExample
i_contextBuilder.publish(WSExample.class)
    .usingClass(WSExampleImpl.class)
    .withConfigurator(lookupService(WConfiguratorFactory.class).configure()
        .databinding(WConfiguratorFactory.DataBindingType.AEGIS)
        .serviceAddress("WSExample"));
```

To specify the target namespace the standard JAXWS annotations are used on the interface:

WSExample.java

```
@WebService(targetNamespace = "http://my.custom.namespace", serviceName = "WSExample")
public interface WSExample {
    @WebMethod
    String hello(@WebParam(name = "name") String i_name);
}
```

To further customize the AEGIS data binding (field mapping etc.) and controlling the NILLABLE schema attribute aegis.xml files can be used. For example to make the parameter to the hello method above not NILLABLE the following file is created next to the Java interface source.

WSExample.aegis.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<mappings>
  <mapping name="WSExample">
    <method name="hello">
      <parameter index="0" nillable="false"/>
    </method>
  </mapping>
</mappings>
```

4.5.11 Migrating files in the data area

In Pulsar 2 each module could use a data area in the `pulsar-dir/service-dir/data` directory to read and write module specific data, usually application specific configuration files. In Pulsar 3 the same functionality exists but the data area is located at `pulsar-dir/data/module-symbolic-name` instead.

4.6 JDK system packages and overrides

4.6.1 Introduction


Pulsar handles dependencies between modules based on the Java packages that are imported or exported from/to each module. The dependency is automatically created when a Pulsar module is packaged (after compilation) and is included in the resulting artifact (jar-file). In runtime the dependency version is verified using semantic versioning and required modules (exporting the required packages) are automatically loaded. Since there are several packages (mainly `javax.*`) that have not always been part of the JDK, they exist as third party packages that can also be used with Pulsar. A further matter of complication is that some of the packages are SPIs which also requires an implementation to function. The JDK also provides a default implementation for some of these SPIs.

Pulsar needs to manage these common API in a consistent way. It is possible, in theory, to allow multiple version of a package in runtime but this quickly becomes unmanageable, especially when several modules need to share object instances created from these different APIs and SPI implementations.

Pulsar therefore provides the `javax.*` packages either through the JDK or through a third-party packaging. Decisions on whether to use a JDK package or a third-party has been made to maintain an overall compatibility for all the Pulsar modules as well as the modules provided through the endorsed packages. This package setup can be modified but such modification may cause internal compatibility problems and unexpected runtime results.

4.6.2 Adding your own third party libraries

Each Pulsar module allows for libraries to be added, either as internal or exported libraries. If libraries containing any of the packages below are added to a module unexpected runtime results may occur. The most likely problem to occur is `ClassCastException` or `ClassNotFoundException`. The cause of the problem would be that different versions of the packages are loaded by the classloaders of different modules and then instances of these classes are passed as parameters or return values between modules.

 We strongly recommend that additional third party implementations of these packages are not used when developing Pulsar modules. If they are used, make sure they are strictly internal to the module.

4.6.3 JDK packages exported in Pulsar

The table below documents the current selection of packages provided in the Pulsar runtime environment.

System	Packages	API Version	API Provider	SPI Implementation	Comments
NIO File	com.sun.nio, com.sun.nio.file	JDK version	JDK	N/A	Used internally by pulsar.deployer to detect file system changes.

System	Packages	API Version	API Provider	SPI Implementation	Comments
Java Core packages	java.*	JDK version	JDK	N/A	
Java Activation	javax.activation	JDK version (aliased 1.1.0)	JDK	N/A	
	javax.activity	JDK	JDK	N/A	
Java Annotations	javax.annotation.*	JDK version	JDK	N/A	
Java Crypto	javax.crypto.*	JDK version	JDK	N/A	
Java Image IO	javax.imageio.*	JDK version	JDK	N/A	
JAX-WS Annotations	javax.jws.*	JDK version	JDK	N/A	
	javax.lang.model.*	JDK version	JDK	N/A	
	javax.management.*	JDK version	JDK	N/A	
	javax.naming.*	JDK version	JDK	N/A	
Java Net and SSL	javax.net.*	JDK version	JDK	N/A	
	javax.print.*	JDK version	JDK	N/A	
	javax.rmi.*	JDK version	JDK	N/A	
	javax.script	JDK version	JDK	N/A	

System	Packages	API Version	API Provider	SPI Implementation	Comments
	javax.security.*	JDK version	JDK	N/A	
	javax.sound.*	JDK version	JDK	N/A	
	javax.sql.*	JDK version	JDK	N/A	
	javax.swing.*	JDK version	JDK	N/A	
	javax.tools	JDK version	JDK	N/A	
	javax.transaction.*	JDK version	JDK	N/A	
JAX-RS	javax.ws.rs	2.2.0	org.apache.servicemix.specs.jaxrs-api-2.2	org.apache.cxf.cxf-rt-front-end-jaxrs (2.7.2)	
JAXB - Java XML Binding	javax.xml.bind.*	2.2.0	org.apache.servicemix.specs.jaxws-api-2.2	org.apache.servicemix.bundles.jaxb-impl (2.2.1.1_2)	The JAXB API and SPI implementation of the JDK is not used by Pulsar or any Pulsar modules.
	javax.xml.crypto.*	JDK version	JDK	N/A	
	javax.xml.datatype	JDK version	JDK	N/A	
	javax.xml.namespace	JDK version	JDK	N/A	
JAXP	javax.xml.parsers	JDK version	JDK	JDK (com.sun.org.apache.xerces.*)	
SAAJ - SOAP with	javax.xml.soap	JDK version (aliased 1.3.0)	JDK	N/A	

System	Packages	API Version	API Provider	SPI Implementation	Comments
Attachments API					
XML Streaming	javax.xml.stream	JDK version (aliased 1.0.0, 2.2.0)	JDK	N/A	
XML Transform	javax.xml.transform	JDK version	JDK	N/A	
XML Validation	javax.xml.validation	JDK version	JDK	N/A	
JAX-WS	javax.xml.ws.*	2.2.0	org.apache.servicemix.specs.jaxws-api-2.2	org.apache.cxf.cxf-rt-frontend-jaxws	
XPATH	javax.xml.xpath	JDK version	JDK	JDK (com.sun.org.apache.xpath.*)	
JDOM	org.jdom	1.1.2	org.apache.servicemix.bundles.jdom	N/A	
	org.omg.*	JDK version	JDK	N/A	
	org.w3c.dom.*	JDK version	JDK	N/A	
	org.xml.sax.*	JDK version	JDK	N/A	
Security	sun.security.*	JDK version	JDK	N/A	

Compiling against the correct APIs

As a developer you should always compile against the same version of the API that will be using in runtime to prevent any unexpected runtime dependency problems. The APIs can be extracted from the pulsar-endorsed archive. (When the Maven setup for Pulsar is completed this will be simplified.)

5 Development guides

5.1 Planning a module system

5.1.1 Naming a module

Advice on how to structure the modules into directories and name them (symbolic name, package names and directory names)

5.1.2 Dependencies should always be one-way

Give any two modules in the system they should either have no dependency or one directed dependency, direct or transient. It is possible to create circular dependencies and direct two-way dependencies between modules but this is highly discouraged because of the added complexity it brings (during development, continuous integration and deployment). If two-way or circular dependencies appear in your design you should refactor the involved modules so that the shared functionality is moved into a new or existing third, separate, module on which both the original modules can depend.

Given that the above practice is adhered to your modules dependencies can be described as a directed graph without any loops. This simplifies reasoning about the system of modules which is a huge benefit during system evolution.

5.1.3 Splitting an application into sub modules

When converting a monolithic application into modules the best practice is to first move the entire application into a single module and verify that it works as before. The next step is to select one suitable part and refactor that into a module. The extraction can be divided into these steps:

- Identify a block of functionality which is cohesive enough to be able to be encapsulated in a separate module. Also consider deployment requirements. Functionality that is not used by all deployments of a system might be a good candidate since it can then only be deployed when it is actually needed.
- Create the new module. (see [Creating a new module](#)(see page 75))
- Design the API of the new module. What methods of interaction should the module provide. Possible methods include Java API or exposure of resources, such as common HTML templates, XSL stylesheets or XML resources.
- Migrate the code and resources into the new module directory.
- Extract the API from the private code.
- Consume the new API where needed in the main application.

5.2 Creating a new module

5.2.1 Introduction

This section describes the fundamental steps that is involved when creating a new module in Pulsar.

- Setting up a Pulsar development environment
- Creating the required folder structure
- Building a module artifact
- Testing a module
- Deploying a module

5.2.2 Steps for creating a new module

The steps describes below are listed in a chronological manner where the first topic is a wise choice to start with.

Setting up the Pulsar development environment

In Pulsar 3.0 the development environment will be available as a preconfigured workspace for IntelliJ IDEA. In future versions Pulsar will include a Developer Tools module which will be able to create development projects for the most popular IDEs or a stand alone setup without IDE configuration.

Required module folder structure

Create a proper folder structure as follows:

- module-directory/
 - conf
 - lib/
 - exported (optional)
 - internal (optional)
 - native (optional)
 - resources
 - static
 - stylesheets
 - templates
 - script
 - src
 - src-test

This structure is required for the Pulsar tools to work. For more information on the directory structure see Development Reference / [Directory Structures](#)¹⁴.

Writing module code

The Java code is placed in the `src` directory. Make sure that each module uses a unique package name. Having several modules use the same package will result in dependency conflicts and is highly discouraged.

Using other modules

When importing APIs from other modules you need to have these modules available both during the phases of compilation, test, packaging (to establish version dependencies) and in runtime. Pulsar 3.0 currently provides

¹⁴ <https://denebsoftware.atlassian.net/wiki/spaces/PULSAR/pages/45727/Directory+Structures>

dependencies using the build files. To specify module dependencies use the `dependencies.compile` attribute in the build file, see example below.

Writing tests

Tests should be seen as a natural part of the development process. A good manner is to follow a [test-driven development](#)¹⁵ where tests are defined according to contract before starting to write the code. The Pulsar scripts assume that JUnit will be used for unit testing.

In Pulsar 3.0 only plain unit tests are supported, however in Pulsar 3.1 a framework for integration testing will be available. Using the framework it will be easy to create integration tests which involves several modules interacting with each other.

Test classes should be placed in the `src-test` folder.

Creating a build script

To be deployable into a Pulsar framework the module needs to be packaged. Packaging is done with an [Ant](#)¹⁶ build script. The script has to be created in the `<MODULEDIR>/script` directory and called `build.xml`.

```
<project name="my_module" default="dist" basedir=".">
  <import file="../../../../script/build.macro.xml"/>
  <pulsar-module
    dir="."
    pulsar.dir="../../.."
    dependencies.compile="my_alfa_module, my_bravo_module"
  />
</project>
```

Running tests

The testing of a module is done by running the ant task `module.test` which is provided by `build.macro.xml`.

Building a module artifact

The module artifact (jar file) is created by running the ant task `module.dist` which is provided by `build.macro.xml`. By default javadoc is automatically generated for the API part of the module, this behavior may be overridden using the attribute `generate-javadoc` attribute of the `pulsar-module` tag in the build file.

Deploying a module

In a development environment deployment is usually handled implicitly. Pulsar has a development mode which provides automatic upgrades. This means that when Pulsar detects a newer module version in any of the current repositories it will automatically update that module, and all required dependencies. The module will be stopped, updated and restarted automatically, together with all the modules that depend on it.

¹⁵ http://en.wikipedia.org/wiki/Test-driven_development

¹⁶ <http://ant.apache.org/>

In a remote deployment of Pulsar a module is deployed by adding the module artifact it to a HTTP repository or by packaging the module (usually together with other modules) into a repository package file (containing both modules and the repository index file). The repository package is then transferred to the remote Pulsar deployment and placed in at the root level of the installation. The module then is automatically available for installation or upgrade in the Admin Console / Install utility.

5.3 Logging for developers

5.3.1 Introduction

The choice of logging framework is not dictated by Pulsar. Pulsar is configured to support logging with the most common logging frameworks, Java Util Logging (JUL), Java Commons Logging (JCL) and Log4J. However, to get the most out of the logging functionality it is recommended to use the framework [SLF4J](http://www.slf4j.org/)¹⁷ (Simple Logging for Java). Internally all logging through the supported frameworks is automatically routed through SLF4J which is then used as the main framework though which log output is produced and routed to different targets.

5.3.2 Implementing logging

```
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;

public classClazz {
    private final static Logger logger = LoggerFactory.getLogger(Clazz.class);

    void method() {
        logger.warn("[method] Something is not right!");
        logger.info("[method] Information about what's happening");
        logger.debug("[method] Debug info");
        logger.trace("[method] Detailed information");
        try {
            ...
        }
        catch (Exception e) {
            logger.warn("[method] Exception ...", e);
        }
    }
}
```

Migrating from JUL to SLF4J

In Pulsar 2 `java.util.logging` (JUL) was the standard logging framework. However, the migration is quite straightforward and the following best practice can be used when translating logger method calls.

¹⁷ <http://www.slf4j.org/>

Old Logger (java.util.logging.Logger)	New Logger (org.slf4j.Logger)
severe(...)	error(...)
warning(...)	warn(...)
info(...)	info(...)
config(...)	debug(...)
fine(...)	debug(...)
finer(...)	trace(...)
finest(...)	trace(...)
log(Level,...)	No dynamic selection of logging is available in SLF4J. This is probably by design since it is not good practice to select log level in runtime. Logging filters should be configured using log configuration instead. When migrating a log level needs to be selected for each instance.

Note that the SLF4J logger only has five different levels.

5.3.3 Configuration

See the [Logging](#)(see page 102) part of the [Operations reference](#)(see page 89).

5.4 Working with Web Services and REST Services

- [Introduction](#)(see page 79)
- [Web Service](#)(see page 80)
 - [Publishing a Web Service](#)(see page 80)
- [REST service](#)(see page 81)
 - [Publishing a REST service](#)(see page 81)
 - [REST service permissions](#)(see page 82)

5.4.1 Introduction

Pulsar provides the ability to publish both [Web Services](#)¹⁸ and [REST services](#)¹⁹ though the same service mechanism which is used to publish and consume Pulsar service. A service in Pulsar is defined by its Java interface and this is true also for Web Services and REST services. A Web Service or a REST service is a Pulsar service with extra

¹⁸ http://en.wikipedia.org/wiki/Web_service

¹⁹ http://en.wikipedia.org/wiki/Representational_state_transfer

annotations describing the service and some additional configuration which is supplied during the publishing of the service. This means that a service can be simultaneously published as a Pulsar service, Web Service and REST service.

5.4.2 Web Service

Publishing a Web Service

Create the service interface in an API package and annotate it according to the JAX-WS standard, using the annotations specified in the `javax.ws` package.

```
package se.dse.pulsar.examples.wsservice.api;

import javax.ws.WebMethod;
import javax.ws.WebParam;
import javax.ws.WebService;

@WebService
public interface WSExample {
    @WebMethod
    String hello(@WebParam(name = "name") String i_name);
}
```

Create the implementation (`WSExampleImpl` according to the code example) in an internal package and publish it in the module activator `init()` method. Note, the implementation doesn't require any JAX-WS annotations.

```
package se.dse.pulsar.examples.wsservice;

import se.dse.pulsar.core.api.ModuleContextBuilder;
import se.dse.pulsar.core.api.PulsarActivator;
import se.dse.pulsar.core.api.configurators.RSConfigurator;
import se.dse.pulsar.examples.wsservice.api.WSExample;

public class WSExampleModuleActivator extends PulsarActivator {
    @Override
    public void init(ModuleContextBuilder i_contextBuilder) {
        i_contextBuilder
            .publish(WSExample.class)
            .usingClass(WSExampleImpl.class)
            .withConfigurator(lookupService(WConfiguratorFactory.class).configure());
    }
}
```

The Web Service will now be available as soon as the module has been installed and started. The service is automatically shut down when the module is stopped.

Web Services and their [WSDL specifications](#)²⁰ are available at their respective endpoint addresses. In the example above the WSDL would be available at `http://localhost:8080/pulsar/ws/se.dse.pulsar.examples.wsservice.api.WSExample?wsdl`.

Note, the `WSConfiguratorFactory` uses the builder pattern to provide additional configuration options for the web service, such as XML binding style, custom addresses and more. The JAX-WS standard also allows for customization of the service namespace, service and endpoint names using annotations on the interface.

5.4.3 REST service

Publishing a REST service

Create the service interface in an API package and annotate it according to the JAX-RS standard, using the annotations specified in the `javax.ws.rs` package.

```
package se.dse.pulsar.examples.rsservice.api;

import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.PathParam;

@Path("example")
public interface RSExample {
    @GET
    @Path("hello/{name}")
    public String hello(@PathParam("name") String name);
}
```

Create the implementation (`RSExampleImpl` according to the code example) in an internal package and publish it in the module activator `init()` method. Note, the implementation doesn't require any JAX-RS annotations.

```
package se.dse.pulsar.examples.rsservice;

import se.dse.pulsar.core.api.ModuleContextBuilder;
import se.dse.pulsar.core.api.PulsarActivator;
import se.dse.pulsar.core.api.configurators.RSConfigurator;
import se.dse.pulsar.examples.wsservice.api.RSExample;

public class RSExampleModuleActivator extends PulsarActivator {
    @Override
    public void init(ModuleContextBuilder i_contextBuilder) {
        i_contextBuilder
            .publish(RSExample.class)
            .usingClass(RSExampleImpl.class)
            .withConfigurator(lookupService(RSConfiguratorFactory.class).configure());
    }
}
```

²⁰ <http://www.w3.org/TR/wsdl>

The REST Service will now be available as soon as the module has been installed and started. The REST service may now be invoked through a browser using the URL `http://localhost:8080/pulsar/rs/se.dse.pulsar.examples.wsrsservice.api.RSExample/example/hello/merlin` (passing the parameter 'merlin' to the hello method). The service is automatically shut down when the module is stopped.

