



**Submission prepared in response to the Department of
Broadband Communications and the Digital Economy discussion
paper:**

**National Broadband Network: Regulatory Reform
for 21st Century Broadband**

June 2009

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 through the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) on the economic and effective utilisation of online technologies in Australian education and training.

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 technical colleges together with several thousand Registered Training Organisations (RTOs), located throughout the country.

The 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.

As the Minister for Broadband, Communications and the Digital Economy has said¹, “The National Broadband Network will underpin the Government's Digital Education Revolution. It will support new learning and teaching practices and help prepare students for further education, training and life in a digital world. It will support virtual classrooms, video and audio streaming and high definition video conferencing – helping students and teachers to work together. It will provide gateways for students to interact with peers and teachers in schools across Australia and around the world.”

AICTEC wishes to see the development of a telecommunications regulatory framework 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.

¹ Minister for Broadband, Communications and the Digital Economy. Address to the National Press Club, Canberra, 28 April 2009

What is currently provisioned across the education sector in general falls short of what is needed, the notable exceptions being within the higher education sector. The reason for this appears to lie as much in the current commercial offers available from service providers and, in some areas, the lack of market incentives to make capacity available, as it does in the availability of fibre per se. In the schools sector, for example, the relatively high number of schools (47 percent²) connected by fibre does not correlate with higher broadband capacities being used by these schools. This disparity is due to lack of affordable service options and/or the specific contractual arrangements negotiated with the provider. The education and training sector would therefore support reform of the underpinning regulatory framework to address these factors.

It is important that the competition regulatory framework, in particular access and structural regulation, provide strong incentives for the provision of sufficient 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. Depending on network architecture, this is most likely to be achieved by provision of access to the dark fibre (or wholesale bitstream services) by network managers independent of the fibre owner/operator. This would be in addition to the competitive market at the retail level envisaged under the proposed National Broadband Network (NBN) arrangements. Quality of service is also important to the sector and appropriate incentives to enhance network performance and reliability will be important if the significant benefits of realtime communication are to be realised.

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'.

Timing

AICTEC welcomes the opportunity to provide input on the regulatory regime to apply in the lead-up to the establishment of the NBN. AICTEC envisages that this process is part of an iterative approach to regulation which will initially set the regulatory principles and parameters to apply to the NBN, then modify the existing regulatory regime as it will apply in the transitional period and ultimately, set the regulatory regime which is appropriate to the network architecture decided upon as a result of the Implementation Study.

AICTEC recognises that the primary focus of the discussion paper is reviewing the existing regulatory regime to explore ways that the regime can be made to work more

² The Department of Education, Employment and Workplace Relations undertook the Fibre Connections to Schools 2008 Baseline Survey of Australian schools broadband connectivity in August 2008 (92.3 percent of Australian schools responded).

effectively while the NBN is being built. The education sector is already a significant user of fibre, and may indeed have the highest penetration of fibre to the premises of any industry sector. The sector is currently facing issues about cost effective utilisation of that fibre which all potential users of the NBN will face if regulatory reform is not put in place. The sector has opportunities to make much more productive use of the fibre now if appropriate regulatory changes are made as soon as possible in the intervening period before the NBN is in operation. Therefore the sector is keen that process of regulatory reform is rapid and that changes necessary to ensure proper utilisation of existing fibre to the premises infrastructure are enacted as soon as possible.

The submission makes comment on the shape of access regulation which will apply once the NBN is established to inform early planning to address these longer term issues. It is not possible to forecast what speeds or even what network services may be required in the longer term. Therefore, what is required for the education sector is a platform for innovation, which essentially depends on open access and competition.

2. CONTEXT

Through its broad membership, AICTEC represents the ICT interests of each state and territory government school and Vocational Education and Training (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 by MCEETYA on 17 April 2008, extend AICTEC's role to include providing strategic policy advice on implementation of the Digital Education Revolution (DER). In making this decision, MCEETYA noted that AICTEC would provide cross-jurisdictional and cross-sectoral policy advice to MCEETYA, COAG's Productivity Agenda Working Group and relevant sub-groups, and the Australian Government regarding implementation of the Digital Education Revolution 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)³. The Ministerial Statement recognises the importance of the role of ICT in assisting 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 the Council of Australian Government (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.⁴

³ The Statement is available at <http://www.aictec.edu.au/aictec/go/home/about/cache/offonce/pid/95;jsessionid=ABBB86635EB505E27F587B30FADA4D92>.

⁴ See http://www.coag.gov.au/coag_meeting_outcomes/2007-12-20/index.cfm.

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.

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. 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 billion over six years to:

- provide for new ICT equipment for all secondary schools with students in years 9 to 12.
- support the deployment of fibre-to-the-premises broadband connections to Australian schools
- collaborate with states and territories and Deans of Education to ensure new and continuing teachers have access to training in the use of ICT that enables them to enrich student learning
- 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.

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 some of the views put in this submission.

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.

