Blair Bethwaite (NeSI)
Sean Matheny (NeSI)

Richard Tumaliuan (REANNZ)

NeSI's Flexible HPC

A programmable infrastructure for science data collaboration

Feb, 2022

ABSTRACT / INTRODUCTION

Through 2021 NeSI has procured and integrated a new high-performance private cloud platform we are calling FlexiHPC. This presentation will cover some of the motivations and early use-cases for the new infrastructure, alongside a helicopter view of the core technology components, key partnerships and integrations (such as direct REANNZ connectivity).

This platform will deliver base Infrastructure-as-a-Service (compute, storage, and network, among others) in a multi-tenanted design leveraging the OpenStack private cloud framework. Some elements of the FlexiHPC platform have been designed specifically to accommodate high-performance workloads whilst maximising opportunities for shared investment and benefit at scale.

The FlexiHPC platform is being designed to support multiple models of consumption and integration, including contemporary on-demand access to shared services alongside dedicated hardware tenancies with deep local integration. A significant example of this is AgResearch's new eResearch Infrastructure, which is being integrated within the FlexiHPC architecture (we plan to talk specifically about the AgResearch Infrastructure in another session).

It is envisaged that NeSI's FlexiHPC will provide the sector with a programmable platform for collaboration around science data and support a scalable approach to mid-tier HPC with national expertise complementing localised integration.


genomics
aotearoa


MALAG
INSTIT
OF MEDICAL R


Antarctic
Science Platform


agresearch
āta mātai, mātai whetū


NATURAL
HAZARDS
RESEARCH PLATFORM


AUT


RSE
RSE-AUNZ


globus


Departme
Conserv
Te Papa At


CallaghanInnova
New Zealand's Innovation A


Plant & Food
Research
Rangahau Ahumāra Kai


THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato


Science
New Zealand


QuakeCoRE
NZ Centre for Earthquake Resilience
Te Hiranga Rū


hrc nz
Health Research Council
of New Zealand
Te Kaunihera Rangahau Hauora o Aotearoa


BRAGATO
RESEARCH INSTITUTE
NEW ZEALAND GRAPE AND WINE RESEARCH
RANGAHAU KAREPE, WĀINA O AOTEAROA


PACIFIC EDGE LTD
CANCER DIAGNOSTICS COMPANY


CRA
a Hewlett Packard Enterprise


BIOTELLIGA
Harnessing nature's genius


RUTHERFORD
DISCOVERY FELLOWSHIPS


ROYAL
SOCIETY
TE APĀRANGI


PlantTech


Livestock
Improvement


VICTORIA UNIVER
WELLING
TE HERENGA


REANNZ
THE
CARPENTRIES


MARSDEN FUND
TE PŪTEA RANGAHAU
A MARSDEN


MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND


Ministry for Primary Industries
Manatū Ahu Matua


MOANA
PROJECT


PAWSEY
supercomputing centre


aarnet
Australia's Academic
and Research Network


MetService
TE RATONGA TIRORANGI


GNS
SCIENCE
TE PŪ AO


UC
UNIVERSITY
CANTERBU
CHRISTCHURCH NEW ZI


THE DEEP SOUTH
Te Kōmata o
Te Tonga
National
SCIENCE
Challenges


AeRO
Australasian eResearch Organisations


NCI
AUSTRALIA


MetOcean
SOLUTIONS


MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

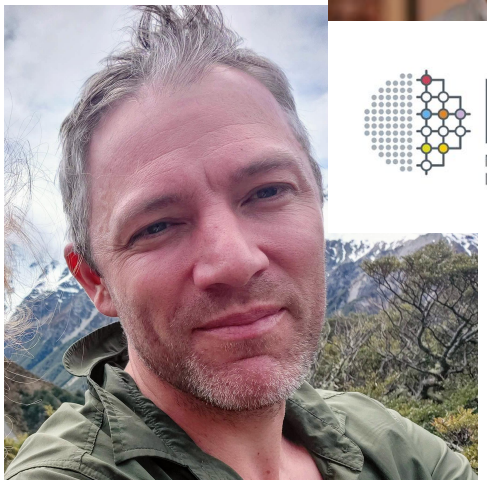
THE UNIVERSITY OF
AUCKLAND
NEW ZEALAND

NIWA
Taihoro Nukurangi

UNIVERSITY of
OTĀGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

Manaaki Whenua
Landcare Research

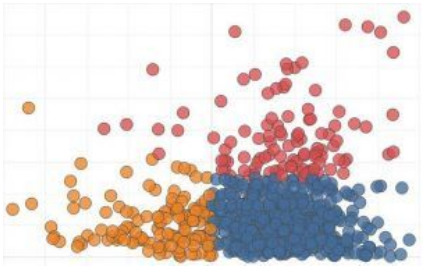
Intros



Presentation outline

- Intro and outline
  - you are here, roll 8 or more on D20 to continue
- Live demo!
- Introducing Flexible HPC
- Initial use-cases
- Mid-tier HPC use-case - AgResearch
- REANNZ fastpath
- NeSI Flexible HPC Capabilities & Capacities
- Research Data Security
- Demo wrap

Let’s start off with something FUN!



- What we are seeing here:
- Log in to FlexiHPC cloud dashboard
- Navigate to the Magnum container orchestration service interface
- Launch a Kubernetes cluster taking note of various network and self-healing options
- Our k8s cluster is deploying!
- We’ll come back to it later…

