

Longhorn Project TACC's XD Visualization Resource

DOE Computer Graphics Forum

April 14, 2010



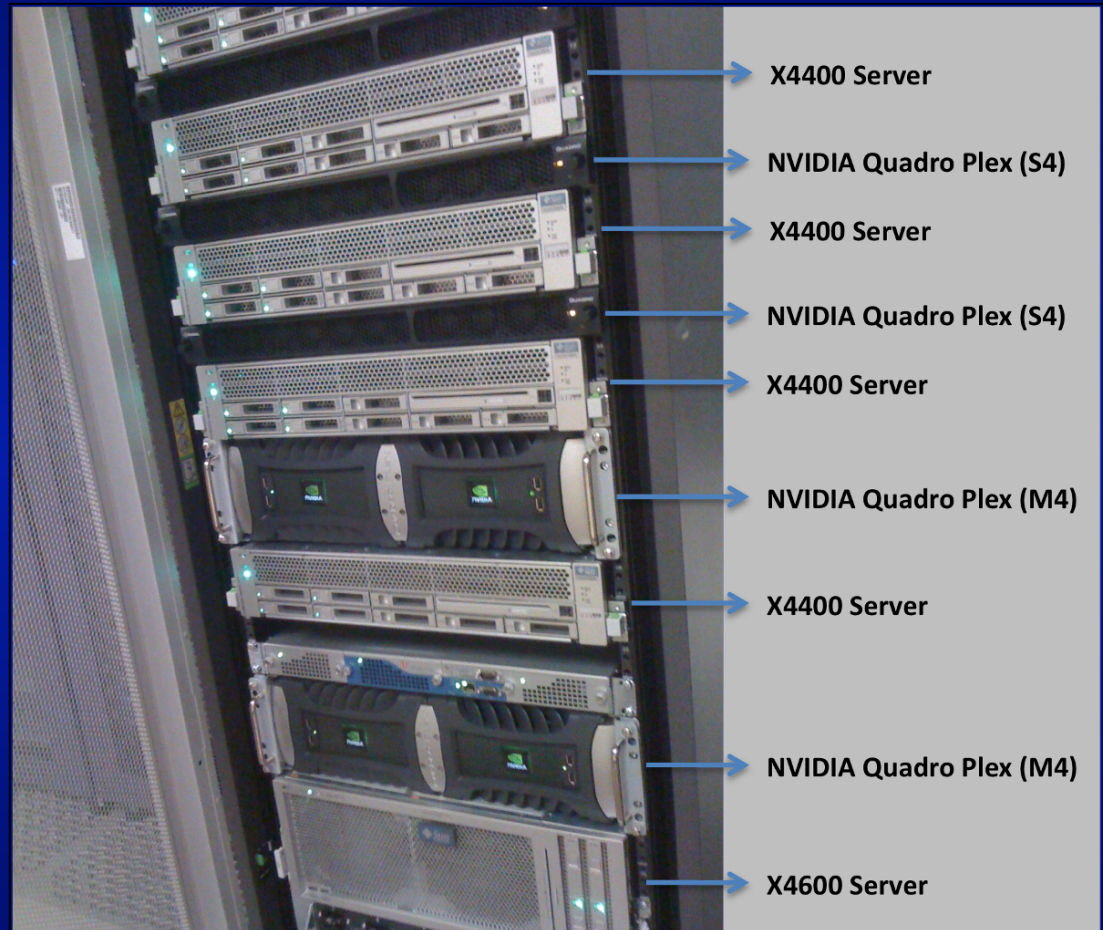
THE UNIVERSITY OF TEXAS AT AUSTIN
TEXAS ADVANCED COMPUTING CENTER

Longhorn Visualization and Data Analysis

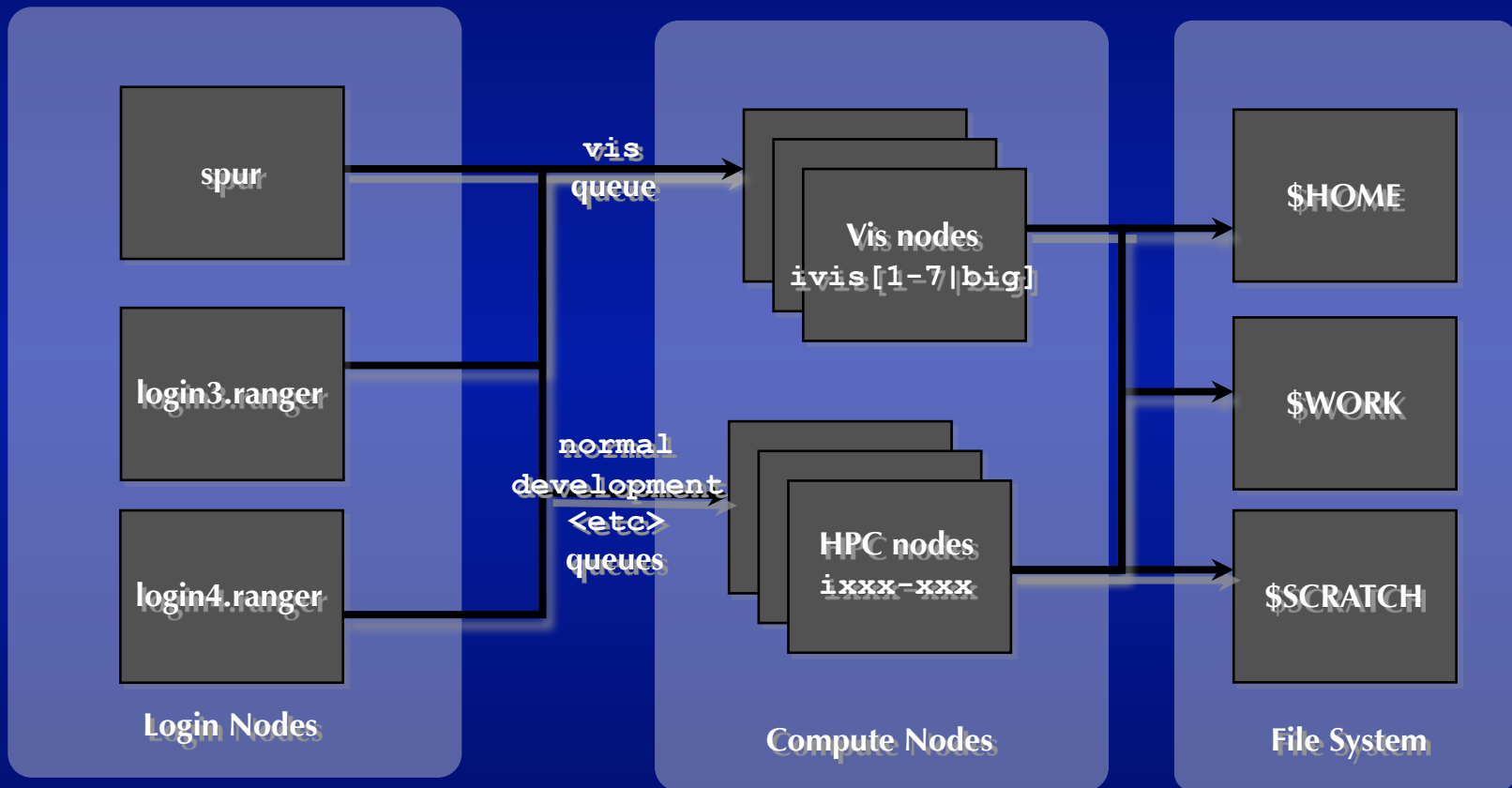
- In November 2008, NSF accepted proposals for the Extreme Digital Resources for Science and Engineering
- The Longhorn project was proposed as a next generation response to TeraGrid's growing visualization and data analysis needs

