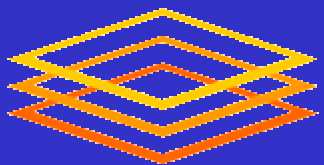


A Status Report on the Prototype NYS Grid: September 21, 2006

Russ Miller

Comp Sci & Eng, SUNY-Buffalo

Hauptman-Woodward Medical Res Inst



Open Science Grid

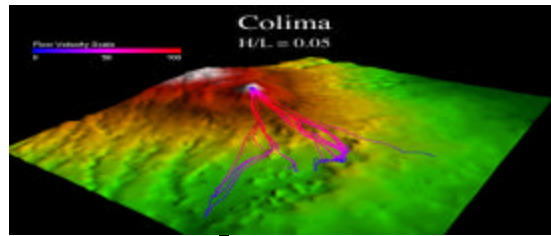


Advanced
Center for Computational Research
Data
Center

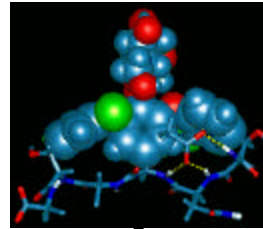
Cyberinfrastructure (e-Science)

- **CI, HPC, & CSE are Critical to 21st Century**
 - **Discovery**
 - **Economic Development**
 - **EOT**
- **Digital Data-Driven Society**
- **Knowledge-Based Economy**
- **Mission**
 - **Seamless, Ubiquitous, Secure, Interwoven, Dynamic**
 - **Compute Systems, Storage, Instruments, Sensors**
 - **Computational Methodologies (Algorithms)**
 - **Networking**
 - **HCI**
- **Immediate Goals Include**
 - **Develop Software, Algorithms, Portals, Interfaces**

Grid Computing Overview



Data Acquisition



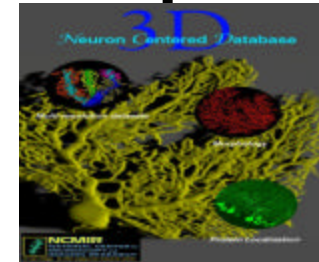
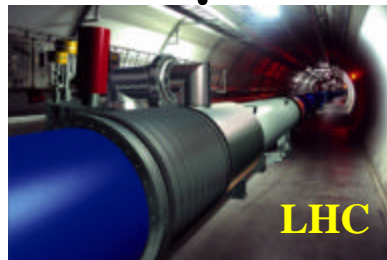
Advanced Visualization



Analysis



Imaging Instruments



Large-Scale Databases

- Coordinate Computing Resources, People, Instruments in Dynamic Geographically-Distributed Multi-Institutional Environment
- Treat Computing Resources like Commodities
 - ❑ Compute cycles, data storage, instruments
 - ❑ Human communication environments
- No Central Control; No Trust

Grid Services and Applications

**ACDC-Grid
Computational
Resources**

Applications

Shake-and-Bake

Apache

MySQL

Oracle

High-level Services and Tools

Globus
Toolkit

NWS

MPI

MPI-IO

C, C++, Fortran, PHP

globusrun

Core Services

Metacomputing
Directory
Service

Globus
Security
Interface

GRAM

GASS

**ACDC-Grid
Data
Resources**

Local Services

Condor

Stork

MPI

RedHat Linux

WINNT

LSF

PBS

Maui Scheduler

TCP

UDP

Irix

Solaris

Adapted from Ian Foster and Carl Kesselman

"Middleware"

- **Intermediate Software Layer between Application Codes and Grid Resources**
- **Required for applications, users, and resource providers to operate effectively in a manner transparent to the user**
- **Security; Resource Management; Data Access; Policies; Accounting;**
- **Globus; Condor**
- **Checks availability of Resources**
 - CPUs; Storage; Networking; Render Farms; etc.
- **Scheduling / Workload Management System**
- **Resource Broker**
 - Evaluates Job and Breaks Up/Submits

NSF Middleware Initiative (NMI)

- **Develop, improve, and deploy a suite of reusable software components for use in national-scale “cyberinfrastructure”.**
- **APST, Condor, CPM, DataCutter, DataCutter STORM, Globus Toolkit, GPT, Gridconfig, GridPort, GridSolve, GSI OpenSSH, Inca, KX.509/KCA, Look, MPICH-G2, MyProxy, Network Weather Service, OpenSAML, PERMIS, PyGlobus, Shibboleth, SRB Client, UberFTP, and WebISO (Web Initial Sign-on).**

Grid Issues

- **High-Throughput Computing**
- **Transparent Integration of Data, Computing, Sensors/Devices, Networking**
- **Heterogeneous Resources**
- **Standards (Grid, Data)**
- **Major User Communities**
 - **High-Energy Physics and Astrophysics**
 - **Medicine and Biological Sciences**
 - **Earth Sciences**
- **Public Funding Still Critical**
- **Grids are in their Infancy**

