Australian Information
and Communications Technology
in Education Committee

WBT INQUIRY

Submission No. 35

The Secretary
House of Representatives Communications,
Information Technology and the Arts Committee
Suite R1, 116
Parliament House
Canberra ACT 2600

Dear Sir

The Australian ICT in Education Committee (AICTEC) appreciates this opportunity to participate in the House of Representatives Inquiry into the use of wireless technologies to provide broadband communication services in Australia.

AICTEC is a cross-sectoral, national committee responsible for providing advice to all Australian Ministers of Education and Training on the economic and effective utilisation of online technologies in Australian education and training.

It is apparent that schools, vocational education and training institutions, and universities are exploring a wide range of flexible options for increasing access to online educational content and improving education and training outcomes for students.

The Inquiry thus comes at a critical time in the investigation of new technologies and their potential for providing practicable solutions for improving connectivity within the education and training sector in Australia.

A copy of the Committee's submission to the Inquiry is attached.

Yours sincerely

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June 2002

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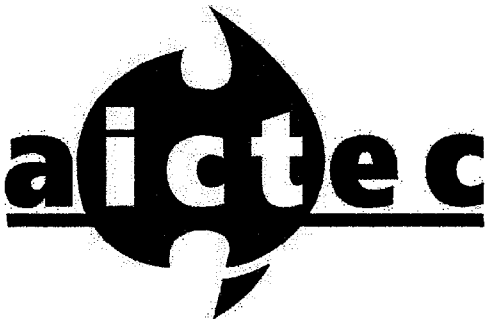

Australian Information and Communications Technology in Education Committee (AICTEC)

Submission to the Inquiry by the House of Representatives into the use of Wireless Broadband in Australia

June 2002

Preamble

The Australian Information and Communications Technology in Education Committee (AICTEC) is a cross-sectoral, national committee responsible for providing advice to all Australian Ministers of Education and Training on the economic and effective utilisation of online technologies in Australian education and training.

The Committee, known as the Education Network Australia Reference Committee (ERC) before 2001, has been endorsed by the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) as the national forum for advice on issues relating to the educational use of information and communications technology. AICTEC is also accepted as a national forum by the Commonwealth Government's Ministerial Council for the Information Economy.

AICTEC has representation from the schools, vocational education and training and higher education sectors, and includes both public and private education and training sector interests. Through its broad membership, the Committee represents the information and communication technology interests of each State and Territory school and VET system, the non-government school sector, higher education, and the Commonwealth Government.

Introduction

It is apparent that schools, vocational education and training institutions, and universities are exploring a wide range of flexible options for increasing access to affordable bandwidth and improving education and training outcomes for Australian students. The Inquiry thus comes at a critical time in the investigation of new technologies and their potential for providing practicable solutions for improving connectivity within the education and training sector in Australia.

It is widely recognised that Australia's growth potential is strongly linked to the continued take-up of new information and communications technologies. There is also general consensus that access to online education and training is a critical factor in the development of a knowledge economy. Governments around the world are similarly recognising that information technology skills are essential in virtually every field of modern endeavour with priorities being given to facilitating their development across all aspects of the education and training system.

With this understanding MCEETYA Ministers released a *Joint Ministerial Statement* in December 2000 that undertook to:

- Ensure that the education and training sector is able to provide all learners with opportunities to develop their ability to use technology confidently and creatively, and to develop the specialist skills needed to service the needs of the information economy;
- Provide effective and affordable access to the Internet for all learners regardless of their geographic location; and to

- Promote collaboration in the development and dissemination of high quality digital educational content, services and applications that enable Australian learners to gain maximum educational benefits from the online revolution.

Within this policy framework there are clear indications in Australian education and training institutions of an increase in the use of a vast range of technologies to access educational content through an array of wired and wireless devices including desk-top PCs, hand-held pocket PCs, PDAs, laptop computers, wireless LANS and satellite technologies.

Every Australian educational jurisdiction recognises the importance of advanced information infrastructure to maximise online learning opportunities for all Australians. The availability of broadband through the use of fibre optic, wireless and other converging technologies at a reasonable cost is critical to improved education and training outcomes and improved equity of access to quality education and training across the whole community. The education and training sector needs the technical infrastructure to support access to high-speed bandwidth in the provision of online content and administrative support for students. This supports the aims of its information economy action plan *Learning for the Knowledge Society*[1] and the wide range of initiatives outlined in its accompanying action plans which include:

- *Learning in an Online World: School Education Action Plan for the Information Economy*
- *Flexible Learning for the Information Economy: A Framework for National Collaboration in Vocational Education and Training 2000-2004*
- *The Way Forward: Higher Education Action Plan for the Information Economy*

Technical infrastructure is also an essential component in the support of broader nationally agreed education and training agendas such as the *National Goals for Schooling for the 21st Century* and the *Australian Flexible Learning Framework for the National Vocational Education and Training System 2000-2004* as well as the education elements underpinning the broader Innovations agenda under *Backing Australia's Ability*.

