Filling the Void: The Case for Local Digital Research Infrastructure (DRI)

Roman Baranowski, Ryan Thomson, Venkat Mahadevan, Wade Klaver

UBC Advanced Research Computing

Overview

- The Canadian Digital Research Infrastructure (DRI) landscape has evolved rapidly over the past 10 years.

- There is increasing recognition that DRI is vital to keeping Canadian research institutions competitive on the global stage.

- Major growth in DRI usage across all disciplines (including humanities & social sciences, natural sciences, and engineering).

BCNET 2019

Overview

- Data sizes and computational requirements continue to grow.

- Increase in demand for High Performance Computing (HPC), large scale data storage, and on-demand computing, including Cloud computing.
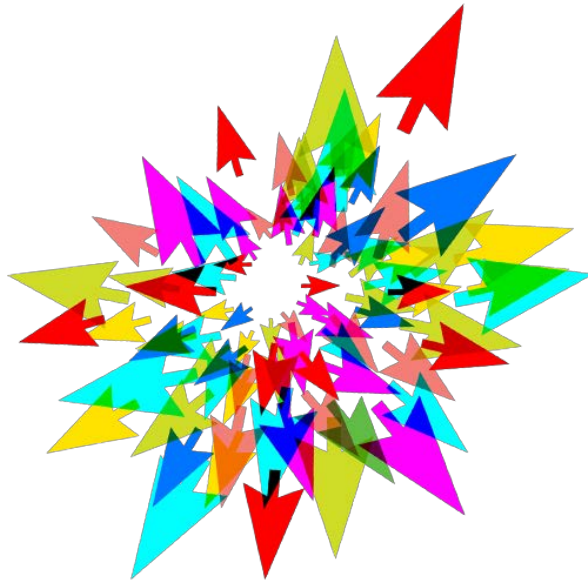
Overview

- Investments in DRI have traditionally come from a variety of funding sources including national agencies, provincial, and institutional funds.

- The Canadian Foundation for Innovation (CFI) provides significant funding for large scale DRI.

- Push to centralize CFI funded DRI at national sites under the Compute Canada umbrella.

Centralization

Compute Canada, in partnership with regional organizations ACENET, Calcul Québec, Compute Ontario and WestGrid, leads the acceleration of research and innovation by deploying state-of-the-art advanced research computing (ARC) systems, storage and software solutions.

https://www.computecanada.ca/about/

BCNET 2019

National Sites

- University of Victoria (BC): Arbutus Cloud
- Simon Fraser University (BC): Cedar HPC
- University of Waterloo (Ontario): Graham HPC
- University of Toronto (Ontario): Niagara HPC
- École de Technologie Supérieure (Quebec): Béluga HPC
- Sick Kids Hospital (Ontario): HPC4Health

Benefits of Centralization

- Aggregate computing power at national sites with trained support staff.

- Reduce costs (e.g. data centre space, volume purchasing, staffing).

- Improve utilization and platform consistency.

Benefits of Centralization

"In theory there is no difference between theory and practice; in practice there is."

— *Quote overheard at a Computer Science conference*

BCNET 2019

Things Fall Apart

There Simply Isn't Enough

Problems Meeting Demand

- https://www.computecanada.ca/research-portal/accessing-resources/resource-allocation-competitions/rac-2019-results/

- For 2019, Compute Canada was able to meet 40.3% of the demand for CPU core years.

- Only 20.3% of GPU requests were able to be fulfilled for 2019.

BCNET 2019

Problems Meeting Demand

- Some researchers who received reasonable allocations in previous years, received very low allocations for 2019.

- Young researchers often find it difficult to get their research off the ground due to lack of resources.

- Research is in jeopardy!

BCNET 2019

General Purpose HPC

- 3 national sites run General Purpose (GP) HPC systems.

- There are challenges running different types of workloads on GP systems.

- Traditional HPC workloads e.g. Physics generally run without issue.

BCNET 2019

General Purpose HPC

- Other kinds of workloads, notably Bioinformatics, which can read/write to many small files, can bring parallel filesystems to their knees.

- One size fits all approach is hard to manage and unpredictable.

- Highly complex scheduling policies (by core vs by node): very hard to debug.

CFI Funding Conditions

- CFI is imposing conditions on grants that mandate DRI infrastructure usually be contributed and integrated with national systems.

- In practice, this has proven to be an extremely time consuming and costly process for both national host sites and contributing institutions.

- Integrated systems represent a one-size-fits-all model that may not be suitable for all researchers.

BCNET 2019

CFI Funding Conditions

- Case A: PI with a CFI grant with conditions at University A wanted to buy server hardware; told to integrate with national system at University B.

- From date of funding availability to computing on contributed hardware was in excess of 1 year.

BCNET 2019

CFI Funding Conditions

- Case B: PI wants to apply for computing resources. Should they request everything in hardware form or use Compute Canada resources (which have no guarantee) or a combination of both?

- The CFI provides funding for Compute Canada.

- Let not thy left hand know what thy right hand doeth.

BCNET 2019

Data Privacy and Security

- Many kinds of research data, i.e. health or indigenous data, have governance requirements enforcing strict privacy, security and curation controls.

- Such data typically cannot be stored on national systems and are often mandated to be held at the institution performing the research.

- Various other jurisdictional laws and data sharing agreements can apply.

Institutional Impacts

- Virtually all research fields have become digital in some respect.

- Top researchers will go where they can access the resources they need. Worse, they will go elsewhere if they cannot.

- Globally leading institutions are making significant investments in local DRI

Present Day, Present Time

- Institutions and funding agencies must be under no illusion that centralized resources can fulfill the needs of the community.

- Institutional investments in local DRI must be increased to maintain relevance on the global stage.

- Investments are needed for the training of support staff and the formation of Advanced Research Computing teams.

Present Day, Present Time

- UBC is in the process of deploying HPC and large-scale storage systems on-premises.

- Priority focus on new Faculty and researchers for whom the national platform is not suitable.

- Serve as a gateway to national systems.

Turning the Tide

- UBC Advanced Research Computing (ARC) team is expanding to meet the needs of researchers.

- UBC continues to make investments to retain its status as a leading research institution.