

HPC IS IN OUR DNA



REQUIREMENTS



ARCHITECTURE



DESIGN AND DEVELOP



OPERATE, OPTIMIZE AND SUSTAIN



INTEGRATE AND TEST

ENGILITY HIGH PERFORMANCE COMPUTING (HPC)

At Engility, HPC is in our DNA. Our legacy of HPC stretches back a quarter of a century, and our experience is woven into all of our solutions. We collaborate with scientists, technologists and decision makers across the federal government, industry and academia to apply complex science to real-world challenges—transforming ideas from the drawing board to mission success. Our computational scientists offer strategic insights and trusted advice to our customers at every stage of the technology lifecycle. We believe in mission-driven HPC—tailoring solutions that best serve the vital objectives of federal government clients addressing national priorities.



REQUIREMENTS: MISSION DRIVES INVESTMENT

Apply New Innovations

We channel leading edge insights from academia and industry while offering a neutral hardware viewpoint

- **NOAA** - In 2002, we helped deliver the 8th fastest supercomputer in the world to NOAA at fraction cost of any other Top-10 system
- **DoD** - Since 1996, we have continuously led the efforts to promote technology transfer by partnering with industry and academia (active relationships with over 60 universities and 20 industry partners)
- **Army** - In 2007, we established the advanced computing research program in support of the Army's HPC Research Center, partnering with universities and government labs like NASA Ames Research Center
- **Air Force** - In 1993, we reduced USAF weather model time by 75% with innovative supercomputing solution

Organized around 12 computational science areas

- Advanced Computational Environments
- Computational Chemistry, Biology, and Materials Science
- Computational Electromagnetics and Acoustics
- Computational Fluid Dynamics
- Computational Structural Mechanics
- Electronics, Networking and Systems/Command, Intelligence (C4I)
- Climate/Weather/Ocean Modeling and Simulation (M&S)
- Environmental Quality M&S
- Forces M&S
- Integrated Modeling and Test Environment
- Signal/Image Processing
- Space and Astrophysical Sciences

- **NOAA** - We develop tools to allow climate modelers to produce higher-efficacy results more quickly, training and advising on the use of a disparate group of supercomputers

We offer technical capabilities in scientific disciplines such as:

- Meteorology
- Oceanography
- Classical Physics
- Fluid Dynamics
- Applied Mathematics
- Numerical Analysis
- Code Optimization
- Workflow Design

Maximize Scientific and Engineering Outputs

Enable non-traditional HPC users to maximize resource use

- **DoD** - We train hundreds of DoD HPC users each year on advanced tools, technologies and productivity-enhancing methodologies
- **DoD** - We offer technical capabilities across the full spectrum of science disciplines, complementing existing laboratory and test centers' expertise with over 30 onsite doctoral-level computational specialists nationwide

- **FDA** - We support approximately 2,100 scientific computing workstations and thousands of associated users, enabling faster, better-informed regulatory decisions with increased emergency response capacity

In support of the scientific community at FDA,

- HPC Advanced Architecture and Operations
- HPC Support and Services
- Engineering/Technical Project Management
- System Engineering for Scientific Computing
- Computational Science/Bioinformatics Support
- Computing Security Services
- Advanced Text Analytics and Network Analysis
- Next Generation Sequencing and Metagenomic Data Analysis of Foodborne Pathogens

Secure Data

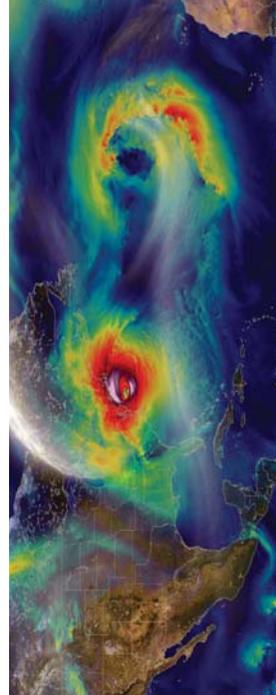
Apply cybersecurity insights from intelligence community (IC)

- **NOAA** - We deliver in-depth knowledge, support and direction for all IT security-related activities at Geophysics Fluid Dynamics Laboratory and the Research and Development HPC Program
- **Multiple Clients** - We have applied many IC insights to HPC clients, including evaluating security readiness and a vulnerability study for space and mission systems