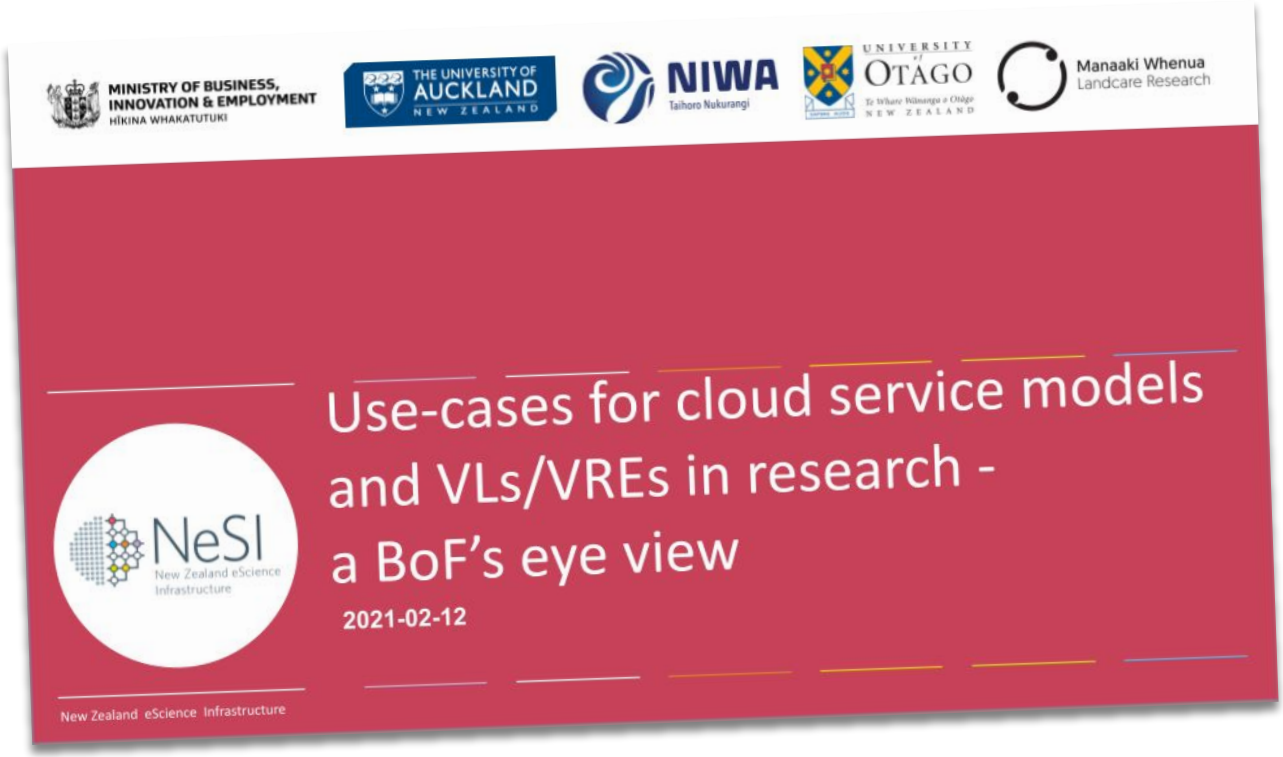
Flexible HPC Intro - What

FlexiHPC for short

From a platform capability perspective FlexiHPC enables:

- Cloud-native eResearch service development and hosting platform
- Access to and hosting of emerging technologies
- A more inclusive approach to eResearch & HPC infrastructure, acknowledging the sheer breadth / diversity of needs across the sector
- Pathway to commercial or multi-cloud / diversity of resources
- Equitable access to capability across the sector

Flexible HPC Intro - What



Some of you who were at last year's meeting will recall that we discussed the Virtual Labs / Virtual Research Environments that NeSI has piloted on the current Mahuika adjacent virtual infrastructure.
Those efforts led to a case for new NeSI platforms investment…

Flexible HPC Intro - Why & How

National Platforms Investment Case 2021

Investment in new infrastructure (to scale up existing platforms, and particularly into advanced GPU to support Data Science, Artificial Intelligence and Machine Learning) is needed, as are **new styles of access** offering both **increased user interactivity** and the ability to provide **complete data and compute isolation** (to meet security needs and/or to support multi-tenant infrastructure). These latter needs speak to a **more flexible design than traditional HPC** that is becoming mainstream across the modern HPC ecosystem globally from vendors to service providers. Initial investment into what we term here Flexible HPC will **enable our learning to support these emerging needs** to inform future investments.

Enabled by a modest initial investment from NeSI's Platform Access Fund with a little bit of everything to facilitate maximum experimentation.

Flexible HPC Intro - What

From an infrastructure perspective:

- A multi-tenant high-performance infrastructure
- Cloud provisioning of metal & VMs alike
- Designed to support multiple layers of tenancy from BYO hardware and up
- Modern OpenStack deployment under the hood
- Software-defined 100GbE+ networking including HPC offload capabilities
- REANNZ WAN integrations

Flexible HPC Intro - Tenancy examples

Direct to researcher - hosting of enabling services

- Researchers accessing shared solutions and common tool chains for high value common use cases/needs, e.g., Notebooks, Virtual Labs, National Data Transfer Platform, etc
- Slurm - isolated on-demand HPC, extension of NeSI HPC Capacity
- Could be services not developed or

