Submission prepared in response to the House of Representatives Standing Committee on Infrastructure and Communications inquiry into the National Broadband Network

February 2011

1. INTRODUCTION

This submission is made by the Australian Information and Communications Technology in Education Committee (AICTEC). AICTEC is a national, cross-sectoral committee that advises Australian, state and territory Ministers for education and training on the economic and effective utilisation of online technologies in Australian education and training. AICTEC Membership is listed at **Attachment A**.

Education and training plays a central role in Australian's economic, social and cultural life, and it is growing ever more important. Education and training is delivered by over 10,000 schools, as well as universities, private higher education providers, and TAFE institutions together with several thousand Registered Training Organisations (RTOs), located throughout the country.

The Australian Government has committed to a number of fundamental education and training reform initiatives that aim to support the long term productivity and economic growth of Australia through facilitating the integration of information and communications technologies (ICT) to support teachers and students to communicate, collaborate and access education resources. Affordable, high speed broadband connections – to educational institutions and to students and learners in their homes and workplaces – will be essential if this potential is to be realised.

AICTEC wishes to see the development of an environment which will make it possible for Australia's education and training providers to make the fullest possible use of broadband connections to deliver the best possible educational outcomes that are achievable in a digital world. The education sector is a significant user of telecommunications and requires high speed and high capacity connections within the education system to enable effective communication between educational institutions and between these institutions and other providers of educationally relevant material. Equally important are broadband connections across the wider community, as these will help make education and training more accessible and promote strengthening of relationships between educators, students, parents, employers and community organisations.

Broadband connectivity within the education sector is improving. The higher education sector is generally well served by a high speed broadband network. The vocational education and training (VET) sector has a high degree of fibre connectivity but a wide range of line speeds ranging from less than 4 megabits per second (Mbps) to over 100Mbps. An increasing proportion of schools are connected to fibre and line speeds are improving but they remain varied, ranging from less than 4Mbps to over 100Mbps.

The NBN has the potential to address a number of issues and thereby enhance broadband connectivity across and within education sectors and with the community (including students in their homes and workplaces). In particular, the NBN rollout has the potential to provide, over time:

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- high speed broadband connections to those educational institutions not currently on fibre or with connections which deliver less than the NBN would deliver; and
- high speed broadband connections to homes and workplaces not already connected.

It is also hoped that enhanced competition, and in some cases, the introduction of competition, and pricing arrangements which arise from the NBN regulatory regime will provide strong incentives for the provision of capacity for the needs of the education sector, under affordable and predictable terms to encourage full utilisation of broadband connections to deliver the educational outcomes available in a digital world.

The enhanced broadband connectivity to be provided by the NBN will provide the basis and an incentive for the development of a range of new services which can enhance the teaching and learning experience at all levels of the education sector. It will also provide improved accessibility for the increasing number of individuals pursuing learning opportunities online.

AICTEC notes that the education and training departments in a number of States and Territories utilise whole of Government purchasing arrangements for communications and related services. Thus, State and Territory Government submissions to this consultation process may make comments which relate to the education sectors and their communications issues. Please note that references in the submission to 'education' and/or 'the education sector' are inclusive of training and the term 'students' also encompasses 'learners'.

2. CONTEXT

Through its broad membership, AICTEC represents the ICT interests of each state and territory government school and VET system, the Catholic and independent non-government school sectors, the higher education sector and the Australian Government. AICTEC's revised Terms of Reference, endorsed in April 2008 by the then Ministerial Council[1], extend AICTEC's role to include providing strategic policy advice on implementation of the Digital Education Revolution (DER). In making this decision, the Ministerial Council noted that AICTEC would provide cross-jurisdictional and cross-sectoral policy advice to the Ministerial Council, the Council of Australian Government's (COAG's) Productivity Agenda Working Group and relevant sub-groups, and the Australian Government regarding implementation of the DER and related ICT issues and, in this context, facilitate national consultation, collaboration and coordination as appropriate.

The framework for AICTEC's priorities and work program is set by the cross-jurisdictional Joint Ministerial Statement on ICT in Australian Education and Training (2008-2011)[2]. The Ministerial Statement recognises the importance of the role of ICT in assisting

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[1] Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA)

[2] The Statement is available at
http://www.aictec.edu.au/aictec/go/home/about/cache/offonce/pid/95;jsessionid=ABBB86635EB505E27F587B30FADA4D92 .

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students to achieve high quality learning outcomes and thus to productively contribute to our society and economy. Commonwealth and State/Territory governments view ICT as an essential tool for advancing the agenda being pursued by them through COAG to pursue substantial reform in the areas of education, skills and early childhood development, to deliver significant improvements in human capital outcomes for all Australians.[3]

Under the auspices of AICTEC, the Department of Education, Employment and Workplace Relations (DEEWR) has been working with stakeholders to investigate and understand key issues relevant to the deployment and use of high speed broadband in schools. The information gathered in this process has been used to inform the preparation of this submission.

3. IMPORTANCE OF HIGH SPEED BROADBAND TO EDUCATION AND TRAINING

AICTEC views access to affordable high speed broadband as essential to realising the transformative potential of ICT in education and training and hence to advancing COAG's wider productivity agenda.

In Australia and internationally, reliable and affordable broadband connectivity is recognised as having the capacity to transform the ways in which teachers, students and their families communicate, collaborate and access educational resources across traditional boundaries.

The Australian Government is committed to enriching the quality of education in Australia and is working collaboratively with state and territory government and non-government education authorities to achieve this through the DER[4]. The aim of the DER is to contribute sustainable and meaningful change to teaching and learning in Australian schools that will prepare students for further education, training and to live and work in a digital world.

