科学技術振興機構
Japan Science and Technology Agency

行政院國家科學委員會
National Science Council

NSC-JST Workshop

The Development of Cloud Interoperability

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Outline

- Where are we?
  - Our experiences
    - before the Cloud
    - What has been done
  - Demand of Interoperability
    - tri-sites' experiments
- Where are we going?

Goal of NCHC

To establish a national level high performance computing center, to integrate computing resources, and to elaborate the benefits of resource sharing

HPC

- In 1991, the NCHC headquarters was established in the Hsinchu Science Park. It is the only national HPC center providing scientific and technological research and development.

Research Network

- In 1998, the NCHC assumed responsibility for the operation and maintenance of the TANet2 R&D network.

Advanced Technology

- In 2003, the NCHC accepted the Executive Yuan's "Challenge 2008 National Development: Asia-Pacific Hub " project; The Grid Computing.
- Cloud Computing.

Position & Role

To Become a World-class Supercomputing Center Bringing About Scientific Discovery & Technological Innovation.

Fundamental Role

- Establish sophisticated HPC, Storage, and Networking infrastructure to the academic circles, thus, promoting Taiwan's fundamental & technological power
- Infuse innovative technology, develop value added systems, and foster the growth of HPC professionals

Enabling Role

- Link the facility with user needs, provide customized "total solution" to users, and enable scientific discovery
- Perform collaborative research with academic and research institutes, create technology break throughs, and bring contributions to the society and economy

Cloud Computing -

Challenges & Requirements

- Federated Cloud Infrastructure for Elastic Applications
  - Data centers in multiple geographical locations
    - To provide localized service
    - To provide redundancy
    - To ensure reliability in case of site failure

    under same authority or NOT?
  - Hundreds of services hosted by dozens of Cloud DCs
  - Each AP component must dynamically scale to offer good quality of experiences to users
    - When a variation in temporal and spatial locality of workload happens

Cloud Computing -

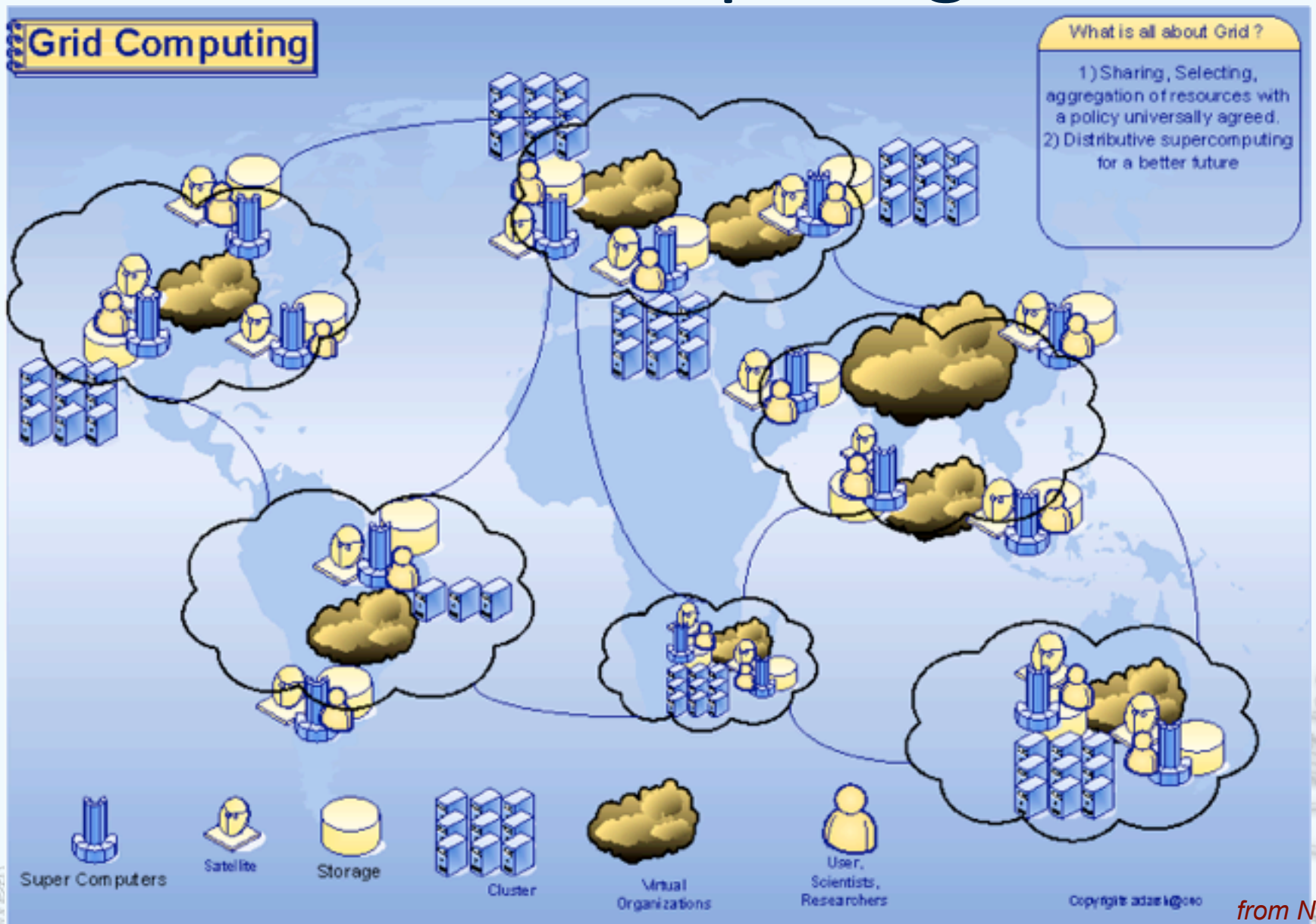
Challenges & Requirements

- Issues
  - AP service behavior prediction
  - Flexible mapping of services to resources
  - Economic models driven optimization techniques
  - Integration and ***Interoperability***
  - Scalable monitoring of system components

