Environments, Services and Network Management for Green Clouds

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Summary

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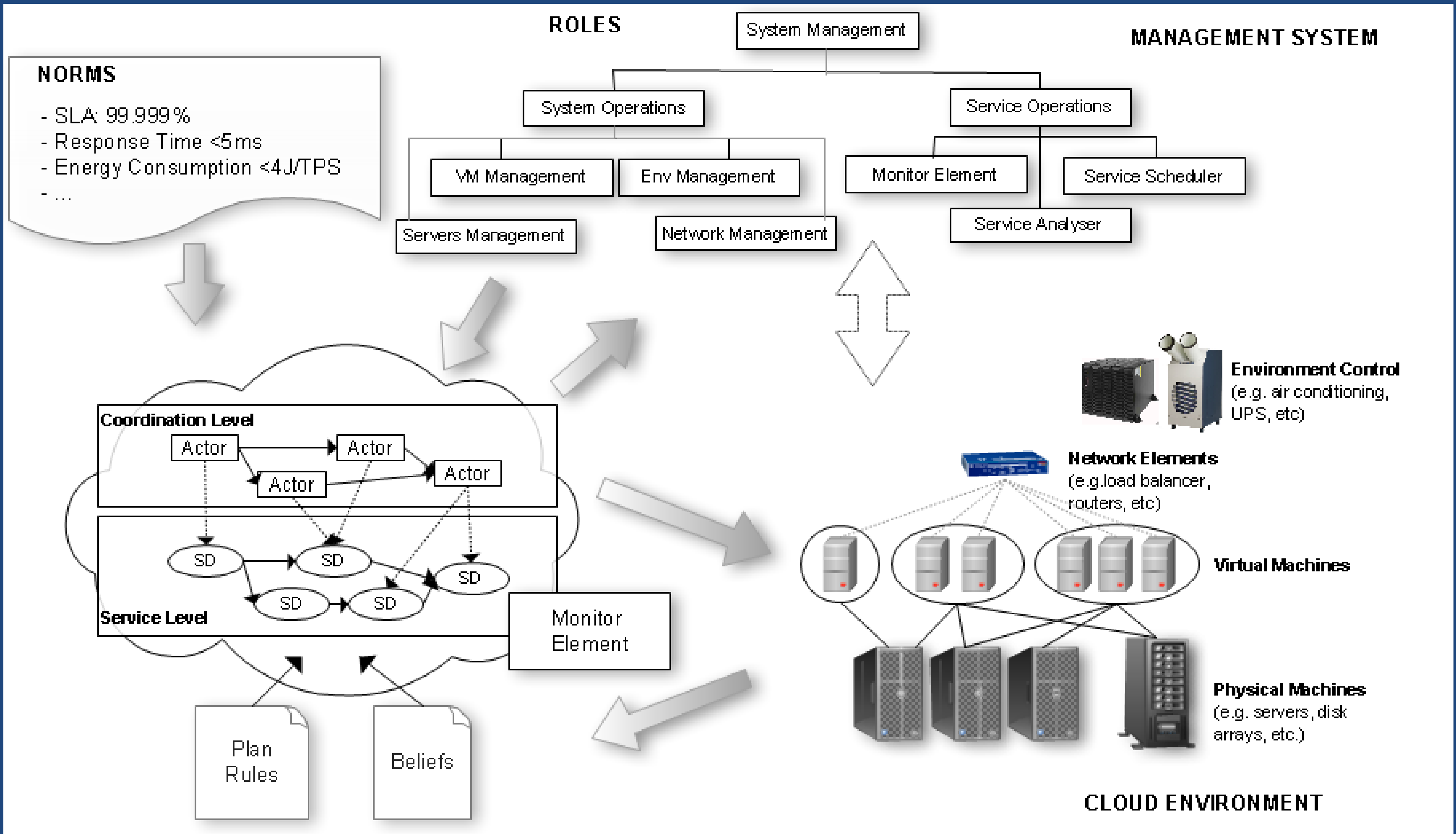


(J. Werner, G. A. Geronimo, C. B. Westphall et al. CLEI EJ 2012)

1 Introduction

- We propose an integrated solution for environment, services and network management based on organization theory model.

- This work introduces the system management model, analyses the system's behavior, describes the operation principles, and presents case studies and some results.

1 Introduction

- We extended CloudSim to simulate the organization model approach and implemented the migration and reallocation policies using this improved version to validate our management solution.

- Organization:

  2 introduces a motivating scenario.