Through the DER, the Government is providing $2.4 billion over seven years to:

- provide for new ICT equipment for all secondary schools with students in years 9 to 12 through the National Secondary School Computer Fund
- support the deployment of high speed broadband connections to Australian schools
- support systemic change to increase the level of ICT proficiency for teachers and school leaders across Australia to embed the use of ICT in teaching and learning

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[3] See http://www.coag.gov.au/coag_meeting_outcomes/2007-12-20/index.cfm .

[4] The DER is governed by the Digital Education Revolution National Partnership with the State and Territories and by Digital Education Revolution Funding Agreements with the Catholic and Independent education authorities. The implementation of the DER will be guided by the DER Strategic Plan and Roadmap and supported by the *Digital Education Revolution Projects, Infrastructure and Support Program Guidelines.*

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and support the development of innovative projects and research that enable professional learning in the use of ICT

- provide for online curriculum tools and resources that support the national curriculum and specialist subjects such as languages
- enable parents to participate in their child's education through online learning and access
- support mechanisms to provide vital assistance for schools in the deployment of ICT.

These initiatives aim to support the long term productivity and economic growth of Australia through facilitating the integration of ICT, including high speed broadband, to support teachers and students to communicate, collaborate and access education and training resources. Australian students and learners need greater access to, and more sophisticated use of ICT. They need the best hardware, high speed broadband connections, quality digital content and well trained teachers to integrate technology into teaching and learning.

There is also potential for high speed broadband to schools to assist in progressing other education objectives such as literacy and numeracy programs and strengthening capability in National Asian Languages and Studies through enhancing connections between schools and with other educational institutions and with international sources of information.

The Australian Flexible Learning Framework (Framework) is the VET sector's national e-learning strategy. It provides the VET system with the essential e-learning infrastructure and expertise needed to respond to the challenges of a modern economy and the training needs of Australian businesses and workers. The Framework has acknowledged, as a fundamental principle, the importance of a cost effective, high speed broadband that supports flexibility in the delivery of education and training to the VET sector. The Chair of the Flexible Learning Advisory Group recently noted that e-learning was now an entrenched training tool for Australian businesses and that both in Australia and Britain e-learning was seen as beneficial to employers and staff. He noted the Framework's sustained and systematic investment in shared national infrastructure for businesses looking to harness the benefits of e-learning and concluded that the NBN could enable the use of this infrastructure. His article concluded that on a vocational education and training front, its introduction is expected to deliver social and economic benefits and drive Australia's productivity competitiveness and that for Australian business, it represents an unprecedented opportunity for innovation and radical changes to the way learning and training is conducted. [5]

High speed broadband connectivity is a crucial component of Australia's higher education and research system, not least because it underpins improved learning

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[5] See http://www.flexiblelearning.net.au/content/why-business-needs-flexible-learning

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outcomes, access to international research materials, national and international collaboration, and facility sharing. High speed cost effective networking can result in efficiency gains from facility sharing, for example by providing the ability for many institutions to access one single instance of a research instrument, such as a synchrotron or a telescope. By having one single instrument of a particular type in Australia, it is possible to concentrate funding sufficiently to acquire an instrument which has the necessary capability to be effective. It must, however, be sited at one physical location and only a high speed network, capable of transferring the vast amounts of data that research instruments produce, will enable all appropriate institutions to take advantage of it. The alternatives are to duplicate instruments around the country or to constantly fly researchers to the instrument. Allowing individual institutions to concentrate on the delivery of particular areas of specialist teaching requires more collaboration between them to support the teaching of multi-institutional courses and media rich learning resources, which in turn requires high speed networks.

There are also some activities, which can only occur through the use of high speed networks. For example, radio telescopes use a technique called aperture synthesis to simulate the resolution of a very large dish aerial, using a lot of small aerials situated some distance apart and this is one of the main ways of improving the capability to "see" radio events. To achieve these results, the instruments require to be connected together in such a way as to allow the rapid transfers of vast amounts of data and this is only possible with very high speed networks.

In general terms educational institutions are not like surrounding residential users. One educational enterprise connection may support 1,000 or more users (students, teachers and administrative staff) capable of generating as much traffic as 1,000 homes. Educational institutions also have different needs to residential consumers – educational institutions require high symmetry and high bandwidth, they have low latency and peaks in demand. Connectivity between institutions is important, in addition to connectivity to external sources such as the Internet. Educational needs require access to capacity at a reasonable price to enable permanent networks to be created and to cater for the potential increase in demand which is likely to result as innovations are more widely adopted.

4. POTENTIAL SERVICES WHICH COULD BE OFFERED OVER BROADBAND

The Schools Sector

High speed broadband is the foundation on which information technology can be integrated into our schools, making a new approach to learning and teaching possible. Teachers, parents, students and other members of the community can get involved in online communication and information sharing, regardless of location or school system.

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High speed broadband to schools is an important aspect of the DER, supporting:

- schools with the technological tools to work together (for example, virtual classrooms, video and audio streaming, high definition video conferencing) and create flexible, personalised learning for all students;
- teachers, to communicate, collaborate and access education resources across traditional boundaries; and
- students with networked computers to interact with their peers and teachers in other schools across Australia and around the world.

Schools are already trialling innovative services and resources which are deliverable over broadband connections. These include:

- As part of a trial related to the NBN, Year 3 and 5 students from Middleton Grange and Kellyville Public Schools took part in the Connected Classes & Interactive Storytime from Home project. Under this project students communicate and collaborate in a structured learning activity using a virtual classroom. Using the same technology, pre-schoolers from Parkbridge Estate could participate from home in Storytime sessions held in the Middleton Grange Public School library.

- St. Peter Chanel Catholic School at Smithton was one of the first Tasmanian schools to connect to optic fibre for the NBN. Using connection speeds of 100Mbps, the school has been able to provide innovative learning opportunities for students such as video-conferencing with someone diving on the Great Barrier Reef and interacting with schools around Australia such as on the Tiwi Islands and near the Murray River.

