cosTime Application

version 1.1

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Contents

Chapter 1

cosTime User's Guide

The *cosTime* application is an Erlang implementation of the OMG CORBA Time and TimerEvent Services.

1.1 The cosTime Application

1.1.1 Content Overview

The cosTime documentation is divided into three sections:

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

1.1.2 Brief Description of the User's Guide

The User's Guide contains the following parts:

- cosTime overview
- cosTime installation
- A tutorial example

1.2 Introduction to cosTime

1.2.1 Overview

The cosTime application is Time and TimerEvent Services compliant with the OMG[1] Services CosTime and CosTimerEvent.

[1] URL: `http://www.omg.org`

Purpose and Dependencies

This application use `calender:now_to_universal_time(Now)` to create a UTC. Hence, the underlying OS must deliver a correct result when calling `erlang:now()`.

cosTime is dependent on *Orber*, which provides CORBA functionality in an Erlang environment.

cosTimerEvent is dependent on *Orber* and *cosNotification*, which provides CORBA functionality and Event handling in an Erlang environment.

Prerequisites

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

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*.

1.3 Installing cosTime

1.3.1 Installation Process

This chapter describes how to install cosTime [page 19] in an Erlang Environment.

Preparation

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

Configuration

When using both the Time and TimerEvent Services the `cosTime` application first must be installed using `cosTime:install_time()` and `cosTime:install_timerevent()`, followed by `cosTime:start()`. Now we can choose which can start the servers by using `cosTime:start_time_service(Tdf, Inaccuracy)` and `cosTime:start_timerevent_service(TimeService)`.

1.4 cosTime Examples

1.4.1 A Tutorial on How to Create a Simple Service

Initiate the Application

To use the complete cosTime application Time and Timer Event Services must be installed. The application is then started by using `cosTime:start()`. To get access to Time Service or Timer Event Service, use `start_time_service/2` or `start_timerevent_service/1`.

The Time Service are global, i.e., there may only exist one instance per Orber domain.

The Timer Event Service is locally registered, i.e., there may only exist one instance per node.

> **Note:**
> The Time and Timer Event Service use the time base *15 october 1582 00:00*. Performing operations using other time bases will not yield correct result. Furthermore, time and inaccuracy must be expressed in 100 nano seconds.

How to Run Everything

Below is a short transcript on how to run cosTime.

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

%% Install Time Service in the IFR.
cosTime:install_time(),

%% Install Timer Event Service in the IFR. Which, require
%% the Time Service and cosEvent or cosNotification
%% application to be installed.
cosNotification:install(),
cosTime:install_timerevent(),

%% Now start the application and necessary services.
cosTime:start(),
%% Tdf == Time displacement factor
%% Inaccuracy measured in 100 nano seconds
TS=cosTime:start_time_service(TDF, Inaccuracy),
TES=cosTime:start_timerevent_service(TS),

%% Access a cosNotification Proxy Push Consumer. How this is
%% done is implementation specific.
ProxyPushConsumer = ....

%% How we construct the event is also implementation specific.
AnyEvent = ....

%% Create a new relative universal time.
%% Time measured in 100 nano seconds.
UTO='CosTime_TimeService':
      new_universal_time(TS, Time, Inaccuracy, TDF),
EH='CosTimerEvent_TimerEventService':
      register(TES, ProxyPushConsumer, AnyEvent),

%% If we want to trigger one event Time*10^-7 seconds from now:
'CosTimerEvent_TimerEventHandler':set_timer(EH, 'TTRelative', UTO),

%% If we want to trigger an event every Time*10^-7 seconds, starting
```

```
%% Time*10^-7 seconds from now:
'CosTimerEvent_TimerEventHandler':set_timer(EH, 'TTPeriodic', UTO),

