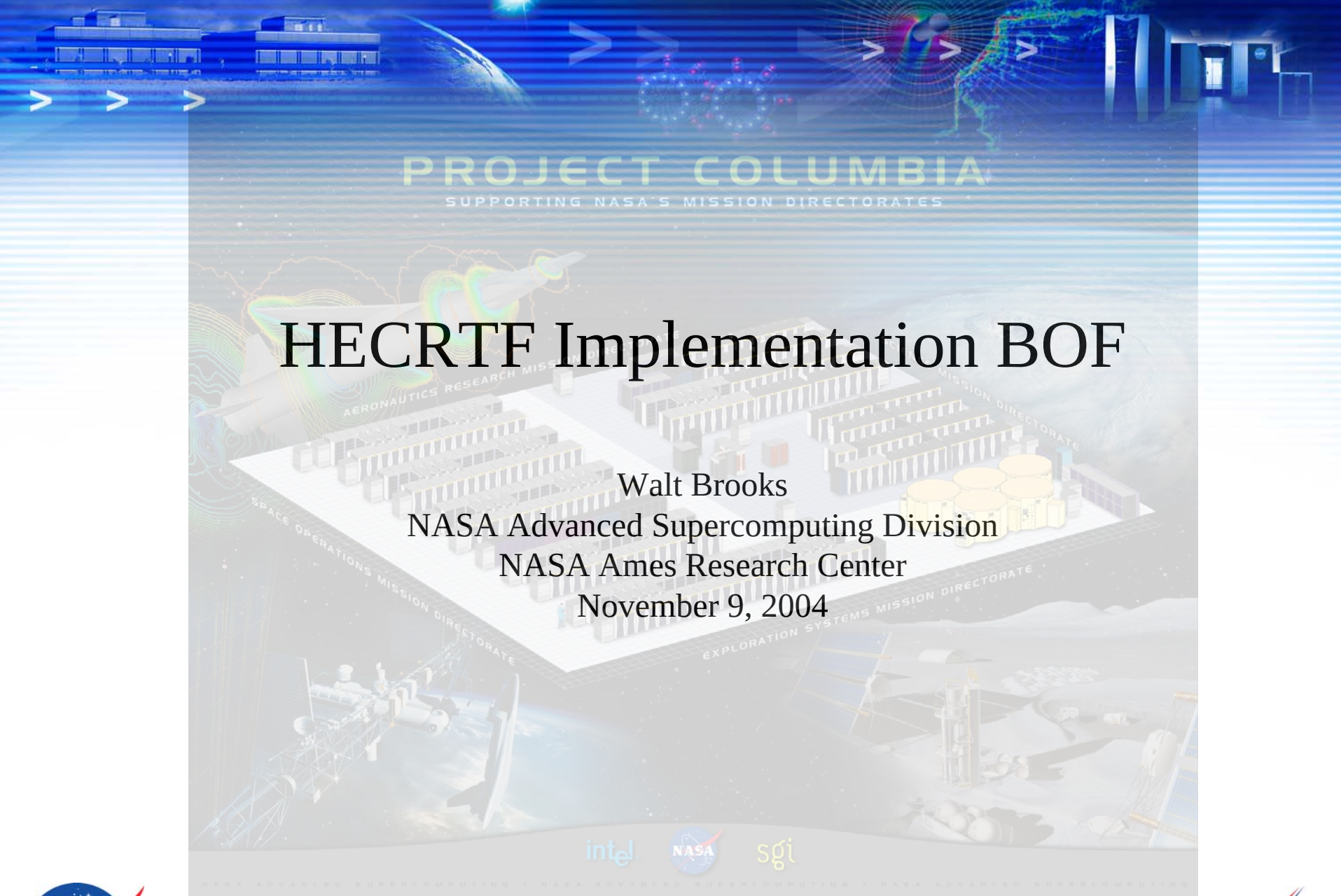


HECRTF Implementation BOF

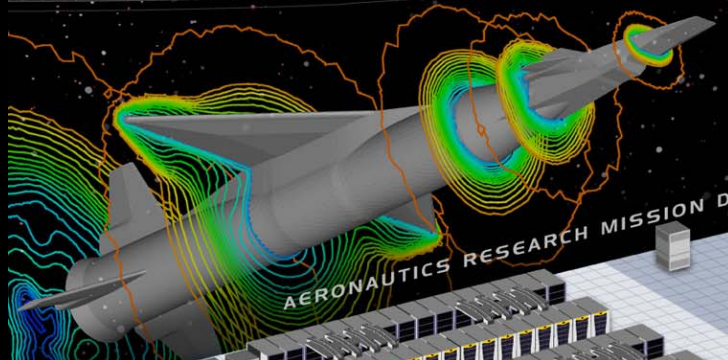
Walt Brooks
NASA Advanced Supercomputing Division
NASA Ames Research Center
November 9, 2004

NASA

NAS
NASA Advanced Supercomputing

PROJECT COLUMBIA

SUPPORTING NASA'S MISSION DIRECTORATES

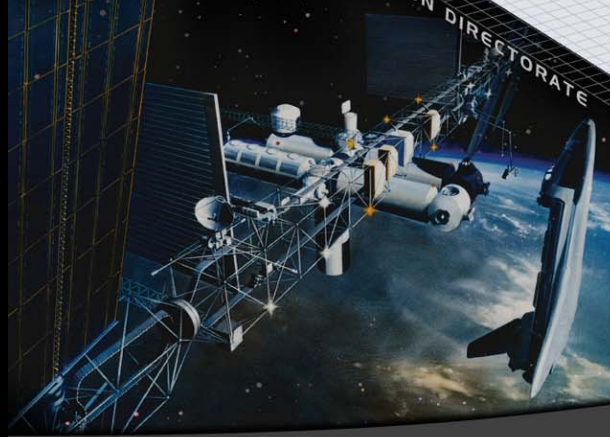


AERONAUTICS RESEARCH MISSION DIRECTORATE

SCIENCE MISSION DIRECTORATE

SPACE OPERATIONS MISSION DIRECTORATE

EXPLORATION SYSTEMS MISSION DIRECTORATE



intel NASA sgi

State of Supercomputing in NASA April 2004

What Are Our Challenges?

- NASA has a limited ability to do the most challenging problems and can only do “one at a time”
  - Current system was grown by 4X in FY2004 and was immediately saturated with critical engineering and science simulations
  - In order to provide priority support to Return-to-Flight and NESC, all on-going science and engineering problems were limited or put on hold
- NASA’s supercomputing capability has not kept pace with its inherent role as a technology leader for the government
  - NASA has the smallest Investment in supercomputing of any of the major technical agencies by a factor or 5
  - NASA installed peak and capacity in supercomputing is 5-10X smaller than other technology-oriented U.S. government agencies

What Can We Build Upon?

- NASA is recognized as the world leader in Single System Image (SSI) architectures (which have proven to be most effective for NASA’s most challenging problems)
  - In FY03, NASA built, characterized and put into production the worlds first 512 processor SSI supercomputer based on Intel Itanium processors and the Linux operating system in 3 months
  - This system currently is providing critical computing for RTF and NESC problems

Project Columbia

- Partnership between NASA and industry to significantly enhance the national compute capability
- Unique opportunity that met both industry and NASA objectives
- In line with HECRTF findings
- National asset available to multiple agencies through competitive selection process
- Unique capability built from proven technologies
- Asset enhances capability that was not currently being targeted by other leadership class systems
- Immediate capabilities provide NASA with increasing capabilities.