- A project, funded in part by Multimedia Victoria, establishing a high-speed broadband network linking seven secondary colleges, 40 primary schools and one special school in the Yarra Valley included a cutting edge 'learning management system' which facilitates collaboration between teachers on curriculum development and lesson planning, provides opportunities for online student learning and discussion, and offers the ability to monitor and record student progress. The network also enables the use of laptops and electronic 'smart boards' in the classroom, voice over IP communication, and remote or home access for teachers, students and parents.

- A project to develop an international languages classroom is underway at Narrabundah College in the ACT. Upgraded video conferencing facilities will allow Narrabundah students to connect with schools overseas, particularly in Asian countries, and practice their chosen language with native speakers.

For greater detail see **Attachment B**.

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In the United Kingdom (UK) it is reported[6] that three areas in particular can be seen to benefit from embracing broadband enabled technologies:

- Teaching and learning. ICT allows teachers to deliver greater flexibility and tailor teaching techniques to suit individuals;
- Professional development. Sharing of material and resources is helpful, especially for teachers in small schools or isolated communities; and
- Community links. ICT can help the schools communicate with parents to inform them of progress and let them know how they can support their child's learning at home. It can also encourage parents' interest in their own personal development and online learning.

Attachment C identifies further potential applications which could be delivered where schools have access to broadband networks.

Vocational Education and Training (VET)

A range of potential services which could be delivered with high speed broadband such as that to be provided over the NBN has been identified for the VET sector:

- Rich media. Publically funded multimedia e-learning resources are artificially constrained to relatively small file sizes as a direct result of the lack of bandwidth. This is a real constraint for teachers and developers of e-learning content because it can reduce the potential scope of multimedia resources and requires specialist expertise to create resources to operate effectively over low bandwidth connections.
- Synchronous communications. The potential for video conferencing, fully-featured virtual classrooms and webcasting are likewise compromised by lack of suitable internet connectivity. Mainstream use of video conferencing is not practical at the current average connection speeds of TAFEs. Virtual classrooms are currently popular, but are likewise not being used in the sector to their full potential. These technologies have been demonstrated to facilitate collaboration across Australia and beyond. Providing innovative and efficient ways of connecting teachers with learners can be utilised to address skills shortages.
- Immersive technologies. The use of web based simulations and virtual learning environments have show great promise in vocational education because they enable a learner to enter a simulated environment to learn and test their skills prior to applying those skills to real world situations. Connectivity constraints mean that use of such technologies are severely limited and can sometimes actually be discouraged by IT departments who are not able to provide the required bandwidth without negatively impacting other users of the RTO computer network.

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[6] See report "Connecting Communities – The impact of broadband on communities in the UK and its Implications for Australia" on
http://www.huawei.com.au/connectingcommunities/

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- Workplace training and assessment. Facilitating workplace training and assessment is vital for improving the productivity of the Australian workforce. With the wide availability of fast internet, web based communication tools can be utilised by work-place trainers and assessors for training and assessment purposes, enabling learners to stay in the work place for more of their training while still receiving the support of peers and trainers in remote locations. Recent trials of workplace assessment tools such as camera glasses and high quality video streaming show that there is the potential to provide significant productivity gains for workplace assessors, particularly those covering large geographic regions.

Other services identified as likely to be increasing demand and in use in some form in most jurisdictions Include:

- Peering arrangements with other networks or content providers, providing direct access to commonly used sites and content;

- Access to teaching resources via repositories such as the Australian Flexible Learning Framework's Learning Object Repository (LORN) with capacity for users to control distribution and copyright of their own resources; and

- Access to lifelong learning repositories, such as e-portfolios, allowing students to store evidence of their lifelong educational achievements.

By way of example, State Training Providers in Western Australia, during the analysis and design stages of the Department of Training and Workforce Development wide area network, indicated that there will be an increasing requirement for bandwidth as rich media such as video conference, high definition video and virtual classroom technologies are integrated into the standard learning environment.

In 2009, the Australian Government announced funding of $80 million for a high speed broadband network for the training sector. The Vocational Education Broadband Network (VEN) will, along with the NBN, support the use of interactive e-learning materials, virtual classrooms and real time access to content collections for TAFEs and learners.

The VEN will contribute to the Government's priority to create a world class education system for Australia by providing the infrastructure that will allow TAFE institutes access to a high quality broadband network that is tailored to the specific requirements of the training sector. The VEN will promote collaboration across the training sector and enable increased flexibility in the place and pace of learning and speedy access to resources no matter where in Australia they are located. It will complement the rollout of the NBN by creating a broadband network connecting existing state and territory networks serving TAFE institutions, whilst the NBN will address connectivity to individual institutions (where necessary), to industry and to the home.

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The VEN initiative includes:

- The *VEN backbone network* (VBN) will establish a robust, resilient, high capacity backbone network connecting state and territory networks that serve TAFEs. It is envisaged that the VBN will be able to be accessed by non-TAFE registered training organisations, school authorities, peering networks and providers of online education and training resources.

- *Services and applications* that make effective educational use of the high-speed broadband network.

As indicated above, in Australia and internationally, reliable and affordable broadband connectivity is recognised as having the capacity to transform the ways in which teachers, students and their families communicate, collaborate and access educational resources across traditional boundaries.

5. CURRENT STATUS OF BROADBAND IN EDUCATION

Schools

Since 2008, DEEWR has undertaken an annual survey on schools' broadband connectivity. Findings from the survey[7] in 2010 indicate an increase in the proportion of schools that reported using fibre (63.4 per cent in 2010 compared to 46.5 per cent in 2009 and 47.0 per cent in 2008). This has resulted in a decrease in the use of most other technology types with 32.8 per cent using copper (39.6 per cent in 2009 and 42.3 per cent in 2008), 1.9 per cent using satellite (2.2 per cent in 2009 and 2.4 per cent in 2008) and 1.2 per cent using wireless (1.1 per cent in 2009 and 1 per cent in 2009).

