



3 July 2009

VERNet Pty Ltd

Submission to the Senate Select Committee on the National Broadband Network: Revised Terms of Reference

“All schools and educational institutions should be connected to broadband internet services to facilitate research, support interactive learning and provide access to innovative and varied curriculum content.”

Recommendation 8, *Australia's Broadband Connectivity: The Broadband Advisory Group's Report to the Government* National Office of the Information Economy, 2003

“Our capacity to innovate depends on a solid platform of enabling knowledge and technologies. A weakening of that platform over time will have serious consequences for our international standing and our national prosperity.”

Venturous Australia: Building strength in innovation Cutler & Company Pty Ltd, 9 September 2008, Annex 6 pp12-13.

“...the reach, quality and performance of a nation's higher education system will be key determinants of its economic and social progress.”

Executive summary p xi, *Review of Australian Higher Education Final Report* , 17 December 2008

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1.1 Summary

The Australian research and education sector has unique high bandwidth and connectivity requirements that are best met by dedicated dark fibre networks. This has been acknowledged and recommendations for investment or reform made in numerous past sector or telecommunications inquiries; yet the available infrastructure does not reach far enough nor does it provide the necessary capacity.

The NBN represents a unique opportunity to provide key infrastructure for Australian growth and innovation by building on existing research and education networks in the course of the NBN rollout.

VERNet like its counterparts wishes to assist with deployment of the NBN wherever possible. It will continue to attempt to address immediate needs while the NBN arrangements are finalised and the network itself established.

1.2 About VERNet

VERNet Pty Ltd (**VERNet**) is a private company owned by the CSIRO and the nine universities operating in Victoria. Established as the realisation of a long-incubated vision for provision of telecommunications infrastructure for the Victorian research and education sector, VERNet is a licensed carrier under the *Telecommunications Act 1997* (Cth).

Since incorporation in November 2004, VERNet has built, leased or procured 1700km of optic fibre cable throughout metropolitan Melbourne and regional and rural Victoria to connect key sites of its ten members to each other and to the Victorian Point of Presence (**PoP**) sites of the national R&E telecommunications backbone, the AARNet. The Victorian Research and Education Network operated by VERNet (**VERN**) links 120 sites and represents tens of millions of dollars in deployed capital comprising member equity and Commonwealth Government funding. The Victorian Government has also assisted by facilitating access to the network owned and operated by Victorian Rail Access. Phase One of the VERN is now complete.

Recently, VERNet's performance in delivering its members' requirements and utilising capital was independently assessed in a network assurance review following completion of the VERN Phase One rollout. Although the report is confidential, it favourably assessed both the scope and capability of the VERN in meeting member requirements and the procurement/pricing outcome as against market alternatives. The report recommended further investment to

fully realise the network's potential and ensure that it continues to meet the sector's evolving needs.

1.3 Topics to be addressed in this submission

VERNet does not have the expertise to respond to all aspects of the revised terms of reference. However, VERNet's experiences in delivering complex, large-scale dark fibre networking to regional Victorian research and education centres give it a unique perspective on several of the issues raised by those terms. This submission will address:

- connectivity for education and research and the particular bandwidth requirements for the research and education sector;
- the implications of telecommunication infrastructure support for national innovation and growth;
- the availability of bandwidth products to the sector and the effect of the NBN on such availability; and
- public policy goals for communications in Australia.

2 Telecommunications and the Research and Education sector

2.1 Research and Education Networks

Australian research and education telecommunications infrastructure is provided by institution-specific links (generally, microwave or managed services) and research and education networks (**RENs**) connecting multiple institutions and campuses. Different RENs service State requirements, for example VERNet in Victoria and SABRENet in South Australia, and provide the national intercapital backbone and international interconnect, the AARNet. The Australian Research and Education Network (**AREN**), is itself a "network of networks" to enable intercampus, interstate and international connectivity for Australian research and education.

Generally, the State and Territory RENs provide intercampus connectivity, regional and remote trunk infrastructure, "last mile" and "middle mile" connections between sites and other service providers and interconnect to the AARNet PoPs. The REN operators and their nature vary. Where they are separately incorporated entities, they are not related bodies corporate, but may have common shareholders with other RENs. Inter-REN access is obtained by arms'-length commercial negotiation.

2.2 Drivers for connectivity

The NBN "90% connectivity" statement includes schools and the Government is separately investing fibre connection for schools.

But education in Australia comprises much more than schools. It is a spectrum; not just “K to 12” but including preschool, tertiary (both higher and vocational education), adult, community and elder education.