The 'new generation' technologies offer the education and training sector a vast array of opportunities to deliver its services better, more accessibly and more cost-effectively, while taking full advantage of the benefits of networked learning communities. Stakeholder advice indicates that there has been a rapid increase in interest in all forms of wireless technologies and the way as they can be utilised to improve educational outcomes. At this point in time much of this interest appears to be related to investigation and trialling of specific technologies. Implementations are somewhat patchy and tend to be restricted to technologically advanced early adopters. It is however clear that the educational community sees wireless technologies as an important emerging option for developing their technical infrastructure and delivering new functionality. This is consistent with overseas trends in education which predict the use of wireless as the norm in offering students greater mobility and freedom to access information, courses and online materials both on and off campus.

[1] Learning for the Knowledge Society: an education and training action plan for the information economy (DETYA 2001) (http://www.detya.gov.au/edu/edactplan.htm)

The extent to which the technologies have been picked up varies dramatically across sectors and across states and territory boundaries. This is evidenced in the case studies below.

Terms of Reference

It was noted that the Minister for Communications, Information Technology and the Arts had asked the Communications Committee to inquire and report on the current and potential use of wireless technologies to provide broadband communication services in Australia, including regional Australia.

The Terms of Reference of the Inquiry thus indicated an examination within the education and training sector of:

- the extent of the use of wireless broadband technologies across Australian schools, TAFE institutions, universities and other education facilities;
- the type of wireless technologies used within the education and training sector and the potential for their use in educational environments;
- the benefits, practical outcomes and limitations of using wireless technologies in education and training environments; and
- the effect of the current telecommunications regulatory regime on the development and use of wireless broadband technologies in education and training institutions.

Extent of rollout

Based upon responses to an informal survey conducted by AICTEC for the purpose of ascertaining the extent of wireless utilisation, the use of wireless broadband technologies by education and training facilities in Australia states and territories is growing but at this point in time tends to be limited to early adopters. This being said, there is, however, a definite sense of being on the verge of a technology boom that includes the use of innovative wireless gadgets and options for educational purposes. (It should be noted that data were not available from TAFE colleges and other vocational education and providers to enable input into this Inquiry within the time available.)

It is evident that, although some institutions are working at the leading edge of wireless technologies and providing a focus of international interest (eg University of Southern Queensland), the utilisation of wireless technologies generally ranges from tentative forays into wireless networking by schools looking for short term and low cost solutions to temporary networking difficulties, to extremely high levels of deployment in some of the larger universities. Its main use would seem to be as a supplement to bridge the gap between the fibre backbone and end users without last-mile bottlenecks, rather than as a stand-alone arrangement or as a generic replacement to existing technologies. It would be difficult without a more expansive survey to ascertain the real extent of take-up of wireless platforms by Australia's schools, TAFE colleges and universities, however the available data provide sufficient

evidence to propose that the new generation technologies are offering a tangible and inexpensive boost to wired infrastructures.

Higher Education Sector

According to information provided by the Australian Vice-Chancellors' Committee and CAUDIT, only a handful of Universities have Wireless LANs in production (eg Ballarat, Griffith, Northern Territory, Tasmania, New England). This is in contrast to the United States where universities such as Carnegie Mellon University have been extensively using wireless networks for more than six years. Other Australian universities are piloting the technology (eg Flinders, NSW, Victoria, Wollongong), whilst some, such as the University of Southern Queensland (USQ) are deploying wireless LAN technologies across entire campuses.

In most cases where wireless access is provided to existing networks, installations are reportedly campus wide or limited to individual departments or faculties, with libraries and congregation areas appearing to be among the priority zones for initial experimentation.

As an example, the University of Queensland has used a wireless system for access to the network from the refectory, tennis courts and other areas of its Ipswich campus. USQ has also rolled out Wireless Local Area Networks on its Toowoomba, Wide Bay and Brisbane Campuses. This allows all staff and students to access email and the Internet (typically) and other USQ information technology resources from anywhere on campus. As another practical example, the University of Ballarat sets up temporary enrolment centres each year where the use of wireless has simplified the exercise to the point where set-up/strikedown costs are almost eliminated.