Recently it was announced that COAG had agreed to establish a Compact with Young Australians. This will ensure that as we recover from the global recession, young Australians have the skills required to realise their potential. Under the terms of the Compact, every Australian under the age of 25 will have a guaranteed education or training place. Improved connectivity between institutions and with young people will enhance the ability to provide the necessary training in this environment.

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.

High speed broadband connectivity is a crucial component of Australia's higher education and research system, not least because it underpins improved learning outcomes, access to international research materials, national and international collaboration, and facility sharing.

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.

Current Concerns about Potential Delivery and Use of High Speed Broadband

The current structure of the telecommunications market fails to provide 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 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 web browsing can saturate their current links. More advanced functions – for

example running class room to class room 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.

While institutions in the VET sector are served by connections of variable quality and speed at present, their position is likely to improve following the Government's recent decision to commit \$81.9 million to fund the development of a Vocational Education Broadband Network by 30 June 2011.

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, that capacity is relatively costly. Whereas southern mainland universities use the AARNet⁵ infrastructure to connect at 1G and in some cases 10G speeds, the connections to the NT are limited to 155Mbps⁶. 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.

Cross sectoral (i.e. schools, VET, university) connectivity is important so that realtime communications such as video-conferencing and access to and exchange of publicly funded educational content is not inhibited by volume based traffic pricing regimes. For example, University Faculties of Education need to be able to deliver support to their students and mentor teachers when they are undertaking in-service teacher training in schools. The delivery of VET courses through schools is also likely to increase demand for interoperability between these two sectors.

Cross sectoral and cross jurisdictional collaboration is also limited due to the charging models some carriers employ for interstate traffic. Any virtual private network (VPN) established through Telstra for example 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.

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.

⁵ 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.

⁶ 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.

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 new and richer content is leveraged in the delivery of learning outcomes. 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 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.

This submission:

- describes what the education and training sector wishes the telecommunications regulatory framework to deliver (**Section 3**);
- provides comments against each of the regulatory issues in which AICTEC has an interest (**Section 4**);
- provides comments on related issues (**Section 5**); and
- provides comments on desirable features of the NBN open access regime (**Section 6**).

A summary of these comments is at **Attachment A**.

More details on connectivity in the education and training sector are at **Attachment B**.

3. THE REGULATORY FRAMEWORK – EXPECTATIONS OF THE EDUCATION AND TRAINING SECTOR

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.

In the context of supporting the deployment of fibre connections to schools, stakeholders identified key principles which underpin the vision⁷ for connectivity of schools into the future, namely:

⁷ 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/FibreConnection/Pages/FibreConnectionsToSchools.aspx>

- *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 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 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.

The telecommunications regulatory framework should encourage, or at the very least not impede, the widespread provision of high speed broadband connections with these characteristics. These arrangements may, for example, need to permit services layers and charging regimes which foster the creation of education networks separate from wholesale and retail service providers.

In addition to these enterprise level concerns, the education and training sector needs a regulatory regime applying to residential customers which enables students to connect with educational resources using affordable and reliable high speed broadband connections anywhere, anytime.

This requires a regulatory regime which provides open access to the fibre infrastructure and fosters competition between wholesale and retail service providers using this infrastructure.

With these considerations in mind, AICTEC wishes to comment on the following aspects of the regulatory framework:

- *the access regime*. The education and training sector will need access arrangements which facilitate competitive provision of residential broadband services for students; enable competitive provision of broadband services to education systems or educational institutions and/or allow for affordable access to capacity on fibre by those institutions’ and systems’ service providers. (see **section 4.1** below)

- *anti-competitive conduct provisions.* It will be important that regulatory regime discourages anti-competitive behaviour by infrastructure providers and by wholesale and retail service providers. (see **section 4.2** below)
- *separation arrangements for Telstra.* It will be important to address Telstra's vertically integrated market power to ensure that other providers are able to obtain wholesale capacity on Telstra's network on an equivalent basis to Telstra and thereby compete against Telstra at the retail level. (see **section 4.3** below)
- *facilities access regime.* To enhance connectivity and the ability to collaborate, including through the potential for networks of education and training institutions it will be important that access is provided to not only the fibre but also to the associated facilities (and space for equipment) to enable providers to provide network services. (see **section 4.4** below)
- *spectrum allocation.* It will be important to ensure that sufficient spectrum to support high-performance point-to-point wireless links outside the NBN footprint and wireless coverage over the widest possible geographic area is readily available and affordable. As a general principle, spectrum allocation arrangements (or the open access regime as applied to the NBN infrastructure) should encourage competition between providers within platforms. (see **section 4.5** below)
- *Telecommunications Consumer Safeguard Framework.* Consumer safeguards focussed on residential consumers are important to the education sector as they foster the ability of students to communicate and continue their learning activities beyond the institutional gate. In addition, consumer service guarantees and network reliability frameworks provide general encouragement to service providers to enhance their performance and strengthening such mechanisms would be welcome. It will also be important that the regulatory environment enables and encourages pricing for high speed broadband for schools and/or school sectors which is affordable and predictable in the longer term. (see **section 4.6** below)

Education sectors may be part of wider purchasing arrangements. By way of example:

- State and territory government schools may be party to whole of government arrangements in their state and territory;
- catholic or independent schools may adopt joint purchasing arrangements (and in some cases may be party to whole of government arrangements in their jurisdiction) and/or utilise independent network management services and Internet Service Providers (ISPs); and
- universities and other research institutions have joint arrangements and shareholding in a telecommunications carrier.