Experiences related to Grid/Cloud

- Grid Computing
- Phantom Cluster
- Crawlzilla
- Ezilla

Grid Computing

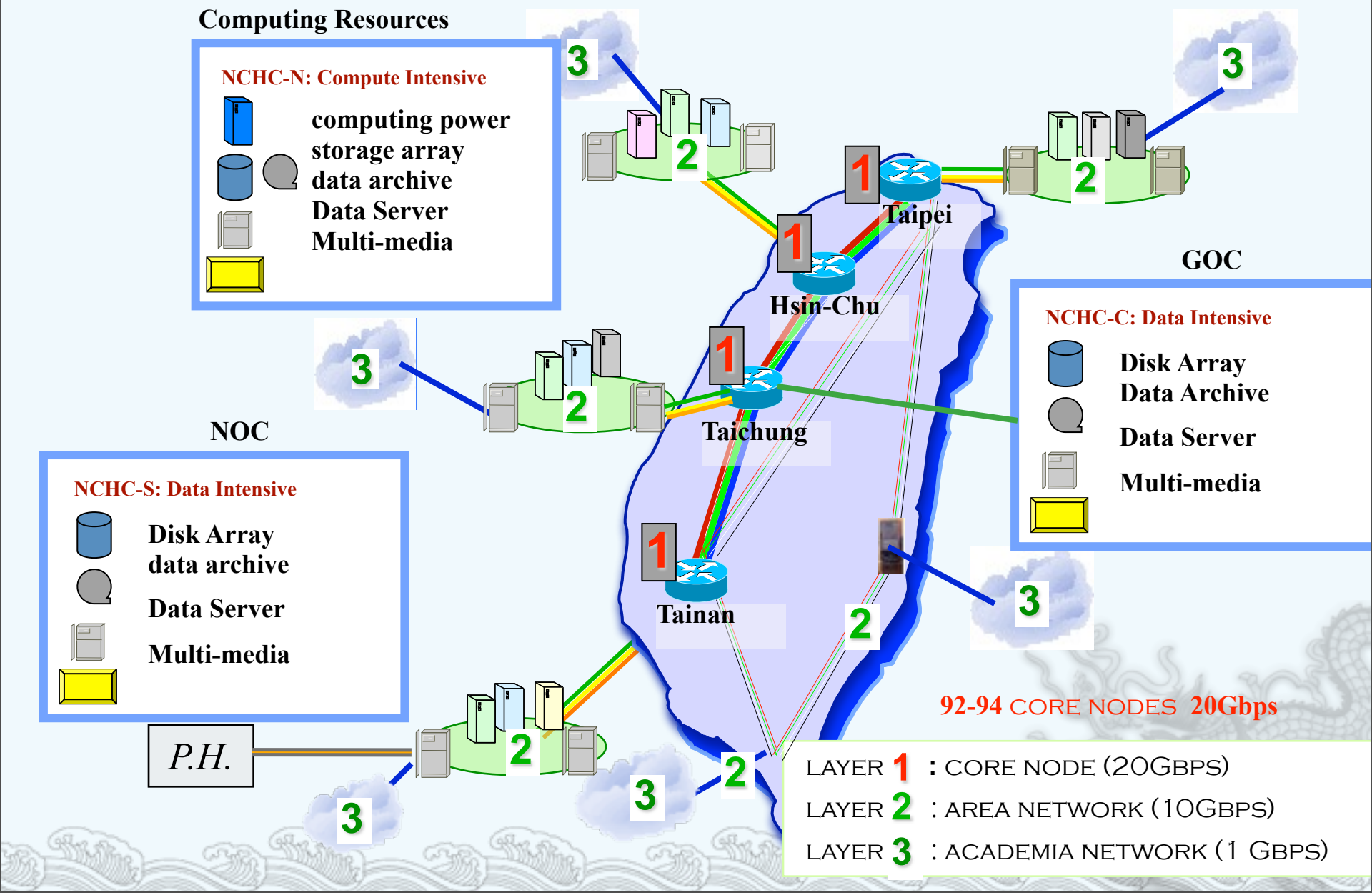


from NIST

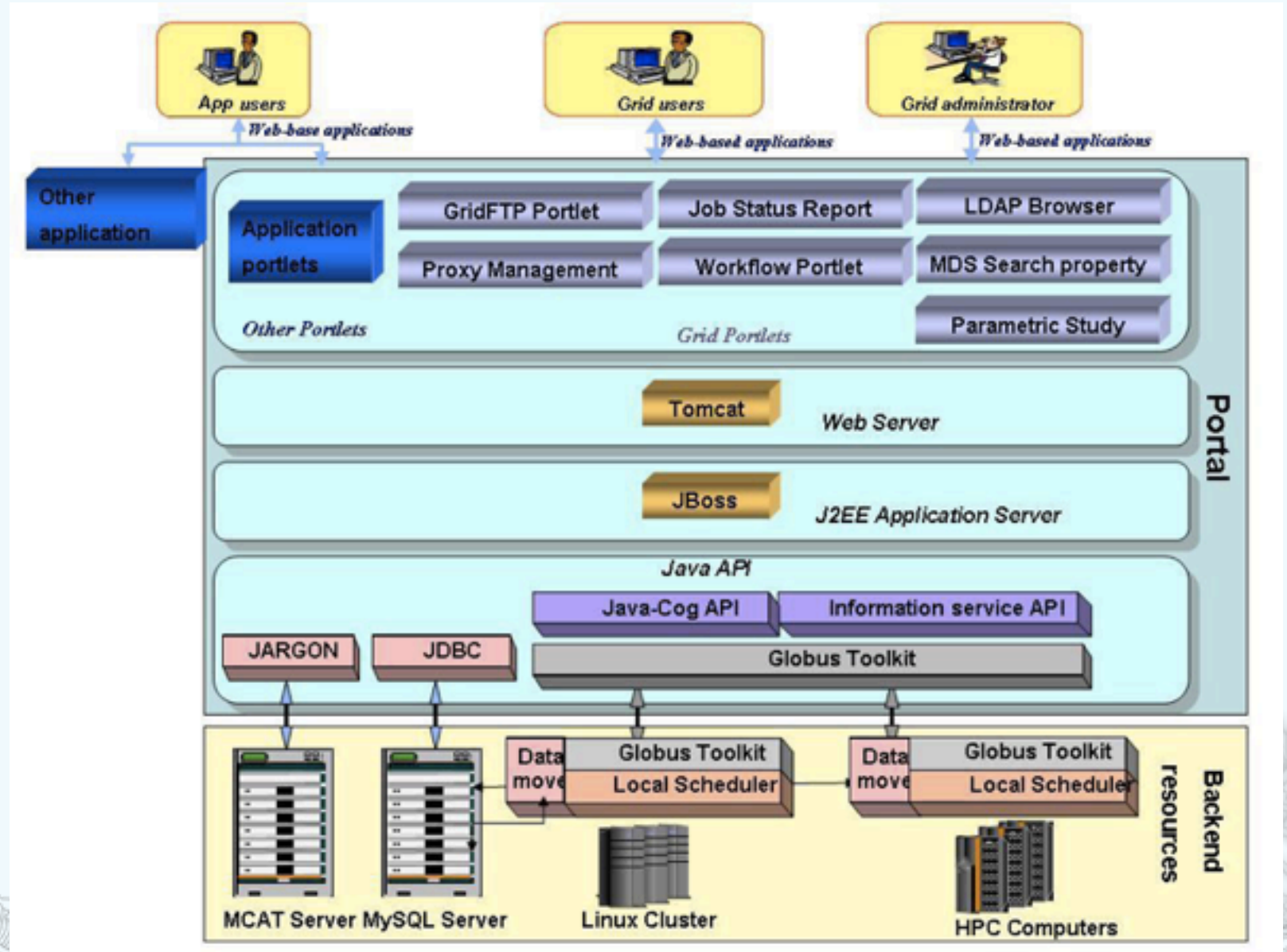
What are Grids

- ***Middleware*** for uniform, secure, and highly capable access to large and small scale ***computing***, ***data***, ***Instrument*** systems that are ***distributed*** across organizations
- Ancillary ***services*** supporting application frameworks/ portals
- Persistent infrastructure (e.g. DOE Science Grid and NASA's IPG...) supporting
  - Grid services on the compute and data systems of interest (Grid sysadmin)
  - authentication supporting single sign-on (X.509 Certification Authorities)