The University of Southern Queensland presents an exemplary case study of an educational institution that has deployed wireless technologies. This case study is available through the current website for the project at http://www.usq.edu.au/its/wireless/ The site incorporates a wide range of frequently asked questions associated with wireless networking in general and its particular application and management at USQ. Professor James Taylor, Vice-President (Global Learning Services) at USQ thus describes the 'Fifth Generation' of online delivery based on the further exploitation of new technologies which capitalise on the features of the Internet and the Web as part of USQ's e-University project[2]:

> This freedom to have access to the Internet from virtually anywhere on campus is a key feature of providing access to online courseware and services to all students whether on or off campus (2001).

[2] Taylor, Professor J C, 'Fifth Generation Distance Education', Keynote Address presented at the 20th ICDE World Conference, Dusseldorf, Germany, 1-5 April 2001

Schools Sector

In the schools sector as in the higher education sector, government and non-government schools are experimenting with wireless at differing levels.

The Northern Territory Department of Employment Education and Training recently successfully piloted broadband wireless (802.11b) in a very limited trial as a proof of concept. Formal testing was conducted during the pilot and test documentation produced which demonstrated that the technology was cost effective, secure, and capable of running asynchronous satellite back channel communications. Optus in conjunction with the Northern Territory Department of Corporate and Information Services (DCIS) is also conducting a review and pilot of wireless technologies with a view to implementation if successful.

In South Australia, the Department of Education, Training and Employment has indicated that 10-20% of schools are in the early stages of adopting wireless technologies using 802.11b base stations as LAN edge devices with the following provided as examples of the use of broad spectrum links between school campuses:

- Norwood Morialta HS - Radio
- Port August schools - Radio
- Anangu schools - Satellite downlink and landline; Use of radio phones
- Open Access College home school initiative – Satellite downlink
- Glenunga International High – 10Mb broad spectrum Internet link

The Department of Education in Western Australia also has a number of schools that have implemented wireless networks for use within their curriculum. Wireless technologies have been implemented in 12 schools participating in the Application Service Provisioning (ASP) trial in the Fremantle District where students using laptop computers have access to wireless as a supplement to the wired network. As part of the installation process, the schools were surveyed so that sufficient base stations were procured to enable every classroom and a large proportion of the school grounds to have wireless coverage. It is still early days using wireless within the ASP schools, but preliminary results and responses from teachers indicate that the solution provides a very useful and flexible environment that meets the needs.

In Tasmania, the rebuild of a new government high school from ground level following a devastating fire has provided an opportunity to incorporate future capacity for wireless technologies into the new building design features. This should provide a solid pilot for another 50 Tasmanian government schools which are being considered for wireless connections in 2003 (subject to State Government regulations and arrangements under 'Networking Tasmania').

The Department of Education and Training in Victoria reports that there has been limited deployment of Local Multipoint Distribution Services (LMDS) and microwave technologies by AAPT in providing links for Victorian Government schools to the VicOne wide area network which links all schools, TAFE colleges and all central and regional offices of the Department. Where used, LMDS has typically been used in stand alone configurations and microwave in mixed configurations. The extent of implementation in Victoria is as follows:

- LMDS: 10 nodes, 21 sites

- Microwave: 3 nodes, 3 sites used in tailored point to point solutions off LMDS nodes where LMDS cannot be used.

- Microwave was also used in some areas during the early roll out of VicOne prior to availability of ISDN services. These services have been replaced with ISDN as services became available.

Examples of educational facilities in Victoria where wireless technologies have been successfully incorporated include:

- Parkridge Primary School where teachers use wireless enabled notebooks to access network resources including the Internet.
- Frankston High School where there is 'Roll call online' using IPAQ pocket PCs and notebook computers with wireless LAN cards.
- Other installations have enabled networks to be extended to locations that would not otherwise have been covered by hard wire implementations. Examples include heritage buildings, staff rooms and demountable/portable classrooms.
- An Adult Community and Further Education (ACFE) training program, using notebooks equipped with wireless LAN cards and access points taken from training centre to training centre.

Independent schools are also developing experience in using the technology. The Presbyterian Ladies College in Sydney deploys 30 wireless cells and 150 wireless notebooks with the result that most staff and many students are reliant on wireless as their principal means of connection across campus. Other schools, such as John Paul College Brisbane, report the use of radio cells covering entire campuses including classrooms, public areas, boarding accommodation, libraries and staff areas, that allow the use of personal laptops for students and teachers, portable computers on trolleys and hand held computers.

