



Upstream

information technology and services

Oil and Gas HPC Update

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HPC Summary

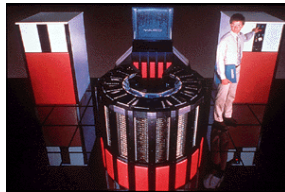


Seismic Imaging is critical to discovering and progressing resources across BP's portfolio, enabling description of the subsurface for prospect generation, resource appraisal ahead of field development and reservoir monitoring during production.

- The HPC Team is dedicated to the computing needs of Seismic Imaging R&D
 - Support the largest commercial research computing facility in the world
 - Partnership with Intel has been critical to our early access to technology
 - Team has the skills required to identify and implement breakthroughs at scale
 - We have grown from 0.1 teraflop in 1999 to 3800 teraflops now!
 - And we are a Group Resource, willing to help Distributed Research Lab computing challenges



Upstream supercomputing timeline



1993-2001
Thinking Machine CM-5
0.1 Gflop / cpu
512 cpus, 16 GB memory



2000
IA-32 clusters
0.8 Gflop/cpu
1 cpu
0.5 GB mem/computer
32 computers

2005
SGI Altix – Itanium2 (6 Gflop/cpu)
64 cpu 512 GB mem/computer
HPC Total: 35 TF



1985
Cray 2
0.4 Gflop/cpu
4 cpus
2 GB memory



1975	1980	1985	1990	1995	2000	2005	2010	2015
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1976
Cray 1
0.13 Gflop/cpu
1 cpu
0.008 GB memory



1997-2002
SGI Origin servers
0.8 Gflop / cpu
32 cpu
32 GB mem/computer
37 computers



2015
HPC Total: 115,000 cpus / 3800 TF
Intel Haswell - 2700TF
Intel Ivy Bridge - 1130 TF

1992
Cray C90
1.0 Gflop/cpu
16 cpus
4 GB memory



2002
HP Itanium 2 (4 Gflop/cpu)
HPC Total: 3 Tflops



HPC Team



The HPC Team have highly specialized skills in geophysics, computer science and mathematics required to enable Imaging Research and Deployment.

- The HPC Development Team works directly with Researchers to develop codes, optimize algorithms and automate processes. It typically takes 3-5 years for a new PhD to develop the skills to be fully productive.
- The HPC Operations Team provide seismic processing and data management skills to enable researchers to focus on delivery of new technology
- The HPC Systems Team manages a huge computing center, implementing leading-edge technology at scale



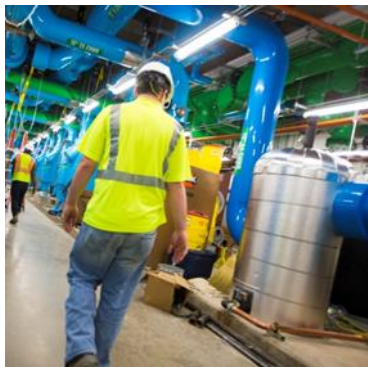
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Next Generation HPC Facility



- HPC growth was limited by Westlake 1 electrical and cooling capacity
- New Facility addresses safety and integrity issues
- Design began Q1 '11, construction began Q3 '12
- 30% more energy efficient than Westlake 1
- HPC: 15,000 sq. ft. of compute space
- HPC: 8.8 MW electrical growth capacity (3.8 MW installed today)
- Oct 9: Day 1 Research Computing, Oct 22, 2013: Grand Opening
- Nov 12, 2013: Complete move from Westlake 1, <4 hour outage!



Delivering HPC for the Future



Computing and Programming Model

- >2X growth per year is needed to keep pace with imaging requirements
- Improvements in the tools and processes used by Researchers are needed to improve their effectiveness
- Acceleration: some companies fully committed, some still studying. But convergence?
- Interconnect: becoming more important
- Data volumes: exponential growth possible!

People

- We must renew our People Capability; partnerships with NCSA (University of Illinois), Rice University and University of Texas let us identify and train the best recruits

Visualization & Remote Graphics

- Visualization of the results of imaging workflows is critical to understand and communicate results, increased area of focus moving forward
- Advancing remote graphics capabilities, to enable use of HPC by researchers outside of Houston