- Engility's Blue Team Vulnerability Assessment Program (VAP) was selected by NASA to evaluate space and mission systems at a major ground station. Our Blue Team VAP provides a litmus test of a mission system's security posture and ability to operate in a contested environment. NASA's space and mission systems and operations are exposed to

Information and Communications Technology (ICT) security risks that they were not engineered to meet given the ever-changing threat environment. The ICT infrastructure ranges from new to more than 20 years old, making engineering and evaluation of systems a complex challenge. Engility fully and successfully evaluates systems with no disruption to operational mission elements. We've conducted vulnerability assessments for DoD, the IC, NASA and other customers.

- **DoD** - We developed a turnkey solution for varied users and security levels
- To facilitate the use of the HPCMP resources, the Portal to the Information Environment (PIE) was developed and implemented for the DoD HPCMP. PIE is a role-based, distributed application that allows authorized users to perform various HPC administrative functions based on the assigned role of the user. It provides DoD HPC users with seamless access to distributed relational account data, improves information sharing and gathering among the HPC associated sites, standardizes data exchange and reporting and integrates operational data into a common data repository.
- **FDA** - We protect the confidentiality, availability and integrity of HPC systems and data





ARCHITECTURE: WHERE AND HOW TO SPEND

Technology Refresh

Channel innovations from industry and academia

- **DoD** - We form integrated teams with Engility, partners and end users to address time critical capability requirements—transferring technology into DoD from other Government, industrial and academic communities
 - **DOE** - We participate in national HPC hackathons, delivering insights back to DoD and NOAA
 - **DoD** - We set up an HPC system to help investigate biological effects from directed energy in the visible and infrared portions of the electromagnetic spectrum
- At the Tri-Service Research Laboratory, Fort Sam Houston, TX, we support the Air Force Research Laboratory, Optical Radiation Bioeffects Branch. Our team

- Conducts all stages of the HPC systems lifecycle: planning, design, installation, configuration, documentation, system remediation, operations and maintenance, performance tuning, data protection, backup and recovery
- Administers the server and system
- Interfaces with vendors and service providers for analysis and troubleshooting
- Supports users with hardware, software and multimedia services
- Monitors HPC clusters, servers, storage arrays, high performance workstations and associated elements

Future Architecture Uncertainty

Maintain flexibility in your HPC architecture

- **All Clients** - We partner with National Science Foundation organizations on R&D and deliver observations to customers

Investment Tradeoffs

Understand multivariate problems and complexities of software/hardware tradeoffs

- **DoD** - We deploy computational scientists and SMEs that understand the hardware, the software and the application space, providing real-time, onsite consultative support to researchers driven by real-time requests for expert advice and assistance in developing and using HPC applications
- **NOAA** - We conducted systems optimization for the remote HPC platforms at the NOAA Environmental Security Computing Center, the National Climate-Computing Research Center at Oak Ridge National Lab, the Argonne Leadership Computing Facility in Argonne National Lab as well as the local post-processing and analysis cluster at GFDL
- **NOAA** - In 2004, we delivered first commodity-based 64-bit cluster

Infrastructure Decisions

Serve as trusted partner in site studies

- **NOAA** - We gathered technical requirements for future systems effort culminating in Gaea at Oak Ridge National Laboratory as well as Zeus and Theia at NOAA facilities
- At NOAA, we developed a tool that enabled decision makers to evaluate technical, financial and architectural components of the major technology refresh that resulted in the Gaea, Zeus and Theia systems. That tool allowed NOAA to make strategic investments in their technology that have resulted in an accelerated path to next-generation weather and climate modeling.



