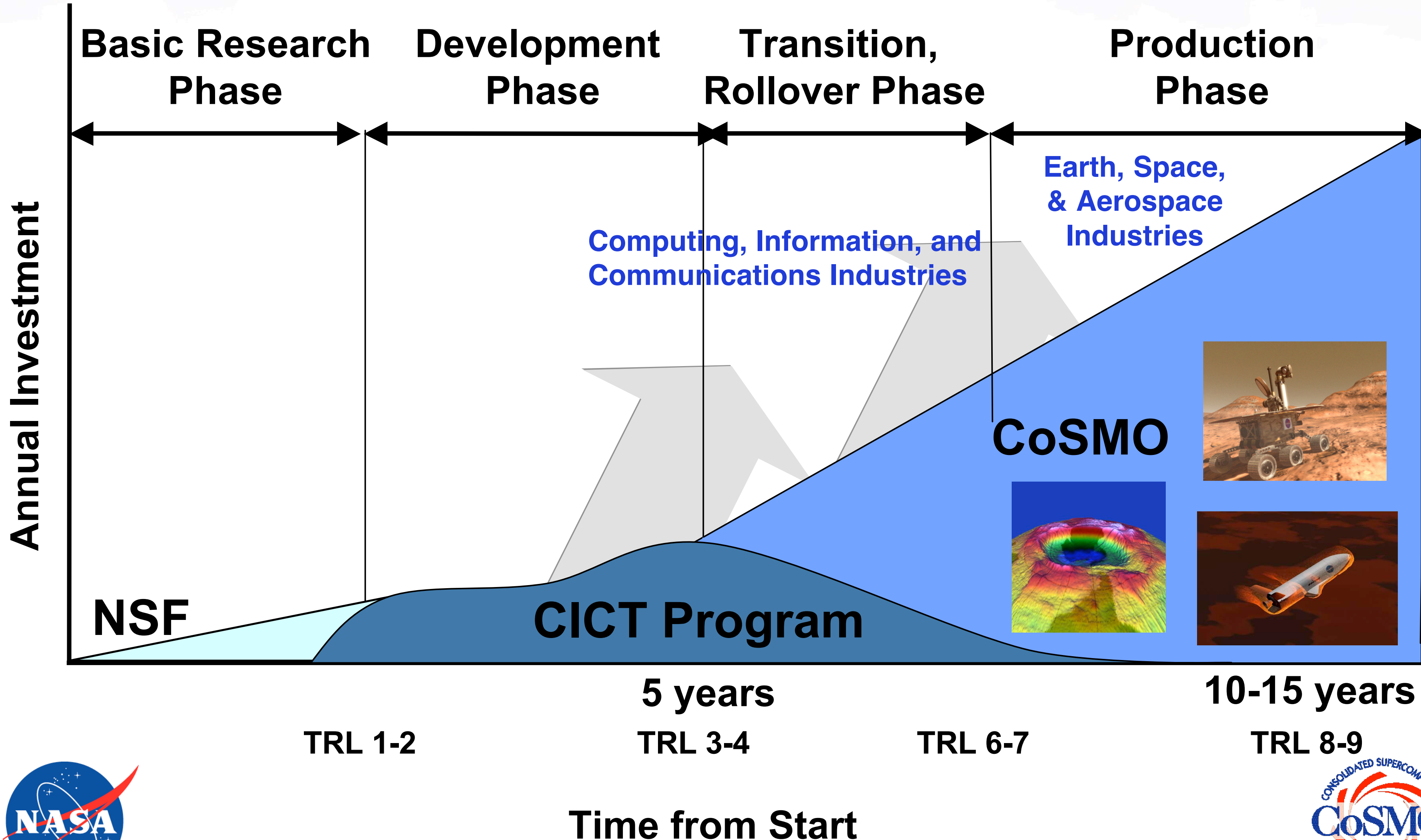
Challenges of Moving IPG into Full Production
Global Grid Forum 11
June 7, 2004

Catherine.H.Schulbach@nasa.gov
Consolidated Supercomputing
Management Office (CoSMO)

Outline

- CoSMO Overview
- Information Power Grid (IPG) Development and Applications
- Current IPG Status and Services
- Lessons Learned
- Issues in Moving to Full Production
- Road Map for Moving to Full Production
- Conclusions