Major Grid Initiatives

- **EGEE: Enabling Grids for E-ScienceE (European Commision)**
 - ❑ **Initial Focus on CERN (5PB of Data/Year)**
 - **High-Energy Physics and Life Sciences**
 - ❑ **Expanded Focus Includes Virtually All Scientific Domains**
 - ❑ **200 Institutions; 40 Countries**
 - ❑ **20K+ CPUs; 5PB; 25,000 jobs per day!**
- **OSG (DOE, NSF)**
 - ❑ **High-Throughput Distributed Facility**
 - ❑ **Open & Heterogeneous**
 - ❑ **Biology, Computer Science, Astrophysics, LHC**
 - ❑ **57 Compute Sites; 11 Storage Sites;**
 - ❑ **10K CPUS; 6PB**
- **TeraGrid (NSF)**
 - ❑ **Integrates High-End Resources**
 - ❑ **High-Performance (Dedicated) Networks**
 - ❑ **9 Sites; 100TF & 15PB**
 - ❑ **100+ Databases Available**

Open Science Grid

Courtesy of Paul Avery

Open Science Grid *Applications, Infrastructure, and Facilities*

Applications

BaBar,
STAR, PHENIX
etc

Biology

Computer
Science

Astrophysics

Run 2
CDF, D0

LHC
Atlas, CMS
Alice

Persistent Grid
Infrastructure

User Support
Center

Middleware
Providers

Certificate
Authorities

Service
Providers

Grid Operations
Center

Database
Operators

Facilities

General Facility
for any
Community e.g.
TeraGrid

Laboratory
Serving Multiple
Communities
e.g. Fermilab,
BNL, NERSC

Community
Facility
e.g. US ATLAS
or CMS
Tier-1/Tier-2

University
Facility e.g.
UFlorida,
Buffalo

University
Community
Facility e.g.
GLOW

Organization of Cyberinstitute at SUNY-Buffalo

CSNY (Miller)

HPC
(Furlani: CCR)