REST Services and their WADL specifications are available at their respective endpoint addresses. In the example above the WADL would be available at `http://localhost:8080/pulsar/rs/se.dse.pulsar.examples.rsservice.api.RSExample?_WADL`²¹.

Note, the RSConfiguratorFactory uses the builder pattern to provide additional configuration options for the web service, such as XML binding style, custom addresses and more. The JAX-WS standard also allows for customization of the service namespace, service and endpoint names using annotations on the interface.

REST service permissions

Read [this](#)²² documentation about how to set permissions for REST resources.

5.5 Development troubleshooting

5.5.1 Introduction

The main source of information about the state of the running Pulsar framework are the log files. All the code which makes up Pulsar and its core modules aims at producing relevant and succinct logging information to be used by developers or operations. Warnings and errors in the log should be treated seriously and during normal operations no warnings or errors should be present.

5.5.2 Increase the logging output to troubleshoot

Check the log for warnings. Under normal circumstances the log should not contain any warnings or errors. Read the message thoroughly and examine the call stack if available.

To be able to get more information you can change the log level for a module. This is specified in the config file `conf/logback.xml`. As a general rule start with activating the `DEBUG` level of logging and advance to `TRACE` if the debug level is not providing enough detail.

Example for setting Session Manager to log debug information.

logback.xml

```
<configuration ...>
  ...
  <logger name="se.dse.pulsar.module.sessionmanager" level="DEBUG"/>
</configuration>
```

For more information about logging see Development Reference / [Logging for developers](#)(see page 78).

²¹ <http://pulsarhost/pulsar/ws/se.dse.pulsar.examples.wsservice.api.WSExample?.wsdl>

²² <http://confluence.dse:8080/display/PULSARDOC/Permission+Manager#PermissionManager-PermissionswithREST>

5.5.3 Use the debugger and set breakpoints

To be able to examine application flow and get information about variable, it is very handy to use the debugger in the IDE.

5.5.4 Using a command line shell to introspect

The Apache Felix project provides a runtime command shell, called GoGo which may be used to introspect Pulsar modules and their dependencies in runtime. To install and activate the GoGo shell on a Pulsar instance use the command line options below when starting Pulsar. The shell commands are documented by the Apache Felix project on their web site.

```
java -jar pulsar.launcher-v.v.v.jar shell
```

5.5.5 Using Hot Swap to deploy minor code changes

If your IDE supports hot swapping classes in the running Java runtime this can be used as an efficient tool for correcting and retesting code without having to re-dist your modules using the build scripts.

5.5.6 Coding considerations

Using the correct annotations

Annotation problems can be very difficult to debug since the wrong type of annotation produce the same result as no annotation. Further if an annotation class is unavailable at runtime this also has the same effect as if no annotation was present, no error or warning is shown.

The `javax.inject` annotations `@Inject`, `@Named` should always be used instead of the corresponding `com.google.inject` alternatives. A good idea is to filter away the import suggestion the `com.google.inject` package.

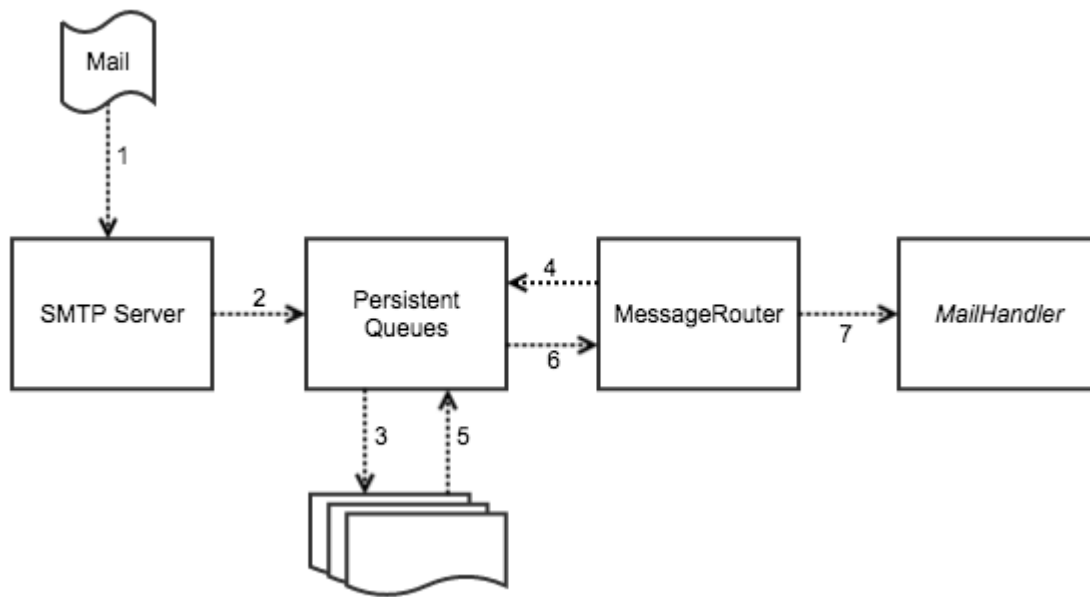
Only interfaces may be published as services

When publishing services a Java interface must be used to represent the service. An implementation class may not be published directly.

5.6 Handling incoming SMTP-emails

5.6.1 Overview

The picture below shows the different modules involved in handling incoming SMTP emails.



Step-by-step description:

1. An incoming email is received by the [SMTP Server](#)(see page 112). The email is mapped from the senders mail address to an queue-id.
2. The SMTP Server uses the [Persistent Queues](#)(see page 59) to save the incoming message to the mapped queue-id.
3. By saving it persistent to disc Pulsar can be restarted without any loss of data.
4. [Message Route](#)(see page 54)r polls the persistent queue to get new mails.
5. New mails are read from the persistent storage...
6. ... and delivered to the Message Router.
7. Message Router delivers e-mails to the MailHandlers that are subscribing to the correlating queue-id.

5.7 How to access a file programmatically

5.7.1 Introduction

Sometimes there is a need to get access to a file in the module either to stream the content or copy the file to an other location.

Get a `Resource` object

Use `ResourceManager` to get a `Resource` object representing a file.

```
PulsarModuleRef l_moduleRef = moduleManager.getModuleRef("module.symbolic.name");

Resource l_confResource = resourceManager.getResource(l_moduleRef, CONF, "file.conf");
```

```
Resource l_staticResource = resourceManager.getResource(l_moduleRef, STATIC, "file.html");
Resource l_dataResource = resourceManager.getResource(l_moduleRef, RESOURCE, "data/file.dat");
```

Resource type

There are five different resource types, defined in `ResourceManager.ResourceType` that is used to specify the location of the file:

Resource type	Location
CONF	conf
RESOURCES	resources
TEMPLATES	resources/templates
STYLESHEETS	resources/stylesheets
STATIC	resources/static

Access the file

The file is access by getting an `URL` from the `Resource`.

```
Resource l_resource = resourceManager.getResource(l_moduleRef, RESOURCE, "data/file.dat");

URL l_resourceURL = l_resource.getURL();
```

Reading a file

A file can be accessed by open a stream on the URL.

```
URL l_resourceURL = l_resource.getURL();

InputStream l_inputStream = l_resourceURL.openStream();
```

Copy a file

Use `Files.copy` to copy a file from a module to an other location.

```
Resource l_resource = resourceManager.getResource(l_moduleRef, RESOURCE, "data/file.dat");
File l_destinationFile = new File("copy.dat");
```

5.7.2 Warnings

Do not convert `Resource` to a `File`

Do not try to convert the resource to a `File`! This will work in development, but not in run time!

```
Resource l_resource = resourceManager.getResource(l_moduleRef, RESOURCE, "data/file.dat");
URL l_url = l_resource.getUrl();
File l_thisWillNotWork = new File(l_url.getPath());
```

Do not use `PulsarModuleContext::getResource()`

The method `getResource` in `PulsarModuleContext` is only for internal use in Pulsar.

5.8 Extending the Pulsar CLI and Shell

Pulsar can be used to implement automation tasks (like custom installation scripts) which can then be run directly from the command line using specific launcher arguments. A command or script is executed and then automatically exits when finished.

Pulsar supports automation through a command mode where any published command can be invoked directly through the command line.

5.8.1 Publishing a command

Any module can publish one or more commands. As long as the module publishing the command is installed the command is accessible. Commands are published in the same way as services, using an interface, an implementation and a publishing configurator.

Command interface

```
public interface MyCommands extends PulsarCommand {
    @Command(description = "Example command which takes one parameter.")
    void myCommand(
        @CommandParameter(name = "arg", description = "Argument of the command") String i_arg,
    );
}
```

Command implementation

```
@Singleton
public class MyCommandsImpl extends AbstractCommand implements MyCommands {
```

```
public void myCommand(String i_arg) {
    ...
}
}
```

Command publication

Publish the command In the module activator.

```
public void init(ModuleContextBuilder i_contextBuilder) {
    i_contextBuilder.publish(MyCommands.class)
        .usingClass(MyCommandsImpl.class)
        .withConfigurator(new CommandConfigurator("misc", MyCommands.class));
}
```

i The `CommandConfigurator` allows a command category to be defined in the example the category is “misc”. This results in a command that can be invoked using `misc:myCommand`. However the category is not mandatory when invoking if no clashing command names are used.

Setting the exit code of the command

During automation process exit codes are often used to determine if a command was successfully executed or not. To control the exit code after command execution, use the service method `ShutdownService.setExitCode()` published by `pulsar.core`.

5.8.2 Invoking a command

Commands can be invoked three ways:


1. Using launcher switch `---command “<cmd> <arg1> <arg2> ...”`
2. Interactively using the shell, by just issuing the command.
3. Through a profile which defines the property `pulsar.commandsupport.command`

5.8.3 Invoking a script

Scripts are a list of commands written to a file. Script files can be invoked three ways:

1. Using launcher switch `---script “<path/to/scriptfile>”`
2. Interactively using the shell, by issuing `gosh <path/to/scriptfile>`
3. Through a profile which defines the property `pulsar.commandsupport.script`

⚠ Script file invocation requires the module `org.apache.felix.gogo.shell` to be installed. Make sure it is installed by the profile used.

 If both a command and a script is specified the script will be run first and then the command.

5.8.4 Preventing Pulsar from shutting down after running a command or script from the command line

Use the command line switch `--noexit` to leave Pulsar running after executing a command or script.

6 Operations reference

6.1 Installation and upgrades

6.1.1 Hardware and software requirements

Pulsar requires Java JDK/JRE 8 or above and may be run on any hardware on which the JDK can be used. Either 32-bit or 64-bit JDK/JRE can be used.

Pulsar requires 200 MB of disk space for an initial installation.

Pulsar, including dependencies, has an initial memory footprint of around 100 MB (Java Heap Space). The minimal memory requirement for running the JDK/JRE can be found in the documentation of the JDK/JRE.

The Pulsar Launcher (packaged in `pulsar.launcher-v.v.v.jar`) is responsible for loading the core libraries, which are included in the launcher and then start the boot module, which is also included within the launcher. The boot module then takes over and handles the rest of the Pulsar startup sequence.

6.1.2 Installing a new Pulsar instance

To install Pulsar you need four files and JDK/JRE 8+ installed:

1. `pulsar.launcher-v.v.v.jar`
2. `pulsar-modules-4.v.v.pulsar`
3. `pulsar-apps-4.v.v.pulsar`
4. `pulsar-endorsed-4.v.v.pulsar`

Create the directory where you want the pulsar instance to be installed and copy the installation files into that directory.

Install and start Pulsar by invoking the launcher:

```
java -jar pulsar.launcher-v.v.v.jar [PROFILES...]
```

This will extract the Pulsar runtime into the subdirectory `.pulsar-runtime` and start the application server. Once the Pulsar modules are loaded a browser (using your default browser) window will automatically be launched and logged into the Admin Console application.

The Pulsar Launcher contains minimal functionality which is used to boot the system, load core modules and boot the rest of the system. Therefore it is expected that module upgrades will be far more frequent than Launcher upgrades, which should only happen very seldom. For this reason the Launcher is also versioned separately from the other Pulsar packages.

Pulsar Launcher Reference

```
Usage:
java -jar pulsar.launcher-1.2.3.jar [--help] [--version] [--relink]
    [--bypasslock] [--nobrowser]
```

```

[--upgrade-launcher] [--upgrade-modules] [--start-and-exit]
[---config <CONFIGFILES>]
[---command <COMMAND>] [---script <SCRIPTFILE>] [--noexit]
[--extractlogconfig]
[PROFILES...]

```

Options:

<code>--help</code>	Print this usage help.
<code>--version</code>	Print Launcher version and exit.
<code>--relink</code>	Exit after creating or updating a hard link to the current launcher named 'pulsar.launcher-link.jar' Note: Re-linking is always performed as part of the launch phase unless the launcher is started from the linked version.
<code>--bypasslock</code>	Force startup even if a locked lock file exists.
<code>--nobrowser</code>	Flag to prevent Admin Console from opening a browser window on first start.
<code>--upgrade-launcher</code>	Upgrade Launcher modules (core libraries and the boot module).
<code>--upgrade-modules</code>	Perform an upgrade of all profile modules using available repositories.
<code>--start-and-exit</code>	Exit once bootup is completed. Useful in combination with the upgrade flags.
<code>---config <CONFIGFILES></code>	Load configuration file and apply configurations when the target modules are installed. CONFIGFILES is a comma (',') separated list of configuration files to load, the parameter must be quoted if it contains spaces. Note: Requires module 'pulsar.configmanager'.
<code>---command <COMMAND></code>	Runs the COMMAND as a Pulsar Shell command. Shell commands can be published by any Pulsar module. Once the command is completed Pulsar exists, unless --noexit is used. Note: Requires module 'pulsar.commandsupport'.
<code>---script <SCRIPTFILE></code>	Runs all the commands in the SCRIPTFILE as Pulsar Shell commands. Note: Requires module 'pulsar.commandsupport'.
<code>--noexit</code>	Prevent exit after running a command or script.
<code>--extractlogconfig</code>	Force overwrite of default log config to './conf/logback.xml'. Note: The log config is automatically extracted if no file exists.

Creation of a Launcher link

When the Pulsar Launcher is started it always creates a link file `pulsar.launcher-link.jar`. This file is relinked whenever a different Launcher is started so that it always points to the Launcher which was last used. The purpose of the Launcher link is to provide a consistent filename over upgrades, which may be used to start Pulsar as a service or from a script. Without having to update the service definition or the script when the Launcher is upgraded or downgraded.

The link created is a hard link, this means that it is a proper file in all respects, but which points to the same inode as the linked file. (See you file system documentation for further information.)

Administrative (super user) password

The password for the super user, which is used to access Admin Console, is randomly generated as a part of the install. The password for the pulsar.superuser ('admin') can be changed directly after an installation through the Admin Console / Configuration screen for the pulsar.usermanager module. If the password is not changed it can be retrieved from the file `logs/admin-pwd.log`.

The default user name for the super user is 'admin' this can also be changed through the configuration of the pulsar.usermanager module.

Note: If the super user password is empty login is disabled.

Crypt the password

To prevent someone with access to the server where Pulsar is installed, the password can be stored as a MD5 hash. When the super user logs in to Admin Console, the following message is seen in the log file;

```
[checkMD5orClearPassword] Clear text password detected, can be replaced with hashed value:
MD5abcdef1234567890abcdef1234567890
```

To save the password as a MD5 hash, you copy the hashed value `MD5xxx` and save it as the password in Admin Console.

Time-based One-Time Password

Time-based One-time Password (TOTP) is a computer algorithm that generates a one-time password (OTP) which uses the current time as a source of uniqueness. Enabling logon using Time-based One-Time Password is done by setting the config `UseTOTPlogin` in the module `pulsar.app.adminconsole`. When TOTP is enabled the first time, a setup key (TOTP_KEY) is found in the `data` -folder. A new key is generated if the file is deleted. The key file can be copied between installations so that the same password can be used.

Installing pulsar without firing the browser

After a successful install of Pulsar there might not be a need for the browser to fire up. Maybe Pulsar is installed for test purposes. To tell Pulsar to not fire the browser, developers can pass a `--nobrowser` option to the launch process.

```
java -jar pulsar.launcher-v.v.v.jar --nobrowser [PROFILES...]
```

6.1.3 Starting an existing Pulsar instance

Since Pulsar Core 4.0.2 / Launcher 3.6.0

When the launcher is used a check is performed to ensure that a Pulsar instance is not already started using the current `pulsar.launcher.jar`.

If a running instance is detected Pulsar will exit with the error message `ERROR se.dse.pulsar.launcher.Launcher - Failed to acquire runtime lock. Lock file in use: /some/dir`

This check can be disabled, for special use cases, by specifying the flag `-bypasslock` on the command line.

❗ When starting Pulsar from the command line it is important that the command line session used has the required access privileges. If the instance has been started with administrative privileges earlier these must also be available when starting from the command line.

To start an existing Pulsar instance from the command line, use the same command as used when installing. The Pulsar Launcher will detect the existing instance and launch it instead of reinstalling.

```
java -jar pulsar.launcher-v.v.v.jar [PROFILES...]
```

If Pulsar is installed as a system service the service control panel in the operating system may be used to start Pulsar (see [Running Pulsar as a system service](#))

6.1.4 Installing, upgrading and uninstalling modules

Modules in Pulsar may be installed, upgraded or installed without restarting the Pulsar instance (Java process).

Only one version of a specific module (symbolic name) is allowed to be installed at the same time. When a newer version of a module is installed the older version is automatically removed.

The installation, upgrade and uninstallation is handled the Pulsar Launcher command line, the Pulsar Shell or a web interface of Admin Console / Install. The web interface also shows which module versions are currently installed and if any upgrades are available in the known repositories. See [Operations reference / Repositories](#) (see [page 95](#)) for more information on how Pulsar detects and handles module repositories (local and remote).