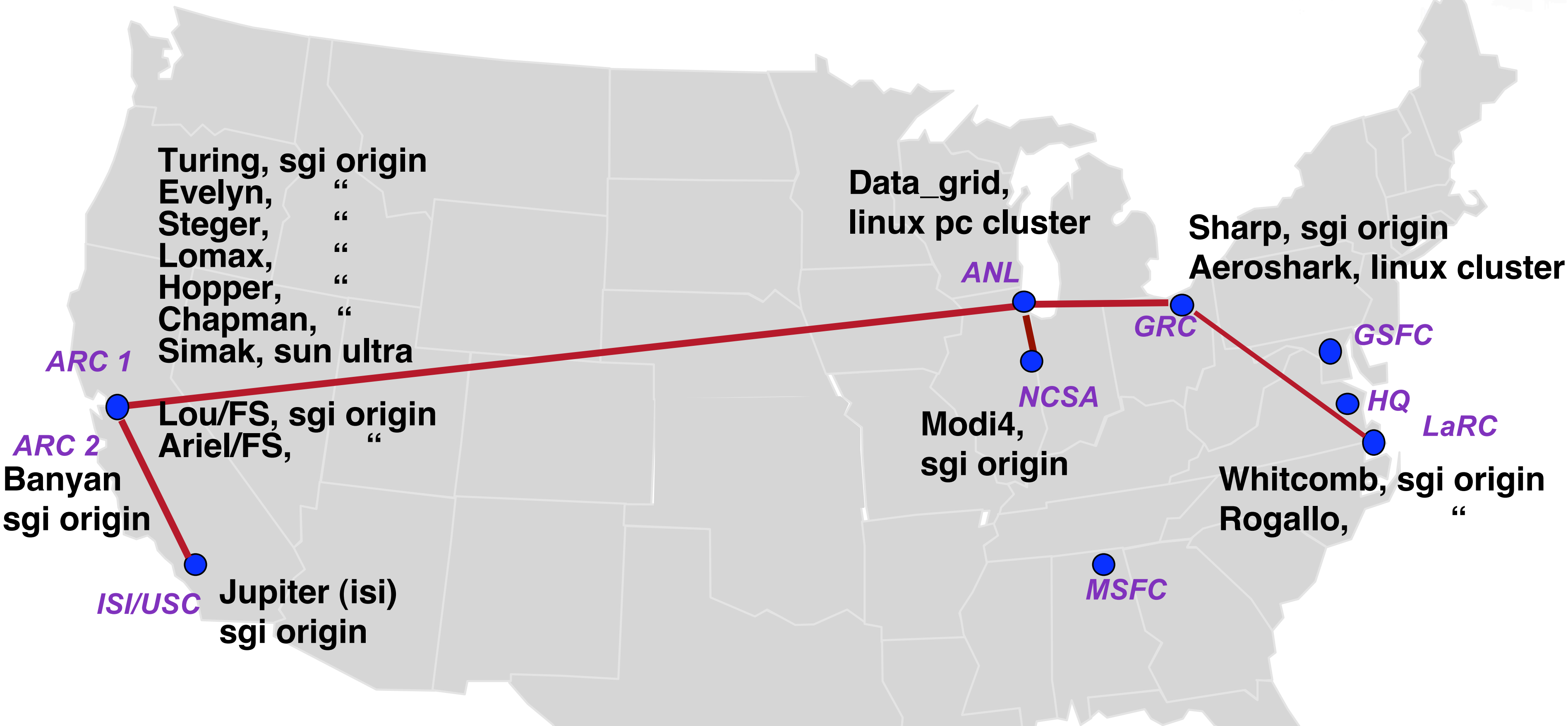
NASA Technology Flow



Motivation for CoSMO Interest in Production Grid

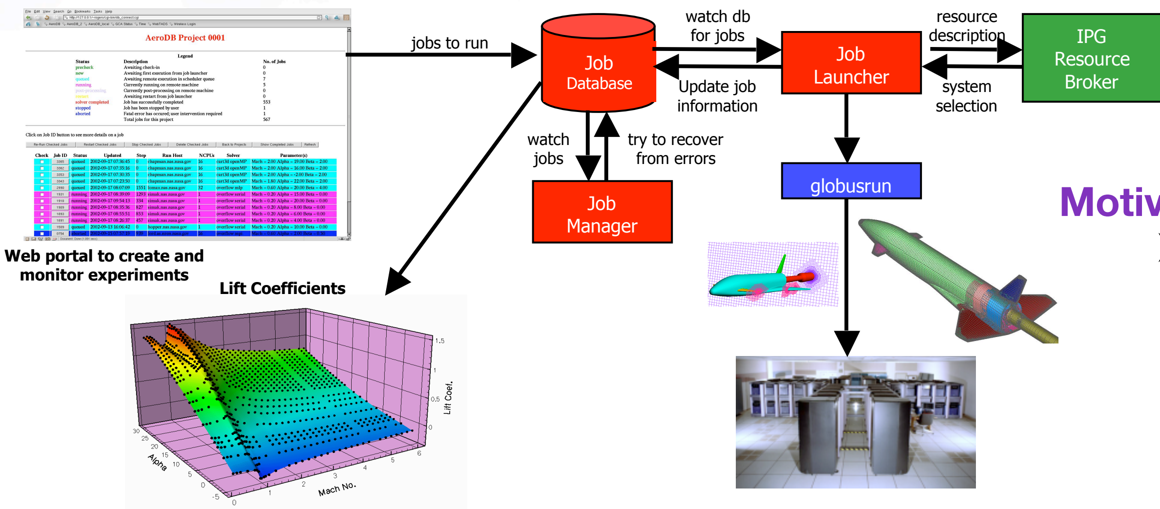
- Lifetime involvement in sport of “technology infusion”
  - ➢ Frequent switches between R&D and operations positions
- Belief in ONE NASA: NASA R&D without artificial barriers
  - ➢ Seamless access to tools => Seamless access to resources
- First-hand experience with new capabilities enabled by grids
  - ➢ Job submission and job management tool developed for grid R&D milestone dramatically improved Columbia accident investigation capability
- Changing nature of science and engineering work
  - ➢ Move to “community” efforts and models
- Desire to provide more fertile environment for technology maturation
  - ➢ Need to bridge the *technology valley of death*

Initial Information Power Grid (IPG)—Sept. 2002
17 Resources at 7 Geographical Sites



ISI/USC = Information Sciences Institute, University of Southern Calif.
ANL = Argonne National Lab (US DOE)
NCSA = National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign

Parameter Studies on The Grid: AeroDB Overview



Motivation

- To build a Stability and Control database, one might require:
  - 10 angles of attack
  - 5 side slip angles
  - 25 Mach numbers
  - 10 aileron deflections
  - 10 rudder deflections
  - 10 elevator deflections
- Total of 1.25 million conditions

Goal:

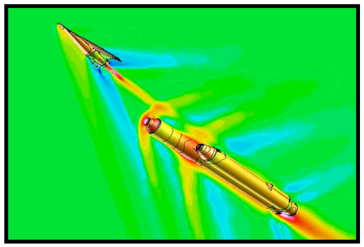
- Automate the process of running thousands of CFD cases with little user intervention
- Use the NASA IPG resources to run a large CFD parameter study

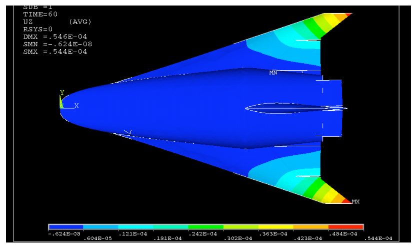
Results

Location	Host	Hardware Type	Number of jobs	Approx CPU Hours
ARC	hostA	SGI O3K	3489	25485.0
	hostB	SGI O3K	1074	15678.3
	hostC	SGI O2K	477	8017.0
	hostD	SGI O2K	411	4702.3
	hostE	SGI O2K	61	262.3
	hostF	Sun Ultra	136	234.6
GRC	hostF	SGI O2K	126	1014.1
	hostG	Linux PC Cluster	70	976.1
NCSA	hostH	SGI O2K	99	483.3
ISI	hostI	SGI O2K	21	212.3
Total			**5964**	**57065.2**

Grid Applications—June 2003

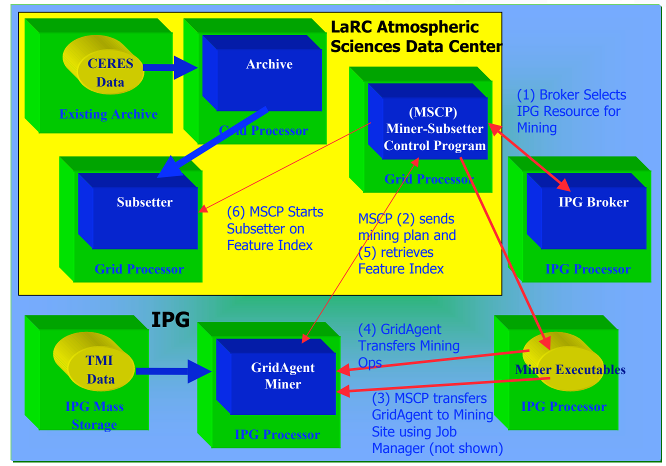
Computations on Abort of CTV from Atlas V Booster using Tool Agent Framework and Grid Resources.