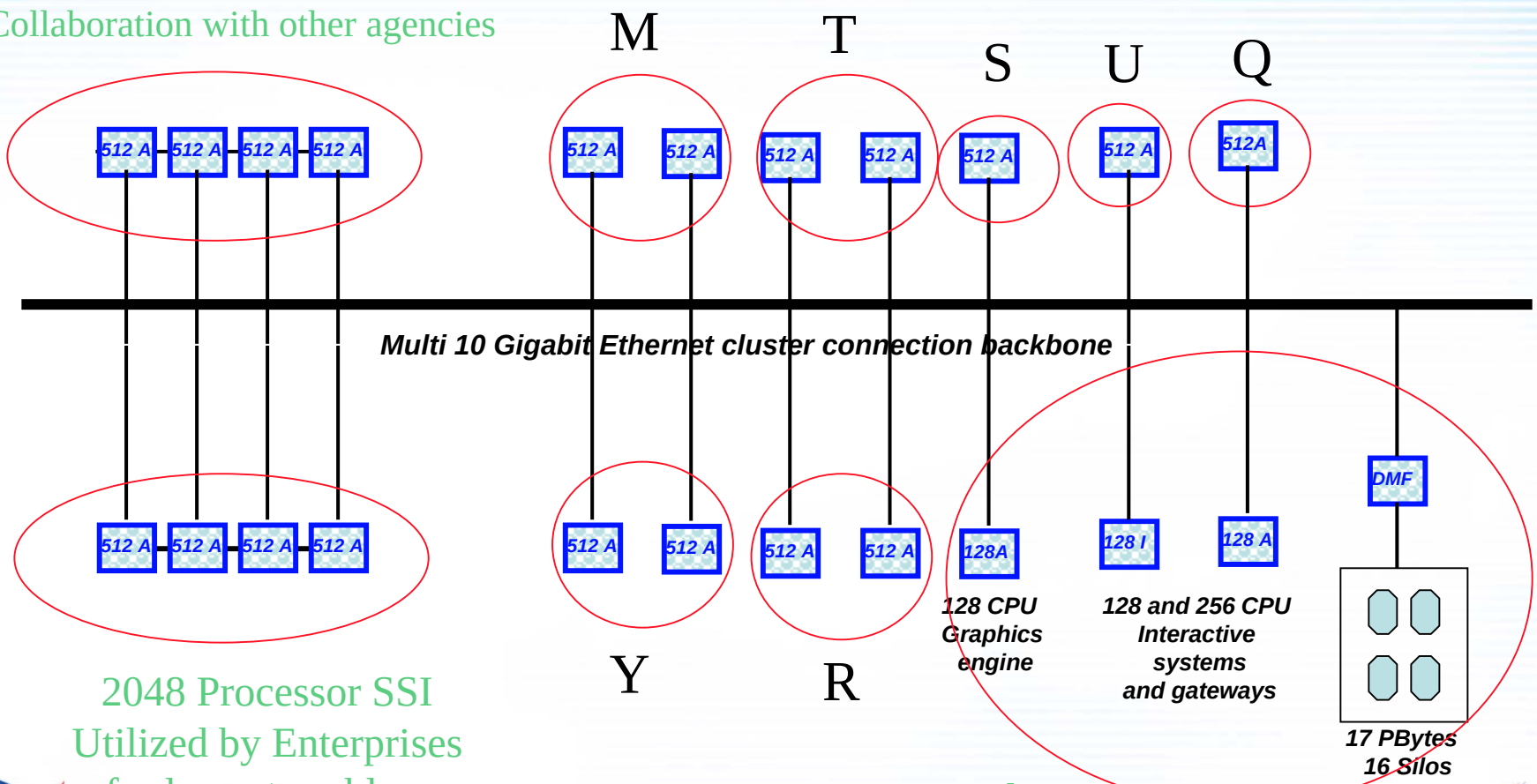
“Project Columbia”

- The Proposal
  - SGI and Intel team to provide NASA with twenty 512 Single System Image Supercomputers (61 Teraflops peak) that are interconnected to create enough capability and capacity to accelerate NASA’s Engineering and Science
  - Columbia Project team deploys and characterizes this system by late October of FY04 to provide immediate capability to NASA and to meet industry visibility objectives
- The Impact
  - NASA obtains a major simulation capability that provides the Enterprises the capability and capacity to move their programs forward in parallel
    - 10X the current NASA HEC capabilities
  - SGI and Intel use the NASA mission requirement to demonstrate the effectiveness of their design on the world’s hardest Science and Engineering problems