In Admin Console / Install all modules which can be upgraded are shown. It is possible to upgrade all modules together using the "Upgrade All" button, or to upgrade one module at a time. The same result can be achieved by using the built in profile `upgrade` on the Pulsar Launcher command line.

When a module is selected for upgrade Pulsar will compute all the required dependencies to make sure that all mandatory requirements are available before applying the upgrade. Pulsar also check that the upgrade will not break any existing dependencies to the older version of the modules being upgraded. If the upgrade can't be performed because of missing dependencies or lacking backwards compatibility an error message will be shown and the upgrade will be cancelled.

6.1.5 Running Pulsar as a system service

Note: To apply the autostart configuration Pulsar needs administrative privileges. On Windows this can be achieved by starting Pulsar in a Command Windows which has been started with the **"Run as Administrator..."** option.

❗ When running Pulsar as system service it is important that the command line session or service user that is used has the required access privileges.

Installation of Pulsar as a system service is handled by the pulsar.autostart module. The configuration of the service is done in the Admin Console / Config / pulsar.autostart. The service is installed when the autostart parameter is enabled. The service name default is "Pulsar" but this may be changed in the configuration.

Configuration of JVM parameters

When Pulsar is started as a system service any JVM command line parameters, for example memory allocation parameters, can be configured through the configuration parameter `JvmOptions` under Admin Console / Config / pulsar.autostart.

Service Logging


The Windows service is installed using [Apache Commons Daemon](#)²³. Logging from the Common Daemon is done to a log file called commons-daemon.YYYY-MM-DD.log.

Starting the service from the command line

For troubleshooting purposes it might be necessary to start the service from the command line.

```
prunsv run ServiceName
```

6.1.6 Upgrading Pulsar

 When upgrading Pulsar it is important that the command line session used has the required access privileges. If the instance uses administrative privileges, for example to configure a Windows Service, these must also be used when upgrading (i.e. "Run As Administrator" in Windows or `sudo` on Linux).

When a new Pulsar version is released it is usually distributed as the four files:

1. pulsar.launcher-v.v.v.jar
2. pulsar-modules-4.v.v.pulsar
3. pulsar-apps-4.v.v.pulsar
4. pulsar-endorsed-4.v.v.pulsar

To upgrade an existing installation just replace the files you used to install it with their new versions and **use the new Launcher to start Pulsar**. If you are using a system service to start Pulsar then see "Upgrading the Pulsar Launcher" below. All Pulsar Core components will be automatically upgraded to their latest versions on next start.

Since Pulsar Core 4.7.0

The recommended way to upgrade a Pulsar instance since Pulsar Core 4.7.0 is to use the built in command line profile `upgrade` :

²³ <http://commons.apache.org/proper/commons-daemon/>

1. Replace `pulsar.launcher-v.v.v.jar` and the `*.pulsar` files in the instance directory.
2. Add the upgrade profile to the command line (keep any custom profiles used to define additional modules used):
`java -jar pulsar.launcher-v.v.v.jar upgrade ...other profiles...`
3. Pulsar will exit once the upgrade is completed. Restart without the upgrade profile to perform a normal startup.

Optionally upgrades (except Pulsar Launcher upgrades) can be performed using the Pulsar Admin Console UI and the following steps:

1. Replace the `*.pulsar` files for the applications with their latest version (compiled against the corresponding Pulsar Core version).
2. Open AdminConsole / Install.
3. Select the "Upgrade All" option.

This will resolve any dependency issues and restart the applications.

Note: The Admin Console UI also allows individual modules to be installed and upgraded separately.

Since Pulsar Core 4.7.0

Since Pulsar Core 4.7.0 it is no longer needed or recommended to upgrade the Pulsar Launcher separately from the Pulsar Core module and any application modules that are present in the instance. However it is still possible to only upgrade the Pulsar Launcher using the command line switch `--upgrade-launcher`, see the Pulsar Launcher Reference below.

Downgrading Pulsar

A general downgrade of Pulsar is currently not supported. To preform the equivalent of a downgrade to a previous Pulsar version:

- 1) Backup your existing installation.
- 2) Export module configurations.
- 3) Remove the installation, see "Removing a Pulsar Instance" below.
- 4) Perform a reinstall based on the previous Pulsar version.

Checking which Launcher version the Launcher Link file points to

The easiest way to check which version the Launcher link points to is to use the following command:

```
java -jar pulsar.launcher-link.jar --version
```

Reverting to an older launcher

If a Launcher needs to be downgraded the same procedure as when upgrading may be used.

6.1.7 Removing a Pulsar instance

To remove a Pulsar instance all that is needed is to delete the directory where Pulsar is installed. However you need to check the following before doing that:

- If you installed Pulsar as a Windows Service and want to remove that as well, first deactivate autostart in the Admin Console / Config / `pulsar.autostart`.
- If you have module configurations, or other instance persisted information you need to preserve, export this first. Module configurations can be exported in Admin Console / Config.
- Make sure Pulsar is not running.
- Make sure you do not have any files you want to keep in the Pulsar directory and it's sub-directories.
- Delete the Pulsar directory, and it's sub-directories, including `.pulsar-runtime`.

In the event of orphaned services in Windows, these may be cleaned up manually using the `sc` command, which is provided by Microsoft.

6.2 Repositories

6.2.1 What is a module repository?

A module repository is a set of Pulsar module artifacts (jar files created in a development environment or on a build server) together with an index (XML file) which describes the modules. The index contains extracted information from the artifacts, such as, module names, versions, exported packages, required packages, timestamps and paths to the module artifacts files. A module index can be built entirely from the module artifacts. Pulsar contains tools for creating these indexes.

6.2.2 Why use a module repository?

A module repository can be used to store several versions of the same module. Usually modules are never removed from the repository. New module versions are continually added as they are released. This is a very important concept when working with module dependencies and semantic versioning. Since one module may be compatible with certain versions of another module the Pulsar installer, which uses the repository, may select the latest compatible version instead of failing the install because of a broken dependency.

The repository concept together with the semantic versioning of modules provides a dynamic release system where modules are free to evolve independently, while at the same time module compatibility and configuration management is ensured in runtime.

6.2.3 Different forms of repositories

A repository may exist in different forms:

1. In a development environment the modules under development are treated as a repository. The index file is generated at `dist/repository.xml` and it will point to all the module artifacts that has been built (using `module.dist`) on the local machine.
2. When a repository is published over HTTP the same structure is used and the artifact files and the `repository.xml` is made available over HTTP from any web server.

- When installations are made without an online repository a packaged form of the repository may be used. Here the artifacts and the index is packaged into a single file with the suffix `.pulsar`. Pulsar uses this way of distribution for it's own modules and endorsed libraries.

6.2.4 Adding repositories to a Pulsar instance

Pulsar repositories are added to an instance as `.pulsar` files or `.pulsarlink` files.

To connect a Pulsar instance to a pulsar repository file (`.pulsar` file) just copy the repository file to the root directory where Pulsar is installed/running. Pulsar automatically detects when repositories are added or removed. If a repository is temporarily unavailable, for example caused by a network outage, this will be logged to the `pulsar.log`. To see which modules are available for installation or upgrade through all currently available repositories, use the Admin Console, Install page.

To connect a Pulsar instance to a HTTP repository create a pulsar repository link (`.pulsarlink` file). The file is a plain text file, only containing a URL pointing to the repository index file (usually `repository.xml`). Example of a `.pulsarlink` file:

```
http://repo.example.org:8080/products/alfa/develop-repo/repository.xml
```

6.2.5 Using an other directory for the repository files

The default directory for the pulsar repository files are the root directory where Pulsar is installed, but this can be overridden by using the system property `pulsar.repository.dir` when starting pulsar. Example:

```
java -Dpulsar.repository.dir=/some/directory -jar pulsar.launcher-v.v.v.jar
```

When Pulsar is running as a Windows service with the pulsar module `pulsar.autostart`, this property can be set in Config Manager in the config parameter "JvmOptions".

6.2.6 Setting up a HTTP repository

To publish a repository over HTTP the following is required:

- Any HTTP-server capable of serving repository content.
- A directory structure with the modules to be published in the repository (`.jar` files).
- An index file (`repository.xml`) generated by a module indexing tool (*scheduled to be bundled with Pulsar 3.x*).

On the instances where the repository should be consumed a `.pulsarlink` file, which points to the repository, needs to be added (see example above).

6.3 Configuration

6.3.1 Deployment profiles

Pulsar uses deployment configuration profiles to define sets of modules which can be installed and configured by applying one or more additional profiles. A profile defines both the start levels for all the modules that should be installed when the profile is enabled, as well as start levels for other modules that might be installed at a later time.

The following profiles are bundled with Pulsar:

Profile name	Description
<i>default</i>	The default profile which is a base profile required to start the Pulsar infrastructure services and their dependencies, the default profile is always applied and any other specified profiles are merged with it, possibly overriding the defaults.
developer	Enables automatic upgrades on start and when a new module version becomes available in any repository. I.e developer mode. This profile enables: <ul style="list-style-type: none"> ▪ Deployment auto upgrade (<code>se.dse.pulsar.module.deployer.autoupgrade</code>) ▪ Direct reload of local resources (instead of packaged resources) (<code>pulsar.enable.development.phase</code>)
shell	Enable the interactive Pulsar Shell (Apache Felix GoGo).
install	Perform manual installation/upgrades in the shell. Upgrades the launcher, install shell modules and set target start level to 25.
upgrade	Perform automatic upgrade of launcher and all modules in profiles to latest available versions and then exit.
command	To be used in conjunction with the <code>---command</code> option, when the web server modules (Jetty, CXF) and Admin Console UI are not needed. This decreases startup time significantly.

Applying profiles

Any number of profiles can be applied, just separate them with space on the command line.

Profiles affect the modules which are installed during startup and basic framework configuration parameters. Profiles are applied using the Pulsar Launcher. For example to install Pulsar and apply the developer profile use the following command:

```
java -jar pulsar.launcher-V.V.V.jar developer
```

To enable both the shell profile and the developer mode use the following command:

```
java -jar pulsar.launcher-V.V.V.jar developer shell
```

A profile can not be "uninstalled" through the command line but the modules concerned may be uninstalled manually through the Admin Console / Install page.

Note that profiles can be specified both during the first installation and subsequent starts of Pulsar. When omitting a profile which was applied on a previous start the configuration in the omitted profile will not be available to Pulsar, however any modules that were deployed according to the profile earlier will still be installed. However any modules that are not part of a profile, or a dependency to one that is, will have their start level reassigned to 100 if it was below 100 earlier.

Custom profiles

The concept of profiles makes it easy to create custom module sets which can be installed together with Pulsar. In a near future it will be possible to create your own custom profiles and leverage this way of deploying your modules.

6.3.2 Module configurations

Each module have a configuration associated with it in Pulsar. The configuration functionality is handled by the Configuration Manager module (see Developer reference). Operations concerning module configuration is performed in Console Admin / Configure page. The web based configuration services allows configuration changes in runtime.

Configurations may also be imported or exported as text files. When configuration is represented as text files Pulsar uses a hybrid format mixing SGML-tags and property file syntax. This means that a configuration file may contain several sections which are applied to different modules.

When a configuration change is saved in Console Admin / Configure the affected module will be automatically restarted by Pulsar.

Protecting sensitive configuration information

Pulsar provides encryption for sensitive configuration information, i.e password fields, which avoids them being stored in clear text. Encryption is applied to password fields when exporting the configuration. To encrypt a password, enter the password in the configuration section in Admin Console, then export the configuration to encrypt it. The encrypted password can then be pasted into other configuration files.

6.3.3 Apply configuration at launch

There are two ways of applying custom module configuration file during launch. Either by placing configurations in `conf/install` folder or by explicitly linking to a configuration via a launcher command option.

Via conf/install folder (applied when a module is installed)

Any configuration file placed in `dse-pulsar-workspace\pulsar\conf\install`, see figure 1, folder will automatically be picked up and added during launch. If multiple configuration files are present at launch, these will be sorted and added ascending by file name. Note that if a config file is added after Pulsar startup this file will be ignored until Pulsar is restarted. Also note that a configuration file can have any filename but must use the extension `.conf`.

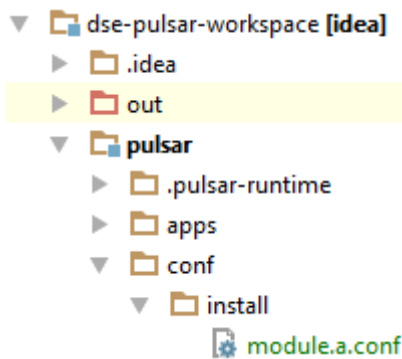


Figure 1

Via launcher command option (applied when a module is installed or restarted)

Configuration can be added during launch by explicitly pointing out a configuration on the local disc by using the parameter `---config`. Please see the example below.

```
java -jar pulsar.launcher-V.V.V.jar ---config some/arbitrary/path/module.a.conf
```

NOTE: Multiple config files should be separated with a comma character.

NOTE: If the path include white space, the path must be embedded in quotation marks like `---config "some/arbitrary/path/with white space/module.a.conf"`

Limitations

If there are multiple configurations present for the same module (in either a single configuration file or spread over multiple files), the last configuration to be added will be the one that is loaded ignoring any preceding configurations.

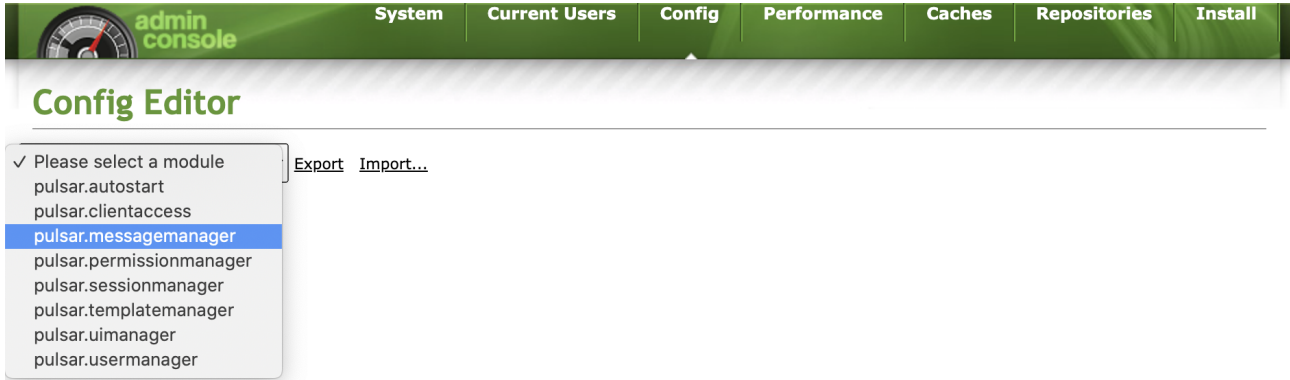
For example; let's say that message manager have one configuration loaded via `conf/install` and one configuration loaded via the command line. When pulsar is installed with this set up, the configuration loaded via the command line will be the one that is set since it is considered the last configuration. The same goes if there are multiple configurations for the same module in the same file, then the last configuration, read descending, will be set.

Notes on configuration

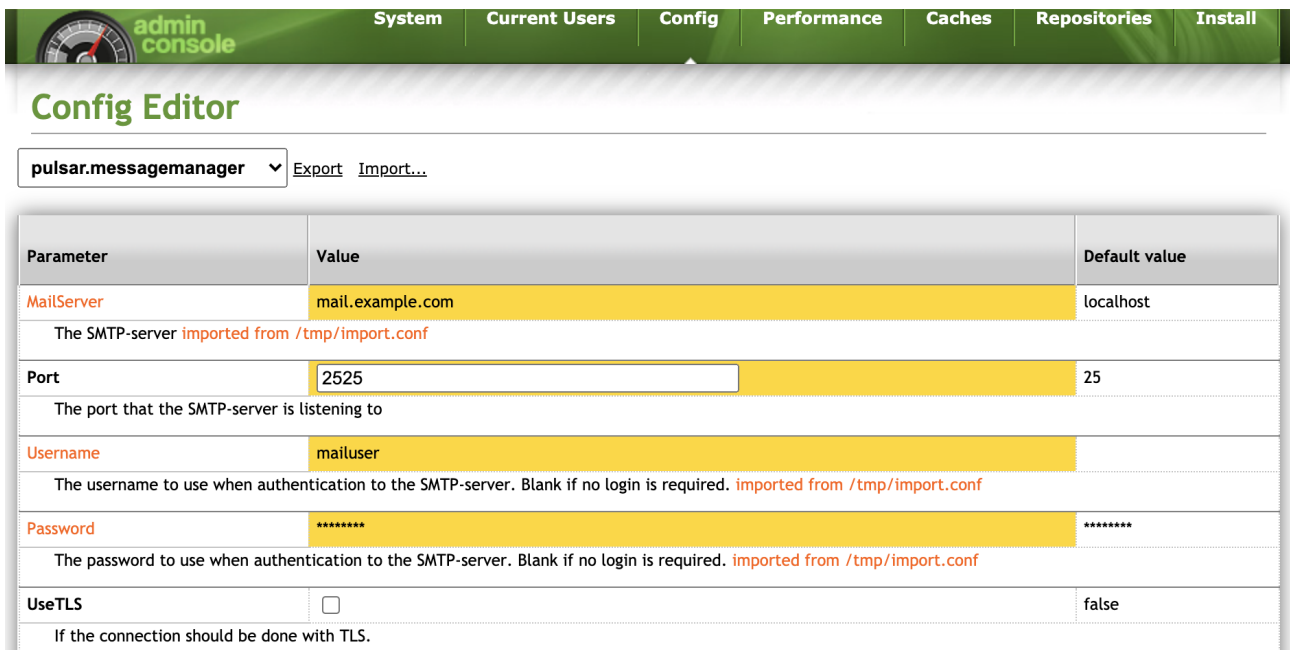
When the text "NULL" is used as a configuration value the Java value `null` will be assigned to the corresponding configuration parameter in the Java code.