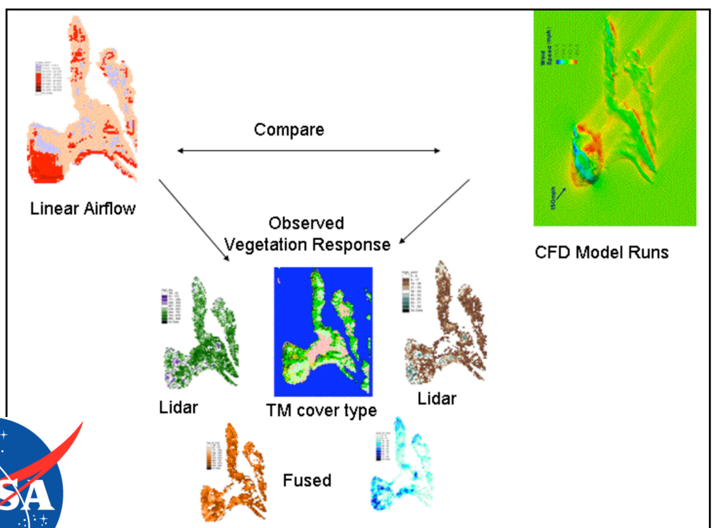


Time-accurate separation w/ dynamics (left) & structural analysis (right)

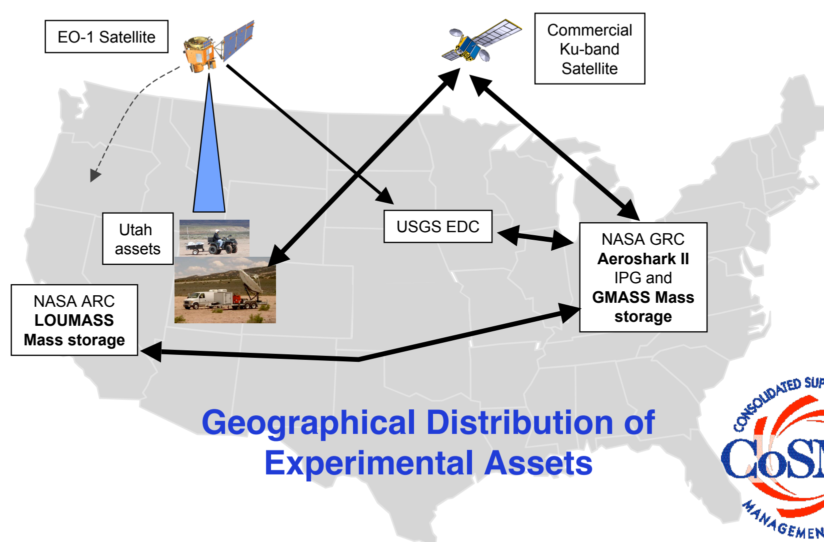
Data Subsetting & Data Mining on Very-Large-Scale Datasets

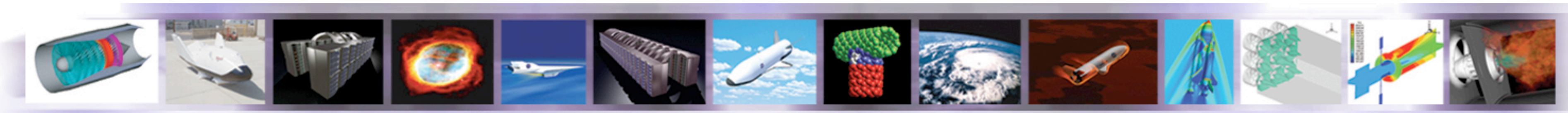


Integration of Instrument Data and Modeling to Improve Understanding of Extreme Wind Events



Hybrid Networks Support Simultaneous Collection of Data from Space and Ground.





