State of NASA High End Computing Capability Project and its Support of Heliophysics

December 1, 2017

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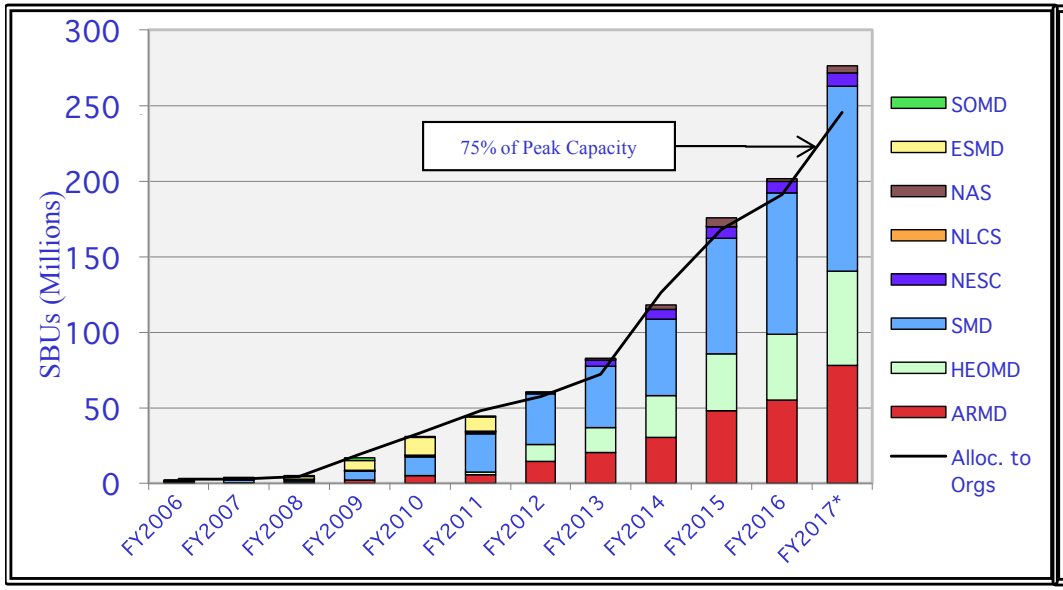
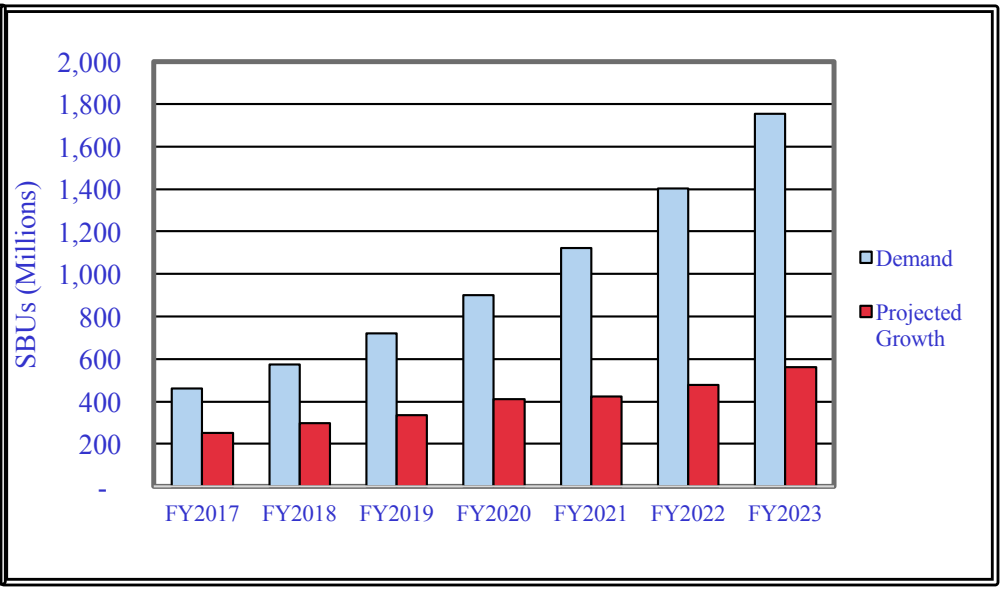
Past Utilization and Projected Yearly Demand and Growth





- The year-to-year growth of HECC utilization is 70% since 2006. The utilization is constrained by funding.
- Each year demand far exceeds capacity.
- Standard Billing Units represent work completed normalized over different architectures.

