*Broadband for a Broad Land: The role and potential benefits of the National Broadband Network the for Environment and Education*

**Submission** to the Inquiry into the role and potential of the National Broadband Network

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## About the Author

Tom Worthington is an independent IT consultant, an Adjunct Senior Lecturer in the School of Computer Science at The Australian National University and a Visiting Scientist at the CSIRO ICT Centre. He has been an expert witness in several court cases involving international patent, computer, web and Internet issues, as well as advising governments and companies on computer problems. He is a course designer and teacher for vocational and postgraduate university courses on e-records management, green ICT, the design of web sites, e-commerce and professional ethics. In 1999 he was elected a Fellow of the Australian Computer Society for his contribution to the development of public Internet policy. Tom is a Certified Professional, past president, Fellow and Honorary Life Member of the Australian Computer Society, a voting member of the Association for Computing Machinery and a member of the Institute of Electrical and Electronics Engineers. This submission is made as an individual and may not reflect the views of any of the organizations mentioned.

## Introduction

This submission addresses two issues: the environmental costs and benefits of the NBN and its role in education.

The Australian Parliament has invited submissions for an Inquiry into the role and potential of the National Broadband Network (the Inquiry) by 5 February 2011. This is a very important topic, as while billions of dollars have been committed to building a broadband network, little thought or investment has gone into what it might be used for.

The cost of the NBN (about $43B over 8 years) should be seen in perspective with other public expenditure. As an example Australian public expenditure on education each year is 4.5% of GDP (from "Education in Australia", OECD, 2008), or about $56B (based on the OECD States Extract estimate of Australian GDP of $1,253,121.0 for 2009). If the NBN achieved a 10% saving in the cost of education, this would pay for the capital cost of the entire network in eight.

The role of the NBN in chaining the way Australia does business should also not be under estimated. Presently work on reducing Australia's greenhouse gas emissions, even by a modest amount are stalled. In 2008 the Climate Group estimated that ICT could reduce carbon emissions by 15%. Effective use of the NBN could result in a larger carbon emissions saving while lowering costs to the economy at the same time.

**Previous Broadband Inquiries**

In the mid 1990s a series of Australian parliamentary inquiries looked into the role of what was then called the "Information Superhighway". There was a broad consensus across political parties that policies and investment by government to encourage what became known as the Internet was in the public

interest. Roger Clarke wrote "Vision for a Networked Nation" in 1994, with my assistance, and we submitted it on Behalf of the Australian Computer Society to several of the inquiries. Successive state and federal Australian governments drew on the rhetoric and the specific proposals from these enquiries. Most notable was Networking the Nation (DCITA 1996).

Also state and federal government implemented the idea of funding Internet access in public libraries.

Recent public debate has become bogged down in the technical details of how to implement the NBN and its cost. Little tought has gone into how government, households and businesses will effectively use such a service. Of itself the NBN will do little, as people will need training in how to use the NBN to make it of value.

The NBN could greatly benefit the Australian community, culturally, economically and environmentally. Australians will have better access to medical, financial and educational services, particularly in regional areas. However, the NBN will only provide the technical link for households and small businesses. To provide a useful service, cultural, educational, medical, financial and government services need to be provided online and staff trained to use them to provide useful services.

In many cases the necessary network connections are already in place for medium to large organisations to provide services via the NBN, but appropriate software, procedures and trained staff are also needed. The cost of training staff and the community to use the NBN will be higher than the capital of the NBN . However, if that training is incorporated into normal staff training, schooling and community education, the overall cost can be lower. The NBN can pay for itself in savings for education alone.

**Terms of Reference**

The NBN Inquiry Terms of Reference, listed listed eight areas to examine, in relation to the capacity of the National Broadband Network:the delivery of government services and programs:

1. achieving health outcomes;
2. improving the educational resources and training available for teachers and students;
3. the management of Australia's built and natural resources and environmental sustainability;
4. impacting regional economic growth and employment opportunities;
5. impacting business efficiencies and revenues, particularly for small and medium business, and Australia's export market;
6. interaction with research and development and related innovation investments;
7. facilitating community and social benefits; and
8. the optimal capacity and technological requirements of a network to deliver these outcomes.

From: Terms of Reference, Inquiry into the role and potential of the National Broadband Network, House Standing Committee on Infrastructure and Communications, House of Representatives, Australian Parliament, 16 November 2010

The eight areas can be grouped into four broad categories:

1. **Social impacts:**
   a. achieving health outcomes;
   b. improving the educational resources and training available for teachers and students;
   c. facilitating community and social benefits;
2. **Regional and environmental impacts:**
   a. the management of Australia's built and natural resources and environmental sustainability;
   b. impacting regional economic growth and employment opportunities;
3. **Business impacts:**

a. impacting business efficiencies and revenues, particularly for small and medium business, and Australia's export market;

b. interaction with research and development and related innovation investments;

4. **Requirements**:

a. the optimal capacity and technological requirements of a network to deliver these outcomes.

The fourth area "Requirements" differs from the other three, in that it is about what is needed from the NBN to achieve favourable outcomes in the other areas.