Individual Catholic schools are also exploring the potential of wireless technologies. This is generally in multi-campus secondary schools where there is physical separation and wireless is viewed as a better option than cable. Significantly, both the Archdiocese of Melbourne and the Catholic Education Office in Western Australia are formally investigating the potential for the utilisation of wireless technologies in Australian Catholic schools.

Type of wireless technologies in use

Where wireless broadband is utilised, it is mainly as an extension to wired networks for mobility and also for accessing difficult locations or older (heritage) buildings. In most cases wireless access is provided to existing networks. The existence of a robust wired infrastructure has been identified as a highly desirable prerequisite in that it provides access to the widest possible range of existing infrastructure and services. Installations are either campus wide or limited to individual departments or faculties and buildings. Libraries and congregation areas appear to be among the priorities. As an example, the University of Southern Queensland has established wireless access in the major social areas of the campus, including the Refectory, the coffee shop and the quadrangle.

The most common platform generally deployed in educational facilities is 802.11b which is recognised as being slower than 802.11a, but offering a greater range. Some universities and schools are experimenting with 802.11a, SMS and WAP. Individual staff at some universities and schools are reportedly using Bluetooth on their palm pilots and laptops, although this did not appear to be widespread from the (limited) survey conducted.

Wireless technologies (802.11b) have been installed in Northern Territory remote schools as part of the Learning and Technology in Schools (LATIS) rollout. This was only done where it was not feasible to install optic fibre. In these environments a combination of 10/100 switched cat5 networks and wireless was installed. Further, an investigation by the NT Department of Education, Employment and Training is currently evaluating the viability of a broadband wireless mesh network for urban schools using a combination of 802.11a (for the trunks) and 802.11b. The main intent for such an implementation would be satellite back channel communications with some potential for using Citrix across the wireless component of the network. If this further investigation reveals that wireless is technically stable and cost effective, the network may be commissioned at the end of 2002 to begin in 2003.

In Victoria, government schools have utilised LMDS and Microwave in WAN/Broadband applications, with 802.11b used for bridging multi campus sites and for wireless LAN networking within school sites.

The ASP Schools in WA were provided with trolleys for storage, charging and transport of laptop computers. The Department of Education in WA is also currently trialling the use of PDAs (Personal Digital Assistants) with wireless connections as a systems administrative tool to enable systems administrators visiting schools to test the wireless connectivity using wireless software tools and utilise network management tools to monitor school technology. 802.11b has been used by the WA Department of Education as providing the most stable technology. The Department has chosen to use powered ethernet switches in all wiring closets in the 12 ASP schools to enable ease of portability of the wireless base station. The base station draws power from the powered switch, similar to a desk phone, which means that the base station has only a single cable to connect to the wired network.

In addition to the rollout outlined above, the Department of Education, Training and Employment (DETE) in South Australia is researching trends in the integration of

wireless and mobile technologies and their role in education. DETE is also providing systemic information to schools along with recommendations on wireless LAN options.

Griffith University has utilised stand-alone point to point WAN connections with STM1 Microwave Radio WAN links. The University of Southern Queensland is providing VPN (Virtual Private Network) access for all staff to securely access their faculty/department servers, seamlessly from mobile devices such as laptop computers, PDAs and webpads. USQ is implementing 802.11b, but is reviewing 802.11a and will address this platform in more detail once the wireless cards for this standard are released later in the year. USQ is also reviewing other emerging standards, such as 802.11g.

Benefits

The listings of benefits provided by vendors to educational institutions are impressive, and have generally managed to live up to the hype. The main benefits identified by the current survey however include:

- Mobility
- Cost
- Flexibility

Mobility

The obvious advantage of using wireless computing is that it takes technology to the learner. The old adage of "anytime-anywhere learning" is becoming a reality. Laptops are free to roam wherever students are learning. Special furniture is not required, and ease of access is likely to encourage integration of computers into teaching and learning. As reported by the WA Department of Education:

> Teachers and students have the flexibility of moving around the school, having lessons in the classroom, undercover areas or outdoors without the need to have network cabling to contend with. It also allows for flexible seating arrangements within a class.

Costs

It is evident that the cost of installing and maintaining wireless networks is vastly superior to the cost of laying cable. The potential for wireless broadband technologies to provide a 'last mile' broadband solution (particularly to difficult locations; rural and regional areas; old/heritage buildings), and to encourage the development and use of broadband content applications were cited by a number of respondents as major benefits of wireless. The cost of laying fibre optic cables between buildings was reported+ to be very expensive, especially if it is only servicing a few people.

