

cosTransactions

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1 cosTransactions User's Guide

The **cosTransactions** application is an Erlang implementation of the OMG CORBA Transaction Service.

1.1 The cosTransactions Application

1.1.1 Content Overview

The cosTransactions documentation is divided into three sections:

- PART ONE - The User's Guide
  Description of the cosTransactions Application including services and a small tutorial demonstrating the development of a simple service.
- PART TWO - Release Notes
  A concise history of cosTransactions.
- PART THREE - The Reference Manual
  A quick reference guide, including a brief description, to all the functions available in cosTransactions.

1.1.2 Brief Description of the User's Guide

The User's Guide contains the following parts:

- cosTransactions overview
- cosTransactions installation
- A tutorial example

1.2 Introduction to cosTransactions

1.2.1 Overview

The cosTransactions application is a Transaction Service compliant with the **OMG** Transaction Service CosTransactions 1.1.

Purpose and Dependencies

cosTransactions is dependent on **Orber version 3.0.1** or later(see the Orber documentation), which provides CORBA functionality in an Erlang environment.

cosTransactions is dependent on **supervisor/stdlib-1.7** or later.

Basically, cosTransaction implements a **two-phase commit protocol** and allows objects running on different platforms to participate in a transaction.

Prerequisites

To fully understand the concepts presented in the documentation, it is recommended that the user is familiar with distributed programming, CORBA and the Orber application.

Recommended reading includes **CORBA, Fundamentals and Programming - Jon Siegel** and **Open Telecom Platform Documentation Set**. It is also helpful to have read **Concurrent Programming in Erlang** and, for example, **Transaction Processing: concepts and techniques - Jim Gray, Andreas Reuter**.

Note:

The cosTransaction application is compliant with the OMG CosTransactions specification 1.1. Using other vendors transaction service, compliant with the OMG CosTransactions specification 1.0, may not work since the `'TRANSACTION_REQUIRED', 'TRANSACTION_ROLLEDBACK'` and `'INVALID_TRANSACTION'` exceptions have been redefined to be system exceptions, i.e., used to be transaction-specific ('CosTransactions_Exc').

1.3 Installing cosTransactions

1.3.1 Installation Process

This chapter describes how to install *cosTransactions* in an Erlang Environment.

Preparation

Before starting the installation process for cosTransactions, the application Orber must be running.

The cosTransactions application must be able to log progress to disk. The log files are created in the current directory as "oe_name@machine_type_timestamp". Hence, `read` and `write` rights must be granted. If the transaction completes in an orderly fashion the logfiles are removed, but not if an error, which demands human intervention, occur.

Configuration

When using the Transaction Service the `cosTransactions` application must be started using either `cosTransactions:start()` or `application:start(cosTransactions)`.

The following application configuration parameters exist:

- `maxRetries` - default is 40 times, i.e., if a transaction participant is unreachable the application will retry to contact it `N` times. Reaching the maximum is considered to be a disaster.
- `comFailWait` - default is 5000 milliseconds, i.e., before the application retries to contact unreachable transaction participants the application wait `Time` milliseconds.

Then the *Transaction Factory* must be started:

- `cosTransactions:start_factory()` - starts and returns a reference to a factory using default configuration parameters.
- `cosTransactions:start_factory(Options)` - starts and returns a reference to a factory using given configuration parameters.

The following options exist:

- `{hash_max, HashValue}` - This value denotes the upper bound of the hash value the *Coordinator* uses. Default is `1013`. HashValue must be an integer.
- `{allow_subtr, Boolean}` - If set to true it is possible to create *subtransactions*. Default is `true`.
- `{typecheck, Boolean}` - If set to to true all transaction operation's arguments will be type-checked. Default is `true`.
- `{tty, Boolean}` - Enables or disables error printouts to the tty. If Flag is false, all text that the error logger would have sent to the terminal is discarded. If Flag is true, error messages are sent to the terminal screen.
- `{logfile, FileName}` - This function makes it possible to store all system information in `FileName` (string()). It can be used in combination with the tty(false) item to have a silent system, where all system information are logged to a file. As default no logfile is used.

