



Advanced Network Capability Building

Roadmap 2007-2009

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Document control

Audience

The intended audience for this document includes:

- REANNZ Board members and staff
- members of the Advanced Network Capability Building Advisory Panel
- staff within KAREN member institutions, particularly those involved in supporting KAREN and e-research development
- the wider network of KAREN stakeholders in the government, education, cultural, health and business sectors.

Related Documents

This document is the Advanced Network Capability Development Roadmap 2007-2009.

Three background papers are available that cover:

- Workforce Capability
- Technological Capability, and
- Sector Capability.

Version control

VERSION	DATE	REASON FOR UPDATE	AUTHOR
1.0	2 April 2007	New overview document extracted from single Roadmap document	Sam Searle
1.1	3 April 2007	Revisions; addition of diagram of KAREN relationship; in-text citation changed to footnote; addition of section on key constraints and issues; addition of heading for section on moving forwards [will need to be completed following next Panel meeting]	Sam Searle
1.2-1.3		Minor changes based on feedback	Sam Searle
1.4	7 May 2007	Substantial feedback from the Advisory Panel incorporated	Sam Searle
1.5	31 May 2007	New priorities; reformatting; Advisory Panel changes	Sam Searle

Review and Approval

This document has been approved for release by the following:

NAME	ROLE	ORGANISATION	DATE
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- Auckland University of Technology
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- CWA New Media
- CORE Education
- Council for the Humanities Te Whāinga Aronui
- Lincoln University
- Ministry of Education
- National Library of New Zealand
- New Zealand Network of Earthquake Engineers (NZ-NEES)
- New Zealand Vice Chancellors Committee Standing Committee on Information Technology (SCIT)
- RMIT University, Melbourne
- University of Auckland
- University of Canterbury
- University of Otago
- Victoria University of Wellington

Members of the REANNZ team and Board (<http://www.reannz.co.nz/reannz-team/>) and the Capability Build Panel (<http://www.reannz.co.nz/assets/Uploads/Advisory-Panel-Role-Contacts.doc>) have also provided assistance.

Advanced Network Capability Development

KAREN is New Zealand's advanced research and education network. It is operated on behalf of the Government by Research and Education Advanced Network New Zealand (REANNZ). REANNZ's mission is *to make KAREN essential infrastructure for an innovative New Zealand*.

KAREN has the potential to contribute to New Zealand's economic development; to underpin the provision of richer and more accessible learning opportunities for New Zealanders throughout their lifetimes; and to make it easier to showcase New Zealand's digital content and research, not only to New Zealanders but also to a global audience.

In developing this document, an inclusive view of capability building has been adopted:

The appropriate combination of competent people, knowledge, money, technology, physical assets, systems and structures necessary to deliver a specified level of performance in pursuit of the organisation's objectives, now and/or in the future.¹

The breadth of this vision means that a wide range of capability building activities will be required so that very different kinds of organizations can take advantage of KAREN now and in the future. This document provides a Roadmap for these capability building activities, and should be treated as a living document: annual reviews are likely to change both the actions and the priorities given to individual actions.

This initial Roadmap has identified and prioritised thirty-three actions. These actions represent an ambitious programme of activities designed to increase *workforce capability* (skills and knowledge in the KAREN community) and *technological capability* (making sure that the right infrastructure and tools are available). These activities take place in a wider context in which policy-making, funding mechanisms and complex stakeholder relationships all play a part, so this wider sectoral environment is a key site for awareness-raising activities and relationship building (*sector capability*).

The actions identified as essential in this initial Roadmap address three key areas for the current and future success of KAREN: skills, technologies and awareness.

a. Skills

Educators and researchers must develop the skills to adapt the ways they work to the new environment provided by KAREN.

¹ Department of Conservation (NZ). *Appendix 5. Glossary. Statement of Intent 2004–2007*. <http://www.doc.govt.nz/templates/MultipageDocumentPage.aspx?id=41244>.



- Develop and/or support a broad programme of short-term capability building activities, including an annual event along the lines of the UK e-Science All Hands Meeting, hands-on workshops, roadshows and technical training courses.

b. Technologies

The focus of research and education networks is on sharing and collaboration. Key technologies must be adopted and the capability to use and maintain them developed.



- Support the adoption and implementation of middleware – e.g. identity and access management (IAM) and grid services management – *particularly where this specifically enables the sharing of data and/or information and computing resources, and/or scientific equipment, or facilitates national or international collaboration.*
- Support the adoption and implementation of real-time collaboration technologies for teaching and research.
- Recognise that a coordinated standards-based approach to the storage and long-term management of datasets (primary research outputs) is required if sharing and re-use of data is to take place, and to undertake to lobby relevant agencies with a mandate in this area.

c. Awareness

Educators, researchers, policymakers and funding agencies must be made aware of the benefits to be derived from KAREN, and of the requirements to develop current and future capabilities to use KAREN.



- Exemplar projects will demonstrate the benefits while embedding skills and knowledge.
- The KAREN community must identify and communicate KAREN's future requirements amongst the relevant bodies.
- The research community must maintain an active dialogue with government about KAREN and capability building requirements.

The remainder of this document outlines all thirty-three actions: some of these may be viewed as targeted components of the essential actions listed above, while others are independent. All actions have been prioritised on a scale of 1 to 5, where 1 is essential, 3 is important, and 5 is desirable. The Roadmap also lists some relevant agencies and possible sources of resources (e.g. funding, advice and in-kind support). Supporting material relating to these actions is provided in a series of three background documents focusing on workforce, technological and sector capabilities.

The Roadmap actions are based on international trends and the identified needs of the KAREN community, and have not been limited to what is achievable with current resources. For this reason, this document also outlines some constraints and issues that are open to wider discussion. Variable current levels of capacity and capability, the rapidly changing demographics of KAREN membership, an extremely complex funding and policy environment, and the limited funds and timeframe that are currently allocated to capability building are all issues that will need to be addressed, not only by REANNZ and the current membership, but by many other organisations in New Zealand with mandates in areas such as education, research, innovation and economic development.

About the Roadmap

KAREN, REANNZ and the Capability Building Advisory Panel

KAREN is the Kiwi Advanced Research and Education Network, a high-performance network that supports data transfer at the gigabit speeds required for advanced research and education.

KAREN is owned and operated by the Crown-owned company Research and Education Advanced Network New Zealand (REANNZ), on behalf of the KAREN membership, which currently consists of 18 organisations including universities, Crown Research Institutes (CRIs) and the National Library.