%% If we want to use absolute time we must retrieve such an object.
%% One way is to convert the one we got, UTO, by using:
UTO2='CosTime_UTO':absolute_time(UTO),
%% If any other way is used, the correct time base MUST be used, i.e.,
%% 15 october 1582 00:00.
'CosTimerEvent_TimerEventHandler':set_timer(EH, 'TTAbsolute', UTO2),
```

1.5 cosTime Release Notes

1.5.1 cosTime 1.1, Release Notes

Improvements and new features

- The stub/skeleton-files generated by IC have been improved, i.e., depending on the IDL-files, reduced the size of the erl- and beam-files and decreased dependencies off Orber's Interface Repository. It is necessary to re-compile all IDL-files and use COS-applications, including Orber, compiled with IC-4.2.
  Own id: OTP-4576

Fixed bugs and malfunctions

-

Incompatibilities

-

Known bugs and problems

-

1.5.2 cosTime 1.0.1.1, Release Notes

Improvements and new features

-

Fixed bugs and malfunctions

-

Incompatibilities

- An includepath in `CosTimerEvent.idl` have been changed. Hence, if you include this file you should check your include paths for your IDL-file(s), i.e., add the path to CosEventComm.idl.
  Own Id: OTP-4093

Known bugs and problems

-

1.5.3 cosTime 1.0.1, Release Notes

Improvements and new features

- First release of the cosTime application.
  Own Id: -

Fixed bugs and malfunctions

-

Incompatibilities

-

Known bugs and problems

-

cosTime Reference Manual

Short Summaries

- Erlang Module **CosTime_TIO** [page 10] – This module implements the OMG CosTime::TIO interface.
- Erlang Module **CosTime_TimeService** [page 12] – This module implements the OMG CosTime::TimeService interface.
- Erlang Module **CosTime_UTO** [page 14] – This module implements the OMG CosTime::UTO interface.
- Erlang Module **CosTimerEvent_TimerEventHandler** [page 16] – This module implements the OMG CosTimerEvent::TimerEventHandler interface.
- Erlang Module **CosTimerEvent_TimerEventService** [page 18] – This module implements the OMG CosTimerEvent::TimerEventService interface.
- Erlang Module **cosTime** [page 19] – The main module of the cosTime application

CosTime_TIO

The following functions are exported:

- `'_get_time_interval'(TIO) -> TimeInterval`
  [page 10] Return the interval associated with the target object
- `spans(TIO, UTO) -> Reply`
  [page 10] Return an OverlapType which describe how the interval in the target object and the timerange represented by the UTO object overlap
- `overlaps(TIO, OtherTIO) -> Reply`
  [page 10] Return an OverlapType which describe how the interval in the target object and the timerange represented by the TIO object overlap
- `time(TIO) -> UTO`
  [page 11] Return a UTO in which the interval equals the time interval in the target object and time value is the midpoint of the interval

CosTime_TimeService

The following functions are exported:

- `universal_time(TimeService) -> Reply`
  [page 12] Return the current time and the Inaccuracy given when starting this application in a UTO

- `new_universal_time(TimeService, Time, Inaccuracy, Tdf) -> UTO`
  [page 12] Create a new UTO object representing the time parameters given
- `uto_from_utc(TimeService, Utc) -> UTO`
  [page 12] Create a UTO representing the given time in Utc form
- `new_interval(TimeService, Lower, Upper) -> TIO`
  [page 12] Create a new TIO object representing the input parameters

CosTime_UTO

The following functions are exported:

- `'_get_time'(UTO) -> ulonglong()`
  [page 14] Return the time associated with the target object
- `'_get_inaccuracy'(UTO) -> ulonglong()`
  [page 14] Return the inaccuracy associated with the target object
- `'_get_tdf'(UTO) -> short()`
  [page 14] Return the time displacement factor associated with the target object
- `'_get_utc_time'(UTO) -> UtcT`
  [page 14] Return the data associated with the target object in Utc form
- `absolute_time(UTO) -> OtherUTO`
  [page 14] Create a new UTO object representing the time in the target object added to current time (UTC)
- `compare_time(UTO, ComparisonType, OtherUTO) -> Reply`
  [page 15] Compare the time associated with the target object and the given UTO object
- `time_to_interval(UTO, OtherUTO) -> TIO`
  [page 15] Create a TIO representing the interval between the target object and the given UTO midpoint times
- `interval(UTO) -> TIO`
  [page 15] Create a TIO object representing the error interval around the time value represented by the target object

CosTimerEvent_TimerEventHandler

The following functions are exported:

- `'_get_status'(TimerEventHandler) -> Reply`
  [page 16] Return the status of the target object
- `time_set(TimerEventHandler) -> Reply`
