

Minutes of the Hyak Governance Board Meeting

Physics/Astronomy Tower, Rm. C610, on Wednesday, June 29 (2016) 11.30 am

Present: Ackerman, Alonso, DiMaio, Greer, Lestrangle, Lundberg, Miller, Reschke, Savage, Stiber

Absent: Eastin, Trosvig

[11.30-11.45]: **News**

1) Chemistry MRI: Status (Jim Pfaendtner)

The MRI proposal from the UW for compute hardware, including KNL nodes, will be (has been) funded at the level of \$580K with this to be split \$410K (nodes) and \$170K (infrastructure). The plan is to acquire both conventional and KNL nodes.

2) UW-IT Organization Changes (Brad Greer)

Brad Greer provided an overview of the re-organization of UW-IT that has happened recently. One of the changes is that **Research Computing** has been promoted in the *Org Chart*, which is to be interpreted as **good** in order to address the needed increase research funding for research computing. An aspect of this is that *Cloud* and *HPCDE* computing have been combined under one umbrella.

Tom Ackerman asked how we (the many of the UW researchers, students and faculty with HPCDE needs) were going to have a larger voice in UW's higher administration (the lack of which has been identified as a root cause of the demise of Scientific Computing at the UW decades ago). Erik assured us that such things were getting better in this regard.

Chance segued into document he and I are writing, entitled ***Recommendation to the University of Washington Regarding Workforce Support of its High-Performance Computing and Data Ecosystem***. This documents contains the HGB recommendation that ***that the University of Washington enhance its HPC-proficient workforce supporting the Hyak HPCDE and associated activities by at least two FTEs***. See attached. Only a draft of the document existed at the time of this meeting. [**Update:** It was completed within two days of the meeting and circulated]

3) Data Center Cooling event(s) (Chance Reschke)

Within the last week, there was a cooling event at Data Center housing the Hyak HPCDE. The monitoring and control systems were all functional and prevented damage to the system, but did require a system shutdown. The problem was

identified as a stuck valve in the water-cooling system. We all agreed that the even was well handled and no damage or long-term implications resulted.

4) Update on National Exascale Efforts (Martin Savage)

Martin Savage gave a short overview of the status of the nations Exascale Computing initiative, resulting from the Executive Order creating the National Strategic Computing Initiative (NSCI).

5) Globus Online funded by UW-IT (Chance Reschke)

Chance Reschke detailed the UW involvement with and plans to utilize Globus-Online: <https://www.globus.org>. It is a research data management tool that is used to move large amounts of data from site-to-site. We have found it to be far superior to simple **scp** usage. He explained that it requires a one-time investment to get into Globus-Online, and that UW will become a node on this network. He suggests that the UW-IT monitor data transfer rates in order for us (HGB and UW) to understand how to go forward.

6) NextGen Project progress (Omnipath, Storage, Delivery, Deployment)(Chance Reschke)

Chance Reschke provided a detailed update on the status of the Hyak NextGen project.

1) Intel changed switch design – the switches that are available to us connect 768 nodes and not >1K nodes. This changes the design of Hyak into a split system and, like Hyak Phase-1, users will not be able to run jobs across islands, but their nodes will not be not split across 2 islands in order to avoid this feature. There is no indication that this will impact users obtained research performance. This design changed was adopted by HGB.

2) There was extensive discussion on the nature of the MOU, the size of the dollar request, and who is going to make the decisions about asking for the funds. Chance agreed to draft an MOU for the HGB to consider.

3) A matter related to item 2) was a discussion about how to collaborate with UW-IT to go to higher administration and ask for support, not only increased support, but ANY support. It was noted that the UW administration has systematically eliminated its support for HPCDE at the UW, leaving the researchers and UW-IT to pay for the entire system.

7) Facebook page for Hyak (Chance Reschke).

Chance Reschke announced that there will be a Facebook page related to the Hyak HPCDE.