- Computing
- Data
- Visualization
- Networking

CSE

- MultiScale
- Sciences
- Engineering
- Life Sciences
- Media

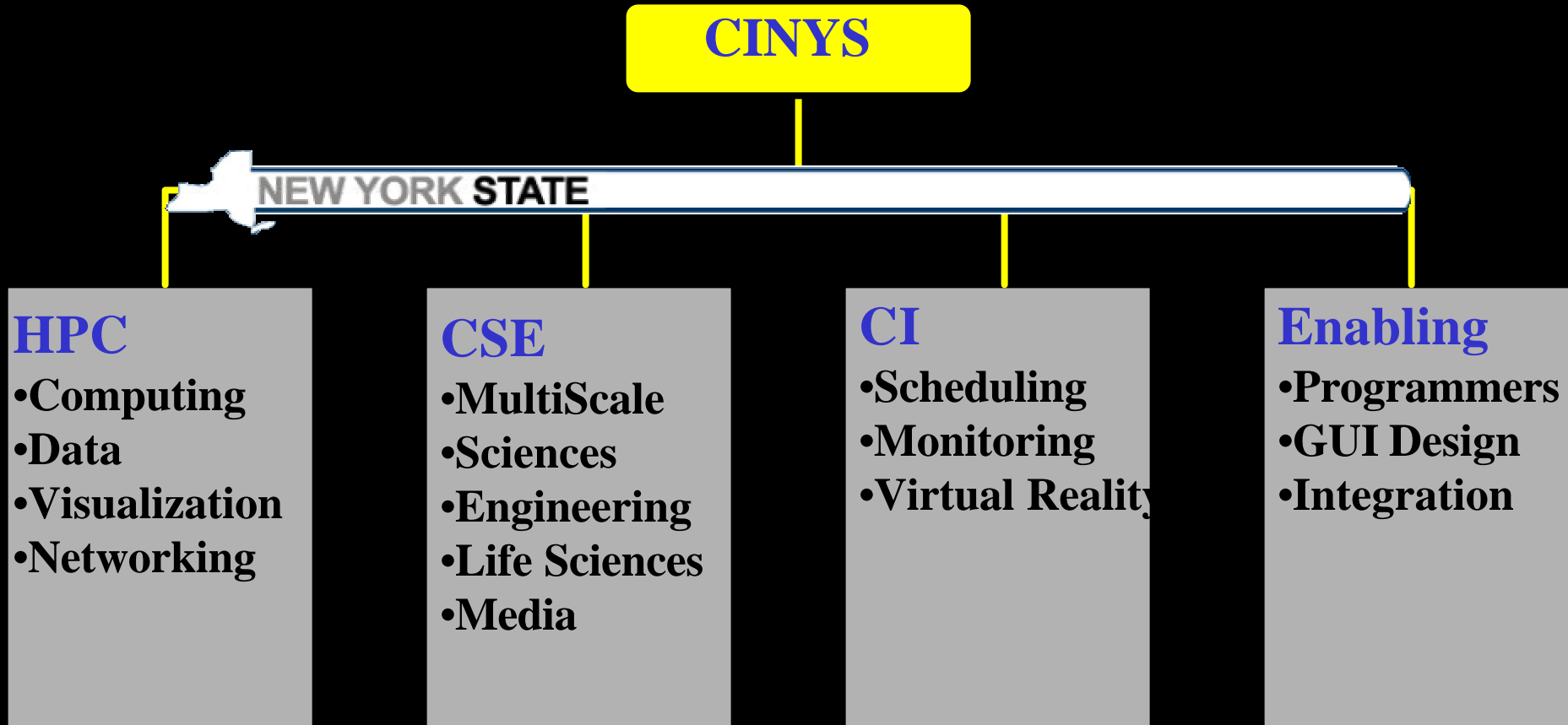
CI

- Scheduling
- Monitoring
- Virtual Reality

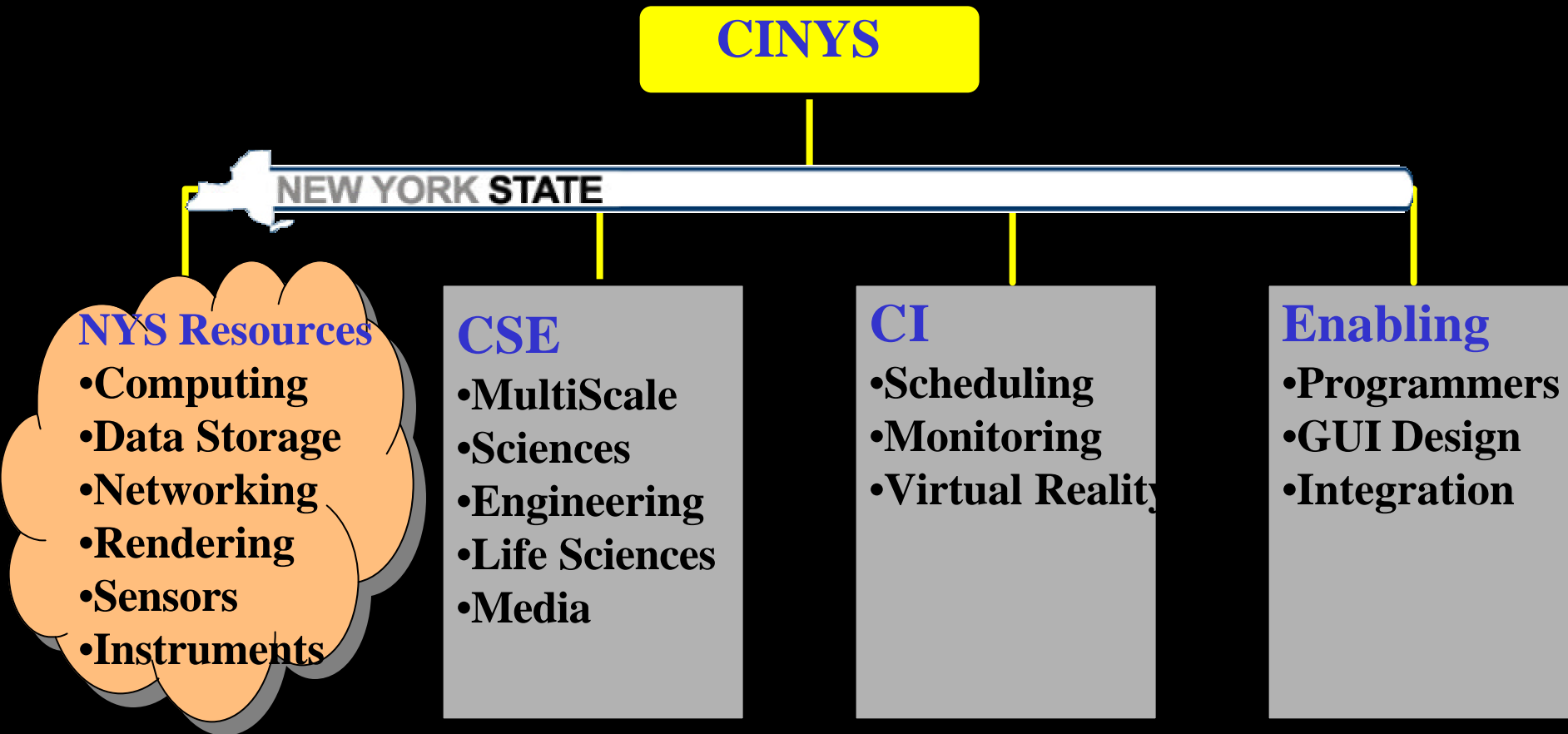