- `{maxRetries, Integer}` - default is 40 times, i.e., if a transaction participant is unreachable the application will retry to contact it `N` times. Reaching the maximum is considered to be a disaster. This option overrides the application configuration parameter.
- `{comFailWait, Integer}` - default is 5000 milliseconds, i.e., before the application retries to contact unreachable transaction participants the application wait `Time` milliseconds. This option overrides the application configuration parameter.

The Factory is now ready to use. For a more detailed description see *Examples*.

1.4 cosTransactions Examples

1.4.1 A Tutorial on How to Create a Simple Service

Interface design

To use the cosTransactions application **participants** must be implemented. There are two types of participants:

- *CosTransactions_Resource* - operations used to commit or rollback resources.
- *CosTransactions_SubtransactionAwareResource* - operations used when the resources want to be notified when a subtransaction commits. This interface inherits the CosTransactions_Resource

The interfaces for these participants are defined in **CosTransactions.idl**

Generating a Participant Interface

We start by creating an interface which inherits from **CosTransactions::Resource**. Hence, we must also implement all operations defined in the Resource interface. The IDL-file could look like:

```
#ifndef _OWNRESOURCEIMPL_IDL
#define _OWNRESOURCEIMPL_IDL
#include <CosTransactions.idl>

module ownResourceImpl {

  interface ownInterface:CosTransactions::Resource {

    void ownFunctions(in any NeededArguments)
       raises(Systemexceptions,OwnExceptions);

  };
};

#endif
```

Run the IDL compiler on this file by calling the `ic:gen/1` function. This will produce the API named `ownResourceImpl_ownInterface.erl`. After generating the API stubs and the server skeletons it is time to implement the servers and if no special options are sent to the IDl compiler the file name is `ownResourceImpl_ownInterface_impl.erl`.

Implementation of Participant interface

If the participant is intended to be a plain Resource, we must implement the following operations:

- `prepare/1` - this operation is invoked on the Resource to begin the two-phase commit protocol.
- `rollback/1` - this operation instructs the Resource to rollback all changes made as a part of the transaction.
- `commit/1` - this operation instructs the Resource to commit all changes made as a part of the transaction.
- `commit_one_phase/1` - if possible, the Resource should commit all changes made as part of the transaction. This operation can only be used if the Resource is the only child of its parent.

- `forget/1` - this operation informs the Resource that it is safe to forget any Heuristic decisions is a unilateral decision by a participant to commit or rollback without receiving the true outcome of the transaction from its parent's coordinator. and the knowledge of the transaction.
- `ownFunctions` - all application specific operations.

If the participant wants to be notified when a subtransaction commits, we must also implement the following operations (besides the operations above):

- `commit_subtransaction/2` - if the `SubtransactionAwareResource` have been registered with a transactions using the operation `CosTransactions_Coordinator:register_subtran_aware/2` it will be notified when the transaction has committed.
- `rollback_subtransaction/1` - if the `SubtransactionAwareResource` have been registered with a transactions using the operation `CosTransactions_Coordinator:register_subtran_aware/2` it will be notified when the transaction has rolled back.

Note:

The results of a committed subtransaction are relative to the completion of its ancestor transactions, that is, these results can be undone if any ancestor transaction is rolled back.

Participant Operations Behavior

Each application participant must behave in a certain way to ensure that the two-phase commit protocol can complete the transactions correctly.

prepare

This operation ask the participant to vote on the outcome of the transaction. Possible replies are:

- **'VoteReadOnly'** - if no data associated with the transaction has been modified VoteReadOnly may be returned. The Resource can forget all knowledge of the transaction and terminate.
- **'VoteCommit'** - if the Resource is able to write all the data needed to commit the transaction to a stable storage, VoteCommit may be returned. The Resource will then wait until it is informed of the outcome of the transaction. The Resource may, however, make a unilateral decision (Heuristic) to commit or rollback changes associated with the transaction. When the Resource is informed of the true outcome (rollback/commit) and it is equal to the Heuristic decision the Resource just return 'ok'. But, if there is a mismatch and the commit-operation is irreversible, the Resource must raise a *Heuristic Exception* and wait until the `forget` operation is invoked. The Heuristic Decision must be recorded in stable storage.
- **'VoteRollback'** - the Resource may vote VoteRollback under any circumstances. The Resource can forget all knowledge of the transaction and terminate.