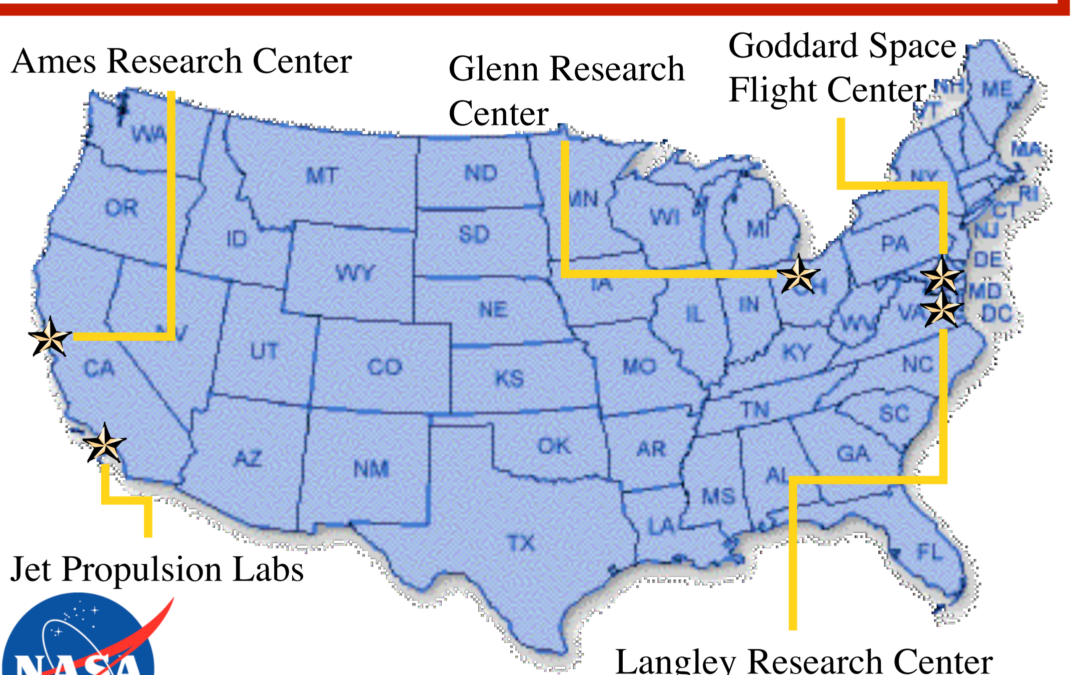
NASA Grid—June 2004

Vision

To make the practice of large-scale science and engineering, as well as other widely distributed, data intensive NASA activities, much more effective than it is today.

Grid technologies are the foundation to making this vision a success

- **Grid Nodes**
  1. 1024 CPU SGI O3K IRIX ARC
  2. 512 CPU SGI O3K IRIX ARC
  3. 512 CPU SGI Altrix LINUX ARC (in progress)
  4. 128 CPU (node) Linux Cluster GRC
  5. 128 CPU SGI O2K IRIX ARC
  6. 128 CPU SGI O2K IRIX ARC
  7. 64 CPU SIG O2K IRIX ARC
  8. 32 CPU SGI O2K IRIX ARC
  9. 24 CPU SGI O3K IRIX ARC
  10. 24 CPU SGI O2K IRIX GRC
  11. 16 CPU SGI O2K IRIX LaRC
  12. 16 CPU SGI O2K IRIX ARC
  13. 12 CPU (node) Linux Cluster (in progress)
  14. 8 CPU SGI O3K IRIX LaRC
  15. 8 CPU SUN Ultra Sparc3 ARC - Storage
  16. 8 CPU SGI O2K IRIX ARC - Storage
  17. 8 CPU SGI O3K IRIX JPL
  18. 8 CPU SGI O3K IRIX GSFC (planned)
  19. 4 CPU LINUX ARC (planned)



Grid Capabilities & Tools—June 2004

- Currently based on *Globus Toolkit 2.4.2*
- *IPG certificates* for user authentication to each resource
- *globusrun* to submit jobs
- *gridftp* to grid enabled, secure FTP to transfer files
- *gsissh* or *globus-job-run* for simple shell tasks
- *Resource Broker* to suggest compute node
- *Job Manager* to manage jobs as they move through the system
- *Workflow Manager* for high-level construction of complex jobs execution scenarios, including conditionals, loops, and data flow specification

