Achieving Better Performance Through True Best Effort in Scavenging Grid Computing

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Introduction

Grid environment

- Heterogeneous components (software and hardware)
- Extremely dynamic
  - Can exists unexpected join/exit of nodes
  - Their topology is not fixed and therefore cannot be predefined
- No-dedicated resources (this is truer for scavenging grid)
- Usually **best-effort**
  - Same priority for all users
  - Absence of guarantees

Introduction
Typical actions and their problems

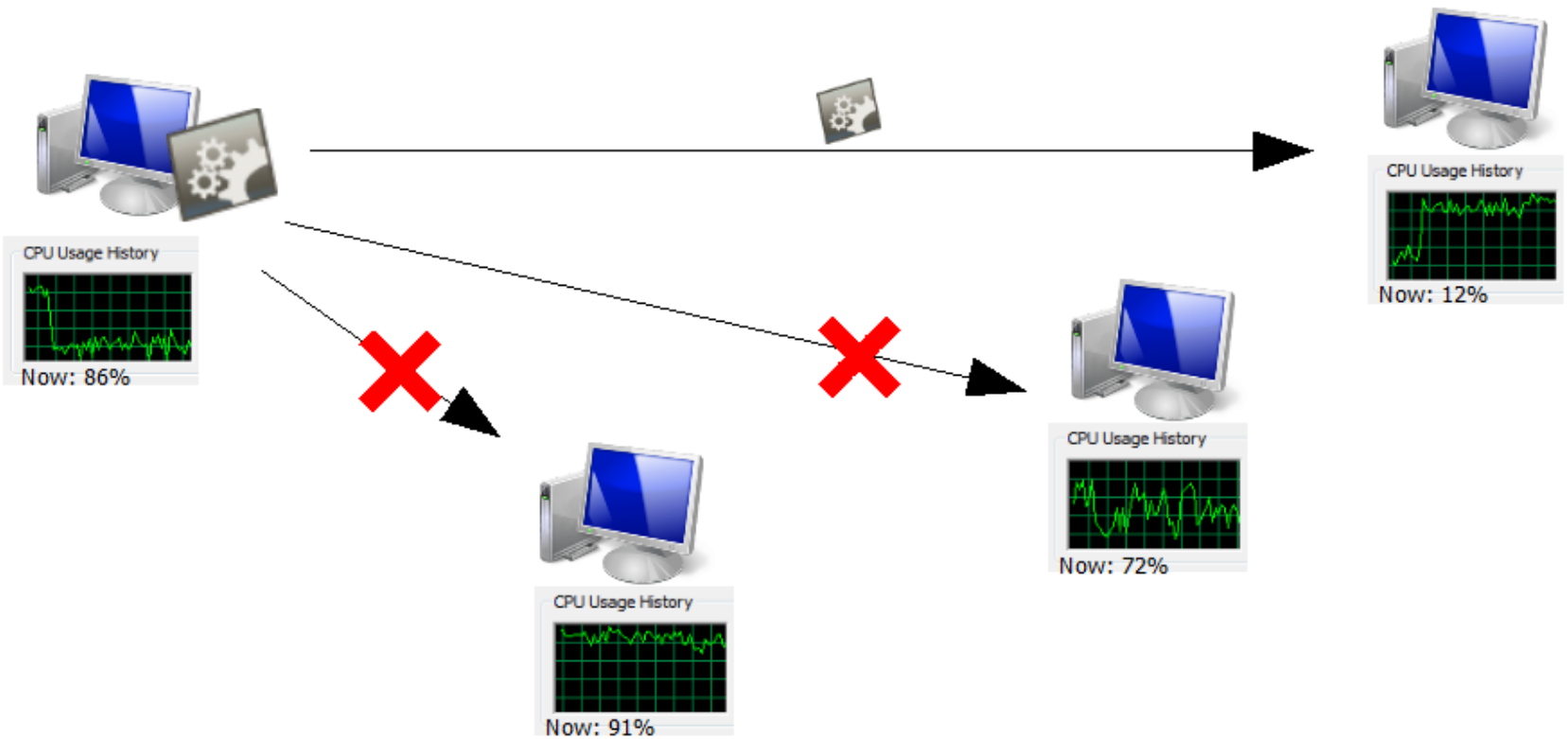
To act upon task schedules where tuning is applied through the identification of behavior patterns