DESIGN AND DEVELOP: MISSION-FOCUSED IT

Analyze Big Data

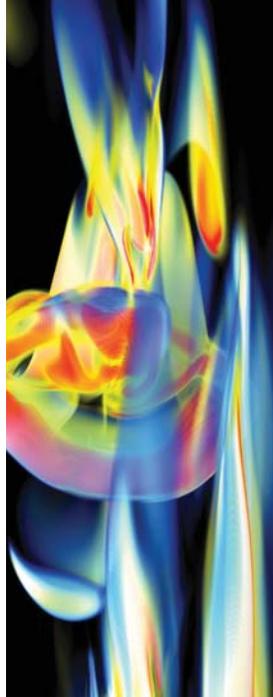
Drive granularity, complexity and resolution for mission objectives

- **DoD** - We benchmarked ARL Excalibur Cray supercomputer using two publicly available Graph 500 benchmark packages
- **DoD** - Our scientists develop new tools and methodologies for data analytics and visualization
- **FDA** - We manage requirements for integrating information platforms to automate the bioinformatics pipeline and customize the workflows in the genomic laboratory, enhancing national health and safety
- **NOAA** - We conduct post-processing analysis of petabytes of data to create high-resolution data visualizations

Code Optimization

Bring computational expertise to domain-generated codes

- **DoD** - Improving code that is widely used in the design and analysis of high-speed vehicles and aircraft
- **DoD** - We enhance software to transition into new architectures, including the next generation of pre-exascale systems
- **DoD** - Conducted 100K+ Core Challenge to enhance the parallelization of input/output
- **NOAA** - Support the development of next-generation prediction systems and the rewrite of existing code for next-generation computing architectures





INTEGRATE AND TEST: MAXIMIZE RETURN ON INVESTMENT

Move New Systems to Operational Status Quickly and Seamlessly

- **DoD** - Porting performance without need for multiple source codes
- **Air Force** - Simulate systems for operational use
 - The TRIGS team works with the USAF to model and evaluate guided weapons concepts and sensor systems. Using Hardware-in-the-Loop (HWIL), Software-in-the-Loop (SWIL) and Algorithm in the Loop (AIL) simulations, we help the client simulate entire scenes in which a weapon or network of distributed weapons might operate, including changing operational conditions that a system will encounter in the real world. For instance, wind and weather variables will change, and that volatility should be part of scenario simulations during an active test.

Maintain Quality, Speed and Precision for Next Generation Systems

- **DoD** - We analyze HPC solutions to verify solutions function as required, ensuring codes talk with machines

- **NOAA** - We develop quantifiable metrics that show contribution to mission
 - Engility maintains and enhances the GFDL-developed Flexible Modeling System (FMS) framework. As part of this framework, Engility administers the supercomputer nodes and develops software to manage the scheduling, submission and efficiency of jobs, making adjustments as needed to improve performance and alleviate problems. The team recently tested a new online tool that will be used to run diagnostic routines and monitor system performance to increase system usage efficiency. Engility is instrumental in helping the scientists at GFDL build and run these large computational models. The FMS, along with the FMS Runtime Environment, allows the scientists to more easily process and analyze the resulting large amounts of data.

Mission Assurance

- **Perform independent testing, independent verification and validation (IV&V) analyses and safety and mission assurance analysis of high-risk, mission- and safety-critical software and hardware**
 - **NASA** - We verify and validate critical software to ensure it will perform in adverse conditions using independent testing and analysis
 - **NASA** - We created a comprehensive vulnerability assessment and cybersecurity testing framework for spacecraft mission systems



OPERATE, OPTIMIZE AND SUSTAIN: MAKE THE MOST OF HPC INVESTMENT

Avoid Downtime and Run Errors

- **Apply predictive analytics to HPC and perform IO studies and create workflow tools**
 - **San Diego Super Computing Center** - We invested to sponsor a project to examine machine learning-based approach to identifying HPC jobs that conflict due to interacting I/O patterns; results feedback to the scheduler to avoid such conflicts in future jobs scheduling
 - **Virginia Tech** - We invested in a VT-sponsored project to identify precursors to fault states in HPC system operation, enabling predictive fault analytics and reducing expensive HPC system downtime
 - **DoD** - We provide customer support, systems administration, computer operations and management, applications development and support and data visualization services for four of the DoD HPCMP's DoD Supercomputing Resource Centers