Enabling

- Programmers
- GUI Design
- Integration

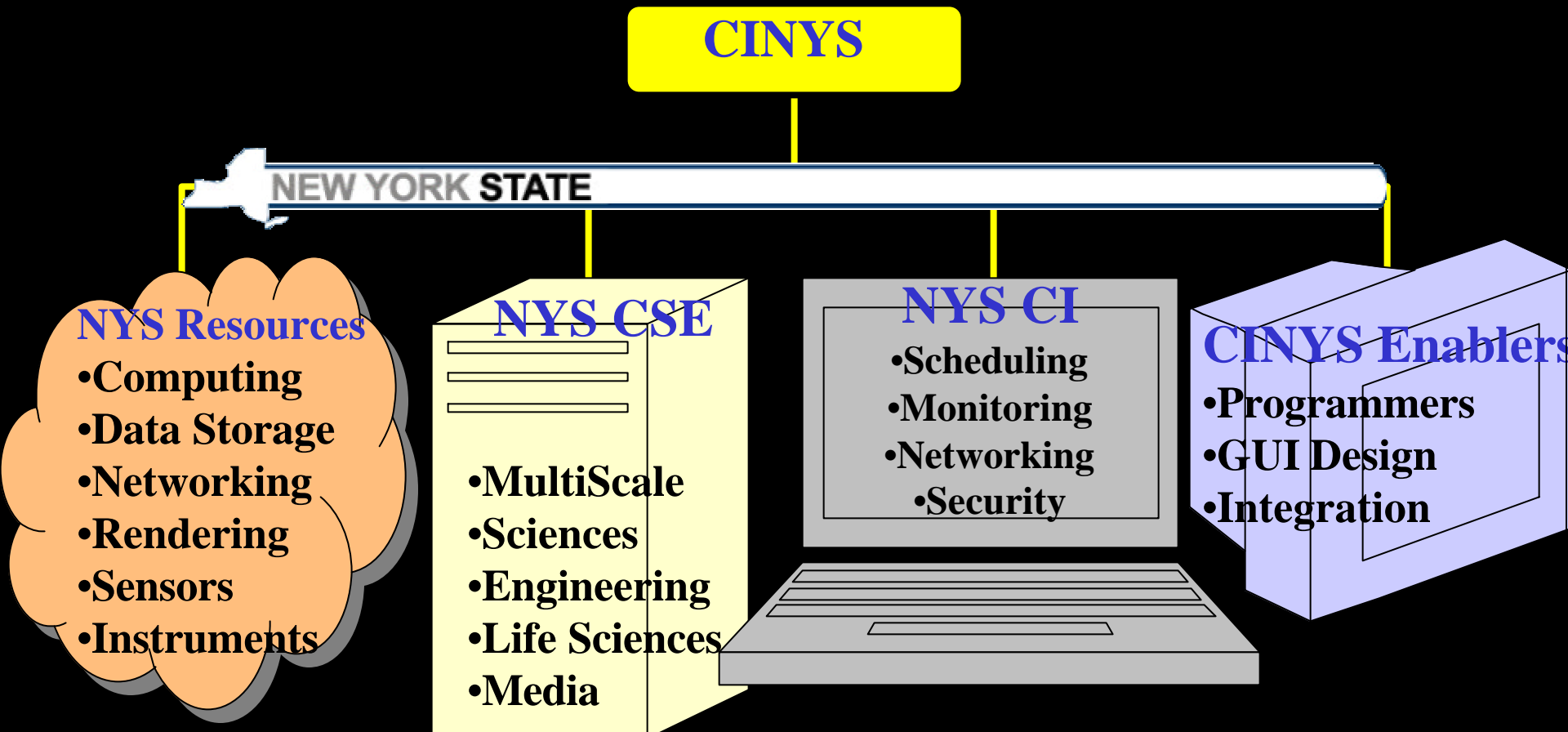
Proposed Organization of CyberInstitute of New York State

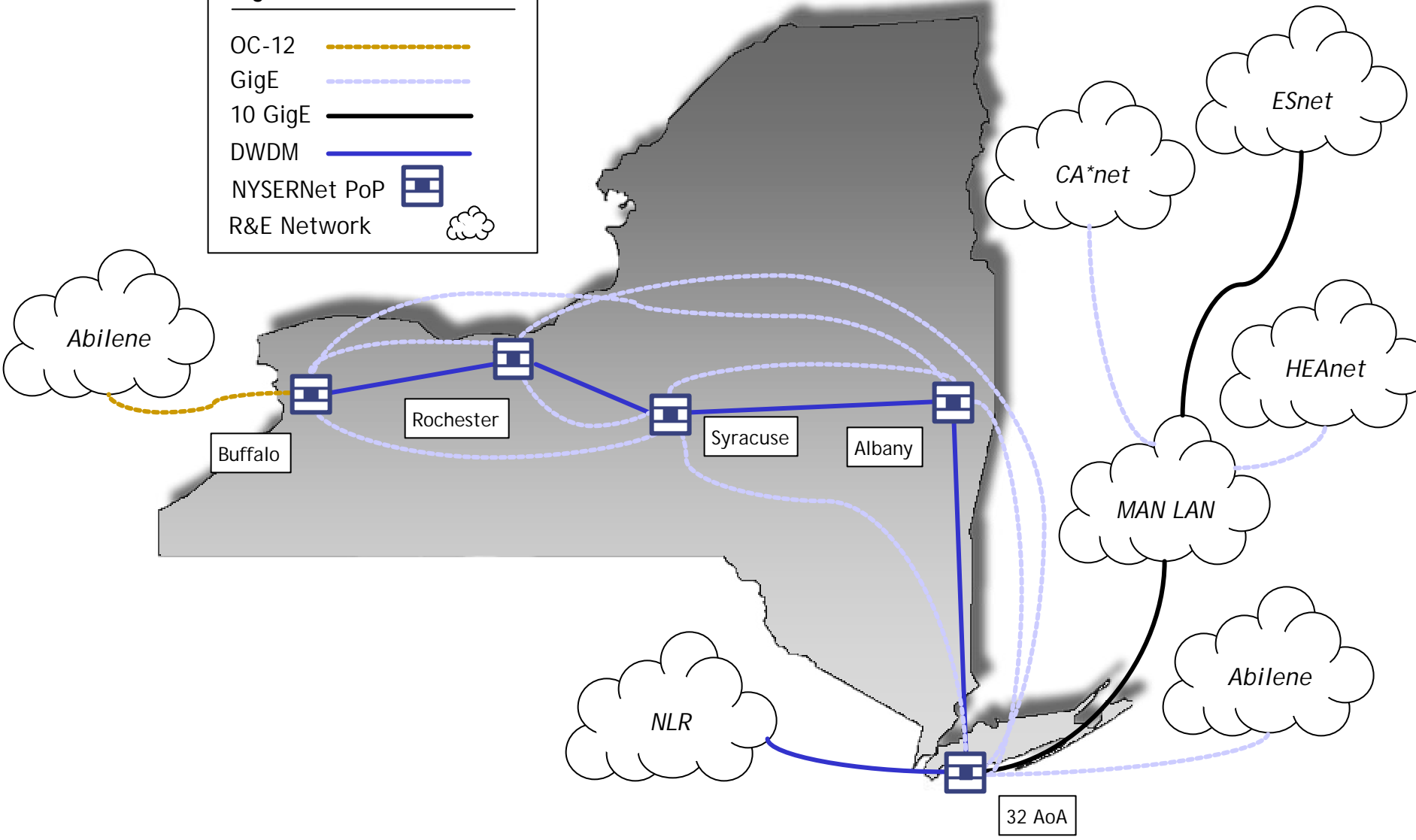
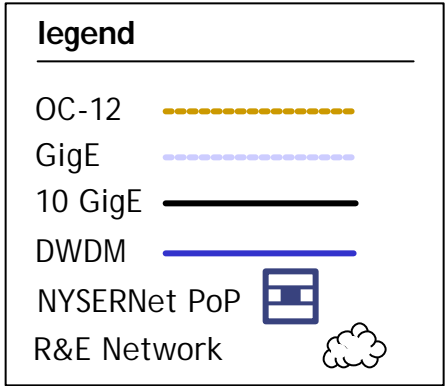


