Application Deployment using Catallactic Grid Middleware

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Goals of the Presentation

- Make a case for decentralized economic models for self managed resource allocations in grid applications

- Present an architecture for integrating resource allocation mechanisms in grid applications

- Highlight challenges and sketch a research agenda

- Avoid too many implementation details
 - Of course, Available upon request!

Outline

- Introduction and Motivation
    - Resource allocation in emerging grid applications
    - A Case for Economics based resource allocation
- Proposed Architecture
    - Conceptual framework
    - Technical platform
- The catallaxy enablement of the Cat-Covite grid applications
- Conclusions and future work
- Questions

Evolution of Grid Applications
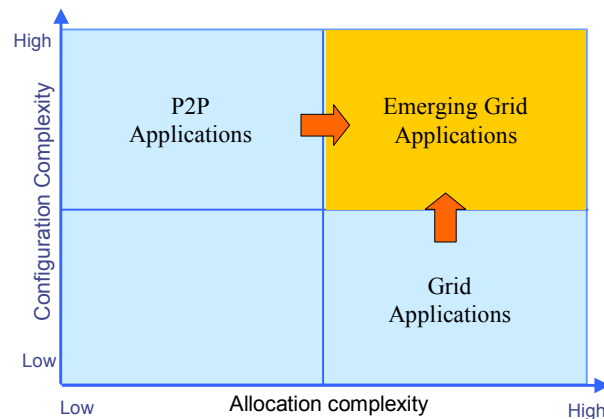
Configuration Complexity: dynamics of the configuration, lack of global knowledge and evolutionary environment

Allocation Complexity: Diversity of requirements and complexity of allocation demands
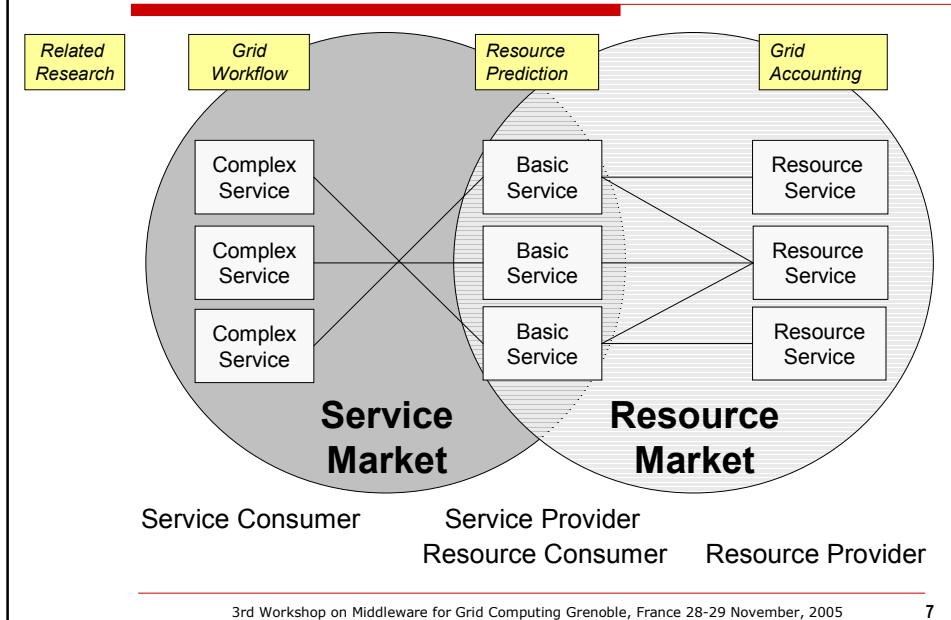
Requirements for Resource Allocation

- Situateness
  - Consider location of requestors
  - Be aware of context and environment
- Dynamic (re)configuration
  - Adapt to unpredictable usage patters
  - New instances must be created and located as needed
- Topology neutrality
  - Adapt to different interaction topologies ranging from centralized to fully P2P
- Autonomy
  - Allow for multiple administrative domains with particular policies

