EUROPEAN COMMISSION

DIGIT
Connecting Europe Facility

Domibus 4.0

Software Architecture Document

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Table of Contents

1. INTRODUCTION 5
1.1. Purpose 5
1.2. Scope 5
1.3. References 5
1.4. Document Content Overview 7
2. ARCHITECTURAL REPRESENTATION 8
3. ARCHITECTURAL GOALS AND CONSTRAINTS 9
4. SECURITY 10
4.1. Introduction 10
4.2. Corner 1 - Corner 2 Communication 10
4.3. Corner 2 – Corner 3 Communication 10
4.3.1. Certificate Configuration 10
4.3.2. Client Certificate 10
4.4. Corner 3 – Corner 4 Communication 10
4.5. Administrative Sites 11
5. USE-CASE VIEW 12
6. LOGICAL VIEW 14
6.1. Overview 14
6.2. Architecturally Significant Design Packages 14
6.2.1. Back office system (Corner 1/4) 14
6.2.2. Domibus plugin implementation 14
6.2.3. Domibus default plugins 15
6.2.4. Domibus plugin API 15
6.2.5. Domibus MSH (Corner 2/3) 15
6.2.6. Administrative GUI 15
7. DEPLOYMENT VIEW 16
8. IMPLEMENTATION VIEW 17
8.1. Overview 17
9. DATA VIEW 19
9.1. Data Model 19
9.2. State Machines 22
9.2.1. Outgoing Message State Machine 22
9.2.2. Incoming Message State Machine 22
10. SIZE AND PERFORMANCE 23

10.1. Size 23
10.2. Performance 23

11. QUALITY 24

11.1. Extensibility 24
11.2. Reliability 24
11.3. Portability 24

12. LOGGING 25

12.1. Implementation 25
12.2. Domibus log codes 26

13. CACHING 32

14. MULTITENANCY 33

14.1. General 33
14.1. Identifying the domain (tenant) 33
14.1.1. Selecting the database schema 34
14.2. User association to a domain 34
14.3. UI 34
14.3.1. Managing multiple domains from the Domibus Administration Console 34
14.3.2. Security 35
14.4. Plugins 35
14.4.1. Security 35
14.4.2. Plugin API 36
14.4.3. WS Plugin 36
14.4.4. JMS Plugin 36
14.4.5. FS Plugin 37
14.5. Domibus Properties 37
14.6. Logging 38
14.7. Message Payloads 38
14.8. Quartz 39

15. UI REPLICATION MECHANISM 40

15.1. TB_MESSAGE_UI table and V_MESSAGE_UI_DIFF view 40
15.1.1. TB_MESSAGE_UI 40
15.1.2. V_MESSAGE_UI_DIFF 41
15.1.3. Native tables 42
15.2. UIReplication queue, JMS message producer and consumer 42
15.3. UIReplication Quartz Job 43
15.4. UIReplication REST methods 43
15.5. Migration script 43
15.6. Enabling/disabling the UIReplication mechanism 44

1. INTRODUCTION

1.1. Purpose

This document provides a comprehensive architectural overview of the system, using a number of different architectural views to depict individual aspects of the system. It is intended to capture and convey the significant architectural decisions that have been made on the system.

1.2. Scope

The architecture described in this document concerns the middleware Domibus created by the e-CODEX project and adopted by the CEF as sample platform for e-delivery. It is compliant with the eDelivery profile [REF2] of the OASIS ebMS3/AS4 standard. This document is not intended to explain the ebMS3/AS4 standards, the four-corner model or any other concepts described in the provided references.

1.3. References

#	Document	Contents outline
[REF1]	eDelivery AS4 Profile	The eDelivery AS4 Profile is a profile of the ebMS3 and AS4 OASIS Standards. It has provisions for use in four-corner topologies, but it can also be used in point-to-point exchanges.
[REF2]	OASIS AS4 Profile	AS4 Profile of ebMS 3.0 Version 1.0. OASIS Standard, 23 January 2013.
[REF3]	ebMS3 Core	OASIS ebXML Messaging Services Version 3.0: Part 1, Core Features. OASIS Standard. 1 October 2007.
[REF4]	Domibus plugin cookbook	Technical manual on Domibus plugin development.
[REF5]	Apache CXF	Apache CXF is an open source services framework. These services can speak a variety of protocols such as SOAP, XML/HTTP, RESTful HTTP, or CORBA and work over a variety of transports such as HTTP, JMS or JBI.

[REF6]	Apache WSS4J	The Apache WSS4J™ project provides a Java implementation of the primary security standards for Web Services, namely the OASIS Web Services Security (WS-Security) specifications from the OASIS Web Services Security TC
[REF7]	WS-Policy Specification	The Web Services Framework provides a general-purpose model and corresponding syntax to describe the policies of entities in a Web services-based system.
[REF8]	Spring Security	Spring Security is a framework that focuses on providing both authentication and authorization to Java applications. It can easily be extended to meet custom requirements.
[REF9]	Bcrypt	*Provos, Niels; Mazières, David; Talan Jason Sutton 2012 (1999). "A Future-Adaptable Password Scheme". Proceedings of 1999 USENIX Annual Technical Conference: 81–92.*
[REF10]	JMS	The Java Message Service (JMS) API is a Java Message Oriented Middleware API for sending messages between two or more clients.
[REF11]	e-CODEX	The e-CODEX project improves the cross-border access of citizens and businesses to legal means in Europe and furthermore creates the interoperability between legal authorities within the EU.
[REF12]	Java Servlet 3.0	A Java servlet is a Java program that extends the capabilities of a server. Although servlets can respond to any types of requests, they most commonly implement applications hosted on Web servers. Such Web servlets are the Java counterpart to other dynamic Web content technologies such as PHP and ASP.NET.
[REF13]	Xtext	Xtext is a framework for development of programming languages and domain-specific languages.
[REF14]	SOAP	Simple Object Access Protocol

[REF15] HTTP Chunking	A mechanism by which data is broken up into a number of chunks when sent over an HTTP connection.

1.4. Document Content Overview

After summarizing the architectural representation, goals and constraints, this document describes the system using several architectural views (Use Case, logical, process, deployment, implementation and data) and then concludes with size, performance and quality considerations.

2. ARCHITECTURAL REPRESENTATION

The next two sections of the document describe the architectural goals and constraints.

Architecturally relevant Use Cases are described by a Use Case diagram and a short explanation of their impact on the architecture. The following views will also be provided:

- A logical view provides a high-level view of the platform presenting the structure of the system through its components and their interactions.
- An implementation view describes the software layers and the main software components. A component diagram is used in this view.
- A deployment view provides a description of the hardware components and how they are linked together. This view gives a technical description of protocols and hardware nodes used.
- A data view provides information about the data persistency. A class diagram will be used to model the main system data.

UML diagrams are systematically used to represent the different views of the system.

3. ARCHITECTURAL GOALS AND CONSTRAINTS

The following non-functional requirements that affect the architectural solution have been identified:

Non-functional requirement	Description
Adaptability	The application shall be easy to be integrated into existing business workflows using different communication protocols and data formats
Portability	The application shall be able to be deployed on a wide variety of software/hardware systems
Interoperability	The system shall be interoperable with both commercial and free alternative implementations of the eDelivery profile.

4. SECURITY

4.1. Introduction

The Domibus middleware provides built-in security in accordance to the implemented [REF2] specification and industry best practices. It can also be easily integrated into existing security domains.

4.2. Corner 1 - Corner 2 Communication

As no assumptions can be made about the security architecture of corner 1/4 (back office), the integration into the existing architecture has to be provided by the Domibus plugins. While the default plugins do not include any security constraints they can be easily extended to accommodate most of the security requirements.

4.3. Corner 2 – Corner 3 Communication

The communication between corner 2 and corner 3 is able to fulfil all the security requirements specified in the eDelivery AS4 profile. The configuration is handled via WS-Policy files and PMode configuration. All webservice security is enforced by the Apache CXF framework [REF5].

4.3.1. Certificate Configuration

The location and credentials of private and public certificates used by CXF are configured in the “domibus.properties” property configuration file.

4.3.2. Client Certificate

The client certificate for use with client authentication (two-way SSL) is configured in the “clientauthentication.xml” spring configuration file. Incoming TLS secured connections terminate at the proxy server (e.g. Apache httpd) and must be configured according to the employed proxy servers documentation.

4.4. Corner 3 – Corner 4 Communication

The security between corner 3 and corner 4 is handled via the same mechanisms used in the communication corner 1 – corner 2.

4.5. Administrative Sites

Access to the Domibus administration page is secured with username/password. The credentials are managed by a Spring authentication manager and multiple authentication providers can be plugged into it By default, the credentials are stored in the database and they are managed by an authentication provider that uses a Bcrypt strong hashing function for encoding them. Integration into an existing authentication scheme (i.e. LDAP) can be performed via Spring configuration.

SECURITY DISCLAIMER

On top of the security that Domibus provides, the user shall take additional security measures according to best practices and regulations. This includes, but is not limited to, using firewalls, IP whitelists and file system/database encryption. DIGIT shall not be held responsible for any security breach that might occur due to User not respecting this recommendation.

5. USE-CASE VIEW

This section provides a representation of the use cases relevant for the architecture.