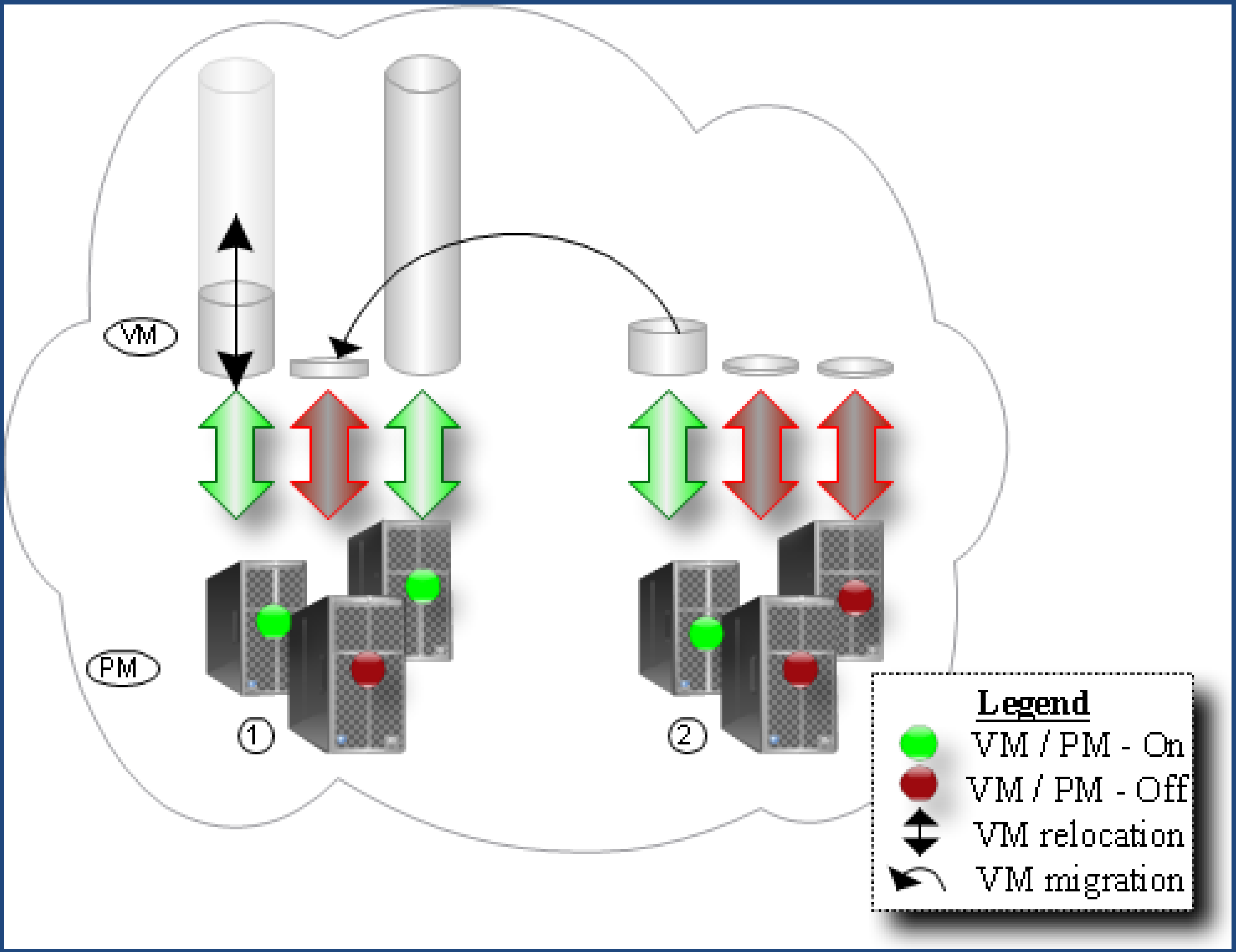
  3 outlines the system design.

  4 presents case studies.

  5 presents some results.

2 Motivation

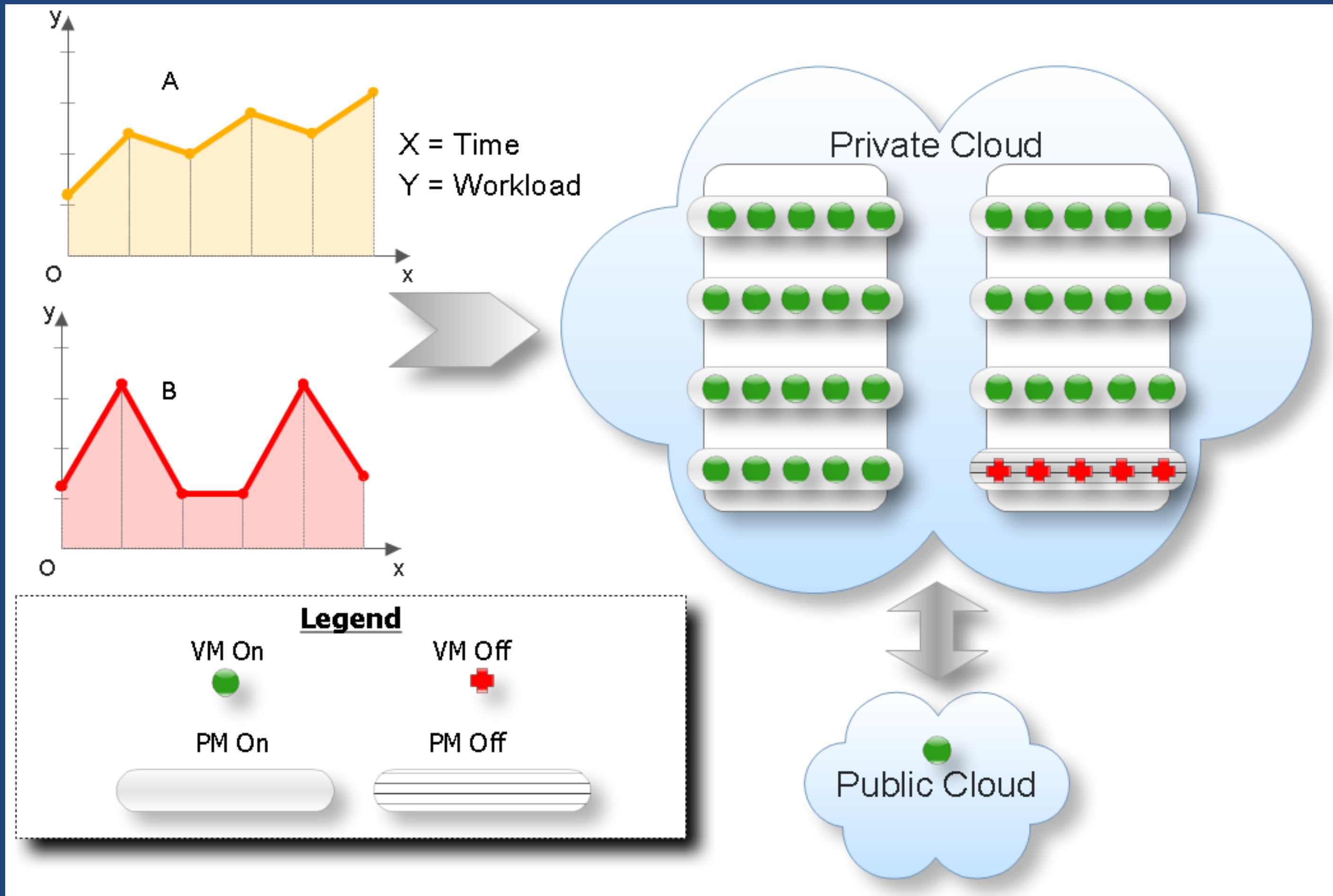
- Our research was motivated by a practical scenario at our university's data center.
- Organization theory model for integrated management of the green clouds focusing on:
- (i) optimizing resource allocation through predictive models;



(J. Werner, G. A. Geronimo, C. B. Westphall et al. CLEI EJ 2012)

2 Motivation

- (ii) coordinating control over the multiple elements, reducing the infrastructure utilization;
- (iii) promoting the “balance” between local and remote resources; and
- (iv) aggregating energy management of network devices.



