Introduction to Grid Computing in Korea

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- Overview of K*Grid
- Building of K*Grid Infrastructure
- K*Grid Middleware/Service Activity
- Application Researches of K*Grid
- Grid Forum Korea
- Future Plans

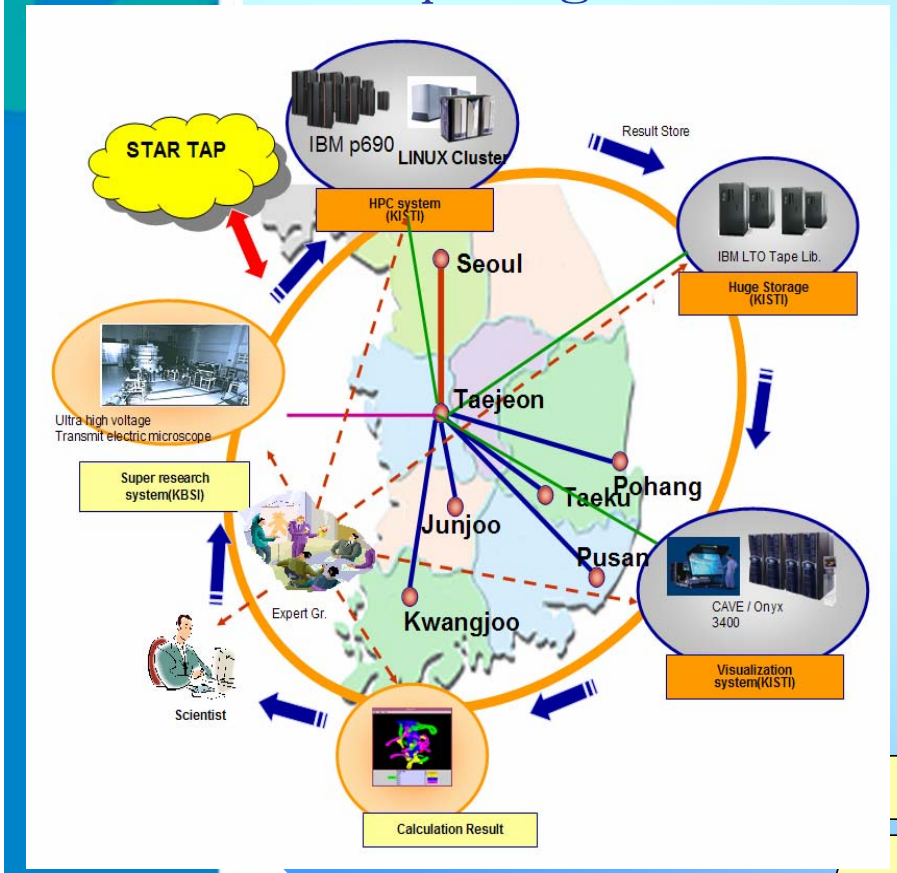
Overview of Korea Grid Project (K*Grid)

Introduction of K*Grid

- Goal : Implementation of the National Grid infrastructure in Korea
- Fund : Government level support by MIC
  - Period : 2002 – 2006 (5 Years)
  - Total budget : about U$ 32M
- Leading organization : KISTI
- PI of K*Grid Project: Dr. Jysoo Lee
- Partners : Various research partners selected from academia, industry, and government lab. through a public competition

Concept of K*Grid

- Efficient utilization of distributed computing/scientific resources



Increment of research capacity

=> Next generation internet business model

Grid Application Project

IT, BT, NT, ET applied science & semiconductor, automobile, steel, machine industries

[Computational Grid]-[Data Intensive Grid]-[Access Grid]

Grid project (next gen. Internet appl.)

- Computing res.
- Data storage
- Scientific Inst.
- Human res.

Grid Middleware

Computing Resources, Scientific Instrument

KOREN, KREONET, etc. high speed network

Scopes of K*Grid (1/2)

- Grid Forum Korea (GFK) :
  - Outreach program for Korean Grid community and international collaboration for standardization
- Construction of K*Grid Infrastructure
  - Phase I (2002~2004) : Experimental Grid testbed for the pilot K*Grid applications
  - Phase II (2005~2006) : Production-level Grid infrastructure for the Grid R&D

Scopes of K*Grid (2/2)

- Development of Grid Middleware Technology
  - KMI-R1 (K*Grid Middleware Initiative – Release 1) : Integrated Grid middleware service package
  - MoreDream : Grid middleware toolkit based on OGSI
- Research on Grid Applications
  - Phase I (2002 ~ 2004) : Molecular simulation Grid, Toxicity prediction system, Grid-based remote services for high tech scientific instruments (UHV-TEM)
  - Phase II (2005 ~ 2006) : Rendering Farm, Game Server Administration, Telematics

Building of K*Grid Infrastructure

Introduction to K*Grid Infrastructure

- A computational Grid testbed for K*Grid and the other spin-off Grid project in Korea such as National e-Science project and KoCED etc.
- Phase I (2002~2004) : Experimental Grid testbed for the pilot K*Grid applications
  - Consists of 12 resource providers in Korea, most of them are small-scale clusters and supercomputers
  - Provides basic Grid services based on non-Web Services Globus Toolkit and MPICH-G2
- Phase II (2005~2006) : Production-level Grid infrastructure for the Grid R&D
  - Consists of sustainable Teraflops clusters and large-scale data storages
  - Provides advanced Grid services based on Web Services Globus Toolkit and MPICH-G2
- Hope to interconnect with the other international Grid projects such as EGEE and PRAGMA, etc.

K*Grid Infrastructure : Future Plans

- Construction of a production-level Grid infrastructure with tera-scale computing resources in Korea
- Global collaboration with the international Grid project such as EGEE, PRAGMA, etc.