Bandwidth available to schools has also improved over time due to the increased number of schools with fibre connections. 52.6 per cent of schools reporting download speeds in the 5-20Mbps range compared to 29.7 per cent in 2009 and 16.4 per cent in 2008. While these improvements are evident across all school sectors there remains variation in the bandwidth available to schools in metropolitan regions and those in provincial and remote regions. For example 33.9 per cent of schools in metropolitan regions received 4Mbps or less compared to 51.4 per cent in provincial and 78.4 per cent in remote regions.

The relatively high number of schools connected by fibre does not always result in high download speeds being used by these schools (there are 43.6 per cent of schools using 4 Mbps or less). This disparity is likely to be due to affordability of the service or the specific contractual arrangements negotiated with the provider. A teacher's use of e-mail, Internet browsing, collaboration tools, downloading of content including learning

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[7] School Broadband Connectivity Survey 2010 reflects responses as at 8 October 2010. (95.2 per cent of schools responded). http://www.deewr.gov.au/Schooling/DigitalEducationRevolution/HighSpeedBroadband/Pages/ImplementationApproach.aspx#a survey of school connectivity across states and territories and school sectors

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objects in a class is not practical if response times for many students working simultaneously is slow or unpredictable. Satellite poses difficulty for utilisation of real time applications such as video-conferencing and online learning.

The ability of education departments and Catholic and independent schools to obtain adequate and affordable broadband services varies significantly across jurisdictions, government and non-government schools, and metropolitan, regional and remote areas.

Vocational Education and Training (VET)

DEEWR conducted a Survey of TAFE Broadband Connectivity for the first time in 2010. The jurisdictions' response to the survey covered all TAFE institutes (415 TAFE sites including main campuses and secondary facilities). The aggregated national findings from the survey indicates that:
- across the range of technology types, fibre is clearly dominant (80%) with copper a distinct second (13.3%);
- in relation to bandwidth used (reported as "Download Speeds") by TAFEs across technology types:

    o 24.8% of TAFEs still have line speeds of less than 4 mbps
    o 53.5% have speeds of between 5 and 20 mbps
    o around 8% have speeds of between 21-50 mbps
    o around 4% have speeds of between 51-100 mbps
    o just over 8% have download line speeds of more than 100 mbps.

The cost of broadband services across the country can vary significantly between metropolitan and region areas and therefore between campuses, thus creating difficulties in providing high broadband connectivity across the sector. For example, the cost of broadband connectivity in regional areas of Western Australia can be up to 220 per cent more than the same service in Perth metropolitan areas.

It is expected that there will be increasing demand for vocational education and training as workforce demographics, economic structural change, rapid advancement in technology and environmental factors such as climate change, create the need for new skills and new ways of working and learning. Prospective learners are increasingly seeking the enhanced flexibility and convenience of online or blended delivery VET courses.

Higher Education and Research

The higher education and research organisations that connect to the Australian research and education network managed and operated by AARNet Pty Ltd (AARNet) have significantly improved connectivity up to 10Gbps assisted by the $88 million investment

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in this network from the Australian Government[8]. Some universities (Australian National University, the University of NSW, the University of Melbourne and the University of Queensland) now connect at 10Gbps or more. However, a number of regional universities have low connectivity - Charles Darwin University (2x155 Mbps) and University of Tasmania (2x155 Mbps) as well as intercampus links to a number of regional campuses[9].

A typical example of intercampus requirements is Curtin University, with remote campuses in Northam, Esperance, Margaret River and Geraldton all of varying sizes and complexity but all of which depend heavily on broadband connectivity to function effectively. At present all of these sites are being supported via network connections which are not part of the Australian research and education network and so have limited bandwidth available. A number of regional university sites also require improved bandwidth.

Smaller university sites in regional areas such as those involved in the training of health professionals still face significant challenges in access to and affordability of the necessary connectivity, although other impediments such as outdated network security policies may also play a part. Video conferencing is a critical application, especially for students on work experience rotations in rural health clinics.

AARNet Pty Ltd operates the Australian education and research network on a subscription basis and also uses the core network infrastructure to provide commodity Internet access for its members. However, many researchers (e.g. agricultural researchers working within state departments of primary industry) are not co-located with AARNet members such as universities and CSIRO. This part of the research sector needs improved co-operation with government entities and commercial telecommunications providers to connect these researchers with their colleagues and to major research facilities nationally and internationally. Data generated on-site in regional, rural and remote areas (e.g. from sensors) needs to be transmitted to national data centres for analysis and retention. The variable nature of the traffic volumes does not match the traditional commercial and residential telecommunications business models and more flexible solutions are required.

Home use and workplace fibre connections for education

Many homes now have access to some form of broadband connection – by mid 2010 around 66 per cent of the population had access to broadband at home and 99 per cent of small and medium enterprises (SMEs) that had access to the Internet (93 per cent) did so via broadband. The majority of these home connections were fixed line but increasingly, mobile connections are being used to complement these connections. A significant proportion of SMEs used internet-enabled 3G mobile phones.[10]

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[8] See http://ncris.innovation.gov.au/Capabilities/Pages/PfC.aspx
[9] See http://www.aarnet.edu.au/aarnet3.aspx
[10] ACMA 2009-10 Communications Report Series http://www.acma.gov.au/WEB/STANDARD/pc=PC_312356

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Increased participation at all levels of the educational system will require more flexible approaches to educational delivery than has been previously available. Students in tertiary education already juggle work commitments with their studies and if there is to be a real increase in participation at this level, an increasing number of students are also likely to be working full time. Some school students in remote areas already undertake studies from home but increasingly, students from all schools require access to school or other digital educational resources from home.

