# MnemoSyne - Garbage Collection in Transactional Persistent Distributed Stores

## Goal

Improve programming productivity and reliability by providing fault-tolerant automatic memory management

## Partners

Inesc

## Duration

December 1999 - November 2003

## More information

http://www.gsd/projects/mnemosyne.htm
(PRAXIS/P/EEI/12111/1998)



# Motivation

- workers and organizations carrying out cooperative tasks interacting via shared data
  - e.g.: a virtual enterprise working with interactive CAD for engineering or financial purposes
- shared data accessed either concurrently or sequentially:
  - available at different locations
  - persists beyond completion of a particular application
  - remains consistent even in presence of faults
- these needs are being addressed by several European projects
  - e.g.: PerDiS long-term-research

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## Environment: TPDS

- wide-area transactional distributed persistent stores (TPDS):
  - shared address space spanning every participating site
  - API similar to a centralized system through the use of a distributed shared memory approach
  - automatic persistence (by reachability)
  - optimistic transactional support with versions, conflict detection, and reconciliation
  - support for disconnected work and check-in/check-out operations
  - cooperative caching
  - distributed checkpointing
  - **automatic memory management (i.e. garbage collection)**



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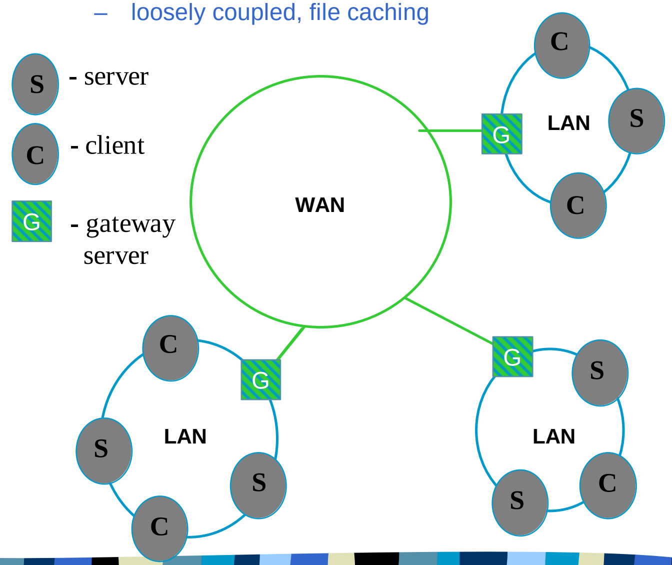
## TPDS in a Wide Area Network

- LAN
  - strongly coupled, DSM based
- WAN
  - loosely coupled, file caching



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## Problem: Maintain the Referential Integrity

- programmer must keep track of references:
  - stored on disk
  - sent to other sites
  - replicated in several objects
- manual memory management results:
  - dangling references
  - memory leaks
- in short lived applications a painful debug solves these problems, but
  - in a TPDS these errors are much more dramatic:
    - a dangling reference stored on disk will result in a fatal error much later
    - the application suffering the consequences is not responsible for the dangling reference
    - dangling references to remote objects
    - memory full of garbage preventing applications from working (due to leaks)



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## Research Issues

- consistency interference:
  - the GC must not compete with transactions for consistent data (replicated on several sites)
- integration with fault-tolerant mechanisms:
  - the GC must be safe, live and complete in presence of multi-version transactions and checkpointing
- fault-tolerance:
  - the GC must be safe, live and complete in presence of site crashes and communication failures
- scalability:
  - the GC must be capable of handling a large amount of data without the need for lots of data structures
- performance:
  - GC overhead must be acceptable

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## GC Current Solutions and Approach

- GC
  - aimed at simple systems based on function-shipping
  - no data replication
  - simple transactional support (either centralized or with no versioning)
  - no cooperative caching or distributed checkpointing
  - fault-tolerance is not fully handled:
    - site crashes
    - communication failures
  - not scalable given the large amount of data structures
- Approach
  - develop a general model of a TPDS and characterize the memory usage of applications
  - design, implement and measure a fault-tolerant GC algorithm:
  - continue previous work done in: Broadcast, PerDiS, COOP



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## References


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