Lessons Learned

- Functionality
  - ➢ Need more large systems distributed across the grid
    - 87% of 2308 processors used in Sept. 2002 milestone were on same computer room floor—% even higher now
  - ➢ Need improved bandwidth between locations
    - Support for high-speed networks declined in last few years
  - ➢ Fault tolerance and error recovery need attention
    - Systems
    - Servers
    - Networks
  - ➢ Security
    - Need to protect data
    - Address different security models

Lessons Learned

- Usability
  - ➢ Using the grid is still hard work—need more transparency
    - Users perceive small benefit for extra work to use grid
    - Many users run just single jobs
    - Don't realize some useful features even for high concentration of processors in single location
  - ➢ Standards need to be better defined and enforced
    - Differences between IPG environments and non-IPG environments
    - Differences between IPG sites (LSF vs. PBS, interpretation of maxMemory values, etc.)
  - ➢ Need increased emphasis on system administration
    - Site certification process for grid/IPG systems/locations
  - ➢ Need improved documentation and user support
    - Bring in consulting staff trained by developers

Lessons Learned

- Reliability
  - Redundancy of systems and critical servers (certificate authority, server for IPG software, etc.)
  - Duplicate servers, or run services on “front ends”
  - 24X7 support for servers, certificate authority, etc.
  - Make client software easily accessible—put all clients on all IPG systems if possible
  - Make sure all sites can use IPG software regardless of bandwidth
  - Don’t want sites down because of network problems—should be able to access own systems even with WAN down

Issues in Moving to Full Production

- Tension between centralized and distributed computing
  - Centralized easier for support staff, distributed easier for user community
- Culture differences between development and operations staff
  - “Cool new stuff “ vs. “if it ain’t broke, don’t fix it”
- Users and systems managers often overlooked in planning and development
  - Extended grid community brings reality to help identify key functions, interface specification, priority of services, etc.
- Security
  - Protecting systems from other users/locations creates problems for grid concept
- *Technical issues not necessarily the most difficult!!*

Centralized vs. Distributed

- Centralized
  - ➢ Easy to control and support
  - ➢ Coordination within single organization
  - ➢ Cohesive unit with common views
  - ➢ Focused tool development
  - ➢ Single point of failure
- Distributed
  - ➢ Responsive to user needs
  - ➢ Requires coordination of multiple groups
  - ➢ More buy-in and diversity of expertise
  - ➢ Tools work where needed
  - ➢ Redundancy, backups

Culture Differences

- Research and Development
  - Publications
  - Individual research
  - New features
  - Soft deadlines
  - Coordination within small PI group
  - Idealized problems
  - Satisfy curiosity
  - Best effort
- Operations
  - Up-time, user productivity
  - Group efforts
  - Tested & standard tools
  - Hard deadlines
  - Coordination with users and operations groups
  - Real-life,hard problems
  - Provide results
  - Quality of service

Need to Involve Extended Grid Community

- Extended grid community has key stakeholder groups that are often overlooked
  - Users
  - System managers/service providers
- Needs and buy-in of both are essential to grid acceptance
  - Coordination at multiple levels is required
  - Tailoring of training and support
- Grid community priorities affect technology development priorities
  - New capabilities may not be important if basic functionality is missing
  - Others don’t always use tools in the way developers expected

Security

- Rash of attacks on scientific computer centers that has been going on since the beginning of the year
  - Many centers limiting access by external organizations
  - Centers that previously cooperated are taking different approaches to security

Road Map for Moving to Full Production

- Create Working Groups
  - Users
  - Systems managers/service providers
- Develop approach to extend capability across agency
  - Shared vision and goals
  - Inclusive processes
- Assess Requirements
  - Science and engineering needs and capabilities from users
  - Operations and maintenance needs from the systems managers
- Develop acceptance plan
  - Features to be provided
  - Test suite for features
- Develop operations & support plan
  - Support for distributed operations, maintenance
  - Operations staff training & user training
  - Standards

SECURITY, SECURITY, SECURITY!!!

Conclusions

- Technology infusion from R&D to production is hard work
  - It’s a *contact* sport
- Sociological problems at least as hard, if not harder, than technical issues
  - Shared vision
  - Culture gap
- Community involvement is essential
  - Users
  - System mangers
- Security becoming NUMBER ONE issue
  - Balance *protectionism* with required levels of security