At the same time, providers of online educational resources have been generating more sophisticated approaches to the delivery of online learning, allowing students to participate fully in their courses and minimise the typical disadvantages of not attending class in person.   Lecture recordings are now commonly available online, as are podcasts, online tutorials, course materials and access to digital library resources. The growing use of bandwidth intensive content and services in education means students increasingly require access to reliable high speed connections at their home and workplace in order to benefit from the full range of learning opportunities provided by their school, TAFE or university.

6.   BROADBAND NEEDS OF EDUCATION SECTOR

The education sector is made up of a number of quite different organisations, each with different existing network arrangements. In summary:

- Universities usually are characterised by multiple large multi-building campuses some of which are geographically dispersed and largely autonomous. Universities have a network provided by AARNet, for traffic between universities (domestic and international), and university links to the Internet.

- TAFEs connect to the Internet through independent systems, sometimes with state government aggregation. A number of TAFEs are connected to university based networks at speeds of 1Gbps or more[11].

- State departments of education are large organisations (in terms of staff and locations), with centralised wide area network (WAN) networking based on private network (ie. a VPN isolated from the Internet), mostly decentralised local area network (LAN) and desktop, so "shared" information technology (IT) models, with a single gateway to the Internet.

- In 2009, the creation of Catholic Network Australia (CNA) was announced. CNA, which was launched in March 2010, is a broadband network which will connect over 1500 Catholic K-12 schools and Catholic Education offices across Australia. The predominantly fibre-based network will connect five data centres across Australia and use Telstra Internet Direct, which provides carrier-grade connectivity. Management of the network will be handled through a range of VPNs and gateway

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[11] For example, Central TAFE in Western Australia (See http://www.ivec.org/services/networks) and TAFEs connected to SABRENet (See http://www.sabrenet.edu.au/news/2008/7/18/new-web-site.html)

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exchanges, enabling Catholic education offices to share and exchange resources. It was expected that over 90 per cent of Catholic schools would join the CNA.[12]

- In the Independent sector, most schools establish and operate their connectivity arrangements independently of one another. However, there are a number of broadband networks emerging. For example, some 120 regional and metropolitan schools in Victoria are connected with ISNet[13].

Every educational institution, including even the smallest school, has an "enterprise" networking requirement, not a consumer requirement, ie. symmetric speed, very high bandwidth, low latency (for interactive services), rich media, and access to relevant virtual private networks, in addition to the public Internet. This means that it would be preferable that under the NBN fibre connections to schools (and other educational institutions) are not "shared" with a number of other customers using something like Passive Optical Networking (PON). The NBN Implementation Study notes the appropriateness of Ethernet point-to-point connections for schools[14]. A single point to point connection would allow flexibility and scalability of network services to be provided to each educational institution. This could take the form of a private network connection as part of (say) the managed service of a school network, a private fibre link to schools or between two campuses of a single TAFE/university, or simply a high speed Internet connection for an independent school.

In the context of supporting the deployment of fibre connections to schools, stakeholders identified key principles which underpin the vision[15] for connectivity of schools into the future, namely:

- *affordability* – the vision of affordable high speed broadband connections for schools is one where the schools can afford to use such connections to their full potential. This will be possible under charging models for data network services that are predictable and minimise the recurrent costs, such as subscription based charging, or pricing that is not volume or distance/location based. The issue of affordability has long been identified as a major barrier to high speed broadband uptake and utilisation by Australian schools.

- *scalability* – schools will require scalable broadband that is not constrained by network architecture and/or incompatible standards and can deliver bandwidth intensive educational applications.

- *collaboration* – The *Joint Ministerial Statement on ICT in Australian Education and Training: 2008-2011* provides a national framework for cross-sectoral collaboration

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[12] http://www.telstra.com.au/abouttelstra/media-centre/speeches/launch-of-catholic-network-australia.xml?searchYear=2010
http://www.telstra.com.au/abouttelstra/media-centre/announcements/national-broadband-network-for-catholic-schools.xml
[13] http://www.independentschools.vic.edu.au/victor/
[14] http://data.dbcde.gov.au/nbn/NBN-Implementation-Study-complete-report.pdf.   (For example pages 48, 171, 179 and 347)
[15] The vision of connectivity for Australian schools was developed by the Department of Education, Employment and Workplace Relations in consultation with education stakeholders.   The vision paper can be found at
http://www.deewr.gov.au/Schooling/DigitalEducationRevolution/HighSpeedBroadband/Pages/ImplementationApproach.aspx#a
vision of connectivity for Australian schools

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on the effective and efficient use of ICT in education and training. Through this framework, Ministers of education and training have committed both to "national collaboration to share resources and expertise, and to leverage existing initiatives while recognising the importance of innovation and experimentation" and to "national, cross jurisdictional and cross sectoral approaches … to address the ICT enablers of technology rich learning environments, …including broadband".

Whilst these principles were developed in relation to schools, they have general application across the education and training sector.

Current Concerns about Potential Delivery and Use of High Speed Broadband

The telecommunications market has not provided an environment in which a large enterprise or system operator like the education sector is able to access sufficient affordable bandwidth and therefore the education and training sector is unable to take full advantage of the transformative potential of high speed broadband connections.

At present, most Australian schools are unable to access the full potential of their physical network connection. Whilst many schools and TAFEs have fibre connections to the premises they do not have access to high speed broadband at prices they can afford. In addition, connectivity and bandwidth delivered under contractual arrangements may be limited when shared amongst a large number of simultaneous users as in a school environment. In these circumstances even attempting to use all the computers in a school for simple web browsing can saturate their current links, causing poor internet performance and frustration for teachers and students alike. More advanced functions – for example running classroom to classroom video conferences, participating in live demonstrations of how a telescope works or receiving real-time instruction from a specialist teacher in a distant location – lie far beyond what is generally affordable or possible.