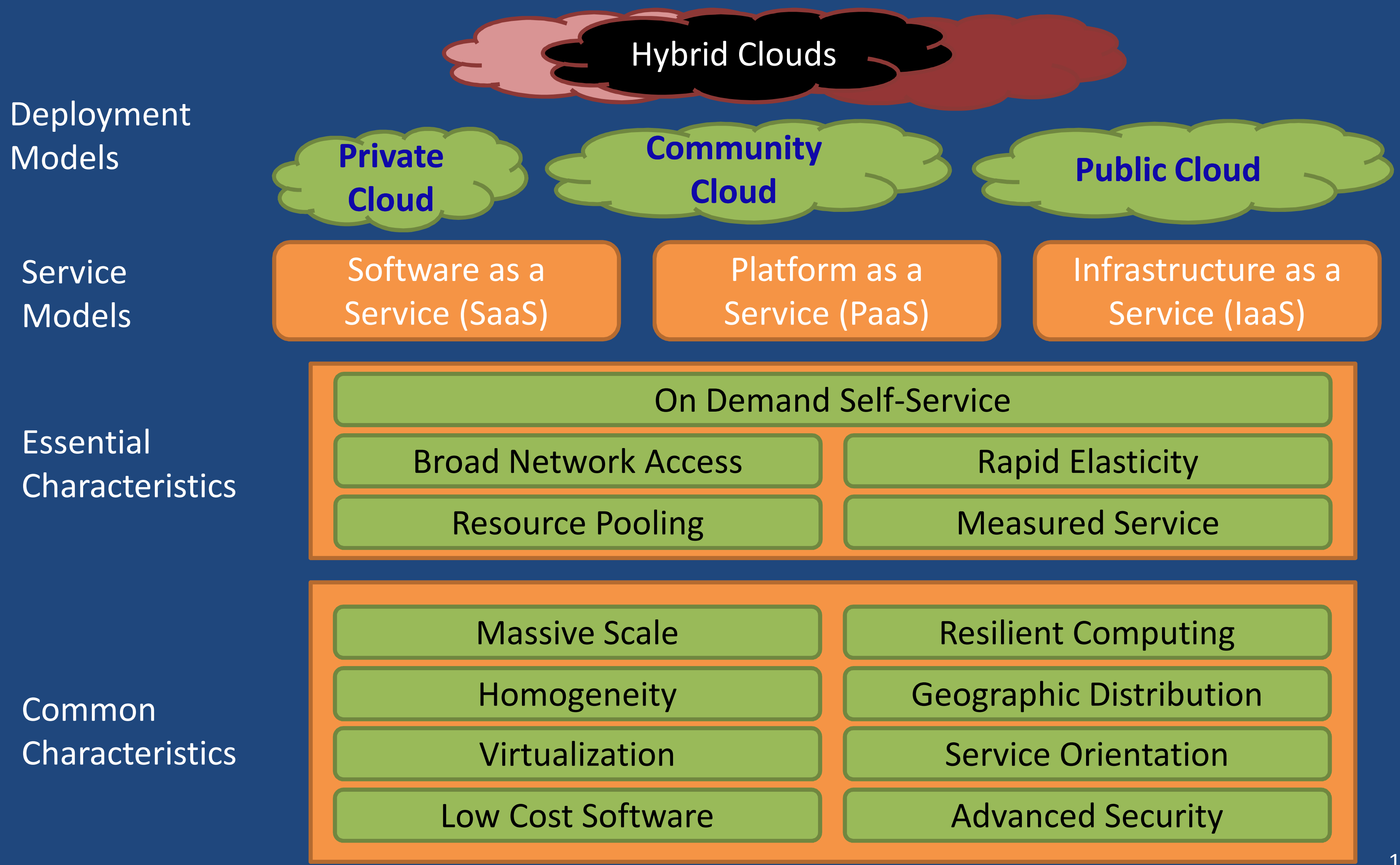
(J. Werner, G. A. Geronimo, C. B. Westphall et al. CLEI EJ 2012)

2 Motivation (*Concepts & Analysis)*

Cloud computing

- This structure describes the most common implementation of cloud; and
- It is based on server virtualization functionalities, where there is a layer that abstracts the physical resources of the servers and presents them as a set of resources to be shared by VMs.

The NIST Cloud Definition Framework



Based upon original chart created by Alex Dowbor

2 Motivation (*Concepts & Analysis)*

Green cloud

- The green cloud is not very different from cloud computing, but it infers a concern over the structure and the social responsibility of energy consumption; and
- Hence aiming to ensure the infrastructure sustainability without breaking contracts.

2 Motivation (*Concepts & Analysis)*

Analysis

- Table I relates (1) the 3 possible combinations between VMs and PMs, with (2) the average activation delay, and (3) the chances of the services not being processed (risk); and
- It also presents the energy consumed according to each scenario.

2 Motivation (*Concepts & Analysis*)

PM State	VM State	Time	Risks	Watts	Consumption
Down	Down	30s	High	0Ws	None
Up	Down	10s	Medium	200Ws	Medium
Up	Up	0s	None	215Ws	High

RELATION BETWEEN SITUATIONS & RISKS & ACTIVATION DELAY & CONSUMPTION

(ASSUNÇÃO, M. D. ET AL. ENERGY 2010)

2 Motivation (*Related Works*)

- E. Pinheiro, et al. "Load balancing and unbalancing for power and performance in cluster-based systems" in Proceedings of the Workshop on Compilers and Operating Systems for Low Power. 2001.
- Pinheiro et al. have proposed a technique for managing a cluster of physical machines that minimizes power consumption while maintaining the QoS level.