6.3.4 Editing Configuration in run time

Editing of configuration can be done in run time in AdminConsole.



Choose the module to edit with the drop down.



In the config editor the parameter values are shown in different ways:

- Config values that is changed from default is marked with an orange background.
- Config values that has been imported has a red label, and the value is read only. To edit a value that is imported, the value must be changed in the file that is imported. In the example above the config is imported from the file `/tmp/import.conf`. Pulsar must be restarted for a modified configuration file to be re-imported.

6.4 Performance monitor

6.4.1 Performance monitoring

Pulsar provides a runtime monitoring application called Performance Viewer which presents web oriented performance statistics in the Admin Console. For monitoring of memory usage Pulsar provides the Memory Viewer app (since Pulsar Apps 3.0.2). Both the Performance Viewer and Memory Viewer are part of the Pulsar Apps package.

A screen shot of Performance Viewer in Admin Console:

Action	#Calls	Last Access	Min Time	Max Time	Latest Time	Total Time	Average Time	#Errors
ieb.leb-portal								
ieb.api.LEB#login	2	15 s	17341 ms	17844 ms	17844 ms	35185 ms	17592 ms	0
Sql:SELECT [iebcustomize]	1	1 min	8623 ms	8623 ms	8623 ms	8623 ms	8623 ms	0
Template:Allm/index.html	1	1 min	6354 ms	6354 ms	6354 ms	6354 ms	6354 ms	0
Template:Allm/loginFail.html	2	15 s	12 ms	6129 ms	12 ms	6141 ms	3070 ms	0
Sql:INSERT [syslogg]	2	21 s	1813 ms	2146 ms	2146 ms	3959 ms	1979 ms	0
Sql:INSERT [sysloggmsg]	6	15 s	1831 ms	2068 ms	1937 ms	11836 ms	1972 ms	0
Sql:UPDATE [dusys]	2	24 s	921 ms	1261 ms	921 ms	2182 ms	1091 ms	0
Sql:SELECT [dusys]	2	25 s	889 ms	1023 ms	1023 ms	1912 ms	956 ms	0
Sql:SELECT [divakt]	14	27 s	58 ms	2001 ms	1965 ms	12591 ms	899 ms	0
ieb.api.LEB#setFlags	13	15 s	2 ms	8628 ms	4 ms	8706 ms	669 ms	0
Sql:SELECT [iebtabbk]	4	6 min	152 ms	1464 ms	188 ms	1980 ms	495 ms	0
Sql:SELECT [iebttext]	26	1 min	4 ms	2075 ms	2061 ms	12434 ms	478 ms	0
Sql:SELECT [aoatg, aostatustxt]	4	6 min	127 ms	854 ms	468 ms	1795 ms	448 ms	0
Sql:SELECT [repv]	4	6 min	43 ms	422 ms	44 ms	704 ms	176 ms	0
Template:Allm/login.html	6	37 s	70 ms	90 ms	73 ms	473 ms	78 ms	0
Template:LEB.html	2	2 min	12 ms	16 ms	12 ms	28 ms	14 ms	0
Sql:CREATE []	8	6 min	5 ms	65 ms	5 ms	111 ms	13 ms	0

Logout User: admin (Administrator) Admin Console v2.1.10.150424-1007-pruzze

6.5 Logging

6.5.1 Logs created by Pulsar

By default Pulsar generates seven types of logs during run time:

- General log - *pulsar-instance/pulsar/logs/pulsar-yyyy-mm-dd.log* (content in this log also serves as output for the console)
- Warnings log - *pulsar-instance/pulsar/logs/warnings/pulsar-warnings-yyyy-mm-dd.log*
- HTTP log - *pulsar-instance/pulsar/logs/http/pulsar-http-yyyy-mm-dd.log*
- Boot log - *pulsar-instance/pulsar/logs/boot/pulsar-boot-yyyy-mm-dd.log*
- Config log - *pulsar-instance/pulsar/logs/config/pulsar-config-yyyy-mm-dd_hh_mi_si.log*
- Memory log - *pulsar-instance/pulsar/logs/memory/pulsar-memory-yyyy-mm-dd.log*
- Service log (used when Pulsar is started as an operating system service) - *pulsar-instance/pulsar/logs/service/commons-daemon-yyyy-mm-dd.log*

By default all the log files are rotated day wise at 00:00 a clock. Please note that a log file is only created if logging actually occurs within the current day. A maximum of ten log files are kept as history.

6.5.2 General log

The general log contains all the logging information generated by Pulsar and all modules running in the system, including third party and user modules. The level of log information can be controlled by configuration and may be adjusted in run time without restarting the Pulsar instance.

6.5.3 Warnings log

The warnings log only contains warnings or error messages. These are also available in the general log. The purpose of the warning log is to be able to check warnings and errors without having to scan the entire general log. During normal operations the warning log should be empty and any warnings or errors should be acted on.

6.5.4 HTTP log

The HTTP log contains logging about traffic analysis. standard HTTP logging to be used for traffic analysis.

6.5.5 Boot log

Contain all the logging which occur during boot up procedure before the framework is completely started. Logging from the boot procedure is only located in this file.

6.5.6 Config log

Contains a history of all the config for the system. Every time the config is changed an export is done to the log directory.

6.5.7 Memory log

Contain all the logging information about how memory is used by the JVM/JDK. In order to produce this file the MemoryViewer module needs to be installed. Memory logging of this character is only located in this file.

6.5.8 Service log

The service log is only created when Pulsar is installed as an operating system service. This log can be used to troubleshoot service configuration errors such as permissions etc.

6.5.9 Configuration of logging

Configuration file

The logging framework is configured through the file `<PULSARDIR>/conf/logback.xml`. An other config file can be used by setting a system property; `-Dlogback.configurationFile=/path/to/config.xml`.

Changing default log level

The default log level is specified in the `level` attribute in the `root`-tag in the `logback.xml` file. Setting the default level to `DEBUG` or `TRACE` is not recommended since massive amounts of logging information will be generated. Instead set the logging levels for specific packages of interest, as described below.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration ...>
  ...
  <root level="INFO">
    <appender-ref ref="STDOUT" />
    <appender-ref ref="FILE" />
    <appender-ref ref="FILE_WARNINGS" />
  </root>
  ...
</configuration>
```

Setting the logging levels for specific packages

You can set the log level for a module by setting its corresponding package logging level in `logback.xml`.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration scan="true" scanPeriod="10 seconds" debug="false">
  ...
  <!-- Setting levels for different packages -->
  <logger name="se.dse.pulsar.module.permissionmanager" level="DEBUG"/>
  <logger name="se.dse.pulsar.module.sessionmanager" level="TRACE"/>
  ...
</configuration>
```

</configuration>

Splitting logging into different files

By default the log is split up into two different type of log files;

- `pulsar.log` - This log contains the current logging file where Pulsar is currently writing to.
- `pulsar-YYYY-MM-DD.N.log` - This log contains logging for the ten latest days. If the log files are too large (10MB) the log files are split.
- `warnings/pulsar-warnings-YYYY-MM-DD.log` - This log file contains only warnings and error for the ten latest days.

Extraction of logback.xml

The logging config file `conf/logback.xml` is automatically extracted to the file system when Pulsar is started if it doesn't exist.

Automatic reload of configuration file

By default, the configuration file will be scanned for changes once every 10 seconds, so there is no need to restart Pulsar if you change the logging config.

6.5.10 References

1. Logback configuration - <http://logback.qos.ch/manual/configuration.html>

6.6 Operations troubleshooting

6.6.1 Recovering from errors during installation or upgrade

When dependencies are unavailable, if a package file is damaged or if a HTTP repository suddenly no longer is available because of a network failure, the installation or upgrade of Pulsar might not be able to complete successfully. In this case the instance might be in a partially installed state where the administrative tools are unavailable. The following approaches may be used to recover enough to get the administrative tools online again.

Restart and automatically reapply the deployment profile, upgrading any obsolete module versions

Every time Pulsar starts the default profile is applied and Pulsar will try to install all the default modules again, the same way as when the instance was first installed, at their original start levels. Reapplying the profiles is generally a safe operation and may solve some intermittent upgrade problems. Modules will be upgraded by default if newer versions exist and no modules or persisted data (like configurations) are removed. For more information on deployment profiles see Configuration.

```
cd my-pulsar-instance
```



```
java -jar pulsar.launcher-v.v.v.jar
```

Restarting without upgrading

By default Pulsar searches all available repositories for upgrades to the currently installed modules for the specified profile during start. To disable the upgrade of installed modules use the `-noProfileUpgrade` command line switch, like this:

```
cd my-pulsar-instance
java -jar pulsar.launcher-v.v.v.jar -noProfileUpgrade
```

To prevent an upgrade of the launcher itself (and the base modules bundled within) the switch `-noLauncherUpgrade` may be used. This switch can be combined with `-noProfileUpgrade` described above. For example to start Pulsar without upgrading either the Launcher components or any modules use this command line:

```
cd my-pulsar-instance
java -jar pulsar.launcher-v.v.v.jar -noProfileUpgrade -noLauncherUpgrade
```

Reinstalling Pulsar

To completely reinstall an existing Pulsar instance, delete the `.pulsar-runtime` directory and then rerun the Pulsar Launcher. Note, this will remove any configuration and other information persisted by all modules in the instance. Note that each module may have additional data files under the `data` directory, this information will be kept unless the `data` directory is also deleted.

Reinstalling Pulsar on Windows

```
cd my-pulsar-instance
rm -rf .pulsar-runtime
java -jar pulsar.launcher-v.v.v.jar
```

Reinstalling Pulsar on Linux/OSX

```
cd my-pulsar-instance
rmdir /s /q .pulsar-runtime
java -jar pulsar.launcher-v.v.v.jar
```

Advanced - Manual recovery using a command line shell

Modules may be installed and started using a command line shell which can be activated after installation. See [Development troubleshooting](#)(see page 82) / Using a command line shell to introspect for instruction on how to activate the shell.

6.6.2 Recovering from runtime errors

Restarting modules

Sometimes restarting a module may recover from a module local failure mode. Individual modules can be restarted in runtime, using the Console Admin / Install page.

Restarting Pulsar

Runtime errors may be caused by a huge number of different reasons. Some of the reasons may be memory leaks, network failures, software bugs etc. Sometimes a restart of Pulsar may cause modules to recover from their failure mode. Restarting Pulsar will ensure that all essential modules are installed, assigned a correct start level and restarted.

If Pulsar is installed as a system services the service console should be used to perform the restart. If the Pulsar process (java process) is terminated the running module will not shut down in a controlled fashion, which may cause further problems. Thus, terminating the process should only be used as a last resort.

Restarting Pulsar will not affect which modules are installed or their current configuration since this information is persisted within the `.pulsar-runtime` directory.

6.6.3 Operations errors

Upgrades from 3.5.1 (or earlier), to 3.6.0 (or later) may cause Pulsar Core to increase the HTTP port number

Due to changes, introduced in Pulsar Core 3.6.0, in how Pulsar detects if a module has been installed or updated. This leads to that the module **pulsar.clientaccess** is identified as installed instead of upgraded which causes it to check for available ports while the already installed HTTP-server is starting. This race condition may lead to the case of Pulsar Core being reconfigured to use the next available port.

Symptoms

After an upgrade (restart) of Pulsar Launcher or Pulsar Core Modules the HTTP server increases it's port number, making any Pulsar application / module (including AdminConsole) inaccessible on the expected port number.

Workaround

1. Login to AdminConsole on the new port (usually found on old-port + 1, for example port 80 becomes 81 etc.)
2. Select "Configuration" for module "pulsar.clientaccess".
3. Restore the parameter "HTTP.Port" to the desired value.
4. Save settings.
5. Restart Pulsar.

Note: Upgrades from version 3.6.0 and above are not affected by this problem.

Pulsar can't start or Bundles can't be properly installed / updated or uninstalled due to lack of access privileges

This problem may occur during Pulsar startup or when a module fails to install / uninstall or update.

Symptoms

The log contains one or several of the following messages:

- `ERROR: Could not purge bundle`
- `ERROR: Unable to re-install`
- `The requested operation requires elevation`
- `Access is denied`

Cause:

The cause for this problem is that Pulsar is unable to find or modify internal files or directories from the `.pulsar-runtime` directory. **Most often this is caused by files being locked or removed by another process.**

Resolution or workaround

1. Make sure the current effective user (used to start Pulsar) has the correct privileges.
2. Make sure that multiple Pulsar instances are not running concurrently against the same installation directory.
3. Check that any anti virus or backup software is not locking the files.

Usually the situation can be recovered by using a user with higher administrative privileges. But in a situation where the files are owned/restricted to a high privilege when Pulsar is supposed to run with a low privilege user the access rights on the files in the Pulsar directory will need manual correction.

Intermittent problems when accessing Pulsar Core <= 4.1 from iOS devices

Some combinations of iOS and browser versions intermittently causes an internal error in the Pulsar sub system Jetty, which is used for HTTP request processing.

Symptoms

Empty responses or errors are returned to the clients and the message `java.lang.IllegalStateException: DISPATCHED,initial` is logged in the pulsar log.

Workaround

Use the JVM command line parameter `-Dorg.osgi.service.http.useNIO=false` when starting Pulsar. See [Operations reference](#)(see page 89) for information about configuring the JVM command line parameter when starting Pulsar as a service.

6.7 SSO - Single Sign On

Pulsar supports application (service provider role) SSO using either SAMLv2 or Integrated Windows Authentication.

6.7.1 SSO - Integrated Windows Authentication

Integrated Windows Authentication (IWA) Single sign on is provided by the module `sso-iwa`. The purpose of the Single Sign On (SSO) is that users should not have to provide login information for each system when they already have logged in once. In a Windows environment, a typical use case is that a user has logged on to the domain via

their computer, and when the user tries to access a web site that requires authentication, this is handled automatically without specifying user name and password again. To enable this the systems need to be compatible with the Integrated Windows Authentication (IWA) and the underlying technology NTLMv2.

Licensing

The implementation of SSO/NTLMv2 is build on a third party product from IOplex <http://www.ioplex.com>²⁴, called Jespa. Without a license key only 25 users can be authenticated.

Requirements for technical environment

- Microsoft Active Directory
- Internet Explorer
- User should log in to the domain when the log in to their computers.

Configuration

The configuration is done in the Config-tab in AdminConsole.

Applying a Jespa license file

The Jespa license is delivered as a license file which has to be applied to the library file itself to be activated. The library file is handled automatically by the Pulsar module system and some steps, that require technical knowledge and server access, are needed to find it and apply the license.

1. Find the file `jespa-<version>.jar` in the `.pulsar-runtime/felix-cache` directory by searching for the file name (using file explorer or command line tools).
(The path to the file will have the following structure: `.pulsar-runtime/felix-cache/bundleNN/versionN.N/bundle.jar-embedded/PULSAR-INF/lib-internal.`)
2. Open a command window/shell with, the directory where the `jespa-*.jar` file is placed, as the current path.
3. To apply the license file (called `license.key` in this example):
`java -cp "jespa-<version>.jar" jespa.License -u license.key`
4. To verify/check if a license is installed:
`java -cp "jespa- <version> .jar" jespa.License`

Notes:

1. The license will need to be reapplied when the `sso-iwa` module is re-installed or upgraded.
2. A restart of Pulsar is required for the license installation to take effect.
3. Check the specific log file for troubleshooting: `logs/jespa.log`

²⁴ <http://www.ioplex.com/>

6.7.2 SSO - SAMLv2

Overview

Security Assertion Markup Language 2.0 is a protocol used to establish users identity, for a session, between a service provider (SP, i.e. the application) and a identity provider (IdP, i.e. the user management service). When logging in to an application the identification process is deferred by the SP to the IdP, once authenticated a secure response is sent back to the SP asserting that the user has certain attributes (i.e. a user id, e-mail adress, name, group memberships etc.).

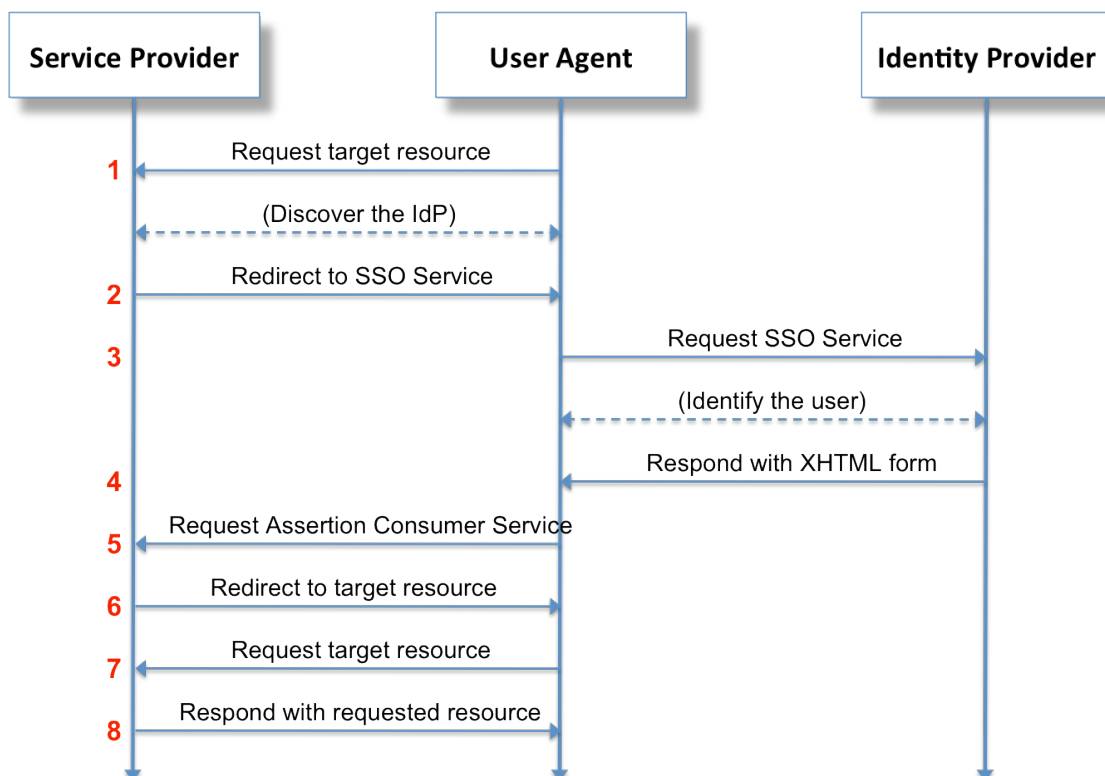
If the specific user has not been logged in to the SP before the user can be configured automatically by the SP, this is called automatic provisioning.