K*Grid Resources

		SNU		KISTI	
Type		MPP	Linux cluster	Linux cluster	Linux cluster
Model		IBM SP Nighthawk-II	IBM BladeCenter JS20	IBM eServer x335	
OS		AIX 5.1	SLES 9.0	Redhat 7.3	Scientific Linux 3.0.4
CPU	CPU	POWER3-II	PPC970	PentiumIV Xeon DP	PentiumIV
	Clock	375MHz	2.2GHz	2.8GHz	2.0 GHz
	#CPU / Node	16	2	2	1
	#Node	9	480	256	63
	Total	144	960	512	63
RAM	#RAM / Node	16 GB	2 GB	3 GB	512 MB
	Total	144 GB	960 GB	768 GB	31.5 GB
Disk	#Disk / Node	333 GB	23.5 GB	36.4 GB	40 GB
	Total	3 TB	11 TB	9 TB	2.5 TB
Performance (Theoretical)		0.2 TFLOPS	8 TFLOPS	2.8 TFLOPS	0.2 TFLOPS

K*Grid Service

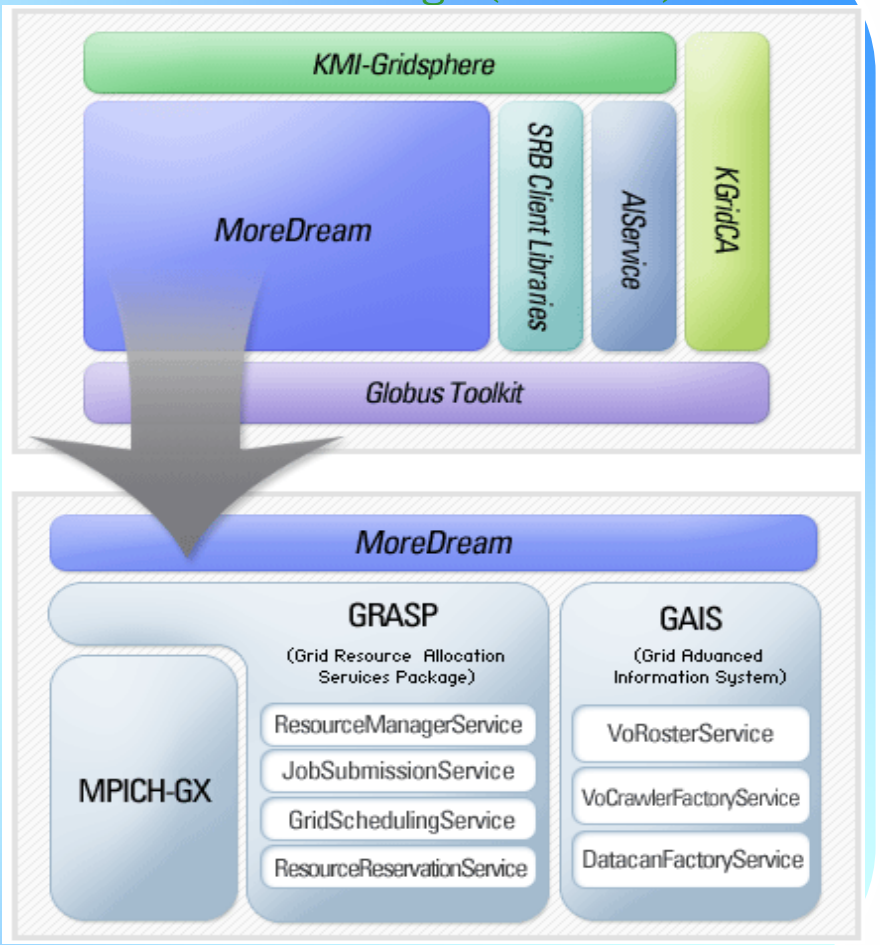
- Development of Web-based Grid Service Platform
  - Ongoing project: April ~ Dec. 2005
  - Features:
    - ✓Web-based Grid Service user environment
      - SSO(single sign-on) of accesses to Grid resources
      - Offers personal accounting information
      - Individual job status monitoring
    - ✓Resource monitoring environment
      - Web Service based monitoring module
      - Monitoring integrated database
    - ✓Accounting environment
      - Accounting information from various queuing system
    - ✓Job, Application, Usage, Monitoring Management

K*Grid Middleware/Service Activity

KMI-R1
(K*Grid Middleware Initiative – Release 1)

- An integrated Grid middleware package
  - Making scientists able to set easily the computational Grid and data Grid environment for their researches
  - harnessing all the advantages of Grid in their fingertips
- Developed for helping to build K*Grid infrastructure, but not limited for it
- OGSI based Toolkit

Grid Service Package (KMI-R1)



Grid Middleware Toolkit (MoreDream) Structure

MoreDream: Grid Middleware Toolkit

- Goal :
  - To develop a Grid middleware which makes possible to organize a Grid environment easily
- Research Items
  - Resource management : GRASP
  - Grid information service : GAIS
  - Grid-enabled MPICH : MPICH-GX
- Middleware Implementation
  - Conforms to OGSI specification

MoreDream: GRASP

- Grid Resource Allocation Services Package (GRASP)
  - A package of Grid services which are related to resource allocation process in Grid
  - A tool for users to submit jobs easily to Grid environment
- Main Features
  - Job submission & allocation services based on OGSI
  - Supporting MPI-based HPC job and HTC job
  - Automatic resource selection by Grid scheduling mechanism
  - Enhancement of reliability of resource selection with resource reservation
  - File staging in/out from/to SRB server via SRB enabled globus-url-copy
  - New job submission language, JRDL (Job & Resource Description Language), for resource matchmaking

MoreDream: GAIS

- Grid Advanced Information System (GAIS)
  - A package of Grid services which are related to provide mechanisms for discovery and monitoring resources
  - Indexes service data carrying state information from multiple Grid service instances
- Main Features
  - Universal VO information management
  - Categorization of Grid services
  - Decentralized architecture
  - Flat, dynamic network of directory servers
  - Group mechanism based on OGSI factory approach
  - Query load balancing for efficient VO query
  - Rich information providers
  - User-friendly interface implemented in portlets

MoreDream: MPICH-GX

- Enables an MPI job to execute through Grid middleware such as GT3 by file based initialization
- Main Features
  - File-based MPI initialization
  - Private IP Support for MPI communication between private IP clusters : MPICH-GP
  - Fault tolerant MPICH by check-point mechanism: MPICH-GF
  - Initialization enabling co-allocation of distributed resources to a job by GRASP