Note:

Before replying to the prepare operation, the Resource must record the prepare state, the reference of its superior *RecoveryCoordinator* in stable storage. The RecoveryCoordinator is obtained when registering as a participant in a transaction.

rollback

The Resource should, if necessary, rollback all changes made as part of the transaction. If the Resource is not aware of the transaction it should do nothing, e.g., recovered after a failure and have no data in stable storage. Heuristic Decisions must be handled as described above.

commit

The Resource should, if necessary, commit all changes made as part of the transaction. If the Resource is not aware of the transaction it should do nothing, e.g., recovered after a failure and have no data in stable storage. Heuristic Decisions must be handled as described above.

commit_one_phase

If possible, the Resource should commit all changes made as part of the transaction. If it cannot, it should raise the TRANSACTION_ROLLEDBACK exception. This operation can only be used if the Resource is the only child of its parent. If a failure occurs the completion of the operation must be retried when the failure is repaired. Heuristic Decisions must be handled as described above.

forget

If the Resource raised a Heuristic Exception to `commit`, `rollback` or `commit_one_phase` this operation will be performed. The Resource can forget all knowledge of the transaction and terminate.

commit_subtransaction

If the `SubtransactionAwareResource` have been registered with a **subtransaction** using the operation `CosTransactions_Coordinator:register_subtran_aware/2` it will be notified when the transaction has committed. The Resource may raise the exception `'TRANSACTION_ROLLEDBACK'`.

> **Note:**
>
> The result of a committed subtransaction is relative to the completion of its ancestor transactions, that is, these results can be undone if any ancestor transaction is rolled back.

rollback_subtransaction

If the `SubtransactionAwareResource` have been registered with a **subtransaction** using the operation `CosTransactions_Coordinator:register_subtran_aware/2` it will be notified when the subtransaction has rolled back.

How to Run Everything

Below is a short transcript on how to run cosTransactions.

```
%% Start Mnesia and Orber
mnesia:delete_schema([node()]),
mnesia:create_schema([node()]),
orber:install([node()]),
application:start(mnesia),
application:start(orber),

%% Register CosTransactions in the IFR.
'oe_CosTransactions':'oe_register'(),

%% Register the application specific Resource implementations
%% in the IFR.
'oe_ownResourceImpl':'oe_register'(),

%%-- Set parameters --
%% Timeout can be either 0 (no timeout) or an integer N > 0.
%% The later state that the transaction should be rolled
%% back if the transaction have not completed within N seconds.
TimeOut = 0,

%% Do we want the transaction to report Heuristic Exceptions?
%% This variable must be boolean and indicates the way the
%% Terminator should behave.
Heuristics = true,

%% Start the cosTransactions application.
cosTransactions:start(),  %% or application:start(cosTransactions),

%% Start a factory using the default configuration
TrFac = cosTransactions:start_factory(),
%% ... or use configuration parameters.
TrFac = cosTransactions:start_factory([{typecheck, false}, {hash_max, 3013}]),

%% Create a new top-level transaction.
Control = 'CosTransactions_TransactionFactory':create(TrFac, TimeOut),

%% Retrieve the Coordinator and Terminator object references from
%% the Control Object.
Term = 'CosTransactions_Control':get_terminator(Control),
Coord = 'CosTransactions_Control':get_coordinator(Control),

%% Create two SubTransactions with the root-Coordinator as parent.
SubCont1 = 'CosTransactions_Coordinator':create_subtransaction(Coord),
SubCont2 = 'CosTransactions_Coordinator':create_subtransaction(Coord),

%% Retrieve the Coordinator references from the Control Objects.
SubCoord1 = 'CosTransactions_Control':get_coordinator(SubCont1),
SubCoord2 = 'CosTransactions_Control':get_coordinator(SubCont2),

%% Create application Resources. We can, for example, start the Resources
%% our selves or look them up in the naming service. This is application
%% specific.
Res1 = ...
Res2 = ...
Res3 = ...
Res4 = ...

%% Register Resources with respective Coordinator. Each call returns
%% a RecoveryCoordinator object reference.
RC1 = 'CosTransactions_Coordinator':register_resource(SubCoord1, Res1),
RC2 = 'CosTransactions_Coordinator':register_resource(SubCoord1, Res2),
RC3 = 'CosTransactions_Coordinator':register_resource(SubCoord2, Res3),
RC4 = 'CosTransactions_Coordinator':register_resource(SubCoord2, Res4),

%% Register Resource 4 with SubCoordinator 1 so that the Resource will be
```

```
%% informed when the SubCoordinator commits or roll-back.
'CosTransactions_Coordinator':register_subtran_aware(SubCoord1, Res4),

%% We are now ready to try to commit the transaction. The second argument
%% must be a boolean
Outcome = (catch 'CosTransactions_Terminator':commit(Term, Heuristics)),
```