2 Motivation (*Related Works*)

- The main technique to minimize power consumption is to adjust the load balancing system to consolidate the workload in some resources of the cluster to shut down the idle resources.
- At the end, besides having an economy of 20% compared to fulltime online clusters, it saves less than 6% of the whole consumption of the data center.

2 Motivation (*Related Works)*

- R. N. Calheiros, et al. "Cloudsim: A toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms" Software: Practice and Experience. 2011.
- Calheiros et al. have developed a framework for cloud computing simulation. It has four main features:

2 Motivation (*Related Works)*

- (i) it allows for modeling and instantiation of major cloud computing infrastructures,
- (ii) it offers a platform providing flexibility of service brokers, scheduling and allocations policies,
- (iii) its virtualization engine can be customized, thus providing the capability to simulate heterogeneous clouds, and

2 Motivation (*Related Works)*

- (iv) it is capable of choosing the scheduling strategies for the resources.
- R. Buyya, et al. "Intercloud: Utility-oriented federation of cloud computing environments for scaling of application services" Proceedings of the 10th International Conference on Algorithms and Architectures for Parallel Processing. 2010.

2 Motivation (*Related Works)*

- Buyya et al. suggested creating federated clouds, called Interclouds, which form a cloud computing environment to support dynamic expansion or contraction.
- The simulation results revealed that the availability of these federated clouds reduces the average turn-around time by more than 50%.

2 Motivation (*Related Works)*

- It is shown that a significant benefit for the application’s performance is obtained by using simple load migration policies.
- R. Buyya, et al. “Energy-Efficient Management of Data Center Resources for Cloud Computing: A Vision, Architectural Elements, and Open Challenges” in Proceedings of the 2010 International Conference on Parallel and Distributed Processing Techniques and Applications.

2 Motivation (*Related Works)*

- Buyya et al. aimed to create architecture of green cloud. In the proposals some simulations are executed comparing the outcomes of proposed policies, with simulations of DVFS (Dynamic Voltage and Frequency Scaling).
- They leave other possible research directions open, such as optimization problems due to the virtual network topology, increasing response time for the migration of VMs because of the delay between servers or virtual machines when they are not located in the same data centers.

2 Motivation (*Related Works)*

- L. Liu, et al. "Greencloud: a new architecture for green data center" in Proceedings of the 6th international conference industry session on autonomic computing. 2009.
- Liu et al. presented the GreenCloud architecture to reduce data center power consumption while guaranteeing the performance from user perspective.

2 Motivation (*Related Works)*

- P. Mahavadevan, et al. "On Energy Efficiency for Enterprise and Data Center Networks" in IEEE Communications Magazine. 2011.
- Mahadevan et al. described the challenges relating to life cycle energy management of network devices, present a sustainability analysis of these devices, and develop techniques to significantly reduce network operation power.

2 Motivation (*Problem Scenario)*

- To understand the problem scenario, we introduce the elements, interactions, and operation principles in green clouds.
- The target in green clouds is: how to keep resources turned off as long as possible?
- The interactions and operation principles of the scenario are:

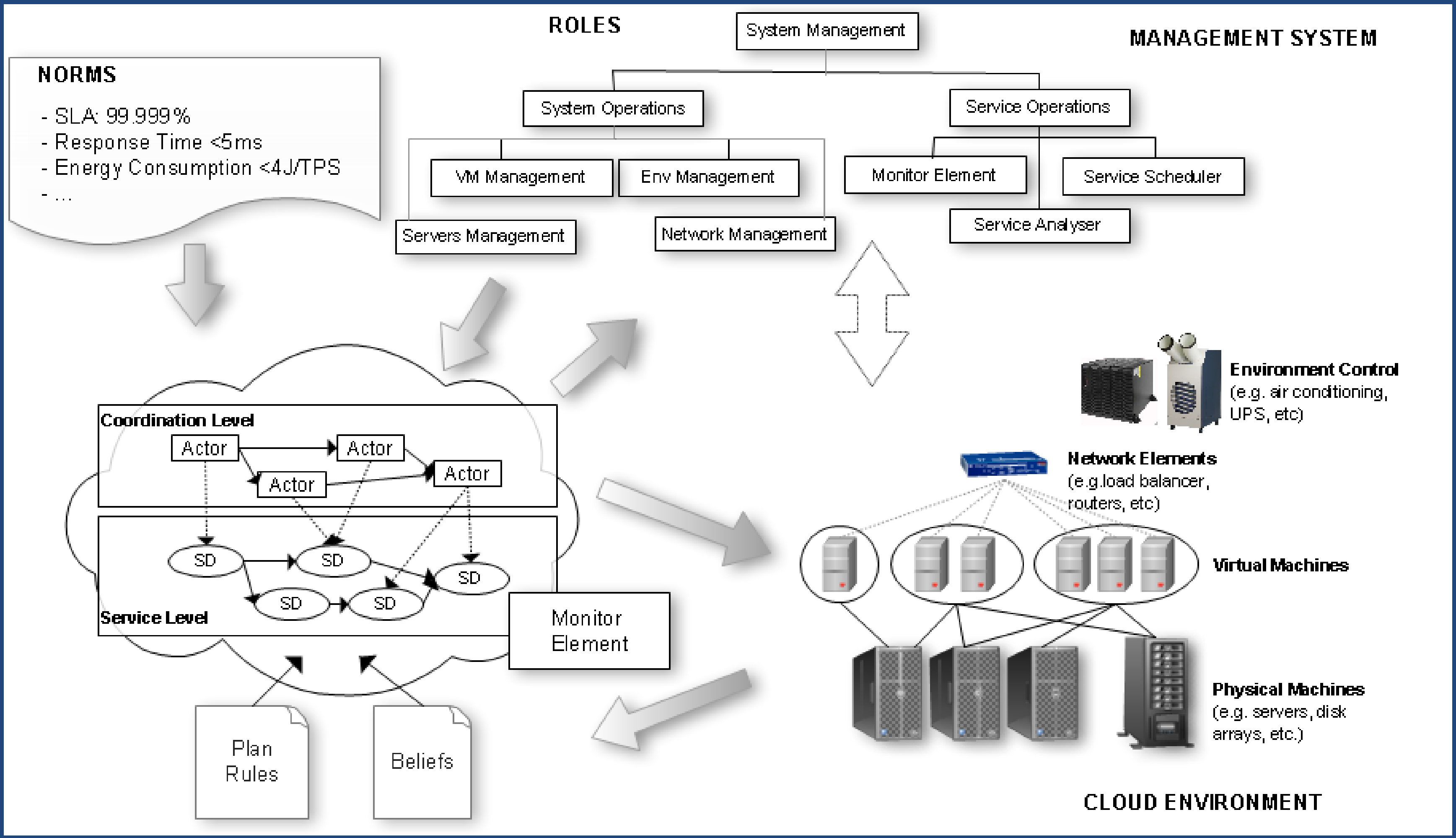
2 Motivation (*Problem Scenario)*

- (i) there are multiple applications generating different load requirements over the day;
- (ii) a load "balance" system distributes the load to active servers in the processing pool;
- (iii) the resources are grouped in clusters that include servers and local environmental control units; and

2 Motivation (*Problem Scenario)*

- (iv) the management system can turn on/off machines overtime, but the question is when to activate resources on-demand?
- In other words, taking too much delay to activate resources in response to a surge of demand (too reactive) may result in the shortage of processing power for a while.

3 Proposals and Solutions



3 Proposals and Solutions

- The four roles that operations system may be classified as are: VM management; Servers management; Network management; and Environment management.
- The three roles that service system may be classified as are: Monitor element; Service scheduler; and Service analyser.

4 Case Studies

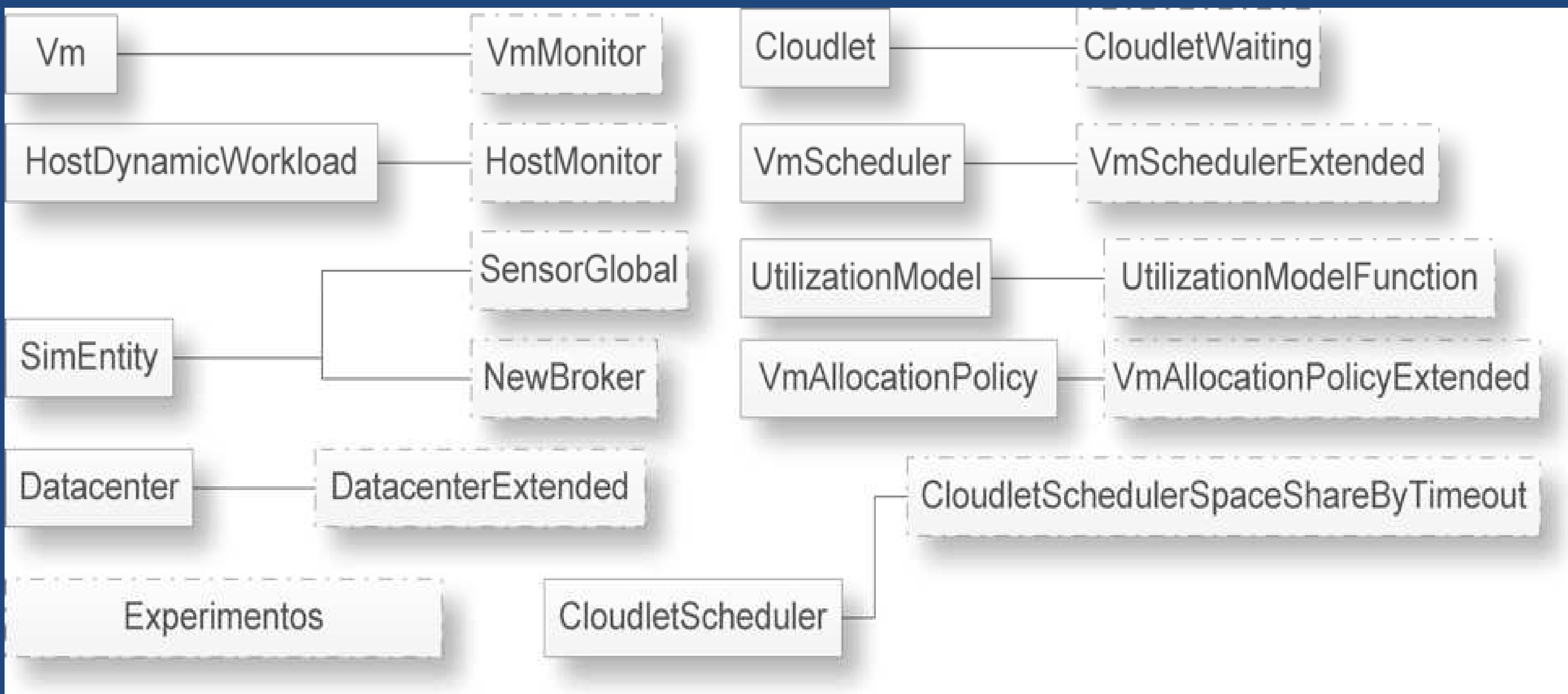
- We modeled the system using Norms (NM), Beliefs (BL) and Plan Rules (PR), inferring that we would need (NM) to reduce energy consumption.
- <u>Based on inferences from NM, BL and PR agents would monitor the system and determine actions dynamically.</u>

5 Results

The main components implemented in the improved version at CloudSim are as follows:

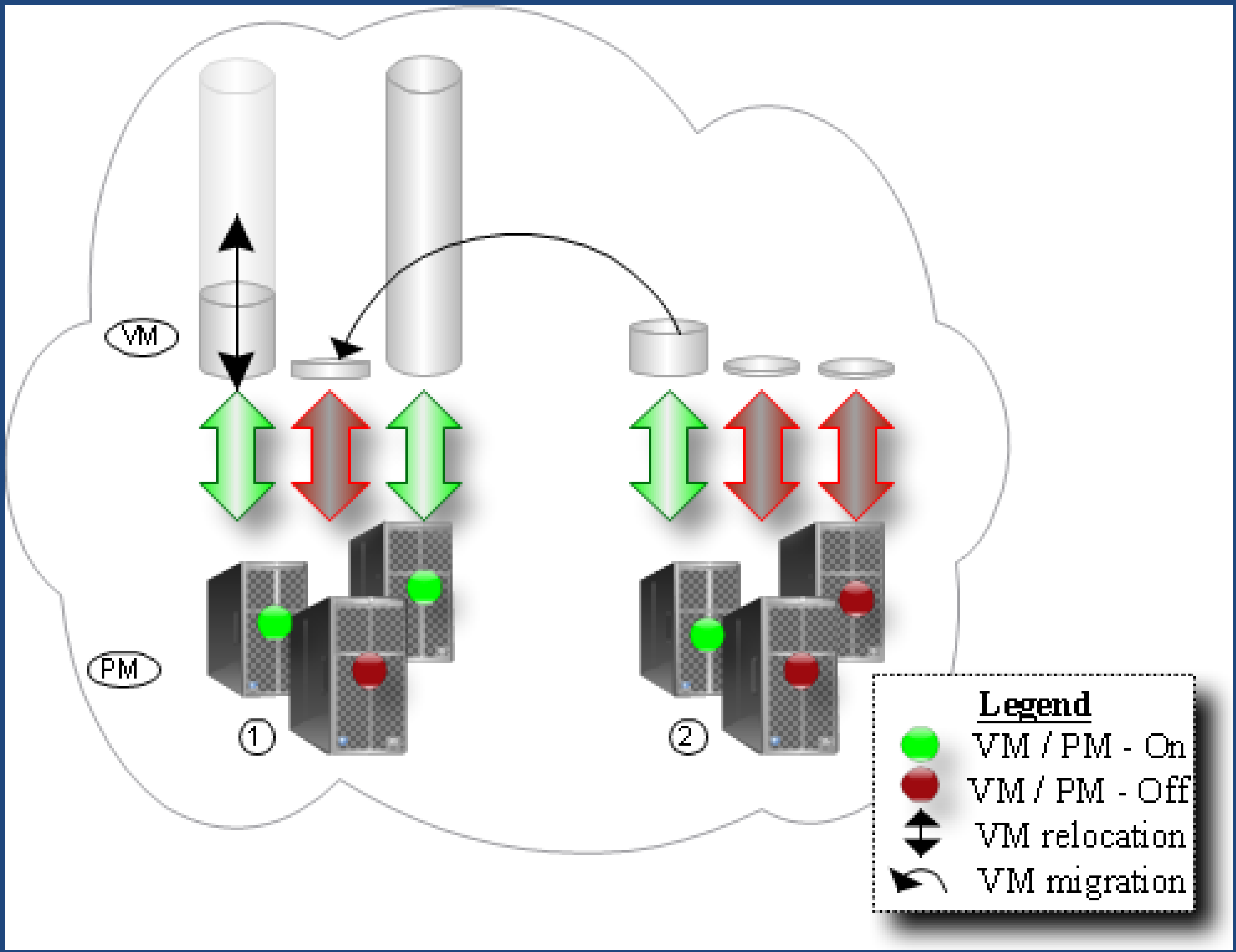
HostMonitor: controls the input and output of physical machines; VmMonitor: controls the input and output of virtual machines; NewBroker: controls the size of requests; SensorGlobal: controls the sensors; CloudletSchedulerSpaceShareByTimeout: controls the size and simulation time; VmAllocationPolicyExtended: allocation policy; VmSchedulerExtended: allocates the virtual machines; UtilizationModelFunction: checks the format of requests; CloudletWaiting: controls the time of the request; and DatacenterExtended: controls the datacenter.

5 Results



(J. Werner, G. A. Geronimo, C. B. Westphall et al. LANOMS 2011)

