



Fostering Innovation at AFRL



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Advanced HW & SW Technologies Branch

Air Force Research Laboratory

DOD Supercomputing Resource Center



Dual Mission



- Accelerate & enable RDT&E by providing accessible, easy to use supercomputing resources, support and expertise for DoD-sponsored scientists and engineers
- Leverage our experienced staff to advance technologies & create intuitive environments for scientific discovery & engineering knowledge
- Collaborate with partners to overcome complex national security challenges

HPCMP High-Level Operational Concept



Users



DEPARTMENT OF DEFENSE
HIGH PERFORMANCE COMPUTING
MODERNIZATION PROGRAM

A technology-led, innovation-focused program committed to extending HPC to address the DOD's most significant challenges

DOD Supercomputing Resource Centers (DSRCs)

- AFRL DSRC: US Air Force Research Laboratory DSRC
- ARL DSRC: US Army Research Laboratory DSRC
- ERDC DSRC: US Army Engineer Research and Development Center DSRC
- Maii High Performance Computing Center DSRC
- NAVY DSRC: US Navy DSRC

Information-assured Networking

Defense Research & Engineering Network (DREN)

Connects DOD HPC Centers and Users

High-bandwidth, Low-latency Full-service Network

Software Applications

- Core Software
- Computational Environments
- Education and Training
- Support

Results

Acquisition Engineering

Decision Support

Science and Engineering Research



AFRL DSRC:

We Offer A Spectrum of Services and Capabilities

AFRL Supercomputing Resource Division (AFRL/RCM)

DoD Supercomputing Resource Center (DSRC)

HPC Design & Consulting



- Dedicated/Shared AFRL Compute Clusters
- AFRL Data Servers
- Local R&D Networks
- Classified Environments
- HPC Expertise/R&D Support



- Large Shared/Allocated DoD HPC Systems
- Data Storage
- DREN
- Common Software
- Customer Assistance
- Leverage DoD Funding (\$13-15M/yr)

- Predictable & Reliable Availability**
- Dedicated Support Partitions
 - Advance Reservation Service



Visualization Support

Data Analysis and Assistance Center (DAAC)
Secure Remote Desktop (SRD)

Software Applications Support

Institutes/Portfolios

Resource Management Requirements & Allocations

DHPis

Frontier Projects

Redeployment of Retired Systems

DOD HPC MODERNIZATION PROGRAM

Program Elements



Outreach Initiative



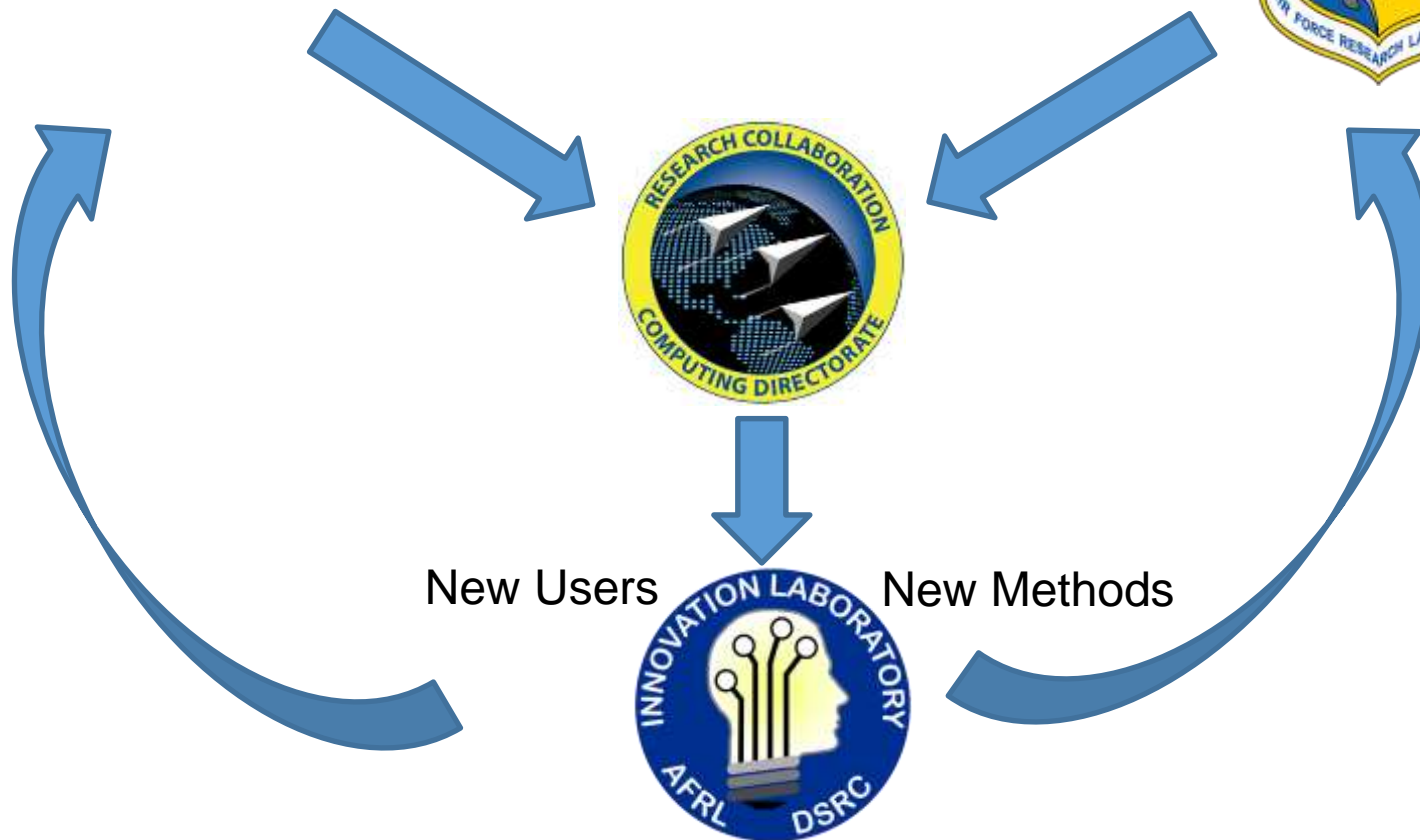
- **Increase Leadership Awareness of Our Capabilities**
- **Appeal to 'Entry-level' Users**
- **Establish Relationships**
- **Help New Customers Access and Utilize HPC**
- ***Evident that Non-Traditional Users Are Not Being Served***



Innovation Laboratory



DEPARTMENT OF DEFENSE
HIGH PERFORMANCE COMPUTING
MODERNIZATION PROGRAM





Innovation Laboratory



- The Innovation Laboratory allows DOD HPC *users* to develop, evaluate and test new concepts and new capabilities for DOD HPC systems
- Stimulates innovation applying HPC systems to solve DOD problems
- Consists of systems, software and expert support
 - System/application configuration support is key
 - Evolution of the capabilities provided by the Talon, Lancer and Navajo “non-allocated” systems
- Institutionalize the processes and policies
 - Flexible and loosely controlled processes



Innovation Lab Value



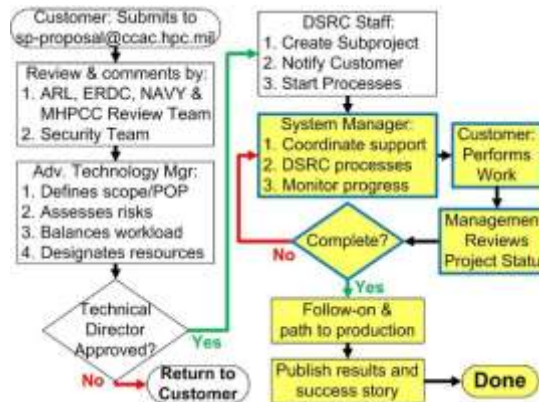
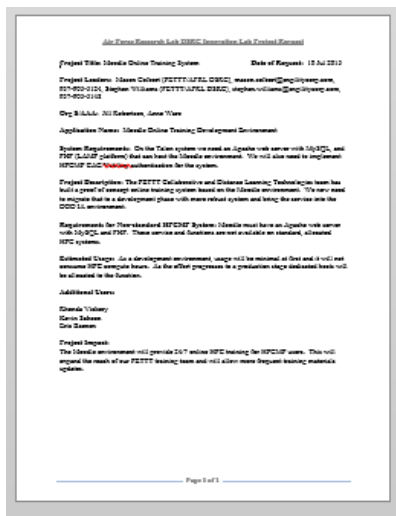
- **Energizes projects developing or evaluating new capabilities on flexible systems and/or special HW**
- **Goal is to grow HPC by fostering and nurturing new projects, new uses and new capabilities for DOD**
- **Provides access to new technologies and concepts:**
 - Database, big data, data analytics and Hadoop
 - Emerging computational accelerators
 - Job/task scheduling management, workflows, data and content management
 - Web portals, virtual machine environments, etc.



Project Management Process



“Hell, there are no rules here – we’re trying to accomplish something.”
-Thomas Edison





Innovation Laboratory Components



Small clusters, custom configurations, unique or specialized HW & SW, new or unusual architectures

- **Navajo: Experiment with and code for latest generation of accelerators. Includes NVIDIA and Intel Phi coprocessors along with Intel and PGI compilers and performance tools (~40 coprocessors)**
- **Talon: Develop capabilities that require special configurations and software or dedicated applications and services (<500 cores)**
- **Lancer: Evaluate Virtual Shared Memory alternative to hardware shared memory systems (2500 cores)**



Intentions



- **Initiate, approve and manage new projects**
- **Publish Innovation Laboratory policy, process and results**
- **Innovation Laboratory systems, components, uses and capabilities will evolve as technologies emerge and user needs change**



Innovation Laboratory Impact



- **uBatchManager (MindModeling):** easy to use parameter space exploration and optimization to naturally parallel modeling and simulations
 - Planned for adoption into HPCMP Portal
- **INSIGHTS:** biologist friendly bioinformatics image processing, analytics, workflow management and reporting
- **Image Processing:** demonstrated “dense GPU” (16-GPUs/node) Image Processing for new HPC system design and acquisition
- **Advanced Framework for Simulation, Integration and Modeling (AFSIM) - Evaluation and Testing**



Large-scale Model Evaluation Process



Simulation Tracking

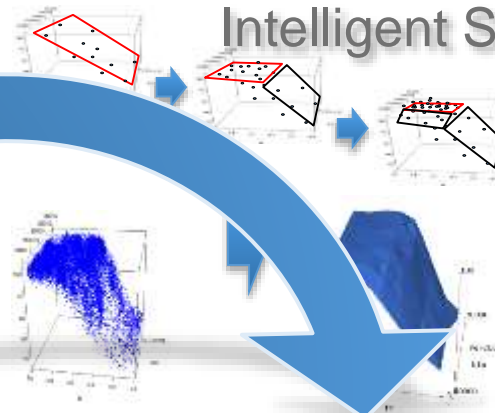
MindModeling

Job ID#: 1855
 Owner: Jack Harris
 Collaborators: Chris Myers (Remove), ... (Add Users)
 Status: Complete
 Actions: Action, Details, Refresh

Submitted: Fri, Feb 6 2015 8:14:01 EST
 Resource: none
 Usage: none
 Completion Date: Fri, Feb 6 2015 13:28:04 EST
 Date: Full Single: 11:30 days
 Core: none
 Runtime: 5 hours 14 minutes 53 seconds
 Actual Job Duration: none
 Job Speed: 32.0%

Up: Average: 25 seconds
 Model Runtime: none
 Completed: 100% (37,832 out of 37,832)

Intelligent Search



Utility



Thunder



Lightning



Condor



Garnet



Spirit



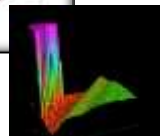
Talon



Anytime Visualizations and Data Analytics



CV series	formula	R ²
18A_1895E	444.118524512 * (tpc / utbytes) + 1272.75355804 * utbytes / tpc + 1405.51842284	0.998284165865
mindModelingParTime	164.167422679 * tpc + 237.26762919 * utbytes + 39.231168065 * utbytes * tpc + 199.953258443	0.119243300741
condorUserAgentJobStatus	294.817018125 * tpc + 194.510683408 * utbytes + 29.728831444 * utbytes * tpc + 212.514052370	0.85485387218813
condorUserAgentJobStatus	184.442113221 * tpc + 57.8944822934 * utbytes + 115.624932415 * utbytes * tpc + 31.8902218821	0.88112746304758
condorUserAgentJobStatus	294.817018125 * tpc + 194.510683408 * utbytes + 29.728831444 * utbytes * tpc + 212.514052370	0.85485387218813



Volunteer Resources



Large-scale Model Execution



Conclusion



Innovation Laboratory

- **Stimulates innovation applying HPC to new problems**
- **Energizes projects via partnership with Users and the DSRC developing and evaluating new capabilities**
- **Nurtures development of new applications and new service models to support new users and projects**



QUESTIONS?

