



RFC 221 Transaction Control

Draft

51 Pages

Abstract

10 point Arial Centered.

The OSGi Alliance Enterprise Expert Group has developed adaptations of the JDBC, JTA, and JPA Java EE specifications. These resulted in a disparate set of services, that is they provide factory services (DataSourceFactory and EntityManagerFactoryBuilder) and a JTA Transaction service. However, the native OSGi model is to be able to use configured instance services so they can directly be injected through DS and used together. This RFC proposes a client transaction management specification that fully leverages the OSGi service model and Java 8, whilst also making it easy to use resources as part of the transaction.

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0.3 Feedback

This document can be downloaded from the OSGi Alliance design repository at <https://github.com/osgi/design> The public can provide feedback about this document by opening a bug at <https://www.osgi.org/bugzilla/>.

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0.5 Terminology and Document Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY" and "OPTIONAL" in this document are to be interpreted as described in 1.

Source code is shown in this typeface.

0.6 Revision History

The last named individual in this history is currently responsible for this document.

| Revision | Date | Comments |
|----------|-------------|-----------------|
| Initial | Feb 09 2016 | Initial version |

1 Introduction

The EEG has developed adaptations of the JDBC and JPA Java specifications. These resulted in a non-managed model, that is they provided factory services (Data Source Factory and Entity Manager Factory Builder) and a JTA Transaction service, but no easy way to combine these services into a transactional programming model.

This is at odds with the typical OSGi model where configured instances of services can directly be injected through DS and used together in a simple way. This RFC proposes a client API for transaction management that leverages the OSGi service model and Java 8. This API will make it simple for client applications to use transactions with JDBC, JPA or other technologies, without the need for adapters or additional boilerplate.

This RFC originates from OSGi enRoute work, and from RFP-170. In the enRoute project a number of services were identified, designed and implemented based on their needs for web based applications. These use cases help to define the problem that need to be solved.

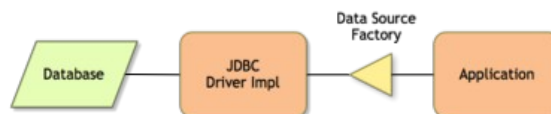
2 Application Domain

Persistence is one of the most important aspects of modern applications. The current mainstream standard for Java is the Java Persistence Architecture (JPA), an Object Relational Mapping (ORM) framework that allows developers to work with objects and builds the corresponding SQL to persist those objects in a relational database.

JPA collaborates with the Java DataBase Connectivity (JDBC) and the Java Transaction Architecture (JTA) specifications. In the first OSGi Enterprise Release these Java EE specifications were adapted to OSGi to make them service based. Together these are called the OSGi *persistence services*. The OSGi persistence services are very much *factory* oriented instead of *instance* based. Instance based services are ready to use, they are usually configured by Configuration Admin, and have their dependencies resolved.

2.1.1 Data Source Factory

The JDBC Data Source Factory specification describes how a *database driver* can register a Data Source Factory service.



The Data Source Factory Service provides a number of methods to create a *Data Source*. A Data Source configures the underlying database and then provides a way to get the database *connections*. Since connections are expensive objects, implementations of a Data Source are often required to *pool* these connections. Pooling

reuses connections for other requests after they are closed. Many libraries have been developed to optimize this pooling; these libraries often act as an intermediate between the actual Data Source or Driver and the application. They often use dynamically generated proxies since the JDBC API has gone through several non-backward compatible changes. This is so common that the API supports methods to unwrap these proxies.

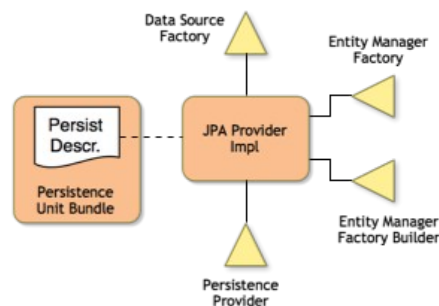
There is also an XA Data Source, which provides access to the XA 'resource' protocol. The XA protocol is used by databases and other transaction aware resources to participate in transactions.

Since the underlying connections can be pooled, it is crucial that operations are properly *scoped*. That is, any obtained connections must be closed to allow them to be returned to the pool. Connection Pooling is typically achieved using a library which “wraps” the DataSource. BoneCP, Apache DBCP and C3P0 are examples of libraries which offer this functionality.

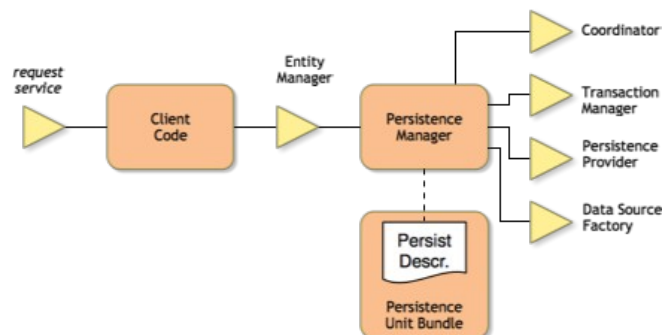
In the OSGi enRoute project the Data Source Factory model was extended with a component with a well known PID and set of configuration properties to automatically register Data Source services.

2.2 JPA

The JPA specification defines how a JPA *provider* can discover a *persistence descriptor* in a bundle. After this discovery, the provider registers an Entity Manager Factory when the persistence descriptor has sufficient information and can be associated with a Data Source Factory. It also registers a Entity Manager Factory Builder that can be used by the application to provide additional properties for configuration and that can create an Entity Manager Factory. Applications that created an Entity Manager from this factory whenever they had to execute a request. Entity Managers are not thread safe.

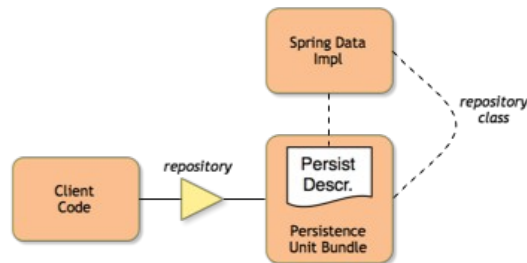


In OSGi enRoute, a component was defined with a well known PID and properties schema that registered an Entity Manager if an appropriate Data Source was available. This required the Entity Manager to proxy an actual Entity Manager since now the life cycle could be managed per thread. All requests would start a Transaction for the request thread. This allowed the Entity Manager proxy to detect the first request and it would then join the Transaction Synchronization Registry. At the end of the transaction, the resources used by the Entity Manager like pooled connections could then be cleaned up automatically. A similar model is used in Apache Aries



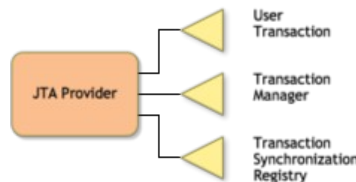
2.3 Spring Data

Christian Baranowski [4]. was inspired by OSGi enRoute and Spring Data. Spring Data provides a model where the methods on an interface are used to specify the query. That is, `findBlogByTitle("hello")` would translate to a request to the database to retrieve the blogs that match the title "hello". He provides an implementation that gets the class name for the repository, which must extend a provided base class, and then registers the repository service for that persistent unit.



2.4 Transactions

The OSGi JTA specification only provides access to the different Transaction objects via services. It does not provide any other features than that are available from the existing JTA specification.



2.4.1 Client-side Transaction management

A Transaction is started by a client by beginning a transaction. It then executes the request code inside a block. If the requests is successful, the transaction is committed, otherwise it is rolled back. In general the catch block and finally block are used to ensure proper termination of the transaction. For example:

```

Transaction transaction = tm.getTransaction();

try {

    ... do work

    transaction.commit();

} catch( Throwable t) {

    transaction.rollback();

    throw t;

}

```

In general, applications must minimize any code inside a transaction since transactions lock database tables. In applications build from different parts, this creates the Transaction Composability problem, see [3]. When a method gets called it can be called inside a transaction or outside a transaction. However, it can require that no transaction is active, that a transaction should be active, or that it requires a new transaction. Handling this inline increases the boiler plate code significantly. For this reason, Spring provides transaction annotations.

```
@Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)

public void doWork() {...}
```

These annotations require a proxy that sets up a transaction before the method is executed. This implies that the method cannot call methods on the `this` object since this bypasses the proxy.

In containers like Java EE the transaction manager is often not directly used. The container provides an Entity Manager that is already associated with a transaction manager. Since the container knows when a request is finished, it can perform any required cleanup. This called *managed transactions*.

