

Every Supercomputer is a Record of Decisions

Navigating New Tensions in HPC and AI



Cristin Merritt
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Hello!

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Alces Flight:

Long-term, Sustainable Development

Three Points of Focus:

- Open source and shared methodology
- Client advocacy and best practices
- Education and workforce development



made possible by:



How will the future see us?

We are transitioning to a period in which our field will be defined beyond just hardware performance.

Opportunities are everywhere. Now is the time to take action.





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Understanding Supercomputing Civilization

Abstraction Wave: 2016 - 2026

Royal Society of Ancient Fortran | June 16, 2226

The Abstraction Wave

Value, Effort and Structure

Pre-Ridiculous Computing Civilisation

- Value of Physical Assets held high weight
- Foundational Research Efforts were central
- Period of opportunity and introspection



Supercomputers are more than technology.

They are also comprised of policies, workflows, capabilities and “features*.”

*Fortran.

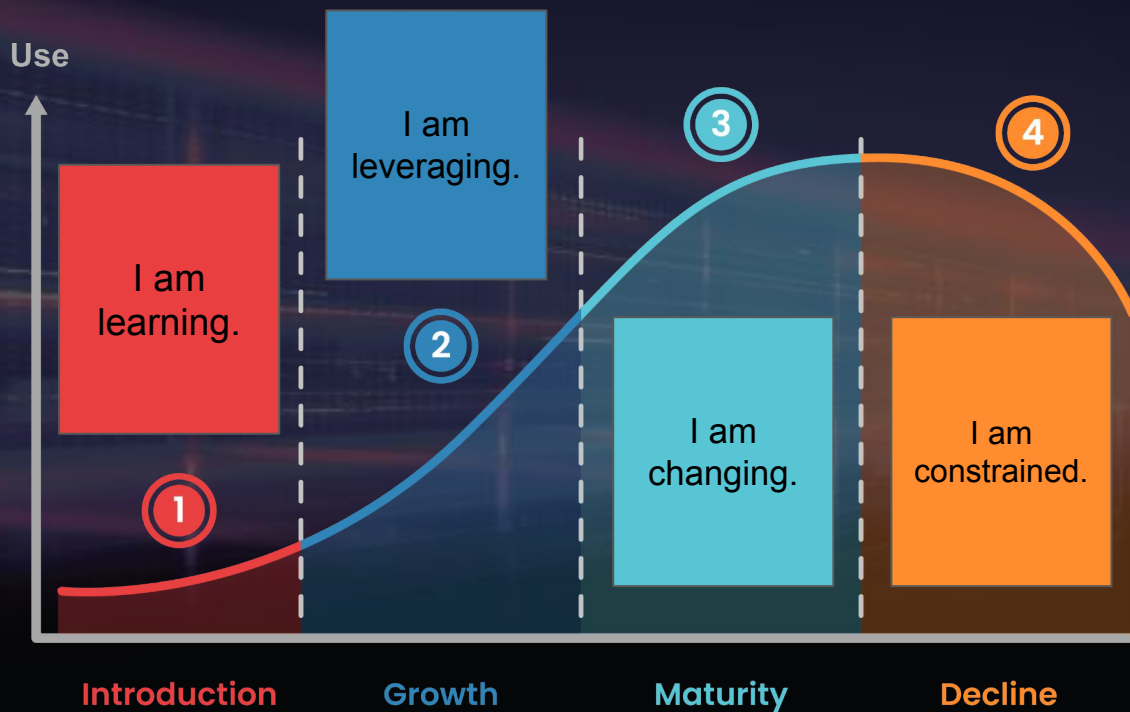


DEFINING FEATURE OF THE ABSTRACTION WAVE

Fundamental change in how our society aligned with the use of hardware.