Tertiary education entities have important partnerships with hospitals and health services; other education providers; CRCs and other research centres; cultural centres such as museums and State libraries; and community programmes. These partnering programmes need students, educators and collaborators located off-campus to have access to high-speed, reliable communications with the primary campuses and systems. Local delivery of, or access to, tertiary education is an important social and economic benefit to many remote and regional communities.

Education has long been acknowledged as an industry sector with “unusually high” bandwidth requirements; another, health and community, is closely aligned to education¹. In spite of already significant investment the higher education sector still requires substantial expansion to obtain the services necessary and desirable to support world-class education. Other education providers may have to resort to low-capacity links that simply do not enable effective access to remote data repositories, regional students’ videoconferenced access to specialised education or collegiate realtime communication.

Australian researchers and innovators also increasingly require telecommunications connectivity in order to access remote knowledge bases and collaborate with peers. There are some research areas which by nature require high bandwidth capability such as certain astronomy programmes, complex computer modelling and design applications and the world-class physics research undertaken by the Australian Synchrotron. These research initiatives already require capacity far beyond the bandwidth limits described in the Committee’s terms of reference, and require both further reach (for instance, network extensions to enable and increase eResearch collaboration) and service enhancement (bandwidth upgrades to 10 Gbps have already been undertaken by VERNet to accommodate high-performance requirements at several Victorian universities). However, telecommunications infrastructure is rarely explicitly recognised as a base requirement for better education delivery or enhanced research capability.

REN access or enhancement can be very difficult to accommodate under the existing Commonwealth funding programmes². Generally, RENs do not undertake higher or tertiary education or research themselves, although they may actively facilitate particular examples. VERNet itself was established as a result of a large-scale co-operative effort by multiple institutions. In a competitive grants environment, it is more usual for institutions to seek funding

¹ *National Bandwidth Inquiry*, Australian Information Economy Advisory Council April 2000, chapter 6.

² For example, none of the Education Infrastructure Fund (EIF) Round 1 or Round 2 funds were allocated to telecommunications infrastructure projects, notwithstanding at least one bid by a REN. The Research Block Initiative Grant (RIGB) programme expressly excludes capital works, which prevents such funds being used for network extensions to remote campuses. The Systemic Infrastructure Initiative (SII) programme has ceased and the Capital Development Pool (CDP) programme is intended only for minor projects.

for network enhancement of direct benefit to their own campuses or programmes rather than for general network upgrades or new links of benefit to the sector generally. Funded requests for enhancement of the VERN have related to individual institutions' needs.

2.3 Research and Education bandwidth requirements

Unlike homes, or many workplace environments, education and research requires very high capacity bandwidth. Videoconferenced distance education, realtime online interactive collaboration, data repository access, massively parallel compute-intensive applications and collaborative research project each require reliable telecommunications connectivity at 1 Gbps or more to be effective or even possible. This need has driven the various RENs established across Australia.

Broadband capacity has not been commercially available at affordable terms or at all,³ especially to regional or remote campuses or at the high capacity required. This has forced the research and education sector to establish its own telecommunications infrastructure using dedicated dark fibre wherever feasible. The networks have been procured with a range of sources and include purpose-built OFC vested in the REN, co-built leaseback arrangements, leases of pre-existing cores and leased wavelengths. Suppliers are also typically diverse, including carriers, utilities and other infrastructure providers such as rail transport entities.

In addition to the national intercapital REN, several localised initiatives have established purpose-built networks to replace individual institutions' managed service connectivity or microwave links, which no longer adequately service requirements. These RENs procure, manage and operate the infrastructure on behalf of multiple institutions with the purpose of delivering scalable and more extensive and cost-effective networks than could be achieved by the institutions acting for themselves alone.

Currently delivered transmission capacity on the Australian RENs already far exceeds the 100 Mbps (OFC) or 12 Mbps (satellite) bandwidths proposed for the NBN. By late 2002, most research and education requirements had been identified as needing 100Mbps to 1 Gbps and demand has grown since that time; growth has historically been at 30-50% p.a.⁴ The VERN, and comparable dedicated R&E networks elsewhere in Australia, delivers a baseline 1 Gbps capacity now. VERNet has also provisioned 10 Gbps services over a number of links and is currently assessing 40Gbps and 100Gbps trials.

³ *A Framework for An Australian Research and Education Network: The Final Report of the Systemic Infrastructure Initiative Higher Education Bandwidth Advisory Committee* Commonwealth Department of Education, Science and Training November, 2002; *Australia's Broadband Connectivity: The Broadband Advisory Group's Report to the Government National Office of the Information Economy*, 2003 p 26

⁴ Commonwealth Department of Education, Science and Training *A Framework for An Australian Research and Education Network: The Final Report of the Systemic Infrastructure Initiative Higher Education Bandwidth Advisory Committee* November 2002 pp 6 & 40.