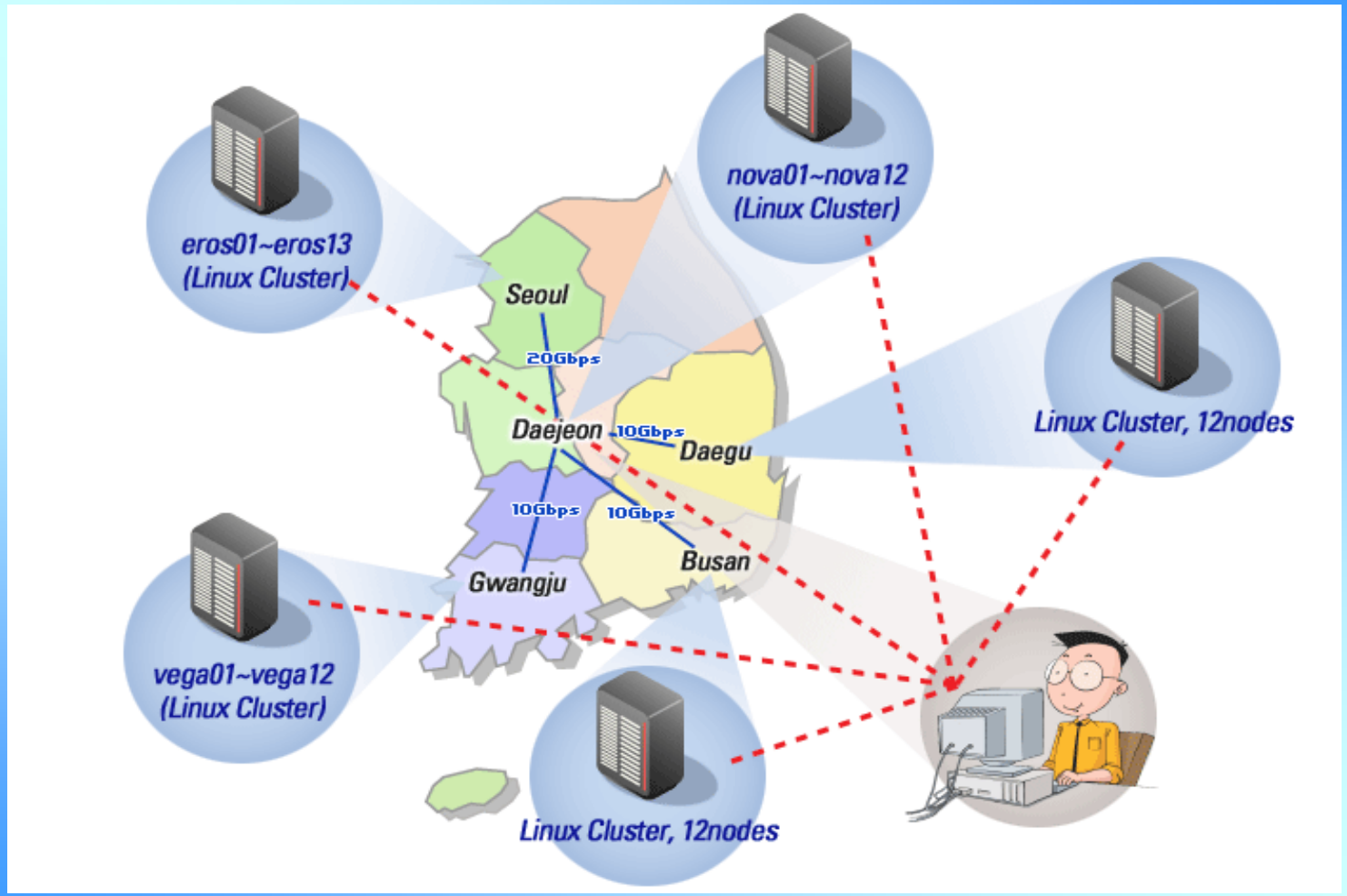
Other Components of KMI-R1 (1/2)

- Globus Toolkit 3
  - Grid core services
  - Reference implementation of OGSI specifications
  - Software services and libraries for resource monitoring, discovery, management, security and file management
- SRB (Storage Resource Broker) Client Libraries
  - For access to data in SRB server by GRASP
  - To show replica info in SRB server by GAIS
- KGridCA System
  - Certificate Authority for K*Grid Testbed operation
  - Certificate Management (Requesting, Issuing, Storing) by Web browsers
  - Email Notification (CSR (Certificate Signing Request) Upload, Certificate Issue)
  - Providing Web user interface (http://ca.gridcenter.or.kr)
  - Approved as a production-level CA by ApGrid PMA

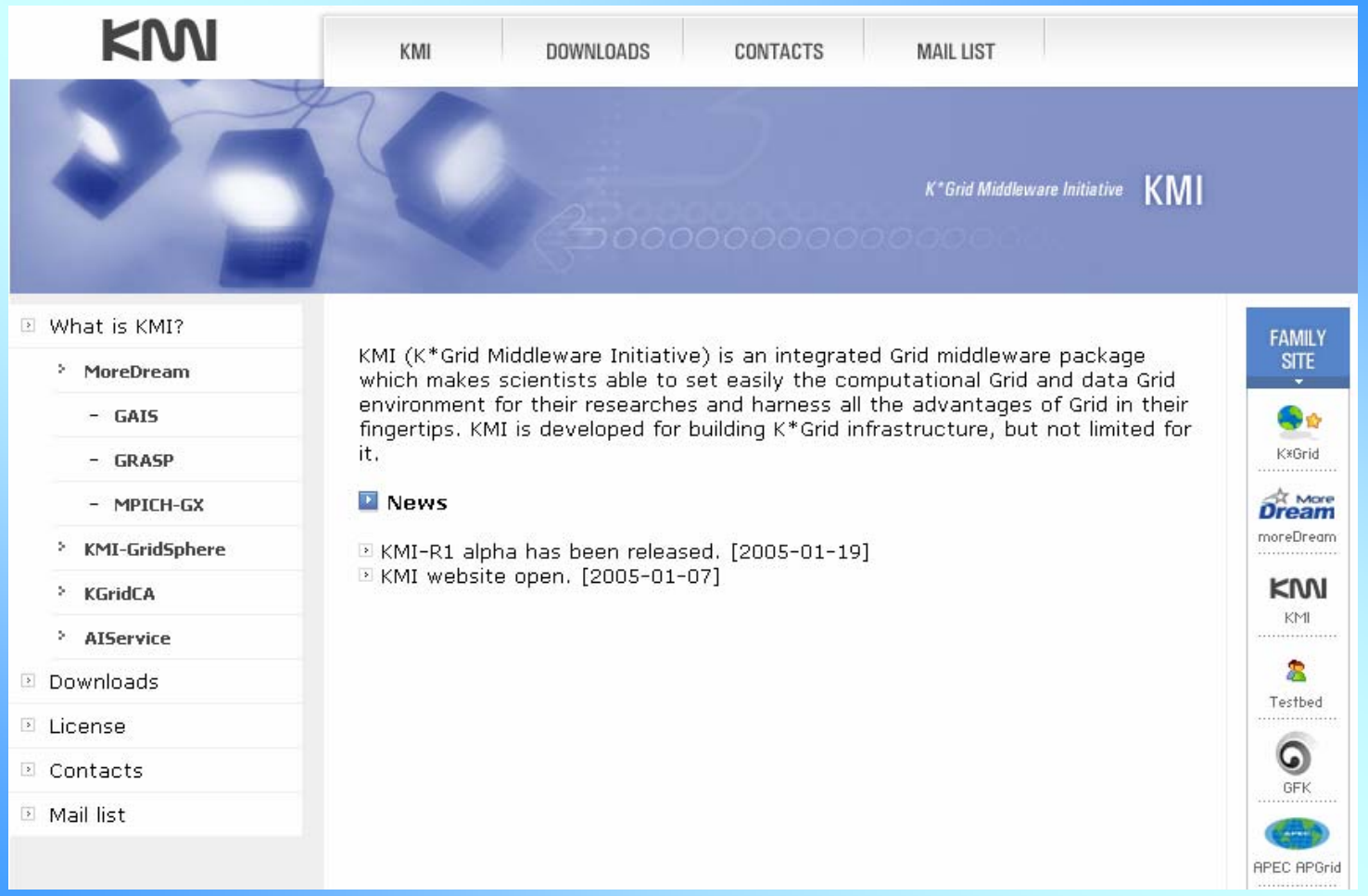
Other Components of KMI-R1 (2/2)