These arrangements can strengthen the market position of individual institutions. However, even with this improved position in the market, wider purchasing arrangements are not sufficient to guarantee educational institutions access to affordable high speed broadband.

It is recognised that the provision of the NBN on an open access basis has the potential to address a number of these issues, as has the introduction of additional fibre capacity links on some routes currently served by a single provider. Nevertheless, it is desirable that the regulatory framework enables the negotiation of arrangements which facilitate access to affordable high speed broadband and the benefits it can potentially deliver.

4. DETAILED RESPONSES TO ISSUES RAISED IN DISCUSSION PAPER

4.1 ACCESS REGIME

AICTEC welcomes the Government's commitment to legislative amendments to establish an access regime to facilitate open access to the NBN for retail level telecommunications service providers.

Education and training stakeholders consider that the establishment of a regime where the wholesale, open access environment is completely separate from all retail players in the marketplace will make a significant difference to their operating environment. It is hoped that this facilitates outcomes that open up the market to innovative players with new approaches to competitive service provision.

This approach should also prevent the major carriers from monopolising 'Whole of Business' offers. For example, Queensland and South Australia would see benefit in an environment under which the education system can take advantage of innovative offers in metropolitan areas without being penalised in regional and remote areas.

As discussed later (see section 6. NBN Regulation) the network architecture adopted may affect the base level of access which is provided and therefore, the type of open access regime required.

Access arrangements are likely to affect both capacity available and terms and conditions of utilisation of this capacity, which will in turn affect the affordability and availability of services for educational institutions and students in households and workplaces.

As noted above, some 47 per cent of schools already have fibre connections. The problem is that they cannot afford to use them to anything like their fullest extent because the charges are prohibitively high and volume-related. Volume related 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. Volume based pricing also stifles innovation and the adoption of modern teaching and learning practices by, for example, discouraging use of media rich content.

Access arrangements will need to be such that service providers are able to offer pricing arrangements which are more affordable and predictable. It is recognised that infrastructure and service providers will need to be able to price services in a way that reflects reasonable costs. However, the access model needs to enable service providers to offer a range of pricing models including pricing that is not necessarily volume related. Such arrangements are most likely to be provided where access is available to dark fibre or wholesale bit stream services.

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 155 Megabits per second (Mbps), the capacity AARNet has leased from Telstra, and the requirements to upgrade to a gigabyte service are not economically feasible with the current sole supplier backhaul service. A review of backhaul pricing suggests that links between Darwin and Adelaide are six times more expensive than similar links where there are alternate suppliers such as Cairns to Sydney or Perth to Adelaide. The universities' service provider is also limited to 2.5 Gigabits per second (Gbps) on its connection to Townsville with less capacity onto Cairns which is insufficient to sustain the tropical research into the future.

It is not clear whether the inability to obtain sufficient capacity is a result of the limitations of the access regime, or because of other factors. The routes in question would appear to be covered by the declaration of domestic transmission capacity services, thus requiring access to be provided under standard access obligations. It may be that the definition of domestic transmission capacity services does not require access to the fibre as sought by the education sector, or it may be that the access regime is too challenging for smaller competitors.

It may also be that if an additional fibre link is provided on these routes through the backhaul blackspots component of the NBN or through other commercial processes, these issues will be resolved.

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 the Diocese of Wagga Wagga can be up to 300 per cent more expensive than those available in the Archdiocese of Sydney. 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.

Regardless of the reason, given the geographic spread of many school systems, single supplier arrangements (which some may argue are more efficient in terms of management overhead) are currently not possible except through Telstra.

In any case, the education sector's desired outcome is that the various education sectors' service providers, are able to obtain, on affordable terms, access to dark fibre, or rights to managed bandwidth, such that sufficient capacity is available for their needs (although it is recognised that not all education providers will choose this route - some may indeed prefer to purchase a service that meets their needs from a service provider). This requires that the regulatory regime is able to accommodate a range of options (from access to dark fibre through to some form of managed service) in an open and competitive way to create innovation and provide flexibility to the education sector.

Strong open access provisions in the regulatory framework relating to existing fibre, to fibre installed as part of the NBN and to any non-NBN fibre installed in the future are all critical.

In addition, a model which provides access to the dark fibre has greater ability to deal with the differing (and increasing) capacity needs of the education and training sector, including the higher education sector, without unnecessary duplication of infrastructure.

Education stakeholders share the views expressed in the discussion paper that the current negotiate-arbitrate model is very slow, cumbersome and open to gaming (obstruction).

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. Changes to the regulatory regime ensuring that schools have access to fibre quickly and efficiently would enhance their ability to deliver the benefit envisaged through the Government's education reforms.