  - resource discovery (Grid Information Service – distributed directory service)

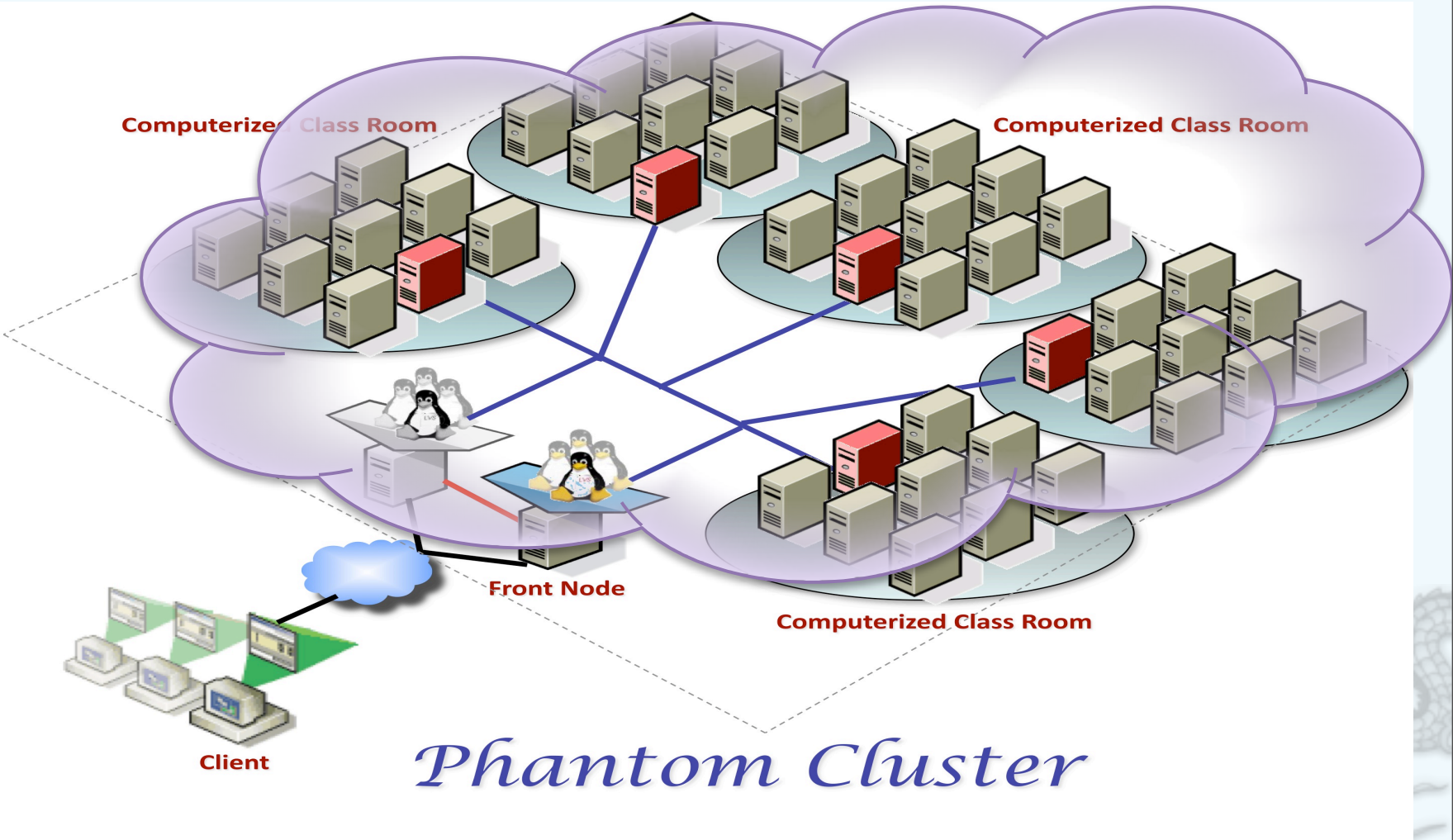
Infrastructure of KING



Layered Grid Portal



Phantom Cluster



Utilization/“Free” cycles

Aspects Regarding the Cloud Computing

- Elastic/Dynamic vs. High Performance *HPC view*
  - Conventional HPC service harvest the computing power and performance
  - Cloud focuses on the flexibility/usability of the IT resources
  - HPC : adjust the applications to meet the facility
  - Cloud : adjust facility to meet the demands from the applications
- Shared vs. Dedicated
  - Shared resources for better utilization
  - Shared resources with bargain power