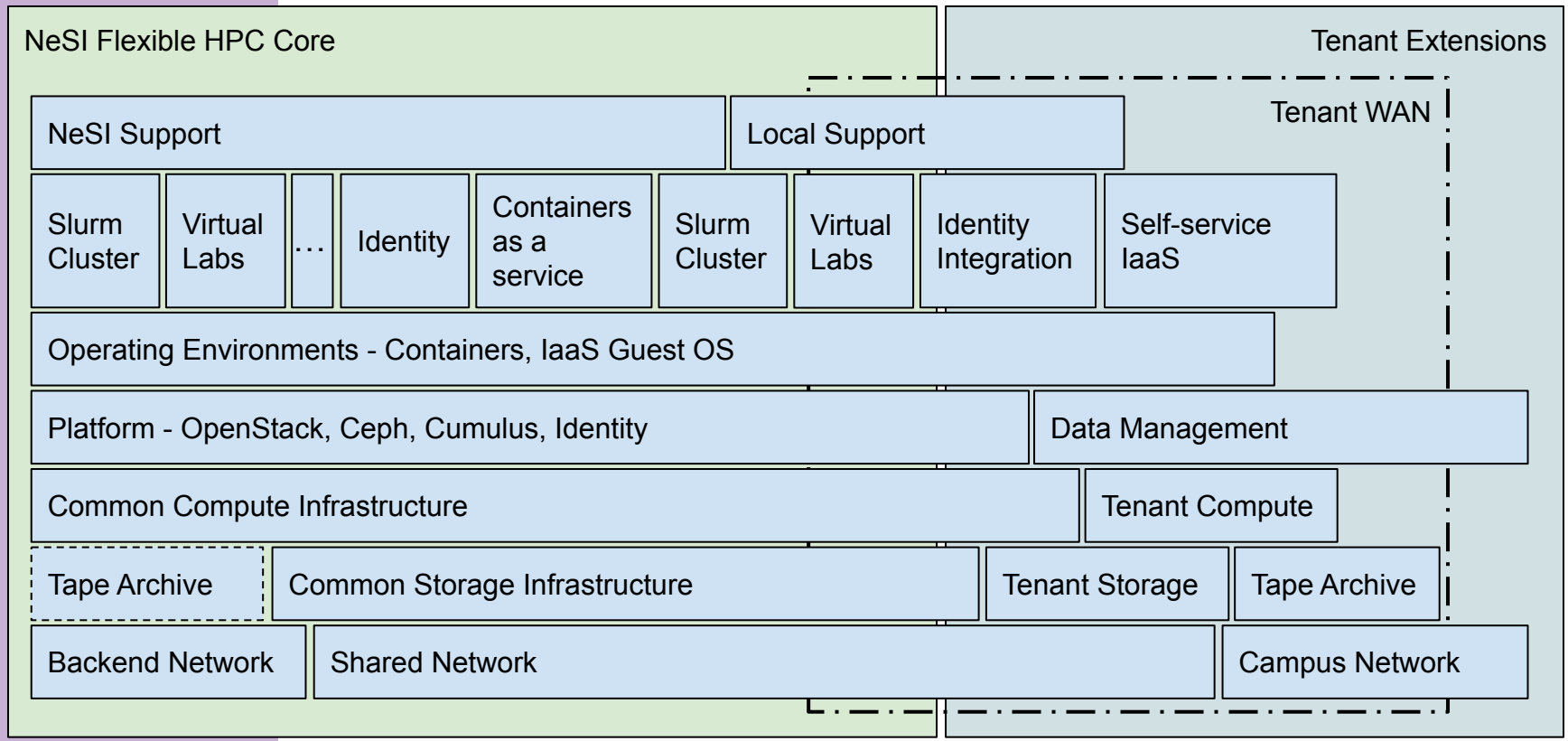
RSEs / Devops / Data Engineers …

- Leveraging as application service hosting environment/s
- Allows devops capable users to self provision and hand craft their virtual labs

Institutional partners

- Opportunity to contribute and build scale nationally
- Allow for infrastructure extension, expansion, and integration to meet institutional goals
- Resolving tensions between collaboration and secure isolation

