

An Introduction to Leadership Computing Facilities and OLCF

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ORNL is managed by UT-Battelle LLC for the US Department of Energy



U.S. DEPARTMENT OF
ENERGY

Oak Ridge Leadership Computing Facility (OLCF)

Mission: Deploy and operate the computational and data resources required to tackle global challenges

- Providing the resources to investigate otherwise inaccessible systems at every scale: from galaxy formation to supernovae to earth systems to automobiles to nanomaterials
- With our partners, deliver transforming discoveries in materials, biology, climate, energy technologies, and basic science



Leadership Computing Facilities

Department of Energy High-End Computing Revitalization Act of 2004 (Public Law 108-423):

The Secretary of Energy, acting through the Office of Science, shall

- Establish and operate Leadership Systems Facilities
- Provide access [to Leadership Systems Facilities] on a competitive, merit-reviewed basis to researchers in U.S. industry, institutions of higher education, national laboratories and other Federal agencies.

118 STAT. 2400

PUBLIC LAW 108-423—NOV. 30, 2004

Public Law 108-423
108th Congress

An Act

Nov. 30, 2004
[H.R. 4516]

To require the Secretary of Energy to carry out a program of research and development to advance high-end computing.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Department of
Energy High-End
Computing
Revitalization
Act of 2004.
15 USC 5501
note.
15 USC 5541.

SECTION 1. SHORT TITLE.
This Act may be cited as the “Department of Energy High-End Computing Revitalization Act of 2004”.

SEC. 2. DEFINITIONS.

In this Act:

(1) CENTER.—The term “Center” means a High-End Software Development Center established under section 3(d).

(2) HIGH-END COMPUTING SYSTEM.—The term “high-end computing system” means a computing system with performance that substantially exceeds that of systems that are commonly available for advanced scientific and engineering applications.

(3) LEADERSHIP SYSTEM.—The term “Leadership System” means a high-end computing system that is among the most advanced in the world in terms of performance in solving scientific and engineering problems.

(4) INSTITUTION OF HIGHER EDUCATION.—The term “institution of higher education” has the meaning given the term in section 101(a) of the Higher Education Act of 1965 (20 U.S.C. 1001(a)).

(5) SECRETARY.—The term “Secretary” means the Secretary of Energy, acting through the Director of the Office of Science of the Department of Energy.

15 USC 5542.

SEC. 3. DEPARTMENT OF ENERGY HIGH-END COMPUTING RESEARCH AND DEVELOPMENT PROGRAM.

(a) IN GENERAL.—The Secretary shall—
(1) carry out a program of research and development (including development of software and hardware) to advance high-end computing systems; and
(2) develop and deploy high-end computing systems for advanced scientific and engineering applications.