- Pattern anomalies: Resource utilization diverges from the statistical values
- The arithmetic functions used to estimate the reference behavior often rule out sporadic bursts.
- Non-determinism: no guarantees that resources will stay idle

To use task migration in lack of resources. Problems:

- Constant migration affects application execution performance
- There are costs: data transfer and rollback of the tasks
- Can cause migration chaining (Migrating a task back and forth two nodes may happen)
- Lack of extra resources

Introduction
Typical actions and their problems



Introduction
Our Approach

1. Analysis of the execution pattern of local applications. Wishes:
   - Enhances the migration process of grid tasks
   - Improves the performance through **real best-effort**
2. Use of dynamic adaptation techniques as an alternative to migration
3. Research on grid middleware: InteGrade[1]

[1] http://www.integrade.org.br

Related Work

"Pre-execution" operations

- Choi *et al* analyzes the influence of the heterogeneity of grid nodes on the performance
- Scheduling algorithms that take into account the properties of volunteer nodes
- Profiling for the whole node (not for individual applications)

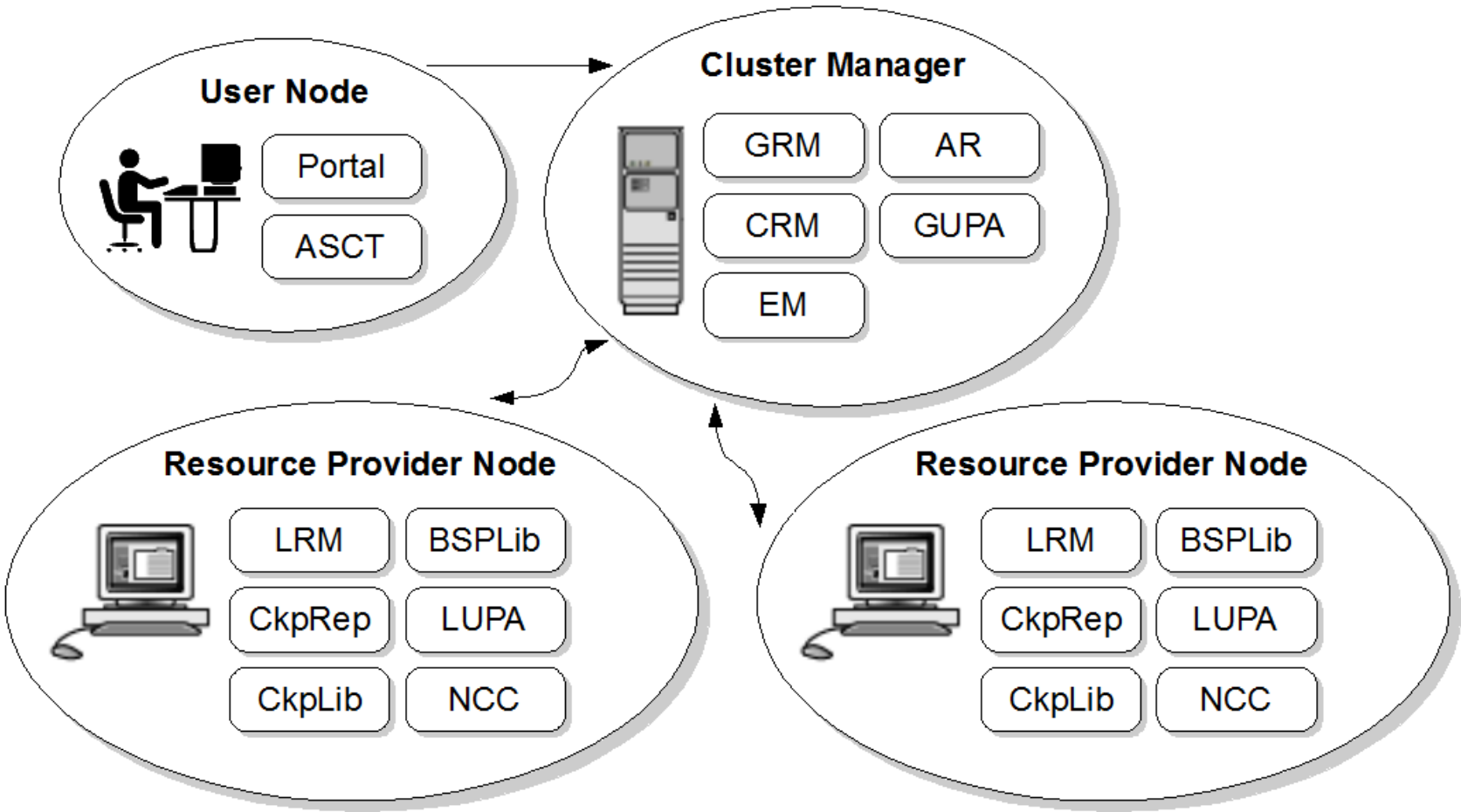
Anomaly-aware prediction

- Grid Harvest Service (GHS): parallel application scheduling system
- The system is monitored aiming identify anomalies about the identified patterns. However the only operation is scheduling
- We hope to get better results through a wider analysis and taking alternatives actions, such as adaptation

InteGrade Overview

- Grid middleware that uses the idle computing power of personal computers
- Object-oriented architecture (CORBA standard)
- Sequential, parameter sweeping, and parallel (BSP and MPI) applications
- Usage pattern collection and analysis
- Preserves resource provider's QoS at all costs
  - Grid users' QoS: currently not a concern