- AIService (Accounting Information System)
  - OGSI-compliant Service which gathers resource usage information from heterogeneous platforms and provides it as a standard format
  - Provide a portlet for Grid accounting information working on the GridSphere portal
- KMI-GridSphere
  - Portal framework from GridSphere with MoreDream Grid service portlets – GRASP job submission & GAIS information provision
  - Portlets compliant with JSR 168

KMI-R1 Testbed



KMI-R1 Homepage



(http://kmi.moredream.org/)

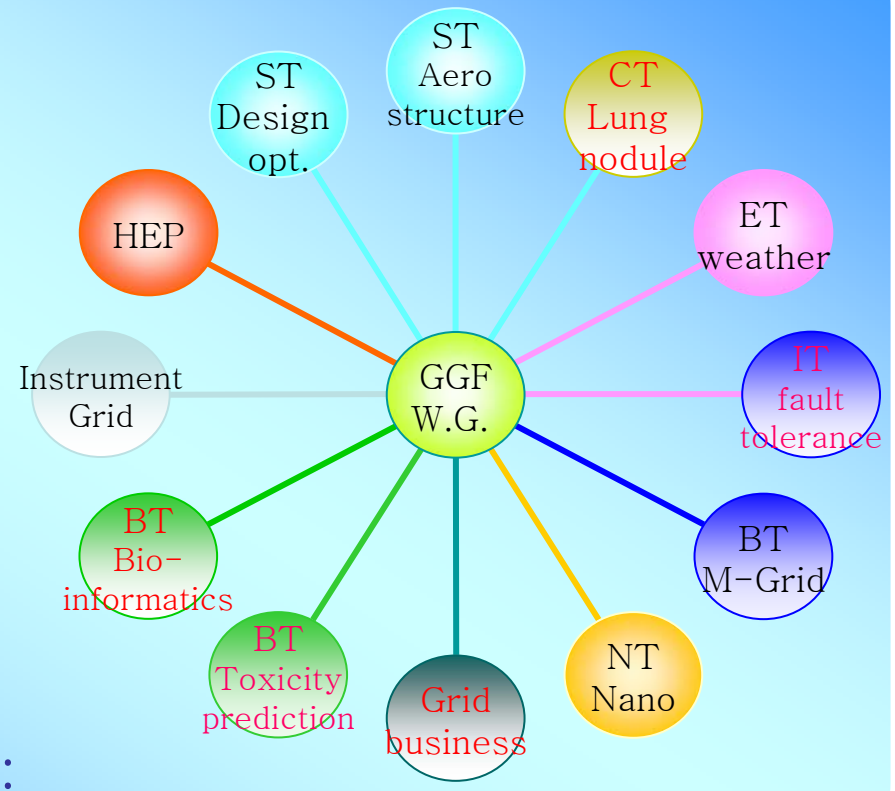
Milestone for KMI-R1

- KMI-R1 Package Release & Evaluation
  - Version Alpha Release : Jan. 19, 2005
  - Version Beta Release : Jul. 15, 2005
  - Version 1.0 Release : Oct. 2005
- KMI-R1 is under evaluation at KMI-R1 Testbed

Application Researches of K*Grid

Researches on Grid Application

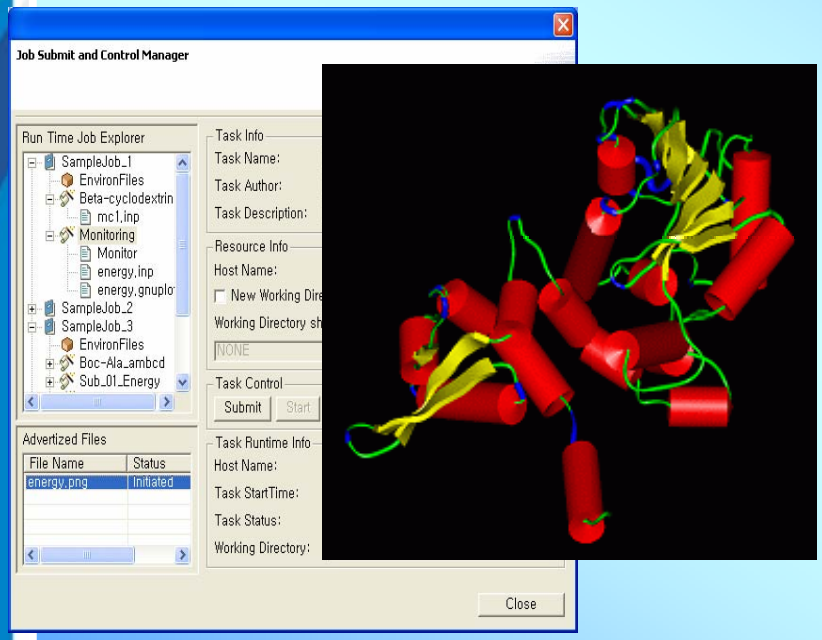
- Phase I (2002 ~ 2004)
  - Molecular simulation Grid
  - Toxicity prediction system
  - Lung nodule detection/analysis system
  - Grid-based weather forecasting system
  - Grid-based remote services for high tech scientific instruments : UHV-TEM
  - Bio-informatics