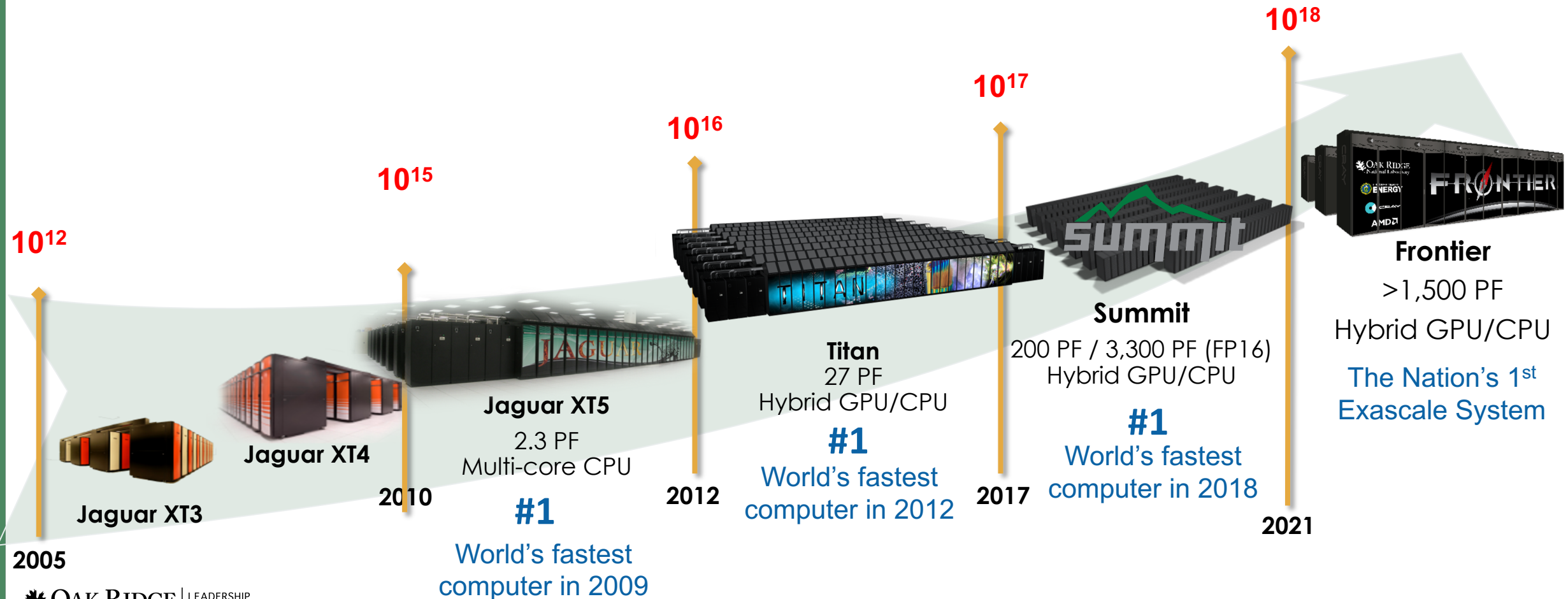
(b) PROGRAM.—The program shall—
(1) support both individual investigators and multidisciplinary teams of investigators;
(2) conduct research in multiple architectures, which may include vector, reconfigurable logic, streaming, processor-in-memory, and multithreading architectures;

What is the Leadership Computing Facility (LCF)?

- Collaborative DOE Office of Science user-facility program at ORNL and ANL
- Mission: Provide the computational and data resources required to solve the most challenging problems.
- 2 centers/2 architectures to address diverse and growing computational needs of the scientific community
- Highly competitive user allocation programs (INCITE, ALCC).
- Projects receive 10x to 100x more resources than at other generally available centers.
- LCF centers partner with users to enable science and engineering breakthroughs (Liaisons, Catalysts).



ORNL has had a Top 10 supercomputer in every year since the Leadership Computing Facility was founded in 2005. Jaguar, Titan, and Summit are the only DOE/SC systems to be ranked #1 on the TOP500 list of fastest computers.



ORNL Summit System Overview

System Performance

- Peak of 200 Petaflops (FP_{64}) for modeling and simulation
- Peak of 3.3 ExaOps (FP_{16}) for data analytics and artificial intelligence

The system includes

- 4,608 nodes
- Dual-rail Mellanox EDR InfiniBand network
- 250 PB IBM file system transferring data at 2.5 TB/s

Each node has

- 2 IBM POWER9 processors
- 6 NVIDIA Tesla V100 GPUs
- 608 GB of fast memory (96 GB HBM2 + 512 GB DDR4)
- 1.6 TB of NV memory



In 2021, Frontier will become the nation's first exascale computer



FRONTIER	
Peak Performance	>1.5 EF
Node	1 HPC and AI-optimized AMD EPYC CPU + 4 purpose-built AMD Radeon Instinct GPU
Memory	Approximately 10 PB of combined high bandwidth and DDR memory
On-node Interconnect	AMD Infinity Fabric Coherent memory across the node
System Interconnect	Cray four-port Slingshot network 100 GB/s
Topology	Dragonfly
Storage	2-4x performance and capacity of Summit's I/O subsystem.
Node-local NVMe	Yes



Questions?