Accordingly, AICTEC would support:

- Strong measures to ensure that competitors are able readily to gain access to capacity on fibre networks owned by others, on terms and conditions that make it possible for them to offer high speed bandwidth at affordable prices and with predictable costs. Ideally, access arrangements should also enable access to fibre so that predictable arrangements can be put in place to allow the education sector access to sufficient capacity under affordable pricing arrangements.
- Amendments to the current process which provide the most speedy resolution of access issues. [On the face of it, this would appear to be Option 2, Replace the Part XIC negotiate-arbitrate model with a streamlined regulatory process.]
- Once the NBN is in operation, a strong open access regime applying to all dark fibre networks and, if relevant, to those service providers using the fibre network to provide wholesale services.

4.2 ANTI-COMPETITIVE CONDUCT PROVISIONS

AICTEC would welcome provisions which strengthen the ability to address anti-competitive conduct. Under an open access regime, there will be stronger incentives for the infrastructure provider not to indulge in anti-competitive behaviour. However, there may be no such incentive in smaller retail markets served by one or a small number of providers. Therefore it will be important that the regime address anti-competitive behaviour by infrastructure providers and by wholesale and retail service providers.

4.3. SEPARATION ARRANGEMENTS FOR TELSTRA

AICTEC supports the view in the discussion paper that maintaining the current separation arrangements will not deal with the issues concerning Telstra's vertically integrated market power. AICTEC supports measures to promote equivalence of outcomes to allow efficient competitors to access Telstra's essential infrastructure and produce equally competitive outcomes.

As noted above, AICTEC welcomes the Government's commitment to legislative amendments to a regime where the NBN is a wholesale provider for retail level telecommunications services providers. Arrangements more consistent with this approach should be applied to the current telecommunications market.

A recently completed, 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 Metro 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. Generally speaking, it is believed that the level of service available for current budgets would be exponentially improved in a vertically separated, truly competitive marketplace – with the service provider market competing fairly on open access infrastructure.

In general terms, Telstra's significant presence in the market place limits the ability of the education sector to procure services from a range of providers. Education providers would benefit from a rebalancing in Telstra's market power so that other providers could obtain wholesale capacity on Telstra's network and thereby compete against Telstra at the retail level.

Education providers would also benefit from being able to access sufficient broadband capacity on routes dominated by Telstra. It appears on some routes fibre exists (eg. in South Australia) but there is reluctance on the part of the fibre owner to make fibre available for use by others. Enhanced separation provisions may encourage Telstra to make capacity available, rather than to retain the capacity so that it can provide highly priced retail services.

Separation arrangements should be as strong as is necessary to ensure that the issues arising because of Telstra's vertically integrated market power are definitively addressed.

4.4 FACILITIES ACCESS REGIME

AICTEC strongly favours regulation that delivers an effective facilities access regime. The education sector has from time to time encountered difficulties in accessing ducts for installation of fibre. This is of benefit for construction and enhancements of networks. A major aim of education sectors has been to enhance connectivity and the ability to collaborate, including through the potential for networks of educational institutions. It will be important if this agenda is to be advanced that access is provided to not only the fibre but also to the associated facilities to enable providers to provide network services. Requirements should include requirements for access to sufficient space to install equipment.

4.5 SPECTRUM ALLOCATION

It is intended that the NBN provide fibre coverage to around 90 per cent of the population. Outside these areas, it is expected that wireless or satellite services will provide broadband to educational institutions. Given the latency issues with satellite

services, wireless is especially important and it will be critical to ensure that sufficient spectrum is made available to provide these services.

Addressing the problem of open access backhaul will enhance the viability of wireless service providers in the regions and will increase the need for real competition in the area of wireless service delivery.

In other areas, wireless broadband services may provide complementary services to the NBN and providers of services on fibre eg. for mobile consumers of education. Spectrum availability will be important in delivery of these services.

As a general principle, spectrum allocation arrangements (and/or the open access regime as applied to the NBN infrastructure) should encourage competition between providers.

4.6 TELECOMMUNICATIONS CONSUMER SAFEGUARD FRAMEWORK

The discussion paper examines consumer safeguards within the *current* framework and considers changes which can be implemented immediately to make the existing regime more effective during the transition to the NBN environment. The chapter addresses issues relating to, and potential areas of reform for, key consumer safeguards including:

- Universal Service Obligation
- Customer Service Guarantee
- Network Reliability Framework
- retail price controls
- priority assistance
- access to emergency calls, and
- regulatory obligations in relation to carrier licence conditions, enforcement of consumer safeguards, and regulatory reporting.

The current focus of consumer safeguards largely emphasises the service to be provided to residential consumers. In some cases the safeguards have provisions relating to small business. In one case, the provisions relate to schools.

As a general point, consumer safeguards focussed on residential consumers are important to the education sector in that they foster the ability of students to communicate and continue their learning activities beyond the institutional gate. Prior to the NBN being established, there is a need to maintain the degree of regulatory control and incentive necessary to ensure that services are delivered on an equitable

basis. This degree of control will vary as the NBN comes to reality, but prior to that time, measures should be retained to ensure individuals, businesses and communities are not let down by market pressures.