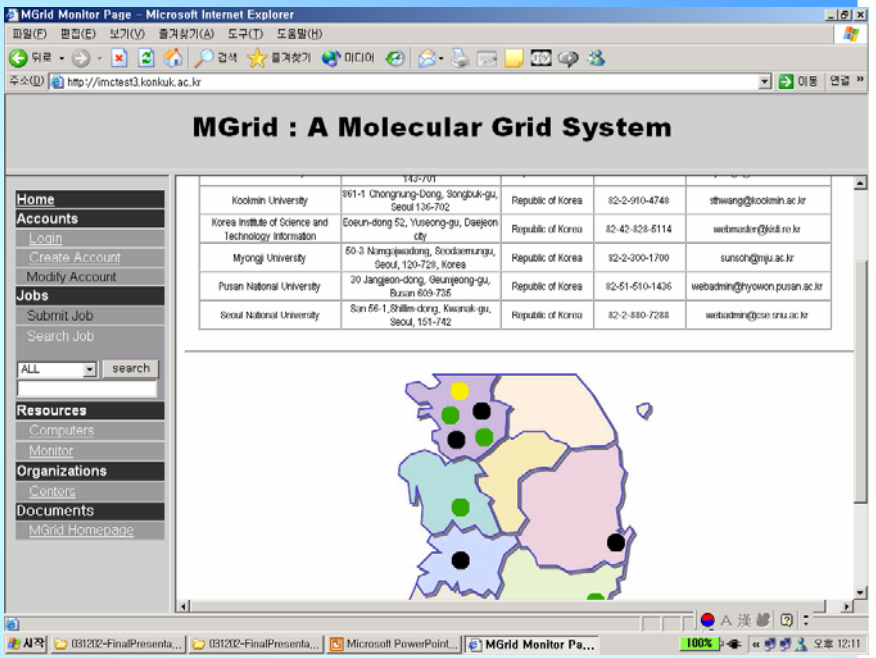


Areas of 1st Phase

K*Grid Application : Bio I

- Molecular Simulation Grid





Support methods:
- Execution time prediction
- Task migration
- Hierarchical scheduling

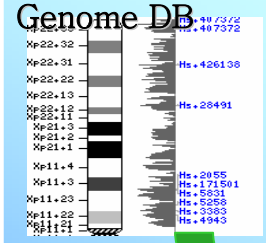
Support methods:
- Real time monitoring for remote simulation tasks

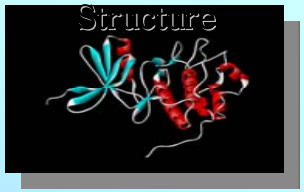
K*Grid Application : Bio II

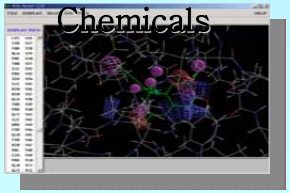
- Toxicity Prediction System

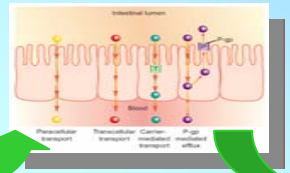
Human G2C System (Time)

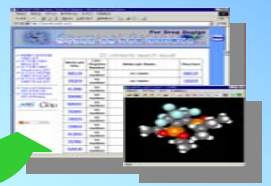
13 years	1 month ~ 1 year	3 years	6 years	can not expectable
13 years	1 week	1 month	2 weeks	1/60
Genome DB	Protein 3D Structure	Hitting Chemicals	Filtered Leads	Drug Candidate Database











Protein Str. Generation
X-ray
NMR
Homology
Threading
Folding

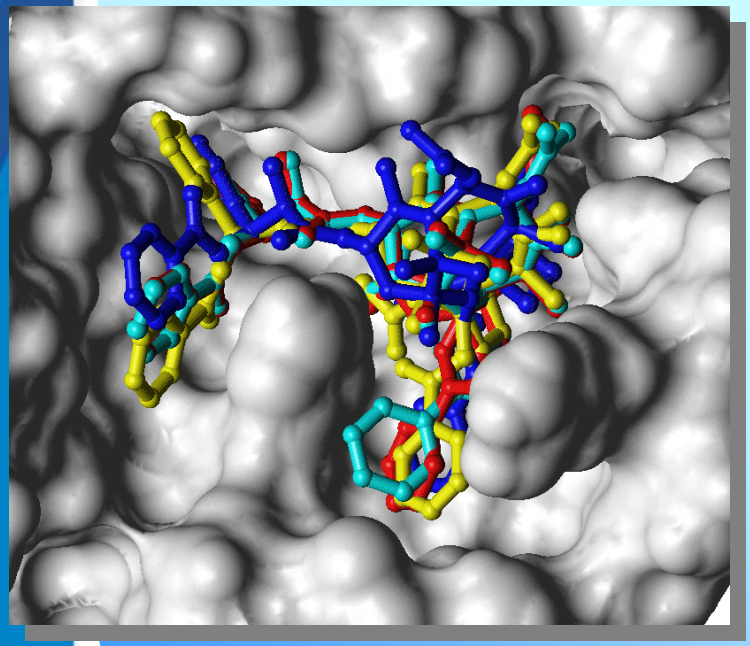
Screening
HTS
Docking
Feature mapping
de novo Design