Deploying a SAMLv2 enabled application with Pulsar entails the following steps:

1. Enable SSO interaction and user provisioning in your application (SP).
2. Install the Pulsar module `pulsar.ssosaml`` and configure it (information required from the IdP).
3. Deploy configuration (SAML metadata) about the SP to the IdP.

Compatibility

The Pulsar module `pulsar.ssosaml` supports the SAMLv2 Web Browser SSO Profile using *SP HTTP-Redirect Binding* and *IdP HTTP-POST Response Binding*, as described in the following sequence diagram.



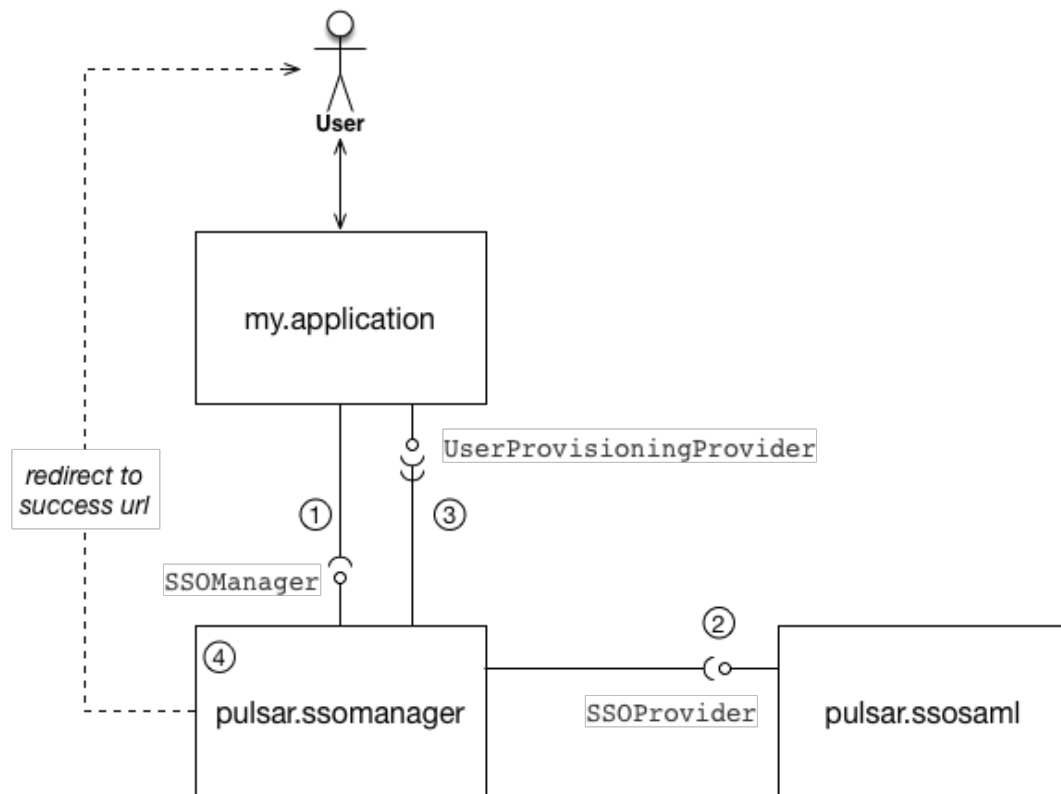
(Illustration by: Tom Scavo [Creative Commons²⁵ Attribution-ShareAlike 3.0²⁶ License](https://creativecommons.org/licenses/by-sa/3.0/).)

Enabling SSO and user provisioning in your application

The primary service for interacting with the SAMLv2 SSO functionality in Pulsar is the `se.dse.pulsar.ssomanager.api.SSOManager` service provided by the module `pulsar.ssomanager`. Your application should use this service as part of its login/logout flow to enable SSO. See JavaDoc for details.

To perform user provisioning an application supporting SAMLv2 SSO also needs to provide an implementation of `se.dse.pulsar.ssomanager.api.spi.provisioning.SSOProvisioningProvider`. This provider will be automatically invoked by Pulsar's SSO Manager when a user has been successfully authenticated by a IdP.

Module interactions during SSO authentication



1. The application invokes `SSOManager.requestSSOAuth(String i_successURL, String i_failureURL)`, from a user request (i.e. an established session).
2. The `SSOManager` defers the authentication to the `SSOProvider` (if any provider is installed and configured, otherwise it fails).
3. Once the `SSOProvider` has established the user identity and attributes, the `UserProvisioningProvider` implementation in `my.application` is invoked with user

²⁵https://en.wikipedia.org/wiki/Creative_Commons

²⁶<https://creativecommons.org/licenses/by-sa/3.0/>

attributes. The implementation then looks up or creates the user and returns a `PulsarUser`, if provisioning was successful.

4. Finally the SSOManager assigns the provisioned `PulsarUser` to the current session and the user is redirected to the `i_successURL` specified in step 1.

Configuration and registration with IdP

To enable SAMLv2 SSO for your Pulsar application you need to install the module `pulsar.ssosaml` (the module `pulsar.ssomanager` will be automatically installed as a dependency).

Configuration of the `pulsar.ssosaml` module is handled through Pulsar Admin Console (where each configuration parameter is documented).

Configuration checklist

Base URL configuration

The base URL of the site (as configured using parameter `sp.base.url`) must be the same for users accessing the site and using SSO. For example if the site is available as <https://site.example.com> the IdP must use the same host name, otherwise the session can not be matched. If the IdP responds to <https://internal.example.com> authentication will not work. This also means that if the IdP responds using HTTPS the user must have been using HTTPS when SSO was initiated.

A typical configuration of a SAMLv2 integration requires the following parameters (mandatory if not explicitly noted otherwise):

1. **sp.base.url**: Configures the base URL of your application on the form `http://host:port` or `https://host:port` (omit port if the default ports are used) this is used to build the redirect URL:s used to send the user back to your application after SSO and therefore need to be resolvable by the user browser. *Note: If this parameter is updated the SP needs to be re-registered with the IdP.*
2. **idp.uid.attributename**: The attribute from the IdP which should be interpreted as the user id. The SSO Manager will expect this attribute to be available for every user.
3. **onelogin.saml2.sp.entityid**: A URI which uniquely identifies your application for the IdP. Use your own naming standard. *Note: If this parameter is updated the SP needs to be re-registered with the IdP.*
4. **onelogin.saml2.sp.x509cert** and **onelogin.saml2.sp.privatekey**: **Certificate (x509 format) and private key (PKCS#8 format)** for the application. Represented as a BASE64 encoded string (without header/footer or newlines). Typically you generate the cert and key using a third party library, like openssl (see [Generating a certificate and private key using openssl](#)²⁷).
5. **onelogin.saml2.idp.entityid**: Identifier for the IdP (received from IdP).
6. **onelogin.saml2.idp.single_sign_on_service.url**: URL of IdP to use for SSO (received from IdP).
7. **onelogin.saml2.idp.single_logout_service.url**: Optional, URL of IdP to use for logout (SLO), if left empty SLO will be skipped (received from IdP).
8. **onelogin.saml2.idp.x509cert**: The certificate of the IdP, represented as a BASE64 encoded string (without header/footer or newlines). (received from IdP).

²⁷ <https://denebsoftware.atlassian.net/wiki/pages/resumedraft.action?draftId=292782089#SSO-SAMLv2-openssl>

For completeness the following informational configuration should also be filled out correctly since they may be used by the IdP (*Note: If these parameters are updated the SP needs to be re-registered with the IdP.*):

1. `onelogin.saml2.organization.name`
2. `onelogin.saml2.organization.displayname`
3. `onelogin.saml2.organization.url`
4. `onelogin.saml2.organization.lang`
5. `onelogin.saml2.contacts.technical.given_name`
6. `onelogin.saml2.contacts.technical.email_address`
7. `onelogin.saml2.contacts.support.given_name`
8. `onelogin.saml2.contacts.support.email_address`

Registering your SAML application with a IdP

Many IdPs can consume the SAMLv2 metadata format. The metadata for your service is provided on the URL: `http(s)://host:port/saml/spmetadata`. If the IdP your are integrating with doesn't support this format you can usually find the respective pieces of information required by the IdP in the XML.

Limitations

- No support for automated certificate roll over - IdP certificated needs to be manually updated.

Misc

Generating a certificate and private key using openssl

```
openssl req -new -newkey rsa:1024 -days 365 -nodes -x509 -keyout sp.key -out sp.cert
```

Then use the `sp.key` as `onelogin.saml2.sp.privatekey` and `sp.cert` as `onelogin.saml2.sp.x509cert`. Note that you have to remove the header and footer, only leaving the BASE64 content as a long string. Further you have to remove the newlines from this string and then paste it into the corresponding configuration in Admin Console. For further information on using `openssl` see related documentation at <https://www.openssl.org/>.

References

https://en.wikipedia.org/wiki/SAML_2.0

<https://github.com/onelogin/java-saml>

6.8 SMTP Server

Introduction

The main purpose of the SMTP-server module is to listen for incoming SMTP-messages and handle them by filtering, extracting and saving data. The SMTP-server module has one mandatory dependency to the persistent queue module in order to store retrieved message information.

6.8.1 Features

Message handling and persistent queue

Since one of the main purposes for the SMTP-server is to store SMTP-message information it contains functionality to extract SMTP-message information and store this in a persistent queue. The information extracted and saved is:

- From address
- Recipient address
- Message-ID
- Subject
- Content
- In-Reply-To
- References
- Attachments

6.9 Pulsar Shell

The Pulsar Shell (GoGo Shell) is a command line environment within Pulsar.

The Shell can be extended with custom commands, see [Extending the Pulsar CLI and Shell](#)(see page 86).

6.9.1 Built in commands

Boot

The boot module provides commands for deploying modules and some other utility functions.

```
pulsar:deploy [-force] [-dry-run] <MODULES...>
```

Manually deploy (installs or upgrade) the latest available version of specific modules and their required dependencies. The command will fail if dependencies are unavailable or if the upgraded dependencies (including transitive) would cause a conflict with the currently installed modules.

-force Force upgrade even if dependency conflicts are detected. Modules with unmet dependencies will be stopped.

-dry-run Only calculate what actions would be performed and report. Do not change any modules.

MODULES... A list of module symbolic names to deploy.

```
pulsar:upgradeProfile
```

Upgrade all modules defined in the current effective profile to latest available versions.

```
pulsar:upgradeInstalled
```

Upgrade all currently installed modules to latest available versions.

```
pulsar:adjustLevels
```

Recalculate start levels according to module dependencies. This command applies an algorithm where start levels for all bundles that have a higher start level than bundles that have a static package dependency on them. In normal operations there should be no need to use this command but it can be useful if the module start orders contains conflicts for some reason. Note: Start levels are only lowered, never raised.

```
pulsar:help
```

Display help for the `pulsar:*` commands.

6.10 JDBC-drivers

Pulsar is distributed with modules containing JDBC-drivers for different databases.

Driver	Module	Version
Oracle	pulsar.databaseaccess.oracle	12.1.0.1.0
Microsoft SQL Server	pulsar.databaseaccess.sqlserver	11.2.2
Derby	pulsar.databaseaccess.derby	10.10.1.1

7 Support

7.1 Collecting information for a support request

A support issue request must contain the following items:

1. Subject - a short caption describing the problem.
2. Description - problem description, when did the problem occur and how can it be reproduced.
3. Timestamp - when did the problem occur (used to cross reference any logs).
4. Versions used - which versions of Pulsar (launcher, apps, services, modules, endorsed) were used.
5. Environment - Windows, Linux or OSX, which JDK/JRE version.
6. Contact information - your contact information.

A support issue request should also contain the following items:

1. Log files (pulsar-warnings-YYYY-MM-DD.log, pulsar.log)
2. Screen shots if the problem manifests in the user interface.

7.2 Contact

Customers with support entitlements may report issues and suggestions to support@dse.se.²⁸

For general inquiries contact info@dse.se²⁹.

²⁸ <mailto:support@dse.se>

²⁹ <mailto:info@dse.se>

8 Licenses

8.1 Documentation License

This documentation is Copyright (c) 2020. Deneb Software Engineering AB. All rights reserved.

8.2 Pulsar License

Copyright (c) 2020. Deneb Software Engineering AB. All rights reserved.

Licenses for any use of the Pulsar software, or any of its parts, tools, scripts and documentation, is currently negotiated on a per customer basis. Please contact us for further information.

Pulsar is currently not licensed under a Open Source license, however this is something we are looking into and we hope to be able to provide an Open Source licensing option in the near future.

8.3 Open Source Licenses

Pulsar is powered by several Open Source tools and libraries (using their binary distributions).

We humbly acknowledge the great work produced by the committers on the following projects:

Libraries	Vendor / Organization	License
Apache Felix (and sub projects) Apache Ant Apache Lang Commons Apache IO Commons Apache Logging Commons Apache XML Commons Apache XML Graphics Commons Apache FOP Apache Batik Apache Avalon Apache Xalan Apache Xerces Apache CXF Apache DOSGi Apache Tika Apache PDFBox Apache POI Apache Commons Codec	Apache Software Foundation ³⁰	http://www.apache.org/licenses/LICENSE-2.0
OSGi Compendium 4.3	OSGi Alliance ³¹	http://www.osgi.org/Main/OSGiSpecificationLicense
Google Guice	Google ³²	http://www.apache.org/licenses/LICENSE-2.0
javax.inject	JCP ³³	http://www.apache.org/licenses/LICENSE-2.0 ³⁴
Simple Logging Facade for Java (SLF4J)	QOS.ch ³⁵	Copyright (c) 2004-2013 QOS.ch. All rights reserved. http://slf4j.org/license.html

³⁰ <http://www.apache.org/>

³¹ <http://www.osgi.org/>

³² <https://www.google.com/about/company/>

³³ <https://www.jcp.org>

³⁴ <http://www.apache.org/licenses/LICENSE-2.0.txt>

³⁵ <http://www.qos.ch/>

Libraries	Vendor / Organization	License
LogBack	QOS.ch ³⁶	EPL v1.0 and the LGPL 2.1, http://logback.qos.ch/license.html
Glassfish (javax.mail, javax.servlet)		https://glassfish.java.net/public/CDDL+GPL.html (WITH "CLASSPATH EXCEPTION")
aQute BND	aQute ³⁷	http://www.apache.org/licenses/LICENSE-2.0
Oracle JDBC Driver	Oracle ³⁸	http://www.oracle.com/technetwork/licenses/distribution-license-152002.html ³⁹
Microsoft JDBC Driver	Microsoft ⁴⁰	https://download.microsoft.com/download/3/C/6/3C6DEF35-C214-4283-A3AD-BD73DED9B95D/SQL_Server_JDBC_Driver_20_EULA.htm
Transloader	https://code.google.com/p/transloader/	http://www.apache.org/licenses/LICENSE-2.0
Bean Shell	http://www.beanshell.org/	http://www.beanshell.org/license.html
JavaMail(TM) API Design Specification	Oracle ⁴¹	https://glassfish.java.net/public/CDDL+GPL_1_1.html (WITH "CLASSPATH EXCEPTION")
JDOM	http://www.jdom.org/	Copyright (C) 2000-2004 Jason Hunter & Brett McLaughlin. All rights reserved. (Apache-style open source license)
DOM4J	MetaStuff, Ltd	BSD Style license http://dom4j.sourceforge.net/dom4j-1.6.1/license.html
Elastic Search	http://www.elasticsearch.org	http://www.apache.org/licenses/LICENSE-2.0

³⁶ <http://www.qos.ch/>

³⁷ <http://www.aqute.biz/>

³⁸ <http://www.oracle.com/>

³⁹ <http://www.oracle.com/technetwork/licenses/distribution-license-152002.html>

⁴⁰ <https://www.microsoft.com>

⁴¹ <http://www.oracle.com/>

Libraries	Vendor / Organization	License
JCIFS	https://jcifs.samba.org/	http://www.gnu.org/licenses/lgpl-2.1.txt
Jespa	https://www.ioplex.com/jespa.html	Not open source, free for 25 users https://www.ioplex.com/purchase.php
Gabor Cselle PersistentQueue	<i>Gabor Cselle</i>	Public Domain - you can modify and redistribute without restrictions. http://www.gaborcselle.com/open_source/java/persistent_queue.html
Byte Buddy	http://bytebuddy.net/ ⁴²	http://www.apache.org/licenses/LICENSE-2.0.txt
OneLogin	https://github.com/onelogin/java-saml	MIT License https://github.com/onelogin/java-saml/blob/master/LICENSE

⁴² <http://bytebuddy.net/#/>

9 Component Lifecycle Management (CLM) Policy

9.1 Background

Pulsar Core depends on several software components. The Component Lifecycle Management (CLM) Policy describes how the lifecycle of these components is managed during the development of Pulsar Core.

9.2 General

An up to date inventory of all software components that are bundled with releases of Pulsar Core should be kept. This inventory should be used to determine if newer versions of the components are available or if security vulnerabilities have been disclosed for the versions of the components that are in use.