[11.45-12.20]: **Hyak NextGen** (Chance Reschke)

1) Budget and MOU Discussion

There was an extensive discussion regarding the financing of the Hyak HPCDE, particularly in light of the zero funding from the UW administration. We heard in detail about the excessive workload on the shoulders of Stephen Fralich alone – the sole person with the HPCDE training and skill-set to handle the day-to-day Hyak-related issues. There is concern, based upon feedback from Human Resources, that we are in danger of losing him unless his workload and expectations are reduced. His departure would represent a single point of failure for the Hyak NextGen project, delaying deployment until a suitable replacement could be hired. The HGB reiterated the obvious fact that a single FTE supporting the Hyak HPCDE is insufficient. The recommendation requesting increased FTE support for the project will be forth coming, and is attached to these minutes. [after this meeting, further discussion has revealed that Stephen is being heavily recruited by other HPCDE efforts in industry and academia, with compensation well in excess of what UW currently provides him.]

In the absence of support for Scientific Computing from the UW administration, the HGB found it has little choice but to endorse the increase of fees requested from the units and faculty in order to finance the additional FTE's that the HGB recommends are required to fully support the Hyak HPCDE. Ideally, this would not be the case, but without increased institutional support, no alternative was identified.

As part of the financial discussions, the number that we need to keep in our minds is \$1.6M to support Hyak, and this will require a 50% increase in costs to sponsors in order to support the increased number of FTEs.

The HGB expressed support for the evolution of the HGB, and more generally the Hyak community, and UW-IT toward a partnership with common objectives and plans. The HGB values this partnership and expressed a desire for this partnership to become even stronger.

2) Discussion of College of the Environment's funding proposal

We had a discussion of different funding/support models around campus. These discussions focused on Advanced User Support only. [It remains the case that funding for core systems management/engineering staff needs to be provided by ongoing central funding.]

The College of the Environment will reduce the funds it sends to UW-IT in support of Hyak (based upon current usage data), BUT fund 0.5 FTE to support its researchers use of Hyak and HPCDE. That is to say that it will maintain its present funding level, but add ½ FTE.

Greg Miller indicated that engineering do something similar. They have identified possible problems associated with this mechanism, but have not found them to be a serious impediment. This is a sentiment to centralize the associated support people so that they can effectively communicate and brain storm with each other. This is found to work well.

It was noted that there maybe a perception among departmental support staff that Hyak is a threat to their position. One possibility to mitigate this perception is to reassign 50% of their time to support Hyak.

The HGB gave itself homework. Each member is to determine how to optimize their own department's investment in the Hyak HPCDE.

Tim Ackerman said that he runs large institute and needs HPCDE trained people to help bring others up to speed to become effective users.

Jim Pfaendtner suggested that it might be possible to obtain concessions for trained graduate students to provide support to others. The HGB thought that this idea should be pursued and could be made to work, as it would be a helpful vehicle for education in parallel computing.

[12.20-12.30]: **Other** (Chance Reschke)

- 1) Research Computing Governance, HGB structure and bylaws
- 2) Expansion of Hyak beyond present boundaries - outreach

We did not get time to discuss these items during this meeting.

Attachment:

Recommendation to the University of Washington Regarding Workforce Support of its High-Performance Computing and Data Ecosystem

Draft by **Hyak Governance Board**, June 2016.

[<http://www.int.washington.edu/users/mjs5/HYAK/governance/index.html>]



Preamble

High-Performance Computing and Data Ecosystems (HPCDEs) are essential to scientific discovery and to advancing many fields of science, engineering, and medicine. They are key to furthering the social sciences, are critical to an increasing number of industrial sectors and other commercial activities, as well as many other areas that have significant impact upon society. A HPCDE provides the necessary infrastructure to: (a) share expertise and experience in high-performance computing and data, scientific computing, and its application across a broad range of disciplines that are critical to the state of Washington and the nation; (b) educate the next generation of leaders who will continue to address the most challenging scientific, engineering and societal problems; and (c) enhance UW's leadership in research and education by providing faculty, students, researchers and staff with access to, and the capability to use, the HPCDE resources that they require.

The United States is poised to deploy a generation of pre-Exascale leadership-class computers, which are on the critical path to Exascale Ecosystems. These are expected to be heterogeneous-architected supercomputers embedded in low-latency/high data rate communication fabrics with peak performances in the multi-exaflops range that are capable of producing, storing and curating exabytes of data with a range of storage options and networks sufficient to generate, analyze and

store the data, and with real-time capabilities to interface with users. Such systems are essential to meeting the objectives of a wide range of the domain sciences, engineering applications, medicine and information sciences. The optimal use of these compute resources will require close collaboration between domain scientists, applied mathematicians and computer scientists. Given the complexity and cost of such resources, novice users will learn the necessary tools from running single-core serial applications on “workstations”, to multi-core parallel applications on small CPU clusters, to larger-scale parallel applications on architecture similar to the leadership computing platforms, before ultimately migrating into the exascale ecosystem (the “HPC user escalator”). The Hyak phase-1 ecosystem has proven to be a successful resource in this education path (P2E, or “Path to Exascale”), enabling students with a limited knowledge of scientific computing to quickly develop the skills necessary to undertake meaningful, productive use of some of the nation’s largest supercomputers.

Equally important to the education path of young scholars, is the evolution of codes to optimize scientific productivity. During the last decade, homogeneous compute platforms, comprised of CPUs evolved toward heterogeneous systems with their benchmarked performances dominated by accelerators. Existing application codes did not run or ran poorly on such systems, and a significant effort has been required to translate or reinvent code in a way to exploit the heterogeneity. This trend will continue and increase going forward. At the UW, we have seen a significant growth in the demands on the HPC trained workforce in UW-IT due to this evolution, and this growth is expected to accelerate during time frame of Hyak NextGen and beyond.

Data – storage, movement, production, and analysis, are significant foci in current national supercomputing efforts, and have a defining role in the emerging Exascale ecosystems, requiring new algorithms, code structures, concepts regarding workflows and most other aspects of computing. As a result, the need for increased institutional support to provide the workforce infrastructure that enables UW researchers to remain at the forefront of scientific computing and information technology is now extreme. Further, the workforce need is similarly extreme to support the UW administration, non-scientists, business intelligence. For example, there is a growing need for real-time rapid access to, and manipulation of, large-scale databases across nearly every aspect of contemporary university operations.

We are not alone in identifying this present and future need. Michigan State University has recently created the *Department of Computational Mathematics, Science and Engineering* (CMSE) to lead research and educate the next generation of scholars in data science, computational modeling and high performance computing. CMSE has been created to enhance MSU research across a number of frontiers, and provide a talent stream with applied computation expertise to industry. This forward-looking strategic move by MSU will position them well for the future of higher education and cutting-edge research.

The UW's High Performance Computing and Data Ecosystem

The Hyak High Performance Computing and Data Ecosystem has been in full production since July 1, 2010 — about six years. In that time the Hyak user community has grown by more than ten-fold (10x), increasing in diversity at an even greater rate. User outreach and support demands continue to grow with the expanding diversity among user needs. This increase in demand has resulted in a growth in system size and complexity, requiring increased systems engineering and support efforts. In short, Hyak has matured. It is no longer a startup system, and, as a going concern, staffing levels should increase to effectively support this growing resource.

Hyak has grown from fewer than four hundred compute nodes, with fewer than 3,000 CPU cores, to approximately 900 compute nodes with approximately 11,000 cores today, while system performance has increased by more than 20x. With the addition of NextGen Hyak in late 2016, total system size will grow to more than 14,000 CPU cores. At that time, the UW will have entered an era in which Hyak HPCDE staff will operate a minimum of two different compute clusters, each with a different design (as the ecosystem evolves into the natural cycle of “standing up” the next generation of system as the previous one runs out its last few years). Sustaining this evolution requires skilled, and difficult to find (and hire), HPCDE engineers.

In the last six years, Hyak's user community has grown from approximately 20 unique users per month at the outset to hundreds of unique users per month today. And the diversity of users has increased immensely, from just a few natural science domains initially, to the situation today where Hyak supports research in dozens of academic units across the university. More so than the absolute increase in numbers, it is this diversity which presents the greatest outreach and support challenge. The Hyak governance board (HGB) and UW-IT have embraced the “HPC User Escalator” concept in principle, but to be effective, substantial increases in advanced user support staffing are necessary.

The 2013 CASC report on staffing levels at academic HPC centers** is helpful in understanding the situation we have in the context of national HPCDEs. The Hyak HPCDE is an outlier in terms of being understaffed. That report breaks down results by the size of each center, measured in the number of CPU cores. Phase-1 Hyak sits at the boundary between small and medium sized centers. The report's basic measure of relative staffing is **Compute Cores/FTE**, and by that measure, Hyak has **FIVE** times less staff (i.e. 1/5 of the staffing level) than the median of other small centers and at **LESS THAN HALF** the median for medium-sized centers. In terms of advanced user support — the critical limiter in realizing the goals of the HPC User Escalator — the situation is even more challenging. The median staffing levels in this area for small and medium-sized centers, respectively, is 2.0 FTEs and 4.0 FTEs, while at UW, staffing is at the level of 0.5 FTE.