ADME/Tox
Absorption
Distribution
Metabolism
Eliminati

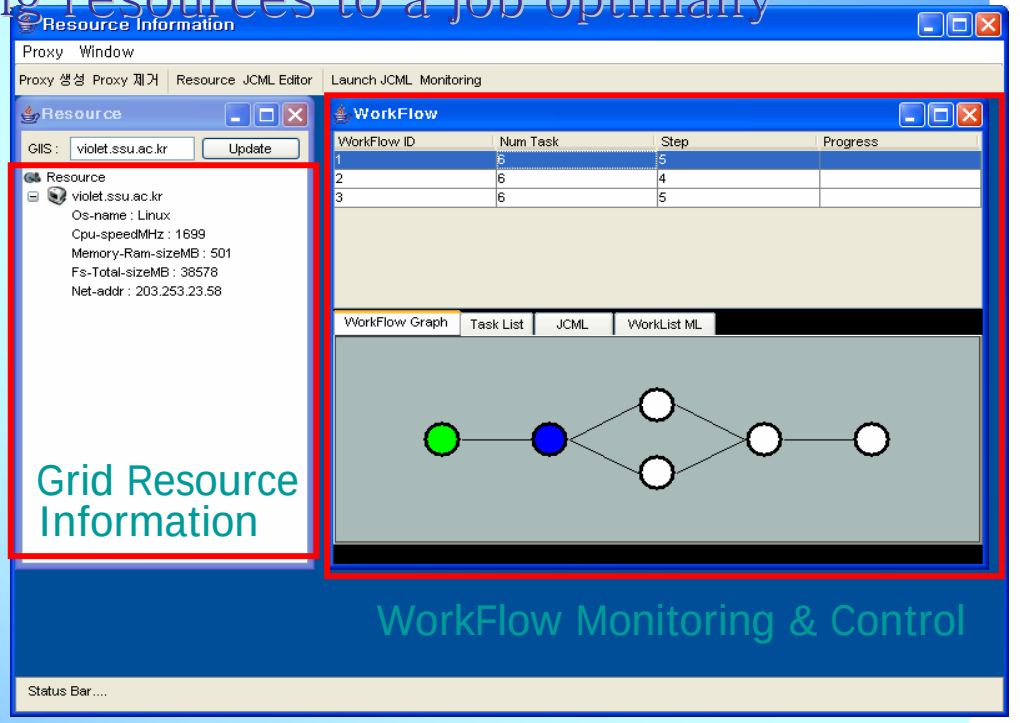
Genome Information -> Drug Candidate

K*Grid Application : Bio III

- Virtual Screening and Toxicity Prediction System
  - Meta Scheduling Framework (MSF) can prevent wasting resources by allocating resources to a job optimally



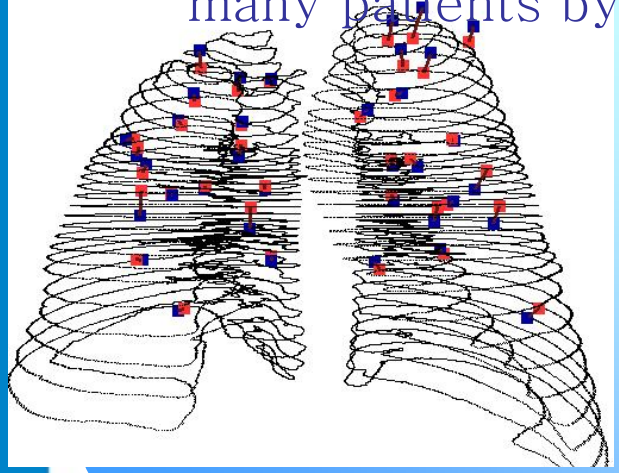
Virtual Screening



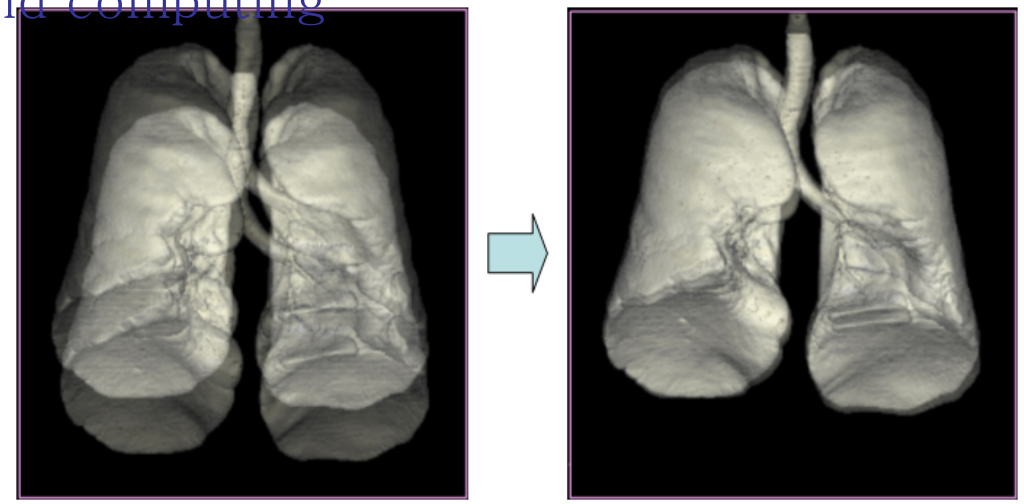
MSF Workflow

K*Grid Application : Medical

- Lung Nodule Detection
  - Increase the efficiency, speed, and accuracy of diagnosis by automating manual work to detect lung nodules on CT image.
  - Development of automatic lung nodule detection system by using the image processing technique
  - Implementing rapid analysis system of lung nodules of many patients by grid computing

