# cosTime

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# 1 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** Services CosTime and CosTimerEvent.

#### 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* 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),
```

# 2 Reference Manual

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

# 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.

# 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.