Pre-2016: Realignment Response = Replace

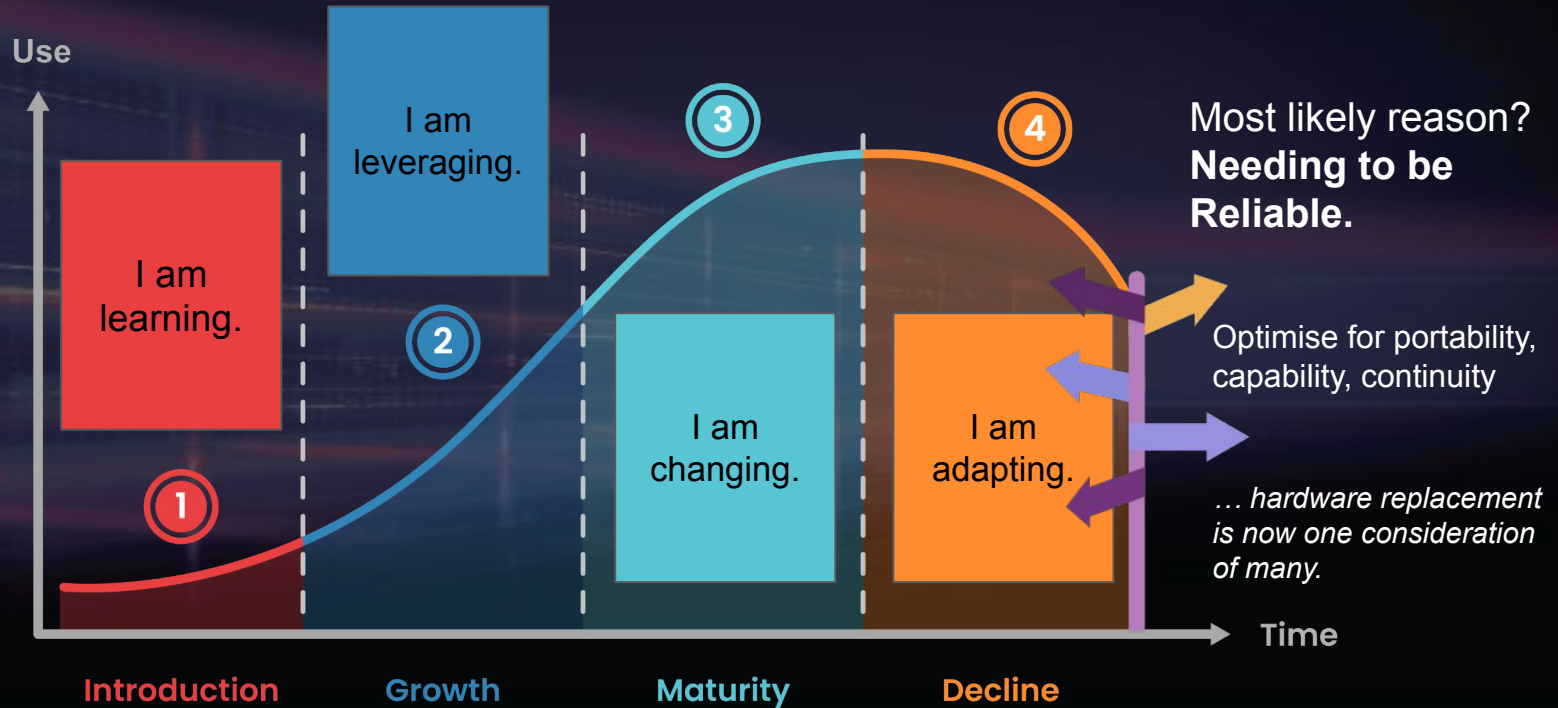


Most likely reason?
Performance decline.

New hardware installed.



2016 - 2026: Realignment Response = Adapt



2016 - 2026: What changed?

Cloud Viability

Non-Native User Influx

New Requirements (AI)

Financial/Budgetary

Physical Capacity

Security (Policy/Ethics)



2016 - 2026: What changed?

Orchestrated for efficiency and fairness.

Users

Applications

Hardware
(+ Performance)



Orchestrated for trust and interaction.

User Environment

Governance Abstraction

Software Abstraction

Hardware
(+ Performance)

2016 - 2026: What changed?

PERFORMANCE EXPANSION

The performance of your service matters just as much as the performance of your hardware.



Alignment Through Abstraction: Two Key Examples



Containerisation: Agility + Portability

The goal of containers is to focus on adapting and negotiating inside of the boundaries the current hardware presents.



Containerisation: Agility + Portability

PROS:

- ★ Portability + Continuity Focused
- ★ Not dependent on environment consistency
- ★ Integrity: software and security validation
- ★ Simplifies collaboration

HPC Wave Impact: runtime injections (on demand and interactive), host MPI, GPU passthrough, scheduler integrations



Containerisation: Agility + Portability

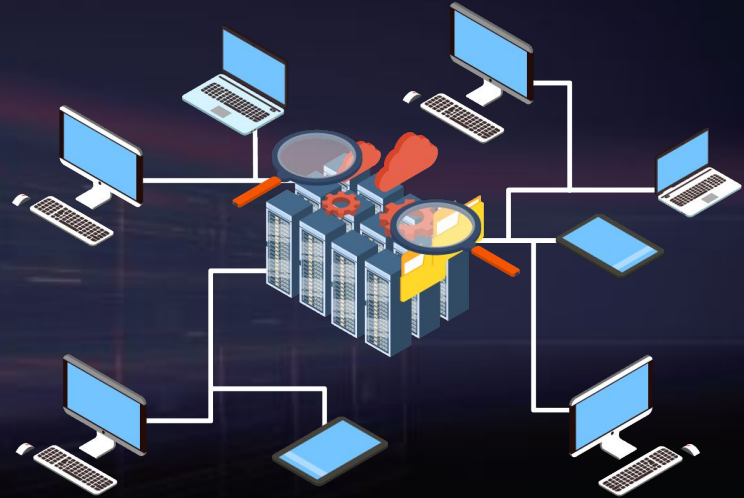
What's the trade-offs?