FlexiHPC tenancy cake



Initial research use-cases

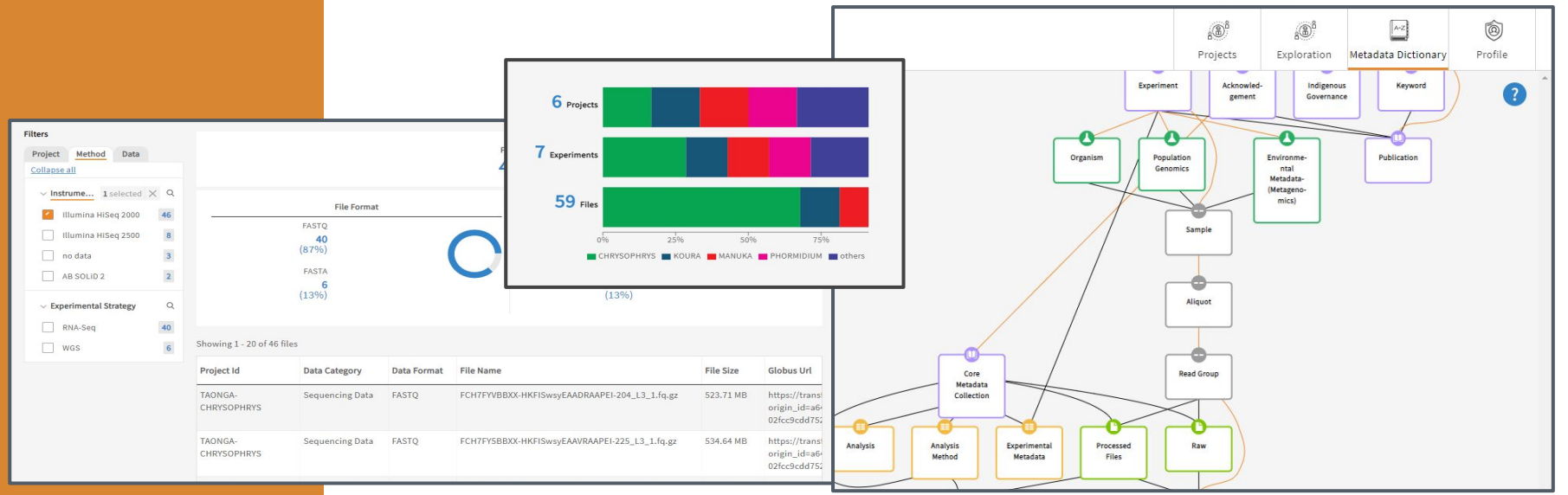
- We've identified a set of diverse initial use cases across different layers of tenancy to serve as pilots and (hopefully) exemplars which could be scaled out more broadly by expanding NeSI's platform capacity & support capability and/or new hardware tenancies

- We are exploring a variety of eResearch & HPC solution spaces that could be underpinned by this platform architecture…

Initial research use-cases

- NeSI internal - research services, dev/test, training environments
- Aotearoa Genomics Data Repository
- Rakeiora Pathfinder prototyping

