



HPC Partnerships at Lawrence Livermore National Laboratory

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Program Developer

HPC Capability Engagements

LLNL-PRES-652726

This work was performed under the
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Lawrence Livermore National Security, LLC



LLNL: a multidisciplinary, applied research national security lab



Northern CA, East Bay



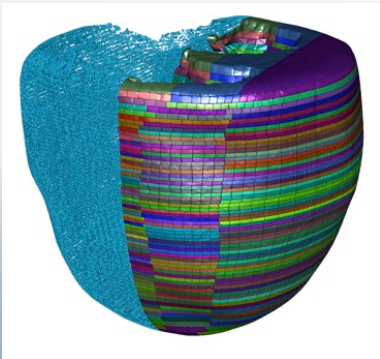
Experimental Test Site
(11 miles² near Tracy, CA)



- Established in 1952
- Approximately 6,500 employees
- 7.1M gross ft², 684 facilities
- Annual federal budget: ~ \$1.5B
- 28 PF/s peak computing
- 2.2M cores
- 2.5 PB DRAM
- 10 file systems, 74PB storage

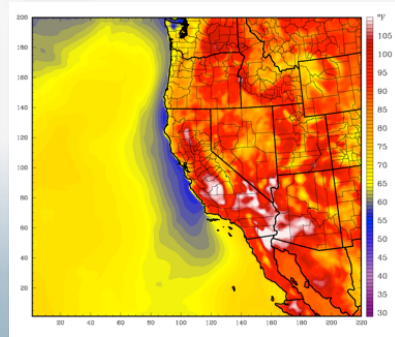
Beyond nuclear security, HPC spans many scientific and technical applications

Human Health



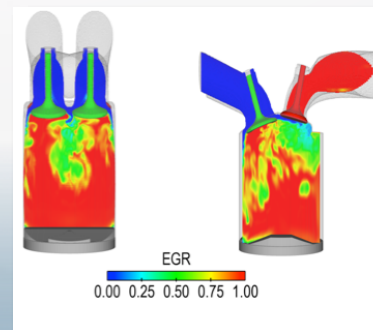
Cardiac modeling
Drug discovery
Host / pathogen metagenomics
Bioinformatics

Energy and Climate



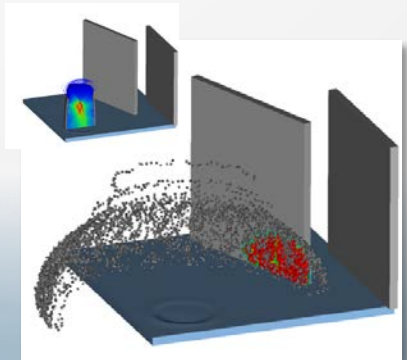
Oil and gas
Alternative energy
Renewables
Climate modeling
Smart Grid

Industry



Engineering
Transportation
Advanced manufacturing
Data science

National Security



DoD / DHS
Cyber security
Biosecurity
Counter-terrorism

Leading Supercomputing Center Seeks Partners for High-Impact Collaborations

The High Performance Computing Innovation Center (HPCIC) is an outreach initiative to industry and academia by Lawrence Livermore National Laboratory under the auspices of the U.S. Department of Energy.

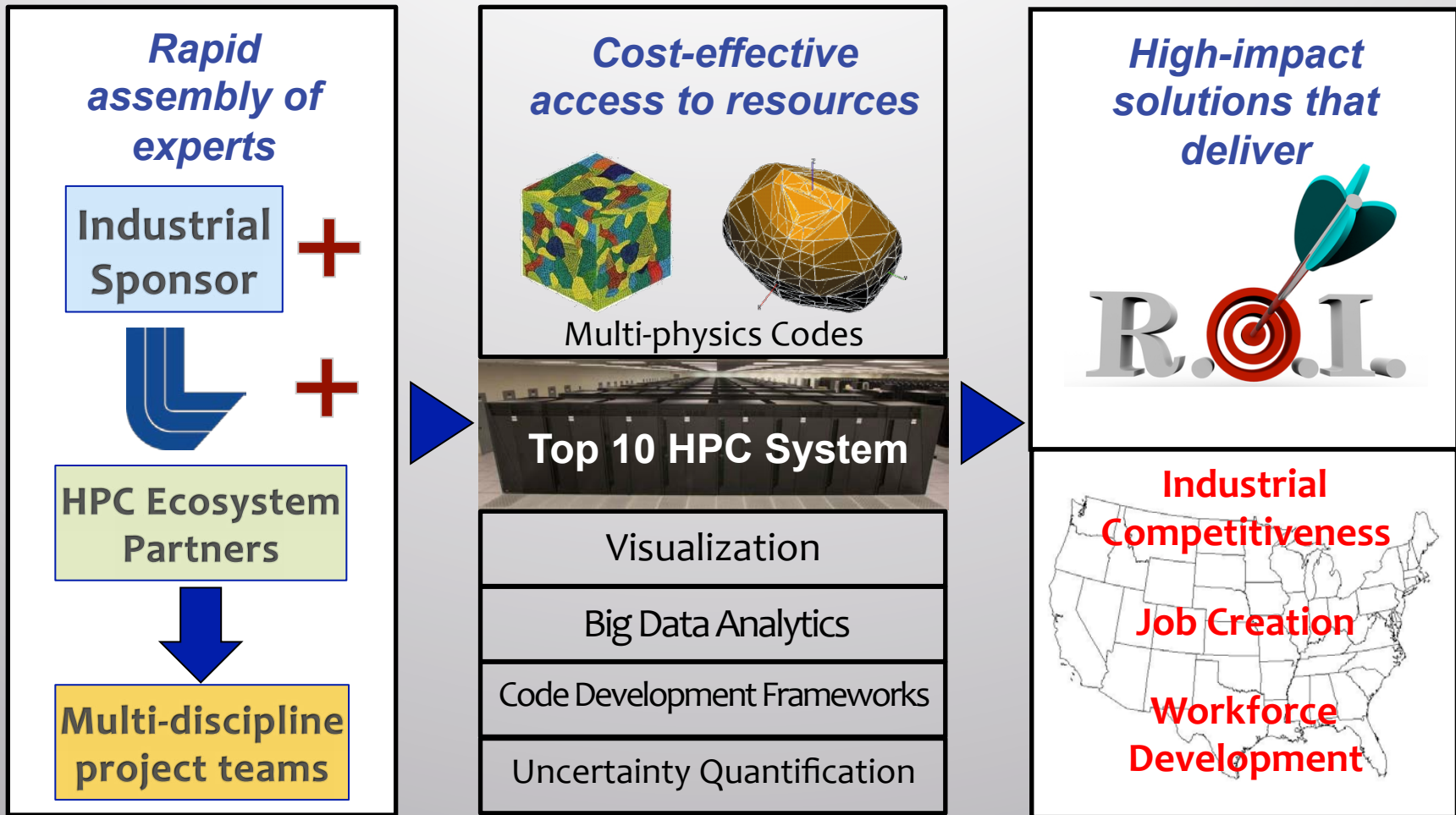
In support of LLNL's national security mission to:

- boost American competitiveness
- accelerate science and technology advancements
- develop a future HPC-skilled workforce



**Situated on the Livermore Valley Open Campus,
in Livermore, California**

High-impact capability engagements to accelerate innovation and create transformational solutions



Decades of investments in supercomputing expertise accessible to industry

Scalable capability engagement model goes beyond pure research to deliver on-demand solutions



HPC partnership categories



INNOVATION CENTER

HPC Supply Chain



Procurements
FastForward
Hyperion
Tools
Evaluations

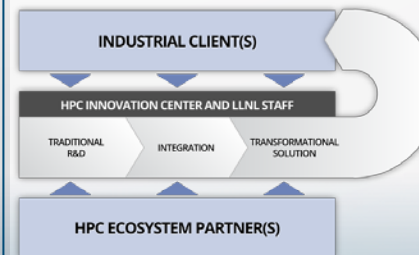
Sponsored Projects



Work For Others

Capability engagements
Research
Licensing
Events

Ecosystem



Joint industrial engagements
Teaming for grants
Licensing
Open source communities