The NBN vision to connect 90% of all homes, schools and workplaces does not clearly include tertiary education or research institutions (other than as workplaces). If these sectors are intended to be covered by connection via “next generation wireless” to premises outside the 90% coverage statement, there is a significant bandwidth shortfall against the current and projected needs of research and education connectivity in Australia. If the NBN will offer only upstream wholesale supply of managed services, it will not address the needs of a critical component of Australia’s society and economy.

Research and education need competitive links to reach locations with poor current service. Rather than access to services retailed over NBN infrastructure, research and education entities require access to dark fibre or, perhaps, wavelength services, for operation of the high-demand applications of the sector. The NBN initiative represents a unique opportunity to deliver cost-effective connectivity for Australian research and education.

3 Telecommunications infrastructure and national innovation and growth

3.1 Education

“The education and health sectors have a critical need for high quality internet access in regional, rural and remote areas.”⁵ Education now requires broadband capacity rather than internet access alone, but the need remains critical. Notwithstanding a number of vision statements and funding initiatives, only forty-seven percent of Australian schools have fibre telecommunications connectivity.⁶ For geographically dispersed Australian school students, high-bandwidth communications could be a key enabler of collaborative education.⁷ Students and teachers may be able to achieve better educational outcomes through sharing resources and knowledge.

The Bradley Report identifies broader participation in higher education and nurturing a breadth of education and research capability as key elements of necessary, critical changes to education in Australia. Regional/local delivery through collaborative arrangements is recommended.⁸ High-capacity broadband access at rural, remote and regional locations could assist delivery of the Bradley Report’s objectives of increased social equity participation, improved distance education, improved access for indigenous and disadvantaged students. The recommendation that students choose their education providers will have more impact and scope if students can access Australia’s best systems and educators without being concentrated in a few physical locations⁹.

The report also contemplates the establishment of a new regional university and increased collaboration between institutions and community resources. If

⁵ *Connecting Regional Australia: The Report of the Estens Regional Telecommunications Inquiry*, 2002, Finding 5.5.

⁶ *Towards a National Vision of Connectivity for Australian Schools*, DEEWR, August 2008

⁷ *Ibid*, p 9.

⁸ Recommendations 4, 16 and 31.

⁹ Recommendation 25.

these recommendations are to be effected, extension of research and education telecommunications infrastructure will be critical.

3.2 Science and innovation

In 2003, connectivity to international peers and resources was seen as the core deliverable that broadband reform could contribute to the Australian research community.¹⁰ Since then, the AREN has implemented international and national backbone connectivity, and a number of State and territory RENs provide the campus-to-PoP connectivity required to take advantage of this important infrastructure. The challenges for research and innovation communications are now to facilitate collaboration and co-operation between disparate disciplines and institutes within Australia as well as overseas.

Telecommunications infrastructure is increasingly a basic tool of research and scientific endeavour. It does not yet appear to be recognised as a substantial indirect cost, an element of the full-funding shortfall identified in the Cutler Report.¹¹

As with higher education, breadth and coverage are emphasised and the importance of domestic and international networking recognised¹². Although this appears to be intended in the collegiate rather than the technology sense, there is no doubt that access to high-quality communications enhances collaboration and participation opportunities. Co-ordination and collaboration between institutions and researchers are recognised as strategies to reverse fragmentation and improve research performance.¹³ There is no recommendation as to the infrastructure and systems necessary to underpin such an approach: world-class collaboration requires world-class communications in a country of dispersed research centres. Research funding is "overwhelmingly episodic and ad-hoc"¹⁴. In VERNet's experience this includes funding for communications infrastructure which is intended to support research, rather than being its subject.

3.3 e-Research

e-Research is a relatively new descriptor of activities and methodologies that rely on high-capacity broadband, data repository access and collaboration and interaction to undertake research.

Research and education institutions have an increasing focus on e-Research as an approach which "...is revolutionising researchers' ability to collect, generate, share, analyse, store and retrieve information i.e. to conduct e-Research. Crucially, it also provides platforms enabling increased levels of collaboration – not only within the research community (across institutional, disciplinary and national boundaries) but also between the research community and users of research in the business and wider communities. This is critically

¹⁰ *Australia's Broadband Connectivity: The Broadband Advisory Group's Report to the Government National Office of the Information Economy*, 2003.

¹¹ See "*Venturous Australia: Building strength in innovation*" pp 7, 13 and 67 and Recommendation 6-1.