9.3 Major components

9.3.1 Java Runtime

Pulsar Core requires a Java Runtime (JRE) to run. Pulsar Core follows the release schedule for new Java versions and the major releases of Pulsar should always be compatible with one of the stable and active Oracle JRE version available at the time. *Note: The Java runtime (JRE) is not distributed with Pulsar and must be installed and upgraded separately from Pulsar. We advice all customers to keep the JRE updated to the latest stable version which is compatible with Pulsar.*

9.3.2 Eclipse Jetty

Pulsar Core embeds the Eclipse Jetty web server. Starting with Pulsar Core 4.2, this version and every subsequent major release (yearly) should contain the latest compatible and stable Jetty release available at the time of the Pulsar release.

9.4 Minor components

Pulsar Core depends on a large number of smaller components that are used both internally and as shared libraries used for application development. Examples of such libraries are JAXB, JAX-RS, JAX-WS, JAXP and OSGi libraries. Many of these libraries/implementations have dependencies on each other and needs to be upgraded in sync. Minor components are reviewed on a yearly basis and updated when newer versions with new desirable features are available.

9.5 Security related updates

Major and minor components with security vulnerabilities are updated or patched with the next upcoming release of Pulsar Core. For issued that have a high security impact and are highly exploitable a new version of Pulsar Core will be fast tracked to mitigate the risks for Pulsar Core users. The main sources for information about security vulnerabilities are:

- Oracle Critical Patch Updates, Security Alerts and Third Party Bulletin <https://www.oracle.com/technetwork/topics/security/alerts-086861.html>
- Jetty Security Reports <https://www.eclipse.org/jetty/documentation/9.4.5.v20170502/security-reports.html>
- Common Vulnerabilities and Exposures <http://cve.mitre.org/data/downloads/index.html>

9.6 License compliance

When components are added or updated their licence requirements should be checked or re-checked for compliance with the current Pulsar Core licensing, see [Licenses](#)(see page 116).

9.7 Notification

Announcements regarding new releases and upgrade advice is published to the mailing list pulsar-users@dse.se⁴³.

⁴³ <mailto:pulsar-users@dse.se>

10 Release Notes

10.1 Release 4.13.0

10.1.1 Artifacts released in this version

- pulsar.launcher-4.2.7.pulsar
- pulsar-modules-4.13.0.pulsar
- pulsar-apps-4.13.0.pulsar
- pulsar-endorsed-4.13.0.pulsar

10.1.2 Changes since 4.12.0

pulsar.databaseaccess: 4.3.5 (4.3.3)

Feature - [PULSAR-1835] - Don't try to connect instantly if database is not available

pulsar.util: 1.17.1 (1.16.0)

Feature - [PULSAR-1798] - Don't fill up the log if same log message repeats, `DeduplicationLogger`

pulsar.autostart: 1.2.3 (1.2.1)

Feature - [PULSAR-1833] - Parameter -XX:MaxPermSize=128m should be removed from autostart default config

Bug - [PULSAR-1839] - Error message if AutoStart is used in developer environment in Windows

pulsar.databaseaccess.sqlserver: 11.2.2 (1.0.1)

Feature - [PULSAR-1776] Upgrade MS SQL-Server JDBC

10.1.3 Known Issues

[PULSAR-1654] - Restarting the sso-iwa module causes the Pulsar HTTP/HTTPS listener to stop listening.

[PULSAR-934] - When uninstalling a bundle with incoming direct bundle dependencies the dependent bundles are not uninstalled.

[PULSAR-507] - Caused by exception is hidden when a ClassDefNotFound exception is thrown in a library constructor.

10.2 Release 4.12.0

10.2.1 Artifacts released in this version

- pulsar.launcher-4.2.7.pulsar
- pulsar-modules-4.12.0.pulsar
- pulsar-apps-4.12.0.pulsar
- pulsar-endorsed-4.12.0.pulsar

10.2.2 Changes since 4.11.1

pulsar.frameworks: 5.0.5 (5.0.4)

Feature - [PULSAR-1819] - Use Oracle SUBSTR(text, 1, len) instead of SUBSTR(text, 0, len)

pulsar.util: 1.16.0 (1.15.2)

Feature - [PULSAR-1823] - API for crypt/decrypt password

pulsar.app.watchdog: 1.0.4 (1.0.3)

Bug - [PULSAR-1816] - Exception if warning-log is empty when Watchdog is mailing

pulsar.databaseaccess: 4.3.3 (4.3.2)

Bug - [PULSAR-1801] - Database cache floods the log if the directory disappears

10.3 Release 4.11.1

10.3.1 Artifacts released in this version

- pulsar.launcher-4.2.6.pulsar
- pulsar-modules-4.11.1.pulsar
- pulsar-apps-4.11.1.pulsar
- pulsar-endorsed-4.11.0.pulsar

10.3.2 Changes since 4.11.0

pulsar.autostart: 1.2.1 (1.2.0)

Bug - [PULSAR-1811] - Can't extract prunsrv.exe

10.4 Release 4.11.0

10.4.1 Artifacts released in this version

- pulsar.launcher-4.2.6.pulsar
- pulsar-modules-4.11.0.pulsar
- pulsar-apps-4.11.0.pulsar
- pulsar-endorsed-4.11.0.pulsar

10.4.2 Changes since 4.10.0

pulsar.autostart: 1.2.0 (1.1.14)

Bug - [PULSAR-1800] - java.lang.NoClassDefFoundError: Could not initialize class java.awt.Font when starting windows service when using AdoptOpenJDK.

pulsar.clientaccess: 6.1.3 (6.1.2)

Bug - [PULSAR-1805] - JavaScriptHandler (/pulsar/js) should have information for cache-control

pulsar.messagemanager: 6.1.6 (6.1.5)

Bug - [PULSAR-1807] - Problem med TLS when sending mail using javax.mail.glassfish

10.5 Release 4.10.0

10.5.1 Artifacts released in this version

- pulsar.launcher-4.2.6.pulsar
- pulsar-modules-4.10.0.pulsar
- pulsar-apps-4.10.0.pulsar
- pulsar-endorsed-4.10.0.pulsar

10.5.2 Changes since 4.9.0

pulsar.tfa-totp: 1.0.0 - New module

Feature - [PULSAR-1795] - Support for login with Time-based One-Time Password in AdminConsole.

10.6 Release 4.9.0

10.6.1 Artifacts released in this version

- pulsar.launcher-4.2.6.pulsar
- pulsar-modules-4.9.0.pulsar
- pulsar-apps-4.9.0.pulsar
- pulsar-endorsed-4.9.0.pulsar

10.6.2 Changes since 4.8.1

Pulsar is now built with AdoptOpenJDK. Everything should work as before.

10.7 Release 4.8.1

10.7.1 Artifacts released in this version

- pulsar.launcher-4.2.5.pulsar
- pulsar-modules-4.8.1.pulsar
- pulsar-apps-4.8.1.pulsar
- pulsar-endorsed-4.8.0.pulsar

10.7.2 Changes since 4.8.0

pulsar.configmanager: 7.4.1 (7.4.0)

Bug - [PULSAR-1787] - Config can't be manually edited. Only import works

pulsar.usermanager: 1.0.20 (1.0.19)

Bug - [PULSAR-1788] - User password in usermanager that is imported is lost after clean install

pulsar.app.adminconsole: 2.1.31 (2.1.30)

Bug - [PULSAR-1790] - Auto login after clean install should always redirect to Admin ConsoleRelease 4.8.0

10.8 Release 4.8.0

10.8.1 Artifacts released in this version

- pulsar.launcher-4.2.5.pulsar
- pulsar-modules-4.8.0.pulsar
- pulsar-apps-4.8.0.pulsar
- pulsar-endorsed-4.8.0.pulsar

10.8.2 Changes since 4.7.3

pulsar.doctor: 1.0.0 - New module

Feature - [PULSAR-1781] - New module to monitor network and database connectivities

pulsar.configmanager: 7.4.0 (7.3.0)

Bug - [PULSAR-1756] - Configuration profiles causes modules to restart indefinitely

pulsar.search.engine 8.1.2 (8.1.1)

Bug - [PULSAR-1764] - Date detection in Elasticsearch must be turned off

10.9 Release 4.7.3

10.9.1 Artifacts released in this version

- pulsar.launcher-4.2.5.pulsar
- pulsar-modules-4.7.3.pulsar
- pulsar-apps-4.7.3.pulsar
- pulsar-endorsed-4.7.0.pulsar

10.9.2 Changes since 4.7.2

pulsar.app.configeditor: 3.1.5 (3.1.2)

Feature - [PULSAR-1740] - Forbid editing of imported configs. Read more in the Operations reference section of the Pulsar documentation.

pulsar.autostart: 1.1.14 (1.1.12)

Feature - [PULSAR-1765] - Move the execution with prunsrv.exe from run to start

pulsar.clientaccess: 6.1.2 (6.1.0)

Feature - [PULSAR-1662] - Remove the Server HTTP header from all responses.

pulsar.configmanager: 7.3.0 (7.2.3)

Bug - [PULSAR-1766] - Configuration file import was skipped if any section is commented out.

pulsar.core: 9.0.1 (9.0.0)

Bug - [PULSAR-1761] - Resources could be read from the path "Pulsar-Development-Path" in the MANIFEST-file when not running in development mode.

pulsar.ssoiwa: 1.1.1 (1.1.0)

Feature - [PULSAR-1763] - Upgrade Jespa version to support SSO without using SMB. **IMPORTANT! The Jespa license will need to be reapplied when this module is upgraded! Read how this is done in the Operations reference section of the Pulsar documentation.**

pulsar.usermanager: 1.0.19 (1.0.18)

Bug - PULSAR-1757 - File admin-pwd.log was overwritten when running a temporary runtime

10.10 Release 4.7.2

10.10.1 Artifacts released in this version

- pulsar.launcher-4.2.3.pulsar
- pulsar-modules-4.7.2.pulsar
- pulsar-apps-4.7.2.pulsar
- pulsar-endorsed-4.7.0.pulsar

10.10.2 Changes since 4.7.1

pulsar.autostart: 1.1.12 (1.1.11)

Bug - [PULSAR-1752] - Faulty warning message "ERROR, Pulsar is not started from Package. Can't install service!".

Bug - [PULSAR-1753] - Can't delete a service in pulsar.autostart config if not exists.

pulsar.core: 9.0.0 (8.8.2) - New major release

Feature - [PULSAR-1754] - Updates to service extension model.

Feature - [PULSAR-1755] - Support for dynamic resource delegation/routing.

pulsar.util: 1.15.2 (1.15.1)

Bug - [PULSAR-1759] - Crypted password fails to decrypt when imported from settings file.

10.11 Release 4.7.1

10.11.1 Artifacts released in this version

- pulsar.launcher-4.2.3.pulsar
- pulsar-modules-4.7.1.pulsar
- pulsar-apps-4.7.1.pulsar
- pulsar-endorsed-4.7.0.pulsar

10.11.2 Changes since 4.7.0

pulsar.deployer: 6.0.0 (5.0.0) - New major release

Bug - [PULSAR-1750] - Installing some modules using AdminConsole locks the UI and fails after timeout.

10.12 Release 4.7.0

10.12.1 Artifacts released in this version

- pulsar.launcher-4.2.3.pulsar
- pulsar-modules-4.7.0.pulsar
- pulsar-apps-4.7.0.pulsar
- pulsar-endorsed-4.7.0.pulsar

10.12.2 Changes since 4.6.2

pulsar.autostart: 1.1.11 (1.1.10)

Feature - [PULSAR-1732] - Add a message in AutoStart Config to show the user if there is a problem.

pulsar.boot: 3.2.0 (2.4.0)

pulsar.deployer: 5.0.0 (4.6.2) - New major release

Feature - [PULSAR-1729] - Improved module upgrade - delayed start.

pulsar.commandsupport: 1.1.1 (1.0.0)

Feature - [PULSAR-1727] - Batch command support.

pulsar.configmanager: 7.2.2 (7.0.1)

Feature - [PULSAR-1728] - Automation and configuration profiles.

Feature - [PULSAR-1741] - Support for import of multiple config files for same module.

Bug - [PULSAR-1730] - Importing config file from command line can cause StackOverflowException in java.util.regex.Pattern.

Bug - [PULSAR-1743] - Crypted password are not decrypted when config is imported through command line.

pulsar.launcher: 4.2.3 (3.9.0)

Feature - [PULSAR-1731] - Support to start Pulsar with different logging configuration files ("logback.xml").

Feature - [PULSAR-1733] - Support for starting with different/temporary pulsar-runtime directory.

10.13 Release 4.6.3

10.13.1 Artifacts released in this version

- pulsar.launcher-3.9.1.pulsar
- pulsar-modules-4.6.3.pulsar
- pulsar-apps-4.6.3.pulsar
- pulsar-endorsed-4.6.0.pulsar

10.13.2 Changes since 4.6.2

pulsar.frameworks: 5.0.2 (5.0.0)

Bug - [PULSAR-1707] - Defined SQL-columns are converted to lower case making constants in SQL mismatch

Bug - [PULSAR-1724] - Searching in a date column gives wrong result

10.14 Release 4.6.2

10.14.1 Artifacts released in this version

- pulsar.launcher-3.9.1.pulsar
- pulsar-modules-4.6.2.pulsar
- pulsar-apps-4.6.2.pulsar
- pulsar-endorsed-4.6.0.pulsar

10.14.2 Changes since 4.6.1

pulsar.installer: 8.2.0 (8.1.0)

Bug - [PULSAR-1703] - Removed false warning in log ([mapToSourceType] Unknown source type: jar:file:/...)

10.15 Release 4.6.1

10.15.1 Artifacts released in this version

- pulsar.launcher-3.9.1.pulsar
- pulsar-modules-4.6.1.pulsar
- pulsar-apps-4.6.1.pulsar
- pulsar-endorsed-4.6.0.pulsar

10.15.2 Changes since 4.6.0

pulsar.app.configeditor: 3.1.1 (3.0.5)

Feature - [PULSAR-1687] - When config is updated in AdminConsole save a complete export to `logs/config/<timestamp>.conf`

pulsar.app.installerui: 1.5.0 (1.4.10)

Feature - [PULSAR-1693] - Show "Latest Repository Version" instead of "Latest Version" on AdminConsole/Install

Bug - [PULSAR-1696] - InstallerUI hangs when the module itself is updated though the AdminConsole "Install" tab

pulsar.autostart: 1.1.10 (1.1.9)

Bug - [PULSAR-1692] - Multiple profiles can not be specified when configuring autostart

pulsar.clientaccess: 6.1.0 (6.0.2)

Bug - [PULSAR-1609] - Use custom error page that never exposes stack traces or internal info on errors

pulsar.core: 8.7.0 (8.6.1)

Feature - [PULSAR-1695] - Add support to get a reference to `<pulsar-home>/logs/<folder>` so that modules can log module specific information

10.16 Release 4.6.0

10.16.1 Artifacts released in this version

- pulsar.launcher-3.9.1.pulsar
- pulsar-modules-4.6.0.pulsar
- pulsar-apps-4.6.0.pulsar
- pulsar-endorsed-4.6.0.pulsar

10.16.2 Changes since 4.5.1

pulsar.app.adminconsole: 2.1.23 (2.1.22)

Feature - [PULSAR-1686] - Add current Pulsar directory as property on System tab in AdminConsole

pulsar.app.repositoryviewer: 1.0.0 - New module

Feature - [PULSAR-1690] - Add listing of which `.pulsar` files are discovered by `deployer` to AdminConsole

pulsar.clientaccess: 6.0.2 (6.0.0)

Bug - [PULSAR-1652] - Using different keystore and key passwords cause keystore loading to fail with exception and HTTPS listener to be unavailable

Bug - [PULSAR-1660] - When there is an exception in a SPA-UI feature, `monitor.addError` is not called

pulsar.commandsupport: 1.0.0 - New module

Feature - [PULSAR-1678] - Support for adding commands to the gogo shell.

pulsar.core: 8.6.1 (8.5.0)

Bug - [PULSAR-1658] - PathGuard fails if base directory ends with period (".")

pulsar.databaseaccess: 4.3.0 (4.2.3)

Bug - [PULSAR-1677] - Shutdown of module `pulsar.databaseaccess` requires all database connections to exit before terminating

pulsar.deployer: 4.6.1 (4.6.0)

pulsar.launcher: 3.9.1 (3.9.0)

Feature - [PULSAR-1683] - Configurable directory for the pulsar-files other than pulsar.root.dir

pulsar.packager: 1.7.2 (1.7.0)

Feature - [PULSAR-1542] - Generate dependency info during module build

Bug - [PULSAR-1688] - Packages in `package-dependencies.txt` are not always sorted

pulsar.sessionmanager: 3.3.0 (3.2.0)

Bug - [PULSAR-1657] - Timed out sessions are removed without being invalidated, which prevents any observers from being notified

pulsar.smtpserver: 1.4.0 (1.3.5)

Bug - [PULSAR-1655] - The config parameter filter.sender is not used (name should be filter.senders)

pulsar.ssomanager: 1.2.1 (1.2.0)

pulsar.ssosaml: 1.1.2 (1.1.1)

Feature - [PULSAR-1673] - Update logging for `sso-saml` to always log received attributes before provisioning users

10.17 Release 4.5.1

10.17.1 Artifacts released in this version

- pulsar.launcher-3.9.0.pulsar
- pulsar-modules-4.5.1.pulsar
- pulsar-apps-4.5.1.pulsar
- pulsar-endorsed-4.5.0.pulsar

10.17.2 Changes since 4.5.0

pulsar.ssosaml: 1.1.0 (1.0.1)

Bug - [PULSAR-1671] - Fixed name of config parameter

pulsar.frameworks: 5.0.0 (4.1.2) - New major release

Bug - [PULSAR-1670] Can't LIMIT SQL results to 0 (zero) rows

10.18 Release 4.5.0

10.18.1 Artifacts released in this version

- pulsar.launcher-3.9.0.pulsar
- pulsar-modules-4.5.0.pulsar
- pulsar-apps-4.5.0.pulsar
- pulsar-endorsed-4.5.0.pulsar

10.18.2 Changes since 4.4.0

pulsar.app.performanceviewer: 3.1.0 (3.0.2)

