SSAG SUBMISSION QUESTIONS – PHASE 1

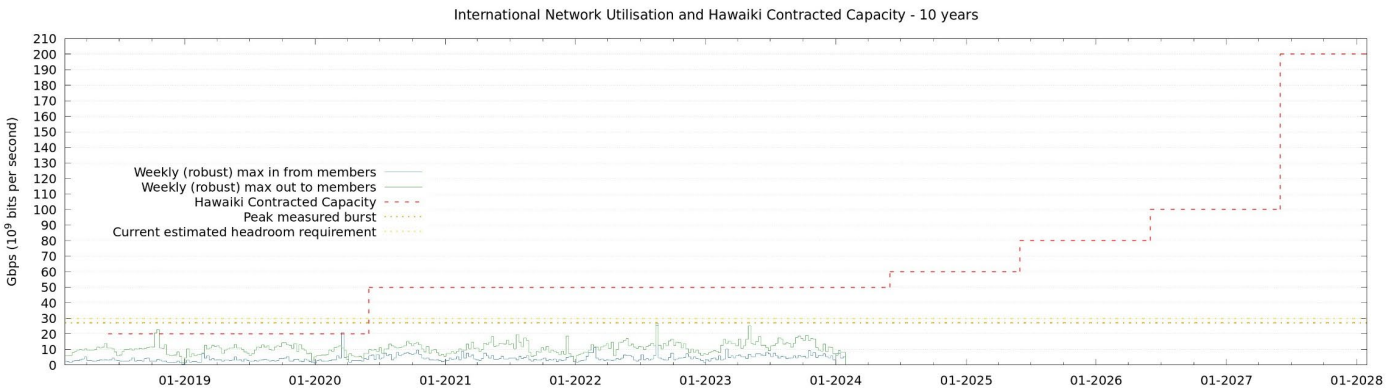
1. Introduction

1.1. The network REANNZ operates is the backbone of New Zealand's research and education sector. It is a high availability, low latency network designed to move and share data around the country, and across the world, at a scale that isn't consistently possible using a standard network.

1.2. The network connects into high-performance computing tools like the National eScience Infrastructure (NeSI) and provides access to specialist scientific instruments, like the Australian Synchrotron, and on-site storage arrays. Alongside our specialist network, REANNZ supports the sector with the products, tools and services they need to collaborate, educate and deliver excellent research.

1.3. REANNZ is the point of connection with c120 global National Research and Education Networks (NRENs) and thus is a critical enabler of leading-edge research and collaboration. As such the traffic handled on the REANNZ network provides a proxy of the level of national and international connection and collaboration.

1.4. The volume handled by the network is persistently low by international standards and has changed little since 2018, as illustrated below (blue line - base load of research traffic, red line maximum capacity available). It is considered this reflects the limited span of data intensive research being undertaken and the level of digital skills in the research community.



1.5. It is worth noting that we do not expect Artificial Intelligence (AI) and Large Language Models (LLM) to change the above traffic pattern materially[1]. We have validated this assumption with other in-country NRENs who have a similar view.

[1] AI means we will see the baseload traffic on our networks increase slightly as people make requests to various AI platforms. The requirement of LLM to have the data next to the compute means we will see more bursts of traffic (green line) as people train the LLM, but this won't cause an increase in baseload traffic. The network is designed to cater for large bursts of traffic such as these so no material network changes are required.

1.6. In summary, we do not expect the network traffic pattern to change dramatically without a system wide intervention. It is REANNZ's hope that this review of the science, innovation and technology system will consider the recommendations contained in this submission to increase collaborations and the volume of eResearch occurring within the system.

1.7. We look forward to discussing the points made in this paper further and are available to provide more detail if required, either in person, or as part of the submissions for phase 2.

2. Question set 1 – The Science, Innovation and Technology System

2.1. Q1.1 - What future should be envisaged for a publicly supported science, innovation and technology systems?

2.1.1. The future REANNZ envisages is of a Science, Innovation and Technology (SIT) system populated with researchers working seamlessly across multiple institutions to deliver world leading eResearch. This is made possible by publicly enabled federated research infrastructure accessible to all. Researchers are further supported with the training and skills they need to use the infrastructure to advance their research.

The infrastructure to enable this future exists today and does not need significant additional investment.

- The existing infrastructure elements that will help deliver this future are: Global research networks - REANNZ as New Zealand's National Research and Education Network (NREN) is part of a c120 strong global federation of high-speed, low latency networks designed to help innovators, researchers and educators share data and collaborate.
- Access – REANNZ provides global NREN federated Wi-Fi (eduroam) and identity management solutions (Tuakiri) to enable researchers to work collaboratively across organisational and geographic boundaries. These services control access to the system and help protect data and institutions as a result. There is more that can be done to secure the sector, which is discussed in 2.2 below.
- High Performance Compute – HPC capability exists centrally (NeSI) and within institutions to support research. The REANNZ backbone connects researchers this core infrastructure. The specialised NREN networks and federated access services mean that researchers can access this capability regardless of where they are based.

2.1.2. The final element to enable this future, is not infrastructure it is people. As highlighted above more work needs to be done to build the eResearch capability of researchers across the country. NeSI has a focus on capability building and a track record of improving the eResearch skills of the researchers they support. A vision of the proposed Data and Digital Research Institute was to consider ways to make this capability available to more researchers. This could be done centrally, or by a change in focus across education institutions.