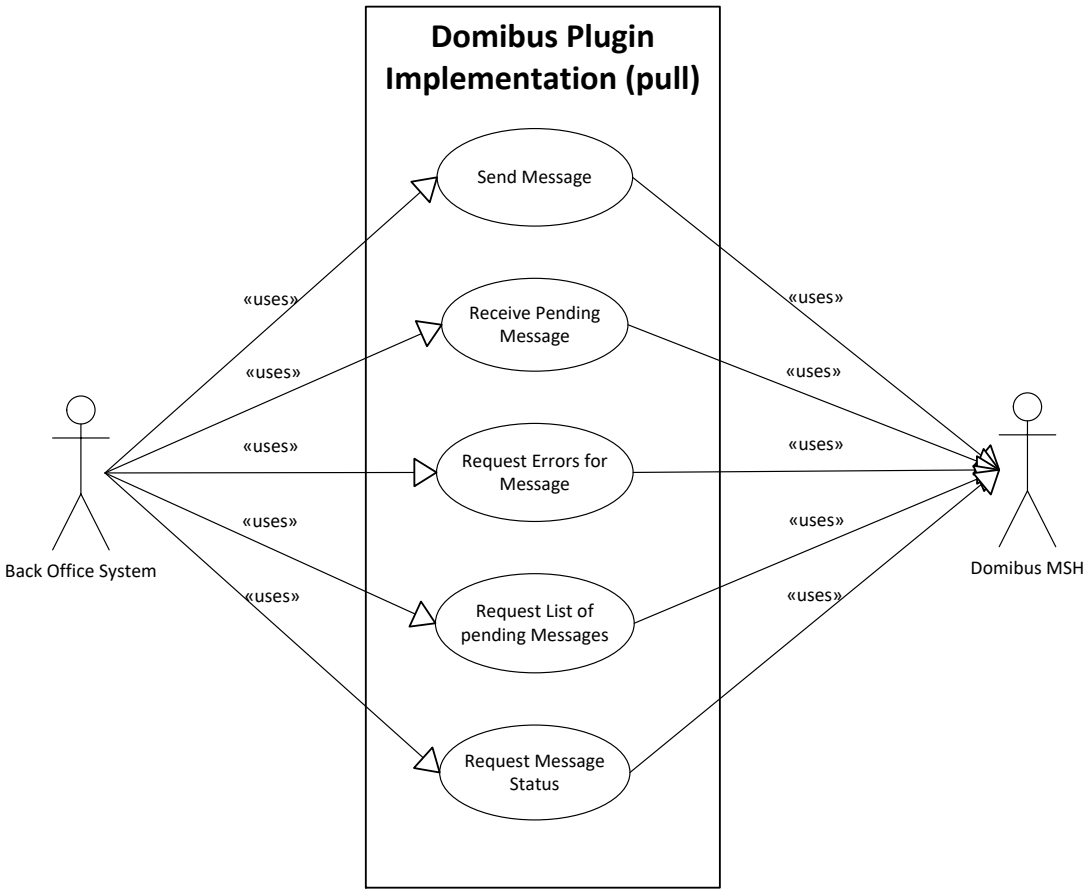
5.1. Selection Rationale

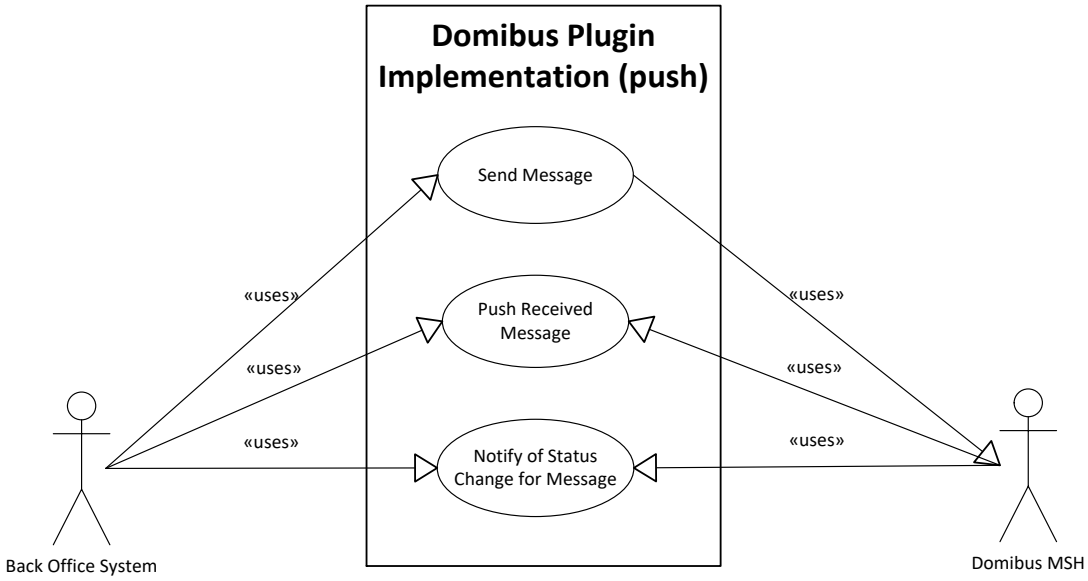
The use cases relevant for the architecture have been selected based on the following criteria:

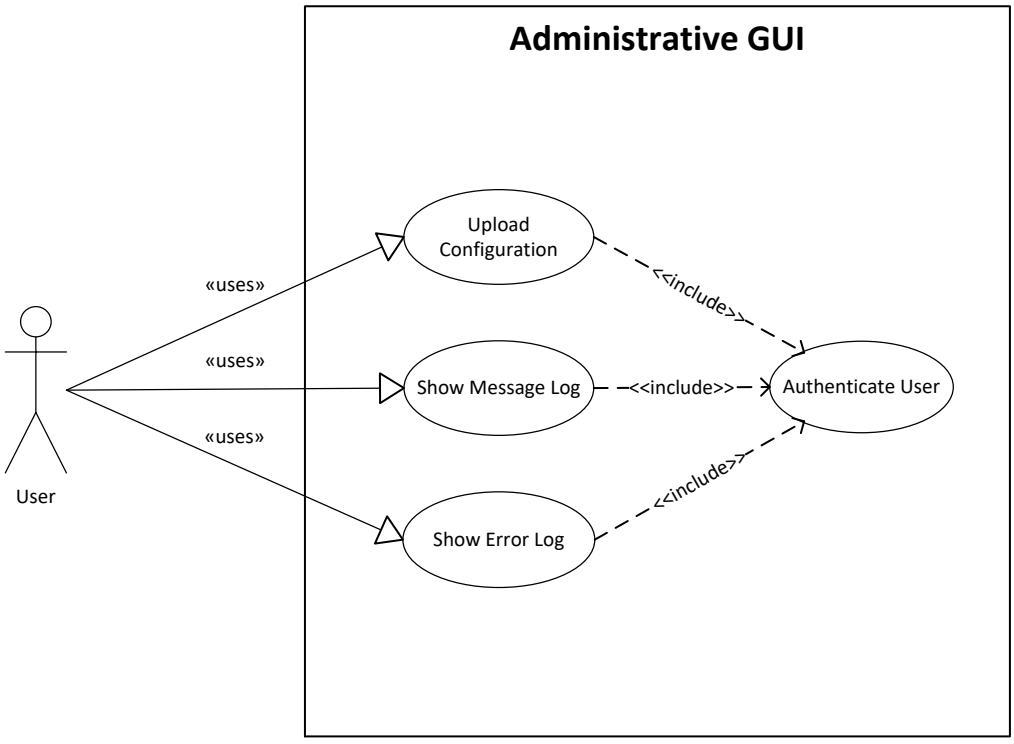
- Use cases affecting the exchange between the back office system and the Domibus MSH.
- Use cases representing critical parts of the architecture, thereby addressing the technical risks of the project at an earlier stage.

The following use cases have been selected:

- Back office integrations using pull communication (i.e. WebService)
- Back office integrations using push communication (i.e. JMS)
- Usage of the administrative GUI




Domibus Plugin Implementation (push)
Send Message
Push Received Message
Notify of Status Change for Message
«uses»
«uses»
«uses»
«uses»
«uses»
«uses»
Back Office System
Domibus MSH


Administrative GUI
Upload Configuration
Show Message Log
Show Error Log
Authenticate User
<<include>>
<<include>>
<<include>>
«uses»
«uses»
«uses»
User

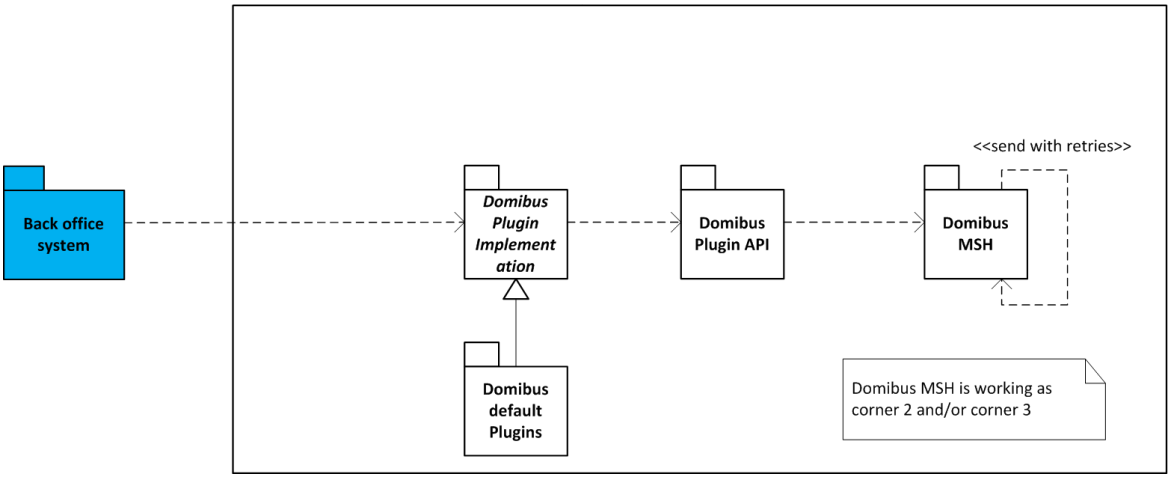
6. LOGICAL VIEW

6.1. Overview

This chapter describes the main application modules, how they interact and how they implement the specification and profile.