¹² *Ibid* p 70

¹³ *Ibid* Recommendation 6.5

¹⁴ *Ibid* p 77.

important given the great distances over which our research resources are dispersed within Australia, and between Australia and other countries.”¹⁵

The 2006 *e-Research Report* acknowledges that further investment in telecommunications infrastructure will be necessary to support e-Research capability: “...there will be an ongoing need to extend broadband capability.”¹⁶ The Report contemplates extensions to remote institutions and to data sources. Yet initiatives for telecommunications infrastructure extension and capacity expansion barely feature in the Report.

This issue is inherent in the highly targeted nature of funding for e-Research and research generally. Funding is available for data repositories, climate change and sustainability, and specific research capabilities such as marine biology centres. None of these appears to encompass the basic connectivity necessary to deliver policy outcomes. A new data repository that is effectively inaccessible to regional and remote researchers is not going to improve the breadth and diversity of Australian research and education participation. The National Collaborative Research Infrastructure Strategy (NCRIS) Committee, which assumed responsibility for decisions on systemic infrastructure investment, has made provision for telecommunications in relation to specific initiatives rather than a general, systemic improvement. The 2009-2010 Commonwealth Budget allocated \$37M over four years to extend and upgrade the AREN, primarily to facilitate researchers’ access to data sources and remote locations. High performance computing centres and regional data repositories and other high volume data sets are notable connection targets.

These funds will not be adequate to address the more difficult connectivity issues. For example, the cost of works to connect just one remote Victorian location - Echuca - to the VERN is estimated to be \$9M. Even if Echuca qualifies as one of the AREN extension connectivity targets, the cost represents almost a quarter of the entire four-year budget for all RENs to extend and enhance communications. In Victoria alone there are competing interests for extension or expansion and in fact there are Victorian campuses even further from the backbone. It seems unlikely that the AREN expansion budget by itself will comprehensively address the research and education sector’s general needs for connectivity and capacity.

4 Broadband availability and the expected effect of the NBN

4.1 Availability, price, level of innovation and service characteristics of products presently available

Dark fibre is decreasingly available in the Victorian market. Since VERNet’s incorporation at the end of 2004, the number of commercial suppliers (carriers

¹⁵ *An Australian e-Research Strategy and Implementation Framework: Final report of the e-Research Co-Ordinating Committee* April 2006, p 2.

¹⁶ *Ibid*, p xi.

and utilities) willing and able to offer dark fibre in the Victorian market has shrunk dramatically. At the same time, prices for such services as are available have increased. There appears to be a trend to offer managed services, presumably in order to leverage greater profitability out of the infrastructure, and reluctance to offer transmission capacity services for on-supply.

Victorian higher education and research presents some interesting design and construction issues, given a relatively large number of universities and important research institutes operate in the State, a very large number of campuses on metropolitan, rural and remote locations and dispersion of the sites from the far north-west and north-east to the far south-east of the State. Many of those sites present geographical and other challenges for OFC construction. Phase 1 of the VERN sought to connect locations as cost-effectively as possible given limited capital. There are a number of campuses and partnering locations still outside the current reach of the network. Generally, those locations are also outside the current reach of competitive backhaul infrastructure.

4.2 Effect of the NBN on research and education telecommunications

Funding

The NBN appears to be having a chilling effect on several telecommunications initiatives which may otherwise have enabled further funding and development of Australian RENs. Possibly, State and Commonwealth funding agencies consider telecommunications infrastructure to be a low priority in the expectation that all needs will be addressed through the NBN. Some programmes appear to have been frozen or cancelled in order to synergise with the NBN by tipping-in existing infrastructure or funding.

Delayed delivery

For the research and education sector this poses immediacy problems. Other than the regional backhaul blackspots programme and the Tasmanian connectivity project, the NBN will obviously take several years to design and implement. Research and education institutions still have inadequate connectivity and capacity and their programmes will suffer unless this is addressed as soon as possible. Accordingly RENs can be expected to continue to seek funding from other avenues while the NBN is rolled out.

For example, VERNet has been able to provision Phase One of the VERN with the start-up capital provided by instructions' equity funding and Commonwealth grants. This has allowed the connection of members' key sites and baseline (1 GBps) services. The trunk infrastructure was completed in June 2009. Even before completion, however, demand began for increasing for higher-capacity services, fibre channel capability and network extensions to further remote and regional locations of members and to permit non-member research and education entities to use the VERN.