2.2. **Q1.2 What are the opportunities, challenges and barriers that need to be addressed to build a more thriving research, science, innovation, and technology system that delivers positive sustainable growth and prosperity for New Zealand?**

2.2.1. The opportunity to be addressed is ensuring research infrastructure is available to all researchers regardless of institution. There are four elements to enabling this:

- Increase usage of existing SIT infrastructure
- Ensure the SIT system is open to all
- Improve the security of the sector through the provision of secure research environments
- Expand available infrastructure through federated models.

2.2.2. Increase use of existing infrastructure – centralised infrastructure providers, such as NRENs, have not traditionally done a good job of reaching researchers, this is evidenced by most relationships being with technology teams within research institutions rather than the researchers themselves. A model we have seen working well in Europe and is one we are considering, is the creation of a centralised team of researchers who work with research programmes and help them maximise the use of existing infrastructure. The driver behind this approach is to "shorten the time to research" and to ensure the envisaged ROI on infrastructure investment is maximised.

2.2.3. Open to all – review current funding arrangements and membership models to ensure publicly supported federated infrastructure is available to all, regardless of size and scale of institution.

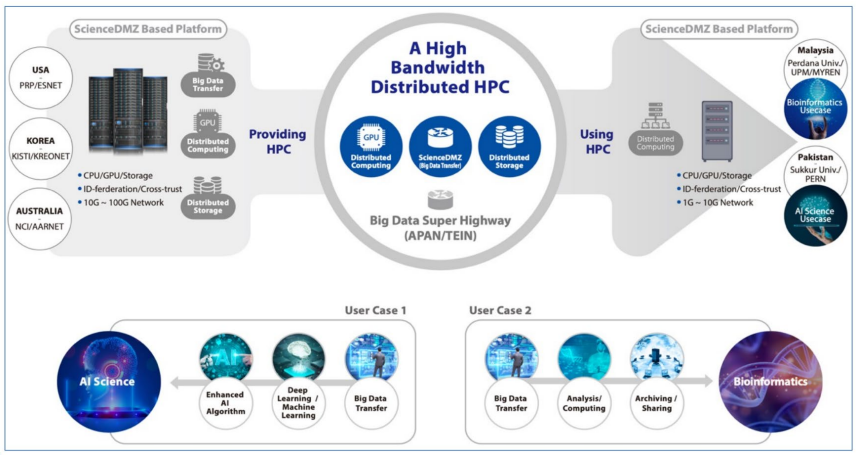
2.2.4. Secure research environments – in addition to using federated identity management services to control access into the system, there is more that can be done to lift security across the sector.

Today, REANNZ works to protect the sector at a network level through DDoS mitigation and Malware Free Network services. The opportunity exists to go further and provision centralised Security Operations Centre (SOC) support and associated services for the sector ensuring a consistent approach to security is maintained. Currently we are seeing an increasing gap in cyber capability as larger well-funded research organisations are investing in protecting their assets, whereas smaller entities do not necessarily have access to the resources required. We view the centralised provision of secure research environments as a key element of any future SIT system.

2.2.5. Expand available infrastructure through federation – global NREN networks such as REANNZ are designed to federate access to global infrastructure. The opportunity exists to formalise additional asset sharing arrangements to provide New Zealand researchers with access to globally connected infrastructure.

A working model exists today as illustrated by the arrangement governing access to the Australian Synchrotron, but the opportunity exists to identify additional assets to connect, for example the Square Kilometre Array[2] data sets.

This model of federating existing research infrastructure is widely adopted overseas with NRENs connecting diamond light sources and telescopes and more recently smaller infrastructure such as HPC and Cloud providers. The below example is of a federated HPC model established in APAC for two specific research programmes:



Federation not only provides access to advanced technologies it also brings a level of resiliency and redundancy into the NZ system. This was evidenced in 2023 when REANNZ provided network services to the University of Hawai'i (UoH) when the undersea cable was cut between Hawai'i and Guam. This ensured global research collaborations continued during a material eResearch infrastructure failure. This global response to infrastructure failure is a key pillar of the NREN community.

[2] https://www.skao.int/en

2.3. **Q3 What principles should underpin the design of a science, innovation, and technology system for New Zealand, given its demographic composition and distinctive cultural makeup, its geographical position, and its social, environmental, and economic futures?**

2.3.1. There are two key principles that should underpin the design of the future SIT system:

- Infrastructure available to all – all researchers across New Zealand should have access to the centralised infrastructure they need to advance their research. It means that access to publicly funded infrastructure such as NREN connectivity and centralised HPC should be institution agnostic. This will mean a change in funding models to ensure the smaller research institutes have the same level of access as the larger ones.
- Federation – we should consider adopting a principle of federating access to existing infrastructure where practical, rather than focusing only on building and buying new. This won't work for all use cases but helps quickly expand the infrastructure available to the sector and provides resiliency by reducing reliance on single infrastructure elements.

2.3.2. Creating a SIT system that facilitates universal access to global infrastructures and provides researchers with the skills to use it empowers researchers and enables us to highlight the international connectedness of our science system as a means to attract highly skilled scientists to New Zealand.

2.3.3. We note, elsewhere the question relating to a "Pacific research strategy". It is worth the panel noting that through the global NREN relationships REANNZ holds, the approaches outlined in this response can be applied to research happening across the Pacific.

Amber McEwen
Chief Executive Officer