6.2. Architecturally Significant Design Packages

The following diagram provides a high-level view of the main packages composing the system. The Database persistence and file system persistence are logical packages representing the physical data storages used by the platform. The others represent different application layers and give an overview of the organisation of the platform's code.



6.2.1. Back office system (Corner 1/4)

The whole purpose of Domibus is to connect different back office systems via structured, secure message exchange. While, regarding a single message exchange, corner 1 and 4 are usually different applications running in different environments, within a single deployment the role of corner 1 and corner 4 (for different message exchanges) is usually occupied by the same application. Therefore, from a logical point of view, corner 1 and 4 are the same package.

6.2.2. Domibus plugin implementation

This module is responsible for the communication between the back office system and Domibus and for the mapping from the back office internal data format to Domibus internal data format. The communication and the mapping of the data can be done in both directions. Integration into existing security architecture can also be implemented here.

As there can be made few assumptions about the back office system, this module is commonly implemented by the Domibus user. Details on this process can be found inside the Domibus Plugin Cookbook.

6.2.3. Domibus default plugins

Domibus provides three default plugins, which serve for testing purposes and as examples for custom implementations. They were initially developed to accommodate the needs of the e-CODEX project and thus will not be suitable for every use case.

6.2.4. Domibus plugin API

This package contains all necessary interfaces and classes required to implement a Domibus plugin

6.2.5. Domibus MSH (Corner 2/3)

The Domibus MSH (Message Service Handler) is the main module, representing corner 2 and/or 3 in a 4-corner message exchange. All the implementation relevant to the eDelivery profile is done inside this package. It is deployable on any Container supporting the Java Servlet Specification v 3.0.

To support the required AS4 retry mechanisms a spring configured cronjob regularly checks for messages that need to be resent. The cronjob is configured using Spring and it uses the property: “domibus.msh.retry.cron” defined in the configuration file domibus.properties. This does not configure the retry interval for messages (which is done via PModes).

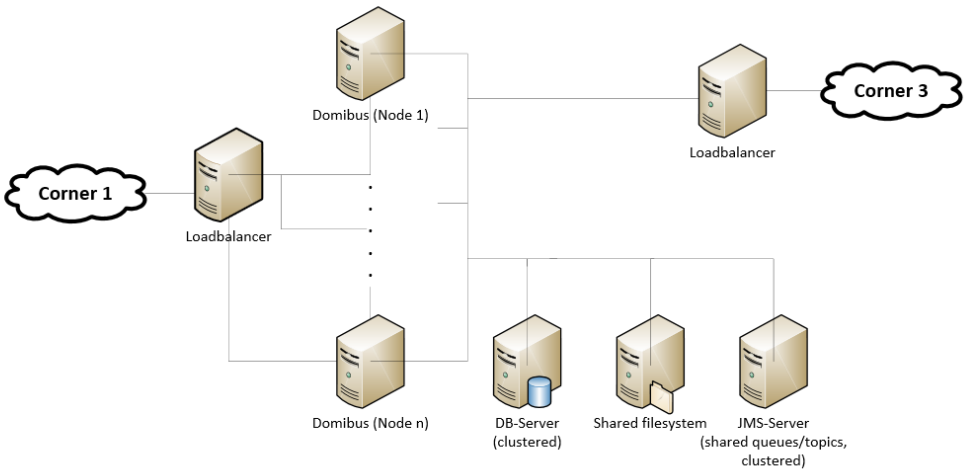
6.2.6. Administrative GUI

This package contains of a Spring MVC web application providing basic monitoring and configuration options.

7. DEPLOYMENT VIEW

The following is a description of the hardware nodes running the execution environment for the system.

The following diagram provides a view of hardware components involved in this project. Note that a clustered environment is shown. If a single server deployment is sufficient (i.e. for testing purposes), a load balancer and multiple hardware nodes are not required.



It is important to note that not all physical nodes are represented on this diagram. Indeed load balancers, database servers and JMS servers could be duplicated for scalability, performance and availability reasons. Furthermore, security mechanisms like firewalls are not shown.

These are the identified hardware nodes.

- Load balancers are responsible for distributing requests among multiple Domibus nodes. A random round robbing/no sticky session setup is recommended.
- Java servlet containers with deployed Domibus instances are responsible for message processing
- A database server (MySQL 5.5+ or Oracle 10g+) is responsible for storing messages and PMode configuration data
- The shared file system contains shared Domibus configuration data, file based PMode data (Keystores) and, depending on configuration, binary data of message attachments.

Domibus has been successfully tested on Tomcat 8, WebLogic 12.1.x and WildFly 9.0.2 servers.

8. IMPLEMENTATION VIEW

8.1. Overview

The following diagram describes the software layers of the system and their components.

The AS4 MSH Service is the web service which accepts the AS4 requests and it is the one that is called by the external systems. External MSH services are accessed through the **AS4 Message Dispatch Service**, which is a web service client capable of sending AS4 requests. The Back office systems can access the platform through their respective plugin implementations. The **Web Layer** is accessed typically by a web browser. The MSH SOAP handling is implemented using the Apache CXF framework.

The **Integration Layer** uses the Spring framework and is responsible for the integration of custom plugins and all communication processes and data format translations between back office systems and Domibus.

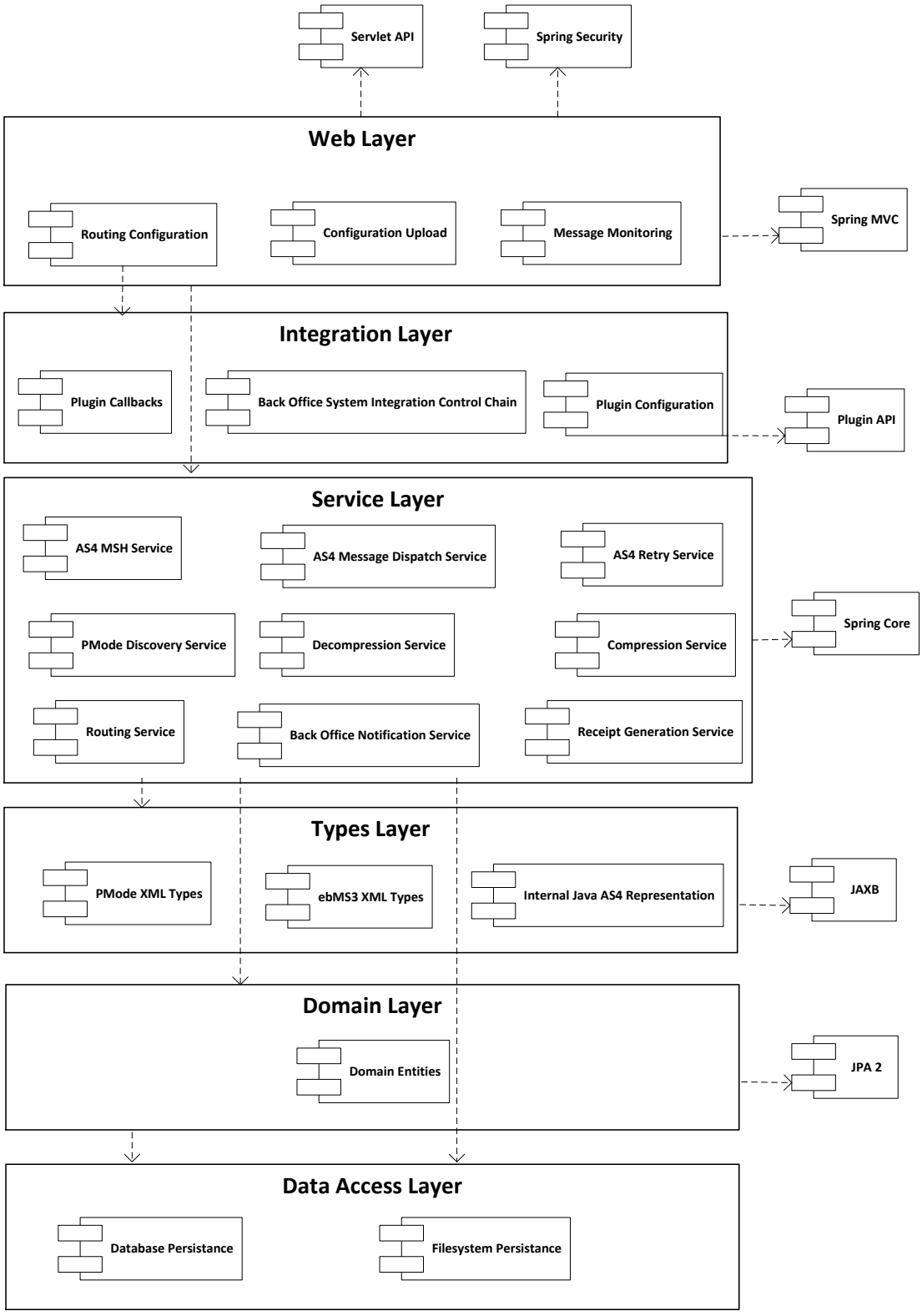
The **Services Layer** offers access to the domain objects of the platform as well as to the platform data layer. These services are Plain Old Java Objects relying on the Spring framework for dependency injection and for transaction management.

