



A Response from AARNET to the DCITA Discussion Paper:

Broadband Connect and Clever Networks: Supporting Investment in Sustainable Broadband Infrastructure November 2005

AARNET Pty Ltd (APL) welcomes these two initiatives, aimed at improving network infrastructure in regional, rural and remote parts of Australia. APL endorses in broad terms the approaches being proposed for both initiatives, and makes below a number of comments which it hopes will be helpful to DCITA as these programmes are launched.

AARNET Pty Ltd, Australia's Research and Education Network, provides high capacity, cost-effective Internet services to the education and research communities and their research partners both nationally and internationally. AARNET serves over 1,000,000 end users who access the network through local area networks at member institutions.

The intention of this response is to comment on the above discussion paper. This is not a submission on or definitive summary of the opportunities that exist for the future development of the Australian Research and Education Network.

AARNET has previously made informed representations to government on policy, legislation, strategy and programmes to improve the telecommunications facilities and services available not only to the education and research sector but also to the whole Australian community.

For instance, the research and education community has benefited from far-sighted investments under the government's Backing Australia's Ability. This Strategic Infrastructure Initiative funding to the universities has assisted AARNET to acquire access to high bandwidth capacity on the advanced fibre optic network, NextGen Networks (spanning the nation from Brisbane to Perth) and to Southern Cross Cable Networks for SXTransPORT (spanning the Pacific Ocean). In addition, AARNET or its members have acquired access to fibre and other capacity to provide individual connections to the sites of all its members, including regional locations across Australia (including within Tasmania) and Darwin.

Australia has in its research an education network, AARNET, a world leader in the provision of communications infrastructure and the continued investment in this network will provide the best possible return to the nation. This network is a vital element in international collaboration engendering the development of intangible networks; and of 'person to person collaboration'. Researchers and educators across Australia are engaging in joint research, exchanging information using the wide range of collaboration models, tools and information that are facilitated by AARNET.

Further information concerning AARNET and its network can be seen in Appendix A.

Comments on the Discussion Paper:

AARNet makes these comments in the light of the following position statement about the critical strategic importance of communications infrastructure:

Communication networks are among society's most important infrastructures. They underpin the economic growth of Australia. They are vital to the operations of many sectors of our society: from research and education and healthcare to the commercial competitiveness of our financial and manufacturing sectors.

1. AARNet specifically applauds the government for this initiative, designed as it is to address some of the connectivity deficiencies of regional, rural and remote Australia, where special challenges are presented by the enormous distances and sparse population involved. It has made its own efforts (as outlined in the Appendix) to address the equity issues of access to high-speed networks by some of its regional and remote member sites. Not all these requirements have yet been adequately addressed, and we believe that demand aggregation with other educational, health and similar agencies may well provide the best opportunity to address many of these needs.
2. In order to provide equity of access for regional Members AARnet is looking to fill the “gaps” in the reach of the R&E network (together with those of its members).

Access to extensive ‘dark fibre’ is key to building a flexible, high capacity national backbone, to provide access to a large number of regional sites with network capacity unprecedented outside metropolitan areas. Those areas that will benefit from this focus are:

- Queensland/Sunshine Coast
- North Queensland
- Adelaide – Alice Springs – Darwin (a long term sustainable solution)
- Adelaide – Whyalla – Pt Lincoln
- Adelaide – Ceduna (radio telescope at Ceduna)
- Melbourne – Hobart
- Perth – Bunbury
- Perth – Geraldton – Mileura Station (in the Gascoigne)
- Redundancy for regional connections such as Wagga Wagga

Specifically in relation to Connect Australia, AARNet and its members will be looking to collaborate with other compatible agencies in making bids which will serve them, AARNet’s members, and the broader community wherever possible, by acting as “anchor tenants”, or installing fibre which can be shared by others.

3. AARNet notes that the connectivity requirements of its members are typically significantly greater than what is normally termed “broadband”, with 10Mbps regarded as a desired minimum connectivity, and typically speeds of 1-10 Gbps being desired. Also some services to research and education are better delivered over dedicated circuits. For example extending the AARNet optical network from Adelaide to Perth would also provide equity of advanced networking services to WA. In addition, many of the applications our members wish to run across the AARNet network cannot tolerate significant latencies or delays, so that satellite is rarely the most appropriate solution.

[Broadband Connect Question 4: Is terrestrial or satellite the most appropriate means of delivering broadband in regional, rural and remote areas?].