genomics aotearoa



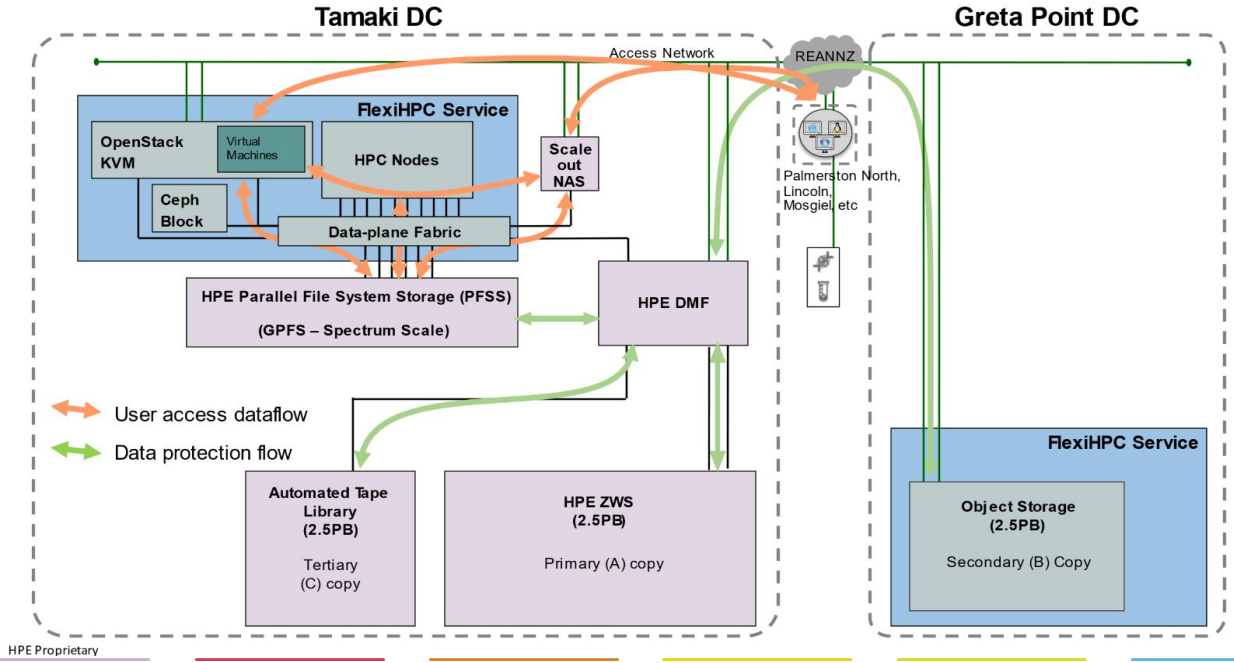
Initial research use-cases continued

- Research Software Engineers (RSE) / DevOps

- Collaborative AI Lab platform (UoA SAIL group)

Mid-tier HPC use-case - AgResearch's eResearch Infrastructure

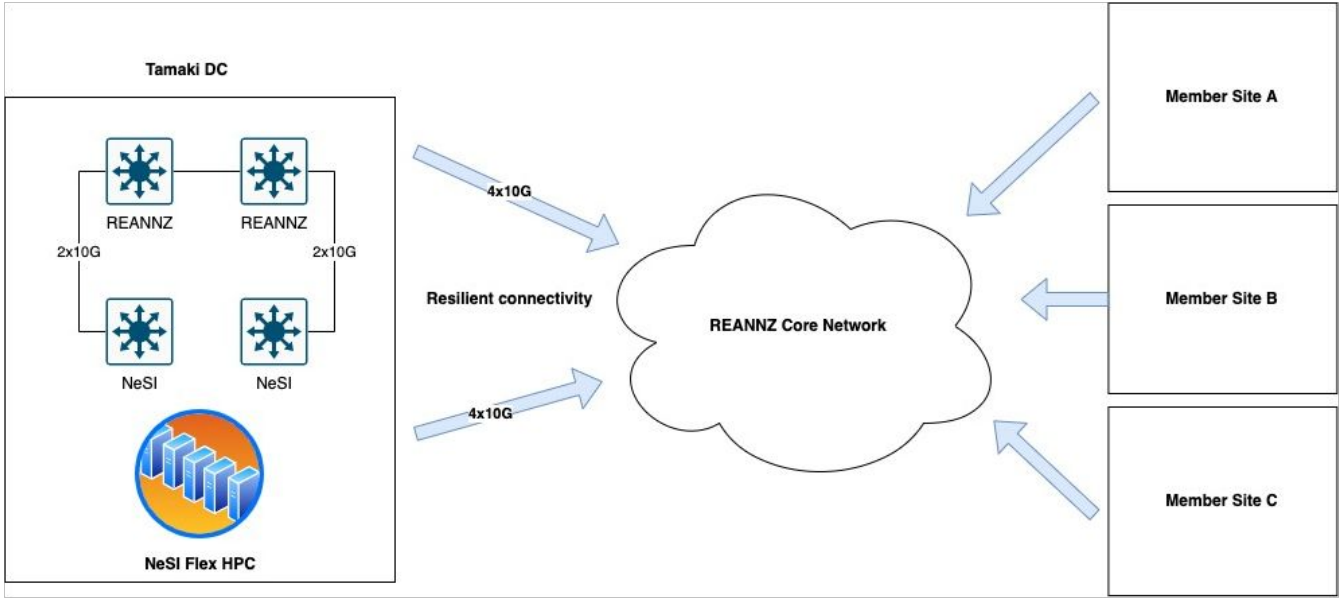
- AgResearch's new institutional HPC and eResearch services platform is being integrated into FlexiHPC
- This a deep partnership and collaboration building capability on both sides
- AgResearch's infrastructure investment has helped add scale and capability to FlexiHPC for shared benefit - tape library, second geographical object storage region, resilient REANNZ connectivity