Note:

For the cosTransaction application to be able to recognize if a Resource is dead or in the process of restarting the Resource must be started as persistent, e.g., 'OwnResource':oe_create_link(Env, [{regname, {global, RegName}}, {persistent, true}]). For more information see the Orber documentation.

The outcome of the transaction can be:

- ok - the transaction was successfully committed.
- {'EXCEPTION', HeuristicExc} - at least one participant made a Heuristic decision or, due to a failure, one or more participants where unreachable.
- {'EXCEPTION', #'TRANSACTION_ROLLEDBACK'{}} - the transaction was successfully rolled back.
- Any system exception - the transaction failed with unknown reason.

1.5 Resource Skeletons

1.5.1 Resource Skeletons

This chapter provides a skeleton for application Resources. For more information see the Orber documentation.

```
%%%----------------------------------------------------------
%%% File    : Module_Interface_impl.erl
%%% Author  :
%%% Purpose :
%%% Created :
%%%----------------------------------------------------------

-module('Module_Interface_impl').

%%--------------- INCLUDES -----------------------------------
-include_lib("orber/include/corba.hrl").
-include_lib("cosTransactions/include/CosTransactions.hrl").

%%--------------- EXPORTS------------------------------------
%%- Inherit from CosTransactions::Resource ------------------
-export([prepare/2,
         rollback/2,
         commit/2,
         commit_one_phase/2,
         forget/2]).

%%- Inherit from CosTransactions::SubtransactionAwareResource
-export([commit_subtransaction/3,
         rollback_subtransaction/2]).

%%--------------- gen_server specific ------------------------
-export([init/1, terminate/2, code_change/3, handle_info/2]).

%%----------------------------------------------------------
%% function : gen_server specific
%%----------------------------------------------------------
init(Env) ->
    %% 'trap_exit' optional
    process_flag(trap_exit,true),

    %%--- Possible replies ---
    %% Reply and await next request
    {ok, State}.

    %% Reply and if no more requests within Time the special
    %% timeout message should be handled in the
    %% Module_Interface_impl:handle_info/2 call-back function (use the
    %% IC option {{handle_info, "Module::Interface"}, true}).
    {ok, State, TimeOut}.

     %% Return ignore in order to inform the parent, especially if it is a
     %% supervisor, that the server, as an example, did not start in
     %% accordance with the configuration data.
     ignore.

     %% If the initializing procedure fails, the reason
     %% is supplied as StopReason.
     {stop, StopReason}.


terminate(Reason, State) ->
    ok.

code_change(OldVsn, State, Extra) ->
    {ok, NewState}.

%% If use IC option {{handle_info, "Module::Interface"}, true}
handle_info(Info, State) ->
     %%--- Possible replies ---
     %% Await the next invocation.
```

```
     {noreply, State}.
     %% Stop with Reason.
     {stop, Reason, State}.


%%- Inherit from CosTransactions::Resource -------------------
prepare(State) ->

    %%% Do application specific actions here %%%

    %%-- Reply: --
    %% If no data related to the transaction changed.
    {reply, 'VoteReadOnly', State}
    %% .. or (for example):
    {stop, normal, 'VoteReadOnly', State}.

    %% If able to commit
    {reply, 'VoteCommit', State}

    %% If not able to commit
    {reply, 'VoteRollback', State}
    %% .. or (for example):
    {stop, normal, 'VoteRollback', State}.

rollback(State) ->

    %%% Do application specific actions here %%%

    %%-- Reply: --
    %% If able to rollback successfully
    {reply, ok, State}
    %% .. or (for example):
    {stop, normal, ok, State}.

    %% If Heuristic Decision. Raise exception:
    corba:raise(#'CosTransactions_HeuristicMixed' {})
    corba:raise(#'CosTransactions_HeuristicHazard' {})
    corba:raise(#'CosTransactions_HeuristicCommit'{})


commit(State) ->

    %%% Do application specific actions here %%%

    %%-- Reply: --
    %% If able to commit successfully
    {reply, ok, State}
    %% .. or (for example):
    {stop, normal, ok, State}.

    %% If the prepare operation never been invoked:
    corba:raise(#'CosTransactions_NotPrepared'{})

    %% If Heuristic Decision. Raise exception:
    corba:raise(#'CosTransactions_HeuristicMixed' {})
    corba:raise(#'CosTransactions_HeuristicHazard' {})
    corba:raise(#'CosTransactions_HeuristicRollback'{})


commit_one_phase(State) ->

    %%% Do application specific actions here %%%

    %%-- Reply: --
    %% If able to commit successfully
```

```
    {reply, ok, State}
    %% .. or (for example):
    {stop, normal, ok, State}.

    %% If fails. Raise exception:
    corba:raise(#'CosTransactions_HeuristicHazard' {})

    %% If able to rollback successfully
    corba:raise(#'CosTransactions_TransactionRolledBack' {})


forget(State) ->

    %%% Do application specific actions here %%%

    %%-- Reply: --
    {reply, ok, State}.
    %% .. or (for example):
    {stop, normal, ok, State}.



%%%%%% If the Resource is also supposed to be a     %%%%%%
%%%%%% SubtransactionAwareResource implement these. %%%%%%

%%- Inherit from CosTransactions::SubtransactionAwareResource
commit_subtransaction(State, Parent) ->
    %%% Do application specific actions here %%%

    %%-- Reply: --
    {reply, ok, State}.
    %% .. or (for example):
    {stop, normal, ok, State}.

rollback_subtransaction(State) ->
    %%% Do application specific actions here %%%

    %%-- Reply: --
    {reply, ok, State}.
    %% .. or (for example):
    {stop, normal, ok, State}.

%%--------------- END OF MODULE ------------------------------
```