**What is the NBN?**

*The two Key Objectives for the NBN, as set down in the NBN Co. Corporate Plan, are to*

- Connect homes, schools and workplaces with optical fibre (fibre to the premises or 'FTTP'), providing broadband services to Australians in urban and regional towns with speeds of 100 megabits per second - 100 times faster than those currently used by most people extending to towns with a population of around 1,000 or more people;
- Use next generation wireless and satellite technologies that will be able to deliver 12 megabits per second or more to people living in more remote parts of Australia; ...

National Broadband Network Corporate Plan 2011 – 2013
(NBN Co., 17 December 2010),

The NBN is in essence about delivering broadband to homes, schools and workplaces. The most significant aspect in terms of social policy is delivery to homes. It is likely that this will be the area it has most impact in terms of education, health, the environment, business and employment.

The NBN will deliver two different levels of service: 100 mbps in the city and 12 mbps in the country. There is a risk that this will make greater the disadvantages of distance. Services which require more than 12 mbps will only be available to city residents. However, 12 mbps is sufficient for many current and foreseen online services and so is more likely to lessen the disadvantages of regional areas. Also many online services are now being designed for use with wireless smart phone and tablet devices, which will have much less than 100 mbps capacity, making a 12 mbps connection more than adequate.

Delivery of broadband to schools was already under-way through other government programs and so the NBN will have little direct impact on broadband use on school premises. Similarly, organisations having medium to large offices are able to arrange the installation of high speed broadband and so the NBN will have little direct impact on these. It is in the area of micro and small business and in home users where the NBN can have more impact.

The NBN will have an impact on education, business and employment by allowing greater access from homes. Activities which previously required people to meet at a central location will be able to be done online from home. This will have a profound effect on education, government and business, at a local, national and international level.

The main issues for the NBN are not technological, but social, in terms of how people interact: how much will they use the NBN in place of face to face contact? The NBN can reduce financial, social and environmental costs by replacing travel to school, shop or office with online communication. But how many will use this and what might be the side effects?

## NBN and the Environment

NBN can reduce dependence on transport of people and goods, thus reducing energy use and greenhouse gas emissions. In 2008 the Climate Group estimated that ICT could reduce carbon emissions by 15%. However, this will not happen without explicit planning and investment. In the absence of planning and investment, there is a risk the NBN will harm the environment through the creation of *Electronic waste* ("e-waste").

Each NBN fibre optic node in a household will require a battery to provide service in the event of a mains power failure. Without such a backup, 000 emergency phone calls will not be available via the NBN, nor will back to base fire-alarms, or medical alert systems operate. Replacement of millions of batteries in the NBN equipment, containing toxic materials, represents a risk to the environment from improper disposal.

The consumer equipment made obsolete by the NBN will also contribute to e-waste. The NBN will make obsolete millions of ADSL modems, which will require disposal. An example of where this problem is now occurring is with the transition to digital TV. The Australian government has a long term plan to replace analogue with digital TV transmission. However, no provision has been made for disposal of millions of obsolete analogue TVs, which may end up in landfill.

The NBN will also be a major consumer of energy in Australia and may increase greenhouse gas emissions. The NBN is primarily a Passive Optical Network (PON). This is relatively efficient in its use of energy, as reported by Zhang and others in "Energy Efficiency in Telecom Optical Networks" (*Communications Surveys & Tutorials, IEEE* , vol.12, no.4, pp.441-458, Fourth Quarter 2010). However, for a given technology, as the data rate increases, so does the power consumption. Most of the time, most of the NBN will be carrying little or no data. The equipment used should therefore be designed to switch to a low power mode to conserve energy when possible.

The NBN could reduce energy use in Australia through "dematerialisation", that is replacing physical goods and activities with network based alternatives. Examples of de-materialisation include replacing travelling to meetings with videoconferencing and paper documents with electronic ones. This saves the energy used in transporting people and paper from place to place. However, it requires the people to be trained in how to work effectively online. As an example, Australian MPs are provided with computer networking to their electorate offices, but this system is not used for conducting parliamentary proceedings. Such use would require MPs and their staff to be trained in how to use such a system (and some minor changes to parliamentary rules).

## NBN and Education

The NBN could revolutionise education in Australia. However, this requires coordination of education resources and planning. In a speech to the *Committee for Economic Development of Australia* the Prime Minister discussed the need for "Skills for the Future", with education at schools, vocational education at TAFE and university education. However, at present those education sectors are handled in a fragmented way, with duplicated underused facilities.

Australia is a world leader in e-learning, with the Australian developed Moodle open source software being deployed in schools, vocational education and universities. The same software tools, online facilities and educational techniques are applied from school through TAFE to tertiary education. The US Government's "National Education Technology Plan 2010" (November 2010) provides one model for the use of technology to assist education.

A revolution is now taking place in the design of physical educational facilities. "Learning Commons" with flexible classroom designs are being built at schools and universities. However, the different education sectors are duplicating the work needed for both online learning and for physical infrastructure, with the federal and state governments paying for this unnecessary duplication.