Proposed Organization of CyberInstitute of New York State

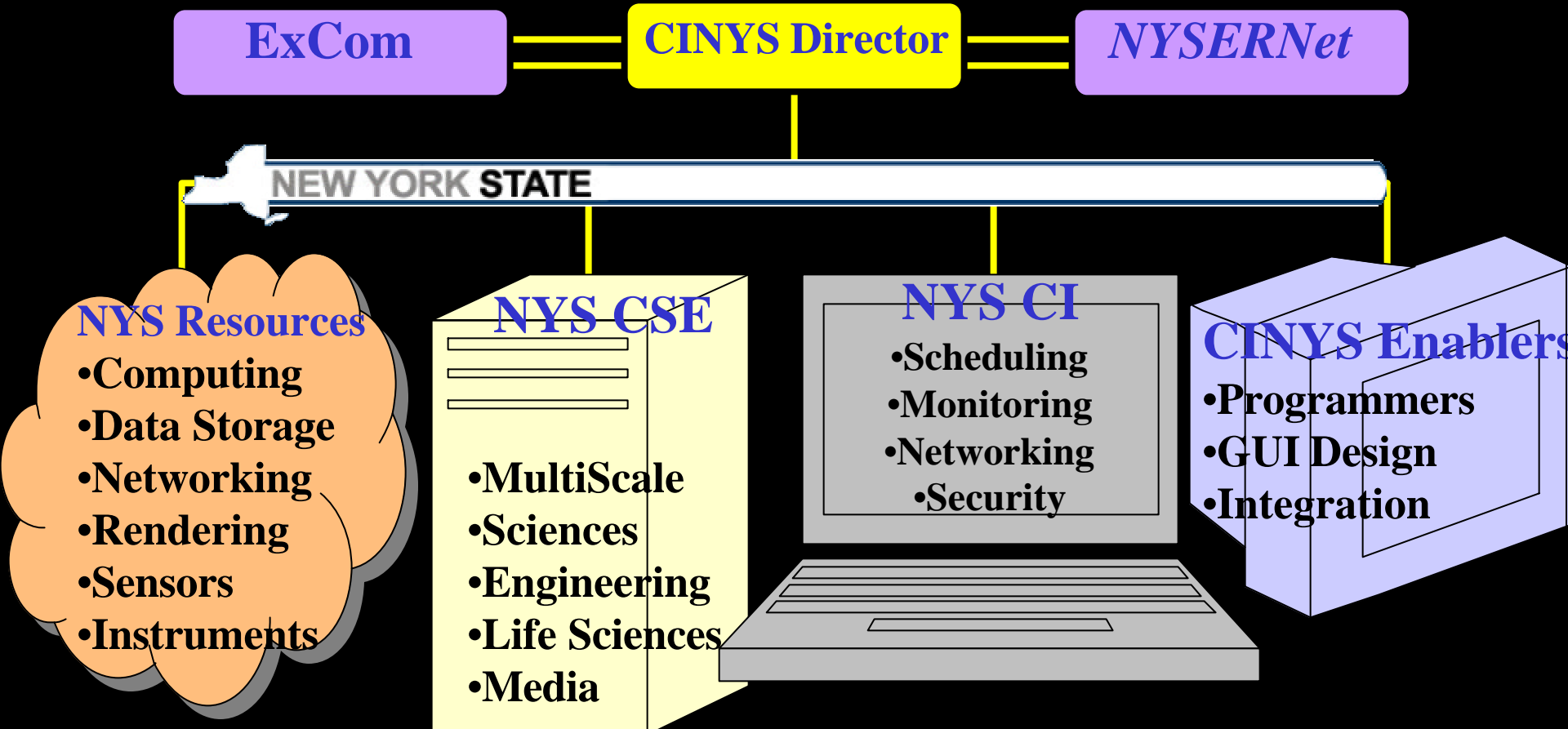


Proposed Organization of CyberInstitute of New York State





Proposed Organization of CyberInstitute of New York State



Proposed CINYS Budget

■ Participants

- Standard Resources
 - Compute Systems
 - Data Storage
 - Visualization Devices
 - Sensors
 - Internet-Ready Devices
- Percent FTE Sysadmin
- Faculty Research Groups
- Intellectual Capital