- There can be a performance cost
- Utilisation efficiency peaks and troughs
- Container source / supply chain security issue
- Portability does not eliminate lifecycle management



Trusted Research Environments (TREs)

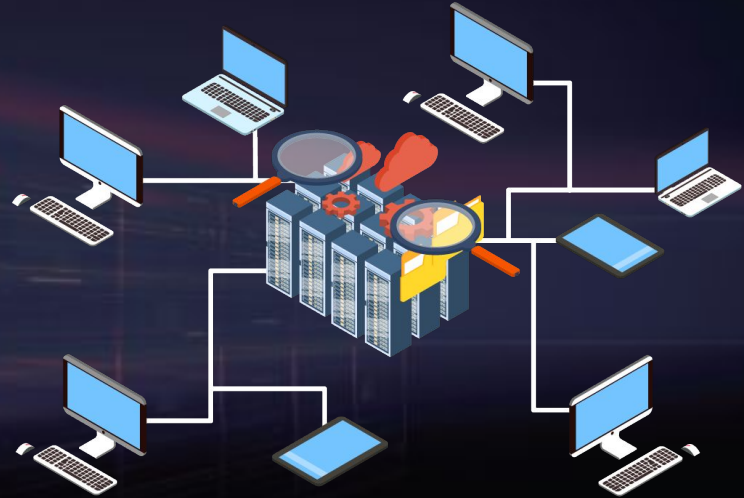
The goal of TREs is not to constrain experimentation, but to support accountable and trustworthy experimentation at scale.



Trusted Research Environments (TREs)

What's the trade-offs?

- Goes against culture of 'open' research
- Prioritises accountability over flexibility
- Requires governance coordination
- Cost, budget and timescale

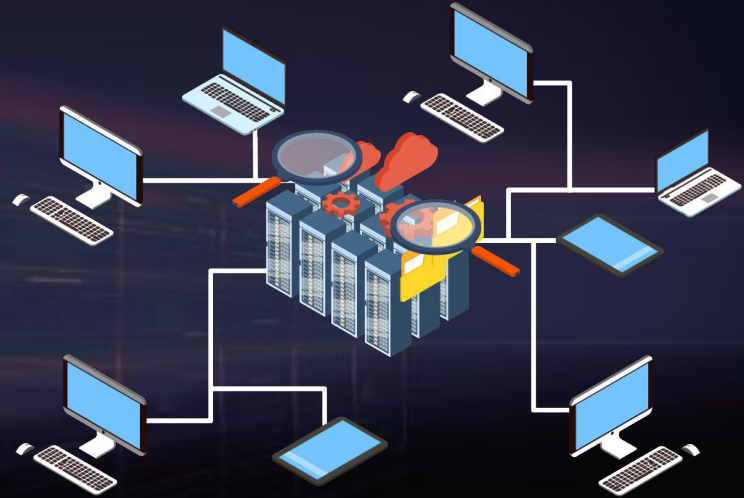


Trusted Research Environments (TREs)

PROS:

- ★ Directly addresses trust in sensitive, large-scale data research
- ★ Allows work under specific governance and security rules
- ★ Process-driven, auditable and accountable

HPC Wave impact: governance could be operationalised through infrastructure (scheduling, allocation, access)



DEFINING FEATURE OF THE ABSTRACTION ERA

The goal of these advancements was never to escape historical decisions, only to find expansion within the design boundaries.



So then...

What happened next?



Join the Accessibility Era

Let's Build the Next Generation

Sustainable Reality Showcase

- Designed for students with little to no experience.
- Hands-on exposure to real hardware
- Opportunities to join the CIUK Student Cluster Competition
- Build skills, exchange ideas, help us get supercomputing to Ridiculous Speed!



In sum.

- Our previous era centered around Hardware Performance
- We are in a Wave of Abstraction:
 - Hardware (+Performance) maintain the foundation
 - Six changes have triggered this wave:
 - Cloud
 - New Requirements (AI)
 - Non-Native User Influx
 - Financial/Budget
 - Physical/Environmental
 - Security (Policy and Ethics)
 - Two key examples that showcase the benefits of abstraction: Containers, TREs
- The Abstraction Wave is leading to an Accessibility Era
 - The importance of building new talent
 - The importance of full system leverage before or alongside replacement/expansion
 - The need to address change from a wider perspective (understanding service performance)



Thanks!

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