4. AARNet is firmly committed to the view that fibre (or similar technologies) is key to building the critical communications infrastructure that it and its members have come to rely upon. Experience of all research and education networks worldwide confirms this view, which enables a greater degree of disconnection between capacity and cost. The rate of growth in demand for bandwidth is such that the costing and pricing models of conventional carriers is inappropriate, stifling the high-growth demand that creates new opportunities, technologies and industries. This is absolutely true for research and education; but we are firmly of the view that the same applies to government and the commercial sector. We therefore urge DCITA to give high priority to bids which seek to install basic fibre backhaul capability, either to unserved localities or to localities currently having a single supplier, offered in a shared way among diverse entities, in a fashion that can generate competitive local service provision (eg see 6 and 7 below). We believe that funding needs to be directed towards creating orders of magnitude improvements in capacity and price, rather than incremental improvements.
5. AARNet also brings to DCITA's attention the possibility of exploiting "drop-offs" from AARNet's existing or planned fibre network, or that of its members, to improve connectivity to regional and rural communities in close proximity to the physical route that those fibres take, and where existing contracts with other interested parties permit.
6. AARNet understands the trade-offs between directing resources on the one hand towards improving existing connections to regional, rural or remote areas (to more closely match those pertaining in the major cities), and on the other hand towards addressing new areas currently hardly served at all (and which, for instance, were not recipients of grants under the previous NCF and HiBIS programmes). However, AARNet is convinced of the critical importance of providing this basic infrastructure (akin to the Nation's roads), and as such would urge that special efforts be made to extend the reach of the country's fibre infrastructure at this time. In general, it is much easier at a later date to improve the capacity of such links than to extend existing links to unserved areas.
7. AARNet believes that there may be some areas where the investment to provide adequate capacity is still too great to expect commercial operators to undertake it. We think, for example, of Darwin, where attempts to foster competitive provision are not likely to succeed in the short term. We believe that consideration should be given to the following approach in areas of such strategic national importance: some portion of the funding being provided under these programmes should be used directly by DCITA itself (perhaps under contract) to build fibre backhaul runs to such locations to provide the necessary alternative provision; invitations could then be issued to the industry to bid to operate networks based on these backhaul runs. The bidders should undertake to operate these networks on an ongoing basis (this is much more likely to be financially viable if the initial capital injection has already been made), with the capital sum they pay for these rights being used to offset in part the capital injection made by DCITA.

AARNet has no other direct comments to make in response to the specific issues and questions raised in the Discussion Paper, but stands ready to collaborate with appropriate agencies or its own members in making submissions under the Clever Networks programme when it is launched.

Appendix A: AARNet, the Australian Academic and Research Network

AARNet Pty Ltd is the not-for-profit company that operates the AARNet network which provides high-capacity Internet services to Australia's universities and research institutions, including CSIRO, DSTO, ANSTO and certain other related organisations as permitted by the AARNet Access Policy. Shares in AARNet Pty Ltd (AARNet) are held by 37 Australian universities and the CSIRO. AARNet is a licensed Australian telecommunications carrier (No. 61 under the Telecommunications Act 1997 Cth).

Its Board of Directors is made up of appointed and elected representatives of the sector and the community. The Chief Executive Officer reports to the Board of Directors.

AARNet has offices and staff in all mainland States, and its headquarters in Canberra. It is assisted by the AARNet Advisory Committee (AAC) which represents the interests of the members and is a principal source of considered advice on policy and business matters. The AAC also provides advice and recommendations on technical and operational matters to the CEO. Regional network organisations, which are generally state based, each elect one representative to the AAC. These organisations have been instrumental in collaborating with governments in developing rural and regional networking capabilities, in particular through earlier initiatives such as NCF and HiBIS.

The development of AARNet3:

The development of AARNet since 2004 has been guided by the concept, "the Australian Research and Education Network" (AREN), which was developed by the Australian Research and Education Advisory Committee (ARENAC), reporting to the Minister for Education, Science and Training. AARNet also provides technical expertise to this committee, and undertakes the acquisition of infrastructure and services to assist Research and Education as necessary from time to time.

In this role, AARNet has acquired fibre capacity to serve its members right across Australia, including many regional and rural locations (see maps at Figures A and B), which has upgraded the network from the previous AARNet2 to AARNet3. In addition, it has acquired a range of high-speed international connections (see map at Figure C).

The development and importance of international relationships has grown with AARNet now being represented on the International Committee of the Board of Internet2, the Coordinating Committee for Intercontinental Research Networking, the International Task Force on Advanced Networks, and the Asia Pacific Advanced Network Backbone Committee. AARNet is also engaged with the European Commission on research networking and support for e-science.

For Australia to continue to participate in internationally recognized initiatives, AARNet intends to capitalise on these previous investments and plan for the future. In particular, AARNet is working to provide equity of access for regional Australia and connectivity into the growing Asian market. AARNet also endeavours to keep pace with the significant innovations that are necessary to facilitate new applications and to meet the future demands of the government's national research priorities.

AARNet is well on the way to establishing strategic global infrastructure. It has plans to augment this with increased connectivity to Europe for high energy physics, South Asia and Africa for education, and North Asia for both research and education. However, to support the next generation of research networks in this vitally important age of global communications,

AARNet is seeking to provide for a future in which communication networks are available ‘anywhere and any time’ and be accessible from a variety of devices. They will need to be more robust and immune from attacks to be entrusted with the communication traffic vital to research and education.

The recently commissioned AARNet3 network is such a quantum leap in capacity from the previous AARNet2 network that it is difficult to quantify the unmet demand likely to be unleashed as clients utilise their direct linkages to AARNet3. However we expect that the backbone capacity will satisfy this demand.