Education



HPC workforce development
Training
Academia
Students

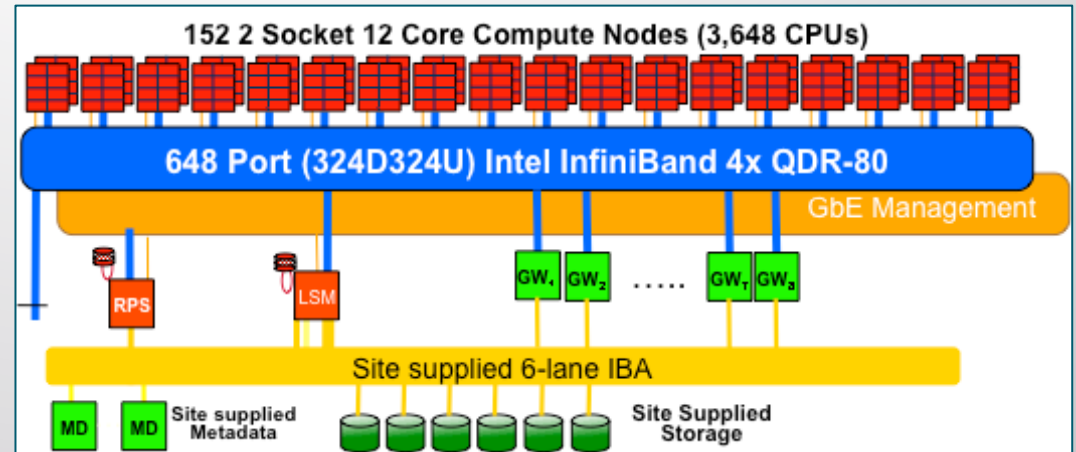
Intel/Cray collaboration complements IBM/HPCIC relationship – a “Catalyst” for data analytic projects

Uses HPCIC partnership model to bring in a cost-shared formidable 150 TF/s data analytics computer

Technical focus on NVRAM layers in memory hierarchy supporting 24 core nodes – prototyping analytics in new environment

Initial applications to focus on

- Prototyping exascale simulation analysis architectures
- Bioinformatics algorithms
- Graph analytics



324 nodes
7,776 cores
149.3 TF/s, 41.5 TB DRAM, 281.6 TB NVRAM, IB QDR-80

Over 5GB DRAM & 36GB NVRAM per CORE



Sponsored (proprietary) industrial engagement examples

1. Semiconductor equipment company developing technology critical for advancing Moore's Law
 - Sponsor was not using modeling and simulation because it has historically lagged experimental approaches
 - 2D & 3D simulations using LLNL/ASC codes provide extraordinary visibility into complex phenomena too difficult to observe/optimize experimentally
 - Accelerating research & development to meet ITRS roadmap
2. Industrial equipment manufacturer seeking to incorporate modeling and simulation into design processes
 - Commercial codes not providing adequate performance (runtimes too long, resolutions too coarse, more physics needed)
 - LLNL codes provide acceleration to acceptable runtimes
 - LLNL interest to engage with ISVs to help improve their codes
 - Fred Streit leading ISV outreach in 2014 for Council on Competitiveness

Partnership with STFC - Daresbury, UK



Hartree Centre
Science & Technology Facilities Council

- MOU signed August 29, 2013 between two similar organizations with common aspirations
 - Similar industrial engagement goals, and organizational constructs
 - Both centers utilize Blue Gene/Q supercomputers and Linux clusters
- Both parties intend the relationship to accelerate and enable
 - Sharing: expertise, best practices, tools, software, solutions, successes
 - Rapid solution development for big data applications – using NVRAM on BlueGene/Q and Catalyst
 - Unique multi-continent value proposition for large, multi-disciplinary projects, such as pre-competitive shared research or proprietary work for multi-national organizations

Lessons learned from industrial engagements

- HPC capability engagements are complex sales
 - Identify and aim to solve relevant, high-impact problems
 - Must develop compelling, relevant proposal with low-risk ROI
 - Requires customer participation
 - Requires effective team formation
 - Requires LLNL management and DOE approval
 - Say “no” early to unqualified leads, otherwise high COS
- Ensure execution team’s commitment to completion
 - Each project develops your reputation
- Resource-intensive
 - Scaling engagements requires scaling staff

How can we help you?



For more information on HPC capability engagements, please visit www.hpcinnovationcenter.com and contact:

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HPC Innovation Center: 5+ PF of supercomputing and decades of expertise available to benefit industrial partners



- Livermore Valley Open Campus offers a campus-like environment, permitting access by all partners
- Unclassified HPC Enclave allows outside users access to over 800 TF of shared LLNL cluster resources
- 5.0 PF IBM Blue Gene/Q “Vulcan” now available for industrial use
- Team approach coupled with exceptional resources enables creation of transformational solutions

~100,000 times more powerful than a desktop computer
= 100,000 times more realistic simulations

Deep Computing Solutions:

a collaboration between IBM and LLNL



- Operates within LLNL's HPC Innovation Center as an HPC ecosystem partner option for industrial engagements
 - Joint staffing of industrial partner projects by experts from both IBM and LLNL
 - Extends HPCIC's range of industrial solutions to include integration, installation and management of enterprise-critical systems
 - Built on 20 year track record of collaborative innovation
 - Seven #1 ranked supercomputers, five Gordon Bell awards
- Shared commitment by IBM and LLNL to explore collaboration with other ecosystem partners to broaden adoption of advanced computing technologies by American industries