  [page 16] Return `true` if the time has been set for an event that is yet to be triggered, `false` otherwise. The outparameter represents the current time value of the target object
- `set_timer(TimerEventHandler, TimeType, TriggerTime) -> void()`
  [page 16] Terminate terminate any previous set trigger, and set a new trigger specified by the `TimeType` and `UTO` objects
- `cancel_timer(TimerEventHandler) -> boolean()`
  [page 17] Cancel, if possible, triggering of event(s). Return `true` if an event is actually cancelled, `false` otherwise
- `set_data(TimerEventHandler, EventData) -> ok`
  [page 17] Change the event data sent when triggered

CosTimerEvent_TimerEventService

The following functions are exported:

- `register(TimerEventService, CosEventCommPushConsumer, Data) -> TimerEventHandler`
  [page 18] Create a new `TimerEventHandler` object which push the given `Data` to given `CosEventCommPushConsumer` after the timer have been set
- `unregister(TimerEventService, TimerEventHandler) -> ok`
  [page 18] Terminate the target TimerEventHandler object
- `event_time(TimerEventService, TimerEvent) -> UTO`
  [page 18] Return a UTO containing the time at which the associated event was triggered

cosTime

The following functions are exported:

- `install_time() -> Return`
  [page 19] Install the cosTime Time Service part application
- `uninstall_time() -> Return`
  [page 19] Uninstall the cosTime Time Service part application
- `install_timerevent() -> Return`
  [page 19] Install the cosTime Timer Event Service part application
- `uninstall_timerevent() -> Return`
  [page 20] Uninstall the cosTime Timer Event Service part application
- `start() -> Return`
  [page 20] Start the cosTime application
- `stop() -> Return`
  [page 20] Stop the cosTime application
- `start_time_service(Tdf, Inaccuracy) -> Return`
  [page 20] Start a Time Service object
- `stop_time_service(TimeService) -> ok`
  [page 20] Stop the target Time Service object
- `start_timerevent_service(TimeService) -> ok`
  [page 20] Start a Timer Event Service object
- `stop_timerevent_service(TimerEventService) -> ok`
  [page 21] Stop the target Timer Event Service object

CosTime_TIO

Erlang Module

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

Exports

`'_get_time_interval'(TIO) -> TimeInterval`

Types:

- TIO = #objref
- TimeInterval = #'TimeBase_IntervalT{lower_bound, upper_bound}
- lower_bound = upper_bound = ulonglong

This operation returns the interval associated with the target object.

`spans(TIO, UTO) -> Reply`

Types:

- TIO = UTO = OtherTIO = #objref
- Reply = {OverlapType, OtherTIO}
- OverlapType = 'OTContainer' | 'OTContained' | 'OTOverlap' | 'OTNoOverlap'

This operation returns a *OverlapType* depending on how the interval in the target object and the timerange represented by the UTO object overlap. If the OverlapType is 'OTNoOverlap' the out parameter represents the gap between the two intervals. If OverlapType is one of the others, the out parameter represents the overlap interval. The definitions of the OverlapType's are:

- 'OTContainer' - target objects lower and upper limits are, respectively, less or equal to and greater or equal to given object's.
- 'OTContained' - target objects lower and upper limits are, respectively, greater or equal to and less or equal to given object's.
- 'OTOverlap' - target objects interval overlap given object's.
- 'OTNoOverlap' - target objects interval do not overlap given object's.

`overlaps(TIO, OtherTIO) -> Reply`

Types:

- TIO = OtherTIO = AnotherTIO = #objref
- Reply = {OverlapType, AnotherTIO}
- OverlapType = 'OTContainer' | 'OTContained' | 'OTOverlap' | 'OTNoOverlap'

This operation returns a *OverlapType* depending on how the interval in the target object and the timerange represented by the TIO object overlap. The OverlapType's are described under spans/2.

`time(TIO) -> UTO`

Types:

- TIO = UTO = #objref

This operation returns a UTO in which the interval equals the time interval in the target object and time value is the midpoint of the interval.

CosTime_TimeService

Erlang Module

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

Exports

`universal_time(TimeService) -> Reply`

Types:

- TimeService = #objref
- Reply = UTO | {'EXCEPTION", #'TimerService_TimeUnavailable'{}}
- UTO = #objref

This operation returns the current time and the Inaccuracy given when starting this application in a UTO. The time base is *15 october 1582 00:00*. Comparing two time objects which use different time base is, by obvious reasons, pointless.

`new_universal_time(TimeService, Time, Inaccuracy, Tdf) -> UTO`

Types:

- TimeService = UTO = #objref
- Time = Inaccuracy = ulonglong()
- Tdf = short()