Why Economic Based Models?
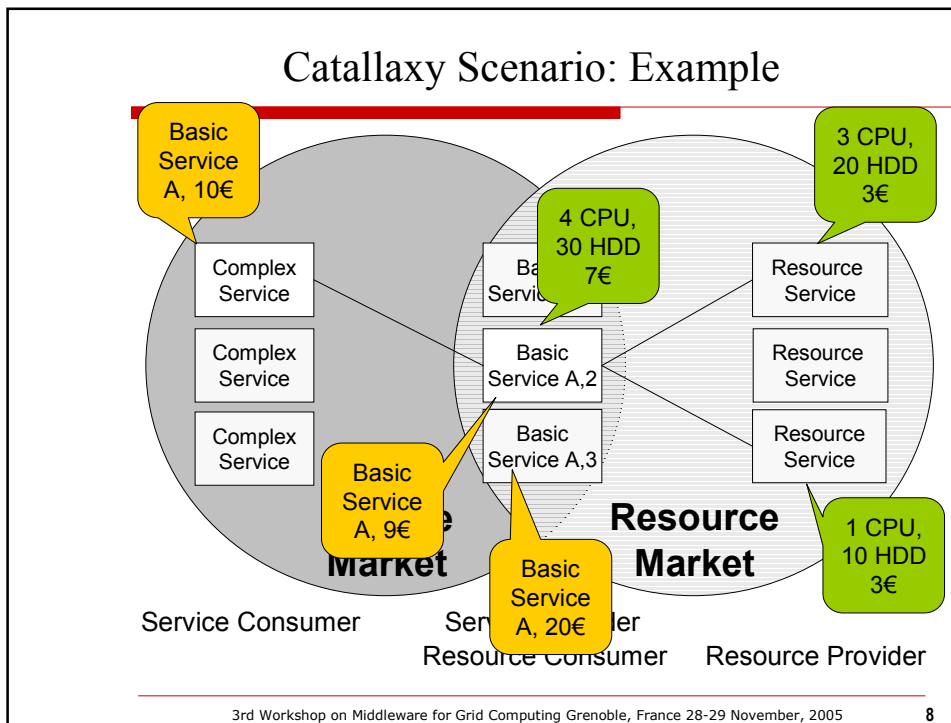
- What does Economics offer
  - Rich conceptual framework
  - Formal models and analytical insight
  - Theoretical benchmarks

- Decentralized economic models are a promising approach for resource allocation
  - Economy as a **coordination** device (distributed decision making)
  - Can handle **conflicting** needs
  - **Partial knowledge** is a fundamental assumption
  - Participants are **selfish** (don't require cooperation)
  - Price and price changes **synthesizes information** about resources and the environment.
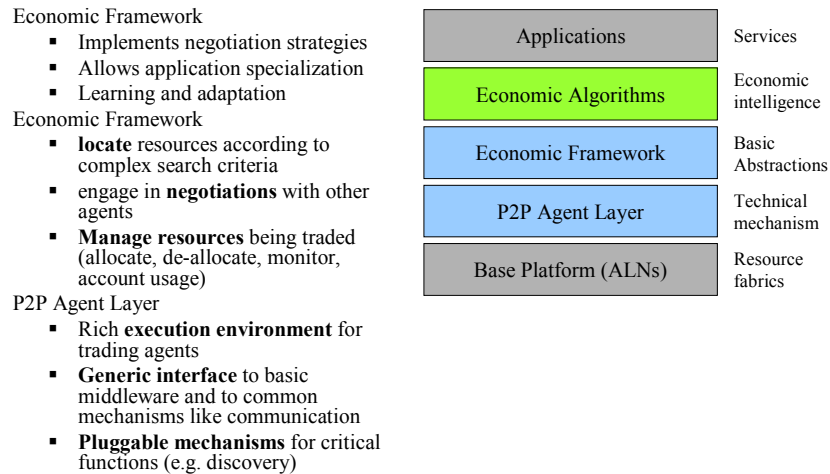 - Bidding **protocol amenable for standardization** (e.g. Contract net)

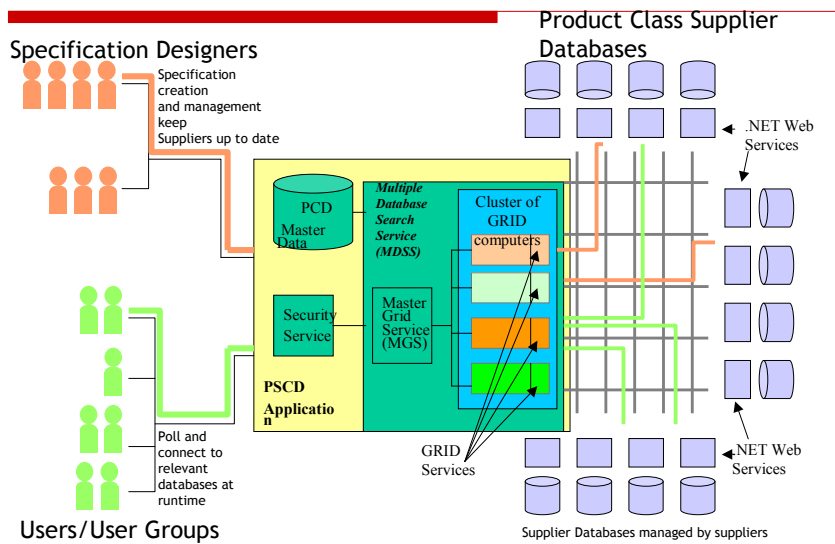Catallactic Scenario: Two-tiered Market

Catallaxy Scenario: Example

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Layers Functionality

Economic Framework
- Implements negotiation strategies
- Allows application specialization
- Learning and adaptation

Economic Framework
- **locate** resources according to complex search criteria
- engage in **negotiations** with other agents
- **Manage resources** being traded (allocate, de-allocate, monitor, account usage)

P2P Agent Layer
- Rich **execution environment** for trading agents
- **Generic interface** to basic middleware and to common mechanisms like communication
- **Pluggable mechanisms** for critical functions (e.g. discovery)

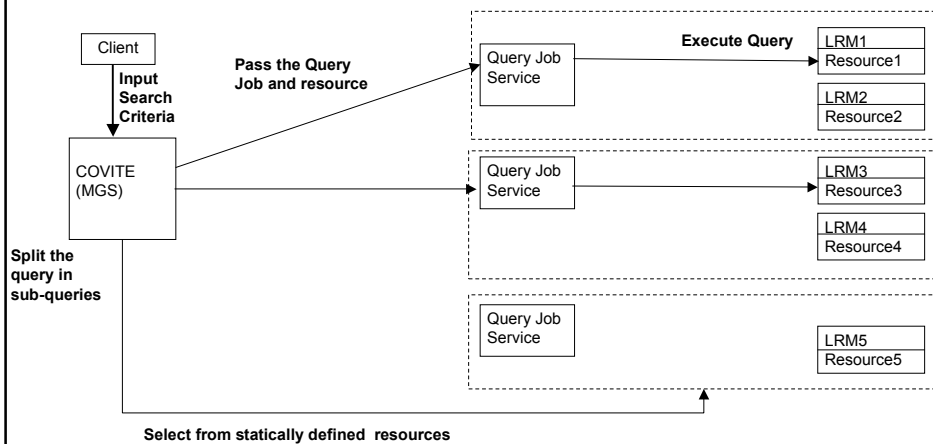| Layer	Role
Applications	Services
Economic Algorithms	Economic intelligence
Economic Framework	Basic Abstractions
P2P Agent Layer	Technical mechanism
Base Platform (ALNs)	Resource fabrics

Adoption of Standards

- **WS-Agreement**
  - **Used to implement negotiation protocols**

- **WSRF, SOAP and WSDL (Java and .NET Web Services)**
  - **SOAP/WSDL for interoperability (Java and .Net)**
  - **WSRF as a foundation for the implementation of resource management in the middleware**
    - Adoption of Globus Toolkit 4.0.x container
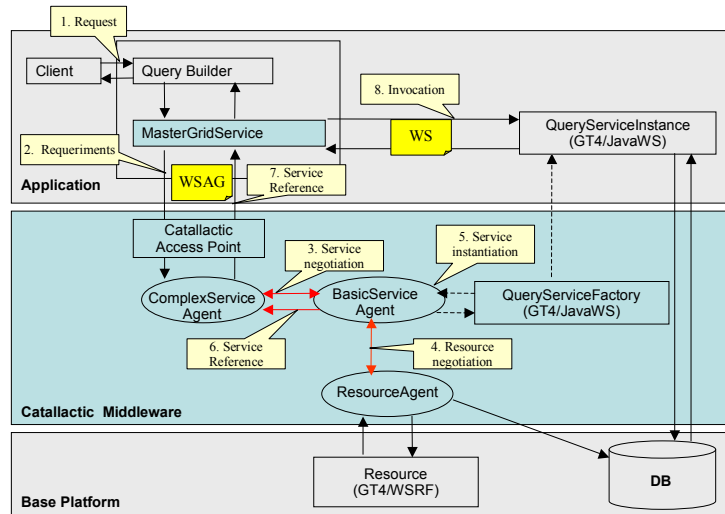
Grid Application (COVITE)

Specification Designers
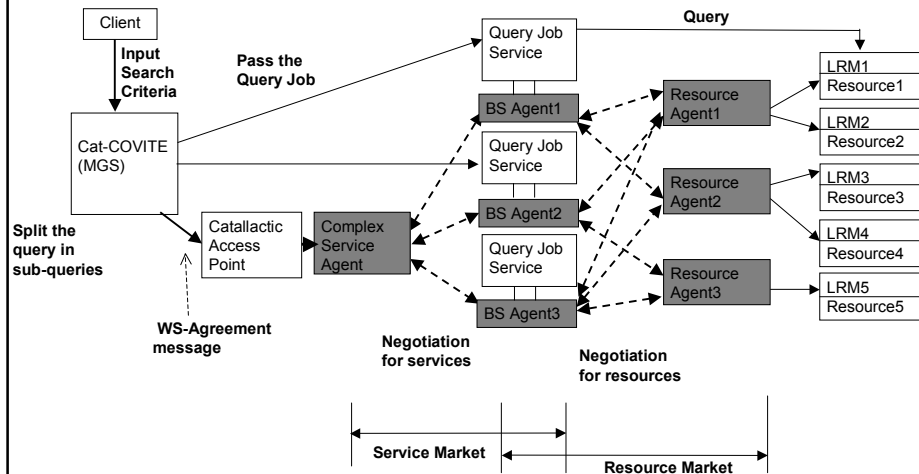
Specification creation and management keep Suppliers up to date

Product Class Supplier Databases

.NET Web Services

PCD Master Data

Multiple Database Search Service (MDSS)

Cluster of GRID computers

Security Service

Master Grid Service (MGS)

PSCD Application

GRID Services

.NET Web Services

Poll and connect to relevant databases at runtime

Users/User Groups

Supplier Databases managed by suppliers

active**plan** Cardiff University

Execution of Queries in COVITE

Client

Input Search Criteria

Pass the Query Job and resource

Execute Query

Query Job Service

LRM1 / Resource1

LRM2 / Resource2

COVITE (MGS)

Query Job Service

LRM3 / Resource3

LRM4 / Resource4

Split the query in sub-queries

Query Job Service

LRM5 / Resource5

Select from statically defined resources

Catallactic Middleware + Cat-COVITE

Catallactic Covite (Cat-COVITE)

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Conclusions

- Service oriented architectures and resource virtualization will drive the adoption of economic based resource allocation models.
  - The Catallaxy is a promising option
- WS-Agreement specification need to evolve to handle the complexities of the bargaining process.
- WSRF specifications are still too general and do not offer a clear approach managing virtual resources.
- Next steps include
  - The development of economic based metrics to measure efficency of allocations
  - Asset the performance of the developed application
  - Proving this architecture in other application models to evaluate qualitatively the architecture under diverse scenarios.

Questions?

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