Spur - Visualization System

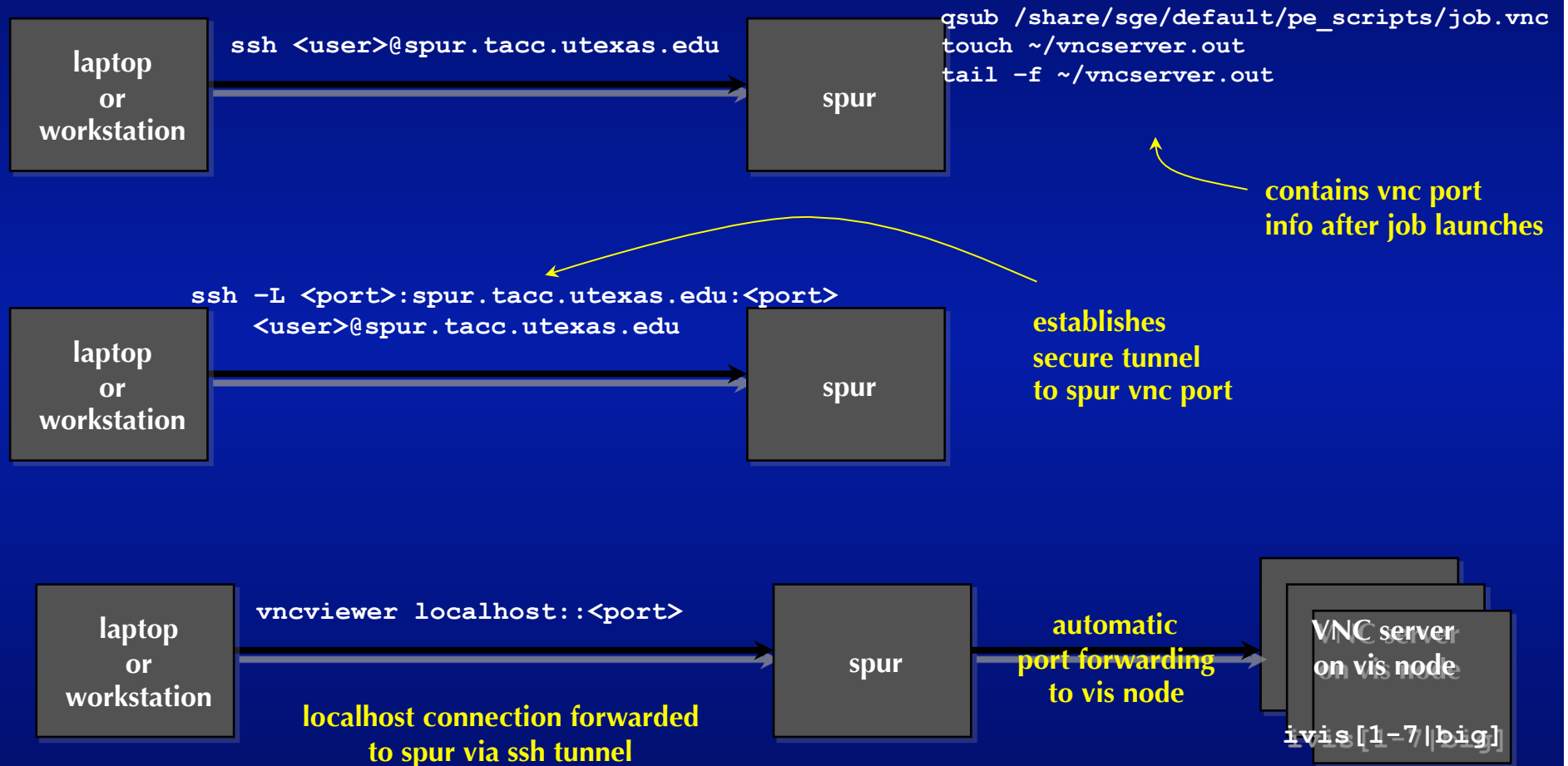
- 128 cores, 1 TB distributed memory, 32 GPUs
- `spur.tacc.utexas.edu` login node, no GPUs
don't run apps here!
- `ivisbig.ranger`
Sun Fire X4600 server
 - 8 AMD Opteron dual-core CPUs @ 3 GHz
 - 256 GB memory
 - 4 NVIDIA FX5600 GPUs
- `ivis[1-7].ranger`
Sun Fire X4440 server
 - 4 AMD Opteron quad-core CPUs @ 2.3 GHz
 - 128 GB memory
 - 4 NVIDIA FX5600 GPUs



