Chapter 32 - Grid Resource Allocation and Control using computational economies

Grid Computing– Making the Global Infrastructure a Reality

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Introduction

Basic strategies used for Computational Grid Resource Allocation and Scheduling

- Centralized resource control
- Localized application control

Pros and Cons

- Centralized Approach
  - Not Scalable in terms of execution efficiency (Resource Broker or the scheduler becomes the bottleneck)
  - Has Single Point of failure, not fault resilience
- Localized Approach
  - Leads to unstable resource allocation as grid aware applications tend to compete for resources.

Issues

– Server / Network Status dynamically change
– Status information is distributed globally

Due to the complexity of allocation problem and dynamically changing characteristics of the grid resources, static solutions are inept.

Thus we need truly automated scheduling software.

Various Techniques

- Dynamic resource allocation and application adaptation
- Decision systems
- Matchmaking broker
- MetaServer Approach (Ninf System)
- AppLeS , NWS , NetSolve

Scheduling with Grids in Perspective

- Need for new resource allocation methods or modification to the existing technologies.
- Higher expectations from the system
- Reduced tolerance
- Mainly Problem of Quality Of Service

Computational Economies

- Two formal approaches to Grid Allocation
  - Control Theory
  - Economics

  Chapter focuses on Computational Economies that can be employed for the Grid
  - Artificial
  - Can be restarted

Categories

Computational Economy categories

- Commodities Market
  - Equal resources are treated interchangeable
  - Request is not made for specific resource
- Auction Market
  - Request\ Bid is for specific resource

Drawbacks of Market Simulations

– Agents interact out-of-band.

– Applications do not compete.

Economics assumptions made for the Grid

- Can be predicted to behave as economic system
- Can be analyzed as an economic system
- Relative worth of a resource is determined by its supply and the demand for it.
- Price of a given resource is its worth relative to the value of a unit resource called currency.

Examples where these principles can be used

- Lottery scheduling, tickets, tokens.
- Resource providers bid for jobs in queue.

Special Scenarios

- What happens when consumers use more resources than what they paid for
- how do the resource providers react, do they preempt or kill the jobs

- Assumption : if a consumers exceeds its time limit, his job is not killed instead they are charged for the total time even though it was not included in the initial contract.

Price-setting mechanisms

- Both Auction and Commodities market, Use **Trusted third party called Market** decides the price for a resource.
  - Queries consumers and producers.
  - Interested parties participate in the transaction.
- Unsatisfied supply and demand is observed before new value for resources are set.
- Auction markets also introduce concept of Winner

Pricing functions

- English Auctions
- Second Bid Vickery Auctions

Case Study: G-Commerce

- Aims to investigate feasibility and efficiency of market formulations for grid economics.
- Addresses following two questions
  - What is the effect on resource allocation stability of auctions versus commodities markets?
  - What is the effect of choosing a particular market formulation on resource utilization?

Simulation Parameters

- Producers and Consumers
  - Resource Providers
  - Application
- Types of Resources available
  - CPUs
  - Disk Storage

CPU producer model

Each producer agrees to sell 10% sized variable number of slots.

For CPU's Mean_price = revenue/now/slots

For Disks Mean_price = revenue/now/capacity

- Consumers publish theirs needs in terms of jobs and a budget.

  Inspired by Budget Refresh policy used at NPACIs centers
- Consumer demand
  - Request for second resource (disk\cpu) is only made if the first request was satisfied.
  - So consumer demands for resources can be related but Supplies are not

Conclusions

- Commodity Markets outperform Auctions in simulated Grid Settings.
- Simulation done at the Laboratory for Middleware and Applications Yielding Heterogeneous Environment for Metacomputing (MAYHEM) at UCSB

References

- Grid Computing– Making the Global Infrastructure a Reality

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