As an example of how resources can be used more efficiently, the Australian National University uses Moodle for pure e-learning courses, such as [Green Information Technology Strategies COMP7310](). The ANU also uses the same software for blended online/classroom [Engineering '*Hubs and Spokes*' Project]() in collaboration with the University of South Australia. The allows advanced courses presented by world leaders in their field to be made available to more students. The use of online systems also lowers the energy use and therefore greenhouse gas emissions by replacing classrooms with e-learning and reducing the need for students and staff to travel to a campus. Teaching skills can also be shared between institutions.

The Australian federal and state governments have jointly funded programs to educate school and university teachers on how to use online education, including [EdNa]() and the [Australian Flexible Learning Framework](). These provide the opportunity for not only improving Australian education but also maintain Australia's major export industry in educating international students.

It should be noted that the NBN represents a risk, as well as an opportunity. Not only will the NBN allow Australian students to enrol in Australian courses online, but they can equally choose to bypass Australian institutions and enrol in overseas courses. The international agreements which Australia has concluded for access to education with [countries such as India](), not only allows Indian students to study in Australia, but allows Australian students to study in India. Students need not leave home to study overseas. If Australia does not continue to innovate in the education sector, it will not only loose the valuable market for overseas students, but will also loose its domestic education market to overseas suppliers.

Some early use of the technology provides pointers for the future. Australian educators are pioneering the use of online education. This shows that online education cannot completely replace face-to-face teaching, particularly for younger students. A blended (hybrid) mode of education has been adopted in many areas. With this the student undertakes part of a course online and partly in a classroom. However, provision of broadband at home and in educational facilities is the simplest and least expensive part of the process.

The blended mode of education will require retraining of teachers, restructuring of courses and the remodelling of buildings. The cost of this restructuring of the Australian education sector will dwarf the cost of the NBN itself. The logistical and political complexity of changing the education system will be far higher than for the implementation of the NBN.

The cost and complexity of remodelling Australian classrooms to take advantage of the NBN will be far larger than the $14.2b Primary Schools for the 21st Century component of the Australian Government's "[Building the Education Revolution]()". It has been assumed that providing broadband to schools involves providing a fibre cable to the premises and perhaps some re-cabling to deliver it to classrooms. However, to gain educational benefit from the broadband requires a change in the way education is done and the redesign of the classrooms to accommodate this, turning them into "[learning commons]()".

One aspect of the change to education which will be less difficult is the curriculum. The work by federal and state government on a [National Curriculum]() for Kindergarten to Year 12, will provide a useful framework for work on integrating online education into schools. This will allow resources to be shared across geographic and organisational boundaries. Students in different locations can share the same course materials, take part in the same classes and be part of study groups. Use of online educational facilities can greatly enhance the national curriculum, reduce the cost of its implementation and speed its introduction.

## Australian Learning Commons Proposal

As an example of policy to augment the NBN, it is suggested that all Australians be offered free online publicly accessible education from pre-school to university level. This would be supported through a program of multi-use schools, vocational education and university campuses equipped to provide public

facilities.

**Multi-use school buildings**

The current model of education in Australia is that students enrol in a educational institution associated with exclusive use of a particular physical location. This should change to so that a student enrols in a course online and then attends face-to-face classes, when necessary, at the most convenient physical facility. Schools, public libraries, vocational and unviersity education can all be provided in the same shared buildings. This will lower the cost of education and increase access to education.

The new $72.4 million Gungahlin College in Canberra provides a good example of this approach. The College will accommodate 900 upper secondary students and includes a CIT learning centre (for vocational TAFE education). The college library will be available to the community, providing learning rooms for both child and adult students.

The Gungahlin College is planned to have a 5 Green Star design rating from the Green Building Council of Australia. The ACT Government aims to install photovoltaic (solar power) systems at all public schools over the next four years. One enhancement I would suggest is extra investment so that the solar panels can provide emergency power to the buildings during blackouts. This way the schools can be used as emergency centres during disasters. As recent flooding in Queensland has highlighted, standard solar panels cease to provide power when mains power is lost.

**Online educational materials available to all Australians**

eLearning Services at the Queensland Department of Education and Training has made 'virtual classroom' spaces available for students where the January 2011 floods have disrupted normal classes. This, and similar initiatives, could be expanded to to provide educational resources to students across Australia. Rather than online support for education being a special exception made in an emergency, materials and support could be made as a normal and routine part of education at all levels.

The Queensland Department of Education is providing Maths, English & Science materials, including:

- Resources - self-paced digital learning resources by year level
- Activities - self-paced structured lessons by year level
- Programs - self-paced vodcasts or daily scheduled multimedia events by year level

There is also a special collaborative project **Healing words - Helping hands** for Education Queensland teachers to discuss the floods and share experiences.

Despite work on a national curriculum, educational system (state or non-government), individual teachers have to find materials to teach. Sharing of materials can be facilitated by the use of Creative Commons licensing, which allows any teacher to use the materials produced by any Australian educator, without the need for separate permission or payment of fees.

## References and Background

This document contains hypertext links. Please check the committee web site for an electronic copy with the links: http://www.aph.gov.au/house/committee/ic/NBN/subs.htm

Background on preparation of this submission is at: http://blog.tomw.net.au/2011/02/broadband-for-broad-land-envrionment.html