Aspects Regarding the Cloud Computing

- Integrated vs. Individual Service
  - From the view point of users
  - From the view point of result/solution provider
  - Not from the view point of processing
  - Integration over data, processing power, pre-/post-processing, ...
- Cloud vs. Grid
  - Dealing with computing, data, instrument, ... via middleware
  - Presented as Services via network
  - ***Distributed*** establishment ⇨Grid computing
  - ***Centralized*** establishment ⇨Cloud computing
  - Collaboration between various authorities, instead of Integration
    - Why not the integration of distributed establishments?
    - loosely coupled interoperability

Aspects Regarding the Cloud Computing

- Application style
  - Single/simple application
  - Genetic application service
- Management
  - Simpler, fewer sites to be taken cared of
  - Cost effective in every way
  - Well-controlled/highly-secured environment and data
  - Ease of use vs. Secured environment
    - one of the reasons why Grid is stalled
    - highly secured solution comes with complicated insurance process
  - **Vulnerability**
    - Increased or reduced?
    - Focused resources for protection
    - “Single Point of Failure”?
- **Industry vs. Academia**

The Cloud

- Architecture

Users

Single Access Point

SSO

Scientific/Engineering Applications

Engineering Application

Scientific Exploration

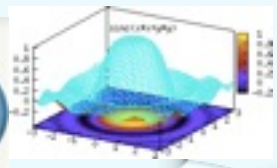
SaaS

Customized Platform

PaaS

Multi-Disp. Res.

Data Base



Simulation

Resources on Demand

IaaS

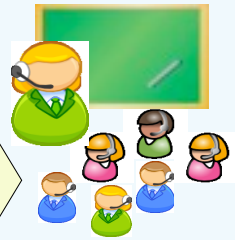
VM Images Virtual Storage Virtual Servers

Physical cluster

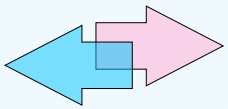
Physical Storage

Physical Servers

Education/ Collaboration



Middleware distribution



Int. Collab.

Security

Compute Cloud

- Easy customization and configuration based on users' demand
- Without re-inventing the wheel
  - Open Source solution
- Lower the barrier of using Cloud computing resources
  - independent operation space
  - controlled thread
  - easy access to Cloud applications

Ezilla

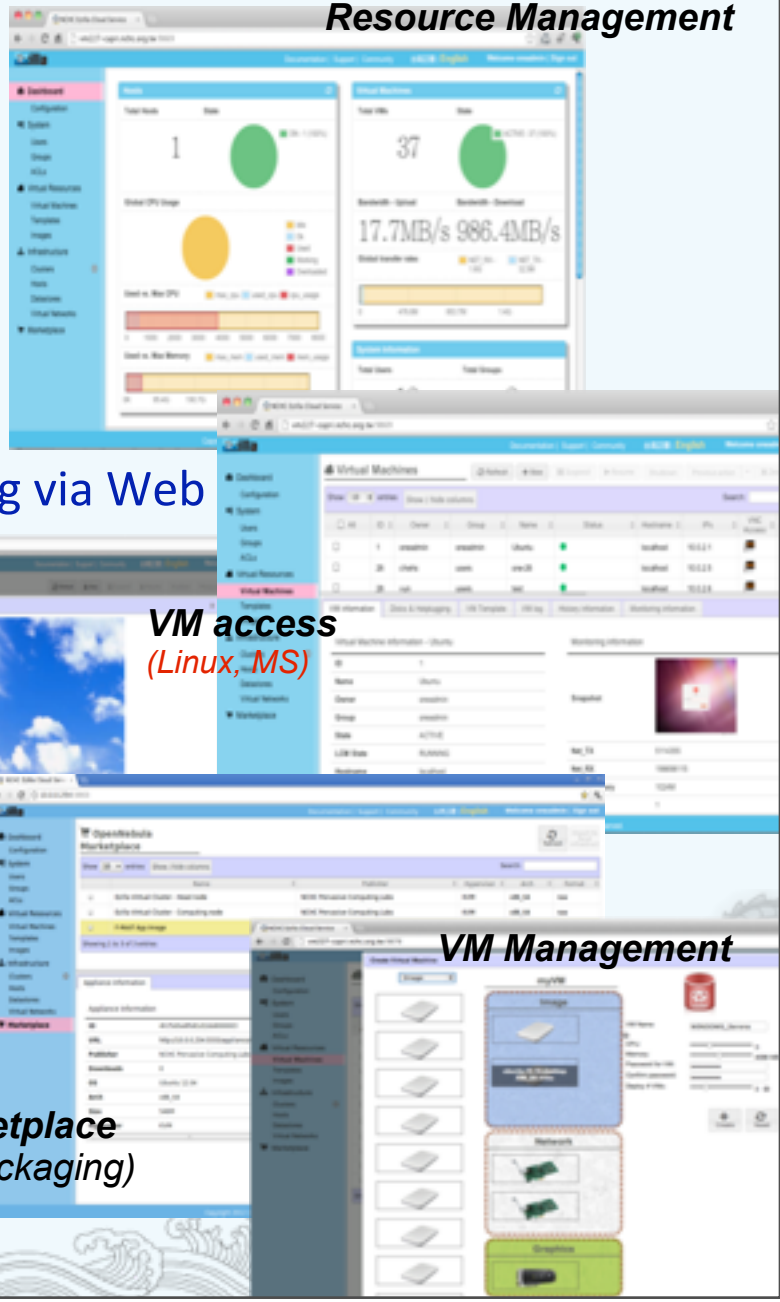
- Design Philosophy
  - Building cloud environment with ease
  - Providing friendly UI to users
  - Providing easier way to customize & configure cloud to meet the user's demand
  - Tools and GUI for System Admin.
  - Complying with OCCI (Open Cloud Computing Interface)
- Technologies adopted
  - DRBL (Diskless Remote Boot in Linux)
  - WebOS
  - Cloud Middleware
  - MooseFS (Distributed File System)