This operation creates a new UTO object representing the time parameters given. This is the only way to create a UTO with an arbitrary time from its components. This is useful when using the Timer Event Service.

`uto_from_utc(TimeService, Utc) -> UTO`

Types:

- TimeService = UTO = #objref
- Utc = #'TimeBase_UtcT'{time, inacclo, inacchi, tdf}
- time = ulonglong()
- inacclo = ulong()
- inacchi = ushort()
- tdf = short()

This operation is used to create a UTO given a time in the Utc form.

`new_interval(TimeService, Lower, Upper) -> TIO`

Types:

- TimeService = TIO = #objref
- Lower = Upper = ulonglong()

This operation is used to create a new TIO object, representing the input parameters. If *Lower* is greater than Upper BAD_PARAM is raised.

CosTime_UTO

Erlang Module

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

Exports

`'_get_time'(UTO) -> ulonglong()`

Types:

- UTO = #objref

This operation returns the time associated with the target object.

`'_get_inaccuracy'(UTO) -> ulonglong()`

Types:

- UTO = #objref

This operation returns the inaccuracy associated with the target object.

`'_get_tdf'(UTO) -> short()`

Types:

- UTO = #objref

This operation returns the time displacement factor associated with the target object.

`'_get_utc_time'(UTO) -> UtcT`

Types:

- UTO = #objref
- Utc = #'TimeBase_UtcT'{time, inacclo, inacchi, tdf}
- time = ulonglong()
- inacclo = ulong()
- inacchi = ushort()
- tdf = short()

This operation returns the data associated with the target object in Utc form.

`absolute_time(UTO) -> OtherUTO`

Types:

- UTO = OtherUTO = #objref

This operation create a new UTO object representing the time in the target object added to current time (UTC). The time base is *15 october 1582 00:00*. Comparing two time objects which use different time base is, by obvious reasons, pointless. Raises DATA_CONVERSION if causes an overflow. This operation is only useful if the target object represents a relative time.

`compare_time(UTO, ComparisonType, OtherUTO) -> Reply`

Types:

- UTO = OtherUTO = #objref
- ComparisonType = 'IntervalC' | 'MidC'
- Reply = 'TCEqualTo' | 'TCLessThan' | 'TCGreaterThan' | 'TCIndeterminate'

This operation compares the time associated with the target object and the given UTO object. The different `ComparisonType` are:

- 'MidC' - only compare the time represented by each object. Furthermore, the target object is always used as the first parameter in the comparison, i.e., if the target object's time is larger 'TCGreaterThan' will be returned.
- 'IntervalC' - also takes the inaccuracy into consideration, i.e., if the two objects interval overlaps 'TCIndeterminate' is returned, otherwise the as for 'MidC'.

`time_to_interval(UTO, OtherUTO) -> TIO`

Types:

- UTO = OtherUTO = TIO = #objref

This operation returns a TIO representing the interval between the target object and the given UTO midpoint times. The inaccuracy in the objects are not taken into consideration.

`interval(UTO) -> TIO`

Types:

- UTO = TIO = #objref

This operation creates a TIO object representing the error interval around the time value represented by the target object, i.e., `TIO.upper_bound = UTO.time+UTO.inaccuracy` and `TIO.lower_bound = UTO.time-UTO.inaccuracy`.

CosTimerEvent_TimerEventHandler

Erlang Module

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

Exports

`'_get_status'(TimerEventHandler) -> Reply`

Types:

- TimerEventHandler = #objref
- Reply = 'ESTimeSet' | 'ESTimeCleared' | 'ESTriggered' | 'ESFailedTrigger'

This operation returns the status of the target object.

- 'ESTimeSet' - timer is set to trigger event(s).
- 'ESTimeCleared' - no time set or the timer have been reset.
- 'ESTriggered' - event has already been sent.
- 'ESFailedTrigger' - tried to, but failed, sending the event.

If the target object is of type 'TTPeriodic' the status value 'ESTriggered' is not valid.

`time_set(TimerEventHandler) -> Reply`

Types:

- TimerEventHandler = #objref
- Reply = {boolean(), UTO}
- UTO = #objref

This operation returns `true` if the time has been set for an event that is yet to be triggered, `false` otherwise. The outparameter represents the current time value of the target object.

`set_timer(TimerEventHandler, TimeType, TriggerTime) -> void()`

Types:

- TimerEventHandler = #objref
- TimeType = 'TTAbsolute' | 'TTRelative' | 'TTPeriodic'
- TriggerTime = UTO
- UTO = #objref

This operation terminates any previous set trigger, and set a new trigger specified by the `TimeType` and `UTO` objects.

The relation between the UTO object and the TimeTypes are:

- 'TTAbsolute' - the UTO object must represent absolute time, i.e., number of 100 nanoseconds passed since 15 october 1582 00:00.