2 Reference Manual

The **cosTransactions** application is an Erlang implementation of the OMG CORBA Transaction Service.

cosTransactions

Erlang module

To get access to the record definitions for the structures use:
`-include_lib("cosTransactions/include/CosTransactions.hrl").`

This module contains the functions for starting and stopping the application. If the application is started using `application:start(cosTransactions)` the default configuration is used (see listing below). The Factory reference is stored using the CosNaming Service under the id `"oe_cosTransactionsFac_IPNo"`.

The following application configuration parameters exist:

- **maxRetries** - default is 40 times, i.e., if a transaction participant is unreachable the application will retry to contact it `N` times. Reaching the maximum is considered to be a disaster.
- **comFailWait** - default is 5000 milliseconds, i.e., before the application retries to contact unreachable transaction participants the application wait `Time` milliseconds.

Exports

`start() -> Return`

Types:

`Return = ok | {error, Reason}`

This operation starts the cosTransactions application.

`stop() -> Return`

Types:

`Return = ok | {error, Reason}`

This operation stops the cosTransactions application.

`start_factory() -> TransactionFactory`

Types:

`TransactionFactory = #objref`

This operation creates a *Transaction Factory*. The Factory is used to create a new top-level *transaction* using default options (see listing below).

`start_factory(FacDef) -> TransactionFactory`

Types:

`FacDef = [Options], see Option listing below.`
`TransactionFactory = #objref`

This operation creates a *Transaction Factory*. The Factory is used to create a new top-level transaction.

The FacDef list must be a list of {Item, Value} tuples, where the following values are allowed:

- {hash_max, HashValue} - This value denotes the upper bound of the hash value the *Coordinator* uses. Default is `1013`. HashValue must be an integer.
- {allow_subtr, Boolean} - If set to true it is possible to create *subtransactions*. Default is `true`.