The **Types Layer** contains all the java objects generated from the XSDs used by the platform. These are JAXB generated objects.

The **Domain Layer** holds all the platform entities. The persistence of these entities is implemented using the Java Persistence API version 2.0.

Finally, the **Data Persistence** relies on the database and the file system to persist the data. The file system is used to store configuration data and the database to persist the incoming and outgoing messages.

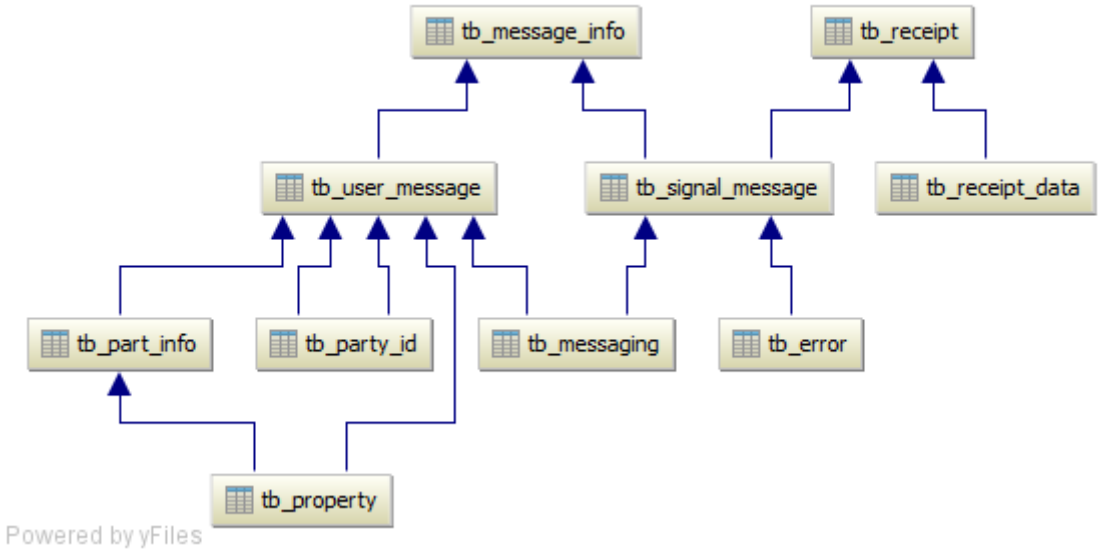
All these layers run on a Java Servlet Container. The platform has been tested on Tomcat 8.x, WildFly 9.0.2 and WebLogic 12.1.x.


Servlet API
Spring Security
Web Layer
Routing Configuration
Configuration Upload
Message Monitoring
Spring MVC
Integration Layer
Plugin Callbacks
Back Office System Integration Control Chain
Plugin Configuration
Plugin API
Service Layer
AS4 MSH Service
AS4 Message Dispatch Service
AS4 Retry Service
PMode Discovery Service
Decompression Service
Compression Service
Spring Core
Routing Service
Back Office Notification Service
Receipt Generation Service
Types Layer
PMode XML Types
ebMS3 XML Types
Internal Java AS4 Representation
JAXB
Domain Layer
Domain Entities
JPA 2
Data Access Layer
Database Persistance
Filesystem Persistance

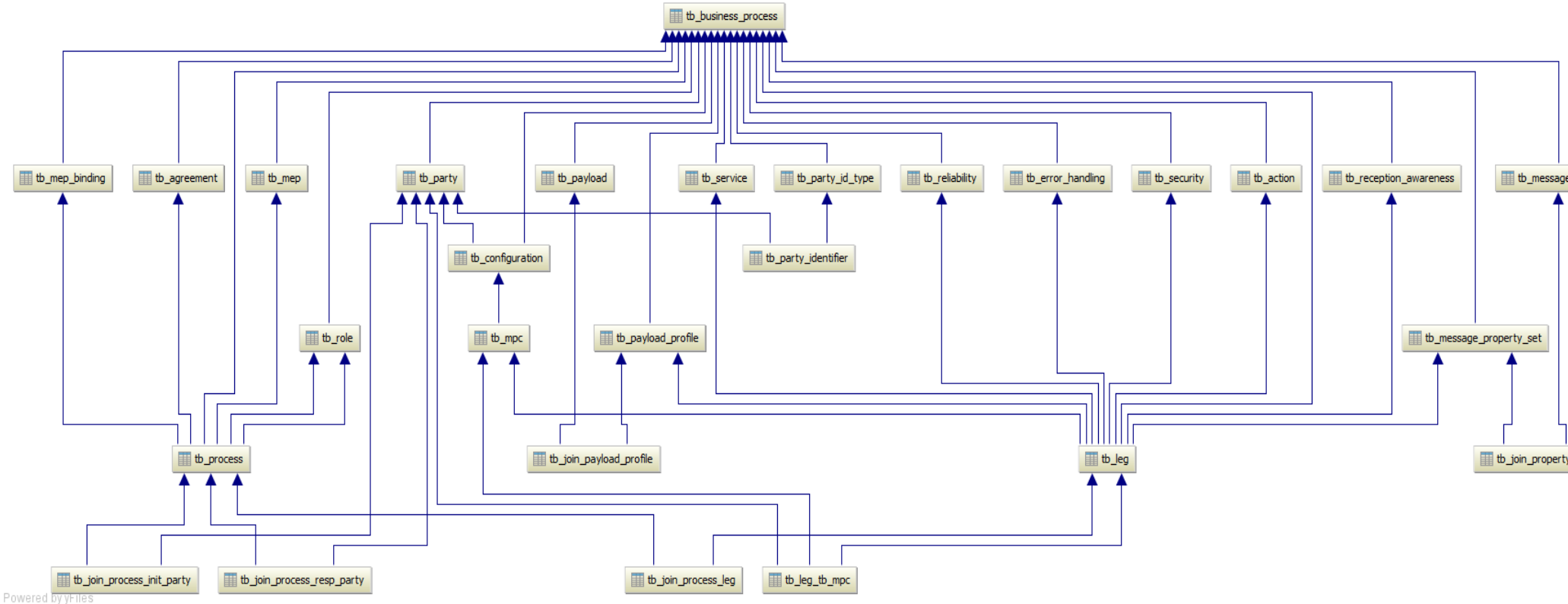
9. DATA VIEW

9.1. Data Model

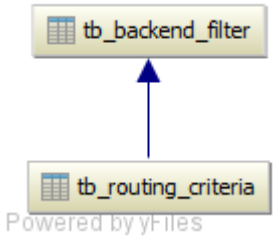
The following diagrams show a high-level abstraction of the data entities, which must be implemented by the system:



The above tables represent a 1:1 mapping of the ebMS3 XSD to database tables.

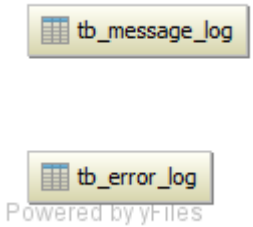

tb_business_process
tb_mep_binding
tb_agreement
tb_mep
tb_party
tb_payload
tb_service
tb_party_id_type
tb_reliability
tb_error_handling
tb_security
tb_action
tb_reception_awareness
tb_configuration
tb_party_identifier
tb_role
tb_mpc
tb_payload_profile
tb_message_property_set
tb_process
tb_join_payload_profile
tb_leg
tb_join_process_init_party
tb_join_process_resp_party
tb_join_process_leg
tb_leg_tb_mpc
Powered by yFiles

The above tables represent a 1:1 mapping of the PMode configuration XSD to database tables.



Routing criteria contains the data that are needed to perform the routing of the messages to a specific plugin implementation.

Backend filters are collections of routing criteria associated with a specific backend representation.



