The Θ-Model for Distributed Fault-Tolerant Real-Time Systems

The Θ-Model is a time free, message driven system model for distributed systems, which assumes that end-to-end delays of the fastest and slowest messages simultaneously in transit over the network are correlated.

Real-Time Scheduling
During high load periods even fast messages must pass all queues and are thus slowed down due to scheduling and queuing phenomena.

Dynamic Timing Model
The behavior of a distributed system is modelled via time dependent envelope functions $d(t)$ and $D(t)$, which can be arbitrary but must satisfy $D(t)/d(t) \leq \Theta$.

Experimental Validation

Dynamic Timing Model

Distributed Computing Theory
Classic fundamental problems in Distributed Computing have provably correct and efficient solutions in the Θ-Model:

- Consensus
- Non-blocking Atomic Commitment
- The Strongly Dependent Decision problem
- Fault-Tolerant Self-Stabilization
- Round Synchronization
- Failure Detectors

FIT-IT Project DARTS
Distributed Algorithms for Robust Tick Synchronization

A clock synchronization algorithm is implemented in hardware in order to generate a fault-tolerant clock. The local clock signals supplied to different functional units are synchronized to be within $\pi(\Theta)$ cycles of each other.