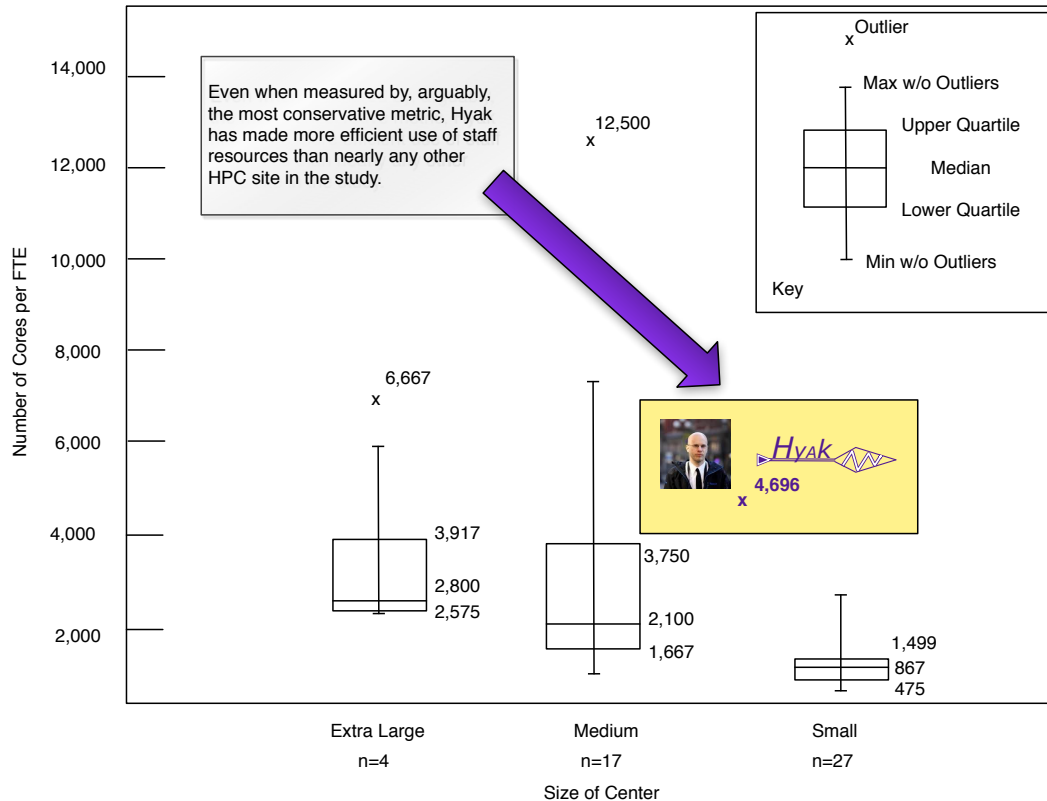


Figure 1: Conventional compute cores supported by each FTE at HPCDEs within the US.

Even in the absence of evidence from other HPC centers, it can be concluded that the present situation of operating the Hyak HPCDE with a single systems administrator is sub-optimal. It exposes the Hyak enterprise to an unacceptable level of risk of service interruption when the administrator is unavailable (vacation, sick leave, etc.), and increases the work stress of that person (increasing the risk of departure of that person). The Hyak Governance Board believes that a minimum of two senior systems managers is required for the operation of such an enterprise.

Recommendation

To realize the full potential of UW researchers and to effectively educate the next generation of scientific leaders in the state of Washington, we require new investments in the Hyak High-Performance Computing and Data ecosystem. These investments are crucial to the UW recruiting and retaining world-class faculty, students and researchers, and are necessary to satisfy the clearly demonstrated increasing demand for the HPCDE established with Phase-1 Hyak.

In light of the increasing number and diversity of users of the Hyak HPCDE and the established "long tail" distribution of usage requirements, along with the increase in the size and complexity of the system anticipated with Hyak NextGen, we recommend

that the University of Washington enhance its HPC-proficient workforce supporting the Hyak HPCDE and associated activities by at least two FTEs.

****http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2313089**