The TB_MESSAGE_LOG table contains information about the User Messages and the Signal Messages (both sent and received ones). The stored values are the following:

MESSAGE_ID, MESSAGE_STATUS, MESSAGE_TYPE, MPC, MSH_ROLE, NEXT_ATTEMPT, NOTIFICATION_STATUS, RECEIVED, SEND_ATTEMPTS, SEND_ATTEMPTS_MAX, BACKEND, ENDPOINT, DELETED

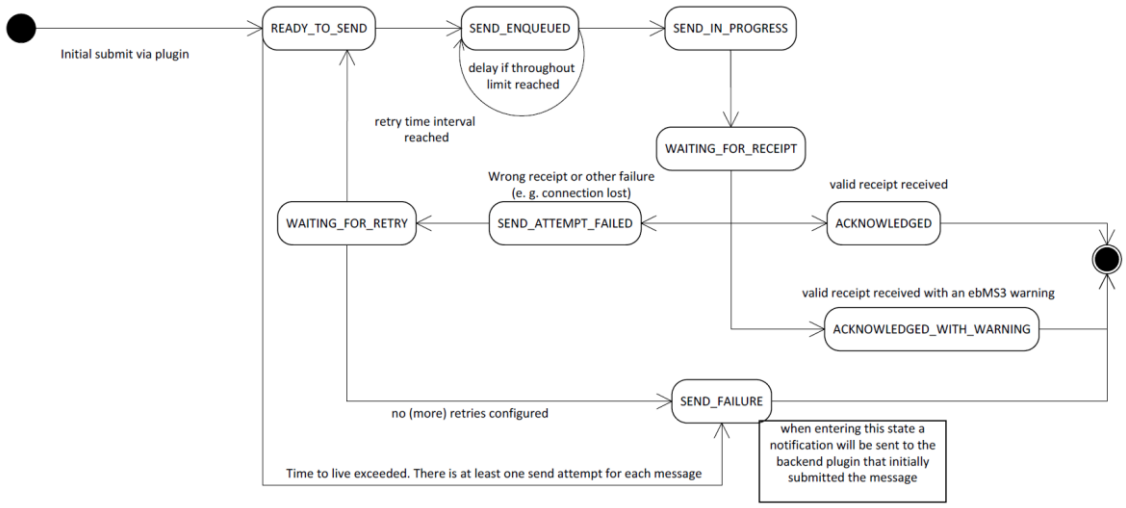
The TB_ERROR_LOG table contains information of the errors occurred during message transmission. The stored values are the following:

ERROR_CODE, ERROR_DETAIL, ERROR_SIGNAL_MESSAGE_ID, MESSAGE_IN_ERROR_ID, MSH_ROLE, NOTIFIED, TIME_STAMP

9.2. State Machines

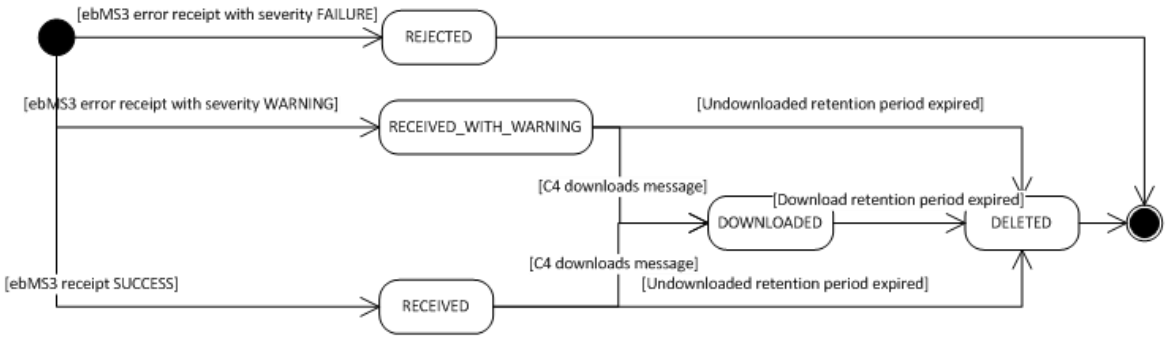
9.2.1. Outgoing Message State Machine

The outgoing messages have the following state machine:



9.2.2. Incoming Message State Machine

The incoming messages have the following state machine:



10. SIZE AND PERFORMANCE

10.1. Size

Size restrictions applied on the data that is exchanged by the back office systems, but not on the application or its components themselves, have an impact on the architecture and on the configuration of the system.

To support the exchange of large binary files, the plugin API supports payload submission by reference, meaning that Domibus is able to download a payload from a given URI. Additionally payloads can be stored on the file system instead of the database to avoid the processing of huge blobs.

As the eDelivery AS4 profile provides no provisions for ebMS large file handling (split/join) the transfer of data is limited by bandwidth and memory constraints.

Extra restrictions can be implemented via the business process PModes. These restrictions concern the maximum size of a payload and the maximum number of payloads in a message.

10.2. Performance

An important architectural decision that benefits the performance of Domibus includes the decoupling of the solution into corner 1/4 representing the back office systems and corner 2/3 representing the Domibus Access Point.

The back office systems (corner1/4) interact with the Domibus MSH (corner 2/3) via the interfaces (web services, JMS, REST, etc) exposed by the plugins deployed on the Domibus MSH side.

Domibus MSH is using internally JMS queues to perform the processing of the messages coming from the back office systems via the plugins or from other access points.

All this architectural decisions lead to an improved throughput and load distribution of the messages.

11. QUALITY

The architecture of Domibus contributes to improve extensibility, reliability and portability.

11.1. Extensibility

Domibus is designed in a layered fashion and consists of multiple interconnected modules. This modular design facilitates the upgrades by replacing existing modules and extensions by adding additional modules.

11.2. Reliability

The reliability of Domibus is enhanced through the decoupling of each architectural layer by JMS queues. A store and forward mechanism and automatic retry policy ensures that parts of the system can continue functioning without losing data when an issue occurs in a specific component.

11.3. Portability

Currently the application can be deployed on Tomcat 8, WebLogic 12.1.x and WildFly 9.0.2 and can connect to Oracle and MySQL databases.

With minor changes, it might be deployed on any Java Servlet 3.0-compliant server and it might connect to any RDBMS (Relational Database Management System).

Besides being extensible, Domibus is carefully designed in such a way that it is independent of the specific external system that communicates with. The use of a generic plugin API leaves the different layers unaffected when an additional external systems need to be supported by Domibus.

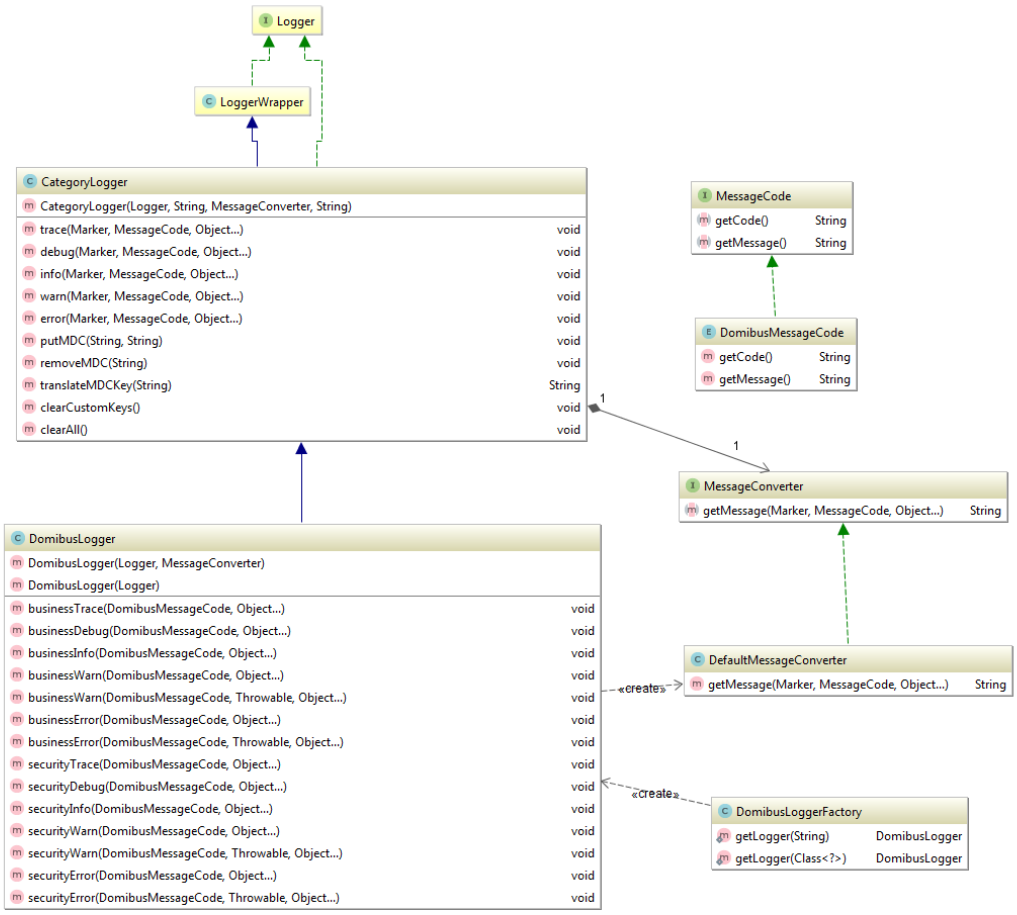
The usage of JPA to access the database makes it easy for implementers to change the relational database used to store the platform data.

12. LOGGING

12.1. Implementation

The logging framework used by Domibus is SLF4J API together with Logback as the SLF4j implementation.

The *domibus-logging* module provides the custom SLF4J logger *DomibusLogger*. This logger must be used for all the logs within the Domibus application.



There are three types of logs: security logs, business logs and miscellaneous logs. Each log category has its own marker defined in the DomibusLogger class. By default, each category will be logged in a separate file:

- domibus-security.log : This log file contains all the security related information. For example, you can find information about the clients who connect to the application.
- domibus-business.log: This log file contains all the business related information. For example, when a message is sent or received, etc.
- domibus.log : This log file contains both the security and business logs plus miscellaneous logs like debug information, logs from one of the framework used by the application, etc.

The security and business logs require a code that is defined in the *DomibusMessageCode* class.

The logs pattern is defined in the *logback.xml* file. The default pattern is:

```
%d{ISO8601} [%X{d_user}] [%X{d_messageId}] %5p %c{1}:%L - %m%n
```

- *d_user*: The authenticated user.
- *d_messageId*: The message id currently being sent/received.