InteGrade Overview

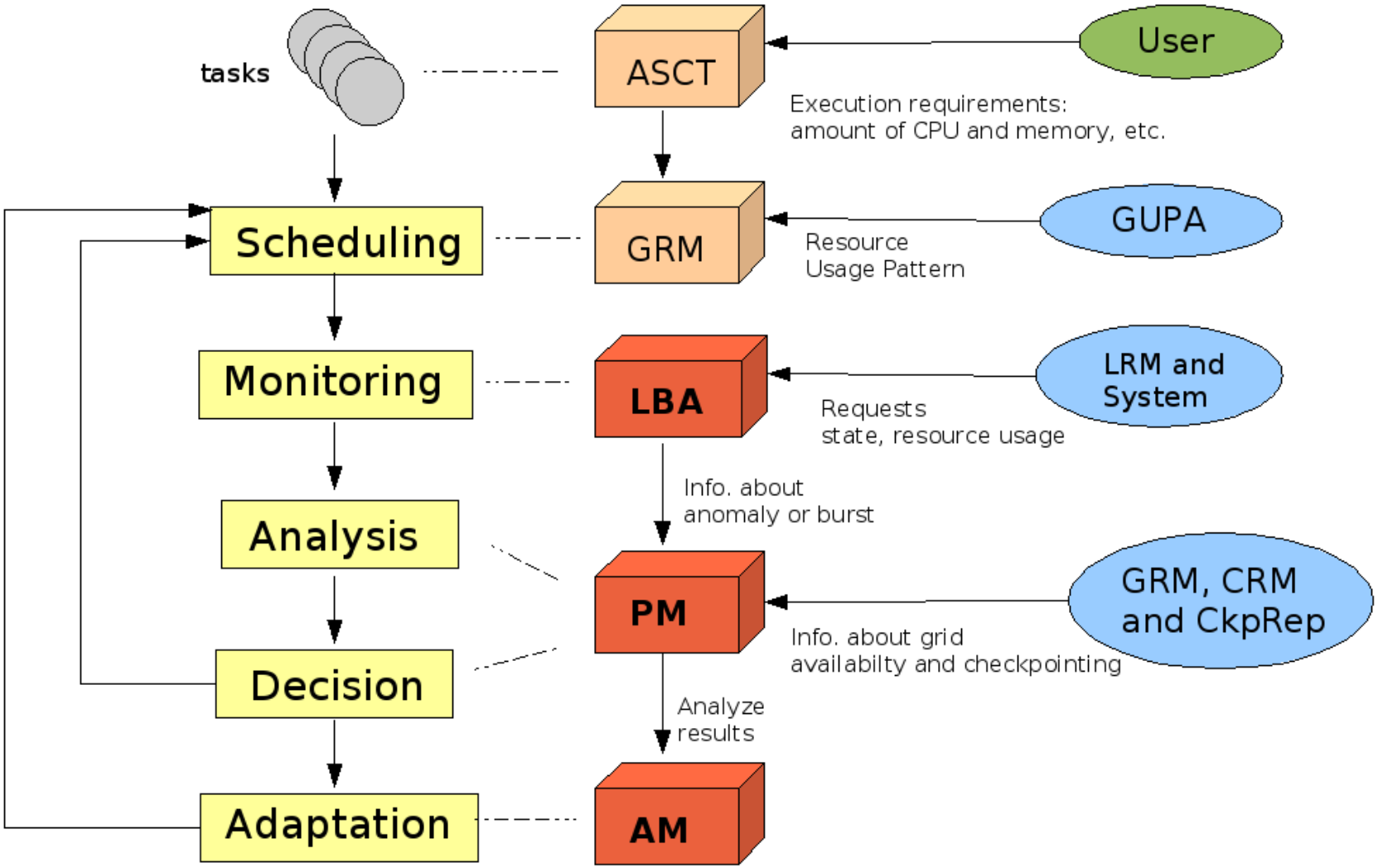


Our Approach
Achieving True Best-Effort

LUPA and GUPA optimize the performance but they have some limitations:

- Are based on standard/usual resource behaviour