The objectives of KAREN are:

- To enable leading edge e-research;
- To facilitate universal connectivity throughout the New Zealand and international research and education community;
- To encourage broad participation by the research and education sector in New Zealand through accessible technology and reasonable pricing;
- To connect the research and education sector to the broader innovation community for pre-commercial, research and development based collaboration; and
- To facilitate participation by multiple telecommunications sector partners to ensure the greatest possible flexibility for ongoing evolution.

Meeting these objectives will require significant capability building in terms of people, technology and the wider sectoral environment in which KAREN operates. REANNZ has appointed a Capability Building Advisory Panel to guide this activity

(<http://www.reannz.co.nz/assets/Uploads/Advisory-Panel-Role-Contacts.doc>).

One of the Panel's key responsibilities is to advise the REANNZ board on the operation of the Capability Build Fund (CBF). The vision for the CBF is that by June 2009:

- New Zealand researchers will be able to participate in international research as equal partners;
- New or enhanced research collaborations, facilitated by KAREN, will be established within New Zealand;
- Funding agencies will be fully aware of the value of KAREN to education and research;
- KAREN will facilitate the development of new types of research that will be undertaken in New Zealand; and

- KAREN will facilitate the development of new forms of education including the use of national and international services such as data repositories and simulation.

As currently outlined the goals of the CBF in achieving these objectives are to:

- a. Establish an awareness of KAREN
 - a) Produce success stories to demonstrate value
 - b) Facilitate New Zealand access to international funding
- b. Enable effective use of KAREN
 - a) Establish sufficient expertise within each current member to enable KAREN to be used effectively
 - b) Establish centres of expertise and co-ordination, e.g. for Access GRID scheduling
 - c) Enable new forms of collaboration, leading eventually to new funding opportunities
 - d) Develop a culture amongst educators and researchers that includes elements of awareness of and ability in advanced networking techniques
- c. Promote the use of KAREN
 - a) Develop a culture amongst educators and researchers that includes elements of awareness of and ability in advanced network techniques
 - b) Produce success stories to demonstrate value
 - c) Ensure that the use of KAREN is not inhibited by lack of skills or access to expertise.
- d. Create a community ethos of sharing knowledge.
 - d) All activities will share acquired knowledge and technology development.

Purpose

The Advisory Panel has been tasked with developing a Capability Building Roadmap. REANNZ has supported the development of the Roadmap as part of its Output Agreement with the Ministry of Research, Science and Technology (MoRST) that covers the CBF. The purpose of the Roadmap is to outline areas of capability building that should be pursued over the next two years by REANNZ and the Advisory Panel.

Using the vision and goals already established for KAREN and the Capability Build Fund as a framework, the Roadmap is designed to:

- Provide KAREN members with a national framework, within which complementary local activities can be planned;

- Assist agencies such as MoRST and TEC with policy development;
- Guide the Capability Building Advisory Panel's activities for 2007-2009;
- Give the Advisory Panel and other interested stakeholders an up-to-date overview of activities internationally and in NZ;
- Reflect the views of the KAREN community, gained through feedback from key representatives;
- Provide a basis for ongoing discussions between REANNZ, the KAREN community, the research community, and the wider network of KAREN stakeholders in government, education, industry and the cultural sector.

Format

The Roadmap as a whole consists of four documents:

- this document, which provides an overview and contains the suggested outcomes and actions that form the 'Roadmap' for future activities; and
- three additional supporting papers that contain more detailed background information in the areas of Workforce Capability, Technological Capability and Sector Capability.

Scope

The Roadmap and its supporting background papers describe:

- International and national trends and issues;
- Specific activities that should be initiated or reinforced in NZ;
- Suggested relative priorities or importance of the activities as indicated by international contexts and consultation with key players in NZ;
- Desirable outcomes in the key areas of development; and
- Suggested methods for achieving the outcomes sought including collaboration and cost sharing with other agencies such as KAREN members, Government and private sector organisations.

More than 40 countries now have a national advanced research and education network, and related infrastructure and services are being widely worked on. While huge amounts of information are available, time constraints mean that the scope of the Roadmap has been limited in a number of ways:

- While the Roadmap tries to cover applications and activities that are generic and/or cross-disciplinary as well as those that are domain-specific, it has not been possible to cover in detail requirements at the level of individual disciplines or research areas.
- In the medium to long term, the Panel and the CBF – or other bodies with similar objectives - will need to address the needs of a wider range of members from higher education (e.g. polytechnics), compulsory education (primary and secondary schools), the cultural sector (e.g. archives, art galleries, libraries and museums) and other central and local government agencies. The focus for this initial report is on the types of organisations that are current members (i.e. universities, CRIs and the National Library) and that can apply to the CBF; however much of the work done under this Roadmap should be applicable to other sectors.
- The Roadmap focuses on technical capability building in terms of middleware and applications and related expertise, rather than development of the physical network and the network technical workshops supplied as part of core REANNZ operations.
- E-research is a strong focus of this report. While this reflects that far more capability building has already taken place in the fields of e-learning and ICT in education than in the area of e-research, it is not intended to downplay the role that KAREN will play in teaching and learning and the capability building still required in this area.
- The Capability Development Fund is not available for substantial capital purchases. For this reason, the Roadmap does not cover needs for physical infrastructure/hardware (e.g. high performance computers, scientific equipment, and data storage) except where:
 - capability building may enable better use of existing physical infrastructure and contribute to KAREN goals and objectives; and
 - obvious gaps in basic infrastructure present a risk for overall capability development, e.g. in the area of data storage.

Approach

1. Environmental scan: The desk research phase of the process involved environmental scanning of publicly available information.
2. Discussion document and feedback: A discussion document was disseminated via the KAREN website and blog and e-mailed directly to stakeholders identified by REANNZ as leaders in this area. This could not be comprehensive but aimed to be representative. Multiple perspectives (e.g. KAREN 'champion', central IT service manager) from a range of members (university, CRI, National Library) were sought.

Organisations that provided feedback are noted in the Acknowledgements.

3. Preparation of this report: A draft report was presented to REANNZ and members of the KAREN Capability Fund Advisory Panel. Following a period of discussion and prioritisation of actions and outcomes, the final report and Roadmap, incorporating feedback from REANNZ and the Advisory Panel, was then prepared.

Future of the Roadmap

To fulfil the purpose of the Roadmap as outlined above, it is recommended that:

- the REANNZ Board and the Capability Building Advisory Panel endorse the Roadmap and use it to guide their activities in 2007-2009, including making changes to the scope and criteria of the Capability Build Fund, if required;
- the Advisory Panel, REANNZ Board, REANNZ staff, and KAREN champions within member organisations promote the Roadmap and discussions about it within the wider network of KAREN stakeholders;
- members of the KAREN community use the national framework provided by the Roadmap as a planning tool for developing their own organisational and regional programmes of activities;
- the Roadmap is treated as a living document that should reflect changes in the needs of the KAREN community and the environment in which KAREN operates by being reviewed, e.g. on an annual basis.