Ezilla

- Design Philosophy ⇨ **Build around users**
  - Building cloud environment with ease
  - Providing friendly UI to users
  - Providing easier way to customize & configure cloud to meet the user's demand
  - Tools and GUI for System Admin.
  - Complying with OCCI (Open Cloud Computing Interface)
- Technologies adopted ⇨ **Build to last**
  - DRBL (Diskless Remote Boot in Linux)
  - WebOS
  - Cloud Middleware
  - MooseFS (Distributed File System)

Ezilla

- Features of the Ezilla
  - Auto Installation
  - Dynamical Resource Pooling
  - Friendly UI, including Drag & Drop (D&D)
  - Real Time VM Management & Monitoring via Web
  - Interactive Access to VMs
    - VNC : direct access
    - SPICE : video streaming
  - *Virtual Cluster*, HPC style
  - VM Image *Packaging*
  - *P2V*
  - Application *Marketplace*
  - Light Migration : to come
    - shared storage approach
    - share-nothing approach



http://ezilla.info
http://sourceforge.net/projects/ezilla-nchc

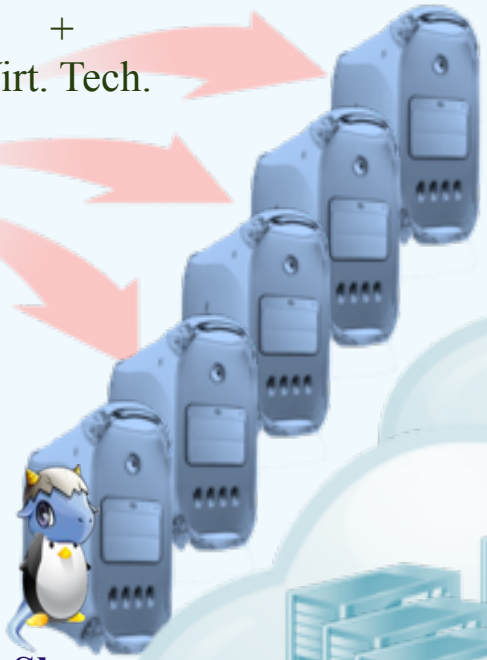
Deployment of Cloud via Ezilla

Unattended Installation

DRBL-SSI/Clonezilla
+
Virt. Tech.

Resource Pool
Resources added/removed dynamically
Disk-less version
Disk-full version