The education and training sectors require effective communications with students, parents and the community. For this reason, mechanisms such as the Universal Services Framework play an important role in ensuring the feasibility of such communications – particularly in regional and remote areas. The sector supports the concept of a Communications Service Standard for all communications services as proposed by the Glasson report. In some circumstances, payphones are of importance to educational institutions.

In addition, consumer service guarantees and network reliability frameworks provide general encouragement to service providers to enhance their performance and strengthening such mechanisms would be welcome. It would also be desirable if the regulatory model contained network performance standards that are consistent with or facilitate the ability of schools to make best use of fibre connections by ensuring timely repair and fault correction to minimise disruption to education delivery and enable effective collaboration between educational institutions. It would also be desirable for these standards to take account of the increasing need to provide services outside the traditional working hours.

In Queensland TAFE institutes are being driven to increasing flexible delivery including providing access to infrastructure at nights and on weekends for staff, students and industry partners. Furthermore the Queensland Skills Plan (QSP) and its South Australian counterpart, VET Skills Strategy, promotes community access to public infra-structure including ICT's. Faults that occur outside working days for example, weekends and Public holidays take much longer to repair.

The current service delivery model seems to be based on an out-dated paradigm of a standard Monday-Friday, 9-5 working week. The TAFE service delivery model is increasingly one of open access and extended hours including evening and weekend delivery. Additionally VOIP, web-services and Videolink are critical to TAFE delivery, particularly outside standard working hours.

The rest of the education sector faces similar constraints.

As noted above, there is currently a specific price control relating to schools. Telstra must offer a line rental to schools at a price at or below the standard line rental offered to residential customers. As also noted previously, a key principle for education relates to affordable ongoing pricing. To this end, it may be useful for schools to have a price cap on standard line rental. However, it is also important that pricing for usage of this line and fibre connections is predictable. It may therefore be preferable to have a larger up-front cost relating to line or fibre rental with smaller daily usage related costs. Alternatively, a higher one-off installation charge would be preferable if it enabled lower monthly line rental and lower usage charges.

AICTEC considers that at this point in time it is not possible to determine whether competition will provide the range of options necessary to provide schools with the desired predictable pricing outcomes. Therefore it supports retention of the price cap in the transition period. Once the competitive NBN environment is settled, the necessity for the existing price cap, or indeed, the need for an extension of the price cap to relate to wholesale access could be re-examined. At that stage it could also be considered whether it is necessary to have some independent assessment of pricing (whether this is part of the access regime or a separate mechanism).

5. ADDITIONAL ISSUES

In Australia, charging for data used on an Internet connection is high compared to many other developed countries and constrains Internet use even on high bandwidth connections. Contributory factors to these costs are the high cost of international connections from Australia and the barriers to peering within Australia.

5.1 INTERNATIONAL CONNECTIONS

AICTEC notes the importance of access to affordable high speed broadband connections to international markets, particularly in the case of the higher education sector. For example, AARNet in its submission to the National Innovation Review Paper emphasised that international connectivity is of particular importance in internationally collaborative research, noting that in Australia, the number of researchers in a particular discipline may be so small that the only way they may advance their work is through continuous collaboration with international researchers.

It appears that there may be constraints in supply of international communications services. There appears to be relatively limited competition on transpacific links into the United States and a lack of new undersea infrastructure out of Western Australia to Asia. These constraints result in the lack of affordable pricing models for this traffic, apparently because of lack of capacity and lack of providers. These constraints also flow through to domestic traffic emanating from overseas eg. Internet downloads.

AARNet, in the above submission, indicated that the cost of international connectivity in Australia is many times that in the USA and Europe and that these high costs act as a deterrent to international scientific collaboration limiting our global competitiveness. AARNet's submission said that this was not a technology limitation; rather the economics of investing in undersea cable infrastructure over such vast distances and that while there is the promise of additional competitive cable systems, international connectivity both east and west out of Australia is likely to remain a financial challenge simply due to Australia's geographic remoteness.

AICTEC recognises that capacity constraints may be a result of lack of market investment and therefore not directly resulting from regulatory regimes. AICTEC also understands that there are current commercial moves to increase the capacity on international routes eg. from Guam to Papua New Guinea to Australia. However, AICTEC urges that in

considering any new regulatory regime, arrangements aim to facilitate greater access to international capacity on competitive terms and conditions.

5.2 PEERING

Peering is the exchange of network traffic between two ISPs where no money changes hands. The costs are, therefore, proportional to the costs of equipment and network circuits for interconnection. In practice, large carriers peer with each other but tend not to peer with others, instead to charging others (often on a data basis) for Internet traffic. Some ISPs peer with each other through peering exchanges. Some national research and educational networks peer with each other to provide un-metered traffic to educational resources, that they obtain through peering arrangements.