The Roadmap: findings, outcomes and actions

Workforce capability: summary of findings

Key findings from environmental scanning and consultation with the KAREN community include:

- E-research requires input from a number of distinct groups, e.g. domain specialists (e-researchers), technical specialists and support staff such as project managers and information specialists. Other groups such as senior managers in KAREN member organisations, e-learning specialists, and policy makers in government will also be involved in achieving the KAREN vision.
- All of these groups will need professional development if member organisations are to make the most of KAREN. A one-size-fits-all approach will not work across all groups, as their concerns, requirements and skill levels vary greatly.
- A wide range of capability development initiatives are in place internationally. There is consensus in the KAREN community that short-term activities that will 'kickstart' KAREN usage should be given a high priority: in the longer-term, more formal structures could be developed (e.g. e-research streams within degrees) but these are not the immediate priority.
- Because of their future leadership potential, new researchers (postgraduate students and postdoctoral staff) are a group in need of targeted support.
- Professional development in the workplace is required alongside off-site events.
- E-researchers need to become familiar with the new environment and to understand its relevance to their research through demonstrations of exemplar initiatives. To enable them to use e-research applications, both an understanding of functionality and good online communication and facilitation skills will be required.
- Pedagogic and technical issues are well-covered in existing professional development programmes for e-learning practitioners and learning technologists, however these groups will also benefit from demonstrations of exemplar initiatives utilising advanced networks.
- Technical specialists will require expertise in middleware (identity and access management, grid services) so that NZ organisations share resources effectively using KAREN. Experienced software engineers and developers will be needed to adapt and develop e-research applications that are technically fit-for-purpose (secure, modular etc) and meet user needs.

- Application specialists (e.g. node operators for room-based videoconferencing) will need instruction in installing, configuring and upgrading existing and new applications, and hands-on experience in using these in production.
- Other support specialists will likely need a mix of the above skills and knowledge, and may need to build capability in new areas such as data curation.
- The collaborative and large-scale nature of the environment means that generic skills such as project management, team-building, and communication will also be highly valued. Currently there is an uneven distribution of these skills across the KAREN members.

A range of national activities that could be funded through the CBF and other means are recommended.

There is significant scope for KAREN member organisations to both benefit from and contribute to these national activities by offering to develop and/or host events, communities of practice and online resources.

Individual organisations should also be able to utilise existing internal structures and processes (e.g. professional development, sabbaticals, awards, travel funds) to achieve similar local outcomes.

Workforce capability: recommended actions

	Action	Outcomes	Agencies and resourcing options	Priority <i>1=essential 3=important 5=desirable</i>
1.	Develop and/or support a broad programme of short-term capability building activities, including an annual event along the lines of the UK E-Science All Hands Meeting, hands-on workshops, roadshows and technical training courses.	Events are well-attended, and evaluated by participants as relevant and high quality. Events target a range of groups within the KAREN community, and external groups as appropriate. Participants gain first-hand experience of KAREN's benefits for research and education.	REANNZ: Additional operational funds; CBF KAREN members: Operational or strategic funds; in-kind contributions Training providers (cost recovery or commercial basis)	1
2.	Provide workplace-based learning by <ul style="list-style-type: none"> scheduling events in different NZ centres fostering online communities of practice linking to, licensing or developing online training resources. 	There are no major geographic barriers to gaining knowledge and skills. Participants learn in the workplace as well as at external events.	REANNZ: Additional operational funds; CBF KAREN members: Operational or strategic funds; in-kind contributions Training providers (cost recovery or commercial basis)	2
3.	Recognise the special role of postgraduate research students and new researchers as the future leaders in e-research; support them through targeted scholarships, post-doctoral fellowships, intensive summer schools, and internships in NZ and overseas.	Postgraduates' and new researchers' uptake of KAREN and participation in the KAREN community increases. Policy and funding bodies are aware of the need for targeted assistance for postgraduates and new researchers.	REANNZ: CBF KAREN members: Internal research funds Funding bodies (e.g. TEC, Fulbright NZ, British Council): through schemes such as Bright Futures	2
4.	Establish a visitors programme and continue to award travel grants.	International knowledge is transferred and collaboration is fostered.	REANNZ: Additional operational funds; CBF KAREN members: Internal research and travel funds MoRST: ISAT Linkages Fund Other funding bodies e.g. Fulbright NZ, British Council	2

5.	Recognise the role of exemplar projects in embedding skills and knowledge, and continue to fund these as appropriate; ensure mechanisms are in place for transfer of knowledge from funded exemplar projects to the wider KAREN community.	Individual and teams develop skills and knowledge that are embedded within and across member organisations. Skills and knowledge are applied and success stories result. Knowledge is transferred easily and appropriately.	REANNZ: CBF KAREN members: Internal research funds Research funding bodies (where applicable) Industry partners	1
6.	Investigate curricula initiatives relating to streaming of postgraduate and undergraduate qualifications; undertake market research to establish demand for these in NZ; revise curricula in line with research findings.	Graduates with the skills and attributes required for careers in e-research are produced.	KAREN members: Operational funds; curriculum review processes TEC: Innovation and Development Fund	5
7.	Develop an awards scheme for innovative use of KAREN; encourage member organisations to reward staff and students through existing or new local schemes.	Early adopters receive recognition.	REANNZ KAREN members	4
8.	Ensure that university researchers are aware that leadership in and contribution to the KAREN community are likely to be recognised within the PBRF process.	Leaders in the KAREN community and early adopters receive recognition.	TEC: PBRF-related planning and communications KAREN members: In-house communications and processes	4

9.	<p>Prioritise capability development activities in the following areas of immediate need:</p> <ul style="list-style-type: none"> • for e-researchers: e-research basics, exposure to exemplar projects, e-research applications, accessing e-research resources, online communication and facilitation, and data/information management; • for technical specialists: identity and access management, grid services management, and building e-research applications; • for node operators: installation and configuration, new applications, production techniques; • for e-learning specialists: advanced network basics, exposure to exemplar projects, e-learning applications; • for other support specialists: to be defined, but likely to be a combination of the above topics, as appropriate for their needs. 	<p>Events are well-attended, and evaluated by participants as relevant and high quality. Knowledge is applied and success stories result.</p> <p>Events target a range of groups within the KAREN community, and external groups as appropriate.</p>	<p>REANNZ: Additional operational funds; CBF KAREN members: Internal staff development resources Training providers (cost recovery or commercial basis)</p>	2
10.	<p>Promote the value of generic skills such as project management, science communication, teamwork and consensus-building.</p>	<p>Initiatives are more efficiently and effectively managed.</p> <p>Knowledge is transferred easily and appropriately.</p> <p>E-research teams develop trust and working practices that support current and future collaboration.</p>	<p>KAREN members: Internal staff development resources Training providers (cost recovery or commercial basis)</p>	5