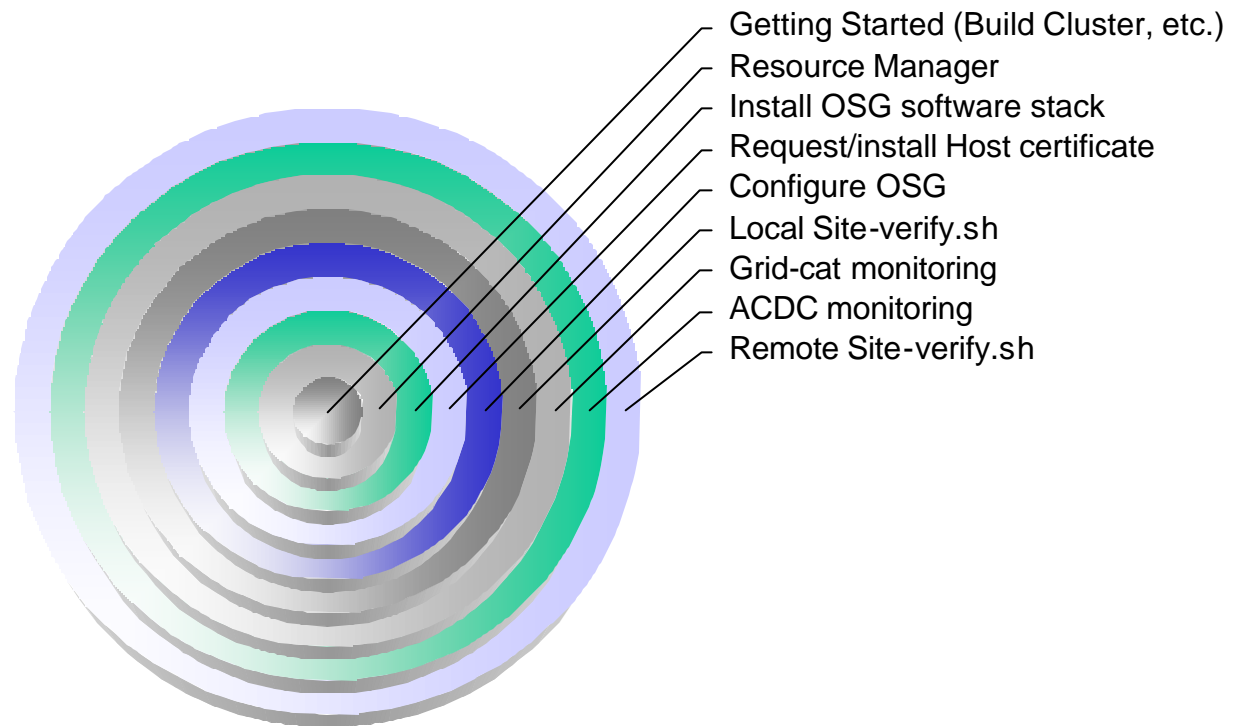
■ New York State

- Seed Funds
- Special Resources
 - Networking
 - Large Data Storage
- Operating Budget
 - Enablers/Programmers
 - Access Grid Nodes
 - General Operating
 - Travel
 - Training

Federal Funding Opportunity

- **NSF “High-Performance Computing for Science and Engineering Research and Education: Operations (User Support, System Administration and Maintenance)”**
 - ❑ **NSF 06-599**
 - ❑ **Due Nov 28**
 - ❑ **\$2-10M/year**
 - ❑ **Integrate with TeraGrid**
 - ❑ **Min of 5TF *Sustained***
 - ❑ **Min 50% of Machine**

NYSGrid Status: Implementation Details (Jon Bednasz & Steve Gallo)



Getting Started

- **Physically build a cluster**
 - ❑ 1 head node
 - ❑ 4+ compute nodes
- **Install Cluster Software**
 - ❑ Operating System (Red Hat)
 - ❑ Drivers for Interconnect (Myrinet, Infiniband, etc.)
 - ❑ Resource Manager (PBS, LSF, Condor, SGE)
- **Identify Gatekeeper Node for OSG Software**
 - ❑ Either stand alone machine or co-resident on Head Node
 - ❑ 5GB of space in /opt/grid
 - ❑ 5GB of space in /grid-tmp
- **Need to have ability to adjust firewalls**
- **Need to have ability to add users**

Installing OSG Stack on Gatekeeper

■ Installs are done via PACMAN

- ❑ `wget http://physics.bu.edu/pacman/sample_cache/tarballs/pacman-3.16.1.tar.gz`

■ Install OSG software

- ❑ `pacman -get OSG:ce`

■ Install (1) Package for your Resource Manager

- ❑ `pacman -get OSG:Globus-Condor-Setup`

- ❑ `pacman -get OSG:Globus-PBS-Setup`

- ❑ `pacman -get OSG:Globus-LSF-Setup`

- ❑ `pacman -get OSG:Globus-SGE-Setup`

Obtain OSG Secure Certificate

- Request integration of new resource into OSG
- Request host certificate to identify resource
- Approved host certificate is imported into web browser
- Export host certificate from web browser
- Install host certificate on resource