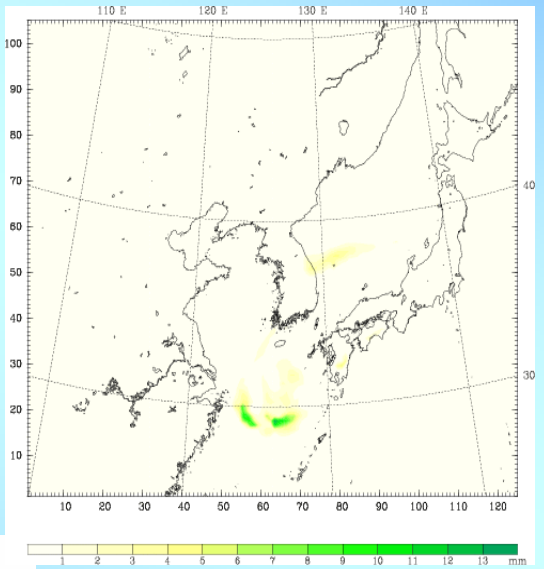


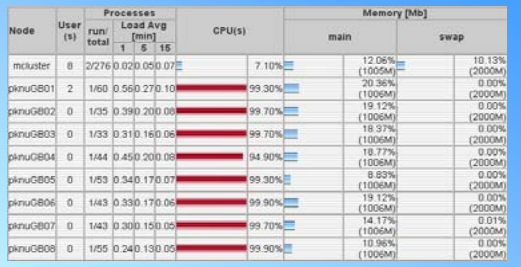
Lung Surface Registration

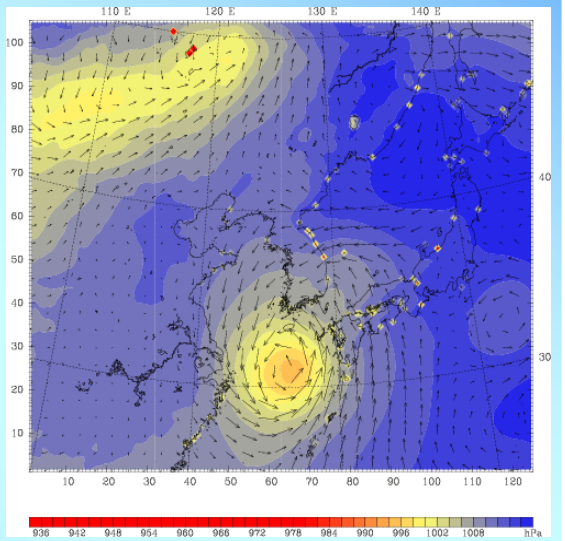


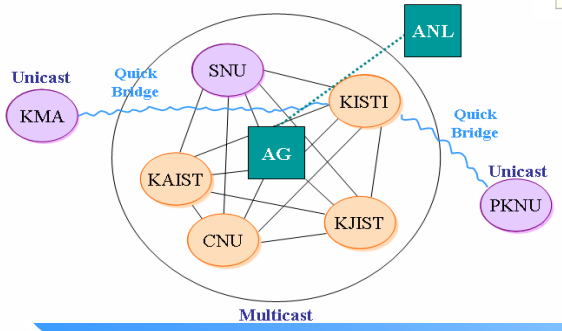
K*Grid Application : Weather Modeling

- Virtual Lab. for Weather Modeling
  - Improved forecasting capability: 10km → 5km









Storm monitoring, Precipitation, wind
Sep. 12, 2003 09:00 LST~ Sep. 13, 2003 09:00 LST

K*Grid Application : Instrument

- Grid-based Remote Operation: UHV-TEM
  - Experimental Grid: Activation of UHV-TEM Application

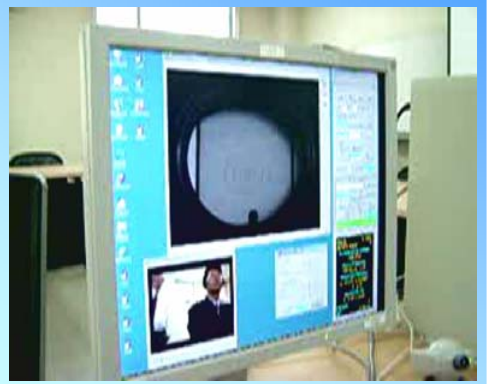
FasTEM installation
(2003.8)

UHV-TEM Grid
Web portal

Seoul

KBSI,
Daejeon

UHV-TEM



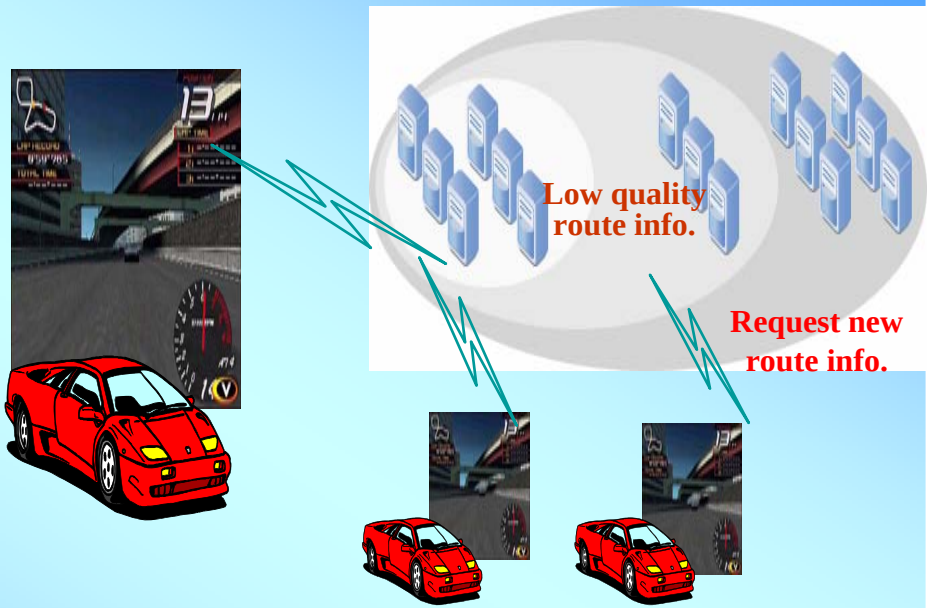
K*Grid application : IT

- Phase II (2005 ~ 2006)
  - Extension of Grid technology through presentation of Grid Application Model in IT
  - Development of technology for high quality IT service using Grid Technology and environment
  - Presentation of Grid Adoption Model through analyzing IT applications included in the IT839 Strategy and apply to some IT applications
  - Telematics, On-Line Game, Rendering Service(2005)

(Source : MIC)