As noted by AARNet⁸, peering significantly improves network performance, delivers cost savings for all customers of the peering ISPs by reducing transit costs and enables new and innovative services. AARNet recommended that the Government to legislate for the appropriate regulatory framework to ensure that public good content is freely exchanged among all Australian ISPs including the dominant carriers.

AICTEC suggests that regulatory arrangements should be such that they encourage peering. This has the potential to substantially improve the affordability of domestic Internet data and this is particularly important for educational resources in Australia.

6. REGULATION OF THE NBN

AICTEC notes that the primary focus of the discussion paper is reviewing the existing regulatory regime to explore ways that the regime can be made to work more effectively while the NBN is being built. However, AICTEC also wishes to comment on the shape of access regulation which will apply to the NBN.

AICTEC welcomes the Government's commitment that the NBN company will be required to be wholesale-only and operate on an open access basis.

A key aim for any open access regime will no doubt be to ensure that the fibre network provider does not have the freedom to extract monopoly rents from the fibre network. Accordingly, it will be important that the access is provided to the most basic service that is economically viable to offer. This may vary according to the network architecture adopted and the class of end-user.

AICTEC understands that there is a range of possibilities of network architecture which could be adopted, depending on the approach taken in linking the NBN to existing infrastructure. For example, fibre access could be linked to existing network structures such that the fibre tails mirror existing copper tails. Alternatively, longer fibre tails could be built if existing networks are not to be followed.

⁸ AARNet submission to Innovation Review.

AICTEC also understands that, for example, the longer the fibre tail, the less viable it may be to require access to 'dark fibre' and that access may need to be provided instead to wholesale bit-stream services. AICTEC also understands that the feasibility of providing fibre access rather than wholesale bit-stream access may differ according to market density.

AICTEC considers that it will be important that educational institutions (like other destinations/organisations that accommodate a large number of users) are able to be provisioned (through their chosen service provider) with the most basic unit of access. This would require access to multiple point-to-point fibres so that there are no future limitations imposed by shared fibre on the speed at which connections to educational institutions can be operated; if possible, those fibres should be made available on a 'dark fibre' basis. The education sector sees it as particularly important that educational institutions are provided with direct point to point connections (rather than being part of, for example, a passive optical network structure, which would require sharing of bitstreams). It would also be desirable that 'middle mile' dark fibre infrastructure is available to support the carriage of education related traffic further up the network to points of presence for any core network infrastructure that is put in place.

In addition, the regulatory regime will need to foster competition at all levels. For example, if, as appears to be the case in Singapore, the fibre network owner is only permitted to provide dark fibre, there will be the potential for different layers of service providers eg. the fibre network provider, a number of wholesale network providers (like our current carriers) and a number of retail service providers (like the current carriage or ISPs). It will be important that the regulatory regime provides incentives for competition at each of these levels either through access requirements, structural separation or rules relating to anti-competitive behaviour.

In addition it will be important that aggregation points have the physical capacity to accommodate the equipment required by service providers and that an access regime (for facilities) includes access to space for equipment.

It will also be important that appropriate incentives are put in place so that the NBN (and other wholesale operators) continue to evolve their wholesale offerings in terms of capacity and features as the world market evolves and develops.

In conclusion, AICTEC sees the NBN as having tremendous potential to assist in delivering the Australian governments' broad social and economic policy agendas for education, health and productivity. It will be vital that the NBN is regulated in such a way that its commercial incentives are intrinsically aligned to supporting the economic welfare objectives of Australia.

**DBCDE Discussion Paper: *National Broadband Network: Regulatory reform for the 21st Century*
Response by the Australian Information and Communications Technology in Education Committee (AICTEC)**

The education and training sector needs access to broadband on terms that are affordable, predictable and priced in ways that ensure it can be used to maximum educational effect. Currently, high speed broadband is too expensive, with volume-related pricing that makes costs difficult to predict and budget for. In addition, there are hindrances to the ability to access sufficient capacity to serve the needs of the sector. Accordingly, AICTEC wishes to see changes to the regulatory regime which:

- more strongly encourages competition in the telecommunications marketplace, to enable educational institutions, and students in their homes and workplaces, to gain access to broadband services on more reasonable terms and conditions than is currently possible in most cases;
- requires providers to meet performance standards that ensure high standards of network reliability, so as to provide a robust platform for national collaboration on the design and delivery of education services;
- creates incentives for fibre infrastructure owners/operators to provide access to sufficient capacity for educational institutions to provide innovative educational services which require significant bandwidth.