Ezilla Master



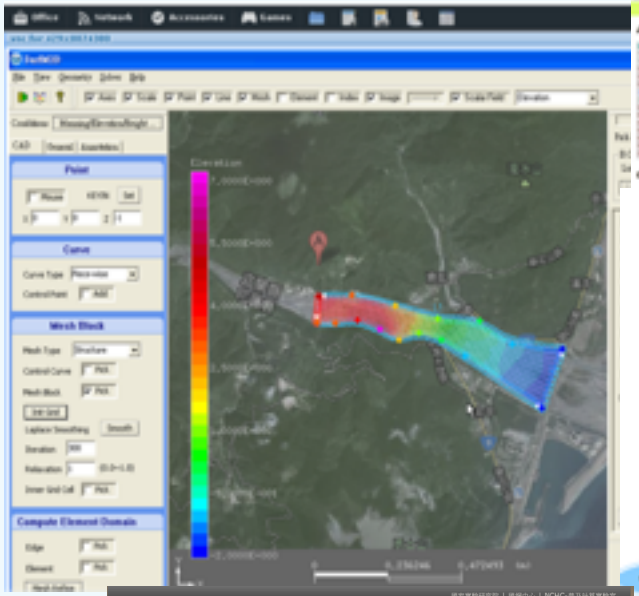
Ezilla Slave

Virtual Machines

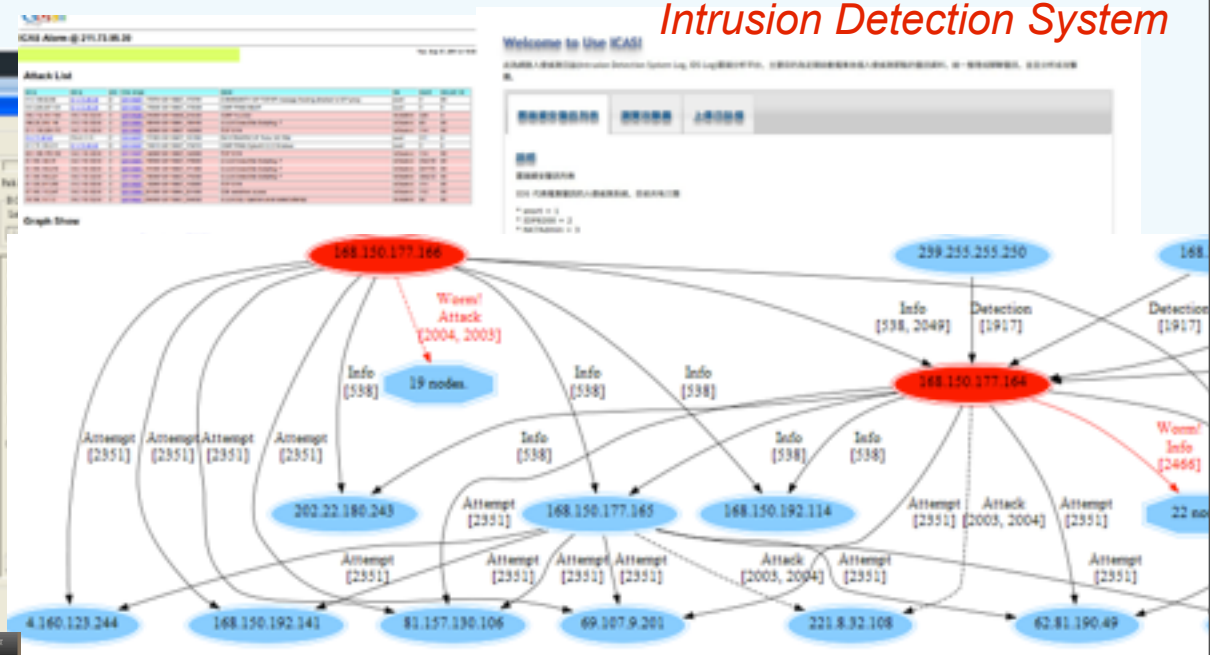
Web Access

Scientific/Engineering Application

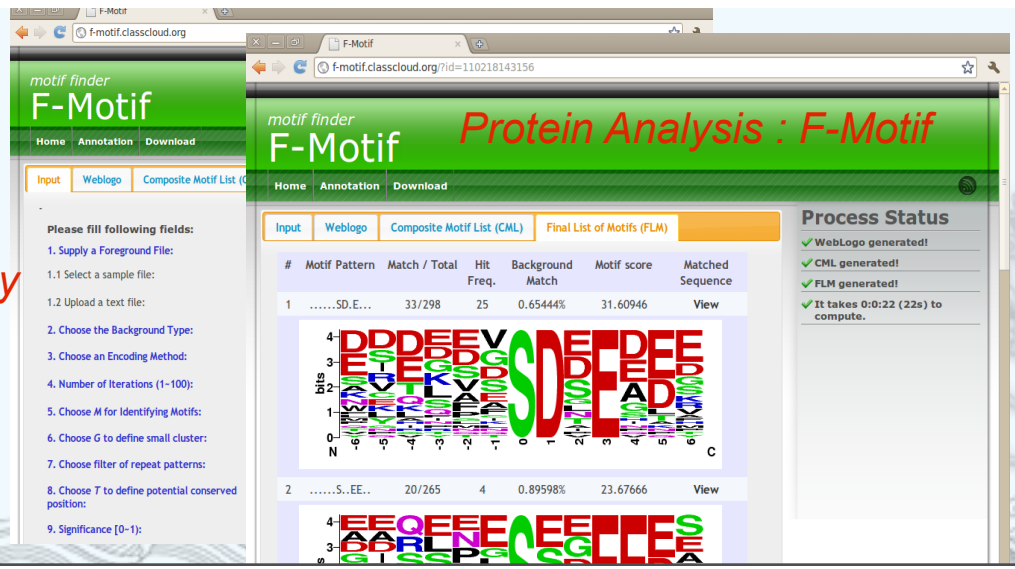
Flood simulation



Intrusion Detection System



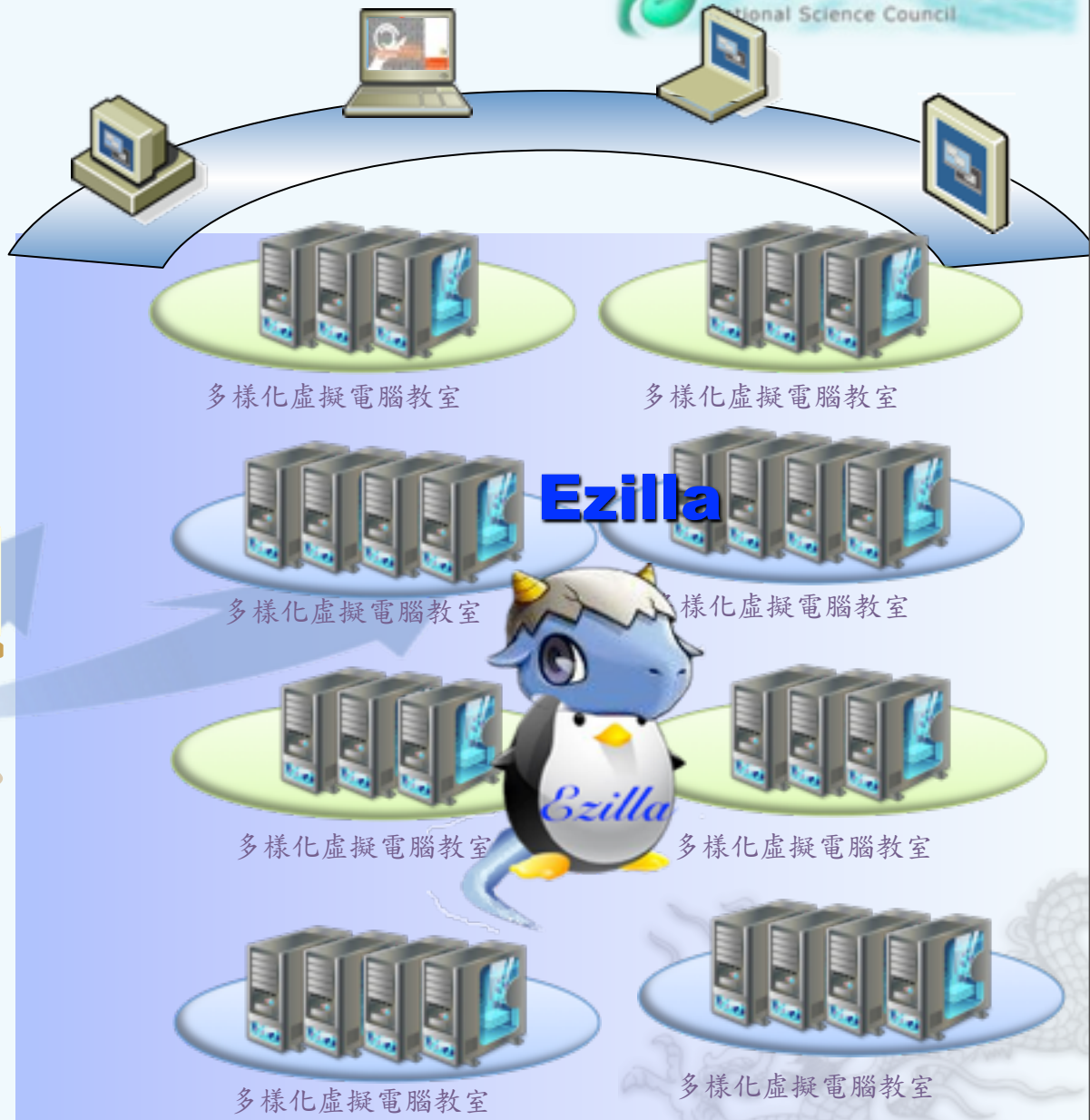
Finance : volatility



Educational Purpose

Virtual Computerized Classroom

conventional Computerized Classroom



Educational Purpose

F-R-E-E

Flexibility + **R**eusability + **E**ase efforts + **E**qual opportunity

- Flexible/Extended Training/Lab. Time
- Flexible/Extended Location
- Diverse Training Environment/Courses
- Easier Maintenance of Training Materials
- Build Once, Use Everywhere
- Faster Deployment, Less Preparation Time
- Equal Opportunity for Students
- Virtual Lab. w/hand-on Experience
- …

Demand of Interoperability

- Why interoperability?
  - Motivation
- Current Activities
  - Tri-sites' Experiments
- Goal
  - Persistent/DR of IT Service

Demand of Interoperability

- Why interoperability
  - Utilization of Computing Resources
  - Centralized w/o exception?
    - Grid vs. Cloud : distributed vs. centralized
    - commercial sector vs. academia
  - No fully "centralized" in practice
    - Monopoly of IaaS providers is not possible
    - To guarantee Secured/Persistent Service - QoS
    - Availability of Service
      - ✓ Service Migration/Porting
    - Enterprise Private Cloud back up by Public Cloud
      - ✓ dynamical resource demand/allocation
    - Vender Lock-in/Data Lock-in

Demand of Interoperability

- Motivation
  - Background/lesson learned
    - IT Services play important roles in disaster response
    - Massive disaster strikes
      - ✓ earthquake, tsunami, power outage, forest fire, ...
    - Resources might be overwhelmed by unexpected service demands
    - W/O preparation, it takes time to get it going
  - Objective
    - Development of technologies related to Cloud Interoperability
    - To ensure persistent key IT services via Recovery of the Key Services remotely, via Cloud technology, at a time of disruptions

Demand of Interoperability

- Current Status
  - Collaborative works related to Grid/Cloud middleware development
  - Benchmarking middleware developed by each site
  - Shared experimental test-bed via PRAGMA Resource & Data WG
  - Joint demos in SCXY/PRAGMA
  - *Loosely coupled style*
    - progress relatively slow
    - interrupted easily and constantly
    - not persistent services