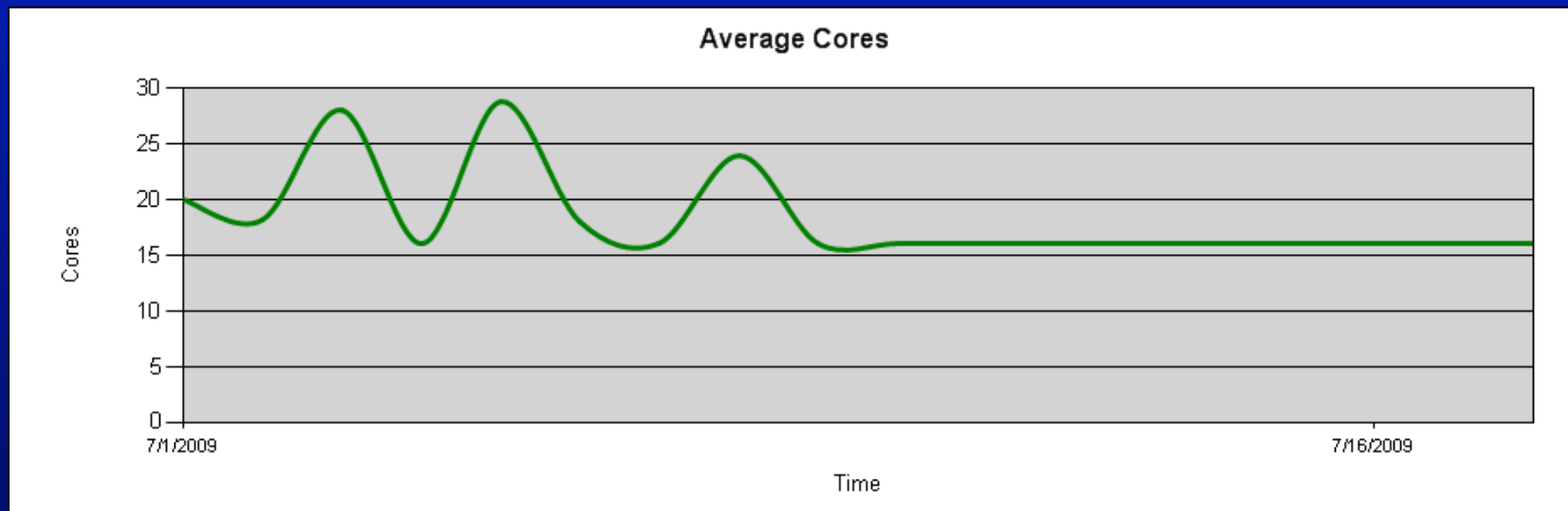
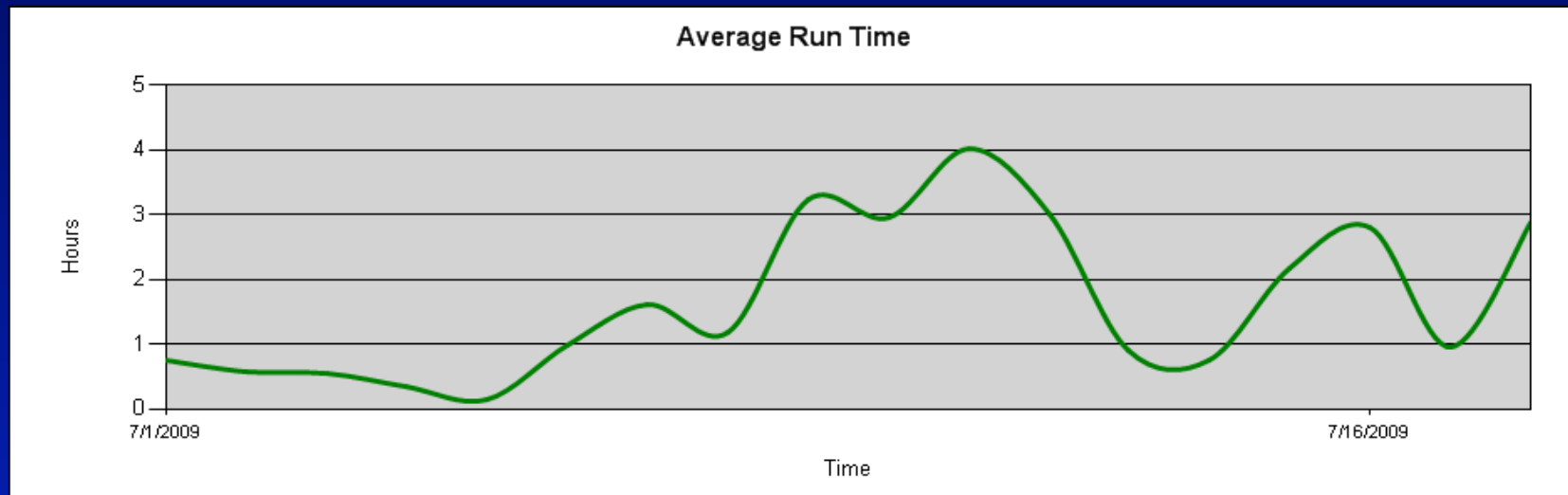
Spur / Ranger topology