REANNZ Connectivity

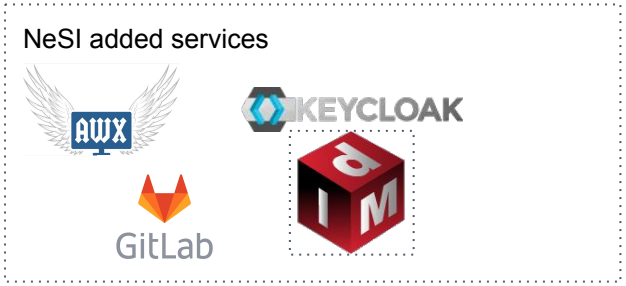
- In order to make the most from the NeSI HPC installation a high performance network is also required.
- REANNZ provide high-capacity connectivity to the NeSI FlexiHPC platform ensuring that dedicated bandwidth is always available.
- We are building a fully resilient solution ensuring that no single failure will impact connectivity.
- With NeSI's FlexiHPC directly connected to the REANNZ Network a service can quickly be configured for any of our members.

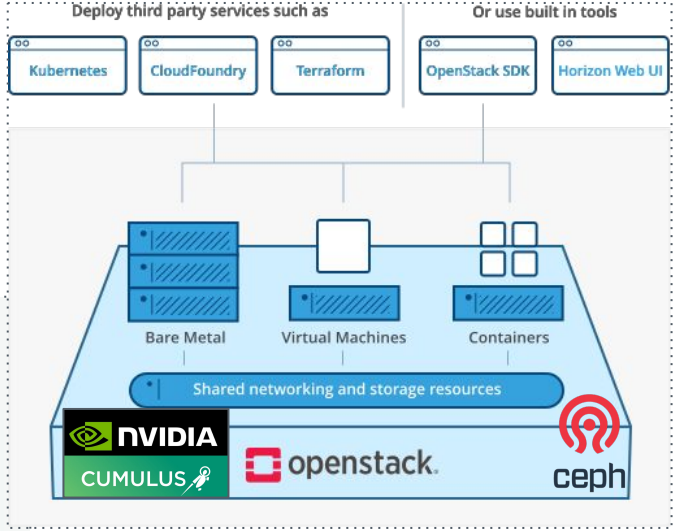
REANNZ Connectivity - Diagram

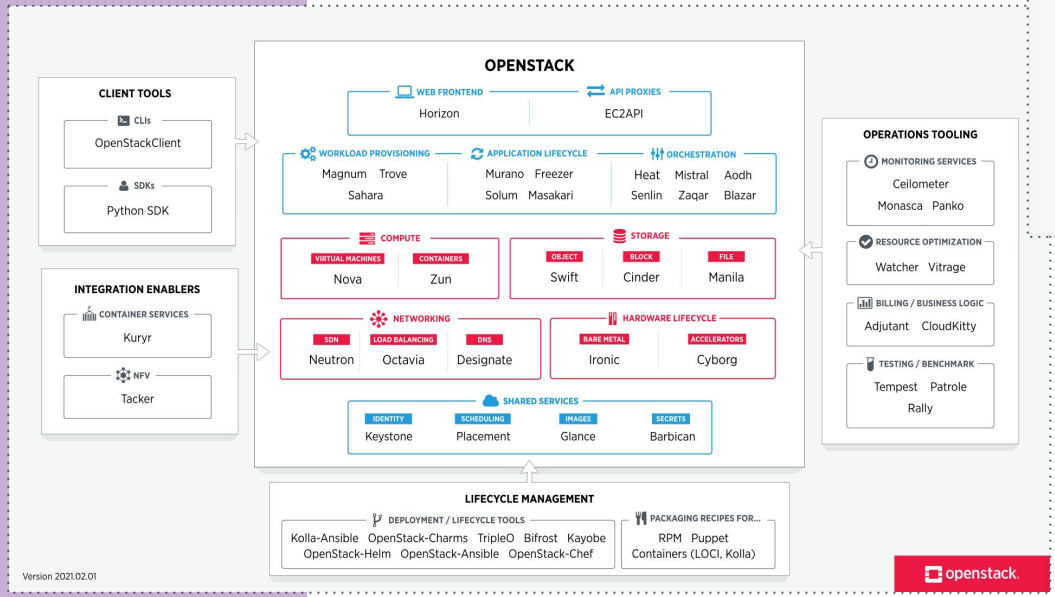


- This network solution allows simple access to the NeSI HPC platform for any REANNZ Member from any of their connected locations.
- Network capacity will be scaled as needed to ensure it remains well ahead of demand.

NeSI Flexible HPC Capabilities & Capacities







- Approx NeSI infrastructure capacities:
- 1000 vCPUs (AMD Milan)
- 30TB flash storage
- 600TB object & block storage
- selection of GPU models (A40, A100)
- multi 100GbE consolidated high-perf fabric

Research Data Security

Rakeiora: A pathfinder for genomic medicine in Aotearoa/New Zealand

genomics aotearoa

- Secure research data a core value proposition
  - Collaborative security posture with both UoA SecOps and commercial security provider(s)
  - Internet access can be limited upstream to/from only REANNZ members, other filters