- 'TTRelative' - the UTO object must represent the from now until when the event should be triggered, e.g., within 30*10^7 nanoseconds.
- 'TTPeriodic' - the same as for 'TTRelative', but this option will trigger an event periodically until timer cancelled.

`cancel_timer(TimerEventHandler) -> boolean()`

Types:

- TimerEventHandler = #objref

This operation cancel, if possible, the triggering of event(s). Returns `true` if an event is actually cancelled, `false` otherwise.

`set_data(TimerEventHandler, EventData) -> ok`

Types:

- TimerEventHandler = #objref
- EventData = #any

This operation changes the event data sent when triggered.

CosTimerEvent_TimerEventService

Erlang Module

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

Exports

`register(TimerEventService, CosEventCommPushConsumer, Data) -> TimerEventHandler`

Types:

- TimerEventService = CosEventCommPushConsumer = TimerEventHandler = #objref
- Data = #any

This operation will create a new `TimerEventHandler` object which will push given `Data` to given `CosEventCommPushConsumer` after the timer have been set.

`unregister(TimerEventService, TimerEventHandler) -> ok`

Types:

- TimerEventService = TimerEventHandler = #objref

This operation will terminate the given TimerEventHandler.

`event_time(TimerEventService, TimerEvent) -> UTO`

Types:

- TimerEventService = #objref
- TimerEvent = #'CosTimerEvent_TimerEvent'{utc, event_data}
- utc =
- event_data = #any}
- UTO = #objref

This operation returns a UTO containing the time at which the associated event was triggered.

cosTime

Erlang Module

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

This module contains the functions for starting and stopping the application.

This application use the time base *15 october 1582 00:00*. Performing operations using other time bases will not yield correct result.

The OMG CosTime specification defines the operation `secure_universal_time`. As of today we cannot provide this functionality considering the criteria demanded to fulfill the OMG specification.

When using this application, time and inaccuracy supplied by the user must be given in number of *100 nano seconds*. The *Time Displacement Factor* is positive east of the meridian, while those to the west are negative.

This application use `calender:now_to_universal_time(Now)` to create a UTC. Hence, the underlying OS must deliver a correct result when calling `erlang:now()`.

When determining the inaccuracy of the system, the user should consider the way the time objects will be used. Communicating with other ORB's, add a substantial overhead and should be taken into consideration.

Exports

`install_time() -> Return`

Types:

- Return = ok | {'EXIT', Reason}

This operation installs the cosTime Time Service part application.

`uninstall_time() -> Return`

Types:

- Return = ok | {'EXIT', Reason}

This operation uninstalls the cosTime Time Service part application.

`install_timerevent() -> Return`

Types:

- Return = ok | {'EXIT', Reason}

This operation installs the cosTime Timer Event Service part application.

> **Note:**
> The Timer Event Service part requires *Time Service* part and *cosEvent* or the *cosNotification* application to be installed first.

`uninstall_timerevent() -> Return`

Types:

- Return = ok | {'EXIT', Reason}

This operation uninstalls the cosTime Timer Event Service part application.

`start() -> Return`

Types:

- Return = ok | {error, Reason}

This operation starts the cosTime application.

`stop() -> Return`

Types:

- Return = ok | {error, Reason}

This operation stops the cosTime application.

`start_time_service(Tdf, Inaccuracy) -> Return`

Types:

- Tdf = short()
- Inaccuracy = ulonglong(), eq. #100 nano seconds
- Return = ok | {'EXCEPTION', #'BAD_PARAM'{}}

This operation starts a Time Service server. Please note that there may only be exactly one Time Service active at a time. The `Inaccuracy` parameter defines the inaccuracy the underlying OS will introduce. Remember to take into account latency when passing time object between nodes.

`stop_time_service(TimeService) -> ok`

Types:

- TimeService = #objref

This operation stops the Time Service object.

`start_timerevent_service(TimeService) -> ok`

Types:

- TimeService = #objref

This operation starts a Timer Event Service server. Please note that there may only be exactly one Timer Event Service per node active at a time. The supplied TimeServcie reference will be the object Timer Event Service contacts to get access to a new UTC.

`stop_timerevent_service(TimerEventService) -> ok`

Types:

- TimerEventService = #objref

This operation stops the Timer Event Service object.

Index of Modules and Functions

Modules are typed in *this way*.
Functions are typed in `this way`.