Connecting to Spur

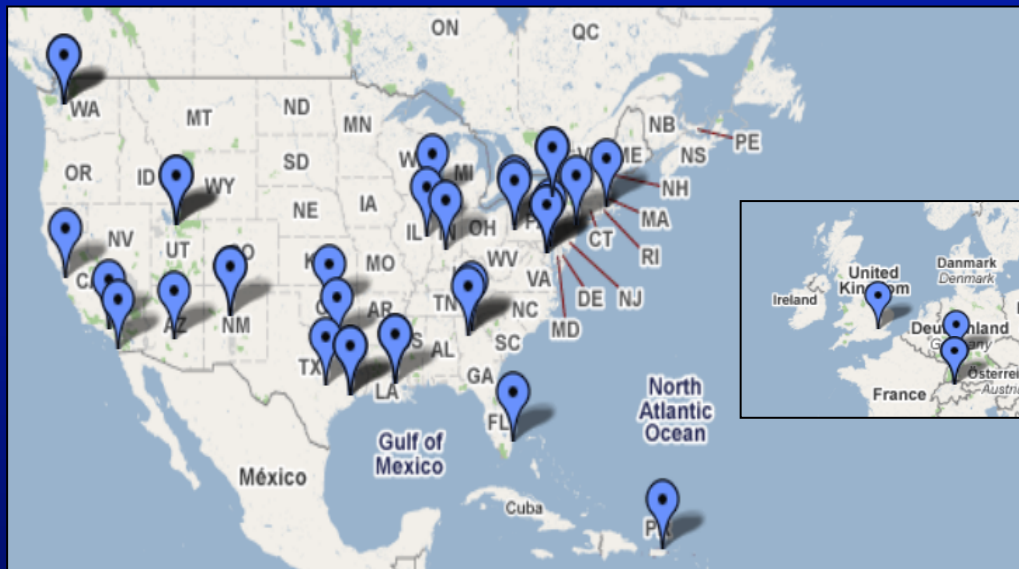


Spur Usage

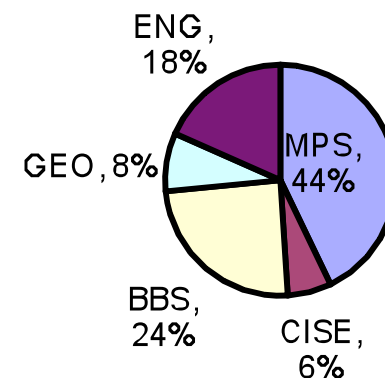


XD Vis Requirements Analysis

- Surveyed members of the science community via personal interviews and email surveys
- Received ~60 individual responses



NSF Fields of Science Represented



XD Vis Requirements Analysis

Requirement	% Users Requested
User Support and Consulting	96%
Large-Scale DAV Tools/Resources	39%
Remote/Collaborative DAV Services	27%
Computational Steering	10%
In-simulation DAV Tools	6%
Tools for 3D Measurement and Query	6%
Tools for Multiple Length and Time Scales	6%

(DAV = Data Analysis/Visualization)