As noted above, some 63.4 per cent of schools already have fibre connections. However, schools are constrained in using them to their fullest extent due to current charging regimes including volume-based charging. Volume-based charging is very difficult for schools systems to manage as it reduces their ability to control their budgets. Schools need access to high speed broadband services on terms and conditions that are predictable, affordable and sustainable in the longer term. Pricing arrangements which limit or discourage bandwidth usage stifle innovation and the adoption of modern teaching and learning practices by, for example, discouraging use of media rich content. As a means to contain internet access costs, some schools allocate each student with a modest download limit, and request that students purchase additional 'credit' when they reach that threshold. This can result in students being unable to participate fully during internet based lessons or conduct online assignment research at school.

Web technologies are being successfully trialled, used and adopted across the VET sector, and have already brought productivity gains, and new opportunities and modes

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of learning. However, current internet connectivity levels in Australian VET result in unnecessary constraints and limitations to how such technologies can be used and widely adopted. Many of the restrictions on innovative use of emerging technologies exist because of limited connectivity. Limited bandwidth means that IT departments are often forced to constrain the use of web technologies that strain local computer networks which in turn stifles innovation and uptake.

The position is significantly different for universities, which are generally well served by their own Australian education and research network. However, despite the improvements of the last four years, Australia's infrastructure for research and teaching remains inadequate in certain regional areas. For example, on some routes (eg. Adelaide to Darwin), where there is only one provider of fibre, there is not only limited capacity available for the Australian education and research network, but that capacity is relatively costly. Whereas southern mainland universities use the AARNet[16] infrastructure to connect at 1G and in some cases 10G speeds, the connections to the Northern Territory (NT) are limited to 155Mbps[17]. If this situation persists, Charles Darwin University and Batchelor Institute for Indigenous Tertiary Education will be increasingly precluded from whole categories of academic activities that require more advanced infrastructure. There are also concerns about the lack of competition in the provision of services in other education sectors, for example, in regional areas of Western Australia fibre connectivity is limited to a single provider in the majority of areas.

Cross sectoral (i.e. schools, VET, university) connectivity is important so that real time communications and access to and exchange of publicly funded educational content is not inhibited. For example, video conferencing could assist university faculties of education deliver enhanced support to their students and mentor teachers when they are undertaking pre-service teacher training in schools. Growth in the delivery of VET courses through schools is also increasing the demand for interoperability between these two sectors. All sectors are being constrained by the limited availability of affordable bandwidth to the homes and workplaces of their students and stakeholders in the wider community. This is of particular impact in the VET sector, where education is increasingly needed to be delivered in the workplace. There is an increasing tendency towards the use of e-learning technologies for the delivery of better outcomes. The lack of availability of high capacity, symmetric broadband connectivity between the education provider and the home is severely limiting as bandwidth intensive content and services are increasingly used to deliver e-learning. Internet usage in Australia is generally constrained by quotas on downloads (and sometimes uploads) to and from the Internet. This practice of charging for each Megabyte transferred has the effect of placing a barrier to the affordability of using services with richer media content and of

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[16] AARNet Pty Ltd is a not-for-profit company that operates a telecommunications network with links across the world – AARNet3 – providing high-capacity internet services to Australia's universities, research institutions and other related organisations.
[17] The NT AARNet link is also used to connect all the schools in the NT to the internet, therefore NT schools are also disadvantaged by the limited capacity.

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constraining the user who is required to stay within a particular download quota to avoid higher charges. Without action to address the affordability of data it will be difficult to provide greater and more equitable access to educational content from the home.

Cross sectoral and cross jurisdictional collaboration is also limited due to the charging models some carriers employ for interstate traffic. In some circumstances, for example, any virtual private network (VPN) established that has nodes/schools in two different states attracts an extra levy for data transmission across state boundaries regardless of the actual distance involved. This also restricts interstate VPNs being created to serve multiple jurisdictions. Once again a subscription based charging model for backhaul services or inter-network connectivity would advance collaborative educational practices between sectors/jurisdictions across states.

Current arrangements limit the options that are available to educational institutions and education system providers to meet their bandwidth needs in certain locations. For example, Northern Territory Schools and other education and research users are experiencing congestion on the current backbone link which is limited to 155Mbps, and the requirements to upgrade to a gigabyte service are not economically feasible with the current sole supplier backhaul service.

A second optical fibre connection linking Darwin to Brisbane is being constructed under the Backhaul Black spots program and this will provide a competitive source of supply for backhaul and commodity Internet services at the end of 2011.

The significant increase in Internet bandwidth provided with new backhaul services will be essential to support high speed fibre access by students from to online learning services and resources and the migration of services to the cloud.

Catholic education systems have also found that they are not able to purchase equitable network access services for all schools because of the lack of capacity in regional areas and the huge differential cost between fibre services in metro areas to those in regional areas. As an example, the sector has found that the pricing for fibre services for schools in certain rural/regional areas can be up to three times more expensive than those available in metropolitan areas. The huge differential which exists in the provision of bandwidth in regional locations as opposed to metropolitan locations also limits the capacity for school systems to deliver and guarantee access to cost efficient enterprise systems. It continues to drive less cost efficient network/system architectures which are centred upon infrastructure and services delivered at the school level. Many regional Catholic dioceses in NSW for example have deployed student management applications servers at each of their schools whereas Catholic dioceses in metropolitan areas have moved quickly to host such systems in centrally located data centres. The resultant efficiencies and lower total cost of ownership to deliver these systems is made possible due to the provision of affordable and adequate bandwidth at each of their metropolitan schools.

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The education sector, in particular, the schools sector, has encountered difficulty in obtaining speedy access to fibre tails to obtain sufficient capacity for their needs. For example, in the ACT, negotiations between the education sector's service provider, which had insufficient coverage for all schools, and the owner of a large fibre network to obtain access to additional fibre tails, were slow and costly.