Participation

The recently released Regional Backhaul Blackspots Initiative first round of tenders indicates it may be difficult for RENs to participate in construction of the NBN. Firstly, the RENs generally have capital and authority to undertake works for the benefit of their members, and other research and education entities. Funding for speculative building is not generally available and in some instances capital would need to be raised in order to undertake any works at all. Accordingly, a REN would be hard-pressed to make an additional cash contribution to the project, as preferred by the Commonwealth.

Secondly, many RENs are purpose-constrained – in order to manage capital constraints, assets have been obtained at discounted rates provided they are for the purposes of research and education rather than general or commercial use. This likewise makes it difficult for RENs to contribute assets to the NBN.

Finally, the preferred operational model is for the constructing entity to provide transmission services to third parties suitable for retail on-supply to consumers. Although the provision of transmission services to third parties is not in itself an issue, supply of service other than for education and research may pose governance issues for RENs. The RENs are very experienced at the creative and cost-effective construction, procurement and management of large-scale optic fibre networks. However, they are not generally experienced or resourced to support retail or consumer operations in any volume.

It would be a poor social equity outcome if education and research communities were unable to benefit from the NBN other than by paying market rates to successful construction participants. The necessary high-capacity services are unlikely to be any more affordable under that model than they are at present. The RENs and institutions will have to seek further Government funding to procure services constructed with Government funds. This double-spending is not necessary if access for research and education is obtained under a different model.

5 A vision for the NBN

There is a shortfall between the infrastructure needed for excellence, sustainability and accessibility in research and education communications and the connectivity and capacity that has been, or foreseeable could be, funded.

Funding for specific institutions or initiatives will continue to be determined by then current Government policy. Institutional or programme-based grants will be important to address particular needs but cannot be expected to deliver national baseline infrastructure of the reach and capacity required. Existing Commonwealth grant programmes (EIF, RIGB and CDP) appear to be unlikely to accommodate to deliver substantial REN improvement. The sector itself cannot fund REN expansion to the extent required.

The National Broadband Network initiative could complement the existing REN investments and deliver improved connectivity and capacity to the sector.

Rather than overbuild or isolate existing connectivity, the NBN could offer a chance to connect remote, regional and rural education and research sites into RENs. The goal should be to allow access to and exchange of ideas and resources to allow participation and contribution regardless of the physical location of students, teachers, researchers, or data.

Telecommunications support for research and education is so fundamental to the identified keys for Australia's future success that its improvement should override concerns for commercial return. The locations which have not been connected to RENs are generally uneconomic for commercial providers and beyond the funded capability of the sector.

The NBN allows a new model for investment in Australia's long-term future.

Dedicated dark fibre pairs should be allocated for research and education use in any NBN build or infrastructure acquisition. Infeasible rights of use should be granted to the appropriate REN operator for integration with the State or national network as applicable. With some differences on the proposed implementation and delivery arrangements, this general model has support from State Governments and, not surprisingly, another REN¹⁷. VERNet suggests a minimum of two pairs on all links of the NBN be reserved for research and education networks to allow for both dark fibre express links and the provision of high-capacity services on collector links to multiple stakeholders. Providing R&E capacity over the NBN is unlikely to materially increase the construction scope or cost of the overall project. With few exceptions, if the NBN connects a research or education facility it will also be reaching homes and workplaces nearby.¹⁸

REN operators of necessity have sourced asset from multiple suppliers and methods, are generally flexible and creative on their approach to solutions and to accommodating the sectors' requirements. They are well experienced in extracting high value from the available, limited, funds and resources. The RENs can assist with other communities that are at a disadvantage in seeking commercial broadband services, such as community and cultural organisations. Indeed, research and education are synergistic with such communities and access would allow collaboration and integration opportunities to be better explored.

The RENs are generally not-for-profit and focussed on supporting the sector. They are well placed to assist in extending research and education capabilities.

¹⁷ Victorian Government Submission to the Commonwealth Government's Backhaul Blackspots Initiative Consultation Paper, p 3; Backhaul Blackspots Consultation paper: Submission to the Department of Broadband Communications, and the Digital Economy, Department of Further Education, Employment, Science and Technology (South Australia) p 26; Submission to the Department of Broadband Communications and the Digital Economy on Backhaul Blackspots Initiative Stakeholder Consultation Paper, AARNet Pty Ltd p 3.

¹⁸ For example, VERNet has provided broadband access to research and education sites such the Dookie Agricultural campus of the University of Melbourne, where there is little other call for residential or commercial services. More typically it provides connectivity to locations where there is little competitive service capability but potential retail customers, such as its multiple sites in Lakes Entrance.

Greater access to education for Australians is within reach; leverage of research potential could be delivered – if the opportunity is taken now.

6 References

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