2.4.2 Infrastructure integration with Transactions

For work to be included in a transaction It is necessary, but not sufficient, for a client to run code within a transaction. The other critical point is that any resource access that occurs within the transaction must be registered with the transaction manager. Typically this work is not performed by the client, but by a middleware component. In a Java EE application server this role is usually performed a JCA Resource Adapter.

The integration point is responsible for registering the connection with the transaction. If a two-phase commit (XA) transaction is needed then the XAResource associated with the XAConnection must be registered with the Transaction. This enables the Transaction manager to log the details of the resource (to enable recovery) and to prepare/commit/rollback any work. If no XA transaction is required then the resource adapter must register a synchronization with the transaction. This synchronization is responsible for rolling back or committing the work performed with that connection.

2.5 Versions and Migration

Code has an actual dependency on the layout of the database but this tight version dependency is rarely managed. New bundles often require a *migration* of the database but do not have standard support. New columns and tables must be added and sometimes data must be converted. This is often a manual error prone operation. An interesting development is Liquibase [6]. and Flyaway [7]. These projects allow refactoring of databases.

Terminology + Abbreviations

3 Problem Description

The Java EE persistence model with its statics and factories is not natural for OSGi and therefore offers a number of challenges to use. Additionally, the primary providers of JPA Hibernate, OpenJPA, and EclipseLink have varying levels of OSGi adoption/tolerance, which makes it hard to find a complete solution. The Apache Aries project

provides most parts but the Gemini project has all but died. However, even with a full set of implementations the model is non-trivial to use since it still requires the client code to handle a lot of configuration details.

Overall, JPA persistence has its problems in Java EE due to portability problems but in OSGi using JPA is really hard and clearly does not provide the plug and play as well as the collaborative component model that OSGi promotes. The current specifications are not very well matched to the OSGi service model that is configured instance based and not factory based (let alone statics).

Additionally, there are a number of promising developments on the horizon.

- Java 8 lambdas will make it easier to use transactions in a way that is as easy as annotations without the corresponding drawbacks
- The Spring Data JPA Repository looks very interesting for simple database models. Though large enterprise applications might have no use for this, it would lower the threshold for OSGi if it was easier to get started with small models. Obviously there should be a migration path to go to the Entity Manager and Data Source.
- Migration of databases and dependency management on the installed db version is becoming increasingly important. Obviously, the OSGi require-capability and extender model make excellent mechanisms to provide this kind of support.

This RFC therefore seeks a comprehensive service based model for transaction management persistence in OSGi leveraging Java 8 features.

4 Requirements

4.1 General

- G0010– The service solutions must be able to work with JDBC 4 and JPA 2.1
- G0020 – Provide a simplified way to handle the transaction composition that does not require boiler plate code nor suffers from the problem that methods on the 'this' pointer are different..
- G0030 – The solution must not require that configured Data Access resources are publicly available. This prevents other bundles having access to database credentials.

4.2 Data Source Service

- D0010 – Provide a configuration model for a Data Source service
- D0014 – Must be able to transparently register connections with an ongoing transaction.
- D0017 – Must be able to support both two-phase (XA) resources, and non XA resources

- D0020 – Must be able to transparently handle connection pooling of “plain” DataSources
- D0030 – Must support all OSGi JDBC Factory defined possibilities and properties
-

4.3 Entity Manager Service

- E0010 – Provide a configuration model for an Entity Manager service
- E0020 – Must be able to use the Data Source service from 4.2
- E0030 – Must be able to have managed transactions. That is, the client uses an injected Entity Manager.
-
- E0050 – Must provide access to the underlying Data Source

4.4 Database Versioning

- V0010 – Provide a require-capability model for handling the version of the database
- V0020 – Provide a model so that bundles can be used to migrate and rollback a database.

5 Technical Solution

OSGi components and services are designed to be modular, lightweight and easily deployable across a variety of environments. Whilst this model has many benefits, it means that transaction management is difficult when compared to centralised container solutions. This solution therefore needs to offer a simple, way to manage transactions in OSGi components.

5.1 Client Transaction Management

In Java EE and Spring application containers transactions are typically managed declaratively via annotations.

```
@Transactional(readonly = false, propagation = Propagation.REQUIRES_NEW)

public void doWork() {...}
```

The problem with this model is that it requires a third-party to proxy the doWork() method, adding the necessary transaction management semantics. Furthermore, the doWork() method must be public and if the doWork() method is called from within the object, or called without using the proxy (for example in Test code), then no transaction management will occur.

Due to the limitations of proxy-based approaches, the undesirability of universal proxying in an OSGi container, and the lambda expression support added in Java 8, this RFC proposes a programmatic transaction management model using callback functions. These callback functions are known as “work”.

Another issue with transaction management is that both the Java EE and Spring transaction models have a poorly defined behaviour when no transaction is active. This RFC therefore proposes the following three states:

- **Unscoped:** if code execution is unscoped then it means that the TransactionControl service has no context associated with it (i.e. it is not being run as a piece of work). No callbacks, data storage, or transaction management are available to unscoped executions
- **No Transaction Scope:** if a piece of work has “No Transaction” scope then the Transaction Control service has not created a transaction, but has created a coordination to represent the scope of the piece of work. The coordination will complete when the piece of work has completed. Clients may use scoped variables and register for a final callback at the end of the piece of work, but they may not register resources to participate in a transaction.
- **Active Transaction Scope:** if a transaction is active this means that the TransactionControl service has created a transaction *and* a coordination around a piece of work. Resources used during the transaction will be committed or rolled back based on the outcome of the piece of work.

5.1.1 Beginning a transaction

Client management of transactions occurs through the TransactionControl service. This service allows for simple management of transaction lifecycles using four methods:

| Method | Behaviour |
|------------------------|---|
| required(Callable) | Begins a new Active Transaction scope around the piece of work if there is no Active Transaction, otherwise the existing transaction scope continues. |
| requiresNew(Callable) | Begins a new Active Transaction scope around the piece of work, Suspending the the existing transaction if it exists. Afterwards the suspended transaction is resumed |
| supports(Callable) | Continues an Active Transaction or No Transaction scope if it exists, otherwise a new No Transaction scope is begun around the piece of work |
| notSupported(Callable) | Continues an existing No Transaction scope if it exists, otherwise a new No Transaction scope is begun around the piece of work, suspending an ongoing Active Transaction if necessary. Afterwards the suspended transaction is resumed |

A client can therefore begin a transaction as follows:

```
txControl.required(() -> {

    // Do some work in here

    return result;

});
```

5.1.2 Querying the current Transaction Context

The TransactionControl Service provides methods that can be used to query the current transaction context.

| Method | Behaviour |
|----------------------------------|--|
| <code>activeTransaction()</code> | Returns true if there is an Active Transaction Scope |
| <code>activeScope()</code> | Returns true if there is an Active Transaction or a No Transaction scope |
| <code>getCurrentContext()</code> | Gets the current transaction context, or null if none exists |

These methods can be used to verify that particular a particular transaction scope is active, or to interact with the transaction lifecycle.

5.1.3 Controlling Transaction Rollback

By default a transaction will commit automatically when the piece of work completes normally. If this is not desired (for example the work's business logic determines that the transaction should not complete) then the work may trigger a rollback in one of two ways:

1. Throw an exception from the piece of work. By default all exceptions will cause the transaction to be rolled back.
2. Call `setRollbackOnly()` on the Transaction Control object. This will mark the transaction for rollback so that it will never commit, even if the method completes normally. This is a one-way operation, and the rollback state can be queried using `getRollbackOnly()`.

5.1.3.1 Avoiding Rollback

Sometimes it is preferable for a piece of work to throw an exception, but for that exception not to trigger a rollback of the transaction. For example some business exceptions may be considered “normal”, or it may be the case that the work performed so far must be persisted for audit reasons.

There are two ways to prevent a transaction from rolling back when a particular exception occurs:

1. The TransactionControl service provides a TransactionBuilder. This builder can be used to define sets of Exception types that should, or should not, trigger rollback. The most specific match will be used to determine whether the transaction should roll back or not.
2. The Transaction Control service provides an `ignoreException()` method. This can be used from within an Active Transaction to declare a specific Exception object that should not trigger rollback.

5.2 Resource Providers

Whilst it is important that clients can easily control the transaction boundaries within their application it is equally important that the resources that the clients use participate in these transactions. In a Java EE Application server this is achieved by having the central application container create and manage all of the resources. In the Spring framework the Application context is responsible for ensuring that the resources are linked to a Transaction Manager.

In existing OSGi solutions this is the weakest part of the transactional persistence story. Typically libraries provide some level of transaction enlistment by shadowing partially configured services, and the way in which the resources are linked to the active transaction is poorly defined.