System - Utilization

2048 Advanced processor SSI System
Utilized for next
generation models-peer review
Collaboration with other agencies

Eleven 512 CPU "capacity nodes"
Function as a single computer but
Enterprises have guaranteed log-ons

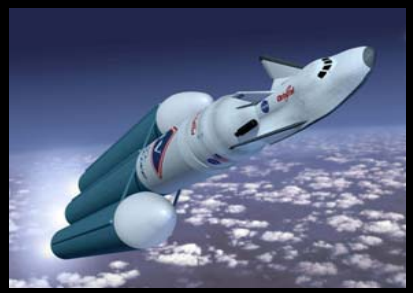


2048 Processor SSI
Utilized by Enterprises
for largest problem
production runs

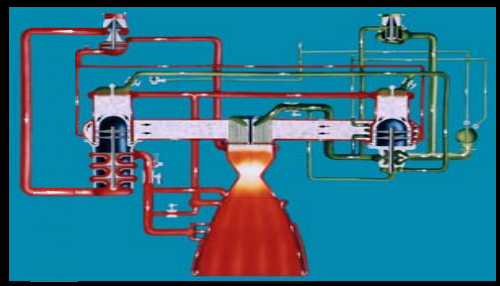
Front End, Data
management and
Visualization Systems

High-end Computing and Modeling: Driving Exploration Requirements

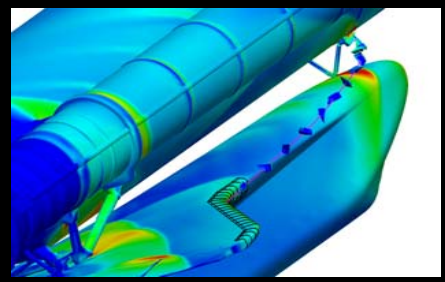
Problems that Require Models and Simulation Capability 100X current SOA



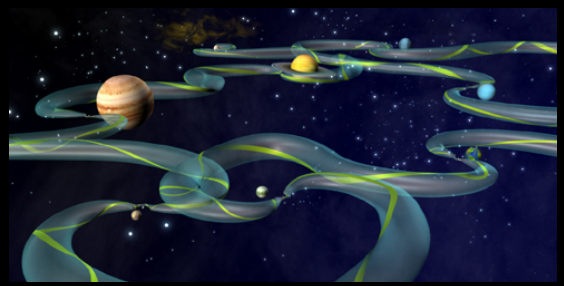
Next Generation Vehicle Design



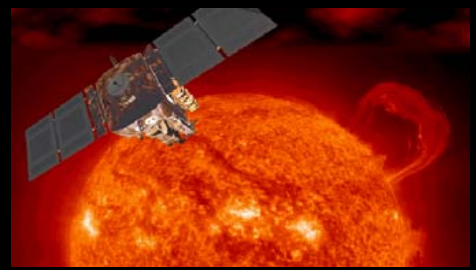
Shuttle Stewardship



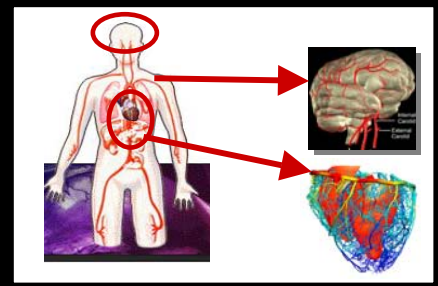
Emergency Response



Low Thrust Trajectory



Solar Weather



Digital Astronaut

Each of these missions requires:

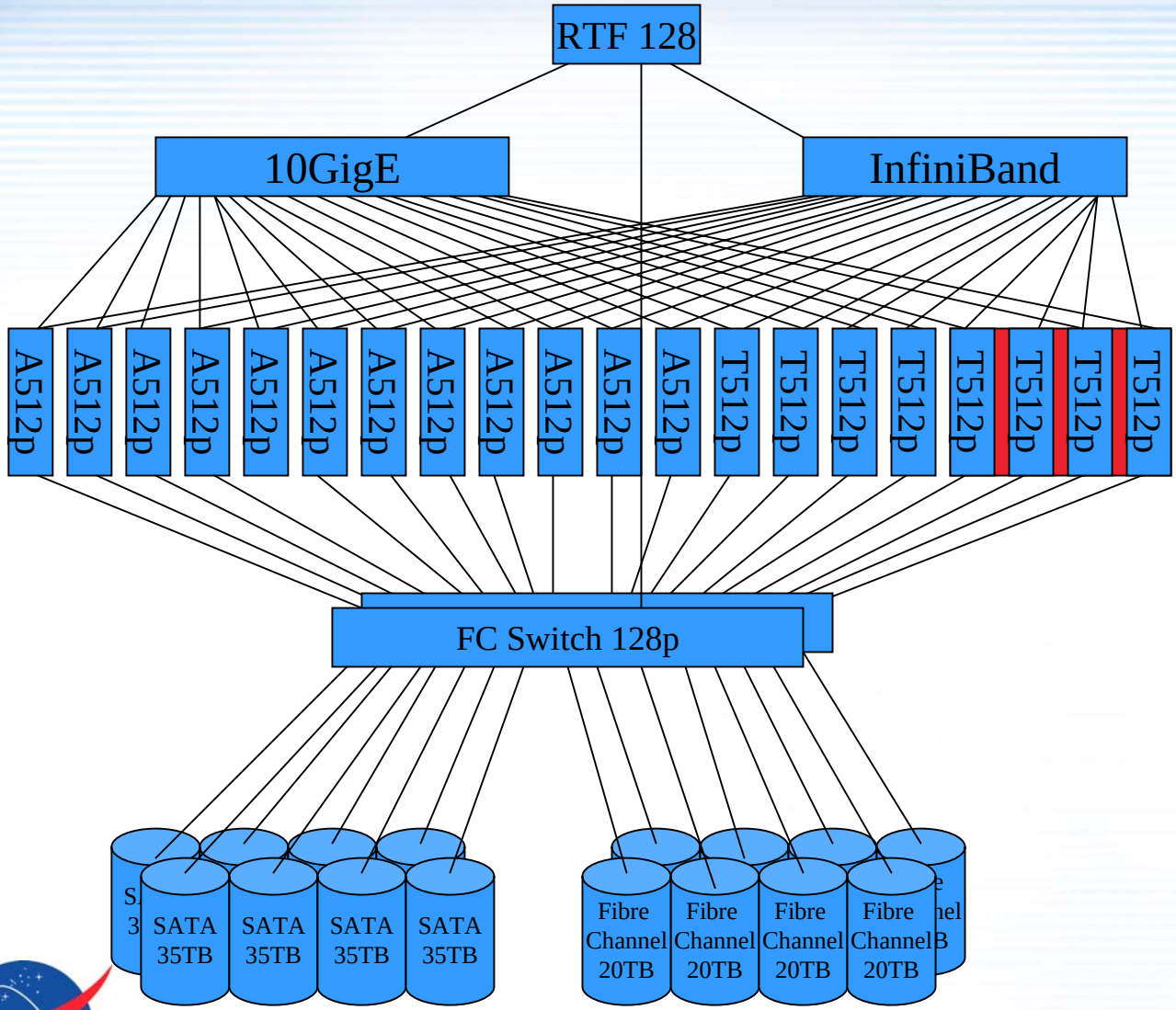
- Advanced Models
- Ensemble Analysis
- Engineering environments
- Efficient codes
- TB/PB data management
- NASA-wide resource access
- TFlop Computation
- Data analysis/vis/understanding

Thank You SGI !!!