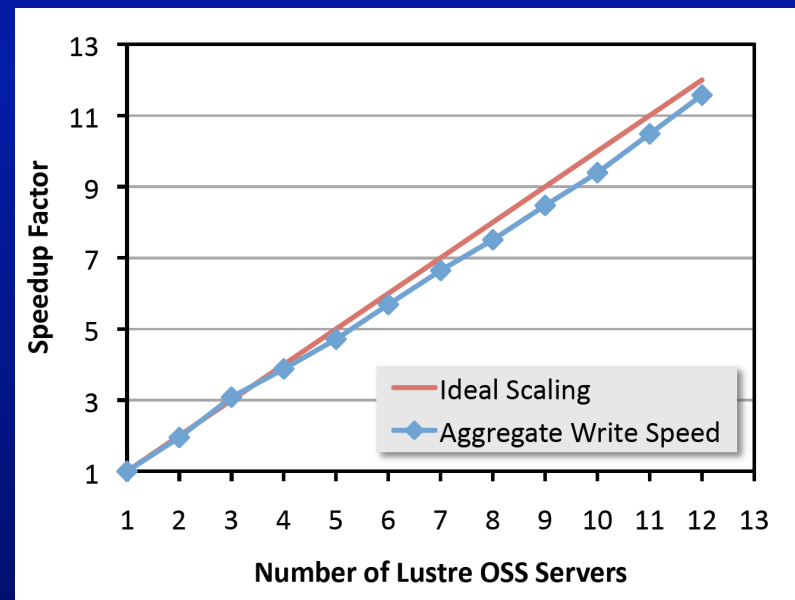
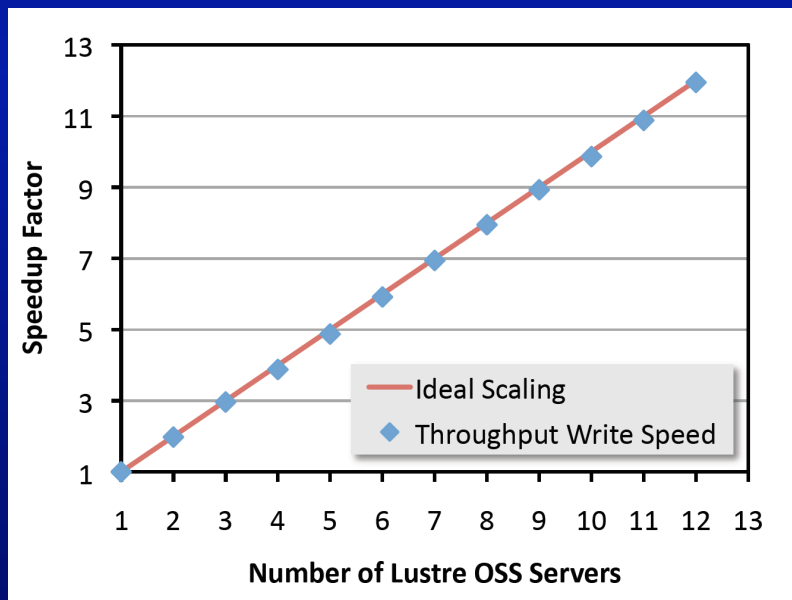
Longhorn Configuration

(256 Nodes, 2048 Cores, 512 GPUs, 14.5 TG Aggregate Memory)

- 256 Dell Quad Core Intel Nehalem Nodes
 - 240 Nodes
 - Dual socket, quad core per socket: 8 cores/node
 - 48 GB shared memory/node (6 GB/core)
 - 73 GB Local Disk
 - 2 Nvidia GPUs/node (FX 5800 - 4GB RAM)
 - 16 Nodes
 - Dual socket, quad core per socket: 8 cores/node
 - 144 GB shared memory/node (18 GB/core)
 - 73 GB Local Disk
 - 2 Nvidia GPUs/node (FX 5800 – 4GB RAM)
 - ~14.5 TB aggregate memory
- QDR InfiniBand Interconnect
- Direct Connection to Ranger's Lustre Parallel File System
- 10G Connection to 210 TB Local Lustre Parallel File System
- Jobs launched through SGE

Longhorn's Lustre File System (\$SCRATCH)

- OSS's on Longhorn are built on Dell Nehalem Servers Connected to MD10000 Storage Vaults
- 15 Drives Total Configured into 2 Raid5 pairs with a Wandering Spare
- Peak Throughput Speed of the File System is 5.86 GB/sec
- Peak Aggregate Speed of the File System is 5.43 GB/sec



Longhorn Partners and Roles:

- TACC (Kelly Gaither – PI)
 - **Longhorn** machine deployment
 - User support
 - Visualization and Data Analysis portal development
 - Software/Tool development
- NCAR (John Clyne – CoPI)
 - User support
 - VAPOR Enhancements
- University of Utah (Valerio Pascucci – CoPI, Chuck Hansen)
 - User support
 - Software Integration of RTRT and topological analysis


Longhorn Partners and Roles:

- Purdue University (David Ebert – CoPI)
 - User support
 - Integration of visual analytics software
- UC Davis (Hank Childs – Chief Software Integration Architect)
 - Directly facilitate tools being integrated into the VisIt software suite
- SURA (Linda Akli – MSI Outreach/Broadening Participation)

Longhorn Usage Modalities:

- Remote/Interactive Visualization
 - Highest priority jobs
 - Remote/Interactive capabilities facilitated through VNC
 - Run on 4 hour time limit
- GPGPU jobs
 - Run on a lower priority than the remote/interactive jobs
 - Run on 12 hour time limit
- CPU jobs with higher memory requirements
 - Run on lowest priority when neither remote/interactive nor GPGPU jobs are waiting in the queue
 - Run 12 hour time limit

Longhorn User Portal

TACC  **Longhorn Visualization Portal**

TACC\kelly [logout](#)
No resource selected.