- {typecheck, Boolean} - If set to to true all transaction operation's arguments will be type-checked. Default is `true`.
- {tty, Boolean} - Enables or disables error printouts to the tty. If Flag is false, all text that the error logger would have sent to the terminal is discarded. If Flag is true, error messages are sent to the terminal screen.
- {logfile, FileName} - This function makes it possible to store all system information in `FileName` (string()). It can be used in combination with the tty(false) item in to have a silent system, where all system information are logged to a file. As default no logfile is used.
- `{maxRetries, Integer}` - default is 40 times, i.e., if a transaction participant is unreachable the application will retry to contact it `N` times. Reaching the maximum is considered to be a disaster. This option overrides the application configuration parameter.
- `{comFailWait, Integer}` - default is 5000 milliseconds, i.e., before the application retries to contact unreachable transaction participants the application wait `Time` milliseconds. This option overrides the application configuration parameter.

`stop_factory(TransactionFactory) -> Reply`

Types:

```
TransactionFactory = #objref
Reply = ok | {'EXCEPTION', E}
```

This operation stop the target transaction factory.

CosTransactions_Control

Erlang module

To get access to the record definitions for the structures use:
`-include_lib("cosTransactions/include/CosTransactions.hrl").`

Exports

`get_coordinator(Control) -> Return`

Types:

```
Control = #objref
Return = Coordinator | {'EXCEPTION', E}
Coordinator = #objref
E = #'CosTransactions_Unavailable' {}
```

This operation returns the Coordinator object associated with the target object. The Coordinator supports operations for termination of a transaction.

`get_terminator(Control) -> Return`

Types:

```
Control = #objref
Return = Terminator | {'EXCEPTION', E}
Terminator = #objref
E = #'CosTransactions_Unavailable' {}
```

This operation returns the Terminator object associated with the target object. The Terminator supports operations for termination of a transaction.

CosTransactions_Coordinator

Erlang module

To get access to the record definitions for the structures use:
`-include_lib("cosTransactions/include/CosTransactions.hrl").`

Exports

`create_subtransaction(Coordinator) -> Control`

Types:

```
Coordinator = #objref
Control = #objref
```

A new subtransaction is created whose parent is the Coordinator argument.

Raises exception:

- 'SubtransactionsUnavailable' - if nested transactions are not supported.
- 'Inactive' - if target transaction has already been prepared.

`get_transaction_name(Coordinator) -> Name`

Types:

```
Coordinator = #objref
Name = string() of type "oe_name@machine_type_timestamp"
```

Returns a printable string, which describe the transaction. The main purpose is to support debugging.

`get_parent_status(Coordinator) -> Status`

Types:

```
Coordinator = #objref
Status = atom()
```

Returns the status of the parent transaction associated with the target object. If the target object is a top-level transaction this operation is equivalent to `get_status/1` operation.

Possible Status replies:

- 'StatusCommitted'
- 'StatusCommitting'
- 'StatusMarkedRollback'
- 'StatusRollingBack'
- 'StatusRolledBack'
- 'StatusActive'
- 'StatusPrepared'
- 'StatusUnknown'
- 'StatusNoTransaction'
- 'StatusPreparing'

get_status(Coordinator) -> Status

Types:

Coordinator = #objref
Status = atom()

Returns the status of the transaction associated with the target object.

get_top_level_status(Coordinator) -> Status

Types:

Coordinator = #objref
Status = atom()

Returns the status of the top-level transaction associated with the target object.

hash_top_level_tran(Coordinator) -> Return

Types:

Coordinator = #objref
Return = integer()

Returns a hash code for the top-level transaction associated with the target object. Equals the operation `hash_transaction/1` if the target object is a top-level transaction.

hash_transaction(Coordinator) -> Return

Types:

Coordinator = #objref
Return = integer()

Returns a hash code for the transaction associated with the target object.

is_descendant_transaction(Coordinator, OtherCoordinator) -> Return

Types:

Coordinator = #objref
OtherCoordinator = #objref
Return = Boolean

Returns true if the transaction associated with the target object is a descendant of the transaction associated with the parameter object.

is_same_transaction(Coordinator, OtherCoordinator) -> Return

Types:

Coordinator = #objref
OtherCoordinator = #objref
Return = Boolean

Returns true if the transaction associated with the target object is related to the transaction associated with the parameter object.

is_top_level_transaction(Coordinator) -> Return

Types:

```
Coordinator = #objref
Return = Boolean
```

Returns true if the transaction associated with the target object is a top-level transaction.