Feature - [PULSAR-1659] - Generate performance charts from monitor data

pulsar.app.watchdog: 1.0.0 - New module

Feature - [PULSAR-1661] - Generate and mail a performance and error report

pulsar.search.engine 8.1.0 (8.0.0)

Feature - [PULSAR-1666] - New method `hasField` in `SearchHit`

Bug fix - [PULSAR-1665] - Elastic Search is now listening and answering on port 9200 only from localhost

10.19 Release 4.4.0

10.19.1 Artifacts released in this version

- pulsar.launcher-3.9.0.pulsar
- pulsar-modules-4.4.0.pulsar

- pulsar-apps-4.4.0.pulsar
- pulsar-endorsed-4.4.0.pulsar

10.19.2 Changes since 4.3.2

pulsar.clientaccess: 6.0.0 (5.0.2) - New major release

Feature - [PULSAR-1637] - Updated, simplified, error templates, changed status code for redirects to MOVED_TEMPORARILY. Updated handling of HTTP-contexts to prevent HTTP-listener to become unavailable on module restarts.

pulsar.configmanager: 7.1.0 (7.0.2)

Feature - [PULSAR-1637] - Support for binding all configuration properties for dependency injection.

pulsar.core: 8.5.0 (8.4.2)

Feature - [PULSAR-1637] - Updates to service extension model.

pulsar.search.engine 8.0.0 (7.0.0) - New major release

pulsar.search.dbscanner: 1.0.13 (1.0.12), pulsar.search.filescanner: 1.0.13 (1.0.12), pulsar.search.scanner: 3.0.5 (3.0.4), pulsar.app.adminconsole: 2.1.22 (2.1.21), pulsar.app.configeditor: 2.1.22 (2.1.21), pulsar.app.searchviewer: 1.1.0 (1.0.4), pulsar.app.usersviewer: 1.0.9 (1.0.8), pulsar.util: 1.13.0 (1.12.1)

Bug fix - [PULSAR-1541] - Search cache needs to be manually deleted after upgrade (sometimes)

pulsar.ssomanager: 1.2.0 (new module), pulsar.ssosaml: 1.1.0 (new module), pulsar.ssoiwa: 1.1.1 (1.1.0), pulsar.sessionmanager: 3.2.0 (3.0.1)

Feature - [PULSAR-1637] - SAML 2.0 Service Provider Initiated SSO support

10.20 Release 4.3.2

10.20.1 Artifacts released in this version

- pulsar.launcher-3.9.0.pulsar
- pulsar-modules-4.3.2.pulsar
- pulsar-apps-4.3.0.pulsar
- pulsar-endorsed-4.3.0.pulsar

10.20.2 Changes since 4.3.1

pulsar.clientaccess: 5.0.2 (5.0.1)

Bug fix - [PULSAR-1648] - Sometimes CSS in AdminConsole can't be loaded (HTTP 404 Not Found)

10.21 Release 4.3.1

10.21.1 Artifacts released in this version

- pulsar.launcher-3.9.0.pulsar
- pulsar-modules-4.3.1.pulsar
- pulsar-apps-4.3.0.pulsar
- pulsar-endorsed-4.3.0.pulsar

10.21.2 Changes since 4.3.0

pulsar.clientaccess: 5.0.1 (5.0.0)

Bug fix - [PULSAR-1646] - Dynamic Doc "/pulsar/xxx/doc/filename.ext" didn't work since Pulsar 4.3.0.

pulsar.ssoiwa: 1.1.0 (1.0.5)

Feature - [PULSAR-1645] - Max number of SSO-attempts is now configurable.

10.22 Release 4.3.0

10.22.1 Artifacts released in this version

- pulsar.launcher-3.9.0.pulsar
- pulsar-modules-4.3.0.pulsar
- pulsar-apps-4.3.0.pulsar
- pulsar-endorsed-4.3.0.pulsar

10.22.2 Changes since 4.2.0

pulsar.clientaccess: 5.0.0 (4.8.1) - New major release

Feature - [PULSAR-1607] - Enforce HTTP Strict Transport Security.

Feature - [PULSAR-1608] - Set secure.flag for session cookies on SSL.

Bug fix - [PULSAR-611] - Removed unused config "SessionIdInURL".

Bug fix - [PULSAR-1435] - Fix problem "Module rs is not available" for the SPA when changing port in runtime.

Bug fix - [PULSAR-1556] - Exception when accessing the SPA-UI application from iPhone 6 and iPad Air (iOS).

pulsar.core 8.4.2 (8.4.0)

Bug fix - [PULSAR-1594] - ModuleContextBuilder.extendServicesUsing().onInterface() never matches any published services.

pulsar.databaseaccess: 4.2.3 (4.2.0)

Feature - [PULSAR-1636] - Show information about who took the database connections when the pool is empty.

Bug fix - [PULSAR-1632] - SQL translator is applied multiple times.

Bug fix - [PULSAR-1633] - Fixed method tableExists for MS SQL Server.

pulsar.frameworks: 4.1.2 (4.0.1)

Feature - [PULSAR-1638] - Support for sorting on aggregated columns when grouping.

Bug fix - [PULSAR-1629/1630] - Support for MS SQL Server.

Bug fix - [PULSAR-1639] - Fix for filtering exact negative value.

pulsar.packager: 1.7.0 (1.6.3)

Feature - [PULSAR-1642] - Improved multi project development integration.

pulsar.sessionmanager 3.0.1 (2.4.2) - New major release

Feature - [PULSAR-1608] - Support for separated scopes for sessions.

pulsar.app.configeditor: 3.0.4 (3.0.3)

Feature - New GUI layout for changed configs.

10.23 Release 4.2.0

10.23.1 Artifacts released in this version

- pulsar.launcher-3.9.0.pulsar

- pulsar-modules-4.2.0.pulsar
- pulsar-apps-4.2.0.pulsar
- pulsar-endorsed-4.2.0.pulsar

10.23.2 Changes since 4.1.0

pulsar-endorsed

Upgrade - [PULSAR-1002] - Upgraded Jetty to 8.2.0.v20160908 (8.1.14.v20131031).

pulsar.boot 2.4.0 (2.3.4)

Bug fix - [PULSAR-1002] - Better handling of unsatisfied resources.

pulsar.clientaccess: 4.8.1 (4.8.0)

Bug fix - [PULSAR-1002] - Fixed NPE if cookies doesn't existed.

pulsar.databaseaccess: 4.2.0 (4.0.1)

Feature - [PULSAR-1617] - Support for SQL translation callbacks.

Feature - [PULSAR-1621] - Using OFFSET-syntax instead of ROWNUM if supported by the database.

pulsar.frameworks: 4.0.1 (2.7.1) - New major release

Feature - [PULSAR-91] - Support for ANSI-joins

Bug fix - [PULSAR-1624] - Fixed problem when grouping by a column that belongs to a dynamic table


Bug fix - [PULSAR-1627] - Using named inner query to be compatible with SQL Server.

pulsar.launcher: 3.9.0 (3.8.1)

Feature - [PULSAR-1002] - Debug logging of framework properties

Feature - [PULSAR-1584] - Added support for specifying version when un-deploying bundles using the profile property `pulsar.undeploy`

10.24 Release 4.1.0

 Since Pulsar Core 4.1 JDK/JRE 7 is no longer supported. JDK/JRE 8 is required for development and deployment.

Source code for the Pulsar Core API:s is now bundled with the released modules. This enhances the developer experience in most IDE:s which now will be able to provide JavaDoc and suggest better parameter names when implementing or overriding methods defined in Pulsar Core. Further more, debugging into the actual source code of the API layer is now possible.

10.24.1 Artifacts released in this version

- pulsar.launcher-3.8.1.pulsar
- pulsar-modules-4.1.0.pulsar
- pulsar-apps-4.1.0.pulsar
- pulsar-endorsed-4.1.0.pulsar

10.24.2 Changes since 4.0.4

pulsar.launcher: 3.8.1 (3.7.0)

Feature - [PULSAR-655] - Automatic extraction of logback.xml if it is not available when Pulsar starts.

Feature - [PULSAR-965] - Updated rules for log file rotation. Maximum individual file size is 10MB. Total maximum log size is 1GB. Maximum number of log files kept is 10. Logging output is now tabulated for easier reading. Note the the current log file is named `pulsar.log`.

pulsar.boot: 2.3.4 (2.3.3)

Minor refactorings.

pulsar.app.adminconsole: 2.1.20 (2.1.19)

Feature - [PULSAR-1595] - Updated version and copyright texts.

pulsar.app.usersviewer: 1.0.6 (1.0.5)

Fixed display of dates.

pulsar.autostart: 1.1.9 (1.1.8)

Bug fix - [PULSAR-1604] - Support for running Pulsar as a Windows service with 64-bit Java.

Bug fix - [PULSAR-926] - Now removes any spaces in Windows service names.

pulsar.clientaccess: 4.7.6 (4.7.5)

Feature - [PULSAR-1613] - Added support for enabling or disabling search engine crawlers (/robots.txt).

pulsar.core: 8.4.0 (8.3.0)

Feature - [PULSAR-1593] - Added AbstractServiceExtender.

pulsar.frameworks: 2.7.1 (2.7.0)

Feature - [PULSAR-1600] - Removed unnecessary WARN-messages in pulsar.framework

pulsar.databaseaccess: 4.0.1 (3.0.0) - New major release

Bug fix - [PULSAR-1592] - Parameter type in DatabaseAuditor was restored to the API.

Feature - [PULSAR-1611] - Added monitor logging for createNewConnection i DatabasAccessPool.

pulsar.packager: 1.6.3 (1.6.2)

Feature - [PULSAR-1135] - API sources are now included in module packages.

pulsar.app.configeditor 3.0.4 (3.0.3)

Feature - [PULSAR-1135] - API sources are now included in module packages.

10.25 Release 4.0.4

10.25.1 Artifacts released in this version

- pulsar-modules-4.0.4.pulsar

10.25.2 Changes since 4.0.3

pulsar.core 8.3.0 (8.1.0)

Bug fix - [PULSAR-1603] - Path traversal vulnerability accessing resources

pulsar.resourcemanager 4.0.3 (4.0.2)

Bug fix - [PULSAR-1603] - Path traversal vulnerability accessing resources

10.25.3 Release 4.0.3

10.25.4 Artifacts released in this version

- pulsar.launcher-3.7.0.jar
- pulsar-modules-4.0.3.pulsar
- pulsar-apps-4.0.2.pulsar
- pulsar-endorsed-4.0.3.pulsar

10.25.5 Changes since 4.0.2

pulsar.boot 2.3.3 (2.3.2)

Feature - [PULSAR-1561] Change warning to info when a profile overrides a bundle start level.

pulsar.clientaccess 4.7.5 (4.7.3)

Bug fix - [PULSAR-1564] Redirects via DefaultURLPath should not make the redirect absolute

pulsar.databaseaccess 3.0.0 (2.1.12) - New major release

Feature - [PULSAR-1545] Error logging of SQL statement inlines parameters

Bug fix - [PULSAR-1572] OracleTableStatusHandler can't handle view that consists of other views

pulsar.databaseaccess.sqlserver 1.0.0 (NEW)

Feature - [PULSAR-1563] Create module pulsar.databaseaccess.sqlserver

pulsar.deployer 4.6.0 (4.5.5)

Feature - [PULSAR-1571] Improved turnaround time for reloading rebuilt modules in development

Bug fix - [PULSAR-485] - Can't dist module within the same minute.

pulsar.launcher 3.7.0 (3.6.1)

Automatic undeploy of deprecated `pulsar.search.poiwrapper` .

pulsar.search.fileextractor 2.1.8 (2.1.7)

Feature [PULSAR-672] Create integration tests to validate extraction of supported file types.

Feature - [PULSAR-1012] Check if regex pattern is null after compile in FileExtractorImpl.

Bug fix - [PULSAR-681] Problem (race condition) with integration testing using poiwrapper (doc docx).

pulsar.search.filescanner 1.0.12 (1.0.11)

Bug fix - [PULSAR-1569] Files containing pipe-characters ends the filescanning

pulsar.search.poiwrapper DEPRECATED (1.0.1)

Module has been deprecated and removed. The POI libraries are now distributed with pulsar-endorsed.

pulsar.sessionmanager 2.4.2 (2.4.0)

Bug fix - [PULSAR-1570] Unavailable user plugin causes CFX permission check to always fail

10.26 Release 4.0.2

10.26.1 Artifacts released in this version

- pulsar.launcher-3.6.1.jar
- pulsar-modules-4.0.2.pulsar
- pulsar-apps-4.0.2.pulsar
- pulsar-endorsed-4.0.0.pulsar

10.26.2 Changes since 4.0.1

pulsar.clientaccess 4.7.2 (4.7.1)

Bug fix - [PULSAR-1547] Upgrades may cause Pulsar to increase the HTTP port number

pulsar.core 8.1.0 (8.0.0)

Feature - [PULSAR-1557] Make the ExecutorService available in PulsarModuleContext

pulsar.frameworks 2.7.0 (2.6.1)

Feature - [PULSAR-1551] OverviewPresentation.getData should be able to get raw data without formatting

pulsar.launcher 3.6.1 (3.5.5)

Feature - [PULSAR-1547] Check file accessibility when Pulsar is started or relinked and abort with error if there are problems

pulsar.search.engine 7.0.0 (6.0.3) - New major release

Bug fix - [PULSAR-1543] Searching on a word with "-" don't get any search hits. I.e. Swedish "personnummer"

10.27 Release 4.0.1

10.27.1 Artifacts released in this version

- pulsar.launcher-3.5.5.jar
- pulsar-modules-4.0.1.pulsar
- pulsar-apps-4.0.1.pulsar
- pulsar-endorsed-4.0.0.pulsar

10.27.2 Changes since 4.0.0

pulsar.autostart 1.1.8 (1.1.7)

Bug fix - [PULSAR-1536] Could not remove windows service, NPE.

pulsar.clientaccess 4.7.0 (4.6.7)

Feature - [PULSAR-1527] Log separate performance for each provider/SPI/method (SPA-UI)

Bug fix - [PULSAR-1531] Default URL can not point to "/pulsar/rs/..."

Bug fix - [PULSAR-1478] Files downloaded from Pulsar contains the server side path as part of the filename

pulsar.clientaccessobjects 3.0.0 (2.0.1) - New major release

Bug fix - [PULSAR-1537] Could not get headers in upper case from SPA-UI

pulsar.database 2.1.12 (2.1.11)

Bug fix - [PULSAR-1540] Remove unnecessary stack trace logging in OracleTableStatusHandler

pulsar.frameworks 2.6.1 (2.5.1)

Feature - [PULSAR-1535] Ignore AND/OR when searching with exact match (=)

Feature - [PULSAR-1530] Make it possible to check if a column has "multi data"

pulsar.smtpserver 1.3.4 (1.3.3)

Bug - [PULSAR-1539] All attachment not available when processing mail in SMTP-server

10.28 Release 4.0.0

10.28.1 Artifacts released in this version

- pulsar.launcher-3.5.5.jar
- pulsar-modules-4.0.0.pulsar
- pulsar-apps-4.0.0.pulsar
- pulsar-endorsed-4.0.0.pulsar

10.28.2 Changes since 3.6.0

pulsar.core 8.0.0 (7.7.0) - New major release

Feature - [PULSAR-1023] Support for Service Extender.

pulsar.frameworks 2.5.0 (2.3.3)

Feature - [PULSAR-1254] New method to get data with offset and limit.

Feature - [PULSAR-1360] Helper function to get aggregates and group data.

pulsar.launcher 3.5.5 (3.5.4)

Bug fix - [PULSAR-1515] Changed startlevel for module pulsar.util to 30.

pulsar.sessionmanager 2.4.0 (2.3.3)

Feature - [PULSAR-1211] New method unAccess to prevent polling functionality to affect session timeout.

10.29 Release 3.6.0

10.29.1 Artifacts released in this version

- pulsar.launcher-3.5.4.jar
- pulsar-modules-3.6.0.pulsar
- pulsar-apps-3.6.0.pulsar
- pulsar-endorsed-3.6.0.pulsar

10.29.2 Changes since 3.5.1

pulsar.configmanager 7.0.1 (6.0.0) - New major release

Feature - [PULSAR-1038] Support for loading of e files on installation

Bug fix - [PULSAR-1312] Remove warn logging when install/conf folder does not exist.

Bug fix - [PULSAR-1162] Implement ConfigManager.importConfig to prioritize configurations originating from "conf/install" rather than the module configuration.

pulsar.clientaccess 4.6.6 (4.6.2)

Bug fix - [PULSAR-1230] Session is not set in RequestScope when using REST/WS

Bug fix - [PULSAR-1159] jespas.dns.DnsException: com.sun.jndi.dns.DnsContextFactory not found by pulsar.clientaccess

Bug fix - [PULSAR-1046] False warning in TemplateHandler when client closed its connection

pulsar.launcher 3.5.4 (3.5.0)

Bug fix - [PULSAR-1137] Package javax.xml is missing from pulsar export profiles.

pulsar.smtpserver 1.3.2 (1.3.0)

Bug fix - [PULSAR-1192] Mail with attachments named with ÅÄÖ doesn't get saved

pulsar.performance viewer 3.0.1 (3.0.0)

Bug fix - [PULSAR-1045] Division by zero when getting XML to PerformanceViewer

10.30 Release 3.5.1

Upgrading from 3.5.1 or earlier to 3.6.0 or later

Due to changes in Pulsar 3.6.0 (and later) upgrades from 3.5.1 (or earlier) may cause the HTTP port to be changed during upgrade. For more information see [Operations troubleshooting](#) (see page 104).

