

eXtremeDB/rt for Real-time Systems

eXtremeDB/rt is the first of its kind – a commercially supported deterministic, true real-time database system.



eXtremeDB/rt is a true real-time deterministic database for mission- and safety-critical systems.

Background

For mission- and safety-critical systems' software in avionics, autonomous systems, railroad, critical control systems, and the like, time is of the essence. These systems demand deterministic, predictable, fully controllable database management that complements modern real-time operating systems' time and space partitioning and advanced real-time schedulers. Often non-interruptible and with stringent requirements on timely execution, these systems' data management impose temporal constraints on critical data and transactions that can only be met with a true real-time database system.



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eXtremeDB/rt is a first-of-its-kind commercial, supported, database management system designed to preserve the temporal validity of data through time-cognizant transaction processing that guarantees predictable execution of critical transactions. In simpler terms, eXtremeDB/rt is a deterministic, true real-time database system.

Overview

eXtremeDB/rt extends conventional eXtremeDB transaction processing by adding semantics for, and enforcing, database transaction priorities and deadline scheduling. Like conventional eXtremeDB, eXtremeDB /rt is an embedded database management system that provides services for the storage, retrieval and manipulation of data. The differences lay in the temporal requirements of the managed data, transaction scheduling policy, timing constraints on transactions, and in performance goals. Conventional eXtremeDB, like other ACID-compliant DBMSs, maintains databases' internal consistency, preventing contradictory data in the same database. In addition to preserving internal consistency, eXtremeDB /rt ensures that stored data reflects the state of the real world at a moment in time (temporal consistency). The eXtremeDB/rt kernel exposes transaction deadline semantics through a real-time transaction manager that ensures that transactions can “meet” (successfully commit) or “miss” (successfully abort) within their deadlines, but can never be “late” (run past their deadline) to commit or abort.

Implementation

The *eXtremeDB/rt* kernel modifies the conventional *eXtremeDB* kernel by making sure that all database kernel components are time-cognizant. The *eXtremeDB/rt* transaction scheduler implements two algorithms: High Priority Earliest Deadline First (EDF) algorithm and Priority Inheritance. Developers choose the best algorithm for their system's execution pattern. Transaction deadlines are enforced through a time-cognizant rollback mechanism. The database kernel identifies transactions destined to be "late", interrupts them, and forces the rollback in time to satisfy the deadline. Transactions are allowed to modify or retrieve data only if they are able to complete within the set deadlines.

Supported Platforms

Real-time applications must run in the context of a real-time operating system, or be able to access hardware resources — interrupts, timers, memory management, etc. Therefore, *eXtremeDB/rt* is currently available for the following real-time operating systems on select hardware platforms (the list of platforms is constantly expanding)

- Azure RTOS ThreadX
- Deos™, from DDC-I
- embOS® from Segger
- FreeRTOS™, a widely used real-time operating system kernel for embedded systems
- INTEGRITY, from Green Hills Software
- LynxOS-178, from Lynx Software Technologies a hard real-time partitioning operating system developed and certified to FAA DO-178B/C DAL A safety standards
- Siemen's Nucleus™
- VxWorks®, from WindRiver
- Linux, x86-64-bit (for evaluation, not for production)
- PetaLinux 2019.1 (Zynq UltraScale+ MPSoC ZCU104 with ARM-A53) (for evaluation, not for production)
- MacOS (for evaluation, not for production)
- Microsoft Windows Desktop (Visual Studio 2017, x64) (for evaluation, not for production)

eXtremeDB/rt is also available for Adaptive and Classic AUTOSAR platforms.