Code Optimization

Support codes and users for optimization

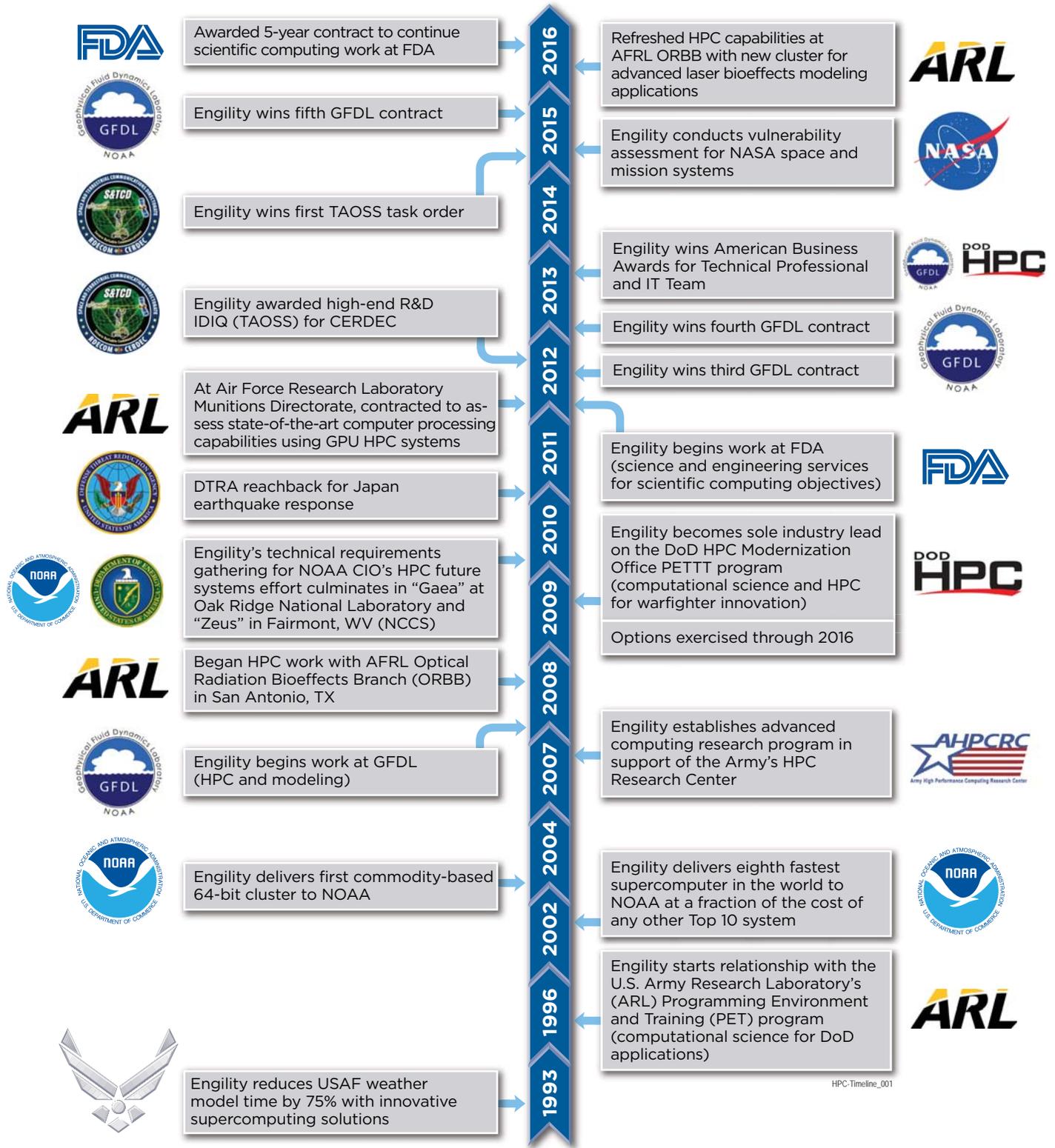
- **DoD** - We deliver expertise in physics-based code modernization, porting, benchmarking, optimizing and parallelizing computational applications. We improve HPC hardware operational performance via benchmarking tests

Future HPC Workforce Development

- **Develop and attract next generation of HPC experts**
 - **DoD and NOAA** - We invest in development of young talent
 - Every year, Engility seeks out young talent in the HPC and IT fields and engages them on summer internships with direct mission impact. In 2016, Engility invested in an intern at Virginia Tech to fund research into data analytics research that was featured as an adjudicated poster at Supercomputing Conference 2016.



HPC Timeline



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