DESIRED OUTCOME	RELATIONSHIP TO REGULATORY FRAMEWORK	SUMMARY OF AICTEC COMMENTS	Discussion in AICTEC submission
<p>The various education sectors (through their service provider) are able to obtain, on affordable terms, access to dark fibre, or wholesale bit-stream services, such that sufficient capacity is available for their needs.</p> <p>Access arrangements which facilitate competitive provision of affordable residential broadband services for students; and enable competitive provision of affordable broadband services to education systems or educational institutions.</p> <p>Genuinely open access to broadband infrastructure to all service providers on terms</p>	<p>Part XIC access arrangements</p>	<p>Strong measures to ensure that competitors are able readily to gain access to capacity on fibre networks owned by others, on terms and conditions that make it possible for them to offer high speed bandwidth at affordable prices and with predictable costs that reflect the fair costs of provision.</p> <p>The regulatory regime should also ideally enable access to dark fibre so that predictable arrangements can be put in place to allow the education sector access to sufficient capacity under affordable pricing arrangements. However, some education providers may prefer to purchase a service that meets their needs from a service provider and thus the regulatory regime will need to accommodate a range of options (from access to dark fibre through to some form of managed service) in an open and competitive way.</p> <p>The open access regime should apply to all existing and future fibre networks (NBN and non-NBN).</p>	<p>Pages 11-14</p>

		Amendments to the current process which provide the most speedy resolution of access issues. [On the face of it, this would appear to be Option 2, Replace the Part XIC negotiate-arbitrate model with a streamlined regulatory process.]	
	Anti-competitive conduct provisions	The regulatory regime should discourage anti-competitive behaviour by infrastructure providers and by wholesale and retail service providers	Page 14
and conditions that enable competition to occur on a level playing field.	Separation arrangements for Telstra	<p>Education providers would benefit from a rebalancing in Telstra's market power so that other providers could obtain wholesale capacity on Telstra's network on an equivalent basis to Telstra and thereby compete against Telstra at the retail level.</p> <p>Separation arrangements should encourage Telstra to make capacity available, rather than to retain the capacity so that it can provide highly priced retail services.</p> <p>Separation arrangements should be as strong as is necessary to ensure that the issues arising because of Telstra's vertical integration are definitively addressed.</p>	Pages 14-15
Genuinely open access to broadband infrastructure to all service providers on terms and conditions that enable competition to occur on a level playing field (continued)	Facilities access regime	To facilitate the competitive supply of services, access should be provided to not only the fibre but also to the associated facilities (and space for equipment) to enable providers to provide network services.	Pages 15

<p>To facilitate the provision of the best possible broadband connections to educational institutions in areas not serviced by the NBN fibre network, and to complement broadband fibre services.</p>	<p>Spectrum allocation</p>	<p>It will be important to ensure that sufficient spectrum is made available to provide non-fibre broadband services.</p> <p>As a general principle, spectrum allocation arrangements (and/or the open access regime as applied to the NBN infrastructure) should encourage competition between providers.</p>	<p>Page 15-16</p>
<p>Network performance standards and service guarantees that facilitate interoperability of customer equipment and services across networks to enable national collaboration on the design and delivery of education services, and requiring timely repair and fault correction to minimise service disruptions.</p> <p>Safeguards which foster affordable pricing and reasonable service standards for residential and institutional consumers and provide strong incentives for service providers to meet performance standards</p>	<p>Network Performance standards and customer services guarantees</p> <p>Telecommunications Consumer Safeguard Framework</p>	<p>Consumer safeguards focussed on residential consumers to enhance the ability of students to communicate and continue their learning activities beyond the institutional gate.</p> <p>Consumer service guarantees and network reliability frameworks to encourage service providers to enhance their performance.</p> <p>Retention of price cap on line rental for schools until new competitive market is apparent.</p>	<p>Pages 16-18</p>
<p>The National Broadband Network company will be required to be wholesale-only and operate on an open access basis such that educational institutions' network manager can have access to most basic service eg. dark fibre or wholesale bit-stream services.</p>	<p>Open access for the NBN</p>	<p>A key aim for any open access regime should be to ensure that the fibre network provider does not have the incentive to obtain monopoly rents from the fibre network. Accordingly, it will be important that the access is provided to the most basic service that is economically viable to offer.</p> <p>The regulatory regime should provide incentives for competition at each of the wholesale and retail levels either through access requirements, structural separation or rules relating to anti-competitive behaviour</p>	<p>Pages 19-20</p>

EDUCATION SECTOR CONNECTIVITY

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, 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. There are 13 TAFEs connected to AARNet at speeds of 1Gbps.
- 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 very high duty of care responsibilities and a single gateway to the Internet
- the Catholic school system – 90% of Catholic systemic schools are on private WANs which range in size from 30 schools to 450 schools. The major WANs in the Catholic sector include CathEdNet (Western Australia), CESAnet (South Australia), CEVN (Victoria), LINCs (Brisbane) and CEnet (NSW, ACT and QLD). Many of these networks are interconnected across state boundaries and share common Internet access gateways and other centrally hosted services. A small number of schools have direct Internet access. The sector has high duty of care responsibilities
- independent schools – most schools are independent in all aspects for IT, Internet access is per school, and there are high duty of care responsibilities.

Every education location, 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 not just the Internet, but the rest of their any relevant virtual private network. This means that under the NBN fibre connections to schools (and other educational institutions) should not be "shared" using something like Passive Optical Networking (PON). A single point to point connection would allow flexibility and scalability of network services to be provided to that education location, be it 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.