Configure OSG

- **Configure OSG**

- `cd $VDT_LOCATION/monitoring`

- `./configure-osg.sh`

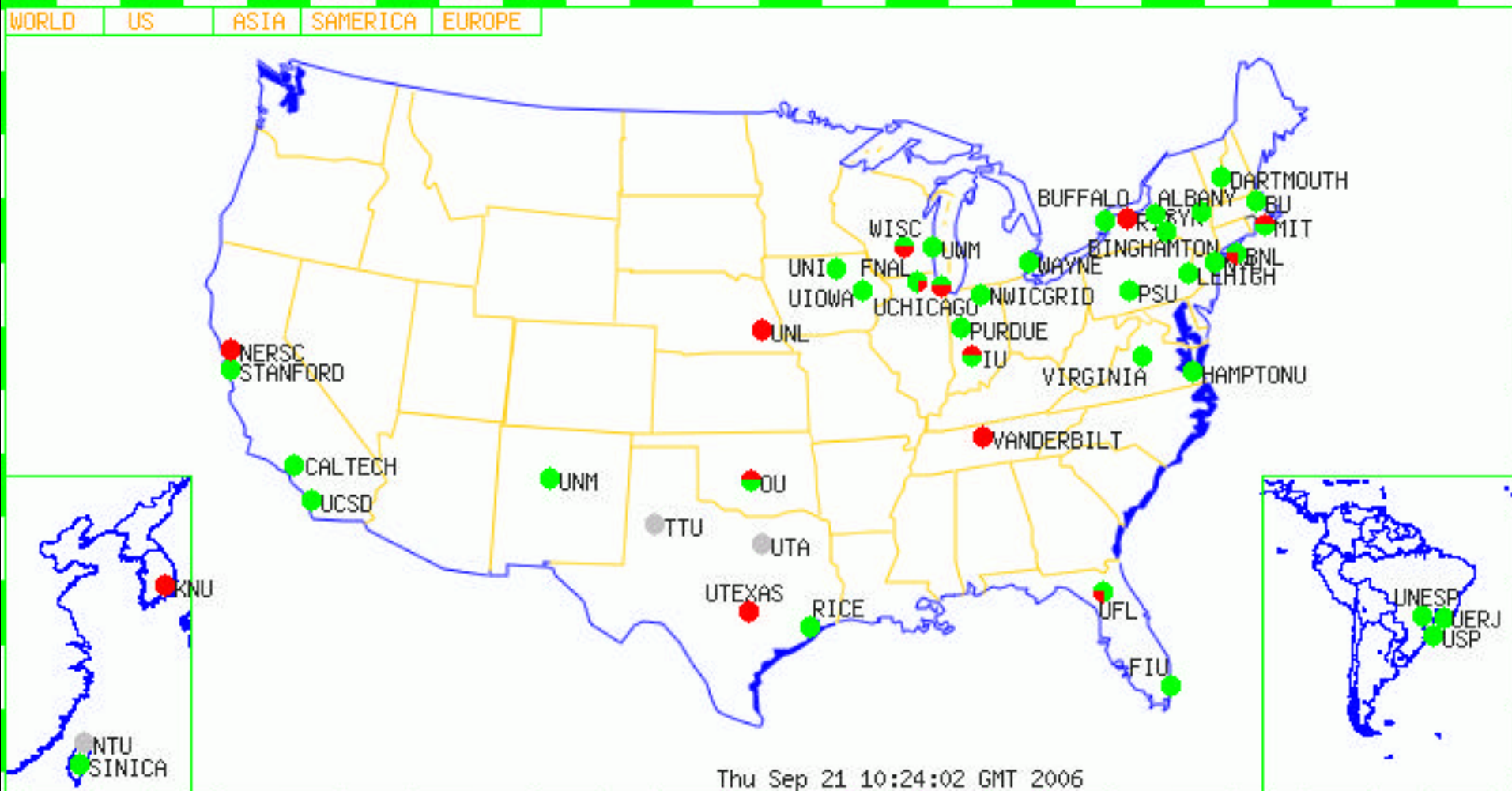
- **Determine and configure OSG to use range of firewall ports.**

Local Site-Verify.sh

```
$ cd $VDT_LOCATION  
$ source ./setup.sh  
$ grid-proxy-init  
Enter "Your Passphrase"  
$ cd verify  
$ perl site_verify.pl --  
host=hostname.domain.tld
```