A 2009 comprehensive review and analysis of the Queensland Department of Education and Training (QDET) network requirements has highlighted the gaps in existing supply of bandwidth and the inadequacy of the capability it delivers. This analysis is supported by work performed interstate where network links to schools have grown exponentially off the back of recent requirements analysis and procurement activities. It is apparent from comparison between services available across different regions that the absence of choice and real competition outside of inner metropolitan areas means that QDET are not optimising the value that they achieve from existing expenditure on telecommunications services. South Australian education authorities have identified similar problems.

Recent discussions with stakeholders from within QDET have verified that increasingly the current network poses severe limitations on the department to provide quality educational outcomes to both its students and for the ongoing professional development of its academic staff.

7. POTENTIAL FOR NBN TO ADDRESS THESE ISSUES

The NBN has the potential to address a number of these concerns.

Firstly, as part of the Australian Government's commitment to deliver a National Broadband Network that will provide superfast broadband to Australian homes and workplaces, it is investing up to $250 million to immediately address backbone blackspots throughout regional Australia. The provision of these backbone links is likely to enhance capacity on a number of routes important to educational institutions eg. to Darwin. Enhancing backbone competition on these routes is also likely to assist broadband and telephony providers to improve the range, quality and prices of the services they offer in regional areas.

Secondly, the gradual rollout of the NBN network will provide the opportunity to connect educational institutions that are not already on fibre or that do not already have connections capable of delivering services to the level which will be delivered by the NBN. NBN Co has the objective of providing 93 per cent of Australian homes, schools and workplaces with a 'fibre to the premise' connection delivering speeds of up to 100 megabits per second. All remaining premises will be served by a combination of next generation wireless and satellite technologies providing peak speeds of at least

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12 megabits per second.[18] Appropriately prioritised rollout of the NBN will assist in addressing the digital divide which exists, and is at risk of increasing, between those schools (and other educational institutions) which currently have access only to low bandwidth arrangements and those on high bandwidth fibre connections.

The enhanced broadband capacity that will be provided to educational institutions will enable innovative services to be used and shared effectively across Australia. Additional connectivity to homes and workplaces will also enable greater access to educational material and new ways of learning which are not available with existing low bandwidth utilisation. The NBN, by dramatically improving general internet connectivity speeds, is also expected to make web-facilitated work place based training and assessment more cost effective and technically feasible across the country.

Thirdly, the sector would expect that the new regulatory environment provided with the establishment of the NBN will foster a greater degree of competition amongst retail providers of broadband services and that more affordable and predictable pricing regimes will emerge which allow educational institutions to fully utilise their broadband connections. It is hoped that in some areas the rollout of the NBN will see the introduction of competition where there is currently only one provider of fibre connectivity.

To complement the NBN rollout, which will focus on connections to premises and schools, the Government is developing initiatives which will enhance connectivity between, and use of, existing networks which provide services to TAFE institutions across Australia and thereby facilitate collaboration.

Improvements in broadband services delivered via the NBN are needed to provide students and teachers with efficient and effective access to online learning systems, digital learning resources, online professional development systems, and to video and web-conferencing platforms whenever and wherever an internet connection is available.

The NBN will also support more equal access to the core ICT systems that promote innovation and efficiency in student assessment and reporting, community engagement and school administration.

Currently many schools, particularly those in regional and remote areas, are disadvantaged by slow and unreliable network links. With universal high speed broadband, all schools will experience a comparable quality of access to a wide range of educational content and services including:

- new national curriculum resources;
- student information;
- online teaching and learning;

[18] http://www.dbcde.gov.au/__data/assets/pdf_file/0003/132069/Statement_of_Expectations.pdf

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- digital learning materials;
- content management and search;
- collaboration tools (including video and web conferencing);
- professional learning; and
- curriculum information management.

The NBN is considered vital to creating fully connected networked learning communities where every student, parent and teacher has enhanced access to the services, resources, support and opportunities needed for a 21st century education.

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AICTEC MEMBERSHIP

AICTEC is comprised of members that represent the peak education bodies in Australia. This includes:

- one representative from:
  - each state and territory government school system
  - the Catholic schools sector
  - the independent schools sector
  - each state and territory VET system
- one representative from Universities Australia
- two representatives from the higher education sector with relevant skills (determined by the Secretariat on advice from Members and Universities Australia)
- two representatives from the Australian Government.

Members collate and distribute relevant AICTEC information within the community they represent. Standing observers and guests can also attend, if nominated by a Member and approved by the Chair.

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ATTACHMENT B

EXAMPLES OF SCHOOLS USE OF BROADBAND

- As of 25 June 2010, NBN was trialled in Middleton Grange in South-West Sydney. As part of this trial, Year 3 and 5 students from Middleton Grange and Kellyville Public Schools took part in the Connected Classes & Interactive Storytime from Home project. Under this project students communicate and collaborate in a structured learning activity using a virtual classroom. This involves using web cameras and computers to "immerse" themselves in a virtual world learning environment. Students are represented by their live video image and they are able to see and hear each other and interact with video screens and virtual interactive whiteboards. Using the same technology, pre-schoolers from Parkbridge Estate can participate from home in Storytime sessions held in the Middleton Grange Public School library. The project was a partnership between NSW Department of Education and Training partnered with the Smart Services Cooperative Research Centre. (http://www.broadband.nsw.gov.au/sites/default/files/MinisterMRParkbridgeTestbed250610_0.pdf)