  - Storage cluster disks encrypted (at rest)
  - Self-service storage volume encryption (at rest)
  - IdP integrations can be offered at OS-login layer
  - Daily security scanning
  - Bare metal solutions available
  - First tenants exemplify the secure data use case

- This approach is a journey, and this is the base iteration

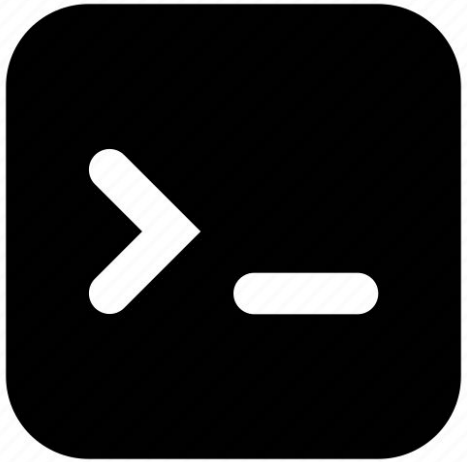
What can something so complex that even its name requires an abbreviation offer to research workflows?

K8s is very complex.

FlexiHPC can help simplify Kubernetes deployments, and more easily enable powerful research platforms, such as:

Kubernetes Demo

Let’s connect to the Kubernetes cluster we launched at the beginning (what could possibly have gone wrong?!)



Let's stay connected

Interested in news & events ...

Join our mailing list at https://www.nesi.org.nz/
(training alerts, newsletters, event announcements, etc.)

Follow us on social channels

@NeSI_NZ

New Zealand eScience Infrastructure

Technical questions ...

Email our Team: support@nesi.org.nz

Visit our Support site: https://support.nesi.org.nz/

Ready to get started ...

Apply for access: https://www.nesi.org.nz/apply

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

NIWA
Taihoro Nukurangi

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

Manaaki Whenua
Landcare Research

www.nesi.org.nz

support@nesi.org.nz

@NeSI_NZ

https://www.nesi.org.nz/apply