Technological capability: summary of findings

Key findings from environmental scanning and consultation with the KAREN community include:

- Advanced networks must be refreshed every 4-6 years.
- 'Middleware' is a vital part of the e-research infrastructure. National middleware initiatives are active internationally but require large-scale investment. In many cases, best practice has stabilised to the point that New Zealand will be able to adopt and adapt existing middleware; this will still require significant resources.
- In the area of identity and access management (IAM) middleware:
 - A communications issue exists in that there are different views in the KAREN community about the importance of IAM activities and use of the CBF for this purpose. Some in the community feel that a focus on IAM will divert funds away from researchers and the adoption of e-research applications that directly support collaboration, and that IAM should more properly be dealt with as part of each organisation's internal operations. Others feel equally strongly that IAM is an obvious candidate for CBF support since it is essential for collaboration.
 - Within New Zealand, organisations in the KAREN community are taking different internal approaches to identity and access management (IAM).
 - There is a need to be aware of, and potentially to align with, other IAM developments in New Zealand, particularly those in education and government.
 - IAM federations overseas are mostly utilising the Security Assertion Markup Language (SAML2.0) and Shibboleth (an open source implementation of SAML); NZ organisations urgently need hands-on experience with using these standards.
 - Australia has invested heavily in IAM developments; they have an active test federation and certificate authorities, and have deployed EduRoam: New Zealand can contribute to and benefit from these developments, though there may be sovereignty issues in the longer term that would need to be addressed.
- In the area of grid services, de facto standards and best practice are converging internationally. NZ organisations need to build hands-on experience with tools like the Globus Toolkit and Condor through testbeds and exemplar projects that build upon the work of the TEC-funded BeSTGRID project (<http://www.bestgrid.org>). Partnership with organisations like the Australian Partnership for Advanced Computing (APAC) would assist, as would participation in forums for developing standards and tools (e.g. Open Grid Forum and Globus Alliance).
- A wide variety of real-time communication applications such as the Access Grid and

standard videoconferencing are in use internationally and in NZ. Both room-based systems and desk-top systems are likely to see increased usage, and opportunities are increasing to augment videoconferencing functionality with shared applications (e.g. whiteboards, visualisation tools, real-time monitoring of equipment) to provide highly interactive shared workspaces. In the past the main driver has been travel costs but environmental sustainability is now also an important factor.

Interoperability across different systems and protocols is a big issue. There is huge potential for these tools to support teaching and research, but national infrastructure and support services such as bridging between different protocols and quality assurance are required to overcome a range of technical and logistical barriers. National research and education networks often supply these services to their members.

- At the low end of the spectrum, out-of-the-box 'virtual research environments' (VREs) can support a wide range of researchers and other groups (e.g. support specialists) that need basic group support functions such as scheduling, discussion boards and document sharing. There is also potential to customise VREs to include the workflows, toolkits and information needs of particular domain-based communities, but this would require much greater investment.
- New and/or improved methods of collaborating (high definition videoconferencing, tele-haptics, augmented reality), collecting data (e.g. sensor networks), analysing data (e.g. high performance computing, data and text mining, visualisation) and managing scholarly knowledge (workflows, indexing and retrieval, annotation) are emerging. Many are still at an experimental stage internationally and appear unlikely to be widely adopted within the KAREN community within the timeframe of the Roadmap (i.e. the next two years). Nevertheless, these kinds of initiatives could be very valuable as examples of what advanced networks can help organisations achieve in terms of innovation and new relationships with other sectors such as business and health.
- The ways in which data (or information or knowledge) are published or delivered are changing; overseas, there is greater emphasis on open access to research outputs from a range of organisations, and increasingly policy is dictating sharing and re-use of data as the norm. Data from publicly-funded research is on the radar of the policy-makers and funding organisations that support publicly-funded research. In future we will likely have to comply with more stringent data management requirements included in research contracts, national legislation, and international agreements such as the OECD Declaration on Access to Research Data from Public Funding. Calls for open access are also coming from individual end users and organisations that would like to re-use research data for further research and/or service delivery (e.g.

web-based 'mash-ups', which combine data sources to provide new kinds of services).

- The availability of KAREN could drive the development of repositories of digital content – both born-digital and digitised, and particularly rich media content that requires significant streaming/downloading bandwidth - for research and education purposes, and this should be encouraged wherever possible.
- Data storage and management is emerging as a key issue within international research and education sectors. While some work is starting in this area in NZ, a coordinated national approach would be beneficial. Issues to consider include:
 - The amount of data generated by research projects will continue to increase exponentially; it has been suggested internationally that in many disciplines data production is doubling annually.
 - There is an urgent need for research datasets to be protected as information assets. CRIs and the National Library emphasise best practice in this area, but many research datasets in universities are managed by individual researchers and/or at the level of projects, schools and research centres. Storage failures, hardware/software obsolescence, and poor data management practices are risks that should be mitigated through use of appropriate technologies and skills in data management and data curation.
 - As noted above, there is also increasing emphasis on collaborative access to data, which KAREN will facilitate; however, sharing and re-using data raises intellectual property, data privacy and other digital rights management issues. Emerging national and international best practice for management of datasets will need to be adopted (e.g. provenance metadata standards for datasets, access policies).