NASA Guidance

- *It also is expected that NASA will make a portion of its assets available to other agencies through a peer-reviewed process as was envisioned by the High-End Computing Revitalization Task Force strategy for access to leadership systems.*

Components



Front End
- 128p Altix 3700 (RTF)

Networking
- InfiniBand Switch (288port)
- InfiniBand (4 per 3700, 8 per 3700Bx2))
- 10GigE Switch 32-port
- 10GigE Cards (1 Per 512p)
- GigE Switch 384-port, 96-port
- GigE (12 per 512)
- Altix 3700Bx2 2048 Numalink Kit

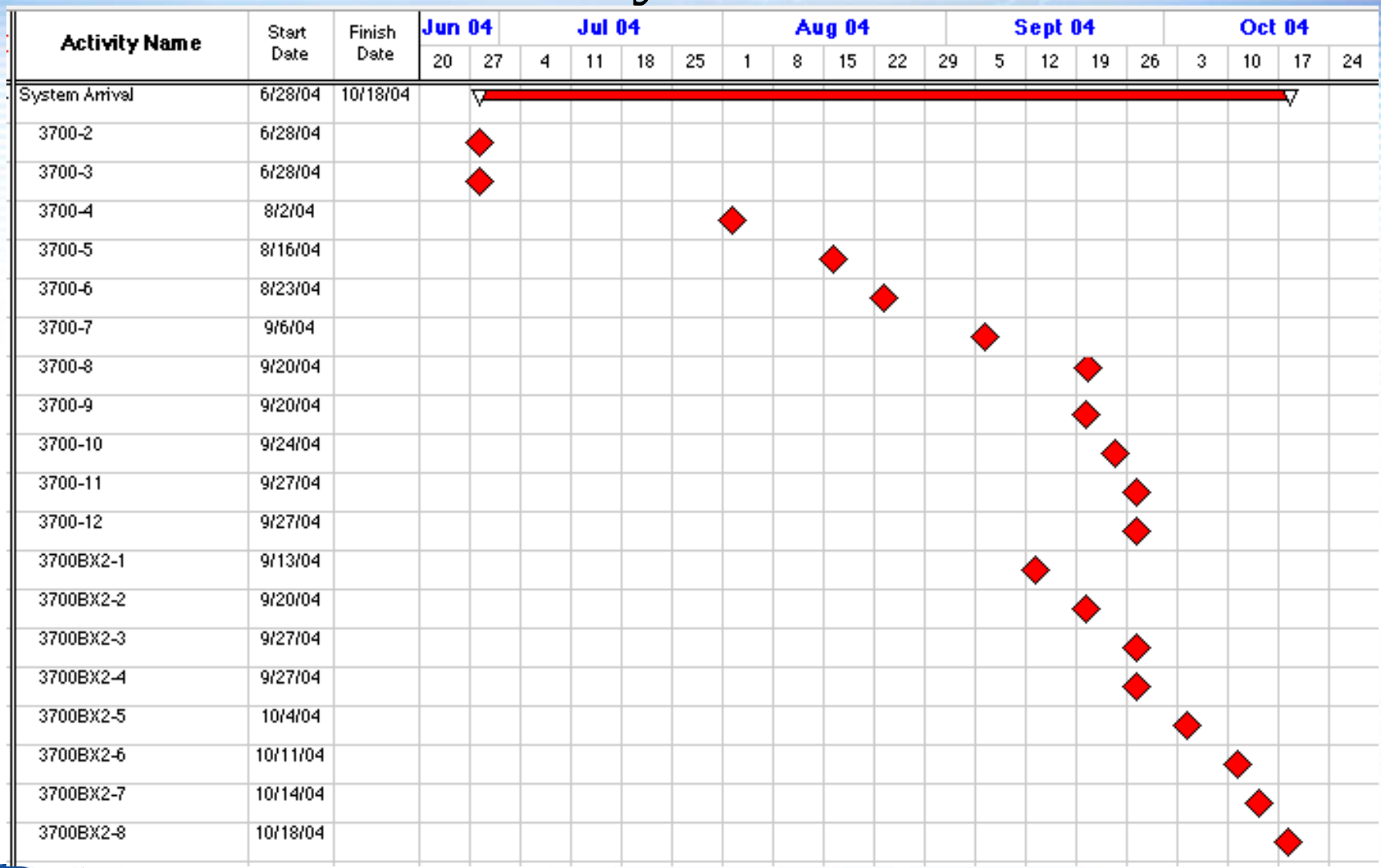
Compute Nodes
- Altix 3700 12x512p
- Altix 3700Bx2 8x512p