This RFC defines the concept of a Resource Provider as a generic way to ensure that a particular resource will be enlisted with the correct transaction context.

5.2.1 Generic Resource Providers

The purpose of a ResourceProvider is to provide the client with a configured resource which will automatically integrate with the correct transaction context at runtime.

```
public <T> T getResource(TransactionControl txControl);
```

The returned resource is a proxy to an underlying resource factory. When the resource is accessed then the proxy will check the current transaction scope. If this is the first time the resource has been accessed in this scope then the factory returns a new copy of the resource. If the scope is an Active Transaction then the resource must also be enlisted into the transaction at this point. Subsequent resource access within the same scope must use the same backing resource.

5.2.1.1 Resource Lifecycle

When a scope finishes any resources associated with the scope must be cleaned up without action required by the client. This rule applies to both the Active Transaction scope and the No Transaction scope, meaning that a client can safely write code using TransactionControl#supports(Callable) without being concerned about resource leaks.

5.2.1.2 Unscoped Resource Access

If a resource is accessed by unscoped code then it may throw a TransactionException to indicate that it cannot be used.

5.2.1.3 Closing Resources

If a client attempts to close a scoped resource then this operation should be silently ignored. The resource will be automatically cleaned up when the current scope completes. If the resource were prematurely closed then it may prevent other services from accessing the resource within this scope. Also in an Active Transaction the resource cannot be committed or rolled back until the commit operation occurs.

5.2.2 JDBC

One of the most common resources to use in a transaction is a JDBC Connection. This RFC defines a specialised resource provider for obtaining JDBC Connections called a JDBCConnectionProvider. The purpose of this type is simply to reify the generic type of the ResourceProvider.

5.2.2.1 JDBC Active Transaction behaviours

When enlisted in an Active Transaction a JDBC connection will have autocommit set to false. Also the following methods must not be called by the client and will trigger a TransactionException.

- commit()
- rollback() and rollback(Savepoint)
- setAutoCommit()
- setSavepoint(), setSavepoint(String) and releaseSavepoint()

If the Active Transaction commits the JDBC Connection must commit any work performed in the transaction. Similarly if the Active Transaction rolls back then the JDBC Connection must roll back any work performed in the transaction. After the transaction completes the JDBC connection must be cleaned up in an appropriate way, for example by closing it or returning it to a connection pool.

5.2.2.2 JDBC No Transaction behaviours

When accessed with from the No Transaction scope the JDBC connection may have autocommit set to true or false depending on its underlying configuration. This value may be changed by the client within the scope of the resource access, but will be reset after the end of the scope.

In the No Transaction context the JDBC connection will not be committed or rolled back, it is therefore the client's responsibility to call `commit()` or `rollback()` as appropriate. Savepoints may be used for partial rollback if desired.

After the end of the scope the JDBC connection must be automatically cleaned up in an appropriate way, for example by closing it or returning it to a connection pool.

5.2.2.3 JDBCConnectionProviderFactory

The `JDBCConnectionProvider` may be provided directly in the OSGi service registry, however this may not be acceptable in all use cases. JDBC Connections are often authenticated using a username and password. If the username and password relate to a specific bundle then it may not be appropriate to have the configured connections available in the Service Registry. In this case the `JDBCConnectionProviderFactory` offers several factory methods that can programatically create a `JDBCConnectionProvider`.

Provider Configuration

Each factory method here supplies set of properties which are used to configure the `ResourceProvider`, including the connection pooling behaviour, and whether the `ResourceProvider` can be enlisted with XA and/or Local transactions.

By default the `JDBCConnectionProvider` will have a pool of 10 connections with a connection timeout of 30 seconds, an idle timeout of 10 minutes and a maximum connection lifetime of 3 hours. The `JDBCConnectionProvider` will also, by default, work with Local and XA transactions.

If the `JDBCConnectionProvider` is configured to enable XA then the `DataSourceFactory` or `DataSource` must support the creation of an `XADataSource`

Creating a JDBCConnectionProvider Using a DataSourceFactory

```
JDBCConnectionProvider getProviderFor(DataSourceFactory dsf, Properties  
jdbcProperties, Map<String,Object> resourceProviderProperties);
```

In this case the client provides the `DataSourceFactory` that should be used, along with the properties that should be used to create the `DataSource/XADataSource`. If XA transactions are enabled then the factory must create an `XADataSource`, otherwise the "osgi.use.driver" property can be used to force the creation of a `Driver` instance rather than a `DataSource`.

Creating a JDBCConnectionProvider Using a DataSource

```
JDBCConnectionProvider getProviderFor(DataSource ds, Map<String,Object>  
resourceProviderProperties);
```

In this case the client provides a preconfigured DataSource that should be used. If XA transactions are enabled then the datasource must either implement XADataSource or be “unwrappable” to XADataSource.

Creating a JDBCConnectionProvider Using an XADataSource

```
JDBCConnectionProvider getProviderFor(XADataSource xaDs,  
Map<String,Object> resourceProviderProperties);
```

In this case the client provides a preconfigured XADataSource that should be used.

Creating a JDBCConnectionProvider Using a Driver

```
JDBCConnectionProvider getProviderFor(Driver driver, Properties  
jdbcProperties, Map<String,Object> resourceProviderProperties);
```

In this case the client provides the pre-loaded driver class that should be used, along with the properties that should be used to create the JDBC connection. XA transactions may not be enabled when using a Driver instance.

5.2.3 JPA

JPA is a popular Object Relational Mapping (ORM) framework used to abstract away the low-level database access from business code. As an alternative means of accessing a database it is just as important for JPA resources to participate in transactions as it is for JDBC resources. This RFC therefore defines the JPAEntityManagerProvider interface as a specialised resource provider for JPA.

5.2.3.1 JPA Active Transaction behaviours

When enlisted in an Active Transaction a JPA EntityManager will automatically track the state of persisted entity types and update the database as necessary. When participating in a transaction it is forbidden to call getTransaction on the EntityManager as manual transaction management is disabled.

If the Active Transaction commits then the JPA EntityManager must commit any work performed in the transaction. Similarly if the Active Transaction rolls back then the JPA EntityManager must roll back any work performed in the transaction. After the transaction completes the JDBC connection must be cleaned up in an appropriate way, for example by closing it or returning it to a connection pool.

5.2.3.2 JPA No Transaction behaviours

When accessed with from the No Transaction scope the JPA EntityManager will not be committed or rolled back, it is therefore the client's responsibility to set up an EntityTransaction and to call commit() or rollback() as appropriate.

After the end of the scope the EntityManager must be automatically cleaned up in an appropriate way, for example by closing it or returning it to a pool.

5.2.3.3 RESOURCE_LOCAL and JTA EntityManagerFactory instances

When defining a JPA Persistence Unit the author must declare whether the EntityManagerFactory integrates with JTA transactions, or is suitable for resource local usage. The JPAEntityManagerProvider must take this into account when creating the transactional resource.

JTA scoped `EntityManager` instances may not manage their own transactions and must throw a `JPA TransactionRequiredException` if the client attempts to use the `EntityTransaction` interface. In effect the `EntityManager` behaves as a Synchronized, Transaction-Scoped, Managed Persistence Context as per the JPA 2.1 Specification. It is important to ensure that the Database connections used in a JTA Persistence Unit are integrated with the ongoing transaction.

`RESOURCE_LOCAL` scoped `EntityManager` instances may not participate in XA transactions, but otherwise behave in much the same way as JTA `EntityManager` instances. The one significant difference is that `RESOURCE_LOCAL` `EntityManager` instances may obtain an `EntityTransaction` when running in the No Transaction context.

5.2.3.4 *JPAEntityManagerProviderFactory*

The `JPAEntityManagerProvider` may be provided directly in the OSGi service registry, however this may not be acceptable in all use cases. Database Connections are often authenticated using a username and password. If the username and password relate to a specific bundle then it may not be appropriate to have the configured connections available in the Service Registry. In this case the `JPAEntityManagerProviderFactory` offers several factory methods that can programatically create a `JPAEntityManagerProvider`.

Creating a JPAEntityManagerProvider Using an EntityManagerFactoryBuilder

```
JPAEntityManagerProvider getProviderFor(EntityManagerFactoryBuilder emfb,  
Map<String,Object> jpaProperties, Map<String,Object>  
resourceProviderProperties);
```

In this case the client provides the `EntityManagerFactoryBuilder` that should be used, along with the properties that should be used to create the `EntityManagerFactory`. The “`osgi.jdbc.provider`” property can be passed to the resource provider defining the `JDBCConnectionProvider` that should be converted into a `DataSource` and passed to the `EntityManagerFactoryBuilder` using the `javax.persistence.jtaDataSource` property.