The values for the *d_user* and *d_messageId* properties can be set by calling the method *DomibusLogger.putMDC(String key, String value).* The prefix ***d_*** is added automatically by the DomibusLogger in order to easily identity the Domibus specific MDC properties.

Eg:

```
LOGGER.putMDC(DomibusLogger.MDC_USER, authenticationResult.getName());
```

The MDC values need to be always cleaned after the thread execution. Otherwise, the thread might be returned back to the thread pool with previously set MDC values and on the next thread execution, the old MDC values will be used.

In order to easily clear the MDC values after a method execution a custom annotation, *MDCKey*, has been created in order to mark a method that is setting values in the MDC. An AOP aspect is detecting the methods annotated with the *MDCKey* annotation and after the execution of the method it is clearing the MDC values.

Eg:

```
@MDCKey(DomibusLogger.MDC_MESSAGE_ID)
public String submit(final Submission messageData, final String backendName)
```

12.2. Domibus log codes

Category	Event code	Description
SECURITY	SEC-001	Unsecure login is allowed, no authentication will be performed
SECURITY	SEC-002	Basic authentication is used
SECURITY	SEC-003	X509Certificate authentication is used
SECURITY	SEC-004	Blue coat authentication is used
SECURITY	SEC-005	The host [{}] attempted to access [{}]

SECURITY	SEC-006	The host [{}] has been granted access to [{}] with roles [{}]
SECURITY	SEC-007	The host [{}] has been refused access to [{}]
SECURITY	SEC-008	Certificate is not valid at the current date [{}]. Certificate valid from [{}] to [{}]
SECURITY	SEC-009	Certificate is not yet valid at the current date [{}]. Certificate valid from [{}] to [{}]
SECURITY	SEC-010	No security policy (intended for testing alone) is used. Security certificate validations will be bypassed!
SECURITY	SEC-011	User [{}] is trying to access a message having final recipient: [{}]
SECURITY	SEC-012	X509Certificate invalid or not found
SECURITY	SEC-013	The user [{}] is unknown
SECURITY	SEC-014	The user [{}] is not active
SECURITY	SEC-015	The user [{}] is suspended
SECURITY	SEC-016	The user [{}] is trying to login with bad credentials
SECURITY	SEC-017	The user [{}] is locked after trying to login for [{}] wrong attempts.
SECURITY	SEC-018	The certificate with alias [{}] will be revoked on [{}]
SECURITY	SEC-019	The certificate with alias [{}] is revoked since [{}]
BUSINESS	BUS-001	Message successfully received
BUSINESS	BUS-002	Failed to receive message
BUSINESS	BUS-003	Failed to validate message

BUSINESS	BUS-004	Failed to notify backend for incoming message
BUSINESS	BUS-005	Invalid charset [{}] used
BUSINESS	BUS-006	Invalid NonRepudiationInformation: no security header found
BUSINESS	BUS-007	Invalid NonRepudiationInformation: multiple security headers found
BUSINESS	BUS-008	Invalid NonRepudiationInformation: eb:Messaging not signed
BUSINESS	BUS-009	Invalid NonRepudiationInformation: non repudiation information and request message do not match
BUSINESS	BUS-010	There is no content inside the receipt element received by the responding gateway
BUSINESS	BUS-011	Reliability check failed, check your configuration
BUSINESS	BUS-012	Reliability check was successful
BUSINESS	BUS-013	Compression failure: no mime type found for payload with cid [{}]
BUSINESS	BUS-014	Error compressing payload with cid [{}]
BUSINESS	BUS-015	Payload with cid [{}] has been compressed
BUSINESS	BUS-016	Decompression failure: no mime type found for payload with cid [{}]
BUSINESS	BUS-017	Payload with cid [{}] will be decompressed
BUSINESS	BUS-018	Decompression is not performed: leg compressPayloads parameter is false
BUSINESS	BUS-019	Decompression is not performed: partInfo with cid [{}] is in body

BUSINESS	BUS-020	Message action [{}] found for value [{}]
BUSINESS	BUS-021	Message action not found for value [{}]
BUSINESS	BUS-022	Message agreement [{}] found for value [{}]
BUSINESS	BUS-023	Message agreement not found for value [{}]
BUSINESS	BUS-024	Party id [{}] found for value [{}]
BUSINESS	BUS-025	Party id not found for value [{}]
BUSINESS	BUS-026	Party [{}] is not a valid URI [CORE] 5.2.2.3
BUSINESS	BUS-027	Message service [{}] found for value [{}]
BUSINESS	BUS-028	Message service not found for value [{}]
BUSINESS	BUS-029	Message service [{}] is not a valid URI [CORE] 5.2.2.8
BUSINESS	BUS-030	Leg name found [{}] for agreement [{}], senderParty [{}], receiverParty [{}], service [{}] and action [{}]
BUSINESS	BUS-031	Leg name not found found for agreement [{}], senderParty [{}], receiverParty [{}], service [{}] and action [{}]
BUSINESS	BUS-032	Preparing to send message
BUSINESS	BUS-033	Message sent successfully
BUSINESS	BUS-034	Message send failure
BUSINESS	BUS-035	No Attachment found for cid [{}]
BUSINESS	BUS-036	More than one Partinfo referencing the soap body found
BUSINESS	BUS-037	Payload profile validation skipped: payload profile is not

		defined for leg [{}]
BUSINESS	BUS-038	Payload profiling for this exchange does not include a payload with CID [{}]
BUSINESS	BUS-039	Payload profiling for this exchange requires all message parts to declare a MimeType property [{}]
BUSINESS	BUS-040	Payload profiling error, missing payload [{}]
BUSINESS	BUS-041	Payload profile [{}] validated
BUSINESS	BUS-042	Property profile validation skipped: property profile is not defined for leg [{}]
BUSINESS	BUS-043	Property profiling for this exchange does not include a property named [{}]
BUSINESS	BUS-044	Property profile [{}] validated
BUSINESS	BUS-045	Message persisted
BUSINESS	BUS-046	Message receipt generated with nonRepudiation value [{}]
BUSINESS	BUS-047	Message receipt generation failure
BUSINESS	BUS-048	Message status updated to [{}]
BUSINESS	BUS-049	All payloads data for user message [{}] have been cleared
BUSINESS	BUS-050	Security policy [{}] was not found for outgoing message
BUSINESS	BUS-051	Security policy [{}] is used for outgoing message
BUSINESS	BUS-052	Security algorithm [{}] is used for outgoing message
BUSINESS	BUS-053	Security algorithm [{}] is used for incoming message

BUSINESS	BUS-054	Security encryption username [{}] is used for outgoing message
BUSINESS	BUS-055	Security policy [{}] for incoming message was not found
BUSINESS	BUS-056	Security policy [{}] for incoming message is used
BUSINESS	BUS-057	No Role with value [{}] has been found
BUSINESS	BUS-058	Party with name [{}] has not been found
BUSINESS	BUS-059	Message with id [{}] has not been found
BUSINESS	BUS-060	Message with id [{}] has been consumed from the queue [{}]
BUSINESS	BUS-061	Received payload with cid [{}] for message [{}] of size [{}] (in bytes)
BUSINESS	BUS-062	Saved payload with cid [{}] for message [{}] of size [{}] (in bytes) for sending
BUSINESS	BUS-063	Notifying about message status change from [{}] to [{}]

13. CACHING

In order to enhance the performance domibus uses caching in specific areas of the application:

- caching of security policies
- caching of backend filter configuration
- caching of pmodes, when using the “CachingPModeProvider”

This is the default configuration of ehcache defines the following properties:

```
maxBytesLocalHeap = 5m
timeToLiveSeconds = 3600
overflowToDisk= false
```

14. MULTITENANCY

14.1. General

There were multiple options to choose from to support Multitenancy:

1. Selected option: ***One Schema per tenant***: tenant's data is saved in the same database for all tenants but in different schemas. When a new tenant needs to be added a new related DB schema is created in the same database instance. It is easier to add new tenants comparing with the **DB per tenant** approach**,** as the same connection pool can be reused. Switching between tenants is performed centrally by selecting the DB schema related to the tenant. A huge advantage of this approach is that the application code impact is limited compared to the **Discriminator field** approach described below.

2. ***One DB per tenant***: each tenant has its own separate database. This is the highest level of isolation, however it is complex and cumbersome to maintain. Whenever a new tenant has to be added a new database instance needs to be created, a new database connection pool also needs to be created in Domibus which points to the tenant database, etc…

3. **Discriminator field**: All tenants' data is saved on common tables, and each table holds a discriminator field to distinguish data from each tenant. This approach has quite some disadvantages: no physical isolation of data between tenants (a bug in the application might leak between tenants), performance decrease as the data for all the tenants are saved into the same tables (resulting in bigger tables and more complex/heavier queries), significant changes to the application code to take into account that discriminator field.

The solution that has been chosen to implement Multitenancy in Domibus is "One **Schema per tenant"** due its many advantages. Hibernate 5.0, already used in Domibus, comes by default with support for "One **Schema per tenant"** strategy, more info about Multitenancy in Hibernate https://docs.jboss.org/hibernate/orm/5.0/userguide/html_single/chapters/multitenancy/MultiTenancy.html .

In the following document the term *tenant* is (the technical) synonym with the (more business-oriented) term *domain*.

14.1. Identifying the domain (tenant)

For every outgoing/incoming message, the related unique domain needs to be identified in order to use the configuration related to the appropriate domain (DB schema, PMode, keystore, truststore, Domibus properties, etc).