Home Allocations **Resources** Help Admin

Select a Resource

Resource: Longhorn

Project: TG-STA060015N

Session type: ☒ VNC ☐ EnVision guided visualization

Number of nodes: 1 (8 slots)

Note: increasing the number of nodes will only increase performance for parallel applications (e.g. ParaView or VisIt).

Select

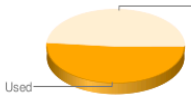
Available Resources

- Longhorn**

Longhorn (longhorn.tacc.utexas.edu), TACC's Dell XD Visualization Cluster, contains 2048 compute cores, 14.5 TB aggregate memory and 512 GPUs. Longhorn has a QDR InfiniBand interconnect and has an attached Lustre parallel file system. Longhorn is connected by 10GigE to Ranger's Lustre parallel file system thus making it more convenient to work on datasets generated on Ranger. Longhorn has 256 nodes + 2 login nodes, with 240 nodes containing 4GB of RAM, 8 Intel Nehalem cores (@ 2.5 GHz), and 2 NVIDIA Quadro FX 5800 GPUs. Longhorn also has an additional 16 large-memory nodes containing 144GB of RAM, 8 Intel Nehalem cores (@ 2.5 GHz), and 2 NVIDIA Quadro FX 5800 GPUs. For more detailed information on Longhorn, please see the [Longhorn User Guide](#).

Queue information:

updated at February 25, 2010, 9:40:11 am ([refresh](#))



Available

Used

The Longhorn queues are open.
121 nodes available out of 250 total.

ACTIVE JOBS-----

JOBID	JOBNAME	USERNAME	STATE	CORE	REMAINING	STARTTIME
6772	ubiq_NVE_5	dlebard	Running	512	11:27:58	Thu Feb 25 09:08:09
6773	vncserve	pederzani	Running	8	00:00:42	Thu Feb 25 09:10:53
6774	lys_NVE_20	dlebard	Running	512	11:30:58	Thu Feb 25 09:11:09

3 active jobs : 129 of 248 hosts (52.02 %)

WAITING JOBS-----

JOBID	JOBNAME	USERNAME	STATE	CORE	WCLIMIT	QUEUETIME
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WAITING JOBS WITH JOB DEPENDENCIES---

TACC

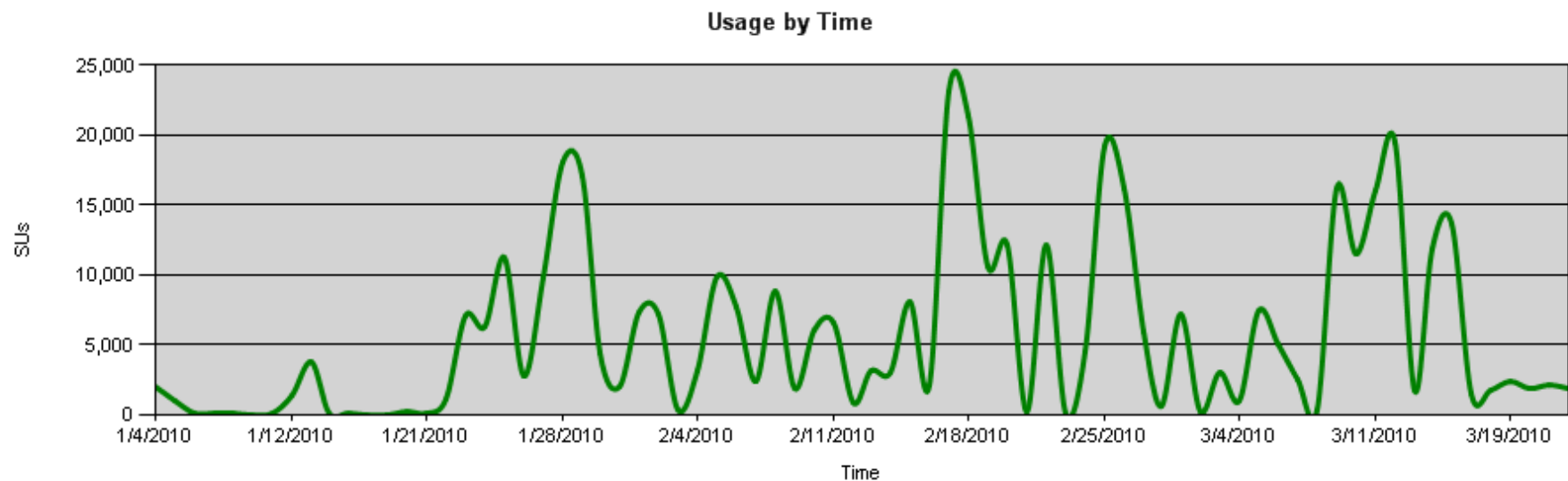
Longhorn Queue Structure

SGE Batch Environment Queues			
Queue Name	Max Runtime	Max Cores	Node Pool
normal	8 hrs	128	All nodes
long	24 hrs	128	All nodes
largemem	8 hrs	128	16 Large memory nodes
devel	1 hrs	32	8 Nodes
request	---	---	special requests

