

# Autonomic Energy Management of Multi-Tier Clustered Applications

A. Gadafi, D. Hagimont, L. Broto, JM. Pierson

Toulouse University, France

# Distributed Infrastructures : Clusters, Grids

- Increased use
  - web servers
  - scientific applications
- Power consumption
  - more than \$30 billion in 2008 "worldwide cost"
  - increased by 10 times over the past ten years
- Power wasting
  - rarely used at their full capacity

# Autonomic Computing

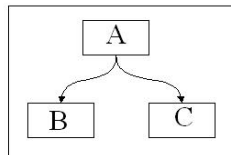
- IBM, The Vision of Autonomic Computing. IEEE Computer Magazine, 2003
- Management of distributed infrastructures
  - self deployment
  - self configuring
  - self optimizing

# TUNe : Toulouse University Network

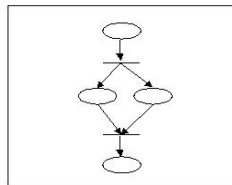
- Autonomic management system
- Management policies specification with high level formalism  
"UML profiles"
- Legacy software encapsulation with Wrapping Description  
Language

## Administration views

uml profiles {

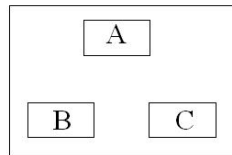


Deployment



Reconfiguration

Wrapping  
Description  
Language {

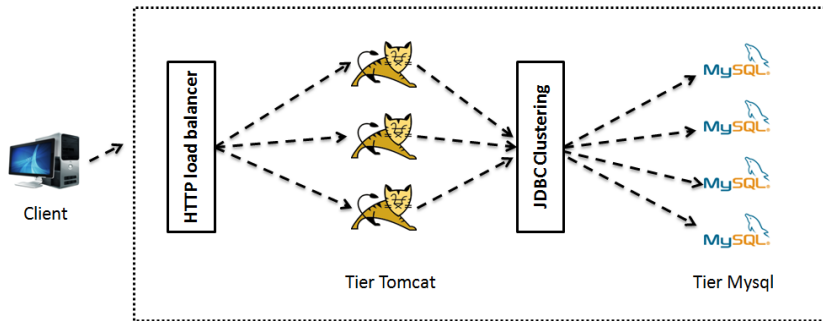


Wrapping

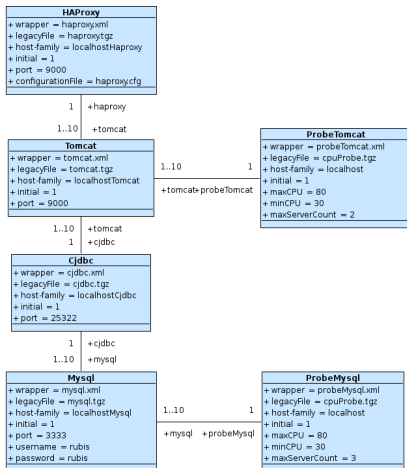
## Our Approach

- Autonomic energy management
- Dynamic architecture adaptation
  - allocate/free dynamically the machines according to the received load
    - turning machins on to ensure QoS and efficiently handle the load imposed on the system
    - turning machins off to save power under lighter load

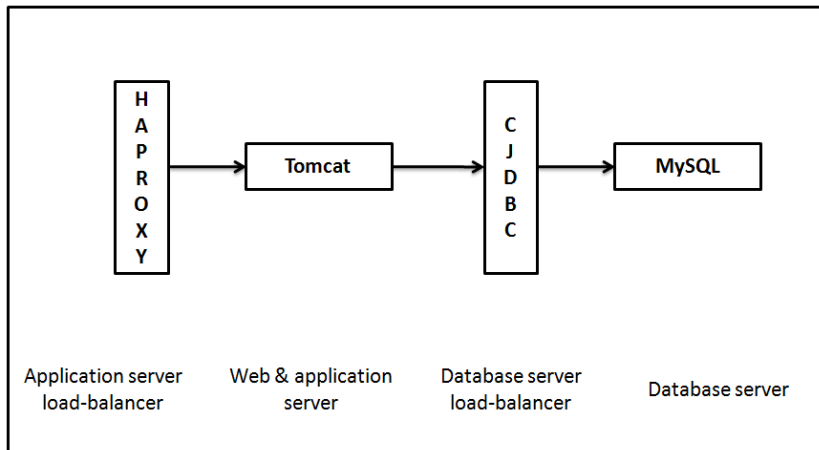
# Self-sizeable clustered J2EE application