`register_resource(Coordinator, Resource) -> RecoveryCoordinator`

Types:

```
Coordinator = #objref
Resource = #objref
RecoveryCoordinator = #objref
```

This operation registers the parameter `Resource` object as a participant in the transaction associated with the target object. The `RecoveryCoordinator` returned by this operation can be used by this Resource during recovery.

> **Note:**
>
> The Resources will be called in FIFO-order when preparing or committing. Hence, be sure to register the Resources in the correct order.

Raises exception:

- 'Inactive' - if target transaction has already been prepared.

`register_subtran_aware(Coordinator, SubtransactionAwareResource) -> Return`

Types:

```
Coordinator = #objref
Return = ok
```

This operation registers the parameter `SubtransactionAwareResource` object such that it will be notified when the transaction, associated wit the target object, has committed or rolled back.

> **Note:**
>
> The Resources will be called in FIFO-order. Hence, be sure to register the Resources in the correct order.

`rollback_only(Coordinator) -> Return`

Types:

```
Coordinator = #objref
Return = ok
```

The transaction associated with the target object is modified so the only possible outcome is to rollback the transaction.

CosTransactions_RecoveryCoordinator

Erlang module

To get access to the record definitions for the structures use:
`-include_lib("cosTransactions/include/CosTransactions.hrl").`

Exports

`replay_completion(RecoveryCoordinator, Timeout, Resource) -> Return`

Types:

```
RecoveryCoordinator = #objref
Timeout = integer(), milliseconds | 'infinity'
Resource = #objref
Return = Status | {'EXCEPTION', E}
E = #'CosTransactions_NotPrepared'{}
Status = atom()
```

The `RecoveryCoordinator` object is returned by the operation `CosTransactions_Coordinator:register_resource/3`. The `replay_completion/2` may only be used by the registered Resource and returns the current status of the transaction. The operation is used when recovering after a failure.

Possible Status replies:

- 'StatusCommitted'
- 'StatusCommitting'
- 'StatusMarkedRollback'
- 'StatusRollingBack'
- 'StatusRolledBack'
- 'StatusActive'
- 'StatusPrepared'
- 'StatusUnknown'
- 'StatusNoTransaction'
- 'StatusPreparing'

Warning:

replay_completion/3 is blocking and may cause dead-lock if a child calls this function at the same time as its parent invokes an operation on the child. Dead-lock will not occur if the timeout has any value except 'infinity'.

If the call is external incoming (intra-ORB) the timeout will not be activated. Hence, similar action must be taken if the Resource resides on another vendors ORB.

CosTransactions_Resource

Erlang module

To get access to the record definitions for the structures use:
`-include_lib("cosTransactions/include/CosTransactions.hrl").`

Exports

`commit(Resource) -> Return`

Types:

```
Resource = #objref
Return = ok | {'EXCEPTION', E}
E = #'CosTransactions_NotPrepared'{} |
#'CosTransactions_HeuristicRollback'{} |
#'CosTransactions_HeuristicMixed'{} | #'CosTransactions_HeuristicHazard'{}
```

This operation instructs the Resource to commit all changes made as a part of the transaction.

The Resource can raise:

- Heuristic Exception - if a Heuristic decision is made which differ from the true outcome of the transaction. The Resource must remember the Heuristic outcome until the `forget` operation is performed.

`commit_one_phase(Resource) -> Return`

Types:

```
Resource = #objref
Return = ok | {'EXCEPTION', E}
E = #'CosTransactions_HeuristicHazard'{} |
#'CosTransactions_TransactionRolledBack'{}
```

If possible, the Resource should commit all changes made as part of the transaction, else it should raise the TRANSACTION_ROLLEDBACK exception. This operation can only be used if the Resource is the only child of its parent.

`forget(Resource) -> Return`

Types:

```
Resource = #objref
Return = ok
```

This operation informs the Resource that it is safe to forget any Heuristic decisions and the knowledge of the transaction.