  - Do not capture anomalous behavior (which deviates from the standard)
- Information about resource usage bursts is eliminated

Our Approach
Architecture

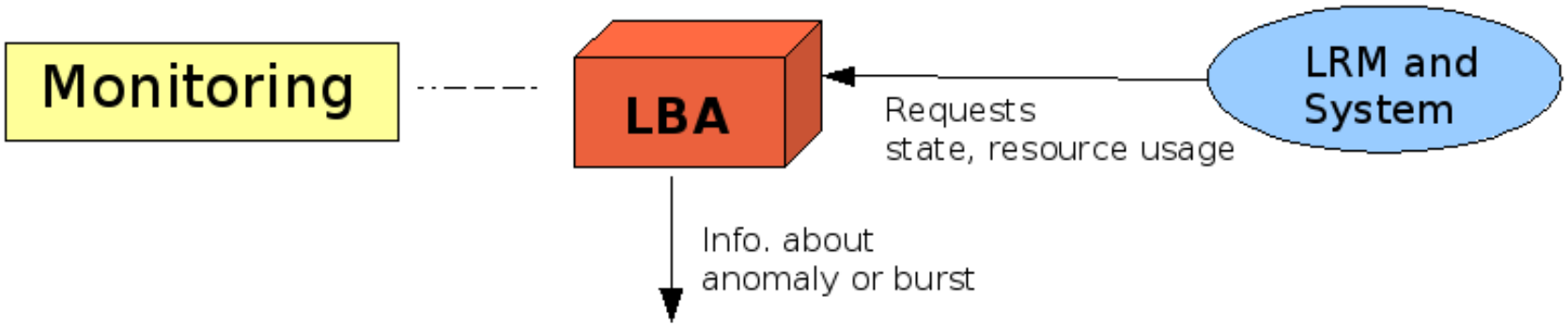


Our Approach
Architecture

LBA (Local usage pattern anomaly and Burst Analiser)