This was supported by the University of Southern Queensland which describes wireless technology as providing convenient flexible access in a cost-effective way to

its existing infrastructure through providing an option for the last few metres to access the local area network (WLAN).

Cost was also cited by USQ as one of the major benefits. As a flow-on effect, there was found to be reduced dependency on computer labs so that the access to email and online resources is able to be managed in a flexible and cost-effective manner that is consistent with the emerging 'Mobile Information Economy'.

It has been suggested as a response to the current Inquiry that the Australian education and training sector could legitimately seek benefits from its aggregated purchasing power to lower the prices and improve the affordability of wireless technology solutions.

Flexibility

Wireless is easy to use and configure in that it can be installed based on one of two models – where the receiver (or terminal) is fixed in position, or where it is mobile. Equipment can be easily configured to work in point-to-point or point-to-multipoint modes. Wireless also has obvious advantages when the physical location of ports is likely to change, for example to provide links to temporary buildings and annexes. Within a room, infrared technology is a cost-effective solution to eliminate some of the cabling required for PC connections.

A further benefit was realised in the Northern Territory where teachers in remote communities are able to access the school network from home using installed wireless technology.

Identified limitations

The survey of the experience of States and Territories in the deployment of wireless protocols has highlighted a number of barriers to the successful implementation of wireless technologies including:

- Security
- Reliability
- Health
- Bandwidth
- Extent of coverage
- Network management and support
- Cost
- Environment. Wireless towers and antennas will generally be more visually obtrusive than cable network installations.
- Range and coverage
- Effect of interference

Security

The issue of security was identified by several respondents. An emerging issue with regard to the use of wireless communications options is the potential for breaches in

security and pirated access if the network is not sufficiently protected (BBC, 2001)[3]. Although the attractiveness of wireless networks is high, the encryption and other protection measures must be ascertained before purchase, during installation and setup. Placement of base stations can help to some degree, away from outer walls, to make them less discoverable by persons who might be scanning areas for open connections. A good security regime (such as VPN tunnelling technology used for authentication and encryption) was identified as an essential requirement together with the usual network of switches/routers behind the access points.

In WA, the Department of Education has chosen base stations that require user authentication, but the fact that the network is broadcast in the open air remains a concern. The USQ has also had to spend time addressing the security issues and is looking towards developing a "spectrum management policy" with associated regulatory implications.

Reliability

Generally respondents to the survey expressed satisfaction with the technology, although some commented on dropouts with portable computers on the wireless network that were not previously apparent on the wired network.

The nature of the existing infrastructure was described by one respondent as being absolutely critical to effective wireless operation, with physical constraints caused by building construction and landscapes creating radio shadows. Penetration of the signal in metal clad and fabricated buildings (common at the edge of schools) was identified as the cause of problems in some cases, with some comment put forward on the minimal signal strength in demountable buildings with steel frames and panel walls.

Other complaints were about not being able to obtain range due to the nature of classroom construction which utilises brick walls and metal window frames. Victoria University described mix success with some trials experiencing nuisance to serious performance degradation due to the nature of the physical environment. USQ described the only major interference experienced with the network as being caused by microwave ovens. It is possible that such interference could increase as more devices are introduced to the consumer market.

Health

The perception that wireless services present a health hazard was raised by several respondents with concerns expressed about the unknown effect of radio emissions (electromagnetic fog). While the British Educational Communications and Technology agency (BECTa) recognises that the output power of wireless networking devices is significantly less than that of mobile phone systems, the agency also

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[3] BBC, "Hackers Take to the Air", BBC News, Wednesday, 17 October, 2001, http://news.bbc.co.uk/hi/english/sci/tech/newsid_1596000/1596033.stm

recognises that results from the research have been inconclusive, due primarily to lack of evidence. (http://www.becta.org.uk/technology/infosheets/html/wan.html)

Bandwidth

Complaints were received around lower than required bandwidth. Almost all of the wireless devices available today operate on the 802.11b standards, which is 11 Mbps. This is vastly less than what is required for sessions involving the production and editing of multimedia material which require high capacity, as the file sizes can range up to 100 MB.

One school in NSW reported that 11 Mbps hubs provide an intermittent 1-2 Mbps per user to a handful of users in a 15m radius. Video and graphic work needs better than 10 Mbps throughput, so wireless is being used mainly for messaging, web browsing and office applications, with cabled labs continuing to be used for multimedia work. Wireless communication to laptops would generally provide adequate capacity for less resource intensive and administrative applications.