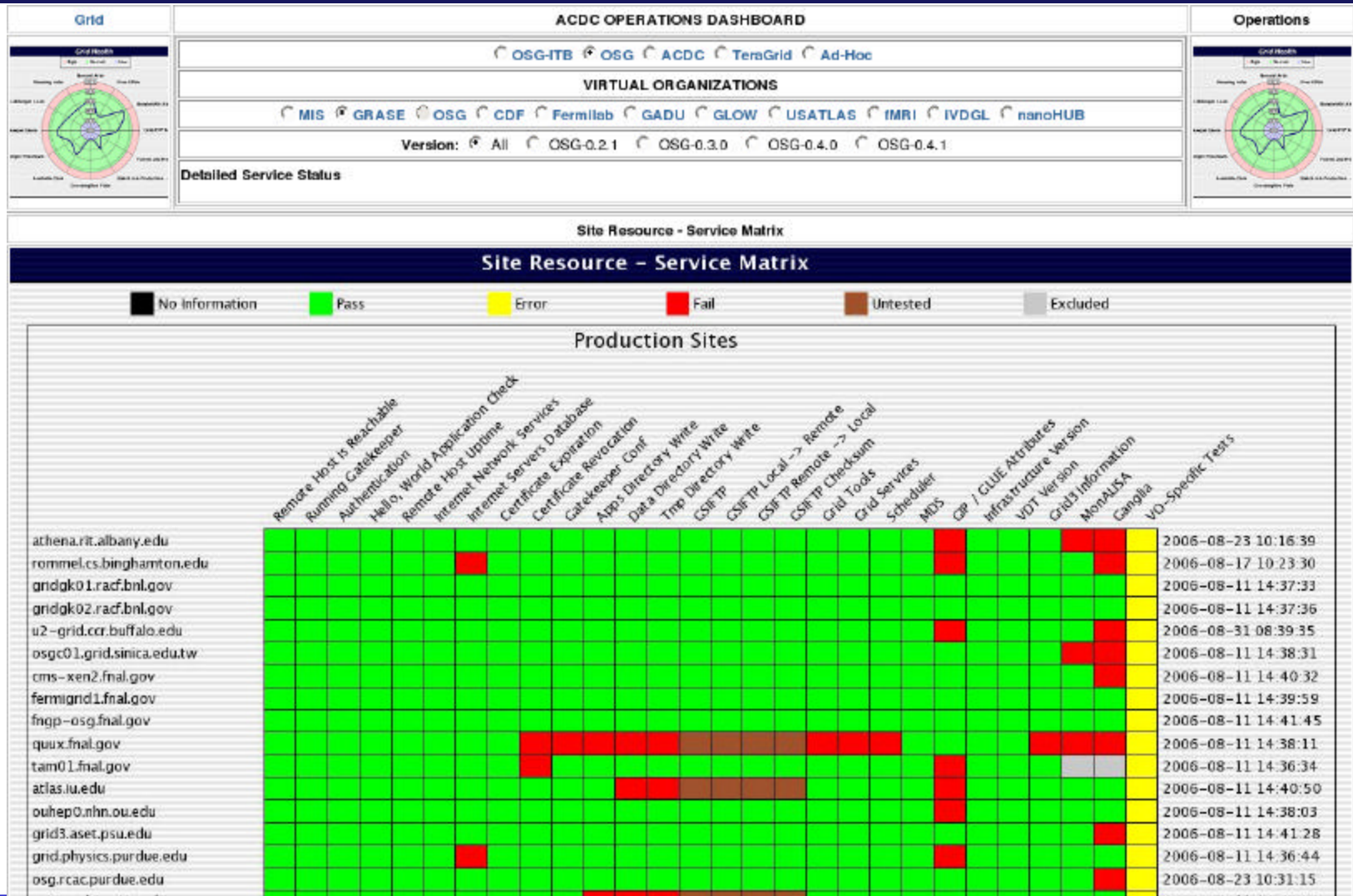
Grid-cat Monitor

<http://osg-cat.grid.iu.edu/>



ACDC Monitor

<http://osg.ccr.buffalo.edu/operations-dashboard.php?grids=3&vos=10>



Remote Site-Verify.sh

■ From another OSG site:

```
$ cd $VDT_LOCATION
$ source ./setup.sh
$ grid-proxy-init
Enter "Your Passphrase"
$ cd verify
$ perl site_verify.pl --
host=hostname.domain.tld
```

Status I

■ On-Line

- RIT (later today)
- SUNY-Albany
- SUNY-Binghamton
- SUNY-Buffalo
- Syracuse University

■ Waiting on Host Cert

- Niagara University
- NYU

■ Installing

- University of Rochester
- Cornell University

Status II

■ Building Gatekeeper Machine

- Hauptman-Woodward Medical Research Institute (HWI)
- SUNY-Geneseo

Acknowledgments I

- Jon Bednasz, CCR
- Steve Gallo, CCR
- Mark Green, ITR/CCR
- Cathy Ruby, ITR
- Amin Ghadersohi, ITR
- Naimesh Shah, ITR
- Jason Rappleye, CCR
- Sam Guercio, CCR
- Martins Innus, CCR
- Cynthia Cornelius, CCR
- Tom Furlani, CCR
- NSF, NIH, NYS, NIMA, NTA, Oishei, Wendt, DOE

Acknowledgments II

- **UAlbany: Eric Warnke**
- **RIT: Rick Bohn**
- **SU: Jorge González Outeiriño**
- **NYU: Chris Grim**
- **U of R: Bill Webster**
- **Cornell: Resa Alvord**
- **Binghamton: Steaphan Greene**
- **Niagara U: Ann Rensel**
- **HWI: Steve Potter**
- **Geneseo: Kirk Anne**

Acknowledgments III

- **Cornell (CTC & Administration): Vision, Leadership, & Guts to bring us all together in the hope that by working together we, and many others in NYS, will all prosper.**
- **Cornell: Hosting Workshop I**
- **RPI: Hosting Workshop II**



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