Cloud-TM
Overview & Collaboration Opportunities

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At a glance

Partners:

- INESC ID (PT)
- Algorithmica (IT)
- C.I.N.I. (IT)
- Red Hat (IE)

Project coordinator: Paolo Romano, INESC ID (PT)
Duration: From June 2010 to May 2013

Programme: FP7-ICT-2009-5 – Objective 1.2
Further information: http://www.cloudtm.eu
Cloud computing: the vision

- lower barriers to entry and capital costs via usage-based pricing schemes
- minimize operating costs & carbon footprint via elastic resource provisioning
- achieve unprecedented scalability levels
Project Motivations

• Cloud computing is at the peak of its hype…

• How to materialize the vision and maximize actual productivity?

SIMPLIFYING THE DEVELOPMENT AND ADMINISTRATION OF CLOUD APPLICATIONS
Develop an open-source middleware platform for the Cloud:

1. Providing a simple and intuitive programming model:
   - hide complexity of distribution, persistence, fault-tolerance
   - let programmers focus on differentiating business value

2. Minimizing administration and monitoring costs:
   - automate elastic resource provisioning based on applications QoS requirements

3. Minimize operational costs via self-tuning
   - maximizing efficiency adapting consistency mechanisms upon changes of workload and allocated resources
The Cloud-TM Programming Paradigm: Background

• Transactional Memories (TM):
  – replace locks with atomic transactions in the programming language
  – hide away synchronization issues from the programmer
    • avoid deadlocks, priority inversions, convoying
    • way simpler to reason about, verify, compose
    • deliver performance of hand-crafted locking via speculation
  – drastically simplify development of parallel applications

• Distributed Transactional Memories (DTM):
  – extends the TM abstraction over the boundaries of a single machine
  – avoid performance pitfalls of Distributed Shared Memory by batching consistency actions at commit time
The Cloud-TM Programming Paradigm: Elastic Distributed Transactional Memory

- Elastic scale-up and scale-down of the DTM platform:
  - data distribution policies minimizing reconfiguration overhead
  - auto-scaling based on user defined QoS & cost constraints

- Transparent support for fault-tolerance via data replication:
  - self-tuning of consistency protocols driven by workload changes

- Language level support for:
  - persistence (ACI vs ACID transactions)
  - parallel transaction nesting
Architectural Overview

User-Level Application

STM

Reconfiguration Manager

Group Communication System

Reconfigurable Distributed STM

Reconfigurable Storage System

Policy Repository

WORKLOAD MONITOR

WORKLOAD ANALYZER

ADAPTATION MANAGER

Autonomic Manager
Autonomic adaptation at play

• low resources:
  - minimum costs
  • primary-backup:
  - low % write:
    low load on primary

• auto-scale up:
  - new nodes hired for
    read-only requests
  • primary-backup:
  - low % write:
    primary stands the load

• multi-master:
  - hi % write
    primary overwhelmed
  • higher scalability

• auto-scale down:
  - minimum costs
  • switch back to
    primary-backup

Legend

: node processing read-only requests
: node processing read&write requests

• low traffic
  • read-dominated
  • low conflict

• hi traffic
  • read-dominated
  • low conflict
  • write dominated
  • low conflict

High

% write

Low % write transactions

Hi % write

Low

Time

High

Hi traffic

Low traffic

reqs/sec
Project’s timeline

Dec 2010
- User requirements

June 2011
- Architecture Specification Draft
- Preliminary Prototype of RDSTM & RSS

Dec 2012
- Initial Pilot Applications
- Prototype of RDSTM & RSS
- Prototype of the Autonomic Manager

Mar 2013
- Final Pilot Applications
- Final CloudTM Prototype

June 2013
- Demonstration
- Evaluation
Opportunities for collaboration

• Standards/tools to specify and negotiate SLAs
  – focus in Cloud-TM is on performance, reliability and cost

• Standards/tools to allocate resources from the Cloud

• Tools for monitoring provided QoS

• Auto-scaling/proactive reconfiguration:
  – challenging goal common to very projects
  – in Cloud-TM we will target data intensive applications

• Achieve interoperability with storage solutions for the cloud developed by other projects
THANKS FOR THE ATTENTION

Q&A

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