Demand of Interoperability

- Current Activities
  - Tri-sites' experiments

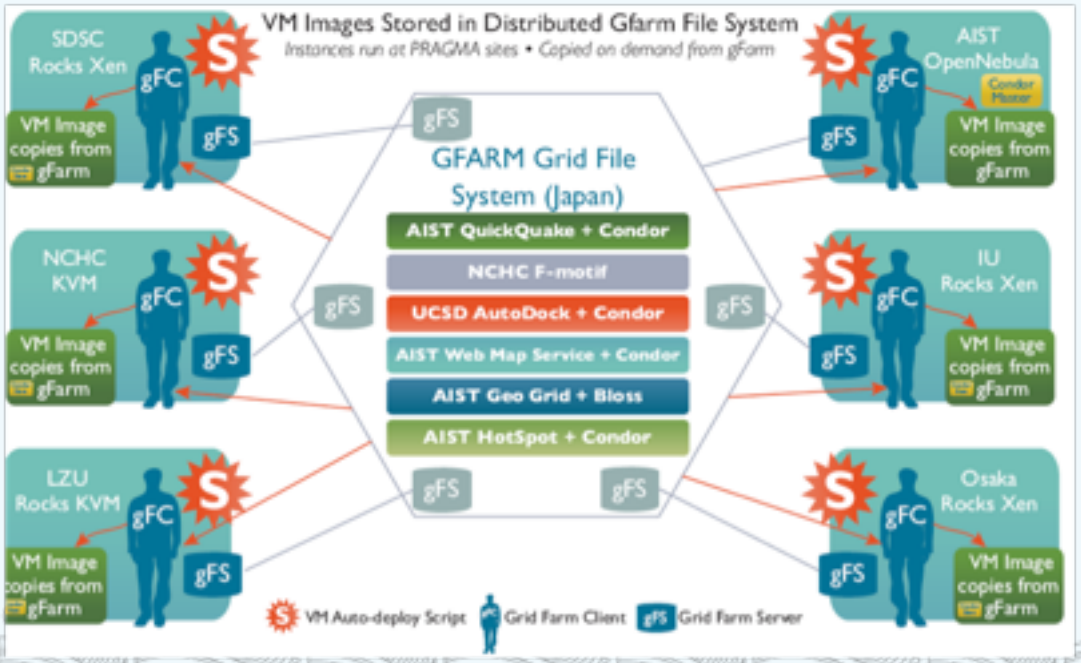
Partnership：10 organizations

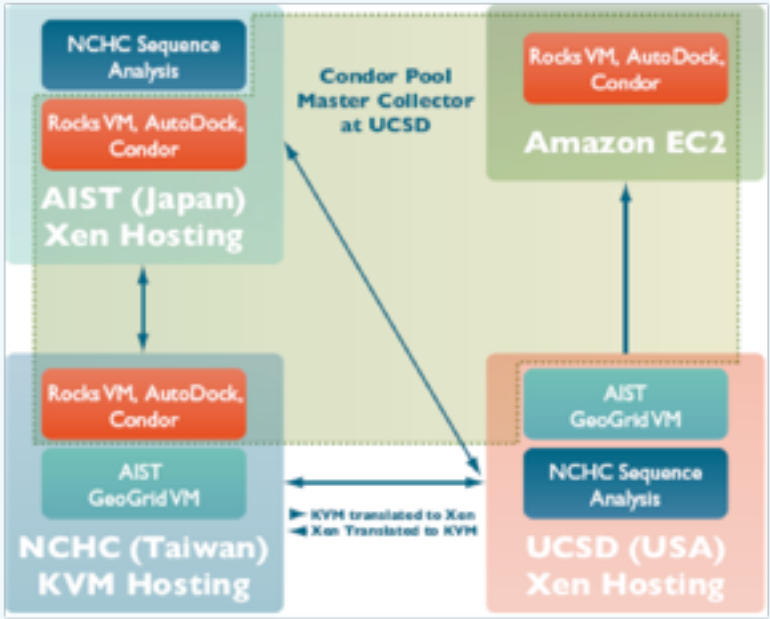
Computing power :

124 servers, 367 cores, memory 2.5 TB, disk 657 TB

Virtualized & physical machines

Semi-automatics distributed 3 sites (SDSC, AIST, NCHC) VM Transfer with Amazon EC2 connected

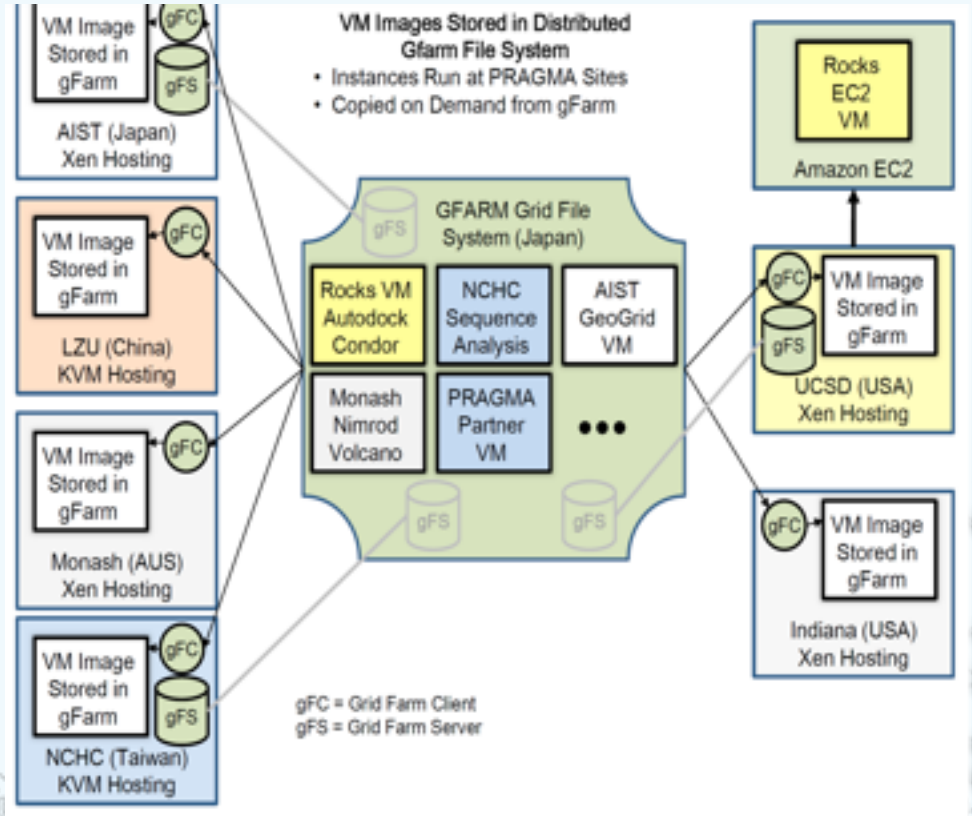




Distributed 3 sites (SDSC, AIST, NCHC) VM Transfer

Demand of Interoperability

- Current Activities
  - Developed approach to migrate VM images, multiple hosting environment



Demand of Interoperability

- Goal -- Persistence/Recovery of Key IT Services
  - Implementation Plan
    - Joint middleware development/deployment
    - Establishment of remote-site recovery mechanism
    - Routine VM images distribution between two organizations
    - Cloud Scientific Application Marketplace
    - Quick response to service demands via distributed resources
    - Leverage the partnership via PRAGMA community, to link more resources, expertise, … thus to broaden the impact
    - Researcher exchange and short-term site visit

Demand of Interoperability

- Goal -- Persistence/Recovery of Key IT Services
  - Expected Outcome
    - Shorten the middleware development time and efforts
    - Cloud Interoperability middleware & mechanism to overcome the lock-in problem
    - Scientific Cloud service model (Application Marketplace)
    - Improved safety of cloud service
    - Establish international remote site(s) and resources for key IT services
    - Joint publications

Current Status

- Issues ahead
  - Integration of existing Academic Clouds
  - Adoption of International Standard
    - OCCI (Open Cloud Computing Interface)
    - OVF (Open Virtualization Format)
  - Middleware Development
  - Network Virtualization
  - Data Management
- International open implementations
  - OpenNebula
  - OpenStack
    - working on

Current Status

- Domestic Collaborators
  - National Chiao Tung University
  - National Cheng Kung University
  - Industry Partner
    - Inventec
- International Partners
  - PRAGMA partners
    - AIST
    - SDSC
    - ...
  - Volunteer-based work
    - loosely coupled

Wishing ...

- Continuing of on-going efforts
- Seek out the possibility of strengthen collaboration
  - Goal
    - *Persistence/Recovery of Key IT Services*
    - Readiness of mechanism/data/VM/network for the unexpected
  - Why
    - To move things ahead with stronger motivation/ strength
    - To produce results in a more responsible/effective way

Comments
Suggestions