Technological capability: recommended actions

	Action	Outcomes	Agencies and resourcing options	Priority <i>1=essential 3=important 5=desirable</i>
11.	Raise awareness of advanced network refreshment requirements amongst relevant bodies.	Network lifecycles and their implications for technical capability development are understood. Risk of existing investment failing to be leveraged in future is lowered.	REANNZ and the Capability Building Advisory Panel KAREN members Industry partners	2
12.	Support the adoption and implementation of middleware - e.g. identity and access management (IAM) and grid services management – <i>particularly where this specifically enables the sharing of data and/or information and computing resources, and/or scientific equipment, or facilitates national or international collaboration.</i>	KAREN members assess their readiness to join federations. Exemplar projects demonstrate resource sharing more easily. NZ organisations can participate in national and international collaborations that require the adoption of middleware technologies.	REANNZ: CBF KAREN members: Operational or strategic funds NZVCC SCIT: Advice and strategic direction CRIITAS services: Advice and strategic direction BeSTGRID: TEC (current) CAUDIT: Advice and in-kind support Industry partners (commercial basis) Australian middleware (e.g. Australian Access Federation, MAMS project, MAPS project, APAC): Advice and in-kind support	1
13.	Encourage use of certificate authorities based in Australia.	Certification is an area of Australasian cooperation. Lack of a local certificate authority is not a barrier to NZ initiatives.	REANNZ KAREN members NZVCC SCIT CRI IT services BeSTGRID CAUDIT Australian CAs (.g. APAC, AUSCERT): Advice and in-kind support	4

14.	Deploy EduRoam in New Zealand.	Commitment is demonstrated to building trust amongst KAREN members and sharing resources.	KAREN members: Operational or strategic funds NZVCC SCIT: Advice and strategic direction BeSTGRID: TEC (current) Wireless service providers	5
15.	Promote the value of middleware to the KAREN community.	The KAREN community understands the importance of middleware and its relationship to e-research applications.	REANNZ KAREN members NZVCC SCIT CRIITAS National Library ITS	3
16.	Support the adoption and implementation of applications for real-time collaboration technologies for teaching and research.	Many users across many disciplines use real-time collaboration tools over KAREN.	REANNZ: CBF KAREN members: Operational or strategic funds NZVCC SCIT: Advice and strategic direction CRIITAS: Advice and strategic direction Technology providers (commercial basis) Industry partners	1
17.	Establish national services providing centralised infrastructure and support services for real-time collaboration technologies, including videoconferencing, the Access Grid and shared applications.	Technological and logistical barriers to uptake of real-time collaboration technologies are removed. The usage of real-time collaboration tools increases.	REANNZ: Additional operating funds; CBF KAREN members: Subscription, in-house support NZVCC SCIT: Advice and strategic direction Service providers (cost recovery or commercial basis)	2
18.	Maintain a watching brief on innovative technologies for collaboration, e.g. high definition videoconferencing, tele-haptics and augmented reality; promote these to the KAREN community and support their adoption and implementation <i>particularly where these applications make use of KAREN and/or facilitate collaboration, particularly with industry, and/or otherwise contribute to KAREN goals.</i>	New Zealand e-researchers have current knowledge of and access to best-of-breed applications. Knowledge of international best practice is maintained so that interoperability issues are minimised. Collaboration with industry partners is fostered.	REANNZ: CBF KAREN members: Operational funds; in-kind support Research funding bodies (e.g. FRST, HRC): Various research funds Policy agencies (e.g. MoRST, Ministry of Education) Industry partners	3

19.	Support the development, adoption and implementation of technologies that enable novel methods of data collection and analysis, including high performance computing, grid portals, tele-instrumentation, visualisation and simulation, and data and text mining, <i>especially where these applications make use of KAREN and/or facilitate collaboration, particularly with industry.</i>	New Zealand e-researchers have current knowledge of and access to best-of-breed infrastructure and applications. Collaboration with industry partners is fostered.	REANNZ: CBF MoRST / RIAG: business cases for infrastructure investment Research funding bodies (e.g. FRST) Industry partners	2
20.	Recognise that a coordinated standards-based approach to the storage and long-term management of datasets (primary research outputs) is required if sharing and re-use of data is to take place, and undertake to lobby relevant agencies with a mandate in this area.	Awareness of data storage and management issues increases amongst researchers, policy makers and funders.	REANNZ: Additional operational funds; CBF National Library: Operational and strategic funds Other KAREN members: Operational and strategic funds BeSTGRID: TEC (current) MoRST: Policy advice Research funding bodies: Strategic research funds	1
21.	Build relationships with relevant NZ and international initiatives that: <ul style="list-style-type: none"> • create digital resources (especially rich media) for the purposes of research and education; • digitise analogue materials for the purposes of research and education; • facilitate open access to research outputs (e.g. institutional repositories, Creative Commons); • encourage consortial purchasing and mirroring of large-scale and aggregated resources. 	Creation and delivery of digital resources (particularly rich media) is enabled by KAREN and contributes to KAREN usage. Access to resources for research and education is easier and more cost-effective.	REANNZ: Additional operational funds; operating activity National Library: Operational and strategic funds; in-kind support Other KAREN members: Operational and strategic funds; in-kind support MED: Digital Strategy funding CONZUL Cultural organisations Service providers (e.g. publishers)	3
22.	Maintain a watching brief on the development of innovative knowledge management / semantic grid technologies; promote these to the KAREN community; and support their adoption and implementation <i>especially where these applications make use of KAREN and/or facilitate collaboration.</i>	New Zealand e-researchers have current knowledge of and access to best-of-breed applications.	REANNZ: CBF KAREN members: Operational or strategic funds Research funding bodies (e.g. FRST, TEC, HRC): Various research funds Policy agencies (e.g. MoRST, Ministry of Education)	5

Sector capability: summary of findings

Key findings from environmental scanning and consultation with the KAREN community include:

- KAREN operates in a complex environment in which a wide range of central and local government agencies have policies, strategies and funding regimes that are relevant to advanced network capability building efforts.
- The amount of capability development funding within NZ is insufficient to meet the needs of the KAREN community and relatively low compared to other countries such as the US, Japan, Australia, the UK and other European countries.
- Lack of funding for research infrastructure in New Zealand is a long-standing issue. There are few obvious sources of funding for activities such as middleware adoption and deployment. The recent establishment by MoRST of the Research Infrastructure Advisory Group (RIAG) is a welcome step.
- There are multiple sources of funding for domain-based research grants and special initiatives, but it can be difficult to gauge how fund criteria will be applied to the inclusion of capability building components, which may have different outcomes than the overall project. The process of submitting proposals is often onerous.
- Significant strategic investment in e-research by government would be required to match the investment in e-learning capability building that was made via TEC's e-Learning Collaborative Development Fund (\$28 million over four years 2003-07).
- The KAREN community expressed a number of views about the operations of the Capability Build Fund:
 - There is consensus within the KAREN community that the CBF should not support substantial capital investments and organisations' operational expenses.
 - There is also agreement that CBF funds should not be viewed as a replacement for existing sources of funds for research. It is recognised though that some exemplar projects must have a research component in order to demonstrate benefits of KAREN in a 'real-life' setting: clarification of the role of the CBF in supporting exemplar projects may be required.
 - There is a strong desire in the KAREN community to avoid 'reinventing the wheel' and to re-use existing tools and leverage existing knowledge whenever possible.
 - Although there is an understanding that niche or domain-based applications will be required in some areas, there is also a strong consensus that support should be given to generic tools that can be widely used by researchers in many disciplines.