5 Results



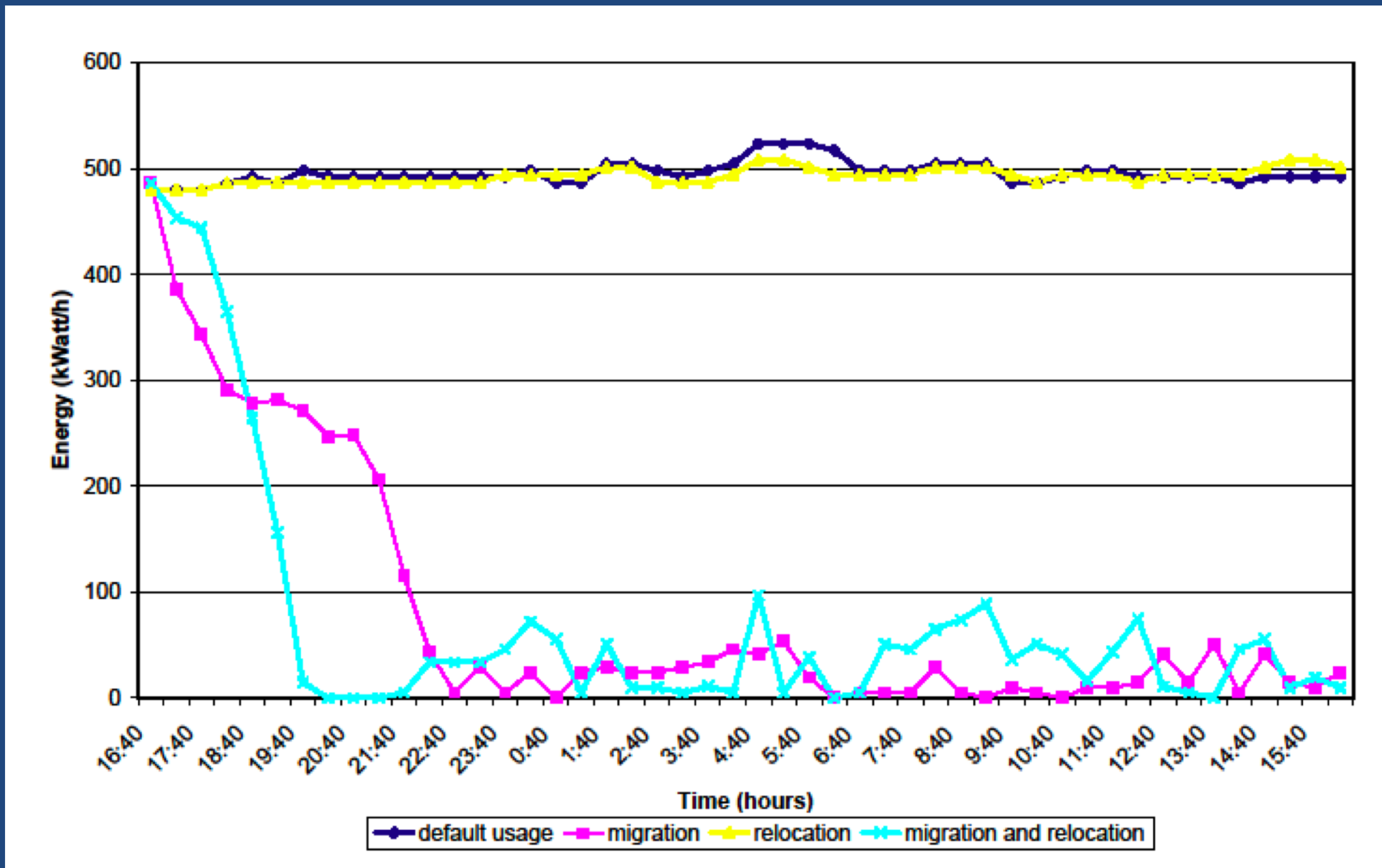
5 Results

Parameter	Value
VM – Image size	1GB
VM - RAM	256MB
PM - Engine	Xen
PM - RAM	8GB
PM - Frequency	3.0GHZ
PM - Cores	2

PROPOSED SCENARIO CHARACTERISTCS

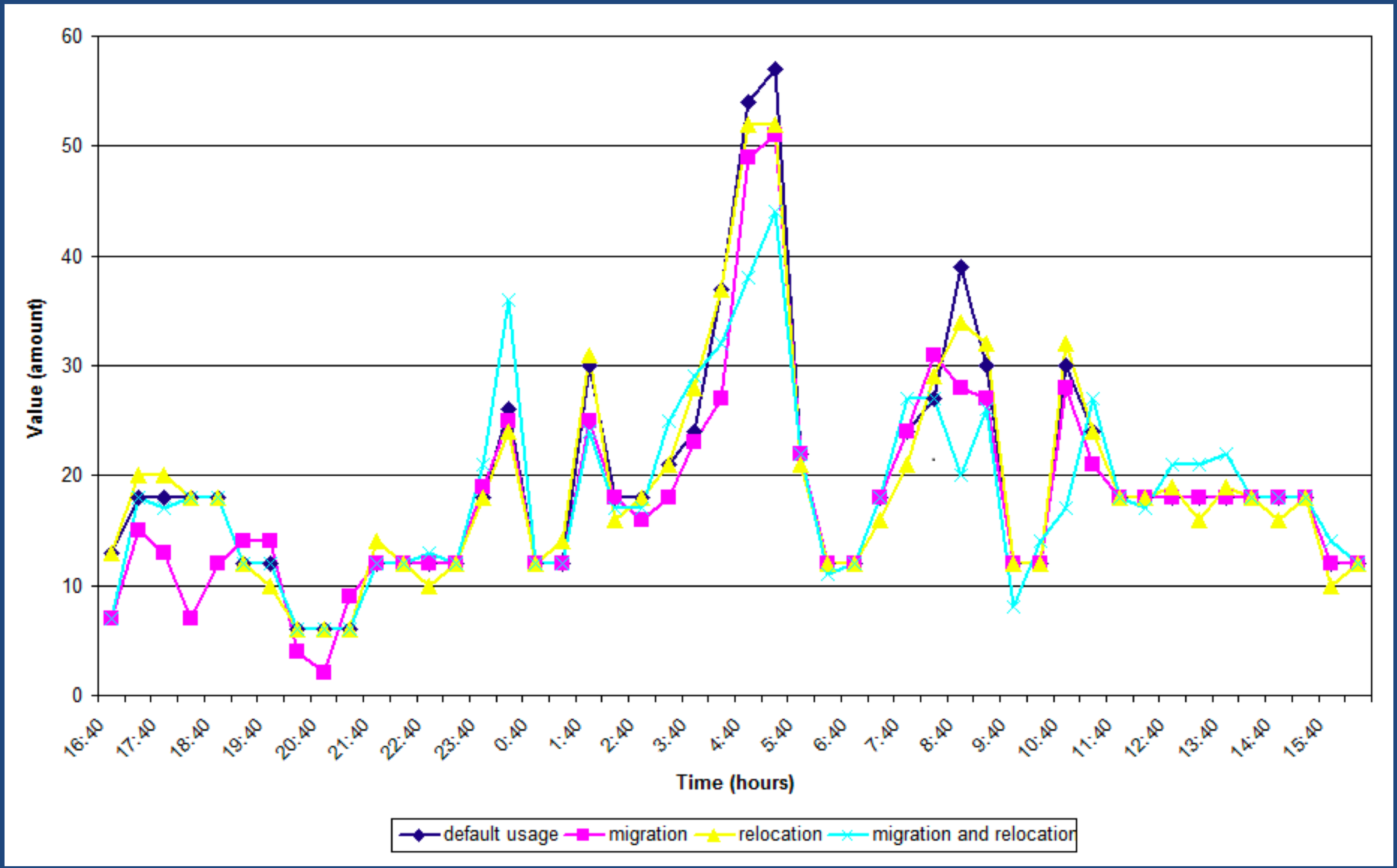
(J. Werner, G. A. Geronimo, C. B. Westphall et al. CLEI EJ 2012)