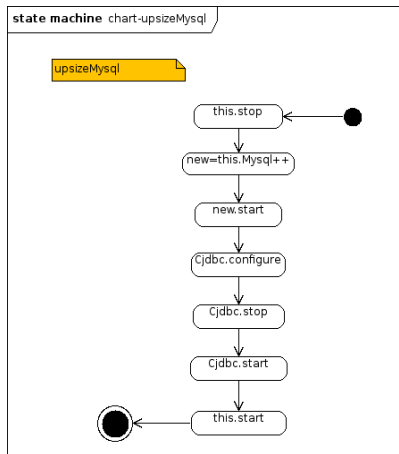
# Deployment Diagram



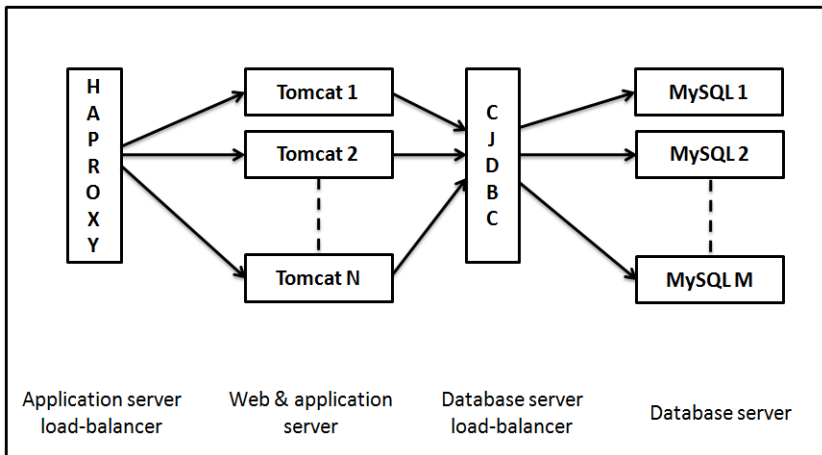
## Initial J2EE Architecture



## Reconfiguration : Add Mysql Server



## J2EE Architecture After The Reconfiguration



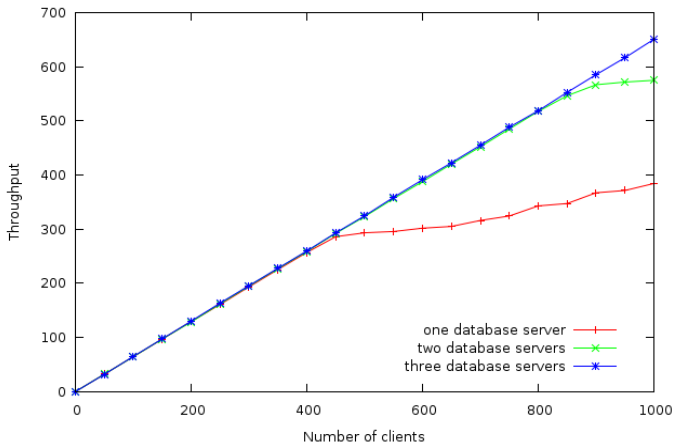
## Evaluation Scenario

- Measurement of database tier only
- Comparaision energy consumption and QoS in two situations :
  - static configuration : one, two, and three database servers
  - dynamic configuration : dynamically adapt the number of database servers by TUNE