- There is an opportunity for the CBF to strengthen criteria around collaboration.
- Given the limited resources of the CBF and the competing demands on it, a process of direct allocation to well-defined projects in essential areas could be useful; an 'open' component of funding would still be required to ensure innovative initiatives did not get sidelined.
- High-value research areas have been identified through various government strategies. There are opportunities, but also risks, in aligning the Capability Build Fund goals more closely with these criteria.
- Significant international attention is now being shifted to e-research, not just e-science: it is recognised that the social sciences and arts and humanities have an important role to play and require support.
- There are opportunities to develop KAREN-related projects focusing on Māori teaching and research that would align with government priorities and existing capability building activities.
- There is support amongst KAREN members for REANNZ to widen the KAREN community, but to ensure that the needs of current members should continue to be a high priority for capability building. There is scope for involvement of other tertiary education organisations, schools and the cultural sector (especially the public libraries in the NZ People's Network) in the KAREN community. Health sector initiatives that could utilise KAREN (e.g. tele-medicine) should also be explored. Because of the development of the Shared Government Network, government agencies may require a different approach.
- REANNZ aims to connect KAREN with the "broader innovation community", which includes businesses that could operate as research partners, sponsors, commercialisers, service providers and consultants to KAREN members. A range of non-profit organisations are also potential KAREN members/partners.
- In the longer-term there is a need for national leadership by groups that represent the diverse interests of KAREN users and the wider R&E sector, and for the establishment of national (and/or regional and/or discipline-based) structures that support collaborative activities and coordinated planning and decision-making. Things of note relating to governance and support structures include:
 - There is no single preferred governance model or operational framework and further analysis will be required to determine appropriate structures for New Zealand, terms of reference and sustainable funding streams. There are many options that will need to be considered including steering committees and advisory groups; taskforces and commissions; support centres and centralised

service providers; advanced computing partnerships; trust federations; centres of excellence (not necessarily Centres of Research Excellence as defined by TEC, though that is one possible path); and less formal user-driven support structures such as special interest groups (SIGs) and 'birds of a feather' (BOFs).

- No single agency or centre can support all required functions; a number of related, but distinct, governance groups and support structures will need to evolve to address different needs.
- Roles and mandates must be considered in geographic, disciplinary, technical and organisational contexts, and relationships with REANNZ will need to be determined.
- Options for 'virtual organisations' and relationships with off-shore support centres and service providers need to be considered.
- It will be essential to leverage existing capability in the Vice-Chancellors' Standing Committee on Information Technology (SCIT), the Association of Crown Research Institutes (ACRI), the Council of New Zealand University Librarians (CONZUL), and the numerous professional associations for educators and researchers, many of which are associated with the Royal Society of New Zealand.
- The development of robust governance and support structures requires significant investment: strategic funding from central government and research councils has been required overseas.

Sector capability: recommended actions

	Action	Outcomes	Agencies and resourcing options	Priority <i>1=essential 3=important 5=desirable</i>
23.	Actively communicate with government about KAREN and capability building requirements.	Policy makers and funders are aware of KAREN and understand its value.	REANNZ and the Capability Building Advisory Panel KAREN members NZVCC SCIT ACRI Research networks	1
24.	Analyse existing funding structures; provide information to KAREN members that will assist them with accessing funds for capability building from sources other than the Capability Build Fund.	KAREN members are aware of funding opportunities. Funding bodies are aware of co-funding opportunities and the role of the Capability Build Fund.	REANNZ KAREN members: Operational or strategic funds; in-kind support Funding bodies (e.g. TEC, FRST): Advice and in-kind support	4
25.	Lobby for further strategic funding for collaborative e-research.	KAREN uptake and e-research development are kickstarted by additional investment. TEC's existing investment in e-learning is leveraged through enhanced advanced network capabilities.	REANNZ and the Capability Building Advisory Panel KAREN members TEC: Strategic funds Research funding bodies (e.g. FRST, TEC, HRC): Various research funds	2
26.	Consider ring-fencing portions of the Capability Build Fund for more direct allocation to projects specifically designed to address KAREN objectives, whilst still ensuring innovation through an 'open' component.	A component of funding directly allocated to high performing groups leads to success stories. An open component of funding fosters innovative use of KAREN and new kinds of research.	REANNZ and the Capability Building Advisory Panel	2
27.	Ensure that CBF funding criteria are consistent with international and national priorities, including mātauranga Māori.	Opportunities for co-funding are enhanced by recognition of existing research priorities. The international e-research landscape reflects the contribution of New Zealand knowledge, including mātauranga Māori.	REANNZ and the Capability Building Advisory Panel	3

28.	Ensure that CBF funding criteria encourage participation from all disciplines.	Success stories and exemplar projects reflect the diversity of New Zealand research.	REANNZ and the Capability Building Advisory Panel	2
29.	Strengthen CBF criteria in terms of collaboration (national and international) and inter-disciplinary work, and provide support accordingly.	Collaboration within NZ increases and/or improves. International collaboration increases and/or improves. Interdisciplinary collaboration increases and/or improves.	REANNZ and the Capability Building Advisory Panel	3
30.	Ensure capability building activities support the widening of the KAREN community, especially within the education and cultural sectors.	Steps are taken towards the KAREN objectives of universal connectivity and broad participation. Schools gain access to KAREN and are using KAREN to support learning, teaching and research. Libraries gain access to KAREN to support learning, teaching and research.	REANNZ: CBF KAREN members Polytechnics Ministry of Education & schools National Library, Local Government New Zealand and individual local government agencies with library services	4
31.	Provide opportunities for the KAREN community and the wider innovation sector to interact and collaborate.	The R&E sector becomes better connected to the wider innovation sector; this is greater potential for collaboration.	REANNZ: CBF KAREN members Industry partners and service providers Funding bodies (e.g. TEC): strategic funds for fostering collaboration with industry (e.g. Partnerships for Excellence)	3
32.	Investigate national governance and support structures; encourage the development of appropriate bodies, leveraging off existing groups and structures wherever possible.	KAREN capability building and NZ e-research development are facilitated by national structures that reflect the diverse needs of KAREN members. Centres of excellence and expertise are established. KAREN members, as well as policy and funding agencies, can seek advice from fewer and more authoritative sources.	REANNZ: Additional operational funds; CBF KAREN members: Operational or strategic funds; in-kind support Research funding bodies (e.g. TEC): Centre of Research Excellence (CoREs) and other strategic funds	3 <i>NB. This reflects the immaturity of KAREN-related activity: a higher priority would be expected in future years.</i>
33.	Ensure that national frameworks and programmes are both supportive of and supported by local capability initiatives.	KAREN members develop activities that meet local needs and support the national programme. Knowledge and best practice gained at the local level is shared with the wider KAREN community.	REANNZ and the Capability Building Advisory Panel KAREN members: Operational or strategic funds; in-kind support	4

