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EPTF CLL Red Black Tree, User Guide

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# Introduction

## Revision history

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| --- | --- | --- | --- |
| Date | Rev | Characteristics | Prepared |
| 2007-11-30 | PA1 | First draft version | EGBOTAT |
| 2007-12-06 | PA2 | Final version after review | EGBOTAT |
| 2011-09-15 | PB1 | Added refactored Red Black Tree | EGBOTAT |
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## About this Document

### How to Read this Document

This is the User Guide for the Red Black Tree of the Ericsson Performance Test Framework (TitanSim), Core Load Library (CLL). TitanSim CLL is developed for the TTCN-3 ‎[1] Toolset with TITAN ‎[2]. This document should be read together with the Function Description of the Red Black Tree feature ‎[6]. For more information on the TitanSim CLL please consult the Product Revision Information ‎[3], the Users Guide ‎[4] and the Function Specification ‎[5] of the TitanSim.

### References

1. ETSI ES 201 873-1 v3.2.1 (2007-02)  
   The Testing and Test Control Notation version 3. Part 1: Core Language
2. 1/198 17-CRL 113 200 Uen  
   User Guide for the TITAN TTCN-3 Test Executor
3. 109 21-CNL 113 512-2 Uen   
   TitanSim CLL for TTCN-3 toolset with TITAN, Product Revision Information
4. 155 17-CNL 113 512 Uen   
   TitanSim CLL for TTCN-3 toolset with TITAN, Function Specification
5. 198 17-CNL 113 512 Uen  
   TitanSim CLL for TTCN-3 toolset with TITAN, User Guide
6. 12/155 16-CNL 113 512 Uen  
   EPTF CLL Red Black Tree, Function Description
7. TitanSim CLL for TTCN-3 toolset with TITAN, Reference Guide  
   <http://ttcn.ericsson.se/products/libraries.shtml>

### Abbreviations

CLL Core Load Library

EPTF Ericsson Load Test Framework, formerly TITAN Load Test Framework

TitanSim Ericsson Load Test Framework, formerly TITAN Load Test Framework

TTCN-3 Testing and Test Control Notation version 3 ‎[1]

### Terminology

*TitanSim Core (Load) Library(CLL)* is that part of the TitanSim software that is totally project independent. (I.e., which is not protocol-, or application-dependent). The TitanSim CLL is to be supplied and supported by the TCC organization. Any TitanSim CLL development is to be funded centrally by Ericsson

*Free Busy Queue* The aim of the EPTF Free Busy Queue feature is to provide dynamic memory allocation and list element sorting for the TTCN-3 language in an efficient way.

## System Requirements

In order to use the Red Black Tree feature the system requirements listed in TitanSim CLL User Guide ‎[5] should be fulfilled.

# Red Black Tree

## Overview

The EPTF CLL Red Black Tree component is a fundamental component providing an implementation for red-black tree in a load test environment.

The EPTF Red Black Tree feature is a self-balancing binary search tree. Each node in the EPTF Red Black Tree is a linked list. This makes it possible to store more than one item with the same key, in the order of the insertion. Each item in the tree (or the lists) has a unique ID/index, which is allocated incrementally with each item-insertion into the tree. Removed items are reused in subsequent insert operations. This makes the Red Black Tree feature useful in book-keeping items in an associated array, similar to the Free Busy Queue. However, the Red Black Tree makes it also possible to search for an item by its key much quicker than with queues, and to sort these items (i.e. get a list of indices with the order of the items).

## Description of files in this feature

The EPTF CLL Red Black Tree API includes the following files:

* EPTF\_CLL\_RBT\_Definitions.ttcn: contains TTCN-3 type and component definitions for the feature
* EPTF\_CLL\_RBT\_Functions.ttcn: contains TTCN-3 function declarations and the implementation of the init/cleanup functions
* EPTF\_CLL\_RBT\_ExternalFunctions.cc: contains the C++ implementation of the external functions declared in the TTCN-3 module EPTF\_CLL\_RBT\_Functions.

Currently, the following **obsolete** implementation is also included. Please note that these files will be removed in a later release of the Core Load Library:

* Red Black Tree
  + EPTF\_CLL\_RBtree\_Definitions.ttcn: This TTCN-3 module contains common type definitions for Red Black Tree
  + EPTF\_CLL\_RBtree\_Functions.ttcnpp: This TTCN-3 module contains common function definitions for Red Black Tree
  + EPTF\_CLL\_RBtree\_PrivateFunctions.ttcnpp: This module contains private functions used by the Red Black Tree
* Integer Red Black Tree
  + EPTF\_CLL\_IntegerRBtree\_Functions.ttcnpp: This TTCN-3 module contains function definitions for the integer Red Black Tree
  + EPTF\_CLL\_IntegerRBtree\_PrivateFunctions.ttcnpp: Contains private functions used by the integer Red Black Tree
* Float Red Black Tree
  + EPTF\_CLL\_FloatRBtree\_Functions.ttcnpp: Contains function definitions for the float Red Black Tree
  + EPTF\_CLL\_FloatRBtree\_PrivateFunctions.ttcnpp: Contains private function definitions used by the float Red Black Tree

## Description of required files from other features

The Red Black Tree feature is part of the TitanSim EPTF Core Load Library (CLL). It relies on several features of the CLL. To use the Red Black Tree, the user has to obtain the respective files from the following features:

* Base
* Common

## Installation

Since EPTF CLL Red Black Tree is used as a part of the TTCN-3 test environment this requires TTCN-3 Test Executor to be installed before any operation of these functions. For more details on the installation of TTCN-3 Test Executor see the relevant section of ‎[2].

If not otherwise noted in the respective sections, the following are needed to use EPTF CLL Red Black Tree:

* Copy the files listed in section [‎2.2, ‎2.3] to the directory of the test suite or create symbolic links to them.
* Import the Red Black Tree demo or write your own application using Red Black Tree.
* Create Makefile or modify the existing one. For more details see the relevant section of ‎[2].
* Edit the config file according to your needs, see following section [‎2.5].

## Configuration

The executable test program behaviour is determined via the run-time configuration file. This is a simple text file, which contains various sections. The usual suffix of configuration files is .cfg. For further information on the configuration file see ‎[2].

This Red Black Tree feature defines TTCN-3 module parameters as defined in ‎[2] clause 4. Actual values of these parameters – when no default value or a different from the default actual value wished to be used – shall be given in the [MODULE\_PARAMETERS] section of the configuration file.

This Red Black Tree feature defines no module parameters.

# Error messages

Please note, that besides the below described error messages, error messages shown in ‎[2] or those of other used features or product may also appear.

No error messages are defined for Red Black Tree.

# Warning messages

Please note, that besides the below described warning messages, warning messages shown in ‎[2] or those of other used features or product may also appear.

No warning messages are defined for Red Black Tree.

# Examples

The “demo” directory of the deliverable contains the following examples:

* EPTF\_RedBlackTree\_demo.cfg
* EPTF\_RedBlackTree\_demo.prj
* EPTF\_RedBlackTree\_demo.ttcnpp

## Configuration file

The used configuration file (EPTF\_RedBlackTree\_demo.cfg) for the Red Black Tree example is placed in the demo directory.

## Demo Module

The demo module (EPTF\_RedBlackTree\_demo.ttcn) illustrates a typical usage of the Red Black Tree feature.