Goal: Estimate resource usage (during a burst) and identify anomalous behavior

- It must be able to run on the presence of resource scarcity
- Requirements: simplicity and high priority

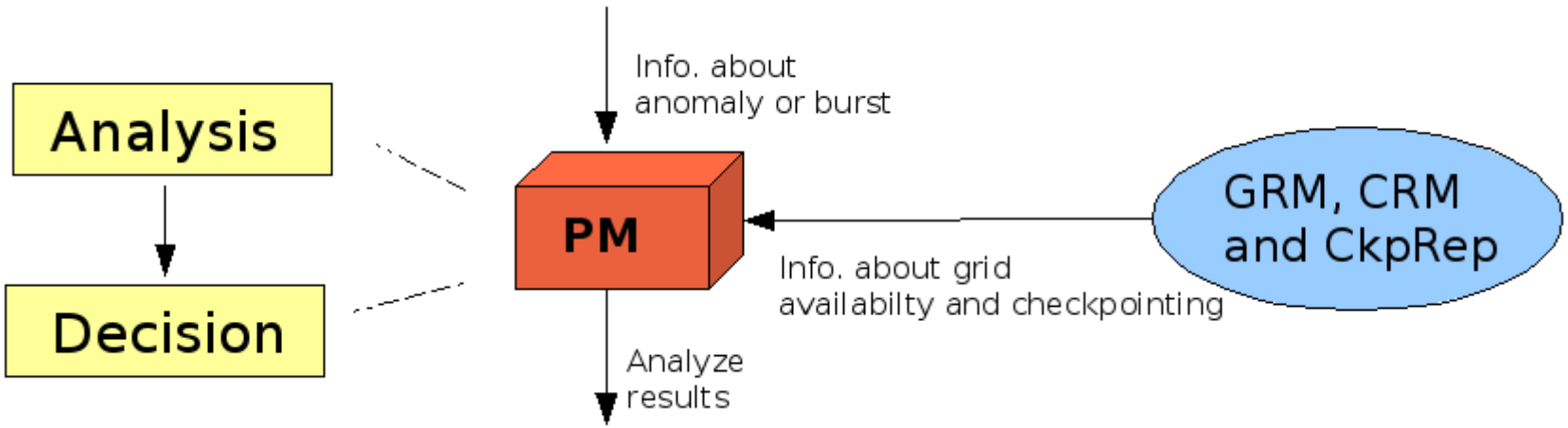


Our Approach
Architecture

PM (Performance Manager)

Goal: Decide the best strategy – migration or adaptation (can be both)

Migration is not the best solution for all case!

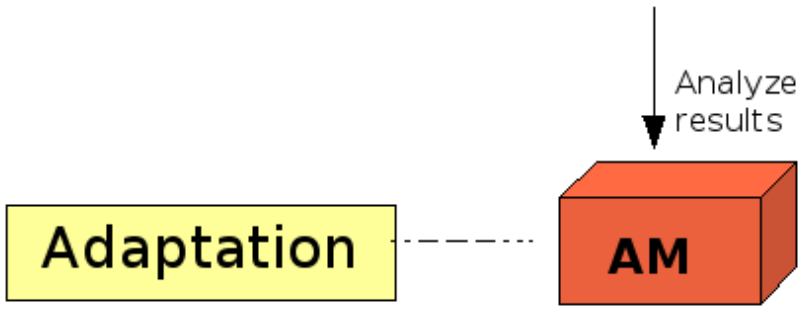


Our Approach
Architecture

AM (Adaptation Manager)

Goal: Implement adaptive operations as an alternative (or a complement) to migration

- The adaptation is performed on the node where the task is running (without migration) or on the grid middleware components

