Fujitsu’s Challenges in Grid Computing

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Outline

- Fujitsu’s Experience in Grid
- Fujitsu’s Grid Strategy
- Fujitsu’s Activity
  - Computational Grid
  - Data Grid
  - Access Grid
  - Utility Computing
- Conclusion
Fujitsu’s Experience in Grid

- **ITBL Project**
  - *Basic software Development for Collaborative Research Environment*

- **Super-SINET Project**
  - *Construction of Grid Environments by Globus Toolkit on Super Computer VPP*

- **VizGrid Project**
  - *System Development for Virtual Reality Collaborative Research Environment*

- **UNICORE Project**
  - *Research and Development of Server side Software for Grid*

- **NAREGI Project**
  - *Started from April 2003, Contribution as key members*
Issues for Grid Business

- How to create New Paradigm by integrating “Grid”, “Web Services” and “Organic Computing”

- How to establish Success Story by Grid not only in Scientific domain, but in Real Business
Fujitsu’s Strategy to realize New Paradigm

TRIOLE

Integration

Autonomy

Virtualization

Basic Technologies

Organic Computing

Web Services

Grid
Relationship with “Autonomy”, “Virtualization” and “Integration”
Web Services powered by Grid

Request + SLA

Customized Application

Solution for Users

-Dynamic workflow
-Personalization

Fast & Stable Web Services

Raw Resources

SLA based Resource Management

Web Service Interface

Integrator

Grid

Grid

Grid
Integrated Layer Structure

- Web Services
- Web Applications Services
- Network
  - UDDI, Directory Services
  - GRID
  - Organic Functions
  - Server, Storage, Network Devices
Strategy focusing on Grid

Virtualization

Application Services

IT Resources

Databases

Grid Technologies

Computational Grid

Access Grid

Data Grid
How to establish Success Story in Grid

Shall we start Application!!
Computational Grid

Focusing on Massive Computing

- Manufacturing industry
  - Many high quantity simulations to reduce TAT and to improve the quality of products
    - e.g.) LSI development, Crash Analysis, Electromagnetic Field Analysis
  - Aerospace, Auto industry, Electrical equipment manufacturer

- Financial business
  - A large quantity simulations
    - e.g.) Derivative, Risk management and etc..
  - Data processing under time restrictions
    - e.g.) Shortening a settlement-of-accounts period, Current price evaluation, Global risk management and etc..

- Distribution industry
  - Marketing strategy planning using data mining
Are Users Satisfied?

- Manufacturing industry
  - People manage compute resources by hands
  - Various scale of simulation
    - Have to interrupt simulation due to time limit
    - Retrogression of development, Great losses caused by remake of LSI
- Financial business
  - 1 more figure of simulation accuracy
    - Lost business chance
- Distribution industry
  - data mining
    - Necessity of supercomputer

NO!!
Problem Solving with Grid

- Do you use compute resource fully?
  - Usage of servers: Under 30%
  - Usage dispersion for each working group
  - Large remaining power leaves desktop PCs

How to get best efficiency of all compute resources in a enterprise!!
System Configuration of GRIP

User Request
• Parameters
• Number of node
• Amount of memory
• Limit execution time
• Service level

Organic Job Controller
- Assignment of job dependency
- Control of job execution (Creation & Cancel)
- Automatic cancel based on job dependency
- Automatic job creation

Resource Manager for Server (GRM)

Matchmaking

Resource State

DesktopPC (Win2000/XP)

Resource Manager for Desktop PC (GRM) Job Submitting

Office-A

Office-Z

GMW (Grid Mediator for Windows)

Portal

Dynamic Schedule management

GRIP
Characteristics of GRIP

- Monitoring the state of all resources
- Matching most suitable resource for each job
- Organic Job Control
- Real time feedback of computing results
Field Trial of CAD-Grid

Web Browser Command I/F
Design Division

Corporate Product Engineering Group

Phase-1 2003/2/21～
Job Admin.、Resource Management
(Prime Power, Organic Server, PC Cluster)

Phase-2 2003/5～
Join of Desktop PCs

PCs in FUJITSU
(Phase-2 2003/5～)

fnet

GMW

PC Cluster
(Linux)
45CPU

Desktop PCs ～10k CPU
(Windows 2K,XP)

Prime Power
(Solaris)
16 CPU

Prime Power
(Solaris)
62CPU

IT Core LABS, IDC LAB.