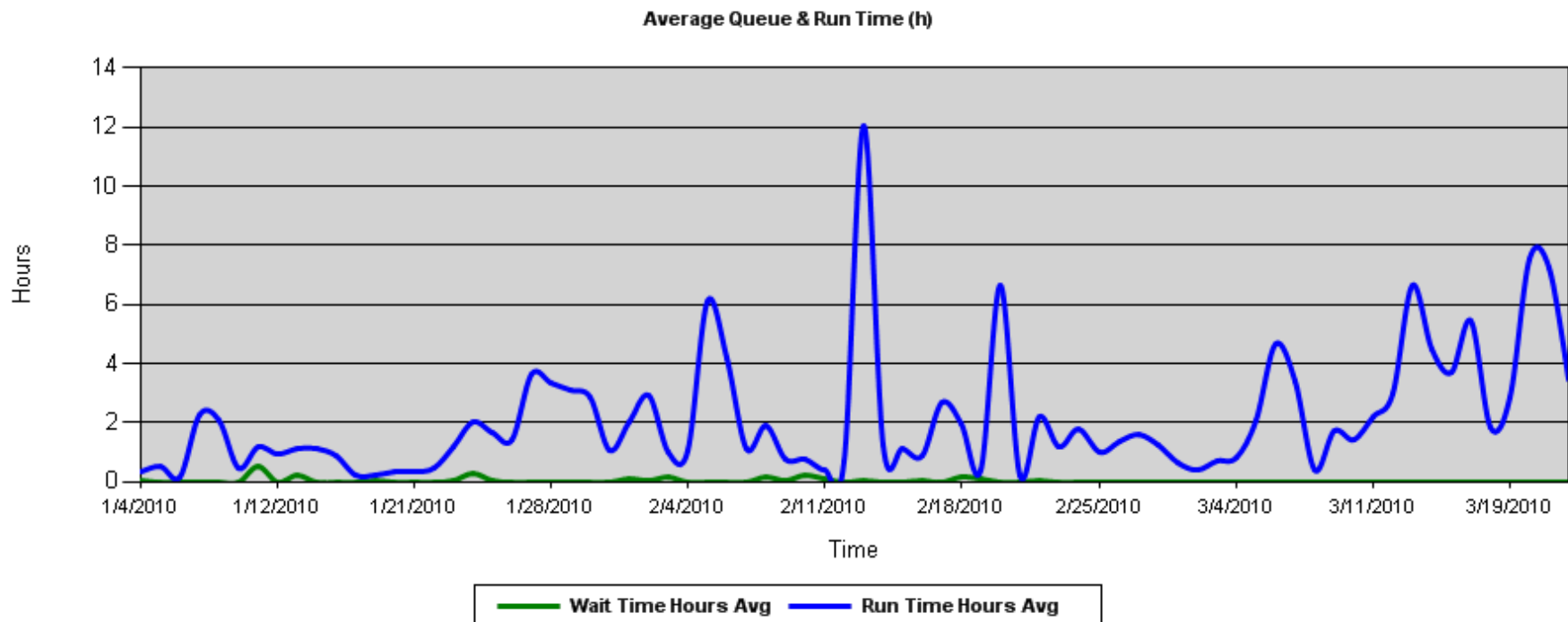
Project Types		
Type	Purpose	Special Environment Modifications
vis	Visualization jobs	
data	Data Analysis jobs	
gpgpu	GPGPU jobs	disables X server
hpc	HPC jobs	