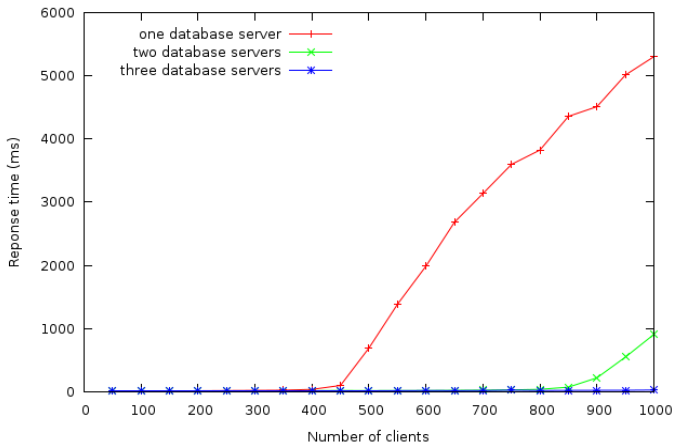
## Management Policy

- Monitoring CPU usage information for Mysql servers
- Adding a new replica
  - allocating a node from a list of available nodes
  - turning it on "wake on lan notification"
  - applying reconfiguration diagram corresponding to adding a new server
- Removing a replicat
  - applying the reconfiguration diagraeme corresponding to removing a replica
  - freeing the node "suspension to RAM"

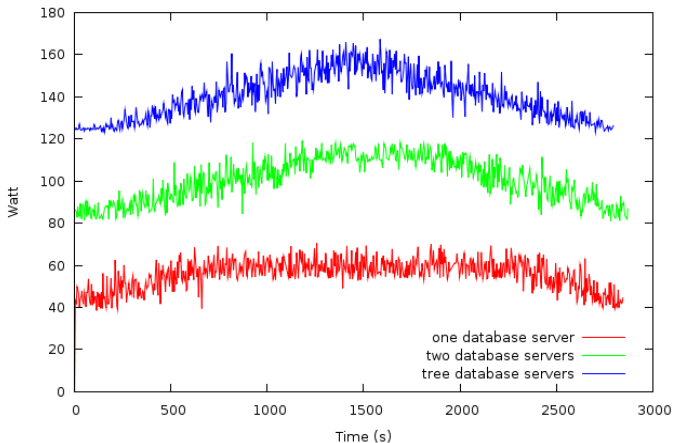
# Static Configuration : Throughput



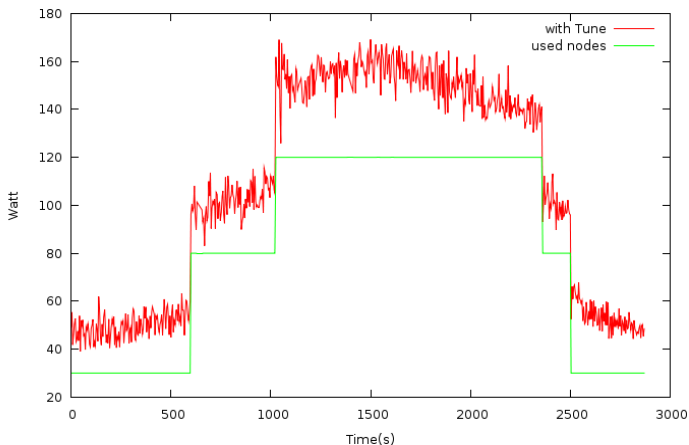
# Static Configuration : Response Time



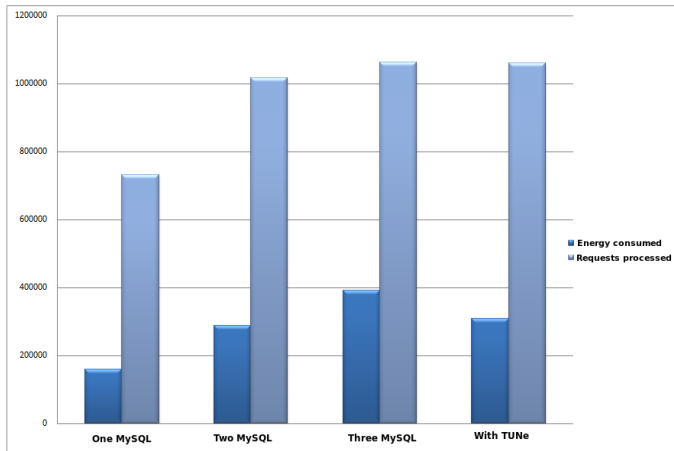
# Static Configuration : Energy Consumption



## Dynamic Configuration : Energy Consumption



## Comparison



## Conclusion

- Autonomic computing approach meets the need of energy aware computing
  - Power consumption reduced by 21%
  - Maintaining QoS

## Future Work

- More elaborated power management policies
  - include other parameters "e.g. network traffic information"
- Integration of virtualization techniques
  - enable transparent process (VM) migration between hardware nodes.