10.30.1 Artifacts released in this version

- pulsar.launcher-3.5.0.jar
- pulsar-modules-3.5.1.pulsar
- pulsar-apps-3.5.0.pulsar
- pulsar-endorsed-3.5.0.pulsar

10.30.2 Changes since 3.5.0

pulsar.smtpserver (1.3.0)

Bug fix - [PULSAR-1099] - Config for max attachments = -1 doesn't work. Should be unlimited

Bug fix - [PULSAR-1100] - Problem with attachments - Can't serialize - ClassNotFoundException

10.31 Release 3.5.0

10.31.1 Artifacts released in this version

- pulsar.launcher-3.5.0.jar
- pulsar-modules-3.5.0.pulsar
- pulsar-apps-3.5.0.pulsar

- pulsar-endorsed-3.5.0.pulsar

10.31.2 Changes since 3.4.2

pulsar.clientaccess 4.6.2 (4.4.3)

pulsar.clientaccessobject 2.0.0 (1.2.0) - New major release

Feature - [PULSAR-883] - Prevent problem with MIME sniffing of HTTP responses

Feature - [PULSAR-884] - Set X-Frame-Options header to protect against 'ClickJacking' attacks

Feature - [PULSAR-970] - Implement support for RequestScope and Session when using WS/Rest

Bug fix - [PULSAR-899] - Exception when posting form with a field with name="".

Bug fix - [PULSAR-1026] - REST services can't return XML only JSON

pulsar.core 7.5.1 (7.4.3)

Bug fix - [PULSAR-215] - Resolve problem with classes used as parameters or exceptions being unavailable during proxy creation in ServiceProxy

Bug fix - [PULSAR-924] - Resource path allows case insensitivity in development mode but not when running from a package

Bug fix - [PULSAR-964] - Fresh Pulsar installation intermittently fails to start

pulsar.launcher 3.5.0 (3.3.2)

Bug fix - [PULSAR-1025] - Problems with JAXB/REST library conflicts

pulsar.search.dbscanner 1.0.9 (1.0.8), pulsar.search.filescanner 1.0.8 (1.0.7), pulsar.search.engine 6.0.1 (6.0.0)

Bug fix - [PULSAR-931] - If search-engine is unavailable to accept data, DBScanner and FileScanner continues and fills the log

pulsar.permissionmanager 3.1.0 (3.0.0)

Feature - [PULSAR-904] - Implement permission check for HTTP methods (RS/WS)

10.32 Release 3.4.2

10.32.1 Artifacts released in this version

- pulsar.launcher-3.3.2.jar
- pulsar-modules-3.4.2.pulsar
- pulsar-apps-3.4.1.pulsar
- pulsar-endorsed-3.4.0.pulsar

10.32.2 Changes since 3.4.1

pulsar.clientaccess 4.4.3 (4.4.2)

Bug fix - [PULSAR-1007] - ClientAccess don't start; ServiceUnavailableException: interface org.ops4j.pax.web.service.WebContainer

10.33 Release 3.4.1

10.33.1 Artifacts released in this version

- pulsar.launcher-3.3.2.jar
- pulsar-modules-3.4.1.pulsar
- pulsar-apps-3.4.1.pulsar
- pulsar-endorsed-3.4.0.pulsar

10.33.2 Changes since 3.4.0

pulsar.app.cacheviewer 1.0.2 (1.0.1), pulsar.databaseaccess 2.1.8 (2.1.7), pulsar.search.engine 6.0.1 (6.0.0), pulsar.templatemanager 3.0.5 (3.0.4)

Bug fix - [PULSAR-1000] - Problem with upgrade - version numbers was not updated for all modules that used Monitor.

10.34 Release 3.4.0

Artifacts released in this version

- pulsar.launcher-3.3.2.jar
- pulsar-modules-3.4.0.pulsar
- pulsar-apps-3.4.0.pulsar
- pulsar-endorsed-3.4.0.pulsar

10.34.1 Changes since 3.3.0

pulsar.autostart 1.1.5 (1.1.4)

Feature - [PULSAR-896] - Make it possible to enter parameters in autostart.

pulsar.clientaccess 4.4.2 (4.3.0)

Feature - [PULSAR-938] - Add configuration parameter to return JSON arrays when returning arrays or collections from a REST method.

Feature - [PULSAR-938] - Added support class for JSON streaming.

pulsar.core 7.4.3 (7.4.2)

Bug fix - [PULSAR-897] - NullPointerException in getModuleExternalDataDir in PulsarModuleContextFactory.

pulsar.frameworks 2.3.3 (2.3.2)

Bug fix - [PULSAR-937] - Performance; Unnecessary SQL is run if a grouped overview doesn't have any sums.

pulsar.launcher 3.3.2 (3.2.2)

Feature - [PULSAR-879] - Add launcher switch -noBrowser to prevent Pulsar from opening the browser after a fresh install.

pulsar.messagemanager 6.1.0 (4.0.5) - New major release

Feature - [PULSAR-916] - Support to set In-Reply-To and References headers.

Feature - [PULSAR-945] - The messageId is returned when sending mail.

Feature - [PULSAR-966] - Support for TLS in MessageManager.

pulsar.messagerouter (3.1.0)

Feature - [PULSAR-915] - New module for routing incoming SMTP-mail to a client.

pulsar.performanceviewer 3.0.0 (2.0.4) - New major release

Feature - [PULSAR-730] - Support for persistent monitor data. Performance can be compared between different days.

pulsar.persistentqueues (1.0.3)

Feature - [PULSAR-914] - New module to support persistent queues.

pulsar.smtpserver (1.2.2)

Feature - [PULSAR-913] - New module, SMTP server.

pulsar.usermanager 1.0.11 (1.0.10)

Bug fix - [PULSAR-940] - If pulsar.superuser is changed in config of User Manager the session gets messed up, and Pulsar need to be restarted.

10.35 Release 3.3.0

10.35.1 Artifacts released in this version

- pulsar.launcher-3.3.0.jar
- pulsar-modules-3.3.0.pulsar
- pulsar-apps-3.3.0.pulsar
- pulsar-endorsed-3.2.2.pulsar

10.35.2 Changes since 3.2.6

pulsar.boot (2.3.0)

Bug fix - [PULSAR-895] - Start level for Pulsar modules must be defined even if they are not deployed according to a profile.

pulsar.databaseaccess (2.1.7)

Bug fix - [PULSAR-787] - Error message when two Pulsar-instances is started when OracleTableStatusHandler is activated.

pulsar.deployer (4.5.3)

Bug fix - [PULSAR-787] - Upgrade of bundles fails with TimeoutException.

pulsar.templatemanager (3.0.4)

Bug fix - [PULSAR-881] - pulsar:echo must escape all HTML-tags by default.

pulsar.ssoiwa (1.0.0)

Feature - [PULSAR-229] - Support for SSO with IWA/NTLMv2.

pulsar.app.configeditor (2.0.6)

Bug fix - [PULSAR-811] - Configuration import of "field = \\host" becomes "field = \host" (lost one slash).

pulsar.search.engine (6.0.0)

Bug fix - [PULSAR-903] - OutOfMemory when creating SearchResponse.

pulsar.search.filescanner (1.0.7)

Bug fix - [PULSAR-902] - NPE in FileScanner.

Bug fix - [PULSAR-905] - DBScanner does not index all information when indexing several rows as bulk.

10.36 Release 3.2.6

10.36.1 Developer notes

Since Pulsar 3.2.6 redefines the start levels for modules updates to the `package-info.java` files containing the `@PulsarModule` definition might require adjustments. If the `startLevel` attribute is used it now needs to be set to a level of 100 or above for user created modules. If multiple module groups are not required we recommend that the `startLevel` attribute is removed altogether.

10.36.2 Changes since 3.2.5

pulsar.boot (2.2.2)

Feature - [PULSAR-760] - Possible to use framework level higher than 10 for modules

Feature - [PULSAR-862] - Always apply any changed profiles when Pulsar is starting

Bug fix - [PULSAR-662] - Pulsar upgrades may cause an inconsistent dependency state

pulsar.frameworks (2.3.2)

Feature - [PULSAR-873] - Search for date + time doesn't work for columns with format that shows date and time

pulsar.messagemanager (4.0.5)

Feature - [PULSAR-835] - Add config to set timeout for SMTP-communication in MessageManager

pulsar.app.configeditor (2.0.6)

Bug fix - [PULSAR-811] - Configuration import of "field = \\host" becomes "field = \host" (lost one slash)

pulsar.app.installerui (1.4.8)

Feature - [PULSAR-842] - Improved messages shown when dependencies are missing

pulsar.search.dbscanner (1.0.7)

pulsar.search.engine (5.1.1)

Feature - [PULSAR-867] - Make indexing from db-scanner with bulk-function for better performance

Bug fix - [PULSAR-863] - NPE in SearchStatus in AdminConsole

10.37 Release 3.2.5

10.37.1 Changes since 3.2.4

package endorsed (3.2.1)

Feature [PULSAR-828] - Added Jettison 1.3.7 to support for automatic serialization to JSON/XML for JAXB-annotated classes.

pulsar.deployer (4.3.10)

Bug fix - [PULSAR-662] - Pulsar upgrades may cause an inconsistent dependency state

10.38 Release 3.2.4

10.38.1 Changes since 3.2.3

pulsar.autostart (1.1.4), pulsar.clientaccess (4.2.5), pulsar.permissionmanager (3.0.5), pulsar.search.dbscanner (1.0.6), pulsar.search.filescanner (1.0.6), pulsar.templatemanager (3.0.4), pulsar.uimanager (3.0.1)

Bug fix - [PULSAR-809] - Problem with upgrade - version numbers was not updated for all modules that used ConfigManager.

pulsar.databaseaccess (2.1.4)

Bug fix - [PULSAR-794] - Error message in OracleTableStatusHandler

10.39 Release 3.2.3

10.39.1 Changes since 3.2.2

pulsar.databaseaccess (2.1.3)

Bug fix - [PULSAR-802] - Exception when using "\$" in parameter in an SQL statement.

10.40 Release 3.2.2

10.40.1 Changes since 3.2.1

pulsar.app.installerui (1.4.6)

Feature - [PULSAR-801] - New button "Upgrade All".

pulsar.autostart (1.1.3)

Feature - [PULSAR-738] - Autostart should be able to config windows service to run Pulsar with JDK

Bug fix - [PULSAR-742] - Service don't start after update on settings in Autostart, error message "Commons Daemon procrun failed with exit value: 5 (Failed to start service)"

pulsar.clientaccess (4.2.4)

Feature - [PULSAR-788] - Look over HTTP-headers for caching, expire time for static resource should be configurable

Bug fix - [PULSAR-625] - New methods in pulsar/js are not updated on reload, only on forced reload

pulsar.configmanager (6.0.0)

Bug fix - [PULSAR-691, PULSAR-718] - Fix Config Manager race conditions (indexOutOfBounds)

Bug fix - [PULSAR-768] - Setting user password on initial installation of Pulsar triggers restart of User Manager

pulsar.databaseaccess (2.1.2)

Bug fix - [PULSAR-793] - Argument as Date or Calendar to SQL is always treated as 1970-01-01

Bug fix - [PULSAR-794] - Warning in logg for OracleTableStatusHandler; [cleanup] SQL=DELETE pulsar_table_status WHERE 1=2 OR rowid=? java.sql.SQLException: Invalid column index

pulsar.permissionmanager (3.0.4)

Bug fix - [PULSAR-796] - Cached permissions i PermissionManager is never flushed!

pulsar.templatemanager (3.0.3)

Bug fix - [PULSAR-417] - Stylesheet is picked up from the wrong module in `<pulsar:method44 module="..." stylesheet="..." />`

Bug fix - [PULSAR-608] - Templates is affected by the default file.encoding, it should only be affected by config in Template Manager

Bug fix - [PULSAR-792] - Missing template in `<pulsar:include45>` throws exception and aborts page rendering

⁴⁴ <http://pulsarmethod>

⁴⁵ <http://pulsarinclude>

10.41 Release 3.2.1

10.41.1 Changes since 3.2.0

Bug fixes

[PULSAR-675] - Concurrent service invocations were in some cases unnecessarily synchronized (blocking)

10.42 Release 3.2.0

10.42.1 Changes since 3.1.0

[PULSAR-241] - Implement understandable error messages for common developer errors

[PULSAR-644] - Implement tab in Admin Console for search status

[PULSAR-660] - Add support for auditing plugins in DatabaseAccess

[PULSAR-666] - Add description for all Pulsar modules in package-info.java

[PULSAR-726] - DataAccess: If InitialConnection = 0, you can't get a connection

[PULSAR-733] - UserManager: performance issue - getUser creates a new object every time

[PULSAR-735] - Better logging from DatabaseAccess

Bug fixes

[PULSAR-703] - Current Users in Admin Console shows wrong module and action

[PULSAR-713] - Logs are not always rotated when size limit is reached

[PULSAR-717] - UserManager : AnonymousUser is not unique

[PULSAR-749] - onUnavailable is not called for iterable services

10.43 Release 3.1.0

10.43.1 Changes since 3.0.5

[PULSAR-631, PULSAR-638, PULSAR-639, PULSAR-640, PULSAR-641, PULSAR-645] - Added APIs for and implementations of search engine, scanners and indexers.

[PULSAR-697] - Deterministic definition of context class loader to bundle classloader in PulsarActivator life cycle methods

[PULSAR-698] - Monitoring the creation of new threads in all PulsarActivator life cycle methods

[PULSAR-701] - Added new bundle dependencies for search to endorsed package

[PULSAR-719] - Documentation of Search Module

Bug fixes

[PULSAR-614] - When ClientAccess configuration is updated through AdminConsole the Pulsar servlet becomes unavailable

[PULSAR-707] - InstallerUI can't show modal install dialog in IE 9

10.44 Release 3.0.5

Changes since 3.0.4

[PULSAR-668] - Changed location of HTTP-logs och commons-daemon log files to sub directories

10.44.1 Bug fixes

[PULSAR-624] - Module upgrades sometimes causes two versions of the module to be installed

[PULSAR-684] - Exception when instantiating a web service client, added test cases.

10.45 Release 3.0.4

10.45.1 Changes since 3.0.3

Bug fixes

[PULSAR-687] - MessageManager - Can't add attachment, exception
`javax.activation.UnsupportedDataTypeException`.

10.46 Release 3.0.3

10.46.1 Changes since 3.0.2

[PULSAR-602] - Support for Launcher upgrades when autostart service is used

Bug fixes

[PULSAR-665] - Out of Memory when using iterable service provider

[PULSAR-679] - MemoryViewer - Exception thrown when trying to set threshold on unlimited pools.

10.47 Release 3.0.2

10.47.1 Changes since 3.0.1

- [PULSAR-595] - Support for selecting SMTP port, username and password in MessageManager
- [PULSAR-669] - Support for monitoring of memory usage

Bug fixes

- [PULSAR-670] - MessageManager can't find javax.net.ssl, which causes send to fail

10.48 Release 3.0.1

10.48.1 Changes since 3.0.0

- [PULSAR-249] - Write draft of Operations reference
- [PULSAR-609] - Improved boot logging to make troubleshooting/support easier
- [PULSAR-632] - Add JVM memory options to autostart (service)
- [PULSAR-642] - Always log which ports are used and when they are updated
- [PULSAR-623] - Release adjustments of documentation

Bug fixes

- [PULSAR-613] - Can't rename ServiceName in Autostart
- [PULSAR-633] - NPE in Admin Console / PerformanceViewer
- [PULSAR-634] - Template cache grows

11 Documentation Notes

2014-09-08 Pulsar 3.0.0 Preview
2014-09-25 Pulsar 3.0.0 Release
2014-10-09 Pulsar 3.0.1 Release
2014-10-13 Pulsar 3.0.2 Release
2014-10-20 Pulsar 3.0.3 Release
2014-10-21 Pulsar 3.0.4 Release
2014-10-29 Pulsar 3.0.5 Release
2014-11-13 Pulsar 3.1.0 Release
2014-12-08 Pulsar 3.2.0 Release
2014-12-12 Pulsar 3.2.1 Release
2015-01-20 Pulsar 3.2.2 Release
2015-01-23 Pulsar 3.2.3 Release
2015-01-29 Pulsar 3.2.4 Release
2015-02-24 Pulsar 3.2.5 Release
2015-03-27 Pulsar 3.2.6 Release
2015-05-12 Pulsar 3.3.0 Release
2015-08-21 Pulsar 3.4.0 Release
2015-09-02 Pulsar 3.4.1 Release
2015-09-09 Pulsar 3.4.2 Release
2015-09-29 Pulsar 3.5.0 Release
2015-10-30 Pulsar 3.5.1 Release
2016-03-10 Pulsar 3.6.0 Release
2016-09-19 Pulsar 4.0.0 Release
2016-11-14 Pulsar 4.0.1 Release
2017-03-01 Pulsar 4.0.2 Release
2017-04-05 Pulsar 4.0.3 Release
2017-05-16 Pulsar 4.0.4 Release
2017-06-28 Pulsar 4.1.0 Release
2017-09-20 Pulsar 4.2.0 Release
2017-11-28 Pulsar 4.3.0 Release
2017-12-05 Pulsar 4.3.1 Release
2017-12-07 Pulsar 4.3.2 Release
2018-05-14 Pulsar 4.4.0 Release
2018-06-27 Pulsar 4.5.0 Release
2018-09-14 Pulsar 4.5.1 Release
2018-12-18 Pulsar 4.6.0 Release
2019-04-08 Pulsar 4.6.1 Release
2019-04-10 Pulsar 4.6.2 Release
2019-10-20 Pulsar 4.6.3 Release
2020-03-03 Pulsar 4.7.0 Release
2020-03-19 Pulsar 4.7.1 Release
2020-05-15 Pulsar 4.7.2 Release
2020-11-13 Pulsar 4.7.3 Release
2020-12-22 Pulsar 4.8.0 Release
2021-01-14 Pulsar 4.8.1 Release
2021-01-18 Pulsar 4.9.0 Release
2021-05-17 Pulsar 4.10.0 Release
2021-10-25 Pulsar 4.11.0 Release
2021-10-29 Pulsar 4.11.1 Release
2022-03-11 Pulsar 4.12.0 Release