Constraints and issues

The Roadmap's outcomes and actions have not been limited to what is achievable with the current level of resources available from the CBF or from within the member organisations. The questions of how outcomes can be achieved, and who will be responsible for them in terms of resourcing, are important; but not as important at this point in time as understanding the scale of the issues that are being addressed. This means that the activities and technologies that advanced networks internationally have successfully adopted have been documented in the Roadmap and given a priority based on the needs of the KAREN community and not on the available resources.

Unfortunately this means that there is a significant gap between what is outlined in the Roadmap and what is likely to be achievable in the current situation. REANNZ and the Capability Building Advisory Panel are tasked with developing a programme of activities over the next two years but are severely constrained by a number of factors:

a. Variability of existing capacity and capability and readiness to use KAREN

Issues around KAREN-readiness and inconsistent levels of capacity and capability are already arising within the current membership.

To take advantage of funding processes as they currently stand, organisations already have to be aware of KAREN, and to have buy-in from staff and access to a mix of technical skills and domain expertise. Internal capability development within KAREN members is uneven: governance structures, communication channels, staffing support and senior management buy-in all differ from organisation to organisation. Capacity is also variable across the membership: CRIs operate under commercial imperatives that leave staff with little time for the informal experimentation and hands-on learning required to gain familiarity with new technologies and embed them into everyday work. As universities are encouraged through new funding models to conduct more externally-funded research, these pressures could also become a wider issue.

Feedback from the KAREN community, and particularly CRIs, indicates that longer lead-in times are required for some organisations to experiment with KAREN, to make changes to existing processes and to develop new activities; in the meantime there is the danger that some organisations are moving rapidly forwards whilst others are left behind.

b. The need for KAREN to become sustainable through increased and more diverse membership

Issues with differing capability levels and capability building requirements will be exacerbated as new members come on board at later stages of KAREN's development. The broad vision for KAREN, combined with REANNZ's aim to be self-sustaining within the next few years, mean that KAREN's membership will expand. Currently the membership is limited to universities, CRIs and the National Library, but the benefits of broadband connectivity – as outlined in the government's Digital Strategy – mean that other organisations from the education sector (e.g. schools) and the cultural sector (e.g. libraries and museums) are keen to participate in KAREN activities, sharing resources and collaborating nationally and internationally on research and education initiatives. There is also momentum for greater collaboration between publicly-funded organisations and the private sector, and KAREN should facilitate this through enabling commercial organisations to access KAREN as associates of partnering KAREN members. In opening up KAREN to a wider constituency, prioritisation for capability building will be required. Growing and supporting the KAREN membership and wider network of collaborators is obviously important for KAREN's sustainability, but this growth means more capability building will be required across many more organisations, and that the needs will become more heterogeneous. It will be important to identify those areas that are specific to KAREN, and to ensure that existing capability building programmes are complemented and built upon, rather than replicated.

c. The complexity of the policy and funding environment

The possibility that the KAREN membership may expand rapidly and cut across multiple sectors means that planning for capability development is taking place within a policy and funding context that is perhaps more complex than that in which KAREN's international counterparts must operate.

The following diagram provides an overview of the many relationships between KAREN, KAREN members and other stakeholders in the wider environment.