Schools

The ability of education departments and catholic and independent schools to obtain adequate and affordable broadband services varies significantly from jurisdiction to jurisdiction and from across government and non-government schools. Some systems

are able to connect in excess of 50 per cent of schools at 4Mbps to 10Mbps, whilst others are limited to 2Mbps and often 128Kbps ISDN. A teacher's use of e-mail, Internet browsing, collaboration tools, downloading of content including learning objects in a class is not practical if response times for many students working simultaneously is slow or unpredictable. Satellite is a last resort for education sites as it is not suitable for real time applications such as video-conferencing and online learning.

In August 2008, DEEWR undertook a survey⁹ to establish a baseline of schools' broadband connectivity. Findings from the survey indicate that 47.0 per cent of schools are connected by fibre, 42.3 per cent by digital subscriber line (DSL) and 2.4 per cent by satellite. Although 47.0 per cent of schools use fibre, the majority of schools (80.5 per cent) have download speeds of up to 4 Mbps. It is also worth noting that there is a disparity in connectivity across regions and across sectors.

The relatively high number of schools connected by fibre does not correlate with higher download speeds being used by these schools. This disparity is due to affordability of the service or the specific contractual arrangements negotiated with the provider. The majority of schools (63.9 per cent) use Telstra, 11.2 per cent Soul, 3.9 per cent Optus with the remaining schools serviced by other providers.¹⁰

Vocational Education and Training (VET)

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.

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 states and territories, through the Proof of Concept Fibre-optic TAFE Network Project (see below) and the Framework's Access to Bandwidth Project, have already recognised the potential for efficiencies and improvements in the quality of outcomes for VET through a broadband network. An example of this is the efficiencies of storage and sharing of corporate and educational data and materials on the network.

⁹ The Fibre Connections to Schools 2008 Baseline Survey of Australian schools broadband connectivity was established in August 2008 (92.3 percent of schools responded). The information used in this submission is based on this data.

¹⁰ The survey indicated that there were 31 providers servicing schools. A full listing can be found on the Digital Education Revolution website at: <http://www.deewr.gov.au/Schooling/DigitalEducationRevolution/Pages/Nationalbaselineofschoolbroadbandconnectivity2008.aspx>

Proof of Concept TAFE Network Project

Over the past year, the Australian Government, in collaboration with the governments of ACT, Victoria and South Australia, has been developing a proof of concept TAFE network to test a range of hypothesis in relation to the value of a high speed broadband network for the VET sector and to assist in developing effective strategies for cross-jurisdictional and cross-sectoral collaboration with a view to implementing a national network. Specifically this has involved initiating a fibre-optic TAFE network connecting selected South Australian, Victorian and ACT TAFE sites, through the AARNet backbone (the fibre-optic backbone being used by the university sector); building fibre-optic tail circuits to specific TAFE sites; and testing a number of network applications.

Learnings from the proof of concept project provide insights into some of the challenges that may be encountered in providing such a network including challenges associated with achieving outcomes in both contractual and technical arrangements.

Vocational Education Broadband Network (VEN)

On 22 April 2009, the Prime Minister announced, as part of the Australian Government's Response to the 2020 Summit, funding of \$81.9 million for a high speed broadband network - the Vocational Education Broadband Network (VEN).

The VEN will contribute to 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 complement the NBN initiative.

Higher Education and Research

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

The higher education and research organisations that connect to the AARNet have significantly improved connectivity from 34Mbps in 2002 to up to 10Gbps today assisted by the \$88 million investment of Backing Australia’s Ability (BAA) Systemic Infrastructure Initiative (SII) funds. This initiative created the Australian education and research network. Access to dark fibre on the Nextgen Network, as well as a number of Co-ordinated Communications Infrastructure Fund (CCIF) and Clever Network projects and regional initiatives administered by the former Department of Communications, Information Technology and the Arts, have underpinned this major upgrade. 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), University of the Sunshine Coast (20Mbps) and University of Tasmania (2x155 Mbps) as well as intercampus links to a number of regional campuses.

A typical example of inter-campus 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 AARNet 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. 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 fibre connections for education

There has been a substantial shift to broadband services by consumers over the last few years with many homes now having some form of broadband connection. This may be, at the lowest end, an ADSL connection and at the highest end an ADSL2+ connection with services such as broadband wireless or cable sitting between the two. The download speeds of these services range from 256Kbps to 20Mbps (although very few services operate at this highest speed).

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, then an increasing number of students will also 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 educational digital resources whilst working from home on assignments; this will generate an inevitable increase in demand for home access to online educational resources.

At the same time, the providers of these on-line resources have been generating more sophisticated approaches to their delivery so that students connecting from home can participate fully in their courses and therefore significantly reduce any disadvantage that might result from any lack of the more traditional physical participation. Lecture recordings are now commonly available, as are podcasts, on-line tutorials, on-line delivery of course materials and on-line access to digital library resources. Many of these resources use video or other rich media and this has the inevitable effect of increasing the amount of data that a student or other home consumer of educational resources needs to transmit from the educational provider to the home and vice versa. There is no evidence that this trend will do anything other than increase.