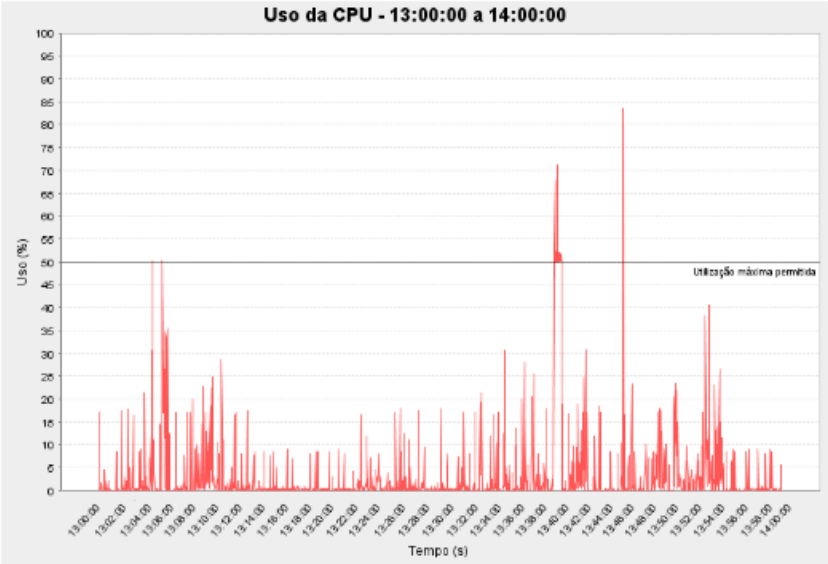


Experiments

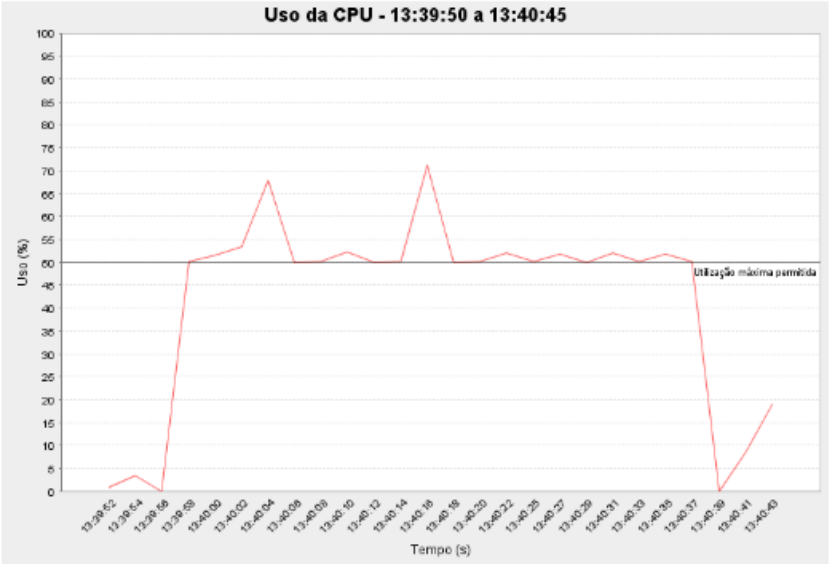
There is no implementation yet to alow a thorough evaluation of our approach. But we've carried out experiments that demonstrate the existence of the problem

- Testbed: DELL Optiplex 745, Intel Core 2 Duo 2.2GHz, 4 GB
- We collected CPU and memory usage measurements at intervals of 1 second
  - CPU data extracted from */proc/stat*
  - Memory data obtained with the *free* command

Experiments



(a)



(b)

CPU usage - average level (13:00-14:00)

2.98 %

Standard deviation (13:00-14:00)

7.98 %

Usage average between 13:39:00 and 13:44:00 (taken at intervals of 5 min)

8.43 %

13:39:58 a 13:40:38

> 50 % (40 sec)

Conclusion

- We proposed to investigate a more efficient task recovery strategy to improve grid applications performance
- Another contribution is the inclusion of adaptive methods in the InteGrade middleware – allows the dynamic adaptation of grid services aiming to enhance global performance
- This work is in progress – implementation of the architecture
  - Implementation status: LBA prototype nearly completed

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Questions

Thank You!

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