`prepare(Resource) -> Return`

Types:

```
Resource = #objref
Return = Vote | {'EXCEPTION', E}
Vote = 'VoteReadOnly' | 'VoteCommit' | 'VoteRollback'
```

```
E = #'CosTransactions_HeuristicMixed'{} |
#'CosTransactions_HeuristicHazard'{}
```

This operation is invoked on the Resource to begin the two-phase commit protocol.

The Resource can reply:

- 'VoteReadOnly' - if no persistent data has been modified by the transaction. The Resource can forget all knowledge of the transaction.
- 'VoteCommit' - if the Resource has been prepared and is able to write all the data needed to commit the transaction to stable storage.
- 'VoteRollback' - under any circumstances but must do so if none of the alternatives above are applicable.
- Heuristic Exception - if a Heuristic decision is made which differ from the true outcome of the transaction. The Resource must remember the Heuristic outcome until the `forget` operation is performed.

`rollback(Resource) -> Return`

Types:

```
Resource = #objref
Return = ok | {'EXCEPTION', E}
E = #'CosTransactions_HeuristicCommit'{} |
#'CosTransactions_HeuristicMixed'{} | #'CosTransactions_HeuristicHazard'{}
```

This operation instructs the Resource to rollback all changes made as a part of the transaction.

The Resource can raise:

- Heuristic Exception - if a Heuristic decision is made which differ from the true outcome of the transaction. The Resource must remember the Heuristic outcome until the `forget` operation is performed.

CosTransactions_SubtransactionAwareResource

Erlang module

This interface inherits the CosTransactions::Resource interface. Hence, it must also support all operations defined in the Resource interface.

To get access to the record definitions for the structures use:
`-include_lib("cosTransactions/include/CosTransactions.hrl").`

Exports

`commit_subtransaction(SubtransactionAwareResource, Coordinator) -> Return`

Types:

`SubtransactionAwareResource = #objref`
`Coordinator = #objref`
`Return = ok`

If the `SubtransactionAwareResource` have been registered with a **subtransaction** using the operation `CosTransactions_Coordinator:register_subtran_aware/2`, it will be notified when the transaction has committed.

> **Note:**
>
> The results of a committed subtransaction are relative to the completion of its ancestor transactions, that is, these results can be undone if any ancestor transaction is rolled back.

`rollback_subtransaction(SubtransactionAwareResource) -> Return`

Types:

`SubtransactionAwareResource = #objref`
`Return = ok`

If the `SubtransactionAwareResource` have been registered with a transactions using the operation `CosTransactions_Coordinator:register_subtran_aware/2` it will be notified when the transaction has rolled back.

CosTransactions_Terminator

Erlang module

To get access to the record definitions for the structures use:
`-include_lib("cosTransactions/include/CosTransactions.hrl").`

Exports

`commit(Terminator, ReportHeuristics) -> Return`

Types:

```
Terminator = #objref
ReportHeuristics = boolean()
Return = ok | {'EXCEPTION', E}
E = #'CosTransactions_HeuristicMixed'{} |
#'CosTransactions_HeuristicHazrd'{} |
#'CosTransactions_TransactionRolledBack'{}
```

This operation initiates the two-phase commit protocol. If the transaction has not been marked `'rollback only'` and all the participants agree to commit, the operation terminates normally. Otherwise, the TransactionRolledBack is raised. If the parameter `ReportHeuristics` is true and inconsistent outcomes by raising an Heuristic Exception.

`rollback(Terminator) -> Return`

Types:

```
Terminator = #objref
Return = ok
```

This operation roles back the transaction.

CosTransactions_TransactionFactory

Erlang module

To get access to the record definitions for the structures use:
`-include_lib("cosTransactions/include/CosTransactions.hrl").`

Exports

`create(TransactionFactory, Timeout) -> Control`

Types:

`TransactionFactory = #objref`
`Timeout = integer()`
`Control = #objref`

This operation creates a new top-level transaction.

The `Timeout` argument can be:

- 0 - no timeout.
- N (integer() > 0) - the transaction will be subject to being rolled back if it does not complete before N seconds have elapsed.