Network users have been characterised into 3 broad groups¹. These groups are:

- A. Lightweight users, browsing, mailing, home use: these users need full Internet routing, one to many;
- B. Business applications, multicast, streaming, VPN’s, mostly LAN: these users need VPN services and full Internet routing, several to several + uplink; and
- C. Scientific applications, distributed data processing, all sorts of grids: these users need very fat pipes, limited multiple Virtual Organizations, few to few, peer to peer.

The AARNet3 (router based) backbone is designed to support users in the first two categories and the initial phases of the third. Experience from Canada, where CANARIE made no significant backbone capacity upgrade when it transitioned from CA*net3 to CA*net4, would suggest that growth to support these users is relatively slow and so within the next 5 years AARNet is unlikely to require capacity upgrades to the AARNet3 backbone, although increasing its reach is expected.

The drivers for additional capacity for the next 5 years will be the users in the third category. While these users are small in number, their bandwidth demands are high and often include an international component. AARNet’s optical network will give it the opportunity to provide dedicated “light paths” to support the activity of these users, but as instruments such as the SKA, LHC and ITER become available the demand for bandwidth by Australian and international researchers using these facilities may require AARNet to upgrade the optical network to 40Gbps and beyond.

AARNet is also very conscious of the need to extend the reach of its network to regional, rural and remote areas currently not well served. Accordingly, it will be looking to every opportunity to extend that reach, whether on its own, in partnership only with its own members, or in conjunction with other compatible user categories within the same regions.

Support for innovative applications and architecture in a secure environment:

AARNet recognises that its endeavours to keep pace with the significant innovations that are necessary to facilitate new applications and to meet the future demands of the government’s national research priorities cannot be done alone.

AARNet has established a number of technical and specialist Working Groups which draw on the collective expertise of universities, research organisations and industry to encourage innovative uses of the AARNet network and to develop leading edge applications and services. Working groups typically comprise a small steering committee and a much larger interest group. Working Groups are encouraged and assisted to undertake pilot projects, demonstrations, proofs of concept and the like, as well as general educational and dissemination initiatives designed to

¹ Cees de Laat, of the Informatics Institute at the University of Amsterdam.

encourage and promote the development and uptake of new services. They thus provide an invaluable mechanism for drawing on the collective expertise of AARNet's members, as well as devising, developing and promoting new applications to exploit network capabilities. AARNet also works with organisations such as NICTA and APAC which are developing the technology, applications, services and innovative curricular and educational materials to prepare the next generation of Australians for their place in the competitive global marketplace.

AARNet will continue to develop its capability to support the advanced features of IPv6, multicast, VOIP and video-over-IP, which are all strategically important to the research and education sector. Both nationally and internationally, governments are driving IPv6 development to underpin their manufacturing sectors. The Australian Defence Department requires all networks to be IPv6 compliant by 2008.

VOIP and Video-over-IP are top of the list of clients' requirements, and the AARNet3 network provides the quality of service needed to support differentiated standards. AARNet would benefit from dedicated resources to meet the growing needs for these applications to be successfully implemented. Network security is vital to ensure the trust in the network. AARNet would recommend any significant collaborative initiatives aimed at improving and developing new capabilities in network security.

AARNet and ResearchChannel demonstrated the first high definition uncompressed interactive video interaction across the Pacific at 1.4 gigabits per second in each direction throughout the week of the Supercomputing 2004 conference (SC2004, 8-12 November 2004, Pittsburg, Pennsylvania).

This was made possible by the massive increases in bandwidth capabilities from Australia to the continental United States on network capacity provided by Southern Cross Cable Networks, and delivered a truly remarkable quality video interaction between AARNet's head office in Canberra and the Supercomputing Conference in Pittsburgh.

The partnership between ResearchChannel and AARNet has spurred the development of high speed networks and enabled data transfers previously unavailable between the two continents opening a whole range of scientific and research collaborations that exploit new Internet technologies.

AARNet proposes to offer these and additional resources to other continents, and bring scientists and researchers together by exploiting new Internet technologies.

AARNet is thus an important source of information and expertise (both within the company itself, or by drawing upon its extensive member network) on emerging applications and services which are expected to drive demand for bandwidth and reach in the future.

AARNet support for the wider Education Initiatives:

AARNet is willing to support education pilots that need national and international connectivity to information resources such as on-line learning information such as EdNA Online, The Learning Federation and myfuture content.

Cooperative Research Centres emphasise the importance of collaborative arrangements to maximise the benefits of research through an enhanced process of utilisation, commercialisation and technology transfer. There is also a strong education component. CRCs operate in many areas, including Agribusiness, Environment, IT Standards and Services, Manufacturing,

Minerals and Energy, Pharmaceuticals and Human Health. AARNet works with members to understand their needs and those of their own communities.

Figure A: AARNet's National Network:



Figure B: AARNet’s Regional Network based on NextGen Fibres:



[AARNet and its members have acquired, and thus could make available drop-off points on, additional fibre networks in WA, SA, NSW, Queensland, Victoria and Tasmania]

Figure C: AARNet’s Global Connections:

