Agent-based Grid Flow Mgt Framework

by Mr. Krishna Kumar
Institute of High Performance Computing,
Singapore

IHPC: Terence Hung and Brian Yeo

IBM: Benjamin Khoo
Agenda

- **Our Motivation**

- **Grid Flow Management Framework:**
  1) Current Situation
  2) Conceptual Model
  3) GFMF Components
  4) Interaction Scenarios:
     - Between Agent Management Grid Services (AMGS) and Eisenhower (GFMS Core)
     - Grid Service Management
  5) Agent Advantage

- **Conclusion**
Our Motivation

- How can we help users to truly harness the full potential of Grid resources?
- How to provide better support for the Computational Science and Engineering (CSE) R&D Lifecycle?
Grid Components ~ circa 2003

Applications
- Scientific
- Engineering
- Collaboration
- Computational

Development Environments and Tools
- Languages
- Monitoring
- Debuggers
- Resource Brokers

Distributed Resources Coupling Services
- Security
- Process
- Resource Trading
- Market Info
- QoS

Local Resource Managers
- Operating Systems
- Queuing Systems
- Libraries
- TCP/IP & UDP

Networked Computing Resources
- Computers
- Data Sources
- Storage Systems
- Instruments

Grid Applications

Grid Tools

Grid Middleware

Grid Fabric
Agent-based Grid Flow Management System (GFMS)
Interaction between users & the Grid

Motivation: Setting the stage

GOALS
- CFD, FEM, …

TASKS
- Modeling, Meshing, Analysis, …

JOBS
- Fluent, ANSYS, …

Globus

PSE

Meta-scheduler
Motivation: Work Flow Management

START

Node #1
Design Optimization Engine

Node #2
IGES (Secondary Model Files)

Node #3
PATRAN

Node #4
PATRAN

Node #5
Research/Non-commercial Application

Node #6
NASTRAN

Node #7
CAVE

User PC

Feedback Loop (for Design Optimization)

Motivation: Work Flow Management

Modelling Meshing Analysis Visualization
A possible high-level Grid Flow
Grid Flow of a Multi-layered CSE Life Cycle

**Initialization**
- Start
- Node #1
- Optimization Engine
- Initial Parameters and Termination Conditions
- IGES (Base Model Files)

**Evaluation**
- Node #2

**Multi-Process Runs**
- Node #3

**Visualization**
- Node #4
- CAVE
- User PC

END
Conceptual Model: Grid Flow Management Framework

Process Engine of GFMS: Eisenhower @ Process Hub

- Process Composer: Grid Flow Editor
- Process Monitor: Status Viewer

Users in Grid Portal

GPEL Grid: Process Execution Language

Autonomic Mgr (Agent Factory) Grid Service:
- GT3.0.2
- GT3.2
- GT2.2
- GT2.4

Customized WSE

Autonomic Mgr (Agent Factory) Grid Service:
- GT-less

Society of contracted Grid Service Agents for a particular Process Instance/"Run"
Components of the proposed agent-based GFMS

- Process & Policy Management
  - Resource Trading (Resource Identifier & Tender Office)
  - Grid Services Management (Node Managers)
  - Grid Services (Node Managers)
  - Customized Web Service Engine (Optional)
- Monitoring Tools
- Process Definition Tools
- Invoked App #1 ... N
  - Autonomic Manager #1
  - Autonomic Manager #N
  - Grid Service Agents (under contract)
- Invoked App #M ... Z
Interaction between players in our Grid

Grid Services Management

Resource Trading & Market Info

Resource Identifier

Tender Office

Independent Grid Bank

Grid Market Directory (GMD)

AMGS #1

AMGS #2

AMGS #3

AMGS #N

Update the Grid Credits (GC$) owed to each participating node for a Process Run

Credit transfer for AMGS which sub-contracts its jobs to others

Public key of an AMGS?

Services available?

Update services available

Public key of an AMGS?

Learn who is hosting identical services

Bid Price

Bid Price

Bid Price

Bid Price

Bid Price

Sub-contract certain tasks to AMGS #3, bec. Node #N is overloaded

Process Manager

Services available?

AMGS #1

AMGS #2

AMGS #3

AMGS #N
Basic Constituents of our Meta-scheduler

- Task Scheduler
- Node Managers
- Resource Identifier
- Tender Office

Grid Services Management

Resource Trading & Market Info

- Grid Market Directory (GMD)
- AMGS #1
- AMGS #2
- GSA #N-1
- AMGS #N
Agent Advantage

- Active Health Monitoring
- Resource Trading w/ Cost Optimization
- Embrace emerging standards
- Service Redirection ("Sub-contracting")
Agent Advantage

Active Health Monitoring
- Applications need not be exposed as Web/Grid Service (better performance)
- Grid Service Agent act as application/data resource proxy for a particular Process Run/Instance.
- Grid Service Agents able to record resource usage patterns to:
  - Prevent Service Overloading
  - Aid Service Redirection
  - Ensure Quality of Service

Resource Trading and Cost Optimization
- Tender Office (TO) calls for tender (in WSDL) to support a specific Process Run – $X_{mj}$ matrix.
- Autonomic (System) Manager Grid Service (AMGS) bids with their best price (WS-Secured Conversation) – Cost $[mj]$.
- TO minimizes $Z = Cost^{\text{transposed}} \cdot X_{mj}$ (Machine).
- Resource Identifier keeps latest Market Info.
- AMGS of successful nodes spawn Grid Service Agents to form a Agent Society based on SLA contract.
- Service extension (timeslots) through WSDL contract
Embrace emerging standards

Policy Management
- WS-Policy & WS-Security

Agent Communication Language (ACL)
- WS-Secured Conversation

Service Authentication & Addressing
- WS-Authentication & WS-Addressing

Service Transaction Management
- WS-Transaction
R&D Topics

Further research for GFMS

- Grid Flow Editor, with Online Status Monitoring
- Grid Process Execution Language and Flow Management
- Resource negotiation among Agents and the Process Engine
- Optimization algorithm for Resource Identification
- Task Scheduling and Autonomic Node Management
- Autonomic Management of Grid Service Agents, with A.I. Analysis, Planning and Knowledge Extraction capabilities
- Auto-metering and billing system that supports machines of different CPU and I/O bandwidth.
THANK YOU