Storage Area Network
-Brocade Switch 2x128port

Storage (440 TB)
-FC RAID 8x20 TB (8 Racks)
-SATARAID 8x35TB (8 Racks)

Delivery Schedule

Activity Name	Start Date	Finish Date
System Arrival	6/28/04	10/18/04
3700-2	6/28/04	
3700-3	6/28/04	
3700-4	8/2/04	
3700-5	8/16/04	
3700-6	8/23/04	
3700-7	9/6/04	
3700-8	9/20/04	
3700-9	9/20/04	
3700-10	9/24/04	
3700-11	9/27/04	
3700-12	9/27/04	
3700BX2-1	9/13/04	
3700BX2-2	9/20/04	
3700BX2-3	9/27/04	
3700BX2-4	9/27/04	
3700BX2-5	10/4/04	
3700BX2-6	10/11/04	
3700BX2-7	10/14/04	
3700BX2-8	10/18/04	



The Road There

June - 28 - 2004

In Summary

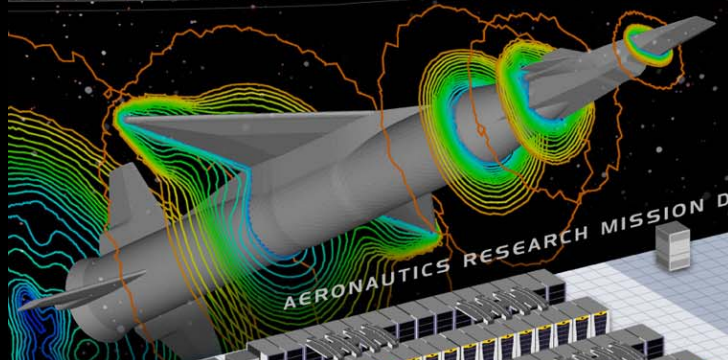
- World's Fastest Operational Supercomputer (650 users)
- System Deployed in 120 Days
  - 19Altix deployed in 109 days
- Columbia is delivering unparalleled computational capability enabling new scientific discoveries
- Columbia is answering NASA's mission critical computing fro STS and NESC
- 51.9 Tflops --2nd on Top 500 list
  - 88% efficiency tops the scalar systems on the top500 list
- Built the world's 1st 2048 initial runs completed on POP code

52 TFlops in 120 days for $50M

ON TIME ------ON COST------ON SCHEDULE

PROJECT COLUMBIA

SUPPORTING NASA'S MISSION DIRECTORATES



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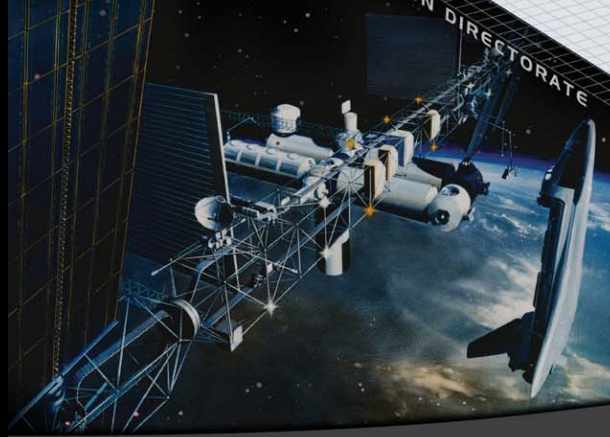

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