For outgoing messages, sent by C2 to C3, the association to a specific domain is performed based on the Spring Security info available in the current thread after the authentication has been done by the plugins.

For incoming messages, received by C3 from C2, the association to a domain is based on an HTTP parameter ("domain") appended by C2 to the MSH endpoint of C3. In case the domain name sent by C2 is not defined in C3, an EBMS3 exception will be sent to C2.

Example:

Let us suppose that C3 exposes the MSH endpoint with URL: http://localhost:8080/domibus/service/msh. Then C2 belonging to the domain **DIGIT** will call the MSH C3 endpoint using http://localhost:8080/domibus/service/msh**?domain=DIGIT**.

Please note that adding the HTTP parameter in the MSH endpoint is in-line with eDelivery AS4 specification.

14.1.1. Selecting the database schema

In Multitenancy mode, the database schema has to be configured per domain in the Domibus domain properties. More information on how to configure it please refer to the **Domibus Administration Console**.

14.2. User association to a domain

When a user authenticates in the Admin Console, the domain is not yet identified and Domibus must find out which DB schema to select. In order to achieve this, a **general DB schema** is used. In this general DB schema, a table tells which user that has access to the Admin Console (defined in the **tb_user** table) and to the domain he belongs to. This association is automatically updated by Domibus when users are added or removed. Therefore, a constraint has been added in Domibus: a username needs to be unique amongst the existing domains. The same mechanism and constraints applies to the **tb_user** table and has been implemented for the table supporting plugins security: **tb_authentication_entry.**

14.3. UI

14.3.1. Managing multiple domains from the Domibus Administration Console

All the screens **from Domibus Administration Console** have been adapted in order to support Multitenancy. This paragraph briefly summarizes these changes throughout the application.

The **Login page** does not require filling in the domain. Once the user is authenticated, Domibus automatically identifies its associated domain based on the association of the users to their domain contained in the general schema. For more information how this mechanism works please check **14.1 Identifying the domain (tenant)** section.

There is a new **super** admin user for the Administration Console that has access to all domains' data but only one domain at a time. This solution has been chosen in order to simplify the user interface. In addition, the **super** admin user is responsible to manage **admin** users for every domain and is the only one authorized to do so.

14.3.2. Security

The UI is communicating with the Domibus backend via REST resources.

The UI REST resources are protected so that users belonging to domain **A** are forbidden to modify the configuration belonging to any other domain. This is implemented with an interceptor acting on the all the UI REST resources that automatically identify the DB schema associated to the logged in user (please check the **14.1.1 Selecting the database schema** section for more details). Using this strategy, a user belonging to domain **A** is not able to access the data of any other domain.

14.4. Plugins

The introduction of Multitenancy has an impact on how the plugins manage the incoming/outgoing messages.

For outgoing messages, C1 to C2, the plugins need to authenticate first so that Domibus can identify the domain of the user and treat the message accordingly.

Domibus identifies the associated domain of the user based on the Spring Security information from the current thread (for instance the logged in user id) and the users configuration in table **tb_authentication_entry**. As a result, it is mandatory for C1 to authenticate itself so that Domibus is able to determine the domain related to the authenticated user. It is possible for the same C1 to send messages to different domains C1 needs to authenticate with different user credentials

For incoming messages, e.g. from C3 to C4, the plugins have to segregate the messages based on the domain name received from Domibus and deliver to C4 only the messages associated to the C4's domain.

The changes implemented in the Default Plugin for Multitenancy are described in the following sections.

14.4.1. Security

The plugins security configuration is stored in databse table **tb_authentication_entry**. As every domain has its own separate schema, the table **tb_authentication_entry** will contain entries specific to each domain.

ID_PK	CERTIFICATE_ID	USERNAME	PASSWD	AUTH_ROLES	ORIGINAL_USER	BACKEND
1	NULL	admin	$2a$10$HApapHvDStTEwjjneMCvxuqUKVyycX…	ROLE_ADMIN	NULL	NULL
2	NULL	user	$2a$10$HApapHvDStTEwjjneMCvxuqUKVyycX…	ROLE_USER	urn:oasis:names:tc:ebcore:partyid-type:unregist…	NULL
3	CN=blue_gw,O=eDelivery,C=BE:103700358308…	NULL	NULL	ROLE_ADMIN	NULL	NULL

Example of the data in tb_authentication_entry

As mentioned in section **14.1 Identifying the domain (tenant)** the **username** should be unique amongst all domains. Moreover, there is a table **tb_user_domain** in the general DB schema that maps all usernames defined in the **tb_authentication_entry** to one associated domain.

When multiple domains are configured in Domibus, the plugins security activates automatically overriding the value configured using the following property.

```
#To activate security set this to false

domibus.auth.unsecureLoginAllowed=false
```

If Domibus is running only with one domain, the plugins security activation is optional.

14.4.2. Plugin API

As every domain has its own dedicate DB schema, there are little changes required in the **Plugin API**. The only change that is required is to include in the class **eu.domibus.plugin.Submission** a new field named **domain.** This way the plugins can select the domain for a specific message. This is specifically useful for the incoming messages, C3 to C4, when the plugins need to segregate messages and expose to C4 only messages that are intended to C4 domain.

14.4.3. WS Plugin

Security is already implemented in the WS Plugin using the **CustomAuthenticationInterceptor** and the **eu.domibus.ext.services.AuthenticationService**, which retrieves information from the DB table **tb_authentication_entry**. For the WS Plugin security, activation is mandatory in order to use Domibus with multiple domains.

The implementation of the WS Plugin has been changed to take into account the domain according with the general requirements stated in the **14.4 Plugins** section.

14.4.4. JMS Plugin

The JMS Plugin is implemented using 5 queues:

- One queue for outgoing messages, C1 to C2: **domibus.backend.jms.inQueue**
- One queue for incoming messages, C3 to C4: **domibus.backend.jms.outQueue**
- Three queues for reporting message statuses and errors: **domibus.backend.jms.replyQueue, domibus.backend.jms.errorNotifyConsumer, domibus.backend.jms.errorNotifyProducer**

C1 and C4 interact with the JMS Plugin by sending/receiving messages from queues mentioned above so the JMS Plugin does not really have control on the messages once they are put in a JMS queue.

In order to segregate the data between domains, the JMS Plugin needs to connect to queues dedicated to each domain. Therefore, every domain will have its own set of 4 queues mentioned above with the exception of the **domibus.backend.jms.inQueue.** The queue **domibus.backend.jms.inQueue** is common to all the domains but when sending message to Domibus, C1 needs to authenticate with specific domain credentials. This is needed to allow Domibus to associate the submitted message with a specific domain. The association of the JMS queues and the domain are be done in the **jms-plugin.properties** file .

In order to make the migration easier the existing queue names used by the JMS plugin and associated to the **default** domain will not be modified.

The following convention to prefix the JMS queues with the domain name must be used to associate the JMS queues to a specific domain in the **jms-plugin.properties** file:

***domain_name.*domibus.backend.jms.inQueue**

where ***domain_name*** is the name of the domain.

For outgoing messages, C1 to C2, C1 sends JMS messages containing the credentials of a specific domain to the **IN** queue **domibus.backend.jms.inQueue.** The JMS Plugin reads the JMS message, performs the authentication using the credentials sent by C1 and determines the domain based on Spring Security information from the current thread.

For incoming messages, C3 to C4, the JMS Plugin receives the domain name from Domibus'API and then sends the incoming message to the JMS **OUT** queue associated to the domain where C4 is listening to.

14.4.5. FS Plugin

The FS Plugin has been designed in such a way that it is already domain aware. Briefly, the domain concept is implemented in the FS Plugin as follows:

- A file system location is defined per domain, which is protected with username/password. The username/password credentials are defined per domain in the FS Plugin property file
- In order to send messages, a user α belonging to domain A will copy the payloads to be "sent" directory in the file system location configured for domain A (the user α must have access to the protected file location). A similar process is happening when user A wants to retrieve messages.

For outgoing messages (C1 to C2), the FS Plugin authenticates itself using credentials (username/password) configured per FS Plugin domain. These new credentials are configured in the FS Plugin properties file. Once the user is authenticated, user information is extracted from the Spring Security data, associated to the current thread and passed to the Domibus Core.

For incoming messages (C3 to C4), the FS Plugin receives the domain name from Domibus so that the incoming messages are into the directory associated to the respective domain.

The domains configured in Domibus and the domains configured in the FS Plugin properties must match. An error will be raised if the domain is not configured as needed in the FS Plugin properties.

14.5. Domibus Properties

The Domibus properties defined in the **domibus.properties** file are used for the **default** domain, when Domibus manages one single domain.

When Domibus is configured with multiple domains, several properties will have to be customized per domain. More information on which properties can be overridden per domain are available in the **Domibus Administration Guide**. In order to customize a property the following convention is used:

DEFAULT domain property name	DOMAIN1 domain property name

domibus.security.keystore.location	**DOMAIN1**.domibus.security.keystore.location

14.6. Logging

In order to associate each log statement to a specific domain the **Logback** format pattern contains the domain name.

Eg: <pattern>%d{ISO8601} [%X{d_user}] **[%X{d_domain}]** [%X{d_messageId}] %5p %c{1}:%L - %m%n</pattern>

The domain name is added in the MDC context so that every log statement contains the domain name.

The domain name is added in the MDC context as soon as a thread is started:

- For a web service, a CXF interceptor is adding the domain to MDC as close as possible to the START phase. The MDC context value is cleared with a CXF interceptor added at before the END phase.
- For a JMS message listener, the domain name is extracted from the JMS message that is being consumed and added programmatically to MDC.