5 Results *(consumption)*



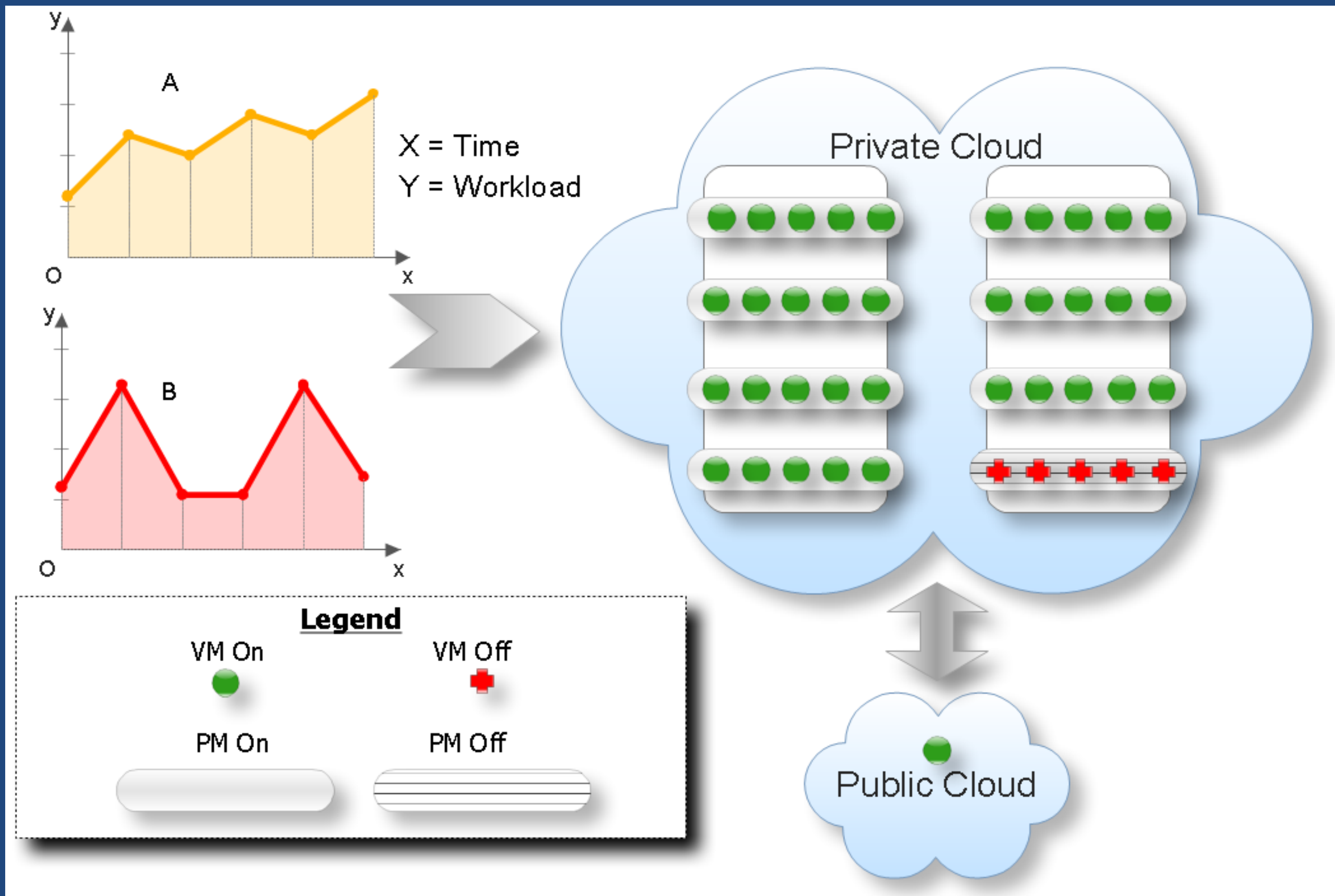
(J. Werner, G. A. Geronimo, C. B. Westphall et al. CLEI EJ 2012)

5 Results *(SLA violations)*



(J. Werner, G. A. Geronimo, C. B. Westphall et al. CLEI EJ 2012)

5 Results *(Hybrid strategy)*



5 Results *(Hybrid strategy)*

Strategy	Cost	Consumption
On-demand	- 3.2 %	- 23.5 %
Idle resources	- 49.0 %	- 59.0 %

REDUCTION OF COST AND POWER CONSUMPTION

(J. Werner, G. A. Geronimo, C. B. Westphall et al. CLEI EJ 2012)

6 Conclusions

- Tests were realized to prove the validity of the system by utilizing the CloudSim simulator from the University of Melbourne in Australia.
- We have implemented improvements related to service-based interaction.
- We implemented migration policies and relocation of virtual machines by monitoring and controlling the system.

6 Conclusions

We achieved the following results in the test environment:

- Dynamic physical orchestration and service orchestration led to 87,18% energy savings, when compared to static approaches; and

- Improvement in load "balancing" and high availability schemas provide up to 8,03% SLA error decrease.

7 Future Works

- As future work we intend to simulate other strategies to get a more accurate feedback of the model, using other simulation environment and testing different approaches of beliefs and plan rules.
- Furthermore, we would like to exploit the integration of other approaches from the field of artificial intelligence, viz. bayesian networks, advanced strategies of intention reconsideration, and improved coordination in multi-agent systems.