The very slow access speed to network printers and general unreliability of connected printers was a common complaint.

The following information provided by the Department of Education, Training and Employment (SA) demonstrates a number of factors influencing the speed with which wireless can access the network:

- Access point network structure – under this structure, the 11 Mbps is the limit per access point, not the limit for the entire wireless network, meaning that if there are two access points in close proximity serving 4 students, each student would have up to 5.5 Mbps simultaneously.

- Access point client densities – each manufacturer claims a different number of students can connect to their access points, although essentially all access points are fundamentally the same and the real limit depends on the speed required for each device. If 20 students were accessing the network simultaneously they would each receive 0.55 Mbps or 550 Kbps. This is adequate for low-level applications such as accessing the Internet. If the students are downloading large files from local servers or sending large print jobs, then 550 Kbps per student will almost certainly be enough.

- Speed/signal scaling – for a student to maintain a connection to the access point of 11 Mbps certain signal strengths must be achieved. If the signal strength falls below this level, the connection speed will be reduced in stages to 2 Mbps. A student can still maintain connection as they move further away from the access point.

  (Source: DETE, SA)

The above speeds are dependent upon the type of device being used and the number of connections to the base station – generally, the greater the number of devices, the less bandwidth is available.

Other barriers

The experience of the Northern Territory Department of Employment Education and Training (DEET) as part of the Learning and Technology in Schools (LATIS) rollout also revealed some practical issues. As wireless is a shared protocol, DEET reported that bandwidth intensive use of the link caused it to degrade rapidly. It was not found to be suitable where a school relied on a wireless link for computer lab connectivity to the wider school network. In these instances DEET found it necessary to install fibre optic cable.

Similarly, the Victorian Department of Education and Training found that 802.11b has not lived up to expectations created by the industry, with security, lack of interoperability and performance being the key issues. It should be noted, however, that in deployments where user expectations have been formally managed, the end result has been more positive. The Victorian experience also found that microwave failed to meet customer expectations especially due to the performance impact of climatic conditions. The Department also identified a number of other disincentives and barriers to adopting wireless platforms. These included:

- WAN: Need for line of sight, limitations of distance and range, impact of climate on functionality, limited infrastructure, industry delays in delivering solutions.

- LAN: Need for line of sight, limitations of distance and range, security, impact of climate, interoperability, industry delays in delivering solutions, and lack of price competitiveness in many circumstances.

The lack of knowledge of the upper limits of the technology was also viewed as a barrier as was the lack of universal policies on the provision of laptops and other mobile devices for students (together with the associated equipment purchasing costs).

Regulation

Generally respondents were unaware of any restrictions that have occurred as a result of having to work within the government's regulatory framework. As the technology uses public spectrum frequencies, the regulatory environment was not viewed as a barrier. Education facilities mix and match technologies to suit their particular needs and it is important that the regulatory and technical environments continue to support this practice.

Conclusion

The Australian ICT in Education Committee (AICTEC) appreciates this opportunity to participate in the House of Representatives Inquiry into the use of wireless technologies to provide broadband communication services in Australia. The Inquiry has generated a definite view that the education and training sector is on the brink of

recognising the undoubted potential for the technology to significantly enhance opportunities for teaching and learning.

It is evident that the promises offered by wireless/mobile technology to the education and training sector are living up to the hype in most instances, although in many cases it is still too early for respondents to be able to report on the outcomes of trials and pilot projects. Australia could be said to be taking its first tentative steps towards a new future – as compared to the US where wireless technologies are described as the beginning of a phenomenon in education – with many institutions piloting new ways of using the technology.

Wireless technologies definitely have a place in the education market, providing mobility, system flexibility and control of costs where the equipment is owned. As with many technologies, it is seen as part of a complete solution rather than a stand-alone approach, with cable still being used for heavy bandwidth applications.

Increased connectivity offers significant opportunities to improve the quality and accessibility of teaching and learning including improving communication and interaction among and between learners and educators, and between education providers, parents and the community. Increased connectivity can empower learners by increasing their ability to communicate with, and gain access to, learning resources and people from multiple sources, at times and places convenient to them and in ways that best suit their particular needs and learning styles.

The utilization of wireless broadband offers the educational community the potential to apply new solutions to existing connectivity requirements and introduce additional functionality, particularly in respect of the provision of pervasive network access to educational consumers and providers.

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