Creating a JPAEntityManagerProvider Using an EntityManagerFactory

```
JPAEntityManagerProvider getProviderFor(EntityManagerFactory emf,  
Map<String,Object> jpaProperties, Map<String,Object>  
resourceProviderProperties);
```

In this case the client provides the configured `EntityManagerFactory` that should be used, along with the properties that should be used to create the `EntityManager`.

5.2.4 Connection Pooling

Database connections are usually heavyweight objects that require significant time to create. They may also consume physical resources such as memory or network ports. Creating a new database connection for every request is therefore wasteful, and adds unnecessary load to both the application and the database. Caching of database connections is therefore a useful way of improving performance. On the other hand applications must be careful not to create too many database connections. If one thousand requests arrive simultaneously then creating one thousand database connections is likely to crash the database server. These two requirements make database connections an excellent candidate for pooling. A small number of connections are made available and recycled after use. This saves the cost of recreating the connection and limits the overall load on the database.

In fact pooling is an excellent solution for many transactional resources, including JMS and EIS access.

5.2.4.1 Connection Pooling in OSGi

Pooling has traditionally been difficult in OSGi because most connection pooling libraries use reflective access to load the underlying resource connector. This obviously fails unless the pooling library creates a static wiring to the connector, or has dynamic package imports. Both of these “solutions” are bad practices which create brittle dependencies.

The correct way to obtain Database connections in OSGi is to use a DataSourceFactory, however this offers no Connection Pooling. There is no real equivalent of a DataSourceFactory for JMS ConnectionFactory instances, but they also require manual decoration to enable connection pooling.

As pooling is such a core requirement for transactional resource access it is required for JDBCConnectionProviderFactory instances to offer connection pooling. The resource provider properties can be used to override the connection pooling configuration defaults (or to disable connection pooling entirely).

| Property | Default | Purpose |
|---------------------------------|---------|---|
| osgi.connection.pooling.enabled | true | Whether connection pooling is enabled for this ResourceProvider |
| osgi.connection.timeout | 30,000 | The maximum time that a client will wait for a connection |
| osgi.idle.timeout | 180,000 | The time that a connection will remain idle before being closed |
| osgi.connection.lifetime | 3 hours | The maximum time that a connection will remain open |
| osgi.connection.min | 10 | The minimum number of connections that will be kept alive |
| osgi.connection.max | 10 | The maximum number of connections that will exist in the pool |

5.3 The TransactionContext

When a client uses the TransactionControl service to scope a piece of work, the scope gains an associated Transaction Context. The current transaction context is not normally needed by clients, but is an important integration point for ResourceProviders, and for clients that wish to register transaction completion callbacks.

The current TransactionContext is available using the `getCurrentContext()` method of the TransactionControl service. The context will be null if the currently executing code is unscoped. If the current work has a No Transaction scope then a TransactionContext will be returned, however it will report its status as `NO_TRANSACTION`.

5.3.1 Scoped Variables

A Transaction context may be used to store scoped variables. These variables are attached to the TransactionContext, and will be de-referenced once the Context finishes.

Variables may be added to the scope using `putScopedValue()` and retrieved using `getScopedValue()`. These methods are valid both for Active Transactions and the No Transaction scope.

5.3.2 The Transaction Key

Every Active Transaction has an associated key, which will be unique within the lifetime of the TransactionControl service. The key object is opaque, but is guaranteed to be suitable for use as a key in a HashMap.

TransactionContexts for the NoTransaction scope have a null key

5.3.3 Local Transactions

A LocalTransaction is not persistent, and therefore not recoverable. It also may not be atomic or consistent if multiple resources are involved (although it is if only a single resource is used). Local transactions do, however, provide isolation and durability, even when multiple resources are involved.

A Local Transaction is therefore a very good choice when a single resource is involved as it is extremely lightweight and provides ACID behaviour. Local Transactions do provide benefits when multiple resources are involved, however it is important to realise that Local Transactions may end up in a state where some commits have succeeded and others failed.

5.3.3.1 The Local Transaction Lifecycle

The transaction context for a local transaction begins in the ACTIVE state, and may enter the MARKED_ROLLBACK state if the client calls setRollbackOnly().

A local transaction will return true from the supportsLocal() method, indicating that LocalResource participants may be registered using the registerLocalResource(LocalResource) method.

Once the transactional work has completed the transaction will proceed as follows:

| Work state | Action |
|---|--|
| ACTIVE TransactionContext, successful return | Set the Transaction Status to COMMITTING Call commit on each LocalResource. <ul style="list-style-type: none"> If the first LocalResource fails to commit then set the Transaction status to ROLLING_BACK , rollback all subsequent resources and throw a TransactionRolledBackException with its cause set to the first failure. Subsequent failures must be added as suppressed Exceptions If the first LocalResource commits and then one or more LocalResource instances fail to commit then a TransactionException must be thrown with the cause set to the first failure. Subsequent failures must be added as suppressed Exceptions Set the Transaction Status to COMMITTED or ROLLED_BACK as appropriate The return value is returned by the Transaction |
| ACTIVE TransactionContext, noRollbackFor Exception | As for a successful return, but rethrow the exception afterwards rather than returning a value |
| ACTIVE TransactionContext, rollbackFor Exception | Set the Transaction Status to ROLLING_BACK Call rollback on each LocalResources gathering any exceptions that occur. Set the Transaction Status to ROLLED_BACK as appropriate Throw a TransactionRolledBackException with the cause set to the original Exception and suppressed exceptions for any rollback failures |
| MARKED_ROLLBACK TransactionContext, successful return | Set the Transaction Status to ROLLING_BACK Call rollback on each LocalResourcer gathering any exceptions that occur. Set the Transaction Status to ROLLED_BACK as appropriate If no rollback failures occurred then return the successful return value, otherwise |

| Work state | Action |
|---|--|
| | throw a TransactionException with the cause set to the first rollback exception and any subsequent failures as suppressed exceptions |
| MARKED_ROLLBACK TransactionContext, noRollbackFor Exception | As for a successful return, but rethrow the exception afterwards rather than returning a value |
| MARKED_ROLLBACK TransactionContext, rollbackFor Exception | Same as ACTIVE TransactionContext, rollbackFor Exception |

5.3.3.2 Local Transaction Support Service Properties

A TransactionControl Service which supports local transactions may be identified using the “osgi.local.enabled” property which will be set to Boolean.TRUE.

5.3.4 XA Transactions

An XA transaction is persistent, and therefore can be recoverable. It is also may atomic and consistent even if multiple resources are involved.

An XA Transaction is therefore a very good choice when a multiple resource are involved as it provides ACID behaviour. XA transactions are, however, more heavyweight than local transactions, and should only be used where they are needed.

5.3.4.1 The XA Transaction Lifecycle

The transaction context for anX A transaction begins in the ACTIVE state, and may enter the MARKED_ROLLBACK state if the client calls setRollbackOnly().

An XA transaction will return true from the supportsXA() method, indication that XAResource participants may be registered using the registerXAResource(XAResource) method.

Once the transactional work has completed the transaction will be proceed as follows: (TransactionContext Status changes follow the XA 2PC algorithm)

| Work state | Action |
|---|--|
| ACTIVE TransactionContext, successful return | Begin committing the XA Transaction If the commit fails then throw a TransactionRolledBackException with its cause set to the XA failure. Otherwise the return value is returned by the Transaction |
| ACTIVE TransactionContext, noRollbackFor Exception | As for a successful return, but rethrow the exception afterwards rather than returning a value |
| ACTIVE TransactionContext, rollbackFor Exception | Begin rolling back the XA Transaction Throw a TransactionRolledBackException with its cause set to the thrown Exception. If the rollback fails then add the XA failure as a suppressed Exception. |
| MARKED_ROLLBACK TransactionContext, successful return | Begin rolling back the XA Transaction If the rollback fails then throw a TransactionException with its cause set to the XA failure. Otherwise the return value is returned by the Transaction |
| MARKED_ROLLBACK TransactionContext, | As for a successful return, but rethrow the exception afterwards rather than returning a value |

| Work state | Action |
|---|--|
| noRollbackFor Exception | |
| MARKED_ROLLBACK TransactionContext, rollbackFor Exception | Same as ACTIVE TransactionContext, rollbackFor Exception |

:

5.3.4.2 XA support service properties

A TransactionControl Service which supports local transactions may be identified using the “osgi.xa.enabled” property which will be set to Boolean.TRUE.