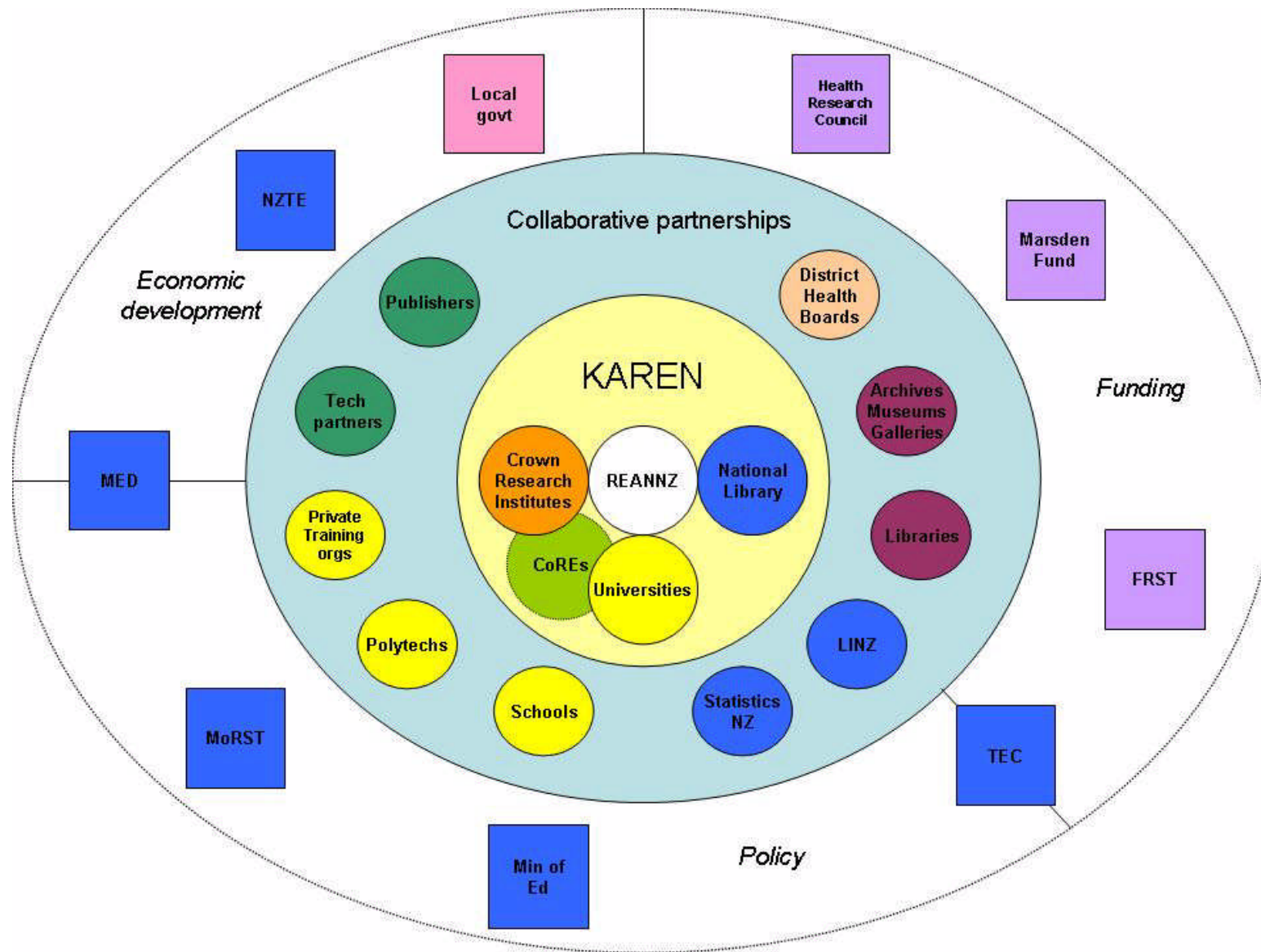


Figure 1: Relationship of REANNZ and KAREN to current members, future members and broader stakeholder environment

d. The amount of available funding

The NZ research community is embracing the opportunities offered by KAREN to enhance national and international collaborations. The Capability Build Fund is already achieving its objectives through awards of:

- \$2.6M to exemplar projects in astronomy, bio-informatics, agricultural research, collaboration technologies, social sciences, genomics, data storage, microbiology and earth sciences, which will provide success stories and transfer knowledge to other organisations;
- \$82K funding for workshops on collaborative communications, and travel to national and international events relating to grid computing, geography education, bioinformatics, and physics, providing valuable learning opportunities for NZ researchers and enhancing opportunities for international collaboration.

Although valuable as a 'kickstarter', the Capability Build Fund will only be able to cover a fraction of what is required for KAREN to become an essential part of New Zealand's research and education infrastructure, and for the New Zealand workforce to get up to speed with the infrastructure and applications that will become available to them. The CBF's total expenditure over four years will be roughly a tenth of what has been spent on the network overall; prioritisation will be needed and it is likely that many important activities will be delayed or will not happen unless other sources of funding can be found.

The community is actively exploring ways of engaging with government to further NZ's research infrastructure through sources other than the CBF, such as TEC's various funds and the process established by MoRST for the Research Infrastructure Advisory Group (RIAG). The absence, outside the CBF, of funds dedicated to building capability – in terms of people, technology and the wider network of stakeholders in the innovation community – leaves a gap that cannot solely be met by the KAREN members if all the activities outlined in the Roadmap are to be achieved.

The role of research funds is also not clear. Agencies like the Foundation for Research, Science and Technology, the Health Research Council, and the Tertiary Education Commission will need to explore support for capability building: as New Zealand takes its place in the world of advanced networks, the technology and skills required for world-class collaborative and/or data-intensive e-research will need to be developed if projects are to succeed.

Although precise figures for comparative levels of investment are difficult to source, the amount of funding for building e-infrastructure and related skills seems low by international standards for this kind of initiative. In 2004, the University of

Queensland's Distributed Systems Technology Centre collated statistics across e-research programmes that revealed that the EU, Japan, the UK and the US were investing NZ\$135-365M a year as part of multi-year programmes. Of course these investments have been made within much larger national frameworks, but even considering investment on a per capita basis the current level of investment by NZ is at the low end; roughly a quarter of the US's and a sixth of the UK's per capita investments in dedicated funding for e-research (which builds on, but does not for the most part include, outlays for the advanced networks or substantial funds for e-learning initiatives).²

As our nearest neighbour and an important partner in much collaborative research, Australia provides a counterpoint to the situation in New Zealand. By September 2006, the Australia government had invested a total of AUS\$84M (NZ\$94) in AARNet, but it has also recently announced a provisional investment of AUS\$75M (NZ\$84M) over four years to support 'Platforms for Collaboration' (PfC) as part of the National Collaborative Research Infrastructure Strategy (NCRIS). PfC will develop essential e-infrastructure – in the areas of data management, computation and interoperation/collaboration – and the skilled workforce required to support these. It is important to note that the PfC Investment Plan is largely independent from the operation of AARNet, which is now well-established and considered as 'foundational infrastructure'. This funding also augments investment relating to specific research: eight high-value areas have been awarded the remainder of the AUS\$500M (NZ\$558M) that has been allocated to NCRIS as a whole. NCRIS also builds on more than five years of sustained investment in research infrastructure including schemes such as:

- the Major National Research Facilities Programme, which allocated AUS\$150M (NZ\$167M) to fifteen infrastructure facilities in 2001-2006;
- the Systemic Infrastructure Initiative, which allocated AUS\$246M (NZ\$275) over the same time period to link or expand access to shared facilities, introduce new e
 - research initiatives and foster collaboration.³

These figures are not intended to downplay the importance of the CBF and the impact that these funds are already having within the KAREN community. They do suggest though that realistically the CBF must be treated as the first 'seed funds' available for

² Hunter, Jane, Rob Cook, Simon Pope [Distributed Systems Technology Centre, Australia]. March 2004. E-Research Middleware: The Missing Link in Australia's e-Research Agenda. Discussion Whitepaper on E-Research Middleware for submission to The Commonwealth of Australia Department of Education, Science and Training National Research Infrastructure Taskforce: 7. <http://www.itee.uq.edu.au/~eresearch/papers/eResearchMiddleware.pdf>.

Figures sourced by the DSTC relate to: the European Union's EGEE, GEANT and other programmes (but not including national programmes within member states); Japan's Information Technology Based Laboratory (ITBL), National Research Grid (NAREGI) and Grid Technology Research Centre (GTRC) (some network infrastructure funding is included for Japan); the UK's e-Science Programme (middleware component only); and the US's Advanced Cyberinfrastructure, Internet2 Middleware and NSF Middleware Initiatives.

³ Department of Education, Science and Training [Australia]. Research Infrastructure. http://www.dest.gov.au/sectors/research_sector/programmes_funding/general_funding/research_infrastructure/.

this area of work. The figures demonstrate that our international counterparts are providing capability development activities and services with ongoing financial support so that for educators and researchers continue to make the most of advanced networks and maximise initial national investments in them.

e. The limited timeframe

As described above, membership, underlying technologies and activities that are conducted over KAREN will grow and change over time. It follows from this that capability building should be seen as an ongoing activity; however, the CBF has a very short timeframe. As noted above, this is particularly an issue in an environment where even current members are starting with very different levels of existing capacity and capability.