- St. Peter Chanel Catholic School at Smithton was one of the first Tasmanian schools to connect to optic fibre for the National Broadband Network. Using connection speeds of 100 Mbps, the school has been able to provide innovative learning opportunities for students such as video conferencing with someone diving on the Great Barrier Reef, interacting with schools around Australia such as on the Tiwi Islands and near the Murray River. (http://www.abc.net.au/7.30/content/2010/s3097939.htm; http://www.iprimus.com.au/PrimusWeb/AboutUs/News/FirstAustralianschooltoconnecttotheNationalBroadbandNetworkinTasmaniawithiPrimus.htm and http://www.media.tas.gov.au/release.php?id=31030)

- Arnhem Land Fibre Project initiative involved over 800 kilometres of fibre optic backbone laid from Jabiru to Nhulunbuy (NT) and a second stage with required a further 190km of fibre and five radio systems to each of the islands. One of the outcomes of this project was that it provided twelve schools with increased speeds from 256kbps to 20Mbps. This meant that students in these remote communities have access to classrooms online. For example, video conferencing is allowing students in Nhulunbuy, Katherine and Alice Springs to link up and participate in classes delivered from Adelaide and Darwin. The project was a joint venture between Telstra, Rio Tinto Alcan and the Northern Territory Government (http://newsroom.nt.gov.au/index.cfm?d=5&fuseaction=viewRelease&id=7498 and http://www.telstra.com.au/abouttelstra/corporate-citizenship/case-studies/customers/ and http://www.telstra.com.au/abouttelstra/download/document/arnhem-land-fibre-fact-sheet.pdf

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- The Bush Schools Network Project delivered ICT services to 90 participating schools in remote, rural and regional Western Australia by connecting them to the Catholic Education Office of Western Australia's virtual private network with a centralised remote management solution, and broadband connections. The project was managed by the Catholic Education Office of Western Australia in partnership with the Association of Independent Schools of WA.
  Expected outcomes and benefits of the project included:
  - o reducing the digital divide between regional, rural and remote communities; and
  - o improving the quality of educational services provided by both government and non government sectors in remote areas
  (http://www.commerce.wa.gov.au/scienceinnovation/Content/Innovation_Technology_and_Sci/Science_and_technology_sectors/Digital_economy_and_broadband_.html and
  http://www.pdc.wa.gov.au/media/70488/pilbara%20and%20gascoyne%20broadband%20project%20officer%20report.pdf)

- A number of education related projects have been funded under the Multimedia Victoria Broadband Innovation Fund. For example, the Yarra Valley eRich Learning Environment project involved establishing a high-speed broadband network linking seven secondary colleges, 40 primary schools and one special school in the Yarra Valley, including Lilydale Heights College. Benefits of this project included having access to a secure, virtual network with shared servers and improved bandwidth which was said to make a huge difference in terms of being able to integrate technology into the school curriculum. The new network includes a cutting edge 'learning management system' which facilitates collaboration between teachers on curriculum development and lesson planning, provides opportunities for online student learning and discussion, and offers the ability to monitor and record student progress. The network also enables the use of laptops and electronic 'smart boards' in the classroom, voice over IP communication, and remote or home access for teachers, students and parents. Major benefits of the technology were an improvement in the quality and quantity of curriculum resources available to students, enhanced ICT skills of teachers, and opportunities for students to learn outside the classroom environment.
  http://www.mmv.vic.gov.au/YarraValleyeRichLearningEnvironmentCaseStudyPrincipal

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EXAMPLES ILLUSTRATING HOW HIGH SPEED BROADBAND COULD ENHANCE SCHOOL EDUCATION

High speed broadband would provide teachers and students with fast, reliable access to bandwidth intensive on-line content.

For example, year 10 history students studying Gallipoli could investigate the campaign using the ABC's website, *Gallipoli: The First Day*. Teachers would have the confidence to direct students to rich content such as interactive maps, 3D animations, video interviews with veterans and primary source documents, knowing the whole class can access the relevant material simultaneously and without delay.

To consolidate and share their learning, the teacher could arrange a web-conference with a historian from the Australian War Memorial. The teacher could record the web conference and make it available for students to review from home or school as they work on their subsequent essay.

High speed broadband could help all Australian teachers access quality professional development regardless of where they live or in which education sector or system they work.

A national calendar of events could be established to schedule virtual workshops, seminars and working groups, allowing teachers to access the most relevant and beneficial professional development available by participating in real time or downloading recorded sessions.

Students from regional and remote schools could use high speed broadband to attend differentiated literacy and numeracy classes delivered by a virtual classroom service.

Virtual classrooms allow teachers and students to see and interact with each other in real time, share applications and files and collaborate on group tasks. This type of service would benefit students who need additional support as well as those identified as gifted and talented. It would allow specialist teachers to work intensively with small groups of students who have similar academic needs but attend schools separated by vast distances.

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High speed broadband could assist high schools delivering VET courses to deliver units toward higher level certificates in partnership with TAFE institutes.

Students could complete additional theory elements using an online learning platform and demonstrate mastery of relevant skills for their TAFE supervisor via a real time video service. This would avoid the travel time and duty of care issues that could arise with students attending classes at the TAFE campus in person.

All students undertaking a VET course are required to complete a work experience placement to develop and apply their skills in a real work environment. During the placements the teacher could use video-conferencing to discuss student progress with supervising employers. Teachers could also observe students performing practical tasks and demonstrating course competencies. This process currently involves considerable time spent visiting work experience sites in person, however, high speed broadband could allow teachers to complete the task without leaving their school and in a fraction of the time.

High speed broadband could assist more students to participate in student conferences and competitions.

For example, the annual 'Kids Teaching Kids' sustainability conference include a workshop program which allows students to share their own research and environmental solutions with other students from around Australia. As the events are usually held in major cities, transport and accommodation costs can present a challenge for regional students.

Using high speed broadband, students from regional and remote schools could deliver workshops at the conference, based on their own environmental projects. Students could use a range of tools to present virtual workshops such as video diaries and demonstrations, and real time question and answer sessions for students interested in adopting their ideas for projects at their own school.

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