5.3.5 Mixed mode transactions

Some TransactionControl Providers will support the use of both XAResources and LocalResources. In this case they should register service properties for both resource types. The TransactionControl service may place restrictions on mixed resource registration. For example it may not be possible to register both XA resources and LocalResources in the same Transaction, or it may only be possible to register one LocalResource in addition to XAResources (as per the last resource gambit). If the Transaction cannot support the registration of a resource then it must throw a TransactionException.

In the case where both XAResources and LocalResources are in the same transaction the XAResources should be committed first, then the LocalResources afterwards. If any of the LocalResources experience a failure then it should be treated as if a virtual “first LocalResource” had already completed with the same result as the XAResources.

5.3.6 Lifecycle callbacks

In addition to registering Resources with the TransactionContext clients or resources may register callback functions. Callback functions may run either before or after the transaction commits, depending as to whether they are registered using preCompletion or postCompletion to register their callbacks.

Precompletion callbacks are run after the transactional work, but immediately before the commit operation begins. PostCompletion callbacks are run after the commit process.

5.3.6.1 Exceptions from callbacks

Exceptions generated by precompletion callbacks are gathered, If any of the generated Exceptions would trigger rollback then the transaction is treated as having failed with the first of those exceptions. Any other exceptions are added as suppressed exceptions.

Exceptions generated by postcompletion callbacks are unable to affect the outcome of the transaction, and must therefore be logged, but not acted on further by the TransactionControl service.

6 Data Transfer Objects

RFC 185 defines Data Transfer Objects as a generic means for management solutions to interact with runtime entities in an OSGi Framework. DTOs provides a common, easily serializable representation of the technology.

For all new functionality added to the OSGi Framework the question should be asked: would this feature benefit from a DTO? The expectation is that in most cases it would.

The DTOs for the design in this RFC should be described here and if there are no DTOs being defined an explanation should be given explaining why this is not applicable in this case.

This section is optional and could also be provided in a separate RFC.

7 Javadoc

OSGi Javadoc

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| Package Summary | | Page |
|---|-----------------------------------|------|
| org.osgi.service.transaction.control | JDBC Service Package Version 1.0. | 23 |
| org.osgi.service.transaction.control.jdbc | | 40 |
| org.osgi.service.transaction.control.jpa | | 46 |

Package org.osgi.service.transaction.control

JDBC Service Package Version 1.0.

See:

[Description](#)

| Interface Summary | | Page |
|------------------------------------|---|------|
| LocalResource | Resources that can integrate with local transactions should do so using this interface | 24 |
| ResourceProvider | A resource provider is used to provide a transactional resource to the application | 25 |
| TransactionContext | A transaction context defines the current transaction, and allows resources to register information and/or synchronisations | 28 |
| TransactionControl | The interface used by clients to control the active transaction context | 31 |
| TransactionStatus | Implementations of this interface are able to run a piece of work within a transaction | 35 |

| Class Summary | | Page |
|------------------------------------|---|------|
| TransactionBuilder | A builder for a piece of transactional work | 26 |

| Enum Summary | | Page |
|-----------------------------------|--|------|
| TransactionStatus | The status of the transaction A transaction may not enter all of the states in this enum, however it will always traverse the enum in ascending order. | 37 |

| Exception Summary | | Page |
|--|---|------|
| TransactionException | An Exception indicating that there was a problem with starting, finishing, suspending or resuming a transaction | 33 |
| TransactionRolledBackException | An Exception indicating that the active transaction was rolled back | 34 |

Package org.osgi.service.transaction.control Description

JDBC Service Package Version 1.0.

Bundles wishing to use this package must list the package in the Import-Package header of the bundle's manifest. This package has two types of users: the consumers that use the API in this package and the providers that implement the API in this package.

Example import for consumers using the API in this package:

```
Import-Package: org.osgi.service.jdbc; version="[1.0,2.0]"
```

Example import for providers implementing the API in this package:

```
Import-Package: org.osgi.service.jdbc; version="[1.0,1.1]"
```

Interface LocalResource

org.osgi.service.transaction.control

```
public interface LocalResource
```

Resources that can integrate with local transactions should do so using this interface

| Method Summary | | Page |
|----------------|--|------|
| void | commit() Commit the resource | 24 |
| void | rollback() Roll back the resource | 24 |

Method Detail

commit

```
void commit()  
    throws TransactionException
```

Commit the resource

Throws:
[TransactionException](#)

rollback

```
void rollback()  
    throws TransactionException
```

Roll back the resource

Throws:
[TransactionException](#)

Interface ResourceProvider

[org.osgi.service.transaction.control](#)

All Known Subinterfaces:

[JDBCConnectionProvider](#), [JPAEntityManagerProvider](#)

```
public interface ResourceProvider
```

A resource provider is used to provide a transactional resource to the application

Method Summary

| | Pag e |
|---|----------|
| T getResource (TransactionControl txControl) Get a resource which will associate with the current transaction context when used | 25 |

Method Detail

getResource

[T](#) [getResource](#) ([TransactionControl](#) txControl)
throws [TransactionException](#)

Get a resource which will associate with the current transaction context when used

Returns:

The resource which will participate in the current transaction

Throws:

[TransactionException](#) - if the resource cannot be registered with the transaction

Class TransactionBuilder

[org.osgi.service.transaction.control](#)

```
java.lang.Object
└─ org.osgi.service.transaction.control.TransactionBuilder
```

All Implemented Interfaces:
[TransactionStarter](#)

```
abstract public class TransactionBuilder
extends Object
implements TransactionStarter
```

A builder for a piece of transactional work

| Constructor Summary | Page |
|---------------------------------------|------|
| TransactionBuilder () | 26 |

| Method Summary | Page |
|--|------|
| TransactionBuilder noRollbackFor (Class<? extends Throwable> t, Class<? extends Throwable>... throwables) Declare a list of Exception types (and their subtypes) that <i>must not</i> trigger a rollback. | 27 |
| TransactionBuilder rollbackFor (Class<? extends Throwable> t, Class<? extends Throwable>... throwables) Declare a list of Exception types (and their subtypes) that <i>must</i> trigger a rollback. | 26 |

| Methods inherited from interface org.osgi.service.transaction.control.TransactionStarter |
|--|
| notSupported , required , requiresNew , supports |

Constructor Detail

TransactionBuilder

```
public TransactionBuilder()
```

Method Detail

rollbackFor

```
@SafeVarargs
public final TransactionBuilder rollbackFor(Class<? extends Throwable> t,
                                             Class<? extends Throwable>... throwables)
```

Declare a list of Exception types (and their subtypes) that *must* trigger a rollback. By default the transaction will rollback for all `RuntimeExceptions`. If a more specific type is registered using [noRollbackFor\(Class, Class...\)](#) then that type will not trigger rollback. If the same type is registered using both [rollbackFor\(Class, Class...\)](#) and [noRollbackFor\(Class, Class...\)](#) then the transaction *will not* roll back for that Exception type.

Parameters:
 throwables - The Exception types that should trigger rollback

Returns:
 this builder

noRollbackFor

```
@SafeVarargs
public final TransactionBuilder noRollbackFor(Class<? extends Throwable> t,
                                             Class<? extends Throwable>... throwables)
```

Declare a list of Exception types (and their subtypes) that *must not* trigger a rollback. By default the transaction will not rollback for all `Exceptions`. If a more specific type is registered using [rollbackFor\(Class, Class...\)](#) then that type will trigger rollback. If the same type is registered using both [rollbackFor\(Class, Class...\)](#) and [noRollbackFor\(Class, Class...\)](#) then the transaction *will not* roll back for that Exception type.

Parameters:

`t` - An exception type that should not trigger rollback
`throwables` - further exception types that should not trigger rollback

Returns:

this builder

Interface TransactionContext

org.osgi.service.transaction.control

```
public interface TransactionContext
```

A transaction context defines the current transaction, and allows resources to register information and/or synchronisations

| Method Summary | | Page |
|-----------------------------------|--|------|
| boolean | getRollbackOnly () Is this transaction marked for rollback only | 29 |
| Object | getScopedValue (Object key) Get a value scoped to this transaction | 28 |
| Object | getTransactionKey () Get the key associated with the current transaction | 28 |
| TransactionStatus | getTransactionStatus () | 29 |
| void | postCompletion (Consumer< TransactionStatus > job) Register a callback that will be made after the decision to commit or rollback | 29 |
| void | preCompletion (Runnable job) Register a callback that will be made before a call to commit or rollback | 29 |
| void | putScopedValue (Object key, Object value) Associate a value with this transaction | 29 |
| void | registerLocalResource (LocalResource resource) Register an XA resource with the current transaction | 30 |
| void | registerXAResource (XAResource resource) Register an XA resource with the current transaction | 30 |
| void | setRollbackOnly () Mark this transaction for rollback | 29 |
| boolean | supportsLocal () | 30 |
| boolean | supportsXA () | 30 |

Method Detail

getTransactionKey

```
Object getTransactionKey ()
```

Get the key associated with the current transaction

Returns:
the transaction key, or null if there is no transaction

getScopedValue

```
Object getScopedValue (Object key)
```

Get a value scoped to this transaction

Returns:
The resource, or null

putScopedValue

```
void putScopedValue(Object key,  
                   Object value)
```

Associate a value with this transaction

getRollbackOnly

```
boolean getRollbackOnly()  
        throws IllegalStateException
```

Is this transaction marked for rollback only

Returns:

true if this transaction is rollback only

Throws:

IllegalStateException - if no transaction is active

setRollbackOnly

```
void setRollbackOnly()  
        throws IllegalStateException
```

Mark this transaction for rollback

Throws:

IllegalStateException - if no transaction is active

getTransactionStatus

```
TransactionStatus getTransactionStatus()
```

Returns:

The current transaction status

preCompletion

```
void preCompletion(Runnable job)  
        throws IllegalStateException
```

Register a callback that will be made before a call to commit or rollback

Throws:

IllegalStateException - if no transaction is active or the transaction has already passed beyond the [TransactionStatus.MARKED_ROLLBACK](#) state

postCompletion

```
void postCompletion(Consumer<TransactionStatus> job)  
        throws IllegalStateException
```

Register a callback that will be made after the decision to commit or rollback

Throws:

IllegalStateException - if no transaction is active

supportsXA

boolean **supportsXA**()

Returns:

true if the current transaction supports XA resources

supportsLocal

boolean **supportsLocal**()

Returns:

true if the current transaction supports Local resources

registerXAResource

void **registerXAResource**(XAResource resource)
throws IllegalStateException

Register an XA resource with the current transaction

Throws:

IllegalStateException - if no transaction is active, or the current transaction is not XA capable

registerLocalResource

void **registerLocalResource**([LocalResource](#) resource)
throws IllegalStateException

Register an XA resource with the current transaction

Throws:

IllegalStateException - if no transaction is active, or the current transaction is not XA capable

Interface TransactionControl

org.osgi.service.transaction.control

All Superinterfaces:

[TransactionStarter](#)

```
public interface TransactionControl
extends TransactionStarter
```

The interface used by clients to control the active transaction context

| Method Summary | | Page |
|------------------------------------|---|------|
| boolean | activeScope () | 31 |
| boolean | activeTransaction () | 31 |
| TransactionBuilder | build () Build a transaction context to surround a piece of transactional work | 31 |
| TransactionContext | getCurrentContext () | 32 |
| boolean | getRollbackOnly () Gets the rollback status of the active transaction | 32 |
| void | ignoreException (Throwable t) Marks that the current transaction should not be rolled back if the supplied Exception is thrown by the current transactional work | 32 |
| void | setRollbackOnly () Marks the current transaction to be rolled back | 32 |

Methods inherited from interface [org.osgi.service.transaction.control.TransactionStarter](#)

[notSupported](#), [required](#), [requiresNew](#), [supports](#)

Method Detail

build

[TransactionBuilder](#) **build**()

Build a transaction context to surround a piece of transactional work

Returns:

A builder to complete the creation of the transaction

activeTransaction

boolean **activeTransaction**()

Returns:

true if a transaction is currently active

activeScope

boolean **activeScope**()

Returns:

true if a transaction is currently active, or if there is a "no transaction" context active

getCurrentContext

[TransactionContext](#) `getCurrentContext()`

Returns:

The current transaction context, which may be a "no transaction" context, or null if there is no active context

getRollbackOnly

`boolean getRollbackOnly()`
throws `IllegalStateException`

Gets the rollback status of the active transaction

Returns:

true if the transaction is marked for rollback

Throws:

`IllegalStateException` - if no transaction is active

setRollbackOnly

`void setRollbackOnly()`
throws `IllegalStateException`

Marks the current transaction to be rolled back

Throws:

`IllegalStateException` - if no transaction is active

ignoreException

`void ignoreException(Throwable t)`
throws `IllegalStateException`

Marks that the current transaction should not be rolled back if the supplied Exception is thrown by the current transactional work

Parameters:

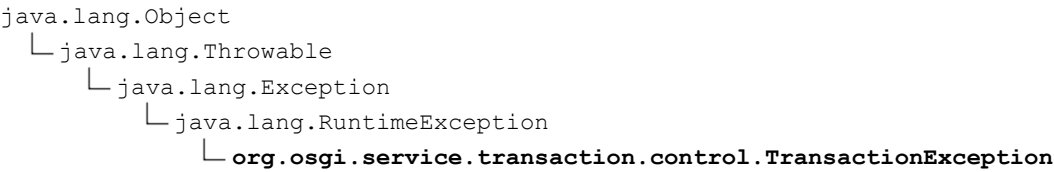
`t` - The exception to ignore

Throws:

`IllegalStateException` - if no transaction is active

Class TransactionException

[org.osgi.service.transaction.control](#)



All Implemented Interfaces:
Serializable

Direct Known Subclasses:
[TransactionRolledBackException](#)

```
public class TransactionException
extends RuntimeException
```

An Exception indicating that there was a problem with starting, finishing, suspending or resuming a transaction

| Constructor Summary | Page |
|--|------|
| TransactionException (String message) Creates a new TransactionException with the supplied message | 33 |
| TransactionException (String message, Throwable cause) Creates a new TransactionException with the supplied message and cause | 33 |

Constructor Detail

TransactionException

```
public TransactionException(String message)

    Creates a new TransactionException with the supplied message
```

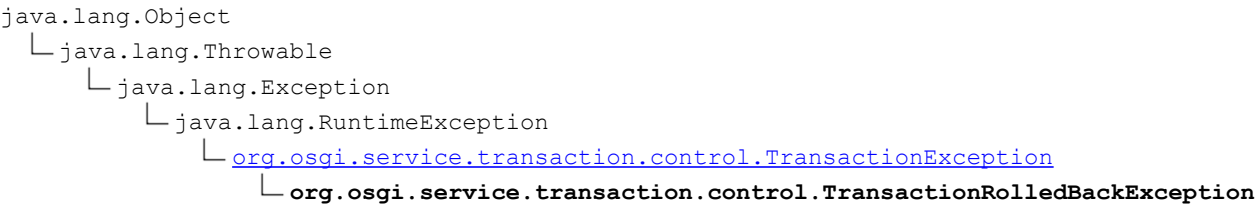
TransactionException

```
public TransactionException(String message,
                             Throwable cause)

    Creates a new TransactionException with the supplied message and cause
```

Class TransactionRolledBackException

[org.osgi.service.transaction.control](#)



All Implemented Interfaces:
Serializable

```
public class TransactionRolledBackException
extends TransactionException
```

An Exception indicating that the active transaction was rolled back

| Constructor Summary | | Page |
|---|--|------|
| TransactionRolledBackException (String message) Create a new TransactionRolledBackException with the supplied message | | 34 |
| TransactionRolledBackException (String message, Throwable cause) Create a new TransactionRolledBackException with the supplied message | | 34 |

Constructor Detail

TransactionRolledBackException

```
public TransactionRolledBackException(String message)

Create a new TransactionRolledBackException with the supplied message
```

TransactionRolledBackException

```
public TransactionRolledBackException(String message,
                                     Throwable cause)

Create a new TransactionRolledBackException with the supplied message
```

Interface TransactionStarter

org.osgi.service.transaction.control

All Known Subinterfaces:

[TransactionControl](#)

All Known Implementing Classes:

[TransactionBuilder](#)

```
public interface TransactionStarter
```

Implementations of this interface are able to run a piece of work within a transaction

| Method Summary | | Page |
|----------------|---|------|
| T | notSupported (Callable<T> work) The supplied piece of work must be run outside the context of a transaction. | 36 |
| T | required (Callable<T> work) A transaction is required to run the supplied piece of work. | 35 |
| T | requiresNew (Callable<T> work) A new transaction is required to run the supplied piece of work. | 35 |
| T | supports (Callable<T> work) The supplied piece of work may run inside or outside the context of a transaction. | 36 |

Method Detail

required

```
T required(Callable<T> work)
    throws TransactionException,
           TransactionRolledBackException
```

A transaction is required to run the supplied piece of work. If no transaction is active then it must be started and associated with the work and then completed after the transactional work has finished.

Returns:

The value returned by the work

Throws:

[TransactionException](#) - if there is an error starting or completing the transaction
[TransactionRolledBackException](#) - if the transaction rolled back due to a failure

requiresNew

```
T requiresNew(Callable<T> work)
    throws TransactionException,
           TransactionRolledBackException
```

A new transaction is required to run the supplied piece of work. If an existing transaction is active then it must be suspended and a new transaction started and associated with the work. After the work has completed the new transaction must also complete and any suspended transaction be resumed.

Returns:

The value returned by the work

Throws:

[TransactionException](#) - if there is an error starting or completing the transaction
[TransactionRolledBackException](#) - if the transaction rolled back due to a failure

notSupported

T **notSupported**(Callable<T> work)
throws [TransactionException](#)

The supplied piece of work must be run outside the context of a transaction. If an existing transaction is active then it must be suspended and a "no transaction" context associated with the work. After the work has completed any suspended transaction must be resumed.

The "no transaction" context does not support resource enlistment, and will not commit or rollback any changes, however it does provide a post completion callback to any registered functions. This function is suitable for final cleanup, such as closing a connection

Returns:

The value returned by the work

Throws:

[TransactionException](#) - if there is an error starting or completing the transaction

supports

T **supports**(Callable<T> work)
throws [TransactionException](#)

The supplied piece of work may run inside or outside the context of a transaction. If an existing transaction or "no transaction" context is active then it will continue, otherwise a new "no transaction" context is associated with the work. After the work has completed any created transaction context must be completed.

The "no transaction" context does not support resource enlistment, and will not commit or rollback any changes, however it does provide a post completion callback to any registered functions. This function is suitable for final cleanup, such as closing a connection

Returns:

The value returned by the work

Throws:

[TransactionException](#) - if there is an error starting or completing the transaction

Enum TransactionStatus

[org.osgi.service.transaction.control](#)

```
java.lang.Object
├─ java.lang.Enum<TransactionStatus>
│   └─ org.osgi.service.transaction.control.TransactionStatus
```

All Implemented Interfaces:

Comparable<[TransactionStatus](#)>, Serializable

```
public enum TransactionStatus
extends Enum<TransactionStatus>
```

The status of the transaction A transaction may not enter all of the states in this enum, however it will always traverse the enum in ascending order. In particular if the TransactionStatus is reported as X then it will never proceed into a state Y where X.compareTo(Y) >= 0;

| Enum Constant Summary | | Page |
|---------------------------------|---|------|
| ACTIVE | A transaction is currently in progress | 38 |
| COMMITTED | The transaction has committed | 38 |
| COMMITTING | The transaction is in the process of being committed | 38 |
| MARKED_ROLLBACK | A transaction is currently in progress and has been marked for rollback | 38 |
| NO_TRANSACTION | No transaction is currently active | 37 |
| PREPARED | A two phase commit is occurring and the transaction has been prepared | 38 |
| PREPARING | A two phase commit is occurring and the transaction is being prepared | 38 |
| ROLLED_BACK | The transaction has been rolled back | 38 |
| ROLLING_BACK | The transaction is in the process of rolling back | 38 |

| Method Summary | | Page |
|---|---------------------------------------|------|
| static TransactionStatus nStatus | valueOf (String name) | 39 |
| static TransactionStatus nStatus [] | values () | 39 |

Enum Constant Detail

NO_TRANSACTION

```
public static final TransactionStatus NO_TRANSACTION
```

No transaction is currently active

ACTIVE

public static final [TransactionStatus](#) ACTIVE

A transaction is currently in progress

MARKED_ROLLBACK

public static final [TransactionStatus](#) MARKED_ROLLBACK

A transaction is currently in progress and has been marked for rollback

PREPARING

public static final [TransactionStatus](#) PREPARING

A two phase commit is occurring and the transaction is being prepared

PREPARED

public static final [TransactionStatus](#) PREPARED

A two phase commit is occurring and the transaction has been prepared

COMMITTING

public static final [TransactionStatus](#) COMMITTING

The transaction is in the process of being committed

COMMITTED

public static final [TransactionStatus](#) COMMITTED

The transaction has committed

ROLLING_BACK

public static final [TransactionStatus](#) ROLLING_BACK

The transaction is in the process of rolling back

ROLLED_BACK

public static final [TransactionStatus](#) ROLLED_BACK

The transaction has been rolled back

Method Detail

values

```
public static TransactionStatus[] values()
```

valueOf

```
public static TransactionStatus valueOf(String name)
```

Package `org.osgi.service.transaction.control.jdbc`

| Interface Summary | | Page |
|---|---|------|
| <i>JDBCConnectionProvider</i> | A specialised ResourceProvider suitable for obtaining JDBC connections. | 41 |
| <i>JDBCConnectionProviderFactory</i> | A factory for creating JDBCConnectionProvider instances | 42 |

Interface JDBCConnectionProvider

[org.osgi.service.transaction.control.jdbc](#)

All Superinterfaces:

[ResourceProvider](#)<Connection>

```
public interface JDBCConnectionProvider  
extends ResourceProvider<Connection>
```

A specialised [ResourceProvider](#) suitable for obtaining JDBC connections.

Instances of this interface may be available in the Service Registry, or can be created using a [JDBCConnectionProviderFactory](#).

Methods inherited from interface [org.osgi.service.transaction.control.ResourceProvider](#)

[getResource](#)

Interface JDBCConnectionProviderFactory

org.osgi.service.transaction.control.jdbc

```
public interface JDBCConnectionProviderFactory
```

A factory for creating JDBCConnectionProvider instances

This factory can be used if the [JDBCConnectionProvider](#) should not be a public service, for example to protect a username/password.

| Field Summary | | Page |
|---------------|---|------|
| String | CONNECTION_LIFETIME The property used to set the maximum amount of time that connections in the pool should remain open | 43 |
| String | CONNECTION_POOLING_ENABLED The property used to determine whether connection pooling is enabled for this resource provider | 43 |
| String | CONNECTION_TIMEOUT The property used to set the maximum amount of time that the pool should wait for a connection | 43 |
| String | IDLE_TIMEOUT The property used to set the maximum amount of time that connections in the pool should remain idle before being closed | 43 |
| String | LOCAL_ENLISTMENT_ENABLED The property used to determine whether local enlistment is enabled for this resource provider | 43 |
| String | MAX_CONNECTIONS The property used to set the maximum number of connections that should be held in the pool | 43 |
| String | MIN_CONNECTIONS The property used to set the minimum number of connections that should be held in the pool | 43 |
| String | USE_DRIVER The property used to set the maximum number of connections that should be held in the pool | 44 |
| String | XA_ENLISTMENT_ENABLED The property used to determine whether XA enlistment is enabled for this resource provider | 43 |

| Method Summary | | Page |
|--|--|------|
| JDBCConnectionProvider | getProviderFor (Driver driver, Map<String,Object> resourceProviderProperties) Create a private JDBCConnectionProvider using an existing Driver. | 44 |
| JDBCConnectionProvider | getProviderFor (DataSource ds, Map<String,Object> resourceProviderProperties) Create a private JDBCConnectionProvider using an existing DataSource. | 44 |
| JDBCConnectionProvider | getProviderFor (XADataSource ds, Map<String,Object> resourceProviderProperties) Create a private JDBCConnectionProvider using an existing XADataSource. | 44 |
| JDBCConnectionProvider | getProviderFor (org.osgi.service.jdbc.DataSourceFactory dsf, Properties jdbcProperties, Map<String,Object> resourceProviderProperties) Create a private JDBCConnectionProvider using a DataSourceFactory. | 44 |

Field Detail

XA_ENLISTMENT_ENABLED

```
public static final String XA_ENLISTMENT_ENABLED = "osgi.xa.enabled"
```

The property used to determine whether XA enlistment is enabled for this resource provider

LOCAL_ENLISTMENT_ENABLED

```
public static final String LOCAL_ENLISTMENT_ENABLED = "osgi.local.enabled"
```

The property used to determine whether local enlistment is enabled for this resource provider

CONNECTION_POOLING_ENABLED

```
public static final String CONNECTION_POOLING_ENABLED = "osgi.connection.pooling.enabled"
```

The property used to determine whether connection pooling is enabled for this resource provider

CONNECTION_TIMEOUT

```
public static final String CONNECTION_TIMEOUT = "osgi.connection.timeout"
```

The property used to set the maximum amount of time that the pool should wait for a connection

IDLE_TIMEOUT

```
public static final String IDLE_TIMEOUT = "osgi.idle.timeout"
```

The property used to set the maximum amount of time that connections in the pool should remain idle before being closed

CONNECTION_LIFETIME

```
public static final String CONNECTION_LIFETIME = "osgi.connection.lifetime"
```

The property used to set the maximum amount of time that connections in the pool should remain open

MIN_CONNECTIONS

```
public static final String MIN_CONNECTIONS = "osgi.connection.min"
```

The property used to set the minimum number of connections that should be held in the pool

MAX_CONNECTIONS

```
public static final String MAX_CONNECTIONS = "osgi.connection.max"
```

The property used to set the maximum number of connections that should be held in the pool

USE_DRIVER

```
public static final String USE_DRIVER = "osgi.use.driver"
```

The property used to set the maximum number of connections that should be held in the pool

Method Detail

getProviderFor

```
JDBCConnectionProvider getProviderFor(org.osgi.service.jdbc.DataSourceFactory dsf,  
                                         Properties jdbcProperties,  
                                         Map<String,Object> resourceProviderProperties)
```

Create a private [JDBCConnectionProvider](#) using a DataSourceFactory.