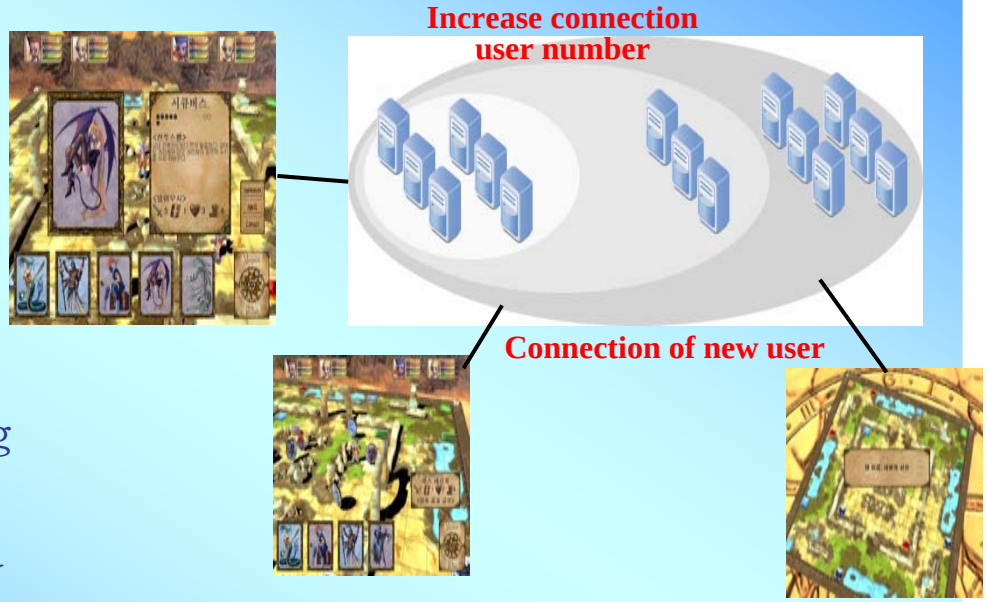
Grid Based Telematics Service

- Objectives
  - Development of 3D realistic image contents service in Grid environment
  - Create benefit model for Grid-based Telematics service
- Significance
  - To enhance processing capacity of server using Grid resource allocation or discovery service
  - To apply to the field of providing high volume contents service



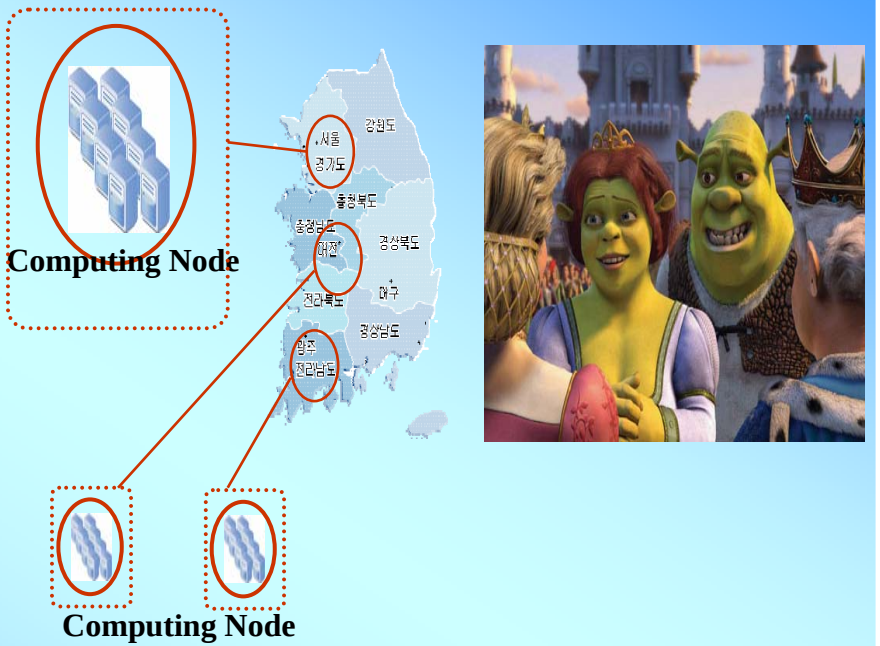
Grid Based On-Line Game Service

- Objectives
  - Design and implementation of On-line game server technique on Grid environment
  - Development of client program for demonstrating Grid-based on-line game server
- Significance
  - To enhance processing capacity of server using Grid resource allocation or discovery service
  - To present possibility of Grid in field of on-line game



Grid Based Rendering Service

- Objectives
  - Development of infra system for rendering service on Grid environment
  - Accomplishment of commercial or non-commercial rendering project on infra system
- Significance
  - To present Rendering Service Model through rendering farm constructed using Grid technology
  - To create benefit model for Grid-based Rendering service



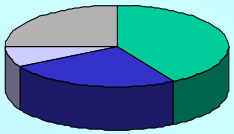
Grid Forum Korea (GFK)

Grid Forum Korea (1/2)

- Goals :
  - Introduction and deployment of Grid new technology
  - Grid technology support for research, grand challenge project and international collaborative research
- Statistics (as of May 2005)
  - 903 members from 254 organizations & 25 WGs

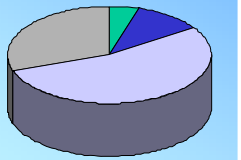
Working Groups

Application Area : 10 WGs
Middleware Area : 6 WGs
Network Area : 2 WGs
Etc. : 7 WGs



Participating Individuals

Government Institution : 41
University : 105
Research Institute : 485
Industry : 272



- Workshops
  - 2002 GFK Summer Workshop (July 11-12, 280 participants)
  - 2002 GFK Winter Workshop (Dec. 10-11, 200 participants)
  - 2003 GFK Summer Workshop (Aug. 19-21, 200 participants)
  - 2003 GFK Winter Workshop (Dec. 1 - 2, 200 participants)
  - 2004 GFK Summer Workshop (Aug. 26-27, 200 participants)
  - 2004 GFK Winter Workshop (Dec. 2 - 3, 250 participants)
  - GGF13/GFK 2005 Workshop (Mar. 13-16, 700participants)

Future Plans

Future Plans

- Establish next generation internet service infrastructure through Grid-based virtual integration of IT resources and IT New Growth Engines (Ex: Mobile Comm., Telematics, Intelligent Service Robots, S/W solution and Digital Contents, Home Network and Embedded S/W, BcN, etc)
- Increase R&D productivity and create economic driving forces through sharing nation-wide Grid resources and liking IT839 strategy
- Generate and support other Grid-based government initiatives: providing K*Grid infrastructure to KCED, e-Science, e-Health and e-Buisness programs

If you want more information about
K*Grid,
please visit the website:

http://www.gridcenter.or.kr/