The separation of logs per domain is achieved using the existing **Logback** marker mechanism and a **Logback** configuration file distributed in each server configuration archive. As a result, separate log files are created containing only the logs for one domain. For instance for a domain named **DOMAIN1** the following log files are saved under the **logs/DOMAIN1** directory: **DOMAIN1-domibus.log, DOMAIN1-business.log, DOMAIN1-security.log** provided that the **DOMAIN1-logback.xml** is configured**.**

This configuration is managed in the Domibus **logback.xml** file and it is independent of the Domibus application.

For more detail on how to configure the Domibus logging can be found in the **Domibus Administration Guide.**

14.7. Message Payloads

Domibus supports two strategies for saving the messages payloads: in the database or in a local directory on the file disk. Each domain can customize the strategy for saving the payloads via the **domibus.properties** file.

In case a domain chooses to save the payloads in the database, the payloads segregation is ensured as only the users registered in that domain have access to the domain specific schema.

In case a domain chooses to save the payloads in a local filesystem directory configured per domain, the payloads segregation needs to be ensured via OS access rights. It is recommended that each domain configures its own dedicated filesystem directory.

14.8. Quartz

In the current version of Domibus, each domain can customize the Quartz jobs (like the retry job expression defined with the property **domibus.msh.retry.cron**). The Quartz jobs are saved in the database schemas of each domain. A **Quartz Scheduler** can only be configured to work with one DB schema at a time. In order to support Multitenancy, a **Quartz Scheduler** instance is created for each domain with specific properties for that domain. The creation of a Quartz Scheduler per domain is performed at runtime during the Domibus starts up.

15. UI REPLICATION MECHANISM

There have been situations when due to a large volume of data in the database message tables (from 100k to even 5M messages) the search in the Domibus GUI messages page takes longer than few seconds – up to 30 seconds.

The UI Replication mechanism consists in using a dedicated flat table (optimized with indexes for search) which is asynchronously populated when native message tables are populated. If the mechanism is enabled the search screen will use this table which should perform faster on large amount of data.

Below will follow description for main components:

15.1. TB_MESSAGE_UI table and V_MESSAGE_UI_DIFF view

15.1.1. TB_MESSAGE_UI

TB_MESSAGE_UI table is the main table which is asynchronously populated when UI replication is enabled. It has the following structure:

Column name	Data type (Oracle)
ID_PK	NUMBER(38,0)
MESSAGE_ID	VARCHAR2(255 BYTE)
MESSAGE_STATUS	VARCHAR2(255 BYTE)
NOTIFICATION_STATUS	VARCHAR2(255 BYTE)
MSH_ROLE	VARCHAR2(255 BYTE)
MESSAGE_TYPE	VARCHAR2(255 BYTE)
DELETED	TIMESTAMP(6)
RECEIVED	TIMESTAMP(6)
SEND_ATTEMPTS	NUMBER(38,0)
SEND_ATTEMPTS_MAX	NUMBER(38,0)
NEXT_ATTEMPT	TIMESTAMP(6)
CONVERSATION_ID	VARCHAR2(255 BYTE)
FROM_ID	VARCHAR2(255 BYTE)
TO_ID	VARCHAR2(255 BYTE)
FROM_SCHEME	VARCHAR2(255 BYTE)
TO_SCHEME	VARCHAR2(255

	BYTE)
REF_TO_MESSAGE_ID	VARCHAR2(255 BYTE)
FAILED	TIMESTAMP(6)
RESTORED	TIMESTAMP(6)
MESSAGE_SUBTYPE	VARCHAR2(255 BYTE)
LAST_MODIFIED	TIMESTAMP(6)
LAST_MODIFIED2	TIMESTAMP(6)

Where ID_PK is the generated sequence, LAST_MODIFIED and LAST_MODIFIED2 are columns dedicated for the mechanism of replication. All the other columns (from MESSAGE_ID to MESSAGE_SUBTYPE) are used for search on message page and populated with data from native tables.

15.1.2. V_MESSAGE_UI_DIFF

V_MESSAGE_UI_DIFF is a control view. His purpose is to show in real time how many records from native tables are not in sync with TB_MESSAGE_UI – as this number is always 0 everything is in sync. Also this view is used for UIReplicationJob to update the TB_MESSAGE_U records not in sync.

Column name	Data type (Oracle)
MESSAGE_ID	VARCHAR2(255)
MESSAGE_STATUS	VARCHAR2(255)
NOTIFICATION_STATUS	VARCHAR2(255)
MSH_ROLE	VARCHAR2(255)
MESSAGE_TYPE	VARCHAR2(255)
DELETED	TIMESTAMP(6)
RECEIVED	TIMESTAMP(6)
SEND_ATTEMPTS	NUMBER
SEND_ATTEMPTS_MAX	NUMBER
NEXT_ATTEMPT	TIMESTAMP(6)
CONVERSATION_ID	VARCHAR2(255)
FROM_ID	VARCHAR2(255)
TO_ID	VARCHAR2(255)
FROM_SCHEME	VARCHAR2(255)
TO_SCHEME	VARCHAR2(255)
REF_TO_MESSAGE_ID	VARCHAR2(255)
FAILED	TIMESTAMP(6)
RESTORED	TIMESTAMP(6)
MESSAGE_SUBTYPE	VARCHAR2(255)

15.1.3. Native tables

These tables are the source for populating TB_MESSAGE_UI and for the V_MESSAGE_UI_DIFF view:

TB_MESSAGE_LOG

TB_MESSAGE_INFO

TB_USER_MESSAGE

TB_PROPERTY

TB_PARTY_ID

TB_MESSAGING

TB_SIGNAL_MESSAGE

15.2. UIReplication queue, JMS message producer and consumer

There is a UIReplication JMS queue which is defined as internal queue

```
#Domibus internal queue used for UI replication
domibus.jms.queue.ui.replication=domibus.internal.ui.replication.queue
```

The name of the queue could be overwritten as is defined in domibus-default.properties file

There is a producer defined for this JMS queue which will produce messages in the following situations:

- creation of a User or Signal message

- update of status, notification status and other fields of a User or Signal message

For this we create several types of JMS messages:

```
USER_MESSAGE_RECEIVED,
USER_MESSAGE_SUBMITTED,
MESSAGE_STATUS_CHANGE,
MESSAGE_NOTIFICATION_STATUS_CHANGE,
MESSAGE_CHANGE,

SIGNAL_MESSAGE_SUBMITTED,
SIGNAL_MESSAGE_RECEIVED
```

The consumer on the other hand is multi-thread (in order to speed up the replication process) and is able to insert or update a row into TB_MESSAGE_UI based on the type of JMS messages above. Also a type of Optimistic Lock mechanism based on LAST_MODIFIED (status) and LAST_MODIFIED2 (notification status) is in place which assures that only latest relevant information is updated or inserted.

The level of the multi-threading of the consumer is defined by this property form domibus-default.properties files:

```
#concurrency (no of threads) for dispatching messages of ui replication queue
domibus.ui.replication.queue.concurency=3-10
```

15.3. UIReplication Quartz Job

The purpose of the job is to check regularly (once per day) any unsynchronized data between native tables and TB_MESSAGE_UI.

The frequency to run is defined in the following domibus-default.properties key:

```
#Cron job that will check unsynchronized data between native tables and
TB_UI_MESSAGE_UI
domibus.ui.replication.sync.cron=0 0 2 * * ?
```

And it could be overridden in the domibus.properties if the user wants a different moment of time.

If there are more rows to be synchronized than the following property:

```
#max number of records that will be processed by cron job
domibus.ui.replication.sync.cron.max.rows=10000
```

Then the job will stop and issue a warning to use the REST method.

15.4. UIReplication REST methods

The purpose of the REST service is to offer a manual synchronization between the native tables and TB_MESSAGE_UI.

There are two methods:

GET /rest/uireplication/count – it will just count the differences

GET /rest/uireplication/sync?limit=x – this will sync the first x unsynchronized rows where x has a default value of 10.000

15.5. Migration script

Migration script is intended to be run for both Oracle and MySQL database and is included in the oracle/mysql-3.3.4.-to-4.0-migration.ddl which is provided within distribution packages.

It performs an INSERT into TB_MESSAGE_UI and it should be run with the table having no records:

```
-- Changeset src/main/resources/db/changelog-4.0-delta-migration.xml::EDELIVERY-
3361::CatalinEnache
INSERT /*+ append*/ INTO tb_message_ui (
            id_pk,
            message_id,
            message_status,
            notification_status,
            msh_role,
            message_type,
            deleted,
            received,
            send_attempts,
            send_attempts_max,
            next_attempt,
            conversation_id,
            from_id,
            to_id,
            from_scheme,
            to_scheme,
            ref_to_message_id,
            failed,
            restored,
            message_subtype
            )
            SELECT
...
```

15.6. Enabling/disabling the UIReplication mechanism

There is a property defined into domibus-default.properties:

```
#enabled or disabled the UI Replication mechanism
domibus.ui.replication.enabled=false
```

The value set to false will disable:

- JMS consumer and producer

- UIReplication Job to run

- UIReplication REST methods – just to show a message and not to execute the sync

More information about configuring UIReplication mechanism could be found in the Admin Guide for Domibus.

16. CONTACT INFORMATION

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Support Service: 8am to 6pm (Normal EC working Days)