Parameters:

jdbcProperties - The properties to pass to the org.osgi.service.jdbc.DataSourceFactory in order to create the underlying DataSource
resourceProviderProperties - Configuration properties to pass to the JDBC Resource Provider runtime

Returns:

A [JDBCConnectionProvider](#) that can be used in transactions

getProviderFor

```
JDBCConnectionProvider getProviderFor(DataSource ds,  
                                         Map<String,Object> resourceProviderProperties)
```

Create a private [JDBCConnectionProvider](#) using an existing DataSource.

Parameters:

resourceProviderProperties - Configuration properties to pass to the JDBC Resource Provider runtime

Returns:

A [JDBCConnectionProvider](#) that can be used in transactions

getProviderFor

```
JDBCConnectionProvider getProviderFor(Driver driver,  
                                         Map<String,Object> resourceProviderProperties)
```

Create a private [JDBCConnectionProvider](#) using an existing Driver.

Parameters:

resourceProviderProperties - Configuration properties to pass to the JDBC Resource Provider runtime

Returns:

A [JDBCConnectionProvider](#) that can be used in transactions

getProviderFor

```
JDBCConnectionProvider getProviderFor(XADataSource ds,  
                                         Map<String,Object> resourceProviderProperties)
```

Create a private [JDBCConnectionProvider](#) using an existing `XADataSource`.

Parameters:

`resourceProviderProperties` - Configuration properties to pass to the JDBC Resource Provider
`runtime`

Returns:

A [JDBCConnectionProvider](#) that can be used in transactions

Package `org.osgi.service.transaction.control.jpa`

| Interface Summary | | Page |
|--|--|------|
| <code>JPAEntityManagerProvider</code> | A specialised <code>ResourceProvider</code> suitable for obtaining JPA <code>EntityManager</code> instances. | 47 |
| <code>JPAEntityManagerProviderFactory</code> | A factory for creating <code>JDBCConnectionProvider</code> instances | 48 |

Interface JPAEntityManagerProvider

[org.osgi.service.transaction.control.jpa](#)

All Superinterfaces:

[ResourceProvider](#)<EntityManager>

```
public interface JPAEntityManagerProvider  
extends ResourceProvider<EntityManager>
```

A specialised [ResourceProvider](#) suitable for obtaining JPA `EntityManager` instances.

Instances of this interface may be available in the Service Registry, or can be created using a [JPAEntityManagerProviderFactory](#).

Methods inherited from interface [org.osgi.service.transaction.control.ResourceProvider](#)

[getResource](#)

Interface JPAEntityManagerProviderFactory

org.osgi.service.transaction.control.jpa

```
public interface JPAEntityManagerProviderFactory
```

A factory for creating JDBCConnectionProvider instances

This factory can be used if the [JDBCConnectionProvider](#) should not be a public service, for example to protect a username/password.

| Field Summary | | Page |
|---------------|--|------|
| String | LOCAL_ENLISTMENT_ENABLED The property used to determine whether local enlistment is enabled for this resource provider | 48 |
| String | TRANSACTIONAL_DB_CONNECTION The property used to provide a JDBCConnectionProvider to the resource provider. | 48 |
| String | XA_ENLISTMENT_ENABLED The property used to determine whether XA enlistment is enabled for this resource provider | 48 |

| Method Summary | | Page |
|---|--|------|
| JPAEntityManagerProviderFactory | getProviderFor (EntityManagerFactory emf, Map<String,Object> jpaProperties, Map<String,Object> resourceProviderProperties) Create a private JPAEntityManagerProvider using an existing EntityManagerFactory. | 49 |
| JPAEntityManagerProviderFactory | getProviderFor (org.osgi.service.jpa.EntityManagerFactoryBuilder emfb, Map<String,Object> jpaProperties, Map<String,Object> resourceProviderProperties) Create a private JPAEntityManagerProvider using an org.osgi.service.jpa.EntityManagerFactoryBuilder | 49 |

Field Detail

XA_ENLISTMENT_ENABLED

```
public static final String XA_ENLISTMENT_ENABLED = "osgi.xa.enabled"
```

The property used to determine whether XA enlistment is enabled for this resource provider

LOCAL_ENLISTMENT_ENABLED

```
public static final String LOCAL_ENLISTMENT_ENABLED = "osgi.local.enabled"
```

The property used to determine whether local enlistment is enabled for this resource provider

TRANSACTIONAL_DB_CONNECTION

```
public static final String TRANSACTIONAL_DB_CONNECTION = "osgi.jdbc.provider"
```

The property used to provide a [JDBCConnectionProvider](#) to the resource provider. This will be converted into a DataSource by the factory, and passed to the

`org.osgi.service.jpa.EntityManagerFactoryBuilder` using the `javax.persistence.jtaDataSource` property

Method Detail

getProviderFor

[JPAEntityManagerProvider](#) **getProviderFor**(`org.osgi.service.jpa.EntityManagerFactoryBuilder` emfb, `Map<String,Object>` jpaProperties, `Map<String,Object>` resourceProviderProperties)

Create a private [JPAEntityManagerProvider](#) using an `org.osgi.service.jpa.EntityManagerFactoryBuilder`

Parameters:

`jpaProperties` - The properties to pass to the `org.osgi.service.jpa.EntityManagerFactoryBuilder` in order to create the underlying `EntityManagerFactory` and `EntityManager` instances
`resourceProviderProperties` - Configuration properties to pass to the JPA Resource Provider runtime

Returns:

A [JPAEntityManagerProvider](#) that can be used in transactions

getProviderFor

[JPAEntityManagerProvider](#) **getProviderFor**(`EntityManagerFactory` emf, `Map<String,Object>` jpaProperties, `Map<String,Object>` resourceProviderProperties)

Create a private [JPAEntityManagerProvider](#) using an existing `EntityManagerFactory`.

Parameters:

`jpaProperties` - The properties to pass to the `EntityManagerFactory` in order to create the underlying `EntityManager` instances
`resourceProviderProperties` - Configuration properties to pass to the JDBC Resource Provider runtime

Returns:

A [JPAEntityManagerProvider](#) that can be used in transactions

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8 Considered Alternatives

For posterity, record the design alternatives that were considered but rejected along with the reason for rejection. This is especially important for external/earlier solutions that were deemed not applicable.

9 Security Considerations

Description of all known vulnerabilities this may either introduce or address as well as scenarios of how the weaknesses could be circumvented.

10 Document Support

10.1 References

- [1]. Bradner, S., Key words for use in RFCs to Indicate Requirement Levels, RFC2119, March 1997.
- [2]. Software Requirements & Specifications. Michael Jackson. ISBN 0-201-87712-0
- [3]. <http://blog.osgi.org/2013/11/the-transaction-composability-problem.html>
- [4]. <http://www.slideshare.net/tux2323/osgi-and-spring-data-for-simple-web-application-development>
- [5]. <http://projects.spring.io/spring-data/>
- [6]. <http://www.liquibase.org/>
- [7]. <http://flywaydb.org/>

*Add references simply by adding new items. You can then cross-refer to them by choosing <Insert><Cross Reference><Numbered Item> and then selecting the paragraph. **STATIC REFERENCES (I.E. BODGED) ARE NOT ACCEPTABLE, SOMEONE WILL HAVE TO UPDATE THEM LATER, SO DO IT PROPERLY NOW.***

10.2 Author's Address

| | |
|---------|--|
| Name | |
| Company | |
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| e-mail | |

10.3 Acronyms and Abbreviations

10.4 End of Document