qsub -q normal -P vis

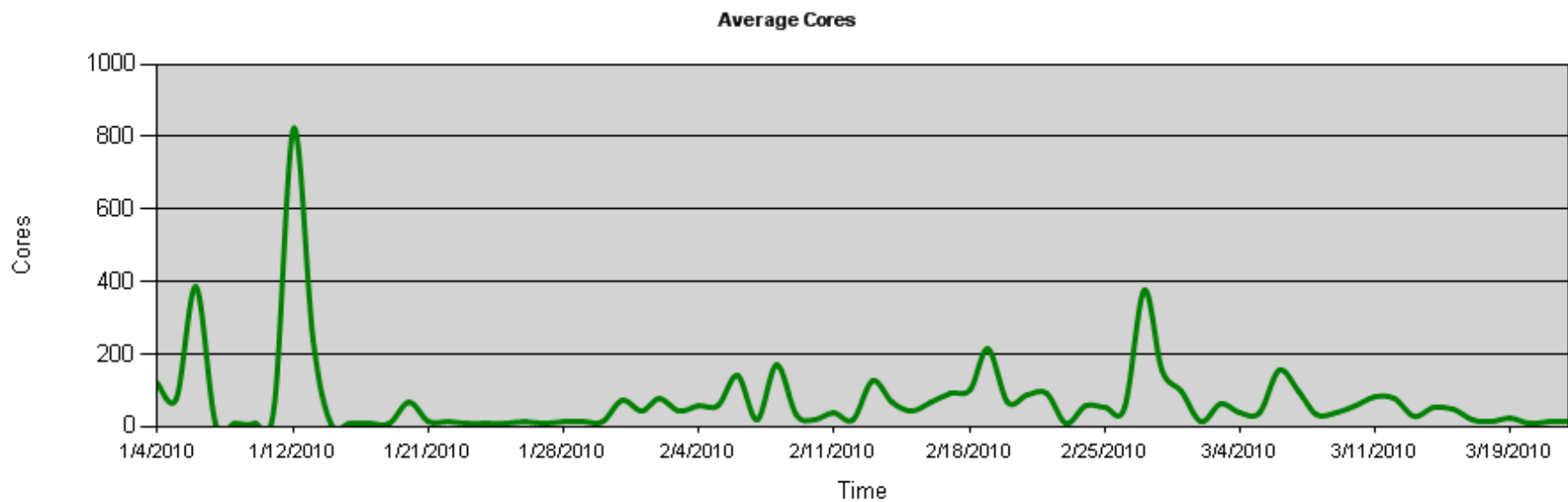
Longhorn Usage



Longhorn Usage

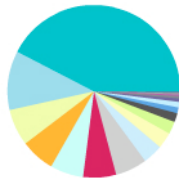


Longhorn Usage



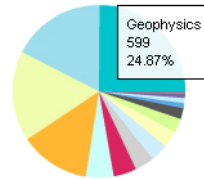
Longhorn Usage

Field of Science Since
Production



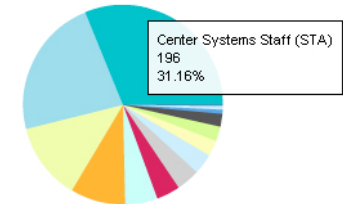
■ Advanced Scientific Computing (ASC) ■ Research Instrumentation
 ■ Visualization, Graphics and Image Processing ■ Unknown ■ Special Projects
 ■ Geophysics ■ Center Systems Staff (STA) ■ Computational Mathematics
 ■ Physical Chemistry ■ Condensed Matter Physics
 ■ COMPUTER AND INFORMATION SCIENCE AND ENGINEERING (CISE)
 ■ Fluid, Particulate, and Hyrdraulic Systems ■ Training (TRA) ■ Tectonics
 ■ MATHEMATICAL AND PHYSICAL SCIENCES (MPS)
 ■ Extragalactic Astronomy and Cosmology ■ Software Development
 ■ Seismology ■ Cross-Disciplinary Activities (CDA)

Field of Science Last 30
Days



■ Geophysics ■ Research Instrumentation ■ Special Projects
 ■ Center Systems Staff (STA) ■ Condensed Matter Physics
 ■ Visualization, Graphics and Image Processing
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Field of Science Last 7
Days



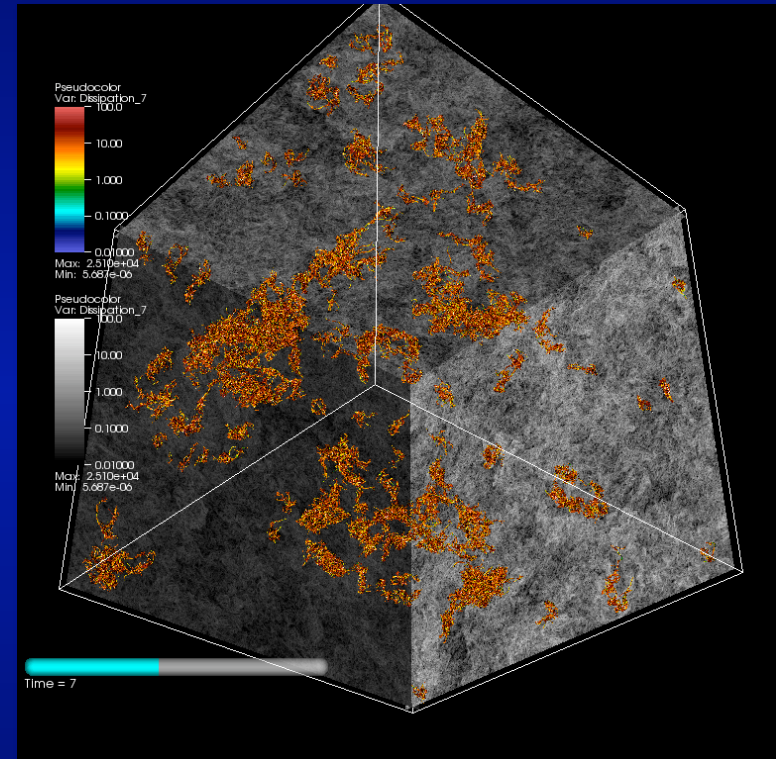
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Sampling of Current Projects

- Computational Study of Earth and Planetary Materials
- Simulation of Quantum Systems
- Visualization and Analysis of Turbulent Flow
- A probabilistic Molecular Dynamics Optimized for the GPU
- Visualization of Nano-Microscopy
- MURI on Biologically-Inspired Autonomous Sea Vehicles: Towards a Mission Configurable Stealth Underwater Batoid
- Adaptive Multiscale Simulations

Visualizing and Analyzing Large-Scale Turbulent Flow

- Detect, track, classify, and visualize features in large-scale turbulent flow.
- Collaborative effort between TACC, VACET and domain scientists.
- Paper submitted to IEEE Vis 2010.
- Thanks to Cyrus Harrison for developing connected components code in VisIt.
- Thanks to Hank Childs for developing chord length distribution code and visualization.
- Thanks to Wes Bethel for facilitating the collaboration!



VisIt calculated connected components on a $4K^3$ turbulence data in parallel using TACC's Longhorn machine. 2 million components were initially identified and then the map expression was used to select only the components that had total volume greater than 15. Data courtesy of P.K. Yeung & and Diego Donzis

Questions?

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