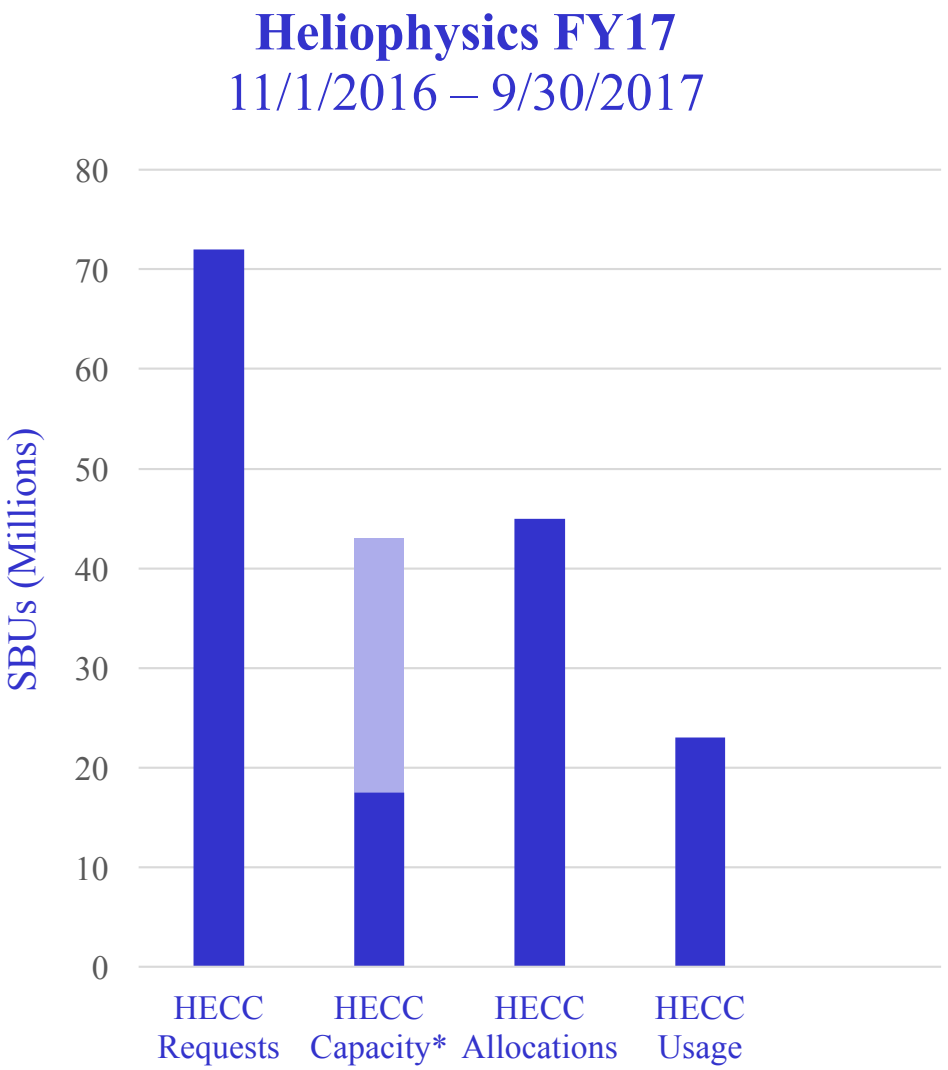
- Demand is based on request for compute resources in FY17 with 25% year-to-year growth.
- Demand in FY17 is over twice the available capacity.
- The demand will not be met with this expansion project. However, the facility expansion will allow augmentation in computing capability.

Facing the HEC Resource Challenge

Current HEC Resource Allocation and Access Challenge

- Demand for HEC resources has increased significantly in the past couple of years in all disciplines.
- Compute capacity has not kept up with demand.
- As a result, there is an oversubscription of resources.
- Time critical engineering and data processing projects have caused further delays to research projects.
- As a reference, 1 SBU* = $0.26 for FY17

*A Standard Billing Unit (SBU) is a common unit of measurement employed by the HEC program for allocating and tracking computing usage across its various architectures. SBUs charged = number of Minimum Allocatable Units x number of wall clock hours x SBU Conversion Factor.



*Includes an additional 26M SBUs to the baseline capacity (17.5M) to account for significant demand.

Mitigation Strategy

- Build HECC facility to allow future expansion.
- Tie HEC resource needs to the budget planning process.
  - Allocate **planned** HEC resource during the proposal evaluation and award process (consider all the resource needs).
- Advocate for more HEC investment at SMD level.
- When needed, SMD science Divisions has the flexibility to buy more resources (Caveat: this is assuming facility is already available).
- Document the needs through various reports.
  - Subcommittee recommendations
  - NRC studies
  - Decadal surveys

Modular Supercomputing Facility (MSF) Expansion: Electra

20 SGI Racks (4.78 PF; 369 TB; 11,981 SBUs/hr)

- 16 racks of ICE-X with Intel Xeon processor E5-2680v4 (Broadwell): 1.24 PF; 147 TB; 4,654 SBUs/hr
- 4 E-Cells of ICE-XA with Intel Xeon Gold processor 6148 (Skylake): 3.54 PF; 221 TB; 7,327 SBUs/hr

Nodes

- 2,304 nodes (dual-socket blades)

Cores

- 2,304 Intel Xeon processors (32,256 cores)
- 2,304 Intel Xeon Skylake processors (46,080 cores)

The first Electra module with Broadwell processors was augmented with a second module containing the latest generation of Intel Xeon Gold 6148 Skylake processors.

Networks

- Internode: Dual-plane partially-populated 9D hypercube (FDR/EDR) EDR portion is enhanced
- Gigabit Ethernet Management Network
- Metro-X IB extenders for shared storage access

NAS Facility Expansion

- NASA approved the NAS Facility Expansion plan for FY18 – FY22 budget cycle
- Procurement ongoing for the site preparation and the concrete pad
- Pro: the modular facility approach allows maximum flexibility for future expansion
- Con: in the near term, resource is diverted into construction
  - As a result, FY18 would be a year with near zero expansion in computing capacity

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Tie HEC Resource Needs to the Budget Planning Process

A bottom-up requirements gathering, top-down allocation model will now be employed to instill planning discipline and ensure continued delivery of HEC resources.

Governing Principles:

1. HEC resources will be treated as a limited resource. Proper planning is needed for managing the resource.
2. HEC requires significant budgetary investment. SMD will plan for HEC resources similar to and in coordination with the Planning, Programming, Budgeting, and Execution (PPBE) process.
3. HEC resource demands will be gathered and adjudicated during the PPBE process. Once approved and funded, they become a requirement for implementation by the HEC program.

Resource Allocation:

– Allocate **planned** HEC resource during the proposal evaluation and award process

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Questions?