Organic Server
(Linux)
200CPU

Grid Middleware

Organic Job Controller
GRM
(Grid Resource Manager)
Management Tools

CAD-Grid Portal
Program, Data Transfer
Job Submit

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Simulation Program for Field trial

- Target: W-CDMA Communication between Mobile Phone and Exchange System
- Purpose: To get the value of electric power (X-axis) when the error rate (Y-axis) becomes below than base value

Set various communication Conditions

Exchange System
Simulation Program for Field trial

- Target: W-CDMA Communication between Mobile Phone and Exchange System
- Purpose: To get the value of electric power (X-axis) when the error rate (Y-axis) becomes below than base value

Error rate

- Base value
- Calculated Value
- Nasty condition

Electric Power

Calculated Value
Organic Job Controller

- Graph is automatically created from simulation

![Graph image]

- Initial Job
- Additional Job

Error rate vs S/N ratio

Retry any timing, any case
Results of Field Trial

Average working time

Average working to get one BER characteristic curve

(Average for 620 curves)

<table>
<thead>
<tr>
<th></th>
<th>Without Grid</th>
<th>With Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Proc</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Execution</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Pre Proc</td>
<td>40</td>
<td>12</td>
</tr>
</tbody>
</table>

Man-Power for Simulation

- Former: 3.8 Man-Month
  (3 engineers x 1/2 x 2.5)

- After applying GRIP:
  0.8 Man-Months
  (1 engineer x 1/3 x 2.5)

Number of executed job
- Number of job: 4,720 jobs
- Sum of Calculation Time: 31,000 Hours
  (In usual environment, it takes 7 months)

Turn Around Time: 1/3
Man-Power: 1/4
Data Grid

Research Target of Data Grid

- Virtualization of Heterogeneous and Distributed Database Systems
- Realization of Data Migration
Logical View explained by XML
<xml>
...</xml>

Basic Architecture of Data Grid

Integrated XML Query System
- Metadata
- XML

SymfoWARE
Metadata
Oracle
Metadata
XML-DB
Metadata
XML Doc
Metadata
DTD
SQL
XQuery
XQuery
XQuery
Data Migration
(Organic Storage System)

- A Storage System with Autonomy & Unlimited Scalability
  - Delivers Disk Volume Image over IP Network
  - Autonomic Module Architecture Enables Unlimited Scalability, and Parallel Data Transfer between Modules Accelerates Volume Duplication and Migration

Black hole capacity for keep-growing data

Data generated at every corner of the world

Huge number of modules spread over wide area network organize themselves as a data grid, which serves data access demand from anywhere in the network.
Access Grid

- Virtualization of IT Resources for users
- Process Integration

PIV Virtual Laboratory using Grid Technology

(Collaborative Research with Kanazawa University)

PIV: Particle Image Velocimetry
Establishment of Collaborative Research Environment

To Realize Collaborative Research Environment for Experiments and Simulations
Process Integration

Virtualization

Data Processing → Calculation

Visualization

Broker

Data store/retrieve
KMU-PIV System

Particle Image Velocimetry (PIV) developed by Korea Maritime University
Architecture of PIV Virtual Laboratory

- **Portal Server**
  - Client PC
  - Instrument for PIV experiment
  - Raw Data
  - Display/Operation

- **PIV Virtual Laboratory 1**
  - Broker Engine
    - DB
    - Raw data + Results of Calculation
    - 3D Visualization Engine
    - Physical Quantity Calculation
    - Tools for Collaborative Research

- **KMU-PIV**
  - 3D Visualization Engine
  - Tools for Collaborative Research

- **PIV Virtual Laboratory 2**
  - Raw Data
  - Results of Calculation
  - Kinetic Energy

- **PIV Virtual Laboratory N**
  - Raw Data

- **Tools for Collaborative Research**
  - AmiraVR
  - UNICORE
  - HDF5

**PIV Experimental Center A**

**PIV Experimental Center Z**
Experimental Data (Obstacle)
Demonstration by Amira

Visualization

PIV Research

Supercomputer

Portal Server

3D PIV Software

Data Storage
Utility Computing (Concept Idea)

Server, storage, network (bandwidth, cache etc.)

Resource
ServiceA/corporate system

Standby resources

Control mechanism

Resource
ServiceB/corporate system

Internet
Utility Computing (Accounting)

- Dynamic resource allocation/control according to load status.
- Various account control according to amount of use of resource.

Application Management Enforcement

- Load Amount Detection (CPU, Memory, Link belt region)
- Service Quality Monitoring

Account Mechanism

- Utility Time
  - CPU
  - bandwidth

User profile

Resource Re-allocation

- Bottleneck Analysis
- Optimization of Resource/Contents Arrangement (simulator etc.)

- Load balance control (between/centers in center)
- Traffic Redirection

Monitoring

- Measurement
- Control

Platform: Server, Storage, and Network

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Linkage among Local IDC and Central IDC

- Deployment of Outsourcing
- e-JAPAN Initiative
- Small Start
- Keep the level of IDC

Local IDC Launching

Role of Central
- Integrated Mgt.
- Spare Resource
- Backup (Power, Net)
- Remote Operation
- Common ASP

Merits of Local IDC
- Small Initial Investment
- Easy Task in emergency
- Use Common ASP
- Additional Invest. on-demand
- Cut of Running Cost
Conclusion

Web Services powered by
GRID computing + TRIOLE
(Organic Computing)